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# IBM 5250 Information Display System Functions Reference Manual

**Third Edition (May, 1980)**

This is a major revision of, and obsoletes, SA21-9247-1. Because the changes and additions are extensive, this publication should be reviewed in its entirety. Changes are periodically made to the information herein; changes will be reported in technical newsletters or in new editions of this publication.

This publication is for system programmers familiar with SNA (system network architecture) and SDLC (synchronous data link control). It contains information about programming the 5250 Information Display System devices. This publication contains examples of the data streams used by the 5250 devices. All names used in these examples are fictitious and any similarity to names or addresses used by an actual business enterprise is coincidental.

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# Preface

This manual describes the programming requirements for communicating with the controller in the 5251 Model 2 or 12 that controls all 5250 devices attached via a cluster feature (either Cluster Feature or Dual Cluster Feature). It also contains information that will allow a system programmer to design a configuration using the 5250 system and to determine problem-causing areas within the remote link to that system.

There is no separate functions reference manual for the 5251 Model 1 or 11. For information about developing a program to control a 5251 Model 1 or 11, refer to this manual or to the functions reference manual for your host system.

The 5250 Information Display System is a cluster of work stations that uses a controller that is remotely linked to a host system. The remote 5251 controller uses the SDLC/SNA protocols and commands to establish, maintain, and regulate communications between itself and the host system. The programmer using this manual must be familiar with both SDLC and SNA. This manual describes only the parts of SDLC and SNA that the 5250 system uses. Details about SDLC and SNA are only in respect to the specific protocols and commands that the 5250 system implements.

The manual is divided into two sections. Section 1 is for the reader who is unfamiliar with the 5250 system devices. It describes (1) the system, (2) basic SDLC and SNA concepts utilized by the system, and (3) basic terms necessary to understanding the presentation of the topics relating to SNA and SDLC. Examples of the 5250 device data streams conclude Section 1.

Section 2 is an encyclopedia that presents topics alphabetically. This section is designed for use by the programmer familiar with the operation of the 5250 system but in need of specific detailed information about a particular area of the programming.

Both sections use cross-references that lead the reader to other topics of interest. These cross-references take the following form: See the index entry: *display, commands*.

The manual uses the convention that *he* represents both *he* and *she*.

Manuals of related interest to the reader are:

- *IBM 5250 Information Display System Planning and Site Preparation Guide*, GA21-9337
- *IBM 5256 Printer Setup Procedure*, GA21-9290
- *IBM 5251 Display Station Models 1 and 11 Setup Procedure*, GA21-9286
- *IBM 5252 Dual Display Station Setup Procedure*, GA21-9288
- *IBM 5251 Display Station Models 2 and 12 Setup Procedure*, GA21-9289
- *IBM 5251 Display Station Models 1 and 11 IBM 5252 Dual Display Station Operator's Guide*, GA21-9248
- *IBM 5251 Display Station Models 2 and 12 Operator's Guide*, GA21-9323
- *IBM 5256 Printer Operator's Guide*, GA21-9260
- *IBM Data Communications Concepts*, GC21-5169
- *System Network Architecture General Information*, GA27-3102
- *IBM Synchronous Data Link Control General Information*, GA27-3093

# Contents

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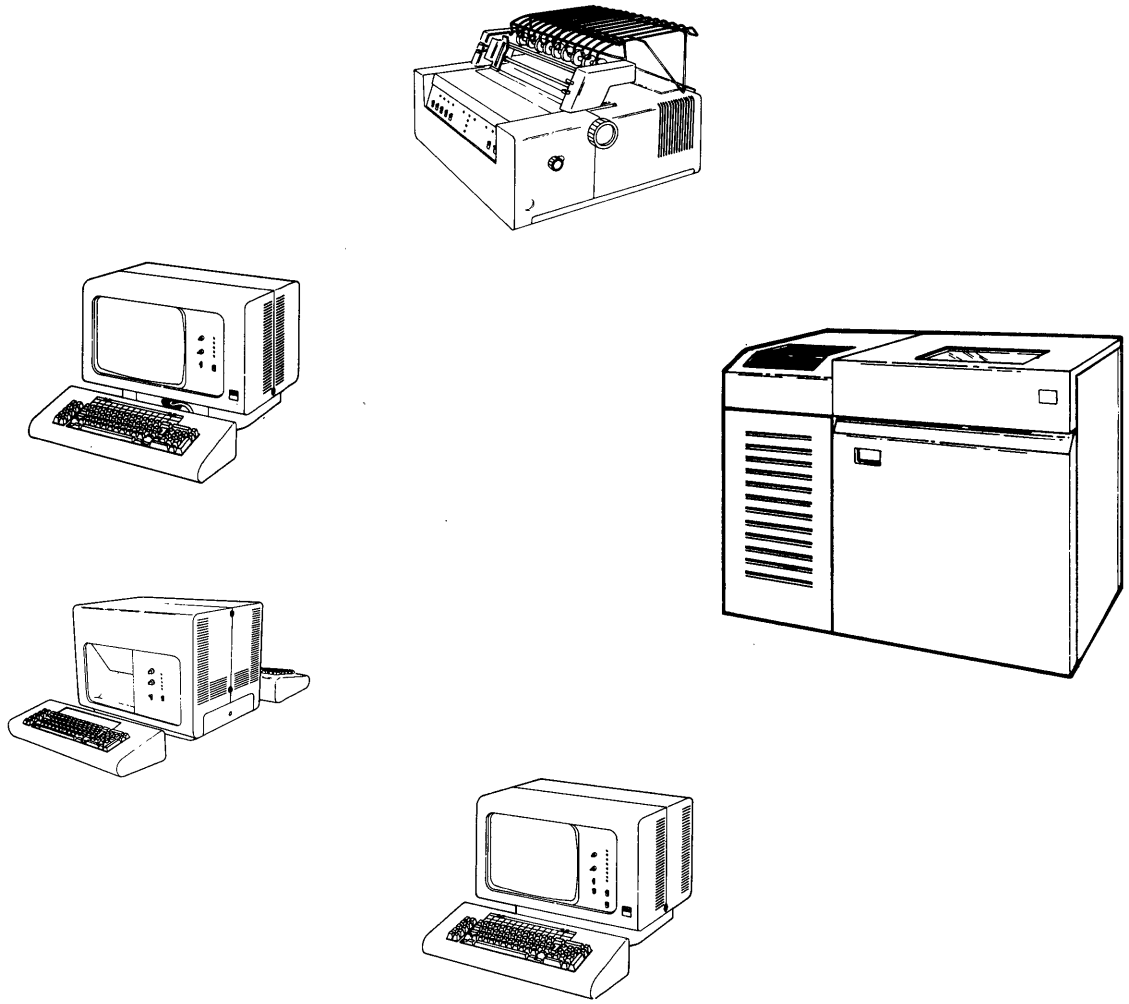


**Figure 1. Devices that Form the 5250 Information Display System**

# Section 1. Description of the 5250 Information Display System

## INTRODUCTION

This manual describes a configuration in which a 5251 Model 2 or 12 Display Station is attached to a host system via an SDLC (synchronous data link control) communications link and in which the controller drives the attached 5251 Models 1 and 11 Display Stations, 5252 Dual Display Stations, 5225 Printers, and 5256 Printers. See Figure 1.

The functions reference manual for each system that uses the 5250 Information Display System devices describes the configuration in which the host system is the controller (native attach). This manual describes only the operations of the 5251 Model 2 or 12; no direct-attach operations are described. Figure 2 shows the basic functions performed by the 5250 devices.

The intended audience for this manual is system programmers who need to understand the communications, editing, and control operations of the 5251 Models 2 and 12 and their associated devices. Prerequisites to using this manual are a knowledge of SDLC (synchronous data link control) and SNA (system network architecture), and an understanding of the contents of the *5250 Introduction* and the *5251, 5225, 5256, and 5252 Operator's Guides*. The purpose of this manual is to give the system programmer enough information about the 5250 Information Display System to allow him to implement his own configurations and to create the data streams and SDLC/SNA linkages and controls necessary to solve program-related problems.

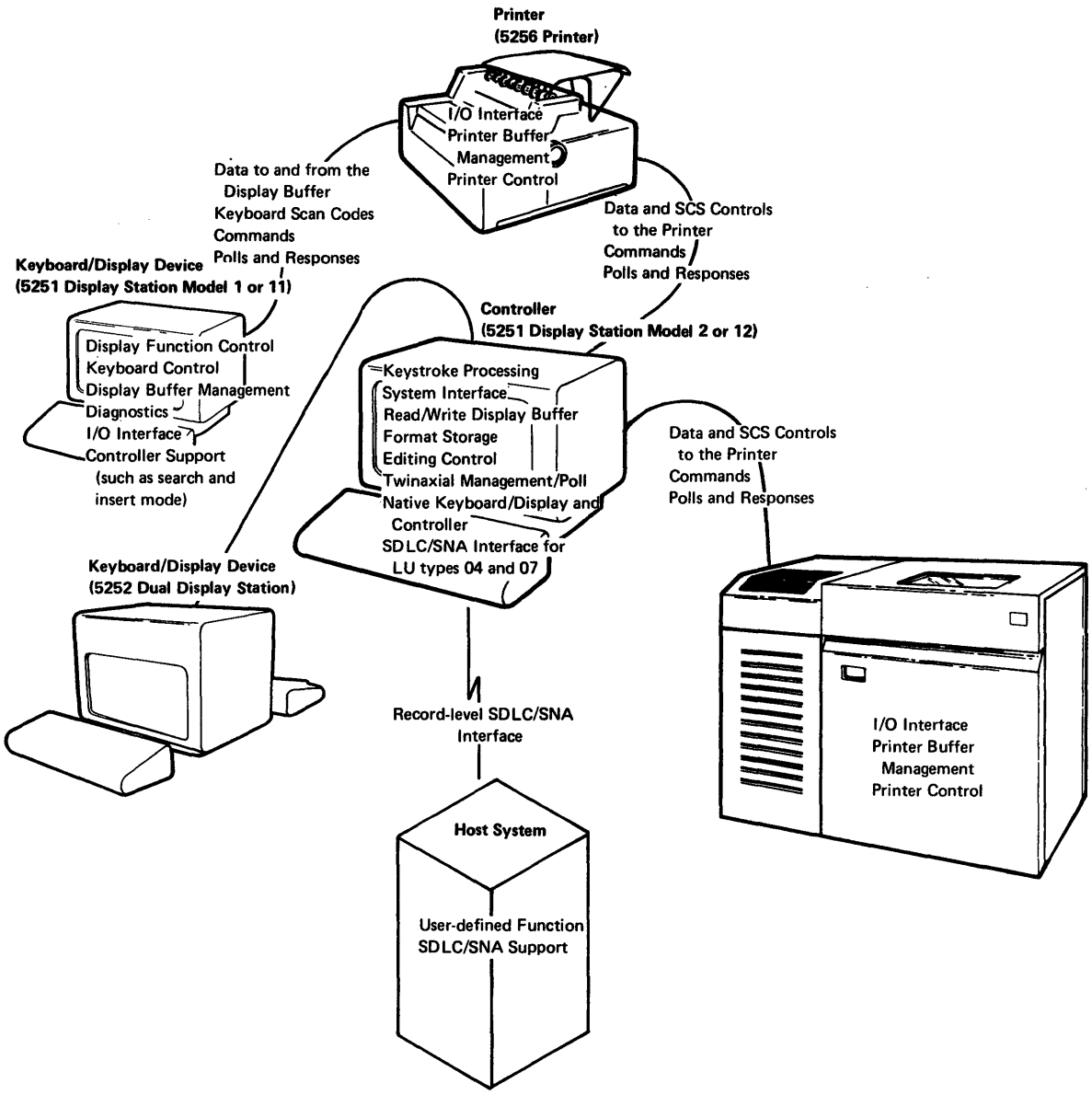
This manual is organized into two sections. Section 1 describes the 5250 work stations, outlines their functional characteristics, describes the way the 5251 Model 2 or 12 Display Station with the Cluster feature implements SNA, provides definitions for some basic SNA terms, and contains examples showing data streams for writing onto and reading from a display and writing to a printer. It is written for the programmer who is unfamiliar with the 5250 Information Display System and who needs to understand how it functions.

Section 2 is an encyclopedia that provides detailed information about topics important to a programmer who is trying to implement the 5250 Information Display System. These topics are arranged alphabetically and have cross-references to related topics. For example, if you want to know what the code for the Write to Display command is, look in the *Encyclopedia* section under the heading *Commands*; within this topic, you will find the Write to Display command with references to topics describing the parameters within the command (such as screen attributes and orders). Using this organization, you can go to any subject without having to first determine where the author has grouped the information.

## DESCRIPTION OF THE 5250 DEVICES

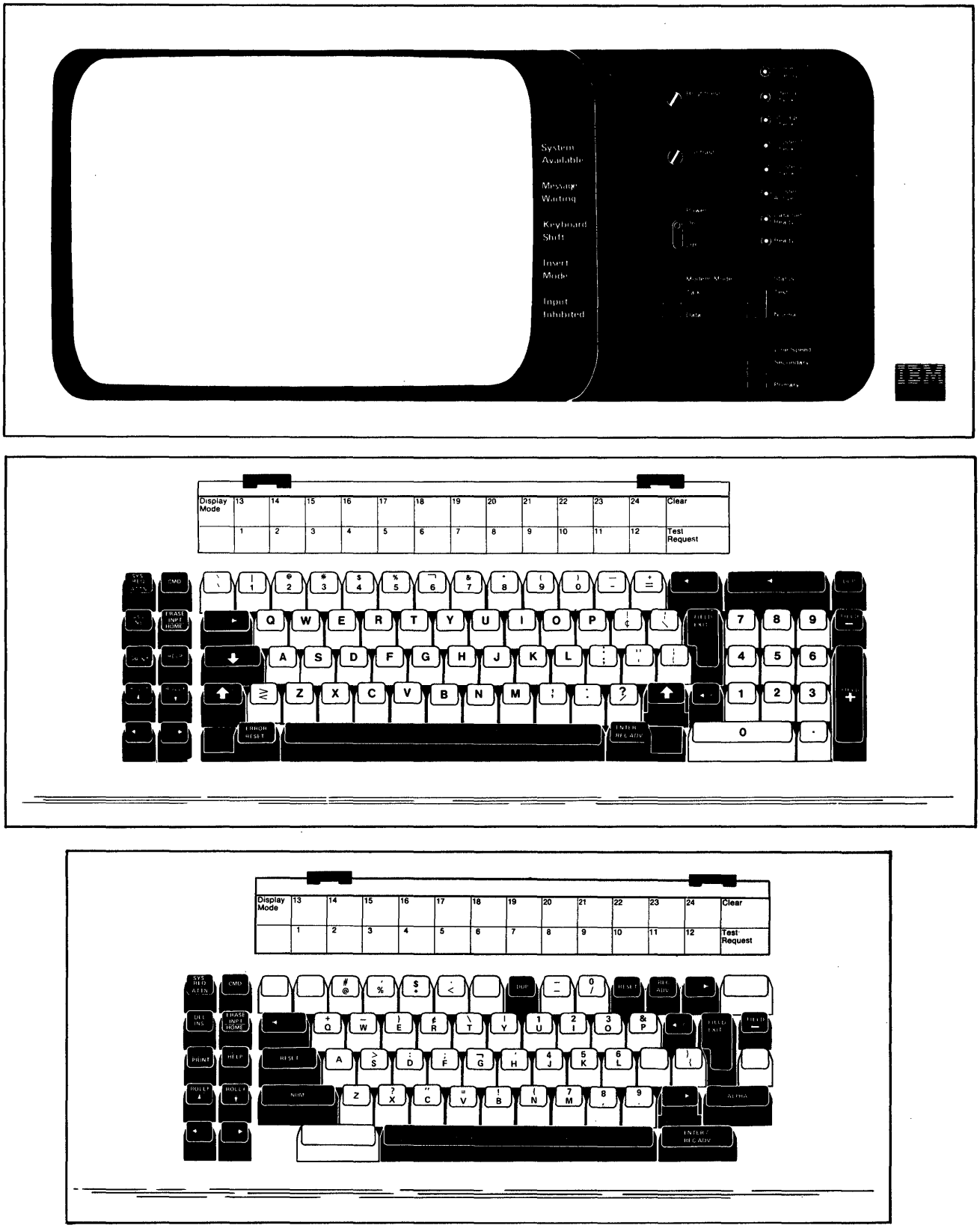
The 5250 Information Display System is a family of keyboard/display and printer work stations (see Figure 1). It includes the 5251 Model 2 and 12 Display Stations, the 5251 Model 1 and 11 Display Stations, 5252 Dual Display Stations, 5225 Printers, and 5256 Printers. The following text describes the devices that are offered as part of this 5250 system.

The 5251 Models 1 and 11, 5252, 5225, and 5256 devices are nonintelligent work stations; this means that they require a controller to tell them what to do. This controlling device in the 5250 system may be a 5251 Model 2 or 12 (work station/controller) with a cluster feature installed or the controller in the host system. When a 5251 Model 2 or 12 is the controller for the 5251 Models 1 and 11, 5225, and 5256 devices, it is attached to the host system by a common carrier or private communications network. This link uses SDLC to establish, maintain, and monitor the transmission link between the host system and the controller in the 5251 Model 2 or 12.




*Note:* The configuration shown in this illustration implements both the Cluster feature (CF) and Cable Thru feature. These features and the possible configurations offered within the 5250 Information Display System are described later in this section.

**Figure 2. Functional Representation of the 5250 Information Display System**




*Note:* The Modem Mode, Line Speed and Comm Line switches are optional and are not included on all 5251 Models 2 or 12.

**Figure 3. 5251 Model 12 Display Station (and Controller)**

### 5251 Models 2 and 12 Display Station (and Controller) Description

The 5251 Model 2 or 12 is a keyboard/display work station; it also has a controller for all the 5251 Model 1 and 11, 5252, 5225, and 5256 devices that are attached to it via the cluster feature (either Cluster feature or Dual Cluster feature). Figure 3 shows the 5251 Model 12 keyboard and screen.

The 5251 Model 2 or 12 is a keyboard/display work station that can be attached via a remote communications network to the host system. The following list gives attributes and features of the 5251 Model 2 or 12 Display Station:

- A display of 960 (Model 2) or 1920 (Model 12) characters
- A choice of three styles of movable keyboards
- A keyboard Cmd (command) key with 12 user-programmable (command function) keys
- A security Keylock feature
- A Magnetic Stripe Reader feature
- An internal communications adapter for remote attachment to a common carrier communications line using SDLC/SNA:
  - A DDS Adapter feature
  - An EIA Interface feature
  - A 1200 bps Integrated Modem feature
  - A 2400 bps Integrated Modem feature
  - A 4800 bps Integrated Modem feature
- Transmission speeds up to 9600 bps
- Cluster feature and Dual Cluster feature
- A Selector Light Pen feature
- A self-check feature
- A Copy to Printer feature
- An Internal Clock feature

The keyboard/display for the 5251 Model 2 or 12 has the same general characteristics as the 5251 Model 1 and 11 and 5252 keyboard/displays. These characteristics are described under the following heading.

### General Characteristics of the Keyboard/Display Work Stations

All displays provide green characters on a dark background; reverse-image displays are available through programming and operator control. See the index entry: *Display Mode keys* for text describing how the operator controls the display image.

Display control is accomplished through the screen attributes (see the index entries: *screen attributes* and *display, commands*). These are the highlighting techniques the screen attributes control:

- Image reversal
- Column separators
- Underscore
- Blink
- High intensity

**Note:** A combination of the underscore, high intensity, and reverse image screen attributes results in no display until the next screen attribute is encountered.

Figure 4 shows a sample display illustrating the display attribute controls available.

All keyboard/display work station models support a 96-character standard or a 188-character multinational graphic set. See the index entry: *EBCDIC* for a listing of these characters. The cursor is user-programmable through orders that accompany the display write commands (see the index entry: *IC order*).

The displays also contain two kinds of visual indicators (LEDs and screen indicators) and a programmable audible alarm that alerts the operator of the work station's status. Indicators on the 5251 Models 2 and 12 show the operator the status of the communication line and of the installed cluster feature. See the index entry: *indicators, controller* and *indicators, display* for a description of the visual indicators and audible alarm functions and the index entries: *control characters, display, display, commands,* and *Signal, command and response* for a description of how the programmer can control the audible alarm and Message Waiting indicator.

The keyboards provided with the 5250 system are uppercase and lowercase typewriter-like keyboards with a numeric key entry pad, data entry and data entry with proof arrangement keyboards with embedded numeric configurations. All three keyboard styles have special function keys.

The special function keys provided by the keyboard are:

- Aid-generating keys
- Cursor movement keys
- Field exit keys
- Signal keys
- Special keys

Figure 5 shows the types of special-purpose keys available.

The aid-generating keys are Clear, Enter/Rec Adv, Help (in the nonerror state), Cmd and command function keys, Print, Record Backspace (Home), Roll ↑ (Roll Up), and Roll ↓ (Roll Down). These keys allow the user to advise the host system that the device he is using requires some action from the host system. The index entry: *aid-generating keys* describes the specific keys within this group. The index entry: *aid codes* identifies the hexadecimal code generated by each aid-generating key.

The cursor movement keys are ← (Character Backspace), ↑ (Cursor Up), ↓ (Cursor Down), ← (Cursor Left), → (Cursor Right), →| (Field Advance), |← (Field Backspace), and ←┘ (New Line). These keys allow the operator to manually position the cursor. Field definition does affect the usage of these keys; see the index entries: *fields* and *cursor movement keys* for details.

The field exit keys are Dup, Field Exit, Field- (Minus), and Field+ (Plus). These keys are field-definition dependent. This means that all field requirements must be satisfied before the key is operable. The index entries: *fields* and *field exit keys* contain details.

The signal keys are Attn and Help (in the error state). When the operator presses one of the signal keys, the controller sends a Signal command to the host system. This requests the host system to perform a specified function. See the index entries: *Signal keys* and *Signal, command and response* for details.

The special control keys are Home, Display Mode, Ins, Del, (Shift) and (Shift Lock) on the typewriter-like keyboard and Alpha and Numeric shifts on the data-entry keyboards, Erase Input, and (Error) Reset. The index entry: *special control keys* contains information describing the functions of these keys.

The special host keys are Test Request and Sys Req. These keys require SNA-related host system intervention. The index entry: *special keys, host* contains information describing the functions of these keys.

The keyboards also provide a typamatic function for all data keys; this allows the operator to repeat a character by holding a key until the desired number of repetitive characters has been entered. Each key gives a clicking sound when pressed while the keyboard is active.

### 5251 Models 1 and 11 Display Station Description

The 5251 Models 1 and 11 are keyboard/display work stations that are directly attached to a controller either (1) in the 5251 Model 2 or 12 via a cluster feature or (2) in a host system. Model 1 has a 960-character display and Model 11 has a 1920-character display. Figure 6 shows a 5251 Model 11 keyboard/display.

The 5251 Models 1 and 11 have the following features and attributes:

- A display of 960 (Model 1) or 1920 (Model 11) characters
- A choice of three styles of movable keyboards
- A keyboard Cmd (command) key and 12 user-programmable (command function) keys
- A security Keylock feature
- A Magnetic Stripe Reader feature
- A Cable Thru feature
- A Selector Light Pen feature

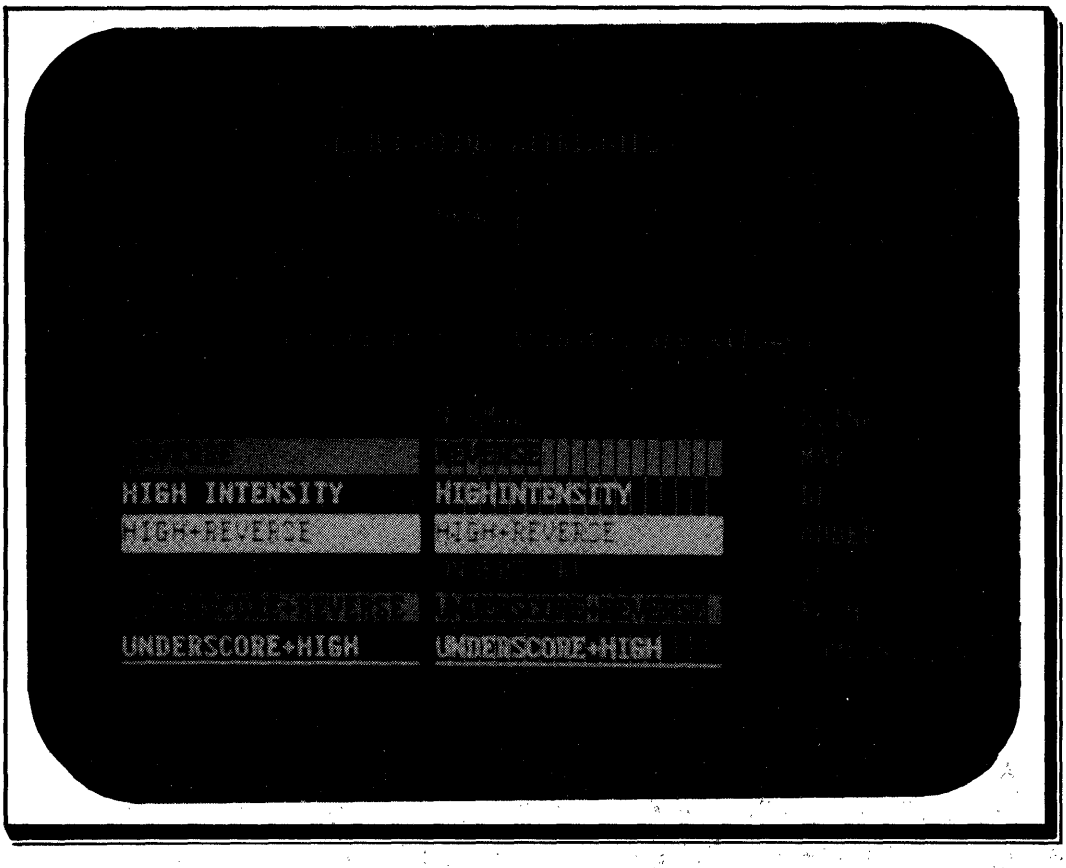
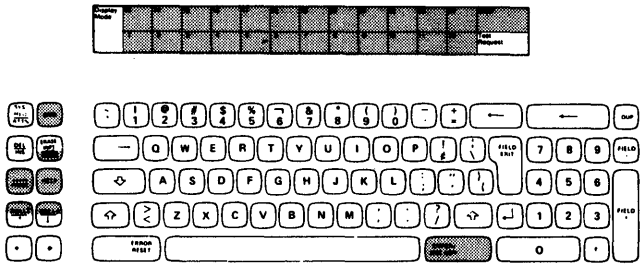


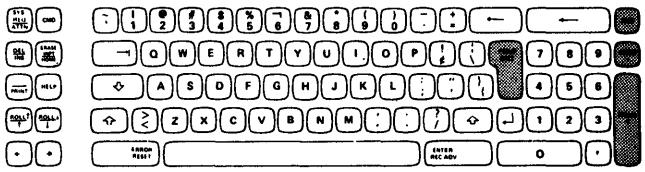

**Figure 4. Sample Screen Showing the Display Attributes Available on the 5250 Display Stations**

## Typewriter-like Keyboard

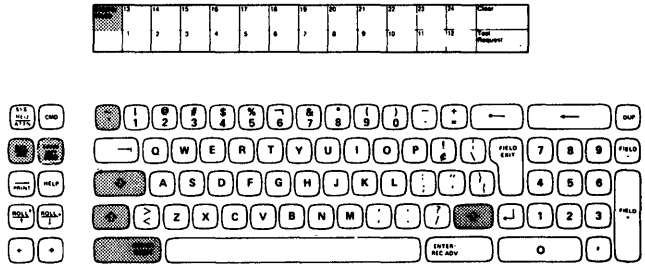
### Aid-Generating Keys



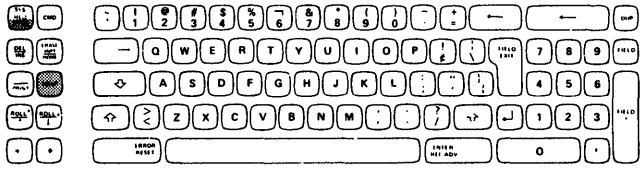
### Field Exit Keys



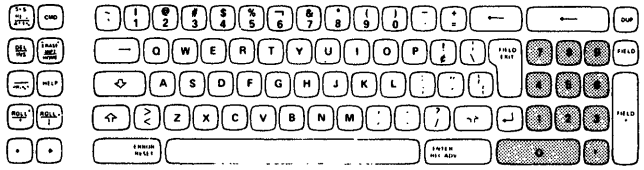
### Special Control Keys



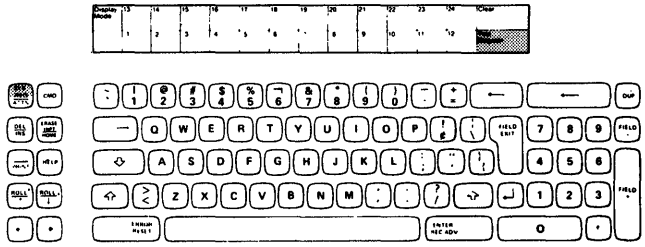
### Signal Keys



### Numeric Pad



### Special Host Keys



### Cursor-Movement Keys

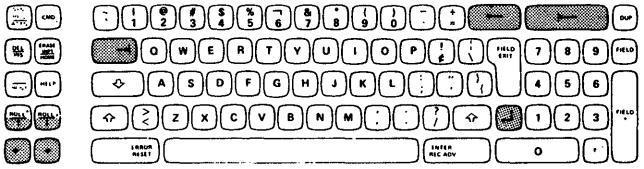
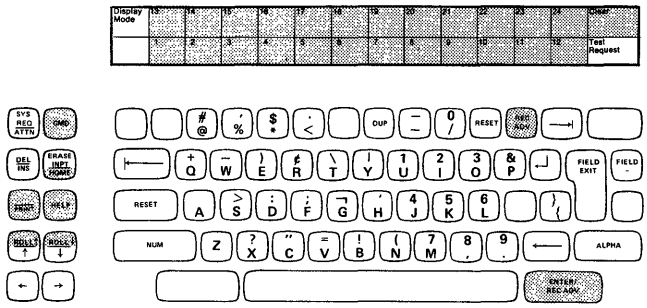


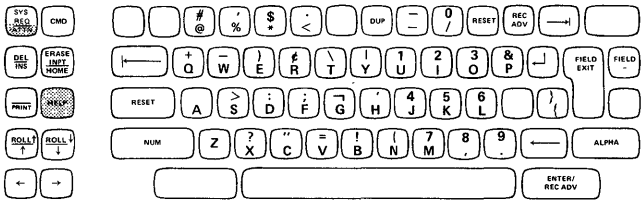
**Figure 5 (Part 1 of 2). The Types of Special-Purpose Keys Available on the 5250 Keyboard/Display Stations**

## Data-Entry Keyboard

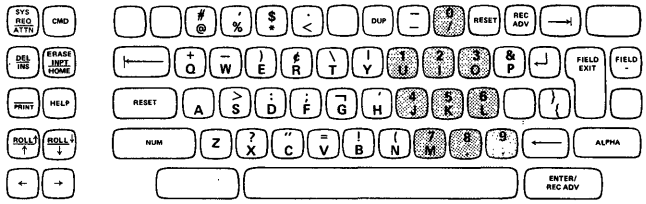
### Aid-Generating Keys



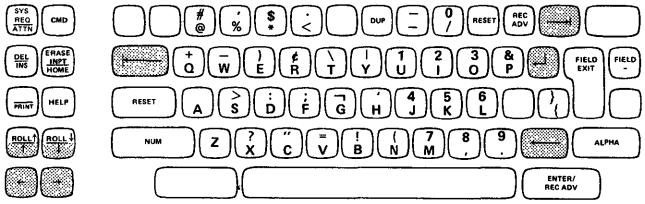

### Signal Keys



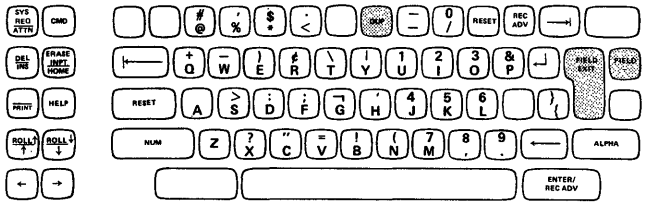
### Embedded Numeric Keys



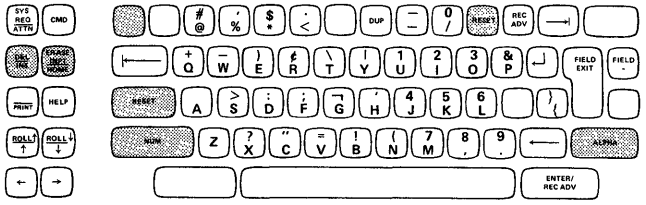
### Cursor Movement Keys



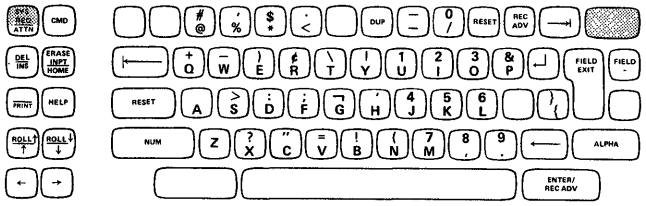
### Field Exit Keys



### Special Control Keys



### Special Host Keys



### Proof Arrangement

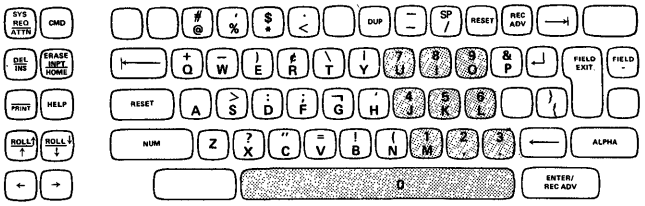


**Figure 5 (Part 2 of 2). The Types of Special-Purpose Keys Available on the 5250 Keyboard/Display Stations**

### 5252 Dual Display Station Description

The 5252 is a directly attached device that consists of two work stations: two keyboards and two 960-character displays. Both 5252 displays share a common cathode-ray tube (CRT). Figure 7 shows a 5252 keyboard/display. One work station is designated as primary and the other as secondary. Only the primary 5252 work station has the control panel lights (see the index entry: *indicators, display*).

Because the primary and secondary 5252 work stations share a single split screen, there can only be one Keylock feature for each 5252. A maximum of 60 blinking characters is recommended for each display. Within the cluster feature configurations, each 5252 counts as two devices; therefore, there can be a maximum of two 5252 devices on the Cluster feature and four on the Dual Cluster feature. The heading *Cluster Feature and Dual Cluster Feature* in this section contains additional details.

### 5225 Printer Description

The 5225 printer attaches directly to a host system or a 5251 Model 2 or 12 controller. The 5225 is a wire matrix line printer that prints bidirectionally. Available in four models, the 5225 can print at maximum rates ranging from 80 to 560 lines per minute. Figure 8 shows the 5225 printer.

Two indicator lights and an operator panel display alert the operator of the device status. (See the index entries: *indicators, printer* and *operator panel display*.) If the Audible Alarm feature is installed, the user programs the alarm by using the printer bell control character (see the index entry: *control characters, printer*). The alarm is also sounded when an error occurs that causes the printer to enter a *not ready* condition.

The 5225 has the capability to print a maximum of 132 or 198 position lines depending on the preestablished print density of 10 or 15 characters per line respectively. Continuous forms (3 to 17.7 inches wide) of up to six parts are acceptable, but forms of more than four parts should be tested to determine if proper feeding and legibility result.

The carrier bar holds a variable number of groups of eight print wires each. Depending on the printer model, two to eight of these groups will form the print matrix. The carrier bar moves the wire groups across the paper bidirectionally. Print positions are spaced at 10 or 15 characters per inch as determined by the operator or the using system program. Each character is printed in a space eight dots high by seven dots wide with only four of the horizontal dots present for a given character. The eighth horizontal dot line (bottom wire of the print group) is used only for some lowercase characters, special characters, and as an underscore.

The 5225 has two sets of pin-feed tractors that move the forms up or down and adjust to accommodate form widths from 3 to 17.7 inches.

Maximum printing speeds vary with the following:

- Model of printer
- Printed data format (formatted forms or maximum forms)
- Print density (10 or 15 characters per inch)
- Length of the printed line
- Amount of spacing within the printed line
- Number of lines skipped

### 5256 Printer Description

Like the 5225, the 5256 Printer requires either a 5251 Model 2 or 12 controller with a cluster feature or a direct-attach host system to drive it. The 5256 is a bidirectional matrix printer that includes models that print at a maximum rate of 40 (Model 1), 80 (Model 2), or 120 (Model 3) characters per second. Figure 8 shows the 5256 printer.

Lights on the printer panel alert the operator to the status of the device. (See the index entry: *indicators, printer* for details.) If the Audible Alarm feature is installed, the user programs this alarm by using the printer bell control character (see the index entry: *control characters, printer*). The alarm is also sounded when an error occurs that causes the printer to enter a *not ready* condition.

The printer uses the SNA standard character string (SCS). It uses the unprintable character options provided by the SGEA (set graphic error action) control character. Unprintable characters show as a user-defined default symbol. See the index entry: *EBCDIC* for a list of printable characters.

The maximum print line is 132 characters. Individual, continuous, and up to six-part forms (five copies plus one original) are recommended for use.

The print head holds the eight print wires that make the print matrix. A carrier moves the print head across the paper. The print positions are spaced at 10 character positions per inch. The print matrix is 7 x 7 dots with only four of the horizontal dots present at one time. The eighth wire forms the underscore and is used for some lowercase characters and other language character sets.

The printer has a platen and pressure feed rolls that handle single-page documents such as those used in typewriters; when these are used, the operator must align and load each page. The forms tractors handle continuous forms from 3 to 15 inches wide. The operator must align and adjust the forms in the tractors when he loads them.

As stated before, the maximum throughput rates are 40, 80, and 120 characters per second. The things that affect the throughput are:

1. The length of the printed line
2. The amount of tabbing done within the line
3. The amount of line feeding between lines
4. The amount of variation in the length of the lines

The printer's transparent mode allows diagnosis of both hardware and software problems and can be of use to the engineer, programmer, and/or service representative. See the index entry: *transparent mode.*

## GENERAL PHYSICAL CONFIGURATION

Within the 5250 system, the 5251 Model 2 or 12 Display Station is the controller for all 5251, 5252, 5225, and 5256 work stations attached via a cluster feature. Figure 9 illustrates a typical user configuration.

The attachment of the 5251 Model 1 and 11, 5252, 5225, and 5256 devices to the 5251 Model 2 or 12 controller is via a twinaxial or coaxial cable connection into CF ports (physical cable connectors on the 5251 Model 2 or 12), and the communication link between the host system and the 5251 Model 2 or 12 controller is via SDLC/SNA. Two features that are offered affect the user's configuration pattern and addressing scheme; these are the Cable Thru feature and the Cluster feature or Dual Cluster feature. See the headings that follow for details about configuration restrictions.

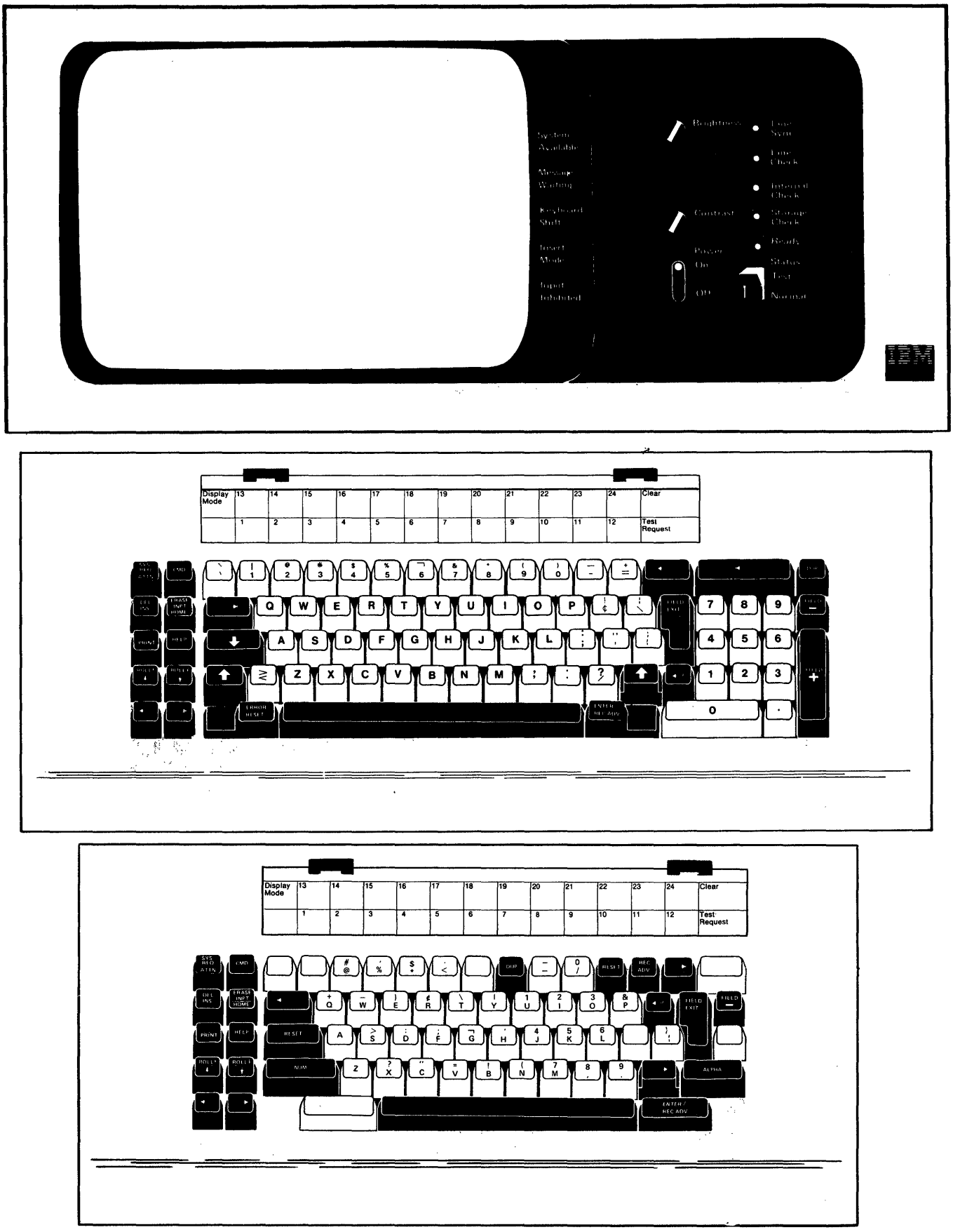



**Figure 6. 5251 Model 11 Display Station**

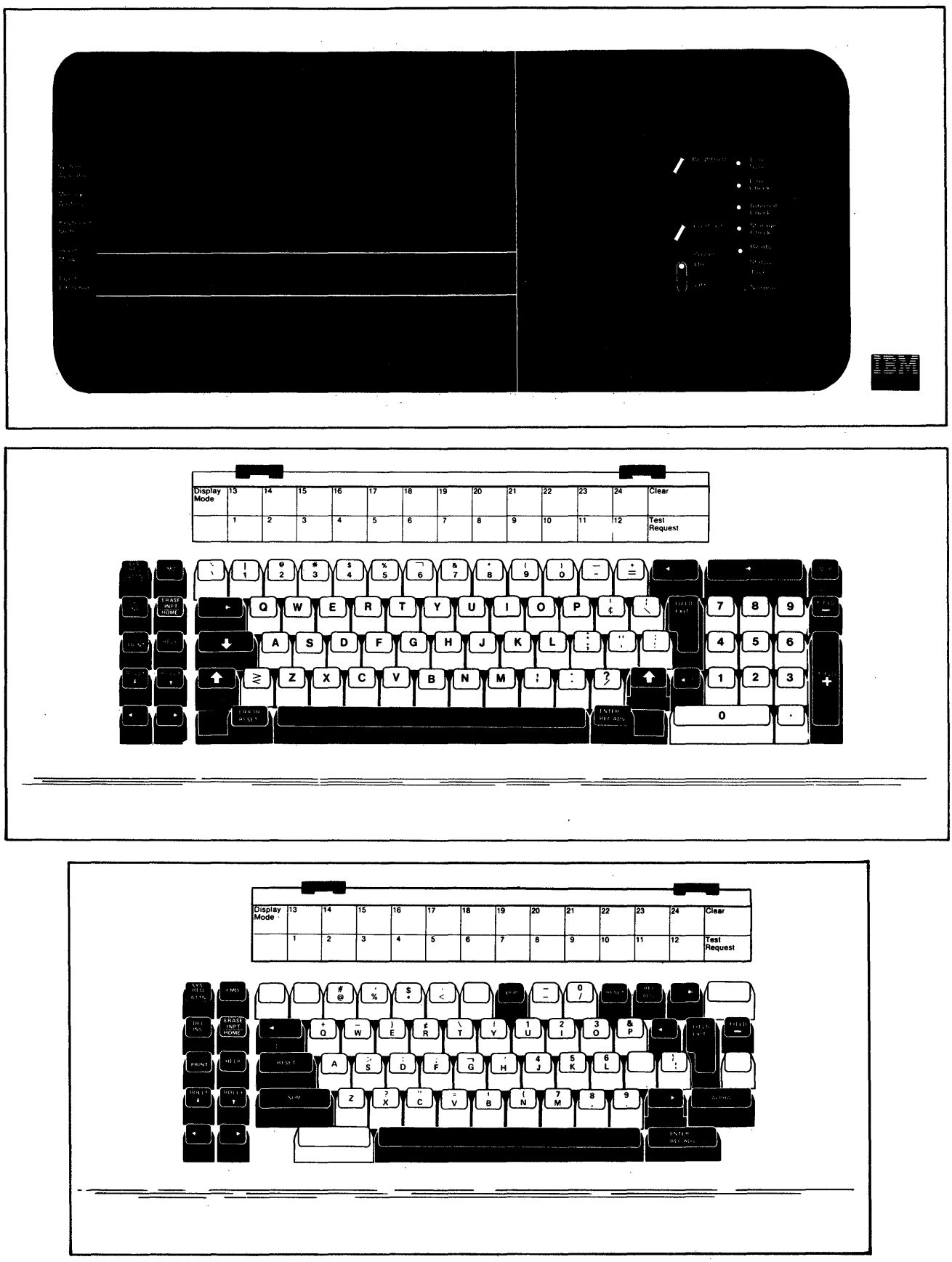



**Figure 7. 5252 Dual Display Station (Primary Side)**

**5225 Printer**

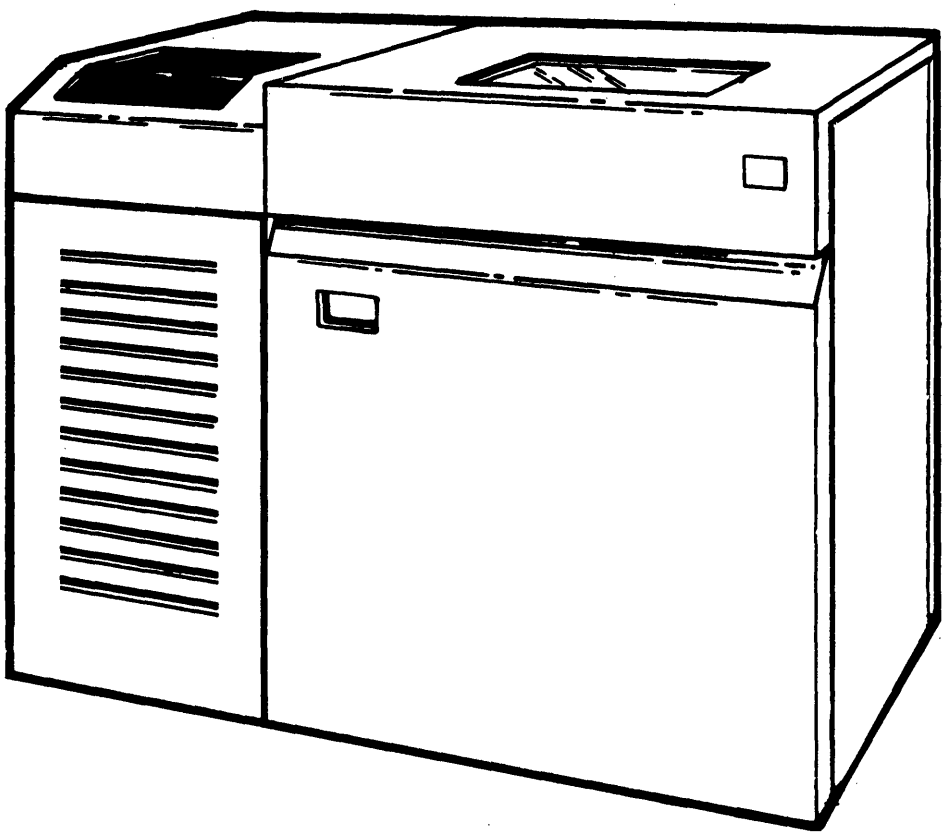


**Figure 8 (Part 1 of 2). Printers for the 5250 Display System**

## 5256 Printer

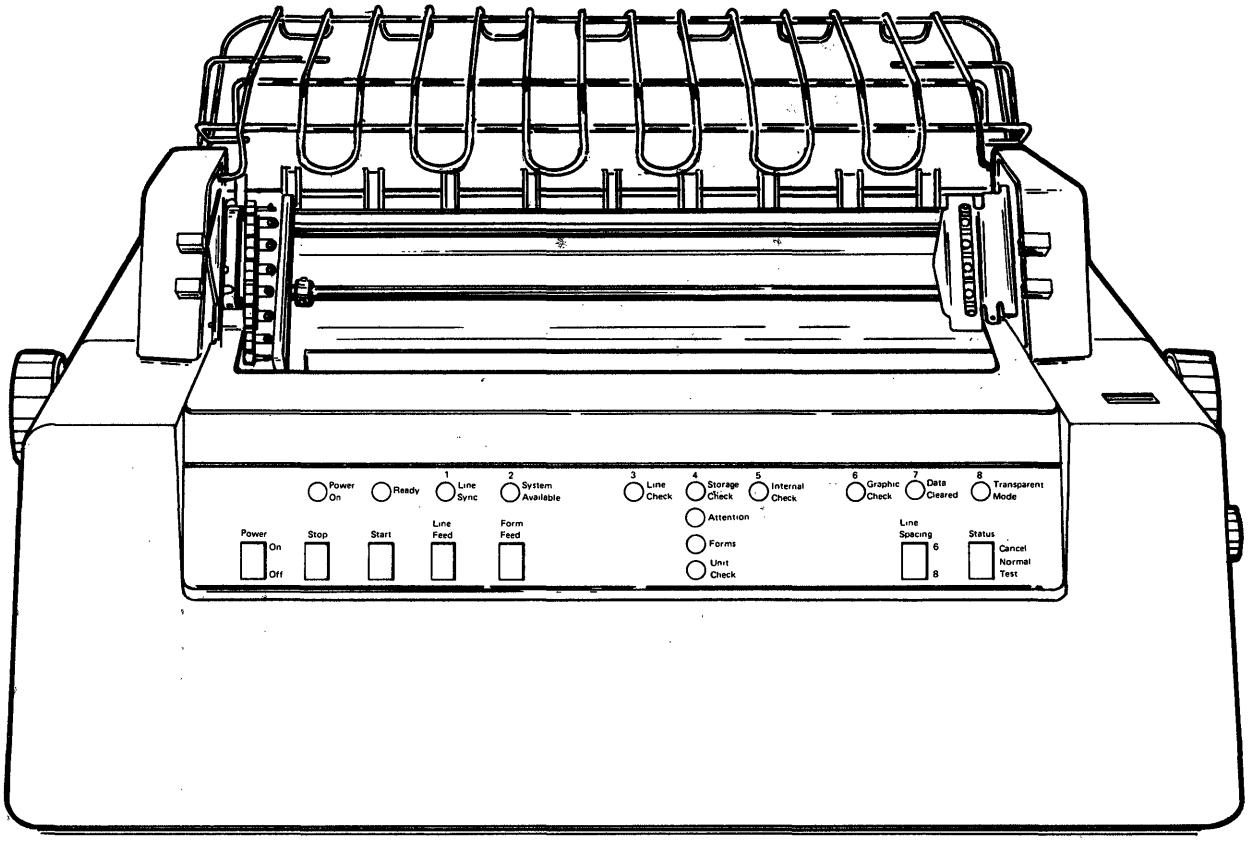



**Figure 8 (Part 2 of 2). Printers for the 5250 Display System**

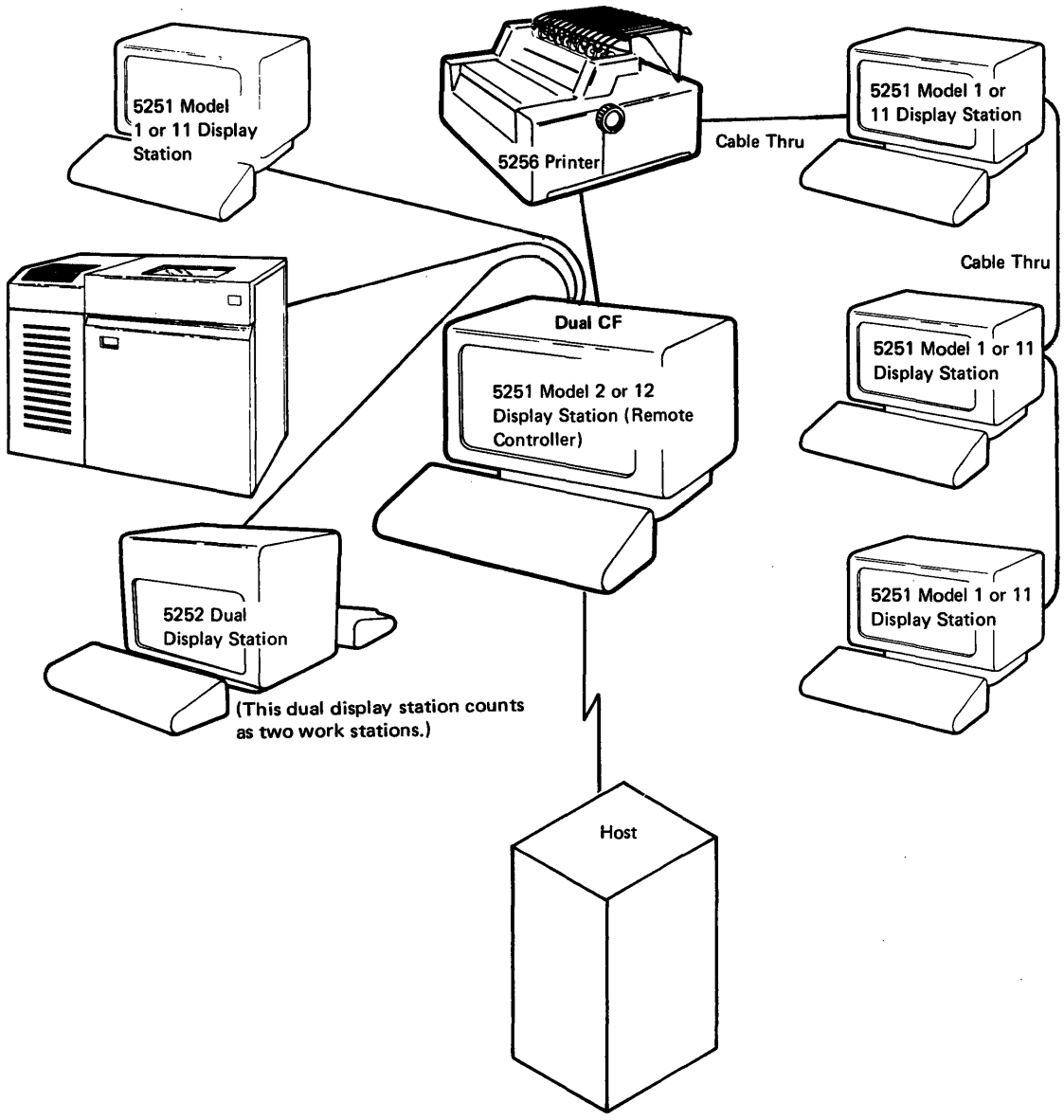



**Figure 9. A Sample Configuration Showing Dual Cluster Feature and Cable Thru Feature**

### Cluster Feature and Dual Cluster Feature

A Cluster feature provides a controller and a twinaxial interface between the 5251 Model 2 or 12 and any attached 5251 Model 1 or 11, 5252, 5225, or 5256 work stations[1]. There are two cluster features offered: (1) Cluster feature, which has four ports and provides for the attachment of up to four work stations, and (2) Dual Cluster feature, which has eight ports and provides for the attachment of up to eight work stations[2]. The 5252 Dual Display Station is counted as two work stations when it is attached to the 5251 Model 2 or 12 controller using one of the cluster features.

Four ports and four rocker switches are provided with the Cluster feature, and eight ports and four rocker switches are provided with the Dual Cluster feature. See Figure 10.

**Note:** All four rocker switches are present whether or not Cluster feature or Dual Cluster feature is installed; they are not operational if a cluster feature is not installed.

Before turning power on, the user must set the CF port rocker switches to indicate the maximum number of CF ports he intends to use in the configuration; this information is used at power on time to set the addressing for the attached devices. Details are given in *Addressing in the 5250 System*. The CF port switch settings begin at 00, which represents one port. The ports on each cluster feature (CF1 if Cluster feature is installed and both CF1 and CF2 if Dual Cluster feature is installed) should be used consecutively in order to allow the controller to address the attached work stations correctly; in other words, if the user wants to use two of the four CF ports, he should use cluster feature ports 1 and 2 (switch setting 01) and not 3 and 4; when Dual Cluster feature is installed, ports 5 and 6 equate to ports 1 and 2 of the Cluster feature. Figure 11 illustrates the CF port switch settings.

The righthand column of Figure 11 shows that numbers are assigned to each port. These numbers, along with the CF port switch settings, provide information used to address the devices attached via a cluster feature.

### Cable Thru Feature

Cable Thru is an optional feature on the keyboard/display and printer work stations that are attached to the 5251 Model 2 or 12 controller via a cluster feature or to a host system.

**Note:** Cable Thru applies only to the 5251 Models 1 and 11, 5252, 5225, and 5256 devices.

Cable Thru allows the user to drive multiple work stations using the same twinaxial or coaxial cable. When installed, Cable Thru must be on all but the last device on the cable; it can also be installed on the last device, but it is not a requirement. A work station without the Cable Thru feature must be the last on the line and its work station address will be 0. If the last work station on a cable has the Cable Thru feature, the terminator switch on that device must be on (set to 1). The terminator switch on all other work stations on the cable must be off (set to 2). See Figure 12.

Work station address switches are provided for each device using Cable Thru. These switches allow the user to assign the work station a unique address (work station address) for use by the controller. Figure 12 illustrates the location and appearance of these switches. The work station address switch settings for the Cable Thru feature must match the configuration reflected by the CF port switch settings and CF port numbers used. If these do not match, the controller cannot address the work station. The heading *Addressing in the 5250 System* in this section describes the information necessary to select the correct work station address.

### Acceptable Configurations

The user must have an acceptable configuration for the 5250 system devices before the host system or controller in the 5251 Model 2 or 12 can address a specific device attached via a cluster feature on the 5251 Model 2 or 12. The ports the user chooses to implement should be consecutive (within each cluster feature) and should begin with the first port; see the heading *Addressing in the 5250 System* for work station placement.

---

[1]When using coaxial cable to connect a 5251 Model 1 or 11, a 5252, a 5225, or a 5256 to the 5251 Model 2 or 12, a twinaxial-coaxial adapter must be used at the twinaxial interface on the Model 2 or 12 and also at the attachment point to the connecting work station.

[2]When using coaxial cable to connect a 5251 Model 1 or 11, a 5252, a 5225, or a 5256 to a 5251 Model 2 or 12 (maximum length 2000 feet), only one additional station may be attached using Cable Thru feature, and the cable thru line must be of twinaxial cable (maximum length 100 feet).

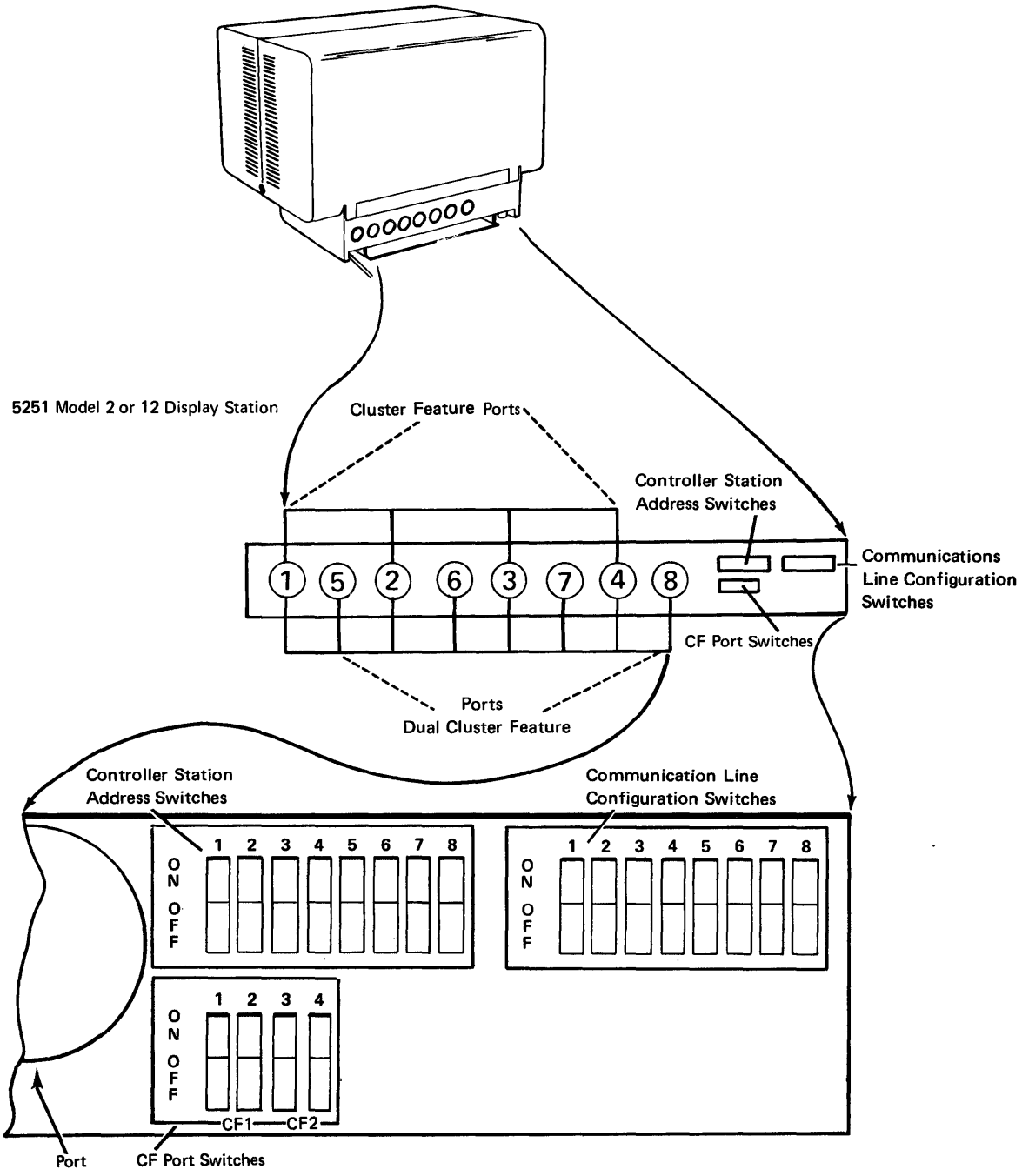



**Figure 10. 5251 Model 2 or 12 Showing the Location of the Controller Station Address Switches, Communications Line Configuration Switches, CF Port Switches, and Ports**

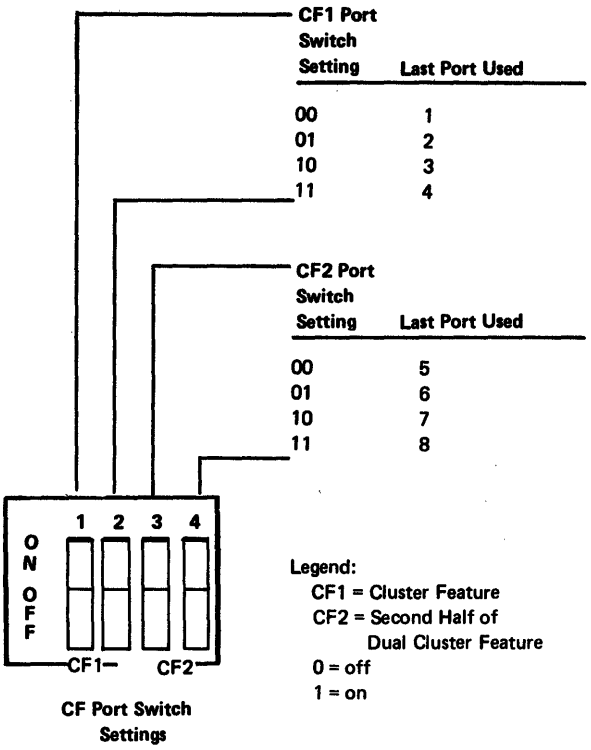



**Figure 11. CF Port Switch Settings**

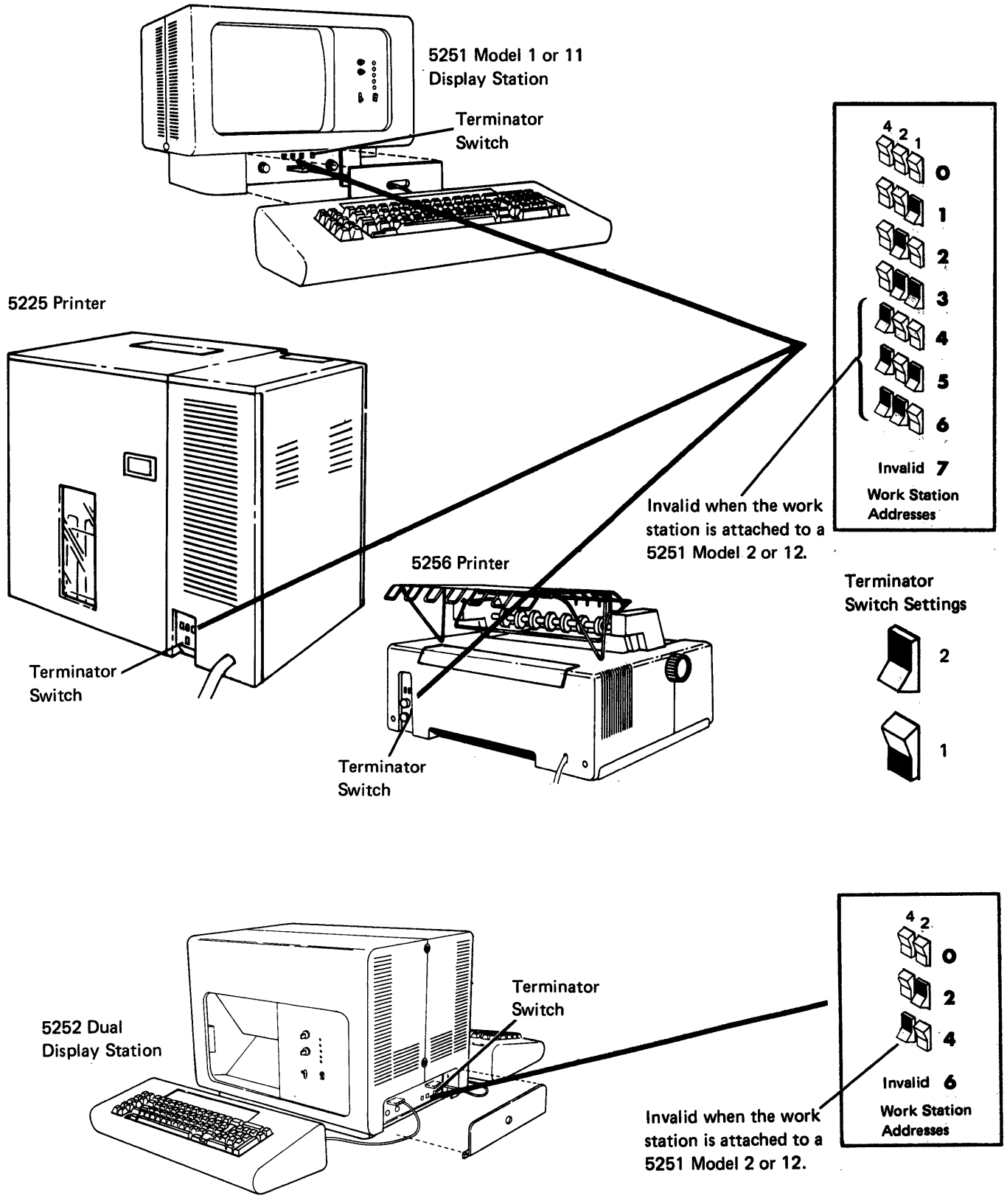



**Figure 12. The Location of the Work Station Address Switches and Terminator Switch**

Figure 13 lists all acceptable configurations. The configurations that are shown are for cluster feature only. Before using Figure 13, the programmer must determine the following things:

- How many work stations will be used?
- How many ports will be used?
- What devices will be attached using a cluster feature?
- Will the Cable Thru feature be installed?

Using the answers to these questions in conjunction with Figure 13, the programmer can determine the appropriate configurations for his system.

## GENERAL FUNCTIONAL INFORMATION

The 5251 Models 2 and 12 contain the SNA support necessary to communicate with a host system. The Models 2 and 12 support LU 4 and 7 protocols. For a more detailed description of the operation of SNA, refer to the *IBM Systems Network Architecture Format and Protocol Reference Manual*, SC30-3112.

The 5251 Model 1 and 11, 5252, 5225, and 5256 work stations are attached to the 5251 Model 2 or 12 controller via a twinaxial or coaxial cable. The transfer of information over the cable interface is called *local operations*. This manual contains no detailed information about the 5250 local operations.

### Functional Characteristics of the 5251 Controller in Remote Operations

The 5251 Model 2 and 12 controller consists of microprocessors and a shared storage area; when the Cluster feature or Dual Cluster feature is installed, the controller consists of additional microprocessors and shared storage areas for the cluster features. These storage areas temporarily hold data or commands as they pass between the addressed device and the host system. The cluster feature microprocessors control the attached 5251 Models 1 and 11, 5252, 5225, and 5256 devices.

The 5251 Model 2 and 12 microprocessors (including any cluster feature microprocessors) (1) determine the type of commands the host system has sent, (2) translate these commands into microcoded transmission commands that can be sent to the attached device or perform the specified operations for the native device, and (3) send these microcoded commands in the acceptable transmission protocol to the addressed, directly attached 5250 work station or send the appropriate native display commands to the native keyboard/display.

In addition to routing commands, the 5251 Model 2 and 12 microprocessors route data and status information between the 5250 work stations and the host system. The controller, attached keyboard/display work stations, and attached printer work stations all contain storage areas that hold commands and information until they can be either processed or routed on to the intended receiver.

### Overview of 5250 Implementation of SDLC (Synchronous Data Link Control)

The protocol used by SDLC consists of (1) an established format for sending link-level commands and data, (2) a pattern for initiating a transfer link between the host system and the controller, and (3) a format for transmitting SNA protocols. The format SDLC uses to convey information is the SDLC frame. See Figure 15. An SDLC frame is a bit pattern that contains flags for synchronization, 2 bytes for error checking, and formats for conveying both SDLC link-level control information and SNA data information. The SDLC frame that contains the SNA RUs is called the I (information) frame; this is the only SDLC frame type that contains the 5250 user data. See the index entry: *frames* for details about the frame contents and types.

Typically, SDLC's requirements are set and remain unaltered by the user. The SDLC XID response can be an exception to this general usage; therefore, specific details about the contents of the XID response are given in the index entry: *SDLC, commands and responses*. In addition, the other SDLC commands are briefly described to help an interested user determine or locate the causes of SDLC-generated errors.

The 5250 implementation of SDLC is half-duplex (HDX). This means that the 5251 Model 2 or 12 can be in the receive state or transmit state; but not simultaneously.

| Number of Ports Being Used on CF1 | CF1 Port Switch | Description of the Available Configurations |
|---|---|---|
| 1 | 00 | 1. Two 5252 work stations can be attached to the first port using the Cable Thru feature.<br>2. One 5252 work station and two individual work stations can be attached to the first port using the Cable Thru feature.<br>3. Four individual work stations can be attached to the first port using the Cable Thru feature. |
| 2 | 01 | 1. A 5252 work station and an individual work station can be attached to the first port using the Cable Thru feature, then an individual work station can be attached to the second port.<br>2. Three individual work stations can be attached to the first port using the Cable Thru feature, then an individual work station can be attached to the second port.<br>3. Two individual work stations can be attached to the first port using the Cable Thru feature, then two individual work stations can be attached to the second port using the Cable Thru feature.<br>4. A 5252 work station can be attached to the first port, then two individual work stations can be attached to the second port using the Cable Thru feature.<br>5. One individual work station can be attached to the first port, then three individual work stations can be attached to the second port using the Cable Thru feature.<br>6. A 5252 work station can be attached to the first port, then a 5252 work station can be attached to the second port. |
| 3 | 10 | 1. A 5252 work station can be attached to the first port, then an individual work station can be attached to the second port, and an individual work station can be attached to the third port.<br>2. Two individual work stations can be attached to the first port, then an individual work station can be attached to the second port, and an individual work station can be attached to the third port.<br>3. An individual work station can be attached to the first port, then two individual work stations can be attached to the second port using the Cable Thru feature, and an individual work station can be attached to the third port.<br>4. An individual work station can be attached to the first port, then an individual work station can be attached to the second port, and two individual work stations can be attached to the third port using the Cable Thru feature. |
| 4 | 11 | 1. An individual work station can be attached to the first port, and an individual work station can be attached to the second port, and an individual work station can be attached to the third port, and an individual work station can be attached to the fourth port. |

**Legend:**
An individual work station is a 5251 Model 1 or 11, a 5225, or a 5256.

**Figure 13. Possible 5250 Configurations**

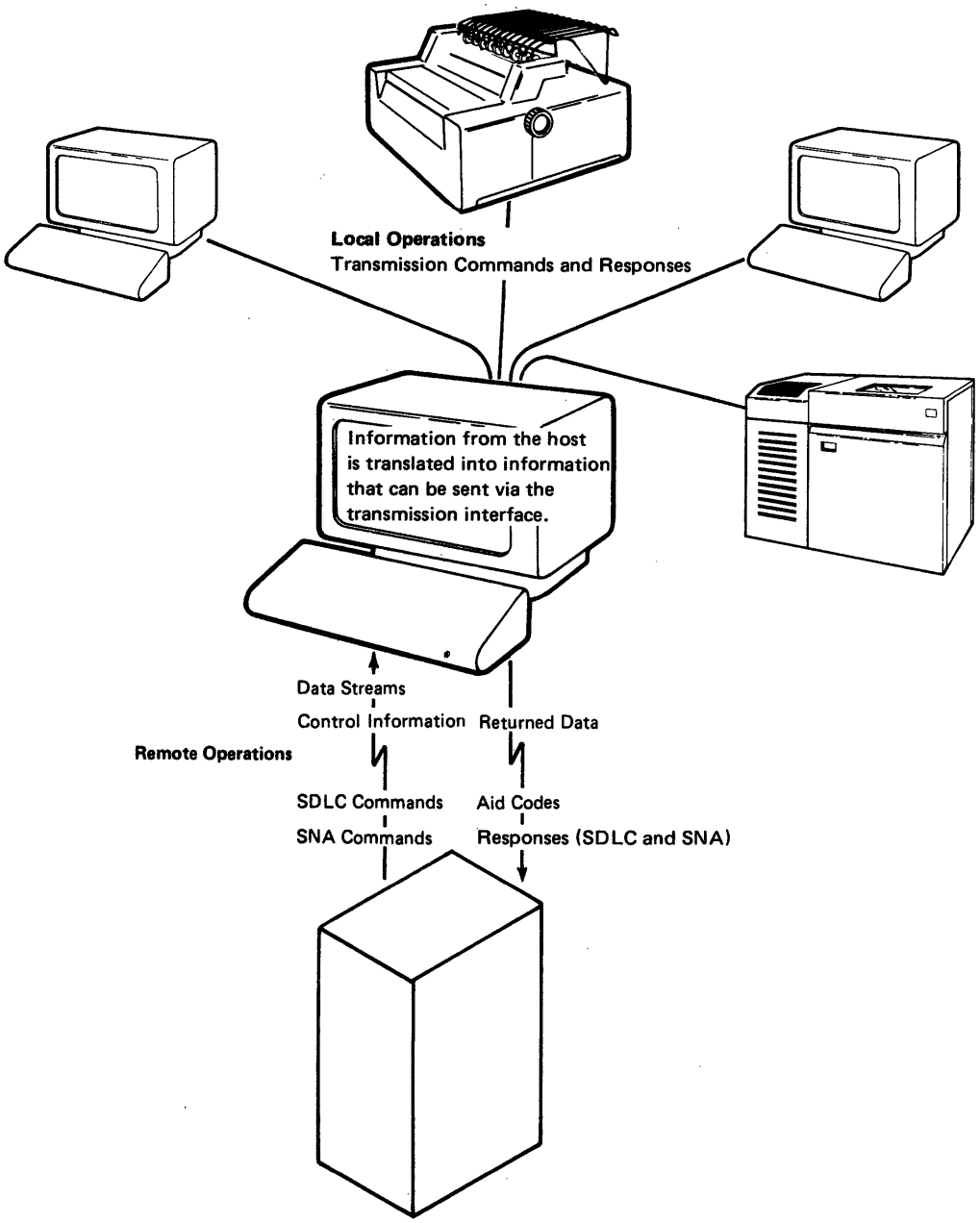



**Figure 14. Overview of the Data Flow for the 5250 Information Display System**

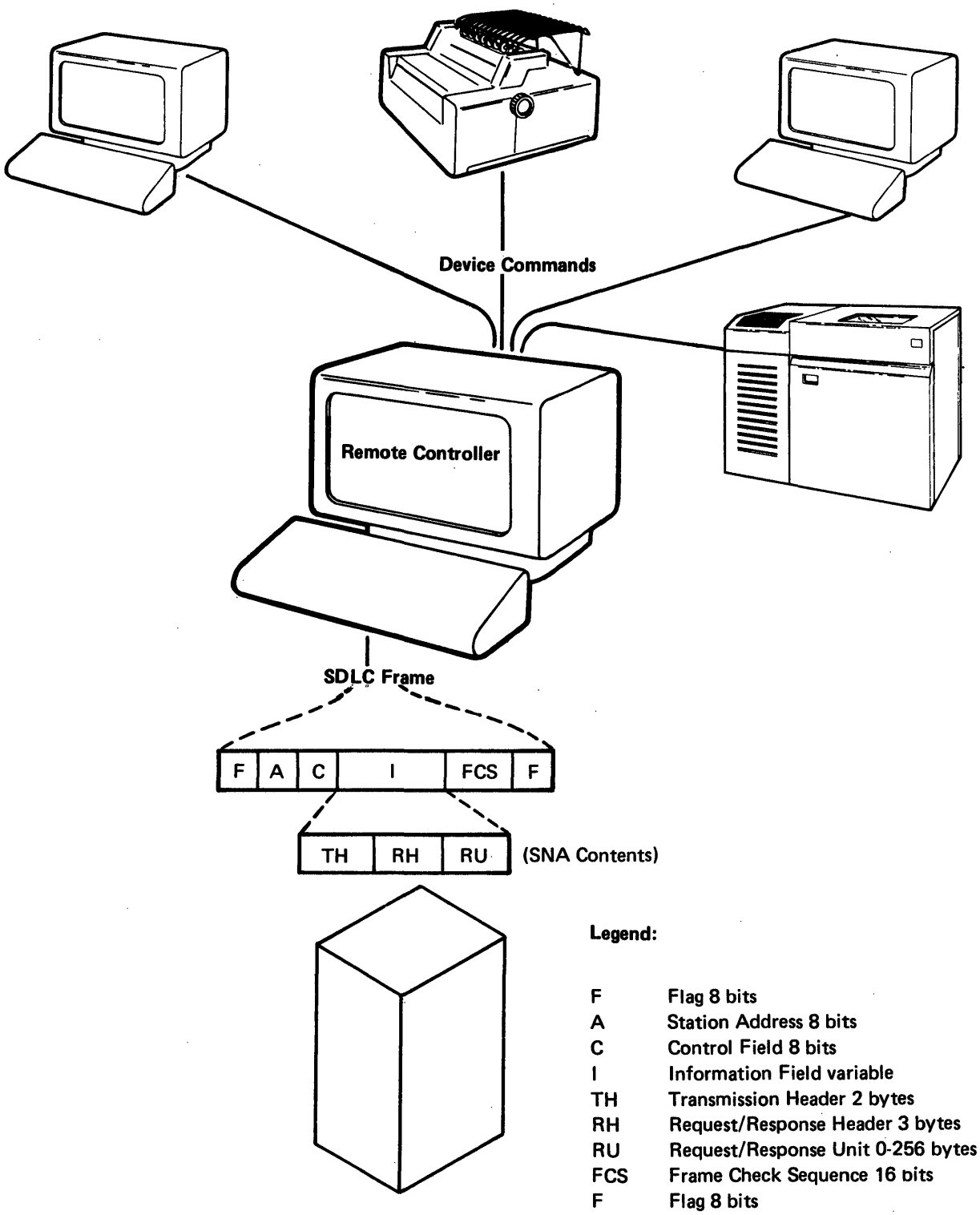



**Figure 15. The SDLC/SNA Relationship**

## Overview of the 5250 Implementation of SNA (System Network Architecture)

SNA is a system of hierarchical rules (commonly called protocols). These rules define such things as the data stream format (RUs) and the process for routing data (data flow control).

The user's primary concern in programming the 5250 devices is the SNA support that the 5250 system implements. The 5250 uses a subset of SNA; the following text describes the implementation of this SNA subset.

### *Description of General SNA Terms Used in This Manual*

When in operation, terminals are normally connected to two independent control points. These are a supervisory control point and an application user control point. LU (logical unit) type 4 and 7 provide two independent sessions, one for each control point. The supervisory control is accomplished on the SS-LU (supervisory services-logical unit) session. Because each control point has different requirements, the sessions have different protocols. The LU-LU session controls the entire display screen or printer page. The SS-LU session has limited control over the devices, one display line (called the system message line), and no print capability. Because the SS-LU session is informed of the availability of the device for a LU-LU session, the supervisory control point may control application programs using these terminal LUs.

The supervisory services in the host system may also communicate with the 5251 Model 2 or 12 on another session with the physical unit. This session protocol allows only maintenance information to be passed between the 5251 Model 2 or 12 and the host system.

A session is the logical connection that exists between two control points. To establish these sessions different commands are used, ACTLU and Bind. The SS-PU (supervisory services-physical unit) session is assumed automatically whenever communication at the data link level is established. The SS-LU session is established after the SNA ACTLU (active logical unit) command is positively responded to; the LU-LU session is established after the SNA Bind command is positively responded to.

An *RU* (request/response unit) is an SNA data area. It is a maximum of 256 bytes long. The RUs contain (1) all the information (commands, parameters, and associated data) required by the controller to make the LUs perform a user-specified (SS or application program) function, (2) all data returned to the host system in response to a command, and (3) responses both from the controller (initiated by either the controller or the LU) and from the host system. RUs can be linked in multiple SDLC I frames such that multiple RUs can be sent. This is called *chaining*; see the index entry: *chaining*. When chaining is used, the relative position of each RU in the chain must be indicated to the host system; the heading *Protocols and Synchronization for 5250 Implementation of SNA* in this section describes this subject. In addition, the rate at which the receiver can accept SNA RUs can also be adjusted. This is called *pacing*; see the index entry: *pacing* for details.

Each RU is prefixed by header information defining its type. Together, the header information and the RU form the *PIU* (Path Information Unit). The headers are the *TH* and *RH* parts of the frames. TH stands for transmission header and RH stands for request/response header. The TH and RH define the session type and RU characteristics; the RU contains all LU information such as the commands, data, and responses required.

The types of RUs that flow vary. The RUs can be normal or expedited and can consist of (1) session control (SC), (2) data flow control (DFC), or (3) function management data (FMD) RUs. These RUs flow on either the SS-LU or LU-LU session. There are different protocol restrictions for each type of RU. For example, LU data streams are always in the normal FMD flow. See the heading *Protocols and Synchronization for 5250 Implementation of SNA* in this section.

In the 5250 implementation of SNA, the two SNA *session partners* are the host system and the 5251 Model 2 or 12 controller. The host system controls the LUs (5250 work stations) by sending commands and data to that LU. These commands and data are embedded in the SNA RUs. The sender determines the type of response requested by coding bits 0 and 3 of byte 1 of the RH accordingly. He specifies RQE or RQD.

*Request exception* (RQE) asks for a response only if the RU is unacceptable; that is a *negative response.* A negative response RU identifies the type of RUs and carries information identifying the error condition.

The other type of response request is *request definite* (RQD). RQD requests that the receiving partner always respond to the RU that has been sent. If the RU is without error, the receiver responds positively; this response may consist of returning the SNA command code that was sent. If an error is encountered in the RU, the receiving partner returns a negative response.

## ADDRESSING IN THE 5250 SYSTEM

The three addresses that the 5250 system uses and that the system programmer must determine (or default to) are the station address, the work station address, and the LSID (local session identifier). Note that the LSID includes the local station address. Figure 16 shows the relationships of the addresses.

### Controller Station Address

The station address field is 8 bits long; it is the A part of the SDLC frame. For the 5251 Models 2 and 12 this field carries the controller station address. See the index entry: *frames.* The programmer uses this address to identify the 5251 Model 2 or 12 that he wants to communicate with. The programmer determines the address and then sets it in the 5251 Model 2 or 12 controller station address switches. See Figure 10. The switch setting and the address that the programmer encodes in the A part of the frame must match.

### Work Station Address

The work station address is 3 bits long. It is in the transmission frame. The 5251 Model 2 or 12 uses it to address the devices attached via the twinaxial (cluster feature) interface. The Cable Thru feature has a direct effect on the work station address:

- If Cable Thru is not installed, the programmer is not concerned with the work station address. The system automatically defaults to 000 for the 5251 Model 1 and 11, 5225, and 5256 devices and 000 and 001 for the 5252 devices.

- If Cable Thru is installed, the programmer must assign appropriate work station addresses to all devices with Cable Thru installed. By answering the questions in Figure 17, the programmer can determine which address assignment and configuration chart in Figure 18 to use to determine these addresses.

  **Note:** There is only one set of these switches for each 5252 device.

**Legend:**

**Local Station Address (Unit Address)**
This is 6 bits of the LSID. The system programmer determines this when he configures the system. These bits identify a specific device attached to the native keyboard/display device. For details see the index entry: *local station address.*

**LSID**
Eight bits of the TH. The system programmer determines this by determining the local station address, which is 6 bits, and the session type identifier, which is 2 bits. See the index entries: *LSID* and *sessions.*

**Controller Station Address**
The host system uses this to identify the 5251 Model 2 or 12. The 5251 Model 2 or 12 scans the A part of the SDLC frame for its controller station address. See the index entries: *frames* and *station address.*

**Work Station Address**
The address set with the switches on the work station. The 5251 Model 2 or 12 uses this to identify a specific device attached to it via CF. See the appropriate host system's function's reference manual.

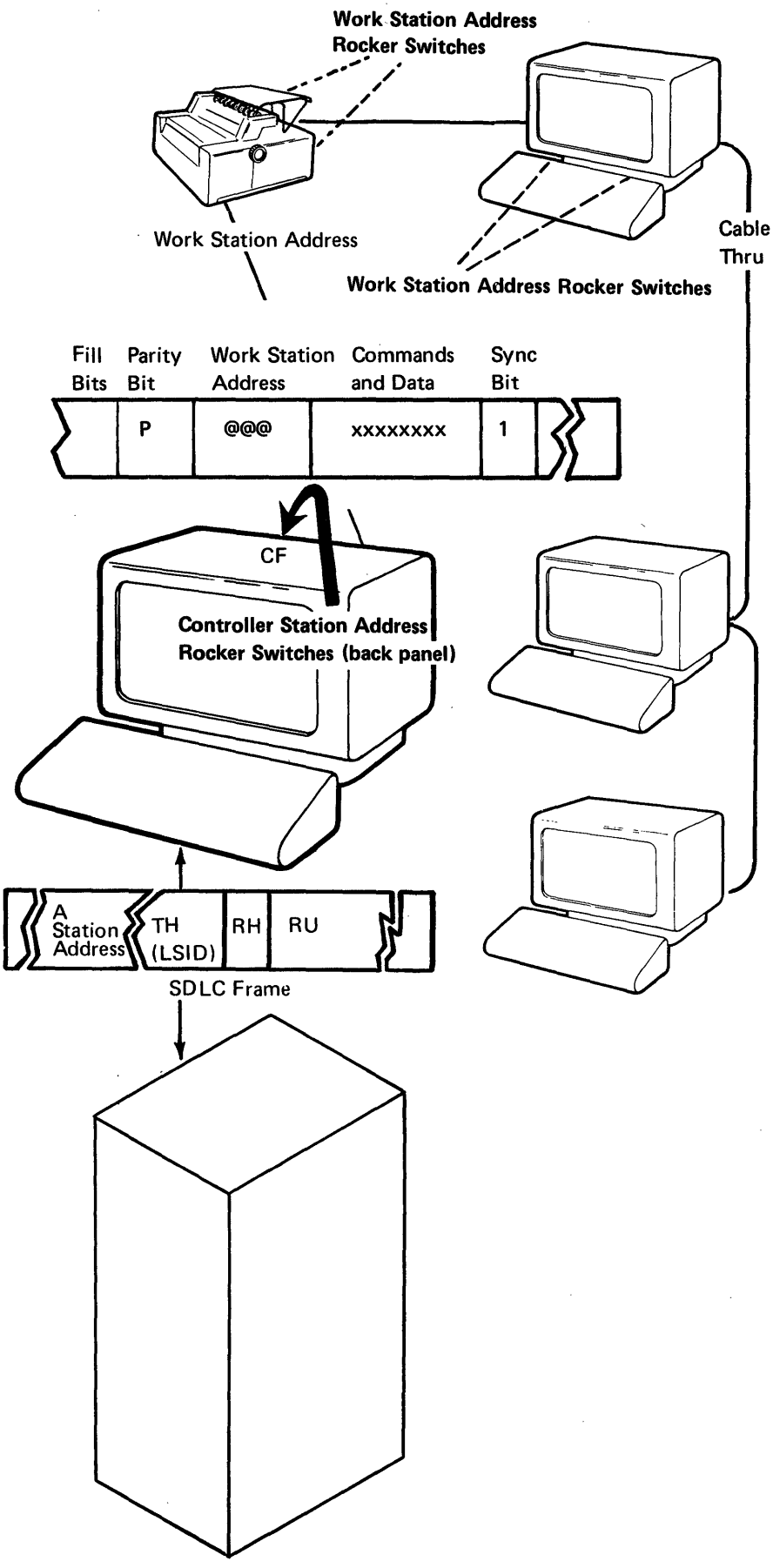



**Figure 16. Addresses**

**Actions to Take in Establishing the Work Station and Local Station Address**

1. **Are you using the Cluster feature?**

   Y N

   No devices can be attached to the 5251 Model 2 or 12 without Cluster feature; therefore, there are no work station addresses in your configuration. The local station address for the work station/controller is preset at 000000.

2. **Do you have the Cable Thru feature installed and operating in this configuration?**

   Y N

   The largest configuration that you can have is one device on each CF port. Each work station address defaults to 000 (or 000 and 001 if the 5252 is installed). Use the Figure 18 configuration showing use of two ports, three ports, and four ports to determine the local station addresses for the devices attached to the 5251 Model 2 or 12 via a cluster feature.

3. **Are you using more than one port in this configuration?**

   Y N

   You must assign a unique work station address to each device using the Cable Thru feature. Use the Figure 18 configuration showing use of one port to determine the work station and local station addresses for all attached devices.

4. **Are you using more than two ports in this configuration?**

   Y N

   You must assign a unique work station address to each device using the Cable Thru feature. Use the Figure 19 configuration showing use of two ports to determine the work station and local station addresses for devices attached via a cluster feature.

5. **Are you using three ports in this configuration?**

   Y N

   You are using four ports. Because the use of Cable Thru feature is not allowed for this configuration, you have an invalid configuration.

   Assign a unique work station address to each device using Cable Thru feature. Use the Figure 18 configurations showing use of three ports to determine what the work station and local station addresses should be.

**Figure 17. Access Chart to Figure 18**

### When One Port is Being Used

| CF Port Switch | CF Port Number | | Work Station Address | | | | Description |
|---|---|---|---|---|---|---|---|
| | CF1 | CF2 | | | | | |
| 00 | 1 | 5 | 000* | (001)* | 010* | (011)* | Two 5252 work stations can be attached to the first port using the Cable Thru feature. |
| | | | 000* | (001)* | 010 | 011 | One 5252 work station and two individual work stations can be attached to the first port using the Cable Thru feature. |
| | | | 000 | 001 | 010* | (011)* | |
| | | | 000 | 001 | 010 | 011 | Four individual work stations can be attached to the first port using the Cable Thru feature. |
| | | | | | | | **Local Station Address (6 bits of the LSID)** |
| | | | 00010 | 000011 | 000100 | 000101 | **CF1** |
| | | | 000110 | 000111 | 001000 | 001001 | **CF2** |

**Legend:**
The designation * represents the primary station of the 5252 work station.
The designation ( )* represents the secondary station of the 5252 work station; the 5252 work station has only one set of work station address switches. The address represented by ( )* cannot be set.
An individual work station can be a 5251 Model 1 or 11, a 5225, or a 5256.

**Figure 18 (Part 1 of 4). Chart for Determining the Work Station and Local Station Addresses**

**When Two Ports are Being Used**

| CF Port Switch | CF Port Number | | Work Station Address | | | | Description |
|---|---|---|---|---|---|---|---|
| | CF1 | CF2 | | | | | |
| 01 | 1 | 5 | 000* | (001)* | | 010 | One 5252 work station and one individual work station can be attached to the first port using the Cable Thru feature, and |
| | 2 | 6 | | | 000 | | one individual work station can be attached to the second port. |
| | 1 | 5 | 000 | 001 | | 010 | Three individual work stations can be attached to the first port using the Cable Thru feature, and one individual work station can be attached to the second port. |
| | 2 | 6 | | | 000 | | |
| | 1 | 5 | 000 | 001 | | | Two individual work stations can be attached to the first port using the Cable Thru feature, and two individual work stations can be attached to the second port using the Cable Thru feature. |
| | 2 | 6 | | | 000 | 010 | |
| | | OR | | | | | |
| | 1 | 5 | 000 | | | | |
| | 2 | 6 | | | | 010 | |
| | | | | 001 | | | |
| | | | | | | 000 | |
| | 1 | 5 | 000* | (001)* | | | A 5252 work station can be attached to the first port, and |
| | 2 | 6 | | | 000 | 010 | two individual work stations can be attached to the second port using the Cable Thru feature. |
| | 1 | 5 | 000 | | | | One individual work station can be attached to the first port, and |
| | 2 | 6 | | 001 | 000 | 010 | three individual work stations can be attached to the second port using the Cable Thru feature. |
| | 1 | 5 | 000* | (001)* | | | 5252 work stations can be attached to both the first and second ports. |
| | 2 | 6 | | | 000* | (001)* | |
| | | | | | | | **Local Station Address (6 bits of the LSID)** |
| | | | 000010 | 000011 | 000100 | 000101 | **CF1** |
| | | | 000110 | 000111 | 001000 | 001001 | **CF2** |

**Legend:**
The designation * represents the primary station of the 5252 work station.
The designation ( )* represents the secondary station of the 5252 work station; the 5252 work station has only one set of work station address switches. The address represented by ( )* cannot be set.
An individual work station can be a 5251 Model 1 or 11, a 5225, or a 5256.

**Figure 18 (Part 2 of 4). Chart for Determining the Work Station and Local Station Addresses**

### When Three Ports are Being Used

| CF Port Switch | CF Port Number | | Work Station Address | | | | Description |
|---|---|---|---|---|---|---|---|
| | CF1 | CF2 | | | | | |
| 10 | 1<br>2<br>3 | 5<br>6<br>7 | 000* | (001)* | 000 | 000 | One 5252 work station can be on the first port, and one individual work station can be on the second and one on the third port. |
| | 1<br>2<br>3 | 5<br>6<br>7 | 000 | 001 | 000 | 000 | Two individual work stations can be attached to the first port using the Cable Thru feature, and one individual work station can be attached to the second port and one to the third port. |
| | 1<br>2<br>3 | 5<br>6<br>7 | 000 | 001 | 000 | 000 | One individual work station can be attached to the first port and one to the second port, and two individual work stations can be attached to the third port using the Cable Thru feature. |
| | 1<br>2<br>3 | 5<br>6<br>7 | 000 | 000<br>001 | 001 | 000 | One individual work station can can be attached to the first port and one to the second port, and two individual work stations can be attached to the third port using the Cable Thru feature. |
| | | | | | | | **Local Station Address (6 bits of the LSID)** |
| | | | 000010 | 000011 | 000100 | 000101 | **CF1** |
| | | | 000110 | 000111 | 001000 | 001001 | **CF2** |

**Legend:**
The designation * represents the primary station of the 5252 work station.
The designation ( )* represents the secondary station of the 5252 work station; the 5252 work station has only one set of work station address switches. The address represented by ( )* cannot be set.
An individual work station can be a 5251 Model 1 or 11, a 5225, or a 5256.

**Figure 18 (Part 3 of 4). Chart for Determining the Work Station and Local Station Addresses**

**When Four Ports are Being Used**

| CF Port Switch | CF Port Number CF1 | CF2 | Work Station Address | | | | Description |
|---|---|---|---|---|---|---|---|
| 11 | 1 | 5 | 000 | | | | An individual work station can be attached to each port. |
| | 2 | 6 | | 000 | | | |
| | 3 | 7 | | | 000 | | |
| | 4 | 8 | | | | 000 | |
| | | | | | | | **Local Station Address (6 bits of the LSID)** |
| | | | 000010 | 000011 | 000100 | 000101 | **CF1** |
| | | | 000110 | 000111 | 001000 | 001001 | **CF2** |

**Legend:** An individual work station can be a 5251 Model 1 or 1, a 5225, or a 5256.

**Figure 18 (Part 4 of 4). Chart for Determining the Work Station and Local Station Addresses**

Figure 18 shows the assignments of the work station address switches. The programmer makes the work station address assignments by setting these switches; he does not directly use the work station address to communicate with the specific device. He addresses a device attached via a cluster feature through the LSID (local station address bits). Figure 19 illustrates a sample configuration with work station addresses assigned.

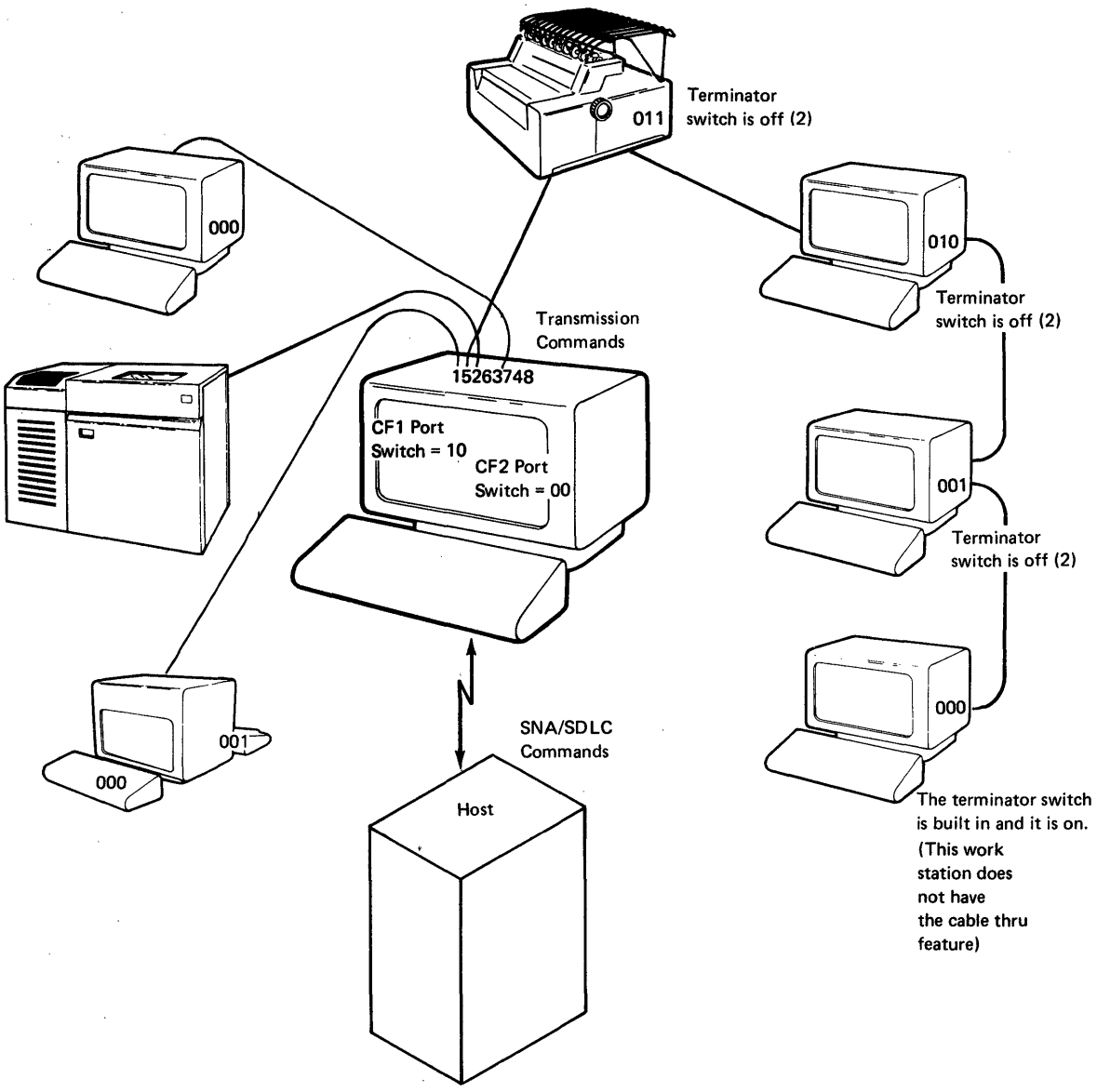
### LSID and Local Station Address

The LSID is a 6-bit address which is in the TH (in the SNA header). See the index entry: *TH*. Six bits of the LSID are the local station address. These bits identify the specific device (attached to the 5251 Model 2 or 12 via a cluster feature or the native device) that the host system wants to address. The remaining 2 bits of TH byte 1 are session flow information and indicate which SNA session is used in communicating to the LU.

**Note:** An LSID=0 (hex 00) indicates an SS-PU session used only for maintenance services by 5251 Models 2 and 12.

The programmer must provide both the local station address and the session flow information for the LSID. The following text describes how to determine the appropriate local station address for a device and index entry: *sessions* describes information about the sessions and session flow bits.

The native keyboard/display always has the local station address 000000. All other local station addresses are determined by using Figure 18. Use this chart to determine the local station address. The local station address is determined by tracing the column containing the appropriate work station address to the bottom of the chart. Use the local station address specified for the device as the 6-bit address part of the LSID. Determine the session type and code the remaining 2 bits accordingly.




**Legend:**

**Cluster Feature (CF1)**

No Cable Thru feature is installed. A 5252 work station is attached to port 1. A 5251 Model 1 or 11, a 5225, or a 5256 work station is attached to port 2 and 3.

**Dual Cluster Feature (CF1 and CF2)**

The Cable Thru feature is installed and being used on three of the devices attached to port 5 of CF2. Four 5251 Model 1 or 11, 5225, or 5256 work stations are attached to the 5251 Model 2 or 12 port 5. Unique work station addresses must be assigned and the Cable Thru terminator switch must be set on (on the last device with Cable Thru installed). If the last device does not have the Cable Thru feature installed, its work station address defaults to 000.

**Figure 19. Sample Configuration of the 5250 Information Display System Addressing**

## ERROR HANDLING IN THE 5250 SYSTEM

The SNA protocol determines the error-handling process used by the 5250 system; for operator errors, this association is indirect as described in the following text. The type of error and the point of processing at which it occurs in the RU chain determines the resulting error code (SNA command or negative response).

The error codes identify both the device in which the error is occurring and the reference to the condition causing the error. These error codes are found in the Signal commands, negative responses, and the error log. The format for the error codes is:

XXYY

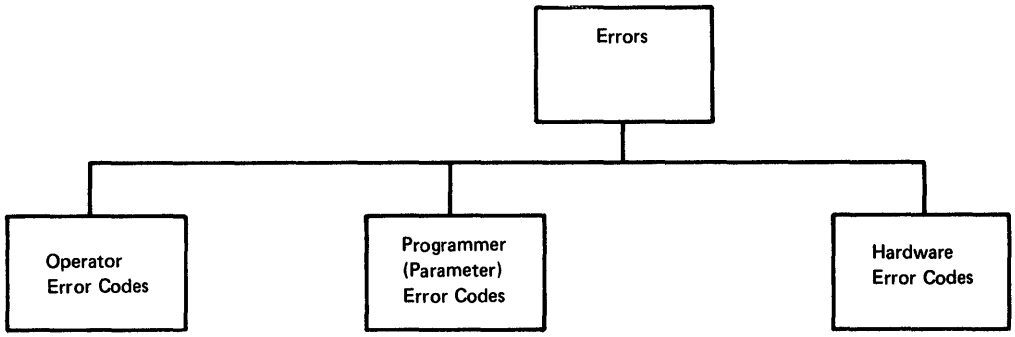
XX=device type

00=controller
01=display
02=printer

YY=error identifier

See the index entries for these topics to find detailed information.

The basic categories of errors within the 5250 system are: (1) operator-associated errors, (2) programming (parameter) errors, and (3) hardware errors. Figures 20 and 21 illustrate the resulting SNA commands and responses and error codes implemented by these error types. As you can see by looking at Figures 20 and 21, the SNA Signal, Rshutd, Lustat, and Cancel commands and the negative response are the ways that SNA uses to identify errors in the programming and hardware areas of the 5250 system.




| Type of Error Code | Result |
|---|---|
| Operator | The error message provided by the host is accessed by the operator using the Help key, on the display station, to generate a Signal command.<br><br>Some operator error codes are logged. |
| Programmer (Parameter Error) | Lustat and negative response are sent to the host. |
| Hardware | See Figure 21. |

**Figure 20. Types of Errors and the Results of These Errors**

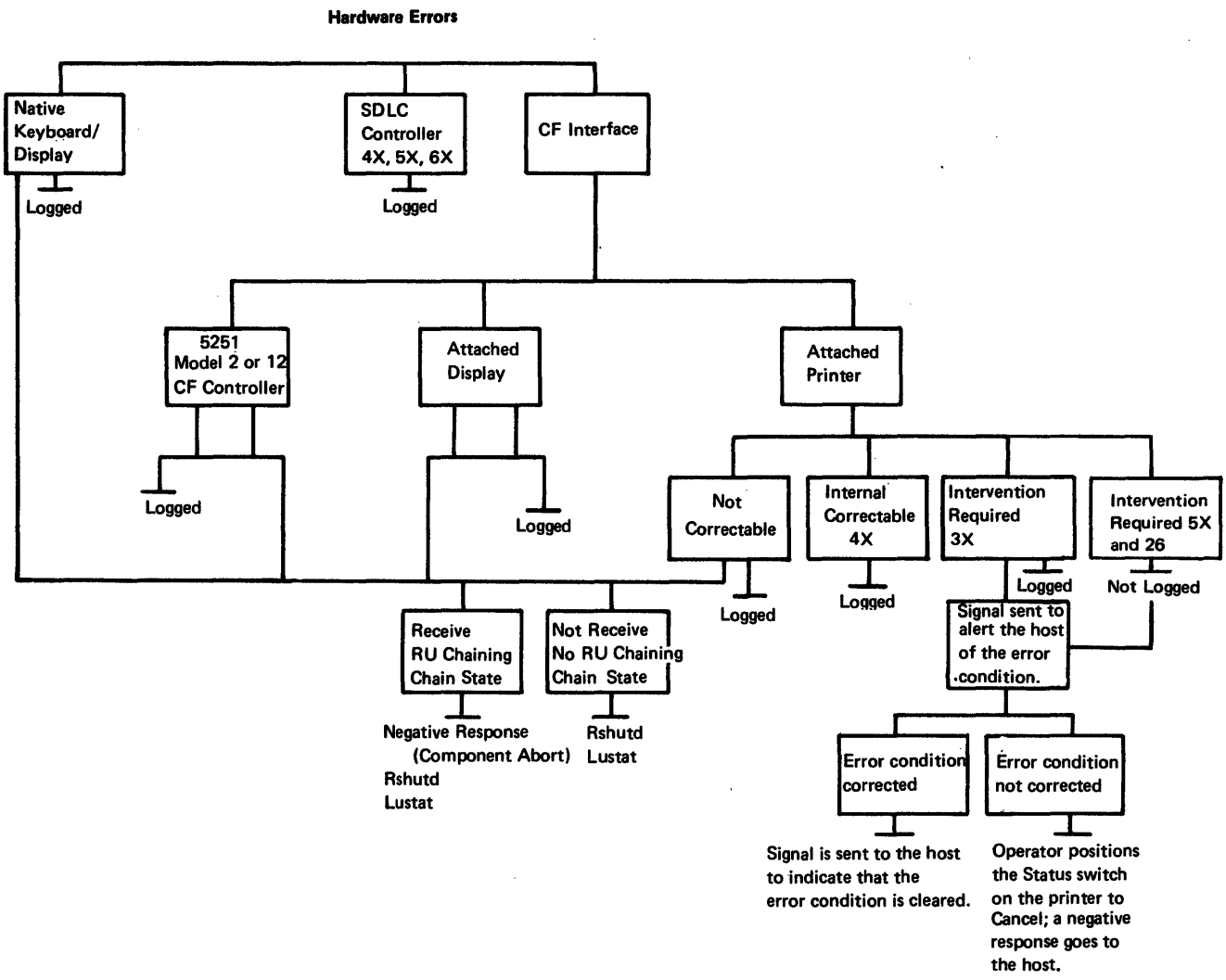



**Figure 21. Hardware Errors and the Responses Generated by These Errors**

### Operator Errors

Operator error codes that appear on the display and that are returned to the host system in the Signal command (when the operator uses the Help key in an error state) are the way the 5250 system identifies operator errors. The operator accesses descriptive information about the error condition by using the Help key in the error state; the information obtained by using the Help key is the responsibility of the host programmer. One way to provide this information to the operator is via the Write Error Code command. If the host system does not provide additional information, the original error code remains and the work station enters the posthelp error state. Index entries: *operator error codes, Signal, command and response, Help key*), and *Write Error Code command* refer to text containing specific information about these subjects. The index entry: *error states* refers to the descriptions of the conditions that exist while the device is in an error state.

### FMD Programming Errors

FMD programming errors are the result of incorrect or unacceptable coding being used by the sending partner. For programming errors, if the LU is in a receive state when the error occurs, the controller sends the host system a negative response; and if the LU is in a send state (LU has CD) when the error occurs, the controller sends the host system a Cancel command if in the chain state and a Lustat command. See index entries: *negative responses* and *Lustat command* for additional information. The host programmer should replace the incorrect parameter and reissue the command.

### SNA Protocol Errors

If an SNA protocol error is detected, a negative response is generated immediately regardless of the state of the LU. No Cancel, Rshutd, or Lustat command will be sent.

### Hardware Errors

The hardware errors are those errors detected in the controller, keyboard/display, and printer physical devices. Figure 21 shows the paths the hardware error conditions take.

If the controller detects a hardware error either in itself or in an attached display device when it is in a receive chain state, it sends a negative response, a Rshutd command, and a Lustat command to the host system. The negative response identifies the error condition; the Rshutd command requests the host system to terminate the session and send an Unbind command; and the Lustat reports the LU as unavailable to the SS. If the LU is not in a chain state, it sends the Rshutd and Lustat commands. These commands request the host system to terminate the session and report the unavailability of the LU respectively. See index entries: *negative responses, Rshutd command,* and *Lustat command* for details.

The handling of printer hardware errors is the most complex of all the error conditions. Figure 21 shows the paths the printer hardware error conditions take. The method used for identifying the printer hardware errors depends on the condition of the error; in other words, it depends on whether or not the error condition can be corrected by the operator. In addition, the state of RU chaining determines the resulting SNA code sent by the controller to the host system to identify the error.

When an operator-correctable error occurs in the printer (such as a forms jam), the controller sends the host system a Signal command. If the operator successfully corrects the error, the controller sends the host system another Signal command indicating that the error condition no longer exists. See the index entry: *Signal, command and response.* If, however, the operator cannot correct the error, he positions the printer Status switch to Cancel and the controller sends the host system a negative response. This indicates that the error has not been corrected and that other action is required. The host programmer determines what must be done when he receives a negative response. See the index entries: *CD, chaining, Rshutd command, Lustat command, negative responses,* and *Cancel command.*

In addition to identifying errors, the 5251 Model 2 or 12 implements an error log buffer in the controller. This error log holds error information about selected error conditions. The user obtains the log in one of two ways: (1) he requests the log contents using the SNA Reqms command, or (2) the log contents are automatically sent to him when a log overflow condition exists (Recfms command). See index entries: *Reqms command, Recfms command,* and *error log.*

## SNA SESSION FLOW

The three types of sessions that allow RUs containing user-defined commands and responses (to varying extents) are SS-PU, SS-LU, and LU-LU.

See Figure 22.

The host system to controller commands (such as Reqms) are used in the SS-PU sessions; the host system to LU commands (such as Actlu) are used in the SS to LU sessions; and the application program to LU commands (such as Write to Display) are used in the LU-LU sessions. The controller to LU commands are the transmission commands. The TH and RH determine the type of session and the RU type for the RU data flow. Figure 23 shows which commands are valid on each session and whether those commands are normal or expedited flow. The SS-PU session is always considered active.

Only one session is available for user data. The user application program data stream flows only on the LU to LU session. Certain RUs may contain SNA commands (Session control or Data Flow Control commands) that allow the host system to establish, control, and terminate sessions with the addressed LU.

The type of LU, display or printer, that is addressed by the host system determines what the data stream must include. For example, the printer data stream contains only control characters and data. The control characters are mixed with the data; they determine the format of the lines and specify a write operation. On the other hand, the keyboard/display LUs are both input and output devices. The host system can issue both read and write commands to them. Because the screen is a field-formatted input/output device, it also requires formatting controls such as control characters and orders to be intermixed with data.

### SNA Session Control and Data Flow

Before any data stream commands can be sent to the addressed LU, a session must be established between the host system and the addressed LU. This is accomplished by the session control (for example, Actlu and Bind) commands. A detailed description follows Figures 24, 25, and 26.

**Note:** See the heading, *Protocols and Synchronization for 5250 Implementation of SNA* in this section for an example of session flow control. Some of the normal activities that occur between the host system and LU are:

- Establishing a session between the SS and the LU
- Establishing a user program to LU session–binding
- User sending commands to the LU (read/write–printer and display)
- LU sending information to the host system
- Maintaining an error history for maintenance purposes
- Sending unit tests to a selected device

### Establishing a Session

The LU cannot initiate a session. The host system must do this. Prior to the host system initiating a session, a typical keyboard/display operation might look like this:

1. Power is on.
2. The keyboard is unlocked and in free keying mode. When the operator presses a key that requires host system action, an operator error occurs. The operator presses the Error Reset key and the keyboard returns to the free keying mode. See the index entries: *Signal keys* and *aid-generating keys* for information about the keys that require host system action.
3. The host system initiates the session (SS to LU) by sending an Actlu. The LU sends a positive response back to the SS, indicating the requested device's status. If the response is positive, an SS-LU session is established.

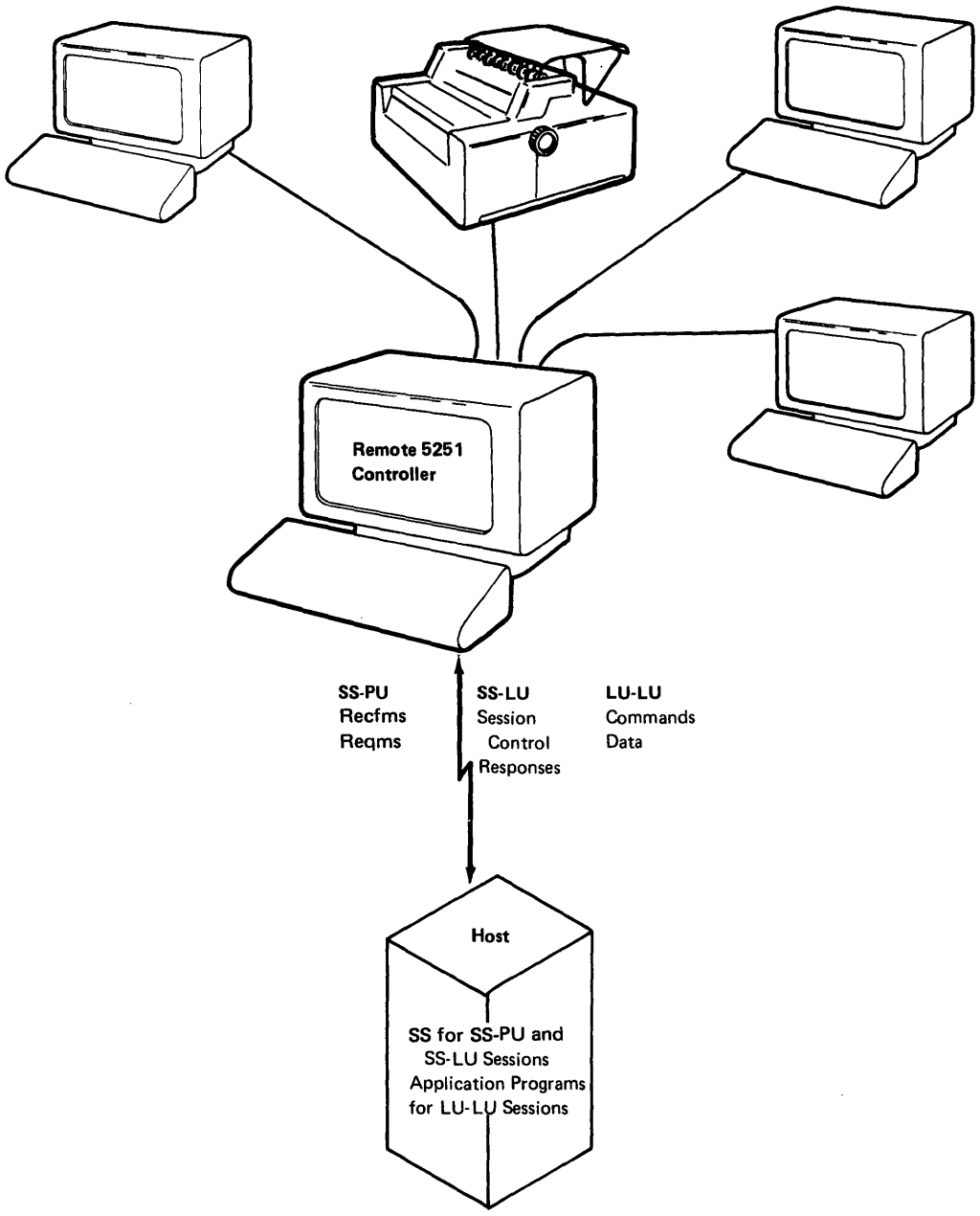



**Figure 22. Types of Session Flow**

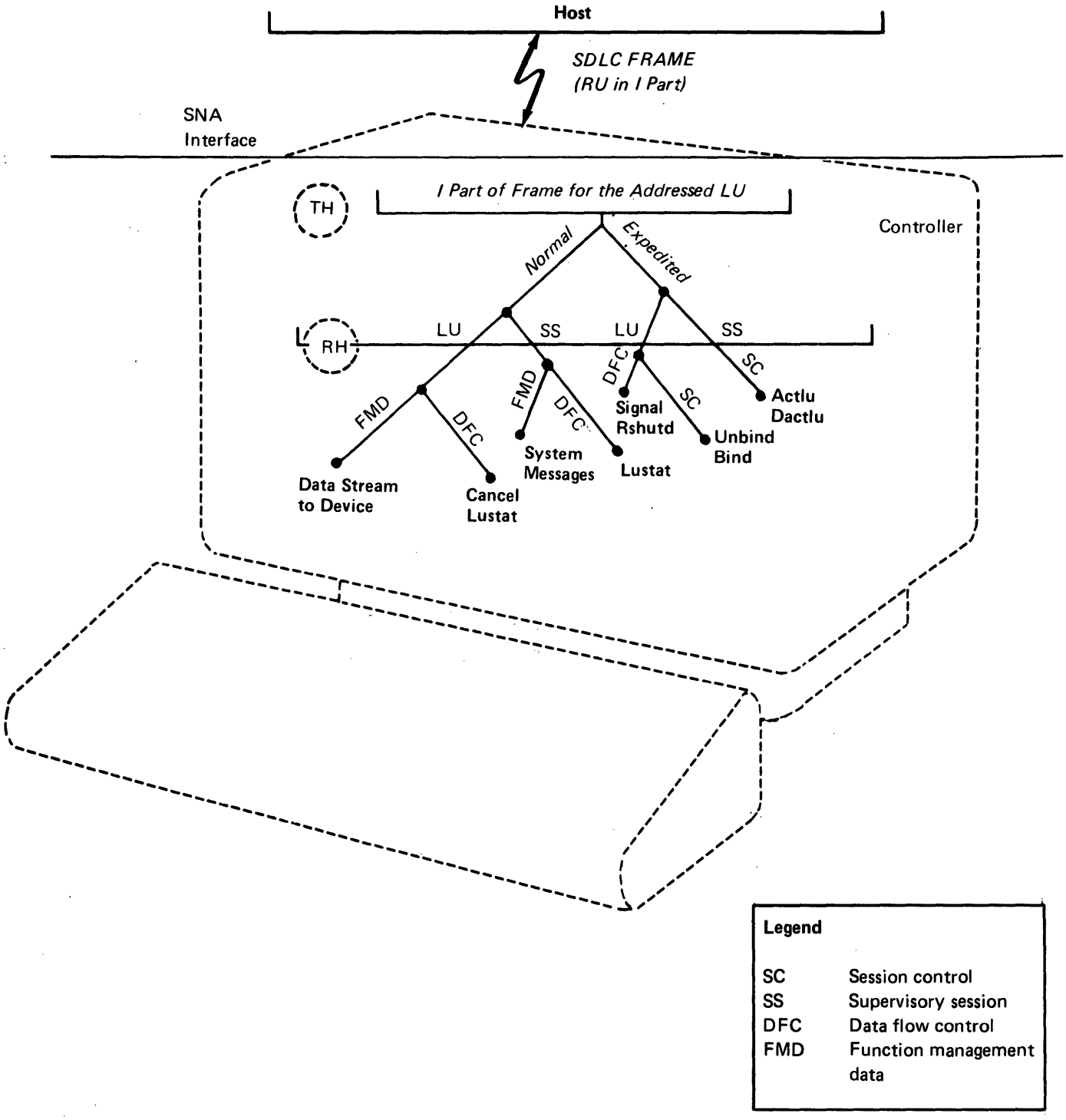



**Figure 23. Allowable Sessions and RU Types for Commands and Data Sent to, or from, the 5251 Model 2 or 12**

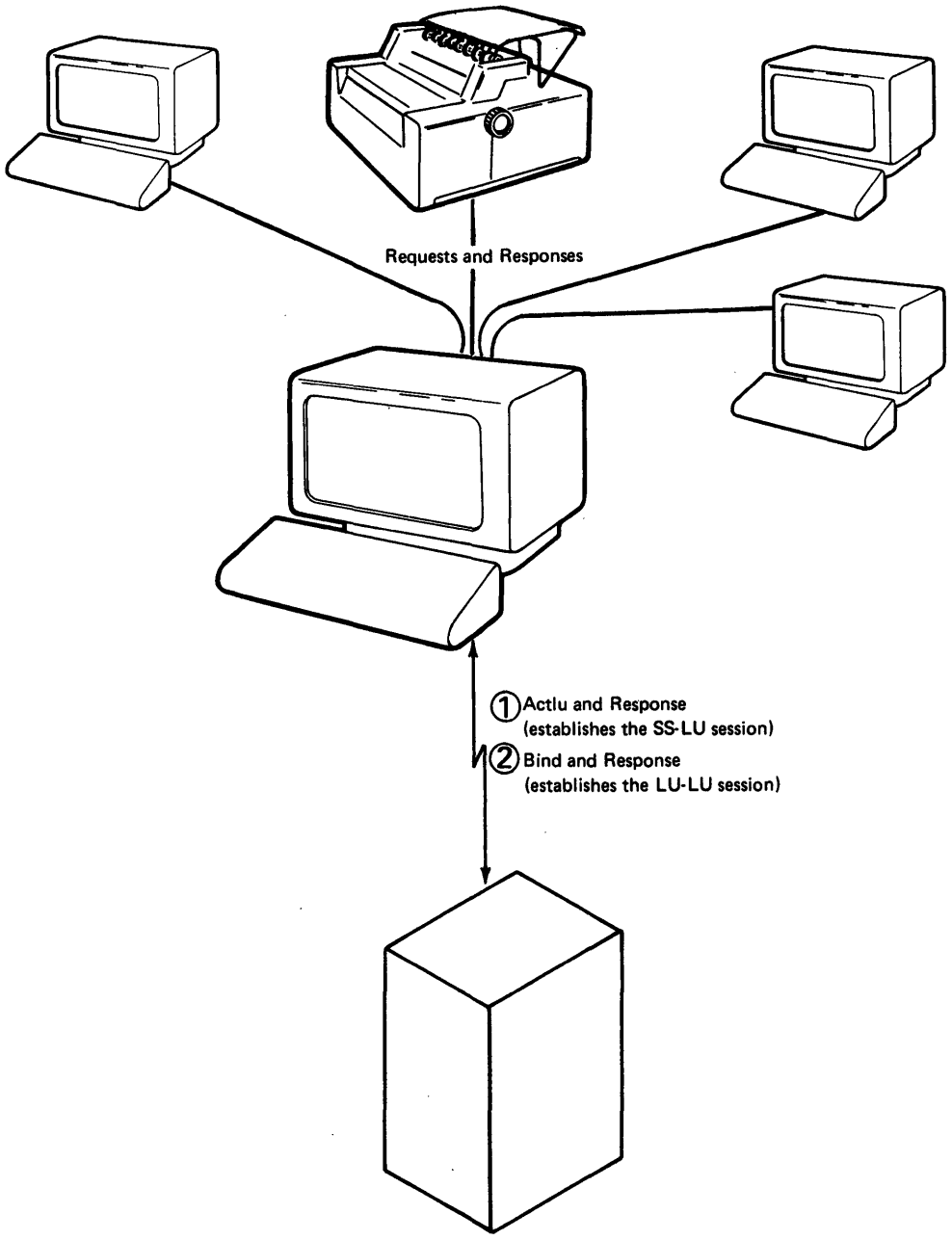



**Figure 24. Establishing Sessions**

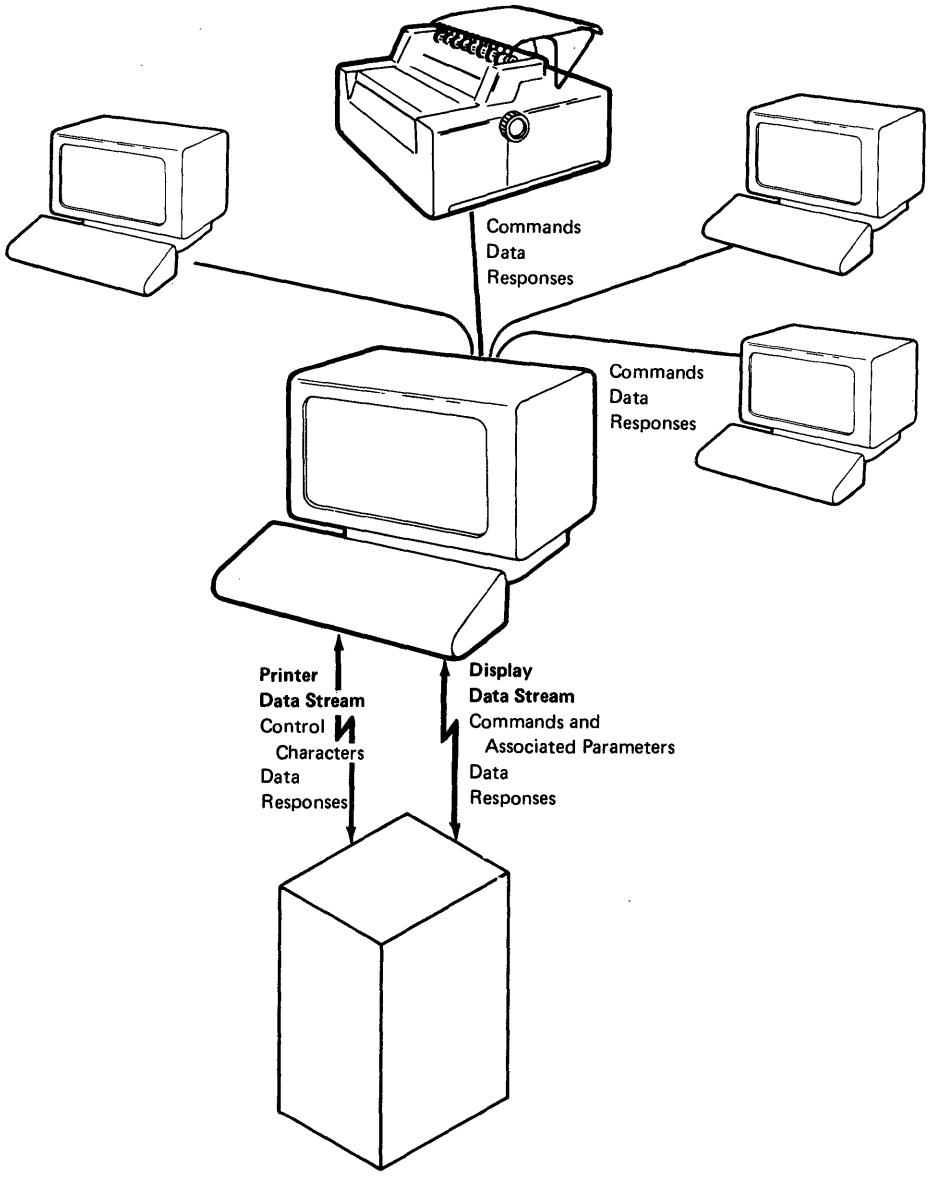



**Figure 25. Display and Printer Data Streams**

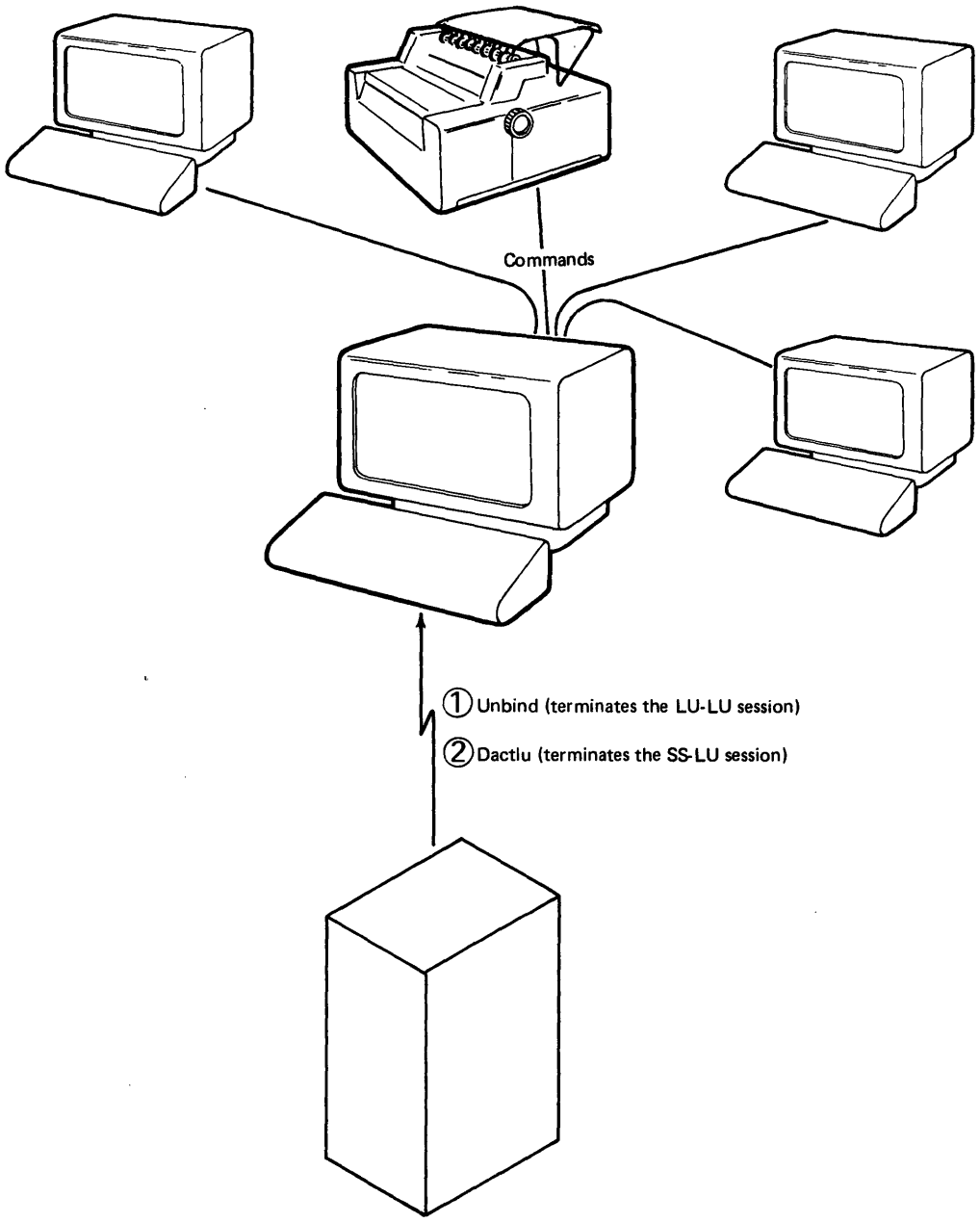



**Figure 26. Terminating Sessions**

### Establishing a User Program to LU Flow–Binding

Now that an SS-LU session has been established, the SS initiates an LU-LU session:

1. The SS or user sends a Bind command to the requested device to establish an LU-LU session between the user's application program and the 5250 LU.

2. The device (LU) responds positively with session and device parameters in the Bind Response RU. (See the index entry: *Bind command, responses* for details.)

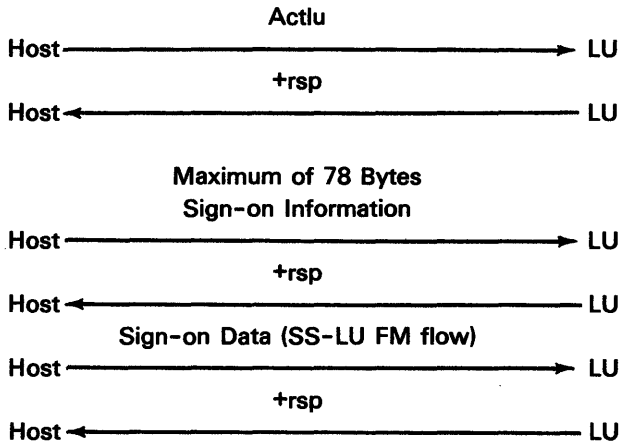
3. An LU-LU session is established between a program in the host system and the requested 5250 device.

### Signing On

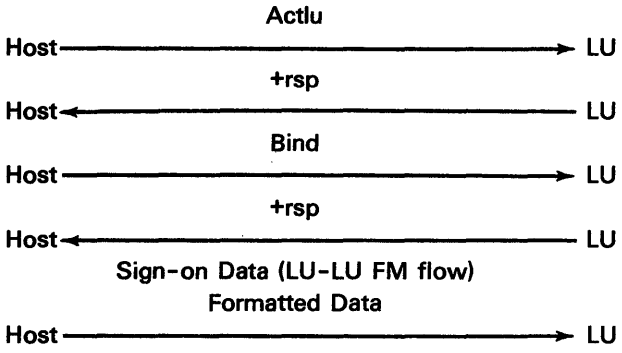
The user can use either the SS-LU or LU-LU session to sign on. Each session type has restrictions. The SS-LU flow is restricted to 78 bytes of unformatted information and the LU-LU flow is restricted to formatted information. (This means that all the control characters and commands for building the display must be included in the RU.)

The two session flow types are illustrated here:

**SS-LU Flow Sign On**




**LU-LU Flow Sign On**




### User-LU Communication

*Write Commands (User to LU)*

1. First, the host programmer sends an RU in the FM flow. Typically, the RU is an escape character followed by a Clear Unit command followed by another escape character.

2. Then, in the same RU, the host programmer sends the next command, which is a Write to Display (WTD) command. See the index entry: *Write to Display command* for details. This builds the format table, which determines the field characteristics of the display.

3. The host programmer sends more information and commands (such as the read commands) and when the end of the chain is reached (LOC), the LU responds as directed by the host system (either RQE or RQD). See the heading, *Protocols and Synchronization for 5250 Implementation of SNA* in this section for additional information about LOC, RQE, and RQD.

*Read Commands (LU to User)*

1. The operator begins entering data when the keyboard is unlocked after the Write to Display command has been processed. This results in:
   a. The keystrokes being translated into EBCDIC
   b. The translated keystrokes being put into a buffer and held until the LU is given authority by the host system (in the CD bit and Read command) to send the information, and the operator presses an aid-generating key
   c. The cursor advancing

2. The operator presses the Enter/Rec Adv key. If the host system has sent a read command and the CD bit, SNA puts the information that is in the buffer in one or more RUs and sends it to the host system (for the user's program) in the FM flow.

*Printer Write Operations*

When the user wants to write to the printer, he codes the appropriate control characters (see the index entry: *control characters, printer*) into the data stream where he wants the control to occur. When the printer receives the data stream, it prints the information as formatted.

*Maintaining an Error Log*

The 5251 Model 2 or 12 contains a local error log which is sent to the host system on the SS-PU SNA session whenever the buffer containing the log is almost overflowing. In addition, the SS can request this log by issuing a Reqms command. (See the index entry: *Reqms command* for details.) See the index entry: *error log* for a description of the contents of this log.

*Testing a Unit Device*

To request a test operation, the operator:

1. Presses and releases the Cmd key

2. Presses and releases the Character Backspace (←) key on the typewriter-like keyboard or the rightmost blank key on the top row on the data-entry keyboards. As a result, the 5251 Model 2 or 12 controller sends an SNA command called Reqtest on the SS-LU flow to the SS. The SS can reply with either test routines or menus to select tests; this is a user-defined or system-defined function.

## PROTOCOLS AND SYNCHRONIZATION FOR 5250 IMPLEMENTATION OF SNA

The 5251 Model 2 or 12 controller uses the SNA protocol in communicating with the host system. This protocol consists of (1) formats and sequences to manage multiple sessions and (2) the data flowing with these sessions. The following text describes this protocol. A description of specific SNA terms precedes the protocol description because an understanding of the definitions is prerequisite to an understanding of the text and illustrations that follow.

### SNA Terminology Used in Describing the SNA Protocols

*CD*: Change of direction; bit 2, byte 2 of the RH. It reverses the direction of flow when examined on LOC. See index entries: *CD* and *RH*.

*Chain*: A unit of error recovery composed of RUs. See the index entry: *chaining*.

*FOC*: First of chain; this refers to the first RU in a chain of RUs. See the following chart.

*MOC*: Middle of chain; this refers to the RUs within a chain of RUs. See the following chart.

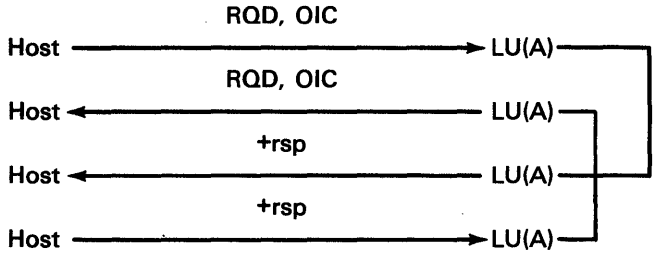
*LOC*: Last of chain; this refers to the last RU in a chain. See the following chart.

*OIC*: Only in chain; this refers to one RU in a chain. See the following chart.

**RH – Byte 0**

| Position of the RU in the Chain | Bit 6 | Bit 7 |
|---|---|---|
| FOC | 1 | 0 |
| MOC | 0 | 0 |
| LOC | 0 | 1 |
| OIC | 1 | 1 |

*FDX*: FDX stands for full duplex. Within the SNA structure, this means that both session partners can be in send state simultaneously. However, because the 5251 Model 2 or 12 implementation of SDLC allows only half duplex, a buffer is required to hold information sent by one session partner while the other session partner is transmitting. This is how a full duplex SS-LU flow looks:

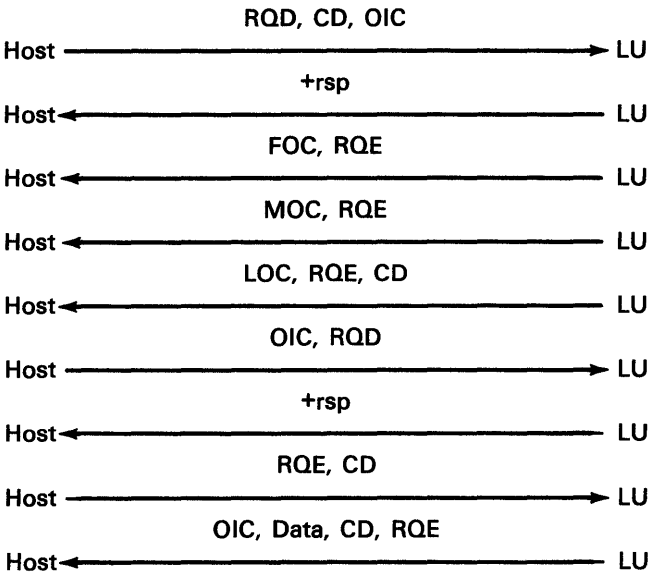



Although both stations are in SNA send state simultaneously, only one SDLC transmission can occur at a time because of the half duplex restrictions of the SDLC communications lines. Therefore, the extra information must be held.

*Flow*: Flow is the SNA path routing the RU type takes. The two types of flow are normal and expedited. See Figure 23 and 27.

*Formatted*: Formatted refers to the SNA-defined format required for an RU. To the programmer, this means that bit 4 of byte 0 in the RH is on. See Figure 27 to determine when formatting occurs.

*HDX*: Stands for half duplex. Within the SNA structure, it means that only one session partner can be sending at a time. The sending session partner must include a CD bit in the flow in order to give authority to the remaining session partner to send information. Without CD, the other session partner cannot send information. The CD is required only to send an RQ (RQE and RQD) and not to send a rsp (response). This is an FM example of half-duplex flow:




*RU Types*: The RU types used by the 5250 system are FMD (function management data), DFC (data flow control), and SC (session control). Figure 27 shows the characteristics and contents of these. The data stream for the LUs is in the FMD LU-LU normal flow. Bits 1-2 of byte 0 in the RH part of the SNA header contain the code for the various RU types. See the index entry: *RH*.

*-rsp*: Negative response. An SNA structure that allows the controller or host system to report to its session partner that an invalid condition exists. See the index entry: *negative responses* for details about the use of the negative response with the 5250 devices.

*+rsp*: Positive response; the return code for the command (such as the Bind response code). See index entry: *SNA, commands* for details.

| | FMD | | | DFC | | SC | |
|---|---|---|---|---|---|---|---|
| **Sessions** | **SS-LU** | **LU-LU** | **SS-PU** | **SS-LU** | **LU-LU** | **SS-LU** | **LU-LU** |
| **Flow** | Normal | Normal | Normal | Normal | Normal<br>*Expedited* | Expedited | Expedited |
| **Mode** | FDX | HDX | FDX | FDX | HDX | Not Applicable | Not Applicable |
| **Chain and RU Restrictions** | 1 RU<br>≤128 bytes<br>OIC<br>(Note) | ≤256 bytes<br>Normal | ≤256 bytes<br>OIC | <256 bytes<br>OIC | <256 bytes<br>OIC | ≤256 bytes<br>OIC | ≤256 bytes<br>OIC |
| **Response and CD** | RQD no CD | RQE – CD<br>RQD – CD<br>and no CD | RQD no CD | RQD no CD | CD optional for Lustat RQD | RQD no CD | RQD no CD |
| **Contents** | Display only: Messages in EBCDIC characters | LU Data Stream | Reqms<br>Recfms | Lustat | Cancel<br>*Lustat*<br>*Signal*<br>*Rshutd* | Actlu<br>Dactlu | Bind<br>Unbind |
| **SNA Formatted** | Unformatted | Unformatted | Formatted | Formatted | Formatted | Formatted | Formatted |

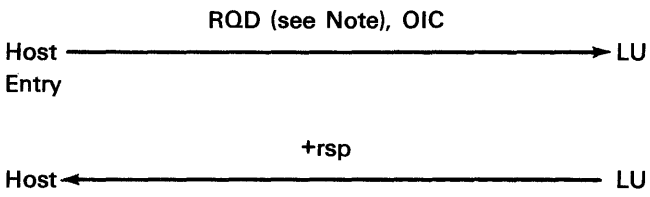
**Note:** The controller truncates data allowed on the display to 78 bytes.

**Figure 27. SNA Protocols Used by the 5250 Information Display System**

**Keyboard/Display Protocols**

The following topics show what happens when the user LU initiates RUs and the addressed keyboard/display LU executes them.

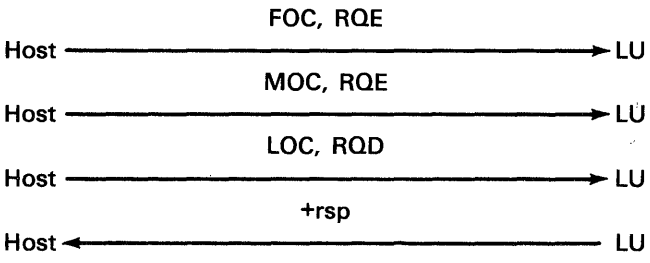
*Log On*




The programmer determines the sign-on sequence. See the heading *Signing On* earlier in this section.

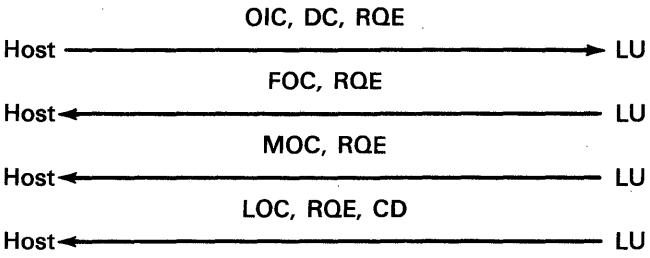
**Note:** A response demanded (RQD) is required only on the SS-LU flow.

*Write Command Flow*



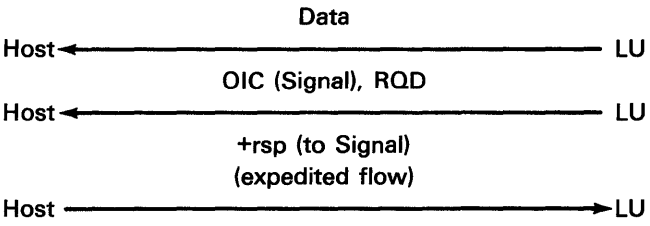

Add more writes (if needed) in the above format.

*Read Commands*




*Operator Uses the Attn Key*

**Note:** The keyboard can either be locked or unlocked.



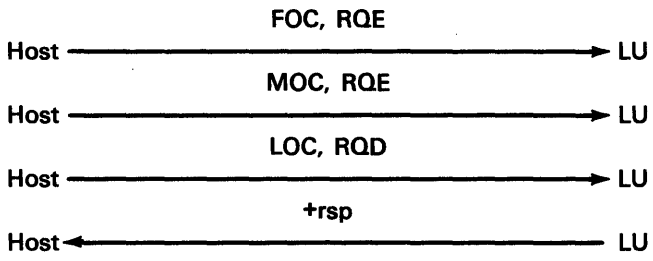

For a description of the Signal command, see the index entry: *Signal, command and response.*

**Printer Protocols**

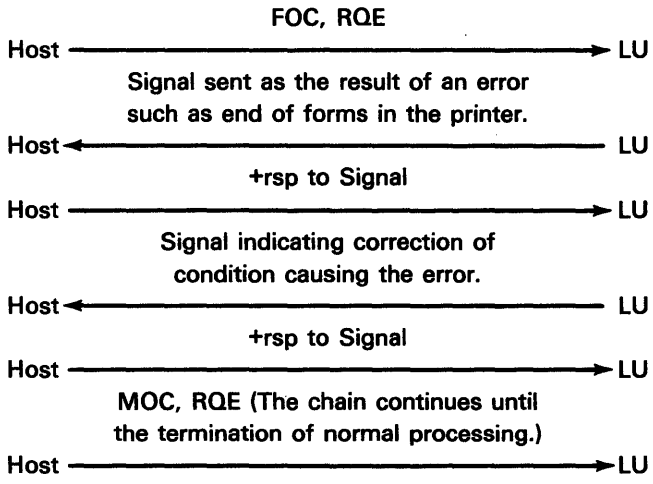
The following topics show acceptable printer protocols.

**Note:** CD should not be sent to the printer; if it is sent, the printer returns a Lustat of 00 02 00 00 to the host system. See the index entry: *Lustat command* for details.

*Writing to the Printer*

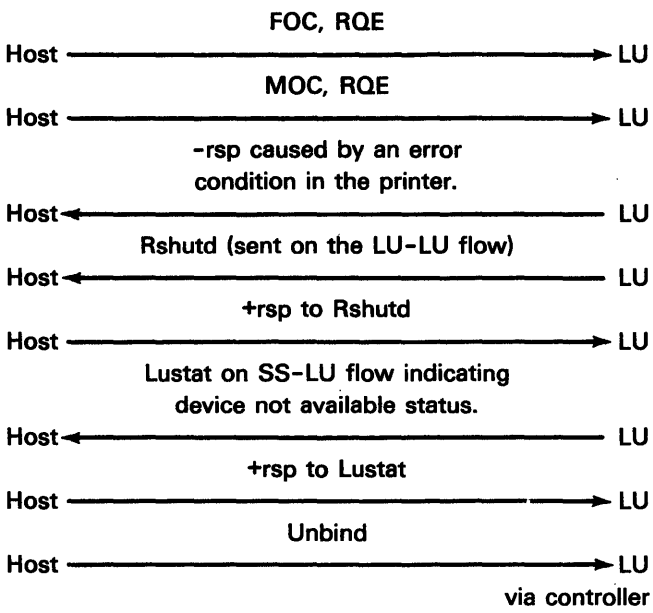



*A Correctable Error Occurs*




For a description of the Signal command, see the index entry: *Signal, command and response.*

*A Noncorrectable Error*

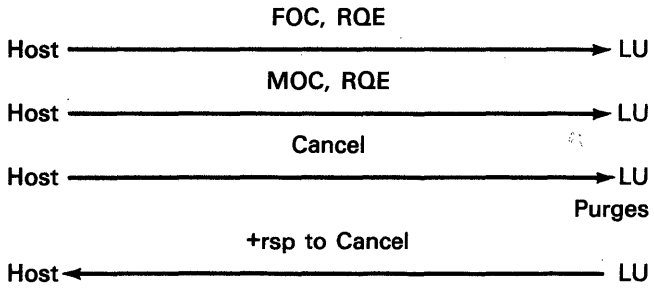



The host system determines whether to unbind (use the Unbind command) or de-activate (use the Dactlu commmand). See the index entries: *Dactlu command* and *Unbind command* for details.

**Note:** By using the Unbind command, the controller will notify the host system when the device is available again by issuing another Lustat. If the host system issues a Dactlu command, no Lustat can be issued.

For descriptions of Lustat, Rshutd, and Unbind, see the index entries: *Lustat command, Rshutd command,* and *Unbind command.*

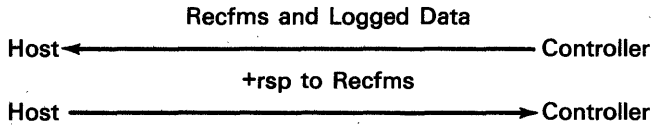
*The Host System Terminates a Chain*



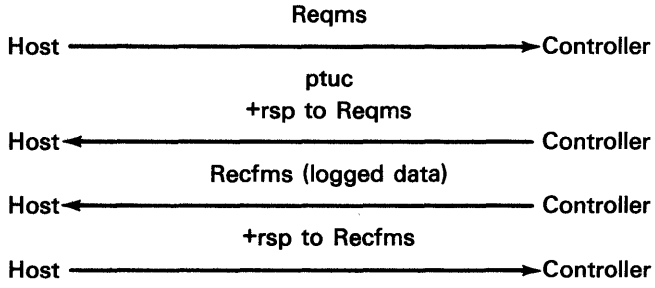

**Note:** For details about the Cancel command, see the index entry: *Cancel command*

**Controller Error Log Support**

*Error Log Overflow Condition (Unsolicited)*




*Requested Log Data (Solicited)*




For a description of Reqms and Recfms, see the index entries: *Reqms command* and *Recfms command*. For a description of the logged errors, see the index entry: *error log*.

## DISPLAY DATA STREAM EXAMPLE

This topic consists of examples showing the coding required to write to a display, read from a display, and respond to an error condition in the display. In the examples, the comma (,) is used as a byte separator. Single quotes delineate a character string. Within the character string, each character represents one byte of EBCDIC code. The row and column parameters for the SBA (Set Buffer Address) and IC (Insert Cursor) orders and the length parameter for the SF (Start of Field) order are given in decimal in this example. In an actual programming environment, these parameters must be in hexadecimal notation. For example, SBA,10,27 should appear hex 110A1B in actual code.

No attempt has been made to represent the SDLC/SNA headers and flags; only the contents of the SNA RUs are given. For purposes of explanation, code is divided into pieces. In the actual environment, all code is consecutively linked. Maximum throughput is achieved when data is sent in 256-byte SNA RUs which are linked together in one SNA RU chain.

**Note:** In the following illustrations, @ represents the screen attributes. These attributes are not normally displayed; they are shown on these illustrations to help the programmer understand their location within the displays. If the programmer wants to see the screen attributes he can display them by positioning the Status switch to Test.

**Writing to a Display**

There are two aspects of writing to a display. First, a display must initially be written with the information the programmer has provided in the Write to Display command; next, the information must be altered to reflect changes made by the operator.

```
ESC,CU,ESC,WTD,CC,
```

ESC

Escape character (hex 04), required to begin each RU chain.

CU

Clear Unit command (hex 40), recommended to ensure the integrity of the data to be written to the display. This command clears the display and format table of all information. See the index entry: *Clear Unit command*.

ESC

Escape character, required to link commands within an RU chain.

WTD

Write to Display command (hex 11), required to write any information on the display. This command has many associated parameters. As used here, these consist of the SBA and SF orders, control characters, screen attributes, display and field control words. See the index entry: *Write to Display command* for details.

CC

Two-byte control character associated with the Write to Display (WTD) command. In this case, the CC bytes are hex 00 and 08; in this example, only the second byte is functional; it unlocks the keyboard. See the index entry: *control characters, display* for details.

```
SBA,01,15,@,'ACCOUNTS RECEIVABLE -- UPDATE
MODE',@,
```

SBA

Set Buffer Address order (hex 11), required to locate the beginning position of the data to be written on the display. The two numbers that follow the order (which in this example are 01 and 15) are the row and column address that define the data position. See the index entry: *SBA order* for details.

@

Screen Attribute. A screen attribute of high intensity or underlining would most likely be used here because this is a title. See the index entry: *screen attributes* for details.

'ACCOUNTS RECEIVABLE -- UPDATE MODE',

Data to be written to the field in the position defined by the preceding SBA order. The characteristics of this data on the display have been defined by the screen attribute.

@

Screen Attribute. This is the ending attribute for the field. If a screen attribute was used to highlight the title, this screen attribute is used to reset the fields that follow to normal attributes. If the title has a normal attribute (hex 20), no ending screen attribute is required.

```
SBA,03,01,@,'ACCOUNT:',SBA,03,15,SF,FFW,@,21,
```

SBA

Set Buffer Address order (hex 11). This order defines the position of the next data field to be written as row 3 and column 1.

SF

Start of Field Order (hex 1D). This order defines the beginning position of the first operator-entry field. The parameters following the order locate the field and define its characteristics. The parameters are FFW, @, and length. The field can contain data; in this event, the data is alterable. See the index entry: *SF order* for details.

FFW

Field Format Word (2 bytes). In this example, the field is a numeric only (hex 4300) field with no other restrictions. See the index entries: *fields* and *field format word* for details.

@

Screen attribute that determines how the field is displayed.

21

Field Length. This parameter consists of 2 bytes. It specifies the length of the field. In this example, 21 locations are required, so hex 0015 would appear in the RU.

**Note:** The controller automatically writes a normal attribute (hex 20) at the end of the field.

In the same manner, the programmer builds the name, address, city, state, and zip fields.

```
SBA,09,01,@,'--DATE---   --CODE--
    --LEDGER XREF--  --DEBIT--
    --CREDIT--',@
```

This coding writes the data headings on a line beginning at row 9 and column 2. The screen attributes will be on row 9, column 1. The screen attributes that the user defines determine the characteristics of the line. Remember, if the screen attributes are other than normal, an ending screen attribute should be specified to reset all fields that follow to normal display.

```
SBA,10,1,SF,FFW*,@,8,SBA,10,18,SF,FFW*,@,2,
SBA,10,26,SF,FFW*,@,10,SBA,10,45,SF,FFW**,@,7,
SBA,10,58,SF,FFW**,@,7,. . ..this coding scheme
continues for all 24 rows.
```

**Note:** The asterisks refer to the following text:

Some of the entry fields are not only numeric-only but also mandatory entry (*) and some are right-adjust fields with blank fill (**). This field entry control is accomplished with the FFW. For numeric-only fields with mandatory entry, the FFW = hex 4308. For numeric fields with right adjust and blank fill, the FFW = hex 4306.

Figure 28 shows how the display looks after all previously described orders have been processed.

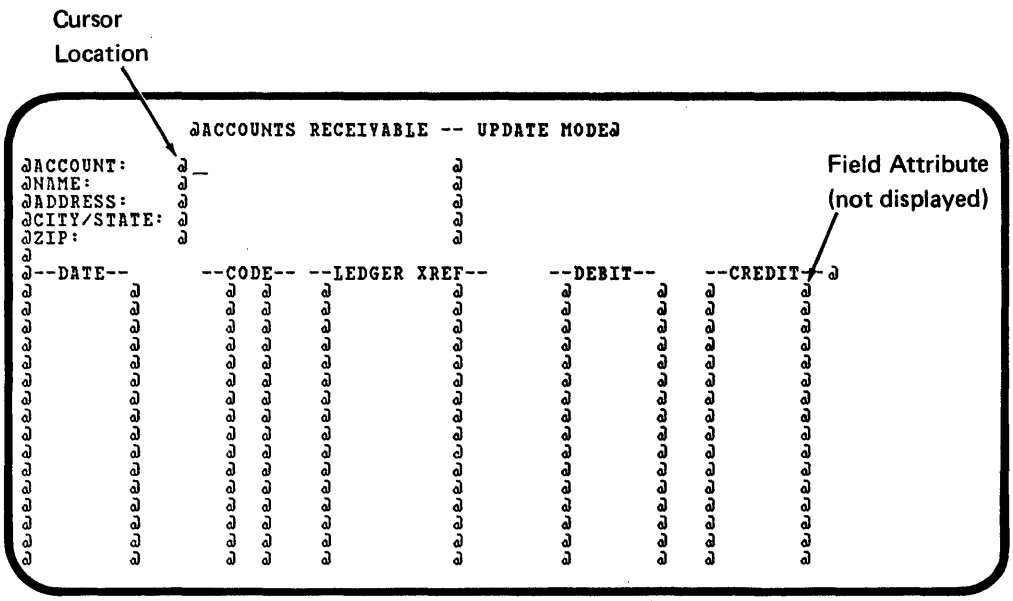



**Figure 28. Display Initially Written by the Programmer to the Screen**

*Updating the Display*

When the display is built as shown in the previous illustration, the programmer may choose to fill some of the fields and make them available for user update. This is accomplished in the following coding:

```
ESC,WTD,CC,SBA,3,16,'7-333',
SBA,4,16,'JOE SMITH',
SBA,5,16,'0000 B STREET',
SBA,6,16,'SOMETOWN, MN',
SBA,7,16,'99999',
SBA,10,02,'11-10-77',SBA,10,19,'20',
SBA,10,27,'125670-100',SBA,10,46,...
```

This continues until the programmer has filled all the fields he wants to make available for the operator to update. Figure 29 illustrates how the display will look:

Remember, the RU chain is still being formed. Now the programmer inserts a read command to prepare to read any data the operator provides.

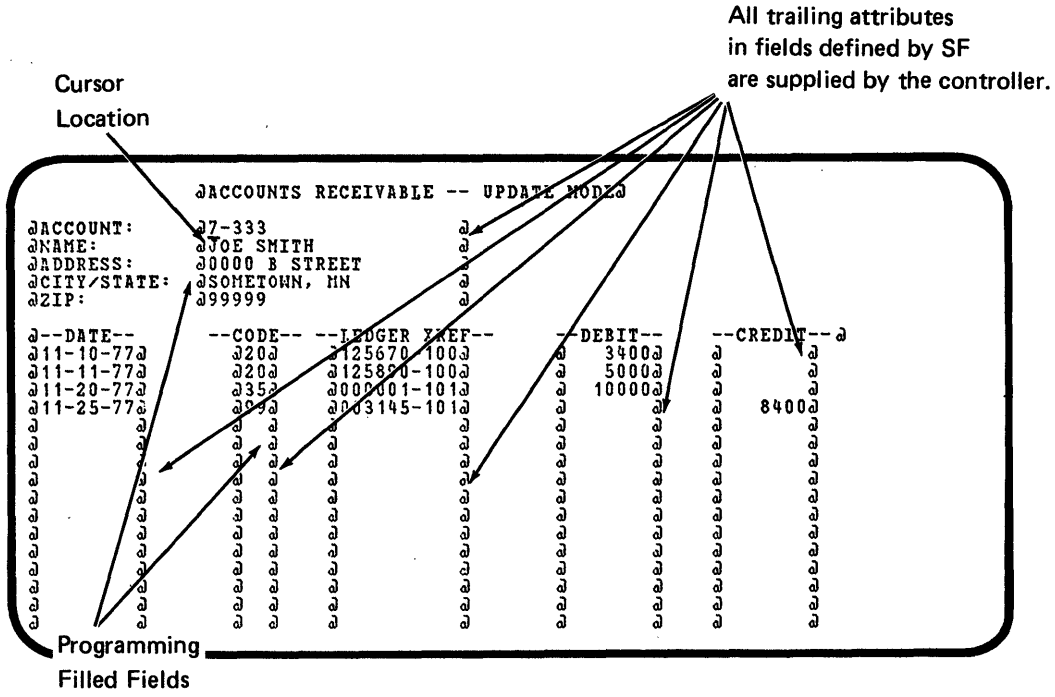



**Figure 29. The Display With the Filled-in Update Fields**

**Reading Fields from a Display**

| ESC,Read MDT,CC, |
|---|

ESC

Escape character (hex 04). It signals the beginning of another command.

Read MDT

The Read Modify Tag Bit command (hex 52). When the operator alters a field on the display, the MDT bit for the field is set. Any field with an MDT bit on is sent to the host system when the operator presses an aid-generating key and all field requirements have been met. See the index entries: *display commands* and *aid-generating keys* for details.

CC

The control characters are associated with the Read MDT command. In this example, the CC is hex 4000, which specifies that MDT bits of nonbypass fields are to be cleared after servicing the read command.

**Note:** The master MDT bit is also cleared.

The complete SNA RU is now sent to the LU. The operator updates the display and presses the Enter/Rec Adv key. The following illustration shows the changes the operator made on the display:

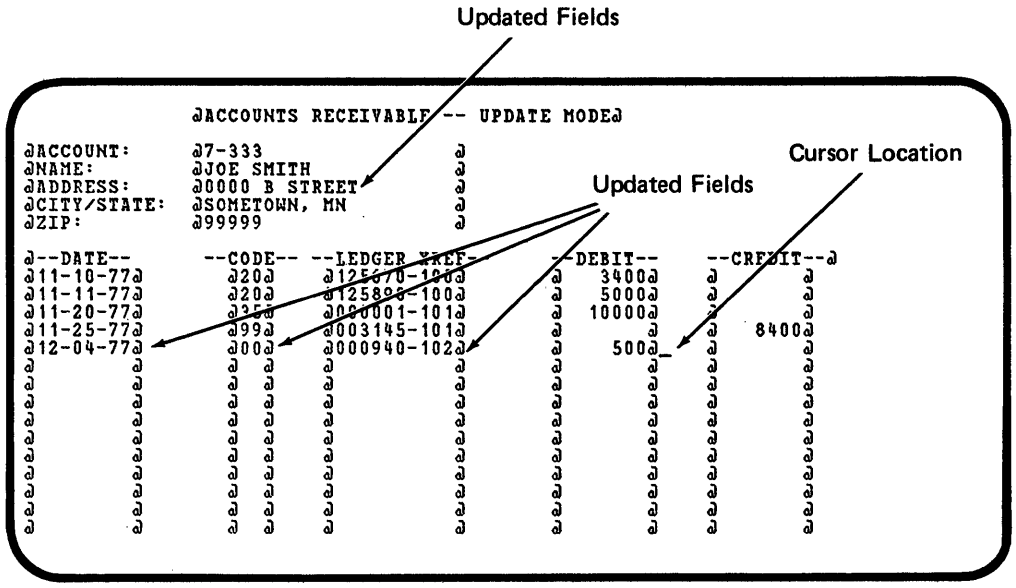



**Figure 30. Display Updated by Operator Entry**

The controller sends the host system the following data stream when the operator presses the Enter/Rec Adv key (see the index entry: *aid-generating keys* for details):

```
14,59,Enter,
SBA,5,16,'0000 B STREET',
SBA,14,02,'12-04-77',SBA,14,19,'00',
SBA,14,27,'000940-102',
SBA,14,46,'  500',
```

14,59,Enter

14,59 is the cursor address at the time the operator pressed the Enter/Rec Adv key. Enter stands for the aid code (hex F1) that the controller sends the host system when the operator presses the Enter/Rec Adv key.

**Error Discovery and Recovery**

1. When the host system checks the incoming data, it finds the numbers sent in the last transaction are invalid; it sends an error message to the operator to alert him of the problem. The code for the error message looks like this:

```
ESC,Wrt Error Code,IC,14,19,@,
'9001 -- INVALID TRANSACTION CODE,
PRESS RESET AND CORRECT',@,
ESC,Read MDT,CC,
```

Wrt Error Code

The Write Error Code command (hex 21) allows the host system to force the keyboard into the prehelp error state. When the operator presses the Error Reset key in response to the Write Error Code command, he unlocks the keyboard, so no Write to Display command is needed. See the index entry: *Write Error Code command.*

IC,14,19

IC is the insert cursor order (hex 13). 14 and 19 define the row and column where the host system wants the controller to set the cursor. This is the location of the error.

@

The host system is responsible for the screen attribute. It should be high intensity blink for the first @ and nondisplay for the last @. Characters appearing in columns 2-5 of the error line (9001 in this example) should be some user text message that can be used to index help messages. The host system should not duplicate error codes generated by the controller. See the index entry: *error codes.*

The following illustration shows the display when the error message is generated:

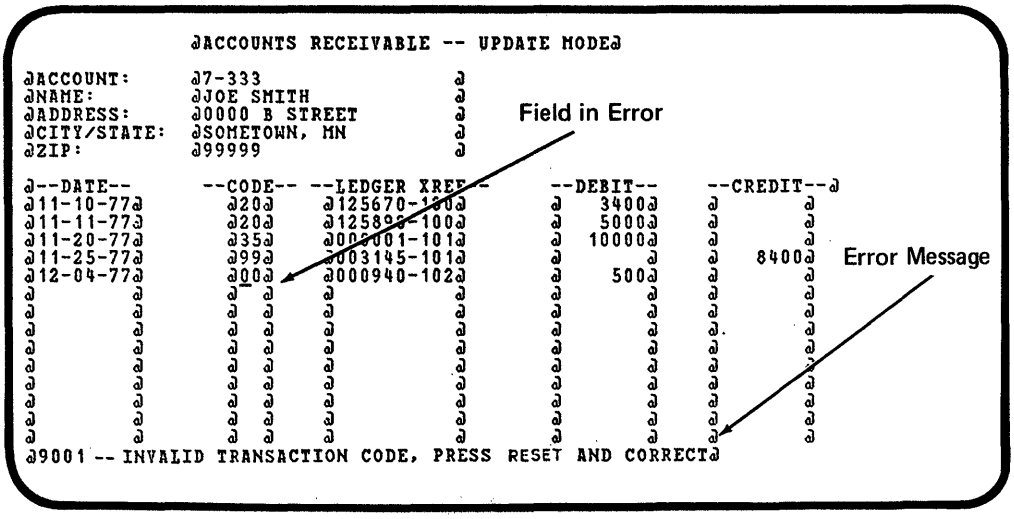



**Figure 31. Display Containing an Error Message**

2. The operator presses the Error Reset key, corrects the error, and then presses the Enter/Rec Adv key. This data stream goes to the host:

```
14,27,Enter,
SBA,14,19,'20',
```

14,27,Enter

This is the cursor location by row and column and the Enter aid code.

SBA,14,19,'20'

This is the SBA order and associated parameters that tell the host that the number 20 is now to be placed into row 14 and column 19 in place of whatever was previously there.

*Note*: Only the corrected fields are sent; previously corrected fields are not resent. This is accomplished by the control character (MDT reset) that followed the first read command.

This is what the display looks like now that the error has been corrected:

The programmer can now write another RU chain to the display.

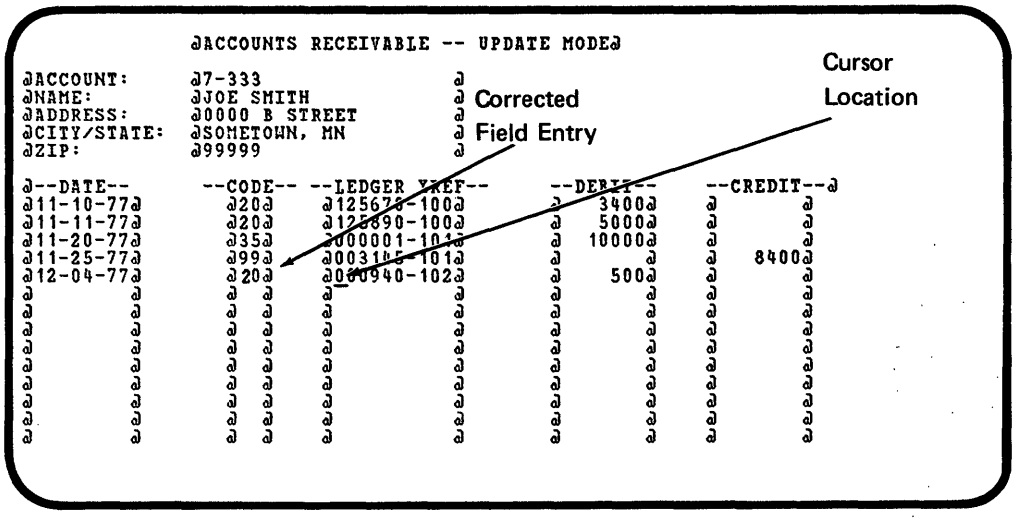



**Figure 32. Final Display**

## PRINTER DATA STREAM EXAMPLE

This example shows the contents of a printer data stream. In normal applications, the data stream is a continuous stream of control characters and data; in this example, for purposes of explanation only, the data stream is broken into pieces. The comma (,) is a byte separator. Within the character strings, each character represents one byte of EBCDIC code. No attempt has been made to represent the SNA headers or flags. Only the contents of the RU are given in this example. The example given here is a 256-byte block which is the maximum single transmission size. The illustration that follows the coding is the result of the data stream.

```
34,C4,0B,
```

34

The PP (print position) control character. It establishes the print position where the next two parameters designate it.

C4

The absolute vertical functional parameter of the PP control character. It establishes the vertical print position at the value set by the next parameter.

0B

The hexadecimal value of the vertical print position. In this example, the printing will start on row 11.

```
34,C0,10,'ABC ELECTRIC CO.',
```

34

1

The PP control character.

C0

The absolute horizontal functional parameter of the PP control character. It defines the print position at the horizontal value given in the next parameter.

10

The hexadecimal value of the horizontal print position. In this example, the beginning horizontal print position is column 16.

ABC ELECTRIC CO.

The data that is written beginning in row 11 and column 16 of the page.

```
15,34,C0,10,1234 SNELLING AVE.,15,34,C0,10,
MINNEAPOLIS, MINN.,15,34,C0,10,55401,
```

15

The hexadecimal code for the new line control character. It positions the printer at the first print position of the next line.

The remainder of this code has the same meaning as the previous code did for the first line printed. These values will cause the printer to align the data given here with the data previously printed.

```
15,15,34,C0,10,XYZ ELECTRIC INC.,
15,34,C0,10,WEST LAKE,
15,34,C0,10,MINNETONKA, MINN.,
15,34,C0,10,55003,
```

The only thing that differentiates this coding from the preceding coding is the use of the 15,15 to insert a blank line between the preceding block of data and this block of data.

```
15,34,4C,03,34,C0,04,92354,
```

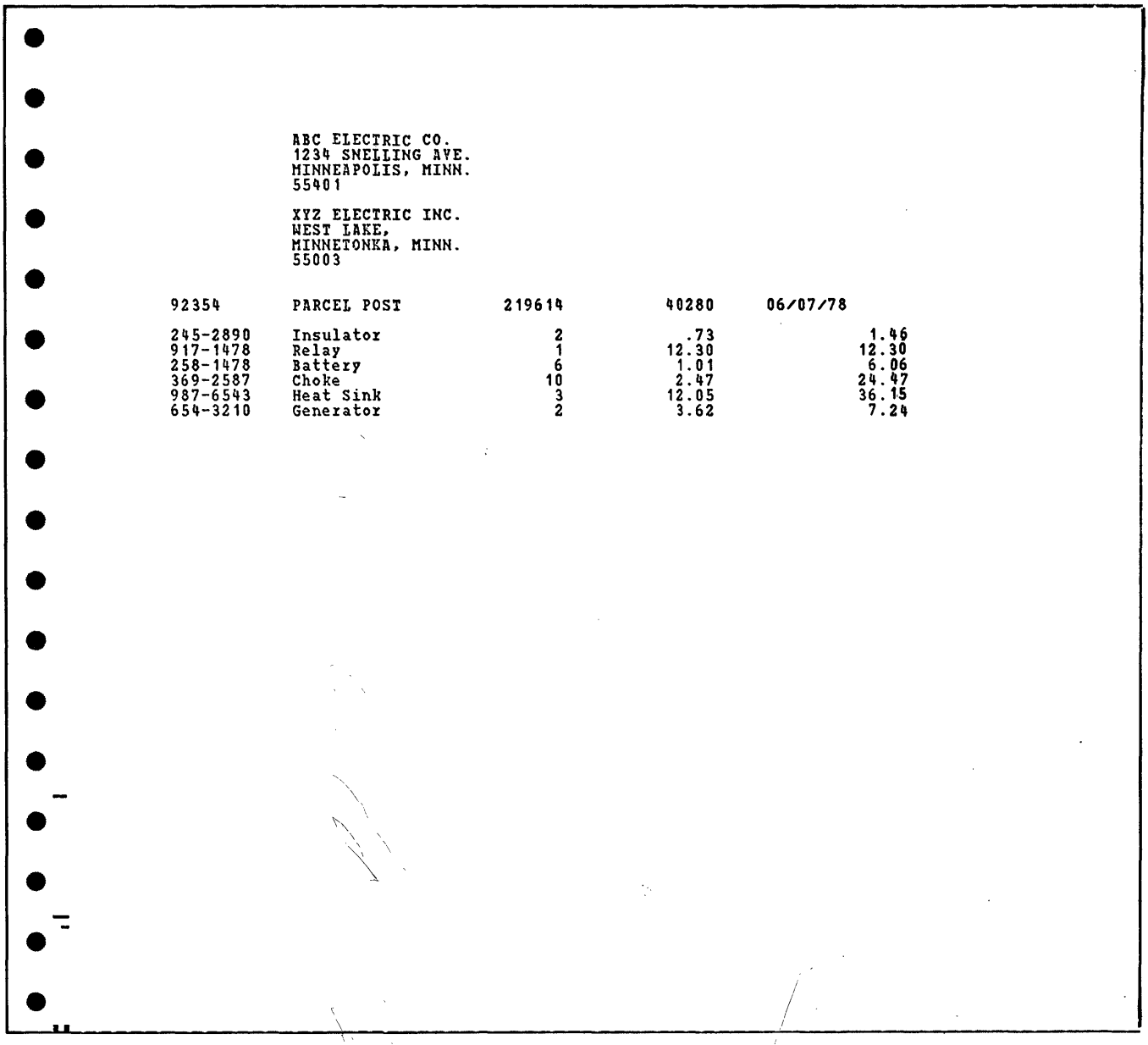
In this block of coding, the programmer inserts three blank lines between the previous data and the data being written. This is accomplished by using the relative vertical functional parameter (4C) of the PP (34) control character. The 03 defines the move as three lines down from the last print position.

```
34,C0,10,PARCEL POST,34,C0,22,219614,
34,C0,2E,40280,34,C0,3A,06/07/78,
```

This block of code is writing the data horizontally at print positions 16(hex 10), 34(hex 22), 46(hex 2E), and 58(hex 3A).

```
15,15,34,C0,04,245-2890,34,C0,10,Insulator,
34,C0,27,2,34,C0,2E, .73,34,C0,49,1.46,15, etc.
```

This coding skips two lines and then begins to print the data in the positions defined by the parameters of the PP control character. This data stream continues until the entire 256 bytes have been transmitted. The result is shown in Figure 33. See the index entry: *control characters, printer.*



ABC ELECTRIC CO.
1234 SNELLING AVE.
MINNEAPOLIS, MINN.
55401

XYZ ELECTRIC INC.
WEST LAKE,
MINNETONKA, MINN.
55003

| | | | | | |
|---|---|---|---|---|---|
| 92354 | PARCEL POST | 219614 | 40280 | 06/07/78 | |
| 245-2890 | Insulator | 2 | .73 | | 1.46 |
| 917-1478 | Relay | 1 | 12.30 | | 12.30 |
| 258-1478 | Battery | 6 | 1.01 | | 6.06 |
| 369-2587 | Choke | 10 | 2.47 | | 24.47 |
| 987-6543 | Heat Sink | 3 | 12.05 | | 36.15 |
| 654-3210 | Generator | 2 | 3.62 | | 7.24 |

**Figure 33. Printer Output**

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## ADDRESSES

The three addresses the 5251 Model 2 or 12 controller uses when it is attached to the host system via a communications network are the LSID address, the controller station address, and the work station address.

### *LSID Address*

The LSID (local session identifier) is in byte 1 of the SNA transmission header (TH); see the index entry: *TH*. This address allows the host system to identify to the controller in the 5251 Model 2 or 12 which specific work station (LU) it wants to communicate with. The heading *Addressing in the 5250 System* in Section 1 of this manual describes the process the user must go through to determine the local address part of the LSID. The local station address is the last 6 bits of the LSID address. The first 2 bits are session type identifiers.

### *Controller Station Address*

The controller station address is in the A part of the SDLC frame (see the index entry: *frames*); it allows the host system to address a specific 5251 Model 2 or 12 controller. This address is defined by the user and set in the eight rocker switches on the 5251 panel.

### *Work Station Address*

The work station address is set on the 5251 Models 1 and 11, 5256, 5225, and 5252; this address allows the controller to communicate with a specific work station. The work station address is determined by the physical configuration of the user's system. See Figure 18 in Section 1.

## AID CODES

The aid code identifies to the host system the function being requested from the keyboard. The aid code is returned via the Read Input or Read MDT command when the operator presses an aid-generating key. See the index entries: *display, commands* and *aid-generating keys*.

**5250 Aid Codes**

| Key | | Aid Code Generated (in Hex) |
|---|---|---|
| Command | 1 | 31 |
| Function | 2 | 32 |
| Keys | 3 | 33 |
| | 4 | 34 |
| | 5 | 35 |
| | 6 | 36 |
| | 7 | 37 |
| | 8 | 38 |
| | 9 | 39 |
| | 10 | 3A |
| | 11 | 3B |
| | 12 | 3C |
| | 13 | B1 |
| | 14 | B2 |
| | 15 | B3 |
| | 16 | B4 |
| | 17 | B5 |
| | 18 | B6 |
| | 19 | B7 |
| | 20 | B8 |
| | 21 | B9 |
| | 22 | BA |
| | 23 | BB |
| | 24 | BC |
| Clear | | BD |
| Enter/Rec Adv | | F1 |
| Help (not in operator-error mode) | | F3 |
| Roll Down | | F4 |
| Roll Up | | F5 |
| Print | | F6 |
| Record Backspace | | F8 |
| Auto Enter (for Selector Light Pen) | | 3F |

## CCITT/EIA ADAPTER

This special feature allows the user to attach a 5251 Model 2 or 12 controller to an external modem. The modem that it attaches to, however, must have (1) an interface that meets the *EIA Standard RS-232C* and *100 Series Interchange Circuits* defined in the *CCITT Internal Recommendations*, Volume 24, and (2) electrical characteristics compatible with the electrical requirements of the *EIA Standard RS-232C* and conform to the CCITT recommendations in Volume 28. This feature is restricted to speeds up to 9600 bps.

## CD (CHANGE OF DIRECTION) BIT

The change of direction bit is bit 2 of byte 2 of the RH. It reverses the normal flow direction and is examined only on RUs with the End Chain indicator on. It is used in the normal flow LU-LU session FM RUs and DFC RUs. See the heading, *Protocols and Synchronization for 5250 Implementation of SNA* in Section 1 for more information.

## CHAINING

The SNA chain carries commands and information between the host system and 5251 Model 2 or 12 controller. The length of the chain is not restricted (it can contain multiple RUs). See the index entry: *RU*. The first RU is marked first of chain (FOC); the last is marked last of chain (LOC), and all in the middle are marked middle of chain (MOC). A single RU in a chain is marked only in chain (OIC). The RH that immediately precedes the RU in the SDLC frame contains the information about the position of that RU in the SNA chain (see the index entry: *RH*). See also *Protocols and Synchronization for 5250 Implementation of SNA* in Section 1 for a description of how this information is used.

## CLOCK (SYNCHRONOUS)

This is a clock feature that is offered for external modems that do not provide their own clocking. It is required when the 1200 bps (bits per second) Integrated Modem feature is installed. The internal clock provides clock speeds of 1200 bps with 600 bps also available for World Trade countries.

## COMMANDS

The four types of commands that are described in detail in the following text are: display data stream commands, SDLC commands, SNA commands, and transmission commands.

### Display Data Stream Commands

The display commands are in the LU-to-LU flow.

**Note:** The printer does not use data stream commands to interface to the host system; it uses an SNA SCS character string. (The printer does use the transmission command set that the controller supplies.) This is referenced by index entry: *control characters, printer*.

Both the display commands and responses are found in the SNA RUs. These are routed between the host system and controller in the FM data flow. See Figure 27 for a list of the SNA sessions and their contents. The format of the display data stream is:

| Escape Character | Command | Associated Data or Parameters | More of the Same or SNA Chain End |
|---|---|---|---|

These are the commands that the user's application program uses to control the display:

| Input Commands | Output Commands |
|---|---|
| Read Immediate | Clear Format Table |
| Read Input Fields | Clear Unit |
| Read MDT Fields | Restore Screen |
| Read Screen | Roll |
| Save | Write Error Code |
| | Write to Display |
| | (See also *Copy to Printer Feature*) |

For each command, the following text includes function, restrictions, format, and results. The display commands form two basic categories: the input commands and the output commands.

Input Commands

This category consists of the save and read commands. Within this category there is a further subdivision into immediate and aid-associated read commands. The immediate commands are those that are executed when the controller receives the command and the aid-associated commands are those that are queued until the operator presses an aid-generating key such as Enter/Rec Adv. The immediate commands are titled as such; those not labeled as immediate are aid-associated. For details about aid codes, see index entries: *aid-generating keys* and *aid codes*.

The host system sends the read commands to the 5251 Model 2 or 12 controller in the LU-LU FM session; when the controller receives them, it determines if they are immediate or aid-associated. If they are immediate, they are executed without delay. If they are aid associated, the controller queues them until it receives an aid code caused by the operator pressing an aid-generating key. These commands are held one at a time in a queue until the addressed LU can perform the requested function. When multiple read commands are sent to a display to be enqueued, only the last one is preserved; the others are overlaid.

**Note:** When an aid code is serviced, the command is cleared.

*Read Immediate (Immediate)*

*Function:* This command sends back the contents of all the input fields on the display.

*Restrictions:* This command must be the last command in the chain (see the heading, *Protocols and Synchronization for 5250 Implementation of SNA* in Section 1), and the controller must have CD (see the index entry: *CD*). This command is rejected if the station is in an error, system request, or SS message state.

*Format:*

| ESC | Read Command | SNA Chain End |
|---|---|---|
| Hex 04 | Hex 72 | |

*Results:* The information associated with this command returns to the user in the LU-LU nonexpedited flow. What the user receives when he issues this command depends on the condition of the master MDT bit. See the index entry: *MDT bit*.

- If the master MDT bit is not set, the user receives:

  Cursor Address Aid Code

- If the master MDT bit is set, the user receives:

  Cursor Address Aid Code Field Data

The field data consists of the contents of all input fields as they appear on the display unless resequencing has been specified. See the index entry: *field control words*. Remember, any attributes contained in a field are treated as data and returned as such. Field boundary attributes are not considered part of the field. All nulls are converted to blanks. If the specified field is a signed numeric field, the last character is not sent; if that same field is negative, the zone position of the next-to-the last character is changed to hex D.

In each case, the returned cursor address indicates the current location of the cursor and the aid code is hex 00.

**Note:** Queued read commands and pending aid codes are not cleared. The format table, display indicators, insert and command modes keying history, and display contents are not affected.

*Read Input Fields*

*Function:* This command allows the host system to have the controller send the contents of all input fields defined in the format table.

*Restrictions:* The operator must press an aid-generating key to execute this command. See the index entry: *aid-generating keys*. Also, CD in the RH must be on before the aid byte can be serviced. (See index entry: *CD*.) This command is cleared if:

1. The host system issues a session control request (such as Bind).
2. The host system issues a Clear Unit command and the controller executes it.
3. The host system sends another read command to the same LU and overlays this command.
4. The read command is executed.

*Format:*

| | | | |
|---|---|---|---|
| ESC | Read | CC | ESC or SNA |
| Hex 04 | Command | See Note | Chain End |
| | Hex 42 | | |

**Note:** This is a 2-byte control character. See the index entry: *control characters, display* for details.

*Results:* The information associated with this command returns to the user in the LU-LU nonexpedited flow. Note that the host system cannot receive this information until the operator presses an aid-generating key. See the index entry: *aid-generating keys*. What the user receives when he issues this command depends on the condition of the master MDT bit. See the index entry: *MDT bit*.

- If the master MDT bit is not set, the user receives:

  Cursor Address Aid Code

  - Cursor Address: The position of the cursor when the aid-generating key was pressed.
  - Aid Code: The code for the aid-generating key the operator used.

- If the master MDT bit is on, the user receives:

  Cursor Address Aid Code Field Data

  - Cursor Address: The position of the cursor when the aid-generating key is pressed.
  - Aid Code: The code for the aid-generating key the operator used.
  - Field Data: Returned only when one of the following aid-generating keys is used:

    Roll↑ Up
    Roll↓ Down
    Enter/Rec Adv
    An unmasked command function key

    When it is returned, the field data consists of the contents of all input fields as they appear on the display unless resequencing has been specified. See the index entry: *field control words*.

  Remember, any attributes contained in a field are treated as data and returned as such. Screen boundary attributes are not considered part of the field. All nulls are converted to blanks. All pending aid request bytes are cleared. If the specified field is a signed numeric field, the last character is not sent; if that same field is negative, the zone position of the next-to-last character is changed to hex D. Though data is not sent, the CC bytes are processed.

*Read MDT Fields*

*Function:* This command allows the host system to ask the controller to send data from only those fields that have been modified. A field is recognized as having been modified if the MDT bit for the field is on. See the index entry: *MDT bit*.

*Restrictions:* The operator must press an aid-generating key to execute this command. See the index entry: *aid-generating keys*. In addition, the CD in the RH for the requested LU must be on before any information can be sent back to the host system in response to the command. See the index entry: *CD*. The command is cleared if:

1. A session control request (such as Unbind) is issued by the host system.
2. A Clear Unit command is issued.
3. The host system sends another read command to the same LU and overlays this command.
4. The read command is serviced.

*Format:*

| | | | |
|---|---|---|---|
| ESC<br>Hex 04 | Read<br>Command<br>Hex 52 | CC<br>(See Note) | ESC or SNA<br>Chain End |

**Note:** Two bytes of control characters must be included in this command. These are referenced by the index entry: *control characters, display*.

*Format of Returned Data:*

| | | | | |
|---|---|---|---|---|
| Cursor Address (2 bytes: row, column | Aid Code | SBA<br>hex 11 | Row, Column Address | Field Data |

*Results:* The contents of each field that has an MDT bit on is returned to the host system in the order that the fields appear in the format table if one of the following aid-generating keys is used:

Roll↑ Up
Roll↓ Down
Enter/Rec Adv
Unmasked command function keys

If no MDT bits are on or if the operator does not use one of the acceptable aid-generating keys, only the cursor and aid code are returned to the host system.

The host system can use field control words to rearrange the sequence in which the fields are returned. See the index entry: *field control words* for more details.

If data is returned, the following formatting is done:

- Trailing nulls are stripped. If the field consists of all nulls, only the SBA, row, and column are returned.
- Leading and embedded nulls are converted to blanks.
- If the field is signed numeric, the last character is not sent; if that same field is negative, the zone position of the next-to-last character is changed to hex D.

Remember that hex 11 marks the beginning of all fields; therefore, avoid writing hex 11 to the display as data.

*Read Screen (Immediate)*

*Function:* This command causes the contents of the display to go to the host system in the sequence that it appears on the display (for example, row 1 goes first).

*Restrictions:* This command must be the last command in the SNA chain, and CD must be on. See the heading, *Protocols and Synchronization for 5250 Implementation of SNA* in Section 1 and index entry: *CD* for more information. The command is rejected when the addressed display is in the prehelp error, posthelp error, system request, or SS message state.

*Format:*

| | | |
|---|---|---|
| ESC<br>Hex 04 | Read Command<br>Hex 62 | SNA Chain End |

*Results:* The content of the entire display, including the attributes, is sent to the host system just as it appears in the regeneration buffer (no formatting or conversion is done). This command does not clear either pending read commands or aid requests. The keyboard is temporarily locked. The following are unaltered: display indicators, cursor location, modes, keying history, display contents, and format table.

*Save (Immediate)*

*Function:* This command allows the host system to save the present display so it can be restored later.

**Note:** This is accomplished by sending back the data received after a Save operation. See index entry: *Restore command.*

*Restrictions:* This command must be the last command in the SNA chain and CD must be on. See the heading *Protocols and Synchronization for 5250 Implementation of SNA* in Section 1 and index entry: *CD.* The command is rejected if the addressed LU is in either the system request or SS message state.

*Format:*

| | | |
|---|---|---|
| ESC | Save Command | SNA Chain End |
| Hex 04 | Hex 02 | |

*Result:* All data that is required to restore the display is sent to the host system; it must not be modified by the host system if the result of the Restore command is to have integrity. See index entry: *Restore command.*

Approximately 2 K bytes are returned to the host system for the 960-character display and 3 K bytes are returned to the host system for the 1920-character display.

Read commands and pending aid requests are not cleared when this command is executed. The keyboard is temporarily locked. The display indicators, cursor location, modes (command and insert), keying history, display content, and format table are not affected by this command.

Output Commands

The output commands are Restore, Write to Display, Write Error Code, Clear Unit, Clear Format Table, and Roll. Some of the commands have associated data and control information (write control characters and orders). The control information is not included in this topic; see the index entries: *control characters, display* and *orders* for details about these topics. The write commands are executed immediately.

*Clear Format Table*

*Function:* This command clears the format table but does not affect the present display.

*Restrictions:* The command is rejected if the LU is in an error, system request, or SS message state.

*Format:*

| | | |
|---|---|---|
| ESC | Clear Format | SNA Chain End |
| Hex 04 | Table Command | or ESC |
| | Hex 50 | |

*Results:* The following list describes what happens when this command is executed:

1. The keyboard is locked.
   a. The keyboard clicker is turned off.
   b. The Input Inhibited indicator on the display is turned on.
   c. The insert mode is cleared (as is the indicator).
   d. The command mode is cleared.

2. The format table is cleared. (Format level 0 is not selected.) The format table header will look like this:

| Item | Value |
|---|---|
| Format ID | Hex 00 |
| First field transmitted to host system | 0 (Resequencing is disabled) |
| Error line | Bottom line of display |

3. The system insert cursor address is set to row 1, column 1; this clears any previous IC order.

4. Any pending aid request is cleared.

5. All keying history is cleared.

6. The master MDT bit is cleared.

7. A blinking cursor caused by waiting for a required field exit key is reset.

**Note:** Operator-selected reverse image and the Message Waiting indicator are not affected by this command.

*Clear Unit*

*Function:* This command clears the display and format table.

*Restrictions:* The command is rejected if the display is in the SS Message state.

*Format:*

| | | |
|---|---|---|
| ESC<br>Hex 04 | Clear Command<br>Hex 40 | ESC or<br>SNA Chain<br>End |

*Results:*

1. The keyboard locks.
   a. The clicker is turned off.
   b. The Input Inhibited indicator is turned on.
   c. The error state is cleared.
   d. The system request state is cleared.
   e. Insert mode is cleared.
   f. Command mode is cleared.
2. The format table is cleared. Since this is not format level 0, a default header is assumed. See the Clear Format Table command.
3. The display is cleared of all characters, by writing nulls to the regeneration buffer.
4. A nonblinking, nonreverse image with a normal intensity screen attribute is written to the regeneration buffer.
5. The cursor position is row 1, column 2.
6. The system IC (insert cursor) address is set to row 1 column 1 (clearing any previous insert orders sent by the host system).
7. All unserviced aid requests are cleared.
8. The history of previous keystrokes is cleared.
9. The master MDT bit is cleared.
10. If the cursor is blinking, it is reset.
11. Pending Read Input or Read MDT commands are cleared.

**Note:** Operator-selected reverse image and the Message Waiting indicator are not affected by this command.

*Restore Screen (Immediate)*

*Function:* This command restores the contents of the display by returning data saved in the Save command.

*Restrictions:* This command is rejected when the station is in a system request or SS message state. The command must be issued to a device that is the same machine type, model, and release as the one that received the Save command.

*Format:* This is generated via a Save command; therefore, all the user has to do to execute this command is to return the data it received as the result of the Save command.

*Results:*

1. These things are restored:
   a. Contents of the display.
   b. Contents of the format table.
   c. State of the keyboard including the insert mode with the indicators and the command mode.
   d. Location of the cursor and the way it was displayed.
   e. System insert cursor address.
   f. State of the master MDT bit.
   g. If the user was in an error state, the error code and any explanatory information provided by the host system in the Write Error Code command are returned via the operator's use of the Help key.
   h. Requirements to send LU-LU Lustat when error line is available.
   i. Any Read command that was pending at the time.
   j. Any aid requests that were outstanding at the time of the Save command.
   k. Dead Key Diacritic and Hex modes are cleared.
2. This data is not restored:
   a. Shift and shift indicators.
   b. State of the Message Waiting indicator.
   c. Requirement to send SS-LU Lustat when error line is available.

3. The following conditions cause a parameter error:
   a. Invalid data is detected.
   b. The required amount of data is not received.

**Note:** A Clear Unit command is executed if an error is detected.

*Roll*

*Function:* This command allows the lines to be rolled up or down on the display as specified by the size parameter of the command.

*Restrictions:* The command is rejected if the display is in the prehelp error, posthelp error, system request, or SS message state.

*Format:*

| ESC | Roll | Parameters | ESC or SNA |
|---|---|---|---|
| Hex 04 | Command | 3 bytes | Chain End |
| | Hex 23 | (See Note) | |

**Note:** The following describes the contents of the 3 parameter bytes:

| Byte | Bits | Description |
|---|---|---|
| 1 | 0 | 0=Roll Up<br>1=Roll Down |
| | 1-2 | Reserved |
| | 3-7 | Number of lines that the designated area is to be rolled |
| 2 | 0-7 | Line number defining the top line of the area that will participate in the roll |
| 3 | 0-7 | Line number defining the bottom line of the area that will participate in the roll |

*Results:*

1. The display is rolled as designated.
2. Lines vacated by the roll are not cleared to nulls.
3. The format table is not affected.

   **Note:** If the display does not conform to the format table, the roll should not be done.
4. The lines rolled out of the area are lost (cannot be rolled back onto the screen).
5. The state of the keyboard is not affected.
6. Pending aid bytes are not affected.

The following conditions cause parameter errors:

- A top line of zero
- A top line greater than or equal to the display length
- A bottom line of zero
- A bottom line greater than the display length
- A top line greater than or equal to the bottom line
- A roll area greater than the bottom line minus the top line

*Write Error Code*

*Function:* This command allows the host system to force the keyboard into the prehelp error state. See index entry: *error states.*

*Restrictions:* The command is rejected if the display is in the prehelp error, system request, or SS message state. Data must not exceed 80 characters (1 display line). See step 9 in the Results heading of this topic.

*Format:*

| ESC | Write | IC Order | Screen | Screen | ESC or |
|---|---|---|---|---|---|
| Hex 04 | Error | R/C | Attributes | Attributes | SNA |
| | Command | Address | Data | (see Note) | Chain |
| | Hex 21 | Hex 13 | | | End |

These are optional although at least one of them must be included to make the command valid.

An IC (insert cursor) order can appear anywhere within the data. If an IC order is included, it immediately moves the cursor to that display location without altering the system insert cursor address. All keying history is lost, and therefore, field checks such as self check and mandatory fill are inhibited.

If an IC order is not included, the cursor remains where it was at the time of error. See the index entry: *IC order*.

**Note:** The user should include screen attributes so such things as his security requirements are fulfilled; however, it is recommended that the leading and trailing attributes be high-intensity blink and nondisplay respectively.

*Results:* When the operator presses the Help key (prehelp error state only) in response to the error condition, characters from columns 2, 3, 4, and 5 of the error line are returned to the host system in a packed form and sent as a Signal command. These characters form an index code that elicits a user-generated description of the error for the operator. See the index entry: *Signal, command and response* for details.

1. The prehelp error state is selected for the keyboard.
2. The Input Inhibited indicator is on.
3. The keyboard clicker is off.
4. The insert mode and Insert indicator are cleared.
5. The command, Dead Key Diacritic, and Hex modes are cleared.
6. The cursor blinks.
7. The line in the format table header defined as an error line is saved. See index entry: *SOH order*.
8. The cursor moves to the location specified by the IC order. If no IC order is given, the cursor does not move.
9. All characters (except IC order) found between the command byte and the end of the chain or next ESC are written on the error line. If the data exceeds 80 characters, an error occurs.
10. All outstanding aid bytes are cleared.
11. When the operator presses Help, the 5251 Model 2 or 12 controller places a nonblink high intensity attribute in column 1 of the error line, replacing anything that was previously there.
12. The locked state of the keyboard is cleared if the keyboard was locked and the station was not in a posthelp error state; this allows the operator to release the keyboard by pressing the Error Reset key.

The following conditions cause parameter errors:

- Neither an IC order nor data follows the command.
- Invalid IC order.
- More data than 80 bytes is specified.

*Write to Display (WTD)*

*Function:* This command writes characters and attributes into the display regeneration buffer and creates, adds to, and modifies the format table that is associated with the display.

*Restrictions:* This command is rejected if the display is in a prehelp error, posthelp error, system request, or SS message state.

*Format:*

| | | | | |
|---|---|---|---|---|
| ESC<br>Hex 04 | Write<br>Command<br>Hex 11 | CC 2 bytes<br>(See Note 1) | Orders &<br>Data<br>(See<br>Note 2) | ESC or<br>SNA<br>Chain<br>End |

**Notes:**
1. CC are the write control characters. See index entry: *control characters, display*.
2. The orders are described in detail as referenced by index entry: *orders*. Any character that is not an order and not associated with an order is considered data, and is written on the screen at the current display address. The address is then incremented by 1 for each character written. These characters should be hex 00, hex 1C, or above hex 1F, so there is no conflict with the codes reserved for orders.

*Results:* The display contains exactly what the programmer has specified in the control characters and orders:

1. The state of the keyboard is not affected by the Write to Display command unless one of the following is specified (in which case the locked state results):
   a. An SF order is used to define the input field.
   b. An SOH order is present.
   c. CC byte 1 specifies either clear MDT bits or clear input fields.

2. The physical location of the cursor is not affected if the keyboard is in the unlocked state when the Write to Display command is detected, and it remains unlocked after processing the control characters and all orders. For all other conditions, the cursor is moved to one of the following places:
   a. The IC order specified by the host system
   b. The first nonbypass field
   c. Row 1, column 1

3. If the keyboard is in the unlocked state when the Write to Display command is detected, it is possible for the 5251 Model 2 or 12 controller to go to the error state between RUs. This results in the command being rejected after being partially processed. This can be avoided by issuing single RU chains when the keyboard is in the unlocked state.

   **Note:** If the programmer is initially writing to the display, it is a good practice to issue a Clear Unit command before issuing the Write to Display command to ensure that the format table is not at format level 0. Do not use the Clear Unit command for updating a display.

The following conditions cause parameter errors:

1. Invalid orders; see the index entry: *orders*.

2. No data, orders, or CC follow the command byte.

**SDLC Commands and Responses**

As described in the heading *Frame—SDLC* in this section, nonsequenced and supervisory frames contain commands (and responses) that serve the data link and link level needs of the host system-5251 Model 2 or 12 controller communication transfer. Normally, these commands and responses are transparent to the user. They are included in this manual because not all commands and responses available with SDLC are supported by the 5251 Model 2 or 12 controller. The following information gives the command and associated response name and tells whether or not it is supported by 5251 Models 2 and 12. The commands and responses are grouped by format type (nonsequenced commands and responses, followed by supervisory format commands and responses). Because a user can affect the contents of the XID command, specific bit information about the XID command contents is included in this text.

*Unnumbered Nonsequenced Commands*

Nonsequenced (Unnumbered) Commands and Responses (Part 1)

| Commands | Responses | Y=Yes; N=No Supported | Hexadecimal Code | Description |
|---|---|---|---|---|
| DISC (Disconnect) | | Y | 53 with P bit | Places the work station in the normal disconnect mode and goes onhook in a switched environment (Note 1). |
| | UA (NSA) (Nonsequenced Acknowledgement/ Unnumbered Acknowledgement) | Y | 73 with F bit | Indicates that the disconnect is complete; the work station is now in a normal disconnect mode (onhook for switched lines). |
| SNRM (Set Normal Response Mode) | | Y | 93 with P bit | Places the 5251 controller in the normal response mode. |
| | UA (NSA) | Y | 73 with F bit | Verifies that the 5251 controller is in normal response mode. |
| Test | | Y | F3 with P bit | The user can send a maximum of 256 bytes of data with this. |
| | Test | Y | F3 with F bit | This returns the data sent with the Test command (Note 2). |
| XID (Exchange Station Identifier) | | Y | BF with P bit | Requests information about the addressed work station. The 5251 Model 2 or 12 interrogates byte 16 (LOC) of the XID command. If byte 16 is 7 or less, the work station/controller uses that value; otherwise the default is 7. |
| | XID | Y | BF with F bit | Returns 20 bytes of information about the work station. See XID in this topic for details. |

**Notes:**
1. If received when the 5251 Model 2 or 12 is in normal disconnect mode, the response will be DM.
2. If the data associated with the Test command exceeds 256 bytes, the command is returned with no data.
3. FRMR (CMDR) or DM will never be returned as a response to XID or Test.

Nonsequenced (Unnumbered) Commands and Responses (continued)

| Commands | Responses | Y=Yes; N=No Supported | Hexadecimal Code | Description |
|---|---|---|---|---|
| | FRMR (CMDR) (Frame Reject/ Command Reject) | Y | 97 with F bit | This is sent in the normal response mode. It is sent when there is an invalid command, there is data in a command where data is not acceptable, or the Nr count is out of range in either direction (Note 3). |
| | Disconnect Mode (DM) | Y | 1F with F bit | Indicates that the work station/controller is in normal disconnect mode (Note 3). |

**Notes:**
1. If received when the 5251 Model 2 or 12 is in normal disconnect mode, the response will be DM.
2. If the data associated with the Test command exceeds 256 bytes, the command is returned with no data.
3. FRMR (CMDR) or DM will never be returned as a response to XID or Test.

Nonsequenced (Unnumbered) commands and Responses (Part 2)

The following commands and responses are supported for loop operation only. if they are received when your system is not in a loop operation, they will be treated as nonsupported commands.

| Commands | Responses | Y=Yes; N=No Supported | Hexadecimal Code | Description |
|---|---|---|---|---|
| NSP (UP) (Nonsequenced Poll/ Unnumbered Poll | | Y, if loop operation. | 23 without P bit<br>33 with P bit | Used to solicit information or responses from loop terminals. |
| CFGR (Configure) | | Y, if loop operation. | C7 without P bit<br>D7 with P bit | Used for diagnostic purposes. |
| | CFGR | Y, if loop operation. | C7 without F bit<br>D7 with F bit | If a data byte is received with the response, the work station/controller has accepted the CFGR command. |

The contents of the XID response are as follows:

| Byte | Bits | Code (X=Hex and B=Binary) | Meaning |
|---|---|---|---|
| 0 | 0-3 | B'0001' | Variable format. |
| | 4-7 | B'0001' | PU.T1 (FID3). |
| 1 | 0-7 | X'14' | XID information field length. |
| 2-5 | 0-11 | B'000000100000' | Block number. |
| | 12-15 | B'0000' | Specific ID |
| | 16-23 | B'00000000' | (Note 5). |
| | 24-31 | B'--------' | |
| 6-7 | 0-15 | X'0000' | Reserved. |
| 8 | | X'00' | Configuration flags. |
| | *Configuration Code for Secondary Station* | | |
| 9 | | | PU characteristics (Note 1). |
| | 0 | B'1' | PU can receive FM RUs from SS. |
| | 1 | B'0' | Reserved. |
| | 2-3 | B'11' | No segments allowed. |
| | 4-7 | B'0000' | Reserved. |
| 10-11 | | | Maximum length for receive (Note 2). |
| | 0-15 | X'0105' | Maximum length of information field is 261 bytes. |
| 12 | | | SDLC command profiles. |
| | 0-3 | B'0000' | Reserved |
| | 4-7 | B'0000' | SNA set (Note 3). |
| 13 | | | SDLC function flags. |
| | 0 | B'0' | Reserved. |
| | 1 | B'0' | Reserved. |
| | 2 | B'0' | SIM and RQI (RIM) not supported. |
| | 3-7 | B'00000' | Reserved. |
| 14 | 0-7 | X'00' | Reserved. |
| 15 | 0-7 | X'00' | Reserved. |
| 16 | 0-7 | X'03' or X'07' | Maximum out count (Note 4). |
| 17-19 | | X'00' | Reserved. |

**Notes:**

1. This field describes the restrictions, if any, on the PU the user is using.
2. This is a binary count of the maximum number of bytes in the information field. Bit 0 is a flag.
3. Bits 4-7 of byte 12 contain the SDLC function profile. Value X'0' defines the SNA link set. The SNA link set is:

| Commands | Responses |
|---|---|
| I-frames | I-frames |
| RR | RR |
| RNR | RNR |
| TEST | TEST |
| XID | XID |
| SNRM | NSA (UA) |
| DISC | DM |
| | FRMR (CMDR) |

4. This is the maximum number of consecutive frames the 5251 is able to accept. It will always be either 3 or 7.
5. Bits 24-31 contain controller station address. See the *IBM 5250 Planning and Site Preparation Guide*, GA21-9337, for details on setting this address.

| Commands | Possible Responses | Y=Yes; N=No Supported | Hexadecimal Code | Description |
|---|---|---|---|---|
| RR (Receiver Ready) | | Y | Variable | Host system is ready but has no data to send the controller; it is asking if the controller has data to send. This also acknowledges previously sent data (see note). |
| | RR (Receiver Ready) | Y | Variable | The 5251 Model 2 or 12 controller is ready but it has no data to send the host system at this time. This also acknowledges previously sent data. |
| | RNR (Receiver Not Ready) | Y | Variable | There are no available buffers and therefore, no I frames from the host system can be accepted. This also acknowledges previously sent data. |
| | I Frame | Y | Variable | This contains the SNA RUs from the controller. |
| RNR (Receiver Not Ready) | | Y | Variable | There are no available buffers and therefore, the host system cannot accept any I frames from the controller (see Note). |
| | RNR (Receiver Not Ready) | Y | Variable | Same meaning as RNR command.<br>This also acknowledges previously sent data. |
| | RR (Receiver Ready) | Y | Variable | The 5251 Model 2 or 12 controller is ready, but it has no data to send at this time. This also acknowledges previously sent data. |

**Note:** FRMR (CMDR) or DM may be sent as a response.

*Nonsupported Commands and Responses*

The following commands and responses are not supported by the 5251 Model 2 or 12. If these commands are received while the 5251 Model 2 or 12 is in normal disconnect mode, the response will be DM. If these non-supported commands are received while in normal response mode, the response will be FRMR (CMDR).

| Command | Response | Description |
|---|---|---|
| NSI (UI) (Nonsequenced Information/ Unnumbered Information) | | Command contains nonsequenced (unnumbered) information. |
| | NSI (UI) | Response contains nonsequenced (unnumbered) information. |
| | SIM (Set Initialization Mode) | Command is dependent on system use; consult your host system documentation. |
| | RQI (RIM) (Request/ Initialization/Request Initialization Mode) | Initialization needed; expect SIM. |
| | RQD (RD) (Request Disconnect) | Request to be placed in disconnect mode. |
| REJ (Reject) | | Transmit, starting with frame Nr. |
| | REJ (Reject) | Retransmit, starting with frame Nr. |

*I Frame SDLC Responses*

The I frames contain the SNA RUs and all the information and data that the 5250 devices use. The *SNA Commands* and *Display Data Stream Commands* descriptions within this topic give detailed information about the contents of the I frames. The host system can send I frames to a controller that has responded RR (receiver ready). The controller can send I frames to the host system when it receives either an I frame with the P (poll of the P/F) bit on or an RR (receiver ready) command from the host system. Remember, the control field of the SDLC frame contains sequence count information for the I frames; the RU is contained in the information fields of the I frames. See the index entry: *frames* for details.

**SNA Commands**

These are the commands that the host system uses to control the LU. Normally, these commands and responses are supplied by IBM; however, it is possible for the user to affect some of these commands and responses; therefore, the commands and responses available to the user are described in detail in this text. The SNA commands supported by the 5251 Models 2 and 12 are:

| | |
|---|---|
| Actlu | Recfms |
| Bind | Reqms |
| Cancel | Reqtest |
| Dactlu | Rhshutd |
| Lustat | Signal |
| | Unbind |

**Note:** The headings *SNA Session Flow* and *Synchronization of 5250 Implementation of SNA* in Section 1 describe the session types and paths these commands take. They also describe typical usage of these commands. The following text describes the individual SNA commands and responses and details the bit meanings of the commands and responses that the user can affect.

*Actlu (Activate Logical Unit)*

This command is sent by the host system to the controller on the SS-LU flow; it synchronizes the flow of system request data. When the host system receives acknowledgement of the Actlu by the 5251 Model 2 or 12 controller, an SS-LU session is said to be established.

This is the format of the Actlu command:

| Byte | Hex Code | Meaning |
|---|---|---|
| 0 | 0D | Request code |
| 1 | 01 | Cold activation |
| | 02 | ERP activation |
| 2 | 01 | FMP profile, TSP profile |

This is the format of the Actlu response:

| Byte | Bit | Code (X=Hex; B=Binary) | Meaning |
|---|---|---|---|
| 0 | | X'0D' | Response code |
| 1 | | X'01' | Cold activation |
| 2 | | X'01' | FMP, TSP |
| 3 | | X'00' | |
| 4 | | X'84' | Maximum SS RU=128 bytes. |
| 5 | 0-1 | B'10' | RUs allowed on SS flow (keyboard/ display). |
| | | B'00' | RUs not allowed on SS flow (printer). |
| | 2 | B'0' | LU is able to process RUs. |
| | | B'1' | LU is unable to process RUs, including Bind. **Note:** Lustat is sent informing the SS if the LU changes its available state. (See *Lustat* in this topic.) |
| | 3-7 | B'00000' | |
| 6 | | X'00' | |
| 7 | | X'00' | |

**Note:** When the LU becomes available, the controller issues a Lustat command on the SS flow.

The controller sends a negative response (-rsp) to the host system if the Actlu type is not supported. See the index entry: *negative responses* in this section for details.

*Bind*

The Bind request is sent by the host system to the controller on the LU-LU flow. It establishes an LU-to-LU session between the host system and the requested work station (LU). The 5251 Model 2 or 12 controller never sends a Bind request. The controller returns either a positive or negative Bind response in answer to a Bind request from the host system; the controller returns a negative response when there is an invalid Bind parameter or invalid Bind type, or when the LU is already in session.

If the Bind that the host system sends the controller is supported (a negotiable Bind), the controller sends the parameters that it wants the host system to use in the session. The 5251 Model 2 or 12 controller does not check the length of a Bind request. It checks only bytes 0, 1, 8, 9, and 10. The Bind request consists of 29 bytes of RU. The meanings of the bytes and bits that are checked by the controller are given in the following table.

**Bind Request Contents**

| Byte | Bits | Description | Code (X=Hex; B=Binary) |
|---|---|---|---|
| 0 | 0-7 | Request code | X'31' |
| 1 | 0-7 | Format | X'00' supported; -rsp if not supported. See the index entry: *negative response* |
| 8 | | Pacing from controller to host system | |
| | 0 | Stage of pacing from controller to host system | B'0'=1-stage pacing. B'1'=2-stage pacing. |
| | 1 | | B'0' |
| | 2-7 | Pacing count to be used when the controller is sending to the host system | B'_____' |
| 9 | 0-1 | | B'00' |
| | 2-7 | Pacing count to be used when the host system is sending to the controller (see *Notes*) | B'_____' |
| 10 | 0-7 | Maximum RU size for RUs sent from the controller to the host system | Must be ≥X'85' or -rsp is returned. See the index entry: *negative responses.* |

**Notes:**

1. If byte 9 contains either 1 or 2, the 5251 Model 2 or 12 uses the count supplied in the Bind request. If it is any other value, the 5251 sets the pacing count to 3 when received for the printer.
2. If bits 2-7 of byte 9 are not 0 for the displays, the controller sends a negative response (indicating invalid session parameters) because the display LUs do not allow pacing of received RUs.

When the controller receives the Bind request from the host system, it issues a Bind response. The host system should check the Bind response to verify that it is compatible with the request or that it can support any changed parameters.

The Bind response depends on the type of LU being requested. The printer issues one kind of response and the display another; these are detailed in the following text.

**Bind Response for Printer (LU Type 04)**

| Byte | Bits | Description | Code (X=Hex; B=Binary) | Notes |
|---|---|---|---|---|
| 0 | 0-7 | Code | X'31' | |
| 1 | 0-3 | Format | X'0' | |
| | 4-7 | Type | X'0' | Negotiable. |
| 2 | 0-7 | FMP | X'07' | FM profile 7. |
| 3 | 0-7 | TSP | X'07' | TS profile 7. |
| 4 | | *FM usage* | | Host system's send protocols. |
| | 0 | Chaining use | B'1' | Multiple RUs can be used. |
| | 1 | RQ mode | B'1' | Delayed RQ may be used. |
| | 2-3 | Chain response | B'11' | RQE or RQD. |
| | 4-5 | Reserved | B'00' | |
| | 6 | Compression | B'0' | No compression. |
| | 7 | Send end bracket (EB) | B'0' | Bind response receiver will not send end brackets (EB). |
| 5 | | *FM usage* | | Bind response sender's send protocols. |
| | 0 | Chaining use | B'1' | Multiple RU chains can be sent. |
| | 1 | RQ mode | B'0' | Immediate request mode. |
| | 2-3 | Chain response | B'11' | RQE or RQD. |
| | 4-5 | Reserved | B'00' | |
| | 6 | Compression | B'0' | No compression. |
| | 7 | Send EB | B'0' | Bind response sender will not send EB. |
| 6 | | *FM usage* | | Common usage. |
| | 0 | Reserved | B'0' | |
| | 1 | FM headers | B'0' | Not supported. |
| | 2 | Brackets | B'0' | Reset in bracket state. |
| | 3 | Bracket term rule | B'1' | Rule 1 termination. |
| | 4 | Code set | B'0' | No alternate code supported. |
| | | | B'1' | Alternate code supported. |
| | 5-7 | Reserved | B'000' | |

**Bind Response for Printer (LU Type 04) (continued)**

| Byte | Bits | Description | Code (X=Hex; B=Binary) | Notes |
|---|---|---|---|---|
| 7 | | *FM usage* | | Common usage. |
| | 0-1 | FM transaction mode | B'10' | HDX-FF. |
| | 2 | Recovery responsibility | B'0' | Host system responsible for ERP. |
| | 3 | Contention winner/loser | B'0' | Bind response sender is contention winner. |
| | 4-6 | Reserved | B'000' | |
| | 7 | HDX-FF reset states | B'1' | Bind sender reset to send. |
| 8 | | *TS usage fields* | | |
| | 0 | Staging indicator for 5251 Model 2 or 12 to host system direction | B'__' | Echoed from Bind request. |
| | 1 | Reserved | B'0' | |
| | 2-7 | Bind request/ receivers send pacing count | B'-----' | Echoed from Bind request. |
| 9 | 0-1 | Reserved | B'00' | |
| | 2-7 | Bind request receivers receive pacing count | B'000011' | (Unless sent by the host system as a 1 or 2.) |
| 10 | 0-7 | Maximum RU sent by Bind request receiver | X'85' | Inbound 256 bytes maximum. |
| 11 | 0-7 | Maximum RU sent by Bind sender | X'85' | Outbound 256 bytes maximum. |
| 12 | 0 | Staging indicator Bind RQ sender-receiver direction | B'__' | Echoed from Bind request. |
| | 1 | Reserved | B'0' | |
| | 2-7 | Bind RQ sender: send pacing count | B'000011' | |
| 13 | 0-1 | Reserved | B'00' | |
| | 2-7 | Bind RQ sender: receive pacing count | B'_____' | Echoed from Bind request. |

**Bind Response for Printer (LU Type 04) (continued)**

| Byte | Bits | Description | Code (X=Hex; B=Binary) | Notes |
|---|---|---|---|---|
| 14 | 0 | PS usage format | B'0' | Basic format. |
| | 1-7 | LU type | B'0000100' | LU type 04. |
| 15-18 | | *Bind sender's send capability* | | |
| 15 | | *Printer data stream profile* | | |
| | 0 | Base displacement | B'1' | Base disp supported. |
| | 1 | GSD subset | B'1' | GSD subset supported. |
| | 2-7 | | B'000000' | Not supported. |
| 16 | 0-7 | Additional media | X'00' | No additional media. |
| 17 | | Console | | |
| | 0-3 | Console definition | B'0000' | No console. |
| | 4-7 | Reserved | B'0000' | |
| 18 | | *FM/FMH usage field* | | |
| | 0 | SS FM data | B'0' | Not supported. |
| | 1-7 | FM header bits | B'0000000' | No FM headers. |
| 19-22 | 0-7 | Bind receiver's send capability | X'00' | No send capability. |
| 23 | | *Code selection repertoire* | | |
| | 0-3 | | B'1000' | EBCDIC if no alternate code |
| | 4-7 | | B'0000' | No alternate code. |
| 24 | 0-7 | General | X'00' | Attended mode assumed. |
| 25 | 0-7 | NCI characteristics | X'00' | No NCI supported. |
| 26-Q | | These are not returned and therefore are implied X'00'. | | |

**Bind Response for Display (LU Type 07)**

| Byte | Bits | Description | Code (X=Hex; B=Binary) | Notes |
|---|---|---|---|---|
| 0 | 0-7 | Code | X'31' | |
| 1 | 0-3 | Format | X'0' | |
| | 4-7 | Type | X'0' | Negotiable. |
| 2 | 0-7 | FMP | X'07' | FM Profile 7. |
| 3 | 0-7 | TSP | X'07' | TS Profile 7. |
| 4 | | *FM usage* | | Host system's send protocols. |
| | 0 | Chaining use | B'1' | Multiple RUs can be sent. |
| | 1 | RQ Mode | B'0' | Delayed RQ may not be sent. |
| | 2-3 | Chain Response | B'11' | RQE or RQD. |
| | 4-5 | Reserved | B'00' | |
| | 6 | Compression | B'0' | No compression. |
| | 7 | Send end brackets (EB) | B'0' | Bind response receiver cannot end bracket. |
| 5 | | *FM usage* | | Bind response sender's send protocols. |
| | 0 | Chaining use | B'1' | Multiple chains can be sent. |
| | 1 | RQ mode | B'0' | Immediate request mode. |
| | 2-3 | Chain rsp | B'11' | RQE or RQD. |
| | 4-5 | Reserved | B'00' | |
| | 6 | Compression | B'0' | No compression. |
| | 7 | Send end brackets (EB) | B'0' | Bind response sender will not send end brackets. |
| 6 | | *FM usage* | | Common. |
| | 0 | Reserved | B'0' | |
| | 1 | FM headers | B'0' | Not supported. |
| | 2 | Brackets | B'0' | Reset in bracket state. |
| | 3 | Bracket term rule | B'1' | Rule 1 termination. |
| | 4 | Code set | B'0' | No alternate code supported. |
| | | | B'1' | Alternate code supported. |
| | 5-7 | Reserved | B'000' | |

**Bind Response for Display (LU Type 07) (continued)**

| Byte | Bits | Description | Code (X=Hex; B=Binary) | Notes |
|---|---|---|---|---|
| 7 | | *FM usage* | | Common. |
| | 0-1 | FM transaction mode | B'10' | HDX-FF. |
| | 2 | Recovery responsibility | B'0' | Host system responsible for ERP. |
| | 3 | Contention winner/loser | B'0' | Bind response sender is contention winner. |
| | 4-6 | Reserved | B'000' | |
| | 7 | HDX-FF reset states | B'1' | Bind sender reset to send. |
| 8 | | *TS usage fields* | | |
| | 0 | Staging indicator for work station/controller to host system direction | B'__' | Echoed from Bind request. |
| | 1 | Reserved | B'0' | |
| | 2-7 | Bind request receiver's send pacing count | B'__________' | Echoed from Bind request. |
| 9 | 0-1 | Reserved | B'00' | |
| | 2-7 | Bind request receiver: receive pacing count | B'000000' | No pacing supported on display. |
| 10 | 0-7 | Maximum RU sent by Bind request receiver | X'85' | Inbound 256 bytes maximum. |
| 11 | 0-7 | Maximum RU sent by Bind sender | X'85' | Outbound 256 bytes maximum. |
| 12 | 0 | Staging indicator Bind RQ sender-receiver direction | B'__' | Echoed from Bind request. |
| | 1 | Reserved | B'0' | |
| | 2-7 | Bind request sender's send pacing count | B'000000' | |

**Bind Response for Display (LU Type 07) (continued)**

| Byte | Bits | Description | Code (X=Hex; B=Binary) | Notes |
|---|---|---|---|---|
| 13 | 0-1 | Reserved | B'00' | |
| | 2-7 | Bind request sender's receive pacing count | B'_____' | Echoed from Bind request. |
| 14 | 0 | PS usage format | B'0' | |
| | 1-7 | LU type | B'0000111' | LU type 07. |
| 15-23 | | Reserved | X'00' | |
| 24 | | *Screen Size* | | |
| | 0 | Reserved | B'0' | |
| | 1-7 | 24x80 | B'0000010' | 1920-character display with 24 rows. |
| | | 12x80 | B'0000011' | 960-character display with 12 rows. |
| 25 | | Reserved | X'00' | |
| 26-Q | | These are not returned; therefore, they have the implied value X'00'. | | |

**Notes:** The following describes TSP and FMP, as referred to in the Bind command and responses and as implemented by the 5251 Model 2 or 12 controller:

1. *TSP (Transmission Service Profile)*
   The 5251 supports TSP-7, which has these characteristics:
   a. Allows bidirectional pacing on the normal flow.
   b. Does not allow SDT, CLEAR, RQR, and STSN.
   c. Allows for the specification of the maximum RU size for FM data in the TS usage field in the Bind request.

2. *FMP-7 (Function Management Profiles):*
   a. Allows multiple RU chains.
   b. Uses HDX-FF FM transaction mode.
   c. Supports these DFC functions: Cancel, Lustat, Rshutd, and Signal.
   d. Allows these optional FM usage fields to be selected via the Bind parameters: FM headers usage, contention resolution, alternate code setting, compression indicator, request mode, ERP mode, send EB, contention winner/loser.
   e. Uses the immediate response mode.
   f. Allows chains from both half sessions to ask for either RQE or RQD. RQE chains must carry CD.
   g. Allows Bind sender to be in send state following session activation.
   h. Bracket reset state is INB.

*Cancel*

The 5251 Model 2 or 12 controller sends this command to the host system when it is sending chains and it encounters an error that can affect the integrity of the data. The host system sends this command to the controller any time it wishes to prematurely terminate a chain; for example, the host system may send this to the controller in response to a negative response received from the controller. The effect of the command is the cessation of all RU chaining. The format of the command is hex 83. The positive response to an RQD request for this command is also hex 83.

When the host system issues the Cancel command to the printer, the controller purges the print buffers and issues a positive response.

See the heading, *Protocols and Synchronization for 5250 Implementation of SNA* in Section 1 and index entry: *negative responses* for additional details.

*Dactlu (De-activate Logical Unit)*

This command is sent by the host system to the controller in the 5251 and to the printer on the SS-LU flow. It terminates the SS-to-LU or LU-LU session when received by the 5251 Model 2 or 12 controller.

The code is:

Command byte request code = hex 0E; response code hex 0E.

*Lustat (Logical Unit Status)*

This command is sent by the 5251 Model 2 or 12 controller to report (1) the correction of a previously reported unavailable status of a 5250 component (hex 0001 on the SS flow), or (2) that an unavailable condition for the LU has occurred (hex 0831 on the SS flow). In addition, Lustat is also sent by the 5256 when it receives CD in the LOC of an RU.

The second function of Lustat as listed here refers to an environment in which the addressed LU had initially sent an unavailable response to an Actlu from the host system because it was unavailable or had caused a negative response to an SS-LU write. When the LU becomes available, the controller sends a Lustat to the host system notifying it of the change of status of the LU. The command byte request code is hex 04.

The format for the controller's Lustat is:

| Hexadecimal Code | Meaning |
|---|---|
| 00020200 | There is no data to send (printer only). |
| 00010000 | LU was unavailable, but is available now. |
| 0000yyzz | No-op used to report error conditions. (See the legend below.) |

Legend:

yy = 01 This reports a parameter error found during a read operation.

zz = Error code for the error causing the Lustat.

03=resequencing error

02 This reports a parameter error found during the processing of a feature field.

zz = Error code for the error causing the Lustat.

86=feature requested not installed
87=self-check field greater than 33 bytes specified

88=self-check modulus specified but not supported

Any Lustat issued by the host system is unexpected; the controller will supply a positive response.

*Recfms (Record Formatted Maintenance Statistics)*

This command is concerned with the error log. Recfms can be either a solicited or an unsolicited command.

*Solicited Recfms:* When there is no overflow condition and the host system wants the error log, the host system sends the Reqms command to the controller. This requests the controller to immediately send the host system the error log. The controller immediately sends the error log contents via the Recfms command. (See the index entry: *error log*.)

*Unsolicited Recfms:* When an overflow condition exists, the controller immediately sends the Recfms command to the host system. It does this by prefixing the Recfms command to the error log data.

**Note:** Remember that the error log is cleared when either of these commands is used. If byte 7 of the Reqms command has *bit 0 = 0*, the error log is not cleared. If the host system does not have a buffer allocated to collect the contents of the error log, valuable information for diagnostic maintenance could be lost.

The format of the Recfms command is:

| Byte | Bit | Hex Code | Description |
|---|---|---|---|
| 0 | | 41 | Network services (physical services) |
| 1 | | 03 | Maintenance code |
| 2 | | 84 | Request code |
| 3-4 | | | Reserved |
| 5-6 | | | Set to 0 |
| 7 | | | |
| | 0 | | 0=log overflow<br>1=sent in reply to Reqms |
| | 1-7 | | B'0000100' |
| 8-13 | | | XID Data |
| 14 | | FF | Log segment |
| 15-255 | | | Error Statistics |

The response format consists of bytes 0-2 in this chart.

*Reqms (Request Maintenance Statistics)*

This command is concerned with error log.

The format of the Reqms command is:

| Byte | Hex Code | Description |
|---|---|---|
| 0 | 41 | Network services (physical services) |
| 1 | 03 | Maintenance services |
| 2 | 04 | Request code |
| 3-4 | | Reserved |
| 5-6 | | (Set to 0) |
| 7 | 84 | Reset log after sending it |
| | 04 | No reset log after sending it |

*Reqtest (Request Test Procedure)*

Whenever the operator keys the test request sequence (see the index entry: Test Request keys), the controller sends the following Reqtest command to the host system:

| Byte | Hex Code | Description |
|---|---|---|
| 0 | 01 | Network services |
| 1 | 03 | Maintenance services |
| 2 | 80 | Request code (Test) |
| 3 | 00 | Network name 1 |
| 4 | 00 | Network name 2 |
| 5 | 00 | Procedure name |
| 6 | 00 | Requester ID |
| 7 | 00 | Password |
| 8 | 00 | User field |

Normally, the host system sends back a test menu in response to this command. This menu allows the operator to determine which tests he wants to use. The Reqtest command is sent in the SS-LU flow as formatted, FM, nonexpedited data with RQD specified.

**Note:** The 5251 Model 2 or 12 controller does not support receiving this command from the host system.

*Rshutd (Request Shutdown)*

The 5251 Model 2 or 12 controller sends this command when it wants to terminate the LU-LU session because it has sensed a hardware error. This command is in the expedited data flow; it is followed by Lustat hex 08310000 to indicate that this LU is not available. The host system should respond to this command by sending an Unbind command. The error log contains explanatory information (see the index entry: *error log*). The user can access this information by using the Reqms command. See the index entry: *Reqms command*. The 5251 Model 2 or 12 controller does not support receiving an Rshutd command from the host system. The command code is hex C2.

*Signal*

The Signal command is an expedited means of alerting session partners of an occurrence or request that needs attention. Some examples of this are:

1. The receiving partner wishes to send data. The operator presses the Attn key and the controller issues a Signal command to the host system.

2. Intervention is required on the printer. For example, the printer has no forms left to print on. The controller sends the host system a Signal command.

3. The operator requires assistance, in an error state, so he presses the Help key. The controller sends the host system a Signal command.

4. The Message Waiting indicator needs to be turned on or off. The host system sends the controller a Signal command.

5. A previous condition that required intervention has been cleared. For example, forms have been loaded into the printer. The controller sends the host system a Signal command.

This is the format for the Signal command:

| Byte | Hex Code | Description |
|---|---|---|
| 0 | C9 | Command code |
| 1-4 | 00 01 00 01 | Request to send (Attn key pressed on the keyboard/display) |
| | 00 03 02 xx | Intervention required |

**5225 Printer:**

| xx | Description | Logged? |
|---|---|---|
| 00 | No response time-out | Yes |
| 01 | Transmit activity check | Yes |
| 03 | Receive parity check | Yes |
| 04 | Line parity check | Yes |
| 06 | Receive length check (wrong number of bytes, poll or read status) | Yes |
| 07 | Wrong station responded | Yes |
| 08 | Power on transition (in session) | Yes |
| 09 | Activate command failure | Yes |
| 11 | Control adapter | Yes |
| 20 | Command or device ID not valid | Yes |
| 21 | Undefined exception status | Yes |
| 22 | Input queue or storage overrun | Yes |
| 23 | Activate lost | Yes |
| 24 | Invalid activate | Yes |
| 25 | Undefined exception status | Yes |
| 26 | Graphic check | No |
| 28 | Invalid SCS control character | No |
| 29 | Invalid SCS parameter | No |
| 30 | Reserved | |
| 31 | Control and sense card | Yes |
| 32 | Actuator carrier servo card | Yes |
| 34 | Driver/servo card/motor | Yes |
| 35 | Overcurrent | Yes |
| 36 | Emitters | Yes |
| 37 | Reserved | |
| 38 | Actuator carrier speed | Yes |
| 39 | Undetermined | Yes |
| 40 | Reserved | |
| 41 | Control and sense card | Yes |
| 42 | Forms servo card | Yes |
| 43 | Driver/servo card/motor | Yes |
| 45 | Overcurrent | Yes |
| 46 | Emitters | Yes |
| 47 | Reserved | |
| 48 | Forms speed check | Yes |
| 49 | Undefined sense data | Yes |
| 50 | End of forms | No |
| 51 | Not ready | No |
| 80 | Reserved | |
| 81 | High voltage | Yes |
| 82 | Reserved | |
| 83 | DOT image generator | Yes |
| 84 | Wire latch card | Yes |
| 85 | Pedestal | Yes |
| 86 | Actuator group jumpers | Yes |
| 87 | Timers | Yes |
| 88 | Ribbon jam | Yes |
| 89 | Ribbon card | Yes |
| 90 | Even/odd status time-out | Yes |
| 91 | Hardware busy time-out | Yes |

**5256 Printer:**

| xx | Description | Logged? |
|---|---|---|
| 26 | Graphic error | No |
| 30 | Printer mechanism not ready | Yes |
| 31 | Wire check | Yes |
| 32 | Invalid status | Yes |
| 33 | Fast speed check | Yes |
| 34 | Emitter sequence check | Yes |
| 35 | No emitters | Yes |
| 36 | Overrun error | Yes |
| 37 | Forms stop | Yes |
| 38 | Forms position lost | Yes |
| 39 | No status byte after error flagged | Yes |
| 50 | End of forms | No |
| 51 | Printer not ready and not available | No |

| Hex Code | Description |
|---|---|
| 00 00 00 02 | Component now available (operator has cleared the error on the printer). |
| 00 00 00 01 | Signal operator (turns on the Message Waiting indicator and sounds the audible alarm). |
| 00 00 00 05 | Resets the Message Waiting indicator. |
| 00 02 yy yy | Signal help code<br><br>yyyy is four digits of packed decimal code indicating either (1) operator error or (2) information sent by a previous Write Error Code command. See index entry: *operator error codes*. |

*Unbind*

The host system sends this command to the 5251 Model 2 or 12 controller on the LU-LU flow; this command terminates the LU-LU session. The controller accepts and executes any valid Unbind command when the LU is in an LU-LU session. The result of this command is that all LU-LU session parameters and SNA states are reset. The controller sends the host system a positive response and hex 32 to indicate to the host system that the command execution is complete.

The format of the Unbind command is:

Byte 0=unbind code (hex 32)
Byte 1=status (See Note)

**Note:** Any status code is acceptable here.

**Transmission Commands**

The 5251 Model 2 or 12 controller implements the transmission protocol and command set to drive the attached LUs on the Cluster feature. These are transparent to the user; therefore, this text does not include details about transmission commands or responses.

## COMMON CARRIER SERVICES

There is a set of services provided in the domestic United States and another set provided in the world trade countries; these are as follows.

### Domestic Services

*Nonswitched Voice Grade Communication Lines*

These lines may operate at speeds up to and including 9600 bps using IBM or OEM supplied modems. This type of line is referred to as a 3002 channel or equivalent.

- IBM 1200, 2400, or 4800 bps modems; IBM 3863, 3864, 3865, and 3872 modems operate on a type 3002 basic channel. See Note.
- IBM 3874 (4800 bps) modems operate on a type 3002 channel with C-1 conditioning.
- IBM 3875 (7200) bps modems operate on a type 3002 channel with C-2 conditioning.
- OEM modems that are compatible with the 5251 Models 2 and 12 may operate at speeds up to 9600 bps on a 3002 channel with conditioning as required by the modem.

**Note:** In some cases, the IBM 3865 may require a type 3002 channel with D-1 conditioning for the Model 1 and D-2 conditioning for the Model 2. Check with your planning representative for details.

*Common Carrier Switched Telephone Network*

These lines may operate at speeds up to 4800 bps and may use IBM or OEM modems.

*AT&T's Private Line Data-Phone[1] Digital Service*

These operate at 2400, 4800, and 9600 bps and use an AT&T Channel Service or its equivalent.

**World Trade Common Carrier Services**

*Nonswitched Voice Grade Communication Lines*

These lines operate at speeds up to 9600 bps. However, most PTTs do not provide services equivalent to the 3002 channel with various types of conditioning as are available in the United States. The type of line used depends on the modem chosen and would be either a *Normal Quality Line* designated type M.1040 (for international service) or a *Special Quality Line* type M.102 (for international service type M.1020).

The selection of modems may be limited by PTT rules and regulations or by line types available.

*Common Carrier Switched Telephone Network*

These operate at speeds up to 4800 bps and use IBM, OEM, and PTT mandatory modems.

The selection of modems may be limited by PTT rules and regulations or by line types available.

## CONTROL CHARACTERS (CC)

This topic includes two types of control characters (CC): control characters for the display and control characters for the printer. The display control characters are used in some of the display LU-LU commands to allow the user to determine the characteristics of the display. The printer control characters, which are an SNA subset called SCS (standard character string), are in the printer output data stream; they allow the user to determine the format of the printed output. Although both are called control characters, they share no function and have no relationship.

[1]Trademark of AT & T.

### Display

The display CCs are always used as 2-byte (two CCs) fields. They appear in the Write-to-Display, Read MDT Fields, and Read Input Fields commands in the display's output data stream (see the index entry: *display commands*). These characters select the specific operations for the display station to perform. Byte 1 is always processed first. When the CCs are used with the Write-to-Display command, the first CC is processed immediately while the second CC is not processed until all the other information associated with the command has been processed. The following gives the format and bit information for these 2 bytes:

### First Byte

| Bits 0-2 | Reset Pending Aid Lock Keyboard | Clear Master MDT Reset MDT Flags in Nonbypass Fields | Clear Master MDT Reset MDT Flags in All Fields | Null Nonbypass Fields with MDT On | Null All Nonbypass Fields |
|---|---|---|---|---|---|
| 000 | | | | | |
| 001 | X | | | | |
| 010 | X | X | | | |
| 011 | X | | X | | |
| 100 | X | | | X | |
| 101 | X | X | | | X |
| 110 | X | X | | X | |
| 111 | X | | X | | X |

**Notes:**
1. Bits 3 through 7 are reserved and should be set to 0.
2. If there are no bypass fields with MDT flags on, then the master MDT will be cleared.

**Second Byte**

| Bit | Code | Meaning |
|---|---|---|
| | | |
| 0 | | Reserved. |
| 1 | | Reserved. |
| 2 | 0<br>1 | No action.<br>Reset blinking cursor (Note 1). |
| 3 | 0<br>1 | No action.<br>Set blinking cursor (Note 1). |
| 4 | 0<br>1 | No action.<br>Unlock the keyboard and reset any pending aid bytes (Note 2). |
| 5 | 0<br>1 | No action.<br>Sound alarm. |
| 6 | 0<br>1 | No action.<br>Set Message Waiting indicator off (Note 3). |
| 7 | 0<br>1 | No action.<br>Set Message Waiting indicator on (Note 3). |

**Notes:**

1. If bits 2 and 3 are both on, the cursor blinks.
2. If the keyboard is already unlocked, this is ignored; otherwise, it:
   a. Unlocks the keyboard.
   b. Turns the keyboard clicker on.
   c. Turns the Input Inhibit indicator off.
   d. Moves the cursor to the address given in the last IC order (see the index entry: *IC order*) or defaults to the first position of the first nonbypass input field if no IC order has been given. If there is no nonbypass field, it defaults to row 1, column 1.
   c. Clears all unserviced aid requests.
3. If bits 6 and 7 are both on, it sets the Message Waiting indicator on.

**Printer**

The SNA subset support for the 5225 and 5256 printers is accomplished through SCS (standard character string) control characters. The user codes these control characters in the printer output data stream. SCS control character codes (00-3F) not recognized by the printer, set invalid SCS control character status. See the index entry: *data streams*. The heading *Printer Data Stream Example* in Section 1 shows a sample printer data stream. The following chart describes the general functions provided by the printer control characters. A detailed description of each control character follows the chart.

| Function to Perform | SCS Control Character and Code | Description |
|---|---|---|
| Define the next print position | PP (34xxnn) | Identifies the next print position, either horizontal or vertical, as defined by xx. |
| Horizontal: Absolute | 34C0nn | Horizontally moves the print position to the position defined by nn. |
| Relative | 34C8nn | Horizontally moves the print position nn print positions away from the present print position. |
| Vertical: Absolute | 34C4nn | Vertically moves the paper to the line specified by nn. |
| Relative | 344Cnn | Vertically moves the paper nn lines from its present position. |
| Maximum print position: | Fmt (2Bxxnn____) | Defines either the maximum horizontal or vertical print position as specified by xx. |
| Horizontal | 2BC1nnhh | Sets the maximum horizontal print position where nn=the number of bytes in the string and hh=the maximum horizontal print position. |
| Vertical | 2BC2nnvv | Sets the maximum vertical print position where nn=the number of bytes in the string and vv=the maximum vertical print position. |
| Define the unprintable character: | SGEA (2BC8nngguu) | Sets the unprintable character option and defines the default character where nn=the number of bytes in the string, gg=the default graphic, and uu=the print option. See SGEA in this topic. |

| Function to Perform | SCS Control Character and Code | Description |
|---|---|---|
| Move the paper: | NL (15) | Logically moves the print position to the first position of of the next line. |
| | IRS (1E) | Same as NL. |
| | LF (25) | Logically moves the print position vertically to the same horizontal print position of the next line. |
| | FF (0C) | Moves the print position to the first print position of the next logical page. |
| Move the print position: | CR (0D) | Logically moves the print position to the first position of the same line. |
| No operation: | NUL (00) | No-op |
| Stop printing and alert operator: | BEL (2F) | Turns off the Ready indicator and turns on the Attn indicator, sounds the audible alarm (if installed), and stops printing. |
| Transparent (5225 only) | TRN (35nn) | Permits the codes normally used as control characters to be used as printable characters. The parameter frame nn specifies the number of frames that follows the 35 command frame. |
| Set Character Distance (5225 only) | SCD (2BD20429P1P2) | Sets the character density to 10 or 15 characters per inch as specified by the P1 and P2 parameter frames. |
| Set CGCS through Local ID (5225 only) | SCL (2BD10381P1) | Loads 1 of 16 graphic character sets specified in the P1 parameter frame. |
| Load Alternate Characters (5225 only) | LAC (2BFEnn01 EEI1I1e) | Allows user designed fonts or characters to be loaded for printing. |
| Set Line Density (5225 only) | SLD (2BC6nnLD) | Selects vertical line density of 6, 8, or 9 lines per inch or other densities in multiples of 1/72 of an inch. |

*BEL*

*Function:* This control character stops printing, sounds the audible alarm, if installed, and turns on the Attention indicator.

*Code:* Hex 2F

*Results:* When the printer microprocessor detects this control character, it:

1. Allows all preceding data to be printed and all preceding control characters to be executed
2. Turns the Ready indicator off
3. Turns the Attention indicator on
4. Sounds the audible alarm, if installed
5. Stops printing
6. Stops formatting
7. Returns an unavailable status to the controller

*CR (Carrier Return)*

*Function:* This control character performs a carrier return to the first print position on the same line.

*Code:* Hex 0D

*Results:* The horizontal print position logically moves to the the first print position on the same line. If it already is at the first print position, no operation occurs.

*FF (Forms Feed)*

*Function:* This control character moves the paper to the next logical page as specified by the Set Vertical Format control character (see *Fmt*) in this topic.

*Default:* 1 logical page = 1 logical line.

*Code:* Hex 0C

*Results:* The print position moves to the first logical print line and first logical print position of the next logical page.

*Fmt (Format)*

*Function:* This control character defines data formatting for a specified length (provided in the parameter).

*Default:* Logical line length = 132 character positions; logical page length = 1 line.

*Code and Format:*

| Code | Set Type | Associated Parameters |
|---|---|---|
| Hex 2B | Start of formatted data stream. Must include: SHF, SVF, or SGEA (See Note) | Length of formatted data stream. |

**Note:** The following chart shows the various set types and their associated parameters.

**Set Types Available for Use with the Format (Fmt) Printer Control Character**

| Set Type | Format | Values of Parameters | Description of Set Type |
|---|---|---|---|
| SHF (set Horizontal Format) | C1nnhh | nn= Number of bytes in the SHF string. | |
| | | hh= Maximum horizontal print position (greater than or equal to 1 and less than or equal to 132); the default is 132. If a 00 is sent, the printer substitutes its largest maximum print position, which is 132, for the 5256 and the 10 characters per inch density of the 5225, and substitutes 198 for the 15 characters per inch density of the 5225. | Sets the maximum print position (MPP), which is the value of the print line length. |
| SVF (Set Vertical Format) | C2nnvv | nn= Number of bytes in the SVF string. | |
| | | vv= Maximum number of lines on a page greater than or equal to 1 and less than or equal to 255). The default is a page length of one line. | Sets the maximum print line (MPL) on the logical page; it overrides the physical device logical page. |

| Set Type | Format | Values of Parameters | Description of Set Type |
|---|---|---|---|
| SGEA (Set Graphic Error Action) | C8nnggxx | nn= Number of bytes in the SGEA string. | |

| Input Hex Data Stream[2] | | | | 5256 Results | | |
|---|---|---|---|---|---|---|
| SGEA Code | SCS Count NN | Default Graphic GG | Unprintable Character Option UU | Default Graphic | Unprintable Character Option | Error Status |
| 2BC8 | 00 | – | – | Hyphen | 01 | • Invalid SCS parameter |
| 2BC8 | 01 | – | – | Hyphen | 01 | • |
| 2BC8 | 02 | GG | – | GG[1] | 01 | • |
| 2BC8 | 03 | GG | 00, 01, 02 | GG[1] | 01 | • |
| 2BC8 | 03 | GG | 03 or 04 | GG[1] | 03 | • |
| 2BC8 | 03 | GG | 05-FF | GG[1] | 01 | • Invalid SCS parameter |
| 2BC8 | 04 | GG | | Hyphen | 01 | • Invalid SCS parameter |

[1] If GG is unprintable, including characters in the EBCDIC control code quadrant, a hyphen (-) is printed.

[2] The first two characters (the first byte) in the hex data stream are control characters; if unspecified ones are used, an error code 28 results. The characters to the right of the control characters are control parameters; if unspecified ones are used, an error code 29 results.

gg= Unprintable character option. Sets the way the printer will respond when it encounters an unacceptable symbol in the data stream.
**Note:** On early production 5256 printers, options 02 and 04 will allow printing of the International Extension characters. See Figure 34 (Part 3).
**Note:** nn must be at least 1 and not greater than 3 for the SGEA set type.
01=No stop, no status.
02=Defaults to 01.
03=Stop, hard error status. Unit not available
04=Defaults to 03.
The default for xx is 01.

The following chart shows the characteristics of the SHF and SVF set types.

**Valid Values for the SHF and SVF Set Types**

| Set Type Code | Parameters | Results (MPL and MPP) | Error |
|---|---|---|---|
| SHF<br>2BC1nnhh | nn=00 | MPP=132 | Invalid SCS parameter |
| | nn=01 | MPP=132 | None |
| | nn=02<br>hh=00 | MPP=132<br>MPP=198* | None |
| | nn=02<br>hh=1-84 | MPP=1-132 as specified | None |
| | hh=85-C6 | MPP=133-198 as specified* | |
| | nn=02<br>hh=85-FF | MPP=132 | Invalid SCS parameter |
| | nn=03FF | MPP=132 Invalid SCS parameter | |
| SVF<br>2BCnnvv | nn=00 | MPL=1 | Invalid SCS parameter |
| | nn=01 | MPL=1 | None |
| | nn=02<br>vv=00 | MPL=1 | None |
| | nn=03-FF | MPL=1 | Invalid SCS parameter |

*A maximum print position of greater than 132 is only possible on the 5225 printer when a print density of 15 characters per inch has been set prior to the execution of this command.

*IRS (Interchange Record Separator)*

*Function:* This control character does the same thing that NL does.

*Code:* Hex 1E

*LF (Line Feed)*

*Function:* This control character moves the paper one line without altering the print position.

*Code:* Hex 25

*Results:* Moves the paper logically to the same print position on the following line. If you use this control character on the last line of a page, it will move the print position to the first line of the next page.

*NL (New Line)*

*Function:* This control character moves the paper to the next line.

*Code:* Hex 15

*Results:* The print position moves to the first print position on the next line if it is not coded on the last line of the page. If you code this on the last line, it moves the paper to the first print position on the first line of the next page.

*NUL*

*Function:* No-op

*Code:* Hex 00

*Results:* No characters are printed and no functions are performed.

*PP (Print Position)*

*Function:* This control character moves the logical print position as determined by the associated parameters.

*Restrictions:* The absolute parameters (see the following explanation) must be equal to or less than the page length. If the absolute horizontal parameter is less than the current print position, the printer microprocessor treats it as a separate line and inserts a CR control character in the printer data stream. If the absolute vertical parameter is less than the current line number, the microprocessor treats it as a new page. If both are equal, no operation is performed. Relative values must indicate a move to but not past the end of the line or page. A value of 0 is not valid, and no operation is performed.

*Code and Format:*

| Hex 34 | Function Parameter (Hex) (See Note 1) | Value Parameter (Decimal) (See Note 2) |
|---|---|---|

The results are determined by the parameters as described in the following notes.

**Notes:**

1. The following chart shows the types of moves available and indicates what the PP CC accomplishes for each type.

| Function | Function Parameter (Hex) | Value Parameter (Decimal) |
|---|---|---|
| Absolute horizontal move | C0 | Numeric value of horizontal position (less than or equal to the end of the line). |
| Absolute vertical move | C4 | Numeric value of vertical position (less than or equal to the end of page). |
| Relative horizontal move | C8 | Numeric value of horizontal movement from the present position (less than or equal to the end of the line). |
| Relative vertical move | 4C | Numeric value of vertical movement from the present position (less than or equal to the end of the page). |

2. **The following chart shows the relationships of the parameters.**

| Function | Value Parameter (nn) | Results |
|---|---|---|
| Absolute horizontal move (hex 34C0nn) | 00 | No-op; the current print position is unchanged; no error. |
| | 00<nn≤132 | The print position becomes the value of nn. |
| | nn>max PP | Error; invalid SCS parameter. |
| Absolute vertical move (hex 34C4nn) | 00 | No-op; the current print position is unchanged; no error. |
| | current PP ≤nn≤max PP | The print position becomes the value of nn and remains on the same logical page. |
| | 0<nn<current PP | The print position becomes the value of nn and goes to the next logical page. |
| | nn>max PP | Error; invalid SCS parameter. |
| Relative horizontal move (hex 34C8nn) | 00 | No-op; the current print position is unchanged; no error. |
| | nn+current PP ≤ max PP | The new print position is equal to the current print position plus the value of nn. |
| | nn+current PP >maxPP | Error; invalid SCS parameter. |
| Relative vertical move (hex 344Cnn) | 00 | No-op; the current print position is unchanged; no error. |
| | nn+current PP ≤max PP | The print position becomes the value of the current print position plus the value of nn. |
| | nn+current PP >max PP | Error; invalid SCS parameter. |
| Set Horizontal Format 2B(C1nnhh) | (nn)<br>01, 02 | Total number of frames following the command (including the count frame) is defined. |
| | (hh)<br>hh=max PP<br>Hex 01≤hh≤hex C6 | The maximum print position is set at a value between 1 and 198. |
| | 00 | No-op, the default value of hex 84 (132) is supplied. |
| | hh>C6 | Error; invalid SCS parameter. |
| Set Vertical Format 2B(C2nnvv) | (nn) | Number of frames to end of SVF string (including the count frame) is defined. |
| | (vv) 1≤vv≤255 | Sets the value of the maximum number of print lines per page. |
| | 00 | The function retains the default value of one line. |

| Function | Value Parameter (nn) | Results |
|---|---|---|
| Set Graphic Error Action<br>2B(C8nnggxx) | (nn)<br>01, 02, 03 | Number of frames to the end of the SGEA string (including the count frame) is defined. |
| | (gg) | Substitutes a desginated graphic character for any unprintable characters encountered. If the graphic character selected is also unprintable or if no character is designated, the default character is a hyphen (-). |
| | (uu)<br>If SGEA has not been sent, the default is:<br>Hex 01 (no stop, no status)<br>Hyphen in place of any unprintable character | Determines error and status action resulting from an unprintable character as follows:<br>Hex 01 = no stop, no status<br>Hex 00 = default to hex 01<br>Hex 02 = default to hex 01<br>Hex 03 = stop, hard error status<br>Hex 04 = default to hex 03 |
| Transparent[1] (35nn) | | Permits codes normally used as control characters to be used as printable characters. |
| | (nn)<br>$01 \leq nn \leq 255$ | Number of frames of transparent data to follow (not including count frame) is defined. |
| | 00 | No-op; following data is treated as normal data. |
| | Use of the codes hex 00 through hex 3F requires that print images for those values have been loaded into the 5225 print buffers by the using system. If no image was loaded for a given code, the 5225 inserts a blank. | |
| Set Character Distance[1]<br>2B(D20429P1P2) | | Defines the number of characters per inch to be printed. |
| | (on) | |
| | P2 = 0A (10 cpi)<br>0F (15 cpi)<br>00 (no-op)<br>FF (default to 10 cpi)<br>P2 = 0A, 0F, 00, or FF | Error; invalid SCS parameter. |
| Set CGSC through Local ID[1]<br>2B(D10381P1) | (P1)<br>P1 = FF or $00 \leq p1 \leq 0F$ | Selects 1 of 16 predetermined character sets used to print data. These character sets are designated by a code (P1). FF sets printer to default (jumper setting) character set. |
| Load Alternate Character(s)<br>(2BFEnn01EEI1I18*) | (nn) = 10x<br>$nn \leq 250$<br>EE = code point where character is to be placed<br>I1 through I18 = 9 bytes making up the character | Allows loading of from 1 to 25 character images into the alternate character buffer. |
| Set Line Density<br>(2BC6nnLD) | nn = count byte<br>LD = number of 1/72 inch forms movement per line | Allows 6, 8, or 9 lines per inch |

[1]Applies to the 5225 Printer only.

## COPY TO PRINTER FEATURE

This feature allows the user to print the contents of the display using any printer that is attached via a cluster feature. When the feature is installed, the host system sends the Copy to Printer command to the controller in the following format:

| | | | | |
|---|---|---|---|---|
| ESC Character Hex 04 | Copy to Printer Command Hex 16 | Printer LSID (See the index entry: *addresses*.) | Maximum Number of Lines on Page (See Note) | SNA Chain End |

**Note:** The default for this is the same number of print lines per page as there are lines in a display. If 00 is specified, the default is to the display size.

The Copy to Printer command must be LOC on the RU, or followed by null RUs.

The operator should ensure that the printer is positioned at the first print position on a new page when he issues this command. The format of the data stream as it is created and sent by the controller to the printer is the printer control character with the horizontal control set to the display line length and the vertical controls set to the maximum print line. (See the index entry: *control characters, printer* for specific details about the types of characters that control these formats.)

The results of using the Copy to Printer feature are:

- All nondisplay fields are printed as blanks.
- All null characters are printed as blanks.
- All screen attributes are printed as blanks.
- All dup characters are printed as an overstruck asterisk (*).
- Blank lines on the display are translated to new lines at the printer.
- A form feed control CC is appended to the end of the data stream to position the printer at the top of the next page.

The terminal returns a positive response when it completes this command. The operator can cancel this command from either the keyboard or the printer. To cancel the operation from the keyboard, the operator first presses a shift key and then the Print key. This terminates the operation without alerting the host system that an abnormal termination has occurred (normal +rsp). To terminate the operation from the printer, the operator sets the Status switch to the Cancel position. The controller then sends a negative response to the host system, indicating that an abnormal termination has occurred. The following conditions result in the terminal responding to the command with a negative response:

- Another command is outstanding for the printer.
- The printer is involved in an LU-LU session.
- There is an error condition.
- Status switch set to Cancel on the printer.
- An incorrect LSID has been specified.
- An RU error exists.
- A Bind command has been issued to the printer.
- Intervention required condition of printer.

**Note:** See the index entry: *negative responses.*

## DATA STREAMS

The data streams consist of all the information required by the controller to drive the attached devices (LUs) and of all the response information furnished by the LUs and sent to the host system by the controller. The 5250 device data streams reside in the SNA RUs, which are embedded in the I part of the SDLC I frames. See the index entries: *frames* and *RU* for details about these subjects. If you are not familiar with SNA, please read the information under the headings *Protocols and Synchronization for 5250 Implementation of SNA* in Section 1 of this manual.

### Display

The display data stream is on the normal FMD LU-LU flow in SNA RUs; it contains commands, data, orders, and parameters that the host system uses to control the display and data and status information that the controller sends the host system in response to the host system's requests. See the index entries: *display, commands* and *orders*. The general format of the output display data stream is:

| | | |
|---|---|---|
| ESC Command<br>Hex 04 | Associated<br>Parameter | ESC or<br>SNA Chain End |

The general format of the data stream that the controller sends to the host system for the display is:

| | | |
|---|---|---|
| Cursor Address<br>(2 bytes) | Aid Code | Field Data |

**Note:** See the index entries: *aid codes* and *input commands* for detailed descriptions of these.

### Printer

The data stream for the printer contains a mixture of output data for the printer to print and control characters that direct the printer to format the data as the user has specified. See the index entry: *control characters, printer* for details about these topics. The printer data stream comes in the normal FMD LU-LU flow path in SNA RUs. The format for the printer data stream looks like this:

| | | | | | |
|---|---|---|---|---|---|
| CC | Data | CC | Data | CC | Data |

The host system writes information to the printer by issuing the printer data stream. There are no printer commands. The Copy to Printer feature is executed by issuing a command to the display. See the index entry: *Copy to Printer feature* for details.

## DIGITAL DATA SERVICE ADAPTER

This special feature allows the controller to attach to the AT&T's Private Line Data-Phone[1] Digital Service (or equivalent) through the use of an AT&T Channel Service Unit (or equivalent). The data rates are 9600, 4800, and 2400 bps.

## DISPLAY SCREEN FILTER

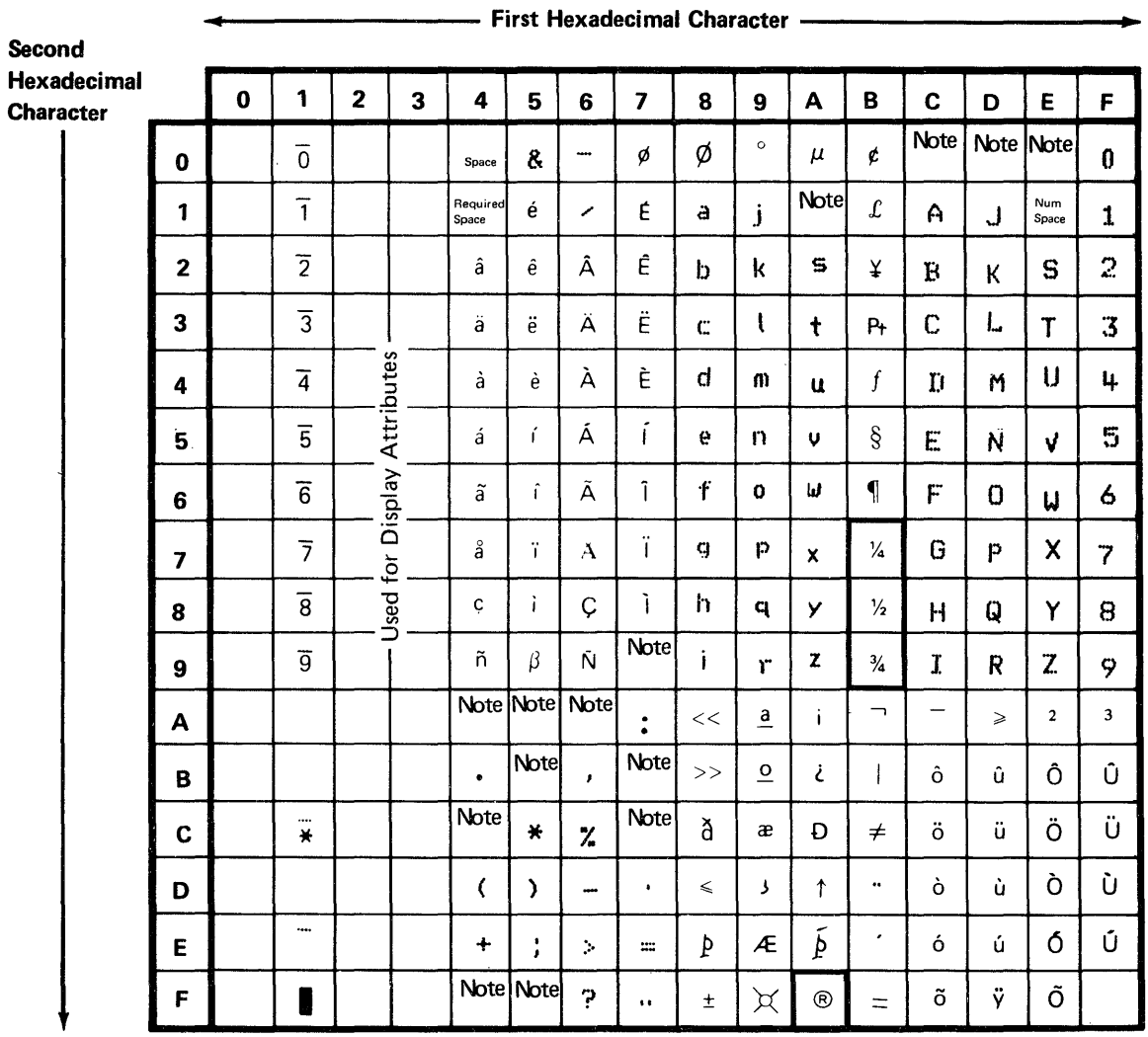
A display screen filter is available for the 5251 Models 1, 11, 2 and 12. It is designed to reduce glare and sharpen contrast. It should not be used on displays equipped with the Selector Light Pen feature, because it increases the failure rate of the pen's selector tip switch.

[1]Trademark of AT & T.

## EBCDIC CHARACTER SETS

### 5250 Character Sets

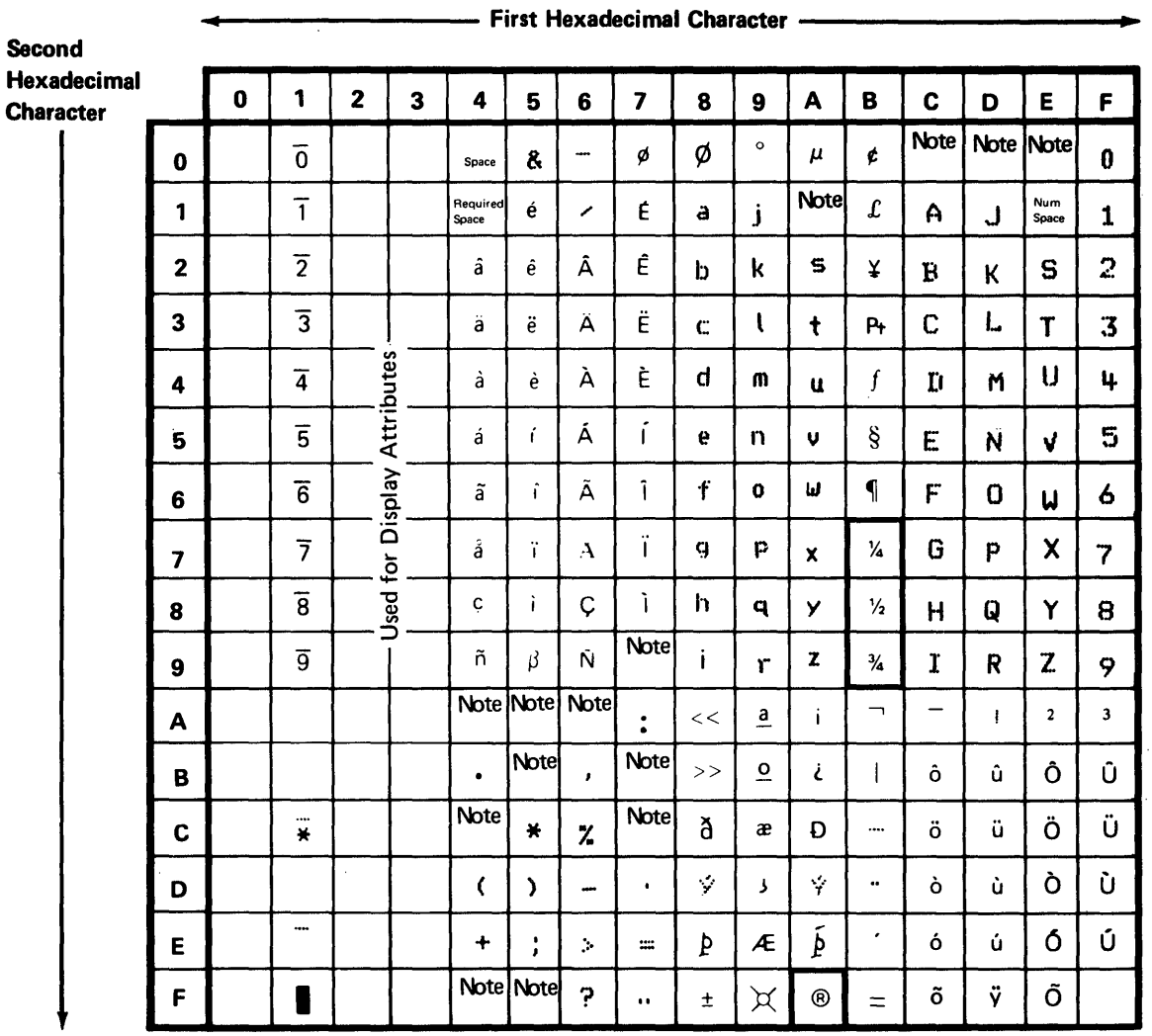
The following chart applies to current shipments of the IBM 5251 Models 1, 2, 11, and 12 Display Stations and the IBM 5252 Dual Display Station. Characters that have a heavy line surrounding them are unprintable characters and will be represented as specified by the Set Graphic Error Action control character or, if unspecified, as a hyphen. See part 3 of Figure 34 for country dependent characters. See part 5 of Figure 34 for the Katakana character set. For information about the Multinational Character Set feature, see *Multinational Character Set* in this section.




| Second Hexadecimal Character | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | 0 | | | Space | & | — | ø | Ø | ° | μ | ¢ | Note | Note | Note | 0 |
| 1 | | 1 | | | Required Space | é | / | É | a | j | Note | £ | A | J | Num Space | 1 |
| 2 | | 2 | | | â | ê | Â | Ê | b | k | s | ¥ | B | K | S | 2 |
| 3 | | 3 | | | ä | ë | Ä | Ë | c | l | t | Pt | C | L | T | 3 |
| 4 | | 4 | | | à | è | À | È | d | m | u | f | D | M | U | 4 |
| 5 | | 5 | | | á | í | Á | Í | e | n | v | § | E | N | V | 5 |
| 6 | | 6 | | | ã | î | Ã | Î | f | o | w | ¶ | F | O | W | 6 |
| 7 | | 7 | | | å | ï | A | Ï | g | p | x | ¼ | G | P | X | 7 |
| 8 | | 8 | | | ç | ì | Ç | Ì | h | q | y | ½ | H | Q | Y | 8 |
| 9 | | 9 | | | ñ | ß | Ñ | Note | i | r | z | ¾ | I | R | Z | 9 |
| A | | | | | Note | Note | Note | : | << | a | ¡ | ¬ | — | ≥ | 2 | 3 |
| B | | | | | . | Note | , | Note | >> | o | ¿ | \| | ô | û | Ô | Û |
| C | | * | | | Note | * | % | Note | ð | æ | Ð | ≠ | ö | ü | Ö | Ü |
| D | | | | | ( | ) | — | · | ≤ | ɔ | ↑ | " | ò | ù | Ò | Ù |
| E | | ¨ | | | + | ; | > | = | þ | Æ | Þ | ´ | ó | ú | Ó | Ú |
| F | | ■ | | | Note | Note | ? | .. | ± | ¤ | ® | = | õ | ÿ | Õ | |

**Figure 34 (Part 1 of 5). EBCDIC Character Sets (Multinational as Printed by 5256)**

**Note:** Use this chart with part 3 of Figure 34 for country dependent characters. When the Multinational Character Set feature is installed, the country dependent characters will be the same as shown for International/ASCII regardless of country.




| Second Hexadecimal Character | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | 0̄ | | | Space | & | — | ø | Ø | ° | μ | ¢ | Note | Note | Note | 0 |
| 1 | | 1̄ | | | Required Space | é | ´ | É | a | j | Note | £ | A | J | Num Space | 1 |
| 2 | | 2̄ | | | â | ê | Â | Ê | b | k | s | ¥ | B | K | S | 2 |
| 3 | | 3̄ | | | ä | ë | Ä | Ë | c | l | t | Pt | C | L | T | 3 |
| 4 | | 4̄ | | | à | è | À | È | d | m | u | f | D | M | U | 4 |
| 5 | | 5̄ | | | á | í | Á | Í | e | n | v | § | E | N | V | 5 |
| 6 | | 6̄ | | | ã | î | Ã | Î | f | o | w | ¶ | F | O | W | 6 |
| 7 | | 7̄ | | | å | ï | A | Ï | g | p | x | ¼ | G | P | X | 7 |
| 8 | | 8̄ | | | ç | ì | Ç | Ì | h | q | y | ½ | H | Q | Y | 8 |
| 9 | | 9̄ | | | ñ | ß | Ñ | Note | i | r | z | ¾ | I | R | Z | 9 |
| A | | | | | Note | Note | Note | : | << | a | ¡ | ¬ | — | ! | 2 | 3 |
| B | | | | | • | Note | , | Note | >> | o | ¿ | \| | ô | û | Ô | Û |
| C | | ¨ | | | Note | * | % | Note | ð | æ | Ð | ··· | ö | ü | Ö | Ü |
| D | | | | | ( | ) | _ | · | ý | ý | ý | ¨ | ò | ù | Ò | Ù |
| E | | ··· | | | + | ; | > | = | þ | Æ | þ | ´ | ó | ú | Ó | Ú |
| F | | ■ | | | Note | Note | ? | .. | ± | ¤ | ® | = | õ | ÿ | Õ | |

**Figure 34 (Part 2 of 5). EBCDIC Character Sets (Multinational as Printed by 5225)**

| Country/ Language Group | Hexadecimal Characters | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4A | 4C | 4F | 5A | 5B | 5F | 6A | 79 | 7B | 7C | A1 | C0 | D0 | E0 |
| U.S. and Canada | ¢ | < | \| | ! | $ | ¬ | ¦ | ` | # | @ | ~ | { | } | \ |
| International | [ | < | ! | ] | $ | ^ | ¦ | ` | # | @ | ~ | { | } | \ |
| Austria/Germany | Ä | < | ! | Ü | $ | ^ | ö | ` | # | § | β | ä | ü | Ö |
| Belgium | [ | < | ! | ] | $ | ^ | ù | ` | # | à | ¨ | é | è | ç |
| Brazil | É | < | ! | $ | Ç | ^ | ç | ã | Õ | Ã | ~ | õ | é | \ |
| Canada (French) | à | < | ! | ' | $ | ^ | ù | ` | # | @ | ¨ | é | è | ъ |
| Denmark/Norway | # | < | ! | ¤ | Å | ^ | ø | ` | ₧ | Ø | ü | æ | å | \ |
| Finland/Sweden | § | < | ! | ¤ | Å | ^ | ö | é | Ä | Ö | ü | ä | å | É |
| France | ° | < | ! | § | $ | ^ | ù | ` | £ | à | ¨ | é | è | ç |
| Italy | ° | < | ! | é | $ | ^ | ò | ù | £ | § | ì | à | è | ç |
| Japan (English) | £ | < | \| | ! | ¥ | ¬ | ¦ | ` | # | @ | — | { | } | $ |
| Portugal | [ | Ç | ! | ] | $ | ^ | õ | ` | Ã | Õ | ç | ã | ' | Ç |
| Spain | [ | < | \| | ] | ₧ | ¬ | ñ | ` | Ñ | @ | ¨ | { | } | \ |
| Spanish-Speaking | [ | < | \| | ] | $ | ¬ | ñ | ` | Ñ | @ | ¨ | { | } | \ |
| United Kingdom | $ | < | \| | ! | £ | ¬ | ¦ | ` | # | @ | — | { | } | \ |

**Figure 34 (Part 3 of 5). EBCDIC Character Sets (Differences Between Countries)**

Characters that have a heavy line surrounding them (International Extension) are printable only on early production 5256 printers when options 02 or 04 of the Set Graphic Error Action have been set.

The Set Graphic Error Action control character can be set to do one of the following when an unprintable character is encountered:

01: Continue printing (character set: 96 character EBCDIC) without an error; a default character will be substituted for any unprintable characters.

02: Continue printing (character set: 96 character EBCDIC plus International Extension) without an error; a default character will be substituted for any printable characters.

03: Finish printing the line (character set: 96 character EBCDIC) supplying a default character for the unprintable character(s), and post an error.

04: Finish printing the current line (character set: 96 character EBCDIC plus International Extension) supplying a default character for the unprintable character(s), and post an error.

First Hexadecimal Character →

Second Hexadecimal Character ↓

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | Sp | & | - | ø | | | | 0 | Note 1 | Note 1 | Note 1 | 0 |
| 1 | | | | | | é | ´ | É | a | j | Note 1 | 1 | A | J | | 1 |
| 2 | | | | | â | ê | Â | Ê | b | k | s | 2 | B | K | S | 2 |
| 3 | | | | | ä | ë | Ä | Ë | c | l | t | 3 | C | L | T | 3 |
| 4 | | | | | à | è | À | È | d | m | u | 4 | D | M | U | 4 |
| 5 | | | | | á | í | Á | Í | e | n | v | 5 | E | N | V | 5 |
| 6 | | | | | ã | î | Ã | Î | f | o | w | 6 | F | O | W | 6 |
| 7 | | | | | å | ï | Å | Ï | g | p | x | 7 | G | P | X | 7 |
| 8 | | | | | ç | ì | Ç | Ì | h | q | y | 8 | H | Q | Y | 8 |
| 9 | | | | | ñ | ß | Ñ | Note 1 | i | r | z | 9 | I | R | Z | 9 |
| A | | | | | Note 1 | Note 1 | Note 1 | : | | | | | | | | |
| B | | | | | . | Note 1 | , | Note 1 | | | | | ô | û | Ô | Û |
| C | | ¨ * | | | Note 1 | * | % | Note 1 | | æ | | | ö | ü | Ö | Ü |
| D | | | | | ( | ) | _ | ' | | | | | ò | ù | Ò | Ù |
| E | | | | | + | ; | > | = | | Æ | | | ó | ú | Ó | Ú |
| F | | | | | Note 1 | Note 1 | ? | .. | | ▮ | | | õ | ÿ | Õ | |

**Notes:**
1. Variable; see Part 3 for the specific characters.
2. See Part 4 for the Katakana character set.

**Figure 34 (Part 4 of 5). EBCDIC Character Sets (96 Character EBCDIC plus International Extension)**

### Katakana Character Set

In the following chart, the character that has a heavy line surrounding it is not printable and cannot be entered from the keyboard, but will be displayed if the corresponding hexadecimal code is received as data from the host system.

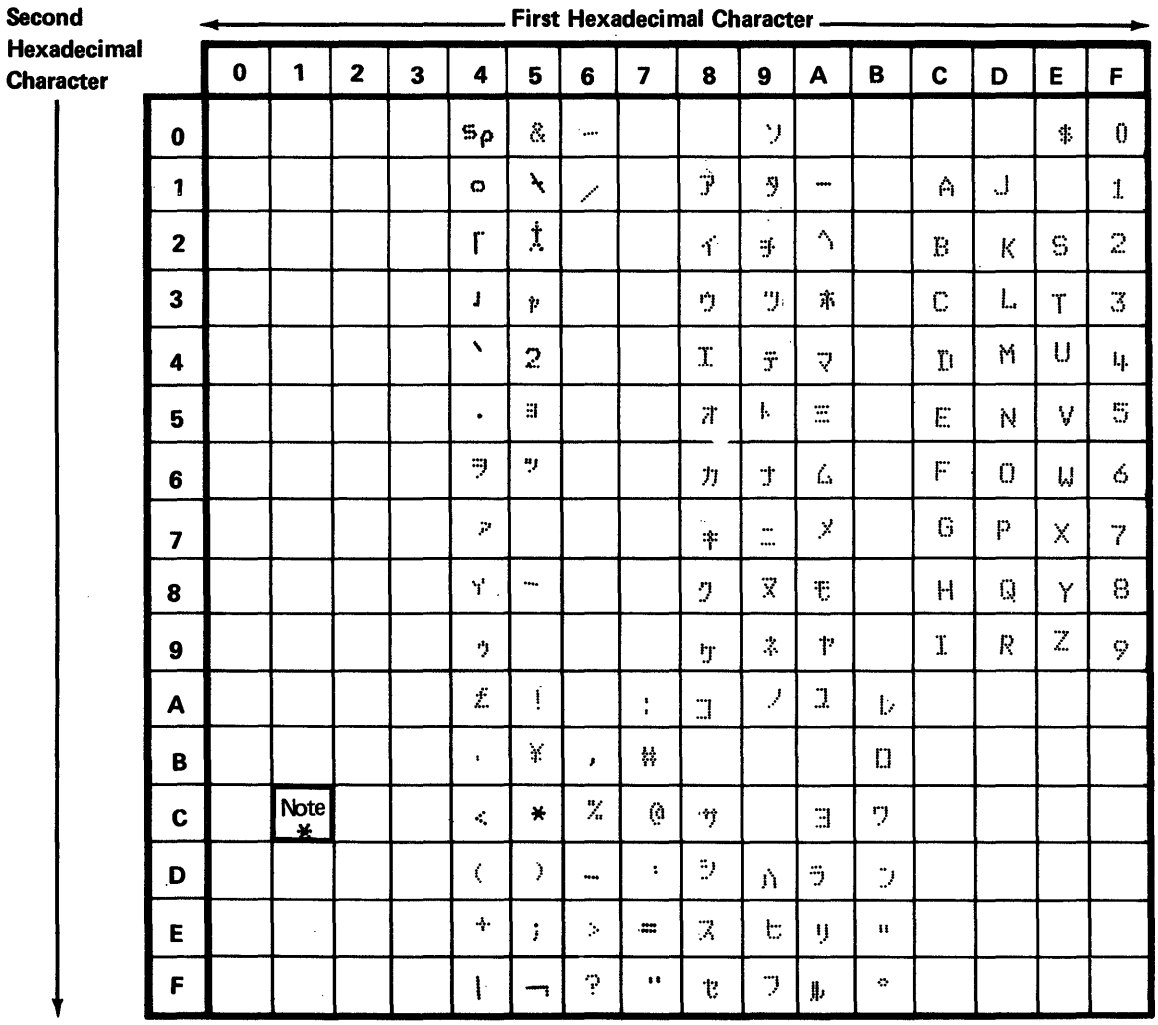



**Figure 34 (Part 5 of 5). EBCDIC Character Sets (Katakana)**

**Multinational Character Set**

The Multinational Character Set is a feature that contains a 188-character set and supports the hexadecimal usage and diacritic keys on the 5251 and the 5252.

*Hexadecimal Usage of the Keyboard*

By entering hexadecimal codes on the keyboard, you can generate any EBCDIC character that is not available on the keyboard but is needed for input and displaying within an input field. The hexadecimal usage of the keyboard is not allowed when the display station is in the insert mode.

To enter a hexadecimal code for an EBCDIC character, do the following:

1. Press the Cmd key.
2. Press the first key on the top row located to the right of the Cmd key.
3. Press the key for the first character of the hexadecimal code (only 4 through 9 or A through F are valid).
4. Press the key for the second character of the hexadecimal code (0 through 9 or A through F are valid).

Repeat the steps above for each EBCDIC character to be generated.

**Note:** FF is not a valid hexadecimal combination that can be entered on the display station.

After the hexadecimal code for a valid EBCDIC character has been entered, the EBCDIC character will be shown on the display screen.

If you have entered a hexadecimal code that does not have a valid EBCDIC character, you can see the code you entered by setting the Status switch to the Test position. Then set the Status switch to the Normal position to resume normal operation.

*Diacritic Keys*

Using a diacritic key allows you to place a diacritic (modifying) mark above a character to indicate a different phonetic value for that character.

Various diacritic keys are available. However, the only diacrictic you can enter above a character is one that appears on one of the diacritic keys on your keyboard. the diacritics that are available are shown below:

` (Grave Accent)
' (Acute Accent)
~ (Tilde)
^ (Circumflex)
¨ (Diaeresis)
¸ (Cedilla)

To enter a diacritic above a character, press the diacritic key and then the character. The 5251 Model 2 or 12 or the system then checks to see that the diacritic key and the character key pressed are a valid combination. Valid combinations for each diacritic are shown below:

| **Diacritics:** | **Allowable Characters:** |
|---|---|
| ` (Grave Accent) | A E I O U |
| ' (Acute Accent) | A E I O U |
| ~ (Tilde) | A N O |
| ^ (Circumflex) | A E I O U |
| ¨ (Diaeresis) | A E I O U y (y is allowable only as a lowercase character) |
| ¸ (Cedilla) | C |

After the diacritic and character combination has been checked and found to be correct, the cursor moves to the next position. If the combination is not valid, a 0029 error code is shown on the display screen.

**Note:** When the diacritic is keyed, the cursor will stay under the diacritic in anticipation of the combining character. If only a diacritic is desired, press the Spacebar on the typewriter-like keyboard or on the data entry keyboard, the Space key on the data entry keyboard with Proof Arrangement, or the → (Right Cursor Movement) key to advance the cursor to the next position.

*Using the Hexadecimal Code to Enter Diacritics or Accented Characters*

The diacritics, their allowable characters, and corresponding hexadecimal codes are given in the following chart. Characters that have a heavy line surrounding them will not print as shown but will print as specified by the Set Graphic Error Action control character or, if unspecified, as a hyphen (-).

Select the desired diacritic or the accented character from the chart. Its corresponding hexadecimal code can be found by:

1. Following the column containing the diacritic or the accented character to the top of the chart. The character at the top of the chart is the first character of the hexadecimal code.

2. Following the row containing the diacritic or the accented character to the left of the chart, the character at the left of the chart is the second character of the hexadecimal code.

**First Hexadecimal Character →**

**Second Hexadecimal Character ↓**

| | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Space | & | - | ø | Ø | ° | µ | ¢ | { | } | \ | 0 |
| 1 | Required Space | é | / | É | a | j | ~ | £ | A | J | Num Space | 1 |
| 2 | â | ê | Â | Ê | b | k | s | ¥ | B | K | S | 2 |
| 3 | ä | ë | Ä | Ë | c | l | t | ₧ | C | L | T | 3 |
| 4 | à | è | À | È | d | m | u | ƒ | D | M | U | 4 |
| 5 | á | í | Á | Í | e | n | v | § | E | N | V | 5 |
| 6 | ã | î | Ã | Î | f | o | w | ¶ | F | O | W | 6 |
| 7 | å | ï | Å | Ï | g | p | x | ¼ | G | P | X | 7 |
| 8 | ç | ì | Ç | Ì | h | q | y | ½ | H | Q | Y | 8 |
| 9 | ñ | ß | Ñ | ` | i | r | z | ¾ | I | R | Z | 9 |
| A | [ | ] | ¦ | : | << | a | i | ¬ | — | ⩾ | 2 | 3 |
| B | . | $ | , | # | >> | o | ¿ | \| | ô | û | Ô | Û |
| C | < | * | % | @ | ð | æ | Ð | ≠ | ö | ü | Ö | Ü |
| D | ( | ) | _ | ' | ⩽ | ¸ | ↑ | ¨ | ò | ù | Ò | Ù |
| E | + | ; | > | = | þ | Æ | þ | ´ | ó | ú | Ó | Ú |
| F | ! | ^ | ? | " | ± | ¤ | ® | = | õ | ÿ | Õ | |

If you want *only* a diacritic in the current position, enter the hexadecimal code for that diacritic by doing the following:

1. Press the CMD (Command) key.
2. Press the first key on the top row located to the right of the Cmd key.
3. Press the key for the first character of the hexadecimal code (from the preceding chart).
4. Press the key for the second character of the hexadecimal code (from the preceding chart).

Repeat the steps above for each diacritic you wish to enter.

After you have entered the hexadecimal code for the diacritic, the diacritic will be shown on the display screen.

**Note:** Diacritics entered in this manner cannot be combined with another character.

## ERROR LOG

The error log is a buffer that is 16 bytes for the controller and an additional 64 bytes for each installed cluster feature. The log contains information about errors that have occurred (both soft errors and errors sent via a signal).[1] See the index entries: *error codes* and *negative responses*.

The format of the error log entries is:

L,LSID,xxyy,S0,S1,S2,S3,S4

L is the number of bytes in the entry.

LSID is the local session identifier address (see the index entries: *addresses* and *LSID*).

xxyy is either the error code or the user bytes of the negative response that describe the condition causing the error. xx is the device type and yy is the error type.

S0, S1, S2, S3, and S4, if present, are predefined and used only as diagnostic maintenance information.

The error log exists only in the 5251 Models 2 and 12. The 5251 Models 1 and 11, 5252, 5225, and 5256 are dependent on the 5251 Model 2 or 12 controller or on a host system for error logging.

**Note:** If the host system does not have a buffer area for the error log, its contents are lost when transmitted and valuable information ecessary to diagnose error-related problems is lost.

The heading *Protocols and Synchronization for 5250 Implementation of SNA* in Section 1 and index entries: *Reqms command* and *Recfms command* describe how to access this error log.

## FIELD CONTROL WORDS (FCW)

The field control words (each 2 bytes) are sent by the user's program to the controller via the Write to Display command. The field control words are optional and if coded, they should follow the field format word of the SF order. See the index entry: *SF order*. Any field control word encountered during the modification of an existing format table entry is ignored. A field control word of hex FFXX will not be accepted by the LU. The types of field control words are (1) resequencing, (2) self-checking, (3) magnetic stripe reader, and (4) selector light pen. The resequencing control words alter the sequence of sending information; they do not alter the sequence of information on the display. The self-check feature determines the validity of the data that is sent. The Magnetic Stripe Reader feature allows the reading of numeric encoded information from a magnetic stripe. The Selector Light Pen feature permits attachment of a light pen to the 5251 Model 2 or 12 or its remote work stations.

---

[1] Hardware errors may be logged but not sent via a signal, because the unit was not in session.

### Resequencing Feature

Resequencing allows the controller to send the input fields to the host system in any specified order. Resequencing is accomplished by chaining input fields togethr via FCW (field control words) specifying resequencing. The format of the resequencing FCW is as follows:

| Bits | Binary Description |
|---|---|
| 0-1 | 10 |
| 2-7 | 000000 |
| 8-15 | The normal sequence position of the next field to be returned to the host system. (The first field on the screen is number 1; the field numbers progress sequentially, left to right and top to bottom.) |

The first field to be sent to the host system is identified in the SOH (start of header) by its number. If the first field identifier in the SOH is set to zero, resequencing will not occur (that is, all resequencing FCWs will be ignored; fields will be sent to the host system in the order defined in the format table). The last field to be sent to the host system must have a field control word defined as follows:

| Bits | Binary Description |
|---|---|
| 0-1 | 10 |
| 2-7 | 000000 |
| 8-15 | 11111111 |

**Notes:**

1. A closed resequencing loop will result in an endless transmission of data, terminated only by a negative response, UNBIND, or DACTLU from the host system. See the index entries: *SNA Commands* and *negative response.*
2. It is not a requirement to have a resequencing FCW for each field. A FCW pointing to the next sequential field will be assumed if no resequencing FCW is specified. (The last field in the format table must have a resequencing FCW.) See the index entry: *SOH* for more information.

### Self-Check Feature

The self-check feature on the controller provides additional integrity for the data entry. All field types can be specified for self-checking. The following requirements must be met when specifying a field for self-checking:

- A field control word must be defined for the field:
  - Hex B1A0 is for Modulus 10 checking.
  - Hex B140 is for Modulus 11 checking.

- Field lengths for checking are restricted to 33 positions. For signed numeric fields, only 32 positions can contain digits. The sign is not checked. If more than 33 characters are given, a Lustat parameter error results.

- The self-check feature must be installed or a Lustat parameter error results when self-check is specified for the field and the operator tries to leave the field.

The self-check feature resolves fields and conditions in the following ways:

- The feature converts nonnumeric characters, including nulls and blanks, by using the 4 low-order bits from their EBCDIC representation, when the low-order bits are in the range 0-9. For example:
  - A in EBCDIC is C1; therefore A=1.
  - R in EBCDIC is D9; therefore R=9.

  All other characters with the 4 low-order bits in the range of hexadecimal A-F are replaced by 0.
  For example: % is EBCDIC 6C; therefore %=0.

  Null and blank characters are also converted to 0.

- All high-order nulls, zeros, and blanks in a field are converted to 0 and do not affect the value of the check number.

- An all-null field checks correctly. This kind of field can result when an operator has unsuccessfully tried to enter digits into a field and checking fails, so the controller allows the operator to exit the field from the first position by using the Field Exit key.

- A duplication character (hex 1C) resulting from the operator using the Dup key automatically causes the field to pass this test.

- Checking errors result in the controller issuing a 0015 error code and placing the cursor at the first position of the field containing the error.

### Magnetic Stripe Reader Feature

The MSR (magnetic stripe reader) feature, which is available for all display station models, provides the capability of reading numeric encoded information from a magnetic stripe. The Magnetic Stripe Reader card may be encoded with up to 128 numeric characters, including control characters. The following requirements must be met when specifying a field for MSR input:

- A field control word must be defined for the field only if OID (operator ID) secure data is to be entered into this field.
  - Hex 8101 is for a MSR operator ID secured field. When the MSR OID data is read into the field, the OID code is converted to a colon (:) which appears in position 1 of the field to indicate secured data.
  - Hex 8103 allows both MSR and selector light pen to enter data.

- The MSR data must be entered with the keyboard unlocked or after pressing the System Request key, otherwise the data is lost and no error will appear to inform the operator of the situation. If the OID is encoded on the card, it can only be entered in response to the OID display provided by the host system.

- MSR data can be entered into an I/O field.

- Data will be entered starting at the cursor position; the operator must position the cursor within a field.

- Data entered from the card must satisfy the requirements of any mandatory fill, check digit, signed numeric, numeric only, alpha only, and auto enter specifications for the field into which MSR data is entered or the appropriate operator error will be posted.

- There can be only one field on each magnetic stripe card. This field can range from 1 to 125 characters plus SOM, EOM, and LRC control characters. All data between the first SOM and the last EOM LRC is translated and placed in the field on the screen.

- No data overflow is allowed. Magnetic stripe data must all fit within the field or an operator error 0034 will be displayed.

### Selector Light Pen Feature

The Selector Light Pen feature, which is available for all models of the 5251 Display Station, is a pen-like device that permits the operator to select fields of data from the display screen for system input. The ease with which the operator can select and designate the correct light pen field is affected by the format, content, intensity, and spacing of the light pen fields upon the screen. The following requirements must be met when specifying a field for the selector light pen:

- A field control word must be defined for the field:
  - Hex 8102 is for a selector light pen tip switch allowed field.
  - Hex 8103 allows both magnetic stripe reader and selector light pen to enter data.

- There should be only one light pen field per line (other fields may be present on the same line).

- The light pen field should be formatted as follows:

  @?b*bxx...x@

  where:

  @ – The leading attribute should be high intensity. The trailing attribute should be normal intensity.

  ? – A designator character (?) in the first position of the field indicates field selection or reselection. This character should change from ? to < after selection and back to ? after reselection.

  b – A blank should separate the designator character from the rest of the field.

  * – A target character (asterisk) may be inserted into the field format. This character enhances the pen's ability to detect the field and the pen should be aimed at this target character during the selection process.

  xx...x – These character combinations indicate a variable length name or description of the selectable field. (The name should be at least two characters long.)

## FIELD FORMAT WORDS (FFW)

The field format words (each 2 bytes long) are sent by the host system in the SF order to the controller to be placed in the format table. They allow the programmer to control the type of fields on the display. The index entry: *fields* references the details for the types of fields that are supported and their characteristics. See also the index entries: *SF order* and *format table* for additional information. The following describes the meanings of the field format word bits:

| Byte | Bit | Code | Description |
|---|---|---|---|
| 1 | 0-1 | 01 | |
| | 2 | | Bypass. |
| | | 0 | This is not a bypass field. |
| | | 1 | This is a bypass field. |
| | 3 | | Dup enable. |
| | | 0 | Duplication is not allowed in this field. |
| | | 1 | Duplication is allowed in this field. |
| | 4 | | Modified data tag (MDT). |
| | | 0 | This field has not been modified. |
| | | 1 | This field has been modified. **Note:** This may be turned on by the host system before being sent to the the display. |
| | 5-7 | | Field shift/edit specifications. |
| | | 000 | Alphabetic shift. |
| | | 001 | Alphabetic only. |
| | | 010 | Numeric shift. |
| | | 011 | Numeric only. |
| | | 100 | Katakana shift. |
| | | 101 | Reserved. |
| | | 110 | I/O (magnetic stripe reader, selector light pen input only). |
| | | 111 | Signed numeric. |
| 2 | 0 | | Auto enter. |
| | | 0 | No auto enter. |
| | | 1 | Auto enter. |
| | 1 | | Field exit required (FER). |
| | | 0 | Field exit key is not required. |
| | | 1 | Field exit key is required. |
| | 2 | | Monocase. |
| | | 0 | Accept lowercase letters. |
| | | 1 | Translate operator-entered letters to uppercase. |
| | 3 | | Reserved. |
| | 4 | | Mandatory enter. |
| | | 0 | This is not a mandatory enter field. |
| | | 1 | This is a mandatory enter field. |
| | 5-7 | | Right adjust/mandatory fill (MF). |
| | | 000 | No adjust specified. |
| | | 001 | Reserved. |
| | | 010 | Reserved. |
| | | 011 | Reserved. |
| | | 100 | Reserved. |
| | | 101 | Right adjust, zero fill. |
| | | 110 | Right adjust, blank fill. |
| | | 111 | Mandatory fill. |

No checks are made against the field format word when the host system writes to the display; therefore, the user can initialize the field he wants. The host system can turn on the master MDT bit by placing a field format word with bit 4 on in the display data stream. When there is a Read MDT command, the field is sent back to the host system as if the operator had modified it.

## FIELDS

The display fields are defined by the field format word. The information in parentheses immediately following the field name gives the byte and bit identifiers of the field in the field format word. See the index entry: *field format word* for specific bit information. The following identifies the types of fields available and their characteristics:

| Field Type | Description |
|---|---|
| Alphabetic only (byte 1 bits 5-7=001) | Accepts only characters A-Z (both uppercase and lowercase plus the , . - and space symbols. Other characters cause operator errors. Some special characters for World Trade countries are also acceptable. |
| Alphabetic shift (byte 1 bits 5-7=000) | Accepts all characters. The shift keys are acknowledged. The characters on the the lower symbol of each key are valid. |
| Auto enter (byte 2, bit 0) | Sends the contents of all fields except Read MDT fields to the host system when the operator either enters the last character into the last position of the field or enters one of the field exit keys. (The only Read MDT fields sent are those that have been modified.) |
| Bypass (byte 1, bit 2) | Entries are not allowed in this field. If the operator tries to enter something into this field, an error results. |
| Dup enable (byte 1, bit 3) | The controller repeats hex 1C from the cursor position to the end of the field when the operator presses the Dup key; this shows on the display as an overstruck asterisk (*). |
| Field exit required (byte 2, bit 1) | Requires the operator to exit the field with a nondata key. When the operator has entered the last character, the cursor remains under the character and blinks, indicating that a field exit key is required. |
| I/O (byte 1, bits 5-7=110) | Rejects any data keys from the keyboard. The operator can move the cursor in and out of the field as in a nonbypass field. Any entered data results in an error. Data from a magnetic stripe reader or light pen selector can be entered into an I/O field without causing an error. |
| Katakana shift (byte 1, bits 5-7=100) | This is the same as the alphabetic shift except the keyboard is Katakana and is placed in Katakana shift. |
| Mandatory enter (byte 2, bit 4) (ME) | Requires the operator to enter something in the field before the controller allows the Enter key to be active. The controller recognizes the state of these fields by checking the MDT bit for the field.<br><br>If the operator tries to bypass the field using a Field+, Field-, Field Exit key, an error occurs. |
| Mandatory fill (byte 2, bits 5-7=111) (MF) | Requires that once the operator has entered data into the field, he must completely fill the field before exiting. Any attempt to leave an unfilled field causes an error. The operator can use the Dup key to fill the field. If the field is nulled by exiting from the first position using the Field Exit or Erase Input key and the MDT bit is on, the null fields can be sent back to the host system in response to a read command. |

| Field Type | Description |
|---|---|
| Monocase (byte 2, bit 2) | Regardless of the shift state, the keyboard enters only the uppercase characters A-Z in the field. In addition, the following character on the specified World Trade typewriter keyboard will be translated to uppercase.<br>Austria/Germany ü ä ö<br>Brazil ã ç õ<br>Denmark ñ<br>Finland ñ<br>Norway å ä é ø<br>Portugal ã ç é õ<br>Spain å ¤ ø<br>Spanish Speaking á ü ö é<br>Sweden å ¤ ø<br>For the remaining World Trade typewriter-like and all data-entry keyboards, the lowercase special characters are keyed and displayed as is. |
| Numeric only (byte 1, bits 5-7=011) | This accepts only characters 0-9 and the symbols + , . - and space. Any other character causes an operator error. The unit position carries the sign digit for the field. Use either the Field+, the Field-, or the Field Exit key to exit this field. If you use the Field- key to exit the field, the controller changes the zone of the low-order digit to hex D, unless it is one of the symbols (+ - , . or blank); in this case, an error results. |
| Numeric shift (byte 1, bits 5-7=010) | Accepts all characters. |
| Right adjust (byte 2, bits 5-7: 101=0 110-blank) | Fills all leftmost unoccupied positions of a field with the specified character; characters are right-adjusted and spaces are blank-filled or zero-filled. The user must specify this as either blank or 0. The fill character will appear on the display. |

| Field Type | Description |
|---|---|
| Signed numeric (byte 1, bits 5-7=111) | Allows only characters 0-9. An attempt to enter any other character causes an error.<br>The field must be at least 2 bytes long.<br>Reserves the righthand position for the sign display (- for negative and null for positive).<br>The operator cannot key a digit into the last position; an error results if this attempt is made.<br>Use either the Field+, the Field-, or the Field Exit key to exit this field. If you use the Field- key to exit this field, the controller right adjusts the field and places a negative sign in the rightmost position. If you use Field+, the controller right adjusts the field and blanks the rightmost position.<br>The rightmost sign position is not sent to the host system in response to either the Read MDT or Read Input commands. The rightmost character is affected in the following way before it is sent to the host system:<br>If it is a negative sign, the zone of the low-order digit is set to hex D.<br>If it is positive, the low-order digit is not changed. |

**FORMAT LEVEL 0**

Format level 0 is the condition of the format table at power on and reset time. It has the following characteristics:

1. There is one input field that goes from row 1, column 2 to the last row, column 80.
2. The field is normal entry; no Field Exit key is required; there are no mandatory enter, no auto record advance, no right adjust, and no mandatory fill field requirements.
3. The error line is on row 1.
4. Alphabetic shift is in effect.
5. No field control words are specified.
6. Uppercase and lowercase output is allowed.

See also the index entry: *power-on state*.

## FORMAT TABLE

These tables contain the format information for the displays. There is one format table for each display. The Write to Display command from the host system builds the format tables. The entries in the tables define the characteristics of the field. Specifically, the format tables contain entries that describe (1) each input field that is returned to the system by all read commands (except Read Screen) and (2) each field that is modified from the keyboard (see the index entry: *MDT bit*).

The format table contains the field control and field format words. It has room for a maximum of 127 fields if there are no field control words and no SOH order (see the index entry: *SOH order*). The field length, field format, and field control words are sent by the host to the controller in the Write to Display command in the display data stream. The controller then stores these in the current format table. At power on time, the format table is at format level 0. See these index entries for details: *field control words*, *field format word*, *format level 0*, and *display, commands*.

## FRAME – SDLC

The frame is the SDLC format used to convey commands and information between the host system and the 5250 controller. The SDLC frame is the organizational unit required to send information between the host system and the controller using remote attachment. The frame is what the host system and controller use to send requests for service, commands, data, and responses to each other. To be valid, the frame must be bounded by flags, a minimum of 32 consecutive bits, or any greater length divisible by 8. The frame has a fixed format. This format is as shown:

| | F | A | C | I | FCS | F |
|---|---|---|---|---|---|---|
| Bytes: | 1 | 1 | 1 | *Determined by physical limitations required for accuracy.* | *2* | *1* |

This is an optional field. It is where the SNA RUs reside. *I* field is associated with an information frame and is restricted to a maximum of 261 bytes for the 5251 Models 2 or 12. See index entry: SDLC commands and responses.

The first F is a flag, A is the address of the referenced controller, C contains commands, responses, and information about the frame type (and commands and responses for the data link and link level types of formats), FCS performs transmission checking, and the last F is another flag.

### Flag Sequence

All frames start and end with the bit sequence 01111110. An ending flag for one frame can also be the beginning flag for the next or a single ending 0 can be shared to couple the ending flag sequence of one frame with the beginning flag sequence of another. The communications adapter hardware checks for the flag sequence.

### Station Address Field (A)

This is the first 8-bit sequence following the flag; it contains the controller station address which identifies the secondary station (5251 Models 2 and 12) that is involved in the transmission. See the index entry: *station address* for details.

### Control Field (C)

The control field is 1 byte long; it contains (1) commands and responses, (2) the poll bit for the host system, (3) the final bit for the 5251 Model 2 or 12 controller, and (4) the sequence numbers for some commands and responses. See the index entries: *SDLC, commands and responses* and *P/F bit* for detailed information. The control field supports three frame types; they are: information, nonsequenced, and supervisory.

Only the information (I) frame contains data for the LUs. The other frames are for SDLC link-level control. The control field for each frame type is different. Do not confuse the I control field with the information field. It is the information field of the information frame that contains the RUs that the I frames support. The information format of the control field only identifies the information frame. The I format has this configuration:

Information (I) Format:

```
0 1 2|3 | 4 5 6|7
| Nr |PF|  Ns  |0
```

The I frames are used to transfer information. They are the only frames that contain Ns bits.

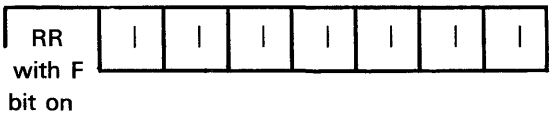
Nr = Station-receive sequence count;
3 bits for error detection
and recovery.

Ns = Station-send sequence count;
3 bits to number information
frames as they are sent.

P/F = Poll/final bit. The poll bit
is in frames sent by the host system and the
final bit is in the frames sent by the controller.

The 5251 Model 2 or 12 controller cannot send a response to the host system until it receives a frame with the poll bit on. When the controller responds to a command from the host, it will send no more than seven consecutive I-frames. The transmission of the I-frames will be followed by either an RR (ready to receive) or an RNR receive (not ready) response and the F bit of this last frame will be on. This indicates to the host system that the controller has finished.

In this example, the frames are traveling ——>




**Information Field (I)**

This contains such things as the RUs (LU data streams), status, controls, and SNA responses and commands. The I field of an information frame consists of 2 bytes of TH followed by 3 bytes of RH and finally followed by up to 256 bytes of RU. The maximum length of this field is 261 bytes (including the SNA header information, which is 5 bytes long and the RU which can be a maximum of 256 bytes long). See the index entries: *RU, RH, TH,* and *SNA, commands* for specific information about the contents of the I-field.

```
                    |
| TH RH  --    RU       --|  |
|--------------- I part of SDLC frame----------
```

**Flag Uniqueness**

The frame can consist of any sequence of bits. If there are five consecutive 1's, the controller inserts a 0 when transmitting and deletes a 0 when receiving to indicate that the bit sequence has been checked. This prevents data from being misinterpreted as a flag.

**Frame Check Sequence (FCS)**

This field is 16 bits long. It is used for detecting transmission errors. Any frame that contains an FCS error is discarded.

## INDICATORS

This text is divided into three areas; controller, keyboard/display, and printer indicators. It is further subdivided to identify the category of indicator being described. The controller does share some basic indicators with the displays (5252 and 5251 Models 1 and 11); therefore, assume that all indicators described under the subdivision, *Keyboard/Display Indicators*, are common both to the controller and the display work stations unless otherwise specified.

### Controller Indicators

Figure 35 shows the controller indicators.

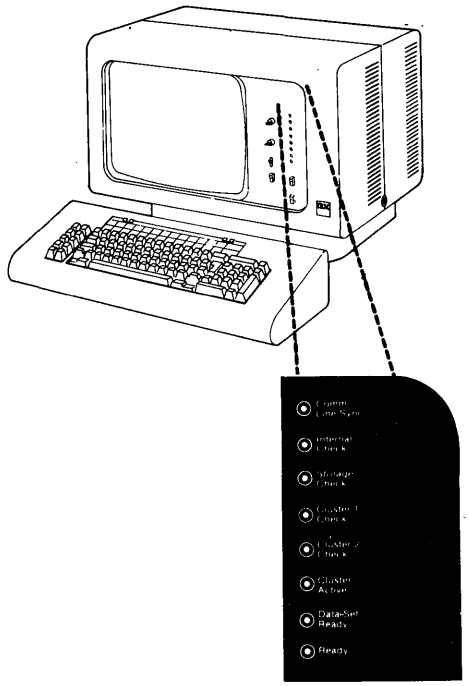


**Figure 35. Controller Indicators**

These are the indicators that appear on the 5251 Models 2 and 12 displays.

*Cluster Active:* On when any device attached to the controller via the cluster feature is responding to poll commands (via twinaxial attach).

*Cluster 1 Check:* On when CF1 fails its power on diagnostic tests.

*Cluster 2 Check:* On when CF2 fails its power on diagnostic tests.

*Comm Line Sync:* Flashes on briefly when the controller detects the SDLC flag (see the index entry: *frames*). It remains on only when the controller is receiving flags at least every 600 milliseconds.

*Data Set Ready:* On when the data communications equipment is ready to communicate with the host system.

*Internal Check*[1]*:* Comes on when bad parity is sensed in data in the regeneration buffer.

*Ready:* Comes on when the power on diagnostics are complete. For the Model 2 or 12 this also indicates that the controller is ready to communicate with the host system.

*Storage Check*[1]*:* Comes on when bad parity is sensed in data coming from main storage.

### Keyboard/Display Indicators

There are four types of keyboard/display indicators:

- Audible
- Error
- Hardware status
- Operational status

*Audible Indicator*

The two audible indicators are the audible alarm and the clicker associated with the keyboard keys. A clicker signals the operator when each key is pressed. When the keyboard is locked, the clicker is inoperable. In addition to the clicker, the keyboard issues an audible alarm when operator attention is required. The duration of the alarm is approximately 1 second. The display CC sets the audible alarm. See the index entries: *control characters, display* and *Signal, command and response.*

[1]These indicators also appear on the 5251 Models 1 and 11 displays and on the primary side of the 5252 dual display.

*Error Code Indicators*

The error codes are four-digit numbers that represent an index to a description of the condition that caused the error. They appear where the SOH order points. The default for work stations that are in session is to the bottom row and left side of the display. The default for work stations that are not in session is to the upper left corner of the display. See Figure 36. See the index entry: *SOH order.* If any characters were present in this row, the error code replaces them. The operator can return the data replaced by the error code by pressing the Reset key. See the index entry: *error, codes* for more details.

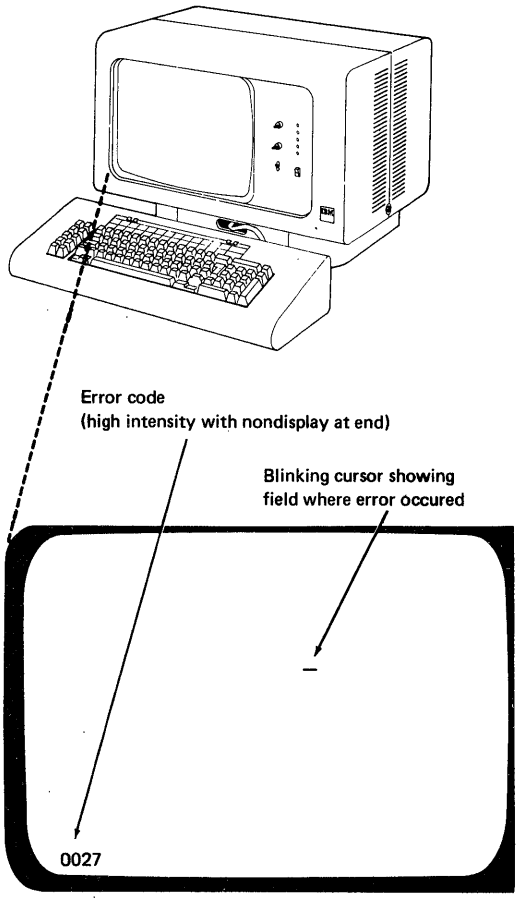



**Figure 36. Error Code Indicators**

*Hardware Status Indicators*

There are five hardware status indicators that appear only on the 5251 Model 1 and 11 and the 5252 (primary) work stations (see Figure 37). These indicators are:

- Internal Check
- Line Check
- Line Sync
- Ready
- Storage Check

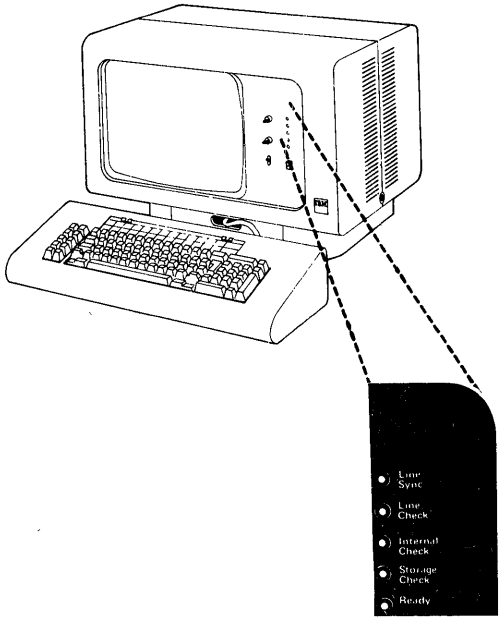



**Figure 37. Hardware Status Indicators**

These indicators are LEDs on the right side of the display device.

*Internal Check:* This indicator comes on when a storage parity error is found.

*Line Check:* This indicator comes on when a command or data byte with the wrong parity is received from the controller.

*Line Sync:* This indicator verifies that the twinaxial line has activity.

*Ready:* This indicator tells when the display station is available to the controller.

*Storage Check:* This indicator is on when a display station storage parity error is found in extended storage.

*Operational Status Indicators*

There are six operational status indicators:

- Input Inhibited
- Insert Mode
- Katakana Shift (on Katakana keyboard)
- Keyboard Shift
- Message Waiting
- System Available

See Figure 38.

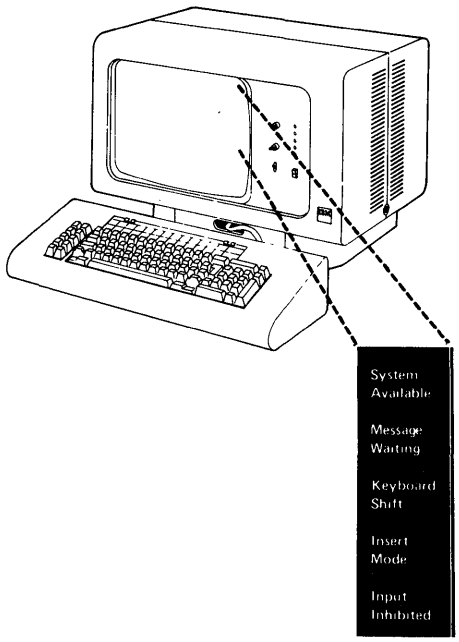



**Figure 38. Operational Status Indicators**

These indicators are located on the right side of the 5251 displays. On the 5252 Dual Display Station, the operational status indicators are located on the left edge of the primary side and on the right edge of the secondary side.

*Input Inhibited:* This indicator comes on when the keyboard is locked and will not accept input from the operator.

**Note:** The Shift, Sys Req, and Attn keys are always valid.

The operator can use this indicator to determine when the keyboard is available for entry. See the index entry: *states.*

*Insert Mode:* This indicator tells when the display is in the insert mode, that is, when it will allow the operator to insert characters into a data field. See the index entry: *Ins key.*

*Katakana Shift:* This is available only on the Katakana displays. This indicator shows when the operator has used the Katakana shift keys. When the operator uses the Katakana symbol shift key, both the Keyboard Shift and Katakana Shift indicators come on.

*Keyboard Shift:* This indicator is on when the keyboard is in the uppercase shift position. See the index entry: *shift keys.*

*Message Waiting:* This indicator is on when a message for the display is in the system. The host system programming determines the procedure the operator must use to access the message. A control character allows the programmer to turn this indicator on. The Signal command also allows the host to turn this indicator on. See the index entries: *control characters, display* and *Signal command.*

*System Available:* For the 5251 Models 1 and 11, the 5252, and the 5256, this indicator verifies that the controller (in the host system or in the 5251 Model 2 or 12) is polling the work stations. For the 5251 Models 2 or 12, this indicator verifies that the power on diagnostics have been completed and that the 5251 Model 2 or 12 is ready.

### 5225 Printer Indicators

The 5225 printer has two indicators: Attention and Ready.

*Attention:* This indicator is on during diagnostics and when the operator has pressed the Stop switch on the printer. The operator must take any necessary recovery action and then press the Start switch to turn this indicator off.

*Ready:* The on condition of this indicator shows that the printer is operational (either in normal or diagnostic modes). The indicator comes on when the operator presses the Start switch, providing there are no error conditions. The following will turn this indicator off:

- Nonrecoverable errors
- A BEL control character in the data stream (see the index entry: *control characters, printer*)
- The Stop switch

See Figure 39.

For further information about status indication on the 5225, see the index entry: *Operator Panel Display*.

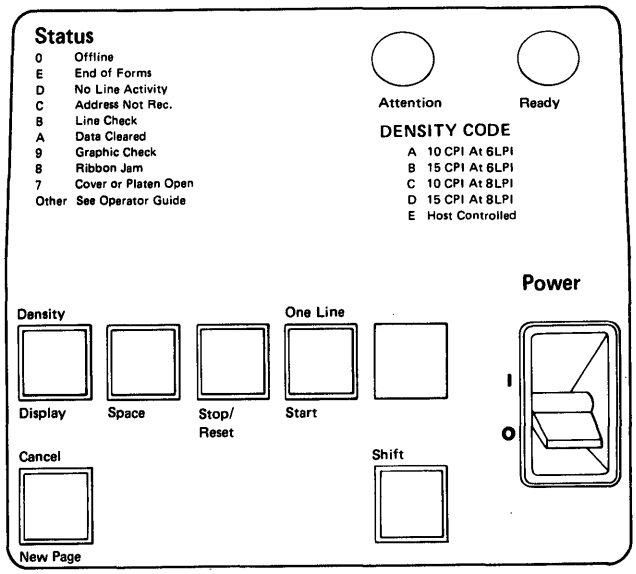



**Figure 39. 5225 Printer Operator Indicators**

### 5256 Printer Indicators

The 5256 printer indicators fall into two categories: operator indicators and problem determination indicators.

As the 5256 goes through power-on diagnostics, these indicators will alternate between on and off. When the power-on diagnostics are complete, the Power On light should remain on. The Line Sync and System Available indicators come on even when the printer is communicating with the 5251 Model 2 or 12 (normally at the end of the power-on diagnostics). Press the Start switch to turn on the Ready indicator.

*Operator Indicators*

The indicators available to the 5256 operator are:

- Attention
- Forms
- Power On
- Ready
- Unit Check

See Figure 40.

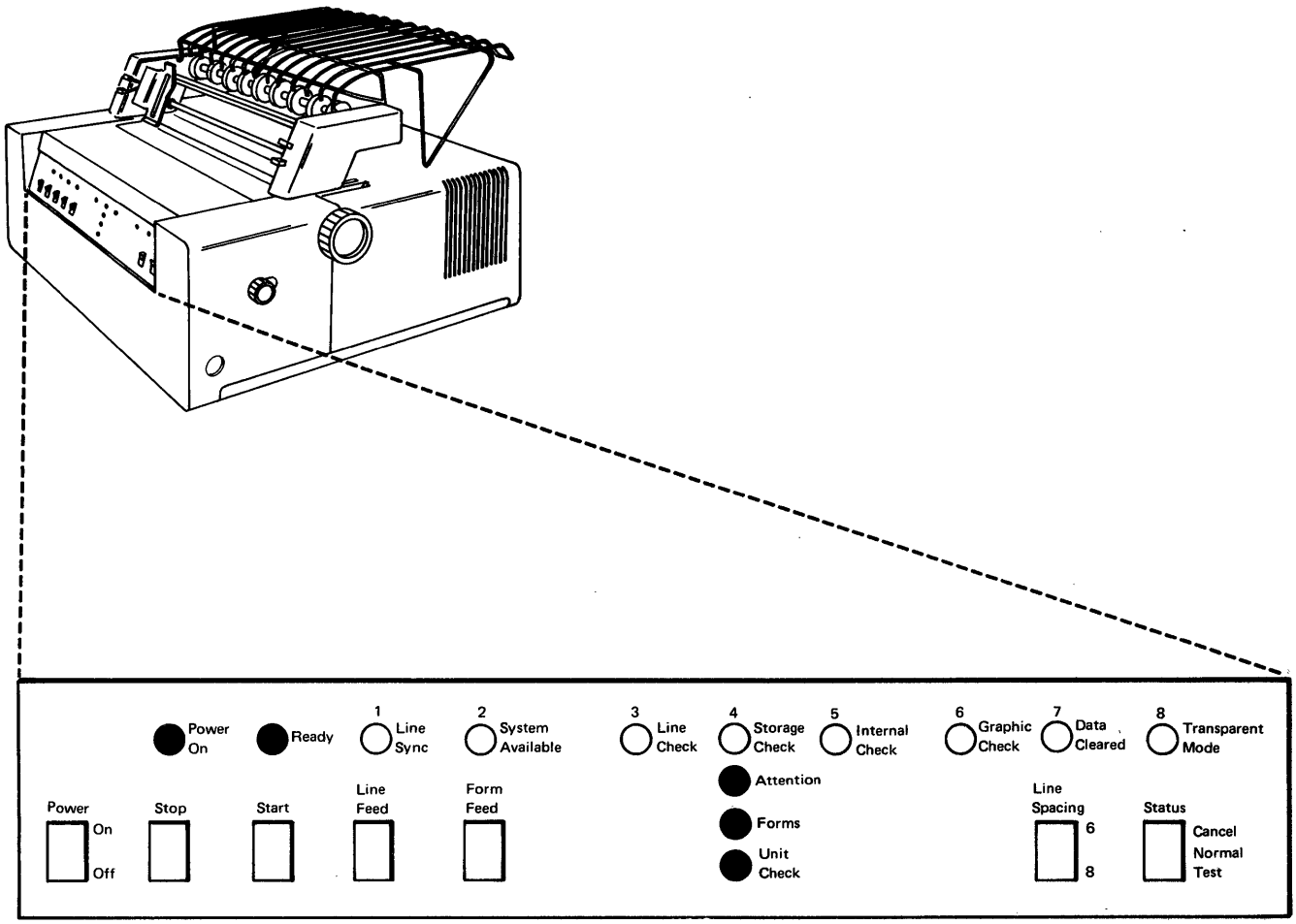



**Figure 40. 5256 Printer Operator Indicators**

*Attention:* This indicator is on when the printer requires the operator to manually intervene. A Bell control character (see the index entry: *control characters, printer*) or an error condition that turns the Ready indicator off can cause Attention to come on. The operator must activate the Stop switch to turn this indicator off.

**Note:** If the Audible Alarm feature is installed, it will work in conjunction with the Attention indicator. This indicator is on when the Forms Check, Unit Check, and Graphic Check indicators are on.

*Forms Check:* The meaning of this indicator must be interpreted along with that given for the Unit Check indicator. When only the Forms indicator is on, an end-of-forms condition exists and the operator must insert more paper and press the Stop switch to reset the indicator and resume operations. When the Forms and Unit Check indicators are both on, the printer has a paper feed malfunction. The operator must press the Stop switch, check the feed mechanism, and correct the problem to resume operations. Manipulation of the forms feed knob on the printer while the printer is in the Ready state will result in a loss of forms position and an error condition.

*Power On:* This indicator verifies that power is available to the printer.

*Ready:* This indicator verifies that the printer is operational. The indicator comes on when the operator presses the Start switch and there are no errors. The things that turn this indicator off are (1) nonrecoverable errors, (2) a Bell control character in the data stream (see the index entry: *control characters, printer*), and (3) the Stop switch.

**Note:** The Power On and Ready indicators are normally on. The Attention, Forms Check, and Unit Check indicators represent unexpected conditions when on.

*Unit Check:* This indicator has two meanings. When it is on at the same time the Forms indicator is on, it means that there is a malfunction in the paper feed operation (forms stop, forms position, or forms check). See the index entry: *Forms Check indicator*). When it alone is on, it means that a hard printer error exists. The possible errors are:

- Printer not ready
- Wire check
- Fast speed check
- Emitter sequence check
- No emitter
- Overrun error

The printer microprocessor sends information to the controller to identify the error condition.

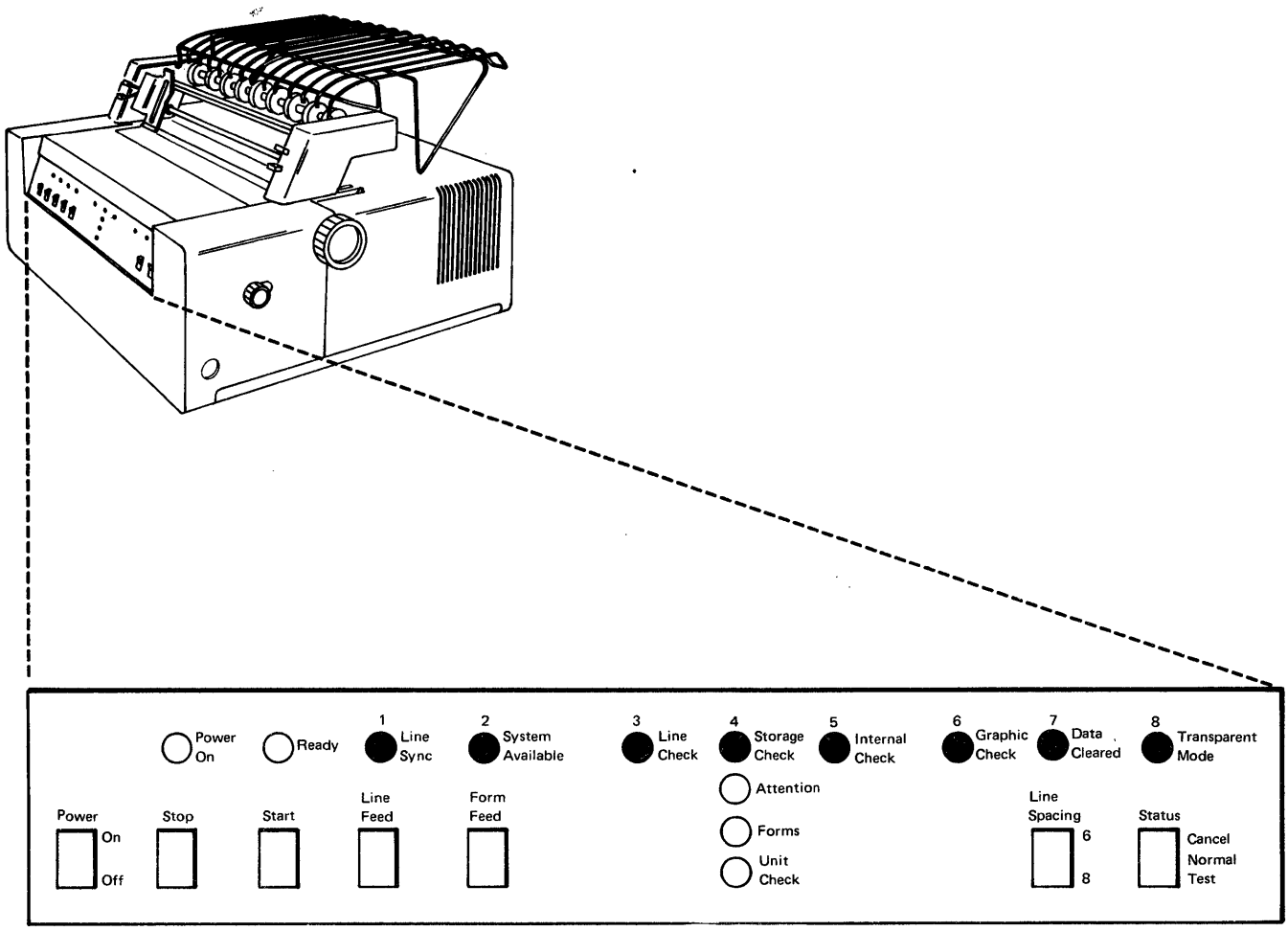
The operator can turn this indicator off by pressing the Stop switch or performing a new power on operation if the cause of the error was either a wire check or a printer not ready condition. The controller can also turn this indicator off by resetting it.

*Problem Determination Indicators*

The 5256 printer problem determination indicators are:

- Line Sync (error condition when off)
- System Available (error condition when off)
- Line Check
- Storage Check
- Internal Check
- Graphic Check
- Data Cleared
- Transparent Mode

See Figure 41.




**Note:** The Power On, Ready, Line Sync, and System Available indicators indicate that the 5256 has been powered on, made ready, and can execute print jobs.

**Figure 41. 5256 Printer Problem Determination Indicators**

These indicators are numbered 1 through 8 on the 5256 printer panel. When the printer is powered up, the indicators come on as the printer proceeds through its diagnostics. When the Status switch is in the Test position, they display the contents of the read status byte (which is returned to the controller in the device response as the result of the controller's request for the device's status). During normal operations, the indicators show the status of the printer and alert the operator when error conditions arise.

*Line Sync (1):* This indicator is on when there is activity on the interface between the printer and the controller. Specifically, it senses when synchronization pulses are present. The indicator goes off when there is no activity for 160 milliseconds.

*System Available (2):* For the 5251 Models 1 and 11, the 5252, and the 5256, this indicator verifies that the controller (in the host system or the 5251 Model 2 or 12) is polling the work stations. For the 5251 Models 2 and 12, this indicator verifies that the power on diagnostics have been completed and that the 5251 Model 2 and 12 is ready to establish communications (switched line).

*Line Check (3):* This indicator is on when the printer detects a parity error in transmission. The controller resets the indicator after it acknowledges that it received the parity error condition information.

*Storage Check (4):* This indicator is on when the printer senses a parity error in its data storage area. No information is sent back to the controller, but the printer becomes unavailable to the controller. The only way to reset this type of error is to power off and restart the device.

*Internal Check (5):* This indicator is used for diagnostic purposes.

*Graphic Check (6):* This indicator is on when the printer has received both an unprintable character and a control character that has set the stop-on-graphic-check option. See the index entry: *SGEA*.

When this occurs, the printer microprocessor turns the Attention indicator on and the Ready indicator off. The microprocessor also returns a unit not available flag to the controller. The only recovery for this is for the operator to press the Stop switch, thereby resetting the error indicators.

*Data Cleared (7):* This indicator comes on when the controller sends the printer a Clear Unit command in response to a hard error. The operator turns this indicator off by pressing either the Start or Stop switch.

*Transparent Mode (8):* This indicator is on when the printer is in Transparent mode. Transparent mode means that the printer will print all hexadecimal codes for each byte of the input data. All control characters and print characters not defined in the character generator are printed with the default graphic (which is a blank unless otherwise specified). See the index entry: *SGEA*.

## INHIBIT DOWNSHIFT FUNCTION

The automatic inhibit downshift function allows the operator of a typewriter-like keyboard to use the ⇧ (Shift) key and any of the following without resetting the shift lock:

- Erase Input key
- Del key
- Roll↑ (Roll Up) key
- Roll↓ (Roll Down) key
- Clear key
- Command function keys (shown on the keyboard template)
- → (Right Cursor Movement) key
- ← (Left Cursor Movement) key

**Note:** Pressing either the → (Right Cursor Movement) key or the ← (Left Cursor Movement) key after the ⇧ (Shift) key has been pressed results in the cursor moving three positions.

## KEYLOCK FEATURE

This is a physical key and lock that is installed on the keyboard/display. When the key is removed, the device is locked and cannot be accessed via the keyboard; the LU does, however, remain in active session with the controller (the display is turned off, but the data is not changed). Any data remaining in the device from a previous session is available to the controller. The controller is not aware of the locked status of the display. When the Keylock feature is installed on the 5252 devices, it locks both displays.

## KEYS

The basic types of keys on the keyboard are:

- Alphameric keys (typewriter-like in nature; including both letters, numbers, and special characters)
- Numeric keys; these are used for entering numeric data only
- Special function keys:
  - Aid-generating
  - Cursor movement
  - Field exit
  - Signal
  - Special control
  - Special host

### Aid-Generating Keys

The aid-generating keys are (see Figure 42):

- Clear
- Enter/Rec Adv
- Help (from nonerror state)
- Command Function 1-24
- Print
- Record Backspace (Home)
- Roll↑ (Roll Up) and Roll↓ (Roll Down)

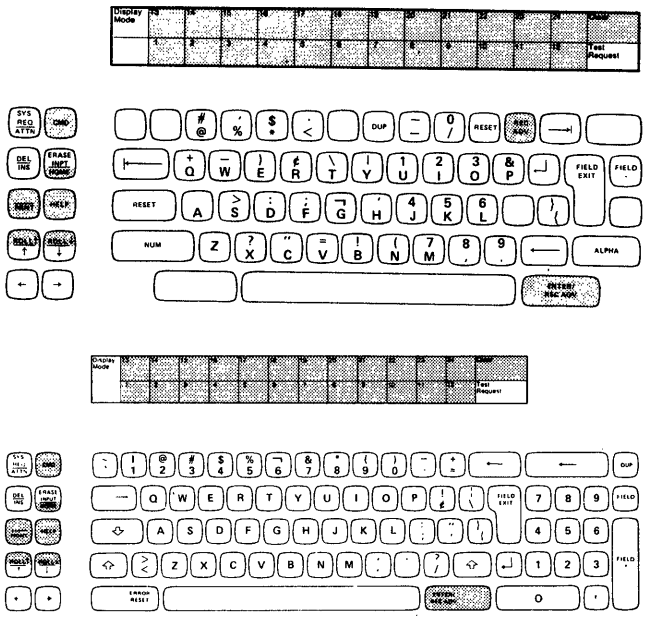


**Figure 42. Aid-Generating Keys**

The aid-generating keys (when pressed) generate aid codes that go in the display data stream to the host system in response to the LU-LU read commands. They alert the host system that the controller requires some action. These keys are not operational when the keyboard is locked, or the cursor is in an active, right-adjust field. When the keys are operational, they lock the keyboard and (depending on the key that was pressed), the aid code either goes immediately to the host system if a read command is pending or is kept pending until the controller receives a read command; when this happens, the aid code is sent to the host system in the normal FM LU-LU flow.

*Clear*

Clear is not a key but rather a sequence of key actions that consists of the following:

1. Press and release the Cmd key.
2. Press and hold the ⇧ (Shift) key on the typewriter-like keyboards; press the Numeric Shift key on the data-entry keyboards.
3. Press and release the ← (Character Backspace) key on the typewriter-like keyboard or the rightmost blank key on the top row of the data-entry keyboards.

The session environment determines the results of the Clear function:

1. If the LU is not involved in a session, it clears the entire display regeneration buffer (fills it with nulls and selects format level 0). See the index entry: *format level 0* for details.
2. If the LU is involved in a session, Clear issues the aid code hex BD, which requests that the host system issue a Clear Unit command to the LU to clear the display. See the index entry: *Clear Unit command*.

*Enter Rec/Adv*

In the normal unlocked state when the operator presses the Enter/Rec Adv key:

1. The controller checks for the completion of mandatory fill, self-check, and right-adjust fields when in an active field. An active field is one in which the operator has begun entering data. If the requirements of the field have not been satisfied, an error occurs.
2. It locks the keyboard.
3. If the master MDT bit is on, it checks for unentered mandatory enter fields, positions the cursor where there is such a field that is unentered, and posts an operator error.

4. Assuming there is a read command and CD, it sends the cursor address, aid code, and data in the input fields to the host system. This is the data formatting it does:
   a. Sets the zones on signed numeric fields.
   b. Sends the entire input field and changes nulls to blanks on the Read Input command.
   c. Strips trailing nulls from the fields and changes leading and embedded nulls to blanks for the Read MDT command.
   d. Resequences the field as specified by the field control word. See the index entry: *field control words* for details.

**Note:** When the host system unlocks the keyboard, the cursor goes to the address specified by the IC, to the first nonbypass field if no IC is specified, or to row 1, column 1 if neither one of these is given.

*Help*

(See also the heading *Signal Keys* within this topic.)

If the display is not in an operator-error state, and the operator presses the Help key, the display issues an hex F3 aid byte to the host system. If, however, the operator presses Help after having used the Cmd key or the Sys Req key, an error results.

*Command Function Keys*

The command function keys are those that the operator accesses by first pressing Cmd and then one of the 24 numeric keys across the top of the keyboard. The functions of these keys are user-defined.

**Note:** To access command function keys 13-24, press the Cmd key, then the Shift key on the typewriter-like keyboard or the Numeric Shift key on the data-entry keyboards, and the appropriate numeric key.

In the normal unlocked state when the operator presses a command function key, the controller:

1. Checks for the completion of mandatory fill, self-check, and right-adjust fields when in an active field. An active field is one in which the operator has begun entering data.

2. Locks the keyboard.

3. If the master MDT bit is on, it checks for unentered mandatory enter fields, positions the cursor where there is such a field, and posts an operator error.

4. Assuming there is a read command and CD, it sends the cursor address, aid code, and data in the input fields to the host system. This is the data formatting it does:
   a. Sets the zones on signed numeric fields.
   b. Sends the entire input field and changes nulls to blanks on the Read Input command.
   c. Strips trailing nulls from the fields and changes leading and embedded nulls to blanks for the Read MDT command.
   d. Resequences the field as specified by the field control word. See the index entry: *field control words* for details.

**Note:** When the host system unlocks the keyboard, the cursor goes to the address specified by the IC, to the first nonbypass field if no IC is specified, or to row 1, column 1 if neither one of these is given.

The associated Cmd aid byte is generated and sent to the host system preceding the first input field; sending the input fields can be inhibited by coding bytes 5-7 of the SOH order. See index entry: *SOH order*.

*Print*

This key informs the host system the operator wants to print the contents of the present display. See the index entry: *Copy to Printer feature.*

*Record Backspace (Home)*

When the Home key is pressed with the cursor already at the home position, a record backspace is requested; the keyboard is locked and the aid code (hex F8) and cursor address are sent to the host system. The host system should respond by repeating the writing of the previous record to the display.

*Roll ↑ (Roll Up) and Roll ↓ (Roll Down)*

These keys ask the host system to roll the information on the display. Roll Up issues aid code hex F5 and Roll Down issues aid code hex F4. The operator must first press a shift key, then the appropriate Roll key.

The following conditions cause errors:

1. Using a roll key after the Sys Req key.
2. Using a roll key after the Cmd key.
3. Using a roll key when the display station is in the insert mode.

**Cursor Movement Keys**

These keys allow the operator to reposition the cursor on the display. These keys are:

- ←— (Character Backspace)
- ↑ (Cursor Up), ↓ (Cursor Down)
- ← (Cursor Left), and → (Cursor Right)
- —→| (Field Advance)
- |←— (Field Backspace)
- ←┘ (New Line)

See Figure 43.

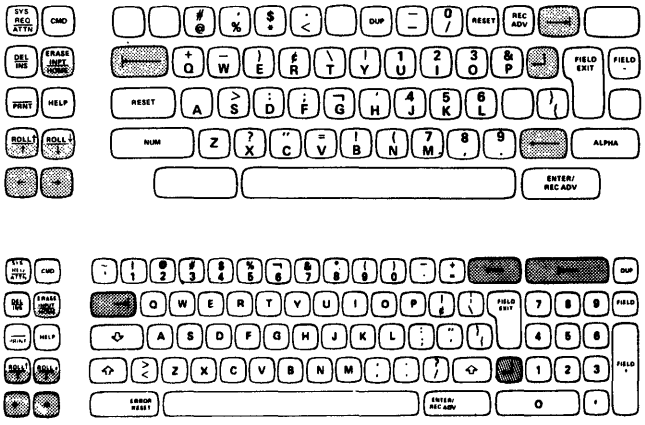


**Figure 43. Cursor Movement**

These keys are not operational when the keyboard is locked (see the index entry: *normal locked state*). The ↑ (Cursor Up), ↓ (Cursor Down), → (Cursor Right), ← (Cursor Left), ←— (Character Backspace), |←— (Field Backspace), —→| (Field Advance), and ←┘ (New Line) keys are operational during the time the controller is awaiting a field exit key (that is during AWFER), if one is required. When the Cursor Left and Character Backspace keys are used during AWFER, the first time the operator presses the key, it terminates AWFER; the second time the operator presses it, the key performs its normal function. (The field exit keys are intended for use in AWFER.)

*←— (Character Backspace)*

When the operator uses this key, the cursor goes to the first entry position before the current position. If the cursor is in the first position of a field when the operator uses this key, the cursor moves to the last position of the previous unprotected field. If that field is signed numeric, the cursor goes to the position preceding the sign position.

*↑ (Cursor Up), ↓ (Cursor Down)*

These keys move the cursor up or down one line on the display without altering the data the cursor passes under. If these keys are used at the top or bottom of the display, wraparound occurs.

*← (Cursor Left), and → (Cursor Right)*

These keys move the cursor past the character positions one at a time without altering them. If the cursor is on the left or right edge of the display when one of the horizontal cursor movement keys is used, wraparound occurs; when the Cursor Right key is used on the right edge, wraparound is to the beginning of the next line. When the Cursor Left key is used on the left edge, wraparound is to the end of the previous line.

The high speed cursor function may be implemented by pressing the Shift key on the typewriter-like keyboard or the Numeric Shift key on the data-entry keyboards, together with one of the horizontal cursor movement keys. Each keystroke moves the cursor three positions.

→| *(Field Advance)*

This key moves the cursor to the first position of the next unprotected field on the display. When the display does not contain any unprotected fields, the cursor uses the insert cursor (IC) address (see the index entry: *IC order*).

If no IC was specified in the Write to Display command, row 1, column 1 is the default.

|← *(Field Backspace)*

When used in an unprotected field, this key works in one of two ways:

1. If the cursor is presently in the first position of the field, the cursor moves to the first position of the preceding unprotected field.

2. If the cursor is in any other position of the field, it moves to the first position of that field.

   When used in a protected field, the key moves the cursor to the first position of the previous unprotected field.

↵ *(New Line)*

This key moves the cursor to the first position on a subsequent line that is in a nonbypass field. If there are no nonbypass fields, the cursor goes to the insert cursor (IC) address that was part of the last Write to Display command. See the index entry: *Write to Display command*. If there is no IC address, the cursor defaults to the column 1, row 1 position.

**Field Exit Keys**

These keys have field fill and exit functions. They do not operate when one of the following conditions exists:

- The keyboard is locked.
- The key is used with the Cmd key.
- The display is in the insert mode.

See Figure 44.

The field exit keys are:

- Dup
- Field Exit
- Field- (Minus)
- Field+ (Plus, typewriter-like keyboard only)

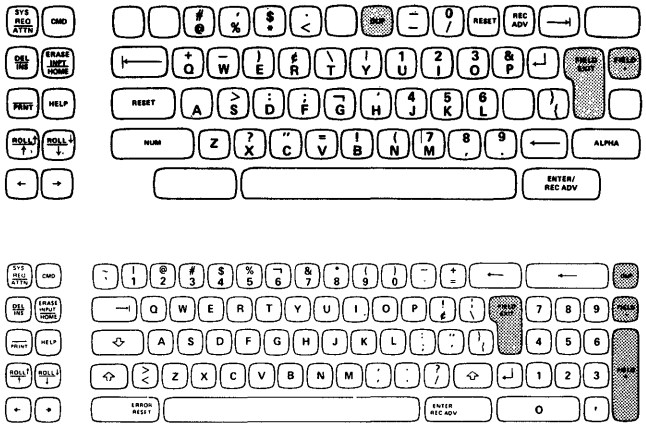


**Figure 44. Field Exit Keys**

*Dup*

This key results in a hex 1C being placed in every character position from the cursor to the end of the field. The code that is displayed looks like an * with hyphen over it. See the index entry: *fields*.

*Field Exit and Field+*

The results of using this key depend upon the type of field the cursor is in and the position of the cursor in that field. The following describes these relationships:

1. If the cursor is in any position of an unprotected field, this key moves the cursor to the start of the next unprotected field after first clearing all characters between the cursor position and the end of the current field.

2. If the cursor is in the first position of a mandatory fill field, this key clears the field and then places the cursor at the start of the next unprotected field.

3. If the cursor is in a mandatory fill field and beyond the first position, this key causes the display to show an error code.

4. If the cursor is in a mandatory enter field (in any position) and no data characters have been entered or if the cursor is in the first position of the field, if no data has been entered, the display shows an error code.

5. If the cursor is in a signed numeric field, a positive number is generated. The character reserved for the sign position is converted to a null.

6. If right adjust is required, it is performed. A signed numeric field is automatically right adjusted by default.

*Field-*

This key operates the same as the Field+ and Field Exit keys except that it is allowed only in signed numeric and numeric-only fields. In this application, pressing the key results in a minus sign being displayed in the rightmost character position of the signed numeric field and the cursor leaving the field. The numeric only field reserves the righthand position for a sign display by D-zoning negative numbers (a 123 becomes a 12L).

**Signal Keys**

The signal keys are:

- Attn
- Help (from error state)

See Figure 45.

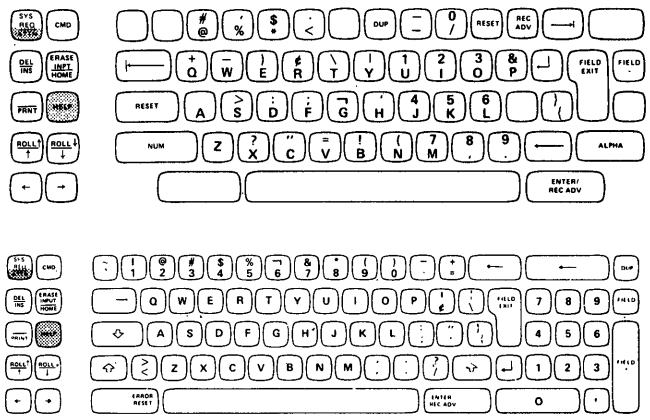


**Figure 45. Signal Keys**

The Signal-generating keys cause a Signal command to go from the controller to the host system. The index entry: *Signal, command and response* lists the pages that contain specific information about the contents of the Signal command.

*Attn*

This key is valid both when the keyboard is locked and when the keyboard is unlocked. Pressing the key does not affect the state of the keyboard or of the cursor position. The operator uses the key to alert the host system that a requested function (such as Enter) is not being honored.

*Help from Error State*

During an error condition, the operator uses this key to request that the host system send data about the error to the display. The controller sends a Signal command to the host system containing columns 2-5 (which is the error code) of the error line in the user bytes of the Signal command on the LU-LU flow. If the host programmer wants the operator to obtain explanatory information about the error when the operator uses the Help key, the programmer must furnish this information. One way of doing this is with the Write Error Code command. (See the index entries: *Signal, command and response; error states,* and *Write Error Code command* for details). If the operator uses the Help key a second time, bytes 2-5 of the error line return to the host system.

## Special Control Keys

The special control keys allow the operator to alter operator-generated information on the display. They do not work when the keyboard is locked (see the index entry: *states*). The special control keys are:

- Del (Delete)
- Display Mode
- Erase Input
- Error Reset
- Hex Key Function
- Home
- Ins (Insert)
- ⇧ (Shift) and ⇩ (Shift Lock) on typewriter-like keyboard
- [ALPHA] and [NUM] shifts on data-entry keyboards
- [ ] (Hex Function) key on the typewriter-like keyboard
- [ ] key (Hex Function) on the data entry keyboard (the first key on the top row located to the right of the Cmd key).

See Figure 46.

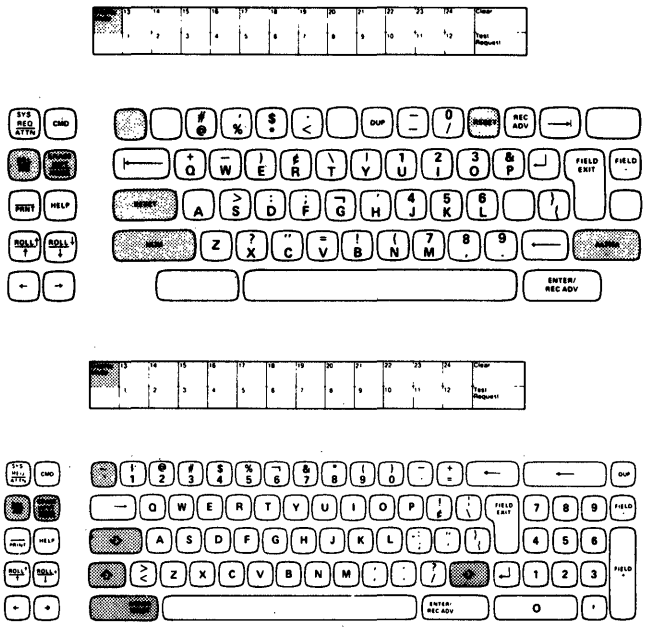


**Figure 46. Special Control Keys**

*Del*

To use this key, first press and hold one of the shift keys, then press the Del key. The result is a deleted character in the position where the cursor was located. All remaining characters in the field then shift to the left to fill the column vacated by the deleted character.

*Display Mode*

This is not a single key but rather a key sequence. This sequence is:

1. Press Cmd.
2. Press and hold the ⇧ (Shift) key.
3. Press the ~ Grave Accent key on the typewriter-like keyboards or the leftmost blank key on the top row of the data-entry keyboards.

The display mode allows the operator to adjust the display to the operator's preference. Normally, the display is light characters with a dark background; using display mode, the operator can change this to dark characters on a light background.

*Erase Input*

This works only on the unprotected fields that the operator has modified. When the operator presses the (Shift) key along with the Erase Input/Home key, all the modified fields are cleared to nulls and the cursor is moved to the insert cursor (IC) address specified in the last Write to Display command (see the index entries: *Write to Display command* and *IC order*). The MDT bit remains on. If no IC has been specified, the cursor defaults to the first nonbypass field, or if there is no nonbypass field, to row 1, column 1 (the first input field).

*Error Reset*

Depending on the state of the system, pressing this key resets one of the following: operator error state, command mode, system request state, or insert mode (see the index entry: *states*). During these states, using the key restores the original data on the error line of the display and resets the state. Note, however, that during the operator error state this key is not operational from the time the operator uses the Help key to the time he receives the Write Error Code command and contents from the host system. (The Write Error Code command and contents are issued by the host in response to the operator using the Help key.)

*Hex Key Function (Multinational Character Set Only)*

By using the command function of the Grave Accent key on the typewriter-like keyboard or the first key on the top row (to the right of the Command key) on the data-entry keyboards, the operator can enter hexadecimal codes from the keyboard to generate any EBCDIC character needed for input and display[1].

Press the key for the first character of the hexadecimal code you want to enter (only 4 through 9 or A through F are valid).

Press the key for the second character of the hexadecimal code you want to enter (0 through 9 or A through F are valid).

**Note:** FF is not a valid hexadecimal combination that can be entered on the 5251 Model 1 or 11, Model 2 or 12, or 5252.

[1]The Grave Accent key is blank or has another character represented on some World Trade typewriter-like keyboards.

*Home*

This key moves the cursor to the position specified by the insert cursor (IC) address. The IC is in the last Write to Display command (see the index entries: *Write to Display command* and *IC order*). If there is no IC order, the default is to the first nonbypass input field or, if there is none, to row 1, column 1 (the first input field). If the cursor is already in the home position when the operator uses the key, the key functions as the Record Backspace key.

*Ins*

This key sets the insert state for the field the operator is in. The state must be reset before the operator is allowed to leave the field. (Using the Help, Reset, or Enter/Rec Adv key resets the state.)

⇧ *(Shift) and* ⇩ *(Shift Lock)*

There are two Shift keys and one Shift Lock key on the typewriter keyboard. The shift keys not only put the keyboard into an uppershift condition, but also act in conjunction with the Sys Req, Del, and Roll keys to perform special functions. See the index entry: *inhibit downshift function.*

When pressed, the ⇩ (Shift Lock) key sets the keyboard in the uppershift condition, and this condition remains when the key is released. To unlock the keyboard, the operator must press one of the two Shift keys. If the operator presses a Shift key along with a special function key, the inhibit downshift function may be enabled.

ALPHA *(Alpha) and* NUM *(Numeric) Shifts*

There are two shift keys on the data-entry keyboards. The Alpha Shift key puts the keyboard into lower shift when the operator wishes to select lower symbols on the keytop in a programmed numeric field. The Numeric Shift key is used to select upper symbols on a keytop when in a programmed alpha field and also to select upper shift command functions.

There is no Shift Lock on the data-entry keyboards.

## Special Host Keys

The special host keys are Sys Req and Test Request. See Figure 47.

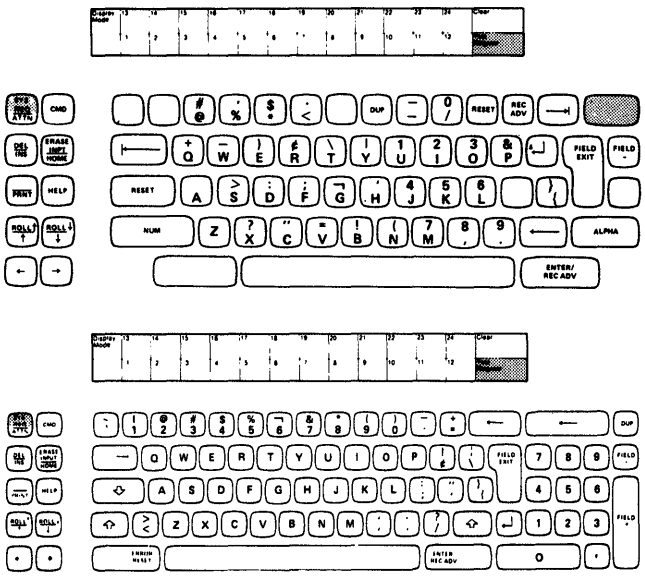


**Figure 47. Special Host Keys**

*Sys Req*

This key allows the display to enter the system request state (see the index entry: *system request state*). The key will not work when the display is in an error or SS state or when the controller is processing a Read, Write, Roll, Save, Restore, Write Error, or Copy command. See the index entry: *display, commands*. Otherwise, the key is operational when the keyboard is in the locked or unlocked state. When Sys Req is used to exit a field, all field requirements must be met or an error occurs and Sys Req is ignored. See the index entry: *fields* for a description of the field restrictions.

Using the Sys Req key results in the following actions:

- Data on the error line is saved.
- The error line is cleared.
- A column separator, underscore field attribute is supplied for column 1 of the error line.
- The cursor is located under column 2 and polling for keystrokes begins.

When the LU is in the system request state, a message can be entered. When the operator presses the Enter/Rec Adv key, the controller sends the message to the host system on the SS-LU flow. No cursor address or aid codes are returned, embedded and leading nulls are converted to blanks, and trailing nulls are stripped. The resulting recovery depends on the state of the LU:

- If the LU was in an LU-LU session, the previous contents of the error line are restored and the LU is returned to its pre-system request state.
- If the LU was in an SS-LU session, the message stays on the display but has normal attributes assigned. The LU returns to the pre-system request state.
- If the LU had not been activated, it is restored to its pre-system request state and an operator error of 004X, 005X, or 0099 is posted. See the index entry: *operator error codes* for details.

Any replies sent on the SS-LU (FMD) session are posted on the error line. When the operator presses the Error Reset key, the previous contents of the error line are restored and the LU returns to its pre-system request state.

- *Test Request*

Test Request is not a key but rather a sequence of keys. This sequence is:

1. Press and release the Cmd key.
2. Press and release ←—(Character Backspace) on the typewriter-like keyboard or the rightmost blank key on the top row of the data-entry keyboards.

This results in the controller issuing Reqtest (see the index entry: *Reqtest command*) to the host system to request a set of test routines to be sent to the controller.

This key locks the keyboard but requires no Read command to generate an aid code.

## MDT BIT

There is an MDT bit for each input field and there is a master MDT bit. The host system programmer can set the MDT bit for a field and the master MDT bit by coding bit 4 of the field format word in the SF order of the Write to Display command; the operator sets the master MDT bit and the MDT bit for a field any time he keys data into or alters the field. These bits are used to determine which fields the controller should send the host system in response to the Read MDT command. Once the bits are set, only a control character for resetting it, a Clear Unit or Clear Format Table command, or an SOH order can reset them. See these index entries: *field format words; display, commands; orders;* and *control characters, display* for details.

## MODEMS

There are basically two types of modems: synchronous and nonsynchronous. In a synchronous modem, the clocking signals are generated within the modem and sent to the 5251 Model 2 or 12 for clocking purposes. In the nonsynchronous modem, a clock in the 5251 Model 2 or 12 (see the index entry: *clock*) must supply the synchronization for signals to be sent to and from the host system.

## MODES–SDLC

This topic describes the SDLC/SNA modes that 5251 Models 2 and 12 supports; if you want information about the keyboard/display and printer modes, see *States and Modes* in this section. These are the available SDLC modes; when the controller does not support the mode, it is marked not supported:

- NRM (normal response mode): For 5251 Models 2 and 12, this means that the work station/controller has entered an operational mode by receiving an SNRM that will allow informational interchange.

- NDM (normal disconnect mode): For 5251 Models 2 and 12, this means that the Models 2 or 12 is in a disconnected state that will not allow informational interchange (except XID or Test information). SNRM, XID, DISC, TEST, and CFGR commands are accepted and acted upon. All other commands are responded to with DM. In this mode, no I or supervisory frames are allowed to be sent. See the index entries: *SDLC, commands and responses* and *frames.*

## MULTINATIONAL CHARACTER SET

The Multinational Character Set is a feature that contains a 188-character set and supports the hexadecimal usage and diacritic keys on the 5251 and the 5252. For more information, see the description of the Multinational Character Set under *EBCDIC Character Sets.*

## NEGATIVE RESPONSES

The state of the LU determines the sequence of actions that results from either of the following kinds of errors: (1) hardware failures or (2) data stream errors or contention.

### *Hardware Errors*

If the LU is receiving RU chains from the host system and a hardware error occurs, the controller sends the host system a negative response followed by the Rshutd command and Lustat command.

If the LU is sending RUs or not sending or not receiving RUs when a hardware error occurs, the controller sends an Rshutd and Lustat command to the host system. See the index entry: *Rshutd command.*

### *Data Stream or Contention Errors*

If the LU is receiving RU chains from the host system when a data stream error or contention occurs, the controller issues a negative response to the host system.

If the LU is sending RU chains when a data stream error or contention occurs, the controller sends a Cancel command followed by a Lustat (indicating the error has been sent to the host system). A Lustat is sent when a contention error is cleared. See the index entries: *Cancel command* and *Lustat command* for details.

*Contents of the Negative Response*

The negative response is an 8-bit code that has the following format:

| Major/Minor Code | User Byte 1 | User Byte 2 |
|---|---|---|
| xxxx | yy | zz |

The Major and Minor code is a standard SNA code that identifies the error class. User byte 1 identifies the failing component:

for yy:

00=SNA data, SS-PU error, or
cluster feature controller error
01=display
02=printer

User byte 2 identifies the specific error. The following chart gives detailed information about these contents.

| Major Minor Code (xxxx) | User Code Byte 1 (yy) | User Code Byte 2 (zz) | Description |
|---|---|---|---|
| (All code is shown in hexadecimal.) | | | |
| 0801 | 00 | 00 | Resource is not available. |
| 0811 | 02 | zz | Break |
| | | 00 | Cancel from printer while not in error state. |
| | | 01 | Cancel from printer while in error state. |
| 0813 | 00 | 00 | Begin bracket indicator on in RQ. |
| 0815 | 00 | 00 | Bind received but LU already active. See the index entry: *Bind command.* |
| 081C | yy | zz | Hardware error. |
| | 00 | zz | Controller error. |
| | | 70 | Invalid sense information. |
| | | 72 | Cable overrun condition. |
| | | 73 | Send hardware failure. |
| | | 98 | Undefined hardware error. |
| | 01 | zz | Display failure. |
| | | 00 | No response. |
| | | 01 | Transmit activity check. |
| | | 03 | Receive parity check. |

| Major Minor Code (xxxx) | User Code Byte 1 (yy) | User Code Byte 2 (zz) | Description |
|---|---|---|---|
| | | 04 | Send parity check. |
| | | 06 | Receive length check. |
| | | 07 | Wrong station response. |
| | | 08 | Power on transition. |
| | | 09 | Missing activate Read/Write response. |
| | | 20 | Invalid command. |
| | | 21 | Invalid register value. |
| | | 22 | Storage or input queue overrun. |
| | | 23 | Null/attribute exception check. |
| | | 24 | Invalid activate. |
| | | 25 | Undefined exception response. |
| | | 49 | Invalid bit in poll response. |
| | | 89 | Invalid outstanding status. |
| | | 90 | Even/odd change in status time-out. |
| | | 91 | Busy time-out or invalid busy. |

| Major Minor Code (xxxx) | User Code Byte 1 (yy) | User Code Byte 2 (zz) | Description |
|---|---|---|---|
| | 02 | zz | Printer hardware failure. |
| | | 00 | No response. |
| | | 01 | Transmit activity check. |
| | | 03 | Receive parity check. |
| | | 04 | Line parity check. |
| | | 06 | Receive length check (wrong number of bytes, poll or read status). |
| | | 07 | Wrong work station responded. |
| | | 08 | Power-on transition (in session). |
| | | 20 | Invalid command. |
| | | 21 | Undefined exception station (110). |
| | | 22 | Input queue or storage overrun. |
| | | 23 | Line parity error during active sequence should have been reported 0204). |
| | | 24 | Invalid activate. |
| | | 25 | Undefined exception status (011). |
| | | 90 | Even/Odd Status time-out. |
| | | 91 | Hardware busy time-out. |

| Major Minor Code (xxxx) | User Code Byte 1 (yy) | User Code Byte 2 (zz) | Description |
|---|---|---|---|
| 0821 | 00 | 00 | Invalid session parameters in Bind or Actlu command. |
| 0829 | 01 | 00 | CD bit not sent with request that requires it; for example, CD not sent with a Save, Read Screen, or Read Immediate command. |
| 082D | 01 | 00 | The command is valid but has been rejected because the display is in a mode that does not support the command. (For example, display error line is in use.) Chain processing ceases. **Note:** The host system should send a null RU with CD on if this -rsp is received on the LU-LU flow. The controller will send Lustat X00010000 when the contention condition has cleared. |
| 1003 | yy | zz | Actlu or Bind type not supported. See index entries: *Actlu, command* and *Bind command.* |
| | 00 | 00 | |
| | 01 | 01 | Invalid data stream command. |
| 1005 | yy | zz | Parameter error. All chain chain processing stops. |
| | 01 | zz | Display data stream error. |
| | | 21 | Premature data stream termination. |
| | | 22 | Invalid row and column parameters in SBA, IC, or RA order. See index entry: *orders.* |
| | | 23 | The address in the RA order is less than the display address. See the index entry: *RA order.* |
| | | 25 | Invalid SF order field length. See the index entry: *SF order.* |
| | | 26 | Invalid SF order starting address. See the index entry: *SF order.* |
| | | 27 | Invalid data following Restore command. See the index entry: *Restore command.* |
| | | 28 | Attempt to define a field past the end of the display. |
| | | 29 | Format table overflow. |
| | | 2A | Attempt to write data past the end of the display. |
| | | 2B | Invalid SOH length. See the index entry: *SOH order.* |
| | | 2C | Parameter error in the Roll command. See the index entry: *Roll command.* |
| | | 2D | Reserved. |
| | | 2E | Reserved. |
| | | 2F | Reserved. |

| Major Minor Code (xxxx) | User Code Byte 1 (yy) | User Code Byte 2 (zz) | Description |
|---|---|---|---|
| | | 30 | Invalid SF order screen attribute. See the index entry: *SF order.* |
| | | 80 | Printer in session. See the index entry: *Copy to Printer Feature.* |
| | | 81 | The LSID is not valid for the printer. See index entry: *Copy to Printer feature.* |
| | 02 | zz | Printer data stream error. See index entry: *printer, data stream.* |
| | | 28 | Invalid SNA SCS command. See index entry: *control characters, printer.* |
| | | 29 | Invalid SNA SCS parameter. See the index entry: *control characters, printer.* |
| 2002 | 00 | 00 | Chaining error detected. |
| 2004 | 00 | 00 | Request received while in send state. |
| 8004 | 00 | 00 | The specified LSID is not assigned to an LU. See the index entry: *addressed.* |
| 8005 | 00 | 00 | A request is issued to an LU that is not in session. See the index entries: *Bind command* and *Actlu, command.* |

## OPERATOR ERROR CODES

When the controller posts an operator error to the display, the controller performs the following actions:

1. Locks the keyboard.
2. Determines the error display line by using byte 5 of the SOH order (see the index entry: *SOH order*) or defaults to the last line.
3. Saves the contents of the error display line.
4. Writes a screen attribute and a four-digit error code to the error display line. The beginning screen attribute is a high intensity blink (see the index entry: *screen attributes*) and the trailing screen attribute is nondisplay.
5. Positions the cursor at the error and then blinks the cursor.
6. Polls the locked keyboard looking for the operator to press one of the following keys:
   a. Attn: When pressed, the controller sends this to the host system as a Signal command. See the index entry: *Signal, command and response.*
   b. Help: When pressed, the controller:
      (1) Changes the leading screen attribute of the error message to a high-intensity no-blink.
      (2) Sends the Signal command, which includes the 2-byte error code. If the host system does not respond with a Write Error Code command and text, the keyboard remains locked. See the index entry: *Signal, command and response* for details.
      (3) Waits for the operator to press the Error Reset key. If instead the operator presses Help again, the controller sends a Signal command containing bytes 2, 3, 4, and 5 of the error message back to the host.
   c. Error Reset: When pressed, the controller:
      (1) Restores the contents of the area that had been saved, when the error code was written, back to the display.
      (2) Leaves the cursor at its current position.
      (3) Unlocks the keyboard and allows the operator to enter data.

**Note:** All other keys except the shift keys, which are always valid, are ignored.

The following chart lists all the operator error codes, describes their causes, and indicates the cursor position after the error.

| Error Code | Cursor Location | Description |
|---|---|---|
| 0001 | X | Keyboard overrun. |
| 0002 *Logged* | X | Invalid scan code received from a 5251 Model 1, 11, 2, or 12. |
| 0003 | X | Invalid command (Cmd) key. |
| 0004 | X | The operator is trying to key into an I/O field. |
| 0005 | X | The operator is trying to use a Field Exit, Field+, Field-, Del, Ins, data key, or Magnetic Stripe Reader card when the cursor is either not in an input field or is in a protected field where these inputs are not permitted. See the index entry: *fields* for additional information. |
| 0006 | X | The operator tried to use an invalid key during the system request state. See the index entry: *Sys Req key* for details. |
| 0007 | S | The operator has not entered a mandatory enter field (see the index entry: *fields*). |
| 0008 | X | The operator has tried to enter a nonalphabetic character in an alphabetic-only field (see the index entry: *fields*). |
| 00009 | X | The operator has tried to enter a nonnumeric-only character in a numeric-only field (see the index entry: *fields*). |
| 0010 | X | The operator has tried to enter a nonsigned numeric character in a signed numeric field. See the index entry: *fields*. |
| 0011 | X | The operator has tried to enter a character into a sign position of a signed numeric field. See the index entry: *fields*. |
| 0012 | X | Either the operator is trying to insert a character into the last position of a field or the last position is not X'00'. |
| 0013 | X | The operator is trying to leave the field before resetting the insert mode. |
| 0014 | S | A mandatory fill field contains a null. See the index entry: *fields*. |
| 0015 | S | There is a check-digit error in modulus 10 or 11. See the index entries: *field format word* and *self-check feature*. |

| Error Code | Cursor Location | Description |
|---|---|---|
| 0016 | X | The operator pressed the Field- key in a non-numeric field. See the index entry: *fields*. |
| 0017 | S | The operator pressed a Field Exit, Field-, or Field+ key in a mandatory fill field and the cursor is not:<br>• In the first position of the field<br>• AWFER in the last position of a filled field<br>• At the sign position of a signed numeric field<br>See the index entry: *fields*. |
| 0018 | X | The operator has pressed Dup or a data key from AWFER. The cursor blinks. |
| 0019 | X | The operator has used the Dup key and it is not allowed. |
| 0020 | X | The operator has pressed one of the following keys from an active right-adjust field and this is not allowed:<br>Enter/Rec Adv<br>Roll<br>Clear<br>Test Request<br>Help<br>Record Backspace (Home)<br>Sys Req/Attn<br>Print<br>Command Function (1-24) |
| 0021 | X | The operator has used a Field Exit, Field+, or Field- key in a mandatory enter field from:<br>1. Position 1.<br>2. Before entering any data into the field. |
| 0022 | X | A parity error has occurred. The state of the delete or insert attempt is unknown. |
| 0023 | X | The operator used an invalid hexadecimal code. Only 4 through 9 and A through F are allowed for the first character of the code; 0 through 9 and A through F are allowed for the second character of the code. |
| 0026 | X | The operator has used the Field- key in the last digit of a numeric-only field but the digit is not 0-9. See the index entry: *fields*. |
| 0027 | X | The operator has pressed a blank key. |
| 0028 | X | The operator has tried to use an inactive key. |
| 0029 | X | The operator entered a diacritic that was not valid for the character that was to be accented. |
| 0031 | X | Too much data was received from the magnetic stripe reader. |
| 0032 | X | The work station/controller did not receive the data from the magnetic stripe reader correctly. |

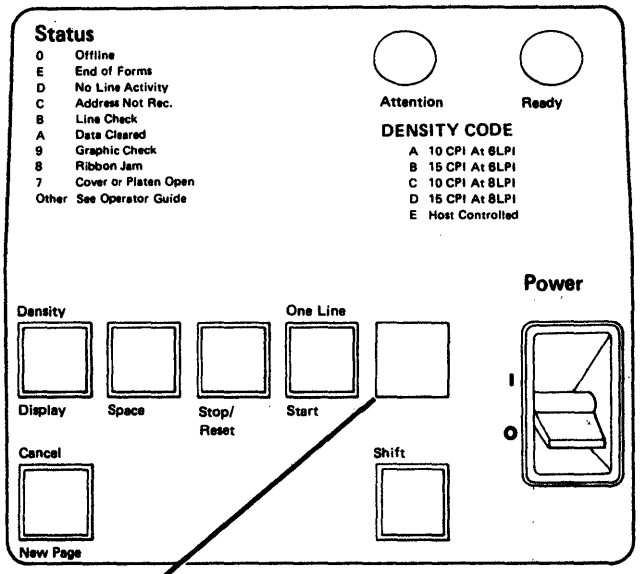
| Error Code | Cursor Location | Description |
|---|---|---|
| 0033 | X | The operator entered an operator ID through the magnetic stripe reader, but input is not allowed at this time. |
| 0034 | X | Data received from the magnetic stripe reader exceeded the length of the input field. |
| 0035 | X | The data received from the magnetic stripe reader is invalid for one or more of the following reasons:<br>– The card was inserted incorrectly into the magnetic stripe reader.<br>– The card was incorrectly made.<br>– The card is damaged and/or data is erased. |
| 0036 | X | The operator attempted to use the selector light pen before completing the current field. The current field must be exited before the light pen can be used. |
| 0037 | X | The selector light pen tip switch has been activated, but the field the operator chose is not a valid selectable field. |
| 004Y *Logged* | Z | A key that is either aid- or signal-generating (see the index entries: *Signal keys* and *aid-generating keys*) was used and requires host system action, but a problem exists in the communication adapter:<br>Y=0 Data set ready off<br>2 Lost clocking (receive)<br>3 DSR will not go inactive (switched line only)<br>4 30-second time-out expired (switched line only) |
| 005Y *Logged* | Z | A key that is either aid- or signal-generating (see the index entries: *Signal keys* and *aid-generating keys*) was used and requires host system action, but a problem exists in the communication adapter:<br>Y=0 Clear to send<br>1 Lost clocking (transmit)<br>2 Hardware failure<br>4 CMDR sent last (See the index entry: *CMDR*). |
| 0097 | X | The programming required for the test request function is not installed in the host system. |
| 0099 | Z | An aid- or signal-generating key was used when the device was not in a LU-LU session. See the index entries: *aid codes*, *aid-generating keys*, *Signal keys*, and *Signal, command and response*. |

*Legend:*

S Cursor moves to the start of the field.
X Cursor remains at its present position.
Y Value varies.
Z Cursor moves to row 1, column 2 when the operator uses an aid-generating key.

## OPERATOR PANEL DISPLAY

The 5225 printer uses an LED to display various informational codes to the operator. This operator panel display is located on the 5225 control panel and alternately displays status and density codes, most of which are described on this same panel. For more information about these codes, see the *5225 Operator's Guide*.




Operator Panel Display

## ORDERS

Five orders appear in the write commands that are in the output data stream (FM LU-LU flow) for the keyboard/display LUs. (The output data stream is what the host system sends the LU via the controller in the SNA RU.) The orders specify the characteristics of the display. These orders are:

- Insert cursor
- Repeat to address
- Set buffer address
- Start of field
- Start of header

The heading *Display Data Stream Commands* in this section describes how the orders are coded within the output LU-LU commands. Figure 48 illustrates the sequence of the orders.

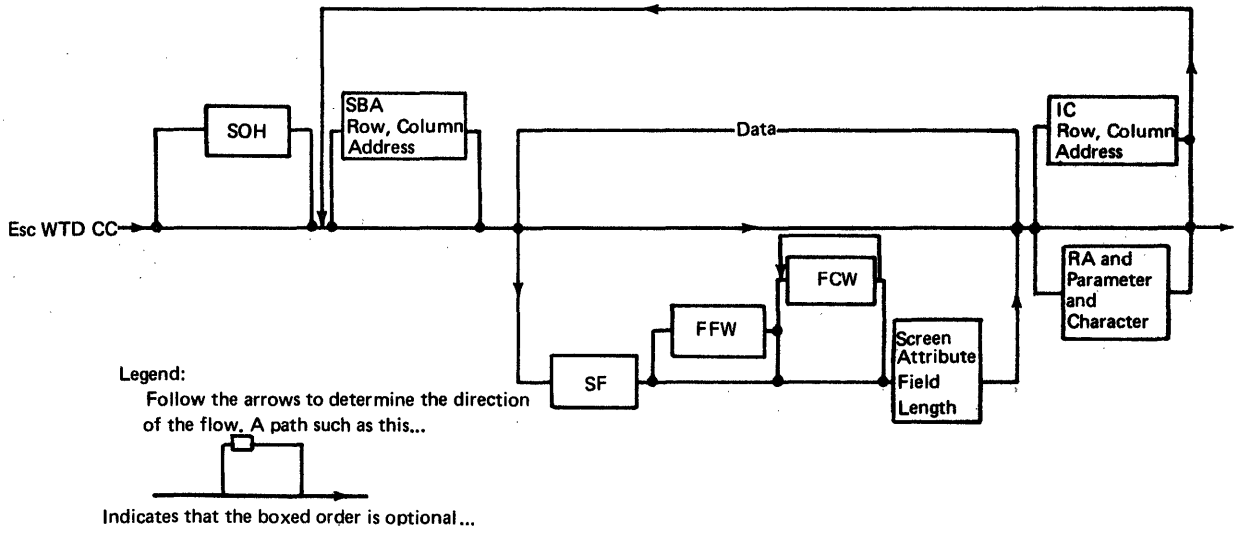



**Figure 48. Orders**

The following description gives specific information about each order.

*Insert Cursor (IC) Order*

*Function:* This order (1) sets the system IC (insert cursor) address to the location specified by the 2 bytes that follow the order when it is included in the Write to Display command or (2) moves the cursor to the specified address without affecting the system IC address when it is included in Write Error Code command. Byte 1 gives the row address and byte 2 gives the column address. See index entries: *Home key* and *display, commands.*

**Note:** If there are more than one of these in the keyboard/display output data stream (LU-LU commands from host system to controller for LU), only the last one is saved. It is used as the home address (system IC address) for the Home function.

*Restrictions:* A parameter error is posted when:

1. There are less than two bytes following the order.
2. The row address equals 0 or is greater than
   a. 24 for Model 12 (1920 character) or
   b. 12 for Model 2 (960 characters)
3. The column address equals 0 or is greater than 80.

*Format:*

| Insert Cursor Order Hex 13 | Byte 1 (Row Address) | Byte 2 (Column Address) |
|---|---|---|

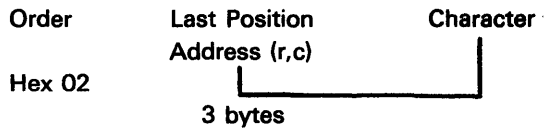
*Results:*

1. When used in the Write to Display command, the cursor is not immediately moved; the address is saved for later use.
2. When used in the Write Error Code command, the cursor is moved to the address given in the IC order and does not affect the system IC address. The cursor exits the field regardless of the type and does not perform any field checks (for example, it does not check for a filled field for a field specified as mandatory fill).

*Repeat to Address (RA) Order*

*Function:* This order displays a character in every position starting from the current display address and going to the last position specified by this order. If these two addresses match, one character is displayed.

*Format:*




*Restrictions:* A parameter error is posted when there are less than three bytes after the order, there is a row address value equal to 0 or greater than 24 for Model 12 (1920 characters) or 12 for Model 2 (960 characters), or there is a column address value greater than 80 or equal to 0. It is also rejected if the specified ending address is less than the current display address.

**Note:** Although any character can be repeated, avoid using hex 11 (SBA), because this value is used as the delimiter between the fields sent in response to the Read MDT command.

*Results:* The character is repeated from the current display address through the ending display address specified. The current display address is then updated to the value of the last position +1.

*Set Buffer (SBA) Address*

*Function:*

- Read: Used as a delimiter between fields that are sent back to the host system in response to the Read MDT command. See the index entry: *Read MDT Fields command.*
- Write: Used to set the current display address and thereby determines where the data display or field definition begins. Two bytes that follow this order tell the controller this information.

*Restrictions:* A parameter error is posted when:

1. There are less than two bytes following the order.
2. The row address is equal to 0 or greater than 24 for Model 12 (1920 characters) and 12 for Model 2 (960 characters).
3. The column size is equal to 0 or greater than 80.

*Default:* When the SBA is not specified in the Write to Display, the data starts at row 1, column 1 because this is where the Write to Display command initializes it. See the index entry: *Write to Display command.*

*Format:*

| Set Buffer Address Order Hex 11 | Byte 1 (Row Address) | Byte 2 (Column Address) |
|---|---|---|

*Start of Field (SF)*

*Function:* This order defines the input and output fields. If an input field is being defined, it also resets any pending aid byte and locks the keyboard.

**Note:** Although this order can be used for output fields, it is not recommended because it degrades performance. Use the SBA order instead.

*Restrictions:* A parameter error is posted when:

1. The output data stream ends before the given number of bytes have been sent.
2. The field length is equal to 0 if the field is not signed numeric. If the field is signed numeric, either a 0 or a 1 causes an error.

   **Note:** The length byte is ignored when modifying an entry in the format table.
3. The address for the end of the field exceeds the end of the display.
4. The input field addresses are not in ascending order. For input fields defined by previous Write to Display commands, this must be equal to the starting address of an already specified field or greater than the last field already defined.
5. Too many input fields are defined for the display.
6. Invalid screen attribute is specified.
7. The defined input field overlays a previously defined field.

*Format:*

| SF Order Hex 1D | 2 Byte Field Format Word | 2 Byte Field Control Word | 1 Byte Screen Attribute (See Note) | 2 Byte Field Length |
|---|---|---|---|---|
| | (optional) | (optional) | | |
| | 1 or more | | | |

**Note:** See the index entry: *screen attributes.* Bits 0-2 must be in the format B'001xxxxx' or else an invalid screen attribute error is posted. All other bits are described in the screen attributes text.

*Results:*

1. The display address is set to the end of field address (as specified by the last SF order) +1. This does not happen if this is the first SF order or if an SBA order precedes it.
2. The screen attribute in the SF order is written in the location defined by the display address.
3. The start-of-field address is set to the display address +1.
4. The end-of-field address is set to the display address + the field length (see Notes) specified in the SF order.
5. The ending screen attribute (hex 20) is supplied by the controller and written (see Notes) at the end-of-field address + 1.
6. The display address is incremented by 1.
7. If this is an input field (one in which a field format word has been specified), a format table entry consisting of the field format and field control words is generated. In addition, if the SF order is rejected, the keyboard is locked and any outstanding aid byte is cleared. (See Notes 1, 2, and 3.)

**Notes:**

1. Format Table Modification: If the display address + 1 is equal to the starting address of an input field that was previously defined, then:
   a. The field format word of the previously defined field is overlaid with the new field format word.
   b. All field control words and length parameters that were specified are ignored. Two bytes, however, are still required for the length parameter even though no value check is made against them.
   c. The field ending address is set equal to the field's original ending address.
   d. Writing the screen ending attribute at the end of the field is suppressed.
2. The defined field is not filled with nulls; if you require nulls in the field, use the Clear Unit command prior to issuing the Write to Display command.
3. If the SF order is rejected due to an error condition, the keyboard will be locked and the aid codes cleared; however, all other operations associated with the SF order will be suppressed and the format table will be intact.

*Start of Header (SOH)*

*Function:* This order specifies the header information that goes into the format table (see the index entry: *format table*). It also selects the resequencing function when data is read from the display. See the index entry: *field control words*.

*Restrictions:* A parameter error is posted when the output data stream ends before the number of bytes needed have been sent or the first byte of the order is not between 1 and 254.

*Format:*

| Order | Length | Variable Bytes |
|---|---|---|
| Hex 01 | (Note 1) | (Note 2) |

**Notes:**

1. The length byte determines the number of header bytes following the length byte, but not counting the length byte. It must be greater than 0 and less than 255.
2. This chart shows what the bytes following the length byte can contain:

| Byte | Description |
|---|---|
| 1 | Reserved |
| 2 | Format ID - from hex 00 to hex FF |
| 3 | Hex 00 = no resequencing (all resequencing field control words are ignored).<br>Hex xx = resequence per field control words in format table. See the index entry: *field control words*.<br>(For example, xx = 01 = field 1)<br>Byte 3 also points to the first field to be returned when the Read Input Fields/Read MDT command is serviced. |
| 4 | Row address of the operator error line. If this is unspecified or out of range, the error line defaults to the last line of the display. |
| 5-7 | These are the data-included switches for the command function keys (see Note). |

| Byte | Bit | Command Function Key |
|---|---|---|
| 5 | 0 | 24 |
| | 1 | 23 |
| | 2 | 22 |
| | 3 | 21 |
| | 4 | 20 |
| | 5 | 19 |
| | 6 | 18 |
| | 7 | 17 |
| 6 | 0 | 16 |
| | 1 | 15 |
| | 2 | 14 |
| | 3 | 13 |
| | 4 | 12 |
| | 5 | 11 |
| | 6 | 10 |
| | 7 | 9 |
| 7 | 0 | 8 |
| | 1 | 7 |
| | 2 | 6 |
| | 3 | 5 |
| | 4 | 4 |
| | 5 | 3 |
| | 6 | 2 |
| | 7 | 1 |

**Note:** If the mask bit=0, then the field data is returned via the Read MDT or Read Input Fields command when the command function key is pressed. If the mask bit=1, only the cursor address and aid code are returned. Remember, if all three data included bytes are not coded, the Cmd and command function keys will act like aid-generating keys and return the cursor address, aid code, and data in the input fields to the host system when they are used.

## P/F BIT

The P/F (poll/final) bit is a single bit that is in the control field of every SDLC frame type (Supervisory, Nonsequenced, and Information). When the host system sends an SDLC frame to the controller, the bit becomes the poll bit. When the poll bit is on, it indicates that the host system's transmission is complete; it also demands an immediate response from the controller. When the controller sends an SDLC frame to the host system, the bit becomes the final bit. When the final bit is on, it indicates that the controller's transmission is complete.

## PACING

Byte 9 of the Bind command (see the index entry: *Bind command*) contains a parameter that allows the user to determine the rate at which the receiver can accept data via the SNA data flow. This ability to control the rate of transmission of data is called pacing. The host system should use a pacing count of 0 (no pacing) when it transmits to the keyboard/display units and a pacing count of 3 when it transmits to the printer. **Note:** If the host system wants to pace the display, its pacing value should be placed in byte 8 of the Bind request.

## RH (REQUEST/RESPONSE HEADER)

The RH (request/response header) consists of three bytes. These 3 bytes follow the TH and immediately precede the RU part of the SDLC frame. The following describes specifically what each byte in the RH stands for:

| Byte | Bit | Description |
|---|---|---|
| 0 | | |
| | 0 | When on, the RU is a response. |
| | 1-2 | RU type.<br>See Note 1. |
| | 3 | Set to 0. |
| | 4 | Format Indicator.<br>See Note 2. |
| | 5 | When on, sense data is included.<br>See index entry: *negative response.* |
| | 6 | When set to 1, FOC.<br>See Note 3. |
| | 7 | When set to 1, LOC.<br>See Note 3. |

| Byte | Bit | Description |
|---|---|---|
| 1 | | |
| | 0 | When on, sets RQD. See Note 4. |
| | 1 | Set to 0. |
| | 2 | Set to 0. |
| | 3 | When on, sets RQE. See Note 4. |
| | 4 | Set to 0. |
| | 5 | Set to 0. |
| | 6 | Queued response indicator. |
| | 7 | Pacing indicator. See Note 5. |
| 2 | | |
| | 0 | Set to 0. |
| | 1 | Set to 0. |
| | 2 | When set to 1 indicates change direction. See index entry: *CD*. |
| | 3-7 | Set to 0. |

**Notes:**

1. The valid values of these 2 bits for the RU types are as follows:

   00 = FM data
   10 = data flow control
   11 = session control

   See the heading, *Protocols and Synchronization for 5250 Implementation of SNA* in Section 1.
2. Bit 4 of byte 0 determines whether an SNA formatted command is in the RU.
3. 

| Bit 6 | Bit 7 | Meaning |
|---|---|---|
| 0 | 0 | MOC |
| 1 | 0 | FOC |
| 0 | 1 | LOC |
| 1 | 1 | OIC |

4. Byte 1, bit 0 is always on. If it is on but bit 3 is off, RQD is selected. If bit 3 is on, RQE is selected.
5. When on in an RQ (request), this indicates that the first of *n* more RUs are being sent. When on in an RSP (response), this indicates that *n* more RQs may now be sent.

## RU (REQUEST/RESPONSE UNIT)

The RU (request response unit) contains all the commands and data sent between the host system and the controller. It is immediately preceded by the TH and RH. The Ru, together with the TH and RH, form the PIU (path information unit). The RUs can be a maximum of 256 bytes long; however, FMD RUs may be chained together if more than 256 bytes need to be sent by marking the RUs relative to their position in a chain by bits in the RH.

| | | |
|---|---|---|
| ESC Hex 04 | Command Code and associated data (See the index entry: *display, commands.*) | ESC More Cmds |

See also the heading, *Protocols and Synchronization for 5250 Implementation of SNA* in Section 1.

## SCREEN ATTRIBUTES

The screen attributes are 8 bits long; they reside in the regeneration buffers and control the characteristics of the display. They are coded in the SF order or may be embedded with other display data following the Write to Display command. See the index entries: *SF order* and *display, commands*. Each bit has a specific reference to the display. These bits determine how the information is going to be displayed.

They show as blanks on the normal display. The meanings of the bits are as follows:

| Bit | Code | Meaning |
|---|---|---|
| 0-2 | 001 | Identifier |
| 3 | 0 | No column separator |
| | 1 | Column separator |
| 4 | 0 | No blink |
| | 1 | Blink |
| 5 | 0 | No underscore |
| | 1 | Underscore |
| 6 | 0 | Low intensity |
| | 1 | High intensity |
| 7 | 0 | No reverse |
| | 1 | Reverse |

**Note:** If bits 5, 6, and 7 are all 1's, then the field becomes a nondisplay.

## SDLC ERROR CODES

The SDLC error codes are the 006X error codes. They are placed in the error log when the controller counters that track SDLC transmission errors overflow or when the host system solicits the error log. They are never displayed automatically. The operator may display the counters that are formatted into these errors. See *Problem Determination Procedures* in the *IBM 5251 Display Station Models 2 and 12 Operator's Guide,* GA21-9323. See index entries: *error log; errors handling;* and *Reqms command.*

| Code | Description |
|---|---|
| 0060 | Bad test counter.<br>Used with the SDLC Test command for diagnostic purposes. |
| 0061 | Good test counter.<br>Used with the SDLC Test command for diagnostic purposes. |
| 0062 | Communications adapter underrun counter. |
| 0063 | Communication adapter overrun counter. |
| 0064 | Carrier detect glitch counter.<br>This happens when the carrier detect line is unexpectedly inactive. |
| 0065 | Clear to send glitch counter.<br>Happens if the clear to send line is unexpectedly inactive. |
| 0066 | Data set ready glitch counter.<br>Happens if the data set ready line is unexpectedly inactive. |
| 0067 | Frame sequence error counter.<br>Occurs when frame sequence errors occur. |
| 0068 | Transmit retry counter.<br>Happens each time a frame has to be retransmitted. |
| 0069 | CRC errors in FCS field.<br>Happens each time the FCS character does not match the expected FCS character. |

## SNA CHAIN END

The last RU in a chain is indicated by turning on the Last of Chain indicator (bit 7) in byte 0 of the RH.

## STATES AND MODES

The possible states of the keyboard/display are:

- Prehelp and Posthelp Error
- Hardware Error
- Normal Locked
- Normal Unlocked
  - Command Mode
  - Insert Mode
  - Data Mode
- Power on
- SS Message
- System Request

An explanation of each of the keyboard/display states and any accompanying modes follow.

### Prehelp Error State

The prehelp error state is the first that the keyboard enters when the operator makes a keying error. The programmer can also enter this error state by coding the Write Error Code command. The characteristics of this error state are that:

1. The keyboard is locked, the clicker is off, and the Input Inhibit indicator is on.
2. All keys except: Attn, Help, Reset, and the Shift keys are ignored.
3. The error line is saved.
4. The error code is posted.
5. The cursor blinks.

The operator can exit this state by pressing Error Reset; this returns the keyboard to its previous state. The operator can also choose to press the Help key and enter the posthelp error state.

### Posthelp Error State

The operator enters the keyboard into this state when he presses the Help key after an error has occurred. The characteristics of this error state are:

1. The keyboard is locked, the clicker is off, and the Input Inhibit indicator is on.
2. Only the Attn and Shift keys are operational.
3. The leading attribute on the error line becomes high intensity.

### Hardware Error State

The keyboard enters the hardware error state when a malfunction in the physical machine is detected. The characteristic of this state is that no keystrokes are processed. When the error is cleared, the exit is to the normal unlocked state (format level 0 selected). See the index entry: *format level 0*.

### Normal Locked State

This state is entered either by the operator pressing a key that requires host system attention or by the host issuing a command that locks the keyboard. These are the valid commands the host system can use to bring the keyboard/display into this state:

- Clear Unit
- Clear Format Table
- Write to Display (if the format table is altered)
- Restore (if Save was issued to a locked keyboard)

The characteristics of the locked state are that:

1. The keyboard is locked, the clicker is off, and the Input Inhibit indicator is on.
2. All keys except Sys Req, Attn, Print (Cancel), and the Shift keys are ignored.

The operator can exit this state by pressing the Sys/Req key. This places the keyboard/display in the System/request state. The programmer can exit this state by (1) issuing an unlock control character in a host command that will unlock the keyboard, (2) entering the SS message state, or (3) issuing an Actlu, Dactlu, Bind, or Unbind command. See these index entries: *control characters, display; SNA, commands; display, commands;* and *system request state.*

### Normal Unlocked State

The characteristics of this state are that:

1. The keyboard is unlocked (clicker on) and the Input Inhibit indicator is off.
2. Invalid keys cause errors.

The possible ways to enter the normal unlock state are via:

1. Host commands that contain CC to unlock the keyboard.

2. Operator pressing Error Reset after a keying error.

3. Operator performing one of the following reset operations when the original operation was initiated during a normal unlocked state:
   a. Error Reset following a Write Error command.
   b. Error Reset following a Sys Req key activation.
   c. Error Reset following an SS message.
   d. Error Reset following a Cmd key activation.

There are three modes within the normal unlock keyboard state. They are characterized in the following way:

*Command Mode*

This mode is selected by the operator when he presses the Cmd key. This mode cannot be entered when the keyboard is in the system request, normal locked, or error state or in the insert mode. The operator can exit from this by pressing the Error Reset key.

*Insert Mode*

This mode is selected by the operator when he presses the Ins key. When in effect, the Insert indicator is on. This mode cannot be entered if the keyboard is in the normal locked, or error state or in command mode. The exit is to the data mode when the operator presses the Error Reset key.

*Data Mode*

The operator enters this mode by keying or the programmer selects it with a CC. During this mode, the keyboard clicker is on, the Input Inhibit indicator is off, and the keyboard is unlocked. Exit to any of the other states is possible.

**Power-on State**

This is the state that occurs between the time the controller receives electrical power and the time it enters another state such as the system request state. During this time, it is in a free keying mode. Note that Free keying cannot occur if the controller is powered down. During this free keying mode, all functions that do not require the host system but that can be done under the control of the controller are allowed. The characteristics of this state are:

1. From row 1 and column 2 of the display to the end is considered one alphameric field.

2. The cursor movement and shift keys are functional.

3. Alphameric characters are accepted, translated, and returned to the display. The cursor is updated to the next entry position.

4. Functions that the controller can handle are operational. These are such things as Del, Ins, and Clear.

5. Function keys that require the host system cause errors when activated.

**SS Message State**

The host system enters the keyboard into this state by information contained in the inbound SS-LU data flow. The characteristics of this state are that:

1. The keyboard is locked, the clicker is off, the Input Inhibit indicator is on.

2. Invalid keys are ignored.

3. The error line is saved.

The operator exits this state by pressing the Error Reset key; the exit is to the previous state.

### System Request State

The operator initiates this state by pressing the Sys/Req key. The characteristics of the state are that the keyboard is unlocked. The error line is saved and filled with null characters. Use of invalid keys causes an exit to the error state. If the system request state was entered from the normal unlock state by the operator using the Sys Req key, the operator can reenter the normal unlocked state by pressing Error Reset; otherwise, input inhibited remains in effect.

Figure 49 shows the relationships of the various 5250 states to the keys.

**The Normal Unlocked State**

| Keys | Command Mode | Insert Mode | Data Mode |
|---|---|---|---|
| Alpha (shift) | Always valid. | Always valid. | Always valid. |
| Attn | Invalid. Causes an error. | Always valid. | Always valid. |
| Cancel<br>**Note:** Cancel is not a key. On the printer, it is the Cancel position of the Status switch and on the keyboard, it is the uppercase Print key. | Invalid. Causes an error. | Printer:<br>Ignores the key unless it is receiving SNA chains. Then it issues a -rsp to direct the user to stop sending chains. | Printer:<br>Ignores the key unless it is receiving SNA chains. Then, it issues a -rsp to direct the user to stop sending chains. |
| | | Keyboard:<br>Ignores the key unless the copy to Printer feature is installed and operating. Then it terminates the operation without causing an error. | Keyboard:<br>Ignores the key unless the Copy to Printer feature is installed and operating. Then it terminates the operation without causing an error. |
| ←—<br>(Character Backspace) | Not applicable. In the U.S. typewriter keyboard, this is the Clear and Test Request command function key. | Valid if the cursor does not leave the field. | Invalid if there is an attempt to leave a mandatory fill or self-check field without first satisfying the field requirements. |
| Clear | Always valid. Goes to the normal locked state and services any pending read commands by returning the clear aid code. If you are not in session, the controller clears the screen and format table. | Not applicable. The Cmd key is invalid in this mode. | Not applicable. The Cmd key exits from this mode. |
| Cmd | Always valid. | Invalid. Causes an error. | Invalid if a mandatory fill or self-check field was being keyed without satisfying the requirments of the field. |

**Figure 49 (Part 1 of 10). The Effects of the Keyboard/Display States on the Keys**

**The Normal Unlocked State**

| Keys | Command Mode | Insert Mode | Data Mode |
|---|---|---|---|
| Command Function Keys 1-24 | Invalid if there is an attempt to leave a field without first satisfying the mandatory fill, self-check, or right adjust requirements of the field. It causes a mandatory enter check if the master MDT bit is on. If it is valid, it goes to the locked state and services any pending read commands. | Not applicable. The Cmd key is invalid in this mode. | Not applicable. The Cmd key exits from this mode. |
| ↓(Cursor Down) | Invalid. Causes an error. | Valid if the cursor does not leave the field. | Invalid if an attempt is made to leave a mandatory fill or self-check field without first satisfying the field requirements. |
| ←(Cursor Left) | Invalid. Causes an error. | Valid if the cursor does not leave the field. | Invalid if an attempt is made to leave a mandatory fill or self-check field without first satisfying the field requirements. |
| →(Cursor Right) | Invalid. Causes an error. | Valid if the cursor does not leave the field. | Invalid if an attempt is made to leave a mandatory fill or self-check field without first satisfying the field requirements. |
| ↑(Cursor Up) | Invalid. Causes an error. | Valid if the cursor does not leave the field | Invalid if an attempt is made to leave a mandatory fill or self-check field without first satisfying the field requirements. |
| Data Keys | Invalid. Causes an error. | Validity depends on the format table, cursor location, and data on the display. | Same as for insert mode. |
| Del | Invalid. Causes an error. | Always valid. | Validity depends on the format table and cursor location. |
| Display Mode | Always valid. | Not applicable. The Cmd key is invalid in this mode. | Not applicable. The Cmd key exits from this mode. |
| Dup | Invalid. Causes an error. | Invalid. Causes an error. | Validity depends on the format table and cursor location. |

**Figure 49 (Part 2 of 10). The Effects of the Keyboard/Display States on the Keys**

**The Normal Unlocked State**

| Keys | Command Mode | Insert Mode | Data Mode |
|---|---|---|---|
| Enter/Rec Adv | Invalid. Causes an error. | Invalid if there is an attempt to leave a field without first satisfying the mandatory fill, self-check, or right adjust requirements of the field. Clears the insert mode. Causes a mandatory enter check if the master MDT bit is on. If valid, goes to the locked state, and services any pending read commands. | Invalid if there is an attempt to leave a field without first satisfying the mandatory fill, self-check, or right adjust requirements to the field. Clears the insert mode. Causes a mandatory enter check if the master MDT bit is on. If valid, goes to the locked state, and services any pending read commands. |
| Erase Input | Invalid. Causes an error. | Invalid. Causes an error. | Always valid. |
| Error Reset | Always valid. | Always valid. | Always valid. |
| Field+ (typewriter-like keyboard only) | Invalid. Causes an error. | Invalid. Causes an error. | Validity depends on the format table, cursor location, and data on the display. |
| Field - | Invalid. Causes an error. | Invalid. Causes an error. | Validity depends on the format table, cursor location, and data on the display. |
| ⟶\| (Field Advance) | Invalid. Causes an error. | Valid if the cursor does not leave the field. | Invalid if there is an attempt to leave a mandatory fill or self-check field without first satisfying the field requirements. |
| \|⟵ (Field Backspace) | Invalid. Causes an error. | Valid if the cursor does not leave the field. | Invalid if there is an attempt to leave a mandatory fill or self-check field without first satisfying the field requirements. |
| Field Exit | Invalid. Causes an error. | Invalid. Causes an error. | Validity depends on the format table, cursor location, and data on the display. |
| Help | Invalid. Causes an error. | Always valid. Goes to the normal locked state, and services any pending read commands. Clears the insert mode. | Valid except in active right-adjust fields. Goes to the normal locked state, and services any pending read commands. |

**Figure 49 (Part 3 of 10). The Effects of the Keyboard/Display States on the Keys**

**The Normal Unlocked State**

| Keys | Command Mode | Insert Mode | Data Mode |
|---|---|---|---|
| Home | Invalid. Causes an error. | Invalid. Causes an error. | Invalid if an attempt is made to leave a mandatory fill or self-check field without first satisfying the field requirements. |
| Ins | Invalid. Causes an error. | Always valid. | Validity depends on the format table and cursor location. |
| ←┘ (New Line) | Invalid. Causes an error. | Valid if the cursor does not leave the field. | Invalid if an attempt is made to leave a mandatory fill or self-check field without first satisfying the field requirements. |
| Num (Shift) | Always valid. | Always valid. | Always valid. |
| Print | Invalid. Causes an error. | Invalid. Causes an error. | Invalid if an attempt is made to leave a mandatory fill, self-check, or active right adjust field without first satisfying the field requirements. If valid, it goes to the locked state and services any pending read commands. |
| Record Backspace Function (**Note:** Record Backspace is not a key; it is a function performed by using the Home key when the cursor is at the home position.) | Invalid. Causes an error. | Invalid. Causes an error. | Valid any time except from an active right-adjust field. Goes to normal locked state and services any pending read commands. |
| Roll↓ (Roll Down) | Invalid. Causes an error. | Invalid. Causes an error. | Invalid if an attempt is made to leave a mandatory fill, self-check, or active right-adjust field without first satisfying the field requirements. If valid, it goes to the locked state and services any pending read commands. If the master MDT bit is on, it causes a mandatory enter check. |

**Figure 49 (Part 4 of 10). The Effects of the Keyboard/Display States on the Keys**

**The Normal Unlocked State**

| Keys | Command Mode | Insert Mode | Data Mode |
|---|---|---|---|
| Roll↑ (Roll Up) | Invalid. Causes an error. | Invalid. Causes an error. | Invalid if an attempt is made to leave a mandatory fill, self-check, or active right-adjust field without first satisfying the field requirements. If valid, it goes to the locked state and services any pending read commands. If the master MDT bit is on, it causes a mandatory enter check. |
| ⇩ (Shift Lock) (Typewriter-like only) | Always valid. | Always valid. | Always valid. |
| ⇧ (Shift Up) (Typewriter-like only) | Always valid. | Always valid. | Always valid. |
| Sys Req | Invalid. Causes an error. | Invalid. Causes an error. | Invalid if an attempt is made to leave a mandatory fill or self-check field without first satisfying the field requirements. Flushed when the controller is processing data received from the host system. |
| Test Request | Always valid. Goes to the normal locked state. Sends the SNA Reqtest. | Not applicable. The Cmd key is not valid in this mode. | Not applicable. The Cmd key exits from this mode. |

**Figure 49 (Part 5 of 10). The Effects of the Keyboard/Display States on the Keys**

**System Request, Normal Locked, and Prehelp Error States**

| Keys | System Request State | I Normal Locked State | Prehelp Error State |
|---|---|---|---|
| Alpha (shift) | Always valid. | Ignored. | Ignored. |
| Attn | Invalid. Causes an error. | Always valid. | Always valid. |
| Cancel (**Note:** Cancel is not a key. On the printer, it is the Cancel position of the Status switch and on the keyboard, it is the uppercase Print key. | Ignored. Same as for normal unlocked state. | | Ignored. |
| ← (Character Backspace) | Always valid. | Ignored. | Ignored. |
| Clear | Not applicable. The Cmd key is invalid. | Not applicable. The Cmd key is invalid. | Not applicable. The Cmd key is invalid. |
| Cmd | Invalid. Causes an error. | Ignored. | Ignored. |
| Command Function Keys 1-24 | Not applicable. The Cmd key is invalid. | Not applicable. The Cmd key is invalid. | Not applicable. The Cmd key is invalid. |
| ↓(Cursor Down) | Always valid. | Ignored. | Ignored. |
| ←(Cursor Left) | Always valid. | Ignored. | Ignored. |
| →(Cursor Right) | Always valid. | Ignored. | Ignored. |
| ↑(Cursor Up) | Always valid. | Ignored. | Ignored. |

**Figure 49 (Part 6 of 10). The Effects of the Keyboard/Display States on the Keys**

**System Request, Normal Locked, and Prehelp Error States**

| Keys | System Request State | I Normal Locked State | Prehelp Error State |
|---|---|---|---|
| Data Keys | Valid. | Ignored. | Ignored. |
| Del | Always valid. | Ignored. | Ignored. |
| Display Mode | Not applicable. The Cmd key is invalid. | Not applicable. The Cmd key is invalid. | Not applicable. The Cmd key is invalid. |
| Dup | Invalid. Causes an error. | Ignored. | Ignored. |
| Enter/Rec Adv | Always valid. | Ignored. | Ignored. |
| Erase Input | Always valid. | Ignored. | Ignored. |
| Error Reset | Always valid. | Ignored. | Always valid. |
| Field+ (Typewriter-like only) | Always valid. | Ignored. | Ignored. |
| Field | Invalid. Causes an error. | Ignored. | Ignored. |
| ⟶\| (Field Advance) | Always valid. | Ignored. | Ignored. |
| \|⟵ (Field Backspace) | Always valid. | Ignored. | Ignored. |
| Field Exit | Always valid. | Ignored. | Ignored. |
| Help | Invalid. Causes an error. | Ignored. | Always valid. |

**Figure 49 (Part 7 of 10). The Effects of the Keyboard/Display States on the Keys**

| System Request, Normal Locked, and Prehelp Error States | | | |
|---|---|---|---|
| Home | Always valid | Ignored. | Ignored. |
| Ins | Always valid. | Ignored. | Ignored. |
| ↵ (New Line) | Always valid. | Ignored. | Ignored. |
| Print Num (Shift) | Always valid. | Always valid. | Always valid. |
| Print | Invalid. Causes an error. | Ignored. | Ignored. |
| Record Backspace Function (**Note:** Record Backspace is not a key; it is a function performed by using the Home key when the cursor is at the home position.) | Always valid. | Ignored. | Ignored. |
| Roll↓ (Roll Down) | Always valid. | Ignored. | Ignored. |
| Roll↑ (Roll Up) | Invalid. Causes an error. | Ignored. | Ignored. |
| ⇩ (Shift Lock) (Typewriter-like only) | Always valid. | Always valid. | Always valid. |
| ⇧ (Shift Up) (Typewriter-like only) | Always valid. | Always valid. | Always valid. |
| Sys Req | Ignored. | Valid when not processing data from the host system. Flushed otherwise. | Ignored. |
| Test Request | Not applicable. The Cmd key is invalid. | Not applicable. The Cmd key is invalid. | Not applicable. The Cmd key is invalid. |

**Figure 49 (Part 8 of 10). The Effects of the Keyboard/Display States on the Keys**

**Posthelp Error and SS Error States**

| Keys | Posthelp Error State | SS Error State |
|---|---|---|
| Alpha (shift) | Always valid. | Always Valid. |
| Attn | Always valid. | Always valid. |
| Cancel<br>**Note:** Cancel is not a key. On the printer, it is the Cancel position of the Status switch and on the keyboard, it is the uppercase Print key. | Ignored. | Ignored. |
| ←(Character Backspace) | Ignored. | Ignored. |
| Clear | Not applicable. The Cmd key is invalid. | Not applicable. The Cmd key is invalid. |
| Cmd | Ignored. | Ignored. |
| Command Function Keys 1-24 | Not applicable. The Cmd key is invalid. | Not applicable. The Cmd key is invalid. |
| ↓ (Cursor Down) | Ignored. | Ignored. |
| ← (Cursor Left) | Ignored. | Ignored. |
| → (Cursor Right) | Ignored. | Ignored. |
| ↑ (Cursor Up) | Ignored. | Ignored. |
| Data Keys | Ignored. | Ignored. |
| Del | Ignored. | Ignored. |
| Display Mode | Not applicable. The Cmd key is invalid. | Not applicable. The Cmd key is invalid. |
| Dup | Ignored. | Ignored. |
| Enter/Rec Adv | Ignored. | Ignored. |
| Erase Input | Ignored. | Ignored. |
| Error Reset | Ignored. | Always valid. |
| Field+ (Typewriter-like only) | Ignored. | Ignored. |
| Field- | Ignored. | Ignored. |

**Figure 49 (Part 9 of 10). The Effects of the Keyboard/Display States on the Keys**

**Posthelp Error and SS Error States**

| Keys | Posthelp Error State | SS Error State |
|---|---|---|
| →\| (Field Advance) | Ignored. | Ignored. |
| \|← (Field Backspace) | Ignored. | Ignored. |
| Field Exit | Ignored. | Ignored. |
| Help | Ignored. | Ignored. |
| Home | Ignored. | Ignored. |
| Ins | Ignored. | Ignored. |
| ←┘ (New Line) | Ignored. | Ignored. |
| Num (shift) | Always valid. | Always valid. |
| Print | Ignored. | Ignored. |
| Record Backspace Function (**Note:** Record backspace is not a key; it is a function performed by using the Home key when the cursor is at the home position.) | Ignored. | Ignored. |
| Roll↓ (Roll Down) | Ignored. | Ignored. |
| Roll↑ (Roll Up) | Ignored. | Ignored. |
| ⇩ (Shift Lock) (Typewriter-like only) | Always valid. | Always valid. |
| ⇧ (Shift Up) (Typewriter-like only) | Always valid. | Always valid. |
| Sys Req | Ignored. | Ignored. |
| Test Request | Not applicable. The Cmd key is invalid. | Not applicable. The command key is invalid. |

**Figure 49 (Part 10 of 10). The Effects of the Keyboard/Display States on the Keys**

Figure 50 illustrates the errors that result from using invalid keys.

| Key | Data Mode | | | | Insert Mode |
|---|---|---|---|---|---|
| | Mandatory Enter Field | Right Adjust Field | Mandatory Fill Field | Check Digit Field | |
| Command Function 1-24 | 0007 | 0020 | 0014 | 0015 | 0013 (Note 1) |
| Clear | --- | 0020 | --- | --- | 0013 (Note 1) |
| Test Request | --- | 0020 | --- | --- | 0013 (Note 1) |
| Display Mode | --- | --- | --- | --- | 0013 (Note 1) |
| Sys Req | --- | 0020 | 0014 | 0015 | 0013 |
| Attn | --- | --- | --- | --- | --- |
| Erase Input | --- | --- | --- | --- | 0013 |
| Home | --- | --- | 0014 (Note 2) | 0015 (Note 2) | 0013 |
| Print | --- | 0020 | 0014 | 0015 | 0013 |
| Help (nonerror) | --- | 0020 | --- | --- | --- (Note 3) |
| Roll | 0007 | 0020 | 0014 | 0015 | 0013 |
| Enter/Rec Adv | 0007 | 0020 | 0014 | 0015 | --- (Note 3) |
| Sys Req/Attn | --- | NA | NA | NA | NA |
| Record Backspace | --- | 0020 | --- | --- | NA |

**Notes:**
1. The error occurs when the operator presses the Cmd key.
2. The error occurs only if the home position is not in the field. The insert mode is automatically reset.
3. The insert mode is automatically reset.

**Legend:**

00-- The operator error code is displayed if the display is in insert mode, or if the field specified is mandatory enter, right-adjust, mandatory fill, or check digit and the function specified is not satisfactorily fulfilled.
--- The function is valid and is performed.

**Figure 50. The Errors that Occur When Invalid Keys are Used in the Data and Insert Modes**

## SWITCHES

### Controller Switches

See Figure 51.

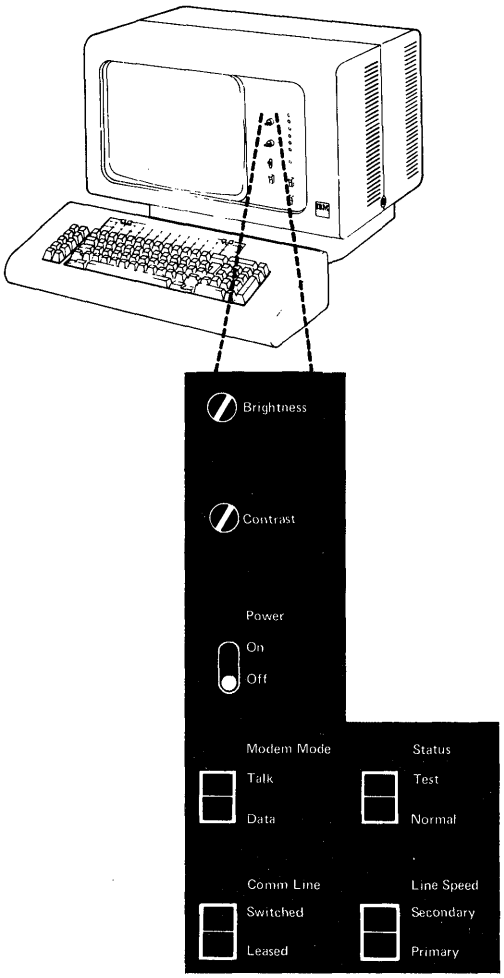



**Figure 51. Controller Switches**

*Brightness Control*

This adjusts the brightness of the CRT.

*Contrast Control*

This adjusts the CRT contrast between normal and high intensity.

*Line Speed (Available Only in World Trade Countries Except Canada)*

The two positions of this switch are Primary Line Speed and Secondary Line Speed. These two positions determine the clocking and communication rate of the controller. The modem operates at full speed when the switch is in the Primary position and at half speed when the switch is in the Secondary position.

*Modem Mode (Used with Integrated Switched Network Modem in World Trade Only)*

This switch has two positions (Talk and Data); the switch should be in the Talk position anytime that the device is not communicating with the host system. When the switch is in the Talk position, the operator must manually intervene, answer, and establish communications with the host system to exchange data. When communications have been completed, the switch must be returned to the Talk position. This switch is provided only with integrated modems used on switched telephone lines.

*Power Switch*

Controls AC power to the controller; two-position switch.

*Comm Line (Optional – Used for SNBU Operation)*

The SNBU capability is available only in the United States and Canada and only with the EIA interface. The external modem must support SNBU operation.

This switch has two positions: Leased and Switched. The Leased position is the usual setting. When the switch is set to Leased, the controller is communicating with the host system via a nonswitched (leased) line. If the leased line becomes unavailable, the operator may move the switch to the Switched position and can dial-up the host system on another telephone line. The Switched position of the switch enables switched network backup (SNBU), a condition in which the controller will automatically disconnect communications if no response is received from the host system within 30 seconds.

**Display Switch**

*Status Switch*

Two positions (Test and Normal) control the operating mode of the controller. Use of the Test position keeps the controller in the diagnostic mode until an error is found or the switch is repositioned. Use of the Normal position executes the power on diagnostics and proceeds to allow the controller to enter the ready state. (The Start switch must be pressed to enter the ready state.)

**5225 Printer Switches**

*Shift Switch*

The Shift switch allows the selection of an alternate function of a switch. As on a typewriter, the shifted position of the switch is named by the upper of the designations.

*Density/Display Switch*

The shifted position of this switch allows the operator to advance to the next alphabetically designated density code. For example, if the printer is currently set to a print density of 15 characters per inch at 6 lines per inch (Density Code B), the Shift Density/Display switching sequence will reset the printer to a print density of 10 characters per inch at 8 lines per inch (Density Code C). The Operator Panel Display will display the density codes.

The unshifted position of this switch (DISPLAY) allows the operator to determine the density to which the printer is currently set. The Operator Panel Display will show the current density code.

*Space Switch*

The Space switch allows the operator to move the forms forward. This switch is not operational when the printer is in a *ready* condition. The operator should press the Stop switch before pressing the Space switch.

*Stop/Reset Switch*

The Stop switch allows the operator to interrupt the print operation and bring the printer to a *not ready* condition. This switch is generally used to enable maintenance on the printer. When the Stop switch is pressed, the Attention indicator will come on. If the printer was printing a line when Stop was pressed, it will finish the line and return to the left margin home position before terminating print.

*Start Switch*

The shifted position of this switch (ONE LINE) will start the printer, allow it to print one line, and then stop it again. This procedure is generally used as a diagnostic aid.

The unshifted position of this switch brings the printer to the *ready* condition when no errors in operation are sensed. The operator uses this switch to ready the printer after the Power On sequence.

*Cancel/New Page Switch*

The shifted position of this switch allows the operator to interrupt a print operation. When this switch is pressed (with the Shift switch), the printer sends a Cancel request (see the heading, *Protocols and Synchronization for 5250 Implementation of SNA* in Section 1) to the controller over the twinaxial interface. This causes the controller to send an 0811 negative response (see the index entry: *negative responses*) to the host system and clears the print buffers. The controller will then purge any additional RUs for that printer until an end of chain is received.

The unshifted position of this switch (NEW PAGE) executes the line feed operation until the forms have been moved to the start of the next logical page. The logical page is determined by the SVF control character. See the index entry: *control characters, printer* for details. If there is no SVF, the default is a single line = a logical page.

**Note:** The printer must be in the *not ready* condition for this switch to work. If necessary, press the Stop switch to remove the printer from its *ready* condition.

*Mode Switch*

The 16-position Mode switch is located behind the front door of the 5225 printer.

The first three switch positions are used by the operator to select these modes.

*On Line:* The normal operating position. When the switch is set to this position, the 5225 accepts commands from the using system.

*Test:* Used for offline checkout and problem determination. In test mode, the Ready indicator is turned off and diagnostic tests stored in the printer control unit are run when the Start switch is pressed. If an error is detected, the printer stops and displays an error code in the operator panel display (see the *5225 Operator's Guide* for more information). If the tests are completed without errors, the display returns to 0.

*Buffer Print:* Used for data and formatting commands verification. All data is printed in hexadecimal code with the character represented. Formatting commands are treated as data and are printed in hexadecimal code with the designated default character. Service personnel can use this mode for locating character code problems and debugging application programs.

The remaining Mode switch positions enable diagnostics tests and offline problem determination by the service representative. See Figure 52.

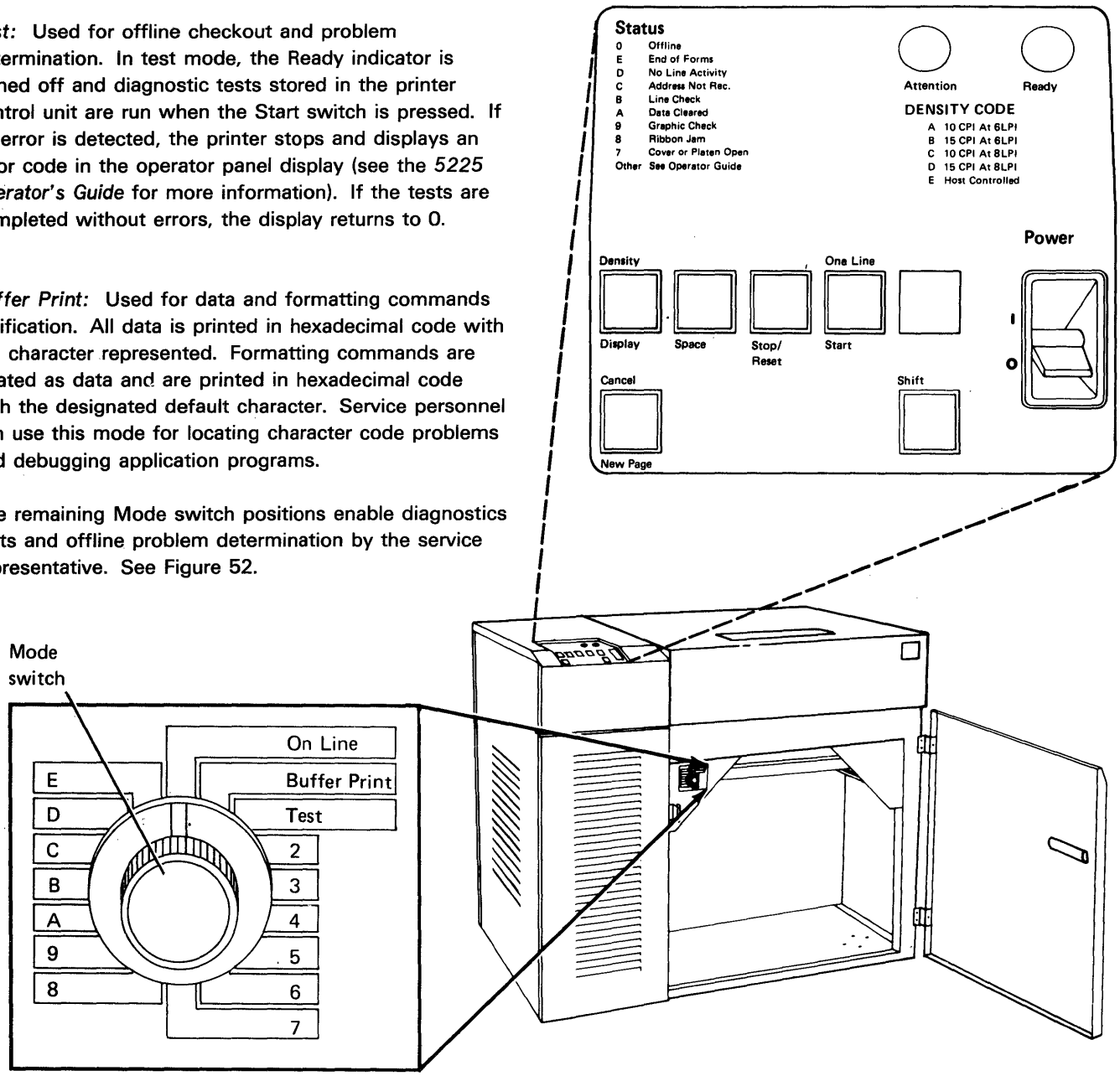



**Figure 52. 5225 Printer Switches**

## 5256 Printer Switches

See Figure 53.

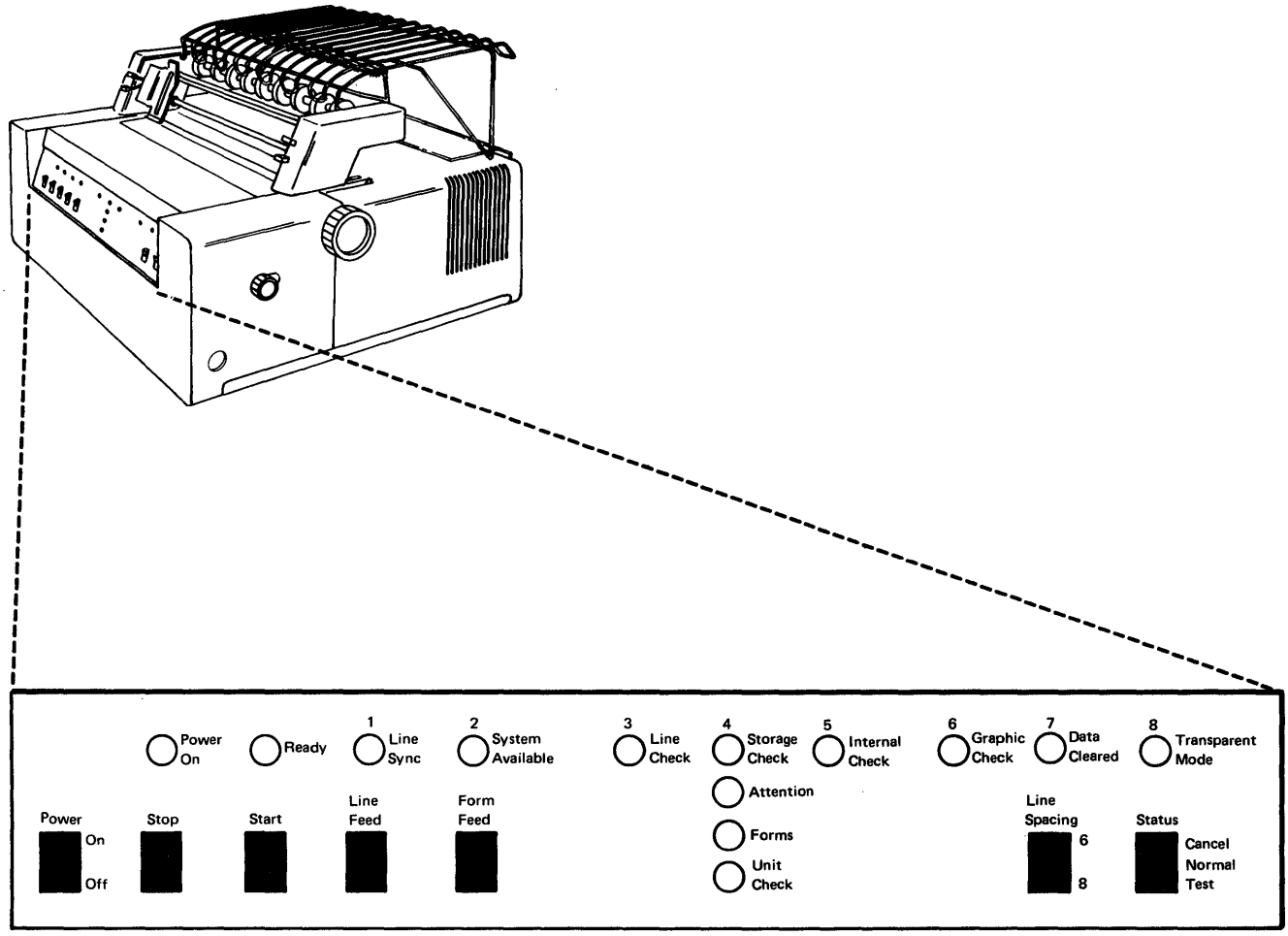



**Figure 53. 5256 Printer Switches**

*Forms Feed Switch*

This switch executes the line feed operation.

Using the Forms Feed switch with the Status switch:

- When the Status switch is in the Normal position, using the Forms Feed switch executes the number of line feeds necessary to move the forms to the start of the next logical page. The logical page is determined by the SVF Control Character. See the index entry: *control characters, printer* for details. If there is no SVF, the default is a single line = a logical page.

  **Note:** The printer cannot be in a ready condition for this switch to work; press Stop to remove the printer from the ready condition.

- When the Status switch is in the Test position, using the Line Feed, Forms Feed, and Start switches in that sequence selects an offline diagnostic program and inhibits its normal function.

*Line Feed Switch*

The Line Feed switch works in conjunction with the Status switch. It allows the operator to move the forms forward.

- When the Status switch is in the Normal position, using the Line Feed switch moves the forms 1 line position forward. This switch is not operational when the printer is in a ready condition. The operator should use the Stop switch to remove the ready condition.

- When the Status switch is in the Test position, using the Line Feed, Forms Feed and Start switch in the sequence selects an offline diagnostic program and inhibits its normal function.

*Line Spacing Switch*

This switch allows the operator to manually set the line spacing to either 6 or 8 lines per inch.

*Power Switch*

The 5256 Power switch makes AC power available to the printer.

*Start Switch*

Pressing this brings the printer to the ready condition when no errors such as Out of Forms, Printer Not Ready or Wire Check are sensed. The operator must use this switch to ready the printer after he has completed a Power On sequence.

*Status Switch*

This switch allows the operator to set the printer mode. The three modes and corresponding switch positions are Cancel, Normal, and Test.

*Cancel:* The operator sets the switch at the Cancel position when he wants to interrupt a print job. The result of setting this switch to this position is that the printer sends a Cancel request (see the heading, *Protocols and Synchronization for 5250 Implementation of SNA* in Section 1) to the controller over the twinaxial interface. This causes the controller to send an 0811 negative response (see the index entry: *negative responses*) to the host system and clears the print buffers. The controller will then purge any additional RUs for that printer until an end of chain is received.

*Normal:* The Normal position of the switch places the printer online and available to execute commands from the host system.

*Test:* The Test position of the switch places the printer offline to allow the service personnel to perform diagnostics and test its performance.

*Stop Switch*

The Stop switch allows the operator to interrupt the printer and bring it to a not ready status. Generally, the operator uses it to perform maintenance on the printer such as changing forms. You must use the Stop switch any time you service the printer. If you do not use Stop and move the forms, the Forms, Attention, and Unit Check lights come on. This switch can also be used to turn off the Attention, Unit Check and Forms indicators and reset error indicators when recoverable errors occur. Stop must be pressed before any offline diagnostics can be performed in the test mode. In addition, it halts the execution of the offline diagnostic tests when pressed after they have been initiated. If Stop is pressed while a line is printing, the printer finishes the line then returns to the home position at the left margin.

## TRANSPARENT MODE (PRINTER)

Transparent mode can be used by the programmer or customer engineer for problem determination among the 5256, controller, and program, and as a software debug tool.

When operating in transparent mode, characters and formatting control codes are printed in hexadecimal code with the character representing the code printed below. To aid counting and identification, a hexadecimal count is printed above every sixteenth character and a vertical bar above every eighth character starting from the second character on the left. The second digit on the left column indicates the print buffer used. One line of data prints out as four lines in transparent mode. Formatting control codes are not executed but are treated as data. The default character is printed below the hexadecimal code for the formatting control codes and other unprintable characters.

A sample transparent mode printout is as follows:

```
          8th Character from Buffer Number
Buffer                 |
Number                 |   16th Character from Buffer Number
|                      |            |
00                     |            1
CC1C4CC2CCCCDDDDOD
1253945567891234 5D
AB|C|DE|FGHIJKLM|N
    |  |    Line Feed      Carrier Return
    |  Space Character
   New Line
```

In Normal mode, with the SCS control characters executed, the above would print as:

```
AB
C DE
N       FGHIJKLM
```

### Procedures For the 5225

For the 5225 printer, Transparent mode is in effect if these procedures have been followed and the printer and system are in correct operating condition.

To enter Transparent mode:

1. Press the Stop switch on the 5225.
2. Set the Mode switch on the 5225 to the Buffer Print position.
3. Press the Start switch on the 5225; the Read light will come on and printing in Transparent mode will begin.

To leave Transparent mode:

1. Set the Mode switch back to the Online (first) position.
2. Press the Stop switch.

### Procedures for the 5256

For the 5256 printer, the Transparent Mode light is turned on when PRT14 is selected. It turns off when the Stop switch is pressed. However, the 5256 remains in Transparent mode and the light comes back on when the Status switch is returned to the Normal position. Transparent mode can be active whether the Status switch is set to Test or Normal. The 5256 remains in Transparent mode until the Status switch is moved from the Normal to the Test position.

To enter Transparent mode:

1. Set the Status switch to the Test position.
2. Press the Forms Feed switch.
3. Press the Line Feed switch.
4. Press the Start switch; the Ready light will blink.
5. Press the Line Feed switch.
6. Press the Start switch; the Ready and Transparent Mode lights will come on.
7. Press the Stop switch; the Ready and Transparent Mode lights will go off.
8. Set the Status switch to the Normal position; the Transparent Mode light will come on.
9. Press the Start switch; the Ready light will come on.

To leave Transparent mode:

1. Move the Status switch to the Test position; then move it back to the Normal position. (This resets the Transparent mode.)
2. If unsuccessful (the Transparent Mode light does not come on), turn the power off, then turn it on again and wait approximately five seconds. Reposition the paper. Make the printer ready and attempt to restart the job. If the problem persists and you are unable to restart the job, call your service representative.

## TH (TRANSMISSION HEADER)

The TH is 2 bytes long; it follows FAC in the SDLC frame. The following describes the bytes and bits of the TH:

| Byte | Bit | Description |
|---|---|---|
| 0 | | |
| | | Bits 0-3 are format ID |
| | 0 | Set to 0 |
| | 1 | Set to 0 |
| | 2 | Set to 1 |
| | 3 | Set to 1 |
| | | Bits 4-5 indicate no segmenting. |
| | 4 | Set to 1 |
| | 5 | Set to 1 |
| | 6 | Set to 0 |
| | | Bit 7 is the expedited flow indicator |
| | 7 | 0 = normal flow<br>1 = expedited flow<br>(Use for expedited commands.)<br>See *Protocols and Synchronization for 5250 Implementation of SNA* |
| 1 | | |
| Session type identifier | | |
| | 0-1 | 00=SS-PU session<br>01=SS-LU session<br>11=LU-LU session<br>10=invalid |
| | 2-7 | Local station address field.<br>000000=first keyboard on 5251 Model 2 or 12 keyboard (PU for SS-PU session).<br>000001=reserved.<br>The remainder of these addresses are determined from the port (CF) address with the unique LU address. See *Addresses* in this section. |

## TWINAXIAL-COAXIAL ADAPTER

This adapter is for system users who elect to use existing coaxial cabling to attach work stations. Because 5250 work stations and systems have twinaxial receptacles, the coaxial cable must be adapted to connect them. Certain restrictions apply when coaxial cable is used. For more information, see the *IBM 5250 Planning and Site Preparation Guide*, GA21-9337.

## 1200 bps INTEGRATED MODEM

The 1200 bps Integrated Modem is an internal modem that provides a means of communication between a 5251 Model 2 or 12 and a host system over switched or nonswitched communications lines. It requires the Internal Clock feature to generate a clocking pulse to synchronize its signals for transmitting and receiving.

## 2400 OR 4800 bps INTEGRATED MODEM

The 2400 bps or 4800 bps Integrated Modem provides communication between the 5251 Model 2 or 12 and a host system over switched or nonswitched communications lines. (Internal Clock feature is not required.)

This page intentionally left blank.

# Acronym and Abbreviation List

A

| | |
|---|---|
| A | address |
| Actlu | activate logical unit |
| ADM | asynchronous disconnect mode |
| Alpha | alphabetic |
| Aid | attention identification |
| ARM | asynchronous response mode |
| Attn | attention |
| AWFER | awaiting field exit required |

B

| | |
|---|---|
| B | binary |
| BIU | basic information unit |
| bps | Bits per second |

C

| | |
|---|---|
| c | column |
| C | control field |
| CC | control characters |
| CCITT | Consultative Committee on International Telephone and Telegraph |
| CF | cluster feature |
| CF1 | Cluster feature or first half of Dual Cluster feature |
| CF2 | second half of Dual Cluster feature |
| CD | change of direction |
| Cmd | command |
| CMDR | command reject |
| CR | carriage return |
| CRC | cyclic redundancy check |
| CRT | cathode-ray tube |
| CU | clear unit |

D

| | |
|---|---|
| Dactlu | de-activate LU |
| Del | delete |
| DFC | data flow control |
| DISC | disconnect |
| DM | disconnected mode |
| dsp | displacement |
| DSR | data set ready |
| Dual CF | Dual Cluster feature |
| Dup | duplicate |

E

| | |
|---|---|
| EB | end bracket |
| EIA | Electronic Industries Association |
| ERP | error recovery procedure |
| ESC | escape character |
| Exr | exception request |

F

| | |
|---|---|
| F | flag |
| FCS | frame check sequence |
| FCW | field control word |
| FDX | full duplex |
| FER | field exit required |
| FF | forms feed |
| FFW | field format word |
| FM | function management |
| FMD | function management data |
| FMP | function management profile |
| Fmt | format |
| FOC | first of chain |

H

| | |
|---|---|
| HDX | half duplex |
| hex | hexadecimal |

I

| | |
|---|---|
| I | information |
| IC | insert cursor |
| ID | identification, identifier |
| I/O | input/output |
| IPR | isolated pacing response |

L

| | |
|---|---|
| LED | light-emitting diode |
| LF | line feed |
| LOC | last of chain |
| LSID | local session identifier |
| LU | logical unit |
| Lustat | logical unit status |

M

| | |
|---|---|
| MDT | modify data tag |
| ME | mandatory enter |
| MF | mandatory fill |
| MOC | middle of chain |
| MPL | maximum print line |
| MPP | maximum print position |

N

| | |
|---|---|
| NDM | normal disconnect mode |
| NL | new line |
| Nr | station receive |
| NRM | normal response mode |
| Ns | station send |
| NSA | nonsequenced acknowledgement |
| NSI | nonsequenced information |
| NUL | null |
| num | numeric |

O

| | |
|---|---|
| OEM | Original equipment manufcaturers |

P

| | |
|---|---|
| PP | print position |
| PIU | path information unit |
| PTT | post telegraph telephone |
| PU | physical unit |

Q

| | |
|---|---|
| QRI | queued response indicator |

R

| | |
|---|---|
| r | row |
| RA | repeat to address |
| rcvr | receiver |
| Rec Adv | Record Advance |
| Rec Bksp | Record Backspace |
| Recfms | record formatted maintenance statistics |
| RGA | remote go ahead |
| REJ | reject |
| req | request |
| Reqms | request maintenance statistics |
| RH | request/response header |
| RNR | receiver not ready |
| ROL | request on line |
| RQD | request definite |
| RQE | request exception |
| RR | receiver ready |
| Rshutd | request shutdown |
| RU | request/response unit |

S

| | |
|---|---|
| SARM | set asynchronous response mode |
| SBA | set buffer address |
| SC | system control, session control |
| SCS | standard character string |
| SDLC | synchronous data link control |
| SF | start of field |
| SGEA | set graphic error action |
| SHF | set horizontal format |
| SIM | set initialization mode |
| SOH | start of header |
| SNA | system network architecture |
| SNBU | switched network backup |
| Sndr | sender |
| SNRM | set normal response |
| SREJ | selective reject |
| SS | System Services (Control Point), supervisory session |
| SSCP | System Services Control Point |
| SVF | set vertical format |
| S0,S1, S2 | sense bytes |

T

| | |
|---|---|
| TH | transmission header |
| TS | transmission services |
| TSP | transmission services profile |

W

| | |
|---|---|
| WTD | write to display |

X

| | |
|---|---|
| X | hexadecimal |
| XID | exchange identifier |
| xx | variables |
| yy | variables |
| zz | variables |
| +rsp | positive response |
| -rsp | negative response |

**-rsp:** Negative response. SNA coding that identifies an error. See the index entry: *negative responses.*

**+rsp:** The return code that indicates the data has been received in a way acceptable to the receiving partner.

**Active field:** A field in which the operator has begun entering data. Once the field is active, all field requirements must be satisfied before the operator is allowed to exit the field. See the index entry: *fields.*

**Aid codes:** Attention identification. A byte sequence that is generated when the operator presses certain function keys. See the index entry: *aid-generating keys.*

**BIU:** Basic information unit. The RH and the RU. See index entries: *RH and RU.*

**CC:** Control characters. Formatting controls for data for both the display/keyboard and printer LUs. See the index entry: *control characters.*

**CD:** Change of direction. A bit in the RH that determines which SNA session partner has the right to transmit data. See the index entry: *CD.*

**CF:** Cluster feature. A purchasable feature attachable to a 5251 Model 2 or 12 remote controller. It allows the user to cable attach up to four 5251 Model 1 and 11, 5252, or 5256 work stations to the controller. See the index entry: *Cluster feature.*

**Cable Thru:** A purchasable feature that allows the user to cable link (via twinaxial) together a maximum of four 5250 work stations which are attached to a 5251 remote controller via CF. See the index entry: *Cable Thru feature.*

**Chaining:** A process that allows the programmer to link RUs together. Bits in byte 0 of the RH identify the respective position of each RU within the chain. See the heading *SNA Terminology Used in Describing the SNA Protocols* in Section 1 and index entry: *RH.*

**Controller:** The 5251 Model 2 or 12 that is linked to the host system via an SDLC communications network and that has 5250 devices attached to it via CF. It controls the operation of all 5251, 5252, and 5256 work stations attached via CF.

**Controller station address:** The 8-bit address that the host system uses to address the 5251 Model 2 or 12. The work station/controller scans the station address field of the SDLC frame for its address. 00 and FF are not acceptable as controller station addresses.

**Display:** The information that the operator sees projected on the display work station screen.

**D zones (or dezones):** The removal of the first 4 bits of a byte and their replacment with bits 1101.

**FCW:** Field control word. A write command parameter that controls resequencing and self-check (when installed) operations. See the index entry: *field control words.*

**FFW:** Field format word. A write command parameter that defines the field type. See the index entry: *field format word.*

**Flag:** The unique bit pattern that SDLC uses to identify the beginning and end of the SDLC frames. See index entries: *flags* and *frames.*

**Frame:** A 32-bit (minimum) format that SDLC uses for sending commands and data to and from the 5251 remote controller and the host system. See the index entry: *frames.*

**Note:** This can also refer to the format used by the twinaxial commands and responses; in this case, the frame is 16 bits.

**Home position:** The position that the cursor seeks. It can be one of the following: (1) the address sent via the IC order, (2) the first nonbypass input field, or (3) row 1, column 1.

**IC:** Insert cursor. A write command parameter that controls the location of the cursor on the display. See the index entry: *IC order.*

**Immediate commands:** The display commands that are executed as soon as the controller receives them. See the index entry: *display, commands.*

**LSID:** Local session identifier. The distinct LU address contained in the TH. See the index entry: *addressing.*

**LU:** Logical unit. An SNA term that, in the 5250 configuration, refers to a 5251 Model 1 or 11, 5252, or 5256 work station attached to a 5251 controller via CF. See *Description of General SNA Terms Used in This Manual* in Section 1 of this manual.

**MDT:** Modify data tag. A bit that flags a field as having been altered by the operator. See the index entry: *MDT bit.*

**Null:** This is the hexadecimal value 00 which displays as a blank.

**Pacing:** The rate at which the SNA session partners have agreed to transmit data. See the index entry: *pacing.*

**Panel:** The contents of one full display.

**PIU:** Path information unit. Consists of the TH followed by a BIU.

**Port:** The hardware coupling used to attach work stations to the 5251 remote controller using CF.

**Protocol:** A series of rules used by SNA to provide a common hierarchy and architecture for programming in the remote controller and host system.

**queued response indicator:** This indicator denotes whether the response is to be enqueued in transmission control queues or whether it is to bypass these queues. The setting of the queued response indicator in the request header determines what its setting will be in the response header.

**Queued response indicator:** In a response header, the queued response indicator denotes whether the response is to be enqueued in Transmission Control queues or whether it is to bypass these queues. In a request header, it indicates what the setting of the QRI should be on the response.

**Regeneration buffer:** Also known as regen; it is the reserved area of storage within a display LU that holds the contents of the display and information about the field and screen attributes.

**RH:** Request/response header. An SNA bit pattern that precedes the RU. It defines the RU type, response type requested, CD, and position in the chain. See the index entry: *RH.*

**RQD:** Request definite. This means that the receiving partner is required to respond to the transmission from the other partner. See *Description of General SNA Terms Used in This Manual* in Section 1.

**RQE:** Request exception. This means that the receiving partner is required to respond only if the response is negative. See *Description of General SNA Terms Used in This Manual* in Section 1.

**RU:** Request/response unit. The programming unit that contains all the 5250 data streams. It is an SNA convention. See index entry: *RU.*

**Screen:** The hardware device upon which the display is projected.

**Scan codes:** Identification codes sent from the keyboard to the host system when the operator keys in data.

**SDLC:** Synchronous data link control. A discipline for the management of information transfer over a half-duplex communications channel. The configuration can be point-to-point, multipoint, or loop. SDLC includes comprehensive detection and recovery procedures, at the data link level, for transmission errors that can be introduced by the data communications channel.

**Session:** The logical coupling of a device within or attached to a 5251 remote controller and the SS or an application program in the host system.

**Session partners:** The host system and the controller in the 5251 Model 2 or 12 in the 5250 Information Display System. See the heading *Description of General SNA Terms Used in This Manual* for additional details.

**SNA:** System network architecture. A series of rules and program design techniques that provide a commonality of program content and management to two divergent users (in this case, the host system and the 5251 remote controller).

**TH:** Transmission header. An SNA bit pattern that allows the host system to address data streams to the appropriate LU. See the index entry: *TH.*

**Work station:** Either the display and keyboard or the printer.

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