Rainbow™
100

Terminal Emulation Manual

digital equipment corporation

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PREFACE

INTENDED READER

This guide assumes you are an application programmer.

The information in this guide describes escape sequences and codes used by the Rainbow 100's terminal emulation.

GUIDE ORGANIZATION

Chapter 1   shows the characters transmitted by each terminal key.

Chapter 2   describes how the terminal processes received characters. It also describes the use of control functions. Control functions control the display, processing, and transmission of characters received by the terminal. The application programmer uses the chapter when creating applications software for the terminal.

Appendix A   summarizes the character codes and control functions used to program the terminal.

Appendix B   describes the ANSI code extension techniques used to create escape and control sequences.

Appendix C   describes the differences between the Rainbow 100 computer and a VT102 terminal.

Appendix D .   contains the international language keyboards

CHAPTER 1

TRANSMITTED CHARACTERS

INTRODUCTION

This chapter describes the characters generated by the Rainbow 100 keyboard. The keys are divided into four groups: standard keys, editing and cursor keys, function keys, and numeric keypad keys.

A distinction is also made between console mode and terminal mode on the Rainbow 100 computer.

STANDARD KEYS

The keyboard generates American Standard Code for Information Interchange (ASCII) characters. The standard keys (Figure 1) generate lowercase ASCII characters when neither **Shift** nor **Lock** is down. These keys generate uppercase ASCII characters when either **Shift** or **Lock** is down. **Lock** does not affect the nonalphabetic keys.
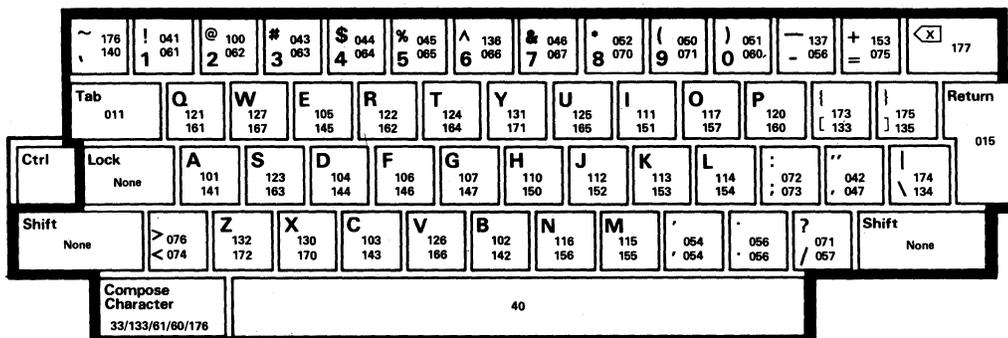
Figure 1: Standard Key Codes

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Figure 2: Editing and Cursor Keys

Table 1: Rainbow 100 Editing and Cursor Keys

Key	Characters Generated
Find	ESC [1 ~
Insert Here	ESC [2 ~
Remove	ESC [3 ~
Select	ESC [4 ~
Prev Screen	ESC [5 ~
Next Screen	ESC [6 ~
Up Arrow	ESC [A
Down Arrow	ESC [B
Right Arrow	ESC [C
Left Arrow	ESC [D

Cursor Control Keys

In ANSI mode the cursor keys generate either application or cursor
control sequences. Cursor key mode selects the type of sequence.

The cursor keys generate ANSI cursor commands. The computer selects
both cursor key mode and keypad mode. See Cursor Key Character
Selection in Chapter 2 for more information.

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In VT52 mode, the cursor keys only generate VT52 cursor control sequences. Table 2 lists the ANSI and VT52 compatible cursor key characters.

Table 2: Cursor Control Key Codes

| Cursor Keys | ANSI Mode | | VT52 Mode |
	Cursor Key Mode Reset	Cursor Key Mode Set	
	ESC [A 033 133 101	ESC O A 033 117 101	ESC A 033 101
	ESC [B 033 133 102	ESC O B 033 117 102	ESC B 033 102
	ESC [C 033 133 103	ESC O C 033 117 103	ESC C 033 103
	ESC [D 033 133 104	ESC O D 033 117 104	ESC D 033 104

Control Character Keys

Table 3 lists the control characters generated by the keyboard. You can generate control characters in two ways.

● Hold down **Ctrl** and press any key in Table 3 under the Key Pressed column.

● Press any key in Table 3 under the Dedicated Key column. These dedicated keys generate control characters without the use of **Ctrl**.

Different computer systems may use each control character differently.

NOTE

The Rainbow 100 computer generates some control characters differently than previous DIGITAL terminals. Table 4 lists the changes.

Table 3: Control Codes Generated

Control Character	Mnemonic		Transmitted Code (Octal)	Key Pressed	Dedicated Key
Null	NUL		000	Space Bar	–
Start of heading	SOH		001	A	–
Start of text	STX		002	B	–
End of text	ETX		003	C	–
End of transmission	EOT		004	D	–
Enquire	ENQ		005	E	–
Acknowledge	ACK		006	F	–
Bell	BEL		007	G	–
Back space	BS		010	H	Back Space
Horizontal tabulation	HT		011	I	Tab
Line Feed	LF		012	J	Line Feed
Vertical tabulation	VT		013	K	–
Form feed	FF		014	L	–
Carriage return	CR		015	M	Return*
Shift out	SO		016	N	–
Shift in	SI		017	O	–
Data link escape	DLE		020	P	–
Device control 1	DC1	(XON)	021	Q	–
Device control 2	DC2		022	R	–
Device control 3	DC3	(XOFF)	023	S	–
Device control 4	DC4		024	T	–
Negative acknowledge	NAK		025	U	–
Synchronous idle	SYN		026	V	–
End of transmission block	ETB		027	W	–
Cancel previous word or character	CAN		030	X	–
End of medium	EM		031	Y	–
Substitute	SUB		032	Z	–
**Escape	ESC		033	[unshifted	Escape
**File separator	FS		034	/ unshifted	–
**Group separator	GS		035	] unshifted	–
**Record separator	RS		036	~ shifted	–
**Unit separator	US		037	? shifted	–
Delete	DEL		177		Delete

*In numeric keypad mode (application keypad mode off), you can change the **Enter** character code with the line feed/new line feature. When off, this feature causes **Enter** to generate a single control character (CR, octal 015). When on, this feature causes Enter to generate two characters (CR, octal 015 and LF, octal 012).

**Shift/unshift has an effect on these control characters.

Table 4: Rainbow 100 Key Changes

Control Code	VT102	Previous Terminals	Rainbow 100 Computer
NUL (octal 000)	Ctrl Space Bar	Ctrl @	Ctrl Space Bar
RS (octal 036)	Ctrl ~	Ctrl ^	Ctrl Shift ~
US (octal 037)	Ctrl ?	Ctrl -	Ctrl Shift ?
ESC	Ctrl [		Ctrl Unshifted [
FS	Ctrl /		Ctrl Unshifted /
GS	Ctrl]		Ctrl Unshifted]

FUNCTION KEYS

The function keys (Figure 3) generate characters used by the computer software or communication system. The following paragraphs describe the function keys.

Break

In terminal mode this key generates a break defined by the computer system when the break enable feature is on. This feature does not affect other key sequences using **Break**.

Hold down **Shift** and press **Break** to generate a long break disconnect. A long break disconnect usually disconnects the terminal from the communication line.

Hold down **Ctrl** and press **Break** to transmit the answerback message. In console node this key is not functional.
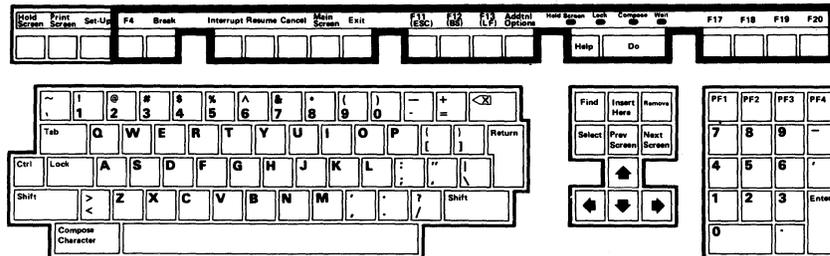
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Figure 3: Function Keys

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Table 5: Rainbow 100 Function Keys

Key	Characters Generated
F4	ESC [14 ~
Interrupt	ESC [17 ~
Resume	ESC [18 ~
Cancel	ESC [19 ~
Main Screen	ESC [20 ~
Exit	ESC [21 ~
(ESC)	ESC
(BS)	BS
(LF)	LF
Addtnl Options	ESC [26 ~
Help	ESC [28 ~
Do	ESC [29 ~
F17	ESC [31 ~
F18	ESC [32 ~
F19	ESC [33 ~
F20	ESC [34 ~
Compose	ESC [10 ~

NOTE

The Compose key escape sequence is
reserved for future use. Any software
using this may not run on future
operating systems and hardware.

NUMERIC KEYPAD KEYS

These keys generate characters selected by the ANSI/VT52 feature and alternate (application) keypad mode. The computer selects application keypad mode. See Keypad Character Selection in Chapter 2 for more information.

In numeric keypad mode, the numeric keypad generates the numeric, comma, period, and minus sign characters used by the main keyboard. In application keypad mode, the numeric keypad generates escape sequences. Table 6 lists the characters generated by the numeric keypad.

Table 6: Keypad Codes

| | ANSI Mode | | VT52 Mode | |
Key	Numeric Keypad Mode	Application Keypad Mode	Numeric Keypad Mode	Application Keypad Mode
0	0 060	ESC O p 033 117 160	0 060	ESC ? p 033 077 160
1	1 061	ESC O q 033 117 161	1 060	ESC ? q 033 077 161
2	2 062	ESC O r 033 117 162	2 062	ESC ? r 033 077 162
3	3 063	ESC O s 033 117 163	3 063	ESC ? s 033 077 163
4	4 064	ESC O t 033 117 164	4 064	ESC ? t 033 077 164
5	5 065	ESC O u 033 117 165	5 065	ESC ? u 033 077 165
6	6 066	ESC O v 033 117 166	6 066	ESC ? v 033 077 166
7	7 067	ESC O w 033 117 167	7 067	ESC ? w 033 077 167
8	8 070	ESC O x 033 117 170	8 070	ESC ? x 033 077 170
9	9 071	ESC O y 033 117 171	9 071	ESC ? y 033 077 171

Table 6 (Cont.): Keypad Codes

	ANSI Mode		VT52 Mode	
Key	Numeric Keypad Mode	Application Keypad Mode	Numeric Keypad Mode	Application Keypad Mode
-	-(minus) 055	ESC O m 033 117 155	-(minus) 055	ESC ? m 033 077 155*
,	,(comma) 054	ESC O l 033 117 154	,(comma) 054	ESC ? l 033 077 054*
.	.(period) 056	ESC O n 033 117 156	.(period) 056	ESC ? n 033 077 156
Enter+	CR or CR LF 015 015 012	ESC O M 033 117 115	CR or CR LF 015 015 012	ESC ? M 033 077 115
PF1	ESC O P 033 117 120	ESC O P 033 117 120	ESC P 033 120	ESC P 033 120
PF2	ESC O Q 033 117 121	ESC O Q 033 117 121	ESC Q 033 121	ESC Q 033 121
PF3	ESC O R 033 117 122	ESC O R 033 117 122	ESC R 033 122	ESC R 033 122
PF4	ESC O S 033 117 123	ESC O S 033 117 123	ESC S 033 123	ESC S 033 123*

*These sequences are not generated by the VT52 terminal.

+In numeric keypad mode (application keypad mode off), you can change the **Enter** character code with the line feed/new line feature. When off, this feature causes **Enter** to generate a single control character (CR, octal 015). When on, this feature causes **Enter** to generate two characters (CR, octal 015 and LF, octal 012).

CHAPTER 2

RECEIVED CHARACTER PROCESSING

GENERAL

This chapter describes how the Rainbow 100 computer processes received characters. There are two types of received characters, display characters and control functions. The chapter covers all display characters and control functions used by the Rainbow 100 computer.

RECEIVED CHARACTERS

The Rainbow 100 computer processes characters according to American National Standards Institute (ANSI) standards X3.64-1979, X3.4-1977, and X3.41-1974. ANSI standard X3.4 defines the American Standard Code for Information Interchange (ASCII). Table 7 shows each ASCII character with its binary, octal, decimal, and hexadecimal values. ASCII corresponds to the International Standards Organization (ISO) Standard 646 and International Telegraph and Telephone Consultive Committee (CCITT) Alphabet 5.

The Rainbow 100 computer processes a received character based on character types defined by ANSI. Position in the ASCII table tells you whether a character is a control function or display character. The ASCII table is 8 columns wide and 16 rows long. The control functions are in columns 0 and 1. The display characters are in columns 2 through 7. In addition to the characters shown in Table 7, the Rainbow 100 computer displays the 8-bit character shown in Table 8.

CONSOLE MODE TABLES

In terminal mode, however, it depends on the communication port's configurations. In order to correctly process the 8-bit characters in Table 8, you must have the communication port parameter set to 8 data bits. If it is set to 7 data bits the high order bit is set to zero and the character is processed as though in Table 7.

Table 7: 7-bit US/UK ASCII Characters

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

NOTE: * DEPENDS ON THE CHARACTER SET SELECTED; U.S.=# U.K.= £

← C0 CODES → ← GL CODES (ASCII GRAPHICS) →

KEY

CHARACTER	ESC	33 OCTAL
		27 DECIMAL
		1B HEX

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Table 8: 8-bit Control and Displayable Characters

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

Header bits key: b8 b7 BITS / b6 / b5 / b4 b3 b2 b1

|←— C1 CODES —→|←———————— GR CODES ————————→|
(DEC SUPPLEMENTAL GRAPHICS)

KEY

CHARACTER	Æ	306	OCTAL
		198	DECIMAL
		C6	HEX

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DISPLAY CHARACTERS

Display characters are received characters displayed on the screen. The actual character displayed depends on the character set selected. You select the character set by using control functions. See Character Sets and Selection in this chapter for more information.

CONTROL CHARACTERS

These single-character control functions start, modify, or stop terminal operations; the control functions are not displayed. Table 9 defines the control characters recognized by the terminal. All other control characters are ignored.

Each control character in this chapter has a mnemonic, listed in Table 9. The mnemonic is an abbreviation of the control character name.

Table 9: Control Characters Recognized by Rainbow 100 Computer

Character	Mnemonic	Octal Code	Function
Null	NUL	000	Ignored when received (not stored in input buffer) and used as a fill character
Enquire	ENQ	005	Transmits answerback message
Bell	BEL	007	Generates bell tone.
Backspace	BS	010	Moves cursor to the left one character position; if cursor is at left margin, no action occurs.
Horizontal tab	HT	011	Moves cursor to next tab stop, or to right margin if there are no more tab stops.
Line Feed	LF	012	Causes a line feed or a new operation. (See Line Feed/New Line). Also causes printing in terminal mode only if auto print operation is selected.
Vertical tab	VT	013	Processed as LF.
Form feed	FF	014	Processed as LF.
Carriage return	CR	015	Moves cursor to left margin on current line.
Shift out	SO	016	Selects G1 character set designated by a select character set sequence.
Shift in	SI	017	Selects G0 character set designated by a select character set sequence.

Table 9 (Cont.): Control Characters Recognized by Rainbow 100 Computer

Character	Mnemonic	Octal Code	Function
Device control 1	DC1	021	Processed as XON. DC1 causes the Rainbow 100 computer to resume (if previously stopped by XOFF) transmitting characters only in terminal mode.
Device control 3	DC3	023	Processed as XOFF. DC3 causes the Rainbow 100 computer to stop transmitting all characters except XOFF and XON.
Cancel	CAN	030	If received during an escape or control sequence, cancels the sequence and displays substitution character (cursor).
Substitute	SUB	032	Processed as CAN.
Escape	ESC	033	Processed as an escape sequence introducer.
Index	IND	204	Processes a LF.
Next line	NEL	205	Processes a CR LF sequence.
Horizontal	HTS	210	Sets a horizontal tab at the current cursor location.
Reverse index	RI	215	Equals a reverse line feed.
Single shift 2	SS2	216	Selects G2 character set for the next character only.
Single shift 3	SS3	217	Selects G3 character set for the next character only.
Control sequence introducer	CSI	233	Equals an ESC [.

ESCAPE AND CONTROL SEQUENCES

Escape and control sequences provide additional control functions not provided by the single-character controls of the character set. These multiple-character sequences are not displayed; instead, they control Rainbow 100 computer operation. Escape and control sequences are defined by ANSI X3.41-1977 and X3.64-1979. See Appendix B for more information about sequences and sequence formats.

The ANSI-compatible control functions in this user guide have a mnemonic assigned by ANSI. If the control function is an ANSI private control function (defined by DIGITAL), the mnemonic begins with DEC. The escape and control sequences shown here use ASCII characters. You must type the characters in the sequences exactly as shown (upper or lowercase). The text provides the octal equivalent of each character in the sequence as a second reference. See Table 7 for decimal and hexadecimal representations.

The following section groups sequences by software compatibility (ANSI or VT52) and function (Table 10). Appendix A summarizes all control functions.

Error Recovery

Current standards do not specify the action performed when the terminal receives a control function with an error. Errors are incorrect parameters; invalid control functions. The terminal usually recovers from these errors by performing as much of the function as possible. The specific error recovery procedures are as follows:

- Unrecognized control functions are usually ignored.

- Unsupported control functions (valid control functions not listed in this user guide) are usually ignored, but may produce unexpected results.

- If a 7-bit control character from Table 7 is received within a sequence, the terminal performs the function of the control character, followed by the function of the sequence.

- If cancel (CAN, octal 030) or substitute (SUB octal 032) is received during a sequence, the current sequence is aborted. The terminal displays the substitute character, followed by characters in the sequence received after CAN or SUB.

- If an 8-bit control character from Table 8 is received, the current escape sequence is aborted, and the function of the character is performed.

- If an 8-bit displayable character is received from Table 8, the current escape sequence continues and the 8-bit character is displayed.

Ansi-Compatible Sequences

```
Set-Up Feature and Mode Selection
      Set mode (SM) and reset mode (RM)
ANSI/VT52 Compatibility
      ANSI/VT52 mode (DECANM)
Scrolling
      Scroll mode (DECSCLM)
Scrolling Region
      Set top and bottom margins (DECSTBM)
Origin
      Origin mode (DECOM)
Cursor Positioning
      Cursor up (CUU)
      Cursor down (CUD)
      Cursor forward (CUF)
      Cursor backward (CUB)
      Cursor position (CUP)
      Horizontal and vertical position (HVP)
      Index (IND)
      Reverse index (RI)
      Next line (NEL)
      Save cursor (DECSC)
      Restore cursor (DECRC)
Columns Per Line
      Column mode (DECCOLM)
Auto Wrap
      Auto wrap mode (DECAWM)
Screen Background
      Screen mode (DECSCNM)
Line Feed/New Line
      Line Feed/New Line mode (LNM)
Keyboard Action
      Keyboard action mode (KAM)
Auto Repeat
      Auto repeat mode (DECARM)
*Local Echo
      Send-receive mode (SRM)
Cursor Key Character Selection
      Cursor key mode (DECCKM)
Keypad Character Selection
      Numeric keypad (DECKPNM)
      Application keypad (DECKPAM)
Character Sets and Selection
      Select character set (SCS)
      Single shift 2 (SS2)
      Single shift 3 (SS3)
Character Attributes
      Select graphic rendition (SGR)
Tab Stops
      Horizontal tab sets (HTS)
      Tabulation clear (TBC)
Line Attributes
      Double-height line (DECDHL)
      Single-width line (DECSWL)
      Double-width line (DECDWL)
```

Table 10 (Cont.): Escape and Control Sequences

Ansi-Compatible Sequences

Erasing
    Delete character (DCH)
    Insert line (IL)
    Delete line (DL)
Inserting and Replacing Characters
    Insertion-replacement mode (IRM)
*Printing
    Media copy (MC)
*Printer Extent
    Printer extent mode (DECPEX)
*Print Termination Character
    Printer form feed mode (DECPFF)
Reports
    Device status report (DSR)
    Cursor position report (CPR)
    Device attributes (DA)
    Identify terminal (DECID)
Reset
    Reset to initial state (RIS)
Adjustments
    Screen alignment display (DECALN)
Modes
ANSI/VT52 Compatibility
    ANSI mode (DECANM)
Cursor Positioning
    Cursor up
    Cursor down
    Cursor right
    Cursor left
    Cursor to home
    Direct cursor address
    Reverse line feed
Keypad Character Selection
    Application keypad mode
    Numeric keypad mode
Character Sets and Selection
    Enter graphics mode
    Exit graphics mode
Erasing
    Erase to end of line
    Erase to end of screen
*Printing
    Auto print
    Print controller
    Print cursor line
    Print screen
Reports
    Identify

*Only in terminal mode.

ANSI-Compatible Sequences

ANSI-compatible sequences meet ANSI standards X3.64-1979 and X3.41-1974. This section describes the ANSI control functions used by the terminal. You can select ANSI compatibility from the keyboard in Set-Up or have the computer use a sequence. (See VT52-Compatible Sequences in this chapter).

Set-Up Feature and Mode Selection - Set-Up features change how the Rainbow 100 computer operates. You can select these features from the keyboard or through escape sequences.

Some Set-Up features are modes. A mode affects Rainbow 100 computer operation. The Rainbow 100 computer uses the selected mode until you or an escape sequence changes the selection. Table 11 lists Set-Up features and modes. Modes are changed by using set mode (SM) and reset mode (RM) sequences. Set and reset the terminal modes by using the following sequences.

<div align="center">

NOTE

Ps represents a variable parameter selected from a list of parameters. A series of asterisks (***) represent the parameter in the octal sequence. The parameter is transmitted using decimal ASCII characters. When you set several modes with a single SM or RM sequence, a semicolon (;, octal 073) separates parameters.

</div>

Set Mode (SM)

```
ESC  [  Ps   ;...  ;  Ps   h
033 133 *** 073   073 *** 150
```

Sets one or more modes specified by selective parameters (Ps) in the parameter string.

Reset Mode (RM)

```
ESC  [  Ps   ;...  ;  Ps   l
033 133 *** 073   073 *** 154
```

Resets one or more modes specified by selective parameters (Ps) in the parameter string.

Table 11: Set-Up Features and Modes

Set-Up Feature or Mode	Change by Escape Sequences	Change from Keyboard in Set-Up
On/off line**	No	Yes
Columns per line	Yes (DECCOLM)	Yes
Tab stops	Yes (HTS/TBC)*	Yes
Scroll rate	No	Yes
Auto repeat	Yes (DECARM)	Yes
Screen background	Yes (DECSCNM)	Yes
Cursor	No	Yes
Margin bell volume	No	Yes
Keyclick volume	No	Yes
ANSI/VT52	Yes (DECANM)	Yes
Auto XON/XOFF**	No	Yes
US/UK character set	Yes (SCS)*	Yes
Auto Wrap	Yes (DECAWM)	Yes
Line Feed/New Line	Yes (LNM)	Yes
Local echo**	Yes (SRM)	Yes
Print termination character**	Yes (DECPFF)	Yes
Printer extent**	Yes (DECPEX)	Yes
One or two stop bits	No	Yes
Receive parity	No	Yes
Break enable**	No	Yes
Disconnect character enable**	No	Yes
Disconnect delay**	No	Yes
Auto answerback enable**	No	Yes
Power	No	Yes
Modem data/parity bits	No	Yes
Transmit speed	No	Yes
Receive speed	No	Yes
Modem control**	No	Yes
Printer data/parity bits	No	Yes
Transmit/receive speed	No	Yes
Application keypad mode/ numeric keypad mode	Yes (DECKPAM/DECKPNM)*	No
Cursor key mode	Yes (DECCKM)	No
Origin mode	Yes (DECOM)	No
Insertion-replacement mode	Yes (IRM)	

*These features are not changed using the set mode (SM) and reset mode (RM) sequences.

**Happens only in terminal mode.

Table 12 lists the ANSI-specified modes and their selective parameters (Ps). Table 13 lists the ANSI-compatible private modes and their selective parameters. When you change ANSI-compatible private modes, the first character in the parameter string is a question mark (?, octal 077). All parameters in the sequence are interpreted as ANSI compatible private parameters. This chapter explains each mode in detail and provides the sequences to set and reset each mode.

The following example shows the use of the question mark (used with ANSI private parameters) and semicolon (used with multiple parameters). The sequence sets both column and scroll modes.

```
     ESC  [   ?   3   ;   4   h
     033 133 077 063 073 064 150
```

Table 14 describes modes specified in ANSI X3.64-1979 that are permanently set, permanently reset, or not applicable. See the ANSI standard for more information about these modes.

Table 12: ANSI-Specified Modes

Name	Mnemonic	Parameter (Ps)
Error (ignored)	−	0
Keyboard action	KAM	2
Insertion-replacement	IRM	4
Line Feed/New Line	LNM	20

Table 13: ANSI-Compatible Private Modes

Name	Mnemonic	Parameter (Ps)
Error (ignored)	−	0
Cursor key	DECCKM	1
ANSI/VT52	DECANM	2
Column	DECCOLM	3
Scroll	DECSCLM	4
Screen	DECSCNM	5
Origin	DECOM	6
Auto wrap	DECAWN	7
Auto repeat	DECARM	8
Printer form feed*	DECPFF	18
Printer extent*	DECPEX	19

*Happens only in terminal mode.

NOTE

The application keypad and numeric keypad modes are selected using dedicated sequences, not set and reset mode sequences. See Keypad Character Selection in this chapter for more information.

Table 14: Permanently Selected Modes

Name	Mnemonic	Selection	Function
Control representation	CRM	Reset	Rainbow 100 computer performs control functions without displaying a character to represent control function received.
Editing boundary	EBM	Reset	Characters moved outside the margins are lost; terminal does not perform erasing and cursor positioning functions outside the margins. This does not affect horizontal and vertical position (HVP) and cursor position (CUP) sequences.
Erasure	ERM	Set	All characters displayed can be erased.
Format effector action	FEAM	Reset	Terminal immediately performs control functions that affect the screen display.
Format effector transfer	FETM	N/A	-
Guarded area transfer	GATM	N/A	-
Horizontal editing	HEM	N/A	-
Multiple area transfer	MATM	N/A	-
Positioning unit	PUM	Reset	Terminal specifies horizontal and vertical positioning parameters in control functions in units of character position.
Selected area transfer	SATM	N/A	-
Status reporting transfer	SRTM	Reset	Terminal transmits status reports by using device status report (DSR) sequences.
Tabulation stop	TTM	N/A	-
Vertical editing	VEM	N/A	-

ANSI/VT52 Compatibility – The Rainbow 100 computer is compatible with both ANSI and private DIGITAL standards. Therefore, you can use new software that meets both ANSI standards and existing software designed for previous terminals (such as the VT52).

ANSI-compatible sequences meet ANSI standards X3.64-1979 and X3.41-1974. You select ANSI compatibility by using the ANSI/VT52 mode (DECANM) sequence in VT52 mode. See VT52-Compatible Sequences in this chapter for details on selecting ANSI sequence compatibility. In ANSI mode, the following sequence selects (VT52 mode).

Features and modes selected in ANSI mode are also used in VT52 mode. However, these features and modes usually cannot change in VT52 mode.

VT52 Mode (DECANM)

```
ESC  [   ?   2   1
033 133 077 062 154
```

In ANSI mode, reset selects VT52 compatibility. In VT52 mode, the Rainbow 100 computer responds like a VT52 to private DIGITAL sequences.

Scrolling – Scrolling is the upward or downward movement of existing lines on the screen. This makes room for more display lines at either the top or bottom of the scrolling region. There are two methods of scrolling, jump scroll and smooth scroll. Select the type of scrolling by using the following sequences.

NOTE

> In full-duplex communication, the auto XON/XOFF Set-Up feature prevents the loss of received characters when using smooth scroll. If auto XON/XOFF is not used, fill characters are needed.

Scroll Mode (DECSCLM)

```
ESC [ ?   4 h
033 133 077 064 150
```

Set selects smooth scroll. Smooth scroll rate selected in Set-Up.

```
ESC  [   ?   4   1
033 133 077 064 154
```

Reset selects jump scroll. Jump scroll lets the terminal add lines to the screen as fast as possible.

Scrolling Region - This inclusive region is the area of the screen defined by top and bottom margins. The margins determine which screen lines move during scrolling. Characters added outside the scrolling region do not cause the screen to scroll. The minimum size of the scrolling region is two lines. Therefore, the line number of the top margin must be less than the number of the bottom margin. The origin mode selects line numbers relative to the whole screen or the scrolling region.

After the margins are selected, the cursor moves to the home position. The origin mode feature also affects the home position. Select the top and bottom margins of the scrolling region by using the following sequence.

NOTES: When you power up or use the system reset command, the scrolling region becomes the full screen.

Pt and Pb represent variable numeric parameters. The parameters are decimal numbers transmitted to the terminal as ASCII characters. Asterisks (***) represent one or more variable numeric parameters in the octal sequence.

Set Top and Bottom Margins (DECSTBM)

    ESC [Pt   ; Pb   r
    033 133 *** 073 *** 162

Selects top and bottom margins, defining the scrolling region. Pt is line number of first line in the scrolling region. Pb is line number of bottom line. If Pt and Pb are not selected, the complete screen is used (no margins).

Origin - This mode determines if the cursor can move outside the scrolling region (the area between the top and bottom margins). You can move the cursor outside the margins with the cursor position (CUP) and horizontal and vertical position (HVP) sequences.

Lines on the screen are numbered according to the location of the home position. Home position is always line 1, column 1. The cursor moves to the new home position whenever origin mode is selected. Select origin mode by using the following sequences.

<div align="center">NOTE</div>

      When you power up or use the system
      reset command, origin mode resets.

Origin Mode (DECOM)

    ESC [? 6 h
    033 133 077 066 150

Set selects home position in scrolling region. Line numbers start at top margin of scrolling region. The cursor cannot move out of scrolling region.

    ESC [? 6 l
    033 133 077 066 154

Reset selects home position in upper-left corner of screen. Line numbers are independent of the scrolling region (absolute). Use CUP and HVP sequences to move cursor out of scrolling region.

Cursor Positioning - The cursor indicates the active screen position where the next character will appear. The cursor moves:

- One column to the right when a character appears

- One line down after a line feed (LF, octal 012), form feed (FF, octal 014) or vertical tab (VT, octal 013) (Line feed/new line may also move the cursor to the left margin). If at the bottom margin, this causes an upward scroll.

- One line up after a reverse index, if at the top margin, it causes a downward scroll.

- To the left margin after a carriage return (CR, octal 015)

- One column to the left after a backspace (BS, octal 010)

- To the next tab stop (or right margin if no tabs are set) after a horizontal tab character (HT, octal 011)

- To the home position when the top and bottom margins of the scrolling region (DECSTBM) or origin mode (DECOM) selection changes.

You can also move the cursor by using the following sequences.

NOTE

Pn represents a variable numeric parameter. The parameter is a decimal number transmitted to the terminal by using ASCII characters. If you select no parameter or 0, the terminal assumes the parameter equals 1. Asterisks (***) represent one or more characters in the octal sequence.

Cursor Up (CUU)

        ESC [Pn   A
        033 133 *** 101

Moves cursor up Pn lines in same column. Cursor stops at top margin.

Cursor Down (CUD)

        ESC [Pn   B
        033 133 *** 102

Moves cursor down Pn lines in same column. Cursor stops at bottom margin.

Cursor Forward (CUF)

```
ESC  [  Pn   C
033 133 *** 103
```

Moves cursor right Pn columns. Cursor stops at right margin.

Cursor Backward (CUB)

```
ESC  [  Pn   D
033 133 *** 104
```

Moves cursor left Pn columns. Cursor stops at left margin.

Cursor Position (CUP)

```
ESC  [  Pl   ;  Pc   H
033 133 *** 073 *** 110
```

Moves cursor to line Pl, column Pc. If Pl or Pc are not selected or
selected as 0, the cursor moves to first line or column, respectively.
Origin mode (DECOM) selects line numbering and ability to move cursor
into margins.

<center>NOTE</center>

> Pl and Pc represent variable numeric
> parameters. The parameter is a decimal
> number that represents one or more
> characters transmitted to the terminal
> as ASCII characters. Asterisks (***)
> represent the variable parameter in the
> octal sequence.
>
> CUP operates the same as the horizontal
> and vertical position (HVP) sequence.

Cursor Position (Home) (CUP)

```
ESC  [   H
033 133 110
```

Moves cursor to home position, selected by origin mode (DECOM).

Horizontal and Vertical Position (HVP)

```
ESC  [  Pl   ;  Pc   f
033 133 *** 073 *** 146
```

Moves cursor to line Pl, column Pc. If Pl or Pc are not selected or
selected as 0, the cursor moves to first line or column, respectively.
Origin mode (DECOM) selects line numbering and ability to move the
cursor into margins.

<center>NOTE</center>

> HVP operates the same as the cursor
> position (CUP) sequence.

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Horizontal and Vertical Position (Home) (HVP)

```
ESC  [    f
033 133 146
```

Cursor moves to home position selected by origin mode (DECOM).

Index

```
ESC  D  or   IND
033 104      204
```

Moves cursor down one line in same column. If cursor is at bottom margin, screen performs a scroll-up.

Reverse Index (RI)

```
ESC  M  or RI
033 115    215
```

Moves cursor up one line in same column. If cursor is at top margin, screen performs a scroll-down.

Next Line (NEL)

```
ESC  E  or NEL
033 105    205
```

Moves cursor to first position on next line. If cursor is at bottom margin, screen performs a scroll-up.

Save Cursor (DECSC)

```
ESC  7
033 067
```

Saves cursor position, character attribute (graphic rendition), character set, and origin mode selection. (See restore cursor.)

Restore Cursor (DECRC)

```
ESC  8
033 070
```

Restores previously saved cursor position, character attribute (graphic rendition), character set, and origin mode selection. If none were saved, the cursor moves to home position.

Columns Per Line – This mode selects the number of columns in a display line, 80 or 132. With either selection, the screen can display 24 lines. Select the number of columns per line by using the following sequences.

NOTE

When you change the number of columns per line, the screen is erased. This also sets the scrolling region for full screen (24 lines).

Column Mode (DECCOLM)

```
ESC  [   ?   3   h
033 133 077 063 150
```

Set selects 132 columns per line.

```
ESC  [   ?   3   1
033 133 077 063 154
```

Reset selects 80 columns per line.

Auto Wrap – This mode selects where a received character will appear when the cursor is at the right margin. Select auto wrap by using the following sequences.

NOTE

Regardless of the auto wrap Set-Up feature selection, the tab character never moves the cursor to the next line.

Auto Wrap Mode (DECAWM)

```
ESC  [   ?   7   h
033 133 077 067 150
```

Set selects auto wrap. Any display characters received when cursor is at right margin appear on next line. The display scrolls up if cursor is at end of scrolling region.

```
ESC  [   ?   7   1
033 133 077 067 154
```

Reset turns auto wrap off. Display characters received when cursor is at right margin replace previously displayed character.

Screen Background – This mode selects either light (reverse) or dark display background on the screen. Select screen mode by using the following sequences.

Screen Mode (DECSCNM)

```
ESC  [   ?   5   h
033 133 077 065 150
```

Set selects reverse screen, a white screen background with black characters.

```
ESC  [   ?   5   1
033 133 077 065 154
```

Reset selects normal screen, a black screen background with white characters.

Line Feed/New Line – This mode selects the control character(s) transmitted by **Return**. Line feed/new line also selects the action taken by the terminal when receiving line feed, form feed, and vertical tab. Table 15 provides a summary of the feature. Select line feed/new line mode by using the following sequences.

Line Feed/New Line Mode (LNM)

```
ESC  [    2    0    h
033 133 062 060 150
```

Set causes a received line feed, form feed, or vertical tab to move cursor to first column of next line. **Return** transmits both a carriage return and line feed. This selection is also called new line option.

```
ESC  [    2    0    l
033 133 062 060 154
```

Reset causes a received line feed, form feed, or vertical tab to move cursor to next line in current column. **Return** transmits a carriage return.

Table 15:   Line Feed/New Line Feature

Feature Selection	Key Pressed-Character Sent	Character Received-Function
Off	**Return-CR**	CR-Cursor moves to left margin.
Off	**Line Feed-LF**	LF, FF, VT-Cursor moves to next line but stays in same column.
On	**Return-CR LF**	CR-cursor moves to left margin.
On	**Line Feed-LF**	LF, FF, VT-Cursor moves to left margin of next line.

Keyboard Action – Keyboard action lets the computer turn the keyboard on or off. This mode always resets when you enter Set-Up. Select keyboard action mode by using the following sequences.

Keyboard Action Mode (KAM)

```
ESC  [    2    h
033 133 062 150
```

Set turns off keyboard and turns on the Wait indicator.

```
ESC  [    2    l
033 133 062 154
```

Reset turns on keyboard and turns off the Wait indicator.

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Auto Repeat - This mode selects automatic key repeating. A key pressed for more than one-half second automatically repeats the transmission of the character. Key repeating does not affect **Set-Up, ESC, Return, Enter, Hold Screen,** and **Ctrl.** Select auto repeat mode by using the following sequences.

Auto Repeat Mode (DECARM)

```
ESC  [   ?   8   h
033 133 077 070 150
```

Set selects auto repeat. A key pressed for more than one-half second automatically repeats.

```
ESC  [   ?   8   l
033 133 077 070 154
```

Reset turns off auto repeat. Keys do not automatically repeat.

Local Echo (Keyboard Send-Receive) - This mode selects local echo, only in terminal mode, which causes every character transmitted by the Rainbow 100 computer to automatically appear on the screen. Therefore, the host computer does not have to transmit (echo) the character back to the Rainbow 100 computer for display. When local echo is off, the Rainbow 100 computer only transmits characters to the host computer. The host computer must echo the characters back to the Rainbow 100 computer for display. Select send-receive mode by using the following sequences.

Send-Receive Mode (SRM)

```
ESC  [   1   2   h
033 133 061 062 150
```

Set turns off local echo. The Rainbow 100 computer transmits characters to the host computer, which must echo characters for display on screen.

```
ESC  [   1   2   l
033 133 061 062 154
```

Reset selects local echo. Characters transmitted to the host computer automatically appear on the screen.

Cursor Key Character Selection - Cursor key mode selects the set of characters transmitted by the cursor keys. See Table 16 for the codes transmitted by the cursor keys. Select cursor key mode by using the following sequences.

NOTE

If you power up or use a system reset command, cursor key mode resets. This mode also resets during a communication line connection in all communication except full-duplex no modem control (FDX A).

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Cursor Key Mode (DECCKM)

    ESC [?   1   h
    033 133 077 061 150

Set selects cursor keys to generate (application) functions.

    ESC [?   1   l
    033 133 077 061 154

Reset selects cursor keys to generate cursor control sequences.

              Table 16: ANSI Cursor Control Key Codes

                    Cursor Key Mode   Cursor Key Mode
                    Reset Sends   Set Generates
                    Cursor Control   Application
    Cursor Key   Sequence   Functions

                    ESC   [A   ESC   O   A
                    033 133 101   033 117 101

                    ESC   [B   ESC   O   B
                    033 133 102   033 117 102

                    ESC   [C   ESC   O   C
                    033 133 103   033 117 103

                    ESC   [D   ESC   O   D
                    033 133 104   033 117 104

Keypad Character Selection – The numeric keypad generates either
numeric characters or control functions. Selecting application or
numeric keypad mode determines the type of characters. The program
function (PF) keys generate the same characters regardless of the
keypad character selection. See Table 17 for the characters generated
by the keypad. Select the keypad mode by using the following
sequences.

                              NOTE

            When you power up or use a system reset
            command, the terminal selects numeric
            keypad mode. This mode is also selected
            during communication line connections,
            except full-duplex no modem control (FDX
            A).

Application Keypad Mode (DECKPAM)

    ESC =
    033 075

Selects application keypad mode. Keypad generates control functions.

Numeric Keypad Mode (DECKPNM)

> **ESC >**
> 033 076

Selects numeric keypad mode. Keypad generates characters that match
the numeric, comma, period, and minus sign keys on main keyboard.

Table 17: ANSI Keypad Codes

Key	Numeric Keypad Mode	Application Keypad Mode
0	0 060	ESC O p 033 117 160
1	1 061	ESC O q 033 117 161
2	2 062	ESC O r 033 117 162
3	3 063	ESC O s 033 117 163
4	4 064	ESC O t 033 117 164
5	5 065	ESC O u 033 117 165
6	6 066	ESC O v 033 117 166
7	7 067	ESC O w 033 117 167
8	8 070	ESC O x 033 117 170
9	9 071	ESC O y 033 117 171
-(minus)	-(minus) 055	ESC O m 033 117 155
,(comma)	,(comma) 054	ESC O l 033 117 154
.(period)	.(period) 056	ESC O n 033 117 156

Table 17 (Cont.): ANSI Keypad Codes

Key	Numeric Keypad Mode	Application Keypad Mode
Enter*	CR or CR LF 015 015 012	ESC O M 033 117 115
PF1	ESC O P 033 117 120	ESC O P 033 117 120
PF2	ESC O Q 033 117 121	ESC O Q 033 117 121
PF3	ESC O R 033 117 122	ESC O R 033 117 122
PF4	ESC O S 033 117 122	ESC O S 033 117 123

NOTE

In ANSI mode, if the codes are echoed back to the terminal or if the terminals is off-line, the last character of the sequence appears on the screen; for example, PF4 appears as an "S".

*In numeric keypad mode, **Enter** generates the same characters as **Return**. You can change the **Return** key character code with the line feed/new line feature. When off, this feature causes the key to generate a single control character (CR, octal 015). When on, this feature causes the key to generate two characters (CR, octal 015 and LF, octal 012).

Character Sets and Selection - The Rainbow 100 computer can display the characters found in Tables 18 through 20.

The Rainbow 100 computer can select only one character set at a time. Therefore, the Rainbow 100 computer uses the following three character sets, with some characters appearing in more than one set. The GR displayable characters found in Table 8 are always available.

    United States
    United Kingdom
    Special characters and line drawing (VT100 compatible)

Tables 18 through 20 show the character sets. The United States and United Kingdom character sets meet the standard of the "ISO international register of character sets to be used with escape sequences." The space (SP) and control characters are the same in all sets.

The terminal uses two active character sets at any one time. The computer designates these sets as G0 and G1, using the select character set (SCS) sequence. Then a single control character can switch between sets. Shift in (SI, octal 017) invokes the G0 character set; shift out (SO, octal 016) invokes the G1 character set.

The designated character sets are active until the terminal receives another SCS sequence. You can use the SCS sequence as often as needed to designate G0 and G1. Designate G0 by using the following sequences.

NOTE

The terminal uses the character set selected in Set-Up after all communication line connections, except full-duplex no modem control (FDX A).

Select Character Set (SCS)

    ESC   (A
    033 050 101

Designates the UK character set as G0.

    ESC   (B
    033 050 102

Designates the US character set as G0.

    ESC   (0
    033 050 060

Designates the special characters and line drawing character set as G0.

Designate G1 by using the following sequences.

Select Character Set (SCS)

    ESC   )   A
    033 051 101

Designates the UK character set as G1.

    ESC   )   B
    033 051 102

Designates the US character set as G1.

    ESC   )   0
    033 051 060

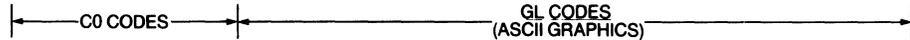Designates the special characters and line drawing character set as G1.

The terminal also has G2 and G3 character sets. However, these are always the default (selected in Set-Up) character sets. You select G2 and G3 for only one character at a time. The terminal returns to the previous character set after displaying a single character. Select G2 and G3 for one character by using the following sequences.

Table 18: 7-bit US/UK ASCII Characters

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

Values shown as (octal/decimal/hex).

BITS: b8 b7 b6 b5 for columns; b4 b3 b2 b1 for rows.

NOTE: DEPENDS ON THE CHARACTER SET SELECTED; U.S.=# U.K.=£

|← CO CODES →|← GL CODES (ASCII GRAPHICS) →|

KEY

CHARACTER	ESC	33	OCTAL
		27	DECIMAL
		1B	HEX

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Table 19: 8-bit Control and Displayable Characters

8	9	10	11	12	13	14	15	COLUMN (b8 b7 / b6 b5 / b4 b3 b2 b1)	ROW
200 128 80	220 144 90	▨ 240 160 A0	° 260 176 B0	À 300 192 C0	320 208 D0	à 340 224 E0	360 240 F0	0 0 0 0	0
201 129 81	221 145 91	¡ 241 161 A1	± 261 177 B1	Á 301 193 C1	Ñ 321 209 D1	á 341 225 E1	ñ 361 241 F1	0 0 0 1	1
202 130 82	222 146 92	¢ 242 162 A2	² 262 178 B2	Â 302 194 C2	Ò 322 210 D2	â 342 226 E2	ò 362 242 F2	0 0 1 0	2
203 131 83	223 147 93	£ 243 163 A3	³ 263 179 B3	Ã 303 195 C3	Ó 323 211 D3	ã 343 227 E3	ó 363 243 F3	0 0 1 1	3
IND 204 132 84	224 148 94	244 164 A4	264 180 B4	Ä 304 196 C4	Ô 324 212 D4	ä 344 228 E4	ô 364 244 F4	0 1 0 0	4
NEL 205 133 85	225 149 95	¥ 245 165 A5	µ 265 181 B5	Å 305 197 C5	Õ 325 213 D5	å 345 229 E5	õ 365 245 F5	0 1 0 1	5
206 134 86	226 150 96	246 166 A6	¶ 266 182 B6	Æ 306 198 C6	Ö 326 214 D6	æ 346 230 E6	ö 366 246 F6	0 1 1 0	6
207 135 87	227 151 97	§ 247 167 A7	· 267 183 B7	Ç 307 199 C7	Œ 327 215 D7	ç 347 231 E7	œ 367 247 F7	0 1 1 1	7
HTS 210 136 88	230 152 98	¤ 250 168 A8	270 184 B8	È 310 200 C8	Ø 330 216 D8	è 350 232 E8	ø 370 248 F8	1 0 0 0	8
211 137 89	231 153 99	© 251 169 A9	¹ 271 185 B9	É 311 201 C9	Ù 331 217 D9	é 351 233 E9	ù 371 249 F9	1 0 0 1	9
212 138 8A	232 154 9A	ª 252 170 AA	º 272 186 BA	Ê 312 202 CA	Ú 332 218 DA	ê 352 234 EA	ú 372 250 FA	1 0 1 0	10
213 139 8B	CSI 233 155 9B	« 253 171 AB	» 273 187 BB	Ë 313 203 CB	Û 333 219 DB	ë 353 235 EB	û 373 251 FB	1 0 1 1	11
214 140 8C	234 156 9C	254 172 AC	¼ 274 188 BC	Ì 314 204 CC	Ü 334 220 DC	ì 354 236 EC	ü 374 252 FC	1 1 0 0	12
RI 215 141 8D	235 157 9D	255 173 AD	½ 275 189 BD	Í 315 205 CD	Ÿ 335 221 DD	í 355 237 ED	ÿ 375 253 FD	1 1 0 1	13
SS2 216 142 8E	236 158 9E	256 174 AE	276 190 BE	Î 316 206 CE	336 222 DE	î 356 238 EE	376 254 FE	1 1 1 0	14
SS3 217 143 8F	237 159 9F	257 175 AF	¿ 277 191 BF	Ï 317 207 CF	ß 337 223 DF	ï 357 239 EF	▨ 377 255 FF	1 1 1 1	15

C1 CODES ←——→ ←——— GR CODES (DEC SUPPLEMENTAL GRAPHICS) ———→

KEY

CHARACTER		
Æ	306	OCTAL
	198	DECIMAL
	C6	HEX

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BITS B4 B3 B2 B1	ROW	Col 0 (000)	Col 1 (001)	Col 2 (010)	Col 3 (011)	Col 4 (100)	Col 5 (101)	Col 6 (110)	Col 7 (111)
0 0 0 0	0	NUL — 0/0/0	(blank) — 20/16/10	SP — 40/32/20	0 — 60/48/30	@ — 100/64/40	P — 120/80/50	♦ — 140/96/60	— SCAN 3 — 160/112/70
0 0 0 1	1	(blank) — 1/1/1	DC1 (XON) — 21/17/11	! — 41/33/21	1 — 61/49/31	A — 101/65/41	Q — 121/81/51	▒ — 141/97/61	SCAN 5 — 161/113/71
0 0 1 0	2	(blank) — 2/2/2	(blank) — 22/18/12	" — 42/34/22	2 — 62/50/32	B — 102/66/42	R — 122/82/52	�H — 142/98/62	— SCAN 7 — 162/114/72
0 0 1 1	3	ETX — 3/3/3	DC3 (XOFF) — 23/19/13	# — 43/35/23	3 — 63/51/33	C — 103/67/43	S — 123/83/53	⌠ — 143/99/63	— SCAN 9 — 163/115/73
0 1 0 0	4	EOT — 4/4/4	(blank) — 24/20/14	$ — 44/36/24	4 — 64/52/34	D — 104/68/44	T — 124/84/54	⌐ — 144/100/64	├ — 164/116/74
0 1 0 1	5	ENQ — 5/5/5	(blank) — 25/21/15	% — 45/37/25	5 — 65/53/35	E — 105/69/45	U — 125/85/55	⌡ — 145/101/65	┤ — 165/117/75
0 1 1 0	6	(blank) — 6/6/6	(blank) — 26/22/16	& — 46/38/26	6 — 66/54/36	F — 106/70/46	V — 126/86/56	° — 146/102/66	⊥ — 166/118/76
0 1 1 1	7	BEL — 7/7/7	(blank) — 27/23/17	' — 47/39/27	7 — 67/55/37	G — 107/71/47	W — 127/87/57	± — 147/103/67	┬ — 167/119/77
1 0 0 0	8	BS — 10/8/8	CAN — 30/24/18	(— 50/40/28	8 — 70/56/38	H — 110/72/48	X — 130/88/58	⌐ — 150/104/68	│ — 170/120/78
1 0 0 1	9	HT — 11/9/9	(blank) — 31/25/19	) — 51/41/29	9 — 71/57/39	I — 111/73/49	Y — 131/89/59	⌐ — 151/105/69	≤ — 171/121/79
1 0 1 0	10	LF — 12/10/A	SUB — 32/26/1A	* — 52/42/2A	: — 72/58/3A	J — 112/74/4A	Z — 132/90/5A	┘ — 152/106/6A	≥ — 172/122/7A
1 0 1 1	11	VT — 13/11/B	ESC — 33/27/1B	+ — 53/43/2B	; — 73/59/3B	K — 113/75/4B	[— 133/91/5B	┐ — 153/107/6B	π — 173/123/7B
1 1 0 0	12	FF — 14/12/C	(blank) — 34/28/1C	, — 54/44/2C	< — 74/60/3C	L — 114/76/4C	\ — 134/92/5C	┌ — 154/108/6C	≠ — 174/124/7C
1 1 0 1	13	CR — 15/13/D	(blank) — 35/29/1D	− — 55/45/2D	= — 75/61/3D	M — 115/77/4D	] — 135/93/5D	└ — 155/109/6D	£ — 175/125/7D
1 1 1 0	14	SO — 16/14/E	(blank) — 36/30/1E	. — 56/46/2E	> — 76/62/3E	N — 116/78/4E	^ — 136/94/5E	┼ — 156/110/6E	· — 176/126/7E
1 1 1 1	15	SI — 17/15/F	(blank) — 37/31/1F	/ — 57/47/2F	? — 77/63/3F	O — 117/79/4F	(BLANK) — 137/95/5F	— SCAN 1 — 157/111/6F	(blank) — 177/127/7F

KEY

ASCII CHARACTER	ESC	
	33	OCTAL
	27	DECIMAL
	1B	HEX

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Single Shift 2 (SS2)

    ESC   N   or SS2
    033 116   216

Selects G2 (default) character set for one character. You   select   G2
in Set-Up.

Single Shift 3 (SS3)

    ESC   O   or SS3
    033 117   217

Selects G3 (default) character set for one character. You   select   G3
in Set-Up.

Character Attributes – The   terminal   can   display   the   following
character   attributes   that   change   the   character   display   without
changing the character.

- Underline

- Reverse video (character background   opposite   of   the   screen
  background feature)

- Blink

- Bold (increased intensity)

- Any combination of these attributes (applied in the   order   of
  reception)

You can select one or more character attributes at one time.
Selecting an attribute does not turn off other attributes already
selected. After you select an attribute, all characters received by
the terminal appear with that attribute. If you move the characters
by scrolling, the attribute moves with the characters. Select the
character attributes by using the following sequences.

Select Graphic Rendition (SGR)

    ESC   [m   or ESC   [0   m
    033 133 155   033 133 060 155

Turns off character attributes.

    ESC   [1   m
    033 133 061 155

Selects bold (increased intensity).

    ESC   [4   m
    033 133 064 155

Selects underline.
    ESC   [5   m
    033 133 064 155

Selects blink.

    ESC   [7   m
    033 133 067 155

Selects reverse video.

Tab Stops - You select tab stop positions on the horizontal lines of the screen. The cursor advances (tabs) to the next tab stop when the terminal receives a horizontal tab (HT, octal 011). If no tab stops are set, horizontal tab moves the cursor to the right margin. Set and clear the tab stops by using the following sequences.

Horizontal Tabulation Set (HTS)

      ESC H   or HTS
      033 110   210

Sets a horizontal tab stop at cursor position.

Tabulation Clear (TBC)

      ESC [g or ESC [0   g
      033 133 147   033 133 060 147

Clears a horizontal tab stop at cursor position.

      ESC [3   g
      033 133 063 147

Clears all horizontal tab stops.

Line Attributes - These are display features that affect a complete display line. The cursor selects the line affected by the attribute. The cursor stays in the same character position when the attribute changes. However, if the attribute would move the cursor past the right margin, the cursor stops at the right margin. When you move lines on the screen by scrolling, the attribute moves with the line. Select line attributes by using the following sequences.

                              NOTE

          If you erase an entire line by using the
          erase in display (ED) sequence, the line
          attribute changes to single-height and
          single-width.

Double-Height Line (DECDHL)

      Top Half: Bottom Half:
      ESC #   3   ESC #   4
      033 043 063   033 043 064

Makes the line with the cursor the top or bottom half of a double-height, double-width line. Sequences work in pairs on adjacent lines. The same character must be used on both lines to form full characters. If the line was single-width, single-height, all characters to the right of center are lost.

Single-Width Line (DECSWL)

```
ESC  #   5
033 043 065
```

Makes the line with the cursor single-width, single-height. This is
line attribute for all new lines on screen.

Double-Width Line (DECDWL)

```
ESC  #   6
033 043 066
```

Makes the line with the cursor double-width, single-height.   If the
line was single-width, single-height, all characters to the right of
center screen are lost.

Erasing – Erasing removes characters from the screen without affecting
other characters on the screen.   Erased characters are lost. The
cursor position does not change when erasing characters or lines.

If you erase a line by using the erase in display (ED) sequence, the
line attribute becomes single-height, single-width. If you erase a
line by using the erase in line (EL) sequence, the line attribute is
not affected.

Erasing a character also erases any character attribute of the
character.   Erase characters by using the following sequences.

Erase in Line (EL)

```
ESC  [   K  or ESC  [   0   K
033 133 113     033 133 060 113
```

Erases from cursor to end of line, including cursor position.

```
ESC  [   1   K
033 133 061 113
```

Erases from beginning of line to cursor, including cursor position.

```
ESC  [   2   K
033 133 062 113
```

Erases complete line.

Erase in Display (ED)

```
ESC  [   J  or ESC  [   0   J
033 133 112     033 133 060 112
```

Erases from cursor to end of screen, including cursor position.

```
ESC  [   1   J
033 133 061 112
```

Erases from beginning of screen to cursor, including cursor position.

```
ESC  [   2   J
033 133 062 112
```

Erases complete display. All lines are erased and changed to
single-width. Cursor does not move.

Computer Editing - Editing allows the computer to insert or delete
characters and lines of characters at the cursor position. The cursor
position does not change when inserting or deleting lines. Delete
characters or insert and delete lines by using the following
sequences.

NOTE

Insertion-replacement mode (RM) selects
how characters are added to the screen.
See Inserting and Replacing Characters
in this chapter for more information.

Delete Character (DCH)

```
ESC  [  Pn   P
033 133 *** 120
```

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

Insert Line (IL)

```
ESC  [  Pn   L
033 133 *** 114
```

Inserts Pn lines at line with cursor. Lines displayed below cursor
move down.   Lines moved past the bottom margin are lost. This
sequence is ignored when cursor is outside scrolling region.

Delete Line (DL)

```
ESC  [  Pn   M
033 133 *** 115
```

Deletes Pn lines starting at line with cursor. As lines are deleted,
lines displayed below cursor move up. Lines added to bottom of screen
have spaces with same character attributes as last line moved up.
This sequence is ignored when cursor is outside scrolling region.

Inserting and Replacing Characters - The terminal displays received
characters at the cursor position.   This mode determines how the
terminal adds characters to the screen.   Insert mode displays the
character and moves previously displayed characters to the right.
Replace mode adds characters by replacing the character at the cursor
position.   Select insertion-replacement mode by using the following
sequences.

NOTE

> This mode resets after a communication
> line connection in all communication
> except full-duplex no modem control (FDX
> A). It also resets any time NVM is
> saved.

Insertion-Replacement Mode (IRM)

    ESC [4   h
    033 133 064 150

Set selects insert mode and turns INSERT on. New display characters move old display characters to the right. Characters moved past the right margin are lost.

    ESC [4   l
    033 133 064 154

Reset selects replace mode and turns INSERT off. New display characters replace old display characters at cursor position. The old character is erased.

Printing in Terminal Mode – The Rainbow 100 computer has a serial printer interface for local printing. The host computer can select all print operations by using escape sequences. You can only select two of the print operations from the keyboard, auto print and Print Screen.

When you print characters from the screen, Rainbow 100 computer terminal and printer tab stops are ignored. Print characters are spaced with the space (SP, octal 040) character. The terminal transmits a carriage return (CR, octal 015) and line feed (LF, octal 012) after the last printable character of a line – but not a space character.

A line of double-height characters prints as two identical lines of single-width characters. Double-width characters print as single-width characters on a single line.

Before selecting a print operation, check the printer status by using the printer status report (DSR) in ANSI mode. Do not select a print operation if the serial printer is not ready to print. Select print operations by using the following sequences.

Media Copy (Auto Print ON) (MC)

    ESC [?   5   i
    033 133 077 065 151

Turns on auto print. A display line prints after you move cursor off the line, using a line feed, form feed, or vertical tab (also transmitted to printer).

The line also prints during an auto wrap. Auto wrap lines end with a CR,LF.

Media Copy (Auto Print Off) (MC)

    ESC [?   4   i
    033 133 077 064 151

Turns off auto print.

<div align="center">NOTE</div>

        Printer controller has a higher priority
        than auto print. Therefore, you can
        select printer controller and print
        characters during auto print.

Media Copy (Printer Controller On) (MC)

    ESC [5   i
    033 133 065 151

Turns on printer controller. The terminal transmits received
characters to printer without displaying them. The terminal does not
insert or delete spaces, provide line delimiters, or select the
correct printer character set.

Media Copy (Printer Controller Off) (MC)

    ESC [4   i
    033 133 064 151

Turns off printer controller. Always move printhead to left margin
before turning off printer controller.

Media Copy (Print Cursor Line) (MC)

    ESC [?   1   i
    033 133 077 161 151

Prints display line with cursor. Cursor position does not change.
Print cursor line ends when line prints.

Media Copy (Print Screen) (MC)

    ESC [i or ESC [0   i
    033 133 151   033 133 060 151

Prints the screen. Printer extent (DECEXT) selects full screen or
scrolling region to print. Select scrolling region by using set top
and bottom margins (DECSTBM) sequence. Print Screen ends when screen
prints.

Printer Extent in Terminal Mode – This mode selects the full screen or
the scrolling region to print during a Print Screen. Select printer
extent mode by using the following sequences.

Printer Extent Mode (DECPEX)

```
ESC   [   ?   1   9   h
033 133 077 061 071 150
```

Set selects the full screen to print during a Print Screen.

```
ESC   [   ?   1   9   l
033 133 077 061 071 154
```

Reset selects the scrolling region to print during a Print Screen.

Print Termination Character in Terminal Mode – This mode determines if the terminal should transmit a print termination character after a Print Screen. The form feed (octal, 014) control character serves as the print termination character. Select printer form feed mode by using the following sequence.

```
ESC   [   ?   1   8   h
033 133 077 061 070 150
```

Set selects form feed as print termination character. The terminal transmits this character to printer after each Print Screen.

```
ESC   [   ?   1   8   l
033 133 077 061 070 154
```

Reset selects no termination character.

Reports – The Rainbow 100 computer transmits reports in response to escape sequence requests. Reports determine terminal emulation type and status, and cursor position. The report requests and responses are as follows.

NOTE

The terminal does not respond to the DSR, DA, or DECID sequences during printer controller operation.

Device Status Report (DSR)

```
ESC   [   5   n
033 133 065 156
```

Computer requests a status report (using a DSR sequence).

```
ESC   [   0   n
033 133 060 156
```

Terminal response: Ready, no malfunctions detected.

These next four codes apply to terminal mode only.

```
ESC  [   ?   1   5   n
033 133 077 061 065 156
```

Computer requests a printer status report. Terminal checks status of
printer. This report should be requested before any print operation.

```
ESC  [   ?   1   3   n
033 133 077 061 063 156
```

Printer not connected to terminal. Data terminal ready (DTR) signal
of the printer has not been on since terminal turned on.

```
ESC  [   ?   1   1   n
033 133 077 061 061 156
```

Printer not ready to print. Printer DTR was on, but is now off.

```
ESC  [   ?   1   0   n
033 133 077 061 060 156
```

Printer ready to print. Printer DTR is on.

Cursor Position Report (CPR)

```
ESC  [   6   n
033 133 066 156
```

Requests a cursor position report.

```
ESC  [  Pl   ;  Pc   R
033 133 *** 073 *** 122
```

Terminal reports cursor position in response to DSR sequence request
from computer.   Pl indicates line and Pc indicates column. No
parameters, or parameters of 0, indicate cursor is at home position.
Origin mode (DECOM) determines whether line numbering is relative to
the top of the screen or the top of the scrolling region.

Device Attributes (DA)

```
ESC  [   c  or ESC  [   0   c
033 133 143     033 133 060 143
```

A request for Rainbow 100 computer identification.

Identify Terminal (DECID)

```
ESC  Z
033 132
```

A request for Rainbow 100 computer identification.   Rainbow 100
computer uses device attributes (DA) to respond. Future DIGITAL
terminals may not support this sequence.   Therefore, new software
should use device attributes.

Device Attributes (DA)

```
ESC  [   ?   6   c
033 133 077 066 143
```

Rainbow 100 response: "I am a VT102."

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Reset to Initial State(RIS)

ESC c
033 143

Resets the terminal to its initial state.

CAUTION

It is recommended that this not be used
due to unpredictable results.

Adjustments – The terminal has a screen alignment pattern that lets
Field Service personnel adjust the screen. Display the screen
alignment pattern by using the following sequence.

Screen Alignment Display (DECALN)

ESC # 8
033 043 070

Fills screen with uppercase E's for screen focus and alignment. This
command is used by DIGITAL Manufacturing and Field Service personnel.

VT52-Compatible Sequences

VT52-compatible sequences meet private DIGITAL standards. Therefore,
the terminal can use existing software designed for previous terminals
(such as the VT52). You can select VT52 compatibility from the
keyboard in Set-Up or the computer can use a sequence. (See
ANSI-Compatible Sequences in this chapter).

NOTE

In VT52 mode, 8-bit control characters
and displayable characters are processed
just as in ANSI mode.

Modes – In VT2 mode, you cannot select most terminal features by using
sequences. You can, however, select the following three modes by
using sequences: ANSI mode, application keypad mode on, and
application keypad mode off (numeric keypad mode on).

ANSI/VT52 Compatibility – The terminal is compatible with both ANSI
and private DIGITAL standards. Therefore, the terminal can use new
software that meets ANSI standards and existing software designed for
previous terminals (such as the VT52). ANSI-compatible sequences meet
standards X3.64-1979 and X3.41-1974. You use ANSI mode to select most
terminal features; the terminal uses the same features when it
switches to VT52 mode. You cannot, however, change most of these
features in VT52 mode. Select ANSI compatibility by using the
following sequence.

ANSI Mode (DECANM)

>   ESC   <
>   033 074

The terminal interprets all sequences according to ANSI standards X3.64-1979 and X3.41-1974. The VT52 escape sequences described in this chapter are not recognized.

Cursor Positioning - The cursor indicates the active screen position where the next character will appear. You must select the margins for VT52 mode in ANSI mode. If you do not select margins, the terminal uses the complete screen. The cursor moves:

- One column to the right when a character appears

- One line down after a line feed, form feed, or vertical tab (Line feed/new line may also move the cursor to left margin.)

- To the left margin after a carriage return

- One column to the left after a backspace

- To the next tab stop (or right margin if no tabs are set) after a horizontal tab character.

You can also move the cursor by using the following sequences.

Cursor Up

>   ESC   A
>   033 101

Moves cursor up one line in same column. Cursor stops at top margin.

Cursor Down

>   ESC   B
>   033 102

Moves cursor down one line in same column. Cursor stops at bottom margin.

Cursor Right

>   ESC   C
>   033 103

Moves cursor one column to right. Cursor stops at right margin.

Cursor Left

>   ESC   D
>   033 104

Moves cursor one column to left. Cursor stops at left margin.

Cursor to Home

    ESC H
    033 110

Moves cursor to home position.

Direct Cursor Address

    ESC Y line column
    033 131 *** ***

Moves cursor to specified line and column. Line and column numbers
are ASCII characters whose codes are their octal value plus octal 037.
For example, line 1 column 8 parameters are octal 040 (first line) and
octal 047 (eighth column).

Reverse Line Feed

    ESC I or RI
    033 111   215

Moves cursor up one line in same column. If cursor is at top margin,
screen performs scroll-down.

Keypad Character Selection – The numeric keypad generates either
numeric characters or control functions. Select application keypad
mode to generate control functions. Exit application keypad mode
(select numeric keypad mode) to generate numeric characters. See
Table 21 for the characters generated by the keypad. Enter and exit
application keypad mode by using the following sequences.

<div align="center">NOTE</div>

> When you power up or use a system reset
> command, the terminal exits application
> keypad mode (selects numeric keypad
> mode). This mode is also selected
> during communication line connections,
> except full-duplex no modem control (FDX
> A).

Enter Application Keypad Mode

    ESC =
    033 075

Keypad generates sequences used by the application program.

Exit Application Keypad Mode (Numeric Keypad Mode)

    ESC >
    033 076

Keypad generates characters that match the numeric, comma, period, and
minus sign keys on main keyboard.

Table 21:   VT52 Keypad Codes

Key	Application Keypad Mode Off (Numeric Keypad Mode)	Application Keypad Mode On
0	0 060	ESC ? p 033 077 160
1	1 061	ESC ? q 033 077 161
2	2 062	ESC ? r 033 077 162
3	3 063	ESC ? s 033 077 163
4	4 064	ESC ? t 033 077 164
5	5 065	ESC ? u 033 077 165
6	6 066	ESC ? v 033 077 166
7	7 067	ESC ? w 033 077 167
8	8 070	ESC ? x 033 077 170
9	9 071	ESC ? y 033 077 171
-(minus)	-(minus) 055	ESC ? m 033 077 155*
,(comma)	,(comma) 054	ESC ? l 033 077 154*
.(period)	.(period) 056	ESC ? n 033 077 156

Table 21 (Cont.): VT52 Keypad Codes

Key	Application keypad Mode Off (Numeric Keypad Mode)	Application Keypad Mode On
Enter+	CR or CR LF 015 015 012	ESC ? M 033 077 115
PF1	ESC P 033 120	ESC P 033 120
PF2	ESC Q 033 121	ESC Q 033 121
PF3	ESC R 033 122	ESC R 033 122
PF4	ESC S 033 123	ESC S 033 123*

*These sequences are not generated by the VT52.

+In numeric keypad mode, (application keypad mode off), **Enter** generates the same characters as **Return**. You can change the **Return** key character code with the line feed/new line feature. When off, this feature causes the key to generate a single control character (CR, octal 015). When on, this feature causes the key to generate two characters (CR, octal 015 and LF, octal 012).

Character Sets and Selection – In VT52 mode, the terminal uses either the US/UK character set selected in Set-Up or the special characters and line drawing character set. Tables 18 and 19 show the United Kingdom and United States character sets. Table 20 shows the special characters and line drawing character set. Table 22 compares the special characters and line drawing character set to VT52 graphics mode (character set). Select the character sets by using the following sequences.

NOTE

The character set selected in Set-Up is used after all communication line connections, except full-duplex no modem control (FDX A).

Enter Graphics Mode

ESC F
033 106

Selects the special characters and line drawing character set.

Exit Graphics Mode

ESC G
033 107

Selects the character set selected in Set-Up.

Table 22: Special Characters and Line Drawing Set and VT52
Graphics Mode Comparison

Octal Code	US or UK Set	Special Characters and Line Drawing Set	VT52 Graphics Mode (Not Available in Rainbow 100 Computer
137	–	Blank	Blank
140	/	Diamond	Reserved
141	a	Checkerboard (error indicator)	Solid rectangle
142	b	Horizontal tab	1/
143	c	Form feed	3/
144	d	Carriage return	5/
145	e	Line feed	7/
146	f	Degree symbol	Degrees
147	g	Plus/minus	Plus or minus
150	h	New line	Right arrow
151	i	Vertical tab	Ellipsis (dots)
152	j	Lower-right corner	Divide by
153	k	Upper-right corner	Down arrow
154	l	Upper-left corner	Bar at scan 0
155	m	Lower-left corner	Bar at scan 1
156	n	Crossing lines	Bar at scan 2
157	o	Horizontal line – scan 1	Bar at scan 3
160	p	Horizontal line – scan 3	Bar at scan 4
161	q	Horizontal line – scan 5	Bar at scan 5
162	r	Horizontal line – scan 7	Bar at scan 6
163	s	Horizontal line – scan 9	Bar at scan 7
164	t	Left "T"	Subscript 0
165	u	Right "T"	Subscript 1
166	v	Bottom "T"	Subscript 2
167	w	Top "T"	Subscript 3
170	x	Vertical bar	Subscript 4
171	y	Less than or equal to	Subscript 5
172	z	Greater than or equal to	Subscript 6
173	{	Pi	Subscript 7
174	|	Not equal to	Subscript 8
175	}	UK pound sign	Subscript 9
176	~	Centered dot	Paragraph

Erasing – Erasing removes characters from the screen. Erased
characters are lost. Erase characters by using the following
sequences.

Erase to End of Line

    ESC K
    033 113

Erases all characters from cursor to end of current line, including
cursor position. Cursor does not move.

Erase to end of Screen

    ESC J
    033 112

Erases all characters from cursor to end of screen, including cursor to end of position. Cursor does not move.

Printing in Terminal Mode - The Rainbow 100 computer has a serial printer interface for local printing. The host computer can select all print operations by using sequences. You can only select two print operations from the keyboard, auto print and Print Screen.

When you print characters from the screen, terminal and printer tab stops are ignored. Characters printed are spaced with the space (SP, octal 040) character. The Rainbow 100 computer transmits a carriage return and line feed - but not a space character - after the last printable character of a line.

A line of double-height characters print as two identical lines of single-width characters. Double-width characters print as single-width characters on a single line.

Before selecting a print operation, check the printer status by using the printer status report (DSR) in ANSI mode. Do not select a print operation if the serial printer is not ready to print. Select print operations by using the following sequences.

Auto Print

    ESC ^
    033 136

Turns on auto print. A display line prints after you move cursor off the line, using a line feed, form feed, or vertical tab (also transmitted to printer).

The line also prints during an auto wrap. Auto wrap lines end with CR, LF.

    ESC _
    033 137

Turns off auto print.

<div align="center">NOTE</div>

> Printer controller has a higher priority
> than auto print. Therefore, you can
> select printer controller and print
> characters during auto print.

Print Controller

>   **ESC   W**
>   033 127

Turns on print controller. The terminal transmits received characters
to printer without displaying them. The terminal does not insert or
delete spaces, provide line delimiters, or select printer character
set.

>   **ESC   X**
>   033 130

Turns off printer controller. Always move printhead to left margin
before turning off printer controller.

Print Cursor Line

>   **ESC   V**
>   033 126

Prints display line with cursor. Cursor position does not change.
Print cursor line ends when the line prints.

Print Screen

>   **ESC   ]**
>   033 135

Prints the screen. Printer extent (DECPEX) determines whether full
screen or scrolling region prints. Select scrolling region by using
DECSTBM sequence. Print Screen ends when screen prints.

Reports – The Rainbow 100 computer transmits reports in response to
escape sequence report requests. The Rainbow 100 computer generates
only one report in VT52 mode. The report requests and responses are
as follows.

Identify

>   **ESC   Z**
>   033 132

This escape sequence requests the Rainbow 100 computer to identify
itself.

>   **ESC   /   Z**
>   033 057 132

Rainbow 100 computer responds "I am a VT52." (Same as VT52.)

APPENDIX A

PROGRAMMING SUMMARY

GENERAL

This appendix provides a summary of Rainbow 100 computer escape and control sequences.

Figure 4 shows the codes generated by the standard keys. Figure 5 shows the control codes generated by the function keys; shaded keys do not need **Ctrl** down to generate the control character.

Figure 4: Standard Key Codes   MR-9592

Programming Sequences

The rest of this appendix repeats the information in summary form.

Control Characters Received

Name	Character Mnemonic	Octal Code	Function
Null	NUL	000	Ignored when received (not stored in input buffer) and used as a fill character.
End of transmission	EOT	004	Can be selected as a disconnect character. When used as a turnaround character, the disconnect character is DLE-EOT.

Name	Character Mnemonic	Octal Code	Function
Enquire	ENQ	005	Transmits answerback message.
Bell	BEL	007	Generates bell tone.
Backspace	BS	010	Moves cursor to the left one character position; if cursor is at left margin, no action occurs.
Horizontal	HT	011	Moves cursor to next tab stop, or to right margin if there are no more tab stops.
Line feed	LF	012	Causes a line feed or a new line operation (See line feed/new line mode.) Causes printing if in terminal mode and if auto print operation selected.
Vertical tab	VT	013	Processed as LF.
Form feed	FF	014	Processed as LF.
Carriage return	CR	015	Moves cursor to left margin on current line.
Shift out	SO	016	Selects G1 character set designated by a select character set sequence.
Shift in	SI	017	Selects G0 character set designated by a select character set sequence.
Device control 1	DC1	021	Processed as XON. DC1 causes terminal to continue transmitting characters. (Terminal mode only).
Device control 3	DC3	023	Processed as XOFF. DC3 causes terminal to stop transmitting all characters except XOFF and XON. (Terminal mode only).
Cancel	CAN	030	If received during an escape or control sequence, cancels the sequence and displays substitution character ( ).
Substitute	SUB	032	Processed as CAN.
Escape	ESC	033	Processed as a sequence introducer.
Index	IND	204	Processes a line feed.
Next line	NEL	205	Processes as a CR LF sequence.
Horizontal tab set	HTS	210	Sets a horizontal tab at cursor location.
Reverse index	RI	215	Equals a reverse line feed.

Name	Character Mnemonic	Octal Code	Function
Single shift 2	SS2	216	Selects G2 character set for the next character only.
Single shift 3	SS3	217	Selects G3 character set for the next character only.
Control sequence introducer	CSI	233	Equals an ESC [.

ANSI Compatible Sequences

Set Mode

Name	Mnemonic	Mode	Sequence
Keyboard action	KAM	Locked	ESC [2 h
Insertion-replacement	IRM	Insert	ESC [4 h
Send-receive	SRM	Off	ESC [1 2 h **
Line feed/new line	LMN	New line	ESC [2 0 h
Cursor key	DECCKM	Application	ESC [? 1 h
ANSI/VT52	DECANM	ANSI	N/A
Column	DECCOLM	132 column	ESC [? 3 h
Scrolling	DECSCLM	Smooth	ESC [? 4 h
Screen	DECSCNM	Reverse	ESC [? 5 h
Origin	DECOM	Relative	ESC [? 6 h
Auto Wrap	DECAWM	On	ESC [? 7 h
Auto repeat	DECARM	On	ESC [? 8 h
Print form feed	DECPFF	On	ESC [? 1 8 h**
Print extent	EDCPEX	Full screen	ESC [? 1 9 h**

Reset Mode

Name	Mnemonic	Mode	Sequence*
Keyboard Action	KAM	Unlocked	ESC [2 1
Insertion-replacement	IRM	Replace	ESC [4 1
Send-receive	SRM	On	ESC [1 2 1**
Line feed/new line	LMN	Line feed	ESC [2 0 1
Cursor Key	DECCKM	Cursor	ESC [? 1 1
ANSI/VT52	DECANM	VT52	ESC [? 2 1
Column	DECCOLM	80 column	ESC [? 3 1
Scrolling	DECSCLM	Jump	ESC [? 4 1
Screen	DECSCNM	Normal	ESC [5 ? 1
Origin	DECOM	Absolute	ESC [? 6 1
Auto wrap	DECAWM	Off	ESC [? 7 1
Auto repeat	DECARM	Off	ESC [? 8 1
Print form feed	DECPFF	Off	ESC [? 1 8 1**
Print extent	DECPEX	Scrolling region	ESC [? 1 9 1**

*The last character of the sequence is lowercase L(154 octal)
**Terminal mode only.

Cursor Key Codes Generated

Cursor Key (Arrow)	ANSI Characters Generated Reset (Cursor)	Set (Application)
Up	ESC [A	ESC O A
Down	ESC [B	ESC O B
Right	ESC [C	ESC O C
Left	ESC [D	ESC O D

Keypad Character Selection

Name	Mnemonic	Sequence
Alternate	DECKPAM	ESC =
Numeric	DECKPNM	ESC >

Keypad Codes Generated

Key	VT52 Numeric Keypad Mode	VT52 Alternate Keypad Mode	ANSI Numeric Keypad Mode	ANSI Alternate Keypad Mode
0	0	ESC ? p	0	ESC O p
1	1	ESC ? q	1	ESC O q
2	2	ESC ? r	2	ESC O r
3	3	ESC ? s	3	ESC O s
4	4	ESC ? t	4	ESC O t
5	5	ESC ? u	5	ESC O u
6	6	ESC ? v	6	ESC O v
7	7	ESC ? w	7	ESC O w
8	8	ESC ? x	8	ESC O x
9	9	ESC ? y	9	ESC O y
-(minus)	-(minus)	ESC ? m	-(minus)	ESC O m
,(comma)	,(comma)	ESC ? l*	,(comma)	ESC O l*
.(period)	.(period)	ESC ? N	.(period)	ESC O n
ENTER	Same as RETURN	ESC ? M	Same as RETURN	ESC O M
PF1	ESC P	ESC P	ESC O P	ESC O P
PF2	ESC Q	ESC Q	ESC O Q	ESC O Q
PF3	ESC R	ESC R	ESC O R	ESC O R
PF4	ESC S	ESC S	ESC O S	ESC O S

*The last character of the sequence is lowercase L (154 octal)

Select Character Sets SCS

Character Set	G0 Designator	G1 Designator
United Kingdom (UK)	ESC (A	ESC) A
United States (USASCII)	ESC (B	ESC) B
Special characters and line drawing set	ESC (0	ESC) 0

Name	Mnemonic	Sequence
Single shift 2	SS2	ESC N
Single shift 3	SS3	ESC O

Character Attributes

Name	Mnemonic	Sequence
Select graphic rendition (no attributes)	SGR	ESC [m
Select graphic rendition (no attributes)	SGR	EC [0 m
Select graphic rendition (select attribute bold)	SGR	ESC [1 m
Select graphic rendition (select attribute underline)	SGR	ESC [4 m
Select graphic rendition (select attribute blink)	SGR	ESC [5 m
Select graphic rendition (select attribute, reverse video)	SGR	ESC [7 m

Scrolling Region

Name	Mnemonic	Sequence
Cursor up	CUU	ESC [Pn A
Cursor down	CUD	ESC [Pn B
Cursor forward (right)	CUF	ESC [Pn C
Cursor backward (left)	CUB	ESc [Pn D
Cursor position	CUP	ESC [Pl; Pc H
Cursor position (home)	CUP	ESC [H
Horizontal and vertical position	HVP	ESC [Pl; Pc f
Horizontal and vertical position (home)	HVP	ESC [f
Index	IND	ESC D
Reverse index	RI	ESC M
Next line	NEL	ESC E
Save cursor (and attributes)	DECSC	ESC 7
Restore cursor (and attributes)	DECRC	ESC 8

Tab Stops

Name	Mnemonic	Sequence
Horizontal tab set (at current column)	HTS	ESC H
Tabulation clear (at current column)	TBC	ESC [g
Tabulation clear (at current column)	TBC	ESC [0 g
Tabulation clear (all tabs)	TBC	ESC [3 g

Line Attributes

Name	Mnemonic	Sequence
Double-height top half	DECDHL	ESC # 3
Double-height bottom half	ECDHL	ESC # 4
Single-width single-height	DECSWL	ESC # 5
Double-width single-height	DECDWL	ESC # 6

Erasing

Name	Mnemonic	Sequence
Erase in line (cursor to end of line)	EL	ESC [K
Erase in line (cursor to end of line)	EL	ESC [0 K
Erase in line (beginning of line to cursor)	EL	ESC [1 K
Erase in line (entire line containing cursor)	EL	ESC [2 K
Erase in display (cursor to end of screen)	ED	ESC [J
Erase in display (cursor to end of screen)	ED	ESC [0 J
Erase in display (beginning of screen to cursor)	ED	ESC [1 J
Erase in display (entire screen)	ED	ESC [2 J

Editing Functions

Name	Mnemonic	Sequence
Delete character	DCH	ESC [Pn P
Insert line	IL	ESC [Pn L
Delete line	DL	ESC [Pn M

Print Commands for Terminal Mode

Name	Mnemonic	Sequence
Media copy (enter auto print)	MC	ESC [? 5 i
Media copy (exit auto print)	MC	ESC [? 4 i
Media copy (enter printer controller)	MC	ESC [5 i
Media copy (exit printer controller)	MC	ESC [4 i
Media copy (Print Screen)	MC	ESC [i
Media copy (Print Screen)	MC	ESC [0 i
Media copy (print cursor line)	MC	ESC [? 1 i

Reports

Name	Mnemonic	Sequence
Device status report (request status of VT102)	DSR	ESC [5 n
Response: Terminal OK	DSR	ESC [0 n
Device status report (request status of printer)	DSR	ESc [? 1 5 n
Response: Printer ready	DSR	ESC [? 1 0 n*
Printer not ready	DSR	ESC [? 1 1 n*
No printer	DSR	ESC [? 1 3 n*
Device status report (report cursor position)	DSR	ESC [6 n
Cursor position report	CPR	ESC [Pl; Pc R
Device attributes (what are you)	DA	ESC [c
Device attributes (what are you)	DA	ESC [0 c
Identify terminal (what are you)	DECID	ESC Z

NOTE

ESC Z is not recommended.

Name	Mnemonic	Sequence
Device attributes response: VT102	DA	ESC [? 6 c

NOTE

ESC c is not recommended.

*Terminal mode only.

Reset

Name	Mnemonic	Sequence
Reset to initial state	RIS	ESC c

CAUTION

Do not use, unpredictable results.

Tests and Adjustments

Name	Mnemonic	Sequence
Screen alignment display (fill screen with "Es")	DECALN	ESC # 8

VT52 Compatible Mode

Modes	Sequence
Enter ANSI mode	ESC <

Keypad Character Selection

Name	Sequence
Enter alternate keypad mode	ESC =
Exit alternate keypad mode (Numeric keypad mode)	ESC >

NOTE

VT52 alternate keypad and numeric keypad mode different than ANSI.

Character Sets

Name	Sequence
Special graphics character set	ESC F*
Select US/UK character set (as determined by US/UK character Set-Up feature)	ESC G

*Same as special character and line drawing set in ANSI mode.

Cursor Position

Name	Sequence
Cursor up*	ESC A
Cursor down*	ESC B
Cursor right*	ESC C
Cursor left*	ESC D
Cursor to home	ESC H
Direct cursor address	ESC Y pl Pc**
Reverse line feed	ESC I***

*Same when sent from the terminal.

**Line and column numbers for direct cursor address are single character codes whose values are the desired number plus 37 octal. Line and column number start at one.

***The last character of the sequence is an uppercase I (111 octal).

Erasing

Name	Sequence
Erase to end of line	ESC K
Erase to end of screen	ESC J

Print Commands for Terminal Mode

Name	Sequence
Enter auto print mode	ESC ^
Exit auto print mode	ESC -
Enter printer controller mode	ESC W
Exit printer controller mode	ESC X
Print Screen	ESC]
Print cursor line	ESC V

Reports

Name	Sequence
Identify (what are you)	ESC Z
Response: VT102	ESC / Z
(same as VT52)	

APPENDIX B

CONTROL FUNCTIONS (SEQUENCE FORMATS)

GENERAL

This appendix summarizes the ANSI code extension techniques defined in
standards X3.41-1974 and X3.64-1979. Those specifications cover many
special cases and details not included here.

Control Functions

The ANSI standards define types of characters used for specific
purposes. You can determine a character's type by its position in the
ASCII table (Table 22). There are two general categories of
characters:

- display (columns 2 through 7; 10-15)

- control (columns 0 and 1; 8 and 9)

This table and the ANSI system can work for either a 7-bit or 8-bit
character environment. The Rainbow 100 computer uses both 7-bit and
8-bit characters.

NOTE

> The ASCII 7-bit table corresponds to
> International Standards Organization
> (ISO) standard 646 and International
> Telegraph and Telephone Consultive
> Committee (CCITT) alphabet 5.

All control characters and groups of characters (sequences) not
intended for display on the screen are control functions. Not all
control functions perform an action in every ANSI device, but each
device can recognize all control functions and discard any that do not
apply to it. Therefore, each device performs a subset of the ANSI
functions.

Because different devices use different subsets, compliance with ANSI
does not mean compatibility between devices. Compliance only means
that a particular function, if defined in the ANSI standard, is
invoked by the same control function in all devices. If an ANSI
device does not perform an action that has a control function defined
in the ANSI standard, it cannot use that control function for any
other purpose.

Table 23: US/UK ASCII Characters

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

NOTE: DEPENDS ON THE CHARACTER SET SELECTED; U.S.=# U.K.= £

← C0 CODES → ← GL CODES (ASCII GRAPHICS) →

KEY

CHARACTER	ESC	
	ESC	33 OCTAL
		27 DECIMAL
		1B HEX

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Table 24: Control and Displayable Characters

8	9	10	11	12	13	14	15	COLUMN / BITS (b8 b7 b6 b5) (b4 b3 b2 b1)	ROW
200 128 80	220 144 90	▨ 240 160 A0	° 260 176 B0	À 300 192 C0	320 208 D0	à 340 224 E0	360 240 F0	0 0 0 0	0
201 129 81	221 145 91	¡ 241 161 A1	± 261 177 B1	Á 301 193 C1	Ñ 321 209 D1	á 341 225 E1	ñ 361 241 F1	0 0 0 1	1
202 130 82	222 146 92	¢ 242 162 A2	² 262 178 B2	Â 302 194 C2	Ò 322 210 D2	â 342 226 E2	ò 362 242 F2	0 0 1 0	2
203 131 83	223 147 93	£ 243 163 A3	³ 263 179 B3	Ã 303 195 C3	Ó 323 211 D3	ã 343 227 E3	ó 363 243 F3	0 0 1 1	3
IND 204 132 84	224 148 94	244 164 A4	264 180 B4	Ä 304 196 C4	Ô 324 212 D4	ä 344 228 E4	ô 364 244 F4	0 1 0 0	4
NEL 205 133 85	225 149 95	¥ 245 165 A5	µ 265 181 B5	Å 305 197 C5	Õ 325 213 D5	å 345 229 E5	õ 365 245 F5	0 1 0 1	5
206 134 86	226 150 96	246 166 A6	¶ 266 182 B6	Æ 306 198 C6	Ö 326 214 D6	æ 346 230 E6	ö 366 246 F6	0 1 1 0	6
207 135 87	227 151 97	§ 247 167 A7	· 267 183 B7	Ç 307 199 C7	Œ 327 215 D7	ç 347 231 E7	œ 367 247 F7	0 1 1 1	7
HTS 210 136 88	230 152 98	¤ 250 168 A8	270 184 B8	È 310 200 C8	Ø 330 216 D8	è 350 232 E8	ø 370 248 F8	1 0 0 0	8
211 137 89	231 153 99	© 251 169 A9	¹ 271 185 B9	É 311 201 C9	Ù 331 217 D9	é 351 233 E9	ù 371 249 F9	1 0 0 1	9
212 138 8A	232 154 9A	ª 252 170 AA	º 272 186 BA	Ê 312 202 CA	Ú 332 218 DA	ê 352 234 EA	ú 372 250 FA	1 0 1 0	10
213 139 8B	CSI 233 155 9B	« 253 171 AB	» 273 187 BB	Ë 313 203 CB	Û 333 219 DB	ë 353 235 EB	û 373 251 FB	1 0 1 1	11
214 140 8C	234 156 9C	254 172 AC	¼ 274 188 BC	Ì 314 204 CC	Ü 334 220 DC	ì 354 236 EC	ü 374 252 FC	1 1 0 0	12
RI 215 141 8D	235 157 9D	255 173 AD	½ 275 189 BD	Í 315 205 CD	Ÿ 335 221 DD	í 355 237 ED	ÿ 375 253 FD	1 1 0 1	13
SS2 216 142 8E	236 158 9E	256 174 AE	276 190 BE	Î 316 206 CE	336 222 DE	î 356 238 EE	376 254 FE	1 1 1 0	14
SS3 217 143 8F	237 159 9F	257 175 AF	¿ 277 191 BF	Ï 317 207 CF	ß 337 223 DF	ï 357 239 EF	▨ 377 255 FF	1 1 1 1	15

|← C1 CODES →|← GR CODES (DEC SUPPLEMENTAL GRAPHICS) →|

KEY

CHARACTER	Æ	306	OCTAL
		198	DECIMAL
		C6	HEX

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Table 25: Special Characters and Line Drawing Set

BITS B4 B3 B2 B1 / ROW	Column 0 (000)	1 (001)	2 (010)	3 (011)	4 (100)	5 (101)	6 (110)	7 (111)
0 0 0 0 / 0	NUL 0/0/0	20/16/10	SP 40/32/20	0 60/48/30	@ 100/64/40	P 120/80/50	♦ 140/96/60	— SCAN 3 160/112/70
0 0 0 1 / 1	1/1/1	DC1 (XON) 21/17/11	! 41/33/21	1 61/49/31	A 101/65/41	Q 121/81/51	▒ 141/97/61	— SCAN 5 161/113/71
0 0 1 0 / 2	2/2/2	22/18/12	" 42/34/22	2 62/50/32	B 102/66/42	R 122/82/52	╫ 142/98/62	— SCAN 7 162/114/72
0 0 1 1 / 3	ETX 3/3/3	DC3 (XOFF) 23/19/13	# 43/35/23	3 63/51/33	C 103/67/43	S 123/83/53	╞ 143/99/63	— SCAN 9 163/115/73
0 1 0 0 / 4	EOT 4/4/4	24/20/14	$ 44/36/24	4 64/52/34	D 104/68/44	T 124/84/54	╢ 144/100/64	├ 164/116/74
0 1 0 1 / 5	ENQ 5/5/5	25/21/15	% 45/37/25	5 65/53/35	E 105/69/45	U 125/85/55	╧ 145/101/65	┤ 165/117/75
0 1 1 0 / 6	6/6/6	26/22/16	& 46/38/26	6 66/54/36	F 106/70/46	V 126/86/56	° 146/102/66	⊥ 166/118/76
0 1 1 1 / 7	BEL 7/7/7	27/23/17	' 47/39/27	7 67/55/37	G 107/71/47	W 127/87/57	± 147/103/67	┬ 167/119/77
1 0 0 0 / 8	BS 10/8/8	CAN 30/24/18	(50/40/28	8 70/56/38	H 110/72/48	X 130/88/58	╨ 150/104/68	│ 170/120/78
1 0 0 1 / 9	HT 11/9/9	31/25/19	) 51/41/29	9 71/57/39	I 111/73/49	Y 131/89/59	╤ 151/105/69	≤ 171/121/79
1 0 1 0 / 10	LF 12/10/A	SUB 32/26/1A	* 52/42/2A	: 72/58/3A	J 112/74/4A	Z 132/90/5A	⌡ 152/106/6A	≥ 172/122/7A
1 0 1 1 / 11	VT 13/11/B	ESC 33/27/1B	+ 53/43/2B	; 73/59/3B	K 113/75/4B	[133/91/5B	⌐ 153/107/6B	π 173/123/7B
1 1 0 0 / 12	FF 14/12/C	34/28/1C	, 54/44/2C	< 74/60/3C	L 114/76/4C	\ 134/92/5C	⌐ 154/108/6C	≠ 174/124/7C
1 1 0 1 / 13	CR 15/13/D	35/29/1D	- 55/45/2D	= 75/61/3D	M 115/77/4D	] 135/93/5D	L 155/109/6D	£ 175/125/7D
1 1 1 0 / 14	SO 16/14/E	36/30/1E	. 56/46/2E	> 76/62/3E	N 116/78/4E	^ 136/94/5E	┼ 156/110/6E	· 176/126/7E
1 1 1 1 / 15	SI 17/15/F	37/31/1F	/ 57/47/2F	? 77/63/3F	O 117/79/4F	(BLANK) 137/95/5F	— SCAN 1 157/111/6F	177/127/7F

KEY

ASCII CHARACTER	ESC	33 OCTAL
		27 DECIMAL
		1B HEX

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Escape and Control Sequences

Escape and control sequences provide more controls in addition to the control characters in the ASCII 7-bit table. These multiple-character control sequences are not displayed but control the displaying, processing, and transmission of characters. At the end of a sequence or during an error condition, the terminal continues to display received characters.

Escape Sequences

The format for an escape sequence is as follows:

ESC	1....1	F
033	040-057	060-176
Escape	Intermediate	Final
sequence	characters	character
introducer	(0 or more	(1 character)
	characters)	

Escape Sequence Introducer - This is the ESC character (octal 033) defined by ANSI X3.4-1977. After receiving ESC, the terminal stores (but does not display) all control function characters received in the proper range.

Intermediate Characters - These are characters received after ESC in the octal range of 040 - 057 (column 2 of the ASCII table). The terminal stores intermediate characters as part of the control function.

Final Character - This is a character received after ESC in the octal range of 060 - 176 (columns 3 - 7 of the ASCII table). The final character indicates the end of the control function. The intermediate and final characters together define the function of the sequence. The terminal then performs the specified function and continues to display received characters. ANSI standard control functions have a final character in the octal range of 100 - 176 (columns 4 - 7 of the ASCII table). Private sequences have a final character in the octal range of 060 - 077 (column 3 of the ASCII table).

Example

Action: Designate ASCII character set as G0.

Sequence

ESC	(	B
033	050	102

Escape sequence   Intermediate Final character
introducer   character

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Control Sequence Format

The format of a control sequence is as follows:

CSI	P.....P	l.....l	F
033 133	060-077	040-057	100-176
Control sequence introducer	Parameter characters (0 or more characters)	Immediate characters (0 or more (characters)	Final character (1 character)

Control Sequence Introducer - The CSI is the ESC (octal 033) and [(octal 133) characters defined by ANSI X3.41-1977. These characters provide 8-bit control functions by using 7-bit characters. After receiving CSI characters, the Rainbow 100 computer stores (but does not display) all control function characters received in the proper range.

During an escape sequence, if the Rainbow 100 computer receives an 8-bit control character, (octal 200-237), the escape sequence is aborted. The 8-bit control character's function is then executed if it is one of the supported functions.

An 8-bit display character, received during an escape sequence, is displayed and does not affect the escape sequence in process.

Parameter Characters - These are characters received after the CSL character, in the octal range of 060 -077 (column 3 of the ASCII table). The parameter characters modify the action or interpretation of the control function. The terminal interprets parameter characters as private when the < = > ? characters (octal 074 - 077) begin the parameter string. The : character (octal 072) is reserved. This means an ANSI-specified control sequence can have a parameter function with a private interpretation.

The Rainbow 100 computer uses two types of parameter characters, numeric and selective. A numeric parameter represents a decimal number, designated by Pn. The decimal characters have a range of 0 -9 (octal 060 - 071). A selective parameter comes from a list of specified parameters, designated by Ps.

If a control sequence includes more than one parameter, the parameters are separated by a delimiter, the ; character (octal 073).

Intermediate Characters - These are characters received after the CS1 character, in the octal range of 040 -057 (column 2 of the ASCII table). The terminal stores these characters as part of the control function.

NOTE

The terminal does not use intermediate characters in control functions.

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Final Character – This is a character received after the CS1 character, in the octal range of 100 - 176 (columns 4 - 7 of the ASCII table). The final character indicates the end of the control function. The intermediate and final characters together define the function of the sequence. The terminal then performs the specified function and continues to display received characters. ANSI standard control functions have a final character in the octal range of 100 - 157 (columns 4 - 6 of the ASCII table). Private sequences have a final character in the octal range of 160 - 176 (column 7 of the ASCII table).

Example

Action: Clear all horizontal tabs.

Sequence

```
ESC  [    3    g
033 133 063 147
Control      Parameter      Final
sequence     character      character
introducer
```

Sequence Examples

These examples show the use of multiple functions selected in one sequence, private parameters and private sequences.

```
ESC  [   ?   4   h      Set smooth scroll mode
033 133 077 064 150      (? = ANSI private parameter)

ESC  [   2   ;   1   y  Invoke self-test
033 133 062 073 061 171  (y = ANSI private sequence)
```

APPENDIX C

RAINBOW 100 COMPUTER AND VT100 TERMINAL FAMILY DIFFERENCES

The following is a list of the differences between the Rainbow 100 and members of the VT100 family of terminals. Also included are certain "points-of-interest" that should be considered by programmers.

DEC'S MULTINATIONAL 8-BIT CHARACTER

The Rainbow 100 computer implements the printing graphics found in DEC's Multinational Character set, and the 8-bit character codes for the printing characters. It is a subset of the Multinational Character set. It is not the full character set. In particular, it does not implement all the control sequences specified for the Multinational Character set.

8-BIT CHARACTER CODES

The Rainbow 100 computer accepts and acts on 8-bit character codes, the VT102 terminal always strips the 8th bit. If 8-bit codes are received in VT52 mode, they will be handled the same as in ANSI mode.

C1 CONTROL CODES

Rainbow 100 computer executes (8-bit) control codes for index, next line, horizontal tab set, reverse index, single shift 2, single shift 3, control sequence introducer. Reception of any C1 control code will abort an escape sequence in process (CSI restarts an escape sequence). The control codes are processed and the graphic characters are displayed. This is not a recommended way of aborting escape sequences. It is not guaranteed to work this way in future versions of the Rainbow personal computer family.

KEYBOARD AND 8-BIT KEY CODES

Rainbow 100's keyboard is called the LK201 keyboard. The Rainbow 100 computer never asks the LK201 Keyboard's non-US keys (those keys that generate 8-bit character codes). Software written for Rainbow should always treat 8-bit characters generated by the keyboard the same as 7-bit characters. In future Rainbow systems 8-bit characters will be generated by all keyboards, US and non-US. This is to say, an operator will be able to generate an 8-bit "a-umlat" character from any national version of the keyboard.

KEYBOARD COMPOSE KEY

When in terminal mode, the Compose key is non-functional and rings the bell when pressed. When the operating system is running, the Compose key, if pressed, generates an escape sequence. Application software should never use this key for any purpose. In future Rainbow 100 systems the key will be used by the firmware or the operating system to generate 8-bit character codes.

KEYBOARD CONTROL CODE GENERATION

Rainbow 100 computer requires use of the Shift key for some of the keyboard-entered control codes. This is due to the uncertainty of character location on various non-US national keyboards.

SET-UP PURGING KEYBOARD BUFFER

When the Set-Up key is pressed to enter Set-Up mode in the Rainbow 100, the key-holding buffer is cleared which causes any unserviced keys to be lost and Set-Up is immediately honored.

WAIT INDICATOR

When the keyboard buffer fills up, the Rainbow 100 computer ignores further entries and sounds the bell. It lights the Wait LED as the VT102 terminal does. The bell and Wait LED are used to notify the user that the key was not accepted.

KEYBOARD PRINT SCREEN KEY IN TERMINAL MODE

Terminal mode print functions are implemented via the Print Screen key on the Rainbow 100 computer. VT102 terminal uses the keypad Enter key. Rainbow 100's Print Screen is equivalent to VT102's <Shift/Enter> and Rainbow 100's <Ctrl/Print Screen> is equivalent to VT102's <Ctrl/Enter>.

KEYBOARD HOLD-SCREEN KEY

The Hold Screen key on the Rainbow 100 computer does not work the same as the NO SCROLL key on a VT102 terminal. On a VT102 terminal it sends an XOFF/XON as it toggles back and forth the <Ctrl/S> and <Ctrl/Q> typed from the keyboard can be used to get the same effect. Setting Hold Screen for the Rainbow 100 computer does not necessarily cause an XOFF to be sent. It sets an internal flag that causes the "receive character" process to loop until the flag is cleared. This effectively "hangs" any console output (normal or direct) in console mode. In terminal mode this "hang" causes the comm receive buffer to fill up until it reaches the high water mark at which point it will send an XOFF, if enabled by Set-Up. After the Hold Screen is removed, characters are removed from the receive buffer until the low water mark is reached which causes XON to be sent, if enabled.

As a result of this method of implementation, Rainbow 100 computer honors Hold Screen even in "local", VT102 terminal does not.

In Rainbow 100 terminal mode, after using Hold Screen on incoming data, the last char for display is being 'held'. Entering setup, switching to local, and exiting from setup does not clear the 'hold' state or the char. When 'hold' is finally removed, the char originally being 'held' is displayed before any locally generated characters.

In the Rainbow 100 computer, if the Print Screen key is depressed while the Hold Screen is asserted, the print is deferred until after the 'hold' is removed and char being 'held' is processed. The VT102 terminal prints a screen even if the NO SCROLL key as been depressed.

KEYBOARD CURSOR KEY MODES

Cursor key mode and keypad mode for the Rainbow 100 computer are independent. In the VT102 terminal, the cursor keys only send application codes if both cursor and keypad modes are set to 'application'.

PRINTER CHARACTER SETS IN TERMINAL MODE

The Rainbow 100 computer assumes the printer is capable of properly receiving 8-bit DEC Multinational characters.

PRINTING BLOB CHARACTERS IN TERMINAL MODE

When printing from the screen in terminal mode and encountering a 'blob' character, the VT102 terminal sends ASCII 'SUB' to the printer. The Rainbow 100 computer sends the VT100 line-drawing graphics character 'blob' bracketed by the appropriate character set selection escape sequence if required.

PRINTER PORT DEFAULTS

Factory Set-Up defaults are not the same as the VT102 terminal for the printer port.

PRINT CURSOR LINE OPERATION IN TERMINAL MODE

At the completion of a 'print cursor line' operation, Rainbow 100 computer sends the escape string to restore the printers G0 char set in between the terminating carriage return and line feed. VT102 terminal sends it after the line feed.

PRINTER PORT STATUS REQUEST IN TERMINAL MODE

The following anomaly occurs when a printer cable is attached to a Rainbow after it is powered up, but the printer end of the cable is not attached to anything.

```
A printer status request is made to Rainbow :   ESC [ ?  n
Rainbow responds:         Printer not ready   :   ESC [ 11 n
                          or No printer        :   ESC [ 13 n
VT102 responds:           No printer           :   ESC [ 13 n
```

TERMINAL ID

The Rainbow 100 computer identifies itself as a VT102 terminal.

INSERT AND DELETE LINE ESCAPE SEQUENCES

```
    Insert Line:    CSI   Pn   L
    Default line:   CSI   Pn   M
```

If the cursor is on the last line of the scrolling regions, and the line is double-width, then after execution of either of the above controls, the active line attributes are:

A0 On Rainbow 100: single-width

B0 On the VT102 terminal: whatever the active line attributes were before execution of the control sequence.

ALTERNATE ROM CHARACTER SETS

Rainbow 100 computer does not implement the alternate ROM character sets found in the VT102 terminal.

ALTERNATE ROM AND LED ESCAPE SEQUENCES

The Rainbow 100 computer parses but ignores the escape sequences to set G0 and G1 to the alternate ROM and alternate ROM special graphics (ESC (1 , ESC (2 , ESC) 1 , ESC) 2). It will parse but ignore the escape sequence for LED control (ESC [Pn q). Rainbow has no alternate ROMs and the LEDs are not available for software control.

G2 AND G3 CHARACTER SETS

G2 and G3 are permanently designated as the NVM default character set. They are either US or UK variations of Rainbow's subset of the multinational character set. They can be invoked for single characters by the single-shift-2 or single-shift-3 escape sequences or the C1 control codes.

ERASE LINE AND ERASE DISPLAY

In Rainbow 100, escape sequences for erase in line and erase in display, only the first selective parameter is processed. If more than one is sent, the additional parameters are ignored.

ABORTING ESCAPE SEQUENCES BY INTERMEDIATE CHARACTERS

Rainbow 100 computer aborts escape sequence parsing when it finds an intermediate char causing all following characters to be displayed. VT102 terminal aborts the sequence but continues parsing until it finds a final char so the intervening part of the escape sequence does not display.

INSERT AND REPLACE MODES

Rainbow 100 computer always sets insertion/replacement mode to replacement before saving into NVM. These modes are not user selectable. They are only selectable by software.

SELFTEST ESCAPE SEQUENCES

The Rainbow 100 computer parses but ignores the escape sequences to run self tests (ESC [2 , Pn y). Also the device status report request (ESC [5 n) will always cause the ready, no malfunctions reply (ESC L 0 n).

RESET TO INITIAL STATE

In Rainbow 100 computer, ESC c (reset to initial state) does not reset keypad and cursor keys to their normal modes. RIS is a dangerous sequence to issue from workstation software. It is not recommended to be used. Its function will change in future versions of Rainbow.

VT52 MODE AND ORIGIN MODE

The Rainbow 100 computer in VT52 mode honors the origin mode setting, VT102 terminal in VT52 modes does not.

AUTOWRAP MODE

The Rainbow 100 computer maintains the wrap-pending flag unconditionally and tests it conditionally. VT102 terminal maintains the flag conditionally and tests it conditionally. This implementation affects where the next character goes when the auto-wrap mode is CHANGED while the cursor is in the 'line-filled' position. The VT102 terminal places the cursor in a different place than the Rainbow. Software is recommended to not use auto wrap mode for controlling the placement of the text on the screen.

TAB AND AUTO WRAP

In Rainbow 100 computer the Tab character always clears the wrap-pending flag. As a result, if Tab is the 81st char in an 80 char line, char 82 will not wrap but char 83 will. In a VT102 terminal, char 82 will wrap.

DISABLE CURSOR AND ENABLE CURSOR FIRMWARE FUNCTIONS

The Rainbow 100's ENABLE and DISABLE cursor firmware functions are designed to only work with the direct video formware functions. They will not work with the normal single character at a time screen updates.

XON/XOFF PROTOCOL AND BUFFER SIZE IN TERMINAL MODE

In Rainbow 100 terminal mode, the second XOFF is sent at 'buffer-full'. In a VT102 terminal, the second XOFF is sent 12 char before 'buffer-full'. Also the Rainbow 100 buffer is 255 char in size, a VT102 terminal is 128.

FULL DUPLEX COMMUNICATION PROTOCOL IN TERMINAL MODE

The Rainbow 100 computer always precedes the dropping of DTR with a EOT character. The VT102 terminal does not always do this. The Rainbow 100 computer does not disconnect if it is placed in Local mode. The VT102 terminal disconnects if placed in local mode.

HALF DUPLEX COMMUNICATION SUPPORT IN TERMINAL MODE

The Rainbow 100 terminal emulation does not support the half duplex communication protocols of the VT102 terminal.

APPENDIX D

INTERNATIONAL LANGUAGE KEYBOARDS

The figures in this appendix illustrate the different national
language keyboards that are or will be available. One of the main
differences is the label strip that you add to the top of the
keyboard. The label strip comes in the country kit.
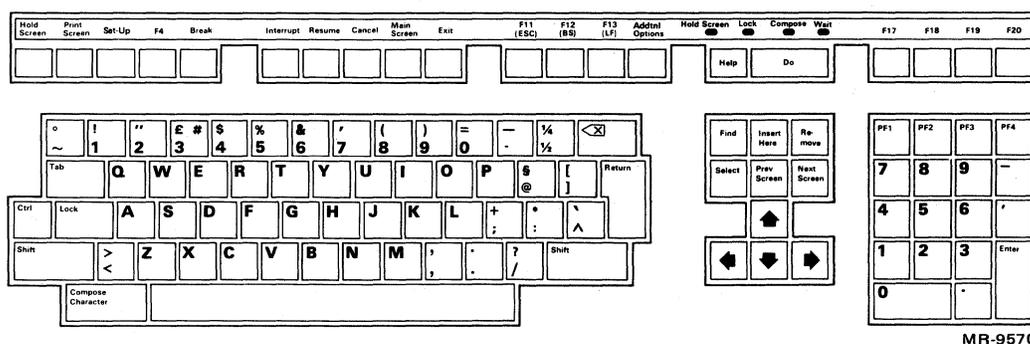
Figure 5: LK201-AE British Keyboard
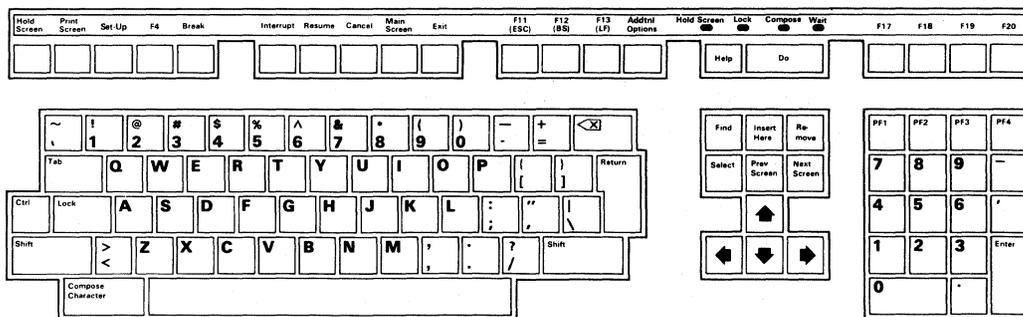
Figure 6: LK201-AA American (English) Keyboard
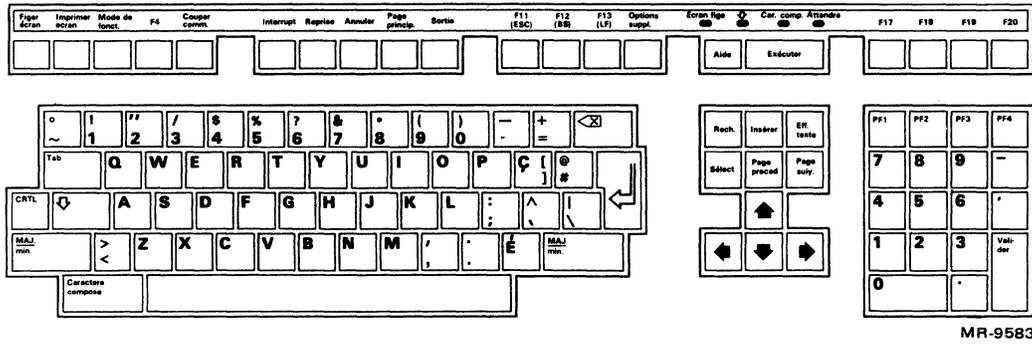
Figure 7: LK201-AC Canadian (French) Keyboard
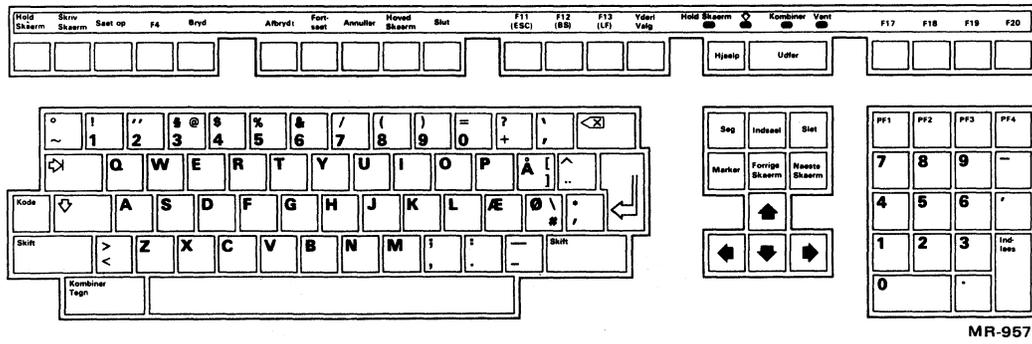
Figure 8: LK201-AD Danish Keyboard
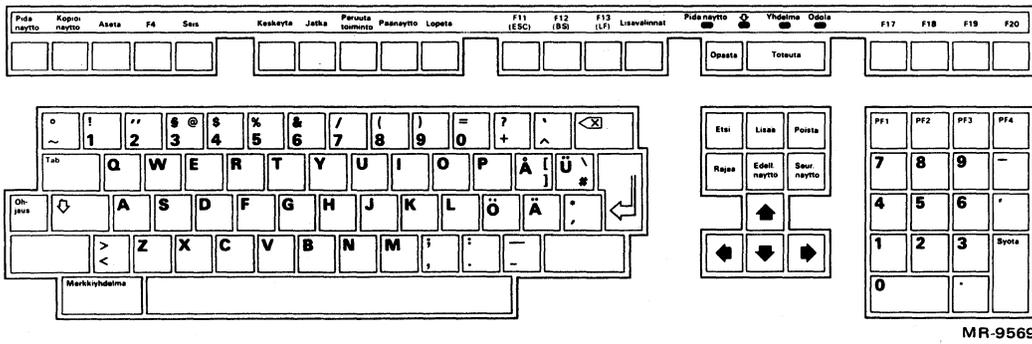
Figure 9: LK201-AF Finnish Keyboard

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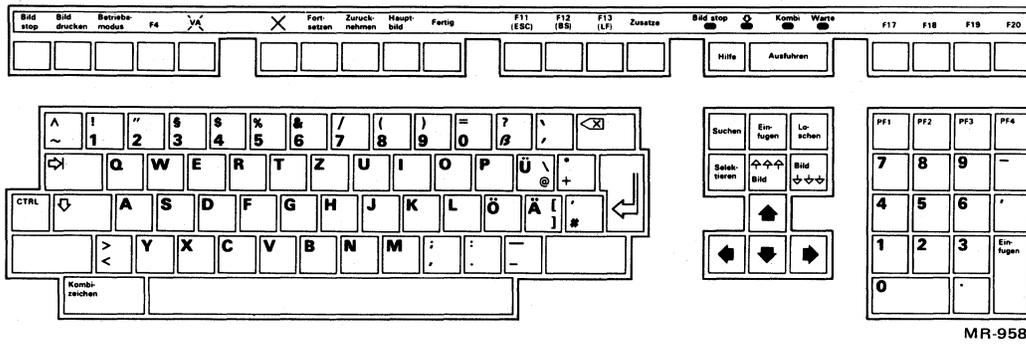
Figure 10:   LK201-AG Austrian/German Keyboard
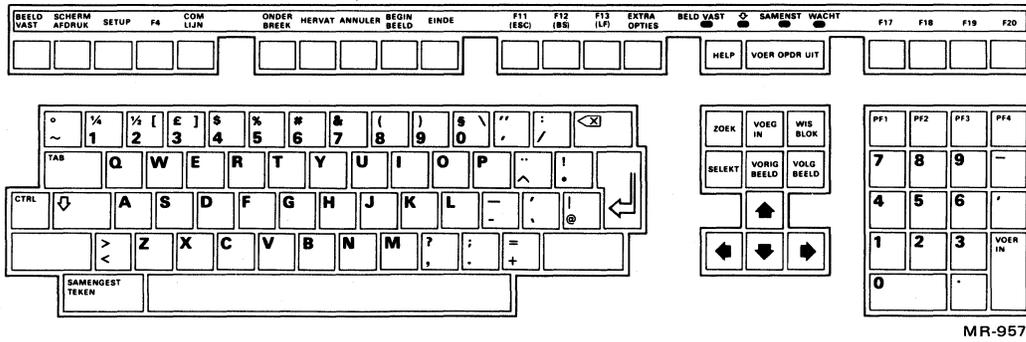
Figure 11:   LK201-AH Dutch Keyboard
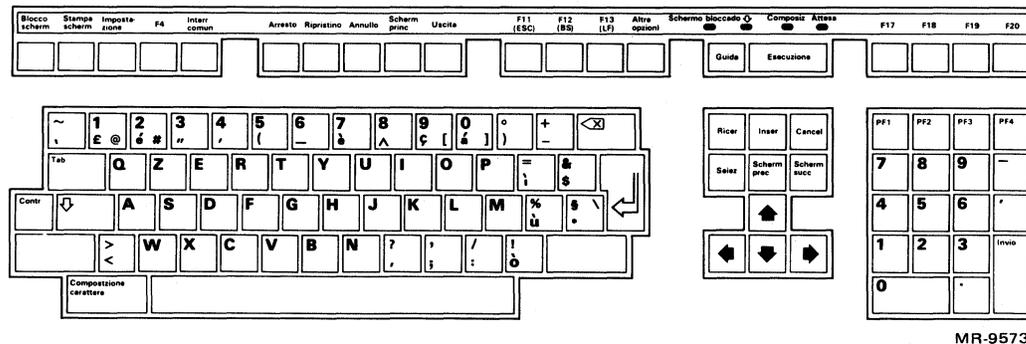
Figure 12:   LK201-AI Italian Keyboard
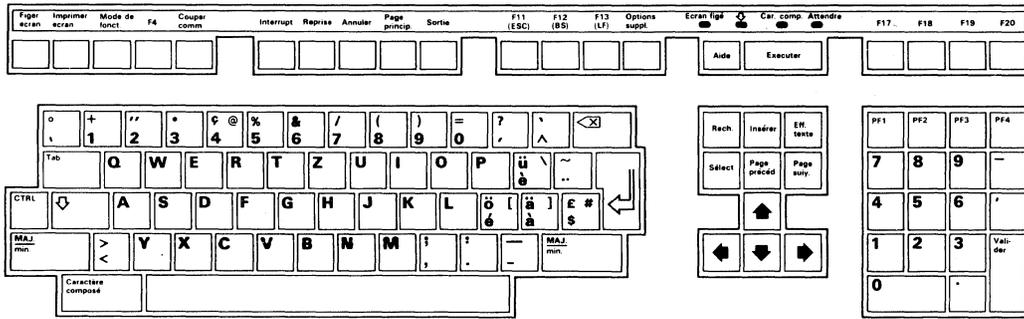
Figure 13:   LK201-AK Swiss (French) Keyboard
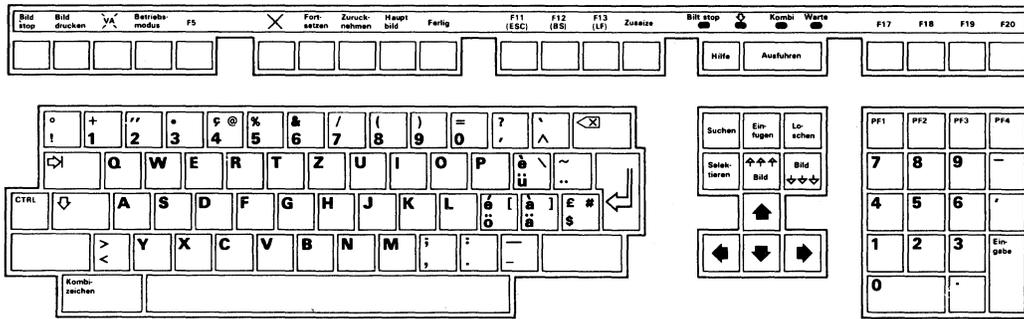
Figure 14:   LK201-AL Swiss (German) Keyboard
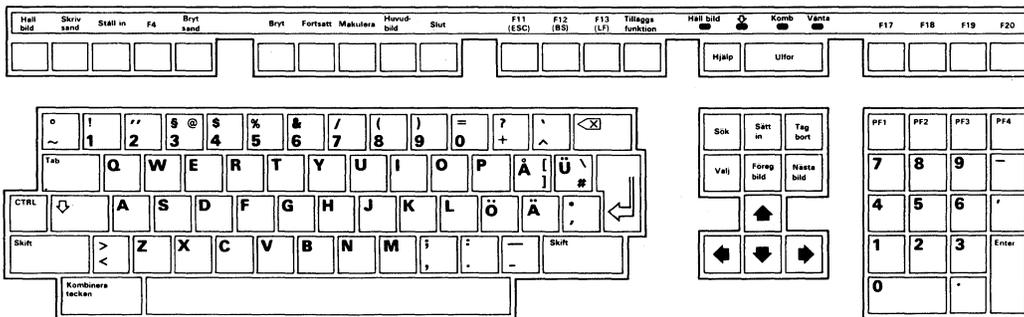
Figure 15:   LK201-AM Swedish Keyboard
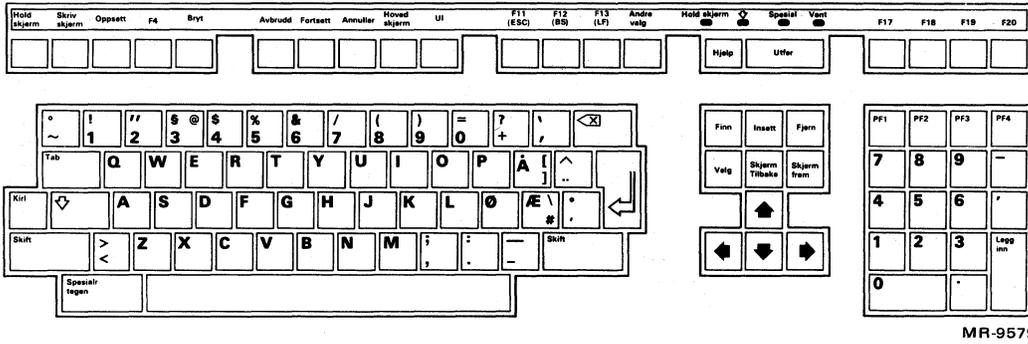
Figure 16:   LK201-AN Norwegian Keyboard
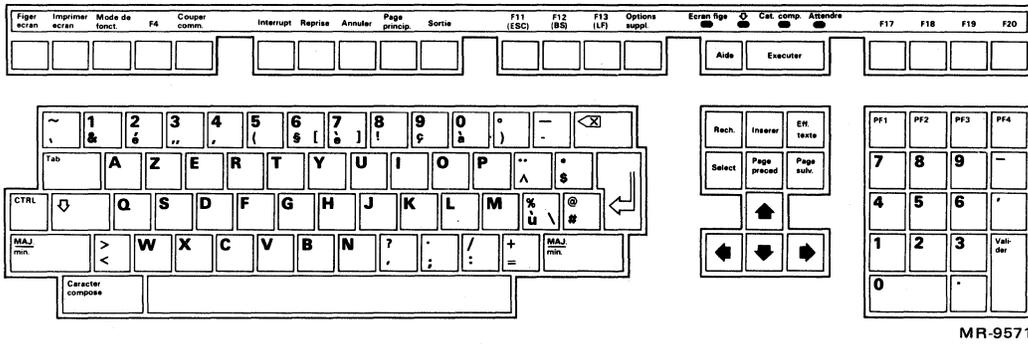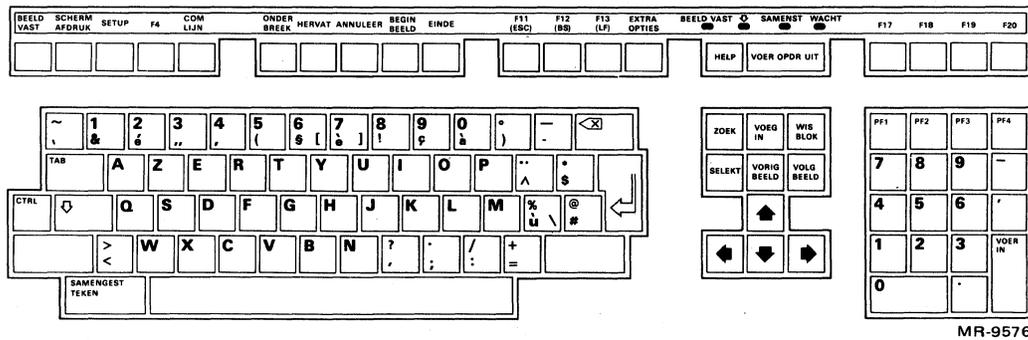
MR-9579

Figure 17:   LK201-AP Belgian/French Keyboard

MR-9571

Figure 18:   LK201-AT Flemish Keyboard
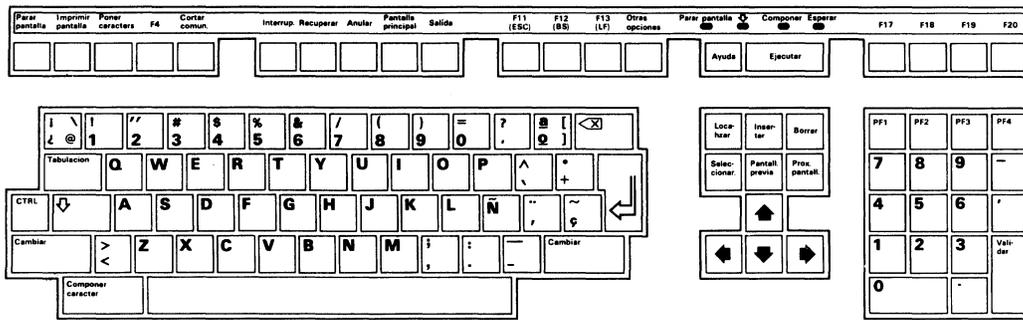
MR-9576

Figure 19: LK201-AS Spanish Keyboard

MR-9574

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