

TeleVideo[®]
Video Display Terminal
Operator's Manual

970

TeleVideo® 970 Video Display Terminal Operator's Manual

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1. Introduction

Terminal Overview

TeleVideo's 970 terminal incorporates the latest advances in human engineering with advanced terminal features and ANSI X3.64-compatible codes.

User convenience and productivity had high priority when we designed the 970. The set up menu permits you to quickly change many of the advanced operating features from the keyboard. And the 970's unique cooling tower design eliminates noisy fans while reducing operating temperatures. The result is even greater reliability.

Optional Configurations

You can order the terminal with an optional configuration that substitutes an RS-422 interface for the standard RS-232C computer interface. Both configurations include an RS-232C printer interface.

You can also add a Tektronix 4010/4014-compatible graphics option with a graphics mouse.

Using This Manual

Organization

The manual contains the following chapters:

2. INSTALLATION

Installing the terminal

3. CONFIGURATION

Using the set up menu to

Configure the terminal to match the requirements of the computer and printer

Select the terminal's operating characteristics

Change the insert character

Set, change, or delete tab stops

4. OPERATION

Turning on and adjusting the terminal; editing and printing; a description of the status line

5. PROGRAMMING

Controlling the terminal with remote commands or the LOC ESC key

6. PERSONALIZING THE 970

Reprogramming the 970 and downloading special programs

7. TROUBLESHOOTING AND SERVICE

Troubleshooting, self testing, changing fuses, and obtaining assistance and service

APPENDICES

Specifications

Statement of limited warranty

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QUICK REFERENCE GUIDE

Control and escape commands

Symbols

Throughout the manual, the following symbols call your attention to information of special importance:

NOTE! *General information.*

STOP! *Warning concerning your safety or possible loss of data. When you see this note, STOP and read the note before proceeding!*

Commands

Escape sequences and control codes are shown with a space between the characters. Do **not** enter this space as part of the sequence; it is included only for the sake of clarity. For example, the sequence shown as

ESC c

involves pressing only the ESC key followed by the lowercase c key.

Enter commands exactly as shown so they will work as expected. Notice whether the command requires an upper- or lowercase character, a number **one** or a lowercase **L**, a **zero** or an uppercase **O**. Make sure the ALPHA LOCK key is not depressed.

CTRL and ESC Keys

Always press the CTRL (CONTROL) key first and hold it down while you press the other key. (The CTRL key is similar in action to the SHIFT key.)

The ESC (ESCAPE) key is used with one or more alphanumeric characters. Always press and release the ESC key before you press the next key.

Terminology

The optional lines of memory allow you to create pages that are longer than the 24-line screen display. In this manual, these terms are used:

Page An amount of memory. If you divide the memory into pages of more than 24 lines each, you may not be able to see the entire page of memory at one time since the screen displays 24 lines at a time.

Display The amount of memory that can be displayed at one time on the screen.

Screen The physical viewing area of the terminal.

2. Installation

WARNING!

Do not open the case as described in this manual unless you are a qualified technician. Opening the case exposes you to potential shock hazards.

Inspection

After you unpack the terminal, keep the shipping carton. Inspect the terminal for damage.

1. Inspect the keyboard, cabinet, and video screen.
2. Check the tilting mechanism. Loosen the knob on the left side and retighten it so the terminal can be tilted without loosening the knob again.

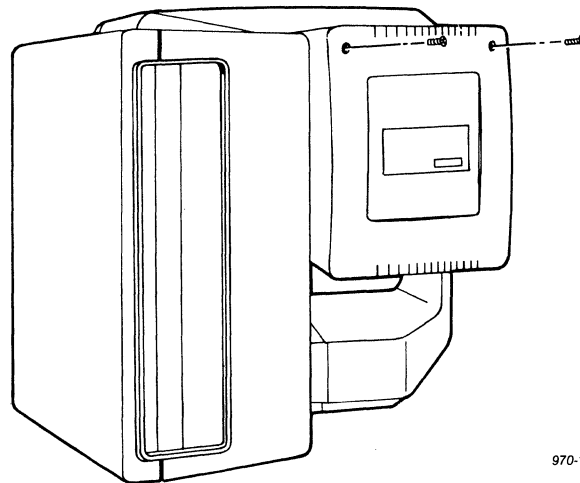
NOTE! *The 970 has a balanced touch-tilt mechanism that allows the cathode ray tube (CRT) to stay wherever you put it. Once you adjust the tilt resistance with the knob, you do not need to change the knob again to tilt the CRT.*

3. **STOP!** *Skip this step, as well as the next two steps, unless you are a qualified technician.*

Remove the two screws that hold the cover on the CRT's back, as shown in Figure 2-1. Pull the cover gently toward you to remove it.

STOP! *Keep your hands out of the case. If the CRT is broken, do not touch any broken fragments since they are extremely sharp and the tube's inner coating is poisonous.*

Figure 2-1
Location of Screws in CRT Cover



970-1

4. **Visually** inspect the CRT (Figure 2-2). If it is cracked or broken, call a service technician. Remember, do not reach inside the enclosure or touch any broken fragments.
5. Replace the cover and tighten the screws (Figure 2-3).

Figure 2-2
Location of CRT

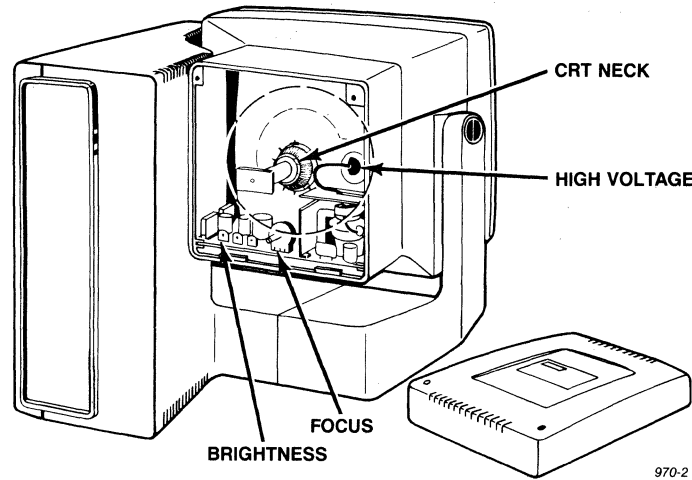
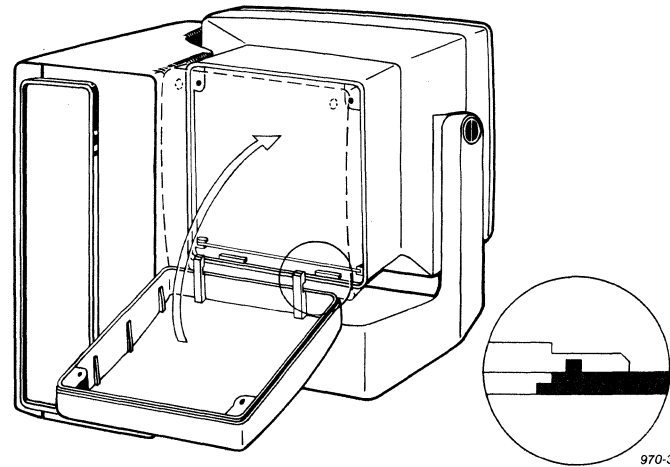


Figure 2-3
Replacing the CRT Cover



Site Requirements

The 970 terminal was designed with operator comfort in mind. However, the location of the terminal is also an important factor. Choose a site with indirect lighting and a table and chair that permit good working posture. If possible, place the terminal away from windows and other sources of bright light to prevent reflections that could cause eye strain.

Power Requirements

The 970 requires 110 volts alternating current (60 hertz) at 0.5 amp or 220 volts alternating current (50 hertz) at 0.25 amp. In the United States, use a 3-prong receptacle with a National Electrical Manufacturers Association (NEMA) Standard 5-15R rating.

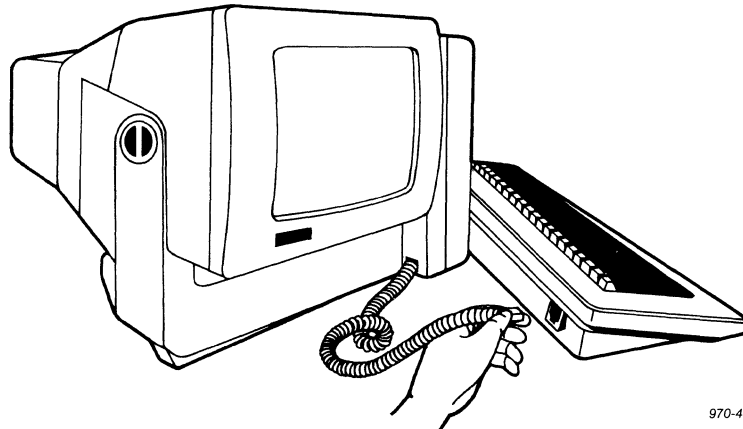
WARNING! *If you are installing this terminal outside the United States, you will need an adaptor between the power cord and the wall outlet or an ac cord approved in the country in which the terminal is being installed.*

Physical Requirements Make sure that the location you select for the terminal provides 4 inches (10.2 cm) around it for ventilation.

Installation Installing the terminal consists of five easy steps.

Connecting the Keyboard Plug the end of the coiled keyboard cable into the connector on the back of the keyboard case (Figure 2-4).

Figure 2-4
Connecting the Keyboard Cable



970-4

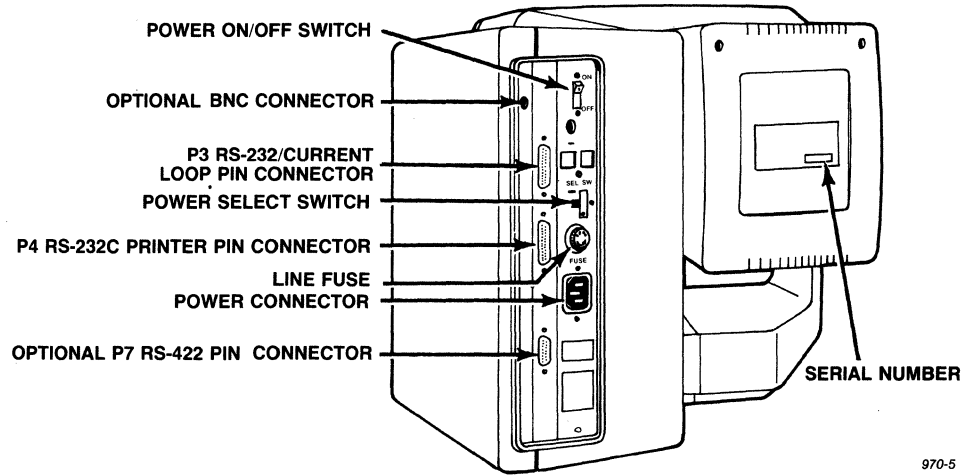
Setting Power Configuration Check the power select switch on the rear of the terminal (Figure 2-5). A blocking strip holds the power select switch in position for either 110 (US) or 220 (international) volt operation. Figure 2-6 shows the two possible switch positions. If you find the switch is not set for your power requirements, unscrew the blocking strip and move the switch. Then reattach the blocking strip.

Connecting the Terminal to a Computer System or Modem The types of input/output connectors (ports) on the terminal determine the type of interface cables required. Normally you specify this configuration when you order the terminal, but it can be changed by a service technician later. Two types of terminal interface configurations are possible:

Configuration	Computer Port	Printer Port
Standard	RS-232C	RS-232C
Optional	RS-422	RS-232C

If you order the terminal with an RS-422 interface, the terminal contains two RS-232C pin connectors and one RS-422 pin connector, but only the RS-232C connector labeled **P4 Printer** is connected internally. Current loop is part of the P3 RS-232C interface and thus is not available if you ordered the RS-422.

Figure 2-5
Rear View of Terminal



970-5

Figure 2-6
Power Select Switch Settings



a. 110 Volt Operation

b. 220 Volt Operation

The type of interface determines the maximum distance between the terminal and the computer or modem.

- RS-232C** Limits the distance between the terminal and computer or modem to 50 feet (if shielded, twisted-pair cable is used)
- Current loop** Already included in the RS-232C connector, it allows the terminal to be located up to 1,000 feet from the computer
- RS-422** Allows the terminal to be located up to 4,000 feet from the computer

Table 2-1 lists the suggested pin connector assignments for each connector type. Compare the pin assignments listed with those required by your computer before proceeding. If necessary, change the pin assignments of the interface cable.

Table 2-1
Pin Connector Assignments of Computer Interface
a. RS-232C (P3)¹

Pin No.	Signal Name ²	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	Carrier Detect	Input
20	Data Terminal Ready	Output

1. Refer to EIA Standard RS-232C for signal definitions.
2. For computer/modem interface.

b. Current Loop (P3)¹

Pin No.	Signal Name	Direction
9	20 mA Source (+ 12V, no load)	
10	Detected Current Loop Data	
12	Current Loop +	Receive
13	Current Loop -	Transmit
14	20 mA Source (+ 12V, no load)	
24	Current Loop -	Receive
25	Current Loop +	Transmit

1. Not used for modem interface.

c. RS-422 (P7)

Pin No.	Signal Name
1	Ground
2	Transmit High
3	Receive High
4	Request to Send High
5	Clear to Send High
6	Transmit Clock Low
7	Receive Clock Low
8	Ground
9	Transmit Low
10	Receive Low
11	Request to Send Low
12	Clear to Send Low
13	Transmit Clock High
14	Receive Clock High
15	Test

Connect the terminal to the computer or modem with an appropriate interface cable. To connect the terminal to a modem, use an RS-232C cable with pin assignments that correspond to those in Table 2-1a (i.e., non-current loop configuration).

Current loop is part of the P3 RS-232C interface only (i.e., not available on RS-422 configurations). To use current loop, use an RS-232C cable with pin assignments corresponding to Table 2-1b. For current loop, choose any **one** of the following configurations:

- Full duplex, active transmit, active receive
- Full duplex, active transmit, passive receive
- Full duplex, passive transmit, active receive
- Full duplex, passive transmit, passive receive
- Half duplex, active transmit/receive
- Half duplex, passive transmit/receive

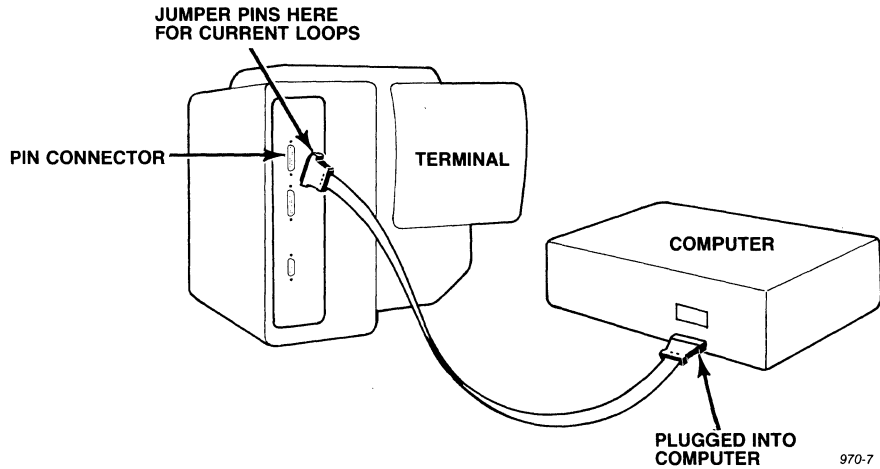
Once you have chosen the configuration compatible with your computer, jumper the appropriate pins in the computer interface cable connector, as described in Table 2-2.

Table 2-2
Configuration of Computer Interface Connector for Current Loop

Transmission	20 mA Current Source¹	Cable Connector Jumpers²	Pin No.³	Connector Polarity
Full duplex transmit	Active	9 to 25	7 13	- +
	Passive	-	13 25	- +
Full duplex receive	Active	14 to 12 3 to 10	7 24	- +
	Passive	3 to 10	12 24	+ -
Half duplex	Active	3 to 10 9 to 25 12 to 13	7 24	- +
	Passive	3 to 10 12 to 13	24 5	- +

1. Where source is 970.
2. Jumpers are within the interface connector going to the computer, as shown in Figure 2-7.
3. In the interface cable connector.

Figure 2-7
Current Loop Cable Connector Jumpers



Connecting the Terminal to a Printer

The terminal's RS-232C 25-pin interface labeled **P4 Printer** allows the terminal to be used with most RS-232C-compatible serial printers. Table 2-3 defines the printer interface cable pin connections.

Table 2-3
RS-232C Printer Interface (P4) Connector Assignments

Pin No.	Signal Name ¹	Direction
1	Protect 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
20	Data Terminal Ready	Input

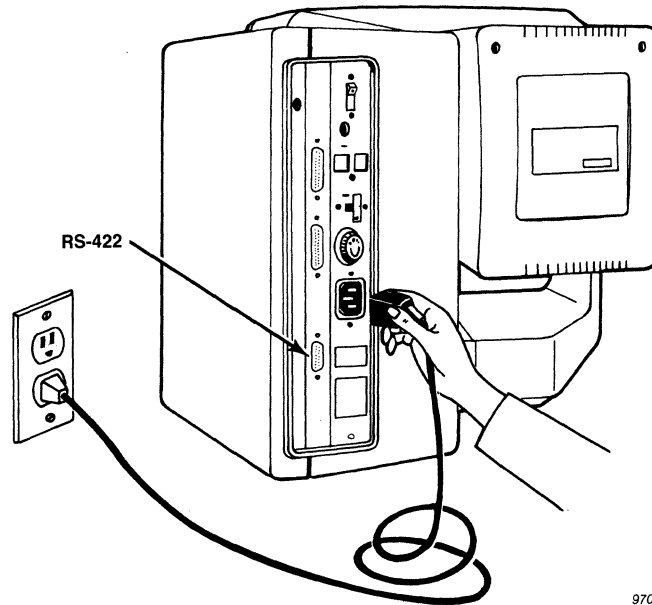
1. Refer to EIA Standard RS-232C for signal definitions.

NOTE! *Not all printers have a one-to-one pin compatibility with standard RS-232C pin assignments. If your printer does not operate properly, call the printer manufacturer for assistance in wiring the interface cable. If the printer fails to operate properly although the pin connections are correct, call TeleVideo for technical assistance.*

Plugging In the Terminal

After connecting all of the interface cables, plug the power cable into the terminal and into the wall outlet. Refer to Figure 2-8. Outside the United States you may need an adaptor between the power cord and the wall outlet.

Figure 2-8
Plugging Power Cord into Terminal and Wall Outlet



970-8

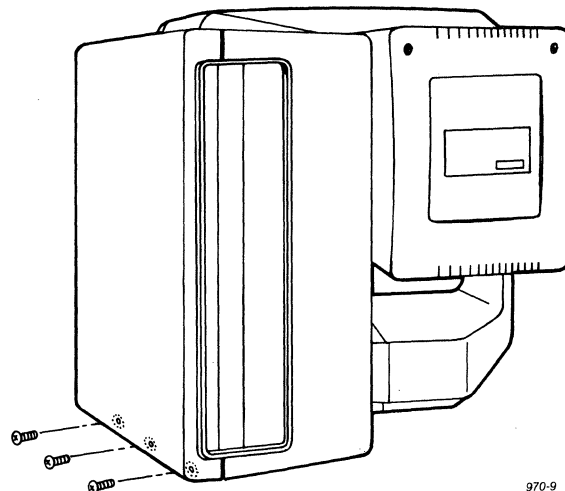
Field Modifications

If you want to drive a monitor in addition to the terminal monitor (i.e., add a composite video option), add an Amphenol BNC connector (Amphenol part 227169-5) to the logic board.

STOP! Any modification described in this manual should be performed only by a qualified service technician. Opening the case exposes you to potential shock hazard. Call your dealer if you are not a qualified technician.

1. Unplug the terminal from the wall outlet.
2. Unscrew the three screws holding on the side panel cover (Figure 2-9) and remove the cover.

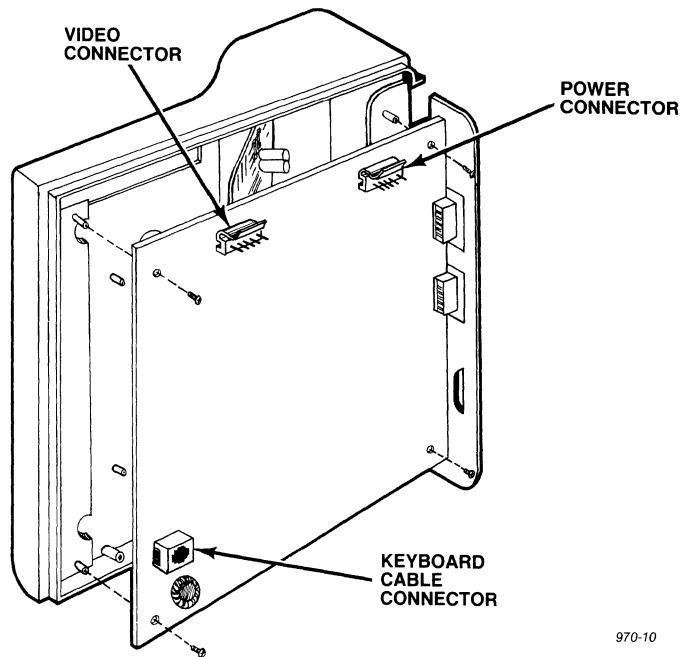
Figure 2-9
Screws Holding Side Panel in Place



970-9

3. Remove the four screws that hold the logic board in place (Figure 2-10).

Figure 2-10
Side Panel Interior

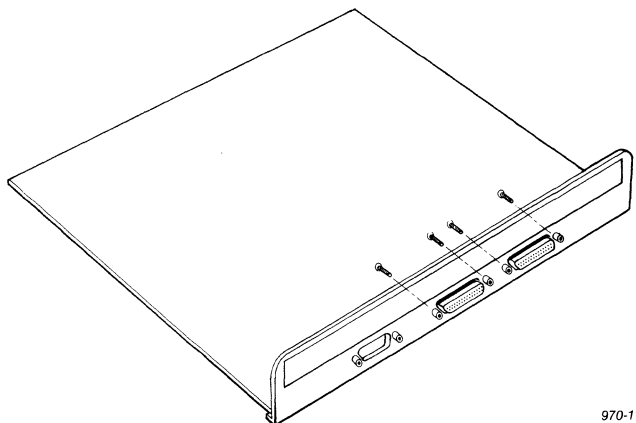


4. Disconnect the video connector, power connector, and keyboard cable connector (Figure 2-10).

NOTE! Two connectors are attached to the internal power cable. Only one (either one) is attached to the board. The other connector is not attached to anything.

5. Remove the screws near the pin connectors so you can take the shroud off the logic board (Figure 2-11).

Figure 2-11
Screws Holding Shroud onto Logic Board



6. Drill a hole in the shroud for the connector. (Figure 2-5 shows a suggested location for this hole.)
7. Connect the center lead of the BNC connector to P2 pin 6 and the BNC ground lead to P2 pin 3.
8. Replace the shroud, connectors, logic board, and side panel cover.

NOTE! *The cable between the monitor and the terminal must be less than 10 feet long.*

Installation Summary

Plug the terminal into the keyboard.

Set the power select switch to match your power requirements.

Connect the appropriate interface cable to the computer system or modem and to the terminal.

Attach a printer interface cable (if you are using a printer).

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

3. Configuration

What Is Set Up?

Once you have installed the terminal, you must define its operating parameters so it can communicate with the computer and the printer. On most terminals, this would involve changing tiny DIP switches on the inside of the terminal or on the rear panel. But the 970's unique set up menu allows you to

Redefine most of the factory-set operating characteristics

Add, change, or delete tab stops

Redefine the insert character

by entering set up mode from the keyboard at any time.

The 970 can store these operating parameters in two memories: a current (temporary) memory and a permanent (nonvolatile) memory. Whenever you change a parameter in set up mode, you are changing the current memory. If you save the changes, they are copied onto the permanent memory and used to refresh the current memory every time you turn on the terminal.

Using the Set Up Menu

The terminal displays the set up menu whenever it is in set up mode. You can easily toggle the terminal in and out of set up mode with the SET UP key.

Although you can enter set up mode at any time, you will probably want to wait until any data transmission in progress is finished.

Entering Set Up Mode

STOP! *Entering set up mode erases any data contained in the last 24 lines of memory and unlocks the keyboard.*

1. Press SET UP to enter set up mode.

Unless you press the SHIFT key with the SET UP key, you are pressing the NO SCROLL key. **That could stop all data transmission to the terminal** because it causes the terminal to send an X-Off to the computer (if Receive Data Control is set to X-On/X-Off) or toggle the DTR line.

2. Look for the set up menu to appear, with the cursor in the upper left corner as shown in Figure 3-1.

Figure 3-1 shows how the set up menu looks when the 970 is shipped from the factory. These values are the **factory default values**. They will remain in effect until you change them with escape sequences or while the terminal is in set up mode.

Figure 3-1
Set Up Menu with Factory Default Values



970-12

Notice that the menu is divided into six areas:

- Main Communications
- Print Communications
- Edit
- Transfer
- Status I
- Status II

The last three lines indicate the current insert character (programmable), the terminal identification, and where tab stops are set.

Changing the Set Up Menu

1. Move the cursor to the feature you want to change, using the keys listed in Table 3-1.
2. Press T (shifted or unshifted) to see another value for that feature. This displays all possible values, one at a time. Stop when you see the desired value.

Table 3-2 lists all the parameters shown on the set up menu, by area.

Table 3-1
Moving the Cursor in Set Up Mode

Direction	Key	Effect
Down	↓ LINE FEED	Moves the cursor down within the column
Up	↑	Moves the cursor up within the column
Right	→ TAB	Moves the cursor right
Left	← BACK TAB BACK SPACE	Moves the cursor left
	HOME	Moves the cursor to the top left field

Table 3-2
Changeable Parameters
a. Main Communications Parameters

Name ¹	Parameters ^{1,2}	Description
COMMunication	CoNV	Selects conversational (interactive) communication with computer. Can be half or full duplex.
	BLoCK	Does not send data to computer as it is entered. Permits editing prior to transmission.
	LOCal	Does not permit communication between terminal and computer. Commands affect only data on the screen.
DUPLeX	FDX³	Allows terminal to receive and transmit information simultaneously. Keyboard entries go only to computer (if no echo is also enabled) or to both computer and screen (if echo is enabled).
	HDX ⁴	Sends keyboard entries to the computer. If echo is enabled, the terminal echoes entries to the screen.
SEND/ReCeive	NO ECHO	Does not echo each character transmitted to the computer back to the screen during conversational mode. Select this value for normal full duplex operation.
	ECHO	Echoes each character transmitted to the computer back to the screen during conversational mode. Select this value for normal half duplex operation.

1. Only characters in uppercase are displayed on screen.
2. **Bold** type indicates the values set at the factory (factory default values). Most of these characteristics are described in more detail in Chapter 5.
3. For normal full duplex, select "No Echo."
4. For normal half duplex, select "Echo."

Table 3-2
Continued

Name¹	Parameters^{1,2}	Description
BAUD	19.2	Selects baud rate of RS-232C computer port. This value has no effect if the optional RS-422 port is installed.
	50	
	75	
	110	
	135	
	150	
	300	
	600	
	1200	
	1800	
	2400	
	3600	
	4800	
7200		
9600		
PARITY	NOne	Disables parity.
	ODd	Enables parity to odd.
	EVEN	Enables parity to even.
	MaRK	Enables parity to mark, transmit only.
	SPace	Enables parity to space, transmit only.
DATA BITS	8	Lets main port recognize/ transmit only 8-bit words to/from the computer.
	7	Lets main port recognize/transmit only 7-bit words to/from the computer.
STOP BIT	1	Sends one bit to signal that one character code has been transmitted. Always has a value of one.
	2	Sends two bits to signal that one character code has been transmitted. Both bits are ones.
ReCeIve data ConTRoL	XON/xOff	Allows the terminal to control the receipt of data from the computer with X-On/X-Off signals to the computer.
	NOne	Does not let terminal control the receipt of data from the computer by sending X-On/X-Off signals or changing the Data Terminal Ready (DTR) line.
	DTR	Lets the terminal control the receipt of data during printing by lowering and raising the DTR line.

1. Only characters in uppercase are displayed on screen.
2. **Bold** type indicates the values set at the factory (factory default values). Most of these characteristics are described in more detail in Chapter 5.

Table 3-2
Continued

Name¹	Parameters^{1,2}	Description
XMIT ConTRoL	NOne	Does not let the computer port control the transmission of data to/from the computer.
	XON/xOff	Lets the terminal recognize X-On/X-Off signals used by the computer to control the transmission of data to/from the terminal. When the terminal receives X-Off, its status line displays HBSY.

b. Print Communications Parameters

Name¹	Parameters^{1,2}	Description
BAUD	1200	Baud rate of RS-232C serial printer port.
	50	
	75	
	110	
	135	
	150	
	300	
	600	
	1800	
	2400	
	3600	
	4800	
	7600	
9600		
19200		
PARITY	NOne	Disables parity.
	ODd	Enables parity to odd.
	EVen	Enables parity to even.
	MarK	Enables mark parity, transmit only.
	SPace	Enables parity to space, transmit only.
DATA BITS	8	Sends only 8-bit words to the printer from the printer port.
	7	Sends only 7-bit words from the printer port.
STOP BIT	1	Sends one bit to signal that one character code has been transmitted. Always has a value of one.
	2	Sends two bits to signal that one character code has been transmitted. Both bits are ones.

1. Only characters in uppercase are displayed on screen.

2. **Bold** type indicates the values set at the factory (factory default values). Most of these characteristics are described in more detail in Chapter 5.

**Table 3-2
Continued**

Name¹	Parameters^{1,2}	Description
XMIT ConTRoL	NOne	Causes printer port to recognize DTR to control the transmission of data to the printer. Printer port does not recognize X-On/X-Off.
	XON/xOFF	Causes printer port to recognize X-On/X-Off or DTR signals from the printer to control the transmission of data to the printer.
PRINT STATus	NOne	Does not define capabilities of the printer port. Any data still in the buffers goes to the printer when you select this value.
	BUF/CPY	Selects buffered copy print. Allows data to go through the buffers to the printer and to the screen. Baud rates for computer and printer can differ.
	BUF/XPT	Selects buffered transparent print. Data passes through the buffers to the printer but not to the screen. Baud rates for computer and printer can differ.
	DIR/CPY	Selects bidirectional extension (i.e., copy) print. Connects the P3 or P7 (computer) and P4 (printer) ports so two-way communication can occur between the computer and the printer. Data being printed is displayed on the screen.
	DIR/XPT	Selects bidirectional transparent print. Connects P3 or P7 (computer) and P4 (printer) ports so two-way communication can occur between computer and printer. Data is not displayed on the screen.

c. Edit Parameters

Name¹	Parameters^{1,2}	Description
INSert/RePLaCe	RePLaCe	Replaces new data with existing data.
	INSert	Causes new data to move existing data aside.
ConTRoL REPresentation	PROCCess	Causes terminal to act upon commands received from the computer and display data.
	MONitor	Causes terminal to display data and commands but not to act upon the commands.
AUTOPaGe	SINGLE	Scrolls data up when the cursor tries to go past the last line on the page if memory has been divided into 24-line pages.
	MULTI	Moves the cursor to the next page after you enter a character on the last position on the current page if memory has been divided into 24-line pages.

1. Only characters in uppercase are displayed on screen.
2. **Bold** type indicates the values set at the factory (factory default values). Most of these characteristics are described in more detail in Chapter 5.

Table 3-2
Continued

Name¹	Parameters^{1,2}	Description
AUTOWRAP	WRAP	Automatically advances the cursor to the first character position on the next line after a character is entered for the first position on the next line. But if protect mode is enabled, the cursor goes to the next protected field after the last character is entered in the current field. Has no effect during block mode.
	NO WRAP	Does not advance the cursor so characters supersede each other instead of appearing on the next line (or the next protected field).
EDIT BOUNDary	PaGe	Allows editing commands to affect the entire page.
	DiSPLaY	Restricts editing changes to the displayed area.
EDITING EXTent	DiSPLaY	Restricts effect of insert/delete character commands and insert mode to displayed data.
	LiNe	Restricts effect of insert/delete character commands and insert mode to the current cursor line.
HORiZontal EDIT	Right	Restricts effect of insert/delete character commands and insert/replace modes to data to the right of the current cursor position.
	LeFT	Restricts effect of insert/delete character commands and insert/replace modes to data to the left of the current cursor position.
VERTical EDIT	DoWN	Lets insert and delete line commands only affect lines below the cursor line.
	UP	Lets insert and delete line commands only affect lines above the cursor line.
ANSI/Vt100/Vt52	Vt100	Causes terminal to recognize VT100 escape sequences instead of native mode (970 ANSI) sequences.
	Vt52	Causes terminal to recognize VT52 escape sequences instead of native mode (970 ANSI) sequences.
	ANSI	Causes terminal to recognize native mode (970 ANSI) sequences.

1. Only characters in uppercase are displayed on screen.
2. **Bold** type indicates the values set at the factory (factory default values). Most of these characteristics are described in more detail in Chapter 5.

Table 3-2
Continued
d. Transfer Parameters

Name¹	Parameters^{1,2}	Description
MAIN PORT CONFiGuration	RS-232C	Selects the RS-232C port (P3) as the main port.
	RS-422	Selects the optional RS-422 port (P7) as the main port.
RS-422 XMIT BAUD	4800	Sets baud rate of optional RS-422 port (P7).
	9600	
	19.2K	
	38.4K	
	55.9K	
	307.2K	
XFER TERMinate	PARTial	Defines the data to be transferred as a partial page up to and including the cursor position.
	FULL	Defines the data to be transferred as the entire page.
LiNe XFER ³	PaGe	Allows transfer termination command to specify whether the terminal transmits entire page or through cursor position.
	LiNe	Lets the terminal transmit data from the beginning of the current line up to and including the cursor position. Does not transmit end-of-line control codes.
XFER EXECution	DEFERred	Causes the SEND key to transmit a set-transmit-state sequence that notifies the computer when the terminal is ready to transmit. The computer requests transmission at its convenience by sending the transmit sequence.
	IMMEDiate	Lets the SEND key transmit a block of data immediately.
AUTOPRINT	NONE	Turns off autoprint mode.
	AUTOLiNe	Causes the terminal to send the current line to its printer as soon as it receives the LF character (from the computer or keyboard).
	AUTOCHaRacter	Causes the terminal to send each character entered on the keyboard to its printer (in one of the conversational communication modes).

1. Only characters in uppercase are displayed on screen.
2. **Bold** type indicates the values set at the factory (factory default values). Most of these characteristics are described in more detail in Chapter 5.
3. Same as transfer amount command.

Table 3-2
Continued
e. Status I Parameters

Name¹	Parameters^{1,2}	Description
CHARacter/LiNe	80	Lets each line contain up to 80 characters. Changing this value clears the screen.
	132	Lets each line contain up to 132 characters. Changing this value clears the screen.
LiNes/PaGe	24	Divides the memory into 24-line pages. The character/line value (above) determines the resulting number of pages: 80 columns creates 3 pages; 132 columns creates 2 pages.
	48	Creates one 48-line page, regardless of character/line value (above).
	72	Creates one 72-line page only if the character/line value (above) is 80.
SCReeN BACKground	DARK	Makes screen background dark with light characters.
	LITE	Makes screen background light with dark characters.
SCReen SAVER	OFF	Lets the screen remain on regardless of the time lapse between data entries on the keyboard.
	5	Causes the screen to turn off if no keys are pressed for 5 minutes.
	10	Causes the screen to turn off if no keys are pressed for 10 minutes.
	15	Causes the screen to turn off if no keys are pressed for 15 minutes.
SCROLL type	JuMP	Causes the terminal to display an entire line of data at the same rate it processes it.
	Smooth/NORM	Causes the terminal to display data one scan line at a time at an even rate of 6 lines per second if the computer uses X-On/X-Off or DTR protocol.
	Smooth/FAST	Causes the terminal to display data one scan line at a time at an even rate of 12 lines per second if the computer uses X-On/X-Off or DTR protocol.
	Smooth/SLOW	Causes the terminal to display data one scan line at a time at an even rate of 3 lines per second if the computer uses X-On/X-Off or DTR protocol.

1. Only characters in uppercase are displayed on screen.

2. **Bold** type indicates the values set at the factory (factory default values). Most of these characteristics are described in more detail in Chapter 5.

**Table 3-2
Continued**

Name¹	Parameters^{1,2}	Description	
25TH LINE	NOne	Prevents display of the screen's 25th line.	
	STATus	Causes the screen's 25th line to display the status line.	
	MeSsaGe	Causes the screen's 25th line to display a programmable user message (up to 80 or 132 user-defined characters).	
1ST CHAR SET	U.S.	Determines the language in which the primary character set appears.	
	U.K.		
	FRENCH		
	GERMAN		
	PORTUGS		(Portuguese)
	SPANISH		(Norwegian/Danish) (Swedish/Finnish)
2ND CHAR SET	U.K.	Determines the language in which the secondary character set appears.	
	U.S.		
	FRENCH		
	GERMAN		
	PORTUGS		(Portuguese)
	SPANISH		(Norwegian/Danish) (Swedish/Finnish)
Line Feed/NEW LiNe	LiNe FEED	Causes the LINE FEED key to send only a line feed code. Also causes the RETURN key to send only a carriage return code. When the terminal receives a line feed code, it performs a line feed. When it receives a carriage return code, it performs only a carriage return.	
	NEW LiNe	Causes the LINE FEED key to send only a line feed code. When the terminal receives a line feed code, the terminal performs a new line (carriage return and line feed), while a carriage return code causes only a carriage return. Pressing the RETURN key sends both carriage return and line feed codes.	

f. Status II Parameters

Name¹	Parameters^{1,2}	Description
CURSOR STYLE	BLock/BLiNk	Makes the cursor a blinking block.
	BLock/STeaDy	Makes the cursor a steady block.
	UnderLine/BLiNk	Makes the cursor a blinking underline.
	UnderLine/STeaDy	Makes the cursor a steady underline.
	NOne	Prevents the display of the cursor. ³

1. Only characters in uppercase are displayed on screen.
2. **Bold type** indicates the values set at the factory (factory default values). Most of these characteristics are described in more detail in Chapter 5.
3. Appropriate for applications programs that move the cursor frequently.

**Table 3-2
Continued**

Name¹	Parameters^{1,2}	Description
LiNe ATTRibute	NORMal	Displays single-height/single-width characters.
	2 WD	Displays single-height/double-width characters.
	2 HT	Displays double-height/double-width characters.
NORMAL ATTRibute	NORMal = High	Causes normal intensity (selected with the ESC [0 m command) to produce full intensity characters.
	NORMal = LOw	Causes normal intensity (selected with the ESC [0 m command) to produce half intensity characters.
POWER/Hertz	60	Selects screen refresh rate of 60 hertz.
	50	Selects screen refresh rate of 50 hertz.
KEYCLICK	On	Causes keys to make an audible click when you press them.
	Off	Keeps keys from making any sound when you press them.
BREAK KEY EXEC	OFF	Lets the terminal ignore the code sent by the shifted or unshifted BREAK keys.
	On	Lets the terminal respond to the code sent by the shifted or unshifted BREAK keys.

1. Only characters in uppercase are displayed on screen.
2. **Bold type** indicates the values set at the factory (factory default values). Most of these characteristics are described in more detail in Chapter 5.

Changing the Screen Contrast

The contrast (intensity) of the screen can be changed while set up mode is enabled.

1. Press shifted ↑ to increase the contrast. Stop when the screen has the desired contrast.
2. Press shifted ↓ to decrease the contrast. Stop when the screen has the desired contrast.

Changing the Insert Character

The insert character is the character that replaces erased data. Originally it is programmed as a space character, but you can reprogram it in the set up mode.

1. Press CTRL C while the set up menu is displayed. The cursor will move to the line labeled INS CHAR.
2. Enter a three-digit decimal value (up to 255) for the desired ASCII code, using the numeric keys on the main keyboard. (See Appendix C for the decimal ASCII values).
3. Press CTRL C again to return the cursor to the body of the set up menu.

Changing or Setting a Tab Stop

Tab stops are preset at every eighth column position following the first position. You can see each tab stop on the set up menu's bottom line. While the terminal is in set up mode, you can easily add, change, or delete tab stops.

1. Press CTRL TAB to move the cursor to the tab line.

Each preset tab stop is indicated on the bottom line of the menu by a T.

2. Move the cursor to the desired tab position with the ← or → keys and press shifted or unshifted T to set a new tab stop.
3. Move the cursor to the stop to be deleted. Press shifted or unshifted T to delete that tab stop.
4. Press CTRL TAB to return the cursor to the set up menu.

Saving the Set Up Menu Values

Unless you press CTRL S before leaving set up mode, the permanent memory continues to contain the values previously in effect. The next time you turn on the terminal, these values refresh the current memory. Thus the values that you failed to save before leaving the set up menu are lost. (However, you can restore all except the computer baud rate with the command ESC [2 y.)

Table 3-3 lists three ways to restore old set up values.

Table 3-3
Restoring Set Up Values

Press	Restores	Comment
CTRL R (uppercase)	Previously saved values (including insert character and tab stops)	Effective only in set up mode.
CTRL D (uppercase)	Initial (factory default) set up values (including insert character and tab stops)	Effective only in set up mode. Changes nonvolatile and current memories.
CTRL RESET ¹	Previously saved values (including insert character and tab stops)	Can be used any time but destroys displayed data.

1. Pressing CTRL RESET has the same effect as turning the terminal's power off and back on.

Leaving Set Up Mode

Leaving the set up mode is as easy as entering it.

Press SET UP (i.e., shifted NO SCROLL) again to leave the set up mode and reenter normal operation.

Summary of Set Up Procedures

Table 3-4 summarizes how to change the terminal's operating characteristics.

Table 3-4
Summary of Set Up Controls

Function	Key
Enter set up mode	SET UP (shifted NO SCROLL)
Move cursor	Cursor control keys (see Table 3-2)
Enter/exit tab line	CTRL TAB
Change tab stop	T (upper- or lowercase)
Enter/exit insert character line	CTRL C
Change insert character	Numeric keys
Increase contrast	Shifted ↑
Decrease contrast	Shifted ↓
Save parameters after power off	CTRL S (uppercase)
Leave set up mode	SET UP (shifted NO SCROLL)
Return to saved values while in set up mode	CTRL R (uppercase)
Return to saved values any time	CTRL RESET
Restore factory default values to nonvolatile and current memories while in set up mode	CTRL D



4. Operation

Turning On the Terminal

Turning on and adjusting the terminal is very simple:

1. Locate the ON/OFF rocker switch on the rear of the terminal (Figure 4-1) and push the end marked with a white dot.
2. Listen for the terminal to "beep" within about a second.
3. Look for the cursor to appear in the upper left corner of the screen within 10 to 15 seconds.
4. Adjust the tightness of the knob located in a recess on the left side of the case until the case tilts easily (Figure 4-2). You only need to adjust this knob once. Then whenever you want to change the angle of the screen, just push the case.

Figure 4-1
Turning On the Terminal

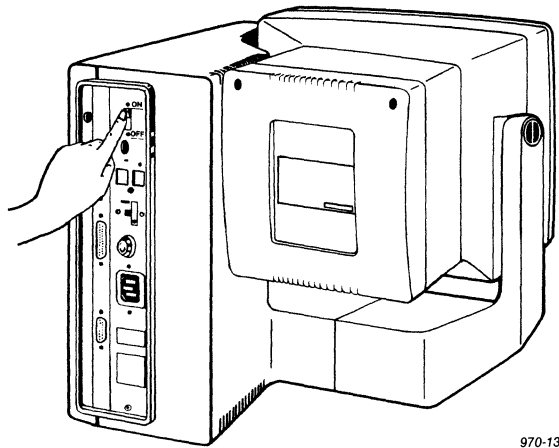
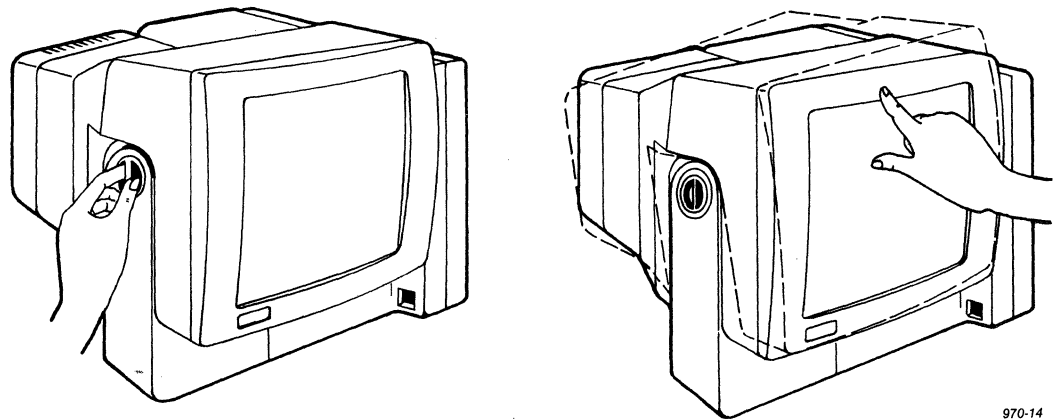


Figure 4-2
Adjusting Screen Tilt



Now follow your computer system's log-on procedure. The 970 is ready to accept application programs from your computer or data input from the keyboard.

The Keyboard

The 970 keyboard contains two types of keys:

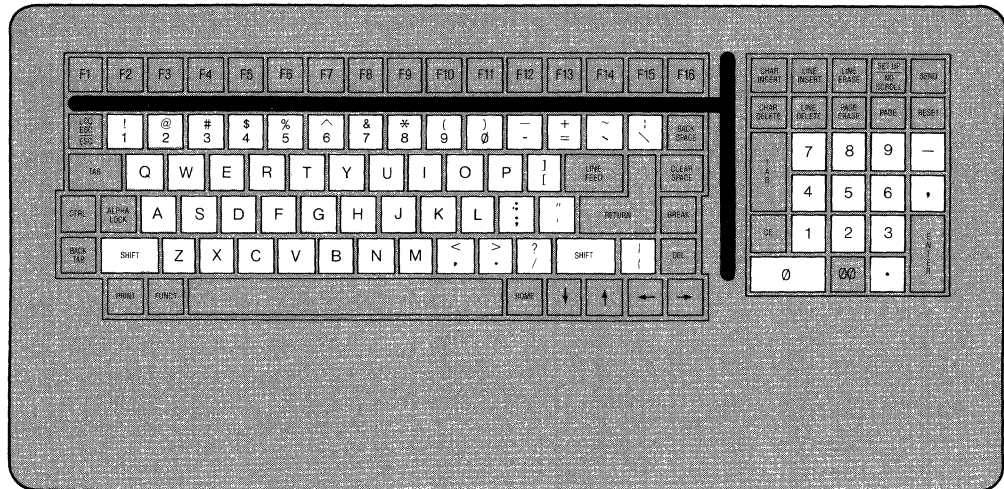
Alphanumeric character keys

Special and editing keys that control the terminal and how it processes, sends, and receives data from the computer

Character Keys

Figure 4-3 highlights the character keys on the keyboard. **Character keys** include all alphabetic characters (a through z), numbers (0 through 9), punctuation marks, and mathematical symbols. The character keys repeat when pressed for more than one-half second (unless you reprogram their repeating action).

Figure 4-3
Character Keys



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Special Keys

Table 4-1 summarizes the function of the special keys highlighted on the keyboard in Figure 4-4. Many of these keys also repeat when pressed for more than one-half second. Table 4-1 points out those that do not. Of course, you can reprogram the repeating action of these keys too.

Figure 4-4
Special Keys



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The effect of many keys is changed by modes of operation such as set up, protect, autopage, autowrap, edit boundaries, etc. Refer to the index to find more information on each key's action.

If the shifted name of a key is different from the unshifted name (e.g., SET UP/NO SCROLL), each name is entered separately in Table 4-1. For example, the table lists SET UP, not "Shifted NO SCROLL"—although the effect is the same.

Table 4-1
Function of Special Keys

Key Name	Effect
ALPHA LOCK	Causes the terminal to send the uppercase character code for any alphabetical key pressed. Press once to lock and press again to release. Has no effect when used alone. Does not repeat.
BACK SPACE ¹	Moves the cursor left one character.
BACK TAB ¹	Moves the cursor backward to a typewriter-style tab stop (protect mode off) or to the start of the current or previous unprotected field (protect mode on).
Shifted BACK TAB	Clears all typewriter tab stops.
BREAK	May break communication with the computer. Brings the transmitted data line to the space state for 250 milliseconds. Its effect depends on the status of the BREAK key parameter on the set up menu. Does not repeat.
Shifted BREAK	May break communication with the computer. Brings the transmitted data line to the space state for 3.5 seconds and lowers DTR. Its effect depends on the status of the BREAK key parameter on the set up menu. Does not repeat.
CTRL BREAK	Transmits the answerback message, terminated with turnaround control code. Does not repeat.
CHAR DELETE	Deletes the character at the cursor position and shifts all succeeding characters one position to the left. Adds an insert character to the right of the shifted text. In alternate keypad mode, same as VT100 PF1 key.
Shifted CHAR DELETE	Enables replace mode, allowing new data to replace existing data. Does not move any data.
CHAR INSERT	Adds an insert character and the current visual attribute at the cursor position, shifting all succeeding characters one position to the right. The editing extent mode determines the effect on data.
Shifted CHAR INSERT	Turns on insert mode so new data pushes existing data aside. Affected by the horizontal editing mode selected.
CE (CLEAR ENTRY) ¹	Erases the field between the previous and the next tab stops if protect mode is off. Returns the cursor to the previous tab stop. If protect mode is on, erases the current unprotected field and returns the cursor to the beginning of the field. Does not repeat.
Shifted CE (CLEAR ENTRY)	Erases the entire line and its attributes. Same as erase-in-line command. Does not repeat.

1. Pressing this key (shifted or unshifted) with the CTRL key is the same as pressing this key unshifted.

**Table 4-1
Continued**

Key Name	Effect
CLEAR SPACE	Erases all unprotected characters on the page and replaces them with the insert character and the current visual and line attributes unless ignore BREAK key command has executed.
Shifted CLEAR SPACE	Same as CLEAR SPACE.
CTRL (CONTROL)	Used with another key to generate normally undisplayed control codes, CTRL key sequences cause the terminal and/or computer program to take special action. When the CTRL key is used with alphanumeric or some symbol keys, the output data of the typed character is changed. Has no effect when used alone. Always used simultaneously with another character. Hold the CTRL key down while pressing the other key . (Similar in action to the SHIFT key.) Does not repeat.
← ^{1,2}	Moves the cursor left one character within the same line. Stops at the left margin.
Shifted ←	Deletes a character from the first column of each line and adds the insert character at the right edge of each line. Shifts all characters on the line/page left one position, regardless of cursor location. Affected by edit boundary mode. Ignored during protect mode.
↑ ^{1,2}	Moves the cursor up one line within the same column. Stops at the upper boundary. Affected by edit boundary mode.
Shifted ↑	Same as reverse index (except in set up mode). Does not repeat.
↓ ^{1,2}	Moves the cursor down one line within the same column. If the cursor is on the bottom line of the screen and more than 24 lines per page are selected, the display rolls up one line. If the cursor is on the bottom line of the page, pressing the key has no effect. Affected by edit boundary mode.
Shifted ↓	Same as index. Moves the cursor down one line within the current column position. Does not repeat.
→ ^{1,2}	Moves the cursor right one character within the same line. May stop at the right margin. Depends on how autowrap is set in the set up menu. Does not repeat.
Shifted →	Same as horizontal scroll right.
DEL (DELETE)	When the terminal receives this command, nothing is performed or displayed. In control representation mode, data is displayed.
ENTER ¹	Same as RETURN key (if they have not been reprogrammed). Each sends a carriage return (CR) code to the computer. Does not repeat. If the entire current line is protected, pressing the key moves the cursor to the next unprotected position on the page. Enabling autowrap in the set up menu eliminates the need to press RETURN and LINE FEED at the end of each line.

1. Pressing this key (shifted or unshifted) with the CTRL key is the same as pressing this key unshifted.
2. If cursor key mode is enabled, cursor keys generate control sequences.

Table 4-1
Continued

Key Name	Effect
Shifted ENTER	Same as page print. In VT100 mode, this becomes the local command for page print and is not transmitted. Disregards any reprogramming of the ENTER key. Does not repeat.
CTRL ENTER	Toggles auto line print mode on and off locally in all modes.
ESC (ESCAPE)	The ESC key sends a code to momentarily leave (escape) an application program to use a special feature or function. Press and release the ESC key before pressing the next key. Does not repeat.
FUNCT	Pressing the FUNCT key and another key (with a hex value from 00H through 7EH) immediately interrupts any other transmission. The FUNCT key transmits an ESC O (unless reprogrammed), the key code of the other key, and the turnaround control code. See Chapter 6 to reprogram the code transmitted by the FUNCT key. (Has no effect if used alone.) Does not repeat.
F1 through F16	Sends a reprogrammable three-code sequence and a turnaround control code. May cause the computer to initiate a special subroutine in the program, causing the terminal to display or perform a special function. Does not repeat.
Shifted F1 through F16	Enables F17 through F32. Does not repeat.
HOME ¹	Moves the cursor to the first unprotected character position on the page (usually column one of line one). Affected by origin mode. Does not repeat.
LINE DELETE	Deletes the current line and shifts all following lines up one line. A line filled with insert characters and the current visual attribute fills the last line of the display or scrolling region. Ignored if the cursor is in a locked area or if protect mode is on. Affected by vertical editing mode.
Shifted LINE DELETE	Same as line edit. Limits the effect of editing keys and commands to the current line. If protect mode is on, effect is limited to the current field.
LINE ERASE	Erases data from the cursor to the end of the line. If protect mode is on, the effect is limited to the current field. Does not repeat.
Shifted LINE ERASE	Restricts editing changes to the display or the page. Does not repeat.
LINE FEED ¹	Moves the cursor down one line within the current column. Affected by protect and new line/line feed modes.
Shifted LINE FEED	Moves the cursor to the first character position of the next line. Affected by autopage and protect modes.
LINE INSERT	Adds an entire line of insert characters (with the current visual attribute) on the cursor line. The data on the line below the cursor line and all following lines shifts down one line. If the cursor is on the bottom line, a line is lost. The vertical editing mode determines which line is lost and which lines move.

1. Pressing this key (shifted or unshifted) with the CTRL key is the same as pressing this key unshifted.

Table 4-1
Continued

Key Name	Effect
Shifted LINE INSERT	Limits effect of editing commands to the display or current line. Same as editing extent to display.
LOC ESC	Allows you to use any terminal feature without transmitting it to the computer (if the computer does not echo escape codes). Does not repeat.
NO SCROLL	Press once to stop screen updating; press again to resume. Does not repeat. If the receive buffer fills up while update is disabled, the terminal sends X-Off to the computer, causing it to stop sending data. When update is reenabled, the buffer empties, X-On is sent, and data is transmitted from the computer.
Numeric keypad ¹	Each key in the numeric keypad becomes a function key when the escape sequence for alternate keypad mode is received by the terminal. Unless this mode is enabled, the keypad keys generate numeric character codes and have repeat action.
PAGE	Shows next page. In alternate keypad mode, same as VT100 PF4 key. Does not repeat.
Shifted PAGE	Shows previous page. Does not repeat.
PAGE ERASE	Erases data from the cursor to the end of page. Affected by edit boundary mode. In alternate keypad mode, same as VT100 PF3 key. Does not repeat.
Shifted PAGE ERASE	Allows editing changes to affect entire page. Same as page edit boundary mode. Does not repeat.
PRINT	Same as page print. Functions only locally, regardless of how you may have reprogrammed the PRINT key. Does not repeat.
Shifted PRINT	Same as auto line print mode. Prints current line as soon as the terminal receives a carriage return code. Functions only locally, regardless of how you may have reprogrammed the PRINT key.
CTRL PRINT	Turns on auto line print mode so the terminal sends the current line to the printer as soon as the terminal receives a carriage return code. Functions only locally as the page print command, regardless of how you may have reprogrammed the PRINT key. Does not repeat.
RESET	Has no effect.
CTRL RESET	Downloads contents of the terminal's permanent (nonvolatile) memory into its current (active) memory. Has the same effect as power on (ESC c). Does not repeat.

1. Pressing this key (shifted or unshifted) with the CTRL key is the same as pressing this key unshifted.

Table 4-1
Continued

Key Name	Effect
RETURN ¹	Same as ENTER key (if they have not been reprogrammed). Each sends a carriage return (CR) code to the computer. Does not repeat. If the entire current line is protected, the cursor moves to the next unprotected position on the page. Enabling auto wrap mode eliminates the need to manually press RETURN and LINE FEED at the end of each line.
SEND	Sends a set transmit state sequence from the terminal if deferred transmission is also selected. If immediate transmission is selected, sends data immediately. In alternate keypad mode, same as the VT100's RESET key. Does not repeat.
Shifted SEND	Sends a transmit sequence to the terminal if deferred transmission is selected. Does not repeat.
SET UP	Press once to enter set up mode and display menu. Press again to return to previous screen display. Does not repeat.
SHIFT	Selects the upper character inscribed on a key, changes the operation of most special keys, and capitalizes alphabetic characters. Used simultaneously with another key. Has no effect when used alone.
Space bar	Causes a space code to appear on the screen.
TAB ¹	Moves the cursor forward to the next typewriter-type tab stop (protect mode off) or to the start of the next unprotected field (protect mode on).
Shifted TAB	Moves the cursor to the previous tab stop or the start of the previous field. Cursor does not wraparound backward except during block mode. Then it moves to the beginning of the previous field.
00 ¹	Sends two zeroes.
Shifted 00	Sends three zeroes.

1. Pressing this key (shifted or unshifted) with the CTRL key is the same as pressing this key unshifted.

Control Codes

As described in Table 4-1, the CTRL key generates a control code when it is pressed with another character key. Appendix F lists the control codes recognized by the terminal. Also refer to the sections on Control Representation and Control Codes.

Cursor Style and Movement

The cursor is a lighted rectangular block or underline (selected during set up) that indicates where the next entered character will appear. You may also choose not to have any cursor appear.

You can move the cursor with the cursor control keys (described in Table 4-1) or by command sequences (listed in the Quick Reference Guide).

The 25th Line

What (if anything) is displayed on the 25th line depends on what commands the terminal receives from the computer or the set up mode configuration. This line can display either the user's message line or the status line, or it can be blank.

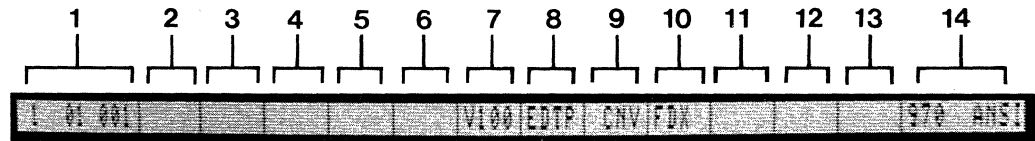
The User's Message Line

The user's message line contains a special message sent from the computer. See Chapter 6 for instructions to program this message.

The Status Line

The status line summarizes the terminal's operating characteristics—either the default conditions or those changed in set up mode or with escape sequences. Additional information (e.g., terminal or printer busy and some error messages) appears automatically when appropriate. Some areas are normally blank. Figure 4-5 shows a typical status line, with each area numbered. Table 4-2 lists all possible status line values for each numbered area. The line number shown in the status line is based on absolute origin mode.

**Figure 4-5
Typical Status Line**



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**Table 4-2
Status Line Values**

Area	Display	Value
1	P LL CCC	Cursor position P = Page L = Line C = Column
2	TBSY/blank	Terminal status ¹ (terminal busy)
3	1234/blank	LED indicator 1 = L1 2 = L2 3 = L3 4 = L4
4	HBSY/blank	Host (computer) busy
5	PBSY/blank	Printer busy
6	XYZZ	X = Display print function P = Page print ² L = Cursor line print Y = Auto print mode L = Auto line print mode on C = Auto character print mode on ZZ = Host print data BC = Buffered extension print on BX = Buffered transparent print on DC = Bidirectional extension print on DX = Bidirectional transparent print on
7	V100/V52/blank	VT100 mode/VT52 mode/970 (native) mode
8	EDT/INS	Edit control (replace/insert)
9	P/D/L	Edit boundary condition (page/display/line)
10	M/blank	Control representation (monitor/process)
11	CNV/BLK/LOC	Conversational/block/local communication

1. Terminal's receive buffer full during receipt of data.
2. Terminal received DCD or DSR in inactive instead of active state.

Table 4-2
Continued

Area	Display	Value
12	FDXE/FDX/HDXE/HDX	Full/half duplex; echo/no echo
13	LOCK/blank	Keyboard lock/unlock
14	SEND/LOAD/blank	Transmit condition block/download/none
15	FBLD/PROT/PRO1/ PRO2/PRO3/blank	Forms build/protected/unprotected ³
16	970 ANSI	Personalized message/defined area qualifications message/error message

3. When PROT appears and you move forward or backward to another page, the T becomes the number of the page on which defined area qualifications are stored.

Error Messages

Should an error message appear in the far right status line field (see Figure 4-5), the terminal's bell also rings. Two types of errors cause an error message to appear in that particular field: operator entry errors in a protected field and programming errors while a protected form is being created.

Operator entry errors occur when you enter the wrong type or amount of data in an application program's form that has special data entry requirements. If the bell rings and you see an error message, refer to Table 4-3 to find out what you did wrong and then correct your entry.

A programming error can occur while you are defining a field's defined area qualifications (DAQ) during protect mode.

Table 4-3
Error Messages

Type	Message	Definition
Data Entry	ALPHA	You have tried to enter a digit (0 through 9) in a field that can accept only nondigit characters.
	DIGIT	You have tried to enter a nondigit character in a field that can accept only digits (0 through 9).
	FILL ALL	You have failed to completely fill a field that must be filled (i.e., can not accept blank codes).
	MUST FILL	You have failed to enter a character in a field in which at least one character must be entered.
	NUMERIC	You have tried to enter a nonnumeric character in a field that can accept only numeric characters (0 through 9, plus sign, comma, hyphen, and period).
Programming	OVERFLOW	You defined a field's defined area qualification in a location that is causing the firmware's Define Area Qualification table to overflow. Move the cursor a column or two (i.e., change the form's format slightly) and try again.

Communicating with the Computer

The set up menu and escape sequences allow you to select any of four communication modes:

- Local
- Block
- Half duplex (conversational)
- Full duplex (conversational)

- Local** Turns off the port leading from terminal to the computer. When you enter or change text, the data goes only to the screen. No data can be received or transmitted. Can not be enabled with an escape sequence, only with set up menu.
- Block** The terminal first sends data only to the screen so you can check and correct it. You determine when the data is sent (in a block) to the computer with the SEND key. Block mode allows you to make all corrections before transmission and transmission is faster than with conversational mode.
- Conversational** Allows interactive communication with the computer. The terminal is conversational in either half or full duplex modes.
 - Half Duplex** The terminal sends keyboard entries to the screen and to the computer at the same time (if echo is on). Does not permit simultaneous transmission and reception of information. For normal half duplex, select echo.
 - Full Duplex** The terminal sends keyboard entries to the computer only (unless echo is selected). If the computer is programmed to act upon a code received from a keyboard entry, it may echo the result back to the terminal. Permits simultaneous transmission and reception of information.

Editing

The editing keys listed here allow you to edit text easily without entering control or escape sequences:

- | | |
|-------------|-------------|
| CHAR INSERT | LINE DELETE |
| CHAR DELETE | LINE ERASE |
| LINE INSERT | PAGE ERASE |

These keys are described in detail in Table 4-1 and in the next chapter.

Printing

You can use PRINT and shifted PRINT to print data (as described in Table 4-1). The sequences described in Chapter 5 give you more control over the printing.

Resetting the Terminal

To reset the terminal (i.e., return to its previous operating characteristics) when the set up menu is not displayed, press CTRL RESET. This is the same as turning the power off and back on again. (Any displayed data is destroyed.)

The terminal may also be reset if you unplug the keyboard cable.

5. Programming the 970

Introduction

This chapter describes commands that both programmers and operators can use to control the terminal.

Using These Commands in Your Programs

Incorporating these commands in your computer programs lets you control the terminal remotely.

How you incorporate these commands depends on your programming language. The multitude of languages and syntaxes recognized by each language makes it impossible to show you specifically how to incorporate commands in each program. The terminal's response is based on the control code or escape sequence received, regardless of the format and syntax used by a programming language to send it to the terminal. If you need help with the proper syntax, refer to your programming language's documentation.

Entering These Commands on the Keyboard for Local Display

If you only want to change data displayed on the screen and in the terminal's screen memory, press the LOC ESC key instead of ESC in the escape sequences in this chapter. The computer will not be aware of these commands or the changes caused by them unless you send the revised data to it.

You can also use the editing keys without sending anything to the computer while local edit mode (discussed later in this chapter) is on.

Conventions

In this chapter, opposite the command name you may see:

SET UP Identifies a feature you can also control in set up mode

DEFAULT States the parameter's value if you have not entered a new value

Returning to Factory Default Values

Return to factory default values ESC [2 y

Use this sequence when you want to reset all operating parameters except the computer baud rate to the values set at the factory. These values are listed in bold-faced type in Table 3-2.

Saving Set Up Values

Save set up values after power off ESC [9 x

This command performs the same function as a CTRL S does during set up mode. All set up values are saved in the nonvolatile memory.

ANSI Commands

ANSI commands are multiple-character commands that control terminal functions (i.e., how characters are displayed, processed, and transmitted). They contain the following parts:

Control sequence introducer (always ESC [) or escape sequence introducer (always ESC)

Intermediate characters (optional)

P_n (a numeric parameter)

P_s (a selective parameter)

One final (termination) character

Separate parameters with a semicolon, but do not include a semicolon before the terminating character. A series of periods indicates you can include more than one value for that parameter. <space> indicates a space character.

When the command allows a combination of entries for one parameter (e.g., visual attributes can include increased/decreased intensity, reverse, blink, and underline), it includes two parameters separated by a semicolon. For example, the command for visual attributes is printed as:

ESC [	P _s ; ...	m
control sequence introducer	parameters	final character

Enter the semicolon only to separate the variable (decimal) parameters.

An actual entry for half intensity, underlined, and blinking data when the normal attribute is high would be

ESC [2 ; 4 ; 5 m

Operating Modes

VT100 mode¹

Native (970 ANSI) mode

VT52 mode¹

Return to previous mode from VT52 mode

ESC [? 21 I

ESC [? 21 h

ESC [? 2 I

ESC <

1. In this mode, turning on the terminal initializes the four cursor control keys to their factory default values. (This is the factory default mode.)

These modes determine which commands the terminal will recognize and how it will treat double-height lines.

At power on, the 970 is in the VT100 mode. In this mode, the terminal recognizes the commands described elsewhere in this chapter and the screen is considered to have 24 lines, regardless of each line's height. While this mode is enabled, you must define each page as 24 lines. Each double-height line is considered two separate lines. Treating double-height lines differently also affects the way the following commands function:

Cursor addressing

Horizontal and vertical cursor positioning

Line feed

Erase line

Erase page

In the native mode, the number of lines refers to the number of displayed data lines. Each double-height line is considered one addressable line.

The commands recognized in the VT52 mode are listed in Appendix H. In the VT52 mode, the cursor control keys return to their default value.

Controlling the Display

The commands in this section allow you to control characteristics of the display.

Number of Lines Displayed

The standard display contains 24 lines. In addition, the terminal can display the 25th line.

The 25th Line

Define contents of 25th line

SET UP
DEFAULT $P_n = 0$
ESC [0 ; P_n z

where

P_n	Effect
0	No display (blank)
1	Status
2	User message

The 25th line can display any one of the following:

The status line (containing descriptions of the terminal's configuration)

A computer-originated message to the user (user message line)

No display

Refer to Table 4-2 for a description of the status line and to Chapter 6 if you want to program the user message line.

You can change some of the attributes of the 25th line; what you can change depends on whether you are displaying the status line or the user message line. Table 5-1 shows which attributes you can change.

Table 5-1
Attributes of the 25th Line

Attribute	User Line	Status Line
Screen background	Reverse of other lines	Reverse of other lines
Visual attributes	Can be used	Can not be used
Number of characters	Same as other lines	Same as other lines
Line	Can be double width/single height or single height/single width	Can be single height/single width only
Character sets	Any	Same as primary character set

Line Attributes

Select single-width line	ESC # 5
Select double-width line	ESC # 6
Select native double-height line ¹	ESC # 2
Select top half of double-height line ²	ESC # 3
Select lower half of double-height line ²	ESC # 4

1. This command is ignored unless the terminal is in native mode.

2. This command is ignored when protect or native mode is on; the terminal must be in VT100 mode. After you select a double-height line, do not change operating modes.

where

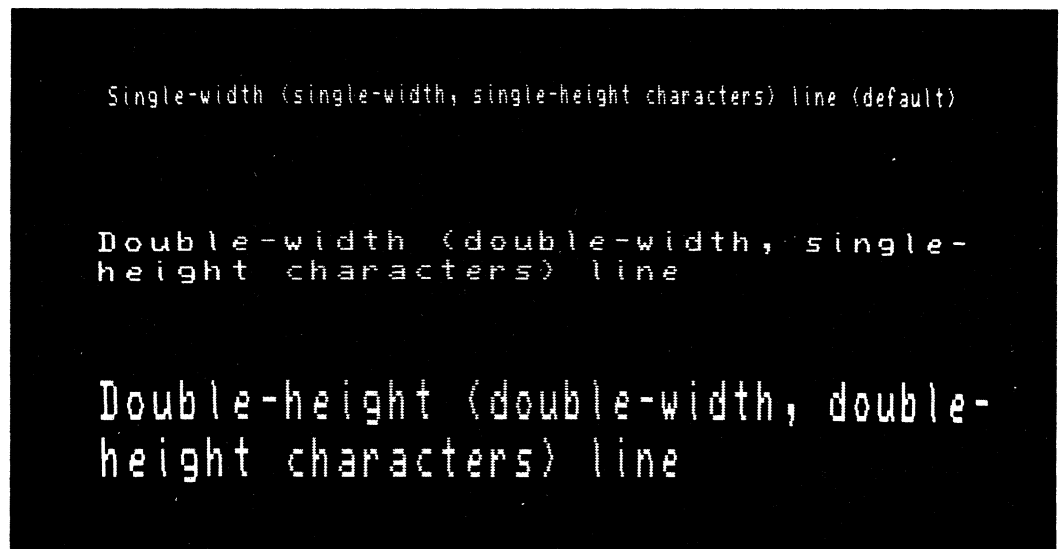
You must set the line attribute and the number of columns per line before you set the lower half of the double-height line.

Since the cursor's position determines the line affected by this command, you must place the cursor within that line before executing the command.

These commands let you change the height and width of all characters within a line on a line-by-line basis. The command affects the whole line.

Figure 5-1 illustrates the possible line dimensions.

Figure 5-1
Line Sizes



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Redefining the size of a line redefines all characters already on that line as well as data entered after you change the attribute.

Each double-height line decreases the total number of **visible** lines by one. Changing the height of lines can affect the appearance of data as it scrolls within the scrolling region.

Enlarging a line can affect previously displayed data. For instance, if the cursor is on the bottom line when you double the height of that line, the first line is pushed up and out of sight while all of the 24th line is displayed. However, if the cursor is in the 23rd line or above when you double the height of the cursor's line, the 24th line disappears from sight. When you change the size of the line back to single height, the line will reappear.

Characters within the message line are either single height/single width or single height/double width.

Single-Width Line—A single-width line can contain either 80 or 132 columns of characters, each displayed as a single-width, single-height character. Executing this command does not move the cursor.

Double-Width Line—Characters in a double-width line are twice as wide as standard characters, but their height is not changed. Using a double-width line means that only half as many characters can fit on that line. If a line is defined as an 80-character double-width line, only 40 double-width characters can actually be displayed on that line.

If you change a line from single width to double width after you have entered data, the last half of the line disappears from view until you redefine the line as single. To see this data again, redefine the line as single width (collapsing the character width).

If the cursor is on a character position that moves beyond the right margin, the cursor moves to the right margin of the screen.

Double-Height Line—A double-height line contains characters twice as high and twice as wide as standard characters. Defining a line as double height means that only half as many characters can fit on that line.

Each double-height line reduces the screen display by one line. If you redefine a line as double height after the screen is full, the last line of the display disappears from view but is not destroyed—you can later scroll the screen up to view that line.

If you define a scrolling region and then enlarge the height of two or more lines within the scrolling region, a line disappears from the bottom and the top of the screen. However, the line that reappears when you reverse the line size may not be the same line.

Page Attribute Mode

Define page attribute

SET UP
DEFAULT $P_s = 0$
ESC [5 ; P_s z

where

P_s	Effect
0	Single-height/single-width page
1	Single-height/double-width page
2	Double-height/double-width page

After you execute a clear page command, the page will be defined as a double height/double width (i.e., contains double-height, double-width characters). When you move the cursor from the home position to the bottom of the screen, the terminal considers the cursor to be on line 12 (indicated on the status line). Even though you can not see all 24 lines of data when the page attribute mode is double-height, double-width, you can scroll up and down within the page without losing data. Any lines that scroll off the page will be replaced with the above line setting.

Characters per Line

Maximum 80 columns
Maximum 132 columns

SET UP
DEFAULT = 80
ESC [? 3 l
ESC [? 3 h

where

Changing the number of characters in a line also:

Replaces all data on the screen with the insert character

Erases the visual attribute setting(s) regardless of the visual attributes switch's setting

Changes the entire screen to single-height/single-width lines

Moves the cursor to the home position

*Cancel*s any scrolling region

*Cancel*s protect mode

Each line can contain a maximum of either 80 or 132 characters. Changing this value changes the entire page and restructures the display area; i.e., you can not mix 80- and 132-column lines within a page. After you specify the number of columns, all subsequent pages use that value until you redefine the number of columns.

Lines per Page

SET UP
DEFAULT P_s = 0
ESC [1 ; P_s z

Set number of lines per page

where

P _s	Effect
0	24 lines
1	48 lines
2	72 lines ¹

1. Ignored if you also select 132 columns.

Executing this command also causes these changes:

Replaces all data within the page with the insert character

Displays the first page with the cursor on the home position

*Cancel*s forms build and protect modes (if set)

*Cancel*s any defined scrolling region

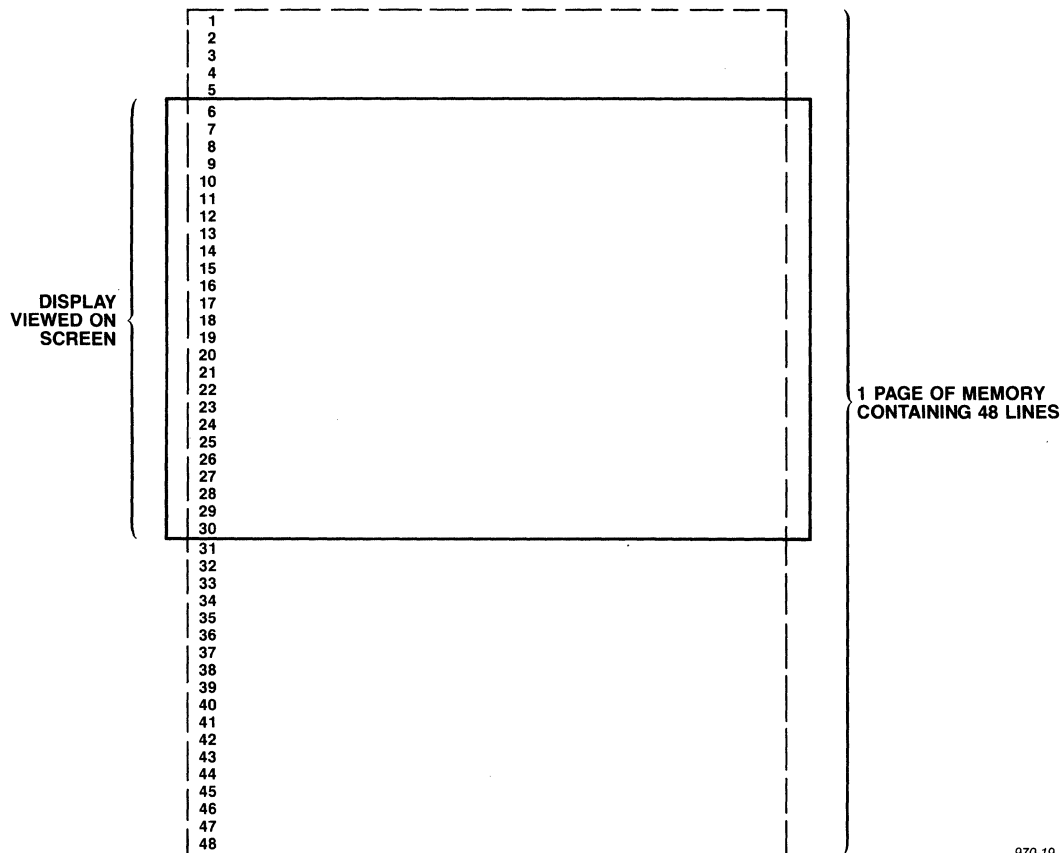
*Cancel*s any line attributes

As used here, the term **page** refers to an amount of memory ranging from 24 to 72 lines. However, since the screen shows 24 lines, you may not always see the entire page of memory on the screen. See Figure 5-2. The entire page can scroll unless you define a smaller scrolling region.

Not to be confused with the term **page**, **screen** refers to the physical cathode ray tube on which data appears. The **display** is the amount of data which can be viewed on the screen at one time—the viewable scrolling region.

You can divide the memory into more than one page. The number of characters per line determines the number of pages and lines available. Table 5-2 summarizes how you can divide the memory.

Figure 5-2
Part of a Page of Memory Displayed on the Screen



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Table 5-2
Dividing Memory into Pages

No. of Columns/Line	Pages	Lines/Page
80	3	24
	1	48
	1	72
132	2	24
	1	48

Screen Background

Dark background
Light background

SET UP
ESC [? 5 l
ESC [? 5 h

Two screen backgrounds are possible: light with dark characters or dark with light characters.

Remember that you can also change the background in the set up mode. The effect of a screen background command depends on how you defined the screen appearance in set up mode. If the terminal receives a command that corresponds to the value selected in set up mode, no change occurs.

Screen Intensity

SET UP
DEFAULT $P_n = 0$
ESC [4 ; P_n z

Establish screen intensity

where

P_n is a decimal value ranging from 0 through 63. A value of 1 produces minimum intensity (contrast) and a value of 63 causes maximum intensity.

The default value (zero) causes maximum intensity.

This command allows you to control the screen intensity.

Cursor Attributes

DEFAULT $P_s = 0$
ESC [3 ; P_s z

Define cursor attribute

where

- | P_s | Effect |
|-------|--------------------------------|
| 0 | Blinking block cursor |
| 1 | Steady block cursor |
| 2 | Blinking underline cursor |
| 3 | Steady underline cursor |
| 4 | No cursor (cursor not visible) |

NOTE! *The page attribute mode determines the cursor's size.*

Contrast Emphasis

SET UP
DEFAULT $P_s = 0$
ESC [7 ; P_s z

Define normal contrast setting

where

- | P_s | Effect |
|-------|--------------------------|
| 0 | Normal is low intensity |
| 1 | Normal is high intensity |

This command determines how the terminal interprets normal intensity. If you enter 0 in this command, normal intensity appears half as bright as high intensity. But if you enter 1, normal intensity will be the brightest intensity available.

Visual Attributes

Define visual attribute(s) of display \

DEFAULT $P_s = 0$
ESC [P_s ; ... ; P_s m

where

P_s	Effect
0	Normal video (either increased or decreased intensity)
1	Increased intensity ^{1, 2}
2	Decreased intensity ^{1, 3}
3	Blank (invisible)
4	Underline
5	Blink
7	Reverse video

1. Normal video is determined by the value entered in the contrast emphasis escape sequence above (called normal attribute in the set up menu).
2. An invalid parameter if normal contrast setting (in the previous section) has a value of one (1).
3. An invalid parameter if normal contrast setting (in the previous section) has a value of zero (0).

Visual attributes do not occupy a character position.

Attributes accumulate.

Visual attributes change the appearance of data on the screen. When changing visual attributes, use the value for normal screen ($P_s = 0$) first unless you want to combine the new attribute with the previous attribute. For example, when most data is light on a dark background, defined areas can contain blinking dark characters on a light background.

Visual Attribute Action Mode

Enable visual attribute action mode
Disable visual attribute action mode

ESC [? 18 I
ESC [? 18 h

Enabling this mode before you build a form embeds the current visual attributes. After you finish the form and protect it, disable the visual attribute action mode. Now entering data or executing a clear or erase command can not affect the embedded visual attributes. You can enable this mode whenever forms build mode is also enabled.

Screen Saver

Select screen saver time limit

SET UP
DEFAULT $P_s = 0$
ESC [2 ; P_s z

where

P_s	Effect	Elapsed Time in Minutes Between Data Entry
0	Disabled	0
1	Enabled	5
2	Enabled	10
3	Enabled	15

Since any key pressed to activate the screen is also displayed, press a key such as the HOME key or a cursor key (so you will not write over or erase existing data).

By turning off the display when data is not being input, you prolong the life of the CRT's phosphor. No data is lost while the screen saver feature is active. As soon as the terminal receives data from the computer or the keyboard, the screen comes back on.

**CLEAR SPACE
Key Mode**

Ignore CLEAR SPACE key
Recognize CLEAR SPACE key

ESC [? 8 I
ESC [? 8 h

where

You must define the communications mode as block or local before you select the ignore CLEAR SPACE key mode.

This mode determines whether or not the terminal recognizes the code sent by the unshifted CLEAR SPACE key. To protect the screen from being accidentally cleared, select **ignore** CLEAR SPACE. This allows the terminal to recognize and process only the code from the **shifted** CLEAR SPACE key.

Select **recognize** when you want the terminal to process the unshifted CLEAR SPACE key codes.

BREAK Key Mode

Ignore BREAK key
Recognize BREAK key

SET UP
ESC [? 16 I
ESC [? 16 h

Execute the recognize BREAK key command when you want the terminal to process shifted and unshifted BREAK key codes. When the terminal is in this mode, the shifted BREAK key causes a 3.5-second break pulse and the unshifted BREAK key causes a 250-millisecond break pulse.

Execute the ignore BREAK key command when you want the unshifted BREAK key to be ignored by the terminal and the shifted BREAK key to be recognized. When the terminal is in this mode, the shifted BREAK key causes a 250-millisecond break.

This mode corresponds to the parameter called BREAK KEY EXEC in the set up menu.

Keyclick Mode

Keyclick on
Keyclick off

SET UP
ESC [? 22 I
ESC [? 22 h

This mode controls whether or not the keys click when they are pressed.

Character Sets

The 970 contains many character sets. You can define any two of them (primary and secondary) to be used interchangeably. By following the instructions in Chapter 6, you could also design your own character set of up to 240 characters and download them into the memory as the primary or secondary character set.

You can use two types of commands when you want to select one of the resident character sets. One type gives you access to eight resident character sets and lets you define both the primary and secondary character sets with the same command. The other type makes available a special and line-drawing (graphic) character set or one of the eight resident character sets. This command defines either the primary or secondary character set.

After you define which character set is primary and which is secondary, you can activate them interchangeably. Now all data entered will be displayed in the active character set. Having primary and secondary character sets lets you use two character sets within the same display.

**Defining Both
Character Sets**

SET UP
DEFAULT P₀ = 0; P₁ = 1
ESC [P₀ ; P₁ (space) D

Define primary and secondary character sets

where

P₀ defines which character set is the primary character set.

P₁ defines which character set is the secondary character set.

P ₀ /P ₁	Character Set ¹
0	US (ASCII)
1	UK
2	German
3	French
4	Spanish
5	Portuguese
6	Norwegian/Danish
7	Swedish/Finnish

1. Appendix E lists the characters that change in the eight character sets.

**Defining One
Character Set**

Define primary character set
Define secondary character set

ESC (P_s
ESC) P_s

where

P _s	Character Set
0	Special and line-drawing characters
A	UK
B	US ASCII
C	German
D	French
E	Spanish
F	Portuguese
G	Norwegian/Danish
H	Swedish/Finnish

If you select a character set with one of these sequences, you must use a similar escape sequence to change it.

These commands let you designate one of these character sets as primary or secondary. The special and line-drawing character set (selected with the ESC (0 or ESC) 0 command) replaces some characters with the characters shown in Table 5-3. These special characters are produced by the lowercase keys. Pressing an uppercase key produces the standard character.

**Activating a
Character Set**

Activate primary character set
Activate secondary character set

CTRL O
CTRL N

Table 5-3
Special and Line-Drawing Characters

Key	ASCII	Bit Value	Binary								Octal	Decimal	Hex	
			7 128	6 64	5 32	4 16	3 8	2 4	1 2	0 1			Accept	Display
_	(blank)	0	1	0	1	1	1	1	1	1	137	095	5F	80
`	◊	0	1	1	0	0	0	0	0	0	140	096	60	0E
(grave) a	⌘	0	1	0	0	0	0	0	1	1	141	097	61	7F
b	⌡	0	1	1	0	0	0	1	0	0	142	098	62	09
c	⌢	0	1	1	0	0	0	1	1	1	143	099	63	0C
d	⌣	0	1	1	0	0	1	0	0	0	144	100	64	0D
e	⌤	0	1	1	0	0	1	0	1	1	145	101	65	0A
f	◌	0	1	1	0	0	1	1	0	0	146	102	66	14
g	±	0	1	1	0	0	1	1	1	1	147	103	67	12
h	⌥	0	1	1	0	1	0	0	0	0	150	104	68	1F
i	⌦	0	1	1	0	1	0	0	1	1	151	105	69	0B
j	⌧	0	1	1	0	1	0	1	0	0	152	106	6A	88
k	⌨	0	1	1	0	1	0	1	1	1	153	107	6B	87
l	〈	0	1	1	0	1	1	0	0	0	154	108	6C	86
m	〉	0	1	1	0	1	1	0	1	1	155	109	6D	85
n	+	0	1	1	0	1	1	1	0	0	156	110	6E	89
o	—	0	1	1	0	1	1	1	1	1	157	111	6F	81
p	—	0	1	1	1	0	0	0	0	0	160	112	70	82
q	—	0	1	1	1	0	0	0	1	1	161	113	71	8B
r	—	0	1	1	1	0	0	1	0	0	162	114	72	83
s	—	0	1	1	1	0	0	1	1	1	163	115	73	84
t	⌫	0	1	1	1	0	1	0	0	0	164	116	74	8D
u	⌬	0	1	1	1	0	1	0	1	1	165	117	75	8C
v	⌭	0	1	1	1	0	1	1	0	0	166	118	76	8F
w	⌮	0	1	1	1	0	1	1	1	1	167	119	77	8E
x	⌯	0	1	1	1	1	0	0	0	0	170	120	78	8A
y	≦	0	1	1	1	1	0	0	1	1	171	121	79	0F
z	≧	0	1	1	1	1	0	1	0	0	172	122	7A	10
{	π	0	1	1	1	1	0	1	1	1	173	123	7B	13

**Table 5-3
Continued**

Key	ASCII	Bit Value	Binary								Octal	Deci- mal	Hex	
			7 128	6 64	5 32	4 16	3 8	2 4	1 2	0 1			Accept	Display
|	≠		0	1	1	1	1	1	0	0	174	124	7C	11
}	£		0	1	1	1	1	1	0	1	175	125	7D	16
~	•		0	1	1	1	1	1	1	0	176	126	7E	15

Graphics

You can create outlined blocks and blocks filled with visual effects when you use the commands described in this section.

Block Graphics

Outline area with thin-line graphics

DEFAULT $P_w/P_d = 1$
ESC [$P_w ; P_d$ (space) p

where

P_w is the outside width of the block in character positions, starting with the current cursor position and extending forward. This value must be two or greater. A value of zero or one results in a horizontal line.

P_d is the outside depth of the block in lines, starting with the current cursor line. This value must be two or greater. A value of zero or one results in a vertical line.

P_w	P_d	Effect
0	0	Crosshair graphics character at the cursor location
1	1	Crosshair graphics character at the cursor location
2 or more	0 or 1	Horizontal line graphics characters at the cursor location
2 or more	2 or more	Horizontal and vertical graphics characters outline the block
1	0	Horizontal line graphics character at the cursor location
0 or 1	2 or more	Vertical line graphics characters at the cursor location
0	1	Vertical line character appears at the cursor location

Block graphics are limited by the length of the page and the defined scrolling region. While the block can extend beyond the limits of the display, only part of it may be visible. Entering values greater than the page results in a block that ends at the right or bottom margin.

You can outline one or more blocks. Figure 5-3 shows three overlapping blocks.

Before entering the sequence, position the cursor where you want the top left corner. This sequence does not move the cursor.

Block Attributes

Create area with predefined visual attribute(s)

DEFAULT $P_w/P_d = 1$
ESC [$P_w ; P_d$ (space) q

where

P_w is the width of the block in character positions, starting with the current cursor position and extending forward.

P_d is the depth of the block in lines, starting with the current cursor line.

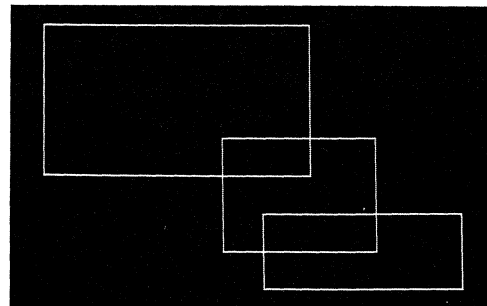
This command has no effect if protect mode is on.

Before issuing the command, you must define the visual attribute for the area and position the cursor on the upper left corner of the area to be defined.

Block attributes are limited by the length of the page and the scrolling region. While the block can extend beyond the limits of the display, only part of it may be visible. Entering values greater than the display results in a block which ends at the right or bottom margin.

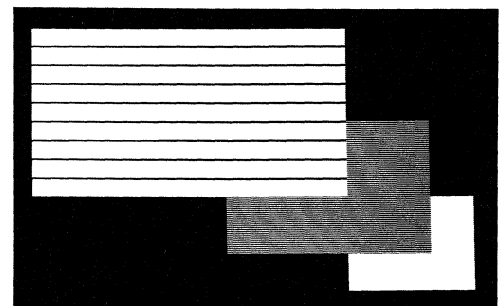
One or more visual attributes can affect characters within defined blocks of the display. Figure 5-4 illustrates a display in which three blocks are defined.

Figure 5-3
Display with Three Blocks of Graphics



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Figure 5-4
Display with Three Blocks of Attributes



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Display Movement

You can move or scroll data into view on the screen. The commands described in this section let you control the direction, rate, and evenness of the scrolling and the region in which it occurs.

Next Line

Move cursor to next line

ESC E

When this command executes, the cursor moves to the first position on the next line down. If the cursor is on the display's bottom line with autopage mode set on single, data scrolls up one line. If the cursor is on the page's last line, the scrolling action destroys the page's first line. But if autopage mode is multiple, the cursor moves to the first character position on the first line of the next page and the display shows the first 24 lines of this next page (assuming single-height/single-width lines).

Next Page

Display next page

DEFAULT $P_n = 1$
ESC [P_n U

where

P_n	Effect
0 or 1	Displays the next page
2 or more	Displays the page a defined number of pages beyond the current page

Executing this command displays the specified page of memory. The page is selected relative to the currently displayed page.

Although this command does not affect the cursor position, it automatically resets any defined scrolling region and cancels forms build and protect modes (if on).

For example, if you configure the terminal with three pages of 24 lines before executing the command ESC [3 U, the current page remains on the screen but the defined scrolling region is redefined.

Previous Page

Display previous page

DEFAULT $P_n = 1$
ESC [P_n V

where

P_n	Effect
0 or 1	Displays the previous page of memory with the cursor in its previous position on that page
2 or more	Displays the page a defined number of pages before the current page

This command is ignored while single protect page mode is on.

This command is identical to the next page command—except the movement within memory is backward.

Although this command does not affect the cursor position within the current page, it automatically resets any scrolling region.

Horizontal Scroll Right

Scroll right

DEFAULT $P_n = 1$
ESC [P_n <space>

where

P_n defines how many character positions to the right the display is to move.

The size of the area within which scrolling occurs depends on the edit boundary you have defined.

The command is ignored while protect mode is on.

This command moves the entire contents of the screen to the right and adds an insert character on the first position of each line. Data on the last character position of each line is lost.

Horizontal Scroll Left

Scroll left

DEFAULT $P_n = 1$
ESC [P_n <space> A

where

P_n is the number of character positions to the left the display is to move.

The size of the area within which scrolling occurs depends on the edit boundary you have defined.

The command is ignored while protect mode is on.

This moves the entire contents of the screen to the left and adds an insert character at the last character position of each line. Data on the first character position of each line is lost.

Scrolling Type and Rate

Select vertical scrolling type and rate

SET UP
DEFAULT $P_s = 0$
ESC [P_s w

where

- | | |
|-------|------------------------------------|
| P_s | Effect |
| 0 | Jump |
| 1 | Normal smooth (6 lines per second) |
| 2 | Fast smooth (12 lines per second) |
| 3 | Slow smooth (3 lines per second) |

Unless the computer uses either X-On/X-Off or Data Terminal Ready (DTR) protocol and you have selected those values in set up mode, smooth scroll does not function.

If you select smooth scroll, the terminal displays incoming data at an even rate. This command does not affect horizontal scroll.

Scrolling Mode

Define scrolling mode as jump
Define scrolling mode as smooth

ESC [? 4 I
ESC [? 4 H

Smooth scroll mode causes data to scroll smoothly at the normal rate (6 lines per second).

Defined Scrolling Region

Define scrolling region

DEFAULT $P_t = 1$; $P_b = 24$
ESC [P_t ; P_b r

where

P_t is the line number of first (top) line in the scrolling region (entered in decimal notation).

P_b is the line number of last (bottom) line in the scrolling region (entered in decimal notation).

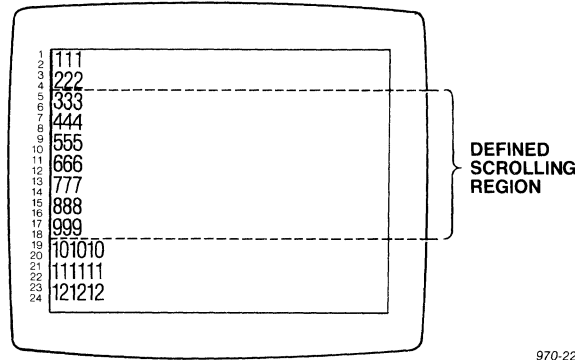
Each value represents a vertical position on the screen as if each of the 24 lines displayed were single-height lines.

The first line on the screen is line number one.

Whenever you enter a new page, the defined scrolling region is redefined as the displayed area.

This command lets you confine vertical scrolling to one region within the display. Line height determines the actual location of the defined scrolling region on the screen. Figure 5-5 shows a screen containing all double-height lines, with the defined scrolling region starting at line five.

Figure 5-5
Scrolling Region of Double-Height Lines



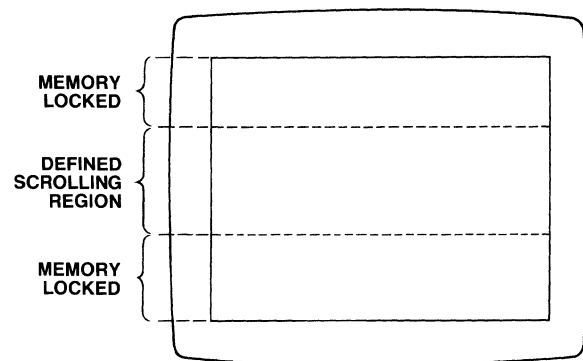
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You can use jump or smooth scrolling within the defined scrolling region. Although you can only move the cursor within the defined scrolling region, data can scroll out of that area. Whether or not this scrolling destroys data depends on the number of lines within that page of memory.

The area outside the defined scrolling region is called the **memory locked area** (shown in Figure 5-6). Although you can still write data into this area, you can not move the cursor into it with the ↑ or ↓ keys and data within that area can not scroll. Whether or not you can address the cursor to the memory locked area depends on how origin mode (described in the next section) is set.

By defining a defined scrolling region, you also enable relative origin mode and move the cursor to the scrolling region's home position. You can not change the line attributes of the memory locked area.

Figure 5-6
Memory Locked Area



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Origin Mode

Enable relative origin mode (dependent)
Enable absolute origin mode (independent)

ESC [? 6 h
ESC [? 6 l

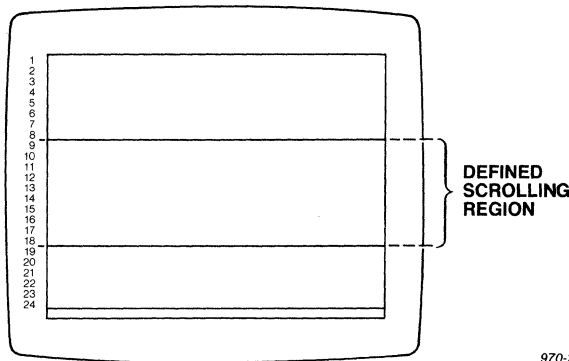
After you define a scrolling region, origin mode specifies whether home and line positions refer only to the defined scrolling region (dependent) or to the entire screen area.

After you enable relative origin mode, the line numbers relate to the area within the defined scrolling region. But if you enable absolute origin mode, line numbers refer to the screen lines, regardless of any scrolling region.

Origin mode affects cursor movement. If origin mode is relative, you can not move the cursor outside the scrolling region from the keyboard. If origin mode is absolute and you press the HOME key while the cursor is in the scrolling region, it goes to the home position.

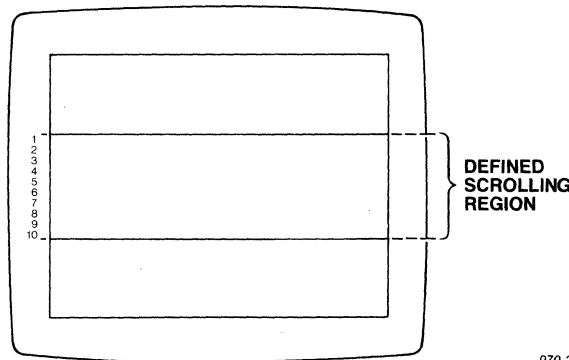
In Figure 5-7, the line numbers are **independent** of the scrolling region. In Figure 5-8, a scrolling region has been defined and the line numbers are **dependent** on the scrolling region.

Figure 5-7
Line Numbers Independent of Scrolling Region



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Figure 5-8
Line Numbers Dependent on Scrolling Region



970-25

Autopage Mode

Single autopage mode
Multiple autopage mode

SET UP
ESC [? 20 I
ESC [? 20 h

where

Autopage mode functions only when memory is divided into 24-line pages.

This mode has no effect while protect mode is on.

If you enable single autopage and new line modes before executing a line feed command, the following occurs:

The first line of the display is lost.

The remaining data moves up one line.

A blank line filled with insert characters appears on the bottom of the display.

The cursor goes to the first character position on the bottom line (now blank).

Autopage mode determines what happens when the cursor attempts to go beyond the bottom margin of the screen when the memory contains 24-line pages. Enabling single autopage mode lets the data on the current page scroll up and adds a new line (filled with insert characters). Multiple autopage mode lets the cursor proceed into the next page.

Cursor Movement

Basic cursor movements (up, down, backward, forward, and next line) move the document without loss of data; they are influenced by autowrap, autopage, and edit boundary modes.

Cursor movement is different when the terminal is in block mode. In that mode, cursor movement commands do not move the cursor off the screen. (Refer also to the section on block mode.)

Cursor Up

Move cursor up

DEFAULT $P_n = 1$
ESC [P_n A

where

P_n is an optional variable that defines how many lines up the cursor is to move.

A value of zero or one moves the cursor up one line.

The cursor up command moves the cursor position upward within the current column but does not let it move above the top of the display or the defined scrolling region. The cursor stops at line one.

Cursor Down

Move cursor down

DEFAULT $P_n = 1$
ESC [P_n B

where

P_n is an optional variable that defines how many lines down the cursor is to move.

A value of zero or one moves the cursor down one line.

The cursor down command moves the cursor position downward within the current column. If you have defined a scrolling region, the cursor can not move below the defined scrolling region or the display; it stops on the bottom line of the area.

Cursor Forward

Move cursor forward

DEFAULT $P_n = 1$
ESC [P_n C

where

P_n is an optional variable defining how many columns forward the cursor is to move.

A value of zero or one moves the cursor right one column.

The cursor forward command moves the cursor right within the current line. After the cursor reaches the last column position on the current line, it can not continue to move unless autowrap is set for wrap. Enabling autowrap allows the cursor to move to the first column position of the next line and continue until the P_n value is satisfied.

Cursor Backward

Move cursor backward

DEFAULT $P_n = 1$
ESC [P_n D

where

P_n is an optional variable that defines how many columns back the cursor is to move.

A value of zero or one moves the cursor left one column position.

The cursor backward command moves the cursor position backward within the current line. The cursor can not move beyond the left margin of the display; it stops in the first character position on the current line. Autowrap mode does not affect this command.

Cursor Next Line

Move cursor to next line

DEFAULT $P_n = 1$
ESC [P_n E

where

P_n is an optional variable that defines how many lines down the cursor is to move.

A value of zero or one moves the cursor to the first character position of the following line.

This command moves the cursor to the first character position a defined number of lines down.

In single autopage mode, the display scrolls up when the cursor reaches the last line of the display while satisfying the P_n line value. However, in multiple autopage, the cursor moves to the first column of the first line on the next page and continues until the P_n line value is satisfied.

Cursor Previous Line

Move cursor to previous line

DEFAULT $P_n = 1$
ESC [P_n F

where

P_n is the number of lines backward the cursor is to move.

A value of zero or one moves the cursor up one line and to the first character position.

This command moves the cursor to the first character position of the previous line. In single autopage mode, the display scrolls down until the cursor reaches the top line of the display or defined scrolling region while satisfying the P_n line value. However, in multiple autopage, the cursor moves to the last column of the last line on the previous page and continues to satisfy the P_n line value.

If you try to move the cursor above the top margin of the display or defined scrolling region, the cursor stops there.

Index

Index

ESC D

The index command moves the cursor down one line within the current column position.

If the cursor is on the last line of the display while autopage is set for single, the display scrolls up. However, if autopage is on multiple, the cursor goes to the first line on the next page without changing its column position.

Reverse Index

Reverse index

ESC M

The reverse index command moves the cursor up one line while keeping it in the current column. If the cursor is already on the top line of the display and you have selected single autopage, the display scrolls down one line. Multiple autopage allows the cursor to move to the last line of the previous page of memory instead.

Autowrap Mode

Disable autowrap mode (no wrap)
Enable autowrap mode (wrap)

SET UP
ESC [? 7 I
ESC [? 7 H

After you enter a character at the last position on the present line, enabling autowrap mode lets the cursor automatically advance to the first character position on the next line after the character is entered. If protect mode is enabled, the cursor goes to the next unprotected field after the last character is entered in the present field.

With autowrap mode disabled, the last character entered supersedes the previous character once the cursor reaches the last character position in the current line. Or, if protect mode is on, a newer character supersedes the previous one when the cursor reaches the last character position of the last unprotected field.

As discussed in the block mode section, the status of block mode affects cursor movement.

Line Feed/New Line Mode

Enable line feed mode; disable new line mode
Enable new line mode, disable line feed mode

SET UP
ESC [20 I
ESC [20 H

After you enable new line mode, pressing RETURN generates both a carriage return and a line feed code. When the terminal receives a line feed code from the computer, it performs both a carriage return and a line feed.

During line feed mode, the RETURN key generates only a carriage return code. If the terminal receives a line feed code, it only performs a line feed.

**Relative Horizontal
(Column) Movement**

Specify relative right cursor movement

DEFAULT $P_n = 1$
ESC [$P_n a$

where

P_n is a decimal number less than the difference between the maximum columns possible for that line and the cursor's current column position.

Negative P_n values are not recognized.

A value that is too large moves the cursor to the line's right margin.

This command moves the cursor to the right a given number of column positions relative to the cursor's position, while leaving it on the present line.

**Relative Line
Positioning**

Specify relative downward movement of cursor

DEFAULT $P_n = 1$
ESC [$P_n e$

where

P_n is a decimal number less than the difference between the maximum lines within that page of memory and the cursor's current line position.

A value that is too large moves the cursor to the last line of that page of memory.

This command moves the cursor down a given number of lines within the column position on which it is resting when the terminal receives the sequence.

Cursor Addressing

This section includes commands that move the cursor to a specific location.

**Absolute Horizontal
Cursor Positioning**

Move cursor to absolute column address

DEFAULT $P_n = 1$
ESC [$P_n G$
or ESC [$P_n `$

where

P_n is a decimal number corresponding to the column to which the cursor is to move. Unless this value is less than the maximum number of columns possible for that line, the cursor moves to the line's right margin.

You must move the cursor to the appropriate line before you execute this command.

This command moves the cursor to a specific column position within the line on which it is resting when the terminal receives the sequence.

**Cursor Line/Column
Addressing**

Address the cursor to line and column

DEFAULT $P/P_c = 1$
ESC [$P_l ; P_c H$
or ESC [$P_l ; P_c f$

where

P_l is the decimal line number.

P_c is the decimal column number.

A value of zero or one moves the cursor to the first line or column.

This command positions the cursor at a designated page, line, and column (called **addressing** the cursor). For example, entering a value of one for P_l and one for P_c moves the cursor to the display's home position (line one, column one).

If you have already defined a scrolling region, where this command sends the cursor depends on whether you selected relative or absolute origin mode. For example, if you position the cursor to line three, column five, origin mode determines whether the cursor goes to line three of the scrolling region or of the display.

Cursor Page Addressing

Address the cursor to page, line, and column

DEFAULT $P_p/P_l/P_c = 1$
ESC [$P_p ; P_l ; P_c$ s

where

P_p is the decimal page number.

P_l is the decimal line number.

P_c is the decimal column number.

A value of zero or one moves the cursor to the first page, line, or column.

This command positions the cursor at a designated page, line, and column. This is called addressing the cursor.

If you address the cursor to a location beyond the display, the display moves up to show the specified location.

If you have already defined a scrolling region, the location of the cursor after this command depends on whether origin mode is relative or absolute. For example, if you position the cursor to line three, column five, origin mode determines whether the cursor goes to line three of the scrolling region or the display. The state of origin mode may be changed by these commands if the cursor is moved to a different page.

Absolute Vertical (Line) Positioning

Specify cursor's absolute line position

DEFAULT $P_l = 1$
ESC [P_l d

where

P_l is a decimal number corresponding to the line and is less than the maximum number of lines within that page of memory.

If you have defined a scrolling region, line numbers depend on the origin mode setting.

This command moves the cursor to a specific line within the column in which it is located when the terminal receives the sequence. If you enter a value greater than the number of lines within that page, the cursor moves to the last line of that page of memory.

Cursor Description

Save Cursor Description Save cursor description ESC 7

This sequence saves the visual attribute, the current character set, and the current cursor position.

Restore Cursor Description Restore cursor description ESC 8

This sequence returns the cursor to the position noted by the save cursor sequence (above) and displays it with the visual attribute and character set that were in effect when it was stored.

Keyboard Action

You can change the operation of some keys with two keyboard modes: cursor key mode and keypad character selection mode. You can also prevent unauthorized or accidental data entry by locking the keyboard.

Cursor Key Mode Disable cursor key mode ESC [? 1 l
Enable cursor key mode ESC [? 1 h

Enabling this mode causes the cursor keys to generate control codes. When it is disabled, they generate ANSI cursor key sequences instead. Table 5-4 shows what each cursor key can generate.

**Table 5-4
Effect of Cursor Key Mode**

Key	Cursor Key Mode	
	Disabled	Enabled
↑	ESC [A	ESC O A
↓	ESC [B	ESC O B
→	ESC [C	ESC O C
←	ESC [D	ESC O D

Keypad Character Selection Enable numeric keypad mode ESC >
Enable alternate keypad mode ESC =

These modes control what is generated by the numeric keypad and four of the five keys above it (CHAR DELETE, LINE DELETE, PAGE ERASE, and PAGE).

After you enable alternate keypad mode, the numeric keypad generates control codes. As shown in Table 5-5, the codes generated by shifted ENTER, CHAR DELETE, LINE DELETE, PAGE ERASE, and PAGE differ from those generated during numeric keypad mode.

During numeric keypad mode, these keys instead generate numeric characters. Turning the power on or resetting the terminal reenables numeric keypad mode.

Table 5-5
Effect of Keypad Modes

Key	Numeric	Mode	
		Unshifted	Alternate Shifted
0	0	ESC O p	ESC O p
1	1	ESC O q	ESC O q
2	2	ESC O r	ESC O r
3	3	ESC O s	ESC O s
4	4	ESC O t	ESC O t
5	5	ESC O u	ESC O u
6	6	ESC O v	ESC O v
7	7	ESC O w	ESC O w
8	8	ESC O x	ESC O x
9	9	ESC O y	ESC O y
-	-	ESC O m	ESC O m
,	,	ESC O l	ESC O l
.	.	ESC O n	ESC O n
ENTER	CTRL M	ESC O M	ESC [i
CHAR DELETE (PF1)	ESC [P	ESC O P	ESC [4 l
LINE DELETE (PF2)	ESC [M	ESC O Q	ESC [1 Q
PAGE ERASE (PF3)	ESC [J	ESC O R	ESC [19 h
PAGE (PF4)	ESC [U	ESC O S	ESC [V

Keyboard Lock/Unlock

Unlock the keyboard
Lock the keyboard

ESC [2 l
ESC [2 h

The lock keyboard command disables the keyboard and prevents data from being entered on the keyboard. However, unless the terminal is in local mode, the following keys can still function:

- BREAK
- Function keys (all)
- FUNCT
- LOC ESC
- RESET

Whenever you enter set up mode or press shifted RESET, the keyboard automatically unlocks.

Tabs

The factory default typewriter-style tab stops are set at every eighth column position after the first column. You can set tab stops in set up mode or with one of the commands listed in this section.

If you try to tabulate when no tab stops are set on that line, the cursor moves to the last column position. The next tabulation moves it to the first column position of the next line.

Horizontal Tabulation

Set horizontal tab stop at cursor position

ESC H

where

This command is ignored while protect mode is on.

This command sets a tab stop at the current cursor position.

Tab Clear

Clear tab stop(s)

SET UP
DEFAULT $P_s = 0$
ESC [$P_s g$

where

P_s	Effect
0	Clears the tab stop at the current cursor position
3	Clears all tab stops
?0	Clears all tab stops and restores factory tab stops ¹

1. The factory default tab stops are at every eighth column position after the first column.

This command is ignored while protect mode is on.

To clear an individual tab stop, put the cursor on that column position before entering the command.

Cursor Horizontal Tabulation

Tab cursor forward

DEFAULT $P_n = 1$
ESC [$P_n I$

where

P_n is the number of tab stops forward the cursor is to move.

This command moves the cursor forward a specified number of tab stops. The movement of the cursor is also affected by the setting of autowrap, protect, and autopage modes.

After you enable protect mode, the command moves the cursor forward a specified number of unprotected fields. If you enter a value greater than the number of fields available, the cursor moves from the last unprotected field up to the first unprotected field on the page.

Cursor Back Tab

Tab cursor backward

DEFAULT $P_n = 1$
ESC [$P_n Z$

where

P_n is the number of tab stops backward the cursor is to move.

This command moves the cursor back a specified number of tab stops. The cursor moves backward only within the present line; it stops at the first character position in that line.

Control Representation Mode

Process the command
Monitor the command

SET UP
ESC [3 I
ESC [3 h

Set control representation mode to monitor when you want the terminal to display all received data and commands without acting upon them. During process mode, the terminal can process the commands. Appendix D lists the characters displayed by control representation mode.

Control Codes

Disable control code mode
Enable control code mode

ESC [? 9 I
ESC [? 9 h

Control code mode determines the effect of control codes. After you disable this mode, all codes perform as listed in Table 5-6. When you enable it, all codes except those shown in Table 5-7 are interpreted as listed in Table 5-6.

Table 5-6
Control Codes

Control Character	ASCII Code	Hex Code	Effect
@	NUL	00	Has no effect during transmission to the computer or during terminal processing.
E	ENQ	05	Transmits answerback message.
G	BEL	07	Sounds keyboard's bell.
H	BS	08	Moves the cursor back one position.
I	HT	09	Moves the cursor to the next tab stop, or, if protect mode is enabled, to the next field.
J	LF	0A	Causes a line feed or a new line operation.
K	VT	0B	Same as LF. ¹
L	FF	0C	Same as LF. ¹
M	CR	0D	Moves the cursor to the left margin of the current line or next line. Refer to autowrap mode.
N	SO	0E	Selects secondary (G1) character set.
O	SI	0F	Selects primary (G0) character set.
P	DLE	10	Has no effect.
Q	XON	11	Allows transmission to resume if X-On/X-Off mode is enabled.
R	DC2	12	Enables bidirectional printing.

1. Action is altered if control code mode is enabled.

**Table 5-6
Continued**

Control Character	ASCII Code	Hex Code	Effect
S	XOFF	13	Stops transmission of all codes except X-On and X-Off if X-On/X-Off mode is enabled.
T	DC4	14	Disables bidirectional printing.
V	SYN	16	Has no effect. ¹
X	CAN	18	Terminates sequence if sent during an escape sequence.
Z	SUB	1A	Same as CAN. ¹
[	ESC	1B	Introduces a command sequence.
^	RS	1E	Has no effect. ¹
_	US	1F	Has no effect. ¹

1. Action is altered if control code mode is enabled.

**Table 5-7
Alternative Control Code Values**

ASCII Code	Hex Value	Effect	Corresponding Command
VT	0B	Moves the cursor up	ESC [A
FF	0C	Moves the cursor forward	ESC [C
SYN	16	Moves the cursor down	ESC [B
SUB	1A	Clears the page and fills it with insert characters	ESC [2 J
RS	1E	Moves the cursor home (with respect to origin mode)	ESC [H
US	1F	Moves the cursor to the next line	ESC [E

To save the status of the control code mode, press CTRL S or send the sequence ESC [9 x (the software save command) from the computer.

NOTE! Regardless of the mode chosen, you can embed control characters with codes 00H through 1FH within a command, where they are immediately executed by the firmware. However, a received escape sequence aborts the current control function, allowing the received escape sequence to start. The ASCII character CAN (18H) aborts the function. The ASCII character SUB (1AH) also aborts it unless the alternate control code mode is selected.

Controlling Editing

The commands described in the following section let you change existing data by:

Replacing it as you type over it

Inserting new text that pushes the old text to the right from the cursor position

Deleting it by removing it and letting existing text move back into its place

Erasing it by replacing a line or character with the insert character(s)

This section tells you how to limit the area within which those editing commands are effective.

Editing Extent

Select extent of editing

SET UP
DEFAULT $P_s = 0$
ESC [P_s Q

where

P_s is a value that determines what part of the display can be changed by three editing commands/modes:

Insert character

Delete character

Insert mode

P_s Effect

0 Edit within the display

1 Edit within the current cursor line

While protect mode is enabled, this command has no effect and these editing functions can only affect the current field (regardless of the value entered for this command). The status line remains unchanged.

The editing extent command lets you decide whether editing changes will be limited to the cursor line or affect anything within the display. Edit boundary mode (described in the next section) restricts them to the display or the page.

Edit Boundary Mode

Display area is edit boundary
Page of memory is edit boundary

SET UP
ESC [19 I
ESC [19 H

Edit boundary mode restricts editing changes to the displayed area or allows changes to affect the entire page. The editing functions controlled by this mode are:

Delete character¹

Delete line

Erase character

Erase display

Insert line

Insert character¹

Cursor back tab

Cursor horizontal tab

Cursor left

Cursor right

Cursor up

Cursor down

Cursor next line

Cursor previous line

Data entry with insert or

replace mode¹

1. These can be further restricted by the editing extent commands.

Vertical Editing Mode

Edit on or below current line
Edit on or above current line

SET UP
ESC [7 I
ESC [7 h

where

While protect mode is on, this mode has no effect and the commands are ignored.

Vertical editing mode restricts the effect of insert and delete line commands to those lines above or below the cursor's current position.

Horizontal Editing Mode

Edit on or to the right of cursor
Edit on or to the left of cursor

SET UP
ESC [10 I
ESC [10 h

where

While protect mode is on, this mode defaults to commands that edit to the right of the cursor.

Horizontal editing restricts the effect of the insert and delete character commands and insert/replace modes to the right or left of the current cursor position.

Editing

STOP! *The editing commands described in this section may cause data to be lost as inserted lines scroll onto the screen or data is moved between the left and right margins.*

Insert/Replace Modes

Replace mode enabled
Insert mode enabled

SET UP
ESC [4 I
ESC [4 h

Insert mode pushes existing data aside as new data is entered, while replace mode actually replaces the existing data with the new data. How far existing text moves depends on the edit extent and edit boundary modes selected.

Insert Character(s)

Add an insert character(s)

DEFAULT $P_n = 1$
ESC [P_n

where

P_n is the number of insert characters to be added.

While protect and insert modes are on, this command only effects data including and to the right of the cursor in the current unprotected field.

The insert character command adds an insert character and the current visual attribute at the cursor position and shifts data on the current line to the right, starting at the cursor's position. How far the data shifts depends on the editing extent and edit boundary modes selected and how autowrap was set in the set up menu.

Insert Line

Insert line

DEFAULT $P_n = 1$
ESC [P_n L

where

P_n is the number of lines to be inserted.

The command is ignored if the cursor is outside the defined scrolling region or protect mode is on.

This command inserts a defined number of lines (filled with single-height/single-width insert characters and the current visual attribute) and sets the line attribute to single-height/single-width. It is the same as pressing the LINE INSERT key a given number of times. Existing data may move down, depending on the vertical editing mode selected.

If the new line is inserted just above the bottom margin of the display or defined scrolling region, data pushed down by the new line is not lost, just moved out of sight. If the cursor is at the bottom of the page when you insert a line, a line is lost. Which line is lost is determined by the vertical editing mode in effect.

Delete Character

Delete character(s)

DEFAULT $P_n = 1$
ESC [$P_n P$

where

P_n is the number of character positions to be deleted.

In protect mode, only data within the current field is deleted, and horizontal editing mode has no effect.

A delete character command has the same effect as pressing the CHAR DELETE key. It causes a selected number of characters to be deleted starting at the cursor position.

The command affects data at and to the left (or at and to the right) of the cursor, depending on the horizontal editing mode in effect. If you have enabled left (i.e., backward) horizontal editing, the deletion starts with the cursor position and goes backward instead of forward.

Delete Line

Delete current line

DEFAULT $P_n = 1$
ESC [$P_n M$

where

P_n is the number of lines to be deleted.

The line attribute is set to single-height/single-width.

The command is ignored if the cursor is outside the scrolling region or protect mode is on.

This command deletes lines beginning with the cursor line. It is the same as pressing the LINE DELETE key. Existing data moves up and a line filled with single-height/single-width insert characters and the current visual attribute occupies the last line of the display or defined scrolling region.

Erasure Mode

Erase all data
Erase only unprotected data

ESC [6 h
ESC [6 l

where

This command is ignored unless protect mode is enabled.

This mode allows you to control how unprotected data will be affected by the erase in page command. (That command, described in the next section, defines the quantity, not type, of data that can be erased.)

If the erasure mode is set as erase all, the erase in page command replaces all screen data (protected and unprotected), all visual attributes, and all defined area qualifications with the insert character. It also disables forms build and protect modes.

Executing the command to erase only unprotected data limits the effect of the erase in page command (see below) to unprotected data.

Erase in Page

Erase in page

DEFAULT $P_s = 0$
ESC [P_s J

where

P_s is a value that defines how much of the page will be erased.

P_s Effect

- 0 Erase from, and including, cursor to end of page
- 1 Erase from beginning of page up to and including the cursor position
- 2 Erase entire page, change all lines to the current line attribute, and move the cursor to the beginning¹

1. In VT100 mode, the cursor does not move.

During protect mode, this command erases all unprotected fields on the page and moves the cursor to the beginning of the first unprotected field.

Once you set edit boundaries, this command controls the amount of data you can erase. If you erase a partial page, the line attribute of all lines except the cursor line becomes single-high/single-wide. The cursor line retains its original line attribute.

Erase in Line

Erase within current line

DEFAULT $P_s = 0$
ESC [P_s K

where

P_s is a value that defines how much of the line will be erased.

P_s Effect

- 0 Erase from cursor to end of current line
- 1 Erase from the beginning of current line up to and including the cursor
- 2 Erase entire current line

This command erases data within the line on which the cursor is positioned and the attribute(s) of the line.

Erase in Field

Erase within field

DEFAULT $P_s = 0$
ESC [P_s N

where

P_s is a value that defines how much of the field will be erased.

P_s Effect

- 0 Erase from the cursor position to but not including the next tab stop or through the end of the field
- 1 Erase from the start of the tab field through the cursor position
- 2 Erase the entire tab field and reposition the cursor at the current tab stop or the beginning of the line

While protect mode is on, this command erases the unprotected field and moves the cursor to the first position of the current unprotected field.

If protect mode is disabled, the tab field is 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. If protect mode is enabled, the field is the current unprotected field.

This command erases data within the field in which the cursor is positioned.

Erase Between Columns Within Line

Erase between columns within line ESC [? 3 C₁ ; C_r K

where

C₁ is the column number of the first (i.e., left) position at which data is to be erased.

C_r is the column number of the last (i.e., right position) at which data is to be erased.

This command is ignored while protect mode is on.

This command erases all data between the specified columns within the current cursor line.

Erase Between Columns Within Page

Erase between columns within page ESC [? 3 ; L_t ; C₁ ; L_b ; C_r J

where

C₁ is the column number of the first (i.e., left) position at which data is to be erased.

C_r is the column number of the last (i.e., right) position at which data is to be erased.

L_t is the number of the first (i.e., top) line within which data is to be erased.

L_b is the number of the last line (i.e., bottom) line within which data is to be erased.

During protect mode this command is ignored.

This command erases data within a specified area of the current page.

Function Keys

Execute a function key DEFAULT P_s = 1
ESC [P_s |

where

P_s is the number of the function key (1 through 32), given below.

Key	P _s Value		Key	P _s Value	
	Unshifted Key	Shifted Key		Unshifted Key	Shifted Key
F1	1	17	F9	9	25
F2	2	18	F10	10	26
F3	3	19	F11	11	27
F4	4	20	F12	12	28
F5	5	21	F13	13	29
F6	6	22	F14	14	30
F7	7	23	F15	15	31
F8	8	24	F16	16	32

When you execute a function key, it will send the sequence shown below in Table 5-8 (unless you have reprogrammed it).

Table 5-8
Default Function Key Values

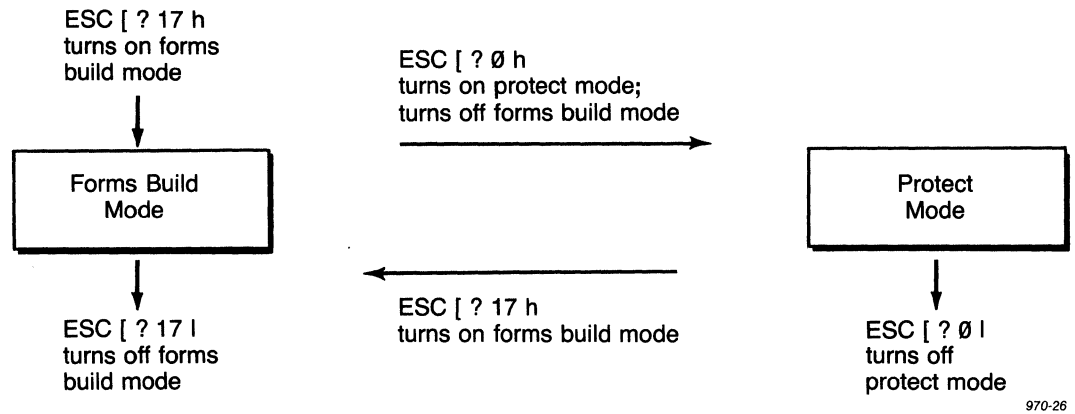
Key	Unshifted	Shifted
F1	ESC ? a	ESC ? A
F2	ESC ? b	ESC ? B
F3	ESC ? c	ESC ? C
F4	ESC ? d	ESC ? D
F5	ESC ? e	ESC ? E
F6	ESC ? f	ESC ? F
F7	ESC ? g	ESC ? G
F8	ESC ? h	ESC ? H
F9	ESC ? i	ESC ? I
F10	ESC ? j	ESC ? J
F11	ESC ? k	ESC ? K
F12	ESC ? l	ESC ? L
F13	ESC ? m	ESC ? M
F14	ESC ? n	ESC ? N
F15	ESC ? o	ESC ? O
F16	ESC ? p	ESC ? P

Forms

Forms build mode allows you to define areas and limit subsequent data entry by type and amount. Later, using the guarded area command, you can prevent transmission of these protected fields.

The following section, Forms Build Mode, summarizes how to use these commands together. Figure 5-9 illustrates when you can use these commands.

Figure 5-9
Forms Build Commands



Forms Build Mode

Turn on forms build mode; turn off protect mode (if on)
Turn off forms build mode

ESC [? 17 h
ESC [? 17 I

You must enable forms build mode before you can add defined area qualifications specifying the type and amount of data entry (if any) permitted in designated areas.

Protect Mode

Disable protect mode
Enable protect mode; disable forms build mode

ESC [? 0 I
ESC [? 0 h

where

You must enable block and forms build modes before enabling protect mode.

Enabling protect mode affects cursor movement during many other modes of operation (noted in each relevant section).

Turning on protect mode is the final step in building a protected form. It protects the form you built with forms build mode. After you enable protect mode, you can still change the form if you reenables forms build mode again. Then after the corrections are done, reenables protect mode (automatically disabling forms build mode). When you turn off protect mode, the form loses all of its protection.

Defined Area Qualifications

Define the area qualification

DEFAULT $P_s = 0$
ESC [$P_s ; \dots ; P_s o$

where

P_s	Effect
0	Accept all input and start unprotected area ¹
1 or 8	Accept no input and start protected area ¹
3	Accept numerics (digits and comma, period, and plus and minus signs) ¹
4	Accept alphabetic characters ¹
10	Data entry required (must fill) ²
11	Total fill ³
12	Accept digits (0 through 9)

1. Checked during data entry. Incorrect data entry triggers status line to display an error message (see Table 4-2) and rings the bell.
2. Checked before data is transmitted. If no data is entered, the terminal continues to wait for some data entry, while displaying the error message MUST FILL. It sends the sequence ESC [? 3 ; 1 n to the computer but does not ring the bell.
3. Checked before data is transmitted. If more data is needed, the terminal continues to wait for the remainder, while displaying the error message FILL ALL. It sends the sequence ESC [? 3 ; 2 n to the computer but does not ring the bell.

Defined area qualifications (DAQ) are embedded.

You must enable forms build mode before executing this command.

The command affects the area between the present cursor position and the next DAQ.

More than one DAQ can be included in an unprotected field.

This command allows you to define the type of data required in an unprotected field by assigning one or more DAQ codes to the field. After executing the command, enable protect mode.

Multiple DAQs can be used during page print to define subfields. See the section on page print for more information.

Clear Defined Area Qualifications

Clear defined area qualifications

DEFAULT $P_s = 0$
ESC [$P_s u$

where

P_s	Effect
0	Clear the defined area qualification at the cursor position
1	Clear all defined area qualifications on the cursor line
2	Clear all defined area qualifications in memory

This command is ignored unless forms build mode is enabled.

Removing an area's defined area qualifications with this command gives it the qualifications of the preceding area.

How to Build a Form

To build a new form, follow these steps:

1. Enable block mode (with the command ESC [? 10 h or by changing the set up menu).
2. Enable forms build mode (with the command ESC [? 17 h).
3. Clear any defined area qualifications (with the command ESC [2 u).
4. Enter the form, which may contain defined area qualifications and visual attributes.
5. Enable visual attribute action mode (with the command ESC [? 18 h). This embeds the visual attributes you entered in the previous step so they will not be affected later by clear or erase commands.
6. Turn on protect mode (with the command ESC [? 0 h). This automatically turns off the forms build mode.

NOTE! *If you turn off protect mode later with the ESC [? I command, you will lose the protection given to the form, although the data will remain.*

To modify an existing form:

1. Enable block mode (with the command ESC [? 10 h), unless it is still enabled.
2. Enable forms build mode (with the command ESC [? 17 h).
3. Disable visual attribute action mode (with the command ESC [? 18 I).
4. Modify the form.
5. Enable visual attribute action mode (with the command ESC [? 18 h).
6. Turn on protect mode (with the command ESC [? 0 h).

Protected Page Action Mode

Enable single-page protect mode
Enable multiple-page protect mode

ESC [? 15 I
ESC [? 15 h

where

The default mode is single-page protect mode.

When single-page protect mode is on, a protected form can only contain one page.

Using multiple-page protect mode makes it possible for you to create a protected form containing several pages, with defined area qualifications on one of them. The DAQs are only retained on the last protected page on which you entered them. If they are on the current page, the status line displays PROT; if they are on another page, it displays the page number as PRO# (where # is the page number).

To build a form containing more than 24 lines with DAQs within the form, first define the page as greater than 24 lines.

Communication

You can change the type of communication between the terminal and the computer by changing the set up menu or, in most cases, entering escape sequences. Three types of communication are possible:

- Local
- Block
- Conversational
 - Half duplex
 - Full duplex

Local Mode

SET UP

Selectable only in the set up menu, local mode disables both the transmitting and receiving capabilities of the computer port (P3 or P7). Codes affect only displayed data and can not be transmitted to the computer.

Block Mode

SET UP
ESC [? 10 h

Enable block communication mode

Block mode causes the terminal to display characters entered at the keyboard without sending them to the computer until requested from the keyboard or the computer. Then they are sent as a block. As described in the section on transmitting data, you can control when and how much data is transmitted. Any data received from the computer appears on the screen.

Space can be compressed (i.e., spaces deleted) during data transmission if, prior to data entry, you erase all unprotected areas with an insert character whose value is the null code.

During block mode, the autowrap mode setting is ignored; whenever data is entered on the last column, the cursor moves to the first position on the next line. Only data entry will cause the screen to scroll.

Conversational Mode

SET UP
ESC [? 10 I

Select conversational mode

Both half and full duplex are conversational modes. Once you have selected conversational mode, select either full or half duplex.

Send/Receive Mode

SET UP
ESC [12 h
ESC [12 I

- Echo
- No echo

While conversation mode is enabled, you can control whether or not every character being transmitted to the computer is also echoed by the terminal back to its screen.

Half Duplex Mode

SET UP
ESC [? 12 h

Enable half duplex mode

In half duplex mode, the terminal transmits each keyboard code to the computer and either displays it at the cursor location or processes it. Other data received from the computer is stored at a screen location or processed. When this remote command executes, the send/receive mode is automatically set to echo.

During data transmission, Request to Send (RTS) goes high. The computer returns Clear to Send (CTS), transmits the character, and RTS goes low. When this command executes, the local echo mode is also enabled.

In half duplex mode, a turnaround control code (TACC) can replace the secondary channel line turnaround control code. The TACC tells the terminal or the computer that the last character of the message has been received and the state should be changed from receive to transmit.

The TACC terminates all function and FUNCT key transmissions, answerback transmissions, and status transmissions. To keep the TACC from being transmitted, set the control codes to null codes.

Full Duplex Mode

Enable full duplex mode

SET UP
ESC [? 12 I

where

When this command executes, the send/receive mode is automatically set to no echo.

Full duplex mode lets the terminal transmit all key codes generated by the keyboard to the computer. With local and echo modes enabled, the codes are also sent to the screen. Data received from the computer is stored at a screen location or processed.

Full duplex mode lets the terminal transmit each key code to the computer. Depending on the setting of local echo mode, the code may be treated as received data. Data received from the computer is stored at a screen location or processed.

Transmitting Data

After you enter data for block transmission, you can determine whether the SEND key will transmit it immediately or later. And you can specify how much it will transmit. Table 5-9 lists the choices available to you.

NOTE! The term *protect* is used to define data that has been entered in the forms build mode and protected from operator change in the protect mode.

Table 5-9
Specifying the Amount of Data To Be Transmitted

Type of Document (Protected/Unprotected)	Name of Control	Amount To Be Transmitted
Protected	Guarded area transfer	Unprotected areas All
Protected	Multiple area transfer	All One area
Either	Transfer termination	Partial page Full page
Either	Line transfer	Page Line
Either	Transfer execution	Immediate Deferred
Either	Page transfer	Page Display

Before any block transmission can occur, you must enable block communication mode. To disable it before transmission ends, enter and exit set up mode.

Within an unprotected field, you can place a defined area qualification on several positions. This effectively divides the field into several smaller subfields. These subfields can be separated with a distinguishable delimiter. (See Chapter 6, Reprogramming the Keys/Functions, and reprogram P_s value 14, the DAQ subfield delimiter.)

Deferred Transmission

Defer transmission	SET UP ESC [? 14 I
Transmit immediately	ESC [? 14 h
Set transmit state sequence (from terminal)	ESC S
Transmit sequence (from computer)	ESC 5

The deferred transmission command defines whether the SEND key will transmit data immediately or later. When you choose deferred transmission, the SEND key transmits a **set transmit state sequence** (ESC S) notifying the computer that the terminal is ready to transmit. The computer can request transmission of a block of data at its convenience by sending the **transmit sequence** (ESC 5).

When you change transfer execution, the terminal reprograms the SEND key (eliminating any prior reprogramming of it that you may have done).

Data transmitted as a block is framed by the start of message (SOM) and end of message (EOM) codes.

Transfer Termination

Transfer partial page through cursor position	SET UP ESC [16 I
Transfer entire page	ESC [16 h

Partial transfer causes the SEND key to send all data on the page up to and including the cursor position, while full transfer sends the entire page.

Transfer Amount

Transfer page	SET UP ESC [? 11 I
Transfer line	ESC [? 11 h

The **transfer page** command allows the transfer termination command to specify how much of the page will be transmitted by the SEND key (through the cursor or through the end of the page).

The **transfer line** command causes the SEND key to transmit data from the beginning of the current line up to and including the cursor position. It does not, however, include the end-of-line control codes.

Double-height or double-width line attributes are recognized. When the terminal is in VT100 mode and double-height lines are included, the terminal sends each half of the line to the printer twice. To keep the line from being printed twice, reprogram the delimiters for double-height lines (see Chapter 6, Reprogramming the Keys/Functions, P_s values 12 and 13).¹

For the commands to disable the printer, see the documentation for your printer.

While multiple autopage mode is enabled, the page print command sends the whole page to the printer port and advances the cursor to the next page. Data can be entered on this page while the previous page is being printed. (However, if autopage is on single, the screen display remains and data entry is not processed while the page is being printed.)

The data is printed with all programmable line delimiters (with a default value of CR, LF).

After you enable auto line print mode, the terminal sends the contents of the current line to its printer when it receives the line feed code. (If the terminal is in the default VT100 mode, a line feed code is generated by an LF, a VT, or an FF character.)

Auto character print mode sends each character to the terminal's printer as soon as it is entered on the keyboard. The terminal must be in a conversational mode.

If protect mode is enabled, each protected character is sent to the printer port as a space character.

1. If you reprogram these by changing values 12 and 13 in the reprogram key/function command (described in Chapter 6) to add inhibit print before the top half line and start print at the end of the top half line, only one line of double-height characters will be printed.

These commands allow you to define when data will be printed—either as soon as a character is received, or after each line or page.

As soon as the terminal sends the data out its printer port, it also sends an acknowledge (ACK) code to the computer. You can reprogram this acknowledgment delimiter (see Chapter 6).

Sending Data to the Printer

Buffered Print Modes

Enable buffered transparent print mode	ESC [5 i
Enable buffered extension print mode	ESC [? 7 i
Disable all print modes	CTRL T
Disable only buffered extension print modes	ESC [? i or ESC [? 0 i
Disable buffered print mode	ESC [4 i

where

During transparent print, only a CTRL T code disables the print mode.

The terminal's two buffers (main port and printer port) have a combined capacity of 512 characters.

After data is received by the terminal in its main port buffer, buffered print mode sends it through the printer port buffer and out the printer port. Data entry can continue while the printer output buffer empties. However, once both buffers are full, data entry at the keyboard has no effect. The terminal acts on the last print command received.

When the main port buffer is full, the terminal either sends an X-Off to the computer or toggles the DTR (Data Terminal Ready) line. When the buffer empties, the terminal transmits X-On to the computer. If the receive data control is set to none, the DTR signal controls data transmission from the computer.

Buffered print commands allow the baud rate between the computer and terminal to be different than the baud rate between the terminal and its printer. Screen updating can also continue.

After you disable buffered print, any data remaining in the buffers is sent to the printer port until the printer output buffer is empty.

Transparent print sends received data from the main port buffer to the printer port buffer but not to the screen.

Buffered extension print is the same as transparent print except that data is also displayed on the screen.

Bidirectional Printer Port

Select bidirectional transparent print	ESC [? 26 I
Select bidirectional extension print	ESC [? 26 h
Enable bidirectional print mode	CTRL R
Disable bidirectional print mode (transparent or extension)	CTRL T

where

Bidirectional print mode must be disabled when you execute the command to select the type of bidirectional print (either transparent or extension print).

The computer and printer port baud rates must match.

After you select a print type (transparent or extension), the CTRL R command turns it on. CTRL T stops it.

These commands are effective when two RS-232C ports are installed.

While bidirectional print mode is enabled, the two RS-232C ports (P3 and P4) are connected (internally). Therefore, a peripheral device such as a printer connected to the P4 port can communicate through the terminal with the computer connected to the P3 port. (However, unless the printer has a keyboard, the printer can only receive data from the computer, while the computer can both send and receive.) Only the computer, however, can write to the terminal screen.

Before you enable bidirectional print mode, you must select the type of bidirectional printing to be performed by the printer—either transparent or extension.¹ Then enable bidirectional print mode.

1. Extension print (sometimes called copy print) allows you to print data and display it on the screen at the same time, while transparent print does not display data being printed.

Tests and Reports

This section describes commands with which the computer can request a report from the terminal.

NOTE! Each report sent by the terminal automatically includes a turnaround control code (TACC). The section on reprogramming the keys in Chapter 6 tells how you can reprogram the TACC.

Self Tests

Perform self test

DEFAULT $P_s = 0$
ESC [2 ; P_s y

where

P_s is the sum of all test values to be performed.

Test Value	Effect
0	Reset all terminal variables in nonvolatile memory to the factory default condition and perform power-up, self-test routines. ¹ Does not change the computer port's baud rate, parity, or word structure.
1	Test the ROM's LRC and test the displayable RAM. ¹
2	Test the RS-232C computer port (P3) if a loopback connector is installed between ports P3 and P4. ¹
4	Test EIA control if a loopback connector is installed between ports P3 and P4. ²
8	Repeat selected test(s) indefinitely until test(s) fails or power is turned off. ¹

1. To get results, request a device status report (next section).
2. This is an RS-232C interface cable with a 25-pin male connector at each end. Pins 2, 3, 4, 5, 6, 7, 8, and 20 require one-to-one assignments. The results are shown on the status line.

These commands ask the terminal to perform one or more self tests or return the terminal to the saved set up parameters. The next section tells how to request a report on the test(s).

Device Status Report

Request/report terminal status

DEFAULT $P_s = 0$
ESC [P_s n

where

P_s	Effect
0	Terminal reports to computer that no malfunctions were detected during terminal's self test
3	Terminal reports to computer that malfunction(s) was detected during terminal's self test
5	Computer requests results of tests from terminal

If you send this command with a value of 5, the terminal automatically responds with the same command. The P_s value of either 0 or 3 in its response gives the results of the self test(s) specified in the self test command (above).

Return to Initial State

Return to initial power-on state

ESC c

This sequence is the same as turning the terminal's power off and back on again. All saved set up values are restored, even though subsequent sequences may have changed them.

Device Attribute Report Request device attribute report ESC [c

This command asks the terminal to identify itself by sending a device attribute control sequence (ESC [? 8 c).

Printer Status Report Request/report printer status ESC [? P_s n

where

P_s Effect

- 10 Terminal tells the computer that the terminal's printer port is ready to accept data and the printer's DTR signal is high
- 11 Terminal tells the computer that the terminal's printer port is not ready to accept data and the printer's DTR signal is low
- 15 Computer requests a printer status report from the terminal

A P_s value of 15 asks the terminal to report the status of its printer port and the DTR line. The terminal automatically responds with the same command, substituting a P_s value of either 10 or 11.

Cursor Position Report Request a report on the cursor's position (line and column) ESC [6 n

where

The response is ESC [P_r ; P_c R

P_r is the line number (expressed in decimal value) on which the cursor is located.

P_c is the column number (expressed in decimal value) on which the cursor is located.

Origin mode affects how the lines are numbered.

This command tells the terminal to report on the cursor's position. In response, the terminal automatically sends ESC [P_r ; P_c R.

Cursor Page Position Report Request a report on cursor's position (page, line and column) ESC [? 6 n

where

The response is ESC [P_p ; P_r ; P_c R. P_p is the page number (expressed in decimal value).

Firmware ID and Revision Report Request contents of factory default answerback message ESC [? 0 n

This command allows the computer to read the answerback message (which is TVS/GA970x, where x is the firmware revision).

Terminal Parameters

DEFAULT $P_s/P_1...P_6 = 0$

Request report on terminal's port parameters

ESC [P_s X

Set port parameters

ESC [$P_s ; P_1 ; P_2 ; P_3 ; P_4 ; P_5 ; P_6$ X

where

P_s is a value that defines the port affected by this command.

P_s Effect

- 0 Request report on port P3 or P7
- 1 Set parameter(s) of port P3 or P7
- 2 Request report on printer (P4) port
- 3 Set parameter(s) of printer (P4) port

P_1 sets the parity of the port defined by the P_s value.

P_1 Parity

- 0 None
- 1 Odd
- 2 Even
- 3 Mark (transmit only)
- 4 Space (transmit only)

P_2 defines the word structure.

P_2 Effect

- 0 8 bits
- 1 7 bits

P_3 defines the baud rate of the computer (P3 or P7) and printer (P4) ports.

P_3	Port Baud Rate		
	Main RS-232C	Optional RS-422	Printer
0	19200	4800	1200
1	50	9600	50
2	75	19.2	75
3	110	38.4	110
4	135	55.9	135
5	150	76.8	150
6	300	153.6	300
7	600	307.2	600
8	1200	4800	1200
9	1800	9600	1800
10	2400	19.2	2400
11	3600	38.4	3600
12	4800	55.9	4800
13	7200	76.8	7600
14	9600	153.6	9600
15	19200	307.2	19200

P₄ defines the number of stop bits.

P₄ Stop Bits

0	1
2	2

P₅ defines the receive data control signal.

Receive Data Control		
	P _s = 2 (computer port)	P _s = 3 (printer port)
0	X-On/X-Off	None
1	DTR	X-On/X-Off
2	None	—

P₆ defines the transmit data control signal.

Transmit Data Control		
	P _s = 2 (computer port)	P _s = 3 (printer port)
0	None	None
1	X-On/X-Off	Buffered extension
2	—	Buffered transparent
3 ¹	—	Bidirectional extension
4 ¹	—	Bidirectional transparent

1. You can not get a report on this status while the mode is still enabled. However, you can set the condition.

These commands report on and set the parameters of the computer or the printer port. For instance, sending the **request report** command allows you to ask for a terminal report on a specific parameter, depending on the P_s value(s) included in the request command. The terminal automatically responds with the appropriate report, ending with the turnaround control codes.

By sending the **set port parameter** command, the computer can define one or more of the terminal ports.

Cursor Content

Report content of cursor to computer ESC [t
 Convert content of cursor to decimal value and report to computer ESC [P_n ? t

where

P_n is the decimal value of the cursor character.

The **report content** report causes the terminal to report to the computer the data displayed at the cursor position (i.e., it reads the cursor character). The terminal automatically responds with the **convert cursor content** sequence.



6. Personalizing the 970

Introduction

You can personalize many features of the 970 with the commands described in this chapter.

Designing Custom Character Fonts

You can construct two custom character fonts to be used as the primary or secondary character set or you can redesign any of the existing characters. Designing a character involves three steps:

1. Determine the classification of the character
2. Design the character
3. Download the character

Determining the Classification of the Character

You can design three types of characters:

- General display characters
- Control codes
- Special and line-drawing characters

Since a slightly different method is used to construct each type, you must know the category of the character you want to design before you start.

Even if you are redesigning an existing character, you must determine its type. Find it in the ASCII code chart in Appendix C and note its hex value. Then refer to Table 6-1 where characters are typed according to their hex value.

Table 6-1
Custom Character Fonts

Hex Value of Character Code To Be Changed	Type of Character
20 through 7F	General display (primary character set)
A0 through FF	General display (secondary character set)
00 through 1F	Control
80 through 8F	Special and line-drawing

Designing a Character

Although each type of character differs slightly, many design principles are common to all characters. To help you understand how the general principles apply, we will illustrate and explain how to design an example general display character. Once you have followed the design of this example character, follow the same steps to design control characters and special and line-drawing characters. The same example is also used during the downloading process.

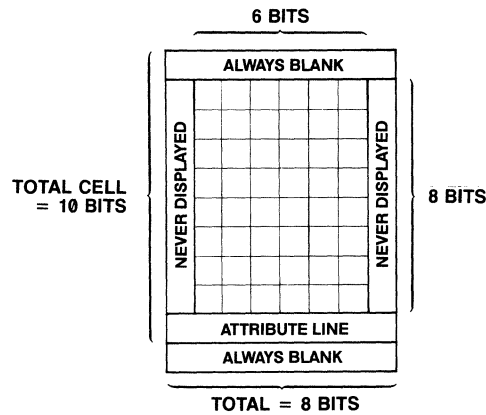
General Display Character—General display characters have the following characteristics:

- Finished dimension of 6 bits wide and 8 bits high
- Constructed in an 8 by 10 cell
- Can contain half-dot shift

Figure 6-1 shows the size of the cell within which a general character can be designed. A column is reserved on the right and left sides of the cell to provide vertical space between characters. Below the cell an additional line is available for attributes. And a blank line is automatically added above and below the cell to separate lines of characters from each other.

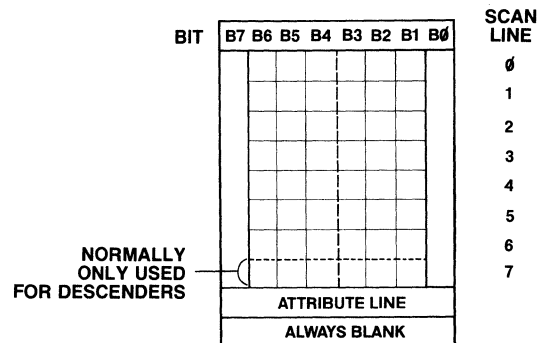
Figure 6-2 shows how each cell is divided into dots. Each column of dots has a bit number. An imaginary line divides the cell into two halves: right and left.

Figure 6-1
General Display Character Cell



970-27

Figure 6-2
Division of General Display Character Cell into Dots



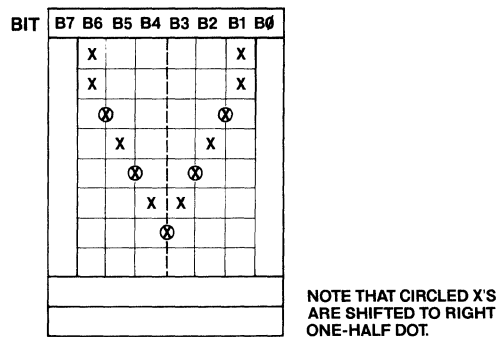
970-28

Although the extreme right and left columns of bits (bits 0 and 7) provide vertical space around the character, they are also used as control bits. Control bits move all three dots within their respective half of the line one-half dot to the right. This is called **half-dot shift**, and it allows characters to have smooth, rather than ragged, diagonal

lines. Thus bit B7 controls whether bits B6, B5, and B4 shift one-half dot to the right, while B0 controls B3, B2, and B1. Although bits B0 and B7 are given a value during character design (to designate whether half-dot shift is to occur), this value is never translated into a displayed dot.

To illustrate how a character is designed, let's analyze the dot pattern for an uppercase character V. Each x will be a dot in the character, as shown in Figure 6-3. Notice that some of the x's are centered in their respective squares, while others need to be in between squares if the V is to have a smooth diagonal line.

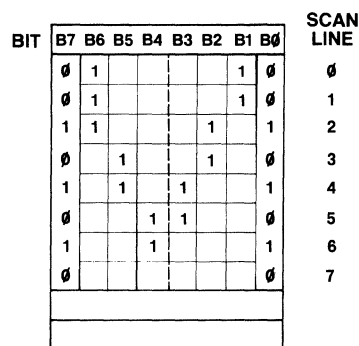
Figure 6-3
Dot Matrix for Uppercase V



970-29

Now you must translate the dot pattern into binary bit values (Figure 6-4). Each x has a bit value of one. Since half-dot shift always moves a dot to the right, an x that is on the line between two squares gives the bit to its left a value of one. And each x that needs to be shifted to the right gives the control bit for that half of the line (B7 or B0) a value of one. (Remember, if you shift one dot within a half of a character line, you also shift all other dots within that half of the character line.) A bit without an x has a value of zero.

Figure 6-4
Binary Value of Dots for Uppercase V



970-30

NOTE! If a shifted dot is on the line between the right and left halves, you must also shift the right half of the line to provide room for the shifted dot from the left side. Thus if a dot is to be centered, both control bits (B0 and B7) must have a value of one.

Each line of the character is a byte. Now convert the binary value for each byte into a hex value. Figure 6-5 lists the resulting values for each line of the example character.

Figure 6-5
Line Values for Example Character V

BINARY VALUE		8	4	2	1	8	4	2	1		
BIT	B7	B6	B5	B4	B3	B2	B1	B0	BYTE	BYTE VALUE (IN HEX)	
0	1						1	0	1	42	
0	1						1	0	2	42	
1	1					1		1	3	C5	
0		1				1		0	4	24	
1		1			1			1	5	A9	
0				1	1			0	6	18	
1				1				1	7	91	
0								0	0	00	

970-31

Notice that each byte is assigned a number. Byte 0 is always on the bottom and is only used for general display character descenders.

Control Code Characters—Designing a control code character is similar to designing a general display character except:

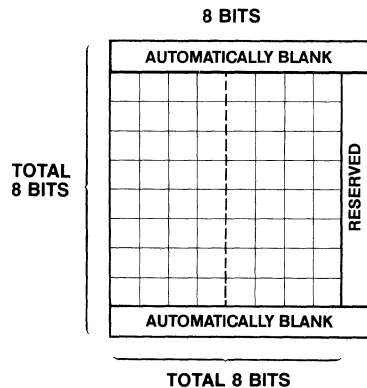
No half-dot shift is available.

The cell is 8 × 8 and must include a blank vertical spacer on the right side (bit 0).

A blank horizontal line is automatically added above and below the control character.

Figure 6-6 shows the dot matrix for a line feed control character, while Figure 6-7 shows the resulting bit and byte numbers.

Figure 6-6
Dot Matrix for Line Feed Control Character



970-32

Figure 6-7
Bit and Byte Values for Line Feed Control Character

BINARY VALUE		8	4	2	1	8	4	2	1	SCAN LINE	BYTE	BYTE VALUE (IN HEX)
BIT		B7	B6	B5	B4	B3	B2	B1	B0			
X										0	1	80
X										1	2	80
X										2	3	80
X					X	X	X			3	4	8E
X	X	X			X					4	5	E8
					X	X				5	6	0A
					X					6	7	08
					X					7	0	08

970-33

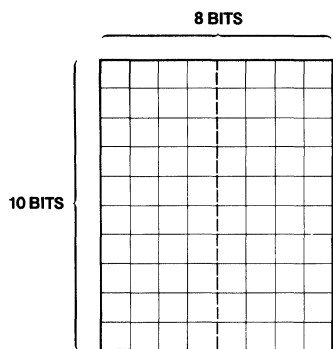
Special and Line-Drawing Characters—The construction of special and line-drawing characters is similar to the construction of general display characters. The differences are:

No half-dot shift is available.

The cell is 8 × 10, which allows for continuous graphics drawings since the character cell size equals the character field size (8 × 10).

Figure 6-8 shows the dot matrix for an intersected linear line, while Figure 6-9 shows the resulting bit and byte numbers.

Figure 6-8
Dot Matrix for Intersected Linear Line Character



970-34

Figure 6-9
Bit and Byte Values for Intersected Linear Line

BIT		BYTE	BYTE VALUE (IN HEX)							
B7	B6			B5	B4	B3	B2	B1	B0	
				X					0	08
				X					1	08
				X					2	08
				X					3	08
X	X	X	X	X	X	X	X	X	4	FF
				X					5	08
				X					6	08
				X					7	08
				X					8	08
				X					9	08

970-35

Downloading the Character

Download a character into memory
End downloading process

ESC _ : KK AAAA 00 XX CC
: 00 0000 01 FF

where

Parameter	Description
ESC _	Indicates that the following sequence is to be downloaded.
:	A start character indicating the beginning of the data to be downloaded.
KK	The byte count of data. Since the example general display character contains 16 bytes (explained also in the entry for XX below), the entry in hex is 08.
AAAA	The address in memory where the first data byte of the record is to be stored. To find this value, find the hex value of the character using Table 6-2. For the example V character shown in the previous sections, the value is 56. Find the address corresponding to that hex value in Table 6-3. In the example, the address would be 02B0. The first two characters (e.g., 02) represent the high order byte of the address, while the last two (B0) represent the low order byte.
00	The record type. For the 970 terminal, this value is always 00.
XX	The hex values of each byte of data. List the value of byte 0 first, then byte 1, 2, etc. Figure 6-5 shows the values for the example V character. For this particular character, there are a total of 16 values (since there are 8 bytes, each containing two hex digits).
CC	A check byte. To compute this, add (in hex) the hex values of the entire sequence so far. To download the example V character, you would add the following:

```

08
02
B0
00
00
42
42
C5
24
A9
18
91

```

Total 379

Convert the two least significant digits of the total into binary, complement, and add 1 (in binary). The hex value of the result is the check byte. For this example, the new value is 87. Enter this value as the check byte.

To download more than one character, start with another colon (:), then add the proper sequence.

When this sequence executes, the firmware loads data coming from the main (computer) port into the desired memory space. It uses a hex file format that is compatible with the Intel family of development systems and possibly compatible with other development systems and operating systems (e.g., CP/M).

Downloading

Starting the Downloading Sequence

Download data or a program into memory ESC _

This sequence causes the terminal to monitor the computer port (P3) and place the data that follows the sequence into a specified unused memory space. The downloading format used by the terminal is similar to the Intel hexadecimal format.

Downloading the Data

Data record to be downloaded : KK AAAA 00 H₁ ; H₂ ; ... ; H_n CC

where

Parameter	Description	No. of Bytes
:	A start character indicating the beginning of data to be downloaded.	1
KK	The byte count (in hex).	2
AAAA	The address in memory where the first data byte of the record is to be stored. The first two characters of the address represent the high order byte of the address, while the last two characters represent the low order byte.	4
00	The record type. For the 970 terminal, this value is always 0000.	2
H _n	Values in hex of the data to be downloaded.	2 each
CC	A check byte found by adding the hex values of the entire sequence.	2

The data is composed of two ASCII characters, expressed in hex digits, for the bit pattern of each eight-bit byte of data.

The total number of data bytes is entered by the byte count.

To enter several sets of data in one downloading sequence, enter another semicolon before each set of data to be downloaded.

Ending the Downloading Sequence

End the downloading sequence : KK AAAA 01 CC

where

Parameter	Description	No. of Bytes
:	A start character indicating the beginning of data to be downloaded.	1
KK	The byte count (in hex). This value must always be 00.	2

Parameter	Description	No. of Bytes
AAAA	The address in memory where the first data byte of the record is to be stored.	4
01	The record type. The record type is always two ASCII characters representing the hex digits 01 (30H and 31H).	2
CC	The check byte. Enter an address of 0000H to return to the previous operation. Entering an address of any value other than 0000H causes the firmware to execute the contents of the specified address.	

Use this sequence to terminate the process of downloading information.

NOTE! *The downloading sequence is also automatically terminated when you press RESET or enter set up mode.*

Programming Vectors

Your program can include instructions that jump to or call the 970's firmware. Table 6-2 lists the addresses of some of the available instructions. Seven are restart instructions to predetermined addresses and one is a restart instruction to a programmable address.

Table 6-2
Restart Vector Addresses

Instruction	Address Called
Restart 0	0000H
Restart 8	0008H
Restart 16	0010H
Restart 24	0018H
Restart 32	0020H
Restart 40	0028H
Restart 48	0030H
Restart 56	0038H

Table 6-3 lists the program addresses you can execute directly or indirectly, while Table 6-4 describes the program vectors.

NOTE! *To use these routines, convert each value to its hex value.*

Table 6-3
Program Vector Addresses

Address	Instruction ¹	Description
0000H ²	JR	Cold start
0002H	JP	Computer receive character
0005H	JP	Keyboard receive character
0008H ²	JP	Receive data from keyboard
000BH	JP	Output data to keyboard port
000EH	—	Beginning address of display RAM
0010H ²	JP	Receive data from computer (RS-232C or RS-422) port
0013H	JP	Output data to printer port
0016H	—	Address of video line list
0018H ²	JP	Output data to computer (RS-232C or RS-422) port
001BH	JP	Priority output data to computer (RS-232C or RS-422) port
001EH	—	Address of line table
0020H ²	JP	Display data at cursor position
0023H	JP	Hex format loaded
0026H	—	Address of user's RAM
0028H ²	JP	Set up mode cursor movement
002BH	JP	Font loader
002EH	—	Address of control code table
0030H ²	JP	Status line's field loader
0033H	JP	One byte hex-to-ASCII conversion
0036H	—	Address of status line
0038H ²	JP	Programmable restart vector
003BH	—	Reserved
003EH	—	Reserved
0060H	JP	Decimal-to-hex conversion
0063H	JP	Hex-to-decimal conversion

1. JR = Jump relative; JP = Jump
2. Restart instruction vectors

**Table 6-4
Program Vector Descriptions**

Vector	Description
Cold start	Same as executing the power-on function. Not a callable routine. Initializes and refreshes the working RAM area with the contents of the nonvolatile RAM's settings. Structures the display RAM to its initial state. The routine's termination point is in the ROM's main loop, where it checks for data from either the keyboard or the computer ports.
Computer receive character	Determines the effect of each byte received at the computer port. Set the received byte in Register C.
Keyboard receive character	Determines the transmission status and effect of each byte received at the computer port. Set the status byte in Register B and the character byte in Register C.
Receive data from keyboard	The carry flag in this routine indicates whether data was received from the keyboard. A set flag indicates no data is available. A reset carry flag sets the status byte in Register B and the character byte in Register C.
Output data to keyboard port	Outputs data in Register A to the keyboard.
Beginning address of display RAM	Marks the location of the attribute byte of the first character displayed on page one of the screen after a cold start. Using this address, you can calculate the RAM addresses required for the downloadable program.
Receive data from computer port	This routine's carry flag indicates whether or not data is received from the computer port. When no data is available, the carry flag is set. If it is reset instead, the character byte is in Register C.
Output to printer port	Outputs data contained in Register C through the RS-232C printer port.
Address of video line list	Marks the first location of a table containing the addresses of the lines to be displayed. The table contains 25 lines. The first location is the least significant byte of the address for the first displayable line. The two most significant bits of each address indicate the displayed line attribute.
Output data to computer port	Outputs data contained in Register C through the computer port.
Priority output data to computer port	Immediately outputs the data contained in Register C through the computer port, regardless of the standard routine that outputs data to this port. This routine is used for X-On/X-Off.
Address of line table	Marks the first location of a table containing the addresses of the lines to be displayed. The table contains 72 lines. The first location is the least significant byte of the address for the first displayable line. The two most significant bits of each address indicate the displayed line attribute.
Display data at cursor position	Stores the character contained in Register C at the cursor location. The video attribute byte's current setting is stored with the character. The cursor increments according to its prior flag settings.
Hex format loader	Processes all data from the communication port according to the downloader format. When the end of the file record is received, the routine exits.

Table 6-4
Continued

Vector	Description												
Address of user's RAM	Contains the first address in nonvolatile memory which is reserved exclusively for a downloaded program. It may be used by a download program to store variables. The last usable location reserved is 7BAFH.												
Set up mode cursor movement	Only used during set up mode; of no use externally.												
Font loader	Loads a font character in RAM. Registers are summarized below.												
	<table border="1"> <thead> <tr> <th>Register</th> <th>Contents</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>Should be set to 4</td> </tr> <tr> <td>B</td> <td>The number of complete characters to load</td> </tr> <tr> <td>D</td> <td>The number of scan lines per character (10 for special and line-drawing characters; 8 for other characters)</td> </tr> <tr> <td>E</td> <td>The destination of the character address</td> </tr> <tr> <td>HL</td> <td>The font data's source address: L = Low order portion H = High order portion</td> </tr> </tbody> </table>	Register	Contents	A	Should be set to 4	B	The number of complete characters to load	D	The number of scan lines per character (10 for special and line-drawing characters; 8 for other characters)	E	The destination of the character address	HL	The font data's source address: L = Low order portion H = High order portion
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A	Should be set to 4												
B	The number of complete characters to load												
D	The number of scan lines per character (10 for special and line-drawing characters; 8 for other characters)												
E	The destination of the character address												
HL	The font data's source address: L = Low order portion H = High order portion												
Address of control code table	<p>Starts the control code table, which is a directory of addresses directly related to each ROM control code function [from null code (00H) to US code (1FH)]. The first location in each table is the least significant byte of the address.</p> <p>The following table shows how to access control code addresses:</p> <table border="1"> <thead> <tr> <th>Add to Control Code Address</th> <th>Table Accessed</th> </tr> </thead> <tbody> <tr> <td>64</td> <td>ESC [control sequence introducer table, an address directory directly related to each final control sequence termination character. The final character starts with the symbol @ (40H) and ends with the DEL code (7FH).</td> </tr> <tr> <td>192</td> <td>ESC [P_s h standard set mode table, an address directory directly related to each selective parameter in the standard set mode. The table starts at zero and ends with the value 27.</td> </tr> <tr> <td>240</td> <td>ESC [? P_s h private set mode table, an address directory directly related to each selective parameter in the private set mode. The table starts at zero and ends with the value 27.</td> </tr> <tr> <td>288</td> <td>ESC [P_s l standard reset mode table, an address directory directly related to each selective parameter in the standard set mode. The table starts at zero and ends with the value 27.</td> </tr> <tr> <td>336</td> <td>ESC [? P_s l private reset mode table, an address directory directly related to each selective parameter in the private reset mode. The table starts at zero and ends with the value 27.</td> </tr> </tbody> </table>	Add to Control Code Address	Table Accessed	64	ESC [control sequence introducer table, an address directory directly related to each final control sequence termination character. The final character starts with the symbol @ (40H) and ends with the DEL code (7FH).	192	ESC [P _s h standard set mode table, an address directory directly related to each selective parameter in the standard set mode. The table starts at zero and ends with the value 27.	240	ESC [? P _s h private set mode table, an address directory directly related to each selective parameter in the private set mode. The table starts at zero and ends with the value 27.	288	ESC [P _s l standard reset mode table, an address directory directly related to each selective parameter in the standard set mode. The table starts at zero and ends with the value 27.	336	ESC [? P _s l private reset mode table, an address directory directly related to each selective parameter in the private reset mode. The table starts at zero and ends with the value 27.
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336	ESC [? P _s l private reset mode table, an address directory directly related to each selective parameter in the private reset mode. The table starts at zero and ends with the value 27.												

**Table 6-4
Continued**

Vector	Description
Status line's field loader	Changes any of the established status line messages except the page/line/column value. The first field after the page/line/column field is counted as one and the far right field is 13. Register B contains the field number; Register C contains that field's message number.
One byte hex-to-ASCII conversion	Converts a one-byte hex value into three bytes of ASCII digits. Register A sets the hex value. Registers HL return the address for the first location of the three ASCII digits.
Address of status line	The video attribute byte for the status line's first character is located here. By adding 264 to the address, you can calculate the beginning location for the video attribute byte of the user's message line's first character.
Programmable restart vector	During the cold start routine, the return instruction code is stored at address 7808H. When the restart instruction is in use or this vector executes, the vector jumps to the address 7808H in nonvolatile RAM. This download routine allows you to reprogram this vector's continuation with eight bytes of instruction.
ASCII-to-hex conversion	If you set the IX registers with the address pointing to the first location of the ASCII digits, this routine converts those digits to the hex value in Registers HL. L is the least significant byte of the register pair.
Hex-to-ASCII conversion	If you set the Registers HL with the hex value and the least significant byte in Register L, this routine converts the value to its ASCII digits. Registers HL are set to the address of the five ASCII digits' first location.

Loading the User's Message Line

Load user's message line ESC ^ D₁ ; D₂ ; ... ; D_n CTRL M

where

D₁ ; D₂ ; ... ; D_n is a message of up to 80/132 characters entered in its decimal value. Separate each value with a semicolon.

All control codes are ignored except the following:

- ESC
- SO
- SI
- DLE
- CR (same as CTRL M)

Escape commands are ignored except those that select

- Double-width line
- Single-width line
- Visual attribute

This sequence sends a message to the user's message line, which occupies the 25th line upon command.

Reprogramming the Function Keys

You can reprogram the function keys from the computer or the keyboard. Both methods automatically clear the memory for that key.

Until you reprogram a function key, it has the default value listed in Table 6-5.

Table 6-5
Default Function Key Values

Key	Unshifted	Shifted
F1	ESC ? a	ESC ? A
F2	ESC ? b	ESC ? B
F3	ESC ? c	ESC ? C
F4	ESC ? d	ESC ? D
F5	ESC ? e	ESC ? E
F6	ESC ? f	ESC ? F
F7	ESC ? g	ESC ? G
F8	ESC ? h	ESC ? H
F9	ESC ? i	ESC ? I
F10	ESC ? j	ESC ? J
F11	ESC ? k	ESC ? K
F12	ESC ? l	ESC ? L
F13	ESC ? m	ESC ? M
F14	ESC ? n	ESC ? N
F15	ESC ? o	ESC ? O
F16	ESC ? p	ESC ? P

Programming from the Keyboard

You can easily program a function key from the keyboard. This lets you enter alphanumeric data and control codes and edit the entry on the screen before storing it. Also, you do not have to convert each entry to its decimal value.

1. Enable block or local mode.
2. Press CLEAR SPACE.
3. Press HOME.
4. If you want to include control codes in the program, enable set up mode and change the value for control representation mode to monitor.
5. Leave the set up menu.
6. Enter a value from Table 6-6 as the first character in the line. (This value must be the first character, since it controls where the function key's new value is sent.)

Table 6-6
Destination of Function Key Program

Value	Effect
1	Send contents to the computer (full duplex)
2	Send contents to the screen (local)
3	Send contents to the computer and to the screen (half duplex)
4	Send contents to the printer

7. Type the data to be stored, including any control codes. You can enter a maximum of 79 or 131 characters, depending upon the line length in effect.

8. Check the data and correct any errors.

NOTE! *If control representation mode is set for monitor, do not try to make any corrections.*

9. If you set control representation mode as monitor, enter set up mode again and disable monitor mode.

10. Edit data other than control codes within the line.

11. Place the cursor on the last character to be stored.

12. Press CTRL while you press the shifted or unshifted function key. The line of data you typed is now stored in memory for that function key.

Programming from the Computer

Program a function key

DEFAULT $P_1/P_2 = 1; D_n = 0$
ESC | $P_1; P_2; D_1; D_2; \dots; D_n$ CTRL M

where

P_1 is a value for the programmable function key to be programmed.

Key	P_1 Value		Key	P_1 Value	
	Unshifted Key	Shifted Key		Unshifted Key	Shifted Key
F1	1	17	F9	9	25
F2	2	18	F10	10	26
F3	3	19	F11	11	27
F4	4	20	F12	12	28
F5	5	21	F13	13	29
F6	6	22	F14	14	30
F7	7	23	F15	15	31
F8	8	24	F16	16	32

P_2 is the value that determines where the contents of the function key will be sent.

$D_1; D_2; \dots; D_n$ is the data, expressed in decimal values, to be transmitted by that function key. Separate each character in the message with a semicolon, as shown.

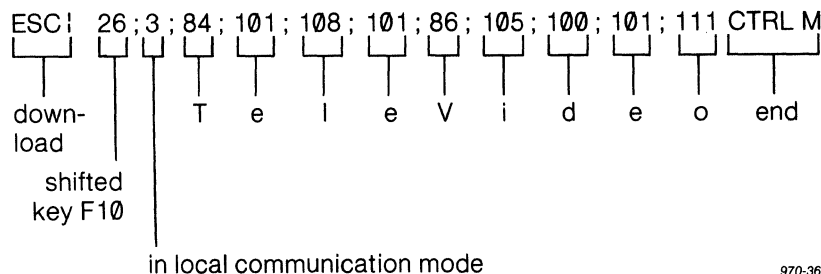
CTRL M is the termination character.

The turnaround control code automatically terminates each sequence.

As soon as the terminal receives the new sequence, it saves it in the nonvolatile RAM.

As an example, Figure 6-10 shows the entry that programs shifted function key F10 to send TeleVideo to the computer and to the screen (i.e., half duplex). The message TeleVideo can be replaced with custom escape sequences, control sequences, etc.

Figure 6-10
Example of Programmed Function Key



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Chaining Function Keys

When you program a function key from the computer, you can include values for several function keys within the same sequence (called chaining) by adding the value 127 and a semicolon before entering the next function key value.

In Figure 6-11, the example from Figure 6-10 is chained to shifted function key F5, which has also been reprogrammed. In this example, the additional part of the sequence is shown in bold.

Figure 6-11
Example of Chained Function Keys

ESC! 26 ; 3 ; 84 ; 101 ; 108 ; 101 ; 86 ; 105 ; 100 ; 101 ; 111 ; **127 ; 21** CTRL M

Available Memory for Function Keys

The memory for all function keys contains 1024 bytes. Each function key that is programmed requires one byte for control purposes and each data character occupies a byte also. If you chain another function key in the sequence, two bytes are added (one for the chain itself and one for the additional function key).

The sequence used as an example in Figure 6-10 occupies 12 bytes of memory. The calculation is shown below.

Bytes	Entry	Description
	ESC |	
	26	Function key to be programmed
1	3	Where contents are to be sent
1	84	T
1	101	e
1	108	l
1	101	e
1	86	V
1	105	i
1	100	d
1	101	e
1	111	o
1	127	Go to next specified function key and transmit its programmed sequence
1	21	Next function key
—	CTRL M	End of downloaded program
Bytes 12		

Thus the total bytes stored in memory for that function key is 12.

Programming the Keys/Functions

You can reprogram what code is sent by each key, the repeat action of each key, the personal message, and many of the functions of the terminal.

Updating Key/Function Values

Update memory with a new key/function DEFAULT $P_s = 0$
 ESC \ $P_s ; D_1 ; D_2 ; \dots ; D_n$ CTRL M

where

$D_1 ; D_2 ; \dots ; D_n$ are decimal values of the byte to be changed. Since they are not reset by CTRL R or CTRL RESET, changing them here will alter the nonvolatile memory.

P_s	Key Label	Function	Maximum No. of Bytes	Default Value
0		Insert character	1	Space code
1		Start of block	2	STX NULL
2		Record separator	2	RS NULL
3		End of line	2	CR LF
4		End of block	2	EOT NULL
5		Turnaround/disconnect	2	NULL NULL
6		FUNCT entry key code	2	ESC O
7		Print form feed	2	FF NULL

P _s	Key Label	Function	Maximum No. of Bytes	Default Value
8		Print line delimiter	2	CR LF
9		Printer acknowledgement	2	ACK NULL
10		Print begin double-width line delimiter	2	SO NULL
11		Print end double-height line delimiter	2	NULL NULL
12		Print begin double-height line delimiter	2	ESC G
13		Print end double-height line delimiter	2	ESC H
14		DAQ subfield delimiter	2	NULL NULL
16	←, shifted ¹		5	ESC [(space) A
17	TAB, shifted (main)		5	ESC [3 g
18	↓, shifted ¹		5	ESC D
19	↑, shifted ¹		5	ESC M
20	→, shifted ¹		5	ESC [(space) @
21	RETURN, shifted		5	CTRL M
22	HOME, shifted		5	ESC [H
23	BACK SPACE, shifted		5	CTRL H
24	← ¹		5	ESC [D
25	TAB (main)		5	CTRL I
26	↓ ¹		5	ESC [B
27	↑ ¹		5	ESC [A
28	→ ¹		5	ESC [C
29	RETURN		5	CTRL M
30	HOME		5	ESC [H
31	BACK SPACE		5	CTRL H
32	LINE FEED		5	CTRL J
33	BACK TAB		5	ESC [Z
34	PRINT		5	ESC [i
35	CLEAR SPACE		5	ESC [2 J
36	CHAR INSERT		5	ESC [@
37	CHAR DELETE		5	ESC [P
38	LINE INSERT		5	ESC [L
39	LINE DELETE		5	ESC [M
40	LINE ERASE		5	ESC [K
41	PAGE ERASE		5	ESC [J
42	PAGE		5	ESC [U
43	ENTER		5	CTRL M
44	TAB (keypad)		5	CTRL I
45	TAB, shifted (keypad)		5	ESC [g
46	CE		5	ESC [2 N
47	CE, shifted		5	ESC [2 K
48	LINE FEED, shifted		5	ESC E
49	BACK TAB, shifted		5	ESC [3 g
50	PRINT, shifted		5	ESC [? 1 i
51	CLEAR SPACE, shifted		5	ESC [2 J
52	CHAR INSERT, shifted		5	ESC [4 h
53	CHAR DELETE, shifted		5	ESC [4 l
54	LINE INSERT, shifted		5	ESC [Q
55	LINE DELETE, shifted		5	ESC [1 Q
56	LINE ERASE, shifted		5	ESC [19 l
57	PAGE ERASE, shifted		5	ESC [19 h
58	PAGE, shifted		5	ESC [V
59	ENTER, shifted		5	ESC [i

1. This key's default value is automatically restored when you enable VT52 mode.

P _s	Key Label	Function	Maximum No. of Bytes	Default Value
60	SEND ²		5	ESC S
61	SEND, shifted ²		5	ESC 5
62		Terminal ID, first half	5	ESC [? 8 c
63		Terminal ID, last half	5	NULL NULL
64		Personal message 0	9	970 ANSI
65		Personal message 1	9	Message 1
66		Personal message 2	9	Message 2
67		Personal message 3	9	Message 3
68		Personal message 4	9	Message 4
69		Personal message 5	9	Message 5
70		Personal message 6	9	Message 6
71		Personal message 7	9	Message 7
72		Answerback message	24	TVS/GA970X
73		Repeat action of keys	3	3

- The default value of this key is automatically restored when the terminal receives a deferred or immediate transfer execution command.
- These values are the decimal values of all bytes up to and including the keys to be changed, entered in the order they are listed Appendix K. See the instructions below.

If you enter less than the maximum bytes permitted, null characters are added to make up the difference.

This sequence lets you change the setting of any listed key or function in the nonvolatile memory or the repeat action of keys.

To change which keys repeat when held down, follow these steps:

- Refer to Appendix K.
- Add together the decimal values of each key that is to repeat within byte 1. Ignore the decimal value of any key that is not to repeat.
- Repeat the process for each byte containing a key whose repeat action is to be changed.
- Include the decimal value for each byte (up to and including the last byte that is to be changed) as a D_n value in the escape sequence. If all the keys within the byte are to repeat, the decimal value is 255.

NOTE! Enter the value of each byte in sequence (starting with byte 1) until you have entered a new byte value for all keys whose repeat action is to be changed. For example, to change the repeat action of a key within byte 3, reenter the unchanged decimal value for bytes 1 and 2.

The following example shows you how to calculate an entry that disables the repeating action of the A (uppercase a) key only. (The repeating action of all other keys will remain unchanged.)

The A key has a decimal value of 64. The total decimal value of the other keys in that byte is 191 (1 + 2 + 4 + 8 + 16 + 32 + 128), since they are to repeat.

The entry needed would be:

Entry	Comment
ESC \ 73 ;	
255 ;	Leaves keys in byte 1 unchanged
255 ;	Leaves keys in byte 2 unchanged
255 ;	Leaves keys in byte 3 unchanged
255 ;	Leaves keys in byte 4 unchanged
255 ;	Leaves keys in byte 5 unchanged
255 ;	Leaves keys in byte 6 unchanged
255 ;	Leaves keys in byte 7 unchanged
255 ;	Leaves keys in byte 8 unchanged
191	Disables the repeat action of the A key while causing all other keys in byte 9 to repeat
CTRL M	Terminates the sequence without changing the rest of the keys listed in Appendix K

**Displaying
Personal Messages**

Display a personal message in the status line's last field

DEFAULT $P_s = 0$
ESC [? P_s q

where

P_s is a value from 0 through 7 representing the number of the personal message to be displayed.

This sequence displays any of the eight personal messages in the far right field of the status line.

7. Troubleshooting and Service

Care

For optimum performance, clean and inspect your terminal periodically.

1. Vacuum the keyboard with a brush attachment or use a small soft brush.
2. Clean the housing with a soft, lint-free cloth and a commercial cleaner. Do **NOT** use solvent-based or abrasive cleaners.
3. If you spill liquids on the keyboard, take apart the keyboard and clean it with a soft cloth and water. Dry it thoroughly before reassembling and using it again.
4. Inspect the cabinet for cracks or breaks.
5. Make sure each key moves freely.
6. Inspect the pin connectors for bent pins and look for kinks and signs of excessive stress on the interface cables caused by stretching.

Refer any damage to a qualified service technician.

Self Tests

Before you request a service call, you may be able to resolve various operating problems yourself by running two self tests. These verify the proper operation of the terminal's video display circuitry and the computer and printer ports.

If both tests run properly and you still have problems, consult the troubleshooting guide in Table 7-1 before placing a service call.

Self Testing the Video Display Circuitry

The first self test verifies that the video display circuitry is working correctly. The test shows all displayable characters, as well as all 32 possible combinations of video attributes.

To activate this self test, follow these steps:

1. Press (in sequence)

SET UP # 1

2. Watch for the test screen to appear, as shown in Figure 7-1.

NOTE! *The appearance of the screen during this test depends on the "characters per line" value chosen in the set up menu (Chapter 3).*

3. Check the screen against the screen shown in Figure 7-1.

Five of the lines should blink.

All characters should be displayed.

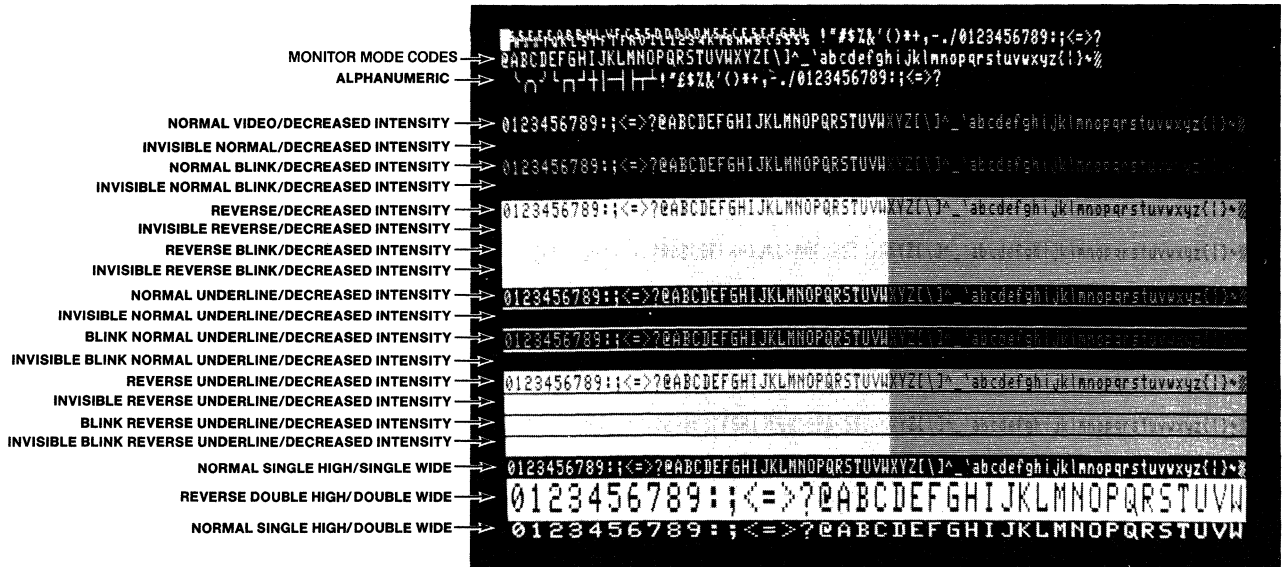
Each character should be formed properly.

You should not see any extra dots and no dots should be missing.

All video attributes and decreased-intensity characters should appear as shown in the figure.

4. Press **SET UP** to stop the test and/or reenter the previous display.

Figure 7-1
Normal Screen During Video Display Test



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Self Testing Port Communications

The second self test runs several tests that check the computer and printer ports as well as DTR, RTS, DSR, DCD, and CTS handshaking signals. Nothing appears on the screen during the test.

To test the ports, follow these steps:

1. Display the status line.
2. Connect the following pins on the rear panel, using a prefabricated RS-232C test cable with two 25-pin male connectors:

- P3-2 to P4-2
- P3-3 to P4-3
- P3-4 to P4-4
- P3-5 to P4-5
- P3-6 to P4-6
- P3-8 to P4-8
- P3-20 to P4-20

3. Press SET UP.
4. Now press (in sequence)

2

5. Wait a second or two while the terminal runs the tests. During the tests, nothing will appear on the screen.

6. Watch the far right field of the status line.

If all tests run successfully, the word **PASS** will appear in the far right field of the status line.

If any of the tests fail, the word **FAIL** will appear instead, followed by the number of the test that failed.

7. If the test fails

Recheck the cable connection

Recheck the baud rates

Run the test again

8. Press **SET UP** again to stop the test and/or when it is completed.

Troubleshooting

Refer to Table 7-1 before placing a service call. Often you can solve the problem without a service call.

STOP! *Some of the solutions listed below involve opening the terminal case. Opening the case exposes you to potential shock hazards, even after the terminal is turned off or unplugged. Do NOT open the case as instructed unless you are a qualified technician.*

Table 7-1
Troubleshooting Terminal Problems

Symptom	Possible Cause	Solution
Terminal dead (no beep; no cursor)	No ac power	Unplug power cord and plug in both ends Turn on power switch Check power select switch
	Line fuse blown	Check and replace line fuse
	Power supply fuse(s) blown	Check and replace power supply fuse
	Loose connectors on power supply or video; loose chips on logic board	Open side panel and inspect connectors and chips on board
Terminal dead; cursor may appear	Loose or defective line fuse	Unplug power cord and change fuse
Terminal will not go on line	System is not "up"	Check system status
	Loose, unconnected, or damaged cables	Reattach all cables; check for damage Check computer (P3) port interface cables: Pins 1 and 7 must be grounded

Table 7-1
Continued

Symptom	Possible Cause	Solution
		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 or be disconnected
	Modem not turned on, or defective, or phone handset upside down in modem cradle	Turn on modem; switch modems; check handset position in cradle
Cursor will not appear	Contrast set too light	Adjust contrast
	Defective contrast pot	Place service call
	Loose connectors on power supply or video; loose chips on logic board	Open side panel and inspect connectors and chips on board
System does not respond while on line	Incorrect parity, word structure, stop bits	Set parity to match system requirements
No keyboard response	Terminal set for on line and full duplex	Set to half duplex using set up
	Keyboard unplugged	Plug in keyboard cable
Terminal locked up	Keyboard disabled	Enter LOC ESC [2 I
	Set up parameters are incorrect	Review all set up menu parameters
Terminal prints correct data only part of the time or prints @ signs	Incorrect parity settings	Check system parity needs
	Stop bits or word structure wrong	Review parameters in set up
Display is wavy	Hertz setting wrong	Change hertz in set up
Display is out of focus	Loose connectors on power supply or video; loose chips on logic board	Open side panel and inspect connectors and chips on board
Escape and control codes do not function as expected	Incorrect escape and control codes used	Make sure upper- and lowercase codes are used as required. Is a 1 used instead of lowercase L?
	ALPHA LOCK on	Press ALPHA LOCK again
		Try local mode
Printer does not print what is typed	Incorrect print mode	Check print function
	Cable connector pins connected incorrectly	Refer to Table 2-3
		Pins 4 and 20 must be driven by +12 Vdc or disconnected

Table 7-1
Continued

Symptom	Possible Cause	Solution
		Pin 3 must be connected to printer data input
		Pin 2 must be connected to printer data output for operation without X-On/X-Off control
	Printer set up incorrectly	Check printer parameters in set up
		Check other printer port device requirements

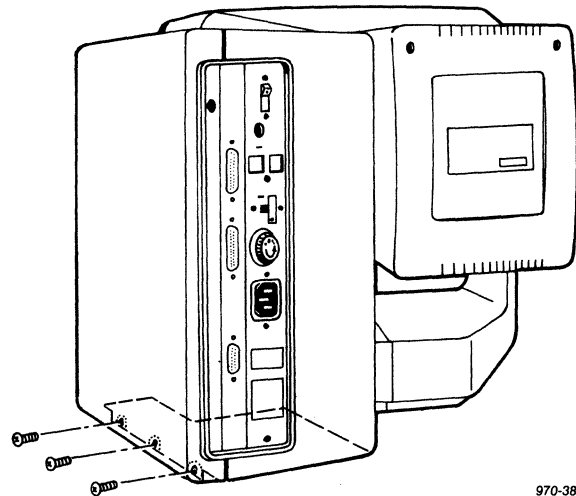
Inspection

If the terminal exhibits symptoms of loose chips or connectors as described in Table 7-1, it may be necessary to inspect the logic board inside the side panel.

STOP! Do not proceed with the directions in this section unless you are a qualified service technician. The components exposed during this procedure contain hazardous voltages that are present even after power has been disconnected.

1. Before opening the case, unplug the terminal's power cord.
2. Remove the three screws on the bottom of the side panel (as shown in Figure 7-2).

Figure 7-2
Location of Screws in Side Panel



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3. Remove the side panel cover and inspect the logic board and connectors (Figure 7-3) for:

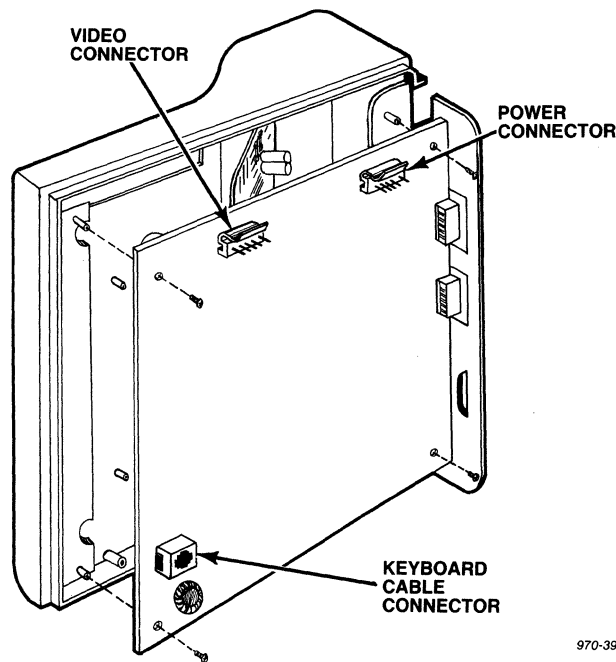
Loose chips

Loose video connector (upper center area of board)

Loose power supply connector (upper right area of board)

Loose keyboard connector (lower right area of board)

Figure 7-3
Logic Board and Connectors



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4. If you find loose components, tighten them, replace the cover, and retest the terminal.
5. Replace the board and cover, being careful not to overtighten the screws. Plug in the power cord to the terminal and the wall outlet.
6. Retest the terminal again. If the terminal still has no power, check the power supply fuses as directed in the next section.

Repair

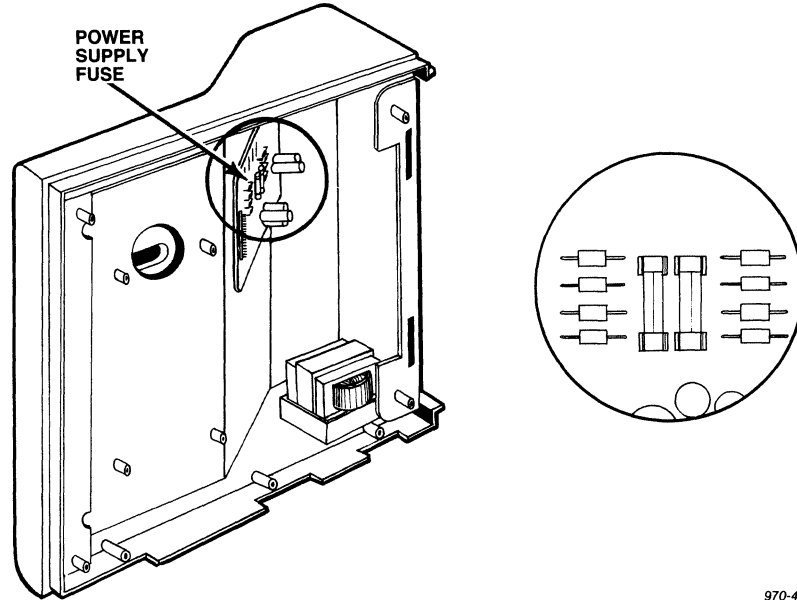
STOP! Do not proceed with the directions in this section unless you are a qualified service technician. The components exposed during this procedure contain hazardous voltages that are present even after power has been disconnected.

Checking the Power Supply Fuses

If you suspect the power supply fuse is defective:

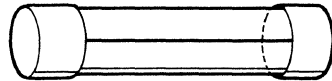
1. Unplug the terminal's power cord.
2. Open the side panel (following the directions in the previous section).
3. Find the power supply fuse, as shown in Figure 7-4.
4. Slip each fuse out of the clip and compare it to Figures 7-5 and 7-6.

Figure 7-4
Location of Power Supply Fuse



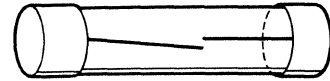
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Figure 7-5
Good Fuse



970-41

Figure 7-6
Burned-Out Fuse



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5. If necessary, replace it with a 5-ampere, fast-blow fuse.
6. Replace the fuses, logic board and cover.
7. Plug the power cord into the terminal and wall outlet.

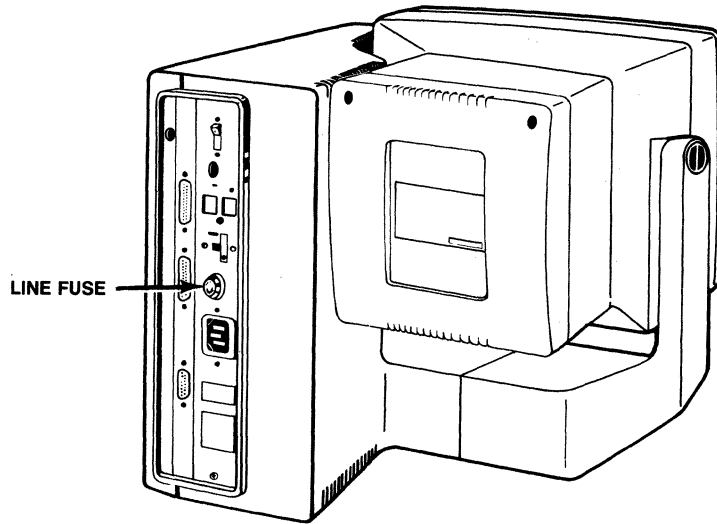
Checking the Line Fuse

To check the line fuse, follow the steps listed.

STOP! To avoid electric shock, unplug the terminal's power cord **before** removing the line fuse.

1. Unplug the terminal's power cord (either from the terminal or from the wall outlet).
2. Remove the fuse holder, unscrewing it counterclockwise (Figure 7-7).

Figure 7-7
Location of Line Fuse



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

If the thin wire inside the fuse is intact (as shown in Figure 7-5), the fuse should be functional.

If the thin strip is broken and/or the glass is black (as shown in Figure 7-6), the fuse is burned out and must be replaced.

4. If the fuse is burned out, replace it with a 1-ampere, fast-blow fuse for 110-volt applications or a 0.5-ampere, fast-blow fuse for 220-volt applications.
5. Replace the fuse holder and tighten it by turning it clockwise.
6. Plug in the terminal power cord.

If You Need Assistance

TeleVideo has two service departments available to help you.

Call Technical Assistance when you want to know how to use the terminal in a particular environment or need marketing information.

Call Customer Service when you need help in troubleshooting a hardware problem or want to return the terminal for repair.

Technical Assistance

For Technical Assistance, call 408/745-7760 (ext. 424) between 8:30 a.m. and 5:00 p.m., Pacific Time, Monday through Friday (except holidays). Ask for the Terminal Division Marketing Department.

Customer Service

Before you place a service call, refer to the Troubleshooting Guide in Table 7-1. Refer also to the index and find the section in the manual that covers that subject.

You can reach the Customer Service department by calling 408/745-7760 between 7:00 a.m. and 5:00 p.m., Pacific Time, Monday through Friday, except holidays. Ask for the Terminal Division.

Before calling, place the terminal in question by the phone if possible. Have your manual with you also.

Be specific when describing the problem and failure history. If the line is busy and your problem can wait, leave a message with the TeleVideo operator. Your call will be returned as soon as possible.

Reshipping the Terminal

Should you need to reship the terminal, follow these procedures:

STOP! Do not proceed with the directions in this section unless you are a qualified service technician. The components exposed during this procedure contain hazardous voltages that are present even after power has been disconnected. Ask your dealer to check the terminal for you if necessary.

1. Remove the side panel cover by removing the three screws on the bottom of the side panel (Figure 7-2).
2. Check the integrity of the cabling and the security of the internal mounting hardware.
3. Replace the cover, being careful not to overtighten the screws.
4. Repack the terminal, using either the original TeleVideo shipping container or other suitable materials.

Appendices

- A Specifications**
- B Statement of Limited Warranty**
- C ASCII Codes**
- D Control Representation Characters**
- E Character Set Differences**
- F Control Codes**
- G Native Mode Escape Sequences**
- H VT52 Mode Escape Sequences**
- I Key Codes**
- J Character Font Addresses**
- K Repeat Action of Keys**



Appendix A Specifications

Screen	Size: 14 inches measured diagonally Attributes: P31 green nonglare phosphor; touch-tiltable
Display Format	24 lines 25th status/user message line 80 or 132 columns
Character Formation	6 × 8 dot matrix 8 × 10 cell with half-dot shift
Character Sets	Two working sets, selected from US ASCII, UK, German, French, Portuguese, Spanish, Norwegian/Danish, Swedish/Finnish, or 256-character downloadable custom font
Displayed Character Set	128 ASCII characters (96 alphanumeric, 32 control) 32 special and line-drawing graphics characters
Software Compatibility	ANSI X3.64 VT52/VT100
Cursor Control	Home (relative or independent of scrolling region), up, down, right, left, carriage return, line feed, next line, previous line, next page, previous page, tabs (forward and backward); addressable/readable cursor
Cursor Attributes	Block (blinking or steady) Underline (blinking or steady) None
Communications Interface	Computer: RS-232C asynchronous buffered port (optional RS-422) Printer: RS-232C buffered port
Communications Modes	Conversational (full or half duplex), block, local, self test
Word Structure	7 or 8 data bits 1 or 2 stop bits 10- or 11-bit word
Parity	Odd, even, mark, space, or none
Communications Protocol	X-On/X-Off Data Terminal Ready
Baud Rates	15 independent rates for each port (50 to 19,200 Kb)
Print Capabilities	Page print (formatted/unformatted) Extension print (buffered/bidirectional) Transparent print (buffered/bidirectional)
Video Attributes	Blink, blank, underline, reverse video; increased/decreased intensity; nonembedded
Editing	Character/line insert/delete Line/page erase
Keyboard	Detached, slim-line, typewriter-style; dust-proof, sealed key switches; N-key rollover with ghost key lockout; accounting-style numeric key pad; 32 nonvolatile, programmable function keys

Appendix A

Fields	Protected/unprotected Logical attributes (defined area qualifications)						
Power Requirements	110/220 volt ac, 50/60 hertz						
Dimensions		Height		Width		Depth	
		(in.)	(cm)	(in.)	(cm)	(in.)	(cm)
	Cabinet	13.5	34.3	16.9	43.0	13.4	34.0
	Keyboard	2.0	5.0	18.5	47.0	9.3	23.6
Weight	Net: 43 pounds Shipping: 58 pounds						
Options	RS-422 interface						

Appendix B Statement of Limited Warranty

TeleVideo Systems, Inc. ("TeleVideo") warrants to its distributors, systems houses, and OEMs ("Buyer"), that products manufactured by TeleVideo are free from defects in materials and workmanship. TeleVideo's obligations under this warranty are limited to repairing or replacing, at TeleVideo's option, the part or parts of the products which prove defective in material or workmanship within 180 days after shipment by TeleVideo. Buyer may pass along to its initial customer or user ("Customer") a maximum of 90 days coverage within this 180-day warranty period, provided that Buyer gives TeleVideo prompt notice of any defect and satisfactory proof thereof.

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 or the Customer. 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.

Exclusions

This limited warranty does not cover losses or damage which occur in shipment to or from Buyer or Customer, or are due to, (1) improper installation or maintenance, misuse, neglect or any cause other than ordinary commercial or industrial application, or (2) adjustment, repair, or modifications by other than TeleVideo-authorized personnel, or (3) improper environment, excessive or inadequate heating or air conditioning and electrical power failures, surges, or other irregularities, or (4) any statements made about TeleVideo's products by salesmen, dealers, distributors or agents, unless confirmed in writing by a TeleVideo officer.

If the firmware or hardware is altered or modified by the Buyer or Customer, this firmware and hardware is not covered within this limited warranty and the Buyer or Customer bears sole responsibility and liability for that firmware and hardware.

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Appendix C ASCII Codes

ASCII Character	Binary								Octal	Decimal	Hex
	Bit 7	6	5	4	3	2	1	0			
Binary Value	128	64	32	16	8	4	2	1			
NUL	0	0	0	0	0	0	0	0	000	000	00
SOH	0	0	0	0	0	0	0	1	001	001	01
STX	0	0	0	0	0	0	1	0	002	002	02
ETX	0	0	0	0	0	0	1	1	003	003	03
EOT	0	0	0	0	0	1	0	0	004	004	04
ENQ	0	0	0	0	0	1	0	1	005	005	05
ACK	0	0	0	0	0	1	1	0	006	006	06
BEL	0	0	0	0	0	1	1	1	007	007	07
BS	0	0	0	0	1	0	0	0	010	008	08
HT	0	0	0	0	1	0	0	1	011	009	09
LF	0	0	0	0	1	0	1	0	012	010	0A
VT	0	0	0	0	1	0	1	1	013	011	0B
FF	0	0	0	0	1	1	0	0	014	012	0C
CR	0	0	0	0	1	1	0	1	015	013	0D
SO	0	0	0	0	1	1	1	0	016	014	0E
SI	0	0	0	0	1	1	1	1	017	015	0F
DLE	0	0	0	1	0	0	0	0	020	016	10
DC1	0	0	0	1	0	0	0	1	021	017	11
DC2	0	0	0	1	0	0	1	0	022	018	12
DC3	0	0	0	1	0	0	1	1	023	019	13
DC4	0	0	0	1	0	1	0	0	024	020	14
NAK	0	0	0	1	0	1	0	1	025	021	15
SYN	0	0	0	1	0	1	1	0	026	022	16
ETB	0	0	0	1	0	1	1	1	027	023	17
CAN	0	0	0	1	1	0	0	0	030	024	18
EM	0	0	0	1	1	0	0	1	031	025	19
SUB	0	0	0	1	1	0	1	0	032	026	1A
ESC	0	0	0	1	1	0	1	1	033	027	1B
FS	0	0	0	1	1	1	0	0	034	028	1C
GS	0	0	0	1	1	1	0	1	035	029	1D
RS	0	0	0	1	1	1	1	0	036	030	1E
US	0	0	0	1	1	1	1	1	037	031	1F
SP	0	0	1	0	0	0	0	0	040	032	20
!	0	0	1	0	0	0	0	1	041	033	21
"	0	0	1	0	0	0	1	0	042	034	22

Appendix C

ASCII Character	Binary								Octal	Decimal	Hex	
	Bit Binary Value	7 128	6 64	5 32	4 16	3 8	2 4	1 2				0 1
#		0	0	1	0	0	0	1	1	043	035	23
\$		0	0	1	0	0	1	0	0	044	036	24
%		0	0	1	0	0	1	0	1	045	037	25
&		0	0	1	0	0	1	1	0	046	038	26
' (apostrophe)		0	0	1	0	0	1	1	1	047	039	27
(		0	0	1	0	1	0	0	0	050	040	28
)		0	0	1	0	1	0	0	1	051	041	29
*		0	0	1	0	1	0	1	0	052	042	2A
+		0	0	1	0	1	0	1	1	053	043	2B
, (comma)		0	0	1	0	1	1	0	0	054	044	2C
- (hyphen)		0	0	1	0	1	1	0	1	055	045	2D
. (period)		0	0	1	0	1	1	1	0	056	046	2E
/		0	0	1	0	1	1	1	1	057	047	2F
0		0	0	1	1	0	0	0	0	060	048	30
1		0	0	1	1	0	0	0	1	061	049	31
2		0	0	1	1	0	0	1	0	062	050	32
3		0	0	1	1	0	0	1	1	063	051	33
4		0	0	1	1	0	1	0	0	064	052	34
5		0	0	1	1	0	1	0	1	065	053	35
6		0	0	1	1	0	1	1	0	066	054	36
7		0	0	1	1	0	1	1	1	067	055	37
8		0	0	1	1	1	0	0	0	070	056	38
9		0	0	1	1	1	0	0	1	071	057	39
:		0	0	1	1	1	0	1	0	072	058	3A
;		0	0	1	1	1	0	1	1	073	059	3B
<		0	0	1	1	1	1	0	0	074	060	3C
=		0	0	1	1	1	1	0	1	075	061	3D
>		0	0	1	1	1	1	1	0	076	062	3E
?		0	0	1	1	1	1	1	1	077	063	3F
@		0	1	0	0	0	0	0	0	100	064	40
A		0	1	0	0	0	0	0	1	101	065	41
B		0	1	0	0	0	0	1	0	102	066	42
C		0	1	0	0	0	0	1	1	103	067	43
D		0	1	0	0	0	1	0	0	104	068	44
E		0	1	0	0	0	1	0	1	105	069	45

Appendix C

ASCII Character	Bit Binary Value	Binary								Octal	Decimal	Hex
		7	6	5	4	3	2	1	0			
F		0	1	0	0	0	1	1	0	106	070	46
G		0	1	0	0	0	1	1	1	107	071	47
H		0	1	0	0	1	0	0	0	110	072	48
I		0	1	0	0	1	0	0	1	111	073	49
J		0	1	0	0	1	0	1	0	112	074	4A
K		0	1	0	0	1	0	1	1	113	075	4B
L		0	1	0	0	1	1	0	0	114	076	4C
M		0	1	0	0	1	1	0	1	115	077	4D
N		0	1	0	0	1	1	1	0	116	078	4E
O		0	1	0	0	1	1	1	1	117	079	4F
P		0	1	0	1	0	0	0	0	120	080	50
Q		0	1	0	1	0	0	0	1	121	081	51
R		0	1	0	1	0	0	1	0	122	082	52
S		0	1	0	1	0	0	1	1	123	083	53
T		0	1	0	1	0	1	0	0	124	084	54
U		0	1	0	1	0	1	0	1	125	085	55
V		0	1	0	1	0	1	1	0	126	086	56
W		0	1	0	1	0	1	1	1	127	087	57
X		0	1	0	1	1	0	0	0	130	088	58
Y		0	1	0	1	1	0	0	1	131	089	59
Z		0	1	0	1	1	0	1	0	132	090	5A
[		0	1	0	1	1	0	1	1	133	091	5B
\		0	1	0	1	1	1	0	0	134	092	5C
]		0	1	0	1	1	1	0	1	135	093	5D
^		0	1	0	1	1	1	1	0	136	094	5E
_ (underline)		0	1	0	1	1	1	1	1	137	095	5F
`		0	1	1	0	0	0	0	0	140	096	60
a		0	1	0	0	0	0	0	1	141	097	61
b		0	1	1	0	0	0	1	0	142	098	62
c		0	1	1	0	0	0	1	1	143	099	63
d		0	1	1	0	0	1	0	0	144	100	64
e		0	1	1	0	0	1	0	1	145	101	65
f		0	1	1	0	0	1	1	0	146	102	66
g		0	1	1	0	0	1	1	1	147	103	67
h		0	1	1	0	1	0	0	0	150	104	68

Appendix C

ASCII Character	Bit Binary Value	Binary								Octal	Decimal	Hex
		7 128	6 64	5 32	4 16	3 8	2 4	1 2	0 1			
i		0	1	1	0	1	0	0	1	151	105	69
j		0	1	1	0	1	0	1	0	152	106	6A
k		0	1	1	0	1	0	1	1	153	107	6B
l		0	1	1	0	1	1	0	0	154	108	6C
m		0	1	1	0	1	1	0	1	155	109	6D
n		0	1	1	0	1	1	1	0	156	110	6E
o		0	1	1	0	1	1	1	1	157	111	6F
p		0	1	1	1	0	0	0	0	160	112	70
q		0	1	1	1	0	0	0	1	161	113	71
r		0	1	1	1	0	0	1	0	162	114	72
s		0	1	1	1	0	0	1	1	163	115	73
t		0	1	1	1	0	1	0	0	164	116	74
u		0	1	1	1	0	1	0	1	165	117	75
v		0	1	1	1	0	1	1	0	166	118	76
w		0	1	1	1	0	1	1	1	167	119	77
x		0	1	1	1	1	0	0	0	170	120	78
y		0	1	1	1	1	0	0	1	171	121	79
z		0	1	1	1	1	0	1	0	172	122	7A
{		0	1	1	1	1	0	1	1	173	123	7B
!		0	1	1	1	1	1	0	0	174	124	7C
}		0	1	1	1	1	1	0	1	175	125	7D
~		0	1	1	1	1	1	1	0	176	126	7E
DEL		0	1	1	1	1	1	1	1	177	127	7F

Appendix D Control Representation Characters

Control Code	ASCII Character	Hex Value	Character Displayed
CTRL @	NULL	00	none
CTRL A	SOH	01	S _H
CTRL B	STX	02	S _X
CTRL C	ETX	03	E _X
CTRL D	EOT	04	E _T
CTRL E	ENQ	05	E _Q
CTRL F	ACK	06	A _K
CTRL G	BEL	07	B _L
CTRL H	BS	08	B _S
CTRL I	HT	09	H _T
CTRL J	LF	0A	L _F
CTRL K	VT	0B	V _T
CTRL L	FF	0C	F _F
CTRL M	CR	0D	C _R
CTRL N	SO	0E	S _O
CTRL O	SI	0F	S _I
CTRL P	DLE	10	D _L
CTRL Q	DC1	11	D ₁
CTRL R	DC2	12	D ₂
CTRL S	DC3	13	D ₃
CTRL T	DC4	14	D ₄
CTRL U	NAK	15	N _K
CTRL V	SYN	16	S _Y
CTRL W	ETB	17	E _B

Appendix D

Control Code	ASCII Character	Hex Value	Character Displayed
CTRL X	CAN	18	C _N
CTRL Y	EM	19	E _M
CTRL Z	SUB	1A	S _B
CTRL [	ESC	1B	E _C
CTRL \	FS	1C	F _S
CTRL]	GS	1D	G _S
CTRL ^	RS	1E	R _S
CTRL _	US	1F	U _S
DEL	DEL	7F	⌘

Appendix E Character Set Differences

Hex Code	US	UK	Germ	French	Span	Port	Dan/ Norw	Fin/ Swed
23	#	£	#	£	£	#	#	#
40	@	@	§	à	@	§	é	é
5B	[	[	Ä	°	ı	Ä	Æ	Ä
5C	\	\	Ö	Ç	Ñ	Ç	Ø	Ø
5D	]	]	Ü	§	ı	Ö	Å	Å
5E	^	^	^	^	^	^	Ü	Ü
60	~	~	~	~	~	~	é	é
7B	{	{	ä	é	°	ã	æ	ä
7C	|	|	ö	ù	ñ	ç	ø	ø
7D	}	}	ü	è	Ç	õ	å	å
7E	~	~	ß	..	~	°	ü	ü

Appendix F Control Codes

Table F-1
Normal Control Codes

Control Character	ASCII Code	Hex Code	Sent by Key	Action Taken
@	NUL	00		Ignored during transmission to computer and ignored during terminal processing.
E	ENQ	05		Transmits answerback message.
G	BEL	07		Sounds keyboard's bell.
H	BS	08	BACK SPACE	Back space.
I	HT	09	TAB	Moves cursor to the next tab stop, or to the next field if protect mode is enabled.
J	LF	0A	LINE FEED	Causes a line feed or a new line operation.
K	VT	0B		Same as LF ¹
L	FF	0C		Same as LF ¹
M	CR	0D	ENTER or RETURN	Moves cursor to left margin on the current line or next line. Refer to autowrap mode.
N	SO	0E		Select secondary (G1) character set.
O	SI	0F		Select primary (G0) character set.
P	DLE	10		Ignored.
Q	DC1	11		Transmission resumes if X-On/X-Off mode is enabled.
R	DC2	12		Enables bidirectional printing.
S	DC3	13		Stops transmission of all codes except X-On and X-Off if X-On/X-Off mode is enabled.
T	DC4	14		Disables bidirectional printing.
V	SYN	16		Ignored ¹
X	CAN	18		Terminates sequence if sent during an escape sequence
Z	SUB	1A		Same as CAN ¹
[	ESC	1B	ESC	Introduces a command sequence
^	RS	1E		Ignored ¹
_	US	1F		Ignored ¹

1. Action is altered if control code mode is enabled.

Appendix F

Table F-2
Alternative Control Code Values

Code	Hex Value	Effect	Command
VT	0B	Cursor up	ESC [A
FF	0C	Cursor forward	ESC [C
SYN	16	Cursor down	ESC [B
SUB	1A	Clear page and fill with insert character	ESC [2 J
RS	1E	Cursor home (with respect to origin mode)	ESC [H
US	1F	Next line	ESC [E

Appendix G Native Mode Escape Sequences

Table G-1
P_s Values of Reset/Set Mode Commands¹

P _s Value	Effect	Corresponding Key
1	Transfer unprotected/all	
2	Unlock/lock keyboard	
3	Process/monitor command	
4	Replace/insert mode	Shifted CHAR DELETE/ Shifted CHAR INSERT
6	Erase unprotected/all data	
7	Edit on and below/above line	
10	Edit on or beyond/before cursor	
12	No echo/echo	
15	Transfer one/all field(s)	
16	Transfer partial/entire page	
19	Display/page edit boundary mode	Shifted LINE ERASE/ Shifted PAGE ERASE
20	Line feed/new line mode	
? 0	Unprotect/protect mode	
? 1	Cursor key mode off/on	
? 2	VT52 mode	
? 3	80/132 columns	
? 4	Jump/smooth scrolling	
? 5	Dark/light background	
? 6	Absolute/relative origin mode	
? 7	Autowrap mode off/on	
? 8	Ignore/recognize CLEAR SPACE	
? 9	Control code mode off/on	
? 10	Conversational/block mode	
? 11	Transfer display/line	
? 12	Full/half duplex mode	
? 13	Transfer page/display mode	
? 14	Transmit later/now	
? 15	Enable single/multiple-page protect mode	
? 16	Ignore/recognize BREAK key	
? 17	Forms build mode off/on	
? 18	Visual attribute action mode	
? 19	Print scrolling region/page	
? 20	Single/multiple autopage mode	
? 21	VT100/native (970 ANSI) mode	
? 22	Keyclick on/off	
? 26	Enable bidirectional transparent/extension print	

1. Reset mode is ESC [P_s |
Set mode is ESC [P_s h

Appendix G

Table G-2
ESC [Commands

Command	Effect	Corresponding Key
P _n @	Add insert character(s)	CHAR INSERT
P _n A	Cursor up	↑
P _n B	Cursor down	↓
P _n C	Cursor forward	→
P _n D	Cursor backward	←
P _n E	Cursor next line	
P _n F	Cursor previous line	
P _n G	Absolute column position	
H	Cursor home	HOME
P _i ; P _c H	Address cursor (line/column)	
P _n I	Tab forward	
P _s J	Erase within page	
	0 Cursor to end	PAGE ERASE
	1 Start to cursor	
	2 All	CLEAR SPACE
? 3 ; L _i ; C _i ; L _b ; C _r J	Erase between columns within page	
P _s K	Erase within line	
	0 Cursor to end	LINE ERASE
	1 Start to cursor	
	2 All	Shifted CE
? 3 ; C _i ; C _r K	Erase between columns within line	
P _n L	Insert line	LINE INSERT
P _n M	Delete line	LINE DELETE
P _s N	Erase within field	
	0 Cursor to end	
	1 Start to cursor	
	2 All	CE
P _n P	Delete character(s)	CHAR DELETE
P _s Q	Editing extent	
	0 In display	Shifted LINE INSERT
	1 In line	Shifted LINE DELETE
P _i ; P _c R	Report cursor's position	
P _n U	Next page	PAGE
P _n V	Previous page	Shifted PAGE
P _n Z	Tab backward	BACK TAB
P _n a	Relative right cursor movement	
P _s c	Device attribute	
	0 Request terminal ID	
	?8 Send 970 ID	
P _i d	Absolute line position	
P _n e	Relative downward cursor movement	
P _i ; P _c f	Address cursor (line/column)	
P _s g	Clear tab(s)	
	0 At cursor	
	3 Clear all	
	?0 Clear all tabs and set to default	
i	Print page	PRINT or shifted ENTER
? i	Disable buffered extension print modes	
? 0 i	Disable buffered extension print modes	
? 7 i	Enable buffered extension print	
? 5 i	Enable auto line print mode	
? 4 i	Disable auto line print mode	
? 3 i	Enable auto character print mode	
? 2 i	Disable auto character print mode	
? 1 i	Print cursor line	Shifted PRINT

Appendix G

Table G-2
Continued

Command	Effect	Corresponding Key
4 i	Disable buffered print mode	
P _s i	Print commands	
4	Buffered extension print off	
5	Buffered transparent print on	
? 0	Buffered extension print off	
? 1	Unformatted page print on	
? 5	Bidirectional extension print on	
? 6	Bidirectional transparent print on	
? 7	Buffered extension print on	
P _s m	Visual attribute(s)	
	0 Off	
	1 Increase intensity	
	2 Decrease intensity	
	3 Blank	
	4 Underline	
	5 Blink	
	7 Reverse	
P _s n	Request/report terminal status	
	0 Report no malfunction(s)	
	3 Report malfunction(s)	
	5 Request terminal status	
	6 Request cursor position	
	?10 Report printer ready	
	?11 Report printer not ready	
	?15 Request printer status report	
? 0 n	Request factory default answerback message	
? P _s n	Request/report printer status	
? 6 n	Request cursor position (page, line, column)	
P _s o	Area qualification(s)	
	0 Accept all input characters	
	1 Accept no input (guarded)	
	3 Accept numeric character	
	4 Accept alpha character	
	8 Accept no input (unguarded)	
	10 Entry required	
	11 Total fill required	
	12 Accept digit character(s)	
P _n q	Display personal message	
P _t ; P _b r	Define scrolling region	
P _p ; P _l ; P _c s	Page, line, column cursor position	
P _s t	Report cursor content	
	0 Request cursor content	
? P _n t	Convert and report cursor's content as decimal value	
P _s u	Clear defined area qualification(s)	
P _s w	Vertical scrolling type/rate	
	0 Jump	
	1 Normal smooth	
	2 Fast smooth	
	3 Slow smooth	
P _s x	Select/report terminal's port parameter	
	0 Report computer port parameters	
	1 Define computer port parameters	
	2 Report printer port parameters	
	3 Define printer port parameters	
	9 Save set up values after power off	
2 y	Return to factory default values	

Appendix G

Table G-2
Continued

Command	Effect	Corresponding Key
2 ; P _s y	Self test 0 Return terminal to default conditions 1 Test ROM and RAM 2 Test RS-232C port 4 Test EIA control 8 Repeat selected test	
0 ; P _s z	Define 25th line 0 No display 1 Status line 2 User's message line	
1 ; P _s z	Lines per page 0 24 1 48 2 72	
2 ; P _s z	Screen saver time limit 0 None 1 5 minutes 2 10 minutes 3 15 minutes	
3 ; P _s z	Define cursor attribute 0 Blinking block 1 Steady block 2 Blinking underline 3 Steady underline 4 Not displayed	
4 ; P _n z	Screen intensity 0-63 Levels	
5 ; P _n z	Page attribute 0 Single width/single height 1 Double width/single height 2 Double width/double height	
6 ; P _n z	Keyclick 0 Click 1 Silent	
7 ; P _s z	Define normal contrast 0 Normal is low intensity 1 Normal is high intensity	
P _s |	Execute function key	
P _n |	Absolute column position	
? 21	Enable VT52 mode	
P _n (sp) @	Scroll right	Shifted →
P _n (sp) A	Scroll left	Shifted ←
P ₀ ; P ₁ (sp) D	Define primary/secondary character sets 0 US 1 UK 2 German 3 French 4 Spanish 5 Portuguese 6 Norwegian/Danish 7 Swedish/Finnish	
P _w ; P _d (sp) p	Outline with thin-line graphics	
P _w ; P _d (sp) q	Create area with predefined visual attributes	

Appendix G

Table G-3
Other Remote Native Mode Commands

Command	Effect	Corresponding Key
ESC D	Index	Shifted ↓
ESC E	Cursor next line	Shifted LINE FEED
ESC H	Set tab stop at cursor	
ESC M	Reverse index	Shifted ↑
ESC O		FUNCT
ESC S	Set terminal transmit state sequence	SEND
ESC c	Return to initial power-on state	
ESC 5	Transmit state sequence (from computer)	Shifted SEND
ESC 7	Save cursor description	
ESC 8	Restore cursor description	
ESC =	Enable alternate keypad mode	
ESC >	Enable numeric keypad mode	
ESC <	Return to previous mode from VT52 mode	
ESC # 2	Native double-height line	
ESC # 3	Top half of double-height line	
ESC # 4	Bottom half of double-height line	
ESC # 5	Single-width line	
ESC # 6	Double-width line	
ESC # 7	Print page	
ESC (P _s	Define primary character set	
ESC) P _s	Define secondary character set	
ESC ^ (data) CTRL M	Load user's message line	
ESC | P ₁ ; P ₂ ; (data) CTRL M	Program function keys P ₁ Function key assignment P ₂ Transmission configuration	
ESC _	Download font or data to memory	
ESC \ P _s ; (data) CTRL M	New key/function value	

Appendix H VT52 Mode Escape Sequences

Sequence	Name	Effect
ESC A	Cursor up	Moves the cursor up one line within the current column. The cursor cannot go back beyond the display's top line.
ESC B	Cursor down	Moves the cursor down one line within the current column. The cursor cannot go beyond the display's bottom line.
ESC C	Cursor right	Moves the cursor one position to the right within the current line. While autowrap mode is set on no-wrap, the cursor can not move beyond the right margin. With autowrap mode set on wrap, the cursor wraps to next line.
ESC D	Cursor left	Moves the cursor one position to the left. The cursor can not move beyond the left margin.
ESC F	Enable graphics mode	Substitutes special and line-drawing character set for current ASCII character set. (Same as ANSI special and line-drawing character set.)
ESC G	Exit graphics mode	Returns to the ASCII character set previously in use.
ESC H	Cursor home	Moves the cursor to the first position on the page's first line.
ESC I	Reverse line feed	Moves the cursor up one line within the same column. If the cursor is already on the top line, the display scrolls down.
ESC J	Erase to end of screen	Erases all characters from (and including) the cursor position to (and including) the end of the display without moving the cursor.
ESC K	Erase to end of line	Erases all characters from (and including) the cursor position to the end of the current line without moving the cursor.
ESC Y c l	Direct cursor address	Moves the cursor to a specified line (l) and column (c). Line and column values sent are ASCII codes composed of the line or column number plus either 32 (decimal) or 20 (hex).
ESC Z	Identify terminal	Directs terminal to send an identifying escape sequence (ESC / Z) to the computer.
ESC =	Enter alternate keypad mode	Causes the keypad keys to send unique sequences in place of the normal numeric values. See Table 5-5 for sequences sent in numeric and alternate keypad modes.
ESC >	Exit alternate keypad mode	Causes the keypad keys to send ASCII codes according to the keypad labels.
ESC <	Enter native mode	Causes subsequent escape sequences to be interpreted as ANSI commands; ignores all VT52 sequences. Cursor key assignments are refreshed with the appropriate ANSI commands.

Appendix I Key Codes

Key Cap Legend	CTRL	CTRL with SHIFT	SHIFT or with ALPHA	ALPHA LOCK	None
A a	01	01	41	41	61
B b	02	02	42	42	62
C c	03	03	43	43	63
D d	04	04	44	44	64
E e	05	05	45	45	65
F f	06	06	46	46	66
G g	07	07	47	47	67
H h	08	08	48	48	68
I i	09	09	49	49	69
J j	0A	0A	4A	4A	6A
K k	0B	0B	4B	4B	6B
L l	0C	0C	4C	4C	6C
M m	0D	0D	4D	4D	6D
N n	0E	0E	4E	4E	6E
O o	0F	0F	4F	4F	6F
P p	10	10	50	50	70
Q q	11	11	51	51	71
R r	12	12	52	52	72
S s	13	13	53	53	73
T t	14	14	54	54	74
U u	15	15	55	55	75
V v	16	16	56	56	76
W w	17	17	57	57	77
X x	18	18	58	58	78
Y y	19	19	59	59	79
Z z	1A	1A	5A	5A	7A
] [	1B	1D	5D	5B	5B
! \	1C	1C	7C	5C	5C
} {	1B	1D	7D	7B	7B
~ `	00	1E	7E	60	60
DEL	1F	1F	7F	7F	7F
SPACE	20	20	20	20	20
" '	27	22	22	27	27
< ,	2C	3C	3C	2C	2C
_ -	2D	1F	5F	2D	2D
> .	2E	3E	3E	2E	2E

Appendix I

Key Cap Legend	CTRL	CTRL with SHIFT	SHIFT or with ALPHA	ALPHA LOCK	None
? /	2F	3F	3F	2F	2F
) 0	30	29	29	30	30
! 1	31	21	21	31	31
@ 2	32	00	40	32	32
# 3	33	23	23	33	33
\$ 4	34	24	24	34	34
% 5	35	25	25	35	35
^ 6	36	1E	5E	36	36
& 7	37	26	26	37	37
* 8	38	2A	2A	38	38
(9	39	28	28	39	39
: ;	3B	3A	3A	3B	3B
+ =	3D	2B	2B	3D	3D
←	88	80	80	88	88
Tab	89	81	81	89	89
↓	8A	82	82	8A	8A
↑	8B	83	83	8B	8B
→	8C	84	84	8C	8C
Return	8D	85	85	8D	8D
Home	8E	86	86	8E	8E
Back space	8F	87	87	8F	8F
Line feed	90	A0	A0	90	90
Back tab	91	A1	A1	91	91
Print	92	A2	A2	92	92
Clear space	93	A3	A3	93	93
Char insert	94	A4	A4	94	94
Char delete	95	A5	A5	95	95
Line insert	96	A6	A6	96	96
Line delete	97	A7	A7	97	97
Line erase	98	A8	A8	98	98
Page erase	99	A9	A9	99	99
Page	9A	AA	AA	9A	9A
,	AC	AC	AC	AC	AC
-	AD	AD	AD	AD	AD
.	AE	AE	AE	AE	AE
0	B0	B0	B0	B0	B0
1	B1	B1	B1	B1	B1

Appendix I

Key Cap Legend	CTRL	CTRL with SHIFT	SHIFT or with ALPHA	ALPHA LOCK	None
2	B2	B2	B2	B2	B2
3	B3	B3	B3	B3	B3
4	B4	B4	B4	B4	B4
5	B5	B5	B5	B5	B5
6	B6	B6	B6	B6	B6
7	B7	B7	B7	B7	B7
8	B8	B8	B8	B8	B8
9	B9	B9	B9	B9	B9
F1	D0	E0	E0	D0	D0
F2	D1	E1	E1	D1	D1
F3	D2	E2	E2	D2	D2
F4	D3	E3	E3	D3	D3
F5	D4	E4	E4	D4	D4
F6	D5	E5	E5	D5	D5
F7	D6	E6	E6	D6	D6
F8	D7	E7	E7	D7	D7
F9	D8	E8	E8	D8	D8
F10	D9	E9	E9	D9	D9
F11	DA	EA	EA	DA	DA
F12	DB	EB	EB	DB	DB
F13	DC	EC	EC	DC	DC
F14	DD	ED	ED	DD	DD
F15	DE	EE	EE	DE	DE
F16	DF	EF	EF	DF	DF
ESC	F0	F1	F1	F0	F0
XMIT	F2	F3	F3	F2	F2
ENTER	F4	F5	F5	F4	F4
TAB (KP)	F6	F7	F7	F6	F6
CE	F8	F9	F9	F8	F8
00	FA	FA	FA	FA	FA
BREAK	FB	FC	FC	FB	FB
SET UP	FD	FE	FE	FD	FD

Appendix J Character Font Addresses

Hex ¹	Address ²	Hex ¹	Address ²	Hex ¹	Address ²	Hex ¹	Address ²
00	0000	30	0180	60	0300	A0	0500
01	0008	31	0188	61	0308	A1	0508
02	0010	32	0190	62	0310	A2	0510
03	0018	33	0198	63	0318	A3	0518
04	0020	34	01A0	64	0320	A4	0520
05	0028	35	01A8	65	0328	A5	0528
06	0030	36	01B0	66	0330	A6	0530
07	0038	37	01B8	67	0338	A7	0538
08	0040	38	01C0	68	0340	A8	0540
09	0048	39	01C8	69	0348	A9	0548
0A	0050	3A	01D0	6A	0350	AA	0550
0B	0058	3B	01D8	6B	0358	AB	0558
0C	0060	3C	01E0	6C	0360	AC	0560
0D	0068	3D	01E8	6D	0368	AD	0568
0E	0070	3E	01F0	6E	0370	AE	0570
0F	0078	3F	01F8	6F	0378	AF	0578
10	0080	40	0200	70	0380	B0	0580
11	0088	41	0208	71	0388	B1	0588
12	0090	42	0210	72	0390	B2	0590
13	0098	43	0218	73	0398	B3	0598
14	00A0	44	0220	74	03A0	B4	05A0
15	00A8	45	0228	75	03A8	B5	05A8
16	00B0	46	0230	76	03B0	B6	05B0
17	00B8	47	0238	77	03B8	B7	05B8
18	00C0	48	0240	78	03C0	B8	05C0
19	00C8	49	0248	79	03C8	B9	05C8
1A	00D0	4A	0250	7A	03D0	BA	05D0
1B	00D8	4B	0258	7B	03D8	BB	05D8
1C	00E0	4C	0260	7C	03E0	BC	05E0
1D	00E8	4D	0268	7D	03E8	BD	05E8
1E	00F0	4E	0270	7E	03F0	BE	05F0
1F	00F8	4F	0278	7F	03F8	BF	05F8
20	0100	50	0280	80	0400	C0	0600
21	0108	51	0288	81	0410	C1	0608
22	0110	52	0290	82	0420	C2	0610
23	0118	53	0298	83	0430	C3	0618
24	0120	54	02A0	84	0440	C4	0620
25	0128	55	02A8	85	0450	C5	0628
26	0130	56	02B0	86	0460	C6	0630
27	0138	57	02B8	87	0470	C7	0638
28	0140	58	02C0	88	0480	C8	0640
29	0148	59	02C8	89	0490	C9	0648
2A	0150	5A	02D0	8A	04A0	CA	0650
2B	0158	5B	02D8	8B	04B0	CB	0658
2C	0160	5C	02E0	8C	04C0	CC	0660
2D	0168	5D	02E8	8D	04D0	CD	0668
2E	0170	5E	02F0	8E	04E0	CE	0670
2F	0178	5F	02F8	8F	04F0	CF	0678

1. Hex represents the hexadecimal character value.
2. The address in hex notation represents the beginning location in RAM for that character font.

Appendix J

Hex¹	Address²	Hex¹	Address²	Hex¹	Address²	Hex¹	Address²
D0	0680	DC	06E0	E8	0740	F4	07A0
D1	0688	DD	06E8	E9	0748	F5	07A8
D2	0690	DE	06F0	EA	0750	F6	07B0
D3	0698	DF	06F8	EB	0758	F7	07B8
D4	06A0	E0	0700	EC	0760	F8	07C0
D5	06A8	E1	0708	ED	0768	F9	07C8
D6	06B0	E2	0710	EE	0770	FA	07D0
D7	06B8	E3	0718	EF	0778	FB	07D8
D8	06C0	E4	0720	F0	0780	FC	07E0
D9	06C8	E5	0728	F1	0788	FD	07E8
DA	06D0	E6	0730	F2	0790	FE	07F0
DB	06D8	E7	0738	F3	0798	FF	07F8

1. Hex represents the hexadecimal character value.
2. The address in hex notation represents the beginning location in RAM for that character font.

Appendix K Repeat Action of Keys

Byte No.	Key Name	Bit No.	Bit's Value		Byte's Default Decimal Value
			Decimal	Binary	
1	CTRL A or CTRL	7	128	1	255
	CTRL A	6	64	1	
	CTRL B	5	32	1	
	CTRL C	4	16	1	
	CTRL D	3	8	1	
	CTRL E	2	4	1	
	CTRL F	1	2	1	
	CTRL G	0	1	1	
2	CTRL H	7	128	1	255
	CTRL I	6	64	1	
	CTRL J	5	32	1	
	CTRL K	4	16	1	
	CTRL L	3	8	1	
	CTRL M	2	4	1	
	CTRL N	1	2	1	
	CTRL O	0	1	1	
3	CTRL P	7	128	1	255
	CTRL Q	6	64	1	
	CTRL R	5	32	1	
	CTRL S	4	16	1	
	CTRL T	3	8	1	
	CTRL U	2	4	1	
	CTRL V	1	2	1	
	CTRL W	0	1	1	
4	CTRL X	7	128	1	255
	CTRL Y	6	64	1	
	CTRL Z	5	32	1	
	CTRL [or CTRL {	4	16	1	
	CTRL \ or CTRL |	3	8	1	
	CTRL] or CTRL }	2	4	1	
	CTRL ^ or CTRL ~	1	2	1	
	CTRL _ or CTRL DEL	0	1	1	
5	space bar	7	128	1	255
	!	6	64	1	
	"	5	32	1	
	#	4	16	1	
	\$	3	8	1	
	%	2	4	1	
	&	1	2	1	
	'	0	1	1	
6	(7	128	1	255
	)	6	64	1
	*	5	32	1	
	+	4	16	1	
	, (comma)	3	8	1	
	- (hyphen)	2	4	1	
	.	1	2	1	
	/	0	1	1	

Appendix K

Byte No.	Key Name	Bit No.	Bit's Value		Byte's Default Decimal Value
			Decimal	Binary	
7	0	7	128	1	255
	1	6	64	1	
	2	5	32	1	
	3	4	16	1	
	4	3	8	1	
	5	2	4	1	
	6	1	2	1	
	7	0	0	1	
8	8	7	128	1	255
	9	6	64	1	
	:	5	32	1	
	;	4	16	1	
	<	3	8	1	
	=	2	4	1	
	>	1	2	1	
	?	0	0	1	
9	@	7	128	1	255
	A	6	64	1	
	B	5	32	1	
	C	4	16	1	
	D	3	8	1	
	E	2	4	1	
	F	1	2	1	
	G	0	0	1	
10	H	7	128	1	255
	I	6	64	1	
	J	5	32	1	
	K	4	16	1	
	L	3	8	1	
	M	2	4	1	
	N	1	2	1	
	O	0	0	1	
11	P	7	128	1	255
	Q	6	64	1	
	R	5	32	1	
	S	4	16	1	
	T	3	8	1	
	U	2	4	1	
	V	1	2	1	
	W	0	0	1	
12	X	7	128	1	255
	Y	6	64	1	
	Z	5	32	1	
	[	4	16	1
	\	3	8	1	
	]	2	4	1
	^	1	2	1	
	_ (underline)	0	0	1	

Appendix K

Byte No.	Key Name	Bit No.	Bit's Value		Byte's Default Decimal Value
			Decimal	Binary	
13	` (grave)	7	128	1	255
	a	6	64	1	
	b	5	32	1	
	c	4	16	1	
	d	3	8	1	
	e	2	4	1	
	f	1	2	1	
g	0	1	1		
14	h	7	128	1	255
	i	6	64	1	
	j	5	32	1	
	k	4	16	1	
	l	3	8	1	
	m	2	4	1	
	n	1	2	1	
o	0	1	1		
15	p	7	128	1	255
	q	6	64	1	
	r	5	32	1	
	s	4	16	1	
	t	3	8	1	
	u	2	4	1	
	v	1	2	1	
w	0	1	1		
16	x	7	128	1	255
	y	6	64	1	
	z	5	32	1	
	{	4	16	1	
	|	3	8	1	
	}	2	4	1	
	~	1	2	1	
DEL	0	1	1		
17	Shifted ←	7	128	1	249
	Shifted TAB	6	64	1	
	Shifted ↓	5	32	1	
	Shifted ↑	4	16	1	
	Shifted →	3	8	1	
	Shifted RETURN	2	4	0	
	Shifted HOME	1	2	0	
Shifted BACK SPACE	0	1	1		
18	←	7	128	1	249
	TAB	6	64	1	
	↓	5	32	1	
	↑	4	16	1	
	→	3	8	1	
	RETURN	2	4	0	
	HOME	1	2	0	
BACK SPACE	0	1	1		

Appendix K

Byte No.	Key Name	Bit No.	Bit's Value		Byte's Default Decimal Value
			Decimal	Binary	
19	LINE FEED	7	128	1	207
	BACK TAB	6	64	1	
	PRINT	5	32	0	
	CLEAR SPACE	4	16	0	
	CHAR INSERT	3	8	1	
	CHAR DELETE	2	4	1	
	LINE INSERT	1	2	1	
	LINE DELETE	0	1	1	
20	LINE ERASE	7	128	0	31
	PAGE ERASE	6	64	0	
	PAGE	5	32	0	
	reserved	4	16	1	
	reserved	3	8	1	
	reserved	2	4	1	
	reserved	1	2	1	
	reserved	0	1	1	
21	Shifted LINE FEED	7	128	1	207
	Shifted BACK TAB	6	64	1	
	Shifted PRINT	5	32	0	
	Shifted CLEAR SPACE	4	16	0	
	Shifted CHAR INSERT	3	8	1	
	Shifted CHAR DELETE	2	4	1	
	Shifted LINE INSERT	1	2	1	
	Shifted LINE DELETE	0	1	1	
22	Shifted LINE ERASE	7	128	0	14
	Shifted PAGE ERASE	6	64	0	
	Shifted PAGE	5	32	0	
	reserved	4	16	0	
	, (keypad)	3	8	1	
	- (keypad)	2	4	1	
	. (keypad)	1	2	1	
	reserved	0	1	0	
23	0 (keypad)	7	128	1	255
	1 (keypad)	6	64	1	
	2 (keypad)	5	32	1	
	3 (keypad)	4	16	1	
	4 (keypad)	3	8	1	
	5 (keypad)	2	4	1	
	6 (keypad)	1	2	1	
	7 (keypad)	0	1	1	
24	8 (keypad)	7	128	1	192
	9 (keypad)	6	64	1	
	reserved	5	32	0	
	reserved	4	16	0	
	reserved	3	8	0	
	reserved	2	4	0	
	reserved	1	2	0	
	reserved	0	1	0	

Appendix K

Byte No.	Key Name	Bit No.	Bit's Value		Byte's Default Decimal Value
			Decimal	Binary	
25	reserved	7	128	0	0
	reserved	6	64	0	
	reserved	5	32	0	
	reserved	4	16	0	
	reserved	3	8	0	
	reserved	2	4	0	
	reserved	1	2	0	
	reserved	0	1	0	
26	reserved	7	128	0	0
	reserved	6	64	0	
	reserved	5	32	0	
	reserved	4	16	0	
	reserved	3	8	0	
	reserved	2	4	0	
	reserved	1	2	0	
	reserved	0	1	0	
27	F1	7	128	0	0
	F2	6	64	0	
	F3	5	32	0	
	F4	4	16	0	
	F5	3	8	0	
	F6	2	4	0	
	F7	1	2	0	
	F8	0	1	0	
28	F9	7	128	0	0
	F10	6	64	0	
	F11	5	32	0	
	F12	4	16	0	
	F13	3	8	0	
	F14	2	4	0	
	F15	1	2	0	
	F16	0	1	0	
29	Shifted F1	7	128	0	0
	Shifted F2	6	64	0	
	Shifted F3	5	32	0	
	Shifted F4	4	16	0	
	Shifted F5	3	8	0	
	Shifted F6	2	4	0	
	Shifted F7	1	2	0	
	Shifted F8	0	1	0	
30	Shifted F9	7	128	0	0
	Shifted F10	6	64	0	
	Shifted F11	5	32	0	
	Shifted F12	4	16	0	
	Shifted F13	3	8	0	
	Shifted F14	2	4	0	
	Shifted F15	1	2	0	
	Shifted F16	0	1	0	

Appendix K

Byte No.	Key Name	Bit No.	Bit's Value		Byte's Default Decimal Value
			Decimal	Binary	
31	ESC	7	128	0	3
	LOC ESC	6	64	0	
	SEND	5	32	0	
	Shifted SEND	4	16	0	
	ENTER	3	8	0	
	Shifted ENTER	2	4	0	
	TAB (keypad)	1	2	1	
	Shifted TAB (keypad)	0	1	1	
32	CE	7	128	0	32
	Shifted CE	6	64	0	
	∅∅	5	32	1	
	BREAK	4	16	0	
	Shifted BREAK	3	8	0	
	NO SCROLL	2	4	0	
	SETUP	1	2	0	
	reserved	0	1	0	

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Quick Reference Guide

Function	Command
Reconfiguration	
Restore previously saved values ¹	CTRL R
Restore factory default values ²	CTRL D
Restore previously saved values ³	CTRL RESET
Enter set up mode	SET UP (shifted NO SCROLL)
Enter/exit tab line	CTRL TAB
Change tab stop	T (upper- or lowercase)
Enter/exit insert character line	CTRL C
Increase contrast	Shifted ↑
Decrease contrast	Shifted ↓
Save parameters after power off	CTRL S (uppercase)
Leave set up mode	SET UP (shifted NO SCROLL)
Setting Values	
Return to factory default values	ESC [2 y
Save set up values after power off	ESC [9 x
Operating Modes	
Enable VT100 mode	ESC [? 21 l
Enable native (970 ANSI) mode	ESC [? 21 h
Enable VT52 mode	ESC [? 2 l
Return to previous mode from VT52 mode	ESC <
Controlling the Display	
*Define contents of 25th line	ESC [0 ; P _n z
Select single-width line	ESC # 5
Select double-width line	ESC # 6
Select native double-height line	ESC # 2
Select top half of double-height line	ESC # 3
Select lower half of double-height line	ESC # 4
*Define page attribute	ESC [5 ; P _s z
*Maximum 80 columns	ESC [? 3 l
*Maximum 132 columns	ESC [? 3 h
*Set number of lines per page	ESC [1 ; P _s z
*Dark background	ESC [? 5 l
*Light background	ESC [? 5 h
*Establish screen intensity	ESC [4 ; P _n z
Define cursor attribute	ESC [3 ; P _s z
*Define normal contrast setting	ESC [7 ; P _s z
Define visual attribute(s) of display	ESC [P _s ; ... ; P _s m
Enable visual attribute action mode	ESC [? 18 l
Disable visual attribute action mode	ESC [? 18 h
*Select screen saver time limit	ESC [2 ; P _s z
Ignore CLEAR SPACE key	ESC [? 8 l
Recognize CLEAR SPACE key	ESC [? 8 h
*Ignore BREAK key	ESC [? 16 l
*Recognize BREAK key	ESC [? 16 h

1. Effective only during set up mode.
2. Effective only in set up mode. Changes nonvolatile and current memories.
3. Can be used any time, but destroys displayed data. Has the same effect as turning the terminal's power off and back on.

Function	Command
*Keyclick on	ESC [? 22 l
*Keyclick off	ESC [? 22 h
Character Sets	
*Define primary and secondary character sets	ESC [P ₀ ; P ₁ (space) D
Define primary character set	ESC (P _s
Define secondary character set	ESC) P _s
Activate primary character set	CTRL O
Activate secondary character set	CTRL N
Graphics	
Outline area with thin-line graphics	ESC [P _w ; P _d (space) p
Create area with predefined visual attribute(s)	ESC [P _w ; P _d (space) q
Display Movement	
Move cursor to next line	ESC E
Display next page	ESC [P _n U
Display previous page	ESC [P _n V
Scroll right	ESC [P _n (space)
Scroll left	ESC [P _n (space) A
*Select vertical scrolling type and rate	ESC [P _s w
Define scrolling mode as jump	ESC [? 4 l
Define scrolling mode as smooth	ESC [? 4 h
Define scrolling region	ESC [P _t ; P _b r
Enable relative origin mode (dependent)	ESC [? 6 h
Enable absolute origin mode (independent)	ESC [? 6 l
*Single autopage mode	ESC [? 20 l
*Multiple autopage mode	ESC [? 20 h
Cursor Movement	
Move cursor up	ESC [P _n A
Move cursor down	ESC [P _n B
Move cursor forward	ESC [P _n C
Move cursor backward	ESC [P _n D
Move cursor to next line	ESC [P _n E
Move cursor to previous line	ESC [P _n F
Index	ESC D
Reverse index	ESC M
*Disable autowrap mode (no wrap)	ESC [? 7 l
*Enable autowrap mode (wrap)	ESC [? 7 h
*Enable line feed mode; disable new line mode	ESC [20 l
*Enable new line mode, disable line feed mode	ESC [20 h
Specify relative right cursor movement	ESC [P _n a
Specify relative downward movement of cursor	ESC [P _n e

*May be controlled in set up mode.

Quick Reference Guide

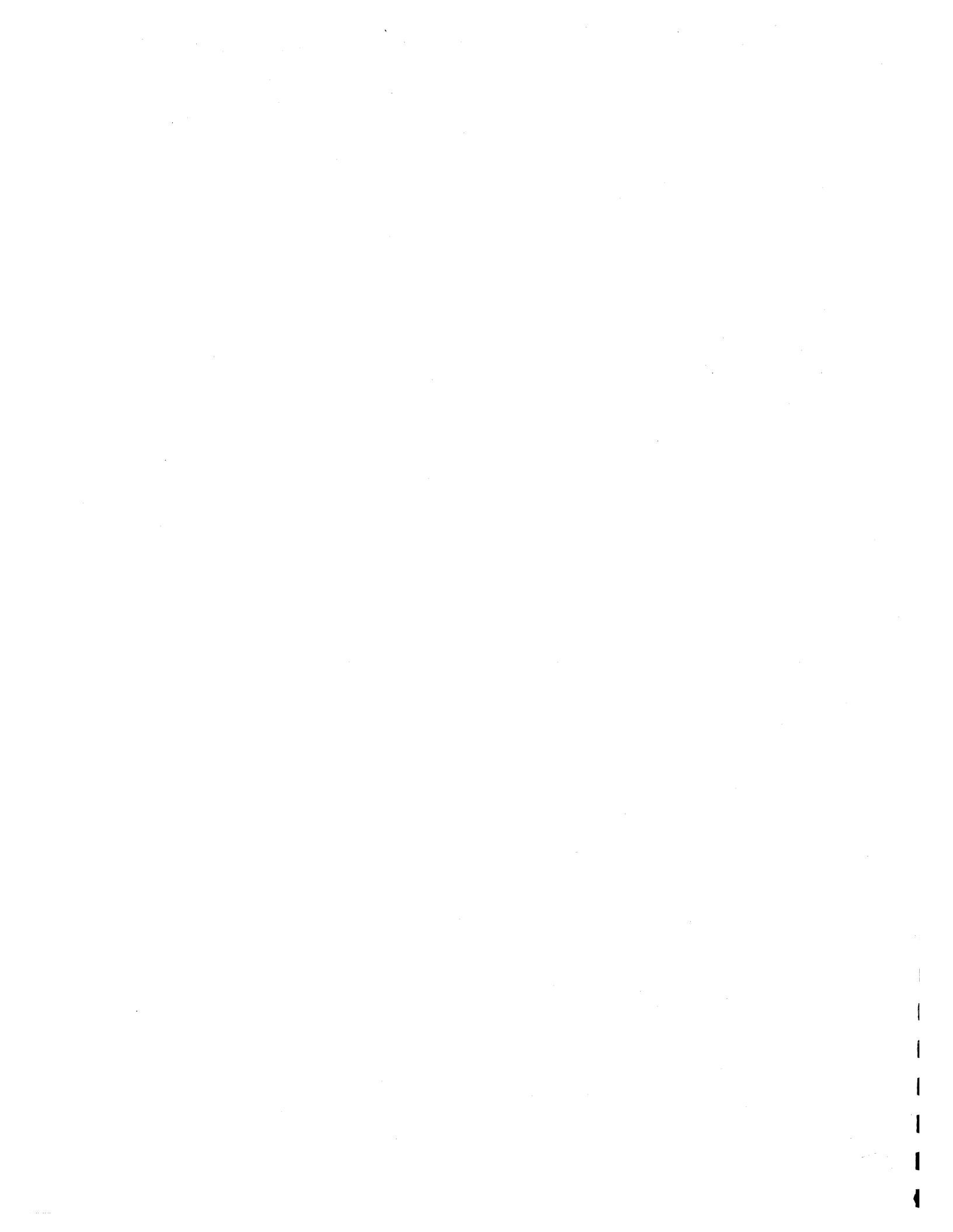
Function	Command
Cursor Addressing	
Move cursor to absolute column address	ESC [P _n G or ESC [P _n ^
Address the cursor to line and column	ESC [P _l ; P _c H or ESC [P _l ; P _c f
Address the cursor to page, line, and column	ESC [P _p ; P _l ; P _c s
Specify cursor's absolute line position	ESC [P _l d
Cursor Description	
Save cursor description	ESC 7
Restore cursor description	ESC 8
Keyboard Action	
Disable cursor key mode	ESC [? 1 l
Enable cursor key mode	ESC [? 1 h
Enable numeric keypad mode	ESC >
Enable alternate keypad mode	ESC =
Unlock the keyboard	ESC [2 l
Lock the keyboard	ESC [2 h
Tabs	
Set horizontal tab stop at cursor position	ESC H
*Clear tab stop(s)	ESC [P _s g
Tab cursor forward	ESC [P _n |
Tab cursor backward	ESC [P _n Z
Control Representation Mode	
*Process the command	ESC [3 l
*Monitor the command	ESC [3 h
Control Codes	
Disable control code mode	ESC [? 9 l
Enable control code mode	ESC [? 9 h
Controlling Editing	
*Select extent of editing	ESC [P _s Q
*Display area is edit boundary	ESC [19 l
*Page of memory is edit boundary	ESC [19 h
*Edit on or below current line	ESC [7 l
*Edit on or above current line	ESC [7 h
*Edit on or to the right of cursor	ESC [10 l
*Edit on or to the left of cursor	ESC [10 h
Editing	
*Replace mode enabled	ESC [4 l
*Insert mode enabled	ESC [4 h
Add an insert character(s)	ESC [P _n
Insert line	ESC [P _n L
Delete character(s)	ESC [P _n P
Delete current line	ESC [P _n M
Erase all data	ESC [6 h
Erase only unprotected data	ESC [6 l
Erase in page	ESC [P _s J
Erase within current line	ESC [P _s K


Function	Command
Erase within field	ESC [P _s N
Erase between columns within line	ESC [? 3 C _l ; C _r K
Erase between columns within page	ESC [? 3 ; L _t ; C _l ; L _b ; C _r J
Function Keys	
Execute a function key	ESC [P _s |
Forms	
Turn on forms build mode; turn off protect mode (if on)	ESC [? 17 h
Turn off forms build mode	ESC [? 17 l
Disable protect mode	ESC [? 0 l
Enable protect mode; disable forms build mode	ESC [? 0 h
Define the area qualification	ESC [P _s ; ... ; P _s o
Clear defined area qualifications	ESC [P _s u
Enable single-page protect mode	ESC [? 15 l
Enable multiple-page protect mode	ESC [? 15 h
Communication	
*Enable block mode	ESC [? 10 h
*Select conversational mode	ESC [? 10 l
*Echo	ESC [12 h
*No echo	ESC [12 l
*Enable half duplex mode	ESC [? 12 h
*Enable full duplex mode	ESC [? 12 l
Transmitting Data	
*Defer transmission	ESC [? 14 l
*Transmit immediately	ESC [? 14 h
*Set transmit state sequence (from terminal)	ESC S
*Transmit sequence (from computer)	ESC 5
*Transfer partial page through cursor position	ESC [16 l
*Transfer entire page	ESC [16 h
*Transfer page	ESC [? 11 l
*Transfer line	ESC [? 11 h
Transfer page	ESC [? 13 l
Transfer display	ESC [? 13 h
*Transfer one field	ESC [15 l
*Transfer all fields	ESC [15 h
*Transfer only unprotected fields	ESC [1 l
*Transfer all areas (protected and unprotected)	ESC [1 h
Printing the Display	
Print scrolling region	ESC [? 19 l
Print page	ESC [? 19 h
Print page	ESC [i
	or
	ESC # 7
Enable auto line print mode	ESC [? 5 i
Disable auto line print mode	ESC [? 4 i
Enable auto character print mode	ESC [? 3 i
*May be controlled in set up mode.	

Quick Reference Guide

Function	Command
Disable auto character print mode	ESC [? 2 i
Print cursor line	ESC [? 1 i
Sending Data to the Printer	
Enable buffered transparent print mode	ESC [5 i
Enable buffered extension print mode	ESC [? 7 i
Disable all print modes	CTRL T
Disable only buffered extension print modes	ESC [? i or ESC [? 0 i
Disable buffered print mode	ESC [4 i
Select bidirectional transparent print	ESC [? 26 l
Select bidirectional extension print	ESC [? 26 h
Enable bidirectional print mode	CTRL R
Disable bidirectional print mode (transparent or extension)	CTRL T
Tests and Reports	
Perform self test	ESC [2 ; P _s y
Request/report terminal status	ESC [P _s n
Return to initial power-on state	ESC c
Request device attribute report	ESC [c
Request/report printer status	ESC [? P _s n
Request a report on the cursor's position (line and column)	ESC [6 n
Request a report on cursor's position (page, line and column)	ESC [? 6 n
Request contents of factory default answerback message	ESC [? 0 n
Request report on terminal's port parameters	ESC [P _s x
Set port parameters	ESC [P _s ; P ₁ ; P ₂ ; P ₃ ; P ₄ ; P ₅ ; P ₆ x
Report content of cursor to computer	ESC [t
Convert content of cursor to decimal value and report to computer	ESC [P _n ? t
Designing Custom Character Fonts	
Download a character into memory	ESC _ : KK AAAA 00 XX CC
End downloading process	: 00 0000 01 FF
Downloading	
Download data or a program into memory	ESC _
Data record to be downloaded	: KK AAAA 00 H ₁ ; H ₂ ; ... ; H _n CC
End the downloading sequence	: KK AAAA 01 CC
Loading the User's Message Line	
Load user's message line	ESC ^ D ₁ ; D ₂ ; ... ; D _n CTRL M

Function	Command
Reprogramming the Function Keys	
Program a function key	ESC | P ₁ ; P ₂ ; D ₁ ; D ₂ ; ... ; D _n CTRL M
Programming the Keys/Functions	
Update memory with a new key/function	ESC \ P _s ; D ₁ ; D ₂ ; ... ; D _n CTRL M
*May be controlled in set up mode.	



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