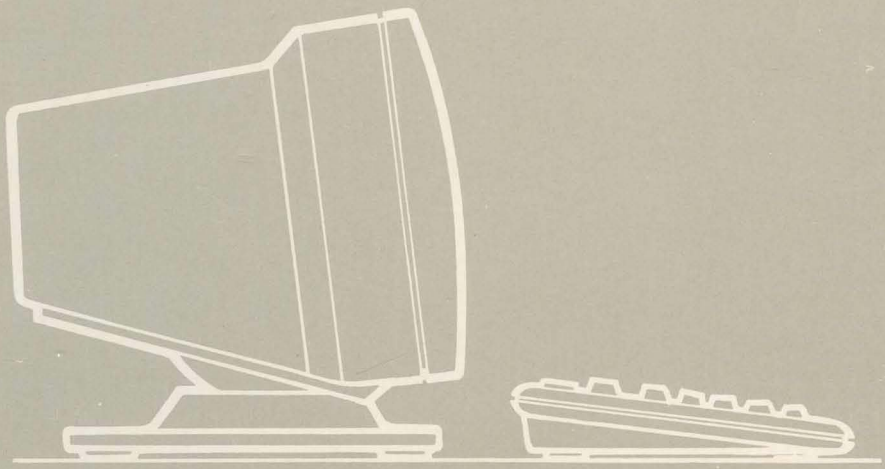
VISUAL

Visual 220
User's Guide



Visual 220
User's Guide

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Part Number: UM220-001-00A

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This equipment generates, uses and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual may cause interference to radio communications. The Visual 220 terminal has been tested and found to comply with the FCC limits set for a Class A computing device, persuant to Subpart J of Part 15 of FCC Rules which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be appropriate to correct the interference.

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PREFACE

The Visual 220 User's Guide provides information required to install, operate and program the Visual 220 terminal.

Part One, Using the Visual 220 Terminal

Part One, addresses the terminal user. A typical user may be a secretary or any person using the Visual 220 terminal for data entry or retrieval. Special technical knowledge not required to perform any of the operations in this part of the document.

Chapter 1, Introduction — Chapter 1 provides a product overview that sets operational and functional expectations for the Visual 220 terminal.

Chapter 2, Operating the Visual 220 Terminal — Chapter 2 describes how to use each of the controls and indicators on the terminal to get work done.

Since many application software packages control terminal operation, documentation supporting such packages may need to be consulted for operating instructions.

Chapter 3, Using Terminal Set-Up Mode — Chapter 3 describes Set-Up mode and how to use it to select terminal operating characteristics.

Part Two, Installation and Configuration

Part two addresses the installer. A typical installer may be a technician or secretary who is already familiar with simple cabling and setup procedures. Some technical knowledge may be required to perform certain operations in this part of the document.

Chapter 4, Terminal Installation — Chapter 4 provides information needed to unpack and install the Visual 220 terminal. Simple procedures for testing the installation are also provided.

Chapter 5, Communications — Chapter 5 provides information needed to configure the host and printer ports.

Chapter 6, Solving Difficulties — Chapter 6 provides simple corrective procedures to be used in the event that difficulties are encountered during installation or operation of the terminal.

Part Three, Programming the V220

Part three addresses the programmer. A typical programmer may use this part of the document as an aid in writing programs that can control the terminal. Knowledge of programming techniques is required to perform the operations in this part of the guide.

Chapter 7, Code Tables and Character Sets — Chapter 7 describes how different character sets may be mapped into code tables.

Chapter 8, Terminal Control Codes — Chapter 8 describes the codes that may be transmitted by the terminal. Received codes and their effects on terminal operation are also discussed.

Appendices

The appendices include miscellaneous information and summaries of other topics discussed in the document. The appendices include:

- Appendix A, Terminal Specifications
- Appendix B, National Language Keyboards
- Appendix C, Character Sets
- Appendix D, Programming Code Summary
- Appendix E, Printed Translations for Supplemental Characters
- Appendix F, Test Connectors

Special Conventions

A special typeface, which looks like this, is used in this guide to represent keyboard keys. For example, "press *Set-Up,* means to press the key that has "Set-Up" printed on it. Not to enter the string of characters S-E-T-U-P.

In addition, the keys that have arrows printed on them are not represented by arrows within the text but with up arrow, dn arrow and so on. Note that the space bar is represented by *space.*

VISUAL

Part One: Using the Visual 220 Terminal

CHAPTER 1
INTRODUCTION

1.1 GENERAL DESCRIPTION

The Visual 220 video display terminal is designed to emulate Digital Equipment Corporation's VT220 terminal. Applications that run on a DEC VT220 terminal run on a Visual 220 terminal. The Visual 220 terminal is illustrated in Figure 1-1.

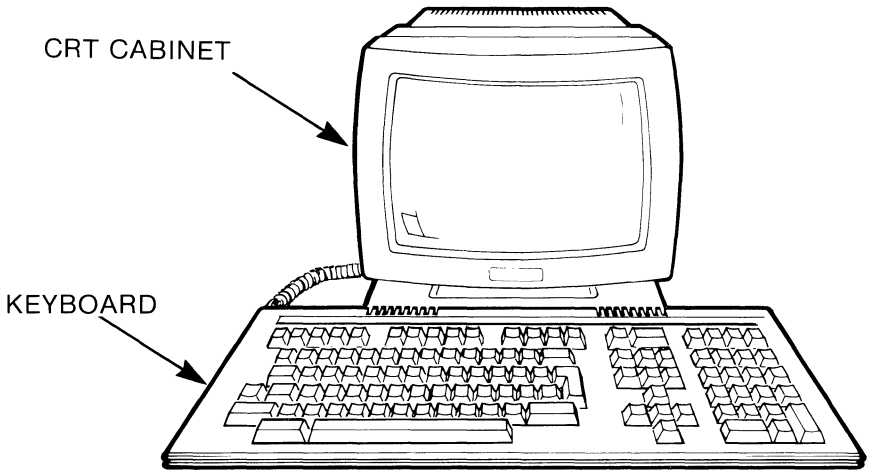


Figure 1-1. Visual 220 Terminal

Major advantages of the Visual 220 terminal stem from its repertoire of firmware-based character sets. The variety of character sets enables the Visual 220 to be easily adapted to many different alphabets including English, French, German and others. This capability is further enhanced by a feature that allows programmers to design custom-tailored character sets.

Additionally, a variety of function keys, many of which are host-programmable, allows programmers to more closely integrate the terminal with software applications.

1.2 PHYSICAL DESCRIPTION

The Visual 220 terminal is made up of the following parts:

- CRT Cabinet (contains the monitor, system unit and power cable).
- Low-profile detachable keyboard and keyboard cable.

The CRT cabinet is permanently attached to a pedestal. This configuration allows a wide range of tilt and swivel positions providing a maximum of operator comfort.

The low-profile keyboard attaches to the CRT cabinet via a short coiled cable.

1.3 FUNCTIONAL DESCRIPTION

This section describes functions and features of the Visual 220 terminal. The terminal includes:

- Four firmware-based character sets including:
  - — ASCII characters
  - — DEC Supplemental characters
  - — United Kingdom
  - — Special Graphics
- A writable character generator allows creation of user-defined characters and character sets.
- The keyboard is compatible with the DEC VT220 keyboard and provides the following:
  - — 106 keys provide a high degree of functional control over the terminal and application software.
  - — 2-key rollover helps prevent loss of characters when two keys are pressed simultaneously.
  - — Four LEDs indicate terminal status at a glance.

- Twenty-four function keys allow maximum control of application software as well as local terminal functions. There are three groups of function keys.
  - The first five top-row function keys (F1 through F5) provide single functions such as printing the screen or controlling entry and exit of Set-Up mode.
  - 15 host-programmable function keys (F6 through F20) accept up to 30 host-programmable values.

    When pressed alone, each host-programmable function key transmits a permanently programmed value to the host system (the values are identified in Section 8.3.4).

    When pressed in combination with the Ctrl or the Shift key, each key can transmit either of two host-programmed values to the host system. Procedures for programming these keys are provided in Section 8.4.2.18.
  - Four non-volatile function keys (PF1 through PF4) retain their messages even when the power is turned off. These keys cannot be programmed by a host computer.
- A status line indicates the current operating state of the terminal and utilizes the 25th line of the display. This leaves 24 display lines that may be used by application software.
- Configurable functions such as communications parameters or terminal modes may be selected from the keyboard via Set-Up Mode.
- Visual character attributes include bold, blink, reverse, blank and underscore. Logical character attribute is "erasable/non-erasable."
- A Screen Saver feature preserves the life of the display. When the display has not been updated for 10 minutes (no data has been entered by the keyboard or the host computer), the display goes blank. No data is lost, however, and the display can be restored by pressing the Shift key (any key may be used, but the Shift key is recommended because it does not perform any action).

1.4 OPERATING STATES

The Visual 220 terminal can be in one of three operating states at a given time. The operating states are:

- On-line
- Local
- Set-Up

1.4.1 On Line

When the terminal is On Line, data is routed to the host system. A Local Echo feature (if enabled in Set-Up) also routes data from the keyboard to the monitor screen.

This is the normal operating state used when running applications with the terminal. The On Line state is entered from the Set-Up Directory menu.

1.4.2 Local

When the terminal is in the Local state, transmission and reception of data is suspended. Data from the keyboard is routed to the monitor screen. The Local state is entered from the Set-Up Directory menu.

1.4.3 Set-Up

Set-Up is similar to the Local state in that transmission and reception of data is suspended. This state is used to select or change the terminal's operating parameters and is entered (and exited) by pressing the Set-Up key (F3) on the keyboard.

1.5 OPERATING MODES

The Visual 220 has four operating modes to ensure compatibility with DEC VT220 operating modes:

- VT200 compatible mode with 7-bit controls
- VT200 compatible mode with 8-bit controls
- VT100 compatible mode
- VT52 compatible mode

1.5.1 VT200 Compatible Mode with 7-bit Controls

This mode is used to execute standard ANSI functions. In addition, this mode utilizes the full range of terminal features except that 8-bit control codes cannot be sent to the host system. These codes can only be interpreted and acted on by the terminal if they are received from a host system.

This mode is used with application programs that expect 7-bit control characters and DEC multinational characters.

NOTE

Many applications that require VT100 compatibility can use VT200 compatible mode with 7-bit controls.

1.5.2 VT200 Compatible Mode with 8-bit Controls

This mode is used to execute standard ANSI functions and utilizes the full range of V220 features.

This mode is used with application programs that expect 8-bit control characters and DEC multinational characters.

1.5.3 VT100 Compatible Mode

This mode executes standard ANSI functions and should be used with application programs that require strict compatibility with VT100 terminals.

1.5.4 VT52 Compatible Mode

This is a text mode that executes DEC private functions (ANSI functions do not execute in VT52 compatible mode). This mode should be used for compatibility with existing application programs designed for DEC VT52 terminals.

1.6 OPERATING MODE DIFFERENCES

Table 1-1 lists the available operating modes and highlights some differences among them.

Table 1-1. Terminal Mode Comparison

Mode	Control Codes Executed	Received Codes Executed	Transmitted Codes
VT200 compatible (7-bit controls)	ANSI	7- and 8-bit	7-bit
VT200 compatible (8-bit controls)	ANSI	7- and 8-bit	7- and 8-bit
VT100 compatible	ANSI	7-bit	7-bit
VT52 compatible	DEC private	7-bit	7-bit

1.7 TERMINAL ENHANCEMENTS

The Visual 220 terminal provides many enhancements to the DEC VT220 terminal. Table 1-2 highlights enhancements that are found on the Visual 220 terminal.

Table 1-2. Visual 220 Terminal Enhancements

Visual 220 Terminal	DEC VT220 Terminal
14" CRT (green or amber).	12" CRT.
10 x 12 pixel resolution.	10 x 10 pixel resolution.
Status line on 25th line.	Status line on 24th line.
Composite video = 19.2 kHz.	Composite video = 15.7 kHz.
Home cursor key.	No such key.
Optional 20 ma current loop integrated with EIA connector.	Separate 20 ma connector is standard equipment.
Tilt and swivel base.	Tilt only.

1.8 OPTIONS

The following options may be available for the Visual 220 terminal:

- 20 ma current loop.
- Module for RS-422 interface.
- Paging option that provides 3 additional pages of display.
- Amber phosphor monitor.
- Second writeable (soft) character set.
- Foreign national keycaps.

CHAPTER 2
OPERATING THE VISUAL 220 TERMINAL

2.1 OVERVIEW

This chapter describes Visual 220 controls and indicators and provides instructions for turning the Visual 220 terminal on and off. Information for using some of the user-preference features is also provided.

Since application software often controls terminal operation, documentation supporting such software should also be consulted.

2.2 CONTROLS AND INDICATORS

The terminal power switch is located on the rear of the CRT cabinet as shown in Figure 2-1. All of the remaining controls and indicators are located on the terminal keyboard.

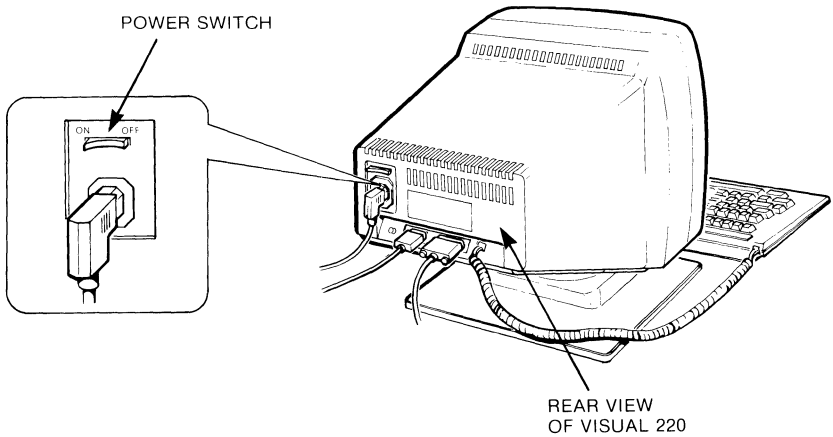


Figure 2-1. The Visual 220 Terminal Power Switch

2.2.1 The Power Switch

To turn the terminal on (or off), use the power switch located at the rear of the terminal (see Figure 2-1).

NOTE

When the switch is pushed to ON, a terminal self-test is performed that lasts for about 10 seconds. During this time, the four keyboard indicator lights blink on and off in a pattern. A ready tone (short beep) is produced after the self-test successfully completes.

After the ready tone is sounded, the terminal should be ready for normal operation. Figure 2-2 illustrates the power-up process.

If difficulties are encountered during start-up, turn to Chapter 6 for information that may help correct the apparent problem.

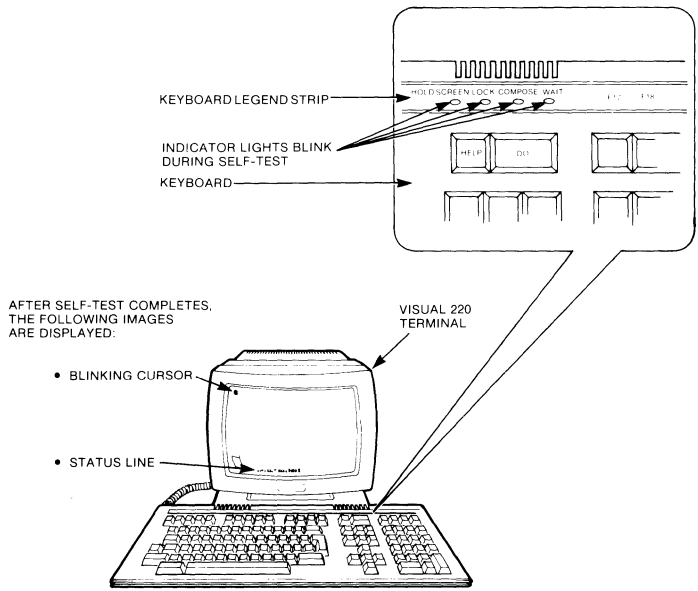


Figure 2-2. Terminal Power-Up Indications

2.2.2 Keyboard Controls

The Visual 220 keyboard shown in Figure 2-3 includes 106 keys that are divided into four distinct groups of keys. The groups are:

- Main keypad
- Editing/Cursor keypad
- Numeric/Application keypad
- Top-row function keys

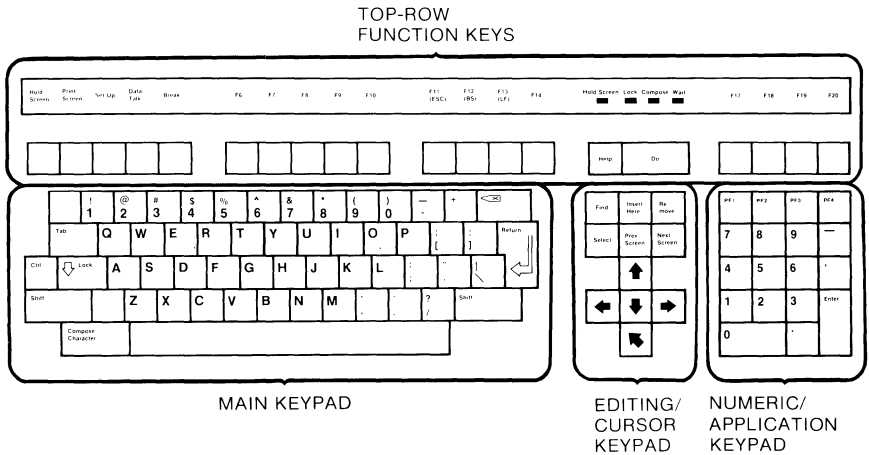


Figure 2-3. Visual 220 (North American) Keyboard

2.2.2.1 Main Keypad — The main keypad includes standard keys and special action keys.

The standard keys generate letters, numbers, punctuation marks and other text symbols (such as % [percent sign]) when they are pressed.

Special action keys perform functions when used alone or in combination with other keys. The special action keys are described in Table 2-1.

Table 2-1. Main Keypad Special Action Key Functions

Key	Function
Ctrl	This key does not transmit a code. If pressed in combination with another key it transmits control codes to the system. Control codes direct the system to perform special operations such as transmitting an XOFF code to the host system.
Shift	This key does not transmit a code. However, when pressed with another alpha-numeric key it causes the generation of the upper case of that letter or the alternate character (if any) printed on that keycap. There are two of these keys for operator convenience.
Lock	This key alternately locks or unlocks the alpha characters. When locked, the codes are upper case letters. If Caps Lock is selected, only the alphabetic keys are affected. If Shift Lock is selected, the alpha keys generate only uppercase codes and the numeric/symbol keys generate codes for the alternate (upper) character printed on the keycap.
Tab	This key transmits a horizontal tab code (HT) that moves the cursor to the next tab stop.
Return	This key transmits a Carriage Return code. If New Line is enabled this key a Carriage Return and a Linefeed code.
⌫ (delete)	Pressing the ⌫ key generates a DEL character.
Space	Pressing Space causes a space code to be transmitted.
Compose Character	The Compose Character key is used to create characters that do not exist as standard keys on the selected keyboard. (Section 2.4 provides information on the uses of this key.)

2.2.2.2 Editing Keypad — The Editing Keypad contains editing keys and cursor control keys.

Editing keys produce codes that are used by the application program to edit data already entered on the display.

Cursor control keys move the cursor in the direction of the arrow on the keycap. The home cursor key (↖) moves the cursor to line 1, column 1 on the display.

2.2.2.3 Numeric/Application Keypad — The function of the numeric/application keypad depends on how it is programmed by the application software in use. This keypad has numeric and programmable function (PF1 through PF4) keys. The programmable function keys generate special codes that may be used by the application to perform specialized actions.

When programmed as a numeric keypad, the keys generate the numbers or symbols printed on the keycaps.

When programmed as an application keypad, the keys generate codes with meanings understood by the application software.

2.2.2.4 Top-Row Function Keys — The twenty top-row function keys include local function keys (F1 through F5) and programmable function keys (F6 through F20).

Local function keys F1 through F5 of the top-row function keys have local functions and do not transmit codes to a host computer. The functions of these keys are described in Table 2-2.

Table 2-2. Local Function Key (F1 - F5) Functions

Key	Function(s)
F1 — Hold Screen	Pressing this key freezes the screen and prevents any new characters from being displayed (the Hold Screen LED illuminates). Pressing the key again returns the screen to normal operation.
F2 — Print Screen	If the printer is available, pressing the Print Screen key sends the screen data to the printer. The amount of data sent depends on the print extent selected (Print Full Page/Scroll Region) from the printer Set-Up menu. Pressing Control-Print Screen toggles Normal/Auto-Print mode from the printer Set-Up menu.
F3 — Set-up	Pressing the Set-up Key causes the terminal to enter or exit Set-up mode (see Chapter 3).
F4 —Data/Talk	This key is active only if EIA modem controls have been selected and jumpers W3, W4, W5 and W6 are installed on the system board. When pressed alone or in combination with the Shift key, the signal on pin 14 of the Comm port connector is reset to 0 volts. When pressed in combination with the Ctrl key, the signal on pin 14 of the Comm port connector is set to 5 volts.

Table 2-2. Local Function Key (F1 - F5) Functions (Contd.)

Key	Function(s)
F5 — Break	Depressing the Break key alone causes the terminal to transmit a break signal if break is enabled from the Keyboard Set-up menu (the transmit data line [TXD] is held low.)
	Depressing Shift and Break simultaneously causes the terminal to turn off Data Terminal Ready (DTR) and Request To Send (RTS). The Transmit Data Line (TXD) is held low. After 0.22 seconds, the terminal tests the condition of Data Set Ready (DSR). When DSR turns off (or after 1.8 seconds), the disconnect is complete.
	Depressing Ctrl and Break simultaneously causes the answerback message to be transmitted (the answerback message is controlled from the Keyboard Set-Up menu).

Each of the top-row programmable function keys (F6 through F20) may have up to three separate functions depending on whether the key is pressed alone or in combination with the Shift or Ctrl keys. Details on programming these keys are provided in Chapter 8.

When pressed alone, function keys F6 through F20 (including HELP and DO) have functions that are determined by the application software. When the terminal is in VT100 mode, keys F11, F12 and F13 transmit escape (ESC), backspace (BS) and linefeed (LF) codes respectively.

When pressed in combination with the Shift key, the function keys F6 through F20 may generate host-programmed messages.

When pressed in combination with the Ctrl key, the function keys may generate alternate host-programmed messages.

2.2.3 Keyboard Indicators

The keyboard provides four visible status indicators and three audible indicators.

2.2.3.1 Visible Status Indicators — Four visible light emitting diodes (LEDs) indicate the current terminal status. These indicators are located on the keyboard function strip shown in Figure 2-2 and are described in Table 2-3.

Table 2-3. Visible Status Indicators

Indicator	
Hold Screen	The Hold Screen indicator is on when the screen is frozen. (See Hold Screen key description in Table 2-2.)
Lock	The Lock indicator is on when the Lock key is pressed (see the Lock key description in Table 2-1). It indicates that only upper-case codes are generated by the keyboard. The LED turns off when the Lock key is struck again. If Shift-Lock is selected, the LED also turns off when a shift key is struck.
Compose	The Compose indicator is on when a Compose Character sequence is in progress (see Section 2.4). The LED turns off when the sequence is completed.
Wait	The Wait indicator comes on to show when the keyboard is locked and cannot transmit data. If this condition does not correct itself, the Wait LED can be cleared by invoking the Clear Comm feature in Set-up Mode. This feature is described in Chapter 3, Table 3-3.

2.2.3.2 Audible Indicators — The keyboard can generate the following three sounds: keyclick, a margin bell and a warning bell. Table 2-4 describes each of the audible indicators.

The audible indicators may be enabled or disabled from the keyboard Set-Up menu (detailed information on using Set-Up mode and Set-Up menus is provided in Chapter 3).

Table 2-4. Audible Indicators

Indicator	Description
Keyclick	The keyclick is sounded each time a key is pressed (if Keyclick is enabled). The Shift and Ctrl keys do not click.
Margin Bell	The Margin bell sounds whenever a key is struck and the cursor is 8 columns from the end of the current line.
Warning Bell	The Warning bell sounds under the following conditions: • upon power-up, • when the terminal receives a BEL code (^G) from the host, • when a compose error is made, • when an invalid key is pressed in setup mode.

2.3 SELECTING THE VISUAL 220 USER-PREFERENCE FEATURES

This section describes setting or selecting user-preference features. These features, such as keyclick or screen intensity, may be set to the preference of the individual user. Virtually all of the Visual 220 features may be selected from menus in Set-Up mode using the keyboard.

NOTE

Detailed instructions for Entering and exiting Set-Up mode are provided in Section 3.3 (Using Set-Up Mode).

Each of the Set-Up menus is fully described in Section 3.4 (Using Set-Up Menus).

Note, however, that many terminal features are designed to be controlled by the currently running application software. Thus some features that may be selected by individual users could be temporarily reset or reconfigured by the application software.

2.3.1 Overview of User-Preference Features

User-preference features are briefly described (in alphabetical order) in Table 2-5. The table also identifies the Set-Up menu used to control each feature.

NOTE

The features noted in Table 2-5 are more fully described in Section 2.3.2.

Table 2-5. User-Preference Feature Overview

Feature	Set-Up Menu	Description/Comment
Auto Repeat	Keyboard	When enabled, keys held down for more than 0.5 seconds begin repeating.
Keyclick	Keyboard	When enabled, an audible tone accompanies each keystroke.
Light/Dark Screen	Display	Controls reverse video.
Margin Bell	Keyboard	When enabled, a tone sounds whenever a key is struck and the cursor is 8 columns from the end of the line.
On Line/ Local	Directory	On Line is for host communication. Local is for communicating with the display only.
Screen Intensity	Any Setup Menu	To brighten, hold Shift and press up arrow. To dim, hold Shift and press dn arrow.
Screen Saver	Display	When enabled, the display goes blank when it has not been used for 10 minutes. Press Shift to restore.

Table 2-5. User-Preference Feature Overview (Cont.)

Feature	Set-Up Menu	Description/Comment
Shift/Caps Lock	Keyboard	Controls whether Lock key (on the main keypad) functions as a shift lock or caps lock key.
Smooth/ Jump Scroll	Display	Controls whether the display scrolls up smoothly or in steps to accommodate each newly displayed line.
Time-of-Day Clock	Enhancement	Enter the (military or civilian) time as prompted on the display.
User Features Lock/Unlock*	General	When locked, prevents the following user-preference features from being changed: • Auto-Repeat • Smooth/Jump Scroll • Light/Dark Screen • Tab Stops • Keyboard Lock
Warning Bell	Keyboard	When enabled, a tone sounds in response to certain keystroke and data entry errors and upon power-up.
80/132 Column	Display	Controls number of columns displayed.

*The lock/unlock feature should normally be unlocked, allowing software applications to control the necessary terminal features.

2.3.2 Descriptions of User-Preference Features

This section describes user-preference features. The features are presented in alphabetical order.

2.3.2.1 Auto Repeat — When enabled (from the Keyboard Set-Up menu), keys held down for more than 0.5 seconds begin repeating. This feature may aid in tasks requiring character repetition such as dotted or dashed lines.

2.3.2.2 Keyclick — When enabled (from the Keyboard Set-Up menu), an audible tone accompanies each keystroke. When disabled, keystrokes are virtually silent.

2.3.2.3 Light/Dark Screen — This feature (selected from the Display Set-Up menu) provides two options for the user:

- Light Text, Dark Screen displays light characters on a dark background.
- Dark Text, Light Screen displays dark characters on a light background.

2.3.2.4 Margin Bell — When enabled (from the Keyboard Set-Up menu), an audible tone is produced when a key is struck and the cursor is at column 72. This feature may be useful when, for example, the terminal is being used in local mode as a typewriter.

2.3.2.5 On Line/Local — This feature (selected from the Set-Up Directory menu) provides two options for the user:

- On Line mode is used for Communicating with a host system. Host system communication is essential for running typical applications. This is the normal operating mode for the Visual 220 terminal.
- Local mode is used to send characters to the display (or a printer if one is connected). This mode is typically used for local testing purposes and has limited applications.

2.3.2.6 Screen Intensity — Screen intensity may be adjusted up or down from any Set-Up menu. There are 16 levels of intensity.

- To increase (brighten) the intensity, hold down the Shift key and press the Up Arrow.
- To decrease (dim) the intensity, hold down the Shift key and press the Dn Arrow

2.3.2.7 Screen Saver — When enabled (from the Display Set-Up menu), the display goes blank when it has not been used for 10 minutes. This helps increase the life of the terminal by preventing characters from "burning" into the phosphor of the display.

The data that was on the display is restored when a character is received from the host, Aux port or the terminal keyboard. To manually restore the display, press the Shift key.

2.3.2.8 Shift/Caps Lock — This feature (selected from the Keyboard Set-Up menu) provides two options for the user:

- Selecting Shift Lock causes the Lock key (on the main keypad) to function as a Shift-Lock Key.
- Selecting Caps Lock causes the Lock key (on the main keypad) to function as a Caps-Lock Key.

The following tables show the effects of each option on alphabetic keys and numeric/symbol keys. Typical keyboard keys (A and 3/#) are used to illustrate the effects.

Table 2-6 illustrates the effects of the Lock key states (unlocked and locked) when Shift Lock is selected and the Shift key state is unshifted and shifted.

Table 2-6. Effects of the Lock Key when Shift Lock is Selected

Lock Key State	Alphabetic Key		Numeric/Symbol Key	
	Unshifted	Shifted	Unshifted	Shifted
Unlocked	a	A	3	#
Locked	A	A	#	#

Table 2-7 illustrates the effects of the Lock key states (unlocked and locked) when Caps Lock is selected and the Shift key state is unshifted and shifted.

Table 2-7. Effects of the Lock Key when Caps Lock is Selected

Lock Key State	Alphabetic Key		Numeric/Symbol Key	
	Unshifted	Shifted	Unshifted	Shifted
Unlocked	a	A	3	#
Locked	A	A	3	#

2.3.2.9 Smooth/Jump Scroll — This feature (selected from the Display Set-Up menu) provides two options for the user:

- Smooth scroll causes the screen data to move at a smooth and steady rate to accommodate new lines of data.
- Jump scroll causes the screen data to step up or down (one full line at a time) to accommodate new lines of data.

2.3.2.10 Time-of-Day Clock — A time-of-day clock (enabled from the Enhancement Set-Up menu) can be displayed on the status line when not in Set-Up mode. When setting the time, the status line is temporarily replaced with the "Enter Time": message. When this message is displayed, the time can be entered in the format hh:mm:ss. Standard (12 hour) or military (24 hour) time may be selected independently (using another field in the Enhancement menu). This feature may also be programmed by the host.

2.3.2.11 User Features Lock/Unlock — When locked (from the General Set-Up menu), this feature prevents the following features from being modified by application software.

- Auto-Repeat
- Smooth/Jump Scroll
- Light/Dark Screen
- Tab Stops
- Keyboard Lock

This feature should normally be left unlocked since some software applications expect to control these features.

2.3.2.12 Warning Bell — When enabled (from the keyboard Set-Up menu) the Warning bell is sounded under the following conditions:

- Upon power-up.
- When a compose error is made,
- When an illegal key is struck in setup mode and
- When the terminal receives a bell code (BEL) from the host.

2.3.2.13 80/132 Column — This feature (selected from the Display Set-Up menu) causes the terminal to display data using a screen width of 80 columns (80 characters) or 132 columns (132 characters).

2.4 COMPOSING CHARACTERS

Certain characters that do not exist as single characters may be "composed" (created) using three-keystroke or two-keystroke compose sequences.

2.4.1 Three-Keystroke Compose Sequences

Three-keystroke compose sequences function on all keyboards and are performed with the following steps:

1. Select the desired "Composed Character" from the first column of Table 2-8.
2. Press (and release) the Compose Character key.
3. Press two standard keys (the keystroke sequence must be a valid sequence shown in second column of Table 2-8).

2.4.2 Two-Keystroke Compose Sequences

Two-keystroke sequences function on all keyboards except the North American keyboard.

Two-keystroke sequences do not use the Compose Character key. Although faster to use than three-keystroke sequences, they are limited to sequences that begin with diacritical marks. Diacritical marks are non-spacing marks that include acute and grave accents, circumflex, tilde, diaresis (umlaut) and ring mark (degree). These marks are available on all but the North American keyboard.

Two-keystroke sequences are performed with the following steps:

1. Select the desired "Composed Character" from the first column of Table 2-8.
2. Press the corresponding two-keystroke sequence shown in the third column of the Table.

Table 2-8 provides a list of composed characters and the corresponding three-keystroke and two-keystroke sequences. Note that a desired character can be selected using the Shift and Lock keys.

If a diacritical mark is used within a three-keystroke sequence, it is treated as though it were its equivalent character. Diacritical marks and their equivalent characters are as follows:

Diacritical Mark	Equivalent Character
Diaresis (umlaut) mark	Double quote (")
Grave accent	Single quote (')
Acute accent	Apostrophe (')
Circumflex accent	Circumflex character (^)
Tilde mark	Tilde (~)
Ring mark	Asterisk (*) or degree (°)

NOTE

In three-keystroke compose sequences, the characters may be entered in any order (unless otherwise stated). All two-keystroke sequences must be entered in the order shown.

Table 2-8. Compose Sequences

Composed Character		Three-Keystroke Sequence	Two-Keystroke Sequence
"	(quotation mark)	" (sp)	.. (sp)
#	(number sign)	++	
'	(apostrophe)	' (sp)	' (sp)
@	(commercial at)	a a or A A	
[	(opening bracket)	((	
\	(backslash)	// or /<	
]	(closing bracket)	))	
^	(circumflex)	^ (sp)	^ (sp)
`	(single quote)	` (sp)	` (sp)
{	(opening brace)	(-	
|	(vertical line)	/^	^/
}	(closing brace)	)-	
~	(tilde)	~ (sp)	~ (sp)
¡	(inverted !)	!!	
¿	(inverted ?)	??	
¢	(cent sign)	c/ or C/ or c| or C|	
£	(pound sign)	l- or L- or l= or L=	
¥	(yen sign)	y- or Y- or y= or Y=	
§	(section sign)	so or SO or S! or s! or s0 or S0	

Table 2-8. Compose Sequences (Contd.)

Composed Character		Three-Keystroke Sequence	Two-Keystroke Sequence
¤	(currency sign)	xo or XO or x0 or X0	Xo OX
©	(copyright sign)	co or CO or c0 or C0	
¶	(paragraph sign)	p! or P!	
ª	(feminine ordinal indicator)	a_ or A_	
º	(masculine ordinal indicator)	o_ or O_	
<<	(angle quotation mark left)	<<	
>>	(angle quotation mark right)	>>	
°	(degree sign)	0^ or (sp)* or (sp)°	^ 0
±	(plus/minus sign)	+_	
¹	(superscript 1)	1^	^ 1
²	(superscript 2)	2^	^ 2
³	(superscript 3)	3^	^ 3
µ	(micro sign) *	/u or /U	
·	(middle dot)	.^	^ .
1/4	(fraction one-quarter) *	1 4	
1/2	(fraction one-half) *	1 2	
À	(A grave)	A‘	‘A
Á	(A acute)	A’	’A
Â	(A circumflex)	A^	^ A

* Must be entered in the order shown

Table 2-8. Compose Sequences (Contd.)

Composed Character		Three-Keystroke Sequence	Two-Keystroke Sequence
Ã	(A tilde)	A~	~A
Ä	(A umlaut)	A" or A¨	¨A
Å	(A ring)	A* or A° (degree sign)	°A
Æ	(A E ligature) *	AE	
Ç	(C cedilla)	C, (comma)	
È	(E grave)	E‘	‘E
É	(E acute)	E’	‘E
Ê	(E circumflex)	E^	^E
Ë	(E umlaut)	E" or E¨	¨E
Ì	(I grave)	I‘	‘I
Í	(I acute)	I’	’I
Î	(I circumflex)	I^	^I
Ï	(I umlaut)	I" or I¨	¨I
Ñ	(N tilde)	N~	~N
Ò	(O grave)	O‘	‘O
Ó	O acute	O’	’O
Ô	(O circumflex)	O^	^O
Õ	(O tilde)	O~	~O
Ö	(O umlaut)	O" or O¨	¨O

* Must be entered in the order shown

Table 2-8. Compose Sequences (Contd.)

Composed Character		Three-Keystroke Sequence	Two-Keystroke Sequence
Œ	(O E ligature) *	O E	
Ù	(U grave)	U‘	‘U
Ú	(U acute)	U’	’U
Û	(U circumflex)	U^	^ U
Ü	(U umlaut)	U” or U¨	¨U
Ÿ	(Y umlaut)	Y” or Y¨	¨Y
ß	(German small sharp s)	ss	
à	(a grave)	a‘	‘a
á	(a acute)	a’	’a
â	(a circumflex)	a^	^ a
ã	(a tilde)	a~	~ a
ä	(a umlaut)	a” or a¨	¨a
å	(a ring)	a* or a° (degree sign)	°a
æ	(a e ligature) *	ae	
ç	(c cedilla)	c, (comma)	
è	(e grave)	e‘	‘e
é	(e acute)	e’	’e
ê	(e circumflex)	e^	^ e
ë	(e umlaut)	e” or e¨	¨e
ì	(i grave)	i‘	‘i

* Must be entered in the order shown

Table 2-8. Compose Sequences (Contd.)

Composed Character		Three-Keystroke Sequence	Two-Keystroke Sequence
í	(i acute)	i'	'i
î	(i circumflex)	i^	^i
ï	(i umlaut)	i" or i¨	¨i
ñ	(n tilde)	n~	~n
ò	(o grave)	o`	`o
ó	(o acute)	o'	'o
ô	(o circumflex)	o^	^o
õ	(o tilde)	o~	~o
ö	(o umlaut)	o" or o¨	¨o
œ	(o e ligature) *	o e	
ø	(slash)	o/	
ù	(u grave)	u`	`u
ú	(u acute)	u'	'u
û	(u circumflex)	u^	^u
ü	(u umlaut)	u" or u¨	¨u
ÿ	(y umlaut)	y" or y¨	¨y

* Must be entered in the order shown

2.5 PRINTING

This section provides an overview of the printer interface and descriptions of various printing modes. Since many printing functions are designed to be controlled by application software, additional information may be found within the application software documentation.

2.5.1 Printer Interface

The Visual 220 terminal has a 9-pin male D-type connector which provides a serial interface for printer connection. The terminal can support a wide variety of serial printers. The necessary interface and data format can be selected from the Communications Set-Up menu.

Chapter 5, Communications, contains the necessary information for making the appropriate connections.

2.5.2 Printing Modes

The Visual 220 terminal has four possible printing modes that determine how data is treated by the terminal/printer configuration.

Application software may control the entering and exiting of the various printer modes.

2.5.2.1 Normal Print Mode — The normal print mode allows print functions (such as print screen) to be invoked from the terminal keyboard or the host system.

2.5.2.2 Auto Print Mode — This mode causes the current line (the line containing the cursor) to be printed on receipt of a linefeed (LF), formfeed (FF) or vertical tab (VT). Any code (LF, FF or VT) that causes a line to be printed is appended to the end of that line.

2.5.2.3 Controller Mode — The controller mode allows the printer to be controlled solely from the host system. Data is routed from the host, through the terminal and to the printer. Data is not displayed on the terminal screen. Data flow control signals such as XOFF/XON, are expected to be managed by the printer (if such control is enabled).

To use the printer without involving the host system, place the terminal simultaneously in local mode and controller mode.

2.5.2.4 Copy Mode — This mode is similar to the Controller mode except that the data is also routed to the terminal screen.

CHAPTER 3
USING TERMINAL SET-UP MODE

3.1 INTRODUCTION

This chapter describes the Visual 220 terminal Set-Up mode, and how to use it to examine and/or modify the terminal's operating characteristics.

Any of the Set-Up features can be modified using the keyboard and then "saved" in NVR (non-volatile RAM). Saved parameters are remembered by the terminal even when the power is turned off. In addition, factory default settings are maintained by the terminal. These settings are typical for many applications and can be recalled at any time in Set-Up mode.

Certain features can be selected or modified by the host system. The control sequences for making these changes are described in Chapter 8 of this guide.

3.2 SET-UP MODE OVERVIEW

Set-up mode is made up of eight selectable displays called "menus." The main Set-Up menu is called the Set-Up Directory. The Set-Up Directory is used to invoke any one of seven available submenus.

Each menu displays information relative to its function and allows you to modify or retain that data. Only one menu can be displayed at a time.

NOTE

In Set-Up mode, screen data is suppressed and is not lost. However, incoming data may be lost unless the host supports XON/XOFF flow control and that feature is enabled on the terminal.

3.2.1 Set-Up Directory and Sub-Menus

The Set-Up Directory menu is displayed when you first enter Set-up mode (by pressing the Set-Up key). All of the sub-menus may be accessed from the Directory menu. Conversly, the Directory menu can be reached from any of the Set-up menus.

The sub-menus are ordered on a one-direction, continuous path. Once a sub-menu is displayed, pressing Enter causes the next sequential sub-menu to be displayed (if the "To Next Set-up" field is selected)

Figure 3-1 shows the relationship among the Set-Up menus.

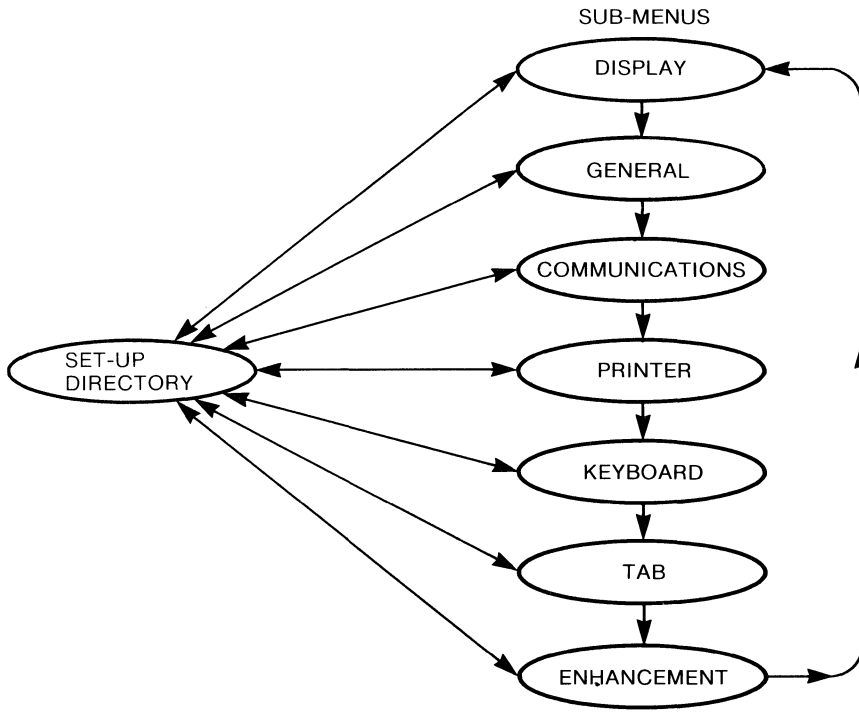


Figure 3-1. Paths to Set-Up Menus

3.2.2 Set-Up Menu Format

Each set-up menu occupies the bottom eight lines of the screen. The rest of the screen is blank. Figure 3-2 shows a typical Set-Up menu.

As shown in Figure 3-2, each menu contains an identifier line, various fields (action fields, parameter fields and text fields), and a status line.

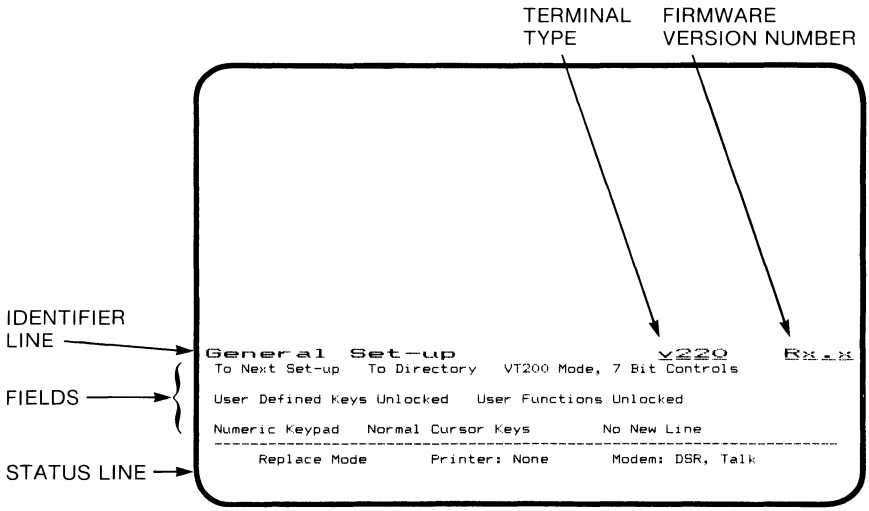


Figure 3-2. Typical Set-Up Menu

3.2.2.1 Menu Identifier Line — The menu identifier line identifies the current Set-Up menu, the type of terminal (v220), and the firmware revision number (refer to Figure 3-2).

3.2.2.2 Fields — The fields on each menu are blocks of text describing the current function or parameter. There are three types of fields: Action fields, Parameter fields, and Text fields.

- Action fields always read the same since, by definition, they have only one value. When an Action Field is selected and the Enter key is pressed, that action is performed.

  For example, when the cursor is positioned on the "To Next Menu" action field in the General Set-Up pressing Enter causes the Communications Set-Up menu to be displayed.

- Parameter fields consist of self-describing text that has two or more values. When a parameter field is selected and the Enter key is pressed, the current value of the field is replaced with the next sequential value.

  For example, pressing Enter when the cursor is positioned on the "Transmit=9600" parameter field in the Communications Set-Up menu, causes that field to read "Transmit=19200."

- Text fields allow direct entry of text by typing the value from the keyboard. When a text field is selected and the Enter key is pressed, the terminal prompts for text entry, temporarily overwriting the status line.

  Type in the desired text. The new data is displayed to the right of the prompt. Press the Enter key to enter the new value.

  For example, when the cursor is positioned on the "Answerback=" text field in the Keyboard Set-Up menu, pressing Enter causes the status line to be temporarily overwritten with "Enter Answerback:_____".

  Additional Information for Text Fields:

  — Mistakes can be erased by pressing the 〈X] (delete) key.

  — To abort the text entry without changing the original value, press a cursor key to move the cursor to another field (or press Set-Up to exit).

  — If any key which transmits a multi-character sequence (such as a function key) is struck, the entire sequence is included in the new value.

  — Data entered beyond the length of the text field is ignored. A warning bell is also sounded (if enabled).

3.2.2.3 Set-Up Status Line — The Set-Up status line appears at the bottom of each menu. It displays the current status of the EIA modem (when modem controls is selected), the printer, and the terminal insert/replace mode.

The status line is for reporting only and can only be modified indirectly. For example, turning off the printer may change a "Printer: Ready" message to "Printer: Not ready." The status line messages are described in Table 3-1.

Table 3-1 identifies the various Set-Up status line messages that may appear at the bottom of each menu. The status line displays three messages that define the current status of the terminal mode, the printer and the EIA modem.

Table 3-1. Status Line Messages

Message	Status	Meaning
Mode	Replace	The terminal is in Replace mode. New display characters replace old characters at the cursor position. Replace is the normal mode of operation.
	Insert	The terminal is in Insert mode. All incoming characters move the old characters to the right. Characters moved past the right margin are lost.
Printer:	Ready	The printer is ready.
	Not ready	The printer is not ready.
	None	There is no printer connected.
	Auto-Print	The terminal is in Auto-Print mode and is ready to print.
	Controller	The terminal is in Printer Controller mode and is ready to print.
	Copy	The terminal is in Printer-Copy mode and is ready to print.
Modem:	DSR, Data DSR, Talk	The modem is ready to send or receive data.
	No DSR, Data No DSR,Talk	The modem is not ready to send or receive data.

3.3 USING SET-UP MODE

This section describes the general procedures for entering and exiting Set-Up Mode and for selecting and using various fields.

3.3.1 Entering and Exiting Set-Up Mode

Enter Set-Up mode by pressing the Set-Up key (F3 of the top-row function keys). Exit Set-Up mode by again pressing the Set-Up key.

3.3.2 Selecting Set-Up Fields

Select a field by positioning the field cursor on the desired field. The field cursor is a highlighted bar that may be moved by pressing the cursor keys. The cursor moves in the direction of the arrow on the cursor keycap. The home arrow key moves the field cursor to the first Set-Up field in the menu.

3.3.3 Using a Selected Set-Up Field

Use a selected field by pressing the Enter key (on the Numeric/ Application keypad).

If an action field is selected, that action is performed when the Enter key is pressed. If a parameter field is selected, pressing the Enter key cycles through the range of values for that field. The value displayed at any given time is the current value.

3.4 USING SET-UP MENUS

This section describes each of the Set-Up menus. Each field is named and identified as an action field, parameter field or text field (refer to Section 3.2.2.2). The default settings and functions of each field are also indicated.

Table 3-2 may be used as a guide for finding various fields in any of the eight Set-Up menus. The table numbers in parenthesis with each menu title identifies the corresponding table number where that menu is fully described.

Table 3-2. Set-Up Menu Contents

Set-Up Directory (Table 3-3)	Display Set-Up (Table 3-4)	General Set-Up (Table 3-5)
Display Set-Up	To Next Set-Up	To Next Set-Up
General Set-Up	To Directory	To Directory
Communications Set-Up	80/132 Columns	Terminal Mode
Printer Set-Up	Display Controls	User Defined Keys Lock
Keyboard Set-Up	Auto-Wrap	User Functions Lock
Tab Set-Up	Scrolling	Keypad Mode
On-line/Local	Light/Dark Screen	Cursor Key Mode
Clear Display	Cursor	New Line
Clear Comm	Cursor Style	
Reset Terminal	Status Line	
Recall Parameters	Screen Saver	
Save Parameters		
Set-Up Language		
Keyboard Language		
Default Parameters		
Exit Set-Up Mode		

Communications Set-Up (Table 3-6)	Printer Set-Up (Table 3-7)	Keyboard Set-Up (Table 3-8)
To Next Set-Up	To Next Set-Up	To Next Set-Up
To Directory	To Directory	To Directory
Transmit Speed	Transmit Speed	Typewriter or D.P. Keys
Receive Speed	Print Mode	Caps/Shift Lock
XOFF Value	Data Bits, Parity	Auto Repeat
Data Bits, Parity	Stop Bit(s)	Keyclick
Stop Bit(s)	Print Extent	Margin Bell
Local Echo	Print Data Type	Warning Bell
Comm Port Interface	Terminator	Break
Disconnect Delay		Auto Answerback
Transmit Limitations		Answerback Message
		Conceal Answerback

Tab Set-Up (Table 3-9)	Enhancement Set-Up (Table 3-10)
To Next Set-Up	To Next Set-Up
To Directory	To Directory
Clear All Tabs	Time-Of-Day
Set 8-Column Tabs	Standard/Military
Individual Tabs and Ruler	PF1/PF2/PF3/PF4

3.4.1 Set-Up Directory Menu

The Set-Up Directory Menu is used to access sub-menus in Set-Up mode. Parameter values can be recalled or saved using this menu. This menu is displayed when Set-Up is first entered. Figure 3-3 shows a Set-Up Directory menu. Table 3-3 describes each of the fields in the Set-Up Directory menu.

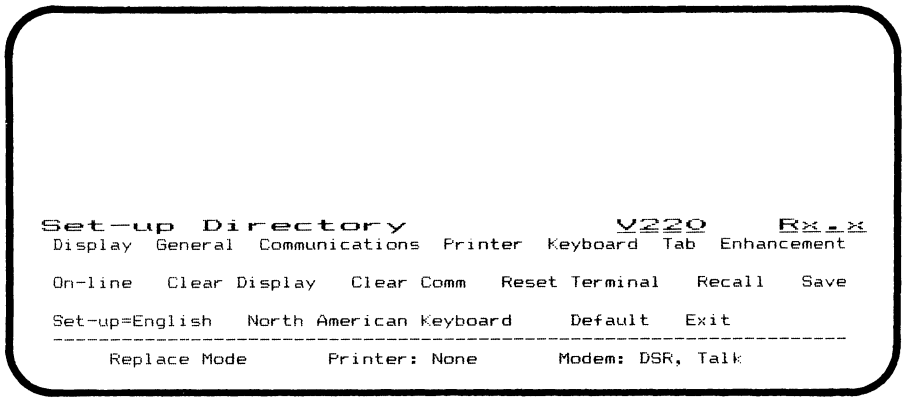


Figure 3-3. Set-Up Directory Menu (with Default Values Displayed)

Table 3-3. Set-Up Directory Menu Field Descriptions

Field Name	(Field Type) Function
Display	**(Action Field)** Pressing Enter replaces the Directory menu with the Display menu (see Table 3-4).
General	**(Action Field)** Pressing Enter replaces the Directory menu with the General menu (see Table 3-5).
Communications	**(Action Field)** Pressing Enter replaces the Directory menu with the Communications menu (see Table 3-6).

Table 3-3. Set-Up Directory Menu Field Descriptions (Contd.)

Field Name	(Field Type) Function
Printer	**(Action Field)** Pressing Enter replaces the Directory menu with the Printer menu (see Table 3-7).
Keyboard	**(Action Field)** Pressing Enter replaces the Directory menu with the Keyboard menu (see Table 3-8).
Tab	**(Action Field)** Pressing Enter replaces the Directory menu with the Tab menu (see Table 3-9).
Enhancement	**(Action Field)** Pressing Enter replaces the Directory menu with the Enhancement menu (see Table 3-10).
On-Line/Local	**(Parameter Field)** Pressing Enter causes the terminal to alternate between on-line and local operation when the Enter key is pressed. • On-line (default) allows the terminal to communicate with a host computer. • Local essentially puts the terminal on "hold". Data entered at the keyboard is sent only to the screen.
Clear Display	**(Action Field)** Pressing Enter clears the text display when Set-Up mode is exited.

Table 3-3. Set-Up Directory Menu Field Descriptions (Contd.)

Field Name	(Field Type) Function
Clear Comm	**(Action Field)** Pressing Enter clears communication functions in the following manner: 1. Aborts any print operation in progress and takes the terminal out of printer controller or printer copy mode. 2. Aborts any escape or control sequence or DCS processing. 3. Erases the keyboard, transmitter and receiver buffers. 4. Sends an XON to the host computer and resets XOFF received flags on the host and printer ports (if XON/XOFF is enabled).
Reset Terminal	**(Action Field)** Pressing Enter resets the terminal to a known (default) state that is used by many application programs. The screen, communication and user-defined keys are not affected.
Recall	**(Action Field)** Pressing Enter replaces all current characteristics with saved values. (See "Save" in this table). The text display is cleared and the cursor returns to the home position. **NOTE** **Performing a "Recall" causes the terminal to disconnect from a modem.**
Save	**(Action Field)** Pressing Enter causes the current Set-up characteristics to be saved in non-volatile memory. The Answerback message is also saved.

Table 3-3. Set-Up Directory Menu Field Descriptions (Contd.)

Field Name	(Field Type) Function
Set-up= English/French/ German	**(Parameter Field)** Pressing Enter changes the language in which the Set-Up menus are displayed.
Keyboard=	**(Parameter Field)** Pressing Enter selects the correct terminal operation for the National keyboard in use. National keyboards are: • British • Canadian (French) • Danish • Dutch • Finnish • Belgian/Flemish • French/Belgian • German • Italian • North American (Default) • Norwegian • Spanish • Swedish • Swiss (French) • Swiss (German)
Default	**(Action Field)** Pressing Enter replaces the current Set-up features with factory default settings. The text display is cleared and the cursor is returned to the Home position. **NOTE** **Performing a "Default" action causes the terminal to disconnect from a modem.**
Exit	**(Action Field)** Pressing Enter returns the terminal to normal operation.

3.4.2 Display Set-Up Menu

The Display Set-Up menu is used to control various parameters that affect the display of information. Figure 3-4 shows a Display Set-Up menu. Table 3-4 describes each of the fields in the Display Set-Up menu.

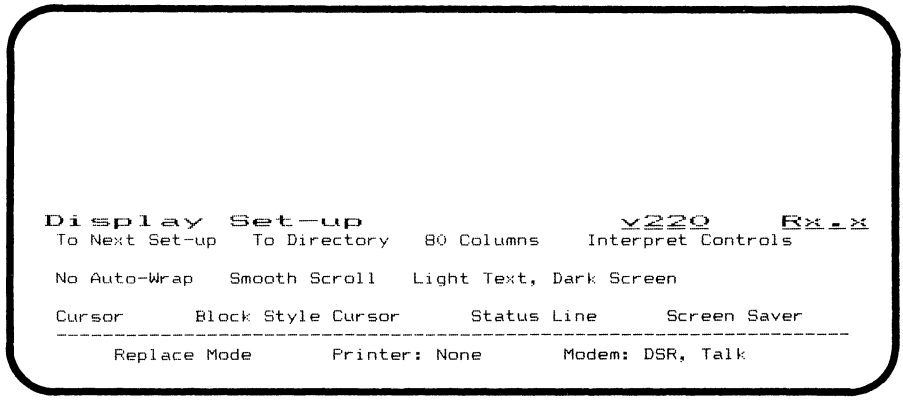


Figure 3-4. Display Set-Up Menu (with Default Values Displayed)

Table 3-4. Display Menu Descriptions

Field Name	(Field Type) Function
To Next Set-up	**(Action Field)** Pressing Enter causes the Display menu to be replaced with the General Set-up menu. (see Table 3-5).
To Directory	**(Action Field)** Pressing Enter causes the display menu to be replaced with the Set-Up Directory. (see Table 3-3).
80/132 Columns	**(Parameter Field)** The terminal alternates between an 80 column (default) and a 132 column text display. This change takes effect immediately and clears the text screen.

Table 3-4. Display Menu Field Descriptions (Contd.)

Field Name	(Field Type) Function
Interpret/Display Controls	**(Parameter Field)** Pressing Enter causes the terminal to alternate between interpreting and displaying control codes received from the host. • When Interpret Controls (default) is selected the control codes are not displayed • When display Controls is selected, the control codes are displayed only and are not interpreted (except for linefeed [LF], formfeed [FF] or vertical tab [VT] which are performed after the code is displayed).
Auto-Wrap	**(Parameter Field)** Pressing Enter causes the display to alternate between Auto-Wrap and No Auto-Wrap. • Auto-Wrap causes a character received beyond the right margin to be displayed in the left-most column of the following line. • No Auto-Wrap (default) causes characters received beyond the right margin to over write the last column of the current line.

Table 3-4. Display Menu Field Descriptions (Contd.)

Field Name	(Field Type) Function
Smooth/Jump Scroll	**(Parameter Field)** Pressing Enter causes the display to alternate between Smooth Scroll and Jump Scroll. • Smooth Scroll (default) gives the impression of a smooth, steady scroll by limiting the speed at which new lines enter the screen. • Jump Scroll gives the impression that the screen jumps up to accept each new line that is displayed. Jump scroll displays new lines as fast as they are received.
Light Text, Dark Screen/ Dark Text, Light Screen	**(Parameter Field)** Pressing Enter causes the display to alternate between light text on dark background (Default) and dark text on a light background.
Cursor/No Cursor	**(Parameter Field)** Pressing Enter selects whether the text cursor is displayed (default) or not displayed.
Block/Underline Cursor Style	**(Parameter Field)** Pressing Enter selects whether the type of cursor displayed is a "Block" (□) cursor (default) or an "Underline" (_) cursor.
Status Line/ No Status Line	**(Parameter Field)** Controls whether the status line is displayed (default) or not displayed. The time-of-day clock is always displayed on the status line (if the clock is programmed).
Screen Saver/ No Screen Saver	**(Parameter Field)** Pressing Enter enables (default) or disables the screen saver feature.

3.4.3 General Set-Up Menu

The General Set-Up menu is used to select various terminal modes and to lock and unlock the keyboard. Figure 3-5 shows a General Set-Up menu. Table 3-5 describes each of the fields in the General Set-Up menu.

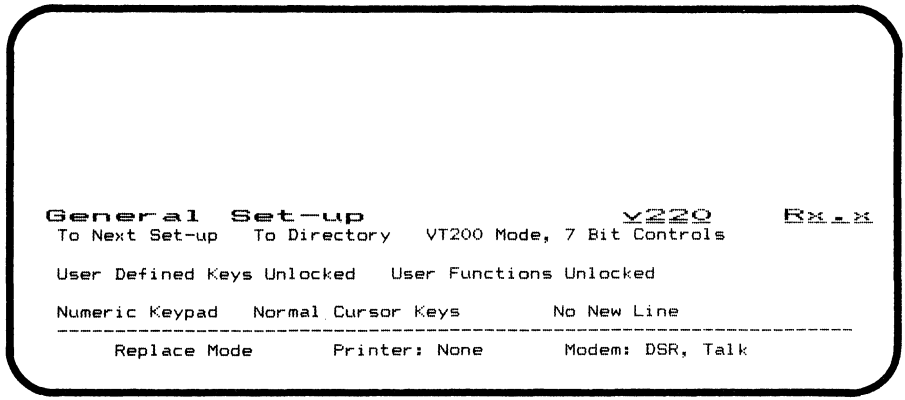


Figure 3-5. General Set-Up Menu (with Default Values Displayed)

Table 3-5. General Set-Up Menu Field Descriptions

Field Name	(Field Type) Function
To Next Set-up	**(Action Field)** Pressing Enter causes the General Set-Up menu to be replaced with the Communications Set-up menu (see Table 3-6).
To Directory	**(Action Field)** Pressing Enter causes the General Set-Up menu to be replaced with the Set-up Directory (see Table 3-3).

Table 3-5. General Set-Up Menu Field Descriptions (Contd.)

Field Name	(Field Type) Function
Mode/Controls	**(Parameter Field)** Pressing Enter causes this field to display each of the four operating modes. **NOTE** **Changing this field causes the Application keypad and Application cursor keys to be reset to their default values.** The four operating modes are: • VT200 Mode: 8 Bit Controls This mode causes the terminal to operate with a full range of capabilities in an 8-bit environment with 8-bit controls and graphic characters. • VT200 Mode: 7 Bit Controls (Default). This mode causes the terminal to operate with a full range of capabilities transmitting 7-bit controls and 8-bit graphic characters. (in any VT200 mode the terminal can receive and interpret 8-bit control codes). This is the recommended mode for most applications. • VT100 Mode This mode causes the terminal to behave as a VT100. This mode is for use with application programs that require strict VT100 compatibility.

Table 3-5. General Set-Up Menu Field Descriptions (Contd.)

Field Name	(Field Type) Function
	• VT52 Mode This mode causes the terminal to behave as a VT52 for use with application programs designed for that terminal.
VT100 ASCII/U.K.	**(Parameter Field)** Pressing Enter selects whether the default character set for use in VT52 or VT100 mode is ASCII (default) or U.K. When VT100 U.K. is selected, the ASCII number sign (#) is replaced with the U.K. Pound symbol (£). **NOTE** **This field is unique. It only appears when the terminal is in VT100 or VT52 mode.**
User Defined Keys Locked/Unlocked	**(Parameter Field)** Pressing Enter causes the terminal to alternately lock and unlock (default) the user defined function keys. When locked, the function keys cannot be programmed by the host computer.
User Features Locked/Unlocked	**(Parameter Field)** Pressing Enter causes the terminal to alternately lock and unlock (default) the User Preference Features. User preference features include Auto-Repeat, Smooth/Jump Scroll, Light/Dark Screen, Tab Stops, and Keyboard Lock. Some software applications expect to control these features. To ensure predictable behavior with these programs, this field should be set to "User Features Unlocked".

Table 3-5. General Set-Up Menu Field Descriptions (Contd.)

Field Name	(Field Type) Function
Numeric/ Application Keypad	**(Parameter Field)** Pressing Enter causes the terminal to alternately select whether numeric or application codes are generated by the numeric/application keypad. When the numeric keypad (Default) is selected, the auxiliary keypad transmits ASCII characters that correspond to the numeric characters on the keys. When the application keypad is selected, the auxiliary keypad transmits escape sequences used by application programs. The sequences transmitted are identified in Chapter 8.
Normal/ Application Cursor Keys	**(Parameter Field)** Pressing Enter causes the terminal to alternately select whether the cursor keys transmit "Normal" ANSI cursor control sequences (default) or application control sequences. Control sequences transmitted are identified in Chapter 8.
New Line/No New Line	**(Parameter Field)** Pressing Enter causes the terminal to alternately select the function of the keyboard Return key. • "New Line" (default) causes the Return key to transmit a carriage return (CR) and a line feed (LF). • "No New Line" causes the Return key to transmit a carriage return (CR) only. **NOTE:** **When the Numeric Keypad is selected, this feature affects the Enter key in the same way as it affects the Return key.**

3.4.4 Communications Set-Up Menu

The Communications Set-Up menu is used to select various communication parameters. Figure 3-6 shows a Communications Set-Up menu. Table 3-6 describes each of the fields in the Communications Set-Up menu.

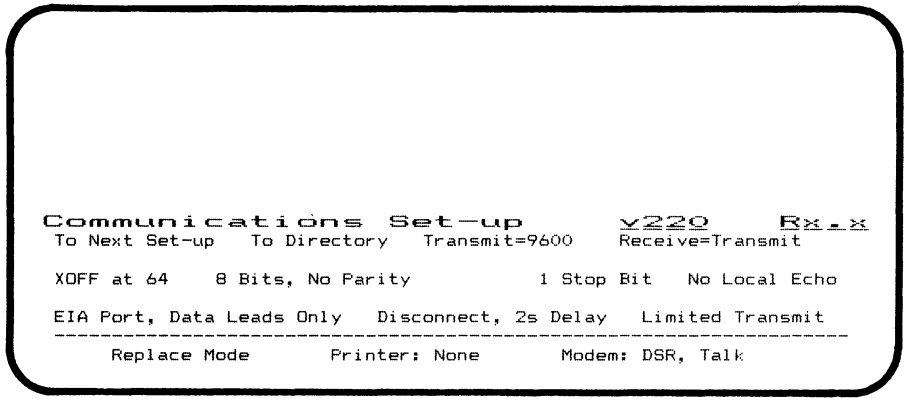


Figure 3-6. Communications Set-Up Menu (with Default Values Displayed)

Table 3-6. Communications Set-Up Menu Field Descriptions

Field Name	(Field Type) Function
To Next Set-up	**(Action Field)** Pressing Enter causes the Communications menu to be replaced with the Printer Set-up menu. (see Table 3-7).
To Directory	**(Action Field)** Pressing Enter causes the Communications menu to be replaced with the Set-up Directory. (see Table 3-3).

Table 3-6. Communications Set-Up Menu Field Descriptions (Contd.)

Field Name	(Field Type) Function
Transmit=	**(Parameter Field)** Pressing Enter causes the terminal to cycle through the sixteen possible baud rates for the transmitter. The terminal transmit speed must be set to match the host receive speed. However, the terminal can transmit at one speed and receive at another. The possible baud rates are: • 50 baud • 75 baud • 110 baud • 134.5 baud • 150 baud • 200 baud • 300 baud • 600 baud • 1200 baud • 1800 baud • 2000 baud • 2400 baud • 3600 baud • 4800 baud • 9600 baud (Default) • 19200 baud

Table 3-6. Communications Set-Up Menu Field Descriptions (Contd.)

Field Name	(Field Type) Function
Receiver=	**(Parameter Field)** Pressing Enter causes the terminal to cycle through the sixteen possible baud rates for the receiver. The terminal receive speed must be set to match the host transmit speed. However, the terminal can receive at one speed and transmit at another. The possible baud rates are: • 50 baud • 75 baud • 110 baud • 134.5 baud • 150 baud • 200 baud • 300 baud • 600 baud • 1200 baud • 1800 baud • 2000 baud • 2400 baud • 3600 baud • 4800 baud • 9600 baud • 19200 baud • Receive=Transmit (Default)
XOFF at 64/128/ 256/No XOFF	**(Parameter Field)** Pressing Enter selects the XOFF point or disables the XON/XOFF flow control. XOFF at 64 characters (12.5% of the input buffer capacity) is the default value for this field.

Table 3-6. Communications Set-Up Menu Field Descriptions (Contd.)

Field Name	(Field Type) Function
Bits/Parity	**(Parameter Field)** Pressing Enter causes the terminal to cycle through various selections of parity and data bits per character when the Enter key is struck. Available selections are: • 8 Bits, No Parity (Default) • 8 Bits, Even Parity • 8 Bits, Odd Parity • 7 Bits, No Parity • 7 Bits, Even Parity • 7 Bits, Odd Parity • 7 Bits, Mark Parity • 7 Bits, Space Parity • 7 Bits, Even Parity, No Check • 7 Bits, Odd Parity, No Check • 8 Bits, Even Parity, No Check • 8 Bits, Odd Parity, No Check
1/2 Stop Bits	**(Parameter Field)** Pressing Enter causes the terminal to alternately select one (default) or two stop bits for the host data format. 2 stop bits are generally used only at baud rates below 200 baud.
Local Echo	**(Parameter Field)** Pressing Enter causes the terminal to alternately enable or disable (default) Local Echo Mode. The Local Echo feature automatically echoes characters to the terminal. If the host echoes data, this feature should be disabled.

Table 3-6. Communications Set-Up Menu Field Descriptions (Contd.)

Field Name	(Field Type) Function
20 mA/EIA Port	**(Parameter Field)** Pressing Enter causes the terminal to cycle through the available interfaces for the host Comm Port • **20 mA Port** should be selected if the terminal is connected to the host via the 20 mA port. • **EIA Port, Data Leads Only** (default) should be selected if the terminal is connected directly to the host via the EIA port. • **EIA Port, Modem Controls** should be selected if the terminal is connected to the host via an external modem requiring modem controls.
Disconnect, 2sec/60ms Delay	**(Parameter Field)** Pressing Enter causes the terminal to alternate between the two available disconnect delay times. Delay time is the time between the loss of DCD (Data Carrier Detect) and terminal disconnection. 60 ms should be used in the U.K. 2 seconds (default) should be used for all other countries.
Limited/Unlimited Transmit	**(Parameter Field)** Pressing Enter causes the terminal to alternate between limited (default) and unlimited transmit. Limited Transmit limits the transmit rate to 150-180 characters per second, regardless of the baud rate, placing a minimum burden on the host operating system.

3.4.5 Printer Setup Menu

The Printer Set-Up menu is used to select various Printer port parameters. Figure 3-7 shows a Printer Set-Up menu. Table 3-7 describes each of the fields in the Printer Set-Up menu.

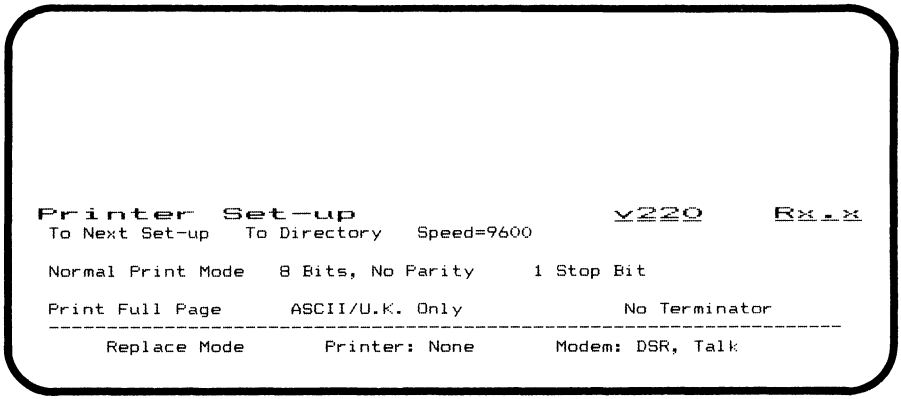


Figure 3-7. Printer Set-Up Menu (with Default Values Displayed)

Table 3-7. Printer Set-Up Menu Field Descriptions

Field Name	(Field Type) Function
To Next Set-up	**(Action Field)** Pressing Enter causes the Printer menu to be replaced with the Keyboard Set-up menu (see Table 3-8).
To Directory	**(Action Field)** Pressing Enter causes the Printer menu to be replaced with the Set-up Directory. (see Table 3-3).

Table 3-7. Printer Set-Up Menu Field Descriptions (Contd.)

Field Name	(Field Type) Function
Speed=	**(Parameter Field)** Pressing Enter causes the terminal to cycle through the sixteen available baud rates for the printer port. The possible baud rates are: • 50 baud • 75 baud • 110 baud • 134.5 baud • 150 baud • 200 baud • 300 baud • 600 baud • 1200 baud • 1800 baud • 2000 baud • 2400 baud • 3600 baud • 4800 baud • 9600 baud (Default) • 19200 baud
Print Mode	**(Parameter Field)** Pressing Enter selects the operating mode for the printer. The available modes are: • **Normal Print Mode** (Default) enables print functions to be invoked from either the host or the keyboard. • **Auto Print Mode** allows a variable number of lines to be sent to the printer. A received linefeed, formfeed or vertical tab causes the line containing the cursor to be transmitted. The control code that initiated printing is appended to the end of the printed data.

Table 3-7. Printer Set-Up Menu Field Descriptions (Contd.)

Field Name	(Field Type) Function
	• **Controller Mode**, routes all data from the host directly to the printer instead of the screen. This means that the printer speed controls the host in terms of XOFF/XON protocol. The host XON/XOFF feature must be enabled. • **Copy Mode** is similar to Controller mode except that data is also routed to the terminal display.
Bits/Parity	**(Parameter Field)** Pressing Enter causes the terminal to cycle through various selections of parity and data bits per character. Available selections are: • 8 Bits, No Parity (default) • 8 Bits, Even Parity • 8 Bits, Odd Parity • 7 Bits, No Parity • 7 Bits, Even Parity • 7 Bits, Odd Parity • 7 Bits, Mark Parity • 7 Bits, Space Parity
1/2 Stop Bits	**(Parameter Field)** Pressing Enter causes the terminal to select one (default) or two stop bits for the printer interface.
Print Full Page/ Scroll Region	**(Parameter Field)** Pressing Enter causes the terminal to alternate between Full Page (default) and Scroll Region for the print extent. If Scroll Region is chosen, only the scrolling region area is printed when a Print Screen command is issued. Otherwise, the full screen is printed.

Table 3-7. Printer Set-Up Menu Field Descriptions (Contd.)

Field Name	(Field Type) Function
Printed Data Type	**(Parameter Field)** Pressing Enter causes the terminal to select the type of characters to be sent to the printer. The printer must be able to support the types of characters sent. • If **ASCII or U.K. Only** (default) is selected, only ASCII or U.K. data is printed. Line drawing and down-line loadable characters are replaced with underbars. Supplemental characters are replaced with appropriate translations (see Appendix E). • If **Line Drawing, ASCII/U.K.** is selected, only Line Drawing, ASCII and U.K. data is printed. Down-line loadable characters are replaced with underbars. Supplemental characters are replaced with appropriate translations (see Appendix E). • If **All Characters** is selected, all characters are printed.
Print Terminator	**(Parameter Field)** Pressing Enter switches the print termination between formfeed (FF) and none. • When **Terminator=FF** is selected, the terminal transmits a FF code at the end of a print operation. • When **No Terminator** (default) is selected, no code is transmitted at the end of a print operation.

3.4.6 Keyboard Set-Up Menu

The Keyboard Set-Up menu is used to select various keyboard features. Figure 3-8 shows a Keyboard Set-Up menu. Table 3-8 describes each of the fields in the Keyboard Set-Up menu.

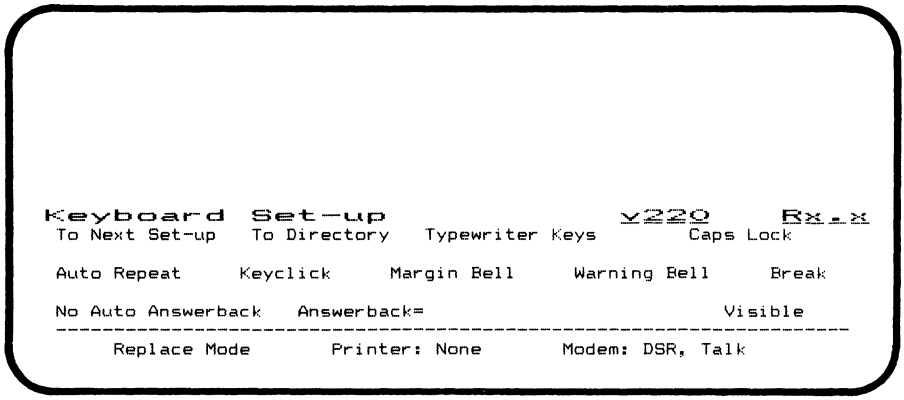


Figure 3-8. Keyboard Set-Up Menu (with Default Values Displayed)

Table 3-8. Keyboard Set-Up Menu Field Descriptions

Field Name	(Field Type) Function
To Next Set-up	**(Action Field)** Pressing Enter causes the Keyboard menu to be replaced with the Tab Set-up menu. (see Table 3-9).
To Directory	**(Action Field)** Pressing Enter causes the Keyboard menu to be replaced with the Set-up Directory. (see Table 3-3).

Table 3-8. Keyboard Set-Up Menu Field Descriptions (Contd.)

Field Name	(Field Type) Function
Typewriter/Data Processing Keys	**(Parameter Field)** Pressing Enter causes the keyboard to switch between Typewriter and Data Processing keys. • Selecting Typewriter Keys (default) causes the keyboard keys to generate the characters shown on left half of foreign national keycaps. • Selecting Data Processing causes the keys to generate the characters on the right half of foreign national keycaps.
Caps/Shift Lock	**(Parameter Field)** Pressing Enter selects the operation of the Lock key. • **Caps Lock** (default) causes the alphabetic keys to generate only uppercase characters when the Lock indicator is on. The numeric/symbol keys generate codes for the bottom character printed on the keycaps. • **Shift Lock** causes the alphabetic keys to generate only uppercase characters and the numeric/symbol keys to generate the top code only when the Lock indicator is on. The lock indicator is set by pressing the Lock key. Caps Lock can be reset by pressing the Lock key again. Shift Lock can be cleared by pressing the Lock key or the Shift key.
Autorepeat/ No Autorepeat	**(Parameter Field)** Pressing Enter alternately enables (default) and disables the autorepeat feature. When enabled, keystrokes are automatically repeated when a key is held down for more than .5 seconds. When disabled, only single keystroke operation is allowed.

Table 3-8. Keyboard Set-Up Menu Field Descriptions (Contd.)

Field Name	(Field Type) Function
Keyclick **No Keyclick**	**(Parameter Field)** Pressing Enter switches the keyboard between **Keyclick** (audible) and **No Keyclick** (silent) operation. Keyclick is the default value for this field.
Margin Bell/ **No Margin Bell**	**(Parameter Field)** Pressing Enter alternately enables (default) and disables the terminal from sounding a bell tone when the cursor is eight characters from the end of the current line.
Warning Bell/ **No Warning Bell**	**(Parameter Field)** Pressing Enter alternately enables (default) and disables the terminal from generating a bell tone for operating errors and receipt of Control-G.
Break/No Break	**(Parameter Field)** Pressing Enter alternately enables (default) and disables the Break key. This only affects break, not shift-break (long disconnect) or control-break (answerback). For more information on the Break key, refer to Table 2-2.
Auto Answerback/ **No Auto Answerback**	**(Parameter Field)** Pressing Enter alternately enables (default) and disables the ability of the terminal to automatically transmit the answerback message after a communication line connection.
Answerback=	**(Text Field)** Pressing Enter allows input of a new Answerback message. The status line is temporarily overwritten with the message, "Enter Answerback." Up to thirty-two (32) characters can be entered. Any ASCII or supplemental code can be programmed. Control codes are represented by their Display Controls characters. Pressing the Enter key terminates entry of the answerback message.

Table 3-8. Keyboard Set-Up Menu Field Descriptions (Contd.)

Field Name	**(Field Type)** Function
Concealed/Visible	**(Parameter Field)** Pressing Enter conceals the answerback message, preventing it from being displayed on the screen during Set-Up. To reset to "Visible" (default), a new answerback message must be entered.

3.4.7 Tab Set-Up Menu

The Tab Set-Up menu is used to set and clear tabs. Figure 3-9 shows a Tab Set-Up menu. Table 3-9 describes each of the fields in the Tab Set-Up menu.

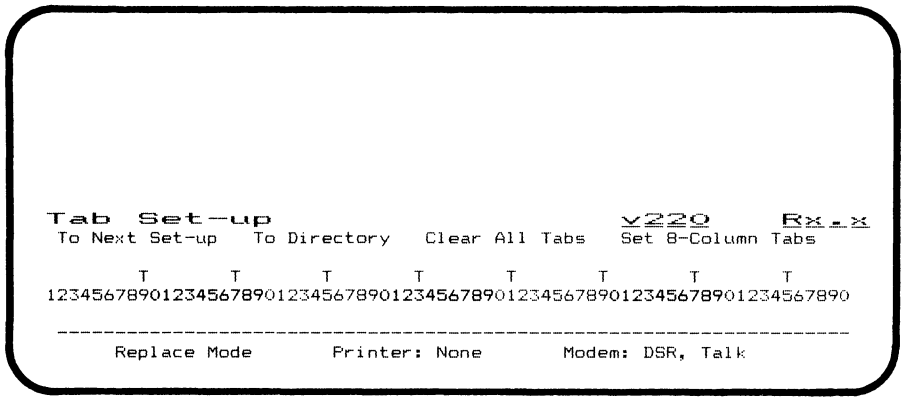


Figure 3-9. Tab Set-Up Menu (with Default Values Displayed)

Table 3-9. Tab Set-Up Menu Field Descriptions

Field Name	(Field Type) Function
To Next Set-up	**(Action Field)** Pressing Enter causes the Tab menu to be replaced with the Enhancement Set-up menu (see Table 3-10).
To Directory	**(Action Field)** Pressing Enter causes the Tab menu to be replaced with the Set-up Directory. (see Table 3-3).
Clear All Tabs	**(Action Field)** Pressing Enter clears all previously set tab stops.
Set 8 Column Tabs	**(Action Field)** Pressing Enter automatically sets tab stops every 8 columns, beginning with column 9. Any previously set tab stops are cleared.

Table 3-9. Tab Set-Up Menu Field Descriptions (Contd.)

Field Name	(Field Type) Function
Tab Stops	**(Parameter Fields)** Pressing Enter alternately sets and removes individual tab stops at the current cursor position. Change the cursor position using Tab, Cursor Left, Cursor Right and Return. **NOTE** **The tab field and ruler can be either 80 or 132 columns, depending on which mode is selected (see Table 3-4).**

3.4.8 Enhancement Set-Up Menu

The Enhancement Set-Up menu is used to enter time and to enter data for the four PF keys (on the Numeric/Application keypad). Figure 3-10 shows an Enhancement Set-Up menu. Table 3-10 describes each of the fields in the Tab Set-Up menu.

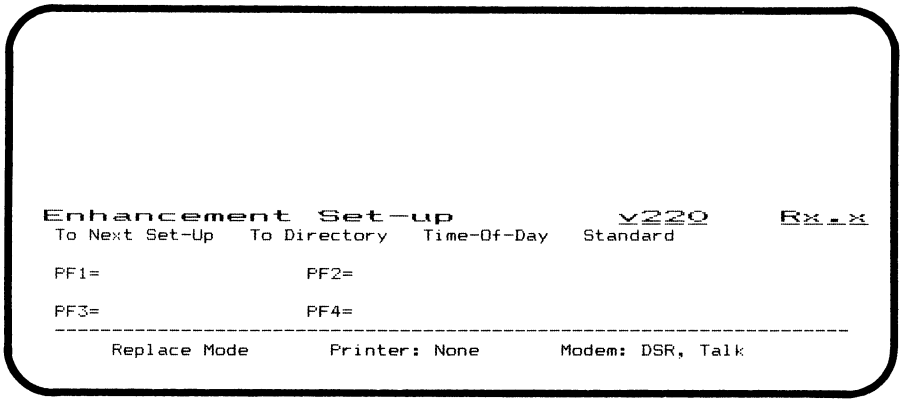


Figure 3-10. Enhancement Set-Up Menu (with Default Values Displayed)

Table 3-10. Enhancement Set-Up Menu Field Descriptions

Field Name	(Field Type) Function
To Next Set-Up	**(Action Field)** Pressing Enter causes the Enhancement menu to be replaced with the Display Set-up menu (see Table 3-4).
To Directory	**(Action Field)** Pressing Enter causes the Enhancement menu to be replaced with the Set-up Directory. (see Table 3-3).
Time-Of-Day	**(Action/Text Field)** Pressing Enter allows input of the time-of-day. The status line is temporarily overwritten with the message "Enter time (hh:mm:ss):". Time can be entered in standard or military format and is translated to the selected format.

Table 3-10. Enhancement Set-Up Menu Field Descriptions (Contd.)

Field Name	(Field Type) Function
Standard/Military	**(Parameter Field)** Pressing Enter alternately selects the Standard or Military format to display the time. The Standard format is a 12 hour clock with AM and PM indicators. The Military format is a 24 hour clock.
PF1/PF2/PF3/PF4	**(Text Fields)** Pressing Enter allows input of data for the selected PF key. The status line is temporarily overwritten with the message "Enter PF key data:". Up to 15 characters can be entered for each key. Data entered is stored in non-volatile memory.

Part Two: Installation and Configuration

CHAPTER 4
TERMINAL INSTALLATION

4.1 OVERVIEW

This Chapter provides information required for installing the Visual 220 terminal. In addition, the self-test indications are also described. The self-test aids in assuring that the Visual 220 terminal is correctly installed and is functioning properly. The following information is provided:

- Site requirements
- Unpacking and inspection
- Installation and testing
- Printer port connection

4.2 SITE REQUIREMENTS

The location where the Visual 220 terminal is to be installed must meet the following requirements:

- The terminal operating area is located where the terminal is not likely to be damaged by bumps, spills, excessive heat and so on.
- All necessary cables reach the appropriate terminal connectors without being strained. Typical cables include:
  - — Power cord
  - — Keyboard cable
  - — Printer cable (if required)
  - — Host communications cable (or modem cable).
- The operating conditions (such as temperature, humidity, voltage levels and so on) are within the ranges prescribed for normal terminal operation. The terminal parameters are listed in Appendix A.

4.3 UNPACKING AND INSPECTION

This section provides instructions for unpacking the keyboard and monitor shipping cartons and verifying the presence and condition of the contents. These instructions may also be used for repacking the terminal in the event that it is to be shipped or moved to another location.

1. Unpack the keyboard and monitor shipping cartons as shown in Figures 4-1 and 4-2.

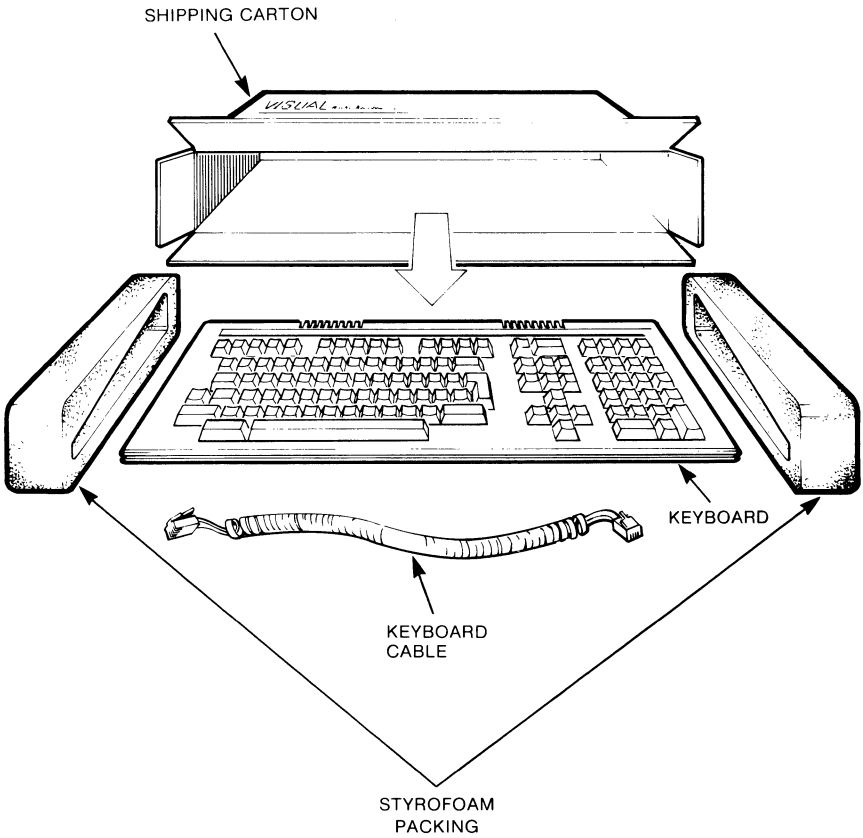


Figure 4-1. Unpacking the Keyboard Shipping Carton

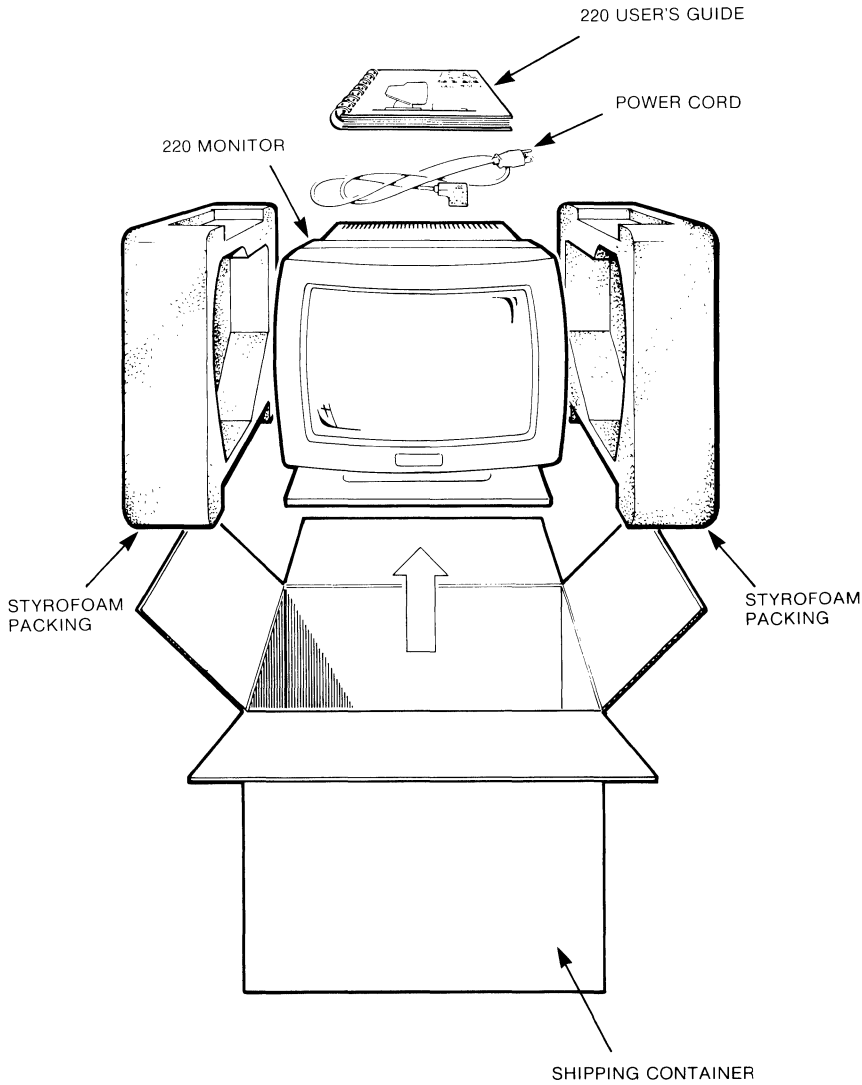


Figure 4-2. Unpacking the Monitor Shipping Carton

2. Verify that all of the items have been received and are not damaged. The items are shown in Figure 4-3.

NOTE

If any items are missing or damaged, contact the Visual sales representative and/or the shipping agent.

THE KEYBOARD CARTON CONTAINS:

☐ KEYBOARD CABLE

SEE NOTE

☐ KEYBOARD

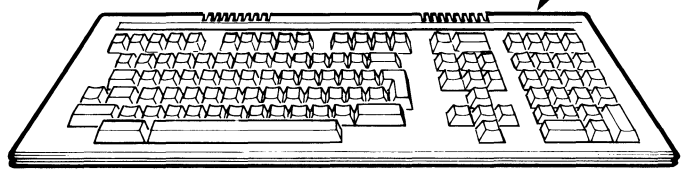


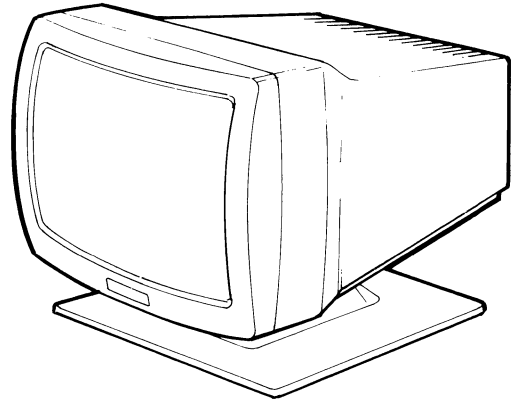
Figure 4-3. Checking the Contents (Sheet 1 of 2)

NOTE

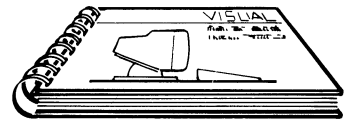
Each keyboard has two function key legend strips. A generic strip is permanently bonded to the keyboard. A removable national language strip slides over the generic strip.

THE MONITOR CARTON CONTAINS:

☐ 220 MONITOR UNIT



☐ 220 USER'S GUIDE



☐ POWER CORD

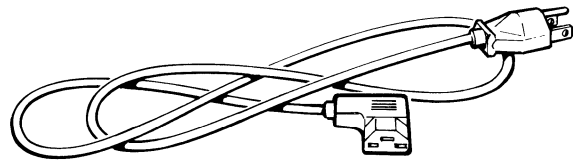


Figure 4-3. Checking the Contents (Sheet 2 of 2)

4.4 INSTALLATION AND TESTING

This section describes when and where to connect the necessary cables and when to perform various tests. The tests include:

- Terminal power-on self-test
- Host communication test
- Printer test

Information on configuring the host Comm port (selecting baud rates and so on) is provided in Chapter 5, Communication. Information on connecting a printer is provided in the subsequent section entitled "Printer Port Connection."

CAUTION

To avoid damage to any equipment, follow the installation instructions carefully. Make sure the terminal is turned off when any cables are being connected.

1. Locate the terminal (monitor and keyboard) where it is to be installed.
2. Make sure the terminal power switch is pushed to OFF as shown in Figure 4-4.

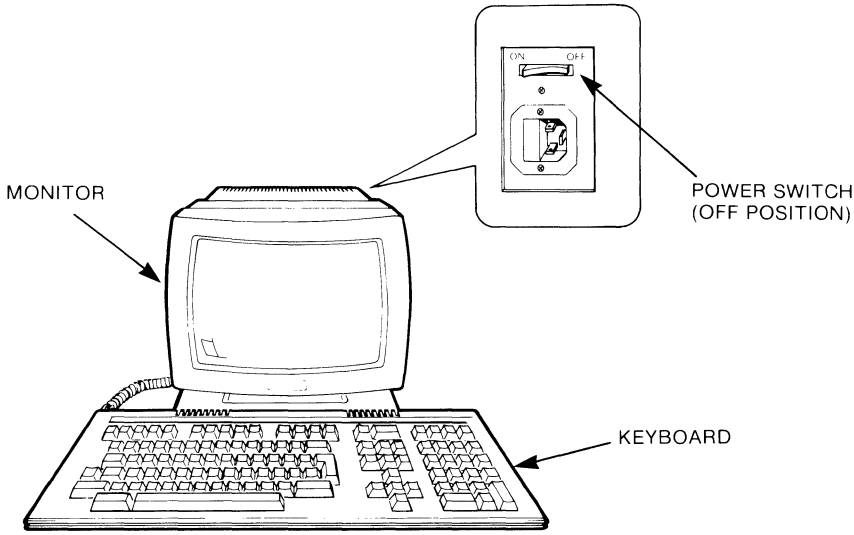
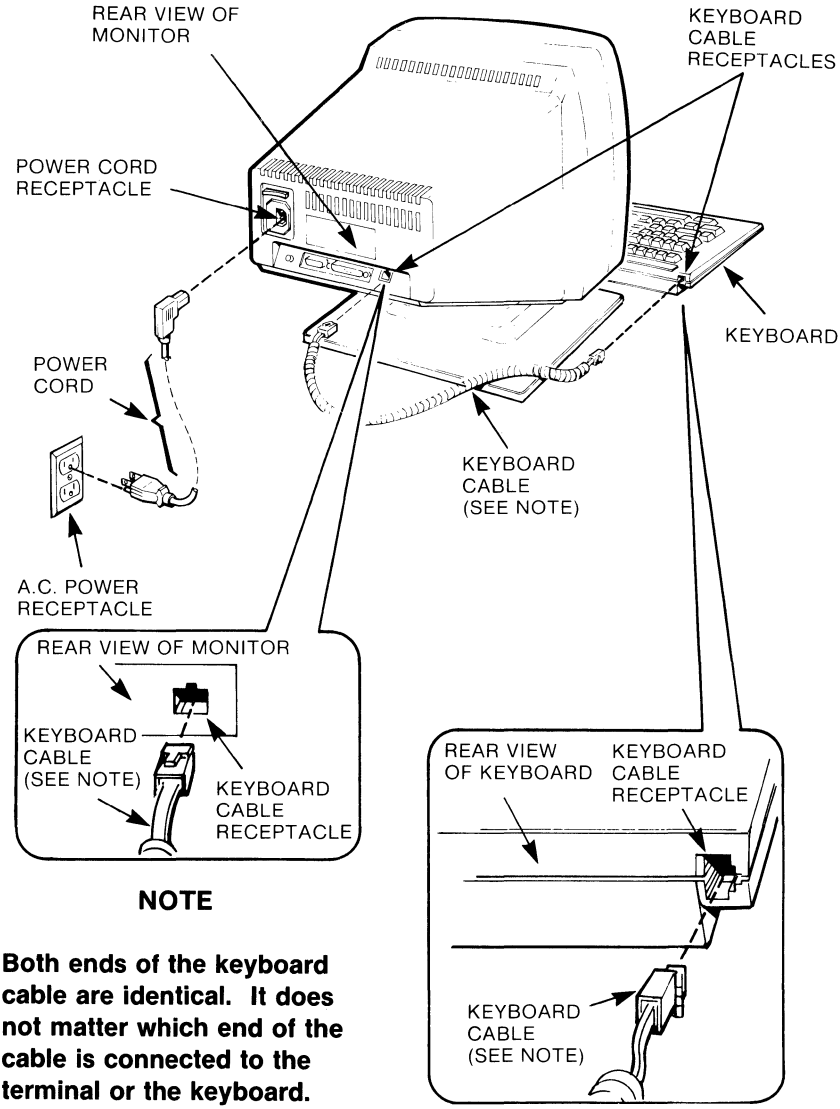


Figure 4-4. Location of the Power Switch

3. Connect the keyboard cable and power cord as shown in Figure 4-5.



NOTE

Both ends of the keyboard cable are identical. It does not matter which end of the cable is connected to the terminal or the keyboard.

Figure 4-5 Keyboard Cable and Power Cord Connections

4. Push the power switch to ON and note the results of the self-test (see Figure 4-6).

NOTE

A self-test that lasts for about 10 seconds executes each time the terminal is turned ON or reset. Keyboard indicator lights (above top-row function keys F15 and F16) blink on and off while the test is executing.

When the self-test completes, the following indications should occur:

a) A short tone (beep) sounds, signalling that the self-test has passed.

b) A blinking cursor and status line are displayed (see Figure 4-6).

If the terminal does not power-up as expected, go to Chapter 6, Problem Solving, and try the suggested corrective procedures.

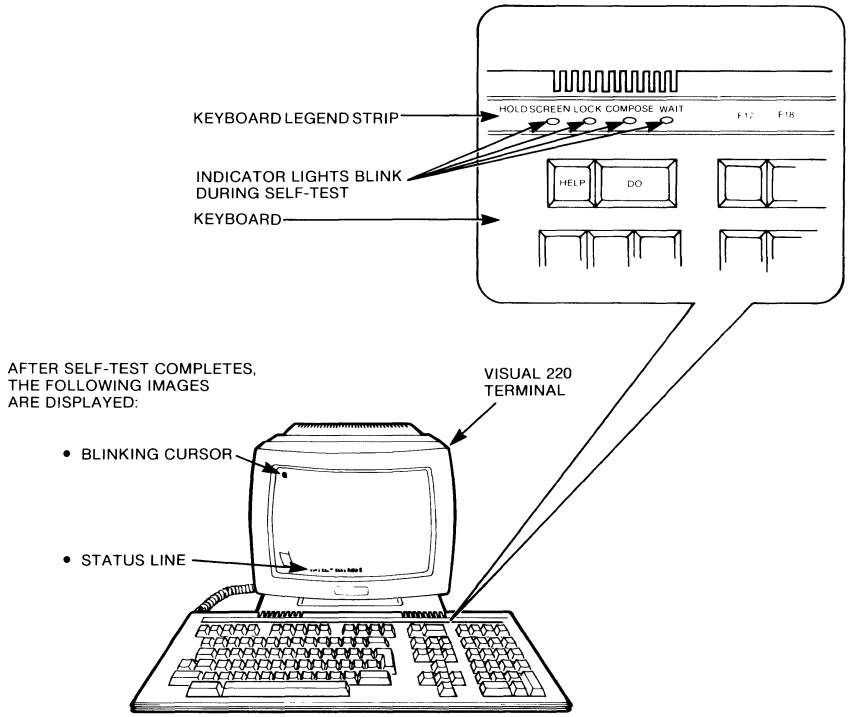


Figure 4-6. Self-Test Indications

5. Push the power switch to OFF and connect the host communication cable or modem cable as shown in Figure 4-7. Be sure to lock the cable onto the connector using the connector's locking hardware.
6. Push the power switch to ON. Use the Communications Set-Up menu to configure the Comm Port so that the terminal can communicate with the host system.

   Information on configuring the Comm Port is provided in Chapter 5, Communications. The Communications Set-Up menu is fully described in Chapter 3, Terminal Set-Up.
7. Test for host communication by logging onto the host system.
8. Save the new configuration in non-volatile RAM (NVR) using the "Save" feature from the Set-Up Directory menu.

If a printer is not to be connected, The installation is complete. Otherwise, continue with printer connection.

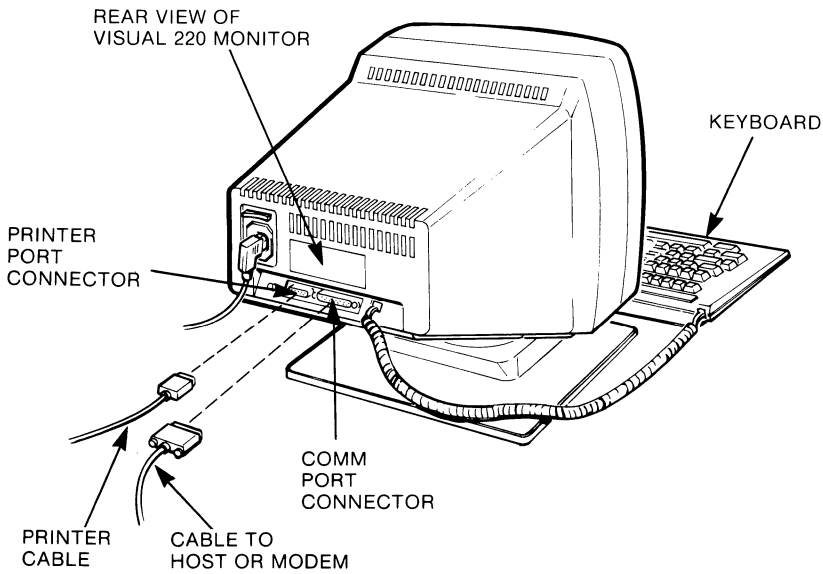


Figure 4-7. Host (or Modem) and Printer Cable Connections

4.5 PRINTER PORT CONNECTION

This section describes the procedure for connecting a printer to the printer port. Instructions for testing the printer interface are also included.

To connect a printer to the printer port, perform the following steps:

1. Log off of the host system (if necessary) and turn off the terminal (refer to Figure 4-4).
2. Connect the cable from the printer to the printer port on the rear of the terminal (refer to Figure 4-7).
3. Turn on the terminal. After self-test completes, use the Printer Set-Up menu to configure the printer port so that the terminal can communicate with the printer.

   Information on configuring the printer port is provided in Chapter 5, Communications. The Printer Set-Up menu is fully described in Chapter 3, Terminal Set-Up.
4. Test the printer interface by performing the following steps:

   a. Type a few lines of characters onto the terminal display (if a host system is not available, first place the terminal in local mode using the Set-Up Directory menu).

   b. Print the displayed characters on the printer by pressing the Print Screen key (top-row function key F2).

   If the printer does not respond by printing the displayed characters, go to Chapter 6, Problem Solving, and try the suggested corrective procedures.
5. Save the new configuration in non-volatile RAM (NVR) using the "Save" feature from the Set-Up Directory menu.

CHAPTER 5
COMMUNICATION

5.1 OVERVIEW

This Chapter provides information to aid in configuring the Visual 220 terminal so that it can communicate with a host system and a printer (if one is connected).

The following sections are included in this Chapter:

- Communications Protocols
- Data Flow Control
- Host Interface
  - — Local Host
  - — Remote Host
- Printer Interface

5.2 COMMUNICATION PROTOCOLS

The Visual 220 terminal must be able to communicate properly with a host computer in order to function. This section describes various standards and protocols supported by the Visual 220 terminal.

Selection of a desired protocol typically requires changing settings in the Communications Set-up menu. All of the Set-up menus are fully described in Chapter 3.

5.2.1 Communications Standards Supported

The Visual 220 terminal supports the following data communication standards:

- EIA Standard RS-232-C
- CCITT V.24
- (Optional) 20 mA current loop interface

The desired interface may be selected from the Communications Set-Up menu.

5.2.2 Communication Modes

The Visual 220 terminal supports full-duplex, asynchronous serial data communications only. The following additional features may be selected or modified from the Communications menu:

- Split data rates on transmit and receive lines.
- Local echo.
- Data Format:
  - — Number of data bits.
  - — Number of stop bits.
  - — Even, odd or no parity.

5.2.2.1 Split Data Rates — The Visual 220 terminal may transmit at one speed and receive at another. However, for compatibility with the host system, the terminal's transmit speed must be set to match the host's receive speed and the terminal's receive speed must be set to match the host's transmit speed. The possible baud rates are: 50, 75, 110, 134.5, 150, 200, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 9600, and 19200.

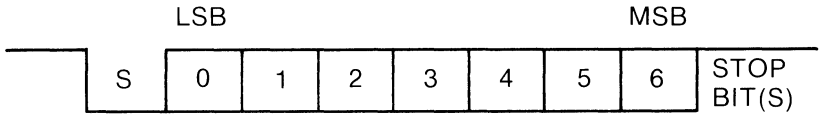
5.2.2.2 Local Echo — Data from the keyboard can be directed to the display as well as to the host computer. If the host computer is set to echo data back to the terminal, local echo should be disabled.

5.2.2.3 Data Format — The Visual 220 terminal uses a data format that consists of a 9- to 12-bit word. The word is made up of the following:

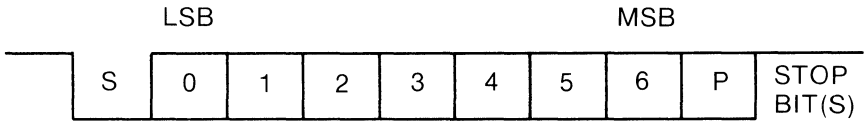
- One start bit (always a spacing [0] bit).
- Seven or eight data bits.
- An optional parity bit.
- One or two stop bits (a stop bit is always a mark [1] bit).

The format can be modified from the Communications menu. Examples of typical formats are shown in Figure 5-1. These examples illustrate the flexible parameters of the data format.

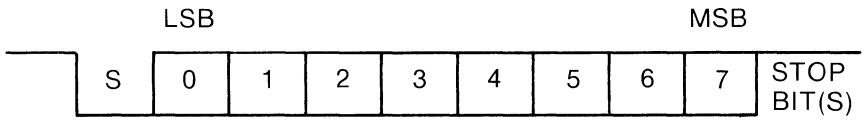
Format of 7 Data Bits with No Parity



Format of 7 Data Bits with Parity



Format of 8 Data Bits with No Parity



Format of 8 Data Bits with Parity

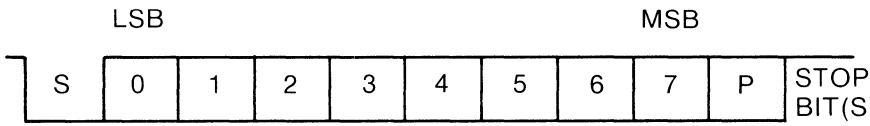


Figure 5-1. Data Format Examples

5.3 TERMINAL/HOST DATA FLOW CONTROL

The Visual 220 terminal supports XON/XOFF data flow control and hardware data flow control. This section describes both types of data flow control.

Data flow control helps to minimize lost data by signalling the host to stop sending data. The conditions under which the flow control signals are generated may be selected by the operator from the Communications Set-Up menu.

5.3.1 XON/XOFF Data Flow Control

The Visual 220 terminal supports the use of XOFF and XON characters to suspend and resume data transmission from the host computer. This feature helps prevent loss of data due to overflow of the terminal's receive data buffer.

5.3.1.1 Conditions Causing XOFF Character Transmission — An XOFF character (DC3 [Ctrl-S]) is transmitted by the terminal when XON/XOFF is enabled and any of the following occurs:

- The receive buffer reaches the selected threshold level of its capacity of 512 characters. The threshold may be set at 64, 128, or 256 characters (12.5%, 25% and 50% respectively) using the Communications Set-Up menu.
- The receive buffer reaches 75% (384 characters) of its capacity of 512 characters.
- A character is received when the receive buffer is full (512 characters). Any character that causes an XOFF transmission due to a full buffer is lost.

If the host system does not respond to XOFF, and the receive buffer continues to fill with characters, the buffer may overflow . When this happens, data is lost. The Visual 220 terminal replaces any lost characters with reverse question marks (¿). The question mark characters are sent to the screen and may be used as a signal that characters are being lost.

5.3.1.2 Conditions Causing XON Character Transmission — An XON character (DC1 [Ctrl-Q) is transmitted by the terminal when XON/XOFF is enabled and any of the following ocurrs:

- The receive data buffer is emptied to a fixed level (16 characters) and XOFF was the last flow control signal sent.
- The Clear Communications (Clear Comm from the Set-Up Directory) function is performed.
- The Recall or Default function (from the Set-Up Directory) is performed.
- The self-test is completed.

5.3.1.3 Host XOFF Response Time — The following formula is used to determine how fast the host must respond to the XOFF character (DC3) to prevent any data from being lost.

Host response time formula:

$$\text{Host Response time (in seconds)} = \text{Overflow} \times \frac{\text{Word Size}}{\text{RxDR}}$$

Overflow = Calculated from the Overflow formula below.

RxDR = The receiver baud rate (receive data rate).

Word Size	=	1	(Start Bit)
		7 or 8	(Number of data bits per character)
		1 or 2	(Number of stop bits per character)
	+	0 or 1	(Number of parity bits per character)

Overflow formula:

$$\text{Overflow} = (\text{RxBUF} - \text{XOFF}) - \frac{\text{RxDR}}{3 \times \text{TxDR}} - \frac{\text{RxDR}}{600}$$

Overflow = The number of characters until overflow occurs.

RxBUF = Size of the receive buffer (512).

XOFF = The selected XOFF point (64, 128 or 256).

RxDR = The receiver baud rate (receive data rate).

TxDR = The transmitter baud rate (transmit data rate).

5.3.2 Using Fill (Null) Characters

With certain situations, data may be lost because the host system does not support (respond to) XON/XOFF characters. In these cases, fill characters (C0 control code "NUL") may be transmitted by the host in place of any real data characters that are being lost.

The terminal can also be used without XON/XOFF characters or fill characters if the following conditions are met:

- The baud rate does not exceed 9600 and
- The software does not send escape (ESC) sequences or use slow scrolling or the printer port.

5.3.3 Modem Connect/Disconnect

When DSR (Data Set Ready) and DCD (Data Carrier Detect) are received from a modem, the Visual 220 terminal performs the following operations to ensure that it is prepared to send and receive data:

- Unlocks the keyboard (if it is locked).
- Clears any transmission in progress.
- Clears the keyboard buffer and all message buffers.
- Clears the receive buffer.
- Clears XOFF sent and XOFF received.
- Asserts the RTS (Request to Send) signal to the modem.

A modem disconnects (hangs up) under the following conditions:

- Holding down the Shift and Break keys.
- Invoking "Saved" or "Default" values from Set-up.
- DSR is lost.
- DCD is lost for time defined by the user in Set-Up.
- DCD is not detected within 30 seconds after DSR.
- Receipt of a self-test command from the host.

5.4 HOST INTERFACE

Communication with a host computer is via the Comm Port on the rear of the terminal. The Comm Port may be configured (with the Communications menu) to support communications with local or remote host systems.

Table 5-1 identifies the Comm port pins that may be used for various local and remote host configurations

Table 5-1. Host Interface (Comm Port) Pin Usage

Interface Type	Connector Pins Used
RS-232-C / CCITT V.24 (connected to host)	1, 2, 3, 6, 7, 8, 12
RS-232-C / CCITT V.24 (connected to modem)	1, 2, 3, 4, 5, 6, 7, 8, 12, 20
20 mA current loop	17, 18, 21, 25

Table 5-2 Provides a pin signal description for the Comm port connector.

Table 5-2. Host Interface Connector Pin Descriptions

Pin	Mnemonic EIA (CCITT)	**Signal Name** / Definition
1	AA (101)	**Protective Ground (GND)** — This signal is connected to the chassis of the terminal. The terminal chassis is connected to the earth-ground pin on the power cord.
2	AB (103)	**Transmit Data (TXD)** — This line is used to transmit data from the terminal to the modem/host. When modem control is enabled, data can be transmitted only when DTR, DSR, RTS and CTS are on.
3	BB (104)	**Receive Data (RXD)** — This line is used to receive data from the host/modem. When modem controls are enabled, DCD must be on for this line to be monitored.
4	CA (105)	† **Request to Send (RTS)** — This signal is from the terminal to the host/modem indicating that the terminal is ready to transmit data. This signal is always asserted.
5	CB (106)	† **Clear to Send (CTS)** — This is a signal from the host/modem to the terminal indicating that transmission of data is allowed. This signal is monitored by the terminal only if modem controls are enabled. If not connected, it defaults to the OFF condition.

†These signals needed for modem control.

Table 5-2. Host Interface Connector Pin Descriptions (Contd.)

Pin	Mnemonic EIA (CCITT)	Signal Name / Definition
6	CC (107)	**Data Set Ready (DSR)** — This is a signal from the host/modem to the terminal indicating that the host/modem is ready for handshaking (exchanging RTS, CTS and DCD).
7	AB (102)	**Signal Ground (GND)** — This signal establishes a ground reference between the terminal and the host.
8	CF (109)	**Data Carrier Detect (DCD)** — This signal from the modem indicates that the quality of incoming data is sufficient for proper demodulation. If not connected it defaults to the ON condition.
12	CI (112)	**Speed Indicator (SPDI)** — This signal is from a modem. The ON condition causes the terminal transmit and receive rates to be 1200 baud regardless of the selection in Set-Up. This allows a modem to set the data rate.
17	N/A (N/A)	* **20 mA Current Loop Receive (-)** — Refer to Figure 5-2.
18	N/A (N/A)	* **20 mA Current Loop Receive (+)** — Refer to Figure 5-2.
20	CD (108.2)	† **Data Terminal Ready (DTR)** — This signal is ON whenever the terminal is ready to transmit or receive data. It is OFF when the terminal is not ready.

† These signals needed for modem control.

* These signals used only for 20 mA current loop interface.

Table 5-2. Host Interface Connector Pin Descriptions (Contd.)

Pin	Mnemonic EIA (CCITT)		Signal Name/Definition
21	N/A (N/A)	*	**20 mA Current Loop Transmit (+)** — Refer to Figure 5-2.
23	CH (111)		**Data Signal Rate Selector** — This signal is from the terminal. This signal is ON when the receive baud rate is greater than 600. This line is used to control a dual rate synchronous data set (if one is used).
25	N/A (N/A)	*	**20 mA Current Loop Transmit (-)** — Refer to Figure 5-2.

* These signals used only for 20 mA current loop interface.

5.4.1 Configuring for Communication With a Local Host

Communication with a local host can use the EIA RS-232-C/CCITT interface or the optional 20 mA current loop interface if it is installed. Use the Communications menu to select one of the following:

- For RS-232-C/CCITT communications, select "EIA Port, Data Leads Only."
- For current loop communications, select "20 mA Port."

5.4.1.1 EIA RS-232-C/CCITT Interface — To communicate with a local host using EIA standard RS-232-C or CCITT V.24, a minimum of three signal lines from the Communication port is required (Transmit Data, Receive Data and Signal Ground). Additional signal lines provide data flow control signals that may help to minimize lost data (refer to Table 5-2).

5.4.1.2 20 MA Current Loop Option — If the optional 20 mA current loop interface is being used, only the four current loop signal lines on the comm port (pins 17, 18, 21 and 25) are required.

The transmitter and/or receiver may be independently active (utilizing an internal current source) or passive (requiring an external current source).

The transmitter is active if jumper W5 on the main PCB is installed. The receiver is active if jumper W7 on the main PCB is installed. If a jumper is not installed, its associated device is passive and an external current source is required.

Figure 5-2 illustrates a full-duplex, current loop configuration. A marking condition (logical 1) is 20 mA flowing in the circuit. A spacing condition (logical 0) is no current flowing.

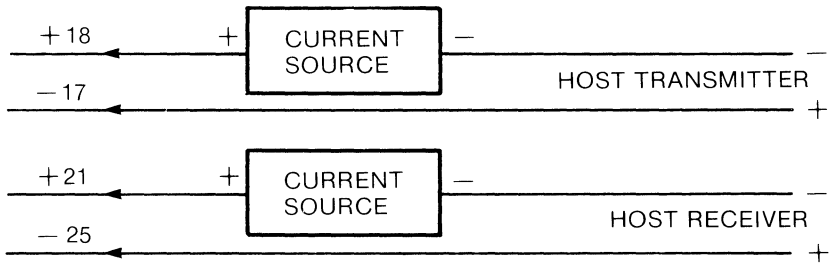


Figure 5-2. Full Duplex 20 mA Current Loop Diagram

5.4.2 Configuring for Communication With a Remote Host

Communication with a remote host requires using the EIA RS-232-C interface and a modem.

To communicate via a modem, select "EIA Port, Modem Control" from the Communications menu. Refer to Table 5-1 for signal line usage and to Table 5-2 for signal line descriptions.

5.5 PRINTER INTERFACE

The printer port uses a 9-pin, male, D-type connector on the rear of the Visual 220 terminal.

The interface includes the following features:

- 256 character FIFO.
- Independent parity from the Comm port. Parity may be selected from the Printer Set-Up menu.
- 16 baud rates (independent from the Comm port). The possible baud rates are: 50, 75, 110, 134.5, 150, 200, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 9600, and 19200. The baud rate is selected from the Printer Set-Up menu.
- XON/XOFF protocol or Printer Busy control line. Control is selected automatically by the printer handler.
- Auto print mode allows individual lines to be sent to a printer. A received linefeed, formfeed or vertical tab causes the line containing the cursor to be transmitted to the printer. This mode may be selected from the Printer Set-Up menu.
- Print Line/Page/Region controlled remotely or by the keyboard.
- Print modes include ASCII/U.K. only, line drawing and ASCII/U.K., all characters.

5.5.1 Printer Port Signal Descriptions

Pin signal descriptions are provided in Table 5-3. The information may be helpful in making sure the proper connection is made.

Table 5-3. Printer Port Pin-Signal Descriptions

Pin	Signal Name	Description
1	Protective Ground	This signal is connected to the chassis of the terminal. The terminal chassis is connected to the earth-ground pin on the power cord.
2	Transmit Data to Printer	This is the data signal line from the terminal to the printer.
3	Receive Data from Printer	This is the data signal line from the printer to the terminal.
4	Request to Send	This signal is ON whenever the terminal is turned on.
5	Data Terminal Ready	This signal is ON whenever the terminal is turned on.
6	Data Set Ready	This is a signal from the printer to the terminal indicating a ready condition. If DSR is not present when the terminal is turned on, the terminal checks for DSR before each character is transmitted to the printer. If DSR is present when the terminal is turned on, the printer is allowed to control printing functions.
7	Signal Ground	This signal establishes a ground reference between the printer and the terminal.
8-9	Not Used	

5.5.2 Printer Port Configuration

The printer port is normally configured for Normal Print mode or Auto Print mode. In Normal Print mode, print functions may be invoked from the host or the terminal keyboard. In Auto Print mode, the current line (the line containing the cursor) is transmitted only when a linefeed, form feed or vertical tab is received from the host.

Two other modes, Controller Mode and Copy Mode, route data from the host directly to the printer or other device connected to the printer port. In this case, the device connected to the printer port manages the device/host XON/XOFF data flow control. Data is not displayed on the terminal screen in Controller Mode. Data is, however, displayed on the screen in Copy Mode.

NOTES

1. **If an 8-bit format is used for terminal/printer communications, C1 control codes are also used. If a 7-bit format is used, the C0 control code extentions (such as ESC [for CSI) are used.**
2. **If the printer cannot accept 8-bit control codes or 8-bit characters but is configured to accept 8-bit wide data with no parity, select "7-bits, space parity" from the Printer Set-Up menu.**

CHAPTER 6
SOLVING DIFFICULTIES

6.1 OVERVIEW

This Chapter contains procedures that are designed to identify and resolve some of the difficulties that may be encountered when installing or using the Visual 220 terminal.

6.2 PROBLEM SOLVING PROCEDURE

The problem solving procedures provide step-by-step instructions for performing the following system functions.

- Turning the terminal ON.
- Communicating with a host.
- Printing on a printer.

When a given function does not perform as expected, you are referred to a specific section that describes related symptoms and suggests corrective procedures.

NOTE

When difficulties are encountered with software applications, you should refer to the particular application documentation for assistance.

6.2.1 Identifying Problems

The procedure for identifying problems begins with performing each action that is presented in Table 6-1. If the expected results are observed, continue with the next action in the table.

If the system does not perform as expected, turn to the section indicated.

If all of the actions in Table 6-1 perform as expected but the symptom persists, suspect a problem outside of the terminal.

Table 6-1. Finding the Problem

Action	Expected Results
Turn the system on	
• Push the power switch to ON	1. Keyboard indicator lights blink on and off in a pattern. 2. A short beep is sounded. 3. A blinking cursor and status line are displayed on the monitor. If the terminal does not respond as described, turn to Section 6.2.2
Communicate with the host computer.	
• Log onto the host system.	The host system (computer) should respond with the appropriate log-on prompts (such as "Name:" and/or "Password:"). If the host system does not respond as expected, turn to Section 6.2.3.
Print on the local printer.	
1. Place the terminal in Local mode. — Select Local Mode from Set-Up Directory menu (in Set-Up mode).	After leaving Set-Up mode, the status line (displayed on the bottom line) on the monitor should read "Local".
2. Type characters from the keyboard.	The display echoes keys pressed.
3. Print displayed characters by pressing Print Screen (F2 in top row function keys).	The printer prints displayed characters. If the printer does not respond as expected, turn to Section 6.2.4.

6.2.2 Power-Up Difficulties

Table 6-2 suggests corrective actions to perform if difficulties are encountered when turning the terminal on.

If the suggested corrective action does not solve the problem, then the problem should be referred to qualified service personnel.

Table 6-2. Difficulties with Turning the Terminal On

Symptom	Suggested Corrective Action
No Response from the terminal: — No Indicator Lights — No Beep — No display	Make sure the terminal is turned ON. Turn the terminal OFF, wait five seconds and turn the terminal ON. Make sure both ends of the power cord are plugged in. Check for power at the outlet by plugging a lamp into it. Check the fuse and replace if necessary (see Figure 6-1). Make sure that both ends of the keyboard cable are connected and that the display intensity is set to maximum. To increase intensity, enter Set-Up mode (press Set-Up) then hold Shift and press up arrow. If the symptom persists, refer the problem to qualified service personnel.

Table 6-2. Difficulties with Turning the Terminal On (Contd.)

Symptom	Suggested Corrective Action
The keyboard indicator lights remain ON (they do not blink). No other response from the terminal.	
— No Beep — No display	Turn the terminal OFF, wait five seconds and turn the terminal ON. If the symptom persists, refer the problem to qualified service personnel.
Multiple beeps or a steady beep is sounded.	A hardware malfunction exists. Refer problem to qualified service personnel.
Display problems (other indications are normal)	
— No display after warm up period.	Screen Saver feature enabled. Press the Shift key to restore display.
— No display.	Make sure that the display intensity is set to maximum. To increase intensity, enter Set-Up mode (press Set-Up) then hold Shift and press up arrow.
— A vertical or horizontal line is displayed.	A hardware malfunction exists. Refer problem to qualified service personnel.
— The display is tilted or rotated or jittery.	A hardware malfunction exists. Refer problem to qualified service personnel.

Figure 6-1 shows the location of the terminal fuse. A screwdriver can be used to release the fuse holder from the power cord receptacle.

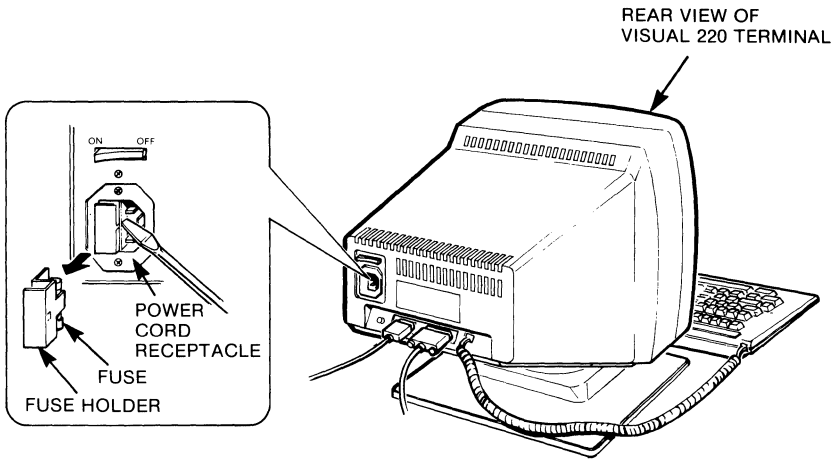


Figure 6-1. Checking the Terminal Fuse

6.2.3 Host Communication Difficulties

Table 6-3 suggests corrective actions to perform if difficulties are encountered when attempting to communicate with a host system.

NOTE

The corrective procedures in this section assume that the terminal has powered-up normally.

If the suggested corrective action does not solve the problem, then the problem should be referred to qualified service personnel.

Table 6-3. Difficulties with Host Communication

Symptom	Suggested Corrective Action
Keyboard keys have no effect.	Free any keys that are stuck in the down position. Then turn the terminal OFF, wait five seconds and turn the terminal ON. If the symptom persists, refer the problem to qualified service personnel.
No response from the host.	Make sure terminal is "On Line" (noted in the status line). Make sure all of the communication cables are properly connected. If a modem is used, make sure it is turned on and properly set. Make sure all of the communication parameters are properly set (check the Communication Set-Up menu). If the symptom persists, a problem may exist with the communication cables or the host system. Refer problem to qualified service personnel.

Table 6-3. Difficulties with Host Communication (Contd.)

Symptom	Suggested Corrective Action
Some Response but the data is garbled, and/or intermittent.	Make sure the terminal mode (such as VT200 Mode: 8-Bit Controls or VT52 Mode) is properly selected from the General Set-Up menu. Make sure all of the communication cables are properly connected. Make sure all of the communication parameters are properly set (check the Communication Set-Up menu). If the symptom persists, a problem may exist with the communication cables or the host system. Refer problem to qualified service personnel.

6.2.4 Printing Difficulties

Table 6-4 suggests corrective actions to perform if difficulties are encountered when attempting to print on a printer connected to the printer port.

NOTE

The corrective procedures in this section assume that the terminal has powered-up normally.

If the suggested corrective action does not solve the problem, then the problem should be referred to qualified service personnel.

Table 6-4. Difficulties with Printing

Symptom	Suggested Corrective Action
No response on the printer.	Make sure that the printer is turned on and plugged in. Also check for proper power at the outlet by plugging a lamp into it.
	Verify printer operation by running the printer self-test (if applicable).
	Make sure the printer cable is the correct type and that it is properly connected.
	Make sure all of the terminal's printer port communication parameters are properly set (check the Printer Set-Up menu).
	If the symptom persists, a problem may exist with the printer cable or the printer. Refer problem to qualified service personnel.
Printing is garbled and/or intermittent.	Make sure the printer cable is properly connected.
	Make sure all of the printer communication parameters are properly set (check the Printer Set-Up menu).
	If the symptom persists, a problem may exist with the printer cable or the printer. Refer problem to qualified service personnel.

Part Three: Programming the Visual 220 Terminal

CHAPTER 7
CODE TABLES AND CHARACTER SETS

7.1 OVERVIEW

This chapter describes how code tables are organized to accommodate the various character sets available for the Visual 220. Other information includes:

- Procedures for mapping hard (ROM-based) and soft (down-line loadable) character sets into code tables.
- Procedures for designing, down-line loading and clearing soft character sets.

7.2 CODE TABLES

The Visual 220 terminal can generate and interpret seven- and eight-bit characters. A code table provides a "picture" of how seven- and eight-bit codes are organized for use by the Visual 220 terminal. Since the terminal supports several character sets, it is essential to know which groups of characters in the code table are replaced when character sets are interchanged.

Up to 128 character codes can be represented using seven bits (the eighth bit is not set and is assumed to be 0). These codes and their character equivalents occupy the left half of the table. In seven-bit environments, only the codes in the left half of the table are used. The codes in the right half cannot be used.

Up to 256 character codes can be represented using eight bits. These codes and their character equivalents occupy the right half of the table. In eight-bit environments, the codes in the entire table may be used.

Figure 7-1 illustrates the Multinational Character set which is a typical code table for seven-bit and eight-bit characters.

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

C0 CODES ASCII GRAPHIC CHARACTERS

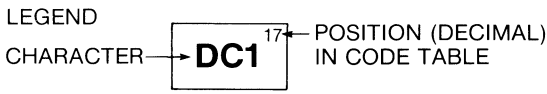


Figure 7-1. Typical Code Table for Seven-Bit and Eight-Bit Characters (Sheet 1 of 2)

1	1	1	1	1	1	1	1	BIT 8				
0	0	0	0	1	1	1	1	BIT 7				
0	0	1	1	0	0	1	1	BIT 6				
0	1	0	1	0	1	0	1	BIT 5				
8	**9**	**A**	**B**	**C**	**D**	**E**	**F**	**COL / ROW**	BIT 4	BIT 3	BIT 2	BIT 1
128	DCS 144	160	176	À 192	208	à 224	240	**0**	0	0	0	0
129	PU1 145	¡ 161	± 177	Á 193	Ñ 209	á 225	ñ 241	**1**	0	0	0	1
130	PU2 146	¢ 162	2 178	Â 194	Ò 210	â 226	ò 242	**2**	0	0	1	0
131	STS 147	£ 163	3 179	Ã 195	Ó 211	ã 227	ó 243	**3**	0	0	1	1
IND 132	CCH 148	164	180	Ä 196	Ô 212	ä 228	ô 244	**4**	0	1	0	0
NEL 133	MW 149	¥ 165	µ 181	Å 197	Õ 213	à 229	õ 245	**5**	0	1	0	1
SSA 134	SPA 150	166	¶ 182	Æ 198	Ö 214	æ 230	ö 246	**6**	0	1	1	0
ESA 135	EPA 151	§ 167	· 183	Ç 199	Œ 215	ç 231	œ 247	**7**	0	1	1	1
HTS 136	152	¤ 168	184	È 200	Ø 216	è 232	ø 248	**8**	1	0	0	0
HTJ 137	153	© 169	1 185	É 201	Ù 217	é 233	ù 249	**9**	1	0	0	1
VTS 138	154	a 170	º 186	Ê 202	Ú 218	ê 234	ú 250	**A**	1	0	1	0
PLD 139	CSI 155	« 171	» 187	Ë 203	Û 219	ë 235	û 251	**B**	1	0	1	1
PLU 140	ST 156	172	¼ 188	Ì 204	Ü 220	ì 236	ü 252	**C**	1	1	0	0
RI 141	OSC 157	173	½ 189	Í 205	Ý 221	í 237	ý 253	**D**	1	1	0	1
SS2 142	PM 158	174	190	Î 206	222	î 238	254	**E**	1	1	1	0
SS3 143	APC 159	175	¿ 191	Ï 207	ß 223	ï 239	255	**F**	1	1	1	1

C1 CODES

DEC™ SUPPLEMENTAL CHARACTER SET

Figure 7-1. Typical Code Table for Seven-Bit and Eight-Bit Characters (Sheet 2 of 2)

A code table is divided into four regions as shown in Figure 7-2. The regions have the following functions:

- The C0 (control 0) region contains 7-bit ASCII (Americal Standard Code for Information Interchange) control characters. These characters are not usually displayed but they do perform special functions in data communications and text processing.
- The C1 (control 1) region contains 8-bit ASCII control characters that provide additional data communication and text processing functions.
- The GL (graphics left) region may contain up to 94 seven-bit characters that can be displayed on a terminal. The graphic characters may include alphanumeric characters as well as punctuation marks and other symbols. SP (space) is considered to be apart from all character sets. DEL (delete) is always ignored by the terminal.

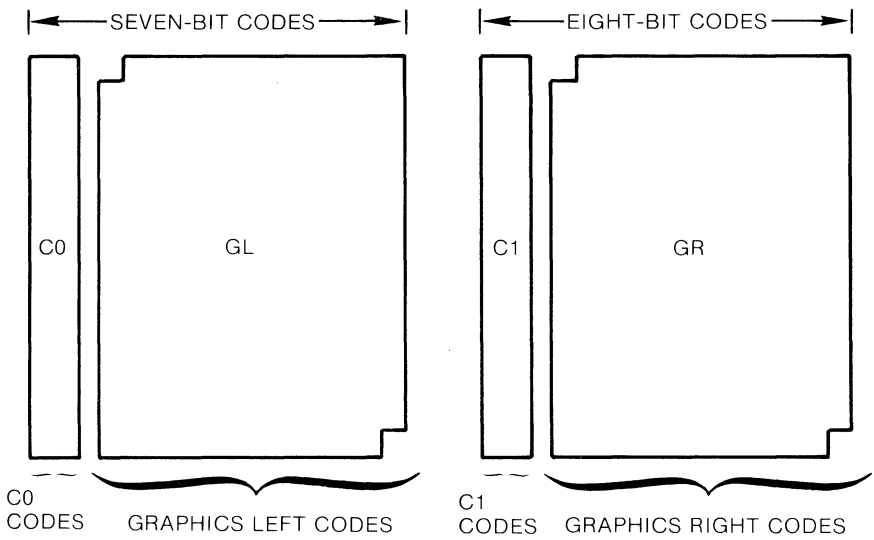


Figure 7-2. Four Regions of the 8-Bit Code Table

- The GR (graphics right) region may contain up to 94 eight-bit characters that can be displayed on a terminal. The graphic characters may include alphanumeric characters as well as punctuation marks and other symbols.

7.3 CHARACTER SETS

The Visual 220 supports a variety of "hard" and "soft" character sets. The hard character sets are permanently stored in read-only memory (ROM) and cannot be changed by users. Hard character sets include:

- ASCII Graphics Set
- United Kingdom National Set
- DEC™ Special Graphics
- DEC™ Multinational Character Set (ASCII Graphics Set and DEC™ Supplemental Graphics Set).
- Display Controls Set

Soft character sets may be designed by a programmer and then downline loaded to the terminal from a host computer. Soft character sets may include up to 94 characters.

Hard and soft character sets may be "mapped" into the GL and/or GR regions of the code table. The C0 and C1 regions of the Table always contain the ASCII control codes with their predefined functions.

NOTE

Each character set can be displayed in 80- and 132-column mode.

7.3.1 ASCII Character Set

The ASCII Character Set is shown in Table 7-1. This character set contains control and graphic characters defined by ANSI X3.4

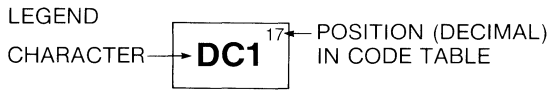
7.3.2 United Kingdom National Set

The United Kingdom National Set differs from the ASCII Character Set only in that the # sign is replaced by the £ sign. This set is available for use only in the VT100 or VT52 compatible modes.

Table 7-1. ASCII Character Set Code Table

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

C0 CODES ASCII GRAPHIC CHARACTERS



7.3.3 DEC Special Graphics

The DEC Special Graphics Set includes ASCII C0 control codes, some alphanumeric graphic characters and a set of special symbols and line segments. The symbols and line segments can be used for drawing simple figures while in text mode. This set is shown in Table 7-2.

Table 7-2. DEC™ Special Graphics Set

				BIT 8	0	0	0	0	0	0	0	0
				BIT 7	0	0	0	0	1	1	1	1
				BIT 6	0	0	1	1	0	0	1	1
				BIT 5	0	1	0	1	0	1	0	1
BIT 4	BIT 3	BIT 2	BIT 1	COL / ROW	0	1	2	3	4	5	6	7
0	0	0	0	0	NUL 0	DLE 16	SP 32	0 48	@ 64	P 80	♦ 96	— 112 SCAN 3
0	0	0	1	1	SOH 1	DC1 17	! 33	1 49	A 65	Q 81	▒ 97	— 113 SCAN 6
0	0	1	0	2	STX 2	DC2 18	" 34	2 50	B 66	R 82	HT 98	— 114 SCAN 9
0	0	1	1	3	ETX 3	DC3 19	# 35	3 51	C 67	S 83	FF 99	— 115 SCAN 11
0	1	0	0	4	EOT 4	DC4 20	$ 36	4 52	D 68	T 84	CR 100	┼ 116
0	1	0	1	5	ENQ 5	NAK 21	% 37	5 53	E 69	U 85	LF 101	┤ 117
0	1	1	0	6	ACK 6	SYN 22	& 38	6 54	F 70	V 86	° 102	┴ 118
0	1	1	1	7	BEL 7	ETB 23	' 39	7 55	G 71	W 87	± 103	┬ 119
1	0	0	0	8	BS 8	CAN 24	(40	8 56	H 72	X 88	NL 104	│ 120
1	0	0	1	9	HT 9	EM 25	) 41	9 57	I 73	Y 89	VT 105	≤ 121
1	0	1	0	A	LF 10	SUB 26	* 42	: 58	J 74	Z 90	┘ 106	≥ 122
1	0	1	1	B	VT 11	ESC 27	+ 43	; 59	K 75	[91	┐ 107	π 123
1	1	0	0	C	FF 12	FS 28	, 44	< 60	L 76	\ 92	┌ 108	≠ 124
1	1	0	1	D	CR 13	GS 29	- 45	= 61	M 77	] 93	└ 109	£ 125
1	1	1	0	E	SO 14	RS 30	. 46	> 62	N 78	^ 94	┼ 110	· 126
1	1	1	1	F	SI 15	US 31	/ 47	? 63	O 79	95	— 111 SCAN 1	DEL 127

C0 CODES DEC™ SPECIAL GRAPHICS SET

LEGEND

CHARACTER → DC1 (17) ← POSITION (DECIMAL) IN CODE TABLE

7.3.4 DEC Multinational Character Set

The DEC Multinational Character Set (see Table 7-3) is made up of the ASCII Character Set, the C1 control codes and the DEC Supplemental Graphics Set (the DEC Supplemental Graphics Set occupies the GR region of the code table).

Table 7-3. DEC™ Multinational Character Set (Sheet 1 of 2)

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

C0 CODES ASCII GRAPHIC CHARACTERS

The DEC Supplemental Graphics Set includes alphabetic characters with diacritical marks that appear in major Western European alphabets. The DEC Supplemental Graphics Set is not available in the VT100 and VT52 modes.

The DEC Multinational Character Set is the (factory programmed) default character set that is mapped into the code table.

Table 7-3. DEC™ Multinational Character Set (Sheet 2 of 2)

1	1	1	1	1	1	1	1	BIT 8				
0	0	0	0	1	1	1	1	BIT 7				
0	0	1	1	0	0	1	1	BIT 6				
0	1	0	1	0	1	0	1	BIT 5				
8	**9**	**A**	**B**	**C**	**D**	**E**	**F**	COL / ROW	BIT 4	BIT 3	BIT 2	BIT 1
128	144 DCS	160	176 °	192 À	208	224 à	240	**0**	0	0	0	0
129	145 PU1	161 ¡	177 ±	193 Á	209 Ñ	225 á	241 ñ	**1**	0	0	0	1
130	146 PU2	162 ¢	178 ²	194 Â	210 Ò	226 â	242 ò	**2**	0	0	1	0
131	147 STS	163 £	179 ³	195 Ã	211 Ó	227 ã	243 ó	**3**	0	0	1	1
132 IND	148 CCH	164	180	196 Ä	212 Ô	228 ä	244 ô	**4**	0	1	0	0
133 NEL	149 MW	165 ¥	181 µ	197 Å	213 Õ	229 å	245 õ	**5**	0	1	0	1
134 SSA	150 SPA	166	182 ¶	198 Æ	214 Ö	230 æ	246 ö	**6**	0	1	1	0
135 ESA	151 EPA	167 §	183 ·	199 Ç	215 Œ	231 ç	247 œ	**7**	0	1	1	1
136 HTS	152	168 ¤	184	200 È	216 Ø	232 è	248 ø	**8**	1	0	0	0
137 HTJ	153	169 ©	185 ¹	201 É	217 Ù	233 é	249 ù	**9**	1	0	0	1
138 VTS	154	170 ª	186 º	202 Ê	218 Ú	234 ê	250 ú	**A**	1	0	1	0
139 PLD	155 CSI	171 «	187 »	203 Ë	219 Û	235 ë	251 û	**B**	1	0	1	1
140 PLU	156 ST	172	188 ¼	204 Ì	220 Ü	236 ì	252 ü	**C**	1	1	0	0
141 RI	157 OSC	173	189 ½	205 Í	221 Ÿ	237 í	253 ÿ	**D**	1	1	0	1
142 SS2	158 PM	174	190	206 Î	222	238 î	254	**E**	1	1	1	0
143 SS3	159 APC	175	191 ¿	207 Ï	223 ß	239 ï	255	**F**	1	1	1	1

C1 CODES — DEC™ SUPPLEMENTAL CHARACTER SET

7.3.5 Display Controls Character Set

The Display Controls character set is mapped into the code table when the "display controls" mode is selected from the display Set-Up menu. When this mode is selected, the control codes are displayed on the terminal screen. The controls are not executed (except for VT, LF, and FF which perform a new line function after the code is displayed). The Display Controls character set is shown in Table 7-4.

Table 7-4. Display Controls Character Set (Sheet 1 of 2)

				BIT 8	0	0	0	0	0	0	0	0
				BIT 7	0	0	0	0	1	1	1	1
				BIT 6	0	0	1	1	0	0	1	1
				BIT 5	0	1	0	1	0	1	0	1
BIT 4	BIT 3	BIT 2	BIT 1	COL / ROW	0	1	2	3	4	5	6	7
0	0	0	0	0	N_U 0	D_L 16	32	0 48	@ 64	P 80	96	p 112
0	0	0	1	1	S_H 1	D_1 17	! 33	1 49	A 65	Q 81	a 97	q 113
0	0	1	0	2	S_X 2	D_2 18	" 34	2 50	B 66	R 82	b 98	r 114
0	0	1	1	3	E_X 3	D_3 19	# 35	3 51	C 67	S 83	c 99	s 115
0	1	0	0	4	E_T 4	D_4 20	$ 36	4 52	D 68	T 84	d 100	t 116
0	1	0	1	5	E_Q 5	N_K 21	% 37	5 53	E 69	U 85	e 101	u 117
0	1	1	0	6	A_K 6	S_Y 22	& 38	6 54	F 70	V 86	f 102	v 118
0	1	1	1	7	B_L 7	E_B 23	' 39	7 55	G 71	W 87	g 103	w 119
1	0	0	0	8	B_S 8	C_N 24	(40	8 56	H 72	X 88	h 104	x 120
1	0	0	1	9	H_T 9	E_M 25	) 41	9 57	I 73	Y 89	i 105	y 121
1	0	1	0	A	L_F 10	$S_\bar{}$ 26	* 42	: 58	J 74	Z 90	j 106	z 122
1	0	1	1	B	V_T 11	E_C 27	+ 43	; 59	K 75	[91	k 107	{ 123
1	1	0	0	C	F_F 12	F_S 28	, 44	< 60	L 76	\ 92	l 108	| 124
1	1	0	1	D	C_R 13	G_S 29	- 45	= 61	M 77	] 93	m 109	} 125
1	1	1	0	E	S_O 14	R_S 30	. 46	> 62	N 78	^ 94	n 110	~ 126
1	1	1	1	F	S_I 15	U_S 31	/ 47	? 63	O 79	_ 95	o 111	DEL 127

C0 CODES

DISPLAY CONTROLS CHARACTERS

Table 7-4. Display Controls Character Set (Sheet 2 of 2)

1	1	1	1	1	1	1	1	BIT 8				
0	0	0	0	1	1	1	1	BIT 7				
0	0	1	1	0	0	1	1	BIT 6				
0	1	0	1	0	1	0	1	BIT 5				
8	**9**	**A**	**B**	**C**	**D**	**E**	**F**	**COL / ROW**	BIT 4	BIT 3	BIT 2	BIT 1
8_0 128	9_0 144	A_0 160	° 176	À 192	D_O 208	à 224	F_O 240	**0**	0	0	0	0
8_1 129	9_1 145	¡ 161	± 177	Á 193	Ñ 209	á 225	ñ 241	**1**	0	0	0	1
8_2 130	9_2 146	¢ 162	² 178	Â 194	Ò 210	â 226	ò 242	**2**	0	0	1	0
8_3 131	9_3 147	£ 163	³ 179	Ã 195	Ó 211	ã 227	ó 243	**3**	0	0	1	1
8_4 132	9_4 148	A_4 164	B_4 180	Ä 196	Ô 212	ä 228	ô 244	**4**	0	1	0	0
8_5 133	9_5 149	¥ 165	µ 181	Å 197	Õ 213	å 229	õ 245	**5**	0	1	0	1
8_6 134	9_6 150	A_6 166	¶ 182	Æ 198	Ö 214	æ 230	ö 246	**6**	0	1	1	0
8_7 135	9_7 151	§ 167	· 183	Ç 199	Œ 215	ç 231	œ 247	**7**	0	1	1	1
8_8 136	9_8 152	¤ 168	B_8 184	È 200	Ø 216	è 232	ø 248	**8**	1	0	0	0
8_9 137	9_9 153	© 169	¹ 185	É 201	Ù 217	é 233	ù 249	**9**	1	0	0	1
8_A 138	9_A 154	ª 170	º 186	Ê 202	Ú 218	ê 234	ú 250	**A**	1	0	1	0
8_B 139	9_B 155	« 171	» 187	Ë 203	Û 219	ë 235	û 251	**B**	1	0	1	1
8_C 140	9_C 156	A_C 172	¼ 188	Ì 204	Ü 220	ì 236	ü 252	**C**	1	1	0	0
8_D 141	9_D 157	A_D 173	½ 189	Í 205	Ý 221	í 237	ý 253	**D**	1	1	0	1
8_E 142	9_E 158	A_E 174	B_E 190	Î 206	D_E 222	î 238	F_E 254	**E**	1	1	1	0
8_F 143	9_F 159	A_F 175	¿ 191	Ï 207	ß 223	ï 239	□ 255	**F**	1	1	1	1

C1 CODES

DISPLAY CONTROLS CHARACTERS

7.4 CHARACTER SETS AND NATIONAL ALPHABETS

The following example describes what happens when a key is pressed on a national keyboard (such as German) and that keyboard has been selected from the keyboard Set-Up menu.

The annotated illustration (Figure 7-3) aids in describing the process that takes place. The circled numbers in the illustration correspond with the numbered steps below.

1. The β key (unshifted) on the German keyboard sends a 2B (hex) scan code to the Visual 220 terminal (the 2B [hex] scan code corresponds to the key's position on the keyboard).
2. The terminal reads the keyboard scan code and interprets it as 0DF (hex).
3. The hex code (0DF) is sent to the host system which processes the code according to the current application.
4. If echo is enabled, the 0DF code is sent (returned) to the Visual 220 terminal.
5. The terminal sees the 0DF code from the host and fetches the character from the corresponding position in the 8-bit code table.
6. If the Multinational Character set is invoked (as shown in Table 7-3), the β character is sent to the monitor screen.

NOTE

The character that is sent to the monitor screen depends on the character set invoked into that region of the code table.

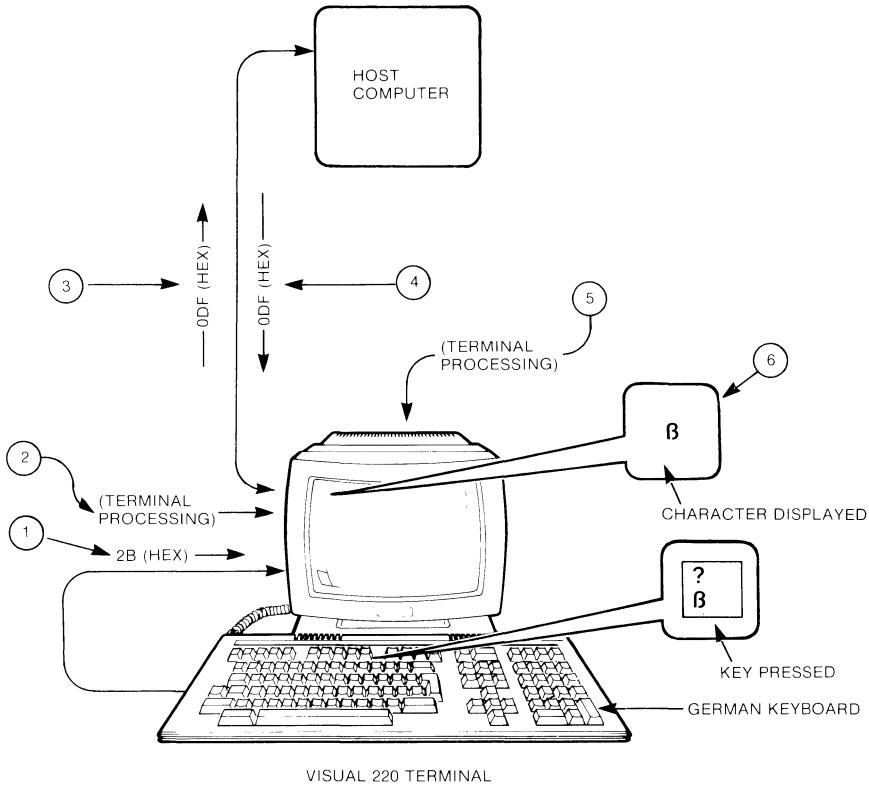


Figure 7-3. Keyboards and Character Sets

7.5 CHARACTER SET SELECTION

This section describes the procedures for designating hard and soft character sets. The procedures for mapping designated sets into the code table are also described.

7.5.1 Default Character Set

Each time the Visual 220 is powered-up or reset, the DEC Multinational Character Set is mapped into the code table.

7.5.2 Changing Character Sets

Once the Visual 220 is powered-up or reset, hard character sets can be "designated" and then mapped into specified regions of the code table.

In VT200 compatible mode a soft character set defined by a programmer can be down-line loaded to a font-buffer (soft character sets may contain up to 94 characters each). The soft character set may be designated and then mapped into the code table.

NOTE

Soft character sets are not supported in the VT100 compatible mode.

Figures 7-4 and 7-5 illustrate the concept of designating and mapping character sets in VT100 and VT200 modes respectively.

7.5.2.1 Designating Hard Character Sets — Before any other character set can be mapped into the code table, it must first be designated as G0, G1, G2, or G3. Once designated, a character set is "on call" for use by the program.

Hard (ROM-based) character sets (ASCII, U.K. National, DEC Supplemental, and DEC Special Graphics Set) can be designated using the escape sequences shown in Table 7-5.

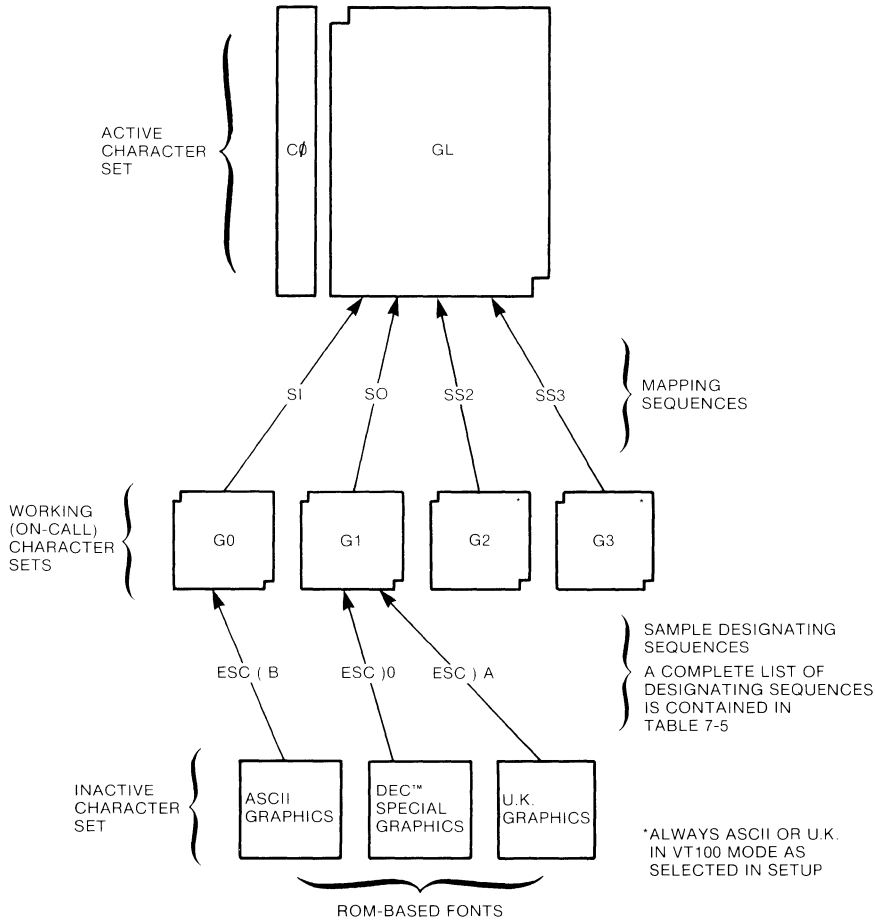


Figure 7-4. Designating and Mapping Character Sets (VT100 Mode)

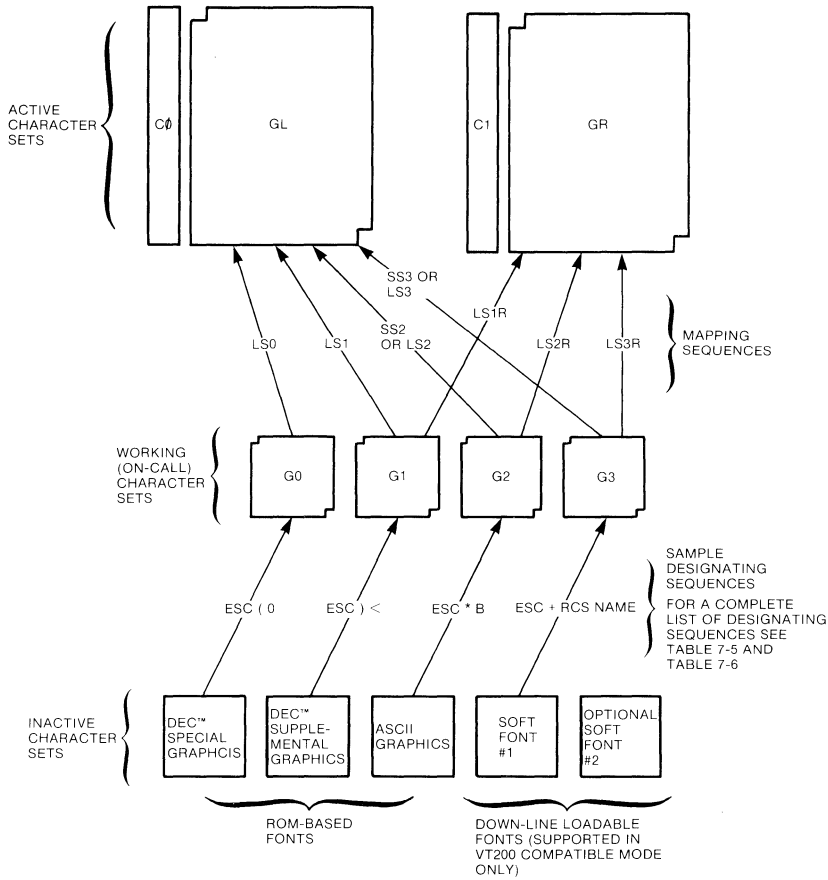


Figure 7-5. Designating and Mapping Character Sets (VT200 Mode)

Table 7-5. Designating Hard Character Sets

Character Set	Designate As:	Use Coding Sequence
ASCII	G0 (Default)	ESC (B
	G1	ESC) B
	G2 (VT200 Mode only)	ESC * B
	G3 (VT200 Mode only)	ESC + B
DEC Special Graphics	G0	ESC (0
	G1 (Default)	ESC) 0
	G2 (VT200 Mode only)	ESC * 0
	G3 (VT200 Mode only)	ESC + 0
DEC Supplemental (VT200 Mode only)	G0	ESC (<
	G1	ESC) <
	G2 (Default)	ESC * <
	G3 (Default)	ESC + <
U.K. National (VT100 Mode only)	G0	ESC (A
	G1	ESC) A

7.5.2.2 Designating Soft Character Sets — A soft character set may be designated when the Visual 220 is in the VT200 compatible mode.

NOTES

- **Soft character sets are not supported in VT100 or VT52 modes.**
- **Before a soft character set can be designated, it must be down-line loaded into the Visual 220 font buffer (see Down-Line Loading Characters).**
- **A second soft character set may be designated when a second soft character set option has been installed.**

The soft set(s) may be designated to replace or be used in addition to hard character sets.

Soft character sets may be designated using the escape sequences in Table 7-6.

Table 7-6. Designating Soft Character Sets

Escape Sequence*	Designate As:
ESC (RCS name	G0
ESC) RCS name	G1
ESC * RCS name	G2
ESC + RCS name	G3

*An RCS name is a variable that specifies the soft character set. An RCS name must be previously assigned to any soft character set that is to be down-line loaded.

The RCS name specifies the desired soft character set and has the following syntax:

RCS name	Description
I I F	RCS name syntax An RCS name can contain from zero to two intermediate values (I) and one final value (F). The intermediate values are in the range of SP to / (column 2 in the code table). Final values are in the range of 0 to ~ (column 3 through column 7 excluding DEL in the code table). 21,567 RCS names can be generated according to the above scheme.

Examples of RCS names are as follows:

SP @	Defines the character set as an unregistered soft set. This value is the recommended default value for user-defined sets.
B	Defines the character set to be ASCII.
0	Defines the character set to be DEC special graphics.
% $ V	Defines the character set to be % $ V. This is currently an unregistered set.

NOTE

If the RCS name is that of an existing character set (ASCII [B], Special Graphics [0] or Supplemental [<]), the existing character set is replaced only until the terminal is reset or the soft character set is renamed.

7.5.3 Invoking Character Sets

Once a character set has been designated, it is placed in the working set of character sets. It can then be mapped into the desired GL or GR region of the code table. Character sets can be "lock shifted" or "single shifted" into the code table.

7.5.3.1 Using Locking Shifts to Invoke Character Sets — Locking shifts imply that the character set is shifted into the code table and locked there. A lock-shifted set remains active until it is temporarily displaced by a single shift or permanently replaced by another lock-shift. Other conditions that may result in replacement of lock-shifted sets include:

- Hard reset or soft reset (see Section 8.4.2.12)
- Changing terminal emulation (see Section 8.4.2.16)

Character sets may be lock-shifted into the code table by using the coding sequences shown in Table 7-7.

Table 7-7. Invoking Character Sets Using Locking Shifts

Control Name Mnemonic	Meaning	Coding	Function
LS0	Lock Shift G0	SI	Map set G0 into GL (Default setting)
LS1	Lock Shift G1	SO	Map set G1 into GL.
LS2*	Lock Shift G2	ESC n	Map set G2 into GL. This sequence may cause software compatibility problems.
LS3*	Lock Shift G3	ESC o	Map set G3 into GL. This sequence may cause software compatibility problems.
LS1R*	Lock Shift G1, Right	ESC ~	Map set G1 into GR. This sequence may cause software compatibility problems.
LS2R*	Lock Shift G2, Right	ESC }	Map set G0 into GR.
LS3R*	Lock Shift G3, Right	ESC |	Map set G0 into GR.

*Used in VT200 compatible modes only.

7.5.3.2 Using Single Shifts to Invoke Character Sets — Single shifts imply that the desired character set is temporarily shifted into the code table. A single shifted set remains active only for the next single graphic character. After the single shifted character has been processed, the previous character set is returned to its original region in the code table.

Character sets may be single-shifted into the code table using eight-bit control codes (SS2 and SS3). These codes can be expressed as escape sequences when coding for a seven-bit environment. Table 7-8 shows the coding sequences for both environments.

Table 7-8. Invoking Character Sets Using Single Shifts

Coding Sequence		
8-Bit	**7-Bit**	**Function**
SS2	ESC N	Map G2 into GL for the next graphic character.
SS3	ESC O	Map G3 into GL for the next graphic character.

7.6 DESIGNING A CHARACTER SET

A VT200 compatible mode allows users to design a Redefinable Character Set (RCS) containing up to 94 characters. Once created, these characters can be down-line loaded into the terminal's font buffer using a device control string (DCS).

NOTE

These characters are not loaded into the terminal's non-volatile RAM and are lost when the terminal power is shut off.

RCS characters must be designed to fit within an RCS cell. An RCS cell is larger than a normal character cell as shown in Figure 7-6. Additionally, RCS characters can be designed for either of two RCS cell sizes. They are:

- 10 scan-lines (10-scan) high RCS cell that is DEC-compatible. This is the default value for the RCS cell size.
- 12-scan RCS cell (Visual enhancement).

Both RCS cell sizes (and the corresponding 'normal character' cell sizes) are shown in Figure 7-6. Notice that 10-scan RCS cells are created from 12-scan RCS cells by blanking (turning off) the top two scan lines.

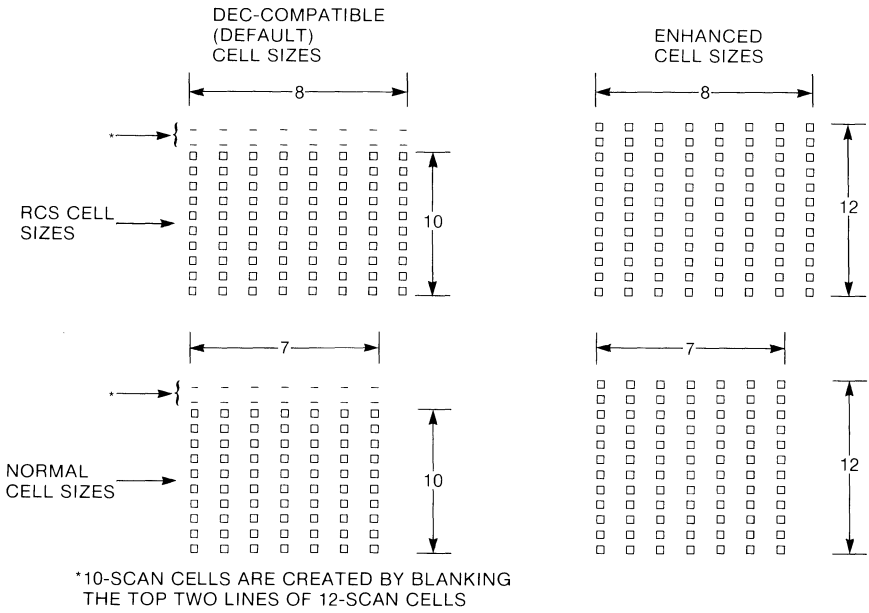


Figure 7-6. RCS Cell Sizes and Normal Cell Sizes

NOTE

The cell height to width ratio shown in Figure 7-6 is reduced for clarity. The vertical distance between pixels is actually about twice the horizontal distance.

7.6.1 Character Design Examples

Two examples illustrate how to design a typical character for 10-scan and 12-scan RCS cells. The examples (for a typical letter 'W') are shown side-by side to highlight any differences.

Characters are created by designating certain picture elements (pixels) in the RCS cell to be on or off. Pixels that are defined outside the RCS cell are ignored. If pixels in column 8 are designated as on, the next two pixels to the right become active (on) also. This effect (called **"dot extension"**) is used primarily for line drawing.

1. Design the character as it would appear in the RCS cell. Figure 7-7 shows a typical design for the letter 'W.'

NOTE

Any pixel that is on is "stretched" to the right until it overlaps the adjacent pixel. This effect (shown below) produces characters that appear more solid and unified.

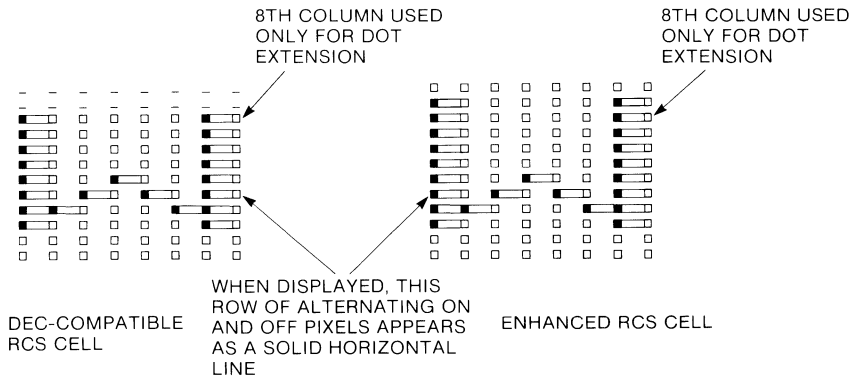


Figure 7-7. Typical RCS Character in RCS Cells

2. Divide and annotate the cell as shown in Figure 7-8. This scheme provides the basis for naming individual pixels in the RCS cell.

   The upper columns are made up of eight, six-pixel columns. Each pixel has an assigned bit position with the top pixel corresponding with the least significant bit. The bottom pixel corresponds with the most significant bit.

The lower columns are made up of eight, four-pixel columns (six-pixel columns for 12-scan characters). The top pixel corresponds with the least significant bit. The bottom pixel corresponds with the most significant bit.

Note that the rightmost column (column 8) is used for dot extension and need not be programmed if dot extension is not desired.

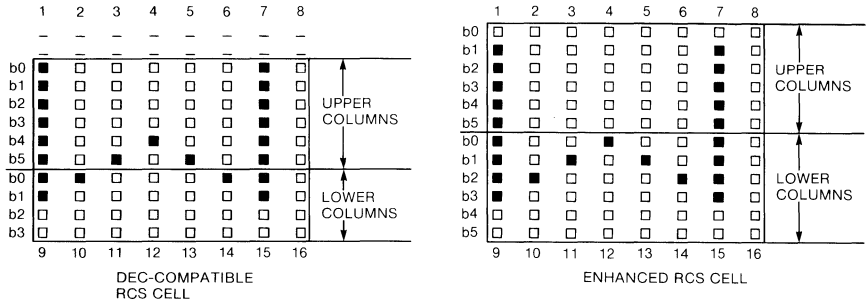


Figure 7-8. RCS Cells Divided Into Annotated Pixel Columns

3. Represent each column value by a character from the ASCII code table. Use Figure 7-9 for 10-pixel high cells and Figure 7-10 for 12-pixel high cells. The characters must be between ? and ~ (position 63 and 126 in the ASCII code table).

   a. Convert each binary column code to its decimal value.

   b. Add the offset (63) to the decimal value to determine each corresponding character position in the ASCII code table.

      For example, column 1 of Figure 7-9 is decoded as follows:

      - All pixels on = $111111_2 = 63_{10}$ (decimal column value)
      - $63_{10} + 63_{10}$ (offset) = 126_{10} (position in code table)
      - Position 126 contains a ~ character

Thus the example letter 'W' is represented by the following:

- ~?_O_?~/A@???@A (for 10-scan RCS cells). The slash (/) advances pixel interpretation from the upper RCS columns to the lower RCS columns.
- }?????}/NCA@ACN (for 12-scan RCS cells)

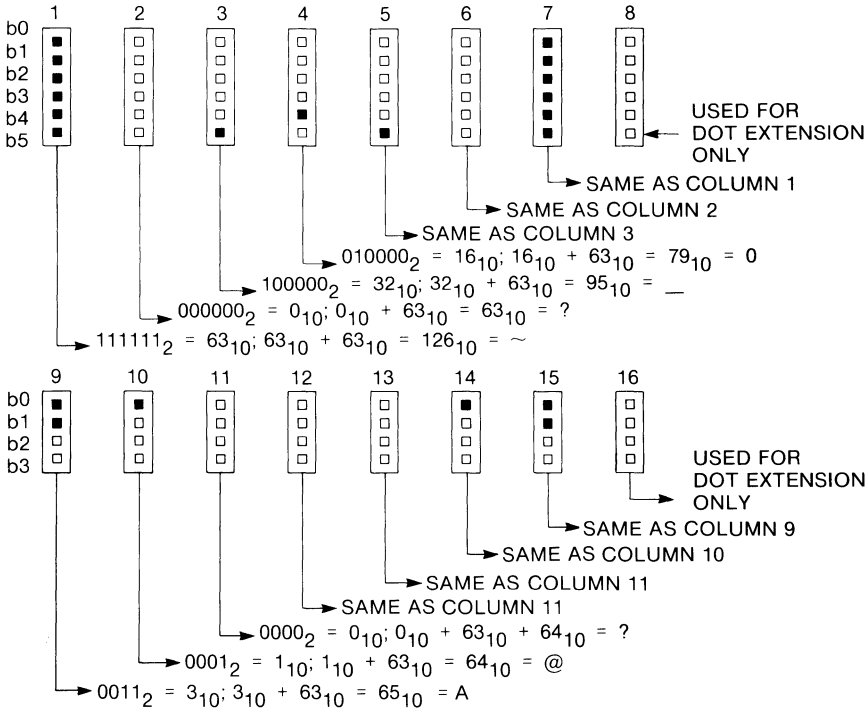
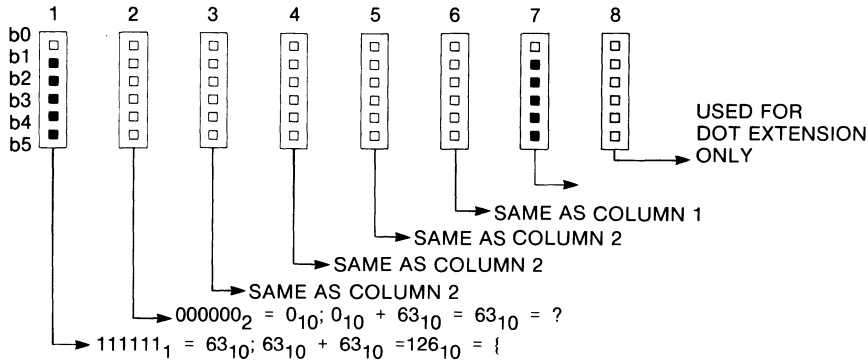


Figure 7-9. Converting 10-Scan Pixel-Bit Patterns to ASCII Code



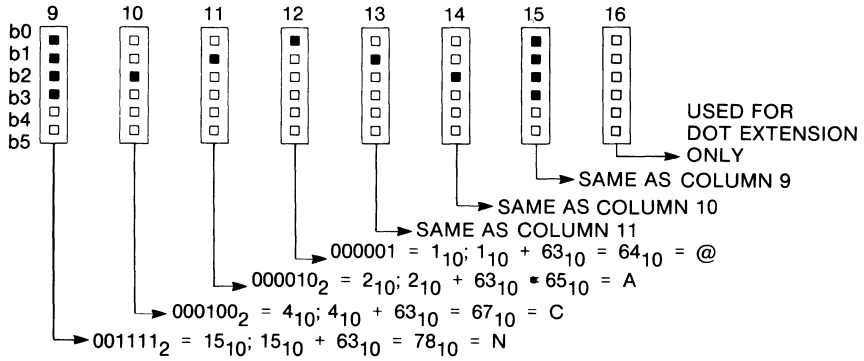


Figure 7-10. Converting 12-Scan Pixel-Bit Patterns to ASCII Code

7.6.2 Compensating for DEC-Compatible RCS Characters

The DEC VT220 terminal has Redefinable Character Set (RCS) cells that are 10 scan lines (scans) high. The Visual 220 RCS cell size is 12-scans high (refer to Figures 7-6 and 7-7).

The Visual 220 terminal compensates for this difference by shifting DEC-compatible characters down two scan lines within the RCS cell and blanking the top two scan lines.

7.7 DOWN-LINE LOADING CHARACTERS

RCS characters and other soft characters can be down-line loaded into the Visual 220 font buffer. The font buffer has a capacity of 94 characters.

NOTE

1.60 seconds are typically required to down-line load 94 characters (at 9600 baud).

The following device control string (DCS) may be used for down-line loading soft characters:

DCS Pfn;Pcn;Pe;Pccs;Pw;Pt { RCS name Bp1;Bp2;Bp3; . . . Bpn ST

Character groupings in the soft character down-line load DCS are described in Table 7-9.

Table 7-9. Down-Line Load DCS Description

DCS Characters	Description
DCS	Introduces a device control string. DCS is an eight-bit control character that can also be expressed as ESC P when coding for a seven-bit environment.
Pfn;Pcn;Pe;Pccs;Pw;Pt	A parameter substring. The parameter values are discussed in Table 7-10.
	Identifies the end of the parameter substring and specifies a down-line load sequence.

Table 7-9. Down-Line Load DCS Description (Contd.)

DCS Characters	Description
RCS name	Defines the name for the soft character set. The RCS name is also used in the escape sequence for designating a soft character set (see Section 7.5.2.2).
Bp1;Bp2;Bp3; . . . Bpn	Character bit patterns for individual RCS characters. Each character bit pattern is separated by a semicolon (;). Up to 94 bit patterns may be included in the DCS.
ST	String Terminator. ST is an eight-bit control character that can be expressed as ESC \ when coding for seven-bit environments.

Table 7-10 names and describes the parameters for an RCS down-line load sequence.

Table 7-10. Down-Line Load Sequence Parameter Values

Parameters	Name	Description
Pfn	Buffer Number	Specifies the RCs font buffer to be used. Legal values and their definitions are: 0 or 1 = Use standard font buffer. 2 = Use optional font buffer.

Table 7-10. Down-Line Load Sequence Parameter Values (Contd.)

Parameters	Name	Description
Pcn	Starting Character Number	Specifies the position in the ASCII code table (and the font buffer) where the first character is to be loaded. 1 specifies position 33 (! in the ASCII table. 94 specifies position 126 (~ in the ASCII table. Default = ! in the ASCII table.
Pe	Erase Control	Specifies which characters in the font buffer are erased before new characters are loaded. Legal values and their definitions are as follows: 0 = erase all characters in the font buffer. 1 = erase those characters that are being reloaded. 2 = erase all characters in all font buffers (standard and optional).
Pccs	Character Cell Size	Specifies the expected limit of the RCS cell size. Legal values and their definitions are as follows: 0 = Device default (7x10) 1 = (not used) 2 = 5x10 3 = 6x10 4 = 7x10 5 = (not used) 6 = 5x12 7 = 6x12 8 = 7x12

Table 7-10. Down-Line Load Sequence Parameter Values (Contd.)

Parameters	Name	Description
Pw*	Width	Specifies the display width attribute as follows: 0 = Device default (80 columns) 1 = 80 column 2 = 132 column
Pt*	Text/ Full Cell	Specifies whether software treats the font as a text font or a full cell font. Legal values and their definitions are as follows: 0 = Device default (text) 1 = Text 2 = Full cell (not used) Text fonts typically cannot address all pixels individually within a cell. Full cell fonts can individually address all pixels in a cell.

*These parameters are defined for future use. Currently they have no effect.

7.7.1 Down-Line Load Example

The following example describes how to down-line load a typical RCS (Redefinable Character Set). The first letter of this RCS is the letter W that is used in the previous example for designing a character set.

DCS 1;1;1 {%$V }?????}/NCA@ACN;(next character); . . . . . ST

Table 7-11 describes various parts of the down-line load sequence used in the above example.

Table 7-11. Down-Line Load Example Description

Characters	Description
DCS	Introduces the string
1;1;1	Three parameters define the following: • Selects the standard RCS font buffer. • Specifies the first character as position 33 in the ASCII code table. • Erases those characters that are to be loaded. Note that the parameters Pccs, Pw, and PT are not specified. They default to 0 values.
{	Signals the end of the parameter characters and specifies a down-line load sequence.
%$V	Names the soft character set to be loaded. This RCS name is also used when designating a soft character set.
}?????}	Specifies the pixel positions for the upper columns of the first RCS character.
/	Advances the display to the lower columns of the RCS character.
NCA@ACN	Specifies the pixel positions for the lower columns of the first RCS character.
;	Signals the end of the first RCS character.
ST	Signals the end of the DCS.

7.7.2 Clearing a Down-Line Loaded Character Set

Down-line loaded character sets may be cleared by the following down-line load device control strings:

Control String:	Effect:
DCS 1;1;0 { SP @ ST	Clear font buffer #1
DCS 2;1;0 { SP @ ST	Clear optional font buffer #2
DCS 1;1;2 { SP @ ST	Clear all font buffers

Other ways to clear a down-line loaded character set include:

- Turning off or resetting the terminal.
- Performing Set-Up Recall or Default functions.
- Performing a hard terminal reset (using ESC c sequences).

CHAPTER 8
TERMINAL CONTROL CODES

8.1 OVERVIEW

This chapter provides information required for programming the Visual 220 terminal. Information in this section is divided into the following three topics

- Operating mode differences. This information helps the programmer to optimize the terminal's capabilities.
- Codes transmitted by the various keys. These descriptions help the programmer to access the necessary codes for programming.
- Effects of received codes. These descriptions help the programmer to fully control all of the terminal's resources.

8.2 OPERATING MODE DESCRIPTIONS

This section describes the four operating modes of the Visual 220 terminal. The mode descriptions assume a compatible communications and host application environment.

There are differences among the operating modes of the Visual 220 that place certain restrictions on some coding sequences. That is, some coding sequences are not supported in every terminal operating mode. These differences are noted within the code descriptions for those coding sequences that are affected.

8.2.1 VT200 Mode (7-bit Controls)

This mode converts 8-bit control codes to the equivalent 7-bit escape sequences before they are sent to the host. Received codes are treated as 8-bit codes. This mode is intended for use in a 7-bit environment. Many VT100-compatible applications operate correctly in this mode.

8.2.2 VT200 Mode (8-bit Controls)

This mode sends and receives 8-bit ANSI codes and utilizes the full range of Visual 220 features. This mode is intended for use in an 8-bit environment.

8.2.3 VT100 Mode

This mode is selected for compatibility with applications and environments intended for use with VT100 terminals. In this mode, the terminal expects and processes 7-bit ANSI codes and certain private functions. The 8th bit of 8-bit codes is ignored.

8.2.4 VT52 Mode

VT52 mode is selected to execute private (non-ANSI) functions only. This mode is used for VT52-compatible applications.

8.2.5 Mode Differences

Some differences between the VT100 and VT200 modes of operation are described in Table 8-1.

Table 8-1. VT100 and VT200 Mode Differences

Area Affected	VT200 Mode	VT100 Mode
Keyboard	Full keyboard capabilities.	VT100 keys only. Function keys F11, F12 and F13 send ESC, BS and LF respectively. Other keys do nothing.
Received Codes	The 8th bit is significant.	The 8th bit is ignored (set to zero).
Character Sets	All Visual 220 character sets (except U.K.) are available.	ASCII, Special Graphics and U.K. only.
C1 Control Codes	Transmitted as 8-bit codes if 8-bit mode is selected.	Transmitted as 7-bit escape sequences.

8.3 TRANSMITTED CODES

This section describes the codes generated by the Visual 220 keyboard. The code descriptions assume that The DEC™ Multinational Character Set is mapped into the 8-bit code table as described in Chapter 7.

NOTE

Some codes may be generated internally as a response to codes received from a host system. These codes are described in Section 8.4.

The Visual 220 keyboard shown in Figure 8-1 includes 106 keys that are divided into four groups of keys. The groups are:

- Main keypad
- Editing/Cursor keypad
- Numeric/Application keypad
- Top-row function keys

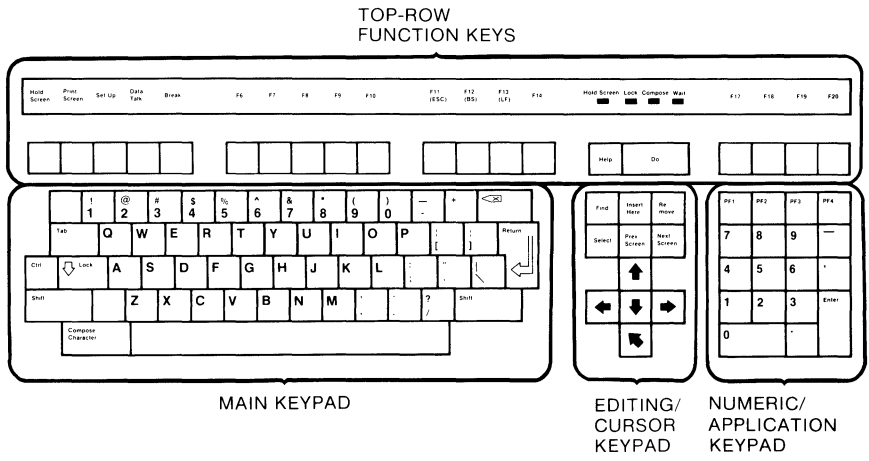


Figure 8-1. Visual 220 (North American) Keyboard

8.3.1 Main Keypad

The main keypad includes standard keys and special action keys. Both types of keys are described below.

8.3.1.1 Standard Keys — Standard keys generate codes for alpha-numeric characters, punctuation marks and other symbols. These keys may be used alone or in combination with special action keys (such as Shift or Ctrl). The character generated depends on several variables including:

- The character set currently in use,
- Whether Typewriter or Data Processing mode is selected is Set-Up.

8.3.1.2 Special Action Keys — The main keypad special action keys generate control codes that perform special functions when used alone or in combination with other keys. Table 8-2 describes the function of these keys.

Table 8-2. Main Keypad Special Action Key Functions

Key	Function
Ctrl	This key does not transmit a code. If depressed in combination with another key it transmits control codes to the system. Control codes direct the system to perform predefined operations (see Section 8.3.5).
Shift	This key does not transmit a code. However, when depressed with another alpha-numeric key it causes the generation of the upper case of that letter or the alternate character (if any) printed on that keycap. There are two of these keys for operator convenience.

Table 8-2. Main Keypad Special Action Key Functions (Contd.)

Key	Function
Lock	This key alternately locks or unlocks the alpha characters. When locked, the codes are upper case letters. If **Caps Lock** is selected, only the alphabetic keys are affected. If **Shift Lock** is selected, the alpha keys generate only uppercase codes and the numeric/symbol keys generate codes for the alternate (upper) character printed on the keycap.
Tab	This key transmits a horizontal tab code (HT) that moves the cursor to the next tab stop.
Return	This key transmits a Carriage Return code. If New Line is enabled this key transmits a Carriage Return and a Linefeed code.
⌫ (delete)	Pressing the ⌫ key generates a DEL character.
Space	Depressing the Space causes a space code to be transmitted.
Compose Character	The Compose Character key is used to create characters that do not exist as standard keys on the selected keyboard. (Chapter 2 provides information on the uses of this key.)

8.3.2 Editing Keypad

The Editing Keypad contains editing keys and cursor control keys. Editing keys are used by the application program to edit data already entered on the display. The codes generated by the editing keys are shown in Table 8-3.

Table 8-3. Editing Key Codes *

Key	Code Generated
Find	CSI 1 ~
Insert Here	CSI 2 ~
Remove	CSI 3 ~
Select	CSI 4 ~
Prev. Screen	CSI 5 ~
Next Screen	CSI 6 ~

* The editing keys do not generate codes in VT100 or VT52 modes.

Cursor control keys move the cursor. When they are pressed, different codes are generated depending on whether the terminal is in ANSI or VT52 mode. Additionally, codes may differ depending on whether the cursor key mode is set for "normal" (ANSI) cursor control sequences or "application" control sequences.

Cursor key codes generated when the terminal is in ANSI mode are listed in Table 8-4. Cursor key codes generated when the terminal is in VT52 mode are listed in Table 8-5.

Table 8-4. Cursor Key Codes (ANSI Mode *)

Key	Cursor Key Mode	
	Normal	Application
Cursor Up	CSI A	SS3 A
Cursor Down	CSI B	SS3 B
Cursor Right	CSI C	SS3 C
Cursor Left	CSI D	SS3 D
Cursor Home	CSI H	SS3 H

* ANSI mode applies to VT100 and VT200 compatible modes only.

Table 8-5. Cursor Key Codes (VT52 Mode *)

Key	Cursor Key Mode	
	Normal	Application
Cursor Up	ESC A	ESC A
Cursor Down	ESC B	ESC B
Cursor Right	ESC C	ESC C
Cursor Left	ESC D	ESC D
Cursor Home	ESC H	ESC H

* VT52 mode is not ANSI compatible.

8.3.3 Numeric/Application Keypad

Codes generated by the numeric/application keypad may differ depending on whether the terminal is in ANSI or VT52 mode. Additionally, codes may differ depending on whether the numeric/application keypad mode is set to generate "numeric" or "application" control sequences. All of the codes are listed in Table 8-6.

Table 8-6. Numeric/Application Keypad Codes

	ANSI MODE*		VT52 MODE	
	Numeric/Application Mode		Numeric/Application Mode	
Key	Numeric	Application	Numeric	Application
0	0	SS3 p	0	ESC ? p
1	1	SS3 q	1	ESC ? q
2	2	SS3 r	2	ESC ? r
3	3	SS3 s	3	ESC ? s
4	4	SS3 t	4	ESC ? t
5	5	SS3 u	5	ESC ? u
6	6	SS3 v	6	ESC ? v
7	7	SS3 w	7	ESC ? w
8	8	SS3 x	8	ESC ? x
9	9	SS3 y	9	ESC ? y
,	,	SS3 l	,	ESC ? l
—	—	SS3 m	—	ESC ? m
.	.	SS3 n	.	ESC ? n
† ENTER	CR or CR LF	SS3 M	CR or CR LF	ESC ? M
†† PF1	SS3 P	SS3 P	ESC P	ESC P
†† PF2	SS3 Q	SS3 Q	ESC Q	ESC Q
†† PF3	SS3 R	SS3 R	ESC R	ESC R
†† PF4	SS3 S	SS3 S	ESC S	ESC S

* ANSI mode applies to VT100 and VT200 modes only.

† The Enter key transmits a carriage return (CR) or a carriage return and linefeed (CR LF), depending on the New Line setting.

†† PF1 through PF4 can have functions assigned to them by the application program.

8.3.4 Top-Row Function Keys

The twenty top-row function keys include local function keys (F1 through F5) and programmable function keys (F6 through F20).

8.3.4.1 Local Function Keys — Local function keys F1 to F5 of the top-row function keys have local functions and do not transmit codes to a host computer. These keys are described in Table 8-7.

Table 8-7. Local Function Key (F1 - F5) Functions

Key	Function(s)
F1 — Hold Screen	Pressing this key freezes the screen and prevents any new characters from being displayed (the Hold Screen LED illuminates). Pressing the key again returns the screen to normal operation. Pressing Hold Screen does not send an XOFF code to the host system. However, if the host is sending data, the terminal transmits an XOFF code when the selected XOFF point is reached.
F2 — Print Screen	If the printer is available, pressing the Print Screen key sends the screen data to the printer. The amount of data sent depends on the print extent selected (Print Full Page/Scroll Region) from the printer Set-Up menu. Pressing Control-Print Screen toggles Normal/Auto-Print mode from the printer Set-Up menu.
F3 — Set-up	Pressing the Set-up Key causes the terminal to enter or exit Set-up mode.
F4 — Data/Talk	This key is active only if EIA modem controls have been selected and jumpers W2, W3, W4 and W6 are installed on the system board (see Table 2-2).

Table 8-7. Local Function Key (F1 - F5) Functions (Contd.)

Key	Function(s)
F5 — Break	Depressing the Break key alone causes the terminal to transmit a break signal if break is enabled from the Keyboard Set-up menu (the transmit data line [TXD] is held low.) Depressing Shift and Break simultaneously causes the terminal to turn off Data Terminal Ready (DTR) and Request To Send (RTS). The Transmit Data Line (TXD) is held low. After 0.22 seconds, the terminal tests the condition of Data Set Ready (DSR). When DSR turns off (or after 1.8 seconds), the disconnect is complete. Depressing Ctrl and Break simultaneously causes the answerback message to be transmitted (the answerback message is controlled from the Keyboard Set-Up menu).

8.3.4.2 Programmable Function Keys — Each of the top-row programmable function keys (F6 through F20) may have up to three separate functions depending on the condition of the Shift and Ctrl keys.

When the Shift key is shifted (held down), the function keys F6 through F20 are assigned host-programmable messages for application purposes. When the Ctrl key is held down, alternate host-programmable messages are assigned. Details of how to program these keys are provided in Section 8.4.2.18.

When the Shift key is unshifted, the top-row function keys F6 through F20 (including HELP and DO) of the top-row function keys have functions that are described in Table 8-8.

Table 8-8. Programmable Function Key (F6 - F20) Descriptions

Function Key Number (Name)	Codes Generated VT200 Mode	VT100/VT52 Mode
F6	CSI 17 ~	- - -
F7	CSI 18 ~	- - -
F8	CSI 19 ~	- - -
F9	CSI 20 ~	- - -
F10	CSI 21 ~	- - -
* F11 (ESC)	CSI 23 ~	ESC (Escape)
* F12 (BS)	CSI 24 ~	BS (Backspace)
* F13 (LF)	CSI 25 ~	LF (Linefeed)
F14	CSI 26 ~	- - -
F15 (HELP)	CSI 28 ~	- - -
F16 (DO)	CSI 29 ~	- - -
F17	CSI 31 ~	- - -
F18	CSI 32 ~	- - -
F19	CSI 33 ~	- - -
F20	CSI 34 ~	- - -

* The name in parentheses is applicable only in VT100 or VT52 modes.

8.3.5 Generating C0 Control Codes

C0 control codes (7-bit codes) can be generated using Ctrl key sequences (Ctrl key sequences are created by holding down the Ctrl key and pressing other specified keys). Table 8-9 provides the sequences used to generate C0 control codes.

8.3.6 Generating C1 Control Codes

C1 (8-bit) control codes can be generated using 7-bit code extension techniques. In general, any C1 code can be expressed by sending the C0 code ESC followed by a second ASCII character that is 64 (decimal) less that that of the C1 character. For example, the C1 characters IND, CSI and SS2 can be expressed as follows:

C1 Character	Code Extension Equivalent
IND	ESC D
CSI	ESC [
SS3	ESC O

Table 8-9. Keystroke Sequences for Generating C0 Control Codes

C0 Control Code Mnemonic	Key pressed with Ctrl (All Modes)	Dedicated Function Key or Special Action Key
NUL	2 or space	
SOH	A	
STX	B	
ETX	C	
EOT	D	
INQ	E	
ACK	F	
BEL	G	
BS	H	F12 (BS) *
HT	I	Tab
LF	J	F13 (LF) *
VT	K	
FF	L	
CR	M	Return
SO	N	

Table 8-9. Keystroke Sequences for Generating C0 Control Codes (Contd.)

C0 Control Code Mnemonic	Key pressed with Ctrl (All Modes)	Dedicated Function Key or Special Action Key
SI	O	
DLE	P	
DC1 (XOFF)	Q †	
DC2	R	
DC3 (XON)	S †	
DC4	T	
NAK	U	
SYN	V	
ETB	W	
CAN	X	
EM	Y	
SUB	Z	
ESC	3 or [	F11 (ESC) *
FS	4 or /	
GS	5 or]	
RS	6 or ~	
US	7 or ?	
DEL	8	⌫

* Pertains to VT100- and VT52-compatible modes only.

† If XON/OFF flow control is enabled, these keys (pressed in combination with the Ctrl key) do not generate codes. Instead, these keystroke combinations toggle the Hold Screen state.

8.4 RECEIVED CODES

This section describes how the Visual 220 responds to the various control codes received from an application or a host system.

NOTE

The code descriptions assume that The DEC™ Multinational character set is mapped into the 8-bit code table as described in Chapter 7.

Control codes are used in programs to determine how the terminal handles data from an application or a host system. Control codes can determine such things as:

- setting the operating mode of the terminal.
- setting specified tab stops.
- moving the cursor to predefined points on the display.
- changing character sets.

All control codes can be expressed as single-byte or multi-byte codes. Single-byte codes (C0 and C1 codes) generate a limited number of control functions. Multi-byte codes, however, can perform many more functions due to the variety of combinations possible. The multi-byte codes are divided into three categories:

- Escape Sequences
- Control Sequences
- Device Control Strings

Escape sequences are made up of one or more 7-bit codes (represented by ASCII characters) that are preceded by the code for the C0 character "ESC."

An example of an escape sequence is **ESC [2 J**. This sequence causes the entire display to be erased (the cursor does not move).

Control sequences are made up of one or more 7-bit codes (represented by ASCII characters) that are preceded by the code for the C1 character "CSI." Note that CSI can also be expressed as the escape sequence ESC [(refer to Section 8.3.6).

NOTE

CSI may be used whenever possible to gain processing speed.

An example of a control sequence is CSI K. This sequence causes the line to the right of the cursor to be erased (including the character in the cursor position). The cursor does not move. The equivalent escape sequence for this control sequence is ESC [K.

Device control strings are used to down-line load character set, program function keys F6 through F20 and to program the time-of-day clock.

A device control string is made up of an opening delimiter a data stream and a closing delimiter and has the following format:

DCS Control String Data ST

DCS (C1 code 90 hex) is the opening delimiter that can also be described as the escape sequence ESC P. ST (string terminator) is the closing delimiter. ST can also be expressed as the escape sequence ESC \.

8.4.1 C0 and C1 Control Characters

This section describes how the Visual 220 responds to C0 and C1 Control Characters that are received from the application or host system. Not all control characters have an effect on the Visual 220. Table 8-10 describes the allowable C0 Control Codes.

Table 8-10. C0 Control Code Functions

Code	Hex Value	Terminal's Response
NUL	00	Ignored when received.
ENQ	05	Initiates Answerback message.
BEL	07	Rings bell if Warning Bell is enabled.
BS	08	Moves cursor one position to the left. No action occurs if cursor is at left margin.
HT	09	Moves cursor to next tab stop, or to end of line if no more tab stops.
LF	0A	Moves cursor down one line or to the left margin depending on the setting of new line mode. Causes a scroll if the cursor is at the bottom line of the scroll region. Also causes printing of current line if auto print is enabled.
VT	0B	Same as LF.
FF	0C	Same as LF.
CR	0D	Moves cursor to first column of current line (this action is not affected by the setting of the New Line mode).
SO	0E	Invokes G1 character set into GL.
SI	0F	Invokes G0 character set into GL.
DC1	11	XON code.
DC3	13	XOFF code.
CAN	18	If received during an escape or control sequence, cancels the sequence. No error character is displayed.

Table 8-10. C0 Control Code Functions (Contd.)

Code	Hex Value	Terminal's Response
SUB	1A	Same as CAN, except causes a reverse question mark (ʕ) to be displayed.
ESC	1B	Initiates control sequence.
DEL	7F	Ignored. Should not be used as a filler.

The C1 control characters require 8-bit codes and are recognized only when the terminal is in 8-bit compatible mode. Table 8-11 describes the terminal's response to C1 control characters. Equivalent 7-bit escape sequences are provided for coding in a 7-bit environment.

Table 8-11. C1 Control Code Functions

Code Name	Hex Value	7-Bit Code Equivalent	Terminal's Response
IND	84	ESC D	Moves cursor down one line in the same column. If cursor is at bottom margin, initiates scroll up.
NEL	85	ESC E	Moves cursor to first column of next line. Initiates scroll up if cursor is at bottom margin.
HTS	88	ESC H	Sets a horizontal tab at the cursor position.
RI	8D	ESC M	Moves cursor up one line in the same column. If cursor is at top margin, initiates scroll down.
SS2	8E	ESC N	Invokes G2 character set into GL for next character only.
SS3	8F	ESC O	Invokes G3 character set into GL for next character only.
DCS	90	ESC P	Recognizes opening delimiter of Device Control String.
CSI	9B	ESC [	Recognizes opening delimiter of extended escape sequences.
ST	9C	ESC \	Recognizes closing delimiter of Device Control String.

8.4.2 Control Sequences Recognized in ANSI (X3.64) Mode

This section describes those control sequences recognized by the Visual 220 that conform to the basic format specified by ANSI X3.64. Example (spaces are for clarity only):

ESC [Ps/Pn X or **CSI Ps/Pn X**

Certain control sequences that are not actually specified in the X3.64 standard are noted. The following conventions are used to identify non-ANSI (X3.64) control sequences:

- Non-ANSI DEC sequences are marked "(private)."
- Sequences that are not present in the DEC VT220 are marked "[VISUAL]." These sequences are enhancements to the DEC VT220.

8.4.2.1 Mode Set and Reset Control Sequences — Control sequences allow the host to set (and reset) terminal parameters. The parameters that are menu-selectable (in Set-Up) can be saved in non-volatile memory.

NOTE

Certain parameters can be "locked" by using Set-Up mode. Features that are locked cannot be changed by the host.

This section identifies control sequences and parameter values required to set and reset various Visual 220 operating modes. The following sequences are only valid in ANSI mode.

SET MODE COMMAND **CSI Ps ; Ps ; ... Ps h**

The Set Mode command is the control sequence used to change Visual 220 operating modes or parameters.

Ps represents a single mode value. A Set Mode control sequence can contain up to 16 different mode values. The modes and values are provided in Table 8-12.

An example of a Set Mode sequence is **CSI 12 ; 7 ; 8 h**. This sequence configures the terminal for local echo.

RESET MODE COMMAND **CSI Ps ; Ps ; ... Ps l**

The Reset Mode command is the control sequence used to reset ANSI and non-ANSI modes. The various modes are described in Table 8-12.

Table 8-12 describes the set/reset modes available in the Visual 220. The modes that include the question mark (?) as part of the selected parameters are private modes that enhance the operation of the Visual 220.

NOTE

If a question mark (?) is used, it must be the first character in the parameter string. All subsequent parameters in the sequence are affected by the question mark.

Table 8-12. Set/Reset Mode Ps Values and Definitions

Mode Name	Ps Value	Function
Keyboard Action	2	When set, this command locks the keyboard. When reset, this command unlocks the keyboard.
Control Representation Mode [VISUAL]	3	When set, this command causes all characters, including control characters to be displayed on the screen. Control characters are represented by the underlined capital letter corresponding to their position while other characters are displayed with normal attributes. Setting this mode prevents any control sequences from being acted upon except for the code to reset control representation mode. When reset, control characters are only acted upon, not displayed.
Insertion-Replacement	4	The terminal displays received characters at the cursor position. This mode determines how the terminal adds characters to the screen. When set, insert mode displays the character and moves previously displayed characters to the right. Characters never wrap past the end of the line. When reset, replace mode adds characters by replacing the character at the cursor position.

Table 8-12. Set/Reset Mode Ps Values and Definitions (Contd.)

Mode Name	Ps Value	Function
Send/Receive Mode	12	When set, no local echo of transmitted data occurs. When reset, this mode causes the transmitted data to be echoed back to the terminal display.
Linefeed / New Line Mode	20	When set, this mode causes the Return key to generate the CR (carriage return) and LF (line feed) codes. When reset, the return key generates a CR code only. LF is generated by the Line Feed key.
Cursor Key Mode (private)	? 1	When set, this mode causes the cursor positioning keys to generate special escape sequences. When reset, the cursor position keys transmit their normal ANSI mode sequences.

Cursor Key	Set	Reset
UP	SS3 A	CSI A
DOWN	SS3 B	CSI B
LEFT	SS3 C	CSI C
RIGHT	SS3 D	CSI D
HOME	SS3 H	CSI H

Table 8-12. Set/Reset Mode Ps Values and Definitions (Contd.)

Mode Name	PS Value	Function
VT52/ANSI Mode (private)	? 2	The set mode sequence is not applicable for VT52/ANSI Mode. Use **ESC** <.
		When reset, this mode causes the terminal to respond to DEC VT52 mode control sequences.
80/132 Column (private)	? 3	When set, this mode configures the terminal for 132 column display width.
		When reset, the terminal is configured for 80 column display width.
Scrolling Mode (private)	? 4	When set, the terminal goes into smooth scrolling mode.
		When reset, the terminal goes into step scrolling mode.
Reverse Video (private)	? 5	When set, this mode causes the screen to form characters with dark dots on a light background.
		When reset, the screen forms characters with light dots on a dark background.

Table 8-12. Set/Reset Mode Ps Values and Definitions (Contd.)

Mode Name	PS Value	Function
Origin Mode (private)	? 6	When set, this mode causes line and column numbers to be dependent on the selected scrolling region and home in the scrolling region. The cursor moves to the new home position after the mode changes. When reset, line and column numbers are independent of the selected scrolling region.
Autowrap Mode (private)	? 7	When set, this mode causes the cursor to automatically advance to the first position of the next line when characters are entered after the last column position is reached. When reset, the cursor does not move (wrap) to the next line. This function does not affect Tab, however. Tab never moves the cursor to the next line.
Autorepeat Mode (private)	? 8	When set, this mode causes most keys to be autorepeating. When reset, no keys autorepeat.
Text Cursor Enable (private)	? 25	When set, this mode causes the text cursor to be visible. When reset, the text cursor is not displayed.

8.4.2.2 Define Scrolling Region — This (private) command selects the portion of the terminal screen to be used for displaying data.

SCROLLING REGION COMMAND **CSI r1 ; r2 r (private)**

The scrolling region command is used to set the top and bottom lines of the screen scrolling region where "r1" defines the first line of scrolling region and "r2" defines the last line of the scrolling region. The minimum number of scrolling lines are two. The default values are 1 for r1 and 24 for r2. The following examples illustrate the effect of various scrolling region commands.

Command Examples	Lines Included in Scrolling Region
ESC [r	1 - 24
ESC [10; 20 r	10 - 20
ESC [10 r	10 - 24
ESC [; 20 r	1 - 20

Once the scrolling region is defined, the cursor positioning commands may move the cursor into but not out of the scrolling region. The only exception to this rule is when Origin Mode is reset and the Absolute Cursor Addressing commands are used. After this command is executed, the cursor moves to the home position, as defined by Origin Mode.

8.4.2.3 Cursor Control Commands — The Visual 220 provides a wide variety of cursor motions to insure that the operator can position the cursor most efficiently. The default value of all cursor movement commands is one.

The cursor positioning commands described in this section may cause a varying action depending on two factors: The defined scrolling region and the current state of the Origin mode. Once the scrolling region is defined, incremental cursor positioning commands, (Up, Down, Right, Left) can position the cursor anywhere within the scrolling region, but cannot position the cursor outside of the scrolling region. The Absolute Cursor Positioning command remains unaffected by the screen scrolling region unless the Origin Mode is set.

CURSOR UP **CSI Pn A**

This command moves the cursor up Pn lines. Pn can be 1 to 255. The cursor cannot move past the top margin.

CURSOR DOWN **CSI Pn B**

This command moves the cursor down Pn lines. Pn can be 1 to 255. The cursor cannot move past the bottom margin.

CURSOR RIGHT **CSI Pn C**

This command moves the cursor right Pn characters. Pn can be 1 to 255. The cursor cannot move past right margin.

CURSOR LEFT **CSI Pn D**

This command moves the cursor left Pn characters. Pn can be 1 to 255. The cursor cannot move past the left margin.

ABSOLUTE CURSOR POSITIONING **CSI r ; c H**
CSI r ; c f

Either of the absolute cursor positioning commands may be used to position the cursor anywhere on the terminal screen between lines (rows) 1 and 24 for the line count and between columns 1 and 80 (or 1 and 132) for the character count. The default values are 1. The line (row) count is specified by r and the column count by c.

If an attempt is made to position the cursor past the screen boundaries, the cursor moves to the screen boundary. If r or c are not selected or selected as 0, the cursor moves to the first line or column, respectively.

CURSOR INDEX **ESC D**

This command causes the cursor to move down one line in the scrolling region. If the cursor moves to the maximum boundary of the scrolling region the terminal scrolls up one line.

CURSOR REVERSE INDEX **ESC M**

This command causes the cursor to move up one line in the scrolling region. If the cursor moves to the minimum boundary of the scrolling region the terminal scrolls down one line.

NEXT LINE **ESC E**

This sequence causes the cursor to move to the beginning of the next line. If the cursor is positioned on the bottom line of the screen or the bottom of the screen scrolling region, the contents of the scrolling screen or scrolling region scrolls up one line.

SAVE CURSOR **ESC 7 (private)**

This (private) sequence causes the cursor position, character set, origin mode selection and graphic rendition to be saved in memory. If the terminal power is shut off or a reset occurs, these values are lost.

RESTORE CURSOR **ESC 8 (private)**

This sequence causes restoration of the previously saved cursor position, character set, origin mode selection and graphic rendition.

8.4.2.4 Erasure Commands — A wide variety of erasing commands permits characters to be removed from the screen without affecting other characters. Characters are lost when they are erased.

ERASE IN PAGE **CSI Ps J**

This command erases some or all the data on a page depending on the value of Ps (Ps values are described below).

Ps Value	Action
0 (default)	Erase from cursor to end of page, including cursor position.
1	Erase from beginning of screen to cursor, including cursor position.
2	Erase page, all lines changed to single width. Cursor does not move.

ERASE IN LINE **CSI Ps K**

This command erases some or all the data on a line according to the Ps value (Ps values are described below).

Ps Value	Action
0 (default)	Erase from cursor to end of line, including cursor position
1	Erase from start of line to cursor, including cursor position.
2	Erase line

SELECTIVE ERASE IN PAGE **CSI ? Ps J**

This (VT200 mode only) command erases some or all erasable data on a page, depending on the value of Ps (Ps values are described below). Erasable characters are those whose logical attribute is set to "erasable" (see Section 8.4.2.10).

Ps Value	Action
0 or none	Erase all "erasable" characters from and including the cursor to the end of the screen
1	Erases all "erasable" characters from the beginning of the screen to and including the cursor.
2	Erases all "erasable" characters in the entire display.

SELECTIVE ERASE IN LINE **CSI ? Ps K**

This (VT200 mode only) command erases some or all erasable data on a line, depending on the value of Ps (Ps values are described below). Erasable characters are those whose logical attribute is set to "erasable" (see Section 8.4.2.10).

PS Value	Action
0 or none	Erases all "erasable" characters from the cursor to the end of the line.
1	Erases all "erasable" characters from the beginning of the line up to and including the cursor position.
2	Erases all "erasable" characters on the line.

ERASE CHARACTER **CSI Pn X**

This (VT200 mode only) command erases characters at the cursor position and the next Pn-1 characters.

8.4.2.5 Tabbing Commands — Tabbing commands permit setting and clearing of tab stops.

TABS CLEAR **CSI Ps g**

This command clears one or more tabs stops depending on the value of Ps (Ps values are described below).

Ps Value	Action
0 (default)	Clears tab at current column
3	Clears all tab stops

SET TAB **ESC H**

This command sets a Tab Stop at the current cursor position.

8.4.2.6 Screen Alignment — The screen alignment command is typically used by field maintenance personnel.

SCREEN ALIGNMENT COMMAND **ESC # 8**

The screen alignment command fills the screen with upper case E's and may be used to focus and align the terminal display.

8.4.2.7 Character Set Selection (private) — The character set selection commands allow for remote selection of various hard (ROM-based) or soft (down-line loadable) character sets.

To use any character set, it first must be designated as G0, G1, G2 or G3. Once designated, the set can be invoked into GL (graphics left) or GR (graphics right) at any time. A detailed discussion of this procedure is provided in Chapter 7.

- Designating Hard Character Sets

  Hard (ROM-based) character sets include U.S., U.K., ASCII Graphics and Supplemental Graphics (these character sets are described in Chapter 7). These character sets may be designated as G0, G1, G2 or G3 using the sequences provided in Table 8-13.

Table 8-13. Designating Hard Character Sets

Character Set	Designate As:	Use Coding Sequence
ASCII	G0 (Default)	ESC (B
	G1	ESC) B
	G2 (VT 200 Mode only)	ESC * B
	G3 (VT 200 Mode only)	ESC + B
DEC Supplemental (VT200 Mode Only)	G0	ESC (<
	G1	ESC) <
	G2	ESC * <
	G3	ESC + <
U.K. National (VT100 Mode Only)	G0	ESC (A
	G1	ESC) A
DEC Special Graphics	G0	ESC (0
	G1	ESC) 0
	G2 (VT 200 Mode only)	ESC * 0
	G3 (VT 200 Mode only)	ESC + 0

- Designating "Soft" Character Sets

  A soft (down-line loadable) character set can be designated as G0, G1, G2 or G3 after it has been down-line loaded into the soft font buffer.

NOTE

The device control string for down-line loading characters is described in Section 8.4.2.19. Additional information on this procedure is contained in Chapter 7.

A soft character set may be designated using the following escape sequences:

To Designate as:	Use Sequence:
G0	ESC (RCS name
G1	ESC) RCS name
G2	ESC * RCS name
G3	ESC + RCS name

- Invoking Character Sets Using Lock Shifts

  Once a character set has been designated, it can be invoked onto GL or GR using "lock shifts." These sequences cause a character set to remain active until:

  a) it is replaced by another lock-shifted character set, or

  b) it is temporarily displaced by a single-shifted character set, or

  c) the terminal is powered off.

Function:	Use Sequence:
Invoke G0 into GL	SI
Invoke G1 into GL	SO
Invoke G1 into GR	ESC ~
Invoke G2 into GL	ESC n
Invoke G2 into GR	ESC }
Invoke G3 into GL	ESC o
Invoke G3 into GR	ESC :

- Invoke Character Sets Using Single Shifts

  Once a character set has been designated, it can be invoked into GL or GR using "single shifts." These sequences cause a character set to remain active for the next single graphics character only. After that character has been processed, the set that was displaced is returned to its previous position.

Function	Use Sequence
Invoke G2 into GL for the next graphic character.	ESC N
Invoke G3 into GL for the next graphic character.	ESC O

8.4.2.8 Report Commands and Responses — The commands in this section allows the host to ask the terminal various questions about its status. The terminal typically responds by returning a specified sequence.

PRIMARY TERMINAL **CSI c**
CSI 0 c
ESC Z

This command allows the host to ask the terminal to identify itself. A terminal's typical response is shown below.

Terminal's Response	Meaning
CSI ? 62; 1; 2; 6; 7; 8c	I am a service class 2 (VT200 family) terminal (62) with 132 columns (1), printer port (2), selective erase (6), RCS characters (7) and programmed function keys (8).

TERMINAL CONDITION **CSI 5 n**

This command allows the host to ask the terminal's condition. The terminal's response is shown below.

Terminal's Response	Meaning
CSI 0 n	I have no malfunction.
CSI 3 n	I have a malfunction.

READ CURSOR LOCATION **CSI 6 n**

This command allows the host to find out where the terminal's cursor is located. The terminal's response is shown below.

Terminal's Response	Meaning
CSI r ; c R,	"r" is the row (line) number and "c" is the column number. No parameters or parameters of 0 indicate the cursor is at the home position.

SECONDARY TERMINAL ID **CSI > c**
CSI > 0 c

This command asks what type of terminal it is, what the firmware version is, and what hardware options you have installed.

Terminal's Response	Meaning
CSI > Pt; Pv; Po c	I am a Visual ... terminal (Pt), my firmware rev is (Pv) and I have (Po) options installed.

Parameters	Values	Definitions
Pt	1	Visual 220 terminal
	2	Visual 240/241 terminal
Pv		Decimal version number (X10). Example; Version 3.2 = 32
Po	0	No options

USER DEFINED KEY LOCK **CSI ? 25n**

This sequence asks the terminal whether the user defined function keys are locked or unlocked. The terminal response may be either of the following:

CSI ? 20 n	User defined keys are unlocked
CSI ? 21 n	User defined keys are locked

8.4.2.9 Video Attributes — Characters may be displayed on the terminal in any combination of the following attributes: Bold, Underline, Blank, Blink and Reverse Video.

VIDEO ATTRIBUTE COMMAND **CSI Ps ; ... Ps m**

This command turns on any or all video attributes. The video attributes are cumulative. When an attribute or combination of attributes is turned on, all subsequently displayed characters remain affected until the attribute (or attributes) is turned off.

Table 8-14 provides the sequences for setting individual attributes.

Table 8-14. Video Attribute Control Sequences

Attribute	Ps Code	Control Sequence
Normal	0 (default)	CSI m
Bold	1	CSI 1 m
Blank	2	CSI 2 m [VISUAL]
Underline	4	CSI 4 m
Blink	5	CSI 5 m
Reverse	7	CSI 7 m
Display Normal Intensity	22	ESC [22m
Display Not Underlined	24	ESC [24 m
Display not Blinking	25	ESC [25 m
Display Positive Image	27	ESC [27 m

8.4.2.10 Logical Attributes — Characters may be assigned an "erasable" or "non-erasable" logical attribute.

SELECT LOGICAL ATTRIBUTES **CSI Ps " q**

Characters entered on the display may be selected as "erasable" or "non-erasable" using this command. Characters selected as "non-erasable cannot be erased using selective erase control sequences. Once the logical attribute is set, all subsequent characters entered on the display are affected. The video attributes are not affected by this command.

Selectable parameter (Ps) values are shown below.

Ps	Effect
0	All logical attributes off
1	Designate characters as non-erasable
2	Designate characters as erasable

8.4.2.11 Character Size Commands (Private) — Characters may be formed on the screen in three different sizes: single height-single width, double height-double width, or single height-double width. When using double size characters, the number of characters per line is halved.

This section describes the various character size commands.

SINGLE HEIGHT - SINGLE WIDTH LINE **ESC # 5**

This command causes the characters in the line marked by the cursor to be single height-single width.

SINGLE HEIGHT - DOUBLE WIDTH LINE **ESC # 6**

This command causes the characters in the line marked by the cursor to be single height-double width.

If the line was previously single height-single width, any characters in the right half of the display are lost. The cursor remains under the same character position, unless its character (column) position is lost, in which case the cursor is moved to the right margin.

DOUBLE HEIGHT - DOUBLE WIDTH LINE (TOP HALF) **ESC # 3**
DOUBLE HEIGHT - DOUBLE WIDTH LINE (BOTTOM HALF) **ESC # 4**

These two commands are used as a pair, on adjacent lines to form double height-double width characters. The same character must be sent to the same column of both lines to form each character. If the line was previously single-height single-width, all characters from the middle of the line to the end of the line are lost. The cursor remains in the same character position unless the character position is lost, in which case the cursor is moved to the right margin.

8.4.2.12 Reset Commands — This section describes hard and soft reset commands. Data not stored in NVR (non-volatile RAM) is lost when these commands are used.

HARD RESET **ESC c**

This command causes the terminal to reset, and has the same effect as powering-down then powering-up the terminal. All set-up parameters are replaced by their NVR values, or power-up default values if NVR values do not exist.

In addition, this command:

- performs a communications line disconnect.
- clears user-defined keys (except non-volatile keys).
- clears all down-line loaded character sets.
- clears the display.
- returns the cursor to the home position.
- sets the video attributes to normal.
- resets the selective erase attribute.
- sets all character sets to the default.

SOFT RESET **CSI ! p**

The Soft Terminal reset sequence sets the terminal to the power-up default status listed in Table 8-15.

Table 8-15. Soft Terminal Reset Status

Terminal Parameter	Status
Text Cursor	On*
Insert/Replace	Replace
Origin Mode	Absolute
Autowrap	Off*
Keyboard Action	Unlocked
Keypad Mode	Numeric
Cursor Key Mode	Normal
Top Margin	1
Bottom Margin	24
Character Sets:	
G0, G1, GL G2, G3, GR	ASCII DEC Supplemental Character Set
Video Character Attributes	Normal
Selective Erase Attributes	Normal (erasable)
Restore Cursor State	
Cursor Position Character Sets Selective Erase Attribute Video Attributes Origin Mode Character Shift (G0 to GL, G2 to GR, no shifts)	Home VT200 defaults Off Normal Absolute Power Up Defaults

* Ignores the "saved" value in the terminal's non-volatile memory.

8.4.2.13 Numeric/Application Keypad Commands — The commands in this section invoke a special set of codes for the Numeric/ Application Keypad. These codes may be used by an application to perform specialized functions.

ENTER APPLICATION KEYPAD MODE **ESC =**

This sequence causes the terminal to enter Application Keypad mode. When entered, this mode causes keys on the numeric keypad to transmit special escape sequences as opposed to their regular codes. These codes are as follows:

Key	Application Keypad Code
0	SS3 p
1	SS3 q
2	SS3 r
3	SS3 s
4	SS3 t
5	SS3 u
6	SS3 v
7	SS3 w
8	SS3 x
9	SS3 y
- (minus)	SS3 m
, (comma)	SS3 l
. (period)	SS3 n
ENTER	SS3 M
PF1	SS3 P
PF2	SS3 Q
PF3	SS3 R
PF4	SS3 S

EXIT APPLICATION KEYPAD MODE **ESC >**

This sequence causes the terminal to exit Application Keypad mode. The Numeric/Application keypad keys resume their numeric code functions.

8.4.2.14 Editing Commands — The following commands allow the host to delete characters or lines and insert lines.

INSERT LINE **CSI Pn L**

This command insert Pn lines (where Pn can vary from 1 to 255) starting at the line with the cursor. Lines displayed below the cursor move down. Lines moved past the bottom margin are lost. This sequence is ignored when the cursor is outside the scrolling region.

DELETE LINE **CSI Pn M**

This command deletes Pn lines (where Pn can vary between 1 and 255) starting at the line with the cursor. As lines are deleted, lines below the cursor move up. Lines added to bottom of screen have spaces with same character attributes as last line moved up. This sequence is ignored when the cursor is outside the scrolling region.

INSERT CHARACTER **CSI Pn @**

This (VT200 mode only) command inserts Pn blank characters at the cursor position, with the character attributes set to normal.

DELETE CHARACTER **CSI Pn P**

Deletes Pn characters starting with the character at the cursor position. When a character is deleted , all characters to the right of the cursor move left. This creates a space character at the right margin with the character attributes set to normal.

8.4.2.15 Terminal Testing — The terminal or host can invoke various tests or combinations of tests. These tests are typically performed by field maintenance personnel. The following control sequence causes the test(s) to be run (Ps values are described below):

RUN TEST(S) **CSI 4; Ps; Ps; ...; Ps y**

Ps Value	Effect
0	Test 1, 2, 3, and 6.
1	Power-up self test.
2	EIA port data loopback test. *
3	Printer loopback test. *
4	Not used.
5	Not used.
6	EIA port modem control line loopback test. *
7	20 MA loopback test. *
8	Not used.
9	Repeat selected tests until failure or power off.

* Loopback tests require loopback connectors (see Appendix F).

8.4.2.16 Select Compatibility Levels — The terminal may be set to a particular emulation mode for compatibility with host software. There are two emulation modes: VT200 and VT100 (VT52 is a subset of VT100 mode).

SELECT EMULATION MODE **CSI Ps1 ; Ps2 ; " p**

This command selects the emulation mode (Ps1) and the control codes for the terminal. The parameter values (Ps1 and Ps2) are defined in Table 8-16.

Table 8-16. Parameter Values to Select Emulation Mode

Parameter	Parameter Value	Definition
Ps1	61	Places the terminal in VT100 mode.
	62	Places the terminal in VT200 mode.
Ps2	0	Selects 8 bit controls (8-bit controls can be transmitted to the host application software).
	1	Selects 7 bit controls (7-bit controls can be transmitted to the host application software).
	2	Selects 8 bit controls.

NOTE

VT200 Modes selected using this control sequence may be altered by also using the sequences to select 7- or 8-bit control codes. These codes are described in Section 8.4.2.17.

8.4.2.17 Selecting 7/8 Bit Control Code Transmission — This section describes commands that may be used to determine whether 8-bit control codes or their equivalent 7-bit extensions are sent to the host application.

SELECT 7-BIT CONTROLS **ESC sp F**

Causes all C1 codes returned to the application program to be converted to their equivalent 7-bit extensions.

SELECT 8-BIT CONTROLS **ESC sp G**

Causes the terminal to return C1 codes to the application without converting them to their equivalent 7-bit extensions.

8.4.2.18 Programming Top-Row Function Keys — Each top-row function key (F6 through F20) can be programmed with two different values. Programmed values are assigned to key numbers that correspond to function keys pressed in combination with special action keys Shift or Ctrl.

The function keys can be programmed using the following device control string:

DCS Pc; Pl | ky1/st1; ky2/st2;...kyn/stn ST

String parameters (Pc and Pl) and their effects are described in Table 8-17. Key numbers (kyn) are identified in Table 8-18.

String data (stn) is made up of hexidecimal numbers that correspond to the code table position (hex) of the desired character. Stn data cannot exceed 256 bytes for any single key number. A maximum of 1024 bytes may be shared among all function keys.

Table 8-17. Function Key Control String Parameter Effects

Parameter	Value	Effect
Pc (Clear)	0 or none	Clear all keys before loading new values.
	1	Load new values, clear old only where defined.
Pl (Lock)	0 or none	Lock the keys against future redefinition
	1	Do not lock the keys against future redefinition *

* A Pl value of 1 does not "unlock" locked keys.

Table 8-18 identifies the key numbers for Function keys that are pressed in combination with the Shift or Ctrl keys.

Table 8-18. Top-Row Function Key Numbers

Function Key	Key Number When Pressed in Combination With:	
	Shift	Ctrl
F6	17	37
F7	18	38
F8	19	39
F9	20	40
F10	21	41
F11	23	43
F12	24	44
F13	25	45
F14	26	46
HELP	28	48
DO	29	49
F17	31	51
F18	32	52
F19	33	53
F20	34	54

The following example illustrates a device control string that programs function key F12 (pressed with Ctrl) with the escape sequence ESC [2 J.

DCS 1; 1 | 44 / 1B 5B 32 4A

8.4.2.19 Down-line Loading Characters — RCS (Redefinable Character Set) characters and other soft characters can be down-line loaded into the Visual 220 font buffer. The font buffer has a capacity of 94 characters.

NOTE

Soft character set selection is described in detail in Chapter 7 of this manual.

The following device control string (DCS) may be used for down-line loading soft characters:

DCS Pfn;Pcn;Pe;Pccs;Pw;Pt { RCS name Bp1;Bp2;Bp3;...Bpn ST

String variables are described in Table 8-19. The parameter substring (Pfn;Pcn;Pe;Pccs;Pw;Pt) is further defined in Table 8-20.

Table 8-19. Soft Character Down-Line Load DCS Description

DCS Characters	Description
DCS	Introduces a device control string. DCS is an eight-bit control character that can also be expressed as ESC P when coding for a seven-bit environment.
Pfn;Pcn;Pe;Pccs;Pw;Pt	A parameter substring. The parameter values are discussed in Table 8-20.
{	Identifies the end of the parameter substring and specifies a down-line load sequence.
RCS name	Defines the name for the soft character set. The RCS name is also used in the escape sequence for designating a soft character set.
Bp1;Bp2;Bp3;...Bpn	Character bit patterns for individual RCS characters. Each character bit pattern is separated by a semicolomn (;). Up to 94 bit patterns may be included in the DCS. Bit patterns are fully described in Chapter 7.
ST	String Terminator. ST is an eight-bit control character that can be expressed as ESC \ when coding for seven-bit environments.

Table 8-20 names and describes the parameters in the parameter substring for the RCS down-line load DCS.

Table 8-20. Parameter Values for a Down-Line Load Sequence

Parameters	Name	Description
Pfn	Font Number	Specifies the RCS font buffer to be used. The Visual 220 has only one RCS font buffer. Legal values are 0 and 1.
Pcn	Starting Character Number	Specifies the position in the ASCII code table (and the font buffer) where the first character is to be loaded. 1 specifies position 33 (! in the ASCII table). 94 specifies position 126 (~ in the ASCII table).
Pe	Erase Control	Specifies which characters in the font buffer are erased before new characters are loaded. Legal values and their definitions are as follows: 0 = erase all characters in the font buffer. 1 = erase the characters that are being reloaded. 2 = erase all characters in all font buffers.
Pccs	Character Cell Size	Defines the expected limit of the RCS cell size. Legal values and their definitions are as follows: 0 = Device default (7x10) 1 = (not used) 5 = (not used) 2 = 5x10 6 = 5x12 3 = 6x10 7 = 6x12 4 = 7x10 8 = 7x12

Table 8-20. Parameter Values for a Down-Line Load Sequence (Contd.)

Parameters	Name	Description
Pw	Width	Specifies the display width attribute as follows: 0 = Device default (80 columns) 1 = 80 column 2 = 132 column
Pt	Text/ Full Cell	Specifies whether software treats the font as a text font or a full cell font. Legal values and their definitions are as follows: 0 = Device default (text) 1 = Text 2 = Full cell (not used) Text fonts typically cannot address all pixels individually within a cell. Full cell fonts can individually address all pixels in a cell.

8.4.2.20 Clearing a Down-Line Loaded Character Set — Down-line loaded character sets may be cleared by the following down-line load device control strings:

Control String:	Effect:
DCS 1;1;0 { SP @ ST	Clear font buffer #1
DCS 2;1;0 { SP @ ST	Clear optional font buffer #2
DCS 1;1;2 { SP @ ST	Clear all font buffers

8.4.2.21 Printer Control Sequences — The Visual 220 terminal provides a variety of commands to enhance terminal/printer performance.

PRINT PAGE **CSI i or CSI 0 i**

XOFF code is sent to host to suspend transmission. Contents of screen or scrolling region are transmitted to printer with CR/LF codes or only CR (depending on New Line selection from the General Set-Up menu) after each line. XON code sent to host to resume transmission once the Print Page function is complete.

If print extent is reset, only the scrolling region is sent to the printer. If print extent is set, the entire screen is transmitted.

If print termination character is set to FF (from the Printer Set-Up menu), a FF character is appended to the end of the transmission.

PRINT CURSOR LINE **CSI ? 1 i**

XOFF code is sent to the host to suspend transmission. Contents of cursor line are transmitted to printer with CR/LF codes or only CR (depending on New Line/No New Line Mode selection) after line. XON code sent to host to resume transmission once the Print Line function is complete.

PRINT LINE "P" **CSI ? 1 ; P i [VISUAL]**

XOFF code is sent to the host to suspend transmission. Contents of line "P" transmitted to printer with CR/LF codes or only CR (depending on New Line/No New Line Mode selection) after line. XON code is sent to the host to resume transmission once the Print Line function complete.

Line P is in decimal notation between the limits of 1 and 24.

PRINT LINES "P" THROUGH "Q" **CSI ? 1 ; P ; Q i [VISUAL]**

XOFF code is sent to the host to suspend transmission. Contents of lines "P" through "Q" are transmitted to printer with CR/LF or only CR (depending on New Line/No New Line Mode selection) after each line. XON code is sent to the host to resume transmission once the Print function complete.

Line P and Q are both in decimal notation between the limits of 1 and 24. This command works independently of the print extent setting.

ENTER PRINTER CONTROLLER MODE **CSI 5 i**

Data sent from host is passed through the terminal to the printer. XOFF code is sent to host in response to printer busy. XON code sent to host in response to printer not busy.

EXIT PRINTER CONTROLLER MODE **CSI 4 i**

The terminal exits printer controller mode, and automatically appends the CAN or DEL code (as dictated by the CANCEL SELECT feature). If the PRINTER TYPE feature is on, no code is appended.

ENTER COPY MODE **CSI ? 7 i**

The terminal enters copy mode. Data sent from host is passed through the terminal to the printer. The data is also displayed on the terminal screen. XOFF code is sent to host in response to printer busy. XON code sent to host in response to printer not busy.

EXIT COPY MODE **CSI ? 6 i**

The terminal exits copy mode.

ENTER AUTO PRINT MODE **CSI ? 5 i**

On receipt of LF code, XOFF code is sent to the host. Contents of line are transmitted to printer with CR/LF or only CR (depending on New Line/No New Line Mode selection) after the line. XON code sent to the host after the line is transmitted.

EXIT AUTO PRINT MODE **CSI ? 4 i**

The terminal exits Auto Print mode.

PRINTER STATUS REPORT **CSI ? 15 n**

This command allows the host to initiate a test of the printer status. When the terminal receives this command it checks the status of the printer's DTR line and responds in the following manner:

Terminal Response	Meaning
CSI ? 13 n	The printer is not connected. This is detected by verifying that printer DTR has not been on since the terminal was turned on.
CSI ? 11 n	The printer is connected but not ready to print. This is detected by verifying that printer DTR has been on at some time since the terminal was turned on but is not on at present.
CSI ? 10 n	The printer is connected and ready to print.

8.4.2.22 Printer Set and Reset Modes —This section defines modes that may be used to control a printer that is connected to the Visual 220 terminal. The parameters that are menu selectable (in Set-Up) can be saved in non-volatile memory.

NOTE

More information on Set and Reset Mode Commands may be found in Section 8.4.2.1.

SET MODE **CSI Ps ; Ps ; ... Ps h**

This command is used to set certain terminal operating parameters. The Ps (selectable parameter) values are described in Table 8-21. Additional Ps values may be found in Table 8-12.

RESET MODE **CSI Ps ; Ps ; ... Ps l**

This command is used to reset certain terminal operating parameters. The Ps (selectable parameter) values are described in Table 8-21. Additional Ps values may be found in Table 8-12.

Table 8-21. Printer Set/Reset Mode Parameter Value Definitions

Mode Name	Ps Value	Set/Reset Definitions
Printer Form Feed	? 18 (private)	When set, this mode selects form feed (FF) as the print termination character. The terminal transmits this character to the printer after each print screen. When reset, no print termination character is selected.
Printer Extent	? 19 (private)	When set, the terminal prints the full screen after receiving a print screen command. When reset, the terminal only prints the scrolling region after receiving a print screen command.

8.4.2.23 Programming the Time-of-Day Clock — A device control string (DCS) may be used to program the time of day clock in the Visual 220 terminal. The DCS has the following form:

DCS 1; Ps ~ hh : mm : ss ST

Selectable parameter (Ps) values are described as follows:

Ps Value	Effect
0	Use value selected in Set-Up
1	Set to a.m. (Standard)
2	Set to p.m. (Standard)
3	Use Military (24 hour) time

The following examples illustrate the effects of typical device control strings used to set the time-of-day clock:

DCS	Effect
DCS 1; 1 ~ 10: 23: 00 ST	10:23 am
DCS 1; 3 ~ 23: 10 ST	23:10

8.4.3 Control Sequences Recognized in VT52 Mode

This section describes those control sequences that are recognized in VT52 mode.

NOTE

These codes may have an unpredictable effect if used when the terminal is in ANSI mode.

8.4.3.1 Terminal Control Sequences — The following control sequences are used to control the terminal when it is in VT52 mode.

MOVE CURSOR UP **ESC A**

This sequence causes the cursor to move up one line. If the cursor is positioned on the top line no action occurs.

MOVE CURSOR DOWN **ESC B**

This sequence causes the cursor to move down one line. If the cursor is positioned on the bottom line no action occurs.

MOVE CURSOR RIGHT **ESC C**

This sequence causes the cursor to move right one position. If the cursor is positioned on the last column of a line no action occurs.

MOVE CURSOR LEFT **ESC D**

This sequence causes the cursor to move left one position. If the cursor is positioned in the first column of a line no action occurs.

ENTER GRAPHICS MODE **ESC F**

This sequence causes the terminal to enter Graphics mode. When graphics mode is entered, all received lower-case ASCII codes (octal 137-172) and the ASCII codes for {,|,} and ~ (octal 173-176) are displayed as graphic characters.

EXIT GRAPHICS MODE **ESC G**

This sequence causes the terminal to exit graphics mode.

CURSOR HOME **ESC H**

This sequence causes the cursor to move to the home position (upper left-hand corner of the screen).

REVERSE LINE FEED **ESC I**

This sequence causes the cursor to move up one line. If the cursor is positioned on the top line, the contents of the screen scroll down one line.

ERASE TO END OF SCREEN **ESC J**

This sequence causes erasure of all data from the cursor position to the end of the screen, including cursor position.

ERASE TO END OF LINE **ESC K**

This sequence causes erasure of all data from the cursor position to the end of the line.

CURSOR ADDRESSING **ESC Y r c**

This sequence is used for positioning the cursor on an absolute basis. The next two codes following this sequence are to be interpreted as the new line and column positions respectively. Line and column numbers are ASCII characters whose codes are their octal value plus octal 37.

IDENTIFY **ESC Z**

This sequence requests the terminal to verify that it is a VT52 and is switched on and ready for commmunication. If this is the case, the terminal responds with the VT200 identification sequence (see Section 8.4.2.8).

ENTER APPLICATION KEYPAD MODE **ESC =**

This sequence causes the terminal to enter Application Keypad mode. When entered, this mode causes keys on the numeric keypad to transmit special escape sequences as opposed to their regular codes. These codes are as follows:

Key	Application Keypad Codes
0	ESC ? p
1	ESC ? q
2	ESC ? r
3	ESC ? s
4	ESC ? t
5	ESC ? u
6	ESC ? v
7	ESC ? w
8	ESC ? x
9	ESC ? y
- (minus)	ESC ? m
, (comma)	ESC ? l
. (period)	ESC ? n
ENTER	ESC ? M
PF1	ESC P
PF2	ESC Q
PF3	ESC R
PF4	ESC S

EXIT APPLICATION KEYPAD MODE **ESC >**

This sequence causes the terminal to exit Application Keypad mode.

ENTER ANSI MODE **ESC <**

This sequence causes the terminal to enter ANSI mode.

8.4.3.2 Printer Control Sequences — The Visual 220 terminal provides commands to control terminal/printer performance when it is in VT52 mode.

PRINT PAGE **ESC]**

XOFF code is sent to the host to suspend transmission. Contents of the screen are transmitted to the printer with CR/LF codes or only CR (depending on the New Line/No New Line Mode selection) after each line. XON code is sent to the host to resume transmission once the Print Page function is complete.

PRINT LINE **Esc V**

XOFF code is sent to the host to suspend transmission. Contents of the cursor line are transmitted to the printer with CR/LF codes or only CR (depending on the New Line/No New Line Mode selection) after line. XON code is sent to the host to resume transmission once the Print Line function is complete.

ENTER PRINTER CONTROLLER MODE **Esc W**

Data sent from the host is passed through terminal to the printer. XOFF code is sent to the host in response to printer busy. XON code is sent to the host in response to printer not busy.

EXIT PRINTER CONTROLLER MODE **Esc X**

The terminal exits printer controller mode, and automatically appends the CAN or DEL code (as dictated by the CANCEL SELECT feature). If the PRINTER TYPE feature is on, no code is appended.

ENTER AUTO PRINT MODE **Esc^**

On receipt of LF code, XOFF code is sent to the host. Contents of the current line are transmitted to the printer with CR/LF or only CR (depending on the New Line/No New Line Mode selection) after the line. XON code is sent to host after the line is transmitted.

EXIT AUTO PRINT MODE **Esc _**

The terminal exits Auto Print mode.

Appendices

APPENDIX A
TERMINAL SPECIFICATIONS

A.1 VISUAL 220 TERMINAL SPECIFICATIONS

The specifications for the Visual 220 terminal are listed below and identify storage, transport and operational constraints.

A.1.1 Physical

- CRT cabinet height (including pedestal base): 12.60 in.(32.00 cm.)
- CRT cabinet width: 13.00 in. (33.02 cm)
- CRT cabinet depth: 13.70 in. (34.80 cm)
- CRT cabinet weight: 19.00 lbs. (8.62 kg)
- Keyboard height: 1.78 in. (4.52 cm)
- Keyboard width: 22.80 in. (57.91 cm)
- Keyboard depth: 7.00 in. (17.78 cm)
- Keyboard weight: 3.50 lbs. (1.59 kg)

A.1.2 Environmental

- Operating temperature: 10 degrees - 40 degrees C
- Operating humidity: 10 - 90% noncondensing
- Operating altitude: 10,000 feet maximum
- Storage temperature: -20 degrees to 60 degrees C
- Storage humidity: 10 - 90% noncondensing
- Storage altitude: 40,000 feet maximum

A.1.3 Electrical

- Input voltage: 95 Vac to 130 Vac (115 Vac nominal)
  190 Vac to 260 Vac (230 Vac nominal)
  (Voltages are configurable internally)
- Input frequency: 50/60 Hz
- Power dissipation: Power Consumption: 50 watts maximum
- Line fuse rating: 2A, 250 V, fast blow, U.L. and C.S.A. approved

A.1.4 Data Communications

- Hardware interfaces: RS-232-C/CCITT V.24 (Comm port)
  RS-232-C/CCITT V.24 (Printer port)
  20 ma current loop option (Comm port)
  RS-422 option (Comm port)
- Protocols: Start-stop asynchronous, 7- or 8-bit, with or without parity, 1 or 2 stop bits
- Parity: Even, odd or none
- Baud rates: 50, 75, 110, 134.5, 150, 200, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 9600, 19200
- Flow control: XON/XOFF
- Duplex: Full duplex

A.1.5 Screen Presentation

- Display type: 14 in. diagonal (across monitor, not display bezel) non-glare P31 phosphor.
- Display format: 24 line by 80 (or 132) columns, plus a 25th status line
- Refresh rate: 60 Hz

- Display memory: 1920 characters @ 24 lines x 80 columns
  3168 characters @ 24 lines x 132 columns
- Screen attributes: Normal and reverse
- Character attributes: Normal, reverse, bold, blink, blank, underline, combinations of the above
- Logical character attribute: Erasable/non-erasable
- Character sets: ASCII graphics, U.K. National, Supplemental graphics, Special graphics
- Scrolling: Jump or smooth (user selectable)
- Tabbing: 80 programmable stops at 80 columns
  132 programmable stops at 132 columns
- Cursor: Block, underline or none (user selectable)
- Screen Saver: The screen is blanked after 10 minutes of host or keyboard inactivity

A.1.6 Keyboard

- General: Detached, low-profile (DIN standard); solid state capacitive scan; auto repeating keys; 2-key rollover; sculptured, nonglare keycaps; coiled cable with modular jack; selectable, audible feedback (keyclick)
- Number of keys: 106
- Cursor movement keys: Up, down, right, left, home. CR, LF, Tab
- Editing keys: Find, Insert Here, Remove, Select, Prev Scrn, Next Scrn

- Function keys: 20 keys. Of these, 15 are programmable and share 1024 bytes of memory. Four additional keys share 64 bytes of non-volatile memory.

A.1.7 Miscellaneous

- Power-on Diagnostic: Automatic upon power-on or reset.
- Mechanical controls: Power on switch
- Indicators: Four LEDs (light emitting diodes) under the legend strip of the keyboard, an audible tone generator (located in the keyboard)

APPENDIX B
NATIONAL LANGUAGE KEYBOARDS

B.1 OVERVIEW

This appendix illustrates each of the national language keyboards that are available for the Visual 220 terminal.

The following keyboards are illustrated in alphabetical order:

- British
- Canadian (French)
- Danish
- Dutch
- Finnish
- Belgian (Flemish)
- French/Belgian
- German
- Italian
- North American
- Norwegian
- Spanish
- Swedish
- Swiss (French)
- Swiss (German)

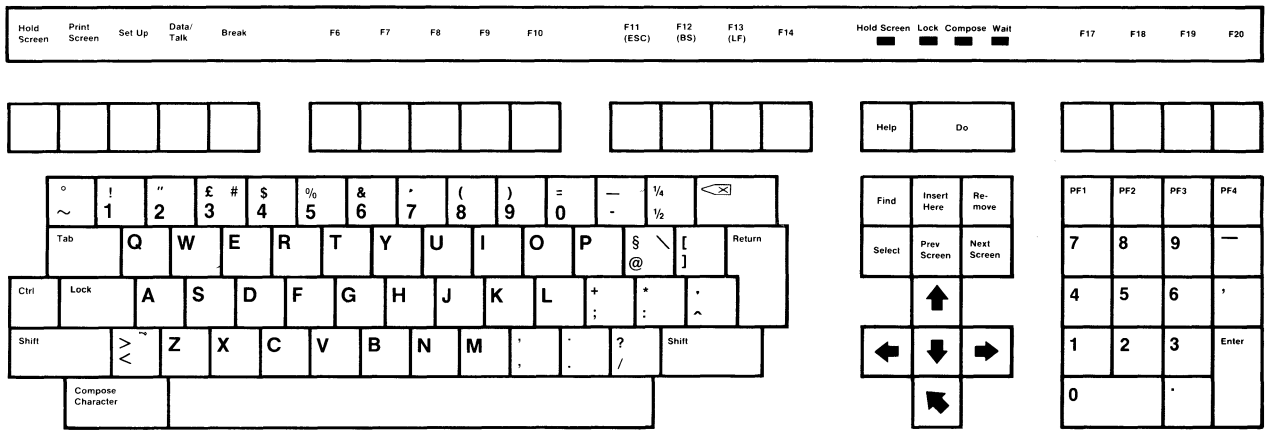


Figure B-1. British Keyboard

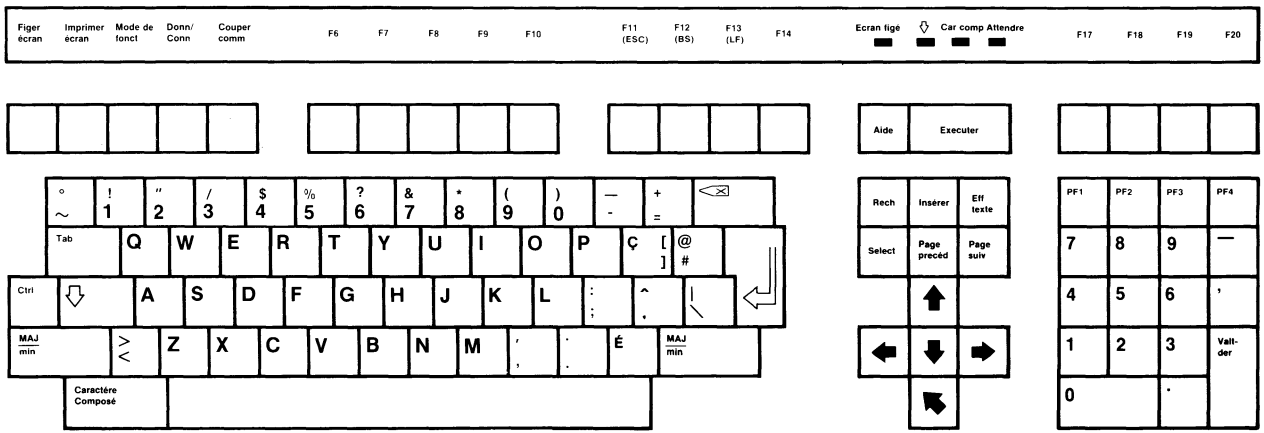


Figure B-2. Canadian (French) Keyboard

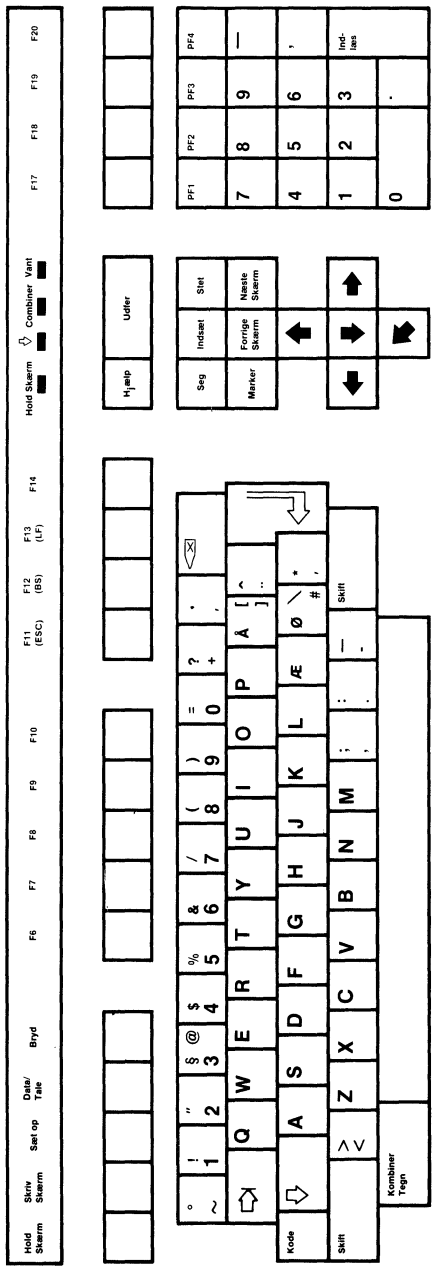


Figure B-3. Danish Keyboard

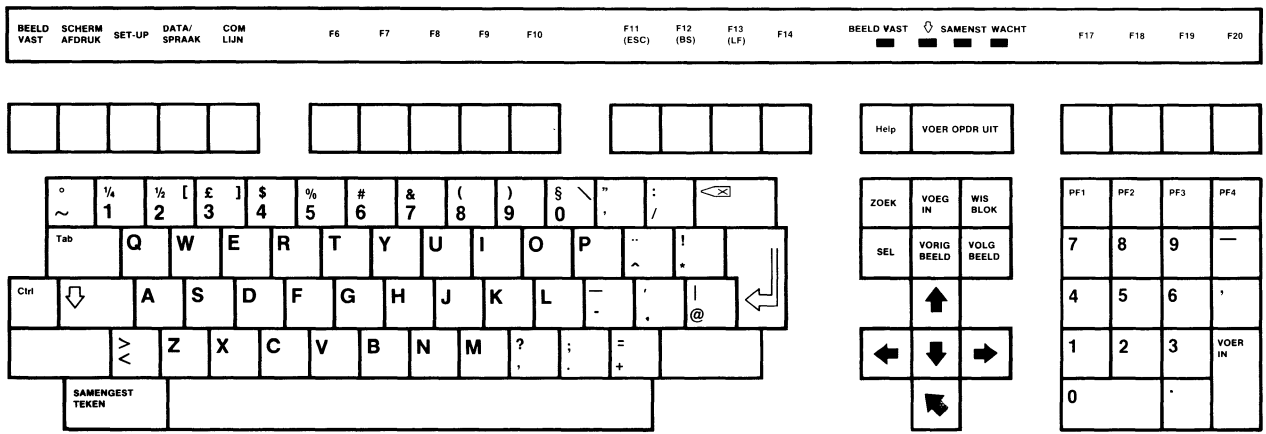


Figure B-4. Dutch Keyboard

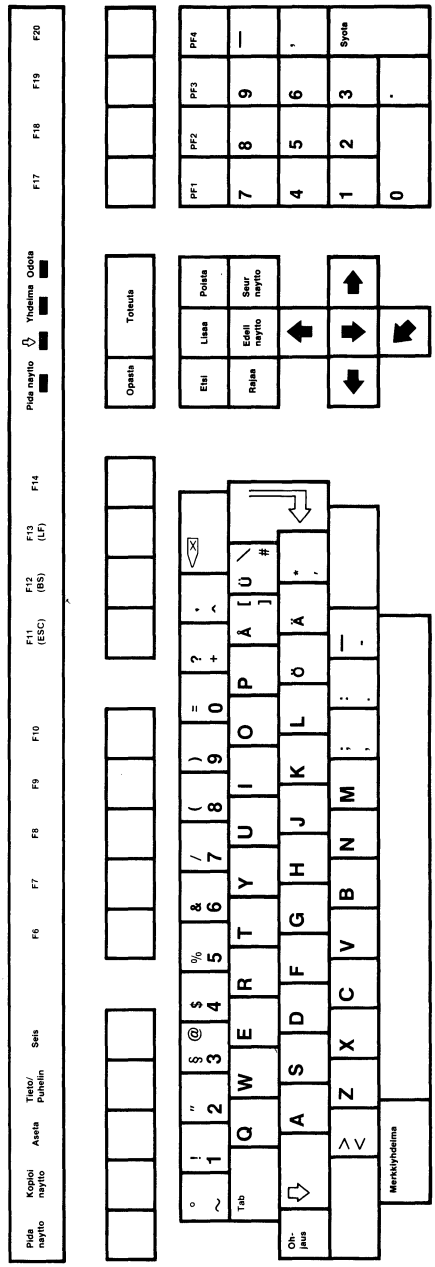


Figure B-5. Finnish Keyboard

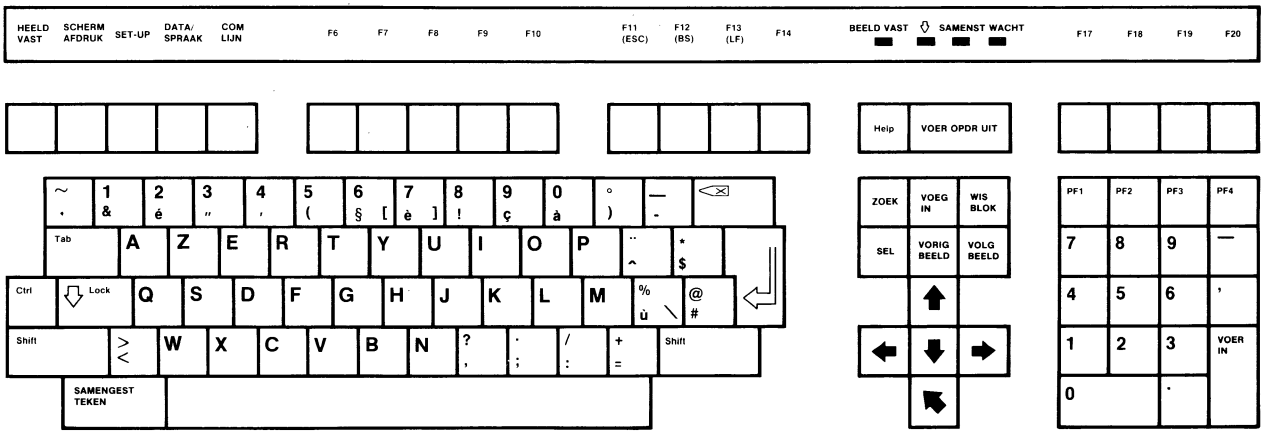


Figure B-6. Belgian (Flemish) Keyboard

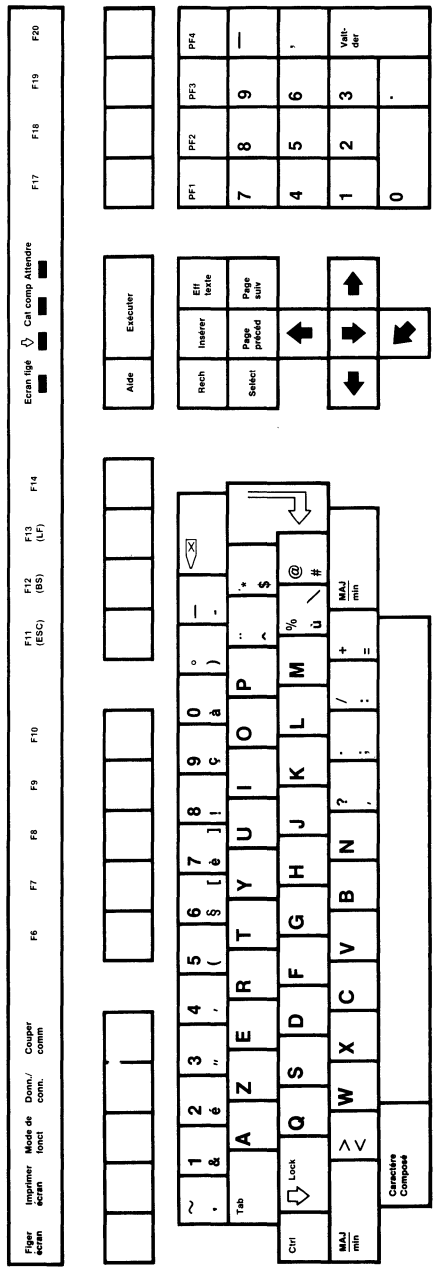


Figure B-7. French/Belgian Keyboard

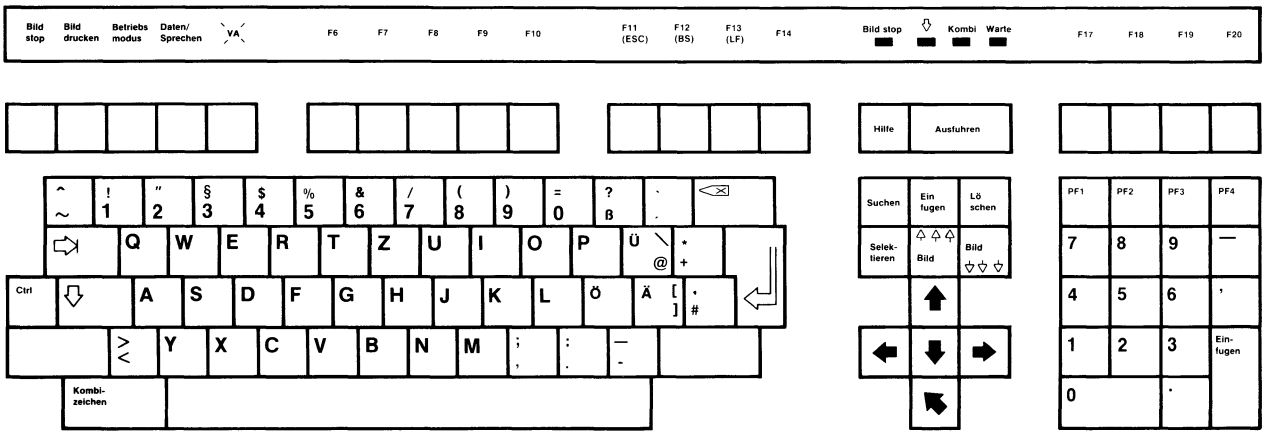


Figure B-8. German Keyboard

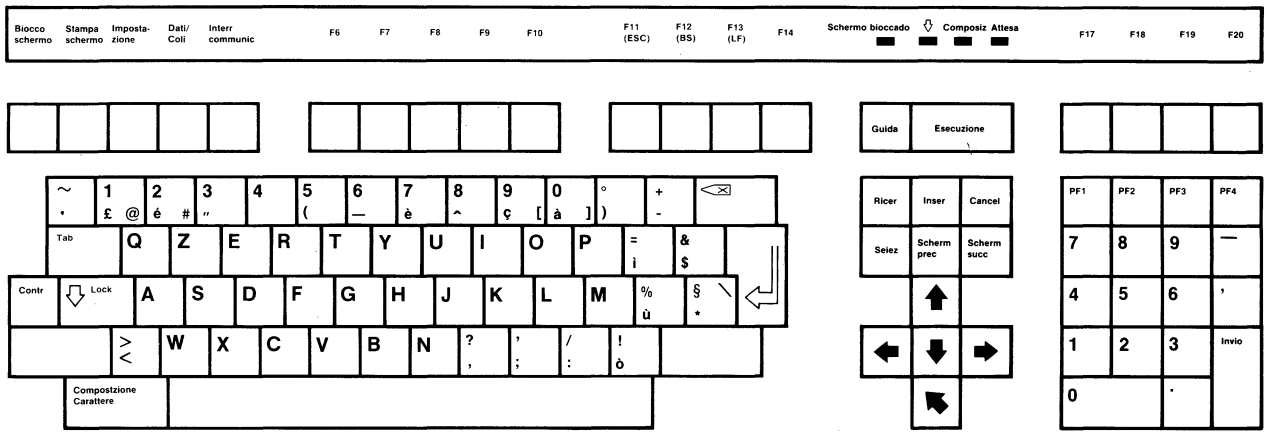


Figure B-9. Italian Keyboard

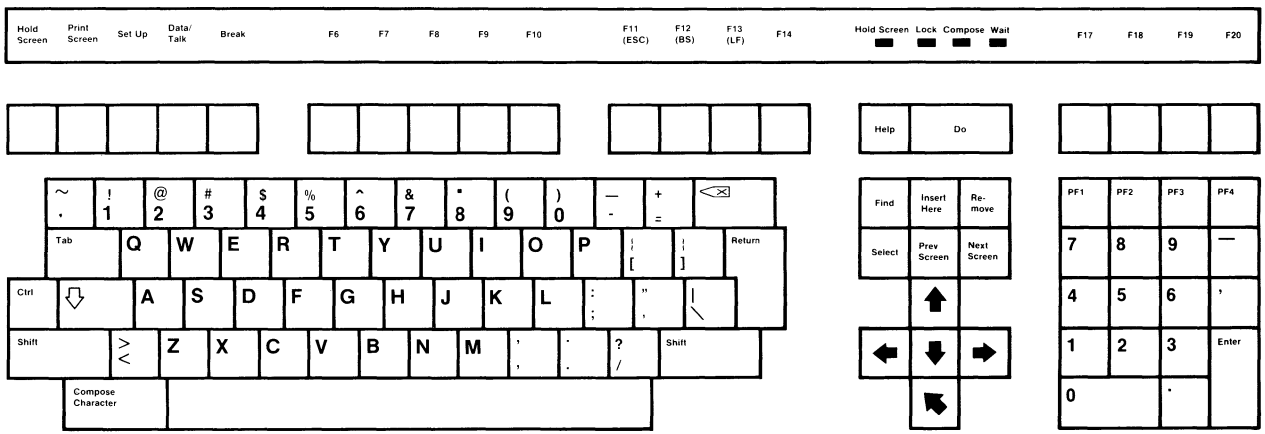


Figure B-10. North American Keyboard

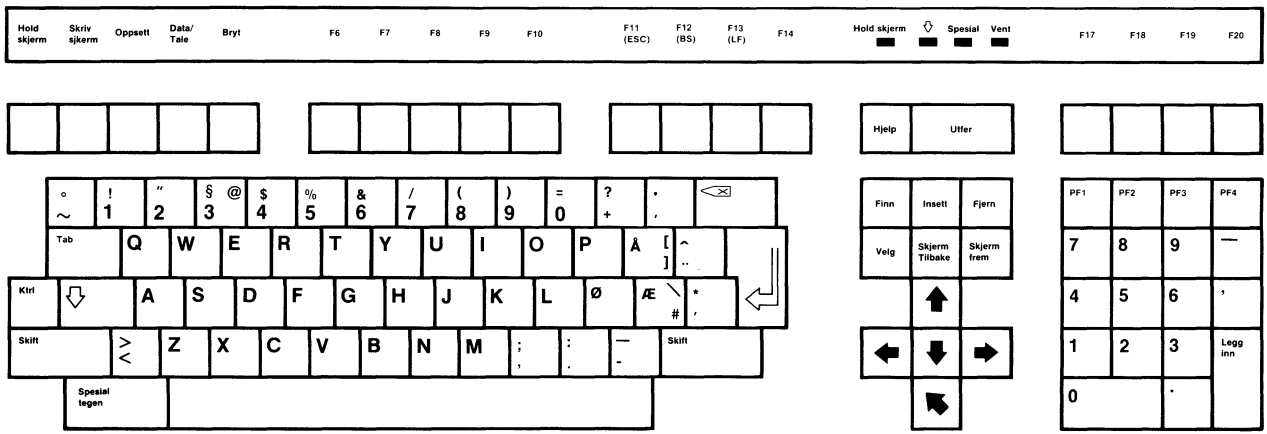


Figure B-11. Norwegian Keyboard

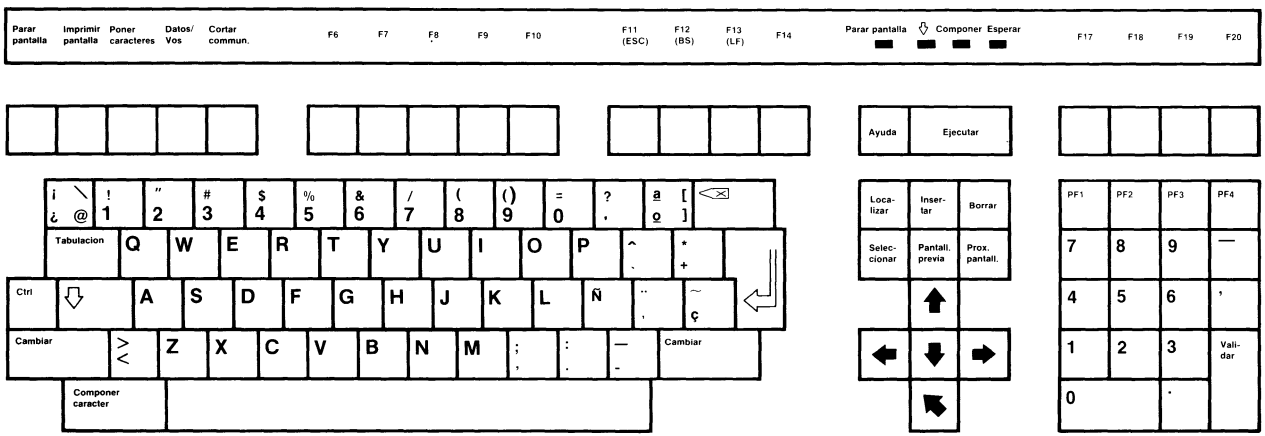


Figure B-12. Spanish Keyboard

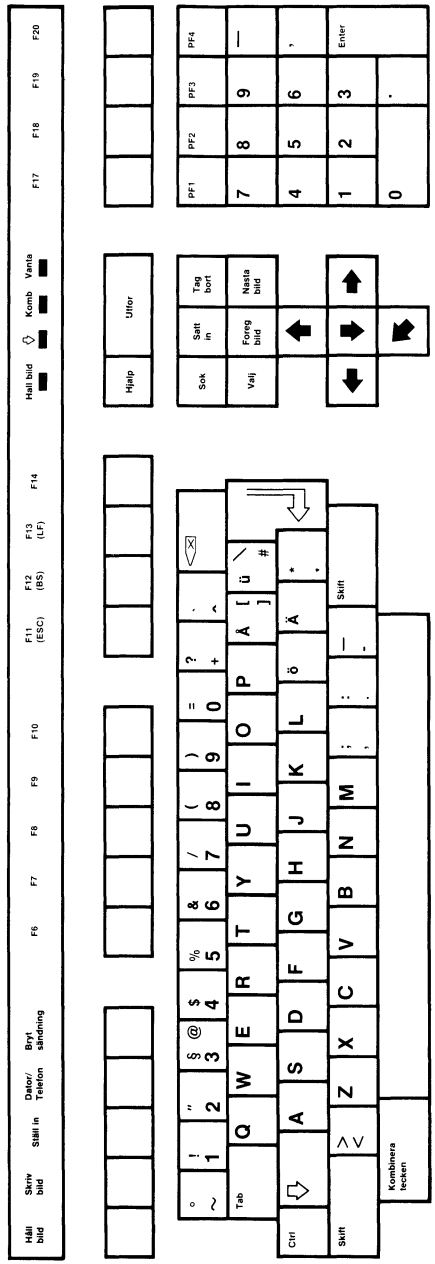


Figure B-13. Swedish Keyboard

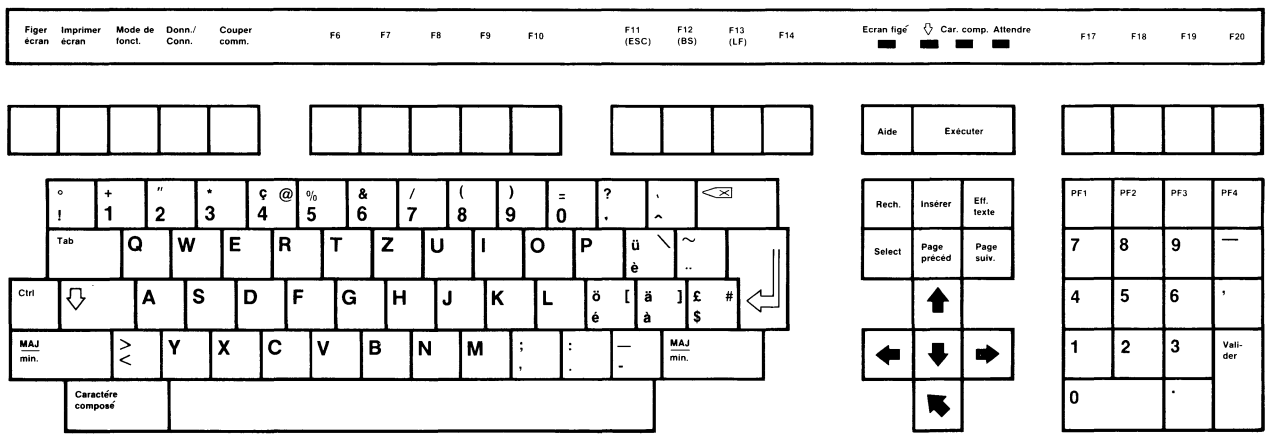


Figure B-14. Swiss (French) Keyboard

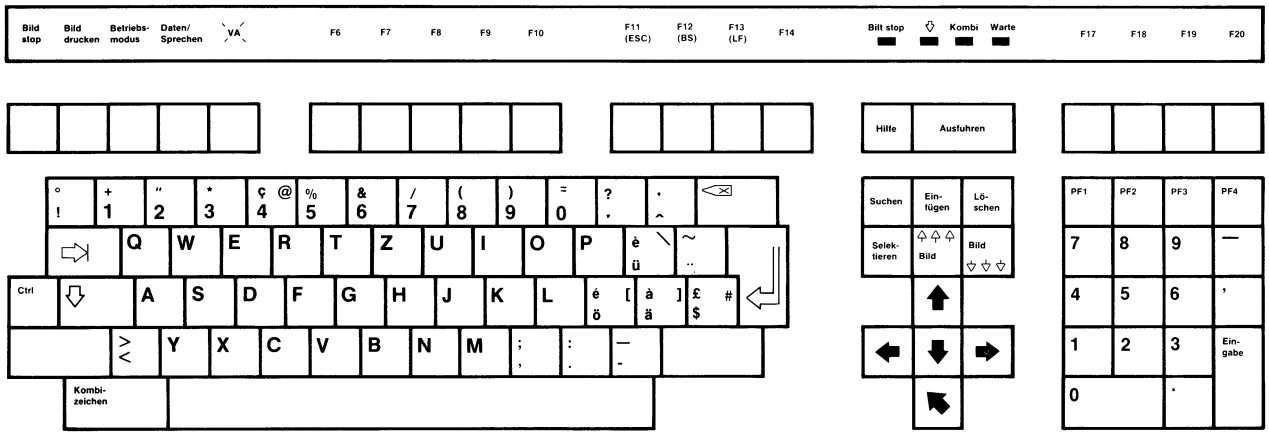


Figure B-15. Swiss (German) Keyboard

APPENDIX C
CHARACTER SETS

C.1 OVERVIEW

This Appendix shows each of the hard character sets available in the Visual 220 terminal. Typical code table mapping is used.

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

Figure C-1. ASCII Character Set

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

Figure C-2. DEC Multinational Character Set (Sheet 1 of 2)

1	1	1	1	1	1	1	1	BIT 8				
0	0	0	0	1	1	1	1	BIT 7				
0	0	1	1	0	0	1	1	BIT 6				
0	1	0	1	0	1	0	1	BIT 5				
8	**9**	**A**	**B**	**C**	**D**	**E**	**F**	**COL / ROW**	BIT 4	BIT 3	BIT 2	BIT 1
128	144 DCS	160	176	192 À	208	224 à	240	**0**	0	0	0	0
129	145 PU1	161 ¡	177 ±	193 Á	209 Ñ	225 á	241 ñ	**1**	0	0	0	1
130	146 PU2	162 ¢	178 ²	194 Â	210 Ò	226 â	242 ò	**2**	0	0	1	0
131	147 STS	163 £	179 ³	195 Ã	211 Ó	227 ã	243 ó	**3**	0	0	1	1
132 IND	148 CCH	164	180	196 Ä	212 Ô	228 ä	244 ô	**4**	0	1	0	0
133 NEL	149 MW	165 ¥	181 µ	197 Å	213 Õ	229 å	245 õ	**5**	0	1	0	1
134 SSA	150 SPA	166	182 ¶	198 Æ	214 Ö	230 æ	246 ö	**6**	0	1	1	0
135 ESA	151 EPA	167 §	183 ·	199 Ç	215 Œ	231 ç	247 œ	**7**	0	1	1	1
136 HTS	152	168 ¤	184	200 È	216 Ø	232 è	248 ø	**8**	1	0	0	0
137 HTJ	153	169 ©	185 ¹	201 É	217 Ù	233 é	249 ù	**9**	1	0	0	1
138 VTS	154	170 a	186 º	202 Ê	218 Ú	234 ê	250 ú	**A**	1	0	1	0
139 PLD	155 CSI	171 «	187 »	203 Ë	219 Û	235 ë	251 û	**B**	1	0	1	1
140 PLU	156 ST	172	188 ¼	204 Ì	220 Ü	236 ì	252 ü	**C**	1	1	0	0
141 RI	157 OSC	173	189 ½	205 Í	221 Ÿ	237 í	253 ÿ	**D**	1	1	0	1
142 SS2	158 PM	174	190	206 Î	222	238 î	254	**E**	1	1	1	0
143 SS3	159 APC	175	191 ¿	207 Ï	223 ß	239 ï	255	**F**	1	1	1	1

Figure C-2. DEC Multinational Character Set (Sheet 2 of 2)

				BIT 8	0	0	0	0	0	0	0	0
				BIT 7	0	0	0	0	1	1	1	1
				BIT 6	0	0	1	1	0	0	1	1
				BIT 5	0	1	0	1	0	1	0	1
BIT 4	BIT 3	BIT 2	BIT 1	COL / ROW	0	1	2	3	4	5	6	7
0	0	0	0	0	NUL 0	DLE 16	SP 32	0 48	@ 64	P 80	♦ 96	— 112 SCAN 3
0	0	0	1	1	SOH 1	DC1 17	! 33	1 49	A 65	Q 81	▒ 97	— 113 SCAN 6
0	0	1	0	2	STX 2	DC2 18	" 34	2 50	B 66	R 82	HT 98	— 114 SCAN 9
0	0	1	1	3	ETX 3	DC3 19	# 35	3 51	C 67	S 83	FF 99	— 115 SCAN 11
0	1	0	0	4	EOT 4	DC4 20	$ 36	4 52	D 68	T 84	CR 100	├ 116
0	1	0	1	5	ENQ 5	NAK 21	% 37	5 53	E 69	U 85	LF 101	┤ 117
0	1	1	0	6	ACK 6	SYN 22	& 38	6 54	F 70	V 86	° 102	┴ 118
0	1	1	1	7	BEL 7	ETB 23	' 39	7 55	G 71	W 87	± 103	┬ 119
1	0	0	0	8	BS 8	CAN 24	(40	8 56	H 72	X 88	NL 104	│ 120
1	0	0	1	9	HT 9	EM 25	) 41	9 57	I 73	Y 89	VT 105	≤ 121
1	0	1	0	A	LF 10	SUB 26	* 42	: 58	J 74	Z 90	┘ 106	≥ 122
1	0	1	1	B	VT 11	ESC 27	+ 43	; 59	K 75	[91	┐ 107	π 123
1	1	0	0	C	FF 12	FS 28	, 44	< 60	L 76	\ 92	┌ 108	≠ 124
1	1	0	1	D	CR 13	GS 29	- 45	= 61	M 77	] 93	└ 109	£ 125
1	1	1	0	E	SO 14	RS 30	. 46	> 62	N 78	^ 94	┼ 110	· 126
1	1	1	1	F	SI 15	US 31	/ 47	? 63	O 79	95	— 111 SCAN 1	DEL 127

Figure C-3. DEC Special Graphics Character Set

APPENDIX D
PROGRAMMING CODE SUMMARY

D.1 OVERVIEW

This Appendix lists the programming codes for the Visual 220 terminal. Section references for the codes are also provided.

D.2 ANSI CONTROL SEQUENCES (see Section 8.4.2)

Mode Set and Reset (see Section 8.4.2.1)

Set mode	CSI Ps ; Ps h
Reset Mode	CSI Ps ; Ps ; ... Ps l

Parameters:

Ps	Set Mode	Reset Mode	Mode Name
2	Lock	Unlock	Keyboard Action
3	Display	Interpret	Control Representation Mode
4	Insertion	Replacement	Insert/Replace Mode
12	No Echo	Local Echo	Send/Receive Mode
20	Linefeed	New Line	Linefeed/New Line Mode
? 1	Non-ANSI	ANSI	Cursor Key Mode
? 2	N/A	VT52 Mode	VT52/ANSI Mode
? 3	132	80	80/132 Column Mode
? 4	Smooth	Jump	Scrolling Mode
? 5	Reverse	Normal	Reverse Video
? 6	Relative	Absolute	Origin Mode
? 7	Autowrap	No Autowrap	Autowrap Mode
? 8	Autorepeat	No Autorepeat	Autorepeat Mode
? 25	Displayed	Not displayed	Text Cursor Enable

Define Scrolling Region (see Section 8.4.2.2)

Scrolling region	CSI r1 ; r2 r (private)

Cursor Control Commands (see Section 8.4.2.3)

Cursor Up	CSI Pn A
Cursor Down	CSI Pn B
Cursor Right	CSI Pn C
Cursor Left	CSI Pn D
Absolute cursor position	CSI r ; c H or CSI r ; c f
Cursor index	ESC D
Cursor reverse index	ESC M
Next line	ESC E
Save cursor	ESC 7
Restore Cursor	ESC 8

Sequences for Erasing (see Section 8.4.2.4)

Erase in page CSI Ps J

Parameters:
- 0 = Erase to end of page (default).
- 1 = Erase screen to cursor.
- 2 = Erase page.

Erase in line CSI Ps K

Parameters:
- 0 = Erase from cursor to end of line (default).
- 1 = Erase from start of line to cursor.
- 2 = Erase line.

Selective erase in page CSI ? Ps J

Parameters:
- 0 = Erase all "erasable" characters from and including the cursor to the end of the screen.
- 1 = Erases all "erasable" characters from the beginning of the screen to and including the cursor.
- 2 = Erases all "erasable" characters in the entire display.

Selective erase in page CSI ? Ps K

Parameters:
- 0 = Erases all "erasable" characters from the cursor to the end of the line.
- 1 = Erases all "erasable" characters from the beginning of the line up to and including the cursor position.
- 2 = Erases all "erasable" characters on the line.

Erase character CSI Pn X

Tabbing Commands (see Section 8.4.2.5)

Tabs clear	CSI Ps g
Parameters:	0 = Clears tab at current column (default).
	3 = Clears all tab stops
Set tab at cursor	ESC H

Miscellaneous Command Sequences (see Section 8.4.2.6)

Screen alignment	ESC # 8

Character Set Selection (see Section 8.4.2.7)

Designating Hard Character Sets

Character Set	Designate As:	Use Coding Sequence
ASCII	G0 (Default)	ESC (B
	G1	ESC) B
	G2 (VT200 Mode only)	ESC * B
	G3 (VT200 Mode only)	ESC + B
DEC Special Graphics	G0	ESC (0
	G1 (Default)	ESC) 0
	G2 (VT200 Mode only)	ESC * 0
	G3 (VT200 Mode only)	ESC + 0
DEC Supplemental (VT200 Mode only)	G0	ESC (<
	G1	ESC) <
	G2 (Default)	ESC * <
	G3 (Default)	ESC + <
U.K. National (VT100 Mode Only)	G0	ESC (A
	G1	ESC) A

Designating "Soft" Character Sets

Designate as G0	ESC (RCS name
Designate as G1	ESC) RCS name
Designate as G2	ESC * RCS name
Designate as G3	ESC + RCS name

Invoking Character Sets Using Lock Shifts

Invoke G0 into GL	SI
Invoke G1 into GL	SO
Invoke G1 into GR	ESC ~
Invoke G2 into GL	ESC n
Invoke G2 into GR	ESC }
Invoke G3 into GL	ESC o
Invoke G3 into GR	ESC |

Invoke Character Sets Using Single Shifts

Invoke G2 into GL	ESC N
Invoke G3 into GL	ESC O

Report Commands and Responses (see Section 8.4.2.8)

Primary terminal ID	CSI c CSI 0 c ESC Z
Terminal condition?	CSI 5 n
Terminal's response:	CSI 0 n = I have no malfunction. CSI 3 n = I have a malfunction.
Read cursor location	CSI 6 n
Terminal's response:	CSI r ; c R, ("r" = row (line) number "c" is the column number)
Secondary terminal ID	CSI > c CSI > 0 c
Terminal's response:	CSI > 1; Pv; Po c I am a VT220 (identification code of 1), my firmware rev is ___ (Pv) and I have (Po) options installed.
Function keys locked?	CSI ? 25n
Terminal's response:	CSI ? 20 n = User Defined Keys are unlocked. CSI ? 21 n = User Defined Keys are locked.

Video Attributes (see Section 8.4.2.9)

Display video attributes CSI Ps ; ... Ps m

Parameters:
- 0 = Normal (none)
- 1 = Bold
- 2 = Blank
- 4 = Underline
- 5 = Blink
- 7 = Reverse
- 22 = Display normal intensity
- 24 = Display not underlined
- 25 = Display not blinking
- 27 = Display positive image

Logical Attributes (see Section 8.4.2.10)

Select logical attributes CSI Ps " q

Parameters:
- 0 = Logical attributes off.
- 1 = Designate characters as non-erasable
- 2 = Designate characters as erasable

Character Size Commands (see Section 8.4.2.11)

Single height - single width line	ESC # 5
Single height - double width line	ESC # 6
Double height - double width line (top half)	ESC # 3
Double height - double width line (bottom half)	ESC # 4

Hard and Soft Reset Commands (see Section 8.4.1.12)

Hard reset	ESC c
Soft reset	CSI ! p

Numeric/Application Keypad Commands (see Section 8.4.2.13)

Enter application keypad mode	ESC =
Exit application keypad mode	ESC >

Editing Commands (see Section 8.4.2.14)

Insert line	CSI Pn L
Delete line	CSI Pn M
Insert character	CSI Pn @
Delete character	CSI Pn P

Terminal Testing (see Section 8.4.2.15)

Run test(s) CSI 4; Ps; Ps; . . .; Ps Y

Parameters:
- 0 = Test 1, 2, 3, and 6.
- 1 = Power-up self test.
- 2 = EIA port data loopback test. *
- 3 = Printer loopback test. *
- 4 = Not used.
- 5 = Not used.
- 6 = EIA port modem control line loopback test. *
- 7 = 20 MA loopback test. *
- 8 = Not used.
- 9 = Repeat tests until failure or power off.

* Loopback tests require loopback connectors (see Appendix F)

Select Compatibility Levels (see Section 8.4.2.16)

Select emulation mode CSI Ps1 ; Ps2 ; " p

Parameters:
- Ps1 = 61 VT100 mode.
- Ps1 = 62 VT200 mode.

- Ps2 = 0 Selects 8 bit controls (VT200 mode only)
- Ps2 = 1 Selects 7 bit controls (VT200 mode only)
- Ps2 = 2 Selects 8 bit controls (VT200 mode only)

Selecting 7/8 Bit Control Code Transmission (see Section 8.4.2.17)

Select 7-bit controls ESC sp F

Select 8-bit controls ESC sp G

Programming Function Keys (F6 through F20) (see Section 8.4.2.18)

DCS Pc; Pl | ky1/st1; ky2/st2;...kyn/stn ST

Parameters:
- Pc = 0 Clear all keys before loading values.
- Pc = 1 Clear keys that are to be reloaded.
- Pl = 0 Lock keys against redefinition
- Pl = 1 Do not lock keys against redefinition.

Function Key Numbers

Function Key	Key Number When Pressed in Combination With:	
	Shift	Ctrl
F6	17	37
F7	18	38
F8	19	39
F9	20	40
F10	21	41
F11	23	43
F12	24	44
F13	25	45
F14	26	46
HELP	28	48
DO	29	49
F17	31	51
F18	32	52
F19	33	53
F20	34	54

Stn = String data. maximum 256 bytes per key;
max 1024 bytes is shared by all keys.

Down-line Loading Characters (see Section 8.4.2.19)

DCS Pfn;Pcn;Pe;Pccs;Pw;Pt {RCS name Bp1;Bp2;Bp3;...Bpn ST

Parameters:

Pfn = Font buffer number

Pcn = Starting character number

Pe = Erase control:

- 0 = erase all characters in the font buffer.
- 1 = erase the characters that are being reloaded.
- 2 = erase all characters in all font buffers.

Pccs = Character cell size:

0 = Device default (7x10)	
1 = (not used)	5 = (not used)
2 = 5x10	6 = 5x12
3 = 6x10	7 = 6x12
4 = 7x10	8 = 7x12

Pw = Width:

0 = Device default (80 columns)
1 = 80 column
2 = 132 column

Pt = Text / Full cell:

0 = Device default (text)
1 = Text
2 = Full cell

Clearing a Down-Line Loaded Character Set (see Section 8.4.2.20)

Control String:	Effect:
DCS 1;1;0 { SP @ ST	Clear font buffer #1
DCS 2;1;0 { SP @ ST	Clear optional font buffer #2
DCS 1;1;2 { SP @ ST	Clear all font buffers

Printer Control Sequences — (see Section 8.4.2.21)

Print page	CSI i
	CSI 0 i
Print cursor line	CSI ? 1 i
Print line "P"	CSI ? 1 ; P i
Print lines "P" through "Q"	CSI ? 1 ; P ; Q i [VISUAL]
Enter printer controller mode	CSI 5 i
Exit printer controller mode	CSI 4 i
Enter copy mode	CSI ? 7 i
Exit copy mode	CSI ? 6 i
Enter auto print mode	CSI ? 5 i
Exit auto print mode	CSI ? 4 i
Printer status report	CSI ? 15 n

Terminal Response: CSI ? 13 n = The printer is not connected.
CSI ? 11 n = The printer is connected but not ready to print.
CSI ? 10 n = The printer is connected and ready to print.

Printer Set and Reset Modes (see Section 8.4.2.22)

Set mode CSI Ps ; Ps ; ... Ps h
Reset mode CSI Ps ; Ps ; ... Ps l

Parameters:

Ps	Set Mode	Reset Mode	Mode Name
? 18	FF	No terminator	Printer Form Feed
? 19	Full Screen	Scrolling region	Printer Extent

Setting the Time-of-Day Clock (see Section 8.4.2.23)

DCS 1; Ps ~ hh : mm : ss ST

Parameters: Ps = 0 Use value selected in Set-Up
1 Set to a.m. (Standard)
2 Set to p.m. (Standard)
3 Use Military (24 hour) time

D.3 VT52 MODE CONTROL SEQUENCES

Control Sequences Recognized in VT52 Mode (see Section 8.4.3.1)

Move cursor up	ESC A
Move cursor down	ESC B
Move cursor right	ESC C
Move cursor left	ESC D
Enter graphics mode	ESC F
Exit graphics mode	ESC G
Cursor home	ESC H
Reverse line feed	ESC I
Erase to end of screen	ESC J
Erase to end of line	ESC K
Cursor addressing	ESC Y r c
Identify	ESC Z
Enter application keypad mode	ESC =
Exit application keypad mode	ESC >
Enter ANSI mode	ESC <

Printer Control Sequences (VT52 Mode) (see Section 8.4.3.2)

Print page	ESC]
Print line	Esc V
Enter printer controller mode	Esc W
Exit printer controller mode	Esc X
Enter auto print mode	Esc ^

APPENDIX E
PRINTED TRANSLATIONS FOR SUPPLEMENTAL CHARACTERS

E.1 TRANSLATIONS

This Appendix shows the printed translations that occur for each of the DEC Supplemental characters.

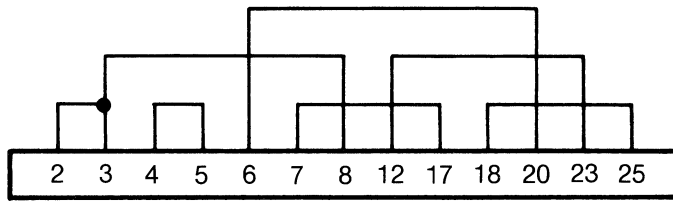
Supplemental Character	Printed Translation	Supplemental Character	Printed Translation
¡	!	·	.
¢	c	¹	1
£	#	º	o
¥	Y	»	>>
§	Sc	¼	1/4
¤	O	½	1/2
©	(c)	¿	?
ª	a	Æ	AE
«	<<	æ	ae
±	+	Œ	OE
²	2	œ	oe
³	3	Ç	C
µ	u	ç	c
¶	Pr	ß	ss

Supplemental characters with diacritical marks are printed without the marks.

APPENDIX F
TEST CONNECTORS

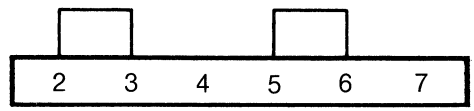
F.1 TEST CONNECTOR DIAGRAMS

Following test connector schematic diagrams may be used to fabricate loopback connectors for the Comm port and the Printer port. The connectors should be used when performing the terminal loopback test procedures described in Section 8.4.2.15.



Connector type
DB25 (female)

Figure F-1. Comm Port Loopback Test Connector



Connector type
DB9 (female)

Figure F-2. Printer Port Loopback Test Connector

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