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## 1. INTRODUCTION

The HOLBORN TERMINAL model 9120 is controlled by an Z80 micro-processor in combination with some peripherals.

(see fig 1.1 - 1.4)

The Terminal consist of 16K byte dynamic RAM and 8K Erasable PROM (for program).

The display format is organized with 24 lines of 80 characters each. Up to 16 atributes per line may be entered, which are not displayed but perform special display functions.

The 25th line is the STATUS line and provides update information on operation modes, error message, communication protocol and the current operating configuration.

At power-up or upon reset function, the Terminal initiates a selftest and the result of it will appear on the STATUS line.

The terminal can easy be set in different modes, by displaying an unique picture that gives the current mode settings of the terminal, where some of these settings can locally be changed under keyboard control.

The operator or host computer has the capability to 'lock' portions of the display from operator access while retaining the capability to enter or receive data in the 'unlocked' portion of the display memory.

Up to eleven graphic characters in four different displayable video levels can be generated.

Two types of character sets are possible namely :

- the 128 ASCII character set.
- the 52 Holborn special character set.

Some other significant features of the terminal include X-Y addressing, read cursor address, invisible memory address pointer and read terminal status.

HOLBORN TERMINAL 9120

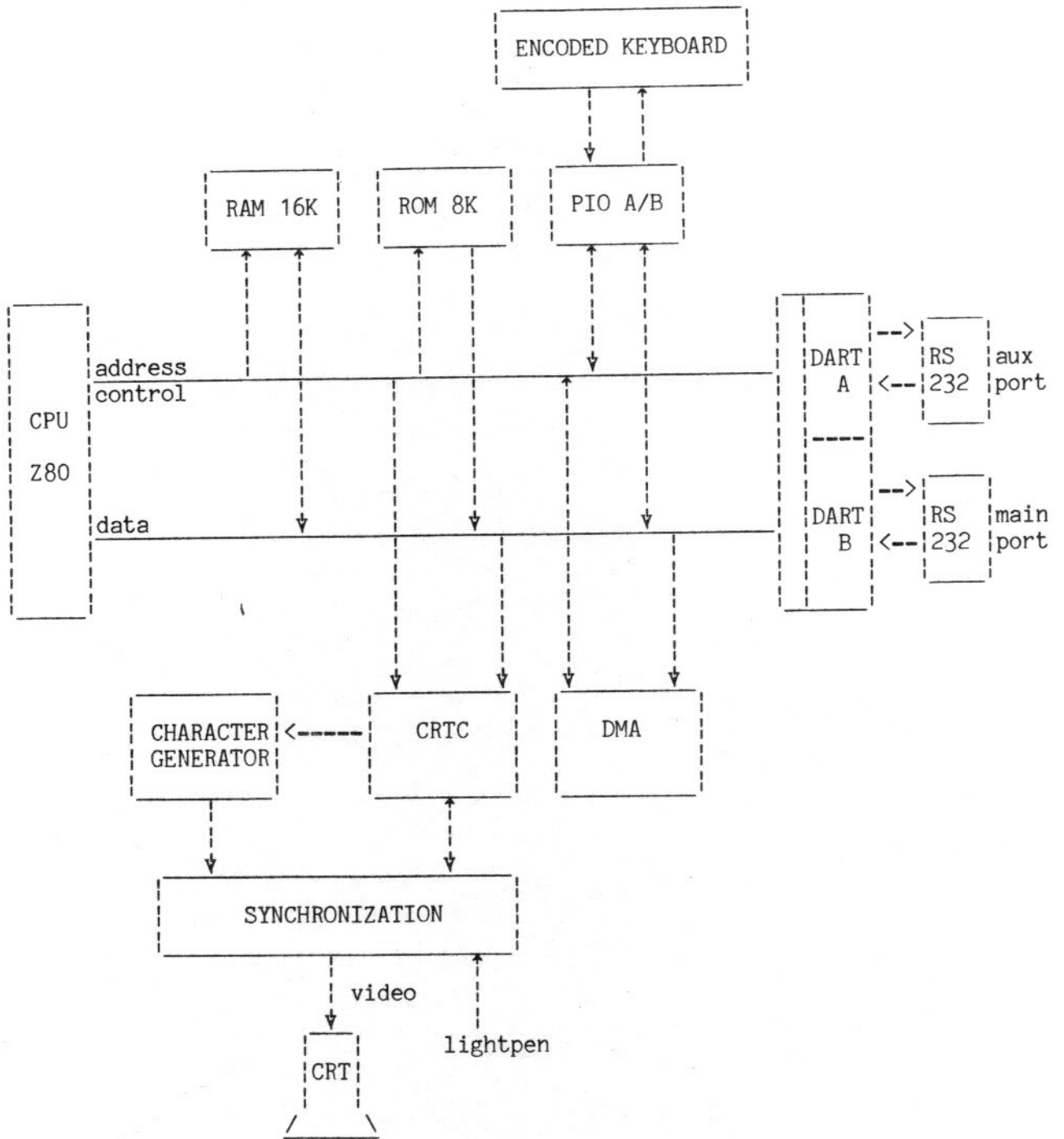


fig. 1.1

## Baudrate Selection

### Receiver Baudrate A

S2		
o	o	19.200
o	o	9.600
o	o	4.800
o	o	2.400
o	o	1.200
o	o	600
o	o	300
o	o	75

### Transmitter Baudrate A

S3		
o	o	19.200
o	o	9.600
o	o	4.800
o	o	2.400
o	o	1.200
o	o	600
o	o	300
o	o	75

### Receiver/Transmitter Baudrate B

S4		
o	o	19.200
o	o	9.600
o	o	4.800
o	o	2.400
o	o	1.200
o	o	600
o	o	300
o	o	75

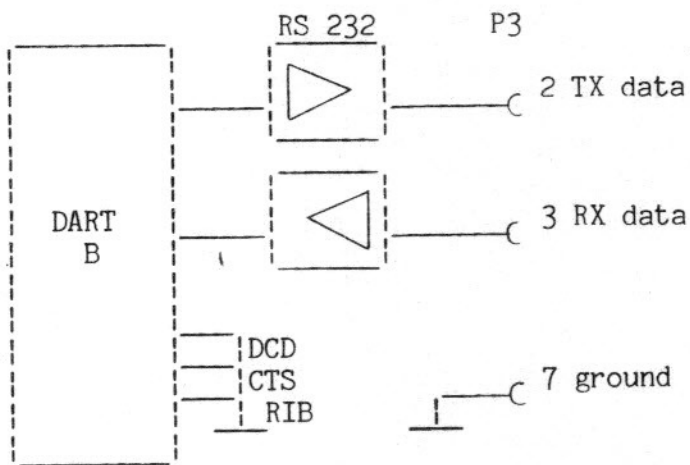
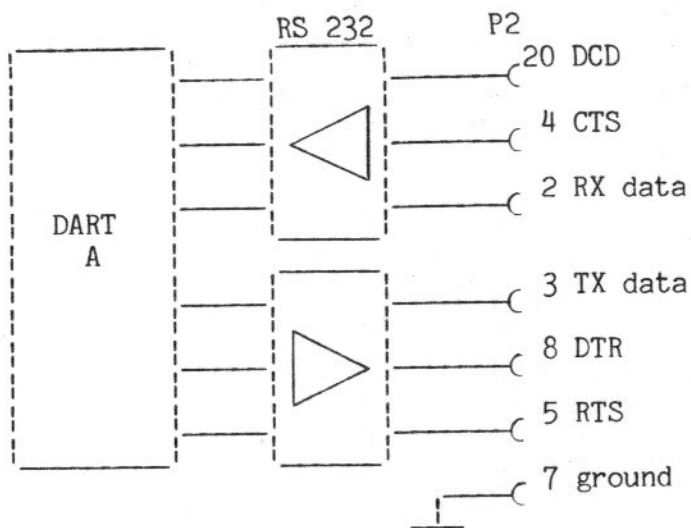


fig. 1.2

HOLBORN TERMINAL 9120

PIO Keyboard  
interface

Keyboard  
signals

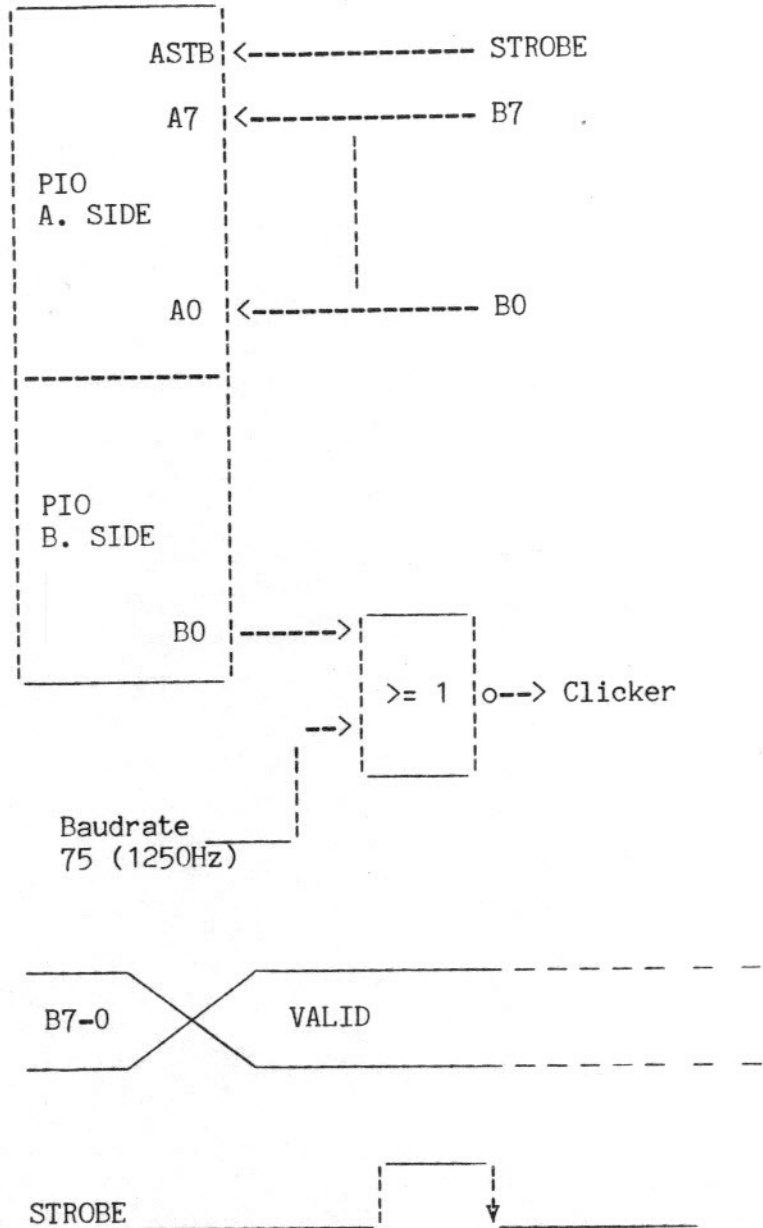
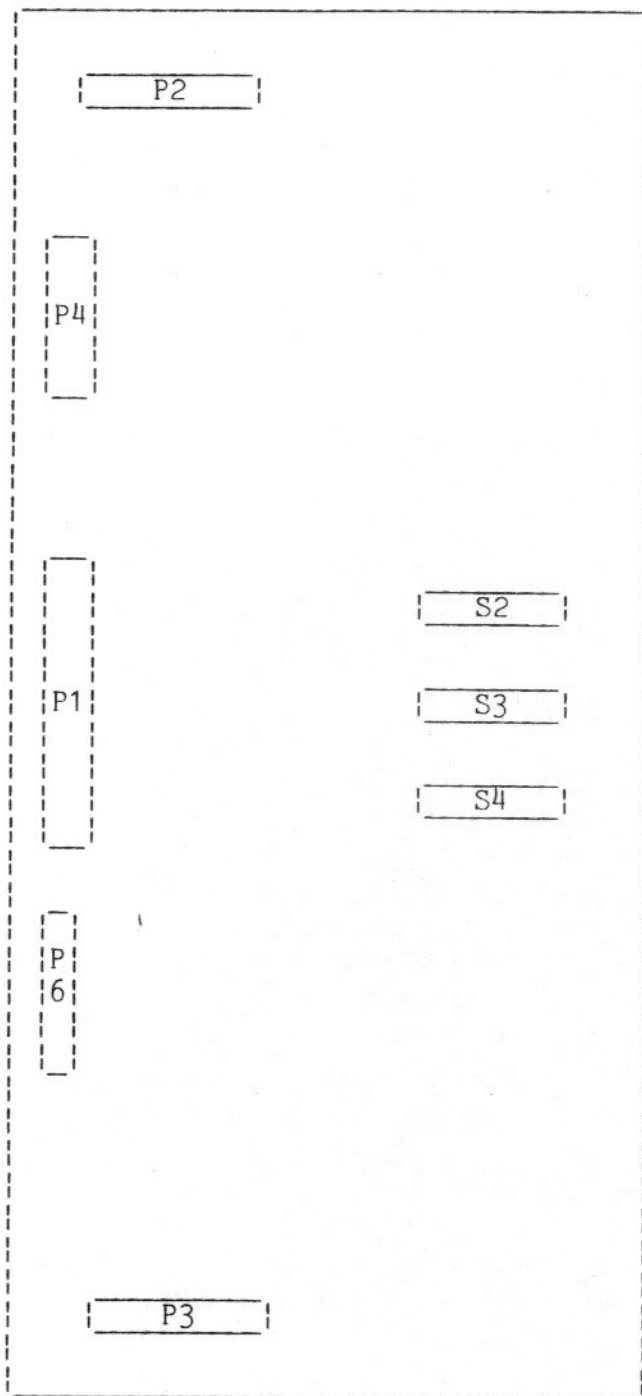


fig. 1.3



- |    |                   |    |                            |
|----|-------------------|----|----------------------------|
| P1 | Z80 bus           | S2 | Baudrate selections Dart A |
| P2 | DART A(Auxiliary) | S3 | Baudrate selections Dart A |
| P3 | DART B(Main)      | S4 | Baudrate selections Dart B |
| P4 | Keyboard          |    |                            |
| P6 | CRT               |    |                            |

fig. 1.4



## 2. TERMINAL MODE SETTINGS

The operating configuration of the Holborn Terminal can be defined in two ways:

- 1 - locally under keyboard control
- 2 - by several ESC sequences (locally and online)

### 2.1 Display/Change Terminal Mode Settings

Associated key : None

Keyboard Operation : | SETUP | | ESC | | # |

I/O operation : None

Typing the sequence | SETUP | | ESC | | # |

saves the current screen display and put an unique picture on the screen (see table 2.1).

This unique picture consist of the current mode settings of the HOLBORN terminal.

Each active setting is displayed in reverse video.

The upper part of these settings can be changed by positioning the cursor (with the cursor control keys) over the setting that must be changed and then pressing the :

| ENTER | key.

If the operator has pressed the ENTER key, the new setting will be displayed in Reverse Video and the old setting will be changed in normal video.

To exit from Terminal mode display, just press the :

| SETUP | key and | any-other | key.

except the SHIFT or CTRL key and the old screen display will be repositioned.

Table 2-1 Terminal Mode Display.

	MAIN BAUD RATE	:	* 1	* 1/2	* 1/4		
	AUXILIARY BAUD RATE	:	* 1	* 1/2	* 1/4		
C							
H	TERMINATION CHARACTER(S)	:	CR-LF	ETX	EOT	CR	
A							
N	PARITY SELECT	:	EVEN	SPACE	ODD	MARK	
G							
E	DUPLEX MODE	:	HALF-DUPLEX		FULL-DUPLEX		
A	RECEIVER ERROR CHECK	:	OFF		ON		
B	ROLL MODE	:	OFF		ON		
L	AUTO-LINEFEED	:	OFF		ON		
E	LOWER CASE INHIBIT	:	OFF		ON		
	AUTO ECHO	:	OFF		ON		
	INHIBIT ESC CODES	:	OFF		ON		
	AUX ON	:	OFF		ON		
	AUX ENABLE	:	OFF		ON		
S	GRAPHICS MODE	:	OFF		ON		
T	LINE LOCK	:	OFF		ON		
A	MEMORY LOCK	:	OFF		ON		
T	HOLBORN MODE	:	OFF		ON		
U	SELF DIAGNOSTIC	:	NO FAULT		ROM-	RAM-	
S					FAULT	FAULT	
	SOFTWARE VERSION	:	HE8				

When the operator performs a selftest

( ESC f or SETUP || CTRL V )

or switch the Power off and on, the Terminal Mode Settings will be set to its initial values (that can only be changed by HOLBORN).

When the operator performs a RESET function,

( ESC V ) the current terminal settings will NOT be changed.

### 2.1.1 Change Main Baud Rate.

The Main Baud Rate can be set by internal jumpers (see fig 1.2) and under software control by means of a multiplication factor (see subhead 3.13.5).

### 2.1.2 Change Auxiliary Baud Rate.

The Auxiliary Baud Rate can be set by internal jumpers (see fig 1.2) and under software control by means of a multiplication factor (see subhead 3.13.6).

### 2.1.3 Change Termination Character(s).

Associated key : None

Keyboard operation : ESC \$ TERM.CHAR.

I/O operation : Receipt of ESC \$ TERM.CHAR.

The initial termination character is CR and can be changed by typing :

( SETUP if online ) ESC || \$ || TERM.CHAR.

TERMINATION CHARACTER	CRLF	ETX	EOT	CR
ESC \$	0	1	2	3

#### 2.1.4 Change PARITY.

Associated key : None

Keyboard operation : ESC % PARITY

I/O operation : Receipt of ESC % PARITY

The initial parity selection is SPACE and can be changed by typing :

( SETUP if online ) ESC % PARITY

PARITY	EVEN	SPACE	ODD	MARK
ESC %	0	1	2	3

The parity selection allows for an ODD or EVEN parity bit, or a mark or space bit to be generated following the data in the serial data word.

Mark or space parity is generated by transmitting an 8-bit data word and forcing the eight bit low or high.

If odd or even parity is selected and Receiver Error Check is on, received data are also examined for proper parity.

#### 2.1.5 Change Duplex Mode.

Associated key : None

Keyboard operation : ESC & DUPLEX MODE

I/O operation : Receipt of ESC & DUPLEX MODE

The initial duplex mode is FULL DUPLEX and can be changed by typing :

( SETUP if online ) ESC & DUPLEX MODE

DUPLEX MODE	HALF DUPLEX	FULL DUPLEX
ESC &	0	1

The full/half duplex setting determines how data originating from the keyboard are routed within the terminal when operating online.

In half duplex mode, data entered via the terminal keyboard are sent to the I/O port and the display memory simultaneously.

In full duplex mode, data entered via the terminal keyboard are sent to the I/O port only.

Data must be received to be displayed except in the auto echo mode. In full duplex mode, RTS (request to send) is raised any time the terminal is online.

In half duplex, RTS is raised only when transmission occurs.

### 2.1.6 Change Receiver Error Check.

Associated key : None

Keyboard operation : | ESC ' ERROR CHECK |

I/O operation : Receipt of | ESC ' ERROR CHECK |

The initial Receiver Error Check is 'OFF' and can be changed by typing :

( | SETUP | if online ) | ESC | | ' | | ERROR CHECK |

Receiver ERROR CHECK	OFF	ON
ESC '	0	1

When receiver error check is 'ON' and parity is set to Even or Odd, an ASCII substitute(SB) is displayed and the Bell will sound if a receiver parity error is detected.

### 2.1.7 Change ROLL MODE.

Associated key : None

Keyboard operation : ESC + ROLL MODE

I/O operation : Receipt of ESC + ROLL MODE

The initial value of ROLL MODE is 'ON' and can be changed by typing :

( SETUP if online ) ESC + ROLL MODE

ROLL MODE	OFF	ON
ESC +	0	1

When roll mode is 'ON', data scrolls upwards if the cursor is in the bottom line and a line feed code is received. As a result of the upward scroll, all data on the page moves up by one line, with data previously on the top line being lost and a new blank line appearing at the bottom of the page. If the roll mode is 'OFF', the display page does not scroll. A command which attempts to move the cursor down from the bottom line causes the cursor to appear in the top line.

### 2.1.8 Change Auto Line Feed MODE.

Associated key : None

Keyboard operation : ESC , AUTO LINEFEED

I/O operation : Receipt of ESC , AUTO LINEFEED

The initial Auto Line Feed Mode is 'OFF' and can be changed by typing :

( SETUP if online ) ESC , AUTO LINEFEED

AUTO LINE FEED MODE	OFF	ON
ESC ,	0	1

In auto line feed mode 'ON', the RETURN key transmits carriage return-line-feed codes and performs a return and line feed locally.

Received or echoed CR is executed as a CR-LF.

With autolinefeed mode 'OFF', the RETURN key transmits and performs only a carriage return.

### 2.1.9 Change Lower Case Inhibit.

Associated key : None

Keyboard operation : ESC - LOWER CASE

I/O operation : Receipt of ESC - LOWER CASE

The initial Lower Case Inhibit mode is 'OFF' and can be changed by typing :

( SETUP if online ) ESC | - | LOWER CASE

LOWER CASE INHIBIT	OFF	ON
ESC -	0	1

When Lower Case Inhibit mode is 'ON', all keyboard entered alpha characters a-z are forced to the upper case regardless of the condition of SHIFT or CAPS-LOCK.

No other codes are affected.

If Lower Case Inhibit is 'OFF', all keys are fully shiftable. Received data remain unaffected by this mode.

### 2.1.10 Change Auto Echo Mode.

Associated key : None

Keyboard operation : ESC . AUTO ECHO

I/O operation : Receipt of ESC . AUTO ECHO

The initial Auto Echo Mode is 'OFF' and can be changed by typing :

( SETUP if online ) ESC | . | AUTO ECHO

AUTO ECHO MODE	OFF	ON
ESC .	0	1

When the Auto Echo Mode is 'ON', the terminal displays and operates on all data transmitted over the main serial port. When the Auto Echo Mode is 'OFF', no automatic echo occurs. This mode is only effective in full duplex and allows full duplex communications without read for echo from the host CPU.

#### 2.1.11 Change Inhibit ESC codes mode.

Associated key : None

Keyboard operation : ESC / ESC CODE

I/O operation : Receipt of ESC / ESC CODE

The initial Inhibit ESC Code Mode is 'OFF' and can be changed by typing :

( SETUP if online ) ESC / ESC CODE

INHIBIT ESC CODES	OFF	ON
ESC /	0	1

When the Inhibit ESC Code Mode is 'ON', all single key escape code sequences (see Subhead 3.8) are performed locally without transmission, regardless of half or full duplex modes.

The ESC key remains unaffected and operational.



## 2.2 Programmable Keys.

Associated key : None

Keyboard operation : 

ESC	w	KEY	Length	Code
-----	---	-----	--------	------

I/O operation : Receipt of 

ESC	w	Length	Code
-----	---	--------	------

When the sequence ESC w is detected, the next ASCII-code must be the key Identification (see table 2.2), then the length (ASCII '0' - '4') of the Code that will be programmed for that key and then the programming code.

Keys that can be programmed are listed in table 2.2.  
(Key '0' - '9' are not those on numerical keyboard)  
The maximum length of the code that can be programmed for each key is four.

After a HARD-RESET or SELF-TEST function (see subhead 3.20.2 and 3.25.4) the programmable keys will return to their initial value (NO SCRL-NO function, FC-NO function).

Table 2-2 Programmable keys.

KEY	KEY IDENTIFICATION	INITIAL VALUE(NORMAL)	INITIAL VALUE(WORD STAR)
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9
0	0	0	0
	CTRL-A	(ESC)(A)	CTRL-E
	CTRL-B	(ESC)(B)	CTRL-X
	CTRL-C	(ESC)(D)	CTRL-S
	CTRL-D	(ESC)(C)	CTRL-D
HOME	CTRL-E	(ESC)(H)	CTRL-Z
FC	CTRL-F	NO FUNCTION	CTRL-C
NO SCRL	CTRL-G	NO FUNCTION	NO FUNCTION
ENTER	CTRL-H	TERMINATION CHAR.	
***** NUMERICAL KEYBOARD *****			
0	CTRL-I	0	CTRL-B
1	CTRL-J	1	CTRL-G
2	CTRL-K	2	CTRL-T
3	CTRL-L	3	CTRL-Y
4	CTRL-M	4	CTRL-N
5	CTRL-N	5	CTRL-Q / A
6	CTRL-O	6	CTRL-L
7	CTRL-P	7	CTRL-K
8	CTRL-Q	8	CTRL-O
9	CTRL-R	9	CTRL-P
.	CTRL-S	.	CTRL-K / D
,	CTRL-T	,	CTRL-V
-	CTRL-U	-	CTRL-Q
PF2	CTRL-V	STATUS(FIXED)	CTRL-W
PF4	CTRL-W	CLEAR	CTRL-R
BREAK	CTRL-X	BREAK	CTRL-F
BACK SPACE	CTRL-Y	BACK SPACE	CTRL-A
ENTER (WS)	CTRL-Z		CTRL-K/S CTRL-Q/P

### 3. OPERATION.

#### 3.1 Turn-On procedure.

#### 3.2 Communication modes.

The Holborn Terminal can operate in off line (local) or online (see subhead 3.26.2)

Two operational modes of communication are provided when the terminal is online : full duplex and half duplex.

##### 3.2.1 Local.

Data communication takes place between the keyboard and display memory only. No data transmission occurs.

##### 3.2.2 On line.

Data are entered into memory, displayed according to the duplex mode setting, and transmitted to the HOST.

Transmission of the data to the HOST takes place in either full duplex or half duplex.

##### 3.2.3 Full duplex.

Data sent from the keyboard through the I/O port goes to the HOST only and are not displayed.

Only data received from the HOST are displayed by the terminal.

##### 3.2.4 Half duplex.

Keyboard entered data are displayed and transmitted to the HOST simultaneously.

### 3.3 Transmission mode.

During character transmission, the terminal must be online. Received alpha numerics are stored in display memory. Received control codes or escape codes cause the terminal to perform the appropriate function and are not stored in memory or displayed.

#### 3.3.1 Auxiliary character transmission.

The Holborn terminal has a bidirectional serial auxiliary port with buffering on both transmit and receive lines.

The terminal recognizes the command to turn on the auxiliary interface even when in local mode.

The buffer size (256 on both sides) compensates for :

1 - similar functional speed between mechanical and electronic devices.

2 - possible differences in baudrate setting (MAIN-AUX).

It is possible that the auxiliary transmit buffer becomes full, if this happens the Terminal will put a X-OFF (CTRL-S) into the MAIN transmit buffer and a X-ON (CTRL-Q) if the auxiliary transmit buffer will again become empty.

#### 3.3.2 I/O DATA FLOW.

Table 3-1 summarizes the possible data flow paths within the terminal.

The STATUS line will indicate what operational mode is selected (see subhead 3.26.2).

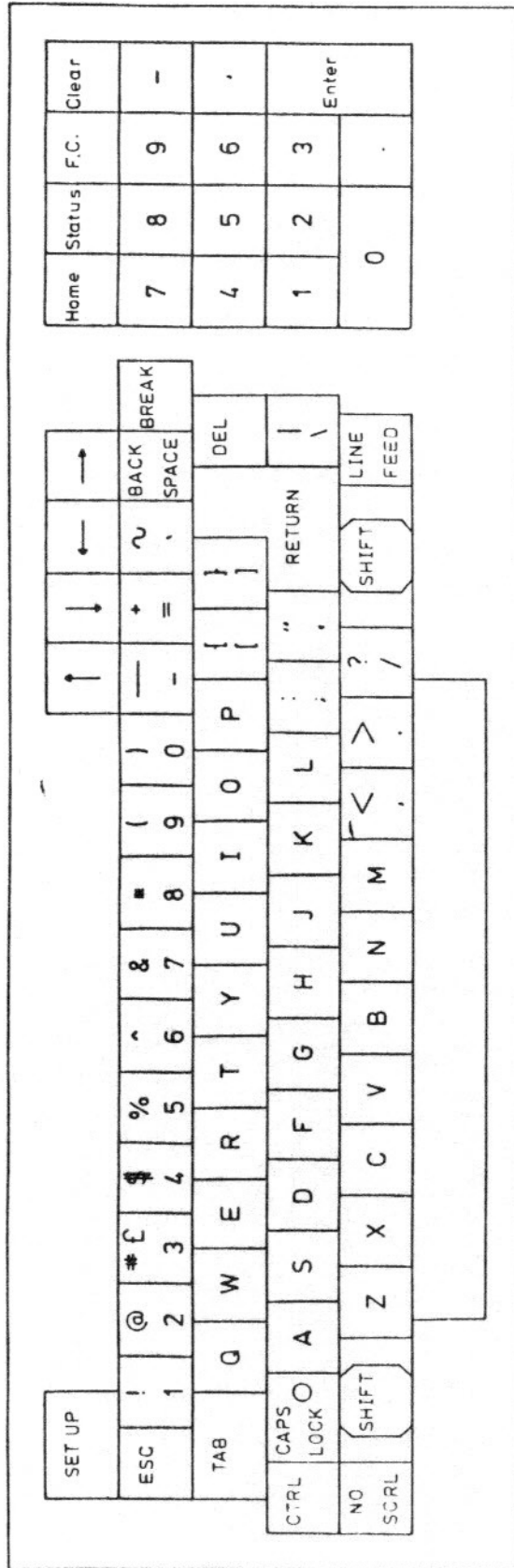


### 3.4 Keyboard operation.

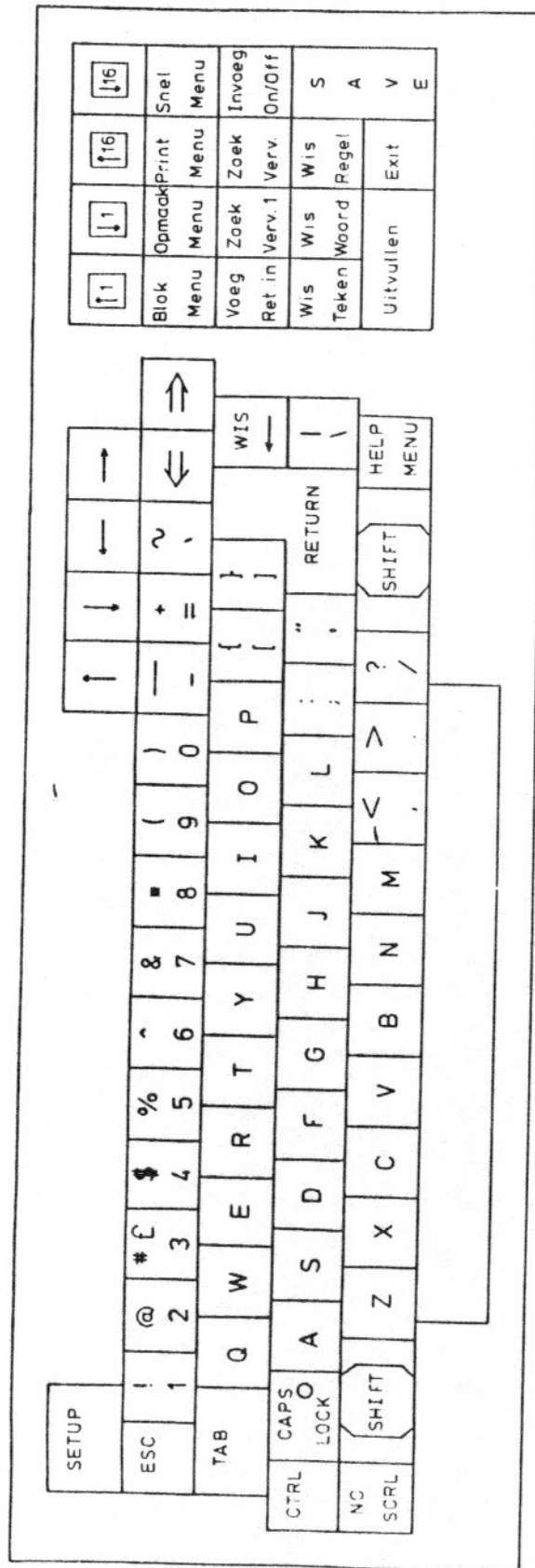
The Keytronic Keyboard model L2207 is an encoded keyboard.

The keyboard produces three main types of codes :

- 1 - Displayable Character codes - Alphanumeric codes which may be displayed on the screen.
- 2 - Control Character codes - These are not displayed (except in line monitor mode) but cause specific functions to occur.  
To generate a control character code, type and hold down the CTRL key while simultaneously typing the required alphanumeric key.
- 3 - Escape sequence codes - These are also non-displayed (except in line monitor mode) and cause specific functions to occur.  
To perform an escape sequence, type and release the ESC key and then the designated alphanumeric key.  
If the SETUP key was typed before the ESC key, the escape sequence only takes place within the terminal and is not transmitted even if the terminal is online.



Keyboard - wordprocessing





### 3.5 SETUP Function.

Associated key : | SETUP |

Transmitted code : None

If the SETUP key is typed before the ESC key, it will cause the escape sequence to be executed only locally and not transmitted even if the terminal is on line.

### 3.6 CONTROL FUNCTION.

Associated key : CTRL

Transmitted code : By itself, none. In conjunction with displayable character keys the code; 00 HEX through 1F HEX are transmitted.

To enter a control character type the CTRL key and hold this key down while simultaneously typing a displayable character key.

### 3.7 ESCAPE FUNCTIONS.

Associated key : | ESC |  
Keyboard Operation : ESC or SETUP ESC  
I/O operation : Receipt of ESC (CONTROL [ or 1D HEX)  
Transmitted Code : ESC (CONTROL [ or 1D HEX)

To initiate an escape sequence type the ESC key, release it, then type and release the displayable character key associated with the required escape function (see table 3.2 and 3.3). The ESC key is used as the first code in a multi-code sequence. It must be typed and released before the second key is typed.

The SETUP ESC entry allows local action of escape sequences. The escape sequence entries are not transmitted even if the terminal is online and in full duplex.

### 3.8 SINGLE KEY ESCAPE FUNCTIONS.

Some keys generate a two code escape sequence when they are pressed. This escape sequence is identical in function to the sequence generated if a multi-key entry was used.

Keys which generate escape sequences are :

↑	ESC A
↓	ESC B
-->	ESC C
<--	ESC D
HOME (PF1)	ESC H

If single key escape codes are inhibited (see subhead 2.1.11) the escape functions that are produced by these keys will be performed locally and will not be transmitted, even if the terminal is online and in full duplex.

Table 3-2 Escape sequences.

CONTROL CHARACTERS		DISPLAYABLE CHARACTERS										ESCAPE SEQUENCE						
BIT	7	6	5	4	3	2	1	0	1	2	3	4	5	6	7			
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14			
43215	000	001	010	011	100	101	110	111	010	010	011	100	101	110	111			
0 0000	NUL	@	P	0	€	P	,	p	SP	!	0	€	P	ENABLE CURSOR	CLEAR TAB			
1 0001	SCH	A	Q	1	A	Q	a	q	PROTECT ON	!	1	A	Q	DISABLE CURSOR	DELETE ATTRIBUTE			
2 0010	STX	B	R	2	B	R	b	r	PROTECT OFF	"	2	B	R	KEYBOARD ENABLE	DELETE CHARACTER			
3 0011	ETX	C	S	3	C	S	c	s	DISPLAY TERMINAL MODE	=	3	C	S	KEYBOARD DISABLE	CHARACTER INSERT			
4 0100	EOT	D	T	4	D	T	d	t	SET TERMINATION CHARACTER	\$	4	D	T	SET EXTRA ATTRIBUTE	CHARACTER INSERT			
5 0101	ENQ	E	U	5	E	U	e	u	SET PARITY	%	5	E	U	SET HOLBORN ATTRIBUTE	SEND LINE			
6 0110	ACK	F	V	6	F	V	f	v	SET DUPLEX MODE	&	6	F	V	RESET	CLEAR FOREGROUND			
7 0111	BEL	G	W	7	G	W	g	w	SET ERROR CHECK RECEIVER	'	7	G	W	INSERT LINE	PROGRAM KEY			
8 1000	BS	H	X	8	H	X	h	x	AUX ON	(	8	H	X	MEMORY LOCK ON	PROGRAM KEY			
9 1001	HT	I	Y	9	I	Y	i	y	AUX OFF	)	9	I	Y	MEMORY LOCK OFF	PROGRAM KEY			

A 1010	LF	J	Z	*	:	J	Z	J	z	LINE MONITOR OFF	LINE MONITOR ON	CLEAR TO END OF SCREEN	CLEAR TO END OF SCREEN	CURSOR SENCE AND TERMINA- TION	ENABLE AUX PORT	k	z
B 1011	VT	K	L	+	;	K	[	k	{	SET ROLL/PAGE MODE	CPU MESSAGE DEPOSIT	CLEAR TO END OF ROW	CLEAR TO END OF ROW	START BLINK	START BLINK	l	{
C 1100	FF	L	\	,	<	L	\	l		SET AUTOLINEFEED MODE	LINE LOCK	ENABLE LIGHT PEN	ENABLE LIGHT PEN	CURSOR SENCE	NORMAL VIDEO	m	
D 1101	CR	M	] ]	-	=	M	] ]	m	}	SET LOWER CASE MODE	LINE UNLOCK	DISABLE LIGHT PEN	DISABLE LIGHT PEN	SEND ROW FROM MEMORY POINTER	ON LINE	n	}
E 1110	:	N	^	.	>	N	^	n	~	SET AUTO ECHO MODE	BACK TAB	OFF LINE (LOCAL)	OFF LINE (LOCAL)	SET MEMORY POINTER	SET FOR/BACK- GROUND	o	~
F 1111	SP	O	/	/	?	O	-	o	D	CHANGE RECEIVER ERROR CHECK/L	UNLOCK ALL LINES	READ TERMINAL STATUS	READ TERMINAL STATUS	READ DATA AT MEMORY POINTER	D E L	D E L	

Table 3-3 Escape and Control Code Function

GROUP	FUNCTION	ESCAPE CODE	CTRL CODE	KEY	SECTION
	Auto Line Feed				2.7.3
	Back Space		BS	BACKSPACE	3.11.6
	Cursor Address	ESC F/Y			3.11.11
	Cursor Down	ESC B			3.11.3
C	Cursor Left	ESC D			3.11.5
U	Cursor Right	ESC C			3.11.4
R	Cursor Sense	ESC \			3.11.12
S	Cursor Up	ESC A			3.11.2
O	Home	ESC H		HOME	3.11.1
R	Line Feed		LF	LINE FEED	3.11.9
	Read Cursor Character	ESC G			3.11.13
	Retrun		CR	RETURN	3.11.8
	Roll Mode	ESC +			2.7.2
	Tab		HT	TAB	3.11.10
	Back Tab	ESC >			3.11.14
	Attribute Delete	ESC q			3.14.1.1
	Attribute set	ESC d			3.14.1
	Clear Screen	ESC E			3.16.1
	Clear to EOL	ESC K			3.16.3
	Clear to EOS	ESC J			3.16.2
	Graphic Mode Off	ESC S			3.14.2
	Graphic Mode On	ESC R			3.14.2
S	Line Lock	ESC <			3.15.3
C	Line Monitor Off	ESC .			3.18.3
R	Line Monitor On	ESC :			3.18.2
E	Line Unlock	ESC =			3.15.4
E	Mem Lock Off	ESC h			3.15.2
N	Mem Lock On	ESC g			3.15.1
	Normal/Half Intensity Video				3.14
	Normal/Reverse Video				3.14
	Normal Video	ESC m			3.14.1
	Start Blink	ESC l			3.14.1
	Unlock All Lines	ESC ?			3.15.5
	Write Control Mode	ESC 6			3.18.1
	Character Delete	ESC r			
	Character Insert On	ESC s			3.14.4
	Character Insert Off	ESC t			3.14.5
M					
E	CPU Message Deposit	ESC ;			3.22.1
C S	Display CPU Message Off	ESC 2			3.22.3
P S	Display CPU Message On	ESC 1			3.22.2
U A	Terminate CPU Message				
G	Deposit		GS		3.22
E					



Table 3-3 Escape and Control Code Function  
(continued)

GROUP	FUNCTION	ESCAPE CODE	CTRL CODE	KEY	SECTION
	Control Functions			CTRL	3.7
	Del			DEL	3.17
K	Escape Functions		ESC	ESC	3.8
E					
Y	Hard Reset			SETUP-CON	3.20.2
B	"			-TROL V	
O	Inhibit Single Key ESC	ESC /			2.8.2
A	Keyboard Disable	ESC c			3.21.1
R	Keyboard Enable	ESC b			3.21.2
D	Lower Case Inhibit	ESC -			2.7.4
	Numeric Pad			0-9,.. ,	3.12
	"			0-9,.. ,	3.10
	Shift & Lock			ENTER	
	Disable Tab	ESC p			3.21.3
M P					
E O	Read Data at Memory Pointer	ESC			3.23.2
M I	Set Memory Pointer	ESC ^			3.23.1
O N	Terminate Memory Pointer		GS		3.23
R T					
Y E					
R					
C M					
O A					
M I P	Auto Echo	ESC .			2.7.10
M N O	Parity	ESC %			2.7.6
U R	Receiver Error Check	ESC '			2.7.1
N A T	Termination Characters	ESC \$			2.7.5
I U S					
C X					
A					
T					2.7.7
I M P	Baud Rate Set	ESC 7			3.13.5
O A O					2.8.6
N I R	Full/Half Duplex	ESC &			2.7.8
S N T	Offline(Local)	ESC N			3.13.2
	Online	ESC n			3.13.1
A P	Aux Port Off	ESC )			3.13.7
U O	Aux Port On	ESC (			3.13.7
X R	Baud Rate Set	ESC 5			3.13.6 & 2.7.9
	T Disable Aux Port	ESC k			3.13.4
	Enable Aux Port	ESC j			3.13.3
A					
U A					
D L	Bell		BEL		3.25.2
I A	Continuous Alarm Off	ESC 9			3.25.3
B R	Continuous Alarm On	ESC 8			3.25.3
L M					
E					

Table 3-3 Escape and Control Code Function  
(concluded)

GROUP	FUNCTION	ESCAPE CODE	CTRL CODE	KEY	SECTION
	Line Send	ESC u			3.11.12.1
O	Control Code Handling			CTRL	3.18
T	Escape		ESC		3.8
H	Null				3.13.9
E	Read Terminal Status	ESC 0			3.26.3
R	Reset	ESC V			3.20.1
	Self-Test	ESC f			3.25.4
	Sub Characters Display		SUB		3.25.1

Table 3-4 Keyboard Functions.

KEY	FUNCTION
0-9 keys (Numeric pad)	These are separate numeric data entry keys. Numeric pad keys are not affected by the SHIFT, LOCK or Control keys.
(.) (Decimal Point)	The decimal point key generates the same code and character as the period on the typewriter array. This key is included on the numeric pad as a convenience feature.
ENTER	The ENTER key generates the termination character selected by the rear panel switches. If CR (carriage (return) or CR LF (carriage return-line feed) are selected, the terminal performs these functions when the ENTER key is depressed. If EOT (end of transmission) or ETX (end of text) are selected, the terminal transmits these codes but no visible display functions occur.
-	The underline or minus key generates the same code and character as in the typewriter array.
CTRL	Depression of either CTRL key with an alphanumeric or symbol key causes the terminal to perform a control function as described in part b. of subhead 3.6 and as listed on the ASCII Code Chart, Table 3-2 and in Table 3-3.
(cursor left) ←	Depression of this key or   <u>ESC D</u>   moves the cursor to the left. If the cursor is at the first character position on a line, the cursor moves to the last character on the line above and upon reaching Home, moves to the last position on the last line.
(cursor down) ↓	Depression of this key or   <u>ESC B</u>   moves the cursor to the same character position on the next line down. If on the last line, the cursor moves to the same character position on the first line.
HOME	Depression of this key or   <u>ESC H</u>   moves the cursor to the first character position on the first available line.
(cursor up) ↑	Depression of this key or   <u>ESC A</u>   moves the cursor to the same character position on the next line above. Upon reaching the top line, the cursor moves to the same character location in the bottom line.

Table 3-4 Keyboard Functions (continued)

KEY	FUNCTION
(cursor right) ---->	Depression of this key or <u>  ESC C  </u> moves the cursor to the next character position. When the cursor reaches the last character position on the line, it moves the first position on the next line down. When the cursor reaches the last position on the last line it moves to the Home position.
TAB	The TAB key moves the cursor to the next tabulation position, e.g., position 1, 9, 17, etc. Tab stops cannot be set by the operator. Selection of roll or non-roll mode also affects TAB key operation. In non-roll, TAB key actuation advances the cursor to the next available tabulation stop. When the cursor is at the last tab stop of line 24, the next TAB key actuation returns the cursor to HOME. In roll mode, the cursor is also positioned from tab stop to tab stop when the TAB key is pressed. However, when the cursor is in the last position of line 24, TAB key actuation causes rolling of the display.
ESC	Depression of ESC with an alphanumeric symbol key causes the terminal to perform a control function as described in part c of Subhead 3.6 and as listed on the ASCII Code Chart, Table 3-2 and in Table 3-3.
BREAK	The CONTROL BREAK entry may be used to interrupt transmission from the host CPU. Actuation of the BREAK key alone causes no operation.
CLEAR	The CLEAR key replaces the current cursor character in space. Other clear functions require an escape code operation: EOS (erase to end of screen) erases from cursor position to end of screen upon depression or receipt of <u>  ESC J  </u> ; EOL (erase to end of line) erases from cursor position to end of line upon depression or receipt of <u>  ESC K  </u> .
RETURN (Carriage Return)	This key causes the cursor to move to first position of the current line while not in auto line feed mode. If auto line feed is on, the cursor advances to the beginning of the following line.

Table 3-4 Keyboard Functions (concluded)

KEY	FUNCTION
BACK SPACE	This key is equivalent to the <-- key, except that the ASCII back space code is transmitted when on line CONTROL H is the ASCII back space (BS) code.
SHIFT	Nonalpha displayable keys such as !/1 are manipulated with the SHIFT keys.
CAPS LOCK	The CAPS LOCK key is more accurately described as a "caps-lock" because it affects the alpha characters (A-Z) only.
LF	Depression of this key causes the cursor to move down one line while occupying the same character position.
Space bar	The space bar moves the cursor to the right one character position. When the cursor reaches the last position on the last line, it returns to the first position on the last line. The space bar moves the cursor over displayable data.
DEL	Depression of this key causes a delete code to be transmitted but not displayed.
Alphanumeric Keys (A-Z), punctuation and shiftable numeric keys.	The remaining keys, which are arranged like the familiar standard typewriter keyboard, function as such. When used in conjunction with SHIFT/LOCK keys, the associated letter number, symbol or punctuation mark is displayed and/or transmitted. When used in conjunction with the ESC/CTRL keys, they produce numerous special function code sequences.

### 3.10 SHIFT AND LOCK.

Associated keys : 

CAPS
LOCK
SHIFT

SHIFT
-------

Transmitted Code : None, by themselves.

The SHIFT and CAPSLOCK keys are used to produce upper case character codes and have the same function as the equivalent typewriter keys, except as follows: The LOCK key (also called the alpha lock key) affects alphabetic characters (A-Z, upper and lower case) only. The SHIFT key must be used to manipulate the other displayable character keys such as !/1. SHIFT does not affect special functions or the numeric pad.

If lower case inhibit is enabled (see Subhead 2.1.9) all alpha keys produce only upper case characters (A-Z) regardless of SHIFT or LOCK positions.

### 3.11 CURSOR CONTROL.

The cursor may be repositioned on the screen by several different keys on the keyboard or by appropriate codes received through the I/O port.

The keys discussed in this subhead are HOME, ↑, ↓, →, ←, BACK SPACE, space bar, RETURN, Line Feed (LF), and TAB. Positioning the cursor by cursor addressing from the keyboard or CPU, and the CPU controlled functions of reading the character at the cursor position or reading the cursor address (cursor sense) are also discussed.

#### 3.11.1 Home.

Associated Key : HOME

Keyboard Operation : HOME or ESC H

I/O Operation : Receipt of ESC H

Transmitted Code : ESC H

The cursor moves to line 1 column 1 (HOME position—the top left corner of the screen). If line 1 is locked the cursor moves to column 1 of the first unlocked line on the screen.

#### 3.11.2 Cursor Up.

Associated Key : ↑


Keyboard Operation : ↑ or ESC A

I/O Operation : Receipt of ESC A

Transmitted Code : ESC A

The cursor moves up to the previous unlocked line, maintaining the same column position. If the cursor is on line 1 or no unlocked lines are above the cursor, it will wrap to line 24 or, if line 24 is locked, to the bottom unlocked line.

### 3.11.3 Cursor down.

Associated Key : 

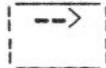
Keyboard Operation : ↓ or ESC B

I/O Operation : Receipt of ESC B

Transmitted Code : ESC B

The cursor moves down to the next unlocked line, staying in the same column position. If the cursor is on line 24, or if there are no unlocked lines below the cursor, it wraps to line 1 or, if line 1 is unlocked, it moves to the first unlocked line.

### 3.11.4 Cursor Right.

Associated Key : 

Keyboard Operation : --> or ESC C

I/O Operation : Receipt of ESC C

Transmitted Code : ESC C

The cursor advances one position to the right. If done from column 80 of a line, the cursor advances to column 1 of the next unlocked line. If the cursor is on line 24, or if no unlocked lines are below the cursor, the cursor wraps to HOME (line 1, column 1); or, if line 1 is locked, it moves to column 1 of the first unlocked line.



### 3.11.5 Cursor Left.

Associated Key : <--

Keyboard Operation : <-- or ESC D

I/O Operation : Receipt of ESC D

Transmitted Code : ESC D

The cursor is moved one position to the left. If done from column 1 of a line, the cursor wraps to column 80 of the previous unlocked line. If done from the HOME position (line 1, column 1) or if no unlocked lines remain above the cursor, the cursor will wrap to line 24 column 80 or, if 24 is locked, to column 80 of the lowest unlocked line. Cursor Left is identical in function to Back Space.

### 3.11.6 Back Space.

Associated Key : BACK  
SPACE

Keyboard Operation : Back Space or CONTROL-H

I/O Operation : Receipt of BS (CONTROL-H or 08 Hex)

Transmitted Code : BS (CONTROL-H or 08 Hex)

Back Space is identical in function to cursor left ( <-- ).  
Read description above.

### 3.11.7 Space Bar.

Associated Key : SPACE BAR

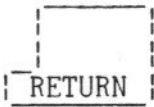
Keyboard Operation : Space bar

I/O Operation : Receipt of ASCII space code (20 Hex)

Transmitted Code : ASCII space code (20 Hex)

The space bar moves the cursor to the right one character position. When the cursor reaches the 80th position on the last line, it returns to the first position on the last line.

### 3.11.8 Carriage return.

Associated Key : 

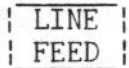
Keyboard Operation : RETURN or CONTROL M

I/O Operation : Receipt of CR (CONTROL M or OD Hex)

Transmitted Code : CR (CONTROL M or OD Hex)

The cursor returns to column 1 of the line it is on. If Auto Line Feed Mode is enabled (see Subhead 2.7.3) a Line Feed will be automatically performed after the RETURN (see Line Feed below).

### 3.11.9 Line Feed.

Associated Key : 


Keyboard Operation : LF or CONTROL J

I/O Operation : Receipt of LF (CONTROL J or OA Hex)

Transmitted Code : LF (CONTROL J or OA Hex)

The cursor is advanced to the next unlocked line, maintaining the same column position. If no unlocked lines are below the cursor or it is on line 24 and Roll Mode is enabled (see Subhead 2.1.7) rolling will occur and the cursor will be on the new bottom unlocked line. If Roll Mode is disabled, the cursor will wrap to line 1 or the first unlocked line.

### 3.11.10 Tab.

Associated Key : 

Keyboard Operation : TAB or CONTROL I

I/O Operation : Receipt of TAB (CONTROL I or 09 Hex)

Transmitted Code : TAB (CONTROL I or 09 Hex)

The cursor is advanced to the right and halts at the next tab stop location. Tab stops are fixed at every eight characters (column 1, 9, 17, 25, 33, 41, 49, 57, 65, and 73) of each line.

If tabbed from column 73 or beyond, the cursor will advance to column 1 of the next unlocked line. If no unlocked lines are below the cursor or it is on line 24 and Roll Mode is enabled (see Subhead 2.1.7) rolling will occur and the cursor will advance to column 1 of the new unlocked bottom line. If Roll Mode is disabled, the cursor will wrap to Home, or if line 1 is locked to column 1 of the first unlocked line.

### 3.11.11 Cursor Address.

Associated Key : None

Keyboard Operation : ESC F (or Y) line address,  
column address.

I/O Operation : ESC F (or Y) line address,  
column address.

Transmitted Code : ESC F (or Y) line address,  
column address.

The cursor is positioned at the line and column address as specified in the escape sequence. Attempts to position the cursor on a locked line or an out of range address are ignored. ASCII line and column address codes as specified in Table 3-5, must be used.

For example, to position the cursor at line 10, column 47 enter:

ESC F ) N

### 3.11.12 Cursor Sense.

Associated Key : None

Keyboard Operation : Illegal

I/O Operation : ESC \

Transmitted Code : ESC F line address,  
column address.

Upon receipt of ESC \ the cursor position (line address, column address) is transmitted to the host CPU in a cursor address escape sequence.

That is :

ESC F line address, column address

where the addresses are ASCII codes as listed in Table 3-5.

Table 3-5 Cursor Address Codes.

X or Y	ASCII CODE	X or Y	ASCII CODE	X or Y	ASCII CODE
1	SPACE	28	;	55	V
2	!	29	<	56	W
3	"	30	=	57	X
4	#	31	>	58	Y
5	\$	32	?	59	Z
6	%	33	@	60	[
7	&	34	A	61	\
8	'	35	B	62	]
9	(	36	C	63	^
10	)	37	D	64	~
11	*	38	E	65	←
12	+	39	F	66	a
13	,	40	G	67	b
14	-	41	H	68	c
15	.	42	I	69	d
16	/	43	J	70	e
17	0	44	K	71	f
18	1	45	L	72	g
19	2	46	M	73	h
20	3	47	N	74	i
21	4	48	O	75	j
22	5	49	P	76	k
23	6	50	Q	77	l
24	7	51	R	78	m
25	8	52	S	79	n
26	9	53	T	80	o
27	:	54	U		

X = line, Y = column.

### 3.11.12.1 Line Send.

Associated keys : None

Keyboard Operation : | ESC u |

I/O Operation : Receipt of | ESC u |

Transmitted code : | ESC u |

If the sequence ESC u is received, the entire line, the cursor is on is transmitted with trailing space suppression wherein the terminal recognizes the portions of the end of a line that are without characters and performs the transmission of the selected termination character(s) (see subhead 2.1.3)

### 3.11.13 Read Cursor Character.

Associated keys : None

Keyboard Operation : Illegal-Rings bell

I/O Operation : Receipt of ESC G

Transmitted code : Character at cursor position.

Upon Receipt of ESC G the terminal transmits the character at the cursor location to the host CPU. If the cursor is positioned over a graphic character, the ASCII equivalent character is sent (see Table 3-7). The cursor does not move after the character is read.

### 3.11.14 Back Tab.

Associated keys : None

Keyboard Operation : ESC >

I/O Operation : Receipt of ESC >

Transmitted code : ESC >

This function works as the reverse of the TAB function (see subhead 3.11.10).

If the cursor is back tabbed while on the top line, the cursor will stop and not pass the HOME position.

### 3.12 NUMERIC PAD.

Associated keys

:

7	8	9	-
4	5	6	,
1	2	3	E N T E R
0	.		

#### 3.12.1 Numerical Keys, Minus, (,), and Period.

The numerical keys in this group as well as the period (.) and minus (-) keys when depressed cause the associated ASCII character to be displayed and/or transmitted. This group is a separate numeric data entry key pad, not affected by the SHIFT, LOCK or CONTROL keys.

### 3.12.2 Enter.

Associated Key : 

E
N
T
E
R

Keyboard Operation : ENTER

I/O Operation : Not Applicable

Transmitted Code : CR or CR LF or EOT or ETX  
(as selected by rear panel switch)

The ENTER key generates the termination character (see Sub-head 2.1.3). This notifies the HOST that the terminal message is complete for that transmission. If selected termination character is a CR, a carriage return is transmitted. If the termination characters are CR LF, a carriage return and line feed are transmitted. If the termination character is EOT (end of transmission) or ETX (end of text), the code is transmitted.

### 3.13 COMMUNICATIONS CONTROL.

Keys and keyboard or I/O entered sequences which affect communication characteristics of the terminal are discussed in this section. Included are LOCAL (Main Port/On Line/Off Line), AUX (Auxiliary Port Enable/Disable), remote baud rate selection, direct Main Port/Aux Port communication, BREAK, and use of null codes in transmission.

#### 3.13.1 Main Port On Line.

Associated keys : None

Keyboard Operation : | ESC n |

I/O Operation : Receipt of | ESC n |

Transmitted Code : | ESC n |

The terminal Main Port is enabled. All operator keyboard entries are transmitted out the Main Port, and all codes received through the Main Port are processed by the terminal. If single key escape codes are inhibited (see Subhead 2.1.11), then those affected keys (see Subhead 3.8) only act locally and do not transmit any code.

The HOST CPU may put the terminal on line even when it is off line. When on line, the terminal displays the message "ONLINE" in Field A of the status line (see Subhead 3.26.2).

#### 3.13.2 Main Port Off Line.

Associated keys : None

Keyboard Operation : | ESC N |

I/O operation : Receipt of | ESC N |

Transmitted Code : | ESC N |

Main port bidirectional communication between the terminal and the CPU is disabled.

All keyboard entries either enter display memory or are acted upon locally. No transmission occurs out the Main Port. The Main Port receiver is not totally disabled however, since it continues to monitor for several escape sequences which the terminal will execute, even while off line.



These sequences are :

ESC n	Go On Line	ESC M	Disable LPEN
ESC V	Reset	ESC b	Enable Keyboard
ESC (	AUX On	ESC c	Disable Keyboard
ESC )	AUX Off	ESC `	Enable LPEN and Keyboard
ESC L	Enable LPEN	ESC a	Disable LPEN and Keyboard
		ESC ;	Fill Message Line

When Off Line the message "LOCAL" is displayed in Field A of the status line (see Subhead 3.26.2).

### 3.13.3 Auxiliary Port Enable.

Associated keys : None

Keyboard Operation : AUX (key toggles) or | ESC j |

I/O operation : Receipt of | ESC j |

Transmitted Code : | ESC j |

Enables the terminal AUX Port. All operator keyboard entries are transmitted out the AUX Port, and all codes received from the AUX Port are processed. If single key escape codes are inhibited (see Subhead 2.8.2), then those affected keys (see Subhead 3.9) only act locally and do not transmit any code. If AUX Port is ready, the message "AUXRDY" is displayed in Field D of the status line (see Subhead 3.26.2). If AUX Port not ready the message "AUXBSY" is displayed in Field D of the status line.

### 3.13.4 Auxiliary Port Disable.

Associated keys : None

Keyboard Operation : | ESC k |

I/O operation : Receipt of | ESC k |

Transmitted Code : | ESC k |

Codes entering the AUX Port Receiver are not processed and operator keyboard entries are not transmitted out the AUX Port.

### 3.13.5 Main Port Baud Rate Remote Set.

Associated keys : None  
Keyboard Operation : | ESC 7 baud rate |  
I/O operation : Receipt of | ESC 7 baud rate |

Once the aux port baud rate is set through the escape sequence, the baud rate can only be changed by another escape sequence or a power-up sequence.

MAIN BAUD RATE	* 1	* 1/2	* 1/4
ESC 7	0	1	2

Once the main port baud rate is set through the escape sequence, the baud rate can only be changed by another escape sequence or a powerup sequence.

### 3.13.6 AUX Port Baud Rate Remote Set.

Associated keys : None  
Keyboard Operation : | ESC 5 baud rate |  
I/O operation : Receipt of | ESC 5 baud rate |

The aux port baud rate is changed in accordance with the ASCII code specified as follows:

AUX BAUD RATE	* 1	* 1/2	* 1/4
ESC 5	0	1	2

### 3.13.7 Direct Main Port/Aux Port Communication (Aux On/Off).

Associated keys : None  
Keyboard Operation : (Aux On) | ESC ( |  
(Aux Off) | ESC ) |  
I/O operation : (Aux On) | ESC ( |  
(Aux Off) | ESC ) |

With Aux On, data received at the Main Port are transmitted to the Aux Port, and data received at the Aux Port are transmitted out the Main Port. No codes are processed by the terminal, but are just transferred between ports (direct bi-directional communication between the Aux and Main ports is enabled). The only exception is the sequence <ESC><>, who will not be send to the Aux Port but put the Aux Port off. Due to possible difference in baudrate settings, it is possible that the Aux Xmitter buffer becomes full, if this happens the terminal will send a CNTL-S (X-Off) to the MAIN port and a CNTL-Q (X-On) if the AUX buffer will again become empty.

### 3.13.7.1 Auxiliary Page Dump.

Associated keys : | FC |

Keyboard Operation : | SETUP FC |

I/O Operation : None

After depress and release of the SFTUP key and then the FC key, the current screen picture will be send to the Auxiliary Port with RS-232-C protocol (X-ON / X-OFF).

During transmission, trailing spaces are suppressed, attributes are ignored and graphics are send as spaces.

### 3.13.8 Break.

Associated keys : | BREAK |

Keyboard Operation : | SETUP BREAK |

Transmitted Code : ESC-Termination Character(s).

The BREAK key by itself has no function. The SFTUP BREAK entry puts the terminal online and transmits the sequence :

<ESC> <Termination Character(s)>

After the termination characters are send, the terminal will reinitialize himself.(see subhead 3.20.1).

### 3.13.9 Null Codes.

Associated keys : None

Keyboard Operation : CONTROL @

I/O Operation : Receipt of NUL (CONTROL @ or 00 Hex).

Normally not processed by the terminal, null codes can be inserted into the I/O data stream as a pad code to create delays. Null codes should not be used as a pad inside an escape sequence because they will cause premature termination of the sequence. Null codes can, however, immediately follow the ESC.

For Example :

| ESC NUL NUL NUL NUL NUL R | will turn on graphics mode.

| ESC F 0 NUL - | will not move the cursor to line 17 column 12, but will write "-" at the current cursor position.

### 3.14 SCREEN VISUAL ATTRIBUTES.

#### 3.14.1 Attribute Set.

Associated keys : None

Keyboard Operation : | ESC d attribute |

I/O Operation : Receipt of | ESC d attribute |

Transmitted Code : | ESC d |

After depression of ESC d, the next key entered places the selected visual attribute invisibly into the display memory at the cursor position. This visually alters the display starting at that point. A maximum of 16 visual attributes per line are permitted, and a visual attribute may not be placed in column 80 of any line. The entered attribute is the ASCII equivalent code as shown in Table 3-6.

A visual attribute placed immediately before a graphic character will cause that graphic character to revert to its ASCII equivalent display character (see Table 3-7).

Attributes placed in display memory propagate through the screen until another attribute is reached, a null line is encountered, or the end of the screen is reached. For internal memory management purposes, when entire lines are cleared (during Power-up, Clear or Clear EOS) they are cleared to a null status.

Table 3-6 Visual Attributes.

Key (ASCII Code)	Visual attributes
@	Normal (Stop Visual Attribute) *
A	Half Intensity
B	Blinking **
C	Half Blink
P	Revers Video
Q	Revers Half
R	Reverse Blink
S	Reverse Half Blink
`	Underline Normal
a	Underline Half
b	Underline Blink
c	Underline Half Blink
p	Underline Reverse
q	Underline Reverse Half
r	Underline Reverse Blink
s	Underline Reverse Half Blink
\$	Security (Invisible)
4	Reverse Security
5	Half Reverse Security
6	Blinking Reverse Security
7	Blinking Half Reverse Security

\* Normal video attribute may also be entered with `|ESC m|` sequence.

\*\* Blinking video attribute may also be entered with `|ESC l|` sequence.

Care must be taken when setting attributes in Roll Mode. If the screen is scrolled, the visual attributes in the line lost at the top of the screen will also be lost and the display will revert to normal video unless there is an attribute in the new top line. Also, if the roll mode switch is off (roll mode enabled), video attributes to the right of the cursor will be erased from memory if a carriage return is done. An attribute placed where an attribute already exists will replace the attribute in that location.

Security attributes cause the data entered in that visual field to become invisible on the display screen. However, the data is still in display memory and may be read by the host CPU using Read Cursor Character (see Subhead 3.11.13) or Memory Address Pointer (see Subhead 3.23.2). This feature is useful for passwords.

### 3.14.1.1 Delete Attribute.

Associated keys : None

Keyboard Operation : | ESC q |

I/O operation : Receipt of | ESC q |

Transmitted Code : | ESC q |

This function deletes the visual attribute at the current cursor position if an attribute is present.

### 3.14.2 Graphics Mode.

Associated keys : None

Keyboard Operation : (Graphics On) | ESC R |  
(Graphics Off) | ESC S |

I/O operation : (Graphics On) receipt of | ESC R |  
(Graphics Off) receipt of | ESC S |

Line drawing is enabled providing access to eleven graphic characters in four visual attributes (see Table 3-7). Once Graphic Mode is enabled any ASCII equivalent character shown in Table 3-7 will produce the appropriate graphic symbol. ASCII characters or control codes not shown in Table 3-7 are displayed or executed normally. The message "GRAPHIC" appears in Field G of the status line (see Subhead 3.26.2). A graphic character should not immediately follow a visual attribute (see Subhead 3.14.1) or it will be displayed as the ASCII equivalent character as shown in Table 3-7. A Read Cursor Character (see Subhead 3.11.13) or Read Memory Pointer (see Subhead 3.23.2) at a graphics character will read the ASCII equivalent character.

When Graphic Mode is disabled by an | ESC S | sequence any graphic characters currently in display memory remain there.

Table 3-7 Graphic Characters.

SYMBOL	NORMAL	ASCII EQUIVALENT		HALF
		HALF	BLINK	BLINK
	@	A	B	C
	D	E	F	G
	H	I	J	K
	L	M	N	O
	P	Q	R	S
	T	U	V	W
	X	Y	Z	[
	\	]	^	_
	`	a	b	c
	d	e	f	g
	h	i	j	k

3.14.3 Special Character Mode.

Associated keys : None

Keyboard Operation : | ESC d H |

I/O operation : Receipt of | ESC d H |

Transmitted Code : | ESC d H |

After depression of ESC d H, some characters will change in alternated characters (special characters).

To reset special character mode, select any other screen visual attribute (see subhead 3.14.1) or by the clear screen / ROW functions (see page 3-37 - 3-39 for special characters)



### 3.14.4 Character Insert On.

Associated keys : None

Keyboard Operation : | ESC s |

I/O operation : Receipt of | ESC s |

Transmitted Code : | ESC s |

After receipt of ESC s and a new character is entered, all data from and including the cursor position to the end of the line is moved one character position to the right with the last character being lost.

The newly entered character is written at the cursor position and the cursor moves one position to the right.

Visual attributes remain fixed and do not move.

### 3.14.5 Character Insert OFF.

Associated keys : None

Keyboard Operation : | ESC t |

I/O operation : Receipt of | ESC t |

Transmitted Code : | ESC t |

This function disables Character Insert (see Subhead 3.14.4)

### 3.14.6 Insert Line.

Associated keys : None

Keyboard Operation : | ESC W |

I/O operation : Receipt of | ESC W |

Transmitted Code : | ESC W |

After receipt of ESC W a new blank line will be inserted at the cursor position and the cursor moves to column 1 of the new blank line.

The line the cursor was on and all 'UNLOCKED' lines below it are scrolled downwards one line.

The last unlocked line is lost.

### 3.14.7 Delete Line.

Associated keys : None

Keyboard Operation : | ESC X |

I/O operation : Receipt of | ESC X |

Transmitted Code : | ESC X |

After receipt of ESC X the line the cursor is on is deleted and all 'UNLOCKED' lines below it scroll upwards one line.

The cursor moves to column 1 of the top line that moved up.

A new blank line is inserted at the bottom of the screen.

### 3.14.8 Set Foreground mode.

Associated keys : None

Keyboard Operation : | ESC 0 @ |

I/O operation : Receipt of | ESC 0 @ |

Transmitted Code : | ESC 0 @ |

After receipt of ESC 0 @ the terminal is set in foreground mode. (default is Background mode).

In foreground mode all characters written to screen are internally marked as foreground characters (no visual effect occurred).

Foreground characters are cleared by the 'Clear Foreground' command (see subhead 3.14.10).

### 3.14.9 Set Background mode.

Associated keys : None

Keyboard Operation : | ESC 0 A |

I/O operation : Receipt of | ESC 0 A |

Transmitted Code : | ESC 0 A |

After receipt of ESC 0 A the terminal is set in Background mode.

In background mode all characters written to screen are internally marked as background characters (no visual effect occurred).

Background characters are unchanged by a 'Clear Foreground' command (see subhead 3.14.10).

### 3.14.10 Clear Foreground.

Associated keys : None

Keyboard Operation : | ESC v |

I/O operation : Receipt of | ESC v |

Transmitted Code : | ESC v |

After receipt of ESC v all foreground characters (see subhead 3.14.8) are cleared to spaces.

Background characters (see subhead 3.14.9) and attributes are unchanged by the 'Clear Foreground' command.

SPECIAL CHARACTERS

A	B	C	D	E	F
***** *****	* *	*** ** ** ** ** ** ** **	***** ***** ***** ***** ***** ***** ***** *****	***** ***** ***** ***** ***** ***** ***** *****	***** ***** ***** ***** ***** ***** ***** *****

G	H	I	J	K	L
**** **** **** **** **** **** **** ****	**** **** **** **** **** **** **** ****	*** *** *** *** *** *** *** ** *	** *** **** ***** ***** ***** ***** ***** *** ** *	** * ** *** * ** ***** ***** ***** ***** ***** ***** *** * ** ** * ** * * *	* ***** ***** ***** ***** ***** ***** ***** ***** ***** *****

M	N	O	P	Q	R
** * ** ** * ** ** * ** ** * ** ** * ** ** * ** ** * ** ** * **	**** **** **** **** **** **** **** ****	**** **** **** **** **** **** **** ****	**** **** **** **** **** **** **** ****	** * ** ** * ** ** * ** ** * ** ** * ** ** * ** ** * ** ** * **	** * * * * * * * * **



e	f	g	h	i	j
				*	*****
				*	*
* * * *	* * * *	* * * *	*****	*	*****
			*****	*	*****
			*****	*	*****
			*****	*	*****
			*****	*	*****
			*****	*	*****
			*****	*	*****
			*****	*	*****
			*****	*	*****
* * * *	*	*	*	*	*
				*	*****

k	l	m	n	o	p
	*****	* *	* *	*****	*****
	*****	* *	* **	*****	* *
	*****	* *	* ****	*****	* *
	*****	* *	* *****	*****	* *
	*****	* *	* *****	*****	* *
	*****	**	*****	**	* *
	*****	* * * *	*****	* * * *	*****
	*****				
	*****				
	*****				
	*****				

q	r	s	t
*****	* *	* *	*****
*****	* *	** *	*****
*****	* *	*** *	*****
*****	* *	**** *	*****
*****	* *	***** *	*****
*****	* *	***** *	*****
*****	**	*****	**
*****	* * * *	*****	* * * *

### 3.15 DISPLAY LOCKING.

#### 3.15.1 Memory Lock On.

Associated keys : None

Keyboard Operation : | ESC g |

I/O operation : Receipt of | ESC g |

Transmitted Code : | ESC g |

All lines above the line the cursor is on are locked. Locked lines cannot be accessed by the operator, cleared or scrolled but can be accessed by the host CPU with Read Data at Memory Address Pointer (see Subhead 3.23.2) and Memory Address Pointer (see Subhead 3.23). The message "MFM LOCK" appears in Field E of the status line (see Subhead 3.26.3).

#### 3.15.2 Memory Lock Off.

Associated keys : None

Keyboard Operation : | ESC h |

I/O operation : Receipt of | ESC h |

Transmitted Code : | ESC h |

All lines locked by memory lock on are unlocked. Lines locked by the line lock command

| ESC < line address |  
remain locked, even if they were in the memory locked area.



### 3.15.3 Line Lock.

Associated keys : None

Keyboard Operation : Illegal

I/O operation : Receipt of ESC < line address

The line at the address in the escape sequence is locked. The line address is an ASCII code as specified in Table 3-5. If the cursor is on the line being locked, it will move down to the next unlocked line. If it is on line 24 or there are no unlocked lines below it, the cursor will move to line 1, or the first unlocked line on the screen. Any 23 of the 24 lines on the screen may be locked at any one time. At least one line will remain unlocked at all times.

While any line on the screen is locked the message "LINE LOCK" appears in Field E of the status line (see Subhead 3.26.2).

The terminal operator does not have access to a locked line. The CPU can access a locked line with the Memory Address Pointer and Read Data at Memory Address Pointer (see Subhead 3.23). If in roll mode and the screen is scrolled, locked lines are unaffected and remain fixed on the screen.

Clear and Clear to End of Screen have no effect on locked lines (see Subhead 3.16).

### 3.15.4 Line Unlock.

Associated keys : None

Keyboard Operation : Illegal

I/O operation : Receipt of ESC = line address

The line at the address in the escape sequence is unlocked. The line address is an ASCII code as specified in Table 3-5. Memory locked lines are not affected.

### 3.15.5 Unlock All Lines.

Associated keys : None

Keyboard Operation : Illegal

I/O operation : Receipt of | ESC ? |

All line locked display lines are unlocked (memory locked lines remain locked, see Subheads 3.15.1 and 3.15.2). All lines are accessible to the operator and are affected by clear and roll functions.

### 3.16 CLEAR (ERASE) FUNCTION.

#### 3.16.1 Clear Screen.

Associated keys : None

Keyboard Operation : | ESC E |

I/O operation : Receipt of | ESC E |

Transmitted Code : | ESC E |

All unlocked lines on the screen are erased and the cursor is positioned at home (line 1, column 1); or if line 1 is locked, column 1 of the first unlocked line on the screen.

#### 3.16.2 Clear to End of Screen.

Associated keys : None

Keyboard Operation : | ESC J |

I/O operation : Receipt of | ESC J |

Data is cleared from (and including) the cursor position to the end of the screen. Locked lines below the cursor are not affected. If a visual attribute immediately precedes the cursor it is deleted. The cursor does not move.

#### 3.16.3 Clear to End of Line.

Associated keys : None

Keyboard Operation : | ESC K |

I/O operation : Receipt of | ESC K |

Data are cleared from (and including) the cursor position to the end of the line. If a visual attribute immediately precedes the cursor it is deleted. The cursor does not move.

### 3.17 DELETE KEY.

Associated key : DEL

Transmitted Code : ASCII DELETE (DEL or 07F Hex)

DEL has no local action and is not displayable but is transmitted.

#### 3.17.1 Delete Character.

Associated keys : None

Keyboard Operation : ESC r

I/O operation : Receipt of ESC r

This function deletes the character at the cursor position and all characters from the cursor to the end of the line move left one position.

A space is inserted at the end of the line.

Visual attributes remains fixed.

### 3.18 RECEIVER CONTROL CODE HANDLING.

In normal operating modes the only received codes written into display memory are, with three exceptions, the Displayable characters as shown in Table 3-2. The three exceptions are: DEL (7F Hex) which is not displayable, SUB (CONTROL Z or 1A Hex) which displays SB and normally indicates a parity error, and a code received as a part of an escape sequence which specifically enters data into display memory (For example: Write Control Mode).

Escape sequences and control characters that are listed in Table 3-3 are valid and executable. Those not listed are invalid and are ignored. If necessary, NUL's (00 Hex) may be used as a pad to create delays in a data stream. NUL's are normally ignored except in escape sequences where they can prematurely terminate the sequence. For example: The escape sequence for cursor addressing

`| ESC F % + |`

will correctly position the cursor at line 6, column 12, but the sequence

`| ESC F % NUL + |`


will terminate when the NUL is received and "+" will be entered in display memory at the current cursor position.

All received codes, whether Control Characters, Displayable Characters, or Escape Sequences (except

`| ESC * |`

which is Monitor Mode Off) are displayed in Monitor Mode. Write Control Mode will display any individual code. Monitor Mode character display symbols are shown in Table 3-8.

Table 3-8 Control Code Symbols.

A - SH	I - HT	Q - D1	Y - EM
B - SX	J - LF	R - D2	Z - SB
C - EX	K - VT	S - D3	[ - EC
D - ET	L - FF	T - D4	\ - FS
E - EQ	M - CR	U - NK	] - GS
F - AK	N - SO	V - SY	^ - RS
G - 	O - SI	W - EB	- - US
H - BS	P - DL	X - CN	@ - .

### 3.18.1 Write Control Mode.

Associated keys : None

Keyboard Operation : | ESC 6 character |

I/O operation : Receipt of | ESC 6 character |

The character immediately following ESC 6 is written directly into display memory, even if it is normally executable. The character can be any control character (except NUL) or displayable character. Table 3-8 shows the displayed control character symbols.

### 3.18.2 Line Monitor On.

Associated keys : None

Keyboard Operation : | ESC : |

I/O operation : Receipt of | ESC : |

All entered data, including all Control Characters (including NUL and ESC) and Escape Sequences except

| ESC \* |  
(Line Monitor Off), are entered directly into display memory without execution. The message "MONITOR" appears in Field B of the status line (see Subhead 3.26.2). Displayed control code symbols are shown in Table 3-8.

### 3.18.3 Line Monitor Off.

Associated keys : None

Keyboard Operation : | ESC \* |

I/O operation : Receipt of | ESC \* |

Monitor Mode is disabled and the terminal's internal bell is turned on for a brief interval. All control code will again be appropriately processed.

### 3.19 FUNCTION KEY.

Associated keys : | STATUS |

Transmitted code : None

The 'STATUS' line is displayed when the | STATUS | key is depressed and hold down. When this key is released, the 'STATUS' line will be replaced by the 'MESSAGE' line (initial empty) after 1 second. For detail information about the STATUS line see Subhead 3.26.2.

## 3.20 RESETTING TERMINAL.

### 3.20.1 Reset.

Associated keys : None

Keyboard Operation : | FSC V |

I/O Operation : Receipt of | ESC V |

The terminal is re-initialized to a power-on state except that no self-test is performed and the screen is not cleared. Although the display memory is not erased, any lines that were in a memory lock area or that were locked are unlocked.

### 3.20.2 Hard Reset.

Associated keys : | SETUP | | CTRL |  
| V |

Transmitted Code : None

Depression of the sequence SETUP-CONTROL-V will re-initialize the terminal to its power-up state, including self-test and clear screen. Hard Reset is always available, even when the terminal is on line, full duplex or the keyboard is locked.



### 3.21 KEYBOARD DISABLE/ENABLE.

#### 3.21.1 Keyboard Disable.

Associated keys : None

Keyboard Operation : | ESC c |

I/O Operation : Receipt of | ESC c |

The keyboard is disabled and all operator entries are ignored. The message "KEYBD LOCK" is displayed in reverse blink video in Field E of the status line (see subhead 3.26.2)

Once disabled, only the Host or a hard reset (see Subhead 3.20.2) can enable the keyboard.

#### 3.21.2 Keyboard Enable.

Associated keys : None

Keyboard Operation : Impossible if disabled.

I/O Operation : Receipt of | ESC d |

The keyboard is enabled and can accept operator entries. The operator can only enable a locked keyboard by performing a hard reset (see Subhead 3.20.2), but be advised that while this will unlock the keyboard it will also restore the terminal to its initial power-up state and the entire screen display memory will be erased.

#### 3.21.3 Clear all Tabs.

Associated keys : None

Keyboard Operation : | ESC p |

I/O operation : Receipt of | ESC p |

This function disables the Tab function. To reenable the TAB function a RESET function must be performed (see subh.3.20.1)

## 3.22 CPU MESSAGE DEPOSIT DISPLAY.

### 3.22.1 CPU Message Deposit.

Associated keys : None

Keyboard Operation : Illegal

I/O Operation : | ESC ; | Message GS (CONTROL ]  
or 1D Hex)

The message following the escape sequence | ESC ; | is deposited into an 80 character CPU message buffer. The message is terminated by receipt of a GS (CONTROL ] or 1D Hex) character. Messages longer than 80 characters will cause all characters beyond the 80th character received to over-write the 80th character in the message buffer. Any control characters in the message text are displayed and not acted upon (except for GS, which is the message terminator). See Table 3-8 for displayed control code symbols. A blank line may be deposited by using the sequence

| ESC ; GS | (CONTROL ] or 1D Hex).

The message "MSG WAIT" appears in reverse blinking video in Field E of the status line (see Subhead 3.26.2).

### 3.22.2 Display CPU Message On.

Associated keys : None

Keyboard Operation : | ESC 1 |

I/O Operation : Receipt of | ESC 1 |

The message deposited by the CPU is displayed in the line normally occupied by the status line. A null message will display a normal video blank line, otherwise the message will be displayed in REVERSE video.

### 3.22.3 Display CPU Message Off.

Associated keys : None

Keyboard Operation : | ESC 2 |

I/O Operation : Receipt of | ESC 2 |

The display CPU message is replaced by the normally present status line. If the CPU message was turned on with the escape sequence

| ESC 1 |

### 3.23 MEMORY POINTER.

#### 3.23.1 Set Memory pointer.

Associated keys : None

Keyboard Operation : Illegal

I/O Operation : | ESC ^ | line address,  
character address, data (optional),  
GS (CONTROL ] or 1D Hex).

A CPU controlled invisible cursor is positioned at the line and column address following the escape sequence

| ECS ^ |.

The line and column addresses are ASCII codes as listed in Table 3-5. If the memory pointer is only to be positioned a GS (CONTROL ] or 1D Hex) is entered after the character address. If data is to be displayed at that position it should follow the character address. The data will be entered in display memory beginning at the specified line and character address. Any control codes (except GS) will be displayed (see Table 3-8 for displayed control code symbols) and not executed. Attempts to write data beyond column 80 of the line the memory pointer is on will cause all characters which should go to the next line to overwrite the character on column 80 (wrap around on line end does not occur). After each character is entered in display memory the memory address pointer is advanced one position to the right stopping at column 80 if the end of the line is reached. Locked and memory locked lines are accessible to the memory pointer.

#### 3.23.2 Read Data at Memory Pointer.

Associated keys : None

Keyboard Operation : Illegal - Rings bell.

I/O Operation : Receipt of | ESC \_ |

Transmitted Code : Character at memory pointer.

The character at the memory pointer is transmitted to the host CPU. If the memory pointer is positioned over a graphic character the ASCII equivalent character is sent (see Table 3.7). The memory pointer does not move after the character is read.

### 3.25 ALARM AND ERROR INDICATORS.

#### 3.25.1 Sub-Character Display.

Associated keys : None

Keyboard Operation : CONTROL Z

I/O Operation : Receipt of SUB (CONTROL Z or 1A Hex) or detection of a receiver parity error when receiver error check is enabled (see Subhead 2.7.1) and odd or even parity is selected.

The sub-character, SB, is displayed and the bell is rung when a receiver error occurs. The bell rings once for each displayed sub-character.

#### 3.25.2 Audible Alarm.

Associated keys : None

Keyboard Operation : CONTROL G

I/O Operation : Receipt of BEL (CONTROL G or 07 Hex)

The terminal's internal bell is turned on for approximately 8/50 second (160 msec). Other operations that will turn the bell on for a short interval are: receipt of the sub-character (CONTROL Z) or detection of a parity error with receiver error check enabled; operator entry of data which causes the cursor to pass through column 72 of a line; when line monitor is turned off; and to warn of illegal operations, such as when read cursor character or read memory pointer is attempted from the keyboard, and when the transmitter buffer is full and keyboard data is entered.

### 3.25.3 Continuous Alarm.

Associated keys : None

Keyboard Operation : Alarm On : | ESC 8 |  
Alarm Off : any key except CONTROL or SHIFT

I/O Operation : Alarm On : Receipt of | ESC 8 |  
Alarm Off : Receipt of | ESC 9 |

The Terminal's internal bell, once turned on, stays on until either the escape sequence

| ESC 9 | is received through the I/O or any keyboard key (except CONTROL or SHIFT) is struck. This feature allows the host CPU to gain the attention of the terminal operator. When keyboard alarm turn off is used, the key struck is not displayed.

### 3.25.4 Self Test.

Associated keys : None

Keyboard Operation : | ESC f | or SETUP-CONTROL-V

I/O Operation : Receipt of | ESC f |

This test is always performed at power-up. Self-testing firmware may be invoked with the above commands to test the terminal's ROM and RAM. Each time the test is performed, the terminal is also initialized to the power-up state. If self test is successful, the message "SYSTEM RDY" is displayed in Field E of the status line (see Subhead 3.26.2). If the test is not successfully "ERR CHECK" is displayed. Results of the self test can be found in positions 5 and 19 (columns 43 and 57) of the terminal status message (see Table 3-10).

## 3.26 SCREEN DISPLAY FORMAT AND STATUS LINE.

### 3.26.1 Display Format.

The display format is organized with 24 lines of 80 characters each. The terminal is capable of transmitting and displaying the entire 128 ASCII code set. All 32 control codes are displayed as special symbols as shown in Table 3-8. Eleven graphic characters which may be displayed are shown in Table 3-7. The screen data may also be presented in various visual attributes as shown in Table 3-6.

### 3.26.2 Status Line.

#### Status Line Field Definition.

The status line occupies the 25th display line of the CRT and is displayed in reverse video. The break down of the status line display fields is outlined in Figure 3.2 and Table 3-10.

To display an alternate status line or no status line at all, use the CPU message deposit function. In order to inhibit display of the status line,

the sequence ! ESC ; GS ESC 1 ! is employed.

This causes no message to be deposited and forces the status line to be displayed in normal video with no data present. The 25th line remains inaccessible to the operator. In order to display an alternate status line, the complete CPU message deposit sequence is followed (see Subhead 3.22).

An additional status line for host CPU system information can be implemented through the use of the CPU line lock feature (see Subhead 3.15.1).

The following is an explanation of the messages which may appear on the status line:

#### Field A - Main Port Status.

ON LINE - indicates that the terminal is on line to the CPU.

LOCAL - displayed when the terminal has been taken off line by placing it in the local mode.

#### Field B - Line Monitor Mode.

MONITOR - indicates line monitor mode has been entered. Control/Escape codes are displayed but not acted upon.

### Field C - Main Port Control Field.

This field indicates the status of EIA circuit Data Set Ready (CC).

### Field D - Auxiliary port.

AUX RDY - appears when the auxiliary device is properly connected and ready to receive or transmit data and Aux Port has been enabled. | ESC j |

AUX ON - appears during aux on mode | ECS ( |. This mode enables the aux device to exchange data directly with the CPU.

AUX BSY - when aux on or aux enabled, appears when an auxiliary device is not properly connected or ready to receive data.

### Field E - Message Field.

This field is used variously, as described in the following list. Only one message at a time can appear.

SYSTEM RDY - displayed if the terminal self-test is completed with no errors.

LINE LOCK - displayed when the host CPU has initiated the line lock feature on one or more data lines.

MEM LOCK - displayed when the host CPU or operator has initiated the memory lock feature.

ERR CHECK - displayed when the self-test fails.

MSG WAIT - displayed in half intensity reverse blinking video when the host processor has completed a message sequence to the terminal message buffer.

KEYBD LOCK - displayed when the keyboard has been disabled.

### Field F and G - Status Message.

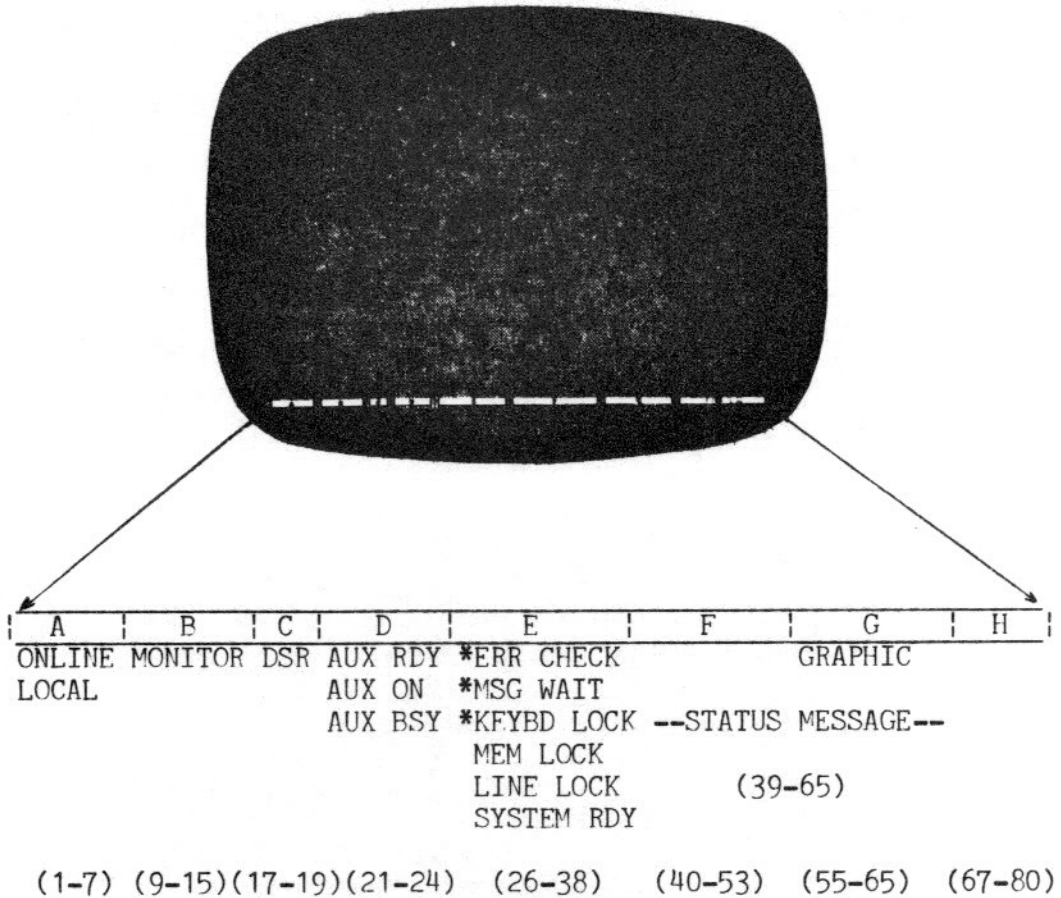
These fields are used jointly to display the 27-byte status message when it is evoked with | ESC O | (see Subh. 3.26.3). See Table 3-10 for a complete explanation of the status message.

### Field G - Graphic.

GRAPHIC - appears in Field G of the status line when this mode has been entered.

### Field H - Reserved.





The numbers in parentheses indicate the character positions occupied by each field in the 80-character status line.

\*Status line indicators which appear in full intensity reversed blinking video. All others appear in reversed video.

Figure 3.2 Status Line Display Fields.

### 3.26.3 Read Terminal Status.

Associated keys : None

Keyboard Operation : | ESC 0 |

I/O Operation : Receipt of | ESC 0 |

Transmitted Code : STX, 27 status characters, TERM

If initiated from the keyboard a 27 character terminal status message is displayed on the status line in columns 39 to 65. The next keyboard entry (except CONTROL or SHIFT) will remove the status message from the status line and that keystroke will be lost. If initiated from the I/O, the following data is transferred by the terminal: STX (Control B or 02 Hex), 27 terminal status characters, TERM (switch selected termination character(s)). An explanation of the individual characters in the status message is in Table 3-10.

Table 3-10 F & G Status Line Indicators.

CHARACTER POSITION	CHARACTER DISPLAYED	FEATURE CONVEYED	MESSAGE CONVEYED
39	0 - 2	Main baud rate	0=*1 1=*1/2 2=*1/4
40	0 - 2	Auxiliary baud rate	
41		Unused	
42	0 - 3	Termination characters	0=CRLF 1=ETX 2=EOT 3=CR
43		Unused	
44	0 - 3	Parity Select	0=EVEN 1=SPACE 2=ODD 3=MARK
45	0 - 1	Keyboard Lock	0=OFF 1=ON
46	0 - 1	Duplex Mode	0=HALF DUPLEX 1=FULL D.
47	0 - 1	Receiver Error Check	0=OFF 1=ON
48	0 - 1	Roll mode	0=OFF 1=ON
49	0 - 1	Auto Line Feed	0=OFF 1=ON
50	0 - 1	Lower Case Inhibit	0=OFF 1=ON
51	0 - 1	Auto Echo	0=OFF 1=ON
52	0 - 1	Inhibit ESC CODES	0=OFF 1=ON
53	0 - 1	AUX ON	0=OFF 1=ON
54	0 - 1	AUX ENABLE	0=OFF 1=ON
55	0 - 1	Graphics Mode	0=OFF 1=ON
56	0 - 1	Line Lock	0=OFF 1=ON
57	0 - 1	Memory Lock	0=OFF 1=ON
58	0 - 1	Holborn Mode	0=OFF 1=ON
59	0 - 1	Main Port	0=OFF 1=ON
60	0 - 2	Self Diagnostic	0=NO FAULT 1=ROM FAULT 2=RAM FAULT
61	0 - 1	Message Wait	0=NO MESSAGE WAIT 1=MESSAGE WAIT
62-63-64	Various	Software Version	