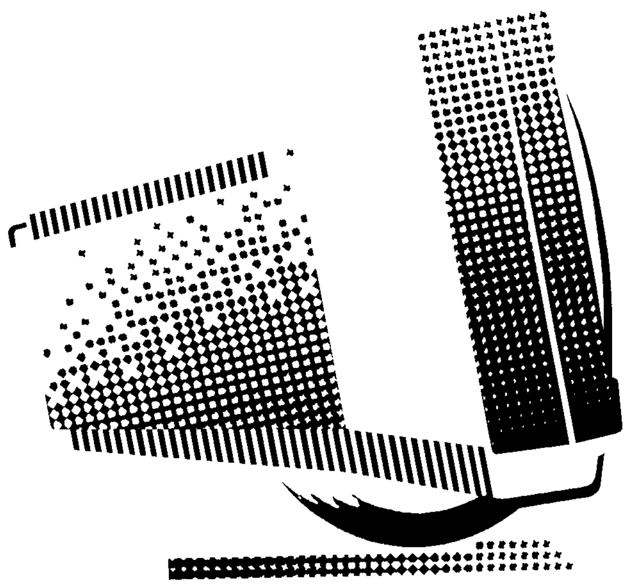
VT420 Programmer Reference Manual

Order Number EK–VT420–RM.002



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About This Manual

This reference manual is for people with a general knowledge of computer programming. The manual provides programmers with information needed in writing applications for the VT420 text terminal.

For general user information, see *Installing and Using the VT420 Video Terminal*.

New Features in This Revision

This revised manual provides new information on operating a VT420 text terminal in PC TERM mode.

There are several versions of the VT420 text terminal:

- North American model—Operates in VT mode.
- Worldwide model—Operates in VT mode.
- Worldwide model with PC TERM mode—Operates in VT mode or PC TERM mode.

Organization

The manual is divided into five parts.

Part 1: Introduction to Your VT420 Terminal

Part 1 covers information you need to know before you begin programming the terminal.

- Chapter 1, “VT420 Features,” provides an overview of the terminal. The chapter briefly describes the terminal’s major features and operating modes.
- Chapter 2, “Character Encoding,” describes the character-encoding concepts used by the VT420. The chapter also describes the terminal’s character sets, the format for control functions, and commands for using macros.

Part 2: Control Functions Sent to the Host

Part 2 covers the codes sent from the keyboard.

- Chapter 3, “ANSI, Short ANSI, and PC Keyboard Codes,” describes the characters and control functions that the terminal sends to the host.

Part 3: Control Functions Received from the Host

Part 3 covers the control functions you can use to program the terminal in VT mode or PC TERM mode. Part 5 describes features unique to PC TERM mode.

- Chapter 4, “Emulating VT Series Terminals,” describes the control functions used to emulate Digital’s other VT series terminals.
- Chapter 5, “Using Character Sets,” describes the control functions used to select the terminal’s built-in character sets and your own soft character sets.
- Chapter 6, “Page Memory,” describes the control functions used to format and move through the terminal’s page memory.
- Chapter 7, “Setting Visual Character and Line Attributes,” describes the control functions used to highlight text, such as bolding and underlining.
- Chapter 8, “Editing,” describes the control functions used to edit characters in the terminal’s page memory.

- Chapter 9, “Rectangular Area Operations,” describes the control functions used to manipulate rectangular areas of text.
- Chapter 10, “Cursor Movement and Panning,” describes the control functions used to move the cursor and pan through data in page memory.
- Chapter 11, “Keyboard, Printing, and Display Commands,” describes the control functions used to program the terminal’s keyboard, printer port, and display screen.
- Chapter 12, “VT420 Reports,” describes the control functions used to request reports on the operating state of the terminal. The chapter also describes the format of the reports sent by the terminal, and the control functions use to restore the terminal to a previous state.
- Chapter 13, “Resetting and Testing the Terminal,” describes the control functions used to reset and test the terminal’s operating features.

Part 4: Dual Sessions

Part 4 describes two methods for managing sessions on the VT420—multiple system communications (MSC) and SSU software.

- Chapter 14, “Session Management,” describes MSC and SSU. The chapter also lists shared and independent resources available to each session when you use two sessions.

Part 5: Emulating a Personal Computer

Part 5 describes how the VT420 model with PC TERM mode can emulate a personal computer (PC).

- Chapter 15, “Operating in PC TERM Mode,” describes how the terminal operates in PC TERM mode. The chapter describes control characters, PC character sets, and codes the PC keyboard sends to the host.

Appendices

- Appendix A, “VT52 Mode Control Codes,” describes control functions used when the terminal is in VT52 mode.
- Appendix B, “Communication,” describes how the terminal communicates with the host system and local devices, such as modems and printers. The appendix also provides cabling information and describes how to connect to non-Digital systems.

- Appendix C, “Related Documentation,” lists other VT420 documentation you can order from Digital.
- Appendix D, “Compatibility with Other Digital Terminals,” compares the VT420 video terminal to Digital’s VT320 and VT220 video terminals.

Conventions

The following conventions are used in this manual:

Notes	Provide general operating information.
Programming tips	Provide helpful suggestions to consider when writing applications.
Set-up features	The names of features appear in **bold** type. Example: Use the **save** feature in the Set-Up Directory screen. Set-up feature settings and fields appear in `this` type. Example: The cursor is on the `Global` field in the Set-Up Directory.
ANSI keyboard keys	Appear as normal text in a [box]. Example: Press the [Return] key.
PC keyboard keys	Appear as **bold** text in a [**box**]. Example: Press the [**Enter**] key.
ANSI keys (with PC keys)	When a PC command sequence differs from an ANSI command sequence, the PC key sequence appears in parentheses after the ANSI sequence. Example: Press the [Return] key ([**Enter**]).
[Ctrl] [*key*]	For [Ctrl] key sequences, hold down [Ctrl] and press the other key.
Characters in control functions	Appear in **bold** type. Variables appear in *italics*. Below each character is a column/row number that indicates the character’s position in a standard code table. Example:

ESC	**#**	**6**	⇐	Control function
1/11	2/3	3/6	⇐	Column/row numbers

Glossary entries	Appear in *italics* when first used in text. Example: The VT420 stores information in its *page memory*.

Part 1
Introduction to Your VT420 Terminal

1

VT420 Features

This chapter provides an overview of the VT420 video terminal. The chapter briefly describes the major features and operating modes of the terminal.

VT420 Models

The VT420 is a monochrome text terminal. The terminal has two major components, a monitor/terminal unit and a keyboard. The monitor has a tilt-swivel base.

The VT420 is available in three models: worldwide, worldwide with PC TERM mode, and North American.

- The **worldwide model** supports 8-bit multinational character sets and several 7-bit national replacement character sets (NRCs) for western Europe. This model has two system communication ports (6-pin, DEC-423 port and 25-pin, RS-232 port) and a detachable power cord.
- The **worldwide model with PC TERM mode** provides all the features of the worldwide model, plus an operating mode that supports personal computer (PC) character sets and PC application software.
- The **North American model** is similiar to the worldwide model, but does not support the NRC sets or PC TERM mode. This model has one system communication port (6-pin, DEC-423 port) and an attached power cord.

All models have a 6-pin, DEC-423 printer port. The printer port can also serve as an extra communication port for connection to a host computer. Users can select whether this port acts as a local printer port or an extra communication port, by setting a feature in the Global Set-Up screen.

This manual covers the programming information you need to use the features for the terminal. The terminal uses control functions specified by the American National Standards Institute (ANSI) and the International Organization for Standardization (ISO).

Keyboards

The terminal uses one of three Digital keyboards (Figure 1–1):

- ANSI keyboard
- Short ANSI keyboard
- PC keyboard (with 101 or 102 keys)

The ANSI and PC keyboards are available in various models for different languages. The PC keyboard is for the VT worldwide model with PC TERM mode; the North American model has 101 keys, and other models have 102 keys. You can use the ANSI and short ANSI keyboards with any VT420 model. See *Installing and Using the VT420 Video Terminal with PC Terminal Mode* for a comparison of the three keyboards.

The next section describes some of the important new features of the terminal.

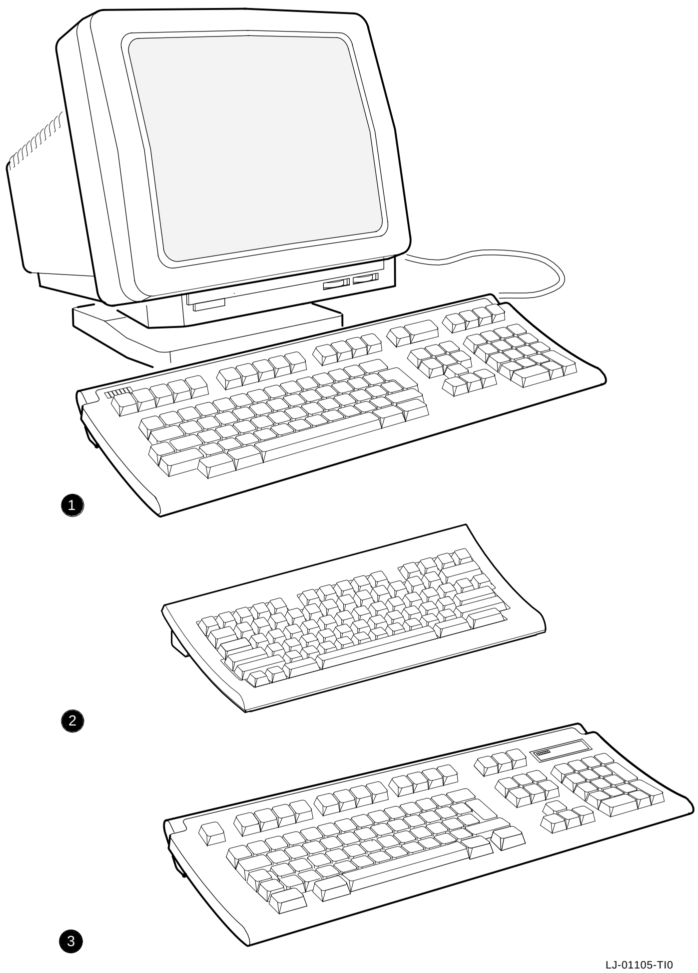

Figure 1–1 VT420 Video Display Terminal with Keyboards

❶ ANSI keyboard

❷ Short ANSI keyboard

❸ PC keyboard (102-key model shown)

New Features

The VT420 is compatible with Digital's VT320 terminal and offers major new features, such as the ability to use PC applications, two sessions, and two windows. You can also create macros and perform rectangular area editing. Local page memory provides faster on-line transaction processing.

PC TERM Mode

The VT420 worldwide model with PC TERM mode supports PC character sets and PC application software. Chapter 15 describes PC TERM mode and PC character sets.

Two Sessions

When you electronically connect to a host system from your terminal, you start an interactive *session*. The VT420 lets you run two sessions at the same time. That is, you can connect to two different jobs on your system.

If you connect your VT420 to two systems, you can log in to both systems and run those sessions at the same time. If you are using a PC keyboard, you can select a different operating mode for each session — VT mode or PC TERM mode. If you connect your VT420 to a *terminal server* that supports several systems, you can run two VT mode sessions, each on a different system.

The two-sessions feature gives you two terminals in one. The VT420 maintains the two sessions separately. You can easily switch back and forth between the two sessions from the keyboard.

The VT420 has two different methods for managing dual sessions, multiple system communications (MSC) and Digital's SSU protocol.

- MSC
  Uses two separate communication lines to maintain two sessions at the same time.

- SSU (VT mode only)
  Uses one communication line and Digital's proprietary SSU software protocol to maintain two sessions at the same time. The SSU protocol is available as a separate VMS layered software product or as part of a DECServer 200, DECserver 300, or DECserver 500 system.

You can select different operating features for each session. For example, you can use different set-up selections, page memory format, and user-defined keys.

For more information on session management, see Chapter 14.

User Windows

The VT420 lets you view data from two sessions at the same time. To view data from two sessions, you divide the screen into two windows.

By default, each session you open with a VT420 terminal uses the complete screen. This means the terminal can only display data from one session at a time. To divide the screen into two windows, you press a sequence of keys. Each window is assigned to a session. Information from one session appears in one half of the screen, information from the second session appears in the other half.

You can divide the screen horizontally. When you divide the screen, a border appears across the middle of the screen from column 1 to the last column.

For more information on user windows, see *Installing and Using the VT420 Video Terminal*.

Page Memory

In VT mode, the VT420 has a multiple-page display memory. The multiple-page feature lets the terminal store more text than appears on the screen. For example, when you use two sessions the terminal can store up to three screen areas of text (three 24-line pages) for each session.

In PC TERM mode, the host system stores data.

Page memory provides a storage space for pop-up menus and a means for instant screen updates. You can select different page sizes. The page sizes available depend on whether you are running one or two sessions.

Two Sessions

- 3 pages of 24 lines × 80 or 132 columns
- 2 page of 25 lines × 80 or 132 columns
- 2 pages of 36 lines × 80 or 132 columns
- 1 page of 48 lines × 80 or 132 columns
- 1 page of 72 lines × 80 or 132 columns

One Session

- 6 pages of 24 lines × 80 or 132 columns
- 5 pages of 25 lines × 80 or 132 columns
- 4 pages of 36 lines × 80 or 132 columns

- 3 pages of 48 lines × 80 or 132 columns
- 2 pages of 72 lines × 80 or 132 columns
- 1 page of 144 lines × 80 or 132 columns

A *page* is a section of the terminal's page memory. Each page has left, right, top and bottom margins. You can define the size and layout of a page by using set-up features or control functions.

For more information on page memory, see Chapter 6.

Macro Feature

This feature lets you download ANSI text and commands into the terminal. The terminal stores the text and commands until you invoke them with a control function. The macro feature provides you with more convenience and flexibility. It lets you execute a group of ANSI control functions as a set. For more information, see Chapter 2.

Rectangular Area Operations

This feature lets you manipulate rectangular areas of text within page memory. You can

- Copy them from one area in page memory to another.
- Erase them.
- Fill them with a character of your choice.
- Change or reverse their visual character attributes.

For more information, see Chapter 9.

Local Copy and Paste Feature (VT Mode)

This feature lets you copy text from the screen to an internal buffer. You can later send the text to the host. This feature is useful for copying text from the terminal screen to the host application.

Number of Lines/Screen

The VT420 has three different character font heights, so users can display 24, 36, or 48 lines of text on the screen. For more information, see Chapter 11.

General Features

This section describes the general operating and communication features of the terminal. You can set many of these features from the keyboard, using set-up.

Set-Up

Set-up is a series of display screens. Each screen lists a group of features, such as communications or printing.

You can use set-up screens to examine and change the current settings for features. For example, you can select the keyclick feature, transmit and receive speeds, page size, and type of session management.

The VT420 set-up feature is similar to the VT320 set-up feature. *Installing and Using the VT420 Video Terminal* describes the set-up screens in detail.

Display Features

The VT420 screen has the following basic features:

- 359 mm (14-inch), flat-screen monitor
- 24, 36, or 48 display lines at a time

  800 (horizontal) × 400 (vertical) pixels
- A separate status line for each session, at the bottom of the screen

  (You can disable the status line to have an additional line for data display.)
- Horizontal split-screen scrolling on any line boundary
  (same as the VT100)

Text Features

The VT420 provides a variety of text and editing features.

- Character sets
  - 5 sets of 94 characters each
  - 1 set of 96 characters
  - National replacement character sets (worldwide model)
  - 3 PC sets of 128 characters each (worldwide model with PC TERM mode)
  - Downloadable character set (94 or 96 characters)

- ANSI keyboard function keys
  - 5 local function keys
  - 15 user-definable keys
- PC keyboard function keys
  - 3 local function keys
  - 30 user-definable keys (VT mode)
    51 user-definable keys (PC TERM mode)
- PC keyboard scan codes sent to the host
- All VT320 editing functions
- Normal, bold, underline, blinking, and reverse video characters
- Single-width/single-height lines
  Double-width/single-height lines
  Double-width/double-height lines
- Control characters and functions
  - 7-bit and 8-bit control characters
  - ANSI control functions
  - DEC private control functions
  - Ability to display control functions

Character Sets

The VT420 has the following built-in character sets:

- ASCII
- DEC Supplemental Graphic
- ISO Latin Alphabet Nr 1 supplemental graphic
- National replacement character sets (NRCs)
  (worldwide model)
- DEC Technical
- DEC Special Graphic (VT100 line drawing)
- PC character sets (worldwide model with PC TERM mode)
  — PC International
  — PC Multilingual
  — PC Danish/Norwegian
  — PC Portuguese
  — PC Spanish

You can also design a soft character set, then load it from the host system into the terminal.

Together, the ASCII and DEC Supplemental Graphic sets make up the **DEC Multinational** character set. When you turn on or reset the terminal, the VT420 automatically uses the DEC Multinational set. The ASCII and ISO Latin-1 supplemental sets make up the ISO Latin-1 character set.

Chapter 2 describes the VT420 character sets. Chapter 5 describes how to select and use different character sets.

Communication Features

The VT420 provides the following features for communicating with the host system:

- 7-bit or 8-bit environments
- XPC communication protocol, which defines the XON and XOFF points
- Asynchronous communication speeds up to 38,400 bits/second
- One DEC-423 host port
- One RS-232 host port, with a 25-pin D-subminiature connector for a host or external modem (worldwide model only)
- One bidirectional DEC-423 printer port, which also serves as a communication port with a host system

The VT420 has two major communication states, on-line and local. You select the communication state in set-up.

- The **on-line** state lets the terminal communicate with a host system. The terminal sends data entered at the keyboard to the host. The terminal displays data received from the host on the screen.
- The **local** state lets you place the host system on hold. Data entered at the keyboard is sent to the screen, but not to the host. The terminal stores data received from the host, until you put the terminal back on-line.

Operating Modes

The VT420 has four major operating modes for text operations. The VT420 with PC TERM mode has five major operating modes. You can select each mode from the keyboard (using set-up screens), or from the host (using control codes). The VT420 uses standard ANSI functions in all operating modes, except VT52 mode and PC TERM mode.

- VT400 mode, 7-bit controls
- VT400 mode, 8-bit controls
- PC TERM mode
- VT100 mode
- VT52 mode

VT400 mode, 7-bit controls is the default operating mode. This mode provides the full range of VT420 capabilities, using 8-bit characters and 7-bit control characters. All character sets are available. This mode provides full compatibility with Digital's VT300 series terminals. Digital recommends this mode for most applications.

VT400 mode, 8-bit controls provides the full range of VT420 capabilities, using 8-bit characters and 8-bit control characters. All VT mode character sets are available, and the terminal recognizes both 7-bit and 8-bit controls.

In this mode, the terminal can run VT300 applications that use 8-bit control characters. The worldwide model with PC TERM mode can use a PC keyboard. The terminal operates most efficiently in this mode, but some systems and applications do not yet support 8-bit operation.

PC TERM mode enables the terminal to support PC application software and character sets. The terminal sends scan codes to the host, which PC applications recognize. The terminal sends scan codes when you press a key and when you release a key. This mode requires a PC keyboard.

VT100 mode provides full compatibility with Digital's VT102 terminal. This mode restricts the terminal to a 7-bit environment. The keyboard is restricted to VT100 keys, and the only available character sets are ASCII, national replacement characters, and DEC Special Graphic. You can use this mode with applications that require strict VT100 compatibility.

VT52 mode provides full compatibility with Digital's VT52 terminal. This mode only uses Digital's private control functions, not standard ANSI functions. You use this mode with applications written for the VT52.

Chapter 2 describes the format for 7-bit and 8-bit character codes. Chapter 4 describes how the VT420 can emulate other VT series terminals.

2

Character Encoding

This chapter describes the character-encoding system that the terminal uses in VT mode to communicate with a host system. See Chapter 15 for a description of PC TERM mode. You must have a basic understanding of the character-encoding system described in this chapter before you use the control functions in the rest of this manual.

The chapter also describes the character sets available in VT mode and the format for sending control functions to the terminal. You can select character sets for different countries or for special uses, such as technical characters. You use control functions to make the terminal perform special functions, such as editing or printing.

Overview

The VT420 uses a communication line to exchange information with a host system. The terminal and the host send data in an encoded form that is different from what you see on the screen.

In VT mode, the keys you type on your keyboard send *scan codes* to the terminal. The terminal converts the scan codes to character codes or ANSI control functions, then sends the information to the host. The host stores the information and passes it to *application software* programs. For example, your host may have applications that let you do word processing, data entry, or programming.

The host processes the output from the application software and displays it on the terminal's screen. You can print the data by sending it to a printer connected to the terminal.

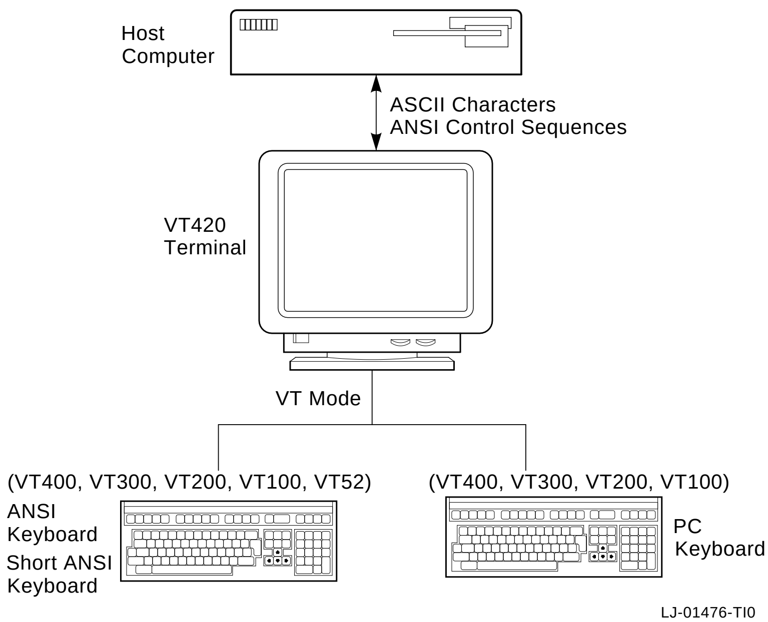

Figure 2–1 VT Mode Operation

Coding Standards

All terminals and computers encode information as binary digits, or bits. Older systems use 7 bits to encode each character. Newer systems such as the VT420 use 8 bits, which provide more codes. The newer systems can also use the 7-bit codes.

The VT420 uses an 8-bit character-encoding system and a 7-bit code extension technique. The “7-Bit Code Extension Technique” section in this chapter explains what 7-bit code extensions are.

The American National Standards Institute (ANSI) and International Organization for Standardization (ISO) specify standards for character encoding in the information-processing industry. The VT420 terminal is compatible with the following ANSI and ISO standards.

Standard	Description
dpANS X3.134.1	8-Bit ASCII structure and rules
dpANS X3.134.2	Code for information interchange of 7-bit and 8-bit ASCII supplemental multilingual graphic character set
ANSI X3.4—1977	American Standard Code for Information Interchange (ASCII)
ANSI X3.41—1974	Code Extension Techniques for Use with the 7-Bit Coded Character Set of American National Code Information Interchange
ANSI X3.32—1973	Graphic Representation of the Control Characters of American National Code for Information Interchange
ANSI X3.64—1979	Additional Controls for Use with American National Standard for Information Interchange
ISO 646—1977	7-Bit Coded Character Set for Information Processing Interchange
ISO 2022	7-Bit and 8-Bit Coded Character Sets—Code Extension Techniques
ISO 6429	Additional Control Functions for Character Imaging Devices
ISO 8859-1	8-Bit single byte code graphic character sets-Part 1: Latin Alphabet Nr 1
ISBN 2-12-953907-0	ISO international register of character sets used with escape sequences

You can order ANSI and ISO standards from the following sources:

ANSI Standards

Sales Department
American National Standards Institute
1430 Broadway
New York, NY 10018

ISO Standards

CCITT
UN Book Store
United Nations Building
New York, NY 10017

Characters and Character Sets

In Digital's computing environment, a character is a symbol represented by an 8-bit binary code. These symbols include letters, digits, and punctuation marks, as well as other symbols used to organize, control, or represent data.

Here are a few examples of characters and their corresponding 8-bit codes.

Character	Code
A	01000001
}	01111101
CSI	10011011

There are two types of computing environments, 7-bit and 8-bit. In a 7-bit environment, only the last 7 bits of the character code define the character. In an 8-bit environment, all 8 bits define the character.

The A character above is defined in a 7-bit or 8-bit environment, because the eighth bit of the code is 0. The 8-bit form of the CSI character is defined only in a 8-bit environment, because its eighth bit is 1.

A coded character set is a group of characters that conform to certain rules and standards. These standards are set by organizations such ANSI and ISO. Each character in a character set is represented by a different combination of 8 bits.

Code Table

A code table is a convenient way to show all the characters in a character set with their codes. Most standard character sets put similar characters into groups, so they have similar codes. A code table lets you see groups of characters and their relative codes clearly.

There are two basic types of characters, graphic characters and control characters. These two character types are defined by ANSI and ISO standards. The VT420 processes received characters based on these two character types.

Graphic characters are characters you can display. Graphic characters include letters, numbers, punctuation marks, and any other characters you can display.

Control characters are characters you do not usually display. They make the terminal or host system perform specific functions in data communications and text processing.

NOTE
You can display control characters on the screen, to help you debug your applications. To display control characters, you set the control representation mode feature in the Display Set-Up screen to `Display Controls`**. See the "Display Controls Mode" section at the end of this chapter.**

This section describes the format for 7-bit and 8-bit code tables.

7-Bit ASCII Code Table

Figure 2–2 is the 7-bit ASCII code table. The table has 128 character codes, arranged in 8 columns and 16 rows.

Every character in a row uses the same binary code for its four least significant bits (Figure 2–3). This value appears at the left of each row. For example, every character in row 0 uses the binary code 0000 for its four least significant bits.

Every character in a column uses the same binary code for its three most significant bits. This value appears at the top of each column. For example, every character in column 0 uses the binary code 000 for its three most significant bits.

The ASCII table also shows the octal, decimal, and hexadecimal code for each character. Different programmers may prefer using octal, decimal, or hexadecimal codes for different purposes.

This manual refers to characters by their position in the table. For example, the character **H** is at 4/8 (column 4, row 8). You can use the column/row number to find a character and its codes in the table. For example

ESC	**#**	**6**
1/11	2/3	3/6

means

The **ESC** character is at column 1, row 11.

The **#** character is at column 2, row 3.

The **6** character is at column 3, row 6.

The ASCII graphic characters are in positions 2/1 through 7/14 of the ASCII table. ASCII graphic characters include all American and English alphanumeric characters, plus punctuation marks and various text symbols. Examples are **C**, **n**, **"**, **!**, **+**, and **$**. (The British pound sign is not an ASCII graphic character.)

Row	Column Bits b8 b7 b6 b5 b4 b3 b2 b1	0 0 0 0 0		1 0 0 0 1		2 0 0 1 0		3 0 0 1 1		4 0 1 0 0		5 0 1 0 1		6 0 1 1 0		7 0 1 1 1	
0	0 0 0 0	NUL	0 0 0	DLE	20 16 10	SP	40 32 20	0	60 48 30	@	100 64 40	P	120 80 50	‘	140 96 60	p	160 112 70
1	0 0 0 1	SOH	1 1 1	DC1 (XON)	21 17 11	!	41 33 21	1	61 49 31	A	101 65 41	Q	121 81 51	a	141 97 61	q	161 113 71
2	0 0 1 0	STX	2 2 2	DC2	22 18 12	"	42 34 22	2	62 50 32	B	102 66 42	R	122 82 52	b	142 98 62	r	162 114 72
3	0 0 1 1	ETX	3 3 3	DC3 (XOFF)	23 19 13	#	43 35 23	3	63 51 33	C	103 67 43	S	123 83 53	c	143 99 63	s	163 115 73
4	0 1 0 0	EOT	4 4 4	DC4	24 20 14	$	44 36 24	4	64 52 34	D	104 68 44	T	124 84 54	d	144 100 64	t	164 116 74
5	0 1 0 1	ENQ	5 5 5	NAK	25 21 15	%	45 37 25	5	65 53 35	E	105 69 45	U	125 85 55	e	145 101 65	u	165 117 75
6	0 1 1 0	ACK	6 6 6	SYN	26 22 16	&	46 38 26	6	66 54 36	F	106 70 46	V	126 86 56	f	146 102 66	v	166 118 76
7	0 1 1 1	BEL	7 7 7	ETB	27 23 17	’	47 39 27	7	67 55 37	G	107 71 47	W	127 87 57	g	147 103 67	w	167 119 77
8	1 0 0 0	BS	10 8 8	CAN	30 24 18	(	50 40 28	8	70 56 38	H	110 72 48	X	130 88 58	h	150 104 68	x	170 120 78
9	1 0 0 1	HT	11 9 9	EM	31 25 19	)	51 41 29	9	71 57 39	I	111 73 49	Y	131 89 59	i	151 105 69	y	171 121 79
10	1 0 1 0	LF	12 10 A	SUB	32 26 1A	*	52 42 2A	:	72 58 3A	J	112 74 4A	Z	132 90 5A	j	152 106 6A	z	172 122 7A
11	1 0 1 1	VT	13 11 B	ESC	33 27 1B	+	53 43 2B	;	73 59 3B	K	113 75 4B	[	133 91 5B	k	153 107 6B	{	173 123 7B
12	1 1 0 0	FF	14 12 C	FS	34 28 1C	,	54 44 2C	<	74 60 3C	L	114 76 4C	\	134 92 5C	l	154 108 6C	|	174 124 7C
13	1 1 0 1	CR	15 13 D	GS	35 29 1D	-	55 45 2D	=	75 61 3D	M	115 77 4D	]	135 93 5D	m	155 109 6D	}	175 125 7D
14	1 1 1 0	SO	16 14 E	RS	36 30 1E	.	56 46 2E	>	76 62 3E	N	116 78 4E	^	136 94 5E	n	156 110 6E	~	176 126 7E
15	1 1 1 1	SI	17 15 F	US	37 31 1F	/	57 47 2F	?	77 63 3F	O	117 79 4F	_	137 95 5F	o	157 111 6F	DEL	177 127 7F

C0 Codes (columns 0–1) — GL Codes (ASCII Graphic) (columns 2–7)

Key

Character			
ESC	33 27 1B	Octal Decimal Hex	

GSF_0586_89.DG

Figure 2–2 7-Bit ASCII Code Table

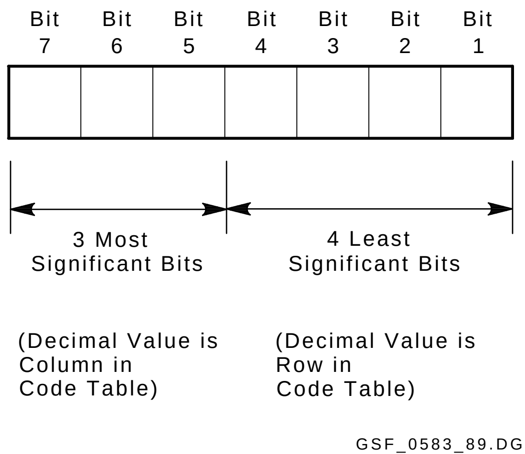

Figure 2–3 7-Bit Code

The ASCII control characters are in positions 0/0 through 1/15 (columns 0 and 1) of the ASCII table. The SP character (2/0) may act as a graphic space character or a control character, depending on the context. DEL (7/15) is always a control character.

ANSI and ISO standards define control character codes and their functions. These standards also define the *mnemonic* used to represent each control character in a code table. Here are some examples of ASCII control characters with their mnemonics.

ASCII Control Character	Mnemonic (Appears in Code Table)
Carriage return	CR
Form feed	FF
Cancel	CAN

8-Bit Code Table

Figure 2–4 shows the format for an 8-bit code table. It has the same number of rows as the 7-bit table, but twice as many columns and character code positions.

Each character in a row of the 8-bit table uses the same binary code for its four least significant bits (Figure 2–5). Each character in a column uses the same binary code for its four most significant bits.

The codes on the left half of the 8-bit table (columns 0 through 7) work like the codes in the 7-bit table. You can use these codes in a 7-bit or 8-bit environment. The eighth bit of these codes is 0.

The codes on the right half of the table (columns 8 through 15) have an eighth bit of 1. You can only use these codes in an 8-bit environment.

The 8-bit code table has two sets of control characters, C0 (control zero) and C1 (control one). The VT420 uses the ANSI definitions for the functions of C0 and C1 controls. The C0 controls are in columns 0 and 1. The C0 controls are the same as the ASCII control characters in the 7-bit table. You can use C0 controls in a 7-bit environment.

The C1 controls are in columns 8 and 9. They perform different functions than the C0 controls. You can only use C1 controls directly in an 8-bit environment. You can select C1 codes indirectly in a 7-bit environment. The "7-Bit Code Extension Technique" section in this chapter explains how to select C1 controls indirectly. Some C1 code positions are blank, because their functions are not yet standardized.

Column / Row	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
00	NUL	DLE	SP							DCS						
01	SOH	DC1								PU1						
02	STX	DC2								PU2						
03	ETX	DC3								STS						
04	EOT	DC4							IND	CCH						
05	ENQ	NAK							NEL	MW						
06	ACK	SYN							SSA	SPA						
07	BEL	ETB							ESA	EPA						
08	BS	CAN							HTS							
09	HT	EM							HTJ							
10	LF	SUB							VTS							
11	VT	ESC							PLD	CSI						
12	FF	FS							PLU	ST						
13	CR	GS							RI	OSC						
14	SO	RS							SS2	PM						
15	SI	US						DEL	SS3	APC						

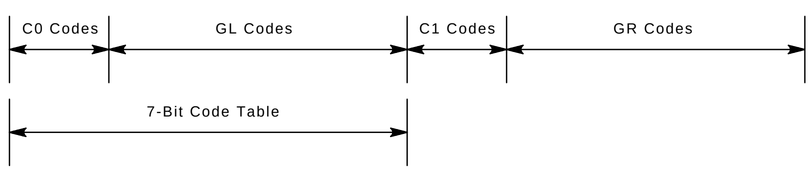

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Figure 2–4 8-Bit Code Table

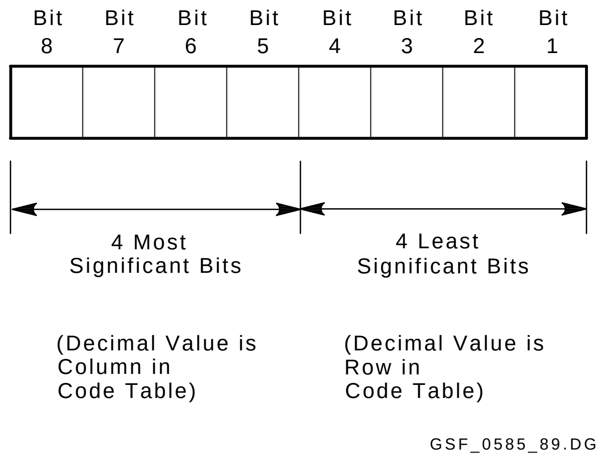

Figure 2–5 8-Bit Code

NOTE

The VT420 does not recognize all C0 and C1 codes. Tables 2–2 and 2–3 list the codes the terminal recognizes. The terminal generally ignores all other control codes.

The table also has two sets of graphic characters, GL (graphic left) and GR (graphic right). There are 94 GL codes in positions 2/1 through 7/14. You can use GL codes in 7-bit or 8-bit environments.

There are 96 GR codes in positions 10/0 through 15/15. Some 8-bit character sets only use 94 of these GR codes. You can use GR codes only in an 8-bit environment.

Together, the GL and GR sets make up the terminal's *in-use table*. The in-use table contains the graphic characters the terminal can currently use. Before the terminal can display and send characters from a character set, the set must be mapped into the in-use table. Chapter 5 describes the in-use table in detail.

VT420 Character Sets

The VT420 provides the following built-in graphic character sets:

ASCII
DEC Supplemental Graphic
ISO Latin Alphabet Nr 1 supplemental graphic
National replacement character sets (NRCs)
DEC Special Graphic
DEC Technical

See Chapter 15 for additional sets available in PC TERM mode. You can also design and load a soft character set into the terminal.

Downloadable (soft) set

All VT420 character sets contain graphic and control characters. The function of control characters never change, no matter what character set you use. The terminal always interprets C0 and C1 control codes as defined by ANSI.

The terminal stores the codes for graphic characters in GL and GR tables. Selecting a new character set changes the characters associated with the GL or GR codes. When you turn on or reset the terminal, you automatically select the following character sets:

ASCII in GL

DEC Supplemental (or ISO Latin-1 supplemental) graphic in GR

Together, the ASCII set and one of the supplemental sets make up a multinational character set.

- The ASCII set and DEC Supplemental Graphic sets are known as the **DEC Multinational** character set.
- The ASCII set and the ISO Latin-1 supplemental set are known as the **ISO Latin Alphabet Nr 1** set.

You select the supplemental set with (1) the **UPSS** (user-preferred supplemental set) feature in the General Set-Up screen, or (2) the assign user-preferred supplemental set (DECAUPSS) control function (Chapter 5).

DEC Supplemental Graphic Character Set

This 8-bit character set has 94 graphic characters. The graphic characters include accented letters and *diacritical marks*, used in many European languages. There are also special symbols, such as currency signs.

When you first turn on your terminal, you automatically select the ASCII character set and the DEC Supplemental Graphic set. The terminal maps the ASCII set into its GL table, and the DEC Supplemental Graphic set into its GR table. Together, these two character sets are known as the DEC Multinational character set (Figures 2–6 and 2–7).

	Column	0	1	2	3	4	5	6	7
	Bits b8 b7 b6 b5	0 0 0 0	0 0 0 1	0 0 1 0	0 0 1 1	0 1 0 0	0 1 0 1	0 1 1 0	0 1 1 1
Row	b4 b3 b2 b1								
0	0 0 0 0	NUL 0 0 0	DLE 20 16 10	SP 40 32 20	0 60 48 30	@ 100 64 40	P 120 80 50	‘ 140 96 60	p 160 112 70
1	0 0 0 1	SOH 1 1 1	DC1 (XON) 21 17 11	! 41 33 21	1 61 49 31	A 101 65 41	Q 121 81 51	a 141 97 61	q 161 113 71
2	0 0 1 0	STX 2 2 2	DC2 22 18 12	" 42 34 22	2 62 50 32	B 102 66 42	R 122 82 52	b 142 98 62	r 162 114 72
3	0 0 1 1	ETX 3 3 3	DC3 (XOFF) 23 19 13	# 43 35 23	3 63 51 33	C 103 67 43	S 123 83 53	c 143 99 63	s 163 115 73
4	0 1 0 0	EOT 4 4 4	DC4 24 20 14	$ 44 36 24	4 64 52 34	D 104 68 44	T 124 84 54	d 144 100 64	t 164 116 74
5	0 1 0 1	ENQ 5 5 5	NAK 25 21 15	% 45 37 25	5 65 53 35	E 105 69 45	U 125 85 55	e 145 101 65	u 165 117 75
6	0 1 1 0	ACK 6 6 6	SYN 26 22 16	& 46 38 26	6 66 54 36	F 106 70 46	V 126 86 56	f 146 102 66	v 166 118 76
7	0 1 1 1	BEL 7 7 7	ETB 27 23 17	’ 47 39 27	7 67 55 37	G 107 71 47	W 127 87 57	g 147 103 67	w 167 119 77
8	1 0 0 0	BS 10 8 8	CAN 30 24 18	(50 40 28	8 70 56 38	H 110 72 48	X 130 88 58	h 150 104 68	x 170 120 78
9	1 0 0 1	HT 11 9 9	EM 31 25 19	) 51 41 29	9 71 57 39	I 111 73 49	Y 131 89 59	i 151 105 69	y 171 121 79
10	1 0 1 0	LF 12 10 A	SUB 32 26 1A	* 52 42 2A	: 72 58 3A	J 112 74 4A	Z 132 90 5A	j 152 106 6A	z 172 122 7A
11	1 0 1 1	VT 13 11 B	ESC 33 27 1B	+ 53 43 2B	; 73 59 3B	K 113 75 4B	[133 91 5B	k 153 107 6B	{ 173 123 7B
12	1 1 0 0	FF 14 12 C	FS 34 28 1C	, 54 44 2C	< 74 60 3C	L 114 76 4C	\ 134 92 5C	l 154 108 6C	| 174 124 7C
13	1 1 0 1	CR 15 13 D	GS 35 29 1D	- 55 45 2D	= 75 61 3D	M 115 77 4D	] 135 93 5D	m 155 109 6D	} 175 125 7D
14	1 1 1 0	SO 16 14 E	RS 36 30 1E	. 56 46 2E	> 76 62 3E	N 116 78 4E	^ 136 94 5E	n 156 110 6E	~ 176 126 7E
15	1 1 1 1	SI 17 15 F	US 37 31 1F	/ 57 47 2F	? 77 63 3F	O 117 79 4F	_ 137 95 5F	o 157 111 6F	DEL 177 127 7F

C0 Codes (columns 0–1) — GL Codes (ASCII Graphic) (columns 2–7)

Key: Character ESC 33 27 1B — Octal, Decimal, Hex

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Figure 2–6 DEC Multinational Character Set (Left Half—C0 and GL Codes)

NOTE
All control function descriptions in this manual assume that the terminal is using the DEC Multinational set.

The DEC Supplemental Graphic set is the right half of the DEC Multinational set (Figure 2–7). The C1 controls are in columns 8 and 9. The graphic characters are in columns 10 through 15.

You can select the DEC Supplemental Graphic set as the default by using control functions (Chapter 5) or the **UPSS** feature in the General Set-Up screen. You can use the DEC Supplemental Graphic set in VT400 mode and PC TERM mode.

Column	8		9		10		11		12		13		14		15		Bits	
b8 b7 b6 b5	1 0 0 0		1 0 0 1		1 0 1 0		1 0 1 1		1 1 0 0		1 1 0 1		1 1 1 0		1 1 1 1		b4 b3 b2 b1	Row
		200 128 80	DCS	220 144 90		240 160 A0	°	260 176 B0	À	300 192 C0		320 208 D0	à	340 224 E0		360 240 F0	0 0 0 0	0
		201 129 81	PU1	221 145 91	¡	241 161 A1	±	261 177 B1	Á	301 193 C1	Ñ	321 209 D1	á	341 225 E1	ñ	361 241 F1	0 0 0 1	1
		202 130 82	PU2	222 146 92	¢	242 162 A2	2	262 178 B2	Â	302 194 C2	Ò	322 210 D2	â	342 226 E2	ò	362 242 F2	0 0 1 0	2
		203 131 83	STS	223 147 93	£	243 163 A3	3	263 179 B3	Ã	303 195 C3	Ó	323 211 D3	ã	343 227 E3	ó	363 243 F3	0 0 1 1	3
	IND	204 132 84	CCH	224 148 94		244 164 A4		264 180 B4	Ä	304 196 C4	Ô	324 212 D4	ä	344 228 E4	ô	364 244 F4	0 1 0 0	4
	NEL	205 133 85	MW	225 149 95	¥	245 165 A5	µ	265 181 B5	Å	305 197 C5	Õ	325 213 D5	å	345 229 E5	õ	365 245 F5	0 1 0 1	5
	SSA	206 134 86	SPA	226 150 96		246 166 A6	¶	266 182 B6	Æ	306 198 C6	Ö	326 214 D6	æ	346 230 E6	ö	366 246 F6	0 1 1 0	6
	ESA	207 135 87	EPA	227 151 97	§	247 167 A7	·	267 183 B7	Ç	307 199 C7	Œ	327 215 D7	ç	347 231 E7	œ	367 247 F7	0 1 1 1	7
	HTS	210 136 88		230 152 98	¤	250 168 A8		270 184 B8	È	310 200 C8	Ø	330 216 D8	è	350 232 E8	ø	370 248 F8	1 0 0 0	8
	HTJ	211 137 89		231 153 99	©	251 169 A9	1	271 185 B9	É	311 201 C9	Ù	331 217 D9	é	351 233 E9	ù	371 249 F9	1 0 0 1	9
	VTS	212 138 8A		232 154 9A	ª	252 170 AA	º	272 186 BA	Ê	312 202 CA	Ú	332 218 DA	ê	352 234 EA	ú	372 250 FA	1 0 1 0	10
	PLD	213 139 8B	CSI	233 155 9B	«	253 171 AB	»	273 187 BB	Ë	313 203 CB	Û	333 219 DB	ë	353 235 EB	û	373 251 FB	1 0 1 1	11
	PLU	214 140 8C	ST	234 156 9C		254 172 AC	1/4	274 188 BC	Ì	314 204 CC	Ü	334 220 DC	ì	354 236 EC	ü	374 252 FC	1 1 0 0	12
	RI	215 141 8D	OSC	235 157 9D		255 173 AD	1/2	275 189 BD	Í	315 205 CD	Ÿ	335 221 DD	í	355 237 ED	ÿ	375 253 FD	1 1 0 1	13
	SS2	216 142 8E	PM	236 158 9E		256 174 AE		276 190 BE	Î	316 206 CE		336 222 DE	î	356 238 EE		376 254 FE	1 1 1 0	14
	SS3	217 143 8F	APC	237 159 9F		257 175 AF	¿	2727 191 BF	Ï	317 207 CF	ß	337 223 DF	ï	357 239 EF		377 255 FF	1 1 1 1	15

← C1 Codes → ← GR Codes (DEC Supplemental Graphic) →

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Figure 2–7 DEC Multinational Character Set (Right Half—C1 and GR Codes)

ISO Latin Alphabet Nr 1 Supplemental Character Set

This 8-bit character set has 96 graphic characters. The graphic characters are similar to those in the DEC Supplemental Graphic set. The ISO Latin-1 supplemental set includes accented letters and diacritical marks, used in many European languages. It also has other special symbols and letters, not included in the DEC Supplemental Graphic set.

Figure 2–8 shows the ISO Latin-1 supplemental set. The C1 controls are in columns 8 and 9. The graphic characters are in columns 10 through 15.

8		9		10		11		12		13		14		15		Column	
1 0 0 0		1 0 0 1		1 0 1 0		1 0 1 1		1 1 0 0		1 1 0 1		1 1 1 0		1 1 1 1		b8 b7 b6 b5 Bits	
																b4 b3 b2 b1	Row
	200 128 80	DCS	220 144 90	NBSP	240 160 A0	°	260 176 B0	À	300 192 C0	Ð	320 208 D0	à	340 224 E0	ð	360 240 F0	0 0 0 0	0
	201 129 81	PU1	221 145 91	¡	241 161 A1	±	261 177 B1	Á	301 193 C1	Ñ	321 209 D1	á	341 225 E1	ñ	361 241 F1	0 0 0 1	1
	202 130 82	PU2	222 146 92	¢	242 162 A2	2	262 178 B2	Â	302 194 C2	Ò	322 210 D2	â	342 226 E2	ò	362 242 F2	0 0 1 0	2
	203 131 83	STS	223 147 93	£	243 163 A3	3	263 179 B3	Ã	303 195 C3	Ó	323 211 D3	ã	343 227 E3	ó	363 243 F3	0 0 1 1	3
IND	204 132 84	CCH	224 148 94	¤	244 164 A4	´	264 180 B4	Ä	304 196 C4	Ô	324 212 D4	ä	344 228 E4	ô	364 244 F4	0 1 0 0	4
NEL	205 133 85	MW	225 149 95	¥	245 165 A5	µ	265 181 B5	Å	305 197 C5	Õ	325 213 D5	å	345 229 E5	õ	365 245 F5	0 1 0 1	5
SSA	206 134 86	SPA	226 150 96	¦	246 166 A6	¶	266 182 B6	Æ	306 198 C6	Ö	326 214 D6	æ	346 230 E6	ö	366 246 F6	0 1 1 0	6
ESA	207 135 87	EPA	227 151 97	§	247 167 A7	·	267 183 B7	Ç	307 199 C7	×	327 215 D7	ç	347 231 E7	÷	367 247 F7	0 1 1 1	7
HTS	210 136 88		230 152 98	¨	250 168 A8	¸	270 184 B8	È	310 200 C8	Ø	330 216 D8	è	350 232 E8	ø	370 248 F8	1 0 0 0	8
HTJ	211 137 89		231 153 99	©	251 169 A9	1	271 185 B9	É	311 201 C9	Ù	331 217 D9	é	351 233 E9	ù	371 249 F9	1 0 0 1	9
VTS	212 138 8A		232 154 9A	ª	252 170 AA	º	272 186 BA	Ê	312 202 CA	Ú	332 218 DA	ê	352 234 EA	ú	372 250 FA	1 0 1 0	10
PLD	213 139 8B	CSI	233 155 9B	«	253 171 AB	»	273 187 BB	Ë	313 203 CB	Û	333 219 DB	ë	353 235 EB	û	373 251 FB	1 0 1 1	11
PLU	214 140 8C	ST	234 156 9C	¬	254 172 AC	1/4	274 188 BC	Ì	314 204 CC	Ü	334 220 DC	ì	354 236 EC	ü	374 252 FC	1 1 0 0	12
RI	215 141 8D	OSC	235 157 9D	—	255 173 AD	1/2	275 189 BD	Í	315 205 CD	Ý	335 221 DD	í	355 237 ED	ý	375 253 FD	1 1 0 1	13
SS2	216 142 8E	PM	236 158 9E	®	256 174 AE	3/4	276 190 BE	Î	316 206 CE	Þ	336 222 DE	î	356 238 EE	þ	376 254 FE	1 1 1 0	14
SS3	217 143 8F	APC	237 159 9F	—	257 175 AF	¿	2727 191 BF	Ï	317 207 CF	ß	337 223 DF	ï	357 239 EF	ÿ	377 255 FF	1 1 1 1	15

← C1 Codes → ← GR Codes (ISO Latin-1 Supplemental Graphic) →

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Figure 2–8 ISO Latin Nr 1 Supplemental Character Set

You can select the ISO Latin-1 supplemental set as the default by using control functions (Chapter 5) or the **UPSS** feature in the General Set-Up screen. The combination of the ASCII character set in GL and the ISO Latin-1 supplemental set in GR is called the ISO Latin Alphabet Nr 1 character set.

You can use the ISO Latin-1 set in VT400 mode and PC TERM mode.

National Replacement Character Sets (NRC Sets) (Worldwide Models Only)

The NRC sets provide character sets for many European languages. There are several NRC sets. Each is a 7-bit character set with 94 graphic characters. The NRC sets are similar to the ASCII set, except for a few characters. See Chapter 15 for additional 8-bit sets available in PC TERM mode.

NOTE
Digital recommends that you operate the terminal in an 8-bit environment. The NRC sets are only provided for compatibility with 7-bit environments.

Table 2–1 lists the characters in each NRC set that are different from the ASCII set. To use an NRC set, you must select national replacement character set mode. You can select this mode by using a control function (Chapter 4) or the **character set mode** feature in the General Set-Up screen. You can only use one NRC set at a time. The NRC set used depends on the keyboard selected in set-up, as follows:

Keyboard	NRC Set
United Kingdom	United Kingdom
Danish	Norwegian/Danish
Finnish	Finnish
Flemish	French
French/Belgian	French
French Canadian	French Canadian
Canadian English	French Canadian
German	German
Italian	Italian
Norwegian	Norwegian/Danish
Portuguese	Portuguese
Spanish	Spanish
Swedish	Swedish
Swiss (French)	Swiss
Swiss (German)	Swiss

Table 2–1 National Replacement Character Sets

Character Set	2/3	4/0	5/11	5/12	5/13	5/14
ASCII	#	@	[	\	]	^
United Kingdom	£	@	[	\	]	^
Finnish	#	@	Ä	Ö	Å	Ü
French	£	à	°	ç	§	^
French Canadian	#	à	â	ç	ê	î
German	#	§	Ä	Ö	Ü	^
Italian	£	§	°	ç	é	^
Norwegian/Danish	#	@	Æ	Ø	Å	^
Portuguese	#	@	Ã	Ç	Õ	^
Spanish	£	§	¡	Ñ	¿	^
Swedish	#	É	Ä	Ö	Å	Ü
Swiss	ù	à	é	ç	ê	î

Character Set	5/15	6/0	7/11	7/12	7/13	7/14
ASCII	_	`	{	|	}	~
United Kingdom	_	`	{	|	}	~
Finnish	_	é	ä	ö	å	ü
French	_	`	é	ù	è	¨
French Canadian	_	ô	é	ù	è	û
German	_	`	ä	ö	ü	ß
Italian	_	ù	à	ò	è	ì
Norwegian/Danish	_	`	æ	ø	å	~
Portuguese	_	`	ã	ç	õ	~
Spanish	_	`	°	ñ	ç	~
Swedish	_	é	ä	ö	å	ü
Swiss	è	ô	ä	ö	ü	û

DEC Special Graphic Character Set

This 7-bit character set has 94 graphic characters. Most of the graphic characters are also in the ASCII character set. The other graphic characters include special symbols and line-drawing characters.

Figure 2–9 shows the DEC Special Graphic set. The C0 controls are in columns 0 and 1. The graphic characters are in columns 2 through 7.

Another name for this character set is the VT100 line-drawing character set. The line-drawing characters let you create a limited range of pictures when you use the VT420 as a text terminal.

You can use the DEC Special Graphic set to replace the ASCII set in GL or the DEC Supplemental Graphic set in GR. Chapter 5 describes how to select character sets.

Row	Column	0		1		2		3		4		5		6		7	
	Bits b7 b6 b5	0 0 0		0 0 1		0 1 0		0 1 1		1 0 0		1 0 1		1 1 0		1 1 1	
	b4 b3 b2 b1																
0	0 0 0 0	NUL	0 0 0	DLE	20 16 10	SP	40 32 20	0	60 48 30	@	100 64 40	P	120 80 50	♦	140 96 60	— SCAN 3	160 112 70
1	0 0 0 1	SOH	1 1 1	DC1 (XON)	21 17 11	!	41 33 21	1	61 49 31	A	101 65 41	Q	121 81 51	▒	141 97 61	— SCAN 5	161 113 71
2	0 0 1 0	STX	2 2 2	DC2	22 18 12	"	42 34 22	2	62 50 32	B	102 66 42	R	122 82 52	␉	142 98 62	— SCAN 7	162 114 72
3	0 0 1 1	ETX	3 3 3	DC3 (XOFF)	23 19 13	#	43 35 23	3	63 51 33	C	103 67 43	S	123 83 53	␌	143 99 63	— SCAN 9	163 115 73
4	0 1 0 0	EOT	4 4 4	DC4	24 20 14	$	44 36 24	4	64 52 34	D	104 68 44	T	124 84 54	␍	144 100 64	├	164 116 74
5	0 1 0 1	ENQ	5 5 5	NAK	25 21 15	%	45 37 25	5	65 53 35	E	105 69 45	U	125 85 55	␊	145 101 65	┤	165 117 75
6	0 1 1 0	ACK	6 6 6	SYN	26 22 16	&	46 38 26	6	66 54 36	F	106 70 46	V	126 86 56	°	146 102 66	┴	166 118 76
7	0 1 1 1	BEL	7 7 7	ETB	27 23 17	'	47 39 27	7	67 55 37	G	107 71 47	W	127 87 57	±	147 103 67	┬	167 119 77
8	1 0 0 0	BS	10 8 8	CAN	30 24 18	(	50 40 28	8	70 56 38	H	110 72 48	X	130 88 58	␤	150 104 68	│	170 120 78
9	1 0 0 1	HT	11 9 9	EM	31 25 19	)	51 41 29	9	71 57 39	I	111 73 49	Y	131 89 59	␋	151 105 69	≤	171 121 79
10	1 0 1 0	LF	12 10 A	SUB	32 26 1A	*	52 42 2A	:	72 58 3A	J	112 74 4A	Z	132 90 5A	┘	152 106 6A	≥	172 122 7A
11	1 0 1 1	VT	13 11 B	ESC	33 27 1B	+	53 43 2B	;	73 59 3B	K	113 75 4B	[	133 91 5B	┐	153 107 6B	π	173 123 7B
12	1 1 0 0	FF	14 12 C	FS	34 28 1C	,	54 44 2C	<	74 60 3C	L	114 76 4C	\	134 92 5C	┌	154 108 6C	≠	174 124 7C
13	1 1 0 1	CR	15 13 D	GS	35 29 1D	-	55 45 2D	=	75 61 3D	M	115 77 4D	]	135 93 5D	└	155 109 6D	£	175 125 7D
14	1 1 1 0	SO	16 14 E	RS	36 30 1E	.	56 46 2E	>	76 62 3E	N	116 78 4E	^	136 94 5E	┼	156 110 6E	·	176 126 7E
15	1 1 1 1	SI	17 15 F	US	37 31 1F	/	57 47 2F	?	77 63 3F	O	117 79 4F	(BLANK)	137 95 5F	— SCAN 1	157 111 6F	DEL	177 127 7F

C0 Codes (columns 0–1) — GL Codes (DEC Special Graphic) (columns 2–7)

Key: Character ESC — 33 Octal, 27 Decimal, 1B Hex

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Figure 2–9 DEC Special Graphic Character Set

DEC Technical Character Set

This 7-bit character set has 94 graphic characters. The DEC Technical set has characters and symbols often used in technical applications, such as schematic and logic diagrams.

Figure 2–10 shows the DEC Technical character set. The C0 controls are in columns 0 and 1. The graphic characters and symbols are in columns 2 through 7. You can use the characters in positions 2/1 through 3/7 to form large composite characters.

You can use the DEC Technical set to replace the ASCII set in GL or the DEC Supplemental Graphic set in GR. You can only use the DEC Technical set in VT400 mode.

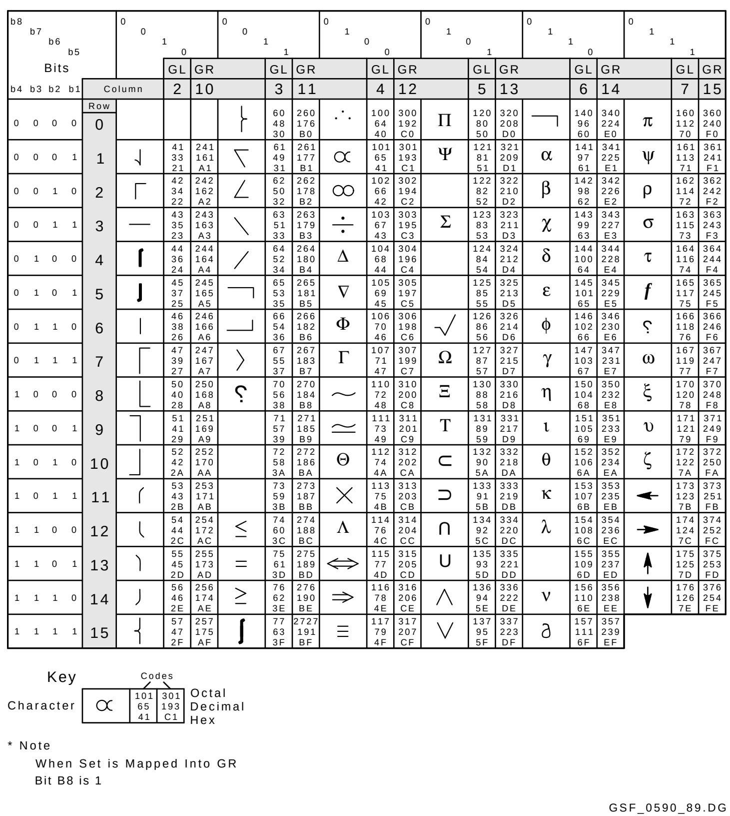

Figure 2–10 DEC Technical Character Set

Downloaded (Soft) Character Set

The VT420 lets you download a character set from the host system. The character set can have up to 96 graphic characters. You can design your own character set, then load the set into the terminal. You can use the set in GL or GR. Chapter 5 describes how to load and use a soft character set.

You can only use this character set in VT400 mode.

Control Characters

The purpose of a control character is to control an action such as line spacing, paging, or data flow. The terminal does not display control characters unless you select display controls mode (described later in this chapter). There are two groups of control characters.

C0	7-bit control characters, in columns 0 and 1 of the 8-bit code table
C1	8-bit control characters, in columns 8 and 9 of the 8-bit code table

Table 2–2 lists the C0 control characters the VT420 recognizes. Table 2–3 lists the C1 control characters the VT420 recognizes. You can also code C1 control characters as 7-bit escape sequences. Table 2–4 lists the equivalent 7-bit sequences for 8-bit control characters. All three tables give column/row locations to help you find the characters in the character sets.

Table 2–2 C0 (7-Bit) Control Characters Recognized

Name	Mnemonic Column/Row	Function
Null	**NUL** 0/0	NUL has no function (ignored by the terminal).
Enquiry	**ENQ** 0/5	Sends the answerback message. (Communications Set-Up)
Bell	**BEL** 0/7	Sounds the bell tone if the bell is enabled in Keyboard Set-Up.
BS	**BS** 0/8	Moves the cursor one character position to the left. If the cursor is at the left margin, no action occurs.

Table 2–2 (Cont.) C0 (7-Bit) Control Characters Recognized

Name	Mnemonic Column/Row	Function
Horizontal tab	**HT** 0/9	Moves the cursor to the next tab stop. If there are no more tab stops, the cursor moves to the right margin. HT does not cause text to auto wrap.
Line feed	**LF** 0/10	Causes a line feed or a new line operation, depending on the setting of line feed/new line mode.
Vertical tab	**VT** 0/11	Treated as LF.
Form feed	**FF** 0/12	Treated as LF.
Carriage return	**CR** 0/13	Moves the cursor to the left margin on the current line.
Shift out (locking shift 1)	**SO** (LS1) 0/14	Maps the G1 character set into GL. You designate G1 by using a select character set (SCS) sequence (Chapter 5).
Shift in (locking shift 0)	**SI** (LS0) 0/15	Maps the G0 character set into GL. You designate G0 by using a select character set (SCS) sequence (Chapter 5).
Device control 1 (XON)	**DC1** 1/1	Also known as XON. If XON/XOFF flow control is enabled in Communications Set-Up, DC1 clears DC3 (XOFF). This action causes the VT420 to continue sending characters.
Device control 3 (XOFF)	**DC3** 1/3	Also known as XOFF. If XON /XOFF flow control is enabled in Communications Set-Up, DC3 causes the VT420 to stop sending characters. The terminal cannot resume sending characters until it receives a DC1 control character.

Table 2–2 (Cont.) C0 (7-Bit) Control Characters Recognized

Name	Mnemonic Column/Row	Function
Device control 4	**DC4** 1/4	Introduces an SSU session management command. The VT420 and host use this control to separate SSU commands from ANSI text and control functions. See Chapter 14.
Cancel	**CAN** 1/8	Immediately cancels an escape sequence, control sequence, or device control string in progress. The VT420 does not display any error characters.
Substitute	**SUB** 1/10	Immediately cancels an escape sequence, control sequence, or device control string in progress. The VT420 displays a reverse question mark for an error character.
Escape	**ESC** 1/11	Introduces an escape sequence. ESC also cancels any escape sequence, control sequence, or device control string in progress.
Delete	**DEL** 7/15	Ignored when received, unless a 96-character set is mapped into GL. DEL is not used as a fill character. Digital does not recommend using DEL as a fill character. Use NUL instead.

Table 2–3 C1 (8-Bit) Control Characters Recognized

Name	Mnemonic Column/Row	Function
Index	**IND** 8/4	Moves the cursor down one line in the same column. If the cursor is at the bottom margin, the page scrolls up.
Next line	**NEL** 8/5	Moves the cursor to the first position on the next line. If the cursor is at the bottom margin, the page scrolls up.

Table 2–3 (Cont.) C1 (8-Bit) Control Characters Recognized

Name	Mnemonic Column/Row	Function
Horizontal tab set	**HTS** 8/8	Sets a horizontal tab stop at the column where the cursor is.
Reverse index	**RI** 8/13	Moves the cursor up one line in the same column. If the cursor is at the top margin, the page scrolls down.
Single shift 2	**SS2** 8/14	Temporarily maps the G2 character set into GL, for the next graphic character. You designate the G2 set by using a select character set (SCS) sequence (Chapter 5).
Single shift 3	**SS3** 8/15	Temporarily maps the G3 character set into GL, for the next graphic character. You designate the G3 set by using a select character set (SCS) sequence (Chapter 5).
Device control string	**DCS** 9/0	Introduces a device control string. Used for loading function keys or a soft character set.
Start of string	**SOS** 9/8	Ignored.
DEC private identification	**DECID** 9/10	Makes the terminal send its device attributes response to the host (same as an ANSI device attributes (DA) sequence). Programs should use the ANSI DA sequence instead. **NOTE** **If the printer is in controller mode, the terminal sends the sequence to the printer.**
Control sequence introducer	**CSI** 9/11	Introduces a control sequence.
String terminator	**ST** 9/12	Ends a device control string. You use ST in combination with DCS.

Table 2–3 (Cont.) C1 (8-Bit) Control Characters Recognized

Name	Mnemonic Column/Row	Function
Operating system command	**OSC** 9/13	Introduces an operating system command.*
Privacy message	**PM** 9/14	Introduces a privacy message string.*
Application program command	**APC** 9/15	Introduces an application program command.*

*The VT420 ignores all following characters until it receives a SUB, ST, or any other C1 control character.

Table 2–4 8-Bit Control Characters and Their 7-Bit Equivalents

Name	8-Bit Character	7-Bit Sequence	
Index	**IND** 8/4	**ESC** 1/11	**D** 4/4
Next line	**NEL** 8/5	**ESC** 1/11	**E** 4/5
Horizontal tab set	**HTS** 8/8	**ESC** 1/11	**H** 4/8
Reverse index	**RI** 8/13	**ESC** 1/11	**M** 4/13
Single shift 2	**SS2** 8/14	**ESC** 1/11	**N** 4/14
Single shift 3	**SS3** 8/15	**ESC** 1/11	**O** 4/15
Device control string	**DCS** 9/0	**ESC** 1/11	**P** 5/0
Start of string	**SOS** 9/8	**ESC** 1/11	**X** 5/8

Table 2–4 (Cont.) 8-Bit Control Characters and Their 7-Bit Equivalents

Name	8-Bit Character	7-Bit Sequence	
DEC private identification	**DECID** 9/10	**ESC** 1/11	**Z** 5/10
Control sequence introducer	**CSI** 9/11	**ESC** 1/11	**[** 5/11
String terminator	**ST** 9/12	**ESC** 1/11	\ 5/12
Operating system command	**OSC** 9/13	**ESC** 1/11	**]** 5/13
Privacy message	**PM** 9/14	**ESC** 1/11	**^** 5/14
Application program	**APC** 9/15	**ESC** 1/11	_ 5/15

Control Functions

You use control functions to make the terminal perform special actions in your applications. These functions range from the simple—editing data—to the complex—reporting on the terminal's operating state. The rest of this manual covers the many uses for control functions. Here are some examples.

Move the cursor.
Delete a line of text.
Select bold or underlined text.
Change character sets.
Make the terminal emulate a VT52 or VT100 terminal.

There are single-character and multiple-character control functions.

The single-character functions are the C0 and C1 control characters. You can use C0 characters in a 7-bit or 8-bit environment. C1 characters provide a few more functions than C0 characters, but you can only use C1 characters directly in an 8-bit environment.

Multiple-character functions provide many more functions than the C0 and C1 characters. Multiple-character functions can use control characters and graphic characters. There are three basic types of multiple-character functions.

Escape sequences
Control sequences
Device control strings

Many sequences are based on ANSI and ISO standards, and are used throughout the industry. Others are private sequences created by manufacturers like Digital for specific families of products. ANSI sequences and private sequences follow ANSI and ISO standards for control functions.

In this manual, private control functions created by Digital have the prefix DEC in their mnemonic name. For example, column mode has the mnemonic DECCOLM. All other control functions are standardized.

The following sections describe the format for escape sequences, control sequences, and device control strings.

Programming Tip

When you use control functions, remember that the binary codes define a function—not the graphic characters. This manual uses graphic characters from the DEC Multinational character set to show control functions. If you use another character set, the graphic characters for control functions may change, but the code is always the same.

Sequence Format

This manual shows escape and control sequences in their 8-bit format. You can also use equivalent 7-bit sequences (Table 2–4).

The 8-bit format uses the C0 and C1 control characters and ASCII characters from the DEC Multinational character set. The sequences also show each character's column/row position in the character set table, below the character. The column/row code eliminates confusion over similar-looking characters such as 0 (3/0) and O (4/15).

NOTE
Spaces appear between characters in a sequence for clarity. These spaces are not part of the sequence. If a space is part of the sequence, the SP (2/0) character appears.

Escape Sequences

An escape sequence uses two or more bytes to define a specific control function. Escape sequences do not include variable parameters, but may include intermediate characters. Here is the format for an escape sequence.

ESC	**I**	**F**
1/11	2/0 to 2/15	3/0 to 7/14
Escape character	Intermediate characters (zero or more characters)	Final character (one character)

ESC introduces escape sequences. After receiving the ESC control character, the terminal interprets the next received characters as part of the sequence.

I represents zero or more *intermediate characters* that can follow the ESC character. Intermediate characters come from the 2/0 through 2/15 range of the code table.

F is the *final character*. This character indicates the end of the sequence. The final character comes from the 3/0 through 7/14 range of the code table. The intermediate and final characters together define a single control function.

For example, the following escape sequence changes the current line of text to double-width, single-height characters:

ESC	**#**	**6**
1/11	2/3	3/6

Control Sequences

A control sequence uses two or more bytes to define a specific control function. Control sequences usually include variable parameters. Here is the format for a control sequence.

CSI	**P...P**	**I...I**	**F**
9/11	3/0 to 3/15	2/0 to 2/25	4/0 to 7/14
Control sequence introducer	Parameter (zero or more characters)	Intermediate (zero or more characters)	Final (one character)

CSI is the *control sequence introducer*. You can also use the equivalent 7-bit sequence, ESC (1/11) [(5/11), as a substitute for CSI. After receiving CSI, the terminal interprets the next received characters as part of the sequence.

P...P are *parameter characters* received after CSI. These characters are in the 3/0 to 3/15 range in the code table. Parameter characters modify the action or interpretation of the sequence. You can use up to 16 parameters per sequence. You must use the ; (3/11) character to separate parameters.

All parameters are unsigned, positive decimal integers, with the most significant digit sent first. Any parameter greater than 9999 (decimal) is set to 9999 (decimal). If you do not specify a value, a 0 value is assumed. A 0 value or omitted parameter indicates a *default value* for the sequence. For most sequences, the default value is 1.

NOTE
All parameters must be positive decimal integers. Do not use a decimal point in a parameter—the terminal will ignore the command.

If the first character in a parameter string is the ? (3/15) character, it indicates that DEC private parameters follow. The terminal interprets private parameters according to ANSI X3.64 and ISO 6429.

The VT420 processes two types to parameters, numeric and selective.

Numeric Parameters

A numeric parameter indicates a number value such as a margin location. In this manual, numeric parameters appear as actual values or as *Pn, Pn1, Pn2,* and so on.

The following is an example of a control sequence with numeric parameters:

CSI	**5**	**;**	**2 0**	**r**
9/11	3/5	3/11	3/2 3/0	7/2
Control sequence introducer	First numeric parameter	Delimiter	Second numeric parameter	Final character

This sequence sets the top and bottom margins of the current page. The top margin is at line 5, the bottom is at line 20. The ; (3/11) separates the two parameters.

Selective Parameters

A selective parameter selects an action associated with the specific parameter. In this manual, selective parameters usually appear as *Ps, Ps1, Ps2,* and so on.

The following is an example of a control sequence using selective parameters:

CSI	**1**	**;**	**4**	**m**
9/11	3/1	3/11	3/4	6/13
Control sequence introducer	First selective parameter	Delimiter	Second selective parameter	Final character

This control sequence turns on the bold and underline attribute at the cursor position. The parameters are 1 (indicating the bold attribute) and 4 (indicating the underline attribute). The ; (3/11) delimiter separates the two parameters.

I...I are zero or more *intermediate characters* received after CSI. These characters are in the 2/0 to 2/15 range.

F is the *final character* from the 4/0 to 7/14 range. The final character indicates the end of the sequence. The intermediate and final characters together define a control function. If there are no intermediate characters, the final character defines the function.

Device Control Strings

Device control strings (DCS), like control sequences, use two or more bytes to define specific control functions. However, a DCS also includes a data string. Here is the format for a device control string.

DCS	**P...P**	**I...I**	**F**	**Data string**	**ST**
9/0	3/0 to 3/15	2/0 to 3/15	4/0 to 3/15	************	9/12
Device control string introducer	Zero or more para-meters	Zero or more inter-mediates	Final	String	String terminator

DCS is *the device control string introducer*. DCS is the C1 control character at position 9/0. You can also use the equivalent 7-bit sequence, ESC (1/11) P (5/0). After receiving DCS, the terminal processes the next received characters as part of the string function.

P..P are *parameter characters* received after DCS. The use of parameter characters in a device control string is a Digital extension to the ANSI syntax. According to ANSI standards, any elements included after DCS are part of the data string.

Parameter characters are in the 3/0 to 3/15 range. They modify the action or interpretation of the device control string. You can use up to 16 parameters per string. Each parameter is separated with a ; (3 /11) character. These characters follow the same rules as in a control sequence. See the “Control Sequences” section in this chapter.

I...I are zero or more intermediate characters received after CSI. These characters are in the 2/0 to 2/15 range.

F is the final character in the 4/0 to 7/14 range. The final character indicates the end of the string. The intermediate and final characters define the string. If there are no intermediates, the final character defines the string.

Data string follows the final character and usually includes several definition strings. Each definition string can be several characters in length. Individual strings are separated by the ; (3/11) delimiter.

ST is the *string terminator*. ST (9/12) indicates the end of a string. You can also use the equivalent 7-bit sequence, ESC (1/11) \ (5/12).

The following is an example of a device control string:

DCS	**0**	**!**	**u**	**%**	**5**	**ST**
9/0	3/0	2/1	7/5	2/5	3/5	9/12
Device control string introducer	Para-meter	Inter-mediate	Final	Data string		String terminator

This device control string assigns the DEC Supplemental Graphic set as the user-preferred supplemental set.

Using Control Characters in Sequences

You can use control characters—ESC, CAN, and SUB—to interrupt or recover from errors in escape sequences, control sequences, and device control strings.

- You can send ESC (1/11) to cancel a sequence in progress and begin a new sequence.
- You can send CAN (1/8) to indicate the present data is in error or to cancel a sequence in progress. The VT420 interprets the characters following CAN as usual.

- You can send SUB (1/10) to cancel a sequence in progress. The VT420 interprets the characters following SUB as usual.

The VT420 does not lose data when errors occur in escape or control sequences and device control strings. The terminal ignores unrecognized sequences and strings, unless they end a current escape sequence.

7-Bit Code Extension Technique

You can represent all C1 control characters as 7-bit escape sequences. You can use the C1 characters indirectly, by representing them as 2-character escape sequences. ANSI calls this technique a 7-bit code extension. The 7-bit code extension provides a way of using C1 characters in applications written for a 7-bit environment. Here are some examples.

8-Bit C1 Character	**7-Bit Code Extension Escape Sequence**	
CSI	**ESC**	**[**
9/11	1/11	5/11
SS3	**ESC**	**O**
8/15	1/11	4/15
IND	**ESC**	**D**
8/4	1/11	4/4
DCS	**ESC**	**P**
9/0	1/11	5/0

In general, you can use the 7-bit code extension technique in two ways.

- You can represent any C1 control character as a 2-character escape sequence. The second character of the sequence has a code that is 40_{16} or 64_{10} less than the code of the C1 character.
- You can make any escape sequence whose second character is in the range of 4/0 through 5/15 one byte shorter by removing the ESC character and adding 40_{16} to the code of the second character. This generates an 8-bit control character. For example, you can change ESC [to CSI with this method.

Working with 7-Bit and 8-Bit Environments

There are three requirements for using one of the terminal's 8-bit character sets.

- Your program and communication environment must be 8-bit compatible.
- The terminal cannot be in national replacement character set mode (DECNRCM).
- The terminal must operate in VT400 mode or PC TERM mode. When the terminal operates in VT100 mode or VT52 mode, you are limited to working in a 7-bit environment (Chapter 4).

The following sections describe conventions that apply in VT400 mode.

Conventions for Codes Received by the Terminal

The terminal expects to receive character codes in a form compatible with 8-bit coding. Your application can use the C0 and C1 control characters, as well as the 7-bit C1 code extensions, if necessary. The terminal always interprets these codes correctly.

When your program sends GL or GR codes, the terminal interprets the character codes according to the graphic character sets in use. When you turn on or reset the terminal, you automatically select the ASCII character set in GL and the current user-preferred character set (DEC Supplemental Graphic or ISO Latin-1 supplemental) in GR. You select the user-preferred set in the General Set-Up screen. This mapping assumes the current terminal mode is VT400 mode.

Conventions for Codes Sent by the Terminal

The terminal can send data to an application in two ways.

- Directly from the keyboard
- In response to commands from the host (application or operating system)

Most function keys on the keyboard send multiple-character control functions. Many of these functions start with CSI (9/11) or SS3 8/15,) which are C1 characters. If your application cannot handle 8-bit characters, you can make the terminal automatically convert all C1 characters to their equivalent 7-bit code extensions before sending them to the application. To convert C1 characters, you use the DECSCL commands described in Chapter 4.

By default, the terminal is set to automatically convert all C1 characters sent to the application to 7-bit code extensions. However, to ensure the correct mode of operation, always use the appropriate DECSCL commands.

NOTE
In VT400 mode, the terminal can send GR graphic characters to an application, even if the application cannot handle 8-bit codes. However, in a 7-bit environment, the terminal sends C1 controls as 7-bit escape sequences and does not send 8-bit graphic characters.

New programs should accept both 7-bit and 8-bit forms of the C1 control characters.

Using Macros

The VT420 lets you define and invoke macros to suit the needs of your application. A *macro* is a string of ANSI text and commands downloaded into the terminal. By invoking the macro, you can execute a group of control functions with one operation.

Define Macro (DECDMAC)

This device control string lets you define a macro consisting of a string of ANSI text and control functions. After you define the macro, you can execute it by using the invoke macro control function (DECINVM). The terminal processes the macro as normal input.

Available in: VT400 mode only

Programming Tip

You can find how much memory space you have available for macros by using a device status report sequence. See Chapter 12.

Format

DCS	*Pid*	**;**	*Pdt*	**;**	*Pen*	**!**	**z**	**D...D**	**ST**
9/0	3/?	3/11	3/?	3/11	3/?	2/1	7/10	...	9/12

Parameters

Pid

is the macro ID number. *Pid* can be any number between 0 and 63, otherwise the terminal ignores the command. If you give a macro an ID that already exists, DECDMAC deletes the old macro definition before using the new one.

Pdt

defines how the terminal treats new macro definitions.

Pdt	Meaning
0 or omitted	DECDMAC deletes the old macro with the same ID number before defining this new macro.
1	DECDMAC deletes all current macro definitions before defining this macro.
Other	The terminal ignores the macro.

Pen

selects the encoding format for the text of the macro definition.

Pen	Meaning
0 or omitted	Use standard ASCII characters in the macro.
1	Use hex pairs in the macro. Each pair of characters in the macro is the hex value for a single ASCII character.
Other	The terminal ignores the macro.

D...D

is the data of the control string. This data is the string of text and control functions performed when an application invokes the macro. The data can consist of ASCII text or hex pairs.

When you use ASCII text (Pen = 0 or omitted), the macro consists of the graphic characters that appear in the device control string. Only characters from positions 2/0 through 7/14 and 10/00 through 15/15 in the code table are valid.

When you use hex pairs (Pen = 1), the macro consists of pairs of hex numbers, each of which represents an ASCII character. When using hex pairs, you can also use a repeat introducer in the data string. The repeat introducer is the **!** (2/1) character. The repeat introducer lets you repeat any hex pair within the definition string any number of times. You embed repeat sequences within the data string of the macro definition.

NOTE
If ASCII text is specified as the encoding format, you cannot use the repeat sequence.

!
is the repeat sequence introducer. The format of the hex string with the repeat introducer is as follows:

! *Pn; D...D* ;

Pn is a numeric parameter that specifies the number of times to repeat the sequence. If *Pn* is omitted, the macro repeats the sequence once.

D...D is the sequence of hex pairs to repeat *Pn* times.

A semicolon ; (3/11) separates the repeat count from the sequence of hex pairs. Another semicolon ends the sequence. If any characters are included before the first semicolon, the terminal ignores the macro. If a string terminator is placed before the final semicolon, the repeat string ends normally.

Notes on DECDMAC

- The VT420 has 6 Kbytes of memory available for the storage of macros. The terminal ignores any macro definitions that cannot fit into this space.
- A reset to initial state (RIS) or secure reset (DECSR) operation clears all macro definitions. A soft terminal reset (DECSTR) has no effect on stored macro definitions.
- You can include characters from positions 0/8 through 0/13 to format the device control string, but these characters cannot be part of the macro definition.

Invoke Macro (DECINVM)

This control function let you execute a stored macro. You store macros with the define macro (DECDMAC) control string. The terminal substitutes the DECINVM sequence with the contents of the macro definition and executes the macro.

Available in: VT400 mode only

Format

CSI	*Pid*	*****	**z**
9/11	3/*n*	2/10	7/10

Parameters

Pid
is the macro ID number. If the *Pid* number is not associated with a particular macro, the terminal ignores the command.

Notes on DECINVM

- Any functions executed with a macro invocation remain in effect after the macro is executed.

Macro Examples

Suppose you want to create a macro that clears all pages in page memory, writes the word “top” at the top of each page, and leaves the cursor on page 1.

First, you would write the string with ASCII characters as follows:

```
DCS 1 ; 0 ; 1 ! z CSI 6 sp P ! 6 ; CSI 1 ; 1 H CSI 2 J TOP
CSI 1 V ; ST
```

Now, you must convert the string into hexadecimal code because the string uses the repeat (!) character. Remember that you can only use the repeat character with hexadecimal sequences. Here is the same string in hex:

```
DCS 1 ; 0 ; 1 ! z 9B 36 20 50 ! 6 ; 9B 31 3B 48 9B 32 49 54
4F 50 9B 31 56 ; ST
```

To invoke the macro, use the following sequence:

```
CSI 1 * z
```

Display Controls Mode

The VT420 lets you display control characters as graphic characters, when you want to debug your applications. In this mode, the terminal does not perform all control functions.

To select this mode, you must set the **control representation mode** feature in the Display Set-Up screen to `Display Controls`. You cannot select this mode with an escape sequence.

The effect of the `Display Controls` setting depends on the operating mode you use. See Chapter 15 for information on PC TERM mode.

In VT400 mode
When you select `Display Controls`, the terminal temporarily loads a special graphic character set into C0, GL, C1, and GR. Figures 2–11 and 2–12 shows this special set, called the display controls font. The terminal uses this font to display control characters on the screen.

In VT52 or VT100 mode
When you select `Display Controls`, the terminal temporarily loads the left half of the display controls font into C0 and GL. The terminal uses this half of the font to display all C0 and GL characters. (C1 and GR are meaningless in VT52 or VT100 mode.)

When Displaying 36 or 48 Lines on the Screen
When you display 36 or 48 lines on the screen (DECSNLS, Chapter 11), the terminal uses a smaller font to display control characters. The smaller font represents each control character as a two-character symbol instead of a three-character symbol. Figures 2–11 and 2–12 show what the control characters look like when displaying 24 lines on the screen. Table 2–5 shows the abbreviation for the control characters in the smaller font.

Table 2–5 Displaying Controls in 36 or 48 Lines

Control Character in 24 Lines	Control Character in 36 or 48 Lines	Name
NUL	NL	Null
SOH	SH	Start of heading
STX	SX	Start of text
ETX	EX	End of text
EOT	ET	End of transmission
ENQ	EN	Enquire
ACK	AK	Acknowledge
BEL	BL	Bell
BS	BS	Backspace
HT	HT	Horizontal tab
LF	LF	Line feed
VT	VT	Vertical tab
FF	FF	Form feed
CR	CR	Carriage return
SO	SO	Shift out
SI	SI	Shift in
DLE	DE	Data link escape
DC1	D1	Device control 1 (XON)

Table 2–5 (Cont.) Displaying Controls in 36 or 48 Lines

Control Character in 24 Lines	Control Character in 36 or 48 Lines	Name
DC2	D2	Device control 2
DC3	D3	Device control 3 (XOFF)
DC4	D4	Device control 4
NAK	NK	Negative acknowledge
SYN	SY	Synchronous idle
ETB	EB	End of transmission block
CAN	CA	Cancel
EM	EM	End of medium
SUB	SB	Substitute
ESC	EC	Escape
FS	FS	Field separator
GS	GS	Group separator
RS	RS	Record separator
US	US	Unit separator
IND	IN	Index
NEL	NE	Next line
SSA	SA	Start selected area
ESA	EA	End selected area
HTS	HS	Horizontal tab set
HTJ	HJ	Horizontal tab with justify
VTS	VS	Vertical tab set
PLD	PD	Partial line down
PLU	PU	Partial line up
RI	RI	Reverse index
SS2	S2	Single shift 2
SS3	S3	Single shift 3
DCS	DC	Device control string
PU1	P1	Private use 1
PU2	P2	Private use 2

Table 2–5 (Cont.) Displaying Controls in 36 or 48 Lines

Control Character in 24 Lines	Control Character in 36 or 48 Lines	Name
STS	SS	Set transmit state
CCH	CC	Cancel character
MW	MW	Message waiting
SPA	SP	Start protected area
EPA	EP	End protected area
CSI	CS	Control sequence introducer
ST	ST	String terminator
OSC	OS	Operating system command
PM	PM	Private message
APC	AP	Application program command
NS	NS	No-break space

Exceptions
Some control functions still work in this mode.

- LF, FF, and VT cause a carriage return and line feed (CR LF) that move the cursor to a new line. The terminal displays the LF, FF, or VT character before performing the new line function.
- XOFF (DC3) and XON (DC1) maintain flow control, if enabled in set-up. The terminal displays the DC1 or DC3 character after performing the control function.
- The terminal does not display SSU session management commands (Chapter 14).

Column	0		1		2		3		4		5		6		7	
Bits b8 b7 b6 b5	0 0 0 0		0 0 0 1		0 0 1 0		0 0 1 1		0 1 0 0		0 1 0 1		0 1 1 0		0 1 1 1	
Row b4 b3 b2 b1																
0 (0 0 0 0)	NUL	0 0 0	DLO	20 16 10	SP	40 32 20	0	60 48 30	@	100 64 40	P	120 80 50	‘	140 96 60	p	160 112 70
1 (0 0 0 1)	SOH	1 1 1	DC1	21 17 11	!	41 33 21	1	61 49 31	A	101 65 41	Q	121 81 51	a	141 97 61	q	161 113 71
2 (0 0 1 0)	STX	2 2 2	DC2	22 18 12	"	42 34 22	2	62 50 32	B	102 66 42	R	122 82 52	b	142 98 62	r	162 114 72
3 (0 0 1 1)	ETX	3 3 3	DC3	23 19 13	#	43 35 23	3	63 51 33	C	103 67 43	S	123 83 53	c	143 99 63	s	163 115 73
4 (0 1 0 0)	EOT	4 4 4	DC4	24 20 14	$	44 36 24	4	64 52 34	D	104 68 44	T	124 84 54	d	144 100 64	t	164 116 74
5 (0 1 0 1)	ENQ	5 5 5	NAK	25 21 15	%	45 37 25	5	65 53 35	E	105 69 45	U	125 85 55	e	145 101 65	u	165 117 75
6 (0 1 1 0)	ACK	6 6 6	SYN	26 22 16	&	46 38 26	6	66 54 36	F	106 70 46	V	126 86 56	f	146 102 66	v	166 118 76
7 (0 1 1 1)	BEL	7 7 7	ETB	27 23 17	'	47 39 27	7	67 55 37	G	107 71 47	W	127 87 57	g	147 103 67	w	167 119 77
8 (1 0 0 0)	BS	10 8 8	CAN	30 24 18	(	50 40 28	8	70 56 38	H	110 72 48	X	130 88 58	h	150 104 68	x	170 120 78
9 (1 0 0 1)	HT	11 9 9	EM	31 25 19	)	51 41 29	9	71 57 39	I	111 73 49	Y	131 89 59	i	151 105 69	y	171 121 79
10 (1 0 1 0)	LF	12 10 A	⸮	32 26 1A	*	52 42 2A	:	72 58 3A	J	112 74 4A	Z	132 90 5A	j	152 106 6A	z	172 122 7A
11 (1 0 1 1)	VT	13 11 B	ESC	33 27 1B	+	53 43 2B	;	73 59 3B	K	113 75 4B	[	133 91 5B	k	153 107 6B	{	173 123 7B
12 (1 1 0 0)	FF	14 12 C	FS	34 28 1C	,	54 44 2C	<	74 60 3C	L	114 76 4C	\	134 92 5C	l	154 108 6C	|	174 124 7C
13 (1 1 0 1)	CR	15 13 D	GS	35 29 1D	-	55 45 2D	=	75 61 3D	M	115 77 4D	]	135 93 5D	m	155 109 6D	}	175 125 7D
14 (1 1 1 0)	SO	16 14 E	RS	36 30 1E	.	56 46 2E	>	76 62 3E	N	116 78 4E	^	136 94 5E	n	156 110 6E	~	176 126 7E
15 (1 1 1 1)	SI	17 15 F	US	37 31 1F	/	57 47 2F	?	77 63 3F	O	117 79 4F	_	137 95 5F	o	157 111 6F	DT	177 127 7F

C0 Codes (columns 0–1) — GL Codes (ASCII Graphic) (columns 2–7)

Key

Character	ESC	33 27 1B	Octal Decimal Hex

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Figure 2–11 Display Controls Font (Left Half)

8		9		10		11		12		13		14		15		Column	
1 0 0 0		1 0 0 1		1 0 1 0		1 0 1 1		1 1 0 0		1 1 0 1		1 1 1 0		1 1 1 1		b8 b7 b6 b5 Bits	
																b4 b3 b2 b1	Row
80	200 128 80	DCS	220 144 90	NSP	240 160 A0	°	260 176 B0	À	300 192 C0	Ð	320 208 D0	à	340 224 E0	ð	360 240 F0	0 0 0 0	0
81	201 129 81	PU1	221 145 91	¡	241 161 A1	±	261 177 B1	Á	301 193 C1	Ñ	321 209 D1	á	341 225 E1	ñ	361 241 F1	0 0 0 1	1
82	202 130 82	PU2	222 146 92	¢	242 162 A2	2	262 178 B2	Â	302 194 C2	Ò	322 210 D2	â	342 226 E2	ò	362 242 F2	0 0 1 0	2
83	203 131 83	STS	223 147 93	£	243 163 A3	3	263 179 B3	Ã	303 195 C3	Ó	323 211 D3	ã	343 227 E3	ó	363 243 F3	0 0 1 1	3
IND	204 132 84	CRH	224 148 94	¤	244 164 A4	´	264 180 B4	Ä	304 196 C4	Ô	324 212 D4	ä	344 228 E4	ô	364 244 F4	0 1 0 0	4
NEL	205 133 85	MW	225 149 95	¥	245 165 A5	µ	265 181 B5	Å	305 197 C5	Õ	325 213 D5	å	345 229 E5	õ	365 245 F5	0 1 0 1	5
SSA	206 134 86	SPA	226 150 96	¦	246 166 A6	¶	266 182 B6	Æ	306 198 C6	Ö	326 214 D6	æ	346 230 E6	ö	366 246 F6	0 1 1 0	6
ESA	207 135 87	EPA	227 151 97	§	247 167 A7	·	267 183 B7	Ç	307 199 C7	×	327 215 D7	ç	347 231 E7	÷	367 247 F7	0 1 1 1	7
HTS	210 136 88	98	230 152 98	¨	250 168 A8	¸	270 184 B8	È	310 200 C8	Ø	330 216 D8	è	350 232 E8	ø	370 248 F8	1 0 0 0	8
HTJ	211 137 89	99	231 153 99	©	251 169 A9	1	271 185 B9	É	311 201 C9	Ù	331 217 D9	é	351 233 E9	ù	371 249 F9	1 0 0 1	9
VTS	212 138 8A	9A	232 154 9A	ª	252 170 AA	º	272 186 BA	Ê	312 202 CA	Ú	332 218 DA	ê	352 234 EA	ú	372 250 FA	1 0 1 0	10
PLD	213 139 8B	CSI	233 155 9B	«	253 171 AB	»	273 187 BB	Ë	313 203 CB	Û	333 219 DB	ë	353 235 EB	û	373 251 FB	1 0 1 1	11
PLU	214 140 8C	ST	234 156 9C	¬	254 172 AC	1/4	274 188 BC	Ì	314 204 CC	Ü	334 220 DC	ì	354 236 EC	ü	374 252 FC	1 1 0 0	12
RI	215 141 8D	OSC	235 157 9D	—	255 173 AD	1/2	275 189 BD	Í	315 205 CD	Ý	335 221 DD	í	355 237 ED	ý	375 253 FD	1 1 0 1	13
SS2	216 142 8E	PM	236 158 9E	®	256 174 AE	3/4	276 190 BE	Î	316 206 CE	Þ	336 222 DE	î	356 238 EE	þ	376 254 FE	1 1 1 0	14
SS3	217 143 8F	APC	237 159 9F	—	257 175 AF	¿	2727 191 BF	Ï	317 207 CF	ß	337 223 DF	ï	357 239 EF	ÿ	377 255 FF	1 1 1 1	15

C1 Codes — GR Codes (ISO Latin-1 Supplemental Graphic)

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Figure 2–12 Display Controls Font (Right Half)

Part 2
Control Functions Sent to the Host

3

ANSI, Short ANSI, And PC Keyboard Codes

This chapter describes the codes the terminal can send to an application program in VT mode. See Chapter 15 for a description of the codes the terminal sends in PC TERM mode. This chapter assumes that you are familiar with the character-encoding concepts described in Chapter 2.

In VT400 or VT100 mode, the keyboard keys send codes that are compatible with ANSI standards. In VT52 mode, some keys send codes that differ from those sent in the ANSI-compatible modes. This chapter lists the ANSI codes and the VT52 codes that differ from the ANSI-compatible codes.

The VT420 worldwide model can use several different national keyboard dialects. Each keyboard dialect pertains to a different country or region of western Europe. You can select the appropriate dialect by setting the **keyboard language** feature in the Set-Up Directory. This chapter describes significant differences among the national keyboards.

Keyboard Layouts

The terminal uses one of three Digital keyboards:

- The ANSI keyboard (Figure 3–1) has four groups of keys: a main keypad, an editing keypad, a numeric keypad, and the top-row function keys.
- The short ANSI keyboard (Figure 3–2) has an Extend key and three groups of keys: a main keypad, arrow keys, top-row function keys.
- The PC keyboard (Figure 3–3) for the VT420 with PC TERM mode has four groups of keys: a main keypad, an editing keypad, a numeric keypad, and the top-row function keys. In VT mode, you can switch the PC keyboard to the ANSI keyboard layout if desired.

This section shows the North American/United Kingdom version of each keyboard.

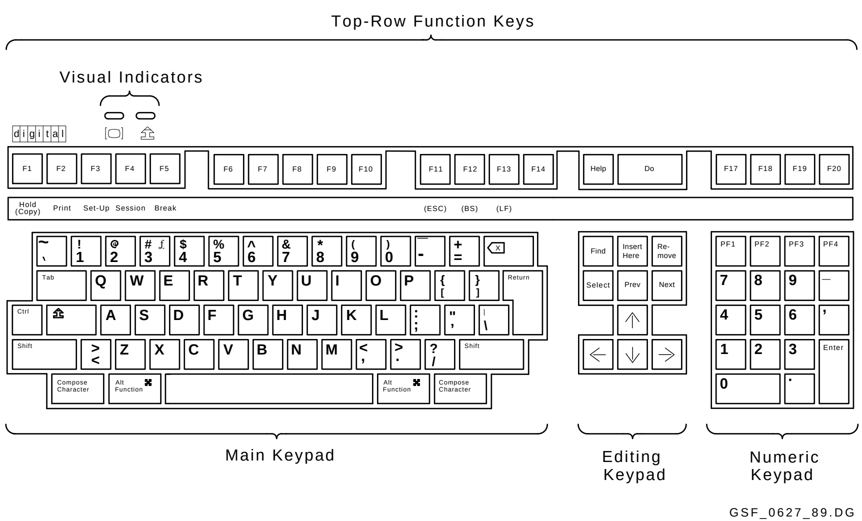

Figure 3–1 ANSI Keyboard

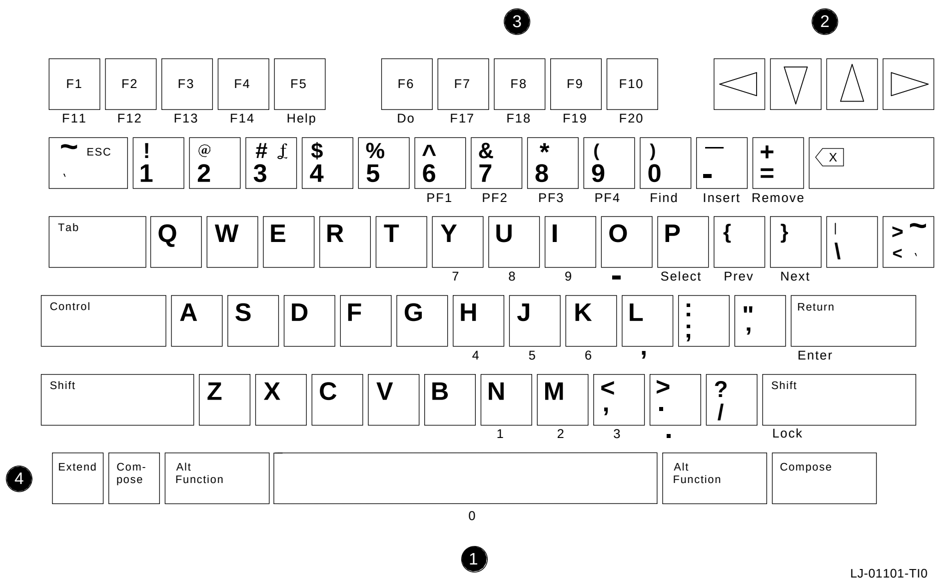

Figure 3–2 Short ANSI Keyboard

❶ Main keypad
❷ Arrow keys
❸ Top-row function keys
❹ Extend key

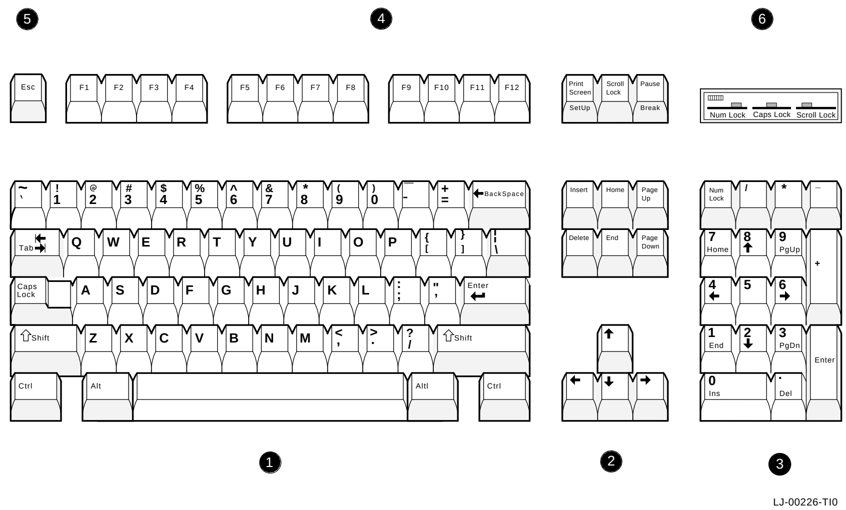

Figure 3–3 PC Keyboard (North American/United Kingdom Keyboard)

❶ Main keypad ❸ Numeric keypad ❺ Esc key
❷ Editing keypad ❹ Top-row function keys ❻ Visual indicators

Main Keypad

The main keypad has standard keys and function keys. You use the standard keys to send letters, numbers, and other symbols. You use the function keys to send special function codes.

Standard Keys

The standard keys send alphanumeric characters.

Some standard keys vary on the different ANSI, short ANSI, and PC keyboard models. On the North American/United Kingdom keyboard, all standard keys are ASCII characters and send only ASCII codes. The North American/United Kingdom keyboard does not have any standard keys that send DEC Supplemental Graphic or ISO Latin-1 supplemental characters alone.

The North American/United Kingdom keyboard is a special case. Most other keyboards have some standard keys that send DEC Supplemental Graphic or ISO Latin-1 supplemental characters, as well as ASCII characters. For example, many of the European keyboards have standard keys that send characters with accent marks or diacritical marks. The PC keyboard can send PC characters.

Even if a character is not available on a standard key, you can create any DEC Supplemental Graphic, ISO Latin-1 supplemental character, or PC character by typing a sequence of keys. On the ANSI or short ANSI keyboards, each sequence begins with the Compose Character key (or Group Shift key on the German keyboard). On the PC keyboards, each sequence begins with the Alt key. *Installing and Using the VT420 Video Terminal* explains how to type additional characters.

In a character set, each graphic character has a unique code. This code is always the same, no matter which keyboard you use or how many keys you press to create that character. The code is based on the character's position in the 8-bit code table (Chapter 2).

You can use GL characters in a 7-bit or 8-bit environment. You can use GR characters only in an 8-bit environment. VT400 mode is intended for use in 7-bit and 8-bit environments, as well as data exchange over 7-bit or 8-bit host lines. PC TERM mode always operates in an 8-bit environment. VT52 and VT100 modes are intended for use in 7-bit environments only, as well as data exchange over a 7-bit host line.

Data Processing Characters (Worldwide Model Only)

On VT420 worldwide models, some standard keys can send data processing characters. The data processing characters are on the right half of the keycap. Data processing characters allow European model keyboards to use characters that appear as standard typewriter characters on the North American/United Kingdom keyboard. The data processing characters are commonly used in data processing applications. For example, Figure 3–4 shows the backslash character on the French /Belgian ANSI keyboard.

You can select `Typewriter Keys` or `Data Processing Keys` in the Keyboard Set-Up screen. When you select `Data Processing Keys`, the data processing keys send the character on the right half of their keycap. When you select `Typewriter Keys`, they send the character on the left half of their keycap. You can select the shifted (upper) character codes for these keys by holding the Shift key down.

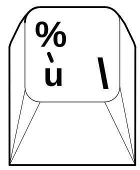

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Figure 3–4 Standard Key with a Data Processing Character (French /Belgian ANSI Keyboard)

Special-Function Keys (ANSI Keyboard)

This section describes the function keys on the main keypad of the ANSI keyboard. The column/row numbers that appear after a character indicate the position of the character in the code table (Chapter 2). For example, the DEL character is at column 7 / row 15.

⌫	The ⌫ key sends a delete character (DEL, 7/15) or a backspace character (BS, 0/8), depending on the setting of the ⌫ key feature in the Keyboard Set-Up screen.
Tab	Tab sends a horizontal tab character (HT, 0/9).
Return	Return sends either a carriage return (CR, 0/13), or a carriage return (CR, 0/13) and line feed (LF, 0/10), depending on the state of line feed/new line mode (LNM).
Ctrl	The Ctrl key alone does not send a code. You use Ctrl with another key to send a control code.
⇪	The lock key alone does not send a code. You use the lock key to set or clear the `Caps Lock` or `Shift Lock` state. You select `Caps Lock` or `Shift Lock` in the Keyboard Set-Up screen.
Shift (left and right)	The Shift keys alone do not send a code. You use Shift with another standard key to send an uppercase character or the top character shown on the key.
Space bar	The space bar sends a space character (SP, 2/0).

Compose Character	Compose Character does not send a code. Pressing Compose Character starts a compose sequence. You can use compose sequences to create characters that do not appear on any single key (such as characters from the DEC Supplemental Graphic set). You can disable the Compose Character key in set-up. See *Installing and Using the VT420 Video Terminal with PC Terminal Mode*.
Alt Function (left and right)	Alt Function is a modifier key, pressed in combination with other keys to send a special function code to host applications. See the "Select Modifier Key Reporting (DECSMKR)" and "Extended Keyboard Report (DECEKBD)" sections in Chapter 11.

Special-Function Keys (Short ANSI Keyboard)

The short ANSI keyboard has the same special-function keys as the ANSI keyboard, with one exception. The short ANSI keyboard has an Extend key rather than a lock key.

Extend *front*	The Extend key alone does not send a code. You use two-stroke Extend sequences to perform the same functions as the following keys on the ANSI keyboard: F11 to F20, editing keypad, and numeric keypad. Functions are printed on the front of short ANSI keys.
Extend right Shift	Pressing the Extend and right Shift keys does not send a code. This sequence sets or clears caps lock mode or shift lock mode. You select the mode in the Keyboard Set-Up screen. The default setting is `Caps Lock` mode. See *Installing and Using the VT420 Video Terminal with PC Terminal Mode* for more operating information.

Special-Function Keys (PC Keyboard)

This section describes the function keys on the main keypad of the PC keyboard. The column/row numbers that appear after a character indicate the position of the character in the code table (Chapter 2). For example, the DEL character is at column 7 / row 15.

The **Tab**, **Return**, **Ctrl**, and space bar keys work the same as on the ANSI keyboard.

Esc	**Esc** sends an escape character (ESC, 1/11).

Caps Lock	The **Caps Lock** key alone does not send a code. You use **Caps Lock** to set or clear caps lock or shift lock mode. You select the mode in the Keyboard Set-Up screen.
Alt	The **Alt** key alone does not send a code. You use Alt with another key to generate characters or alternate functions that do not appear as standard keys on the PC keyboard, such as characters from the PC International character set. **NOTE** **The North American version of the keyboard has a left and right Alt key. They perform the same function.**
AltGr (right)	The **AltGr** key does not send a code alone. You use **AltGr** with *Janus-faced* or front-faced keys to generate the third character on a keycap. The North American version of the keyboard does not have an **AltGr** key.
Enter	**Enter** sends either a carriage return (CR, 0/13), or a carriage return (CR, 0/13) and line feed (LF, 0/10), depending on the state of line feed/new line mode (LNM).
← Backspace	The **← Backspace** key sends a delete character (DEL, 7/15) or a backspace character (BS, 0/8), depending on the setting of the **← Backspace** key feature in the Keyboard Set-Up screen.

Editing Keypad

The ANSI and PC keyboards have an editing keypad with editing keys and arrow keys. The short ANSI keyboard has arrow keys; you use Extend key sequences to perform editing functions.

- Table 3–1 lists the codes sent by the editing keys on the ANSI and short ANSI keyboards. Chapter 4 describes how to select VT400 or VT100 mode.
- Table 3–2 lists the codes sent by the editing keys on the PC keyboard, when it is in ANSI key layout or PC key layout.
- Table 3–3 lists the codes sent by the arrow keys on all keyboards. Normally, you use the arrow keys to move the cursor on the screen. See “Cursor Keys Mode (DECCKM)” in Chapter 11. Appendix A describes how to select VT52 mode.

Table 3–1 Codes Sent by Editing Keys (ANSI/Short ANSI Keyboards)

Key		Code Sent			
ANSI	**S. ANSI**	**VT400 mode**			**VT100, VT52 Modes**
Find	Extend 0	**CSI** 9/11	**1** 3/1	**~** 7/14	The editing keys do not send codes in these two modes.
Insert Here	Extend -	**CSI** 9/11	**2** 3/2	**~** 7/14	
Remove	Extend =	**CSI** 9/11	**3** 3/3	**~** 7/14	
Select	Extend P	**CSI** 9/11	**4** 3/4	**~** 7/14	
Prev	Extend {	**CSI** 9/11	**5** 3/5	**~** 7/14	
Next	Extend }	**CSI** 9/11	**6** 3/6	**~** 7/14	

Table 3–2 Codes Sent by Editing Keys (PC Keyboard)

	Codes Sent in VT400 Mode					
Key	**ANSI Key Layout**			**PC Key Layout**		
Insert	**CSI** 9/11	**2** 3/2	**~** 7/14	**CSI** 9/11	**2** 3/2	**~** 7/14
Home	**CSI** 9/11	**1** 3/1	**~** 7/14	**CSI** 9/11	**1** 4/8	**~** 7/14
Page Up	**CSI** 9/11	**5** 3/5	**~** 7/14	**CSI** 9/11	**5** 3/5	**~** 7/14
Delete	**CSI** 9/11	**3** 3/3	**~** 7/14	**CSI** 9/11	**DEL** 7/15	**~** 7/14
End	**CSI** 9/11	**4** 3/4	**~** 7/14	**CSI** 9/11	**4** 3/4	**~** 7/14

Table 3–2 (Cont.) Codes Sent by Editing Keys (PC Keyboard)

	Codes Sent in VT400 Mode					
Key	**ANSI Key Layout**			**PC Key Layout**		
Page Down	**CSI** 9/11	**6** 3/6	**~** 7/14	**CSI** 9/11	**6** 3/6	**~** 7/14

Table 3–3 Codes Sent by Arrow Keys

	Cursor Key Mode Setting (DECCKM)					
	ANSI Mode*				**VT52 Mode***	
Key	**Cursor**		**Application**		**Cursor or Application**	
↑	**CSI** 9/11	**A** 4/1	**SS3** 8/15	**A** 4/1	**ESC** 1/11	**A** 4/1
↓	**CSI** 9/11	**B** 4/2	**SS3** 8/15	**B** 4/2	**ESC** 1/11	**B** 4/2
→	**CSI** 9/11	**C** 4/3	**SS3** 8/15	**C** 4/3	**ESC** 1/11	**C** 4/3
←	**CSI** 9/11	**D** 4/4	**SS3** 8/15	**D** 4/4	**ESC** 1/11	**D** 4/4

*ANSI mode applies to VT400 and VT100 modes. VT52 mode is not compatible with ANSI mode.

Numeric Keypad

The characters sent by the numeric keypad depend on the setting of numeric keypad mode and VT52 mode. The application usually selects the application keypad codes. However, you can select the application keypad codes in the Keyboard Set-Up screen.

For more information, see “Numeric Keypad Mode (DECNKM)” in Chapter 11. Chapter 4 describes how to select VT400 or VT100 mode. Appendix A describes how to select VT52 mode.

- Table 3–4 lists the character codes sent by the numeric keypad on the ANSI and short ANSI keyboards, and the PC keyboard in ANSI key layout.

- Table 3–5 lists the character codes sent by the numeric keypad on the PC keyboard in PC key layout.

Table 3–4 Codes Sent by Numeric Keypad Keys (ANSI, Short ANSI, and PC Keyboards)

	Numeric Keypad Mode Setting (DECNKM)			
	ANSI Mode*		VT52 Mode*	
Key	Numeric	Application	Numeric	Application
PF1 6 Num Lock	**SS3 P** 8/15 5/0	**SS3 P** 8/15 5/0	**ESC P** 1/11 5/0	**ESC P** 1/11 5/0
PF2 7 /	**SS3 Q** 8/15 5/1	**SS3 Q** 8/15 5/1	**ESC Q** 1/11 5/1	**ESC Q** 1/11 5/1
PF3 8 *	**SS3 R** 8/15 5/2	**SS3 R** 8/15 5/2	**ESC R** 1/11 5/2	**ESC R** 1/11 5/2
PF4 9 -	**SS3 S** 8/15 5/3	**SS3 S** 8/15 5/3	**ESC S** 1/11 5/3	**ESC S** 1/11 5/3
Enter Return Enter	**CR** 0/13 or	**SS3 M** 8/15 4/13	**CR** 0/13 or	**ESC ? M** 1/11 3/15 4/13

*ANSI mode applies to VT400 and VT100 modes. VT52 mode is not compatible with ANSI standards.

Keys in column 1 are shown in the following order. For the short ANSI keyboard, press the Extend key before the key listed.

ANSI: PF1
Short ANSI: 6
PC: Num Lock

Table 3–4 (Cont.) Codes Sent by Numeric Keypad Keys (ANSI, Short ANSI, and PC Keyboards)

	Numeric Keypad Mode Setting (DECNKM)			
	ANSI Mode*		VT52 Mode*	
Key	**Numeric**	**Application**	**Numeric**	**Application**
	CR **LF‡** 0/13 0/10		**CR** **LF‡** 0/13 0/10	
[,] [L] [,]	**comma** 2/12	**SS3** **l** 8/15 6/12	**–** 2/12	**ESC** **?** **l** 1/11 3/15 6/13†
[+]	**plus** 2/11	**SS3** **l** 8/15 6/12		
[—] [O] [Alt] [-]	**minus** 2/13	**SS3** **m** 8/15 6/13	**–** 2/13	**ESC** **?** **m** 1/11 3/15 6/13†
[.] [.] [.]	**period** 2/14	**SS3** **n** 8/15 6/14	**.** 2/14	**ESC** **?** **n** 1/11 3/15 6/14
[0] space bar [0]	**0** 3/0	**SS3** **p** 8/15 7/0	**0** 3/0	**ESC** **?** **p** 1/11 3/15 7/0

*ANSI mode applies to VT400 and VT100 modes. VT52 mode is not compatible with ANSI standards.

†You cannot use this sequence on a VT52 terminal.

‡Keypad numeric mode. [Enter] sends the same codes as [Return]. You can use line feed/new line mode (LNM) to change the code sent by [Return]. When LNM is reset, pressing [Return] sends one control character (CR). When LNM is set, pressing [Return] sends two control characters (CR, LF).

Keys in column 1 are shown in the following order. For the short ANSI keyboard, press the [Extend] key before the key listed.

ANSI: [PF1]
Short ANSI: [6]
PC: [Num Lock]

Table 3–4 (Cont.) Codes Sent by Numeric Keypad Keys (ANSI, Short ANSI, and PC Keyboards)

	Numeric Keypad Mode Setting (DECNKM)			
	ANSI Mode*		VT52 Mode*	
Key	Numeric	Application	Numeric	Application
1 / N / **1**	**1** 3/1	**SS3 q** 8/15 7/1	**1** 3/1	**ESC ? q** 1/11 3/15 7/1
2 / M / **2**	**2** 3/2	**SS3 r** 8/15 7/2	**2** 3/2	**ESC ? r** 1/11 3/15 7/2
3 / , / **3**	**3** 3/3	**SS3 s** 8/15 7/3	**3** 3/3	**ESC ? s** 1/11 3/15 7/3
4 / H / **4**	**4** 3/4	**SS3 t** 8/15 7/4	**4** 3/4	**ESC ? t** 1/11 3/15 7/4
5 / J / **5**	**5** 3/5	**SS3 u** 8/15 7/5	**5** 3/5	**ESC ? u** 1/11 3/15 7/5
6 / K / **6**	**6** 3/6	**SS3 v** 8/15 7/6	**6** 3/6	**ESC ? v** 1/11 3/15 7/6
7 / Y / **7**	**7** 3/7	**SS3 w** 8/15 7/7	**7** 3/7	**ESC ? w** 1/11 3/15 7/7

*ANSI mode applies to VT400 and VT100 modes. VT52 mode is not compatible with ANSI standards.

Keys in column 1 are shown in the following order. For the short ANSI keyboard, press the Extend key before the key listed.

ANSI: PF1
Short ANSI: 6
PC: **Num Lock**

Table 3–4 (Cont.) Codes Sent by Numeric Keypad Keys (ANSI, Short ANSI, and PC Keyboards)

	Numeric Keypad Mode Setting (DECNKM)			
	ANSI Mode*		VT52 Mode*	
Key	Numeric	Application	Numeric	Application
8 U **8**	**8** 3/8	**SS3 x** 8/15 7/8	**8** 3/8	**ESC ? x** 1/11 3/15 7/8
9 I **9**	**9** 3/9	**SS3 y** 8/15 7/9	**9** 3/9	**ESC ? x** 1/11 3/15 7/9

*ANSI mode applies to VT400 and VT100 modes. VT52 mode is not compatible with ANSI standards.

Keys in column 1 are shown in the following order. For the short ANSI keyboard, press the Extend key before the key listed.

ANSI: PF1
Short ANSI: 6
PC: **Num Lock**

Table 3–5 Codes Sent by Numeric Keypad Keys (PC Keyboard, PC Key Layout)

	Numeric Keypad Mode Setting (DECNKM)		
	ANSI Mode*		ANSI Mode*
Key	**Numeric**		**Application**
	Num Lock On	**Num Lock Off**	
Num Lock (PF1)			**SS3 P** 8/15 5/0
/ (PF2)	**slash** 2/15	**slash** 2/15	**SS3 Q** 8/15 5/1
* (PF3)	**asterisk** 2/10	**asterisk** 2/10	**SS3 R** 8/15 5/2
- (PF4)	**minus** 2/13	**minus** 2/13	**SS3 S** 8/15 5/3
+	**plus** 2/11	**plus** 2/11	**SS3 l** 8/15 6/12
Enter	**CR** 0/13 or **CR LF‡**	**CR** 0/13 or **CR LF‡**	**SS3 M** 8/15 4/13
. Del	**period** 2/14	**DEL** 7/15	**SS3 n** 8/15 6/14
0 Ins	**0** 3/0	**CSI 2** 9/11 3/2	**SS3 p** 8/15 7/0
1 End	**1** 3/1	**CSI 4** 9/11 3/4	**SS3 q** 8/15 7/1
2 ↓	**2** 3/2	**CSI B** 9/11 4/2	**SS3 r** 8/15 7/2

*ANSI mode applies to VT400 and VT100 modes.

‡Keypad numeric mode. Enter sends the same codes as Return. You can use line feed/new line mode (LNM) to change the code sent by Return. When LNM is reset, pressing Return sends one control character (CR). When LNM is set, pressing Return sends two control characters (CR, LF).

Table 3–5 (Cont.) Codes Sent by Numeric Keypad Keys (PC Keyboard, PC Key Layout)

	Numeric Keypad Mode Setting (DECNKM)				
	ANSI Mode*			ANSI Mode*	
Key	**Numeric**			**Application**	
3 PgDn	**3** 3/3	**CSI** 9/11	**6** 3/6	**SS3** 8/15	**s** 7/3
4 ←	**4** 3/4	**CSI** 9/11	**D** 4/4	**SS3** 8/15	**t** 7/4
5	**5** 3/5				
6 →	**6** 3/6	**CSI** 9/11	**C** 4/3	**SS3** 8/15	**v** 7/6
7 Home	**7** 3/7	**CSI** 9/11	**H** 4/8	**SS3** 8/15	**w** 7/7
8 ↑	**8** 3/8	**CSI** 9/11	**A** 4/1	**SS3** 8/15	**x** 7/8
9 PgUp	**9** 3/9	**CSI** 9/11	**5** 3/5	**SS3** 8/15	**y** 7/9

*ANSI mode applies to VT400 and VT100 modes.

Top-Row Function Keys

The keyboards have the following top-row function keys and key sequences:

ANSI	40 keys:	F1 to F20 , Shift F1 to Shift F20
Short ANSI	40 keys:	F1 to F10 , Extend F1 to Extend F10 , Shift F1 to Shift F10 , Shift Extend F1 to Shift Extend F10
PC	48 keys:	**F1** to **F12** , **Shift** **F1** to **Shift** **F12** , **Alt** **F1** to **Alt** **F12** , **Shift** **Alt** **F1** to **Shift** **Alt** **F12**

The first five keys on the ANSI and short ANSI keyboard perform predefined local functions: F1 (Hold), F2 (Print), F3 (Set-Up), F4 (Session), and F5 (Break). In VT mode, the PC keyboard also has predefined keys to perform the same functions: **Scroll Lock** (for hold), **Print Screen**, **Alt** **SetUp**, **Alt** **Scroll Lock** (for session), and **Alt** **Break**. In PC TERM mode, three of these functions are predefined: **Alt** **SetUp**, **Alt** **Scroll Lock** (for session), and **Shift** **Print Screen**. Table 3–6 lists the codes sent by the top-row keys. See *Installing and Using the VT420 Video Terminal with PC Terminal Mode* for more information.

Table 3–6 Codes Sent by the Top-Row Function Keys

Keyboard Key			**Mode with Code Sent**				
ANSI	**Short ANSI**	**PC**			**VT400**		**VT100 VT52**
F1 (Hold)*	F1	**F1**	**CSI** 9/11	**1** 3/1	**1** 3/1	**~** 7/14	—
F2 (Print)*	F2	**F2**	**CSI** 9/11	**1** 3/1	**2** 3/2	**~** 7/14	—
F3 (SetUp)*	F3	**F3**	**CSI** 9/11	**1** 3/1	**3** 3/3	**~** 7/14	—
F4 (Session)*	F4	**F4**	**CSI** 9/11	**1** 3/1	**4** 3/4	**~** 7/14	—

*By default, F1 to F5 on the ANSI and Short ANSI keyboards perform predefined local functions; however, you can disable the keys in the Keyboard Set-Up screen.

Table 3–6 (Cont.) Codes Sent by the Top-Row Function Keys

Keyboard Key: ANSI	Keyboard Key: Short ANSI	Keyboard Key: PC	Mode with Code Sent: VT400				VT100 VT52
F5 (Break)*	F5	F5	**CSI** 9/11	**1** 3/1	**5** 3/5	**~** 7/14	—
F6	F6	F6	**CSI** 9/11	**1** 3/1	**7** 3/7	**~** 7/14	—
F7	F7	F7	**CSI** 9/11	**1** 3/1	**8** 3/8	**~** 7/14	—
F8	F8	F8	**CSI** 9/11	**1** 3/1	**9** 3/9	**~** 7/14	—
F9	F9	F9	**CSI** 9/11	**2** 3/2	**0** 3/0	**~** 7/14	—
F10	F10	F10	**CSI** 9/11	**2** 3/2	**1** 3/1	**~** 7/14	—
F11 (ESC)	Extend F1	F11 or Alt F1	**CSI** 9/11	**2** 3/2	**3** 3/3	**~** 7/14	**ESC** 1/11
F12 (BS)	Extend F2	F12 or Alt F2	**CSI** 9/11	**2** 3/2	**4** 3/4	**~** 7/14	**BS** 0/8
F13 (LF)	Extend F3	Alt F3	**CSI** 9/11	**2** 3/2	**5** 3/5	**~** 7/14	**LF** 0/10
F14	Extend F4	Alt F4	**CSI** 9/11	**2** 3/2	**6** 3/6	**~** 7/14	—
Help (F15)	Extend F5	Alt F5	**CSI** 9/11	**2** 3/2	**8** 3/8	**~** 7/14	—
Do (F16)	Extend F6	Alt F6	**CSI** 9/11	**2** 3/2	**9** 3/9	**~** 7/14	—

*By default, F1 to F5 on the ANSI and Short ANSI keyboards perform predefined local functions; however, you can disable the keys in the Keyboard Set-Up screen.

Table 3–6 (Cont.) Codes Sent by the Top-Row Function Keys

Keyboard Key			Mode with Code Sent						
ANSI	**Short ANSI**	**PC**	**VT400**						**VT100 VT52**
F17	Extend F7	Alt F7	**CSI** 9/11	**3** 3/3	**1** 3/1	**~** 7/14			—
F18	Extend F8	Alt F8	**CSI** 9/11	**3** 3/3	**2** 3/2	**~** 7/14			—
F19	Extend F9	Alt F9	**CSI** 9/11	**3** 3/3	**3** 3/3	**~** 7/14			—
F20	Extend F10	Alt F10	**CSI** 9/11	**3** 3/3	**4** 3/4	**~** 7/14			—
—	—	Alt F11	**CSI** 9/11	**3** 3/3	**5** 3/5	**~** 7/14			—
—	—	Alt F12	**CSI** 9/11	**3** 3/3	**6** 3/6	**~** 7/14			—
Shift F1 (Hold)*	Shift F1	Shift F1	**CSI** 9/11	**1** 3/1	**1** 3/1	**;** 3/11	**2** 3/2	**~** 7/14	—
Shift F2 (Print)*	Shift F2	Shift F2	**CSI** 9/11	**1** 3/1	**2** 3/2	**;** 3/11	**2** 3/2	**~** 7/14	—
Shift F3 (SetUp)*	Shift F3	Shift F3	**CSI** 9/11	**1** 3/1	**3** 3/3	**;** 3/11	**2** 3/2	**~** 7/14	—
Shift F4 (Session)*	Shift F4	Shift F4	**CSI** 9/11	**1** 3/1	**4** 3/4	**;** 3/11	**2** 3/2	**~** 7/14	—
Shift F5 (Break)*	Shift F5	Shift F5	**CSI** 9/11	**1** 3/1	**5** 3/5	**;** 3/11	**2** 3/2	**~** 7/14	—

*By default, F1 to F5 on the ANSI and Short ANSI keyboards perform predefined local functions; however, you can disable the keys in the Keyboard Set-Up screen.

Table 3–6 (Cont.) Codes Sent by the Top-Row Function Keys

Keyboard Key			Mode with Code Sent						
ANSI	**Short ANSI**	**PC**	**VT400**						**VT100 VT52**
Shift F6	Shift F6	Shift F6	**CSI** 9/11	**1** 3/1	**7** 3/7	**;** 3/11	**2** 3/2	**~** 7/14	—
Shift F7	Shift F7	Shift F7	**CSI** 9/11	**1** 3/1	**8** 3/8	**;** 3/11	**2** 3/2	**~** 7/14	—
Shift F8	Shift F8	Shift F8	**CSI** 9/11	**1** 3/1	**9** 3/9	**;** 3/11	**2** 3/2	**~** 7/14	—
Shift F9	Shift F9	Shift F9	**CSI** 9/11	**2** 3/2	**0** 3/0	**;** 3/11	**2** 3/2	**~** 7/14	—
Shift F10	Shift F10	Shift F10	**CSI** 9/11	**2** 3/2	**1** 3/1	**;** 3/11	**2** 3/2	**~** 7/14	—
Shift F11 (ESC)	Shift Extend F1	Shift F11 or Shift Alt F1	**CSI** 9/11	**2** 3/2	**3** 3/3	**;** 3/11	**2** 3/2	**~** 7/14	**ESC** 1/11
Shift F12 (BS)	Shift Extend F2	Shift F12 or Shift Alt F2	**CSI** 9/11	**2** 3/2	**4** 3/4	**;** 3/11	**2** 3/2	**~** 7/14	**BS** 0/8
Shift F13 (LF)	Shift Extend F3	Shift Alt F3	**CSI** 9/11	**2** 3/2	**5** 3/5	**;** 3/11	**2** 3/2	**~** 7/14	**LF** 0/10
Shift F14	Shift Extend F4	Shift Alt F4	**CSI** 9/11	**2** 3/2	**6** 3/6	**;** 3/11	**2** 3/2	**~** 7/14	—

Table 3–6 (Cont.) Codes Sent by the Top-Row Function Keys

Keyboard Key			Mode with Code Sent						
ANSI	**Short ANSI**	**PC**	**VT400**						**VT100 VT52**
Shift Help (F15)	Shift Extend F5	Shift Alt F5	**CSI** 9/11	**2** 3/2	**8** 3/8	**;** 3/11	**2** 3/2	**~** 7/14	—
Shift Do (F16)	Shift Extend F6	Shift Alt F6	**CSI** 9/11	**2** 3/2	**9** 3/9	**;** 3/11	**2** 3/2	**~** 7/14	—
Shift F17	Shift Extend F7	Shift Alt F7	**CSI** 9/11	**3** 3/3	**1** 3/1	**;** 3/11	**2** 3/2	**~** 7/14	—
Shift F18	Shift Extend F8	Shift Alt F8	**CSI** 9/11	**3** 3/3	**2** 3/2	**;** 3/11	**2** 3/2	**~** 7/14	—
Shift F19	Shift Extend F9	Shift Alt F9	**CSI** 9/11	**3** 3/3	**3** 3/3	**;** 3/11	**2** 3/2	**~** 7/14	—
Shift F20	Shift Extend F10	Shift Alt F10	**CSI** 9/11	**3** 3/3	**4** 3/4	**;** 3/11	**2** 3/2	**~** 7/14	—
—	—	Shift Alt F11	**CSI** 9/11	**3** 3/3	**5** 3/5	**;** 3/11	**2** 3/2	**~** 7/14	—
—	—	Shift Alt F12	**CSI** 9/11	**3** 3/3	**6** 3/6	**;** 3/11	**2** 3/2	**~** 7/14	—

7-Bit Control Characters

Table 3–7 lists the key or keys you use to send each 7-bit control character. This table applies to all keyboards. The 7-bit control characters are the C0 characters. You cannot send 8-bit C1 control characters from the keyboard, except when using hexadecimal compose sequences.

Table 3–7 Keys Used to Send 7-Bit Control Characters

Control Character Mnemonic	Code Table Position	Key Pressed With Ctrl (All Modes)	Dedicated Function Key
NUL	0/00	2 or space bar	—
SOH	0/01	A	—
STX	0/02	B	—
ETX	0/03	C	—
EOT	0/04	D	—
ENQ	0/05	E	—
ACK	0/06	F	—
BEL	0/07	G	—
BS	0/08	H	F12 (BS)*
HT	0/09	I	Tab
LF	0/10	J	F13 (LF)*
VT	0/11	K	—
FF	0/12	L	—
CR	0/13	M	Return
SO	0/14	N	—
SI	0/15	O	—
DLE	1/00	P	—
DC1	1/01	Q†	—
DC2	1/02	R	—
DC3	1/03	S†	—
DC4	1/04	T	—
NAK	1/05	U	—
SYN	1/06	V	—

*7-bit control characters sent in VT100 or VT52 modes only.

†7-bit control codes sent only when XON/XOFF support is off.

Table 3–7 (Cont.) Keys Used to Send 7-Bit Control Characters

Control Character Mnemonic	Code Table Position	Key Pressed With Ctrl (All Modes)	Dedicated Function Key
ETB	1/07	W	—
CAN	1/08	X	—
EM	1/09	Y	—
SUB	1/10	Z	—
ESC	1/11	3 or [	F11 (ESC)*
FS	1/12	4 or /	—
GS	1/13	5 or]	—
RS	1/14	6 or ~	—
US	1/15	7 or ?	—
DEL	7/15	8	<X]

*7-bit control characters sent in VT100 or VT52 modes only.

Special Cases

This section describes special functions and modes that affect the keyboard.

Turning Autorepeat On and Off

The autorepeat feature makes most keys send their character repeatedly when you hold the key down. You can turn the autorepeat feature on and off by using the Keyboard Set-Up screen or the autorepeat mode (DECARM) control function (Chapter 11).

The following keys on the ANSI and short ANSI keyboards do not repeat:

F1 (Hold)	F5 (Break)	Return
F2 (Print)	Compose Character	Lock key
F3 (Set-Up)	Shift	Ctrl
F4 (Session)	Alt Function	Extend

The following keys on the PC keyboard do not repeat:

Alt	AltGr
Caps Lock	Pause

`Ctrl`	`Print Screen`
`Enter`	`Scroll Lock`
`Num Lock`	`Shift`

Shifted keys and keys pressed with `Ctrl` can repeat.

Keys that can auto repeat usually start repeating after a delay of 0.5 seconds. The autorepeat speed depends on the baud rate of the host system and the type of key. At speeds of 2400 baud or above, all keys repeat 30 times/second.

In general, the **transmit rate limit** feature in the Communications Set-Up screen does not affect repeat rates. The terminal can send codes at the speed of 150 characters/second at most baud rates. In local mode, keys repeat at 30 keystrokes/second.

Unlocking the Keyboard

Two conditions can cause the keyboard to lock:

- An application sends a control function to set the keyboard action mode (KAM), as described in Chapter 11.
- The keyboard input buffer is full.

When the keyboard is locked, all keys except F1 (Hold), F2 (Print), F3 (Set-Up), F4 (Session), and F5 (Break) are disabled. Also, the `Wait` indicator appears on the keyboard indicator line at the bottom of the screen.

Any of the following events can unlock the keyboard:

- The output buffer becomes less than full (assuming KAM is not set).
- The terminal receives KAM when the output buffer is not full (Chapter 11).
- You select the `Clear Comm`, `Reset Session`, or `Recall` fields from the Set-Up Directory screen. (Entering set-up unlocks the keyboard. If you do not select one of these functions in set-up, the keyboard locks again when you leave set-up.)
- The terminal performs the power-up self-test (DECTST) or a hard reset (RIS). See Chapter 13.

Part 3
Control Functions Received from the Host

4

Emulating VT Series Terminals

The VT420 terminal can operate like Digital's VT300, VT200, and VT100 series text terminals. This feature lets you use the VT420 with applications designed for these terminals. You can select from three possible levels of operation. (See Chapter 15 for PC TERM mode.)

Level 1 for VT100 operation
Level 4 for VT200, VT300, and VT400 operation (default)
VT52 mode

When you operate the terminal at level 1, you cannot use some VT420 control functions. Table 4–1 lists the functions you cannot use.

Level 4 includes all the characteristics of levels 2 and 3. This means that applications designed for level 2 terminals (such as the VT200 series) and level 3 terminals (VT300 series) run in level 4.

The following paragraphs describe other limits that apply to each operating level. The chapter also describes how to select an operating level and how to send 7-bit or 8-bit C1 controls to the host.

The VT420 also has an operating mode that lets you use the terminal with applications designed for Digital's VT52 terminal. Appendix A describes how to use VT52 mode.

Level 1 (VT100 Mode)

The following limits apply to operating level 1:

- The keyboard only sends 7-bit ASCII characters.
- The terminal interprets keystrokes that send DEC Supplemental Graphic or ISO Latin-1 supplemental characters as errors.
- The following keys do not operate:
  — special-function keys, except **F11 (ESC)**, **F12 (BS)**, and **F13 (LF)**

- — six editing keys
- — user-defined keys

- Only the ASCII, national replacement (NRC), and DEC Special Graphic character sets are available.
- Soft character sets are not available.
- The terminal sets the eighth bit of all received characters to 0.
- The terminal sends all C1 control characters as 7-bit escape sequences (ESC Fe).

Level 4 (VT400 Mode)

In VT400 mode, you can use all VT400 features. This mode is fully compatible with Digital's VT200 and VT300 series terminals. All keyboard functions are available. You can use all control functions and device control strings described in this manual, except VT52 control functions.

All Levels

You can use the following features at any operating level:

- Printer port
- Status line (You can enable or change the status line at any level.)
- Session management
- User windows

Table 4–1 Control Functions Ignored in Level 1 (VT100 mode)

Name	Mnemonic
Assign user-preferred supplemental set	DECAUPSS
Back index	DECBI
Change attributes in rectangular area	DECCARA
Checksum report	DECCKSR
Delete column	DECDC
Copy rectangular area	DECCRA
Cursor information report	DECCIR

Table 4–1 (Cont.) Control Functions Ignored in Level 1 (VT100 mode)

Name	Mnemonic
Define macro	DECDMAC
Downline-loadable set	DECDLD
Enable local functions	DECELF
Erase character	ECH
Erase rectangular area	DECERA
Fill rectangular area	DECFRA
Forward index	DECFI
Insert character	ICH
Insert column	DECIC
Invoke stored macro	DECINVM
Keyboard usage mode	DECKBUM
Key position mode	DECKPM
Local function key control	DECLFKC
Locking shift 2	LS2
Locking shift 3	LS3
Locking shift 1 right	LS1R
Locking shift 2 right	LS2R
Locking shift 3 right	LS3R
Numeric keypad mode	DECNKM
Presentation state report	DECPSR
Report displayed extent	DECRPDE
Report mode	DECRPM
Report selection or setting	DECRPSS
Report terminal unit ID	DECRPTUI
Request checksum of rectangular area	DECRQCRA
Request displayed extent	DECRQDE
Request mode	DECRQM
Request presentation state	DECRQPSR
Request selection or setting	DECRQSS
Request terminal state	DECRQTSR
Restore presentation state	DECRSPS

Table 4–1 (Cont.) Control Functions Ignored in Level 1 (VT100 mode)

Name	Mnemonic
Restore terminal state	DECRSTS
Reverse attributes in rectangular area	DECRARA
Secure reset	DECSR
Select active status display	DECSASD
Select attribute change extent	DECSACE
Select character attribute	DECSCA
Select font	DECSF
Select modifier key reporting	DECSMKR
Selective erase in display	DECSED
Selective erase in line	DECSEL
Selective erase rectangular area	DECSERA
Select status display type	DECSSDT
Send 7-bit C1 controls	S7C1T
Send 8-bit C1 controls	S8C1T
Set columns per page	DECSCPP
Set left and right margins	DECSLRM
Set terminal unit ID	DECSTUI
Soft terminal reset	DECSTR
Tabulation stop report	DECTABSR
Terminal state report	DECTSR
UDK and keyboard language	DSR
User-defined keys	DECUDK
Vertical split-screen mode	DECVSSM

Selecting an Operating Level (DECSCL)

You select the terminal's operating level by using the following select compatibility level (DECSCL) control sequences. The factory default is level 4 (VT400 mode, 7-bit controls).

NOTE
When you change the operating level, the terminal performs a hard reset (RIS). See Chapter 13 for details.

Format

Sequence							Level Selected
							Level 1
CSI 9/11	**6** 3/6	**1** 3/1	**"** 2/2	**p** 7/0			VT100 mode
							*Level 4**
CSI 9/11	**6** 3/6	*n* 3/*n*	**"** 2/2	**p** 7/0			VT400 mode, 8-bit controls
CSI 9/11	**6** 3/6	*n* 3/*n*	**;** 3/11	**0** 3/0	**"** 2/2	**p** 7/0	VT400 mode, 8-bit controls
CSI 9/11	**6** 3/6	*n* 3/*n*	**;** 3/11	**1** 3/2	**"** 2/2	**p** 7/0	VT400 mode, 7-bit controls
CSI 9/11	**6** 3/6	*n* 3/*n*	**;** 3/11	**2** 3/2	**"** 2/2	**p** 7/0	VT400 mode, 8-bit controls

*Level 4 includes levels 2 and 3. In these sequences, *n* can be 2, 3, or 4

Sending C1 Controls to the Host

The VT420 can send C1 control characters to the host as single 8-bit characters or as 7-bit escape sequences. You should select the format that matches the operating level you are using. You can use the following sequences to select the format for C1 control characters. See Chapter 2 for information on working with 7-bit and 8-bit environments.

The following sequence causes the terminal to send all C1 control characters as 7-bit escape sequences or single 8-bit characters:

Select 7-Bit C1 Control Characters (S7C1T)

ESC	**sp**	**F**
1/11	2/0	4/7

This sequence changes the terminal mode as follows:

Mode Before	Mode After
VT400 mode, 8-bit controls	VT400 mode, 7-bit controls.
VT400 mode, 7-bit controls	Same. Terminal ignores sequence.
VT100 or VT52 mode, 7-bit controls	Same. Terminal ignores sequence.

The following sequence causes the terminal to send C1 control characters to the host as single 8-bit characters:

Select 8-Bit C1 Control Characters (S8C1T)

ESC	**sp**	**G**
1/11	2/0	4/6

This sequence changes the terminal mode as follows:

Mode Before	Mode After
VT400 mode, 8-bit controls	Same. Terminal ignores sequence.
VT400 mode, 7-bit controls	VT400 mode, 8-bit controls.
VT100 or VT52 mode	Same. Terminal ignores sequence.

National Replacement Character Set Mode (DECNRCM)
(Worldwide Model Only)

The terminal has several 7-bit character sets for different national languages. Only one national replacement character set is available at a time.

To use a 7-bit NRC set, you must select national replacement character set mode. When you reset this mode, the terminal uses the 7-bit and 8-bit characters from the DEC Multinational or ISO Latin-1 character set.

Default: Multinational

Format

CSI	**?**	**4**	**2**	**h**	Set: national.
9/11	3/15	3/4	3/2	6/8	
CSI	**?**	**4**	**2**	**l**	Reset: multinational.
9/11	3/15	3/4	3/2	6/12	

Notes on DECNRCM

- When DECNRCM is reset, the VT420 operates as a level 4 terminal. The terminal can send and receive 8-bit characters from the DEC Multinational or ISO Latin-1 character set.

  When DECNRCM is set (national), the VT420 operates as a level 4 terminal. However, the terminal can only send and receive 7-bit characters. Also, the terminal uses one of the national replacement character sets.
- Setting DECNRCM causes the terminal to change character sets to their default state (at power-up or reset).
- If the North American/United Kingdom keyboard is currently selected in set-up, the terminal ignores DECNRCM.

5

Using Character Sets

This chapter describes how you can select character sets to use with your terminal in VT mode. See Chapter 15 for information on character sets in PC TERM mode. The chapter assumes you are familiar with the character-encoding concepts described in Chapter 2.

You can use hard character sets or soft character sets. *Hard character sets* are sets built into the terminal, such as the ASCII and DEC Supplemental Graphic sets. *Soft character sets* are sets that you download into the terminal from a host system. You can design your own soft character sets.

Table 5–1 lists the hard character sets available in VT400 and VT100 modes. See Chapter 4 to select a mode. VT400 mode supports VT200 and VT300 operation.

Table 5–1 Character Sets Available

	Level 1 (VT100 mode)	**Level 4 (VT400 mode)**
ASCII	Yes	All character sets are available.
DEC Supplemental Graphic	No	
ISO Latin-1 supplemental	No	
User-preferred supplemental	No	
National replacement (NRCs)*	Yes	
DEC Special Graphic	Yes	
DEC Technical	No	
Soft character sets (DRCS)	No	

*Worldwide model only

Selecting Character Sets

To understand how to select character sets, you must first understand the function of the terminal's *in-use table*. The in-use table contains the character sets the terminal can currently access. You can place any two character sets in the terminal's in-use table. The in-use table consists of the *graphic left* (GL) and *graphic right* (GR) logical tables.

Each time you turn on the terminal, the terminal places the following default character sets in the in-use table:

ASCII in GL
DEC Supplemental Graphic (or ISO Latin-1 supplemental) in GR

Together, the ASCII and DEC Supplemental Graphic sets make up the DEC Multinational set. The ASCII and ISO Latin-1 supplemental sets make up the ISO Latin-1 set, which is the worldwide standard.

You can select a different character set by following these two steps:

1. **Designate the set as G0, G1, G2, or G3.**

   G0 through G3 are logical sets that the terminal uses to access character sets. You can designate up to four character sets and have them ready for use in the in-use table.

2. **Map the designated set into the in-use table.**

   After you map the set into the in-use table, you can display or send any character from that set by using 8-bit codes.

Figure 5–1 shows how you select character sets. The following sections describe the control functions you use to designate and map character sets.

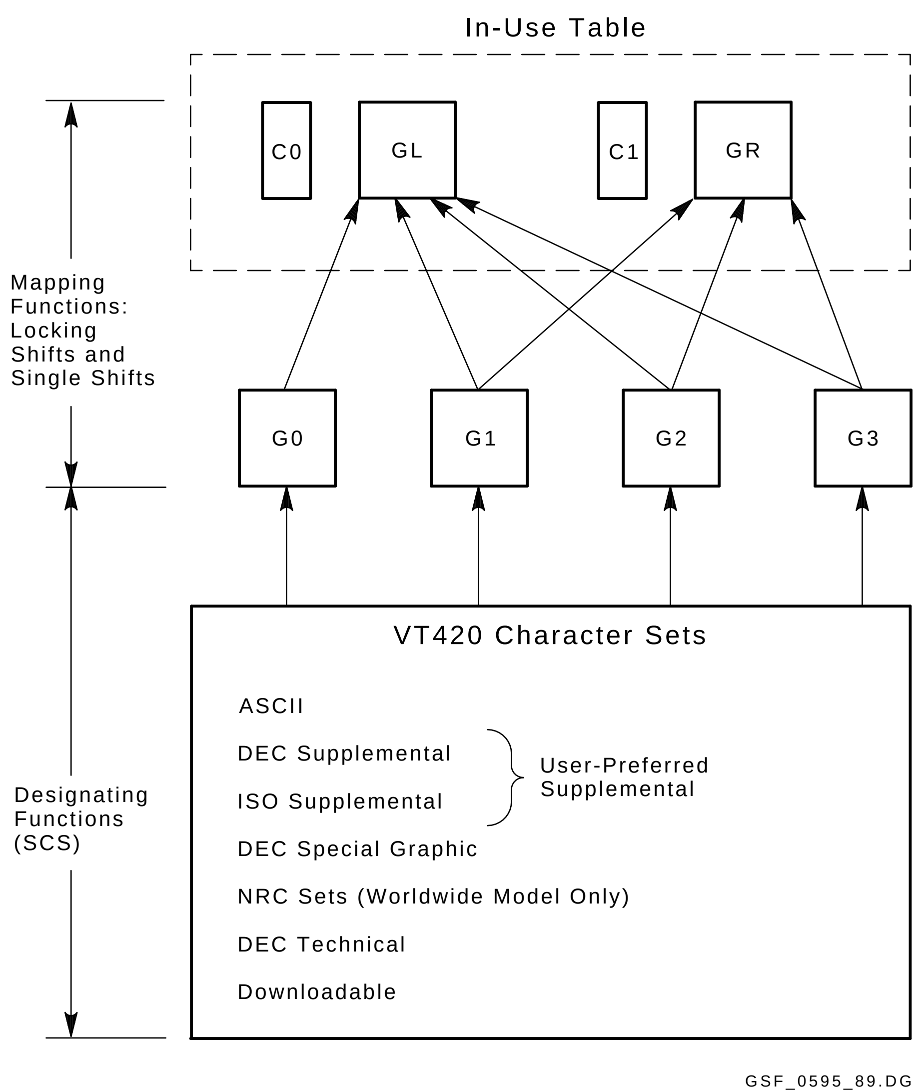

Figure 5–1 Character Set Selection

Designating Character Sets (SCS Sequences)

You designate a hard character set as G0 through G3 by using a select character set (SCS) escape sequence. You cannot designate a 96-character set as G0.

SCS sequences use the following format. Table 5–3 lists the code used to select each available character set.

NOTE
The ISO Latin-1 supplemental character set is the only 96-character hard set available in the terminal. All other hard sets have 94 characters.

Format

ESC	I_1	I_2	...	I_n	F
1/11	***	***	...	***	***

Parameters

I_1, intermediate character
Designates the character set as G0, G1, G2, or G3.

Table 5–2 Designating a Character Set

I_1 Character		Code	Set Selection
94-Character Sets			
(	left parenthesis	2/8	G0 (initial setting for GL)
)	right parenthesis	2/9	G1
*	asterisk	2/10	G2 (initial setting for GR)
+	plus sign	2/11	G3
96-Character Sets*			
-	hyphen	2/13	G1
.	period	2/14	G2
/	slash	2/15	G3

*You cannot designate a 96-character set into G0.

$I_2...I_n$ F, intermediate and final characters

Selects one of the standard character sets. The following table lists the characters used to select standard sets.

Table 5–3 Character Set Codes

Character Set	$I_2...I_n$ F Characters	Code
94-Character Sets		
ASCII (initial setting for G1 and G0)	**B**	**4/2**
DEC Supplemental Graphic (initial setting for G2 and G3)	**%5**	**2/5, 3/5**
DEC Special Graphics	0	3/0
DEC Technical	>	3/14
User-preferred supplemental	<	3/12
NRC Sets*		
ISO United Kingdom	A	4/1
DEC Finnish†	5 or C	3/5 4/3
ISO French	R	5/2
DEC French Canadian†	9 or Q	3/9 5/1
ISO German	K	4/11
ISO Italian	Y	5/9
ISO Norwegian/Danish†	‘	6/0
DEC Norwegian/Danish	6 or E	3/6 4/5

*Only one national character set is available at a time. You must select national mode to use national character sets. See “National Replacement Character Sets (Worldwide Model Only)” in this section.

†Digital recommends using the first code shown.

Table 5–3 (Cont.) Character Set Codes

Character Set	$I_2...I_n$ F Characters	Code
DEC Portuguese	%6	2/5, 3/6
ISO Spanish	Z	5/10
DEC Swedish†	7 or H	3/7 4/8
DEC Swiss	=	3/13
96-Character Sets		
ISO Latin–1 Supplemental	A	4/1

†Digital recommends using the first code shown.

Examples

The following sequence designates the DEC Special Graphic character set as the G1 logical set:

```
ESC ) 0
```

The following sequence designates the ISO Latin-1 supplemental character set as the G3 logical set:

```
ESC / A
```

Mapping Character Sets

After you designate a character set as G0, G1, G2, or G3, you must map the set into the in-use table as GL or GR. To map a set, you use *locking-shift* or *single-shift* control functions.

Figure 5–2 shows how you use locking shifts and single shifts in VT400 mode. Figure 5–3 shows how you use locking shifts and single shifts in VT100 mode.

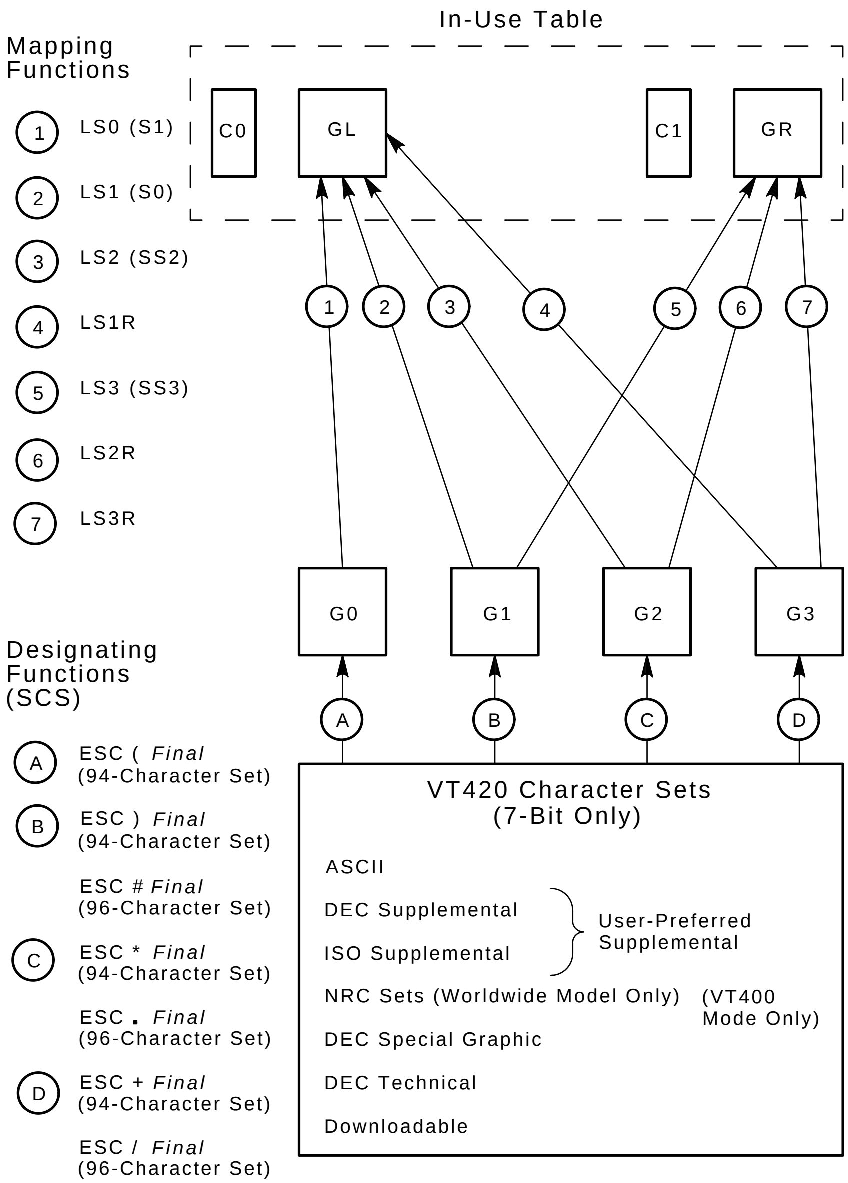

Figure 5–2 Designating and Mapping Character Sets in VT400 Mode

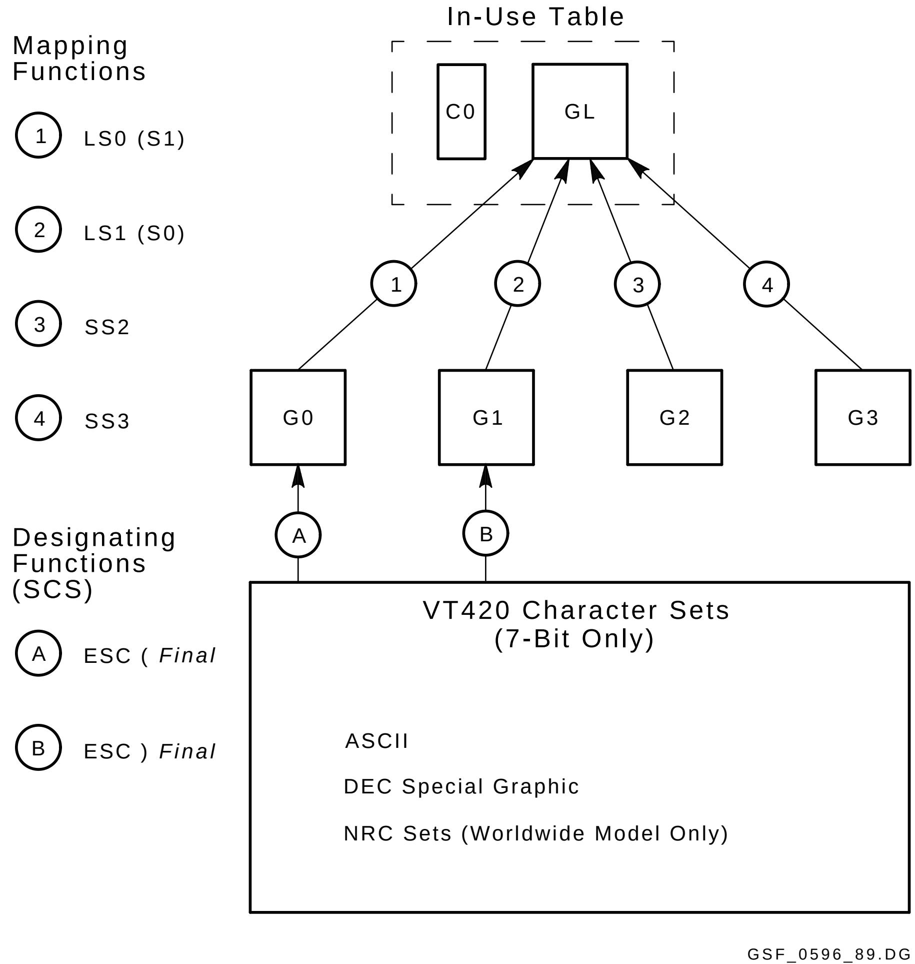

Figure 5–3 Designating and Mapping Character Sets in VT100 Mode

Locking Shifts (LS)

When you use a locking shift, the character set remains in GL or GR until you use another locking shift. Table 5–4 lists all locking shifts available.

Format

Table 5–4 Mapping Character Sets with Locking Shifts

Locking Shift	Code		Function
LS0 (locking shift 0)	**SI** 0/15		**Map G0 into GL.(default)**
LS1 (locking shift 1)	**SO** 0/14		Map G1 into GL.
The following locking shift functions are available only in VT400 mode.			
LS1R (locking shift 1, right)	**ESC** 1/11	**~** 7/14	Map G1 into GR.
LS2 (locking shift 2)	**ESC** 1/11	**n** 6/14	Map G2 into GL.
LS2R (locking shift 2, right)	**ESC** 1/11	**}** 7/13	Map G2 into GR.
LS3 (locking shift 3)	**ESC** 1/11	**o** 6/15	Map G3 into GL.
LS3R (locking shift 3, right)	**ESC** 1/11	**|** 7/12	Map G3 into GR.

Examples

The following sequence designates the DEC Technical character set as G1, then maps G1 into GL:

ESC) >	**SO**
Designate as G1.	Map G1 into GL.

The following sequences designate the ISO Latin-1 supplemental character set as G2, then map G2 into GR:

ESC . A	**ESC }**
Designate as G2.	Map G2 into GR.

Single Shifts (SS)

You use a single shift when you want to display the next character from a different character set. A single shift maps the G2 or G3 set into GL. The character set is active for only one character. Then the terminal returns to the previous character set in GL.

The terminal has two single-shift control functions available.

Format

Single-Shift Control	8-Bit Character	7-Bit Equivalent Sequence		Function
Single shift 2	**SS2** 8/14	**ESC** 1/11	**N** 4/14	Maps G2 into GL for the next character.
Single shift 3	**SS3** 8/15	**ESC** 1/11	**O** 4/15	Maps G3 into GL for the next character.

Example

Suppose the ASCII character set is in GL. You want to display the alpha character from the DEC Technical character set, already designated as G3. You do not want to replace the ASCII set just to display one character. Instead, you can use single shift 3 to temporarily map the DEC Technical set (G3) into GL.

SS3	**a**
single shift 3	alpha character

After displaying the alpha character, the terminal maps the ASCII set (G1) back into GL, replacing the DEC Technical set (G3).

National Replacement Character Sets (Worldwide Model Only)

The terminal has several 7-bit character sets for different national languages (Chapter 2). Only one national replacement character set is available at a time.

To use a national replacement character set, you must select national replacement character set mode. When you reset this mode, the terminal uses 7-bit and 8-bit characters from one of the multinational character sets (DEC Multinational or ISO Latin-1). When you set this mode, the terminal uses 7-bit characters from an NRC set.

See “National Replacement Character Set Mode” at the end of Chapter 4.

Assigning User-Preferred Supplemental Sets (DECAUPSS)

You can assign the supplemental character set you use most often as a special standby set. This standby set is called the user-preferred supplemental set. This feature provides applications with an easy way to access the user’s preferred supplemental set.

Default: DEC Supplemental Graphic

Format

DCS	**0**	**!**	**u**	**%**	**5**	**ST**	DEC Supplemental
9/0	3/0	2/1	7/5	2/5	3/5	9/12	Graphic set.
DCS	**0**	**!**	**u**	**A**	**ST**	ISO Latin-1 set.	
9/0	3/0	2/1	7/5	4/1	9/12		

Description

You can assign the DEC Supplemental Graphic or ISO Latin-1 supplemental set as the standby set. After you assign a set, you must designate and map the set before using it.

1. Designate the set as G1, G2, or G3.
2. Map the set into GR.

For more information on designating and mapping sets, see “Selecting Character Sets” in this chapter.

ANSI Conformance Levels

This control function lets an application map certain character sets into the terminal's in-use table as default sets. The character sets are based on ANSI conformance levels, listed in this section. These conformance levels are from the dpANS X3.134.1 standard.

ANSI conformance levels represent an agreement between the sender and receiver for compatible data exchange. The control function acts as an *announcer* for the data exchange that follows between the terminal and application software. The control function selects which character sets the terminal uses by default in the data exchange.

The VT420 supports three ANSI conformance levels.

ANSI Levels 1 and 2

- ASCII designated as G0.
- ISO Latin-1 supplemental designated as G1.
- G0 mapped into GL.
- G1 mapped into GR.

ANSI Level 3

- ASCII designated as G0.
- G0 mapped into GL.

Format

ESC	**sp**	*Final*
1/11	2/0	4/**

Parameters

Final

indicates the ANSI conformance level for the subsequent data exchange.

Final	**ANSI Conformance Level**
L	Level 1
M	Level 2
N	Level 3

Notes on ANSI Conformance Levels

- If the terminal is reset, turned off, or changed with a set conformance level (DECSCL) sequence, software must send another announcer sequence to the terminal. Otherwise, the terminal uses the default character sets (ASCII in GL, DEC Supplemental or ISO Latin-1 supplemental in GR).
- The announcer sequence is available in VT400 mode only.
- Do not confuse ANSI conformance levels with Digital conformance levels (Chapter 2).

Soft Character Sets

You can download soft character set from the host system into the terminal. This feature lets you design your own soft character sets for use with the terminal. You can only load soft character sets in VT400 mode.

NOTE
VT220 or VT320 fonts may appear different on a VT420 terminal, because VT420 character cell sizes are different from those terminals. See the Pcmw parameter in Table 5–8.

The soft character set is also known as a *dynamically redefinable character set (DRCS)*. The terminal stores the soft characters in its DRCS buffer.

NOTE
The terminal does not store the soft character set in nonvolatile RAM. When you turn off the terminal, the soft characters are lost.

The next section describes the guidelines for designing a soft set. The sections that follow describe how to code, load, designate, and clear a soft set.

Designing a Soft Character Set

Your terminal displays each character by turning on a series of pixels. A *pixel* (picture element) is the smallest displayable unit on the screen. Each character must fit in a limited area, called the character cell. The size of the character cell depends on the number of lines and columns on the screen. The screen can display 24, 36, or 48 lines in 80 or 132 columns. With 24 lines on the screen, the VT420 uses a default character cell size of 10 by 16 pixels for 80 columns and 6 by 16 pixels for 132 columns (Figure 5–4).

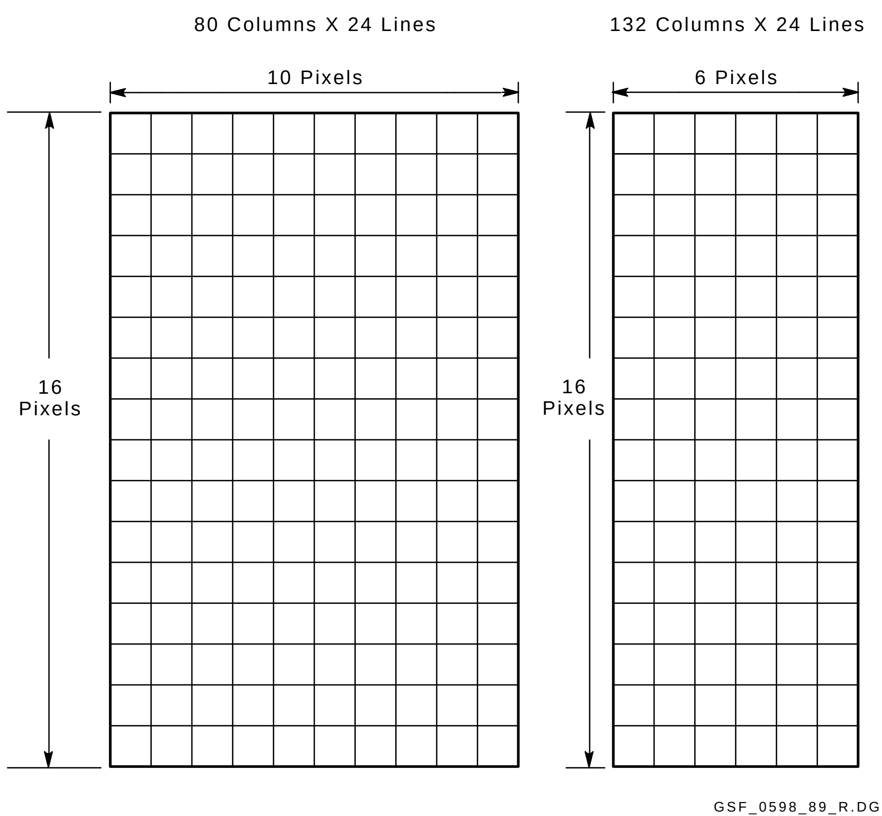

Figure 5–4 Character Cell Sizes for 24-Line by 80- and 132-Column Fonts

Table 5–5 shows the default character cell widths and heights based on the number of lines and columns on the screen.

Table 5–5 Character Cell Sizes

Cell Size	80 Columns	132 Columns
24 Lines/Screen		
Width	10 pixels	6 pixels
Height	16	16
36 Lines/Screen		
Width	10	6
Height	10	10
48 Lines/Screen		
Width	10	6
Height	8	8

When you design a character, you should lay out a character cell on grid paper. The little boxes on the grid paper represent pixels. You fill in the pixels that make up the character. The next section shows an example of a character design.

You should design six versions of your character set to fit six different character cell sizes. This means that there will be a version of your soft character set to fit any combination of lines and columns available on the terminal:

- 24 lines × 80 columns
- 24 lines × 132 columns
- 36 lines × 80 columns
- 36 lines × 132 columns
- 48 lines × 80 columns
- 48 lines × 132 columns

Design your character set, then load six versions of the set, one for each possible line/column combination. The terminal automatically selects which version of the set to use, based on the current number of lines and columns on the screen.

The built-in fonts supplied by Digital follow the guidelines in Table 5–6. The table lists the different guidelines for characters displayed with 24 lines, 36 lines, or 48 lines on the screen. In all cases, the screen resolution is 800 by 400 pixels for 80 columns, 792 by 400 pixels for 132 columns. The pixel aspect ratio is 1:1.4.

You must design your characters to fit the cell. The terminal ignores any pixels that are defined outside the cell. Also, you should include empty pixels on the left or right side of the character cell to allow for space between characters. Figure 5–5 shows an example of spacing for an uppercase D character with 24 lines on the screen. In this example, the character for the 80-column font has two pixel columns reserved for spacing.

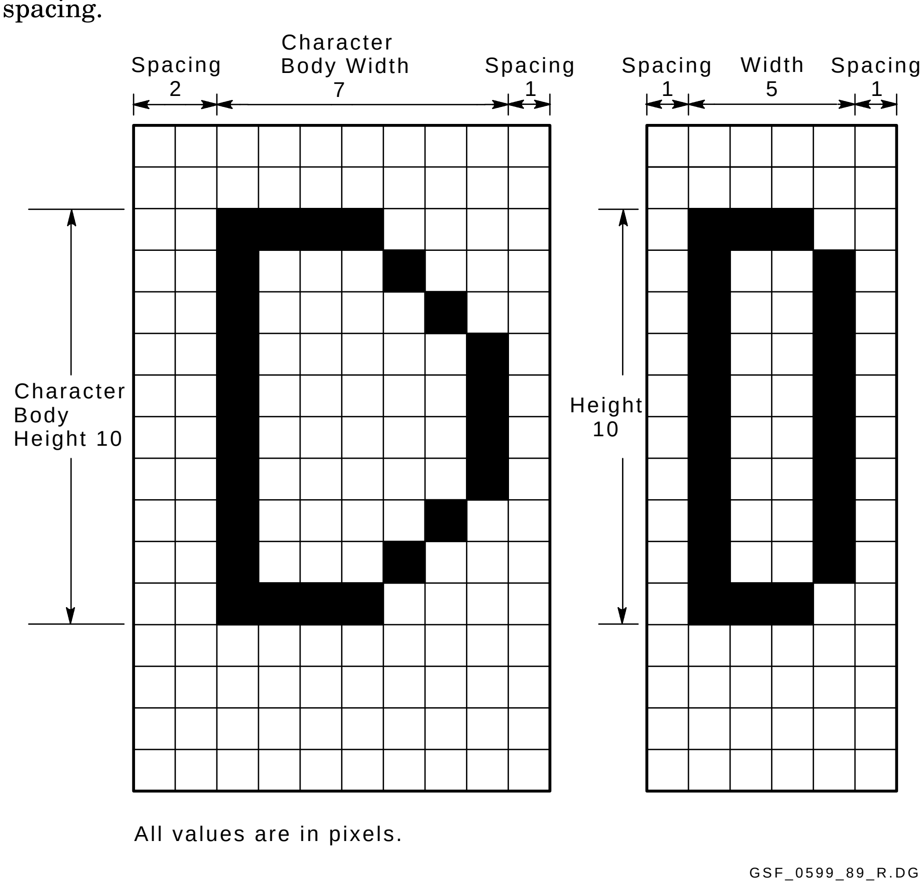

Figure 5–5 Character Body Sizes for 24-Line by 80- and 132-Column Fonts

Table 5–6 Guidelines for Designing Soft Characters

Character Dimension	80-Column Font	132-Column Font
24 Lines/Screen		
Cell width	10 pixels	6 pixels
Cell height	16	16
Body width	8	4
Body height	10	9
Ascender height	3	3
Descender height	3	3
Spacing before character	1	1
Spacing after character	1	1
36 Lines/Screen		
Cell width	10 pixels	6 pixels
Cell height	10	10
Body width	7	5
Body height	7	7
Ascender height	2	1
Descender height	1	2
Spacing before character	2	1
Spacing after character	1	0

Table 5–6 (Cont.) Guidelines for Designing Soft Characters

Character Dimension	80-Column Font	132-Column Font
48 Lines/Screen		
Cell width	10 pixels	6 pixels
Cell height	8	8
Body width	7	4
Body height	6	7
Ascender height	1	1
Descender height	1	1
Spacing before character	2	1
Spacing after character	1	1

Coding the Soft Character Set

After you design your characters, you must code them for the terminal. This section describes how to code soft characters. The next section describes how to load the character codes into the terminal.

Each pixel of a soft character cell receives a binary value of 0 or 1. A 1 bit indicates the pixel is on, and a 0 bit indicates the pixel is off.

The terminal receives the code for a soft character in sections, called *sixels*. A sixel is a 6-bit binary code that represents a vertical column of 6 pixels on the screen. Each bit in a sixel corresponds to a pixel on the screen. The following example describes how to design and code a soft character.

Example

Suppose you want to design an uppercase D for a 24-line by 80-column font.

1. **Draw your design on a grid.**

   Use the grid for an 80-column character cell to draw your design. Mark which pixels will be on and which pixels will be off. Your design may look like Figure 5–5.

2. **Divide the character cell into columns of 6 bits each.**

Use the format shown in Figure 5–6. Each 6-bit pattern represents 6 pixels, or a sixel. The least significant bit is at the top, and the most significant bit is at the bottom. The terminal would receive the sixel columns in order (1 to 10), starting with Group A.

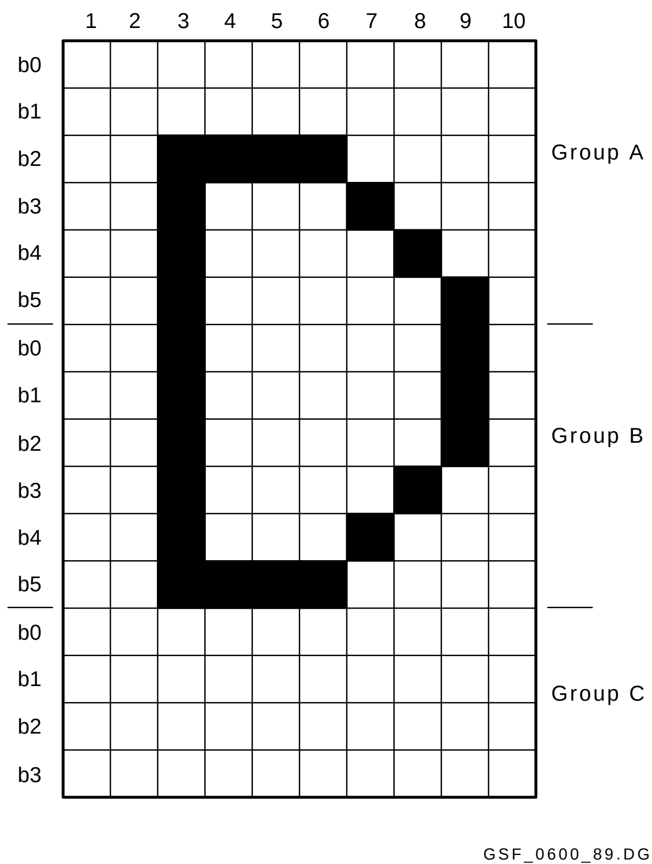

Figure 5–6 Example of an Uppercase D (24-Line by 80-Column Font)

Because the character cell height (16 pixels) is not a multiple of 6, the columns on the bottom of the character cell (Group D) have only 4 bits each, b0 through b3. Bits b4 and b5 in the bottom cell do not affect the character's appearance, so they have been excluded from Figure 5–6.

3. **Convert the binary value of each sixel to its hexadecimal value.**

Sixels codes are restricted to characters in the range of ? ($3F_{16}$) to ~ ($7E_{16}$), so you must add an offset of $3F_{16}$ to the hexadecimal value of each column. For example:

000000_2	=	00_{16}	110101_2	=	35_{16}	111111_2	=	$3F_{16}$
	+	$3F_{16}$		+	$3F_{16}$		+	$3F_{16}$
		$3F_{16}$			74_{16}			$7E_{16}$

4. **Use Table 5–7 to convert each binary number to the equivalent ASCII character.**

   Table 5–7 lists the results of steps 3 and 4 for each possible binary value. All you have to do is find the 6-digit binary number for each sixel bit pattern in your character design.

   Figure 5–7 shows this conversion for the uppercase D in this example.

You use this procedure to convert each character of your soft character set into a string of sixel bit patterns. Then you can download your DRCS characters into the terminal, using the DECDLD device control string described in the next section.

Table 5–7 Converting Binary Code to an ASCII Character

Binary Value	Hex. Value	Hex. Value + 3F Offset	Character Equivalent
000000	00	3F	?
000001	01	40	@
000010	02	41	A
000011	03	42	B
000100	04	43	C
000101	05	44	D
000110	06	45	E
000111	07	46	F
001000	08	47	G
001001	09	48	H
001010	A	49	I
001011	B	4A	J
001100	C	4B	K

Table 5–7 (Cont.) Converting Binary Code to an ASCII Character

Binary Value	Hex. Value	Hex. Value + 3F Offset	Character Equivalent
001101	D	4C	L
001110	E	4D	M
001111	F	4E	N
010000	10	4F	O
010001	11	50	P
010010	12	51	Q
010011	13	52	R
010100	14	53	S
010101	15	54	T
010110	16	55	U
010111	17	56	V
011000	18	57	W
011001	19	58	X
011010	1A	59	Y
011011	1B	5A	Z
011100	1C	5B	[
011101	1D	5C	\
011110	1E	5D	]
011111	1F	5E	^
100000	20	5F	_
100001	21	60	‘
100010	22	61	a
100011	23	62	b
100100	24	63	c
100101	25	64	d
100110	26	65	e
100111	27	66	f
101000	28	67	g
101001	29	68	h
101010	2A	69	i

Table 5–7 (Cont.) Converting Binary Code to an ASCII Character

Binary Value	Hex. Value	Hex. Value + 3F Offset	Character Equivalent
101011	2B	6A	j
101100	2C	6B	k
101101	2D	6C	l
101110	2E	6D	m
101111	2F	6E	n
110000	30	6F	o
110001	31	70	p
110010	32	71	q
110011	33	72	r
100100	34	73	s
110101	35	74	t
110110	36	75	u
110111	37	76	v
111000	38	77	w
111001	39	78	x
111010	3A	79	y
111011	3B	7A	z
111100	3C	7B	{
111101	3D	7C	|
111110	3E	7D	}
111111	3F	7E	~

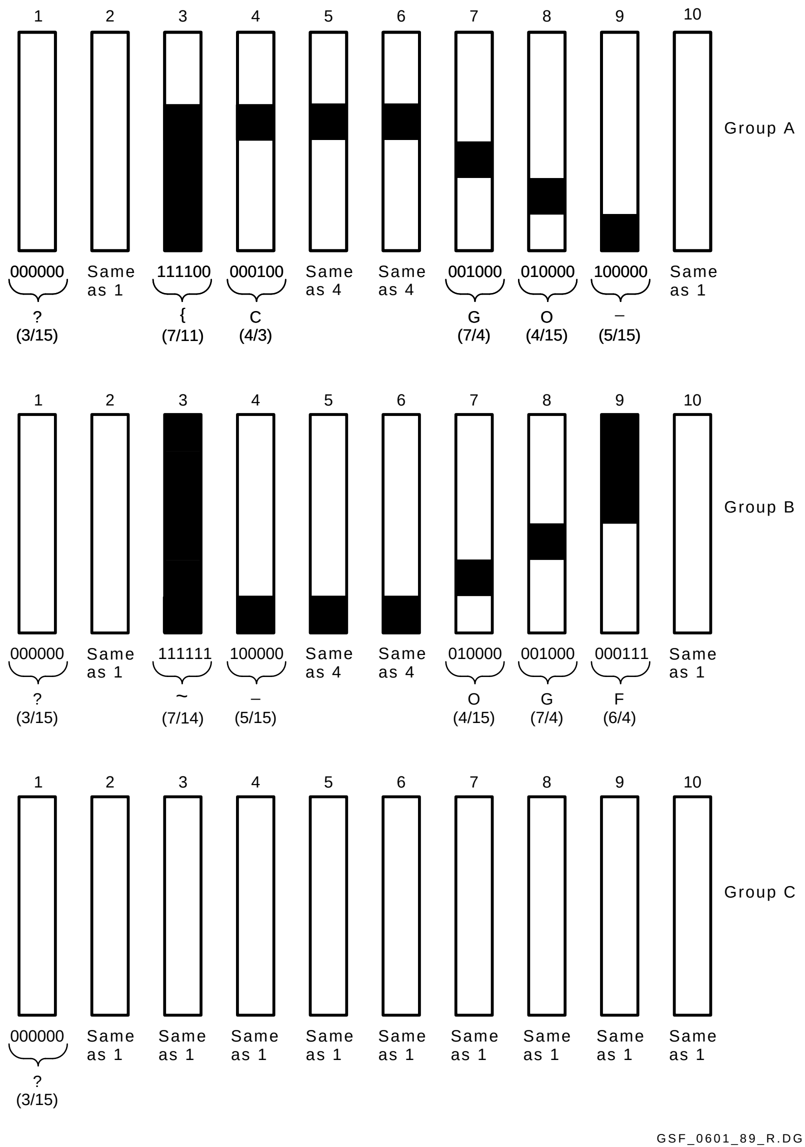

Figure 5–7 Sixel-to-ASCII Conversion

Downloading Soft Characters

The VT420 lets you load up to six variations of the same soft character set for each session. These six variations correspond to the six different combinations of character width and character height the VT420 supports.

Character Width

For 80 columns:	10 pixels
For 132 columns:	6 pixels

Character Height

For 24 lines/screen:	16 pixels
For 36 lines/screen:	10 pixels
For 48 lines/screen:	8 pixels

You can adjust the screen size by using the select number of lines/screen (DECSNLS) control function (Chapter 11). The terminal automatically selects the appropriate soft set for the screen size.

When loading a soft set, you specify which of the six width/height variations the set is intended for. Your set replaces any soft set already loaded for that width/height variation.

You should load six variations of your set to correspond to the six variations of character width and height available in the terminal (80 or 132 columns by 24, 36, or 48 lines). Do not confuse the font rendition with the actual character set. You cannot load six different soft sets. However, you can load six different renditions of the same soft set.

Downline Load (DECDLD)

You load your soft character set with a DECDLD device control string. See Chapter 2 for general information about device control strings.

After you load your soft character set, you must designate the set as G0, G1, G2, or G3.

Format

DCS *Pfn ; Pcn; Pe; Pcmw; Pss; Pt; Pcmh; Pcss* **{** *Dscs Sxbp1 ; Sxbp2 ;...; Sxbpn* **ST**

Parameters

DCS (9/0)
is the *device control string introducer*. DCS is an 8-bit C1 character. You can use the equivalent 7-bit sequence ESC P (1/11, 5/0) when coding for a 7-bit environment.

Pfn; Pcn; Pe; Pcmw; Pss; Pt; Pcmh; Pcss
are *parameter characters*, separated by semicolons (3/11). Table 5–8 describes these parameters and lists their possible values. Table 5–9 describes the combinations of *Pcmw, Pt,* and *Pcmh* you can use for 80- and 132-column fonts. If you use any other combinations, the terminal ignores the DECDLD string.

{
is the *final character*. It marks the end of the parameter characters and indicates that this string is a DECDLD function.

Dscs
defines the name for the soft character set. You use this name in the select character set (SCS) escape sequence. You use the following format for the *Dscs* name:

I F

I	is 0, 1 or 2 intermediate characters from the range 2/0 to 2/15 in the ASCII character set.
F	is a final character in the range 3/0 to 7/14.

Examples of Dscs Names

Name			Function
sp 2/0	**@** 4/0		Defines the character set as an unregistered soft set. **This value is the recommended default for user-defined sets.** The value of *Pcss* defines whether this set has 94 or 96 characters.
A 4/2			If *Pcss* is 0, A defines the soft character set as the U.K. national replacement character set.
			If *Pcss* is 1, A defines the soft character set as the ISO Latin-1 supplemental set.
& 2/6	**%** 2/5	**C** 4/3	Defines the soft character set as % C, which is currently an unregistered set. The value of *Pcss* defines whether this set has 94 or 96 characters.

Sxbp1 ; Sxbp2 ; . . . ; Sxbpn

are the sixel bit patterns for individual characters, separated by semicolons (3/11). Your character set can have 1 to 94 patterns or 1 to 96 patterns, depending on the setting of the character set size parameter (*Pcss*). Each sixel bit pattern is in the following format:

S...S / *S...S*

the first *S...S*
represents the sixels in Group A of the soft character (Figure 5–6).

the second *S...S*
advances the sixel pattern to Group B of the soft character.

/ (2/5)
represents the sixels in Group B of the soft character.

ST

is the *string terminator*. ST is an 8-bit C1 character. You can use the equivalent 7-bit sequence ESC \ (1/11, 5/12) when coding for a 7-bit environment.

Table 5–8 DECDLD Parameter Characters

Parameter	Name	Description
Pfn	Font number	Selects the DRCS font buffer to load. The VT420 has two DRCS font buffers. One font buffer is dedicated to session 1, the other to session 2. Each font buffer is called DRCS buffer 1. *Pfn* has two valid values, 0 and 1. Both values refer to DRCS buffer 1 for each session.
Pcn	Starting character	Selects where to load the first character in the DRCS font buffer. The location corresponds to a location in the ASCII code table (Figure 2–2). For example, a *Pcn* value of 0 means that the first soft character is loaded into position 2/0 of the character table. A *Pcn* value of 1 means position 2/1 in the table, and so on, up to *Pcn* = 95 (position 7/15). *Pcn* is affected by the character set size. See *Pcss* below.
Pe	Erase control	Selects which characters to erase from the DRCS buffer before loading the new font. 0 = erase all characters in the DRCS buffer with this number, width, and rendition. 1 = erase only characters in locations being reloaded. 2 = erase all renditions of the soft character set (normal, bold, 80-column, 132-column).

NOTE

Erased characters are undefined (not blank). The terminal displays these characters as the error character (reverse question mark).

Table 5–8 (Cont.) DECDLD Parameter Characters

Parameter	Name	Description
Pcmw	Character matrix width	Selects the maximum character cell width. *VT400 mode* **0 = 10 pixels wide for 80 columns, 6 pixels wide for 132 columns. (default)** 1 = illegal. 2 = 5 × 10 pixel cell (VT220 compatible). 3 = 6 × 10 pixel cell (VT220 compatible). 4 = 7 × 10 pixel cell (VT220 compatible). 5 = 5 pixels wide. 6 = 6 pixels wide. . . . 10 = 10 pixels wide. If you omit a *Pcmw* value, the terminal uses the default character width. If the *Pe* parameter is 0, *Pcmw* must be less than 10. Any *Pcmw* value over 10 is illegal. For illegal values of *Pcmw*, the terminal ignores the rest of the load sequence.

Table 5–8 (Cont.) DECDLD Parameter Characters

Parameter	Name	Description
		For VT200 compatible software: Use a *Pcmw* value of 2, 3, or 4. When you use these values, the VT420 doubles the height of the font definitions in memory. This makes the soft set the same height as the hard sets. If you use a *Pcmw* value of 0, the VT420 does not double the height and the soft set appears smaller than the hard sets. Remember that the VT200 fonts may appear different on the VT420.
		For fonts designed for the VT420: Use values 5 through 10.
		For compatibility between VT200 and VT420 terminals: Use a *Pcmw* value of 5, 6, or 7.
Pss	Font set size	Defines the screen width and screen height for this font.
		0,1 = **80 columns, 24 lines. (default)**
		2 = 132 columns, 24 lines
		11 = 80 columns, 36 lines
		12 = 132 columns, 36 lines
		21 = 80 columns, 48 lines
		22 = 132 columns, 48 lines
		For illegal values of *Pss*, the terminal ignores the rest of the load sequence.
		If the number of columns or lines/screen changes, the terminal uses the appropriate variation of the soft set. If you try to display a DRCS character when there is no soft set defined for the current number of lines and columns, the terminal displays the error character (reverse question mark).

Table 5–8 (Cont.) DECDLD Parameter Characters

Parameter	Name	Description
		NOTE **For VT220 compatibility, you must use a soft font of 80 or 132 columns (not both). The VT220 allows a single font to be used for 80 and 132 columns.** You can load a font for any of the six sizes at any time. When a new soft set is loaded, any characters from the previous soft set are lost. Characters currently displayed from the old set become reverse question marks.
Pt	Text or full cell	Defines the font as a text font or *full-cell font*. **0 = text. (default)** 1 = text. 2 = full cell. Full-cell fonts can individually address all pixels in a cell. Text fonts cannot individually address all pixels. If you specify a text cell, the terminal automatically performs spacing and centering of the characters.
Pcmh	Character matrix height	Selects the maximum character cell height. **0 or omitted = 16 pixels high. (default)** 1 = 1 pixel high. 2 = 2 pixels high. 3 = 3 pixels high. . . . 16 = 16 pixels high. *Pcmh* values over 16 are illegal. If the value of *Pcmw* is 2, 3, or 4, *Pcmh* is ignored.

Table 5–8 (Cont.) DECDLD Parameter Characters

Parameter	Name	Description
Pcss	Character set size	Defines the character set as a 94- or 96-character graphic set. **0 = 94-character set. (default)** 1 = 96-character set. The value of *Pcss* changes the meaning of the *Pcn* (starting character) parameter above.

Examples

- **If Pcss = 0 (94-character set)**

  The terminal ignores any attempt to load characters into the 2/0 or 7/15 table positions.

Pcn	Specifies
1	column 2/row 1
	.
	.
	.
94	column 7/row 14

- **If Pcss = 1 (96-character set)**

Pcn	Specifies
0	column 2/row 0
	.
	.
	.
95	column 7/row 15

Table 5–9 Valid DECDLD Parameter Combinations

Pt	Pcmw	Pcmh	Pss*
80-column, 24 lines			
0 or 1	0 to 8	0 to 16	0 or 1
2	0 to 10	0 to 16	0, 1
132-column, 24 lines			
0 or 1	0 to 5	0 to 16	2
2	0 to 6	1 to 16	2
80-column, 36 lines			
0 or 1	0 to 8	0 to 10	11
2	0 to 10	0 to 10	11
132-column, 36 lines			
0 or 1	0 to 5	0 to 10	12
2	0 to 6	0 to 10	12
80-column, 48 lines			
0 or 1	0 to 8	0 to 8	21
2	0 to 10	0 to 8	21
132-column, 48 lines			
0 or 1	0 to 5	0 to 8	22
2	0 to 6	0 to 8	22

*The default values are the maximum legal values in each case.

NOTE

For illegal combinations of the *Pss, Pt, Pcmw,* and *Pcmh* parameters, the terminal ignores the rest of the sequence.

Designating the Soft Character Set

You designate your soft character set the same way you designate the hard character sets—using a select character set (SCS) sequence. You also use the same format for the SCS sequence.

ESC	*Intermediate(s)*	*Final*
1/11	*********	*****

Intermediate(s)

are one or more characters that designate the soft character set as one of the logical sets, G0 through G3. You use the same intermediate characters that you use for hard character sets (Table 5–2).

The intermediate character(s) also indicates whether the soft character set is a 94- or 96-character set. Make sure you use an intermediate character that matches the setting of the character set size parameter (*Pcss*) in the DECDLD string (Table 5–8).

Final

is the *Dscs* name you used for the soft character set in the DECDLD string.

Notes on Designating Soft Character Sets

- **Replacing a soft set with a new soft set**

  If you use a new *Dscs* name when you replace the current soft set with another soft set, then the following occurs:

  – Characters from the old soft set are undefined. If you redefine the soft set, characters currently on the screen may change.

  – Any logical sets (G0, G1, G2, G3) used to designate the old soft set are undefined. The in-use table is also undefined.

  After you load a new soft set, use a select character set (SCS) sequence to designate the soft set. Using SCS eliminates the confusion involved with undefined characters.

- **Replacing a hard set with a soft set**

  You can define a soft set that replaces one of the hard sets (such as ASCII or DEC Special Graphic).

A soft set that replaces a hard set remains in effect until you perform one of the following actions:

– Clear the soft set by:
  - Recalling saved settings or factory-default settings with the `Save` or `Default` fields in the Set-Up Directory.
  - Running the power-up self-test.
– Redefine the soft set (using another DECDLD string).

Soft Character Set Example

Suppose you want to create a soft character set containing a solid rectangle, a blank, a rectangular box, and a striped rectangle. You decide to use a font that is 24 lines by 80 columns with a character cell size of 8 by 16 pixels. This example shows how you would

1. Download the set.
2. Designate the set as G1.
3. Map the G1 set into GL.

NOTE
Make sure the terminal is in VT400 mode before you try to load a soft character set. You cannot load soft sets in VT100 mode.

1. You could use the following DECDLD string to load your character set. The string is shown divided into sections for clarity.

```
DCS
  1 ; 1 ; 0 ; 12 ; 1 ; 1 ; 12; 0 { sp @
  --------/--------/--------;
  ????????/????????/????????;
  ~@@@@@@~/~??????~/~GGGGGG~;
  TTTTTTTT/TTTTTTTT/TTTTTTTT;
ST
```

DCS (9/0)
introduces the device control string.

1 ; 1 ; 0 ; 12 ; 1 ; 1 ; 12 ; 0
is the parameter string specifying the following functions. See Table 5–8 for parameter definitions.

Parameter	**Function**
Pfn = 1	Loads this soft set into the DRCS font buffer.
Pcn = 1	Selects the character at row 2/ column 1 in the ASCII table (Chapter 2) as the first character to load.
Pe = 0	Erases all characters in the font buffer for that rendition.
Pcmw = 12	Selects a maximum character width of 12 pixels.
Pss = 1	Selects a font set size of 80 columns, 24 lines.
Pt = 1	Defines the set as a text font.
Pcmh = 12	Selects a maximum character height of 12 pixels.
Pcss = 0	Defines the set as a 94-character set.

{ (7/11)
indicates the end of the parameter characters and specifies that this sequence is a DECDLD string.

sp @
defines the character set as an unregistered soft set. This value is the recommended default value for user-defined sets. The sp represents one space. You can use other values to define other specific character sets.

———/———/———
represents the first character (a solid rectangle).

;
separates the soft characters.)

????????/????????/????????
represents the second character (a blank).

~@@@@@@~/~??????~/~GGGGGG~
represents the third character (a hollow rectangle).

TTTTTTTT/TTTTTTTT/TTTTTTTT
represents the fourth character (a set of horizontal stripes).

ST (9/12)
indicates the end of the DECDLD string.

2. Now you are ready to designate the character set as G1. You can use the following SCS escape sequence:

```
ESC ) sp @
```

ESC (1/11)
introduces the SCS sequence.

) (2/9)
designates the character set as G1.

sp @ (2/0, 4/0)
selects the soft set as the set to designate as G1. Remember, sp @ was the name used for the soft set in the DECDLD string.

3. Finally, you want to map the G1 set into the in-use table as GL. You can map the set by sending a shift out (SO) control character. To send the SO character, you hold down the Ctrl key and press the N key.

   NOTE
   For information on using shift characters, see Chapter 3. For information on mapping sets, see "Mapping Character Sets" in this chapter.

   The soft character set should now be loaded and ready for use.

Clearing a Soft Character Set

You can clear a soft character set that you loaded into the terminal by using the following DECDLD control string:

```
DCS 1;1;2 { sp @ ST
```

Any of the following actions also clear the soft character set:

- Performing the power-up self-test.
- Selecting the `Recall` or `Default` set-up fields from the Set-Up Directory.
- Using a reset to initial state (RIS) sequence.

6

Page Memory

This chapter describes the control functions that affect the terminal's *page memory*. The chapter covers the following topics:

- What is page memory?
- Controlling the page format
- Moving through pages

This chapter assumes you are familiar with the character-encoding concepts described in Chapter 2.

What is Page Memory?

Many terminals only have enough memory to store the data that appears on their screen. The VT420 has memory to store more data than you can display on the screen. The size of this memory is equal to 144 lines by 80 or 132 columns. You can divide this memory into one or more pages.

Page memory lets you store more text locally in the terminal. The screen can display 24, 36, or 48 lines from page memory at a time. You can select how many lines to display by using the select number of lines /screen (DECSNLS) control function (Chapter 11).

You can use control functions (such as scrolling and panning functions) to display the other lines from page memory that are not on the screen.

Page memory can provide a means for faster screen updates. While the terminal displays one page, the host can write to another (Chapter 10).

You divide page memory into a number of equally sized pages, by selecting one of several standard page sizes. A page in page memory is similar to a page in a book. Each page has left, right, top, and bottom margins. You can define the position of the top and bottom, left and right margins on a page. You select the page format by using control functions or set-up. This chapter describes the control functions.

Applications can write to page memory by first addressing a page, then writing data to the page. If the application wants to write to another page, the application must address that page.

Figure 6–1 shows the basic parts of a page. The figure shows the default page size of 24 lines by 80 columns. Your terminal screen can display up to 48 lines at a time. However, you can make the length of a page larger than the screen.

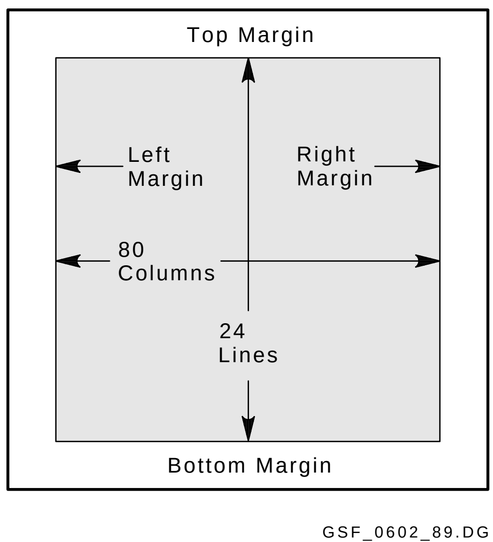

Figure 6–1 A Page in Page Memory

Page Memory for One Session

When you use one session, the full 144 lines of page memory are available. See Chapter 14 for details on session management. You can select one of the following page sizes for one session. Figure 6–2 shows these page sizes.

- 6 pages of 24 lines × 80 or 132 columns
- 5 pages of 25 lines × 80 or 132 columns
- 4 pages of 36 lines × 80 or 132 columns
- 3 pages of 48 lines × 80 or 132 columns
- 2 pages of 72 lines × 80 or 132 columns
- 1 page of 144 lines × 80 or 132 columns

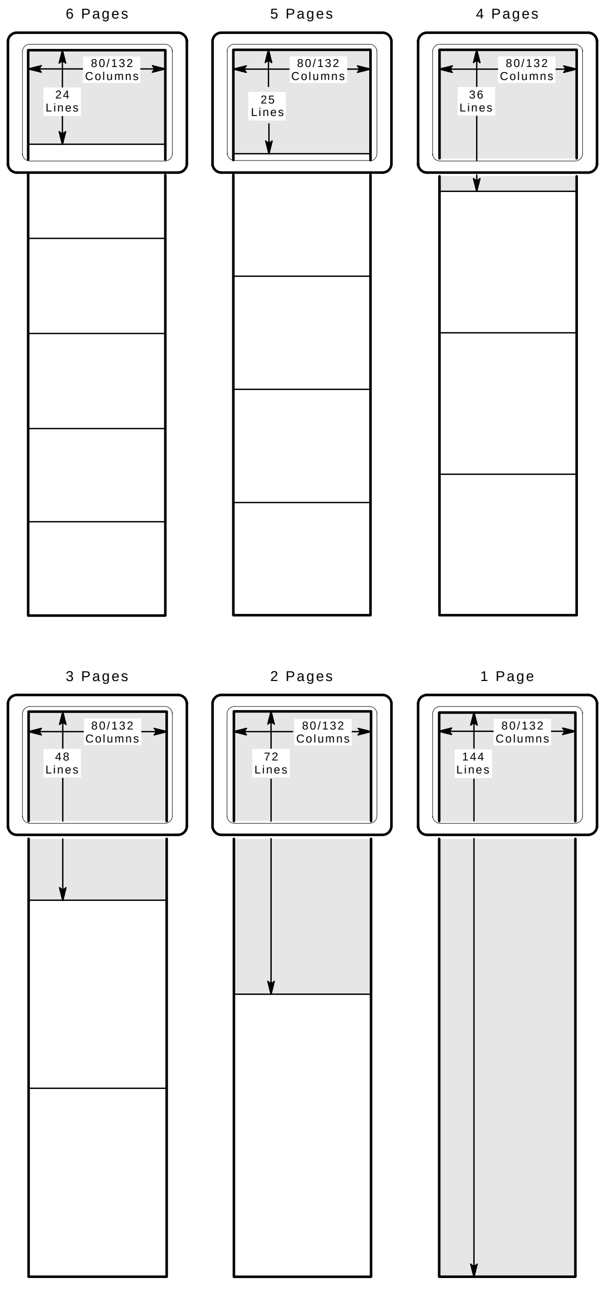

Figure 6–2 Page Sizes for One Session

Page Memory for Two Sessions

When you use two sessions, each session has 72 lines of page memory available. See Chapter 14 for details on session management.

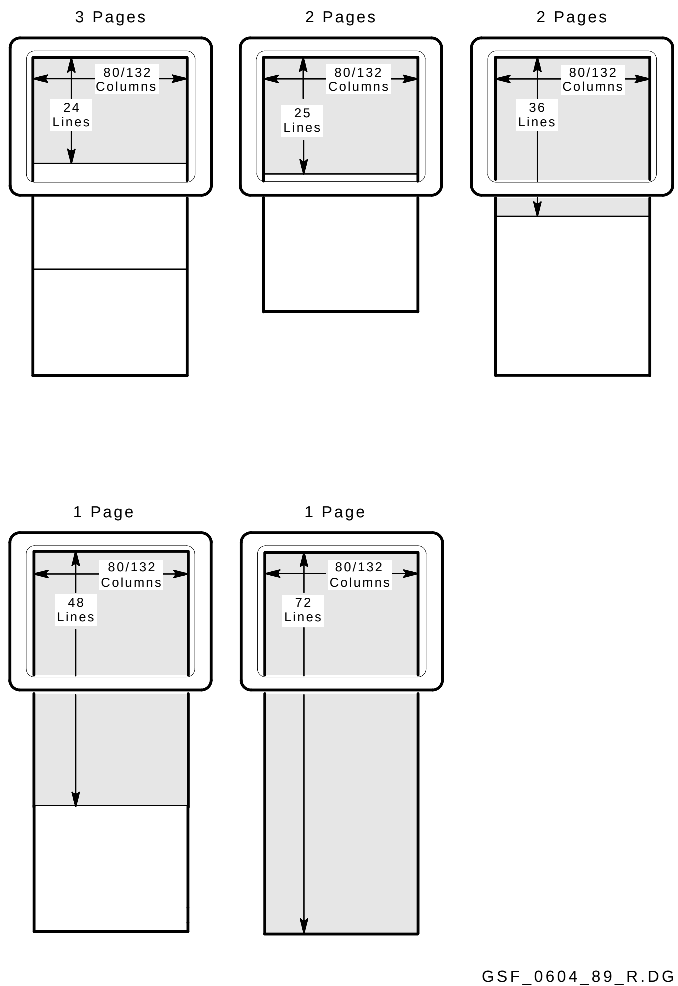

Figure 6–3 Page Sizes for Two Sessions

You can select one of the following page sizes for two sessions. Figure 6–3 shows these page sizes.

- 3 pages of 24 lines × 80 or 132 columns

- 2 pages of 25 lines × 80 or 132 columns
- 2 pages of 36 lines × 80 or 132 columns
- 1 page of 48 lines × 80 or 132 columns
- 1 page of 72 lines × 80 or 132 columns

Controlling the Page Format

This section describes how to select the page size and set margins for pages in page memory. You use the same basic control functions for one or two sessions.

Selecting 80 or 132 Columns per Page

There are two control functions that can set the page width to 80 or 132 columns, DECSCPP and DECCOLM.

Programming Tip

Digital recommends that new applications use DECSCPP rather than DECCOLM. DECSCPP does not clear page memory or reset the scrolling regions, as does DECCOLM. DECCOLM is provided mainly for compatibility with previous products.

Default: 80 columns

Set Columns per Page (DECSCPP)

<table>
<tr><th colspan="6">Sequence</th><th>Sets Each Page to . . .</th></tr>
<tr><td>CSI
9/11</td><td>$
2/4</td><td>|
7/12</td><td></td><td></td><td></td><td>80 columns.</td></tr>
<tr><td>CSI
9/11</td><td>0
3/0</td><td>$
2/4</td><td>|
7/12</td><td></td><td></td><td>80 columns.</td></tr>
<tr><td>CSI
9/11</td><td>8
3/8</td><td>0
3/0</td><td>$
2/4</td><td>|
7/12</td><td></td><td>80 columns.</td></tr>
<tr><td>CSI
9/11</td><td>1
3/1</td><td>3
3/3</td><td>2
3/2</td><td>$
2/4</td><td>|
7/12</td><td>132 columns.</td></tr>
</table>

Notes on DECSCPP

- DECSCPP changes the font to match the current number of columns on the page.
- DECSCPP does not move the cursor. If, however, the cursor is beyond the width of the new page when DECSCPP executes, the cursor moves to the right column of the new page.
- If you switch from 132-column to 80-column pages, you can lose data from page memory. Columns no longer present in page memory are lost. Make sure you set page columns *before* you enter data into page memory.

Column Mode (DECCOLM)

CSI	**?**	**3**	**h**	Set: 132-column font.
9/11	3/15	3/3	6/8	
CSI	**?**	**3**	**l**	Reset: 80-column font.
9/11	3/15	3/3	6/12	

Notes on DECCOLM

- DECCOLM sets the number of columns on the page to 80 or 132 and selects the corresponding 80- or 132-column font.
- If you change the DECCOLM setting, the terminal:
  - Sets the left, right, top and bottom scrolling margins to their default positions.
  - Erases all data in page memory.
- DECCOLM resets vertical split screen mode (DECVSSM) to unavailable.
- DECCOLM clears data from the status line if the status line is set to host-writable.

Set Lines per Page (DECSLPP)

This control function sets the number of lines for each page in page memory. The number of lines you can select depends on whether you use one session or two sessions.

Default: Two sessions—3 pages of 24 lines
One session—6 pages of 24 lines

Format

Sequence					Page Length: Two Sessions	Page Length: One Session
CSI 9/11	**2** 3/2	**4** 3/4	**t** 7/4		3 pages of 24 lines	6 pages of 24 lines
CSI 9/11	**2** 3/2	**5** 3/5	**t** 7/4		2 pages of 25 lines	5 pages of 25 lines
CSI 9/11	**3** 3/3	**6** 3/6	**t** 7/4		2 pages of 36 lines	4 pages of 36 lines
CSI 9/11	**4** 3/4	**8** 3/8	**t** 7/4		1 page of 48 lines	3 pages of 48 lines
CSI 9/11	**7** 3/7	**2** 3/2	**t** 7/4		1 page of 72 lines	2 pages of 72 lines
CSI 9/11	**1** 3/1	**4** 3/4	**4** 3/4	**t** 7/4	Not available	1 page of 144 lines

Notes on DECSLPP

- If you switch to a smaller page size, data that was on the larger page may be split across the smaller pages. To avoid confusion, make sure you set the lines/page *before* you enter data into page memory.
- DECSLPP usually does not change the top and bottom scrolling margins. If, however, you change the page size so that the current scrolling margins exceed the new page size, the terminal resets the margins to the page limits.

Set Left and Right Margins (DECSLRM)

This control function sets the left and right margins to define the scrolling region. DECSLRM only works when vertical split screen mode (DECVSSM) is set.

Available in: VT400 mode only
Default: Margins are at the left and right page borders.

Format

CSI	*Pl*	**;**	*Pr*	**s**
9/11	3/*n*	3/11	3/*n*	7/3

Parameters

Pl
is the column number for the left margin.

Default: *Pl* = 1.

Pr
is the column number for the right margin.

Default: *Pr* = 80 or 132 (depending on the page width).

Notes on DECSLRM

- The value of the left margin (*Pl*) must be less than the right margin (*Pr*).
- The maximum size of the scrolling region is the page size, based on the setting of set columns per page (DECSCPP).
- The minimum size of the scrolling region is two columns.
- The terminal only recognizes this control function if vertical split screen mode (DECVSSM) is set.
- DECSLRM moves the cursor to column 1, line 1 of the page.
- If the left and right margins are set to columns other than 1 and 80 (or 132), the terminal cannot scroll smoothly.

Set Top and Bottom Margins (DECSTBM)

This control function sets the top and bottom margins for the current page. You cannot perform scrolling outside the margins.

Default: Margins are at the page limits.

Format

CSI	*Pt*	**;**	*Pb*	**r**
9/11	3/*n*	3/11	3/*n*	7/2

Parameters

Pt
is the line number for the top margin.

Default: *Pt* = 1.

Pb
is the line number for the bottom margin.

Default: *Pb* = current number of lines per screen.

Notes on DECSTBM

- The value of the top margin (*Pt*) must be less than the bottom margin (*Pb*).
- The maximum size of the scrolling region is the page size.
- DECSTBM moves the cursor to column 1, line 1 of the page.

Origin Mode (DECOM)

This control function allows cursor addressing relative to the top and bottom margins or the complete page. DECOM determines if the *cursor position* is restricted to inside the page margins. When you power up or reset the terminal, you reset origin mode.

Default: Origin is at the upper-left of the screen, independent of margins.

Format

CSI	**?**	**6**	**h**	Set: within margins.
9/11	3/15	3/6	6/8	
CSI	**?**	**6**	**l**	Reset: Upper-left corner.
9/11	3/15	3/3	6/12	

Description

When DECOM is set, the home cursor position is at the upper-left corner of the screen, within the margins. The starting point for line numbers depends on the current top margin setting. The cursor *cannot* move outside of the margins.

When DECOM is reset, the home cursor position at the upper-left corner of the screen. The starting point for line numbers is independent of the margins. The cursor *can* move outside of the margins.

Vertical Split Screen Mode (DECVSSM)

This control function defines whether or not the set left and right margins (DECSLRM) control function can set margins.

Available in: VT400 mode only
Default: DECSLRM cannot set margins.

Format

CSI	?	6	9	h	Set: DECSLRM can set margins.
9/11	3/15	3/6	3/9	6/8	
CSI	**?**	**6**	**9**	**l**	Reset: DECSLRM cannot set margins.
9/11	3/15	3/3	3/9	6/12	

Description

When DECVSSM is set, DECSLRM can set the left and right margins. All line attributes currently in page memory for the session are set to single width, single height. The terminal ignores any sequences to change the line attributes to double width or double height (DECDWL or DECDHL).

When DECVSSM is reset, DECSLRM cannot set the left and right margins. The margins are set to the page borders for every page. The terminal can process sequences to change the line attributes to double width or double height (DECDWL or DECDHL).

Moving to Another Page

The following control functions let you move the cursor forward or backward to another page in page memory. You can move in sequence or randomly. Applications can use these control functions to select the page to write to.

Next Page (NP)

This control function moves the cursor forward to the home position on one of the following pages in page memory. If there is only one page, the terminal ignores NP.

Default: Move to the next page.

Format

CSI	*Pn*	U
9/11	3/*n*	5/5

Parameters

Pn
indicates how many pages to move the cursor forward.

Default: *Pn* = 0.

If *Pn* is 0 or 1, then the cursor moves to the next page in page memory. If *Pn* tries to move the cursor past the last page in memory, then the cursor stops at the last page.

Preceding Page (PP)

This control function moves the cursor backward to the home position on one of the preceding pages in page memory. If there is only one page, the terminal ignores PP.

Default: Move to the preceding page.

Format

CSI	*Pn*	**V**
9/11	3/*n*	5/6

Parameters

Pn
indicates how many pages to move the cursor backward.

Default: *Pn* = 0.

If *Pn* is 0 or 1, the cursor moves to the preceding page. If *Pn* tries to move the cursor back farther than the first page in memory, the cursor stops at the first page.

Page Position Absolute (PPA)

This control function can move the cursor to the corresponding row and column on any page in page memory. You select the page by its number. If there is only one page, the terminal ignores PPA.

Default: Move to page 1.

Format

CSI	*Pn*	sp	P
9/11	3/*n*	2/0	5/0

Parameters

Pn
is the number of the page to move the cursor to. If *Pn* is greater than the number of the last page in memory, the cursor stops at the last page. If *Pn* is less than the number of the first page, the cursor stops at the first page.

Page Position Backward (PPB)

This control function moves the cursor backward to the corresponding row and column on one of the preceding pages in page memory. If there is only one page, the terminal ignores PPB.

Default: Move backward one page.

Format

CSI	*Pn*	sp	R
9/11	3/*n*	2/0	5/2

Parameters

Pn
indicates the number of pages to move the cursor backward. If *Pn* tries to move the cursor back farther than the first page in memory, the cursor stops at the first page.

Page Position Relative (PPR)

This control function moves the cursor forward to the corresponding row and column on one of the following pages in page memory. If there is only one page, the terminal ignores PPR.

Default: Move to the next page.

Format

CSI	*Pn*	**sp**	**Q**
9/11	3/*n*	2/0	5/1

Parameters

Pn
indicates how many pages to move the cursor forward. If *Pn* tries to move the cursor beyond the last page in memory, the cursor stops at the last page.

Summary

Tables 6–1 and 6–2 list the control functions described in this chapter.

Table 6–1 Page Format Sequences

<table>
<tr><th>Name</th><th>Mnemonic</th><th>Sequence</th></tr>
<tr><td>Set columns per page</td><td>DECSCPP</td><td>CSI Pn $ |
Pn columns (80 or 132).</td></tr>
<tr><td>Column mode</td><td>DECCOLM</td><td>Set: CSI ? 3 h
132 columns.

Reset: CSI ? 3 l
80 columns. (D)</td></tr>
<tr><td>Set lines per page</td><td>DECSLPP</td><td>CSI Pn t
Pn lines per page.
The number of pages depend on how many sessions you use.
<table>
<tr><th>Pn</th><th>Two Sessions</th><th>One Session</th></tr>
<tr><td>24</td><td>3 pages</td><td>6 pages</td></tr>
<tr><td>25</td><td>2</td><td>5</td></tr>
<tr><td>36</td><td>2</td><td>4</td></tr>
<tr><td>48</td><td>1</td><td>3</td></tr>
<tr><td>72</td><td>1</td><td>2</td></tr>
<tr><td>144</td><td>—</td><td>1</td></tr>
</table></td></tr>
<tr><td>Set left and right margins</td><td>DECSLRM</td><td>CSI Pl ; Pr s
Pl = column number of left margin.
Pr = column number of right margin.</td></tr>
<tr><td>Set top and bottom margins</td><td>DECSTBM</td><td>CSI Pt ; Pb r
Pt = line number of top margin.
Pb = line number of bottom margin.</td></tr>
</table>

(D) = default.

Table 6–1 (Cont.) Page Format Sequences

Name	Mnemonic	Sequence
Origin mode	DECOM	Set: **CSI ? 6 h** Move within margins. Reset: **CSI ? 6 l** Move outside margins. (D)
Vertical split screen mode	DECVSSM	Set: **CSI ? 6 9 h** Left and right margins can be changed. Reset: **CSI ? 6 9 l** Left and right margins cannot be changed. (D)

(D) = default.

Table 6–2 Sequences for Moving Through Page Memory

Name	Mnemonic	Sequence*	New Cursor Position
Next page	NP	**CSI** *Pn* **U**	Home.
Preceding page	PP	**CSI** *Pn* **V**	Home.
Page position absolute	PPA	**CSI** *Pn* **P**	Same as on the old page.
Page position backward	PPB	**CSI** *Pn* **R**	Same as on the old page.
Page position relative	PPR	**CSI** *Pn* **Q**	Same as on the old page.

**Pn* = the number of pages to move, except for PPA. For PPA, *Pn* = the actual page number.

7

Setting Visual Character and Line Attributes

This chapter describes how to select visual attributes for display characters. *Visual character attributes* change the way characters appear on the screen, without changing the actual characters. For example, the bold character attribute makes a character appear **bolder** on the screen. You can also select the visual attributes for a complete display line on the screen.

Setting Visual Character Attributes

This section describes how to select, change, and reverse visual character attributes. You can set the following attributes:

- Bold
- Underline
- Blinking
- Negative image (dark character on a light background)
- Invisible

Select Graphic Rendition (SGR)

This control function selects one or more character attributes at the same time.

Default: Clear all attributes.

Format

CSI	*Ps*	**;**	*Ps*	. . .	**m**
9/11	3/*n*	3/11	3/*n*	. . .	6/13

Parameters

Ps
is a number representing a certain visual attribute. You can use more than one *Ps* value to select different character attributes. Table 7–1 lists *Ps* values and the attributes they select.

Default: *Ps* = 0 (clears all attributes).

Table 7–1 Visual Character Attribute Values

Ps	Attribute
0	All attributes off
1	Bold
4	Underline
5	Blinking
7	Negative image
8	Invisible image
22	Bold off
24	Underline off
25	Blinking off
27	Negative image off
28	Invisible image off

Examples

When you select more than one attribute in an SGR sequence, they are pexecuted in order. For example, you can use the following sequence to display text that is bold, blinking, and underlined:

```
CSI 0 ; 1 ; 5 ; 4 m
```

The following sequence displays the negative image of text:

```
CSI 7 m
```

Notes on SGR

- After you select an attribute, the terminal applies that attribute to all new characters received. If you move characters by scrolling, the attributes move with the characters.
- If you display control characters, the terminal ignores the bold attribute for displayed control characters. See “Display Controls Mode” in Chapter 2.

Setting Line Attributes

Line attributes are display features that affect the way a line of characters appears on the screen. For example, the double-width, single-height line (DECDWL) attribute makes a line of characters appear twice as wide as a normal line of characters. This section describes how to select line attributes.

Single-Width, Single-Height Line (DECSWL)

This control function makes the line with the cursor a single-width, single-height line. This line attribute is the standard for all new lines on the screen.

Format

ESC	**#**	**5**
1/11	2/3	3/5

Double-Width, Single-Height Line (DECDWL)

This control function makes the line with the cursor a double-width, single-height line. If the line was single width and single height, all characters to the right of the screen's center are lost.

Format

ESC	**#**	**6**
1/11	2/3	3/6

Double-Width, Double-Height Line (DECDHL)

These two control functions make the line with the cursor the top or bottom half of a double-height, double-width line. You must use these sequences in pairs on adjacent lines. In other words, the same display characters must appear in the same positions on both lines to form double-height characters. If the line was single width and single height, all characters to the right of the screen center are lost.

Format

ESC	**#**	**3**	Top Half
1/11	2/3	3/3	
ESC	**#**	**4**	Bottom Half
1/11	2/3	3/4	

Example

The following sequences make the phrase "VT420 Video Terminal" a double-height, double-width line.

ESC#3 `VT420 Video Terminal`

ESC#4 `VT420 Video Terminal`

Summary

Table 7–2 lists the control functions described in this chapter.

Table 7–2 Visual Character and Line Attribute Sequences

Name	Mnemonic	Sequence
Select graphic rendition	SGR	**CSI** *Ps...Ps* **m** *Ps* = character attribute value(s). (Table 7–1)
Single-width, single-height line	DECSWL	**ESC # 5**
Double-width, single-height line	DECDWL	**ESC # 6**
Double-width, double-height line	DECDHL	**ESC # 3** (top half) **ESC # 4** (bottom half)

8

Editing

This chapter describes how to edit characters in page memory. You use editing control functions to insert, delete, and erase characters. The cursor does not move when you use these functions. You can

- Insert or delete columns, lines, or characters
- Erase all or part of the display, all or part of a line, or a selected number of characters
- Define characters as erasable or not, so you can selectively erase text

Inserting and Deleting Columns, Lines, and Characters

This section describes control functions that let you insert or delete data in the scrolling region. The scrolling region is the area of the screen inside the top and bottom margins (Chapter 11).

Insert/Replace Mode (IRM)

This control function selects how the terminal adds characters to page memory. The terminal always adds new characters at the cursor position.

Default: Replace.

Format

CSI	**4**	**h**	Set: insert mode.
9/11	3/4	6/8	
CSI	**4**	**l**	Reset: replace mode.
9/11	3/4	6/12	

Description

If IRM mode is set, new characters move characters in page memory to the right. Characters moved past the page's right border are lost.

If IRM mode is reset, new characters replace the character at the cursor position.

Delete Column (DECDC)

This control function deletes one or more columns in the scrolling region, starting with the column that has the cursor.

Available in: VT400 mode only

Format

CSI	*Pn*	**'**	**~**
9/11	3/?	2/7	7/14

Parameters

Pn
is the number of columns to delete.
Default: *Pn* = 1.

Description

As columns are deleted, the remaining columns between the cursor and the right margin move to the left. The terminal adds blank columns with no visual character attributes at the right margin. DECDC has no effect outside the scrolling margins.

Insert Column (DECIC)

This control function inserts one or more columns into the scrolling region, starting with the column that has the cursor.

Available in: VT400 mode only

Format

CSI	*Pn*	'	**}**
9/11	3/?	2/7	7/13

Parameters

Pn
is the number of columns to insert.
Default: *Pn* = 1.

Description

As columns are inserted, the columns between the cursor and the right margin move to the right. DECIC inserts blank columns with no visual character attributes. DECIC has no effect outside the scrolling margins.

Delete Line (DL)

This control function deletes one or more lines in the scrolling region, starting with the line that has the cursor.

Format

CSI	*Pn*	**M**
9/11	3/*n*	4/13

Parameters

Pn
is the number of lines to delete.
Default: *Pn* = 1.

Description

As lines are deleted, lines below the cursor and in the scrolling region move up. The terminal adds blank lines with no visual character attributes at the bottom of the scrolling region. If *Pn* is greater than the number of lines remaining on the page, DL deletes only the remaining lines. DL has no effect outside the scrolling margins.

Insert Line (IL)

This control function inserts one or more blank lines, starting at the cursor.

Format

CSI	*Pn*	**L**
9/11	3/*n*	4/12

Parameters

Pn
is the number of lines to insert.
Default: *Pn* = 1.

Description

As lines are inserted, lines below the cursor and in the scrolling region move down. Lines scrolled off the page are lost. IL has no effect outside the page margins.

Delete Character (DCH)

This control function deletes one or more characters, from the cursor position to the right.

Format

CSI	*Pn*	**P**
9/11	3/*n*	5/0

Parameters

Pn
is the number of characters to delete. If *Pn* is greater than the number of characters between the cursor and the right margin, DCH only deletes the remaining characters.
Default: *Pn* = 1.

Description

As characters are deleted, the remaining characters between the cursor and right margin move to the left. Character attributes move with the characters. The terminal adds blank spaces with no visual character attributes at the right margin. DCH has no effect outside the scrolling margins.

Insert Character (ICH)

This control function inserts one or more space (SP) characters, starting at the cursor position.

Available in: VT400 mode only

Format

CSI	*Pn*	@
9/11	3/*n*	4/0

Parameters

Pn
is the number of characters to insert.

Default: *Pn* = 1.

Description

The ICH sequence inserts *Pn* blank characters with the normal character attribute. The cursor remains at the beginning of the blank characters. Text between the cursor and right margin moves to the right. Characters scrolled past the right margin are lost. ICH has no effect outside the scrolling margins.

Erasing Text

This section describes control functions that let you erase data from the display. These control functions can affect data inside or outside the scrolling region. They are not restricted by margins.

Erase in Display (ED)

This control function erases characters from part or all of the display. When you erase complete lines, they become single-height, single-width lines, with all visual character attributes cleared. ED works inside or outside the scroling margins.

Format

CSI	*Ps*	**J**
9/11	3/*n*	4/10

Parameters

Ps
represents the amount of the display to erase, as follows:

Ps	Area Erased
0 (default)	From the cursor through the end of the display
1	From the beginning of the display through the cursor
2	The complete display

Programming Tip

Use a *Ps* value of 2 to erase the complete display in a fast, efficient manner.

Erase in Line (EL)

This control function erases characters on the line that has the cursor. EL clears all character attributes from erased character positions. EL works inside or outside the scrolling margins.

Format

CSI	*Ps*	**K**
9/11	3/*n*	4/11

Parameters

Ps
represents the section of the line to erase, as follows:

Ps	Section Erased
0 (default)	From the cursor through the end of the line
1	From the beginning of the line through the cursor
2	The complete line

Erase Character (ECH)

This control function erases one or more characters, from the cursor position to the right. ECH clears character attributes from erased character positions. ECH works inside or outside the scrolling margins.

Available in: VT400 mode only

Format

CSI	*Pn*	**X**
9/11	3/*n*	5/8

Parameters

Pn
is the number of characters to erase. A *Pn* value of 0 or 1 erases one character.

Default: *Pn* = 1.

Selectively Erasing Text

This section describes control functions that let you selectively erase data on the screen. You can only erase characters that you define as erasable.

Select Character Protection Attribute (DECSCA)

This control function defines the characters that come after it as erasable or not erasable from the screen. The selective erase control functions (DECSED and DECSEL) can only erase characters defined as erasable.

Available in: VT400 mode only

Format

CSI	*Ps*	**"**	**q**
9/11	3/*n*	2/2	7/1

Parameters

Ps
defines all characters that follow the DECSCA function as erasable or not erasable.

Ps	Meaning
0 (default)	DECSED and DECSEL can erase characters.
1	DECSED and DECSEL cannot erase characters.
2	Same as 0.

Notes on DECSCA

- DECSCA does *not* affect visual character attributes set by the select graphic rendition (SGR) function.

Selective Erase in Display (DECSED)

This control function erases some or all of the erasable characters in the display. DECSED can only erase characters defined as erasable by the DECSCA control function. DECSED works inside or outside the scrolling margins.

Available in: VT400 mode only

Format

CSI	**?**	*Ps*	**J**
9/11	3/15	3/*n*	4/10

Parameters

Ps
represents the area of the display to erase, as follows:

Ps	**Area Erased**
0 (default)	From the cursor through the end of the display
1	From the beginning of the display through the cursor
2	The complete display

Selective Erase in Line (DECSEL)

This control function erases some or all of the erasable characters in a single line of text. DECSEL erases only those characters defined as erasable by the DECSCA control function. DECSEL works inside or outside the scrolling margins.

Available in: VT400 mode only

Format

CSI	**?**	*Ps*	**K**
9/11	3/15	3/*n*	4/11

Parameters

Ps
represents the section of the line to erase, as follows:

Ps	**Section Erased**
0 (default)	From the cursor through the end of the line
1	From the beginning of the line through the cursor
2	The complete line

Summary

Table 8–1 lists the control functions described in this chapter.

Table 8–1 Editing Sequences

Name	Mnemonic	Sequence
Insert/replace mode	IRM	Set: **CSI 4 h** Insert characters. Reset: **CSI 4 l** Replace characters.
Delete column*	DECDC	**CSI** *Pn* **' ~** *Pn* columns.
Insert column*	DECIC	**CSI** *Pn* **' }** *Pn* columns.
Delete line	DL	**CSI** *Pn* **M** *Pn* lines.
Insert line	IL	**CSI** *Pn* **L** *Pn* lines.
Delete character	DCH	**CSI** *Pn* **P** *Pn* characters.
Insert character	ICH	**CSI** *Pn* **@** *Pn* characters.
Erase in display	ED	**CSI** *Ps* **J** *Ps* = 0, cursor to end. (D) *Ps* = 1, beginning to cursor. *Ps* = 2, complete display.
Erase in line	EL	**CSI** *Ps* **K** *Ps* = 0, cursor to end. (D) *Ps* = 1, beginning to cursor. *Ps* = 2, complete line.
Erase character*	ECH	**CSI** *Pn* **X** *Pn* characters.

*Available in VT400 mode only.

(D) = default.

Table 8–1 (Cont.) Editing Sequences

Name	Mnemonic	Sequence
Select character protection attribute*	DECSCA	**CSI** *Ps* **" q** *Ps* = 0, DECSED and DECSEL can erase. (D) *Ps* = 1, DECSED and DECSEL cannot erase. *Ps* = 2, DECSED and DECSEL can erase.
Selective erase in display*	DECSED	**CSI ?** *Ps* **J** *Ps* = 0, cursor to end. (D) *Ps* = 1, beginning to cursor. *Ps* = 2, complete display.
Selective erase in line*	DECSEL	**CSI ?** *Ps* **K** *Ps* = 0, cursor to end. (D) *Ps* = 1, beginning to cursor. *Ps* = 2, complete line.

*Available in VT400 mode only.

(D) = default.

9

Rectangular Area Operations

This chapter describes control functions you can use to manipulate rectangular areas of text in page memory. You can

- Copy, fill, or erase rectangular areas
- Selectively erase parts of a rectangular area
- Change or reverse visual character attributes in rectangular areas

Copying, Filling, and Erasing Rectangular Areas

This section describes the control functions for copying, filling, or erasing a rectangular area from page memory.

Copy Rectangular Area (DECCRA)

This control function copies a rectangular area of characters from one section to another in page memory. The copied text retains its character values and attributes.

Available in: VT400 mode only

Format

CSI	*Pts; Pls; Pbs; Prs; Pps;*	*Ptd; Pld; Ppd*	**$**	**v**
9/11	*area to be copied*	*destination*	2/4	7/6

Parameters

Pts; Pls; Pbs; Prs; Pps;
define the rectangular area to be copied (the source). A semicolon (3/11) separates parameters.

Pts is the top-line border. *Pts* must be less than or equal to *Pbs*.
Default: *Pts* = 1.

Pls is the left-column border. *Pls* must be less than or equal to *Prs*.
Default: *Pls* = 1.

Pbs is the bottom-line border.
Default: *Pbs* = the last line of the page.

Prs is the right-column border.
Default: *Prs* = the last column of the page.

Pps is the number of the page where the rectangular area is located.
Default: *Pps* = 1.

Ptd; Pld; Ppd;
define the destination of the copied rectangular area.

Ptd is the top-line border.
Default: *Ptd* = 1.

Pld is the left-column border.
Default: *Pld* = 1.

Ppd is the number of the page.
Default: *Ppd* = 1.

Notes on DECCRA

- If *Pbs* is greater than *Pts*, or *Pls* is greater than *Prs*, the terminal ignores DECCRA.
- The coordinates of the rectangular area are affected by the setting of origin mode (DECOM).
- DECCRA is not affected by the page margins.
- The copied text takes on the line attributes of the destination area.
- If the value of *Pt, Pl, Pb,* or *Pr* exceeds the width or height of the active page, the value is treated as the width or height of that page.
- If a page value exceeds the number of pages available in the current page arrangement, the value is treated as the last available page number.
- If the destination area is partially off the page, DECCRA clips the off-page data.
- DECCRA does not change the active cursor position.

Fill Rectangular Area (DECFRA)

This control function fills a rectangular area in page memory with a specified character. DECFRA replaces the rectangular area's character positions and attributes with the specified fill character. The fill character assumes the visual character attributes set by the last select graphic rendition (SGR) command. DECFRA does not change the current line attributes.

Available in: VT400 mode only

Format

CSI	*Pch*	**;**	*Pt; Pl; Pb; Pr*	**$**	**x**
9/11	3/*n*	3/11	3/*n*	2/4	7/8

Parameters

Pch
is the decimal value of the fill character. Pch can be any value from 32 to 126, or from 160 to 255. If Pch is not in this range, the terminal ignores the DECFRA command. The decimal value refers to the character in the current GL or GR in-use table (Chapter 5). See the character tables in Chapter 2 for the decimal values of characters.

Pt; Pl; Pb; Pr
define the rectangular area to be filled:

Pt is the top-line border. *Pt* must be less than or equal to Pbs.
Default: *Pt* = 1.

Pl is the left-column border. *Pl* must be less than or equal to Pr.
Default: *Pl* = 1.

Pb is the bottom-line border.
Default: *Pb* = the last line of the active page.

Pr is the right-column border.
Default: *Pr* = the last column of the active page.

Notes on DECFRA

- The coordinates of the rectangular area are affected by the setting of origin mode (DECOM).
- DECFRA is not affected by the page margins.
- If the value of *Pt, Pl, Pb,* or *Pr* exceeds the width or height of the active page, the value is treated as the width or height of that page.
- DECFRA does not change the active cursor position.

Erase Rectangular Area (DECERA)

This control function erases characters from the specified rectangular area in page memory. When an area is erased, DECERA replaces all character positions with the space character (2/0). DECERA erases character values and visual attributes from the specified area. DECERA does not erase line attributes.

Available in: VT400 mode only

Format

CSI	*Pt*	**;**	*Pl; Pb; Pr*	**$**	**z**
9/11	3/*n*	3/11	********	2/4	7/10

Parameters

Pt, Pl, Pb, and Pr
define the rectangular area to be erased:

Pt is the top-line border. *Pt* must be less than or equal to *Pb*.
Default: *Pt* = 1.

Pl is the left-column border. *Pl* must be less than or equal to *Pr*.
Default: *Pl* = 1.

Pb is the bottom-line border.
Default: *Pb* = the last line of the active page.

Pr is the right-column border.
Default: *Pr* = the last column of the active page.

Notes on DECERA

- The coordinates of the rectangular area are affected by the setting of origin mode (DECOM).
- DECERA is not affected by the page margins.
- If the value of *Pt, Pl, Pb,* or *Pr* exceeds the width or height of the active page, the value is treated as the width or height of that page.
- DECERA does not change the active cursor position.

Selective Erase Rectangular Area (DECSERA)

This control function erases all erasable characters from a specified rectangular area in page memory. The select character protection attribute (DECSCA) control function defines whether or not DECSERA can erase characters (Chapter 8).

When an area is erased, DECSERA replaces character positions with the space character (2/0). DECSERA does not change

- Visual attributes set by the select graphic rendition (SGR) function
- Protection attributes set by DECSCA
- Line attributes (Chapter 7)

Available in: VT400 mode only

Format

CSI	*Pt*	**;**	*Pl; Pb; Pr*	**$**	**{**
9/11	3/*n*	3/11	*********	2/4	7/11

Parameters

Pt, Pl, Pb, and Pr
define the rectangular area to be selectively erased:

Pt is the top-line border. *Pt* must be less than or equal to *Pb*.
Default: *Pt* = 1.

Pl is the left-column border. *Pl* must be less than or equal to *Pr*.
Default: *Pl* = 1.

Pb is the bottom-line border.
Default: *Pb* = the last line of the active page.

Pr is the right-column border.
Default: *Pr* = the last column of the active page.

Notes on DECSERA

- The coordinates of the rectangular area are affected by the setting of origin mode (DECOM).
- DECSERA is not affected by the page margins.
- If the value of *Pt, Pl, Pb,* or *Pr* exceeds the width or height of the active page, the value is treated as the width or height of that page.
- DECSERA does not change the active cursor position.

Changing Attributes of Rectangles

This section describes the control functions that let you change or reverse the visual character attributes in a rectangular area.

Select Attribute Change Extent (DECSACE)

This control function lets you select which character positions in a rectangle can have their attributes changed or reversed. DECSACE controls the effect of two other functions—change attributes in rectangular area (DECCARA) and reverse attributes in rectangular area (DECRARA).

Available in: VT400 mode only

Format

CSI	*Ps*	*	*x*
9/11	3/*n*	*2/10*	7/8

Parameters

Ps
selects the area of character positions affected.

Ps	Area Affected
0 (default)	DECCARA or DECRARA affect the stream of character positions that begins with the first position specified in the DECCARA or DECRARA command, and ends with the second character position specified.
1	Same as 0.
2	DECCARA and DECRARA affect all character positions in the rectangular area. The DECCARA or DECRARA command specifies the top-left and bottom-right corners.

Change Attributes in Rectangular Area (DECCARA)

This control function lets you change the visual character attributes (bold, blink, reverse video, and underline) of a specified rectangular area in page memory. The select attribute change extent (DECSACE) control function determines whether all or some of the character positions in the rectangle are affected. DECCARA does not change the values of characters, just the visual attributes of those characters.

Available in: VT400 mode only

Format

CSI	*Pt; Pl; Pb; Pr;*	*Ps1; . . . Psn*	**$**	**r**
9/11	*area to be changed*	*attributes to change*	2/4	7/2

Parameters

Pt; Pl; Pb; Pr;
define the rectangular area to be changed. A semicolon (3/11) separates parameters.

Pt is the top-line border. *Pt* must be less than or equal to *Pb*.
Default: *Pt* = 1.

Pl is the left-column border. *Pl* must be less than or equal to *Pr*.
Default: *Pl* = 1.

Pb is the bottom-line border.
Default: *Pb* = last line of the active page.

Pr is the right-column border.
Default: *Pr* = last column of the active page.

Ps1; . . . Psn

select the visual character attributes to change. These values correspond to the values used in the select graphic rendition (SGR) function (Chapter 7).

Psn	Meaning
0 (default)	Attributes off (no bold, no underline, no blink, positive image)
1	Bold
4	Underline
5	Blink
7	Negative image
22	No bold
24	No underline
25	No blink
27	Positive image

DECCARA ignores all other parameter values. When you use more than one parameter in a command, DECCARA executes them cumulatively in sequence.

Examples

The following sequence changes the video attributes of the complete screen to blink and underscore:

```
CSI ; ; ; ; 0; 4; 5; $ r
```

The following sequence turns off the blinking character attribute from position line 10, column 2 to position line 14, column 45 on the current page:

```
CSI 10; 2; 14; 45; 25 $ r
```

Notes on DECCARA

- The coordinates of the rectangular area are affected by the setting of origin mode (DECOM).
- DECCARA is not affected by the page margins.
- If the value of *Pt, Pl, Pb,* or *Pr* exceeds the width or height of the active page, the value is treated as the width or height of that page.
- DECCARA does not change the active cursor position.
- DECCARA does not change the current rendition set by the select graphic rendition (SGR) function (Chapter 7).
- The exact character positions affected by DECCARA depend on the current setting of the select attribute change extent (DECSACE) function.

Reverse Attributes in Rectangular Area (DECRARA)

This control function lets you reverse the visual character attributes (bold, blink, reverse video, and underline) of a specified rectangular area in page memory. The select attribute change extent (DECSACE) control function determines whether all or some of the character positions in the rectangle are affected.

Reversing a visual attribute means to change the attribute to its opposite setting, on or off. For example, DECRARA can change character positions that are bold and not underlined to positions that are underlined and not bold. DECRARA does not change the values of characters, just the visual attributes of those characters.

Available in: VT400 mode only

Format

CSI	*Pt; Pl; Pb; Pr;*	*Ps1; . . . Psn*	**$**	**t**
9/11	*area to be reversed*	*attributes to reverse*	2/4	7/4

Parameters

Pt, Pl, Pb, and Pr
define the rectangular area to be reversed.

Pt is the top-line border. *Pt* must be less than or equal to *Pb*.
Default: *Pt* = 1.

Pl is the left-column border. *Pl* must be less than or equal to Pr.
Default: *Pr* = 1.

Pb is the bottom-line border.
Default: *Pb* = last line of the active page.

Pr is the right-column border.
Default: *Pr* = last column of the active page.

Ps1; . . . Psn
select the visual character attributes to reverse. These values correspond to the values used in the select graphic rendition (SGR) function (Chapter 7).

Ps	Meaning
0	Reverse all attributes (default).
1	Reverse the bold attribute.
4	Reverse the underline attribute.
5	Reverse the blink attribute.
7	Reverse the negative-image attribute.

DECRARA ignores all other parameter values.

When you use more than one parameter in a command, DECRARA executes them cumulatively in sequence.

Examples

The following sequence reverses the blink and underscore attributes of the complete screen:

```
CSI ; ; ; ; 0; 4; 5; $ t
```

The following sequence reverses all attributes except the blink attribute, from position line 10, column 2 to position line 14, column 45 on the current page:

```
CSI 10; 2; 14; 45; 1; 4; 7 $ t
```

Notes on DECRARA

- The coordinates of the rectangular area are affected by the setting of origin mode (DECOM).
- DECRARA is not affected by the page margins.
- If the value of *Pt, Pl, Pb,* or *Pr* exceeds the width or height of the active page, the value is treated as the width or height of that page.
- DECRARA does not change the active cursor position.
- DECRARA does not change the current rendition set by the select graphic rendition (SGR) function (Chapter 7).
- The exact character positions affected by DECRARA depend on the current setting of the select attribute change extent (DECSACE) function.

Summary

Table 9–1 is a summary of the control functions in this chapter.

Table 9–1 Rectangular Area Control Functions

Name	Mnemonic	Sequence*		
Copy rectangular area	DECCRA	**CSI** *Pts; Pls; Pbs; Prs; Pps; Ptd; Pld; Ppd* **$ v**		
		Source		
		Pts	=	top-line border.
		Pls	=	left-column border.
		Pbs	=	bottom-line border.
		Prs	=	right-column border.
		Pps	=	page number.
		Destination		
		Ptd	=	top-line border.
		Pld	=	left-column border.
		Ppd	=	page number.
Erase rectangular area	DECERA	**CSI** *Pt; Pl; Pb; Pr* **$ z**		
		Pt	=	top-line border.
		Pl	=	left-column border.
		Pb	=	bottom-line border.
		Pr	=	right-column border.
Fill rectangular area	DECFRA	**CSI** *Pch; Pt; Pl; Pb; Pr* **$ x**		
		Pch	=	decimal code of fill character.
		Pt	=	top-line border.
		Pl	=	left-column border.
		Pb	=	bottom-line border.
		Pr	=	right-column border.
Selective erase rectangular area	DECSERA	**CSI** *Pt; Pl; Pb; Pr* **$ {**		
		Pt	=	top-line border.
		Pl	=	left-column border.
		Pb	=	bottom-line border.
		Pr	=	right-column border.

*All sequences in this chapter work in VT400 mode only.

Table 9–1 (Cont.) Rectangular Area Control Functions

Name	Mnemonic	Sequence*		
Select attribute change extent	DECSACE	**CSI** *Ps* * **x**		
		Ps	=	character positions affected.
		0 or 1	=	stream of character positions.
		2	=	rectangular area of character positions.
Change attributes in rectangular area	DECCARA	**CSI** *Pt; Pl; Pb; Pr; Ps1..Psn* **$ r**		
		Pt	=	top-line border.
		Pl	=	left-column border.
		Pb	=	bottom-line border.
		Pr	=	right-column border.
		Psn	=	visual character attributes.
Reverse attributes in rectangular area	DECRARA	**CSI** *Pt; Pl; Pb; Pr; Ps1..Psn* **$ t**		
		Pt	=	top-line border.
		Pl	=	left-column border.
		Pb	=	bottom-line border.
		Pr	=	right-column border.
		Psn	=	visual character attributes.

*All sequences in this chapter work in VT400 mode only.

10

Cursor Movement and Panning

This chapter describes the control functions you use to move the cursor and view different areas in the terminal's page memory. You can

- Move the cursor on a page
- Pan the user window across a page or to another page

Chapter 6 describes page memory.

Scrolling and Panning

Before you read this chapter, you should understand the difference between *scrolling* and *panning*.

Scrolling is the movement of data between the margins of a page. Data scrolled beyond the margins is lost from the terminal's page memory.

Panning is the movement of the user window in page memory, to view different parts of a page. The *user window* is the area in page memory currently visible on the screen. You do not lose data in page memory, because the window moves rather than the data. You only use panning functions when the page you are viewing is larger than the user window.

For example, suppose the current page is 72 lines by 80 columns and the screen is 24 lines. Initially, only the first 24 lines are visible. To view other parts of the page, you can pan the user window up or down.

Figure 10–1 shows the difference between scrolling and panning.

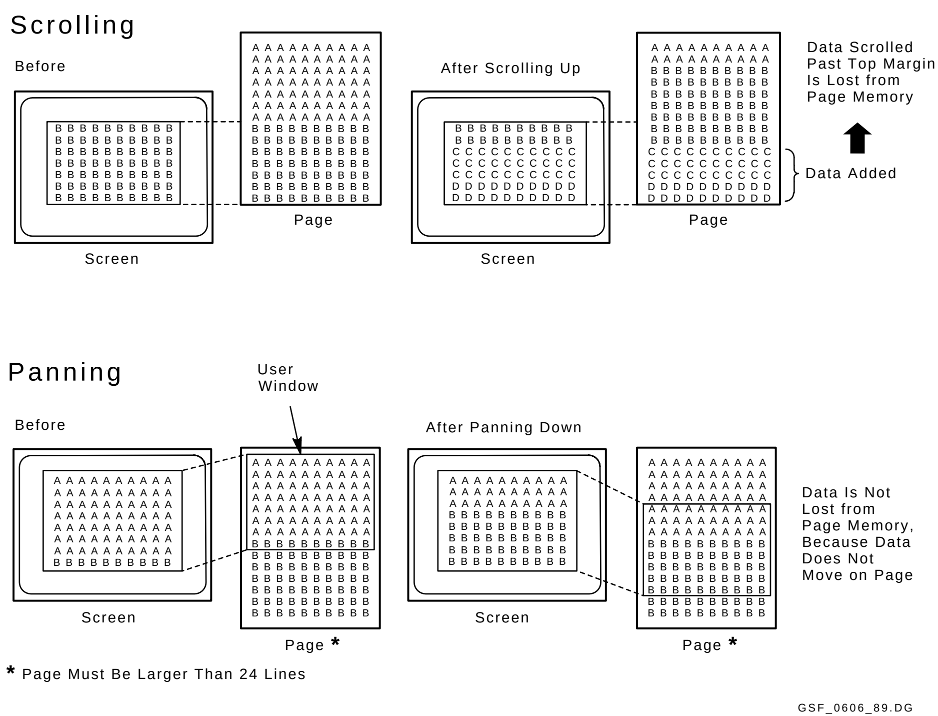

Figure 10–1 The Difference Between Scrolling and Panning

The default user window for the VT420 is 24 lines by 80 columns. You can also divide the screen into two user windows, to view data from two sessions at the same time. *Installing and Using the VT420 Video Terminal* describes how to use windows. Also see Chapter 14 of this manual for more details on using two sessions.

The Cursor

The cursor is a marker that indicates the *active position* in page memory. The active position is the point on the current page where the next character is written.

The default text cursor style is a blinking block. The cursor can also be a steady block, a blinking underscore, or a steady underscore. The user can select one of these cursor styles in the Display Set-Up screen. See *Installing and Using the VT420 Video Terminal* for details.

Usually, the cursor appears on the screen. However, you can use control functions to move the cursor anywhere on the current page, or to any other page in page memory.

Text Cursor Enable Mode (DECTCEM)

This control function makes the cursor visible or invisible.

Default: Visible

Format

CSI	**?**	**2**	**5**	**h**	Set: makes the cursor visible.
9/11	3/15	3/2	3/5	6/8	
CSI	**?**	**2**	**5**	**l**	Reset: makes the cursor invisible.
9/11	3/15	3/2	3/5	6/12	

Moving the Cursor on the Current Page

This section describes the control functions you can use to move the cursor on the current page. Remember, *page* and *display* are two different concepts. The area of the main display is restricted to the screen – 24, 36, or 48 lines by 80 or 132 columns, depending on the number of lines/screen you select (Chapter 11). The area of the current page can be 24, 25, 36, 48, 72, or 144 lines by 80 or 132 columns, depending on the page format you select (Chapter 6).

NOTE
Some C0 and C1 control characters not covered in this chapter also move the cursor. See Chapter 2 for detailed descriptions of these control characters.

In the following sequences, the parameters *Pn, Pl,* and *Pc* indicate cursor position. If you omit a parameter or use a value of 0, the terminal uses a default value of 1.

Back Index (DECBI)

This control function moves the cursor backward one column. If the cursor is at the left margin, all screen data within the margins moves one column to the right. The column shifted past the right margin is lost.

Available in: VT400 mode only

Format

ESC	**6**
1/11	3/6

Description

DECBI adds a new column at the left margin, with no visual attributes. DECBI is not affected by the margins. If the cursor is at the left border of the page when the terminal receives DECBI, the terminal ignores DECBI.

Forward Index (DECFI)

This control function moves the cursor forward one column. If the cursor is at the right margin, all screen data within the margins moves one column to the left. The column shifted past the left margin is lost.

Available in: VT400 mode only

Format

ESC	**9**
1/11	3/6

Description

DECFI adds a new column at the right margin, with no visual attributes. DECFI is not affected by the margins. If the cursor is at the right border of the page when the terminal receives DECFI, the terminal ignores DECFI.

Cursor Position (CUP)

This control function moves the cursor to the specified line and column. The starting point for lines and columns depends on the setting of origin mode (DECOM). CUP applies only to the current page.

Format

CSI	*Pl*	**;**	*Pc*	**H**
9/11	3/*n*	3/11	3/*n*	4/8

Parameters

Pl
is the number of the line to move to. If *Pl* is 0 or 1, the cursor moves to line 1.

Pc
is the number of the column to move to. If *Pc* is 0 or 1, the cursor moves to column 1.

Horizontal and Vertical Position (HVP)

This control function works the same as the cursor position (CUP) function. New applications should use CUP instead of HVP. HVP is provided for compatibility with earlier Digital products.

Format

CSI	*Pl*	**;**	*Pc*	**f**
9/11	3/*n*	3/11	3/*n*	6/6

Cursor Forward (CUF)

This control function moves the cursor to the right by a specified number of columns. The cursor stops at the right border of the page.

Format

CSI	*Pn*	**C**
9/11	3/*n*	4/3

Parameters

Pn
is the number of columns to move the cursor to the right.

Cursor Backward (CUB)

This control function moves the cursor to the left by a specified number of columns. The cursor stops at the left border of the page.

Format

CSI	*Pn*	**D**
9/11	3/*n*	4/4

Parameters

Pn
is the number of columns to move the cursor to the left.

Cursor Up (CUU)

Moves the cursor up a specified number of lines, in the same column. The cursor stops at the top margin. If the cursor is already above the top margin, the cursor stops at the top line.

Format

CSI	*Pn*	**A**
9/11	3/*n*	4/1

Parameters

Pn
is the number of lines to move the cursor up.

Cursor Down (CUD)

This control function moves the cursor down a specified number of lines, in the same column. The cursor stops at the bottom margin. If the cursor is already below the bottom margin, the cursor stops at the bottom line.

Format

CSI	*Pn*	**B**
9/11	3/*n*	4/2

Parameters

Pn
is the number of lines to move the cursor down.

Panning

You can display any part of the current page by moving the user window across the page. The following control functions let you pan the user window up or down. To a user viewing the screen, data appears to scroll in the opposite direction. For example, if you pan up, the data appears to scroll down.

In the following sequences, *Pn* indicates the cursor position. If you omit *Pn* or use a value of 0, the terminal uses a default value of 1. The term *current page* refers to the page with the cursor.

NOTE
The ANSI mnemonics in parentheses are provided only for reference. These mnemonics do not indicate how the VT420 uses the panning functions. For example, the ANSI mnemonic for pan down is SU (scroll up).

Pan Down (SU)

This control function moves the user window down a specified number of lines in page memory.

Format

CSI	*Pn*	**S**
9/11	3/*n*	5/3

Parameters

Pn
is the number of lines to move the user window down in page memory. *Pn* new lines appear at the bottom of the display. *Pn* old lines disappear at the top of the display. You cannot pan past the bottom margin of the current page.

Pan Up (SD)

This control function moves the user window up a specified number of lines in page memory.

Format

CSI	*Pn*	**T**
9/11	3/*n*	5/4

Parameters

Pn
is the number of lines to move the user window up in page memory. *Pn* new lines appear at the top of the display. *Pn* old lines disappear at the bottom of the display. You cannot pan past the top margin of the current page.

Cursor Coupling

This section describes control functions that make the user window pan with the cursor when the cursor moves past the window's boundaries. These functions are called cursor-coupling modes.

A *coupled* cursor is a cursor that appears to pull the user window through the page. When an application tries to write data beyond the borders of the user window, the window pans in that direction to keep the cursor visible in the display. The cursor looks like it is connected, or coupled, to the display.

You can have applications set the coupling modes to cause automatic panning. You can also reset the coupling modes to write data into off-screen page memory.

Vertical Cursor-Coupling Mode (DECVCCM)

This control function determines whether the user window pans with the cursor when the cursor moves past the top or bottom border of the user window. DECVCCM is only useful when the height of the current user window is smaller than the page. The cursor must stay on the current page.

Default: Coupled

Format

CSI	**?**	**6**	**1**	**h**	Set: couples the cursor to the display.
9/11	3/15	3/6	3/1	6/8	
CSI	**?**	**6**	**1**	**l**	Reset: uncouples the cursor.
9/11	3/15	3/6	3/1	6/12	

Description

When DECVCCM is set, the cursor is coupled to the display for vertical movement. When the cursor moves past the top or bottom border of the user window, the window pans to keep the cursor in view.

If the cursor moves past the top of the display, the user window pans up. New lines appear at the top of the screen, while lines at the bottom move out of view.

When DECVCCM is reset, the cursor is uncoupled from the display. If the cursor moves past the top or bottom border of the user window, the cursor disappears.

Page Cursor-Coupling Mode (DECPCCM)

This control function determines if a new page appears in the display when the cursor moves to a new page. DECPCCM is only useful with a multiple-page format (Chapter 6).

Default: Coupled

Format

CSI	**?**	**6**	**4**	**h**	Set: couples the cursor to the display.
9/11	3/15	3/6	3/4	6/8	
CSI	**?**	**6**	**1**	**l**	Reset: uncouples the cursor.
9/11	3/15	3/6	3/1	6/12	

Description

When DECPCCM is set, the cursor is coupled to the display when the cursor moves to a new page. The new page appears in the display to keep the cursor in view.

When DECPCCM is reset, the cursor is uncoupled from the display. If the cursor moves to a new page, the cursor disappears.

Summary

Table 10–1 lists the control functions described in this chapter.

Table 10–1 Cursor Movement and Panning Sequences

Name	Mnemonic	Sequence
Enabling the Cursor		
Text cursor enable mode	DECTCEM	Set: **CSI ? 25 h** Visible cursor. (D) Reset: **CSI ? 25 l** Invisible cursor.
Moving the Cursor*		
Back index†	DECBI	**ESC 6**
Forward index†	DECFI	**ESC 9**
Cursor position	CUP	**CSI** *Pl* **;** *Pc* **H** Line *Pl*, column *Pc*.
Horizontal and vertical position	HVP	**CSI** *Pl* **;** *Pc* **f** Line *Pl*, column *Pc*. (Digital recommends using CUP instead.)
Cursor forward	CUF	**CSI** *Pn* **C** *Pn* columns to the right.
Cursor backward	CUB	**CSI** *Pn* **D** *Pn* columns to the left.
Cursor up	CUU	**CSI** *Pn* **A** *Pn* lines up.
Cursor down	CUD	**CSI** *Pn* **B** *Pn* lines down.
Panning*		
Pan down	SU	**CSI** *Pn* **S** *Pn* lines down.
Pan up	SD	**CSI** *Pn* **T** *Pn* lines up.

*In these sequences, the default value for *Pn, Pl,* and *Pc* is 1.

†Available in VT400 mode only.

(D) = default.

Table 10–1 (Cont.) Cursor Movement and Panning Sequences

Name	Mnemonic	Sequence
Panning*		
Vertical cursor-coupling mode	DECVCCM	Set: **CSI ? 61 h** Coupled. (D)
		Reset: **CSI ? 61 l** Uncoupled.
Page cursor-coupling mode	DECPCCM	Set: **CSI ? 64 h** Coupled. (D)
		Reset: **CSI ? 64 l** Uncoupled.

*In these sequences, the default value for *Pn, Pl,* and *Pc* is 1.

(D) = default.

11

Keyboard, Printing, And Display Commands

This chapter describes the control functions for the following areas:

- Keyboard keys, including user-defined keys
- Printing, including printer port controls
- Screen displays, including the status line and scrolling

In general, the control functions apply to all VT420 keyboards—ANSI, short ANSI, and PC keyboards.

Keyboard Control Functions

This section describes control functions that affect keyboard operation.

- Keyboard action mode (locking or unlocking the keyboard)
- Backarrow key mode
- Line feed/new line mode
- Autorepeat mode
- Autowrap mode
- Cursor keys mode
- Numeric keypad controls
- Typewriter or data processing keys
- User-defined keys

Keyboard Action Mode (KAM)

This control function locks or unlocks the keyboard.

Default: Unlocked

Format

CSI	**2**	**h**	Set: locks the keyboard.
9/11	3/2	6/8	
CSI	**2**	**l**	Reset: unlocks the keyboard.
9/11	3/2	6/12	

Description

If KAM is set, the keyboard cannot send characters to the host. The `Wait` indicator appears on the keyboard indicator line at the bottom of the screen. The terminal ignores all keystrokes that send characters to the host. KAM does not affect the F3 (Set-Up) or F4 (Session) keys.

If KAM is reset, the terminal unlocks the keyboard. The keyboard can send characters to the host.

Backarrow Key Mode (DECBKM)

This control function determines whether the <X] key works as a backspace key or delete key.

NOTE
For compatibility with Digital's software, you should keep DECBKM reset (delete key setting).

Default: Delete key

Format

CSI	**?**	**6**	**7**	**h**	Set: backspace key.
9/11	3/15	3/6	3/7	6/8	

CSI	**?**	**6**	**7**	**l**	Reset: delete key.
9/11	3/15	3/6	3/7	6/12	

Description

If DECBKM is set, ⌫ works as a backspace key. When you press ⌫, the terminal sends a BS character to the host.

If DECKBKM is reset, ⌫ works as a delete key. When you press ⌫, the terminal sends a DEL character to the host.

Line Feed/New Line Mode (LNM)

This control function selects the characters sent to the host when you press the Return key. LNM also controls how the terminal interprets line feed (LF), form feed (FF), and vertical tab (VT) characters.

NOTE
For compatibility with Digital's software, you should keep LNM reset (line feed).

Default: Line feed

Format

CSI	**2**	**0**	**h**	Set: new line.
9/11	3/2	3/0	6/8	

CSI	**2**	**0**	**l**	Reset: line feed
9/11	3/2	3/0	6/12	

Description

If LNM is set, the cursor moves to the first column on the next line when the terminal receives an LF, FF, or VT character. When you press Return, the terminal sends both a carriage return (CR) and line feed (LF).

If LNM is reset, the cursor moves to the current column on the next line when the terminal receives an LF, FF, or VT character. When you press Return, the terminal sends only a carriage return (CR) character.

Notes on LNM

- When the auxiliary keypad is in keypad numeric mode (DECKPNM), the Enter key sends the same character(s) as the Return key.

Autorepeat Mode (DECARM)

This control function determines whether or not keys automatically repeat their character when held down. If DECARM is set, most keys you press for more than 0.5 seconds send a character repeatedly until you release the key.

Default: Repeat

Format

CSI	**?**	**8**	**h**	Set: keys autorepeat when pressed
9/11	3/15	3/8	6/8	for more than 0.5 seconds.
CSI	**?**	**8**	**l**	Reset: keys do not autorepeat.
9/11	3/15	3/8	6/12	

Notes on DECARM

- The following keys on the ANSI and short ANSI keyboards do not repeat:

F1 (Hold)	F5 (Break)	Return
F2 (Print)	Compose Character	Lock key
F3 (Set-Up)	Shift	Ctrl
F4 (Session)	Alt Function	Extend

- The following keys on the PC keyboard do not repeat:

Alt	AltGr
Caps Lock	Pause
Ctrl	Print Screen
Enter	Scroll Lock
Num Lock	Shift

Autowrap Mode (DECAWM)

This control function determines whether or not received characters automatically wrap to the next line when the cursor reaches the right border of a page in page memory.

Default: No autowrap

Format

CSI	**?**	**7**	**h**	Set: autowrap.
9/11	3/15	3/7	6/8	
CSI	**?**	**7**	**l**	Reset: no autowrap.
9/11	3/15	3/7	6/12	

Description

If the DECAWM function is set, graphic characters received when the cursor is at the right border of the page appear at the beginning of the next line. Any text on the page scrolls up if the cursor is at the end of the scrolling region.

If the DECAWM function is reset, graphic characters received when the cursor is at the right border of the page replace characters already on the page.

Cursor Keys Mode (DECCKM)

This control function selects the sequences the arrow keys send. You can use the four arrow keys to move the cursor through the current page or to send special application commands. See Chapter 3 for the sequences the keys send.

Default: Cursor

Format

CSI	**?**	**1**	**h**	Set: application sequences.
9/11	3/15	3/1	6/8	
CSI	**?**	**1**	**l**	Reset: cursor sequences.
9/11	3/15	3/1	6/12	

Description

If the DECCKM function is set, the arrow keys send application sequences to the host.

If the DECCKM function is reset, the arrow keys send ANSI cursor sequences to the host.

Numeric Keypad

The following control functions are for the numeric keypad. The keypad application and numeric modes (DECKPAM and DECKPNM) work the same as numeric keypad mode (DECNKM). See Chapter 3 for the sequences the keys send.

Keypad Application and Numeric Modes (DECKPAM and DECKPNM)

These control functions select whether the numeric keypad sends numeric characters or application sequences to the host.

Default: Numeric characters

Format

ESC 1/11	**=** 3/13	DECKPAM: application sequences.
ESC 1/11	**>** 3/14	DECKPNM: keypad characters

Description

If DECKPAM is selected, the numeric keypad sends application sequences.

If DECKPNM is selected, the numeric keypad sends the characters shown on each key—number, comma, period, or minus sign. Keys PF1 to PF4 send application sequences.

Notes on DECKPAM and DECKPNM

- When you turn on or reset the terminal, the terminal automatically selects numeric keypad mode.

Numeric Keypad Mode (DECNKM)

This control function works like the DECKPAM and DECKPNM functions above. DECNKM is provided mainly for use with the request and report mode (DECRQM/DECRPM) control functions (Chapter 12).

Available in: VT400 mode only

Default: Numeric

Format

CSI 9/11	**?** 3/15	**6** 3/6	**6** 3/6	**h** 6/8	Set: application sequences.
CSI 9/11	**?** 3/15	**6** 3/6	**6** 3/6	**l** 6/12	Reset: keypad characters.

Typewriter or Data Processing Keys

You can select whether the main keyboard keys act as data processing keys or typewriter keys, by using the keyboard usage mode (DECKBUM) function. See Chapter 3 for a description of data processing keys.

Default: Typewriter keys

Keyboard Usage Mode (DECKBUM)

CSI	**?**	**6**	**8**	**h**	Set: data processing keys.
9/11	3/15	3/6	3/8	6/8	
CSI	**?**	**6**	**8**	**l**	Reset: typewriter keys.
9/11	3/15	3/6	3/8	6/12	

Description

If DECKBUM is set, data processing keys send the characters on the right half of their keycaps.

If DECKBUM is reset, data processing keys send the characters on the left half of their keycaps.

Notes on DECKBUM

- DECKBUM changes the characters that the main keyboard keys send. Make sure you are aware of this change if you use DECKBUM in an application.
- If you use the North American dialect, DECKBUM should always be reset (typewriter). For all other languages, you can use either mode.

Key Position Mode (DECKPM)

This control function selects whether the keyboard sends character codes or key position reports to the host. DECKPM lets new applications take full control of the keyboard including single shifts, locking shifts, and compose character processing.

Default: Send character codes

Format

CSI	**8**	**1**	**h**	Set: Send key position reports.
9/11	3/8	3/1	6/8	
CSI	**8**	**1**	**l**	Reset: Send character codes.
9/11	3/8	3/1	6/12	

Description

If the DECKPM function is set, all keyboard keys send extended reports that include the key position and the state of modifier keys when pressed. A *modifier key* is pressed in combination with another key to modify the code sent by that key. The Ctrl key is a modifier key.

If the DECKPM function is reset, the keyboard keys send character codes.

NOTE
DECKPM only affects keyboard input. It does not affect how the terminal interprets data from the host.

Enable Local Functions (DECELF)

This control function lets you enable or disable the keys used to perform several local terminal functions: cutting and pasting tex between sessions, panning, and resizing windows. DECELF is useful for

- Simplifying the keyboard for novice users
- Letting the corresponding keys send position codes to the host when key position mode (DECKPM) is set
- Disabling features that are not compatible with the application

Format

CSI	*Pf1*	**;**	*Pc1*	**;**	. . .	*Pfn; Pcn*	**+**	**q**
9/11	3/*n*	3/11	3/*n*	3/11	. . .	3/*n* 3/*n*	2/11	7/1

Parameters

Pfn

is a number that specifies the local function affected.

Pfn	Local Functions Affected	Default Setting
0 (default)	All local functions listed for 1, 2, and 3.	
1	Copy and paste keys, including F1 (Hold), Select, Remove, and Insert Here.	The keys are enabled.
2	Panning keys, including Ctrl with ↑, ↓, ←, or →.	The keys are enabled.
3	Window resizing keys, including: Control and Shift with ↑ or ↓ keys.	The keys are enabled.

Pcn

controls the action of the local function specified by the correspondng *Pfn* value.

Pcn	Meaning
0	Selects the default setting of the local function. In VT mode, the default setting is enabled. In PC TERM mode, the default setting is disabled.
1	Enables the local function. The associated keys perform the local function and cannot send position codes to the host.
2	Disables the local function. The associated keys do not perform the local function and may send position codes to the host.

Description

DECELF can accept any number of parameter pairs. The terminal executes the parameters in the order it receives them.

Local Function Key Control (DECLFKC)

This control function lets you select the action performed by some of local-function keys on the top row of the keyboard:

ANSI Keyboards		PC Keyboards	
Key	**Action**	**Key**	**Action**
F1	Hold	Scroll Lock	Hold
F2	Print	Print Screen	Print
F3	Set-Up	Alt SetUp	Set-Up
F4	Session	Alt Scroll Lock	Session

You can have the key perform its local function, send a function key sequence to the host, or do nothing.

This control function is useful for

- Simplifying the keyboard for novice users
- Disabling features that are not compatible with the application, such as local printing

Format

CSI	**Pk1**	**;**	*Pf1*	. . .	*Pkn; Pfn*	*****	**}**
9/11	3/*n*	3/11	3/*n*	. . .	3/*n* 3/*n*	2/10	7/13

Parameters

Pkn
is a number from 0 to 4 that corresponds to the local-function key affected (F1 to F4). A *Pkn* value of 0 means that all four keys (F1 through F4) are affected.

Pfn
controls the action of the local-function key specified by the corresponding *Pkn* value.

Pfn	**Meaning**	
0	Selects the default function of the key.	
	VT mode	Local print
	PC TERM mode	Scan code
1	The key performs its local function either shifted, unshifted, or with the Ctrl key.	
	VT mode	Print
	PC TERM mode	Local print
2	The unshifted key sends its function key sequence to the host. The key sends nothing when pressed with Shift or Ctrl.	
	VT mode	Function key
	PC TERM mode	Scan code
3	The key is disabled.	
	VT mode	Disabled
	PC TERM mode	Does not exist

Description

DECLFKC can accept any number of parameter pairs. The terminal executes the parameters in the order it receives them.

NOTE
Applications cannot disable the F5 (Break) key. This restriction is required for secure systems, to ensure that the operator has control of the communication line.

Select Modifier Key Reporting (DECSMKR)

This control function lets you program the modifier keys to send extended keyboard reports when pressed or released. Modifier keys are keys such as Shift or Ctrl whose current state (pressed or released) affects the interpretation of other keys. DECSMKR only works when key position mode (DECKPM) is set.

Applications can use DECSMKR to gain more control over the keyboard, by monitoring the action of each modifier key.

Format

CSI	Pm1	;	Pf1	...	Pmn; Pfn	+	r
9/11	3/*n*	3/11	3/*n*	...	********	2/11	7/2

Parameters

Pmn

is the key number that corresponds to the modifier key affected. A *Pmn* value of 0 selects all modifier keys.

Pmn	**Key**	**Default Function**
1	left Shift	Local shift.
2	right Shift	Local shift.
3	Lock	Local lock.
4	Ctrl	Local control.
5	left Alt Function	Report up or down transitions.
6	right Alt Function	Report up or down transitions.
7	left Compose Character	Local compose.
8	right Compose Character	Local compose.

Pfn

controls the action of the modifier key specified by the corresponding *Pmn* value.

Pfn	**Meaning**
0	Selects the default function of the key.
1	The key performs its default modifier function.
2	The key sends an extended keyboard report when pressed or released. The key does not modify other keystrokes or perform its default function.
3	The key is disabled.

Description

DECSMKR can accept any number of parameter pairs. The terminal executes the parameters in the order it receives them.

NOTE

Applications cannot change the function of the F5 (Break) key. This restriction is required for secure systems to ensure that the operator has control of the communication line.

Extended Keyboard Report (DECEKBD)

This control function is a report that provides applications with more complete keystroke information. Each report consists of an ISO key position code and the current state of the eight modifier keys—pressed or released.

Format

APC	**:**	*ppp*	*mm*	**ST**
9/15	3/10	***	**	9/12

Parameters

ppp
is a three-character ISO key position name, for example C01. For keys that occupy more than one position in the ISO key position map, the VT420 uses the largest lower-left position. The position for the space bar is A02; Return is C13.

mm
are two ASCII hexadecimal digits that represent the state of the modifier keys.

The terminal represents the state of each modifier key as a bit in an 8-bit binary number. A bit value of 1 means the key is pressed, and a bit value of 0 means the key is not pressed. *mm* is the hexadecimal equivalent of the resulting 8-bit binary number.

The following table shows the order in which keys are represented in the binary number, and their corresponding hexadecimal values when pressed. The least significant bit represents the left Shift key. The most significant bit represents the right Compose Character key.

For example, 00000010_2 means that the right Shift key is pressed. The hexadecimal value for 00000010_2 is 02_{16}.

mm	**Key**	
01	left Shift	Least significant bit
02	right Shift	
04	Lock	
08	Ctrl	
10	left Alt Function	
20	right Alt Function	
40	left Compose Character	
80	right Compose Character	Most significant bit

Description

The terminal only sends extended key position reports when key position mode (DECKPM) is set.

The terminal uses the following rules when sending extended key reports:

- A single report may contain more than one keystroke. In this case, each keystroke is separated by a slash (/, 2/15) character. The terminal sends the control string envelope (APC ... ST) when a modifier key changes, or to separate keystroke data from other terminal reports.
- The terminal only sends the modifier key state when it changes in the first keystroke after an APC character.
- The terminal sends repeated key position reports as a single repeat character, period (.).

Examples

The following sequence reports an a key with no modifier keys, four → keys, one ← key, and a b key:

```
APC : C01 00 / B18.../ B16 / B05 ST
```

The following sequence reports a left Shift key and an A key:

```
APC : B99 01 / C01 ST
```

User-Defined Keys (DECUDK)

The following keyboards have the following user-defined keys (UDKs):

ANSI Keyboard

F1 to F20
Shift F1 to Shift F20

Short ANSI Keyboard

F1 to F10
Extend F1 to Extend F10
Shift F1 to Shift F10
Shift Extend F1 to Shift Extend F10

PC Keyboard

F1 to **F12**
Shift **F1** to **Shift** **F12**
Alt **F1** to **Alt** **F12**
Alt **Shift** **F1** **Alt** **Shift** **F12**

The following five keys on the ANSI keyboards—F1 (Hold), F2 (Print), F3 (Set-Up), F4 (Session), and F5 (Break)—have dedicated local functions. You can change the function of keys F1 to F4 on the ANSI keyboards by using the local function key control (DECLFKC) function. Applications cannot disable the F5 (Break) key.

Using UDKs

User-defined keys (UDKs) are only available in VT400 mode and PC TERM mode. UDKs do not work in VT100 and VT52 modes.

You define the function of keys by using a DECUDK device control string, as described in the "Programming UDKs" section that follows. After you define a key, you can use the new function by pressing

Shift *key*

where *key* is the key you defined. This chapter describes how to program the keys by using a DECUDK device control string.

UDK Memory Space

There are 768 bytes of memory available for the 48 user-defined keys. Space is supplied on a first-come/first-serve basis. When the 768 bytes are full, you cannot define any more keys until you clear some of the memory space. There are three ways you can clear space.

- Redefine one or more UDKs, with a DECUDK control string.
- Clear one or more UDKs, with a DECUDK control string.
- Clear all UDKs, with a terminal power-up or reset (RIS) operation.

Programming UDKs

You use the following device control string format to download definitions for user-defined keys. See Chapter 2 for general information about device control strings.

Available in: VT400 mode and PC TERM mode only.

Format

DCS	*Pc ; Pl ; Pm*	**|**	*Ky1/St1;...Kyn/Stn*	**ST**
Device Control String Introducer	Clear, Lock, and Modifier Parameters	Final Character	Key Definition String	String Terminator

Parameters

DCS (9/0)
indicates the beginning of a device control string. DCS is an 8-bit C1 character. You can use ESC P (1/11 5/0) for a 7-bit environment.

Pc
is the *clear parameter*. *Pc* selects how to clear key definitions.

Pc	**Action**
0 (default) or none	Clear all keys before loading new values.

1	Clear one key at a time, before loading a new value.

When *Pc* is 1, the terminal only clears the keys you are loading. By using a *Pc* value of 1, you can redefine some keys without redefining them all.

NOTE
There are 768 bytes of memory for all user-defined keys. A key definition can only use the number of bytes available when that key is loaded.

Programming Tip

If *Pc* is 1, a key load may fail because no memory space is available. The reason for this is as follows.

With *Pc* set to 1, keys are cleared and loaded sequentially. If the new definition for a key is larger than the old one, you may exceed the 768 byte limit.

For example, suppose F6 contains 412 bytes, F7 contains 330 bytes, and F8 contains 20 bytes. You try to load F8 with 40 bytes, F6 with 1 byte, and F7 with 1 byte, in that order. This works if all keys are cleared first (*Pc* is 0), but not if keys are cleared one at a time (*Pc* is 1). When you try to load F8 with 40 bytes, the load fails because only 26 bytes are free at that time.

768 (maximum) − 412 (F6) − 330 (F7) = 26

Pl
is the *lock parameter*. *Pl* determines whether the key definitions are locked or unlocked after you load them.

Pl	Action
0 or none	Lock the keys. If you want to load new values into the keys, you must unlock the keys by using set-up.
1	Do not lock the keys. The keys are unlocked and can be redefined with another DECUDK string.

If *Pl* is 1 and the keys are already locked, nothing happens.

The terminal uses a special lock to prevent or allow the programming of user-defined keys. You can turn on this lock from set-up or from the host (with a DECUDK device control string). The lock affects all programmable keys. When you use the lock, you should follow these guidelines:

- **Unlock the keys to define them.**

The keys must be unlocked before you can define them. You can only unlock the keys from set-up. If a key is locked and an application tries to redefine the key with a DECUDK sequence, the terminal ignores the sequence.

- **Lock the keys to prevent redefinition.**

  You can lock the keys from set-up or from the host (by sending a DECUDK sequence). New key definitions are locked by default.

Pm
is the *modifier parameter*. *Pm* designates whether the key is shifted or unshifted.

Pm	**Action**
0, 2, or none	Define the shifted function key.
1	Defines the unshifted function key.
3	Defines the alternate unshifted function key.
4	Defines the alternate shifted function key.

|
is the *final character*. The vertical bar (7/12) identifies this control string as a DECUDK.

Ky1/St1;...Kyn/Stn
are the *key definition strings*. You include these strings between the final character (|) and the string terminator (ST). Each string consists of a key selector number (*Kyn*) and a string parameter (*Stn*), separated by a slash (/, 2/15). A semicolon (3/11) separates different strings.

- The key selector number (**Kyn**) indicates which key you are defining. Tables 11–1 and 11–2 list the definable keys and their identifying values.

Table 11–1 ANSI and Short ANSI Keyboards

	Pm = 1		Pm = none, 0, or 2	
Kyn	**ANSI**	**Short ANSI**	**ANSI**	**Short ANSI**
11	F1	F1	Shift F1	Shift F1
12	F2	F2	Shift F2	Shift F2
13	F3	F3	Shift F3	Shift F3
14	F4	F4	Shift F4	Shift F4
15	F5	F5	Shift F5	Shift F5
17	F6	F6	Shift F6	Shift F6
18	F7	F7	Shift F7	Shift F7
19	F8	F8	Shift F8	Shift F8
20	F9	F9	Shift F9	Shift F9
21	F10	F10	Shift F10	Shift Extend F10
23	F11	Extend F1	Shift F11	Shift Extend F1
24	F12	Extend F2	Shift F12	Shift Extend F2
25	F13	Extend F3	Shift F13	Shift Extend F3
26	F14	Extend F4	Shift F14	Shift Extend F4
28	F15	Extend F5	Shift F15	Shift Extend F5
29	F16	Extend F6	Shift F16	Shift Extend F6
31	F17	Extend F7	Shift F17	Shift Extend F7
32	F18	Extend F8	Shift F18	Shift Extend F8
33	F19	Extend F9	Shift F19	Shift Extend F9
34	F20	Extend F10	Shift F20	Shift Extend F10

NOTE
Pm values of 3 and 4 are specific to the PC keyboard. They are ignored when you use an ANSI or short ANSI keyboard.

Table 11–2 PC Keyboards

	Pm Value			
Kyn	**1**	**None, 0, or 2**	**3**	**4**
11	F1	Shift F1	Alt F1	Alt Shift F1
12	F2	Shift F2	Alt F2	Alt Shift F2
13	F3	Shift F3	Alt F3	Alt Shift F3
14	F4	Shift F4	Alt F4	Alt Shift F4
15	F5	Shift F5	Alt F5	Alt Shift F5
17	F6	Shift F6	Alt F6	Alt Shift F6
18	F7	Shift F7	Alt F7	Alt Shift F7
19	F8	Shift F8	Alt F8	Alt Shift F8
20	F9	Shift F9	Alt F9	Alt Shift F9
21	F10	Shift F10	Alt F10	Alt Shift F10
23	F11	Shift F11	Alt F11	Alt Shift F11
24	F12	Shift F12	Alt F12	Alt Shift F12
25	Alt F3	Alt Shift F3	–	–
26	Alt F4	Alt Shift F4	–	–
28	Alt F5	Alt Shift F5	–	–
29	Alt F6	Alt Shift F6	–	–
31	Alt F7	Alt Shift F7	–	–
32	Alt F8	Alt Shift F8	–	–
33	Alt F9	Alt Shift F9	–	–
34	Alt F10	Alt Shift F10	–	–
35	Alt F11	Alt Shift F11	–	–
36	Alt F12	Alt Shift F12	–	–

- The string parameters (**Stn**) are the encoded definition of the keys. String parameters consist of hex pairs in the following ranges:

  3/0 through 3/9 (0 through 9)
  4/1 through 4/6 (A through F)
  6/1 through 6/6 (a through f)

  When you combine these hex values, they represent an 8-bit quantity. The ASCII table in Chapter 2 lists the hex values of characters.

  This method lets you use any of the 256 character codes in the key string. You can enter key definition strings in any order.

  Default: Empty. The key is undefined.

ST
is the *string terminator*. ST (9/12) is a C1 8-bit character. You can use ESC \ (1/11, 5/12) for a 7-bit environment.

Notes On Loading UDKs

Here are some general guidelines you should keep in mind when loading UDKs.

- **Clear UDK memory space before loading new definitions.**

  Use a DECUDK string to clear keys without locking them. Then you can use another DECUDK string to redefine the keys and lock them.

- **If you redefine a key, the old definition is lost.**

  This may clear some space if the new definition uses less bytes than the old one.

- **There is only one way to unlock UDKs.**

  To unlock UDKs, you must use the General Set-Up screen.

- **The value for each key definition is empty.**

  When you clear UDKs, they are empty.

- **An invalid hex pair in a DECUDK string stops a UDK load sequence.**

  When a load sequence stops (due to error or other cause), the terminal saves any keys already loaded and sends the rest of the DECUDK sequence to the screen.

Examples of DECUDK Device Control Strings

The following sequence clears unshifted UDKs:

```
DCS 0 ; 1 ; 1 | ST
```

The following sequence locks unshifted UDKs:

```
DCS 1 ; 0 ; 1 | ST
```

Suppose you want to define the unshifted F20 key to be “PRINT”, without clearing or locking any other keys. The first part of your sequence would look like this:

```
DCS 1 ; 1 ; 1 | 3 4 /
```

34 is the code for the F20 key.

After the slash character (/, 2/15), you include the definition. The rest of the sequence after the slash character would look like this:

```
5 0 5 2 4 9 4 E 5 4 ST
```

The hex encoding for “PRINT” is as follows:

50	=	P
52	=	R
49	=	I
4E	=	N
54	=	T

The ST character (9/12) marks the end of the control string.

The complete string is as follows:

```
DCS 1 ; 1 ; 1 | 34 / 50 52 49 4E 54 ST
```

Printer Port Control Functions

This section describes control functions you use to control a local printer.

Printer Extent Mode (DECPEX)

This control function selects how much data you can print when you use the print page function described in the “Printing Functions” section that follows.

Default: Scrolling region

Format

CSI	**?**	**1**	**9**	**h**	The print function prints the complete page.
9/11	3/15	3/1	3/9	6/8	
CSI	**?**	**1**	**9**	**l**	The print function prints the scrolling region only (data inside the margins).
9/11	3/15	3/1	3/9	6/12	

Print Form Feed Mode (DECPFF)

This control function selects whether or not the terminal sends a form feed (FF) character to the printer at the end of a printing function. DECPFF does not affect the print cursor line function described in the next section.

Default: No form feed

Format

CSI	**?**	**1**	**8**	**h**	The terminal sends a form feed (FF) to the printer at the end of a printing function.
9/11	3/15	3/1	3/8	6/8	
CSI	**?**	**1**	**8**	**l**	The terminal sends nothing to the printer at the end of a printing function.
9/11	3/15	3/1	3/8	6/12	

Printing Functions

This section describes control functions you use to print text from the terminal. If you do not have a printer connected to the terminal, the terminal ignores these functions.

When you print characters from the screen or current page, the printer converts all tabs to spaces. Printed characters are spaced with the space (SP) character. The terminal sends a carriage return (CR), line feed (LF), vertical tab (VT), or form feed (FF) character to the printer after the last printed character on a line.

All the printing functions described in this section are variations of the media copy (MC) command. There are two versions of the MC command, standard and DEC private. The format of each version is as follows:

MC	ANSI standard	**CSI**	*Ps*	**i**	
		9/11	3/*n*	6/9	
MC	DEC private	**CSI**	**?**	*Ps*	**i**
		9/11	3/*n*	3/*n*	6/9

where

Ps indicates the function of the command.

Printing a Display Line: Autoprint Mode

In this mode, the printer prints a line from the screen when you move the cursor off that line with an LF, FF, or VT character, or an autowrap occurs. The printed line ends with a CR and the character (LF, FF, or VT) that moved the cursor off the previous line.

Sequence	Action
CSI ? 5 i	Turns on autoprint mode.
CSI ? 4 i	Turns off autoprint mode.

Sending Characters Directly to the Printer: Printer Controller Mode

This mode lets the host control the operation of the printer. The terminal sends characters and control sequences directly to the printer, without displaying them on the screen. The terminal sends all characters and control sequences except NUL, XON, XOFF, and the printer controller mode sequences.

Sequence	Action
CSI 5 i	Turns on printer controller mode.
CSI 4 i	Turns off printer controller mode.

Notes on Printer Controller Mode

- Printer controller mode cancels autoprint mode. When the terminal leaves printer controller mode, the terminal returns to the normal method for printing operations.
- The printer's active column position should always be on the left margin before the terminal leaves printer controller mode.

Print Page

This control function prints the page that has the cursor. The terminal stores data from the keyboard until printing is complete. You can use either of the following sequences to print the page:

CSI i or **CSI 0 i**

Notes on Print Page

- If printer extent mode (DECPEX) is currently reset, the print page function only prints the scrolling region.

Print Composed Main Display

This control function prints the data on the screen. This data may include information from two sessions, if the screen is displaying data from both sessions. See Chapter 14 for information on using two sessions.

CSI ? 10 i

Notes on Print Composed Main Display

- Printer extent mode (DECPEX) does not affect this function.

Print All Pages

This control function prints all pages in page memory for the current session. For example, if the current page format is 3 pages of 24 lines each, the printer prints 3 pages of 24 lines. The terminal stores new data from the keyboard until printing is complete.

CSI ? 11 i

Notes on Print All Pages

- If print form feed mode (DECPFF) is set, the terminal sends a form feed (FF) to the printer after each page.

Print Cursor Line

This control function prints the line that has the cursor. The cursor does not move.

CSI ? 1 i

Start Printer-to-Host Session

NOTE
The following control functions are related to the use of two sessions. See Chapter 14 for details on session management.

This control function enables communication from the printer port to the active host session.

CSI ? 9 i

Stop Printer-to-Host Session

This control function disables communication from the printer port to the active host session.

CSI ? 8 i

Assign Printer to Active Host Session

This control function lets the terminal accept printer commands from the current session only.

Software should use a device status report (DSR) to ask if the printer is not assigned to the other session. If the inactive session sends a DSR while the printer is assigned to the active session, the inactive session receives a `printer assigned` message. See Chapter 12 for details on for details on DSR reports.

CSI ? 18 i

Release Printer

This control function lets the terminal accept printer commands from both sessions. See Chapter 14 for details on session management.

CSI ? 19 i

Printing Visual Attributes

This section describes how the terminal sends visual attributes to a local printer, such as bold or underlining. To send visual attributes, the **printed data type** feature in the Printer Set-Up screen must be set to one of the following three modes:

National and line drawing
Multinational
Print all characters

See *Installing and Using the VT420 Video Terminal* for details.

The VT420 can send two types of visual attributes, line attributes and visual character attributes.

Sending Line Attributes

The terminal sends line attributes to a printer by (1) sending the appropriate line attribute control function, followed by (2) the characters in the current line. There are four line attribute control functions.

Single-width line	**ESC # 5**
Double-width line	**ESC # 6**
Double-width/double-height line	
Top half	**ESC # 3**
Bottom half	**ESC # 4**

Sending Visual Character Attributes

The terminal initializes character attributes at the beginning of each print line or print page operation by sending the following select graphic rendition (SGR) sequence to the printer (Chapter 7):

ESC [0 m

This sequence sets all character attributes to the normal rendition.

To send a visual character attribute to a printer, the VT420 (1) sends the appropriate SGR sequence for that attribute, followed by (2) the current character. The SGR sequence is as follows:

ESC [0; *Ps; Ps; ... Ps* **m**

Ps indicates a character attribute sent.

Ps	Attribute
0	Normal (all attributes off)
1	Bold
2	Underline
5	Blinking

After each print line or print page operation, the terminal clears all attributes by sending the following sequence:

ESC [0 m

Screen Display Control Functions

This section describes control functions that affect how the terminal displays data.

Local Echo: Send/Receive Mode (SRM)

This control function turns local echo on or off. When local echo is on, the terminal sends keyboard characters to the screen. The host does not have to send (echo) the characters back to the terminal display. When local echo is off, the terminal only sends characters to the host. It is up to the host to echo characters back to the screen.

Default: No local echo

Format

CSI	**1**	**2**	**h**	Set: local echo off.
9/11	3/1	3/2	6/8	
CSI	**1**	**2**	**l**	Reset: local echo on.
9/11	3/1	3/2	6/12	

Description

When the SRM function is set, the terminal sends keyboard characters to the host only. The host can echo the characters back to the screen.

When the SRM function is reset, the terminal sends keyboard characters to the host and to the screen. The host does have to echo characters back to the terminal.

Light or Dark Screen: Screen Mode (DECSCNM)

This control function selects a dark or light background on the screen.

Default: Dark background

Format

CSI	**?**	**5**	**h**	Set: reverse video.
9/11	3/15	3/5	6/8	
CSI	**?**	**5**	**l**	Reset: normal display.
9/11	3/15	3/5	6/12	

Description

When DECSCNM is set, the screen displays dark characters on a light background.

When DECSCNM is reset, the screen displays light characters on a dark background.

Notes on DECSCNM

- Screen mode only affects how the data appears on the screen. DECSCNM does not change the data in page memory.

Scrolling Mode (DECSCLM)

This control function selects the way the terminal scrolls lines. You can select one of two scroll settings, smooth or jump.

Default: Smooth scroll

Format

CSI	**?**	**4**	**h**	Set: smooth scroll.
9/11	3/15	3/4	6/8	
CSI	**?**	**4**	**l**	Reset: jump scroll.
9/11	3/15	3/4	6/12	

Description

When DECSLM is set, the terminal adds lines to the screen at a moderate, smooth rate. You can select a slow rate or fast rate in Display Set-Up. See *Installing and Using the VT420 Video Terminal*.

When DECSLM is reset, the terminal can add lines to the screen as fast as it receives them.

Select Number of Lines/Screen (DECSNLS)

This control function selects the maximum number of lines that the screen can display. The terminal supports three different font heights that let it display 24, 39, or 49 lines on the screen, and a status line. When you change the number of lines on the screen, the terminal automatically selects an appropriate font size.

Format

CSI	*Pn*	*	|
9/11	3/*n*	2/10	7/12

Parameters

Pn
is the number of lines the terminal displays on the screen. *Pn* can be any number from 1 to 255. If you use a value that the terminal does not support, the terminal uses the next highest supported value. If you use a value that is higher than the highest supported value, the terminal uses the highest supported value.

NOTE
You should specify *Pn* to match the page size (either 24, 36, or 48). This lets the terminal display a complete page with the minimum number of blank lines on the bottom. Specifying *Pn* to match the page size also provides the best compatibility between implementations.

Notes on DECSNLS

- If the screen is split horizontally for two sessions, the number of display lines is limited by the amount of screen space allocated to that session. For example, if DECSNLS selects 24 lines but only half the screen is allocated to that session, the terminal can only display 12 lines.
- The number of displayable lines is also limited by the current page size. For example, if DECSNLS selects 39 lines but the page size is 36 lines, the bottom 3 lines are blank.

Selecting the Indicator or Host-Writable Status Line

The line below the last line of the user window is reserved for the status line. The terminal lets you use the status line in two ways—as an indicator of the terminal's current state, or as a window the host can use to display application-specific messages.

The *indicator status display* provides information about the current state of the terminal.

- Page number
- Text cursor position (line, column)
- Printer status
- Modem status

The indicator status display is enabled by default. It appears in reverse video (negative image) on the line below the last line of the user window. This status line always appears in set-up.

The *host-writable status display* can provide specific information from the host. That is, you can program this status line to display any information you want. For two sessions, each session has its own host-writable status line. See Chapter 14 for more information on two sessions.

You can send data to the status line and select the type of status line with the following control sequences.

Select Active Status Display (DECSASD)

This control function selects whether the terminal sends data to the main display or the status line.

Available in: VT400 mode only

Default: Main display

Format

CSI	*Ps*	**$**	**}**
9/11	3/*n*	2/4	7/13

Parameters

Ps
represents the display the terminal sends data to, as follows:

Ps	Action
0 (default)	Selects the main display. The terminal sends data to the main display only.
1	Selects the status line. The terminal sends data to the status line only.

Select Status Line Type (DECSSDT)

This control function lets the host select the type of status line displayed.

Available in: VT400 mode only

Default: Indicator status display

Format

CSI	*Ps*	$	~
9/11	3/*n*	2/4	7/14

Parameters

Ps
indicates which status line the host selects, as follows:

Ps	Status Line Selected
0 (default)	No status line
1	Indicator status line
2	Host-writable status line

Notes on DECSSDT

- If you select no status line (*Ps* = 0), the terminal uses the line as an additional user window line to display data.
- If you change from an indicator to a host-writable status line, the new host-writable status line is empty.
- When you select the host-writable status line, most of the control functions that affect the main display also affect the status line. The following list describes the exceptions to the above rule:

Control Function	**Action**
Select character set (SCS)	Both the main display and status line use the same character set.
Cursor position controls	Only the column parameters in cursor-positioning commands operate in the status line.
ANSI mode (DECANM)	Ignored if received in the status line.
Set conformance level (DECSCL)	Exits the status line.
Scrolling mode (DECSCLM)	Affects the main display and the status line.
Soft terminal reset (DECSTR)	Exits the status line.
Insert/replace mode (IRM)	Affects the main display and the status line.
Hard terminal reset (RIS)	Erases and exits the status line.
Tab stops	Affect the main display and status line.
Autowrap mode (DECAWM)	Affects the main display and status line.

- DECSSDT does not affect the status line type displayed in set-up. In set-up, the terminal always uses the indicator status line.

Summary

Tables 11–3 through 11–6 list the control sequences described in this chapter.

Table 11–3 Keyboard Control Sequences

		Sequence	
Mode	**Mnemonic**	**Set**	**Reset**
Keyboard action	KAM	**CSI 2 h** Locked.	**CSI 2 l** Unlocked. (D)
Backarrow key	DECBKM	**CSI ? 67 h** Backspace.	**CSI ? 67 l** Delete. (D)
Line feed/ new line	LNM	**CSI 20 h** New line.	**CSI 20 l** Line feed. (D)
Autorepeat	DECARM	**CSI ? 8 h** Repeat. (D)	**CSI ? 8 l** No repeat.
Autowrap	DECAWM	**CSI ? 7 h** Autowrap.	**CSI ? 7 l** No autowrap. (D)
Cursor keys	DECCKM	**CSI ? 1 h** Application.	**CSI ? 1 l** Cursor. (D)
Keypad application/ numeric modes	DECKPAM	**ESC =** Application.	**ESC >** Numeric. (D)
Numeric keypad	DECNKM	**CSI ? 66 h** Application.	**CSI ? 66 l** Numeric. (D)
Keyboard usage	DECKBUM	**CSI ? 68 h** Data processing.	**CSI ? 68 l** Typewriter. (D)
Key position	DECKPM	**CSI 81 h** Position reports.	**CSI 81 l** Character codes. (D)

(D) = default.

Table 11–3 (Cont.) Keyboard Control Sequences

Name	Mnemonic	Sequence		
Enable local functions	DECELF	**CSI** *Pf1; Pc1; ... Pfn; Pcn* **+ q**		
		Pfn	=	function number.
		0	=	all local functions.
		1	=	local copy and paste.
		2	=	local panning.
		3	=	local window resize.
		Pcn	=	control performed.
		0	=	factory default.
		1	=	enable local function.
		2	=	disable local function.
Local function key control	DECLFKC	**CSI** *Pk1; Pf1; ... Pkn; Pfn* **= }**		
		Pkn	=	function key number.
		0	=	all local function keys.
		1	=	F1 (Hold).
		2	=	F2 (Print).
		3	=	F3 (Set-Up).
		4	=	F4 (Session).
		Pfn	=	function performed.
		0	=	factory default.
		1	=	local function.
		2	=	send key sequence.
		3	=	disable key.

Table 11–3 (Cont.) Keyboard Control Sequences

Name	Mnemonic	Sequence		
Select modifier key reporting	DECSMKR	**CSI** *Pm1; Pf1; ... Pmn; Pfn* **+ r**		
		Pmn	=	key number.
		0	=	all keys.
		1	=	left Shift.
		2	=	right Shift.
		3	=	Lock.
		4	=	Ctrl.
		5	=	left Alt Function.
		6	=	right Alt Function.
		7	=	left Compose Character.
		8	=	right Compose Character.
		Pcn	=	control performed.
		0	=	factory default.
		1	=	modifier function.
		2	=	extended keyboard report.
		3	=	key disabled.
Extended keyboard report	DECEKBD	**APC :** *ppp mm* **ST**		
		ppp	=	key position number.
		mm	=	modifier key state.
		0	=	not pressed.
		1	=	pressed.

Table 11–4 Programming UDKs

DECUDK Device Control String Format

DCS *Pc* ; *Pl* ; *Pm* ; | *Ky1*/*St1*;...*Kyn*/*Stn* ST

Pc is the clear parameter.

0 or none	= Clear all keys before loading new value.
1	= Clear one key at a time, before loading a new value.

Pl is the lock parameter.

0 or none	= Lock the keys.
1	= Do not lock the keys.

Pm is the modifier parameter.

0, 2, or none	= Define the shifted function key.
1	= Define the unshifted function key.
3	= Define the alternate unshifted function key.
4	= Define the alternate shifted function key.

Ky1/*St1*;...*Kyn*/*Stn* are the key definition strings.

The key selector number (*Kyn*) indicates which key you are defining. See Tables 11–1 and 11–2.

The string parameters (*Stn*) are the key definitions, encoded as pairs of hex codes.

3/0 through 3/9 (0 through 9)

4/1 through 4/6 (A through F)

6/1 through 6/6 (a through f)

Table 11–5 Printing Control Sequences

Name	Mnemonic	Sequence
Printer extent mode	DECPEX	Set: **CSI ? 19 h** Page. (D) Reset: **CSI ? 19 l** Scrolling region.
Print form feed mode	DECPFF	Set: **CSI ? 18 h** Form feed. Reset: **CSI ? 18 l** No form feed. (D)
Auto print mode	MC	On: **CSI ? 5 i** Off: **CSI ? 4 i**
Printer controller mode	MC	On: **CSI 5 i** Off: **CSI 4 i**
Print page	MC	**CSI I** or **CSI 0 i**
Print composed main display	MC	**CSI ? 10 i**
Print all pages	MC	**CSI ? 11 i**
Print cursor line	MC	**CSI ? 1 i**
Start printer-to-host session	MC	**CSI ? 9 i**
Stop printer-to-host session	MC	**CSI ? 8 i**
Assign printer to active session	MC	**CSI ? 18 i**
Release printer	MC	**CSI ? 19 i**

(D) = default.

Table 11–6 Screen Display Control Sequences

Name	Mnemonic	Sequence
Send/receive mode	SRM	Set: **CSI 12 h** Local echo off. (D) Reset: **CSI 12 l** Local echo on.
Screen mode	DECSCNM	Set: **CSI ? 5 h** Light background. Reset: **CSI ? 5 l** Dark background. (D)
Scrolling mode	DECSCLM	Set: **CSI ? 4 h** Smooth scroll. (D) Reset: **CSI ? 4 l** Jump scroll.
Select number of lines per screen	DECSNLS	**CSI** *Pn* * **|** *Pn* = number of lines.
Select active status display*	DECSASD	**CSI** *Ps* **$ }** *Ps* = 0, main display. *Ps* = 1, status line.
Select status line type*	DECSSDT	**CSI** *Ps* **$ -** *Ps* = 0, none. *Ps* = 1, indicator. (D) *Ps* = 2, host-writable.

*Available in VT400 mode only.

(D) = default.

12

VT420 Reports

The VT420 sends reports in response to requests from the host system. These reports provide the host with information about the terminal such as:

Identification (type of terminal)
Cursor state
Operating status
Operating level (VT100 or VT400)
Almost all terminal states that software can set

The host can use the reports to adjust the computing environment to match the terminal.

Device Attributes (DA)

The terminal and host computer exchange DA sequences to provide the host with the following information:

Conformance level (1, 2, or 3) and extensions
Basic features
Identification code
Firmware version level
Hardware options
Manufacturing site code
Terminal ID number

Based on this information, the host can

- Use the information it receives to make the best use of the terminal's features.
- Select the correct application software for the terminal.
- Determine the cause of certain communication errors.

There are three types of DA exchanges between the host and the terminal, primary DA, secondary DA, and tertiary DA. The host can request any type of DA report, depending on the information the host needs.

Primary DA

In this DA exchange, the host asks for the terminal's architectural class and basic attributes.

Host Request

The host uses the following sequence to send this request:

CSI	**c**	or	**CSI**	**0**	**c**
9/11	6/3		9/11	3/0	6/3

Terminal Response

The terminal responds by sending its architectural class and basic attributes to the host. This response depends on the terminal's current operating level (VT100 or VT400).

CSI	**?**	*Psc*	**;**	*Ps1*	**;**	**. . .**	*Psn*	**c**
9/11	3/15	3/*n*	3/11	3/*n*	3/11	. . .	3/*n*	6/3

Parameters

Psc
indicates the terminal's architectural class code. The value of *Psc* depends on the terminal's current operating level, as follows:

Psc	**Operating Level**
61	Level 1 (VT100 family)
62, 63, 64	Level 4 (VT400 family)

Ps1; . . . Psn
indicate which of the following extensions the terminal supports:

Ps	Meaning
1	132 columns
2	Printer port
6	Selective erase
7	Soft character set (DRCS)
8	User-defined keys
9	National replacement character sets (worldwide model only)
15	DEC technical character set
18	Windowing capability
19	Dual sessions
21	Horizontal scrolling

Primary DA Example

Here is a typical primary DA exchange.

Exchange	Sequence	Meaning
Request (Host to VT420)	**CSI c** or **CSI 0 c**	The host asks for the terminal's architectural class code and supported extensions.
Response (VT420 to host)	**CSI ? 64; 1; 2; 6; 7; 8; 9; 15; 18; 19; 21 c**	The terminal is a class 4 device (64) and supports the following extensions: • 132 columns (1) • Printer port (2) • Selective erase (6)

Exchange	Sequence	Meaning
		• Soft character set (DRCS) (7) • User-defined keys (8) • NRC sets (9) (worldwide model only) • DEC Technical character set (15) • Windowing (18) • Dual sessions (19) • Horizontal scrolling (21)

Table 12–1 lists all the primary DA alias responses that the VT420 can send to the host. The terminal uses an *alias response* to identify itself to the host as some other type of terminal. You can select these responses in set-up. Each response corresponds to a certain operating level.

Table 12–1 Alias Primary DA Responses From the VT420

Terminal	Identification Sequence	Meaning
VT100 DA	**ESC [? 1; 2 c**	VT100 terminal
VT101 DA	**ESC [? 1; 0 c**	VT101 terminal
VT102 DA	**ESC [? 6 c**	VT102 terminal
VT220 DA*	**CSI ? 62; 1; 2; 6; 7; 8; 9 c**	VT220 terminal
VT320 DA*	**CSI ? 63; 1; 2; 6; 7; 8; 9 c**	VT320 terminal
VT420 DA*	**CSI ? 64; 1; 2; 6; 7; 8; 9; 15; 18; 19; 21 c**	VT420 terminal

NOTE
To change an alias response, you must use the General Set-Up screen. See *Installing and Using the VT420 Terminal.*

*These responses correspond to the worldwide model of the terminal. The North American model does not support NRC sets (9).

Secondary DA

In this DA exchange, the host requests the terminal's identification code, firmware version level, and hardware options.

Host Request

The host uses the following sequence to send this request:

CSI	**>**	**c**	or	**CSI**	**>**	**0**	**c**
9/11	3/14	6/3		9/11	3/14	3/0	6/3

Terminal Response

The terminal uses the following sequence to respond:

CSI	**>**	*4*	*1*	**;**	*Pv*	**;**	*Po*	**c**
9/11	3/14	3/4	3/1	3/11	3/*n*	3/11	3/*n*	6/3

Parameters

41
indicates the identification code for the terminal. The VT420 has an identification code of 41.

Pv
indicates the firmware version level of the terminal. *Firmware* is the software implementation of all the terminal's functions (for example, the editing functions).

Examples

Pv	**Version**
10	V1.0 (released version 1.0)
20	V2.0 (released version 2.0)

Po
indicates the hardware options installed in the terminal. The VT420 does not have any hardware options, so *Po* is 0.

Po	Options
0	No options.
1	LK443 (101 keys) or LK444 (102 keys) PC keyboard with LK401 interface.

Secondary DA Example

Here is a typical secondary DA exchange.

Exchange	Sequence	Meaning
Request (Host to VT420)	**CSI > c** or **CSI > 0 c**	The host asks for the terminal's identification, firmware version, current hardware options.
Response (VT420 to host)	**CSI > 41; 20; 1 c**	The terminal identifies itself as a VT420 that uses version 2.0 firmware and has a PC keyboard option.

Tertiary DA (VT400 Mode Only)

In this DA exchange, the host asks for the terminal unit identification code. This ID code serves as a way to identify each terminal in a system. The unit ID code is preset at the factory.

Host Request

The host uses the following sequence to send this request:

CSI	**=**	**c**	or	**CSI**	**=**	**0**	**c**
9/11	3/13	6/3		9/11	3/13	3/0	6/3

Terminal Response

The terminal responds by sending a report terminal unit ID (DECRPTUI) control string to the host. DECRPTUI is available in VT400 mode only.

DCS	**!**	**|**	*D...D*	*ST*
9/0	2/1	7/12	...	9/12

Parameters

D..D
is the unit ID of the terminal, consisting of four hex pairs. The first hex pair represents the manufacturing site code. This code can be any hex value from 00 through FF.

The last three hex pairs are the terminal ID number. This number is unique for each terminal manufactured at that site.

Tertiary DA Example

Here is a typical tertiary DA exchange.

Exchange	Sequence	Meaning
Request (Host to VT420)	**CSI = c** or **CSI = 0 c**	The host asks for the terminal unit ID.
DECRPTUI Response (VT420 to host)	**DCS ! | 00 01 02 05 ST**	The terminal was manufactured at site 00 and has a unique ID number of 125.

Terminal Identification (DECID)

This control function is similar to a primary device attributes (DA) request from the host. See the previous “Device Attributes (DA)” section.

NOTE
Digital does not recommend using DECID. DECID may not be supported in Digital terminals. You should use the primary device attributes request for this purpose. In VT400 mode, the terminal ignores DECID.

Host DECID Request

ESC	Z
1/11	5/10

Terminal Response

The terminal uses the same response as for a primary DA request. The terminal uses this response for all operating levels (1 or 4).

Device Status Report (DSR)

The host computer and terminal exchange DSR sequences to provide the host with the operating status of the following features:

VT420 operating status	Keyboard dialect
Cursor position	Macro space
Cursor position with page	Memory checksum
Printer port	Data integrity
User-defined keys	Multiple-session status

DSR requests and reports follow one of two formats, ANSI standard or DEC private. The format for each is as follows:

ANSI standard	**CSI**	*Ps*	**n**	
	9/11	3/?	6/14	
DEC private	**CSI**	**?**	*Ps*	**n**
	9/11	3/15	3/?	6/14

Ps indicates the type of DSR requested.

There is a different DSR request for each feature. The following sections describe the possible DSR reports. If the terminal is in printer controller mode (Chapter 11), the printer receives the DSR request. The printer can respond through the bidirectional printer port.

DSR—VT420 Operating Status

The host requests the terminal's operating status.

Exchange	Sequence	Meaning
Request (Host to VT420)	**CSI 5 n**	The host requests the terminal's operating status. The host asks if the terminal is in good operating condition.
Responses (VT420 to host)	**CSI 0 n**	The terminal indicates that it is in good operating condition.
	or	
	CSI 3 n	The terminal indicates that it has a malfunction.

DSR—Cursor Position Report (CPR)

The host asks the terminal for a cursor position report.

Exchange	Sequence	Meaning
Request (Host to VT420)	**CSI 6 n**	The host asks for a cursor position report (CPR).
CPR response (VT420 to host)	**CSI** *Pl; Pc* **R**	The terminal indicates that the cursor is currently at line *Pl*, column *Pc*.

DSR—Extended Cursor Position Report (DECXCPR)

The host asks the terminal for the current cursor position, including the current page number.

Exchange	Sequence	Meaning
Request (Host to VT420)	**CSI ? 6 n**	The host asks for an extended cursor position report (DECXCPR).

Exchange	Sequence	Meaning
DECXCPR response (VT420 to host)	**CSI** *Pl; Pc; Pp* **R**	The terminal indicates that the cursor is currently at line *Pl*, column *Pc*, on page *Pp*.

DSR—Printer Port

The host asks for the status of the terminal's printer.

NOTE
Host software should check the printer status before entering any print mode or starting any printing function.

Exchange	Sequence	Meaning
Request (Host to VT420)	**CSI ? 15 n**	The host asks for the current printer status.
Possible responses (VT420 to host)	**CSI ? 13 n**	No printer. The data terminal ready (DTR) signal has not been asserted on the printer port since the last power-up or reset.
	CSI ? 10 n	Printer ready. DTR is asserted on the printer port.
	CSI ? 11 n	Printer not ready. DTR is not currently asserted on the printer port.
	CSI ? 18 n	Printer busy. DTR is asserted on the printer port, but the other session is using the printer (Chapter 14).
		In VT100 mode, the terminal sends the *printer not ready* sequence above.

Exchange	Sequence	Meaning
	CSI ? 19 n	Printer assigned to other session. DTR is asserted on the printer port, but the printer is assigned to the other session. The printer is not available to this session (Chapter 14). In VT100 mode, the terminal sends the *no printer* sequence above.

DSR—User-Defined Keys (VT400 Mode Only)

The host asks if the user-defined keys (UDKs) are locked or unlocked.

Exchange	Sequence	Meaning
Request (Host to VT420)	**CSI ? 25 n**	The host asks if UDKs are locked or unlocked.
Possible responses (VT420 to host)	**CSI ? 20 n**	UDKs are unlocked.
	CSI ? 21 n	UDKs are locked.

DSR—Keyboard Status

The host asks for the current keyboard dialect, operating status, and type.

Exchange	Sequence	Meaning
Request (Host to VT420)	**CSI ? 26 n**	The host asks for the keyboard status.
Response (VT420 to host)	**CSI ? 27;** *Pn; Pst; Ptyp* **n**	The keyboard dialect is *Pn*, the keyboard status is *Pst*, and the keyboard type is *Ptyp*.

	Dialect			
Pn	**ANSI**	**PC**	**Pst**	**Keyboard Status***
0	Unknown	Unknown	0	Keyboard ready. The terminal sends typed characters to the current session (Chapter 14).
1	North American†	North American†		
2	British	British		
3	Flemish	Belgian		
4	Canadian (French)	—		
5	Danish	Danish		
6	Finnish	Finnish		
7	German	German	3	No keyboard. The terminal does not detect the keyboard.
8	Dutch	—		
9	Italian	Italian		
10	Swiss (French)	Swiss (French)		
11	Swiss (German)	Swiss (German)		
12	Swedish	Swedish	8	Keyboard busy. The other session is currently using the keyboard (Chapter 14).
13	Norwegian	Norwegian		
14	French/Belgian	French		
15	Spanish Int.	Spanish Int.		
16	Portuguese	Portuguese		
28	Canadian (English)	—		
32	—	Spanish National		

Ptyp	**Keyboard Type**
0	LK201 /LK301
1	LK401
2	LK443 /LK444
3	LK421

*The terminal only sends *Pst* in VT400 mode.

†The terminal does not transmit Unknown. Unknown is for devices that cannot determine the keyboard type.

DSR—Macro Space Report

The host asks for the available macro space in the form of a macro space report (DECMSR).

Exchange	Sequence	Meaning
Request (Host to VT420)	**CSI ? 62 n**	The host asks for a macro space report (DECMSR).
DECMSR response (VT420 to host)	**CSI** *Pn* * **{**	The terminal indicates the number of bytes available for macro definitions: $Pn = \frac{number\ of\ bytes}{16}$ rounded down.

DSR—Memory Checksum (DECCKSR)

The host asks for a memory checksum report of current text macro definitions.

Programming Tip

Enter your macro definitions, then request and save a memory checksum. Later, you can request another checksum and see if it has changed.

Exchange	Sequence	Meaning
Request (Host to VT420)	**CSI ? 63;** *Pid* **n**	The host asks for a memory checkum report of current text macro definitions (DECCKSR). *Pid* is an optional numeric parameter that provides a label to identify the particular checksum request. The checksum report returns the label. This label lets you differentiate between multiple checksum reports.

Exchange	Sequence	Meaning
DECCKSR response (VT420 to host)	**DCS** *Pid* **!** **~** *D..D* **ST**	*Pid* is a label indicating which DSR request the report is for. *D..D* is the data string consisting of four hexadecimal digits indicating the checksum. The digits can be in the range of 3/0 through 3/9 and 4/0 through 4/6.

DSR—Data Integrity Report

The host asks for the status of the data integrity flag. The data integrity flag indicates the integrity of the data flow between the terminal and host. This flag is reset each time the terminal sends a data integrity report.

Programming Tip

Applications using the flag should always reset the flag before sending data to the terminal. You can reset the flag with a DSR request (**CSI ? 75 n**) sequence. After the application sends data, the application should send another request to find out if a parity error has occurred.

Exchange	Sequence	Meaning
Request (Host to VT420)	**CSI ? 75 n**	The host asks for the status of the data integrity flag.
Possible responses (VT420 to host)	**CSI ? 70 n**	Ready, no communication errors or power-ups have occurred since last report.
	CSI ? 71 n	Malfunction, a communication error has occurred since the last report.
	CSI ? 73 n	The terminal has not reported data integrity since the last power-up or hard reset (RIS).

DSR—Multiple-Session Configuration Status Report

The host asks for the status of the terminal's multiple-session configuration. See Chapter 14 for details on dual sessions.

Exchange	Sequence	Meaning
Request (Host to VT420)	**CSI ? 85 n**	The host asks for the status of the multiple-session configuration.
Possible responses (VT420 to host)	**CSI ? 80 ;** *Ps2* **n**	Multiple sessions are operating using the session support utility (SSU) and the current SSU state is enabled. *Ps2* indicates the maximum number of sessions available. Default: *Ps2* = 2.
	CSI ? 81 ; *Ps2* **n**	The terminal is currently configured for multiple sessions using SSU but the current SSU state is pending. *Ps2* indicates the maximum number of sessions available. Default: *Ps2* = 2.
	CSI ? 83 n	The terminal is not configured for multiple-session operation.
	CSI ? 87 n	Multiple sessions are operating using a separate physical line for each session, not SSU.

Requesting a Checksum of a Rectangular Area

You can request a checksum of a rectangular area in page memory. To request a checksum of a rectangular area, you use the DECRQCRA control function. In response to this request, the terminal returns a checksum report in the form of a DECCKSR control string.

Request Checksum of Rectangular Area (DECRQCRA) (VT400 Mode Only)

This control function requests a checksum of the specified rectangular area in the specified page. The terminal returns a checksum report (DECCKSR) in response to this request.

Format

CSI	*Pid*	**;**	*Pp;*	*Pt; Pl; Pb; Pr*	*****	**y**
9/11	3/*n*	3/11	3/*n*	3/*n* . . . 3/*n*	2/10	7/9

Parameters

Pid
is a numeric label you can provide to identify the checksum request. The checksum report returns this number. The number serves to differentiate between multiple checksum reports.

Pp
is the page number of the page that has the rectangular area. If *Pp* is 0 or omitted, the terminal ignores the following parameters and reports a checksum for all pages in page memory. If *Pp* is a higher number than the number of pages available, the terminal reports on the last page.

Pt; Pl; Pb; Pr
are the top, left, bottom, and right borders of the rectangular area. *Pt* and *Pb* are line numbers. *Pt* must be less than or equal to *Pb*. *Pl* and *Pr* are column numbers. *Pl* must be less that or equal to *Pr*.

Defaults are *Pt* = 1, *Pb* = current page length, *Pr* = current page width. If these parameters are omitted, the terminal returns a checksum of page *Pp*.

Notes on DECRQCRA

- The coordinates of the rectangular area are affected by the setting of origin mode (DECOM).

Checksum Report

The terminal returns a checksum report in response to one of the following requests:

Request checksum of rectangular area (DECRQCRA)
Device status report (DSR) request for a macro definition checksum

Format

DCS	*Pn*	**!**	**~**	*D...D*	**ST**
9/0	3/*n*	2/1	7/14	...	9/12

Parameters

Pn
is a numeric label for the checksum report requested in the DECRQCRA or DSR control function. *Pn* serves to differentiate between multiple checksum reports if needed.

D..D
is the data string. The string consists of four hexadecimal digits that indicate the checksum. The digits are in the range of 3/0 through 3/9 and 4/1 through 4/6.

Terminal State Reports (VT400 Mode Only)

The host can request the terminal's current operating state. In response to this request, the terminal returns a terminal state report. The host can use the information in the report to save the current terminal state. Later, the host can restore the terminal to the saved state.

This operation is useful for applications that need to temporarily change the terminal's operating state. When the application is finished, it can restore the terminal to the previous operating state.

A terminal state report is a device control string. The report indicates the settings of most of the terminal's features. The terminal sends the report in response to a request terminal state report (DECRQTSR) sequence from the host.

Request Terminal State Report (DECRQTSR)—Host To VT420

The host sends this control function to request a terminal state report (DECTSR). The terminal responds by sending a report indicating the settings of many device attributes.

Format

CSI	*Ps*	**$**	*u*
9/11	3/*n*	2/4	7/5

Parameters

Ps
indicates the type of report the host requests from the terminal.

Ps	**Report Requested**
0 or none	Ignored. No report sent.
1	Terminal state report (DECTSR)

Terminal State Report (DECTSR)—VT420 to Host

The terminal sends this sequence in response to a request terminal state report (DECRQTSR) sequence. DECTSR informs the host of the entire state of the terminal, except for user-defined key definitions and the current soft character set.

Programming Tip

Applications can use the information in the terminal state report to save the current terminal state. Later, the application can restore the terminal to the saved state.

This operation is useful for applications that need to temporarily change the terminal's operating state. When the application is finished, it can restore the terminal to the previous operating state. You use the restore terminal state (DECRSTS) function to restore the terminal state. DECRSTS is described later in this chapter.

Format

DCS	1	$	s	*D . . . D*	ST
9/0	3/1	2/4	7/3	. . .	9/12

Parameters

D...D
is a data string indicating the status of most of the terminal's features.

Notes on DECTSR

- Software should *not* expect the format of DECTSR to be the same for all members of the VT400 family, or for different revisions within each member of the family.

Restore Terminal State (DECRSTS)—VT400 Mode Only

This sequence restores the terminal to a previous state specified in a terminal state report (DECTSR).

Programming Tip

Applications can use DECRSTS to restore the terminal to a previous operating state specified in a terminal state report. See the previous "Terminal State Report (DECTSR)" section in this chapter.

Available in: VT400 mode

Format

DCS	*Ps*	$	p	*D . . . D*	ST
9/0	3/*n*	2/4	7/0	. . .	9/12

Parameters

Ps
indicates the format of the data string (*D...D*).

Ps	Data String Format
0	Error, restore ignored
1	Selects the format of the terminal state report (DECTSR).

D...D
is a data string that contains the restored information. This string is identical to the data string used by the report you are restoring.

Notes on DECRSTS

- If there is an invalid value in the DECRSTS sequence, the terminal ignores the rest of the sequence. This action may leave the terminal in a partially restored state.
- Software should not expect the format of the terminal state report (DECTSR) to be the same for all VT400 family members.

Presentation State Reports (VT400 Mode Only)

The terminal can send two presentation state reports.

Cursor information report (DECCIR)	Reports on the cursor position, including its visual attributes. Also reports on origin mode (DECOM), and the current active character sets.
Tab stop report (DECTABSR)	Reports the current tab stop settings.

The host can request the terminal's current presentation state. In response to this request, the terminal returns a presentation state report. The host can use the information in the report to save the current presentation state. Later, the host can restore the terminal to the saved state.

This operation is useful for applications that need to temporarily change the terminal's presentation state. When the application is finished, it can restore the terminal to the previous presentation state.

A presentation state report is a device control string. The terminal sends the report in response to a request presentation state report (DECRQPSR) sequence from the host.

Request Presentation State Report (DECRQPSR) —Host to VT420

The host sends this sequence to request a cursor information report (DECCIR) or a tabulation stop report (DECTABSR).

Format

CSI	*Ps*	**$**	**w**
9/11	3/*n*	2/4	7/7

Parameters

Ps
indicates which report the host requests.

Ps	Report Requested
0	Error, request ignored.
1	Cursor information report (DECCIR).
2	Tab stop report (DECTABSR).

Cursor Information Report (DECCIR)—VT420 to Host

The terminal sends this sequence in response to a request presentation state report (DECRQPSR) sequence. DECCIR reports the status of the cursor position, including visual attributes and character protection attributes. DECCIR also reports the status of of origin mode (DECOM) and the current active character sets.

Programming Tip

Applications can use the information in the cursor information report to save the current presentation state. Later, the application can restore the terminal to the saved state.

This operation is useful for applications that need to temporarily change the terminal's presentation state. When the application is finished, it can restore the terminal to the previous presentation state. You use the restore presentation state (DECRSPS) function to restore the presentation state. DECRSPS is described later in this chapter.

Format

DCS	**1**	**$**	**u**	*D . . . D*	**ST**
9/0	3/1	2/4	7/5	. . .	9/12

Parameters

D...D
is the data string containing the cursor information. The format for this data string is as follows:

Pr; Pc; Pp; Srend; Satt; Sflag; Pgl; Pgr; Scss; Sdesig

Pr
is the number of the line the cursor is on.

Pc
is number of the column the cursor is at.

Pp
is the number of the current page.

Srend
is one or more characters indicating the visual attributes (such as bold and blinking) currently in use for writing (Chapter 7).

To find out what attributes are set, you must convert the character to an 8-bit binary number. You can use the code table in Chapter 2 to convert characters. After you convert a character, you can find the meaning of its 8-digit binary number in the following table. The table lists the most significant bit (8) to the least significant bit (1).

Bit	Attribute	Bit Value		
8	–	Always 0 (off).		
7	–	Always 1 (on).		
6	Extension indicator	1	=	another character (byte) of visual attribute data follows this one.
		0	=	no more attribute data.
5	–	Always 0 (off).		

Bit	Attribute	Bit Value		
4	Reverse video	0	=	off.
		1	=	on.
3	Blinking	0	=	off.
		1	=	on.
2	Underline	0	=	off.
		1	=	on.
1	Bold	0	=	off.
		1	=	on.

Example

If the bold and underline attributes are currently set for writing, *Srend* is the ASCII uppercase C character (01000011_2).

Satt

is one or more characters indicating any selective erase attributes (Chapter 8) currently set for writing.

To find what attributes are set, you must convert each character to an 8-bit binary number. Use the same method you used to convert the *Srend* parameter above. Then use the following table to find the meaning of the 8-bit binary number:

Bit	Attribute	Bit Value		
8	–	Always 0 (off).		
7	–	Always 1 (on).		
6	Extension indicator	1	=	another character (byte) of selective erase data follows this one.
		0	=	no more protection data.
5	–	0		Reserved for future use.
4	–	0		Reserved for future use.
3	–	0		Reserved for future use.

Bit	Attribute	Bit Value		
2	–	0		Reserved for future use.
1	Selective erase (DECSCA)	0	=	off.
		1	=	on.

Example

If the selective erase protection attribute is currently set for writing, then *Satt* is the ASCII uppercase A character (01000001_2).

Sflag

is one or more characters that indicate several flags and modes the terminal must save.

To see the current state of the flags and modes, you must convert each character to an 8-bit binary number. Use the same method you used to convert the *Srend* and *Satt* parameters above. Then use the following table to find the meaning of the 8-bit binary number:

Bit	Attribute	Bit Value		
8	–	Always 0 (off).		
7	–	Always 1 (on).		
6	Extension indicator	1	=	another character (byte) of flag data follows this one.
		0	=	no more flag data.
5	–	0		Reserved for future use.
4	Autowrap	1	=	autowrap pending.
		0	=	autowrap not pending.
3	Single shift 3 (SS3) setting	1	=	G3 is mapped into GL for the next typed character only.
		0	=	single shift 3 is off.
2	Single shift 2 (SS2) setting	1	=	G2 is mapped into GL for the next typed character only.

Bit	Attribute	Bit Value		
		0	=	single shift 2 is off.
1	Origin mode	1	=	origin mode set.
		0	=	origin mode reset.

Example

If origin mode is set, autowrap is pending, and a single shift 3 has been received, then *Sflag* is the ASCII uppercase M character (01001101_2).

Pgl

indicates the number of the logical character set (G0 through G3) mapped into GL.

0 = G0 is in GL.
1 = G1 is in GL.
2 = G2 is in GL.
3 = G3 is in GL.

Pgr

indicates the number of the logical character set (G0 through G3) mapped into GR.

0 = G0 is in GR.
1 = G1 is in GR.
2 = G2 is in GR.
3 = G3 is in GR.

Scss

is a character indicating the size of the character sets in G0 through G3.

To find out what the character means, you must convert it to an 8-bit binary number. Use the same method you used to convert the *Srend, Satt,* and *Sflag* parameters. Then use the following table to find the meaning of the 8-bit binary number:

Bit	Attribute	Bit Value		
8	–	Always 0 (off)		
7	–	Always 1 (on)		
6	Extension indicator	1	=	another character (byte) of character size data follows this one.
		0	=	no more size data.

Bit	Attribute	Bit Value		
5	–	0		Reserved for future use.
4	G3 set size	0	=	94 characters.
		1	=	96 characters.
3	G2 set size	0	=	94 characters.
		1	=	96 characters.
2	G1 set size	0	=	94 characters.
		1	=	96 characters.
1	G0 set size	0	=	94 characters.
		1	=	96 characters.

Example

Suppose the following conditions exist:

- The ISO Latin-1 supplemental set is designated as G2 and G3.
- The ASCII set is designated as G0 and G1.
- Single shift 2 (SS2) is set.

Then Scss is the ASCII backslash \ character (01011100_2).

Sdesig

is a string of intermediate and final characters indicating the character sets designated as G0 through G3. These final characters are the same as those used in select character set (SCS) sequences (Chapter 5).

Example

Suppose the ASCII character set is designated as G0, DEC Special Graphic as G1, and DEC Supplemental Graphic as G2 and G3. The *Sdesig* string would be **B0%5%5**. Each character corresponds to a final character in an SCS sequence, as follows:

G0	G1	G2	G3
B	**0**	**%5**	**%5**
ASCII set	DEC Special Graphic	DEC Supplemental Graphic	DEC Supplemental Graphic

Example

The following is an example of a cursor information report:

```
DCS 1 $ u 1; 1; 1; @; @; @; 0; 2; @; BB%5%5 ST
```

1; 1; 1; indicates that the cursor is at row 1, column 1, on the first page.

@; @; @; indicates that (1) no visual character attributes or selective erase attributes are set for writing, (2) DECOM is reset, and (3) there is no SS2, SS3, or autowrap pending.

0; 2; indicates that G0 is mapped into GL, and G2 is in GR.

@; indicates that all character sets have 94 characters.

BB%5%5 indicates that ASCII is in G0 and G1, and DEC Supplemental Graphic is in G2 and G3.

Notes on DECCIR

- The cursor information in a DECCIR sequence is the same information saved through a save cursor (DECSC) command.

Tab Stop Report (DECTABSR)—VT420 To Host

The terminal sends this sequence to the host in response to a request presentation state report (DECRQPSR) sequence. DECTABSR informs the host of the terminal's current tab settings.

Programming Tip

Applications can use information in the tab stop report to save the current tab stops. Later, the application can restore the saved tab stops.

This operation is useful for applications that need to temporarily change the terminal's tab stops. When the application is finished, it can restore the tab stops that were in effect before the application changed them. You use the restore presentation state (DECRSPS) function to restore tab stops. DECRSPS is described later in this chapter.

Format

DCS	**2**	**$**	**u**	*D . . . D*	**ST**
9/0	3/2	2/4	7/5	. . .	9/12

Parameters

D...D
is a data string indicating the column number location of each tab stop.

Example

The following is an example of a DECTABSR sequence:

```
DCS 2 $ u 9/ 17/ 25/ 33/ 41/ 49/ 57/ 65/ 73 ST
```

9, **17**, **25**, **33**, **41**, **49**, **57**, **65**, and **73** are the column numbers for tab stops.

Restore Presentation State (DECRSPS)—VT400 Mode Only

This control function restores the terminal to a previous state based on one of the presentation state reports. There are two presentation state reports.

Cursor information report (DECCIR)
Tab stop report (DECTABSR)

A DECRSPS sequence can only restore the information from one report at a time, cursor information or tab stop.

Programming Tip

Applications can use DECRSPS to restore the terminal to a previous state specified in a presentation state report. See the previous “Cursor Information Report (DECCIR)” and “Tab Stop Report (DECTABSR)” sections in this chapter.

Available in: VT400 mode

Format

DCS	*Ps*	**$**	**t**	*D . . . D*	**ST**
9/0	3/*n*	2/4	7/4	. . .	9/12

Parameters

Ps

indicates the format of the data string (*D...D*). You can use one of the two following formats for the data string. These formats correspond to the formats used in the two presentation state reports (DECPSR). Make sure you use the format of the report you are restoring.

Ps	**Data String Format**
0	Error, restore ignored.
1	Selects the format of the cursor information report (DECCIR).
2	Selects the format of the tab stop report (DECTABSR).

D...D

is a data string that contains the restored information. This string is identical to the data string used in the report you are restoring—the cursor information report (DECCIR) or tab stop report (DECTABSR).

Example

The following DECRSPS sequence restores tab stops according to the tab stop report (DECTABSR):

```
DCS 2 $ t 9/ 17/ 25/ 33/ 41/ 49/ 57/ 65/ 73 ST
```

Note that the data string format above is exactly the same as the format for the tab stop report (DECTABSR).

Notes on DECRSPS

- If there is an invalid value in the DECRSPS sequence, the terminal ignores the rest of the sequence. This action may leave the terminal in a partially restored state.

Mode Settings (VT400 Mode Only)

The host can request the current settings of any ANSI or DEC private modes. In response to this request, the terminal returns a report indicating which modes are set and which are reset. The host can use the information in the report to save the current mode settings. Later, the host can restore the mode settings to their saved state.

This operation is useful for applications that need to temporarily change a number of modes. When the application is finished, it can restore the modes to their previous state.

The host requests the setting of a mode with a DECRQM sequence. The terminal responds with a DECRPM sequence. The host can then restore a saved setting with an SM or RM sequence. The following sections describe these sequences.

Request Mode (DECRQM)—Host To VT420

The host sends this control function to find out if a particular mode is set or reset. The terminal responds with a report mode function (DECRPM).

There are two versions of the DECRQM function, for ANSI and DEC private modes.

Requesting ANSI Modes

CSI	*Pa*	**$**	**p**
9/11	3/*n*	2/4	7/0

Parameters

Pa
indicates the ANSI mode that the host is asking about. Table 12–2 lists the values for *Pa*.

Requesting DEC Private Modes

CSI	*?*	*Pd*	**$**	**p**
9/11	3/15	3/*n*	2/4	7/0

Parameters

Pd
indicates the DEC private mode the host is asking about. Table 12–3 lists the values for *Pd*.

Examples

The following sequences request the setting of some ANSI modes:

Host Request	Meaning
CSI 2 $ p	What is the current state of keyboard action mode (KAM)? (KAM = 2)
CSI 4 $ p	What is the current state of insert/replace mode (IRM)? (IRM = 4)

The following sequences request the setting of some DEC private modes:

Host Request	Meaning
CSI ? 61 $ p	What is the current state of vertical cursor-coupling mode (DECVCCM)? (VCCM = 61)
CSI ? 6 $ p	What is the current state of origin mode (DECOM)? (DECOM = 6)

Notes on DECRQM

- A DECRQM sequence can only ask about one mode at a time.

Table 12–2 ANSI Modes for DECRQM, DECRPM, SM, and RM

Mode	Mnemonic	Sequence
Guarded area transfer	GATM*	1
Keyboard action	KAM	2
Control representation	CRM†	3
Insert/replace	IRM	4
Status reporting transfer	SRTM*	5
Vertical editing	VEM*	7
Horizontal editing	HEM*	10
Positioning unit	PUM*	11
Send/receive	SRM	12
Format effector action	FEAM*	13
Format effector transfer	FETM*	14
Multiple area transfer	MATM*	15
Transfer termination	TTM*	16
Selected area transfer	SATM*	17
Tabulation stop	TSM*	18
Editing boundary	EBM*	19
Line feed/new line	LNM	20

*This control function is permanently reset.

†The host cannot change the setting of CRM. You can only change CRM from set-up. If CRM is set, the terminal ignores DECRQM and most other control functions.

Table 12–3 DEC Private Modes for DECRQM, DECRPM, SM, and RM

Mode	Mnemonic	Pd
Cursor keys	DECCKM	1
ANSI	DECANM	2
Column	DECCOLM	3
Scrolling	DECSCLM	4
Screen	DECSCNM	5
Origin	DECOM	6
Autowrap	DECAWM	7
Autorepeat	DECARM	8
Print form feed	DECPFF	18
Printer extent	DECPEX	19
Text cursor enable	DECTCEM	25
National replacement character set	DECNRCM	42
Horizontal cursor coupling	DECHCCM	60
Vertical cursor coupling	DECVCCM	61
Page cursor coupling	DECPCCM	64
Numeric keypad	DECNKM	66
Backarrow key	DECBKM	67
Keyboard usage	DECKBUM	68
Vertical split screen	DECVSSM	69
Transmit rate limiting	DECXRLM	73
Key position mode	DECKPM	81

Report Mode (DECRPM)—VT420 To Host

The terminal sends this control function in response to a request mode (DECRQM) function. DECRPM informs the host whether a certain mode is set or reset.

Programming Tip

Applications can use the information in the DECRPM report to save the current mode settings. Later, the application can restore the saved mode settings.

This operation is useful for applications that need to temporarily change some of the terminal's mode settings. When the application is finished, it can restore the mode settings that were in effect before the application changed them. You use the set mode (SM) and reset mode (RM) functions to restore mode settings. SM and RM are described later in this chapter.

There are two versions of DECRPM, for ANSI and DEC private modes.

Reporting ANSI Modes

CSI	*Pa*	*;*	*Ps*	**$**	**y**
9/11	3/*n*	3/11	3/*n*	2/4	7/9

Parameters

Pa
indicates which ANSI mode the terminal is reporting on. Table 12–2 lists the values for *Pa*.

Ps
indicates the setting of the mode, as follows:

Ps	**Mode Setting**
0	Mode not recognized.
1	Set.
2	Reset.
3	Permanently set.
4	Permanently reset.

Reporting DEC Private Modes

CSI	**?**	*Pd*	*;*	*Ps*	**$**	**y**
9/11	3/15	3/*n*	3/11	3/*n*	2/4	7/9

Parameters

Pd
indicates which DEC private mode the terminal is reporting on. Table 12–3 lists the values for *Pd*.

Ps
indicates the setting of the mode. The *Ps* values are the same as for the ANSI version above.

Examples

The following sequences report the setting of some ANSI modes:

VT420 Report	**Meaning**
CSI 2 ; 1 $ y	Keyboard action mode (KAM) is currently set. (KAM = 2, set = 1)
CSI 4 ; 2 $ y	Insert/replace mode is currently reset (IRM). (IRM = 4, reset = 2)

The following sequences report the setting of some DEC private modes:

VT420 Report	**Meaning**
CSI ? 61; 1 $ y	Vertical cursor coupling mode is currently set. (DECVCCM = 61, set = 1)
CSI ? 6 ; 2 $ y	Origin mode (DECOM) is currently reset. (DECOM = 6, reset = 2)

Notes on DECRPM

- The terminal can only report on one mode at a time.

Setting or Resetting Modes (SM and RM)

ANSI and DEC private modes are control functions that have only two settings, set or reset. Soft terminal reset and hard terminal reset affect many control functions, including some ANSI and DEC private modes.

Programming Tip

Applications can use the SM and RM functions to restore any number of VT420 modes to a desired state. See the previous "Report Mode (DECRPM)" section in this chapter for details.

Set Mode (SM)

This control function has two versions. You use the ANSI version to set one or more ANSI modes. You use the DEC private version to set one or more DEC private modes. You *cannot* set ANSI and DEC private modes with the same SM sequence.

Setting ANSI Modes

CSI	*Pa*	**;**	**. . .**	*Pa*	**h**
9/11	3/*n*	3/11	. . .	3/*n*	6/8

Parameters

Pa
indicates the ANSI mode to set. Table 12–2 lists *Pa* values for ANSI modes. You can use more than one *Pa* value in a sequence.

Setting DEC Private Modes

CSI	**?**	*Pd*	**;**	**. . .**	*Pd*	**h**
9/11	3/15	3/*n*	3/11	. . .	3/*n*	6/8

Parameters

Pd
indicates a DEC private mode to set. Table 12–3 lists the *Pd* values for DEC private modes. You can use more than one *Pd* value in a sequence.

Examples

ANSI Modes
The following sequence sets keyboard action mode (KAM) and insert /replace mode (IRM):

```
CSI 2 ; 4 h
```

2 indicates keyboard action mode.
4 indicates insert/replace mode.

DEC Private Modes
The following sequence sets scrolling mode (DECSCLM) and vertical cursor-coupling mode (DECVCCM):

```
CSI ? 4; 61 h
```

4 indicates scrolling mode.
61 indicates vertical cursor-coupling mode.

Reset Mode (RM)

There are two versions of this control function. You use the ANSI version to reset one or more ANSI modes. You use the DEC private version to reset one or more DEC private modes. You *cannot* reset ANSI and DEC private modes with the same RM sequence.

Resetting ANSI Modes

CSI	*Pa*	**;**	**. . .**	*Pa*	**l**
9/11	3/*n*	3/11	. . .	3/*n*	6/12

Parameters

Pa
indicates an ANSI mode to reset. Table 12–2 lists the *Pa* values for ANSI modes. You can use more than one *Pa* value in a sequence.

Resetting DEC Private Modes

CSI	**?**	*Pd*	**;**	**. . .**	**;**	*Pd*	**l**
9/11	3/15	3/*n*	3/11	. . .	3/11	3/*n*	6/12

Parameters

Pd
indicates a DEC private mode to reset. Table 12–3 lists the *Pd* values for DEC private modes. You can use more than one *Pd* value in a sequence.

Examples

ANSI Modes
The following sequence resets keyboard action mode (KAM) and insert /replace mode (IRM):

```
CSI 2 ; 4 l
```

2 indicates keyboard action mode.
4 indicates insert/replace mode.

DEC Private Modes
The following sequence resets scrolling mode (DECSCLM) and vertical cursor-coupling mode (DECVCCM):

```
CSI ? 4; 61 l
```

4 indicates scrolling mode.
61 indicates vertical cursor-coupling mode.

Control Function Settings (VT400 Mode Only)

The host can request the current selection or setting of any control function listed in Table 12–4. In response to this request, the terminal returns a report indicating the current selection or setting of the selected control function. The host can use the information in the report to save the current setting. Later, the host can restore the control function to its saved state.

This operation is useful for applications that need to temporarily change a number of control function settings. When the application is finished, it can restore the control functions to their previous state.

The host requests the setting of a control function with a DECRQSS sequence. The terminal responds with a DECRPSS sequence. The host can then restore the control function, based on the DECRPSS report. The following sections describe DECRQSS and DECRPSS.

Table 12–4 Control Functions for DECRQSS Requests

<table>
<tr><th>Control Function</th><th>Mnemonic</th><th>Intermediate and Final Characters(s)</th></tr>
<tr><td>Enable local functions</td><td>DECELF</td><td>+ q</td></tr>
<tr><td>Local function key control</td><td>DECLFKC</td><td>* }</td></tr>
<tr><td>Select active status display</td><td>DECSASD</td><td>$ }</td></tr>
<tr><td>Select attribute change extent</td><td>DECSACE</td><td>* x</td></tr>
<tr><td>Select graphic rendition</td><td>SGR</td><td>m</td></tr>
<tr><td>Select modifier key reporting</td><td>DECSMKR</td><td>+ r</td></tr>
<tr><td>Set character attribute</td><td>DECSCA</td><td>" q</td></tr>
<tr><td>Set columns per page</td><td>DECSCPP</td><td>$ |</td></tr>
<tr><td>Set conformance level</td><td>DECSCL</td><td>" p</td></tr>
<tr><td>Set left and right margins</td><td>DECSLRM</td><td>s</td></tr>
<tr><td>Set lines per page</td><td>DECSLPP</td><td>t</td></tr>
<tr><td>Set number of lines per screen</td><td>DECSNLS</td><td>* |</td></tr>
<tr><td>Set status line type</td><td>DECSSDT</td><td>$ ~</td></tr>
</table>

Table 12–4 (Cont.) Control Functions for DECRQSS Requests

Control Function	Mnemonic	Intermediate and Final Characters(s)
Set top and bottom margins	DECSTBM	**r**

Request Selection or Setting (DECRQSS)—Host To VT420

The host sends this sequence to ask for the setting of a control function. The terminal responds with a report selection or setting (DECRPSS) sequence.

Format

DCS	$	q	*D . . . D*	ST
9/0	2/4	7/1	. . .	9/12

Parameters

D...D
indicates the control function the host is asking about. *D...D* consists of the intermediate and/or final characters of the control function requested. Table 12–4 lists the control functions the host can ask about, with their final characters.

Examples

The following DECRQSS sequence asks about the select graphic rendition (SGR) function:

```
DCS $ q m ST
```

m is the final character of the SGR sequence.

The following sequence asks about the set status line type (DECSSDT) function:

```
DCS $ q $ ~ ST
```

$ ~ are the intermediate and final characters of the DECSSDT sequence.

Notes on DECRQSS

- A DECRQSS sequence can only ask about one control function at a time.
- For control functions that have parameters (DECELF, DECLFKC), specify only the intermediate and final characters. The report will contain all parameters and show which are set and reset.

Report Selection or Setting (DECRPSS)—VT420 To Host

The terminal sends the host this sequence in response to a request selection or setting (DECRQSS) sequence. The terminal sends DECRPSS to report the setting of a particular control function.

Programming Tip

Applications can use the information in the DECRPSS report to save the current selections or settings of some control functions. Later, the application can restore the control functions to their saved state.

This operation is useful for applications that need to temporarily change the settings of some of the terminal's control functions. When the application is finished, it can restore the control functions to their previous state.

Format

DCS	*Ps*	**$**	**r**	**D . . . D**	**ST**
9/0	3/*n*	2/4	7/2	. . .	9/12

Parameters

Ps
indicates whether or not the request from the host is valid.

0	Host's request is valid.
1	Host's request is invalid.

D . . . D
indicates the current setting of a valid control function that the host asked about. *D...D* consists of all the characters in the control function, except the CSI (9/11) or ESC [(1/11, 5/11) introducer characters.

Examples

❶ The host requests the setting of the select graphic rendition (SGR) function. If the current graphic rendition is underline, blinking, and reverse, the terminal responds with the following DECRPSS sequence:

```
DCS 0 $ r 0 ; 4 ; 5 ; 7 m ST
```

0; 4 ; 5 ; 7 m are all the characters in the SGR sequence, except CSI.

❷ The host requests the setting of the set top and bottom margin function (DECSTBM). If the current top and bottom margins are set to include the complete screen area (24 lines/screen), the terminal responds with the following DECRPSS sequence:

```
DCS 0 $ r 1 ; 24 r ST
```

1 ; 24 r are all the characters in the DECSTBM sequence, except CSI.

❸ The host requests the setting of a function that the terminal does not recognize. The terminal responds with the following DECRPSS sequence:

```
DCS 1 $ r ST
```

The terminal does not send a data string (*D...D*) to the host when the terminal receives an invalid request.

Saving and Restoring the Cursor State

The save cursor function (DECSC) stores many of the terminal's selections and settings. The restore cursor function (DECRC) restores the terminal to the state saved by DECSC.

Programming Tip

Applications can use DECSC to save the current settings of many modes and control functions. Later, the application can use DECRC restore the control functions and modes to their saved state.

This operation is useful for applications that need to temporarily change the settings of some of the terminal's modes and control functions. When the application is finished, it can restore the modes and control functions to their previous state.

Save Cursor (DECSC)

Format

ESC	**7**
1/11	3/7

Description

Saves the following in the terminal's memory:

- Cursor position
- Character attributes set by the SGR command
- Character sets (G0, G1, G2, or G3) currently in GL and GR
- Wrap flag (autowrap or no autowrap)
- State of origin mode (DECOM)
- Selective erase attribute
- Any single shift 2 (SS2) or single shift 3 (SS3) functions sent

Restore Cursor (DECRC)

Restores the terminal to the state saved by the save cursor (DECSC) function.

Format

ESC	**8**
1/11	3/8

Description

If nothing was saved by DECSC, then DECRC performs the following actions:

- Moves the cursor to the home position (upper left of screen).
- Resets origin mode (DECOM).
- Turns all character attributes off (normal setting).

- Maps the ASCII character set into GL, and the DEC Supplemental Graphic set into GR.

Notes on DECSC and DECRC

- The terminal maintains a separate DECSC buffer for the main display and the status line. This feature lets you save a separate operating state for the main display and the status line.

Window Reports (VT400 Mode Only)

The host can ask the terminal how much of the current page is displayed on the screen at any time. The terminal responds by reporting how much of the page is on the screen, in terms of lines and columns.

Programming Tip

This operation is useful for applications that need to know the size of the current user window.

Request Displayed Extent (DECRQDE)

The host sends this control function to ask how much of the current page is displayed on the screen. The terminal responds with a report displayed extent (DECRPDE) sequence.

Format

CSI	"	v
9/11	2/2	7/6

Report Displayed Extent (DECRPDE)

The terminal sends this control function in response to a request displayed extent (DECRQDE) sequence. DECRPDE indicates how much of the current page is displayed on the screen for the active session.

Remember that the screen can be split into two user windows, one per session. DECRPDE indicates how much of the screen the active session has to display the current page. See *Installing and Using the VT420 Video Terminal* for details on user windows.

Format

CSI	*Ph*	**;**	*Pw;*	*Pml;*	*Pmt;*	*Pmp;*	**"**	**w**
9/11	3/*n*	3/11	3/*n*	3/*n*	3/*n*	3/*n*	2/2	7/7

Parameters

Ph
is the number of lines of the current page displayed in the active session's window, excluding the status line.

Pw
is the number of columns of the current page displayed in the active session's window.

Pml
is the column number displayed in the leftmost column of the active session's window.

Pmt
is the line number displayed in the top line of the active session's window.

Pmp
is the page number displayed in the active session's window.

User-Preferred Supplemental Set (DECRQUPSS)—(VT400 Mode Only)

Applications can ask for the current user-preferred supplemental set. The terminal responds with the assign user-preferred supplemental set (DECAUPSS) sequence (Chapter 5).

Host Request (DECRQUPSS)

The host requests the current user-preferred supplemental set by sending the following sequence:

Format

CSI	***&***	***u***
9/11	*2/6*	*7/5*

Terminal Response

The terminal uses the DECAUPSS device control string to report the current user-preferred supplemental set (Chapter 5). The terminal sends DECAUPSS in response to a DECRQUPSS sequence. The terminal can send one of the following reports:

DCS 0 ! u % 5 ST	The user-preferred supplemental set is DEC Supplemental Graphic.
DCS 1 ! u A ST	The user-preferred supplemental set is ISO Latin-1 supplemental.

Summary

Table 12–5 lists all the sequences described in this chapter.

Table 12–5 Sequences for VT420 Reports

Name	Mnemonic	Sequence		
Primary Device Attributes				
Primary DA request (Host to VT420)	DA	**CSI c** or **CSI 0 c**		
Primary DA response (VT420 to host)	DA	**CSI ?** *Psc; Ps1; ... Psn* **c**		
		Psc	=	architectural class.
		61	=	level 1 (VT100 mode).
		62, 63, 64	=	level 4 (VT400 mode).
		Ps1...Psn	=	extensions.
		1	=	132 columns.
		2	=	printer port.
		6	=	selective erase.
		7	=	soft character set.
		8	=	user-defined keys.
		9	=	NRC sets.
		15	=	DEC Technical character set.
		18	=	user windows.
		19	=	dual sessions.
		21	=	horizontal scrolling.
		See Table 12–1 for alias responses.		

Table 12–5 (Cont.) Sequences for VT420 Reports

Name	Mnemonic	Sequence
Secondary Device Attributes		
Secondary DA request (Host to VT420)	DA	**CSI > c** or **CSI > 0 c**
Secondary DA response (VT420 to host)	DA	**CSI > 41;** *Pv;Po* **c** *Pv* = firmware version. *Po* = keyboard options.
Tertiary Device Attributes (VT400 Mode Only)		
Tertiary DA request (Host to VT420)	DA	**CSI = c** or **CSI = 0 c**
DECRPTUI response (VT420 to host)	DA	**DCS ! | ** *D..D* **ST** *D...D* = unit ID.
Device Status Reports		
VT420 Operating Status		
Request (Host to VT420)	DSR	**CSI 5 n**
Report (VT420 to host)	DSR	**CSI 0 n** No malfunction. **CSI 3 n** Malfunction.
Cursor Position Report		
Request (Host to VT420)	DSR	**CSI 6 n**
Report (VT420 to host)	CPR	**CSI** *Pl; Pc* **R** *Pl* = line number. *Pc* = column number.

Table 12–5 (Cont.) Sequences for VT420 Reports

Name	Mnemonic	Sequence
Device Status Reports		
Extended Cursor Position Report		
Request (Host to VT420)	DSR	**CSI ? 6 n**
Report (VT420 to host)	DECXCPR	**CSI** *Pl; Pc; Pp* **R** *Pl* = line number. *Pc* = column number. *Pp* = page number.
Printer Status		
Request (Host to VT420)	DSR	**CSI ? 15 n**
Report (VT420 to host)	DSR	**CSI ? 13 n** No printer. **CSI ? 10 n** Printer ready. **CSI ? 11 n** Printer not ready. **CSI ? 18 n** Printer busy. **CSI ? 19 n** Printer assigned to other session.
UDK Status (VT400 Mode Only)		
Request (Host to VT420)	DSR	**CSI ? 25 n**
Report (VT420 to host)	DSR	**CSI ? 20 n** UDKs unlocked. UDKs unlocked. **CSI ? 21 n** UDKs locked.

Table 12–5 (Cont.) Sequences for VT420 Reports

Name	Mnemonic	Sequence
Device Status Reports		
Keyboard Status		
Request (Host to VT420)	DSR	**CSI ? 26 n**
Report (VT420 to host)	DSR	**CSI ? 27;** *Pn; Pst; Ptyp* **n**

	Dialect			
Pn	ANSI	PC	Pst	Keyboard Status*
0	Unknown	Unknown	0	Keyboard ready.
1	North American†	North American†	3	No keyboard.
2	British	British	8	Keyboard busy.
3	Flemish	Belgian		
4	Canadian (French)	—	Ptyp	Keyboard Type
5	Danish	Danish		
6	Finnish	Finnish	0	LK201/LK301
7	German	German	1	LK401
8	Dutch	—	2	LK443/LK444
9	Italian	Italian	3	LK421
10	Swiss (French)	Swiss (French)		
11	Swiss (German)	Swiss (German)		
12	Swedish	Swedish		
13	Norwegian	Norwegian		
14	French/Belgian	French		
15	Spanish Int.	Spanish Int.		
16	Portuguese	Portuguese		
28	Canadian (English)	—		
32	—	Spanish National		

*The terminal only sends *Pst* in VT400 mode.

†The terminal does not transmit Unknown. Unknown is for devices that cannot determine the keyboard type.

Table 12–5 (Cont.) Sequences for VT420 Reports

Name	Mnemonic	Sequence
Device Status Reports		
Macro Space		
Request (Host to VT420)	DSR	**CSI ? 62 n**
Report (VT420 to host)	DECMSR	**CSI** *Pn* *** {** $Pn = \frac{number\ of\ bytes}{16}$ rounded down.
Memory Checksum		
Request (Host to VT420)	DSR	**CSI ? 63;** *Pid* **n** *Pid* = request number.
Report (VT420 to host)	DECCKSR	**DCS** *Pid* **! ~** *D..D* **ST** *Pid* = request number. *D...D* = checksum.
Data Integrity		
Request (Host to VT420)	DSR	**CSI ? 75 n**
Report (VT420 to host)	DSR	**CSI ? 70 n** No communication errors. **CSI ? 71 n** Communication errors. **CSI ? 73 n** Not reported since last power-up or RIS.
Device Status Reports		
Multiple-Session Status		
Request (Host to VT420)	DSR	**CSI ? 85 n**

Table 12–5 (Cont.) Sequences for VT420 Reports

Name	Mnemonic	Sequence
Device Status Reports		
Report (VT420 to host)	DSR	**CSI ? 80;** *Ps2* **n** SSU sessions enabled. *Ps2* = Maximum number of sessions. **CSI ? 81;** *Ps2* **n** SSU sessions available but pending. *Ps2* = Maximum number of sessions. **CSI ? 83 n** SSU sessions not ready. **CSI ? 87 n** Sessions on separate lines.
Requesting Checksum of Rectangular Area (VT400 Mode Only)		
Request (Host to VT420)	DECRQCRA	**CSI** *Pid; Pp; Pt; Pl; Pb; Pr* * **y** *Pid* = request label. *Pp* = page number. *Pt* = top-line border. *Pl* = left-column border. *Pb* = bottom-line border. *Pr* = right-column border.
Checksum report (VT420 to host)	DECCKSR	**DCS** *Pid* **! ~** *D..D* **ST** *Pid* = request number. *D..D* = checksum.
Terminal State Reports (VT400 Mode Only)		
Request (Host to VT420)	DECRQTSR	**CSI Ps $ u** *Ps* = report requested. 0 = ignored. 1 = terminal state report.
Terminal state report (VT420 to host)	DECTSR	**DCS 1 $ s** *D..D* **ST** *D...D* = report data.

Table 12–5 (Cont.) Sequences for VT420 Reports

Name	Mnemonic	Sequence
Terminal State Reports (VT400 Mode Only)		
Restore terminal state	DECRSTS	**DCS** *Ps* **$ p** *D...D* **ST** *Ps* = data string format. 0 = error. 1 = terminal state report. *D...D* = restored data.
Presentation State Reports (VT400 Mode Only)		
Request (Host to VT420)	DECRQPSR	**CSI Ps $ w** *Ps* = report requested. 0 = error. 1 = cursor information report. 2 = tab stop report.
Cursor information report (VT420 to host)	DECCIR	**DCS 1 $ u** *D...D* **ST** *D..D* = data string. See text for description.
Tab stop report (VT420 to host)	DECTABSR	**DCS 2 $ u** *D...D* **ST** *D...D* = tab stops.
Restore	DECRSPS	**DCS Ps $ t** *D...D* **ST** *Ps* = data string format. 0 = error. 1 = cursor information report. 2 = tab stop report. *D...D* = data string.

Table 12–5 (Cont.) Sequences for VT420 Reports

Name	Mnemonic	Sequence		
Mode Settings (VT400 Mode Only)				
Request mode (Host to VT420)	DECRQM	**CSI** *Pa* **$ p**		
		Pa	=	ANSI mode. (Table 12–2)
		CSI ? *Pd* **$ p**		
		Pd	=	DEC private mode. (Table 12–3)
Report mode (VT420 to host)	DECRPM	**CSI** *Pa; Ps* **$ y**		
		Pa	=	ANSI mode. (Table 12–2)
		Ps	=	mode state.
		0	=	unknown mode.
		1	=	set.
		2	=	reset.
		3	=	permanently set.
		4	=	permanently reset.
Set mode	SM	**CSI** *Pa; ... Pa* **h**		
		Pa	=	ANSI mode(s). (Table 12–2)
		CSI ? *Pd; ... Pd* **h**		
		Pd	=	DEC private mode(s). (Table 12–3)
Reset mode	RM	**CSI** *Pa; ... Pa* **l**		
		Pa	=	ANSI mode(s). (Table 12–2)
		CSI ? *Pd; ... Pd* **l**		
		Pd	=	DEC private mode(s). (Table 12–3)

Table 12–5 (Cont.) Sequences for VT420 Reports

Name	Mnemonic	Sequence
Control Function Settings (VT400 Mode Only)		
Request (Host to VT420)	DECRQSS	**DCS $ q** *D...D* **ST** *D...D* = intermediate and/or final characters of function. (Table 12–4)
Report (VT420 to host)	DECRPSS	**DCS Ps $ r** *D...D* **ST** *Ps* = 0, valid request. *Ps* = 1, invalid request. *D...D* = intermediate and/or final characters of function. (Table 12–4)
Saving and Restoring the Cursor State		
Save cursor state	DECSC	**ESC 7**
Restore cursor state	DECRC	**ESC 8**
Window Report (VT400 Mode Only)		
Request (Host to VT420)	DECRQDE	**CSI " v**
Report (VT420 to host)	DECRPDE	**CSI** *Ph; Pw; Pml; Pmt; Pmp* **" w** *Ph* = number of lines. *Pw* = number of columns. *Pml* = first column at left. *Pmt* = top line. *Pmp* = page number.
User-Preferred Supplemental Set (VT400 Mode)		
Request (Host to VT420)	DECRQUPSS	**CSI & u**

Table 12–5 (Cont.) Sequences for VT420 Reports

Name	Mnemonic	Sequence
User-Preferred Supplemental Set (VT400 Mode)		
Report (VT420 to host)	DECAUPSS	**DCS 0 ! u % 5 ST** DEC Supplemental Graphic
		DCS 1 ! u A ST ISO Latin-1 supplemental

13

Resetting and Testing The Terminal

This chapter describes how to reset the settings of many VT420 control functions at the same time. The chapter also describes how to run the power-up self-test and other tests on the terminal, using control functions.

NOTE
You can also reset your VT420 by using set-up. See *Installing and Using the VT420 Video Terminal* for information on using set-up.

Resetting the Terminal

This section describes the control functions you can use to reset the VT420 to a saved or factory-default state. There are four control functions you can use to reset the terminal.

Soft terminal reset (DECSTR)	Selects most of the power-up factory-default settings.
Hard terminal reset (RIS)	Selects the saved settings stored in nonvolatile memory.
Secure reset (DECSR)	Sets the terminal to its power-up state to guarantee the terminal state for secure connections
Tab clear (TBC)	Clears tab stops.

Soft terminal reset, hard terminal reset, and secure reset affect many control functions, including some ANSI and DEC private modes. ANSI and DEC private modes are control functions that have only two settings, set or reset.

Soft Terminal Reset (DECSTR)

This control function changes most of the terminal's current settings to the power-up default settings listed in Table 13–1.

Available in: VT400 mode only

Format

CSI	!	p
9/11	2/1	7/0

You can also perform a soft terminal reset by selecting `Reset Session` in the Set-Up Directory screen. See *Installing and Using the VT420 Video Terminal*.

Notes on DECSTR

- DECSTR affects only those functions listed in Table 13–1.
- National replacement character set mode (DECNRCM) is not reset when you select `Reset` in set-up.

Table 13–1 Soft Terminal Reset (DECSTR) States

Mode	Mnemonic	State After DECSTR
Text cursor enable	DECTCEM	Cursor enabled.
Insert/replace	IRM	Replace.
Origin	DECOM	Absolute (cursor origin at upper-left of screen).
Autowrap	DECAWM	No autowrap.
National replacement character set	DECNRCM	Multinational set.
Keyboard action	KAM	Unlocked.
Numeric keypad	DECNKM	Numeric characters.
Cursor keys	DECCKM	Normal (arrow keys).

Table 13–1 (Cont.) Soft Terminal Reset (DECSTR) States

Mode	Mnemonic	State After DECSTR
Other Control Functions		
Set top and bottom margins	DECSTBM	Top margin = 1. Bottom margin = page length.
All character sets	G0, G1, G2, G3, GL, GR	VT420 default settings. (DECSTR works only in VT400 mode.)
Select graphic rendition	SGR	Normal rendition.
Select character attribute	DECSCA	Normal (erasable by DECSEL and DECSED).
Save cursor state	DECSC	Home position with VT420 defaults.
Assign user-preferred supplemental set	DECAUPSS	Set selected in set-up.
Select active status display	DECSASD	Main display (first 24 lines).
Key position	DECKPM	Send character codes.
Select modifier key reporting	DECSMKR	Modifier keys perform default functions.

Reset to Initial State (RIS)

This control function causes a nonvolatile memory (NVR) recall to occur. RIS replaces all set-up features with their saved settings. See *Installing and Using the VT420 Video Terminal*.

The terminal stores these saved settings in NVR memory. The saved setting for a feature is the same as the factory-default setting, unless you saved a new setting.

NOTE
Digital does not recommend using RIS to reset the terminal. You should use a soft terminal reset (DECSTR) instead. RIS usually causes a communication line disconnect and may change the current baud rate settings. When performing a RIS, the terminal

sends XOFF to the host to stop communication. When the RIS is complete, the terminal sends XON to resume communication.

Format

ESC	**c**
1/11	6/3

RIS Actions

- Sets all features listed on set-up screens to their saved settings.
- Causes a communication line disconnect.
- Clears user-defined keys for both sessions. (See Chapter 14 for details on session management.)
- Clears the screen and all off-screen page memory
- Clears the soft character set.
- Clears page memory. All data stored in page memory is lost.
- Clears the screen.
- Returns the cursor to the upper-left corner of the screen.
- Sets the select graphic rendition (SGR) function to normal rendition.
- Selects the default character sets (ASCII in GL, and DEC Supplemental Graphic in GR).
- Clears all macro definitions.
- Erases the paste buffer.

Using RIS with SSU Sessions

If you use Digital's SSU software (Chapter 14) to manage sessions, RIS does *not* disconnect communications. If SSU is enabled and at least one session is open, RIS does the following:

- Erases the screen.
- Moves the cursor to the home position.
- Performs a soft terminal reset (DECSTR).

- Resets the current session.

Secure Reset (DECSR)

This control function sets the terminal to its power-up state. DECSR lets applications know the exact state of the terminal before any attempted operations. You can use DECSR to guarantee the terminal state for secure connections. DECSR is similar to RIS, but does not perform a disconnect from the host.

Format

ESC	**[**	*Pr*	**+**	**p**
1/11	5/11	3/*n*	2/11	7/0

Parameters

Pr
is a optional random number from 0 to 16383. If *Pr* is included, the terminal sends a confirmation (DECSRC) with this number.

DECSR Actions

- Clears user-defined keys.
- Clears soft character sets.
- Clears the screen and all off-screen page memory.
- Returns the cursor to the upper-left corner of the first page.
- Resets the scrolling margins.
- Resets origin mode (DECOM) to absolute.
- Sets visual character attributes to normal.
- Sets the selective erase (DECSCA) attribute to not selectively erasable.
- Sets all character sets to the defaults (G0, G1, G2, G3, GL, GR).
- Erases macro memory.

- Erases the paste buffer.
- Reinitializes the keyboard state by
  - Clearing the keyboard input buffer
  - Canceling compose sequences
  - Resetting the keyboard to send its default codes (in NVR)
  - Unlocking the keyboard (resetting KAM)

DECSR replaces all set-up parameters to their saved settings or power-up default values. If you include the optional *Pr* parameter, the terminal returns a secure reset report to the host.

Notes on DECSR

- When using two sessions, DECSR only affects the current session. The terminal only supports secure connections for a single session. Changing from one session to two sessions causes the terminal to send a break signal to alert the host.
- DECSR works in all conformance levels (level 1 or higher).
- DECSR works in display controls mode (CRM) and causes the terminal to exit this mode.
- DECSR does not work in VT52 mode or printer controller mode. The host software must explicitly exit these modes. You can send DECSR to an attached printer if the terminal is in printer controller mode.
- The terminal buffers DECSR like any other incoming data.

Secure Reset Confirmation (DECSRC)

The terminal returns this report to the host if the *Pr* parameter was included in the last secure reset (DECSR) control function. DECSRC report indicates that the secure reset operation was successful.

Format

ESC	**[**	*Pr*	*****	**q**
1/11	5/11	3/*n*	2/10	7/1

Parameters

Pr
is the number from 0 to 16383 that was included in the corresponding secure reset sequence.

Tab Clear (TBC)

This control function clears tab stops.

Format

CSI	*Ps*	**g**
9/11	3/*n*	6/7

Parameters

Ps
indicates the tab stops to clear. There are only two values for *Ps*, 0 and 3.

0 or none (default)	The terminal only clears the tab stop at the cursor.
3	The terminal clears all tab stops.

Testing the Terminal

This section describes control functions you can use to test the operating status of the terminal. There are two tests you can run:

Screen alignment display (DECALN)
Confidence test (DECTST)

Screen Alignment Pattern (DECALN)

This control functions fills the complete screen area with a test pattern used for adjusting screen alignment. Normally, only Digital's manufacturing and service personnel would use DECALN.

Format

ESC	**#**	**8**
1/11	2/3	3/8

NOTE
DECALN sets the margins to the extremes of the page, and moves the cursor to the home position.

Invoke Confidence Test (DECTST)—Power-Up Self-Test

This control function runs one or more tests to check the terminal's operating status. If possible, the terminal displays an error message on the screen for each error it finds. The *VT420 Service Guide* explains the meaning of each message.

Format

CSI	**4**	**;**	*Ps1;*	. . .	*Psn*	**y**
9/11	3/4	3/11	**	. . .	**	7/9

Parameters

Ps1...Psn
specifies one or more tests to run on the terminal.

Ps	Test
0	All tests (1,2,3,6).
1	Power-up self test.
2	RS-232 port loopback test (worldwide model only).
3	Printer port loopback test.
6	RS-232 port modem control line loopback test (worldwide model only).
7	DEC-423 port loopback test.
9	Repeat the other tests in the control sequence.

You can run several tests at once by including more than one *Ps* parameter in the sequence. The tests do not necessarily execute in the order they appear in the sequence.

Notes on DECTST

- After executing the power-up self test, the terminal displays either a diagnostic message in the upper-left corner of the screen, or a `VT420 OK` message in the center of the screen.
- DECTST causes a disconnect to occur. You should not use DECTST if you have a modem.

Summary

Table 13–2 lists all the control functions described in this chapter.

Table 13–2 VT420 Reset Sequences

Name	Mnemonic	Sequence
Resetting the Terminal		
Soft terminal reset*	DECSTR	**CSI ! p**
Hard terminal reset	RIS	**ESC c** Not recommended.
Secure reset	DECSR	**ESC [** *Pr* **+ p** *Pr* can be any number from 0 to 16383.
Secure reset comfirmation	DECSRC	**ESC [** *Pr* * **q** *Pr* can be any number from 0 to 16383.
Tabulation clear	TBC	**CSI 0 g** Clear tab at cursor position. **CSI 3 g** Clear all tabs.
Testing the Terminal		
Screen alignment display	DECALN	**ESC 8**

*Available in VT400 mode only.

Table 13–2 (Cont.) VT420 Reset Sequences

Name	Mnemonic	Sequence		
Invoke confidence test	DECTST	**CSI 4;** *Ps1;...Psn* **y**		
		Ps	=	test to run.
		0	=	all tests.
		1	=	power-up self-test.
		2	=	RS-232 port data loopback.
		3	=	printer port loopback.
		6	=	RS-232 modem control line loopback.
		7	=	DEC-423 port loopback.
		9	=	repeat tests.

Part 4
Session Management

14

Session Management

Two Sessions

A *session* is an electronic connection between the terminal and a host system. The VT420 lets you run two sessions at the same time. Each time you establish a connection with your host system from the terminal, you open a session on the terminal.

You can use two sessions to process and view information from two sources at the same time. You can easily move back and forth between these sessions. You do not have to end one session before you begin another. You can run the two sessions on separate host systems or on the same system.

The VT420 maintains a separate *context* for each session. What you do in one session does not affect the other session.

Two Ways to Manage Sessions

When you run two sessions at the same time, you need some way to manage the flow of data to and from each session. For example, suppose a user wants to switch from session 1 to session 2. The terminal must be able to inform the host system of the switch, without affecting the normal data flow.

You can use one of two ways to manage sessions on a VT420.

- Multiple system communications (MSC)
- SSU software

Multiple system communications uses two communication lines between the terminal and host to run two sessions. Each session uses a separate line. On the VT420, the second session uses the printer/comm port. You can connect the lines to the same host (or terminal server) or two separate hosts (or terminal servers). Figure 14–1 shows some typical MSC environments.

MSC is basically a hardware solution for session management. MSC is the same type of system used by terminals that can run only one session. MSC does not require special programming commands. MSC session management is transparent to the host. The terminal manages each session locally.

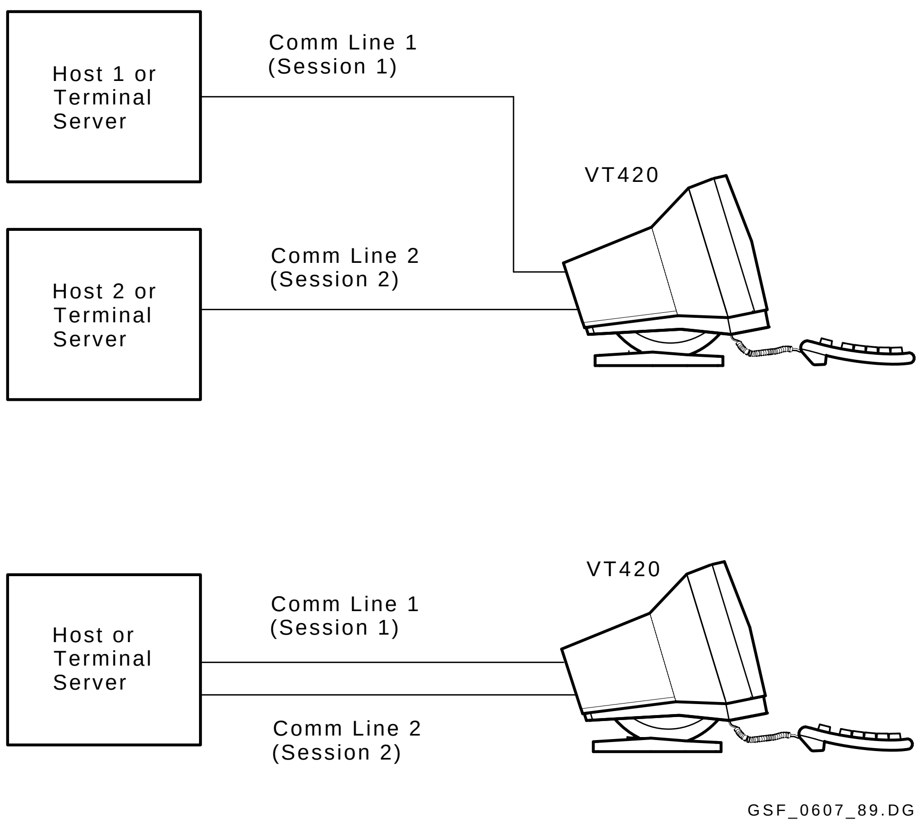

Figure 14–1 Typical MSC Environments

SSU software uses only one communication line to run two sessions. Usually, you use SSU software to run two sessions on the same host computer or terminal server. Figure 14–2 shows a typical SSU environment.

SSU software uses a protocol of system-level commands to maintain two sessions. You can use the commands that best suit your needs.

SSU software differs from MSC in the following ways:

SSU Software	MSC
Uses one communication line for two sessions.	Requires two communication lines, one for each session.
Uses a set of commands to control both sessions.	Does not use commands.
Requires that the host and terminal recognize SSU commands.	Is transparent to the host, since there are no commands to recognize.

NOTE
Make sure your system supports SSU software before you use this protocol. Your host system must be able to interpret and send SSU commands.

The next section describes how the VT420 divides its resources between two sessions. The rest of the chapter describes the two methods of session management, MSC and SSU.

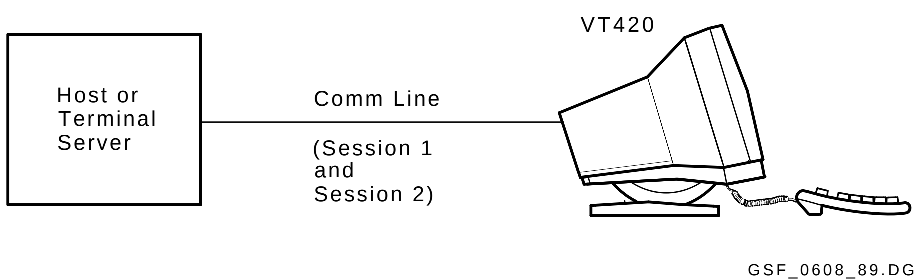

Figure 14–2 Typical SSU Environment

Session Resources

When you run two sessions on the terminal, you interact with one session at a time. This active session has primary access to the terminal's features and resources. The inactive session must wait to use some resources.

This section describes which resources each session can use independently and which resources they must share.

Independent Resources

The terminal maintains two sets of some features, so each session can use those features independently. For example, the terminal has two sets of page memory, one for each session. The terminal has two sets of the following features:

- **Page memory**

  When you run two sessions, each session has 72 lines by 80 or 132 columns of page memory.

- **ANSI text state**

  Each session maintains a record of current character sets, text attributes, and pages.

- **Status lines**

  Each session has a status line.

- **Set-Up**

  Each session has its own set-up feature settings.

- **Macro space**

  Each session has its own memory for macro definitions.

- **Downloadable character set**

  You can design and load a soft character set for each session.

- **User-defined keys (UDKs)**

  Each session can have a set of UDK definitions.

- **Communication lines**

  In an MSC environment, each session has a communication line.

Shared Resources

Only one session can use the following features at a time. If session 1 is using the resource, session 2 must wait until session 1 is finished.

- **Screen**

  You can divide the screen to display data from two sessions at the same time. However, both sessions must compete for time to update the screen. See *Installing and Using the VT420 Video Terminal* for details on dividing the screen into two windows.

- **Copy and paste buffer**

  Only the active session can use the copy and paste buffer. This feature lets you copy text from one session, switch to the other session, then send the text to the other session's host.

- **Keyboard**

  Only the active session can use the keyboard.

- **Printer port**

  Only one session at a time can use the printer port. If session 1 is using the printer, session 2 must wait until session 1 is finished.

  You can assign the printer to a particular session by using set-up, or by using a print control function Chapter 11. When you assign the printer port to a session, you restrict the use of the printer to that session.

Multiple System Communications (MSC)

Multiple system communications lets you run two sessions without software support from the host. MSC uses the primary communication port and the printer port on the rear of the terminal, one port for each session. Each session has a dedicated physical link to the host.

You can select MSC by using set-up. See *Installing and Using the VT420 Video Terminal*. You *cannot* use MSC and SSU software at the same time.

Unlike SSU software, MSC does not use a system-level protocol to maintain two sessions. MSC uses two hardwire links to the host.

SSU Software (VT Mode)

SSU software lets the terminal run two sessions over a single communication line. That is, each session shares the same communication line. SSU is a set of system-level commands that the terminal and host use to maintain sessions.

NOTE
Make sure your system supports SSU software before you use this protocol. Your host system must be able to interpret and send SSU commands.

SSU Environment

The VT420 and the host system exchange different types of data at different levels, called *layers*. When you use SSU software, there are three basic layers of data exchange between the terminal and host. These layers have an order of priority, as follows:

ANSI/VT52 layer
SSU layer
XON/XOFF flow control

ANSI/VT52 Layer

This layer includes all alphanumeric characters as well as text functions the terminal uses. The alphanumeric characters include all characters in the character sets that the terminal supports. Text functions include such tasks as selecting page format, character sets, and character attributes (for example, bold, and underline).

SSU Layer

At this layer, the terminal and host exchange SSU commands to maintain the session environment. This layer connects the terminal to the host, and controls how the terminal and host switch from session to session. SSU software can also control the flow of data between the terminal and host at the session level. However, SSU data flow control is secondary to the XON/XOFF data flow control.

XON/XOFF Data Flow Control

This layer controls the flow of data between the terminal and the host. When the terminal's receive buffer is full, this layer tells the host to stop sending data to the terminal. When the terminal's receive buffer can accept more data, this layer tells the host to resume sending data to the terminal.

This layer affects both sessions, because it controls the link between the terminal proper and the host. Appendix B describes XON/XOFF flow control in detail.

Using SSU Software

See *Installing and Using The VT420 Video Terminal* for details on using SSU session management.

Selecting Sessions (MSC or SSU Software)

You can select the active session by using the F4 key (**Alt** **Scroll Lock**) or the enable session control function.

If session 1 is the active session and you press F4 (**Alt** **Scroll Lock**), session 2 becomes the active session. Session 1 becomes the inactive session. If your host system also requires you to log in, you can log in to the second session.

The enable session command works like the F4 key (**Alt** **Scroll Lock**). If session 1 is the active session and the terminal receives the enable session command, session 2 becomes the active session. Session 1 becomes the inactive session.

Enable Session Command

This command works with MCS or SSU sessions.

Format

CSI	&	x
9/11	2/6	7/8

The session receiving the enable session command becomes the active session. The other session becomes the inactive session.

Part 5
Emulating a Personal Computer

15

Operating in PC TERM Mode

The VT420 worldwide model with PC TERM mode can emulate a personal computer. When the terminal is in PC TERM mode, you can use PC application software. You can still use most VT420 control functions described in Part 3. The primary difference between VT mode and PC TERM mode is how keyboard data is sent to the host.

This chapter describes how to enable PC TERM mode, choose PC character sets, and perform other operations in PC TERM mode. The chapter covers the following topics:

- How the VT420 operates in PC TERM mode
- Selecting PC TERM mode and PC character sets
- Scan codes sent to the host

How the VT420 Operates in PC TERM Mode

To have the VT420 emulate a personal computer, you select PC TERM mode and use a PC keyboard. In PC TERM mode, Digital's PC keyboard sends scan codes to the terminal each time you press a key or release a key.

Figure 15–1 illustrates PC mode operation. The terminal remaps the keyboard scan codes into IBM PC scan codes before sending them to the host. The host passes the information to the PC application software. The software defines each key stroke, then the host processes the information and sends it to the terminal. Finally, the terminal displays the information on the screen.

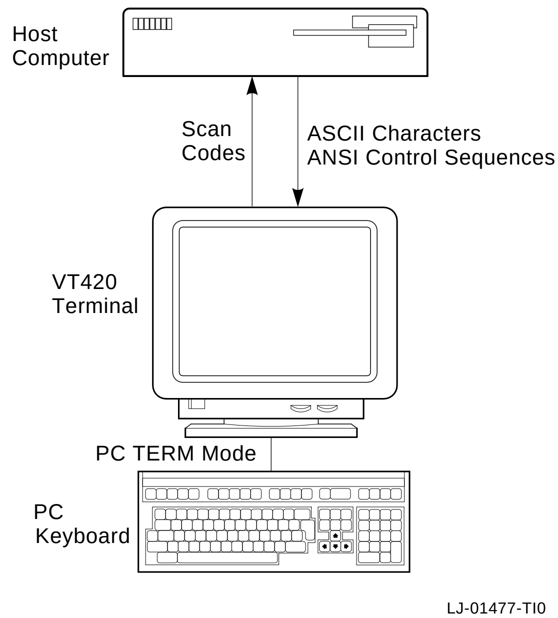

Figure 15–1 PC TERM Mode Operation

Sequence of Operations

When you select PC TERM mode, the terminal performs the following functions:

- Copies current set-up values into a work area in memory. This area is not in the terminal's nonvolatile RAM (NVR).
- Resets the terminal.
- Sets the screen display to 25 lines × 1 page, without a status display line.
- Resets the keyboard, which turns off the LEDs.
- Switches the XON code to 65_{16} characters and the XOFF code to 67_{16} characters. These pseudo scan codes are created to prevent a conflict with any keyboard key when the terminal sends data to the host. When the host wants to hold up data from the terminal, the host uses the normal ASCII characters of 11_{16} for XON and 13_{16} for XOFF.

- Loads font tables to generate characters.
- Disables the following local keyboard commands:
  - — Print screen (hard copy): Shift Print Screen
  - — Change window configuration: Ctrl Alt Scroll Lock
  - — Switch session: Alt Scroll Lock

  The host application may send the DECELF control command later to enable local keyboard commands.
- Enables the local keyboard command for entering and leaving set-up:: Alt Print Screen.
- Sends XON (65_{16}) to host.
- Turns off autowrap mode.
- Sets the cursor to blinking. The shape of the cursor is defined in the host configuration file.
- Passes keyboard scan codes directly to the host.
- Interprets control codes based on type of character set (PC or ISO Latin-1 / DEC Multinational). See "Control Codes Sent in PC TERM Mode" in this chapter.
- Ignores the select character set (SCS) sequences when you select a PC character set. The terminal uses the SCS sequences to designate ASCII character sets as a logical set (G0, G1, G2, G3) before they are mapped to the GL or GR in-use table with lock-shift sequences such as LS0 and LS1R. You can select a character set from the General Set-Up screen.

Control Codes Sent in PC TERM Mode

In PC TERM mode, the terminal interprets control codes based on the type of character set—PC or ISO Latin-1 / DEC Multinational.

The ISO Latin-1 and DEC Multinational character sets have control codes in the C0 and C1 locations (Chapter 2). If you select the ISO Latin-1 or DEC Multinational set in PC TERM mode, the terminal treats characters in the C0 and C1 locations (00_{16} through $1F_{16}$ and 80_{16} through $9F_{16}$) as control characters to execute. When you select display controls mode, these characters are displayed on the screen.

PC character sets have displayable characters mapped into all 256 character locations. When you select a PC character set in PC TERM mode, C0 locations can have both control characters and display characters. Table 15–1 lists the C0 codes that the terminal treats as control functions to execute. All other C0 and C1 locations always select a display character.

Table 15–1 Control Codes for PC Character Sets

Code	Code	Code
ENQ 0/5	**LF** 0/A	**DC1** 1/1
BEL 0/7	**VT** 0/B	**DC3** 1/3
BS 0/8	**FF** 0/C	**ESC** 1/B
HT 0/9	**CR** 0/D	

The table also applies to PC character sets selected in VT mode with a PC keyboard.

To send the display characters that also occupy the locations in Table 15–1, you send the character as the second half of a byte pair:

ESC	*character*
11_{10}	*xx*

The *xx* character value can be in the 00_{10} to 127_{10} range. See the PC character sets in this chapter.

Enabling or Disabling PC TERM Mode

You can enable and disable PC TERM mode from the General Set-Up screen or by using the change emulation mode sequence.

Change Emulation Mode

In this mode, the terminal can use only one PC character set at a time.

Format

ESC	[	?	Ps	;	Pc	r
1/11	5/11	3/15	3/*n*	3/11	3/*n*	7/2

Parameters

Ps

selects the operating mode.

Ps	Operating Mode
0 (default)	VT mode with a PC keyboard
1	PC TERM mode

Pc

selects one PC character set or a UPSS character set.

Pc	Character Set
0 (default)	default
1	PC Multilingual
2	PC International
3	PC Danish/Norwegian
4	PC Spanish
5	PC Portuguese
6	UPSS DEC Supplemental
7	UPSS ISO Latin-1

Enabling PC Keyboard Commands

When you select PC TERM mode, the PC keyboard enables one local keyboard command, for entering and leaving set-up. Other local keyboard commands are disabled. You can control these commands by an escape sequence from the host. You can also control some commands from the set-up screens. Table 15–2 lists each command and its key sequence.

Table 15–2 PC Keyboard Commands in PC TERM Mode

		Can Be Controlled By	
Command	**Key Sequence**	**Escape Sequence**	**Set-Up Screen**
Enabled in PC TERM Mode			
Set-Up	Alt Print Screen	√	√
Disabled in PC TERM Mode			
Switch session	Alt Scroll Lock	√	√
Print screen	Shift Print Screen	√	√
Windows	Ctrl Alt Scroll Lock	√	√
Pan down, one line	Ctrl ↑	√	
Pan up, one line	Ctrl ↓	√	
Hold screen, Session 1	Scroll Lock	√	
Hold screen, Session 2	Ctrl Scroll Lock	√	
Size up	Ctrl Shift ↑	√	
Pan down, one line	Ctrl Shift ↓	√	

Data and Commands Sent from the Host to the Terminal

Screen formatting (data) commands follow the ANSI standard in PC TERM mode.

In PC TERM mode, the terminal processes most commands from the host as it does in VT mode. The terminal processes the following commands normally: clear the screen, move the cursor, and pan. However, the terminal ignores query commands that normally cause the terminal to send a reply.

Secondary DA—PC Keyboard

See Chapter 12, “Device Attributes (DA),” for a description of the secondary device attribute (DA).

DSR—PC Keyboard Status

See Chapter 12, “Device Status Report (DSR),” for the PC keyboard device status report (DSR).

Using PC Character Sets

This section describes 8-bit PC character sets and how you can select them. PC character sets only operate in the 8-bit character mode.

The VT420 worldwide terminal with PC TERM mode has five built-in PC character sets. You can select these character sets in PC TERM mode and VT mode.

- PC International (Figure 15–2 and Figure 15–3)
- PC Multilingual (Figure 15–2 and Figure 15–4)
- PC Danish/Norwegian (Table 15–3)
- PC Portuguese (Table 15–3)
- PC Spanish (Table 15–3)

Row	Column	GL 0		GL 1		GL 2		GL 3		GL 4		GL 5		GL 6		GL 7	Row
0	Ø	0 0 0	▶	20 16 10	SP	40 32 20	0	60 48 30	@	100 64 40	P	120 80 50	`	140 96 60	p	160 112 70	0
1	☺	1 1 1	◀	21 17 11	!	41 33 21	1	61 49 31	A	101 65 41	Q	121 81 51	a	141 97 61	q	161 113 71	1
2	☻	2 2 2	↕	22 18 12	"	42 34 22	2	62 50 32	B	102 66 42	R	122 82 52	b	142 98 62	r	162 114 72	2
3	♥	3 3 3	!!	23 19 13	#	43 35 23	3	63 51 33	C	103 67 43	S	123 83 53	c	143 99 63	s	163 115 73	3
4	♦	4 4 4	¶	24 20 14	$	44 36 24	4	64 52 34	D	104 68 44	T	124 84 54	d	144 100 64	t	164 116 74	4
5	♣	5 5 5	§	25 21 15	%	45 37 25	5	65 53 35	E	105 69 45	U	125 85 55	e	145 101 65	u	165 117 75	5
6	♠	6 6 6	▬	26 22 16	&	46 38 26	6	66 54 36	F	106 70 46	V	126 86 56	f	146 102 66	v	166 118 76	6
7	•	7 7 7	↨	27 23 17	'	47 39 27	7	67 55 37	G	107 71 47	W	127 87 57	g	147 103 67	w	167 119 77	7
8	◘	10 8 8	↑	30 24 18	(	50 40 28	8	70 56 38	H	110 72 48	X	130 88 58	h	150 104 68	x	170 120 78	8
9	○	11 9 9	↓	31 25 19	)	51 41 29	9	71 57 39	I	111 73 49	Y	131 89 59	i	151 105 69	y	171 121 79	9
10	◙	12 10 A	→	32 26 1A	*	52 42 2A	:	72 58 3A	J	112 74 4A	Z	132 90 5A	j	152 106 6A	z	172 122 7A	10
11	♂	13 11 B	←	33 27 1B	+	53 43 2B	;	73 59 3B	K	113 75 4B	[	133 91 5B	k	153 107 6B	{	173 123 7B	11
12	♀	14 12 C	∟	34 28 1C	,	54 44 2C	<	74 60 3C	L	114 76 4C	\	134 92 5C	l	154 108 6C	|	174 124 7C	12
13	♪	15 13 D	↔	35 29 1D	-	55 45 2D	=	75 61 3D	M	115 77 4D	]	135 93 5D	m	155 109 6D	}	175 125 7D	13
14	♫	16 14 E	▲	36 30 1E	.	56 46 2E	>	76 62 3E	N	116 78 4E	^	136 94 5E	n	156 110 6E	~	176 126 7E	14
15	☼	17 15 F	▼	37 31 1F	/	57 47 2F	?	77 63 3F	O	117 79 4F	_	137 95 5F	o	157 111 6F	⌂	177 127 7F	15

LEGEND

	GL	
	4/1	**Column/Row**
A	101 65 41	**Octal Decimal Hex**

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Figure 15–2 PC International and PC Multilingual Character Sets (CO and GL)

Row	Column	GR 8		GR 9		GR 10		GR 11		GR 12		GR 13		GR 14		GR 15	Row
0	Ç	200 128 80	É	220 144 90	á	240 160 A0	░	260 176 B0	└	300 192 C0	╨	320 208 D0	α	340 224 E0	≡	360 240 F0	0
1	ü	201 129 81	æ	221 145 91	í	241 161 A1	▒	261 177 B1	┴	301 193 C1	╤	321 209 D1	β	341 225 E1	±	361 241 F1	1
2	é	202 130 82	Æ	222 146 92	ó	242 162 A2	▓	262 178 B2	┬	302 194 C2	╥	322 210 D2	Γ	342 226 E2	≥	362 242 F2	2
3	â	203 131 83	ô	223 147 93	ú	243 163 A3	│	263 179 B3	├	303 195 C3	╙	323 211 D3	Π	343 227 E3	≤	363 243 F3	3
4	ä	204 132 84	ö	224 148 94	ñ	244 164 A4	┤	264 180 B4	─	304 196 C4	╘	324 212 D4	Σ	344 228 E4	⌠	364 244 F4	4
5	à	205 133 85	ò	225 149 95	Ñ	245 165 A5	╡	265 181 B5	┼	305 197 C5	╒	325 213 D5	σ	345 229 E5	⌡	365 245 F5	5
6	å	206 134 86	û	226 150 96	ª	246 166 A6	╢	266 182 B6	╞	306 198 C6	╓	326 214 D6	μ	346 230 E6	÷	366 246 F6	6
7	ç	207 135 87	ù	227 151 97	º	247 167 A7	╖	267 183 B7	╟	307 199 C7	╫	327 215 D7	τ	347 231 E7	≈	367 247 F7	7
8	ê	210 136 88	ÿ	230 152 98	¿	250 168 A8	╕	270 184 B8	╚	310 200 C8	╪	330 216 D8	Φ	350 232 E8	°	370 248 F8	8
9	ë	211 137 89	Ö	231 153 99	⌐	251 169 A9	╣	271 185 B9	╔	311 201 C9	┘	331 217 D9	Θ	351 233 E9	•	371 249 F9	9
10	è	212 138 8A	Ü	232 154 9A	¬	252 170 AA	║	272 186 BA	╩	312 202 CA	┌	332 218 DA	Ω	352 234 EA	·	372 250 FA	10
11	ï	213 139 8B	¢	233 155 9B	½	253 171 AB	╗	273 187 BB	╦	313 203 CB	█	333 219 DB	δ	353 235 EB	√	373 251 FB	11
12	î	214 140 8C	£	234 156 9C	¼	254 172 AC	╝	274 188 BC	╠	314 204 CC	▄	334 220 DC	∞	354 236 EC	^{n}	374 252 FC	12
13	ì	215 141 8D	¥	235 157 9D	¡	255 173 AD	╜	275 189 BD	═	315 205 CD	▌	335 221 DD	ϕ	355 237 ED	^{2}	375 253 FD	13
14	Ä	216 142 8E	Pts	236 158 9E	«	256 174 AE	╛	276 190 BE	╬	316 206 CE	▐	336 222 DE	ε	356 238 EE	■	376 254 FE	14
15	Å	217 143 8F	ƒ	237 159 9F	»	257 175 AF	┐	277 191 BF	╧	317 207 CF	▀	337 223 DF	∩	357 239 EF	SP	377 255 FF	15

LEGEND

	GR	
	12/1	Column/Row
┴	301 193 C1	Octal Decimal Hex

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Figure 15–3 PC International Character Set (C1 and GR)

Row	GR 8	GR 9	GR 10	GR 11	GR 12	GR 13	GR 14	GR 15	Row
0	Ç 200 128 80	É 220 144 90	á 240 160 A0	░ 260 176 B0	└ 300 192 C0	ð 320 208 D0	Ó 340 224 E0	– 360 240 F0	0
1	ü 201 129 81	æ 221 145 91	í 241 161 A1	▒ 261 177 B1	┴ 301 193 C1	Đ 321 209 D1	ß 341 225 E1	± 361 241 F1	1
2	é 202 130 82	Æ 222 146 92	ó 242 162 A2	▓ 262 178 B2	┬ 302 194 C2	Ê 322 210 D2	Ô 342 226 E2	= 362 242 F2	2
3	â 203 131 83	ô 223 147 93	ú 243 163 A3	│ 263 179 B3	├ 303 195 C3	Ë 323 211 D3	Ò 343 227 E3	¾ 363 243 F3	3
4	ä 204 132 84	ö 224 148 94	ñ 244 164 A4	┤ 264 180 B4	─ 304 196 C4	È 324 212 D4	õ 344 228 E4	¶ 364 244 F4	4
5	à 205 133 85	ò 225 149 95	Ñ 245 165 A5	Á 265 181 B5	┼ 305 197 C5	ı 325 213 D5	Õ 345 229 E5	§ 365 245 F5	5
6	å 206 134 86	û 226 150 96	ª 246 166 A6	Â 266 182 B6	ã 306 198 C6	Í 326 214 D6	µ 346 230 E6	÷ 366 246 F6	6
7	ç 207 135 87	ù 227 151 97	º 247 167 A7	À 267 183 B7	Ã 307 199 C7	Î 327 215 D7	þ 347 231 E7	¸ 367 247 F7	7
8	ê 210 136 88	ÿ 230 152 98	¿ 250 168 A8	© 270 184 B8	╚ 310 200 C8	Ï 330 216 D8	Þ 350 232 E8	° 370 248 F8	8
9	ë 211 137 89	Ö 231 153 99	® 251 169 A9	╣ 271 185 B9	╔ 311 201 C9	┘ 331 217 D9	Ú 351 233 E9	¨ 371 249 F9	9
10	è 212 138 8A	Ü 232 154 9A	¬ 252 170 AA	║ 272 186 BA	╩ 312 202 CA	┌ 332 218 DA	Û 352 234 EA	· 372 250 FA	10
11	ï 213 139 8B	ø 233 155 9B	½ 253 171 AB	╗ 273 187 BB	╦ 313 203 CB	█ 333 219 DB	Ù 353 235 EB	¹ 373 251 FB	11
12	î 214 140 8C	£ 234 156 9C	¼ 254 172 AC	╝ 274 188 BC	╠ 314 204 CC	▄ 334 220 DC	ý 354 236 EC	³ 374 252 FC	12
13	ì 215 141 8D	Ø 235 157 9D	¡ 255 173 AD	¢ 275 189 BD	═ 315 205 CD	¦ 335 221 DD	Ý 355 237 ED	² 375 253 FD	13
14	Ä 216 142 8E	× 236 158 9E	« 256 174 AE	¥ 276 190 BE	╬ 316 206 CE	Ì 336 222 DE	¯ 356 238 EE	■ 376 254 FE	14
15	Å 217 143 8F	ƒ 237 159 9F	» 257 175 AF	┐ 277 191 BF	¤ 317 207 CF	▀ 337 223 DF	´ 357 239 EF	SP 377 255 FF	15

LEGEND

GR	
12/1	**Column/Row**
┴ 301 193 C1	**Octal Decimal Hex**

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Figure 15–4 PC Multilingual Character Set (C1 and GR)

National PC Character Sets

The National PC character sets are the same as the PC International character set, except as indicated in the following table:

Table 15–3 National PC Character Sets

PC Character Set	Hexadecimal Value					
	86	**89**	**8B**	**8C**	**8E**	**8F**
PC International	å	ë	ï	î	Ä	Å
PC Danish/ Norwegian						
PC Spanish	À					È
PC Portuguese	Á	Ê	Í	Ô	Ã	Â
	91	**92**	**93**	**94**	**96**	**98**	**99**
PC International	æ	Æ	ô	ö	û	ÿ	Ö
PC Danish/ Norwegian							
PC Spanish	Í	Ó				Á	
PC Portuguese	À	È	ô	õ	Ú	Ì	Õ
	9B	**9D**	**9F**	**A9**	**AA**	**AF**	
PC International		¥	ƒ	⌐	¬	»	
PC Danish/ Norwegian	ø	Ø				¤	
PC Spanish	Ò	Ú	Ï	|.	⌞.		
PC Portuguese		Ù	Ó	Ò			

Selecting PC Character Sets

When you select a PC character set, the terminal ignores the select character set (SCS) escape sequences. The SCS is not necessary, because the terminal can place only one PC character at a time in the in-use table. In PC TERM mode or VT400 mode, there are two ways to select a PC character set:

1. From the General Set-Up screen
2. With the change emulation mode sequence

The change emulation mode command sequence, which enables and disables PC character sets and PC TERM mode. See “Enabling or Disabling PC TERM Mode” in this chapter.

PC Keyboard Codes

This section describes the codes the terminal sends to the host in PC TERM mode, when you connect a PC keyboard. See Chapter 3 for a description of the codes the PC keyboard and terminal send in VT mode.

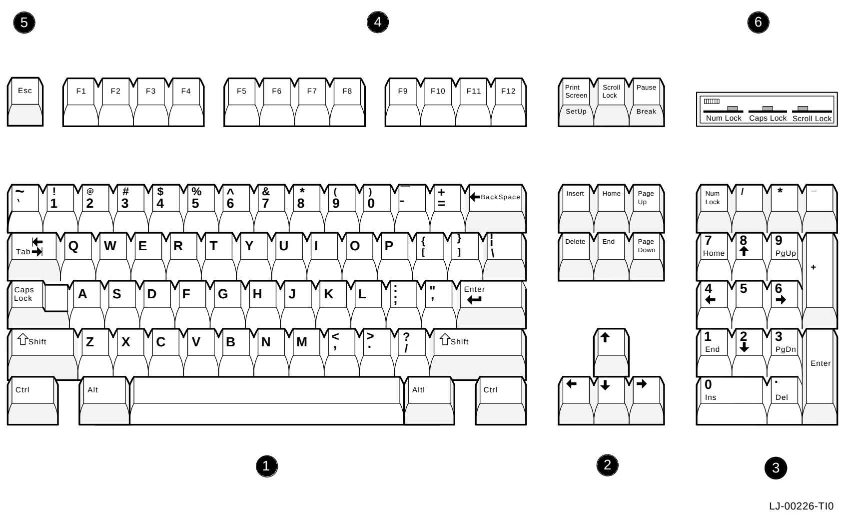
The VT420 worldwide model with PC TERM mode can use different national keyboard dialects. Each keyboard dialect pertains to a different country or region of western Europe. You can select the appropriate dialect by setting the **keyboard language** feature in the Set-Up Directory.

Scan Codes

In PC TERM mode, the terminal maps the keyboard scan codes to IBM PC keyboard scan codes. The terminal sends a unique IBM PC scan code directly to the host each time you press a key and each time you release a key. The PC software in the host defines the key codes.

Layout

The PC keyboard has four groups of keys and three indicator lights. The keys are grouped by function. The PC keyboard also has two audible indicators, a keyclick and bell.



❶ Main keypad
❷ Editing keypad
❸ Numeric keypad
❹ Top-row function keys
— Predefined keys
— Programmable keys
❺ Escape key
❻ Indicator lights

Main Keypad

The layout of the main keypad is similar to a typewriter keyboard with standard keys, such as alphanumeric characters, punctuation marks, and **Shift** keys. The main keypad also has a number of keys not found on a typewriter, such as the top-row function keys and the **Ctrl** and **Alt** keys.

Key Assignments

The following sections list the scan codes sent by each PC keyboard key in PC TERM mode. Keys are referred to by number. There are two models of the PC keyboard:

- North American, with 101 keys (Figure 15–5)
- Worldwide, with 102 keys (Figure 15–6)

The figures show the number assigned to each key.

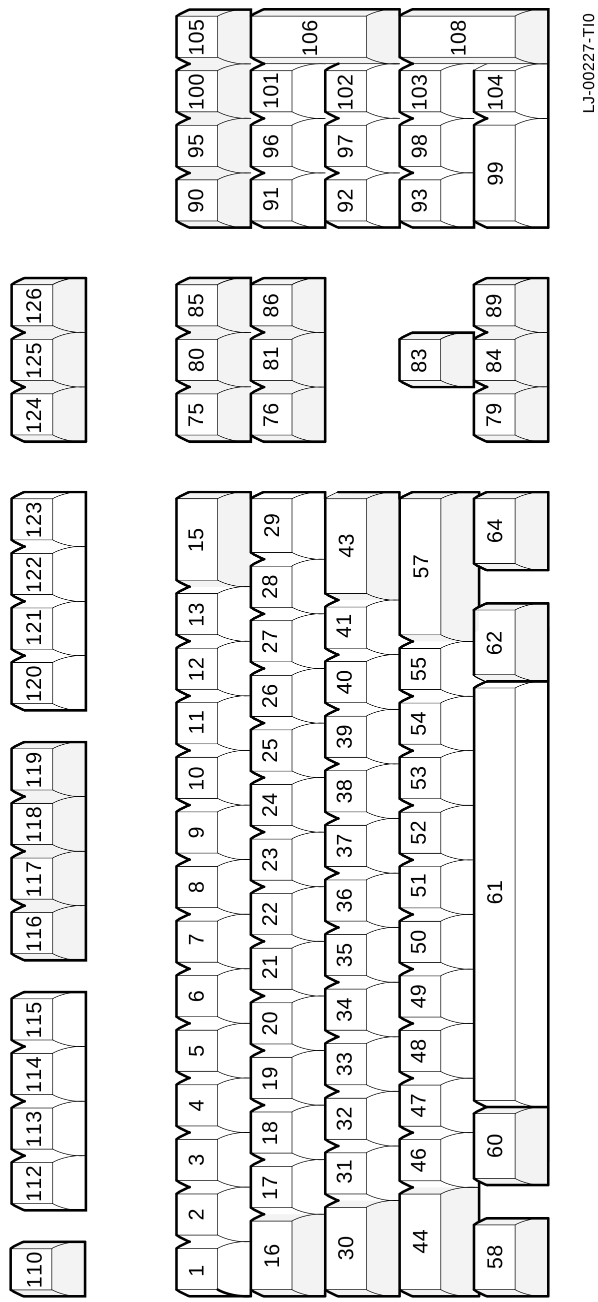


Figure 15–5 North American PC Keyboard (101 Keys)

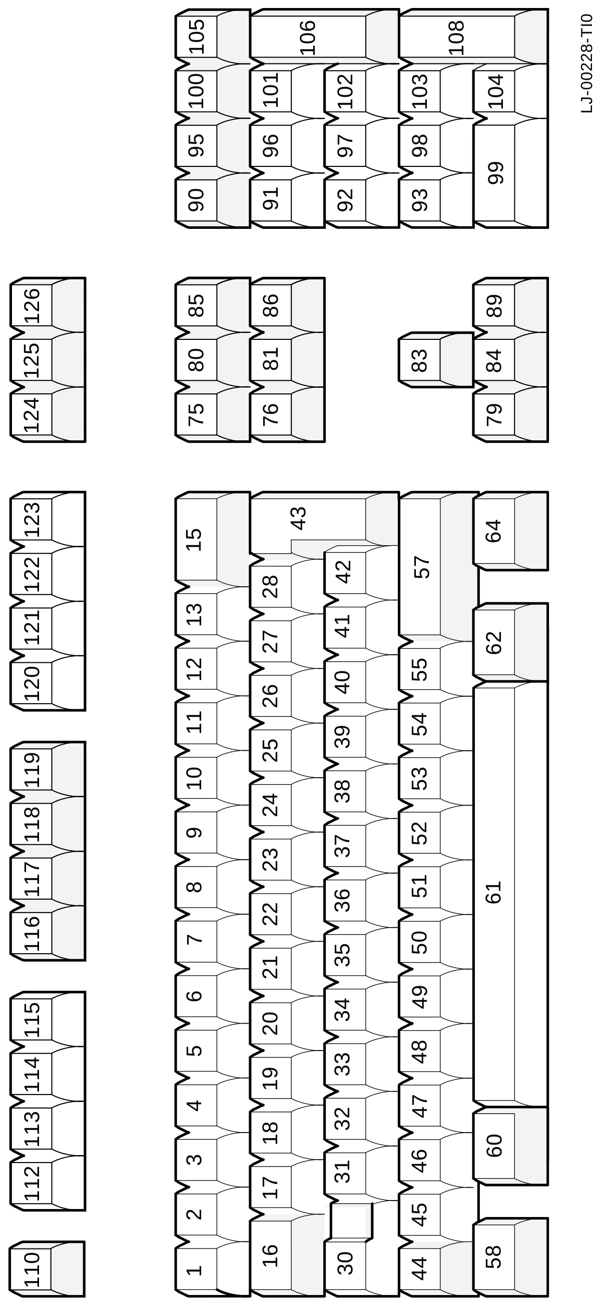


Figure 15–6 Worldwide PC Keyboard (102 Keys)

Standard Keys

The standard keys send scan codes for the alphanumeric characters. Table 15–4 lists the scan codes sent to generate the alphanumeric characters and other symbols. The key numbers in the table correspond to the key numbers in Figures 15–5 and 15–6.

Table 15–4 Scan Codes Sent by Standard Keys

Key	Make Code	Break Code
1	29	A9
2	02	82
3	03	83
4	04	84
5	05	85
6	06	86
7	07	87
8	08	88
9	09	89
10	0A	8A
11	0B	8B
12	0C	8C
13	0D	8D
15	0E	8E
16	0F	8F
17	10	90
18	11	91
19	12	92
20	13	93
21	14	94
22	15	95
23	16	96
24	17	97
25	18	98
26	19	99
27	1A	9A
28	1B	9B
29*	2B	AB
30	3A	BA

*This key is on the PC keyboard with 101 keys only.

Table 15–4 (Cont.) Scan Codes Sent by Standard Keys

Key	Make Code	Break Code
31	1E	9E
32	1F	9F
33	20	A0
34	21	A1
35	22	A2
36	23	A3
37	24	A4
38	25	A5
39	26	A6
40	27	A7
41	28	A8
42†	2B	AB
43	1C	9C
44	2A	AA
45†	56	D6
46	2C	AC
47	2D	AD
48	2E	AE
49	2F	AF
50	30	B0
51	31	B1
52	32	B2
53	33	B3
54	34	B4
55	35	B5
57	36	B6
58	1D	9D
60	38	B8
61	39	B9
62	E0 38	E0 B8
64	E0 1D	E0 9D

†This key is on the PC keyboard with 102 keys only.

Editing Keypad

The editing keypad includes editing and arrow keys. Table 15–5 lists the scan codes sent to generate editing key functions. Key numbers correspond to Figures 15–5 and 15–6.

Table 15–5 Scan Codes Sent by Editing and Arrow Keys

Key	Make Code	Break Code
Unshifted, or Shifted with Num Lock On		
75	E0 52	E0 D2
76	E0 53	E0 D3
79	E0 4B	E0 CB
80	E0 47	E0 C7
81	E0 4F	E0 CF
83	E0 48	E0 C8
84	E0 50	E0 D0
85	E0 49	E0 C9
86	E0 51	E0 D1
89	E0 4D	E0 CD
Shifted*		
75	E0 AA E0 52	E0 D2 E0 2A
76	E0 AA E0 53	E0 D3 E0 2A
79	E0 AA E0 4B	E0 CB E0 2A
80	E0 AA E0 47	E0 C7 E0 2A
81	E0 AA E0 4F	E0 CF E0 2A
83	E0 AA E0 48	E0 C8 E0 2A
84	E0 AA E0 50	E0 D0 E0 2A
85	E0 AA E0 49	E0 C9 E0 2A
86	E0 AA E0 51	E0 D1 E0 2A
89	E0 AA E0 4D	E0 CD E0 2A

*When you press the right **Shift** key, the make/break action sends the scan code B6/36 instead of AA/2A. When you press the right and left **Shift** keys, both scan codes are sent.

Key	Make Code	Break Code
Num Lock On		
75	E0 2A E0 53	E0 D2 E0 AA
76	E0 2A E0 54	E0 D3 E0 AA
79	E0 2A E0 4B	E0 CB E0 AA
80	E0 2A E0 47	E0 C7 E0 AA
81	E0 2A E0 4F	E0 CF E0 AA
83	E0 2A E0 48	E0 C8 E0 AA
84	E0 2A E0 50	E0 D0 E0 AA
85	E0 2A E0 49	E0 C9 E0 AA
86	E0 2A E0 51	E0 D1 E0 AA
89	E0 2A E0 4D	E0 CD E0 AA

Numeric Keypad

Table 15–6 lists the scan codes sent to generate the numeric keypad characters. Key numbers correspond to Figures 15–5 and 15–6.

Table 15–6 Scan Codes Sent by Numeric Keypad Keys

Key	Make Code	Break Code
90	45	C5
91	47	C7
92	4B	CB
93	4F	CF
95	E0 35	E0 B5
	Shifted*	**Shifted***
	E0 AA E0 35	E0 B5 E0 2A
96	48	C8
97	4C	CC
98	50	D0
99	52	D2
100	37	B7
101	49	C9
102	4D	CD

*When you press the right **Shift** key, the make/break action sends the scan code B6/36 instead of AA/2A. When you press the the right and left **Shift** keys, both scan codes are sent.

Table 15–6 (Cont.) Scan Codes Sent by Numeric Keypad Keys

Key	Make Code	Break Code
103	51	D1
104	53	D3
105	4A	CA
106	4E	CE
108	E0 1C	E0 9C

Top-Row Function Keys

Table 15–7 lists the scan codes sent by the top-row function keys. Key numbers correspond to Figures 15–5 and 15–6.

Table 15–7 Scan Codes Sent by Programmable Function Keys

Key	Make Code	Break Code
110	01	81
112	3B	BB
113	3C	BC
114	3D	BD
115	3E	BE
116	3F	BF
117	40	C0
118	41	C1
119	42	C2
120	43	C3
121	44	C4
122	57	D7
123	58	D8
124	E0 2A E0 37	E0 B7 E0 AA
	Ctrl, Shifted	**Ctrl, Shifted**
	E0 37	E0 B7
	Alt	**Alt**
	54	D4
125	46	C6
		Ctrl
126*	E1 1D 45 E1 9D C5	E0 46 E0 C6

*This key is not typematic. All associated scan codes occur on the make of the key.

A

VT52 Mode Control Codes

The VT52 mode lets the VT420 terminal operate like a VT52 terminal. You use VT52 mode with applications designed for the VT52.

NOTE
VT52 mode may not be included in future Digital terminals. Programmers should only write new software for the ANSI operating mode. Software should avoid switching indiscriminately between ANSI and VT52 modes. In VT52 mode, the terminal ignores many features and settings used in the ANSI environment. To avoid confusion, write all new software for the ANSI operating mode.

VT52 Mode

You use the DECANM control function to change the terminal to the VT52 mode of operation. In VT52 mode, the VT420 acts like a VT52 terminal. This mode lets you use applications designed for a VT52 terminal.

CSI	**?**	**2**	**l**
9/11	3/15	3/2	6/12

Table A-1 lists and describes all the escape sequences you can use when the terminal is in VT52 mode.

Notes on DECANM

- ANSI private control functions are not available.
- The DEC Supplemental Graphic, ISO Latin-1 supplemental, and NRC sets are not available.
- C1 control characters are not available.
- The ASCII character set defaults to G0.

Exiting VT52 Mode

You can exit VT52 mode by using the following escape sequence.

ESC	**<**
1/11	3/12

When you you exit VT52 mode, the terminal returns to the mode it was in before entering VT52 mode.

Table A–1 VT52 Escape Sequences

Sequence	Action
ESC A	Cursor up.
ESC B	Cursor down.
ESC C	Cursor right.
ESC D	Cursor left.
ESC F	Enter graphics mode.
ESC G	Exit graphics mode.
ESC H	Cursor to home position.
ESC I	Reverse line feed.
ESC J	Erase from cursor to end of screen.
ESC K	Erase from cursor to end of line.
ESC Y Pn	Move cursor to column Pn.
ESC Z	Identify. (host to terminal)
ESC / Z	Report. (terminal to host)
ESC =	Enter alternate keypad mode.
ESC >	Exit alternate keypad mode.
ESC <	Exit VT52 mode. (Enter VT100 mode.)
ESC ^	Enter autoprint mode.
ESC _	Exit autoprint mode.
ESC W	Enter printer controller mode.
ESC X	Exit printer controller mode.
ESC]	Print screen.
ESC V	Print the line with the cursor.

B

Communication

This appendix provides information on how the VT420 communicates with a host computer and a printer. The appendix describes how XON and XOFF characters help control the data flow between the terminal and the host system or the printer. For information on cables, see the "Communication" appendix in *Installing and Using the VT420 Video Terminal*.

The terminal operates only on full-duplex asynchronous lines, with eight possible transmit and receive speeds. You can transmit at one speed and receive at another, but you must use the same speeds as your host system or printer.

To match your host system's speed, use the Communications Set-Up screen. To match the printer's speed, use the Printer Set-Up screen. *Installing and Using the VT420 Video Terminal* describes the set-up screens.

You can connect the terminal directly to a local host system, using a cable. You can also connect the terminal to a remote system, as follows:

- **In VT mode:** You can use (1) a terminal server, or (2) a modem or acoustic coupler connected to public-switched or dedicated telephone lines.
- **In PC TERM mode:** You can use a modem, but not a terminal server. If you use a modem, the modem's XON and XOFF points must match the terminal's XON and XOFF points, as described in this appendix.

Standards

The VT420 operates in accordance with the following national and international communication standards from the Electronic Industries Association (EIA) and the Comite Consultatif International de Telegraphique et Telephonique (CCITT).

EIA 232-D
CCITT V.24
CCITT V.28
CCITT V.10
ISO 2110.2

Host System and Printer Port Interfaces

The VT420 has two asynchronous serial ports available for communication with a host computer: Comm1 and Comm2. The Comm1 port is for communication with the primary host computer. The Comm2 port is for connecting to a local printer, or to a secondary host computer.

Comm1 Connectors (Primary Host)

- 25-pin subminiature D-type (EIA RS-232/RS-423) connector that connects the terminal to a local or remote host system (worldwide model only)
- 6-pin DEC-423 connector that connects the terminal to a local host system

On the worldwide model, you select which Comm1 connector is active by using the **comm port selection** feature in the Global Set-Up screen. See *Installing and Using the VT420 Video Terminal.*

Comm2 Connector (Printer or Secondary Host)

- 6-pin DEC-423 connector

DEC-423 cabling lets you run your terminal at higher speeds and over longer distances than the RS-232 standards. When you use the RS-232 connector, you are limited to 50 feet of cable between the host system and terminal. When you use the DEC-423 connector, you can use up to 1000 feet of cable between the host system and printer.

The "Communication" appendix in *Installing and Using the VT420 Video Terminal* lists the pin assignments for all VT420 connectors.

Modems

The VT420 can operate with all modems conforming to the national and international standards listed at the beginning of this appendix. However, the modem at the terminal must be compatible with the modem at the host system.

NOTE
In PC TERM mode, the modem's XON and XOFF points must match the terminal's XON and XOFF points. In PC TERM mode, the XON point is 65_{16} characters, and the XOFF point is 67_{16} characters.

You can use Digital's DF124, DF212, DF224, and DF242 modems with the VT420. You can also use compatible modems and acoustic couplers, such as the AT&T 103, 113, and 212A types.

The terminal must be certified for connection to non-AT&T type modems used outside of continental North America. Your local Digital Field Service office has detailed information on terminal certification and use of non-AT&T type modems.

Printers

You can connect the terminal to a local asynchronous serial printer by using a null modem cable. Here are some of the Digital printers you can use with the VT420:

LA Series		Letter-Quality	Laser	Plotter
LA12	LA50	LQP02	LN01	LJ250 †
LA34	LA75	LQP03	LN03*	LJ251†
LA35	LA100 /LA210	DEClaser 1100†		
LA36	LA324	DEClaser 2100†		
LA38		DEClaser 2200†		

*With an H8751-A adapter.

†With an H8751-E adapter.

Character Format

The VT420 can send and receive characters in a 7-bit or 8-bit format. The asynchronous character format consists of a start bit (space), the data bits (1 = mark, 0 = space), the parity bit (if present) and 1 or 2 stop bits (mark). The data bits represent a character, with the least significant bits leading.

You can set the parity bit to even, odd, or none, using the **data bits /parity** feature in the Communications Set-Up screen.

For more information on the asynchronous character format, see ANSI X3.15-1976, "American National Standard for bit sequencings of the American National Standard Code for Information Interchange in Serial-by-Bit Data Transmission."

Terminal-to-Host Data Flow Control

Normally, the VT420 processes and displays characters as fast as it receives them. If the host system sends data faster than the terminal can display it, the terminal can use XON/XOFF flow control to tell the host to wait until the terminal has caught up.

The VT420 stores incoming characters in a 254-character input buffer. When the buffer fills to a predetermined level (XOFF point), the terminal sends an XOFF character to stop the host system from sending more characters. When the buffer empties to an appropriate level (XON point), the terminal sends an XON character to tell the host to resume sending characters.

If the terminal is set up to run one session in VT mode, you can select a first XOFF point of 64 or 128 characters (Communications Set-Up screen). The XON point is 32 characters. If the host system fails to respond to the first XOFF character, the terminal sends another XOFF character when the buffer fills to 220, and when the buffer is completely full.

NOTE
In PC TERM mode, the XON point is 65_{16} characters, and the XOFF point is 67_{16} characters.

If you use SSU software to run two sessions in VT mode, you can select a first XOFF point of 64, 256, or 1792. SSU provides its own credit-based flow control, so XOFF is not needed.

For normal interactive use, you should use the default XOFF point of 64 characters. This setting prevents the host system from getting too far ahead of what is displayed on the screen. In some cases, using an XOFF point greater than 64 characters may improve the average speed for processing characters, since the host does not have to wait as often.

NOTE
If you select `No XOFF` in set-up, the terminal does not send an XOFF character to the host system when the input buffer fills. Selecting `No XOFF` also disables the F1 (Scroll Lock) Hold key function. If XOFF is disabled, there is no way to ensure that data will not be lost.

When XON/XOFF Flow Control is Enabled

If you set the **XOFF** feature to `64`, `128`, `256`, or `1792` in VT mode, you enable XON/XOFF flow control. The terminal recognizes received XON and XOFF characters. When the terminal receives XOFF, the terminal stops sending data (except XON and XOFF characters). If the keyboard data buffer overflows, the keyboard locks and the `Wait` indicator appears on the keyboard indicator line at the bottom of the screen. The terminal resumes transmission when it receives an XON.

When XON/XOFF flow control is enabled, the terminal sends XON and XOFF characters under the following conditions:

Conditions that Send XON

- The number of characters in the input buffer reaches the XON point (32 characters) and the last flow control character sent was XOFF.
- The power self-test is completed (Chapter 7).
- You perform a `Clear Comm` operation, either from the Set-Up Directory or with a hard reset (RIS) function.
- You perform a `Recall` operation, either from the Set-Up Directory or with a hard reset (RIS) function.
- You press the F1 (Scroll Lock) Hold key to release the screen when the input buffer is at or below the XON point.

Conditions that Send XOFF

- The number of characters in the input buffer reaches the first XOFF point (64 or 128 characters, selected from the Communications Set-Up screen) for the first time since the last XON was sent.

- The number of characters in the input buffer reaches the second XOFF point (220 characters) for the first time since the last XON was sent.
- The terminal receives a character when the input buffer is full (256 characters).

Using Fill Characters

Software that does not support XON and XOFF characters from the terminal can still use all terminal features, by using fill characters. In some applications, you can use the terminal without XON/XOFF support or fill characters. However, the bit rate must be limited to 9600, and the software must not send the ESC (escape code), or use slow scrolling or the printer port.

Transmit Rate Limiting

When you enable this feature, the VT420 limits the rate at which it sends data to the host to 150 to 180 characters/second, with even spacing. Some host systems can only keep up with the relatively slow input of keys typed manually from the keyboard. Rate limiting simulates this condition and reduces the interrupt burden on the host.

When this feature is disabled, the terminal sends all messages and keystrokes as fast as possible, limited only by the current transmit speed setting.

Transmit Rate Limiting (DECXRLM)

Applications can control the transmit rate limiting feature through the DECXRLM control function.

Default: Unlimited

Format

CSI	**?**	**7**	**3**	**h**	Set: limited transmit rate.
9/11	3/15	3/7	3/3	6/8	
CSI	**?**	**7**	**3**	**l**	Reset: unlimited transmit rate.
9/11	3/15	3/7	3/3	6/12	

Modem Connections and Disconnections

When the VT420 makes a connection to the host system through a modem, the terminal performs the following operations to ensure it is ready to send and receive.

- Unlocks the keyboard (if it was locked).
- Clears any transmission in progress.
- Clears the keyboard buffer and all message buffers.
- Clears the input buffer.
- Clears XOFF sent and XOFF received.

Any of the following conditions will disconnect the connection to the host system in VT mode:

- You press Shift F5 (**Shift** **Break**).
- You use the `Recall` or `Default` fields in the Set-Up Directory.
- *Worldwide model* : You change the host port you are using (from the RS-232 port to the DEC-423 port, or from the DEC-423 port to the RS-232 port).
- The terminal loses the data set ready (DSR) signal.
- The terminal loses the received line signal detect (RLSD) signal for a peiod of time you defined in set-up. See the **disconnect delay** feature in the Communications Set-Up screen.
- The terminal does not receive an RLSD signal within 30 seconds after DSR.
- The terminal receives a self-test command from the host system.

The usual way to disconnect communications is to type Shift F5 (**Shift** **Break**). The host system's response to the disconnect signal depends on the system and the software.

Terminal-to-Printer Data Flow Control

The VT420 sends only data characters to the printer. The terminal does not send XON and XOFF characters. The terminal recognizes only XON and XOFF characters from the printer. Any other characters from the printer are ignored.

When the terminal receives XOFF from the printer, the terminal stops sending data. The terminal starts sending data again when it receives an XON, or when a clear comm operation is performed.

Using C1 Control Characters

Using an 8-bit setting for the printer port implies the use of 8-bit C1 control characters. Using a 7-bit setting implies the use of the 7-bit ESC [form of C1 control characters. You select the setting by using the **data bits/parity** feature in the Printer Set-Up screen. For more information on control characters, see Chapter 2 in this manual.

NOTE
Older printers may not recognize the 8-bit form of C1 control characters. With these printers, you must set the printer port to 7-bits for correct operation.

C

Related Documentation

You can order the following VT420 manuals from Digital:

Installing and Using the VT420 Video Terminal with PC Terminal Mode	**EK-VT42A-UU**

Provides information to install, operate and maintain the VT420 worldwide model that includes PC terminal (PC TERM) mode. Describes the ANSI, short ANSI, and PC keyboard keys and indicators, set-up screens, and compose sequences (used to select characters not otherwise available from the keyboard).

Installing and Using the VT420 Video Terminal

Worldwide Model	**EK-VT420-UU**
North American Model	**EK-VT420-UG**

Provides information to install, operate and maintain the VT420 models that do not include PC terminal mode. Describes the ANSI keyboard keys and indicators, set-up screens, and compose sequences (used to select characters not otherwise available from the keyboard).

VT420 Service Guide	**EK-VT420-PS**

Provides qualified service personnel with information to troubleshoot and repair all VT420 models.

D

Compatibility With Other Digital Terminals

This appendix compares the VT420 video terminal to Digital's VT320 and VT220 video terminals.

Feature	**VT420**	**VT320**	**VT220**
Character Attributes			
Blinking	Yes	Yes	Yes
Bold	Yes	Yes	Yes
Double height	Yes	Yes	Yes
Double width	Yes	Yes	Yes
Reverse video	Yes	Yes	Yes
Underline	Yes	Yes	Yes
Character Sets			
ASCII	Yes	Yes	Yes
DEC Special Graphic	Yes	Yes	Yes
DEC Supplemental Graphic	Yes	Yes	Yes
Downloadable	Yes	Yes	Yes
ISO Latin-1	Yes	Yes	No
National replacement	Yes	Yes	Yes

Feature	VT420	VT320	VT220
DEC Technical	Yes	No	No
Communication			
Speed up to 38.4K	Yes	No	No
Composite video output	No	No	Yes
6-pin DEC-423 serial port	Yes	Yes	No
25-pin RS-232 serial port	Yes	Yes	Yes
20 milliampere port	No	No	Yes
Optional integral modem	No	No	Yes
Printer port	6-pin DEC-423	6-pin DEC-423	9-pin RS-232
Bidirectional printer port	Yes	Yes	Yes
Two session capability with SSU (VT mode)	Yes	No	No
Compatibility			
VT52	Yes	Yes	Yes
VT100	Yes	Yes	Yes
VT102	Yes	Yes	Yes
VT220	Yes	Yes	Yes
VT320	Yes	Yes	No
Conformance Level	4	3	2
Display Features			
Overscan	Yes	No	No
Variable screen height	Yes	No	No
Default character cell			
80 columns	10 × 16	15 × 12	10 × 10
132 columns	6 × 16	9 × 12	6 × 10

Feature	**VT420**	**VT320**	**VT220**
Cathode ray tube size	359 mm 14 inch	359 mm 14 inch	307 mm 12 inch
Display type	Flat	Flat	Convex
Nonglare screen	Etch	Etch	Coated
Pixel shape	Square	Square	Rectangular
Terminal status line	Yes	Yes	No
Host status line	Yes	Yes	No
Keyboard indicator line	Yes	No	No
Extra display line when status line disabled	Yes	No	No
External Features			
Keyboard	LK401 108 keys	LK201 105 keys	LK201 105 keys
Tilt-swivel base	Yes	Optional	No
Other Features			
User windows	Yes	No	No
Off screen page memory	Yes	No	No
Macro feature	Yes	No	No
Rectangular area operations	Yes	No	No
Local copy and paste	Yes	No	No
Terminal state inquiry	Yes	Yes	No
Screen adjustment from set-up	Yes	No	No
Secure terminal environment	Yes	No	No
Function key controls	Yes	No	No

Glossary

7-bit code extension technique

A method for expressing 8-bit control characters as 7-bit escape sequences.

Active position

The location on the screen where the next typed character will appear. The *cursor* indicates the active position.

Active session

The session that is currently accepting input from the keyboard.

Alias response

A sequence used by the terminal to identify itself to the host as some other type of terminal. You can select these responses in set-up. Each response corresponds to a certain operating level.

ANSI

American National Standards Institute

ANSI character types

There are two types of ANSI characters, graphic and control.

Graphic characters are alphanumeric characters that you can display on the screen. These characters include letters, numbers, punctuation, and any other characters you can display.

Control characters are characters you do not usually display. They make the terminal perform specific functions in data communication and text processing. Carriage return (CR), form feed (FF), and escape (ESC) are examples of control characters.

ANSI key layout

A setting in VT mode that allows the terminal's PC keyboard keys to work like the corresponding keys on the ANSI keyboard. This feature is useful if you are using a PC keyboard, but are more familiar with the ANSI keyboard layout.

ANSI keyboard

A name for Digital's LK401 and LK402 keyboards, indicating that the keyboards follow the ANSI standards for transmitting data. See also *Short ANSI keyboard*.

Application

A computer program designed to perform a specific task, such as a word processor. Applications are usually coded using high-level programming languages, such as FORTRAN or Pascal.

ASCII

American Standard Code for Information Interchange. A set of 7- or 8-bit binary numbers representing the alphabet, punctuation, numerals, and other special symbols used in text representation and communications protocol.

Autorepeat

A VT420 feature that makes most keys send their character repeatedly when you hold the key down. You can turn the autorepeat feature on and off by using the Keyboard Set-Up screen or the DECARM control function (Chapter 11.)

Auxiliary keypad

See *numeric keypad*.

Baud rate

The speed at which the terminal communicates with the host system or a printer. The baud rate is measured in bits/second.

Bit

The smallest unit of storable information in a digital machine. A bit can assume one of two values, 0 (on) or 1 (off).

CCITT

Comite Consultatif International de Telegraphique et Telephonique (International Telegraph and Telephone Consultative Committee). A standards committee for the communication industry in Europe.

Character cell

The pixel area on the screen that the terminal uses to display a single graphic character.

Character encoding

All terminals and computers encode information as binary digits, or bits. Older systems use 7 bits to encode each character. Newer systems such as the VT420 use 8 bits, which provide more codes. The newer systems can also use the 7-bit codes.

The VT420 uses an 8-bit character encoding system and a 7-bit code extension technique.

Character-coding format

There are two types of character-coding formats, 7-bit and 8-bit.

The 7-bit coding format uses 7 bits to store each character in the terminal's memory. The ASCII character set uses a 7-bit coding format.

The 8-bit coding format uses 8 bits to store each character in the terminal's memory. The DEC Supplemental Graphic character set uses an 8-bit format.

Character set

There are two types of character sets, hard and soft.

A hard character set is any one of the terminal's built-in character sets. Hard character sets in the VT420 include the ASCII, DEC Supplemental Graphic, ISO Latin-1 supplemental graphic, DEC Special Graphic, DEC Technical, national replacement character (NRC) sets (worldwide model only). The VT420 with PC TERM mode includes PC character sets, and all of the VT420's character sets.

A soft character set is any character set that you define using a DECDLD device control string (Chapter 5). Soft character sets are also called *downloadable* sets and dynamically redefinable sets (DRCS).

Code table

A list of all characters in a *character set* with their codes. Most standard character sets put similar characters into groups, so they have similar codes. A code table lets you see groups of characters and their relative codes clearly.

Column

A vertical row of character positions on the screen. You can display 80- or 132-column lines.

Compose sequence

A series of keystrokes you can use to display a character that does not appear on any single key. Compose sequences start with the Compose Character key. The German model keyboard uses the Group Shift key. See *Installing and Using the VT420 Video Terminal* for details.

Context

The operating information for a *session*. For example, the settings of set-up features are part of a session's context. The terminal maintains a separate context for each session.

Control characters

Characters that make the terminal or host system perform specific functions in data communications and text processing. The terminal usually does not display control characters. The VT420 uses two groups of control characters, C0 and C1.

C0 (control zero) and C1 (control one) characters

The VT420 uses the ANSI definitions for the functions of C0 and C1 controls.

C0 control characters are in postions 0/0 through 0/15 in the left half (GL) of the 8-bit code table. You can use C0 characters directly in a 7- or 8-bit environment.

C1 control characters are in positions 8/0 through 9/15 in the right half (GR) of the 8-bit code table. You can use C1 characters directly in an 8-bit environment. You can use C1 controls in a 7-bit environment by coding them as 2-byte escape sequences (ESC *final*).

Control functions

Commands you use in your applications to make the terminal perform special functions. These functions range from the simple— editing data— to the complex—reporting on the terminal's operating state. Control functions include control characters, device control strings, control sequences, and escape sequences.

Control sequence

Any control function that begins with the C1 CSI control character.

Coupled cursor

A *cursor* that appears to pull the *user window* through the *page*. When the cursor tries to move beyond the borders of the window, it pans in that direction to keep the cursor visible. If the user window is the complete screen, the cursor looks like it is connected, or coupled, to the screen.

Cursor

An indicator that highlights the *active position* on the screen. The VT420 uses different cursor characters for (1) text, (2) set-up, and (3) the CRT saver feature. The default cursor for text is a blinking block. You can select other cursor characters.

DA

Device attributes. A report the terminal can provide to the host on request. A DA report can provide the host with information about the terminal such as conformance level, basic features, identification code, and firmware version level. The host can use this information to adjust the computing environment and make the best use of the terminal's features.

DA exchange

An exchange between the host and VT420 in which the host requests and the terminal responds with basic information about the terminal, such as the terminal's identification code.

Data flow control

The method used to synchronize communication between the terminal and the host system or a printer.

Data processing keys

Keys that have three or four characters on the top of their keycap, rather than the normal two. Every keyboard used with the terminal, except the North American keyboard, has some data processing keys. To use data processing characters, you must set the **typewriter/data processing keys** feature in Keyboard Set-Up screen to `Data Processing Keys`.

DCS

A C1 control character that introduces *device control strings*. DCS is in position 9/0 of the 8-bit code table. You can use the equivalent 7-bit escape sequence ESC P when coding for a 7-bit environment.

DEC private control functions

Private sequences created by Digital for specific families of products. ANSI sequences and DEC private sequences follow ANSI standards for character codes.

In this manual, private control functions created by Digital have the prefix DEC in their mnemonic name. For example, column mode has the mnemonic DECCOLM. All other control functions are ANSI sequences.

DEC Multinational character set

The factory-*default* character set for the VT420. The left half of this set is the the 7-bit ASCII set (with *C0 control characters*), stored in the *GL* table. The right half is the 8-bit DEC Supplemental Graphic set (with *C1 control characters*), stored in the *GR* table.

DEC Special Graphic character set

A 7-bit character set with 94 graphic characters, built into the VT420. The DEC Special Graphic set has special symbols and line segments, plus many of the graphic characters found in the ASCII character set. Another name for this character set is the VT100 line drawing character set.

DEC Supplemental Graphic character set

An 8-bit character set with 94 graphic characters, built into the VT420. The graphic characters include letters with accents and diacritical marks, used in many European languages. There are also special symbols, such as currency signs.

DEC Technical character set

This 7-bit character set has 94 graphic characters and symbols often used in technical applications such as schematic and logic diagrams.

Default

A standard factory setting for a terminal feature. The VT420 uses default settings for features and control functions, until you change the settings. Many control functions use default values for *parameters*. If you omit a value, the terminal uses the default value.

Designate

Assign a character set to one of the terminal's four logical sets, G0 through G4. This is the first of two steps in selecting a character set for use. The second step is mapping the character set.

Device control string (DCS)

A special form of control function you can use for such operations as downloading character sets or defining user-defined keys. Device control strings begin with the DCS control character.

Diacritical marks

Marks or symbols that indicate a change in the standard pronunciation of a letter. Examples of diacritics are the acute accent (´), grave accent (`), and tilde (~).

On the worldwide model of the VT420, you can use diacritical marks in two-stroke compose sequences.

Display

The area of the video screen where the terminal can present visible data.

Display controls mode

A special operating mode that lets you display control codes as graphic characters, when you want to debug your applications. In this mode, the terminal does not perform control functions.

Download

Move data from the *host* system to the terminal. For example, you can download a *soft character set* into the terminal.

Downloadable (soft) character set

A character set that an application loads into the VT420 from the host system. The character set can have up to 96 graphic characters. You can design your own soft character set. You can use the set in the *GL* or *GR* table. The terminal stores soft characters in its DRCS buffer. When you turn off the terminal, the soft characters are lost.

DRCS

Dynamically redefinable character set. See *downloadable character set*.

DSR

(1) Device status report. The host system sends a DSR request to the terminal to ask for the operating status of several terminal features, such as operating status and cursor position.

(2) Data set ready signal. The state of this signal indicates the status of the printer port.

Echo

To display characters on the screen, in addition to sending them to the host. Either the host or the terminal can echo characters.

Editing keypad

The group of 10 keys (including the arrow keys) to the right of the main keypad. Table 3–1 lists the codes sent by the editing keys, and Table 3–3 lists the codes sent by the arrow keys on the ANSI keyboards. The scan codes for the PC keyboard editing keypad are listed in Chapter 15. Normally, you use the arrow keys to control the cursor on the screen.

Emulation
A method that lets the VT420 operate like other VT series terminals. For example, you can operate the VT420 like a VT220 terminal to run applications designed for the VT220.

Environment
The coding scheme a system uses to encode characters. Today, most systems use an 8-bit coding scheme, where each character of data is represented by an 8-bit binary code. The VT420 can operate in a 7- or 8-bit environment.

ESC
The escape character. Introduces *escape sequences*.

Escape sequences
Control functions that begin with the C0 control character ESC.

Firmware
All commands and control functions that are built into the terminal, such as the editing functions.

Font
A set of graphic characters, all of one size and style.

Full-cell fonts
A font that can individually address all pixels in a cell because the margins separate adjacent characters. Usually, text fonts cannot individually address all pixels.

Graphic left (GL) table
The left half of the terminal's *in-use table*. The GL table can store up to 94 graphic characters for immediate use. You can store characters in the 2/1 through 7/14 range of character positions. You can use GL codes in 7-bit or 8-bit environments.

Graphic right (GR) table
The right half of the terminal's *in-use table*. The GR table can store up to 96 graphic characters for immediate use. You can store characters in the 10/1 through 15/15 range of character positions. Some 8-bit character sets only use 94 of these GR codes. You can use GR codes only in an 8-bit environment.

Graphic characters

Characters you can display on a video screen. Graphic characters include letters, numbers, punctuation, and any other characters you can display.

Graphic rendition

The appearance of a display character, including all of its *visual character attributes*. You use the select graphic rendition (SGR) control function to select visual character attributes.

Hard character set

One of the terminal's built-in character sets, such as the ASCII, DEC Supplemental Graphic, and ISO Latin-1 sets. Some models also have PC character sets.

Home cursor position

Usually the upper-left corner of the screen. However, home position can also be the upper-left corner of the scrolling region (that is, the area within the margins). See "Origin Mode (DECOM)" in Chapter 11.

Host

The computer or terminal server that you connect to the terminal. You cannot connect the VT420 to a terminal server in PC TERM mode.

In-use table

The area in the terminal's memory that defines the character set(s) the terminal is currently using. The in-use table comprises the *C0, GL, C1, and GR* logical tables.

ISO

International Standards Organization (ISO).

ISO Latin Alphabet Nr 1 supplemental set (ISO Latin-1)

An 8-bit character set with 96 graphic characters, built into the VT420. Like the DEC Supplemental Graphic set, the ISO Latin-1 set includes letters with accents and diacritical marks, used in many European languages. The ISO Latin-1 set also has other special symbols, not included in the DEC Supplemental Graphic set. The ISO Latin-1 set is specified in the ISO standard ISO 8859.1.

Layers

The different levels of data exchange between the VT420 and the host system. When you use *SSU*, there are three layers of data exchange between the terminal and the host: ANSI/VT52, SSU, and XON/XOFF flow control.

Line attribute

The visual attributes for a complete display line on the screen.

Local

An operating state in which data entered at the keyboard is sent to the screen, but not to the host. The terminal stores data received from the host, until you return the terminal to the *on-line* state.

Locking shift

A control function used to map a designated character set into the terminal's *in-use table* as *GL* or *GR*. When you use a locking shift, the character set remains in GL or GR until you use another locking shift.

Map

Move a designated character set into the terminal's *in-use table* as *GL* or *GR*. Mapping is the second of two steps in selecting a character set for use. The first step is *designating* the character set. After a set is mapped, it is available from the keyboard.

Margins

See *scrolling margins*.

Mnemonic

An abbreviated name for a control character or control function. For example, CR is the mnemonic for the carriage return control character.

Modifier key

A key pressed in combination with another key, to modify the function of that key. The Ctrl key is a modifier key.

Multiple system communications (MSC)

A method for managing *sessions*, using a separate communication line for each session. The other method for managing sessions is Digital's SSU software.

National replacement character sets (NRCs)

A general name for a class of 7-bit, 94-character sets created for different languages and dialects. The VT420 has several NRC sets for many European languages. The NRC sets are based on ISO standard 646.

Numeric keypad

A group of keys on the right side of the VT420 keyboard that can send numbers and punctuation marks, or special control functions defined by an application (Chapters 3 and 11).

NVR

Nonvolatile RAM (random access memory). NVR retains information when power is turned off. The VT420 stores the factory-default and saved settings for set-up features in the terminal's NVR.

On-line

An operating state of the terminal in which the terminal can communicate with a host system. The terminal sends data entered at the keyboard to the host. The terminal displays data received from the host on the screen.

Operating mode

A functional state of the terminal that determines which VT420 features you can use.

All VT420 terminals have the following operating modes: VT400, VT100, and VT52. Some models also have PC TERM mode. You can use VT400 mode to run VT320 and VT220 applications and PC TERM mode to run PC applications. You can select each mode from the keyboard (using set-up) or from the host (using control codes). The VT420 uses standard ANSI functions in all operating modes, except VT52 mode. See Chapter 1.

Origin

The *home cursor position* on the screen. You can set the home position at the upper-left of the screen or within the scrolling margins.

Page

A section of the terminal's *page memory*. Each page has left, right, top, and bottom scrolling margins. You can define the size and layout of a page by using set-up features or control functions.

Page format

The size and number of pages in the terminal's *page memory*. You can arrange page memory into 1 to 6 pages, depending on whether you use single or *dual sessions*. You can also define the margins of a page.

Page memory

A storage area in the terminal for displayed text, when operating in VT mode. The size of this memory is equal to 144 display lines by 80 or 132 display columns. You can divide page memory into one or more pages. The amount of page memory available depends on whether you use one or two sessions.

Parameter characters

Variable characters in a control function that define the action or limits of that function. See Chapter 2.

PC character sets

Character sets for use with PC applications, when operating the terminal in PC TERM mode. VT420 terminals with PC TERM mode have several 8-bit PC character sets with 127 graphic characters. The graphic characters include letters with accents and diacritical marks, used in many European languages. There are also special symbols, such as currency signs, and other symbols used with personal computers.

PC key layout

The normal setting for the terminal's PC keyboard, in which keys perform their labeled functions. You can change the setting to *ANSI key layout*.

PC keyboard

A name for Digital's LK443 and LK444 keyboards, indicating that they use PC standards for transmitting data. Compare to *ANSI keyboard*.

PC TERM mode

An operating mode available on some VT420 models that lets the terminal support a PC keyboard and run PC software applications. You can select PC TERM mode or VT mode from the General Set-Up screen or with a control sequence from the host.

Pixel

Picture element. The smallest unit of display on the video screen. All graphic characters are displayed in terms of pixels.

Port

A connector on the rear of the terminal that lets the VT420 communicate with another device or host system.

Presentation state report

A VT420 *report* that indicates the settings of the terminal's *character attributes* and *cursor*, or the settings of its tab stops.

Report

Operating information that the terminal provides the host system. The VT420 can provide the host with report information such as identification (type of terminal), cursor state, operating status, conformance level (1, 2, or 3), and extensions.

Reset

(1) To change the terminal's operating features to their default or saved settings. (2) To change the setting of an ANSI or DEC private mode to its *reset state*.

Reset state

One of two possible settings for an ANSI or DEC private mode. Modes are control functions that have only two settings.

Reset to initial state

A control function that resets many of the terminal's features to a group of saved settings. Also called a hard terminal reset. You can perform a reset to initial state by selecting the `Recall` field in the Set-Up Directory.

Restore

To set the terminal to the latest saved operating state. Restoring the terminal is not the same as resetting the terminal. See *reset*.

RIS

See *reset to initial state.*

Scan code

The code that a keyboard key generates when pressed and released. In PC TERM mode, the terminal remaps the keyboard scan code to an IBM scan code and sends it directly to the host computer. In VT mode, the terminal converts the scan code to a character code or control sequence before passing it to the host.

Scrolling

Moving data between the *scrolling margins* on the screen. Data scrolled past the margins is lost from the terminal's memory.

Scrolling margins

The top, bottom, left, and right boundaries on the screen, beyond which data cannot be written or scrolled.

Session

An electronic connection between the terminal and host.

Set-Up

A series of display screens that list the terminal's operating features. Each screen lists a group of features, such as communications or printing. You can examine and change the current settings. For example, you can select the transmit or receive speeds and supplemental character sets. *Installing and Using the VT420 Video Terminal* describes how to use set-up.

Single shift

A control character (SS2 or SS3) used to map a designated character set into the terminal's *in-use table* for one character only. You use a single shift when you want to display the next character from a different character set. A single shift maps the G2 or G3 set into GL. The character set is active for only one character, then the terminal returns to the previous character set in GL.

Short ANSI keyboard

A compact version of Digital's ANSI keyboard, for those who make little use of the numeric and editing keypads on the ANSI keyboard. All keypad functions are still available, by typing a two-stroke Extend key sequence.

Sixel

A column of 6 pixels on the screen. When you load a *soft character set* into the terminal, you use sixel data to code each character.

Soft character sets

See *downloadable (soft) character sets*.

SSU

Digital's software protocol for managing two VT420 *sessions* over one communication line. The other method for managing sessions is *multiple system communications* (MSC).

ST

String terminator character. ST is a C1 control character. You can use the equivalent 7-bit sequence ESC \ (1/11, 5/12) when coding for a 7-bit environment.

Status line

A line of text that appears as reverse video below the user window. There are three possible status line settings: indicator, host-writable, and disabled (default). You select the setting by using the **status display** feature in the Display Set-Up screen. PC TERM mode does not have a status line.

The indicator status line displays operating information about the terminal. The host-writable status line displays information provided by an application. When disabled, the indicator status line appears only when you use set-up.

Terminal state report

A *report* that indicates the complete state of the terminal, except for the current UDK definitions and the soft character set.

Top-row function keys

The function keys on the top row of the keyboard. In VT mode, the first five keys—F1 (Hold), F2 (Print), F3 (Set-Up), F4 (Session), and F5 (Break)—are predefined function keys. In PC TERM mode, only the Print Screen/SetUp key has a predefined function. You can change the function of the predefined keys from the Keyboard Set-Up screen. You can define the function of the other top-row function keys. See *user-defined keys*.

Typewriter keys

The keys on the main keypad. On the worldwide model of the VT420, some keys also have *data processing* characters.

User-defined keys (UDKs)

The function keys on the top row of the keyboard that you can define to send selected characters or control functions. To define the function of a key, you use a DECUDK device control string. To use a user-defined key, you must press Shift *defined key*.

User-preferred supplemental set

A standby set you use to provide quick access to the supplemental set you use most. You can select this set to be ISO Latin-1 supplemental or DEC Supplemental Graphic. You can select the user-preferred set in the General Set-Up screen or with a DECAUPSS control function.

Visual character attribute

A quality assigned to a graphic character that highlights the way the character appears on the screen, without changing the actual character. For example, the **bold** character attribute makes a character appear brighter on the screen.

VT mode

Any of the terminal's operating modes for running VT applications. Compare to *PC TERM mode*.