TeleVideo®
Display Terminal
Operator's Manual

TELEVIDEO® 9220
VIDEO DISPLAY TERMINAL
OPERATOR'S MANUAL

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FCC Class A Warning

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INTRODUCTION

MEET THE 9220

TeleVideo designed the 9220 with high priority on user
convenience and productivity. Its low-profile keyboard and
tilt-and-swivel monitor design make it truly user adaptable.

The 9220 incorporates the latest advances in human-factors
engineering with a full spectrum of operating features and
ANSI X3.64-compatible codes.

Terminal Features

Features of the 9220 include:

    VT220, VT100, and VT52 programming compatibility
    Improved VT220-style keyboard
    30 programmable function keys
    Full 8-bit data word capacity
    Graphics, multinational and user-definable character sets
    16 displayed language sets, set-up selectable
    Optional foreign-language keycap sets
    Keyboard supplemental character composition
    Improved RS-232C/423 main port
    Current loop interface
    Easy-to-use set up screens
    Amber screen; no-cost green option

Graphics Option

TeleVideo offers an optional graphics board kit and mouse that
let you create business, engineering, and scientific graphics
using Tektronix Plot 10-compatible software or programs you
write yourself.

USING THIS MANUAL

Chapter 1 contains step-by-step instructions showing how to install the terminal.

Selecting the terminal's operating characteristics and configuring it to communicate with your computer and printer are covered in Chapter 2.

Chapter 3 describes the keys and terminal operations controlled from the keyboard.

Chapter 4 has a troubleshooting table and tells how to get assistance if you have questions or problems.

Chapter 5 is for programmers and operators who want to control the terminal through programming commands. It explains the commands and the terminal operations they control.

At the back of the manual is reference material: appendices, glossary, index, and a programmer's quick reference guide.

Attention, Please

This manual has three types of notices you should read carefully:

NOTE: Information of special interest or importance about a feature.

WARNING! Potential loss of data or damage to the terminal.

STOP! Possible harm to the user.

1. INSTALLATION

This chapter tells you how to install the 9220. A summary of installation steps is at the end of the chapter.

UNPACKING

Unpack the terminal carefully. Keep the shipping carton and packing material in case you move or ship the terminal.

The packing carton should contain (besides this manual):

    Terminal
    Keyboard
    Two keyboard legend labels
    Coiled keyboard cable
    Power cable

Inspecting the Terminal

STOP! Do not open the case to inspect the interior unless you are a qualified technician. Opening the case exposes you to potential shock hazards.

Inspect all the parts for shipping damage. If anything is missing or damaged, call your distributor or dealer.

If the screen is broken, protect yourself by using tongs and gloves to handle the broken fragments. The fragments are sharp and the coating on the inside of the tube is poisonous.

Selecting a Site

Choose a site with indirect lighting, away from windows and other sources of bright lights and glare, to avoid eyestrain. Figure 1-1 shows comfortable terminal lighting.

Make sure the terminal has adequate ventilation. Allow at least 4 inches (10.2 cm) for ventilation on all sides.

Select furniture conducive to good working posture and place the terminal at the correct height. The keyboard should be lower than the screen.

NOTE: You need not worry about X-ray emissions. Tests performed on TeleVideo terminals by Underwriters Laboratories indicate they emit virtually no radiation and pose no health hazard.

Figure 1-2 shows the ideal relationship between the terminal and the operator.

Figure 1-1
Comfortable Terminal Lighting

WINDOW   WINDOW   WINDOW
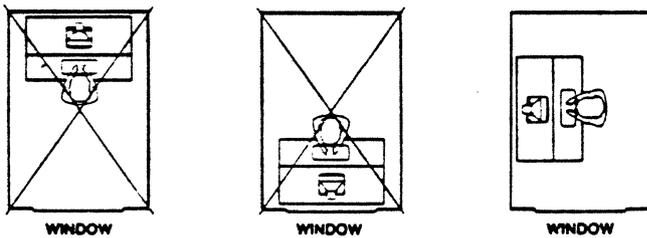
Figure 1-2
Ideal Terminal Placement
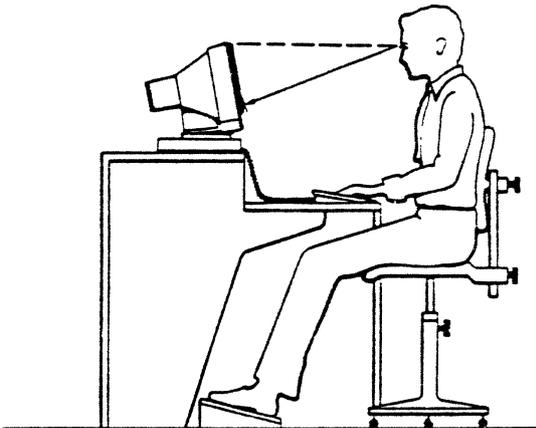
INSTALLATION STEPS

Now you are ready to plug in the keyboard and connect your
terminal to a computer and printer. Figures 1-3 and 1-4 show
front and rear views of the 9220 with ports, switches and
connectors marked.

Figure 1-3
9220 Terminal, Front View
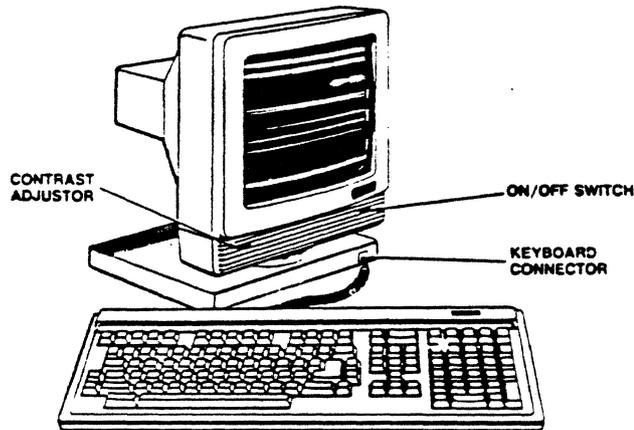
Figure 1-4
9220 Terminal, Back View
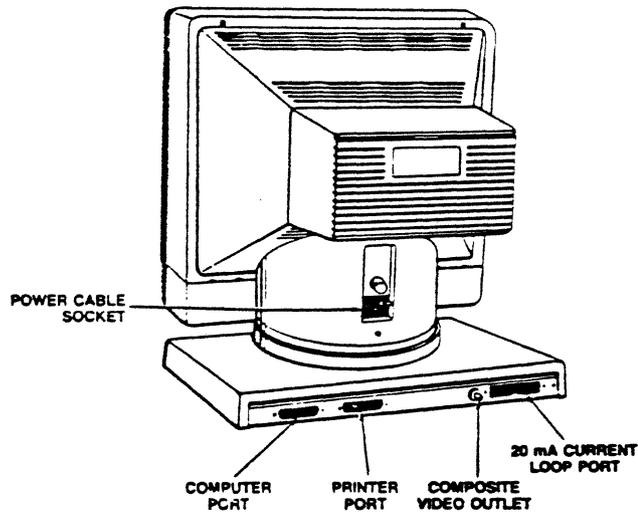
Connecting the Keyboard

Insert the preprinted legend label into the bezel directly
above the row of function keys. Save the other blank label.

Plug the ends of the coiled keyboard cable into the back of
the keyboard case and the front of the terminal (Figure 1-3).

Before You Connect the Terminal

Make sure the terminal voltage setting matches your electrical
outlet. The terminal should carry a label stating whether its
setting is 115 volts or 230 volts ac power. Call the
TeleVideo Customer Service Department for instructions if you
want to change the voltage setting.

If you need a neutral fuse to meet international standards,
ask your dealer or service technician to install it for you.

Measure the distance between the terminal and your computer or
modem. If it is less than 50 feet, you can connect the two
with an RS-232C interface cable (with a 25-pin connector).

If your computer is more than 50 feet away, use a 20 mA
current loop interface with an eight-pin connector.

Connecting the Terminal With an RS-232C Interface

If you use an RS-232C interface, follow these steps:

1.   Compare the suggested connector pin assignments, listed
     in Table 1-1, with your computer's. (Figure 1-5 shows
     the terminal pin numbers.) If necessary, ask your
     service technician to change the interface cable pin
     assignments.

     NOTE: Not all computer connector pins are compatible
     with standard RS-232C pin assignments. See Table 1-1 for
     required signals. If your terminal does not operate
     properly, check your computer manual or company service
     department for assistance in wiring the interface cable.

2.   Connect the interface cable to the terminal port labeled
     RS-232 COMPUTER and the computer RS-232C port.

Table 1-1
RS-232C Connector Pin Assignments

Pin No.	Signal Name*	Direction
1	Frame Ground	
2**	Transmit Data	Output
3**	Receive Data	Input
4	Request to Send	Output
5	Clear to Send	Input
6	Data Set Ready	Input
7**	Signal Ground	
8	Data Carrier Detect	Input
12	Speed Indicator	Input
20***	Data Terminal Ready	Output
23	Speed Select	Output

*Refer to the EIA Standard RS-232C for signal definitions.
**The terminal requires these signals.
***Modems often require pin 20.

Figure 1-5
Pin Numbers (25-Pin RS-232C Connector)
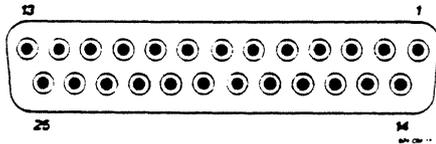
Connecting the Terminal With a Current Loop Interface

The 9220 or your computer can supply the 20 mA power source to
drive a current loop signal. Table 1-2 shows the 9220 current
loop connector pin assignments, and Appendix H shows terminal-
host interface wiring for various power source configurations.

To connect the terminal with a current loop interface:

1.   Ask your service technician to correctly wire the
     interface between the terminal and host. (Figure 1-6
     shows the eight-pin 20 mA connector numbers.)

2.   Connect the interface cable to the eight-pin current loop
     connector (see Figure 1-4) and the host current loop
     connector.

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Table 1-2
20 mA Current Loop Connector Pin Assignments

Pin No.*	Signal	Polarity
1	-12V 20 mA source	
2	Transmit Data	Negative
3	Receive Data	Negative
5	Transmit Data	Positive
7	Receive Data	Positive
8	Ground	

*Jumper pins 4 and 6.

Figure 1-6
Pin Numbers (8-Pin 20 mA Connector)
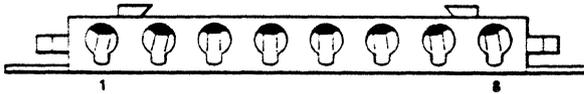
Connecting the Terminal to a Printer

The 9220 has a standard 25-pin printer port.

1. As you did with your computer, check your printer
    connector against the terminal printer port pin
    assignments, shown in Table 1-3.

2. Connect an RS-232C interface cable with a 25-pin
    connector to the 25-pin port at the back of the terminal
    labeled PRINTER. See Figure 1-4 for the location of the
    printer port.

    NOTE: Not all printer connectors are compatible with
    standard RS-232C pin assignments. See Table 1-3 for
    required signals. If your printer does not operate
    properly, check the manual or company service department
    for assistance in wiring the interface cable.

Table 1-3
25-Pin RS-232C Printer (DCE) Interface Connector Assignments

Pin No.	Signal Name*	Direction
1	Frame Ground	
2	Receive Data	Input
3	Transmit Data	Output
4	Request to Send	Input
5	Clear to Send	Output
6	Data Set Ready	Output
7	Signal Ground	
8	Data Carrier Detect	Output
11**	Printer Busy	
20	Data Terminal Ready	Input

*Reference EIA Standard RS-232C for signal definitions.
**Nonstandard handshaking signal used by several printers such
as Epson, Texas Instruments, and Okidata. Pin 11 is not a
control line for the 9220 and must be connected to pin 20.
If you want to use pin 11 instead of pin 20, call a
qualified service technician.

Plugging In and Turning On the Terminal

Now you are ready to plug in the terminal and turn it on.

1. Plug the power cable into the terminal and into a
    grounded wall outlet. Figure 1-4 shows the power cable
    outlet at the rear of the terminal.

    In the United States, use a 3-prong electrical outlet
    with a National Electrical Manufacturers Association
    (NEMA) Standard 5-15R rating. If you use a two-prong
    adapter, ground it with a pigtail.

2. Push the white dot on the ON/OFF switch on the front of
    the terminal (Figure 1-3).

3. Listen for the terminal bell, after about a second, and
    look for the cursor in the top left corner of the screen
    after 10 to 15 seconds. If the screen remains dark, go
    to the next step.

4. Adjust the screen contrast with the roller on the left
    side of the grooved panel below the screen (Figure 1-3).

5. Adjust the angle of the terminal by pushing on the case
    until you can see the screen easily.

INSTALLATION SUMMARY

1. Unpack and inspect the terminal.

2. Plug the keyboard cable into the terminal and the keyboard.

3. Check the terminal voltage setting.

4. Connect the appropriate interface cable between the computer system and the terminal.

5. Attach a printer interface cable (if you are connecting a printer to the terminal).

6. Plug the power cord into both the terminal and the wall outlet.

7. Turn on the terminal, listen for the beep, watch for the cursor to appear, and adjust the screen contrast and tilt.

Before you try to use the terminal, read the next chapters on terminal set up and operation.

2. SETTING OPERATING VALUES

When you turn on the terminal, it is ready to operate. Its factory default operating values are set when it is manufactured. This chapter tells you how to reset the default values from the keyboard.

NOTE: You can temporarily change some set up values with programming commands in Chapter 5. The set up fields then display the current (changed) values.

HOW SET UP WORKS

To change the terminal operating values, select new values from a series of set up screens. Each screen contains fields that let you:

* Choose a value
* Take an action
* Enter text

Set Up Procedure

1. Press the Set Up key (F3). The screen changes to display the Set-Up Directory. Don't worry about your previous screen display: when you leave set up it returns.

   NOTE: You can enter set up any time, but if the computer is sending data, the screen stops receiving incoming data until you leave set up.

2. Move the cursor from one field to another with the Up, Down, Right, and Left keys.

3. Press Enter to take an action, change values, or display an empty text field. See the tables in this chapter for the operating values in each field.

   NOTE: You can display set up screens but cannot change values when set up is disabled by a programming command.

4. When you finish in each field, you can

    *   Move to another field (with the cursor keys), or

    *   Move to the next set up screen (by moving the cursor to the To Next Set-Up field and pressing Enter), or

    *   Return to the Set-Up Directory (by moving the cursor to the To Directory field and pressing Enter).

5. To save new operating values in nonvolatile (permanent) memory:

    *   Enter CTRL S from any set up screen, or

    *   Return to the Set-Up Directory. Move the cursor to the Save field and press Enter.

    NOTE: Leaving set up does not automatically save the new set up values in nonvolatile memory. You must save the values in the separate step described above.

    You can save set up values changed with a programming command by entering set up and using one of the above methods.

6. To leave set up and return to normal operation:

    *   Press Set Up (F3) from any set up screen, or

    *   Return to the Set-Up Directory. Move the cursor to the Exit field and press Enter.

Set Up Categories

Table 2-1 lists the parameters in each set up category.

Table 2-1
Set Up Categories

Name	Controls
Set-Up Directory	Access to other screens, saving and resetting operating values, communication mode.
Display	Columns per line, autowrap, scrolling, display controls, screen and cursor appearance.
General	Programming and bit-control modes; user-definable keys and functions; keypad, cursor keys, and new line modes.
Communi-cations	Baud rate (transmit and receive), handshaking, data word, parity, echo, port, disconnect, character transmission.
Printer	Baud rate, print mode, data word, parity, print region, character transmission, terminator character.
Keyboard	Keycap character selection, shift lock, auto repeat, keyclick, bell, Break key, answerback message.
Tabs	Setting and clearing tab stops.
9220	Additional operating parameters not available in the VT220: intensity, hertz rate, Back Space key, screen saver, status line, transmit control, key control, print mode, terminal ID, compose character key.

THE SET UP SCREENS

Figures 2-1 through 2-8 show the set up screens, with the default values in each field (where applicable).

Tables 2-2 through 2-9 describe the choices in each field. Values that must match the operating values of your computer or printer are shown in **bold** print.

Figure 2-1
Set-Up Directory
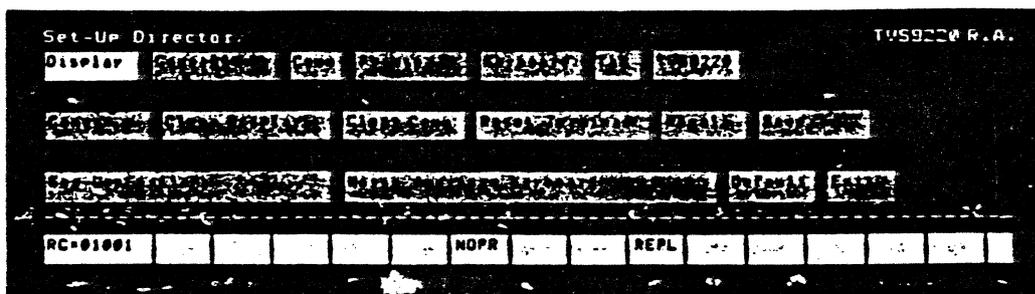
Table 2-2
Set-Up Directory Fields

Field	Action/Text/Values	Description
Display	Action	The Display screen appears.
General	Action	The General screen appears.
Comm	Action	The Communications screen appears.
Printer	Action	The Printer screen appears.
Keyboard	Action	The Keyboard screen appears.
Tab	Action	The Tab screen appears.
TVS9220	Action	The TVS9220 screen appears.

Table 2-2 Continued
Set-Up Directory Fields

Field	Action/Text/ Values	Description
Conv/Block/ Local	Conversa- tional	Permits simultaneous transmission and reception of data. Keyboard entries go only to the computer, unless you select local echo in the Communications screen.
	Block	Sends keyboard entries to the screen only; permits block transmission to the computer. Terminal may receive data from the computer.
	Local	Sends keyboard entries to the screen only. No communication with the computer.
Clear Display	Action	Removes all data from the screen when you leave set up mode.
Clear Comm	Action	Stops all communication (including printing) between host and terminal and clears all terminal buffers.
Reset Terminal	Action	Partial reset; see Table 5-4. Does not clear the screen.
Recall	Action	Power-off reset. Disconnects terminal and host; clears the screen; restores the last values saved in nonvolatile memory.
Save	Action	Saves set up values in nonvolatile memory.
Set-Up=	English	Set up screens appear in English.
Auswahlbild=	Deutsch	Set up screens appear in German.
Modes de fonct. =	Francais	Set up screens appear in French.

Table 2-2 Continued
Set-Up Directory Fields

Field	Action/Text/ Values	Description
Keyboard Language	North American British (220) Flemish Canadian (French) Danish Finnish German Dutch Italian Swiss (French) Swiss (German) Swedish Norwegian French/Belgian Spanish British (100)	Screen characters appear in the selected language character set. You can order matching British, French, German, Spanish and Italian keycap sets.
Default	Action	Default reset; restores the original factory default values. NOTE: Default reset values (like all other set up values) are only stored in temporary memory. Unless you save them before leaving set up, a power-off reset (Recall) will return the values saved in nonvolatile memory.
Exit	Action	Returns from set up mode to normal operation.

Figure 2-2
Display Set-Up Screen

Table 2-3
Display Set-Up Fields

Field	Action/Text/ Values	Description
To Next Set-Up	Action	Displays the General screen.
To Directory	Action	Returns to the Set-Up Directory.
Columns	80	Screen lines contain 80 columns.
	132	Screen lines contain 132 columns.
Controls	Interpret	The terminal interprets (acts on) control codes.
	Display	The terminal displays and does not act on control codes.
Auto Wrap	No Auto Wrap	Cursor does not wrap to the next line during data entry.
	Auto Wrap	Cursor wraps to the start of the next line during data entry.
Scroll	Smooth	Scroll rate is 6 lines per second.
	Jump	Data appears on the screen at the rate the computer sends it.

Table 2-3 Continued
Display Set-Up Fields

Field	Action/Text/ Values	Description
Background	Normal	Screen is dark with light text.
	Reverse	Screen is light with dark text.
Cursor	Cursor No Cursor	Selects visible or invisible cursor.
	Blinking/ Steady	Selects blinking or steady cursor.
	Block/ Underline	Selects block or underline cursor.
Dot Stretch	Dot Stretch	Each character formation dot (pixel) is horizontally stretched to cover the dot to its right. Characters appear thick.
	No Dot Stretch	Characters are formed normally.

Figure 2-3
General Set-Up Screen

Table 2-4
General Set-Up Fields

Field	Action/Text/ Values	Description
To Next Set-Up	Action	Displays the Communications screen.
To Directory	Action	Returns to the Set-Up Directory.
Mode	VT220 VT52 VT100 TVS9220	Selects the terminal emulation mode. Changing the emulation mode resets some operating values.
Controls	7 Bit	In 9220 or VT220 mode (selected in the previous field), terminal editing and function keys send 7-bit codes.
	8 Bit	In 9220 or VT220 mode, terminal editing and function keys send 8-bit codes.
VT100	ASCII U.K.	In VT52 or VT100 U.K. mode (selected in the previous field), choose U.S. ASCII or U.K. character set.

Table 2-4 Continued
General Set-Up Fields

Field	Action/Text/ Values	Description
User Defined Keys	Unlocked	Lets application program reprogram the function keys.
	Locked	Prevents the host from reprogramming the function keys.
User Features	Unlocked	Lets the host application program change auto repeat, smooth/jump scroll, normal/reverse video, keyboard lock/unlock, and tab parameters.
		NOTE: Certain application programs expect to control these parameters. If your host is running one of these programs, select the unlocked value.
	Locked	The host cannot change operating parameters.
Keypad	Numeric	Numeric keypad keys send ASCII display and control characters.
	Application	Numeric keypad keys send codes in Table 5-6.
Cursor Keys	Normal	Cursor keys send cursor movement commands.
	Application	Cursor keys send codes in Table 5-5.
New Line	No	New line mode disabled.
	New Line	Return key sends carriage return and line feed commands; terminal responds to line feed command with carriage return and line feed cursor movement.

Figure 2-4
Communications Set-Up Screen

Table 2-5
Communications Set-Up Fields

Field*	Action/Text/ Values	Description
To Next Set-Up	Action	Displays the Printer screen.
To Directory	Action	Returns to the Set-Up Directory.
Transmit=	75 110 150 300 600 1200 2400 4800 9600 19200	Selects the main (computer) port transmission baud rate.
Receive=	Transmit 75 110 150 300 600 1200 2400 4800 9600 19200	Selects the main (computer) port reception baud rate. **Transmit** sets the reception rate to match the transmission (selected in the previous field). **NOTE:** Transmit and receive rates need not match.

*Fields in **bold** print must match computer values.

Table 2-5 Continued
Communications Set-Up Fields

Field*	Action/Text/ Values	Description
Handshaking Protocol	XOFF at 64	Terminal sends X-Off to computer when receive buffer can hold only 64 more characters.
	XOFF at 128	Terminal sends X-Off to computer when receive buffer can hold only 128 more characters.
	None	No handshaking protocol set between terminal and computer.
	DTR	Enables DTR handshaking protocol between terminal and computer.
Bits	8	Computer port transmits/accepts only 8-bit data words to/from computer.
	7	Computer port transmits/accepts only 7-bit data words to/from computer.
Parity	No Even Odd Space Mark	Selects main port parity setting.
Parity Check	Check	Terminal checks the parity of data received from the host.
	No Check	Terminal does not check parity.
Stop Bit(s)	1	Data words contain one stop bit.
	2	Data words contain two stop bits.

*Fields in bold print must match the computer's values.

Table 2-5   Continued
Communications Set-Up Fields

Field	Action/Text/ Values	Description
Local Echo	No Local Echo	Keyboard data goes to the host only (not to the screen) in conversational mode.
	Local Echo	Keyboard data goes to both the screen and the host in conversational mode.
Port	EIA Port, Data Leads Only	Select this value when you connect the terminal to a computer with an RS-232C interface.
	EIA Port, Modem Control	Select this value when you connect the terminal to a modem.
	20 mA Port	Select this value if you connect the terminal to a computer with a current loop interface.
Disconnect,	2 s Delay	Disconnect between terminal and host occurs when Data Carrier Detect is lost for 2 seconds.
	60 ms Delay	Disconnect between terminal and host occurs when Data Carrier Detect is lost for 60 ms.
Transmit	Limited	Character transmission speed is never greater than 150-180 characters per second, no matter what the baud rate is.
	Unlimited	Removes the character transmission speed limit.

Figure 2-5
Printer Set-Up Screen
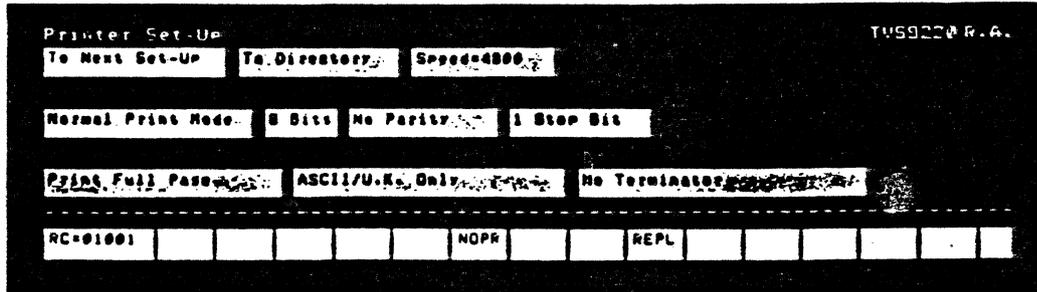
Table 2-6
Printer Set-Up Fields

Field*	Action/Text/ Values	Description
To Next Set-Up	Action	Displays the Keyboard screen.
To Directory	Action	Returns to the Set-Up Directory.
Speed=	75 110 150 300 600 1200 2400 4800 9600 19200	Selects the printer port baud rate.
Print Mode	Normal	Pressing the Print Screen key (F2) sends the screen contents to the printer.
	Buffered	Data from the host or keyboard goes to the printer. Main and printer port baud rates may differ.

*Fields in bold print must match the printer's values.

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Table 2-6 Continued
Printer Set-Up Fields

Field*	Action/Text/ Values	Description
Print Mode (continued)	Auto Print	Terminal sends the current line of text to the printer whenever it receives a vertical tab (hex ØB), line feed (hex ØA), or form feed (hex ØC) command.
		Print Screen key functions in this mode.
	Bidirectional	Enables two-way communication between devices attached to the terminal's computer and printer ports. Both devices must have the same baud rate, parity, word structure (bit mode), and stop bits.
Bits	8	Terminal sends all 8 bits of data words to the printer.
	7	Terminal sends only 7-bit data words to the printer.
Parity	No Even Odd Space Mark	Selects printer port parity setting.
Stop Bit(s)	1	Data words sent to the printer contain one stop bit.
	2	Data words sent to the printer contain two stop bits.
Print Region	Full Page	Page print command prints entire screen.
	Scroll Region	Page print command prints scrolling region.

*Fields in bold print must match the printer's values.

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Table 2-6 Continued
Printer Set-Up Fields

Field	Action/Text/ Values	Description
Printed Characters	ASCII /U.K. Only	Terminal sends to printer only ASCII and U.K. characters.
	ASCII/U.K. And Line Drawing	Terminal sends to printer ASCII, U.K. and special line-drawing characters.
	All Characters	Terminal sends all characters to printer.
Terminator	No Terminator	Terminal does not send a terminator character to the computer after a page print.
	= FF	Terminal sends a form feed character (hex ØC) to the computer after a page print.

Figure 2-6
Keyboard Set-Up Screen

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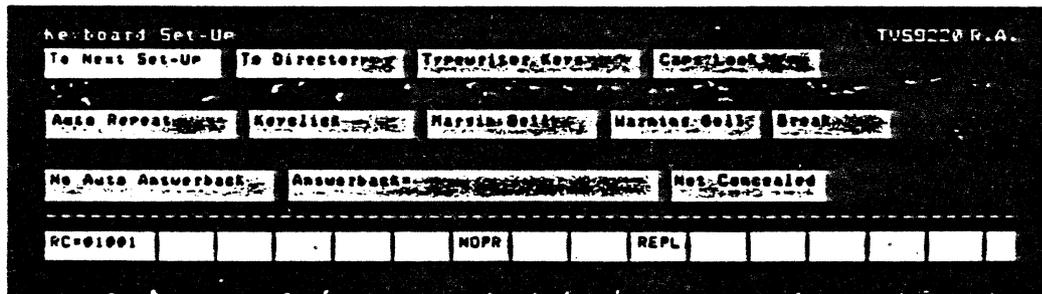
Table 2-7
Keyboard Set-Up Fields

Field	Action/Text/Values	Description
To Next Set-Up	Action	Displays the Tab screen.
To Directory	Action	Returns to the Set-Up Directory.
Keys	Typewriter	Characters on the left side of the key cap appear on the screen.
	Data Processing	Characters on the right side of the key cap appear on the screen.
	NOTE: North American keyboards do not have characters on the left and right sides of the keycaps.	
Lock	Caps	Only the alpha keys produce capital letters when you press the Lock key.
	Shift	All character keys produce uppercase characters when you press Lock.
Auto Repeat	Auto Repeat	Character keys and most special keys repeat when held down.
	No Auto Repeat	No keys repeat.
	NOTE: If you select No Key Control in the TVS9220 screen, you cannot change the auto repeat value.	
Keyclick	Keyclick	Keys click when pressed.
	No Keyclick	Keys are silent when pressed.

Table 2-7 Continued
Keyboard Set-Up Fields

Field	Action/Text/ Values	Description
Margin Bell	Margin Bell	Margin bell sounds when the cursor is eight spaces from the right margin.
	No Margin Bell	Margin bell is silent.
Warning Bell	Warning Bell	Bell sounds when the terminal detectes an operating error or receives CTRL G.
	No Warning Bell	Bell does not sound.
Break	Break	Pressing the Break key (F5) sends a break signal to the host.
	No Break	Break key does not function.
Auto Answerback	No Auto Answerback	Terminal does not send an answerback message to the host.
	Auto Answerback	Terminal sends an answerback message to the host after a disconnect or when the host sends CTRL E.

Table 2-7 Continued
Keyboard Set-Up Fields

Field	Action/Text/ Values	Description
Answerback=	<message>	Press Enter, then type up to 30 characters in the status line as the answerback message. If you make a mistake, press Enter twice to start over again.
		WARNING! Displaying the answerback entry field in the status line automatically erases the current message when you press Enter again. If you do not want to change your present answerback message, you must retype it.
		When you press Enter again, your new message appears in the Answerback= field in place of the old one.
Concealed Message	Not Concealed	Answerback message appears in the answerback field.
	Concealed	<Concealed> appears in the answerback field in place of the answerback message.
		WARNING! You cannot redisplay a concealed message. You must move the cursor back to the Answerback field and press Enter. This clears your previous answerback message and cancels the Concealed value.

Figure 2-7
Tab Set-Up Screen
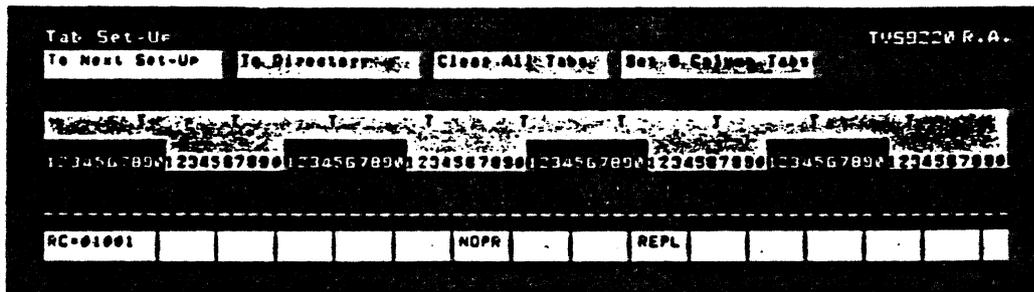
Table 2-8
Tab Set-Up Fields

Field	Description
To Next Set-Up	Displays the TVS9220 screen.
To Directory	Returns to the Set-Up Directory.
Clear All Tabs	Clears all tab settings.
Set 8 Column Tabs	Sets tab stops every eight columns.
Tab ruler (uppercase T's)	Cursor changes to block. Move it with a cursor key, Tab, or Back Tab key to the desired column; then press Enter to set or delete a tab stop.

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Figure 2-8
TVS9220 Screen
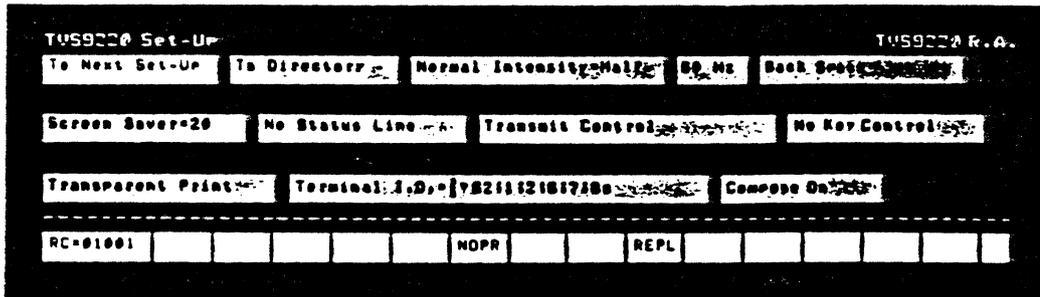
Table 2-9
TVS9220 Set-Up Fields

Field	Action/Text/ Values	Description
To Next Set-Up	Action	Displays the Display screen.
To Directory	Action	Returns to the Set-Up Directory.
Normal Intensity=	Half	Characters are half intensity.
	Full	Characters are full intensity
Hertz	60 Hz	Screen refreshes at 60 Hz (domestic).
	50 Hz	Screen refreshes at 50 Hz (international).
Back Space/ Delete	Back Space	Back Space key sends back space command.
	Delete	Back Space key sends delete code (hex 7F).

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Table 2-9 Continued
TVS9220 Set-Up Fields

Field	Action/Text/ Values	Description
Screen Saver=	Off 5 ~ 60	Select screen saver values in 5-minute intervals from Off (zero) to 60 minutes. See Chapter 3 for information about screen saver feature.
Status Line	No Status Line	Hides the status (25th) line in normal operation. (The status line is always displayed in set up mode.)
	Status Line	Displays the status line in normal operation.
Transmit Control	Transmit Control	Terminal accepts X-On/X-Off commands from the host.
	No Transmit Control	Terminal does not accept X-On/X-Off commands from the host.
Key Control	No Key Control	Auto repeat mode cannot be changed by a command from the keyboard or host or in set up (in the Keyboard Set-Up screen).
	Key Control	Auto repeat mode can be controlled in set up or by command.
Print	Transparent	In buffered or bidirectional print mode (set by a command or in the Printer screen), the terminal sends data from the computer to the printer without affecting the screen display.
	Copy	In buffered or bidirectional print mode, data from the host appears on the screen as it goes to the printer.

Table 2-9   Continued
TVS9220 Set-Up Fields

Field	Action/Text/ Values	Description
Terminal I.D.=	9B?62;1;2; 6;7;8c.	Default terminal I.D.
Terminal I.D.=	Text	Programmable terminal I.D. To change the terminal I.D., follow the instructions in Table 2-7 for programming the terminal's answerback message.
Compose	On	Character compose key enabled.
	Off	Character compose key disabled.

3. OPERATING THE 9220

This chapter lists the keys and explains how to operate the terminal from the keyboard. It also describes the features of the terminal screen.

THE KEYBOARD

The keyboard contains character keys, editing keys, special keys and function keys. They are grouped in four areas: main keypad, cursor-edit keypad, numeric keypad, and function key row.

Character keys and many editing and special keys repeat when pressed for more than one-half second. Function keys do not repeat.

Figure 3-1
9220 Keyboard

FUNCTION KEY ROW

MAIN KEYPAD   CURSOR-EDIT   NUMERIC
                     KEYPAD   KEYPAD
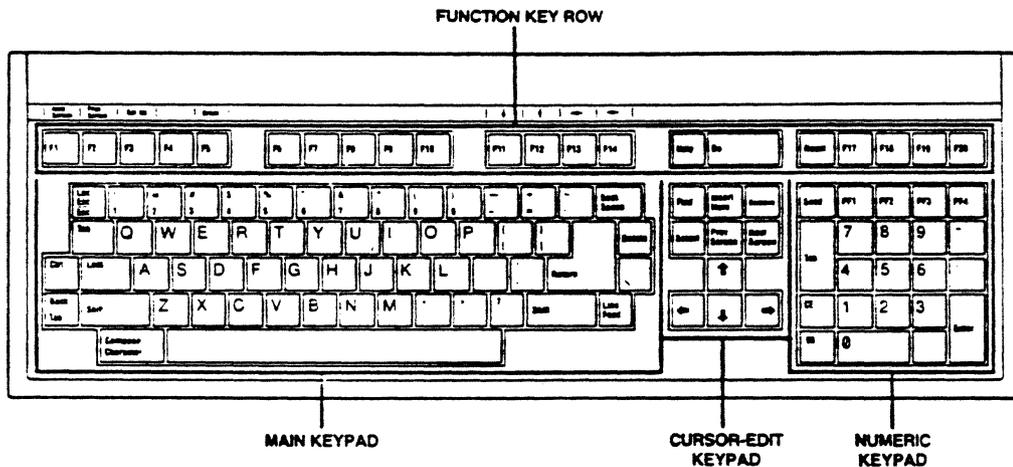
Character Keys

The unshaded keys in Figure 3-2 are the character keys. They
include the alphabet, numbers (∅ through 9), punctuation
marks, symbols, and the space bar.

NOTE: When you press a character key, its code may go to the
computer, but not to the screen, depending on your
communication mode and local echo setting. See the section
later in this chapter about communication modes.

Figure 3-2 shows the North American keyboard. The 9220 offers
various options for displaying alphanumeric characters from other
languages. You can select one of 15 other character sets in set
up (see Table 2-2); Appendix E shows the corresponding keyboard
layout of each character set. You can form individual characters
with the character compose sequences explained later in this
chapter (Table 3-4). Or you can enable the multinational
supplemental character set with a programming command in Chapter
5. See the section called CHARACTER SETS in Chapter 5.

Figure 3-2
Character Keys
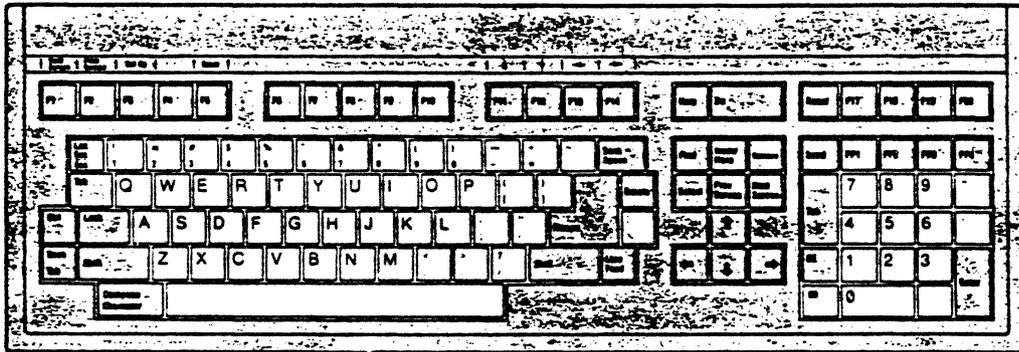
Editing Keys

Editing keys do not display characters; they send editing commands. Appendix G lists the editing key codes. Keys repeat unless noted in Table 3-1.

NOTE: The programming, communication and operating modes affect editing keys. If a key does not operate as described in Table 3-1, its function may be changed by a terminal mode.

Figure 3-3
Editing Keys
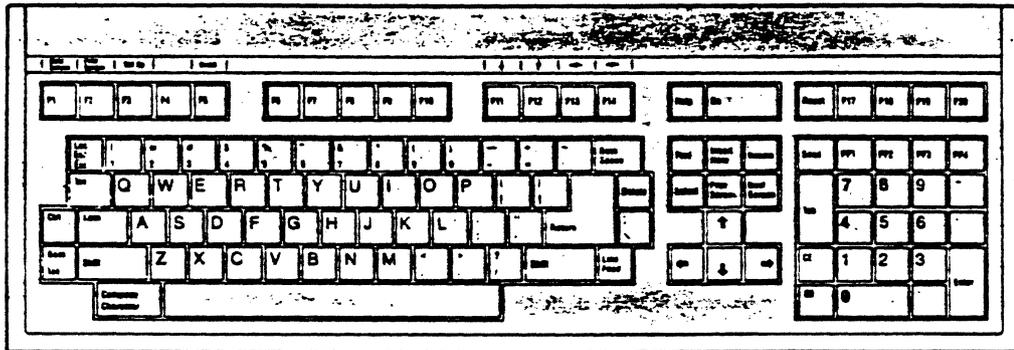
Table 3-1
Editing Keys

Key Name	Effect
Back Space	Moves the cursor left one character or sends a DEL character (hex 7F), depending on value selected in set up.
Back Tab	Moves the cursor left to the previous tab stop. Operates in 9220 mode only.
CE (clear entry)	Erases the field between the previous and next tab stops. Returns the cursor to the previous tab stop. Operates in 9220 emulation mode only. Does not repeat.

Table 3-1   Continued
Editing Keys

Key Name	Effect
Left	Moves the cursor left one character. Cursor stops at the line's left margin.
Up	Moves the cursor up one line in the same column. Cursor stops at the upper boundary of scrolling region or top of the screen.
Right	Moves the cursor right one character. Cursor stops at the end of the line.
Down	Moves the cursor down one line in the same column. Cursor stops on the bottom line of the scrolling area or screen.
Enter	In numeric keypad mode, same as Return key. In application keypad mode, sends ESC O M.
Line Feed	Moves the cursor down one line in the same column. When the cursor reaches the bottom of the scrolling region, data scrolls up one line.
Print Screen (F2)	Sends contents of the screen to the printer in normal or auto print modes.
Ctrl-Print Screen	Toggles auto line print mode on and off.
Return	Sends carriage return or carriage return and line feed commands, depending on your choice in set up. Does not repeat.
Send	During block mode, sends all data between home and the cursor to the computer. Does not repeat.
Tab	Moves the cursor forward to the next typewriter-style tab stop. Duplicated on main and numeric keypads.
Shift-Tab	Sets a typewriter-style tab stop at the cursor.

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Special Keys

Figure 3-4 shows the special keys, and Table 3-2 explains
their effects.

Figure 3-4
Special Keys
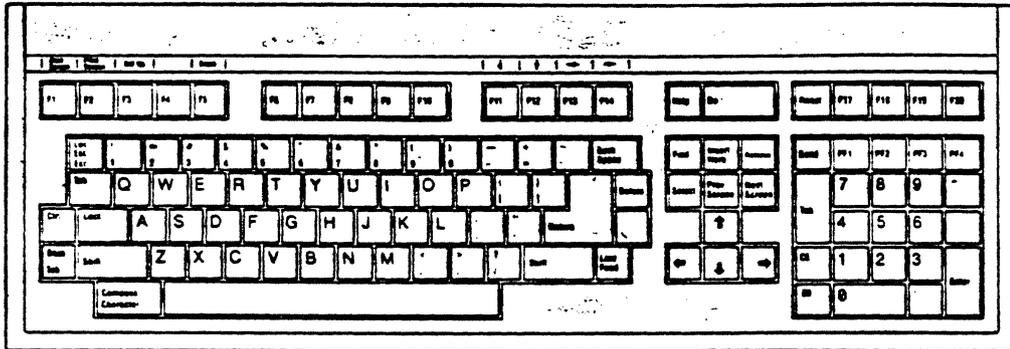
Table 3-2
Special Keys

Key Name	Effect
Break (F5)	Sends a **break signal** (unless disabled in set up). Holds the communication line (pin 2 of the main RS-232C connector) in the $\emptyset$ state (low) for 250 milliseconds. How your computer responds to the signal depends entirely on its program. A break signal may disconnect a modem. Does not repeat.
Shift-Break	Disconnects terminal from DTR (data terminal ready) and RTS (request to send) lines for 250 milliseconds.
Ctrl-Break	Sends the terminal answerback message to the host.

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Table 3-2 Continued
Special Keys

Key Name	Effect
Compose Character	Lets you create supplemental characters not directly available from the keyboard. See the section on composing characters in this chapter. Operates only in 9220 and VT220 modes. May be disabled in set up.
Ctrl (control)	Pressed with some character keys to send operating commands (control characters). Pressed with some editing and special keys to cause terminal operations.
Delete	Displays no character. Operation determined solely by application program.
Esc (escape)	When pressed immediately before pressing a character key, causes the character key to send an operating command (escape sequence). Does not repeat.
F4	No function.
Find	Has no default function and displays no character. Operation determined solely by application program. Operates only in 9220 and VT220 emulation modes.
Hold Screen (F1)	Halts data flowing to the screen from the computer until pressed again. Does not repeat.
Insert Here	Has no default function and displays no character. Operation determined solely by application program. Operates only in 9220 and VT220 emulation modes.
Loc Esc (Shift-Esc)	Press instead of Esc to send escape sequence commands from the keyboard to the terminal only. Does not repeat.

Table 3-2 Continued
Special Keys

Key Name	Effect
Lock	Capitalizes all alphabetic keys. May select upper character on symbol keys, depending on the parameter you choose in set up. Does not repeat.
Next Screen	Has no default function and displays no character. Operation determined solely by application program. Operates only in 9220 and VT220 emulation modes.
PF1-PF4	No default function. Keys display characters from the supplemental character set in 9220 or VT220 modes and uppercase P, Q, R, and S in VT100 mode.
Prev Screen	Has no default function and displays no character. Operation determined solely by application program. Operates only in 9220 and VT220 emulation modes.
Remove	Has no default function and displays no character. Operation determined solely by application program. Operates only in 9220 and VT220 emulation modes.
Reset	No function when pressed alone.
Ctrl-Reset	Resets the terminal to power-off (nonvolatile memory) values.
Select	Has no default function and displays no character. Operation determined solely by application program. Operates only in 9220 and VT220 emulation modes.
Set Up (F3)	Displays the Set-Up Directory. Press again to leave set up. Does not repeat.
Shift	Capitalizes letters and selects the upper characters of other keys.

Function Keys

Function keys F6 through F20 (also called user-defined keys)
send codes to the computer that programmers use. (F1 through
F5 are editing or special keys.) In 9220 and VT220 emulation
modes you can reprogram (load a message into) keys F6 through
F20 with a programming command. See Chapter 5 for the default
codes of those keys and the command to reprogram them.

Two keyboard legend labels come with the terminal. One shows
the operations of keys F1-F5, plus the cursor movement
functions of F11-F14 in VT100 and VT52 modes. If you reprogram
function keys F6-F20, you can write the new values on the
other, unprinted label and insert it above the keys.

Table 3-3 describes how the keys operate in each terminal
emulation mode.

Figure 3-5
Function Keys
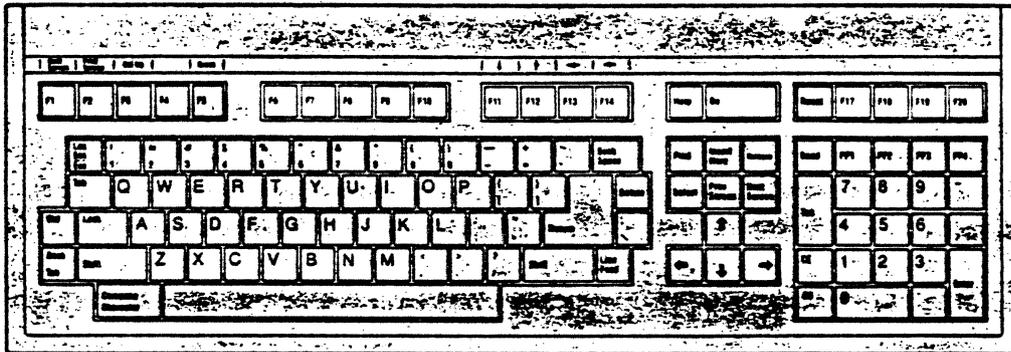
Table 3-3
Function Keys

Key Name	Emulation	Effect
F6-F10	9220	Reprogrammable
Do, Help,	VT220	Nonprogrammable
F17-F20	VT100	No function
	VT52	No function
Shifted	9220	Reprogrammable
F6-F10	VT220	Reprogrammable
Do, Help,	VT100	No function
F17-F20	VT52	No function
F11	9220	Same as F6-F10
(unshifted	VT220	Same as F6-F10
and shifted)	VT100	Up key
	VT52	Up key
F12	9220	Same as F6-F10
(unshifted	VT220	Same as F6-F10
and shifted)	VT100	Down key
	VT52	Down key
F13	9220	Same as F6-F10
(unshifted	VT220	Same as F6-F10
and shifted)	VT100	Left key
	VT52	Left key
F14	9220	Same as F6-F10
(unshifted	VT220	Same as F6-F10
and shifted)	VT100	Right key
	VT52	Right key

CONTROLLING THE TERMINAL FROM THE KEYBOARD

The editing and special keys control many terminal operations. But before you enter data or operate the terminal, you should understand the effects of the communication modes, explained below.

NOTE: Sending the programming commands in Chapter 5 from the keyboard lets you control even more terminal functions. The section in Chapter 5 called Entering Commands From the Keyboard explains how to send programming commands from the keyboard.

Communication Modes

The 9220 has three communication modes:

    Block
    Local
    Conversational

Key codes go immediately to the computer in **conversational** mode, and the terminal can transmit and receive data simultaneously. Unless your computer sends back (echoes) the key codes, data does not appear on the screen when you press character keys, and editing keys do not affect screen data.

If you select local echo mode in set up, key codes go to both the computer and the screen. Characters you type appear on the screen, and editing keys affect screen data.

In **block** communication mode, characters typed at the keyboard go only to the screen, and editing keys affect screen data. Pressing Send transmits screen data to the computer (as explained later in this chapter). However, the terminal can receive data from the computer any time.

In **local** communication mode, the terminal has no communication with the computer.

Editing and Sending Data

The editing keys (described in Table 3-1) move the cursor,
change data on the screen, and send data to the computer and
printer.

NOTE: If the editing keys do not function as described in
Table 3-1, check the terminal's communication and local echo
modes, described in the previous sections.

Pressing the Print Screen key (F2) during normal or auto print
mode sends the current screen display to your printer.

In block mode, the Send key sends all data on the screen, from
the home position through (and including) the cursor position,
to the host.

Figure 3-6
Data Sent by the Send Key

HOME   CURSOR
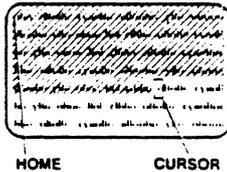
Resetting the Terminal

To reset the terminal, press Ctrl-Reset. This is the same as
turning the terminal off and back on again. All operating
values return to the last values saved in nonvolatile memory.

Composing Characters

In 9220 and VT220 modes, you can create multinational
characters from the keyboard by pressing certain alphanumeric
keys in sequence. Table 3-4 lists the characters and
corresponding two-stroke and three-stroke sequences.

Start three-stroke compose sequences, available on all 9220
keyboards, by pressing the Compose Character key.

Two-stroke sequences, which are not available on the North
American keyboard, use a nonspacing diacritical mark followed
by a standard character. Nonspacing diacritical marks are the
grave accent, accute accent, circumflex accent, tilde mark,
diaeresis mark (umlaut), and ring mark. The two-stroke method
cannot create all characters.

Follow this procedure to compose characters:

1.   Locate the character you want to create in the first
     column of Table 3-4.

2.   Locate the corresponding alphanumeric characters for
     either a two-stroke or three-stroke sequence in the
     second or third column of Table 3-4.

     If you have a North American keyboard or no characters
     appear in the two-stroke column of Table 3-4, start a
     three-stroke sequence by pressing the Compose Character
     key.

3.   Type the two characters that correspond to the character
     you want to create.

     NOTE: Press the keys in the order shown in the table.

COMP appears in the status line during a character compose
sequence.

The sequence aborts without creating a character if you

*   Press the Back Space key
*   Enter an invalid sequence

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Table 3-4
Character Composing Sequences

Character		Sequence	
		Three-Stroke	Two-Stroke
"	quotation mark	" <sp>	.. <sp>
#	number sign	++	' <sp>
'	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 !	!!	
¢	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 SØ or sØ	
◻	currency sign	xo or XO or xØ or XØ	

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Table 3-4 Continued
Character Composing Sequences

		Sequence	
Character		**Three-Stroke**	**Two-Stroke**
©	copyright sign	co or CO or cØ or CØ	
a	feminine ordinal indicator	a_ or A_	
<<	angle quote mark left <<		
•	degree sign	Ø^ or <sp>* or <sp> o	o <sp>
±	plus/minus sign	+-	
²	superscript 2	2^	
³	superscript 3	3^	
μ	micro sign	/u or /U	
¶	paragraph sign	p! or P!	
¹	superscript 1	1^	
.	masculine ordinal indicator	o_ or O_	
>>	angle quotation mark right	>>	
1/4	fraction one-quarter	1 4	
1/2	fraction one-half	1 2	
¿	inverted ?	??	
À	A grave	A`	`A
Á	A acute	A'	'A
Â	A circumflex	A^	^A
Ã	A tilde	A~	~A

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Table 3-4   Continued
Character Composing Sequences

		Sequence	
Character		Three-Stroke	Two-Stroke
Ä	A umlaut	A" or A	A
Å	A ring	A* or A	A
Æ	AE ligature	AE	
Ç	C cedilla	C,	
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
Œ	OE ligature	O E	
Ù	U grave	U`	`U
Ú	U acute	U'	'U
Û	U circumflex	U^	^U

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Table 3-4   Continued
Character Composing Sequences

Character		Sequence Three-Stroke	Two-Stroke
Ũ	U tilde	U˜	˜U
Ü	U umlaut	U" or U	U
Ÿ	Y umlaut	Y" or Y	Y
β	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	ae ligature	a e	
ç	c cedilla	c ,	
è	e grave	e`	`e
é	e acute	e'	'e
ê	e circumflex	c^	^c
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

Table 3-4 Continued
Character Composing Sequences

		Sequence	
Character		Three-Stroke	Two-Stroke
ó	o acute	o'	'o
ô	o circumflex	o^	^o
õ	o tilde	o~	~o
ö	o umlaut	o" or o	o
œ	oe ligature	o e	
ø	o 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

NOTE: The following characters are treated as equivalent when used in three-stroke sequences:

    Diaresis mark (umlaut) and double quote "
    Acute accent and apostrophe '
    Grave accent and single quote '
    Circumflex accent and circumflex character ^
    Tilde mark and tilde character ~
    Ring mark and asterisk * or degree

SCREEN APPEARANCE

You can change many aspects of the screen in set up or by programming commands. The normal screen appearance, dark with light characters, can be reversed to light with dark characters. You can also change the appearance (visual attributes) of the characters or change the character set itself.

The Cursor

When you turn on the terminal, you see the cursor in the upper left corner. It indicates where the next character will be entered. You can select its appearance (block or underline, invisible, steady or blinking) in set up or by a programming command.

You can move the cursor with the Up, Left, Down, Right, Tab, Back Tab, Home, Line Feed, Return, or Back Space keys (described earlier in this chapter).

Screen-Saver Feature

If you enable the screen-saver feature in set up, the screen blanks after a chosen period of inactivity (5 to 60 minutes). Blanking the screen conserves the phosphor coating inside the face of the screen. Any screen activity makes the display reappear.

The Status Line

You can elect in set up mode to display the status line on the 25th screen line. (The status line is always displayed during set up.) This line summarizes current operating characteristics. Many fields are normally blank, and information appears only when appropriate.

The set up screens in Chapter 2 show a typical status line. Table 3-5 lists the messages that can appear in each field.

Table 3-5
Status Line Messages

Area	Display	Value
1	RRCCC	Cursor position where R = Row C = Column
2	HBSY/blank	Host busy
3	CTS/blank	Clear to Send*
4	DSR/blank	Data Set Ready*
5	DCD/blank	Data Carrier Detect*
6	TBSY/blank	Terminal busy (receive buffer full)
7	NOPR/PBSY/PRDY	No printer/printer busy/printer ready
8	SEND/blank	Sending data during block mode
9	1234/blank	Program status indicators
10	REPL/NSRT	Replace/insert mode
11	KLOK/blank	Keyboard lock command enabled
12	DONE/blank	Action completed (in set up)
13	HOLD/blank	Scrolling (screen updating) halted
14	COMP/blank	Character compose mode enabled
15	WAIT/blank	Keyboard buffer full

*These messages appear when main port communication is set for EIA port, modem control, and lines go low.

4. TROUBLESHOOTING

This chapter tells you what to check before placing a service call. It also shows how to change the line fuse and obtain assistance.

TROUBLESHOOTING PROCEDURES

Before placing a service call, find the symptom in Table 4-1 and try the solution listed there. The last part of this section tells how to change the line fuse.

Troubleshooting Table

Table 4-1 lists a variety of terminal problems and simple solutions.

Table 4-1
Troubleshooting Terminal Problems

Symptom	Possible Solution
Terminal dead (no beep; no cursor)	Unplug the power cord and plug in both ends again
	Check and replace the line fuse
	Turn on the power switch
	Check the power select switch setting
Terminal does not go on line	Make sure the system is "up"
	Reset the terminal
	Make sure the terminal is not in block or local mode
	Check the baud rate
	Disconnect all cables and check for damage, then reattach the cables

Table 4-1 Continued
Troubleshooting Terminal Problems

Symptom   Possible Solution

Terminal does not   Check the RS-232C (computer) port
go on line   interface cables:

                                Pins 1 and 7 must be grounded

                                Pin 2 must be connected to the
                                computer receiver

                                Pin 3 must be connected to the
                                computer transmitter

                                Pins 5, 6, and 8 must be driven by
                                +12 volt dc power or be disconnected

                        Turn on the modem

                        Connect a different modem

                        Check the handset position in the modem
                        cradle

Cursor does not   Adjust the screen contrast
appear

Computer does not   Set parity, word structure, and stop bits
respond while   to match computer requirements
on line

No keyboard   Check both ends of the keyboard cable.
response
                        WARNING! Do not unplug the keyboard cable
                        while the terminal is turned on! A power
                        surge may result, which could severely
                        damage the terminal.

                        Enable local echo mode

                        Unlock the keyboard

                        Reset the terminal

Table 4-1 Continued
Troubleshooting Terminal Problems

Symptom	Possible Solution
Printer does not print correctly	Check print mode and print command
	Check baud rate, parity and word structure of the printer port
	Check the printer cable pin assignments:
	Pins 4 and 20 must be driven by +12 volt dc power or disconnected
	Pin 3 must be connected to printer data input
	Pin 2 must be connected to printer data output for operation with X-On/X-Off control
	Check the computer system parity needs
Display is wavy or beep sounds unusual	Change hertz setting in set up
Escape and control codes do not function as expected	Check escape sequences and control codes
	Make sure upper- and lowercase letters are entered correctly. Is a one used instead of a lowercase L? Zero for uppercase O?
	Make sure the Lock key is not engaged
	Put the terminal in block or local mode, or try escape sequences with the Loc Esc key.
	Is the terminal in display controls mode?
	Disconnect the interface from the computer port; connect the computer port pins 2 and 3; try operating in conversational mode.

Testing the Terminal

Each time you turn on the terminal, the self test runs. It
checks communication ports, memory, and internal hardware.
You can also run a series of tests with the commands in
Chapter 5 (see the section Tests and Reports). If the
terminal displays an error message, write it down and call
your service center.

Checking the Line Fuse

To check the line fuse:

1.   Turn off the power and unplug the terminal from the wall
      outlet.

2.   Remove the fuse holder by unscrewing it counterclockwise
      (Figure 4-1).

3.   Slip the glass fuse out of the holder and examine it.

      If the thin wire inside the fuse is intact (Figure 4-2),
      the fuse should be functional. If the thin strip is
      broken and/or the glass is slightly black (Figure 4-3),
      the fuse has blown and must be replaced. (A totally
      black fuse can indicate a problem with the power outlet.
      If that happens, call your service technician.)

4.   Replace a blown fuse with a 1.5-ampere, slow-blow fuse for
      115-volt applications or a 0.75-ampere, slow-blow fuse for
      230-volt applications.

5.   Replace and tighten the fuse holder.

6.   Plug in the terminal power cord.

If the newly replaced fuse blows out immediately, do not
replace it again. Call your service technician.

Figure 4-1
Location of the Line Fuse

LINE
FUSE
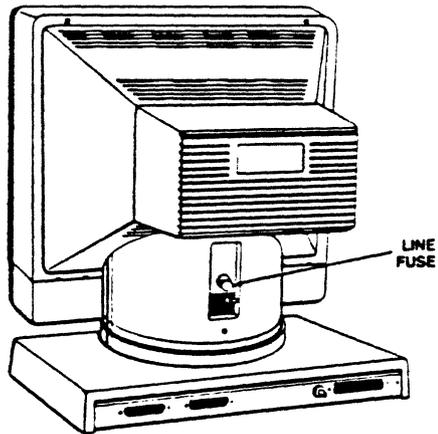
Figure 4-2
Good Fuse
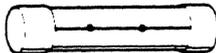
Figure 4-3
Burned-Out Fuse
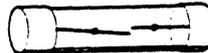
IF YOU NEED ASSISTANCE

TeleVideo's toll-free number for service calls is 800/521-4897
(in California, 800/821-3774). Or call 408/971-0255.

Before calling, check to make sure the terminal is plugged in,
all cables are connected to the correct ports, and all
operating parameters are set correctly (go back to Chapter 2
if you need to review them).

Ask for the Applications Support Department or the Technical
Support Department, depending on your questions. Try to place
the terminal by the phone. Have the terminal's serial number,
found on the rear of the case, and this manual at hand.

If the line is busy, try again or leave a message with the
TeleVideo operator. Your call will be returned as soon as
possible.

Applications Support

Ask for the Applications Support Department when you want to
know more about a feature, how to use the terminal in a
particular environment, or when you need marketing
information. Call between 8:30 a.m. and 5:30 p.m., Pacific
time, Monday through Friday (except holidays).

Technical Support

Call Technical Support for help with hardware problems or to
return the terminal for repair. You can reach the Technical
Support Department between 7:00 a.m. and 5:30 p.m., Pacific
time, Monday through Friday (except holidays).

Service Under Warranty

The terminal is covered by a limited warranty (see Appendix
B). No warranty registration is required. If you need
service while the terminal is covered by the limited warranty,
call the Technical Support Department.

Shipping the Terminal

Should you need to ship the terminal, ask your service
technician to check the integrity of the cabling and the
security of the internal mounting hardware. Repack the
terminal, using either the original TeleVideo shipping
container or other suitable materials.

5. PROGRAMMING THE 9220

Programming commands allow control of the terminal from the keyboard or an application program running on a computer. The terminal responds to a wide range of commands you can include in your programs to make your job faster and easier. You can move the cursor, edit data, change an operating value, and much more. See Appendix F or the Quick Reference Guide for a complete list of control codes and escape sequences and their functions.

NOTE: The terminal stores operating values changed with a programming command in temporary memory. It returns to the nonvolatile memory value after a reset. Values also controlled in set up can be saved in set up, since the set up screens display the current operating values.

The editing keys transmit the same codes (listed in Appendix G) as certain programming commands. Many programs using the terminal's built-in features can be made interactive. You can write a program that calls on the operator to press an editing key to attain certain results.

NOTE: If you are an operator who wants to send programming commands from the keyboard, read the subsection called Entering Commands From the Keyboard in the following section.

We hope you take advantage of the many terminal features in all your programming and data handling jobs. If you have any questions or problems this manual cannot answer, TeleVideo Applications Support personnel are ready to assist you by telephone.

ENTERING COMMANDS

The terminal responds to commands sent from the host or typed at the keyboard.

NOTE: When you enter commands from the keyboard, use the Loc Esc key instead of Esc, or put the terminal into local communication mode.

Sending Commands From the Host

The 9220 responds to control codes and escape sequences from the host regardless of your programming language format and syntax. How you incorporate commands into your programs depends on your programming language.

The multitude of languages and syntaxes recognized by each language makes it impossible to show you in this manual how to incorporate commands in each program. If you need help with the proper syntax, refer to the documentation for your programming language.

Appendix C contains an ASCII chart with the corresponding numeric values in various systems.

Entering Commands From the Keyboard

If you enter commands at the keyboard during conversational communication mode, the results are unpredictable. The computer receives the commands, and its response depends on its application program or operating system.

To make sure commands from the keyboard go to the terminal, enable block or local communication mode.

However, you can send escape sequences to the terminal during conversational mode by entering the commands with the Loc Esc key instead of Esc. This sends commands to the terminal only.

When you enter commands at the keyboard, make sure the Lock key is not locked. Enter the characters exactly as shown so the commands work as described. Notice whether the command requires an upper- or lowercase character, a number one or a lowercase L, a zero or an uppercase O.

Commands are printed in this manual with a space between the characters. Do not type this space as part of the sequence; it is included only for clarity. For example, the sequence

    ESC c

involves pressing only the Esc key followed by a lowercase c.

Always press the Ctrl key first and hold it down while you press the other key (as you would the Shift key). Always press and release the Esc key before pressing the next key.

Command Descriptions

Command descriptions in this manual have up to four elements. Table 5-1 lists each element and its meaning.

Table 5-1
Command Elements

Element	Meaning
Statement	Function of the command
Keyboard entry	How the command is entered at the keyboard (escape sequence or control code)
DEFAULT =	Terminal factory default state (if applicable)*
SET UP	Function or value can also be selected in set up mode. Enter set up to save new value in nonvolatile memory.

Variables in commands are usually shown as **Pn** or **Ps**. Pn represents a decimal value and Ps a selective value. Variable choices and their effects are listed in the descriptive text following each command.*

*The terminal **factory default** state is not necessarily the same as a command **default value**. If you enter a command without its variable, the command **defaults** to the lowest variable value (zero or one), which may not be the factory default state or function.

TERMINAL PROGRAMMING MODES

The terminal programming mode determines what command set it recognizes and how it sends and receives codes. Combinations of the four terminal emulation modes (VT52, VT100, VT220, and 9220) and two control transmission modes (7 bit and 8 bit) define the programming modes.

Changing the emulation and programming modes, by programming command or in set up, causes a soft reset.

Terminal Emulation Modes

You can select an emulation mode in set up or in a command to select a programming mode, given later in this section.

Table 5-2 compares features of the four emulation modes. See Appendix F for a summary of the command set in each emulation mode.

Table 5-2
9220 Emulation Mode Features

Feature	VT52	VT100	VT220	9220
Keypad and cursor key application modes	Yes	Yes	Yes	Yes
Cursor-edit pad special keys	No	No	Yes	Yes
Control transmission	7 bit only	7 bit only	7 or 8 bit	7 or 8 bit
Character sets	ASCII U.K. Special	ASCII U.K. Special	All except U.K.	All except U.K.
Function keys	None	None	Programmable shifted (15 keys)	All pro-grammable

Setting the Control Transmission Mode   SET UP
                                         DEFAULT = 7 bit
Set 7-bit control transmission mode*   ESC <space> F
Set 8-bit control transmission mode*   ESC <space> G

Two separate parameters control the transmission and reception
of 8-bit codes: word structure and control transmission mode.
Both are selectable in set up; you can also change the control
transmission mode by programming commands in this section.

Word structure determines the actual size of a data word. In
all four emulation modes, the terminal can send and receive
either 7- or 8-bit words. This value must agree with your
computer data word structure.

Control transmission mode determines whether the terminal
sends editing and function key codes as 8-bit control codes or
7-bit escape sequences. (The terminal always displays the 8-
bit form in display controls mode.)

You can only enable 8-bit controls in VT220 and 9220 emulation
modes. If the terminal is in 8-bit control mode, but you
choose 7-bit word structure, the terminal masks (ignores) the
eighth (most significant) bit, as shown in Table 5-3, below.

Sending 8-bit codes from the terminal saves transmission time.
In 7-bit mode, an 8-bit control character requires two bytes:
ESC (1Bh) plus the ASCII character that is 40h less than the
desired 8-bit control character.

For example, the 8-bit control character VTS (hex 8A) is ESC J
(hex 1B 4A) in 7-bit mode.

This manual shows all escape sequences in 7-bit form. You can
convert them to 8-bit control codes with the ASCII chart in
Appendix C. Find the ASCII character following ESC in the
code, then add hex 40 to find the equivalent 8-bit control
character. Do not enter ESC in the 8-bit code.

For example, the operating mode commands that begin with ESC [
(hex 1B 5B) start with CSI (hex 9B) in 8-bit mode.

*VT220 and 9220 modes only.

Table 5-3 shows how the terminal operates in 7- and 8-bit
data word and control transmission modes. Appendix C shows
the terminal's 7- and 8-bit character sets.

Table 5-3
Terminal Operation in 7- and 8-Bit Modes

Operation	7-Bit Data Words Either Controls	8-Bit Data Words 7-Bit Controls	8-Bit Controls
Terminal sends editing key codes as	7-bit escape sequences	7-bit escape sequences	8-bit control codes
Character keys send	Only 7-bit characters	7- or 8-bit characters	7- or 8-bit characters
Terminal response to 8-bit commands	Masks the 8th (most sig- nificant) bit	Interprets 8-bit code	Interprets 8-bit code
Response to display characters from host	Masks the 8th (most sig- nificant) bit	Displays 7- or 8-bit characters	Displays 7- or 8-bit characters

Setting the Programming Mode	SET UP DEFAULT = VT220 7 bit
VT220 8-bit control	ESC [62 " p
	or ESC [62 ; Ø " p
	or ESC [62 ; 2 " p
VT220 7-bit control	ESC [62 ; 1 " p
VT100	ESC [61 " p
VT52	ESC [? 2 l
Return to VT100 mode from VT52 mode	ESC <

These commands let you choose both terminal emulation and
control transmission modes.

OPERATING MODE COMMANDS

Operating mode commands set functions (on) and reset them
(off). To set or reset modes in strings, separate the
variables by semicolons.

You can also change many operating modes in set up. Changing
them with a command does not save the new value in nonvolatile
memory.

ANSI Set/Reset Mode

Set ANSI standard operating mode   ESC [Ps ; ... ; Ps h
Reset ANSI standard operating mode   ESC [Ps ; ... ; Ps l

Ps	Mode	Set	Reset
0	Error (ignored)	--	--
2	Keyboard action	Lock	Unlock*
4	Insert/replace	Insert	Replace*
12	Echo	No echo*	Echo
20	Line feed/new line	New line	Line feed*

*Factory default setting

These are ANSI standard commands. They start with ESC [.

Private Set/Reset Mode

Set extended standard operating mode   ESC [? Ps ;...; Ps h
Reset extended standard operating mode ESC [? Ps ;...; Ps l

Ps	Mode	Set	Reset
Ø	Error (ignored)	--	--
1	Cursor key codes	Application	Normal*
2	Code set**	ANSI*	VT52
3	Columns	132	80*
4	Scrolling	Smooth*	Jump
5	Screen background	Reverse	Normal*
6	Origin mode	Relative	Absolute*
7	Autowrap	On	Off*
8	Auto repeat	On*	Off
1Ø	Communication***	Block	Conversation*
18	Page print terminator	FF	None*
19	Print region	Full page*	Scroll region
22	Keyclick***	Off	On*
23	Screen visibility***	Off	On*
25	Cursor visibility	On*	Off
26	Print mode***	Transparent*	Copy
27	Character intensity***	Full	Half*
3Ø	Set up fields***	Locked	Unlocked*

These are private sequences that ANSI permits within its
extended standards. They begin with ESC [?.

 *Factory default setting.
 **In VT52 mode, the terminal does not recognize set/reset
   commands. Enter ESC < to return from VT52 to ANSI mode.
***9220 mode only.

RESETTING OPERATING VALUES

The commands in this section let you reset the terminal from
the host or keyboard. Since values changed by programming
commands are only stored in current memory, reset operating
values revert to nonvolatile memory values when you turn the
terminal off.

Soft Reset   **SET UP**

Perform a soft reset*   **ESC [! p**

This command resets the operating values listed in Table 5-4.
You can also perform a soft reset by selecting Reset Terminal
in set up.

Soft reset changes operating values stored in nonvolatile
memory in the cases noted below.

Table 5-4
Effect of Soft Reset

Function/Mode	Reset Value
Text cursor	On**
Insert/replace	Replace
Origin mode	Absolute
Autowrap	Off**
Keyboard action.	Unlocked
Keypad mode	Numeric
Cursor key mode	Normal
Character set(s)	Terminal mode default set(s)
Character attributes	Normal
Selective erase attributes	Normal (erasable)
Cursor description (restored)	
Cursor position	Home
Character set	Terminal mode default
Selective erase attribute	Off
Visual attributes	Default
Origin mode	Absolute
Character shift	Default

*VT220 and 9220 modes only.
**Changes nonvolatile memory value.

Power—On Reset   **SET UP**

Reset the terminal to power—on   **ESC c**
(nonvolatile memory) values

This command, also called a hard reset, returns the terminal
to nonvolatile memory values. It replaces values changed (but
not saved) in set up or by a programming command. You can
also reset the terminal by turning it off and then on again,
pressing Ctrl Reset, or selecting Recall in set up. The
power—on reset has these effects:

      Disconnects the communications line
      Clears user-defined keys
      Clears any user-defined character set
      Clears the screen
      Returns the cursor home
      Sets visual attributes to normal
      Sets the selective erase attribute to nonselective erasable

Factory Default Reset

Return to factory default values*   **ESC [2 y**

This sequence resets all the operating values to the factory
default values. It does not, however, save the default values
in nonvolatile memory. When you turn the terminal off and
back on or perform a hard reset (above), the terminal returns
to the values saved in nonvolatile memory.

*9220 mode only.

KEYBOARD AND BELL

You can change the codes sent by some of the keys, control
keyboard operation, and ring the terminal bell.

Cursor Key Mode   SET UP
                                                   DEFAULT = Normal
Normal cursor key mode   ESC [? 1 l
Application cursor key mode   ESC [? 1 h

Cursor keys Cursor keys generate cursor movement codes.

Application keys Cursor keys do not move the cursor.
Instead, they generate escape sequences that are not commands
the terminal recognizes.

Enable application key mode if you want to use the cursor keys
for special purposes in a program, but retain the terminal
response to the cursor movement commands.

Table 5-5 shows the codes generated by the cursor keys in each
mode. See Appendix G for the codes the cursor keys send in
VT52 mode.

NOTE: When the terminal is in VT100 mode, keys F11 through
F14 also act as cursor keys.

Table 5-5
Cursor Key Codes

Arrow Key	VT100 Key	Cursor Mode	Application Mode
Up	F11	ESC [A	ESC O A
Down	F12	ESC [B	ESC O B
Right	F14	ESC [C	ESC O C
Left	F13	ESC [D	ESC O D

Keypad Mode   SET UP
                                               DEFAULT = Numeric
Enable numeric keypad mode   ESC >
Enable application keypad mode   ESC =

Numeric keypad Numeric keypad keys generate numbers.

Application keypad Numeric keypad keys generate user-definable control codes.

Table 5-6 shows the codes generated by the numeric keypad keys in each mode.

See Appendix G for PF key and VT52 mode key codes.

Table 5-6
Numeric and Application Mode Key Codes

Application Mode	Numeric Mode	Key
ESC O o	ØØ	ØØ
ESC O p	Ø	Ø
ESC O q	1	1
ESC O r	2	2
ESC O s	3	3
ESC O t	4	4
ESC O u	5	5
ESC O v	6	6
ESC O w	7	7
ESC O x	8	8
ESC O y	9	9
ESC O m	–	– (hyphen)
ESC O l	,	, (comma)
ESC O n	.	. (period)
ESC O M	CTRL M	ENTER

Disabling the Keyboard
                                          DEFAULT = Unlocked
Unlock the keyboard   ESC [2 l
Lock the keyboard   ESC [2 h

Keyboard locked The keyboard is locked (disabled), preventing
data entry. However, the following keys still function:

    Hold Screen
    Print Screen
    Set Up
    Reset

Keyboard unlocked To unlock the keyboard locally, press Ctrl-
Reset, or enter set up and reset the terminal, or turn the
terminal off and back on.

Disabling Set Up
                                          DEFAULT = Unlocked
Lock the set up fields*   ESC [? 3Ø h
Unlock the set up fields   ESC [? 3Ø l

Fields locked You can view the screens but cannot change any
values or take any actions except Clear Display, Clear
Communication, and Reset Terminal.

NOTE: This command is saved in nonvolatile memory. Resetting
the terminal does not unlock set up.

Fields unlocked Operator can change set up values.

Keyclick   SET UP
                                          DEFAULT = On
Keyclick on*   ESC [? 22 h
Keyclick off*   ESC [? 22 l

Keyclick on Keys click when pressed.

Keyclick off Keys are silent when pressed.

*9220 mode only.

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Auto Repeat Mode   SET UP
                                          DEFAULT = On
Auto repeat on   ESC [? 8 h
Auto repeat off   ESC [? 8 l

Repeat on Keys (except those noted in Chapter 3) repeat when
pressed for more than one-half second.

Repeat off No keys repeat.

NOTE: If you selected No Key Control in set up, the terminal
does not respond to this command.

Sounding the Bell

Sound the terminal bell   **CTRL G**

Insert this command in a program where you want the terminal
bell to sound (unless you disabled the bell in set up.)

SCREEN APPEARANCE

You can control almost all aspects of the screen appearance,
as well as the size and style of the characters and lines.

Screen Saver   SET UP
                                                DEFAULT Ps = 4
Select screen saver time*   ESC [2 ; Ps z

        Ps   Effect

        Ø   No screen saver
        1   Screen blanks after 5 minutes of inactivity
        2   Screen blanks after 10 minutes of inactivity
        3   Screen blanks after 15 minutes of inactivity
        ~
        12   Screen blanks after 60 minutes of inactivity

If the screen is not active (no data received from the
keyboard or computer) for the duration selected with this
command, the screen blanks to conserve the phosphor coating
inside the face of the screen.

Any data entry from the keyboard or host makes the display
reappear.

Screen Visibility Mode
                                                DEFAULT = On
Screen display on*   ESC [? 23 l
Screen display off*   ESC [? 23 h

Entering the display off command lets you hide your screen
display quickly, if necessary.

Screen Background   SET UP
                                                DEFAULT = Dark
Dark background   ESC [? 5 l
Light background   ESC [? 5 h

The screen background is either light with dark characters or
dark with light characters. If you send a command to select
the current screen background (defined in set up), no change
occurs.

*9220 mode only.

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Character Intensity Mode   SET UP
                                        DEFAULT = Half
Select full-intensity characters*   ESC [? 27 h
Select half-intensity characters*   ESC [? 27 l

This command defines the normal visual attribute (see below) as half or full intensity, whether you have selected light or dark characters. If you select the current value defined in set up, no change occurs.

Visual Attributes

                                        DEFAULT Ps = ∅
Select the visual attribute(s)   ESC [Ps ; ... ; Ps m

    Ps   Attribute

    ∅   Normal intensity
    1   Full intensity (when character intensity is half)
    2   Half intensity (when character intensity is full)
    3   Blank (invisible)*
    4   Underlined
    5   Blinking
    6   Double width*
    7   Reverse video
    22   Normal intensity
    23   Cancel invisible*
    24   Cancel underlined
    25   Cancel blinking
    26   Cancel double width*
    27   Cancel reverse video

Normal intensity and reverse video are defined by the values previously in effect (chosen in set up or by the commands above) for character intensity and screen background.

The full-intensity and half-intensity commands (Ps = 1 and 2) only change intensity from normal; they do not return intensity to normal.

If you select the current attribute, no change occurs.

Visual attributes do not occupy a character position (are not embedded). The current attribute set affects data subsequently entered anywhere on the screen.

*9220 mode only.

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You can combine attributes by separating the variables in the command with semicolons.

Changing character appearance can increase the visual impact of your screen display. Use this feature in forms and messages for clarity and emphasis.

Line Attributes

Define the cursor line as single-width characters	ESC # 5
Define the cursor line as double-width characters	ESC # 6
Define the cursor line as the top half of double-height/double-width characters	ESC # 3
Define the cursor line as the bottom half of double-height/double-width characters	ESC # 4

WARNING! Changing from single width to double width destroys all characters on the right half of the line.

Lines of double-width characters can contain only one-half the number of characters that a single-width line contains. An 80-column line can contain only 40 characters and a 132-column line, only 66. The cursor moves to the screen's right margin if it is in a column that moves beyond the right margin when you enable the double-width attribute.

Specify double-width/double-height lines in pairs (top line first) and send the same data to both. (The display may look strange until both lines are on the screen.)

Line attributes affect all current characters on the cursor line and any entered on that line after you change the attribute. Line attributes affect only the cursor line. The screen can contain lines with different attributes.

Most printers print one character for each character position. Thus, printing a page of double-height/width characters could result in four printed characters for each display character.

Figure 5-1 illustrates line attributes.

Figure 5-1
Line Attributes

Single-width (single-width, single-height characters) line (default)

Double-width (double-width, single-height characters) line

Double-height (double-width, double-height characters) line
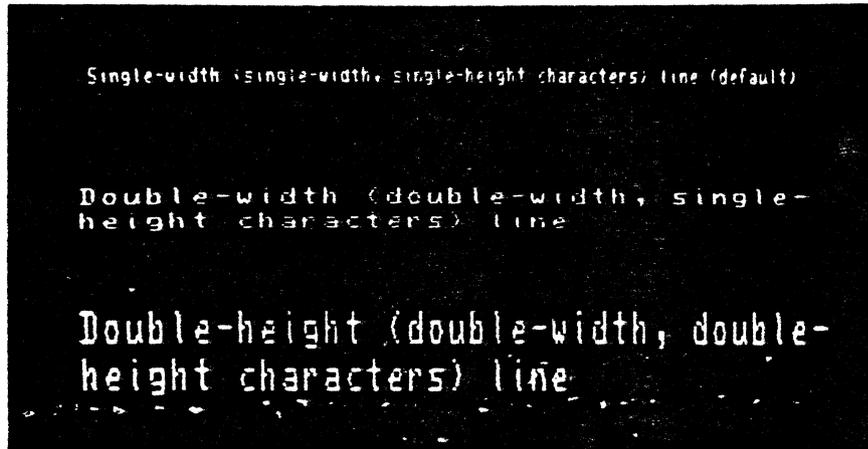
Columns Per Line	SET UP
	DEFAULT = 80
80 columns	ESC [? 3 1
132 columns	ESC [? 3 h

This command defines the number of columns (characters) in a line. You cannot mix 80- and 132- column lines within a page.

When you change from one column setting to another, the terminal:

Clears the screen to space characters.

Moves the cursor to home position.

Resets line attributes to normal.

Cancels any defined scrolling region.

Cursor Visibility Mode   SET UP
                                               DEFAULT = Visible
Select visible cursor   ESC [? 25 h
Select invisible cursor   ESC [? 25 l

Hide the cursor to avoid distracting the operator during
portions of a program.

Cursor Attributes   SET UP
                                               DEFAULT Ps = 0
Select cursor attribute*   ESC [3 ; Ps z

    Ps   Effect

    0   Blinking block
    1   Steady block
    2   Blinking underline
    3   Steady underline
    4   No cursor

If you select the current set up attribute, no change occurs.

Displaying the Status Line   SET UP
                                               DEFAULT Ps = Blank
Display the status line*   ESC [0 ; 1 z
Blank the status line*   ESC [0 ; 0 z

Chapter 3 describes the status line.

Programming the Status Indicators
                                               DEFAULT Ps = 0
Program status indicators   ESC [Ps ; ... ; Ps q

    Ps   Effect   Ps   Effect

    0   Clear all indicators
    1   Set indicator 1
    2   Set indicator 2
    3   Set indicator 3
    4   Set indicator 4

The four status indicators replace the light-emitting diodes
(LEDs) many terminals have. If you insert this command at any
of four points in a program, an indicator number appears in
full intensity in the status line as your program reaches each
point. The numbers can appear in any order.

*9220 mode only.

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CHARACTER SETS

The 9220 has four character sets:

    Multinational
         7-bit-compatible ASCII
         8-bit-compatible supplemental
    U.K.
    Special graphics
    User-definable

The multinational, U.K., and special sets are "hard" or
registered character sets: The name of the set and the
formation of each character is already determined. The user-
definable set is unregistered, or "soft": You name and create
the set yourself.

The 9220 character generator has two 128-character areas
called GL and GR. Commands in this section let you map
character sets into GL and GR. You can send both GL and GR
characters from the host, but the keyboard always sends the
set mapped into GL.

Hard Character Sets

The multinational character set has two parts: 7-bit ASCII
characters and 8-bit supplemental characters. Appendices C
and D show the multinational control and display characters.

The supplemental display characters are alphabetic characters
with accents and diacritical marks that appear in the major
Western European alphabets, plus other symbols not included in
the ASCII set. Mapping the supplemental set into GL lets you
display supplemental characters from the keyboard.

You can also select character sets of 16 languages in set up.
(Characters in each language are drawn from the multinational
character set.) Appendix E shows the keyboard of each
language. Corresponding keycap sets for some languages
(specified in Appendix A) are available from the TeleVideo
spare parts department.

The U.K. character set differs from the ASCII set only in the
pound sign, which replaces the number sign (hex code 23). It
is not available in VT220 mode.

The special graphics set emulates the VT100 line-drawing
character set. The line segments create a limited range of
figures in text mode.

Figure 5-2 shows the special and multinational character sets.
See Appendix D for corresponding bit codes and hex values.

Figure 5-2
Special and Multinational Characters
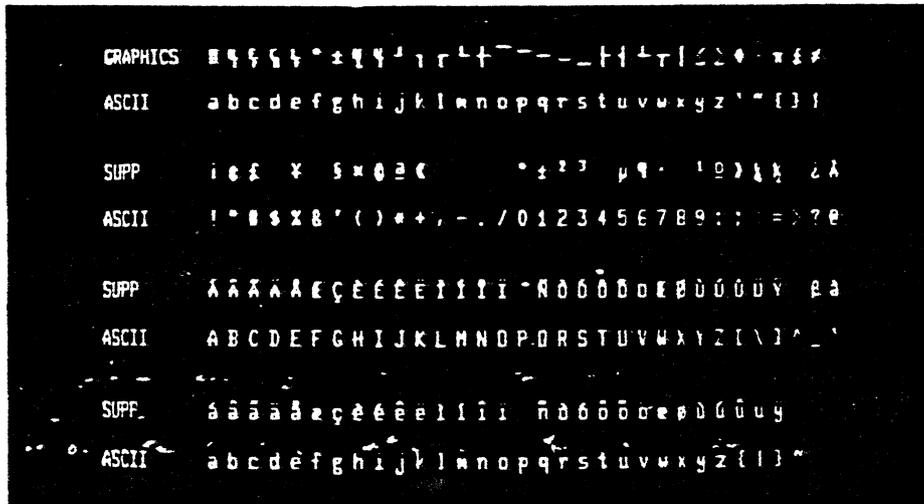
User-Definable Character Sets

You can create an unregistered, or soft, character set of up
to 94 characters and then load it into temporary memory.
Turning off the terminal clears the set from memory.

Each character's pixel matrix is divided into upper and lower
cells (columns). The upper cells are six pixels high and the
lower cells are four pixels high, as shown in Figure 5-3.
Each row of pixels has a bit number, with the least
significant bit (b$\emptyset$) at the top and the most significant bit
(b5 or b3) at the bottom.

Each pixel in the matrix has a bit value of zero if it is not
displayed in the character and a bit value of one if it is
displayed in the character.

Figure 5-3 shows the pixel matrix of the Greek uppercase sigma
character.

Figure 5-3
Greek Sigma Character

```
         U U U U U U U
         c c c c c c c
         c c c c c c c
         1 2 3 4 5 6 7

   bØ    0 0 0 0 0 0 0      Upper
   b1    1 1 1 1 1 1 1      Character
   b2    0 1 0 0 0 0 0      Cells
   b3    0 0 1 0 0 0 0      (Ucc1 ... Ucc7)
   b4    0 0 0 1 0 0 0
   b5    0 0 0 0 1 0 0
   bØ    0 0 0 1 0 0 0      Lower
   b1    0 0 1 0 0 0 0      Character
   b2    0 1 0 0 0 0 0      Cells
   b3    1 1 1 1 1 1 1      (Lcc1 ... Lcc7)

         L L L L L L L
         c c c c c c c
         c c c c c c c
         1 2 3 4 5 6 7
```

Creating a Soft Character Set	DEFAULT Pcn = 1;

Create and load a soft character set*

```
DEFAULT Pcn = 1;
Pfn/Pe/Pcms/Pw/Pt = Ø
ESC P Pfn ; Pcn ; Pe ;
Pcms ; Pw ; Pt { Dscs
Ucc1 ... Uccn / Lcc1
... Lccn ESC \
```

Pfn   Values

Ø, 1   Font buffer (interchangeable)

Pcn = a decimal value from Table D-2 for the character
set's starting position in the font buffer.

*VT220 and 9220 modes only.

The soft character set positions on the ASCII chart range
from ! (decimal 33) to ˜ (decimal 126). Your character
set can have one to 94 characters, and start anywhere in
the range of ! to ˜. Since position 1 corresponds to
ASCII character !, which has a decimal value of 33, you
can find the starting position's numeric value by finding
the decimal value of the ASCII character and then
subtracting 32. Table D-2 shows the corresponding ASCII
character for each Pcn value.

Pe   Effect

Ø   Erase all previously loaded characters in this set
1   Erase only characters that are being reloaded
2   Erase all characters in all soft sets

Pcms   Character Cell Size

Ø   Default (7x10)
1   Not used
2   5x10
3   6x10
4   7x10

Pw   Screen Width in Columns

Ø   Default (80 columns)
1   80 columns
2   132 columns

Pt   Values

Ø, 1   Font type (interchangeable)

Dscs = zero, one, or two intermediate characters (hex 2Ø-
2F) and one final character (hex 3Ø-7F) that name the
character set.

Three examples of Dscs names are

ASCII Characters	Hex Values Intmed.	Final	Effect
<sp> @	2Ø	4Ø	Defines the character set as an unregistered set. This is the recommended name for unregistered sets.
B		42	Replaces ASCII character set.
& % c	26 25	63	Defines the character set as an unregistered set.

Uccl ... Uccn / Lccl ... Lccn = ASCII characters derived from the binary values of the upper and lower cells in the pixel matrix. Read on:

Each cell (column) in the upper and lower sections of the pixel matrix (see Figure 5-3) has a binary value found by assigning a value of 1 to pixels displayed in the character and a Ø value to those not displayed. Upper cells can range from 000000 to 111111 (bit 5 is the most significant bit) and lower cells from 0000 to 1111 (bits 4 and 5 are omitted).

However, the character creation command uses ASCII characters for the cell values. To derive the ASCII character for each cell, find the decimal equivalent of the cell's binary value in Appendix C. Add 63. Enter the sum's corresponding ASCII character (from Appendix C) as the appropriate variable Uccn or Lccn (upper character cell n/lower character cell n).

NOTE: The slash (/) is part of the command.

If you give an unregistered set the name of a registered set (B, <, A, Ø), the unregistered set replaces the registered set in graphics mapping until you clear or rename the unregistered set (or reset the terminal).

You can load all 94 soft characters in one command, separating them with semicolons. If your set does not replace an existing registered set, the terminal uses it in addition to the registered sets.

For example, create a soft character set consisting of the Greek letter sigma. You want to start at the first position in the font buffer and erase all previous characters in this set, which is named <sp> @. Your screen width is 80 columns.

1. Send ESC P to begin the command sequence.

    If you are entering this command from the keyboard, press the Loc Esc key.

2. Enter the variable values (separated by semicolons):

Variable	Value	Specifies
Pfn	$\emptyset$	NA
Pcn	1	Character set starts at character position one (ASCII 1) in the font buffer.
Pe	$\emptyset$	Erase all previous characters in this set.
Pcms	$\emptyset$	Default cell size (7x10).
Pw	$\emptyset$	Default (80-column) screen width.
Pt	$\emptyset$	NA

3. End the variable string with {. Now you are ready to name the set and give the upper and lower cell values.

4. Enter ASCII characters <space> and @ to name the character set.

5. Calculate the binary value of each upper character cell and lower character cell. Convert binary to decimal, add 63, and convert again to ASCII:

Cell	Binary	Decimal	Plus 63	ASCII
Ucc1	000010	2	65	A
Ucc2	000110	6	69	E
Ucc3	001010	10	73	I
Ucc4	010010	18	81	Q
Ucc5	100010	34	97	a
Ucc6	000010	2	65	A
Ucc7	000010	2	65	A

Cell	Binary	Decimal	Plus 63	ASCII
Lcc1	1000	8	71	G
Lcc2	1100	12	75	K
Lcc3	1010	10	73	I
Lcc4	1001	9	72	H
Lcc5	1000	8	71	G
Lcc6	1000	8	71	G
Lcc7	1000	8	71	G

6.   Enter the string AEIQaAA/GKIHGGG for the character sigma. Be sure to include the slash.

7.   Enter ESC \ to end the command.

The complete command is

ESC P Ø ; 1 ; Ø ; Ø ; Ø ; Ø { <sp> @ AEIQaAA/GKIHGGG ESC\

Designating Character Sets

DEFAULT Pa = B; Pb = <

Designate character set GØ	ESC (Pa
Designate character set G1	ESC) Pa
Designate character set G2*	ESC * Pb
Designate character set G3*	ESC + Pb

Pa/Pb	Character Set
B	ASCII
<	Supplemental
A	U.K.
Ø	Special graphics
Dscs	Unregistered (soft)

Before you map a character set into the character generator, designate it as GØ, G1, G2 or G3.

Then map two of the designated sets into GL or GR areas of the character generator, using the commands that follow for mapping character sets.

Character sets remain designated until you designate another set or reset the terminal.

*VT220 and 9220 modes only.

Mapping Character Sets

Map G∅ into GL	CTRL N
Map G1 into GL	CTRL O
Map G1 into GR*	ESC ~
Map G2 into GL**	ESC n
Map G2 into GR**	ESC }
Map G3 into GL* **	ESC o
Map G3 into GR**	ESC ¦

Map designated character sets G∅, G1, G2 or G3 into GL or GR
with these commands.

In the default terminal emulation mode, VT220, the default
character set is the multinational set, with the ASCII set in
GL (displayed from the keyboard) and supplemental set in GR.

NOTE: The terminal does not accept the U.K. set during VT220
mode.

You can map the special graphics set into GL or GR, replacing
either the ASCII set or the supplemental set. If you replace
the ASCII set with the special graphics set in GL, you still
have about two-thirds of the standard ASCII characters. Also,
this mapping is compatible with VT100 terminal mode.

Character set mapping remains in the terminal's memory until
you reset or turn off the terminal (or redefine the set). The
terminal then returns to default character set mapping.

Mapping a Single Character

Map G2 into GL for one character**	ESC N
Map G3 into GL for one character**	ESC O

These commands map the character set designated G2 or G3 into
GL for a single character (the character sent immediately
following the command).

This command is useful for displaying a foreign character on
screen from the keyboard. Enter the command from the keyboard
with the Loc Esc key. See Appendix D for the supplemental and
special graphics characters that correspond to ASCII
(keyboard) characters.

*This sequence can cause software incompatibility problems.
**VT220 and 9220 modes only.

SCROLLING

Scrolling is the movement of data on the screen. The commands
in this section regulate the rate of scrolling, define a
scrolling region, and control your ability to move the cursor
outside of it.

Controlling the Rate of Scrolling   SET UP
                                           DEFAULT = Smooth
Enable jump scroll mode   ESC [? 4 l
Enable smooth scroll mode   ESC [? 4 h

Jump scroll Data scrolls onto the screen at the rate the
computer sends it.

Smooth scroll Data scrolls smoothly at six lines per second.

Defining a Scrolling Region
                                           DEFAULT Pt = 1; Pb = 24
Define a scrolling region   ESC [Pt ; Pb r

    Pt = the decimal number of the top line in the scrolling
    region

    Pb = the decimal number of the bottom line in the
    scrolling region

This command fixes certain lines on the screen, while
permitting the display to scroll through a section of the
screen. You can design pages, such as a business form, with a
defined head and foot area and a center area through which
data can scroll.

Count Pt and Pb from the screen's top line (line number one),
in single-height lines, even when you have configured the
display for double-height lines. Values range from 1 to 24.

The area outside the defined scrolling region is called the
memory-locked area (shown in Figure 5-4). Data in that area
cannot scroll. However, if you have not turned on origin
mode, you can move the cursor into that area and manipulate
data.

Defining a scrolling region moves the cursor to home position.
The next section explains how origin mode affects the location
of home position and the ability to move the cursor outside a
scrolling region.

Figure 5-4 shows a screen containing all double-height lines, with the defined scrolling region starting at line five and ending at line 18 (Pt = 5, Pb = 18).

Figure 5-4
Scrolling Region of Double-Height Lines
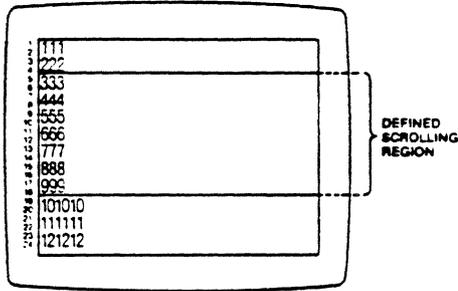
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Origin Mode

DEFAULT = Off

Origin mode on   ESC [? 6 h
Origin mode off   ESC [? 6 l

Origin mode on Display lines are numbered only in the defined
scrolling region. Home position is column 1, line 1 of the
scrolling region. You cannot move or address the cursor into
a memory-locked area.

Origin mode off Line numbers refer to all 24 screen lines,
regardless of scrolling region. You still cannot move the
cursor out of a scrolling region with the cursor movement keys
and commands. However, you can address the cursor to any
location on the screen, in or out of the scrolling region.

Once you have moved the cursor into a memory-locked area, you
can then move it around in the area (and back into the
scrolling region) with the cursor movement keys and commands.

Each time you set or reset origin mode, the cursor moves to
the new home position.

Figure 5-5 shows how origin mode affects line numbering on the
screen.

Figure 5-5
Effect of Origin Mode on Screen Line Numbers

ORIGIN MODE OFF:
Line Numbers Independent
of Scrolling Region

ORIGIN MODE ON:
Line Numbers Dependent
on Scrolling Region
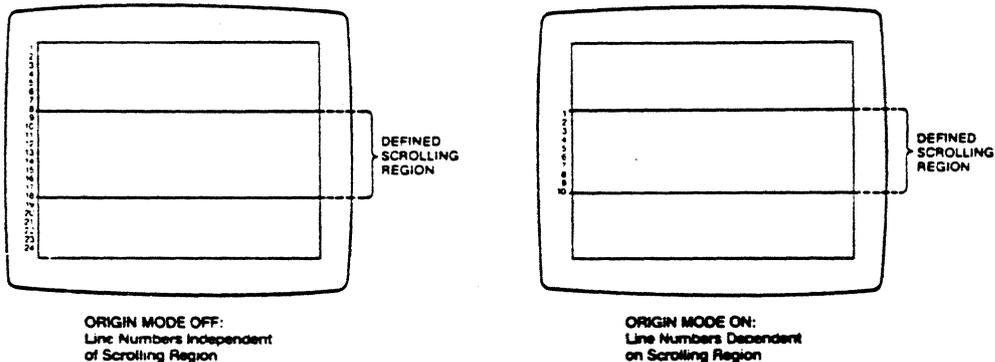
CURSOR CONTROL

The basic cursor movements move the cursor through a document, but do not scroll data off the screen. Scrolling cursor movements can scroll data off the screen.

New Line Mode	**SET UP** **DEFAULT = Off**
New line mode off	ESC [2∅ l
New line mode on	ESC [2∅ h

Mode on The Return key sends a carriage return and line feed; the terminal responds to a line feed command, from the keyboard or host, with a carriage return and line feed cursor movement.

Mode off The line feed command and Line Feed key only cause a line feed. The carriage return command and Return key cause only a carriage return.

Scrolling Cursor Movement

	DEFAULT Pn = 1
Index	ESC D
Move the cursor to the next line(s)*	ESC [Pn E
Reverse index	ESC M
Move the cursor to the previous line(s)*	ESC [Pn F
Line feed	CTRL J
	or CTRL K
	or CTRL L
Carriage return	CTRL M
New line (line feed/carriage return)	ESC E

Pn = A decimal value specifying the number of moves.

WARNING! Scrolling cursor movement commands can cause loss of data. Experiment with them on data you do not mind losing.

These commands move the cursor up or down within the display. When the cursor reaches the top or bottom of the screen or the defined scrolling region, the display scrolls. The lines that scroll off the screen are lost, and new lines of space characters appear at the other end of the screen.

If you enter the next or previous line command without a variable, the cursor moves one position.

*9220 mode only.

Basic Cursor Movement

DEFAULT Pn = 1

Move the cursor up	ESC [Pn A
Move the cursor down	ESC [Pn B
Move the cursor right	ESC [Pn C
Move the cursor left	ESC [Pn D
Back space	CTRL H

Pn = A decimal value specifying the number of moves.

These commands move the cursor within its current line or column. They cannot cause data to scroll off the screen. The cursor stops at the margins of the display or the defined scrolling region; it does not wrap around.

If you enter one of these commands without a variable, the cursor moves one position.

Cursor Addressing

DEFAULT Pl/Pc = 1

Address the cursor to line and column   ESC [Pl ; Pc H
                                      or ESC [Pl ; Pc f

Pl = A decimal value with one or two digits for the row (line).

Pc = A decimal value with one, two or three digits for the column.

This command moves the cursor to a designated line and column. For example, if you enter a value of one or zero for Pl and Pc, the cursor moves to the display's home position (line one, column one).

If you have defined a scrolling region and turned on origin mode, cursor addressing lines start at the top of the scrolling region, and you cannot address the cursor outside the scrolling region. If origin mode is off, the cursor can move within the entire display.

Cursor Home

Move the cursor to home position   ESC [H
                                    or ESC [f

The cursor home commands are simplified versions of the cursor addressing commands (above). They move the cursor to line 1, column 1 of the display or the scrolling region.

Cursor Description

Save the cursor description	ESC 7
Restore the cursor description	ESC 8

Save Saves the cursor position, character set, visual and selective erase attribute(s), and origin mode in current memory. When you reset the terminal, the cursor description returns to nonvolatile settings.

Restore Returns the cursor to the saved position and characteristics. If the cursor description was not previously saved, the cursor moves to home position and the other description values reset to nonvolatile settings.

TABS

The terminal's default tab stops are set at every eight columns, starting with column 9.

Changing the Tab Stops	SET UP
Set a tab stop	ESC H
Clear tab stop at cursor position	ESC [0 g
Clear all tab stops	ESC [3 g

Place the cursor where you want to set or clear just one tab stop and enter the command.

Cursor position is irrelevant when you clear all tab stops.

Turning off the power resets the terminal to the default tab stops, unless you save the new tab stops in set up.

Moving the Cursor to a Tab Stop

	DEFAULT Pn = 1
Tab forward to the next stop	CTRL I
Tab forward Pn tab stops*	ESC [Pn I
Tab backward Pn tab stops*	ESC [Pn Z

   Pn = the decimal number of tab stops

When the cursor reaches the end of a line, it does not move to the next line.

If you try to tabulate when no tab stops are set, the cursor moves to the last position on the current line.

*9220 mode only.

EDITING MODES

Editing modes affect the action of many editing commands, some of which can cause loss of data. If you are unsure about the setting of a mode or the effect of a command, experiment on data you don't mind losing.

Autowrap Mode	SET UP
	DEFAULT = Off
Autowrap mode off	ESC [? 7 l
Autowrap mode on	ESC [? 7 h

Mode on The cursor wraps from the end of one line to the start of the next line during data entry.

Mode off The cursor stops at the end of a line. Each character you enter at the end of a line writes over the previous character without advancing the cursor to the next line.

Insert/Replace Mode	
	DEFAULT = Replace
Enable replace mode	ESC [4 l
Enable insert mode	ESC [4 h

Insert mode Entering new data pushes existing data to the right. Excess data drops from the end of the line.

Replace mode New data writes over existing data.

EDITING DATA

You can edit data four ways:

    Write over existing characters
    Insert characters (a single character or a line)
    Delete characters (a single character or a line)
    Erase characters

The terminal must be in replace mode to write over existing characters.

Insert a Character

	DEFAULT Pn = 1
Insert character(s)*	ESC [Pn @

    Pn = the decimal number of characters inserted

This command inserts space characters with the current visual attributes at the cursor. Existing data moves to the right on the line. Characters pushed off the end of the line are lost. The cursor does not move.

Delete Character

	DEFAULT Pn = 1
Delete character(s)	ESC [Pn P

    Pn = the decimal number of characters deleted.

Deleting removes characters, starting with the cursor character. Data is drawn to the left from the end of the line, and space characters with the current visual attributes appear at the end of the line. Data from the next line does not wrap around, and the cursor does not move.

Insert a Line

	DEFAULT Pn = 1
Insert line(s)	ESC [Pn L

    Pn = the decimal number of lines inserted

This command inserts lines of single-height/single-width space characters with the current visual attributes at the cursor line and resets the line attribute. All lines below move down. Lines pushed off the page or out of the scrolling region are lost. The cursor moves to column one of the first new line.

*9220 and VT220 modes only.

Delete a Line

                                              DEFAULT Pn = 1
Delete line(s)   ESC [Pn M

Pn = the decimal number of lines deleted.

This command removes lines, from and including the cursor
line, and resets the line attribute. The lines beneath move
up. New bottom lines of single-height/single-width space
characters in the current visual attribute appear at the
bottom of the screen or defined scrolling region. The cursor
moves to the beginning of the new current line.

The terminal ignores the command if the cursor is outside the
scrolling region.

Erasing Characters

                                              DEFAULT Pn = 0
Erase character(s) in a line*   ESC [Pn X

Pn = the decimal number of characters erased

Erasing removes existing characters and their visual
attributes, replacing them with space characters and normal
attributes. Erased characters start at the cursor character
and can extend as far as the end of the line (depending on the
value of Pn). The cursor and remaining data do not move.

Erasing a Line

                                              DEFAULT Ps = 0
Erase the current line   ESC [Ps K

Ps   Amount Erased

0   From cursor to end of line
1   Start of line up to and including cursor
2   Entire line

This command removes existing characters and attributes,
replacing them with space characters and normal attributes.
The cursor and remaining data do not move. It does not reset
the line attribute.

*9220 and VT220 modes only.

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Erase Screen

DEFAULT Ps = $\emptyset$

Erase the screen   ESC [Ps J

   Ps   Amount Erased

   $\emptyset$ From cursor to end of screen
   1   Home position up to and including cursor
   2   Entire screen

All completely erased lines become single height, single width
with default visual attributes. A partially erased line (the
cursor line) retains its original line attributes.

Erase in Field

DEFAULT Ps = $\emptyset$

Erase in the current tab field*   ESC [Ps N

   Ps   Amount Erased

   $\emptyset$ From cursor to end of tab field
   1   Start of tab field up to and including cursor
   2   Entire tab field

The tab field extends from the previous tab stop or the
beginning of the line to, but not including, the next tab stop
or the end of the line. The cursor moves to the beginning of
the line or field when Ps = 1 or 2.

*9220 mode only.

Setting the Selective Erase Attribute

DEFAULT = 1

Set the character erase attribute*   ESC [Ps " q

    Ps   **Attribute**

    0   Erasable character(s)
    1   Nonerasable character(s)
    2   Erasable character(s)

Setting the erase attribute to nonerasable before entering
characters protects them from being erased by the selective
erase commands below. Change the attribute to erasable when
you finish entering data you want to protect.

Erase attributes, like visual attributes, are not embedded.
The current attribute affects data subsequently entered
anywhere on the screen, until you change the attribute. After
you change the attribute, previously entered characters retain
their attribute until you erase, delete or write over them.

Selective Erasing

DEFAULT Ps = 0

Erase only erasable characters in   ESC [? Ps K
the current line*
Erase only erasable characters in   ESC [? Ps J
the screen*

    Ps   **Amount Erased**

    0   Erasable characters from and including cursor to end
         of line or screen
    1   Erasable characters from start of line or screen up
         to and including cursor
    2   All erasable characters in the line or screen

These commands erase only erasable characters. They do not
reset line and visual attributes.

*9220 and VT220 modes only.

COMMUNICATING WITH A COMPUTER

The 9220 has three communication modes:

    Local
   Block
    Conversational

Programming commands can enable block or conversational mode, but not local.

Table 5-7 describes each communication mode, and Figure 5-6 shows how data flows in each mode.

Table 5-7
Communication Modes

Name	Effect
Block	In block mode the terminal first sends data only to the screen, so you can edit it before sending it to the computer. Block mode sends data faster than the conversational modes because the terminal transmits faster than you can enter data on the keyboard. The terminal can receive data from the computer in block mode.
Local	The main (computer) port is turned off. All commands and keyboard entries go only to the terminal's screen, and the terminal cannot receive any data from the computer.
Conversational w/no local echo	The terminal sends keyboard entries only to the computer. Characters and commands from the keyboard do not affect the screen unless the computer echoes the keycodes back to the terminal.
Conversational w/local echo	The terminal sends keyboard entries to both the screen and the computer. If your computer echoes back keycodes, two characters may appear on the screen for each typed character. If this happens, disable local echo.

Figure 5-6
Data Flow in Communication Modes
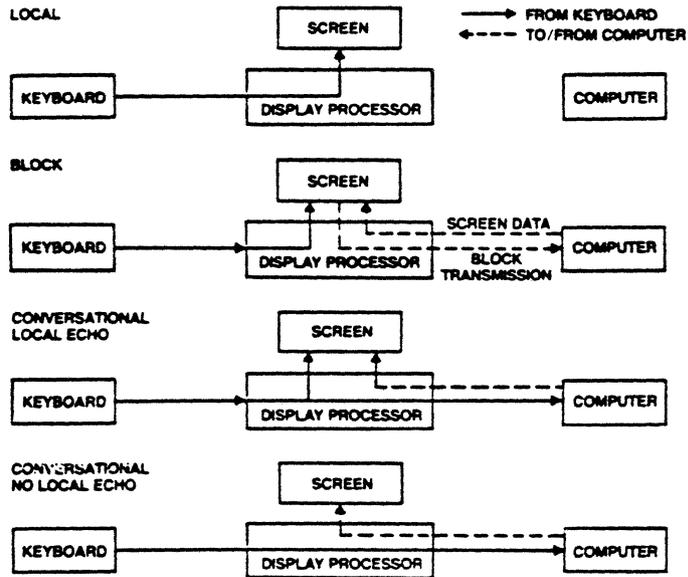
Setting the Communication Mode   SET UP
                 DEFAULT = Conversational
Enable block mode*   ESC [? 1∅ h
Enable conversational mode*   ESC [? 1∅ l

These commands let you move from one communication mode to
another while running a program.

Local Echo Mode   SET UP
                 DEFAULT = No echo
No local echo   ESC [12 h
Local echo   ESC [12 l

Enabling local echo mode during conversational mode sends key
codes to the screen as well as the computer.

Sending Transmit Control Characters

Send data to the computer (X-On) CTRL Q
Stop sending data to the computer CTRL S
(X-Off)

If transmit control is enabled in set up, the host can command
the terminal to stop sending characters with the X-Off (DC3)
commands. Sending X-On (DC1) permits the terminal to resume
sending characters.

The terminal cannot respond to the screen send command (below)
while X-Off is enabled.

Sending Screen Data in Block Mode

Send screen data to the host*   ESC 5

Sending data to the computer is a separate step during block
mode. This command is the same as pressing the Send key. It
sends all data from home up to and including the cursor. At
the beginning of each line, it sends the line attribute
command; at the beginning of any character set, it sends the
character set command.

*9220 mode only.

PRINTING

Print modes control how the terminal transmits data from the host or the screen to a printer.

You can choose in set up whether to send just ASCII/U.K. display characters, ASCII/U.K. and special graphics, or all characters. When you send double-height lines to the printer, the terminal sends each half of the line to the printer twice.

Table 5-8 describes print modes and commands, and Figure 5-7 shows the flow of data in print modes.

Table 5-8
Print Modes and Commands

Mode/Command	Effect
Buffered mode	Data from the host or keyboard flows through the terminal to the printer. Computer and printer baud rates can differ.
	The terminal can continue receiving data either from the keyboard or host while the printer output buffer empties. However, after the main port buffer and the printer port buffer fill (they each hold 256 characters), the terminal signals the host to stop sending data. When the main receive buffer empties, the terminal signals the computer to resume sending data.
	When the terminal receives the command to disable buffered mode, data already in the buffers continues going to the printer until the print buffer empties. Incoming data goes to the screen only.
Copy	Data from the computer goes to both the screen and the printer. Keyboard entries go to the printer and, if local echo is enabled, to the screen.
Trans-parent	Data from the computer cr keyboard (if local echo mode is enabled) passes through the terminal to the printer without being displayed on the screen. During transparent print, you cannot edit the existing screen display.

Table 5-8 Continued
Print Modes and Commands

| Mode/Command	Effect
Bidirectional mode	Data can pass both directions through the terminal. Computer and printer baud rates must be the same.
Copy	Data from the computer goes to both the screen and the printer. Keyboard entries go to the printer and, if local echo is enabled, to the screen. Data from the printer to the computer is not displayed on the screen.
Trans- parent	Data transmitted through the terminal is not displayed on the screen. During transparent print, you cannot edit the existing screen display.
Normal mode	Default print mode. Pressing F2 (Print Screen) causes a page print. Terminal responds to page print and line print commands.
Auto line print mode	The currently entered line prints when the terminal receives a linefeed, form feed, vertical tab, or autowrap. The printed line ends with a carriage return, plus the linefeed, form feed, or vertical tab that ended the line (a linefeed is added to autowrap lines). Pressing F2 (Print Screen) causes a page print.
Page print command	Prints the contents of the screen memory (page) or the scrolling region. Adds CR/LF after each line and FF after each page (unless print terminator character is disabled). Screen updating (from keyboard or computer) halts during transmission.
Line print command	Prints the cursor line. Adds CR/LF after the line.

Figure 5-7
Print Modes

BUFFERED
COPY

DATA DISPLAYED
ON SCREEN

COMPUTER

PRINTER

COMPUTER   PRINTER
   PORT   PORT

BUFFERED
TRANSPARENT

DATA NOT
DISPLAYED
ON SCREEN

COMPUTER

PRINTER

COMPUTER   PRINTER
   PORT   PORT

BIDIRECTIONAL
COPY

DATA DISPLAYED
ON SCREEN

COMPUTER

PRINTER

COMPUTER   PRINTER
   PORT   PORT

BIDIRECTIONAL
TRANSPARENT

DATA NOT
DISPLAYED
ON SCREEN

COMPUTER

PRINTER

COMPUTER   PRINTER
   PORT   PORT

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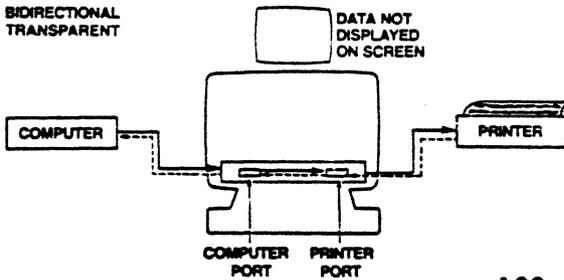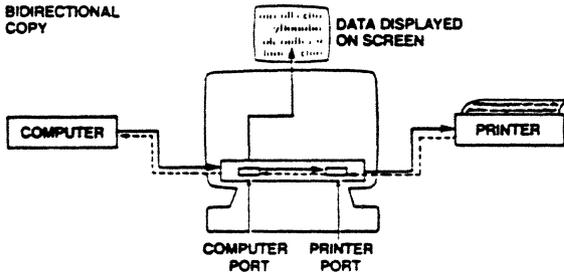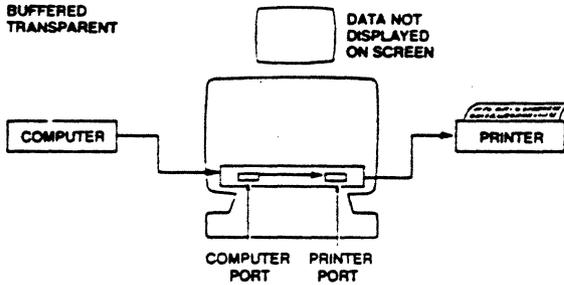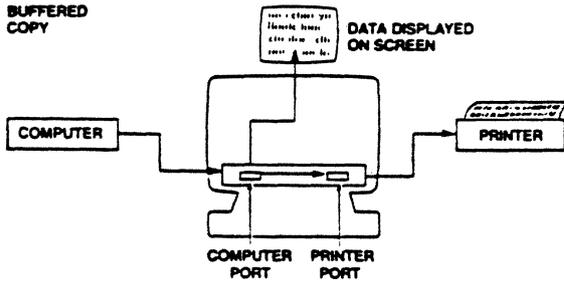
```
Buffered Print Mode                        SET UP
                                           DEFAULT = Transparent
Enable buffered transparent print          ESC [ 5 i
Enable buffered copy print*                ESC [ ? 7 i
Disable buffered print/enable              ESC [ 4 i
normal print
```

Enabling buffered print mode disables normal print mode. The computer and printer baud rates can differ during buffered printing.

```
Bidirectional Print Modes                  SET UP
                                           DEFAULT = Transparent
Select bidirectional as copy*              ESC [ ? 26 1
Select bidirectional as transparent*       ESC [ ? 26 h
Enable bidirectional print mode*           CTRL R
Disable bidirectional/enable normal        CTRL T
print*
```

Select transparent or copy bidirectional printing before you enable bidirectional print mode.

Enabling bidirectional print mode disables normal print mode.

NOTE: The computer and printer communication format must match during bidirectional print mode.

```
Auto Line Print Mode
                          .                DEFAULT = Disabled
Enable auto line print mode                ESC [ ? 5 i
Disable auto line print mode               ESC [ ? 4 i
```

Mode on The terminal sends the current line to the printer after each carriage return, a vertical tab, line feed or form feed.

Mode off Terminal returns to normal print mode.

*9220 mode only.

Print Region Mode   SET UP
DEFAULT = Full page
Print region is scrolling region   ESC [? 19 l
Print region is full page   ESC [? 19 h

Scrolling region The page print command sends only the
scrolling region to the printer.

Full page The page print command sends the entire screen to
the printer.

Line and Page Print

Page print   ESC [i
Line print   ESC [? 1 i

The screen print command lets you print the entire screen or
just the defined scrolling region, depending on which print
region mode you selected.

The line print command prints the cursor line.

Page Print Terminator Mode   SET UP
DEFAULT = No character
No terminator character   ESC [? 18 l
Form feed terminator   ESC [? 18 h

No terminator The terminal sends no terminating character
after a page print.

Form feed The terminal sends a form feed character (hex $0C$)
after a page print.

THE FUNCTION KEYS

Function keys F6 through F2Ø (including Help and Do) send
user-definable codes in 9220 and VT220 modes. The terminal
does not recognize the escape sequences as commands.

Both shifted and unshifted keys are reprogrammable in 9220
mode. Until reprogrammed, the shifted keys send no codes (are
empty).

In VT220 mode, only the shifted keys are reprogrammable.

Default Function Key Codes

The unshifted function keys send the escape sequences listed
in Table 5-9 in VT220 and 9220 modes.

Table 5-9
Unshifted Function Key Codes

Key   Code

Key	Code
F6	ESC [17 ~
F7	ESC [18 ~
F8	ESC [19 ~
F9	ESC [20 ~
F10	ESC [21 ~
F11	ESC [23 ~
F12	ESC [24 ~
F13	ESC [25 ~
F14	ESC [26 ~
Help	ESC [28 ~
Do	ESC [29 ~
F17	ESC [31 ~
F18	ESC [32 ~
F19	ESC [33 ~
F20	ESC [34 ~

Programming the Function Keys

Program a function key*

DEFAULT Pc/Pl/Stn = Ø
                Ps = 1
ESC P Pc ; Pl ; Ps ¦
Kyl / Stl ; Ky2 / St2
; ... ; Kyn / Stn ESC \

Pc	Effect
1	Clear only each key as it is reprogrammed
Ø	Clear all keys before reprogramming

Pl	Effect
1	Keys can be reprogrammed
Ø	Keys are locked and cannot be reprogrammed

Ps**	Message Destination
1	Host only (even when local echo is enabled)
2	Terminal
3	Host and terminal
4	Printer only

Unshifted Key	Kyn	Shifted Key	Kyn
F6	37	F6	17
F7	38	F7	18
F8	39	F8	19
F9	40	F9	20
F10	41	F10	21
F11	43	F11	23
F12	44	F12	24
F13	45	F13	25
F14	46	F14	26
Help	48	Help	28
Do	49	Do	29
F17	51	F17	31
F18	52	F18	32
F19	53	F19	33
F20	54	F20	34

Stn = hexadecimal values programmed into each key.

*VT220 and 9220 modes only.
**This variable recognized only in 9220 mode. Omit in VT220
mode.

The total capacity of the function keys is 512 bytes. Each shifted or unshifted set holds 256 bytes, and any function key can hold up to 255 bytes. Unshifted and shifted function key memories cannot be combined.

If you clear only the key you are reprogramming (Pc = 1), and the remaining byte capacity of all the keys is less than the number of bytes you attempt to load, your key loading sequence can fail because of insufficient space.

If Ps is omitted when local echo is enabled (in 9220 mode), the message goes to both the screen and the host.

Function key information is stored in nonvolatile memory, so you do not lose the key's contents when you reset or turn off the terminal.

Here are some examples of function key programming. Suppose you want unshifted key F14 to send the message STOP, and you don't want to clear any other keys. The command string would look like this:

```
ESC  P 1  ; 1    4 6 / 5 3  5 4  4 F  5 0   ESC \
                          S    T    O    P    END
DOWN-
LOAD         UNSHIFTED
              F14

       KEYS ARE
       REDEFINABLE

   CLEAR ONLY
   KEYS BEING
     LOADED
```
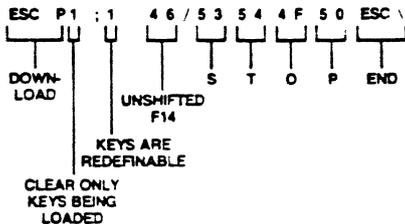
This string locks all the function keys:

ESC P 1 ; Ø ¦ ESC \

This string clears all the function keys:

ESC P Ø ; 1 ¦ ESC \

This string loads a message in shifted F6 to perform two carriage returns and indent 5 spaces:

ESC P 1 ; 1 ¦ 17 / ØD ØD 2Ø 2Ø 2Ø 2Ø 2Ø ESC \

TESTS AND REPORTS

Tests in this section are intended for service personnel.

Displaying Test Patterns

Display the screen adjustment pattern   ESC # 8
Display the character set pattern*   ESC # 9

The screen adjustment pattern fills the screen with uppercase
E's you can watch while adjusting the quality of the screen
display.

**STOP! DO NOT OPEN THE TERMINAL UNLESS YOU ARE A QUALIFIED
SERVICE TECHNICIAN.** Opening the case exposes you to potential
shock hazards, even after the terminal is turned off.

The character set pattern displays all characters (control and
display) of all terminal character sets and all visual and
line attributes.

*9220 mode only.

The Self Tests

Run self test(s)   ESC [4 ; Ps ;...; Ps y

    Ps   Test

    0   Tests 1, 2, 3, and 6
    1   Power-up self test
    2   EIA port data loopback test
    3   Printer port loopback test
    6   Modem control line loopback test
    7   20 mA loopback test
    9   Repeat selected tests

The tests are not necessarily executed in the order in which
you enter them.

The Answerback Message

Transmit answerback message   CTRL E

If you program an answerback message (in set up), the terminal
sends it when it receives this command. The terminal
automatically transmits the message after a disconnect.

Terminal Status Report

Report device status   ESC [5 n

The response indicates the internal hardware condition.

    ESC [∅ n   Terminal is OK
or ESC [3 n   Terminal is not OK

When the terminal is in a buffered print mode, the printer
receives the request, but cannot answer.

Cursor Position Report

Report cursor position   ESC [6 n

The terminal replies with the sequence

    ESC [Pl ; Pc R

Pl is the decimal line number and Pc is the decimal column
number. If origin mode is enabled, the line number is
relative only to lines inside the scrolling region.

Printer Port Status Report

Report printer port status   ESC [? 15 n

The terminal responds to a printer status report request with

    ESC [? 1∅ n   Printer ready
or ESC [? 11 n   Printer not ready
or ESC [? 13 n   No printer

Determine the printer status before changing the print mode or
starting a print function.

User-Defined Keys Status Report

Report user-defined keys status   ESC [? 25 n

The terminal responds

    ESC [? 2∅ n   Unlocked
or ESC [? 21 n   Locked

Your application program cannot reprogram the function keys if
the user-defined (function) keys are locked.

Device Attribute Requests

Report primary device attributes   ESC [c
Report secondary device attributes   ESC [> c

The terminal sends its ID in the primary device attribute
report. Default IDs in each terminal mode are

Mode   ID

VT220   ESC [? 62 ; 1 ; 2 ; 6 ; 7 ; 8 c

9220   ESC [? 63 ; 1 ; 2 ; 6 ; 7 ; 8 c

VT100   ESC [? 1 ; 2 c

VT52   ESC / Z

        1 = 132 columns
        2 = Printer port
        6 = Selective erase
        7 = User-defined character set
        8 = User-defined keys

The secondary report sends the terminal's identification
code, firmware version level, and the hardware options
installed. The report format is

     ESC [> 1 ; Pv ; Po c

     1 = Terminal identification code (9220)
     Pv = Firmware version
     Po = Options installed

For example, a 9220, firmware version A.∅, no options, would
respond

     ESC [> 1 ; 1∅ ; ∅ c

The Terminal ID

Send the terminal ID   **ESC Z**

Not all VT220 and VT100 software supports this command.

APPENDICES

APPENDIX A   SPECIFICATIONS

Cabinet	Touch tilt (-5 to +15 degrees) Swivel (270 degrees) Front-mounted power switch, brightness adjustment, and keyboard connector
Screen	14 inches measured diagonally Standard amber with green option Screen saver; selectable on/off and background color
Display	24 80- or 132-column lines 25th status line 8 set up screens
Character size	7 x 9 dot matrix
Character sets	U.S. and U.K. ASCII (96 upper- and lowercase display with descenders, 32 control), 32 special graphics, DEC supplemental (81 multinational display, 25 control), 94 user-definable soft font; 16 foreign language character sets selectable in set up
Visual attributes	Nonembedded, combinable, character-based; blink, blank, underline, full/half intensity, reverse, double width
Line attributes	Single or double wide and high
Cursor attributes	Blinking/steady, block/underline, invisible
Cursor control	Home (relative to or independent of scrolling region), up, down, right, left, carriage return, line feed, new line, tabs (forward and backward), save/restore position, address/read position
Editing	Character/line insert/delete, character/line/field/screen erase, selective erase; smooth or normal scrolling, defined scrolling region; cursor key and keypad application modes

Keyboard control	Enable/disable keyboard, keyclick, auto repeat; margin bell
Reprogramming	Up to 30 (15 unshifted and shifted) nonvolatile function keys; answerback; status indicators; terminal ID
Software compatibility	DEC VT52, VT100, VT220 ANSI X3.64 7- or 8-bit control transmission Optional Tektronix Plot 10 graphics
Communication modes	Conversational, block, local; local echo
Print modes	Buffered or bidirectional transparent/copy Auto line Normal Line or page print commands
Word structure	7 or 8 data bits; 1 or 2 stop bits
Parity	Odd, even, mark, space, or none
Ports	Computer: 25-pin full-duplex RS-423 and 8-pin 20-mA current loop Printer: 25-pin RS-232C Composite video: BNC connector
Buffers	256-character computer and printer
Protocol	X-On/X-Off or Data Terminal Ready at either RS-232C port
Baud rates	10 for each port (75 to 19,200)
Keyboard	Detached, DIN standard low profile, sculptured keycaps with home key indicators, N-key rollover with ghost key lockout
Keypads	Main (alphanumeric and editing) Cursor-edit Accounting-style numeric Function key row
Power	115/230 volt ac, 50/60 Hz

Dimensions	Height (in.) (cm)	Width (in.) (cm)	Depth (in.) (cm)
Cabinet	15.0 38.1	12.8 32.5	12.8 32.5
Keyboard	1.9 4.7	21.0 53.3	7.3 18.5

Footprint	12.5 x 11.5 inches
Weight	Net: terminal, 30 pounds; keyboard, 4.5 pounds
Ventilation	4 inches minimum on all sides
Temperature	Operating: 32 degrees F (0 degrees C) to 113 degrees F (45 degrees C) Storage: -40 degrees F (-40 degrees C) to 140 degrees F (60 degrees C)
Relative humidity	Operating: 10%-85% noncondensing Nonoperating: 10%-85% noncondensing
Option board	Dimensions: 8.25 in. x 8 in. Available power: 5V 1 amp (maximum) +12V 100 mA -12V $\emptyset$ amp
Options	Graphics board and mouse British, French/Belgian, Spanish, German/Austrian, Italian keycap sets. [Canadian (French), Danish, Dutch, Finnish, Flemish, Norwegian, Swedish, Swiss (French), Swiss (German) keycaps available by special order.]

APPENDIX B   STATEMENT OF LIMITED WARRANTY

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Products may be returned by Buyer only after a Return Material Authorization number ("RMA") has been obtained from TeleVideo by telephone or in writing. Buyer will prepay all freight charges to return any products to the repair facility designated by TeleVideo and include the RMA number on the shipping container. TeleVideo will, at its option, either repair the defective products or parts or deliver replacements for defective products or parts on an exchange basis to Buyer, freight prepaid to the Buyer. Products returned to TeleVideo under this warranty will become the property of TeleVideo. With respect to any product or part thereof not manufactured by TeleVideo, only the warranty, if any, given by the manufacturer thereof, applies.

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APPENDIX C   ASCII CODE TABLES

Table C-1
ASCII Code Chart

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

KEY

ESC	33	OCTAL
	27	DECIMAL
	1B	HEX

Table C-2
Supplemental Character Code Chart

BITS 8 7 6 5					1 0 0 0	1 0 0 1	1 0 1 0	1 0 1 1	1 1 0 0	1 1 0 1	1 1 1 0	1 1 1 1
4	3	2	1	Column → / Row ↓	8	9	A (10)	B (11)	C (12)	D (13)	E (14)	F (15)
0	0	0	0	0	200 128 80	DCS 220 144 90	240 160 A0	• 260 176 B0	À 300 192 C0	320 208 D0	à 340 224 E0	360 240 F0
0	0	0	1	1	201 129 81	PU1 221 145 91	¡ 241 161 A1	± 261 177 B1	Á 301 193 C1	Ñ 321 209 D1	á 341 225 E1	ñ 361 241 F1
0	0	1	0	2	202 130 82	PU2 222 146 92	¢ 242 162 A2	² 262 178 B2	Â 302 194 C2	Ò 322 210 D2	â 342 226 E2	ò 362 242 F2
0	0	1	1	3	203 131 83	STS 223 147 93	£ 243 163 A3	³ 263 179 B3	Ã 303 195 C3	Ó 323 211 D3	ã 343 227 E3	ó 363 243 F3
0	1	0	0	4	IND 204 132 84	CCH 224 148 94	244 164 A4	264 180 B4	Ä 304 196 C4	Ô 324 212 D4	ä 344 228 E4	ô 364 244 F4
0	1	0	1	5	NEL 205 133 85	MW 225 149 95	¥ 245 165 A5	µ 265 181 B5	Å 305 197 C5	Õ 325 213 D5	å 345 229 E5	õ 365 245 F5
0	1	1	0	6	SSA 206 134 86	SPA 226 150 96	246 166 A6	¶ 266 182 B6	Æ 306 198 C6	Ö 326 214 D6	æ 346 230 E6	ö 366 246 F6
0	1	1	1	7	ESA 207 135 87	EPA 227 151 97	§ 247 167 A7	• 267 183 B7	Ç 307 199 C7	Œ 327 215 D7	ç 347 231 E7	œ 367 247 F7
1	0	0	0	8	HTS 210 136 88	230 152 98	¤ 250 168 A8	270 184 B8	È 310 200 C8	Ø 330 216 D8	è 350 232 E8	ø 370 248 F8
1	0	0	1	9	HTJ 211 137 89	© 231 153 99	251 169 A9	¹ 271 185 B9	É 311 201 C9	Ù 331 217 D9	é 351 233 E9	ù 371 249 F9
1	0	1	0	A (10)	VTS 212 138 8A	ª 232 154 9A	252 170 AA	º 272 186 BA	Ê 312 202 CA	Ú 332 218 DA	ê 352 234 EA	ú 372 250 FA
1	0	1	1	B (11)	PLD 213 139 8B	CSI 233 155 9B	« 253 171 AB	» 273 187 BB	Ë 313 203 CB	Û 333 219 DB	ë 353 235 EB	û 373 251 FB
1	1	0	0	C (12)	PLU 214 140 8C	ST 234 156 9C	254 172 AC	¼ 274 188 BC	Ì 314 204 CC	Ü 334 220 DC	ì 354 236 EC	ü 374 252 FC
1	1	0	1	D (13)	RI 215 141 8D	OSC 235 157 9D	255 173 AD	½ 275 189 BD	Í 315 205 CD	Ŷ 335 221 DD	í 355 237 ED	ŷ 375 253 FD
1	1	1	0	E (14)	SS2 216 142 8E	PM 236 158 9E	256 174 AE	276 190 BE	Î 316 206 CE	336 222 DE	î 356 238 EE	376 254 FE
1	1	1	1	F (15)	SS3 217 143 8F	APC 237 159 9F	257 175 AF	¿ 277 191 BF	Ï 317 207 CF	β 337 223 DF	ï 357 239 EF	377 255 FF

KEY

ESC	33 OCTAL / 27 DECIMAL / 1B HEX

Table C-3
Displayed ASCII Control Characters

Control Code	ASCII Character	Hex Value	Character Displayed
CTRL @	NUL	00	NU
CTRL A	SOH	01	SH
CTRL B	STX	02	SX
CTRL C	ETX	03	EX
CTRL D	EOT	04	ET
CTRL E	ENQ	05	EQ
CTRL F	ACK	06	AK
CTRL G	BEL	07	BL
CTRL H	BS	08	BS
CTRL I	HT	09	HT
CTRL J	LF	0A	LF
CTRL K	VT	0B	VT
CTRL L	FF	0C	FF
CTRL M	CR	0D	CR
CTRL N	SO	0E	SO
CTRL O	SI	0F	SI
CTRL P	DLE	10	DL
CTRL Q	DC1	11	D1
CTRL R	DC2	12	D2
CTRL S	DC3	13	D3
CTRL T	DC4	14	D4
CTRL U	NAK	15	NK
CTRL V	SYN	16	SY
CTRL W	ETB	17	EB
CTRL X	CAN	18	CN
CTRL Y	EM	19	EM
CTRL Z	SUB	1A	
CTRL [	ESC	1B	EC
CTRL \	FS	1C	FS
CTRL]	GS	1D	GS
CTRL ^	RS	1E	RS
CTRL _	US	1F	US
DEL	DEL	7F	DT

Table C-4
Displayed Supplemental Control Characters

Escape Sequence	Supplemental Character	Hex Value	Character Displayed
ESC @	--	80	80
ESC A	--	81	81
ESC B	--	82	82
ESC C	--	83	83
ESC D	IND	84	84
ESC E	NEL	85	85
ESC F	SSA	86	86
ESC G	ESA	87	87
ESC H	HTS	88	88
ESC I	HTJ	89	89
ESC J	VTS	8A	8A
ESC K	PLD	8B	8B
ESC L	PLU	8C	8C
ESC M	RI	8D	8D
ESC N	SS2	8E	8E
ESC O	SS3	8F	8F
ESC P	DCS	90	90
ESC Q	PU1	91	91
ESC R	PU2	92	92
ESC S	STS	93	93
ESC T	CCH	94	94
ESC U	MW	95	95
ESC V	SPA	96	96
ESC W	EPA	97	97
ESC X	--	98	98
ESC Y	--	99	99
ESC Z	--	9A	9A
ESC [	CSI	9B	9B
ESC \	ST	9C	9C
ESC]	OSC	9D	9D
ESC ^	PM	9E	9E
ESC _	APC	9F	9F
--	///	FF	

APPENDIX D   CHARACTER SETS

Table D-1
ASCII, Supplemental and Special Graphics Characters

Supple-mental (Bit 7 High)	ASCII (Bit 7 Low)	Special	Binary Code								
			Bit 7 High	Low	6	5	4	3	2	1	0
	SP	SP	1	0	0	1	0	0	0	0	0
¡	!	!	1	0	0	1	0	0	0	0	1
¢	"	"	1	0	0	1	0	0	0	1	0
£	#	#	1	0	0	1	0	0	0	1	1
--	$	$	1	0	0	1	0	0	1	0	0
¥	%	%	1	0	0	1	0	0	1	0	1
--	&	&	1	0	0	1	0	0	1	1	0
§	' (apostrophe)	'	1	0	0	1	0	0	1	1	1
☐	(	(	1	0	0	1	0	1	0	0	0
©	)	)	1	0	0	1	0	1	0	0	1
ª	*	*	1	0	0	1	0	1	0	1	0
«	+	+	1	0	0	1	0	1	0	1	1
--	, (comma)	,	1	0	0	1	0	1	1	0	0
--	- (hyphen)	-	1	0	0	1	0	1	1	0	1
--	. (period)	.	1	0	0	1	0	1	1	1	0
--	/	/	1	0	0	1	0	1	1	1	1
°	0	0	1	0	0	1	1	0	0	0	0
±	1	1	1	0	0	1	1	0	0	0	1
²	2	2	1	0	0	1	1	0	0	1	0

Table D-1   Continued
ASCII, Supplemental and Special Graphics Characters

Supple-mental (Bit 7 High)	ASCII (Bit 7 Low)	Special	Binary Code								
			Bit 7 High	Low	6	5	4	3	2	1	0
³	3	3	1	0	0	1	1	0	0	1	1
--	4	4	1	0	0	1	1	0	1	0	0
µ	5	5	1	0	0	1	1	0	1	0	1
¶	6	6	1	0	0	1	1	0	1	1	0
•	7	7	1	0	0	1	1	0	1	1	1
--	8	8	1	0	0	1	1	1	0	0	0
¹	9	9	1	0	0	1	1	1	0	0	1
º	:	:	1	0	0	1	1	1	0	1	0
»	;	;	1	0	0	1	1	1	0	1	1
¼	<	<	1	0	0	1	1	1	1	0	0
½	=	=	1	0	0	1	1	1	1	0	1
--	>	>	1	0	0	1	1	1	1	1	0
¿	?	?	1	0	0	1	1	1	1	1	1
À	@	@	1	0	1	0	0	0	0	0	0
Á	A	A	1	0	1	0	0	0	0	0	1
Â	B	B	1	0	1	0	0	0	0	1	0
Ã	C	C	1	0	1	0	0	0	0	1	1
Ä	D	D	1	0	1	0	0	0	1	0	0
Å	E	E	1	0	1	0	0	0	1	0	1
Æ	F	F	1	0	1	0	0	0	1	1	0
Ç	G	G	1	0	1	0	0	0	1	1	1

Table D-1   Continued
ASCII, Supplemental and Special Graphics Characters

Supple-mental (Bit 7 High)	ASCII (Bit 7 Low)	Special	Bit 7 High	Binary Code							
				Low	6	5	4	3	2	1	0
È	H	H	1	0	1	0	0	1	0	0	0
É	I	I	1	0	1	0	0	1	0	0	1
Ê	J	J	1	0	1	0	0	1	0	1	0
Ë	K	K	1	0	1	0	0	1	0	1	1
Ì	L	L	1	0	1	0	0	1	1	0	0
Í	M	M	1	0	1	0	0	1	1	0	1
Î	N	N	1	0	1	0	0	1	1	1	0
Ï	O	O	1	0	1	0	0	1	1	1	1
--	P	P	1	0	1	0	1	0	0	0	0
Ñ	Q	Q	1	0	1	0	1	0	0	0	1
Ò	R	R	1	0	1	0	1	0	0	1	0
Ó	S	S	1	0	1	0	1	0	0	1	1
Ô	T	T	1	0	1	0	1	0	1	0	0
Ō	U	U	1	0	1	0	1	0	1	0	1
Ö	V	V	1	0	1	0	1	0	1	1	0
Œ	W	W	1	0	1	0	1	0	1	1	1
Ø	X	X	1	0	1	0	1	1	0	0	0
Ù	Y	Y	1	0	1	0	1	1	0	0	1
Ú	Z	Z	1	0	1	0	1	1	0	1	0
Û	[	[	1	0	1	0	1	1	0	1	1

Table D-1   Continued
ASCII, Supplemental and Special Graphics Characters

Supplemental (Bit 7 High)	ASCII (Bit 7 Low)	Special	Binary Code Bit 7 High	Low	6	5	4	3	2	1	0
Ü	\	\	1	0	1	0	1	1	1	0	0
Ÿ	]	]	1	0	1	0	1	1	1	0	1
——	^	^	1	0	1	0	1	1	1	1	0
β	(underline)	blank	1	0	1	0	1	1	1	1	1
à	` (grave)	◊	1	0	1	1	0	0	0	0	0
á	a	⫽	1	0	1	1	0	0	0	0	1
â	b	Hт	1	0	1	1	0	0	0	1	0
ã	c	FF	1	0	1	1	0	0	0	1	1
ä	d	Cя	1	0	1	1	0	0	1	0	0
à	e	Lf	1	0	1	1	0	0	1	0	1
æ	f	°	1	0	1	1	0	0	1	1	0
ç	g	±	1	0	1	1	0	0	1	1	1
è	h	Us	1	0	1	1	0	1	0	0	0
é	i	тт	1	0	1	1	0	1	0	0	1
ê	j	⌟	1	0	1	1	0	1	0	1	0
ë	k	⌐	1	0	1	1	0	1	0	1	1
ì	l	⌐	1	0	1	1	0	1	1	0	0
í	m	L	1	0	1	1	0	1	1	0	1
î	n	+	1	0	1	1	0	1	1	1	0
ï	o	—	1	0	1	1	0	1	1	1	1

Table D-1   Continued
ASCII, Supplemental and Special Graphics Characters

Supple-mental (Bit 7 High)	ASCII (Bit 7 Low)	Special	Bit 7 High	Binary Code Low	6	5	4	3	2	1	0
--	p	▬	1	0	1	1	1	0	0	0	0
ñ	q	▬	1	0	1	1	1	0	0	0	1
ò	r	▬	1	0	1	1	1	0	0	1	0
ó	s	▬	1	0	1	1	1	0	0	1	1
ô	t	⊦	1	0	1	1	1	0	1	0	0
õ	u	⊣	1	0	1	1	1	0	1	0	1
ö	v	⊥	1	0	1	1	1	0	1	1	0
œ	w	⊤	1	0	1	1	1	0	1	1	1
ø	x	│	1	0	1	1	1	1	0	0	0
ù	y	$\leqq$	1	0	1	1	1	1	0	0	1
ú	z	$\geqq$	1	0	1	1	1	1	0	1	0
û	{	π	1	0	1	1	1	1	0	1	1
ü	¦	$\neq$	1	0	1	1	1	1	1	0	0
ÿ	}	£	1	0	1	1	1	1	1	0	1
--	~	•	1	0	1	1	1	1	1	1	0
	DEL	DEL	1	0	1	1	1	1	1	1	1

Table D-2
Soft Pont Character Positions

ASCII Character	Pcn	ASCII Character	Pcn	ASCII Character	Pcn
!	1	6	22	K	43
"	2	7	23	L	44
#	3	8	24	M	45
$	4	9	25	N	46
%	5	:	26	O	47
&	6	;	27	P	48
'	7	<	28	Q	49
(	8	=	29	R	50
)	9	>	30	S	51
*	10	?	31	T	52
+	11	@	32	U	53
,	12	A	33	V	54
-	13	B	34	W	55
.	14	C	35	X	56
/	15	D	36	Y	57
0	16	E	37	Z	58
1	17	F	38	[	59
2	18	G	39	\	60
3	19	H	40	]	61
4	20	I	41	^	62
5	21	J	42	_	63

Table D-2 Continued
Soft Font Character Positions

ASCII Character	Pcn	ASCII Character	Pcn
`	64	p	80
a	65	q	81
b	66	r	82
c	67	s	83
d	68	t	84
e	69	u	85
f	70	v	86
g	71	w	87
h	72	x	88
i	73	y	89
j	74	z	90
k	75	{	91
l	76	¦	92
m	77	}	93
n	78	~	94
o	79		

APPENDIX E   CHARACTER SET KEYBOARDS

Table E-1
North American Keyboard
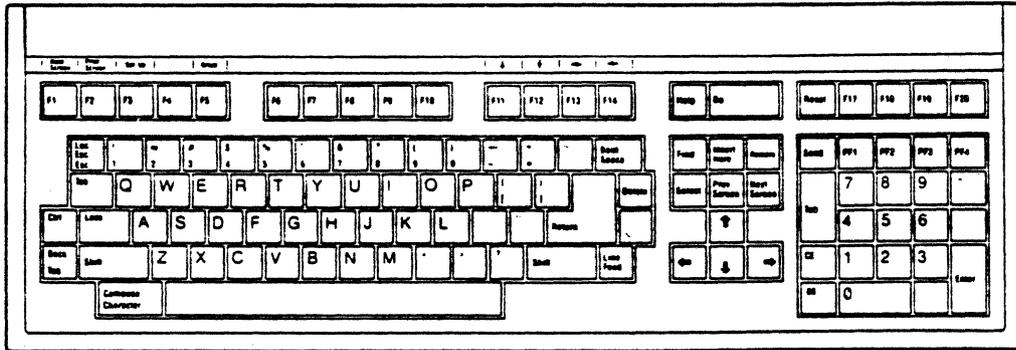
Table E-2
United Kingdom Keyboard*

*Keycap set available.

Table E-3
Flemish Keyboard

Table E-4
Canadian (French) Keyboard

Table E-5
Danish Keyboard

Table E-6
Finnish Keyboard

Table E-7
German/Austrian Keyboard*

* Keycap set available.
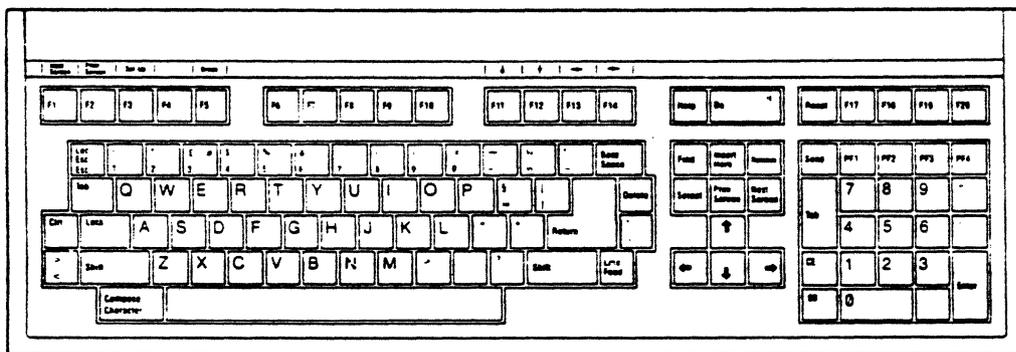
Table E-8
Dutch Keyboard

Table E-9
Italian Keyboard*
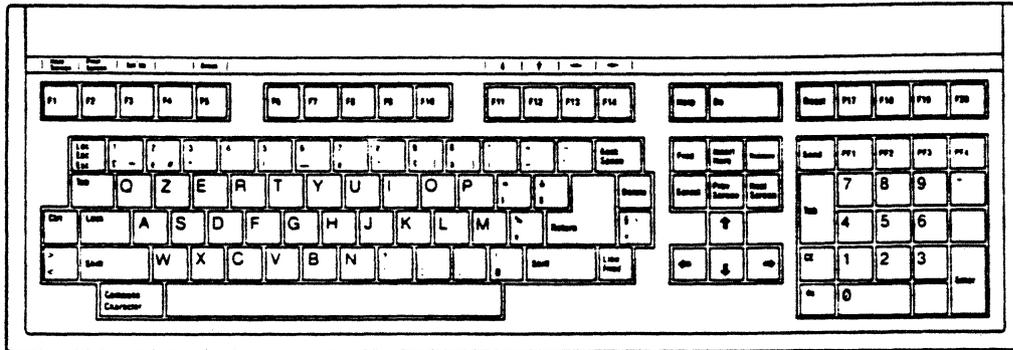
*Keycap set available.

Table E-10
Swiss (French) Keyboard
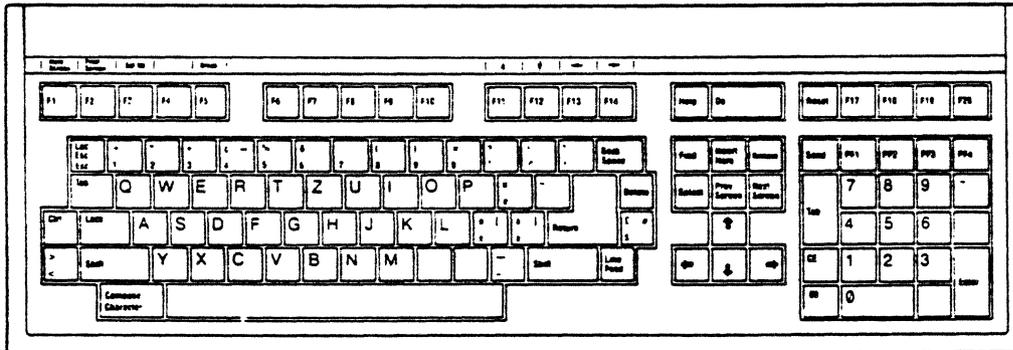
Table E-11
Swiss (German) Keyboard
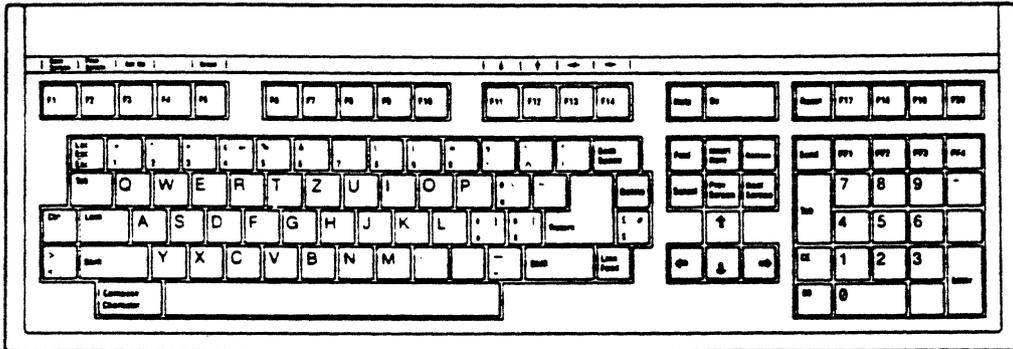
Table E-12
Swedish Keyboard
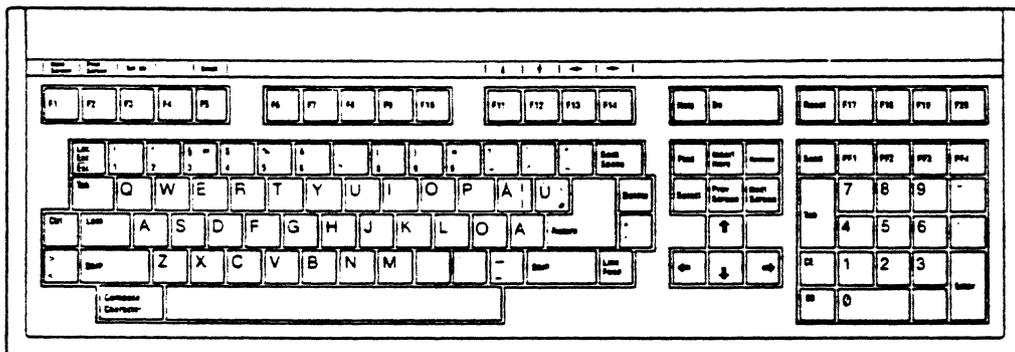
Table E-13
Norwegian Keyboard
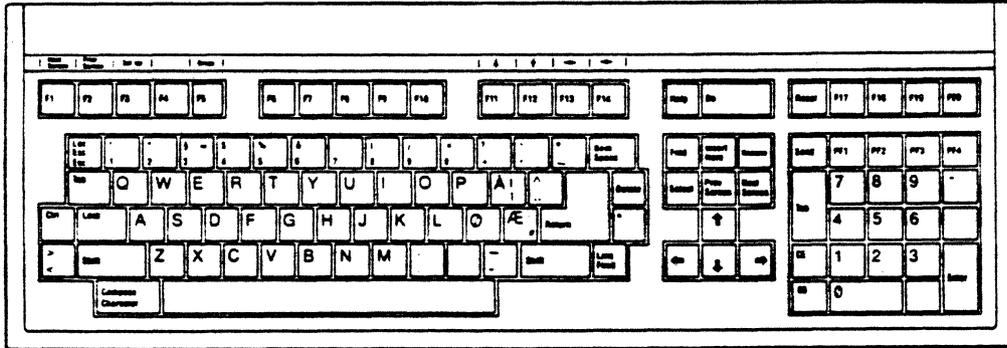
Table E-14
French/Belgian Keyboard*

*Keycap set available.

Table E-15
Spanish Keyboard*
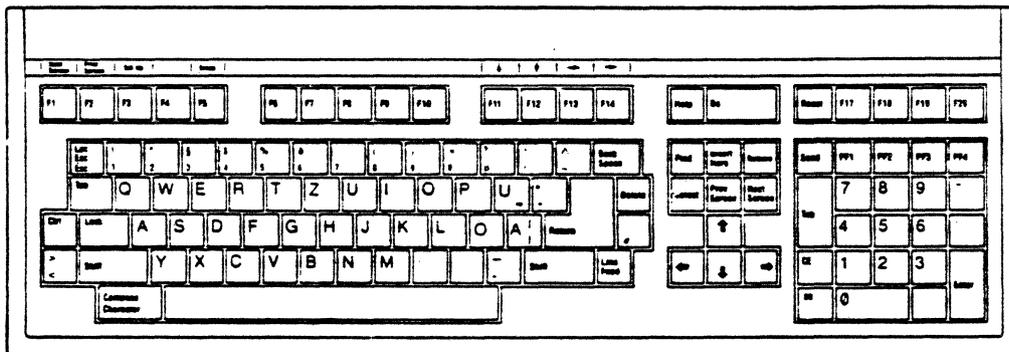
*Keycap set available.

APPENDIX F CONTROL CODES AND ESCAPE SEQUENCES

Table F-1
Control Codes

Command	Function
CTRL E	Transmit answerback message
CTRL G	Sound the terminal's bell
CTRL H	Back space
CTRL I	Tab forward to the next stop
CTRL J	Line feed
CTRL K	Line feed
CTRL L	Line feed
CTRL M	Carriage return
CTRL N	Map G∅ into GL
CTRL O	Map G1 into GL
CTRL Q	Send data to the computer (X-On)
CTRL R	Enable bidirectional print mode*
CTRL S	Stop sending data to the computer (X-Off)
CTRL T	Disable bidirectional/enable normal print*

*9220 mode only.

Table P-2
Escape Sequences

Command	Function
ESC <space> F	Set 7-bit control transmission mode**
ESC <space> G	Set 8-bit control transmission mode**
ESC # 3	Define the top half of double-height/ double-width characters
ESC # 4	Define the bottom half of double-height/double-width characters
ESC # 5	Define single-width characters
ESC # 6	Define double-width characters
ESC # 8	Display the screen adjustment pattern
ESC # 9	Display the character set pattern
ESC (Ps	Designate character set in G0
ESC) Ps	Designate character set in G1
ESC * Ps	Designate character set in G2**
ESC + Ps	Designate character set in G3**
ESC 5	Send screen data to the host*
ESC 7	Save the cursor description
ESC 8	Restore the cursor description
ESC <	Return to VT100 mode from VT52 mode
ESC =	Enable application keypad mode
ESC >	Enable numeric keypad mode
ESC D	Index
ESC E	New line (line feed/carriage return)
ESC H	Set a tab stop
ESC M	Reverse index
ESC N	Map G2 into GL for one character**
ESC O	Map G3 into GL for one character**
ESC P Pfn ; Pcn ; Pe ; Pcms ; Pw ; Pt [Dscs Uccl ... Uccn / Lccl ... Lccn ESC \	Create and load a soft character set**
ESC P Pc ; Pl ; Ps ¦ Kyn / Stn ESC \	Program a function key**
ESC Z	Send the terminal ID
ESC c	Reset the terminal to power-on (nonvolatile memory) values
ESC n	Map G2 into GL**
ESC o	Map G3 into GL**
ESC ¦	Map G3 into GR**
ESC }	Map G2 into GR**
ESC ~	Map G1 into GR

*9220 mode only.
**VT220 and 9220 modes only.

Table F-3
CSI Sequences

Command	Function
CSI Pn @	Insert character(s)**
CSI Pn A	Move the cursor up
CSI Pn B	Move the cursor down
CSI Pn C	Move the cursor right
CSI Pn D	Move the cursor left
CSI Pn E	Move the cursor to the next line(s)*
CSI Pn F	Move the cursor to the previous line(s)*
CSI H	Move the cursor to home position
CSI Pl ; Pc H	Address the cursor to line and column
CSI Pn I	Tab forward Pn tab stops*
CSI Ps J	Erase the screen
CSI Ps K	Erase the current line
CSI Pn L	Insert line(s)
CSI Pn M	Delete line(s)
CSI Ps N	Erase in the current tab field*
CSI Pn P	Delete character(s)
CSI Pn X	Erase character(s) in a line**
CSI Pn Z	Tab backward Pn tab stops*
CSI c	Report primary device attributes
CSI > c	Report secondary device attributes
CSI f	Move the cursor to home position
CSI Pl ; Pc f	Address the cursor to line and column
CSI Ø g	Clear tab stop at cursor position
CSI 3 g	Clear all tab stops
CSI i	Page print
CSI 4 i	Disable buffered print/enable normal print
CSI 5 i	Enable buffered transparent print
CSI Ps ; ... ; Ps m	Select the visual attribute(s)
CSI 5 n	Report device status
CSI 6 n	Report cursor position
CSI ! p	Perform a soft reset**
CSI 61 " p	VT100 mode
CSI 62 " p	VT220 8-bit control mode
CSI 62 ; Ø " p	VT220 8-bit control mode
CSI 62 ; 1 " p	VT220 7-bit control mode
CSI 62 ; 2 " p	VT220 8-bit control mode

*9220 mode only.
**VT220 and 9220 modes only.

Table P-3 Continued
CSI Sequences

Command	Function
CSI Ps ; ... ; Ps q	Program status indicators
CSI Ps " q	Set the character erase attribute**
CSI Pt ; Pb r	Define a scrolling region
CSI 2 y	Return to factory default values*
CSI 4 Ps ;...; Ps y	Run self test(s)
CSI Ø ; 1 z	Display the status line*
CSI Ø ; Ø z	Blank the status line*
CSI 2 ; Ps z	Select screen-saver time*
CSI 3 ; Ps z	Select cursor attribute*
CSI ? Ps K	Erase only erasable characters in the current line**
CSI ? Ps J	Erase only erasable characters in the screen**
CSI ? 1 i	Line print
CSI ? 4 i	Disable auto line print mode
CSI ? 5 i	Enable auto line print mode
CSI ? 7 i	Enable buffered copy print*
CSI ? 15 n	Report printer port status
CSI ? 25 n	Report user-defined keys status

*9220 mode only.
**VT220 and 9220 modes only.

Table P-4
ANSI Set/Reset Operating Modes

Command	Function
CSI Ps ; ... ; Ps h	Set ANSI standard operating mode
CSI Ps ; ... ; Ps l	Reset ANSI standard operating mode

Ps	Mode
2	Keyboard lock
4	Insert/replace
12	Local echo
2Ø	New line

Table P-5
Private Set/Reset Operating Modes

Command	Function
CSI ? Ps ;...; Ps h	Set extended standard operating mode
CSI ? Ps ;...; Ps l	Reset extended standard operating mode

Ps	Mode
1	Cursor key mode
2	ANSI/VT52
3	80/132 columns
4	Scroll mode
5	Screen background
6	Origin
7	Autowrap
8	Auto repeat
1Ø	Communication mode*
18	Print terminator character
19	Print region
22	Keyclick*
23	Screen display*
25	Cursor visibility
26	Bidirectional copy/transparent print*
27	Character intensity*
3Ø	Set up lock*

*9220 mode only.

Table F-6
VT52 Mode Commands

Command	Function
ESC >	Enable numeric keypad mode
ESC =	Enable application keypad mode
ESC <	Return to previous ANSI mode
ESC A	Cursor up
ESC B	Cursor down
ESC C	Cursor right
ESC D	Cursor left
ESC F	Enter graphics mode
ESC G	Exit graphics mode
ESC H	Cursor home
ESC I	Reverse line feed
ESC J	Erase to end of screen
ESC K	Erase to end of line
ESC V	Line print
ESC W	Enable buffered transparent print mode
ESC X	Disable buffered transparent print mode
ESC Y l c	Address cursor to line and column
ESC Z	Send terminal ID
ESC]	Page print
ESC ^	Enable autoprint mode
ESC _	Disable autoprint mode

APPENDIX G KEY CODES

Table G-1
Editing Key Codes

Key	ANSI* Code Unshifted	Shifted	VT52 Code Unshifted	Shifted
Up/F11**	ESC [A	ESC M	ESC A	ESC I
Down/F12**	ESC [B	ESC D	ESC B	ESC B
Right/14**	ESC [C	ESC [E	ESC C	ESC C
Left/13**	ESC [D	ESC [F	ESC D	ESC D
Back Space	CTRL H	CTRL H	CTRL H	CTRL H
Tab (Main)	CTRL I	ESC H	CTRL I	CTRL I
Back Tab***	ESC [Z	ESC [3 g	--	--
Line Feed	CTRL J	CTRL J	CTRL J	CTRL J
Return	CTRL M	CTRL M	CTRL M	CTRL M
CE	ESC [2 N	ESC [2 J	ESC [2 N	ESC [2 J
Tab (Kypd)	CTRL I	ESC [I	CTRL I	CTRL I
Send	ESC 5	ESC 5	ESC 5	ESC 5
Enter	CTRL M	CTRL M	CTRL M	CTRL M

Table G-2
PF Key Codes

Key	ANSI* Mode	VT52 Mode
PF1	ESC O P	ESC P
PF2	ESC O Q	ESC Q
PF3	ESC O R	ESC R
PF4	ESC O S	ESC S

Table G-3
Application Mode Cursor Key Codes*

Key	Code
Up/F11**	ESC O A
Down/F12**	ESC O B
Left/F13**	ESC O D
Right/F14**	ESC O C

   *VT100, VT220, and 9220 modes.
  **These function keys send the same codes as unshifted cursor
   keys in VT100 and VT52 modes.
***9220 mode only.

Table G-4
Application Mode Numeric Keypad Codes

ANSI* Mode	VT52 Mode	Key
ESC O o	ESC ? o	ØØ
ESC O p	ESC ? p	Ø
ESC O q	ESC ? q	1
ESC O r	ESC ? r	2
ESC O s	ESC ? s	3
ESC O t	ESC ? t	4
ESC O u	ESC ? u	5
ESC O v	ESC ? v	6
ESC O w	ESC ? w	7
ESC O x	ESC ? x	8
ESC O y	ESC ? y	9
ESC O m	ESC ? m	- (minus)
ESC O l	ESC ? l	, (comma)
ESC O n	ESC ? n	. (period)
ESC O M	ESC ? M	Enter

*VT100, VT220, and 9220 modes.

Table G-5
VT220 and 9220 Function Key Codes

Key	Code	Key	Code
Find	ESC [1 ~	F11	ESC [23 ~
Insert Here	ESC [2 ~	F12	ESC [24 ~
Remove	ESC [3 ~	F13	ESC [25 ~
Select	ESC [4 ~	F14	ESC [26 ~
Prev Screen	ESC [5 ~	Help	ESC [28 ~
Next Screen	ESC [6 ~	Do	ESC [29 ~
F6	ESC [17 ~	F17	ESC [31 ~
F7	ESC [18 ~	F18	ESC [32 ~
F8	ESC [19 ~	F19	ESC [33 ~
F9	ESC [20 ~	F20	ESC [34 ~
F10	ESC [21 ~		

APPENDIX H   CURRENT LOOP CONFIGURATION TABLES

Table H-1
Active Transmit and Receive

```
        Terminal              Host
        Pin Number            Port

        1 -----------|----> TxD -
                     |----> RxD -

        2 ----------------> RxD +

        3 <--------------- TxD +

---> 4
 |
 |      5 <---|
---> 6       |
             |
        7 <---|
             |
        8 <---|
```

Table H-2
Active Transmit and Passive Receive, -20 mA From Host

```
        Terminal              Host
        Pin Number            Port

        1 ----------------> RxD -

        2 ----------------> RxD +

        3 <---------------  -20 mA

---> 4                    TxD + ---|
 |                                 |
 |      5 <---|                     V
 |                          Signal Gnd
---> 6       |
             |
        7 <-- |  ---------- TxD -
             |
        8 <---|
```

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Table H-3
Active Transmit and Passive Receive, +20 mA From Host

```
        Terminal                Host
        Pin Number              Port

         1 ----------------> RxD -

         2 ----------------> RxD +

         3 <---------------   TxD +

---> 4                        TxD -    ----|
    |                                       |
    |    5 <---|                            V
---> 6        |                          Signal Gnd
    |         |
         7 <--|  . ----------   +20 mA
    |         |
         8 <---|
```
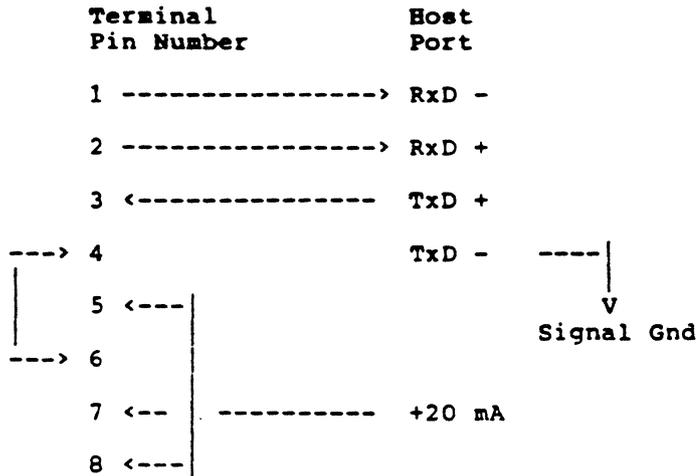
Table H-4
Passive Transmit and Receive, +20 mA From Host

```
        Terminal                Host
        Pin Number              Port

         1

         2 ----------------> RxD +

         3 <---------------   TxD +

---> 4
    |
    |    5 <---|------------   +20 mA
---> 6        |          |--- RxD -
    |         |          |--- TxD -
         7 <---|         |
    |                    V
         8         Signal Gnd
```

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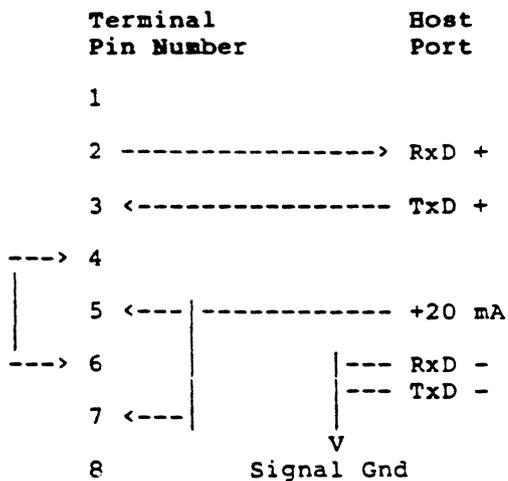
Table H-5
Passive Transmit and Receive, -20 mA From Host

```
        Terminal                  Host
        Pin Number                Port

        1

        2  <---|------------     -20 mA

        3  <---|                  RxD + -----|
                                  TxD + -----|
 --->  4                                     V
    |                                 Signal Gnd
    |    5  ----------------->  RxD-
    |
 --->  6

        7  <---------------  TxD -

        8
```
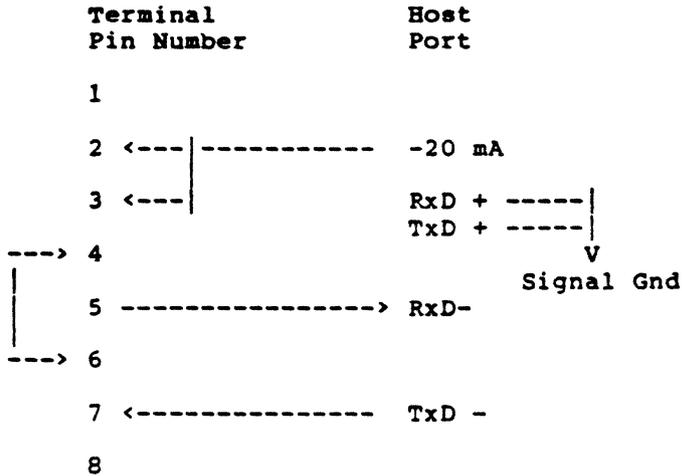
Table H-6
Passive Transmit and Active Receive

```
        Terminal                  Host
        Pin Number                Port

 --->  1
    |
    |    2  ----------------->  RxD +
    |
 --->  3                         RxD -   <-------|
                                                  |
 --->  4                         -20 mA  <------- |
    |
    |    5  ----------------->  Gnd
    |
 --->  6

        7  <----------------  TxD -

        8  <----------------  TxD +
```
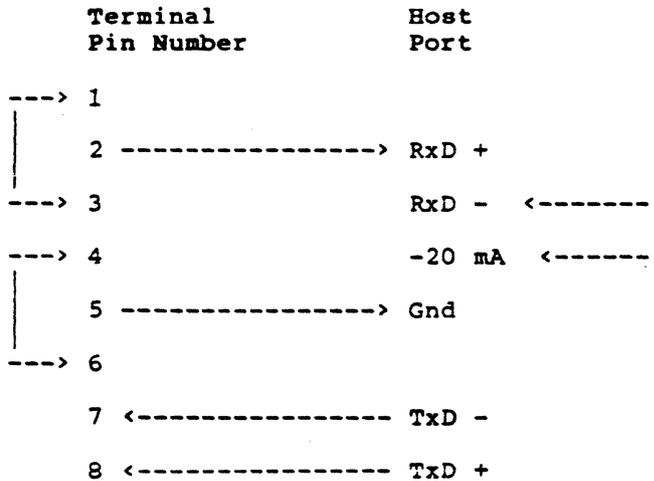
GLOSSARY

ACK An ASCII character (hex 06) meaning acknowledgement. Usually sent by the terminal to the computer to indicate page print or some local function is finished.

address Noun: A number identifying a unique location in the computer's memory where information is stored. Similar to a post office box number. Verb: To send something to a particular location. The computer can **address** the cursor to a specific line and column position on the screen.

alphanumeric characters Alphabetic, numeric, and special data symbols. The standard ASCII character set includes 96 alphanumeric characters. See **character, display characters.**

ANSI Acronym: American National Standards Istitute. A private organization that sets voluntary data processing standards. Sponsor of the ASCII communication standard and the ANSI X3.64 command standard. See **ASCII.**

answerback A programmable response sent to the computer upon request. Can identify a particular terminal when several terminals are connected to a computer, since each terminal's answerback can be unique. If 25 9220 terminals are connected to the computer, the fifth 9220 terminal could be programmed to reply, "9220 5." Answerback codes are also used with modems.

applications program A program to accomplish a specific task, such as word processing, financial analysis, or retrieval of corporate data. See **program, software.**

ASCII Acronym: American Standard Code for Information Interchange, pronounced ask-key. A standard set of characters used in most data transmission applications in the United States. An ASCII character is expressed as a group of 7 bits. The 128 ASCII characters (found in Appendix C) are divided into 96 alphanumeric (display) and 32 control characters. See **alphanumeric characters, control characters.**

autowrap A mode that automatically moves the cursor to the beginning of the next line after it reaches the end of the current line during data entry.

baud rate The number of binary bits transmitted per second.

bidirectional print A communication mode that enables two-way communication between devices attached to the computer and printer ports. Both devices must have the same baud rate, parity, word structure, and stop bits.

bit Acronym: binary digit. The simplest unit of data; always a one or a zero (meaning yes/no, on/off). A group of bits (usually seven or eight) that represents a character is called a byte. See **byte, character.**

block mode A communication mode that sends text entered from the keyboard only to the screen until you signal the terminal to send it as a block to the computer.

break signal A signal sent by the Break key that holds the communication line (pin 2 of the main RS-232C connector) in the 0 state (low) for 250 milliseconds. It does not affect the terminal's operation and no character appears on the screen. How your computer responds to the signal depends entirely on its programming. A break signal can cause a modem to disconnect.

buffer A temporary data storage location in the terminal's memory. Can be used to compensate for differences in transmission rates or temporarily store characters until the computer or printer can accept them. Buffers let data flow from the computer to the terminal at a different baud rate than from the terminal to the printer. See **handshaking protocol, DTR, X-On/X-Off.**

buffered print A print mode (either transparent or copy) that stores data in the terminal's buffer(s) when the computer sends data faster than the printer can receive it. See **transparent print, copy print, buffer.**

byte A group of bits (usually eight) representing a character. See **bit.**

character A unique, transmittable data symbol. See **display character, control character.**

character keys The keys that send display (alphanumeric) characters to the terminal and/or computer.

connector The device (plug or jack) at the end of the cable
and the electrical interface (port) of the computer, terminal,
printer, etc. RS-232 connectors are commonly D-shaped and
contain pins (male connector) or holes (female connector).
The number of pins varies between equipment manufacturers.
TeleVideo terminals have 25-pin female connectors.

control characters Characters that send a command to the
terminal, rather than being displayed on the screen. The
standard ASCII control characters are in the range of hex 00
to 1F. See the ASCII Control Chart in Appendix C.

controls display mode A mode in which the screen displays all
ASCII characters (control and alphanumeric) and does not act
on command characters.

conversational mode A communication mode that lets data flow
interactively from one communication device to another. See
full duplex, half duplex.

copy print A print mode that sends data from the computer to
the printer and the screen at the same time. Sometimes called
extension print. See transparent print, page print.

CRT Acronym: cathode ray tube. An electronic vacuum tube,
like a TV picture tube, that displays images. See screen.

cursor A marker showing where the next character should
appear on the screen. Can be blinking or steady, a block or
an underline, or invisible.

current loop A method of sending data as 20-milliampere
current pulses over a serial line (up to 700 meters).
Although usually slower than RS-232, it permits accurate
communication over longer distances. Either the computer or
the terminal may supply the current. The configuration chosen
(active or passive) depends on whether the terminal or
computer is supplying the power. If the terminal supplies the
current, configure the terminal's current loop for active; if
the computer supplies the current, configure the terminal for
passive. To determine correct configuration, think of a
person holding a garden hose with a nozzle on the end. If the
house supplies the water pressure to the hose and the person
merely opens the nozzle, the house is the active device and
the person is passive device. However, if opening and closing
the nozzle causes water to flow from (i.e., suctioned out of)
a holding tank within the house, the person is the active
device and the house is the passive device.

CTS Acronym: Clear to Send. A signal on a dedicated RS-232 line indicating that the computer is ready to receive more data from the terminal.

data Information that can be coded into bits, to be stored in a computer or terminal's memory and transmitted between devices.

DCD Acronym: Data Carrier Detected. A signal on a dedicated RS-232 line that indicates whether or not the data carrier in the phone system is active and the device at the other end of the phone line is available.

DCE Acronym: Data Communications Equipment. Usually the computer or the equipment connected to it.

default A value or instruction in effect until otherwise defined.

delete To eliminate (destroy) data stored in certain memory locations. See **erase**.

delimiter A code transmitted at the end of a predefined area (field) of data. Could be a field, end of line, or end of text delimiter.

descender That part of a lowercase character that hangs below the main body of the character. The tail of the lowercase y is a descender. A terminal with true descenders (such as TeleVideo's) displays the tail below the main line of text.

DIP Switches Acronym: Dual In-Line Package. A panel of very small switches.

display The amount of data that can be viewed on the terminal screen at one time. See **page, screen**.

display characters Characters that appear on the terminal's screen, including alphanumeric and graphic symbols. See **characters, alphanumeric characters, graphics characters**.

download To copy (read) data from the computer into the terminal's memory.

DSR Acronym: Data Set Ready. A signal on a dedicated RS-232 line indicating when the data coming from the computer is meant for your terminal (or another terminal on a network).

DTE Acronym: Data Terminal Equipment. Equipment that supports data transmission from a terminal.

DTR Acronym: Data Terminal Ready. A handshaking protocol that controls the flow of data between the terminal and the computer or printer by lowering and raising the voltage on pin 20 (the DTR line) in the RS-232C connector. See **handshaking protocol, X-On/X-Off, buffer**.

duplex Bidirectional communication. See **conversational mode, half duplex, full duplex**.

echo To send back received data. For example, in full duplex communication mode, the computer must echo back data it receives from the terminal before that data can be displayed on the screen.

EM Acronym: End of Message. An ASCII control character (hex 19) sometimes marking the end of a block transmission.

EPROM Acronym: Erasable, Programmable ROM. A read-only memory chip that can be erased and reprogrammed.

erase To replace data in certain memory locations with replacement characters. See **delete, replacement character**.

escape sequence A command introduced by an ASCII escape character (hex 1B) that controls terminal operations.

ETX Acronym: End of Text. An ASCII character (hex 03) that marks the end of a block transmission message.

extension print See **copy print**.

field A group of characters affected in the same way by commands (e.g., a tab field).

firmware A program embedded on a chip, usually called an EPROM, inside the terminal that tells the terminal how to operate. See **program**.

formatted Screen data that includes the delimiters that signal the line ends (e.g., CR, LF, and null) and end of the transmission. See **delimiter, page print**.

full duplex A communication mode that lets the terminal and computer transmit and receive simultaneously. Data from the computer is not displayed on the screen unless the computer echoes it back. See **echo**.

function keys Keys that send preset escape sequences whose application is user definable. Many TeleVideo terminals have reprogrammable function keys.

graphics characters Special non-ASCII characters used to draw lines, figures, and graphs.

half duplex An interactive communication mode that lets the terminal transmit and receive data in separate, consecutive operations. Key codes go to both the computer and the screen.

handshaking protocol Prearranged signals the computer and the peripherals send when they are ready to send or receive data. They prevent data loss when the other device is not able to accept or handle more data at that time. They can be ASCII control characters (X-On/X-Off) in the data stream or they can be raised or lowered voltage on RS-232C lines dedicated to that purpose (DTR). See **DTR, X-On/X-Off, DCD, DSR**.

hardware The physical components of a system, such as computer, terminals, cables, printers, modems.

hertz A unit of frequency (of electrical waves) equal to one cycle per second. If the frequency rate of the terminal does not match the frequency rate of the incoming alternating current, the display may waver. Abbreviated Hz.

hexadecimal A numbering system with a base of 16 (digits 0-9 and A-F). Commonly used by programmers to indicate locations and contents of a computer's memory. Abbreviated hex. See the ASCII Code Chart in Appendix C.

home The first character position on the page (line 1, column 1). Pressing HOME moves the cursor to this position.

host The computer controlling the terminal.

insert To add data within existing data, which is usually moved to the right at the point of insertion to make room for the new data.

interface   An interaction or connection between devices in a
computer system (i.e., the computer and peripherals).   See
current loop, RS-232C, RS-422.

interface cable   A cable with connectors that can be plugged
into the port connectors of the components in a system, thus
linking the various devices.   See connector, RS-232C,
interface.

keyboard   An arrangement of keys, similar to a typewriter's,
on which an operator can enter data, send commands, and
operate the terminal.

load   To program information into memory.

local mode   A mode that disconnects the terminal and computer.
Keyboard entries go only to the screen.   See block mode,
conversational mode.

menu   A displayed list of operating values from which the
operator can make selections.

millisecond   1/1000 of a second.

mode   An operating state that controls how the terminal
operates or reacts to commands.   For instance, in controls
display mode, the terminal displays all characters (including
control codes and escape sequences), not just alphanumeric
characters.   The terminal can be in several modes at the same
time, e.g., autowrap and duplex edit modes.

modem   Acronym: modulator/demodulator)   An electronic device
that changes digital signals (bits) to analog signals (tones),
or vice versa.   A modem translates digital signals from a
computer to analog signals, which can be sent across telephone
wires.   The modem at the other end translates the analog
signals back to digital signals and passes them on to the
other computer.

monitor   Hardware: A video screen on which you can see
computer output and input.

N-key rollover   A keyboard feature that lets you type faster
than the keyboard can transmit without locking up or missing a
character.   You can strike a series of keys virtually
simultaneously, and the characters will be transmitted in the
order in which the keys are pressed.

nonvolatile memory A permanent memory storage area not affected by loss of power. This memory is backed up by a lithium battery.

null An ASCII character (hex 00) that occupies no space and is not transmitted.

operating parameter A value (constant or selectable) that determines terminal operating characteristics, such as the speed of data transmission, the status of an operating mode, and operating appearance (dark or light screen background). See **mode**.

page The amount of available screen memory. Can range from 24 to 96 lines, depending on your terminal's configuration. Since the screen displays 24 lines at a time, you may not see the entire page. See **display, screen**.

page print A print command that sends data on the terminal's screen to the printer. See **formatted, unformatted**.

parameter See **operating parameter**.

parity A method of checking received data bits to ensure they are complete and accurate. If two devices are connected, the parity setting for both devices must be the same. See **start bit, stop bit**.

peripheral External equipment connected to a computer. The most common peripherals are terminals, disk drives, printers, modems, and cassette-tape recorders.

permanent memory See **nonvolatile memory**.

port The location at which data goes in and out of the device, usually the physical connector into which interface cables are plugged. See **connector, RS-232C, interface**.

program A set of commands that control a computer or terminal. There are three kinds of programs: firmware, which is burned into the EPROMs that control the system; applications, which accomplish specific tasks; and the operating system, which controls the overall operation of the system, directing the firmware and applications programs. See **firmware, applications program, software**.

RAM Acronym: Random-Access Memory. The changeable part of the computer or terminal's memory that can be read and written into during normal operation. It is erased (lost) when power to the RAM chip is turned off. RAM is used in all computers to store the instructions of programs being run. See **ROM**.

read the cursor Report the cursor's position and content to the computer.

refresh To change or update the screen with new data.

replacement character The character that occupies the position previously occupied by an erased character. Usually a space character. See **delete, erase, space character.**

resolution The sharpness of the characters on the display. When a character contains a lot of small dots (pixels), it is much sharper than a character containing only a few large dots.

reverse video A terminal feature that produces the opposite combination of characters and background from the one usually employed (i.e., light characters on a dark background if normally characters are dark on a light background).

ROM Acronym: Read-Only Memory. A memory chip that, after manufacture, can be read but not written or altered. Used to store permanent instructions.

RS-232C A standard technical specification written by the Electronic Industry Association for data sent as voltage pulses over a serial cable at distances up to 50 feet (although shielded wires allow greater length). See **interface, current loop, RS-422.**

RS-422 A technical specification for high-speed communication between the computer and a peripheral. When used, sends data faster than RS-232C while allowing the peripheral to be located up to 4,000 feet from the computer. See **interface, current loop, RS-232C.**

RTS Acronym: Request to Send. A line whose voltage changes to control data flow between computer, terminal, and printer. See **handshaking protocol.**

screen The terminal viewing area that shows 24 lines of data and a 25th status line. See **display, page.**

screen saver   A feature that causes the screen to go blank when no data entry or editing occurs for a fixed time span (e.g., 10, 20, or 30 minutes), thus preventing the display pattern from being burned into the phosphor. To redisplay the screen, press any key. No data is lost.

screen updating   Data changing on the terminal's screen as new data is received from the computer.

scroll   The action that moves the display (screen area) up or down in the page so you can see more than 24 lines on that page of memory. The direction, rate, and evenness of the scrolling can be controlled. See **page, display, screen**.

scrolling region   The area in a page of memory through which the display can scroll. Movement of the cursor is limited to the scrolling region.

self-test   A procedure that causes the terminal (or a program or peripheral) to check its own operation.

serial transmission   A method of sending one bit of data at a time in a stream. See RS-232C.

set up   A terminal mode that lets the operator change the terminal's operating values from the keyboard.

set up menu   Lines displayed on the screen during set up mode. Set up menus list all terminal operating values that can be changed from the keyboard.

software   Various programs, including the operating system and the applications programs, that can be loaded into the terminal. See **firmware, program, system**.

SOH   Acronym: Start of Header. An ASCII character (hex 01) that frames the start of block of data to be transmitted. See **EM**.

space character   An ASCII alphanumeric character (hex 20) that occupies a character position on the screen and in the terminal's memory. Not the same as a null, which looks like a space but contains nothing (i.e., is a void) and does not occupy memory space. The terminal transmits space characters, while it does not transmit null characters. See **null**.

special keys Keys that do not send display characters or editing commands, used for a variety of purposes in controlling the terminal.

status line A line appearing on the bottom (25th) line that describes the terminal's current operating conditions.

start bit The bit that signals the beginning of data transmission. It is always a one (1). **See parity, stop bit.**

stop bit The bit that signals the end of data transmission. It is always a one (1). The terminal can use either one or two stop bits, depending on the computer's requirements. See **parity, start bit.**

STX Acronym: Start of Text. An ASCII character (hex 02) signalling that text transmission follows.

system The computer, the peripheral devices (such as terminals, printers, and modems), and the programs that work together to accomplish various tasks.

tab stop A preset position to which the cursor goes when the TAB key is pressed or the terminal receives the tab command. Tab stops can be changed or deleted on command.

transmit To send data between one system component (such as the computer) and another (such as the terminal).

transparent print A print mode that sends all data received by the terminal to the printer without displaying it on the screen. See **copy print, bidirectional print, page print.**

unformatted Screen data that contains no delimiters marking line ends. See **delimiter.**

VDT Acronym: video display terminal. A terminal containing a cathode ray tube on which information received from the computer or keyboard can be displayed. Different than a terminal that uses a printer to display data. Video display terminals include a keyboard, while printer terminals may not.

visual attributes The aspects of a character's appearance on the screen. The character can be steady or blinking, full or half intensity, visible or blank (invisible), normal or reverse video, and underlined.

word structure The arrangement of bits in each piece of transmitted data. Consists of a start bit, the data bits, a parity bit (optional) and one or two stop bits.

X3.64 A uniform set of programming commands developed under the American National Standards Institute. **See ANSI, ASCII.**

X-On/X-Off A handshaking protocol in which the terminal and computer or printer recognize the ASCII control characters X-On (hex 11) and X-Off (hex 13) as signals to regulate data flow. **See handshaking protocol, DTR.**

QUICK REFERENCE GUIDE

TERMINAL PROGRAMMING MODES

Set 7-bit control transmission mode*   ESC <space> F
Set 8-bit control transmission mode*   ESC <space> G
VT220 8-bit control   ESC [62 " p
                                    or ESC [62 : Ø " p
                                    or ESC [62 : 2 " p
VT220 7-bit control   ESC [62 : 1 " p
VT100   ESC [61 " p
VT52   ESC [? 2 1
Return to VT100 mode from VT52 mode   ESC <

OPERATING MODE COMMANDS

Set ANSI standard operating mode   ESC [Ps ; ... ; Ps h
Reset ANSI standard operating mode   ESC [Ps ; ... ; Ps l
Set extended standard operating mode   ESC [? Ps ;...: Ps h
Reset extended standard operating mode   ESC [? Ps ;...; Ps l

RESETTING OPERATING VALUES

Perform a soft reset*   ESC [! p
Reset the terminal to power-on   ESC c
(nonvolatile memory) values
Return to factory default values**   ESC [2 y

 *VT220 and 9220 modes only.
**9220 mode only.

KEYBOARD AND BELL

Normal cursor key mode	ESC [? 1 l
Application cursor key mode	ESC [? 1 h
Enable numeric keypad mode	ESC >
Enable application keypad mode	ESC =
Unlock the keyboard	ESC [2 l
Lock the keyboard	ESC [2 h
Lock the set up fields*	ESC [? 30 h
Unlock the set up fields*	ESC [? 30 l
Keyclick on*	ESC [? 22 h
Keyclick off*	ESC [? 22 l
Auto repeat on	ESC [? 8 h
Auto repeat off	ESC [? 8 l
Sound the terminal's bell	CTRL G

SCREEN APPEARANCE

Select screen saver time*	ESC [2 ; Ps z
Screen display on*	ESC [? 23 l
Screen display off*	ESC [? 23 h
Dark background	ESC [? 5 l
Light background	ESC [? 5 h
Select full-intensity characters*	ESC [? 27 h
Select half-intensity characters*	ESC [? 27 l
Select the visual attribute(s)	ESC [Ps ; ... ; Ps m
Define the cursor line as single-width characters	ESC # 5
Define the cursor line as double-width characters	ESC # 6
Define the cursor line as the top half of double-height/double width characters	ESC # 3
Define the cursor line as the bottom half of double-height/double width characters	ESC # 4
80 columns	ESC [? 3 l
132 columns	ESC [? 3 h
Select visible cursor	ESC [? 25 h
Select invisible cursor	ESC [? 25 l
Select cursor attribute*	ESC [3 ; Ps z
Display the status line*	ESC [0 ; 1 z
Blank the status line*	ESC [0 ; 0 z
Program status indicators	ESC [Ps ; ... ; Ps q

*9220 mode only.

CHARACTER SETS

Create and load a soft character set*	ESC P Pfn ; Pcn ; Pe ; Pcms ; Pw ; Pt { Dscs Uccl ... Uccn / Lccl ... Lccn ESC \
Designate character set GØ	ESC (Pa
Designate character set G1	ESC) Pa
Designate character set G2*	ESC * Pb
Designate character set G3*	ESC + Pb
Map GØ into GL	CTRL N
Map G1 into GL	CTRL O
Map G1 into GR	ESC ~
Map G2 into GL*	ESC n
Map G2 into GR*	ESC }
Map G3 into GL*	ESC o
Map G3 into GR*	ESC ¦
Map G2 into GL for one character*	ESC N
Map G3 into GL for one character*	ESC O

SCROLLING

Enable jump scroll mode	ESC [? 4 l
Enable smooth scroll mode	ESC [? 4 h
Define a scrolling region	ESC [Pt ; Pb r
Origin mode on	ESC [? 6 h
Origin mode off	ESC [? 6 l

CURSOR CONTROL

New line mode off	ESC [2Ø l
New line mode on	ESC [2Ø h
Index	ESC D
Move the cursor to the next line(s)**	ESC [Pn E
Reverse index	ESC M
Move the cursor to the previous line(s)**	ESC [Pn F
Line feed	CTRL J
	or CTRL K
	or CTRL L
Carriage return	CTRL M
New line (line feed/carriage return)	ESC E

 *VT220 and 9220 modes only.
**9220 mode only.

CURSOR CONTROL

Move the cursor up	ESC [Pn A
Move the cursor down	ESC [Pn B
Move the cursor right	ESC [Pn C
Move the cursor left	ESC [Pn D
Back space	CTRL H
Address the cursor to line and column	ESC [Pl ; Pc H
	or ESC [Pl ; Pc f
Move the cursor to home position	ESC [H
	or ESC [f
Save the cursor description	ESC 7
Restore the cursor description	ESC 8

TABS

Set a tab stop	ESC H
Clear tab stop at cursor position	ESC [Ø q
Clear all tab stops	ESC [3 q
Tab forward to the next stop	CTRL I
Tab forward Pn tab stops*	ESC [Pn I
Tab backward Pn tab stops*	ESC [Pn Z

EDITING MODES

Autowrap mode off	ESC [? 7 l
Autowrap mode on	ESC [? 7 h
Enable replace mode	ESC [4 l
Enable insert mode	ESC [4 h

EDITING DATA

Insert character(s)**	ESC [Pn @
Delete character(s)	ESC [Pn P
Insert line(s)	ESC [Pn L
Delete line(s)	ESC [Pn M
Erase character(s) in a line**	ESC [Pn X
Erase the current line	ESC [Ps K
Erase the screen	ESC [Ps J
Erase in the current tab field*	ESC [Ps N
Set the character erase attribute**	ESC [Ps " q
Erase only erasable characters in the current line**	ESC [? Ps K
Erase only erasable characters in the screen**	ESC [? Ps J

*9220 mode only.
**VT220 and 9220 modes only.

COMMUNICATING WITH A COMPUTER

Enable block mode*	ESC [? 1Ø h
Enable conversational mode*	ESC [? 1Ø l
No local echo	ESC [12 h
Local echo	ESC [12 l
Send data to the computer (X-On)	CTRL Q
Stop sending data to the computer (X-Off)	CTRL S
Send screen data to the host*	ESC 5

PRINTING

Enable buffered transparent print	ESC [5 i
Enable buffered copy print*	ESC [? 7 i
Disable buffered print/enable normal print	ESC [4 i
Select bidirectional as copy*	ESC [? 26 l
Select bidirectional as transparent*	ESC [? 26 h
Enable bidirectional print mode*	CTRL R
Disable bidirectional/enable normal print*	CTRL T
Enable auto line print mode	ESC [? 5 i
Disable auto line print mode	ESC [? 4 i
Print region is scrolling region	ESC [? 19 l
Print region is full page	ESC [? 19 h
Page print	ESC [i
Line print	ESC [? 1 i
No terminator character	ESC [? 18 l
Form feed terminator	ESC [? 18 h

THE FUNCTION KEYS

Program a function key**	ESC P Pc ; Pl ; Ps ¦ Ky1 / St1 ; Ky2 / St2 ; ... ; Kyn / Stn ESC \

*9220 mode only.
**VT220 and 9220 modes only.

TESTS AND REPORTS

```
Display the screen adjustment pattern    ESC # 8
Display the character set pattern*       ESC # 9
Run self test(s)                         ESC [ 4 ; Ps ;...; Ps y
Transmit answerback message              CTRL E
Report device status                     ESC [ 5 n
Report cursor position                   ESC [ 6 n
Report printer port status               ESC [ ? 15 n
Report user-defined keys status          ESC [ ? 25 n
Report primary device attributes         ESC [ c
Report secondary device attributes       ESC [ > c
Send the terminal ID                     ESC Z
```

*9220 mode only.