DASHER® D410 and D460 DISPLAY TERMINALS

USER'S MANUAL

《‣ DataGeneral

VT100.net

TECHNICAL SPECIFICATIONS

Functional:

Display Unit	Tabletop, tiltable mounting; 305-mm (12-in.) diagonal screen with 212-mm (8.35-in.) by 137-mm (5.4-in.) viewing area; 24 lines by 81 characters per line
Keyboard	Low-profile, independent tabletop mounting with sculptured keys; n-key rollover; typematic and manual repeat; 5 basic keypad groups; on-line, alpha-lock, and hold lamps
Screen Phosphor	P31 green
Screen Refresh Rate	60 frames/second (domestic 60 Hz) 50 frames/second (foreign 50 Hz)
Display Technique	Non-interlaced raster
Characters	10 × 12 dot matrix character cell
Character Sets	U.S., (D211 Only - U.K., French, German, Swedish/Finnish, Spanish, Danish/Norwegian, Swiss)
Display Scrolling	One-row increments ("jump" scrolling)
Self-Test	On power-up, program verifies terminal is operational

Communication:

Interface Types	Asynchronous serial, full-duplex; RS-232C; (D210 and 211) RS-422A or 20-mA current loop (D211 only); XON/XOFF protocol
Baud Rates	50, 75, 110, 134.5, 150, 300, 600, 1200, 1800, 2400, 3600, 4800, 7200, 9600, and 19200 baud (EIA RS-232C and RS-422A; 110-9600 (20-mA))
Data Format	ASCII; 7- or (D211) 8-bit characters; even, odd, or no parity; one stop bit DG or ANSI (switch selectable)
Printer/Port (D211)	7-/8-bit; serial; EIA RS-232C (D211 only)

Physical:

Display Unit Dimensions	Height: 34 cm (13.1 in.) Depth: 32.7 cm (12.8 in.) Width: 32.7 cm (12.8 in.)
Keyboard Dimensions	Height: 4.4 cm (2.4 in.) Depth: 19.6 cm (7.5 in.) Width: 51.9 cm (20 in.)
Display Unit Weight	7.3 kg (16.1 lb)
Keyboard Weight	2.6 kg (5.8 lb)
Cable Lengths:	
Keyboard Cable (extended)	1.2 m (4 ft)
Display Unit Power Cord	2.25 m (7.5 ft)
EIA, Modem, 20-mA Current Loop	6.1 m (25 ft) standard for all three cable types

Power:

0 or 1 Power Suffix:	
Voltage	90-132 VAC
Frequency	50 or 60 Hz ± 1%
Current	2.4 Amps peak at 90 VAC
Start-up Surge	22 Amps at 120 VAC for 1/2 cycle
2 or 4 Power Suffix:	
Voltage	187-264 VAC
Frequency	50 or 60 Hz ± 1%
Current	2.0 Amps peak at 187 VAC
Start-up Surge	11 Amps at 240 VAC for 1/2 cycle

Environmental:

Temperature Range	Operating: 10 to 38°C (50 to 100°F) Storage: −40 to 65°C (−40 to 149°F)
Humidity Range	Operating: 20 to 80% Non-condensing Storage: 10 to 90% Non-condensing
Altitude	Operating: Maximum 2438 m (8000 ft) Storage: Maximum 7620 m (25000 ft)
Radiation	Below 0.5 milliroentgens per hour (complies with FCC regulation Part 15, Subpart J, and CISPRE Part 16 for Class "A" computing devices

DASHER® D410 and D460 DISPLAY TERMINALS
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Warning:

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

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NOTICE

FIRST EDITION

(First Printing July 1983)

PREFACE

This DASHER D410 and D460 Display Terminal User's Manual provides an overview of the terminal's features and contains operating, programming, and installation instructions. Throughout this manual the term "D410/460 terminal" is used whenever the current topic is common to both the D410 and D460 display terminals. This manual is divided into chapters and appendices as follows:

Chapter/
Appendix

NOTES

• *Third-person masculine pronouns are used in this manual in a purely generic sense to avoid awkward grammatical constructions.*

• *To order any Data General manual, contact your sales representative and supply the manual title and order number.*

• *We would appreciate your comments on this manual. Please take the time to record your reactions and suggestions on the form provided on the last page.*

OTHER RELATED MANUALS

• *DASHER D410 and D460 Display Terminals Field Engineers Maintenance Series, part number 015-000135*

• *DASHER D410 and D460 Display Terminals Programmer's Reference Card, part number 014-000760*

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CHAPTER 1

PRODUCT OVERVIEW

Figure 1-1. DASHER D410/460 Display Terminal

INTRODUCTION

The DASHER D410 and D460 Display Terminals (Figure 1-1) are desk-top, 12-inch, monochrome, terminals containing many advanced features that combine to improve user productivity in a business and/or data processing environment. These features include the option of selecting from among four separate operating modes, the ability to divide the display screen into independent screens called windows, bi-directional vertical and horizontal scrolling, built-in editing functions, 81- and 135-column character viewing, protected character fields, a printer port, and much more.

The D460 terminal is identical to the D410 terminal with one major addition: the D460 includes a downline loadable (DLL) or soft character set feature that pro-

vides for user-defined characters and basic drawing functions that make the display and printing of graphics possible. Both the D410 and D460 terminals are intended to be connected to any host computer system that supports full-duplex communications via a 20-mA current loop or EIA RS-232C compatible interface and uses XON/XOFF protocol. An EIA RS-422 interface is provided as an alternative to current loop for long lines. This interface does not conform to the associated RS-449 mechanical standard. The terminal's EIA RS-232C interface can be used at a remote site in conjunction with Bell 103, 113, or 212 compatible modems and an available telephone system.

Throughout this manual, the term "D410/460 terminal" is used whenever the current topic is common to both the D410 and D460 terminals.

PRODUCT FEATURES

The basic D410/460 terminal consists of a CRT display unit and a keyboard as shown in Figure 1-1. The display unit, mounted on a tiltable base, and the detached, sculptured keyboard combine to provide maximum flexibility in viewing and keyboard access for the operator.

The D410/460 terminal can be configured in a United States version or in 11 different European versions. It offers the option of operating in either Data General command syntax or in the American National Standards Institute's (ANSI) standard command syntax. The terminal can operate in four different command syntax modes: two of the modes are compatible with previous command sets used with DG display terminals, and the other two meet ANSI standards. A special key provides, in three of the four modes, the option of conveniently creating any of 45 different international characters immediately, regardless of keypad nationality.

The next few sections highlight the more important features of the D410/460 terminal. While reading through these features, keep in mind that the D410/460 terminal, which includes significant advances over the D400/450 terminals, is also compatible with the earlier DASHER D200 Display Terminal. That is, the D200 can be disconnected and replaced with the D410/460 without making hardware or software changes. The added features of the D410/460 terminal can then be taken advantage of as existing software is modified or replaced.

All of the features described in the next few pages are programmable. A programmable feature is one that can be exercised on command from a host computer. The D410/460 terminal command set is both versatile and easy to use, simplifying the process of implementing the terminal features in various applications. Some of the features can be controlled directly by the user from the keyboard. These features will be pointed out as they are discussed.

Display Screen Management

The D410/460 terminal includes several new features that significantly extend the screen management capabilities available to the user. Examples of most of the features in the following list are shown in Figure 1-2.

* Up to 24 scroll areas, or windows

* Normal (81-column) and compressed (135-column) character viewing (spacing)

* Programmable margins

* Vertical (bi-directional) smooth scrolling
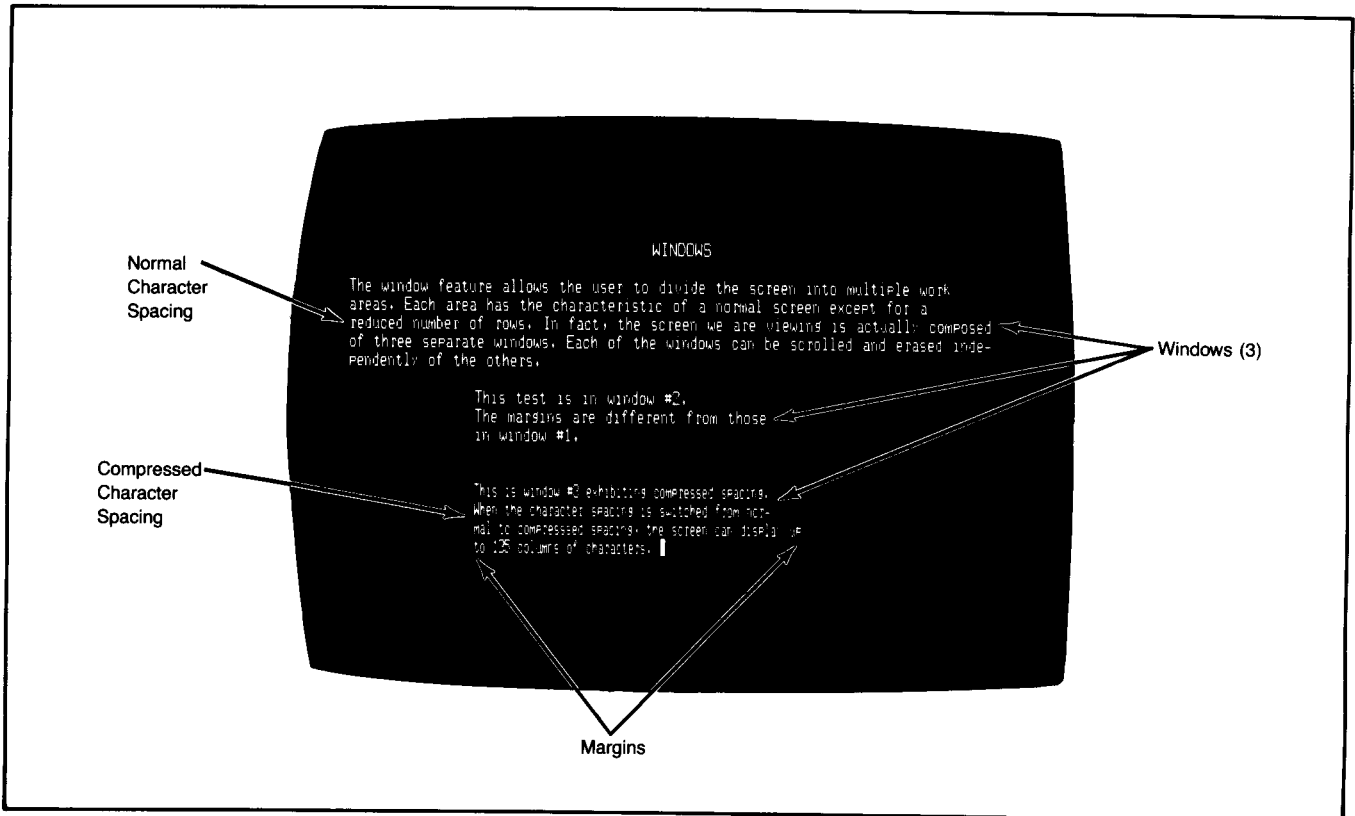
* 162-column horizontal scrolling

Figure 1-2. Display Screen Management Features

Windows

When the D410/460 terminal is turned on, the display screen is organized into 24 character rows with 80 character positions in each row. The "window" feature makes it possible to divide the full screen into multiple miniature screens along character row boundaries. Each window is formed by a consecutive number of character rows, where the smallest window may consist of 1 row and the largest window may consist of 24 rows.

Only one of the windows on the display screen is treated as "active" or "current". This is the window where activity on the display screen is taking place involving either the host computer or the user, or both. The other window(s) are inactive, and may be displaying data from the same file or from files different from the one in the active window. The window feature, therefore, can be used to separate areas of a form, compare the contents of two or more data files, or used in any application where display screen segregation is helpful.

The active window contains the display screen cursor. The cursor marks the position on the display screen that will hold the next character for display from either the host computer or the user at the keyboard. The host computer can easily reassign the active window by simply moving the cursor across window boundaries. The cursor appearance can be selected by the host or from the keyboard to be either a solid or blinking block, a blinking underscore, or invisible.

Character Spacing

The D410/460 terminal is equipped with an extended display screen memory that contains 162 characters in each of the 24 rows, as shown in Figure 1-3. Within each window, either normal (81-column) or compressed (135-column) character viewing (spacing) can be selected. Normal character spacing is similar to that of the earlier model D200 terminal, and makes it possible to build two full screens of data side-by-side in display screen memory. Compressed character spacing will prove invaluable in those applications where all columns of a wide form (up to 135 columns) must be viewed at once.
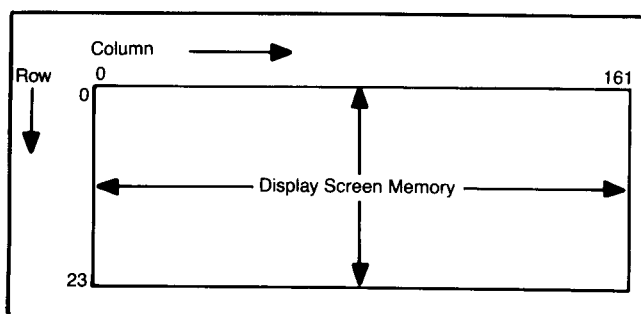
Figure 1-3. Display Screen Memory

Display Scrolling

Left and right horizontal scrolling of the active window makes it possible for the operator to view all 162 columns of the display screen memory. Vertical scrolling (both up and down) of the active window can be performed in three different styles: slow and fast smooth scrolling and the conventional fast jumpy scrolling of the D200. Each of these styles is keyboard selectable. Slow smooth scrolling rolls the screen up or down at the rate of 5 character rows (60 raster lines) each second; fast scrolling, at the rate of 10 character rows (120 raster lines) each second. Vertical scrolling can be halted or "frozen" at any time and then resumed from the keyboard. Smooth scrolling coupled with screen "freeze" makes it very convenient to scan or read through information on the screen.

Margins

The active window combines with the programmable margins feature to define the working area on the display screen. Whereas window boundaries are the upper and lower boundary lines running across the display screen at the top and bottom of each window, margins are the left and right boundary lines. Movement of the display screen cursor is restricted to the area between the margins in the active window. Attempting to position the cursor beyond the edge of a window results in the cursor pegging at the margin. The margin settings extend across window boundaries; i.e., only one set of margins are in effect at any time. An alternate margin feature makes it possible to assign a second set of margins while saving the normal margins for future use.

When the D410/460 terminal is turned on, the left and right margins are set to columns 0 and 79, respectively. The margins may be easily reset under host computer control to any of the columns in the range of 0 to 161. The only restriction on margin assignment is that the left margin column number be less than or equal to the right margin column number. When the left and right margins are the same, the working area in the active window is one column wide.

Editing Functions

The D410/460 terminal includes special built-in editing features that provide for easy and fast reorganization of characters on the display screen. Highlights of the editing features include:

- Insert/delete individual characters or complete lines. This feature cuts down on host/terminal character traffic by making these editing operations possible without rewriting part or all of the display screen.

- Besides the conventional screen and line erase capabilities, the D410/460 terminal is equipped with window erase and unprotected text erase com-

mands. These commands complement the window and protected text features of the terminal.

Character Attributes

Every character position on the display screen has four display attributes, plus a protect attribute.

The display attributes are valuable for character highlighting. Each character displayed on the screen can be underscored, dimmed, made to blink, or displayed in reverse video form independent from all other characters. These four attributes can be applied in all combinations. A special feature allows the programmer to change the display attributes for all characters in the active window with one command.

When enabled, the protect attribute prevents the destruction of a character or character field by the keyboard operator using normal cursor related commands. The cursor will skip over protected characters on the screen so that critical character fields (fixed information on a form, for example) are preserved. Protected text can be deleted with the Erase Screen or Erase Window commands, which are generally restricted to the host computer's use.

Command Syntax Modes

The D410/460 terminal offers the choice of four modes of command syntax operation: DG 7 bit, DG 8 bit, ANSI 7 bit, and ANSI 8 bit. Two switches at the rear of the terminal select the initial mode at power-up or when the terminal goes on-line. One selects data bit size, 7- or 8-bit, and the other selects between DG and ANSI. Read Chapter 4 for details of setting these switches. Software switches override both the DG/ANSI setting and the 7/8-bit mode setting so the command syntax mode can be changed dynamically by the host system. This feature maintains the terminal's compatibility with existing OS support for DG terminals while allowing use of industry standard code sequences involving ANSI 3.4, 3.41, and 3.64 environments.

Character Sets

The D410/460 terminal contains 512 fixed characters including the following predefined characters:

- U.S. ASCII character set

- Foreign language character sets (see Table 1-1)

- Greek alphabet subset

- Extended math symbols

- Forms-ruling set

- Word processing symbols

- Superscripts and subscripts

Any of these character sets can be selected for display on command from the host computer.

Table 1-1. Foreign Language Character Sets:

• U.K.	• Spanish
• French	• Danish/Norwegian
• German	• Swiss
• Swedish/Finnish	• D.G. International

Appendix D shows the characters in each of these sets. When the terminal is powered up, the nationality of the keyboard is sensed by the display unit and the matching character set is automatically selected for display. Any of the other character sets listed can be chosen for display when desired.

The line drawing character set is not the same as the graphics drawing feature of the D460 terminal discussed later in this chapter. The line drawing character set makes it possible for the D410/460 user to build a simple graphics image by positioning line drawing symbols in selected patterns on the screen.

Print Methods

The D410/460 terminal supports local, ASCII-based serial printers.

Table 1-2 shows the three different print methods available in the DG mode on the D410/460 terminal and the commands supported by each. See Chapter 3 for details about each command.

Table 1-2. D410/460 Print Methods for DG Syntax

Mode	Commands Supported
• ASCII Text	• Print Window • Print Form
• Bit-Image Screen Dump Text	• Window Bit Dump • Form Bit Dump
• ASCII Print Pass Through	• Print Pass Through

The standard ASCII character sets for the U.S. and the sets for the various European countries mentioned earlier can be printed using commands under the ASCII TEXT method. The special symbol character sets, those containing the word processing, math, Greek alphabet, super/subscript, and line drawing symbols, and user-defined characters can be printed using commands under the Bit Image Screen Dump method, provided a graphics slave printer is connected. User-defined characters are unique to the D460 terminal, and are discussed in the next section. In the ASCII Print Pass Through method, all characters received over the host link are transmitted to the printer without being displayed on the terminal screen.

Similar printing functions can be obtained using a command in ANSI mode: the Media Copy command used in conjunction with either the set or reset state of the Forms Mode and the Guarded Area Transfer Mode initiates printing and controls the print method. A variation of this same command causes a bit-image dump to be sent to the graphics slave printer.

As explained earlier, the margins for the D410/460 terminal can be set to a maximum width of 162 columns (character positions) so the D410/460 terminal can produce lines of up to 162 characters long. Whether or not lines of this length can be printed depends upon the capabilities of the printer selected for use with the terminal.

D460-Unique Features

The D460 terminal includes an extended character set, downline loadable (DLL) printed circuit board (pcb) not included with the D410 terminal. The DLL pcb can store up to 3572 user-defined or custom character definitions at any one time. These 3572 characters are grouped into 38 sets of 94 characters each. When the D460 terminal is turned on, these 38 character sets do not contain any custom characters. To install custom characters in the terminal, definitions of the custom characters must be downloaded (transferred) from the host computer to the terminal.

After one or more custom character sets have been downloaded, the custom sets may be selected for display or printing just like the standard character sets in the D410 terminal. Custom characters can be displayed with normal, but not compressed, character spacing.

The DLL feature can also be used by the D460 terminal to produce graphics. A graphic image is developed using two basic drawing elements: straight lines and bars (solid rectangles). The bars are either all green phosphor color or all black; the lines can be solid green, solid black, dashed, dotted, or any pattern of green and black desired. The drawing algorithms in the terminal define their own custom characters in the DLL character sets and combine the custom definitions on the screen to draw the desired lines and bars. Figure 1-4 shows an example of how line segments can be combined to draw a simple pie chart.

PRODUCT DESCRIPTION

The basic D410/460 terminal system consists of the following major components:

• Display Unit

• Keyboard (and Cable)*

• Host/Terminal Interface Cable*

*Ordered Separately

Table 1-3 lists the numbers for the D410/460 terminal components. The display unit model number includes a
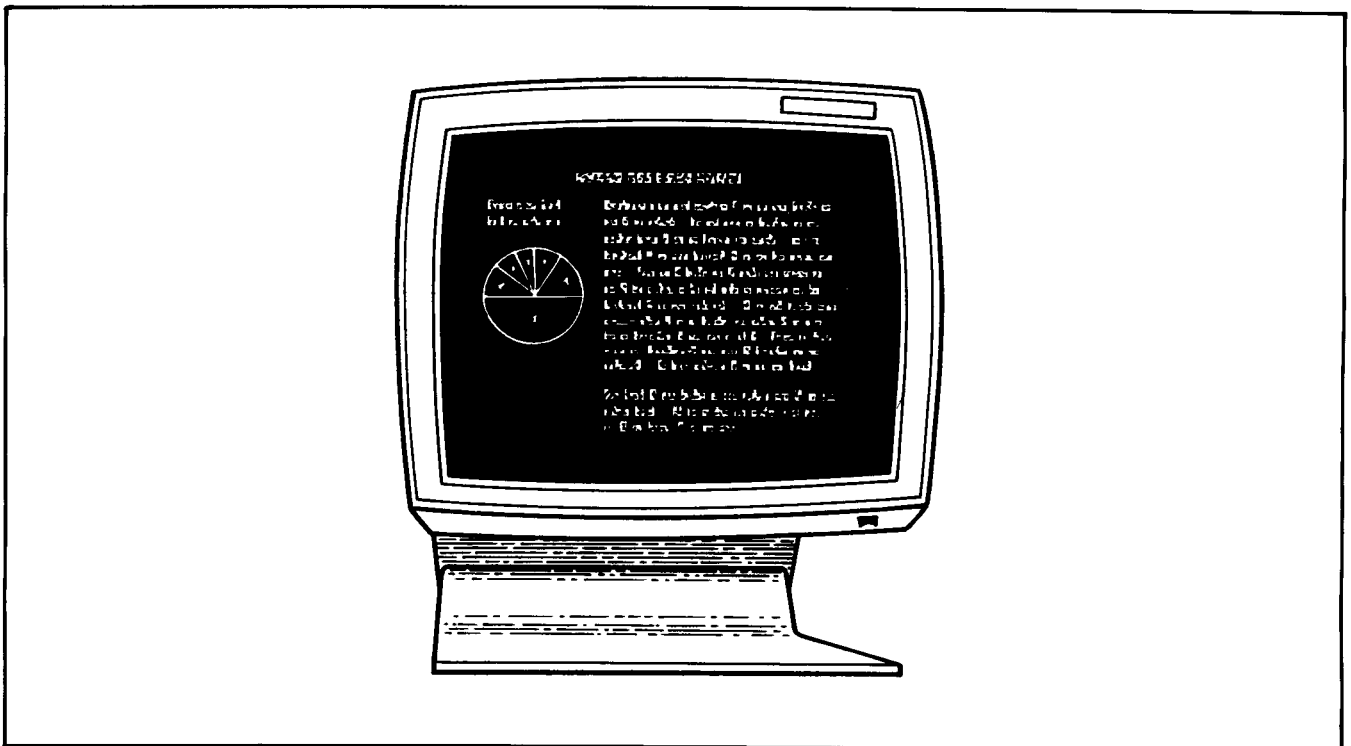
Figure 1-4.   D460 Terminal Graphics

character suffix which defines the power configuration. The keyboard model number includes a suffix character defining the primary nationality. Notice that Table 1-3 shows numerous keyboard nationalities but no display unit nationality. When the D410/460 terminal is powered up, the display unit senses the nationality of the keyboard and automatically displays the matching character set.

Figure 1-5 shows the configuration of a D410/460 terminal connected to a host computer system.

Display Unit

As shown in Figure 1-5, the display unit is the center of activity for the D410/460 terminal. The display unit houses the electronic hardware and firmware that provide the D410/460 terminal with its sophisticated features.

The CRT mounted inside the display unit housing is a 12-inch, green phosphor, monochrome unit. The display unit housing has external cable connections, dual-inline-package (DIP) configuration switches, and a power on/off switch at the rear. A display screen brightness control is located on the lower-right front of the display unit. The housing sits on a base that permits the operator to tilt the display unit for optimum viewing.

The host computer, keyboard, and optional printer cable connections and the DIP switches at the rear of the

Table 1-3.   D410/460 Component Model Numbers

Component	Model No./Suffix	Description
Display Unit	6255	D410 display unit with printer port
Display Unit	6256	D460 display unit with printer port and downloadable character sets
	Power Suffix (display units)	
	0	100 Vac; 50/60 Hz* ±1%
	1	120 Vac; 50/60 Hz* ±1%
	2	220 Vac; 50/60 Hz* ±1%
	4	240 Vac; 50/60 Hz* ±1%
		* 50/60-Hz operation: select through DIP switch on rear of display unit.
Keyboard	6246	Ergonomic keyboard (D410 and D460) with data processing keycaps.
	Keyboard Nationality Suffix	
	A	U.S.
	B	United Kingdom
	C	French
	D	German
	F	Swedish/Finnish
	G	Spanish
	H	Danish/Norwegian
	I	Italian
	J	Swiss/German
	K	Swiss/French
	L	Canadian/French
	M	Canadian/English

display unit are shown in Figure 1-5. The two sets of DIP switches must be set as required by the installation configuration. The right set of DIP switches between the keyboard connector and the host computer
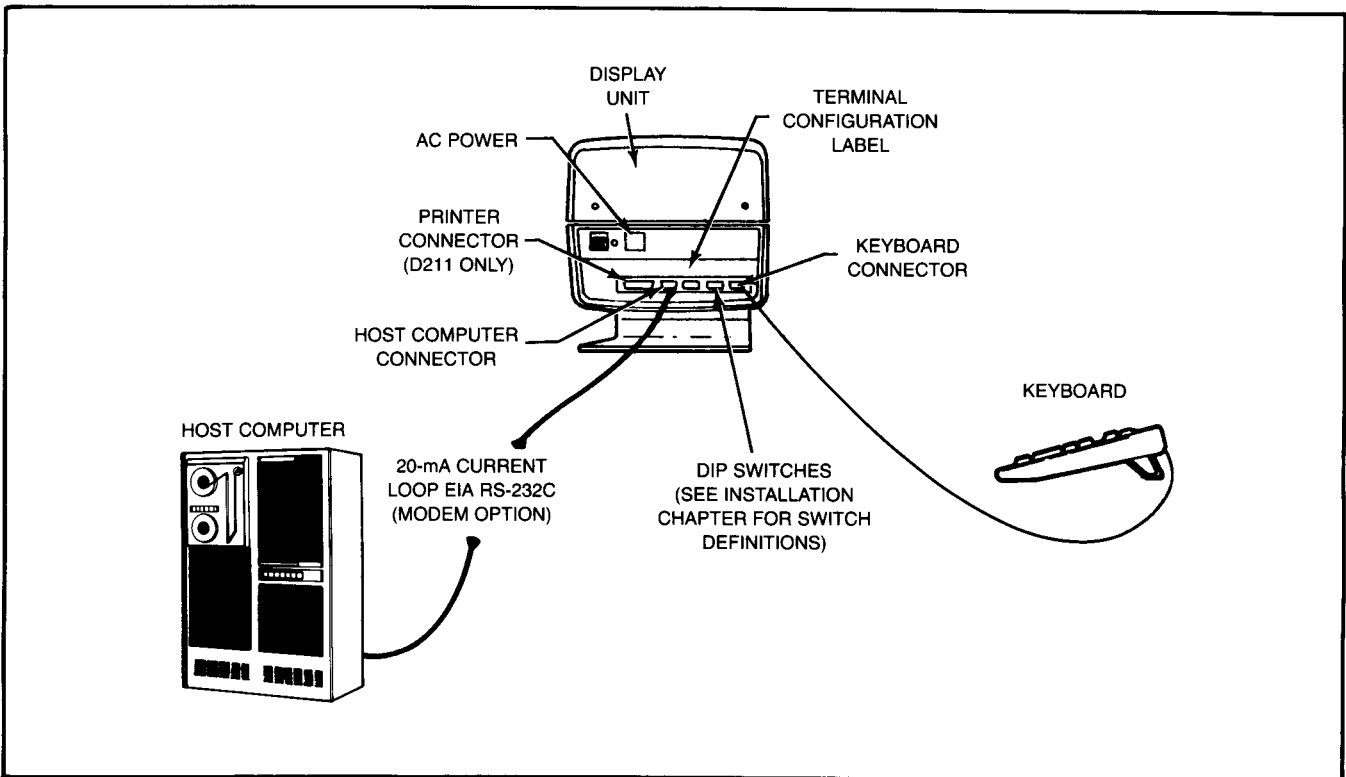
Figure 1-5.   D410/460 Terminal System Configuration

connector is used to select the baud rate (50 to 19200), parity type for host computer communications, and default (power-up) terminal operating mode (DG or ANSI, 7- or 8-bit). The left-hand set of DIP switches is used to select the split baud option, to select 7- or 8-bit printer communications syntax, to set the printer baud rate (110 to 19200), and to select 50 or 60 Hz operation.

A "split baud rate" means that the terminal transmission and reception rates with the host computer are different. Chapter 4 gives details on how to set each DIP switch when a split baud rate is selected.

When power to the display unit is turned on, a self-test automatically verifies that the display unit and attached keyboard are in good working condition. The self-test examines the key elements inside the display unit: the read-only memory (ROM), the DLL board (if present), the read/write memory (RAM), and both the host computer and printer interfaces. The cable connection to the keyboard is checked along with the lamps and bell on the keyboard. If a failure is noted during the self-test, an error message is displayed across the top of the display screen identifying the failing element. For the D410 terminal, the self-test takes approximately 2.5 seconds to complete. For the D460 terminal the DLL printed circuit board (pcb) must be checked in addition to the D410 circuitry, so the self-test takes about 7.5 seconds.

Before the user can begin operating the terminal, the display unit reads the nationality of the keyboard so the nationality of the characters displayed matches that of the keyboard. The DIP switch settings at the rear of the display unit program the baud rates and parity of the host computer and printer interfaces and mode of operation (DG or ANSI, 7- or 8 bit). Finally, the display unit features are initialized to emulate the model D200 terminal (normal character spacing, jumpy scrolling, single window of 24 rows with margins at columns 0 and 79, etc.).

Commands or display characters consisting of ASCII characters or character sequences control operation of the D410/460 terminal. Chapter 3 describes in detail how these commands can be used to manipulate all of the features described earlier in this chapter.

NOTE: *The D410/460 terminal command set is an extension of the model D400/450, which in turn is an extension of the model D200 terminal, so D200 as well as D400/450 software is compatible with the D410/460.*

Commands and characters for display originate from one of two sources: the host computer when the terminal is on-line; the keyboard when the terminal is off-line. The system operation overview paragraph later in this chapter says more about on- and off-line operation.

Keyboard

The D410/460 terminal supports twelve different keyboard configurations (see Table 1-4). The keyboard connects to the rear of the display unit with a 1.2-meter (4-foot) cable.

Table 1-4. Keyboards Supported by the 410/460 Terminal

• U.S.	• German
• United Kingdom	• Italian
• Canadian/French	• Spanish
• Canadian/English	• Swedish/Finnish
• Danish/Norwegian	• Swiss/French
• French	• Swiss/German

Each of the keyboard nationalities works with the display unit to develop ASCII character codes. The ASCII codes include a full set of 95 displayable characters, a delete code, control characters, and special user function code sequences. In addition, when the terminal is off-line, the command header control code ⟨036⟩ can be produced.

NOTE: *In this manual, an octal-based number is enclosed in angle brackets (⟨octal number⟩).*

The ⟨036⟩ code is used extensively in the DG version of the D410/460 command set. Appendix A lists all of the ASCII codes and code sequences and identifies the keys used to produce them.

As shown in Figure 1-6, the keys on the keyboard are organized functionally into the following groups:

• Main keypad

• Screen management keypad

• Numeric keypad

• User function keys

• Local function keys

The difference between the nationalities of keyboards lies with the main keypad. Appendix F shows the main keypads of the European keyboards. Chapter 2 provides a detailed description of the keypads.

The 107-key main keypad is similar to a standard typewriter keyboard with a few additional functions. All the displayable ASCII characters can be entered from the main keypad. The 12-key screen management keypad is used for cursor control, screen erase, and special user functions (keys C1 through C4). The 14-key numeric keypad duplicates some of the main keypad functions, but the keys are arranged in a calculator fashion to make entering numerical data easier. The user function keys (F1 through F15) and the CTRL and SHIFT keys on the main keypad combine to produce most of the special code sequences. The code sequences are often used to invoke special user
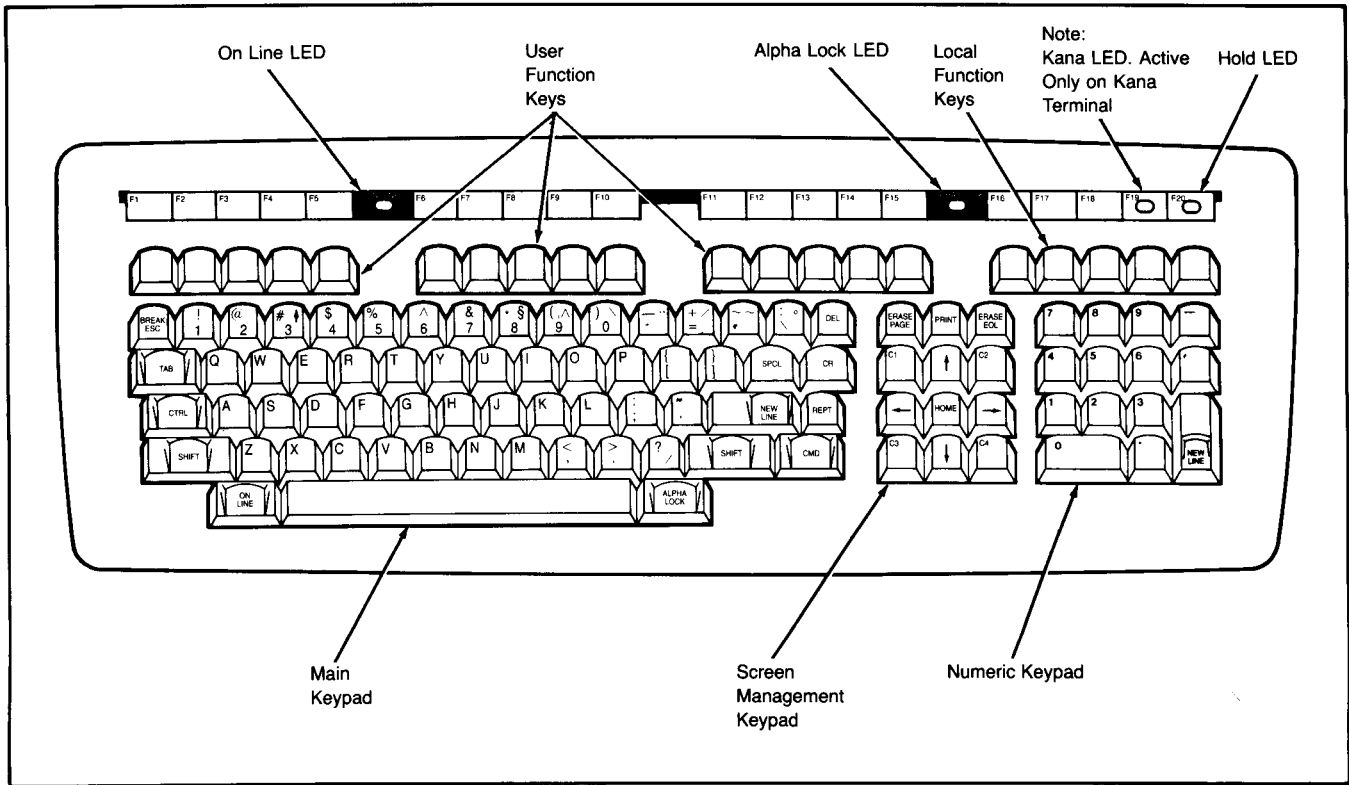
Figure 1-6. D410/460 Terminal Keyboard Layout

functions in the host software servicing the D410/460 terminal. The local function keys control several of the unique features of the terminal, including: cursor appearance, character spacing, print operations, vertical scroll rate, and screen hold (stop/start vertical scrolling).

The SPCL key, on the main keypad, allows the user to generate any character in the U.S. or DG International sets without having to change the terminal's character set orientation. For example, a user of a U.S. keypad operating with the U.S. character set could use the SPCL key to access the Spanish "N tilde" simply by pressing the SPCL key, then the main keypad N key followed by the ˜ key. Note that this function is not applicable in the DG 7-bit mode of operation. Read the SPCL Key section of Chapter 2 for a complete explanation of this feature.

The user has two features available when a key needs to be depressed repeatedly. First is "typematic" repeat. When any one of the typematic keys is depressed and held down for more than three-quarters of a second, the code for that key is repeated at a rate of 15 per second until the key is released. In general, the typematic feature applies to the alphanumeric keys on the main keypad, the cursor control keys on the screen management keypad, and the numeric keypad. The second repeating method is through use of the REPT (repeat) key on the main keypad. REPT can be used in conjunction with any code-generating key to increase the repetition rate to 30 per second.

The bell for the terminal is located inside the keyboard and is controlled from the display unit. The bell is programmable and can be made to ring on command.

SYSTEM OPERATION OVERVIEW

The D410/460 terminal can be used in two basic operating states: on-line and off-line. "On-line" means the terminal is using a communications line to a host computer, as shown in Figure 1-7A. "Off-line" means the communications line to the host computer is not connected, as shown in Figure 1-7B. The on-line state will prove more valuable in most environments because, in addition to the terminal itself, the host computer system and its resources are accessible to the operator. These resources often include development and application software plus hardcopy output devices such as printers and plotters. The off-line state is somewhat restricted because the terminal keyboard, display unit, and an optional printer comprise the complete system.

When the D410/460 terminal is turned on, the terminal automatically performs a self-test as described earlier in this chapter. As the self-test completes, but before the user can begin operating the terminal, an automatic check is made to see if the appropriate host connector is plugged into the rear of the display unit. If a host connection is found, the ON LINE lamp on the keyboard is turned on and the terminal enters the on-line state. If no host connection exists, the ON LINE lamp will blink. While the ON LINE lamp
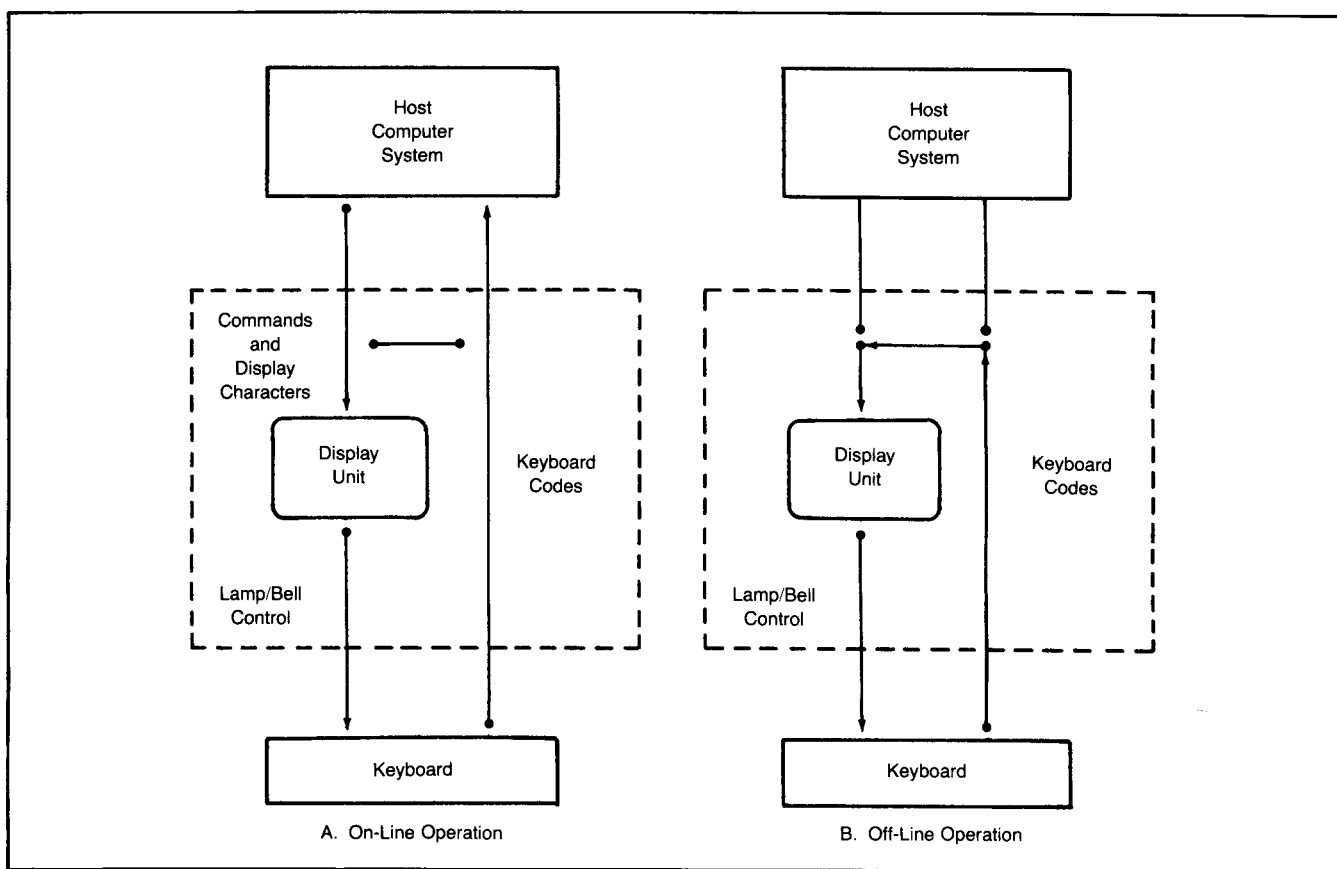
Figure 1-7. D410/460 Terminal and Host Computer Operation

blinks, no characters can be entered from the keyboard. By depressing the CMD and ON LINE keys simultaneously with the ON LINE lamp blinking, the terminal will enter the off-line state and turn the ON LINE lamp off.

On-Line Operation

In the on-line state, the D410/460 terminal communicates with the host computer system as shown in Figure 1-7A. Data entered at the keyboard is first routed to the display unit and then transmitted to the host computer in the form of ASCII characters. The terminal does not process or display characters sent directly from the keyboard. The character format along with the default state of operation and parity, and the baud rate used to communicate with the host computer are selected with the DIP switches at the rear of the display unit. Chapter 4 contains complete details for setting these DIP switches. If no match exists between the terminal and host computer communication characteristics, a transmission error character in the form of a block smaller than the cursor will appear on the display screen.

Five keys grouped in the upper-right-hand corner of the keyboard perform the same function in both the on-line and off-line states. These are the local function keys. Four of these keys send no code at all to the host

computer; when they are depressed, the display unit performs the selected function independent of the host. These four keys control the cursor type, character spacing (normal or compressed), local print operations, and the vertical scrolling rate. The fifth local function key is used to freeze the contents of the display screen. When on-line, this key does send a CTRL-S (ASCII DC3 or ⟨023⟩) and CTRL-Q (ASCII DC1 or ⟨021⟩) to the host to stop and resume, respectively, the character flow from the host.

Downloading custom character sets to the D460 terminal is a special type of on-line operation. Before the download can take place, the custom character definitions must be created and saved in a data file or program on the host computer system. Then, on user request, the character definitions can be transmitted to the terminal and saved in the DLL printed circuit board (pcb).

Off-Line Operation

As shown in Figure 1-7B, in the off-line state no connection exists between the terminal and the host computer. If a communications link to the host does exist and the terminal is on-line, a switch to off-line operation can be made by depressing the ON LINE key while holding down the CMD key.

The terminal can perform all functions off-line, but the user must enter all display characters and commands manually at the keyboard. With the terminal off-line, data entered at the keyboard is interpreted directly by the display unit. All display characters entered at the keyboard are displayed on the screen and all single control characters are interpreted as listed in Appendix A. Appendix E lists the control codes and code sequences for all D410/460 commands.

PRODUCT SPECIFICATIONS

The Technical Specifications table inside the front cover of this manual contains the functional, communication, physical, environmental, and power specifications for the D410/460 terminal.

CHAPTER 2
OPERATION

GENERAL

This chapter contains the following operation information about the D410/460 terminal:

- Display unit controls and indicators

- Keyboard controls and indicators

- Power-up and power-down procedures

- Operating procedures

- Generalized downloading procedures for user-defined character sets (D460 terminal only)

- Operator maintenance procedures

The terminal operating procedures in this chapter are limited in scope because the software in the host computer controls most on-line operation details. Chapter 1 helps clarify this point and includes a discussion of terminal on-line and off-line operation. Off-line operating procedures receive most of the attention in this chapter because they depend only on the characteristics of the D410/460 terminal.

Those users who have a printer configured with their D410/460 terminal should see the printer manual(s) for printer operating instructions.

DISPLAY UNIT CONTROLS AND INDICATORS

The display unit has one control on the front, a display screen, and connectors and DIP switches at the rear. Chapter 4 contains detailed instructions for completing the cable and power cord connections and setting the DIP switches at the rear of the terminal.

   NOTE: *Except where specified, the operation characteristics of the D410/460 terminal described in this chapter apply to both the DG and ANSI modes of operation.*

The power ON/OFF switch is located on the rear of the display unit.

A control located on the lower-right front of the display unit (Figure 2-1), changes display screen brightness. Slide the control to the right to increase brightness, to the left to decrease brightness.

The terminal bell rings once when the terminal is first turned on and a second time when the automatic self-test is completed. The bell is programmable and can be sounded off-line from the keyboard (depress CTRL-G) or on-line by the host computer.

KEYBOARD CONTROL AND INDICATORS

The U.S. keyboard is shown in Figure 2-2. The keyboard contains a typewriter-style, 60-key main keypad, a 12-key screen management keypad, a 14-key numeric keypad, 15 user function keys, and 5 local function keys. Appendix F shows how the main keypads of the European keyboards differ from the U.S. main keypad.

With the keyboard, the operator can generate all 95 displayable ASCII characters, the delete character, control characters, and numerous special character sequences. Appendix A lists all of these characters and character sequences along with codes generated by all keys.

Two separate keyboard features are provided to speed up the entry of repeated characters. One, typematic repeat, applies only to the keys shown in Figure 2-2 as being shaded. When one of these shaded keys is depressed for more than three-quarters of a second, the associated character is generated at a rate of 15 per second until the key is released. Alternatively, depressing and holding down the REPT key along with any other character generating key or key combination, begins immediate repetition of the associated character at the rate of 30 characters per second. Repetition continues at that rate until either the REPT key is released, in which case the rules for typematic repeat begin to apply, or until the other key or combination is released, in which case the repetition ceases. The REPT feature also works for the NEW LINE key. However, the REPT key will not affect the operation of the CTRL, SHIFT, ON LINE, ALPHA LOCK, and CMD key sequences.

Power On/Off and
Brightness Adjust
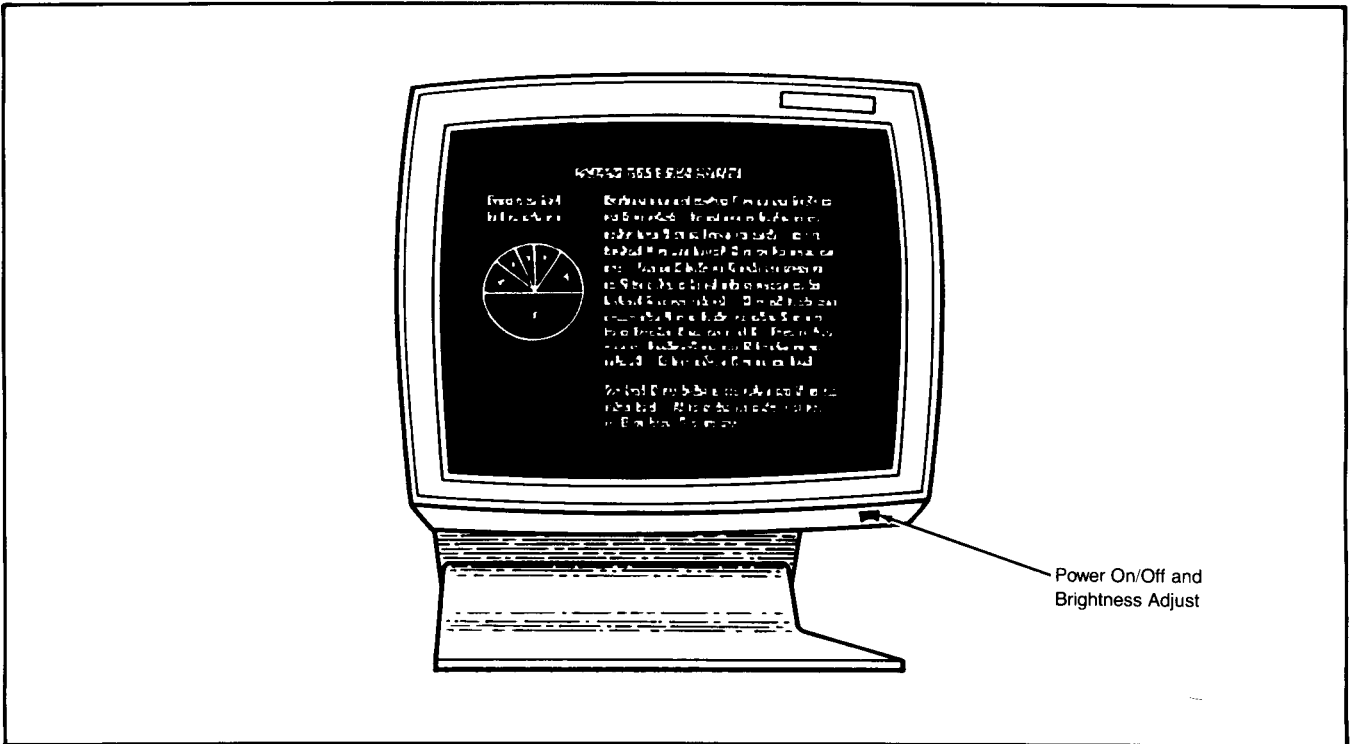
Figure 2-1. Display Unit Brightness Control

NOTE: Typematic keys are shaded
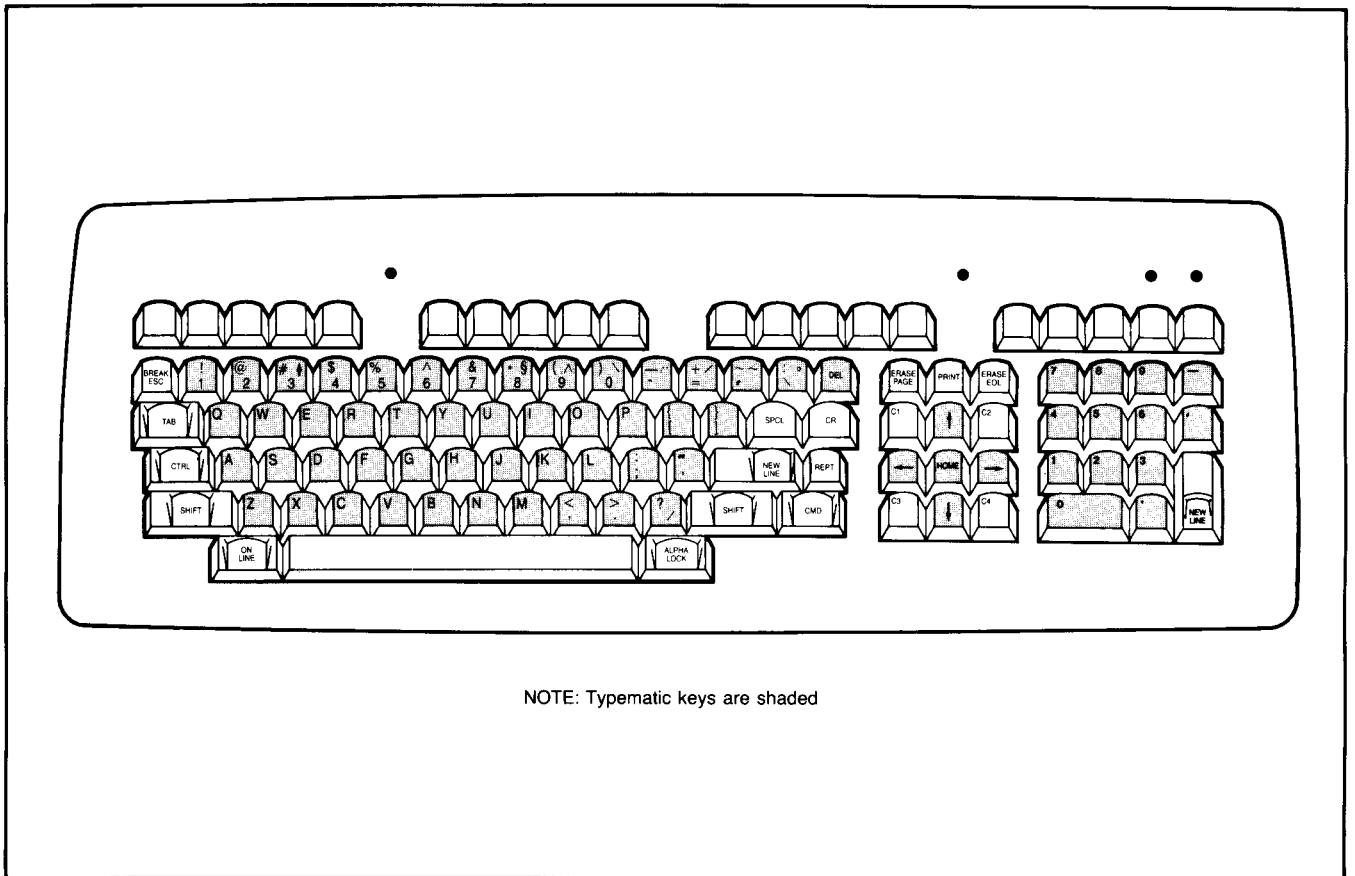
Figure 2-2. Terminal Keyboard

NOTE: *The functions performed by code-generating keys in the on-line mode are controlled by software servicing the D410/460 terminal in the host computer. The following paragraphs describe off-line operation of the code-generating keys and operation of the keys that do not generate codes for the host computer. See the host system or application documentation for a description of on-line operation of the code-generating keys.*

Main Keypad

The main keypad is shown in Figure 2-3. The darker colored keys on the main keypad form the standard typewriter-style keyboard. In the off-line state of the terminal, these keys produce the displayable characters shown on their keycaps.

NOTE: *Depressing the space bar or a display character key writes a space or display character to the alphanumeric cursor location, deleting any previously displayed character in that location. Spacing over characters already typed erases those characters. The cursor control keys can be used to move the cursor without the erasing action.*

The functions of the lighter colored keys on the main keypad in the off-line mode are:

- **BREAK ESC** — Depressing this key alone has no effect. In DG mode, depressing the CMD key and then depressing ESC (CMD-ESC) generates the ASCII control code ⟨036⟩.

  In ANSI mode, depressing ESC and then depressing [generates the control code ⟨CSI⟩ (mnemonic for ⟨233⟩ in 8-bit mode or ⟨033⟩⟨133⟩ in 7-bit mode).

  The DG ⟨036⟩ and ANSI ⟨CSI⟩ control codes are used extensively in programming the terminal and the ⟨036⟩ code cannot be generated from the keyboard when the terminal is on-line in DG mode. The ⟨033⟩⟨133⟩ can be generated at any time.

  NOTE: *In this manual, an octal-based number is enclosed in angle brackets (⟨octal number⟩).*

- **TAB** — Depressing this key has no effect off-line (it generates ⟨011⟩, an undefined control code).

- **CTRL** — Depressing this key alone has no effect. When CTRL is depressed and held down while another key is depressed, the control code of the other key is generated.

- **SHIFT** — Depressing this key alone has no effect. Depressing SHIFT while depressing another key generates the shift code of the other key (uppercase functions on dark keys of main keypad). If the AL-
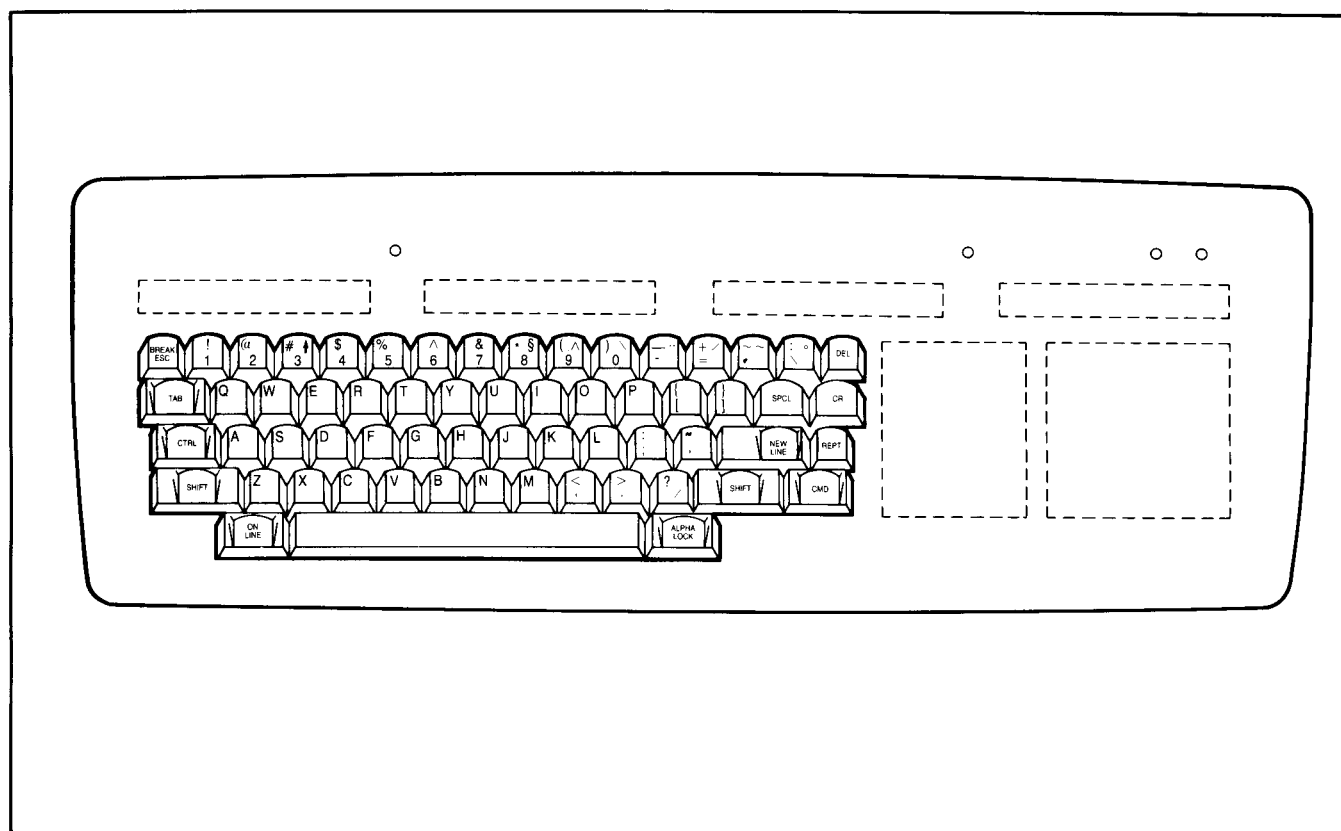
Figure 2-3. Main Keypad

PHA LOCK mode is on, this key has no effect on the alphabetic keys.

- **ON LINE** — Depressing this key alone has no effect. Depressing and holding down CMD while depressing ON LINE (CMD-ON LINE) switches the terminal between the on-line and off-line modes. The ON LINE lamp will light when the terminal is on-line, blink when the terminal is waiting to go on-line due to an incomplete connection to the host computer, and turn off when the terminal is off-line. When the terminal is powered up, it will attempt to go on-line automatically. As a result, the ON LINE lamp will either be on or blinking after power-up.

- **ALPHA LOCK** — This is an alternate action key that places all alphabetic keys in the uppercase mode the same way a shift-lock key does on a typewriter. ALPHA LOCK does not affect numeric or special symbol keys (except that on the French and Italian main keypads it does shift the 0 - 9 keys). The ALPHA LOCK lamp will light when the uppercase mode is in effect.

- **CMD** — Depressing this key alone has no effect. When CMD is depressed and held down while another key is depressed, the command code of the other key is generated.

- **REPT** — Depressing this key alone has no effect. Depressing REPT along with another code-generating key or key combination, causes the code to repeat at a rate of 30 times a second. This key overrides the normal typematic feature of the keyboard. When the terminal is on-line and set to operate at less than 300 baud, the repeat rate is limited by the baud rate.

- **NEW LINE** — Depressing this key moves the cursor to the beginning of the next line (row). If the beginning of the next line is a protected character position, the cursor performs as many Cursor Right operations as needed until the first unprotected character position is reached. Cursor Right is described under the screen management keypad description. If the cursor is at the right margin of the last row of the window, the window is normally scrolled up one line and the cursor moves to the left margin of the new bottom row. The roll enable/disable programming commands determine whether or not the window image scrolls up or the cursor moves to the left margin of the first row. If a protected area is encountered when New Line is depressed, the Cursor Right operation repeats as needed until the first unprotected character position is reached.

NOTE: *Depressing the NEW LINE key while depressing the REPT key repeats the new line function 30 times a second. If these two keys are depressed with smooth scrolling in effect, with the cursor on the bottom row of a window, and with screen roll enabled, the cursor will disap-*

pear off the bottom of the window until the vertical scrolling caused by the repeating new line operation is complete.

- **SPCL** — On the U.S. keyboard, depressing this key and then depressing certain sequences of other keys (see Table 2-1), results in one of the DG International characters being displayed on the screen (see note below). Once the SPCL key has been depressed, the special character will appear on the screen only after the correct sequence has been completed. If a character is entered which is not part of a valid sequence, then the next key depressed will cause a character from the current active character set to be displayed rather than the special character desired. In that case, simply backspace one column and begin the correct sequence by depressing the SPCL key again.

The particular characters shown in Table 2-1 are displayed regardless of the character set otherwise selected to be active at the time. This is true so long as the secondary character set (G1) contains the DG International character set, which is the default G1 character set at power-up for DG 8-bit and ANSI 7-and 8-bit modes. In DG 7-bit mode, if the code generated by the SPCL key sequence represents a graphic present in the 7-bit code keyboard language, then that particular character is displayed. If no such graphic character is present in the keyboard language, then the terminal treats the sequence as invalid. Read Chapter 3 for a detailed discussion of character set selection. Chapter 3, in the section on Host/Terminal Communication, contains a discussion of code generated by the keyboard.

NOTE: *Keyboard nationalities other than U.S., may have different characters associated with the code generated by the SPCL key sequences. See appendix A for the octal codes produced by each SPCL key combination.*

- **CR** — Depressing this key moves the cursor to the left margin of the current line. If the left margin position contains a protected character, the cursor will move to the first unprotected character position to the right of the beginning of the line.

- **DEL** — Depressing this key has no effect off-line.

Screen Management Keypad

The screen management keypad is shown in Figure 2-4. The four keys labeled C1, C2, C3, and C4 are user function keys and are discussed later in this chapter with the user function keys F1 through F15. The remaining keys on the screen management keypad perform the following off-line functions:

- **ERASE PAGE** — Depressing this key clears the current window (window containing the cursor) of both protected and unprotected characters and

Table 2-1. SPCL Key Sequences

Depress SPCL Key		Character Displayed
Then Depress	Then Depress	
A	`	â (Â)
A	¨	à (À)
A	´	ä (Ä)
A	˜	á (Á)
A		ã (Ã)
A	°	å (Å)
e	`	ê (Ê)
e	¨	è (È)
e	´	ë (Ë)
e	^	é (É)
i	`	î (Î)
i	¨	ì (Ì)
i	´	ï (Ï)
i	^	í (Í)
o	^	ô (Ô)
o	`	ò (Ò)
o	¨	ö (Ö)
o	´	ó (Ó)
u	^	û (Û)
u	`	ù (Ù)
u	¨	ü (Ü)
u	´	ú (Ú)
n	˜	ñ (Ñ)
L	—	£
	(?)	(¿)
	(!)	(¡)
	↑	↑
	§	§
o	χ	¤
space	¨	¨
space	´	´
space	`	`
space	˜	˜
space		
space	°	°
a	e	æ (Æ)
c	؛	ç (Ç)
o	e	œ (Œ)
s	s	β
o	˜	õ (Õ)
c	/	¢
o	/	ø (Ø)

NOTE: Parentheses () indicate the character displayed when the Shift Key is depressed and held down while the character is depressed.

   Keys that produce special character accents such as ¨ are identified by the symbols printed in the upper right corner of certain numeric key faces.

   Once the SPCL Key has been depressed, the order in which the other keys are pressed does not matter.

moves the cursor to the left margin of the top line of the window (window home position).

NOTE: *Terminal Reset—When CMD is depressed and held down while ERASE PAGE is depressed, the terminal is reset to its initial power-on state and the terminal self-test is performed. The terminal can be reset in this manner both off-line and on-line. Table 2-2 lists highlights of the terminal reset operation.*

Table 2-2. Terminal Reset Conditions

- Display screen cleared
- Cursor moved to upper-left corner of screen
- Cursor displayed as reverse video block
- Single window (24 rows) with margins at columns 0 and 79
- Primary character set: keyboard nationality (7-bit mode)
                    U.S. ASCII (8-bit mode)
- Normal character spacing selected
- Screen roll and horizontal scrolling enabled
- Character blinking enabled
- Character protection disabled
- Blink, dim, underscore, and reverse video turned off
- Line drawing color set to solid (D460 only)
- User defined characters deleted (D460 only)

- **PRINT** — Depressing this key has no effect off-line.

- **ERASE EOL** — Depressing this key erases characters from the current cursor position to the right margin (including the character in the cursor position). If any characters to the right of the cursor are protected, only those characters between the cursor and the first protected character are erased. The cursor position is not changed with this key.

- **Cursor Right** — Depressing this key moves the cursor one column position to the right on the current row. If the cursor is at the right margin, it moves to the left margin of the next row; that is, a new line function is performed (refer to previous discussion of the New Line key). If the cursor attempts to move into a protected area, the cursor performs as many Cursor Right operations as needed until the first unprotected character position is reached.

- **Cursor Left** — Depressing this key moves the cursor one column position to the left on the current row. If the cursor is at the left margin of a row, it moves to the right margin and then a Cursor Up operation takes place. If the cursor attempts to move into a protected area, the cursor performs as many Cursor Left operations as needed until the first unprotected character position is reached.

- **Cursor Down** — Depressing this key moves the cursor down one row in the current column. If the cursor is on the bottom row of a window, it moves to the top row of the window in the same column. If the cursor attempts to move down into a protected area, the cursor performs as many Cursor Right operations as needed until the first unprotected character position is reached.

- **Cursor Up** — Depressing this key moves the cursor up one row in the current column. If the cursor is on the top row of a window, it moves to the bottom row of the window in the same column. If the cursor attempts to move up into a protected area, the cursor performs as many Cursor Left operations as needed until the first unprotected character position is reached.

- **HOME** — Depressing this key moves the cursor to the left margin of the first row in the current window. If the window home position is protected, the cursor performs as many Cursor Right operations as needed until the first unprotected character position is reached.

Numeric Keypad

The numeric keypad is shown in Figure 2-5. All of the keys on the numeric keypad are duplicated on the main keypad; their arrangement on the numeric keypad makes the entry of numbers easier.

User Function Keys

The user function keys are also shown in Figure 2-5. Keys F1 through F15, keys C1 through C4, PRINT, and the cursor positioning keys can all be considered user function keys. Appendix C shows the code sequences generated by the user function keys for both the DG and ANSI modes. User function keys have no effect in the off-line mode.

Local Function Keys

The local function keys are shown in Figure 2-6. These keys have the same effect whether the D410/460 terminal is on-line or off-line. There are five local function keys and one local function lamp:

- **CURSR TYPE** — Depressing this key changes the appearance of the cursor. When the terminal is turned on, the cursor is displayed as a reverse video block. Depressing CURSR TYPE once causes the cursor to appear as a blinking underline. Subsequent depressions of CURSR TYPE cause the cursor to disappear, appear as a blinking reverse video block, and return to its original form as a non-blinking reverse video block.

- **NORM/COMP** — Depressing this key changes the appearance of the current window by switching between normal and compressed character spacing. When the terminal is turned on, there are 81 columns across the width of the display screen (normal spacing). When NORM/COMP is depressed once, 135 columns are displayed (compressed spacing). Subsequent depressions of NORM/COMP cause the appearance of the window to alternate between the two spacing types. The margins are not affected by this key.

- **LOCAL PRINT** — This key has no effect unless an operating printer is connected to the terminal.

In DG mode, the Local Print key is used alone or in combination with other keys for four different printing operations:

1. Depressing Local Print alone (Print Window) transmits the contents of the current window to
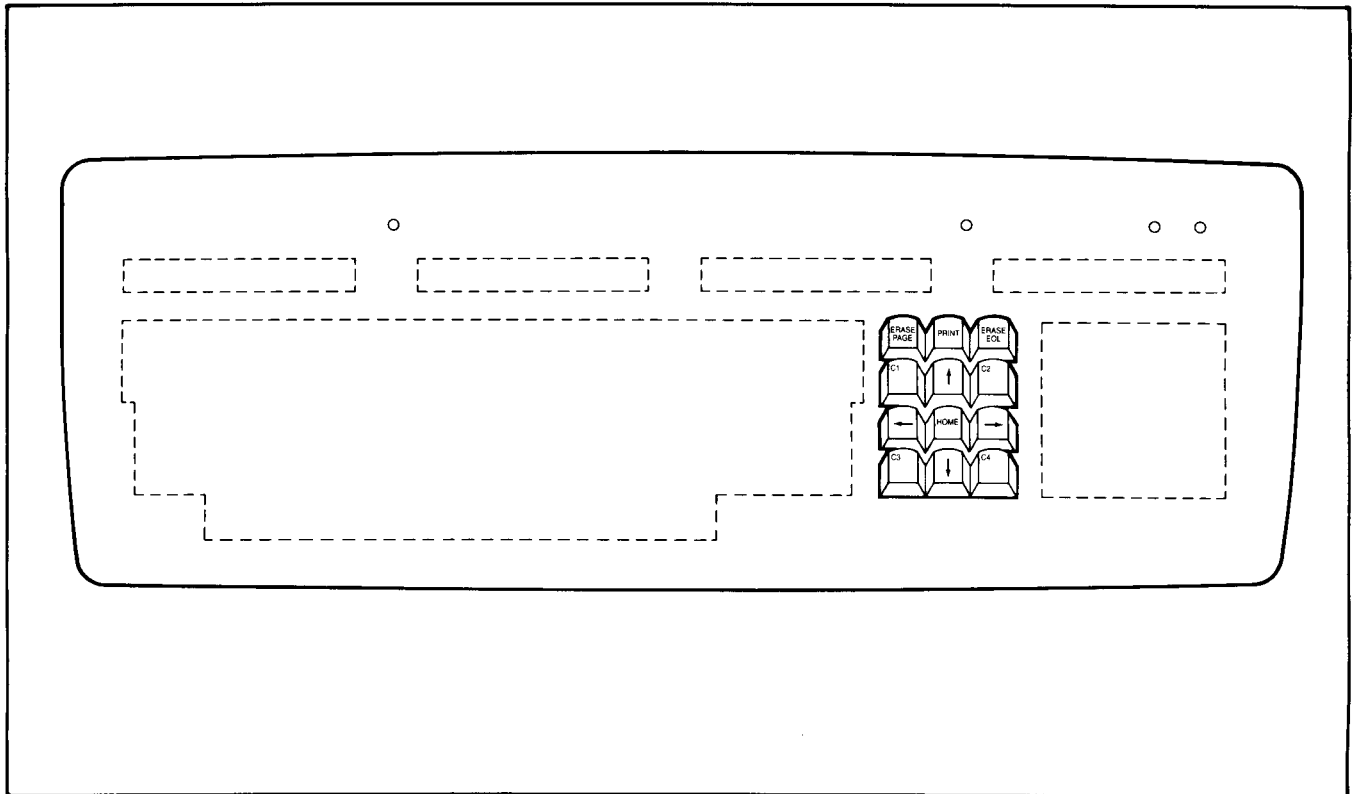

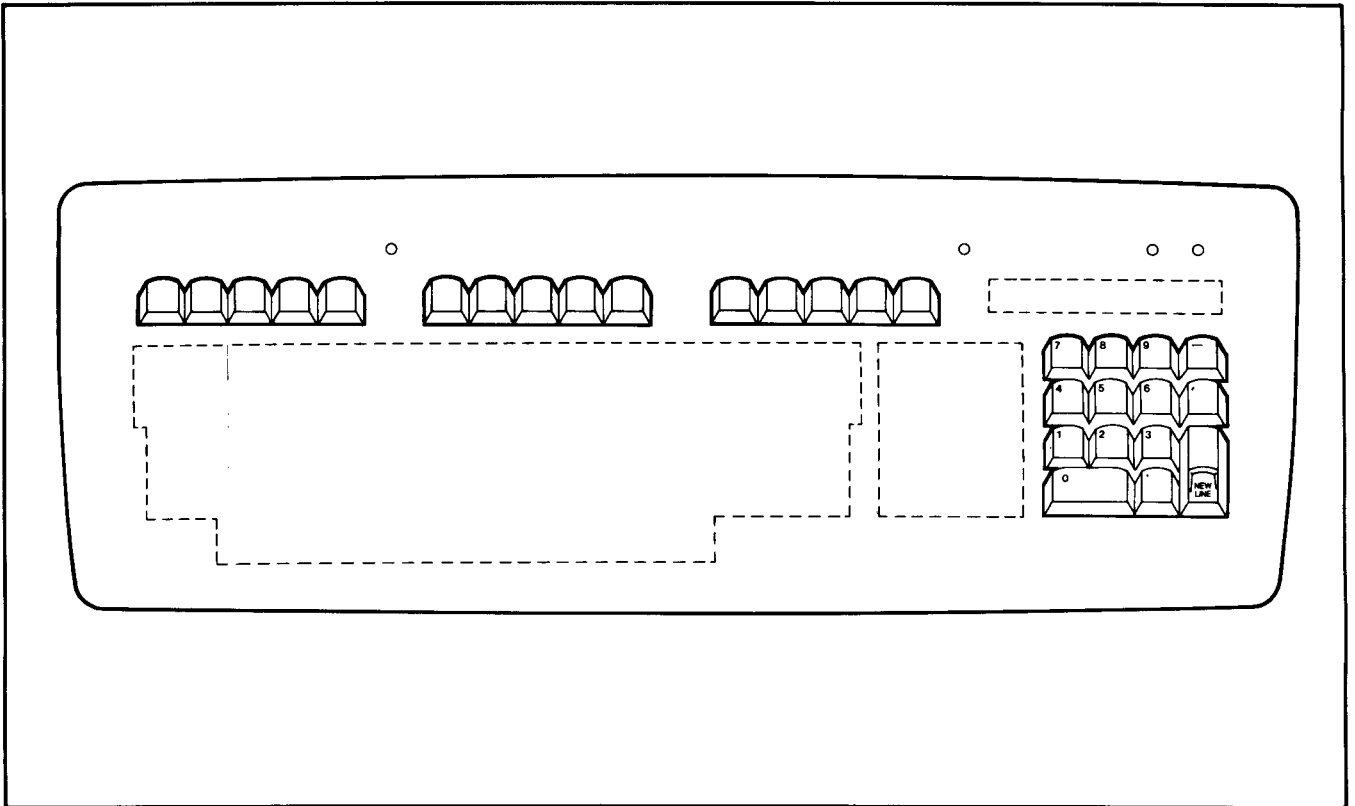**Figure 2-4. Screen Management Keypad**

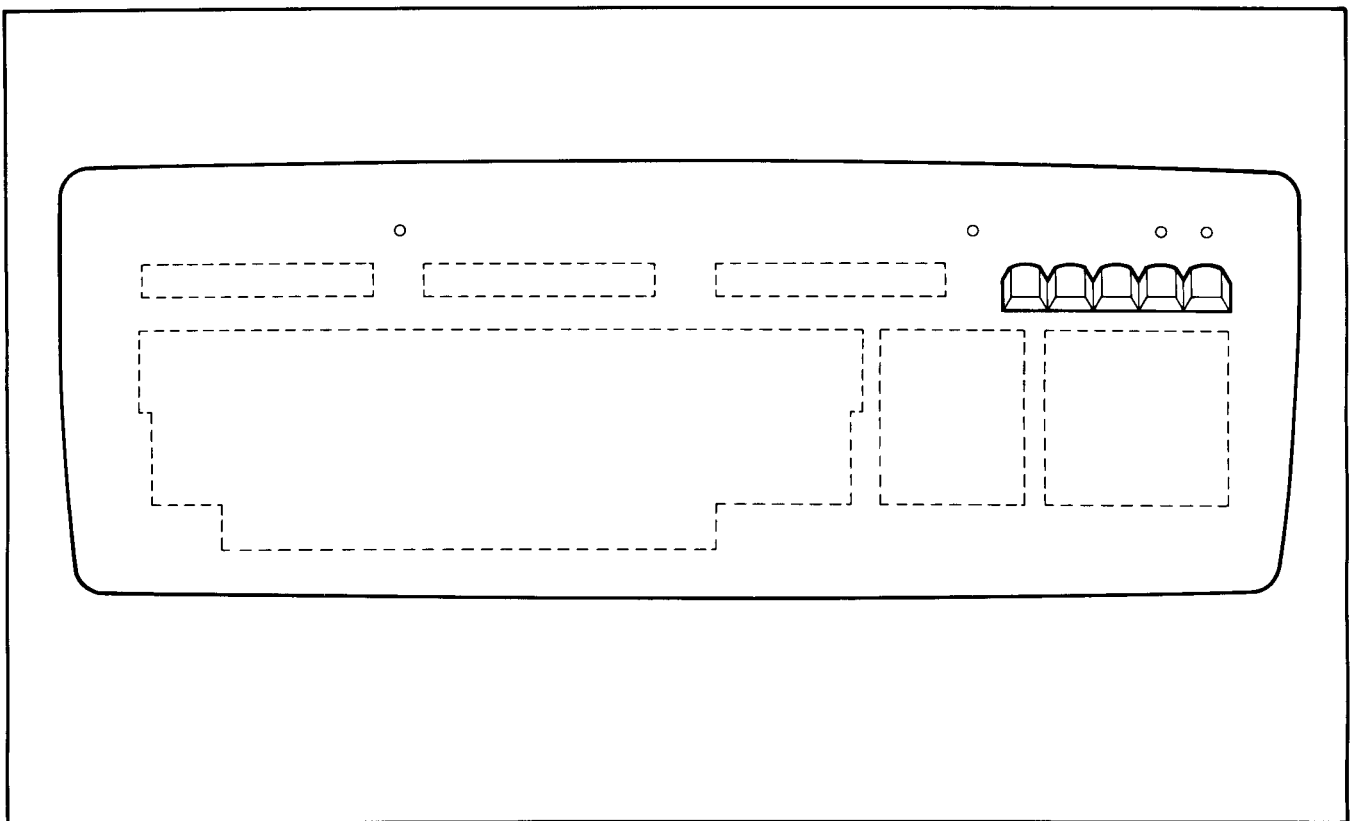Figure 2-5.   Numeric Keypad and User Function Keys

Figure 2-6.   Local Function Keys and Lamp

the printer, beginning with the row containing the cursor. During printing, data entered at the keyboard is ignored and lost. The printing can be aborted before the complete window has been printed by depressing Local Print a second time (or CMD-CR).

2. Depressing and holding down SHIFT while depressing Local Print initiates the Print Form operation. As long as protected text is disabled, print form works the same as print window, except that only data appearing at full intensity in the current window is printed. When protected text is enabled, only unprotected text (both normal intensity and dim) is printed.

3. Depressing and holding down CMD and SHIFT while holding down Local Print initiates the Window Bit Dump operation, which causes a bit image dump to the graphics slave printer. The active window is printed exactly as it appears to the user, except that underscore and blink attributes are ignored.

4. Finally, depressing and holding down CMD along with Local Print starts the Form Bit Dump operation. This causes the graphics slave printer to print the active window exactly as it appears to the user.

• **SCRLL RATE** — When the terminal is turned on, scrolling is performed in single-row increments (jump scrolling). Depressing SCRLL RATE will change the scroll rate for the current window to one of three settings:

1. Depressing SCRLL RATE once enables smooth scrolling (performed at a rate of 5 character rows per second).

2. Depressing SCRLL RATE a second time increases the smooth scroll rate to 10 character rows per second.

3. Depressing it a third time returns the terminal to jump scrolling.

• **HOLD** — When the terminal is turned on, the HOLD lamp is off and the screen image is free to change. Depressing HOLD turns on the lamp, "freezes" the screen image, and prevents it from changing. Keyboard operation may continue while the hold is in effect, but the characters typed will not be displayed. Depressing HOLD again "unfreezes" the screen, turns off the lamp, and causes any characters entered during the hold period to be displayed.

TERMINAL POWER-UP/-DOWN PROCEDURES

The power on/off control is located on the left rear of the display unit.

Power-Up Procedure

Before applying power, verify that the terminal has been installed in accordance with the procedures in Chapter 4. The power application steps in the following procedure will work whether or not a host computer is connected to the terminal:

1. Apply power to the terminal by setting the power control to the "on"or "1" position.

2. When first turned on, the terminal executes a self-test to verify that everything is working. The self-test takes about 2.5 seconds for the D410 terminal and about 7.5 seconds for the D460 terminal. The following sequence of events occurs during the self-test:

   a. Immediately after power is applied, the bell rings and the ON LINE, ALPHA LOCK, and HOLD lamps on the keyboard turn on.

   b. The keyboard lamps remain on as the circuitry inside the terminal is automatically checked to verify that everything is in good working condition.

   c. As the self-test completes, the terminal bell rings a second time and the ALPHA LOCK and HOLD lamps turn off. The ON LINE lamp remains lighted if the terminal is connected directly to a host computer. If no host connection exists, or if modems are used for communications with the host, the ON LINE lamp blinks. If modems are used, the ON LINE lamp stops blinking and remains on when the modem is ready for communications with the remote host.

   d. The reverse video block cursor appears in the screen home (upper-left corner) character position followed by the words "D410/460 Self Test OK".

   NOTE: *When the terminal is not connected to a host computer, keyboard input is disregarded, and the ON LINE lamp blinks until CMD is depressed and held down while ON LINE is depressed (CMD-ON LINE). Then the ON LINE lamp turns off to indicate the terminal is off-line.*

3. To operate the terminal on-line, log on the host computer in accordance with the host software requirements. The details of this step should be found in the host system software documentation.

The descriptions of keyboard controls and indicators earlier in this chapter summarize off-line operation of the terminal. On-line operation is determined by the host software interacting with the terminal functions. For D460 terminals, general guidelines for downloading user-defined character sets from the host to the terminal are provided following the operating procedures section.

Power-Down Procedure

During normal use, the D410/460 terminal should be turned off only when it is not expected to be used for several hours. When power is turned off on a D460 terminal containing downloaded user-defined character sets, the character sets are lost. The download procedure must be repeated each time power is turned back on if the user-defined character sets are needed.

If the terminal is not connected to a host computer system, turn off power by setting the power control on the rear of the display unit to "off."

If the terminal is connected to a host computer system, first log off the host software before shutting off the power. To log off the host software, the terminal must be on-line (ON LINE lamp on). The CMD-ON LINE key sequence is used to switch the terminal between the on-line and off-line modes.

OPERATING PROCEDURES

The operating characteristics of the D410/460 terminal depend on whether the terminal is being used off-line or on-line with a host computer.

On-line operation is controlled by the host. Read host system and application documentation for detailed operating instructions pertaining to the host-resident software. Off-line operation receives more attention in this user's manual because off-line the user can exercise the same terminal features (and commands) that the host computer can when the terminal is on-line.

On-Line Operation

Before D410/460 terminal can be operated on-line, the steps of the Power-up Procedure described above must be followed.

With these initial steps completed, the terminal is ready for communications with the host computer and its software. As discussed earlier in this chapter, the performance of the terminal is under control of the operating system and any other host software the terminal user brings into play. The host software documentation constitutes the primary source of terminal operating instructions.

To switch the terminal off-line, depress CMD-ON LINE and the ON LINE lamp will turn off.

Off-Line Operation

Off-line, the D410/460 terminal can be used as a training tool. The user can manually (from the keyboard) exercise the same terminal features and commands that the host computer can exercise under on-line con-

ditions. The following paragraphs provide general guidelines to off-line operation.

As mentioned earlier, the descriptions of keyboard controls and indicators in this chapter define how the terminal responds off-line when the various keys are depressed. Chapter 3 and Appendix E contain all of the D410/460 terminal commands. These commands can be entered from the keyboard by keying in the ASCII characters or character sequences for the associated commands.

In DG operating mode the terminal commands use some special ASCII characters that do not have a corresponding key on the keyboard. These characters fall in the range of ⟨000⟩ to ⟨036⟩. Appendix A shows how to produce these characters from the keyboard. The ⟨036⟩ code is used extensively in the commands and can only be produced from the keyboard by depressing and holding down CMD while depressing ESC (CMD-ESC) with the terminal off-line.

Terminal commands in the ANSI operating mode also use characters not having corresponding keys on the keyboard and falling in the ⟨000⟩ to ⟨036⟩ range. However, these characters have completely different associated commands and are generally produced by using the CTRL key in conjunction with one of the main keypad keys. Appendix A also shows how to produce each of these characters.

The command execution procedure that follows can be used to execute the terminal commands off-line. Off-line operation can be aborted in favor of on-line operation by depressing CMD-ON LINE at any point in the procedure. However, the environment established off-line (window and margin settings, etc.) will remain until reestablished by the host software.

Command Execution Procedure:

1. With the terminal off-line and using Chapter 3 or Appendix E as a reference, enter a command on the keyboard. The command itself will not be displayed. (For example, the command "⟨036⟩F?3" which causes a Print Pass Through to be executed in DG mode, does not itself appear on the screen.)

2. The command executes as soon as it is completely entered at the keyboard.

3. Repeat steps 1 and 2 for each command to be executed.

   NOTE: *If an error is made entering a command, the command is ignored. Retype the command correctly.*

For a thorough example demonstrating the entry of terminal commands off-line, read the terminal off-line checkout and demonstration procedure in Chapter 4.

DOWNLOADING USER-DEFINED CHARACTER SETS

This section contains general guidelines for loading user-defined characters in the D460 terminal (user-defined characters are not a feature of the D410 terminal).

The D460 terminal is equipped with a download capability that allows the user to define a maximum of 3572 custom characters at any one time. These custom characters are in addition to the standard U.S. ASCII character set, the European character sets, and the word processing, line drawing, super-/subscript, math, and Greek alphabet symbols that the D460 has in common with the D410 terminal.

User-created character sets normally exist in the form of one or more ASCII files or programs on the host computer system. Chapter 3 describes in detail the programming commands involved in defining the custom characters. Every time power to the D460 terminal is cycled off and on, the following general steps must be followed to install the user-defined characters:

1. Power-up the terminal and log onto the host system as described in the power-up procedure earlier in this chapter.

2. Create/install the file(s) or programs containing the custom characters on the host system.

3. Download (transfer) the custom characters from the host to the terminal. One way to do this is with the appropriate operating system command; e.g., TYPE the file(s) to the terminal when a Data General AOS or AOS/VS operating system is being used. A second download method might involve the host program automatically downloading custom characters as needed.

The operating system should signal that the download is complete by prompting the user for input. The downloaded characters are now installed in the terminal and ready for use. The amount of time taken for a download of custom characters depends primarily on the number of characters downloaded and the baud rate setting for the terminal/host connection. An approximate download time calculation can be performed as follows:

TIME	= Total download time in seconds
NO.CHAR	= Number of character definitions to download
CHAR-SEC	= Character definitions downloaded per second
BAUD	= Host/terminal baud rate setting
BITS	= Number of bits per ASCII character (including parity and start/stop bits)
28	= Number of ASCII characters per character definition
TIME	= NO.CHAR/CHAR-SEC
CHAR-SEC	= BAUD/(BITS 28)

therefore:

$$\text{TIME} = ((\text{NO.CHAR})(\text{BITS})28)/\text{BAUD}$$

An example will give a better idea of the total time involved. If a set of 1024 characters is downloaded at 9600 baud, and each ASCII character transferred is assumed to consist of 10 bits (1 start bit, 7 data bits, 1 parity bit, 1 stop bit), the total download time is calculated as follows:

$$\text{TIME} = (1024 \times 10 \times 28)/9600 = 29.9 \text{ seconds}$$

This amounts to less than 3 seconds for each set of 94 characters. Chapter 3 discusses user-defined character sets in detail.

USER MAINTENANCE

User maintenance can be divided into two categories: preventive maintenance and problem diagnosis.

Preventive maintenance for the D410/460 terminal primarily involves maintaining a clean, dust-free environment that conforms to the specifications listed in the site requirements portion of Chapter 4. If dust or dirt accumulates on any of the terminal equipment, wipe the equipment with a clean, dry, dust-free cloth. Also, be careful not to obstruct the cooling vent area on top of the display unit.

If a problem appears to develop with the terminal, the user can take a few steps to solve the problem before calling on your Data General Office for help. See Table 2-3 for a list of failure symptoms and the corresponding solutions. If the suggested solution does not fix the failure, or if an obviously serious problem occurs, contact the nearest Data General Office for help.

Table 2-3.   Terminal Problem Diagnosis

Failure Symptom	Solution
Nothing happens when terminal is turned on	Check terminal power cord connection and verify ac power source to cord is turned on.
Bell does not ring or keyboard lamps do not light when terminal is turned on	Verify keyboard cable connection to rear of display unit is secure, and keyboard cable is attached to proper connector.
Cursor is not displayed on screen within 10 to 15 seconds after power to terminal is turned on	Adjust brightness control on display unit to verify screen brightness is not turned down too far for viewing.
Error message (FAILURE: KBRD, RAM1, URT1, etc.) displayed when terminal turned on	Contact your Data General Office for help. Try using terminal even though error message appears: the failure may not be fatal to normal terminal operation.
Terminal will not go on-line (ON LINE lamp blinking or off)	Verify cable connection from host to terminal is secure: if a user-supplied cable is installed, verify terminal end of cable is wired as shown in Installation Chapter.
Data entered at keyboard is not displayed (on-line and off-line)	Is HOLD lamp on? If so, depress HOLD key to unfreeze screen. If not, try depressing CTRL-Q. Is cursor visible on screen? If not, data entered may be located outside of display area. See Horizontal Scroll Enable command description in DG mode or Set Mode command in ANSI mode.
Data entered at keyboard is not displayed (on-line only)	Verify host computer system is operating.
UART error character displayed (※)	Verify baud rate and parity DIP switches at rear of display unit are set as intended (reference Installation Chapter). If switches must be reset, go off-line and then back on-line to reprogram UART with new settings.
Data entered at keyboard is not same as data displayed	Verify baud rate and parity DIP switches are set as intended. If they are, depress CMD-ERASE PAGE to reset terminal and ensure display character set matches keyboard nationality.
Screen image flickers	Verify 50/60 Hz DIP switch is set to match frequency of power source (reference Installation Chapter).
Printer does not work with terminal	Verify printer is installed and set up to operate with terminal as described in Installation Chapter.

CHAPTER 3
PROGRAMMING

GENERAL

This chapter contains the following information for the user who intends to write host-resident software for the D410/460 terminal:

- Description of host/terminal communications and requirements that must be met by the host-resident software

- Description of the four modes of terminal operation

- Description of printer operations and communications

- Definition of all ASCII codes generated by the keyboard

- Conceptual overview of the programmable features of the terminal, coupled with an introduction to D410/460 commands

- Detailed description of all D410/460 commands for both ANSI and DG modes

The D410/460 terminal can be considered a functional superset of (upwards compatible with) the earlier Dasher D200 and D400/450 display terminals. Host software written to run with the D200 will do the same for the D410/460.

A significant new feature of the D410/460 terminal is that it may be operated in either the existing Data General mode of command syntax used in past DG products or in the ANSI (X3.64 - 1979) command syntax. In addition, the D410/460 supports both 7- and 8-bit operations which permit extended communications and allow for a larger set of character selection. These various modes of operation are described in the next section.

Appendix C lists the command codes and code sequences for all D410/460 commands in a more compact format than presented in this chapter.

HOST/TERMINAL COMMUNICATIONS

This section describes host/terminal communications for the D410/460 terminals. The first part gives a gen-eral overview of host/terminal communications strategy. The second part describes the various modes of terminal operation and how the selection of one of these modes affects host-to-terminal communications (terminal input). The last part discusses terminal-to-host communications strategy (terminal output).

General Overview

The basic terminal consists of two independent devices when on-line with the host computer. First is the keyboard, which serves primarily as an input device that generates ASCII characters for interpretation by the host. Second is the display unit, an output device that interprets a wide range of commands from the host to control the appearance of the display screen image. On-line, the host software links the keyboard to the display unit.

Input from the keyboard consists of characters for display on the screen and control characters and character sequences. Characters entered at the keyboard for display must be echoed back to the display unit screen by the host. Control characters and character sequences from the keyboard may be echoed back to the display unit or used to invoke special functions in the host software.

The display unit functions primarily as an output device for the host that responds to the ASCII display and control characters from the host/keyboard combination. A few of the ASCII character sequences (commands) do request status/configuration information from the display unit; in these cases the display unit functions as an input device for the host. The display unit is capable of interpreting many character sequences that cannot be generated on-line from the keyboard, and therefore must originate from the host. This chapter describes in detail all the characters and character sequences that the display unit can interpret.

The D410/460 terminal uses an asynchronous serial communications interface. The host computer and the optional printer deal with the terminal through serial interfaces and transmitted ASCII characters. The terminal transmit and receive baud rates and serial character format are selected with dual-inline-package (DIP) switches at the rear of the terminal. These switch settings control terminal communications when the terminal is powered up or switched from off-line to

on-line operation. Even though the bit transmission rate is set with the baud rate switches, compatibility with DGC operating systems requires that the D410/460 terminal transmit characters to the host at a maximum effective rate of 60 characters per second (the rate falls below 60 with baud rates of less than 600).

The D410/460 terminal processes all display characters and most commands within the time it takes to receive them (within 2 ms) when the baud rate is 4800 or less. The terminal makes use of a 256-byte input buffer to hold accumulated ASCII characters when the transmission rate is 9600 baud or higher or when a scrolling operation is performed.

As the input buffer approaches its capacity, the terminal automatically issues a CTRL-S (ASCII DC3 or ⟨023⟩) to signal the host to stop transmitting characters. After receipt of the CTRL-S, the host must send no more than 64 characters before halting the character flow to the terminal. If the host does not react to the CTRL-S quickly enough, the terminal input buffer will be filled and additional characters from the host will be lost. As characters are removed from the input buffer for processing, the terminal sends a CTRL-Q (ASCII DC1 or ⟨021⟩) to the host to resume transmission when 64 characters remain in the buffer. The host must respond before the input buffer is emptied to avoid a stuttering effect on the display screen.

Terminal Input (Character Display)

The D410/460 terminal can operate in one of the following four modes:

- Data General 7-bit
- Data General 8-bit
- ANSI 7-bit
- ANSI 8-bit

Two switches on the back of the display unit select the initial operating mode. Chapter 4 gives details for setting these switches. The Command Descriptions section later in this chapter explains the software switches capable of overriding these settings.

In this section, predefined character sets availible for display on the terminal screen (active sets) are referred to as G1 (DG primary), G2 (DG secondary), G3 (ANSI only), and G4 (ANSI only). Figure 3-1 shows that the Select Character Set command determines which of the total available character sets are currently active. Of these active sets, the one currently displayable in the range ⟨041⟩ to ⟨176⟩ is called the GL set. The set displayable in the range ⟨241⟩ to ⟨376⟩ is the GR set.

At power-up or reset, the G0 set becomes the GL set. That means, when the terminal receives an octal code in the ⟨041⟩ to ⟨176⟩ range it chooses the corresponding character from the G0 set for display, rather than a

character from some other active set. For example, with the U.S. character set selected as G0 (the current GL set) an ⟨133⟩ code displays the [character (U.S. ASCII for ⟨133⟩) rather than the degree character (⟨133⟩ in French character set). The Shift Out command selects the G1 set as GL, and the Shift In command switches back to G0 as the GL set (see the Command Set Overview section for details).

The GR box in Figure 3-1 represents the displayable characters in the range ⟨241⟩ to ⟨376⟩. The current G1 set is always the GR displayable set.

> **NOTE:** An ⟨040⟩ or ⟨240⟩ character is always a space and an ⟨177⟩ or ⟨377⟩ character is always a delete, regardless of which character set is selected.

Data General 7-Bit

When the terminal operates in the Data General (DG) 7-bit mode, software compatibility exists with the DG D400/450 and D200 series terminals which are functional subsets of the D410/460 series. Only the GL set is displayable in DG 7-bit mode, so the Shift In/Out commands must be used to choose either G0 or G1 for display. If a GR code corresponds to a character graphic in the GL set, then that character will be displayed. Otherwise, code in the range ⟨241⟩ through ⟨376⟩ is ignored.

Data General 8-Bit

In DG 8-bit mode, the terminal maintains compatibility with DG 7-bit operation software which uses the Shift In/Out mechanism. In addition, the GR (G1) set can be accessed directly using codes in the ⟨241⟩ to ⟨376⟩ range.

ANSI 7-bit

This mode implements ANSI X3.40-1977, X3.41-1974, and X3.64-1979. In addition to G0 and G1, ANSI mode allows G2 and G3 active character sets which are made displayable one character at a time with the Single Shift 2 or Single Shift 3 commands. (For more details see the individual command descriptions in the ANSI commands section in this chapter.)

ANSI 8-bit

This mode also implements ANSI X3.40, X3.41, and X3.64. It differs from ANSI 7-bit in that shorter command headers are possible with the ⟨233⟩ (⟨CSI⟩) code. Also, as in DG 8-bit mode, the GR set can be accessed directly for display without having to resort to the Shift In/Out commands.

> **NOTE:** The Single Shift 2/3 commands place a G2 or G3 character, respectively, for display in the GL set, not in the GR set. Choice of a GR character in ANSI 8-bit mode effectively overrides a Single Shift 2/3 command. This means
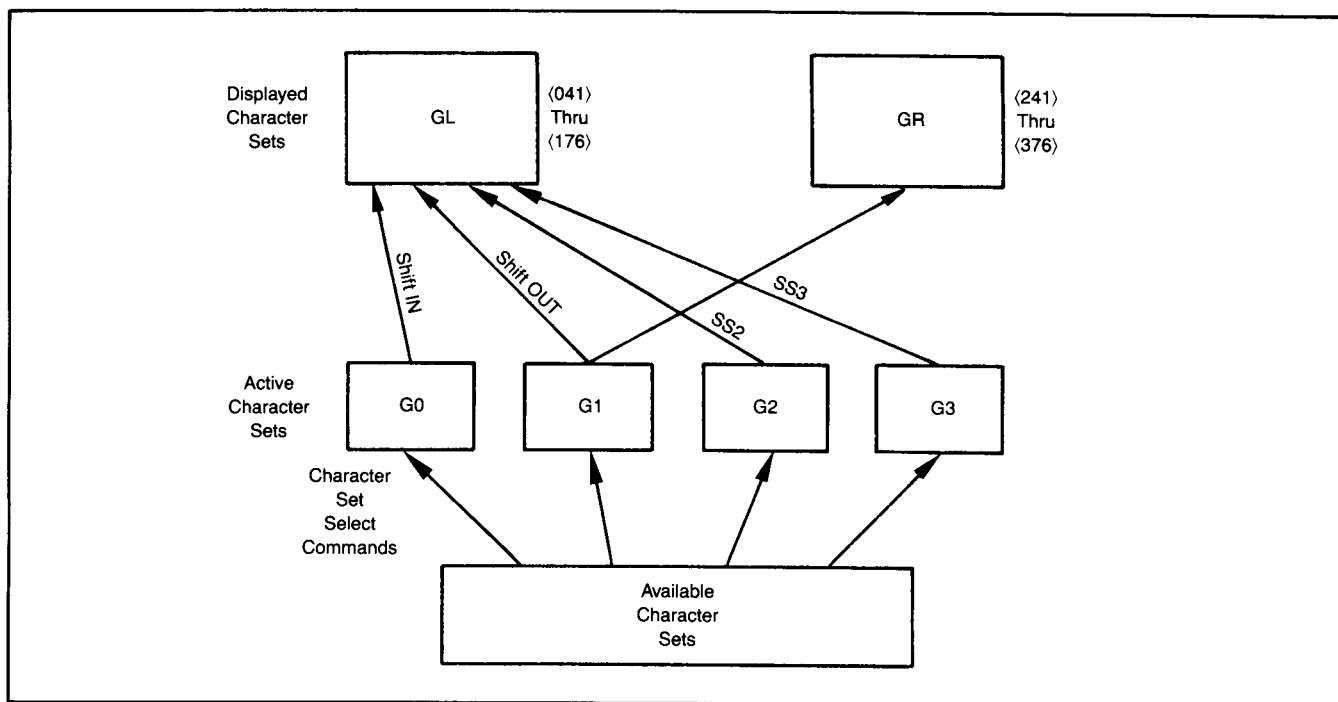
Figure 3-1.   D410/460 Character Set Selection and Display

that a command such as ⟨SS2⟩⟨250⟩ would select for display the ⟨050⟩ character from the G1 character set rather than from the G2 set.

Terminal Output (Keyboard-Generated Characters)

Each time a key on the keyboard is depressed, data is sent to the display which is interpreted by the display unit as a character code. This code output is then either sent on to the host computer (on-line) or is taken as direct input by the display unit (off-line). The keyboard generates code in the range ⟨000⟩ through ⟨377⟩. In this section, K0 refers to keyboard-generated codes ⟨041⟩ through ⟨176⟩ and K1 to codes ⟨241⟩ through ⟨376⟩. A space code is always ⟨040⟩ and a delete, ⟨177⟩. The K0 output set, then, accesses the GL character set for display (input); the K1 set accesses the GR (G1) character set.

The K0 set is either the keyboard language (as selected by the keyboard switches) or U.S. ASCII. The Set Keyboard Language (Set Parameters in ANSI) command allows the keyboard to be configured to the host's requirements. The K1 set is fixed to the DG International set. Table 3-1 shows the default keyboard languages.

> NOTE: *The Read Terminal Configuration command in ANSI mode or the Read Model ID command in DG mode returns information which identifies the keyboard language.*

The SPCL key sequences listed in Chapter 2 allow the U.S. keyboard to generate code in the K1 range for

Table 3-1.   Default (Power-up) Keyboard Languages

Mode	K0	K1
DG 7-bit	Keyboard	—
DG 8-bit	U.S. ASCII	DG International
ANSI 7-bit	U.S. ASCII	DG International
ANSI 8-bit	U.S. ASCII	DG International

directly accessing the G1 sets. For this reason caution should be used in changing the G1 character set because the listed sequences for the SPCL key assume that the G1 set is DG International. If G1 is changed to French, for example, then the sequence SPCL n ˜ results in a "p" being displayed instead of "n tilde".

In DG 7-bit mode, the K0 language cannot be changed and the K1 language cannot be accessed. This maintains compatibility with the 7-bit operations of the earlier D400/450 series terminals. In ANSI 7-bit mode the K1 set is available through the use of the the Shift In/Out protocol which is handled automatically when the SPCL key is used in ANSI 7-bit. If the K0 rather than the U.S. ASCII character set is configured as the keyboard language, then K1 is not accessible.

All control codes generated from the keyboard are contained in the range ⟨000⟩ through ⟨037⟩, with the exception of ⟨233⟩ used in ANSI 8-bit as a command header.

> NOTE: *At power-up in DG 7-bit mode, the K0 set is always keyboard language. If the mode then changes to anything besides DG 7-bit, the K0 automatically becomes U.S. ASCII and the K1 becomes DG International. The default languages go into effect any time the mode changes.*

If the terminal is powered-up in one mode and then the mode is changed, a problem could arise if the terminal is placed off-line and then back on-line. For example: a power-up setting of DG 7-bit is changed, using a DIP switch, to DG 8-bit. The terminal is taken off-line then put back on-line. Use of the SPCL key sequences results in word processing symbols being displayed rather than DG International characters.

PRINTER COMMUNICATIONS

The optional printer is a slave output device controlled by the host via the display unit. The print commands operate only the local printer. A carriage return (CR) and line feed (LF) sequence is placed at the beginning and end of an ASCII character string fed to the printer (except on Print Pass Through).

The terminal uses both hardware busy and software busy protocol to control communications traffic between the terminal and the printer.

Hardware busy communications protocol between the printer and display unit is implemented with the Printer Ready line that runs from the printer to the display unit. When the printer is ready to receive characters from the display unit, a high (or logic 1) signal on the Printer Ready line signals the display unit to transmit characters for printing. When the printer is busy, or unable to receive characters, a low (or logic 0) signal on the Printer Ready line signals the display unit to stop transmitting characters for printing.

Software busy protocol uses the XON/XOFF commands:

X-ON = CTRL-Q
X-OFF = CTRL-S

Table 3-2 summarizes the printer/terminal protocol.

Table 3-2. Printer Communication Protocol

	Software	Hardware
Printer busy	CTRL-S	Logic 0
Printer available	CTRL-Q	Logic 1

Eight baud rates are supported for the printer UART for both 7- and 8-bit communications: 110, 300, 600, 1200, 2400, 4800, 9600, and 19200. Interfaces are based on electrical specifications of EIA RS-232C.

Printer DIP switch 5 (see Chapter 4) sets printer communications to either 7- or 8-bit mode. For both modes, the character spacing (normal or compressed) in the current window has no effect on what is printed.

Printer Operation in 7-Bit Mode

In 7-bit mode, the printer UART uses even parity and 1 stop bit.

For a print operation to work as intended, the printer must be initialized to handle the character set nationality and line length (characters between margins) selected on the D410/460 terminal. For example, if the maximum line length on the printer is 132 characters and there are more than 132 characters between the D410/460 margins, the excess characters might be lost during printing.

Only characters from the native keyboard language are printed. No bit image dumps are possible. That means line drawing, word processing, math, Greek alphabet, super-/subscript, Kata Kana, and user-defined character graphics cannot be printed in 7-bit command syntax mode.

Printer Operation in 8-bit Mode

In 8-bit mode, the printer UART uses no parity and 2 stop bits.

For non-bit-image printing, printer language must be DG International. Valid characters include:

G0 — U.S. ASCII characters
G1 — DG International characters

Any other characters are invalid and are shipped as spaces (⟨040⟩).

Bit-image dump operations enable printing of all displayed characters. See the Command Descriptions section of this chapter for a detailed discussion of the commands in both ANSI and DG modes which control these operations.

NOTE: *Bit-image dump commands in both ANSI and DG modes send the following code sequence to the printer:*

$$⟨033⟩⟨045⟩⟨066⟩⟨N2⟩⟨N1⟩⟨DATA⟩LF$$

where:

N1 and N2 together define a 16-bit sequence giving the number of data bytes that follow them.

N1 = *high 8 bits*

N2 = *low 8 bits*

DATA = *matrix information for each 8-bit vertical column*

LF = *graphic line feed (8 bit rows)*

This prints 8 vertical bit rows of character graphics at a density of 1 vertical dot per 2 horizontal dots. Make certain the printer being used accepts this format.

KEYBOARD CODES

The D410/460 keyboard generates the full set of 95 displayable ASCII character codes, the delete code, and 30 of the 32 ASCII control codes when the terminal is on-line. Appendix A lists these codes along with ANSI control codes and the keys used to generate them. Appendix A also lists the terminal functions invoked by the control codes. Those control codes in Appendix A that do not have dedicated control functions in the terminal and are not used by the host operating system may be used by the programmer to initiate special user functions in the host software. (This is true only for the DG mode. These control codes can be generated in ANSI mode by holding down the CTRL key in combination with various alphabetic keys. But they cannot be used for user functions as their functions are defined by ANSI X3.4.)

In Data General mode, many of the terminal commands use the command header code ⟨036⟩. As a precaution, the ⟨036⟩ code cannot be generated from the keyboard while the terminal is on-line.

In DG mode the ⟨036⟩ command header code can be generated from the keyboard when the terminal is off-line by depressing ESC while holding down the CMD key. This makes the off-line mode valuable to the programmer as a learning and debugging tool. All command sequences (in both DG and ANSI modes) can be generated from the keyboard in the off-line mode.

⟨CSI⟩ can be produced in ANSI by depressing and holding the ESC key and then depressing the [key.

It is important to remember that the function keys and the cursor control keys generate completely different code sequences in ANSI and DG modes. See Appendix A for more details.

DISPLAY SCREEN ORGANIZATION

The display screen memory for the D410/460 terminal consists of 24, 162-column rows, for a total of 3888 character positions. The 24 rows can be divided into groups, with each group containing one or more consecutive rows: these row groupings are called "windows". Within each window, either 81 (normal character spacing) or 135 (compressed character spacing) consecutive columns of the total 162 can be displayed at any one time. Notice that when normal character spacing is used in a window, two 81-column character groupings may be used.

When the terminal is turned on, reset from the keyboard (CMD-ERASE PAGE) or by command (⟨036⟩FA), the display screen consists of one 24-row window with 80 columns between the margins as shown in Figure 3-2. The columns between the margins comprise the active portion of the window; that is, the portion containing the cursor. Both windows and margins are discussed again in the Command Set

Overview as well as in the detailed command descriptions.
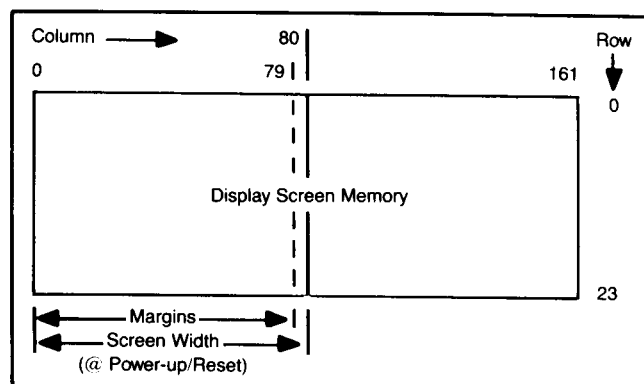
Figure 3-2. Display Screen Memory Organization

Throughout this chapter, the term "display screen memory" refers to all 162 columns of all 24 rows. The term "display screen" refers only to that portion of the display screen memory that appears on the screen of the display unit.

COMMAND SET OVERVIEW

Although the command syntax and many of the command names are completely different in the ANSI mode of operation and the DG mode, the general functionality of the commands is very similar. This section provides an overview of the kinds of tasks that different sets of commands perform. The discussions of each set that follow are not exhaustive of all the commands in each mode. For a complete list of all the specific commands for both DG and ANSI modes which fall within each set, see Tables 3-3 and 3-4.

Screen Management Commands

The screen management command group is used to select character spacing, to control both vertical and horizontal scrolling, and to define windows.

When powered up or reset, the display screen contains 81 columns (normal character spacing) of a 24-row window as shown in Figure 3-3A. This window is called the current or active window because it contains the display unit cursor. The margins, discussed later with the screen edit commands, define the range of columns that can be written to, and are set at 0 and 79. By using the Select Compressed Spacing command, 135 of the total 162 columns can be displayed as shown in Figure 3-3B. Changing the character spacing does not affect the margins.

The Scroll Up and Scroll Down commands scroll the character rows in the current window up or down one row per command at any of the three vertical scrolling rates. The scrolling rates selected by command (jumpy, smooth at 5 lines/second, smooth at 10 lines/second) are the same three that can be chosen

Table 3-3. D410/460 Terminal Command Set in DG Mode

SCREEN MANAGEMENT COMMANDS:

- Set windows
- Select normal spacing
- Select compressed spacing
- Scroll up
- Scroll down
- Scroll left
- Scroll right

- Set scroll rate
- Show columns
- Read horizontal scroll offset
- Roll enable
- Roll disable
- Horizontal scroll enable
- Horizontal scroll disable

CURSOR COMMANDS:

- Carriage return
- New line
- Cursor up
- Cursor right
- Cursor left
- Cursor down
- Screen home

- Window home
- Write screen address
- Write window address
- Read screen address
- Read window address
- Set cursor type

CHARACTER ATTRIBUTE COMMANDS:

- Blink enable
- Blink disable
- Protect enable
- Protect disable
- Blink on
- Blink off
- Underscore on
- Underscore off

- Dim on
- Dim off
- Reverse video on
- Reverse video off
- Protect on
- Protect off
- Change attributes

SCREEN EDIT COMMANDS:

- Erase screen
- Erase window
- Erase end-of-line
- Erase unprotected
- Set margins
- Set alternate margins
- Restore normal margins

- Insert character
- Delete character
- Insert line
- Delete line
- Insert line between margins
- Delete line between margins

TERMINAL DEVICE COMMANDS:

- Reset
- Bell

- Read model ID
- Select 7/8 Bit operation
- Set Keyboard Language

PRINTER COMMANDS:

- Form Bit Dump
- Print window
- Print form

- Print pass through on
- Print pass through off
- Window Bit Dump

CHARACTER SET SELECT COMMANDS:

- Select character set
- Shift-In

- Shift-Out

CUSTOM CHARACTER AND CHARACTER GRAPHICS COMMANDS (D450 only):

- Define character
- Set pattern
- Line

- Bar
- Initialize Draw
- Read characters remaining

Table 3-4. Terminal Command Set in ANSI Mode

SCREEN MANAGEMENT COMMANDS

- Set Windows
- Read Offset/Show Columns
- Scroll Down
- Scroll Up

- Scroll Left
- Scroll Right
- Set Parameters
- Set Windows

CURSOR COMMANDS

- Carriage Return
- Cursor Down
- Cursor Backward
- Cursor Position
- Cursor Forward
- Cursor Up
- Device Status Report

- Form Feed
- Index
- New Line
- Next Line
- Reverse Index
- Screen Position
- Set Parameters

CHARACTER ATTRIBUTE COMMANDS

- Change Attributes
- End Protected Area

- Select Graphic Rendition
- Start Protected Area

SCREEN EDIT COMMANDS

- Delete Character
- Delete Line
- Erase in Display
- Erase in Line

- Insert Character
- Insert Line
- Set Margins

TERMINAL DEVICE COMMANDS

- Bell
- Read Terminal Configuration
- Reset To Initial State

- Xoff
- Xon

PRINTER COMMAND

- Media Copy

CHARACTER SET SELECT COMMANDS

- Set Parameters
- Shift In
- Shift Out

- Single Shift Two
- Single Shift Three
- Select Character Set

CUSTOM CHARACTER AND CHARACTER GRAPHICS COMMANDS (D460 only)

- Bar
- Define Character
- Line

- Set Pattern
- Read/Reserve Characters

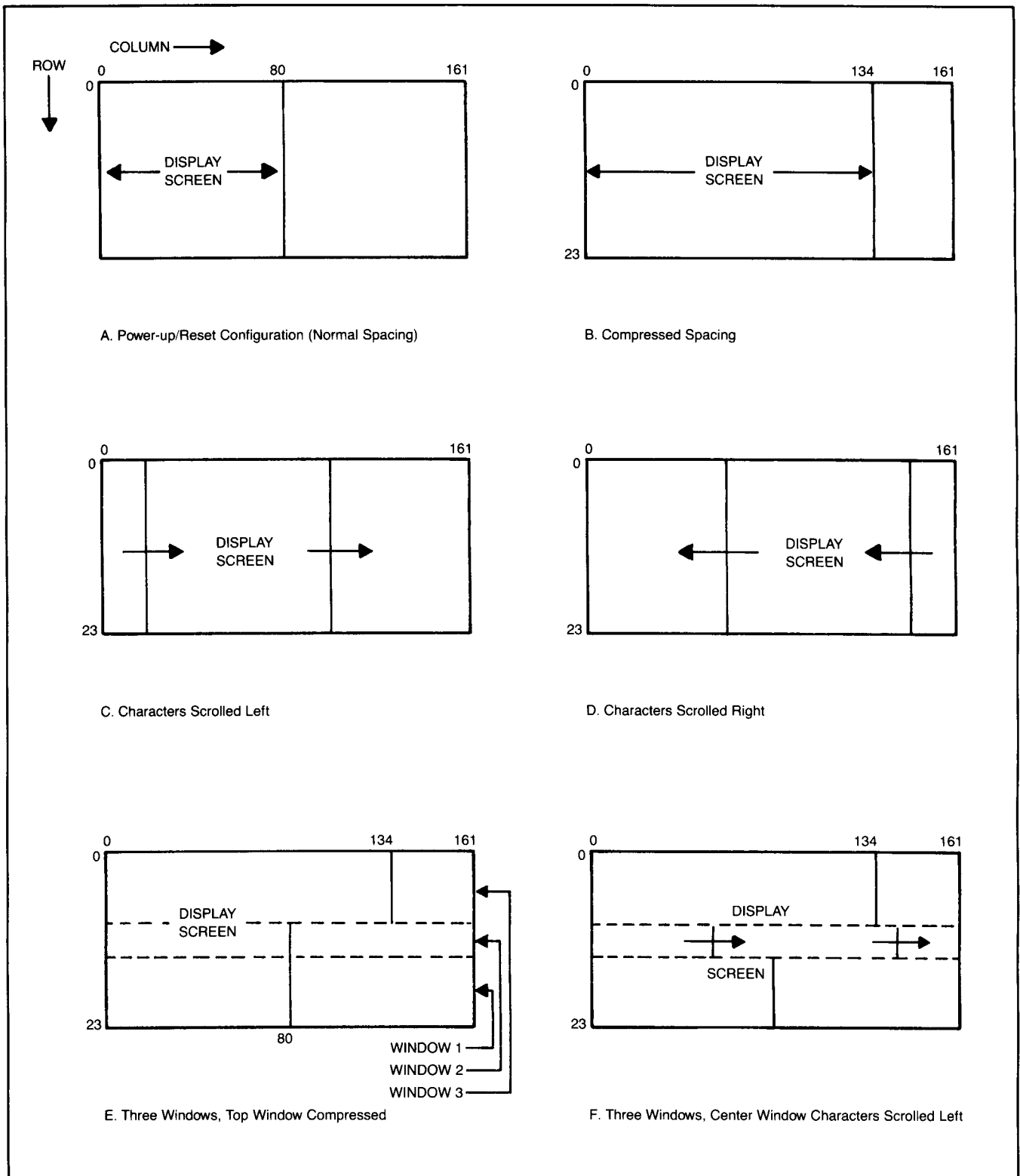**SELECT MODE COMMANDS**

- Reset Mode

- Set Mode

Figure 3-3. Screen Management Command Control

from the keyboard. Screen roll is enabled at power-up or by resetting the terminal and causes an automatic Scroll Up when a New Line command is issued from the bottom row of the current window. Screen roll can be disabled or enabled on command.

Horizontal scrolling is enabled by a power-up, a reset, or on command. With horizontal scrolling enabled, the scrolling commands make it possible to move the current window portion of the display screen contents back and forth across the display screen memory, as shown in Figure 3-3C and Figure 3-3D. The Scroll Left and Scroll Right commands are so named because they scroll characters in the current window to the left and right, respectively. Automatic horizontal scrolling takes place (without issuing any commands) if the margins are wider than the display screen and the cursor moves outside the boundaries of the display screen. If horizontal scrolling is disabled and the margins are wider than the display screen, the contents of the display screen will remain stationary even if the cursor moves outside the screen boundaries. In this case, the cursor actually disappears from view. The Show Columns command (Read Offset/Show Columns in ANSI mode) can be used to horizontally scroll into view a specified range of columns in the current window. The Read Horizontal Scroll Offset command returns to the host the number of columns between column 0 of the display memory and the leftmost column on the display screen for the current window.

The Set Windows command makes it possible to divide the display screen memory into 1 to 24 miniature display screens called "windows". A window consists of from 1 to 24 consecutive rows and spans the entire 162 columns of display screen memory. Figure 3-3E shows a case where the original display screen (Figure 3-3A) has been divided into three windows and the current window (on top) is displaying compressed characters. As in the case for the vertical and horizontal scrolling commands, the character spacing commands apply to the current window. In Figure 3-3F, the center window is the current window and the characters in it are being scrolled to the left.

Cursor Commands

The cursor command group is used to position the cursor anywhere within the margins, to read the cursor location, and to select the appearance of the cursor.

The Index, Reverse Index, Next line, New Line, Carriage Return, and Cursor Up, Down, Left, Right, commands are all cursor-relative positioning commands. The destination location is relative to the current location.

Notice there are screen and window versions of the home, write address, and read address commands. In all three cases, the screen version of the command uses absolute character positioning, ignoring any window boundaries. The Write Screen Address command,

therefore, becomes a valuable tool in selecting the current window. The window version of each command is window-relative, unable to cross window boundaries.

The Set Cursor Type command selects one of the same four cursor forms that can be chosen from the keyboard with the CURSOR TYPE key.

Character Attribute Commands

The character attribute command group is used to control the five character attributes that can be applied to all character positions in display screen memory. The character attributes are blink, dim, underscore, reverse video, and protect.

The attributes can be used one at a time or in any combination on a single character or a character string. The blink, dim, underscore, and reverse video attributes affect the appearance of the displayed characters.

The protect attribute prevents the destruction of a character or character field. Throughout this manual the term "protected" when used in regards to a character or area of text, implies that the area referred to has been assigned the protect attribute *and* that "protect" has been enabled. When "protect" is not enabled, even characters with the protect attribute are not considered "protected." The cursor skips over protected characters. They can only be accessed through use of the commands in this chapter. Character blinking and protection can be enabled or disabled for all of display screen memory with the appropriate enable/disable commands. When the terminal is powered up or reset, blinking is enabled but protection is disabled.

Screen Edit Commands

The screen edit command group is used to set margins, perform erase operations, and insert or delete characters or complete lines (rows).

The columns in the display screen memory accessible to the cursor (those character positions that can be written to) are specified with the Set Margins command. All columns between and including the left and right margins defined with the Set Margins command can be addressed by the cursor. As shown in Figure 3-2, the margins are set to columns 0 and 79 when the terminal is powered up or reset. This margin definition makes the D410/460 terminal compatible with host software written for earlier model display terminals, such as the DASHER D200 and the D400/450 series.

Margins extend across window boundaries; that is, only one set of margins can be in effect for the terminal at any one time. Margins may range in width from 1 to 162 columns. When the margins are wider than the display screen as shown in Figure 3-4, horizontal scrolling becomes necessary to view all columns between the margins. When horizontal scrolling occurs as characters are written out to both margins, the

contents of the current window shift left and right as fast as required to keep up with the writing. Disabling horizontal scrolling on command before writing takes place keeps the current window stationary. When the writing is complete, horizontal scrolling can be enabled so the user can access all of the columns between the margins.
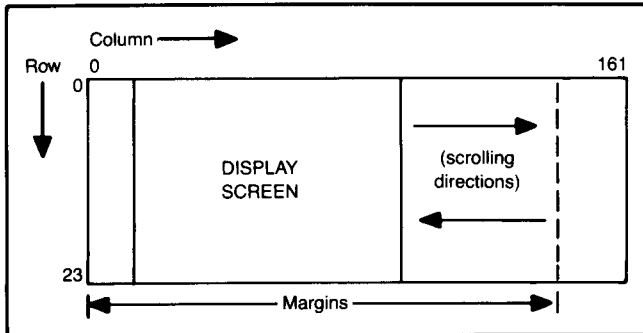

Figure 3-4.   Horizontal Scrolling Between Margins

The Set Alternate Margins command makes it possible to put a new set of margins in effect while saving the original margins. When use of the new margins is complete, the Restore Normal Margins command returns the original margins to use.

The screen edit erase commands can be used to erase all windows (Screen Erase), just the current window, the current line, or all unprotected characters in the current window. The screen edit Insert/Delete commands can be used to insert/delete one character, one row between margins, or all 162 columns of one row.

Terminal Device Commands

The Reset To Initial State command returns the terminal to its initial power-up state (canceling any downloadable characters), but does not affect the vertical scrolling rate in effect at the time the reset command is issued. The Bell command rings the bell in the keyboard once. The Read Terminal Configuration (Read Model ID in DG) command returns the terminal type, the hardware status (printer option, DLL option, etc.), and the firmware revision level. The X-On/Off commands in ANSI mode control buffer overflow.

Printer Commands

In Data General command syntax mode, the printer command group is used to control the three print methods : ASCII Text, Bit Image Screen Dump, and ASCII Print Pass Through. In the ASCII Text method of printing the Print Window and Print Window Form commands perform the same function as the Local Print and SHIFT-Local Print key sequences, respectively. In the Bit Image Screen Dump method, the Window Bit Dump and Form Bit Dump commands cause bit image dumps to be transmitted to the graphics slave printer. The Print Pass Through command is

used to route host/terminal character flow directly through to the optional printer without interpretation by the display unit.

In ANSI command syntax mode the Media Copy command initiates printing on a local printer and controls the print method. Used in conjunction with either the set or reset state of the Forms Mode and the Guarded Area Transfer Mode this command determines exactly which characters (dim or full intensity, protected or unprotected) are to be printed. A bit-image dump variation allows the printing of special symbol character sets provided a dot matrix graphics slave printer is connected.

Character Set Select Commands

The Character Set Select command group is used to select the character set for display on the screen. With the D410/460 terminal, there are 13 character sets to choose from. These sets include the standard U.S. character set, seven European nationalities, DG International, Kata Kana (Japanese), and two special symbol sets. Appendix D shows the characters in all of these sets. With the D460 terminal, up to 38 custom-character sets are available in addition to the first 9.

In DG mode, the terminal maintains a primary and a secondary character set (G0 and G1). These two sets may be the same or different; both sets are selected from the composite list of sets available as described in the previous paragraph. When the terminal is turned on or reset in 7-bit mode, the character set matching the keyboard nationality is assigned as the primary character set and the word processing (includes math, super-/subscript, Greek alphabet) special symbol set is assigned as the secondary character set. In 8-bit mode the default (power-up) primary character set is the U.S. set, and the secondary set is DG International. The primary character set is the set initially displayed.

The primary character set may be reassigned to any of the available character sets with the Select Character Set command. It remains the display set until the secondary set is enabled with the Shift In command. Once the secondary set is enabled, it too may be reassigned to any of the available sets without affecting the previously chosen primary character set. The character set select commands, therefore, allow switching between the primary and secondary character sets with minimum character traffic and the assignment of any available set as primary or secondary.

> **NOTE:** *Changing the secondary character set also changes the characters selected by the SPCL key function in 8-bit mode when off-line.*

In ANSI mode when the terminal is turned on or reset, the default (power-up) G0 character set for both 7-and 8-bit modes is the U.S. set, and the G1 set is DG International. As in DG mode, the Select Character Set command assigns sets to the G0 and G1 designations. Two additional character sets, G2 and G3, can

also be selected with the the Select Character Set command., The Single Shift Two/Three commands enable access to the G2 and G3 sets for only one character at a time. That is, the next character following either of these commands will be taken from the designated G2 or G3 character set and then selection of characters from the otherwise active G0 or G1 character set resumes. At power-up, the terminal defaults to the word processing character set for G2 and to the line drawing character set for G3.

Custom Character/Character Graphics Commands

This group of commands works only with the D460 terminal. Before one or more custom characters can be defined, the Select Character Set command must be used to choose a DLL character set to hold the custom character to be defined. Define Character then specifies the character being defined and the dot pattern comprising the character. DLL character sets defined in this manner can be selected as either the G0 or G1 set, or both. Custom character definitions remain in the terminal until the terminal is turned off or reset.

Two of the character graphics commands, Line and Bar, perform the actual drawing operations. The D460-unique commands paragraph located in both the DG and the ANSI commands sections explains the display coordinate system involved in using these two commands.

Before any graphics can be drawn, the Initialize Draw command (Read/Reserve Characters in ANSI mode) must reserve one or more DLL character sets. To produce a graphics display, the terminal drawing algorithms dynamically define their own custom characters in the DLL character sets based on the Line and Bar commands encountered. The reserved character sets hold the character definitions that make the graphics possible. A good rule is to reserve for graphics all DLL character sets not already being used for custom characters.

After the DLL character sets are reserved, the terminal is ready to begin drawing with the Line and Bar commands. Unless the Set Pattern command is used, all lines drawn will be solid. The Set Pattern command can be used to define custom line styles (dashed, dotted, solid, etc.) for the Line command. Bars are drawn as filled-in blocks. As a graphics display is being assembled on the screen, the Read Characters Remaining command (Read/Reserve Characters in ANSI mode) can be used at any time to determine how many unused characters are still available for use by the drawing algorithms. The graphics display can be added to as long as characters are available.

Do not attempt to reserve the same character sets twice for the same graphics display. That is, after using an Initialize Draw command and starting a graphics image, do not issue a second Initialize Draw command that reserves the same character sets as those reserved by the first command. Otherwise, the character definitions used after the first reserve command might be changed after the second reserve command, causing the appearance of the display to change when drawing of the graphics image continues.

COMMAND DESCRIPTIONS

The D410/460 terminal recognizes two modes of command operation: the standard Data General operating mode and the newly implemented ANSI operating mode. The DG mode is software compatible with earlier Dasher terminals (D200, D400/450) which may be considered functional subsets of the 410/460. Data General customers may continue to use software designed for the Data General family by operating the D410/460 terminal in the DG mode of operation while utilizing the D410/460's enhanced features (SPCL key, bit-dump printer capability, larger choice of character sets, etc.). The terminal may also be set to ANSI operation mode (via software selection or hardware configuration). This mode allows D410/460 commands to be invoked with standard ANSI control sequences.

When the terminal is powered on, a hardware switch setting determines the initial mode of operation. The switch may be set to either Data General Mode or to ANSI Mode. Once the switch is set, however, the hardware mode selection may be overridden by a Select Mode command.

If the terminal is operating in Data General mode, it may be set to ANSI mode by invoking the "Select ANSI Mode" control code sequence (⟨036⟩⟨106⟩⟨100⟩). If the terminal is in ANSI mode, it may be set to Data General mode by issuing the Reset Mode control code sequence (⟨CSI⟩⟨074⟩⟨063⟩⟨154⟩). These commands are described in the appropriate Data General and ANSI Commands sections which follow.

In ANSI operation mode, the terminal does not respond to Data General control sequences. The D410/460, however, does provide the same functional features found in Data General mode while operating in ANSI mode. ANSI's X3.4-1977, X3.41-1974, and X3.64-1979 were used in the implementation of the ANSI operating mode, and references are made to these documents in the description of the ANSI command control code sequences.

In Data General operation mode, complete compatibility exists with the the Data General D100/200 terminal series, as well as with the D400 terminal family. Throughout this chapter, references will be made to "Data General Mode" or to "ANSI Mode." These two terms refer to software compatibility while operating in one of these two modes.

Since the control code sequences for invoking commands are completely different for Data General and ANSI operation modes, the D410/460 command set is described in two sections: Data General Operation Mode Commands and ANSI Operation Mode Com-

mands. Control code sequences *cannot* be mixed between modes. The terminal must either be in a "Data General state" or an "ANSI state," and only one of the following two command sets will be in effect at any one time.

The first command section describes command control sequences and functionality for the terminal when operating in Data General mode. The second covers the command set available while in ANSI mode. Although command functionality is similar for both modes of operation, differences do exist and command names do not always match one to one.

The format for describing each command is the same for both modes (except that a mnemonic may accompany the command name in ANSI mode):

COMMAND NAME
(ANSI mnemonic)   (Command Mode)
⟨octal command form⟩   ASCII/keyboard form

Detailed description of command functionality, arguments required (if any), and examples of use (if appropriate)

These format fields specify the following information:

COMMAND NAME — General name of the command.

(Command Mode) — The specific mode of operation in effect for the command described. Two modes exist: Data General and ANSI.

⟨octal command form⟩ — The sequence of octal codes required to invoke the command.

ASCII/keyboard form — The sequence of keystrokes required to invoke the command from the keyboard.

Command arguments also take the form of ASCII characters. The majority of the arguments in the Data General mode command descriptions that follow are represented by ⟨n⟩, ⟨nn⟩ and ⟨nnn⟩ for 1-, 2-, and 3-byte arguments, respectively. Those arguments that do not fit one of these three forms are explained in the command descriptions where they occur.

For the ⟨n⟩, ⟨nn⟩, and ⟨nnn⟩ argument forms, only the lower 4 bits of each argument byte are used. The lower 4 bits are concatenated for multi-byte arguments to form an 8-bit value with ⟨nn⟩ and a 12-bit value with ⟨nnn⟩. Figure 3-5 shows how the arguments are evaluated.

Since only the lower 4 bits of an argument character are significant, ASCII characters 0 to ? can be used to create all possible argument values as shown in Table 3-5.

In ANSI mode, arguments generally take the form of octal codes representing ASCII characters. The code

⟨060⟩⟨066⟩⟨071⟩, for example, represents the ASCII string 069. In two cases, identified when they occur, the ⟨n⟩,⟨nn⟩, and ⟨nnn⟩ argument forms described above for DG mode are used for ANSI command argument formation.

The Data General command set for the D410/460 is described first and then the ANSI command set is presented. The reader is reminded that only one of these command sets is in effect at any one time. Programmers, for example, that use only the Data General mode of operation may safely ignore the ANSI command descriptions. Similarly, those users who operate exclusively in ANSI mode may skip the Data General command descriptions.

Table 3-5. Creating Command Arguments from ASCII Characters

ASCII Characters (0 to ?)	Argument Forms and Values (Decimal)			
	⟨ n	⟨ n n	⟨ n n ⟩	
0	0	0	0	
1	256	16	1	Examples:
2	512	32	2	
3	768	48	3	For ⟨n⟩ = 12
4	1024	64	4	= "<" (from table)
5	1280	80	5	
6	1536	96	6	For ⟨nn⟩ = 135 = 128 + 7
7	1792	112	7	1st n = 128 = "8"
8	2048	128	8	2nd n = 7 = "7"
9	2304	144	9	⟨nn⟩ = "87"
:	2560	160	10	
;	2816	176	11	For ⟨nnn⟩ = 3888 = 3840 + 48
<	3072	192	12	1st n = 3840 = "?"
=	3328	208	13	2nd n = 48 = "3"
>	3584	224	14	3rd n = 0 = "0"
?	3840	240	15	⟨nnn⟩ = "?30"

Data General Operation Mode Commands

The next few pages contain a detailed description of all D410/460 commands in the DG mode of operation as listed in Table 3-6. This section describes the command structure, how the terminal handles invalid commands, and how arguments are formed and handled.

Command Syntax and Argument Formation

Command sequences in DG mode that are composed of two characters begin with the ASCII code ⟨036⟩. Command sequences comprised of three characters begin with the ASCII codes ⟨036⟩⟨106⟩. The remaining command sequence characters following an ⟨036⟩ are always printable ASCII codes from ⟨101⟩ through ⟨145⟩.

Invalid command sequences are ignored. Function key sequences (all of which begin with an ⟨036⟩ header) that are not valid D410/460 command sequences are also ignored.

Arguments passed to commands take the form of ASCII characters. Only the lower four bits of each
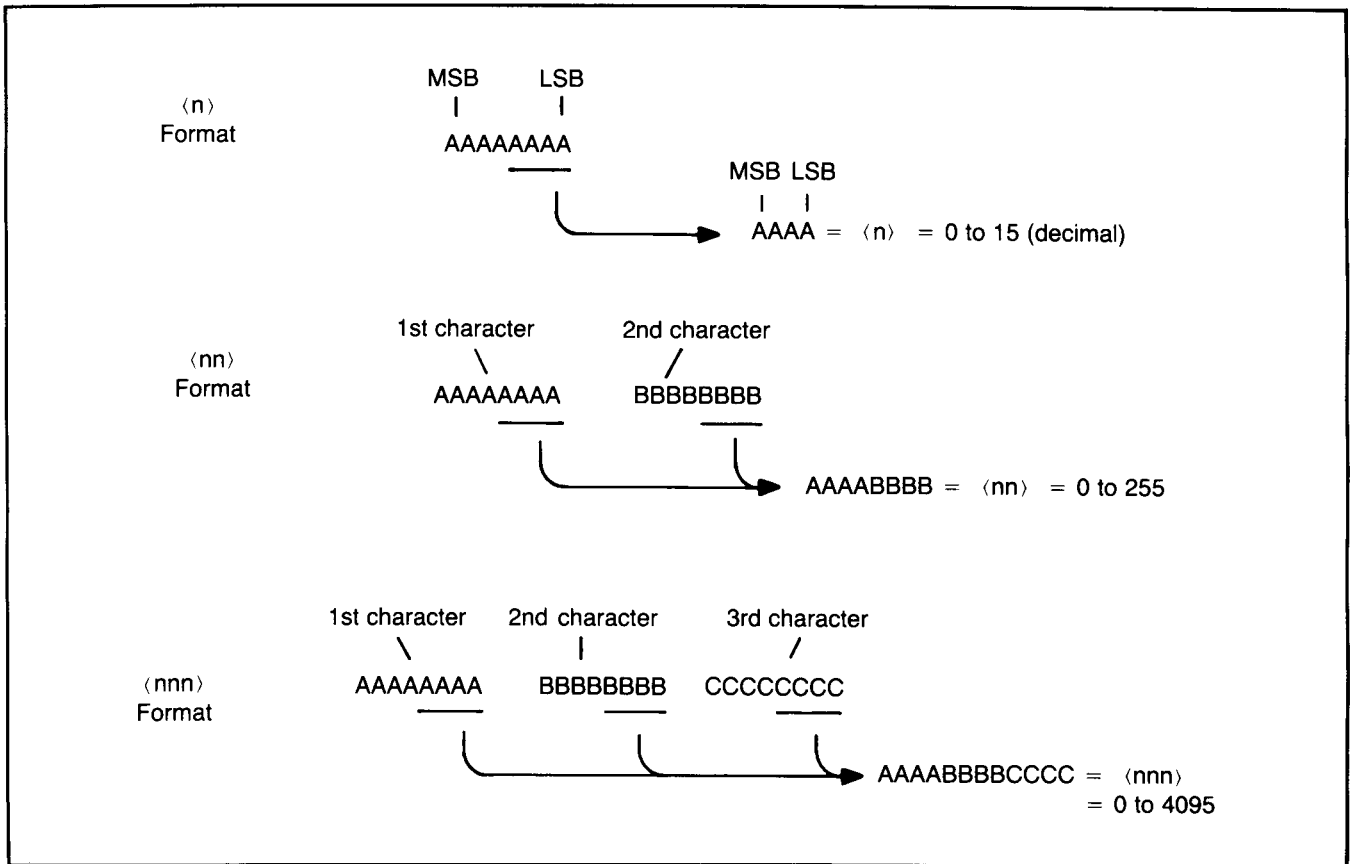
Figure 3-5. D400/450 Command Argument Byte Evaluation

Table 3-6. D410/460 Common Commands in DG Mode in Alphabetical Order

Command Name	Command Name	Command Name
Bell	Horizontal scroll disable	Roll disable
Blink disable	Horizontal scroll enable	Roll enable
Blink enable		
Blink off	Insert character	Screen home
Blink on	Insert line	Scroll down
	Insert line between margins	Scroll left
Carriage return		Scroll right
Change attributes	New line	Scroll up
Cursor down		Select character set
Cursor left	Print Form	Select compressed spacing
Cursor right	Print pass through off	Select normal spacing
Cursor up	Print pass through on	Set alternate margins
	Print window	Set cursor type
Delete character	Protect disable	Set margins
Delete line	Protect enable	Set scroll rate
Delete line between margins	Protect off	Set windows
Dim off	Protect on	Shift In
Dim on		Shift Out
	Read horizontal scroll offset	Show columns
Erase end-of-line	Read model ID	
Erase screen	Read screen address	Underscore off
Erase uprotected	Read window address	Underscore on
Erase window	Reset	
	Restore normal margins	Window Bit Dump
Form Bit Dump	Reverse video off	Window home
	Reverse video on	Write screen address
		Write window address

character are significant. To form a value larger than four bits, the lower four bits of two characters are combined.

For example, in Figure 3-6 the two characters ⟨102⟩⟨116⟩ are combined to represent the octal value 56, decimal 46.

Figure 3-6. Argument Formation

Since only the lower four bits of an argument character are significant, it is suggested that ASCII characters in the sequence 0 through ? be used for argument specification. In this way, all arguments are displayable. Nothing prevents the use of other ASCII codes for argument specification, however.
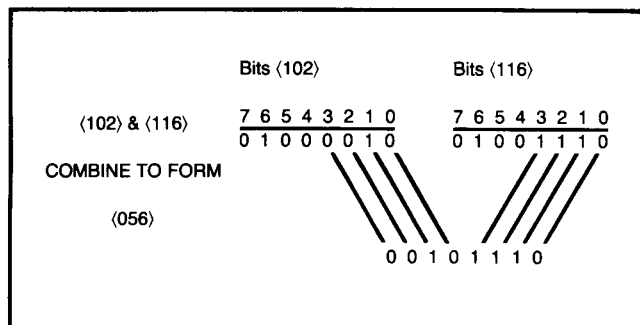
In DG mode, arguments are specified with one of three formats. The representation of these formats in the command descriptions that follow and their meanings are:

- n — Single character, 4-bit value

- nn — Two characters, 8-bit value

- nnn — Three characters, 12-bit value

D410/460 Common Commands In DG Mode

BELL   (Data General Mode)
⟨007⟩   CTRL-G
The terminal bell rings once.

BLINK DISABLE   (Data General Mode)
⟨004⟩   CTRL-D
Disables all character blinking regardless of the state of the blink attributes assigned to display characters.

BLINK ENABLE   (Data General Mode)
⟨003⟩   CTRL-C
Enables the blinking of any character whose blink attribute is turned on. When the terminal is powered up or reset, the Blink Enable command is automatically executed.

BLINK OFF   (Data General Mode)
⟨017⟩   CTRL-O
Turns the off blink attribute for each successive character following this command. This command is issued

automatically with the Erase Screen and Erase Window commands or when the terminal is powered up or reset.

BLINK ON   (Data General Mode)
⟨016⟩   CTRL-N
Turns on the blink attribute for each successive character following this command. Blinking occurs for those characters with their blink attribute turned on if blinking is enabled (see Blink Enable command).

CARRIAGE RETURN   (Data General Mode)
⟨015⟩   CR or CTRL-M
Moves the cursor to the left margin of the current row. If one or more characters are protected at the left margin, a Cursor Right command is issued until the cursor reaches an unprotected character position. If all character positions in the current window are protected, the cursor moves as if no character positions were protected.

> **NOTE:** *Throughout this manual the term "protected" when used in regards to a character or area of text, implies that the area referred to has been assigned the protect attribute **and** that "protect" has been enabled with the Protect Enable command. When "protect" is not enabled, even characters with the protect attribute are not considered "protected."*

CHANGE ATTRIBUTES, character count, on, off
                                         (Data General Mode)
⟨036⟩⟨106⟩⟨116⟩⟨nnn⟩⟨n⟩⟨n⟩   ⟨036⟩FN...
Starting at the cursor location, the attributes of the number of successive characters specified by the character count argument (⟨nnn⟩) are turned on, turned off, or toggled (switched from their current setting). The character count applies only to characters within the margins and in the current window (active portion of display screen). This command affects the blink, dim, underscore, and reverse video attributes. The appearance of protected text can be modified with this command. The command arguments are as follows:

⟨nnn⟩ =
    number of characters having attributes changed; if ⟨nnn⟩ is greater than number of characters from cursor to last character in active portion of screen, only those characters from cursor to end of active area are affected

1st ⟨n⟩ =
    attribute on byte (turn on attributes in this byte)

2nd ⟨n⟩ =
    attribute off byte (turn off attributes in this byte)

In both cases of ⟨n⟩, the four least significant bits (LSB) of each byte are dedicated to the four attributes as follows:
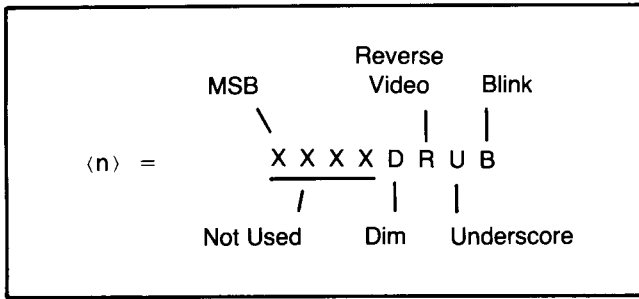
Figure 3-7. Least Significant Bits

The attribute bits in both ⟨n⟩ bytes are evaluated together to determine how the attributes are to change. For each attribute, the following action is taken depending on whether the bits are set (1) or reset (0):

	Attribute On Byte	Attribute Off Byte	Attribute Action
For each	0	0	No change
attribute	0	1	Turn off
bit ⟶	1	0	Turn on
	1	1	Toggle

Figure 3-8. Attribute Changes

Example:
Command ⟨036⟩FN12351 affects 291 (⟨nnn⟩ = 123 ASCII or 291 decimal from Table 3-5) characters, starting with the cursor. The attribute on byte = ASCII 5; 4 LSBs = 0101. The attribute off byte = ASCII 1; 4 LSBs = 0001. As a result, dim and underscore do not change from their settings prior to this command; reverse video turns on; blink toggles.

CURSOR DOWN   (Data General Mode)
⟨032⟩   CTRL-Z
The cursor moves down one row in the current column. If the cursor is on the bottom row of a window, it moves to the top row of the window. If the cursor attempts to move into a protected area, the Cursor Right command is issued until the cursor moves into an unprotected character position. If all character positions in the current window are protected, the cursor moves as if no character positions were protected.

CURSOR LEFT   (Data General Mode)
⟨031⟩   CTRL-Y
The cursor moves one column to the left on the current row. If the cursor is at the left margin, it moves to the right margin and a Cursor Up command takes place. If the cursor attempts to move into a protected area, the Cursor Left command repeats until the cursor moves into an unprotected character position. If all character positions in the current window are protected, the cursor is moved as if no character positions are protected.

CURSOR RIGHT   (Data General Mode)
⟨030⟩   CTRL-X
The cursor moves one column to the right on the current row. If the cursor is at the right margin, it moves to the left margin of the next row down. If the cursor is at the right margin of the last row of the window, cursor movement depends on whether or not screen roll is enabled. If screen roll is enabled, the window scrolls up one line and the cursor moves to the left margin of the new bottom line. If screen roll is disabled, the cursor moves to the left margin of the first row in the window. If the cursor attempts to move into a protected area, the Cursor Right command repeats until the cursor moves into an unprotected character position. If all character positions in the current window are protected, the cursor moves as if no character positions were protected.

CURSOR UP   (Data General Mode)
⟨027⟩   CTRL-W
The cursor moves up one row in the current column. If the cursor is on the top row of a window, it moves to the bottom row of the window. If the cursor attempts to move into a protected area, the Cursor Left command repeats until the cursor moves into an unprotected character position. If all character positions in the current window are protected, the cursor moves as if no character positions were protected.

DELETE CHARACTER   (Data General Mode)
⟨036⟩⟨113⟩   ⟨036⟩K
Deletes (permanently) the character at the cursor location. Performs a left shift of one character position on all characters between the cursor and the right margin. Enters a blank space at the right margin. If the row affected by this command contains a protected area between the cursor and right margin, the left shift applies only to those characters between the cursor and the first protected character position to the right of the cursor. In this case, the blank space is entered in the character position to the immediate left of the first protected character position.

DELETE LINE   (Data General Mode)
⟨036⟩⟨106⟩⟨111⟩   ⟨036⟩FI
Deletes the entire row (162 columns) containing the cursor. All rows below the cursor in the current window, including protected areas, move up one row. A blank row appears in the bottom of the window and the cursor remains fixed on the display screen.

DELETE LINE BETWEEN MARGINS
                    (Data General Mode)
⟨036⟩⟨106⟩⟨134⟩   ⟨036⟩F\
Deletes the characters between the margins in the row containing the cursor. All rows below the cursor and between margins in the current window, including protected areas, move up one row with jump scrolling. A blank row appears in the bottom of the window between the margins and the cursor remains fixed on the display screen. The characters outside the margins are not affected by this command.

DIM OFF (Data General Mode)
⟨035⟩ CTRL-]
Turns off the dim attribute for each successive character following this command. This command is issued automatically with the Erase Screen and Erase Window commands or when the terminal is powered up or reset.

DIM ON (Data General Mode)
⟨034⟩ CTRL-\
Turns on the dim attribute for each successive character following this command. Characters that follow this command and precede the next Dim Off command will be dimmed on the display screen.

ERASE END-OF-LINE (Data General Mode)
⟨013⟩ CTRL-K
Erases all characters from the cursor to the right margin (including the character in the cursor position). The cursor position is unchanged. If a protected area is encountered on the line (row) being erased, the erasing action occurs only to the first protected character to the right of the cursor.

ERASE SCREEN (Data General Mode)
⟨036⟩⟨106⟩⟨105⟩ ⟨036⟩FE
Erases all characters in the display screen memory - including protected characters. The cursor moves to the left margin of the top row on the display screen (screen home) and no horizontal scrolling takes place if the left margin is visible. If horizontal scrolling is enabled and the left margin is not visible, the screen scrolls horizontally the minimum distance required for the cursor (and left margin) to be viewed. That is, if the left margin is off the left side of the screen, it scrolls right to the leftmost column on the screen. If the left margin is off the right side of the screen, it scrolls left to the rightmost column on the screen. The current margins and window definitions remain unaffected. The dim, underscore, and reverse video attributes all turn off.

ERASE UNPROTECTED (Data General Mode)
⟨036⟩⟨106⟩⟨106⟩ ⟨036⟩FF
Erases all unprotected characters between the margins, starting with the cursor location and continuing to the end of the current window. Does not affect protected characters. The cursor position is unchanged.

ERASE WINDOW (Data General Mode)
⟨014⟩ CTRL-L
Erases all characters in the current window, including protected characters. The cursor moves to the left margin of the top row in the window (window home). No horizontal scrolling takes place if the left margin is visible. If horizontal scrolling is enabled and the left margin is not visible, the screen scrolls horizontally the minimum distance required for the cursor (and left margin) to be viewed. That is, if the left margin is off the left side of the screen, it scrolls right to the leftmost column on the screen. If the left margin is off the right side of the screen, it scrolls left to the rightmost column on the screen. Characters above or below the current window are unaffected. The dim, underscore, and reverse video attributes all turn off.

FORM BIT DUMP (Data General Mode)
⟨036⟩⟨106⟩⟨077⟩⟨066⟩ ⟨036⟩F?6
This command causes a bit dump to the slave graphics printer of all full-intensity characters between the margins in the current window, beginning with the row the cursor is on. Reverse video spaces and underscores are printed as they appear on the screen. Simultaneous pressing of the CMD and Local-Print keys or the above sequence causes initiation of printing. the teminal returns ⟨006⟩ to the host upon completion of printing.

To abort this printing command, depress CMD-CR or Local Print.

HORIZONTAL SCROLL DISABLE
(Data General Mode)
⟨036⟩⟨106⟩⟨135⟩ ⟨036⟩F]
Disables all windows from scrolling left or right on the display screen. When the terminal is powered up or reset horizontal scroll is enabled. That means, the current window scrolls left and right as required to display characters written to the display screen memory. This Horizontal Scroll Disable command prevents such horizontal scrolling. With horizontal scrolling disabled, the cursor disappears from view as characters are written outside the display screen viewing area. The Set Alternate Margins command automatically disables horizontal scrolling.

HORIZONTAL SCROLL ENABLE
(Data General Mode)
⟨036⟩⟨106⟩⟨136⟩ ⟨036⟩F↑
Enables horizontal scrolling. All rows in the current window scroll left and right together as required to display characters written to the display screen memory. Horizontal scrolling takes place when one or more characters are written outside the display screen viewing area. Usually, the cursor does not disappear from view with horizontal scrolling enabled. If the cursor is not on the display screen when horizontal scrolling is enabled, the screen scrolls horizontally the minimum distance required to display the cursor. Horizontal scrolling is enabled automatically when the terminal is powered up or reset.

INSERT CHARACTER (Data General Mode)
⟨036⟩⟨112⟩ ⟨036⟩J
Inserts a blank space at the cursor location. All characters from the cursor to the right margin shift right one character position. The character at the right margin is lost. If the row affected by this command contains a protected area between the cursor and right margin, the right shift applies only to those characters from the cursor to the first protected character position to the right of the cursor. In that case, the character to the immediate left of the first protected character is lost by the right shift.

INSERT LINE (Data General Mode)
⟨036⟩⟨106⟩⟨110⟩ ⟨036⟩FH
Inserts a blank row of 162 columns at the row containing the cursor. The row containing the cursor and all rows below the cursor in the current window, including protected areas, shift down one row. The bottom row of the current window is lost. The cursor remains fixed on the display screen.

INSERT LINE BETWEEN MARGINS
(Data General Mode)
⟨036⟩⟨106⟩⟨133⟩ ⟨036⟩F[
Inserts a blank row between the margins at the row containing the cursor. The row containing the cursor and all rows below the cursor in the current window, including protected areas, shift down one row. The characters between the margins in the bottom row of the current window are lost. The cursor remains fixed on the display screen. Characters outside the margins are unaffected by this command.

NEW LINE (Data General Mode)
⟨012⟩ CTRL-J
Moves the cursor to the left margin of the next row down in the current window. If the cursor is on the last row of a window before the command is issued, cursor movement depends on whether or not screen roll is enabled. If screen roll is enabled, the current window scrolls up one row and the cursor moves to the left margin of the new, blank, bottom row. If screen roll is disabled, the cursor moves to the left margin of the top row in the current window. If a protected area is encountered, a Cursor Right command repeats until the cursor moves into an unprotected character position. If all character positions in the current window are protected, the cursor is moved as if no character positions were protected.

PRINT PASS THROUGH OFF (Data General Mode)
⟨036⟩⟨106⟩⟨077⟩⟨062⟩ ⟨036⟩F?2
or ⟨036⟩⟨106⟩⟨141⟩ or ⟨036⟩Fa
Turns off Print Pass Through so that character flow from the host computer to the terminal is again interpreted by the display unit. The display unit returns a CTRL-F (⟨006⟩) to the host to signal that the printing has stopped. The Print Pass Through On command description describes the print pass through operation.

PRINT PASS THROUGH ON (Data General Mode)
⟨036⟩⟨106⟩⟨077⟩⟨063⟩ ⟨036⟩F?3
or ⟨036⟩⟨106⟩⟨140⟩ or ⟨036⟩F'
Sends all subsequent characters from the host to the printer without affecting the display screen. When print pass through is turned on, the character flow from the host is interpreted by the printer and not by the display unit. Control sequences may comprise printer commands; characters for printing are retrieved from the selected printer character set. Both software busy and hardware busy protocols are used for communications between the display unit and printer as described in the Printer Communications section earlier in this chapter.

To abort this printing command, depress CMD-CR or Local Print.

PRINT WINDOW (Data General Mode)
⟨021⟩ CTRL-Q or Local Print
Transmits to the printer all characters between the margins in the current window, beginning with the row containing the cursor. Returns a CTRL-F (⟨006⟩) to the host when the printing operation is completed/terminated. To abort this printing command, depress CMD-CR or Local Print.

PRINT FORM (Data General Mode)
⟨001⟩ CTRL-A or SHIFT-Local Print
When character protection is disabled, this command prints all full-intensity characters between the margins in the current window, beginning with the row containing the cursor. When character protection is enabled, prints all unprotected text in the current window beginning with the row containing the cursor. Prints dimmed and protected text as null characters (spaces in ASCII text). Transmits ⟨CR⟩⟨LF⟩ sequences on initiation of print activity. Reverse video spaces are not output. Sends an ⟨006⟩ (CTRL-F) to the host when the printing operation is completed/terminated if the print was initiated by the host.

To abort this printing command, depress CMD-CR or Local Print.

PROTECT DISABLE (Data General Mode)
⟨036⟩⟨106⟩⟨127⟩ ⟨036⟩FW
Disables all character protection regardless of the state of the protect attributes assigned to display characters (see the Erase Unprotected command description). After this command is issued, the cursor can address any character position in the display screen memory. When the terminal is powered up or reset, the Protect Disable command is automatically executed.

PROTECT ENABLE (Data General Mode)
⟨036⟩⟨106⟩⟨126⟩ ⟨036⟩FV
Enables the protection of all characters whose protect attribute is turned on. Protected characters cannot be addressed by the cursor, and therefore are not accessible from the keyboard or by the host computer. If the cursor attempts to move into a protected area, the protected characters are skipped over. Protected characters can be modified from the host computer by first using the Protect Disable command, and then addressing the characters with the cursor. Protected characters can be erased with the Erase Screen and Erase Window commands or deleted with the Delete Line and Delete Line Between Margins command.

PROTECT OFF (Data General Mode)
⟨036⟩⟨106⟩⟨115⟩ ⟨036⟩FM
Turns off the protect attribute for all subsequent characters. This command is automatically executed when the terminal is powered up or reset.

PROTECT ON (Data General Mode)
⟨036⟩⟨106⟩⟨114⟩ ⟨036⟩FL
The protect attribute for each successive charac ꞏ
following this command is turned on. Those characters
with their protect attribute turned on will be pro-
tected if character protection is enabled with the "pro-
tect enable" command. The "protect enable" command
description discusses character protection in more
detail.

READ HORIZONTAL SCROLL OFFSET
(Data General Mode)
⟨036⟩⟨106⟩⟨117⟩ ⟨036⟩FO
The number of columns from absolute column 0 of the
display screen memory to the leftmost column of the
current window on the display screen is returned to
the host computer in the following form:

⟨036⟩⟨157⟩⟨072⟩⟨nn⟩, or ⟨036⟩o: ⟨nn⟩ in ASCII form

where:

⟨nn⟩ = @@ to EA (ASCII), the horizontal scroll
offset

ASCII characters @ (⟨100⟩) to O (⟨117⟩) represent the
16 possible values for each byte returned. The range of
the number of columns returned is 0 to 81 (decimal).
When this command is entered off-line at the key-
board, the ⟨036⟩o prefix to the return sequence is not
displayed.

Example:
If the terminal responds to command ⟨036⟩FO with
⟨036⟩o:AO, there are 31 columns (ASCII AO = 31
decimal) from column 0 of the display screen memory
to the leftmost column of the current window on the
display screen.

READ MODEL ID (Data General Mode)
⟨036⟩⟨103⟩ ⟨036⟩C
The terminal returns a 6-byte sequence to the host
computer:

⟨036⟩⟨157⟩⟨043⟩⟨052⟩⟨status⟩⟨keyboard⟩,

or:

⟨036⟩o#⟨status⟩⟨rev⟩ in ASCII form

where:

⟨036⟩⟨157⟩ are header codes
⟨043⟩ indicates model report data to follow
⟨052⟩ indicates this is a D410/460 terminal
⟨status⟩ is terminal hardware status
⟨keyboard⟩ indicates keyboard language/model

for ⟨status⟩ byte (bit 7 = MSB, bit 0 = LSB),
bit 7 = 0 constant
bit 6 = 1 constant
bit 5 = 0 self-test ok
1 self-test failed

bit 4 = 1 8-bit mode
= 0 7-bit mode
bit 3 = 0 printer not ready
= 1 printer ready
bit 2 = ⎱ software revision value
bit 1 = ⎰ of one through
bit 0 = ⎱ eight

for ⟨keyboard⟩ byte,

bit 7 = 0 constant
bit 6 = 1 constant
bit 5 = 1 DLL board present
= 0 DLL board not present
bit 4 =
bit 3 = ⎱ These five bits (one byte)
bit 2 = ⎰ identify the keyboard
bit 1 = ⎰ language:
bit 0 =

byte = 00000 No keyboard
= 10011 Swiss/French
= 10100 Swiss/German
= 10101 Canadian/English
= 10111 Italian
= 11000 Canadian/French
= 10110 Kata Kana
= 11001 U.S.
= 11010 United Kingdom
= 11011 French
= 11100 German
= 11101 Swedish/Finnish
= 11110 Spanish
= 11111 Danish/Norwegian

When this command is entered off-line at the key-
board, the ⟨036⟩o prefix to the return sequence is not
displayed.

Example:
The following sequence:

⟨036⟩⟨157⟩⟨043⟩⟨050⟩⟨130⟩⟨171⟩ (octal)

or:

⟨036⟩o#(Xy (ASCII)

indicates that the self-test shows the terminal is ok,
the mode is 8-bit, the printer is ready, the revision
value is 0, the DLL board is present, and the keyboard
is U.S. nationality.

READ SCREEN ADDRESS (Data General Mode)
⟨036⟩⟨106⟩⟨142⟩ ⟨036⟩Fb
The absolute column and row of the cursor on the
display screen memory are returned to the host com-
puter. Window and margin boundaries are ignored in
the absolute column and row counts. The range of the
absolute column count is 0 to 161 and the range of the
absolute row count is 0 to 23. The absolute column and
row counts are returned in the following form:

⟨036⟩⟨157⟩⟨070⟩⟨nn⟩⟨nn⟩,

or:

⟨036⟩o8⟨nn⟩⟨nn⟩ in ASCII form

where:

1st ⟨nn⟩ = @@ to JA (ASCII), the absolute column count

2nd ⟨nn⟩ = @@ to AG (ASCII), the absolute row count

ASCII characters @ (⟨100⟩) through O (⟨117⟩) are used to represent the column and row count bytes returned by the terminal. When this command is entered off-line at the keyboard, the ⟨036⟩o prefix to the return sequence is not displayed.

Example:
If the terminal responds to the command ⟨036⟩Fb with ⟨036⟩o8C@@C, the cursor is located at absolute column 48 (ASCII C@), absolute row 3 (ASCII @C).

READ WINDOW ADDRESS (Data General Mode)
⟨005⟩ CTRL-E
Returns to the host computer the column and row of the cursor location, relative to the left margin of the top row in the current window:

⟨037⟩⟨column⟩⟨row⟩

where:

⟨column⟩ = ⟨000⟩ to ⟨177⟩, for columns 0 to 127
⟨row⟩ = ⟨000⟩ to ⟨027⟩, for rows 0 to 23

The ⟨column⟩ byte returned by the terminal is a modulo-128 value. That is, if the cursor is located in columns 128 through 161 relative to the left margin, those columns are represented by ⟨000⟩ through ⟨042⟩. Notice that the value of the ⟨row⟩ byte will always be an ASCII control code and the value of the ⟨column⟩ byte could be an ASCII control code. As a result, a binary read command/statement should be used to read the relative column and row bytes.

Example:
If the terminal responds to the command ⟨005⟩ with ⟨037⟩P⟨010⟩, the cursor is located at column 80 (ASCII P = ⟨120⟩ or 80 decimal), row 8-relative to the left margin of the top row in the current window.

RESET (Data General Mode)
⟨036⟩⟨106⟩⟨101⟩ ⟨036⟩FA
Resets the terminal to its initial power-on state except:

- No terminal self-test

- Same scrolling rate in effect as before the Reset command. The reset conditions are listed in Table 3-7.

Table 3-7. Terminal Reset Conditions

- Display screen cleared
- Cursor moved to upper-left corner of screen
- Cursor displayed as reverse video block
- Single window (24 rows) with margins at columns 0 and 79
- Primary character set: Keyboard nationality (7-bit mode)
  U.S. ASCII (8-bit mode)
- Normal character spacing selected
- Screen roll and horizontal scrolling enabled
- Character blinking enabled
- Character protection disabled
- Blink, dim, underscore, and reverse video turned off
- Line drawing color set to solid (D460 only)
- User defined characters deleted (D460 only)

RESTORE NORMAL MARGINS
(Data General Mode)
⟨036⟩⟨106⟩⟨132⟩ ⟨036⟩FZ
Restores the original margins that were replaced by the Set Alternate Margins command. If horizontal scrolling remains disabled due to the most recent Set Alternate Margins command, this Restore Normal Margins command re-enables horizontal scrolling. The cursor location is not changed by this command. The screen scrolls horizontally, if necessary, to bring the cursor into view (unless the Horizontal Scroll Disable command was issued following the most recent Set Alternate Margins command).

REVERSE VIDEO OFF (Data General Mode)
⟨036⟩⟨105⟩ ⟨036⟩E
Turns off the reverse video attribute for all subsequent characters. This command is issued automatically with the Erase Screen and Erase Window commands or when the terminal is powered up or reset.

REVERSE VIDEO ON (Data General Mode)
⟨036⟩⟨104⟩ ⟨036⟩D
Turns on the reverse video attribute for all subsequent characters. Remains in effect until the next Reverse Video Off command.

ROLL DISABLE (Data General Mode)
⟨023⟩ CTRL-S
Disables all windows from scrolling up (page mode) when the cursor is commanded to move beyond their bottom row. The cursor moves to the top row of the current window from the bottom row with screen roll disabled.

ROLL ENABLE (Data General Mode)
⟨022⟩ CTRL-R
Enables all windows to scroll up when the cursor moves beyond their bottom row. When the current window scrolls up, the cursor moves to the new bottom row while the top row in the window is lost. When the terminal is powered up or reset, the Roll Enable command is automatically executed.

SCREEN HOME (Data General Mode)
⟨036⟩⟨106⟩⟨107⟩ ⟨036⟩FG
Moves the cursor to the left margin of the top row in

the top window on the display screen. The top window becomes the current window; margin and window boundaries are not affected by this command. If horizontal scrolling is enabled, the top window scrolls the minimum distance required to display the left margin. That is, if the left margin is off the left side of the screen, it scrolls right to the leftmost column on the screen; if the left margin is off the right side of the screen, it scrolls left to the rightmost column on the screen. If the "home" location is protected, the Cursor Right command is issued until the cursor moves into an unprotected character position.

SCROLL DOWN (Data General Mode)
⟨036⟩⟨111⟩ ⟨036⟩I
Scrolls all rows in the current window down one row. The bottom row in the current window is lost and a new, blank row scrolls into the top row of the window. The cursor remains fixed on the display screen. The contents of the current window can be scrolled down with this command even when the Roll Disable command has been issued.

SCROLL LEFT, column count (Data General Mode)
⟨036⟩⟨106⟩⟨103⟩⟨nn⟩ ⟨036⟩FC...
When horizontal scrolling is enabled, the characters in the current window are rapidly scrolled left the number of columns specified by ⟨nn⟩. If horizontal scrolling is disabled, this command is ignored. The cursor location is not affected by this command. The column count argument can be set as follows:

⟨nn⟩ = 00 to 51, the number of columns to scroll left

A scroll left can take place as long as absolute column 161 is not the rightmost column on the display screen. If the column count argument exceeds the number of available columns to scroll, the current window will peg with absolute column 161 at the rightmost column on the display screen. With normal character spacing, a maximum scroll left of 81 (decimal) columns is possible; with compressed character spacing, a maximum scroll left of 27 columns is possible.

Example:
Command ⟨036⟩FC2: scrolls the current window to the left 42 columns (ASCII 2:), assuming there are 42 or more columns to the right of the rightmost column on the screen.

> NOTE: *The cursor may be scrolled off the display screen with horizontal scrolling enabled by using the Scroll Left and Scroll Right commands. If the cursor is scrolled off the screen in this manner, it will return to the screen with the next cursor movement command or display character.*

SCROLL RIGHT, column count (Data General Mode)
⟨036⟩⟨106⟩⟨104⟩⟨nn⟩ ⟨036⟩FD...
Scrolls the characters in the current window to the right the number of columns specified by ⟨nn⟩. If horizontal scrolling is disabled, this command is ignored. The cursor location is not affected. The column count argument can be set as follows:

⟨nn⟩ = 00 to 51, the number of columns to scroll right

A scroll right can take place as long as absolute column 0 is not the leftmost column on the display screen. If the column count argument exceeds the number of available columns to scroll, the current window will peg with absolute column 0 at the leftmost column on the display screen. With normal character spacing, a maximum scroll right of 81 (decimal) columns is possible; with compressed character spacing, a maximum scroll right of 27 columns is possible.

Example:
Command ⟨036⟩FD17 scrolls the current window to the right 23 columns (ASCII 17), assuming there are 23 or more columns to the left of the leftmost column on the screen.

SCROLL UP (Data General Mode)
⟨036⟩⟨110⟩ ⟨036⟩H
Scrolls all rows in the current window up one row. The top row in the current window is lost and a new, blank row scrolls into the bottom row of the window. The cursor remains fixed on the display screen. The contents of the current window can be scrolled up with this command even when the Roll Disable command has been issued.

SELECT ANSI MODE (Data General Mode)
⟨036⟩⟨106⟩⟨100⟩ ⟨036⟩F@
The ANSI mode is selected for all further commands which are received. After this command is issued, the terminal operates as a standard ANSI terminal in accordance with ANSI standards 3.4, 3.41, and 3.64. Data General command sequences are not recognized by the terminal in ANSI mode. The ANSI command sequences recognized by the terminal in ANSI mode are described in the next section of this chapter. To switch back to the standard Data General operating mode, issue the Reset Mode command as described in the ANSI command section.

SELECT CHARACTER SET, set number
(Data General Mode)
⟨036⟩⟨106⟩⟨123⟩⟨nn⟩ ⟨036⟩FS. . .
Selects the character set specified by argument ⟨nn⟩ for display on the screen. This command is one of three in the character set select command group — the group used to select and switch between characters sets for display on the screen as described in the Host/Terminal Communications and Command Set Overview sections.

The terminal keeps track of a G0 (primary) character set and a G1 (secondary) character set. At power-up or reset:

- The active set (DL) is the G0 character set.

- In 7-bit mode, the G0 set is the character set matching the keyboard nationality, and G1 is the word processing set.

- In the 8-bit mode, the G0 set is U.S., and the G1 set is DG International.

To select a character set as the G1 set, first use the Shift Out command to make G1 the active set, then use Select Character Set to choose a particular set. To select a set as the G0 set, first use Shift In to make G0 the active set, then issue the Select Character Set command. The command argument selects the character set as follows:

$\langle nn \rangle$ = 00 Keyboard
= 01 U.S.
= 02 United Kingdom
= 03 French
= 04 German
= 05 Swedish/Finnish
= 06 Spanish
= 07 Danish/Norwegian
= 08 Swiss
= 09 Kata Kana G0
= 0⟩ DG International
= 0? Kata Kana G1
= 10 Word processing, math, super-/ subscript, etc.
= 11 Line drawing
= 20 to 45 - DLL sets 0 to 38

Appendix B shows the character codes and details of each character for all of these character sets (except for the custom characters of the D460 discussed later in this chapter).

NOTE: *Only those characters in Appendix B are supported by the D410/460 terminal. If $\langle nn \rangle$ = 15 for the Select Character Set command, for example, there is no guarantee as to what characters will be displayed.*

Example:
The following sequence involves all three commands from the character set select command group:

Command	Description
1. ⟨036⟩O	Switch to G0 character set
2. ⟨036⟩FS01	Select U.S. set as G0 set
3. ⟨036⟩N	Switch to G1 character set
4. ⟨036⟩FS11	Select line drawing set as G1 set

Generally, select the two most frequently used character sets as G0 and G1, and then use the Shift In/Out commands to switch between the two sets. In this way, host/terminal character traffic can be kept to a minimum when selecting character sets.

SELECT COMPRESSED SPACING
(Data General Mode)
⟨036⟩⟨106⟩⟨113⟩   ⟨036⟩FK
Sets character spacing for the current window to provide 135 columns across the width of the display screen. This is referred to as "compressed" character spacing. When the character spacing is switched from normal (81 columns across the display screen) to compressed, the 135 columns displayed depend on the absolute column number of the leftmost column displayed with normal spacing. As shown in Figure 3-9A, when the leftmost absolute column number ranges from 0 to 26, compressed spacing will display the 135 columns beginning with the leftmost column number. Figure 3-9B shows that when the normal spacing leftmost absolute column number ranges from 27 to 81, the rightmost 135 columns of the display screen memory are displayed. Margin settings are unaffected.
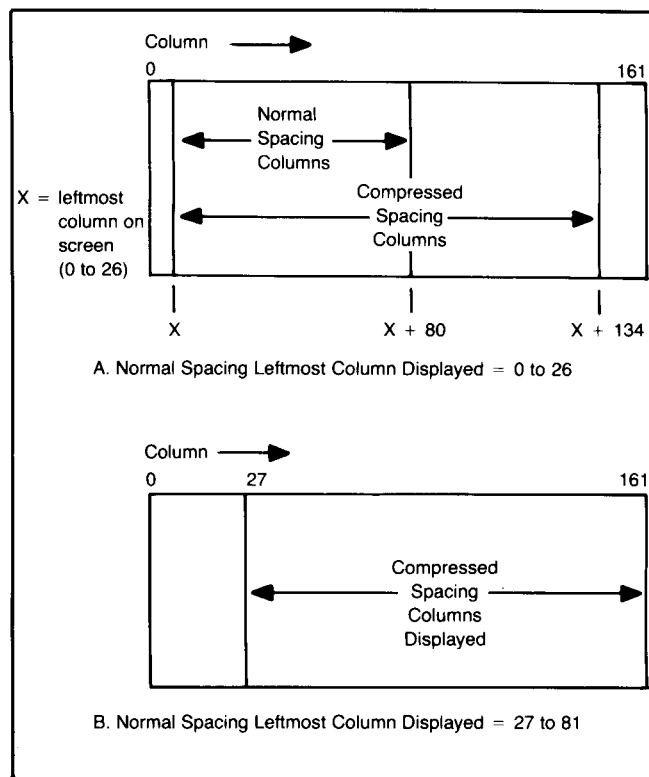

Figure 3-9. Display Screen Columns Displayed with Compressed Character Spacing

SELECT NORMAL SPACING (Data General Mode)
⟨036⟩⟨106⟩⟨112⟩   ⟨036⟩FJ
Sets character spacing for the current window to provide 81 columns across the width of the display screen. This is "normal" character spacing. When the character spacing is switched from compressed (135 columns across the display screen) to normal, the 81 columns displayed depend on whether horizontal scrolling is enabled or disabled and the location of the cursor.

When horizontal scrolling is disabled, switching from compressed to normal spacing displays the 81 columns to the right of (and including) the leftmost column displayed with compressed spacing. When horizontal scrolling is enabled, the columns displayed after switching from compressed to normal spacing depend on the location of the cursor:

• If the cursor is located in the first (leftmost) 81 columns of the screen, those 81 columns are displayed.

• If the cursor is not located in the first 81 columns of the screen, the column containing the cursor and the 80 columns to the immediate left of that column are displayed. The column containing the cursor becomes the rightmost column on the screen.

Margin settings are unaffected.

SELECT 7/8 BIT OPERATION (Data General Mode)
⟨036⟩⟨106⟩⟨125⟩⟨mode⟩   ⟨036⟩FU...
This command sets the 7/8-bit operations for the terminal. The ⟨mode⟩ specifies which data bit syntax (either 7-or 8-bit) is to be set:

⟨mode⟩ = ⟨060⟩ - select 7-bit syntax

= ⟨061⟩ - select 8-bit syntax

The command does not affect the UART settings. The terminal responds to this command ONLY if the switch at the back of the display unit is set for "8-Bit" operations. If the hardware switch is set for "7-Bit" operations, this command has NO effect.

SET ALTERNATE MARGINS, cursor row,
left margin, right margin   (Data General Mode)
⟨036⟩⟨106⟩⟨131⟩⟨nn⟩⟨nn⟩⟨nn⟩   ⟨036⟩FY...
Temporarily assigns a new set of margins while saving the old margins. The command arguments specify the destination row in the current window for the cursor and the new margins relative to the old left margin. When the command is issued, the cursor moves to the new left margin at the specified row and horizontal scrolling is automatically disabled. Horizontal scrolling can be enabled with alternate margins in effect with the Horizontal Scroll Enable or Write Window Address commands. The command arguments are as follows:

1st ⟨nn⟩ = 00 to 17, the destination row for the cursor in the range of 0 to 23 (decimal)

1st ⟨nn⟩ = ?? (255 decimal) for no change in the cursor row from its value before the command

2nd ⟨nn⟩ = 00 to :1, the new left margin column number relative to the old left margin in the range of 0 to 161

3rd ⟨nn⟩ = 00 to :1, the new right margin column number relative to the old left margin in the range of 0 to 161

If the cursor row argument exceeds the number of rows in the current window, the cursor moves to the bottom row in the window. The left and right margin arguments are treated as follows:

• The left margin argument must be less than or equal to the right margin argument or the command will be ignored.

• If the new left margin absolute column number is equal to or greater than the old right margin absolute column number, the new left and right margins are set equal to the old right margin.

• If the new right margin absolute column number is greater than the old right margin absolute column number, the old right margin remains in effect.

There are several ways to change the alternate margins established with this command. The alternate margins can be deleted and the old margins restored with the Restore Normal Margins command. A new set of alternate margins can be specified by using this Set Alternate Margins command repeatedly. In this case, the new set of margins remains relative to the old margins in effect before the first Set Alternate Margins command. New margins can be specified with the Set Margins command.

Example:
Assume the current margins are set at absolute columns 20 and 80. The command ⟨036⟩FY001432 assigns alternate margins to columns 40 and 70 and moves the cursor to the left margin of row 0 in the current window. Calculate the left margin of 40 by adding the decimal equivalent of the ASCII 14 argument to the old left margin of 20 (20 + 20 = 40). Likewise, to derive the right margin of 70, add the decimal equivalent of the ASCII "32" to 20 (50 + 20 = 70).

SET CURSOR TYPE, type number
                              (Data General Mode)
⟨036⟩⟨106⟩⟨121⟩⟨n⟩   ⟨036⟩FQ...
The appearance of the cursor on the display screen is specified by the argument ⟨n⟩, where

⟨n⟩ = 0, cursor not displayed
= 1, cursor displayed as blinking underscore
= 2, cursor displayed as reverse video block
= 3, cursor displayed as blinking reverse video block

This command offers the same four options for cursor appearance as the CURSOR TYPE key.

Example:
The command ⟨036⟩FQ1 sets the cursor appearance to a blinking underscore.

SET KEYBOARD LANGUAGE
                              (Data General Mode)
⟨036⟩⟨106⟩⟨146⟩⟨parameter⟩   ⟨036⟩Ff...
Sets terminal keyboard language. The ⟨parameter⟩

may specify either the default keyboard language or the U.S. ASCII keyboard language:

⟨parameter⟩ = ⟨060⟩ - Set keyboard language to match the keyboard

= ⟨061⟩ - Set keyboard language to:
U.S. ASCII in K0
DG International in K1

SET MARGINS, left margin, right margin
(Data General Mode)
⟨036⟩⟨106⟩⟨130⟩⟨nn⟩⟨nn⟩   ⟨036⟩FX...
Sets the left and right margins for all windows on the display screen to the absolute column numbers specified in the command arguments. The margins define the horizontal limits on cursor movement. The cursor cannot be positioned outside the margins. When the terminal is powered up or reset, the margins are set to absolute columns 0 and 79. Issuing the Set Margins command scrolls the display screen horizontally as required to display both the right and left margins (if horizontal scrolling is enabled). If both margins do not fit on the display screen, the new left margin is positioned to the leftmost column on the screen. The cursor moves to the new left margin, but does not change rows. The command arguments are as follows:

1st ⟨nn⟩ = 00 to :1, the absolute column number of the new left margin in the range of 0 to 161 (decimal)

2nd ⟨nn⟩ = 00 to :1, the absolute column number of the new right margin in the range of 0 to 161

The left margin column number must be less than or equal to the right margin column number, and both margin arguments must be in the range shown, or the command is ignored. The margins established with this Set Margins command can be saved and temporarily replaced with the Set Alternate Margins command, and later restored with the Restore Normal Margins command.

Example:
The command ⟨036⟩FX0:5: establishes new left and right margins at absolute columns 10 (ASCII 0:) and 90 (ASCII 5:), respectively. Both margins are displayed on the screen and the cursor is positioned at the left margin on the same row as before the command.

SET SCROLL RATE, rate number
(Data General Mode)
⟨036⟩⟨106⟩⟨124⟩⟨n⟩   ⟨036⟩FT...
Sets the vertical scrolling rate for the display screen to one of three options as specified by argument ⟨n⟩, where

⟨n⟩ = 0, for "jumpy" single-row increment scrolling at the rate determined by the incoming character traffic rate

= 1, for slow smooth scrolling at 5 rows/second

= 2, for fast smooth scrolling at 10 rows/second

If the command argument does not fall within the range of 0 to 2, jump scrolling is selected. The scroll rate options in this command are the same as those available with the SCROLL RATE key.

Example:
The command ⟨036⟩FT2 selects fast smooth scrolling.

SET WINDOWS, top window row count, spacing type,...bottom window row count, spacing type   (Data General Mode)
⟨036⟩⟨106⟩⟨102⟩⟨nn⟩⟨n⟩...⟨nn⟩⟨n⟩   ⟨036⟩FB...
Divides the display screen into 1 to 24 miniature display screens called windows. A window consists of from 1 to 24 consecutive rows and spans the entire 162 columns of display screen memory. Each window can be scrolled horizontally and vertically, erased, printed, etc., independently from all other windows. The command arguments specify the number of rows and the type of character spacing (normal or compressed) associated with each window, beginning with the top window and continuing down the screen to the bottom window. This command does not affect the margins. When the command is completed, the cursor moves to the home position of the top window and horizontal scrolling is enabled.

The command arguments consist of one or more ⟨nn⟩⟨n⟩ pairs, each of which defines the row count and spacing type for one window as follows:

⟨nn⟩ = 00 to 17, the number of consecutive rows in the window in the range of 0 to 23 (decimal)

⟨n⟩ = 0, for normal (81 columns) character spacing
= 1, for compressed (135 columns) character spacing

The first ⟨nn⟩⟨n⟩ pair in the command applies to the top window on the display screen, the second ⟨nn⟩⟨n⟩ pair applies to the window just below the top window, and so on. The Set Windows command is complete when the row count assigned to one or more windows totals 24 or more. If an attempt is made to allocate more than 24 rows, the bottom window on the screen will end up with the number of rows not assigned to the windows above the bottom. For example, a Set Windows command that attempts to create three windows with row counts of 10, 10, and 8 will end up with a bottom window of 4 rows (and not the 8 specified). A command that specifies a single window of 30 rows will create a single window of 24 rows.

The ⟨nn⟩ = 00 row count argument is a special case. The 00 row count can be used to create a bottom window out of all rows not used by previous ⟨nn⟩⟨n⟩ pairs in the command. If the first ⟨nn⟩⟨n⟩ pair in the com-

mand has a row count of 00, a single window fills the complete display screen.

Windows can be horizontally scrolled independently from one another. As a result, the margins for different windows may not be vertically aligned. When the terminal recognizes the ⟨036⟩FB character sequence as a lead-in to the Set Windows command, all existing windows are aligned at their left margins with normal character spacing in effect. New windows are then defined with no loss of characters. An old window can be broken down into several new windows or old adjoining windows can be combined.

Example:
The following versions of the Set Windows command all divide the display screen into two windows of 12 rows each with normal character spacing in the top window and compressed spacing in the bottom window as shown in Figure 3-10. For the purpose of the figure, the margins have been set to columns 0 and 161.

Command	Comments
⟨036⟩FB0<0001	2nd window row count = 00 (0 decimal)
⟨036⟩FB0<00<1	2nd window row count = 0< (12)
⟨036⟩FB0<0101	2nd window row count = 10 (16)

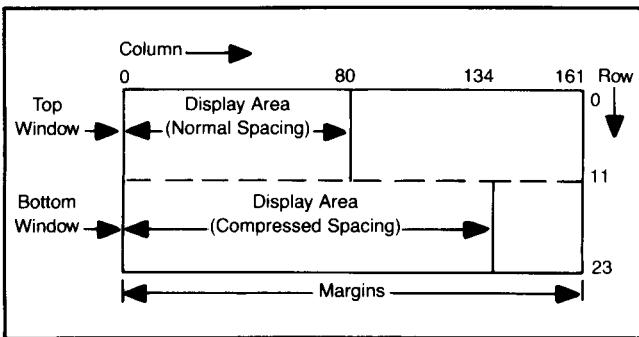**Figure 3-10. Set Windows Command Example**

SHIFT IN   (Data General Mode)
⟨036⟩⟨117⟩   ⟨036⟩O
Invokes the designated G0 (primary) character set into the DL character set (displayable characters in the range ⟨041⟩ to ⟨176⟩). See the Select Character Set command for a description of how to designate a character set to be G0, and the Host/Terminal Communications section at the beginning of this chapter for a discussion of the DL character set. Once the Shift In command has been issued, the G0 character corresponding to the octal code received will be displayed. Appendix A lists the octal codes corresponding to the characters in the various character sets.

Example:
If the French character set has been designated G0 and the ⟨036⟩O command has been issued, depressing the [key on a U.S. keyboard sends ⟨133⟩ to the display unit. Since ⟨133⟩ corresponds to the degree symbol in the French character set, that symbol is displayed

rather than the [. If the U.S. character set is then designated G0, depressing the same key displays the [.

SHIFT OUT   (Data General Mode)
⟨036⟩⟨116⟩   ⟨036⟩N
Invokes the designated G1 (secondary) character set into the DL character set (displayable characters in the range ⟨041⟩ to ⟨176⟩). See the Select Character Set command for a description of how to designate a character set to be G1, and the Host/Terminal Communications section at the beginning of this chapter for a discussion of the DL character set. Once the Shift In command has been issued, the G1 character corresponding to the octal code received will be displayed. Appendix A lists the octal codes corresponding to the characters in the various character sets.

Note that in 8-bit mode, the DR character set (displayable characters in the range ⟨241⟩ to ⟨376⟩) is, by default, the G1 set. The function of the Shift Out control remains the same as in 7-bit mode, however, in order to maintain compatibility with 7-bit operation systems.

Example:
If the Swiss character set has been designated G1 and the ⟨036⟩N command has been issued, depressing the [key on a U.S. keyboard sends ⟨133⟩ to the display unit. Since ⟨133⟩ corresponds to the e umlaut character in the Swiss character set, that symbol is displayed rather than the [. If the U.S. character set is then designated G1, depressing the same key displays the [.

SHOW COLUMNS, left col., right col.
                                      (Data General Mode)
⟨036⟩⟨106⟩⟨137⟩⟨nn⟩⟨nn⟩   ⟨036⟩F_ ...
Displays in the current window the columns specified by the command arguments. The command arguments specify the left and right limits on the column range for display. If the entire range is already displayed when this command is issued, the window does not scroll. Otherwise, the window horizontally scrolls the minimum distance required to bring the column range into view. If the entire range cannot be displayed within the width of the display screen, a horizontal scroll is performed so the leftmost column in the range is at the leftmost column on the screen. The cursor location changes only if the horizontal scrolling would move it off the display screen. Cursor movement is kept to a minimum: the cursor row does not change and the cursor column changes only enough to keep the cursor on the display screen. Horizontal scrolling must be enabled for this command to work. The command arguments are:

1st ⟨nn⟩ = 00 to :1, the absolute column number of the leftmost column for display (0 to 161, decimal)

2nd ⟨nn⟩ = 00 to :1, the absolute column number of the rightmost column for display (0 to 161)

The argument value for the left column must be in the range specified and less than or equal to the value for the right column, or the command will be ignored. Right column argument values greater than 161 default to 161.

Example:
Assume absolute columns 0 to 80 are displayed in the current window. A command of ⟨036⟩F_5078 scrolls the window to the left 40 columns so that columns 80 to 120 can be viewed (left column = 50 ASCII or 80 decimal; right column = 78 ASCII or 120 decimal). Column 120 will be the rightmost column of the window on the display screen.

UNDERSCORE OFF (Data General Mode)
⟨025⟩ CTRL-U
Turns off the underscore attribute for all subsequent characters. This command is issued automatically with the Erase Screen and Erase Window commands or when the terminal is powered up or reset.

UNDERSCORE ON (Data General Mode)
⟨024⟩ CTRL-T
Turns on the underscore attribute for all subsequent characters.

WINDOW BIT DUMP (Data General Mode)
⟨036⟩⟨106⟩⟨077⟩⟨065⟩ ⟨036⟩F?5
This command causes a bit image dump to the graphics slave printer. It prints the current window exactly as it appears to the user including reverse video spaces and underscored, dimmed, and protected text. The blink attribute, however, is disregarded. This command is initiated by the above code sequence or by the simultaneous depression of the CMD-SHIFT-Local-Print keys (in the latter case, the terminal returns code ⟨006⟩ at completion).

To abort this printing command, depress CMD-CR or Local Print.

WINDOW HOME (Data General Mode)
⟨010⟩ CTRL-H
Moves the cursor to the left margin of the top row in the current window. If the home location is protected, the Cursor Right command repeats until the cursor moves into an unprotected character position. If horizontal scrolling is enabled and the new cursor location is not displayed on the screen, the current window scrolls the minimum number of columns required to display the cursor. The Window Home command is issued automatically with the Erase Window command.

WRITE SCREEN ADDRESS, column, row
(Data General Mode)
⟨036⟩⟨106⟩⟨120⟩⟨nn⟩⟨nn⟩ ⟨036⟩FP...
Moves the cursor to the specified character location anywhere between the margins. This command makes it possible to move the cursor between windows, permitting the selection of a new active or current window. If the cursor is written to a location off the

screen, the destination window scrolls horizontally the minimum number of columns to bring the cursor into view (if horizontal scrolling is enabled). If horizontal scrolling is disabled and the cursor is written off the screen, the cursor disappears from view. If the cursor is written to a protected area, the Cursor Right command repeats until the cursor moves into an unprotected character location. The command arguments are:

1st ⟨nn⟩ = 00 to :1 (0 to 161, decimal), the absolute destination column number. An ⟨nn⟩ value of ?? (255, decimal) is a special case specifying no change in the cursor column from its value before this command

2nd ⟨nn⟩ = 00 to 17 (0 to 23, decimal), the absolute destination row number. Again, ?? is a special case specifying no change in the cursor row from its previous value

If the destination column argument is outside the margins, the cursor pegs to the margin closest to the argument value. If the destination row argument is greater than 23 and other than 255, the cursor moves to the bottom row on the screen.

Example:
In Figure 3-11 the cursor is located in the top window of three windows on the display screen. To change the current window from the top to the bottom and to position the cursor at the home location of the bottom window, issue ⟨036⟩FP1⟩10 (ASCII 1⟩ = column 30; ASCII 10 = row 16).
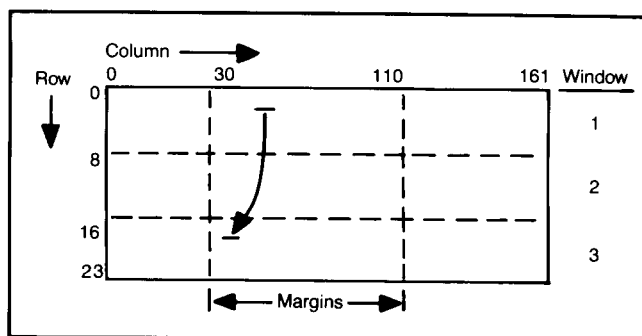

Figure 3-11. Write Screen Address Command Example

WRITE WINDOW ADDRESS, column, row
(Data General Mode)
⟨020⟩⟨column⟩⟨row⟩ CTRL-P...
Moves the cursor to the specified character location between the margins in the current window. The command arguments are relative to the home location for the current window; that is, the left margin of the top row in the current window. If the cursor is written to a location off the screen, the window scrolls horizontally the minimum number of columns to bring the cursor into view (if horizontal scrolling is enabled). If horizontal scrolling is disabled and the cursor is written off the

screen, the cursor disappears from view. If the cursor is written to a protected area, the Cursor Right command repeats until the cursor moves into an unprotected character location. The command arguments are as follows:

⟨column⟩ = ⟨000⟩ to ⟨176⟩ or ⟨177⟩, the destination column number in the range of 0 to 126 (decimal) relative to home of the current window; ⟨177⟩ is a special case where the destination column remains the same as its value before this command.

⟨row⟩ = ⟨000⟩ to ⟨027⟩ or ⟨177⟩, the destination row number in the range of 0 to 23 relative to home of the current window; ⟨177⟩ is a special case where the destination row remains the same as its value before the command.

Notice that the full range of columns (0 to 161) in the display screen memory is not accessible with the ⟨column⟩ argument. This is because the command uses 7-bit characters and only one character is used for the ⟨column⟩ argument. The Write Screen Address command can be used in those cases where the full range of columns must be accessible. If the ⟨row⟩ or ⟨column⟩ argument bytes exceed the size of the current window, the cursor pegs at the bottom row of the window or on the right margin, respectively.

Example:
The command ⟨020⟩⟨177⟩⟨010⟩ moves the cursor to row 8 in the current window without changing the cursor column number from its value before the command.

D460-Unique Commands in DG Mode

The following section describes the custom character and character graphics commands. These D460-unique commands make use of the terminal's ability to accept and display characters of any dot pattern. From the hardware viewpoint, these commands are made possible by the downline loadable (DLL) printed circuit board. The DLL provides the D460 terminal with the capability to maintain up to 3572 custom characters in RAM. Each bit of RAM corresponds to a single dot of one character.

As indicated by the name of the command group - custom character and character graphics - the D460-unique commands fall under two headings. First is the user-definable custom character feature, which is supported with a single command called Define Character. Second is the character graphics feature, supported by five commands:

- Initialize Draw

- Read Characters Remaining

- Set Pattern

- Line

- Bar

All of these commands are multi-character in length and begin with the ⟨036⟩ header code. The command arguments are described in detail with the command descriptions.

User-Defined Custom Characters

The DLL pcb option included with the D460 terminal makes it possible to increase the terminal character set count of 13 by an additional 38 user-defined, or custom, character sets. These sets are also referred to as the soft or DLL character sets. The total available custom character count of 3572 is divided into 38 sets of 94 characters as shown in Table 3-8.

NOTE: *The user-defined character sets can be on the screen with normal spacing only. Custom characters appear as reverse video blocks when displayed with compressed spacing. Since all custom characters are maintained in RAM, their definition is lost each time power to the terminal is switched off or a hard reset (CMD-ERASE PAGE on keyboard) is performed. Custom characters to be used following either of these two events must be reloaded. It is recommended that custom character definitions be saved on the host system in a convenient location so they can be transferred to the D460 terminal as needed.*

Table 3-8. Composite List of Character Sets

Set No. (⟨nn⟩)	Set Contents
00	Keyboard language
01	U.S.
02	United Kingdom
03	French
04	German
05	Swedish/Finnish
06	Spanish
07	Danish/Norwegian
08	Swiss
09	Kata Kana G0
0>	DG International
0?	Kata Kana G1
10	Word processing, math, super-/subscript, etc.
11	Line drawing
User Defined Sets:	
20	DLL set 0
to	to
45	DLL SET 38

The first step in defining one or more custom characters is to select a user-defined character set number from Table 3-8. The character set number used (⟨nn⟩ = 20 to 45) identifies the character set to contain the first group of custom characters.

The ⟨nn⟩ argument numbers in Table 3-8 represent the ASCII character pairs used by the Select Character Set command. This is the same D410/460 command used to select a character set for display on the screen. When custom characters are being defined, this command is used to select the character set(s) destined to hold the new custom characters created with the Define Character command. The procedure for creating custom characters, therefore, is as follows:

1. Use the Select Character Set command to pick a destination character set in the range of 20 to 45. ⟨036⟩FS20 picks set 20 (⟨nn⟩ = 20).

2. Use the Define Character command to create dot patterns for all those characters to be assigned to the character set picked in step 1.

3. Repeat steps 1 and 2 as needed until all custom characters have been defined and assigned to a character set.

When defining new characters in this manner, make a point to conserve as many unused character sets as possible. The reason for this is made clear in the Initialize Draw command description.

NOTE: *Make sure the character set(s) selected to hold user-defined characters have not been reserved for use by the character graphics commands. Following this policy prevents user-definitions and definitions from the graphics drawing algorithms from being assigned to the same characters and causing unwanted results.*

Before getting to the details of the Define Character command, it is important to understand the dot pattern organization of a character cell displayed with normal spacing. Every character cell on the display screen, when normal character spacing is in effect, consists of 12 scan rows in the vertical direction with 10 dots per scan row in the horizontal direction. Figure 3-12 shows how the capital letter A is formed within this matrix of dots for the D410/460 terminal.
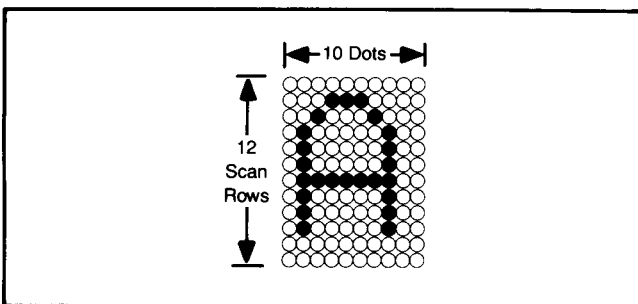

Figure 3-12. Character Dot Matrix for Normal Spacing

The Define Character command encodes the dot pattern representing one character into the arguments of the command. The command must be repeated for each character defined. Notice that the outer scan rows and dot columns for the A in the figure have no dots filled in. Vertical and horizontal spacing between adjacent characters on the screen is maintained in this manner. Details of the Define Character command follow.

DEFINE CHARACTER, character, dot pattern
(Data General Mode)
⟨036⟩⟨106⟩⟨122⟩⟨char⟩⟨dd⟩...⟨dd⟩   ⟨036⟩FR...
The appearance of character ⟨char⟩ in the user-defined character set most recently picked with the Select Character Set command is specified by the 12 pairs of dot pattern arguments ⟨dd⟩...⟨dd⟩. The character definition may be for a new character or used to replace an existing character. As this command executes, the dot pattern for the character being defined is written to the DLL RAM. If the previous definition for this character is displayed on the screen, the new definition shows up immediately causing the screen image to change. This occurs because the DLL character definition is accessed continually to support screen refresh. The command arguments are defined as follows:

⟨char⟩ = ⟨041⟩ to ⟨176⟩ for character sets 20 to 45; the ASCII character code for the character being defined.

⟨dd⟩...⟨dd⟩ = 12 pair of ASCII characters with each pair representing the dot pattern for one scan row of the character being defined, starting with the top scan row of the character cell.

For both bytes in each ⟨dd⟩ pair, only the lower 5 bits are used. The lower 5 bits of each byte are concatenated as shown in Figure 3-13 to form a 10-bit value. Every logic 1 in the 10-bit value represents a dot to be turned on; every logic 0 represents a dot to be turned off. The 12 pair of ⟨dd⟩ bytes, therefore, combine to form a 120-bit sequence that completely defines the appearance of character ⟨char⟩.
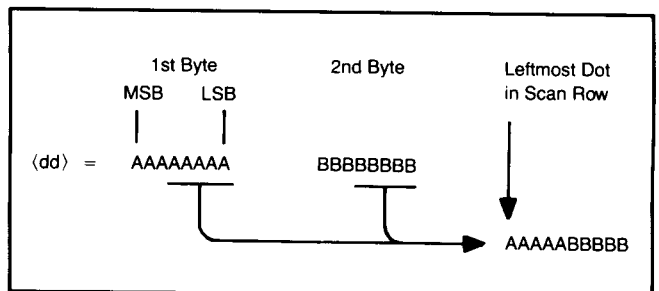

Figure 3-13. Formation of Scan Row Dot Pattern

The Define Character command will be treated as invalid under the following conditions:

• If the character set number most recently selected with the Select Character Set command is not in the range of 20 to 45 hexadecimal (or ⟨nn⟩ = 20 to 45),

the Define Character command aborts as soon as the ⟨036⟩FR sequence is encountered.

- If the ⟨char⟩ command argument is not within the expected range, the command aborts as soon as the invalid ⟨char⟩ argument is encountered.

If a user-defined character set (⟨nn⟩ = 20 to 45) has been selected and the ⟨char⟩ argument is valid, the next 24 bytes interpreted by the display unit are assumed to comprise the dot pattern arguments (⟨dd⟩...⟨dd⟩).

Example:
The capital letter A in Figure 3-13 can be created and assigned to character ! (⟨041⟩) in character set 20 with the following command sequence:
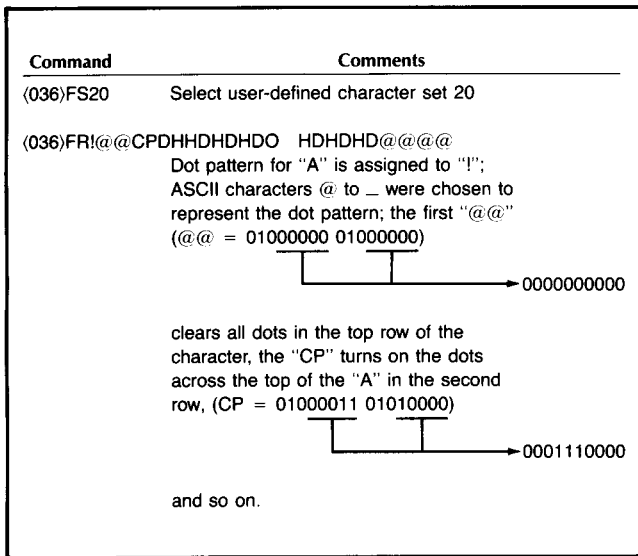
Command	Comments
⟨036⟩FS20	Select user-defined character set 20
⟨036⟩FR!@@CPDHHDHDHDO HDHDHD@@@@	Dot pattern for "A" is assigned to "!"; ASCII characters @ to _ were chosen to represent the dot pattern; the first "@@" (@@ = 01000000 01000000)
	⟶ 0000000000
	clears all dots in the top row of the character, the "CP" turns on the dots across the top of the "A" in the second row, (CP = 01000011 01010000)
	⟶ 0001110000
	and so on.

Figure 3-14.   Command Sequence

Character Graphics Commands

The D460 terminal creates graphics displays by combining line segments and bars (filled-in rectangles) into a composite screen image. The lines and bars are formed using DLL characters defined by the drawing algorithms in the terminal. The DLL character sets used by the drawing algorithms should not be used for user-defined custom characters. When a graphics image is no longer required on the screen, the DLL character sets used to create the image can be released and made available for user-defined custom characters.

The five character graphics commands are presented in alphabetical order and described in detail in the next few pages. A brief overview of the five commands follows:

- **Initialize Draw** — Sets aside one or more DLL character sets for graphics purposes. As long as unused characters remain in the DLL sets reserved, graphics drawing operations may continue.

- **Read Characters Remaining** — Queries the terminal to determine the number of unused DLL characters.

- **Set Pattern** — Used in conjunction with the Line command. Set Pattern changes the solid line style to any pattern of black or green dots and dashes desired.

- **Line** — If Set Pattern is not used, Line draws all line segments in one line style.

- **Bar** — Draws solid rectangles of any size, provided they fit in the current window.

As is the case for the custom characters, graphics images can be displayed only if normal character spacing is in effect. Also, when the terminal is turned off or a terminal reset is performed (CMD-ERASE PAGE), DLL character sets must be reserved again before graphics drawing operations can begin.

Use of the Line and Bar drawing commands is based on an x,y coordinate system. Figure 3-15 shows this coordinate system under power-up or reset conditions. The x-axis of the system runs horizontally across the bottom of the current window and the y-axis runs vertically up the left margin of the current window. The drawing area, then, is comprised of the rows within the current window and the columns between the margins. Along the x-axis of the coordinate system, there are 10 x-coordinate units for each column between margins. Along the y-axis, there are 24 y-coordinate units for each row in the window. These coordinate units are derived from the 10- by 12-dot matrix in each character cell: one coordinate unit in the x-direction for each dot column and two coordinate units in the y-direction for each scan row. Locations on the drawing area are specified by an x,y coordinate pair, such as (100,200), where 100 is the x-coordinate and 200 is the y-coordinate. The drawing origin (coordinates 0,0) for the active drawing area is formed by the intersection of the left margin with the bottom of the last row in the current window.
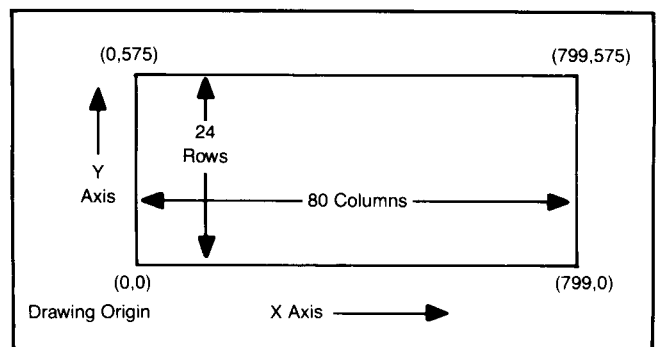

Figure 3-15.   Graphics Coordinate System at Power-Up or Reset

As was already mentioned, the available drawing area for the character graphics commands is limited by the

margins and the boundaries of the current window. As a result, the largest possible drawing area consists of the entire display screen memory (24 rows, 162 columns). X-coordinate units for this area would range from 0 to 1619; y-coordinate units would range from 0 to 575 (as is the case in Figure 3-15). The smallest possible drawing area consists of one character cell (1 row, 1 column). In this case, the x-coordinate range is 0 to 9 and the y-coordinate range is 0 to 23. If the arguments to the Line and Bar commands specify a location or dimension that extends outside the current drawing area, the command aborts immediately.

One last drawing area example should help clear up any remaining questions on the coordinate system before the detailed command descriptions are presented. Figure 3-16A shows the case where the current window is comprised of rows 0 to 9 and the margins are set at columns 10 and 69. For graphics purposes, those boundaries form the x,y-coordinate system shown in Figure 3-16B.
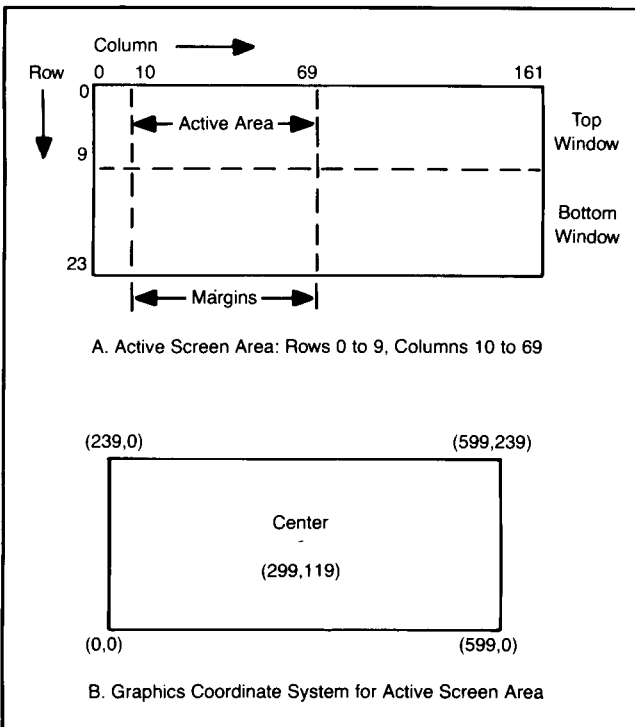

Figure 3-16. Example of Graphics Drawing Area on Display Screen

NOTE: *The Initialize Draw command must be used to reserve one or more DLL character sets before the Bar and Line drawing commands will work.*

BAR, location, width, height, color

(Data General Mode)

⟨036⟩⟨107⟩⟨061⟩⟨loc⟩⟨width⟩⟨height⟩

⟨color⟩   ⟨036⟩G1...

Draws a solid green or black rectangle with the lower left corner at the location ⟨loc⟩. The command argu-

ments specify the width and height of the rectangle:

⟨loc⟩ = ⟨xxx⟩⟨yyy⟩, a 6-byte sequence specifying the coordinates of the lower-left corner of the bar

where:

⟨xxx⟩ = 3-byte   x-coordinate   formed   by concatenating the 5 LSBs of all 3 bytes (15 bits total) as shown in Figure 3-17.

⟨yyy⟩ = 3-byte y-coordinate formed like ⟨xxx⟩

⟨width⟩ = 3-byte width of bar in x-direction formed like ⟨xxx⟩

⟨height⟩ = 3-byte height of bar in y-direction formed like ⟨yyy⟩

⟨color⟩ = ⟨060⟩ (ASCII 0) for black
            = ⟨061⟩ (ASCII 1) for green

The command is ignored if the bar defined by the command arguments extends outside the active drawing area or if the color argument is other than a 0 or 1.

ASCII characters @ to _ can be used to create all valid 3-byte arguments values in the ⟨xxx⟩/⟨yyy⟩ format as shown in Table 3-9. This includes not only location arguments but the width and height arguments of the Bar command. The table includes examples showing how the values picked from the table columns are added together to develop the 3-byte ASCII character sequence for a given argument value.

Example:
The command ⟨036⟩G1@@@@@@CD@FH1 draws a bar with its lower-left corner at location 0,0 (@@@@@@), 100 (@CD) units wide, 200 (@FH) units high, and colors it green (1).

LINE, location,...,location   (Data General Mode)
⟨036⟩⟨114⟩⟨loc⟩...⟨loc⟩⟨000⟩   ⟨036⟩L...
⟨036⟩⟨107⟩⟨070⟩⟨loc⟩...⟨loc⟩⟨000⟩   ⟨036⟩G8...
Draws a line segment between consecutive locations in the argument list, that is, between the first and second locations, the second and third locations, and so on. If only one location argument is supplied with the command, a point is drawn at that location. The number of location arguments in one command is limited only by the number of DLL characters available for graphics drawing purposes. When all the DLL characters have been used up, no more lines can be drawn. The line style used for drawing is solid green unless the Set Pattern command is used to define a different line style. The command arguments are:

⟨loc⟩ = ⟨xxx⟩⟨yyy⟩, a 6-byte sequence specifying the x- and y-coordinates of a point on the line segment; the ⟨xxx⟩⟨yyy⟩ format used to specify a location is the same as that used in the Bar command.

⟨000⟩ = a null character terminating a string of ⟨loc⟩ arguments and marking the end of the Line command. ⟨000⟩ is generated from the keyboard by CTRL-@ CTRL-@ CTRL-@.

Table 3-9 can be used to develop the ⟨xxx⟩ and ⟨yyy⟩ components of each ⟨loc⟩ argument. If any ⟨xxx⟩ or ⟨yyy⟩ value in the argument list is outside the active drawing area, the command terminates immediately as if a null character were encountered.

Table 3-9. Creating Location Arguments with ASCII Characters

ASCII Characters (@ to _)	Argument Forms and Values (Decimal)			
	⟨ x	x or y	x ⟩	
	⟨ y		y ⟩	
@	0	0	0	
A	1024	32	1	Examples:
B		64	2	
C		96	3	For ⟨xxx⟩/⟨yyy⟩ = 455
D		128	4	
E		160	5	= 0 + 448 + 7
F		192	6	= "@NG"
G		224	7	(from table)
H		256	8	
I		288	9	For ⟨xxx⟩/⟨yyy⟩ = 1420
J		320	10	
K		352	11	= 1024 + 384 + 12
L		384	12	= "ALL"
M		416	13	(from table)
N		448	14	
O		480	15	
P	Not	512	16	
Q	Used	544	17	
R		576	18	
S		608	19	
T		640	20	
U		672	21	
V		704	22	
W		736	23	
X		768	24	
Y		800	25	
Z		832	26	
[		864	27	
\		896	28	
]		928	29	
^		960	30	
_		992	31	

Example:
The command ⟨036⟩L@@@@@@@@@ Q_ARS@ Q_ARS @@@@@@@@ ⟨000⟩ draws a line completely around the display screen memory, assuming the margins are set at columns 0 and 161 and the current window has 24 rows. The drawing begins with a point at the drawing origin (@@@@@@), extends up the left side of absolute column 0 to location 0,575 (@@@@Q_), goes across the top of row 0 to location 1619,575 (ARS@Q_), down the right side of column 161 to location 1619,0 (ARS@@@), and returns to the drawing origin (@@@@@@).

READ CHARACTERS REMAINING
(Data General Mode)
⟨036⟩⟨106⟩⟨144⟩   ⟨036⟩Fd
Returns to the host the number of DLL characters remaining for use by the Line and Bar commands.

Form returned:

⟨036⟩⟨157⟩⟨071⟩⟨cc⟩ or ⟨036⟩o9⟨cc⟩ (ASCII)

where:

⟨cc⟩ = 2-byte character count; the 5 LSBs of each byte are concatenated to form a 10-bit value; the count may range from 0 (@@ ASCII) to 1022 (_ ASCII).

Notice the range of ⟨cc⟩ (0 to 1022). Whenever characters are reserved for graphics, two charcters of the total count reserved are used for purposes other than drawing on the screen. When ⟨cc⟩ = 0 (@@ ASCII), no additional drawing operations are possible unless more DLL characters can be reserved with the Initalize Draw command. When this command is entered off-line at the keyboard, the ⟨036⟩o prefix to the return sequence is not displayed.

NOTE: A ⟨cc⟩ value of 1022 returned means there are at least 1022 characters remaining; there may be up to 1502 actual characters left (only the first 16 DLL sets can be reserved for drawing operations. Sets 20 through 2? contain 1502 of the total 3572 DLL characters). The Read Characters Remaining command does not
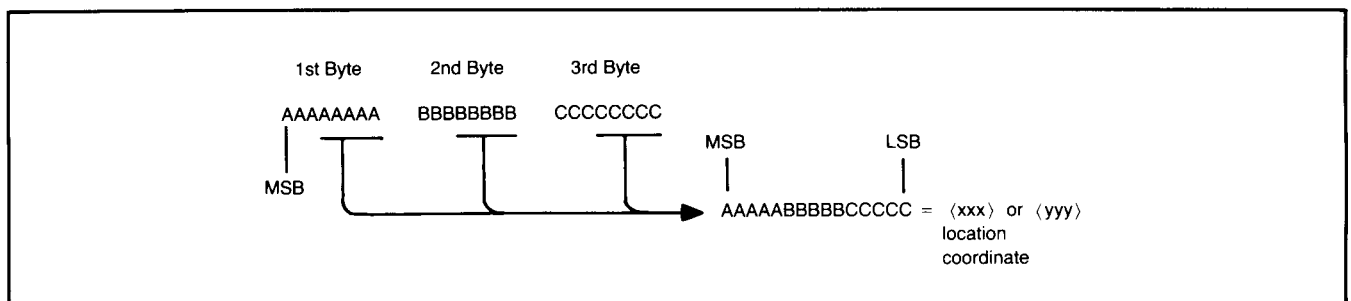

Figure 3-17. Graphics Location Coordinate Format

return an actual count until the number of characters remaining drops below 1022 (this maintains command compatibility with the earlier D450 terminal).

Example:
If the terminal responds to the command ⟨036⟩Fd with ⟨036⟩o9@LP, there are 400 (@LP) DLL characters still available for drawing purposes. But if it responds with ⟨036⟩o9_↑, there are from 1022 to 1502 DLL characters available.

INITIALIZE DRAW starting set, set count

(Data General Mode)
⟨036⟩⟨106⟩⟨145⟩⟨n⟩⟨n⟩   ⟨036⟩Fe...
Reserves for use by the Line and Bar drawing commands the DLL character sets specified in the command arguments. As long as there are unused characters in the sets reserved by this command, drawing operations can continue. As soon as all reserved characters have been used, drawing operations will halt. It is a good practice to reserve as many DLL character sets as possible before creating a new graphics display. The character sets reserved for graphics with the Initalize Draw command remain reserved until the terminal is reset or a second Initialize Draw command is issued.

NOTE: *Only the first 16 DLL sets can be reserved for line and bar drawing operations (sets 20 through 2?). This means a total of 1502 of the total 3572 DLL characters are available. See the Read Characters Remaining command description.*

When a second Initalize Draw command is issued, only the new DLL character sets named in the second command remain reserved. The same DLL character set should not be reserved more than once while a graphics display is present on the screen. If a set is reserved twice, for example, the character definitions used before the second reservation may be changed. When the Reset command is issued, the reserved character count is set to zero.

Command Arguments:

1st ⟨n⟩ = 0 to ? (ASCII), the number of the first DLL character set reserved in the range of 0 to 15 (decimal)

2nd ⟨n⟩ = 1 to ? (ASCII), the number of contiguous DLL sets reserved in the range of 1 to 15 starting with the set specified by the 1st ⟨n⟩ argument

The argument range for the starting DLL character set, 0 to ?, specifies sets in the range of 20 to 2F (hex) respectively. If the second ⟨n⟩ argument is not in the range of 1 to ?, no character sets are reserved.

Example:
The command ⟨036⟩Fe21 reserves DLL character set 22 (hex) for graphics drawing operations.

SET PATTERN, offset, pattern (Data General Mode)
⟨036⟩⟨107⟩⟨160⟩⟨061⟩⟨offset⟩
⟨pattern_definition⟩⟨000⟩   ⟨036⟩Gp1...
All lines drawn with the Line command are solid green unless this Set Pattern command defines another line style. When a new line style pattern is defined, the pattern remains in effect for all Line commands until changed with another Set Pattern command or until a terminal reset occurs. The Set Pattern command does not involve DLL characters, so it may precede the Initialize Draw command.

The ⟨offset⟩ and ⟨pattern_definition⟩ arguments combine to define the new line style pattern. The ⟨pattern_definition⟩ is a string of 1 to 32 pattern characters. Each pattern character specifies an action to be taken at an individual dot along a line. The pattern characters are:

pattern
character = ⟨060⟩ (ASCII 0) for a black dot
         = ⟨061⟩ (ASCII 1) for a green dot
         = something other than ⟨060⟩ or ⟨061⟩ for a dot transparent to the background (i.e., transparent dots do not change the existing screen image)

The null character ⟨000⟩ marks the end of the ⟨pattern_definition⟩ and terminates the command. When a line is drawn, the ⟨pattern_definition⟩ repeats as needed to fill out the length of the line specified. The ⟨offset⟩ is a single-byte argument whose 5 LSBs specify the offset, from the start of the pattern definition, of the first pattern character used in drawing a line. The ⟨offset⟩ can range from 0 to 31 (decimal) and may be specified by ASCII characters @ to _ (or any other ASCII character range that can be used to represent 32 different values in the 5 LSBs).

Example:
The command ⟨036⟩Gp1C1111100000⟨000⟩ creates a new line style of dashes consisting of 5 green dots followed by 5 black dots (1111100000). The offset of 3 (C) means that when a line is drawn, it starts with the fourth green dot in the pattern (the first 3 green dots are skipped over).

ANSI Mode Commands

This section describes all the commands available to the user when the terminal is in ANSI mode. When operating in ANSI mode, the terminal does *not* respond to Data General command control sequences. If you are operating only in DG mode, feel free to skip this section.

The following commands are described in alphabetical order, as shown in Table 3-10.

Table 3-10. D410/460 Command Set (ANSI Mode)

Bell	Read Terminal Configuration
Carriage Return	Read Offset/Show Columns
Change Attributes	Reset Mode
Cursor Backward	Reset To Initial State
Cursor Down	Reverse Index
Cursor Forward	Screen Position
Cursor Position	Scroll Down
Cursor Up	Scroll Left
Delete Character	Scroll Right
Delete Line	Scroll Up
Device Status Report	Select Character Set
End Protected Area	Select Graphic Rendition
Erase In Display	Set Margins
Erase In Line	Set Mode
Form Feed	Set Parameters
Horizontal and Vertical Position	Set Windows
Index	Start Protected Area
Insert Character	Shift In
Insert Line	Shift Out
Media Copy	Single Shift Two
New Line	Single Shift Three
Next Line	XOFF
	XON

ANSI Modes Of Operation

When the D410/460 is used as an ANSI terminal, the ANSI modes of operation affect how the D410/460 will respond to several of the commands. All of the ANSI modes are described in the ANSI X3.64 (1979). Only modes that are directly applicable to the D410/460 are discussed in this manual.

ANSI Fixed Modes of Operation

An ANSI mode of operation may be in one of two states: Set or Reset. Several of the D410/460 ANSI modes are fixed in one of these states and cannot be altered by the programmer.

Table 3-11 shows the fixed ANSI modes of operation that pertain to the D410/460.

Table 3-11. D410/460 ANSI Fixed Modes Of Operation

Mode	⟨Code⟩	Fixed State
Keyboard Action	⟨062⟩	RESET
Control Representation	⟨063⟩	RESET
Status Reporting Transfer	⟨065⟩	RESET
Positioning Unit	⟨061⟩⟨061⟩	RESET
Send-Receive	⟨061⟩⟨062⟩	SET
Format Effector Action	⟨061⟩⟨063⟩	RESET
Format Effector Transfer	⟨061⟩⟨064⟩	RESET
Multiple Area Transfer	⟨061⟩⟨065⟩	SET
Line Feed New Line	⟨062⟩⟨060⟩	SET
Editing Boundary	⟨061⟩⟨071⟩	RESET
Insertion-Replacement	⟨064⟩	RESET
Vertical Editing	⟨067⟩	RESET
Horizontal Editing	⟨061⟩⟨060⟩	RESET
Selected Area Transfer	⟨061⟩⟨067⟩	RESET
Tabulation Stop	⟨001⟩⟨070⟩	RESET
Editing Boundary	⟨061⟩⟨071⟩	RESET

ANSI Selectable Modes of Operation

With the Set Mode and Reset Mode commands, the programmer can set eight of the D410/460 ANSI modes of operation. Table 3-12 outlines the selectable ANSI modes of operation for the D410/460 terminal.

Table 3-12. D410/460 Selectable ANSI Modes Of Operation

Mode ⟨code⟩	State	Effect
Roll Mode ⟨074⟩⟨060⟩	SET	Roll Disabled
	RESET	Roll Enabled
Blink Mode ⟨074⟩⟨061⟩	SET	Blink Disabled
	RESET	Blink Enabled
DG/ANSI Mode ⟨074⟩⟨063⟩	SET	ANSI Mode
	RESET	DG Mode
Forms Mode ⟨074⟩⟨064⟩	SET	Only full intensity characters printed
	RESET	All characters printed
Horizontal Scroll ⟨074⟩⟨062⟩	SET	Horizontal Scroll Enabled
	RESET	Horizontal Scroll Disabled
Guarded Area Transfer ⟨061⟩	SET	Protect attribute disabled for printing transmission
	RESET	Protect attribute enabled for printing transmission
Erasure Mode ⟨066⟩	SET	Erase functions will erase protected text
	RESET	Erase functions won't affect protected text
Margins Mode ⟨074⟩⟨065⟩	SET	Editing within margins only
	RESET	Editing operations not limited by margins

The selectable modes of operation of the D410/460 terminal that pertain to the ANSI X3.64 standard are discussed below. For additional information on the effects of these selectable modes, see the Set Mode and Reset Mode command descriptions in the ANSI Commands Description section which follows.

GUARDED AREA TRANSFER MODE (⟨061⟩)

When in the reset state, only unguarded characters (non-protected text) will be transmitted in a data stream (locally printed). When in the set state, all characters are transmitted.

ERASURE MODE (⟨066⟩)

When in the reset state, erase functions will not affect protected text. When in the set state, erase functions

occur irrespective of protected text. This mode affects the Delete Character, Delete Line, Erase In Display, and Erase In Line commands.

ROLL MODE (⟨074⟩⟨060⟩) *This is a DG private mode.*

When in the reset state (see Roll Enable command), each time a command is issued that would move the cursor beyond the 24th row of the screen, the screen is rolled up one line. When in the set state (see Roll Disable command), each time a command is issued that would move the cursor beyond the 24th row of the screen, the cursor moves to the top line.

BLINK MODE (⟨074⟩⟨061⟩) *This is a DG private mode.*

When in the reset state, characters with their blink attribute set will indeed blink. When this mode is in the set state, characters will not blink, regardless of their blink attribute setting.

DG-ANSI MODE (⟨074⟩⟨063⟩) *This is a DG private mode.*

In the reset state (see SELECT DG MODE), the terminal responds to DG command sequences. In the set state, the terminal responds to ANSI command sequences.

HORIZONTAL SCROLL MODE (⟨074⟩⟨062⟩) *This is a DG private mode.*

See Horizontal Scroll Enable/Horizontal Scroll Disable commands. In the reset state, horizontal scrolling is enabled; in the set state, horizontal scrolling is disabled.

FORMS MODE (⟨074⟩⟨064⟩) *This is a DG private mode.*

In the reset state, a Local Print command will print characters irrespective of their visual attribute settings. In the set state, only those characters displayed at full intensity will be printed.

MARGINS MODE (⟨074⟩⟨065⟩) *This is a DG private mode.*

In the reset state, editing operations operate irrespective of margins; in the set state, editing operations take place within the margins. The commands affected include: Insert Line, Erase In Display, Erase In Line, Insert Character, and Delete Character.

D410/460 Common Commands In ANSI Mode

This section details the ANSI command set common to both the D410 and D460 terminals.

ANSI Mnemonics

Octal constants will be used to compose control sequences. Mnemonics are used for control characters

that can be represented in both 8 and 7 bits. Off-line, only the 7-bit version can be generated. These mnemonics are:

- ⟨CSI⟩ = ⟨233⟩ (7 bits) or ⟨033⟩⟨133⟩ (7 bits)

- ⟨DCS⟩ = ⟨220⟩ (8 bits) or ⟨033⟩⟨120⟩ (7 bits)

- ⟨EPA⟩ = ⟨227⟩ (8 bits) or ⟨033⟩⟨127⟩ (7 bits)

- ⟨RIS⟩ = ⟨033⟩⟨143⟩ (7 bits only)

- ⟨SPA⟩ = ⟨226⟩ (8 bits) or ⟨033⟩⟨126⟩ (7 bits)

- ⟨SS2⟩ = ⟨216⟩ (8 bits) or ⟨033⟩⟨116⟩ (7 bits)

- ⟨SS3⟩ = ⟨217⟩ (8 bits) or ⟨033⟩⟨117⟩ (7 bits)

- ⟨ST⟩ = ⟨234⟩ (8 bits) or ⟨033⟩⟨134⟩ (7 bits)

There is also a mnemonic for each ANSI command. In the command descriptions which follow, each command name is followed by its mnemonic in parentheses.

ANSI Command Arguments

Arguments are generally octal codes representing ASCII characters. The only exceptions are the arguments for the Set Windows command and for the commands in the D-460 Unique Commands section. These exceptions are explained along with the descriptions of the commands in which they occur.

Octal code arguments always fall in the range ⟨060⟩ through ⟨077⟩. An argument outside this range is treated as a command. If such a command is valid, it is executed. Otherwise, it is ignored. In either case, the original command for which the invalid argument was entered, must be reinitiated.

Common Command Descriptions

> **NOTE:** *Throughout this section, wherever the term "protected" is used, assume that the Erasure Mode is in a reset state **and** the Start Protected Area command has been used to delimit a segment of text. If Erasure Mode is not in the reset state, even areas assigned the protect attribute are not protected.*

BELL (BEL)   (ANSI Mode)
⟨007⟩   CTRL-G
The terminal bell rings once. (ANSI X3.4, 5.2)

CARRIAGE RETURN (CR)   (ANSI Mode)
⟨015⟩   CR or CTRL-M
Moves the cursor to the first character position on the current row (left margin). If one or more characters are protected at the left margin, a Cursor Forward command is issued until the cursor reaches an unprotected character position. If all character positions in the current window are protected, the cursor

moves as if no character positions were protected. (ANSI X3.4, 5.2)

CHANGE ATTRIBUTES (DGCA)   (ANSI Mode)
⟨CSI⟩⟨count⟩⟨073⟩⟨on byte⟩⟨073⟩⟨off byte⟩⟨161⟩   ⟨CSI⟩...;...;...q

Manipulates visual attributes according to the last four bits of ⟨on byte⟩ and ⟨off byte⟩. Starting at the cursor location, the attributes of the number of successive characters specified by the character count argument (⟨count⟩) are turned on, turned off, or toggled (switched from their current setting). The character count applies only to characters within the margins and in the current window (active portion of the display screen). This command affects the blink, dim, underscore, and reverse video attributes. The appearance of protected text can be modified with this command.

The command arguments are:

⟨count⟩ = number of characters having attributes changed. If ⟨count⟩ is greater than the number of characters from cursor to last character in active portion of screen, only those characters from cursor to end of active area are affected

⟨on byte⟩ = attribute ⟨on byte⟩ (turn on attributes in this byte)

⟨off byte⟩ = attribute ⟨off byte⟩ (turn off attributes in this byte)

In both ⟨on byte⟩ and ⟨off byte⟩, the four LSBs of each byte are dedicated to four character attributes:
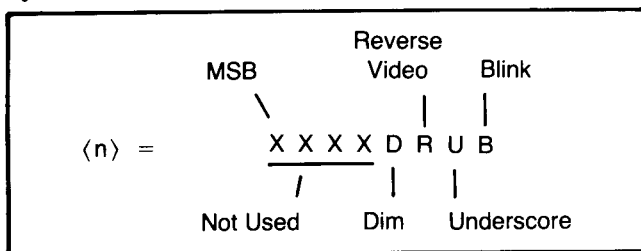
Figure 3-18.   Least Significant Bits

The attribute bits in both the on and the off bytes are evaluated together to determine how the attributes are to be changed. For each attribute, the following action is taken depending on whether the bits are set (1) or reset (0):

	Attribute On Byte	Attribute Off Byte	Attribute Action
For each attribute bit ⟶	0	0	No change
	0	1	Turn off
	1	0	Turn on
	1	1	Toggle

Figure 3-19.   Attribute Changes

Example:
Command ⟨CSI⟩291;5;1q affects 291 characters, starting with the cursor. The attribute ⟨on byte⟩ = ASCII 5; 4 LSBs = 0101. The attribute ⟨off byte⟩ = ASCII 1; 4 LSBs = 0001. As a result, dim and underscore do not change from their settings prior to this command. Reverse video turns on, and blink toggles.

CURSOR BACKWARD (CUB)   (ANSI Mode)
⟨CSI⟩⟨# of columns⟩⟨104⟩   ⟨CSI⟩...D

Moves the cursor one or more column positions to the left on the current row. If the cursor is in the first column position of a row prior to issuing the command, then the cursor moves to the last column position, and a Cursor Up operation is performed.

If the cursor attempts to move into a protected area, the Cursor Backward command repeats until the cursor moves into an unprotected character position. If all character positions in the current window are protected, the cursor moves as if no character positions were protected.

A parameter supplied with the command specifies how many columns to move the cursor; the default value when no parameter is present is one (⟨061⟩). The maximum parameter value is 128.

⟨# of columns⟩ = ⟨061⟩ to ⟨062⟩⟨065⟩⟨065⟩ = 1 to 255 (ASCII)

Example:
The command ⟨CSI⟩4D moves the cursor back 4 columns. (ANSI X3.64, 5.13)

CURSOR DOWN (CUD)   (ANSI Mode)
⟨CSI⟩⟨# of rows⟩⟨102⟩   ⟨CSI⟩... B

Moves the cursor down one or more rows while maintaining the same column position. A parameter supplied with the command specifies how many rows to move the cursor; the default value when a zero or no parameter is present is one (⟨061⟩).

If the cursor attempts to move into a protected area, the Cursor Forward command repeats until the cursor moves into an unprotected character position. If all character positions in the current window are protected, the cursor moves as if no character positions were protected. The maximum parameter value is 128.

⟨# of rows⟩ = ⟨061⟩ to ⟨062⟩⟨065⟩⟨065⟩ = 1 to 255 (ASCII)

Example:
The command ⟨CSI⟩5B moves the cursor down 5 rows. (ANSI X3.64, 5.14)

CURSOR FORWARD (CUF)   (ANSI Mode)
⟨CSI⟩⟨# of columns⟩⟨103⟩   ⟨CSI⟩...C

Moves the cursor one or more column positions to the right on the current row. If the cursor is at the end of the current line prior to issuing the command, a New Line operation is performed. A parameter supplied

with the command specifies how many columns to move the cursor; the default value when no parameter is present is one (⟨061⟩).

If the cursor attempts to move into a protected area, the Cursor Forward command repeats until the cursor moves into an unprotected character position. If all character positions in the current window are protected, the cursor moves as if no character positions were protected. The maximum parameter value is 128.

⟨# of columns⟩ = ⟨061⟩ to ⟨062⟩⟨065⟩⟨065⟩ (1 to 255)

Example:
The command ⟨CSI⟩50C moves the cursor 50 columns to the right. (ANSI X3.64, 5.15)

CURSOR POSITION (CUP)   (ANSI Mode)
⟨CSI⟩⟨y⟩⟨073⟩⟨x⟩⟨110⟩   ⟨CSI⟩...;...H
Moves cursor to the position indicated by the parameter pair. This command operates the same as the Horizontal And Vertical Position command. The first parameter specifies the y position (numbered from the top row, ⟨061⟩ to ⟨062⟩⟨064⟩); the second specifies the x position (numbered from the leftmost column, ⟨061⟩ to ⟨070⟩⟨060⟩). Parameter values greater than the ranges specified cause the cursor to peg. If both parameter values are missing, then both parameter values are assumed to be one, i.e.,the cursor homes.

⟨y⟩ = ⟨061⟩ to ⟨062⟩⟨064⟩ (1 to 24) ⟨x⟩ = ⟨061⟩ to ⟨070⟩⟨060⟩ (1 to 80)

If this command is issued in a way that would put the cursor in a protected position, the cursor jumps past the protected area to the first unprotected position in the general direction the command indicates.

Example:
The command ⟨CSI⟩2;80H moves the cursor to the 2nd row, 80th column.

> **NOTE:** *This command is the same as Horizontal Vertical Position (HVP). (ANSI X3.64, 5.16)*

CURSOR UP (CUU)   (ANSI Mode)
⟨CSI⟩⟨# of rows⟩⟨101⟩   ⟨CSI⟩...A
Moves the cursor up one or more rows while maintaining the same column position. If the cursor is on the top row prior to issuing the command, then the cursor moves to the 24th line of the display. A parameter supplied with the command specifies how many rows to move the cursor; the default value when no parameter is present is one (⟨061⟩).

If the cursor attempts to move into a protected area, the Cursor Backward command repeats until the cursor moves into an unprotected character position. If all character positions in the current window are protected, the cursor moves as if no character positions were protected. The maximum parameter value is 128. (ANSI X3.64, 5.17)

⟨# of rows⟩ = ⟨061⟩ to ⟨062⟩⟨065⟩⟨065⟩ (1 to 255)

Example:
The command ⟨CSI⟩5A moves the cursor up 5 rows. ⟨CSI⟩5A.

DELETE CHARACTER (DCH)   (ANSI Mode)
⟨CSI⟩⟨# of chars⟩⟨120⟩   ⟨CSI⟩...P
Deletes one or more characters at the cursor position; characters not deleted between the cursor and the right margin or row end (see Margins Mode) shift to the left to fill in the blanks created by the deleted characters. Blank characters appear at the right margin or row end.

If the row affected by this command contains a protected area and Erasure Mode is in a reset state, then characters are deleted only up to the first protected text position and the protected characters do not move to fill in the gaps created by deletion (see Erasure Mode).

A parameter supplied with the command indicates how many characters are to be deleted; the default value when no parameter is present is one (⟨061⟩). The maximum parameter value is 128.

⟨# of characters⟩ = ⟨061⟩ to ⟨062⟩⟨065⟩⟨065⟩ (1 to 255)

Example:
If the cursor is located at the beginning of a row in which the first 10 characters are not protected and the 11th character is protected, the command ⟨CSI⟩50P results in only the first 10 characters being deleted and no characters moving to fill the gap. If no characters had been protected, then the next 50 characters would have been deleted and any remaining characters in the row would have moved left to close the gap created by deletion.

DELETE LINE (DL)   (ANSI Mode)
⟨CSI⟩⟨# of rows⟩⟨115⟩   ⟨CSI⟩...M
Deletes the row the cursor is on and one or more rows below that (see Margins mode). Deletes rows only in the current window. Scrolls up rows beneath the deleted rows in the current window and inserts blank rows below them. A parameter supplied with the command specifies how many rows are to be deleted; the default value when no parameter is present is one (⟨061⟩). The maximum parameter value is 128.

⟨# of rows⟩ = ⟨061⟩ to ⟨062⟩⟨065⟩⟨065⟩ (1 to 255)

Example:
The command ⟨CSI⟩10M deletes the row the cursor is on and the nine rows below that. Rows from the 10th row on down move up to replace the deleted rows' positions and 10 blank rows are inserted at the bottom of the window.

> **NOTE:** *This command deletes protected text.*

DEVICE STATUS REPORT (DSR)   (ANSI Mode)
⟨CSI⟩⟨parameter⟩⟨156⟩   ⟨CSI⟩...n
This command queries the terminal according to the
parameter supplied.

A parameter value of ⟨065⟩ causes a ⟨CSI⟩⟨060⟩⟨156⟩ to
be sent to the host. This string is a status report indi-
cating the terminal is ready to continue.

A parameter value of ⟨066⟩ causes the current cursor
position to be sent to the host in the following form:

⟨CSI⟩⟨y⟩⟨073⟩⟨x⟩⟨122⟩

where:

⟨y⟩ = row position, in range ⟨060⟩⟨060⟩ to
⟨062⟩⟨063⟩ (00 to 23)

⟨x⟩ = column position, in range ⟨060⟩⟨060⟩ to
⟨067⟩⟨071⟩ (00 to 79)

(See ANSI X3.64, sections 5.9 and 5.25.)

END PROTECTED AREA (EPA)   (ANSI Mode)
⟨033⟩⟨120⟩   ESC-w
Turns off the character protect attribute for subse-
quent characters. See the Start Protected Area com-
mand description for more information on the protect
attribute.

ERASE IN DISPLAY (ED)   (ANSI Mode)
⟨CSI⟩⟨parameter⟩⟨112⟩   ⟨CSI⟩ ... J
Erases the displayed characters in the window accord-
ing to the parameter. If the Margins Mode is in a set
state, erasure is limited by the left and right margins.
Otherwise, the command ignores the margins and
functions between absolute columns 1 and 162.

Parameter values are:

• ⟨060⟩ — Erases from the cursor to the end of the
window. Cursor position is unaffected. ⟨060⟩ is the
default value when no parameter is supplied with
the command.

• ⟨061⟩ — Erases from the start of the window up to
and including the character in the cursor place.
Cursor position on the screen is unaffected.

• ⟨062⟩ — Erases the entire window. Cancels all vi-
sual attribute commands previously issued. The
cursor is homed.

   NOTE: *Protected text is not erased by this
   command.*

(ANSI X3.64, section 5.29)

ERASE IN LINE (EL)   (ANSI Mode)
⟨CSI⟩⟨parameter⟩⟨113⟩   ⟨CSI⟩ ... K
Erases the displayed characters on the current row
according to the parameters. If the Margins Mode is in

a set state, erasure is limited by the left and right
margins. Otherwise, the command ignores the mar-
gins and functions between absolute columns 1 and
162.

Parameter values are:

• ⟨060⟩ — Beginning with the character in the
cursor's position, erases to end of the row. ⟨060⟩ is
the default value when no parameter is supplied
with the command.

• ⟨061⟩ — Erases from the start of the row up to and
including the character in the cursor's position.

• ⟨062⟩ — Erases the entire row on which the cursor
resides. The cursor returns to the left margin of the
same row.

Protected areas of text are not erased by this com-
mand, but any unprotected text within the range of
the command is erased even if it has protected areas on
either side of it.

Example:
If the cursor is in the 30th column of a row which has
protected text in the first 10 columns, unprotected
text in columns 11 through 15, more protected text in
columns 16 through 20, and unprotected text in col-
umns 21 through 70, the command ⟨CSI⟩2K will erase
everything in columns 11 through 15 and columns 20
through 30. The protected text will remain in the same
screen location, unaffected by the command.

(ANSI X3.64, section 5.31)

FORM FEED (FF)   (ANSI Mode)
⟨014⟩   CTRL-L
Moves cursor to the first character position on the next
row. This control operates the same as the New Line
command. See the description of the that command for
a more complete description. (ANSI X3.4, section 5.2)

**HORIZONTAL AND VERTICAL POSITION
(HVP)**   (ANSI Mode)
⟨CSI⟩⟨row⟩⟨073⟩⟨col⟩⟨146⟩   ⟨CSI⟩...;...f
Moves cursor to the position specified by the param-
eters. Operates the same as the Cursor Position com-
mand. See the description of that command for more
details.

INDEX (IND)   (ANSI Mode)
⟨033⟩⟨104⟩   ESC-D
Moves cursor down one line without changing its hori-
zontal position. If the cursor is located on line 23 (bot-
tom of the screen), a Scroll Up operation occurs: the
cursor moves down one line and its new line assumes
the bottom line position.

This Scroll Up feature is the only difference between
the Index command and the Cursor Down command.
(If the cursor is located on line 23 when a Cursor Down
command is issued, it goes off the bottom of the screen

and reappears on line 0. No Scroll Up occurs.)
See the Cursor Down command for more details.
(ANSI X3.64-1979, section 5.50)

INSERT CHARACTER (ICH)   (ANSI Mode)
⟨CSI⟩⟨# of char⟩⟨100⟩   ⟨CSI⟩...@
Inserts one or more blank characters at the cursor
position. Characters at the cursor and to the right of
the cursor move to the right to make room for the
blanks. Characters which move off the right of the
screen in this way are permanently lost unless the
Margins Mode is in a reset state in which case they can
be located with a Scroll Left command. If the row
affected contains a protected text area and Erasure
Mode is in a reset state, the first protected character
between the right margin and the cursor is treated by
this command like the right margin. However, any
text moved past that first protected character is per-
manently lost regardless of the state of the Margins
Mode. A parameter supplied with the command indi-
cates how many characters are to be inserted; the de-
fault value when no parameter is present is one (⟨061⟩).
The maximum parameter value is 128.

⟨# of Char⟩ = ⟨061⟩ to ⟨062⟩⟨065⟩⟨065⟩ (1 to 255)

Example:
A line contains as unprotected text the word
"unprotected" followed immediately by the word "pro-
tected" composed of protected characters (the string
looks like this: "unprotectedprotected"). With the
cursor on the "u" the command ⟨CSI⟩12@ (which calls
for insertion of 12 blank characters) inserts 11 blanks
beginning with the cursor position. The unprotected
character string is completely lost. The protected
string remains unaffected. The remaining string looks
like this: protected.

INSERT LINE (IL)   (ANSI Mode)
⟨CSI⟩⟨# of rows⟩⟨114⟩   ⟨CSI⟩...L
Inserts one or more rows in the current window start-
ing at the row the cursor is on. Rows at and below the
cursor shift down. Rows located at the bottom of the
window are permanently lost (including those with
protected characters) as they shift off the screen. If
the Margins Mode is in the set state, only characters
within the margins shift down. With Margins Mode
reset, all characters in a row, both inside and outside
the margins, move to make room for blank rows. A
parameter supplied with the command indicates how
many rows are to be inserted. The default value when
no parameter is present is one (⟨061⟩).

⟨# of rows⟩ = ⟨061⟩ to ⟨062⟩⟨065⟩⟨065⟩ (1 to 255)

The maximum parameter value is 128.

MEDIA COPY (MC)   (ANSI Mode)
⟨CSI⟩⟨parameter⟩⟨151⟩   ⟨CSI⟩...i
Causes data to be transmitted to a local printer from
either the host (print pass through) or from the display
screen, depending on the value of the parameter sup-
plied. If the Forms Mode is in a set state, only those

characters at full intensity will be transmitted. If the
Forms Mode is in a reset state, then characters are
transmitted regardless of intensity. If the Guarded
Area Transfer Mode is in a reset state, then only
unprotected characters will be transmitted to a local
device. If the Guarded Area Transfer Mode is in a set
state, then both protected and unprotected text is
transmitted. Table 3-13 summarizes the effects of
these modes on the Media Copy command. Valid pa-
rameter values are:

- ⟨060⟩—Information appearing in the current win-
  dow is printed, starting with the row the cursor is
  currently on. ⟨060⟩ is the default value when no
  parameter is supplied with the command.

- ⟨074⟩⟨060⟩—A bit-image dump of everything in the
  current active window is sent to the graphics slave
  printer. Prints reverse video spaces and under-
  scores as they appear on the screen. The states of
  the Forms Mode and Guarded Area Transfer Mode
  still affect the printing as described above.

- ⟨065⟩—All character traffic from the host is sent to
  the local printer.

- ⟨064⟩—Halts host-printer transmission initiated by
  the ⟨065⟩ parameter.

Table 3-13.   Mode Restrictions on Media Copy Command

	Forms Mode: Set	Forms Mode: Reset
Guarded Area Transfer Mode: Set	Characters Printed: Full intensity Protected Non-protected Not Printed: Dimmed	Characters Printed: All
Guarded Area Transfer Mode: Reset	Characters Printed: Full Intensity Non-protected Not Printed: Dimmed Protected	Characters Printed: Full intensity Dimmed Non-protected Not Printed: Protected

NEW LINE (NL)   (ANSI Mode)
⟨012⟩   NEW LINE key or CTRL-J
Moves the cursor to the first character position on the
next row. If that position is occupied by protected
text, the cursor moves instead to the first unprotected
character position whether it is located on the next
row or several rows down.

If Roll Mode is in the set state and the cursor is located
on the bottom row, it does not move off the bottom of
the screen when the New Line command is issued;
instead, a blank row is inserted at the bottom with the
cursor at its leftmost margin. All other rows on the
screen scroll up one row to make room for this blank
row, and any characters in the top row are lost (even
protected ones) as that row moves off the top of the
screen.

If Roll Mode is in the reset state, however, when New Line is issued with the cursor on the bottom row no scrolling occurs and the cursor reappears in the home position . (ANSI X3.4, section 5.2)

NEXT LINE (NEL) (ANSI Mode)
⟨033⟩⟨105⟩ ESC-E
Moves the cursor to the first position on the next line down. This command works exactly the same as the New Line command. See the New Line command description for more details. (ANSI X3.64-1979, section 5.59)

READ TERMINAL CONFIGURATION (DGRTC)
(ANSI Mode)
⟨CSI⟩⟨170⟩ ⟨CSI⟩x
This command queries for terminal configuration information, such as model ID, keyboard type, etc.

Terminal configuration information is sent back in the following form:

⟨CSI⟩⟨model ID⟩⟨073⟩⟨status⟩⟨073⟩
⟨firmware rev⟩⟨keyboard⟩⟨170⟩

where:

⟨model ID⟩ = ⟨065⟩⟨062⟩

⟨status⟩ = 0 - 15 shipped as two BCD digits
(⟨061⟩⟨065⟩ is 15)

⟨firmware rev⟩ = 0 - 7 ⟨keyboard⟩ = keyboard language in use, shipped as a pair of binary coded digits with the following meanings:

⟨060⟩⟨060⟩	No keyboard
⟨061⟩⟨071⟩	Swiss/French
⟨062⟩⟨060⟩	Swiss/German
⟨062⟩⟨061⟩	Canadian/English
⟨062⟩⟨062⟩	Kata Kana
⟨062⟩⟨064⟩	Canadian/French
⟨062⟩⟨065⟩	United States
⟨062⟩⟨066⟩	United Kingdom
⟨062⟩⟨067⟩	French
⟨062⟩⟨070⟩	German
⟨062⟩⟨071⟩	Swedish/Finnish
⟨063⟩⟨060⟩	Spanish
⟨063⟩⟨061⟩	Danish/Norwegian

Refer to the Host/Terminal Communications section at the beginning of this chapter and to the Set Keyboard Language command description in this section for more information about keyboard languages and how they are selected.

READ OFFSET / SHOW COLUMNS (DGROSC)
(ANSI Mode)
Show columns: ⟨CSI⟩⟨061⟩⟨073⟩ ⟨CSI⟩1;...;...t
⟨left col⟩⟨073⟩⟨right col⟩⟨164⟩

Read offset: ⟨CSI⟩⟨060⟩⟨164⟩ ⟨CSI⟩t or ⟨CSI⟩0t
(the 0 is optional)

Depending upon the parameter(s), either returns to the host the horizontal offset from absolute column one (Read Offset), or scrolls the display left or right to display the columns indicated by the command parameters (Show Columns).

For Read Offset the command format is ⟨CSI⟩⟨164⟩ or ⟨CSI⟩⟨060⟩⟨164⟩. The number of columns from absolute column 1 of the display screen memory to the leftmost column of the current window on the display screen is returned to the host computer in the following form:

⟨CSI⟩⟨column offset⟩⟨164⟩

where:

⟨column offset⟩ = ⟨061⟩ to ⟨070⟩⟨062⟩ (1 to 82)

NOTE: *Nothing changes on the display screen when the Read Offset version of the command is issued. This command is for sending information to the host computer.*

For the Show Columns version, the command has the following format:

⟨CSI⟩⟨061⟩⟨left column⟩⟨073⟩⟨right column⟩⟨164⟩

where:

⟨left column⟩ = ⟨060⟩ to ⟨061⟩⟨066⟩⟨061⟩ (1 to 161)

⟨right column⟩ = ⟨060⟩ to ⟨061⟩⟨066⟩⟨061⟩ (1 to 161)

If the margins are set at the default 1-left and 80-right, nothing happens when the Show Columns version of the command is issued. Before the command is issued, the margins must have been changed by the Set Margins command so that the entire active window cannot appear on the screen (with non-compressed spacing).

Example:
If the margins have been set at 0-left and 90-right and the current window shows columns 0 to 79, the command ⟨CSI⟩1;9;89t causes the display screen to scroll right 10 columns to show columns 9 through 89.

RESET MODE (RM) (ANSI Mode)
⟨CSI⟩⟨mode⟩⟨073⟩⟨mode⟩⟨073⟩... ⟨CSI⟩...;...;...l
⟨mode⟩⟨154⟩
Resets one or more terminal modes of operation according to the parameters supplied. The modes along with their effect in the reset state and their corresponding parameter values are as follows:

• ⟨061⟩ — Guarded Area Transfer Mode
Only unprotected characters are transmitted to the printer. See the Media Copy command description.

• ⟨066⟩ — Erasure Mode
Erase functions do not affect protected characters. See Delete Character, Insert Character, Erase In

Display, and Erase In Line command descriptions. Also see the Delete Line command for an *exception*.

- ⟨074⟩⟨060⟩ — Roll Mode
  The screen rolls up when a command would otherwise send the cursor off the bottom of the screen. See the New Line command and all 5 cursor positioning commands. This mode does not affect the Scroll Up and Scroll Down commands.

- ⟨074⟩⟨061⟩ — Blink Mode
  Characters with the blink attribute blink. See the Select Graphic Rendition command description.

- ⟨074⟩⟨062⟩ — Horizontal Scroll Mode
  Horizontal Scroll is enabled. See the Scroll Left and Scroll Right command descriptions.

- ⟨074⟩⟨063⟩ — DG-ANSI Mode
  The reset state places the terminal in the Data General command syntax mode in which none of the commands in this ANSI commands section are functional.

- ⟨074⟩⟨064⟩ — Forms Mode
  The Media Copy command causes the local printer to print characters without regard to their visual attributes.

- ⟨074⟩⟨065⟩ — Margins Mode
  Editing operates across margins. See the Set Margins, Read Offset/Show Columns, Erase In Display, Erase In Line, Insert Character, Delete Character, Insert Line, and Delete Line command descriptions.

RESET TO INITIAL STATE (RIS)   (ANSI Mode)
⟨033⟩⟨143⟩   ESC-c
Resets the terminal to its initial state. The reset conditions are listed in Table 3-14.

Table 3-14. Terminal Reset Conditions

- Display screen cleared
- Cursor moved to upper-left corner of screen
- Cursor displayed as reverse video block
- Single window (24 rows) with margins at columns 0 and 79
- Primary character set: keyboard nationality (7-bit mode) U.S. ASCII (8-bit mode)
- Normal character spacing selected
- Screen roll and horizontal scrolling enabled
- Character blinking enabled
- Character protection disabled
- Blink, dim, underscore, and reverse video turned off
- Line drawing color set to solid (D460 only)
- User defined characters deleted (D460 only)

REVERSE INDEX (RI)   (ANSI Mode)
⟨033⟩⟨115⟩   ESC-M
Moves cursor up one line without changing its horizontal position. If the cursor is located on line 0 (top of the screen), a Scroll Down operation occurs: the cursor moves up one line and its new line assumes the top line position.

This Scroll Down feature is the only difference between the Reverse Index command and the Cursor Up command. (If the cursor is located on line 0 when the Cursor Up command is issued, it goes off the top of the screen and reappears on line 23. No Scroll Down occurs.) See the Cursor Up command description for more details. (ANSI X3.64-1979, section 5.71)

SCREEN POSITION (DGSP)   (ANSI Mode)
⟨CSI⟩⟨row⟩⟨073⟩⟨col⟩⟨165⟩   ⟨CSI⟩...;...u
Positions the cursor on the display screen according to the parameter values. Thus the cursor can be moved from one window to another within the set margins. If the command places it to the left or right of the currently visible window, the screen scrolls the minimum number of columns left or right to bring the cursor into view. If the command would place the cursor outside the current margins, however, the cursor moves in the direction indicated by the command but stops at the margin.

If a command would place the cursor inside a protected area, the Cursor Right command repeats until the cursor reaches an unprotected area.

⟨row⟩ = ⟨061⟩ to ⟨062⟩⟨064⟩ (1 to 24)
⟨col⟩ = ⟨061⟩ to ⟨061⟩⟨066⟩⟨062⟩ (1 to 162)

⟨row⟩ is numbered from the top row; ⟨col⟩ from the leftmost column.

If both parameters are missing, the cursor moves to the screen home position.

Example:
In Figure 3-20 the command ⟨CSI⟩16;30u moves the cursor from the uppermost of three windows to the home position of the bottom window (row 16, column 30).
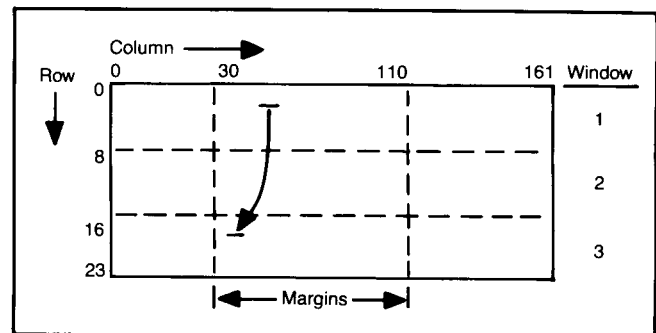

Figure 3-20. Screen Position Command Example

SCROLL DOWN (SD)   (ANSI Mode)
⟨CSI⟩⟨# of rows⟩⟨124⟩   ⟨CSI⟩...T
Allows a reverse scroll of text. All rows of text within the current window are scrolled so they appear to move down the number of rows specified by the parameter. As rows go off the bottom of the window, any characters they contain are permanently lost, including protected characters. The cursor remains fixed in

its location on the screen. This command is not affected by the state of the Roll Mode.

⟨# of rows⟩ = ⟨061⟩ to ⟨062⟩⟨065⟩⟨065⟩ (1 to 255)

The default value when no parameter is present is one (⟨061⟩). The maximum parameter value is 128.

SCROLL LEFT (SL)   (ANSI Mode)
⟨CSI⟩⟨# of col⟩⟨040⟩⟨100⟩   ⟨CSI⟩...(space)@
Causes horizontal movement of text to the left within the current window for a specified number of character positions. If the Horizontal Scroll Mode is in the set state, this command becomes non-functional; if Horizontal Scroll Mode is in the reset state, then horizontal scrolling becomes possible using this command. The cursor location remains the same, even if the cursor is no longer visible on the screen.

Scrolling can take place until column 161 is reached. If the command parameter exceeds the number of columns available between the current rightmost column on the screen and absolute column 161, scrolling occurs until column 161 becomes the rightmost display column and then stops.

⟨# of col⟩ =
⟨061⟩ to ⟨068⟩⟨061⟩
(1 to 81) for normal spacing

⟨# of col⟩ =
⟨061⟩ to ⟨062⟩⟨021⟩
(1 to 21) compressed spacing
The default value when no parameter is present is one (⟨061⟩). The maximum parameter value is 128.

Example:
Assume the word "left" is visible on the far left margin. After the command ⟨CSI⟩2⟨040⟩@, only "ft" remains visible. A Scroll Right command brings the full word back in view.

SCROLL RIGHT (SR)   (ANSI Mode)
⟨CSI⟩⟨# of col⟩⟨040⟩⟨101⟩   ⟨CSI⟩...(space)A
Causes horizontal movement of text to the right within the current window for the specified number of character positions. If the Horizontal Scroll Mode is in a set state, then this command becomes non-functional; if Horizontal Scroll Mode is in a reset state, then horizontal scrolling is possible using this command. The cursor location remains the same even if the cursor becomes no longer visible on the screen.

Scrolling right can take place until absolute column 0 is reached. If the command parameter exceeds the number of columns available between the leftmost column visible on the screen and absolute column 0, scrolling occurs until absolute column 0 is the leftmost column and then stops.

⟨# of col⟩ = ⟨061⟩ to ⟨068⟩⟨061⟩ (1 to 81) for normal spacing

⟨# of col⟩ = ⟨061⟩ to ⟨062⟩⟨021⟩ (1 to 21) compressed spacing

The default value when no parameter is present is one (⟨061⟩). The maximum parameter value is 128.

Example:
In the example given above with the Scroll Left command description, the command ⟨CSI⟩2⟨040⟩A could be used to return the text to its original position with left fully visible.

SCROLL UP (SU)   (ANSI Mode)
⟨CSI⟩⟨# of rows⟩⟨123⟩   ⟨CSI⟩...S
Scrolls all rows of text within the current window so they appear to move up the number of rows specified by the parameter. As rows go off the top of the window, any characters they contain are permanently lost, including protected characters. The cursor remains fixed in its location on the screen. This command is not affected by the state of the Roll Mode.

⟨# of rows⟩ = ⟨061⟩ to ⟨062⟩⟨065⟩⟨065⟩ (1 to 255)

The default value when no parameter is present is one (⟨061⟩). The maximum parameter value is 128.

SELECT CHARACTER SET   (ANSI Mode)
⟨033⟩⟨designation⟩⟨set⟩   BREAK ESC...
In ANSI mode, the D410/460 terminal has four designated graphics character sets: the G0, G1, G2, and G3 sets (see ANSI document X3.41). The Shift In, Shift Out, Single Shift Two, and Single Shift Three command descriptions further on in this section describe how to make each of these sets active (for display on the screen). The Host/Terminal Communications section at the beginning of this chapter contains a general discussion of character set selection with the D410/460 terminal.

Characters are designated as G0, G1, G2, or G3 sets by use of the following control sequences:

⟨033⟩⟨050⟩⟨set⟩ — Selects a character set to be the current G0 set

⟨033⟩⟨051⟩⟨set⟩ — Selects a character set to be the current G1 set

⟨033⟩⟨052⟩⟨set⟩ — Selects a character set to be the current G2 set

⟨033⟩⟨053⟩⟨set⟩ — Selects a character set to be the current G3 set

where ⟨set⟩ is:

⟨102⟩ — U.S. ASCII

⟨101⟩ — United Kingdom

⟨110⟩ — Swedish/Finnish

⟨111⟩ — Kata Kana G1

⟨112⟩ — Kata Kana G0

⟨113⟩ — German

⟨122⟩ — French

⟨060⟩ — Terminal keyboard language

⟨061⟩ — Spanish

⟨062⟩ — Danish/Norwegian

⟨063⟩ — Swiss

⟨064⟩ — DG International

⟨065⟩ — Word processing/math/Greek

⟨066⟩ — Line drawing

⟨040⟩⟨060⟩ thru ⟨040⟩⟨077⟩ — DLL sets 1 thru 16

⟨041⟩⟨060⟩ thru ⟨041⟩⟨077⟩ — DLL sets 17 thru 32

⟨042⟩⟨060⟩ thru ⟨042⟩⟨065⟩ — DLL sets 33 thru 38

Example:
To select the German character set to be the G1 set, issue the command ⟨033⟩)K. To make this set the DL set (see the Host/Terminal Communications section for a discussion of the DL set) which is displayable on the screen by depressing the main keypad keys, issue the Shift Out command, CTRL-N. Now, if the] key on the U.S. keyboard is depressed, the German "u umlaut" appears on the display screen. Note that the display screen result of depressing the SPCL key sequences is now changed, since the keyboard is sending out code expecting to find the DG International character set in the G1 set. Depressing the SPCL key, then the "a" key, then the "umlaut" key results in the "c" character appearing instead of the "a umlaut". The keyboard is sending the ⟨343⟩ code (in 8-bit mode) which corresponds to the DG International character "a umlaut", but the display unit is set to interpret this code as the German "c", ⟨143⟩.

SELECT GRAPHIC RENDITION (SGR)

(ANSI Mode)
⟨CSI⟩⟨parameter⟩⟨073⟩⟨parameter⟩ ⟨CSI⟩...;...m
⟨073⟩...⟨parameter⟩⟨155⟩
Turns on up to four visual attributes for succeeding characters in the data stream as specified by parameter values. Visual attributes not specified in the parameter string supplied with the command are turned off. If no parameters are supplied with the command, then all four attributes for subsequent characters are turned off. Valid parameter values are:

⟨parameter⟩ = ⟨060⟩ — Turns off all visual attributes.

⟨parameter⟩ = ⟨062⟩ — Turns dim on.

⟨parameter⟩ = ⟨064⟩ — Turns underscore on.

⟨parameter⟩ = ⟨065⟩ — Turns blink on.

⟨parameter⟩ = ⟨067⟩ — Turns reverse video on.

Note that the Blink Mode must be in a reset state for the characters which have been given this attribute to actually blink. Changing the state of Blink Mode does not change the blink attribute of characters; it just determines whether this attribute will manifest on the screen or not.

See also the Change Attributes and the Reset To Initial State command descriptions.

SET MARGINS (DGMARG)   (ANSI Mode)

Set main margins:
⟨CSI⟩⟨061⟩⟨073⟩⟨left margin⟩⟨073⟩   ⟨CSI⟩1;...;...w
⟨right margin⟩⟨167⟩

Set alternate margins:
⟨CSI⟩⟨062⟩⟨073⟩⟨row⟩⟨073⟩   ⟨CSI⟩2;...;...;...w
⟨left margin⟩⟨073⟩⟨right margin⟩⟨167⟩

Return to main margins:
⟨CSI⟩⟨167⟩ or ⟨CSI⟩⟨060⟩⟨167⟩   ⟨CSI⟩w or ⟨CSI⟩0w
The first version of this command sets the main margins. The left and right margins for all windows on the display screen are set to the absolute column numbers specified in the command arguments. The margins define the horizontal limits on cursor movement. The cursor cannot be positioned outside the margins. When the terminal is powered up or reset, the main margins are set to absolute columns 0 and 79. When the Set Margins command sets new main margins, the display screen scrolls horizontally as required to display both the right and left margins (if horizontal scrolling is enabled). If both margins do not fit on the display screen, the new left margin is positioned to the leftmost column on the screen. The cursor moves to the new left margin, but does not change rows. The command arguments are as follows:

⟨CSI⟩⟨061⟩⟨073⟩⟨left margin⟩⟨073⟩⟨right margin⟩⟨167⟩

where:

⟨left margin⟩ = ⟨060⟩ to ⟨061⟩⟨066⟩⟨061⟩ (1 to 161)

⟨right margin⟩ = ⟨060⟩ to ⟨061⟩⟨066⟩⟨061⟩ (1 to 161)

The margin parameter values are relative to the absolute left column value of 0.

The left margin column number must be less than or equal to the right margin column number, and both

margin arguments must be in the range shown, or the command is ignored.

Example:
The command ⟨CSI⟩1;10;90w establishes new left and right margins at absolute columns 10 and 90, respectively. Both margins are displayed on the screen and the cursor is positioned at the left margin on the same row as before the command.

A second version of the command sets temporary alternate margins while saving the main margins. The first command argument, ⟨row⟩, specifies the destination row in the current window for the cursor. When the command is issued, the cursor moves to the new left margin at the specified row and horizontal scrolling is automatically disabled (horizontal scrolling can be enabled with alternate margins in effect by using the Reset Mode command). This second version of the command looks like this:

⟨CSI⟩2;⟨row⟩;⟨left margin⟩;⟨right margin⟩w

where:

⟨row⟩ = ⟨060⟩ to ⟨062⟩⟨063⟩ (0 to 23)

⟨left margin⟩ and ⟨right margin⟩ have the same parameter limits as with the first version, but now the values are relative to the left margin as set by the last Set Margins command issued unless that command also set temporary alternate margins. In other words, they are relative to the main margins rather than to any other alternate margins; if this version is issued before any other Set Margins command, the default margins of 0 and 161 are the main margins. More sets of alternate margins can be specified by using this second version of the Set Margins command repeatedly. In that case, each new set of alternate margins remains relative to the old main margins in effect before the first Set Alternate Margins command was issued.

If the cursor row argument exceeds the number of rows in the current window, the cursor moves to the bottom row in the window. Here are some more points to keep in mind:

• The left margin argument must be less than or equal to the right margin argument or the command is ignored.

• If the new left margin absolute column number is equal to or greater than the old right margin absolute column number, the new left and right margins are set equal to the old right margin.

• If the new right margin absolute column number is greater than the old right margin absolute column number, the old right margin remains in effect.

Example:
Assume the current margins are set at absolute columns 20 and 80. The command ⟨CSI⟩2;0;20;50w then

assigns alternate margins to absolute columns 40 and 70 and moves the cursor to the left margin of row 0 in the current window. The left margin of 40 is calculated by adding the parameter value of 20 to the old left margin of 20 (20 + 20 = 40). Likewise, the right margin of 70 comes from adding the parameter value of 50 to the old left value of 20 (50 + 20 = 70).

Finally, to return from alternate margins back to the main margins, issue the following version of the command:

⟨CSI⟩⟨060⟩⟨167⟩

The original margins that were replaced by any alternate margins the command may have established are restored to the terminal. This also restores the reset state of the Horizontal Scroll Mode if it was in effect before alternate margins were established. This command does not change the cursor location. The screen scrolls horizontally, if necessary, to bring the cursor into view (unless the Horizontal Scroll Mode was placed in the set state following the most recent Set Margins command).

SET MODE (SM)   (ANSI Mode)
⟨CSI⟩⟨mode⟩⟨073⟩...⟨mode⟩⟨150⟩   ⟨CSI⟩...;...h
Sets one or more terminal modes of operation according to the parameters supplied. The modes (whose states can be altered) and their corresponding parameter values are:

⟨061⟩ — Guarded Area Transfer Mode
The Media Copy command transmits all text, including protected characters, to the printer. See the Media Copy command description.

⟨066⟩ — Erasure Mode
Erase functions *do* affect protected characters. See the Start Protected Area, Delete Character, Insert Character, Erase In Display, and Erase In Line command descriptions.

⟨074⟩⟨060⟩ — Roll Mode
When a command sends the cursor off the bottom of the screen, it reappears in the same column on the top row of the active window. See the New Line command and all 5 cursor positioning commands. This mode does not affect the Scroll Up and Scroll Down commands.

⟨074⟩⟨061⟩ — Blink Mode
Characters with the blink attribute do not blink. See the Select Graphic Rendition command description.

⟨074⟩⟨062⟩ — Horizontal Scroll Mode
Horizontal Scroll is *not* enabled. See the Scroll Left and Scroll Right command descriptions.

⟨074⟩⟨063⟩ — DG-ANSI Mode
> The set state places the terminal in the ANSI command syntax mode in which the commands in this ANSI commands section are functional.

⟨074⟩⟨064⟩ — Forms Mode
> The Media Copy command causes the local printer to print only those characters which are at full intensity. Dimmed characters are not printed.

⟨074⟩⟨065⟩ — Margins Mode
> Editing operates across margins. See the Set Margins, Read Offset/Show Columns, Erase In Display, Erase In Line, Insert Character, Delete Character, Insert Line, and Delete Line command descriptions.

SET PARAMETERS (DGSP)　　　　(ANSI Mode)
⟨CSI⟩⟨parameter⟩⟨073⟩⟨value⟩　　⟨CSI⟩...;...;...;...v
⟨073⟩...⟨parameter⟩⟨073⟩⟨value⟩
⟨166⟩
Cursor type, scroll rate, character spacing, and keyboard language can be set with this command.

⟨parameter⟩ denotes which parameter is to be set (one or more parameters may be set with a single command); ⟨value⟩ specifies what value the parameter is to be set to:

⟨parameter⟩

= ⟨060⟩ — select default values for cursor type, scroll rate, character spacing, and keyboard language; ⟨060⟩ is the default value when no parameter is supplied with the command

= ⟨061⟩ — Keyboard language (default is U.S./DG International)

= ⟨062⟩ — 7/8-bit operation (default to switch setting)

= ⟨063⟩ — Cursor type (default is reverse video block)

= ⟨064⟩ — Scroll rate (default is jump scroll)

= ⟨065⟩ — Character spacing (default is 80 chars/line)

For keyboard language, ⟨value⟩

= ⟨060⟩ — Keyboard nationality character set in use

= ⟨061⟩ — U.S. ASCII/DG International character set in use (default)

For 7/8-bit operation, ⟨value⟩

= ⟨060⟩ — 7-bit operation

= ⟨061⟩ — 8-bit operation

For cursor type, ⟨value⟩

= ⟨060⟩ — Cursor not displayed

= ⟨061⟩ — Cursor displayed as blinking underscore

= ⟨062⟩ — Cursor displayed as reverse video block

= ⟨063⟩ — Cursor displayed as blinking reverse video block

For scroll rate, ⟨value⟩

= ⟨060⟩ — "Jumpy" single-row incremental scrolling

= ⟨061⟩ — Smooth scrolling at 5 rows/second

= ⟨062⟩ — Smooth scrolling at 10 rows/second

For character spacing, ⟨value⟩

= ⟨060⟩ — Regular spacing: 80 chars/row

= ⟨061⟩ — Compressed spacing: 135 chars/row

Example:
The command ⟨CSI⟩2;0;3;1;5;1v sets the terminal to 7-bit operation mode, makes the cursor a blinking underscore, and switches to compressed spacing.

SET WINDOWS, top window row count, spacing type,...bottom window row count, spacing type (DGSW)　　　　(ANSI Mode)
⟨033⟩⟨120⟩⟨104⟩⟨nn⟩⟨n⟩...⟨nn⟩⟨n⟩　　⟨DCS⟩D...⟨ST⟩
⟨033⟩⟨134⟩
Divides the display screen into 1 to 24 miniature display screens called windows. A window consists of from 1 to 24 consecutive rows and spans the entire 162 columns of display screen memory. Each window can be scrolled horizontally and vertically, erased, printed, etc., independently from all other windows. The command arguments specify the number of rows and the type of character spacing (normal or compressed) associated with each window, beginning with the top window and continuing down the screen to the bottom window. This command does not affect the margins. When the command is completed, the cursor moves to the home position of the top window and horizontal scrolling is enabled.

The command arguments consist of one or more ⟨nn⟩⟨n⟩ pairs, each of which defines the row count and spacing type for one window as follows:

⟨nn⟩ = 00 to 17, the number of consecutive rows in the window in the range of 0 to 23 (decimal)

⟨n⟩ = 0, for normal (81 columns) character spacing

= 1, for compressed (135 columns) character spacing

The first ⟨nn⟩⟨n⟩ pair in the command applies to the top window on the display screen, the second ⟨nn⟩⟨n⟩ pair applies to the window just below the top window, and so on. The Set Windows command is complete when the row count assigned to one or more windows totals 24 or more. If an attempt is made to allocate more than 24 rows, the bottom window on the screen will end up with the number of rows not assigned to the windows above the bottom. For example, a Set Windows command that attempts to create three windows with row counts of 10, 10, and 8 will end up with a bottom window of 4 rows (and not the 8 specified). A command that specifies a single window of 30 rows will create a single window of 24 rows.

The ⟨nn⟩ = 00 row count argument is a special case. The 00 row count can be used to create a bottom window out of all rows not used by prevous ⟨nn⟩⟨n⟩ pairs in the command. If the the first ⟨nn⟩⟨n⟩ pair in the command has a row count of 00, a single window fills the complete display screen.

Windows can be horizontally scrolled independently from one another. As a result, the margins for different windows may not be vertically aligned. When the terminal recognizes the ⟨DCS⟩D character sequence as a lead-in to the Set Windows command, all existing windows are aligned at their left margins with normal character spacing in effect. New windows are then defined with no loss of characters. An old window can be broken down into several new windows or old adjoining windows can be combined.

Example:
The following versions of the Set Windows command all divide the display screen into two windows of 12 rows each with normal character spacing in the top window and compressed spacing in the bottom window as shown in Figure 3-21. For the purpose of the figure, the margins have been set to columns 0 and 161.

Command	Comments — 2nd Window Row Count Equals
⟨DCS⟩D0<0001⟨ST⟩	00 (0 decimal)
⟨036⟩D0<00<1⟨ST⟩	0< (12)
⟨036⟩D0<0101⟨ST⟩	10 (16)
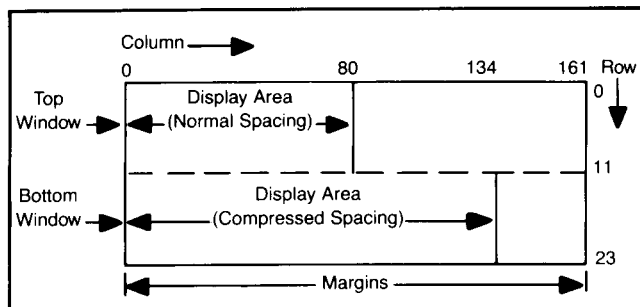
Figure 3-21. Set Windows Command Example

For a further discussion of how to derive ⟨nn⟩ and ⟨n⟩ arguments, see Section 3.7, Command Descriptions.

START PROTECTED AREA (SPA) (ANSI Mode)
⟨033⟩⟨126⟩   ESC-V
Turns on the protect attribute for subsequent characters. Protected characters cannot be addressed by the five cursor position commands, and most of the erase and delete commands do not affect them. Note, however, that the Delete Line command does delete protected text, and scrolling lines of protected text off the top or bottom of the screen with the Scroll Up/Down and New Line commands will result in that text being lost.

This command functions regardless of the state of the Erasure Mode; however, areas assigned the protect attribute by this command are only protected while the Erasure Mode is in the reset state. See the Set Mode and Reset Mode command descriptions for details on controling the state of the Erasure Mode.

Example:
With the Erasure Mode in the set state, issue the command ESC-V followed by the character string "protected". Locate the cursor on the "p" and issue a Delete Character command. This causes the string to become "rotected" with the cursor on the "r". Put the Erasure Mode in the reset state. The cursor jumps to the first column past the "d", and any attempts to locate the cursor on any of the characters in the string fail.

SHIFT IN (SI)   (ANSI Mode)
⟨017⟩   CTRL-O
Invokes the designated G0 character set into the GL character set (displayable characters in the range ⟨041⟩ to ⟨176⟩). See the Select Character Set command for a description of how to designate a character set to be G0 and the Host/Terminal Communications section at the beginning of this chapter for a discussion of the GL character set. Once the Shift In command has been issued, any G0 character corresponding to an octal code received by the display unit will be chosen for display. Appendix A lists the octal codes corresponding to the characters in the various character sets.

Example:
Designate the French character set as G0 and issue the CTRL-O command. Depress the [key (on a U.S. keyboard) sending the ⟨133⟩ to the display unit. Since the ⟨133⟩ corresponds to the degree symbol in the French character set, that symbol is displayed rather than the [. If the U.S. character set is now designated G0, depressing the same key displays the [.

SHIFT OUT (SO)   (ANSI Mode)
⟨016⟩   CTRL-N
Invokes the designated G1 character set into the GL character set (displayable characters in the range ⟨041⟩ to ⟨176⟩). See the Select Character Set command for a description of how to designate a character set to be G1 and the Host/Terminal Communications section at

the beginning of this chapter for a discussion of the GL character set. Once the Shift Out command has been issued, any G1 character corresponding to an octal code received by the display unit will be chosen for display. Appendix A lists the octal codes corresponding to the characters in the various character sets.

Note that in an 8-bit mode, the DR character set (displayable characters in the range ⟨241⟩ to ⟨376⟩) is, by default, the G1 set. The function of the Shift Out control remains the same as in 7-bit mode, however, in order to maintain compatibility with 7-bit operation systems.

Example:
Designate the Swiss character set as G1 and issue the CTRL-N command. Depress the [key (on a U.S. keyboard) sending the ⟨133⟩ to the display unit. Since the ⟨133⟩ corresponds to the e umlaut character in the Swiss character set, that symbol is displayed rather than the [. If the U.S. character set is now designated G1, depressing the same key displays the [.

SINGLE SHIFT TWO (SS2)   (ANSI Mode)
⟨033⟩⟨116⟩   ESC-N
This command is a nonlocking shift character that changes the selection of the next character. ⟨SS2⟩ can be interpreted to mean: take the next character following this command from the G2 set. In other words, the command selects the G2 character set to be the GL set for the duration of the single character following the ⟨SS2⟩ command. After the G2 character is displayed, the active G0 or G1 character set as determined by the Shift In and Shift Out commands again becomes the GL set.

Example:
If the U.S set is the current GL set, depressing the s key causes an s to be displayed (on a U.S. keyboard). Since the default G2 character set is the word processing set, issuing the ⟨SS2⟩ command just before depressing the s key twice causes the subscript 3 symbol to be displayed followed by s. The code ⟨163⟩ which is associated with the s in the U.S. ASCII set, is associated with the subcript 3 in word processing.

SINGLE SHIFT THREE (SS3)   (ANSI Mode)
⟨033⟩⟨117⟩   ESC-O
This command is a nonlocking shift character that changes the selection of the next character. ⟨SS3⟩ can be interpreted to mean: take the next character following this command from the G3 set. In other words, the command selects the G3 character set to be the GL set for the duration of the single character following the ⟨SS3⟩ command. After the G3 character is displayed, the active G0 or G1 character set as determined by the Shift In and Shift Out commands again becomes the GL set.

Example:
If the current GL set is the U.S. set, depressing the 1 key causes a 1 to be displayed (on a U.S. keyboard).

Since the default G3 character set is the line drawing set, issuing the ⟨SS3⟩ command just before depressing the 1 key twice causes an inverted "L" shape line drawing symbol to be displayed followed by 1. The code ⟨061⟩ which is associated with the 1 in the U.S. ASCII set, is associated with an inverted "L" in line drawing.

XOFF (DC3)   (ANSI Mode)
⟨023⟩   CTRL-S
Sent from the host computer, this command signals the terminal that host buffer overflow is imminent; the terminal is to stop transmitting characters until further notified. It may be sent at any time in any position in a character stream, even if the terminal has posted an Xon command. The reverse protocol also applies, that is, the terminal may also send this character when its buffer is about to overflow. See the Xon command description.

Note that the terminal does *not* honor the XON/XOFF protocol for terminal output when operating in DG mode.

XON (DC1)   (ANSI Mode)
⟨021⟩   CTRL-Q
When buffer overflow is no longer imminent, this command alerts the terminal/host that it may resume character transmission. See the Xoff command description.

Note that the terminal does *not* honor the XON/XOFF protocol for terminal output when operating in DG mode.

D460-Unique Commands in ANSI Mode

The remainder of this chapter describes the custom character and character graphics commands. These D460-unique commands make use of the terminal's ability to accept and display characters of any imaginable dot pattern. From the hardware viewpoint, these commands are made possible by the down-line loadable (DLL) printed circuit board. The DLL pcb provides the D460 terminal with the capability to maintain up to 3572 custom characters in RAM at any one time. Each bit of RAM corresponds to a single dot of one character.

User-Defined Custom Characters

The DLL pcb option included with the D460 terminal makes it possible to increase the terminal character set count by an additional 38 user-defined, or custom, character sets. These sets are also referred to as the soft or DLL character sets. The total available custom character count of 3572 is divided into 38 sets of 94 characters as shown in Table 3-15.

NOTE: *The user-defined character sets can be displayed on the screen with normal spacing only. Custom characters will appear distorted if they are displayed with compressed spacing.*

Since all custom characters are maintained in RAM, their definition is lost each time power to the terminal is switched off and on or a hard reset (CMD-ERASE PAGE on keyboard) is performed. If custom characters are to be used following either of these two events, they must be re-defined. It is recommended that custom character definitions be saved on the host system in a convenient location so they can be transferred to the D460 terminal as needed.

Table 3-15. Composite List of Character Sets

Set No.	Set Contents
⟨060⟩	Keyboard language
⟨102⟩	U.S.
⟨101⟩	United Kingdom
⟨122⟩	French
⟨113⟩	German
⟨110⟩	Swedish/Finnish
⟨061⟩	Spanish
⟨062⟩	Danish/Norwegian
⟨063⟩	Swiss
⟨112⟩	Kata Kana G0
⟨064⟩	DG International
⟨111⟩	Kata Kana G1
⟨065⟩	Word processing, math, super-/subscript, etc.
⟨066⟩	Line drawing
User Defined Sets:	
⟨040⟩⟨060⟩ thru ⟨040⟩⟨077⟩	DLL set 1 thru DLL set 16
⟨041⟩⟨060⟩ thru ⟨041⟩⟨077⟩	DLL set 17 thru DLL set 32
⟨042⟩⟨060⟩ thru ⟨042⟩⟨065⟩	DLL set 33 thru DLL set 38

The first step in defining one or more custom characters is to select a user-defined character set number from Table 3-15. The character set number picked will identify the character set used to contain the first group of custom characters.

The argument numbers in Table 3-15 represent the ASCII character pairs used by the Select Character Set command. When custom characters are being defined, this command is used to select the character set destined to hold the new custom characters. Only the G0 and G1 sets can be used for defining characters. To assign a user-defined character set to G2 or G3, first define the set as a G0 or G1 set, then use the Select Character Set command to choose that same set to be the G2 or G3 set. Then, of course, the G0 or G1 set could be assigned another character set, such as U.S. or DG International, and the user-defined set would remain as the G2 or G3 set.

The procedure for creating custom characters, therefore, is as follows:

1. Use the Select Character Set command to pick a destination character set in the range of 20 to 45 (⟨033⟩⟨!4 selects DLL set 20 (⟨041⟩⟨064⟩) to be the G0 character set).

2. Use the Define Character command to create dot patterns for up to 94 characters to be assigned to the character set picked in step 1.

3. Repeat steps 1 and 2 as needed until all custom characters have been defined and assigned to a character set.

When defining new characters in this manner, make a point to conserve as many unused character sets as possible. In addition, begin with the low-numbered character sets and use consecutive sets. If this practice is followed, a maximum number of character sets will be available for graphics operations.

> **NOTE:** *Make sure the character set(s) selected to hold user-defined characters have not been reserved for use by the character graphics commands. If this policy is not followed, it is likely user-definitions and definitions from the graphics drawing algorithms will be assigned to the same characters and cause unwanted results.*

Before getting to the details of the Define Character command, it is important to understand the dot pattern organization of a character cell displayed with normal spacing. Every character cell on the display screen, when normal character spacing is in effect, consists of 12 scan rows in the vertical direction with 10 dots per scan row in the horizontal direction. Figure 3-22 shows how the capital letter A is formed within this matrix of dots for the D410/460 terminal.
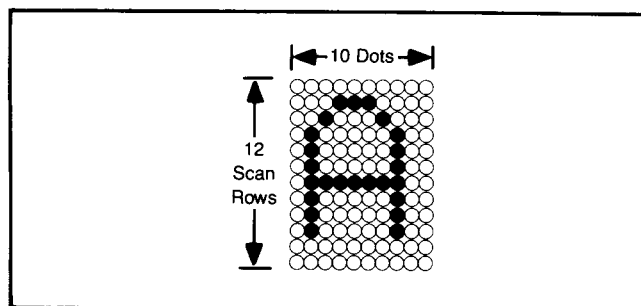
Figure 3-22. Character Dot Matrix for Normal Spacing

The Define Character command encodes the dot pattern representing one character into the arguments of the command. The command must be repeated for each character defined. Notice that the outer scan rows and dot columns for the A in the figure have no dots filled in. Vertical and horizontal spacing between adjacent characters on the screen is maintained in this manner. Details of the Define Character command follow.

DEFINE CHARACTER, character,   (ANSI Mode)
dot pattern
⟨DCS⟩⟨101⟩⟨char⟩⟨dd⟩...⟨dd⟩⟨ST⟩   ⟨DCS⟩A...⟨ST⟩
The appearance of character ⟨char⟩ in the user-defined
character set most recently picked with the Select
Character Set command is specified by the 12 pairs of
dot pattern arguments ⟨dd⟩...⟨dd⟩. The character defi-
nition may be for a new character or used to replace an
existing one. As this command is executed, the dot
pattern for the character being defined is written to
the DLL RAM. If the previous definition for this char-
acter is displayed on the screen, the new definition
shows up immediately, causing the screen image to
change. This occurs because the DLL character defini-
tion is accessed continually to support screen refresh.
The command arguments are defined as follows:

⟨char⟩ = ⟨040⟩ to ⟨176⟩, the ASCII character
code for the character being defined
(see Appendix B).

⟨dd⟩...⟨dd⟩ = 12 pair of ASCII characters with
each pair representing the dot pat-
tern for one scan row of the charac-
ter being defined, starting with the
top scan row of the character cell.

For both bytes in each ⟨dd⟩ pair, only the lower 5 bits
are used. The lower 5 bits of each byte are concat-
enated as shown in Figure 3-23 to form a 10-bit value.
Every logic 1 in the 10-bit value represents a dot to be
turned on; every logic 0 represents a dot to be turned
off. The 12 pair of ⟨dd⟩ bytes, therefore, combine to
form a 120-bit sequence that completely defines the
appearance of character ⟨char⟩.
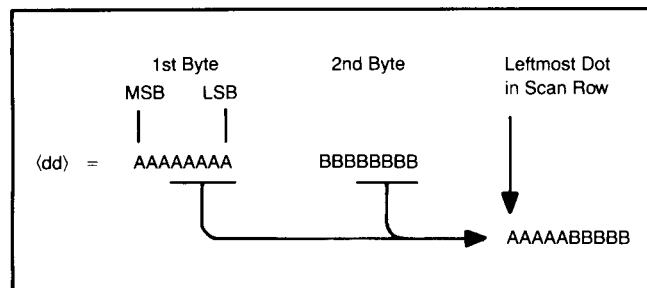
Figure 3-23.   Formation of Scan Row Dot Pattern

The Define Character command is treated as invalid
under the following conditions:

- If the character set number most recently selected
  with the Select Character Set command is not in the
  range of valid DLL set numbers as shown in Table
  3-15, the Define Character command aborts as soon
  as the ⟨DCS⟩A...⟨ST⟩ sequence is encountered.

- If the ⟨char⟩ command argument is not within the
  expected range, the command aborts as soon as the
  invalid ⟨char⟩ argument is encountered.

- If a user-defined character set number has been
  correctly selected and the ⟨char⟩ argument is valid,
  the next 24 bytes interpreted by the display unit
  are assumed to comprise the dot pattern arguments
  (⟨dd⟩...⟨dd⟩).

Example:
The capital letter A in Figure 3-23 can be created and
assigned to character ! in character set 20 by first
issuing the command ⟨033⟩(!4 which selects user-de-
fined character set 20 (⟨041⟩⟨064⟩). Then the dot pat-
tern for A can be assigned to character ! with the
command ⟨DCS⟩A!@@CPDHHDPHDHDO\HDHD
HD@@@@ which uses the ASCII characters @ to _
to represent the dot pattern. Since the least significant
5 bits of the binary equivalent of @ (01000000) are all
0, the first @@ clears the top row of all dots (see
Figure 3-23). Then the CP turns on the three dots for
the top of the A in the second row, and so on.

Character Graphics Commands

The four character graphics commands are presented
in alphabetical order and described in detail in the next
few pages. A brief overview of the four commands
follows:

- **Read/Reserve Characters** — Sets aside one or
  more DLL character sets for graphics purposes. As
  long as unused characters remain in the DLL sets
  reserved, graphics drawing operations may con-
  tinue. Can also be used to query the terminal to
  determine the number of unused DLL characters.

- **Set Pattern** — Used in conjunction with the Line
  command. Set Pattern changes the solid line style
  to any pattern of black or green dots and dashes
  desired.

- **Line** — If Set Pattern is not used, Line draws all
  line segments in one line style: solid green.

- **Bar** — Draws solid rectangles of any size, provided
  they fit in the current window.

As is the case for the custom characters, graphics im-
ages can only be displayed with normal character spac-
ing in effect. In addition, when the terminal is turned
off or a terminal reset is performed (CMD-ERASE
PAGE), DLL character sets must be reserved again
before graphics drawing operations can begin.

Coordinate System

Use of the Line and Bar drawing commands is based
on an x,y-coordinate system. Figure 3-24 shows this
coordinate system under power-up or reset conditions.
The x-axis of the system runs horizontally across the
bottom of the current window and the y-axis runs ver-
tically up the left margin of the current window. The
drawing area, then, is comprised of the rows within
the current window and the columns between the mar-

<u>ADDENDUM TO DASHER D410 and D460 DISPLAY TERMINALS USER'S MANUAL</u>

Ref: Manual # 014-000761 Revision 00,   page 3-47

        The **BAR** command is documented incorrectly. The correct
command is:

BAR, location, width, height, color   (ANSI Mode)
<CSI><x><073><y><073><width>   <CSI>...;...;...;...p
<073><height><073><color><160>

Draws a solid green or black rectangle with the lower left
corner at the location x,y. Specifies the width and height of
the rectangle in the command arguments. The command arguments
are as follows:

<x> =   x-coordinate of the lower left corner of the bar.

<y> =   y-coordinate of the lower left corner of the bar.

<width> =   width of the bar.

<height> =   height of the bar.

<color> =   0 for black,
               1 for green.

Use ASCII encoded decimal for the all of the above parameters.

EXAMPLE:
The command <CSI>0;0;50;50;1p draws a green bar with lower left
corner at the origin and with a width and height of 50.

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        (This ADDENDUM will change the document number to:
                014-000761 Revision 01.)

gins. Along the x-axis of the coordinate system, there are 10 x-coordinate units for each column between the margins. Along the y-axis, there are 24 y-coordinate units for each row in the window. These coordinate units are derived from the 10- by 12-dot matrix in each character cell: one coordinate unit in the x-direction for each dot column and two coordinate units in the y-direction for each scan row. Locations on the drawing area are specified by an x,y coordinate pair, such as (100,200), where 100 is the x-coordinate and 200 is the y-coordinate. The drawing origin (coordinates 0,0) for the active drawing area is formed by the intersection of the left margin with the bottom of the last row in the current window.
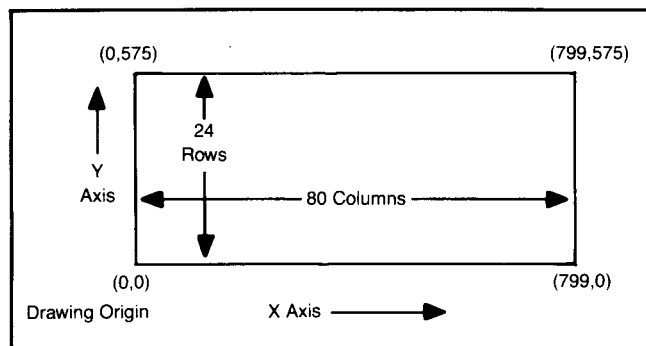
Figure 3-24. Graphics Coordinate System at Power-Up or Reset

As was already mentioned, the margins and boundaries of the current window limit the available drawing area for the character graphics command. As a result, the largest possible drawing area consists of the entire display screen memory (24 rows, 162 columns). X-coordinate units for this area would range from 0 to 1619; y-coordinate units would range from 0 to 575 (as is the case in Figure 3-24). The smallest possible drawing area consists of one character cell (1 row, 1 column). In this case, the x-coordinate range is 0 to 9 and the y-coordinate range is 0 to 23. If the arguments to the Line and Bar commands specify a location or dimension that extends outside the current drawing area, the command aborts immediately.

One last drawing area example should help clear up any remaining questions on the coordinate system before the detailed command descriptions are presented. Figure 3-25A shows the case where the current window is comprised of rows 0 to 9 and the margins are set at columns 10 and 69. For graphics purposes, those boundaries form the x,y-coordinate system shown in Figure 3-25B.

NOTE: *The Read/Reserve Characters command must be used to reserve one or more DLL character sets before the Bar and Line drawing commands will work.*

BAR, location, width, height, color ⟨CSI⟩⟨loc⟩⟨073⟩⟨width⟩ ⟨073⟩⟨h8⟩⟨073⟩⟨color⟩⟨160⟩

(ANSI Mode)
⟨CSI⟩...;...;...;...p
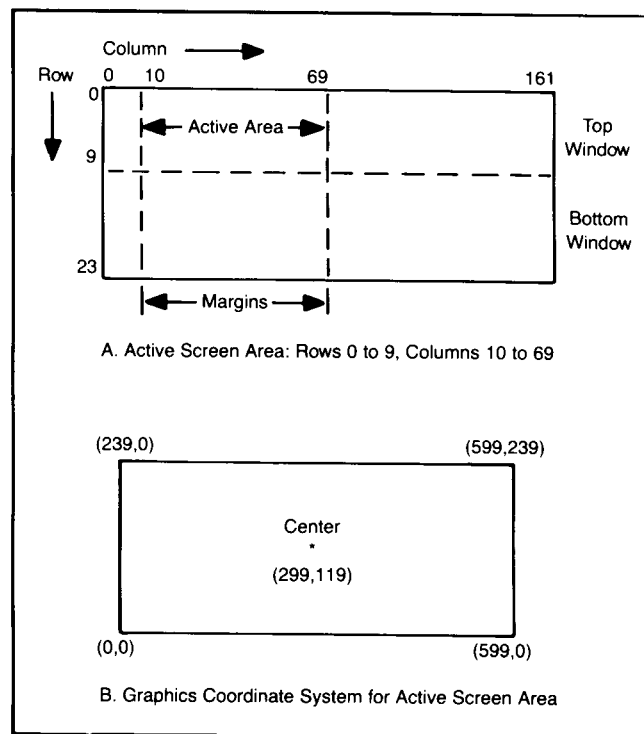
Figure 3-25. Example of Graphics Drawing Area on Display Screen

Draws a solid green or black rectangle with the lower left corner at the location ⟨loc⟩. Specifies the width and height of the rectangle in the command arguments. The command arguments are as follows:

⟨loc⟩ = ⟨xxx⟩⟨yyy⟩, a 6-byte sequence specifying the coordinates of the lower-left corner of the bar,

where:

⟨xxx⟩ = 3-byte x-coordinate formed by concatenating the 5 LSBs of all 3 bytes (15 bits total) as shown in Figure 3-26.

⟨yyy⟩ = 3-byte y-coordinate formed like ⟨xxx⟩

⟨width⟩ = 3-byte width of bar in x-direction formed like ⟨xxx⟩

⟨height⟩ = 3-byte height of bar in y-direction formed like ⟨yyy⟩

⟨color⟩ = ⟨060⟩ (ASCII 0) for black
= ⟨061⟩ (ASCII 1) for green

If the bar defined by the command arguments extends outside the active drawing area, the command is ignored. If the color argument is other than a 0 or 1, the command is ignored.

ASCII characters @ to _ can be used to create all valid 3-byte arguments values in the ⟨xxx⟩/⟨yyy⟩ format as shown in Table 3-16. This includes not only location

arguments but the width and height arguments of the Bar command. The table includes examples showing how the values picked from the table columns are added together to develop the 3-byte ASCII character sequence for a given argument value.

Example:
The command ⟨CSI⟩@@@@@;@CD;@FH;1p draws a bar with its lower-left corner at location 0,0 (@@@@@@), 100 (@CD) units wide, 200 (@FH) units high, and colors it green (1).

Table 3-16. Creating Location Arguments with ASCII Characters

ASCII Characters (@ to _)	Argument Forms and Values (Decimal)			
	⟨ x ⟨ y	x or y	x ⟩ y ⟩	
@	0	0	0	
A	1024	32	1	Examples:
B	↑	64	2	
C		96	3	For ⟨xxx⟩/⟨yyy⟩ = 455
D		128	4	
E		160	5	= 0 + 448 + 7
F		192	6	= "@NG"
G		224	7	(from table)
H		256	8	
I		288	9	For ⟨xxx⟩/⟨yyy⟩ = 1420
J		320	10	
K		352	11	= 1024 + 384 + 12
L		384	12	= "ALL"
M		416	13	(from table)
N		448	14	
O		480	15	
P	Not	512	16	
Q	Used	544	17	
R		576	18	
S		608	19	
T		640	20	
U		672	21	
V		704	22	
W		736	23	
X		768	24	
Y		800	25	
Z		832	26	
[		864	27	
\		896	28	
]		928	29	
^		960	30	
_	↓	992	31	

LINE, location,...,location (ANSI Mode)
⟨DCS⟩⟨102⟩⟨loc⟩...⟨loc⟩⟨ST⟩   ⟨DCS⟩B...⟨ST⟩
Draws a line segment between consecutive locations in the argument list. That is, it draws a line between the first and second locations, the second and third locations, and so on. If only one location argument is supplied with the command, a point is drawn at that location. The number of location arguments in one command is limited only by the number of DLL characters available for graphics drawing purposes. When all the DLL characters have been used up, no more lines can be drawn. The line style used for drawing will be solid green unless the Set Pattern command is used to define a different line style. The command arguments are:

⟨loc⟩ = ⟨xxx⟩⟨yyy⟩, a 6-byte sequence specifying the x- and y-coordinates of a point on the line segment; the ⟨xxx⟩⟨yyy⟩ format used to specify a location is the same as that used in the Bar command

Table 3-17 can be used to develop the ⟨xxx⟩ and ⟨yyy⟩ components of each ⟨loc⟩ argument.

Example:
The command ⟨DCS⟩B@@@@@@@@@Q_ARS@Q_ARS@@@@@@@@⟨ST⟩ draws a line completely around the display screen memory, assuming the margins are set at columns 0 and 161 and the current window has 24 rows. The drawing begins with a point at the drawing origin (@@@@@@), extends up the left side of absolute column 0 to location 0,575 (@@@@Q_), goes across the top of row 0 to location 1619,575 (ARS@Q_), down the right side of column 161 to location 1619,0 (ARS@@@), and returns to the drawing origin (@@@@@@).

READ/RESERVE CHARACTERS (ANSI Mode)
Read:
⟨CSI⟩⟨163⟩ or ⟨CSI⟩⟨060⟩⟨163⟩   ⟨CSI⟩s or ⟨CSI⟩0s
Reserve:
⟨CSI⟩⟨061⟩⟨073⟩⟨set⟩⟨073⟩⟨nnn⟩⟨163⟩   ⟨CSI⟩1;...;...s
Used to either determine the number of reserved DLL characters remaining for line and bar drawing operations or to reserve DLL characters for line drawing operations.
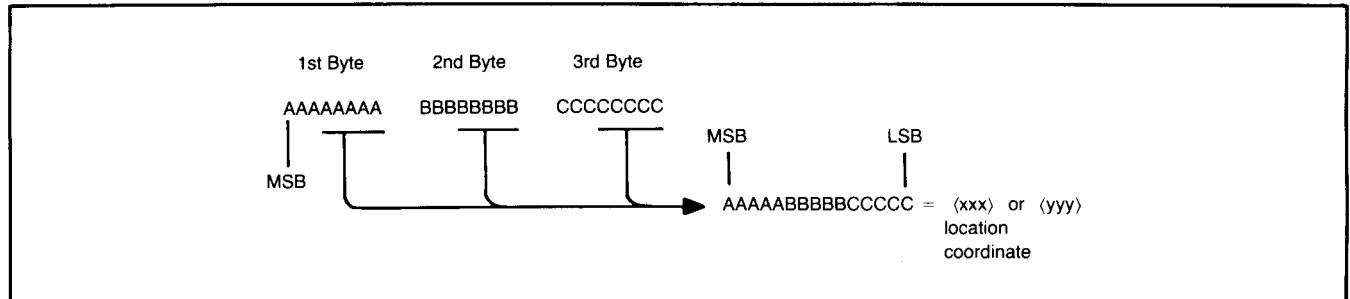
Figure 3-26. Graphics Location Coordinate Format

If the command format is ⟨CSI⟩⟨163⟩ or ⟨CSI⟩⟨060⟩⟨163⟩ (Read Characters), the number of DLL characters remaining for use by the line and bar commands is returned to the host computer in the following form:

⟨CSI⟩⟨cc⟩⟨163⟩

where:

⟨cc⟩ = 2-byte character count. The 5 LSBs of each byte are concatenated to form a 10-bit value; the count may range from 0 (@@ ASCII) to 1022 (__ ASCII).

Notice the range of ⟨cc⟩ (0 to 1022). Whenever characters are reserved for graphics, two charcters of the total count reserved are used for purposes other than drawing on the screen. When ⟨cc⟩ = 0 (@@ ASCII), no additional drawing operations are possible unless more DLL characters can be reserved with the Read/Reserve Characters command.

NOTE: *A ⟨cc⟩ value of 1022 returned means there are at least 1022 characters remaining; there may be up to 3572 actual characters left. The Read/Reserve Characters command does not return an actual count until the number of characters remaining drops below 1022.*

Example:
If the terminal responds to the command ⟨CSI⟩0s with ⟨CSI⟩@LPs, there are 400 (@LP) DLL characters still available for drawing purposes. But if it responds with ⟨CSI⟩_↑s, there are from 1022 to 3502 DLL characters available.

To reserve DLL for line and bar drawing operations, the command format is:

⟨CSI⟩⟨061⟩⟨073⟩⟨set⟩⟨073⟩⟨nnn⟩⟨163⟩

where:

⟨set⟩ = the number of the first DLL character set reserved in the range of 0 to 37 (decimal)

⟨nnn⟩ = the number of DLL characters to reserve in the range of 1 to 38 (decimal)

The DLL character sets specified in the command arguments are reserved for use by the Line and Bar drawing commands. As long as there are unused characters in the sets reserved by this command, drawing operations can continue. As soon as all reserved characters have been used, drawing operations will halt. It is a good practice to reserve as many DLL character sets as possible before creating a new graphics display. The character sets reserved for graphics with the Read/Reserve Characters command remain reserved until the terminal is reset or a second such command is issued. When a second Read/Reserve Characters command is issued, only the new DLL character sets named in the second command remain

reserved. The same DLL character set should not be reserved more than once while a graphics display is produced on the screen. If a set is reserved twice, for example, the character definitions used before the second reservation may be changed and distort the graphics display. When the Reset command is issued, the reserved character count is set to zero. Command arguments are as follows:

⟨set⟩ = 0 to 25 (ASCII), the number of the first DLL character set reserved in the range of 0 to 37 (decimal)

⟨nnn⟩ = 1 to 26 (ASCII), the number of contiguous DLL sets reserved in the range of 1 to 38 starting with the set specified by the ⟨set⟩ argument

The argument range for the starting DLL character set, 0 to 25, specifies sets in the range of DLL character sets listed in Table 3-15. If the ⟨set⟩ argument is not in the range of 0 to 25, the command is aborted immediately. If the ⟨nnn⟩ argument is not in the range of 1 to 26, no character sets are reserved.

Example:
The command ⟨CSI⟩1;2;9s reserves DLL character sets 1 through 9 (⟨040⟩⟨060⟩ through ⟨040⟩⟨068⟩) for graphics drawing operations.

SET PATTERN, offset, pattern   (ANSI Mode)
⟨DCS⟩⟨103⟩⟨offset⟩   ⟨DCS⟩C...⟨ST⟩
⟨pattern_definition⟩⟨ST⟩
All lines drawn with the Line command will be solid green unless this Set Pattern command is used to define another line style. When a new line style pattern is defined, the pattern remains in effect for all Line commands until changed with another Set Pattern command or until a terminal reset occurs. The Set Pattern command does not involve DLL characters, so it may precede the Read/Reserve Characters command.

The ⟨offset⟩ and ⟨pattern_definition⟩ arguments combine to define the new line style pattern. The ⟨pattern_definition⟩ is a string of 1 to 32 pattern characters. Each pattern character specifies an action to be taken at an individual dot along a line. The pattern characters are:

pattern
character = ⟨060⟩ (ASCII 0) for a black dot
= ⟨061⟩ (ASCII 1) for a green dot
= something other than ⟨060⟩ or ⟨061⟩ for a dot transparent to the background (i.e., transparent dots do not change the existing screen image)

The ⟨ST⟩ marks the end of the ⟨pattern_definition⟩ and terminates the command. When a line is drawn, the ⟨pattern_definition⟩ repeats as needed to fill out the length of the line specified. The ⟨offset⟩ is a single-byte argument whose 5 LSBs specify the offset, from the

start of the pattern definition, of the first pattern character used in drawing a line. The ⟨offset⟩ can range from 0 to 31 (decimal) and may be specified by ASCII characters @ to _ (or any other ASCII character range that can be used to represent 32 different values in the 5 LSBs).

Example:
The command ⟨DCS⟩CC1111100000⟨ST creates a new line style of dashes consisting of 5 green dots followed by 5 black dots (1111100000). The offset of 3 (C) means that when a line is drawn, it will start with the fourth green dot in the pattern (skips over the first 3 green dots).

CHAPTER 4

INSTALLATION

GENERAL

This chapter covers all the steps required to install and check operation of the D410/460 terminal. The information in this chapter is organized as follows:

- Site requirements

- Unpacking instructions

- Installation instructions

- Operational checkout instructions

The installation and operational checkout instructions include steps for those terminal configurations that involve a printer. The instructions in this chapter must be followed carefully to ensure a successful installation.

SITE REQUIREMENTS

Before the D410/460 terminal can be installed, an installation site must be found that meets the space, environmental, power, and communications requirements of the terminal.

Ideally, the D410/460 terminal will be located on a desk or table in a normal office environment with the temperature at or near 24°C (75°F) and the relative humidity at or near 50%. All terminal cables and power cords must reach their connection points, and the ac power source must match the voltage and frequency requirements of the terminal (and optional printer). If the terminal is to be connected to a host computer over telephone lines, a terminal-compatible modem must be installed. Otherwise, a current loop or an EIA cable must be installed from the host computer to the terminal site.

Figure 4-1 shows the dimensions of the terminal. Verify that the work surface intended to hold the terminal has the necessary space available. Make sure the chosen site meets the cable length, environmental, and power needs of the terminal listed in Table 4-1.
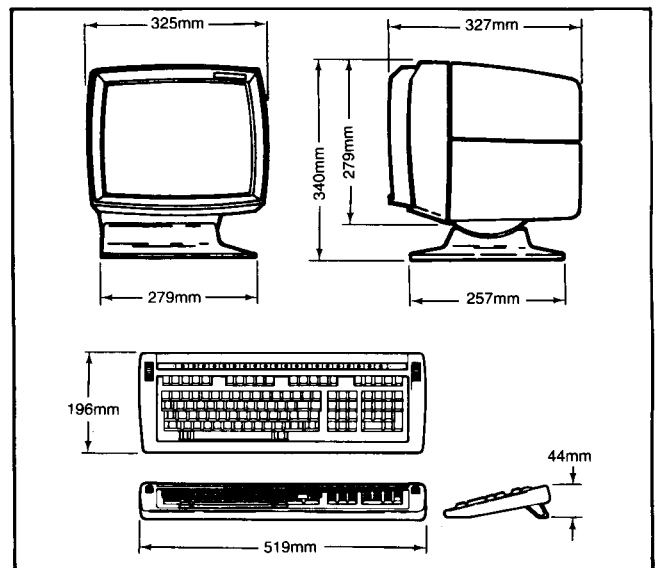
Figure 4-1. D410/460 Terminal Dimensions

The selection of a communications line from the host computer to the terminal depends on the cable length required, whether or not a modem is to be used, and the configuration of the host system. The current loop line and EIA RS 422 line are intended for relatively long cable lengths when a direct connection between the host and terminal is made. The 20-mA current loop supports transmission rates up to 9600 baud; EIA cabling supports rates up to 19200 baud. When a short (15 meters (50 feet) or less) direct connection is required, or the terminal is to interface with a Bell 103, 113, or 212 compatible modem, the EIA RS-232C communications line can be used. Detailed cabling information is provided in the installation instructions later in this chapter; available cable lengths are contained in Table 4-1.

> **NOTE:** *If the D410/460 terminal is to be connected to the host over the telephone lines with a Bell 103, 113, or 212 compatible modem, make sure the modem installation is scheduled early enough so the D410/460 terminal installation is not delayed for lack of a modem.*

Table 4-1. D410/460 Terminal Physical, Environmental, and Power Specifications

ITEM	SPECIFICATION
PHYSICAL:	
Display Unit and Keyboard Dimensions	See Fig. 4-1
Display Unit Weight	8.1 kg (18 lb)
Keyboard Weight	2.6 kg (5.8 lb)
Cable Lengths:	
Keyboard cable	1.2 m (4 ft)
Display unit power cord	2.25 m (7.5 ft)
EIA, Modem, 20-mA current loop	6.1 m (25 ft)
POWER:	
0 or 1 Power Suffix:	
Voltage	90 – 132 VAC
Frequency	50 or 60 Hz ± 1%
Current	3.0 Amps peak at 90 VAC
Start-up Surge	22 Amps at 120 VAC for ½ cycle
2 or 4 Power Suffix:	
Voltage	187 – 264 VAC
Frequency	50 or 60 Hz ± 1%
Current	2.4 Amps peak at 187 VAC
Start-up Surge	11 Amps at 240 VAC for ½ cycle
ENVIRONMENTAL:	
Temperature Range	Operating: 10 to 38° (50 to 100°F)
	Storage: – 40 to + 65°C (– 40 to 149°F)
Humidity Range	Operating: 20 to 80% non-condensing
Altitude	– 1000 ft to + 8,000 ft
Radiation	Below 0.5 milliroentgens per hour

UNPACKING

The D410/460 terminal display unit and keyboard are packed as shown in Figure 4-2. Perform the following steps to unpack and inventory the terminal equipment:

1. Inspect the shipping containers for damage. If obvious damage to the equipment has occurred, notify the shipping carrier as soon as possible.

2. Move the shipping containers to the installation site.

3. Using Figure 4-2 as a guide, unpack the display unit, keyboard, communications cables, and documentation.

4. As each item is unpacked, inspect for damage and verify that the item received is the one ordered. Verify that all items ordered have been received.

   NOTE: *Save the packing material in case reshipment of the terminal becomes necessary.*

Otherwise, Figure 4-2 must be used as a guide in replacing packing material for shipping purposes.

INSTALLATION

After an installation site has been selected that meets all the requirements specified earlier in this chapter and the D410/460 terminal has been unpacked and all parts accounted for, the terminal can be installed. Perform the following steps to complete the installation:

1. Move the terminal equipment to its intended work surface and position the display unit so the rear of the unit is accessible.

2. Locate the terminal configuration label on the rear of the display unit as shown in Figure 4-3. Verify that the model number for the unpacked unit, located on the lower left of the label, matches the number ordered. In particular, verify that the power configuration of the unpacked unit matches the ac power source. The display unit model numbers are explained in Chapter 1.

3. Using Figure 4-3 as a guide, set the DIP switches at the rear of the display unit. The host communications port switches are on the right, the printer port switches on the left:

   a. Set the printer baud rate with printer port switch 6 to either enable or disable the split baud rate feature.

      Table 4-2 and Table 4-3 show how this feature affects other DIP switch settings.

Table 4-2. DIP Switch Settings With Split Baud Rate Disabled

Port	Switch	Selects
Printer	2 - 4	Printer baud rate
	5	Selects 7- or 8-bit printer communications
Host	1 - 4	Host baud rate
	5 - 6	Host parity
	7	Selects 7- or 8-bit host communications

   b. If an 8-bit printer is to be used with the terminal, set printer port switch 5 to the "1" position (up); otherwise, set this switch to the "0" position.

   c. Selection of printer 7-bit mode also sets even parity and 1 stop bit. Selection of printer 8-bit mode sets 2 stop bits with no parity.

DOCUMENT PACKAGE

CABLE

DISPLAY UNIT
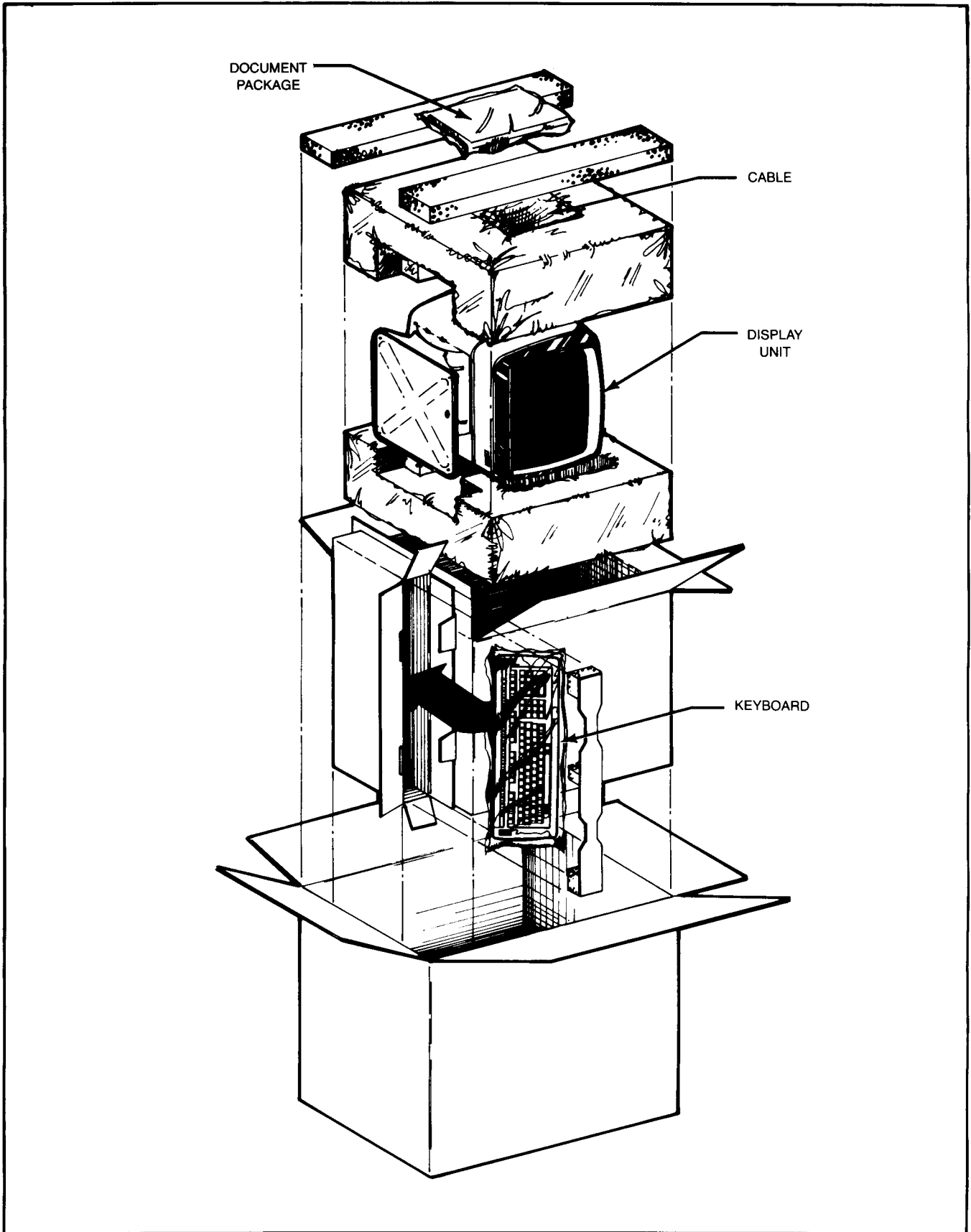
KEYBOARD

Figure 4-2. Display Unit and Keyboard Packing/Unpacking

Power Supply
Power on/off
Terminal Configuration Label
Host Computer Connector
Printer Connector
Keyboard Connector

Printer Port DIP Switches
Host Communications Port DIP Switches

1 = UP   0 = DOWN

RESERVED (UNUSED)

Terminal Operating Mode	SWITCH 8
ANSI	1
DG	0

HOST UART DATA BITS	SWITCH 7
8 BIT	1
7 BIT	0

50/60 Hz	SWITCH 8
50 Hz	1
60 Hz	0

SPLIT BAUD	SWITCH 6
ENABLED	1
DISABLED	0*

*NORMAL SETTING

SWITCH 5	6	PARITY	DESCRIPTION
0	0	NONE	NO PARITY BIT
0	1	ODD	PARITY BIT SET SO ODD NO ONES IN CHARACTER
1	0	MARK	PARITY BIT SET TO 1
1	1	EVEN	PARITY BIT SET SO EVEN NO. ONES IN CHARACTER

Printer Type Switch	Switch 5
8 Bit	1
7 Bit	0

Printer Interface and/or Display Transmit Baud Rate (Split Baud)	Switches 2	3	4
19200	1	1	1
9600	1	1	0
4800	1	0	1
2400	1	0	0
1200	0	1	1
600	0	1	0
300	0	0	1
110	0	0	0

Baud rate	Switches 1	2	3	4	
19200	1	1	1	1	
9600	1	1	1	0	
7200	1	1	0	1	
4800	1	1	0	0	
3600	1	0	1	1	
2400	1	0	1	0	1 stop bit
1800	1	0	0	1	
1200	1	0	0	0	
600	0	1	1	1	
300	0	1	1	0	
150	0	1	0	1	
134.5	0	1	0	0	
110	0	0	1	1	
75	0	0	1	0	2 stop bits
50	0	0	0	1	
50	0	0	0	0	

Figure 4-3. Rear of Display Unit

Table 4-3. DIP Switch Settings With Split Baud Enabled

Port	Switch	Selects
Printer	2 - 4	Host transmit baud rate
	5	Selects 7- or 8-bit printer communications
Host	1 - 4	Host receive baud rate and printer baud rate
	5 - 6	Host parity
	7	Selects 7- or 8-bit host communications

d. Set the host baud/parity to match the baud and parity selections at the host computer, observing the rules listed in step (a) above.

e. Selection of host baud rate at greater than 110 implies 1 stop bit; otherwise, there are 2 stop bits.

f. Verify left DIP switch 8 (50/60 HZ) is set to match the frequency of the power source and the terminal model number. If the switch is set incorrectly, the screen image may flicker.

g. Select 7- or 8-bit command syntax, observing the rules in step (a) above.

h. Select either DG or ANSI operating mode with host port switch 8.

4. Connect the cable attached to the keyboard to the keyboard connector at the rear of the display unit (see Figure 4-3 for the display unit keyboard connector location).

CAUTION: *Do not disconnect the keyboard cable from the display unit when the display unit is powered up! Doing so may cause subsequent terminal operation to be unpredictable.*

NOTE: *Guidelines for selecting host-to-terminal interface cabling are provided in the site requirements paragraph of this chapter. The following step assumes that correct cabling is available as determined by the host computer and the selected communications system.*

5. Connect the communications cabling between the host or modem and the rear of the display unit. Secure the display unit connection with the two screws provided with the 25-pin Cannon connector that plugs into the rear of the display unit.

NOTE: *Figure 4-4 shows the EIA cables available from Data General for Data General host systems; when not using a Data General EIA*

cable for an EIA connection, wire the terminal end of the 25-pin Cannon connector as shown in Figure 4-5. Figure 4-6 shows the 20-mA current loop cables from Data General. Data General 20-mA current loop cables are all wired for a passive connection where the host system supplies the power to drive the terminals interface.

When a Data General current loop cable is not used for a 20-mA current loop connection, wire the 25-pin Cannon connector as shown in Figure 4-4 for a passive connection.

In those cases where a cable other than those available from Data General must be used, keep in mind that to build an FCC-compliant cable, a shielded cable must be terminated as shown in Figure 4-8.

6. If a printer is to be installed with the terminal, such as a DASHER TP1/TP2 receive only (RO) printer or a 340 CPS Serial Matrix Printer, consult the printer documentation for unpacking instructions, parts inventory, etc. Proceed as follows when the printer is ready for installation:

a. Verify that the power source matches the requirements of the printer model.

b. For an 8-bit dot matrix printer, set printer port DIP switch 5 to the 8-bit (up) position as shown in Figure 4-3. Observe the rules listed in step 3(a) above.

For 7-bit communications, set printer port switch 5 to the "0" (down) position. Then, following Figure 4-3, set the terminal to 7-bit, even parity, 1 stop bit mode. Next, configure the printer to receive characters with 7 data bits, even parity, and 1 stop bit.

Finally, set the printer baud rate to match the terminal printer port baud rate selected earlier in this installation procedure.

c. Connect the printer interface cable between the printer and the printer connector at the rear of the display unit. For DASHER LP2, TP1/TP2 RO printers, cables 005-20404 and 005-13280 should be used. For the 150 CPS Matrix Printer Model 4422, use adapter cable 005-20404 with cable 005-13259. Both of these cables are listed in Figure 4-9. Model 4433 uses only 005-20404.

d. With the printer power switch set off, plug in the printer power cord and get the printer ready to print by following instructions in the printer manual for loading paper, etc.

WARNING: *The terminal comes equipped with a three-conductor ac power cord. The power cord must be plugged into a grounded three-contact electrical outlet.*

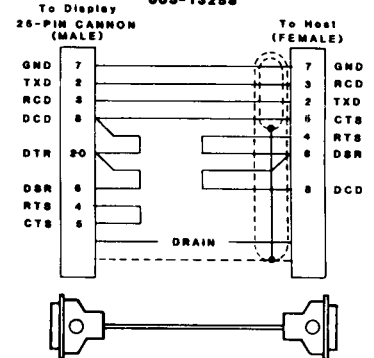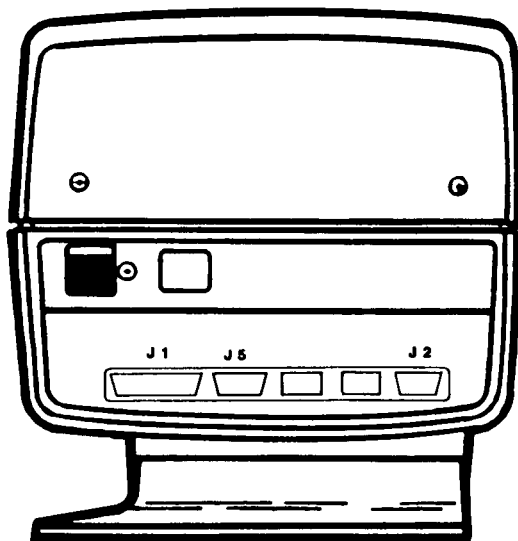Figure 4-4.   Data General EIA RS-232C Host/Terminal Interface Cables
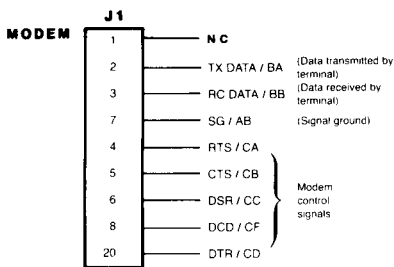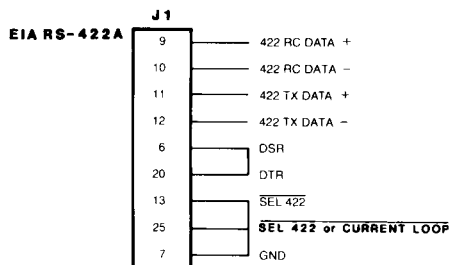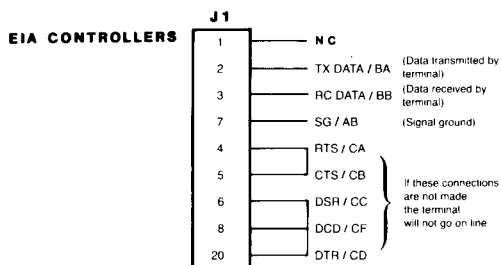
REAR VIEW

Display Unit Connector

13 — Pin 1

25 — 14

25-pin Cannon Connector

KEYBOARD

J2

1	NC
2	CLK COMMON
3	+ 5V
4	KBC RESET
5	ST
6	NC
7	SO
8	SCLK
9	KBIRQ

PASSIVE CURRENT LOOP

J1

1	N C
21	RC DATA – } Data transmitted to the terminal
23	RC DATA +
24	TX DATA + } Data received from the terminal
18	TX DATA –
6	DSR
20	DTR
25	SEL 422 or CURRENT LOOP } Pin 25 grounded for current loop operation
7	SIG GND

EIA CONTROLLERS

J1

1	N C	
2	TX DATA / BA	(Data transmitted by terminal)
3	RC DATA / BB	(Data received by terminal)
7	SG / AB	(Signal ground)
4	RTS / CA	
5	CTS / CB	If these connections are not made the terminal will not go on line
6	DSR / CC	
8	DCD / CF	
20	DTR / CD	

EIA RS-422A

J1

9	422 RC DATA +
10	422 RC DATA –
11	422 TX DATA +
12	422 TX DATA –
6	DSR
20	DTR
13	SEL 422
25	SEL 422 or CURRENT LOOP
7	GND

MODEM

J1

1	N C	
2	TX DATA / BA	(Data transmitted by terminal)
3	RC DATA / BB	(Data received by terminal)
7	SG / AB	(Signal ground)
4	RTS / CA	
5	CTS / CB	
6	DSR / CC	Modem control signals
8	DCD / CF	
20	DTR / CD	

SLAVE PRINTER

J5

1	NC
2	CKT COMMON
3	NC
4	P-RTS
5	NC
6	NC
7	P-TXD
8	P-RXD
9	PRINTER READY

Figure 4-5.   Rear View and Connectors
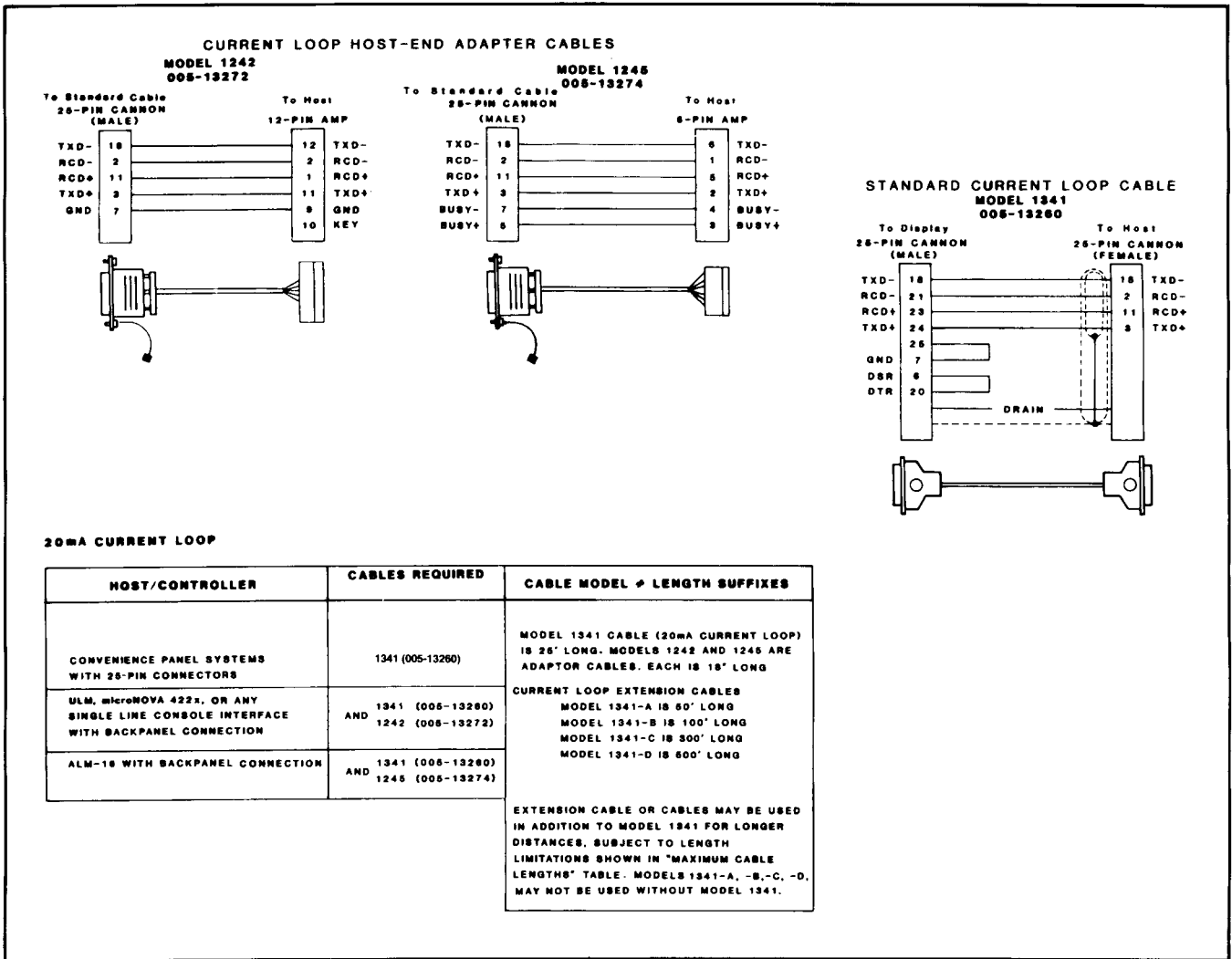
Figure 4-6. Data General 20-mA Current Loop Host/Terminal Interface Cables
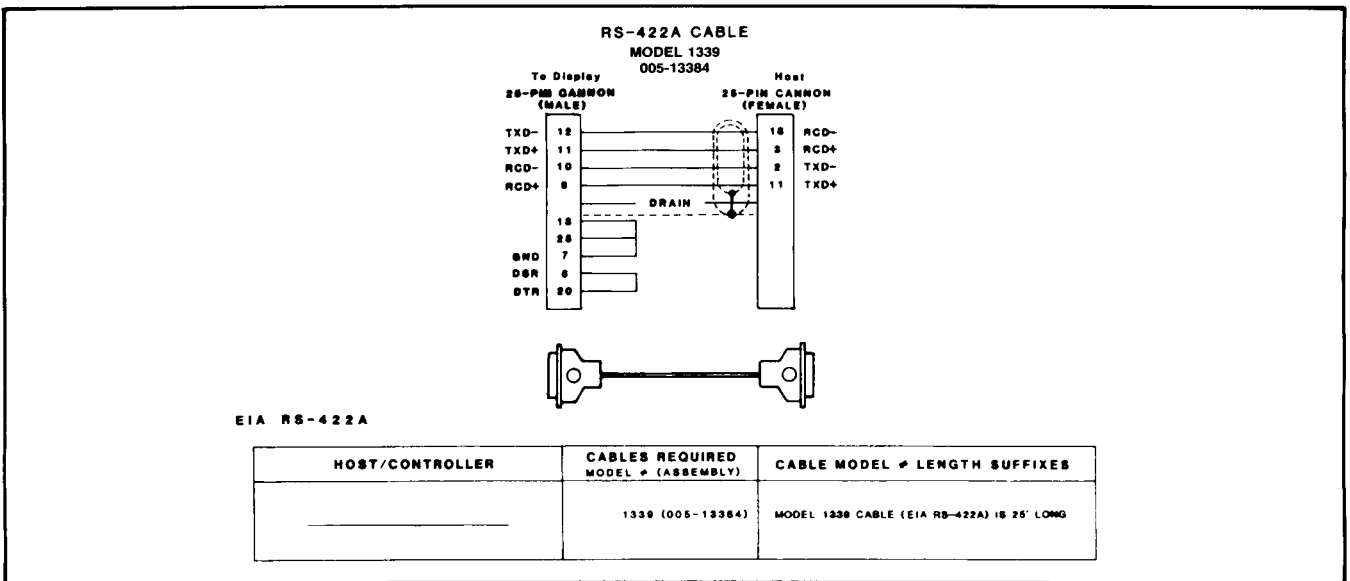
Figure 4-7. RS-422A Host/Controller Cable

7. Make sure the terminal display power control switch on the rear of the display unit is set to the power-off position, plug the display unit power cord into the ac power source, and position the terminal equipment for normal operation.

The D410/460 terminal hardware is now installed and ready for checkout.

OPERATIONAL CHECKOUT

Before beginning normal use of the D410/460 terminal, the self-test and off-line checkout procedures should be performed and the communications link to the host tested (on-line checkout). These checkouts for the terminal are followed by a separate checkout procedure for those terminal configurations that include a printer. If any of the checkout procedures produce results other than those indicated, read through the terminal problem diagnosis information in the User Maintenance section of Chapter 2.

Self-Test and Off-Line Checkout

The self-test and off-line checks verify that the terminal display unit and keyboard work properly when separate from a host computer:

1. Make certain the terminal has been installed as described in the installation paragraph of this chapter.

2. Set the command syntax mode to DG 8-bit using Figure 4-3 as a guide.

3. Turn on power to the terminal with the on/off switch located on the rear of the display unit.

When first turned on, the terminal executes a self-test to verify that everything is working. The following events should occur during the self-test:

a. The terminal bell rings and all three of the lamps on the keyboard (ON LINE, ALPHA LOCK, and HOLD) turn on. If the terminal is still warm from previous use, the screen flashes briefly.

b. The keyboard lamps remain on as the self-test checks ROM, RAM, UARTs, etc. This takes about 2.5 seconds for the D410 and 7.5 seconds for the D460.

c. The terminal bell rings a second time when the HOLD and ALPHA LOCK lamps turn off. The ON LINE lamp remains on if the terminal is connected directly (modems not used) to the host; otherwise, it blinks. If modems are used, the ON LINE lamp blinks until the modems are ready for communications, then stays on.

d. The reverse video block cursor appears in the screen home (upper-left corner) position along with the words "D410/D460 Self Test OK".

4. If the ON LINE lamp on the keyboard is on steady or blinking, depress and hold down the CMD key while depressing the ON LINE key (CMD-ON LINE). The ON LINE lamp should turn off indicating that the terminal is off-line. If the keyboard does not operate, check to make sure it is plugged into the correct place (see Figure 4-3).

5. Perform the terminal off-line checkout and demonstration procedure in Table 4-4.

Figure 4-8. Non-DG Shielded Cable Termination Details

PRINTER PORT CABLE
MODEL 1342
005-20404
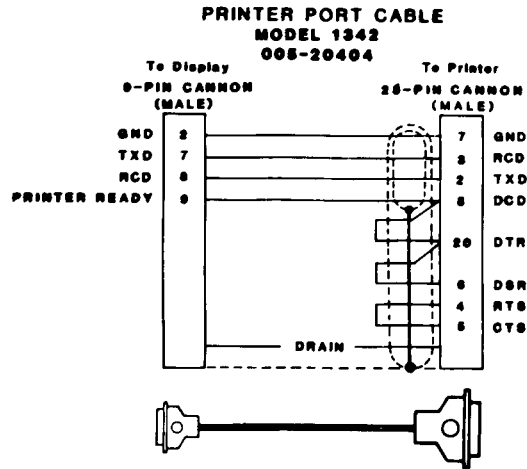
PRINTER PORT CABLE

PRINTER	CABLES REQUIRED MODEL # (ASSEMBLY)	CABLE MODEL # LENGTH SUFFIXES
150 CPS DOT MATRIX (Model 4422)	AND 1342(005-20404) 1256(005-13259)	MODEL 1342 CABLE IS 5' LONG. MODEL 1256 IS AN ADAPTER CABLE. IT IS 18" LONG. THE FOLLOWING MODEL NUMBERS MAY BE USED IN PLACE OF MODEL 1342:
150 CPS DOT MATRIX (Model 4433)	1342 (005-20404)	
LP2, TP1, TP2 (MODELS 6040-6043, 6073-6078, 6088-6089, 6190-6194, 9610-9613)	AND 1342 (005-20404) 1256 (005-13280)	MODEL LENGTH 1342 -R 2' 1342 -T 15' 1342 -U 25' 1342 -A 50'

Figure 4-9. Terminal/Printer Interface Cables

On-Line Checkout

Following a successful self-test and off-line checkout, communications with the host computer should be tested.

> NOTE: *Before proceeding, make sure the host computer system is operational and equipped with the software needed to communicate with the terminal.*

Proceed to test communications with the host:

1. If the terminal is off-line (ON LINE lamp on keyboard is off), depress CMD-ON LINE. The ON LINE lamp should come on indicating that the terminal is on-line with the host.

2. Log on the host-resident software to verify that the host/terminal communications link is working.

Off-Line Printer Checkout

This check verifies that the printer connected to the rear of the D410/460 terminal produces hardcopy as directed from the keyboard of the terminal.

Before proceeding with the checkout steps, make certain the printer has been installed with the terminal as described earlier in this chapter. Be sure that the available power source is in accord with the printer model number.

For a DG slave graphics printer, set printer port DIP switch 5 to the DG slave graphics printer position.

For any other printer, set printer port switch 5 to the "other" position. Then, set the terminal to 7-bit, even parity, 1 stop bit mode; configure the printer to receive characters with 7 data bits, even parity, and 1 stop bit; and set the printer baud rate to match the terminal printer port baud rate.

The printer interface cable should be connected between the printer and the printer connector at the rear of the display unit. The printer power cord should be plugged in, and the printer on-line and loaded with paper; i.e., ready to print.

Proceed with the checkout steps:

1. With the terminal off-line, use the keyboard to enter both full intensity and dim characters on the display screen. To begin a string of dim characters, first enter CTRL-\; to end a string of dim characters, enter CTRL-].

2. Move the cursor to the window "home" location and depress the Local Print key. All characters between the margins in the current window should print. In order for the printer to print all characters between the D410/460 margins, the printer line length must be equal to or greater than the number of character columns between the margins.

3. With the cursor at "home", depress SHIFT-Local Print. Only the full intensity characters in the window should print (print form).

If a DG dot matrix graphics printer is connected, perform a bit image dump :

1. Enter some text, enter CTRL-T, then enter more text which will appear underscored. Now enter CTRL-U, CTRL-N followed by more text which will be blinking but not underscored.

2. Depress CR.

3. With one hand depress and hold down the SHIFT and CMD keys; with the other hand depress the Local Print key (CMD-SHIFT-Local Print). All characters within the margins of the active window, regardless of whether they have blink or underscore attributes, should print. The blinking text is printed as regular text and underscored text is printed with no underscore.

Table 4-4. Terminal Off-Line Checkout and Demonstration Procedure

Procedure	Expected Results
Check ON LINE lamp	ON LINE lamp is off
Depress ALPHA LOCK key	ALPHA LOCK lamp goes on
Enter some text on keyboard	Text entered appears in uppercase
Depress ALPHA LOCK key	ALPHA LOCK lamp goes off
Enter more text	Text appears in lowercase unless SHIFT key is depressed
Depress CR Key	Cursor returns to the left margin of the same line
Depress SPCL Key; then depress the A Key followed by the \ Key.	DG International character Å appears
Depress CTRL and G simultaneously (CTRL-G)	Terminal bell emits a beep
Depress CTRL-T and enter some text	Text appears underscored
Depress CTRL-\ and enter some text	Text appears dimmed and underscored
Depress CTRL-C and CTRL-N and enter some text	Text blinks, is dimmed, and is underscored
Depress CTRL-U and enter some text	Underscore does not appear under new text but remains under old text
Depress CTRL-] and enter some text	New text is brightly displayed but old text remains dim

Table 4-4. Terminal Off-Line Checkout and Demonstration Procedure (Continued)

Procedure	Expected Results	Procedure	Expected Results
Depress CTRL-O and enter some text	New text does not blink but old continues blinking	Depress SCRLL RATE, enter some text, and depress and hold down NEW LINE and REPT	Text scrolls slowly and smoothly up and off screen (if NEW LINE and REPT are held down long enough)
Depress CTRL-D	All text stops blinking		
Depress each of four cursor control keys marked with arrows	Cursor moves in direction of arrow on keycaps	Depress SCRLL RATE, enter some text, and depress and hold down NEW LINE and REPT	Text scrolls smoothly up and off screen, but faster than in previous step
Depress HOME	Cursor moves to upper-left corner of screen	**NOTE:** In the remainder of this checkout, command sequences such as ⟨036⟩FV must be entered from the keyboard. In all cases, ⟨036⟩ is entered by typing CMD-BREAK ESC. The characters following the ⟨036⟩ must be entered exactly as shown (with no embedded spaces), taking care to depress the SHIFT key for uppercase functions.	
Depress CURSR TYPE key four times and note appearance of cursor after each key depression	Cursor changes appearance with key depression as follows: blinking underline, cursor off, blinking reverse video block, reverse video block.		
Depress CTRL-S, enter some text, and repeatedly depress NEW LINE until cursor moves past bottom of screen	Cursor moves to bottom of screen then jumps to top and continues moving downward; text is not affected		
Depress CTRL-R and repeatedly depress NEW LINE until cursor moves past bottom of screen	Cursor moves to bottom of screen then text moves up one line with each depression of NEW LINE	Enter ⟨036⟩D and enter some text	Text appears in reverse video form
Depress CTRL-T; CTRL-\ ; CTRL-C; CTRL-N and enter some text	Text is underscored, dimmed, and blinking	Enter ⟨036⟩E and enter some text	Text appears normal without reverse video
Depress CTRL-L and enter some text	Screen clears and new text is not underscored, dimmed, or blinking	Enter a string of text; Enter ⟨036⟩FV and ⟨036⟩FL followed by a second string of text; enter ⟨036⟩FM	Both text strings appear normal: the first string is unprotected, second string is protected.
Move cursor to middle of previously entered line of text and depress ERASE EOL	Characters from cursor position to end-of-line are erased	Position cursor to beginning of first string entered in previous step then enter ⟨036⟩FF	First string of text is erased; second string remains displayed.
Enter a string of text and depress NORM/COMP key several times	Text appearance alternates between compressed format and normal format with each key depression	Depress ERASE PAGE key	Protected text is erased and cursor moves to upper-left corner of screen.
Depress HOLD key and enter some text	HOLD lamp turns on but text entered is not displayed	Enter a full line or more of text followed by ⟨036⟩FX28:1	Text shifts to left 40 columns with cursor in left column of screen; text margins have been set to columns 40 and 161.
Depress HOLD key again	Text previously entered is displayed and HOLD lamp turns off	Enter ⟨036⟩FD28	Text shifts to right 40 columns
Enter some text in lower part of screen and repeatedly depress NEW LINE until cursor moves past bottom of screen	Cursor moves to bottom of screen then text moves up in jumpy, one-line increments with each depression of NEW LINE	Depress NEW LINE	Cursor moves to next line at new margin (column 40)
		Enter a string of text that extends past right-most column of screen	Text scrolls to left one column for each character entered at rightmost column
Enter some text and depress and hold down NEW LINE and REPT	Text moves quickly up and off screen and in a jumpy fashion (if NEW LINE and REPT are held down long enough)	Enter ⟨036⟩ F] followed by more text	Cursor disappears off right side of screen
		Enter ⟨036⟩F ^	Text shifts to left, displaying cursor and all text entered in previous step

Table 4-4.   Terminal Off-Line Checkout and Demonstration Procedure (Continued)

Procedure	Expected Results
Enter ⟨036⟩FX3050	Cursor moves to new left margin (margins are set to columns 48 and 80)
Depress ERASE PAGE key	Screen is cleared and cursor moves to left margin and top line
Enter text in top and bottom halves of screen. Enter ⟨036⟩FB0⟨00⟨1	Cursor moves to upper-left corner of screen and screen is split into two windows. In top window, text appears normal with left margin in column 0 of screen. In bottom window, text is compressed with left margin shifted right of column 0.
Repeatedly depress NEW LINE	Cursor moves to bottom of top window, then text in window scrolls up one line with each depression of NEW LINE
Enter ⟨036⟩FP300⟨	Cursor moves to top row (row 12) and left margin on bottom window
Enter some text in bottom window if none exists followed by ⟨036⟩I	Text in bottom window scrolls down one line
Position cursor to middle of line of text in bottom window. Enter ⟨036⟩J	Blank space inserted in text at cursor position
Enter ⟨036⟩FH	Blank row inserted at row containing cursor
Enter ⟨036⟩FI	Blank row from previous step deleted
Enter ⟨036⟩K	Character at cursor position deleted
Enter ⟨036⟩FA	Terminal bell sounds, screen is cleared, and cursor moves to upper-left corner of screen
Enter ⟨036⟩N then type on keyboard	DG International characters are displayed

Procedure	Expected Results
Depress CMD-ERASE PAGE	Screen clears, terminal performs self-test, bell tone sounds, and cursor appears in upper-left corner of screen (terminal reset). ON LINE lamp is turned on if terminal is connected to host or blinking if host connection is not complete.
NOTE: The off-line checkout for the D410 terminal is now complete. The remaining steps check the DLL pcb, and only apply to the D460 terminal.	
Depress CMD-ON LINE	ON LINE lamp turns off
Enter ⟨036⟩Fe0:	No visible results; all DLL character sets have been reserved for graphics
Enter ⟨036⟩Fd	"9JJ" is displayed indicating 938 characters have been reserved for graphics. If "9@@" is displayed, try entering ⟨036⟩Fe0: again and retry this step
Enter ⟨036⟩L@@@@@@@X_@Q_ followed by CTRL-SHIFT-2	Cursor disappears, line is drawn from lower-left corner of screen to upper-right corner, and cursor reappears
Enter ⟨036⟩Fd	"9ZH" is displayed indicating 840 characters are still available for graphics use
Depress CMD-ERASE PAGE	Screen clears, terminal performs self-test, bell tone sounds, and cursor appears in upper-left corner of screen followed by words "D410/D460 Self Test OK" (terminal reset). ON LINE lamp is turned on if terminal is connected to host or blinking if host connection is not complete.

APPENDIX A
ASCII D410/460 CONTROL CODES

This Appendix consists of the following tables

- Table A-1 lists ASCII control codes ⟨000⟩ through ⟨037⟩, the function each code has on the D410/460 terminal in Data General mode, and the keys that must be depressed on the keyboard to generate each of the codes in DG mode and in ANSI mode. Note that several of the codes have specific functions listed for ANSI mode; where no function is listed for ANSI Mode, that function is undefined.

- Table A-2 identifies the U.S. and European ASCII characters displayed by the terminal, the octal codes (⟨040⟩ to ⟨176⟩) for the characters, and the keys that must be depressed to produce each character.

- Table A-3 lists the octal codes produced by the SPCL key sequences and the symbol each sequence displays on the U.S. keyboard.

- Table A-4 lists the ASCII code sequences that can be generated by the terminal and the keys that must be depressed to produce the sequences for both DG mode and ANSI mode.

Table A-1. ASCII D410/460 Control Codes ⟨000⟩ through ⟨037⟩

Code (octal)	Keyboard in DG Mode	Function in DG Mode	Keyboard in ANSI Mode	Function in ANSI Mode
000	CTRL-SHIFT-2 (CTRL- @)	—		
001	CTRL-A CTRL-SHIFT-A	Print window form	CTRL-A	
002	CTRL-B CTRL-SHIFT-B	Reserved	CTRL-B	
003	CTRL-C CTRL-SHIFT-C	Enable blink	CTRL-C	
004	CTRL-D CTRL-SHIFT-D	Disable blink	CTRL-D	
005	CTRL-E CTRL-SHIFT-E	Read cursor address	CTRL-E	
006	CTRL-F CTRL-SHIFT-F	—	CTRL-F	
007	CTRL-G CTRL-SHIFT-G	Bell	CTRL-G	Bell
010	CTRL-H CTRL-SHIFT-H HOME CTRL-HOME	Cursor home	CTRL-H	
011	CTRL-I CTRL-SHIFT-I TAB SHIFT-TAB CTRL-TAB CTRL-SHIFT-TAB	—	CTRL-I	
012	CTRL-J CTRL-SHIFT-J NEW LINE CTRL-NEW LINE SHIFT-NEW LINE CTRL-SHIFT-NEW LINE	New line	CTRL-J	New Line
013	CTRL-K CTRL-SHIFT-K ERASE EOL SHIFT-EOL CTRL-EOL CTRL-SHIFT-EOL	Erase to end-of-line	CTRL-K	Erase End-of-Line
014	CTRL-L ERASE PAGE SHIFT-ERASE PAGE CTRL-ERASE PAGE CTRL-SHIFT-ERASE PAGE	Erase page	CTRL-L	New Line
015	CTRL-M CTRL-SHIFT-M CR CTRL-CR SHIFT-CR CTRL-SHIFT-CR	Carriage return	CTRL-M	Carriage Return
016	CTRL-N CTRL-SHIFT-N	Start blink	CTRL-N	Shift-out
017	CTRL-O CTRL-SHIFT-O	End blink	CTRL-O	Shift-in
020	CTRL-P CTRL-SHIFT-P	Write cursor address	CTRL-P	

Table A-1.   ASCII D410/460 Control Codes ⟨000⟩ through ⟨037⟩ (continued)

Code (octal)	Keyboard in DG Mode	Function in DG Mode	Keyboard in ANSI Mode	Function in ANSI Mode
021	CTRL-Q CTRL-SHIFT-Q	Print window	CTRL-Q	X-ON
022	CTRL-R CTRL-SHIFT-R	Roll enable	CTRL-R	
023	CTRL-S CTRL-SHIFT-S	Roll disable	CTRL-S	X-OFF
024	CTRL-T CTRL-SHIFT-T	Start underscore	CTRL-T	
025	CTRL-U CTRL-SHIFT-U	End underscore	CTRL-U	
026	CTRL-V CTRL-SHIFT-V	Reserved	CTRL-V	
027	CTRL-W CTRL-SHIFT-W ↑CTRL-↑	Cursor up	CTRL-W	
030	CTRL-X CTRL-SHIFT-X →,CTRL- →	Cursor right	CTRL-X	
031	CTRL-Y CTRL-SHIFT-Y ←,CTRL- ←	Cursor left	CTRL-Y	
032	CTRL-Z CTRL-SHIFT-Z ↓,CTRL-↓	Cursor down	CTRL-Z	
033	ESC SHIFT-ESC CTRL-ESC CTRL-SHIFT-ESC CTRL-[	—	Break ESC	Command Header
034	CTRL-\	Start dim	CTRL-\	
035	CTRL-]	End dim	CTRL-]	
036	CMD-BREAK ESC*	Function header code	CTRL- ^	
037	—	Read cursor address code prefix	CTRL- —	

Table A-2.   ASCII D410/460 Display Codes

Name	Symbol Display	Octal Code	Keypad *	
			Main Keypad	Numeric Keypad
Space	Blank space	040	Space Bar	-
Exclamation Mark	!	041	SH 1	-
Quotation Marks	''	042	SH '	-
Number Sign	#	043	SH 3	-
Dollar Sign	$	044	SH 4	-
Percent	%	045	SH 5	-
Ampersand	&	046	SH 7	-
Apostrophe (Single Closing Quotation Mark)	'	047	'	-
Opening Parenthesis	(	050	SH 9	-
Closing Parenthesis	)	051	SH 0	-
Asterisk	*	052	SH 8	-
Plus	+	053	SH =	-
Comma	,	054	,	,
Hyphen (Minus)	-	055	-	-
Period (Decimal Point)	.	056	.	-
Slant	/	057	/	-
Zero	0	060	0	0
One	1	061	1	1
Two	2	062	2	2
Three	3	063	3	3
Four	4	064	4	4
Five	5	065	5	5
Six	6	066	6	6
Seven	7	067	7	7
Eight	8	070	8	8
Nine	9	071	9	9
Colon	:	072	SH ;	-
Semicolon	;	073	;	-
Less Than	<	074	SH ,	-
Equals	=	075	=	-
Greater Than	>	076	SH .	-
Question Mark	?	077	SH /	-
Commercial At	@	100	SH 2	-
A	A	101	SH A	-
B	B	102	SH B	-
C	C	103	SH C	-
D	D	104	SH D	-
E	E	105	SH E	-
F	F	106	SH F	-
G	G	107	SH G	-
H	H	110	SH H	-
I	I	111	SH I	-
J	J	112	SH J	-
K	K	113	SH K	-
L	L	114	SH L	-
M	M	115	SH M	-
N	N	116	SH N	-
O	O	117	SH O	-
P	P	120	SH P	-
Q	Q	121	SH Q	-
R	R	122	SH R	-

Table A-2.   ASCII D410/460 Display Codes (continued)

Name	Symbol Display	Octal Code	Keypad	
			Main Keypad	Numeric Keypad
S	S	123	SH S	-
T	T	124	SH T	-
U	U	125	SH U	-
V	V	126	SH V	-
W	W	127	SH W	-
X	X	130	SH X	-
Y	Y	131	SH Y	-
Z	Z	132	SH Z	-
Opening Bracket	[	133	[	-
Reverse Slant	\	134	\	-
Closing Bracket	]	135	]	-
Circumflex	^	136	SH 6	-
Underline	_	137	SH -	-
Single Opening Quotation Mark	`	140	`	-
a	a	141	A	-
b	b	142	B	-
c	c	143	C	-
d	d	144	D	-
e	e	145	E	-
f	f	146	F	-
g	g	147	G	-
h	h	150	H	-
i	i	151	I	-
j	j	152	J	-
k	k	153	K	-
l	l	154	L	-
m	m	155	M	-
n	n	156	N	-
o	o	157	O	-
p	p	160	P	-
q	q	161	Q	-
r	r	162	R	-
s	s	163	S	-
t	t	164	T	-
u	u	165	U	-
v	v	166	V	-
w	w	167	W	-
x	x	170	X	-
y	y	171	Y	-
z	z	172	Z	-
Open Brace	{	173	SH [	-
Vertical Line	|	174	SH \	-
Closing Brace	}	175	SH]	-
Tilde	~	176	SH `	-
Delete*	Non-printing	177	DEL	-

* Not a displayable character.

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Table A-2. ASCII D410/460 Display Codes (continued)

	Name	Symbol Display	Octal Code	Keypad	
				Main Keypad	Numeric Keypad
UNITED KINGDOM	Pound Sign Up Arrow	£ ↑	043 136	SH 3 SH 6	-
FRENCH	Pound Sign a grave Degree C Cedilla Paragraph Sign e aigue u grave e grave	£ à ° Ç § é ù è	043 100 133 134 135 173 174 175	£ à SH) Ç SH ! é ù è	- - - - - - - -
GERMAN	Paragraph Sign A umlaut O umlaut U umlaut a umlaut o umlaut u umlaut Schaffe	§ Ä Ö Ü ä ö ü β	100 133 134 135 173 174 175 176	SH 3 SH Ä SH Ö SH Ü Ä Ö Ü B	- - - - - - - -
SPANISH	N tilde n tilde	Ñ ñ	134 174	SH Ñ Ñ	- -
SWEDISH/ FINNISH	Crown E acute A umlaut O umlaut A dot U umlaut e acute a umlaut o umlaut a dot u umlaut	¤ É Ä Ö Å Ü é ä ö å ü	044 100 133 134 135 136 140 173 174 175 176	SH 4 SH É SH Ä SH Ö SH Å SH Ü É Ä Ö Å Ü	- - - - - - - - - - -
DANISH/ NORWEGIAN	Crown 0 (zero) A umlaut Æ Ø (uppercase) A dot U umlaut a umlaut æ ø (lowercase) a dot u umlaut	¤ 0 Ä Æ Ø Å Ü ä æ ø å ü	044 060 100 133 134 135 136 140 173 174 175 176	SH 4 0 SH Ä SH Æ SH Ø SH Å SH Ü Ä æ Ø Å Ü	- - - - - - - - - - - -
SWISS	u grave a grave e umlaut C cedilla e grave e circumflex o circumflex a umlaut o umlaut u umlaut e acute	ù à ë Ç è ê ô ä ö ü é	174 100 133 134 135 136 140 173 174 175 176	ù à ë Ç è ê ô ä ö ü é	- - - - - - - - - - -
KATA KANA	yen sign	¥	134	¥	-

Table A-3.   Octal Codes Corresponding to SPCL Characters

Name	Symbol Display	Octal Code
Buy	¤	246
Cent sign	¢	247
British pound	£	250
Exclamation introducer	¡	253
Question introducer	¿	254
Accent grave	`	272
Degree	°	274
Umlaut	¨	275
Accent aigue	´	276
Circumflex	^	136
a, (A) aigue	á (Á)	340 (300)
a, (A) grave	à (À)	341 (301)
a, (A) circumflex	â (Â)	342 (302)
a, (A) umlaut	ä (Ä)	343 (303)
a, (A) Tilde	ã (Ã)	344 (304)
a, (A) degree	å (Å)	345 (305)
æ (Æ)	æ (Æ)	346 (306)
c (C) cedilla	ç (Ç)	347 (307)
e (E) aigue	é (É)	350 (310)
e (E) grave	è (È)	351 (311)
e (E) circumflex	ê (Ê)	352 (312)
e (E) umlaut	ë (Ë)	353 (313)
i (I) aigue	í (Í)	354 (314)
i (I) grave	ì (Ì)	355 (315)
i (I) circumflex	î (Î)	356 (316)
i (I) umlaut	ï (Ï)	357 (317)
n (N) tilde	ñ (Ñ)	360 (320)
o (O) aigue	ó (Ó)	361 (321)
o (O) grave	ò (Ò)	362 (322)
o (O) circumflex	ô (Ô)	363 (323)
o (O) umlaut	ö (Ö)	364 (324)
o (O) tilde	õ (Õ)	365 (325)
o (O) slash	ø (Ø)	366 (326)
œ (Œ)	œ (Œ)	367 (327)
u (U) aigue	ú (Ú)	370 (330)
u (U) grave	ù (Ù)	371 (331)
u (U) circumflex	û (Û)	372 (332)
u (U) umlaut	ü (Ü)	373 (333)
Paragraph sign	§	273
Up arrow	↑	277
Schaffe	β	374
		Parentheses indicate uppercase version of symbol

Table A-4.   ASCII D410/460 Code Sequences (DG Operations)

Code Sequence (octal)	Keyboard	Code Sequence (octal)	Keyboard
036,001	CMD-SHIFT-PRINT	036,131	SHIFT-C2
036,010	SHIFT-MODE-HOME	036,132	SHIFT-C3
036,021	CMD-PRINT	036,133	SHIFT-C4
036,027	SHIFT-↑	036,134	C1
036,030	SHIFT-→	036,135	C2
036,031	SHIFT-←	036,136	C3
036,032	SHIFT-↓	036,137	C4
036,040	CTRL-SHIFT-F15	036,140	SHIFT-F15
036,041	CTRL-SHIFT-F1	036,141	SHIFT-F1
036,042	CTRL-SHIFT-F2	036,142	SHIFT-F2
036,043	CTRL-SHIFT-F3	036,143	SHIFT-F3
036,044	CTRL-SHIFT-F4	036,144	SHIFT-F4
036,045	CTRL-SHIFT-F5	036,145	SHIFT-F5
036,046	CTRL-SHIFT-F6	036,146	SHIFT-F6
036,047	CTRL-SHIFT-F7	036,147	SHIFT-F7
036,050	CTRL-SHIFT-F8	036,150	SHIFT-F8
036,051	CTRL-SHIFT-F9	036,151	SHIFT-F9
036,052	CTRL-SHIFT-F10	036,152	SHIFT-F10
036,053	CTRL-SHIFT-F11	036,153	SHIFT-F11
036,054	CTRL-SHIFT-F12	036,154	SHIFT-F12
036,055	CTRL-SHIFT-F13	036,155	SHIFT-F13
036,056	CTRL-SHIFT-F14	036,156	SHIFT-F14
036,060	CTRL-F15	036,160	F15
036,061	CTRL-F1	036,161	F1
036,062	CTRL-F2	036,162	F2
036,063	CTRL-F3	036,163	F3
036,064	CTRL-F4	036,164	F4
036,065	CTRL-F5	036,165	F5
036,066	CTRL-F6	036,166	F6
036,067	CTRL-F7	036,167	F7
036,070	CTRL-F8	036,170	F8
036,071	CTRL-F9	036,171	F9
036,072	CTRL-F10	036,172	F10
036,073	CTRL-F11	036,173	F11
036,074	CTRL-F12	036,174	F12
036,075	CTRL-F13	C36,175	F13
036,076	CTRL-F14	036,176	F14
036,130	SHIFT-C1		

APPENDIX B
U.S., EUROPEAN, AND ALTERNATE CHARACTER SETS

The D410/460 terminal can display complete, 95-symbol character sets for nine nationalities plus word processing, math, Greek alphabet, super-/subscript, and line drawing symbols. The nine nationality sets correspond to the standard ASCII code specifications for the languages of the United States, United Kingdom, France, Germany, Spain, Sweden/Finland, Japan, Switzerland, and Denmark/Norway.

The dot matrix patterns for each ASCII display code are shown in this appendix. The entire U.S. set is illustrated first. For the other eight nationality sets, only those codes that have different dot matrix patterns from the U.S. set are shown.

Note that the last character in all of the sets is the UART error character. The UART error character cannot be generated from the keyboard; the character is displayed when a host UART error is detected. The word processing, math, Greek alphabet, and super-subscript symbols comprise the first special symbol character set; the second special symbol character set consists of line drawing symbols.

AMERICAN USAGE

040	041	042	043	044	045	046	047
	!	"	#	$	%	&	'

050	051	052	053	054	055	056	057
(	)	*	+	,	-	.	/

060	061	062	063	064	065	066	067
0	1	2	3	4	5	6	7

070	071	072	073	074	075	076	077
8	9	:	;	<	=	>	?

100	101	102	103	104	105	106	107
@	A	B	C	D	E	F	G

110	111	112	113	114	115	116	117
H	I	J	K	L	M	N	O

AMERICAN USAGE

120 P	121 Q	122 R	123 S	124 T	125 U	126 V	127 W
130 X	131 Y	132 Z	133 [	134 \	135]	136 ^	137 _
140 `	141 a	142 b	143 c	144 d	145 e	146 f	147 g
150 h	151 i	152 j	153 k	154 l	155 m	156 n	157 o
160 p	161 q	162 r	163 s	164 t	165 u	166 v	167 w
170 x	171 y	172 z	173 {	174		175 }	176 ~	177 UART ERROR

UNITED KINGDOM USAGE
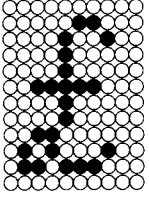
043   136
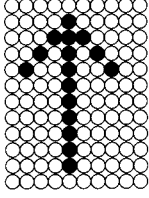
FRENCH USAGE
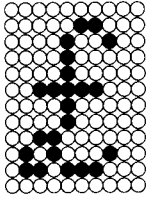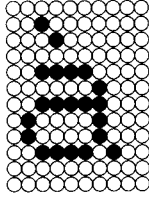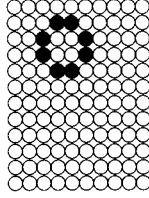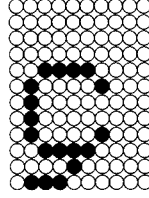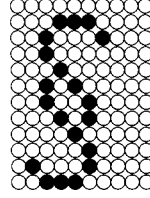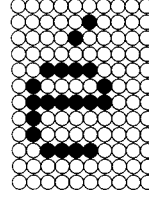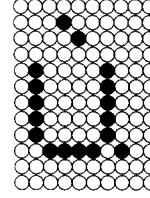
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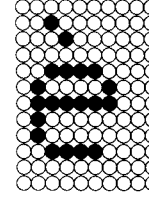
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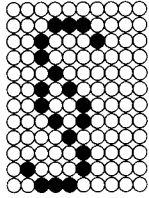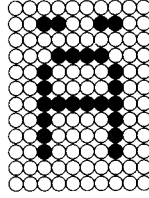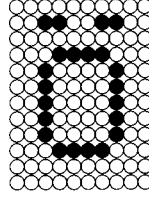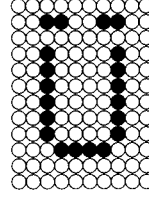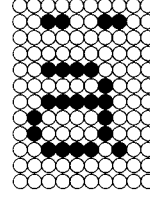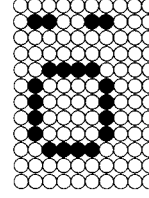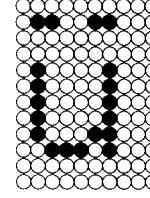
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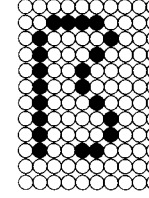
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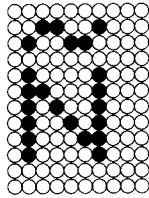
134   174

SWEDISH/FINISH USAGE

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174	175	176

DANISH/NORWEGIAN USAGE

044	100	133	134	135	136	140	173

174	175	176

KANA G0

040

KANA G1

040	041	042	043	044	045	046	047

050	051	052	053	054	055	056	057

060	061	062	063	064	065	066	067

070	071	072	073	074	075	076	077

100	101	102	103	104	105	106	107

110	111	112	113	114	115	116	117
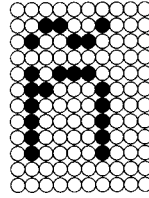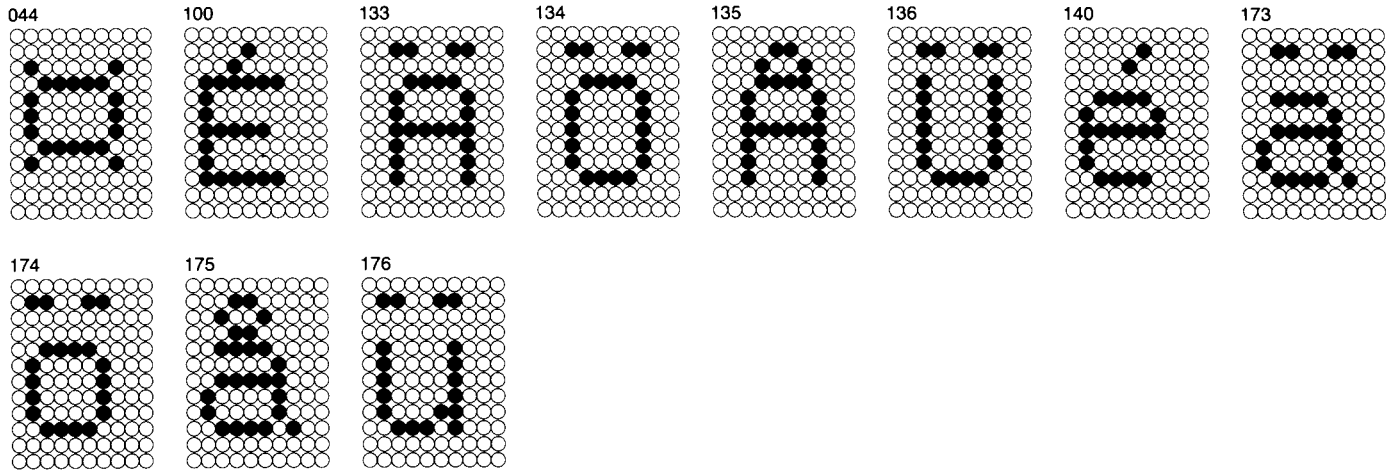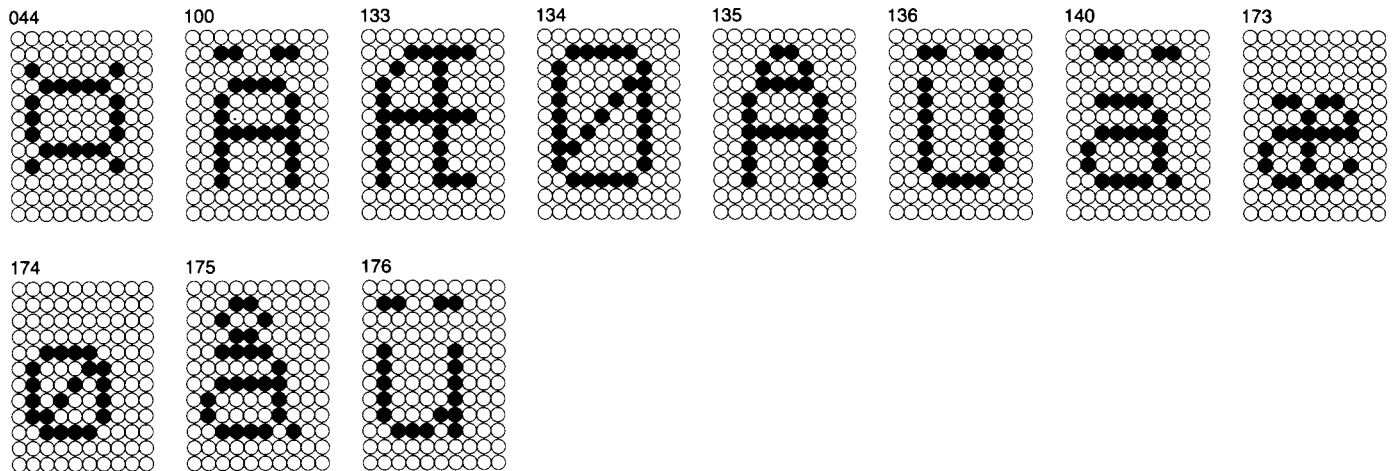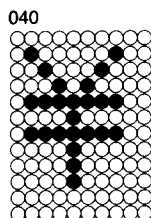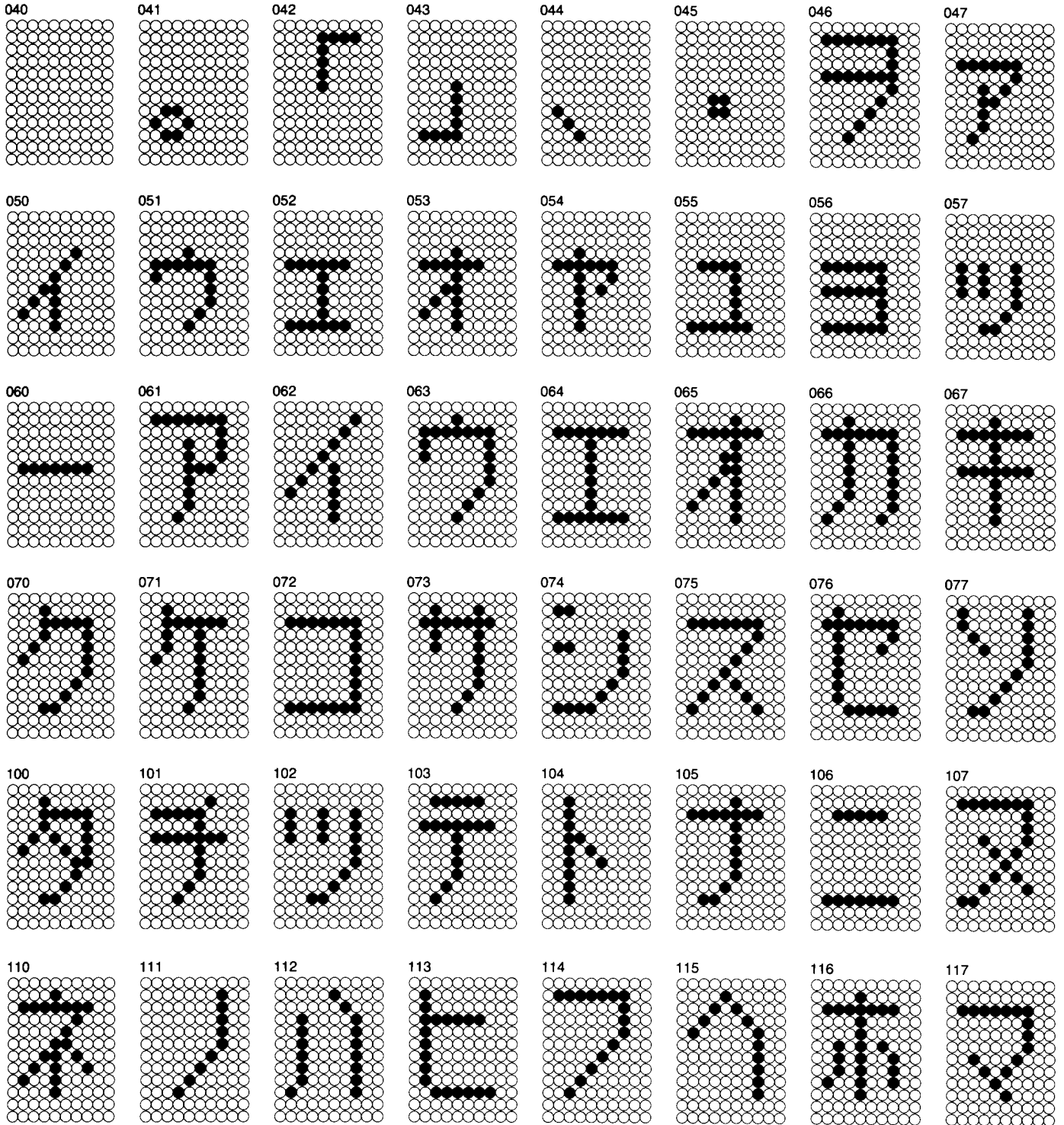
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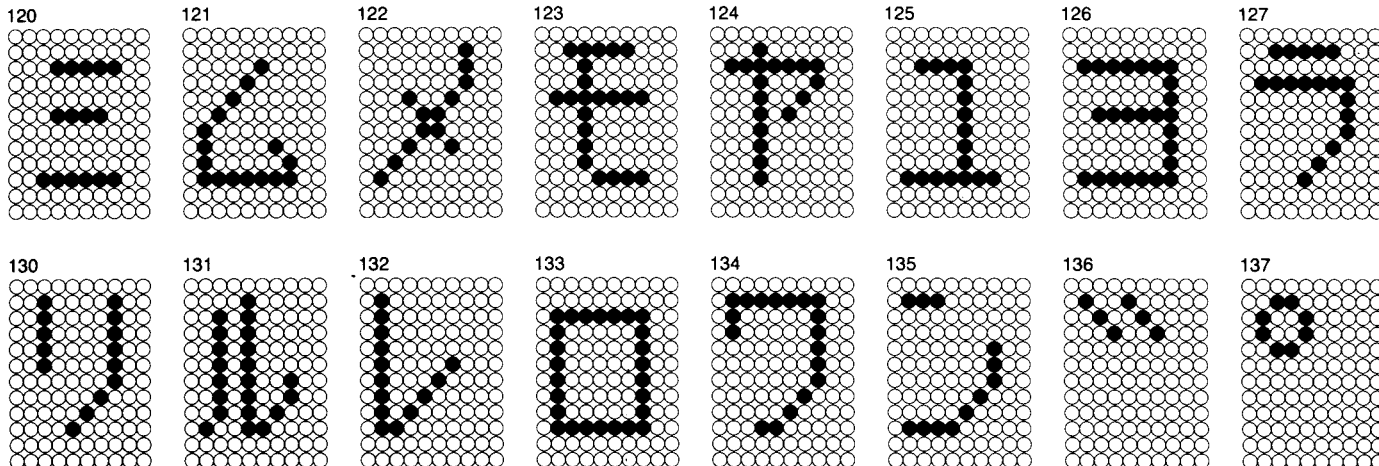
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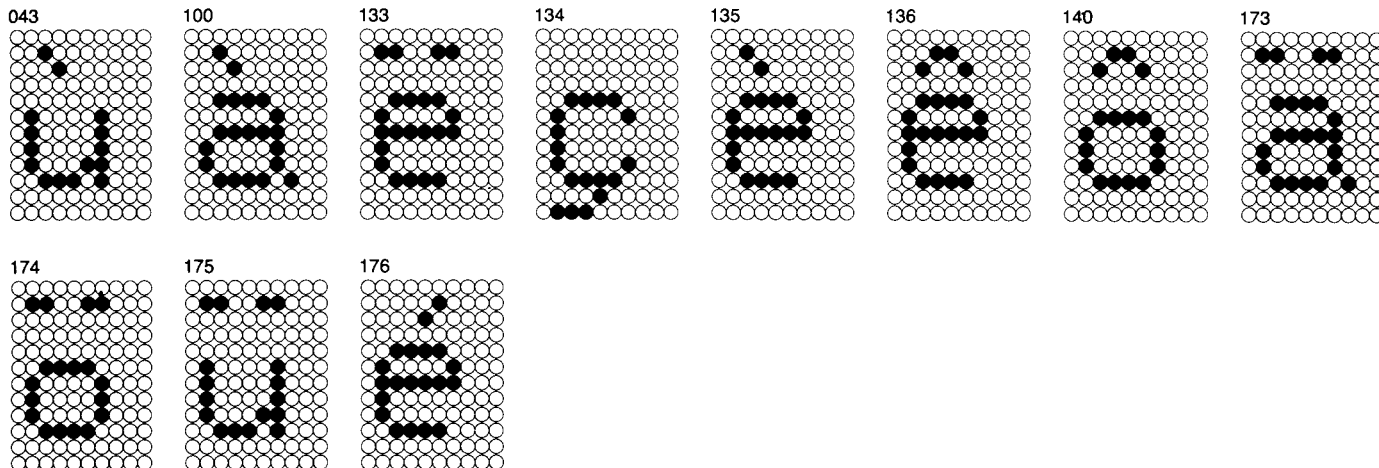
D.G. INTERNATIONAL USAGE

D.G. INTERNATIONAL USAGE

151	152	153	154	155	156	157	160
è	é	ê	ì	í	î	ï	Ñ

161	162	163	164	165	166	167	170
à	á	â	ò	ó	ô	œ	ù

171	172	173	174	177
ú	û	ü	ß	
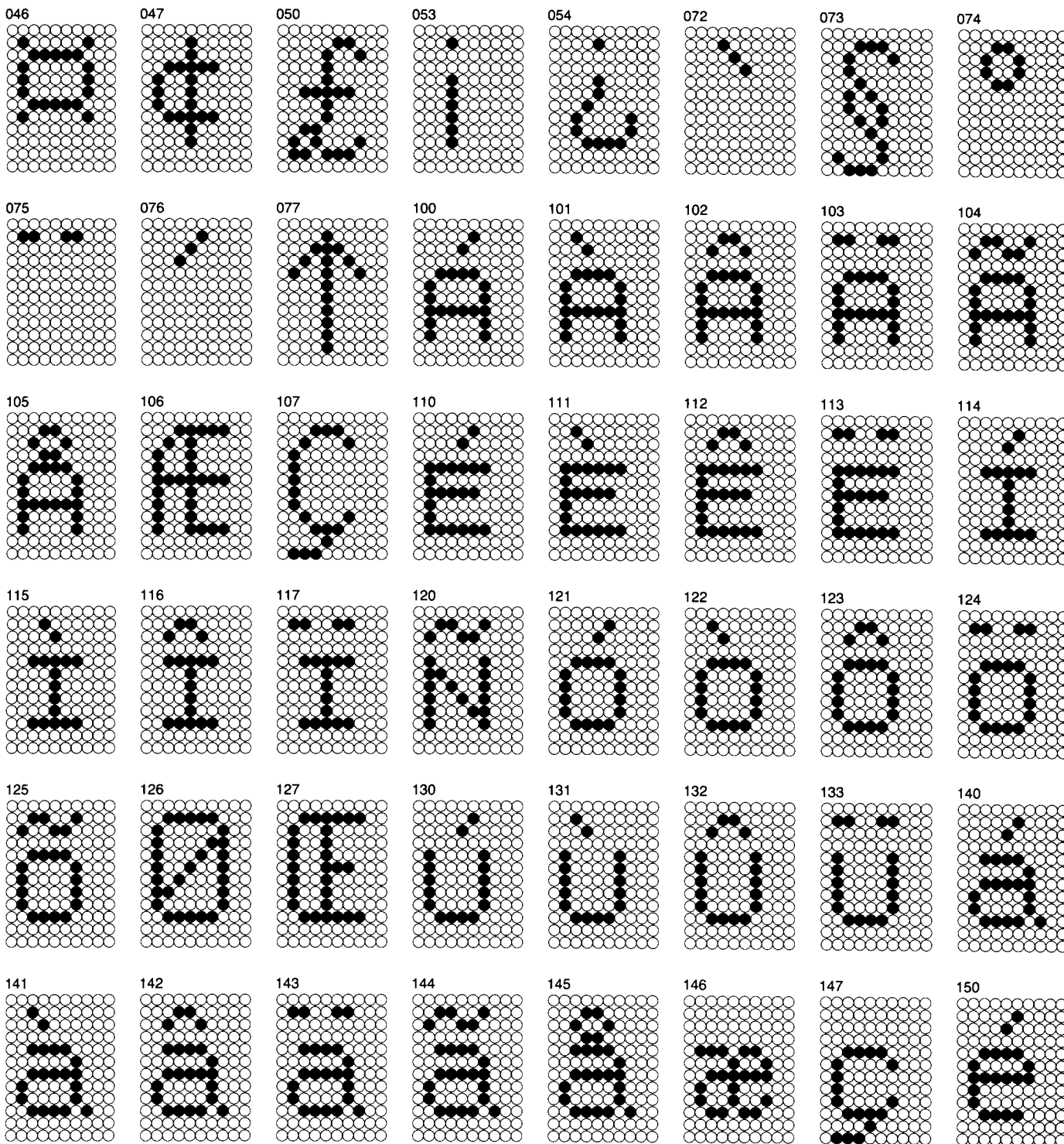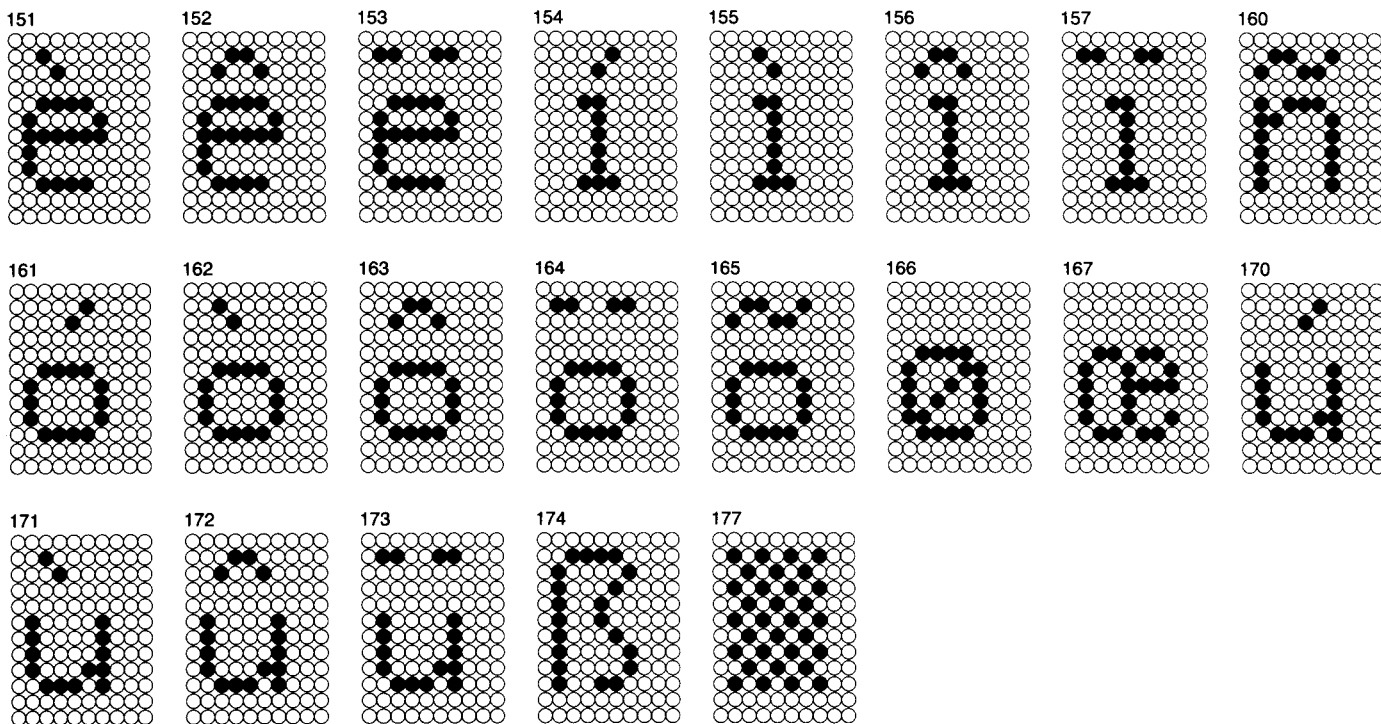
WORD PROCESSING, MATH, GREEK ALPHABET AND SUPER/SUBSCRIPT SYMBOLS

WORD PROCESSING, MATH, GREEK ALPHABET AND SUPER/SUBSCRIPT SYMBOLS

120	121	122	123	124	125	126	127

130	131	132	133	134	135	136	137

140	141	142	143	144	145	146	147

150	151	152	153	154	155	156	157

160	161	162	163	164	165	166	167

170	171	172	173	174	175	176
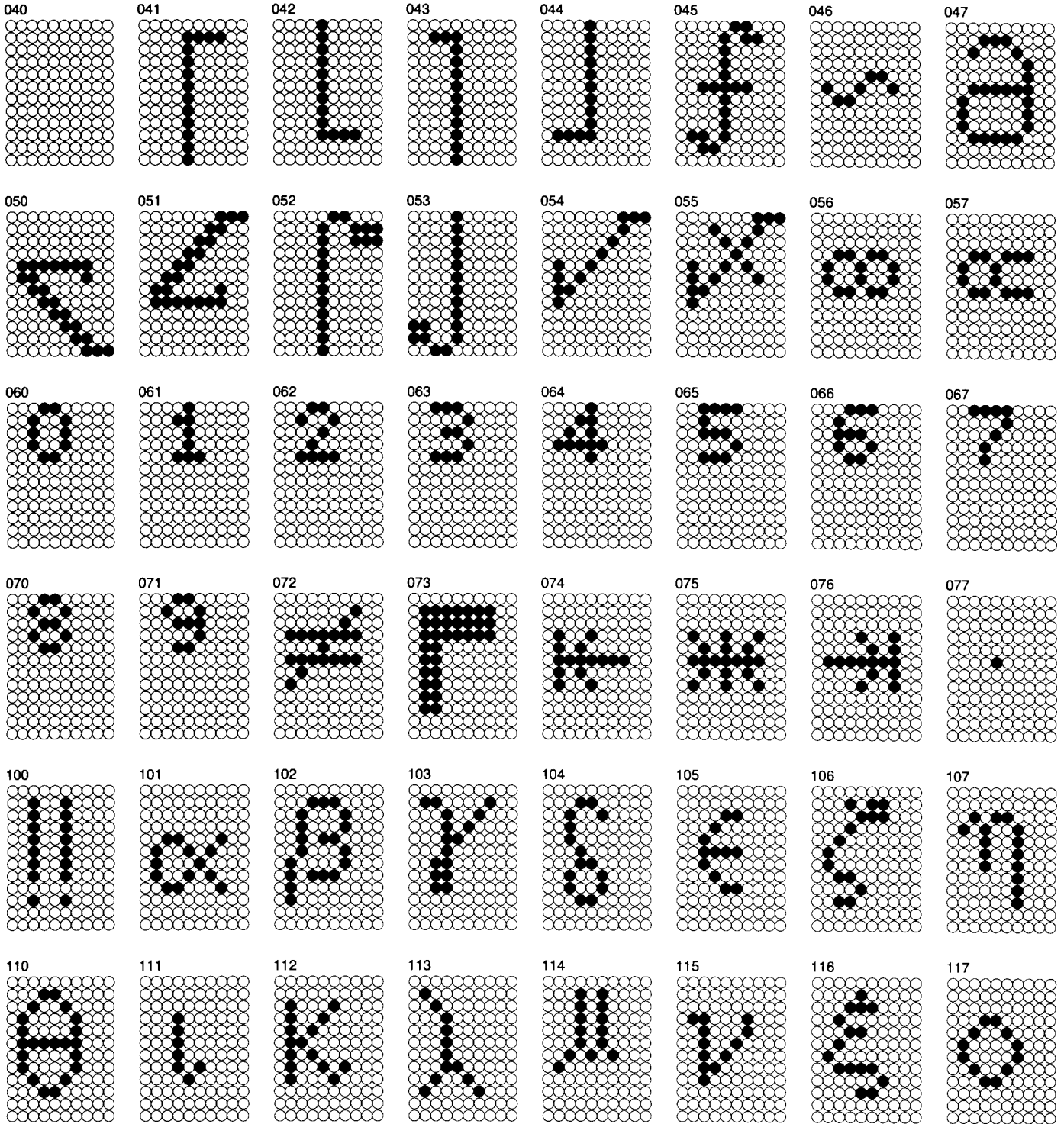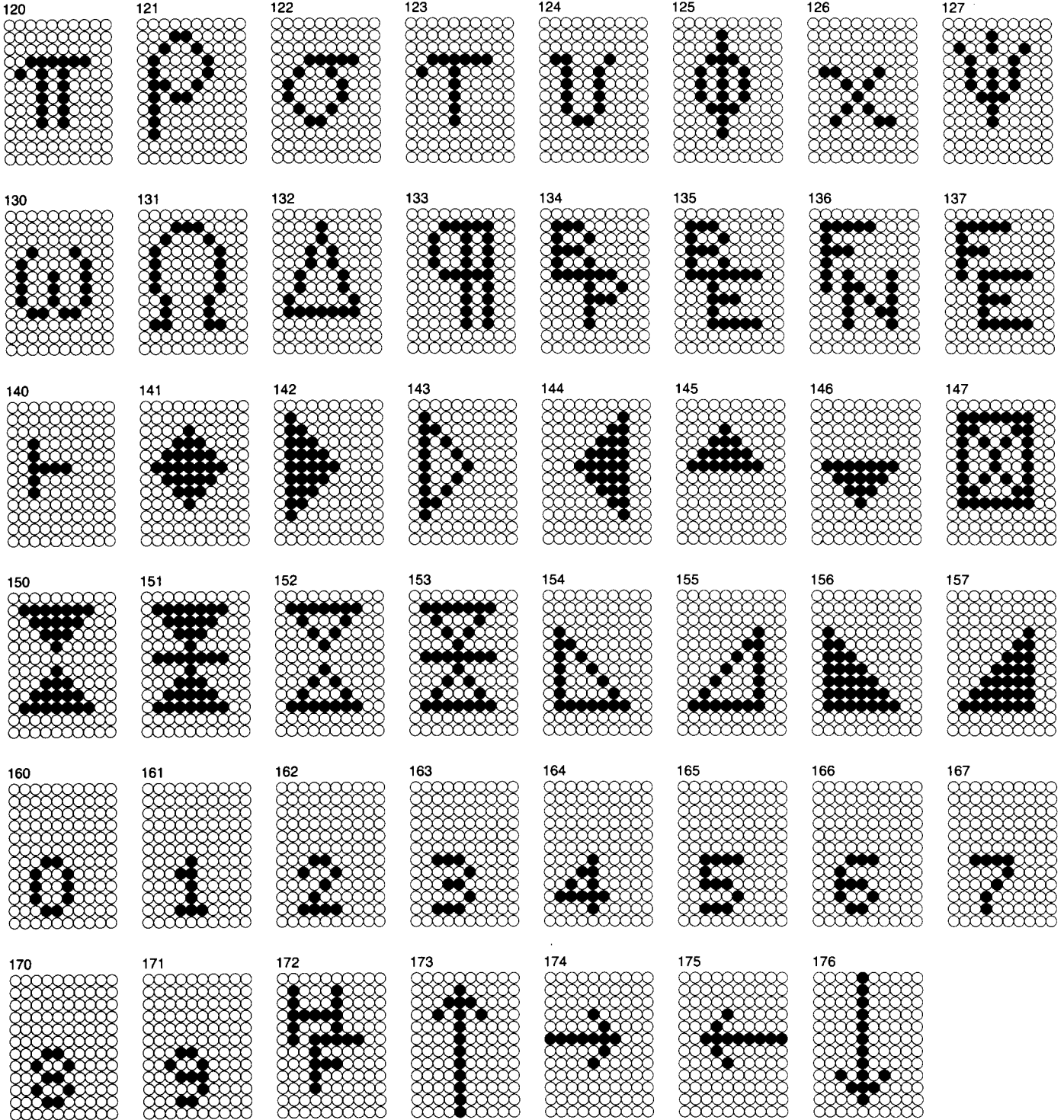
LINE DRAWING SYMBOLS
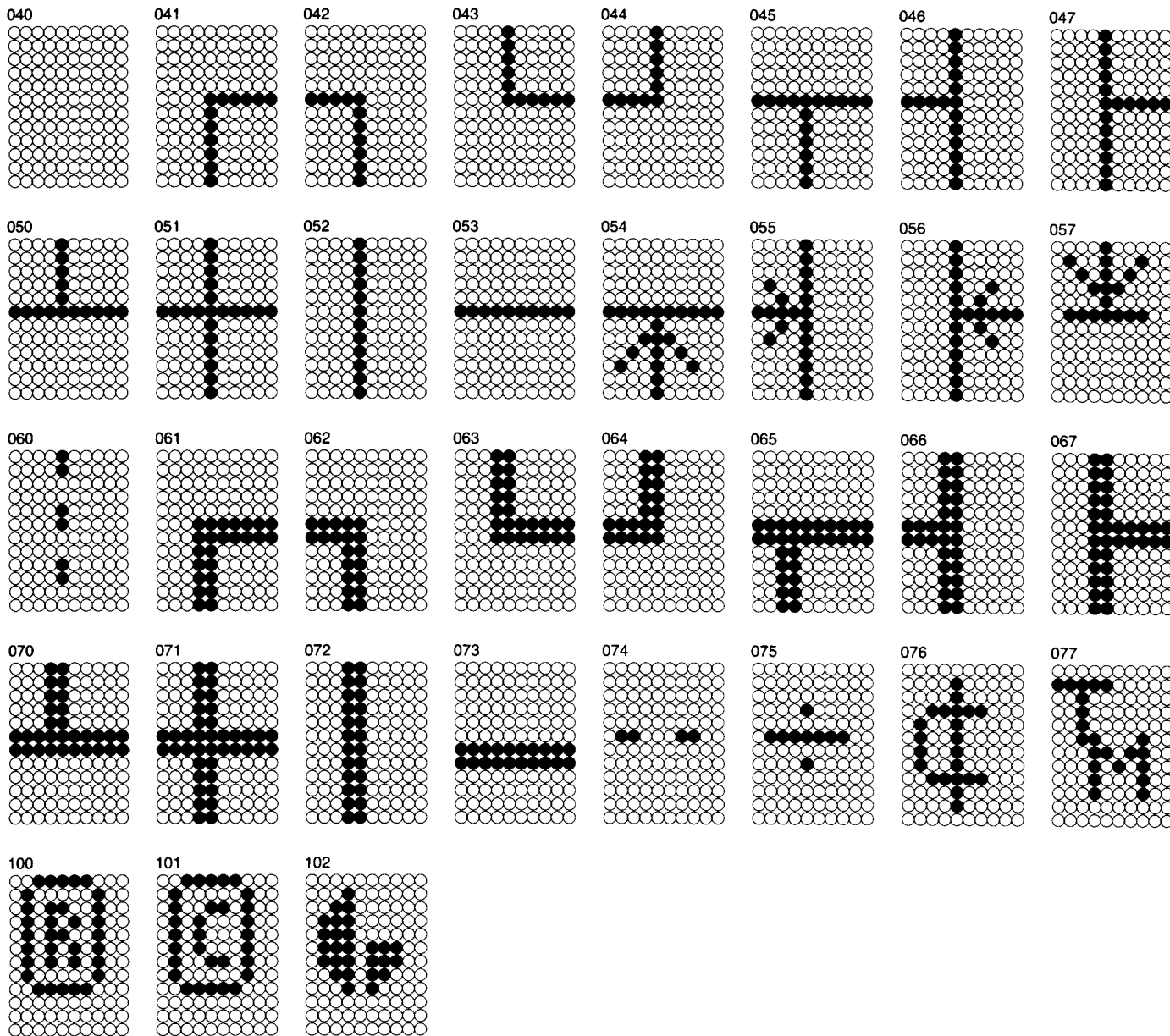
APPENDIX C
SUMMARY OF D410/460 COMMANDS

This appendix lists all of the D410/460 commands and their respective ASCII code or code sequences. The commands can be divided functionally into groups as listed in Tables C-1 and C-2. These commands are listed in alphabetical order by name in Tables C-3 and C-4. The D460-unique commands are listed in alphabetical order in Tables C-5 and C-6.

In Table C-3 and Table C-5, the name of each command and the octal and ASCII forms of the command in DG mode are listed. If a command contains a control code (byte value less than ⟨040⟩), the keys used to generate the code off-line are identified under the ASCII form of the command. The ⟨036⟩ command header is an exception. ⟨036⟩ is produced off-line in DG mode by depressing and holding down CMD and then depressing BREAK ESC (CMD-BREAK ESC). The trailing dots on the ASCII command form indicate arguments are needed.

Table C-1.   D410/460 Terminal Command Set in DG Mode

SCREEN MANAGEMENT COMMANDS:

• Set windows	• Set scroll rate
• Select normal spacing	• Show columns
• Select compressed spacing	• Read horizontal scroll offset
• Scroll up	• Roll enable
• Scroll down	• Roll disable
• Scroll left	• Horizontal scroll enable
• Scroll right	• Horizontal scroll disable

CURSOR COMMANDS:

• Carriage return	• Window home
• New line	• Write screen address
• Cursor up	• Write window address
• Cursor right	• Read screen address
• Cursor left	• Read window address
• Cursor down	• Set cursor type
• Screen home	

CHARACTER ATTRIBUTE COMMANDS:

• Blink enable	• Dim on
• Blink disable	• Dim off
• Protect enable	• Reverse video on
• Protect disable	• Reverse video off
• Blink on	• Protect on
• Blink off	• Protect off
• Underscore on	• Change attributes
• Underscore off	

SCREEN EDIT COMMANDS:

• Erase screen	• Insert character
• Erase window	• Delete character
• Erase end-of-line	• Insert line
• Erase unprotected	• Delete line
• Set margins	• Insert line between margins
• Set alternate margins	• Delete line between margins
• Restore normal margins	

TERMINAL DEVICE COMMANDS:

• Reset	• Read model ID
• Bell	• Select 7/8 Bit operation
	• Set Keyboard Language

PRINTER COMMANDS:

• Form Bit Dump	• Print pass through on
• Print window	• Print pass through off
• Print form	• Window Bit Dump

CHARACTER SET SELECT COMMANDS:

• Select character set	• Shift-Out
• Shift-In	

CUSTOM CHARACTER AND CHARACTER GRAPHICS COMMANDS (D450 only):

• Define character	• Bar
• Set pattern	• Initialize Draw
• Line	• Read characters remaining

Table C-2.   D410/460 Terminal Command Set in ANSI Mode

SCREEN MANAGEMENT COMMANDS:

• Set windows
• Read offset/Show columns
• Scroll down
• Scroll up
• Scroll left
• Scroll right
• Set parameters

CURSOR COMMANDS:

• Carriage return	• Device status report
• Cursor down	• Form feed
• Cursor backward	• New line
• Cursor position	• Screen position
• Cursor forward	• Set parameters
• Cursor up	

CHARACTER ATTRIBUTE COMMANDS:

• Change attributes
• End protected area
• Select graphic rendition
• Start protected area

SCREEN EDIT COMMANDS:

• Delete character
• Delete line
• Erase in display
• Erase in line
• Insert character
• Insert line
• Set margins

TERMINAL DEVICE COMMANDS:

• Bell	• Reset to initial state
• Read terminal configuration	• Xoff
	• Xon

PRINTER COMMANDS:

• Media copy

CHARACTER SET SELECT COMMANDS:

• Set parameters	• Single shift two
• Shift in	• Single shift three
• Shift out	• Select character set

CUSTOM CHARACTER AND CHARACTER GRAPHICS COMMANDS (D450 only):

• Bar	• Read/reverse characters
• Define character	
• Line	
• Set pattern	

SELECT MODE COMMANDS:

• Reset Mode
• Set Mode

Table C-3. D400/450-Common Commands

Command Name	Octal Form	ASCII/Keyboard Form	D100/200 Compatible (X'ed)
Bell	⟨007⟩	CTRL-G	X
Blink disable	⟨004⟩	CTRL-D	X
Blink enable	⟨003⟩	CTRL-C	X
Blink off	⟨017⟩	CTRL-O	X
Blink on	⟨016⟩	CTRL-N	X
Carriage return	⟨015⟩	CTRL-M	X
Change attributes	⟨036⟩⟨106⟩⟨116⟩⟨nnn⟩⟨n⟩⟨n⟩	⟨036⟩FN...	
Cursor down	⟨032⟩	CTRL-Z	X
Cursor left	⟨031⟩	CTRL-Y	X
Cursor right	⟨030⟩	CTRL-X	X
Cursor up	⟨027⟩	CTRL-W	X
Delete character	⟨036⟩⟨113⟩	⟨036⟩K	
Delete line	⟨036⟩⟨106⟩⟨111⟩	⟨036⟩Fl	
Delete line between margins	⟨036⟩⟨106⟩⟨134⟩	⟨036⟩F⟨	
Dim off	⟨035⟩	CTRL-}	X
Dim on	⟨034⟩	CTRL-\	X
Erase end-of-line	⟨013⟩	CTRL-K	X
Erase screen	⟨036⟩⟨106⟩⟨105⟩	⟨036⟩FE	
Erase unprotected	⟨036⟩⟨106⟩⟨106⟩	⟨036⟩FF	
Erase window	⟨014⟩	CTRL-L	X
Form bit dump	⟨036⟩⟨106⟩⟨077⟩⟨066⟩	⟨036⟩F?6	
Horizontal scroll disable	⟨036⟩⟨106⟩⟨135⟩	⟨036⟩F]	
Horizontal scroll enable	⟨036⟩⟨106⟩⟨136⟩	⟨036⟩F ^	
Insert character	⟨036⟩⟨112⟩	⟨036⟩J	
Insert line	⟨036⟩⟨106⟩⟨110⟩	⟨036⟩FH	
Insert line between margins	⟨036⟩⟨106⟩⟨133⟩	⟨036⟩F[	
New line	⟨012⟩	CTRL-J	X
Print form	⟨001⟩	CTRL-A or SHIFT-Local Print	X
Print pass through off	⟨036⟩⟨106⟩⟨141⟩	⟨036⟩Fa	
Print pass through on	⟨036⟩⟨106⟩⟨140⟩	⟨036⟩F`	
Print window	⟨021⟩	CTRL-Q or Local Print	X
Protect disable	⟨036⟩⟨106⟩⟨127⟩	⟨036⟩FW	
Protect enable	⟨036⟩⟨106⟩⟨126⟩	⟨036⟩FV	
Protect off	⟨036⟩⟨106⟩⟨115⟩	⟨036⟩FM	
Protect on	⟨036⟩⟨106⟩⟨114⟩	⟨036⟩FL	
Read horizontal scroll offset	⟨036⟩⟨106⟩⟨117⟩	⟨036⟩FO	
Read model ID	⟨036⟩⟨103⟩	⟨036⟩C	X
Read screen address	⟨036⟩⟨106⟩⟨142⟩	⟨036⟩Fb	
Read window address	⟨005⟩	CTRL-E	X
Reset	⟨036⟩⟨106⟩⟨101⟩	⟨036⟩FA	
Restore normal margins	⟨036⟩⟨106⟩⟨132⟩	⟨036⟩FZ	
Reverse video off	⟨036⟩⟨105⟩	⟨036⟩E	X
Reverse video on	⟨036⟩⟨104⟩	⟨036⟩D	X
Roll disable	⟨023⟩	CTRL-S	X
Roll enable	⟨022⟩	CTRL-R	X
Screen home	⟨036⟩⟨106⟩⟨107⟩	⟨036⟩FG	
Scroll down	⟨036⟩⟨111⟩	⟨036⟩I	
Scroll left	⟨036⟩⟨106⟩⟨103⟩⟨nn⟩	⟨036⟩FC...	
Scroll right	⟨036⟩⟨106⟩⟨104⟩⟨nn⟩	⟨036⟩FD...	
Scroll up	⟨036⟩⟨110⟩	⟨036⟩H	
Select character set	⟨036⟩⟨106⟩⟨123⟩⟨nn⟩	⟨036⟩FS...	
Select compressed spacing	⟨036⟩⟨106⟩⟨113⟩	⟨036⟩FK	
Select normal spacing	⟨036⟩⟨106⟩⟨112⟩	⟨036⟩FJ	
Set alternate margins	⟨036⟩⟨106⟩⟨131⟩⟨nn⟩⟨nn⟩	⟨036⟩FY...	
Set cursor type	⟨036⟩⟨106⟩⟨121⟩⟨n⟩	⟨036⟩FQ...	
Set margins	⟨036⟩⟨106⟩⟨130⟩⟨nn⟩⟨nn⟩	⟨036⟩FX...	
Set scroll rate	⟨036⟩⟨106⟩⟨124⟩⟨n⟩	⟨036⟩FT...	
Set windows	⟨036⟩⟨106⟩⟨102⟩⟨nn⟩⟨n⟩...⟨nn⟩⟨n⟩	⟨036⟩FB...	
Shift in	⟨036⟩⟨116⟩	⟨036⟩N	
Shift out	⟨036⟩⟨117⟩	⟨036⟩O	
Show columns	⟨036⟩⟨106⟩⟨137⟩⟨nn⟩⟨nn⟩	⟨036⟩F_...	
Underscore off	⟨025⟩	CTRL-U	X
Underscore on	⟨024⟩	CTRL-T	X
Window bit dump	⟨036⟩⟨106⟩⟨077⟩⟨065⟩	⟨036⟩F?5	
Window home	⟨010⟩	CTRL-H	X
Write screen address	⟨036⟩⟨106⟩⟨120⟩⟨nn⟩⟨nn⟩	⟨036⟩FP...	
Write window address	⟨020⟩⟨column⟩⟨row⟩	CTRL-P...	X

Table C-4. D410/460-Common Commands in ANSI Standard Mode

Command Name	Octal Form	Keyboard	Command Name	Octal Form	Keyboard
Bell	⟨007⟩	CTRL-G	Reverse Index	⟨033⟩⟨115⟩	⟨ESC⟩M
Carriage Return	⟨015⟩	CTRL-M	Reset To Initial State	⟨RIS⟩	⟨ESC⟩c
Change Attributes	⟨CSI⟩⟨count⟨073⟩⟨on byte⟩ ⟨073⟩⟨off byte⟩⟨161⟩	⟨CSI⟩...;...;...q	Screen Position	⟨CSI⟩⟨row⟩⟨073⟩ ⟨col⟩⟨165⟩	⟨CSI⟩...;...u
Cursor Backward	⟨CSI⟩⟨col⟩⟨104⟩	⟨CSI⟩...D	Scroll Down	⟨CSI⟩⟨# of rows⟩⟨124⟩	⟨CSI⟩...T
Cursor Down	⟨CSI⟩⟨row⟩⟨102⟩	⟨CSI⟩...B	Scroll Left	⟨CSI⟩⟨# of rows⟩ ⟨040⟩⟨100⟩	⟨CSI⟩...(space)@
Cursor Forward	⟨CSI⟩⟨col⟩⟨103⟩	⟨CSI⟩...C			
Cursor Position	⟨CSI⟩⟨row⟩⟨073⟩⟨col⟩⟨110⟩	⟨CSI⟩...;...H	Scroll Right	⟨CSI⟩⟨# of col⟩ ⟨040⟩⟨101⟩	⟨CSI⟩...(space)A
Cursor Up	⟨CSI⟩⟨row⟩⟨101⟩	⟨CSI⟩ ... A	Scroll Up	⟨CSI⟩⟨# of rows⟩⟨123⟩	⟨CSI⟩...S
Delete Character	⟨CS1⟩⟨# of characters⟩⟨115⟩	⟨CSI⟩...P	Select Character Set	⟨033⟩⟨level⟩⟨set⟩	⟨ESC⟩...
Delete Line	⟨CSI⟩⟨# of rows⟩⟨115⟩	⟨CSI⟩...M	Select Graphic Rendition	⟨CSI⟩⟨parameter⟩ ⟨073⟩⟨parameter⟩⟨155⟩	⟨CSI⟩...;...m
Device Status Report	⟨CSI⟩⟨066⟩⟨156⟩	⟨CSI⟩6n	Set Margins	Main Margins: ⟨CSI⟩⟨061⟩ ⟨073⟩⟨left Margin⟩⟨073⟩ ⟨right margin⟩⟨167⟩	⟨CSI⟩1;...;...w
End Protected Area	⟨EPA⟩	⟨ESC⟩w			
Erase In Display	⟨CSI⟩⟨parameter⟩⟨112⟩	⟨CSI⟩...J			
Erase In Line	⟨CSI⟩⟨parameter⟩⟨113⟩	⟨CSI⟩...K		Alternate Margins: ⟨CSI⟩ ⟨062⟩⟨073⟩⟨ROW⟩⟨073⟩ ⟨left margin⟩⟨073⟩ ⟨right margin⟩⟨167⟩	⟨CSI⟩2;...;... ;...w
Form Feed	⟨014⟩	FF			
Horizontal and Vertical Position	⟨CSI⟩⟨row⟩⟨073⟩ ⟨col⟩⟨104⟩	⟨CSI⟩...;...f		Return to Main Margins: ⟨CSI⟩⟨167⟩ or ⟨CSI⟩⟨060⟩⟨167⟩	⟨CSI⟩w or ⟨CSI⟩0w
Index	⟨033⟩⟨104⟩	⟨ESC⟩D	Set Mode	⟨CSI⟩⟨mode⟩⟨073⟩ ⟨mode⟩⟨150⟩	⟨CSI⟩...;...h
Insert Character	⟨CSI⟩⟨# of char⟩⟨100⟩	⟨CSI⟩...@			
Insert Line	⟨CSI⟩⟨# of rows⟩⟨114⟩	⟨CSI⟩...L	Set Parameters	⟨CSI⟩⟨parameter⟩ ⟨073⟩⟨parameter⟩⟨166⟩	⟨CSI⟩...;...h
Media Copy	⟨CSI⟩⟨151⟩	⟨CSI⟩i	Set Windows	⟨033⟩⟨120⟩⟨104⟩ ⟨nn⟩⟨n⟩...⟨nn⟩⟨n⟩ ⟨033⟩⟨134⟩	⟨DCS⟩D...⟨ST⟩
New Line	⟨012⟩	CTRL-J			
Next Line	⟨033⟩⟨105⟩	⟨ESC⟩E			
Read Terminal Configuration	⟨CSI⟩⟨162⟩	⟨CSI⟩r	Start Protected Area	⟨SPA⟩	⟨ESC⟩V
Read Offset/Show Columns	Show columns: ⟨CSI⟩⟨161⟩⟨073⟩ ⟨left col⟩⟨073⟩ ⟨right col⟩⟨164⟩	⟨CSI⟩1;...;...t	Shift In	⟨017⟩	CTRL-O
			Shift Out	⟨016⟩	CTRL-N
			Single Shift Two	⟨SS2⟩	⟨ESC⟩N
	Read Offset: ⟨CSI⟩⟨060⟩⟨164⟩	⟨CSI⟩0t (0 optional)	Single Shift Three	⟨SS3⟩	⟨ESC⟩O
			XOFF	⟨023⟩	CTRL-S
Reset Mode	⟨CSI⟩⟨mode⟩⟨073⟩ ⟨mode⟩⟨154⟩	⟨CSI⟩...;...l	XON	⟨021⟩	CTRL-Q

Table C-5. D460-Unique Commands in DG Mode

Command Name	Octal Form	ASCII/Keyboard Form
Bar	⟨036⟩⟨107⟩⟨061⟩⟨loc⟩⟨width⟩⟨height⟩ ⟨color⟩	⟨036⟩G1...
Define character	⟨036⟩⟨106⟩⟨122⟩⟨char⟩⟨dd⟩...⟨dd⟩	⟨036⟩FR...
Line	⟨036⟩⟨114⟩⟨loc⟩...⟨loc⟩⟨000⟩ or ⟨036⟩⟨107⟩⟨070⟩⟨loc⟩.. ⟨loc⟩⟨000⟩	⟨036⟩L... or ⟨036⟩G8...
Read characters remaining	⟨036⟩⟨106⟩⟨144⟩	⟨036⟩Fd
Initialize Draw	⟨036⟩⟨106⟩⟨145⟩ ⟨n⟩⟨n⟩	⟨036⟩Fe...
Set pattern	⟨036⟩⟨107⟩⟨160⟩⟨061⟩⟨offset⟩⟨pattern— definition⟩⟨000⟩	⟨036⟩Gp1...

Table C-6. D460-Unique Commands in ANSI Mode

Command Name	Octal Form	ASCII/Keyboard Form
Bar	⟨CSI⟩⟨loc⟩⟨073⟩⟨width⟩⟨073⟩ ⟨height⟩⟨073⟩⟨color⟩⟨160⟩	⟨CSI⟩...;...;...;...p
Define Character	⟨DCS⟩⟨101⟩⟨char⟩⟨dd⟩... ⟨dd⟩⟨ST⟩	⟨DCS⟩A...⟨ST⟩
Line	⟨DCS⟩⟨102⟩⟨loc⟩...⟨loc⟩⟨ST⟩	⟨DCS⟩B...⟨ST⟩
Read/Reserve Characters	⟨CSI⟩⟨163⟩ or ⟨CSI⟩⟨060⟩⟨163⟩ ⟨CSI⟩⟨061⟩⟨073⟩⟨set⟩ ⟨073⟩⟨nnn⟩⟨163⟩	⟨CSI⟩s or ⟨CSI⟩ s ⟨CSI⟩q;...;...;
Set Pattern	⟨DCS⟩⟨103⟩⟨offset⟩ ⟨pattern definitions⟩⟨ST⟩	⟨DCS⟩C...⟨ST⟩

APPENDIX D
EUROPEAN KEYBOARDS

The D410/460 terminal can be equipped with a keyboard from one of eleven different countries (nationalities). The differences between the keyboards for the various nationalities lies with the keycaps on the main keypad. The United States keyboard is shown and described in the Operation Chapter of this manual. This appendix shows the main keypad keycaps for the following ten European keyboards:

- Canadian/Bilingual

- Danish/Norwegian

- French

- German

- Italian

- Spanish

- Swedish/Finnish

- Swiss/French

- Swiss/German

- United Kingdom
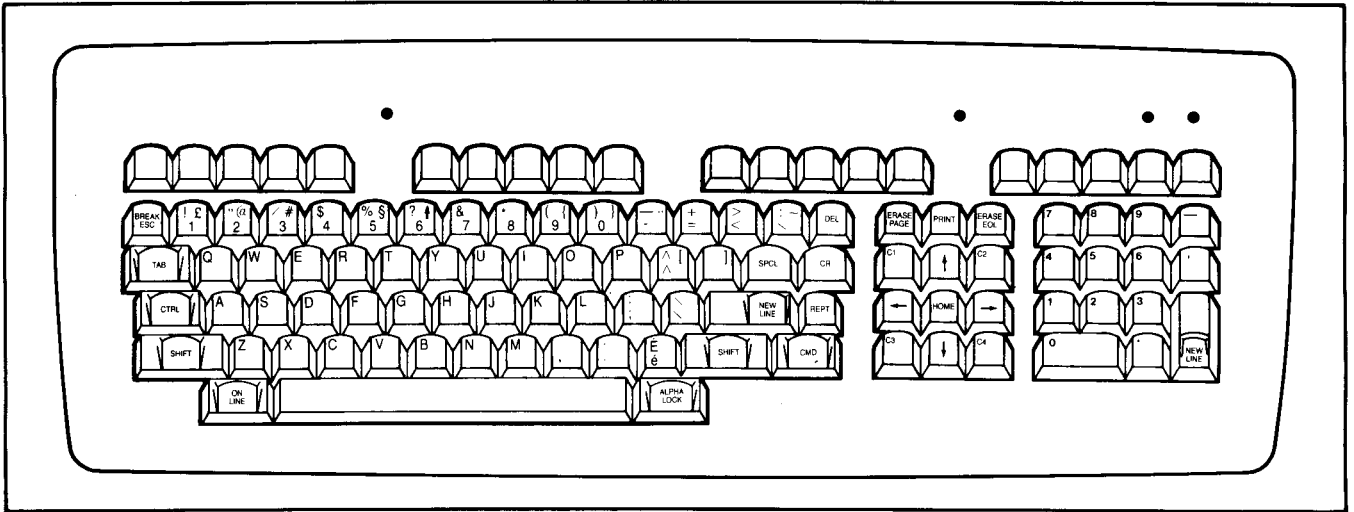
Figure D-1.   Canadian/Bilingual Main Keyboard
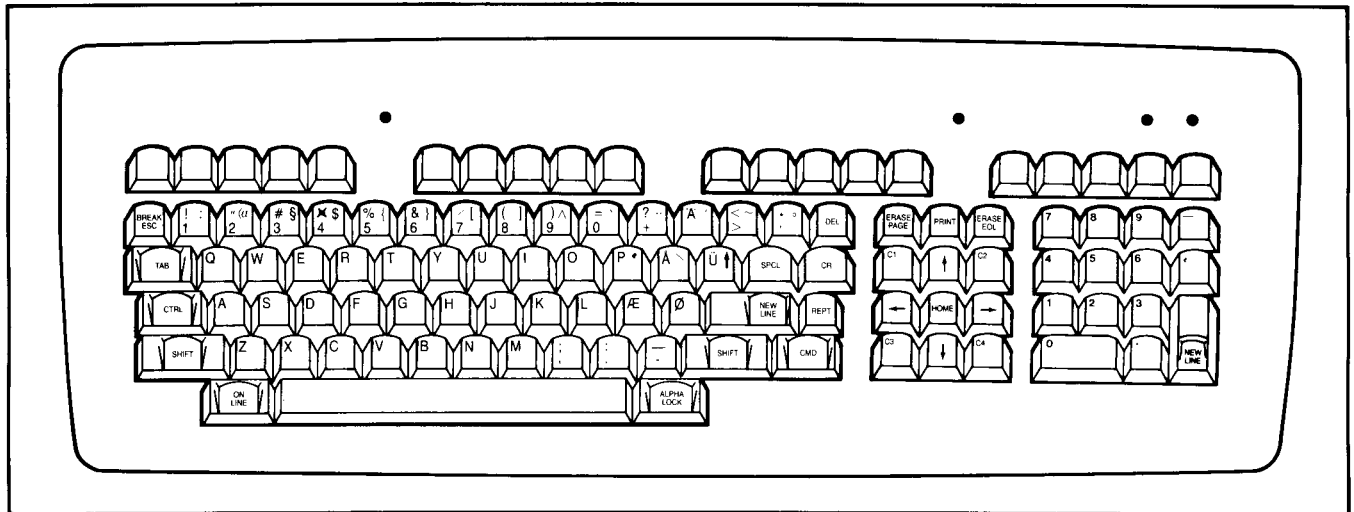
Figure D-2.   Danish/Norwegian Main Keyboard
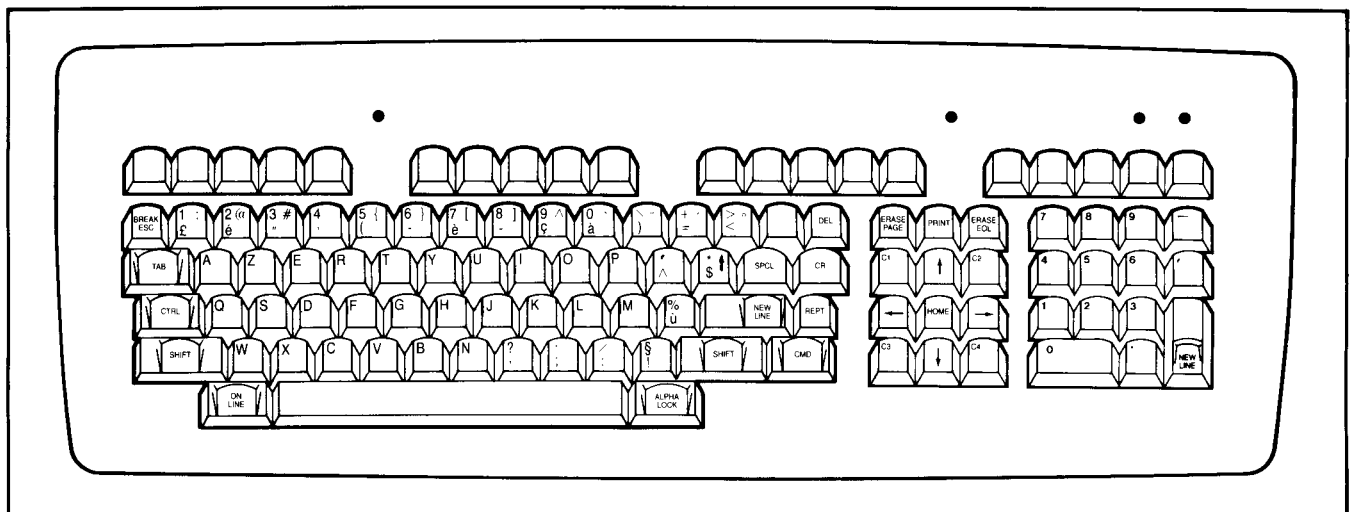
Figure D-3.   French Main Keyboard
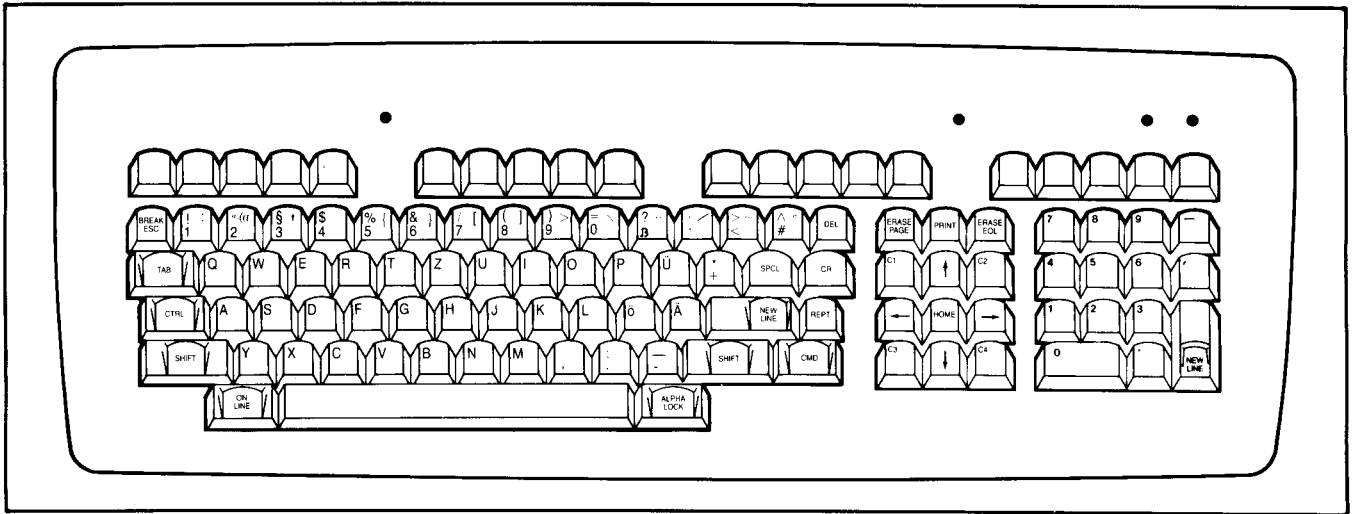
Figure D-4.   German Main Keyboard
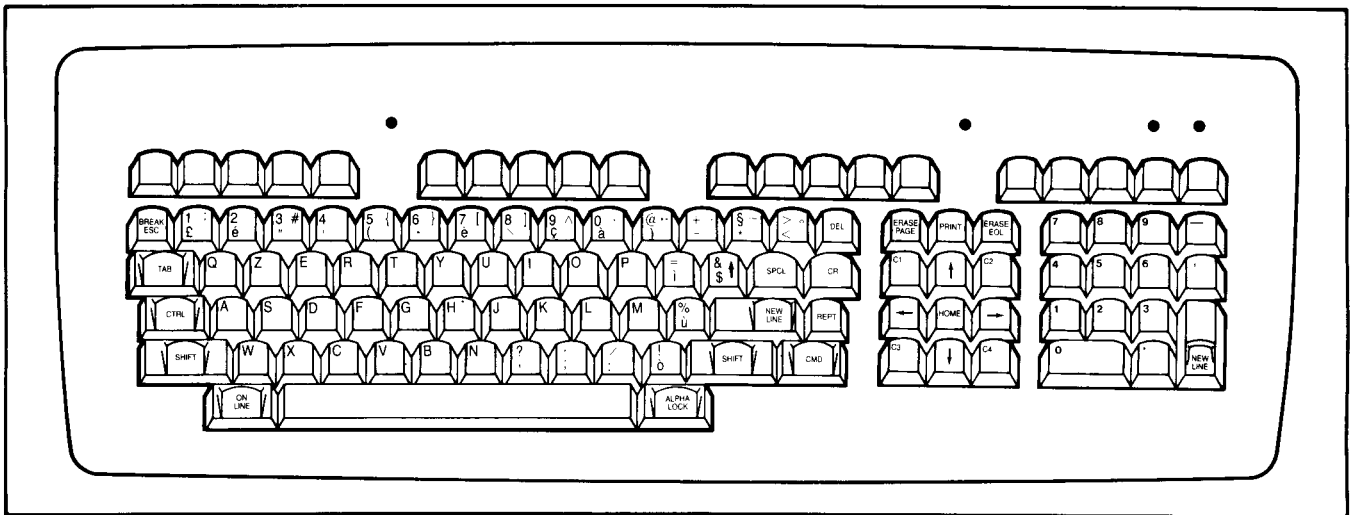
Figure D-5.   Italian Main Keyboard
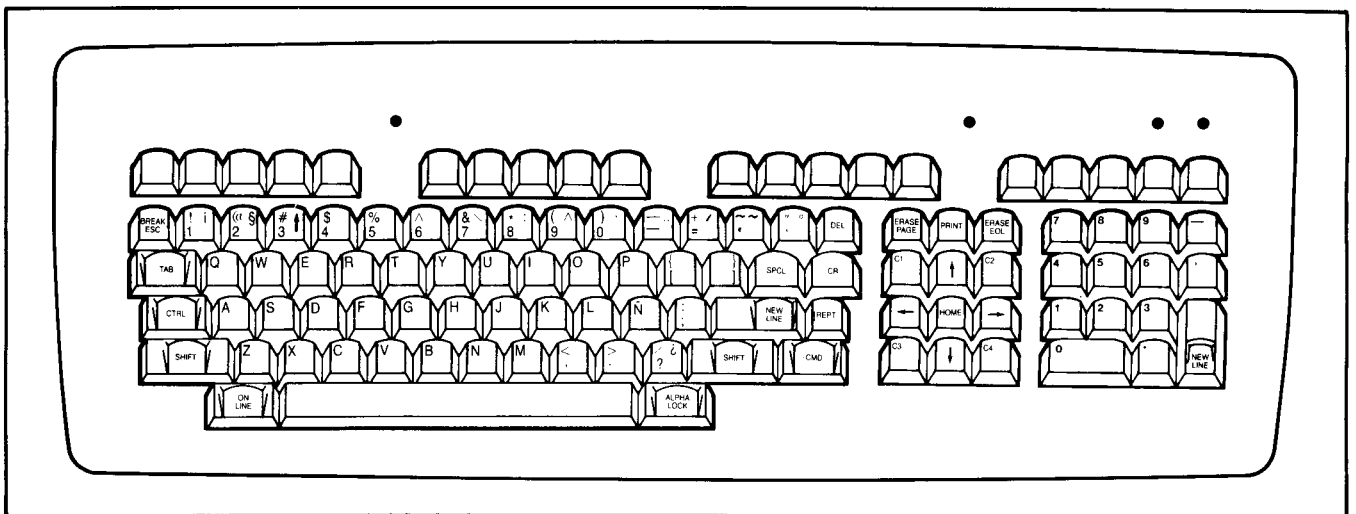
Figure D-6.   Spanish Main Keyboard
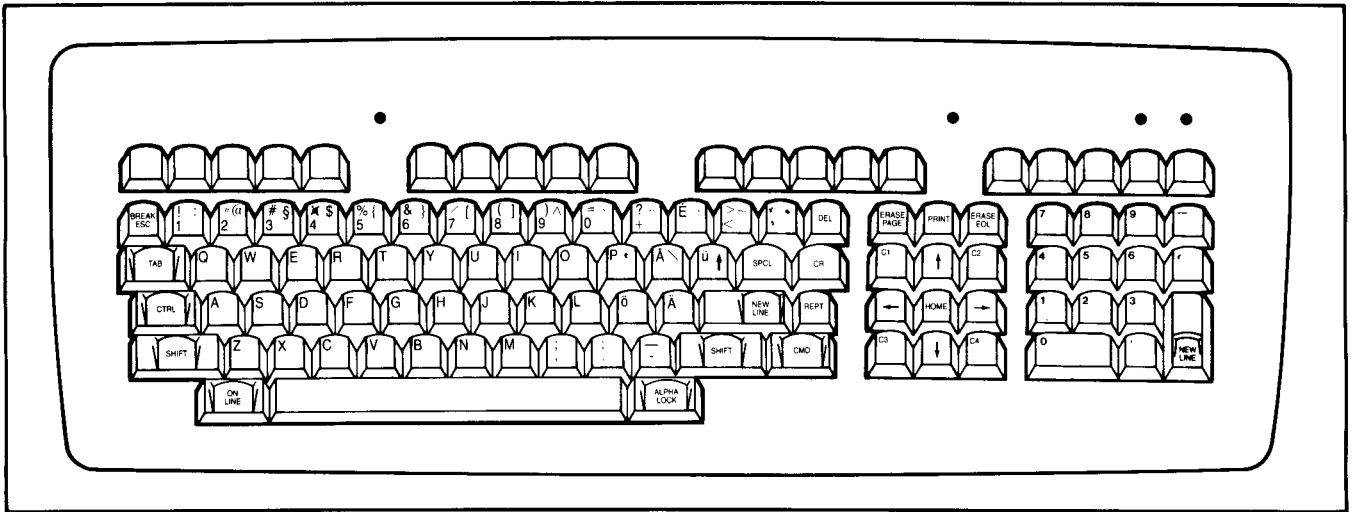
Figure D-7.   Swedish/Finnish Main Keyboard
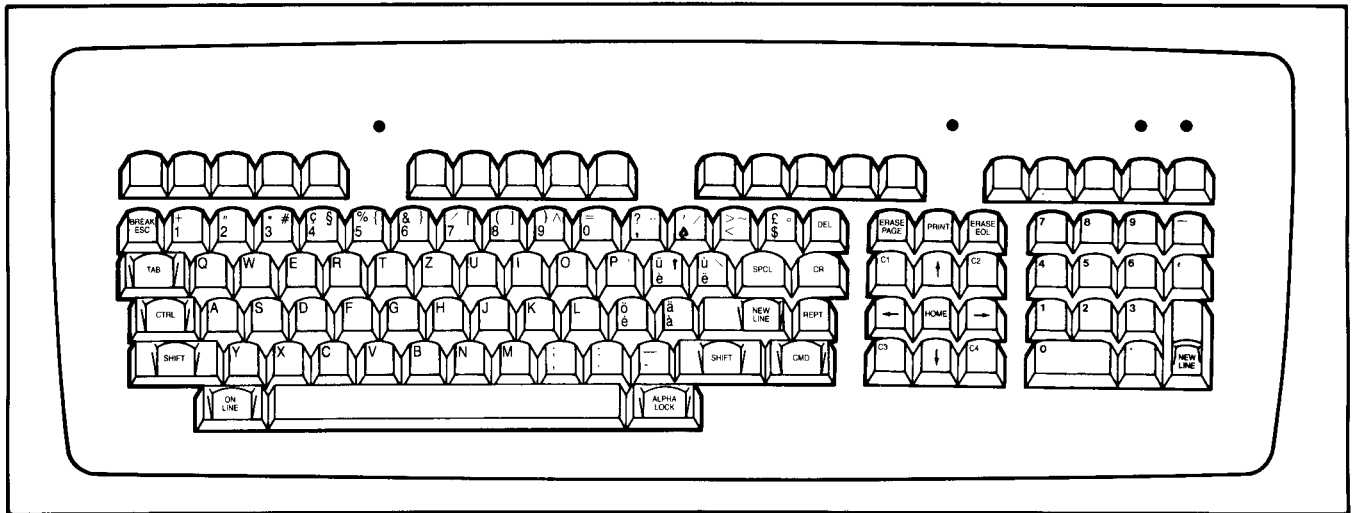
Figure D-8.   Swiss/French Main Keyboard
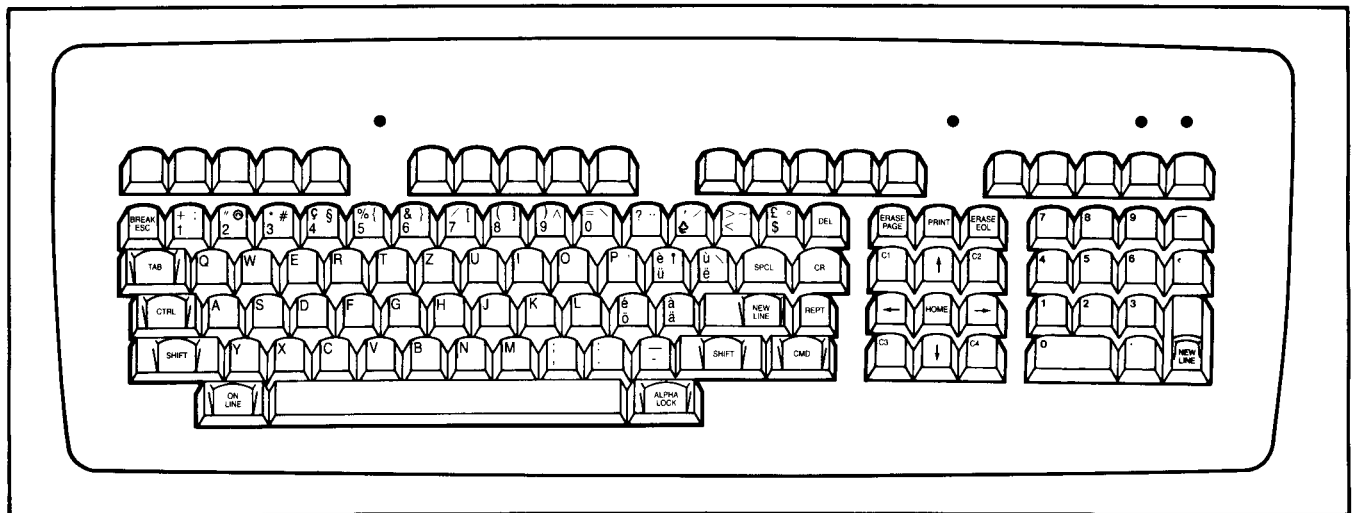
Figure D-9.   Swiss/German Main Keyboard
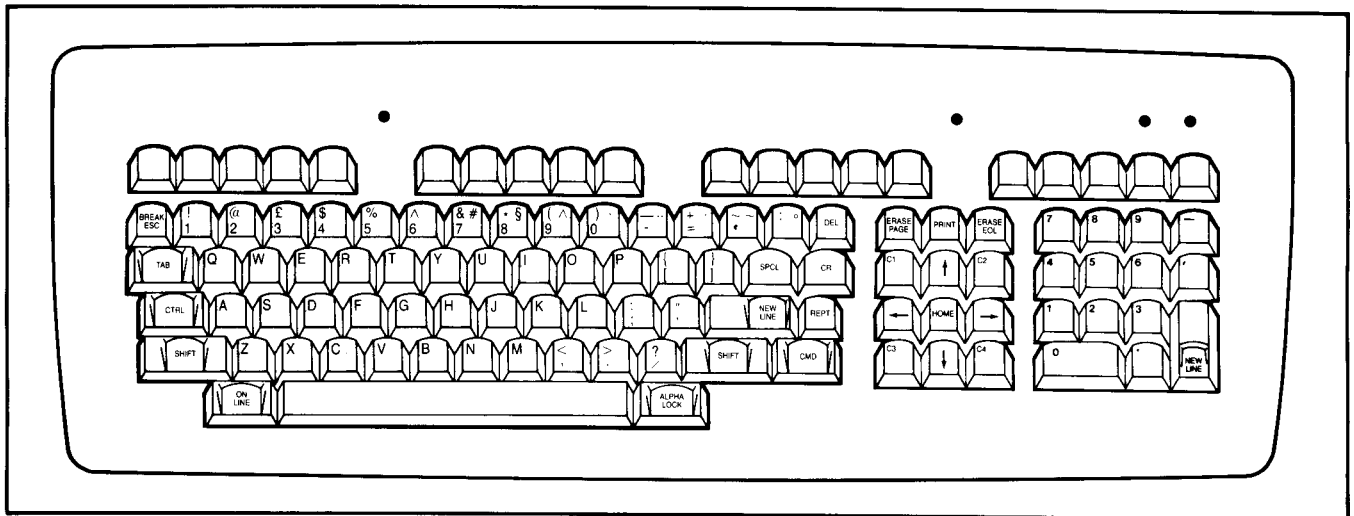
Figure D-10. U.K. Main Keyboard

GLOSSARY

ANSI   American National Standards Institute, Inc., an organization that presents a standard coded character set used for information interchange among information processing systems, communications systems, and associated equipment.

ASCII   American Standard Code for Information Interchange, one of the standards used to translate alphanumeric and control characters into binary numbers. The ASCII code assigns a unique binary number to each symbol (letters, digits, punctuation marks, etc.) and control character.

Alphanumeric   A set of alphabetic, numeric, and other character symbols.

Argument   An independent variable upon whose value the execution of a command depends. Some D400/450 commands include one or more arguments that combine with the command to define an action to be taken by the terminal.

Attribute   For display terminals, an attribute is a characteristic associated with a character position on the display screen. For the D400/450 terminal, each character position can be programmed with five attributes: blink, dim, underscore, reverse video, and protect.

Baud   The number of bits transmitted serially each second over a communication line.

Binary   A numbering system with a radix of two; the two numerals used are 0 and 1.

Bit   A binary digit with a value of either 0 or 1.

Buffer   A temporary storage area for data often used to compensate for the difference in data handling capacities between a transmitting device and a receiving device.

Byte   A group of 8 bits.

Cathode Ray Tube (CRT)   A vacuum tube with a screen and a controlled beam of electrons often used as a display device.

Character   A member of a set of elements used to represent information. Characters are classified in groups, such as alphabetical characters, numeric characters, special sign and symbol characters, and control characters that direct device operations.

Character code   A combination of bits that represent a character in a character set.

Character set   A collection of characters grouped together for a special purpose.

Command   A string of characters that combine to direct a device operation. All D410/460 terminal operations are controlled with the commands defined in the Programming Chapter.

Cursor   A visible marker on the display screen identifying the character position destined to hold the next character for display. For the D410/460 terminal, the cursor may appear as a solid block, blinking block, blinking underscore, or invisible.

Data   A general expression for the information that moves through a computer system or device.

Delimit   To establish the limits or bounds of something; some of the D410/460 commands require delimiter characters to mark their end.

Dot matrix   A rectangular pattern of dots used to form characters for display, also called a character cell. The characters for the D410/460 terminal are all formed in a rectangular pattern that is 10 dots wide and 12 dots high (normal character spacing) or 12 dots wide and 12 dots high (compressed character spacing).

Download   The process whereby data is transmitted from a host device and retained in

EIA Electronic Industries Association, an organization that establishes standards for electronic equipment.

Firmware Programming instructions retained in Read Only Memory (ROM) that can be executed by a computer just like software in Random Access Memory (RAM).

Full duplex A mode of serial data communication which takes place between two points in both directions simultaneously.

Graphics The science of communicating information with artwork, text, special symbols, etc. For the D410/460 terminal, graphics refers to the display of artwork and text symbols with the aid of a host computer (computer graphics).

Hardware The physical equipment comprising the devices in a computer system.

Hexadecimal A numbering system with a radix of 16; the characters used to represent a hexadecimal number range from 0 to 9 and A to F.

Host Computer The computer controlling operation of a device, such as the D410/460 terminal.

Margins For the D410/460 terminal, the margins define the columns between which the cursor is free to move. The margin settings (column numbers) are programmable and may define a column range running from 1 to 162.

Matrix A two-dimensional rectangular array organized into columns and rows.

Microprocessor An electronic component (or part) that contains all the circuits necessary to fetch and execute instructions in a program.

Monochrome A single color system; for the D410/460 terminal green is displayed on black.

Nibble A group of 4 bits.

Octal A numbering system with a radix of eight; the numerals used to represent

a receiving device. For the D410/460 terminal, the custom character definitions can be transmitted from the host computer and retained in the terminal.

an octal number range from 0 to 7. In this manual, octal numbers are enclosed in angle brackets (⟨octal number⟩).

Off-line The state of a device, such as the D410/460 terminal, when it is not in communications with a host device.

On-line The state of a device when it is communicating with a host device.

Operating System The software resident in the host computer that controls the overall operation of the computer system.

Parity An extra bit that is added to the code for each character and is used for error detection. When odd parity is used, the parity bit is set so the number of binary 1s in a character is odd; for even parity, the parity bit is set to maintain an even number of 1s. Errors can be detected by checking for the correct count of 1s in a character.

Pixel A picture element or dot; the smallest element on the display screen that can be illuminated or darkened individually. For the D410/460 terminal with normal character spacing in effect, there are 810 pixels across the width of the display screen; with compressed spacing, there are 1215 pixels across the screen. In both cases there are 12 pixels for each character row (24 rows = 288 pixels).

Program A sequence of instructions or commands that are interpreted by a computer (or microprocessor) to control its operation and the operation of connected devices to perform a specific function.

Query A command issued by a device requesting selected information from another device. Several of the D410/460 commands allow the host computer to request various types of status information from the terminal.

Read/write For the D410/460 terminal, a type of memory that retains data written into it until power is turned off (volatile) or until new data is written over the old data.

Raster scan A method of display information on a CRT. A raster scan consists of sweeping an electron beam across a display screen on a line-by-line basis, turning

on pixels as required to create the desired image.

Read Only Memory (ROM) A type of computer memory that retains data written into it permanently. For the D410/460 terminal, ROM is used to hold firmware that must remain intact when power is turned off.

Serial communication The process whereby bits are transmitted and received one at a time. On a communication line, a character consists of a string of bits, and is not recognized at the receiving end until all of the bits have been received.

Software A collection of instructions (commands) and data that are interpreted and executed by a computer to control the hardware in a computer system. Software is a general term for all the binary data that can be manipulated in a computer system.

Terminal An input/output device that an operator can use to communicate with a computer system, usually in an interactive mode. The D410/460 terminal displays output data on its screen and accepts operator inputs through its keyboard.

UART Universal Asynchronous Receiver Transmitter, used to transmit and receive data serially. The UARTs in the D410/460 terminal are responsible for communications with the host computer and optional printer.

Window For the D410/460 terminal, a window consists of one or more consecutive character rows on the display screen. A window may contain from 1 to 24 rows; there may be from 1 to 24 windows on the display screen. The active window contains the cursor and has all the features of a full display screen.

INDEX

▲ Data General
users group

Installation Membership Form

Name _____ Position _____ Date _____

Company, Organization or School _____

Address _____ City _____ State _____ Zip _____

Telephone: Area Code _____ No. _____ Ext. _____

---

1. Account Category

- ☐ OEM
- ☐ End User
- ☐ System House
- ☐ Government

2. Hardware

	Qty. Installed	Qty. On Order
M/600		
C/350, C/330, C/300		
S/250, S/230, S/200		
S/130		
AP/130		
CS Series		
N3/D		
Other NOVA		
microNOVA		
Other (Specify)		

3. Software

- ☐ AOS
- ☐ DOS
- ☐ SOS
- ☐ RDOS
- ☐ RTOS
- ☐ Other

Specify _____

4. Languages

- ☐ Algol
- ☐ DG/L
- ☐ Cobol
- ☐ ECLIPSE Cobol
- ☐ Business BASIC
- ☐ BASIC
- ☐ Assembler
- ☐ Interactive
- ☐ Fortran
- ☐ RPG II
- ☐ PL/1
- ☐ Other

Specify _____

5. Mode of Operation

- ☐ Batch (Central)
- ☐ Batch (Via RJE)
- ☐ On-Line Interactive

6. Communications

- ☐ RSTCP
- ☐ HASP
- ☐ RJE80
- ☐ SAM
- ☐ CAM
- ☐ 4025
- ☐ Other

Specify _____

7. Application Description

○ _____

8. Purchase

From whom was your machine(s) purchased?

- ☐ Data General Corp.
- ☐ Other
  Specify _____

9. Users Group

Are you interested in joining a special interest or regional Data General Users Group?

○ _____

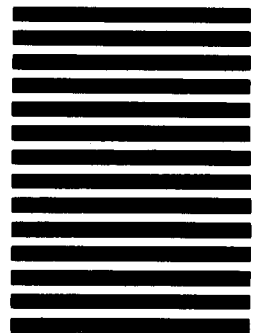# ▲ Data General

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