

CHAPTER 3

PROGRAMMER INFORMATION

The VT100 terminal normally performs a two-part function. It is an input device to a computer – information entered through the keyboard is sent to the computer. It is simultaneously an output device for the computer – that is, data coming in from the computer is displayed on the video screen. Figure 3-1 shows the data flow.

This section of the user's manual discusses data flow between the VT100 and the host. Included are the codes generated by the keyboard; the transmission protocol followed by the terminal; and the actions and reactions of the terminal to control functions in both ANSI and VT52 modes of operation.

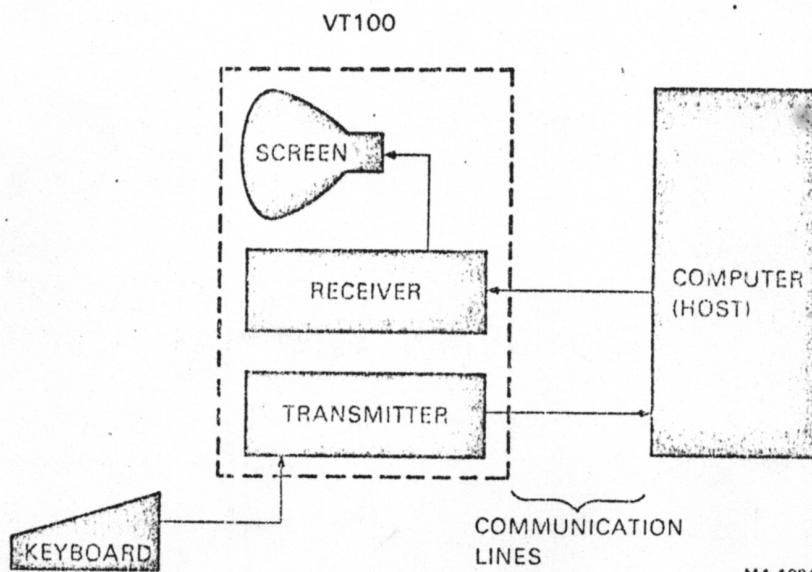


Figure 3-1
Terminal Data Flow

MA-1994

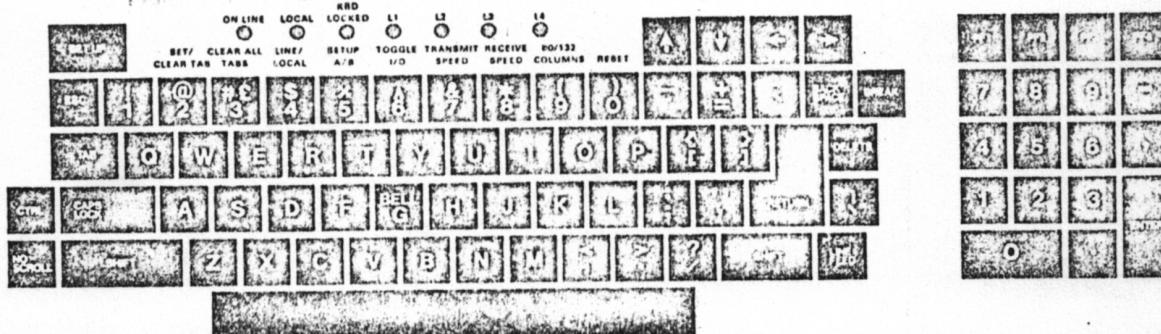


Figure 3-2 VT100 Keyboard

THE KEYBOARD

The VT100 uses a keyboard with a key arrangement similar to an ordinary office typewriter, as shown in Figure 3-2. In addition to the standard typewriter keys the VT100 keyboard has additional keys and indicators used to generate control sequences, cursor control commands, and to show the current terminal status.

LED Indicators

The keyboard has seven light emitting diodes (LEDs) of which two are committed to the complementary ON-LINE/LOCAL function. The power on condition is implicitly shown by one of the two LEDs being on; that is, if the keyboard is connected and power is on, one of these LEDs will be on.

A third LED indicates a "keyboard locked" condition. In this condition the keyboard has been "turned off" automatically by the terminal due to a full buffer or by the host through the transmission of an XOFF to the terminal.

The four remaining LEDs are programmable and can be assigned any meaning for specific applications. The code sequences to turn these LEDs on or off are discussed later in this chapter.



SET-UP

The SET-UP key is at the upper-left corner of the main key array. Operations performed in SET-UP mode can be stored in nonvolatile memory (NVR) so that turning the terminal power off does not, by itself, alter the terminal configuration.

The procedures to change the SET-UP features are provided in the operator's information section of this manual. Those SET-UP features which may be modified by the host are listed in Table 3-1 and described in detail under the escape sequences.

Keyboard Operation

The operator uses the keyboard to transmit codes to the host. Some keys transmit one or more codes to the host immediately when typed. Other keys such as **CTRL** and **SHIFT** do not transmit codes when typed, but modify the codes transmitted by other keys. The code-transmitting keys cause the terminal to make a clicking sound to verify to the operator that the keystroke has been processed by the terminal. If two code-transmitting keys are pressed together, two codes will be transmitted according to the order in which the keys were typed. The terminal will not wait for the keys to be lifted, but will transmit both codes as soon as possible.

after the keys are first typed. If three such keys are pressed simultaneously, the codes for the first two keys are transmitted immediately; the code for the third will be transmitted when one of the first two keys is lifted.

Alphabetic Keys – The VT100 will transmit the lowercase code unless either or both of the SHIFT keys are down, or unless the CAPS LOCK key is down. Pressing the CAPS LOCK key will lock only the 26 alphabetic keys in the shifted (uppercase) mode. Table 3-2 shows the codes generated by the alphabetic keys.

SET-UP Feature or Machine State	Changeable from Host Computer*	Saved in NVR and Changeable in SET-UP
Alternate keypad mode	Yes (DECKPAM/DECKPNM)	No
ANSI/VT52	Yes (DECANM)	Yes
Auto Repeat	Yes (DECARM)	Yes
AUTO XON XOFF	No	Yes
Bits per character	No	Yes
Characters per line	Yes (DECCOLM)	Yes
Cursor	No	Yes
Cursor key mode	Yes (DECCKM)	No
Interlace	Yes (DECINLM)	Yes
New Line	Yes (LNM)	Yes
Keypress	No	Yes
Margin bell	No	Yes
Origin mode	Yes (DECOM)	No
Parity	No	Yes
Parity sense	No	Yes
Power	No	Yes
Receive speed	No	Yes
Screen	Yes (DECSCNM)	Yes
Scroll	Yes (DECSCLM)	Yes
Tabs	Yes (HTS/TBC)	Yes
Transmit speed	No	Yes
Wraparound	Yes (DECAWM)	Yes
# (shifted)	Yes (SCS)	Yes

Table 3-1
Machine States

* The appropriate control or escape sequence mnemonic is indicated in parentheses.

Key	Uppercase Code (octal)	Lowercase Code (octal)	Key	Uppercase Code (octal)	Lowercase Code (octal)
A	101	141	N	116	156
B	102	142	O	117	157
C	103	143	P	120	160
D	104	144	Q	121	161
E	105	145	R	122	162
F	106	146	S	123	163
G	107	147	T	124	164
H	110	150	U	125	165
I	111	151	V	126	166
J	112	152	W	127	167
K	113	153	X	130	170
L	114	154	Y	131	171
M	115	155	Z	132	172

Table 3-2
Alphabetic Key Codes

Nonalphabetic Keys – Each of the nonalphabetic keys can be used to generate two different codes. One code will be generated if neither SHIFT key is pressed. The other code will be generated if either or both of the SHIFT keys are down. Unlike the SHIFT LOCK key of a typewriter, the CAPS LOCK key does not affect these keys; it affects only the alphabetic keys. Table 3-3 shows the nonalphabetic keys and the codes they generate.

Table 3-3
Nonalphabetic Key Codes

Lowercase Character	Neither SHIFT Key Down (Octal)	Uppercase Character	Either or Both SHIFT Keys Down (Octal)
1	061	!	041
2	062	@	100
3	063	# or £	043
4	064	\$	044
5	065	%	045
6	066	^	136
7	067	&	046
8	070	*	052
9	071	(050
0	060)	051
—	055	—	137
=	075	+	053
	133		173
:	073	:	072
' (apostrophe)	047	"	042
, (comma)	054	<	074
. (period)	056	>	076
/	057	?	077
\	134		174
	140	~	176
	135		175

Function Keys – There are several keys on the keyboard which transmit control codes. Control codes do not produce displayable characters but are codes for functions. If these codes are received by the terminal, the VT100 will perform the associated function as shown in Table 3-4.

Table 3-4
Function Key Codes

Key	Octal Value of Code Sent or Received by VT100	Action The Terminal Would Take if Host Sent That Code
RETURN*	015	Carriage return function
LINEFEED	012	Line Feed
BACKSPACE	010	Backspace function
TAB	011	Tab function
SPACE BAR	040	Deposit a space on the screen erasing what was there before.
ESC	033	The initial delimiter of an escape sequence – interpret the following character string from the host as a command, rather than displaying it.
DELETE	177	Ignored by the VT100

* The RETURN key can be redefined so that it issues 015₈, 012₈, (carriage return – line feed). The New Line feature in SET-UP mode provides this capability.

NO SCROLL – When the NO SCROLL key is pressed it generates a single XOFF code, inhibits further scrolling and freezes the screen. When pressed again the same key generates XON. In practice, if the software recognizes XOFF, the host will stop transmitting until the NO SCROLL key is pressed again to allow scrolling. If the XOFF/XON feature is disabled (SET-UP function) the NO SCROLL key causes no action.

BREAK – Typing the BREAK key causes the transmission line to be forced to its zero state for 0.2333 seconds \pm 10 percent. If either SHIFT key is down, the time is increased to 3.5 seconds \pm 10 percent. Data Terminal Ready is also deasserted during this interval. At the conclusion of the 3.5 second interval Data Terminal Ready will again be asserted.

The SHIFT and BREAK keys typed together provide the long-break-disconnect function. Used with properly configured modems with RS-232-C levels, it will cause both the local and remote data sets to disconnect. For modems that are connected via the 20 mA current loop, issuing the long space may disconnect the remote data set only.

The CTRL and BREAK keys typed together cause the transmission of the answerback message.

The BREAK key does not function when the VT100 is in LOCAL mode.

Auto Repeating – All keys will auto repeat except: SET-UP, ESC, NO SCROLL, TAB, RETURN, and any key pressed with CTRL. Auto repeating works as follows: when a key is typed, its code(s) is sent once, immediately. If the key is held down for more than 1/2 second, the code(s) will be sent repeatedly at a rate of approximately 30 Hz (less if low transmit baud rates are used) until the key is released.

CTRL (Control) – The CTRL key is used in conjunction with other keys on the keyboard to generate control codes. If the CTRL key is held down when any of the keys in Table 3-5 are typed, the code actually transmitted is in the range 000₈-037₈.

Key Pressed with CTRL key down			Key Pressed with CTRL key down		
(shifted or unshifted)	Octal Code Transmitted	Function Mnemonic	(shifted or unshifted)	Octal Code Transmitted	Function Mnemonic
Space Bar	000	NUL	P	020	DLE
A	001	SOH	Q	021	DC1 or XON
B	002	STX	R	022	DC2
C	003	ETX	S	023	DC3 or XOFF
D	004	EOT	T	024	DC4
E	005	ENQ	U	025	NAK
F	006	ACK	V	026	SYN
G	007	BELL	W	027	ETB
H	010	BS	X	030	CAN
I	011	HT	Y	031	EM
J	012	LF	Z	032	SUB
K	013	VT	\	033	ESC
L	014	FF	/	034	FS
M	015	CR		035	GS
N	016	SO	~	036	RS
O	017	SI	?	037	US

Table 3-5
Control Codes Generated

Cursor Control – The keyboard also contains four keys labeled with arrows in each of four directions. These keys transmit control sequences. If the host echoes these control sequences back to the terminal, the cursor will move one character up, down, right, or left. Table 3-6 shows the control sequences generated by each key.

Table 3-6
Cursor Control Key Codes

Cursor Key, (Arrow)	VT52* Mode	ANSI Mode and Cursor Key Mode Reset	ANSI Mode and Cursor Key Mode Set
Up	ESC A	ESC [A	ESC O A
Down	ESC B	ESC [B	ESC O B
Right	ESC C	ESC [C	ESC O C
Left	ESC D	ESC [D	ESC O D

* See the control sequences section of this chapter for a complete discussion of these modes.

Auxiliary Keypad – The keys on the auxiliary keypad normally transmit the codes for the numerals, decimal point, minus sign, and comma. In addition, the key labeled ENTER transmits the same code as the RETURN key. The host cannot tell if these keys were typed on the auxiliary keypad as opposed to the corresponding keys on the main keyboard. Therefore, software which requires considerable numeric data entry need not be rewritten to use the keypad.

However, if software must be able to distinguish between pressing a key on the auxiliary keypad and pressing the corresponding key on the main keyboard, the host can give the terminal a command to place it in keypad application mode. In keypad application mode all keys on the auxiliary keypad are defined to give control sequences which may be used by the host as user-defined functions.

The codes sent by the auxiliary keypad for the four combinations of the VT52/ANSI mode and keypad numeric/application mode are shown in Tables 3-7 and 3-8. None of the keys are affected by pressing the SHIFT, CAPS LOCK, or CTRL keys.

Table 3-7
VT52 Mode
Auxiliary Keypad Codes

Key	Keypad Numeric Mode	Keypad Application Mode	Key	Keypad Numeric Mode	Keypad Application Mode
0	0	ESC ? p	– (dash)	– (dash)	ESC ? m
1	1	ESC ? q	, (comma)	, (comma)	ESC ? /
2	2	ESC ? r	. (period)	. (period)	ESC ? n
3	3	ESC ? s	ENTER	Same as RETURN key	ESC ? M
4	4	ESC ? t			
5	5	ESC ? u	PF1	ESC P	ESC P
6	6	ESC ? v	PF2	ESC Q	ESC Q
7	7	ESC ? w	PF3	ESC R	ESC R
8	8	ESC ? x	PF4	ESC S	ESC S
9	9	ESC ? y			

* The last character of this escape sequence is a lowercase L (154₈).

Key	Keypad Numeric Mode	Keypad Application Mode	Key	Keypad Numeric Mode	Keypad Application Mode
0	0	ESC O p	- (dash)	- (dash)	ESC O m
1	1	ESC O q	, (comma)	, (comma)	ESC O /*
2	2	ESC O r	. (period)	. (period)	ESC O n
3	3	ESC O s	ENTER	Same as RETURN key	ESC O M
4	4	ESC O t			
5	5	ESC O u	PF1	ESC O P	ESC O P
6	6	ESC O v	PF2	ESC O Q	ESC O Q
7	7	ESC O w	PF3	ESC O R	ESC O R
8	8	ESC O x	PF4	ESC O S	ESC O S
9	9	ESC O y			

* The last character of the escape sequence is a lowercase L (154).

Table 3-8
ANSI Mode
Auxiliary Keypad Codes

NOTE
In ANSI mode, if the codes are echoed back to the VT100, or if the terminal is in local mode, the last character of the sequence will be displayed on the screen; e.g., PF1 will display a "P."

Special Graphics Characters

If the Special Graphics set is selected, the graphics for ASCII codes 137₈ through 176₈ will be replaced according to Table 3-9. (See the SCS control sequence.)

Octal Code	Graphic with US or UK Set	Graphic with "Special Graphics" Set	Octal Code	Graphic with US or UK Set	Graphic with "Special Graphics" Set
5F 137	—	Blank	6F 157	o	— Horizontal line - Scan 1
60 140	\	♦ Diamond	90 160	p	— Horizontal line - Scan 3
61 141	a	● Checkerboard (error indicator)	91 161	q	— Horizontal line - Scan 5
62 142	b	H Horizontal tab	92 162	r	— Horizontal line - Scan 7
63 143	c	F Form Feed	93 163	s	— Horizontal line - Scan 9
64 144	d	R Carriage return	94 164	t	↖ Left "T"
65 145	e	L Line feed	95 165	u	↗ Right "T"
66 146	f	° Degree symbol	96 166	v	↓ Bottom "T"
67 147	g	± Plus/minus	97 167	w	↑ Top "T"
68 150	h	N New line	98 170	x	Vertical Bar
69 151	i	V Vertical tab	99 171	y	< Less than or equal to
6A 152	j	J Lower-right corner	9A 172	z	> Greater than or equal to
6B 153	k	U Upper-right corner	9B 173		π Pi
6C 154	l	F Upper-left corner	9C 174		≠ Not equal to
6D 155	m	L Lower-left corner	9D 175		£ UK pound sign
6E 156	n	+ Crossing lines	9E 176	~	· Centered dot

Table 3-9
Special Graphics Characters

NOTE 1: Codes 152₈–156₈, 161₈, and 164₈–170₈ are used to draw rectangular grids; each piece of this line drawing set is contiguous with others so that the lines formed are unbroken.

NOTE 2: Codes 157₈–163₈ give better vertical resolution than dashes and underlines when drawing graphs; using these segments 120 X 132 resolution may be obtained in 132 column mode with the Advanced Video Option installed.

TERMINAL CONTROL COMMANDS The VT100 has many control commands which cause it to take action other than displaying a character on the screen. In this way, the host can command the terminal to move the cursor, change modes, ring the bell, etc. The following paragraphs discuss the terminal control commands.

Control Characters Control characters have values of 000_8 – 037_8 , and 177_8 . The control characters recognized by the VT100 are shown in Table 3-10. All other control codes cause no action to be taken.

Control characters (codes 0_8 to 37_8 inclusive) are specifically excluded from the control sequence syntax, but may be embedded within a control sequence. Embedded control characters are executed as soon as they are encountered by the VT100. The processing of the control sequence then continues with the next character received. The exceptions are: If the character ESC occurs, the current control sequence is aborted, and a new one commences beginning with the ESC just received. If the character CAN (30_8) or the character SUB (32_8) occurs, the current control sequence is aborted. The ability to embed control characters allows the synchronization characters XON and XOFF to be interpreted properly without affecting the control sequence.

Table 3-10
Control Characters

Control Character	Octal Code	Action Taken
NUL	000	Ignored on input (not stored in input buffer; see full duplex protocol).
ENQ	005	Transmit answerback message.
BEL	007	Sound bell tone from keyboard.
BS	010	Move the cursor to the left one character position, unless it is at the left margin, in which case no action occurs.
HT	011	Move the cursor to the next tab stop, or to the right margin if no further tab stops are present on the line.
LF	012	This code causes a line feed or a new line operation. (See new line mode.)
VT	013	Interpreted as LF.
FF	014	Interpreted as LF.
CR	015	Move cursor to left margin on the current line.
SO	016	Invoke G1 character set, as designated by SCS control sequence.
SI	017	Select G0 character set, as selected by ESC(sequence.
XON	021	Causes terminal to resume transmission.
XOFF	023	Causes terminal to stop transmitting all codes except XOFF and XON.
CAN	030	If sent during a control sequence, the sequence is immediately terminated and not executed. It also causes the error character to be displayed.
SUB	032	Interpreted as CAN.
ESC	033	Introduces a control sequence.
DEL	177	Ignored on input (not stored in input buffer).

The VT100 is an upward and downward software compatible terminal; that is, previous DIGITAL video terminals have DIGITAL private standards for control sequences. The American National Standards Institute (ANSI) has since standardized escape and control sequences in terminals in documents X3.41-1974 and X3.64-1977.

The VT100 is compatible with both the previous DIGITAL standard and ANSI standards. Customers may use existing DIGITAL software designed around the VT52 or new VT100 software. The VT100 has a "VT52 compatible" mode in which the VT100 responds to control sequences like a VT52. In this mode, most of the new VT100 features cannot be used.

Throughout this section of the manual, references will be made to "VT52 mode" or "ANSI mode." These two terms are used to indicate the VT100's software compatibility. All new software should be designed around the VT100 "ANSI mode." Future DIGITAL video terminals will not necessarily be committed to VT52 compatibility.

Control Sequences

NOTE

The ANSI standards allow the manufacturer flexibility in implementing each function. This manual describes how the VT100 will respond to the implemented ANSI central function.

NOTE

*ANSI standards may be obtained by writing:
Sales Department
American National Standards Institute
1430 Broadway
New York, New York 10018*

Definitions

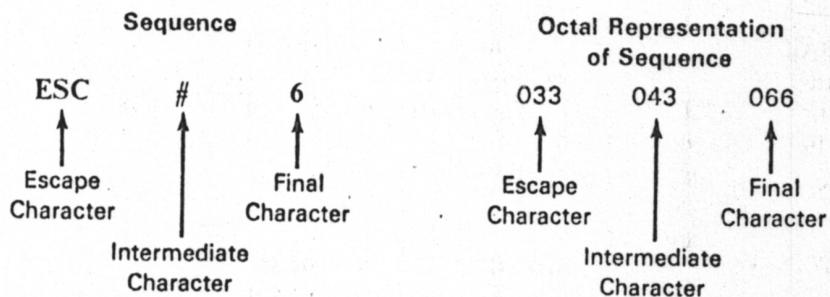
The following listing defines the basic elements of the ANSI mode control sequences. A more complete listing appears in Appendix A.

Valid ANSI Mode Control Sequences

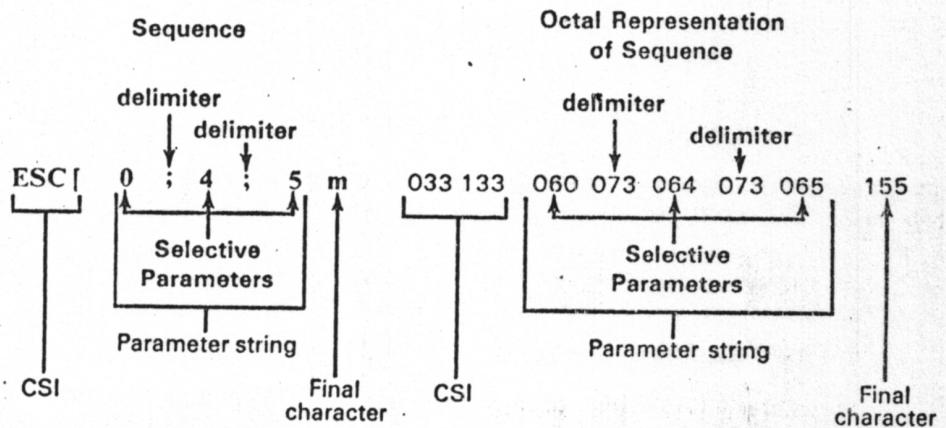
- Control Sequence Introducer (CSI) – An escape sequence that provides supplementary controls and is itself a prefix affecting the interpretation of a limited number of contiguous characters. In the VT100 the CSI is ESC[.
- Parameter – (1) A string of zero or more decimal characters which represent a single value. Leading zeros are ignored. The decimal characters have a range of 0 (60_8) to 9 (71_8). (2) The value so represented.
- Numeric Parameter – A parameter that represents a number, designated by Pn.
- Selective Parameter – A parameter that selects a subfunction from a specified list of subfunctions, designated by Ps. In general, a control sequence with more than one selective parameter causes the same effect as several control sequences, each with one selective parameter, e.g., CSI Psa; Psb; Psc F is identical to CSI Psa F CSI Psb F CSI Psc F.
- Parameter String – A string of parameters separated by a semicolon (73_8).
- Default – A function-dependent value that is assumed when no explicit value, or a value of 0, is specified.
- Final Character – A character whose bit combination terminates an escape or control sequence.

Examples:

1. Control sequence for double-width line (DECDWL) ESC # 6



2. Control sequence to turn off all character attributes, and then turn on underscore and blink attributes (SGR). ESC [0 ; 4 ; 5 m



Alternative sequences which will accomplish the same thing:

Sequence	Octal Representation of Sequence
a. ESC [; 4 ; m	033 133 073 064 073 065 155
b. ESC [m	033 133 155
ESC [4m	033 133 064 155
ESC [5m	033 133 065 155
c. ESC [0;04 ;005 m	033 133 060 073 060 064 073 060 060 065 155

Control Sequences

All of the following escape and control sequences are transmitted from the host computer to the VT100 unless otherwise noted. All of the control sequences are a subset of those specified in ANSI X 3.64 1977 and ANSI X-3.41 1974.

Cursor Position Report — VT100 to Host**CPR****ESC [Pn; Pn R***default value: 1*

The CPR sequence reports the active position by means of the parameters. This sequence has two parameter values, the first specifying the line and the second specifying the column. The default condition with no parameters present, or parameters of 0, is equivalent to a cursor at home position.

The numbering of lines depends on the state of the Origin Mode (DECOM).

This control sequence is solicited by a device status report (DSR) sent from the host.

Cursor Backward — Host to VT100 and VT100 to Host**CUB****ESC [Pn D***default value: 1*

The CUB sequence moves the active position to the left. The distance moved is determined by the parameter. If the parameter value is zero or one, the active position is moved one position to the left. If the parameter value is n, the active position is moved n positions to the left. If an attempt is made to move the cursor to the left of the left margin, the cursor stops at the left margin. *Editor Function*

Cursor Down — Host to VT100 and VT100 to Host**CUD****ESC [Pn B***default value: 1*

The CUD sequence moves the active position downward without altering the column position. The number of lines moved is determined by the parameter. If the parameter value is zero or one, the active position is moved one line downward. If the parameter value is n, the active position is moved n lines downward. If an attempt is made to move the cursor below the bottom margin, the cursor stops at the bottom margin. *Editor Function*

Cursor Forward — Host to VT100 and VT100 to Host**CUF****ESC [Pn C***default value: 1*

The CUF sequence moves the active position to the right. The distance moved is determined by the parameter. A parameter value of zero or one moves the active position one position to the right. A parameter value of n moves the active position n positions to the right. If an attempt is made to move the cursor to the right of the right margin, the cursor stops at the right margin. *Editor Function*

Cursor Position**CUP****ESC [Pn; Pn H***default value: 1*

The CUP sequence moves the active position to the position specified by the parameters. This sequence has two parameter values, the first specifying the line

position and the second specifying the column position. A parameter value of zero or one for the first or second parameter moves the active position to the first line or column in the display, respectively. The default condition with no parameters present is equivalent to a cursor to home action. In the VT100, this control behaves identically with its format effector counterpart, HVP. *Editor Function*

The numbering of lines depends on the state of the Origin Mode (DECOM).

CUU Cursor Up — Host to VT100 and VT100 to Host

ESC [Pn A

default value: 1

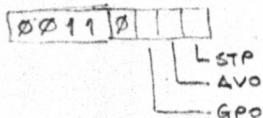
Moves the active position upward without altering the column position. The number of lines moved is determined by the parameter. A parameter value of zero or one moves the active position one line upward. A parameter value of n moves the active position n lines upward. If an attempt is made to move the cursor above the top margin, the cursor stops at the top margin. *Editor Function*

DA Device Attributes

ESC [Pn c

default value: 0

1. The host requests the VT100 to send a device attributes (DA) control sequence to identify itself by sending the DA control sequence with either no parameter or a parameter of 0.
2. Response to the request described above (VT100 to host) is generated by the VT100 as a DA control sequence with the numeric parameters as follows:



Option Present	Sequence Sent
No options	ESC [?1;0c
Processor option (STP)	ESC [?1;1c
Advanced video option (AVO)	ESC [?1;2c
AVO and STP	ESC [?1;3c
Graphics option (GPO)	ESC [?1;4c
GPO and STP	ESC [?1;5c
GPO and AVO	ESC [?1;6c
GPO, STP, and AVO	ESC [?1;7c

DECALN Screen Alignment Display (DEC Private)

ESC # 8

This command fills the entire screen area with uppercase Es for screen focus and alignment. This command is used by DEC manufacturing and Field Service personnel.

DECANM ANSI/VT52 Mode (DEC Private)

This is a private parameter applicable to set mode (SM) and reset mode (RM) control sequences. The reset state causes only VT52 compatible escape sequences to be interpreted and executed. The set state causes only ANSI "compatible" escape and control sequences to be interpreted and executed.

Auto Repeat Mode (DEC Private)**DECARM**

This is a private parameter applicable to set mode (SM) and reset mode (RM) control sequences. The reset state causes no keyboard keys to auto-repeat. The set state causes certain keyboard keys to auto-repeat.

Autowrap Mode (DEC Private)**DECAWM**

This is a private parameter applicable to set mode (SM) and reset mode (RM) control sequences. The reset state causes any displayable characters received when the cursor is at the right margin to replace any previous characters there. The set state causes these characters to advance to the start of the next line, doing a scroll up if required and permitted.

Cursor Keys Mode (DEC Private)**DECCKM**

This is a private parameter applicable to set mode (SM) and reset mode (RM) control sequences. This mode is only effective when the terminal is in keypad application mode (see DECKPAM) and the ANSI/VT52 mode (DECANM) is set (see DECANM). Under these conditions, if the cursor key mode is reset, the four cursor function keys will send ANSI cursor control commands. If cursor key mode is set, the four cursor function keys will send application functions.

Column Mode (DEC Private)**DECCOLM**

This is a private parameter applicable to set mode (SM) and reset mode (RM) control sequences. The reset state causes a maximum of 80 columns on the screen. The set state causes a maximum of 132 columns on the screen.

*& width***Double Height Line (DEC Private)****DEC DHL**

Top Half: ESC # 3

Bottom Half: ESC # 4

These sequences cause the line containing the active position to become the top or bottom half of a double-height double-width line. The sequences must be used in pairs on adjacent lines and the same character output must be sent to both lines to form full double-height characters. If the line was single-width single-height, all characters to the right of the center of the screen are lost. The cursor remains over the same character position unless it would be to the right of the right margin, in which case it is moved to the right margin.

NOTE

The use of double-width characters reduces the number of characters per line by half.

Double-Width Line (DEC Private)**ESC # 6****DEC DWL**

This causes the line that contains the active position to become double-width single-height. If the line was single-width single-height, all characters to the right of the screen are lost. The cursor remains over the same character position unless it would be to the right of the right margin, in which case, it is moved to the right margin.

NOTE

The use of double-width characters reduces the number of characters per line by half.

DECID Identify Terminal (DEC Private)**ESC Z**

This sequence causes the same response as the ANSI device attributes (DA). This sequence will not be supported in future DEC terminals, therefore, DA should be used by any new software.

DECINLM Interlace Mode (DEC Private)

This is a private parameter applicable to set mode (SM) and reset mode (RM) control sequences. The reset state (non-interlace) causes the video processor to display 240 scan lines per frame. The set state (interlace) causes the video processor to display 480 scan lines per frame. There is no increase in character resolution.

DECKPAM Keypad Application Mode (DEC Private)**ESC =**

The auxiliary keypad keys will transmit control sequences as defined in Tables 3-7 and 3-8.

DECKPNM Keypad Numeric Mode (DEC Private)**ESC >**

The auxiliary keypad keys will send ASCII codes corresponding to the characters engraved on the keys.

DECLL Load LEDs (DEC Private)**ESC [Ps q***default value: 0*

Load the four programmable LEDs on the keyboard according to the parameter(s).

Parameter	Parameter Meaning
0	Clear LEDs L1 through L4
1	Light L1
2	Light L2
3	Light L3
4	Light L4

LED numbers are indicated on the keyboard.

DECOM Origin Mode (DEC Private)

This is a private parameter applicable to set mode (SM) and reset mode (RM) control sequences. The reset state causes the origin to be at the upper-left character position on the screen. Line and column numbers are, therefore, independent of current margin settings. The cursor may be positioned outside the margins with a cursor position (CUP) or horizontal and vertical position (HVP) control.

The set state causes the origin to be at the upper-left character position within the margins. Line and column numbers are therefore relative to the current margin settings. The cursor is not allowed to be positioned outside the margins.

Perce que permitia . Mas nesse que o implementado é

The cursor is moved to the new home position when this mode is set or reset.

Lines and columns are numbered consecutively, with the origin being line 1, column 1.

Restore Cursor (DEC Private)

ESC 8

DECRC

This sequence causes the previously saved cursor position, graphic rendition, and character set to be restored.

Report Terminal Parameters

**ESC [<sol>; <par>; <nbits>; <xspeed>;
<rspeed>; <clkmul>; <flags>x**

DECREPTPARM

These sequence parameters are explained below in the DECREQTPARM sequence.

Request Terminal Parameters

ESC [<sol> x

DECREQTPARM

The sequence DECREPTPARM is sent by the terminal controller to notify the host of the status of selected terminal parameters. The status sequence may be sent when requested by the host or at the terminal's discretion. DECREPTPARM is sent upon receipt of a DECREQTPARM. On power-up or reset, the VT100 is inhibited from sending unsolicited reports.

The meanings of the sequence parameters are:

Parameter	Value	Meaning
<sol>	0 or none	This message is a request (DECREQTPARM) and the terminal will be allowed to send unsolicited reports. (Unsolicited reports are sent when the terminal exits the SET-UP mode.)
	1	This message is a request; from now on the terminal may only report in response to a request.
	2	This message is a report (DECREPTPARM).
	3	This message is a report and the terminal is only reporting on request.
<par>	1	No parity set
	4	Parity is set and odd
	5	Parity is set and even
<nbits>	1	8 bits per character
	2	7 bits per character

Parameter	Value	Meaning
<xspeed>, <rspeed>	0 8 16 24 32 40 48 56 64 72 80 88 96 104 112 120	50 75 110 134.5 150 200 300 600 1200 1800 2000 2400 3600 4800 9600 19200
		Bits per second
<clkmul>	1	The bit rate multiplier is 16.
<flags>	0-15	This value communicates the four switch values in block 5 of SET UP B, which are only visible to the user when an STP option is installed. These bits may be assigned for an STP device. The four bits are a decimal-encoded binary number.

DECSC Save Cursor (DEC Private)

ESC 7

This sequence causes the cursor position, graphic rendition, and character set to be saved. (See DECRC.)

DECSCLM Scrolling Mode (DEC Private)

This is a private parameter applicable to set mode (SM) and reset mode (RM) control sequences. The reset state causes scrolls to "jump" instantaneously. The set state causes scrolls to be "smooth" at a maximum rate of six lines per second.

DECSCNM Screen Mode (DEC Private)

This is a private parameter applicable to set mode (SM) and reset mode (RM) control sequences. The reset state causes the screen to be black with white characters. The set state causes the screen to be white with black characters.

DECSTBM Set Top and Bottom Margins (DEC Private)

ESC [Pn; Pn r

default values: see below

This sequence sets the top and bottom margins to define the scrolling region. The first parameter is the line number of the first line in the scrolling region; the second parameter is the line number of the bottom line in the scrolling region. Default is the entire screen (no margins). The minimum size of the scrolling region allowed is two lines, i.e., the top margin must be less than the bottom margin. The cursor is placed in the home position (see Origin Mode DECOM).

Single-width Line (DEC Private)**ESC # 5****DECSWL**

This causes the line which contains the active position to become single-width single-height. The cursor remains on the same character position. This is the default condition for all new lines on the screen.

Invoke Confidence Test**ESC [2 ; Ps y****DECTST**

Ps is the parameter indicating the test to be done. Ps is computed by taking the weight indicated for each desired test and adding them together. If Ps is 0, no test is performed but the VT100 is reset.

Test	Weight
-------------	---------------

Power up self-test (ROM check sum, RAM, NVR keyboard and AVO if installed)

1

Data Loop Back

2 (loop back connector required)

EIA modem control test

4 (loop back connector required)

Repeat Selected Test(s)
indefinitely (until failure or power off)

8

Device Status Report**ESC [Ps n****DSR***default value: 0*

Requests and reports the general status of the VT100 according to the following parameter(s).

Parameter	Parameter Meaning
------------------	--------------------------

- 0 Response from VT100 – Ready, No malfunctions detected (default)
- 3 Response from VT100 – Malfunction – retry
- 5 Command from host – Please report status (using a DSR control sequence)
- 6 Command from host – Please report active position (using a CPR control sequence)

DSR with a parameter value of 0 or 3 is always sent as a response to a requesting DSR with a parameter value of 5.

ED Erase In Display**ESC [Ps J***default value: 0*

This sequence erases some or all of the characters in the display according to the parameter. Any complete line erased by this sequence will return that line to single width mode. *Editor Function*

Parameter	Parameter Meaning
------------------	--------------------------

- | | |
|---|---|
| 0 | Erase from the active position to the end of the screen, inclusive (default) |
| 1 | Erase from start of the screen to the active position, inclusive |
| 2 | Erase all of the display – all lines are erased, changed to single-width, and the cursor does not move. |

EL Erase In Line**ESC [Ps K***default value: 0*

Erases some or all characters in the active line according to the parameter. *Editor Function*

Parameter	Parameter Meaning
------------------	--------------------------

- | | |
|---|---|
| 0 | Erase from the active position to the end of the line, inclusive (default) |
| 1 | Erase from the start of the <u>screen</u> to the active position, inclusive |
| 2 | Erase all of the line, inclusive |

*line?**(over / into)**single width
single height***HTS Horizontal Tabulation Set****ESC H**

Set one horizontal stop at the active position. *Format Effector*

HVP Horizontal and Vertical Position**ESC [Pn ; Pn f***default value: 1*

Moves the active position to the position specified by the parameters. This sequence has two parameter values, the first specifying the line position and the second specifying the column. A parameter value of either zero or one causes the active position to move to the first line or column in the display, respectively. The default condition with no parameters present moves the active position to the

home position. In the VT100, this control behaves identically with its editor function counterpart, CUP. The numbering of lines and columns depends on the reset or set state of the origin mode (DECOM). *Format Effector*

Index**IND****ESC D**

This sequence causes the active position to move downward one line without changing the column position. If the active position is at the bottom margin, a scroll up is performed. *Format Effector*

Line Feed/New Line Mode**LNM**

This is a parameter applicable to set mode (SM) and reset mode (RM) control sequences. The reset state causes the interpretation of the line feed (LF), defined in ANSI Standard X3.4-1977, to imply only vertical movement of the active position and causes the RETURN key (CR) to send the single code CR. The set state causes the LF to imply movement to the first position of the following line and causes the RETURN key to send the two codes (CR, LF). This is the New Line (NL) option.

This mode does not affect the index (IND), or next line (NEL) format effectors.

Next Line**NEL****ESC E**

This sequence causes the active position to move to the first position on the next line downward. If the active position is at the bottom margin, a scroll up is performed. *Format Effector*

Reverse Index**RI****ESC M**

Move the active position to the same horizontal position on the preceding line. If the active position is at the top margin, a scroll down is performed. *Format Effector*

Reset To Initial State**RIS****ESC c**

Reset the VT100 to its initial state, i.e., the state it has after it is powered on. This also causes the execution of the power-up self-test and signal INIT H to be asserted briefly.

Reset Mode**RM****ESC [Ps ;Ps ;...; Ps /***default value: none*

Resets one or more VT100 modes as specified by each selective parameter in the parameter string. Each mode to be reset is specified by a separate parameter. [See Set Mode (SM) control sequence.] (See Modes following this section.)

SCS Select Character Set

The appropriate G0 and G1 character sets are designated from one of the five possible character sets. The G0 and G1 sets are invoked by the codes SI and SO (shift in and shift out) respectively.

G0 Sets Sequence	G1 Sets Sequence	Meaning
ESC(A	ESC)A	United Kingdom Set
ESC(B	ESC)B	ASCII Set
ESC(0	ESC)0	Special Graphics
ESC(1	ESC)1	Alternate Character ROM Standard Character Set
ESC(2	ESC)2	Alternate Character ROM Special Graphics

NOTE
Additional information concerning the SCS escape sequence may be obtained in ANSI standard X3.41-1974.

The United Kingdom and ASCII sets conform to the "ISO international register of character sets to be used with escape sequences." The other sets are private character sets. Special graphics means that the graphic characters for the codes 137₈ to 176₈ are replaced with other characters. The specified character set will be used until another SCS is received.

SGR Select Graphic Rendition**ESC [Ps;...;Ps m***default value: 0*

Invoke the graphic rendition specified by the parameter(s). All following characters transmitted to the VT100 are rendered according to the parameter(s) until the next occurrence of SGR. *Format Effector*

Parameter Parameter Meaning

0	Attributes off
1	Bold or increased intensity
4	Underscore
5	Blink
7	Negative (reverse) image

All other parameter values are ignored.

Without the Advanced Video Option, only one type of character attribute is possible as determined by the cursor selection; in that case specifying either the underscore or the reverse attribute will activate the currently selected attribute. (See cursor selection in Chapter 1.)

SM Set Mode**ESC Ps;...;Ps h***default value: none*

Causes one or more modes to be set within the VT100 as specified by each selective parameter in the parameter string. Each mode to be set is specified by a separate parameter. A mode is considered set until it is reset by a reset mode (RM) control sequence.

Tabulation Clear

TBC

ESC [Pg]

default value: 0

Parameter Parameter Meaning

- 0 Clear the horizontal tab stop at the active position (the default case).
 - 3 Clear all horizontal tab stops.

Any other parameter values are ignored. *Format Effector*

The following is a list of VT100 modes which may be changed with set mode (SM) and reset mode (RM) controls.

ANSI Specified Modes

Parameter	Mode Mnemonic	Mode Function
0		Error (ignored)
20	LNM	Line feed new line mode

DEC Private Modes

If the first character in the parameter string is ? (77₈), the parameters are interpreted as DEC private parameters according to the following:

Parameter	Mode Mnemonic	Mode Function
0		Error (ignored)
1	DECCKM	Cursor key
2	DECANM	ANSI/VT52
3	DECCOLM	Column
4	DECSCLM	Scrolling
5	DECSCNM	Screen
6	DECOM	Origin
7	DECAWM	Auto wrap
8	DECARM	Auto repeating
9	DECINLM	Interlace

Any other parameter values are ignored

The following modes, which are specified in the ANSI X3.64-1977 standard, may be considered to be permanently set, permanently reset, or not applicable, as noted. Refer to that standard for further information concerning these modes.

Mode	Mnemonic	Mode Function	State
CRM		Control representation	Reset
EBM		Editing boundary	Reset
ERM		Erasure	Set
FEAM		Format effector action	Reset
FETM		Format effector transfer	Reset

Mode Mnemonic	Mode Function	State
GATM	Guarded area transfer	NA
HEM	Horizontal editing	NA
IRM	Insertion-replacement	Reset
KAM	Keyboard action	Reset
MATM	Multiple area transfer	NA
PUM	Positioning unit	Reset
SATM	Selected area transfer	NA
SRTM	Status reporting transfer	Reset
TSM	Tabulation stop	Reset
TTM	Transfer termination	NA
VEM	Vertical editing	NA

**Valid VT52
Mode Control
Sequences**

Cursor Up

ESC A

Move the active position upward one position without altering the horizontal position. If an attempt is made to move the cursor above the top margin, the cursor stops at the top margin.

Cursor Down

ESC B

Move the active position downward one position without altering the horizontal position. If an attempt is made to move the cursor below the bottom margin, the cursor stops at the bottom margin.

Cursor Right

ESC C

Move the active position to the right. If an attempt is made to move the cursor to the right of the right margin, the cursor stops at the right margin.

Cursor Left

ESC D

Move the active position one position to the left. If an attempt is made to move the cursor to the left of the left margin, the cursor stops at the left margin.

NOTE

The special graphics characters in the VT100 are different from those in the VT52.

Enter Graphics Mode

ESC F

Causes the special graphics character set to be used.

Exit Graphics Mode**ESC G**

This sequence causes the standard ASCII character set to be used.

Cursor to Home**ESC H**

Move the cursor to the home position.

Reverse Line Feed**ESC I**

Move the active position upward one position without altering the column position. If the active position is at the top margin, a scroll down is performed.

Erase to End of Screen**ESC J**

Erase all characters from the active position to the end of the screen. The active position is not changed.

Erase to End of Line**ESC K**

Erase all characters from the active position to the end of the current line. The active position is not changed.

Direct Cursor Address**ESC Y line column**

Move the cursor to the specified line and column. The line and column numbers are sent as ASCII codes whose values are the number plus 037₈; e.g., 040₈ refers to the first line or column, 050₈ refers to the eighth line or column, etc.

Identify**ESC Z**

This sequence causes the terminal to send its identifier escape sequence to the host. This sequence is:

ESC / Z.**Enter Alternate Keypad Mode****ESC =**

The optional auxiliary keypad keys will send unique identifiable escape sequences for use by applications programs.

NOTE

Information regarding options must be obtained in ANSI mode, using the device attributes (DA) control sequence.

Exit Alternate Keypad Mode**ESC >**

The optional auxiliary keypad keys send the ASCII codes for the functions or characters engraved on the key.

Enter ANSI Mode**ESC <**

All subsequent escape sequences will be interpreted according to ANSI Standards X3.64-1977 and X3.41-1974. The VT52 escape sequence designed in this section will not be recognized.

Control Sequence

Summary The following is a summary of the VT100 control sequences.

ANSI Compatible**Mode Cursor Movement Commands**

Cursor up	ESC [Pn A
Cursor down	ESC [Pn B
Cursor forward (right)	ESC [Pn C
Cursor backward (left)	ESC [Pn D
Direct cursor addressing	ESC [Pl; Pc H† or ESC [Pl; Pc f†
Index	ESC D
New line	ESC E
Reverse index	ESC M
Save cursor and attributes	ESC 7
Restore cursor and attributes	ESC 8

†Pl = line number; Pc = column number.

Pn refers to a decimal parameter expressed as a string of ASCII digits. Multiple parameters are separated by the semicolon character (073g). If a parameter is omitted or specified to be 0 the default parameter value is used. For the cursor movement commands, the default parameter value is 1.

Line Size (Double-Height and Double-Width) Commands

Change this line to double-height top half	ESC #3
Change this line to double-height bottom half	ESC #4
Change this line to single-width single-height	ESC #5
Change this line to double-width single-height	ESC #6

Character Attributes**ESC [Ps;Ps;Ps;...;Ps m**

Ps refers to a selective parameter. Multiple parameters are separated by the semicolon character (073g). The parameters are executed in order and have the following meanings:

0 or None	All Attributes Off
1	Bold on
4	Underscore on
5	Blink on
7	Reverse video on

Any other parameter values are ignored.

Erasing

From cursor to end of line	ESC [K or ESC [0 K
From beginning of line to cursor	ESC [1 K
Entire line containing cursor	ESC [2 K
From cursor to end of screen	ESC [J or ESC [0 J
From beginning of screen to cursor	ESC [1 J
Entire screen	ESC [2 J

Programmable LEDs

ESC [Ps;Ps;...Ps q

Ps are selective parameters separated by semicolons (073₈) and executed in order, as follows:

0 or None	All LEDs Off
1	L1 On
2	L2 On
3	L3 On
4	L4 On

Any other parameter values are ignored.

Character Sets (G0 and G1 Designators)

The G0 and G1 character sets are designated as follows:

Character set	G0 designator	G1 designator
United Kingdom (UK)	ESC (A	ESC) A
United States (USASCII)	ESC (B	ESC) B
Special graphics characters and line drawing set	ESC (0	ESC) 0
Alternate character ROM	ESC (1	ESC) 1
Alternate character ROM special graphics characters	ESC (2	ESC) 2

Scrolling Region

ESC [Pt ; Pb r

Pt is the number of the top line of the scrolling region; Pb is the number of the bottom line of the scrolling region and must be greater than Pt.

Tab Stops:

Set tab at current column	ESC H
Clear tab at current column	ESC [g or ESC [0 g
Clear all tabs	ESC [3 g

Modes

Mode Name	To Set		To Reset	
	Mode	Sequence	Mode	Sequence
Line feed/new line	New line	ESC [20h	Line feed	ESC [20/*
Cursor key mode	Application	ESC [?1h	Cursor	ESC [?1/*
ANSI/VT52 mode	ANSI	N/A	VT52	ESC [?2/*
Column mode	132 Col	ESC [?3h	80 Col	ESC [?3/*
Scrolling mode	Smooth	ESC [?4h	Jump	ESC [?4/*
Screen mode	Reverse	ESC [?5h	Normal	ESC [?5/*
Origin mode	Relative	ESC [?6h	Absolute	ESC [?6/*
Wraparound	On	ESC [?7h	Off	ESC [?7/*
Auto repeat	On	ESC [?8h	Off	ESC [?8/*
Interlace	On	ESC [?9h	Off	ESC [?9/*
Keypad mode	Application	ESC =	Numeric	ESC >

* The last character of the sequence is a lowercase L (154₈).

Reports**Cursor Position Report**

Invoked by ESC [6 n
 Response is ESC [P1 ; Pe R †
 †P1 = line number; Pe = column number.

Status Report

Invoked by ESC [5 n
 Response is ESC [0 n (terminal ok)
 ESC [3 n (terminal not ok)

What Are You

Invoked by ESC [c
 or
 Response is ESC [0 c
 ESC [?1 ; Ps c

Ps is the "option present" parameter with the following meaning:

Ps	Meaning
0	Base VT100, no options
1	Processor option (STP)
2	Advanced video option (AVO)
3	AVO and STP
4	Graphics processor option (GPO)
5	GPO and STP
6	GPO and AVO
7	GPO, STP, and AVO

Alternately invoked by ESC Z (not recommended). Response is the same.

Reset

Reset causes the power-up reset routine to be executed.

ESC c**Confidence Tests**

Fill Screen with "Es"

ESC # 8

Invoke Test(s)

ESC [2 ; Ps y

Ps is the parameter indicating the test to be done and is a decimal number computed by taking the "weight" indicated for each desired test and adding them together.

Test	Weight
Power-up self test (ROM checksum, RAM, NVR, keyboard and AVO if installed)	1
Data Loop Back	2 (loop back connector required)
EIA modem control test	4 (loop back connector required)
Repeat selected test(s) indefinitely (until failure or power off)	8

The following is a summary of the VT100 control sequences.

VT52 Compatible Mode

Cursor Up	ESC A
Cursor Down	ESC B
Cursor Right	ESC C
Cursor Left	ESC D
Select Special Graphics character set	ESC F
Select ASCII character set	ESC G
Cursor to home	ESC H
Reverse line feed	ESC I
Erase to end of screen	ESC J
Erase to end of line	ESC K
Direct cursor address	ESC Y1 c
Identify	ESC Z
Enter alternate keypad mode	ESC =
Exit alternate keypad mode	ESC >
Enter ANSI mode	ESC <

NOTE 1: Line and column numbers for direct cursor address are single character codes whose values are the desired number plus 37₈. Line and column numbers start at 1.

NOTE 2: Response to ESC Z is ESC / Z

NOTATION

I - An intermediate character in an escape sequence or a control sequence, where I is from 40_8 to 57_8 inclusive. ($0x20 \sim 0x2F$)

F - A Final character in:

1. An escape sequence, where F is from 60_8 to 176_8 inclusive. ($0x30 \sim 0x7E$)
2. A control sequence, where F is from 100_8 to 176_8 inclusive. ($0x40 \sim 0x7E$)

Pn - A numeric parameter in a control sequence, where Pn is a string of zero or more characters from 60_8 to 71_8 inclusive. ($0x30 \sim 0x39$)

Ps - A variable number of selective parameters in a control sequence, with each selective parameter separated from the other by 73_8 . Ps is a string of zero or more characters from 60_8 to 71_8 inclusive and 73_8 .

Example: The format of an escape sequence as defined in American National Standard X 3.41-1974 and used in the VT100 is:

ESC I . . . I F

Where:

1. ESC is the introducer control character (33_8) that is named escape.
2. I . . . I are the intermediate bit combinations that may or may not be present. I characters are bit combination 40_8 to 57_8 inclusive in both 7- and 8-bit environments.
3. F is the final character. F characters are bit combinations 60_8 to 176_8 inclusive in escape sequences in both 7- and 8-bit environments.
4. The occurrence of characters in the inclusive ranges of 0_8 to 37_8 within an escape or control sequence, is technically an error condition whose recovery is to execute immediately the function specified by the character and then continue with the escape sequence execution. The exceptions are: If the character ESC occurs, the current escape sequence is aborted, and a new one commences, beginning with the ESC just received. If the character CAN (30_8) or the character SUB (32_8) occurs, the current escape sequence is aborted.