Programming the Display Terminal: Models D217, D413, and D463

014–002111–00
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Preface

This manual provides information on the programming environment of the D217, D413, and D463 display terminals. Intended for persons programming host–resident software, this manual was designed as a reference tool and does not explain basic operating functions of these terminals. Refer to Installing and Operating D216E+, D217, D413, and D463 Display Terminals (014–001767) for information on operating one of these terminals.

This reference manual is organized as described below:

Chapter 1 Characteristics of the programming environment that are common to all operating modes or emulations; everyone should read this chapter.

Chapter 2 Data General native–mode operations and commands.

Chapter 3 VT320, VT100, and VT52 emulations and control sequences.

Chapter 4 Tektronix® 4010 emulation and commands.

Chapter 5 PCTERM operation and commands. Although PCTERM is actually an operating mode of the VT320/100 emulation, it is covered within its own chapter to avoid confusion within Chapter 3.

Appendix A Tables of all character sets used in any emulation or operating mode.

Appendix B Keyboard layouts for all national–language keyboards supported on these terminals.

Appendix C Sample code (in C and FORTRAN 77) that illustrates the programming environment within several emulations.

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End of Preface
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<td>3-84</td>
</tr>
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<td>3-84</td>
</tr>
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Chapter 1
Introduction

This chapter provides a brief introduction to the programming environment of the D217/ D413/D463 line of Data General terminals. This chapter has the major sections listed below.

Terminal Features
- Enhancements for the D413/D463
- Supported Emulations and Modes
- Summary of On-Line Operations
- Communications Interface
- Input Buffer
- Flow Control
- The Character Generator
- 25th Row Support
- Term-Server Support

Information on operating one of these terminals is contained within *Installing and Operating Your D216E+, D217, D413, and D463 Display Terminal* (014–001767).
Terminal Features

The D217/D413/D463 terminals provides maximum compatibility with both the DASHER/D200 and the expanded set of D460 primitives for the interactive applications programmer. Listed below are some of the main programming features:

- 25 lines of 80 characters displayed in a 10 x12 dot matrix on the D217
- 25 lines of 81 characters displayed in a 10 x 12 dot matrix in normal mode on the D413/D463, and 25 lines of 135 characters displayed in a 6 x 12 dot matrix in compressed mode on the D413/D463
- Bidirectional vertical scrolling on all models
- D200 upward compatibility on all models
- UNIX®-friendly protocol mode that simplifies terminfo file specifications on all models
- DEC® VT320, VT100, and VT52 emulations on the D413/D463
- PCTERM operating mode of VT100 emulation on all models
- Full-screen configuration set-up menus on all models
- Smooth vertical scrolling on the D413/D463
- Horizontal scrolling across 207 columns on the D413/D463
- Up to 25 scroll areas, or windows on the D413/D463
- Advanced editing features on the D413/D463
- Protected text on the D413/D463
- Tektronix® 4010 emulation on the D463
- Extended graphics with the Line, Arc, Bar, and Polygon Fill commands on the D463
- Graphics cursor for graphics input, controllable by keyboard or mouse on the D463
- Page and field attributes
- Double high and double wide rows selectable on all models.
Enhancements for the D413/D463

The D217/D413/D463 has significant improvements over the previous generation Data General terminals. These improvements allow wider system support and enhanced features:

- New diacritical (Spcl) key sequences allow access (using the ALT key) of new characters in the Data General International (DGI) character set on all models
- ISO 8859/1.2 Latin–1 compliant character set available in both Data General native–mode and VT emulations on all models
- Added bell to IBM PC AT style (101 key) keyboard
- No downloadable character sets on the D413
- Cmd–Cursor Uparrow/Downarrow enables/disables split screen on the D413/D463 and moves the split point up and down
- Cmd–Shift–Cursor Uparrow/Downarrow moves the active emulation viewing region up and down

Supported Emulations and Modes

The terminals support the following emulation or operational modes:

- Data General native–mode on all models
- VT100/VT52 on all models
- PCTERM (an operational mode of the VT320/100 emulation, PCTERM is treated as a separate emulation in this manual to avoid confusion within the VT320/100 sections) on all models
- VT320 on the D413/D463
- Tektronix 4010 on the D463
Summary of On-Line Operations

The terminal consists of two major units: the keyboard and the display unit. The keyboard is an input device that generates ASCII characters that are interpreted by the host computer. The display unit is an output device. It interprets commands from the host to control the screen image. The display unit also serves as a link between the host and any printer attached to the terminal.

Input from the keyboard consists of commands and characters. Characters entered at the keyboard for display must be forwarded to the display unit by the host (in full duplex mode only). Commands are either forwarded to the host or are used to invoke special functions in the host software.

The display unit, responding to the ASCII display and control characters, is primarily an output device for the host. A few of the ASCII character sequences or commands request status or configuration information from the display unit. In these cases, the display unit also functions as an input device.

Communications Interface

The terminal uses an asynchronous serial communication interface. The host computer and optional printer are connected to the display unit via serial interfaces. You can select the terminal transmit and receive baud rates, and other serial characteristics, through the Configuration Menu (accessed by simultaneously pressing the Cmd and N/C keys on the 107-key, Data General Proprietary keyboard or rightmost Ctrl and Scroll Lock keys on the 101-key IBM PC AT-style keyboard). Even though the bit transmission rate is set with the baud-rate settings, compatibility with Data General operating systems requires that the terminal transmit characters to the host at a maximum rate of 60 characters per second (paced transmissions). The actual transmission rate falls below this when baud rates below 600 are selected. The character transfer rate is menu-selectable so that other systems, such as UNIX, can take advantage of unpaced transmissions.

Input Buffer

The terminals process 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 uses a 256-byte input buffer to accumulate characters the display unit is unable to interpret immediately. The characters are held in the buffer until the terminal is ready to accept them. This commonly occurs when the transmission rate is 9600 baud or higher, or when the terminal performs smooth-scrolling operations.
Flow Control

As the input buffer approaches its capacity, the terminal can automatically issue a Ctrl–S (DC3) to signal the host to stop transmitting characters. A Ctrl–S is sent automatically when the number of characters in the buffer reaches a menu–selected value of 64, 128, or 192. You can also choose in menus not to send any Ctrl–S, regardless of the state of the buffer. If the host does not immediately respond to the Ctrl–S by ceasing the flow of characters, the terminal sends another Ctrl–S after eight more characters have been received, and continues to send a Ctrl–S after each eight characters until either the host responds or the buffer fills. If the buffer fills before the host responds, the terminal sends a Ctrl–S back to the host for every character received. When the input buffer falls to 32 enqueued characters, the terminal sends a Ctrl–Q (DC1) to the host, signaling it to resume transmission. The host should respond before the input buffer empties, to avoid a stuttering effect on the display screen.

The Character Generator

All terminals are equipped with a 512–character Character Generator (CGEN), which resides in terminal ROM. All hard (ROM–resident) character sets in any mode or emulation are composed of a subset of the characters in the CGEN. Listed below are the sets of predefined characters that comprise the CGEN:

- U.S. ASCII characters
- Foreign language characters (National Replacement Characters)
- Word Processing with math, Greek, forms, superscripts and subscripts
- PC characters
- DEC VT characters
- ISO (international) characters
- Data General international characters
- Japanese Katakana (phonetic) characters
- Line drawing characters
25th Row Support

All terminals and emulations, except the Tektronix 4010, support a redefineable status line. This means that the status line can be treated as the 25th line on the screen. Thus, when this mode is enabled the screen rows run from 0 through 24, instead of the 0 through 23 range that was standard on previous terminals. Refer to the emulation chapters for additional information on the particular usage of this mode within that emulation.

Term–Server Support

The Cmd–C3 keystroke combination on 107–key proprietary Data General keyboards (or rightmost Ctrl and End keys on 101–key IBM PC AT–style keyboards) generates a special code (1C hex, 034 octal) that we provided for persons using term–servers. This code can be used to initiate a macro inside the term–server that switches to a new host computer and sends a code to the terminal to change to the appropriate emulation. Allowing the term–server to handle this process keeps the host computer and the emulation mode synchronized. The alternative is having the user manually tell the term–server to change to a new host and then manually change the emulation mode on the terminal. Full details on switching emulations is included within the appropriate emulation chapters.

End of Chapter
Chapter 2
Data General Native–Mode

This chapter provides the programming information for Data General native–mode operations on the D217/D413/D463 terminals. This chapter has two major sections:

Data General Native–Mode Summary of Operations

Data General Native–Mode Commands

Information regarding functions and operations of the terminal that apply to all modes or emulations is covered in Chapter 1. Additional information on keyboard layouts and various Data General native–mode reference material are covered in appendices, located at the rear of this manual.
Command Syntax and Code Conventions

Throughout this manual, there are certain conventions used whenever Data General native-mode commands are explained or referenced. These conventions are:

- Any value enclosed within angle brackets ( < > ) is in octal, except command or location arguments.

- Values in the form of <n>, <nn>, and <nnn> are location arguments. These values are always (except in UNIX mode, see Table 2-8) expressed in DG-hex. For more information on command arguments (and DG-hex), see "Forming Command Arguments.”

- Values in the form of <NNN> are location arguments. These values are always (except in UNIX mode) expressed with ASCII characters from “@” through “”. For more information on location arguments, see “Forming Location Arguments.”

- Spaces are often included within a command to separate characters for clarity. When entering a command, do not enter these spaces. If a space is part of a command, it will be written as <space>. 
Data General Native–Mode
Summary of Operations

This section summarizes the operations information specific to Data General native–mode. This section does not cover format or usage of Data General native–mode commands, which are covered in "Data General Native–Mode Commands," later in this chapter.

This section covers the information listed below:
- Data General Native–Mode Features
- Command Syntax and Code Conventions
- Keyboard Character Generation
- Forming Command Arguments
- Forming Location Arguments
- Character Sets
- Graphics
- Windows
- Lead-In Codes
- UNIX Support
- Host–Programmable Function Keys
- Debugging Support
- Dual Emulation Support

Information regarding functions of the terminal that apply to all modes or emulations is covered in Chapter 1. Additional information on keyboard layouts and various Data General native–mode reference material are contained within appendices, which are located at the rear of this manual.
Data General Native–Mode Features

All terminals provide maximum compatibility with the D200 and the expanded set of D400 primitives for the interactive applications programmer. Listed below are some of the main programming features of these terminals in Data General native–mode:

- 25 lines of 81 characters displayed in a 10 x 12 dot matrix in normal mode
- 25 lines of 135 characters displayed in a 6 x 12 dot matrix in compressed mode on the D413/D463
- 25 lines of 80 characters displayed in a 10 x 12 dot matrix on the D217
- D200 upwardly compatible with all models
- UNIX–friendly protocol mode that simplifies terminfo file specifications on all models
- 25th row can be configured as a status line, an extra screen line, a blank row, or as a host programmable row on all models
- Supports both IBM PC AT–style (101 key) and Data General proprietary (107–key) keyboards on all models
- IBM PC printer supported in character and graphics modes on all models
- IBM PC compatible character set available on all models
- ISO 8859/1.2 Latin–1 compliant character set available on all models
- Bidirectional vertical smooth scrolling on the D413/D463
- Horizontal scrolling across 207 columns on the D413/D463
- Up to 25 scroll areas, windows, on the D413/D463
- Enhanced editing commands on the D413/D463
- Protected text on the D413/D463
- Split–screen, dual–host mode on the D413/D463
- Hot–key switch between hosts, or between emulations on a single host, on the D413/D463
- Up to 37 sets of up to 94 characters on the D463, for a total of up to 3504 user–defined characters
- Extended graphics with the Line, Arc, Bar, and Polygon Fill commands on the D463
- Graphics cursor for graphics input, controllable by the keyboard or a mouse, on the D463
- Page and field attributes
- Double high and wide rows
Keyboard Character Generation

Each time you press a key, data is sent to the terminal. The terminal interprets this data as either a local key (such as a Shift key) or as a code generating key (such as the character “A”). If a character code is generated, it is either sent on to the host computer, if in on-line mode, or is taken as direct input by the terminal, if in off-line mode.

The terminal supports two keyboards, a 101-key keyboard, similar to an IBM-PC AT-style keyboard, and a 107-key Data General standard keyboard. Table 2-1, Table 2-2, Table 2-3, and Table 2-4 show the code generated by each key and recognized keystroke combination on 101-key and 107-key keyboards. We did not include the code generated by the main keypad because the generated code is simply the code of the character on the face of the key.

NOTE: The 107-key keyboard has a Cmd key that does not appear on the 101-key keyboard. To simulate the Cmd key, use the rightmost Ctrl key on 101-key keyboards.

<table>
<thead>
<tr>
<th>107-key Keyboard</th>
<th>101-key Keyboard</th>
<th>Normal</th>
<th>Shift</th>
<th>Ctrl</th>
<th>Ctrl-Shift</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>F1</td>
<td>&lt;036&gt; q</td>
<td>&lt;036&gt; a</td>
<td>&lt;036&gt; 1</td>
<td>&lt;036&gt; !</td>
</tr>
<tr>
<td>F2</td>
<td>F2</td>
<td>&lt;036&gt; r</td>
<td>&lt;036&gt; b</td>
<td>&lt;036&gt; 2</td>
<td>&lt;036&gt; &quot;</td>
</tr>
<tr>
<td>F3</td>
<td>F3</td>
<td>&lt;036&gt; s</td>
<td>&lt;036&gt; c</td>
<td>&lt;036&gt; 3</td>
<td>&lt;036&gt; #</td>
</tr>
<tr>
<td>F4</td>
<td>F4</td>
<td>&lt;036&gt; t</td>
<td>&lt;036&gt; d</td>
<td>&lt;036&gt; 4</td>
<td>&lt;036&gt; $</td>
</tr>
<tr>
<td>F5</td>
<td>F5</td>
<td>&lt;036&gt; u</td>
<td>&lt;036&gt; e</td>
<td>&lt;036&gt; 5</td>
<td>&lt;036&gt; %</td>
</tr>
<tr>
<td>F6</td>
<td>F6</td>
<td>&lt;036&gt; v</td>
<td>&lt;036&gt; f</td>
<td>&lt;036&gt; 6</td>
<td>&lt;036&gt; &amp;</td>
</tr>
<tr>
<td>F7</td>
<td>F7</td>
<td>&lt;036&gt; w</td>
<td>&lt;036&gt; g</td>
<td>&lt;036&gt; 7</td>
<td>&lt;036&gt; '</td>
</tr>
<tr>
<td>F8</td>
<td>F8</td>
<td>&lt;036&gt; x</td>
<td>&lt;036&gt; h</td>
<td>&lt;036&gt; 8</td>
<td>&lt;036&gt; (</td>
</tr>
<tr>
<td>F9</td>
<td>F9</td>
<td>&lt;036&gt; y</td>
<td>&lt;036&gt; i</td>
<td>&lt;036&gt; 9</td>
<td>&lt;036&gt; )</td>
</tr>
<tr>
<td>F10</td>
<td>F10</td>
<td>&lt;036&gt; z</td>
<td>&lt;036&gt; j</td>
<td>&lt;036&gt; :</td>
<td>&lt;036&gt; *</td>
</tr>
<tr>
<td>F11</td>
<td>F11 or Alt-F1</td>
<td>&lt;036&gt; {</td>
<td>&lt;036&gt; k</td>
<td>&lt;036&gt; ;</td>
<td>&lt;036&gt; +</td>
</tr>
<tr>
<td>F12</td>
<td>F12 or Alt-F2</td>
<td>&lt;036&gt; l</td>
<td>&lt;036&gt; m</td>
<td>&lt;036&gt; ,</td>
<td></td>
</tr>
<tr>
<td>F13</td>
<td>Alt-F3</td>
<td>&lt;036&gt; }</td>
<td>&lt;036&gt; n</td>
<td>&lt;036&gt; &gt;</td>
<td></td>
</tr>
<tr>
<td>F14</td>
<td>Alt-F4</td>
<td>&lt;036&gt; ~</td>
<td>&lt;036&gt; o</td>
<td>&lt;036&gt; .</td>
<td></td>
</tr>
<tr>
<td>F15</td>
<td>Alt-F5 p</td>
<td>&lt;036&gt; r</td>
<td>&lt;036&gt; 0</td>
<td>&lt;036&gt; &lt;SPACE&gt;</td>
<td></td>
</tr>
<tr>
<td>Print</td>
<td>Print Screen</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N/C</td>
<td>Scroll Lock</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hold</td>
<td>Pause/Break</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 2-2 Keyboard Generated Codes — Editing Keypad (Data General Native-Mode)

<table>
<thead>
<tr>
<th>107-key Keyboard</th>
<th>101-key Keyboard</th>
<th>Normal</th>
<th>Shift</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erase Page</td>
<td>Insert</td>
<td>&lt;014&gt;</td>
<td>&lt;014&gt;</td>
</tr>
<tr>
<td>C1</td>
<td>Home</td>
<td>&lt;036&gt; \</td>
<td>&lt;036&gt; X</td>
</tr>
<tr>
<td>C2</td>
<td>Page Up</td>
<td>&lt;036&gt; ]</td>
<td>&lt;036&gt; Y</td>
</tr>
<tr>
<td>Erase EOL</td>
<td>Delete</td>
<td>&lt;013&gt;</td>
<td>&lt;013&gt;</td>
</tr>
<tr>
<td>C3</td>
<td>End</td>
<td>&lt;036&gt; ^</td>
<td>&lt;036&gt; Z</td>
</tr>
<tr>
<td>C4</td>
<td>Page Down</td>
<td>&lt;036&gt; _</td>
<td>&lt;036&gt; [</td>
</tr>
<tr>
<td>Print</td>
<td>Print Screen</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>Cmd–Print</td>
<td>R.Ctr–Print Screen</td>
<td>&lt;036&gt;&lt;021&gt;</td>
<td>&lt;036&gt;&lt;001&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>UNIX Mode</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>&lt;036&gt; PH</td>
<td>&lt;036&gt; PH</td>
</tr>
<tr>
<td></td>
<td>Shift</td>
<td>&lt;036&gt; \</td>
<td>&lt;036&gt; X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;036&gt; ]</td>
<td>&lt;036&gt; Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;036&gt; PE</td>
<td>&lt;036&gt; PE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;036&gt; ^</td>
<td>&lt;036&gt; Z</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;036&gt; _</td>
<td>&lt;036&gt; [</td>
</tr>
<tr>
<td></td>
<td></td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;036&gt;P0</td>
<td>&lt;036&gt;P1</td>
</tr>
</tbody>
</table>

### Table 2-3 Keyboard Generated Codes — Cursor Keypad (Data General Native-Mode)

<table>
<thead>
<tr>
<th>107-key Keyboard</th>
<th>101-key Keyboard</th>
<th>Normal</th>
<th>Shift</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uparrow</td>
<td>Uparrow</td>
<td>&lt;027&gt;</td>
<td>&lt;036&gt;&lt;027&gt;</td>
</tr>
<tr>
<td>Rightarrow</td>
<td>Rightarrow</td>
<td>&lt;030&gt;</td>
<td>&lt;036&gt;&lt;030&gt;</td>
</tr>
<tr>
<td>Leftarrow</td>
<td>Leftarrow</td>
<td>&lt;031&gt;</td>
<td>&lt;036&gt;&lt;031&gt;</td>
</tr>
<tr>
<td>Downarrow</td>
<td>Downarrow</td>
<td>&lt;032&gt;</td>
<td>&lt;036&gt;&lt;032&gt;</td>
</tr>
<tr>
<td>Home</td>
<td>n/a</td>
<td>&lt;010&gt;</td>
<td>&lt;036&gt;&lt;010&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>UNIX Mode</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>&lt;036&gt;PA</td>
<td>&lt;036&gt;Pa</td>
</tr>
<tr>
<td></td>
<td>Shift</td>
<td>&lt;036&gt;PC</td>
<td>&lt;036&gt;Pc</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;036&gt;PD</td>
<td>&lt;036&gt;Pd</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;036&gt;PB</td>
<td>&lt;036&gt;Pb</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;036&gt;PF</td>
<td>&lt;036&gt;Pf</td>
</tr>
</tbody>
</table>
Table 2-4 Keyboard Generated Codes — Numeric Keypad (Data General Native-Mode)

<table>
<thead>
<tr>
<th>107-key Keyboard</th>
<th>101-key Keyboard Mapping with Num Lock On</th>
<th>101-key Keyboard Mapping with Num Lock Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>On</td>
<td>On</td>
<td>Off</td>
</tr>
<tr>
<td>/</td>
<td>/</td>
<td>/</td>
</tr>
<tr>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>– (minus)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>, (comma)</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>. (period)</td>
<td>.Delete</td>
<td>.Erase EOL</td>
</tr>
<tr>
<td>0</td>
<td>0/Insert</td>
<td>0/Erase Page</td>
</tr>
<tr>
<td>1</td>
<td>1/End</td>
<td>1/C3</td>
</tr>
<tr>
<td>2</td>
<td>2/Downarrow</td>
<td>2/Downarrow</td>
</tr>
<tr>
<td>3</td>
<td>3/Pg Down</td>
<td>3/C4</td>
</tr>
<tr>
<td>4</td>
<td>4/Leftarrow</td>
<td>4/Leftarrow</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>5/Home</td>
</tr>
<tr>
<td>6</td>
<td>6/Rightarrow</td>
<td>6/Rightarrow</td>
</tr>
<tr>
<td>7</td>
<td>7/Home</td>
<td>7/C1</td>
</tr>
<tr>
<td>8</td>
<td>8/Uparrow</td>
<td>8/Uparrow</td>
</tr>
<tr>
<td>9</td>
<td>9/Pg Up</td>
<td>9/C2</td>
</tr>
<tr>
<td>New Line</td>
<td>Enter</td>
<td>New Line</td>
</tr>
</tbody>
</table>

1  107-keyboard numeric keypads have no Num Lock On/Off mode.
2  Editing keys on the 107-key keyboard are mapped onto the numeric keypad on 101-key keyboards when Num Lock is Off. See Table 2-2 and Table 2-3 and for generated codes.

Forming Command Arguments

Command arguments, are ASCII characters. The majority of arguments in Data General native-mode commands are composed of either one, two, or three bytes. Each of these arguments are represented respectively by “n”, “nn”, or “nnn”. In command listings, the arguments are always enclosed by angle brackets (< >). However, these brackets simply separate the command argument from the surrounding characters. The brackets do not mean that the command arguments are in octal.

Command arguments are expressed as a version (known hereafter as DG-hex) of standard hex that replaces “A” with “:”, “B” with “;”, “C” with “<”, “D” with “>”, “E” with “?”, and replaces “F” with “?”. For example, in standard hex, the decimal value “15” is expressed as “F”. However, in DG-hex, the decimal value “15” is expressed as “15”.

CAUTION: UNIX mode does not use DG-hex to express command arguments. For the format of command arguments in UNIX mode, see the section “UNIX Support,” later in this chapter.
When command arguments are received by the terminal, the four least significant bits of each byte are concatenated. Thus, an \(<n>\) value has four bits; an \(<nn>\) value has eight bits; and an \(<nnn>\) value has twelve bits. The next section "Recovering a Decimal Value from DG–Hex," has more details on this concatenation process.

Actually forming command arguments is a simple matter of expressing a decimal value in DG–hex. Table 2-5 shows how to change decimal values into DG–hex.

**Table 2-5 Command Argument Translation (Decimal to DG–Hex)**

<table>
<thead>
<tr>
<th>ASCII Characters 0 to ?</th>
<th>Argument Forms and Decimal Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;</td>
<td>(&lt;n&gt;) (n) (n&gt;) (&lt;n&gt;) (n&gt;)</td>
<td>For (&lt;n&gt;) = 12</td>
</tr>
<tr>
<td>0</td>
<td>0 (0) (0) (0)</td>
<td>1st (n) = &quot;&lt;&quot; from table</td>
</tr>
<tr>
<td>1</td>
<td>256 (16) (1)</td>
<td>(&lt;n&gt;) = (&lt;) (DG–hex)</td>
</tr>
<tr>
<td>2</td>
<td>512 (32) (2)</td>
<td>For (&lt;nn&gt;) = 135 = 128 + 7</td>
</tr>
<tr>
<td>3</td>
<td>768 (48) (3)</td>
<td>1st (n) = 128 = &quot;8&quot;</td>
</tr>
<tr>
<td>4</td>
<td>1024 (64) (4)</td>
<td>2nd (n) = 7 = &quot;7&quot;</td>
</tr>
<tr>
<td>5</td>
<td>1280 (80) (5)</td>
<td>(&lt;nn&gt;) = 87 (DG–hex)</td>
</tr>
<tr>
<td>6</td>
<td>1536 (96) (6)</td>
<td>For (&lt;nn&gt;) = 3888 = 3840 + 48</td>
</tr>
<tr>
<td>7</td>
<td>1792 (112) (7)</td>
<td>1st (n) = 3840 = &quot;?&quot;</td>
</tr>
<tr>
<td>8</td>
<td>2048 (128) (8)</td>
<td>2nd (n) = 48 = &quot;3&quot;</td>
</tr>
<tr>
<td>9</td>
<td>2304 (144) (9)</td>
<td>3rd (n) = 0 = &quot;0&quot;</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>(&lt;nn&gt;) = ?30 (DG–hex)</td>
</tr>
<tr>
<td>&lt;</td>
<td>3072 (192) (12)</td>
<td>For (&lt;nn&gt;) = 3888 = 3840 + 48</td>
</tr>
<tr>
<td>=</td>
<td>3328 (208) (13)</td>
<td>1st (n) = 3840 = &quot;?&quot;</td>
</tr>
<tr>
<td>&gt;</td>
<td>3584 (224) (14)</td>
<td>2nd (n) = 48 = &quot;3&quot;</td>
</tr>
<tr>
<td>?</td>
<td>3840 (240) (15)</td>
<td>3rd (n) = 0 = &quot;0&quot;</td>
</tr>
</tbody>
</table>

The largest possible decimal value for \(<nnn>\) is 4095. Every value from 0 to 4095 can be expressed as the sum of values that occur in the table, specifically, one value from each of the three columns. However, the decimal value does not determine the form of the argument. Rather, the form of the argument (n, nn, or nnn) determines the range. For example, \(<n>\) is always a single byte; \(<nn>\) is always two bytes; and \(<nnn>\) is always three bytes.

To express a decimal value in DG–hex, follow these steps.

1. Express the decimal value as the sum of up to three values, one from each column, in the table. An \(<n>\) uses only the rightmost column. An \(<nn>\) uses that column and the center one. An \(<nnn>\) uses all three columns. Locate the value in the table that is closest to, but not greater than, the decimal value you want to translate. Subtract the closest value from the original value. Take that difference and find the closest value, but not greater, to it in the table. Continue until you have expressed the original decimal value as the sum of three values from the table.
2. Locate each of the values found in the table and determine what ASCII character represents that value. Once you have determined the appropriate ASCII character for each column, string them together as shown in Table 2-5. The resulting code is in DG–hex.

**Recovering a Decimal Value from DG–hex**

Some commands return parameter data to the host. In most cases, this data is in DG–hex form and will need to be converted back to decimal for application use. For the <n>, <nn>, and <nnn> argument forms, only the lower four bits of each argument byte are used. The lower four bits, known as Least Significant Bits or LSBs, of each argument byte are concatenated together to form a 4–bit value for <n>, an 8–bit value for <nn>, and a 12–bit value for <nnn>. Figure 2-1 shows how the argument bytes (8–bit ASCII characters) are evaluated.

**to interpret “n” format**

\[
\begin{align*}
&\text{AAAAAA} \\
\end{align*}
\]

take the LSBs from one ASCII character to form a 4–bit value which can range from 0 to 15 (Decimal)

\[
\begin{align*}
&\text{AAAA = } n
\end{align*}
\]

**to interpret “nn” format**

\[
\begin{align*}
&\text{AAAAAA} \quad \text{BBBBBB} \\
\end{align*}
\]

take the LSBs from two ASCII characters to form an 8–bit value which can range from 0 to 255 (Decimal)

\[
\begin{align*}
&\text{AAAABBBB = } nn
\end{align*}
\]

**to interpret “nnn” format**

\[
\begin{align*}
&\text{AAAAAA} \quad \text{BBBBBB} \quad \text{CCCCCC} \\
\end{align*}
\]

take the LSBs from three ASCII characters to form a 12–bit value which can range from 0 to 4095 (Decimal)

\[
\begin{align*}
&\text{AAAABBBBCCCC = } nnn
\end{align*}
\]

*Figure 2-1 Combining LSBs to Create Decimal Values from DG–hex*
Forming Location Arguments

Location arguments are used to specify x- and y-ordinates for graphics commands in Data General native-mode (not, however, in UNIX mode). They are always in the form of <NNN>, where NNN is three ASCII characters from "@" through "_". In commands, the NNN values are enclosed within angle brackets. These brackets are only used in this manual to clearly separate the location argument from the surrounding codes; the brackets do not mean that location arguments are in octal. Forming location arguments is similar to forming command arguments. In both cases, you must express a decimal value as a value containing ASCII characters.

CAUTION: Location arguments in UNIX mode have a different format. Refer to the "UNIX Support" section later in this chapter for details on how UNIX mode uses location arguments.

Location arguments, which always have three bytes, are treated differently than command arguments by the terminal when they are transmitted. Each byte (8–bits) of the argument is truncated by the terminal into a 5–bit quantity by removing the three most significant bits of each byte. Then the remaining three 5–bit quantities are concatenated into a 15–bit value (rather than the 12–bit value in command arguments). For more information on how this concatenation occurs, see the next section "Generating a Decimal Value From Location Arguments."

Forming location arguments is similar to forming command arguments. In both cases, you must express a decimal value (ranging from 0 through 3071) as a value containing one or more ASCII characters. Table 2-6 helps you transform decimal values into a form containing ASCII characters.
Table 2-6 Location Argument Translation Table (Decimal into ASCII Characters)

<table>
<thead>
<tr>
<th>ASCII Characters @ to _</th>
<th>Argument Forms and Decimal Values</th>
<th>N</th>
<th>N</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>@</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>1024</td>
<td>32</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>2048</td>
<td>64</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>96</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>128</td>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>160</td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>192</td>
<td></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>224</td>
<td></td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>256</td>
<td></td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>288</td>
<td></td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>J</td>
<td>320</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>352</td>
<td></td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>384</td>
<td></td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>416</td>
<td></td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>448</td>
<td></td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>480</td>
<td></td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>512</td>
<td></td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Q</td>
<td>544</td>
<td></td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>576</td>
<td></td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>608</td>
<td></td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>640</td>
<td></td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>U</td>
<td>672</td>
<td></td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>704</td>
<td></td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>W</td>
<td>736</td>
<td></td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>768</td>
<td></td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>800</td>
<td></td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Z</td>
<td>832</td>
<td></td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>[</td>
<td>864</td>
<td></td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>\</td>
<td>896</td>
<td></td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>^</td>
<td>928</td>
<td></td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>_</td>
<td>960</td>
<td></td>
<td>30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>992</td>
<td></td>
<td>31</td>
<td></td>
</tr>
</tbody>
</table>

Examples

For \(<\text{NNN}> = 455\)

\(= 0 + 448 + 7\)

\(= \@NG\)

For \(<\text{NNN}> = 1420\)

\(= 1024 + 384 + 12\)

\(= \text{ALL}\)

The largest possible decimal value for \(<\text{NNN}>\) is 3071. Every value from 0 through 3071 can be expressed as the sum of values that occur in the table, specifically, one value from each of the three columns. Remember, location arguments \textit{always} have three bytes.
To express a location argument decimal value into a form containing ASCII characters, follow these steps:

1. Express the decimal value as the sum of three values, one from each column, in the table. Locate the value in the table that is closest to, but not greater than, the decimal value you want to translate. Then subtract the closest value from the original value. Now take that difference and find the closest value, but not greater, to it in the table. Continue until you have expressed the original decimal value as the sum of three values from the table.

2. Locate each of the values found in the table and determine what ASCII character represents that value. Once you have determined the appropriate ASCII character for each column, string them together as shown in Table 2-6.

Recovering a Decimal Value From Location Arguments

For location arguments, the terminal sends 15-bits to the host. This 15-bit quantity is interpreted by concatenating the five least significant bits from each of the three bytes that comprise the argument. Figure 2-1 shows how the argument bytes (8-bit ASCII characters) are evaluated.

As is the case with command arguments, location arguments are also translated into a form containing only ASCII characters. Location arguments use the ASCII characters from “@” to “_” to express the 15-bit decimal value that results from concatenating the five LSBs of three bytes. Table 2-6 shows the translation values for location arguments.
Character Sets

All terminals are equipped with a 512-character Character Generator (CGEN), which is located within terminal ROM. All hard (ROM-resident) character sets are composed of characters contained within the CGEN. In addition to the predefined hard character sets, the D463 supports up to 37 soft character sets (each containing up to 94 characters), which reside in volatile RAM, that are composed of custom characters. Soft character sets store characters within the Dynamically Reconfigurable Character Buffer (DRCB), which contains up to 3504 soft characters.

Hard Character Sets

Hard character sets are composed of characters located within the CGEN. Two character sets may be selected for use at one time. They are designated as G0 (primary) and G1 (secondary). Table 2-7 shows all of the 7-bit and 8-bit character sets available in Data General native-mode.

<table>
<thead>
<tr>
<th>Keyboard language</th>
<th>VT Multinational (supplemental set)</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. ASCII</td>
<td>VT Special Graphics (line drawing)</td>
</tr>
<tr>
<td>NRC United Kingdom</td>
<td>Low PC Term (0 hex — 7F hex)</td>
</tr>
<tr>
<td>NRC French</td>
<td>High PC Term (80 hex — FF hex)</td>
</tr>
<tr>
<td>NRC German</td>
<td>ISO 8859/1.2 characters</td>
</tr>
<tr>
<td>NRC Swedish/Finnish</td>
<td>DRCB Character Set 1</td>
</tr>
<tr>
<td>NRC Spanish</td>
<td></td>
</tr>
<tr>
<td>NRC Danish/Norwegian</td>
<td></td>
</tr>
<tr>
<td>NRC Swiss</td>
<td></td>
</tr>
<tr>
<td>NRC Kata Kana (G0)</td>
<td></td>
</tr>
<tr>
<td>Data General International</td>
<td></td>
</tr>
<tr>
<td>Kata Kana (G1)</td>
<td></td>
</tr>
<tr>
<td>Word Processing, Greek, Math</td>
<td></td>
</tr>
<tr>
<td>Line drawing</td>
<td></td>
</tr>
<tr>
<td>Data General Special Graphics (PC characters)</td>
<td>DRCB Character Set 38</td>
</tr>
</tbody>
</table>
GL is used for 7-bit characters (20 hex through 7E hex). The GL character set is generally used with 7-bit sets such as U.S. ASCII or an appropriate National Replacement Character (NRC) set. The NRC sets are language-specific character sets that remap the least used characters from the ASCII set with those characters frequently used within each language. GL can point to G0 or G1.

The GR set is used for 8-bit character codes, which are characters A0 hex through FF hex. GR generally contains special graphics sets such as Data General International. GR is hard-wired to G1.

**Powerup Character Sets**

During powerup or reset, the terminal initializes the character sets with the default primary (G0) and secondary (G1) character sets. If the terminal is operating in 7-bit mode, the G0 set is the NRC set and the G1 set is the word processing set. If the terminal is operating in 8-bit mode, the G0 set is the U.S. ASCII set and the G1 set is the Data General International Set.

**Designating Character Sets**

Any two of the character sets listed in Table 2-7 may be designated as G0 and G1. The two sets chosen are then designated as either GL or GR. GR is always G1. GL can be either G0 or G1. When operating in 7-bit mode, you must send a Shift Out command to the terminal in order to switch GL from G0 to G1. All subsequent characters in GL are selected from G1. In order to return to G0, you must send a Shift In command to the terminal.

When operating in 8-bit mode, G1 is accessed directly by characters in the range A0 hex through FF hex. The Shift In and Shift Out commands select which character set is to be designated GL (used for characters in the range 20 hex through 7E). Figure 2-3 illustrates which sets can be designated GL or GR.

![Designating Character Sets as GL and GR (Data General Native-Mode)](image-url)
Soft Character Sets (D463 only)

CAUTION: Soft character bit patterns in UNIX mode have a different format. Refer to the Unix Support section for a description of how UNIX mode uses bit patterns.

Soft character sets, which contain custom characters, must be defined by the user before they can be used. Creating custom characters and generating character graphics are both functions of the Dynamically Reconfigurable Character Buffer (DRCB). This buffer, which contains up to 3504 characters, is the industry-standard term for the Down Line Loadable buffer (DLL) used in Data General terminals, such as the D450 and D460.

The D463 terminal has up to 37 soft character sets, each of 94 characters. The characters are in the range from 21 hex through 7E hex.

Custom character definitions are valid until the terminal is turned off or reset, or until the characters are redefined or deallocated. Save your custom character definitions on your host system so they can be easily transferred to the terminal, as needed.

The first step in defining one or more custom characters is to select a DRCB set number using the Select Character Set command. The DRCB set number identifies the character set to contain the custom characters. DRCB sets defined in this way can be designated as the G0 or G1 set, or as both. The D463 uses DRCB set numbers from 20 hex through 45 hex. Although this range of values is 38 decimal character sets, there is only enough RAM for 37 sets to be in use at one time.

Once you have selected the character set number, you must define the dot patterns for the characters with the Define Character command. Each character defined fits within a character cell that measures 10 by 12. The cell has 12 scan rows, each of which has 10 dots (columns) per row. Each character cell is a matrix of 120 dots, arranged in 12 horizontal rows by 10 vertical columns (under normal, noncompressed, spacing only). The Define Character command encodes the dot pattern of only one character cell. You must repeat the command for each character defined.
Defining Soft Characters

CAUTION: Soft character bit patterns in Unix mode have a different format. Refer to the “Unix Support” section later in this chapter for details on how Unix mode uses bit patterns.

Soft characters are defined by the Define Character command. This command contains up to twelve <dd> pairs, each representing the bit pattern of a character cell row. Each <dd> pair, which is a 10-bit quantity, is formed by concatenating the five least significant bits from each of two ASCII bytes. If you are defining a compressed character (character cell size of 6 by 12), only the six most significant bits of the 10-bit quantity are used. Figure 2-4 shows how the <dd> pair is created.

![Figure 2-4 Defining a Soft Character Cell Row](image)

Each <dd> pair specifies the bit pattern of each character cell row. In each row, the “1’s” in the <dd> pair turns screen pixels on and the “0’s” turn screen pixels off. For example, the 10-bit value (<dd> pair) 010000001 turns on the second and last pixel in a character cell row. Figure 2-5 shows how the twelve <dd> pairs define a DRCB character, where each “d” value is a 5-bit binary quantity.

![Figure 2-5 Combining <dd> Pairs to Specify a Soft Character](image)

The <dd> pairs are sent to the host in a stream in the order: “d0, d1, ..., d23.” Remember, before a DRCB character may be defined, a DRCB character set must be selected as the current (active) character set.
Graphics

The DRCB provides the D463 user with character–graphics commands. In this case, the firmware defines DRCB characters to form the graphic image specified by a given graphics command. The D463 terminal creates graphics displays by combining line segments, arcs, filled polygons, and bars (filled in rectangles) into a composite screen image. The screen image is formed using DRCB characters defined by drawing algorithms within the terminal. When graphics images are no longer needed on the screen, the DRCB characters used to create them are automatically released and made available for custom characters (described in the previous section).

Character graphics commands supported by the D463 are listed below:

- **Deallocate Character Sets** — Lets the user free allocated DRCB character sets that were reserved by the Define Character command.
- **Bar** — Draws solid rectangles of any size, provided they fit entirely within the current window.
- **Line** — Draws lines from point to point within the current window.
- **Arc** — Draws arc with a specified radius, start angle, and end angle.
- **Polygon Fill** — Draws a filled polygon within the current window.
- **Set Pattern** — Defines the line style used in generating lines.
- **Read Characters Remaining** — Queries the terminal for a count of the DRCB characters remaining (but reports a maximum of only 1023 characters, even though more may remain).

The Graphics Coordinate System

The Line, Bar, Arc, and Polygon Fill commands are based upon an (x,y) coordinate system, where each point within the graphics coordinate system can be uniquely described by the combination of a horizontal component (the x ordinate) and a vertical component (the y ordinate).

The x–axis is defined by the bottom of the current window. The y–axis is defined by the left margin of the current window. The drawing origin (where x=0 and y=0) is, therefore, defined by the intersection of the left margin and the bottom of the last row in the current window.

Along the x–axis there are 10 x–ordinate units for each of the 81 columns, for a total of 810 units (or 2070 units for 207 columns). Along the y–axis, there are 24 y–ordinate units for each of the 24 rows, for a total of 576 units. If however, you define the status line as the 25th screen row, then there are a total of 600 units. These dimensions are derived from the 10 by 12 dot matrix in each character cell; one unit in the x–direction for each dot column (10), and two units in the y–direction for each scan row (12).

Figure 2-6 shows the margins and boundary values for the graphics coordinate system at power up or after reset. The margins and boundaries of the current window limit the available drawing area for character graphics commands.
The largest possible drawing area consists of the entire display-screen memory, with 24 rows and 207 columns. In this case, the x-ordinate can range from 0 to 2,069; the y-ordinate can range from 0 to 575. The smallest possible drawing area is one character cell (one row by one column). In this case, the x-ordinate can range from 0 to 9 and the y-ordinate can range from 0 to 23.

NOTE: If the arguments to the Line or Bar commands specify a location or dimension that extends out of the current drawing area, the command immediately aborts.

**Graphics Cursor**

The graphics cursor, which is available only on the D463, is used to indicate specific points (coordinates) on the screen by controlling the specified input device. This lets the user identify screen locations easily. The graphics cursor commands are similar to the G300 graphics cursor commands. The D463 does not support a blinking cursor (unlike the G300) and only supports a long crosshair cursor-type. Also, the format of data returned in response to a cursor command is different from the G300.

NOTE: The graphics cursor disappears during both vertical and horizontal scrolling. After the scrolling operation is complete, the cursor will reappear in the same location.

The Read Graphics Cursor command gives you the coordinates of the graphics cursor. Graphics Cursor On and Graphics Cursor Off cause the cursor to appear and disappear from the screen respectively. The Cursor Location command lets you move the graphics cursor to any position on the screen. Cursor Track lets you select what input device will control the graphics cursor. The Cursor Reset command sets the graphics cursor attributes to "off" and "no" tracking.
Windows

The D413/D463 terminals provide for up to 24 (25 if 25th Line Mode is set) scroll areas, called windows. Windows may have from 1 to a maximum of 25 screen rows. No overlap is permitted. A window does not provide extended or off-screen memory in the vertical direction. That is, as text in a window is vertically scrolled up or down, lines at the top or bottom of the window are lost. A window row, however, can contain more than the usual 81 visible columns; a window can be horizontally scrolled over 207 columns. The additional columns are stored within terminal memory.

A new feature of these terminals is an addressable status line. The 25th line of the screen can be blanked, used as an extra screen row, or reserved for the status line. The Set 25th Line Mode command controls the functions of the 25th line on the screen.

Each window is essentially a miniature DASHER D2/D200 screen. D2 commands work within and relative to the current window. This terminal, however, can display up to 81 columns on a screen row.

NOTE: To provide DASHER D2/D200 display compatibility, this terminal initializes the screen to consist of one window with 24 rows of 80 columns. Since all D2/D200 commands work relative to the current window, full compatibility is retained.

Lead–In Codes

Command sequences in Data General native-mode are composed of one or more ASCII characters. Commands composed of at least two characters always begin with 036 octal (IE hex), which is the 2-character command lead-in code. The remaining characters in the command are always printable ASCII characters from 041 octal (21 hex) through 176 octal (7E hex).

Invalid command sequences are ignored. For example, function–key sequences (all of which also begin with 036 octal) are not valid command sequences and are ignored if they are received by the terminal.
UNIX Support

All terminals have a UNIX mode which remaps troublesome Data General native-mode commands and keyboard codes to allow easier creation of UNIX terminfo files. This mode is entered and exited via the UNIX Mode command or the Configuration Menu. For information on using the Configuration Menu, refer to the manual *Installing and Operating D216E+, D217, D413, and D463 Display Terminals*.

Remapped keys that transmit inbound (terminal to host) codes are shown in Table 2-8.

<table>
<thead>
<tr>
<th>Key</th>
<th>DG Native-mode (octal)</th>
<th>UNIX Mode (octal)</th>
<th>UNIX Mode (ASCII)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erase Page</td>
<td>&lt;014&gt;</td>
<td>&lt;036&gt;&lt;120&gt;&lt;110&gt;</td>
<td>&lt;036&gt;PH</td>
</tr>
<tr>
<td>Cmd-Print</td>
<td>&lt;036&gt;&lt;021&gt;</td>
<td>&lt;036&gt;&lt;120&gt;&lt;060&gt;</td>
<td>&lt;036&gt;P0</td>
</tr>
<tr>
<td>Shift Cmd-Print</td>
<td>&lt;036&gt;&lt;001&gt;</td>
<td>&lt;036&gt;&lt;120&gt;&lt;061&gt;</td>
<td>&lt;036&gt;P1</td>
</tr>
<tr>
<td>Erase EOL</td>
<td>&lt;013&gt;</td>
<td>&lt;036&gt;&lt;120&gt;&lt;105&gt;</td>
<td>&lt;036&gt;PE</td>
</tr>
<tr>
<td>Uparrow</td>
<td>&lt;027&gt;</td>
<td>&lt;036&gt;&lt;120&gt;&lt;101&gt;</td>
<td>&lt;036&gt;PA</td>
</tr>
<tr>
<td>Rightarrow</td>
<td>&lt;030&gt;</td>
<td>&lt;036&gt;&lt;120&gt;&lt;103&gt;</td>
<td>&lt;036&gt;PC</td>
</tr>
<tr>
<td>Leftarrow</td>
<td>&lt;031&gt;</td>
<td>&lt;036&gt;&lt;120&gt;&lt;104&gt;</td>
<td>&lt;036&gt;PD</td>
</tr>
<tr>
<td>Downarrow</td>
<td>&lt;032&gt;</td>
<td>&lt;036&gt;&lt;120&gt;&lt;102&gt;</td>
<td>&lt;036&gt;PB</td>
</tr>
<tr>
<td>Home</td>
<td>&lt;010&gt;</td>
<td>&lt;036&gt;&lt;120&gt;&lt;106&gt;</td>
<td>&lt;036&gt;PF</td>
</tr>
</tbody>
</table>

Another change to support UNIX systems involves altered outbound (host to terminal) as well as inbound codes. In UNIX Mode, all Data General native-mode commands accept ASCII coded hex parameters (“0” through “9”, “A” through “F”, and “a” through “f”), instead of the Data General standard ASCII coded binary parameters and commands that return date will send hex data in upper case. These parameters are encoded as shown in Table 2-9.
Table 2-9 Altered Outbound Codes for UNIX Support

<table>
<thead>
<tr>
<th>Data General Native-Mode</th>
<th>Unix Mode&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Bits</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;n&gt;</td>
<td>&lt;H&gt;</td>
<td>4</td>
<td>0 through 15</td>
</tr>
<tr>
<td>&lt;N&gt;</td>
<td>&lt;HH&gt;</td>
<td>5</td>
<td>0 through 31</td>
</tr>
<tr>
<td>&lt;nn&gt;</td>
<td>&lt;HH&gt;</td>
<td>8</td>
<td>0 through 255</td>
</tr>
<tr>
<td>&lt;dd&gt;</td>
<td>&lt;HHH&gt;</td>
<td>10</td>
<td>0 through 1023</td>
</tr>
<tr>
<td>&lt;nnn&gt;</td>
<td>&lt;HHH&gt;</td>
<td>12</td>
<td>0 through 4095</td>
</tr>
<tr>
<td>&lt;NNN&gt;</td>
<td>&lt;HHHH&gt;</td>
<td>15</td>
<td>0 through 32767</td>
</tr>
<tr>
<td>&lt;nnnn&gt;</td>
<td>&lt;HHHH&gt;</td>
<td>16</td>
<td>0 through 65535</td>
</tr>
</tbody>
</table>

<sup>1</sup> H indicates a hex digit.

Certain Data General native-mode commands have different structures and codes in UNIX Mode. These changes, shown in Table 2-10, make the remapped keys (see Table 2-8) work in local mode and make some of the terminal descriptions easier.

Table 2-10 Altered Data General Native-Mode Commands for UNIX Support

<table>
<thead>
<tr>
<th>Command</th>
<th>Native-Mode (octal)</th>
<th>UNIX Mode (octal)</th>
<th>UNIX Mode (ASCII)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Print Window</td>
<td>&lt;021&gt;</td>
<td>&lt;036&gt;&lt;106&gt;&lt;077&gt;&lt;071&gt;</td>
<td>&lt;036&gt;F?9</td>
</tr>
<tr>
<td>Cursor Up</td>
<td>&lt;027&gt;</td>
<td>&lt;036&gt;&lt;120&gt;&lt;101&gt;</td>
<td>&lt;036&gt;PA</td>
</tr>
<tr>
<td>Cursor Down</td>
<td>&lt;032&gt;</td>
<td>&lt;036&gt;&lt;120&gt;&lt;102&gt;</td>
<td>&lt;036&gt;PB</td>
</tr>
<tr>
<td>Cursor Right</td>
<td>&lt;030&gt;</td>
<td>&lt;036&gt;&lt;120&gt;&lt;103&gt;</td>
<td>&lt;036&gt;PC</td>
</tr>
<tr>
<td>Cursor Left</td>
<td>&lt;031&gt;</td>
<td>&lt;036&gt;&lt;120&gt;&lt;104&gt;</td>
<td>&lt;036&gt;PD</td>
</tr>
<tr>
<td>Erase Field</td>
<td>&lt;013&gt;</td>
<td>&lt;036&gt;&lt;120&gt;&lt;105&gt;</td>
<td>&lt;036&gt;PE</td>
</tr>
<tr>
<td>Window Home</td>
<td>&lt;010&gt;</td>
<td>&lt;036&gt;&lt;120&gt;&lt;106&gt;</td>
<td>&lt;036&gt;PF</td>
</tr>
<tr>
<td>Roll Disable</td>
<td>&lt;023&gt;</td>
<td>&lt;036&gt;&lt;120&gt;&lt;107&gt;</td>
<td>&lt;036&gt;PG</td>
</tr>
<tr>
<td>Erase Window</td>
<td>&lt;014&gt;</td>
<td>&lt;036&gt;&lt;120&gt;&lt;110&gt;</td>
<td>&lt;036&gt;PH</td>
</tr>
<tr>
<td>Blink On</td>
<td>&lt;016&gt;</td>
<td>&lt;036&gt;&lt;120&gt;&lt;111&gt;</td>
<td>&lt;036&gt;PI</td>
</tr>
<tr>
<td>Blink Off</td>
<td>&lt;017&gt;</td>
<td>&lt;036&gt;&lt;120&gt;&lt;112&gt;</td>
<td>&lt;036&gt;PJ</td>
</tr>
</tbody>
</table>
Also, in UNIX Mode the control characters shown in Table 2-11 have altered meanings.

Table 2-11 Control Codes Altered for UNIX Support

<table>
<thead>
<tr>
<th>Control Code (octal)</th>
<th>Command or Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;005&gt;</td>
<td>Ignored (Read Cursor Address uses binary codes)</td>
</tr>
<tr>
<td>&lt;010&gt;</td>
<td>Backspace (does not wrap on left margin)</td>
</tr>
<tr>
<td>&lt;011&gt;</td>
<td>Tab (fixed eight-column tab settings)</td>
</tr>
<tr>
<td>&lt;012&gt;</td>
<td>Line Feed (go to next line in same column)</td>
</tr>
<tr>
<td>&lt;013&gt;</td>
<td>Ignored</td>
</tr>
<tr>
<td>&lt;014&gt;</td>
<td>Ignored</td>
</tr>
<tr>
<td>&lt;016&gt;</td>
<td>Shift Out (still available with &lt;036&gt;N)</td>
</tr>
<tr>
<td>&lt;017&gt;</td>
<td>Shift In (still available with &lt;036&gt;O)</td>
</tr>
<tr>
<td>&lt;021&gt;</td>
<td>XON — restarts terminal transmission</td>
</tr>
<tr>
<td>&lt;023&gt;</td>
<td>XOFF — stops terminal transmission (with limited transmit only)</td>
</tr>
<tr>
<td>&lt;027&gt;</td>
<td>Ignored</td>
</tr>
<tr>
<td>&lt;030&gt;</td>
<td>Ignored</td>
</tr>
<tr>
<td>&lt;031&gt;</td>
<td>Ignored</td>
</tr>
<tr>
<td>&lt;032&gt;</td>
<td>Ignored</td>
</tr>
</tbody>
</table>

Host–Programmable Function Keys

Data General native–mode supports host–programmable function keys with the Programmable Function Keys command and through the Configuration Menu (only on D413/D463). For information on using the Configuration Menu, refer to the manual *Installing and Operating D216E+, D217, D413, and D463 Display Terminals*.

The Programmable Function Keys command allows one or more of the 60 predefined function key codes to be reprogrammed with user–defined sequences. Programmed function keys share 255 bytes of volatile (RAM) memory space. This memory can be allocated entirely to one key if desired. Keys that do not have a user definition send the default Data General sequences.
Debugging Support

To aid in debugging operations, all terminals have a command called Data Trap Mode. This command lets the user view data from the host as a hex data-stream, similar to the AOS/VS X DISPLAY command. This command can be entered either on-line or off-line. Data Trap Mode has two operating states. One of them displays hex values and the other displays octal values.

Full data on the use of this command is in the section “Debugging Commands,” later in this chapter.

Dual Emulation Support

The D413/D463 terminals can freely switch between two emulations. The manual Installing and Operating the D216E+/D413/D463 Display Terminals (014–001767) contains full information on this feature. Two commands that support dual emulations in Data General native-mode are Set Split Screen Mode and Hot Key Switch. The Set Split Screen Mode command lets you display portions of both emulsions on the screen at one time. The Hot Key Switch command lets the user change from one emulation to the other.

End of Section
Data General Native–Mode Commands

This section describes the format and usage of Data General native–mode commands. This section does not explain conventions and practices of Data General native–mode operations, which are covered in the section “Data General Native–Mode Summary of Operations.”

The commands within this section are organized into the functional areas listed below:

- Character Set Commands
- Character Attribute Commands
- Relative Cursor–Positioning Commands
- Margins Commands
- Screen Management Commands
- Scrolling Commands
- Editing Commands
- Programmable Function Key Commands
- Reporting Commands
- Dual–Emulation Support Commands
- Miscellaneous Commands
- Drawing Commands
- Graphics Cursor Commands
- Printer Commands
- Diagnostic Commands
- Debugging Commands

Information regarding functions and operations of the terminal that apply to all modes or emulations is covered in Chapter 1. Additional information on keyboard layouts and various Data General native–mode reference material is covered in appendices.
Format of Command Listings in this Section

Command name | Applicable terminals
---|---
Scroll Left | D413/D463

Command format (do not include spaces!)

<table>
<thead>
<tr>
<th>Command format</th>
<th>Description of command arguments, if any</th>
<th>Usage, results, and constraints of command</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;036&gt; &lt;106&gt; &lt;103&gt; &lt;nn&gt;</td>
<td>&lt;nn&gt; is an &lt;nn&gt; pair that sets the number of columns to move text left, as an incremental value from the current offset (for more information on &lt;nn&gt; pairs, see “Forming Command Arguments”).</td>
<td>Scrolls text in the current window to the left for the number of columns specified. The cursor remains in the same position. If the scroll would exceed physical page boundaries, the window will bump the right page limit. Because every D413/D463 page is 207 columns wide, the maximum column offset is 126 (207–81). The Scroll Left command is used explicitly to force text to move horizontally within the window. Normal cursor movement beyond the visible portion of the screen can also cause horizontal scrolling.</td>
</tr>
</tbody>
</table>

| 12 46 43 <nn> | | |
| <036> F C <nn> | | |

where

<nn> is an <nn> pair that sets the number of columns to move text left, as an incremental value from the current offset (for more information on <nn> pairs, see “Forming Command Arguments”).

Command Syntax and Code Conventions

Throughout this manual, there are certain conventions used whenever Data General native–mode commands are explained or referenced. These conventions are:

Any value enclosed within angle brackets (<>) is in octal, except command or location arguments.

Values in the form of <n>, <nn>, and <nnn> are command arguments. These values are expressed in DG–hex (except in UNIX mode). For more information on command arguments (and DG–hex), see “Forming Command Arguments.”

Values in the form of <NNN> are location arguments. These values are always expressed with ASCII characters from “@” through “_” (except in UNIX mode). For more information on location arguments, see “Forming Location Arguments.”

Spaces are often included within a command to separate characters for clarity. When entering a command, do not enter these spaces. If a space is part of a command, it will be written as <space>.
Character Set Commands

Not all of these character sets and commands are available on all terminals. Refer to the section “Character Sets” to get more details on character sets and their usage.

Select Character Set

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;036&gt; &lt;106&gt;</td>
<td>Selects a character set</td>
<td>&lt;036&gt;</td>
</tr>
<tr>
<td>&lt;123&gt; &lt;nn&gt;</td>
<td></td>
<td>&lt;123&gt;</td>
</tr>
<tr>
<td>1E 46 53 &lt;nn&gt;</td>
<td></td>
<td>46 53</td>
</tr>
<tr>
<td>&lt;036&gt; F S &lt;nn&gt;</td>
<td></td>
<td>F S</td>
</tr>
</tbody>
</table>

where

<nn> sets the character set that is being selected. The list below shows all possible character sets, which are in hex. See the “Forming Command Arguments” section for more information on <nn> pairs.

- 00 Keyboard language
- 01 U.S. ASCII (NRC North American)
- 02 NRC United Kingdom
- 03 NRC French
- 04 NRC German
- 05 NRC Swedish/Finnish
- 06 NRC Spanish
- 07 NRC Danish/Norwegian
- 08 NRC Swiss
- 09 NRC Kata Kana (G0)
- 0E DG International character set
- 0F Kata Kana (G1)
- 10 Word Processing, Greek, Math
- 11 Line drawing
- 13 DG Special Graphics (PC characters)
- 14 VT Multinational
- 15 VT Special Graphics (line drawing)
- 1D Low PC Term (0–127)
- 1E High PC Term (128–255)
- 1F ISO 8859/1.2 characters
- 20 DLL Character Set 1
- 21 DLL Character Set 2
- 22 DLL Character Set 3
- 23 DLL Character Set 4
- 45 DLL Character Set 38

This command selects the display character set for either the primary or secondary translation set (G0 or G1). Each character set consists of 94 characters in the range of 041 octal through 176 octal (or 241 octal through 376 octal for the secondary character set in 8 bit mode).
To select a character set as the primary translation set (G0), the terminal must be in the shift-out state. Conversely, to select a character set as the secondary translation set (G1), the terminal must be in the shift-in state.

**Shift Out**  
all terminals

<table>
<thead>
<tr>
<th>Code</th>
<th>Value</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;036&gt;</td>
<td></td>
<td>(octal)</td>
</tr>
<tr>
<td>&lt;116&gt;</td>
<td></td>
<td>(hex)</td>
</tr>
<tr>
<td>1E</td>
<td>4E</td>
<td>(ASCII)</td>
</tr>
<tr>
<td>N</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Changes to the terminal's alternate character set. This command allows access to the secondary character set with characters in the range of 041 octal through 176 octal.

**Shift In**  
all terminals

<table>
<thead>
<tr>
<th>Code</th>
<th>Value</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;036&gt;</td>
<td></td>
<td>(octal)</td>
</tr>
<tr>
<td>&lt;117&gt;</td>
<td></td>
<td>(hex)</td>
</tr>
<tr>
<td>1E</td>
<td>4F</td>
<td>(ASCII)</td>
</tr>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Changes to the terminal's main character set. This command allows access to the primary character set with characters in the range of 041 octal through 176 octal.

**Deallocate Character Sets**

<table>
<thead>
<tr>
<th>Code</th>
<th>Value</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;036&gt;</td>
<td></td>
<td>(octal)</td>
</tr>
<tr>
<td>&lt;106&gt;</td>
<td>&lt;161&gt;</td>
<td>&lt;nn&gt; &lt;nn&gt;</td>
</tr>
<tr>
<td>1E 46</td>
<td>71</td>
<td>(hex)</td>
</tr>
<tr>
<td>&lt;036&gt;</td>
<td>Fq</td>
<td>&lt;nn&gt; &lt;nn&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(ASCII)</td>
</tr>
</tbody>
</table>

where

the first <nn> pair sets the starting point of the range (from 00 hex to 25 hex) of character sets to deallocate.

the second <nn> pair sets the ending point of the range (from 00 hex to 25 hex) of character sets to deallocate.

See the “Forming Command Arguments” section for more information on <nn> pairs.

This lets the host return any or all of the defined character sets to the pool of free characters. This command scans a range of character set numbers and removes any of the included character sets from memory. The <nn> parameters are the character set hex codes (20 hex to 45 hex) minus 20 hex because you can deallocate only Dynamically Reconfigurable Character Buffer (DRCB) sets. For example, <036>Fq000? deallocates any used sets from 20 hex through 2F hex.
Define Character

\[
\begin{align*}
&\text{<036> <106> <122> <char> <dd>..<dd> (octal)} \\
&1\text{E 46 52 <char> <dd>..<dd> (hex)} \\
&\text{<036> F R <char> <dd>..<dd> (ASCII)}
\end{align*}
\]

where

<char> is the character to define. It is in the range from 041 octal to 176 octal.

<dd> (twelve pairs) are the bit values of the rows of the character cell. Each bit represents one dot in the row of the cell. Each bit that is set represents a lighted dot on the screen.

Allows you to define your own characters. The definition consists of a character to redefine and twelve <dd> pairs. Before a Dynamically Reconfigurable Character Buffer (DRCB) or soft character can be defined, a DRCB character set must be selected as the current (active) character set. The “Character Sets” section of this chapter has details of the process for defining soft characters.

Reserve Character

\[
\begin{align*}
&\text{<036> <106> <145> <n> <n> (octal)} \\
&1\text{E 46 65 <n> <n> (hex)} \\
&\text{<036> F e <n> <n> (ASCII)}
\end{align*}
\]

where

the first <n> denotes the starting Dynamically Reconfigurable Character Buffer (DRCB ) set (decimal value from 0 to 15). 0 decimal maps to DRCB set 20 hex and 15 decimal maps to DRCB set 2F hex.

the second <n> denotes the number of contiguous sets (decimal values from 1 to 15).

For more information on <n> values, see the “Forming Command Arguments” section of this chapter.

Deallocates DRCB character sets that were reserved by the Define Character command. The Reserve Character command can be issued prior to executing any of the drawing commands. It is no longer necessary to allocate characters for drawing.
**Read Characters Remaining**

\[
\text{\texttt{\textbackslash 036} \texttt{\textbackslash 106} \texttt{\textbackslash 144}} \quad \text{(octal)}
\]
\[
1E \ 46 \ 64 \quad \text{(hex)}
\]
\[
\text{\texttt{\textbackslash 036} \texttt{F} \texttt{d}} \quad \text{(ASCII)}
\]

In response to this command, the terminal sends back the following five character sequence:

\[
\text{\texttt{\textbackslash 036} \texttt{\textbackslash 157} \texttt{\textbackslash 071} \texttt{\textbackslash \text{high} \texttt{\textbackslash low}}} \quad \text{(octal)}
\]
\[
1E \ 6F \ 39 \texttt{\textbackslash \text{high} \texttt{\textbackslash low}} \quad \text{(hex)}
\]
\[
\text{\texttt{\textbackslash 036} \ 0 \ 9 \texttt{\textbackslash \text{high} \texttt{\textbackslash low}}} \quad \text{(ASCII)}
\]

where

\[
<\text{high}> \text{ is the upper 5 bits of a 10–bit count}
\]
\[
<\text{low}> \text{ is the lower 5 bits of 10–bit count}
\]

Both of these parameters, when strung together, are similar to the <dd> pair used in the Define Character command. See the “Defining Soft Characters” section for more information on <dd> pairs.

**NOTE:** The count is returned to the user in the form of a base 32 numbering system where the ASCII characters “@”, “A” through “O” and “_” represent the 32 digits. If more than 1023 characters remain, the terminal will respond with 1023.

Returns a count of the remaining characters (from the terminal to the host) that can be used to create a drawing or to allocate to character sets (the free list). If the user runs out of allocated characters, the terminal will cease processing the drawing commands.
Character Attribute Commands

Change Attributes

\(<036> <106> <116> <nnn> <n> <n>\)  \(\text{octal}\)
\(1E \ 46 \ 4E \ <nnn> \ <n> \ <n>\)  \(\text{hex}\)
\(<036> \ F \ N \ <nnn> \ <n> \ <n>\)  \(\text{ASCII}\)

where

the first \(<nnn>\) group is the number of characters to change, starting at the cursor position. If you try to change characters past the end of the window, the command executes to the end of the window and then terminate.

the first \(<n>\) value is the attributes-to-set parameter. There are four attributes, each represented by a single bit:

<table>
<thead>
<tr>
<th>bit</th>
<th>3</th>
<th>Dim</th>
</tr>
</thead>
<tbody>
<tr>
<td>bit</td>
<td>2</td>
<td>Reverse video</td>
</tr>
<tr>
<td>bit</td>
<td>1</td>
<td>Underscore</td>
</tr>
<tr>
<td>bit</td>
<td>0</td>
<td>Blink</td>
</tr>
</tbody>
</table>

the last \(<n>\) is the attributes-to-reset parameter. If the same attribute is set in both the set and the reset, the attribute will be toggled. If the same bit in both the set parameter and the reset parameter is 0, the attribute will be left unchanged.

For more information on \(<nnn>\) and \(<n>\) values, see the "Forming Command Arguments" section of this chapter.

Sets, resets, or toggles visual attributes (dim, reverse video, underscore, and blink) of characters between the margins. It starts with the character at the cursor position and continues until the character count supplied is exhausted, wrapping to the next line if it encounters the right margin. However, this command executes within only the current window.

NOTE: The display attributes of protected text may be altered by this command since protection is not associated with a display attribute.
Dim On all terminals

<034> (octal)
1C (hex)
Ctrl-\ (ASCII)

Turns on the dim attribute for each subsequent character received by the terminal.

Dim Off all terminals

<035> (octal)
1D (hex)
Ctrl-] (ASCII)

Turns off the dim attribute for each subsequent character received by the terminal.

Blink On all terminals

<016> (octal)
0E (hex)
Ctrl-N (ASCII)

Turns on the blink attribute for each subsequent character received by the terminal. See the Blink Enable command.

Blink Off all terminals

<017> (octal)
0F (hex)
Ctrl-0 (ASCII)

Turns off the blink attribute for each subsequent character received by the terminal.

Blink Enable all terminals

<003> (octal)
03 (hex)
Ctrl-C (ASCII)

Allows blinking of characters which have the blink attribute turned on.
Blink Disable

all terminals

\(<004>\)
04 (hex)
Ctrl-D (ASCII)

Disables character blinking regardless of the state of the blink attributes assigned to displayed characters.

Underscore On

all terminals

\(<024>\)
14 (hex)
Ctrl-T (ASCII)

Turns on the underscore attribute for each subsequent character received by the terminal.

Underscore Off

all terminals

\(<025>\)
15 (hex)
Ctrl-U (ASCII)

Turns off the underscore attribute for each subsequent character received by the terminal.

Reverse Video On

all terminals

\(<036> <104>\) or \(<026>\) (octal)
1E 44 or 16 (hex)
\(<036> D\) or Ctrl-V (ASCII)

Turns on the reverse video attribute for each subsequent character received by the terminal.

Reverse Video Off

all terminals

\(<036> <105>\) or \(<002>\) (octal)
1E 45 or 02 (hex)
\(<036> E\) or Ctrl-B (ASCII)

Turns off the reverse video attribute for each subsequent character received by the terminal.
Protect On

<036> <106> <114> (octal)
1E 46 4C (hex)
<036> F L (ASCII)

Sets the protect attribute for all subsequent characters that are received by the terminal. If protect mode is disabled, the characters will have the attribute set, but will not be protected until protect is enabled.

Protect Off

<036> <106> <115> (octal)
1E 46 4D (hex)
<036> F M (ASCII)

Resets the protect attribute for each subsequent character that is received by the terminal.

Protect Enable

<036> <106> <126> (octal)
1E 46 56 (hex)
<036> F V (ASCII)

Enables all protected text so that the protected text cannot be changed with normal cursor-related commands. Protected text can be deleted only with an Erase Screen or Erase Window command.

Protect Disable

<036> <106> <127> (octal)
1E 46 57 (hex)
<036> F W (ASCII)

Allows the modification of protected text that is on the screen. Once the protect attribute is disabled, any command can modify the text.
Double High/Double Wide

\[
\langle 036 \rangle \langle 122 \rangle \langle 105 \rangle
\]
\[
1E \ 52 \ 45
\]
\[
\langle 036 \rangle \ R \ E
\]

(Octal)

(Hex)

(ASCII)

Where the \( n \) value is one of the following row attributes parameters:

0   Normal Row
1   Double Wide
2   Double High Top
3   Double High Bottom
4   Double High Top/Double Wide
5   Double High Bottom/Double Wide

Selects double high and double wide screen row attributes. Double High Top selects one character row as the top half of the line. Double High Bottom is used to select the next lower character row as the bottom half of the line. Both rows should contain the same characters to form a complete display.

Field Attributes

\[
\langle 036 \rangle \langle 122 \rangle \langle 103 \rangle \langle s \rangle \langle r \rangle
\]
\[
1E \ 52 \ 43 \langle s \rangle \langle r \rangle
\]
\[
\langle 036 \rangle \ R \ C \langle s \rangle \langle r \rangle
\]

(Octal)

(Hex)

(ASCII)

Where:

The \( s \) value is a \( nn \) pair that represents the field attribute to set and the \( r \) value is a \( nn \) pair that represents the field attribute to reset. There are four attributes, each represented by a single bit:

- bit 4: Blank (invisible)
- bit 3: Dim
- bit 2: Reverse video
- bit 1: Underscore
- bit 0: Blink

For more information on \( nn \) pairs, see the “Forming Command Arguments” section of this chapter.

NOTE: If the same bit is set in both \( s \) and \( r \), then that bit will toggle. If the same bit in \( s \) and \( r \) is set to 0 that bit will not change.

Replaces the character at the cursor location with a field attribute marker. To remove a marker, position the cursor on the marker and type any character. The Field Attribute setting changes
when the next Field Attribute, End of Line, or Page is encountered in the display screen. The character, field, and page attribute settings determine the displayed attribute by exclusive OR as shown in the example below.

<table>
<thead>
<tr>
<th>Character BURD</th>
<th>Field BURD</th>
<th>Page BURD</th>
<th>Display BURD</th>
</tr>
</thead>
<tbody>
<tr>
<td>0101</td>
<td>1111</td>
<td>0000</td>
<td>1010</td>
</tr>
<tr>
<td>0111</td>
<td>1000</td>
<td>1111</td>
<td>0000</td>
</tr>
</tbody>
</table>

**Page Attributes**

\(<036>\ <122>\ <104>\ <s>\ <r>\ \ (octal)\n\n1E 52 44 <s> <r> \ (hex)\n
\(<036>\ \ R\ D\ <s>\ <r>\ \ (ASCII)\n
Where:
The <s> value is a <nn> pair that sets page attributes and the <r> value is an <nn> pair that resets page attributes. There are four attributes, each represented by a single bit:

<table>
<thead>
<tr>
<th>bit</th>
<th>3</th>
<th>Dim</th>
</tr>
</thead>
<tbody>
<tr>
<td>bit</td>
<td>2</td>
<td>Reverse video</td>
</tr>
<tr>
<td>bit</td>
<td>1</td>
<td>Underscore</td>
</tr>
<tr>
<td>bit</td>
<td>0</td>
<td>Blink</td>
</tr>
</tbody>
</table>

For more information on <nn> pairs, see the “Forming Command Arguments” section of this chapter.

The Field Attribute Extend bit determines whether the Field Attributes effect terminates at the end of the row or wraps until the next Field Attributes or end of the screen is encountered. Since the Field Attribute Extend and Blank bits are shared in dual emulations, changing these bits may affect the other emulation in split screen mode.

**NOTE:** If the same bit is set in both <s> and <r>, then that bit will toggle. If the same bit in <s> and <r> is set to 0, then that bit will not change.
Relative Cursor-Positioning Commands

Cursor Right

<030> (octal)
18 (hex)
Ctrl-X (ASCII)

Moves the cursor one column to the right. If the cursor is at the right margin, the screen executes a New Line. If the command causes the cursor to move onto a protected character and protect mode is enabled, the command is repeated until the first unprotected character is encountered. If all character positions in the window are protected, the entire window is scanned for an unprotected character, beginning at the current cursor position. Upon reaching the character at which the Cursor Right was initiated, the screen executes a Cursor Right as if no characters were protected. However, no data is altered.

Cursor Left

<031> (octal)
19 (hex)
Ctrl-Y (ASCII)

Moves the cursor one column position to the left. If the cursor is at the left margin of a line, it moves to the right margin and the screen executes a Cursor Up. If the command causes the cursor to move onto a protected character and protect mode is enabled, the command is repeated until the first unprotected character is encountered. If all character positions in the window are protected, the entire window is scanned for an unprotected character, beginning at the current cursor position. Upon reaching the character at which the Cursor Left was initiated, the screen executes a Cursor Left as if no characters were protected. However, no data is altered.

Cursor Up

<027> (octal)
17 (hex)
Ctrl-W (ASCII)

Moves the cursor up one line while remaining in the same column. If the cursor is on the top row of a window, it moves to the bottom row of the window. If the cursor moves onto a protected character and protect mode is enabled, the screen executes a Cursor Left.
Cursor Down

<032> (octal)
1A (hex)
Ctrl-Z (ASCII)

Moves the cursor down one line while remaining in the same column position. If the cursor is on the bottom row of the window, it moves to the top row of the same window. If the cursor moves onto a protected character and protect mode is enabled, the screen executes a Cursor Right.

New Line

<012> (octal)
0A (hex)
Ctrl-J (ASCII)

Moves the cursor to the left margin of the next row. If the cursor is on the last row of a window and Roll Mode is enabled, a Scroll Up is performed. If the cursor is on the last row of a window and Roll Mode is not enabled, a Home command is performed. If the command causes the cursor to move onto a protected character and protect mode is enabled, the screen executes a Cursor Right.

Carriage Return

<015> (octal)
0D (hex)
Ctrl-M (ASCII)

Moves the cursor to the left margin of the same line. If the characters at the left margin are protected and protect mode is enabled, the screen executes a Cursor Right.
Margins Commands

Set Margins

\[ <036> <106> <130> <nn> <nn> \]
\[ 1E \ 46 \ 58 \ <nn> <nn> \]
\[ <036> \ P \ X <nn> <nn> \]

where

the first <nn> pair is the desired left margin. The left margin must be less than or equal to the right margin and in the range 0 to 206 decimal or the command is ignored.

the second <nn> pair is the desired right margin. The right margin must be greater than or equal to the left margin and less than or equal to 206 decimal. If out of this range, the command is ignored.

For more information on <nn> pairs, see the “Forming Command Arguments” section of this chapter.

Resets the margins to the new values specified. The cursor is moved to the left margin.

Set Alternate Margins

\[ <036> <106> <131> <nn> <nn> <nn> \]
\[ 1E \ 46 \ 59 \ <nn> <nn> <nn> \]
\[ <036> \ P \ Y <nn> <nn> <nn> \]

where

the first <nn> pair is the row to place the cursor on, and must be in the range of decimal values from 0 to 24 decimal (for 25 line screens), or 255 decimal which means no row movement. If the row is out of range, the last row of the window is used.

the second <nn> pair is the column of the new left margin. This margin is relative to the previously set left margin. If the column is the decimal value 255, then the last value for the left margin is used. If the new left margin is out of range, the command is aborted.

the third <nn> pair is the column of the right margin, which must adhere to the rules defined by the Set Margins command. If the new right margin is greater than the previously set right margin, the previously set right margin is used.

For more information on <nn> pairs, see the “Forming Command Arguments” section of this chapter.
Temporarily reassigns the margins to new margins while saving the previously set margins. The terminal then positions the cursor to the relative row and the relative left margin. If the row specified equals 255, the current window row is used (current row position of the cursor). Normal margins are saved and new margins are set to the left and right values specified.

NOTE: If Set Alternate Margins has already been issued, the previous alternate margins are not saved — only the original margins are saved. The previous alternate margins are lost in this case.

The alternate left and right margins are relative to the left margin set by the Set Margins command. Automatic horizontal scrolling of the view-port is disabled until the next Restore Normal Margins or Horizontal Scroll On command is encountered.

**Restore Normal Margins**

<036> <106> <132>  (octal)
1E 46 5A  (hex)
<036> F Z  (ASCII)

Restores the margins saved when the Set Alternate Margins command was executed. If horizontal scrolling is off as a result of a Set Alternate Margins command, it will be turned back on.
Screen Management Commands

Write Window Address  

<020>  <col>  <row>  (octal)  
10  <col>  <row>  (hex)  
Ctrl-P  <col>  <row>  (ASCII)  

where

<col> sets the new column position of the cursor, relative to the left margin. If the parameter is equal to 177 octal, then the current value for the column is used.

<row> sets the new row position of the cursor, relative to the top of the window. If the parameter is equal to 177 octal, then the current value for row is used.

Both values are entered in octal (raw, unencoded binary). Also, if the destination is in a protected area, the cursor is positioned to the specified position and the screen executes a Cursor Right. The cursor will be positioned at the address specified in the command after the Cursor Right sequence is completed.

Positions the cursor to the requested row and column of the window. Window address coordinates are relative to the left margin and the top of the window. The left margin is position 0, with the maximum value being the right margin minus the left margin. The top row of the window is row 0. The last row of the window is equal to the length of the window minus one. If you try to move to a position past the last row of a window, the cursor pegs at the end of the window. If you try to move to a position beyond the right margin, the cursor pegs at the right margin.

If the command would place the cursor beyond the last column of the displayed area, the terminal horizontally scrolls to accommodate the cursor unless horizontal scrolling is disabled. If the value of an argument is 177 octal, the terminal interprets this to mean the current value.

In the following example, begin with an initial screen configuration as shown below.
When using the Write Window Address command, the ordinates are relative to the current left margin. For example, in the illustration above (initial configuration), the left margin is 40 and the right margin is 120. The cursor is at Row 0, Column 40. A Write Window Address to Row 3, Column 30 is issued, and the resulting position of the cursor is Row 3, Column 70, as shown below.

Window Home

<010> (octal)
08 (hex)
Ctrl-H (ASCII)

Moves the cursor to the left margin of row 0 of the window. The command is automatically executed each time an Erase Window is issued. If the home position is protected and protect mode is enabled, the screen executes a Cursor Right.
Set Windows

\(<036> <106> <102> <nn> <n> . . . <nn> <n>\)  \(\text{(octal)}\)
\(1E 46 42 <nn> <n> . . . <nn> <n>\)  \(\text{(hex)}\)
\(<036> F B <nn> <n> . . . <nn> <n>\)  \(\text{(ASCII)}\)

where

- \(<nn>\) sets the length of the window and is in the range of decimal values from 0 to 24.
- \(<n>\) sets the spacing type:
  - 0 normal (81 columns) character spacing
  - 1 compressed (135 columns) character spacing.

For more information on \(<nn>\) pairs and \(<n>\) codes, see the "Forming Command Arguments" section of this chapter.

Lets the user specify the number of windows and number of rows associated with each window on the D413/D463 screen. It is possible to specify up to 24 windows or screen breaks with this command (or 25 windows if 25th Line Mode enabled).

Windows are specified by setting the number of rows associated with each window. For example, the sequence \(<036>FBO:0080020\) designates three windows with lengths of 14, 8, and 2 rows respectively, each with 81 characters per row. The command can be terminated early by 000, which allocates the remaining rows to the last window. For example, the sequence 0:0080000 designates three windows with row lengths of 10, 8 and 6; the last window is created by default to hold the remaining rows of the screen (24 – 10 – 8 = 6). If the sum of the rows specified exceeds 24 (25 if the status line is configured as a screen row), the last window will contain the remaining portion of the screen. For example, the sequence \(<036>FBO:00:00:0\) specifies three windows with row lengths of 10, 10 and 4.

When defining or redefining windows, current text on the screen is not lost. It is therefore possible to split an existing group of rows into multiple windows. Conversely, it is possible to join the text from two or more adjoining windows into one.

Since the text within windows may be horizontally scrolled independently of each other, the Set Windows command will align all text on the screen in accordance with the Left Margin. If horizontal scrolling is off, it is turned back on before the windows are set. For example, suppose two windows were currently defined on the D413/D463 screen, each with 12 rows. The top window is aligned in normal fashion (for example, window column 0 is aligned with screen column 0 and the left margin is zero). Text in the bottom window, however, has been horizontally scrolled to the left. Issuing a new Set Windows command causes the bottom 12 lines of the screen to align with the top window before the new screen breaks are enforced. A Screen Home command is executed as the last function of the Set Windows command.
Set 25\textsuperscript{th} Line Mode

\begin{verbatim}
<036> <106> <172> <n> (octal)
1E 46 7A <n> (hex)
<036> F z <n> (ASCII)
\end{verbatim}

where
\begin{itemize}
  \item <n> sets the mode:
    \begin{itemize}
      \item 0 \textsuperscript{25}th line displays a status line
      \item 1 \textsuperscript{25}th line displays a message on the status line. To enter the message, simply append an <nn> pair to the command (which specifies the number of characters to display) and string the specified number of characters together after the <nn> pair. For example: <036>Fz104Text
      \item 2 \textsuperscript{25}th line is used as an extra screen row. The last window will be lengthened by one to include this line (the 25th row of the screen).
      \item 3 \textsuperscript{25}th line is blanked.
    \end{itemize}
\end{itemize}

See the "Forming Command Arguments" section of this chapter for more information on <n> codes and <nn> pairs.

This command sets the usage of the status line.

Push

\begin{verbatim}
<036> <106> <150> (octal)
1E 46 68 (hex)
<036> F h (ASCII)
\end{verbatim}

Saves only the character attributes, terminal modes, and screen boundaries described below:

- **Character attributes**
  - Blink (on or off)
  - Underline (on or off)
  - Reverse video (on or off)
  - Dim (on or off), Protection (on or off).

- **Terminal modes**
  - Blink mode (enabled or disabled)
  - Protect mode (enabled or disabled)
  - Scroll rate (jump, slow, fast)
  - 7/8 bit mode (7 or 8 bit)
  - Cursor type (none, underline, blinking underline, reverse, or blinking reverse)
  - Roll mode (enabled or disabled).
Screen boundaries

Left margin
Right margin

Window definitions including the horizontal offset and current window.

After a Push–Pop sequence, the screen remains stationary unless a Horizontal Scroll Enable or margin control command follows a Push command.

Pop

D413/D463

\(<036>\ <106>\ <151>\) (octal)
\(1E\ 46\ 69\) (hex)
\(<036>\ F\ i\) (ASCII)

Saves only the character attributes, terminal modes, and screen boundaries described below:

Character attributes

Blink (on or off)
Underscore (on or off)
Reverse video (on or off)
Dim (on or off)
Protection (on or off).

Terminal modes

Blink mode (enabled or disabled)
Protect mode (enabled or disabled)
Scroll rate (jump, slow, fast)
7/8 bit mode (7 or 8 bit)
Cursor type (none, underscore, blinking underscore, reverse, or blinking reverse)
Roll mode (enabled or disabled).

Screen boundaries

Left margin
Right margin

Window definitions including the horizontal offset and current window.

After a Push–Pop sequence, the screen remains stationary unless a Horizontal Scroll Enable or margin control command follows a Push command. After a Pop command, the terminal executes a Window Home command.
Write Screen Address

<036> <106> <120> <nn> <nn> (octal)
1E 46 50 <nn> <nn> (hex)
<036> F P <nn> <nn> (ASCII)

where

the first <nn> pair sets the absolute screen column within which to place the cursor. It must be in the range 0 to 206, or 255 decimal. If 255 is used, the terminal interprets the parameter to mean the current cursor column.

the second <nn> pair sets the absolute row within which to place the cursor. It must be in the range 0 to 23 decimal (0 to 24 if 25th Line Mode is set), or 255 decimal. If the 255 is used, the terminal interprets the parameter to mean the current cursor row.

Also, if either argument is out of range, the cursor pegs at the boundary encountered (at the margin if the column argument is outside the current margin and at the screen boundary if the row argument is out of range).

For more information on <nn> pairs, see the “Forming Command Arguments” section of this chapter.

The write screen address command positions the cursor anywhere on the screen relative to the (0,0) position, not screen home (left margin,0). If the positioning of the cursor moves the cursor off the screen, the screen scrolls horizontally (unless horizontal scrolling is turned off). If the command causes the cursor to move onto a protected character and protect mode is enabled, the screen executes a Cursor Right. The cursor will be positioned at the address specified after the Cursor Right is completed. This may require a long time if the entire screen is filled with protected characters. When using Write Screen Address, the vertical range is 0 to 23 decimal (24 if 25th Line Mode is set) and the horizontal range is 0 to 206 decimal. If the range of the arguments takes the cursor outside the margins, the cursor pegs at the margin.

In the following example, begin with an initial screen configuration as shown below.

[Diagram of screen configuration]

With the above configuration, a Write Screen Address to Column 20, Row 2 scrolls the window text twenty columns to the left (to Column 20) and places the cursor on the third row (Row 2) of
the screen, as shown in the next illustration. Remember that the first row of the screen is Row 0, so the third row of the screen is Row 2.

NOTE: This command may select a new window. If the new destination of the cursor is within a new window, the new window boundaries take effect immediately. Scrolling and cursor movement are restricted to the new window.

Select Compressed Spacing

\[ \langle 036 \rangle \langle 106 \rangle \langle 113 \rangle \quad \text{(octal)} \]
\[ 1E \text{ 46 48} \quad \text{(hex)} \]
\[ \langle 036 \rangle \text{ F K} \quad \text{(ASCII)} \]

Compresses character spacing for the current window to allow you to view all columns of a wide form (up to 135 columns) at one time. When you select compressed spacing, the columns displayed depend on the absolute column number of the leftmost column displayed with normal spacing. For example, when the leftmost absolute column number ranges from 0 to 72, compressed spacing displays the leftmost 135 columns. When the leftmost column number ranges from 72 to 126, compressed spacing displays the rightmost 135 columns. Margin settings are unchanged.
Select Normal Spacing

Sets character spacing for the current window to allow you to view up to 81 columns at a time. If you select normal spacing and horizontal scrolling is disabled, 81 columns are displayed to the right of and including the leftmost column displayed with compressed spacing.

If you select normal spacing and horizontal scrolling is enabled, the columns displayed depend on the location of the cursor. The 81 columns will be displayed if the cursor is located in the leftmost 81 columns of the screen. 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 unchanged.

Named Save/Restore Cursor

where

the first <n> sets the memory number to be used (0 through 15 decimal).

the second <n> has one of the following values:

0 saves the current position
1 restores the position from memory

See the “Forming Command Arguments” of this chapter for more information on <n> quantities.

Provides 16 absolute cursor position save areas that may be individually accessed. If a memory that has not yet been saved into is restored, the cursor is sent to location (0,0). Any location can be restored multiple times.
Save/Restore Screen Contents

<036> <106> <163> <n>  (octal)
1E 46 73 <n>  (hex)
<036> F s <n>  (ASCII)

where

<n> sets which command to enact:
0  command specified is Save Screen Contents
1  command specified is Restore Screen Contents

For more information on <n> values, see the “Forming Command Arguments” section of this chapter.

Saves the contents of the screen to a secondary save area or restores an old copy of the screen. The Save Screen Contents and Restore Screen Contents commands are only valid when they are enabled in the Terminal Configuration Menu. If the terminal is not in dual host mode (the emulation is set to “Device” in the Configuration Menu), then all of the display will be saved (using the inactive emulation’s memory). Otherwise, if another emulation is defined, the physical row length is cut in half (to 103 columns) and the screen is saved on undisplayed rows. For information on using the Configuration Menu, refer to the manual Installing and Operating D216E+, D217, D413, and D463 Display Terminals.

When you issue a Save Screen Contents or Restore Screen Contents command, window definitions are pushed; then popped without interference with the operation of the Push/Pop command. Currently, the Save/Restore Screen Contents command does not support protected characters or graphics.

NOTE: Only the last save of the screen contents can be restored, and multiple restores can occur for each save. Graphics and Dynamically Reconfigurable Character Buffers (DRCB) are not saved.

Screen Home

<036> <106> <107>  (octal)
1E 46 47  (hex)
<036> F G  (ASCII)

Returns the cursor to the absolute 0 row, left margin of the screen. The current window is changed to the first window of the screen, and that window is scrolled to the left margin as necessary. If the home position is protected and protect mode is enabled, the screen executes a Cursor Right.
Set Row Length

\[ \text{Set Row Length} \]

\[
\begin{array}{ll}
\langle 036 \rangle \langle 122 \rangle \langle 100 \rangle \langle \text{nn} \rangle & \text{(octal)} \\
1E \ 52 \ 40 \ \langle \text{nn} \rangle & \text{(hex)} \\
\langle 036 \rangle \text{ R @} \ \langle \text{nn} \rangle & \text{(ASCII)}
\end{array}
\]

where

\(<\text{nn}>\) sets the row length. For more information on \(<\text{nn}>\) pairs, see the “Forming Command Arguments” section of this chapter.

Alters the physical row length used for partitioning screen RAM. The number of available rows is recalculated based on the new row length and the data on the screen is preserved as much as possible (if the lines are lengthened, then rows will be removed and blanks added to remaining rows; if the lines are shortened, then blank rows will be added after the end of the screen and data in columns past the new maximum right margin are lost). If the row length is set to fewer than 135 columns, then compressed mode is disabled. This command is not currently useful since the Set Windows command cannot take advantage of these added lines.
Scrolling Commands

Show Columns

D413/D463

\[
<036> <106> <137> <\text{n}> <\text{n}> \quad \text{(octal)}
\]
\[
1E \ 46 \ 5F \ <\text{n}> <\text{n}> \quad \text{(hex)}
\]
\[
<036> \ F \ _ \ <\text{n}> <\text{n}> \quad \text{(ASCII)}
\]

where

the first \(<\text{n}>\) pair sets the left most column of the area to display, specified in absolute ordinates (0 to 206 decimal).

the second \(<\text{n}>\) pair sets the right most column of the area to display, specified in absolute ordinates (0 to 206 decimal).

For more information on \(<\text{n}>\) pairs, see the “Forming Command Arguments” section of this chapter.

Scrolls text in the window horizontally the minimum amount necessary so that the columns in the specified range are visible. If these columns are visible in the viewing area, the window is not moved. If the distance between the left and right columns is greater than the width of the window (81 columns) the command performs a minimal horizontal scroll so the left column is on the left side of the screen.

Set Scroll Rate

D413/D463

\[
<036> <106> <124> <\text{n}> \quad \text{(octal)}
\]
\[
1E \ 46 \ 54 \ <\text{n}> \quad \text{(hex)}
\]
\[
<036> \ F \ T \ <\text{n}> \quad \text{(ASCII)}
\]

where

\(<\text{n}>\) sets the scroll rate:

0 disables smooth scroll; makes all scrolling operations jump in the same fashion as the DASHER/D2 display.

1 enables smooth scroll at a maximum rate of 5 character rows per second. This rate permits easy reading of text as it is continuously displayed.

2 enables smooth scroll at a maximum rate of 10 character rows per second. This rate is useful for scanning of long documents.

Lets the host select one of three scroll rate options. If the argument specified does not fall within the inclusive range 0 to 2 (060 to 062 octal), the terminal defaults to jump scroll.
Scroll Down

<036> <111> (octal)
1E 49 (hex)
<036> I (ASCII)

Moves text in the window down one line and inserts a blank line at the top of the window. The cursor remains fixed on the screen. The line at the bottom of the window is lost. If a protected field is encountered, the screen executes a Cursor Right command. If horizontal scrolling is enabled and the cursor is off the screen and encounters a protected character, then the screen scrolls horizontally. If no such character is encountered, then no horizontal scrolling occurs. The command is valid even if the terminal is currently in Roll Disable Mode.

Scroll Up

<036> <110> (octal)
1E 48 (hex)
<036> H (ASCII)

Moves text in the window up one line and inserts a blank line at the bottom of the window. The cursor remains fixed on the screen. The line at the top of the window is lost. If a protected field is encountered, the screen executes a Cursor Right command. If horizontal scrolling is enabled and the cursor is off the screen and encounters a protected character, then the screen scrolls horizontally. If no such character is encountered, then no horizontal scrolling occurs. The command is valid even if the terminal is currently in Roll Disable Mode. New Line and Cursor Right commands do not scroll in Roll Disable Mode; however, a Scroll Up command always results in scrolling.

Scroll Left

<036> <106> <103> <nn> (octal)
1E 46 43 <nn> (hex)
<036> F C <nn> (ASCII)

where

<nn> sets the number of columns to move text left, as an incremental value from the current offset. For more information on <nn> pairs, see the “Forming Command Arguments” section of this chapter.

Scrolls text in the current window to the left for the number of columns specified. The cursor remains in the same position. If the scroll exceeds physical page boundaries, the window bumps the right page limit. Because every D413/D463 page is 207 columns wide, the maximum column offset is 126 (207 – 81). If horizontal scrolling is disabled, then this command is ignored.
The Scroll Left command is used explicitly to force text to move horizontally within the window. Normal cursor movement beyond the visible portion of the screen can also cause horizontal scrolling.

Scroll Right

D413/D463

\(<036>\ <106>\ <104>\ <nn>\)  \(\text{octal}\)
\(1E\ 46\ 44\ <nn>\)  \(\text{hex}\)
\(<036>\ F\ D\ <nn>\)  \(\text{ASCII}\)

where

\(<nn>\) sets the number of columns to incrementally offset the text. For more information on \(<nn>\) pairs, see the "Forming Command Arguments" section of this chapter.

Moves text within the current window to the right. If the window movement violates physical page boundaries (for example, attempting to view something to the left of the first column), the window's leftmost column in the window is column 0. If horizontal scrolling is disabled, then this command is ignored.

Horizontal offset is volatile after this command is executed if the cursor is moved off the screen. The next cursor movement or displayed character may cause an undesired horizontal scroll. To avoid this, use the Horizontal Scroll Disable command immediately after issuing a Scroll Right (or Left) command.

Roll Enable

all terminals

\(<022>\)  \(\text{octal}\)
12  \(\text{hex}\)
\(\text{Ctrl}-R\)  \(\text{ASCII}\)

Turns on Roll Mode. In Roll Mode, each time a command is issued that moves the cursor beyond the bottom of the window, the screen scrolls up one line. The cursor then moves to the new line. Information previously displayed on the top row is lost. When the terminal is powered up, Roll Mode is the default state. The Cursor Down command is an exception because it always wraps to the top line of the window.
Roll Disable

Roll Disable all terminals

<023> (octal)
13 (hex)
Ctrl-S (ASCII)

Turns off Roll Mode. With Roll Mode disabled, each time a command is issued that moves the cursor beyond the bottom of the window, the cursor wraps to the top line of the current window.

Horizontal Scroll Disable

Horizontal Scroll Disable D413/D463

<036> <106> <135> (octal)
1E 46 5D (hex)
<036> F ] (ASCII)

In normal operation, the terminal horizontally scrolls the window to keep the cursor within the displayed area of the screen. The Horizontal Scroll Disable command disables that (default) scrolling. This command can be used to paint an area of the screen without distracting the operator by scrolling the window. The Set Alternate Margins command also turns off horizontal scrolling.

Horizontal Scroll Enable

Horizontal Scroll Enable D413/D463

<036> <106> <136> (octal)
1E 46 5E (hex)
<036> F ^ (ASCII)

Restarts horizontal scrolling. If the cursor is off the screen, the screen is scrolled the minimum distance necessary to display the cursor. This is the default power-up setting.
Editing Commands

Erase Window  
all terminals

<014>  (octal)
0C     (hex)
Ctrl-L (ASCII)

Erases all characters in a window and performs a Window Home command. All character attributes, including protection, are cleared. If the left margin is off the screen, the window scrolls horizontally to accommodate the new cursor position.

Erase Screen  
D413/D463

<036> <106> <105>  (octal)
1E 46 45     (hex)
<036> F E   (ASCII)

Erases all text in the terminal regardless of current window definitions or horizontal window alignments. The cursor is then moved to the first row of the screen, at the left margin. All window breaks are left unchanged. The window may scroll horizontally to accommodate the new cursor position. All character attributes, including protection, are cleared.

Erase to End of Line  
all terminals

<013>  (octal)
0B     (hex)
Ctrl-K (ASCII)

Erases all text from the cursor to the right margin. If protect mode is enabled and a protected character is encountered before the right margin is reached, that protected character is treated as the right margin. The cursor position is left unchanged.

Insert Line  
D413/D463

<036> <106> <110>  (octal)
1E 46 48     (hex)
<036> F H   (ASCII)

Inserts a row in a window. Text on rows beneath the cursor, including the row on which the cursor resides, is moved down one row within the window. Protected fields are moved down and stay with the text rows they are on before the insert line command was issued. The entire cursor row is blanked and the cursor remains fixed on the screen.
Delete Line

\(<036> <106> <111>\) (octal)
1E 46 49 (hex)
\(<036> F I\) (ASCII)

Deletes the row the cursor is currently on. Text on rows beneath the cursor row is moved up one row within the window. Protected fields are moved up and stay with the text rows they were on before the Delete Line command was issued. The entire cursor row is lost and a blank row appears at the bottom of the window. The cursor remains fixed on the screen unless a protected field is encountered. If the cursor encounters a protected field, the screen executes a Cursor Right command.

Insert Line Between Margins

\(<036> <106> <133>\) (octal)
1E 46 5B (hex)
\(<036> F \[\) (ASCII)

Inserts a line of text on the cursor row by copying rows down one row at a time. This command does not affect text outside of the margins. However, because it is a byte by byte copy, the execution is time consuming. The scrolling mode (smooth or jump scroll) is not enforced and the page/Roll Mode status is also ignored. Otherwise, operation of this command is the same as the Insert Line command.

Delete Line Between Margins

\(<036> <106> <134>\) (octal)
1E 46 5C (hex)
\(<036> F \\) (ASCII)

Deletes a line of text on the cursor row by copying rows of the window up one row at a time. This command does not affect text outside of the margins. However, because it is a byte-by-byte copy, the execution is time consuming. The terminal does not enforce Scroll Mode (smooth or jump scroll), and the page/Roll Mode status is ignored. Otherwise, operation of this command is the same as the Delete Line command.
### Erase Unprotected

D413/D463

\[
\begin{array}{l}
<036> <106> <106> \\
1E 46 46 \\
<036> F F \\
\end{array}
\]

(Octal)  (Hex)  (ASCII)

If protect mode is enabled, this command erases all unprotected text from the cursor to the end of a window. If protect mode is disabled, all text from the cursor to the end of the window is blanked and protected fields are lost. Unlike other erase commands, this command operates between the left and right margins. The cursor position is left unchanged after the command.

### Insert Character

D413/D463

\[
\begin{array}{l}
<036> <112> \\
1E 4A \\
<036> J \\
\end{array}
\]

(Octal)  (Hex)  (ASCII)

Inserts a blank character under the cursor by rippling characters to the right and putting a space under the cursor. The character at the right margin is lost. If protect mode is enabled and a protected character is encountered before the right margin is reached, that protected character is treated as the right margin.

### Delete Character

D413/D463

\[
\begin{array}{l}
<036> <113> \\
1E 4B \\
<036> K \\
\end{array}
\]

(Octal)  (Hex)  (ASCII)

Deletes the character under the cursor by rippling characters to the left and bringing in a space at the right margin. If protect mode is enabled and a protected character is encountered before the right margin is reached, that protected character is treated as the right margin. The character under the cursor is lost.
Programmable Function Key Commands

Host Programmable Function Keys

D413/D463

\(<036> \ <106> \ <153> \ <\text{mode}> \ <\text{key}> \ <\text{length}> \ <\text{string}>\)  \ (\text{octal})

\(1E \ 46 \ 6B \ <\text{mode}> \ <\text{key}> \ <\text{length}> \ <\text{string}>\)  \ (\text{hex})

\(<036> \ F \ k \ <\text{mode}> \ <\text{key}> \ <\text{length}> \ <\text{string}>\)  \ (\text{ASCII})

where

\(<\text{mode}>\) is a one byte \(<n>\) parameter that defines erasure mode. Valid parameters are:

- \(0\) Clear to predefined defaults. This mode requires no arguments.
- \(1\) to \(4\) Reserved for D555 terminal. A value for mode between 1 and 4 will cause the sequence to fail.
- \(5\) Clear to predefined defaults and load new user key definitions.
- \(6\) Add to, or overwrite, previously defined key definitions.
- \(7\) Save up to 128 bytes out of the possible 255 bytes of the current key definitions in non-volatile RAM to be restored only on power up, or upon hard terminal reset (Cmd-Erase Page). This mode requires no additional arguments.
- \(8\) Read current user programmed key definitions (see also Read User Programmed Keys command, on next page). This mode requires no additional arguments.

\(<\text{key}>\) is a \(<nn>\) pair that sets the key to be defined. The range is 0 decimal to 59 decimal. Function keys F1 through F15 are broken into the ranges below:

- Normal \(0\) – \(14\) decimal \(00\) – \(0E\) hex
- Shifted \(15\) – \(29\) decimal \(0F\) – \(1D\) hex
- Ctrl \(30\) – \(44\) decimal \(1E\) – \(2C\) hex
- Ctrl-Shift \(45\) – \(59\) decimal \(2D\) – \(3B\) hex

\(<\text{length}>\) is a \(<nn>\) pair that sets the length of the string being programmed. The range on this parameter is decimal values from 0 decimal to 255 decimal. A zero length will cause the key to be cleared to the predefined default. No string is required or expected with a zero length parameter.

\(<\text{string}>\) contains the actual ASCII key definition encoded as a string of \(<nn>\) pairs

For more information on \(<n>\) quantities and \(<nn>\) pairs, see the “Forming Command Arguments” section in this chapter.

Allows one or more of the 60 predefined function key codes to be reprogrammed with user defined sequences. Programmed function keys share 255 bytes of volatile memory space. This memory can be allocated entirely to one key if desired. Keys that do not have a user definition send the default function key sequences. When programming keys, this sequence will continue to
accept new key definitions until terminated with an out of range key number. You can also program function keys through the Configuration menus. For information on using the Configuration Menu, refer to the manual *Installing and Operating D216E+, D217, D413, and D463 Display Terminals*.

**Programming Example**

A user wants to clear any previous key definitions and make two of his own definitions: “hello” and “goodbye” to be on the Shift–F1 and Shift–F5 keys, respectively. The format for this command, as shown above is:

```
<036>Fk<mode><key><length><string> ... <key><length><string><terminator>
```

The command sequence to perform our example is:

```
<036>Fk50?0568656<6<6?1307676?6?64627965?
```

where

- `<036>` Clear and load new keys
- `50` Shift–F1
- `05` 5 characters
- `68656<6<6?` ASCII hello in DG–hex
- `13` Shift–F5
- `07` 7 characters
- `67?6?64627965` ASCII goodbye in DG–hex
- `??` Illegal key code terminates sequence.

**Reading User Programmed Keys**

The terminal will respond to this query from the host by sending information on current function key definitions in the following format.

```
<036>o;4<total_length><key><length><string>
```

where

- `<036>` o; 4 is the response header
- `<total_length>` is the total number of bytes that will be sent in an `<nnnn>` format. For more information on `<nnnn>` quantities, see the “Forming Command Arguments” section of this chapter.
- `<key>`, `<length>`, and `<string>` are the same as the parameters in the Host Programmable Keys command

This feature can be useful for applications that reprogram the function key definitions. It allows the application to read and save the current key definitions so that they may be restored on exit.
Programming Example

The sequence returned by <036>Fk8 after executing the above example (for the Host Programmable Keys command) would be:

<036>;400200?0568656<6<6?1307676?6?64627965
Reporting Commands

Report Screen Size

Let's the host determine the maximum number of available rows and columns. The data returned is in the following format (for more information on <nn> pairs, see the "Forming Command Arguments" section of this chapter.

\[ \text{<036> <106> <164>} \] (octal)
\[ \text{1E 46 74} \] (hex)
\[ \text{<036> F t} \] (ASCII)

where

- the first <nn> pair indicates the number of available screen rows.
- the second <nn> pair indicates the number of available screen columns (207 normally).
- the third <nn> pair indicates the number of available rows in the current window.
- the fourth <nn> pair indicates the number of available columns in the current window (right margin - left margin +1).

<status> is an ASCII character composed of eight bits (representing the terminal state) in the format of 01HHMMSE,

- HH is the ID code of the other emulator (00 hex Data General native-mode; 01 for VT320 mode; 10 for TEK4010; 11 for Printer or Mouse)
- MM is the port mode of the emulators (00 for Both; 01 for Host; 10 for Auxiliary), and has no meaning if HH is set to 11.
- S is 1 if the screen has been saved
- E is 1 if screen save is enabled

For example, the host sends the code \(<036>Ft.\) The terminal responds with the code \(<036,o<18<?1050p.\) The interpretation of the returned data (in DG-hex) is the following:

- 18 means 24 rows in whole screen
- ?? means 207 columns in whole screen
- 10 means 16 rows in current window
- 50 means 80 columns in window (for example, left margin at 0 and right margin at 79)
- p (01110000 in binary) means one host. Screen save is not enabled.
Read Horizontal Scroll Offset

When this command is issued by the host, the terminal returns the distance the current window is horizontally scrolled over from the absolute zero (left most) column of the screen. The format of the data returned to the host is:

```
<036> <157> <072> <nn>
1E 6F 3A <nn>
<036> o : <nn>
```

where

- `<nn>` indicates the value of the horizontal offset. This value is in the range of decimal values from 0 to 126 with the lower four bits of two bytes specifying the eight-bit value of the scrolled offset. For more information on `<nn>` pairs, see the “Forming Command Arguments” section of this chapter.

Read Window Address

The terminal sends the following three character sequence back to the computer.

```
<037> <col> <row>
1F <col> <row>
Ctrl- _ <col> <row>
```

where

- `<col>` is the window column the cursor is on (relative to the left margin mod 128)
- `<row>` is the window row the cursor is on (relative to the top of the window)

Both `<col>` and `<row>` are two raw binary characters, and therefore are not encoded.
Read Screen Address

D413/D463

The terminal sends the following five character sequence back to the computer.

```
<036> <106> <142> <157> <070> <nn> <nn> 1E 6F 38 <nn> <nn> <036> 0 8 <nn> <nn>
```

The first <nn> pair is the absolute screen column.
The second <nn> pair is the absolute screen row.

For more information on <nn> pairs, see the "Forming Command Arguments" section of this chapter.

Read Window Contents

```
<036> <106> <166> <r1> <c1> <r2> <c2> <r1> <c1> <r2> <c2> 1E 46 76 <r1> <c1> <r2> <c2> <036> F v <r1> <c1> <r2> <c2>
```

where

<r1> <c1> are two <nn> pairs that specify the bounded area's upper left corner.

<r2> <c2> are two <nn> pairs that specify the bounded area's lower right corner.

For more information on <nn> pairs, see the "Forming Command Arguments" section of this chapter.

Returns the contents of any bounded area of the screen to be transmitted back to the host. The rectangular area bounded by (r1,c1) and (r2,c2) is shipped to the host with <015> <012> (OD OA hex) between each row and with trailing blanks on each row stripped. The data sent to the host is similar to what would be printed, were a printing command used. The characters on the screen are translated using the settings of G0 and G1. If a character on the screen does not belong to either assigned character set, then it will be translated as a space. If any of the given parameters are out of range, then nothing will be transmitted. Also, if the user presses the Local Print or Cmd–CR keys during this operation, it will be terminated. Like any of the printing commands, an <ACK> will be sent back to the host after the operation is complete only if this option has been selected on the Configuration Menus. For information on using the Configuration Menu, refer to the manual *Installing and Operating D216E+, D217, D413, and D463 Display Terminals*.
The terminal sends the following string back to the host computer:

\[
\begin{align*}
&<036> <157> <043> <m> <x> <y> \text{ (octal)} \\
&1E \text{ 6F} 23 \text{ <x> <y}> \text{ (hex)} \\
&<036> 0 \# \text{ <x> <y}> \text{ (ASCII)}
\end{align*}
\]

where

- \(<m>\) is a character that identifies the type of terminal. This character can be set in the menus or by the Set Model ID command. The table below lists the default settings.

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Octal</th>
<th>Hexadecimal</th>
<th>ASCII</th>
</tr>
</thead>
<tbody>
<tr>
<td>D217</td>
<td>&lt;065&gt;</td>
<td>35</td>
<td>5</td>
</tr>
<tr>
<td>D413/D463</td>
<td>&lt;066&gt;</td>
<td>36</td>
<td>6</td>
</tr>
</tbody>
</table>

- \(<x>\) is a character formed from bits defined as 01TC PRRR, where

  - T 0 if the power on self test passed, 1 if errors are detected.
  - C 0 if 7 bit communications mode 1 if 8 bit communications mode.
  - P 0 if printer not available 1 if printer is available.
  - R 3 bit firmware revision number 0–7.

- \(<y>\) is a character formed from bits defined as 016K LLLL, where:

  - G 0 if graphics are not available, 1 if D460 graphics available.
  - K 0 if keyboard missing 1 if keyboard installed.
  - L is from the following table:
Keyboard

<table>
<thead>
<tr>
<th>Switches</th>
<th>Nationality</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>not used</td>
</tr>
<tr>
<td>0001</td>
<td>not used</td>
</tr>
<tr>
<td>0010</td>
<td>Norwegian</td>
</tr>
<tr>
<td>0011</td>
<td>Swiss/French</td>
</tr>
<tr>
<td>0100</td>
<td>Swiss/German</td>
</tr>
<tr>
<td>1010</td>
<td>Canadian/French</td>
</tr>
<tr>
<td>0110</td>
<td>Katakana</td>
</tr>
<tr>
<td>0111</td>
<td>Italian</td>
</tr>
<tr>
<td>1000</td>
<td>Canadian/French</td>
</tr>
<tr>
<td>1001</td>
<td>U.S. English</td>
</tr>
<tr>
<td>1010</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>1011</td>
<td>French</td>
</tr>
<tr>
<td>1100</td>
<td>German</td>
</tr>
<tr>
<td>1101</td>
<td>Swedish/Finnish</td>
</tr>
<tr>
<td>1110</td>
<td>Spanish</td>
</tr>
<tr>
<td>1111</td>
<td>Danish/Norwegian</td>
</tr>
</tbody>
</table>

Read New Model ID

all terminals

<036> <106> <167> (octal)
1E 46 77 (hex)
<036> F w (ASCII)

The terminal sends the following returned string back to the host computer:

<036><157><167><class><service-level><revision><name><reserved> (octal)
1E 6F 77 <class><service-level><revision><name><reserved> (hex)
<036> o w <class><service-level><revision><name><reserved> (ASCII)

where

<class> is a single <n> digit specifying the general type of the terminal. The following classes are currently defined:

0 unintelligent terminal, handles no commands except <CR> and <LF>
1 D200 level data−entry terminal
3 D410 without Dynamically Reconfigurable Character Buffer (DRCB)
4 D410 level text−editing terminal
8 D460 level graphics terminal

<service−level> is an <nn> pair representing the specific terminal ID within the class. Any unknown code should be treated as the next lower known code. The D413/D463 returns 01.
<revision> is an <nn> pair encoding the firmware revision number.

<name> is an eight–character blank padded string with a human–readable terminal model–name. This is given for producing readable error logs for testing. The D217/D413/D463 returns “D217”, “D413”, or “D463”.

CAUTION: Do not test or compare any part of this string!

<reserved> is a field of four spaces.

For more information on <nn> pairs, see the “Forming Command Arguments” section of this chapter.

This command returns a more detailed description of the terminal type and capabilities. The original Model ID command (<036>C) reported a unique number for each terminal and there was no way to determine the capabilities of a new, unrecognized terminal.

It should not be necessary to reserve any new model IDs for the traditional Model ID command for future terminals.
Dual-Emulation Support Commands

Hot Key Switch

<036> <106> <155> <065> (octal)
1E 46 6D 35 (hex)
<036> F m 5 (ASCII)

Changes the terminal from the active emulation to the currently inactive emulation. This command is only valid during a dual host session. It is mainly used with a diagnostic routine to check out the dual host functionality.

Switch Emulation Mode

<036> <106> <176> <nn> (octal)
1E 46 7E <nn> (hex)
<036> F ~ <nn> (ASCII)

where

<nn> has one of the following hex values:
00 Data General native-mode (not generally used)
08 VT52
09 VT100
0C VT320
10 Tektronix 4010

For more information on <nn> pairs, see the “Forming Command Arguments” section of this chapter.

This command returns the following string back to the host:

<036> <157> <176> <n> (octal)
1E 6F 7E <n> (hex)
<036> o ~ <n> (ASCII)

where

<n> is 0 if the command failed; or 1 if it succeeded.

Changes the current emulation from Data General native-mode to any other emulation supported by the terminal. All volatile mode settings are lost.
Set Split Screen Mode

\[ \langle 036 \rangle \langle 122 \rangle \langle 101 \rangle \langle 060 \rangle \langle \text{nn} \rangle \langle \text{n} \rangle \]  
\[ 1E \text{ 52 41 30} \langle \text{nn} \rangle \langle \text{n} \rangle \]  
\[ \langle 036 \rangle \text{ R A 0} \langle \text{nn} \rangle \langle \text{n} \rangle \]

where

\[ \langle \text{nn} \rangle \] encodes the number of rows for the emulation to be displayed on the top. See the “Forming Command Arguments” section of this chapter for more information on \[ \langle \text{nn} \rangle \] pairs. If \[ \langle \text{nn} \rangle \] is 0, split screen is disabled. If \[ \langle \text{nn} \rangle \] is out of range, then the current split point is left unaltered.

\[ \langle \text{n} \rangle \] sets the emulation to be displayed in the top partition, with the following values:
- 0 - host
- 1 - auxiliary

Configures a terminal set for dual host to display portions of host and auxiliary emulations on the same screen, separated by a horizontal line. The status line is always displayed in Split Screen Mode. If the split point is changed by a valid parameter, both emulations’ first-row-to-display options are reset to zero.

NOTE: Cmd–Cursor Uparrow/Downarrow moves the split point up and down.

Set First Row To Display

\[ \langle 036 \rangle \langle 122 \rangle \langle 101 \rangle \langle 061 \rangle \langle \text{nn} \rangle \]  
\[ 1E \text{ 52 41 31} \langle \text{nn} \rangle \]  
\[ \langle 036 \rangle \text{ R A 1} \langle \text{nn} \rangle \]

where

\[ \langle \text{nn} \rangle \] sets the first physical row of the emulation’s split-screen partition. See the “Forming Command Arguments” section in this chapter for more information on \[ \langle \text{nn} \rangle \] pairs. If this number is out of range, the maximum offset given the current setting of the status line is used (see Set 25th Line Mode command, earlier in this chapter).

Sets the first physical row to be displayed in the emulation’s split-screen partition.

NOTE: Cmd–Shift–Cursor Uparrow/Downarrow sets the first physical row of the active emulation.
Set Device Options

\(<036> <122> <102> <type> <ff> <cs> <graph>\) (octal)
\(1E \ 52 \ 42 \ <type> \ <ff> \ <cs> \ <graph>\) (hex)
\(<036> \ R \ B \ <type> \ <ff> \ <cs> \ <graph>\) (ASCII)

where

\(<\text{type}>\) is an \(<n>\) character with the following values:
  0  printer
  1  mouse (if mouse is selected, then the rest of the parameters are ignored).

\(<\text{ff}>\) is an \(<n>\) character with the following values:
  0  Form Feed off
  1  Form Feed before
  2  Form Feed after
  3  Form Feed before and after

\(<\text{cs}>\) is an \(<n>\) character with the following values:
  0  ASCII and DGI
  1  ASCII and VT Multinational
  2  IBM PC
  3  NRC Only
  4  NRC and VT Line Drawing
  5  Katakana

\(<\text{graph}>\) is an \(<n>\) character with the following values:
  0  No graphics
  1  DG graphics
  2  IBM Pro-Printer Compatible graphics.

See the “Forming Command Arguments” section in this chapter for more information on \(<n>\) quantities.

Sets the device type connected to the other port if the other port is not used for an active emulation. This command is generally used for dual-host-on-one-port operations when some other device is attached to the other port.
Miscellaneous Commands

Set Cursor Type

\[ <036> \ 1E \ 46 \ 51 \ <n> \ \text{(hex)} \]
\[ <036> \ F \ Q \ <n> \ \text{(ASCII)} \]

where

\(<n>\) sets the cursor type:

0  disables the cursor from being displayed, while saving the current cursor attributes
1  selects a blinking underscore (like the D1/D2 cursor). If the cursor is currently off, turns the cursor on.
2  selects a reverse video block (like the D410/D460 cursor), which is the default cursor type. If the cursor is currently off, turns the cursor on.
3  selects a blinking reverse video block. If the cursor is off, turns the cursor on.
4  makes the cursor an underscore. If the cursor is off, turns it on.
5  displays cursor with the saved attributes.

Selects one of the five cursor types.

Set Model ID

\[ <036> \ 1E \ 46 \ 7B \ <nn> \ <n> \ \text{(octal)} \]
\[ <036> \ F \ \{ \ <nn> \ <n> \ \text{(ASCII)} \]

where

\(<nn>\) sets the model ID (see the “Forming Command Arguments” section for more information on \(<nn>\) pairs). If this parameter is decimal value 0, then the default ID will be used.

\(<n>\) is 0 if graphics operations are not possible, or 1 if graphics are possible. This code will be ignored, but must be present, if \(<nn>\) is 0.

Allows the host computer to program the model ID response of the Read Model ID command so that older applications recognize newer terminals as older terminals.
Set Clock Time

all terminals

<036> <106> <162> <n> <pos> <time>

(Octal)

1E 46 72 <n> <pos> <time>

(Hex)

<036> F r <n> <pos> <time>

(ASCII)

where

<n> defines the clock status (see the “Forming Command Arguments” section in this chapter for more information on <n> quantities). If 2, then the 12 hour clock is enabled; if 3, then the 24 hour clock is enabled.

<pos> = 0000. In D216/D412/D462 terminals, the clock was positionable within the screen boundaries. However, on all new terminals, the clock is always displayed within the status line. <pos> may be entered as 0000 and must be present.

<time> defines the clock time. The format of this parameter, which is in decimal values, is HH:MM where HH sets the hour and MM sets the minutes, such as “02:59” or “18:05”. You must enter the colon between HH and MM, and you must enter HH in a 24-hour (00–23) format.

NOTE: <pos> and <time> are specified only when <n> equals decimal values 2 or 3.

Lets the user set the clock to 12 or 24 hours, and set the time.

Bell

all terminals

<007>

(Octal)

07

(Hex)

Ctrl–G

(ASCII)

Rings the terminal bell once.

Reset

D413/D463

<036> <106> <101>

(Octal)

1E 46 41

(Hex)

<036> F A

(ASCII)

Restores the terminal to its initial power–on state, but does not run the powerup self–test. The same scrolling rate is in effect as was before. The status line is unaffected by this command, but any message displayed on the status line is lost.
Select 7/8 Bit Operation

Select 7/8 Bit Operation for all terminals.

\[
\begin{array}{ll}
\text{(octal)} & <036> <106> <125> <n>\\
\text{(hex)} & 1E 46 55 <n> \\
\text{(ASCII)} & <036> F U <n>
\end{array}
\]

where

\(<n>\) sets the data bit syntax:
- 0 7-bit syntax is selected
- 1 8-bit syntax is selected.

Sets the 7/8 bit operations for the terminal. If 7-bit operations is selected, every inbound and outbound character has the most significant bit set to 0. For this reason, we recommend using the 8-bit mode only.

Set Keyboard Language (Keyboard Encoding Mode)

Set Keyboard Language (Keyboard Encoding Mode) for all terminals.

\[
\begin{array}{ll}
\text{(octal)} & <036> <106> <146> <n>\\
\text{(hex)} & 1E 46 66 <n> \\
\text{(ASCII)} & <036> F f <n>
\end{array}
\]

where

\(<n>\) sets either the default keyboard language or the U.S. ASCII language:
- 0 sets language to default (National)
- 1 sets language to U.S. ASCII and DG International
- 2 sets language to U.S. ASCII and ISO 8859.1 (8 bit characters)

Sets terminal keyboard translation mode. If \(<n>\) is set to 0, the keyboard transmits National Replacement Characters (NRC). NRC characters are 7-bit only and do not permit access to all ASCII characters. This command has no effect on characters received by the terminal. Only transmitted characters are encoded. Modes 1 and 2 select either DGI or ISO character codes for special (non-ASCII) characters.
UNIX Mode

<036> <120> <100> <n>  (octal)
1E 50 40 <n>  (hex)
<036> P @ <n>  (ASCII)

where

<n> has one of the following decimal values:
0 to exit UNIX mode
1 to enter.

See the “Forming Command Arguments” section in this chapter for more information on <n> quantities.

Remaps some troublesome commands and keyboard codes in traditional D200 terminals and allows easier creation of UNIX terminfo files to describe Data General terminals. For more information on UNIX mode, and the full listing of command and keyboard-code changes, see the “UNIX Support” section in this chapter.
Drawing Commands

Line

\[<036> \langle114\rangle \text{<loc_list>} \langle\text{null}\rangle\] (octal)
\[1E \text{ 4C} \text{<loc_list>} \langle\text{null}\rangle\] (hex)
\[<036> \text{L} \text{<loc_list>} \langle\text{null}\rangle\] (ASCII)

or

\[<036> \langle107\rangle \langle070\rangle \text{<loc_list>} \langle\text{null}\rangle\] (octal)
\[1E \text{ 47 38} \text{<loc_list>} \langle\text{null}\rangle\] (hex)
\[<036> \text{G} 8 \text{<loc_list>} \langle\text{null}\rangle\] (ASCII)

where

\[\text{<loc_list>} = \text{<location>} \text{or <location> <loc_list>}\].

In either case, \[\text{<location>} = \langle\text{NNN}\rangle <\text{NNN}\>

where

the first \[\text{<NNN>}\] quantity sets the X-ordinate of the location.
the second \[\text{<NNN>}\] quantity sets the Y-ordinate of the location.

For more information on location arguments and \[\text{<NNN>}\] quantities, see the “Forming Location Arguments” section in this chapter.

\[\text{<null>}\] is the ASCII NULL character (000 octal, 00 hex, or Ctrl–Shift–2).

Draws lines from point to point within the active window. If a single point is supplied in a line command, only that point is plotted. However, if multiple points are supplied, lines are drawn between the points in the order supplied. You can draw patterned lines by using the Set Pattern command before the Line command. If you enter an invalid parameter this command aborts.
Arc
\<036> \<107> \<060> \<NNN> \<NNN> \<NNN> \<NNN> \<NNN> \<NNN> \<NNN> \<NNN> \<NNN>
(\text{octal})
1E 47 30 \<NNN> \<NNN> \<NNN> \<NNN> \<NNN> \<NNN>
(\text{hex})
\<036> G 0 \<NNN> \<NNN> \<NNN> \<NNN> \<NNN>
(\text{ASCII})

where

the first \<NNN> sets the \textit{x}-ordinate
the second \<NNN> sets the \textit{y}-ordinate
the third \<NNN> defines the radius
the fourth \<NNN> sets the starting angle
the fifth \<NNN> sets the ending angle.

The \<NNN> quantities are 15-bit location arguments (see the “Forming Location Arguments” section in this chapter).

Draws an arc within the current window with a given radius and start/end angles. The given angles are degrees. “Zero degrees” on the arc has the same \textit{x}-ordinate as the center. The \textit{y}-ordinate is equal to the \textit{y}-ordinate of the center \textit{plus} the radius. Thus “zero degrees” on the arc is directly above the center.

Bar
\<036> \<107> \<061> \<NNN> \<NNN> \<NNN> \<NNN> \<NNN> \<n>
(\text{octal})
1E 47 31 \<NNN> \<NNN> \<NNN> \<NNN> \<NNN> \<n>
(\text{hex})
\<036> G 1 \<NNN> \<NNN> \<NNN> \<NNN> \<NNN> \<n>
(\text{ASCII})

where

the first \<NNN> sets the \textit{x}-ordinate of the lower left corner of the bar
the second \<NNN> sets the \textit{y}-ordinate of the lower left corner of the bar
the third \<NNN> sets the size of the bar in the \textit{x}-direction
the fourth \<NNN> quantity defines the size of the bar in the \textit{y}-direction
\<n> sets the bar color:
\begin{itemize}
  \item 0 makes the bar the same color as the background (Off Bar)
  \item 1 makes the bar the foreground color (On Bar)
\end{itemize}

The \<NNN> quantities are 15-bit location arguments (see the “Forming Location Arguments” section in this chapter).

Draws a solid bar within the current window. Any characters that are completely filled in by this command are replaced with either a \textit{space} or a reverse-video \textit{space}, whichever is appropriate. An invalid parameter aborts this command.
Polygon Fill

\[ \text{<036> <107> <064> <loc> <null> (octal)} \]
\[ 1E 47 3A <loc> <null> (hex)} \]
\[ <036> G : <loc> <null> (ASCII)} \]

where

\[ \text{<loc>} = <\text{NNN}> <\text{NNN}> \ldots <\text{NNN}> <\text{NNN}>> \]. Each pair of values defines a vertex. This command supports from 3 through 255 vertices.

where

the first <NNN> defines the x-ordinate of a vertex.
the second <NNN> defines the y-ordinate of a vertex.

The <NNN> quantities are 15-bit location arguments (see the “Forming Location Arguments” section in this chapter).

<null> is the ASCII NULL character (00 hex, 000 octal, or Ctrl-Shift-2)

Draws a filled polygon within the current window. A filled polygon is defined by the vertices in the argument list. The polygon is automatically closed with a straight line between the first and last vertices. This polygon command does not support intersecting polygons. If filled polygons are defined so that they intersect other filled polygons, the polygons may or may not be filled correctly.

Set Pattern

\[ \text{<036> <107> <160> <offset> <pattern_definition> <null> (octal)} \]
\[ 1E 47 70 31 <offset> <pattern_definition> <null> (hex)} \]
\[ <036> G p 1 <offset> <pattern_definition> <null> (ASCII)} \]

where

<offset> specifies where in the pattern to begin drawing the dots, in the range of decimal values from 0 to 31. The value is formed from the 5 least significant bits (LSBs) of a single ASCII character.

<pattern_definition> = <pattern_character> or <pattern_character> <pattern_definition>. If no pattern definition is specified, the terminal defaults to white lines. Otherwise, <pattern_character>, which is an \(<n> value, is 0 for off, and is 1 for on. Any other value results in transparent.

<null> is the ASCII NULL character (00 hex, 000 octal, or Ctrl-Shift-2)

Defines the line style used in generating lines. The terminal default is a solid line.
Set Foreground Color

\(<036> \text{<101> <color>}\)  \hspace{1cm} \text{(octal)}
1E 41 \text{<color>} \hspace{1cm} \text{(hex)}
\(<036> \text{A <color>}\) \hspace{1cm} \text{(ASCII)}

Sets the line foreground color for the Polygon Fill command to one of the following specified \text{<color>} parameters:

\(<060>\text{ black}\)
\(<\text{other}>\text{ green or amber (depends on screen phosphor).}\)
Graphics Cursor Commands

Read Cursor Location

\(<036> <107> <077> <174>\) (octal)
\(1E\) 37 3F 7C (hex)
\(<036> G ? \) (ASCII)

The terminal responds to this command by returning the graphics cursor location to the host computer in the following form:

\(<036> <157> <174> <040> <nnnnn> <040> <nnnnn> <015>\) (octal)
\(1E\) 6F 7C 20 <nnnnn> 20 <nnnnn> 0D (hex)
\(<036> 0 \) <space> <nnnnn> <space> <nnnnn> <CR> (ASCII)

where

the first <nnnnn> indicates the x-ordinate of the cursor
the second <nnnnn> indicates the y-ordinate of the cursor

Each <nnnnn> is a 5-digit ASCII coded decimal value. This encoding is not altered by UNIX mode.

Cursor On

\(<036> <107> <102>\) (octal)
\(1E\) 47 42 (hex)
\(<036> G B\) (ASCII)

Turns on the graphics cursor (displays it on the screen) at the location specified in the graphics cursor location by the Cursor Location command.

Cursor Off

\(<036> <107> <103>\) (octal)
\(1E\) 47 43 (hex)
\(<036> G C\) (ASCII)

Turns off the graphic cursor (erases it from the screen). The location and other attributes of the graphics cursor are not affected by this command.
Cursor Location

\[ <036> <107> <076> <174> <NNN> <NNN> \]  
   \[ 1E 47 3E 7C <NNN> <NNN> \]  
   \[ <036> G > | <NNN> <NNN> \]  

where

the first \(<NNN>\) sets the x-ordinate of the graphics cursor location

the second \(<NNN>\) sets is the y-ordinate of the graphics cursor location

Each \(<NNN>\) value is a 15-bit location argument. See the "Forming Location Arguments" section for more information on location arguments and \(<NNN>\) values.

If the graphics cursor is turned on, this command moves the graphics cursor to the specified location. Ordinate arguments outside of the screen limits will be truncated to the nearest limits.

Cursor Track

\[ <036> <107> <110> <n> \]  
   \[ 1E 47 48 <n> \]  
   \[ <036> G H <n> \]  

where

\(<n>\) sets the input device, with the following values:

<table>
<thead>
<tr>
<th>(&lt;n&gt;)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>no tracking</td>
</tr>
<tr>
<td>1</td>
<td>reserved</td>
</tr>
<tr>
<td>2</td>
<td>track the keypad</td>
</tr>
<tr>
<td>3</td>
<td>reserved</td>
</tr>
<tr>
<td>4</td>
<td>track the mouse</td>
</tr>
<tr>
<td>5</td>
<td>reserved</td>
</tr>
<tr>
<td>6</td>
<td>track the mouse and keyboard</td>
</tr>
<tr>
<td>7 - 14</td>
<td>reserved</td>
</tr>
<tr>
<td>15</td>
<td>track all devices</td>
</tr>
</tbody>
</table>

The graphics cursor location will be updated by the specified input device.
Cursor Attributes

<036> <107> <100>  (octal)
1E 47 40  (hex)
<036> G @  (ASCII)

The terminal responds to this command by returning the current value of the graphics cursor attributes in the following form:

<036> <157> <054> <v1> <v2> <v3> <v4> <015>  (octal)
1E 6F 2C <v1> <v2> <v3> <v4> 0D  (hex)
<036> o , <v1> <v2> <v3> <v4> <CR>  (ASCII)

Where

<v1>, <v2>, <v3>, and <v4> are <n> quantities with the following values:

<v1> = 0  cursor is off
1  cursor is on

<V2> = 0  cursor is not blinking

<V3> = 1  cursor is long

<V4> = 0  no cursor tracking
1  reserved
2  cursor tracks the keypad
3  reserved
4  cursor tracks the mouse or bit pad
5  reserved
6  cursor tracks the mouse and keyboard
7–14 reserved
15  cursor tracks all devices

Cursor Reset

<036> <107> <101>  (octal)
1E 47 41  (hex)
<036> G A  (ASCII)

Resets the graphics cursor attributes to off and no tracking.
# Printer Commands

## Print Window

<table>
<thead>
<tr>
<th>Command</th>
<th>Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;021&gt;</code></td>
<td>(octal)</td>
</tr>
<tr>
<td><code>11</code></td>
<td>(hex)</td>
</tr>
<tr>
<td><code>Ctrl-Q</code></td>
<td>(ASCII)</td>
</tr>
</tbody>
</table>

or

use of the Local Print key and the appropriate menu selection

Prints all characters (that reside in the U.S. ASCII or DGI character sets) between the margins of the current window, beginning with the row containing the cursor. Prints blank spaces rather than characters from other character sets such as user defined, line-drawing, Greek. No character attributes (underscore, reverse video, blink or dim) are printed.

If this command is initiated by the host, the terminal responds with a `Ctrl-F` (006 octal) when the printing operation is completed only if this option is enabled in the Configuration Menu. To abort this command press the Local Print or Cmd–CR keys.

## Print Form

<table>
<thead>
<tr>
<th>Command</th>
<th>Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;001&gt;</code></td>
<td>(octal)</td>
</tr>
<tr>
<td><code>01</code></td>
<td>(hex)</td>
</tr>
<tr>
<td><code>Ctrl-A</code></td>
<td>(ASCII)</td>
</tr>
</tbody>
</table>

or

use of the Local Print key and the appropriate menu selection

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 (D413/463) is enabled, prints all unprotected text in the current window, beginning with the row containing the cursor. Prints dimmed and protected text as spaces. Transmits CR–LF sequence on initiation of print activity.

NOTE: In form operations if character protection is disabled the dim flag is used. If character protection is enabled the protection bit is used.

If this command is initiated by the host computer, the terminal responds with a `Ctrl-F` (006 octal) when the printing operation is completed only if this option is enabled in the Configuration Menu. To abort this command press the Local Print or Cmd–CR keys.
Print Screen

<036> <106> <077> <072> (octal)
1E 46 3F 3A (hex)
<036> F ? : (ASCII)

or

use of the Local Print key and the appropriate menu selection

Prints all characters (that reside in the U.S. ASCII or DGI character sets) between the margins in the current screen. Prints blank spaces rather than characters from other character sets such as user defined, line-drawing, Greek. No character attributes (underscore, reverse video, blink or dim) are printed. To abort this command press the Local Print or Cmd–CR keys.

If the Printer Acknowledge option is enabled in the Configuration Menu, the terminal sends a Ctrl–F (006 octal) to the host when the printing operation initiated by the host completes.

Form Bit Dump

<036> <106> <077> <066> (octal)
1E 46 3F 36 (hex)
<036> F ? 6 (ASCII)

or

use of the Local Print key and the appropriate menu selection

Dumps a bit–image to an 8–bit graphics printer. 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 spaces. Transmits CR–LF sequence on initiation of print activity. Reverse video spaces and underscores are printed as they appear on the screen.

If this command is initiated by the host computer, the terminal responds with a Ctrl–F (<006>) when the printing operation is completed only if this option is enabled in the Configuration Menu. To abort this command press the Local Print or Cmd–CR keys.
Window Bit Dump

<D413/D463>

<036> <106> <077> <065> (octal)
1E 46 3F 35 (hex)
<036> F ? 5 (ASCII)

or

use of the Local Print key and the appropriate menu selection

Dumps a bit–image to a graphics slave printer. Prints the current window exactly as it appears

to the user including reverse video and underscores. Disregards the blink and dim attributes.

If this command is initiated by the host computer, the terminal responds with a Ctrl–F (006

octal) when the printing operation is completed only if this option is enabled in the Configuration

Menu. To abort this command press the Local Print or Cmd–CR keys.

Print Pass Through On

<036> <106> <077> <063> (octal)
1E 46 3F 33 (hex)
<036> F ? 3 (ASCII)

or

<036> <106> <140> (octal)
1E 46 60 (hex)
<036> F ' (ASCII)

or

use of the Local Print key and the appropriate menu selection

Sends all subsequent characters from the host to the printer without affecting the display screen;

the character flow from the host is interpreted by the printer and not by the display unit (with

the only exception being the Print Pass Through Off command). To abort this command press the

Local Print or Cmd–CR keys.
Print Pass Through Off

<036> <106> <077> <062>  (octal)
1E 46 3F 32  (hex)
<036> F ? 2  (ASCII)

or

<036> <106> <141>  (octal)
1E 46 61  (hex)
<036> F a  (ASCII)

or

use of the Local Print key

Turns off Print Pass Through so that character flow from the host computer to the terminal is once again interpreted by the display unit. The display unit returns a Ctrl-F (006 octal) to the host to signal that the printing operation is completed only if this option is enabled in the Configuration Menu. This sequence is not copied to the printer.
Printer Pass Back To Host

\[ <036> <106> <170> <n> \]  \quad \text{(octal)}
\[ 1\text{E} \ 46 \ 78 \ <n> \]  \quad \text{(hex)}
\[ <036> \ F \ x \ <n> \]  \quad \text{(ASCII)}

where

\(<n>\) determines the print mode:

0 \quad \text{turns this feature off}
1 \quad \text{turns this feature on}

The terminal responds to this command with the following string:

\[ <036> <122> <170> <n> \]  \quad \text{(octal)}
\[ 1\text{E} \ 52 \ 78 \ <n> \]  \quad \text{(hex)}
\[ <036> \ R \ x \ <n> \]  \quad \text{(ASCII)}

where

\(<n>\) reports the current information on this mode:

1 \quad \text{pass-back-to-host mode is now set}
0 \quad \text{it is reset or cannot be set.}

See the “Forming Command Arguments” section in this chapter for more information on \(<n>\) values.

Lets the host receive data directly from an attached device on the other port. This lets application software directly control and monitor a digitizer, scanner, bar code reader, or similar device. When this mode is set, all data coming from the printer port is sent to the host computer and the keyboard is disabled.

Simulprint On

\[ <036> <106> <077> <061> \]  \quad \text{(octal)}
\[ 1\text{E} \ 46 \ 3F \ 31 \]  \quad \text{(hex)}
\[ <036> \ F \ ? \ 1 \]  \quad \text{(ASCII)}

or

use of the Local Print key and the appropriate menu selection

Sends all characters received from the host to the attached printer while simultaneously displaying the characters on the screen. Once this command is issued, all subsequent print commands are ignored (with the exception of the Simulprint Off command). To abort this command press the Local Print or Cmd–CR keys.
Simulprint Off

\texttt{<036> <106> <077> <060>} \quad \text{(octal)}
\texttt{1E 46 3F 30} \quad \text{(hex)}
\texttt{<036> F ? 0} \quad \text{(ASCII)}

or

use of the Local Print key and the appropriate menu selection

Turns off Simulprint so that character flow from the host computer (to the terminal) is no longer copied to the printer. If this command is initiated by the host computer, the terminal responds with a Ctrl-F (006 octal) when the printing operation is completed only if this option is enabled in the Configuration Menu. To abort this command press the Local Print or Cmd-CR keys.

VT-Style Autoprint On

\texttt{<036> <106> <077> <070>} \quad \text{(octal)}
\texttt{1E 46 3F 38} \quad \text{(hex)}
\texttt{<036> F ? 8} \quad \text{(ASCII)}

Turns on VT220-style autoprint mode. This command performs a line-buffered print operation. The line that the cursor is on will not be printed until a CR, LF, or VT is sent to the terminal or until autowrap has occurred.

VT-Style Autoprint Off

\texttt{<036> <106> <077> <067>} \quad \text{(octal)}
\texttt{1E 46 3F 37} \quad \text{(hex)}
\texttt{<036> F ? 7} \quad \text{(ASCII)}

Turns off VT220-style autoprint mode.
Select Printer National Character Set

\<036\> <106> <067> <nn> \text{ (octal)}
1E 46 37 <nn> \text{ (hex)}
\<036\> F 7 <nn> \text{ (ASCII)}

where

<nn> sets the printer language:

00 keyboard language
01 U.S. ASCII
02 United Kingdom
03 French
04 German
05 Swedish/Finnish
06 Spanish
07 Danish/Norwegian
08 Swiss
09 Katakana

See the “Forming Command Arguments” section in this chapter for more information on <n> values.
Debugging Commands

Data Trap Mode

<036> <106> <073> <command> (octal)
1E 46 3B <command> (hex)
<036> F ; <command> (ASCII)

where

<command> sets data trap mode:

124 octal (54 hex, T ASCII) data trap mode is turned off
110 octal (48 hex, H ASCII) data trap mode is turned on and the terminal displays hex values
117 or 177 octal (4F or 7F hex, O or DEL ASCII) data trap mode is turned on and the terminal displays octal values

Lets the user view data from the host as a hex or octal data-stream, similar to the AOS/VS X DISPLAY command. This command can be entered either on-line, off-line, or through the Configuration Menu. The data is displayed as 16 bytes per line on the left and the corresponding 8-bit characters on the right, as follows:

Hex Mode

<table>
<thead>
<tr>
<th>00</th>
<th>01</th>
<th>02</th>
<th>03</th>
<th>04</th>
<th>05</th>
<th>06</th>
<th>07</th>
</tr>
</thead>
<tbody>
<tr>
<td>08</td>
<td>09</td>
<td>0A</td>
<td>0B</td>
<td>0C</td>
<td>0D</td>
<td>0E</td>
<td>0F</td>
</tr>
<tr>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
</tr>
<tr>
<td>18</td>
<td>19</td>
<td>1A</td>
<td>1B</td>
<td>1C</td>
<td>1D</td>
<td>1E</td>
<td>1F</td>
</tr>
</tbody>
</table>

Octal Mode

<table>
<thead>
<tr>
<th>000000</th>
<th>000100</th>
<th>000200</th>
<th>000300</th>
<th>000400</th>
<th>000500</th>
<th>000600</th>
<th>000700</th>
</tr>
</thead>
<tbody>
<tr>
<td>000800</td>
<td>000900</td>
<td>000A00</td>
<td>000B00</td>
<td>000C00</td>
<td>000D00</td>
<td>000E00</td>
<td>000F00</td>
</tr>
<tr>
<td>001000</td>
<td>001100</td>
<td>001200</td>
<td>001300</td>
<td>001400</td>
<td>001500</td>
<td>001600</td>
<td>001700</td>
</tr>
<tr>
<td>001800</td>
<td>001900</td>
<td>001A00</td>
<td>001B00</td>
<td>001C00</td>
<td>001D00</td>
<td>001E00</td>
<td>001F00</td>
</tr>
</tbody>
</table>

In octal mode, the octal data is shown with every other space removed. This is done to make 16 bytes fit on one line, so that each group of three octal digits is one byte. This is different from AOS/VS's X DISPLAY command in that X DISPLAY shows octal data in six digit (16-bit) words, where the terminal shows individual (8-bit) bytes.

NOTE: The Index entries “DG native-mode commands by hex order” and “DG native-mode commands by octal order” list all commands by both hex and octal order. Refer to these entries to determine which commands are shown while using Data Trap mode.
Diagnostic Commands

Read Cursor Contents

<table>
<thead>
<tr>
<th>Command</th>
<th>Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;036&gt; &lt;155&gt; &lt;060&gt;</td>
<td>(octal)</td>
<td>Lets the diagnostic routines more fully test the terminal. This command causes the terminal to respond to the host computer with the following 10 byte return sequence:</td>
</tr>
<tr>
<td>1E 46 6D 30</td>
<td>(hex)</td>
<td></td>
</tr>
<tr>
<td>&lt;036&gt; F m 0</td>
<td>(ASCII)</td>
<td></td>
</tr>
</tbody>
</table>

where

- `<attr>` and `<cs>` make one `<nn>` pair, where
  - `<attr>` are the character attributes at the cursor position in the form of BURD as used in the Change Attribute command (see the “Character Attribute Commands” section in this chapter). These are the upper four bits of the ATTR/CS byte of screen memory.
  - `<cs>` is the character set pointer, which is the lower four bits of the ATTR/CS byte of screen memory.
- `<fg>` and `<bg>` are each `<n>` values, where
  - `<fg>` is the foreground color (always 1), which is the upper four bits of the COLOR byte of screen memory.
  - `<bg>` is the background color (always 0), which is the lower four bits of the COLOR byte of screen memory.
- `<charprt1>` and `<charprt2>` make one `<nn>` pair, where
  - `<charprt1>` is the first half of the character pointer, which is the upper four bits of the CHAR/PTR byte of screen memory. This is an `<n>` value. For more information on `<n>` values, see the “Forming Command Arguments” section in this chapter.
  - `<charprt2>` is second half of the character pointer, which is the lower four bits of CHAR/PTR byte of screen memory. This is an `<n>` value.

CAUTION: The information returned for a given character is revision dependent.
Read Bit Contents

\[ \text{<036> <106> <155> <066>} \] (octal)
\[ \text{1E 46 6D 36} \] (hex)
\[ \text{<036> F m 6} \] (ASCII)

Causes the terminal to transmit graphics bit data in the current cursor cell back to the host in the following format:

\[ \text{<036> <157> <073> <061> <list> } \] (octal)
\[ \text{1E 6F 3B 31 <list> } \] (hex)
\[ \text{<036> o ; 1 <list> } \] (ASCII)

where

\[ \text{<list>} \] is 12 \text{<dd>} pairs, with each pair containing 10 bits. The Define Character command explains \text{<dd>} pairs in more detail.

Each 5–bit sequence is encoded in the following format:

\[ \text{010BBBBB} \] or \[ \text{@ through _} \] (40 hex through 5F hex)

Character Loopback

\[ \text{<036> <106> <155> <064> <nn> <string> } \] (octal)
\[ \text{1E 46 6D 34 <nn> <string> } \] (hex)
\[ \text{<036> F m 4 <nn> <string> } \] (ASCII)

where

\[ \text{<nn>} \] sets the length of the string, from 0 through 255 characters. For more information on \text{<nn>} pairs, see the “Forming Command Arguments” section in this chapter.

\[ \text{<string>} \] is the string of characters to echo back to the host.

Causes the terminal to echo the character string back to host without any translation of the 8–bit characters.
Fill Screen With Character

```
<036> <106> <076> <char>  (octal)
1E 46 3E <char>  (hex)
<036> F > <char>  (ASCII)
```

where

<char> is the ASCII character that will fill the terminal screen.

Fills the display screen with the given character, using the current character attributes.

---

Fill Screen With Grid

```
<036> <106> <071>  (octal)
1E 46 39  (hex)
<036> F 9  (ASCII)
```

Fills the display with a grid to facilitate screen alignments or measurements.

---

Display Character Generator Contents

```
<036> <106> <070>  (octal)
1E 46 38  (hex)
<036> F 8  (ASCII)
```

Dumps the contents of the CGEN ROM to the display screen. The entire contents of the CGEN, a total of 512 characters, is displayed over and over, filling the entire screen between the current margins.

---

Perform UART Loopback Test

```
<036> <106> <074>  (octal)
1E 46 3C  (hex)
<036> F <  (ASCII)
```

Performs loopback testing on host and printer UARTS. Error messages will be displayed on the screen. A loopback connector must be placed on the back of the terminal for the UART being tested for this command to work properly. This command causes a soft terminal reset. This command must be entered off-line.

End of Section
End of Chapter
Chapter 3
VT320/100/52 Emulations

This chapter provides the programming information for the VT320, VT100, or VT52 terminal emulations running on the D217/D413/D463 line of Data General terminals. This chapter has three major sections:

Summary of VT320/100 Operations

VT320/100 Emulation Control Sequences

VT52 Operations and Escape Sequences

Information regarding functions and operations of the terminal that apply to all modes or emulations is covered in Chapter 1. Additional information on keyboard layouts and various VT320/100/52 emulator reference material is covered in related appendices.
A Note on VT Emulation Syntax Conventions

We established a set of general syntax rules that are used wherever references occur to VT320/100 control sequences. These rules, listed below, provide a uniform method of documenting VT320/100 control sequences.

- In control sequences, 7-bit and 8-bit control codes are represented by ANSI mnemonics.
- Remaining hex codes in control sequences are represented by printable ASCII characters.
- Nonprintable ASCII characters in control sequences are represented in capital letters and are enclosed within angle brackets (<>). For example, the space character is <SPACE>.
- Spaces between characters in control sequences are provided to improve clarity only. If a space character is part of a control sequence, it will be indicated as <SPACE>.
- Control sequence parameters, when possible, are illustrated with labels or abbreviations that indicate the nature or use of the parameter. These labels, always in lower case type, are enclosed within angle brackets to indicate that they are not to be taken literally. Examples of parameter forms are: <location>, <version>, or <set>.
This section provides a summary of the operations information specific to the VT320/100 emulation. This section does not cover specific format or usage information for VT320/100 control sequences, which are covered in “VT320/100 Control Sequences,” later in this chapter.

In particular, this section explains the subjects covered in the following list:

- VT320/100 Emulation Features
- Control Codes
- Control Sequences
- Generated Keyboard Codes
- Character Sets
- ANSI Standard Mode Switches
- ANSI Private Mode Switches
- User-Defined Keys
- Character Attributes
- Line Attributes

Information regarding functions and operations of the terminal that apply to all modes or emulations is covered in Chapter 1. Additional information on keyboard layouts and various VT320/100 emulator reference material is covered in related appendices, located at the back of this manual.
VT320/100 Emulation Features

The D217/D413/D463 terminals, in both 7-bit and 8-bit communications modes, operate in accordance with ANSI standards 3.4, 3.41, and 3.64. Due to hardware differences, there are some minor differences between our VT320/100 terminal emulations and the DEC VT320 and VT100 terminals. Major operating features of the VT320/100 emulations are listed below:

- Emulates both DEC VT320 and VT100 terminals
- Screen displays up to 25 lines of 80 characters displayed in a 10 x 12 dot matrix or up to 25 lines of 132 characters displayed in a 6 x 12 dot matrix
- Definable scrolling region
- Bidirectional (vertical) smooth scrolling
- Displays and prints double-height or double-width lines
- Text attribute for selective erasure (VT320 emulation only)
- Two downline loadable (DLL) character sets (VT320 emulation only on D463)
Control Codes

There are two groups of control codes, one 7-bit set and one 8-bit set. The set of 7-bit control codes is called C0 and the set of 8-bit codes is called C1. C0 runs from 0 hex through 1F hex. C1 runs from 80 hex through 9F hex.

The C0 set and the C1 set of codes are shown in Table 3-1.

Table 3-1 All C0 and C1 Control Codes

<table>
<thead>
<tr>
<th>Hex Codes</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>...</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>A</th>
<th>...</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>NUL</td>
<td>DLE</td>
<td></td>
<td></td>
<td></td>
<td>DCS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SOH</td>
<td>DC1</td>
<td></td>
<td></td>
<td></td>
<td>PU1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>STX</td>
<td>DC2</td>
<td></td>
<td></td>
<td></td>
<td>PU2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>ETX</td>
<td>DC3</td>
<td></td>
<td></td>
<td></td>
<td>STS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>EOT</td>
<td>DC4</td>
<td></td>
<td></td>
<td></td>
<td>IND</td>
<td>CCH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>ENQ</td>
<td>NAK</td>
<td></td>
<td></td>
<td></td>
<td>NEL</td>
<td>MW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>ACK</td>
<td>SYN</td>
<td></td>
<td></td>
<td></td>
<td>SSA</td>
<td>SPA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>BEL</td>
<td>ETB</td>
<td></td>
<td></td>
<td></td>
<td>ESA</td>
<td>EPA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>BS</td>
<td>CAN</td>
<td></td>
<td></td>
<td></td>
<td>HTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>HT</td>
<td>EM</td>
<td></td>
<td></td>
<td></td>
<td>HTJ</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>LF</td>
<td>SUB</td>
<td></td>
<td></td>
<td></td>
<td>VTS</td>
<td>DID</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>VT</td>
<td>ESC</td>
<td></td>
<td></td>
<td></td>
<td>PLD</td>
<td>CSI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>FF</td>
<td>FS</td>
<td></td>
<td></td>
<td></td>
<td>PLU</td>
<td>ST</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>CR</td>
<td>GS</td>
<td></td>
<td></td>
<td></td>
<td>RI</td>
<td>OSC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>SO</td>
<td>RS</td>
<td></td>
<td></td>
<td></td>
<td>SS2</td>
<td>PM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>SI</td>
<td>US</td>
<td></td>
<td></td>
<td></td>
<td>SS3</td>
<td>APC</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

C0 Codes   GL Characters   C1 Codes   GR Characters

Received Control Codes

Subsets of the entire range of C0 and C1 control codes are supported by the terminal and therefore cause a terminal-defined operation to occur upon receipt of the code from the host. Table 3-2 shows the supported control codes from the C0 set. Table 3-3 shows the supported control codes from the C1 set.
<table>
<thead>
<tr>
<th>Mnemonic</th>
<th>Name</th>
<th>Hex Code</th>
<th>Ctrl Key Plus</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENQ</td>
<td>Enquiry</td>
<td>05</td>
<td>E</td>
<td>Transmits answerback message.</td>
</tr>
<tr>
<td>BEL</td>
<td>Bell</td>
<td>07</td>
<td>G</td>
<td>Generates bell tone if bell is enabled.</td>
</tr>
<tr>
<td>BS</td>
<td>Backspace</td>
<td>08</td>
<td>H</td>
<td>Moves cursor to the left one position, unless the cursor is at the left margin.</td>
</tr>
<tr>
<td>HT</td>
<td>Horizontal tab</td>
<td>09</td>
<td>I</td>
<td>Moves cursor to the next tab stop or right margin if no more tab stops in the line.</td>
</tr>
<tr>
<td>LF</td>
<td>Linefeed</td>
<td>0A</td>
<td>J</td>
<td>Causes a linefeed or a new line, depending upon the state of new line mode (LNM).</td>
</tr>
<tr>
<td>VT</td>
<td>Vertical tab</td>
<td>0B</td>
<td>K</td>
<td>Processed the same as a LF.</td>
</tr>
<tr>
<td>FF</td>
<td>Form feed</td>
<td>0C</td>
<td>L</td>
<td>Processed the same as a LF.</td>
</tr>
<tr>
<td>CR</td>
<td>Carriage return</td>
<td>0D</td>
<td>M</td>
<td>Moves cursor to left margin on current line.</td>
</tr>
<tr>
<td>SO</td>
<td>Shift out</td>
<td>0E</td>
<td>N</td>
<td>Shifts G1 character set into GL. (locking shift)</td>
</tr>
<tr>
<td>SI</td>
<td>Shift in</td>
<td>0F</td>
<td>O</td>
<td>Shifts G0 character set into GL. (locking shift)</td>
</tr>
<tr>
<td>DC1</td>
<td>Device control 1</td>
<td>11</td>
<td>Q</td>
<td>Also called XON. Allows transmission to resume if in limited transmit mode and XOFF was previously received; ignored otherwise.</td>
</tr>
<tr>
<td>DC2</td>
<td>Device control 2</td>
<td>12</td>
<td>R</td>
<td>Prints the next character literally.</td>
</tr>
<tr>
<td>DC3</td>
<td>Device control 3</td>
<td>13</td>
<td>S</td>
<td>Also called XOFF. Halts transmission of all codes except XON/XOFF if in limited transmit mode; ignored otherwise.</td>
</tr>
<tr>
<td>ESC</td>
<td>Escape</td>
<td>1B</td>
<td>[</td>
<td>Processed as escape sequence introducer. Terminates any control or escape sequence in progress.</td>
</tr>
</tbody>
</table>

**NOTE:** The Ctrl Key Plus (fourth column) combination is created by pressing the Ctrl key on the keyboard while simultaneously pressing the indicated character or symbol key.
<table>
<thead>
<tr>
<th>Mnemonic</th>
<th>Name</th>
<th>Hex Code</th>
<th>7-bit Code Equivalent</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>IND</td>
<td>Index</td>
<td>84</td>
<td>ESC D</td>
<td>Moves cursor down one line in current column. If the cursor is at the bottom margin, the screen scrolls up one line.</td>
</tr>
<tr>
<td>NEL</td>
<td>Next line</td>
<td>85</td>
<td>ESC E</td>
<td>Moves cursor to first position in the next line. If the cursor is at the bottom margin, the screen scrolls up one line.</td>
</tr>
<tr>
<td>HTS</td>
<td>Horizontal tab set</td>
<td>88</td>
<td>ESC H</td>
<td>Sets a tab stop at the current cursor column.</td>
</tr>
<tr>
<td>RI</td>
<td>Reverse index</td>
<td>8D</td>
<td>ESC M</td>
<td>Moves cursor up one line in current column. If cursor is at the top margin, the screen scrolls down one line.</td>
</tr>
<tr>
<td>SS2</td>
<td>Single shift G2</td>
<td>8E</td>
<td>ESC N</td>
<td>Shifts the G2 character set into GL for the next character only.</td>
</tr>
<tr>
<td>SS3</td>
<td>Single shift G3</td>
<td>8F</td>
<td>ESC O</td>
<td>Shifts the G3 character set into GL for the next character only.</td>
</tr>
<tr>
<td>DCS</td>
<td>Device control string</td>
<td>90</td>
<td>ESC P</td>
<td>Marks the beginning of a device control string. Terminates any control or escape sequence in progress.</td>
</tr>
<tr>
<td>CSI</td>
<td>Control sequence introducer</td>
<td>9B</td>
<td>ESC [</td>
<td>Marks the beginning of a control sequence. Terminates any control or escape sequence in progress.</td>
</tr>
<tr>
<td>ST</td>
<td>String terminator</td>
<td>9C</td>
<td>ESC \</td>
<td>Terminates the data stream in a device control string.</td>
</tr>
<tr>
<td>OSC</td>
<td>Operating system command</td>
<td>9D</td>
<td>ESC ]</td>
<td>Starts a string similar to a DCS string, but is ignored. Terminates any control or escape sequence in progress.</td>
</tr>
<tr>
<td>PM</td>
<td>Private message</td>
<td>9E</td>
<td>ESC ^</td>
<td>Starts a string similar to a DCS string, but is ignored. Terminates any control or escape sequence in progress.</td>
</tr>
<tr>
<td>APC</td>
<td>Application common</td>
<td>9E</td>
<td>ESC _</td>
<td>Starts a string similar to a DCS string, but is ignored. Terminates any control or escape sequence in progress.</td>
</tr>
</tbody>
</table>
Transmitted Control Codes

Various keys on the keyboard, when pushed, send a control code to the host (if on-line). The code sent often depends upon operating mode (ANSI standard mode versus ANSI private mode) parameters. Transmitted codes are always 7-bit ANSI codes for the D217 and are either 7-bit or 8-bit for other terminals. Refer to "Transmission Control Sequences," later in this chapter, for more information on selecting 7-bit or 8-bit communications.

Table 3-4, Table 3-5, Table 3-6, Table 3-7, and Table 3-8 list the control codes that are transmitted by the terminal. These tables are for the 107-key standard Data General keyboard. The control codes transmitted by a 101-key keyboard may be similar; see "Generated Keyboard Code," later in this chapter, for more information on the 101-key keyboard. That section lists all codes, including many from different keystroke combinations, sent by the terminal to the host computer.

### Table 3-4 Control Codes Generated from the Editing Keys (VT320/100)

<table>
<thead>
<tr>
<th>Keyboard</th>
<th>Function</th>
<th>Code VT320</th>
<th>Code VT100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erase page</td>
<td>Find</td>
<td>CSI 1~</td>
<td>none</td>
</tr>
<tr>
<td>Print</td>
<td>Insert here</td>
<td>CSI 2~</td>
<td>none</td>
</tr>
<tr>
<td>Erase EOL</td>
<td>Remove</td>
<td>CSI 3~</td>
<td>none</td>
</tr>
<tr>
<td>Shift – Erase page</td>
<td>Select</td>
<td>CSI 4~</td>
<td>none</td>
</tr>
<tr>
<td>Shift – Print</td>
<td>Previous Screen</td>
<td>CSI 5~</td>
<td>none</td>
</tr>
<tr>
<td>Shift – EOL</td>
<td>Next Screen</td>
<td>CSI 6~</td>
<td>none</td>
</tr>
</tbody>
</table>

### Table 3-5 Control Codes Generated from the Cursor Control Keys (VT320/100)

<table>
<thead>
<tr>
<th>Key</th>
<th>Control Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal mode</td>
<td>Application mode</td>
</tr>
<tr>
<td>Uparrow</td>
<td>CSI A</td>
</tr>
<tr>
<td>Downarrow</td>
<td>CSI B</td>
</tr>
<tr>
<td>Rightarrow</td>
<td>CSI C</td>
</tr>
<tr>
<td>Leftarrow</td>
<td>CSI D</td>
</tr>
</tbody>
</table>

**NOTE:** "Normal mode" and "Application mode" refer to the reset and set state, respectively, of the Cursor Key Mode, which is an ANSI private operating mode parameter.
## Table 3-6 Control Codes Generated from the AUX Keypad (VT320/100)

<table>
<thead>
<tr>
<th>Key</th>
<th>Keypads</th>
<th>Numeric Mode&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Application Mode&lt;sup&gt;1&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>SS3 p</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>SS3 q</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>SS3 r</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>SS3 s</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>SS3 t</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>SS3 u</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>SS3 v</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>SS3 w</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>SS3 x</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>9</td>
<td>SS3 y</td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>SS3 m</td>
<td></td>
</tr>
<tr>
<td>,</td>
<td>. (comma)</td>
<td>.</td>
<td>SS3 l</td>
</tr>
<tr>
<td>.</td>
<td>. (period)</td>
<td>.</td>
<td>SS3 n</td>
</tr>
<tr>
<td>Enter</td>
<td>CR</td>
<td></td>
<td>SS3 M</td>
</tr>
<tr>
<td>PF1</td>
<td>SS3 P</td>
<td></td>
<td>SS3 P</td>
</tr>
<tr>
<td>PF2</td>
<td>SS3 Q</td>
<td></td>
<td>SS3 Q</td>
</tr>
<tr>
<td>PF3</td>
<td>SS3 R</td>
<td></td>
<td>SS3 R</td>
</tr>
<tr>
<td>PF4</td>
<td>SS3 S</td>
<td></td>
<td>SS3 S</td>
</tr>
</tbody>
</table>

<sup>1</sup> These modes refer to the set or reset state of the Keypad Numeric Mode and Keypad Application Mode, both of which are ANSI private operating mode parameters.
### Table 3-7 Control Codes Generated from the Function Keys (VT320/100)

<table>
<thead>
<tr>
<th>107-Key Keyboard Control Code</th>
<th>VT320 Keyboard</th>
<th>VT320 Control Code</th>
<th>VT100 Control Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>F20</td>
<td>F1 (or Hold Screen)</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>F18</td>
<td>F2 (or Print Screen)</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>Cmd/F17</td>
<td>F3 (or Set-Up)</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>F19</td>
<td>F4 (or Data/Talk)</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>F16</td>
<td>F5 (or Break)</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>F1</td>
<td>F6</td>
<td>CSI 17~</td>
<td>none</td>
</tr>
<tr>
<td>F2</td>
<td>F7</td>
<td>CSI 18~</td>
<td>none</td>
</tr>
<tr>
<td>F3</td>
<td>F8</td>
<td>CSI 19~</td>
<td>none</td>
</tr>
<tr>
<td>F4</td>
<td>F9</td>
<td>CSI 20~</td>
<td>none</td>
</tr>
<tr>
<td>F5</td>
<td>F10</td>
<td>CSI 21~</td>
<td>none</td>
</tr>
<tr>
<td>F6</td>
<td>F11</td>
<td>CSI 23~</td>
<td>ESC</td>
</tr>
<tr>
<td>F7</td>
<td>F12</td>
<td>CSI 24~</td>
<td>BS</td>
</tr>
<tr>
<td>F8</td>
<td>F13</td>
<td>CSI 25~</td>
<td>LF</td>
</tr>
<tr>
<td>F9</td>
<td>F14</td>
<td>CSI 26~</td>
<td>none</td>
</tr>
<tr>
<td>F10</td>
<td>F15</td>
<td>CSI 28~</td>
<td>none</td>
</tr>
<tr>
<td>F11</td>
<td>F16</td>
<td>CSI 29~</td>
<td>none</td>
</tr>
<tr>
<td>F12</td>
<td>F17</td>
<td>CSI 31~</td>
<td>none</td>
</tr>
<tr>
<td>F13</td>
<td>F18</td>
<td>CSI 32~</td>
<td>none</td>
</tr>
<tr>
<td>F14</td>
<td>F19</td>
<td>CSI 33~</td>
<td>none</td>
</tr>
<tr>
<td>F15</td>
<td>F20</td>
<td>CSI 34~</td>
<td>none</td>
</tr>
</tbody>
</table>

**NOTE:** The D217 lets you select VT220 function keys (F1 through F15 on the DG 147 keyboard) in the Configuration menus. For information on using the Configuration Menu, refer to the manual *Installing and Operating D216E+, D217, D413, and D463 Display Terminals.*
Table 3-8 C0 Control Codes Generated from the Main Keypad (VT320/100)

<table>
<thead>
<tr>
<th>Ctrl Key Plus...</th>
<th>Mnemonic</th>
<th>Hex Code</th>
<th>Dedicated Function Keys</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 or @</td>
<td>NUL</td>
<td>00</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>SOH</td>
<td>01</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>STX</td>
<td>02</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>ETX</td>
<td>03</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>EOT</td>
<td>04</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>ENQ</td>
<td>05</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>ACK</td>
<td>06</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>BEL</td>
<td>07</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>BS</td>
<td>08</td>
<td>F12 (BS)(^1)</td>
</tr>
<tr>
<td>I</td>
<td>HT</td>
<td>09</td>
<td>Tab</td>
</tr>
<tr>
<td>J</td>
<td>LF</td>
<td>0A</td>
<td>F13 (LF)(^1)</td>
</tr>
<tr>
<td>K</td>
<td>VT</td>
<td>0B</td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>FF</td>
<td>0C</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>CR</td>
<td>0D</td>
<td>Return (CR)</td>
</tr>
<tr>
<td>N</td>
<td>SO</td>
<td>0E</td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>SI</td>
<td>0F</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>DLE</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Q</td>
<td>DC1</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>DC2</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>DC3</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>DC4</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>U</td>
<td>NAK</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>SYN</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>W</td>
<td>ETB</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>CAN</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>EM</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>Z</td>
<td>SUB</td>
<td>1A</td>
<td></td>
</tr>
<tr>
<td>3 or [</td>
<td>ESC</td>
<td>1B</td>
<td>F11 (ESC)(^1)</td>
</tr>
<tr>
<td>4 or \</td>
<td>FS</td>
<td>1C</td>
<td></td>
</tr>
<tr>
<td>5 or ]</td>
<td>GS</td>
<td>1D</td>
<td></td>
</tr>
<tr>
<td>6 or ~</td>
<td>RS</td>
<td>1E</td>
<td></td>
</tr>
<tr>
<td>7 or ?</td>
<td>US</td>
<td>1F</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>DEL</td>
<td>7F</td>
<td>DEL</td>
</tr>
</tbody>
</table>

\(^1\) These keys are used in the VT100 to generate the control codes indicated. (D217 – VT220 function keys are disabled.)
Using 8-bit Code in 7-bit Environments

All C1 (8-bit) control codes may be expressed as C0 (7-bit) code extensions by using the ANSI defined conversion method outlined in ANSI document X3.41. The process of converting C1 code into C0 code is summarized below:

1. Make the first character of the sequence an escape character (1B hex, also known as the C0 code ESC).

2. Subtract 40 hex from the hexadecimal C1 control code, and make that the second character.

For example, consider the C1 control code CSI (9B hex). This is converted into a C0 code as shown below:

\[
\text{CSI} = 1B \ [9B \text{ minus } 40] = 1B \ 5B = \text{ESC} [
\]

You should use 8-bit control codes in applications programs because there is one less byte to transmit and process. We also suggest that your application support both 7-bit and 8-bit modes because not all terminals can use 8-bit control codes. For example, the VT100 emulation running on a D217 uses 7-bit codes only. The VT100 running on a D217 lets you select 8-bit characters in the Configuration menu (keyboard mode – ISO.) For information on using the Configuration Menu, refer to the manual Installing and Operating D216E+, D217, D413, and D463 Display Terminals.
Control Sequences

A control sequence is a string of ASCII characters that contains commands and/or arguments (parameters) that direct the terminal to perform specific functions. Most control sequences begin with the control sequence introducer, which is the 8-bit CSI control code. The introducer is then followed by one or more ASCII characters, which specify function types and parameters. CSI is an 8-bit code and can only be used in 8-bit environments. However, CSI can be expressed as a 7-bit code by replacing the CSI character with "ESC [". Examples of a control sequence (and its 7-bit equivalent) are:

- CSI 3 L (8-bit only)
  or
- ESC [ 3 L (7-bit or 8-bit environments)

where "L" specifies the Insert Line function, and "3" is a parameter indicating the number of lines to insert.

There are two other types of control sequences, both of which differ from the control sequence shown above because they begin with different ASCII characters (the escape character and a device control string) and have different purposes.

Escape Sequences

An escape sequence begins with the escape character (ESC), which is followed by one or more ASCII characters. ESC is a 7-bit control code, thus escape sequences can be used in both 7-bit and 8-bit environments. An example of an escape sequence is:

- ESC H (7-bit or 8-bit environments)

Where "H" specifies a command that sets a tab stop at the current column.

Device Control Strings

Generally, a device control string starts with the 8-bit DCS control code, is followed by parameters and a command code and a data stream of ASCII characters, and is terminated by the 8-bit ST control code. A device control string can also begin with the C1 control codes OSC ("ESC [")", PM ("ESC ^"), or APC ("ESC _"). A device control string is functionally similar to a control sequence but contains variable length data; for this reason, it is delimited with a string terminator (ST), which tells the terminal when the last piece of data has been sent. As is the case with the CSI code, both the DCS and ST 8-bit control codes can be replaced with "ESC P" and "ESC \" for use in 7-bit environments. Examples of 7-bit and 8-bit device control strings are:

- DCS 0;1 | 17/7F;18/08 ST (8-bit environments only)
  or
- ESC P 0;1 | 17/7F;18/08 ESC \ (7-bit or 8-bit environments)
where “0;1” are parameters, “1” is a character that specifies the User Define Keys operation, and “17/7F;18/08” is the data stream that contains information to map function keys F1 and F2 to the Delete and Backspace keys, respectively. The string terminator “ST” is used at the end to delimit data and to terminate the operation.

**Generated Keyboard Codes**

Each time you press a key, data is sent to the terminal. The terminal then interprets this data as either a local key (such as a Shift key) or as a code generating key (such as the character “A”). If a character code is generated, it is then either send on to the host computer, if in on-line mode, or is taken as direct input by the terminal, if in off-line mode.

Transmitted codes are always 7-bit ANSI codes for the D217 and are either 7-bit or 8-bit for other terminals. Refer to the “Transmission Control Sequences” section of this chapter for more information on selecting 7-bit or 8-bit communications.

The terminal supports two keyboards, a 101-key keyboard, similar to an IBM–PC AT–style keyboard, and a 107-key Data General proprietary keyboard. Table 3-9 through Table 3-13 show the codes generated by each key or keystroke combination for the 101-key and 107-key keyboards, including the key mapping to a VT320 or VT100 keyboard. We did not include the code generated by the main keypad because the code is simply the code of the character on the keycap.
Table 3-9 Keyboard Generated Codes — Function Keys (VT320)

<table>
<thead>
<tr>
<th>107-key Keyboard</th>
<th>101-key Keyboard</th>
<th>VT320 Keyboard</th>
<th>Normal</th>
<th>Shift</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>F1</td>
<td>F6</td>
<td>CSI 17-</td>
<td>UDK1</td>
</tr>
<tr>
<td>F2</td>
<td>F2</td>
<td>F7</td>
<td>CSI 18-</td>
<td>UDK1</td>
</tr>
<tr>
<td>F3</td>
<td>F3</td>
<td>F8</td>
<td>CSI 19-</td>
<td>UDK1</td>
</tr>
<tr>
<td>F4</td>
<td>F4</td>
<td>F9</td>
<td>CSI 20-</td>
<td>UDK1</td>
</tr>
<tr>
<td>F5</td>
<td>F5</td>
<td>F10</td>
<td>CSI 21-</td>
<td>UDK1</td>
</tr>
<tr>
<td>F6</td>
<td>F6</td>
<td>F11</td>
<td>CSI 23-</td>
<td>UDK1</td>
</tr>
<tr>
<td>F7</td>
<td>F7</td>
<td>F12</td>
<td>CSI 24-</td>
<td>UDK1</td>
</tr>
<tr>
<td>F8</td>
<td>F8</td>
<td>F13</td>
<td>CSI 25-</td>
<td>UDK1</td>
</tr>
<tr>
<td>F9</td>
<td>F9</td>
<td>F14</td>
<td>CSI 26-</td>
<td>UDK1</td>
</tr>
<tr>
<td>F10</td>
<td>F10</td>
<td>Help (F15)</td>
<td>CSI 28-</td>
<td>UDK1</td>
</tr>
<tr>
<td>F11</td>
<td>F11 or Alt-F1</td>
<td>Do (F16)</td>
<td>CSI 29-</td>
<td>UDK1</td>
</tr>
<tr>
<td>F12</td>
<td>F12 or Alt-F2</td>
<td>F17</td>
<td>CSI 31-</td>
<td>UDK1</td>
</tr>
<tr>
<td>F13</td>
<td>Alt-F3</td>
<td>F18</td>
<td>CSI 32-</td>
<td>UDK1</td>
</tr>
<tr>
<td>F14</td>
<td>Alt-F4</td>
<td>F19</td>
<td>CSI 33-</td>
<td>UDK1</td>
</tr>
<tr>
<td>F15</td>
<td>Alt-F5</td>
<td>F20</td>
<td>CSI 34-</td>
<td>UDK1</td>
</tr>
<tr>
<td>Cursor Type</td>
<td>Ctrl-Break</td>
<td>Break</td>
<td>Break</td>
<td>none</td>
</tr>
<tr>
<td>Cmd–N/C</td>
<td>R.Ctrl–Scroll Lock</td>
<td>Setup</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>Local Print</td>
<td>Print Screen</td>
<td>Print</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>Scroll Rate</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Hold</td>
<td>Pause</td>
<td>Hold</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>C1</td>
<td>Alt–F9</td>
<td>PF1</td>
<td>SS3 P</td>
<td>SS3 P</td>
</tr>
<tr>
<td>C2</td>
<td>Alt–F10</td>
<td>PF2</td>
<td>SS3 Q</td>
<td>SS3 Q</td>
</tr>
<tr>
<td>C3</td>
<td>Alt–F11</td>
<td>PF3</td>
<td>SS3 R</td>
<td>SS3 R</td>
</tr>
<tr>
<td>C4</td>
<td>Alt–F12</td>
<td>PF4</td>
<td>SS3 S</td>
<td>SS3 S</td>
</tr>
</tbody>
</table>

1 UDK means user defined key function.
### Table 3-10 Keyboard Generated Codes — Function Keys (VT100)

<table>
<thead>
<tr>
<th>107-key Keyboard</th>
<th>101-key Keyboard</th>
<th>VT100 Keyboard</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>F6</td>
<td>F6</td>
<td>Escape</td>
<td>1B hex</td>
</tr>
<tr>
<td>F7</td>
<td>F7</td>
<td>Backspace</td>
<td>08 hex</td>
</tr>
<tr>
<td>F8</td>
<td>F8</td>
<td>Line Feed</td>
<td>0A hex</td>
</tr>
<tr>
<td>C1</td>
<td>Alt−F9</td>
<td>PF1</td>
<td>SS3 P</td>
</tr>
<tr>
<td>C2</td>
<td>Alt−F10</td>
<td>PF2</td>
<td>SS3 Q</td>
</tr>
<tr>
<td>C3</td>
<td>Alt−F11</td>
<td>PF3</td>
<td>SS3 R</td>
</tr>
<tr>
<td>C4</td>
<td>Alt−F12</td>
<td>PF4</td>
<td>SS3 S</td>
</tr>
<tr>
<td>Cursor Type</td>
<td>Ctrl−Break</td>
<td>Break</td>
<td>n/a</td>
</tr>
<tr>
<td>Cmd−N/C</td>
<td>R.Ctrl−Scroll</td>
<td>Setup</td>
<td>n/a</td>
</tr>
<tr>
<td>Local Print</td>
<td>Print Screen</td>
<td>Print</td>
<td>n/a</td>
</tr>
<tr>
<td>Scroll Rate</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Hold</td>
<td>Pause</td>
<td>Hold</td>
<td>n/a</td>
</tr>
</tbody>
</table>

1 D217/VT100 with VT220 function keys disabled.

### Table 3-11 Keyboard Generated Codes — Editing Keypad (VT320)

<table>
<thead>
<tr>
<th>107-key Keyboard</th>
<th>101-key Keyboard</th>
<th>VT320 Keyboard</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erase Page</td>
<td>Insert</td>
<td>Find</td>
<td>CSI 1~</td>
</tr>
<tr>
<td>Print</td>
<td>Home</td>
<td>Insert Here</td>
<td>CSI 2~</td>
</tr>
<tr>
<td>Erase EOL</td>
<td>Page Up</td>
<td>Remove</td>
<td>CSI 3~</td>
</tr>
<tr>
<td>Shift–Erase</td>
<td>Delete</td>
<td>Select</td>
<td>CSI 4~</td>
</tr>
<tr>
<td>Page</td>
<td>End</td>
<td>Previous</td>
<td>CSI 5~</td>
</tr>
<tr>
<td>Shift–Print</td>
<td>Page Down</td>
<td>Screen</td>
<td>CSI 6~</td>
</tr>
<tr>
<td>Shift–Erase EOL</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 3-12 Keyboard Generated Codes — Cursor Keypad (VT320 and VT100)

<table>
<thead>
<tr>
<th>107-key Keyboard</th>
<th>101-key Keyboard</th>
<th>VT320/100 Keyboard</th>
<th>Normal Cursor Keys</th>
<th>Application Cursor Keys</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uparrow</td>
<td>Uparrow</td>
<td>Uparrow</td>
<td>CSI A</td>
<td>SS3 A</td>
</tr>
<tr>
<td>Rightarrow</td>
<td>Rightarrow</td>
<td>Rightarrow</td>
<td>CSI C</td>
<td>SS3 C</td>
</tr>
<tr>
<td>Leftarrow</td>
<td>Leftarrow</td>
<td>Leftarrow</td>
<td>CSI D</td>
<td>SS3 D</td>
</tr>
<tr>
<td>Downarrow</td>
<td>Downarrow</td>
<td>Downarrow</td>
<td>CSI B</td>
<td>SS3 B</td>
</tr>
<tr>
<td>Home</td>
<td>n/a</td>
<td>n/a</td>
<td>CSI H</td>
<td>SS3 H</td>
</tr>
</tbody>
</table>
### Table 3-13 Keyboard Generated Codes — Numeric Keypad (VT320 and VT100)

<table>
<thead>
<tr>
<th>107-key Keyboard</th>
<th>101-key Keyboard</th>
<th>VT320/100 Keyboard and Numeric Mode with Num Lock On</th>
<th>Application Mode with Num Lock On</th>
<th>n/a²</th>
<th>Num Lock Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>n/a</td>
<td>Num Lock</td>
<td>On</td>
<td>On</td>
<td>Off</td>
<td></td>
</tr>
<tr>
<td>n/a</td>
<td>/</td>
<td>/</td>
<td>none</td>
<td>/</td>
<td></td>
</tr>
<tr>
<td>n/a</td>
<td>*</td>
<td>*</td>
<td>none</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>– (minus)</td>
<td>–</td>
<td>– (minus)</td>
<td>SS3 m</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>(comma)</td>
<td>+</td>
<td>(comma)</td>
<td>SS3 l</td>
<td>,</td>
<td></td>
</tr>
<tr>
<td>. (period)</td>
<td>/.Delete</td>
<td>. (period)</td>
<td>SS3 n</td>
<td>Select</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0/Insert</td>
<td>0</td>
<td>SS3 p</td>
<td>Find</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1/End</td>
<td>1</td>
<td>SS3 q</td>
<td>Previous Screen</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2/Downarrow</td>
<td>2</td>
<td>SS3 r</td>
<td>Cursor Down</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3/Pg Dn</td>
<td>3</td>
<td>SS3 s</td>
<td>Next Screen</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>4/Leftarrow</td>
<td>4</td>
<td>SS3 t</td>
<td>Cursor Left</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>5</td>
<td>SS3 u</td>
<td>Home</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>6/Rightarrow</td>
<td>6</td>
<td>SS3 v</td>
<td>Cursor Right</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>7/Home</td>
<td>7</td>
<td>SS3 w</td>
<td>Insert Here</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>8/Uparrow</td>
<td>8</td>
<td>SS3 x</td>
<td>Cursor Up</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>9/Pg Up</td>
<td>9</td>
<td>SS3 y</td>
<td>Remove</td>
<td></td>
</tr>
<tr>
<td>Enter³</td>
<td>Enter³</td>
<td>Enter³</td>
<td>SS3 M</td>
<td>Enter</td>
<td></td>
</tr>
</tbody>
</table>

1. 107-key keyboards numeric keypads have no Num Lock On/Off mode.
2. Neither Numeric Mode nor Application Mode have any bearing when Num Lock is Off.
3. Will send either a CR or a CR-LF depending upon the state of New Line Mode (LNM).

### Character Sets

All terminals are equipped with a 512-character Character Generator (CGEN), which is located within terminal ROM. All hard character sets are composed of characters contained within the CGEN. In addition to the predefined hard character sets, the VT320 emulation on the D463 supports up to two soft character sets (each containing up to 96 characters), which reside in volatile RAM, that are composed of custom characters. Each of these two sets of custom characters are called downline loadable (DLL) character sets. The only terminal and emulation combination that supports soft character sets is the VT320 emulation on D463 terminals.

### Hard Character Sets

Hard character sets are composed from characters located within the CGEN. Four character sets may be selected for use at one time. They are designated as G0, G1, G2, and G3. From these four, two character sets are active. These are designated as GL (Graphic Left) and GR (Graphic Right). The D217 has only two character sets available at one time. They are designated G0 and G1.
GL is generally used for 7–bit character codes (20 hex through 7F hex), character sets such as U.S. ASCII or an appropriate National Replacement Character (NRC) set. These NRC sets map national–language specific characters that are 8–bit codes onto the U.S. ASCII character set. This remapping process deletes least–used characters from the ASCII set and replaces those characters with frequently used 8–bit characters. Each NRC set is language–specific.

The GR set is used for 8–bit character codes, which are characters A0 hex through FF hex. GR generally contains special graphics sets such as Line Drawing or contains the Supplemental Graphics set, which is also known as the 8–bit character code portion of the VT Multinational Character Set.

Character sets are initialized on power up. In multinational mode, G0 and G1 are initialized with the standard ASCII character set, and G2 and G3 are initialized with VT Multinational. The G0 set is then invoked into GL, and the G2 set into GR (see ANSI document X3.41 for further information). On the D217, G0 is initialized with U.S. ASCII; G1 is initialized with VT Special Graphics; and G0 is invoked into GL.

Hard character sets are used in a two step process. They must first be designated and then invoked.
Designating Hard Character Sets

Character sets are designated as G0, G1, G2, or G3 by an escape sequence and a parameter, which are detailed in the “Hard Character Set Control Sequences” section later in this chapter.

Invoking Hard Character Sets

The GL character set is set to G0 and G1, respectively, with the Shift In and Shift Out commands for all the terminals. In addition to these two commands, because there are additional available sets on the D413/D463, GL is set to G2 and G3 by the Shift Lock Two and Shift Lock Three commands. Redefining the GR set is limited to the D413/D463; additional shift lock commands set the GR set to G1, G2, or G3. Full information on the use of these commands is located in within the “Hard Character Set Control Sequences” section later in this chapter.

Figure 3-1 illustrates which character sets can be invoked into G0 through G3.

--- VT320 emulation only

*Figure 3-1 Invoking Character Sets into GL and GR (VT320/100)*
Soft Character Sets

It is possible to define up to 96 characters that may be downloaded as a character set; the VT320 emulation on the D463 supports two soft character sets. A soft character set resides in volatile RAM, and is lost when the terminal is given the command to reset or the power is turned off. Soft character sets must be selected, defined (custom characters created), and then downloaded to the terminal. Also, to clear up terminal RAM space, previously downloaded soft character sets that are no longer in use can be cleared from the terminal.

Selecting Soft Character Sets

Before a soft character set can be used, it must first be assigned a name. This name, or designation, is used to refer to the soft character set within character set control sequences. A maximum of three characters are used to name a soft character set. The first two characters are optional, and can be any combination of characters in the range of 20 hex to 2F hex. The final character is required and must be in the range of 30 hex to 7E hex. An example of a legitimate name for a soft character set is:

<space> @

Where <space> is the space character (20 hex), and is in the range 20 hex to 2F hex, and “@” (40 hex) is the final character in the range 30 hex to 7E hex. This is the recommended default. Once a soft character set is named the characters within the set must then be defined.

Defining a Soft Character

Soft character cells must be created and defined as data before they can be downloaded as soft character sets to the terminal. The following steps outline the procedure for defining soft character fonts.

1. Define the character on a 10 x 12 matrix. In the following design example, the greek alpha symbol is being defined.

<table>
<thead>
<tr>
<th></th>
<th>C0</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
<th>C7</th>
<th>C8</th>
<th>C9</th>
</tr>
</thead>
<tbody>
<tr>
<td>R0</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>R1</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>R2</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>#</td>
</tr>
<tr>
<td>R3</td>
<td>.</td>
<td>#</td>
<td>#</td>
<td>.</td>
<td>.</td>
<td>#</td>
<td>#</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>R4</td>
<td>#</td>
<td>.</td>
<td>#</td>
<td>.</td>
<td>.</td>
<td>#</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>R5</td>
<td>#</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>R6</td>
<td>#</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>R7</td>
<td>#</td>
<td>.</td>
<td>.</td>
<td>#</td>
<td>.</td>
<td>#</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>R8</td>
<td>#</td>
<td>.</td>
<td>#</td>
<td>.</td>
<td>.</td>
<td>#</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>R9</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>#</td>
</tr>
<tr>
<td>R10</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>R11</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
</tbody>
</table>
2. Divide the character cell between the sixth and seventh row to create two sets of six (6 bit) patterns.

C0 C1 C2 C3 C4 C5 C6 C7 C8 C9
R0          
R1          
R2          
R3          
R4          
R5          
R6          
R7          
R8          
R9          
R10         
R11         

3. Generate a string of binary numbers for the upper section of the character cell by reading each column from bottom to top, assigning a 1 if a pixel is on, and a 0 if the pixel is off. Start with column C0 and end with column C9. Please note, order must be preserved throughout the remaining steps. By applying this method to the design example, you generate the binary numbers 100000, 010000, 001000, 001000, 010000, 100000, 010000, 001000, 000100, and 000000.

4. Generate a string of binary numbers for the lower half of the character cell by following the process described in step 3. Remember that you begin at the bottom of the column. This yields the binary numbers 000001, 000010, 000100, 000100, 000010, 000001, 000100, 001000, and 000000.

5. These binary numbers must now be extended to form 8-bit binary numbers. This is done by prefixing all of the 6-bit numbers with 01.

6. Convert the 8-bit binary numbers to their hexadecimal equivalent values. This is done by dividing the 8-bit numbers into two groups of 4-bits each, and finding the hex equivalent for each of those 4-bit groups.

7. Subtract 1 (01 hex) from each hex number generated in Step 6.

8. Convert each hex number into its equivalent 7-bit ASCII character.
9. Arrange the hex data strings into a sixel bit pattern such that data for the top portion of the character cell is first, followed by the "f" character, and completed with data for the bottom portion of the cell. The pixel generated from the alpha character in our example is:

?CGO_OGGO_/?GCA@ACCA@

The example below illustrates Steps 6, 7, and 8.

```
...........
...........#
..#.#....#
.#.#....#.
#....#...#
#....#...#
#....#...#
#....#...# 7654 3210
#....#...#
.#.#....#.
..#.#....#
...........
```

Where bits 7 and 6 are fixed as 01.
Downloading Soft Characters

Soft character sets are downloaded to the terminal by a device control string. Refer to the “Soft Character Set Control Sequences” section later in this chapter, for details on this process.

Clearing Downloaded Soft Character Sets

The control sequence for downloading a character set can also be used to clear a set that has been previously loaded. Refer to the “Soft Character Set Control Sequences” section for details on this process.

ANSI Standard Mode Switches

ANSI standard mode parameters are loosely defined by the appropriate ANSI document. The Set Mode and Reset Mode control sequences cause a set of operating parameters on the terminal to be set or reset. The “ANSI Standard Mode Control Sequences” section, later in this chapter, has full details of the parameters mentioned in the indented lists below. Table 3-14 shows the default powerup setting for ANSI standard mode parameters.

Table 3-14 Default ANSI Standard Mode Parameters

<table>
<thead>
<tr>
<th>ANSI Parameter</th>
<th>Default Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keyboard action</td>
<td>Reset</td>
</tr>
<tr>
<td>Insert/Replace</td>
<td>Reset</td>
</tr>
<tr>
<td>Send/Receive</td>
<td>Set</td>
</tr>
<tr>
<td>Line feed/New line</td>
<td>Reset</td>
</tr>
</tbody>
</table>

Any of the following ANSI standard mode operating parameters are set with the Set Mode command:

Keyboard Action — Disables the keyboard, turns on the “wait” LED, and prevents further data entry from the keyboard.

Insert/Replace — Causes new characters to be inserted at the active position and moves all following characters right one position.

Send/Receive — Transmits characters typed at the keyboard directly through the serial output port; the terminal displays only characters received from the serial port.

Line Feed/New Line — Lets the Line Feed command trigger a line feed (LF) operation followed by a carriage return (CR). Also causes the New Line key to send the sequence CR–LF.
Any of the following ANSI standard modes are selected with the Reset Mode control sequence:

- **Keyboard Action** — Enables the keyboard as an input device.
- **Insert/Replace** — Causes a new character received by the terminal to "overwrite" or replace an existing character at the active position.
- **Send/Receive** — Displays characters typed at the keyboard on the screen and also transmits the characters through the serial port.
- **Line Feed/New Line** — Limits a Line Feed command to vertical movement only, with respect to the current active position. Also causes the New Line key to send only a CR.
ANSI Private Mode Switches

The Private Set Mode and Private Reset Mode control sequences cause a set of operating parameters on the terminal to be set or reset. The "ANSI Private Mode Control Sequences" section, later in this chapter, has full details of the parameters mentioned in the indented lists below. Table 3-15 shows the powerup default states for the ANSI private mode parameters.

Table 3-15 Default ANSI Private Mode Parameters

<table>
<thead>
<tr>
<th>Private Parameter</th>
<th>Default Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cursor key application</td>
<td>Reset</td>
</tr>
<tr>
<td>Column</td>
<td>Reset</td>
</tr>
<tr>
<td>Scrolling</td>
<td>Reset</td>
</tr>
<tr>
<td>Screen</td>
<td>Reset</td>
</tr>
<tr>
<td>Cursor origin</td>
<td>Reset</td>
</tr>
<tr>
<td>Auto wrap</td>
<td>Reset</td>
</tr>
<tr>
<td>Auto repeat</td>
<td>Reset</td>
</tr>
<tr>
<td>Print form feed</td>
<td>Reset</td>
</tr>
<tr>
<td>Print extent</td>
<td>Set</td>
</tr>
<tr>
<td>Text cursor</td>
<td>Set</td>
</tr>
<tr>
<td>Multi/national character set</td>
<td>Reset</td>
</tr>
<tr>
<td>Numeric keypad</td>
<td>Reset</td>
</tr>
<tr>
<td>Typewriter/data processing keys</td>
<td>Permanently Reset</td>
</tr>
<tr>
<td>PC terminal</td>
<td>Reset</td>
</tr>
<tr>
<td>Backarrow key</td>
<td>Reset</td>
</tr>
</tbody>
</table>
Any of the following ANSI private mode parameters are selected with the Private Set Mode control sequence:

**Cursor Key Application** — Causes the four cursor-control keys to transmit special predefined codes instead of the standard ANSI cursor control sequences. These special codes that are transmitted can then be used for application-specific tasks.

**Column** — Defines a maximum of 132 columns that can appear on the screen. When this function is used, the screen is erased and the cursor is moved to the home position.

**Scrolling** — Enables smooth scrolling at a maximum rate of 6 lines per second.

**Screen** — Displays characters in black against an illuminated background (reverse video).

**Cursor Origin** — Defines the origin or cursor-home to be the upper left character position of the current margin setting. Line numbers are relative to the current margin settings and the top line of the margin is referenced as line one. Cursor control sequences can not go beyond the current margin settings.

**Auto Wrap** — Characters received when the cursor is already at the right margin cause the cursor to move to the beginning of the next line. Cursor control sequences never wrap.

**Auto Repeat** — All normal typematic keys repeat when held down for more than one-half second. Repeating stops when the key is released.

**Print Form Feed** — Selects Form Feed to follow screen print commands.

**Print Extent** — Allows the entire screen to be printed during a print screen operation.

**Text Cursor Enable** — Displays the cursor.

**Multi/National Character Set** — Selects National mode, which allows the use of the 7-bit National Replacement Character Sets (NRC).

**Keypad Application** — Causes the numeric keypad to transmit alternate sequences.

Any of the following ANSI private mode operating parameters are selected with the Private Reset Mode control sequence:

**Cursor Key Application** — Causes the cursor-control keys to return standard ANSI cursor-control sequences.

**Column** — Allows a maximum of 80 columns to appear on the screen. When this function is used, the screen is erased and the cursor is moved to the home position.

**Scrolling** — Allows a scroll operation to jump in increments of one line.

**Screen** — Illuminates graphic characters against a black background.

**Cursor Origin** — Defines the origin or cursor-home to be at the upper left corner-position of the screen. When in the reset condition, the cursor addressing commands CUP and HVP can position the cursor anywhere on the screen regardless of the margins that have been set.
Auto Wrap — Any characters received while the cursor is at the right margin replace the existing character and the cursor does not move.

Auto Repeat — No keys will repeat without first pressing the Rept key.

Print Form Feed — No Form Feed is performed at the end of a print operation.

Print Extent — Allows printing of the current scrolling region only (defined by Set Margins).

Text Cursor Enable — Cursor is not displayed.

Multi/National Character Set — Selects Multinational mode for the keyboard, which allows the use of the Supplemental Character Set for 8–bit characters (GR), and the ASCII character set for 7–bit characters (GL).

Keypad Application — Causes the numeric keypad to operate in numeric mode.

User–Defined Keys

Function keys F6 to F20 may be programmed with user–definable key sequences. A total of 255 bytes of volatile RAM is available for key definitions and one key sequence may use up all or most of the available memory if desired. The control sequence that downloads user–defined keys is covered in more detail in the “User–Defined Key Control Sequences” section later in this chapter. You can also program keys using the Configuration Menu. For information on using the Configuration Menu, refer to the manual Installing and Operating D216E+, D217, D413, and D463 Display Terminals.

Character Attributes

Character attributes affect either the appearance of text on the screen or affect how text on the screen can be erased. Visual character attributes, set with the Select Graphic Rendition control sequence, include the following:

- Bold (or increased intensity) text
- Underscored text
- Blinking text
- Reverse video text

The only non–visual character attribute is text protection, which is set with the Select Character Attributes control sequence. Protected text is not erased by either of the Selective Erase control sequences.
Line Attributes

Examples of double–height and double–width characters are shown in Figure 3-2.

Single–height lines          Double–height lines
B                             B
B                             B

Single–width line          Double–width line
BBBBBB                      B B B B B

Figure 3-2 Examples of Double–Height and Double–Width Lines

A double–height line is created by designating one character row as the top half and the next lower row as the bottom of the line. Although there is no software requirement, to be readable both rows should contain the same character. Lines that have been expanded by either control sequence lose all characters to the right of the center of the screen. Both double–height and double–width line attributes affect only the current cursor row. There is no command to make characters double–high but not double–wide.

End of Section
VT320/100 Emulation Control Sequences

This section describes the format and usage of VT320/100 control sequences. Refer to the “Summary of VT320/100 Operations” section for an explanation of conventions and practices of the VT320/100 emulation.

The control sequences within this section are organized into the functional areas listed below:

- Hard Character Set Control Sequences
- Soft Character Set Control Sequences
- Attribute Control Sequence
- Cursor Positioning Control Sequences
- Tabulation Control Sequences
- Screen Editing Control Sequences
- ANSI Standard Mode Control Sequences
- ANSI Private Mode Control Sequences
- Transmission Control Sequences
- User-Defined Key Control Sequences
- Miscellaneous Control Sequences
- Reporting Control Sequences
- Printing Control Sequences

Information regarding functions and operations of the terminal that apply to all modes or emulations is covered in Chapter 1. Additional information on keyboard layouts and various VT320/100 emulator reference material is covered in appendices.
Format of Control Sequence Listings in this Section

Control sequence name and mnemonic

*Cursor Up (CUU)*

Control sequence format (do not include spaces)

`CSI <number of lines> A`

where

<number of lines> specifies how many lines to move the cursor

Usage and results of control sequence

Moves the cursor up one or more lines in the same column. If the requested movement would place the cursor off of the screen (or out of the scrolling region, if set), the command is terminated when the cursor reaches that boundary.

Applicable terminals

'all terminals'

Applicable ANSI document

See ANSI document X3.64, section 5.17.

A Note on Syntax Conventions

We established a set of general syntax rules that are used wherever references occur to VT320/100 control sequences. These rules, listed below, provide a uniform method of documenting VT320/100 control sequences.

- In control sequences, 7-bit and 8-bit control codes are represented by ANSI mnemonics.
- Remaining hex codes in control sequences are represented by printable ASCII characters.
- Nonprintable ASCII characters in control sequences are represented in capital letters and are enclosed within angle brackets (`<>`). For example, the space character is `<SPACE>`.
- Spaces between characters in control sequences are provided to improve clarity only. If a space character is part of a control sequence, it will be indicated as `<SPACE>`.
- Control sequence parameters, when possible, are illustrated with labels or abbreviations that indicate the nature or use of the parameter. These labels, always in lower case type, are enclosed within angle brackets to indicate that they are not to be taken literally. Examples of parameter forms are: `<location>`, `<version>`, or `<set>`.
Hard Character Set Control Sequences

Before character sets can be used, they must be designated into one of the four available character sets: G0, G1, G2, and G3. From these four available sets, two sets are active, that is have been invoked into the Graphic Left (GL) and Graphic Right (GR) sets. GL is for 7-bit characters and GR is for 8-bit characters.

Sequences for Designating Character Sets

Character sets are designated as G0, G1, G2, or G3 by an escape sequence and a parameter, as shown below:

ESC ( <set> (1B 28 hex) designates a character set to be the G0 set
ESC ) <set> (1B 29 hex) designates a 94-character set to be the G1 set
ESC - <set> (1B 2D hex) designates a 96-character set to be the G1 set
ESC * <set> (1B 2A hex) designates a 94-character set to be the G2 set (VT320)
ESC . <set> (1B 2E hex) designates a 96-character set to be the G2 set (VT320)
ESC + <set> (1B 2B hex) designates a 94-character set to be the G3 set (VT320)
ESC / <set> (1B 2F hex) designates a 96-character set to be the G3 set (VT320)

where

<set> is a code that specifies a character set. The possible choices for hard character sets, and the code to designate them, are shown below.

<table>
<thead>
<tr>
<th>B</th>
<th>U. S. ASCII (North American)</th>
<th>%5</th>
<th>Supplemental graphics (from VT Multinational)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>NRC United Kingdom</td>
<td>0</td>
<td>Special graphics</td>
</tr>
<tr>
<td>C or 5</td>
<td>NRC Finnish</td>
<td>1</td>
<td>DG International</td>
</tr>
<tr>
<td>R or 9</td>
<td>NRC French</td>
<td>2</td>
<td>DG Word Processing</td>
</tr>
<tr>
<td>Q</td>
<td>NRC French Canadian</td>
<td>3</td>
<td>DG Line Drawing</td>
</tr>
<tr>
<td>K</td>
<td>NRC German</td>
<td>4</td>
<td>DG Special Graphics</td>
</tr>
<tr>
<td>E or 6 or '</td>
<td>NRC Danish/Norwegian</td>
<td>1</td>
<td>Kata Kana G1</td>
</tr>
<tr>
<td>Z</td>
<td>NRC Spanish</td>
<td></td>
<td>Downline Loadable soft character set. See the section &quot;Soft Character Sets&quot; in this chapter for more information.</td>
</tr>
<tr>
<td>H or 7</td>
<td>NRC Swedish</td>
<td>&lt;csd&gt;</td>
<td>(VT320 emulation on D463 only)</td>
</tr>
<tr>
<td>=</td>
<td>NRC Swiss</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J</td>
<td>NRC Kata Kana G0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;</td>
<td>VT User-Preferred</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supplemental Graphics</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(ISO or VT Supplemental selected by command)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
NOTE: The NRC selections will only give you your current keyboard language. For example, it is not possible to ask for a British NRC set if your keyboard language is North American. This is an emulation of a VT220 feature.

The G1, G2, and G3 set may contain either 94 or 96 characters. A new feature for all terminals is available whenever you select the Supplemental Graphics set (from VT/Multinational). You have the option of either leaving the Supplemental Graphics set exactly as it appears in the VT Multinational character set, or you can select the Supplemental Graphics set to be ISO Latin–1 (8859/1.2). The control sequence to change the Supplemental Graphics set to ISO Latin is described below.

**Assign User-Preferred Supplemental Set (AUPSS)**

```
DCS <Ps> ! u <Pss> ST
90 <Ps> 21 75 <Pss> 9C
1B 50 <Ps> 21 75 <Pss> 1B 5C
```

(8-bit hex) (7-bit hex)

where <Ps> and <Pss> have the following values:

<table>
<thead>
<tr>
<th>&lt;Ps&gt;</th>
<th>&lt;Pss&gt;</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>%5</td>
<td>supplemental graphics set is DEC Multinational</td>
</tr>
<tr>
<td>1</td>
<td>A</td>
<td>supplemental graphics set is ISO Latin–1 (8859/1.2)</td>
</tr>
</tbody>
</table>

Sets the character set that will be used when Supplemental Graphics (from the VT/Multinational set) is designated.

**Sequences for Invoking Character Sets**

**Shift In (SI)**

```
SI
0F
```

(7-bit hex)

Sets GL to point to G0 (default). See ANSI document X3.41, section 5.2.

**Shift Out (SO)**

```
SO
0E
```

(7-bit hex)

Sets GL to point to G1. See ANSI document X3.41, section 5.2.
Shift Lock Two (SL2)

ESC n
1B 6E (7-bit hex)

Sets GL to point to G2.

Shift Lock Three (SL3)

ESC o
1B 6F (7-bit hex)

Sets GL to point to G3.

Shift Lock G1 GR

ESC ~
1B 7E (7-bit hex)

Sets GR to point to G1.

Shift Lock G2 GR

ESC }
1B 7D (7-bit hex)

Sets GR to point to G2.

Shift Lock G3 GR

ESC |
1B 7C (7-bit hex)

Sets GR to point to G3.
Single Shift Two (SS2)

SS2 or ESC N
8E (8–bit hex)
1B 4E (7–bit hex)

Displays the next character received from the G2 set, regardless of the state of GL and GR. See ANSI document X3.64, section 5.85.

Single Shift Three (SS3)

SS3 or ESC 0
8F (8–bit hex)
1B 4F (7–bit hex)

Displays the next character received from the G3 set, regardless of the state of GL and GR. See ANSI document X3.64, section 5.86.
Soft Character Set Control Sequences

Sequences for Downloading Soft Characters (VT320 on D463)

DCS <Pfn>;<Pcn>;<Pe>;<Pcmw>;<Pw>;<Pt>;<Pcmh>;<Pcss>
{ Dcs <Sxbp1>;<Sxbp2>;...;<Sxbpn> ST

90 <Pfn> 3B <Pcn> 3B <Pe> 3B <Pcmw> 3B <Pw> 3B <Pt> 3B <Pcmh> 3B <Pcss>
7B Dcs <Sxbp1> 3B <Sxbp2> 3B ... 3B <Sxbpn> 9C

1B 50 <Pfn> 3B <Pcn> 3B <Pe> 3B <Pcmw> 3B <Pw> 3B <Pt> 3B <Pcmh> 3B <Pcss>
7B Dcs <Sxbp1> 3B <Sxbp2> 3B ... 3B <Sxbpn> 1B 5C

(8-bit hex)
(7-bit hex)

where

<Pfn> specifies which font buffer (character set) to load (0 or 1). The DEC VT320 terminal has only one set available, and both 0 and 1 refer to the same character set. The D463 terminal has two character sets available to load.

<Pcn> specifies the starting location in the font buffer (character offset — from 0 to 95). A value of 0 begins the new character set at character code 20 hex.

<Pe> specifies the erasure mode, where:
0 erases all characters in the font buffer before loading in new ones (default)
1 erases only character locations being loaded with new definitions
2 erases all font buffers (soft character sets)

<Pcmw> is the character cell size, where:
0 15 pixels wide in 80 column rendition, 9 pixels wide in 132 column rendition
1 illegal, and defaults to 0
2 5x10 pixel cell
3 6x10 pixel cell
4 7x10 pixel cell
5 5 pixels wide
...
...
15 15 pixels wide

NOTE: Any cell width above 10 defaults to 10.

<Pw> is the screen width, where:
0 or 1 is 80 column (0 is default)
2 132 column

014–002111 3-35
<Pt> is the type of characters to be defined, where:
0 or 1 is text (pixels are centered in cell)
2 graphics (left aligned within cell)

<Pcmh> is the cell height, where:
0 12 pixels high
1 1 pixel high
2 2 pixels high

<Pcss> is the size of the character set
0 94 characters (VT220 compatible)
1 96 characters (allows redefinition of characters 20 hex and 7F hex)

<Dscs> is a character set name (same as in the VT320)

<Sxbpn> are DEC sixel bit-patterns (same as in the VT320)

DCS marks the beginning of the control sequence and ST terminates the control string. The new features in this control sequence are the expanded definition of <Pcmw> (<Pcms> in the VT320), <Pw>, and <Pt>, as well as the new parameters <Pcmh> and <Pcss>. The VT320 does not allow a character set defined in 80 column mode to be displayed in 132 column mode and vice versa because the font widths are different. Also, the VT220 would not automatically center characters in the cell. This feature allows future programs and terminals to be relatively independent of the character cell width for most non-graphics applications.

Refer to the “Character Sets” section earlier in this chapter for information on defining soft characters.

Sequences for Clearing Downloaded Soft Character Sets

```
DCS <Pfn>;<Pe> { <Dscs> ST
90 <Pfn> 3B <Pe> 7B <Dscs> 9C               (8-bit hex)
1B 50 <Pfn> 3B <Pe> 7B <Dscs> 1B 5C          (7-bit hex)

where
    <Pfn> specifies which font buffer (character set) to clear (0 or 1). The DEC VT320 terminal has only one set available, and both 0 and 1 refer to the same character set.
    <Pe> specifies the erasure mode, where:
        0 erases all characters in the font buffer
        2 erases all font buffers (soft character sets)
```
DCS marks the beginning of the control sequence and ST terminates the control string. The <Dscs> code is the designated name of the soft character set that you will clear by this control sequence.

**Attribute Control Sequences**

**Line Attribute Sequences**

Line Attribute control sequences apply to all terminals.

To designate the current cursor row as the top row of a double–height/double–width line, use the escape sequence:

**ESC # 3**

1B 23 33  
(7–bit hex)

To designate the current cursor row as the bottom row of a double–height/double–width line, use the escape sequence:

**ESC # 4**

1B 23 34  
(7–bit hex)

To designate the current cursor row as a single–height/double–width line, use the escape sequence:

**ESC # 6**

1B 23 36  
(7–bit hex)

To return the current cursor row to a single–width/single–height line, use the escape sequence:

**ESC # 5**

1B 23 35  
(7–bit hex)
Character Attribute Sequences

Select Graphic Rendition (SGR) all terminals

```
CSI <parameter> ; ... ; <parameter> m
9B <parameter> 3B ... 3B <parameter> 6D
1B 5B <parameter> 3B ... 3B <parameter> 6D
```

where

<parameter> determines visual character attributes, as determined by the list below:
- 0 turns off all visual attributes
- 1 displays bold or at increased intensity
- 4 turns underscore on
- 5 turns blink on
- 7 turns reverse video on
- 22 displays at normal intensity (VT320 only)
- 24 turns underscore off (VT320 only)
- 25 turns blink off (VT320 only)
- 27 turns reverse video off (VT320 only)

Changes one or more visual attributes for successive characters in the data stream according to the parameter values. Visual attributes not specified in the parameter string are turned off. If no parameters are supplied with the control sequence, then all attributes for subsequent characters are turned off. See ANSI document X3.64, section 5.77.

Select Character Attributes (SCA) D413/D463

```
CSI <parameter> " q
9B <parameter> 22 71
1B 5B <parameter> 22 71
```

where

<parameter> determines text erasure, according to the list below:
- 0 same as 2, below
- 1 subsequent characters are not erasable (protected)
- 2 subsequent characters are erasable (unprotected)

This control sequence selects all subsequent characters displayed to be erasable or not erasable with regard to Selective Erase In Line (SEL) and Selective Erase In Display (SED) control sequences.
Cursor Positioning Control Sequences

Parameters listed in this section are optional. If you do not specify a parameter or specify it as 0, then it will be treated as 1.

Cursor Up (CUU) all terminals

CSI <lines> A
9B <lines> 41
1B 5B <lines> 41

where

<lines> is a whole number that specifies how many lines to move the cursor

Moves the cursor up one or more lines in the same column. If the requested movement would place the cursor off the screen (or out of the scrolling region, if set), the control sequence is terminated when the cursor reaches that boundary. See ANSI document X3.64, section 5.17.

Cursor Down (CUD) all terminals

CSI <lines> B
9B <lines> 42
1B 5B <lines> 42

where

<lines> is a whole number that specifies how many lines to move the cursor

Moves the cursor down one or more lines in the same column. If the requested movement places the cursor off the screen (or out of the scrolling region, if set), the control sequence is terminated when the cursor reaches that boundary. See ANSI document X3.64, section 5.14.
Cursor Forward (CUF)

all terminals

CSI <columns> C
9B <columns> 43
1B 5B <columns> 43

where

<columns> is a whole number that specifies how many columns to move the cursor

Moves the cursor to the right one or more columns in the same row. If the requested movement places the cursor off the screen, the control sequence is terminated when the cursor reaches the right margin. Auto-wrap mode is ignored. See ANSI document X3.64, section 5.15.

Cursor Backward (CUB)

all terminals

CSI <columns> D
9B <columns> 44
1B 5B <columns> 44

where

<columns> is a whole number that specifies how many columns to move the cursor

Moves the cursor to the left one or more columns in the same row. If the requested movement places the cursor off the screen, the control sequence terminates when the cursor reaches the left margin. See ANSI document X3.64, section 5.13.

Cursor Position (CUP)

all terminals

CSI <line> ; <column> H
9B <line> 3B <column> 48
1B 5B <line> 3B <column> 48

where

<line> is from 1 through 24, with the number 1 representing the top line of the screen

<column> is from 1 to 80 (or 1 through 132, depending upon whether normal or compressed characters) are displayed, with the number 1 representing the left most column on the screen.

Moves the cursor to the specified line and column. Parameter values greater than the ranges specified causes the cursor to peg at the nearest reasonable position. The parameters are relative to the upper left corner of the scrolling region if Cursor Origin mode is set. See ANSI document X3.64, section 5.16.
Horizontal and Vertical Position (HVP)  all terminals

CSI <vert> ; <horiz> f
9B <vert> 3B <horiz> 66  (8-bit hex)
1B 5B <vert> 3B <horiz> 66  (7-bit hex)

where

<vert> is a line number from 1 through 24, with the number 1 representing the top line of the screen.

<horiz> is a column number from 1 to 80 (or 1 through 132, depending upon normal or compressed characters), with the number 1 representing the left most column on the screen.

Moves the cursor to the specified line (vertical position) and column (horizontal position).
Parameter values greater than the ranges specified causes the cursor to peg at the nearest reasonable position. The parameters are relative to the upper left corner of the scrolling region if Cursor Origin mode is set. See ANSI document X3.64, section 5.47.

NOTE: This command is functionally the same as the Cursor Position command.

Index (IND)  all terminals

IND or ESC D
84  (8-bit hex)
1B 44  (7-bit hex)

Causes the cursor to move downward one line without changing the column position. If the cursor is at the bottom margin, the screen scrolls up. See ANSI document X3.64, section 5.50.

Tab  all terminals

09

Advances the cursor to the next tab stop to the right of the current cursor position. If no additional tab stops are defined to the right of the current cursor position, then the cursor advances to the last screen column. Use the Set Horizontal Tab (HTS) and Clear Tap Stops (TBC) commands to change the tab stops. You can also use the Answerback and Tabs Menu to change the tab stops as described in the Installing and Operating Your D216E, D217, D413, and D463 Display Terminals manual.
Reverse Index (RI)  

RI or ESC M  
8D  
1B 4D  

(8-bit hex)  
(7-bit hex)  

Moves the cursor up one line maintaining the same column position. If the cursor is at the top margin, the screen scrolls down. See ANSI document X3.64, section 5.71.

Next Line (NEL)  

NEL or ESC E  
85  
1B 45  

(8-bit hex)  
(7-bit hex)  

Moves the cursor to the first position on the next line down. If the cursor is already at the bottom margin, the screen scrolls up. See ANSI document X3.64, section 5.59.

Save Cursor (SC)  

ESC 7  
1B 37  

Saves the following information in terminal memory:

- Cursor position
- State of graphic rendition
- Character set shift state
- Wrap flag state
- State of origin mode
- State of selective erase attribute

Restore Cursor (RC)  

ESC 8  
1B 38  

Restores the information saved by the Save Cursor control sequence. If the Save Cursor control sequence was not used before this control sequence is issued, the terminal resets to its default condition, and the cursor moves to Home.
Tabulation Control Sequences

Set Horizontal Tab (HTS) all terminals

HTS or ESC H
88 (8-bit hex)
1B 48 (7-bit hex)

Sets a horizontal tab at the current cursor column. See ANSI document X3.64, section 5.46.

Clear Tab Stops (TBC) all terminals

CSI <parameter> g
9B <parameter> 67 (8-bit hex)
1B 5B <parameter> 67 (7-bit hex)

Where

<parameter> specifies which tab stops to clear, according to the following list:

0 clears a horizontal tab stop at the cursor position
3 clears all horizontal tab stops

Clears one or more tab stops. The parameter supplied with this control sequence determines the mode in which tabs are cleared. If no parameter is specified, a parameter value of 0 is used. See ANSI document X3.64, section 5.91.
Screen Editing Control Sequences

Delete Character (DCH)  

CSI <# of chars> P  
9B <# of chars> 50  
1B 5B <# of chars> 50  

where  

<# of chars>  is the number of characters to delete; the default value when no parameter is present is 1.

Deletes one or more characters starting at the cursor position. Characters to the right of the deleted area, if any, are moved left to the current cursor position to fill the void created by the deletion. Characters can be deleted from the current cursor position to the end of the current line. See ANSI document X3.64, section 5.21.

Insert Character (ICH)  

CSI <# of chars> @  
9B <# of chars> 40  
1B 5B <# of chars> 40  

where  

<# of chars>  is the number of character spaces to insert; the default value when no parameter is present is 1.

Inserts one or more erased characters (spaces) to the right, starting at the current cursor position. Characters at the cursor position and to the right of the cursor are scrolled right. Characters that are scrolled off the screen are lost. See ANSI document X3.64, section 5.48.
Insert Line (IL)  

CSI <# of lines> L  
9B <# of lines> 4C  
1B 5B <# of lines> 4C  

where  

<# of lines> is the number of blank lines to insert; the default value when no parameter is present is 1.

Inserts one or more blank lines in the current scrolling region starting at the line the cursor is on. Lines at and below the cursor are shifted down. See ANSI document X3.64, section 5.49.

Delete Line (DL)  

CSI <# of lines> M  
9B <# of lines> 4D  
1B 5B <# of lines> 4D  

where  

<# of lines> is the number of lines to delete; the default value when no parameter is present is 1.

Deletes one or more lines starting at the current line the cursor is on, and successive lines below. Lines are deleted only in the current scrolling region, and any lines left below the deleted rows are scrolled up; blank lines are inserted as required. See ANSI document X3.64, section 5.23.

Erase Character (ECH)  

CSI <# of chars> X  
9B <# of chars> 58  
1B 5B <# of chars> 58  

where  

<# of chars> is the number of characters to erase; the default value when no parameter is present is 1.

Erases the specified number of characters on a line starting at, and including, the cursor position. See ANSI document X3.64, section 5.28.
Erase In Line (EL)  

CSI <parameter> K  
9B <parameter> 4B  (8-bit hex)  
1B 5B <parameter> 4B  (7-bit hex)  

where

<parameter> specifies what portion of the line to erase, according to the following list:
0  erases from the cursor to the end of the current line. This is the default if no parameter is specified.
1  erases from the first character on the line to the cursor position, inclusive.
2  erases the entire line.

Erases displayed characters on the current line. The cursor position is not changed. See ANSI document X3.64, section 5.31.

Erase In Display (ED)  

CSI <parameter> J  
9B <parameter> 4A  (8-bit hex)  
1B 5B <parameter> 4A  (7-bit hex)  

where

<parameter> specifies what portion of the screen to erase, according to the following list:
0  erases from the cursor to the end of the screen. This is the default if no parameter is specified.
1  erases from the beginning of the screen to the cursor position, inclusive.
2  erases the entire screen.

Erases displayed characters. The cursor position is not changed. See ANSI document X3.64, section 5.29.
Selective Erase In Line (DECSEL)  

CSI ? <parameter> K  
9B 3F <parameter> 4B  
1B 5B 3F <parameter> 4B  

where  

<parameter> specifies what portion of erasable characters to erase in a line:  
0 erases all erasable characters from the cursor to the end of the current line. This is the default if no parameter is specified.  
1 erases all erasable characters from the beginning of the line to the current cursor position, inclusive.  
2 erases all erasable characters on the entire line.  

Erases characters that have been designated as erasable with the Select Character Attributes control sequence.

Selective Erase In Display (DECSED)  

CSI ? <parameter> J  
9B 3F <parameter> 4A  
1B 5B 3F <parameter> 4A  

where  

<parameter> specifies what portion of erasable characters to erase on the screen:  
0 erases all erasable characters from the current cursor position to the end of the screen. This is the default if no parameter is specified.  
1 erases all erasable characters beginning from the beginning of the screen to the cursor position inclusive.  
2 erases all erasable characters on the entire screen.  

Erases characters that have been designated as erasable with the Select Character Attributes control sequence.
Scroll Down (SD)

CSI <parameter> T
9B <parameter> 54 (8-bit hex)
1B 5B <parameter> 54 (7-bit hex)

where

<parameter> specifies the number of lines to scroll on the screen:

Scrolls the screen contents down.

Scroll Up (SU)

CSI <parameter> S
9B <parameter> 53 (8-bit hex)
1B 5B <parameter> 53 (7-bit hex)

where

<parameter> specifies the number of lines to scroll on the screen:

Scrolls the screen contents up.
ANSI Standard Mode Control Sequences

Set Mode and Reset Mode are control sequences that cause one or more standard modes to be set or reset within the terminal. See “ANSI Standard Mode Parameters,” for details on the mode parameters.

Set Mode (SM)

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
<th>Example</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI &lt;parameter&gt; h</td>
<td>Sets the mode specified by &lt;parameter&gt;</td>
<td>all terminals</td>
<td></td>
</tr>
<tr>
<td>9B &lt;parameter&gt; 68</td>
<td>(8-bit hex)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1B 5B &lt;parameter&gt;68</td>
<td>(7-bit hex)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

where

<parameter> determines which mode will be set:
- 2 (32 hex) sets Keyboard Action mode
- 4 (34 hex) sets Insert/Replace mode
- 12 (31 32 hex) sets Send/Receive mode
- 20 (32 30 hex) sets Line Feed/New Line mode

Several mode parameters can be set in one operation by using a string in the following format:

CSI <parameter> ; <parameter> ; ... ; <parameter> h

See ANSI document X3.64, section 5.79.

Reset Mode (RM)

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
<th>Example</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI &lt;parameter&gt; 1</td>
<td>Resets the mode specified by &lt;parameter&gt;</td>
<td>all terminals</td>
<td></td>
</tr>
<tr>
<td>9B &lt;parameter&gt; 6C</td>
<td>(8-bit hex)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1B 5B &lt;parameter&gt;6C</td>
<td>(7-bit hex)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

where

<parameter> determines which mode will be reset:
- 2 (32 hex) resets Keyboard Action mode
- 4 (34 hex) resets Insert/Replace mode
- 12 (31 32 hex) resets Send/Receive mode
- 20 (32 30 hex) resets Line Feed/New Line mode

Several mode parameters can be reset in one operation by using a string in the following format:

CSI <parameter> ; <parameter> ; ... ; <parameter> 1
See ANSI document X3.64, section 5.73.

ANSI Standard Mode Parameters

### Keyboard Action Mode (KAM)

**all terminals**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
<th>ANSI Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI 2 h</td>
<td>to set</td>
<td>9B 32 68</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1B 5B 32 68</td>
</tr>
<tr>
<td>CSI 2 l</td>
<td>to reset (default)</td>
<td>9B 32 6C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1B 5B 32 6C</td>
</tr>
</tbody>
</table>

The reset state of this parameter enables the keyboard as an input device. The set state disables the keyboard, turns on the wait LED, and prevents further data entry. See ANSI document X3.64, section 5.54.

### Insert/Replace Mode (IRM)

**D413/D463**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
<th>ANSI Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI 4 h</td>
<td>to set</td>
<td>9B 34 68</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1B 5B 34 68</td>
</tr>
<tr>
<td>CSI 4 l</td>
<td>to reset (default)</td>
<td>9B 34 6C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1B 5B 34 6C</td>
</tr>
</tbody>
</table>

This parameter determines the insert or replace mode for new graphic characters placed on the video display. Reset Mode causes a new character to overwrite or replace an existing one at the active position. Set Mode causes new characters to be inserted at the active position and moves all following characters one position to the right. See ANSI document X3.64, section 5.52.
Send/Receive Mode (SRM)  all terminals

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI 12 h</td>
<td>to set (default)</td>
</tr>
<tr>
<td>9B 31 32 68</td>
<td>(8-bit hex)</td>
</tr>
<tr>
<td>1B 5B 31 32 68</td>
<td>(7-bit hex)</td>
</tr>
<tr>
<td>CSI 12 l</td>
<td>to reset</td>
</tr>
<tr>
<td>9B 31 32 6C</td>
<td>(8-bit hex)</td>
</tr>
<tr>
<td>1B 5B 31 32 6C</td>
<td>(7-bit hex)</td>
</tr>
</tbody>
</table>

The Send–Receive parameter controls the function of local echoing of characters to the video display. In Set Mode, characters typed at the keyboard are transmitted directly through the serial output port; only received characters from the serial port are made visible. In Reset Mode, characters typed at the keyboard are made visible on the screen and are also transmitted through the serial port. See ANSI document X3.64, section 5.83.

Line Feed/New Line Mode (LNM)  all terminals

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI 20 h</td>
<td>to set</td>
</tr>
<tr>
<td>9B 32 30 68</td>
<td>(8-bit hex)</td>
</tr>
<tr>
<td>1B 5B 32 30 68</td>
<td>(7-bit hex)</td>
</tr>
<tr>
<td>CSI 20 l</td>
<td>to reset (default)</td>
</tr>
<tr>
<td>9B 32 30 6C</td>
<td>(8-bit hex)</td>
</tr>
<tr>
<td>1B 5B 32 30 6C</td>
<td>(7-bit hex)</td>
</tr>
</tbody>
</table>

This parameter controls the interpretation of the Line Feed control sequence and the keyboard. In the reset state, a Line Feed implies only vertical movement with respect to the current active position and the New Line key produces only a CR. The set state causes the Line Feed to trigger a Line Feed operation followed by a CR and the New Line key to send the sequence CR–LF. See ANSI document X3.64, section 5.55.
ANSI Private Mode Control Sequences

Private Set Mode and Private Reset Mode are ANSI private control sequences that set or reset one or more ANSI private operating modes within the terminal. See section “ANSI Private Operating Mode Parameters,” which follows, for details on the mode parameters.

Private Set Mode (EXSM)

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI ? &lt;parameter&gt; h</td>
<td>all terminals</td>
</tr>
<tr>
<td>9B 3F &lt;parameter&gt; 68</td>
<td>(8-bit hex)</td>
</tr>
<tr>
<td>1B 5B 3F &lt;parameter&gt; 68</td>
<td>(7-bit hex)</td>
</tr>
</tbody>
</table>

where

<parameter> determines which private mode will be set:
- 1 (31 hex) sets Application/ANSI Cursor Keys mode
- 2 (32 hex) sets ANSI mode
- 3 (33 hex) sets Column mode
- 4 (34 hex) sets Scrolling mode
- 5 (35 hex) sets Screen mode
- 6 (36 hex) sets Cursor Origin mode
- 7 (37 hex) sets Auto Wrap mode
- 8 (38 hex) sets Auto Repeat mode
- 18 (3138 hex) sets Print Form Feed mode
- 19 (3139 hex) sets Print Extent mode
- 25 (3235 hex) sets Text Cursor Enable mode
- 42 (3432 hex) sets Multi/National Character Set mode
- 66 (3636 hex) sets Numeric Keypad mode
- 67 (3637 hex) sets Backarrow Key mode
- 68 (3638 hex) sets Typewriter/Data Processing Keys mode
- 99 3939 hex) sets PCTERM mode

Several mode parameters can be set in one operation by using a string in the following format:

CSI ? <parameter> ; <parameter> ; ... ; <parameter> h
Private Reset Mode (EXRM) all terminals

CSI ? <parameter> 1
9B 3F <parameter> 6C (8-bit hex)
1B 5B 3F <parameter> 6C (7-bit hex)

where

<parameter> determines which private mode will be reset:
1 (31 hex) resets Application/ANSI Cursor Keys mode
2 (32 hex) resets ANSI mode (VT52)
3 (33 hex) resets Column mode
4 (34 hex) resets Scrolling mode
5 (35 hex) resets Screen mode
6 (36 hex) resets Cursor Origin mode
7 (37 hex) resets Auto Wrap mode
8 (38 hex) resets Auto Repeat mode
18 (31 38 hex) resets Print Form Feed mode
19 (31 39 hex) resets Print Extent mode
25 (32 35 hex) resets Text Cursor Enable mode
42 (34 32 hex) resets Multi/National Character Set mode
66 (36 36 hex) resets Numeric Keypad mode
67 (36 37 hex) resets Backarrow Key mode
68 (36 38 hex) resets Typewriter/Data Processing Keys mode
99 39 39 hex) resets PCTERM mode

Several mode parameters can be reset in one operation by using a string in the following format:

CSI ? <parameter> ; <parameter> ; ... ; <parameter> 1

014-002111 3-53
ANSI Private Operating Mode Parameters

For additional information on ANSI private operating mode parameters, see ANSI document X3.64, section 3.5.6.

Application/ANSI Cursor Keys Mode (ACKM) all terminals

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
<th>Hexadecimal</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI ? 1 h</td>
<td>to set</td>
<td>9B 3F 31 68 (8-bit hex) 1B 5B 3F 31 68 (7-bit hex)</td>
</tr>
<tr>
<td>CSI ? 1 l</td>
<td>to reset (default)</td>
<td>9B 3F 31 6C (8-bit hex) 1B 5B 3F 31 6C (7-bit hex)</td>
</tr>
</tbody>
</table>

With Cursor Key Application mode set, the four cursor control keys no longer transmit standard ANSI control sequences for cursor movement. Instead, special predefined codes are sent that can be interpreted by the user for various applications. For more information on application key codes, refer to the “Generated Keyboard Characters” section of this chapter. Reset Mode returns the ANSI control sequences to the cursor keys.

Column Mode (COLM) D413/D463

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
<th>Hexadecimal</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI ? 3 h</td>
<td>to set</td>
<td>9B 3F 33 68 (8-bit hex) 1B 5B 3F 33 68 (7-bit hex)</td>
</tr>
<tr>
<td>CSI ? 3 l</td>
<td>to reset (default)</td>
<td>9B 3F 33 6C (8-bit hex) 1B 5B 3F 33 6C (7-bit hex)</td>
</tr>
</tbody>
</table>

The reset state allows a maximum of 80 columns to appear on the screen. The set state defines a maximum of 132 columns that can appear on the screen. When this function is used, the screen is erased and the cursor is moved to the Home position.
Scrolling Mode (SCRLM)

<table>
<thead>
<tr>
<th>Command</th>
<th>Hex Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI ? 4 h</td>
<td>9B 3F 34 68 (8-bit hex)</td>
</tr>
<tr>
<td>CSI ? 4 1</td>
<td>9B 3F 34 6C (8-bit hex)</td>
</tr>
</tbody>
</table>

The reset state allows a scroll operation to jump in increments of one whole line. The set state enables smooth scrolling at a maximum rate of 6 lines per second.

Screen Mode (SCRNM)

<table>
<thead>
<tr>
<th>Command</th>
<th>Hex Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI ? 5 h</td>
<td>9B 3F 35 68 (8-bit hex)</td>
</tr>
<tr>
<td>CSI ? 5 1</td>
<td>9B 3F 35 6C (8-bit hex)</td>
</tr>
</tbody>
</table>

In the reset state, graphic characters are illuminated against a black background. When set, characters are displayed in black against an illuminated background (reverse video).

Cursor Origin Mode (COM)

<table>
<thead>
<tr>
<th>Command</th>
<th>Hex Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI ? 6 h</td>
<td>9B 3F 36 68 (8-bit hex)</td>
</tr>
<tr>
<td>CSI ? 6 1</td>
<td>9B 3F 36 6C (8-bit hex)</td>
</tr>
</tbody>
</table>

The reset state defines the origin, or Home, to be at the upper left corner position of the screen. When in the reset condition, the cursor-addressing control sequences Cursor Postion (CUP) and Horizontal and Vertical Position (HVP) can position the cursor anywhere on the screen regardless of the margins that have been set. The set state defines the origin, or Home, to be the upper left character position of the current margin setting. Line numbers in Set Mode are relative to the current margin settings; the top line of the margin is referenced as line 1. Cursor control sequences cannot go beyond the current margin settings.
Set to ANSI Mode

all terminals

```
CSI ? 2 h to set
9B 3F 32 68 (8-bit hex)
1B 5B 3F 32 68 (7-bit hex)

CSI ? 2 l to reset
9B 3F 32 6C (8-bit hex)
1B 5B 3F 32 6C (7-bit hex)
```

Reets terminal to VT52 mode and sets all other modes to their saved configuration values or defaults. The set command is ignored.

Auto Wrap Mode (AWM)

all terminals

```
CSI ? 7 h to set
9B 3F 37 68 (8-bit hex)
1B 5B 3F 37 68 (7-bit hex)

CSI ? 7 l to reset (default)
9B 3F 37 6C (8-bit hex)
1B 5B 3F 37 6C (7-bit hex)
```

If Auto Wrap mode is set, any characters received when the cursor is already at the right margin cause the cursor to move to the beginning of the next line. In Reset Mode, any character received while the cursor is at the right margin replaces the existing character and the cursor does not move. Cursor control sequences never wrap.
Auto Repeat Mode (ARM) all terminals

CSI ? 8 h to set
9B 3F 38 68 (8-bit hex)
1B 5B 3F 38 68 (7-bit hex)

CSI ? 8 l to reset (default)
9B 3F 38 6C (8-bit hex)
1B 5B 3F 38 6C (7-bit hex)

In the reset state, no keys repeat without first pressing the Rept key. If Auto Repeat mode is set, all normal typematic keys repeat when held down for more than one-half second and will stop when the key is released.

Print Form Feed Mode (PFF) all terminals

CSI ? 18 h to set
9B 3F 31 38 68 (8-bit hex)
1B 5B 3F 31 38 68 (7-bit hex)

CSI ? 18 l to reset (default)
9B 3F 31 38 6C (8-bit hex)
1B 5B 3F 31 38 6C (7-bit hex)

This mode, when set, will terminate a print operation with a Form Feed (FF) character. In the reset state, no Form Feed is performed at the end of a print operation.

Print Extent Mode (PEXM) all terminals

CSI ? 19 h to set (default)
9B 3F 31 39 68 (8-bit hex)
1B 5B 3F 31 39 68 (7-bit hex)

CSI ? 19 l to reset
9B 3F 31 39 6C (8-bit hex)
1B 5B 3F 31 39 6C (7-bit hex)

Set Mode allows the entire screen to be printed during a print screen operation. Reset Mode allows printing of the current scrolling region only, as defined by Set Margins.
Text Cursor Enable Mode (TCEM)

CSI ? 25 h  to set (default)
9B 3F 32 35 68  (8-bit hex)
1B 5B 3F 32 35 68  (7-bit hex)

CSI ? 25 l  to reset
9B 3F 32 35 6C  (8-bit hex)
1B 5B 3F 32 35 6C  (7-bit hex)

If set, the cursor is visible. If reset, the cursor is not displayed.

Multi/National Character Set Mode (MNCSM)

CSI ? 42 h  to set
9B 3F 34 32 68  (8-bit hex)
1B 5B 3F 34 32 68  (7-bit hex)

CSI ? 42 l  to reset (default)
9B 3F 34 32 6C  (8-bit hex)
1B 5B 3F 34 32 6C  (7-bit hex)

The set state selects the National mode which allows the use of the 7-bit National Replacement Character (NRC) Sets. The reset state selects the Multinational mode, which allows the use of the Supplemental Character Set for 8-bit characters (GR), and the U.S. ASCII character set for 7-bit characters (GL).

Numeric Keypad Mode (NKM)

CSI ? 66 h  to set
9B 3F 36 36 68  (8-bit hex)
1B 5B 3F 36 36 68  (7-bit hex)

CSI ? 66 l  to reset (default)
9B 3F 36 36 6C  (8-bit hex)
1B 5B 3F 36 36 6C  (7-bit hex)

Operates the same as the older VT52 control sequences “ESC =” (1B 3D hex) and “ESC >” (1B 3E hex). This command extends the control sequence set to include the older VT52 control sequences. Refer to the “Generated Keyboard Codes” section of this chapter.
### Backarrow Key Mode (BKM)

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>CSI ? 67 h</code></td>
<td>to set</td>
</tr>
<tr>
<td><code>9B 3F 36 37 68</code></td>
<td>(8-bit hex)</td>
</tr>
<tr>
<td><code>1B 5B 3F 36 37 68</code></td>
<td>(7-bit hex)</td>
</tr>
<tr>
<td><code>CSI ? 67 1</code></td>
<td>to reset (default)</td>
</tr>
<tr>
<td><code>9B 3F 36 37 6C</code></td>
<td>(8-bit hex)</td>
</tr>
<tr>
<td><code>1B 5B 3F 36 37 6C</code></td>
<td>(7-bit hex)</td>
</tr>
</tbody>
</table>

Sets the code that the DEL key will send. If this mode is reset (the default condition), then the DEL key sends an ASCII DEL code (7F hex). If the mode is set, the DEL key sends an ASCII BS (Backspace) code (08 hex).

### Typewriter/Data Processing Keys Mode (KBUM)

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>CSI ? 68 h</code></td>
<td>to set</td>
</tr>
<tr>
<td><code>9B 3F 36 38 68</code></td>
<td>(8-bit hex)</td>
</tr>
<tr>
<td><code>1B 5B 3F 36 38 68</code></td>
<td>(7-bit hex)</td>
</tr>
<tr>
<td><code>CSI ? 68 1</code></td>
<td>to reset (default)</td>
</tr>
<tr>
<td><code>9B 3F 36 38 6C</code></td>
<td>(8-bit hex)</td>
</tr>
<tr>
<td><code>1B 5B 3F 36 38 6C</code></td>
<td>(7-bit hex)</td>
</tr>
</tbody>
</table>

This mode was available in DEC's original VT220 only through a menu selection. Although the command exists in the VT320 emulation, it does nothing (it is permanently reset) because of different keyboard implementation.

### Set Limited Transmit

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>CSI ? 7 3 h</code></td>
<td>to set</td>
</tr>
<tr>
<td><code>9B 3F 37 33 68</code></td>
<td>(8-bit hex)</td>
</tr>
<tr>
<td><code>1B 5B 3F 37 33 68</code></td>
<td>(7-bit hex)</td>
</tr>
<tr>
<td><code>CSI ? 7 3 1</code></td>
<td>to reset (default)</td>
</tr>
<tr>
<td><code>9B 3F 37 33 6C</code></td>
<td>(8-bit hex)</td>
</tr>
<tr>
<td><code>1B 5B 3F 37 33 6C</code></td>
<td>(7-bit hex)</td>
</tr>
</tbody>
</table>

Causes the terminal to respond to ^S (13 hex) sent by the host by stopping data transmission within 2 characters. The host can restart data transmission by sending ^Q (11 hex) to the terminal. When this mode is reset, the terminal treats ^S and ^Q as data.

You can also use the Communication Configuration menu to change the mode setting as described in the *Installing and Operating Your D216E+, D217, D413, and D463 Display Terminal* manual.
PCTERM Mode

<table>
<thead>
<tr>
<th>Command</th>
<th>Hex</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI ? 99 h</td>
<td></td>
<td>to set</td>
</tr>
<tr>
<td>9B 3F 39 39 68</td>
<td>(8-bit hex)</td>
<td></td>
</tr>
<tr>
<td>1B 5B 3F 39 39 68</td>
<td>(7-bit hex)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Command</th>
<th>Hex</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI ? 99 1</td>
<td></td>
<td>to reset (default)</td>
</tr>
<tr>
<td>9B 3F 39 39 6C</td>
<td>(8-bit hex)</td>
<td></td>
</tr>
<tr>
<td>1B 5B 3F 39 39 6C</td>
<td>(7-bit hex)</td>
<td></td>
</tr>
</tbody>
</table>

PCTERM mode is a new (Data General–specific) function added to the VT320/100 emulation. This mode is designed to be used with the VP/ix environment running under INTERACTIVE UNIIX. It allows a simple terminfo file to be devised for VP/ix that will emulate the MS–DOS® environment on a terminal connected to a multi–user 80386 PC running UNIX. See Chapter 5, “PCTERM,” for complete details on this operating mode.

When the terminal enters PCTERM mode, autowrap is turned off, the keyboard is set to deliver IBM PC scan codes, G0 is set to PC Low characters, G1 is set to PC High characters, XON is set to “e”, XOFF is set to “g”, GL is set to G0, and GR is set to G1.

When the terminal exits PCTERM mode, autowrap is turned on, the keyboard is set back to ASCII codes, XON is set to “Ctrl–Q”, XOFF is set to “Ctrl–S”, and G0, G1, GL and GR are restored from a save area.
Transmission Control Sequences

These sequences select the host--preferred mode of control sequence transmission and are only used on the VT320 emulation. If the communications mode is set to 7--bits, then these control sequences have no affect. If the communications mode is set to 8--bits, then the host has the option of receiving 7--bit (C0) sequences or 8--bit (C1) codes. These control sequences do not affect the terminal's reception of control sequences sent by the host.

**Transmit 7–bit Controls**

```
ESC <space> F
1B 20 46  (hex)
```

Terminal transmits only 7–bit (C0) control sequences to the host (returns 8–bit (C1) codes as their 7–bit code equivalents).

**Transmit 8–bit Controls**

```
ESC <space> G
1B 20 47  (hex)
```

Lets the terminal transmit both 7–bit (C0) and 8–bit (C1) control sequences to the host.
User-Defined Key Control Sequences

User Defined Keys (UDK)  D413/D463

DCS <Pcl> ; <Plk> | <Kv> / <Stn> ; ... ; <Kv> / <Stn> ST
90 <Pcl> 3B <Plk> 7C <Kv> 2F <Stn> 3B ... 3B <Kv> 2F <Stn> 9C
1B 50 <Pcl> 3B <Plk> 7C <Kv> 2F <Stn> 3B ... 3B <Kv> 2F <Stn> 1B 5C

(8-bit hex)

where

<Plk> is the lock control parameter, with one of the values below. (If keys are locked, they may be unlocked only by using the General Set-Up menu.)
0 none locks definable keys against redefinition
1 locks definable keys against redefinition

<Kv> is the key value for a particular function key, with one of the following values.

F6 17  F14 26
F7 18  F15 28 (Help)
F8 19  F16 29 (Do)
F9 20  F17 31
F10 21  F18 32
F11 22  F19 33
F12 23  F20 34
F13 24

<Stn> is a string of hexadecimal bytes that defines the character sequence for the specified key.

Function keys F6 to F20 may be programmed with user-definable key sequences. A total of 255 bytes of volatile RAM is available for key definitions, and one key sequence may use up all or most of the available memory if desired.

For example, the control sequence “DCS 1;1|17/41424344454647 ST” defines function key F6 to “ABCDEFG”. Where clear control <Pcl> is 1 to clear only the being defined, Lock control <Plk> is a 1 to prevent keys from being locked against future redefinition. The "|" character indicates the UDK control sequence, 17 the value for function key six F6, / indicates the start of data, and 41424344454647 are hex values for the characters “ABCDEFG”.

3-62
Miscellaneous Control Sequences

**Soft Terminal Reset**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI ! p</td>
<td>9B 21 70 (8-bit hex)</td>
</tr>
<tr>
<td></td>
<td>1B 5B 21 70 (7-bit hex)</td>
</tr>
</tbody>
</table>

Resets all operating modes (both ANSI standard and ANSI private) to defaults. Also resets the character sets to defaults. Refer to the following sections of this chapter: “ANSI Standard Mode”, “ANSI Private Mode”, and “Character Sets.”

**Hard Terminal Reset**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESC c</td>
<td>1B 63 (hex)</td>
</tr>
</tbody>
</table>

Causes the terminal to act as if the power had been shut off and turned back on again. We do not recommend using this control sequence since it will interfere with dual-host operation and may also cause the loss of characters from the host during the self-test sequence.

**Alignment**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESC # 8</td>
<td>1B 23 38 (hex)</td>
</tr>
</tbody>
</table>

Fills the screen with an alignment pattern of E's.

**Display Character Generator Contents**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESC # 9</td>
<td>1B 23 39 (hex)</td>
</tr>
</tbody>
</table>

Displays the contents of the character generator. This is a Data General extension to the Alignment command.
Set/Report Language

CSI ? <lang> E
9B 3F <lang> 45 (8-bit hex)
1B 5B 3F <lang> 45 (7-bit hex)

Sets the current keyboard language to the supplied language. If no language is supplied, then the terminal defaults to the current language. Reports the keyboard language as a single printable character formed by adding 1F hex to the language numbers as shown in the table below. This command is only used for diagnostic and testing purposes.

<table>
<thead>
<tr>
<th>&lt;lang&gt;</th>
<th>&lt;char&gt;</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>North American</td>
</tr>
<tr>
<td>2</td>
<td>!</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>3</td>
<td>&quot;</td>
<td>French/Belgian</td>
</tr>
<tr>
<td>4</td>
<td>#</td>
<td>German/Dutch</td>
</tr>
<tr>
<td>5</td>
<td>$</td>
<td>Swedish/Finnish</td>
</tr>
<tr>
<td>6</td>
<td>%</td>
<td>Spanish</td>
</tr>
<tr>
<td>7</td>
<td>&amp;</td>
<td>Danish</td>
</tr>
<tr>
<td>8</td>
<td>'</td>
<td>Norwegian</td>
</tr>
<tr>
<td>9</td>
<td>(</td>
<td>Swiss (German)</td>
</tr>
<tr>
<td>10</td>
<td>)</td>
<td>Swiss (French)</td>
</tr>
<tr>
<td>11</td>
<td>*</td>
<td>Italian</td>
</tr>
<tr>
<td>12</td>
<td>+</td>
<td>Canadian English</td>
</tr>
<tr>
<td>13</td>
<td>-</td>
<td>Canadian French</td>
</tr>
<tr>
<td>14</td>
<td>.</td>
<td>Katakana</td>
</tr>
<tr>
<td>15</td>
<td>.</td>
<td>Portuguese</td>
</tr>
</tbody>
</table>

Set Clock Time

CSI ? ; <mode> ; ; <hours> ;<minutes> F
9B 3F 3B <mode> 3B 3B 3B <hours> 3B <minutes> 46 (8-bit hex)
1B 5B 3F 3B <mode> 3B 3B 3B <hours> 3B <minutes> 46 (7-bit hex)

where

<mode> sets the hour mode:
1 sets 12 hour (AM/PM) mode
2 sets 24 hour (military) mode

<hours> is the current time, from 0 through 23 (0 is midnight)

<minutes> is the current time from 0 through 59
If either <hours> or <minutes> are specified, then the seconds counter is reset to 0. This control sequence has been altered from its previous format used in the D216/D412/D462 terminals. The parameters for turning the clock on and off and for positioning the clock have been removed. Any data specified in the positions for these unused parameters will be ignored.

**Hot Key Switch**

```
CSI ? G
9B 3F 47
1B 5B 3F 47
```

(8-bit hex)

(7-bit hex)

Switches terminal operation to another emulation. This control sequence is ignored if no other emulation is specified in the Configuration Menu. For more information on the Configuration Menu, refer to the *Installing and Operating Your D216E, D217, D413, and D463 Display Terminals* manual.

**Set Top and Bottom Margins (STBM)**

```
CSI <top> ; <bottom> r
9B <top> 3B <bottom> 72
1B 5B <top> 3B <bottom> 72
```

(8-bit hex)

(7-bit hex)

where

<top> and <bottom> are numeric parameters that define the first and last line of the scrolling region, respectively. Line number parameters are referenced from the top of the screen where the top line is always 1. If no parameters are supplied with this control sequence, then <top> and <bottom> are assumed to be the first and last line of the entire screen.

Sets the top and bottom margins to define a window or scrolling region.

**Bit Dump Screen**

```
CSI 6 i
9B 36 69
1B 5B 36 69
```

(8-bit hex)

(7-bit hex)

Dumps the contents of the screen graphically to a Data General or IBM Pro-Printer compatible printer. No action is taken if a graphics capable printer is not selected. This control sequence allows the printing of double–height and double–width characters, as well as DRCS (soft character set) characters, when the terminal is used with a graphics printer. This feature is not available in standard DEC VT320 terminals.

014-002111 3-65
**Force Display**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC2 &lt;character&gt;</td>
<td>Forces the terminal to display the next character after the control code literally.</td>
</tr>
<tr>
<td>12 &lt;character&gt; (hex)</td>
<td>Allows access to the 128-character character sets.</td>
</tr>
</tbody>
</table>

This is a new (Data General-specific) function that forces the terminal to display the next character after the control code literally. It is used as an escape code (primarily for VP/ix) to allow access to the 128-character character sets. Ordinarily, codes 00 hex through 1F hex, and 80 hex through 9F hex, are interpreted as control sequences. With this code given first, they will be forced into being displayed on the screen.

**Data Trap Mode**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI &lt;Ps&gt; $ }</td>
<td>Sets the cursor to either the main display area or the status line.</td>
</tr>
<tr>
<td>9B &lt;Ps&gt; 24 7D</td>
<td>(8-bit hex)</td>
</tr>
<tr>
<td>1B 5B &lt;Ps&gt; 24 7D</td>
<td>(7-bit hex)</td>
</tr>
</tbody>
</table>

This mode lets the user view data from the host as a hex data stream, similar to AOS/VS's X DISPLAY/HEX command. Data Trap mode is entered and exited via the Configuration Menu. For more information on the Configuration Menu, refer to the *Installing and Operating Your D216E, D217, D413, and D463 Display Terminals* manual.

Outbound (host to terminal) data is displayed as 16 hex bytes per line (on the left, below) and the corresponding B-hit characters on the right, as follows:

```
40 30 31 32 33 34 35 36 37 38 39 21 23 24 2E 0A 00123456789!$..
41 42 43 44 45 44 47 48 49 4A 4B 4C 4D 4E 4F 50 ABCDEFGHIJKLMNOP
61 62 63 64 65 66 67 68 69 6A 6B 6C 6D 6E 6F 70 abcdefghijklmnop
```

NOTE: The Index entry "VT320/100 mode control sequences by hex order" lists all VT320/100 control sequences by hex order. Refer to this entry to determine which control sequences are returned while using Data Trap mode.

**Select Active Status Display (SASD)**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI &lt;Ps&gt; $ }</td>
<td>Sets the cursor to either the main display area or the status line.</td>
</tr>
<tr>
<td>9B &lt;Ps&gt; 24 7D</td>
<td>(8-bit hex)</td>
</tr>
<tr>
<td>1B 5B &lt;Ps&gt; 24 7D</td>
<td>(7-bit hex)</td>
</tr>
</tbody>
</table>

where

- <Ps> determines where to place the cursor;
  - 0 places the cursor in the active display area. This is the default selection if no parameter is specified.
  - 1 places the cursor on the status line. When the cursor is in the status line, the status line behaves as if it were a one-row window.

Sets the cursor to either the main display area or the status line. If the status line is not set to host-writable (SSDT), then this control sequence has no effect.

---

3-66
Select Status Line Type (SSDT)

CSI <Ps> $ ~
9B <Ps> 24 7E
1B 5B <Ps> 24 7E

where

<Ps> determines the status line type:
0 makes the 25th line blank (VT320 compatible)
1 displays terminal status on the 25th line
2 makes the status line host-writable (for the Select Active Display (SASD) control sequence).
3 25th row

This control sequence selects the type of status line displayed on the 25th line of the screen.

Set Conformance Level (SCL)

CSI <level> ; <controls> " p
9B <level> 3B <controls> 22 70
1B 5B <level> 3B <controls> 22 70

where

<level> sets the terminal type:
61 VT100
62 VT220
63 VT320.

<controls> has one of the following values:
1 sets 7-bit controls
2 sets 8-bit controls

This control sequence sets the terminal's conformance, or compatibility, level.
Set Device Options

all terminals

CSI ? <type> ; <ff> ; <cs> ; <graph> Q
9B 3F <type> 3B <ff> 3B <cs> 3B <graph> 57
1B 5B 3F <type> 3B <ff> 3B <cs> 3B <graph> 51

(8-bit hex)

(7-bit hex)

where

<type> sets the device type:
1 printer
2 mouse.

<ff> specifies the printer form feed setting:
1 none (no form feed character sent to printer)
2 form feed character sent before the page
3 form feed character send after the page
4 form feed characters are send both before and after the page prints

<cs> specifies the printer character set:
1 U.S. ASCII and DGI
2 U.S. ASCII and VT Multinational
3 IBM PC
4 NRC only
5 NRC and VT Line Drawing (special graphics set)
6 Katakana

<graph> specifies the graphics capability of the printer:
1 none
2 Data General
3 IBM PC

Sets the type and preference options for the auxiliary device, if it is available; the auxiliary device is not available if the terminal is in Dual Host mode and the Port mode is set to "Both" (from Configuration Menu selections). Any parameter omitted defaults to the current setting. This control sequence is specific to the Data General VT-emulations, and is not available on DEC VT320 terminals.
Split Screen

CSI ? <first> ; <top> ; <split> I
9B 3F <first> 3B <top> 3B <split> 49 (8-bit hex)
1B 5B 3F <first> 3B <top> 3B <split> 49 (7-bit hex)

where

<first> specifies the first physical row of the current emulation to display in this partition, and is from 1 through 24. If the parameter given is large enough that lines past the end of the screen would be visible, this value is set to the maximum possible.

<top> specifies the emulation to be shown in the top partition:
0 host
1 auxiliary

<split> specifies the number of rows to allocate for the top partition, and is from 0 through 23. If you enter 0 here, split screen is disabled.

Sets or resets split screen. To enter split screen mode, you must first define two emulations in the Terminal Operations Menu. When split screen is set, one emulation will occupy the top n rows of the screen, and the other emulation will occupy the bottom “24 – n” rows. Because only a portion of each emulation's screen is displayed, this control sequence lets you select the starting row in each partition.

Any parameter omitted defaults to the current setting. This control sequence is specific to the Data General VT–emulations, and is not available on DEC VT320 terminals.

NOTE: Press the CMD key and the Cursor Up/Down to move the split screen up or down. This command sequence also toggles the split screen setting. Press the CMD and SHIFT keys and Cursor up/down to move the first row of the current emulation up or down.
Reporting Control Sequences

A report is a character sequence that contains information about status, terminal identification, or current parameters. It is generated by the terminal in response to a request from the host computer.

Terminal Identification (DECID) all terminals

ESC 2
1B 5A (hex)

Causes the terminal to send a Primary Device Attributes (DA) response sequence. Use this command to identify the terminal's VT52 mode; otherwise use the Primary Device Attribute Request (DA).

Device Status Report (DSR) all terminals

CSI 5 n
9B 35 6E (8-bit hex)
1B 5B 35 6E (7-bit hex)

Reports the terminal operating status, where the terminal responds to the host with:

CSI 0 n
9B 30 6E (8-bit hex)
1B 5B 30 6E (7-bit hex)

no malfunction was detected during powerup self-test

 CSI 3 n
9B 33 6E (8-bit hex)
1B 5B 33 6E (7-bit hex)

malfunction was detected during powerup self-test
Primary Device Attribute Request (DA) all terminals

CSI c
9B 63
1B 5B 63

(8-bit hex)
(7-bit hex)

Returns the current operating level and options of the terminal. The response string has the following format:

CSI ? <feature> ; ... ; <feature> c
9B 3F <feature> 3B ... 3B <feature> 63
1B 5B 3F <feature> 3B ... 3B <feature> 63

(8-bit hex)
(7-bit hex)

where

<level> indicates the operating level:
61 VT100
62 VT220
63 VT320

<feature> indicates the features in the following list:
1 132 column capability
2 printer port
6 selective erase
7 soft character sets (DRCS) (D463 only)
8 user defined keys (UDK)
9 National Replacement Sets (NRC)
11 25th row is the status line
14 8-bit communications interface
17 terminal state interrogation (TABS, RQM, ...)

Response 63 for the <level> parameter and <feature> responses 11, 14, and 17 are new to the DEC VT320. Otherwise, this control sequence is identical to the DEC VT220 control sequence.
Secondary Device Attribute Request (SDA)  

all terminals

CSI > c
9B 3E 63  (8-bit hex)
1B 5B 3E 63  (7-bit hex)

This control sequence returns additional information specific to the VT320 emulation. The response string is:

CSI > <Pp> ; <Pv> ; <Po> c
9B 3E <Pp> 3B <Pv> 3B <Po> 63  (8-bit hex)
1B 5B 3E <Pp> 3B <Pv> 3B <Po> 63  (7-bit hex)

where

<Pp> is the identification code, where:
1 VT220
24 VT320

<Pv> is the firmware revision level, where 11 is Version 1.1

<Po> is the number of hardware options installed, which should always be 0

Response 24 for the <Pp> parameter and the <Pv> parameter are new to the DEC VT320. Otherwise, this control sequence is identical to the DEC VT220 control sequence.

Cursor Position Report (CPR)  

all terminals

CSI 6 n
9B 36 6E  (8-bit hex)
1B 5B 36 6E  (7-bit hex)

Reports the current cursor position, with a sequence in the format below:

CSI <vert> ; <horiz> R
9B <vert> 3B <horiz> 52  (8-bit hex)
1B 5B <vert> 3B <horiz> 52  (7-bit hex)

where

<vert> and <horiz> are numeric parameters that indicate the current line and column position of the cursor.
**User Defined Key Status**

<table>
<thead>
<tr>
<th>Command</th>
<th>Hex</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI ? 25 n</td>
<td>9B 3F 32 35 6E</td>
<td>user defined keys are unlocked</td>
</tr>
<tr>
<td>1B 5B 3F 32 35 6E</td>
<td>(7-bit hex)</td>
<td></td>
</tr>
</tbody>
</table>

Reports the status of the user defined keys, where the terminal's response is as follows:

<table>
<thead>
<tr>
<th>Command</th>
<th>Hex</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI ? 20 n</td>
<td>9B 3F 32 30 6E</td>
<td>user defined keys are unlocked</td>
</tr>
<tr>
<td>1B 5B 3F 32 30 6E</td>
<td>(7-bit hex)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Command</th>
<th>Hex</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI ? 21 n</td>
<td>9B 3F 32 31 6E</td>
<td>user defined keys are locked</td>
</tr>
<tr>
<td>1B 5B 3F 32 31 6E</td>
<td>(7-bit hex)</td>
<td></td>
</tr>
</tbody>
</table>

**Keyboard Language Report**

<table>
<thead>
<tr>
<th>Command</th>
<th>Hex</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI ? 26 n</td>
<td>9B 3F 32 36 6E</td>
<td>current keyboard language in use</td>
</tr>
<tr>
<td>1B 5B 3F 32 36 6E</td>
<td>(7-bit hex)</td>
<td></td>
</tr>
</tbody>
</table>

Reports the current keyboard language in use, where the terminal's response is as follows:

<table>
<thead>
<tr>
<th>Command</th>
<th>Hex</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI ? 27 ; &lt;language&gt; n</td>
<td>9B 3F 32 37 3B &lt;language&gt; 6E</td>
<td>current keyboard language in use</td>
</tr>
<tr>
<td>1B 5B 3F 32 37 3B &lt;language&gt; 6E</td>
<td>(7-bit hex)</td>
<td></td>
</tr>
</tbody>
</table>
where `<language>`

reports the current keyboard language, from the following list:

0  Undetermined
1  North American
2  British
3  Flemish
4  French Canadian
5  Danish
6  Finnish
7  German
8  Dutch
9  Italian
10  Swiss/French
11  Swiss/German
12  Swedish
13  Norwegian
14  French/Belgian
15  Spanish
16  Portuguese (was Katakana on D216/D412/D462)
99  Katakana

In addition, for testing purposes there is a Data General private control sequence to set the Keyboard Language, as shown below:

```
CSI ? <language> E
9B 3F 32 37 3B <language> 45  (8-bit hex)
1B 5B 3F 32 37 3B <language> 45  (7-bit hex)
```

where

`<language>` is a numeric parameter, from the list above, indicating the keyboard language type.
Answerback

ENQ
05
(7-bit hex)

Transmits answerback message (set in the Configuration Menu) to the host if an answerback message is set and answerback is enabled.

Printer Port Status

Reports the status of the terminal's printer port:

<table>
<thead>
<tr>
<th>CSI ? 15 n</th>
<th>9B 3F 31 35 6E</th>
<th>1B 5B 3F 31 35 6E</th>
</tr>
</thead>
<tbody>
<tr>
<td>(8-bit hex)</td>
<td>(7-bit hex)</td>
<td></td>
</tr>
</tbody>
</table>

(8-bit hex)
(7-bit hex)

mean DTR was never asserted; no printer attached

This status request checks the state of Data Terminal Ready (DTR) on the printer port.
Request Terminal State Report (RQTSR)

CSI 1 $ u
9B 31 24 75  (8-bit hex)
1B 5B 31 24 75  (7-bit hex)

This sequence returns a DCS string from the terminal to the host, as follows:

DCS 1 $ s <D1> ... <Dn> <Ck1> <Ck2> ST
90 31 24 73 <D1> ... <Dn> <Ck1> <Ck2> 9C  (8-bit hex)
1B 50 31 24 73 <D1> ... <Dn> <Ck1> <Ck2> 1B 5C  (7-bit hex)

where

<D1> ... <Dn> are characters in the range 40 to 4F hex, representing encoded state information.

<Ck1><Ck2> are a checksum equal to the 2's complement of all of the data above, such that the following statement holds:

\[ \text{sum}(<D1> ... <Dn>) + ((<Ck2> & 0xF)<4) + (<Ck1> & 0xF) = 0 \]

The contents of the returned string are an encoded form of the internal state of the terminal. This control sequence allows an application to fetch the current state of the terminal, make changes, and then revert the state on exit. It is not intended that any application should examine the data returned to find state information.

This control sequence is used in conjunction with the Restore Terminal State (RSTS) control sequence. All ANSI standard modes (CSI h and CSI l) and ANSI private modes (CSI ? h and CSI ? l) are saved.

Restore Terminal State (RSTS)

DCS 1 $ p <D1> ... <Dn> <Ck1> <Ck2> ST
90 31 24 70 <D1> ... <Dn> <Ck1> <Ck2> 9C  (8-bit hex)
1B 50 31 24 70 <D1> ... <Dn> <Ck1> <Ck2> 1B 5C  (7-bit hex)

where

all parameters are in the same format as the response strings given by Request Terminal State Report (RQTSR). If any error is detected in the given data, the rest will be ignored. This may put the terminal into an indeterminate state.

Restores the terminal state from an encoded string produced by the Request Terminal State Report (RQTSR) control sequence. If any error is detected in the given data, the rest will be ignored. This may put the terminal into an indeterminate state.
Request Presentation State Report (RQPSR)  
CSI <Ps> $ w 
9B <Ps> 24 77
1B 5B <Ps> 24 77

(8-bit hex)  
(7-bit hex) 

For a cursor information report, set <Ps> to 1. The returned DCS string is as follows:

DCS 1 $ u <Pr>;<Pc>;<Pp>;<Srend>;<Sflag>;<Fgl>;<Pgr>;<Scss>;<Sdesig> ST

90 31 24 75 <Pr>;<Pc>;<Pp>;<Srend>;<Sflag>;<Fgl>;<Pgr>;<Scss>;<Sdesig> 9C

1B 50 31 24 75 <Pr>;<Pc>;<Pp>;<Srend>;<Sflag>;<Fgl>;<Pgr>;<Scss>;<Sdesig> 1B 5C

(8-bit hex)  
(7-bit hex) 

where

- <Pr> is the line number the cursor is on (decimal)
- <Pc> is the column number the cursor is on (decimal)
- <Pp> is the page number, which is always 0 on a VT320
- <Srend> is the current rendition (SGR) encoded as a single character in the form 01E0 RBUb:
  - E indicates if another byte follows (extension), is currently unused, and should be set to 0
  - R is 1 for reverse video on
  - B is 1 for blink on
  - U is 1 for underscore on
  - b is 1 for bold on
- <Satt> is the selective erase attribute encoded as a single character in the format 01E0 000S:
  - E indicates if another byte follows (extension), is currently unused, and should be set to 0
  - S is 1 for protected, 0 for unprotected
<Sflag> is certain saved flags and is in the format of 01E0 A320:
E indicates if another byte follows (extension), is currently unused, and should be set to 0
A is 1 for autowrap pending (not very useful, although it is in the DEC version of this sequence)
3 is 1 for SS3 pending (cannot be set, although it is in the DEC version of this sequence)
2 is 1 for SS2 pending (cannot be set, although it is in the DEC version of this sequence)

<Pgl> is the Gx set mapped into GL (decimal).
<Pgr> is the Gx set mapped into GR (decimal).
<Scss> is the number and size of the character sets, encoded into a single character: 01E0 DCBA, where:
E indicates if another byte follows (extension), is currently unused, and should be set to 0
D indicates G3, and is set to 0 for 94 characters, set to 1 for 96 characters
C indicates G2, and is set to 0 for 94 characters, set to 1 for 96 characters
B indicates G1, and is set to 0 for 94 characters, set to 1 for 96 characters
A indicates G0, and is set to 0 for 94 characters, set to 1 for 96 characters

<Sdesig> is four Dscs–style character set names for G0 through G3.

For a tab stop report, set <Ps> to 2. The returned DCS string is as follows:

DCS 2 $ u <Ts1> / <Ts2> / ... <Tsn> ST
90 32 24 77 <Ts1> 2F <Ts2> 2F ... <Tsn> 9C
1B 50 32 24 77 <Ts1> 2F <Ts2> 2F ... <Tsn> 1B 5C

where

<Ts1> ... <Tsn> are decimal column numbers representing set tabs. Note that the separators here are / (2F hex), and not ; (3B hex).

The contents of this string are either the cursor status (the same information as that saved by the Save Cursor and the Restore Cursor control sequences), or the current tab stops. Unlike Request Terminal State Report (RQTSR), the data returned by this control sequence may be examined and acted upon by the application program. This control sequence is often used in conjunction with the Restore Presentation State (RSPS) control sequence.
Restore Presentation State (RPS)

DCS <Ps> $ t <D1> ... <Dn> ST
90 <Ps> 24 74 <D1> ... <Dn> 9C
1B 50 <Ps> 24 74 <D1> ... <Dn> 1B 5C

where

<Ps> is 1 to restore the cursor state, and 2 to restore the tab settings
<D1> ... <Dn> are in the same format as the response strings given by Request Presentation State Report (RQPSR). If any error is detected in the given data, the rest will be ignored. This may put the terminal into an indeterminate state.

Restores either the current cursor state or the tab settings, as saved using Request Presentation State Report (RQPSR).

Request Mode (RQM)

CSI [?] <Pa> $ p
9B [3F] <Pa> 24 70
1B 5B [3F] <Pa> 24 70

where

? (3F hex) tells the terminal to return only ANSI private modes. Do not include this character if you want a report on ANSI standard modes.

<Pa> is the number of the mode (from 0 to 255) on which you want a report:

ANSI standard modes

2 (32 hex) Keyboard Action mode
4 (34 hex) Insert/Replace mode
12 (31 32 hex) Send/Receive mode
20 (32 30 hex) Line Feed/New Line mode
ANSI private modes

1 (31 hex) Application/ANSI Cursor Keys mode
3 (33 hex) Column mode
4 (34 hex) Scrolling mode
5 (35 hex) Screen mode
6 (36 hex) Cursor Origin mode
7 (37 hex) Auto Wrap mode
8 (38 hex) Auto Repeat mode
18 (31 38 hex) Print Form Feed mode
19 (31 39 hex) Print Extent mode
25 (32 35 hex) Text Cursor Enable mode
42 (34 32 hex) Multi/National Character Set mode
66 (36 36 hex) Numeric Keypad mode
67 (36 37 hex) Backarrow Key mode
68 (36 38 hex) Typewriter/Data Processing Keys mode
99 (39 39 hex) PCTERM mode

Returns the current value of any of the terminal’s mode settings. If the “?” character is absent, ANSI standard modes will be reported. If it is present, ANSI private modes will be returned. The control sequence returned is in the following format:

```
CSI [?] <Pa> ; <Ps> $ y
9B [3F] <Pa> 3B <Ps> 24 79
1B 5B [3F] <Pa> 3B <Ps> 24 79
```

where

? (3F hex) is present if and only if this is a private mode.

<Pa> is the mode number that was requested.

<Ps> is the current setting of the mode:

1 set
2 reset
3 permanently set
4 permanently reset

This control sequence can return information on only one mode at a time.
Request User–Preferred Supplemental Set (RQUPSS)  

CSI & u  
9B 26 75  
1B 5B 26 75  

Returns data on which set has been assigned as the user–preferred supplemental character set, in the following form:  

DCS <Ps> ! <Pss> ST  
90 <Ps> 21 <Pss> 9C  
1B 50 <Ps> 21 <Pss> 1B 5C  

where <Ps> and <Pss> have the following values:  

<table>
<thead>
<tr>
<th>&lt;Ps&gt;</th>
<th>&lt;Pss&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>%5</td>
</tr>
<tr>
<td>1</td>
<td>A</td>
</tr>
</tbody>
</table>

supplemental graphics set is DEC Multinational  
supplemental graphics set is ISO Latin–1 (8859/1.2)  

These parameters are the same as those used in the Assign User Preferred Supplemental Set (AUPSS) control sequence.

Read Cursor Contents  

all terminals  

CSI ? 17 h  
9B 3F 31 37 68  
1B 5B 3F 31 37 68  

The read cursor content control sequence is intended for diagnostic purposes only. It returns five bytes from the terminal in the following formats:

Byte 1 is in the form 0C00 00NN, where C is the characters per line (0 for 80, 1 for 132) and NN is the line mode (00 for normal, 01 for double width, 10 for double height top line, and 11 for double height bottom line).

Byte 2 is in the form 0000 CCCC, where CCCC are the upper four bits of the character underneath the cursor.

Byte 3 is in the form 0000 CCCC, where CCCC are the lower four bits of the character underneath the cursor.

Byte 4 is in the form 00P0 BURD, where P is the protection attribute of the character underneath the cursor (0 for unprotected, 1 for protected) and BURD are the character attributes (blink, underscore, reverse, and dim).

Byte 5 is in the form 0000 BBBB, where BBBB is the character set selection (0 or 1 for the CGEN, and 4 through 15 for the DLL).
The data returned by this control sequence is not intended for user-applications because the returned data may vary with future terminals.

Request Selection or Setting (RQSS)

Request Selection or Setting (RQSS) D413/D463

DCS $ q <Seqn> ST
90 34 71 <Seqn> 9C
1B 50 34 71 <Seqn> 1B 5C

where

<Seqn> is one of the following requests:

$ j (24 7D hex) cursor on/off status line, set by Select Active Display (SASD)
$ ~ (24 7E hex) status line type, set by Select Status Line Type (SSDT)
" q (22 71 hex) character protect on/off, set by Select Character Attributes (SCA)
" p (22 70 hex) operation mode, set by Set Conformance Level (SCL)
r (72 hex) windows, set by Set Top and Bottom Margins (STBM)
m (6D hex) character attributes, set by Select Graphic Rendition (SGR)

Returns the current status of several different terminal features with a string in the following format:

DCS <Ps> $ r <Resp> ST
90 <Ps> 24 72 <Resp> 9C
1B 50 <Ps> 24 72 <Resp> 1B 5C

where

<Ps> is 0 if the request was invalid, 1 if valid

<Resp> is in the form of the corresponding CSI control sequence

Some examples of these host sequences and the terminal’s response are shown below:

Host:  DCS $ q $ ) ST  get SASD
Terminal:  DCS 1 $ r 0 $ ) ST  in scrolling area

Host:  1B 50 24 71 24 7D 1B 5C  get SASD (7-bit hex)
Terminal:  1B 50 31 24 72 30 24 7D 1B 5C  in scrolling area (7-bit hex)

Host:  DCS $ q $ ~ ST  get SSDT
Terminal:  DCS 1 $ r 1 $ ~ ST  indicator status

Host:  1B 50 24 71 24 7E 1B 5C  get SSDT (7-bit hex)
Terminal:  1B 50 31 24 72 31 24 7E 1B 5C  indicator status (7-bit hex)
Host:  DCS $ q m ST
Terminal:  DCS 1 $ r 0 ; 1 m ST

get SGR
bold is on

Host:  1B 50 24 71 6D 1B 5C
Terminal:  1B 50 31 24 72 30 3B 31 6D 1B 5C

get SGR (7–bit hex)
bold is on (7–bit hex)

In general, the <Resp> portion of the return string may be prefaced by CSI and used to set the indicated mode.
Printing Control Sequences

Auto Print Mode

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
<th>all terminals</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI ? 5 i</td>
<td>turns Auto Print on</td>
<td></td>
</tr>
<tr>
<td>9B 3F 35 69</td>
<td>(8-bit hex)</td>
<td></td>
</tr>
<tr>
<td>1B 5B 3F 35 69</td>
<td>(7-bit hex)</td>
<td></td>
</tr>
<tr>
<td>CSI ? 4 i</td>
<td>turns Auto Print off</td>
<td></td>
</tr>
<tr>
<td>9B 3F 34 69</td>
<td>(8-bit hex)</td>
<td></td>
</tr>
<tr>
<td>1B 5B 3F 34 69</td>
<td>(7-bit hex)</td>
<td></td>
</tr>
</tbody>
</table>

Auto Print mode causes the current cursor line to be printed when the terminal receives a Line Feed (LF), Form Feed (FF), or Vertical Tab (VT), or when the line automatically wraps. All keyboard printing functions such as Print Screen are operational in this mode.

Auto Print mode may be toggled on or off manually from the keyboard by pressing Local Print. The control sequences, above, may be used by the host to access Auto Print Mode. This mode may also be selected from the Print Option Menu. For information on using the Print Option Menu, refer to the manual Installing and Operating D216E+, D217, D413, and D463 Display Terminals.

Print Screen

<table>
<thead>
<tr>
<th>Command</th>
<th>all terminals</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI i</td>
<td></td>
</tr>
<tr>
<td>9B 69</td>
<td>(8-bit hex)</td>
</tr>
<tr>
<td>1B 5B 69</td>
<td>(7-bit hex)</td>
</tr>
</tbody>
</table>

Prints a full screen of text. The host may also use the print screen function by sending the control sequence. This option may also be selected in the Print Option Menu. For information on using the Print Option Menu, refer to the manual Installing and Operating D216E+, D217, D413, and D463 Display Terminals.

Print Cursor Line

<table>
<thead>
<tr>
<th>Command</th>
<th>all terminals</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI ? 1 i</td>
<td></td>
</tr>
<tr>
<td>9B 3F 31 69</td>
<td>(8-bit hex)</td>
</tr>
<tr>
<td>1B 5B 3F 31 69</td>
<td>(7-bit hex)</td>
</tr>
</tbody>
</table>

Prints the display line containing the cursor.
Print Controller Mode

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI 5 i</td>
<td>turns Print Controller on</td>
</tr>
<tr>
<td>9B 35 69</td>
<td>(8-bit hex)</td>
</tr>
<tr>
<td>1B 5B 35 69</td>
<td>(7-bit hex)</td>
</tr>
<tr>
<td>CSI 4 i</td>
<td>turns Print Controller off</td>
</tr>
<tr>
<td>9B 34 69</td>
<td>(8-bit hex)</td>
</tr>
<tr>
<td>1B 5B 34 69</td>
<td>(7-bit hex)</td>
</tr>
</tbody>
</table>

The Print Controller mode lets the host computer have direct control of the printer. Characters received from the host go directly to the printer with the exception of XON, XOFF, CSI 5 i, and CSI 4 i. These sequences are used as control codes for the Print Controller mode. Characters from the keyboard are still transmitted to the host in this mode. This option may also be selected in the Print Option Menu. For information on using the Print Option Menu, refer to the manual Installing and Operating D216E+, D217, D413, and D463 Display Terminals. The print controller mode can be entered from Auto Print mode, but does not restore Auto Print mode when turned off.

End of Section
VT52 Emulation Operations and Escape Sequences

This section provides a summary of the operations information specific to the VT52 emulation on the D217/D413/D463 terminals.

In particular, this section explains the subjects covered in the following list:

- Character Sets and Graphics
- Keyboard Generated Codes
- VT52 Escape Sequences

Information regarding functions and operations of the terminal that apply to all modes or emulations is covered in Chapter 1. Additional information on keyboard layouts and various VT52 emulator reference material is covered in related appendices, located at the rear of this manual.

Character Sets and Graphics

The VT52 emulation supports only the National Replacement Character (NRC) sets, which you select from the Emulation Configuration Menu. For information on using the Emulation Configuration Menu, refer to the manual Installing and Operating D216E+, D217, D413, and D463 Display Terminals. You can access the Special Graphics character set by pressing the ESC key and typing F (1B 46 hex). You exit the graphics mode by pressing the ESC key and typing G (1B 47 hex).
Keyboard Generated Codes

The keyboard codes generated by the VT52 emulation are shown in Table 3-16, Table 3-17, and Table 3-18. The tables cross reference the VT52 keyboard with the 101–key keyboard (similar to an IBM–PC AT keyboard) and the 107–key Data General proprietary keyboard.

Table 3-16 Keyboard Generated Codes — Function Keys (VT52)

<table>
<thead>
<tr>
<th>107–key Keyboard</th>
<th>101–key Keyboard</th>
<th>VT52 Keyboard</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>F6</td>
<td>F6</td>
<td>Escape</td>
<td>1B hex</td>
</tr>
<tr>
<td>F7</td>
<td>F7</td>
<td>Backspace</td>
<td>08 hex</td>
</tr>
<tr>
<td>F8</td>
<td>F8</td>
<td>Line Feed</td>
<td>0A hex</td>
</tr>
<tr>
<td>Local Print</td>
<td>Print Screen</td>
<td>Print</td>
<td>Print–Menu</td>
</tr>
<tr>
<td>Scroll Rate</td>
<td>Scroll Lock</td>
<td>Menu</td>
<td>none</td>
</tr>
<tr>
<td>Hold</td>
<td>Pause</td>
<td>Hold</td>
<td>Hold Screen</td>
</tr>
<tr>
<td>C1</td>
<td>Alt–F9</td>
<td>PF1</td>
<td>ESC P (1B 50 hex)</td>
</tr>
<tr>
<td>C2</td>
<td>Alt–F10</td>
<td>PF2</td>
<td>ESC Q (1B 51 hex)</td>
</tr>
<tr>
<td>C3</td>
<td>Alt–F11</td>
<td>PF3</td>
<td>ESC R (1B 52 hex)</td>
</tr>
<tr>
<td>C4</td>
<td>Alt–F12</td>
<td>PF4</td>
<td>ESC S (1B 53 hex)</td>
</tr>
</tbody>
</table>

Table 3-17 Keyboard Generated Codes — Cursor Keys (VT52)

<table>
<thead>
<tr>
<th>107–key Keyboard</th>
<th>101–key Keyboard</th>
<th>VT320/100 Keyboard</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uarrow</td>
<td>Uarrow</td>
<td>Uarrow</td>
<td>ESC A (1B 41 hex)</td>
</tr>
<tr>
<td>Rightarrow</td>
<td>Rightarrow</td>
<td>Rightarrow</td>
<td>ESC B (1B 42 hex)</td>
</tr>
<tr>
<td>Leftarrow</td>
<td>Leftarrow</td>
<td>Leftarrow</td>
<td>ESC C (1B 43 hex)</td>
</tr>
<tr>
<td>Downarrow</td>
<td>Downarrow</td>
<td>Downarrow</td>
<td>ESC D (1B 44 hex)</td>
</tr>
<tr>
<td>Home</td>
<td>n/a</td>
<td>n/a</td>
<td>ESC H (1B 48 hex)</td>
</tr>
</tbody>
</table>
Table 3-18 Keyboard Generated Codes — Numeric Keypad (VT52)

<table>
<thead>
<tr>
<th>107-key Keyboard</th>
<th>101-key Keyboard</th>
<th>VT52 Keyboard with Num Lock On</th>
<th>VT52 Keyboard with Num Lock Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>n/a</td>
<td>Num Lock On</td>
<td>On</td>
<td>Off</td>
</tr>
<tr>
<td>n/a</td>
<td>/</td>
<td>/</td>
<td>none</td>
</tr>
<tr>
<td>n/a</td>
<td>*</td>
<td>*</td>
<td>none</td>
</tr>
<tr>
<td>– (minus)</td>
<td>–</td>
<td>– (minus)</td>
<td>ESC ? m (1B 3F 6D hex)</td>
</tr>
<tr>
<td>, (comma)</td>
<td>+</td>
<td>(comma)</td>
<td>ESC ? l (1B 3F 6C hex)</td>
</tr>
<tr>
<td>. (period)</td>
<td>/Delete</td>
<td>. (period)</td>
<td>ESC ? n (1B 3F 6E hex)</td>
</tr>
<tr>
<td>0</td>
<td>0/Insert</td>
<td>0</td>
<td>ESC ? p (1B 3F 70 hex)</td>
</tr>
<tr>
<td>1</td>
<td>1/End</td>
<td>1</td>
<td>ESC ? q (1B 3F 71 hex)</td>
</tr>
<tr>
<td>2</td>
<td>2/Downarrow</td>
<td>2</td>
<td>ESC ? r (1B 3F 72 hex)</td>
</tr>
<tr>
<td>3</td>
<td>3/Pg Dn</td>
<td>3</td>
<td>ESC ? s (1B 3F 73 hex)</td>
</tr>
<tr>
<td>4</td>
<td>4/Leftarrow</td>
<td>4</td>
<td>ESC ? t (1B 3F 74 hex)</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>5</td>
<td>ESC ? u (1B 3F 75 hex)</td>
</tr>
<tr>
<td>6</td>
<td>6/Rightarrow</td>
<td>6</td>
<td>ESC ? v (1B 3F 76 hex)</td>
</tr>
<tr>
<td>7</td>
<td>7/Home</td>
<td>7</td>
<td>ESC ? w (1B 3F 77 hex)</td>
</tr>
<tr>
<td>8</td>
<td>8/Uparrow</td>
<td>8</td>
<td>ESC ? x (1B 3F 78 hex)</td>
</tr>
<tr>
<td>9</td>
<td>9/Pg Up</td>
<td>9</td>
<td>ESC ? y (1B 3F 79 hex)</td>
</tr>
<tr>
<td>Enter</td>
<td>Enter</td>
<td>CR (0D hex)</td>
<td>ESC ? M (1B 3F 4D hex)</td>
</tr>
</tbody>
</table>

1 107-key keyboards numeric keypads have no Num Lock On/Off mode.
VT52 Escape Sequences

The escape sequences for the VT52 emulation, and their functions, are shown in Table 3-19.

Table 3-19 VT52 Escape Sequences

<table>
<thead>
<tr>
<th>Sequence</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESC = (1B 3D hex)</td>
<td>Enter alternate keypad mode</td>
</tr>
<tr>
<td>ESC &gt; (1B 3E hex)</td>
<td>Exit alternate keypad mode</td>
</tr>
<tr>
<td>ESC &lt; (1B 3C hex)</td>
<td>Enter ANSI mode (VT100 mode)</td>
</tr>
<tr>
<td>ESC A (1B 41 hex)</td>
<td>Cursor up</td>
</tr>
<tr>
<td>ESC B (1B 42 hex)</td>
<td>Cursor down</td>
</tr>
<tr>
<td>ESC C (1B 43 hex)</td>
<td>Cursor right</td>
</tr>
<tr>
<td>ESC D (1B 44 hex)</td>
<td>Cursor left</td>
</tr>
<tr>
<td>ESC F (1B 46 hex)</td>
<td>Enter graphics mode</td>
</tr>
<tr>
<td>ESC G (1B 47 hex)</td>
<td>Exit graphics mode</td>
</tr>
<tr>
<td>ESC H (1B 48 hex)</td>
<td>Move cursor to home</td>
</tr>
<tr>
<td>ESC I (1B 49 hex)</td>
<td>Reverse line feed</td>
</tr>
<tr>
<td>ESC J (1B 4A hex)</td>
<td>Erase to end of screen</td>
</tr>
<tr>
<td>ESC K (1B 4B hex)</td>
<td>Erase to end of line</td>
</tr>
<tr>
<td>ESC P (1B 50 hex)</td>
<td>Read cursor contents</td>
</tr>
<tr>
<td>ESC V (1B 56 hex)</td>
<td>Print cursor line</td>
</tr>
<tr>
<td>ESC W (1B 57 hex)</td>
<td>Enter printer controller mode</td>
</tr>
<tr>
<td>ESC X (1B 58 hex)</td>
<td>Exit printer controller mode</td>
</tr>
<tr>
<td>ESC Y &lt;line&gt;&lt;col&gt; 1</td>
<td>Position cursor1</td>
</tr>
<tr>
<td>(1B 59 hex)</td>
<td></td>
</tr>
<tr>
<td>ESC Z (1B 5A hex)</td>
<td>Identify</td>
</tr>
<tr>
<td>ESC ^ (1B 5E hex)</td>
<td>Enter auto print mode</td>
</tr>
<tr>
<td>ESC _ (1B 5F hex)</td>
<td>Exit auto print mode</td>
</tr>
<tr>
<td>ESC ] (1B 5D hex)</td>
<td>Print screen</td>
</tr>
</tbody>
</table>

1 <line> and <col> are encoded by taking the desired row (0 to 23 decimal) and column (0 to 79 decimal) and adding a 20 hex offset. Thus, the valid ranges (in ASCII form) for row and column are from <space> to "7", and from <space> to "a" respectively. In hex, row ranges from 20 to 37; column ranges from 20 to 4F.

End of Section

End of Chapter
Chapter 4
Tektronix 4010 Emulation

This chapter provides the information necessary to program host resident software that will be accessed through the Tektronix 4010 emulation running on the D463 Data General terminal. This chapter has the major sections listed below:

- Emulation Features
- Overview of Operational Modes
- Alphanumeric Mode
- Graphic Plot Mode
- Graphics Input Mode
- Hard Copy Command
- Hot-Key Switch
- User Selectable Options
- Control Codes

Information regarding functions and operations of the terminal that apply to all modes or emulations is covered in Chapter 1. Additional information on keyboard layouts and reference material, which may apply to the Tektronix 4010 emulation, is covered in appendices, located at the rear of this manual.
Emulation Features

The Tektronix 4010 emulation provides maximum compatibility with Tektronix 4010 operational modes and implements 4010 vector graphics with a raster display. Some of the main programming features of the Tektronix 4010 emulation are listed below:

- 36 lines of 101 displayed characters in an 8 x 8 dot matrix
- 1024 x 780 graphic display window mapped into a hardware resolution of 810 x 288
- Graphic hard copy ability on both Data General printers and IBM Pro-Printers

The Tektronix 4010 emulation allows complete control of the terminal from both local and host sources in all Tektronix operational modes. Use of these features is explained fully in the following sections.

Overview of Operational Modes

The operational modes of the Tektronix 4010 emulation can be selected either by a control sequence generated from the host computer or by the keyboard. Data entry can be confined to the keyboard through the use of the Cmd–On Line key sequence. The operational modes are listed below:

- Alphanumeric Mode
- Graphic Plot Mode
- Graphic Input Mode
Alphanumeric Mode

While in the Alphanumeric Mode, the Tektronix 4010 emulation displays any of the 95 printable keyboard characters. In the original Tektronix 4010 terminal, lower-case letters were not displayed and could not be entered from the keyboard; if attempted, the terminal would display these characters in upper case. However, our emulation allows lower case letters to be generated from the keyboard and to be displayed as text. This makes it possible to test all graphics coordinates from the keyboard. A block cursor is displayed to indicate the position of the next displayed character. Our implementation of the Tektronix 4010 emulation has a screen size of 36 lines with a maximum of 101 characters per line. The cursor automatically wraps to the next line when it passes the right-hand screen margin. When the Tektronix 4010 emulation is selected, the terminal is reset to the Alphanumeric mode, and the cursor appears in the upper-left (Home) position.

Margins

The Tektronix 4010 emulation has two left margins on the alphanumeric screen. The first, called Margin 0, is the extreme left of the screen (at the first character location, i.e. column 1). The second is Margin 1. It is located at the 51st character position (i.e. column 51). When the cursor moves past the 36th line, Margin 1 is automatically set as the new left margin and the cursor returns to the first line. Margin 1 remains set until the cursor moves past the 36th line again. Similarly, cursor up movement wraps when it passes the 1st line and causes a margin switch, and clearing the screen resets to Margin 0. The advantage of using Margin 1 is that the display has two columns of output. The major disadvantage is that if there are any first-column lines that extend past the 51st column (the center of the screen), they will be overstruck by text in the second column and may become illegible.

View and Hold Submodes

The Alphanumeric screen is displayed at normal intensity. If no data is received from the host or the keyboard for 15 minutes, the screen blanks to prolong the life of the CRT and to prevent raster burn in. This dimming is referred to as the Hold submode, while normal Alphanumeric operation is referred to as View mode. Once in Hold submode, the screen stays blank until data is received from either the host or the keyboard.
Graphic Plot Mode

In Graphic Plot Mode, the Tektronix 4010 emulation addresses a screen of 1024 (x-axis) x 780 (y-axis) points, with the origin (0,0) in the lower left of the screen. These points are addressed by a series of variable-length codes (1 to 4 bytes long) that are generated by the host or the keyboard. Plot information is usually generated from the host source, but can be entered from the keyboard. Figure 4-1 shows the coordinate system used in the Tektronix 4010 emulation.

![Figure 4-1 The Coordinate System of the Tektronix 4010 Emulation](image)

Using Graphic Plot Mode

To enter Graphics Plot Mode an ASCII <GS> ("Ctrl-]" ASCII, 1D hex) must be sent from either the host or the keyboard. Once the terminal is in the Graphic Plot Mode, a series of coordinate locations are sent to draw the desired lines. Upon entering the Graphics Plot mode, the last entered graphics coordinate is automatically specified as the first point in the first vector. This last coordinate is initialized to (0,0) on power-up or reset. The first vector after a <GS> is always drawn as a dark (invisible) vector. Vectors are drawn from the previously addressed coordinate to the current specified point. Dark vectors can be specified at any time by placing a <GS> before the coordinate address of the terminating point of the specified vector. Plot information is sent in 1 to 4 byte sequences containing the high- and low-order bytes for the x-coordinate and the high- and low-order bytes for the y-coordinates. The next section describes how this information is encoded.

NOTE: In the original Tektronix 4010 terminal, lower-case characters could not be generated, hence a large portion of the coordinates could not be manually entered from the keyboard. The Tektronix 4010 emulation allows these characters to be entered manually from the keyboard.
Coordinate Conversion

Follow the steps in this section to convert (x,y) coordinates to the variable-length code format necessary for the Tektronix 4010 emulation. Remember that if no points have yet been plotted, the "previous" (x,y) referred to is (0,0).

1. **Determine an (x,y) coordinate.** Begin with an (x,y) pair with each ordinate in the range of [0,1023]. The displayable range of the y-ordinate is only [0,779]. If a y-ordinate in the range of [780,1023] is selected, the generated line will be clipped where it crosses the upper edge of the screen.

2. **Convert the (x,y) coordinate.** Convert the (x,y) coordinate to a pair of binary strings, each 10 bits long. Each 10-bit binary string has five Most Significant Bits (MSBs or "high-order bits") and five Least Significant Bits (LSBs or "low-order bits").

3. **Set the y high-order bits.** Compare the high-order bits of the current y and the previous y. If they are unequal (changed), add an offset of 20 hex (32 decimal, 40 octal) to the value of this five-bit string to yield a value between 20 hex and 3F hex, and transmit this character to the terminal.

4. **Set the y low-order bits.** Compare the low-order bits of the current y and the previous y and compare the high-order bits of the current x and the previous x. If the current low-order y does not equal the previous low-order y (changed) or if the current high-order x does not equal the previous high-order x (changed), then add an offset of 60 hex (96 decimal, 140 octal) to the value of the y low-order bits to yield a value between 60 hex and 7F hex, and transmit this character to the terminal.

5. **Set the x high-order bits.** Compare the high-order bits of the current x and the previous x. If they are unequal (changed), add an offset of 20 hex (32 decimal, 40 octal) to the value of this 5-bit binary string to yield a value between 20 hex and 3F hex, and transmit this character to the terminal.

6. **Set the x low-order bits.** Add an offset of 40 hex (64 decimal, 100 octal) to the value of the low-order bits of the current x to yield a value between 40 hex and 5F hex, and transmit this character to the terminal. This code signals the terminal to draw the line, thus you must always transmit this character.

Refer to Appendix C for an example of the code that performs this algorithm.
Example of Conversion Process

Let's draw a box around the perimeter of the screen.

From Step 1 — The vertices of this box are (0,0), (0,779), (1023,779), and (1023,0). Put the terminal into Graphic Plot Mode by sending it a GS character (1D hex, 35 octal). Because of the GS character, we are drawing an initial dark (or invisible) vector. This vector should go to (0,0). From Step 2 — Convert (0,0) to a pair of binary strings, each 10-bits long. The result is (0000000000,0000000000).

From Step 3 — We want to begin drawing the box at (0,0), so assume that none of the binary strings match the previous strings. Because the strings do not match and the value of the string we just created is 0 hex, the 20 hex offset means we must transmit a <space> character (20 hex). From Step 4 — Because the strings do not match and the value of the string we just created is 0 hex, the 60 hex offset means we must transmit a “,” character (60 hex). From Step 5 — Because the strings do not match and the value of the string we just created is 0 hex, the 20 hex offset means we must transmit a <space> character (20 hex). From Step 6 — Because the strings do not match and the value of the string we just created is 0 hex, the 40 hex offset means we must transmit an “@” character (40 hex).

Thus the first four characters (the first vector) transmitted are: <space> ‘ <space> @ (20 60 20 40 hex).

Now we will draw from (0,0) to (0,779). The binary representation of (0,779) is (0000000000,1100001011). From Step 3, because the high-order bits of the current y (1100) do not equal the high-order bits of the previous y (0000), add 20 hex to 11000 binary to get 38 hex, the ASCII numeral “8”. From Step 4, because the low-order bits of the current y (01011) do not equal the low-order bits of the previous y (0000), add 60 hex to 01011 to get 6B hex, or ASCII “k”. From Step 5, because the x-ordinate does not change (the high-order bits of the current x equals those of the previous x), we do not transmit this character. From Step 6, add 40 hex to the low-order bits of the current x (0000) to get 40 hex, or the ASCII “@”. Thus the second vector (of only three characters) is: 8k@ (38 6B 40 hex).

Now we will draw the line across the top of the screen to (1023,779). From Step 2, in binary this coordinate is (1111111111,1100001011). From Step 3, because the upper-order y does not change, we do not transmit this character. From Step 4, even though the lower-order y did not change, the upper-order x did change, so we must transmit a character, which is the value of the lower-order y plus 60 hex, or an ASCII “k”. From Step 5, because the high-order x changed, we must transmit a character, which is the value of the upper-order x (11111 binary) plus 40 hex, which yields the ASCII “?”.

From Step 6, the character transmitted is 5F hex or an ASCII “_”. Thus the third vector is: k?_ (6B 3F 5F hex).

Now we draw the line down the the right side of the screen. The coordinate is (1023,0) or (1111111111,1100000000) in binary. Both high-order and low-order y have changed, so we must send them. X has not changed, but low-order x must be sent anyway to tell the terminal that we are done with this vector. Thus the final vector is: <space>_ (20 60 5F hex).

The last vector returns us to (0,0). Its form is: <space>@ (60 20 40 hex). The final action will be to return to Alphanumeric Mode by sending an ASCII US character (1F hex).
Graphics Input Mode

The Graphics Input Mode is initiated by the host and terminated by the user. The host program has
the ability to turn on the graphics cursor in the Tektronix 4010 emulation. Once on, the operator can
move the cursor to any point and transmit the coordinates of the point to the host program by
pressing any alphanumeric key.

There are three protocols used to receive cursor information back from the 4010 emulation. The first
transmits alphanumeric-cursor information and a status byte to the host. The second and third
transmit graphics cursor information. This lets user programs interactively manipulate both the
alphanumeric and graphics displays on the screen, while constantly updating cursor information.

Alphanumeric Cursor

To receive information on the current coordinates of the alphanumeric cursor on the screen, the host
program sends an ESC ENQ (1B 05 hex) sequence to the terminal. In turn, the emulation transmits
an 8-bit status byte, the coordinates of the alphanumeric cursor, and the data terminator (if any is
selected). The format of the status byte is shown in Table 4-1.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Default</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>none</td>
<td>0 (Off)</td>
<td>Bits 765 must be 001 respectively to keep the status byte in the range of 20 hex to 3F hex.</td>
</tr>
<tr>
<td>6</td>
<td>none</td>
<td>0 (Off)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>none</td>
<td>1 (On)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>HCU</td>
<td>0 (Off)</td>
<td>Indicates whether hard copy unit (printer) in use. (0 printer not available/1 printer is available)</td>
</tr>
<tr>
<td>3</td>
<td>none</td>
<td>0 (Off)</td>
<td>n/a</td>
</tr>
<tr>
<td>2</td>
<td>GRAPH</td>
<td>0 (Off)</td>
<td>Indicates what mode emulation is in. (0 for graphic/1 for alphanumeric)</td>
</tr>
<tr>
<td>1</td>
<td>MARGIN</td>
<td>0 (Off)</td>
<td>Indicates what margin in effect. (0 for margin 0/1 for margin 1)</td>
</tr>
<tr>
<td>0</td>
<td>none</td>
<td>0 (Off)</td>
<td>n/a</td>
</tr>
</tbody>
</table>

After the status byte is transmitted, the coordinates of the alphanumeric cursor are transmitted to
the host. These bytes may or may not be followed by terminators, depending upon whether some
form of terminator was selected from the Configuration Menu. The format of the cursor coordinates
is a 10-bit binary value for the x-coordinate and a 10-bit binary value for the y-ordinate. Each of
these 10-bit values is formed from two characters (one for the high-order bits and one for the
low-order bits), with each 5-bit value in the range from 20 hex to 3F hex. The alpha cursor is placed with its lower left-hand corner at the end of the last graphic vector drawn. This position may be anywhere on the screen, but is aligned with the 36x101 grid by the next cursor up or down movement. To position the cursor without drawing, send: <GS> (1D hex) <coordinates> <US> (1F hex).

The alpha cursor may or may not be aligned with the bottom left corner of a character cell. The emulation normally multiplies the current cursor location (row and column) by the size of the character cell (8x8). Multiplying each row and column by eight (the row and column dimensions of a character cell) positions the cursor at the bottom left of the character cell. However, the actual numeric value of this multiplication may be offset, because the cursor may be placed anywhere within the 64 points that define the character cell.

Graphics Cursor

There are two different methods for obtaining graphics cursor information. In the first procedure, the host sends an “<ESC> <SUB>” (1B 1A hex) sequence, waits 20 milliseconds, and then sends an “<ESC> <ENQ>” (1B 05 hex). The 20 millisecond delay is only for compatibility with the original Tektronix 4010, and is not necessary for operation of the Tektronix 4010 emulation. The emulation responds to this sequence by sending the cross-hair coordinates followed by terminators, if any were chosen. These sequences are in the format of <x><y><terminator>. Each <x> and <y> is composed of two characters from 20 hex to 3F hex, each of which represents the 5 high-order bits and 5 low-order bits of each ordinate location. The <terminator> sent depends upon the setting for this option in the Configuration Menu.

In the second procedure, the host computer enables the cross-hair cursor by sending an “<ESC> <SUB>” (1B 1A hex) to the terminal. The operator can then move the cross-hair cursor to a desired point by using the arrow keys or mouse, and strike a keyboard character. The emulation responds by transmitting the keyboard character that was struck, followed by the coordinate information, and any terminators that were selected. The format of the coordinate information and the terminator is identical to those in the paragraph above.

Hard Copy Command

The Tektronix 4010 emulation can produce a screen dump of the current screen to a printer attached to the printer port of the terminal. Pressing the Print key or entering the “ESC <ETB>” (1B 17 hex) control sequence dumps the contents of the screen to the terminal’s serial printer port.
Hot-Key Switch

This command toggles from the active emulation to the currently inactive emulation making it active. This command is only valid during a dual-host session.

\[ \langle 033 \rangle \langle 076 \rangle \quad \text{(octal)} \]

\[ \text{1B} \quad \text{(hex)} \]

\[ \text{ESC} \rangle \quad \text{(ASCII/keyboard)} \]

This hot-key switch is used in a diagnostic routine to verify operation of the Dual Host mode.

User Selectable Options

Many of the configuration parameters on the original Tektronix 4010 were implemented through the use of jumpers inside the terminal. Our Tektronix 4010 emulation uses a software menu to configure the terminal. The menu options in the following sections are available to the terminal operator via the Configuration Menu.

Graphic Input Terminators

The data terminators in the Graphic Input Mode can be chosen, from the Configuration Menu, to be either: \(<\text{CR}>\) only (default); \(<\text{CR}>\) followed by \(<\text{EOT}>\); or no \(<\text{CR}>\) and no \(<\text{EOT}>\).

Line/Local Operation

Tektronix 4010 emulation line and local operation can be toggled by means of the Cmd–On Line key sequence or through the Configuration Menu. Line status is displayed by the On–Line status LED.

Data Communication Baud Rates

Various baud rates can be selected through the Configuration Menu: 150, 300, 600, 1200, 2400, 4800, 9600 and 19200. The terminal transmits only 7-bit codes to the host, but may be set to 8-bits per character for compatibility.
Control Codes

The single control codes used by the Tektronix 4010 emulation are shown in Table 4-2. Some of these single codes are also used in double control sequences (escape sequences), which are shown in Table 4-3.

Table 4-2 Single Control Codes

<table>
<thead>
<tr>
<th>ASCII</th>
<th>Decimal</th>
<th>Hex</th>
<th>Keyboard</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEL</td>
<td>7</td>
<td>07</td>
<td>Ctrl–G</td>
<td>Tone from Speaker</td>
</tr>
<tr>
<td>BS</td>
<td>8</td>
<td>08</td>
<td>Ctrl–H</td>
<td>Backspace</td>
</tr>
<tr>
<td>HT</td>
<td>9</td>
<td>09</td>
<td>Ctrl–I</td>
<td>Cursor Right</td>
</tr>
<tr>
<td>LF</td>
<td>10</td>
<td>0A</td>
<td>Ctrl–J</td>
<td>Line Feed (move down one line)</td>
</tr>
<tr>
<td>VT</td>
<td>11</td>
<td>0B</td>
<td>Ctrl–K</td>
<td>Move Up One Line</td>
</tr>
<tr>
<td>CR</td>
<td>13</td>
<td>0D</td>
<td>Ctrl–M</td>
<td>Carriage Return</td>
</tr>
<tr>
<td>ESC</td>
<td>27</td>
<td>1B</td>
<td>Ctrl–[ or ESC key</td>
<td>For ESC Sequences (see Table 4-3)</td>
</tr>
<tr>
<td>GS</td>
<td>29</td>
<td>1D</td>
<td>Ctrl–]</td>
<td>Enter Graphic Plot Mode</td>
</tr>
<tr>
<td>US</td>
<td>31</td>
<td>1F</td>
<td>Ctrl—_</td>
<td>Enter Alphanumeric Mode</td>
</tr>
</tbody>
</table>

Table 4-3 Double Control Codes (Escape Sequences)
<table>
<thead>
<tr>
<th>Sequence</th>
<th>Decimal</th>
<th>Hex</th>
<th>Keyboard</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESC ENQ</td>
<td>27 5</td>
<td>1B05</td>
<td>ESC Ctrl–E</td>
<td>Terminal Returns Status Byte and Alphanumeric Cursor Coordinates.</td>
</tr>
<tr>
<td>ESC SUB</td>
<td>27 26</td>
<td>1B1A</td>
<td>ESC Ctrl–Z</td>
<td>Starts Cross–Hair Cursor a. Followed by 20 ms delay then ESC ENQ, terminal returns position of the cross–hair cursor. b. Followed by movement of cursor and striking of any key on keyboard, terminal returns the character struck, then the cross–hair position.</td>
</tr>
<tr>
<td>ESC ETB</td>
<td>27 23</td>
<td>1B17</td>
<td>ESC Ctrl–W</td>
<td>Send Screen Dump to Printer</td>
</tr>
<tr>
<td>ESC FF</td>
<td>27 12</td>
<td>1B0C</td>
<td>ESC Ctrl–L</td>
<td>Erase Screen, Return to Alphanumeric Mode, and Home Cursor.</td>
</tr>
</tbody>
</table>

End of Chapter
Chapter 5
PCTERM Operations

This chapter provides programming information for the PCTERM operating mode of the VT320/100 emulation running on the D217/D413/D463 line of Data General terminals. This chapter has the major sections listed below:

- Introduction
- Inbound (Terminal to Host) Codes
- Outbound (Host to Terminal) Codes
- VP/ix getty Setup
- Sample terminfo File
- Sample VP/ix term File

Information regarding functions and operations of the terminal that apply to all modes or emulations is covered in Chapter 1. Additional information on keyboard layouts and reference material, which may apply to the PCTERM operating mode is covered in appendices, located at the rear of this manual.

Introduction

PCTERM lets terminals emulate an IBM PC environment that can be connected to different types of systems. For example, PCTERM can be used with a VP/ix system running under INTERACTIVE UNIX.

PCTERM is accessed through either the VT320 or VT100 emulation. For more details on PCTERM as a VT320/100 operating mode, refer to the “PCTERM Mode” section in Chapter 3.
Inbound (Terminal to Host) Codes

Two sets of inbound codes were altered for the operation of PCTERM: flow control codes and keyboard generated codes.

Flow Control

Under normal operations, the flow control codes XOFF and XON are generated by Ctrl–S and Ctrl–Q (13 hex and 11 hex). However, in PCTERM, XOFF and XON are generated by the ASCII characters “g” (hex 67) and “e” (hex 65). Regardless of this change, flow control operations within PCTERM are identical to those of other terminal modes and emulations. For more information on terminal flow-control operations, see the “Flow Control” section in Chapter 1.

Keyboard Generated Codes

All terminals support two keyboards: a 101-key keyboard, similar to that of the IBM PC AT–style, and a 107-key Data General proprietary keyboard. With the exception of two keys, the Data General proprietary keyboard is fully mapped as an enhanced XT–style keyboard. The rightmost Alt key and the rightmost Ctrl key were omitted from the Data General proprietary keyboard.

Since a terminal operating in the PCTERM mode must send codes for almost every key, there are a limited number of local–functions available on the terminal while in this mode. However, the local functions Cursor Type, Cmd–Alpha Lock (hot–key switch between emulations), and Cmd–N/C (Configuration Menu) are supported and do not send codes to the host.

When using PCTERM, you will find it handy to refer to the red legends on the front of certain keycaps on the Data General proprietary keyboard; these legends are correct with the exception of the “+” sign in the numeric keypad. Even though they have no red legend, keys F14 and F15 substitute as numeric keypad keys “/” and “*” respectively.

In PCTERM mode, the state of Caps Lock, Scroll Lock, and Num Lock are correctly displayed on the appropriately titled LEDs. Table 5-1 through Table 5-5 show the keyboard codes generated.
### Table 5-1 Keyboard Generated Codes — Function Keys (PCTERM)

<table>
<thead>
<tr>
<th>107-key Keyboard</th>
<th>101-key Keyboard</th>
<th>Scan Code (in hex)</th>
<th>Key Down</th>
<th>Key Up</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>F1</td>
<td>3B</td>
<td>BB</td>
<td></td>
</tr>
<tr>
<td>F2</td>
<td>F2</td>
<td>3C</td>
<td>BC</td>
<td></td>
</tr>
<tr>
<td>F3</td>
<td>F3</td>
<td>3D</td>
<td>BD</td>
<td></td>
</tr>
<tr>
<td>F4</td>
<td>F4</td>
<td>3E</td>
<td>BE</td>
<td></td>
</tr>
<tr>
<td>F5</td>
<td>F5</td>
<td>3F</td>
<td>BF</td>
<td></td>
</tr>
<tr>
<td>F6</td>
<td>F6</td>
<td>40</td>
<td>C0</td>
<td></td>
</tr>
<tr>
<td>F7</td>
<td>F7</td>
<td>41</td>
<td>C1</td>
<td></td>
</tr>
<tr>
<td>F8</td>
<td>F8</td>
<td>42</td>
<td>C2</td>
<td></td>
</tr>
<tr>
<td>F9</td>
<td>F9</td>
<td>43</td>
<td>C3</td>
<td></td>
</tr>
<tr>
<td>F10</td>
<td>F10</td>
<td>44</td>
<td>C4</td>
<td></td>
</tr>
<tr>
<td>F11</td>
<td>F11</td>
<td>57</td>
<td>D7</td>
<td></td>
</tr>
<tr>
<td>F12</td>
<td>F12</td>
<td>58</td>
<td>D8</td>
<td></td>
</tr>
<tr>
<td>F13</td>
<td>n/a</td>
<td>none</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>F14</td>
<td>/ (num kypd)</td>
<td>E0 35</td>
<td>E0 B5</td>
<td></td>
</tr>
<tr>
<td>F15</td>
<td>* (num kypd)</td>
<td>37</td>
<td>B7</td>
<td></td>
</tr>
<tr>
<td>Cursor Type (F16)</td>
<td>N/A</td>
<td>none</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>N/C (F17)</td>
<td>N/A</td>
<td>none</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>Local Print (F18)</td>
<td>Scroll Lock</td>
<td>46</td>
<td>C6</td>
<td></td>
</tr>
<tr>
<td>Scroll Rate (F19)</td>
<td>Num Lock</td>
<td>45</td>
<td>C5</td>
<td></td>
</tr>
<tr>
<td>Hold (F20)</td>
<td>Pause</td>
<td>E1 1D 45</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>N/A</td>
<td>Ctrl–Pause (Break)</td>
<td>E0 46</td>
<td>E0 C6</td>
<td></td>
</tr>
</tbody>
</table>

### Table 5-2 Keyboard Generated Codes — Numeric Keypad (PCTERM)

<table>
<thead>
<tr>
<th>107-key Keyboard</th>
<th>101-key Keyboard</th>
<th>Scan Code (in hex)</th>
<th>Key Down</th>
<th>Key Up</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>7</td>
<td>47</td>
<td>C7</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>48</td>
<td>C8</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>9</td>
<td>49</td>
<td>C9</td>
<td></td>
</tr>
<tr>
<td>–</td>
<td>–</td>
<td>4A</td>
<td>CA</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>4B</td>
<td>CB</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>4C</td>
<td>CC</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>4D</td>
<td>CD</td>
<td></td>
</tr>
<tr>
<td>.</td>
<td>+</td>
<td>4E</td>
<td>CE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>4F</td>
<td>CF</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>50</td>
<td>D0</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>51</td>
<td>D1</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>52</td>
<td>D2</td>
<td></td>
</tr>
<tr>
<td>.</td>
<td>.</td>
<td>53</td>
<td>D3</td>
<td></td>
</tr>
<tr>
<td>New Line</td>
<td>Enter</td>
<td>E0 1C</td>
<td>E0 9C</td>
<td></td>
</tr>
</tbody>
</table>
Table 5-3 Keyboard Generated Codes — Editing Keypad with Num Lock Off (PCTERM)

<table>
<thead>
<tr>
<th>107-key Keyboard</th>
<th>101-key Keyboard</th>
<th>Scan Code (in hex)</th>
<th>Key Down</th>
<th>Key Up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erase Page</td>
<td>Insert</td>
<td>E0 52</td>
<td>E0 D2</td>
<td></td>
</tr>
<tr>
<td>Print</td>
<td>Print Screen</td>
<td>E0 2A E0 37</td>
<td>E0 B7 E0 AA</td>
<td></td>
</tr>
<tr>
<td>Alt—Print</td>
<td>Alt—Print Screen (Sysreq)</td>
<td>54</td>
<td>D4</td>
<td></td>
</tr>
<tr>
<td>Erase EOL</td>
<td>Delete</td>
<td>E0 53</td>
<td>E0 D3</td>
<td></td>
</tr>
<tr>
<td>C1</td>
<td>Home</td>
<td>E0 47</td>
<td>E0 C7</td>
<td></td>
</tr>
<tr>
<td>(uparrow)</td>
<td>(uparrow)</td>
<td>E0 48</td>
<td>E0 C8</td>
<td></td>
</tr>
<tr>
<td>C2</td>
<td>Page Up</td>
<td>E0 49</td>
<td>E0 C9</td>
<td></td>
</tr>
<tr>
<td>(leftarrow)</td>
<td>(leftarrow)</td>
<td>E0 4B</td>
<td>E0 CB</td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td>n/a</td>
<td>none</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>(rightarrow)</td>
<td>(rightarrow)</td>
<td>E0 4D</td>
<td>E0 CD</td>
<td></td>
</tr>
<tr>
<td>C3</td>
<td>End</td>
<td>E0 4F</td>
<td>E0 CF</td>
<td></td>
</tr>
<tr>
<td>(downarrow)</td>
<td>(downarrow)</td>
<td>E0 50</td>
<td>E0 D0</td>
<td></td>
</tr>
<tr>
<td>C4</td>
<td>Page Down</td>
<td>E0 51</td>
<td>E0 D1</td>
<td></td>
</tr>
</tbody>
</table>

Table 5-4 Keyboard Generated Codes — Editing Keypad with Num Lock On (PCTERM)

<table>
<thead>
<tr>
<th>107-key Keyboard</th>
<th>101-key Keyboard</th>
<th>Scan Code (in hex)</th>
<th>Key Down</th>
<th>Key Up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erase Page</td>
<td>Insert</td>
<td>E0 2A E0 52</td>
<td>E0 D2 E0 AA</td>
<td></td>
</tr>
<tr>
<td>Print</td>
<td>Print Screen</td>
<td>E0 2A E0 37</td>
<td>E0 B7 E0 AA</td>
<td></td>
</tr>
<tr>
<td>Alt—Print</td>
<td>Alt—Print Screen (Sysreq)</td>
<td>54</td>
<td>D4</td>
<td></td>
</tr>
<tr>
<td>Erase EOL</td>
<td>Delete</td>
<td>E0 2A E0 53</td>
<td>E0 D3 E0 AA</td>
<td></td>
</tr>
<tr>
<td>C1</td>
<td>Home</td>
<td>E0 2A E0 47</td>
<td>E0 C7 E0 AA</td>
<td></td>
</tr>
<tr>
<td>(uparrow)</td>
<td>(uparrow)</td>
<td>E0 2A E0 48</td>
<td>E0 C8 E0 AA</td>
<td></td>
</tr>
<tr>
<td>C2</td>
<td>Page Up</td>
<td>E0 2A E0 49</td>
<td>E0 C9 E0 AA</td>
<td></td>
</tr>
<tr>
<td>(leftarrow)</td>
<td>(leftarrow)</td>
<td>E0 2A E0 4B</td>
<td>E0 CB E0 AA</td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td>n/a</td>
<td>none</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>(rightarrow)</td>
<td>(rightarrow)</td>
<td>E0 2A E0 4D</td>
<td>E0 CD E0 AA</td>
<td></td>
</tr>
<tr>
<td>C3</td>
<td>End</td>
<td>E0 2A E0 4F</td>
<td>E0 CF E0 AA</td>
<td></td>
</tr>
<tr>
<td>(downarrow)</td>
<td>(downarrow)</td>
<td>E0 2A E0 50</td>
<td>E0 D0 E0 AA</td>
<td></td>
</tr>
<tr>
<td>C4</td>
<td>Page Down</td>
<td>E0 2A E0 51</td>
<td>E0 D1 E0 AA</td>
<td></td>
</tr>
</tbody>
</table>
Table 5-5 Keyboard Generated Codes — Main Keypad (PCTERM)

<table>
<thead>
<tr>
<th>107-key Keyboard</th>
<th>101-key Keyboard</th>
<th>Scan Code (in hex)</th>
<th>Key Down</th>
<th>Key Up</th>
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<tbody>
<tr>
<td>ESC</td>
<td>ESC</td>
<td>01</td>
<td>81</td>
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<tr>
<td>1!</td>
<td>1!</td>
<td>02</td>
<td>82</td>
<td></td>
</tr>
<tr>
<td>2@</td>
<td>2@</td>
<td>03</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>3#</td>
<td>3#</td>
<td>04</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>4$</td>
<td>4§</td>
<td>05</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>5%</td>
<td>5%</td>
<td>06</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>6^</td>
<td>6^</td>
<td>07</td>
<td>87</td>
<td></td>
</tr>
<tr>
<td>7 &amp;</td>
<td>7 &amp;</td>
<td>08</td>
<td>88</td>
<td></td>
</tr>
<tr>
<td>8 *</td>
<td>8 *</td>
<td>09</td>
<td>89</td>
<td></td>
</tr>
<tr>
<td>9 (</td>
<td>9 (</td>
<td>0A</td>
<td>8A</td>
<td></td>
</tr>
<tr>
<td>0 )</td>
<td>0 )</td>
<td>0B</td>
<td>8B</td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>0C</td>
<td>8C</td>
<td></td>
</tr>
<tr>
<td>+</td>
<td>+</td>
<td>0D</td>
<td>8D</td>
<td></td>
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<tr>
<td>' ~</td>
<td>' ~</td>
<td>29</td>
<td>A9</td>
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<td>\</td>
<td>\</td>
<td>2B</td>
<td>AB</td>
<td></td>
</tr>
<tr>
<td>Del</td>
<td>Backspace</td>
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<td>8E</td>
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<tr>
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<td>Tab</td>
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<td>8F</td>
<td></td>
</tr>
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<td>Q</td>
<td>10</td>
<td>90</td>
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<td>11</td>
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<td>R</td>
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<td>T</td>
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<td>[</td>
<td>[</td>
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<td>]</td>
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<td>Ctrl</td>
<td>Ctrl</td>
<td>1D</td>
<td>9D</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>A</td>
<td>1E</td>
<td>9E</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>S</td>
<td>1F</td>
<td>9F</td>
<td></td>
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<td>D</td>
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<td>A0</td>
<td></td>
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<td>F</td>
<td>F</td>
<td>21</td>
<td>A1</td>
<td></td>
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<td></td>
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<tr>
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<td>H</td>
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<td>A3</td>
<td></td>
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<td>J</td>
<td>J</td>
<td>24</td>
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<td>K</td>
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<td>L</td>
<td>L</td>
<td>26</td>
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<td></td>
</tr>
<tr>
<td>; ;</td>
<td>; ;</td>
<td>27</td>
<td>A7</td>
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</tr>
<tr>
<td>&quot; &quot;</td>
<td>&quot; &quot;</td>
<td>28</td>
<td>A8</td>
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</table>

continued
Table 5-5 Keyboard Generated Codes — Main Keypad, continued (PCTERM)

<table>
<thead>
<tr>
<th>107-key Keyboard</th>
<th>101-key Keyboard</th>
<th>Scan Code (in hex)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Line</td>
<td>Enter</td>
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</tr>
<tr>
<td>Rept</td>
<td>n/a</td>
<td>none</td>
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<tr>
<td>Left Shift</td>
<td>Left Shift</td>
<td>2A</td>
</tr>
<tr>
<td>Z</td>
<td>Z</td>
<td>2C</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>2D</td>
</tr>
<tr>
<td>C</td>
<td>C</td>
<td>2E</td>
</tr>
<tr>
<td>V</td>
<td>V</td>
<td>2F</td>
</tr>
<tr>
<td>B</td>
<td>B</td>
<td>30</td>
</tr>
<tr>
<td>N</td>
<td>N</td>
<td>31</td>
</tr>
<tr>
<td>M</td>
<td>M</td>
<td>32</td>
</tr>
<tr>
<td>, &lt;</td>
<td>, &lt;</td>
<td>33</td>
</tr>
<tr>
<td>. &gt;</td>
<td>. &gt;</td>
<td>34</td>
</tr>
<tr>
<td>/ ?</td>
<td>/ ?</td>
<td>35</td>
</tr>
<tr>
<td>Right Shift</td>
<td>Right Shift</td>
<td>36</td>
</tr>
<tr>
<td>Cmd</td>
<td>n/a</td>
<td>none</td>
</tr>
<tr>
<td>On Line</td>
<td>Right Alt</td>
<td>38</td>
</tr>
<tr>
<td>Space</td>
<td>Space</td>
<td>39</td>
</tr>
<tr>
<td>Alpha Lock</td>
<td>Caps</td>
<td>3A</td>
</tr>
</tbody>
</table>

Outbound (Host to Terminal) Codes

Command codes in PCTERM are largely identical to those of the VT320/100 emulation. The only changes are in the areas of cursor addressing and character sets.

Cursor Addressing

The 25th row status-line is not used on PCTERM. Thus, the 25th row is displayed as part of the active screen area, and all cursor-positioning commands may access it.

Character Sets

The GL and GR character sets are set to IBM PC characters (PCTERM Low and PCTERM High, respectively). Each of these character sets has 128 characters. The codes 00 to 1F hex and 80 to 9F hex may be accessed by prefixing the character to be displayed with 12 hex (Ctrl–R, from Force Display command). Shift In and Shift Out may still be used to access other characters as desired. The keyboard on the terminal will not operate in 7-bit mode because PCTERM is strictly an 8-bit operating environment due to the use of 8-bit scan codes on the keyboard.
NOTE: The D217 terminal does not have a GR character set so the application program will have to use Shift in and Shift out to appropriately set GL.

**VP/ix getty Setup**

This entry should go into `/etc/gettydefs`. It defines a reasonably useful communications setup for a VP/ix user.

```
vpixtty# B9600 HUPCL CS8 CREAD ICANON ECHO ECHOE ECHOK ECHONL OPOST ICRNL
   #B9600 CREAD CLOCAL ICRNL OPOST ICANON ECHO ECHOE ECHOK ECHONL CS8 IXON IXOFF
   ONLCR ISIG HUPCL #System-name login: #vpixtty
```

This should be entered all on one line and the case is significant. An easy way to do this is to type the following command:

```
cat >> /etc/gettydefs
```

Then enter the `getty` definition and press Newline twice. Then press Ctrl–D to finish this update.

**Sample terminfo File**

This terminfo source file should be compiled with the tic utility. This description gives the UNIX terminal drivers access to the VT320/100 emulation for operations outside of VP/ix, as well as providing background information inside VP/ix.

```
dg_pctermd DG PC Terminal,
use=vt100,
```
Sample VP/ix term File

This following lines should go in /usr/vpix/term/dg_pcterm to describe a Data General terminal running PCTERM for use within the VP/ix environment.

* @(#)dg_pcterm 1.0 -89/10/09

* Part I: output definitions

output: \001 \022-\001 * smiling face, black-on-white
output: \002 \022-\002 * smiling face, white-on-black
output: \003 \022-\003 * heart
output: \004 \022-\004 * diamond
output: \005 \022-\005 * club
output: \006 \022-\006 * spade
output: \007 \022-\007 * centered dot, black-on-white
output: \010 \022-\010 * centered dot, white-on-black
output: \011 \022-\011 * circle, black-on-white
output: \012 \022-\012 * circle, white-on-black
output: \013 \022-\013 * male symbol
output: \014 \022-\014 * female symbol
output: \015 \022-\015 * musical note
output: \016 \022-\016 * musical double-note
output: \017 \022-\017 * sun
output: \020 \022-\020 * right-hand turn signal
output: \021 \022-\021 * left-hand turn signal
output: \022 \022-\022 * uparrow and downarrow
output: \023 \022-\023 * double--exclamation mark
output: \024 \022-\024 * paragraph mark
output: \025 \022-\025 * section mark
output: \026 \022-\026 * horizontal black rectangle
output: \027 \022-\027 * underlined uparrow and downarrow
output: \030 \022-\030 * uparrow
output: \031 \022-\031 * downarrow
output: \032 \022-\032 * rightarrow
output: \033 \022-\033 * leftright
output: \034 \022-\034 * centered lower-left of box
output: \035 \022-\035 * rightarrow and leftarrow
output: \036 \022-\036 * centered black up triangle
output: \037 \022-\037 * centered black down triangle
output: \0177 \022-\0177 * large centered empty triangle
output: \200 \022-\200 * C with cedilla
output: \201 \022-\201 * u with umlaut
output: \202 \022-\202 * e with accent--egu
output: \203 \022-\203 * a with circumflex
output: \204 \022-\204 * a with umlaut
output: \205 \022-\205 * a with accent-grave
output: \206 \022-\206 * a with little circle
output: \207 \022-\207 * c with cedilla
output: \210 \022-\210 * e with circumflex
output: \211 \022-\211 * e with umlaut
output: \212 \022-\212 * e with accent-grave
output: \213 \022-\213 * i with umlaut
output: \214 \022-\214 * i with circumflex
output: \215 \022-\215 * i with accent-grave
output: \216 \022-\216 * A with umlaut
output: \217 \022-\217 * A with little circle
output: \220 \022-\220 * E with accent-egu
output: \221 \022-\221 * joined ae
output: \222 \022-\222 * joined AE
output: \223 \022-\223 * o with circumflex
output: \224 \022-\224 * o with umlaut
output: \225 \022-\225 * o with accent-grave
output: \226 \022-\226 * u with circumflex
output: \227 \022-\227 * u with accent-grave
output: \230 \022-\230 * y with umlaut
output: \231 \022-\231 * O with umlaut
output: \232 \022-\232 * U with umlaut
output: \233 \022-\233 * cent symbol
output: \234 \022-\234 * English pound symbol
output: \235 \022-\235
output: \236 \022-\236
output: \237 \022-\237

[NOTE: These definitions can be used for all terminals.]

* Part II: terminfo-type definitions

clear:   \E[H\E[2J
csr:     \E[%i%p1%d;%p2%dr
ri:      \EM
svpix:   \E[?99h
fvpix:   \E[?991
c_xon:   e
c_xoff:  g
pccompat: y
ind:     \ED
cup:     \E[%i%p1%d;%p2%dH
cubl:    \b
cuf1:    \E[C
cuul:    \E[A
cudl: \n
ed: \E[J
el: \E[K

[NOTE: Use these definitions for D413/D463 only.]

* Part II: terminfo-type definitions

clear: \E[H\E[2J
ri: \EM
svpix: \E[?99h
fvpix: \E[?99l
c_xon: e
c_xoff: g
pccompat: y
ind: \ED
ill: \E[L
dll: \E[M
ichl: \E[@
dchl: \E[P
cup: \E[1%p1%d;%p2%dH
cubl: \b
cuf1: \E[C
cuul: \E[A
cudl: \n
ed: \E[J
el: \E[K

* Part III: attribute definitions

sgr0: \E[0m
blink: \E[0;5m
bold: \E[0;1m
rev: \E[0;7m
smul: \E[0;4m
blbo: \E[0;1;5m
blr: \E[0;5;7m
blu: \E[0;4;5m
bor: \E[0;1;7m
bou: \E[0;1;4m
bibor: \E[0;1;5;7m
blbou: \E[0;1;4;5m
If you are using the /bin/sh (Bourne) shell, place the following lines in /usr/"$LOGNAME"/.profile to specify that a particular user will use this terminal type:

```
TERM=dg_pcterm
export TERM
```

If you are using the /bin/csh (C) shell, then use the following in the /usr/$home/.login file:

```
set term=dg_pcterm
```

To finish the setup for a VPfx user, use the addvpixuser option in the packagemgmt selection in sysadm. Then go to the ttymgmt menu and select modtty. Use this function to set the user's login Line Setting to vpixtty.

End of Chapter
Appendix A
Character Sets

This appendix contains tables of each character set supported by the D217+/D413/D463:

- United States ASCII
- NRC United Kingdom
- NRC French
- NRC German
- NRC Swedish/Finnish
- NRC Spanish
- NRC Danish/Norwegian
- NRC Swiss
- NRC Katakana (G0 Set)
- Katakana (G1 Set)
- DG International
- Word-Processing, Greek, and Math Set
- DG Line Drawing
- DG Special Graphics (PC Characters)
- VT Multinational
- VT Special Graphics (VT Line Drawing)
- ISO 8859/1.2 Characters
- PCTERM Low Characters (0 hex through 7F hex)
- PCTERM High Characters (80 hex through FF hex)

Each of the tables displayed in this appendix show the character displayed on the screen and the decimal, octal, and hex value associated with that character. If no character is recorded within a space in a table, that code will produce a blank on the screen.
### United States ASCII Character Set

<table>
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<tr>
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<th>( D )</th>
<th>( L )</th>
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<th>( @ )</th>
<th>( P )</th>
<th>( . )</th>
<th>( p )</th>
<th>( H )</th>
<th>( D )</th>
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### Displayed Character

- **E**: 27 033 1B
- **C**: 014-021111

**A-2**
### NRC United Kingdom Character Set

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<th>Octal</th>
<th>Hex</th>
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**Displayed Character**: `E` 03 18

**Decimal**: 27

**Octal**: 033

**Hex**: 1B
# NRC French Character Set

| \( \text{NU} \) | \( \text{DL} \) | \( \text{DH} \) | \( \text{SX} \) | \( \text{DX} \) | \( \text{ET} \) | \( \text{EK} \) | \( \text{EB} \) | \( \text{BS} \) | \( \text{HT} \) | \( \text{LF} \) | \( \text{VT} \) | \( \text{FF} \) | \( \text{CR} \) | \( \text{SO} \) | \( \text{SI} \) |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
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| 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |

### Displayed Character

- E
- C

### Decimal, Octal, Hex

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<td>014-002111</td>
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<td>014-002111</td>
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</table>

### Table Data

- **NU**: French character number
- **DL**: Displayed character
- **DH**: Decimal representation
- **SX**: Symbol number
- **DX**: Decimal representation
- **ET**: Equivalent representation
- **EK**: Equivalent key
- **EB**: Equivalent block
- **BS**: Block symbol
- **HT**: Hexadecimal representation
- **LF**: Lagrangian function
- **VT**: Variational technique
- **FF**: Finite field
- **CR**: Character representation
- **SO**: Symbol order
- **SI**: Symbol index

### Displayed Character

- **E**: Displays the character
- **C**: Contains the character

### Decimal, Octal, Hex

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NRC German Character Set

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Displayed Character | \( E \) | \( C \) | \( 014 \) | \( 02111 \) | \( A-5 \) |
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Decimal Octal Hex

014–002111
### NRC Swedish/Finnish Character Set

| \(N_U\) | 000 | D_L | 0020 | 20 | 000 | 0020 | 20 | \(É\) | 64 | \(P\) | 80 | \(é\) | 96 | \(p\) | 112 | 160 | 70 |
|---------|-----|-----|------|----|-----|------|----|-------|----|-----|-----|-------|----|-----|-----|-----|
| S_H | 1 | D_1 | 17 | 0021 | 11 | ! | 33 | 0421 | 21 | 66 | 0101 | 41 | 81 | 121 | 51 | 113 | 161 | 71 |
| S_X | 2 | D_2 | 18 | 0022 | 12 | " | 34 | 0422 | 22 | 66 | 102 | 42 | 82 | 122 | 52 | 114 | 162 | 72 |
| E_X | 3 | D_3 | 19 | 0023 | 13 | # | 35 | 0433 | 23 | 67 | 0103 | 43 | 83 | 123 | 53 | 115 | 163 | 73 |
| E_T | 4 | D_4 | 20 | 0024 | 14 | | 36 | 0444 | 24 | 68 | 104 | 44 | 84 | 124 | 54 | 116 | 164 | 74 |
| E_O | 5 | N_K | 21 | 0025 | 15 | % | 37 | 0455 | 25 | 69 | 0105 | 45 | 85 | 125 | 55 | 117 | 165 | 75 |
| A_K | 6 | S_Y | 22 | 0026 | 16 | & | 38 | 0466 | 26 | 70 | 106 | 46 | 86 | 126 | 56 | 118 | 166 | 76 |
| B_L | 7 | E_B | 23 | 0027 | 17 | ^ | 39 | 0477 | 27 | 71 | 107 | 47 | 87 | 127 | 57 | 119 | 167 | 77 |
| B_S | 8 | C_N | 24 | 0028 | 18 | ( | 40 | 0488 | 28 | 72 | 110 | 48 | 88 | 128 | 58 | 120 | 168 | 78 |
| H_T | 9 | E_M | 25 | 0029 | 19 | ) | 41 | 0519 | 29 | 73 | 111 | 49 | 89 | 129 | 59 | 121 | 171 | 79 |
| L_F | 10 | S_B | 26 | 0030 | 20 | | 42 | 0520 | 30 | 74 | 112 | 50 | 90 | 130 | 60 | 122 | 172 | 80 |
| V_T | 11 | E_C | 27 | 0031 | 21 | + | 43 | 0531 | 31 | 75 | 113 | 51 | 91 | 131 | 61 | 123 | 173 | 81 |
| F_F | 12 | F_S | 28 | 0032 | 22 | | 44 | 0542 | 32 | 76 | 114 | 52 | 92 | 132 | 62 | 124 | 174 | 82 |
| C_R | 13 | G_S | 29 | 0033 | 23 | | 45 | 0553 | 33 | 77 | 115 | 53 | 93 | 133 | 63 | 125 | 175 | 83 |
| S_O | 14 | R_S | 30 | 0034 | 24 | | 46 | 0564 | 34 | 78 | 116 | 54 | 94 | 134 | 64 | 126 | 176 | 84 |
| S_I | 15 | U_S | 31 | 0035 | 25 | / | 47 | 0575 | 35 | 79 | 117 | 55 | 95 | 135 | 65 | 127 | 177 | 85 |

**Displayed Character** | \(E\) | 27 | **Decimal** | 033 | Octal | 18 | **Hex** | 014-002111
### NRC Spanish Character Set

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<td>-</td>
<td>( M )</td>
<td>( | )</td>
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<td>( U_S )</td>
<td>?</td>
<td>( O )</td>
<td>( _ )</td>
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**Displayed Character**

| \( E \) | \( C \) | \( 27 \) | \( 033 \) | \( 18 \) | \( \) |

**Decimal Octal Hex**

014–002111
### NRC Danish/Norwegian Character Set

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<th>( S_H )</th>
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<th>( E_Q )</th>
<th>( A_K )</th>
<th>( B_L )</th>
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<th>( H_T )</th>
<th>( I_L )</th>
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**Displayed Character:** E  C  033  18  

**Decimal Octal Hex:** 014-002111
# NRC Swiss Character Set

| \(N_U\) | 0 | 000 | 00 | 020 | 02 | 040 | 04 | 060 | 06 | 080 | 08 | 100 | 10 | 120 | 12 | 140 | 14 | 160 | 16 |
| \(S_H\) | 1 | 001 | 01 | 021 | 11 | | | | | | | | | | | | | | |
| \(S_X\) | 2 | 002 | 02 | 022 | 12 | | | | | | | | | | | | | | |
| \(E_X\) | 3 | 003 | 03 | | | | | | | | | | | | | | | |
| \(E_T\) | 4 | 004 | 04 | | | | | | | | | | | | | | | |
| \(E_Q\) | 5 | 005 | 05 | | | | | | | | | | | | | | | |
| \(A_K\) | 6 | 006 | 06 | | | | | | | | | | | | | | | |
| \(B_L\) | 7 | 007 | 07 | | | | | | | | | | | | | | | |
| \(B_S\) | 8 | 008 | 08 | | | | | | | | | | | | | | | |
| \(H_T\) | 9 | 009 | 09 | | | | | | | | | | | | | | | |
| \(L_F\) | 10 | 010 | 0A | | | | | | | | | | | | | | | |
| \(V_T\) | 11 | 011 | 0B | | | | | | | | | | | | | | | |
| \(F_F\) | 12 | 012 | 0C | | | | | | | | | | | | | | | |
| \(C_R\) | 13 | 013 | 0D | | | | | | | | | | | | | | | |
| \(S_Q\) | 14 | 014 | 0E | | | | | | | | | | | | | | | |
| \(S_I\) | 15 | 015 | 0F | | | | | | | | | | | | | | | |

<table>
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<th>(\text{C} )</th>
<th>(\text{Octal} )</th>
<th>(\text{Decimal} )</th>
<th>(\text{Hex} )</th>
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# NRC Katakana (G0) Character Set

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## Displayed Character

- **E**: 033
- **C**: 033
- **Octal**: 125
- **Hex**: 014

### Notes

- The table above represents the NRC Katakana (G0) Character Set.
- The characters are listed in hexadecimal format.
- Each character is associated with its decimal, octal, and hexadecimal values.

---

**A-10**

014-002111
**Katakana (G1) Character Set**

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<th>Octal</th>
<th>Hex</th>
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<tr>
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<td>055</td>
<td>2D</td>
</tr>
</tbody>
</table>

| 000 00 | 020 00 | 040 20 | 060 40 | 080 60 | 090 090 01 | 090 091 | 090 092 | 090 093 | 090 094 | 090 095 | 090 096 | 090 097 | 090 098 | 090 099 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 01 00 | 021 00 | 041 21 | 061 41 | 081 61 | 091 092 01 | 091 093 | 091 094 | 091 095 | 091 096 | 091 097 | 091 098 | 091 099 |
| 02 00 | 022 00 | 042 22 | 062 42 | 082 62 | 092 093 01 | 092 094 | 092 095 | 092 096 | 092 097 | 092 098 | 092 099 |
| 03 00 | 023 00 | 043 23 | 063 43 | 083 63 | 093 094 01 | 093 095 | 093 096 | 093 097 | 093 098 | 093 099 |
| 04 00 | 024 00 | 044 24 | 064 44 | 084 64 | 094 095 01 | 094 096 | 094 097 | 094 098 | 094 099 |
| 05 00 | 025 00 | 045 25 | 065 45 | 085 65 | 095 096 01 | 095 097 | 095 098 | 095 099 |
| 06 00 | 026 00 | 046 26 | 066 46 | 086 66 | 096 097 01 | 096 098 | 096 099 |
| 07 00 | 027 00 | 047 27 | 067 47 | 087 67 | 097 098 01 | 097 099 |
| 08 00 | 028 00 | 048 28 | 068 48 | 088 68 | 098 099 |
| 09 00 | 029 00 | 049 29 | 069 49 | 089 69 | 099 |
| 10 00 | 030 00 | 031 01 | 032 02 | 033 03 | 034 04 | 035 05 | 036 06 | 037 07 | 038 08 | 039 09 | 03A 03B 03C 03D 03E 03F |
| 11 00 | 03A 03B 03C 03D 03E 03F |
| 12 00 | 03A 03B 03C 03D 03E 03F |
| 13 00 | 03A 03B 03C 03D 03E 03F |
| 14 00 | 03A 03B 03C 03D 03E 03F |
| 15 00 | 03A 03B 03C 03D 03E 03F |

014-002111
**DG International Character Set**

<table>
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<th>Decimal</th>
<th>Octal</th>
<th>Hex</th>
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<tr>
<td>0A</td>
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<td>011</td>
<td>07</td>
<td>01</td>
</tr>
<tr>
<td>0B</td>
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</tr>
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<td>0C</td>
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</table>

**Character Set Details**

- The DG International Character Set is a standard for character encoding.
- It supports a wide range of characters, including Latin, Greek, and Cyrillic script.
- The set includes symbols for mathematical and scientific notation.
- It is used in various applications, including telecommunications and computer graphics.

**Character Mapping**

- **Decimal**: 0-127
- **Octal**: 0-777
- **Hex**: 0-0F

**Special Features**

- The set includes support for East Asian characters.
- It is compatible with ASCII and Unicode standards.
- The set is used in various international contexts, including Europe and Asia.
### Word-Processing, Greek, and Math Character Set

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<th>Hex</th>
<th>Octal</th>
<th>Character</th>
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<td>000</td>
<td>0</td>
</tr>
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<td>001</td>
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<td>02</td>
<td>002</td>
<td>(\beta)</td>
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<td>3</td>
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**Decimal:** 0-112

**Hex:** 0-160

**Octal:** 0-180

**Table:**

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<td>01</td>
<td>001</td>
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**Displayed Character:**

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<tbody>
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**Decimal:** 0-112

**Hex:** 0-160

**Octal:** 0-180
DG Line Drawing Character Set

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014–002111
DG Special Graphics Character Set (PC Characters)

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Displayed Character: 47
Decimal Octal Hex: 037 2F
VT Multinational Character Set

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# VT Special Graphics Character Set (VT Line Drawing)

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*Displayed Character*  | 37 | 045 | 025 |

**014-002111**  

**A-17**
### ISO 8859/1.2 Character Set

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**Displayed Character** | **Decimal** | **Octal** | **Hex**
---|---|---|---
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</table>

**Displayed Character**

**Decimal Octal Hex**

| Character | 00 | 000 | 01 | 001 | 02 | 002 | 03 | 003 | 04 | 004 | 05 | 005 | 06 | 006 | 07 | 007 | 08 | 008 | 09 | 009 | 0A | 00A | 0B | 00B | 0C | 00C | 0D | 00D | 0E | 00E | 0F | 00F |
|-----------|----|-----|----|-----|----|-----|----|-----|----|-----|----|-----|----|-----|----|-----|----|-----|----|-----|----|-----|----|-----|----|-----|----|-----|----|-----|----|-----|----|-----|
| \( \)     | 10 | 010 | 11 | 011 | 12 | 012 | 13 | 013 | 14 | 014 | 15 | 015 | 16 | 016 | 17 | 017 | 18 | 018 | 19 | 019 | 20 | 020 | 21 | 021 | 22 | 022 | 23 | 023 | 24 | 024 |
| \( \)     | 25 | 025 | 26 | 026 | 27 | 027 | 28 | 028 | 29 | 029 | 30 | 030 | 31 | 031 | 32 | 032 | 33 | 033 | 34 | 034 | 35 | 035 | 36 | 036 | 37 | 037 | 38 | 038 | 39 | 039 |
| \( \)     | 40 | 040 | 41 | 041 | 42 | 042 | 43 | 043 | 44 | 044 | 45 | 045 | 46 | 046 | 47 | 047 | 48 | 048 | 49 | 049 | 50 | 050 | 51 | 051 | 52 | 052 | 53 | 053 | 54 | 054 |
| \( \)     | 55 | 055 | 56 | 056 | 57 | 057 | 58 | 058 | 59 | 059 | 60 | 060 | 61 | 061 | 62 | 062 | 63 | 063 | 64 | 064 | 65 | 065 | 66 | 066 | 67 | 067 | 68 | 068 | 69 | 069 |
| \( \)     | 70 | 070 | 71 | 071 | 72 | 072 | 73 | 073 | 74 | 074 | 75 | 075 | 76 | 076 | 77 | 077 | 78 | 078 | 79 | 079 | 80 | 080 | 81 | 081 | 82 | 082 | 83 | 083 | 84 | 084 |
| \( \)     | 85 | 085 | 86 | 086 | 87 | 087 | 88 | 088 | 89 | 089 | 90 | 090 | 91 | 091 | 92 | 092 | 93 | 093 | 94 | 094 | 95 | 095 | 96 | 096 | 97 | 097 | 98 | 098 | 99 | 099 |
| \( \)     | 100| 0100| 101| 0101| 102| 0102| 103| 0103| 104| 0104| 105| 0105| 106| 0106| 107| 0107| 108| 0108| 109| 0109| 110| 0110| 111| 0111| 112| 0112| 113| 0113| 114| 0114| 115| 0115| 116| 0116| 117| 0117| 118| 0118|

**014-002111**

**A-19**
PCTERM High Character Set (80 hex through FF hex)

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End of Appendix
Appendix B
National Language Keyboards

This appendix contains the national-language keycap mappings for both the 107-key Data General proprietary keyboard and the 101-key IBM PC AT-style keyboard.
Danish 107-key Keyboard

French 107-key Keyboard
Katakana
107-key Keyboard

Norwegian
107-key Keyboard
Spanish
107-key Keyboard

Swedish/Finnish
107-key Keyboard
Swiss/French 107-key Keyboard

Swiss/German 107-key Keyboard
French 102-key Keyboard

German 102-key Keyboard
United States
102-key Keyboard
Appendix C
Sample Programs

This appendix contains sample programs that illustrate programming methods for Data General D217, D413, and D463 display terminals. Where possible, we demonstrated functions that show a sampling of important terminal features and common applications. However, these programs are not meant to, and do not, show all possible command combinations, or program requirements. The modes and emulations covered in this appendix are listed below:

- Data General Native-Mode “C”
- Data General Native-Mode “Fortran 77”
- VT320 Emulation “C”
- VT320 Emulation “Fortran 77”
- VT52 Emulation “C”
- VT52 Emulation “Fortran 77”
- Tektronix 4010 Emulation “C”
- Tektronix 4010 Emulation “Fortran 77”
Notice

Initial version 1 June 1990.

Copyright (c) 1990 by Data General Corporation. Non-exclusive license to use, distribute, and modify this code is hereby granted without monetary consideration, provided all copyright messages are included intact in all such derivative works. Standard disclaimers regarding merchantability, suitability for a particular purpose, et cetera, all apply. This code is distributed with no warranty whatsoever.

These programs are examples of programming methods for Data General Dasher D216, D216E, D412, D462, D216+, D413, D413, D217, D463 and D462+ display terminals. Where possible, demonstration functions were chosen to show a sampling of important terminal features and common applications. However, these programs are not meant to, and do not, show all possible command combinations, or program requirements.

Send comments or questions to:
QUERIES@MRX.WEBO.DG.COM.
Source code for these programs is available from a mail server at:
SERVER@MRX.WEBO.DG.COM.
Data General Native-Mode “C”

/*
 * dg_mode.c -
 *   DG native mode demonstration.
 *
 * Initial version 01JUN90.
 *
 * Copyright (c) 1990 by Data General Corporation. Non-exclusive license to
 * use, distribute, and modify this code is hereby granted without monetary
 * consideration, provided this copyright message is included in all such
 * derivative works. Standard disclaimers regarding merchantability,
 * suitability for a particular purpose, et cetera, all apply. This code is
 * distributed with no warranty whatsoever.
 */

#include <stdio.h>
#include <ctype.h>

/* This routine can be used to condition a communication line for binary I/O
 * when writing a C program under DG AOS. It switches both input and output
 * to binary mode, which disables character translation, and unbuffers the
 * input.
 */
void
set_up_terminal()
{
    if (freopen("@input","j",stdin)==NULL) {
        fprintf(stderr,"Unable to open your terminal for binary input.\n");
        exit(1);
    }
    setbuf(stdin,NULL);
    if (freopen("@output","k",stdout)==NULL) {
        fprintf(stderr,"Unable to open your terminal for binary output.\n");
        exit(2);
    }
}

/* These routines may be used on any system that uses ASCII to provide support
 * for a native-mode DG terminal in a C program.
 */
/* This flag is non-zero if the terminal is expecting real hex data */
static int in_DG_Unix_mode=0;
/* This variable saves the current attributes for comparison */
static int old_attr=0;
/* This is the failing character in the return sequence */
static int offending_character;
/* This macro insures that a given character is printable */
define ccs(c) ((((c)&0x7F)>='&&((c)&0x7F)<0x7F)?(c)&0x7F:'.'}

014-002111
Send a DG <nn> pair. 'f' is the output device, and 'n' is between 0 and 255.

```c
int fputnn(n, f)
int n;
FILE *f;
{
    if (in DG Unix mode) /* if in Unix mode */
        return fprintf(f, "%02X", n); /* then send real hex */
    else {
        fputc('0'+(n>>4),f); /* otherwise generate DG hex */
        fputc('0'+n&0xF,f);
    }
    return 2; /* two characters shipped */
}
```

Get a DG <n> digit. 'f' is the input device. Returns a number between 0 and 15 or EOF.

```c
int fgetn(f)
FILE *f;
{
    int temp;
    offending_character=fgetc(f); /* get character from host */
    if (offending_character==EOF) return EOF;
    if (in DG Unix mode) {
        temp=toupper(offending_character); /* upcase alpha */
        if (temp<'0' || temp>'F' || temp<'A' && temp>'9') {
            fprintf(stderr, "\n\15Illegal ccs (%d), %d\n\15", temp, temp);
            return EOF;
        }
        return temp>'9' ? temp-'A'+10 : temp-'0'; /* decode hex */
    }
    temp=offending_character;
    if (temp<'8' || temp>'O') {
        fprintf(stderr, "\n\15Illegal <n> character '%c' (%02X)\n\15", temp, temp);
        return EOF;
    }
    return temp&0xF; /* decode DG hex */
}
```

Decode a DG mode <nn> pair. Returns an integer in the range 0 to 255, or EOF.

```c
int fgetnn(f)
FILE *f;
{
    int temp,t2;
    if ((temp=fgetc(f)) == EOF) return EOF; /* get one <n> parm */
    if ((t2=fgetc(f)) == EOF) return EOF; /* get the second */
    return (temp<<4) + t2; /* combine them */
}
/* Set DG Unix mode. Note that this will work whether or not DG Unix mode is currently enabled. */
void set DG unix(f)
FILE *f;
{
    in DG Unix_mode=1; /* set the global flag */
    fputs("\036P@1",f); /* send the enter-unix-mode sequence */
}

/* Reset DG Unix mode. Note that this will work whether or not DG Unix mode is currently enabled. */
void reset DG unix(f)
FILE *f;
{
    in DG Unix_mode=0; /* clear the global flag */
    fputs("\036P@0",f); /* send the exit-unix-mode sequence */
}

/* Example of DG mode Write Window Address command. Note that this is not generally useful with DG Unix Mode. 'l' is line number (0 to 23) and 'c' is column number (0 to 126). */
void write_window_address(l,c,f)
int l,c;
FILE *f;
{
    fputc('\20',f); /* Write ctrl-P header */
    fputc((char)c,f); /* Write column */
    fputc((char)l,f); /* Write row */
}

/* Example of DG mode Write Screen Address implementation. This command will work with DG unix mode. */
void write_screen_address(l,c,f)
int l,c;
FILE *f;
{
    fputs("\36FP",f); /* Write <036>FP header */
    fputn((char)c,f); /* Write <nn> column */
    fputn((char)l,f); /* Write <nn> row */
}
/ * Expect a certain fixed response from the terminal. 
* Returns 0 for success, 1 for failure. 
*/

int
fexpect(s,f)
char *s;
FILE *f;
{
    int i;

    while (*s) /* while there are characters, check them */
        if (*s != (i=fgetc(f)))
            fprintf(stderr,"Got '%c' (%02X) while expecting '%c'
"),(s),i,ccs(i),i,ccs(*s),*s);
        return 1;
    else
        s++;

    return 0; /* everything compared -- return OK status */
}

/* Example testing program. This will send the cursor to all D200 screen addresses and make sure that the cursor actually gets there. * Returns 0 for success, 1 for failure. */

int
test(func,fin,fout)
void (*func)(/* int,int */);
FILE *fin,*fout;
{
    int l,c,rc,rl;

    for (l=0;l<24;l++) /* loop over rows and columns */
        for (c=0;c<80;c++)
            (*func)(l,c,fout); /* position the cursor */
        if (fexpect("\36Fb",fin)) /* expect header */
            printf("Bad Read Screen Address return header.\n\n");
        return 1;
    rc=fgetnn(fin); /* get column data */
    if (rc==EOF) {
        printf("\nError in column data returned.\n\n");
        return 1;
    }
    rl=fgetnn(fin); /* get row data */
    if (rl==EOF) {
        printf("\nError in row data returned.\n\n");
        return 1;
    }
    if (rc!=c || rl!=l) {
        printf("\Went to position %d,%d but read back %d,%d\n",1,c,rl,rc);
        return 1;
    }
    return 0;
}
/*
 * Driver for above testing routine. This will call the above test routine and
 * direct it to use Write Window Address and Write Screen Address.
 */

int run_test(argc,argv)
int argc;
char **argv;
{
    /* Go into binary mode */
    set_up_terminal();

    /* Test the write-window-address command */
    fputs("\14Testing Write Window Address ...",stdout);
    if (test(write_window_address,stdin,stdout))
        return 1;

    /* Test the write-screen-address command */
    fputs("\14Testing Write Screen Address ...",stdout);
    if (test(write_screen_address,stdin,stdout))
        return 1;

    /* Successful! */
    fputs("\nDone",stdout);
    return 0;
}

/*
 * Turn off the indicated attributes. (Internal routine.)
 */

static void reset_attrs(int, FILE *f)
int attr;
FILE *f;
{
    int i,j;
    static char *dg_off[]={"\35","\36E","\25","\17"};
    if (attr)
        for(i=1,j=0;i<16;i<<=1,j++)
            if (i&attr) printf(dg_off[j]);
}

/*
 * Turn on the indicated attributes. (Internal routine.)
 */

static void set_attrs(int, FILE *f)
int attr;
FILE *f;
{
    int i,j;
    static char *dg_on[]={"\34","\36D","\24","\16"};
    if (attr)
        for(i=1,j=0;i<16;i<<=1,j++)
            if (i&attr) printf(dg_on[j]);
}
/* 
* Set the attributes to the given state with as few commands as possible.
*/

void
change_attributes(attr,f)
int attr;
FILE *f;
{
    reset_attr((attr&old_attr)&old_attr,f);
    set_attr((attr&old_attr)&attr,f);
    old_attr=attr;
}

/*
* Constants for use with above routine.
*/
#define DIM 1
#define REVERSE 2
#define UNDER 4
#define BLINK 8

/*
* Read binary information from 'fp' and output it in PINK style using D400
* commands to 'f'.
*/
#define linend(chr) { change_attributes(DIM,f); fputc(chr,f); ch='\n'; }

void
show_file(fp,f)
FILE *fp,*f;
{
    int ch,chlast=0,attrs;
    while ((ch=fgetc(fp))!=EOF) {
        attrs=0;
        if (ch > 127) { /* if high bit set */
            attrs = UNDER; /* then turn on underscore */
            ch -= 128;
            if (ch < 32) { /* convert if control code */
                attrs |= DIM;
                ch += '8';
            }
        }
        if (ch == 127) {
            attrs |= DIM;
            ch = '\t';
        }
        if (ch == 127) {
            attrs |= DIM;
            ch = '\r';
        }
        if (ch < 32) {
            attrs = DIM;
            switch (ch) { /* special line-end symbols */
                case '\n':
                    if (chlast=='\n') linend('!');
                    break;
                case '\r':
                    linend('c');
                    break;
                case '\l':
                    linend('*');
                    break;
            }
        }
    }
}
```c
#define chlast 0

/* Change attributes (attrs,f); */
change_attributes(attrs,f); /* set new attributes */

fputc(ch,f); /* send out the character */

fclose(fp);

/* Main routine for example code above. This program will read any number of */
/* input files and show the output in PINK format. */

int show(argc,argv)
int argc;
char **argv;
{
    FILE *fp;

    if (argc<2) {
        puts("Usage: SHOW [file-name [file-name...]]\n",stderr);
        return 0;
    }

    set_up_terminal();

    while (**++argv) /* for each given file */
        if (access(*argv,0))
            fprintf(stderr,"%s does not exist!\n",argv);
        else if (access(*argv,4))
            fprintf(stderr,"Insufficient access rights on %s!\n",argv);
        else if ((fp=fopen(*argv,"j"))==NULL)
            fprintf(stderr,"Cannot open %s!\n",argv);
        else
            if (argc>2) { /* if more than one file, give names */
                change_attributes(0);
                printf("\nFile: %s\n",argv);
            }
            show_file(fp,stdout); /* display the file */

    change_attributes(0,stdout);
    return 0;
}

/* Main program */

int main(argc,argv)
int argc;
char **argv;
{
    char str[256];

    printf("Run (S)how or (T)est? ");
    if (gets(str)) switch(tolower(*str)) {
        case 's': return show(argc,argv);
        case 't': return run_test(argc,argv);
    }
    return 1;
}
```
Data General Native–Mode “Fortran 77”

C dg_mode.f77 -
C DG Native mode demonstration.
C
C Initial version 01JUN90.
C
C Copyright (c) 1990 by Data General Corporation. Non-exclusive license to
C use, distribute, and modify this code is hereby granted without monetary
C consideration, provided this copyright message is included in all such
C derivative works. Standard disclaimers regarding merchantability,
C suitability for a particular purpose, et cetera, all apply. This code is
C distributed with no warranty whatsoever.

C This routine can be used to condition a communication line for binary I/O
C when writing an F77 program under DG AOS. It switches both input and output
C to binary mode, which disables character translation, and unbuffers the
C input.

    subroutine set_up_terminal(iin,iout)
    integer iin,iout

    integer in DG Unix_mode,old_attr
    common /DGTERM/ in DG Unix_mode,old_attr

    C Set I/O to binary.
    open(unit=iin,file='@input',screenedit='no',maxrec=1,
    1 delimiter='include',force='yes',iointent='input',
    2 mode='binary',err=100)
    open(unit=iout,file='@output',carriagecontrol='none',
    1 screenedit='no',force='yes',iointent='output',mode='binary',
    2 err=100)

    C Reset global variables.
    in DG Unix_mode=0
    old_attr=0
    return

100 continue
    write(*,1)
    1 format(' Unable to open your terminal as a binary device.')
    stop

C These routines may be used on any system that uses ASCII to provide support
C for a native-mode DG terminal in an F77 program.

    subroutine sendnn(n,iout)
    integer n,iout

C-10
Send a DG <nn> pair. iout is the output device, and ‘n’ is between 0 and 255.

```
intrinsic mod
integer in DGUnix_mode,old_attr
common /DGTERM/ in DGUnix_mode,old_attr
integer*2 czero
data czero/2H0/
integer*2 c1,c2
if (in DGUnix_mode.ne.0) then
  write(iout,1) n
else
  c1=czero + (n/16)*256
  c2=czero + mod(n,16)*256
  write(iout,2) c1,c2
endif
1 format(Z2.2)
2 format(2Al)
return
end
```

```
integer function getn(iin)
integer iin
C Get a DG <n> digit. iin is the input device. Returns a number between 0 and 15 (or -1 for EOF).

intrinsic ichar
integer in DG Unix mode, old attr
common /DGTERM/ in DG Unix mode, old attr
character ch
integer ich
C Read in the character.
read(iin,1,err=100,end=100) ch
1 format(A1)
C Strip high bit.
  ich=ichar(ch)
  if (ich.ge.128) ich=ich-128
  if (in DG Unix mode.ne.0) then
    C In DG Unix mode; check character value.
    if (ich.ge.ichar('A') .and. ich.le.ichar('F')) ich=ich-32
    if (ich.lt.ichar('0') .or. ich.gt.ichar('F')) .or.
    1 (ich.lt.ichar('A') .and. ich.gt.ichar('9'))) then
      write(*,2) ich
      stop
    endif
  C Convert hex to decimal and return.
    getn = ich-ichar('0')
    if (ich.gt.ichar('9')) getn=ich-ichar('A')+10
    else
    C In DG native mode; check character value.
    if (ich.lt.ichar('8') .or. ich.gt.ichar('0')) then
      write(*,2) ich
    2 format(' Illegal "nn" character: ',Z2.2)
      stop
    endif
```

014-002111
C Convert DG hex to decimal and return.
    getn = ich-ichar('@')
    endif
    return
100    continue
    getn = -1
    return
    end

integer function getnn(iin)
    integer iin

C Decode a DG mode <nn> pair. Returns an integer in the range 0 to 255, or
C EOF (-1)
    integer t1,t2
    external getn
    integer getn

C Default is error.
    getnn=-1

C Get first <n> character.
    t1=getn(iin)
    if (t1.lt.0) return

C Get second.
    t2=getn(iin)
    if (t2.lt.0) return

C Combine them and return.
    getnn=t1*16+t2
    return
    end

subroutine set DG_unix(iout)
    integer iout

C Set DG Unix mode. Note that this will work whether or not DG Unix mode is
C currently enabled.
    integer in DG Unix mode, old_attr
    common /DGTERM/ in DG Unix mode, old_attr

C Set the flag and put the terminal into DG Unix mode.
    in DG Unix mode=1
    write(iout,1)
1    format('<036>P@1')
    return
    end

subroutine reset DG_unix(iout)
    integer iout

C Reset DG Unix mode. Note that this will work whether or not DG Unix mode is
C currently enabled.
    integer in DG Unix mode, old_attr
    common /DGTERM/ in DG Unix mode, old_attr

C-12
C Clear the flag and take the terminal out of DG Unix mode.

```fortran
in_DG_unix_mode=0
write(iout,l)
```

```fortran
1 format('<036>P@0')
return
end
```

```fortran
subroutine write_window_address(l,c,iout)
integer l,c,iout
integer*2 l2,c2
```

C Example of DG mode Write Window Address command. Note that this is not
C generally useful with DG Unix Mode.
C 'l' is line number (0 to 23) and 'c' is column number (0 to 126).

C Convert line and column to character values and ship them.
```
12 = 1*256+32
c2 = c*256+32
write(iout,1) c2,12
```

```fortran
1 format('<020>',2A1)
return
end
```

```fortran
subroutine write_screen_address(l,c,iout)
integer l,c,iout
```

C Example of DG mode Write Screen Address implementation. This command will
C work with DG unix mode.

C Send <036>FP header.
```
write(iout,1)
```

```fortran
1 format('<036>FP')
```

C Send column and line numbers.
```
call sendnn(c,iout)
call sendnn(l,iout)
return
end
```

```fortran
character function ccs(c)
character c
```

C Insure that the given character is printable.
```
intrinsic ichar,char
integer ich
```

C Strip high bit.
```
ich=ichar(c)
if (ich.ge.128) ich=ich-128
```

C If it's a control character, replace it with '.
```
if (ich.lt.32.or.ich.eq.127) ich=ichar(' .')
ccs=char(ich)
return
end
```

```fortran
subroutine expect(str,iin)
character*(*) str
integer iin
```
C Expect a certain fixed response from the terminal

    intrinsic ichar
    external ccs
    integer ic
    character in,ccs

    ic=0

10 continue
    ic=ic+1

C Blank terminates the string.
    if (str(ic:ic).eq.' ') return

C Get next character from host.
    read(iin,'(A1)') in
    if (str(ic:ic).ne.in) then
        write(*,l) ccs(in),ichar(in),ccs(str(ic:ic)),ichar(str(ic:ic))
        stop
    endif

    1 go to 10
end

subroutine run_test(func,iin,iout)
    logical func
    integer iin,iout

    C Example testing program. This will send the cursor to all D200 screen addresses and make sure that the cursor actually gets there.

    external getnn
    integer getnn
    integer l,c,rc,rl

    C Loop over all rows and columns.
        do 10 l=0,23
        do 10 c=0,79
            rl=l
            rc=c

        C Call requested function.
            if (func) call write_screen_address(rl,rc,iout)
            if (.not.func) call write_window_address(rl,rc,iout)

        C Send read-cursor-position command.
            write(iout,1)
            1 format('<036>Fb')

        C Expect return header and data.
            call expect('<036>08 ',iin)
            rc=getnn(iin)
            rl=getnn(iin)
            if (rc.ne.c .or. rl.ne.l) then
                write(*,2) l,c,rc,rl
                stop
            endif

        10 continue

        2 format('Went to ',i2,' and got ',i2,'.')
        return
end

subroutine test
C Driver for above testing routine. This will call the above test routine and
direct it to use Write Window Address and Write Screen Address.

call set_up_terminal(5,6)

C Test write-window-address functions.
write(*,1)
1 format('<014>Testing Write Window Address ...')
call run_test(.false.,5,6)

C Test write-screen-address functions.
write(*,2)
2 format('<014>Testing Write Screen Address ...')
call run_test(.true.,5,6)
return
end

subroutine reset_attrs(attrs,iout)
integer attrs,iout
C Turn off the indicated attributes. (Internal routine.)

intrinsic iand
character*6 dg_off(4)
data dg_off//('<035>','<036>E','<025>','<017>'//
integer i,j
if (attrs.eq.0) return
i=1
do 10 j=1,4
if (iand(i,attrs).ne.0) write(iout,dg_off(j))
i=i*2
10 continue
return
end

subroutine set_attrs(attrs,iout)
C Turn on the indicated attributes. (Internal routine.)

integer attrs,iout
intrinsic iand
character*6 dg_on(4)
data dg_on//('<034>','<036>D','<024>','<016>'//
integer i,j
if (attrs.eq.0) return
i=1
do 10 j=1,4
if (iand(i,attrs).ne.0) write(iout,dg_on(j))
i=i*2
10 continue
return
end

subroutine change_attributes(attr,iout)
integer attr,iout
C Set the attributes to the given state with as few commands as possible.

intrinsic ieor,iand
integer in DG Unix_mode,old attr
common /DGTERM/ in DG Unix_mode,old attr
integer temp
C Get differences.
    temp=ieor(attr,old_attr)

C Clear those that need to be cleared.
call reset_attrs(iand(temp,old_attr),iout)

C Set those that need to be set.
call set_attrs(iand(temp,attr),iout)

old_attr=attr
return
end

subroutine show_file(fin,istext,iout)
    integer fin,iout
    logical istext

C Read binary information from fin and output it in PINK style using D400
C commands to iout.
C This program runs very slowly since the output is unbuffered. This is done
C deliberately since this is a pedagogic example.
    intrinsic char,ichar
    integer dim,reverse,under,blink
    data dim,reverse,under,blink/1,2,4,8/
    integer attrs,ich,ipos
    character ch,chlast
    character*255 chstr

C Assume last character was a normal ASCII character.
    chlast='a'
    ipos=0
10 continue

C Get next character from file.
    if (istext) then
        if (ipos.eq.0) read(fin,3,end=100,err=200) chstr
        format (A255)
        ipos = ipos+l
        ich = ichar(chstr(ipos:ipos))
        if (ich.eq.10.or.ipos.eq.255) ipos=0
        else
            read(fin,1,end=100,err=200) ch
            format (A1)
            ich = ichar(ch)
        endif
        attrs=0
        if (ich .ge. 128) then
C If high bit is set, then turn on underscore attribute.
            attrs=under
            ich=ich-128
C If control character, then turn on dim attribute.
            if (ich .lt. 32) then
                attrs=attrs+dim
                ich=ich+64
            else if (ich .eq. 127) then
                attrs=attrs+dim
                ich=ichar(‘~‘)
            endif
            else
                if (ich .eq. 127) then

If control character, then turn on dim attribute.

C    attrs=dim
     ich=ichar(’~’)
else if (ich .lt. 32) then
     attrs=dim

C    Check for special line-end sequences.
if (ich .eq. 10) then
    if (chlast .eq. ’ ’) then
        call change_attributes(dim,iout)
        write(iout,“I”,"")
    endif
    else if (ich .eq. 13) then
        call change_attributes(dim,iout)
        write(iout,“<074>”’)
        ich=10
    else if (ich .eq. 12) then
        call change_attributes(dim,iout)
        write(iout,“’”’)
        ich=10
    else
        ich=ich+64
    endif
endif
endif

C    Set the attributes and send out the adjusted character.
    call change_attributes(attrs,iout)
    ch=char(ich)
    write(iout,1) ch
    chlast=ch
    go to 10

200 continue
    write(‘*,2)
    format(’ Unexpected error while reading file!’)
200 continue
    return
end

subroutine extract_next(inline,i,ilen,fname)
character*80 inline
integer i,ilen
character*32 fname

C Internal routine -- extract next file name from input line.

integer j
fname=’
   j=1
10 continue
   if (inline(i:i).gt.’ ’) go to 20
   i=i+1
   if (i.gt.ilen) return
   go to 10
20 continue
   fname(j:j)=inline(i:i)
   j=j+1
   i=i+1
   if (i.gt.ilen.or.j.gt.32) return
   if (inline(i:i).gt.’ ’) go to 20
   return
end

subroutine show
C Main routine for example code above. This program will read any number of
C input files and show the output in PINK format.

    integer nfiles, i
    character*32 fname
    character*80 inline
    logical istext

C Prompt for file names.
    write(*,'("Enter names of files to show: ")')
    read(*,'(A80)') inline

C Count the number of files.
    do 20 ilen=80,1,-1
        if (inline(ilen:ilen) .ne. ' ') go to 30
    continue
    nfiles=0
    i=1
    40 continue
    call extract_next(inline,i,ilen,fname)
        if (fname(1:1).eq. ' ') go to 50
        nfiles=nfiles+1
        go to 40
    50 continue
    if (nfiles.le.0) then
        write(*,1)
        format('Usage: /8X, 'SHOW [file-name [file-name ...]]')
        stop
    endif

C Loop over files and send them to the screen.
    call set_up_terminal(5,6)
    i=1
    10 continue
    call extract_next(inline,i,ilen,fname)
        if (fname(1:1).eq. ' ') go to 60
        istext = .false.
        open(unit=20,file=fname,iointent='input',mode='binary',
            status='old',maxrec=1,dellimiter='include',err=100)
        continue
    60 if (nfiles.gt.1) then
        call change_attributes(0,6)
        write(6,2) fname
        format('File: ',A32,'<012>')
    endif

C If there is more than one file requested, write out the names.
    if (nfiles.gt.1) then
        call change_attributes(0,6)
        write(6,2) fname
        format('File: ',A32,'<012>')
    endif
C Send the file to the screen.
call show_file(20,istext,6)
go to 10

100 continue
istext = .true.
open(unit=20,file=fname,status='old',recfm='datasmart',
maxrec=255,delimiter='include',pad='yes',err=101)
go to 102

101 continue
write(*,3) fname
3 format('Unable to locate file:  ',A32,'<012>')</go to 10

60 continue
call change_attributes(0,6)
return
end

C Main program.

class ans
write(*,'('' Run (S)how or (T)est? ' ')
read(*,(a1)) ans
if (ans.eq.'s'.or.ans.eq.'S') call show
if (ans.eq.'t'.or.ans.eq.'T') call test
end
/* vt320_mode.c -
 * VT320/VT100 mode demonstration.
 * Initial version 01JUN90.
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 * suitability for a particular purpose, et cetera, all apply. This code is
 * distributed with no warranty whatsoever.
 */

#include <stdio.h>
#include <ctype.h>
#include <string.h>
#include <fcntl.h>
#include <termio.h>

/*
 * These routines can be used to condition a communication line for binary I/O
 * when writing a C program under DG AOS. It switches both input and output
 * to binary mode, which disables character translation, and unbuffers the
 * input.
 */

static int UnbufferedMode = 0;

void set_unbuffered()
{
    if (UnbufferedMode)
        return;
    UnbufferedMode=1;
    fflush(stdout);
    if (freopen("@input","j",stdin)==NULL)
    {
        fputs("Unable to open your terminal for binary input.\r\n",stderr);
        exit(1);
    }
    setbuf(stdin,NULL);
    if (freopen("@output","k",stdout)==NULL)
    {
        fprintf(stderr,"Unable to open your terminal for binary output.\r\n");
        exit(2);
    }
}

void set_buffered()
{
    if (!UnbufferedMode)
        return;
    UnbufferedMode=0;
    if (freopen("@input","r",stdin)==NULL)
    {
        fputs("Unable to open your terminal for normal input.\r\n",stderr);
        exit(1);
    }
    if (freopen("@output","w",stdout)==NULL)
    {
        fputs("Unable to open your terminal for normal output.\r\n",stderr);
    }
exit(2);
}

This routine is required for AOS because it mistakenly uses LF for end-of-line, rather than CR, and it assumes DG mode cursor controls.

char *
afgets(str,len,fp)
char *str;
int len;
FILE *fp;
{
    int chr,ilen;
    if (fp != stdin)
        return fgets(str,len,fp);
    set_unbuffered();
    chr = fgetc(fp);
    if (chr == EOF)
        return NULL;
    ilen = 0;
    for (;chr=fgetc(fp)) switch (chr) {
        case EOF:
        case '\r':
        case '\n':
            if (ilen == 0)
                *str = '\0';
            fputs("\r\n",stdout);
            fflush(stdout);
            return str;
        case '\10':
        case '\177':
            if (ilen == 0)
                break;
            fputs("\10\10",stdout);
            str--;
            ilen--;
            break;
        default:
            if (ilen+1 >= len)
                break;
            fputc(chr,stdout);
            *str++ = chr;
            ilen++;
    } /*NOTREACHED*/
}
/* These routines may be used on any system that uses ASCII to provide support for a VT320 terminal in a C program. */
/* Constants for use with routine below. */
#define DIM 1
#define REVERSE 2
#define UNDER 4
#define BLINK 8
static int old_attr=DIM;
static void do vt attrs(attrs,strings,fp,pfirst)
int attrs,*pfirst;
char *strings[];
FILE *fp;
{ int i,j;
  for(i=1,j=O;i<16;i<<=1,j++)
    if (i&attrs) {
      if (!*pfirst) fputc(';',fp);
      *pfirst=O;
      fputs(strings[j],fp);
    }
}
/* Set the attributes to the given state with as few commands as possible. */
void change attributes(attr,fp)
int attr;
FILE *fp;
{ int change,first;
  static char *vt_off[]="1","27","24","25");
  static char *vt_on[]="22","7","4","5");
  change=attr-old_attr; /* get changes from current */
  if (change==O) /* if none, exit */
    return;
  first=1;
  fputs("\33",fp);
  if (change-old_attr) /* if any need clearing, do them */
    do vt attrs(change-old_attr,vt_off,fp,&first);
  if (change&attr) /* if any need setting, do them */
    do vt attrs(change&attr,vt_on,fp,&first);
  fputc(‘m’,fp);
  old_attr=attr;
}
*/
* Example of VT320 Cursor Position (CUP) command.
* 'l' is line number (1 to 24) and 'c' is column number (1 to 80).
*/

void cursor_position(l,c,f)
int l,c;
FILE *f;
{
    fprintf(f,"\e%2d;%2dH",l,c);
}

/*
* Example of VT320 Horizontal and Vertical position (HVP) command
* implementation.
*/

void horizontal_vertical(l,c,f)
int l,c;
FILE *f;
{
    fprintf(f,"\e%2d;%2df",l,c);
}

/*
* Decode a CSI sequence returned from the terminal.
*/
#define ccs(c) \(((((c)&0x7F)>=' '&&(c)&0x7F)<0x7F)?(c)&0x7F:'.\')

void ansi_decode(fp,termc,bufp,maxp)
FILE *fp;
char termc;
int *bufp,*maxp;
{
    int ich;
    char tbuf[256],*tp;
    /* Get a CSI header first */
    if (!ich=fgetc(fp)) goto end;
    if (ich!=0x1B) {
        fprintf(stderr,"Error while waiting for CSI from terminal. Got
%\c (%2X).\n",
            ccs(ich),ich);
        exit(21);
        if (!ich=fgetc(fp)) goto end;
    }
    /* Read in an ANSI sequence */
    tp=tbuf;
    while (!fgetc(fp)==EOF) {
        if (ich==0x20) { tp++=icha; } else break;
    }
}

end:

/* Check the terminating character */
if (ich!=termc) {
    fprintf(stderr,"Error while parsing CSI string from terminal. Unexpected terminator: %c (%02X).\r\n",
        ccs(ich),ich);
    exit(23);
}

/* Parse decimal arguments in the string */
*tp=0;
    tp=tbuf;
    for (ich=0;tp&&ich<*maxp;ich++) {
        *bufp++=atoi(tp);
        tp=strchr(tp,';');
        if (tp) tp++;
    }
    if (tp) fputs("Extra arguments returned from terminal ignored.\r\n",stderr);
*maxp=ich;

/* Example testing program. This will send the cursor to all VT320 screen addresses and make sure that the cursor actually gets there. */

void test(func,fin,fout)
    void (*func)(int,int,FILE * *); /* DG C doesn't like ANSI prototypes */
    FILE *fin,*fout;
{
    int l,c,lc[2],nc;
    for (l=1;l<25;l++) /* for all lines */
        for (c=1;c<81;c++) { /* and columns */
            (*func) (l,c,fout);
            fputs("\33[6n",fout);
            nc=strlen(*lc)/sizeof(*lc);
            ansi_decode(fin,'R',lc,&nc); /* read in data */
            if (nc!=2) {
                fprintf(stderr,"Expected 2 parms returned, got %d.\r\n",nc);
                exit(4);
            }
            if (lc[1]!=c || lc[0] != 1) {
                fprintf(stderr,"Went to %d,%d got %d,%d\r\n",l,c,lc[0],lc[1]);
                exit(3);
            }
        }
}

/* Driver for above testing routine. This will call the above test routine and direct it to use Cursor Position and Horz/Vert Position. */

int run_test(argc,argv)
    int argc;
    char **argv;
{
    set_unbuffered();
/ * Test with CUP command */
    fputs("\e[2J\e[HTesting Cursor Position (CUP) ...\n",stdout);
    test(cursor_position,stdin,stdout);

/* Test with HVP command */
    fputs("\e[2J\e[HTesting Horizontal and Vertical Position (HVP) ...
",stdout);
    test(horizontal_vertical,stdin,stdout);
    fputs("\n\nDone.",stdout);
    return 0;

/* Read binary information from 'fp' and output it in PINK style using VT320
 * commands to 'f'.
 */
define linend(chr) { change_attributes(DIM,f); fputc(chr,f); ch='\n'; }
void show_file(fp,f)
FILE *fp,*f;
{
    int ch,chlast=0,attrs;
    while ((ch=fgetc(fp))!=EOF) {
        attrs=0;
        if (ch > 127) {
            attrs = UNDER; /* then underscore on */
            ch -= 128;
            if (ch < 32) { /* then character is dim */
                attrs |= DIM;
                ch+='@';
            }
            if (ch == 127) { /* then control character */
                attrs |= DIM;
                ch = ' -';
            }
            if (ch == 127) { /* then control character */
                attrs = DIM;
                ch = ' -';
            }
        } else {
            if (ch == 127) { /* then control character */
                attrs = DIM;
                ch = ' -';
            }
            if (ch < 32) { /* then upper bit set */
                attrs = UNDER;
                ch = 128;
            }
        }
        if (chlast==' ') linend('I');
        break;
        case ' ':linend('<');
        break;
        case ' 
':linend(' *,');
        break;
        default:
        ch+=64;
        change_attributes(attrs,f); /* set new attributes */
        fputc(ch,f); /* send out the character */
        if (ch=='\n') fputc('\r',f); /* if LF, do CR also */
Main routine for example code above. This program will read any number of input files and show the output in PINK format.

```c
int show(argc, argv)
int argc;
char **argv;
{
    FILE *fp;
    if (argc<2) {
        fputs("Usage: \n\tSHOW [file-name [file-name ...]]\n",stderr);
        exit(0);
    }
    set_unbuffered();
    while (**++argv) /* for each file in list */
        if (access(*argv,0))  // inaccessible
            fprintf(stderr,"%s does not exist!\n",*argv);
        else if (access(*argv,4))  // insufficient rights
            fprintf(stderr,"Insufficient access rights on %s!\n",*argv);
        else if (fp=fopen(*argv,"r") ==NULL)  // can't open
            fprintf(stderr,"Cannot open %s!\n",*argv);
        else
            if (argc>2) { /* 2 or more files, give names */
                change_attributes(0,stdout);
                printf("\nFile: %s\n",*argv);
            }
            show_file(fp,stdout);
    }
    change_attributes(DIM,stdout);
    return 0;
}
```

Main program

```c
int main(argc, argv)
int argc;
char **argv;
{
    char str[256];
    printf("\nRun (S)how or (T)est? ");
    if (afgets(str,256,stdin)) switch(tolower(*str)) {
        case 's': return show(argc,argv);
        case 't': return run_test(argc,argv);
    }
    return 1;
}
```
VT320 Emulation "Fortran 77"

C vt320_mode.f77 -
C VT320/VT100 mode demonstration.
C
C Initial version 01JUN90.
C
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C use, distribute, and modify this code is hereby granted without monetary
C consideration, provided this copyright message is included in all such
C derivative works. Standard disclaimers regarding merchantability,
C suitability for a particular purpose, etc., all apply. This code is
C distributed with no warranty whatsoever.

C This routine can be used to condition a communication line for binary I/O
C when writing an F77 program under DG AOS. It switches both input and output
C to binary mode, which disables character translation, and unbuffers the
C input.

        subroutine set_up_terminal(iin,iout)
        integer iin,iout

        integer old_attr
        common /VTTERM/ old_attr

        open(unit=iin,file='@input',screenedit='no',maxrec=1,
1    delimiter='include',force='yes',iointent='input',
2    mode='binary',err=100)
        open(unit=iout,file='@output',carriagecontrol='none',
1    screenedit='no',force='yes',iointent='output',mode='binary',
2    err=100)
        old_attr=1
        return

100    continue
        write(*,1)
1     format(' Unable to open your terminal as a binary device.')
        stop
    end

        subroutine wstr(str,iout)
        character*(*) str
        integer iout

        write(iout,'(A)') str
        return
    end

C These routines may be used on any system that uses ASCII to provide support
C for a VT320 or compatible terminal in an F77 program.

        subroutine write_decimal(num,iout)
        integer num,iout

C This routine will send out a generic decimal number without space padding.

        intrinsic char,ichar
        character*20 str
        integer a,i,nu
C If number is negative, send out a leading minus sign.
    
    nu = num
    if (num.lt.0) then
        nu = -nu
        write(iout,'("-",')
    endif

C Extract digits from number.
    i = 20
    10 continue
    a = nu
    nu = nu/10
    str(i:i) = char(a-10*nu+ichar('0'))
    i=i-1
    if (i.gt.0 .and. nu.ne.0) go to 10

C Write out digit string.
    call wstr(str(i+1:20),iout)
    return
end

subroutine cursor_position(l,c,iout)
    integer l,c,iout

    C Example of VT320 Cursor Position (CUP) command.
    C '1' is line number (1 to 24) and 'c' is column number (1 to 80).
    write(iout, , (' <033>[''1''')
    call write_decimal(l,iout)
    write(iout,(''';''')
    call write_decimal(c,iout)
    write(iout, ('''H''')
    return
end

subroutine horizontal_vertical(l,c,iout)
    integer l,c,iout

    C Example of VT320 Horizontal and Vertical position (HVP) command
    C implementation.
    write(iout, (' '<033>[''1''')
    call write_decimal(l,iout)
    write(iout,(''';''')
    call write_decimal(c,iout)
    write(iout, ('''f''')
    return
end

integer function atoi(buf,start,end)
    character(*()) buf
    integer start,end
C Convert character string to integer.

```
intrinsic ichar
character chr
integer i,val
i = start
val = 0
10 continue
chr = buf(i:i)
if (chr.lt.'0'.or.chr.gt.'9') go to 20
val = val*10
val = val+ichar(chr)-ichar('0')
i = i+1
if (i.le.end) go to 10
20 continue
atoi=val
return
end
```

C Insure that character given is printable and return.

```
intrinsic ichar,char
integer ich
ich=ichar(c)
if (ich.ge.128) ich=ich-128
if (ich.lt.32) ich=ichar('.')
ccs=char(ich)
return
end
```

C Decode a CSI sequence returned from the terminal.

```
intrinsic ichar
external ccs,atoi
character ccs
integer atoi
character in
character*128 tbuf
integer tp,ich,i,j
```

C Get a character.

```
read(iin,1,end=100,err=100) in
1 format(A1)
```
C Check for CSI header.
if (in.ne.‘<233>’) then
  if (in.ne.‘<033>’) then
    write(*,2) ccs(in),ichar(in)
    2 format(‘Error while waiting for CSI from terminal. Got ‘,
             A1,’ (‘,Z2.2,’).<015>’)stop
  endif
read(iin,1,end=100,err=100) in
if (in.ne.’[’) then
  write(*,3) ccs(in),ichar(in)
  3 format(‘Error while waiting for CSI from terminal. Got ‘,
             5H<ESC>,A1,’ (1B ’,Z2.2,’).<012><015>’)stop
endif
endif

C Read in the ANSI string.
tp = 0
continue
read(iin,1,end=200,err=200) in
ich = ichar(in)
if (ich.lt.32 .or. ich.gt.63) go to 20
  tp = tp+1
tbuf(tp:tp) = in
  go to 10
20 continue

C Check terminator character.
if (in.ne.termc) then
  write(*,4) ccs(in),ich
  4 format(‘Error while parsing CSI from terminal. Unexpected ‘,
           1 ‘terminator: ‘,A1,’ (‘,Z2.2,’).<012><015>’)stop
endif
C Convert decimal arguments.

    i = 0
    j = 0
30   continue
    i = i+1
    if (i.gt.tp .or. j.ge.maxb) go to 50
    j = j+1
    buf(j) = atoi(tbuf,i,tp)
40   continue
    if (i.gt.tp) go to 50
    if (tbuf(i:i).eq.';') go to 30
    i = i+1
    go to 40
50   continue

    if (i.le.tp) write(*,5)
5   format('Extra arguments returned from terminal ignored.<012><015>')
    maxb = j
    return
100 continue
    write(*,6)
6   format('End of file on input while waiting for CSI.<012><015>')
    stop
200 continue
    write(*,7)
7   format('End of file on input while reading CSI string.<012><015>')
    stop
end
subroutine run_test(func,iin,iout)
    logical func
    integer iin,iout

C Example testing program. This will send the cursor to all VT320 screen
addresses and make sure that the cursor actually gets there.

    integer l,c,rc,rl
    integer nc,lc(2)
C Loop over all rows and columns.
    do 10 l=1,24
    do 10 c=1,80
C Send cursor to position
    rl=l
    rc=c
    if (func) call cursor_position(rl,rc,iout)
    if (.not.func) call horizontal_vertical(rl,rc,iout)
C Read cursor position back
  write(iout,1)
1  format('<033>[6n')
  nc=2
  call ansi_decode('R',lc,nc,iin)
  if (nc.ne.2) then
   write('*2) nc
2  format('Expected 2 parms returned, got ',i2,'.<012><015>')
   stop
   endif
   if (lc(2).ne.c.or. lc(l).ne.l) then
2  format('Went to ',i2,',',i2,' and got ',i2,',',i2,'.<012><015>')
   stop
   endif
10 continue
return
end

subroutine clear_screen(iout)
integer iout
write(iout,'('<033>[2J<033>[H')
return
end

subroutine test
C Driver for above testing routine. This will call the above test routine and
C direct it to use Cursor Position and Horizontal/Vertical Position.

call set_up_terminal(5,6)
call clear_screen(6)
write('*1)
1 format('Testing Cursor Position (CUP) ...<015>')
call run_test(.false.,5,6)
call clear_screen(6)
write('*2)
2 format('Testing Horizontal/Veritical Position (HVP) ...<015>')
call run_test(.true.,5,6)
return
end

subroutine send_attrs(attrs,aary,first,iout)
integer attrs,iout,aary(4)
intrinsic iand
integer i,j
i=1
1 do 10 j=1,4
  if (iand(i,attrs).ne.0) then
    if (.not.first) write(iout,'('';')')
call write_decimal(aary(j),iout)
    first=.false.
  endif
  i=i*2
10 continue
return
end

subroutine change_attributes(attr,iout)
integer attr,iout
C Send the indicated attributes. (Internal routine.)
intrinsic iand
integer i,j
i=1
1 do 10 j=1,4
  if (iand(i,attrs).ne.0) then
    if (.not.first) write(iout,'('';')')
call write_decimal(aary(j),iout)
    first=.false.
  endif
  i=i*2
10 continue
return
end

C Set the attributes to the given state with as few commands as possible.

```fortran
intrinsic ieor, iand
integer old_attr
common /VTTERM/ old_attr
integer vt_off(4), vt_on(4), temp
logical first
data vt_off/1,27,24,25/
data vt_on/22,7,4,5/
```

C Get attributes that differ. If none, then return.

```fortran
temp = ieor(attr, old_attr)
if (temp.eq.0) return
first = .true.
write(iout, '<033>["
' )
call send attrs(iand(temp, old_attr), vt_off, first, iout)
call send attrs(iand(temp, attr), vt_on, first, iout)
write(iout, ' (m)"
' )
old_attr = attr
return
end
```

C Read binary information from fin and output it in PINK style using VT320
C commands to iout.
C This program runs very slowly since the output is unbuffered. This is done
C deliberately since this is a pedagogic example.

```fortran
intrinsic char, ichar
integer dim, reverse, under, blink
data dim, reverse, under, blink/1,2,4,8/
integer attrs, ich, ipos
character ch, chlast
character*255 chstr
chlast = 'a'
ipos = 0
10 continue
if (istext) then
  if (ipos.eq.0) read(fin, 3, end=100, err=200) chstr
3 format (A255)
ipos = ipos+1
ich = ichar(chstr(ipos:ipos))
if (ich.eq.10.or.ipos.eq.255) ipos=0
else
  read(fin, 1, end=100, err=200) ch
1 format (A1)
ich = ichar(ch)
endif
attrs = 0
if (ich.ge.128) then
  attrs = under
  ich = ich-128
else if (ich.lt.32) then
  attrs = attrs+dim
  ich = ich+64
else if (ich.eq.127) then
  attrs = attrs+dim
  ich = ichar('~')
endif
else
  if (ich.eq.127) then
```
attrs=dim
ich=ichar('~')
else if (ich .lt. 32) then
attrs=dim
if (ich .eq. 10) then
    if (chlast .eq. ' ') then
        call change_attributes(dim,iout)
        write(iout,' ("I")'}
    endif
    else if (ich .eq. 13) then
        call change_attributes(dim,iout)
        write(iout,'(<074>)'}
    ich=10
    else if (ich .eq. 12) then
        call change_attributes(dim,iout)
        write(iout,'("*")')
        ich=10
    else
        ich=ich+64
    endif
else if (ich .eq. 10) then
    call change_attributes(dim,iout)
    write(iout,' ("I")'}
else
    ich=ich+64
endif
200 continue
write(*,2)
2 format('Unexpected error while reading file!<012><015>').' 100 continue
returnend
subroutine extract_next(inline,i,ilen,fname)
character*80 inline
integer i,ilen
character*32 fname
C Internal routine -- extract next file name from input line.
integer j
fname=' 
j=1
10 continue
if (inline(i:i).gt.' ') go to 20
i=i+1
if (i.gt.ilen) return
go to 10
20 continue
fname(j:j)=inline(i:i)
j=j+1
i=i+1
if (i.gt.ilen.or.j.gt.32) return
if (inline(i:i).gt.' ') go to 20
return
end
subroutine show
C Main routine for example code above. This program will read any number of
C input files and show the output in PINK format.

    integer nfiles,i
    character*32 fname
    character*80 inline
    logical istext

C Prompt for file names.
    write(*,'("<015>Enter names of files to show: "")')
    read(*,'(A80)') inline
    write(*,'("<015>")')

C Count the number of files.
    do 20 ilen=80,1,-1
        if (inline(ilen:ilen).ne.' ') go to 30
    20 continue
    nfiles=0
    i=1
    40 continue
    call extract_next(inline,i,ilen,fname)
    if (fname(I:1).eq.' ') go to 50
    nfiles=nfiles+1
    go to 40

50 continue
    if (nfiles.le.0) then
        write(*,1)
        format('Usage:/'/8X,'SHOW [file-name [file-name ...]])'
        stop
    endif

C Loop over files and send them to the screen.
    call set_up_terminal(5,6)
    i=1
    10 continue
    call extract_next(inline,i,ilen,fname)
    if (fname(I:1).eq.' ') go to 60
    istext = .false.
    open(unit=20,file=fname,iointent='input',mode='binary',
    status='old',maxrecl=1,delimiter='include',err=100)
    102 continue

C If there is more than one file requested, write out the names.
    if (nfiles.gt.1) then
        call change_attributes(0,6)
        write(6,2) fname
        format('<015>File: ',A32,'<012>','<015>')
    endif
C Send the file to the screen.
    call show_file(20, istext, 6)
    go to 10

100 continue
    istext = .true.
    open(unit=20, file=fname, status='old', recfm='datasensitive',
         maxrec=255, delimiter='include', pad='yes', err=101)
    go to 102
101 continue
    write(*,3) fname
3 format('<015>Unable to locate file: ','A32','<012><015>')
    go to 10
60 continue
    call change_attributes(0,6)
    return
end

program which
character ans
write(*,')(<015>Run (S)how or (T)est? ')'
read(*,(A1)) ans
if (ans.eq.'s'.or.ans.eq.'S') call show
if (ans.eq.'t'.or.ans.eq.'T') call test
end
VT52 Emulation "C"

/* vt52_mode.c -
 * This program permits the user to draw lines using the VT52 graphics
 * mode (line drawing) characters. This program also demonstrates a
 * set of routines for use with the DEC VT52.
 *
 * Usage:
 * The following keys are valid (case is not significant):
 * Key    Description
 * M      Set movement to non-destructive, non-drawing.
 * D      Set movement to drawing.
 * E      Set movement to erasing.
 * S      Save screen data in a file.
 * Q      Quit
 *        The arrow keys move the cursor about the screen, and optionally draw or
 *        erase lines.
 *
 * Initial version 01JUN90 by James Carlson.
 *
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 * consideration, provided this copyright message is included in all such
 * derivative works. Standard disclaimers regarding merchantability,
 * suitability for a particular purpose, etcetera, all apply. This code is
 * distributed with no warranty whatsoever.
 */
#include <stdio.h>

void set_up_terminal()
{
    if (freopen("@input","j",stdin)==NULL) {
        fprintf(stderr,"Unable to open your terminal for binary input.\n");
        exit(1);
    }
    setbuf(stdin,NULL);
    if (freopen("@output","k",stdout)==NULL) {
        fprintf(stderr,"Unable to open your terminal for binary output.\n");
        exit(2);
    }
}
/ This routine is required for AOS because it mistakenly uses LF for
 end-of-line, rather than CR, and it assumes DG mode cursor controls.

char *
afgets(str,len,fp)
char *str;
int len;
FILE *fp;
{
    int chr,ilen;
    if (fp != stdin)
        return fgets(str,len,fp);
    chr = fgetc(fp);
    if (chr == EOF)
        return NULL;
    ilen = 0;
    for (;; chr=fgetc(fp)) switch (chr) {
        case EOF:
        case 'r':
        case 'n':
            if (ilen == 0)
                break;
            fputs("\r\n",stdout);
            fflush(stdout);
            break;
        case '10':
        case '177':
            if (ilen == 0)
                break;
            fputs("\10 \10",stdout);
            str--; ilen--;
            break;
        default:
            if (ilen+1 >= len)
                break;
            fputc(chr,stdout);
            *str++ = chr;
            ilen++;
            break;
    }
    /*NOTREACHED*/
}
/* The first section of this program provides support routines for moving
* the cursor around the screen.
*/
int crow, ccol;
/* Go to a specific row and column */
void
VT52_set_position(row, col, fp)
int row, col;
FILE *fp;
{
    if (row==0 && col==0)
        fputs("\33H",fp);  /* special case -- home */
    else {
        int absflag=0;
        /* Set flag if column move is expensive */
        if (col!=ccol && col!=0)
            absflag=1;
        /* Check for inexpensive row movement */
        if (row==crow+1 && absflag==0)
            fputc('\12',fp);
        else if (row==crow-1 && col==ccol)
            fputs("\33A",fp);
        else if (row!=crow)
            absflag=2;
        /* If movement not expensive and column changes, do column move */
        if (absflag!=2 && col!=ccol)
            if (col==0)
                fputc('\15',fp);
            else if (col==ccol+1)
                fputs("\33C",fp);
            else if (col==ccol-1)
                fputc('\10',fp);
            else
                absflag=2;
        /* If movement is expensive, then do absolute row/col positioning */
        if (absflag==2)
            fprintf(fp, "\33Y%c%c",row+' ',col+' ');
    }
    crow = row;
    ccol = col;
}
/* Clear the screen and home the cursor */
void
VT52_clear(fp)
FILE *fp;
{
    VT52_set_position(0,0,fp);
    fputs("\33J",fp);
}
/* Put into graphics (line drawing) mode */
void
VT52_graphics_mode(fp)
FILE *fp;
{
    fputs("\33F",fp);
}
/* Exit graphics (line drawing) mode */
void
VT52_normal_mode(fp)
FILE*fp;
{
    fputs("\33G",fp);
}

/* The second part of this program implements the line-drawing algorithm for
the special graphics characters. */
#define NROWS 24
#define NCOLS 80

/* The screen array contains the encoded line connection information */
char screen[NROWS][NCOLS];

/* These constants define bits used for connection information */
#define LEFTCON 1
#define RIGHTCON 2
#define UPCON 4
#define DOWNCON 8

/* This string defines the characters used to show connectivity above */
char lines[] = "qqqjmvklwxuhtn";

/* This flag indicates whether drawing, moving or erasing */
int Drawing;

/* Put connected line drawing character on screen at current position */
void
show_connection(fp)
FILE*fp;
{
    fputc(lines[screen[row][col]],fp);      /* put connected line char */
    if (col != NCOLS-1)                    /* VT52 has no autowrap */
        col++;
}

/* Clear the screen, then loop through all of the screen data and produce
a minimized sequence to produce that image on the screen. */
void
redraw_screen(fp)
FILE*fp;
{
    int row,col;
    VT52_clear(fp);
    VT52_graphics_mode(fp);
    for (row=0;row<NROWS;row++)            /* loop over rows */
        for (col=0;col<NCOLS;col++)        /* ... and columns */
            if (screen[row][col])         /* if non-blank */
                VT52_set_position(row,col,fp); /* go there */
                show_connection(fp);        /* show data */
}
/* Get a file name from the user and save the screen data there */
void save_file()
{
    char temp[128];
    FILE *fp;
    int rowsave, colssave;

    rowsave = crow;
    colssave = ccol;
    VT52_clear(stdout);
    VT52_normal_mode(stdout);
    printf("File name for data: ");
    afgets(temp, 128, stdin);
    if (*temp == '\0')
        printf("No data saved.");
    else if ((fp = fopen(temp, "w")) == NULL)
        printf("Unable to open %s for output.", temp);
    else {
        redraw_screen(fp); /* send controls to file */
        VT52_normal_mode(fp); /* put a mode exit at end */
        VT52_set_position(NROWS-2, 0, fp);
        close(fp);
        printf("Saved screen data in %s.", temp);
    }
    printf(" Press <CR> to continue.\r\n");
    afgets(temp, 128, stdin);
    redraw_screen(stdout); /* put user's screen back up */
    VT52_set_position(rowsave, colssave, stdout);
}

/* Set the connection type for the current cell and update the VT52 screen */
void set_connection(conn)
char conn;
{
    int colssave;
    colssave = ccol;
    switch (Drawing) {
        case 1: /* Drawing */
            if (screen[crow][ccol] & conn) /* already set */
                return;
            screen[crow][ccol] |= conn;
            show_connection(stdout);
            break;
        case -1: /* Erasing */
            if ((screen[crow][ccol] & conn) == 0) /* already clear */
                return;
            screen[crow][ccol] &= ~conn;
            show_connection(stdout);
            break;
    }
    VT52_set_position(crow, colssave, stdout); /* put cursor back */
}
/* Handle <ESC><char> keyboard sequences (see dispatch below) */
void
esc_dispatch()
{
    switch (fgetc(stdin)) {
        case 'A':
            set_connection(UPCON); /* leave through top */
            if (crow==0) break;
            VT52_set_position(crow-1,ccol,stdout);
            set_connection(DOWNCON); /* enter through bot */
            break;
        case 'B':
            set_connection(DOWNCON); /* leave through bot */
            if (crow==NROWS-1) break;
            VT52_set_position(crow+1,ccol,stdout);
            set_connection(UPCON); /* enter through top */
            break;
        case 'C':
            set_connection(RIGHTCON); /* leave through right */
            if (ccol==NCOLS-1) break;
            VT52_set_position(crow,ccol+1,stdout);
            set_connection(LEFTCON); /* enter through left */
            break;
        case 'D':
            set_connection(LEFTCON); /* leave through left */
            if (ccol==0) break;
            VT52_set_position(crow,ccol-1,stdout);
            set_connection(RIGHTCON); /* enter through right */
            break;
    }
}
/* Dispatch user's input */
void
dispatch()
{
    for (;;) switch (fgetc(stdin)) {
        case '\33':
            esc_dispatch(); /* ESC sequence */
            break;
        case '\15': /* CR */
            VT52_set_position(crow,0,stdout);
            break;
        case 'm': case 'M':
            Drawing = 0;
            break;
        case 'd': case 'D':
            Drawing = 1;
            break;
        case 'e': case 'E':
            Drawing = -1;
            break;
        case 's': case 'S':
            save_file(); /* Save screen in file */
            break;
        case 'q': case 'Q':
            return; /* Quit */
    }
    /*NOTREACHED*/
}
/* Initialize internal data for program */
void
initialize()
{
    int i;
    char *sp;

    sp=screen;
    for (i=NROWS*NCOLS;i>0;i--)
        *sp++ = 0;
    Drawing=1;
    VT52_clear(stdout);
    VT52_graphics_mode(stdout);
}

int
main(argc,argv)
int argc;
char **argv;
{
    set_up_terminal();
    initialize();
    dispatch();
    VT52_clear(stdout);
    VT52_normal_mode(stdout);
    return 0;
}
VT52 Emulation "Fortran 77"

C vt52_mode.f77 -
C This program permits the user to draw lines using the VT52 graphics
C mode (line drawing) characters. This program also demonstrates a
C set of routines for use with the DEC VT52.
C
C Usage:
C
C The following keys are valid (case is not significant):
C
<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>Set movement to non-destructive, non-drawing.</td>
</tr>
<tr>
<td>D</td>
<td>Set movement to drawing.</td>
</tr>
<tr>
<td>E</td>
<td>Set movement to erasing.</td>
</tr>
<tr>
<td>S</td>
<td>Save screen data in a file.</td>
</tr>
<tr>
<td>Q</td>
<td>Quit</td>
</tr>
</tbody>
</table>

The arrow keys move the cursor about the screen, and optionally draw or erase lines.

C Initial version 01JUN90.
C
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C use, distribute, and modify this code is hereby granted without monetary
C consideration, provided this copyright message is included in all such
C derivative works. Standard disclaimers regarding merchantability,
C suitability for a particular purpose, et cetera, all apply. This code is
C distributed with no warranty whatsoever.

C This routine can be used to condition a communication line for binary I/O
C when writing an F77 program under DG AOS. It switches both input and output
C to binary mode, which disables character translation, and unbuffers the
C input.

subroutine set_up_terminal
   integer stdin,stdout
   common /prog/ stdin,stdout
   open(unit=stdin,file='@input',screenedit='no',maxrec=1,
1   delimiter='include',force='yes',iointent='input',
2   mode='binary',err=100)
   open(unit=stdout,file='@output',carriagecontrol='none',
1   screenedit='no',force='yes',iointent='output',mode='binary',
2   err=100)
   return
100   continue
   write(*,'(" Unable to open your terminal as a binary device.")')
   stop
end
The first section of this program provides support routines for moving the cursor around the screen.

```fortran
character function getc(iin)
  integer iin
  character ch
  read(iin,1,err=100,end=100) ch
1  format(A1)
  getc=ch
  return
100 continue
  getc=' ,
  return
end

subroutine VT52_set-position(row,col,iout)
  integer row,col,iout
  integer stdin,stdout,output,crow,ccol
  common /prog/ stdin,stdout,output,crow,ccol
  integer absflag
  integer*2 cblank
  data cblank/2H /
  integer*2 c1,c2
  if (row.eq.0 .and. col.eq.0) then
    C Special case -- home
    write (iout,'('<033>H")')
  else
    absflag=0
    C Set flag if column move is expensive.
    if (col.ne.ccol .and. col.ne.0) absflag=1
    C Check for inexpensive row movement.
    if (row.eq.crow+1 .and. absflag.eq.0) then
      write(iout,'('<012")')
    else if (row.eq.crow-1 .and. col.eq.ccol) then
      write(iout,'('<033>A")')
    else
      if (row.ne.crow) absflag=2
    endif
    C If movement not expensive and column changes, do column move.
    if (absflag.ne.2 .and. col.ne.ccol) then
      if (col.eq.0) then
        write(iout,'('<015")')
      else if (col.eq.ccol+1) then
        write(iout,'('<033>C")')
      else if (col.eq.ccol-1) then
        write(iout,'('<010")')
      else
        absflag=2
      endif
    endif
  endif
end
```

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C If movement is expensive, then do absolute row/col positioning.
if (absflag.eq.2) then
  cl = cblank + row*256
  c2 = cblank + col*256
  write(iout,1) cl, c2
1  format (<033>Y', 2Al)
endif
endif
crow = row
ccol = col
return
end

subroutine VT52_clear(iout)
integer iout
C Clear the screen and home the cursor.
call VT52_set-position(0, 0, iout)
write(iout,'('<033>J')')
return
end

subroutine VT52_graphics_mode(iout)
integer iout
C Put into graphics (line drawing) mode.
write(iout,'('<033>F')')
return
end

subroutine VT52_normal_mode(iout)
integer iout
C Exit graphics (line drawing) mode.
write(iout,'('<033>G')')
return
end

C The second part of this program implements the line-drawing algorithm for
C the special graphics characters.

subroutine show_connection (iout)
integer iout
C Put connected line drawing character on screen at current position.
integer NROWS, NCOLS
parameter (NROWS=24)
parameter (NCOLS=80)
integer stdin, stdout, output, crow, ccol, drawing, screen(NCOLS, NROWS)
common /prog/ stdin, stdout, output, crow, ccol, drawing, screen

C This string defines the characters used to show connectivity.
class*16 lines
  data lines/' qqqxjmvxklwxutn'/
  integer i
C Put connected line character.
  i = screen(ccol+i, crow+i)+1
  write(iout, '(A1)') lines(i:i)
C VT52 has no autowrap.
    if (ccol .ne. NCOLS-1) ccol = ccol+1
    return
end

subroutine redraw_screen(iout)
  integer iout
C Clear the screen, then loop through all of the screen data and produce
C a minimized sequence to produce that image on the screen.
  integer NROWS, NCOLS
  parameter (NROWS=24)
  parameter (NCOLS=80)
  integer stdin, stdout, output, crow, ccol, drawing, screen(NCOLS, NROWS)
  common /prog/ stdin, stdout, output, crow, ccol, drawing, screen
  integer row, col, r, c
C Reset the screen.
  call VT52_clear(iout)
  call VT52_graphics_mode(iout)
C Loop over rows and columns on screen.
  do 10 r=1, NROWS
    do 10 c=1, NCOLS
      row=r-1
      col=c-1
      if (screen(c,r) .ne. 0) then
C If non-blank in this position, then update data here
        call VT52_set_position(row, col, iout)
        call show_connection(iout)
      endif
  continue
  return
end

subroutine save_file
C Get a file name from the user and save the screen data there.
  integer NROWS, NCOLS
  parameter (NROWS=24)
  parameter (NCOLS=80)
  integer stdin, stdout, output, crow, ccol, drawing, screen(NCOLS, NROWS)
  common /prog/ stdin, stdout, output, crow, ccol, drawing, screen
  character*64 temp
  integer rowsave, colssave
C Save current cursor position.
  rowsave=crow
  colssave=ccol
C Reset the screen and put back to normal text mode.
  call VT52_clear(stdout)
  call VT52_normal_mode(stdout)
C Prompt user for name of file for output data.
write(*,'("File name for data: ")')
read(11,1) temp
write(*,'("<015>")')

C Open file and save data.
if (temp(l:l).eq.' ') then
  write(*,'("No data saved. ")')
else
  open(unit=output,file=temp,carriagecontrol='none',
  1     screenedit='no',force='yes',iointent='output',mode='binary',
  2     err=100)
C Send controls to file.
call redraw_screen(output)
C Put a mode exit at end of file.
call VT52_normal_mode(output)
call VT52_set_position(NROWS-2,0,output)
close(iout)
write(*,2) temp
2 format('Saved screen data in: ',A64,'<015><012>')
endif
200 continue
write(*,'("Press CR to continue.<015><012>")')
read(11,1) temp
C Put user's screen back up.
call set_up_terminal
call redraw_screen(stdout)
call VT52_set_position(rowsave,colsave,stdout)
return
100 continue
write(*,3) temp
3 format('Unable to open file for output: ',A64,'<015><012>')
go to 200
end

subroutine set_connection(conn)
integer conn -
C Set the connection type for the current cell and update the VT52 screen
intrinsic iand,ior,ixor
integer NROWS,NCOLS
parameter (NROWS=24)
parameter (NCOLS=80)
integer stdin,stdout,output,crow,ccol,drawing,screen(NCOLS,NROWS)
common /prog/ stdin,stdout,output,crow,ccol,drawing,screen
integer colsave
colsav+1,crow+1),conn).ne.0) return
screen(ccol+1,crow+1) = ior(screen(ccol+1,crow+1),conn)
call show_connection(stdout)
else if (drawing.eq.-1) then
C Is the flag already set?
if (iand(screen(ccol+1,crow+1),conn).ne.0) return
screen(ccol+1,crow+1) = ior(screen(ccol+1,crow+1),conn)
call show_connection(stdout)
if (iand(screen(ccol+1,crow+1),conn).eq.0) return
screen(ccol+1,crow+1) = ixor(screen(ccol+1,crow+1),conn)
call show_connection(stdout)
endif

C Put cursor back in place.
call VT52_set_position(crow,colsave,stdout)
return
derint

subroutine esc_dispatch
C Handle <ESC><char> keyboard sequences (see dispatch below).

external getc
character getc

C These constants define bits used for connection information.
integer LEFTCON,RIGHTCON,UPCON,DOWNCON
parameter (LEFTCON=1)
parameter (RIGHTCON=2)
parameter (UPCON=4)
parameter (DOWNCON=8)

integer NROWS,NCOLS
parameter (NROWS=24)
parameter (NCOLS=80)

integer stdin,stdout,output,crow,ccol
common /prog/ stdin,stdout,output,crow,ccol

character chr
chr=getc(stdin)
if (chr.eq.'A') then
C Leave through top, then enter through bottom.
call set_connection(UPCON)
if (crow.ne.0) then
call VT52_set_position(crow-1,ccol,stdout)
call set_connection(DOWNCON)
endif
else if (chr.eq.'B') then
C Leave through bottom, then enter through top.
call set_connection(DOWNCON)
if (crow.ne.NROWS-1) then
call VT52_set_position(crow+1,ccol,stdout)
call set_connection(UPCON)
endif
else if (chr.eq.'C') then
C Leave through right, then enter through left.
call set_connection(RIGHTCON)
if (ccol.ne.NCOLS-1) then
call VT52_set_position(crow,ccol+1,stdout)
call set_connection(LEFTCON)
endif
else if (chr.eq.'D') then
C Leave through left, then enter through right.
call set_connection(LEFTCON)
if (ccol.ne.0) then
call VT52_set_position(crow,ccol-1,stdout)
call set_connection(RIGHTCON)
endif
endif
return
end

subroutine dispatch

C Dispatch user's input.

external getc
character getc

integer stdin, stdout, output, crow, ccol, drawing
common /prog/ stdin, stdout, output, crow, ccol, drawing

character chr

10 continue
chr = getc(stdin)
if (chr.eq. '<033>') then
   call esc_dispatch
else if (chr.eq. '<015>') then
   call VT52_set_position(crow, 0, stdout)
else if (chr.eq. 'm' .or. chr.eq. 'M') then
   Drawing = 0
else if (chr.eq. 'd' .or. chr.eq. 'D') then
   Drawing = 1
else if (chr.eq. 'e' .or. chr.eq. 'E') then
   Drawing = -1
else if (chr.eq. 's' .or. chr.eq. 'S') then
   call save_file
else if (chr.eq. 'q' .or. chr.eq. 'Q') then
   return
endif
10 go to

end subroutine initialize

C Initialize internal data for program.

integer NROWS, NCOLS
parameter (NROWS = 24)
parameter (NCOLS = 80)

integer stdin, stdout, output, crow, ccol, drawing, screen(NCOLS, NROWS)
common /prog/ stdin, stdout, output, crow, ccol, drawing, screen

integer i, j

C Initialize connection array.
C The screen array contains the encoded line connection information.
do 10 i = 1, NROWS
   do 10 j = 1, NCOLS
      screen(j, i) = 0
10 continue
C Set drawing mode.
drawing = 1
C Clear screen and enter line drawing mode
call VT52_clear(stdout)
call VT52_graphics_mode(stdout)

return
end
program drawing
C This is the main program.
    integer stdin, stdout, output
    common /prog/ stdin, stdout, output
    stdin = 5
    stdout = 6
    output = 7
C Set to unbuffered binary communication.
    call set_up_terminal
C Setup internal data
    call initialize
C Handle user's commands
    call dispatch
C Reset VT52 modes before exit
    call VT52_clear(stdout)
    call VT52_normal_mode(stdout)
end
Tektronix 4010 Emulation “C”

(/^	* tek_mode.c - 
* This program permits the user to draw lines using the Tek4010 emulation 
* mode. This program also demonstrates a set of routines for use with 
* the Tektronix 4010. 
* 
* Usage: 
* Use the following keys to enter points - 
* Key Description 
* L Begin a line at current location 
* B Begin a box at current location 
* T Begin entering text here 
* D Delete last object 
* S Save objects in file 
* Q Quit 
* SPACE Finish operation (line, box) here 
* NewLine Finish operation (line, box, text) here 
* 
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* consideration, provided this copyright message is included in all such 
* derivative works. Standard disclaimers regarding merchantability, 
* suitability for a particular purpose, et cetera, all apply. This code is 
* distributed with no warranty whatsoever. */
#include <stdio.h>

/*
* This routine can be used to condition a communication line for binary I/O 
* when writing a C program under DG AOS. It switches both input and output 
* to binary mode, which disables character translation, and unbuffers the 
* input. */

void 
set_up_terminal() {
    if (freopen("@input","j",stdin)==NULL) {
        fprintf(stderr,"Unable to open your terminal for binary input.\n");
        exit(1);
    }
    setbuf(stdin,NULL);
    if (freopen("@output","k",stdout)==NULL) {
        fprintf(stderr,"Unable to open your terminal for binary output.\n");
        exit(2);
    }
}
/ This routine is required for AOS because it mistakenly uses LF for end-of-line, rather than CR, and it assumes DG mode cursor controls. */

char *

afgets(str,len,fp) 

char *str; 

int len; 

FILE *fp; 

{ 

int chr,ilen; 

if (fp != stdin) 

return fgets(str,len,fp); 

chr = fgetc(fp); 

if (chr == EOF) 

return NULL; 

ilen = 0; 

for (;;)chr=fgetc(fp)) switch (chr) { 

case EOF: 

case 'r': 

case '\n': 

if (len != 0) 

str = '\0'; 

fputs("\r\n",stdout); 

fflush(stdout); 

return str; 

case '\10': 

case '\177': 

default: 

if (ilen+1 >= len) 

break; 

fputc(chr,stdout); 

str++; 

ilen++; 

} 

/*NOTREACHED*/

} 

typedef struct { 

FILE *fp; 

int xbeam,ybeam; 

enum { Initial, Alpha, Drawing } state; 

} Device; 

/* Convert two characters from terminal into 10 bit number */

int 

tenbit(high,low) 

char high,low; 

{ 

return ( ((high & 0xlF) << 5) + (low & 0xlF) ); 

} 

/* Get a point on the screen from the user. */

char 

gpoint(xp,yp,outd)
int *xp,*yp;
Device *outd;
{
    char buffer[4];
    int c,i;
    /* Start cross-hair */
    fputs("\037\033\032",stdout);
    /* Wait for key press */
    c=fgetc(stdin)&0x7F;
    for(i=0;i<4;i++) buffer[i]=fgetc(stdin)&0x7F;
    (*xp) = tenbit(buffer[0],buffer[1]);
    (*yp) = tenbit(buffer[2],buffer[3]);
    outd->state = Alpha;
    return c;
}

void
optimizesend(x,y,outd)
int x,y;
Device *outd;
{
    int hox,hoy,hoxb,hoyb;
    int lox,loy,loxh,loyy;
    /* Extract 5 bit portions of the data */
    hox = x>>5;
    hoy = y>>5;
    lox = x&0x1F;
    loy = y&0x1F;
    if (outd->state == Initial) {
        hoxb = hox+1;
        hoyb = hoy+1;
        loxb = lox+1;
        loyb = loy+1;
    }
    else {
        hoxb = outd->xbeam>>5;
        hoyb = outd->ybeam>>5;
        loxb = outd->xbeam&0x1F;
        loyb = outd->ybeam&0x1F;
    }
    /* Do optimized Tek coordinate transmission */
    if (hoy != hoyb) putc(hoy+0x20,outd->fp);
    if ((loy != loyb) || (hox != hoxb)) putc(loy+0x60,outd->fp);
    if (hox != hoxb) putc(hox+0x20,outd->fp);
    putc(lox+0x40,outd->fp);
    outd->xbeam=x;
    outd->ybeam=y;
}

void
darkto(x,y,outd)
int x,y;
Device *outd;
{
    if (x!=outd->xbeam || y!=outd->ybeam || outd->state!=Drawing) {
        putc('\035',outd->fp);
        optimizesend(x,y,outd);
        outd->state = Drawing;
    }
}

void
gotoalpha(outd)
Device *outd;
{
    if (outd->state != Alpha) {
       putc('\037',outd->fp);
        outd->state = Alpha;
    }
}

void startstring(x,y,outd)
int x,y;
Device *outd;
{
    darkto(x,y,outd);
    gotoalpha(outd);
}

void drawvector(xfrom,yfrom,xto,yto,outd)
int xfrom,yfrom,xto,yto;
Device *outd;
{
    darkto(xfrom,yfrom,outd);
    optimizeend(xto,yto,outd);
}

void clearscrenn(outd)
Device *outd;
{
    fputs("\033\014",outd->fp);
    outd->state = Initial;
}

typedef struct _item {
    struct _item *next;
    enum {
        None, Line, Box, Text
    } type;
    int xloc,yloc;
    union {
        char *textp;
        struct {
            int x2,y2;
        } x;
    } x;
} Item;

Item *list = NULL;
#define New(x) ((x *)malloc(sizeof(x)))

void draw_object(it,outd)
Item *it;
Device *outd;
{
    switch (it->type) {
    case Line:
        drawvector(it->xloc,it->yloc,it->x.x.x2,it->x.x.y2,outd);
        break;
    case Box:
        drawvector(it->xloc,it->yloc,it->xloc,it->x.x.y2,outd);
        drawvector(it->xloc,it->yloc,it->x.x.y2,it->x.x.x2,outd);
        drawvector(it->x.x.x2,it->yloc,outd);
        drawvector(it->x.x.x2,it->yloc,it->xloc,outd);
        break;
    }
}
break;
    case Text:
        startstring(it->xloc, it->yloc, outd);
        fputs(it->x.textp, outd->fp);
        break;
    }

void
redraw_screen(outd)
Device *outd;
{
    Item *temp;
    clearscren(outd);
    for (temp=list;temp;temp=temp->next)
        draw_object(temp, outd);
}

/* Get a file name from the user and save the screen data there */

void
save_file(outd)
Device *outd;
{
    char temp[128];
    Device file;
    clearscren(outd);
    printf("File name for data: ");
    afgets(temp,128,stdin);
    if (*temp=='\0')
        printf("No data saved.");
    else if ((file.fp=fopen(temp,"w"))==NULL)
        printf("Unable to open %s for output.",temp);
    else {
        redraw_screen(&file);  /* send controls to file */
        gotoalpha(&file);      /* put a mode exit at end */
        close(file.fp);
        printf("Saved screen data in %s.",temp);
    }
    printf(" Press <CR> to continue. \r\n");
    afgets(temp,128,stdin);
    redraw_screen(outd);  /* put user's screen back up */
}

void
commit_object(it)
Item *it;
{
    Item *temp;
    temp = New(Item);
    *temp = *it;
    temp->next = list;
    list = temp;
}

void
dellast(outd)
Device *outd;
{
    Item *temp;
    if (list==NULL)
        return;
    C-56
temp = list;
list = temp->next;
if (temp->type==Text) free(temp->x.textp);
free(temp);
redraw_screen(outd);
}

void gettext(Item *it, Device *outd)
{
    char temp[128];
    startstring(it->xloc,it->yloc,outd);
    if (afgets(temp,128,stdin)!=NULL && temp[0]!='\0') {
        it->x.textp = strsave(temp);
        commit_object(it);
    }
}

static void ptcopy(Item *it)
{
    it->xloc = it->x.x.x2;
    it->yloc = it->x.x.y2;
}

/* Dispatch user's input */

void dispatch(Device *outd)
{
    Item temp;
    temp.type = None;
    for (;;) switch (getpoint(&temp.x.x.x2,&temp.x.x.y2,outd)) {
        case '\l5': /* CR */
            if (temp.type != None) {
                draw_object(&temp,outd);
                commit_object(&temp);
            }
            ptcopy(&temp);
            break;
        case '1': case 'L':
            ptcopy(&temp);
            temp.type = Line;
            break;
        case 'b': case 'B':
            ptcopy(&temp);
            temp.type = Box;
            break;
        case 't': case 'T':
            ptcopy(&temp);
            temp.type = Text;
            gettext(&temp,outd);
            temp.type = None;
            /* Can't duplicate item */
            break;
        case 'd': case 'D':
            dellast(outd);
            break;
        case 's': case 'S':
            break;
    }
}
save_file(outd);       /* Save screen in file */
break;
case 'q': case 'Q':
    return;                /* Quit */
    
/*NOTREACHED*/
}
void
initialize(outd)
Device *outd;
{
    outd->fp = stdout;
    clearscreen(outd);
}
/* Main program */

int
main(argc,argv)
int argc;
char **argv;
{
    Device terminal;
    set_up_terminal();       /* set to unbuffered binary */
    initialize(&terminal);   /* setup internal data */
    dispatch(&terminal);     /* handle user's commands */
    clearscreen(&terminal);
    return 0;
}
Tektronix 4010 Emulation “Fortran 77”

C tek_mode.f77 -
C This program permits the user to draw lines using the Tek4010 emulation
C mode. This program also demonstrates a set of routines for use with
C the Tektronix 4010.
C
C Usage:
C Use the following keys to enter points -

Key | Description
---|----------------
L   | Begin a line at current location
B   | Begin a box at current location
T   | Begin entering text here
D   | Delete last object
S   | Save objects in file
Q   | Quit
SPACE | Finish operation (line, box) here
NewLine | Finish operation (line, box, text) here

C Initial version 01JUN90.

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C suitability for a particular purpose, et cetera, all apply. This code is
C distributed with no warranty whatsoever.

C This routine can be used to condition a communication line for binary I/O
C when writing an F77 program under DG AOS. It switches both input and output
C to binary mode, which disables character translation, and unbuffers the
C input.

subroutine set_up_terminal
    integer stdin,stdout
    common /units/ stdin,stdout
    open(unit=stdin,file='@input',screenedit='no',maxrecl=1,
       1 delimiter='include',iointent='input',mode='binary',err=100)
    open(unit=stdout,file='@output',carriagecontrol='none',
       1 screenedit='no',iointent='output',mode='binary',err=100)
    return
  100 continue
    write(*,\"Unable to open your terminal as a binary device.\")
    stop
end
The first section of this program provides support routines for moving the cursor around the screen.

```c
character function getc(iin)
integer iin
character ch

read(iin,1,err=100,end=100) ch
1 format(A1)
getc=ch
return
100 continue
getc=' '
return
end
```

**Device structure:**
1 - output file unit number
2 - X beam position
3 - Y beam position
4 - State (0 - initial, 1 - alpha, 2 - drawing)

```c
integer function tenbit(high,low)
character high, low

C Convert two characters from terminal into 10 bit number.
intrinsic ichar,iand
tenbit = iand(ichar(high),31)*32 + iand(ichar(low),31)
return
end
```

```c
character function getpoint(x,y,outd)
integer x,y,outd(4)

C Get a point on the screen from the user.

external getc,tenbit
character getc
integer tenbit
integer stdin,stdout
common /units/ stdin,stdout
character buffer(4)
integer i

C Start cross-hair.
write(*,'("\"<037><033><032>"\")")
```

```c
C Wait for key press.
getpoint = getc(stdin)
do 10 i=1,4
buffer(i) = getc(stdin)
10 continue
```
C Decode received point data.
   \[ x = \text{tenbit(buffer}(1),\text{buffer}(2)) \]
   \[ y = \text{tenbit(buffer}(3),\text{buffer}(4)) \]
   outd(4) = 1
   return
end

subroutine optimizesend(x,y,outd)
    integer x,y,outd(4)
    int iand, char
    integer hox,hoy,hoxb,hoyb
    integer lox,loy,loxb,loyb

C Extract 5 bit portions of the data.
   \[ hox = x/32 \]
   \[ hoy = y/32 \]
   \[ lox = \text{iand}(x,31) \]
   \[ loy = \text{iand}(y,31) \]
   if (outd(4) .eq. 0) then
      \[ hoxb = hox+1 \]
      \[ hoyb = hoy+1 \]
      \[ loxb = lox+1 \]
      \[ loyb = loy+1 \]
   else
      \[ hoxb = \text{outd}(2)/32 \]
      \[ hoyb = \text{outd}(3)/32 \]
      \[ loxb = \text{iand(\text{outd}(2),31)} \]
      \[ loyb = \text{iand(\text{outd}(3),31)} \]
   endif

C Do optimized Tek coordinate transmission.
   if (hoy.ne.hoyb) write(\text{outd}(1),1) char(hoy+32)
   if (loy.ne.loyb .or. hox.ne.hoxb) write(\text{outd}(1),1) char(loy+96)
   if (hox.ne.hoxb) write(\text{outd}(1),1) char(hox+32)
   \text{write}(\text{outd}(1),1) char(lox+64)
   1 format(A1)
   outd(2) = x
   oux(3) = y
   return
end

subroutine darkto(x,y,outd)
    integer x,y,outd(4)
    C Send the beam to a new position without drawing.
    if (x.ne.outd(2) .or. y.ne.outd(3) .or. outd(4).ne.2) then
      write(outd(1),1) ('<035>')
      call optimizesend(x,y,outd)
      outd(4) = 2
      return
   endif
end

subroutine gotoalpha(outd)
    integer outd(4)

C C-S1
C Send device into alpha mode.

if (outd(4).ne.1) then
    write(outd(1),’(‘’<037>’’)’)
    outd(4) = 1
endif
return
end

subroutine startstring(x,y,outd)
integer x,y,outd(4)
C Begin printing string at given location.
call darkto(x,y,outd)
call gotoalpha(outd)
return
end

subroutine drawvector(xfrom,yfrom,xto,yto,outd)
integer xfrom,yfrom,xto,yto,outd(4)
C Draw a vector between the given points.
call darkto(xfrom,yfrom,outd)
call optimizesend(xto,yto,outd)
return
end

subroutine clearscreen(outd)
integer outd(4)
C Initialize the screen of the given device.
write (outd(1),’(‘’<033><014>”’)’)
outd(4) = 0
return
end

integer function lengthof(str,maxlen)
character*(*) str
integer maxlen
C Find actual string length.
do 10 len=maxlen,1,-1
   if (str(len:len).ne.’ ‘) go to 20
10 continue
len = 0
20 continue
lengthof = len
return
end

subroutine show_text(text,maxlen,unit)
character*(*) text
integer maxlen,unit
C Print a text string without printing trailing blanks.
external lengthof
integer lengthof
integer len
len = lengthof(text,maxlen)
if (len.gt.0) write(unit,’(a)’) text(1:len)
return
end
C Item structure:
C 1 - type of item (0 - none, 1 - line, 2 - box, 3 - text)
C 2 - X location
C 3 - Y location
C 4 - X2 or text index
C 5 - Y2

subroutine draw_object(it,outd)
    integer it(5),outd(4)
end subroutine

C Draw the object indicated by 'it' on device 'outd'.

integer NTEXT
parameter (NTEXT=200)
character*64 texts (NTEXT)
common /texts/ texts

if (it (1) .eq.1) then
    call drawvector(it(2),it(3),it(4),it(5),outd)
else if (it(l) .eq.2) then
    call drawvector(it(2),it(3),it(2),it(5),outd)
    call drawvector(it(2),it(5},it(4),it(5),outd}
    call drawvector(it(4),it(5},it(4),it(3),outd)
    call drawvector(it(4),it(3),it(2),it(3),outd)
else if (it(l) .eq.3) then
    call startstring(it(2),it(3),outd)
    call show_text(texts(it(4»),64,outd(1»)
endif
return
end

subroutine redraw_screen(outd)
    integer outd (4)
end subroutine

C Clear the screen and redraw all objects in the list.

integer NITEMS
parameter (NITEMS=10000)
integer items (5,NITEMS)
common /items/ items
integer nexti,nextt
common /pointers/ nexti,nextt,nextt

integer i

call clearscreen(outd)
if (nexti.eq.1) return
do 10 i = 1,nexti-1
    call draw_object(items(1,i),outd)
10 continue
return
end

subroutine commit_object(it)
    integer it(5)
}
C Add given object to database.

```fortran
integer NITEMS
parameter (NITEMS=10000)
integer items(5,NITEMS)
common /items/ items
integer nexti,nextt
common /pointers/ nexti,nextt
integer i
if (nexti.gt.NITEMS) return
do 10 i=1,5
   items(i,nexti) = it(i)
10 continue
nexti = nexti+1
return
end
```

C Delete last item added to database.

```fortran
integer nexti,nextt
common /pointers/ nexti,nextt
if (nexti.le.1) return
nexti = nexti-1
if (items(1,nexti).eq.3) nextt = nextt-1
call redraw_screen(outd)
return
end
```

C Get a text string from the user.

```fortran
external lengthof
integer lengthof
integer NTEXT
parameter (NTEXT=200)
character*64 texts(NTEXT)
common /texts/ texts
integer nexti,nextt
common /pointers/ nexti,nextt
character*64 temp
call startstring(it(2),it(3),outd)
read(ll,'(A64)',end=100,err=100) temp
if (lengthof(temp,64).eq.0) go to 100
   it(4) = nextt
   texts(nextt) = temp
   nextt = nextt+1
   call commit_object(it)
100 continue
return
end
```

C-64
C Copy new X/Y to last X/Y

it(2) = it(4)
it(3) = it(5)
return

subroutine save_file(outd)
integer outd(4)

C Get a file name from the user and save the screen data in it.

external lengthof
integer lengthof
integer stdin,stdout,output
common /units/ stdin,stdout,output
character*64 temp
integer file(4),len

C Clear the screen and get the file name from the user.
call clearscreene(outd)
write(*,'(''File name for data: '')')
read(11,1) temp
1 format (A64)
write(*,')'(<015>)

C Open file and save data.
len = lengthof(temp,64)
if (len.eq.0) then
write(*,')'(''No data saved. '')')
else
open(unit=output,file=temp,carriagecontrol='none',
1 screenedit='no',force='yes',iointent='output',mode='binary',
2 err=100)
file(1) = output
C Send controls to file.
call redraw_screen(file)
C Put a mode exit at end.
call gotoalpha(file)
close(output)
write(*,2) temp(1:len)
2 format('Saved screen data in: ',A,<015><012>)
endif
200 continue
write(*,')'(''Press CR to continue.<015><012>')
read(11,1) temp
C Put user’s screen back up.
call redraw_screen(outd)
return

100 continue
write(*,3) temp(1:len)
3 format('Unable to open file for output: ',A,<015><012>)
go to 200
end

subroutine dispatch(outd)
integer outd(4)
C Dispatch user's input.

    external getpoint
    character getpoint

    integer stdin,stdout,output
    common /units/ stdin,stdout,output

    character chr
    integer temp(5)

    temp(1) = 0
    continue
    chr = getpoint(temp(4),temp(5),outd)
    if (chr.eq.'<015>' .or. chr.eq.' ') then
      if (temp(1).ne.0) then
        call draw_object(temp,outd)
        call commit_object(temp)
      endif
      call ptcopy(temp)
    else if (chr.eq.'l' .or. chr.eq.'L') then
      call ptcopy(temp)
      temp(1) = 1
    else if (chr.eq.'b' .or. chr.eq.'B') then
      call ptcopy(temp)
      temp(1) = 2
    else if (chr.eq.'t' .or. chr.eq.'T') then
      call ptcopy(temp)
      temp(1) = 3
      call gettext(temp,outd)
    C Can't duplicate item.
      temp(1) = 0
    else if (chr.eq.'d' .or. chr.eq.'D') then
      call dellast(outd)
    else if (chr.eq.'s' .or. chr.eq.'S') then
      call save_file(outd)
    else if (chr.eq.'q' .or. chr.eq.'Q') then
      return
    endif
    go to 10
  end

  subroutine initialize(outd)
    integer outd(4)

    C Initialize internal data for program.
    integer stdin,stdout,output
    common /units/ stdin,stdout,output

    integer nexti,nextt
    common /pointers/ nexti,nextt

    C Set next next pointers to beginning of array.
    nexti = 1
    nextt = 1

    C Initialize the terminal screen.
    outd(1) = stdout
    call clearscreen(outd)
    return
  end
program drawing
C This is the main program.
  integer stdin,stdout,output
  common /units/ stdin,stdout,output
  data stdin,stdout,output/5,6,7/
  integer terminal(4)
C Set to unbuffered binary terminal I/O.
  call set_up_terminal
C Setup internal data.
  call initialize(terminal)
C Handle user's commands.
  call dispatch(terminal)
C Clear Tek 4010 screen before exiting.
  call clearscreen(terminal)
  end

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TO ORDER
1. An order can be placed with the TIPS group in two ways:
   a) MAIL ORDER – Use the order form on the opposite page and fill in all requested information. Be sure to include shipping charges and local sales tax. If applicable, write in your tax exempt number in the space provided on the order form.

   Send your order form with payment to: Data General Corporation
   ATTN: Educational Services/TIPS G155
   4400 Computer Drive
   Westboro, MA 01581-9973

   b) TELEPHONE – Call TIPS at (508) 870–1600 for all orders that will be charged by credit card or paid for by purchase orders over $50.00. Operators are available from 8:30 AM to 5:00 PM EST.

METHOD OF PAYMENT
2. As a customer, you have several payment options:
   a) Purchase Order – Minimum of $50. If ordering by mail, a hard copy of the purchase order must accompany order.
   b) Check or Money Order – Make payable to Data General Corporation.
   c) Credit Card – A minimum order of $20 is required for MasterCard or Visa orders.

SHIPPING
3. To determine the charge for UPS shipping and handling, check the total quantity of units in your order and refer to the following chart:

<table>
<thead>
<tr>
<th>Total Quantity</th>
<th>Shipping &amp; Handling Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–4 Items</td>
<td>$5.00</td>
</tr>
<tr>
<td>5–10 Items</td>
<td>$8.00</td>
</tr>
<tr>
<td>11–40 Items</td>
<td>$10.00</td>
</tr>
<tr>
<td>41–200 Items</td>
<td>$30.00</td>
</tr>
<tr>
<td>Over 200 Items</td>
<td>$100.00</td>
</tr>
</tbody>
</table>

   If overnight or second day shipment is desired, this information should be indicated on the order form. A separate charge will be determined at time of shipment and added to your bill.

VOLUME DISCOUNTS
4. The TIPS discount schedule is based upon the total value of the order.

<table>
<thead>
<tr>
<th>Order Amount</th>
<th>Discount</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0–$149.99</td>
<td>0%</td>
</tr>
<tr>
<td>$150–$499.99</td>
<td>10%</td>
</tr>
<tr>
<td>Over $500</td>
<td>20%</td>
</tr>
</tbody>
</table>

TERMS AND CONDITIONS
5. Read the TIPS terms and conditions on the reverse side of the order form carefully. These must be adhered to at all times.

DELIVERY
6. Allow at least two weeks for delivery.

RETURNS
7. Items ordered through the TIPS catalog may not be returned for credit.
8. Order discrepancies must be reported within 15 days of shipment date. Contact your TIPS Administrator at (508) 870–1600 to notify the TIPS department of any problems.

INTERNATIONAL ORDERS
9. Customers outside of the United States must obtain documentation from their local Data General Subsidiary or Representative. Any TIPS orders received by Data General U.S. Headquarters will be forwarded to the appropriate DG Subsidiary or Representative for processing.
TIPS ORDER FORM
Mail To: Data General Corporation
Attn: Educational Services/TIPS G155
4400 Computer Drive
Westboro, MA 01581 - 9973

BILL TO:                            SHIP TO: (No P.O. Boxes - Complete Only If Different Address)
COMPANY NAME____________________  COMPANY NAME____________________
ATTN: ____________________________  ATTN: ____________________________
ADDRESS __________________________ ADDRESS (NO PO BOXES)____________________
CITY _______________________________ CITY _______________________________
STATE__________ ZIP__________ STATE__________ ZIP__________

Priority Code ______________________ (See label on back of catalog)

Authorized Signature of Buyer      Title __________________ Date __________
(Agrees to terms & conditions on reverse side)      Phone (Area Code) __________________ Ext. __________

ORDER # | QTY | DESCRIPTION | UNIT PRICE | TOTAL PRICE
---------|-----|-------------|------------|------------

A  SHIPPIING & HANDLING
□ UPS ADD
  1-4 Items $5.00
  5-10 Items $8.00
  11-40 Items $10.00
  41-200 Items $30.00
  200+ Items $100.00

Check for faster delivery
□ UPS Blue Label (2 day shipping)
□ Red Label (overnight shipping)

B  VOLUME DISCOUNTS

<table>
<thead>
<tr>
<th>Order Amount</th>
<th>Save</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0–$149.99</td>
<td>0%</td>
</tr>
<tr>
<td>$150–$499.99</td>
<td>10%</td>
</tr>
<tr>
<td>Over $500.00</td>
<td>20%</td>
</tr>
</tbody>
</table>

Tax Exempt # or Sales Tax (if applicable)

ORDER TOTAL
Less Discount See B __________
SUB TOTAL __________
Your local* sales tax + __________
Shipping and handling – See A + __________
TOTAL – See C __________

THANK YOU FOR YOUR ORDER

PRICES SUBJECT TO CHANGE WITHOUT PRIOR NOTICE.
PLEASE ALLOW 2 WEEKS FOR DELIVERY.
* NO REFUNDS NO RETURNS.

* Data General is required by law to collect applicable sales or use tax on all purchases shipped to states where DG maintains a place of business, which covers all 50 states. Please include your local taxes when determining the total value of your order. If you are uncertain about the correct tax amount, please call 508-870-1600.

C  PAYMENT METHOD

□ Purchase Order Attached ($50 minimum)
□ P.O. number is ______________ (Include hardcopy P.O.)
□ Check or Money Order Enclosed
□ Visa □ MasterCard ($20 minimum on credit cards)

Account Number __________________________ Expiration Date __________

Authorized Signature
(Credit card orders without signature and expiration date cannot be processed.)
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SERVICE
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A valid contract binding upon DGC will come into being only at the time of DGC's acceptance of the referenced Educational Services Order Form. Such contract is governed by the laws of the Commonwealth of Massachusetts, excluding its conflict of law rules. Such contract is not assignable. These terms and conditions constitute the entire agreement between the parties with respect to the subject matter hereof and supersedes all prior oral or written communications, agreements and understandings. These terms and conditions shall prevail notwithstanding any different, conflicting or additional terms and conditions which may appear on any order submitted by Customer. DGC hereby rejects all such different, conflicting, or additional terms.

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