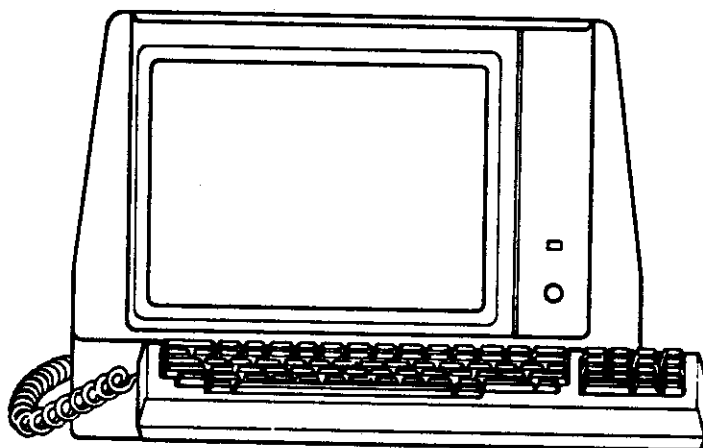


MDT20

Terminal Reference Manual



MORROW 

Morrow Designs 20 (MDT20)
Terminal Reference Manual
Revision 1 January 1983

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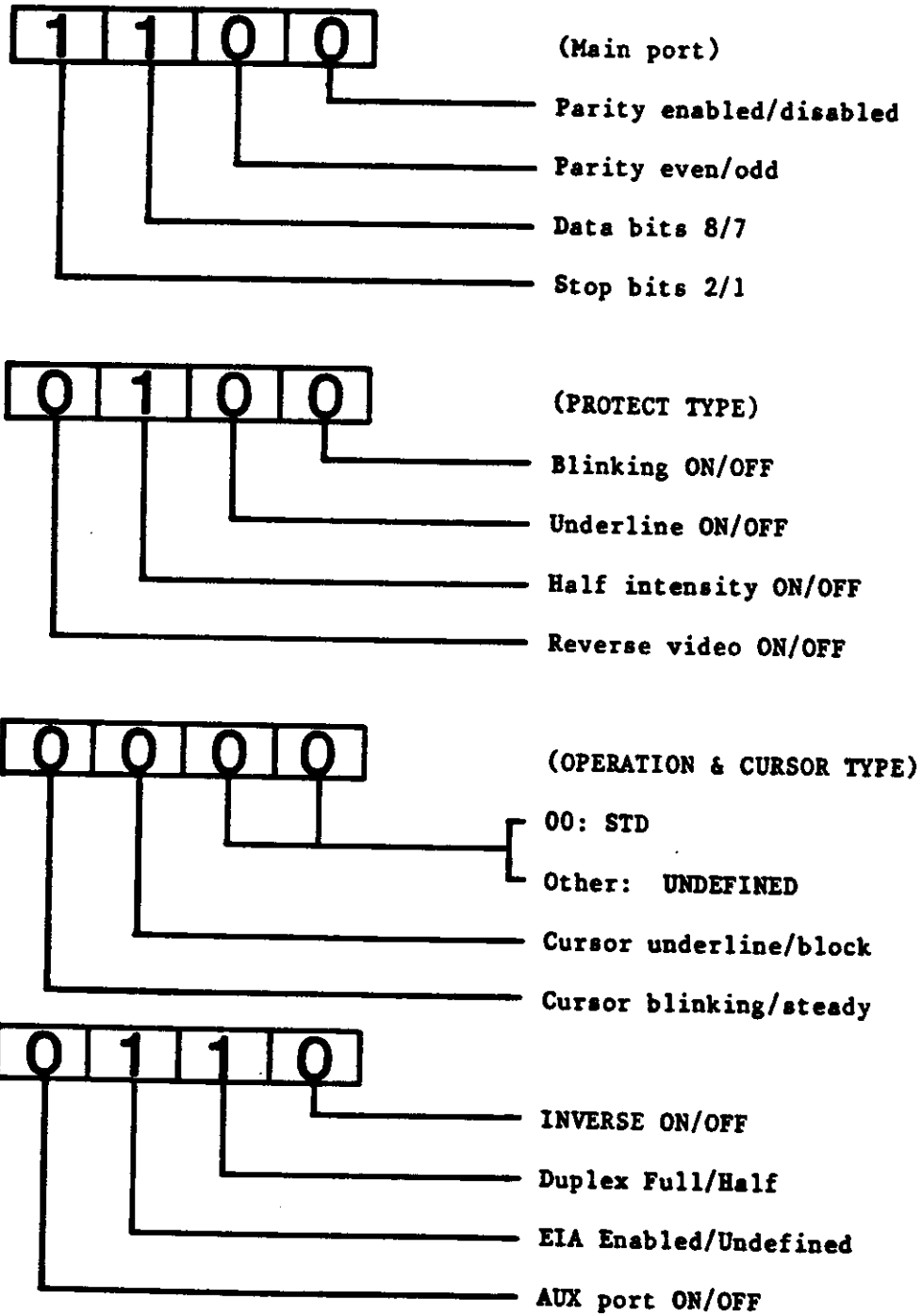
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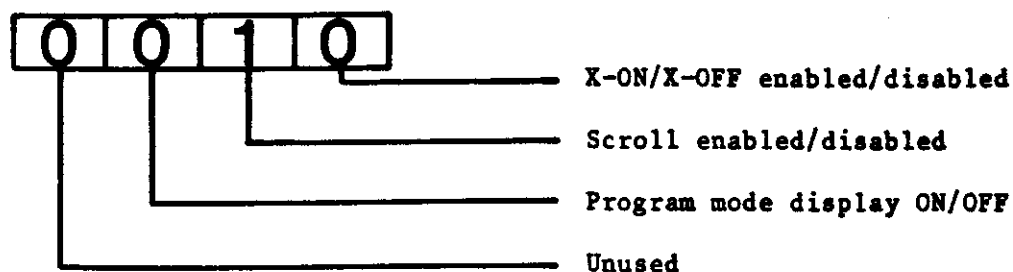
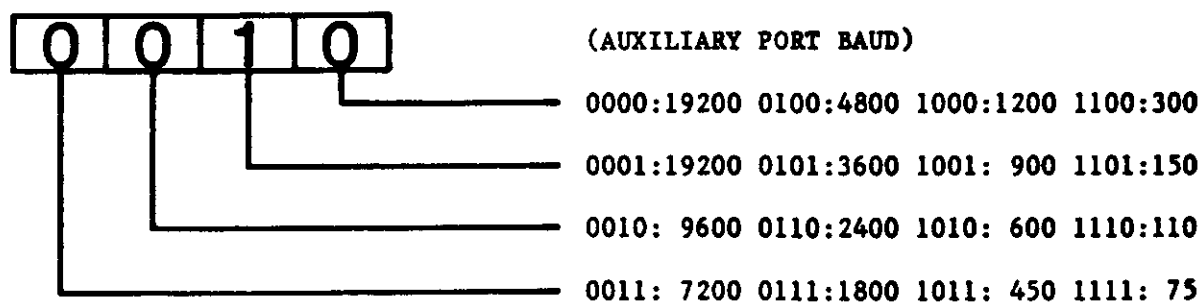
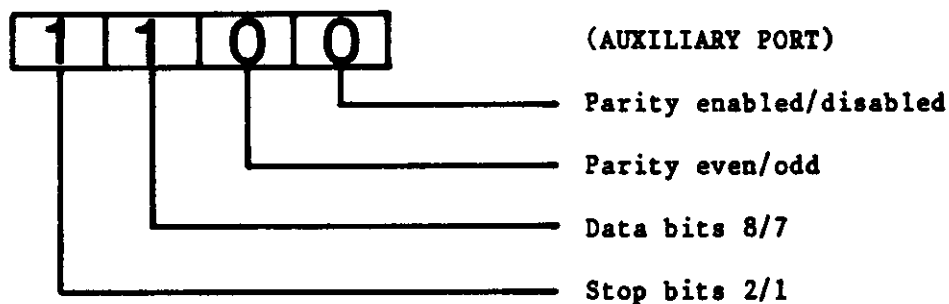
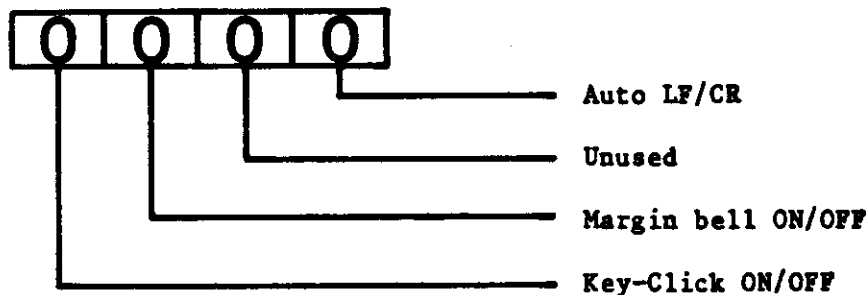
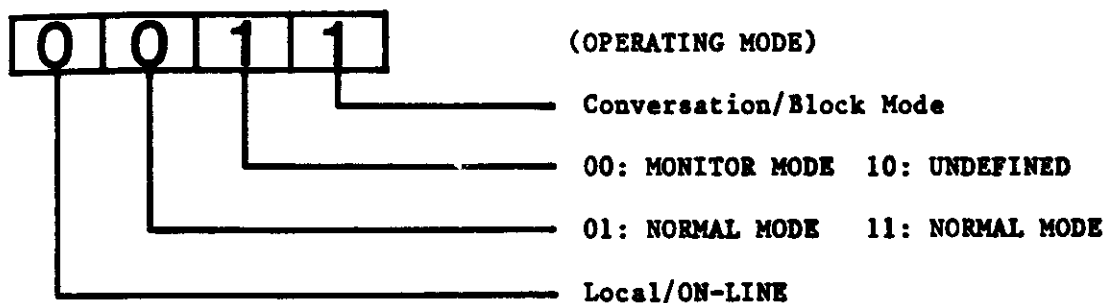
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Morrow Designs
600 McCormick St.
San Leandro, CA 94577
(415) 430-1970

Table 2-1
Status Line and Recommended Set Up





SECTION III OPERATION

3.1 INTRODUCTION

This section provides the information necessary for the operator to utilize the Morrow Terminal to its fullest capabilities. This section emphasizes the commands required to initiate and control various terminal operations, whether originating from the Morrow Designs computer or the keyboard.

3.2 OPERATIONAL MODES

The Morrow Terminal provides several different modes of operation which are selectable by the computer or from the keyboard. The following paragraphs summarize the operating modes and the associated interactions. The power-on mode conditions are established by the last saved functions selected in the associated Set-Up features. The various command sequences used to change the operating characteristics of the Morrow Terminal are detailed in paragraph 3.4.

3.2.1 On-Line Or Local Mode

On-Line Mode - When the terminal is placed On-Line, data being received will be displayed or acted upon, and keyboard entries will be transmitted and/or displayed, depending on the communications mode selected.

Local Mode - In Local Mode the terminal ignores the communications interface and keyboard entries are displayed or acted on locally, no transmission takes place.

3.2.2 Conversation or Block Mode

Conversation Mode - This is the normal mode for operation with the Morrow Designs Computer. In Conversation Mode, data entered on the keyboard is immediately transmitted to the computer, character-by-character. When Conversation Mode is selected the display action is determined by the setting of Full or Half Duplex Mode as follows:

Full Duplex - Characters typed are transmitted only, no local operation takes place. In order for data to be displayed, it must be echoed from the computer.

Half Duplex - Characters typed are transmitted to the computer and routed to the display locally.

Block Mode - When Block Mode is selected data entered on the keyboard is sent to the display only. This allows the operator the ability to format and correct a screen of data prior to transmission to the computer. The extent of transmission (line or page, unprotected only or all) depends on the command issued to initiate the send operation.

3.2.3 Protect Mode

Protect Mode operation allows specified characters on the display to be "protected" or reserved when performing block transmission, tabbing, or erase operations. Characters to be protected are entered after a "Set Write Protect" command is issued. This will cause the data subsequently entered to be displayed with the "Protected-Field Visual Attribute" selected in Set-Up Mode. If "Protect Mode" is not set, no special actions take place. If Protect Mode is set, then the highlighted (Write-Protected) data is not transmitted or erased when the appropriate commands are initiated and tabbing to unprotected fields is enabled. Setting Protect Mode also prevents the display from scrolling.

3.2.4 Normal Or Monitor Mode

Normal Mode - Normal Mode causes the 96-displayable ASCII characters (20-7F Hex) to be displayed when received. The 32 codes (00-1F Hex) are acted upon only if they are control codes for the Morrow Terminal, otherwise they are ignored.

Monitor Mode - Enabling Monitor Mode causes all received data to be displayed as ASCII hexadecimal pairs (00-7F). No control codes are acted upon and all data is displayed. Monitor Mode may only be exited by resetting the terminal or through Set-Up Mode.

3.2.5 Program Mode

Setting Program Mode causes the terminal to display all 32-control codes (00-1F) instead of acting upon them. This allows the embedding of formatting information particularly useful in block transmission or print output, and as a diagnostic aid.

3.2.6 Set-Up Mode

Set-Up Mode is entered by pressing the SET-UP key on the keyboard. The terminal will sound the audible alarm, transmit an X-OFF code (DC3-13 Hex), if X-ON/X-OFF is enabled, and present the 25th status line on the display by scrolling the data up one line. Changes may then be made to the Set-Up Mode features as described in paragraph 2.5.2. Pressing the SET-UP key again exits Set-Up Mode and causes any changes that were made to take effect. The terminal will transmit an X-ON Code (DC1-11 Hex), if X-ON/X-OFF is enabled, and scroll the data down one line returning the original display. The Morrow Terminal ignores all received data while in Set-Up Mode and any invalid keystroke sounds the audible alarm.

3.3 KEYBOARD OPERATION

The operator uses a keyboard very similar to that of a standard office typewriter to enter data and perform control operations. Functionally the keyboard consists of the displayable 96-ASCII character set keys and various control or modifier keys. All keys will repeat automatically if held down for approximately one-half second or more. Paragraphs 3.3.2 thru 3.3.9 detail the keyboard by the following classes of keys:

- . Alphanumeric and Punctuation Keys
- . Numeric Keypad
- . Modifier Keys
- . Cursor Control Keys
- . Edit Keys
- . Transmission Keys
- . Function Keys
- . Special Operation Keys

3.3.1 Keystroke Conventions

Ordinarily each keystroke typed by the operator is independent of the one preceding or following it. The 2-key lockout feature of the unit prevents the production of a second code before the key already typed is released.

3.3.2 Alphanumeric and Punctuation Keys

The upper/lower case, numerics, and punctuation characters from the 96-displayable ASCII character set, (21-7E Hex) including SPACE (20 Hex) and DEL (7F Hex), are output to the display and/or transmitted when a key is pressed. Keys that have a double legend produce the lower-case or lower legend unshifted, and the upper-case or upper legend when pressed with the SHIFT key. The SPACE key generates an ASCII 20 Hex code for transmission and occupies a space on the display.

3.3.3 Numeric Keypad

The ASCII numerals 0 through 9 along with minus, comma, and period, are output to the display and/or transmitted (depending upon the communications mode selected) when a key is pressed. The ASCII hex codes generated are identical to the lower legend numerals and punctuation on the main keyboard area.

3.3.4 Modifier Keys

The following keys do not generate an output by themselves, but modify the code generated by the alphanumeric keys on the keyboard.

SHIFT causes the upper legend character of a double legend key to be produced when pressed in conjunction with either SHIFT key. The 26-alpha characters are shifted for upper-case, and unshifted for lower-case.

CAP LOCK this push-on/push-off key causes the 26-alpha characters to stay shifted (upper-case) when on. The numeric and punctuation keys, as well as the various control keys, are not affected.

CTRL causes one of the 32-ASCII control codes to be generated when pressed in conjunction with an otherwise displayable character key. The character generated will not occupy a space on the display unless program mode or monitor mode are set. Some control codes are utilized by the Morrow Terminal, refer to Table 3-1 for details.

3.3.5 Cursor Control Keys

The Cursor is used to indicate the next character position to be entered on the display. The cursor may be positioned by remote commands from the computer or by cursor control keys on the keyboard. The following keys are used to position the cursor on the display:

← → ↑ ↓ and HOME move the cursor as indicated and transmit the ASCII control codes listed in Table 3-1 when the standard Morrow Terminal command code set has been selected.

If the position moved to is protected, the cursor will move to the first unprotected position in the direction commanded.

TAB will cause the cursor to advance to the next tab stop and an HT (09 Hex) code to be generated. There are two types of tab operations possible, Modulo and Protected Field. When Protect Mode is not set, the tab stops are automatically set at every eight character position, 0, 8, 16, ..., 72. When Protect Mode is set, TAB will cause the cursor to advance to the first unprotected character position following the next protected field. Tabbing will move the cursor to the first tab stop on the next line when at the last tab position on a line.

BACKSPACE causes the cursor to move one character position to the left, or end of the previous line if the cursor has been at the beginning of a line. A BS code (08 Hex) is generated when the key is pressed.

RETURN moves the cursor to the beginning of the line it was in, or the beginning of the next line (carriage return + line feed) depending upon the auto-line feed selection made in Set-Up Mode. The key will generate a CR (0D Hex) or US (1F Hex) code per the auto-line feed selection.

LINE FEED moves the cursor to the same column position of the next line down. This will cause a scroll operation to occur if the cursor was on the bottom line of the display, scrolling was enabled in Set-Up Mode, and Protect Mode is not set. If scrolling is disabled or Protect Mode is set, the cursor will move to the same column in the top line. If the position is protected, the cursor will move to the first unprotected position on the line. The Line Feed key produces an LF (0A Hex) code when pressed.

3.3.6 Edit Keys

The Edit keys on the Morrow Terminal operate differently depending on the serial number of the unit. On units with serial numbers lower than 25110000, the Edit keys will only work when the terminal is being used in Block Mode, and therefore will not normally be used. The operations of the Edit keys in Block Mode are detailed below.

On units with serial numbers from 25220000 and up, the Edit keys operate as described below in Block Mode, and when in Conversation Mode, transmit the appropriate WordStar codes.

Terminals with serial numbers between 25110000 and 25400000 may be upgraded at a small cost to give the added convenience of WordStar code transmission.

In Conversation Mode on terminals which have the WordStar capability, the Edit keys perform as follows in WordStar:

CHAR INS toggles WordStar's INSERT mode on and off. It does this by sending a ^V (control-V) when pressed.

CHAR DEL deletes the character at the current cursor position. All characters on the line to the right of the cursor get moved left one position. It sends a ^G (control-G) when pressed.

LINE INS will insert a new line at the current cursor position, moving all text on the line from the cursor to the end of the line, along with all subsequent lines, down one position. It does this by sending a ^N (control-N) when pressed.

LINE DEL will delete the entire line the cursor is on, after which all subsequent lines will be moved up one row. It generates a ^Y (control-Y) when pressed.

When not in WordStar, the function performed by the keys is dependent upon the applications program being run.

Operation of the Edit keys in Block Mode is as follows:

CHAR INS causes the character under the cursor and all following characters to move one position to the right. The character insert operation terminates at the end of the line, or first protected field if Protect Mode is set, and the last character on the line is lost. A space character is written under the cursor.

CHAR DEL deletes the characters under the cursor and moves all characters that follow on the line, or first protected field if Protect Mode is set, to the left. A space is written in the last character position of the line or field.

LINE INS causes the entire line the cursor is in to move down one line as well as all lower lines. The bottom line of the display scrolls off and is lost. The cursor moves to the beginning of the line created which is filled with spaces. If Protect Mode is set, no operation is performed.

LINE DEL erases the line containing the cursor and moves all lower lines upward one line. The cursor moves to the beginning of the first line that moves upward. The bottom line of the display is filled with spaces. If Protect Mode is set no operation takes place.

3.3.7 Transmission Keys

Two types of data transmission may be initiated from the keyboard - a Send Page Unprotected and a Page Print, as follows:

ENTER will cause the unprotected data from home to the cursor position to be transmitted out the Main Port if Block Mode and Protect Mode are set. If Protect Mode is not set, all data from home to the cursor position will be sent. If Conversation Mode is set, then the ENTER key generates a CR (0D Hex) code only and no block transmission takes place.

COPY causes the data from home to the cursor position to be output to the Auxiliary Port device, usually a printer. At the end of each line transmitted, the Morrow Terminal automatically inserts a CR (0D Hex) and LF (0A Hex) code in the output data. The Auxiliary Port must be enabled in Set-Up Mode for the operation to take place.

3.3.8 Function Keys

The seven function keys, F1 thru F7, transmit a single control character. The keys perform no local operation and are used as special commands to be interpreted by the computer for particular system operations. The keys and each associated transmit sequence are as follows:

	ASCII NAME	HEX CODE
F1 =	SOH	01H
F2 =	STX	02H
F3 =	ETB	17H
F4 =	EOT	04H
F5 =	ENQ	05H
F6 =	CAN	18H
F7 =	SUB	1AH

3.3.9 Special Operation Keys

The keys listed below perform special operations or have a unique effect on the Morrow Terminal.

SET-UP key causes the Morrow Terminal to enter Set-Up Mode when pressed, as described in paragraph 2.5.2. Pressing the key again exits Set-Up Mode.

SAVE is active only when the terminal is in Set-Up Mode. Pressing the key causes the current set-up functions to be saved in non-volatile memory. The saved selections are used to establish the power-on or reset configuration of the Morrow Terminal. The SAVE key has no effect when not in Set-Up Mode.

BREAK causes a break (mark) condition to be presented on the transmit data line of the Main Port for approximately 300 milliseconds. This operation has no effect on the terminal and is usually used for control signaling to the computer device.

ESC generates a special control code (1B Hex), usually followed by one or more characters, used for command operations. Thus, ESCape is usually considered as a "Lead-In" character for terminal control operations. Paragraph 3.4 and Table 3-2 detail the ESCape sequence utilized by the Morrow Terminal.

3.4 CONTROL CODES AND ESCAPE SEQUENCES

3.4.1 Control Codes

The operational characteristics of the Morrow Terminal are controlled, in part, by a group of control codes which may originate at the computer or at the keyboard. Control codes are not displayed unless Program Mode is set. In that case the Morrow Terminal will display, but not act upon, the recognized control code. Of the 32-ASCII standard control codes available for use, the Morrow Terminal utilizes the control codes listed in Table 3-1.

3.4.2 Escape Sequences

An ESCape sequence is formed by executing the ESC ASCII control code, followed by one or more otherwise displayable ASCII characters. Each ESCape sequence controls a specific terminal operation. Some operations are one-time only, others remain operative for as long as power to the unit is not interrupted or until terminated by a control code or ESCape sequence.

Table 3-2 shows the ESCape sequences used by the Morrow Terminal, whether initiated from the computer or the keyboard. ESCape sequences may be initiated from the keyboard using the ESC key during Conversation Mode or Block Mode operations, as follows:

Conversation Mode, Full Duplex - ESC is transmitted directly to the computer and is utilized by the Morrow Terminal only when echoed back by the computer.

Conversation Mode, Half Duplex - ESC is transmitted and acted upon locally by the Morrow Terminal.

Block Mode - each ESC sequence is immediately acted upon by the Morrow Terminal, unless program mode is set. If embedded in memory, the ESC sequence will be displayed but not acted upon, and will be transmitted, along with the block of data.

Table 3-1
Control Codes Utilized by the Morrow Terminal

OPERATION	HOW TO EXECUTE FROM CPU	FROM KEYBOARD	HEX CODE	DESCRIPTION
Bell	BEL	CONTROL G	07	Sounds the audible alarm. (If margin bell enabled in set-up.)
Backspace	BS	← BACKSPACE or CTRL H	08	Moves the cursor to the left one character position. The cursor moves to the last posi- tion of the previous line when at the first character posi- tion of the line.
Tab	HT	TAB or CTRL I	09	Moves the cursor to the next tab stop - Beginning of the next unprotected field if pro- tect mode is set, to every eighth character position (modulo 8 column tabs) if protect mode is reset. (Same as ESC I)
Line Feed	LF	↓ or CTRL J	0A	Moves the cursor to the next line down in the same column. If the cursor is located on the last line, a scroll opera- tion will be performed, if enabled.
Upline	VT	↑ or CTRL K	0B	Moves the cursor to the pre- vious line up in the same col- umn. If the cursor is located on the first line, no opera- tion takes place.
Forespace	FF	→ or CTRL L	0C	Moves the cursor to the right one character position. The cursor moves to the first position of the next line, when at the last character position of a line.
Carriage Return	CR	RETURN* or CTRL M	0D	Moves the cursor to the first character position of the current line.

Table 3-1 (Continued)
Control Codes Utilized by the Morrow Terminal

OPERATION	HOW TO EXECUTE FROM CPU	FROM KEYBOARD	HEX CODE	DESCRIPTION
Keyboard Enable	S0	CTRL N *	0E	Allows data to be entered on the keyboard - keyboard unlock (*from computer only if keyboard is already locked). (Same as ESC ")
Keyboard Disable	S1	CTRL O	0F	Prevents data from being entered on the keyboard - keyboard lock. (Same as ESC #) Auto line feed is disabled.
Reset Auxiliary Port with/without Display	DC4	CTRL T	14	When printing through auxiliary port, with/without display will continue until the buffer is empty.
Clear all to Spaces	SUB	CTRL Z	1A	Erases the display to spaces, and moves the cursor to the Home position.
Escape	ESC	ESC or CTRL [	1B	Recognized by the Morrow Terminal as a code extension character which must be followed by otherwise displayable character or characters to invoke a specific terminal operation.
Home Cursor	RS	HOME or CTRL ^	1E	Moves the cursor to the first character position of the first line of the display.
New Line	US	RETURN * or CTRL _	1F	Moves the cursor to the first character position of the next line (*when auto line feed is enabled)

Table 3-2
Morrow Terminal Escape Sequences

(Operations which have an * beside them are also selectable in set-up mode.)

COMMAND	ESCAPE SEQUENCE	HEX CODE	DESCRIPTION
Keyboard Unlock	ESC "	1B 22	Enables data entry from the keyboard. (Same as S0) (Hitting SET-UP twice will unlock the keyboard.)
Keyboard Lock	ESC #	1B 23	Disables data entry from the keyboard.
Set Protect Mode	ESC &	1B 26	Causes protect mode to be entered, highlighted (write-protected) data is reserved (protected) during certain editing and transmit operations.
Reset Protect Mode	ESC ^	1B 27	Causes protect mode to be exited.
Reset Write Protect	ESC (	1B 28	Causes write protect to be terminated.
Set Write Protect	ESC)	1B 29	Causes all subsequent data to be entered as write protected. Data will be highlighted by the protected field visual attribute selected in the set-up field. Data will not be "protected", however, unless protect mode is set.
Clear all to Null	ESC *	1B 2A	Causes all display data to be cleared to nulls protected or not, and the cursor moves home.
Clear Unprotected to Spaces	ESC +	1B 2B	Causes only unprotected data on display to be cleared to spaces, cursor moves home. If protect mode is not set, all data is cleared. (Same as ESC ;))

Table 3-2 (Continued)
Morrow Terminal Escape Sequences

(Operations which have an * beside them are also selectable in set-up mode.)

COMMAND	ESCAPE SEQUENCE	HEX CODE	DESCRIPTION
Load Default Status Line	ESC 0	1B 30	Causes the diagnostic test mode to be entered.
Send Line	ESC 4	1B 34	Transmits the unprotected data in the line containing the cursor, starting at the beginning of the line and up to the cursor position.
Send Page- Unprotected	ESC 5	1B 35	Transmits the unprotected data on the display starting at home and through to the cursor position. A CR (code 0D Hex) is transmitted at the end of the block.
Send Line-All	ESC 6	1B 36	Transmits all data in the line containing the cursor starting at the beginning of the line and up to the cursor position.
Send Page-All	ESC 7	1B 37	Transmits all data on the display beginning at home and continuing through to the cursor position.
Clear Unpro- tected to Spaces	ESC ;	1B 3B	Causes the unprotected data on the display to be cleared to spaces and the cursor to be moved to the home position. (Same as ESC +)
Address Cursor	ESC=(X ¹ X ²)	1B 3D (20-6F) (20-37)	Used to position the cursor to a specified row and column on the display. The location is expressed as two ASCII characters. The first (X ¹) specifies the column coordinate (20-6F Hex). The second (X ²) specifies the row (20-37 Hex). Refer to Fig. 3-2.

Table 3-2 (Continued)
Morrow Terminal Escape Sequences

(Operations which have an * beside them are also selectable in set-up mode.)

COMMAND	ESCAPE SEQUENCE	HEX CODE	DESCRIPTION
Read Cursor	ESC ?	1B 3F	Causes the terminal to transmit the cursor row and column position in the same format as described in "Address Cursor" Command. Column position is transmitted first, followed by the row position.
Enable Auxiliary Port with Display	ESC ,	1B 2C	This command causes all data received by the primary port to be displayed and/or acted upon, and transmitted to the auxiliary port device. In conversation/half duplex mode, keyboard entries are also transmitted.
Set Block Mode*	ESC B	1B 42	Cancels conversation mode and causes block mode to be entered. Refer to para. 3.2.2 for details of block mode operation.
Set Conversation*	ESC C	1B 43	Cancels block mode and causes conversation mode to be entered. Refer to Paragraph 3.2.2 for details of conversation mode operation.
Insert Line	ESC E	1B 45	Causes a line of spaces to be inserted at the line containing the cursor. All lower lines scroll down one line, the bottom line being lost. No action takes place if protect mode is set.
Back Tab	ESC I	1B 49	Moves the cursor to the beginning of the previous unprotected field if protect mode is set; to the left eight character positions (modulo 8 tab) if protect mode is reset.

Table 3-2 (Continued)
Morrow Terminal Escape Sequences

(Operations which have an * beside them are also selectable in set-up mode.)

COMMAND	ESCAPE SEQUENCE	HEX CODE	DESCRIPTION
Set Monitor Mode*	ESC A	1B 41	When set, all received data will be displayed as hexadecimal ASCII pairs, 00-7F.
Print Page-All	ESC P	1B 50	Causes all data from home up to the cursor position to be transmitted to the auxiliary port device, a CR and LF code (0D and 0A Hex) are added at the end of each line as it is sent. (Pressing [PRINT] on keyboard performs the same function.)
Insert Char- acter	ESC Q	1B 51	Moves all data from the cursor position to the end of the line or protected field one position to the right. A space is written at the cursor position.
Delete Line	ESC R	1B 52	Erases the line containing the cursor and moves all lower lines upward one line. No action takes place if protect mode is set.
Erase to End- of-Line Unpro- tected	ESC U	1B 55	Erases the unprotected data from the cursor position up to the end of the line or protected field.
Delete Character	ESC W	1B 57	Deletes the character under the cursor and moves all characters from the cursor to the end of the line or protected field to the left one position.
Erase to End- of-Page Unprotected	ESC Z	1B 5A	Erases the unprotected data from the cursor position up to the end of the display or protected field.

Table 3-2 (Continued)
Morrow Terminal Escape Sequences

(Operations which have an * beside them are also selectable in set-up mode.)

COMMAND	ESCAPE SEQUENCE	HEX CODE	DESCRIPTION
Enable Auxil- iary Port without Display	ESC -	1B 2D	This command causes all data received by the primary port to be transmitted to the auxiliary port device. No data are sent to the display.
Erase to End- of-Line All	ESC T	1B 54	Erases all data from the cursor position up to the end of the line.
Erase to End- of Page All	ESC Y	1B 59	Erases all data from the cursor position up to the end of the display.

3.5 DATA TRANSMISSION

Data entered from the keyboard may be transmitted to your computer either character-by-character as during Conversation Mode operation, or in message blocks, as during Block Mode operation. Transmission is serial asynchronous, with an ASCII character format of 1 start bit, 7 or 8 data bits, odd/even, or no parity bit and 1 or 2 stop bits. The word structure and baud rate used are selectable in Set-Up Mode. Main Port communications are via a bi-directional RS-232C interface as detailed in Section II. Auxiliary Port communication is uni-directional via an RS-232C interface, also detailed in Section II.

Data communications can take place whenever the Morrow Terminal is placed in On-Line Mode. When receiving data the Morrow Terminal has an X-ON/X-OFF busy indication feature used to command the computer to suspend transmission to prevent data loss.

3.5.1 Conversation Mode Characteristics

When the terminal is operating in Conversation Mode, characters entered on the keyboard are immediately transmitted to the computer. This includes any control codes or ESCape sequences which are normally not displayed. If Full Duplex Mode is set, then only those codes echoed by the computer will be displayed or cause any action to take place.

3.5.2 Block Mode Characteristics

During Block Mode operation, data entered on the keyboard is routed only to the display or acted upon for command sequences utilized by the Morrow Terminal. This allows complete display editing and formatting prior to transmission to the computer. By setting Program Mode, control codes may also be embedded in the display for transmission. A block of data can be transmitted in whole or in part by the use of the Protect Mode feature. This allows the computer the ability to send a form to the terminal which is Write-Protected. When Protect Mode is set, data the operator enters is transmitted only when commanded. Block Mode commands may be used to cause the terminal to transmit a line or page, unprotected only, or all of the data. Received data is accepted conversationally or in blocks, regardless of the mode selected.

3.5.3 X-ON/X-OFF (Busy/Ready Status)

The Morrow Terminal has the ability to signal the computer of a potential data loss if the printer buffer is nearly full or the terminal is otherwise unable to accept data. The X-ON/X-OFF feature may be enabled or disabled through Set-Up Mode. When enabled the terminal will transmit an X-OFF code (DC3-13 Hex, Control S) to the computer if the input buffer has fewer than 256 character locations remaining. An

X-ON code (DC1-11 Hex, Control Q) will be transmitted when there are 1024 locations available in the input buffer. Using the Page Print function or the Pass-through Print with low speed printers will also cause the X-ON/X-OFF commands to be issued when appropriate. Busy/Ready condition is sensed on the Auxiliary Port via one of the RS-232C signal levels. The CP/M operating system will recognize these X-ON/X-OFF codes and stop the transmission when requested by the terminal.

3.6 CURSOR CONTROL

3.6.1 Relative Cursor Positioning

The Cursor may be moved to any position on the screen using the separate cursor control keys. Its position signifies the next character position in the display. When data is being entered, the cursor moves one position to the right on the line or to the first position in the next line each time a character is written. The control codes required to control the cursor position are outlined in Table 3-1.

3.6.2 Absolute Cursor Positioning

Absolute Cursor Addressing requires commanding the cursor to a specific display location. Commanding the cursor to a specific location (loading the cursor) is normally executed by the computer. The Load command is executed by means of an ESCape sequence in which the row and column location of the cursor is expressed in a pair of ASCII characters.

3.6.2.1 Load Cursor Operation

When the Load Cursor operation is initiated the cursor moves to the commanded position. The Load Cursor operation codes required are as follows:

ESC = COL	ROW
ASCII	ASCII
|	| ASCII Character associated with
|	| row (1-24) position.
|	| ASCII Character associated with cursor
|	| column (1-80) position.

EXAMPLE: "ESC=1/" commands the cursor to Column 18, Row 16.

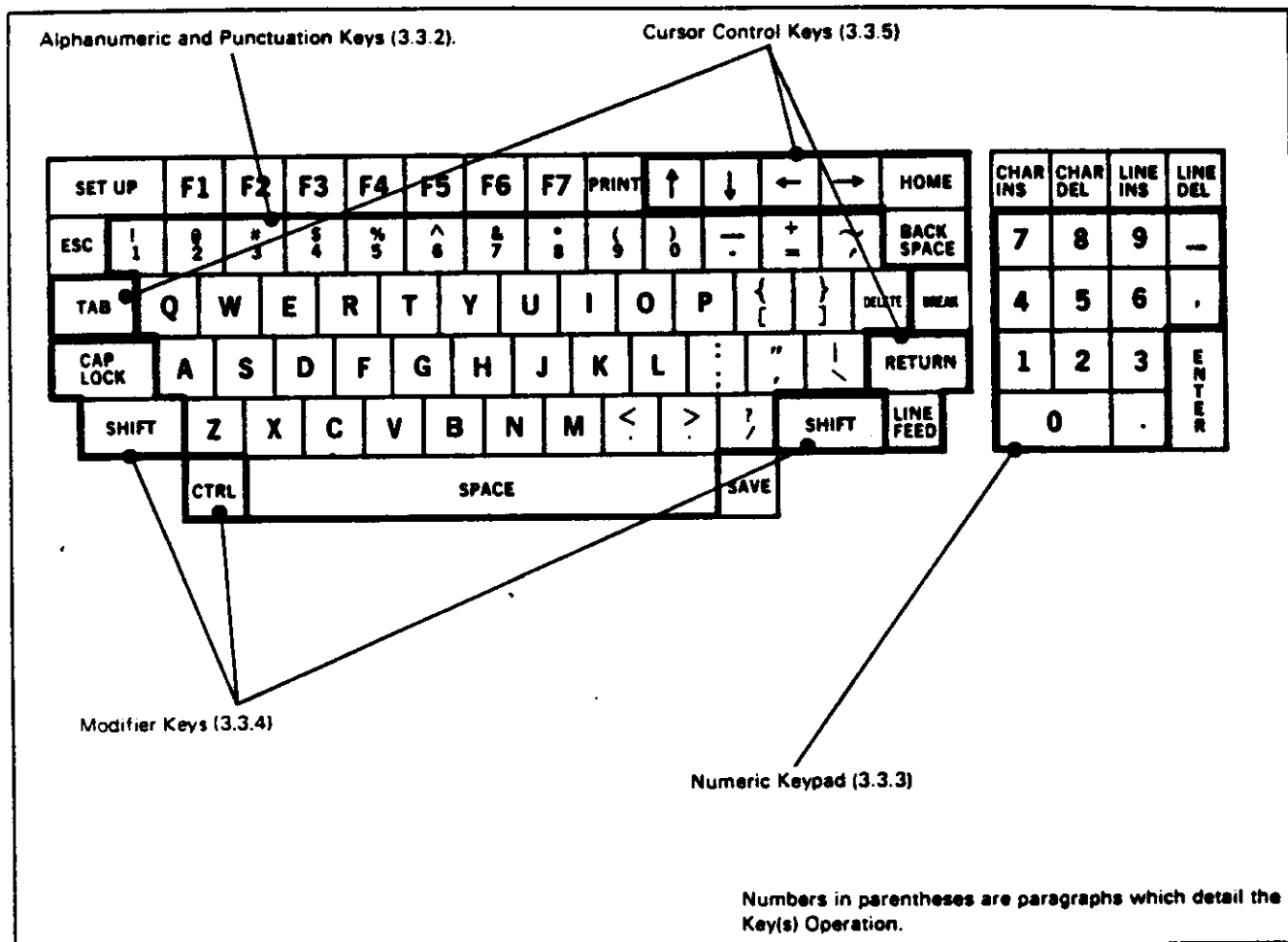


Figure 3-1. Morrow Terminal Keyboard Functions

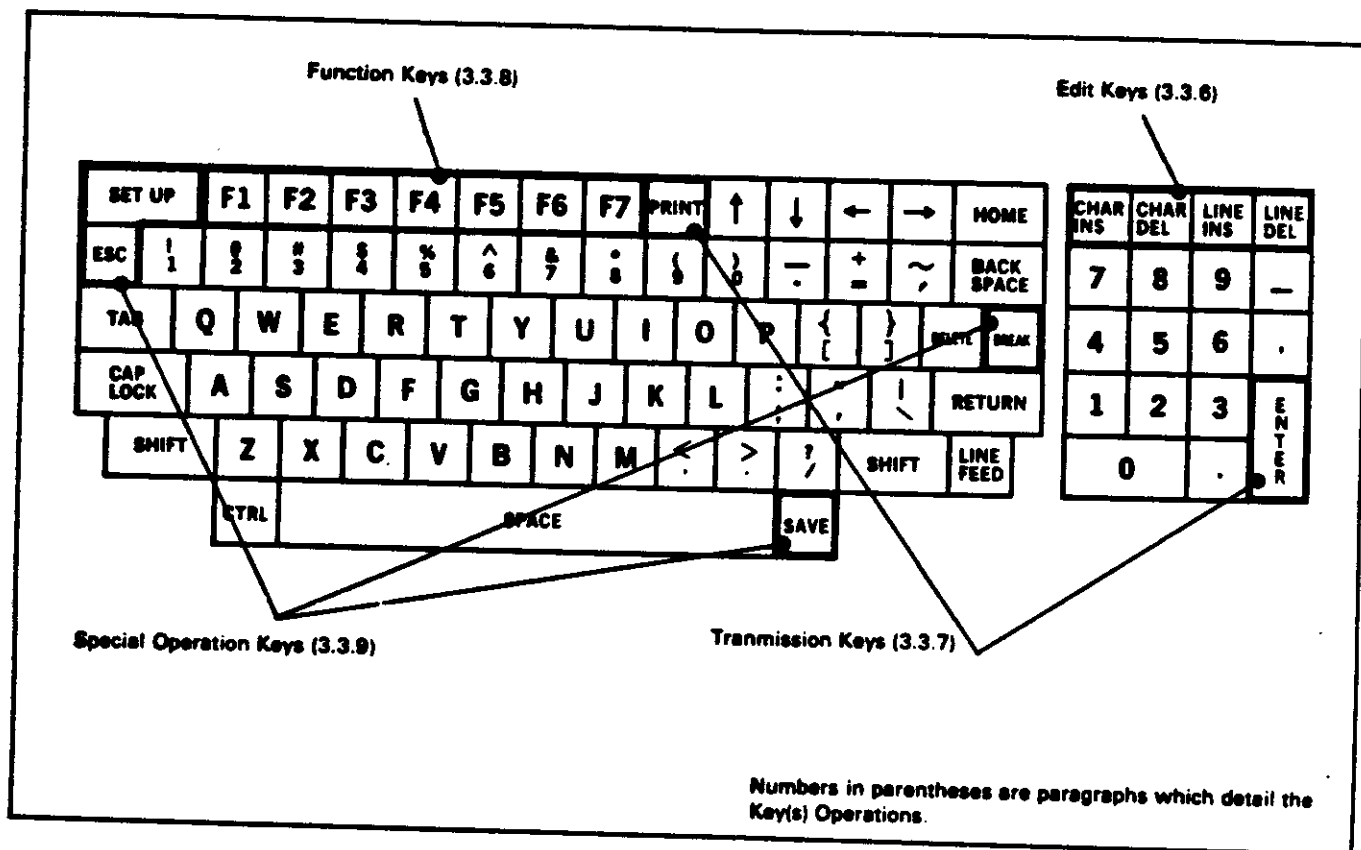


Figure 3-1. Morrow Terminal Keyboard Functions

3.6.3 Tab Control

The Morrow Terminal supports two types of tab operations: Modulo tabs and Protected Field tabs. The tab and back-tab commands are detailed in Tables 3-1 and 3-2. The type of tab performed depends upon whether Protect Mode is set or reset. When Protect Mode is set, the Tab command will cause the cursor to advance to the beginning of the next unprotected field. If no protected fields are encountered by the end of the display, the cursor moves home, or to the first unprotected position if home is protected. When Protect Mode is reset the cursor will advance or backspace by eight character positions (Modulo 8 tab) for each command received.

3.6.4 Scrolling

In the Morrow Terminal, data is entered into display memory starting at the HOME position, and continues through Position 80 or Line 24, (last data position). When Position 80 is filled, or when a New Line or Line Feed occurs in Line 24, the display is shifted upwards one line and data entry continues in Position 1 of the new Line 24. The original top line of the display is lost. Scrolling continues indefinitely. Scrolling may be enabled or disabled through a selection in Set-Up Mode. Scroll is automatically disabled when Protect Mode is set.

3.7 DISPLAY FORMATTING OPERATIONS

The Morrow Terminal may have various attributes and fields used to highlight data on the display. The visual and field attributes used for display formatting are discussed in the paragraphs that follow.

3.7.1 Visual Attributes

There are four Visual Attributes that can be assigned to any character on display. They include: Blink, Underline, Reversed, and Reduced Intensity. The attribute that will be used is assigned singularly or in combination through a set-up function selection. When the "Set Write Protect" command is received all subsequent data entered will appear with the selected attribute. If Protect Mode is not set, the data is not treated uniquely; it may be overwritten and erased or cleared by all associated commands. If Protect Mode is set, the data is treated as protected.

3.7.2 Field Attributes

When the "Set Write Protect" command is received all subsequent data takes on the visual attribute as noted in paragraph 3.6.1, until a Reset Write Protect is issued. By setting Protect Mode, the write protected data is treated as reserved, or protected. This will allow the commands that specify "Unprotected Only" to be used to improve throughput characteristics. In block sends, the protected data will not be sent during "Send Unprotected Only" commands for line or page. During Edit operations the Erase or Clear Unprotected Only commands will leave the protected data on the display. Insert and Delete operations will terminate upon encountering a protected field. Scrolling is also disabled when Protect Mode is set.

3.8 SET-UP MODE OPERATIONS

The general operating characteristics of the Morrow Terminal are controlled by ten 4-bit "nibbles" of information that is displayed on the 25th line of the display, when Set-Up Mode is entered. Both the operator and computer have the ability to change the functions selectable in Set-Up Mode. Selections may be saved in non-volatile memory to re-establish the same functions on the next power-on cycle or terminal reset operation. The operation of Set-Up Mode is fully described in paragraph 2.5.2.

3.9 PRINT OPERATIONS

The Auxiliary Port of the Morrow Terminal is most typically connected to a serial RO printer. The communications of data to the auxiliary device is uni-directional via an RS-232C interface. A Busy/Ready signal level is monitored for status during print operations. The Auxiliary Port may be enabled or disabled through a function setting in Set-Up Mode. The three types of print output are: Page Print, Auxiliary Port with Display, and Auxiliary Port without Display, details as follows:

3.9.1 Page Print

Upon receipt of a Print Page command the Morrow Terminal will transmit data from home up to the cursor position to the auxiliary device. The command may either specify to send all data, or, send the unprotected data normally but the protected data as spaces. This is useful when using a formatted screen being output to a pre-printed form. The Print Page commands can be generated from the computer or keyboard. Each print line output is followed by a CR and LF (0D and 0A Hex) in the data stream.

3.9.2 Auxiliary Port With Display

Auxiliary Port with display is enabled or disabled by entering a command from the keyboard or by receiving the ESCape sequence from the computer. When using this method of transmission the terminal will display and act upon all received data as well as transmitting the data out the Auxiliary Port to the printer. When operating in Conversation Mode Half-Duplex keyboard entries are also output to the printer.

3.9.3 Auxiliary Port Without Display

Auxiliary Port without display is enabled or disabled by entering command from the keyboard or by receiving command from the computer. When operating in this mode, the terminal will not display received data, however, the terminal will transmit the received data out the Auxiliary Port to the printer. No commands except the reset Auxiliary Port with/without display are acted upon.

3.10 POWER-ON RESET

A Power-On Reset consists of a complete recycling of the Morrow Terminal functions, including power. This is accomplished by setting the ON/OFF switch to OFF, waiting 10 seconds, then setting the switch to ON. All display and other volatile memory is erased when powering down. Upon power up, the unit is subject to the complete Power Turn-On procedure specified in Section II.

3.11 SELF-TEST

When the Morrow Terminal is reset the terminal Self-Test will be executed. Self-Test will verify the integrity of the display memory, the program memory, non-volatile memory and the associated internal control logic. Upon completion of Self-Test the terminal will sound the audible alarm and the cursor will appear in the upper left corner of the screen.

IMPORTANT WARRANTY INFORMATION

LIMITED WARRANTY

Morrow Designs, Incorporated, warrants its products to be free from defects in workmanship and materials for the periods indicated below. This warranty is limited to the repair and replacement of parts only and liability is limited to the whole-sale list price of the product.

Limitation of Liability: The foregoing warranty is in lieu of all other warranties, expressed or implied, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. In no event will Morrow Designs, Incorporated, be liable for consequential damages even if Morrow Designs, Incorporated, has been advised of the possibility of such damages.

This warranty is void if, in the sole opinion of Morrow Designs, Incorporated, the product has been subject to abuse or misuse.

Circuit boards - Parts, including the printed circuit board, purchased as factory assemblies, are warranted for a period of ninety (90) days from the original invoice/purchase date.

Electro-mechanical peripherals - Peripheral equipment such as floppy disk drives, etc., not manufactured by Morrow Designs, Incorporated, carry their own manufacturers' warranties. Please contact Morrow Designs' Customer Service Department for information regarding these peripheral devices.

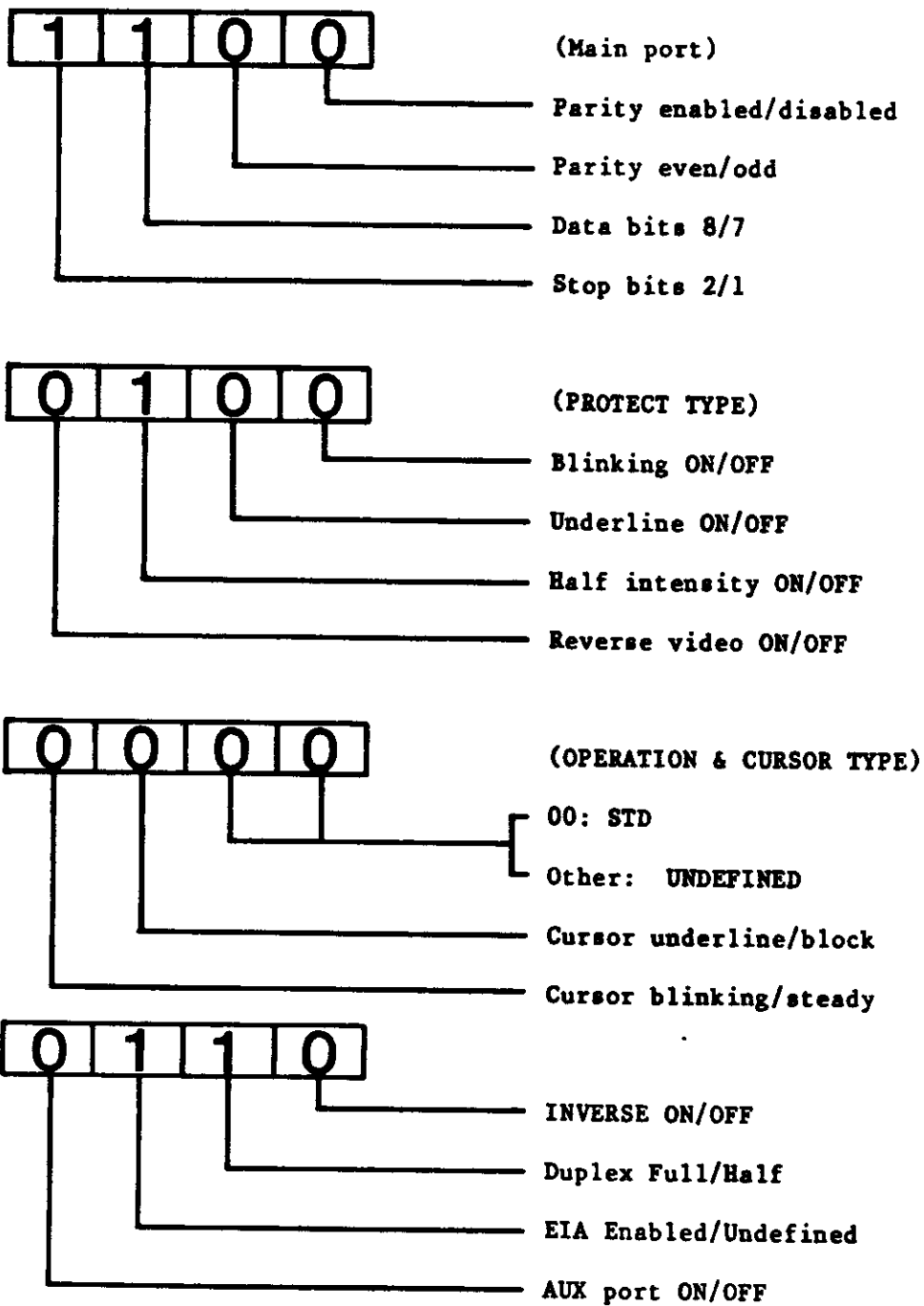
Software/Firmware - Morrow Designs, Incorporated, makes no representations or warranties whatsoever with respect to software or firmware associated with its products and specifically disclaims any implied or expressed warranty of fitness for any particular purpose or compatibility with any hardware, operating system, or software/firmware. Morrow Designs, Incorporated, reserves the right to alter or update any program, publication or manual without obligation to notify any person of such changes.

WARRANTY RETURN PROCEDURE

Should a customer experience a defect in either workmanship or materials during the warranty period, Morrow Designs, Incorporated will replace or repair the product at its expense only if the product is promptly returned to Morrow Designs, Incorporated for repair or replacement, and the following procedure for returning the product is followed:

1. Phone Morrow Design's Customer Service Department at (415) 430-1970. Inform the customer service staff of the nature of your problem and obtain a RETURN AUTHORIZATION NUMBER. No return shipment will be accepted without this number.
2. Repack the equipment and ship it to Morrow Designs, Incorporated, care of the Customer Service Department, 600 McCormick St., San Leandro, California, 94577. All freight charges must be prepaid by the customer, as well as all related charges, such as customs clearance and documentation. CODs WILL BE REFUSED. Indicate the RETURN AUTHORIZATION NUMBER on the waybill and shipping label. Include with the equipment a copy of proof of purchase showing the date the equipment was purchased. Any shipment received without proof of purchase will be billed as non-warranty repairs. Please also include a brief written description of the problem experienced with the equipment.
3. Morrow Designs, Incorporated, will repair or replace defective items and return the product to the customer via UPS surface, prepaid rates. Any other form of delivery or shipment required or requested by the customer is at the sole expense of the customer.
4. SHIPPING DAMAGE: (a) Morrow Designs, Incorporated, is not responsible for damage to goods in transit. (b) If you return a product because of shipping damage, have the product inspected by the carrier before returning it to us. Failure to do so may result in denial of your claim by the carrier. (c) Always ship the product in its original packing material. If the original packing material has been damaged or lost, new packing material can be purchased from Morrow Designs. Many shippers will not honor damage claims if the product is not adequately packaged.
5. Morrow Designs, Incorporated, is not responsible for the integrity of any data recorded on any media returned for service or repair. It is the responsibility of the user to back-up all necessary information.

Table 2-1
Status Line and Recommended Set Up



0 0 1 1

(OPERATING MODE)

Conversation/Block Mode

00: MONITOR MODE 10: UNDEFINED

01: NORMAL MODE 11: NORMAL MODE

Local/ON-LINE

0 0 0 0

Auto LF/CR

Unused

Margin bell ON/OFF

Key-Click ON/OFF

1 1 0 0

(AUXILIARY PORT)

Parity enabled/disabled

Parity even/odd

Data bits 8/7

Stop bits 2/1

0 0 1 0

(AUXILIARY PORT BAUD)

0000:19200 0100:4800 1000:1200 1100:300

0001:19200 0101:3600 1001: 900 1101:150

0010: 9600 0110:2400 1010: 600 1110:110

0011: 7200 0111:1800 1011: 450 1111: 75

0 0 1 0

X-ON/X-OFF enabled/disabled

Scroll enabled/disabled

Program mode display ON/OFF

Unused

SECTION III OPERATION

3.1 INTRODUCTION

This section provides the information necessary for the operator to utilize the Morrow Terminal to its fullest capabilities. This section emphasizes the commands required to initiate and control various terminal operations, whether originating from the Morrow Designs computer or the keyboard.

3.2 OPERATIONAL MODES

The Morrow Terminal provides several different modes of operation which are selectable by the computer or from the keyboard. The following paragraphs summarize the operating modes and the associated interactions. The power-on mode conditions are established by the last saved functions selected in the associated Set-Up features. The various command sequences used to change the operating characteristics of the Morrow Terminal are detailed in paragraph 3.4.

3.2.1 On-Line Or Local Mode

On-Line Mode - When the terminal is placed On-Line, data being received will be displayed or acted upon, and keyboard entries will be transmitted and/or displayed, depending on the communications mode selected.

Local Mode - In Local Mode the terminal ignores the communications interface and keyboard entries are displayed or acted on locally, no transmission takes place.

3.2.2 Conversation or Block Mode

Conversation Mode - This is the normal mode for operation with the Morrow Designs Computer. In Conversation Mode, data entered on the keyboard is immediately transmitted to the computer, character-by-character. When Conversation Mode is selected the display action is determined by the setting of Full or Half Duplex Mode as follows:

Full Duplex - Characters typed are transmitted only, no local operation takes place. In order for data to be displayed, it must be echoed from the computer.

Half Duplex - Characters typed are transmitted to the computer and routed to the display locally.

Block Mode - When Block Mode is selected data entered on the keyboard is sent to the display only. This allows the operator the ability to format and correct a screen of data prior to transmission to the computer. The extent of transmission (line or page, unprotected only or all) depends on the command issued to initiate the send operation.

3.2.3 Protect Mode

Protect Mode operation allows specified characters on the display to be "protected" or reserved when performing block transmission, tabbing, or erase operations. Characters to be protected are entered after a "Set Write Protect" command is issued. This will cause the data subsequently entered to be displayed with the "Protected-Field Visual Attribute" selected in Set-Up Mode. If "Protect Mode" is not set, no special actions take place. If Protect Mode is set, then the highlighted (Write-Protected) data is not transmitted or erased when the appropriate commands are initiated and tabbing to unprotected fields is enabled. Setting Protect Mode also prevents the display from scrolling.

3.2.4 Normal Or Monitor Mode

Normal Mode - Normal Mode causes the 96-displayable ASCII characters (20-7F Hex) to be displayed when received. The 32 codes (00-1F Hex) are acted upon only if they are control codes for the Morrow Terminal, otherwise they are ignored.

Monitor Mode - Enabling Monitor Mode causes all received data to be displayed as ASCII hexadecimal pairs (00-7F). No control codes are acted upon and all data is displayed. Monitor Mode may only be exited by resetting the terminal or through Set-Up Mode.

3.2.5 Program Mode

Setting Program Mode causes the terminal to display all 32-control codes (00-1F) instead of acting upon them. This allows the embedding of formatting information particularly useful in block transmission or print output, and as a diagnostic aid.

3.2.6 Set-Up Mode

Set-Up Mode is entered by pressing the SET-UP key on the keyboard. The terminal will sound the audible alarm, transmit an X-OFF code (DC3-13 Hex), if X-ON/X-OFF is enabled, and present the 25th status line on the display by scrolling the data up one line. Changes may then be made to the Set-Up Mode features as described in paragraph 2.5.2. Pressing the SET-UP key again exits Set-Up Mode and causes any changes that were made to take effect. The terminal will transmit an X-ON Code (DC1-11 Hex), if X-ON/X-OFF is enabled, and scroll the data down one line returning the original display. The Morrow Terminal ignores all received data while in Set-Up Mode and any invalid keystroke sounds the audible alarm.

3.3 KEYBOARD OPERATION

The operator uses a keyboard very similar to that of a standard office typewriter to enter data and perform control operations. Functionally the keyboard consists of the displayable 96-ASCII character set keys and various control or modifier keys. All keys will repeat automatically if held down for approximately one-half second or more. Paragraphs 3.3.2 thru 3.3.9 detail the keyboard by the following classes of keys:

- . Alphanumeric and Punctuation Keys
- . Numeric Keypad
- . Modifier Keys
- . Cursor Control Keys
- . Edit Keys
- . Transmission Keys
- . Function Keys
- . Special Operation Keys

3.3.1 Keystroke Conventions

Ordinarily each keystroke typed by the operator is independent of the one preceding or following it. The 2-key lockout feature of the unit prevents the production of a second code before the key already typed is released.

3.3.2 Alphanumeric and Punctuation Keys

The upper/lower case, numerics, and punctuation characters from the 96-displayable ASCII character set, (21-7E Hex) including SPACE (20 Hex) and DEL (7F Hex), are output to the display and/or transmitted when a key is pressed. Keys that have a double legend produce the lower-case or lower legend unshifted, and the upper-case or upper legend when pressed with the SHIFT key. The SPACE key generates an ASCII 20 Hex code for transmission and occupies a space on the display.

3.3.3 Numeric Keypad

The ASCII numerals 0 through 9 along with minus, comma, and period, are output to the display and/or transmitted (depending upon the communications mode selected) when a key is pressed. The ASCII hex codes generated are identical to the lower legend numerals and punctuation on the main keyboard area.

3.3.4 Modifier Keys

The following keys do not generate an output by themselves, but modify the code generated by the alphanumeric keys on the keyboard.

SHIFT causes the upper legend character of a double legend key to be produced when pressed in conjunction with either SHIFT key. The 26-alpha characters are shifted for upper-case, and unshifted for lower-case.

CAP LOCK this push-on/push-off key causes the 26-alpha characters to stay shifted (upper-case) when on. The numeric and punctuation keys, as well as the various control keys, are not affected.

CTRL causes one of the 32-ASCII control codes to be generated when pressed in conjunction with an otherwise displayable character key. The character generated will not occupy a space on the display unless program mode or monitor mode are set. Some control codes are utilized by the Morrow Terminal, refer to Table 3-1 for details.

3.3.5 Cursor Control Keys

The Cursor is used to indicate the next character position to be entered on the display. The cursor may be positioned by remote commands from the computer or by cursor control keys on the keyboard. The following keys are used to position the cursor on the display:

← → ↑ ↓ and HOME move the cursor as indicated and transmit the ASCII control codes listed in Table 3-1 when the standard Morrow Terminal command code set has been selected.

If the position moved to is protected, the cursor will move to the first unprotected position in the direction commanded.

TAB will cause the cursor to advance to the next tab stop and an HT (09 Hex) code to be generated. There are two types of tab operations possible, Modulo and Protected Field. When Protect Mode is not set, the tab stops are automatically set at every eight character position, 0, 8, 16, ... 72. When Protect Mode is set, TAB will cause the cursor to advance to the first unprotected character position following the next protected field. Tabbing will move the cursor to the first tab stop on the next line when at the last tab position on a line.

BACKSPACE causes the cursor to move one character position to the left, or end of the previous line if the cursor has been at the beginning of a line. A BS code (08 Hex) is generated when the key is pressed.

RETURN moves the cursor to the beginning of the line it was in, or the beginning of the next line (carriage return + line feed) depending upon the auto-line feed selection made in Set-Up Mode. The key will generate a CR (0D Hex) or US (1F Hex) code per the auto-line feed selection.

LINE FEED moves the cursor to the same column position of the next line down. This will cause a scroll operation to occur if the cursor was on the bottom line of the display, scrolling was enabled in Set-Up Mode, and Protect Mode is not set. If scrolling is disabled or Protect Mode is set, the cursor will move to the same column in the top line. If the position is protected, the cursor will move to the first unprotected position on the line. The Line Feed key produces an LF (0A Hex) code when pressed.

3.3.6 Edit Keys

The Edit keys on the Morrow Terminal operate differently depending on the serial number of the unit. On units with serial numbers lower than 25110000, the Edit keys will only work when the terminal is being used in Block Mode, and therefore will not normally be used. The operations of the Edit keys in Block Mode are detailed below.

On units with serial numbers from 25220000 and up, the Edit keys operate as described below in Block Mode, and when in Conversation Mode, transmit the appropriate WordStar codes.

Terminals with serial numbers between 25110000 and 25220000 may be upgraded at a small cost to give the added convenience of WordStar code transmission.

In Conversation Mode on terminals which have the WordStar capability, the Edit keys perform as follows in WordStar:

CHAR INS toggles WordStar's INSERT mode on and off. It does this by sending a ^V (control-V) when pressed.

CHAR DEL deletes the character at the current cursor position. All characters on the line to the right of the cursor get moved left one position. It sends a ^G (control-G) when pressed.

LINE INS will insert a new line at the current cursor position, moving all text on the line from the cursor to the end of the line, along with all subsequent lines, down one position. It does this by sending a ^N (control-N) when pressed.

LINE DEL will delete the entire line the cursor is on, after which all subsequent lines will be moved up one row. It generates a ^Y (control-Y) when pressed.

When not in WordStar, the function performed by the keys is dependent upon the applications program being run.

Operation of the Edit keys in Block Mode is as follows:

CHAR INS causes the character under the cursor and all following characters to move one position to the right. The character insert operation terminates at the end of the line, or first protected field if Protect Mode is set, and the last character on the line is lost. A space character is written under the cursor.

CHAR DEL deletes the characters under the cursor and moves all characters that follow on the line, or first protected field if Protect Mode is set, to the left. A space is written in the last character position of the line or field.

LINE INS causes the entire line the cursor is in to move down one line as well as all lower lines. The bottom line of the display scrolls off and is lost. The cursor moves to the beginning of the line created which is filled with spaces. If Protect Mode is set, no operation is performed.

LINE DEL erases the line containing the cursor and moves all lower lines upward one line. The cursor moves to the beginning of the first line that moves upward. The bottom line of the display is filled with spaces. If Protect Mode is set no operation takes place.

3.3.7 Transmission Keys

Two types of data transmission may be initiated from the keyboard - a Send Page Unprotected and a Page Print, as follows:

ENTER will cause the unprotected data from home to the cursor position to be transmitted out the Main Port if Block Mode and Protect Mode are set. If Protect Mode is not set, all data from home to the cursor position will be sent. If Conversation Mode is set, then the ENTER key generates a CR (0D Hex) code only and no block transmission takes place.

COPY causes the data from home to the cursor position to be output to the Auxiliary Port device, usually a printer. At the end of each line transmitted, the Morrow Terminal automatically inserts a CR (0D Hex) and LF (0A Hex) code in the output data. The Auxiliary Port must be enabled in Set-Up Mode for the operation to take place.

3.3.8 Function Keys

The seven function keys, F1 thru F7, transmit a single control character. The keys perform no local operation and are used as special commands to be interpreted by the computer for particular system operations. The keys and each associated transmit sequence are as follows:

	ASCII NAME	HEX CODE	
F1 =	SOH	01H	^A
F2 =	STX	02H	^B
F3 =	ETB	17H	^W
F4 =	EOT	04H	^D
F5 =	ENQ	05H	^E
F6 =	CAN	18H	^X
F7 =	SUB	1AH	^Z

3.3.9 Special Operation Keys

The keys listed below perform special operations or have a unique effect on the Morrow Terminal.

SET-UP key causes the Morrow Terminal to enter Set-Up Mode when pressed, as described in paragraph 2.5.2. Pressing the key again exits Set-Up Mode.

SAVE is active only when the terminal is in Set-Up Mode. Pressing the key causes the current set-up functions to be saved in non-volatile memory. The saved selections are used to establish the power-on or reset configuration of the Morrow Terminal. The SAVE key has no effect when not in Set-Up Mode.

BREAK causes a break (mark) condition to be presented on the transmit data line of the Main Port for approximately 300 milliseconds. This operation has no effect on the terminal and is usually used for control signaling to the computer device.

ESC generates a special control code (1B Hex), usually followed by one or more characters, used for command operations. Thus, ESCape is usually considered as a "Lead-In" character for terminal control operations. Paragraph 3.4 and Table 3-2 detail the ESCape sequence utilized by the Morrow Terminal.

3.4 CONTROL CODES AND ESCAPE SEQUENCES

3.4.1 Control Codes

The operational characteristics of the Morrow Terminal are controlled, in part, by a group of control codes which may originate at the computer or at the keyboard. Control codes are not displayed unless Program Mode is set. In that case the Morrow Terminal will display, but not act upon, the recognized control code. Of the 32-ASCII standard control codes available for use, the Morrow Terminal utilizes the control codes listed in Table 3-1.

3.4.2 Escape Sequences

An ESCape sequence is formed by executing the ESC ASCII control code, followed by one or more otherwise displayable ASCII characters. Each ESCape sequence controls a specific terminal operation. Some operations are one-time only, others remain operative for as long as power to the unit is not interrupted or until terminated by a control code or ESCape sequence.

Table 3-2 shows the ESCape sequences used by the Morrow Terminal, whether initiated from the computer or the keyboard. ESCape sequences may be initiated from the keyboard using the ESC key during Conversation Mode or Block Mode operations, as follows:

Conversation Mode, Full Duplex - ESC is transmitted directly to the computer and is utilized by the Morrow Terminal only when echoed back by the computer.

Conversation Mode, Half Duplex - ESC is transmitted and acted upon locally by the Morrow Terminal.

Block Mode - each ESC sequence is immediately acted upon by the Morrow Terminal, unless program mode is set. If embedded in memory, the ESC sequence will be displayed but not acted upon, and will be transmitted, along with the block of data.

Table 3-1
Control Codes Utilized by the Morrow Terminal

OPERATION	HOW TO EXECUTE FROM CPU	FROM KEYBOARD	HEX CODE	DESCRIPTION
Bell	BEL	CONTROL G	07	Sounds the audible alarm. (If margin bell enabled in set-up.)
Backspace	BS	← BACKSPACE or CTRL H	08	Moves the cursor to the left one character position. The cursor moves to the last posi- tion of the previous line when at the first character posi- tion of the line.
Tab	HT	TAB or CTRL I	09	Moves the cursor to the next tab stop - Beginning of the next unprotected field if pro- tect mode is set, to every eighth character position (modulo 8 column tabs) if protect mode is reset. (Same as ESC I)
Line Feed	LF	↓ or CTRL J	0A	Moves the cursor to the next line down in the same column. If the cursor is located on the last line, a scroll opera- tion will be performed, if enabled.
Upline	VT	↑ or CTRL K	0B	Moves the cursor to the pre- vious line up in the same col- umn. If the cursor is located on the first line, no opera- tion takes place.
Forespace	FF	→ or CTRL L	0C	Moves the cursor to the right one character position. The cursor moves to the first position of the next line, when at the last character position of a line.
Carriage Return	CR	RETURN* or CTRL M	0D	Moves the cursor to the first character position of the current line.

Table 3-1 (Continued)
Control Codes Utilized by the Morrow Terminal

OPERATION	HOW TO EXECUTE FROM CPU	FROM KEYBOARD	HEX CODE	DESCRIPTION
Keyboard Enable	S0	CTRL N *	0E	Allows data to be entered on the keyboard - keyboard unlock (*from computer only if keyboard is already locked). (Same as ESC ")
Keyboard Disable	S1	CTRL O	0F	Prevents data from being entered on the keyboard - keyboard lock. (Same as ESC #) Auto line feed is disabled.
Reset Auxiliary Port with/without Display	DC4	CTRL T	14	When printing through auxiliary port, with/without display will continue until the buffer is empty.
Clear all to Spaces	SUB	CTRL Z	1A	Erases the display to spaces, and moves the cursor to the Home position.
Escape	ESC	ESC or CTRL [	1B	Recognized by the Morrow Terminal as a code extension character which must be followed by otherwise displayable character or characters to invoke a specific terminal operation.
Home Cursor	RS	HOME or CTRL ^	1E	Moves the cursor to the first character position of the first line of the display.
New Line	US	RETURN * or CTRL _	1F	Moves the cursor to the first character position of the next line (*when auto line feed is enabled)

Table 3-2
Morrow Terminal Escape Sequences

(Operations which have an * beside them are also selectable in set-up mode.)

COMMAND	ESCAPE SEQUENCE	HEX CODE	DESCRIPTION
Keyboard Unlock	ESC "	1B 22	Enables data entry from the keyboard. (Same as S0) (Hitting SET-UP twice will unlock the keyboard.)
Keyboard Lock	ESC #	1B 23	Disables data entry from the keyboard.
Set Protect Mode	ESC &	1B 26	Causes protect mode to be entered, highlighted (write-protected) data is reserved (protected) during certain editing and transmit operations.
Reset Protect Mode	ESC	1B 27	Causes protect mode to be exited.
Reset Write Protect	ESC (	1B 28	Causes write protect to be terminated.
Set Write Protect	ESC)	1B 29	Causes all subsequent data to be entered as write protected. Data will be highlighted by the protected field visual attribute selected in the set-up field. Data will not be "protected", however, unless protect mode is set.
Clear all to Null	ESC *	1B 2A	Causes all display data to be cleared to nulls protected or not, and the cursor moves home.
Clear Unprotected to Spaces	ESC +	1B 2B	Causes only unprotected data on display to be cleared to spaces, cursor moves home. If protect mode is not set, all data is cleared. (Same as ESC ;)

Table 3-2 (Continued)
Morrow Terminal Escape Sequences

(Operations which have an * beside them are also selectable in set-up mode.)

COMMAND	ESCAPE SEQUENCE	HEX CODE	DESCRIPTION
Load Default Status Line	ESC 0	1B 30	Causes the diagnostic test mode to be entered.
Send Line	ESC 4	1B 34	Transmits the unprotected data in the line containing the cursor, starting at the beginning of the line and up to the cursor position.
Send Page- Unprotected	ESC 5	1B 35	Transmits the unprotected data on the display starting at home and through to the cursor position. A CR (code 0D Hex) is transmitted at the end of the block.
Send Line-All	ESC 6	1B 36	Transmits all data in the line containing the cursor starting at the beginning of the line and up to the cursor position.
Send Page-All	ESC 7	1B 37	Transmits all data on the display beginning at home and continuing through to the cursor position.
Clear Unpro- tected to Spaces	ESC ;	1B 3B	Causes the unprotected data on the display to be cleared to spaces and the cursor to be moved to the home position. (Same as ESC +)
Address Cursor	ESC=(X ¹ X ²)	1B 3D (20-6F) (20-37)	Used to position the cursor to a specified row and column on the display. The location is expressed as two ASCII characters. The first (X ¹) specifies the column coordinate (20-6F Hex). The second (X ²) specifies the row (20-37 Hex). Refer to Fig. 3-2.

Table 3-2 (Continued)
Morrow Terminal Escape Sequences

(Operations which have an * beside them are also selectable in set-up mode.)

COMMAND	ESCAPE SEQUENCE	HEX CODE	DESCRIPTION
Read Cursor	ESC ?	1B 3F	Causes the terminal to transmit the cursor row and column position in the same format as described in "Address Cursor" Command. Column position is transmitted first, followed by the row position.
Enable Auxiliary Port with Display	ESC ,	1B 2C	This command causes all data received by the primary port to be displayed and/or acted upon, and transmitted to the auxiliary port device. In conversation/half duplex mode, keyboard entries are also transmitted.
Set Block Mode*	ESC B	1B 42	Cancels conversation mode and causes block mode to be entered. Refer to para. 3.2.2 for details of block mode operation.
Set Conversation*	ESC C	1B 43	Cancels block mode and causes conversation mode to be entered. Refer to Paragraph 3.2.2 for details of conversation mode operation.
Insert Line	ESC E	1B 45	Causes a line of spaces to be inserted at the line containing the cursor. All lower lines scroll down one line, the bottom line being lost. No action takes place if protect mode is set.
Back Tab	ESC I	1B 49	Moves the cursor to the beginning of the previous unprotected field if protect mode is set; to the left eight character positions (modulo 8 tab) if protect mode is reset.

Table 3-2 (Continued)
Morrow Terminal Escape Sequences

(Operations which have an * beside them are also selectable in set-up mode.)

COMMAND	ESCAPE SEQUENCE	HEX CODE	DESCRIPTION
Set Monitor Mode*	ESC A	1B 41	When set, all received data will be displayed as hexadecimal ASCII pairs, 00-7F.
Print Page-All	ESC P	1B 50	Causes all data from home up to the cursor position to be transmitted to the auxiliary port device, a CR and LF code (0D and 0A Hex) are added at the end of each line as it is sent. (Pressing [PRINT] on keyboard performs the same function.)
Insert Char- acter	ESC Q	1B 51	Moves all data from the cursor position to the end of the line or protected field one position to the right. A space is written at the cursor position.
Delete Line	ESC R	1B 52	Erases the line containing the cursor and moves all lower lines upward one line. No action takes place if protect mode is set.
Erase to End- of-Line Unpro- tected	ESC U	1B 55	Erases the unprotected data from the cursor position up to the end of the line or protected field.
Delete Character	ESC W	1B 57	Deletes the character under the cursor and moves all characters from the cursor to the end of the line or protected field to the left one position.
Erase to End- of-Page Unprotected	ESC Z	1B 5A	Erases the unprotected data from the cursor position up to the end of the display or protected field.

Table 3-2 (Continued)
Morrow Terminal Escape Sequences

(Operations which have an * beside them are also selectable in set-up mode.)

COMMAND	ESCAPE SEQUENCE	HEX CODE	DESCRIPTION
Enable Auxil- iary Port without Display	ESC -	1B 2D	This command causes all data received by the primary port to be transmitted to the auxiliary port device. No data are sent to the display.
Erase to End- of-Line All	ESC T	1B 54	Erases all data from the cursor position up to the end of the line.
Erase to End- of Page All	ESC Y	1B 59	Erases all data from the cursor position up to the end of the display.

3.5 DATA TRANSMISSION

Data entered from the keyboard may be transmitted to your computer either character-by-character as during Conversation Mode operation, or in message blocks, as during Block Mode operation. Transmission is serial asynchronous, with an ASCII character format of 1 start bit, 7 or 8 data bits, odd/even, or no parity bit and 1 or 2 stop bits. The word structure and baud rate used are selectable in Set-Up Mode. Main Port communications are via a bi-directional RS-232C interface as detailed in Section II. Auxiliary Port communication is uni-directional via an RS-232C interface, also detailed in Section II.

Data communications can take place whenever the Morrow Terminal is placed in On-Line Mode. When receiving data the Morrow Terminal has an X-ON/X-OFF busy indication feature used to command the computer to suspend transmission to prevent data loss.

3.5.1 Conversation Mode Characteristics

When the terminal is operating in Conversation Mode, characters entered on the keyboard are immediately transmitted to the computer. This includes any control codes or ESCape sequences which are normally not displayed. If Full Duplex Mode is set, then only those codes echoed by the computer will be displayed or cause any action to take place.

3.5.2 Block Mode Characteristics

During Block Mode operation, data entered on the keyboard is routed only to the display or acted upon for command sequences utilized by the Morrow Terminal. This allows complete display editing and formatting prior to transmission to the computer. By setting Program Mode, control codes may also be embedded in the display for transmission. A block of data can be transmitted in whole or in part by the use of the Protect Mode feature. This allows the computer the ability to send a form to the terminal which is Write-Protected. When Protect Mode is set, data the operator enters is transmitted only when commanded. Block Mode commands may be used to cause the terminal to transmit a line or page, unprotected only, or all of the data. Received data is accepted conversationally or in blocks, regardless of the mode selected.

3.5.3 X-ON/X-OFF (Busy/Ready Status)

The Morrow Terminal has the ability to signal the computer of a potential data loss if the printer buffer is nearly full or the terminal is otherwise unable to accept data. The X-ON/X-OFF feature may be enabled or disabled through Set-Up Mode. When enabled the terminal will transmit an X-OFF code (DC3-13 Hex, Control S) to the computer if the input buffer has fewer than 256 character locations remaining. An

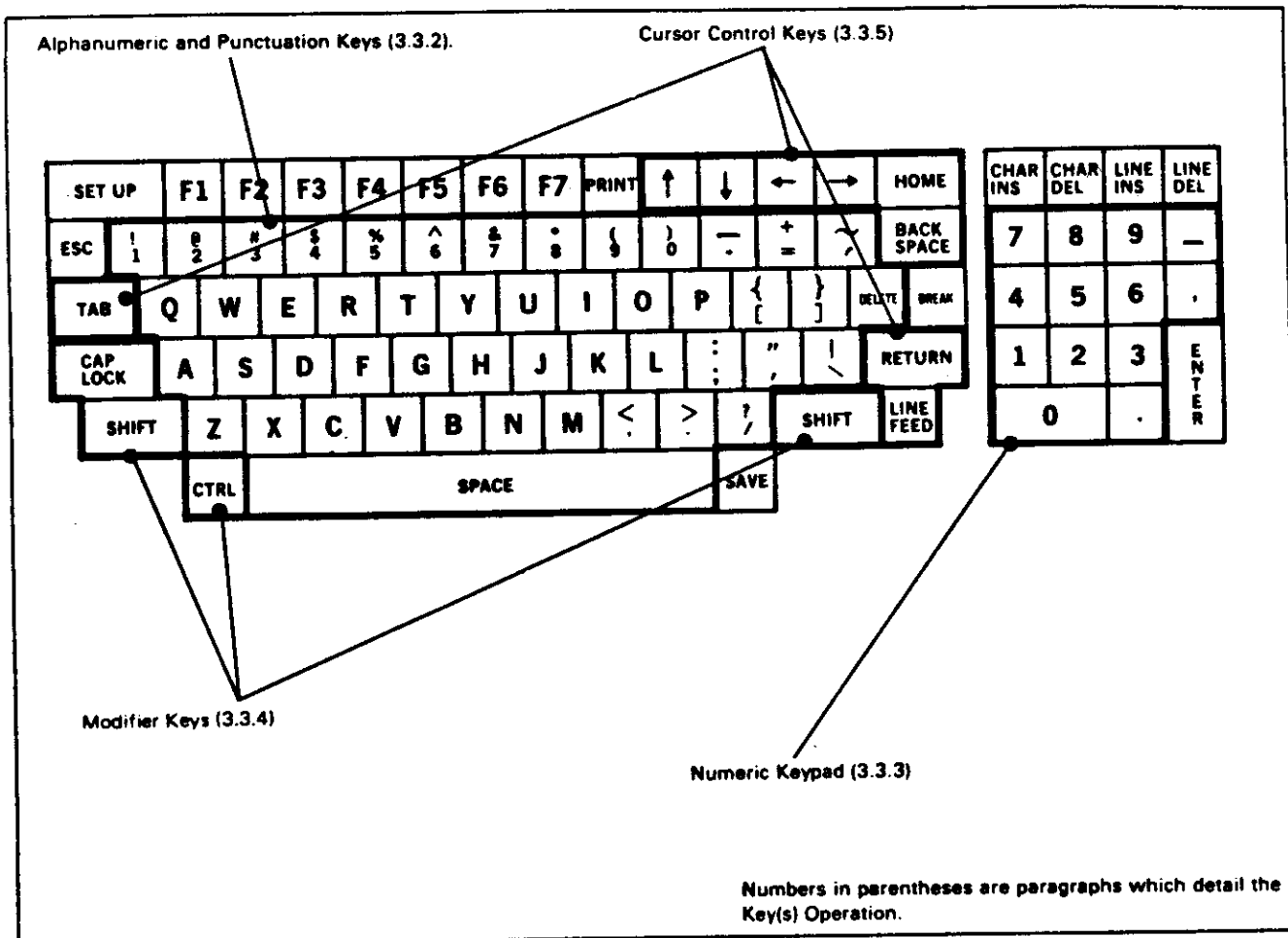


Figure 3-1. Morrow Terminal Keyboard Functions

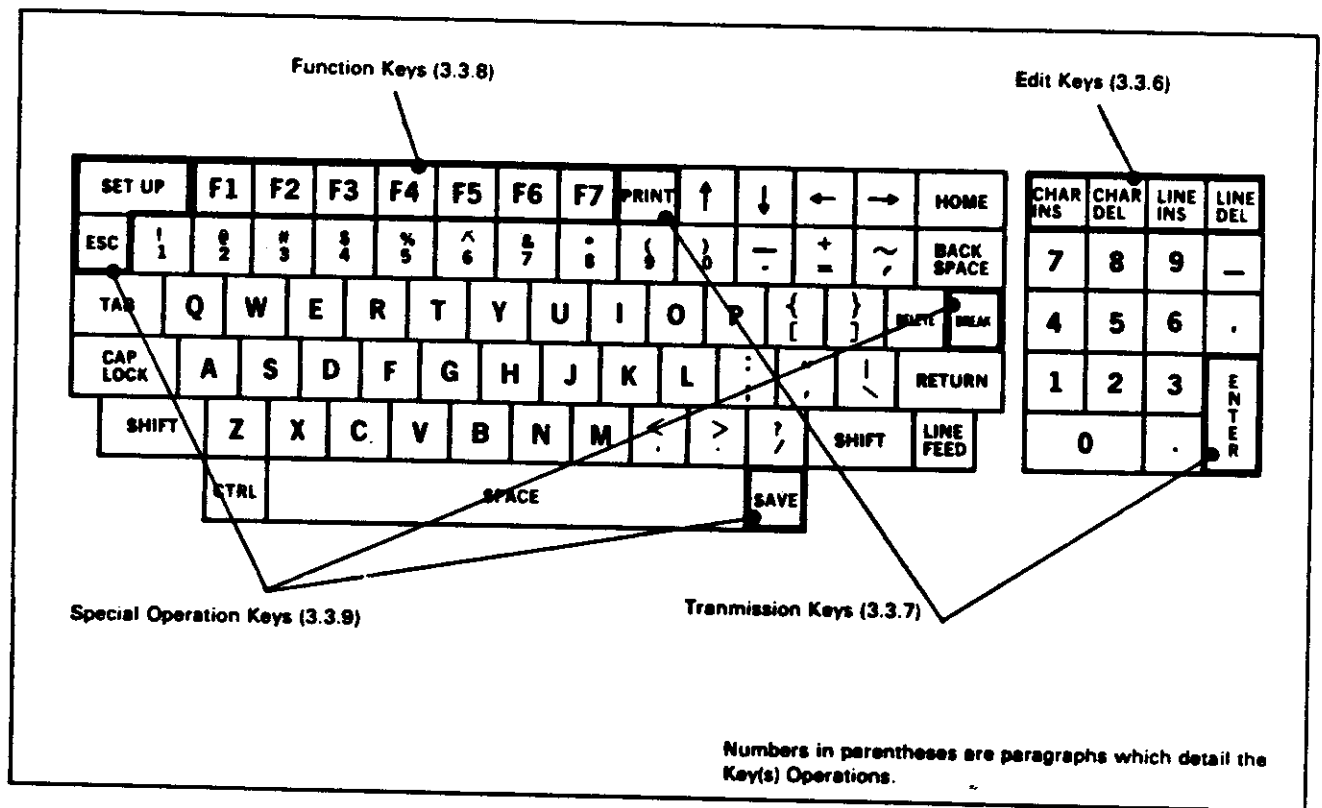


Figure 3-1. Morrow Terminal Keyboard Functions

3.6.3 Tab Control

The Morrow Terminal supports two types of tab operations: Modulo tabs and Protected Field tabs. The tab and back-tab commands are detailed in Tables 3-1 and 3-2. The type of tab performed depends upon whether Protect Mode is set or reset. When Protect Mode is set, the Tab command will cause the cursor to advance to the beginning of the next unprotected field. If no protected fields are encountered by the end of the display, the cursor moves home, or to the first unprotected position if home is protected. When Protect Mode is reset the cursor will advance or backspace by eight character positions (Modulo 8 tab) for each command received.

3.6.4 Scrolling

In the Morrow Terminal, data is entered into display memory starting at the HOME position, and continues through Position 80 or Line 24, (last data position). When Position 80 is filled, or when a New Line or Line Feed occurs in Line 24, the display is shifted upwards one line and data entry continues in Position 1 of the new Line 24. The original top line of the display is lost. Scrolling continues indefinitely. Scrolling may be enabled or disabled through a selection in Set-Up Mode. Scroll is automatically disabled when Protect Mode is set.

3.7 DISPLAY FORMATTING OPERATIONS

The Morrow Terminal may have various attributes and fields used to highlight data on the display. The visual and field attributes used for display formatting are discussed in the paragraphs that follow.

3.7.1 Visual Attributes

There are four Visual Attributes that can be assigned to any character on display. They include: Blink, Underline, Reversed, and Reduced Intensity. The attribute that will be used is assigned singularly or in combination through a set-up function selection. When the "Set Write Protect" command is received all subsequent data entered will appear with the selected attribute. If Protect Mode is not set, the data is not treated uniquely; it may be overwritten and erased or cleared by all associated commands. If Protect Mode is set, the data is treated as protected.

3.7.2 Field Attributes

When the "Set Write Protect" command is received all subsequent data takes on the visual attribute as noted in paragraph 3.6.1, until a Reset Write Protect is issued. By setting Protect Mode, the write protected data is treated as reserved, or protected. This will allow the commands that specify "Unprotected Only" to be used to improve throughput characteristics. In block sends, the protected data will not be sent during "Send Unprotected Only" commands for line or page. During Edit operations the Erase or Clear Unprotected Only commands will leave the protected data on the display. Insert and Delete operations will terminate upon encountering a protected field. Scrolling is also disabled when Protect Mode is set.

3.8 SET-UP MODE OPERATIONS

The general operating characteristics of the Morrow Terminal are controlled by ten 4-bit "nibbles" of information that is displayed on the 25th line of the display, when Set-Up Mode is entered. Both the operator and computer have the ability to change the functions selectable in Set-Up Mode. Selections may be saved in non-volatile memory to re-establish the same functions on the next power-on cycle or terminal reset operation. The operation of Set-Up Mode is fully described in paragraph 2.5.2.

3.9 PRINT OPERATIONS

The Auxiliary Port of the Morrow Terminal is most typically connected to a serial RO printer. The communications of data to the auxiliary device is uni-directional via an RS-232C interface. A Busy/Ready signal level is monitored for status during print operations. The Auxiliary Port may be enabled or disabled through a function setting in Set-Up Mode. The three types of print output are: Page Print, Auxiliary Port with Display, and Auxiliary Port without Display, details as follows:

3.9.1 Page Print

Upon receipt of a Print Page command the Morrow Terminal will transmit data from home up to the cursor position to the auxiliary device. The command may either specify to send all data, or, send the unprotected data normally but the protected data as spaces. This is useful when using a formatted screen being output to a pre-printed form. The Print Page commands can be generated from the computer or keyboard. Each print line output is followed by a CR and LF (0D and 0A Hex) in the data stream.

3.9.2 Auxiliary Port With Display

Auxiliary Port with display is enabled or disabled by entering a command from the keyboard or by receiving the ESCape sequence from the computer. When using this method of transmission the terminal will display and act upon all received data as well as transmitting the data out the Auxiliary Port to the printer. When operating in Conversation Mode Half-Duplex keyboard entries are also output to the printer.

3.9.3 Auxiliary Port Without Display

Auxiliary Port without display is enabled or disabled by entering command from the keyboard or by receiving command from the computer. When operating in this mode, the terminal will not display received data, however, the terminal will transmit the received data out the Auxiliary Port to the printer. No commands except the reset Auxiliary Port with/without display are acted upon.

3.10 POWER-ON RESET

A Power-On Reset consists of a complete recycling of the Morrow Terminal functions, including power. This is accomplished by setting the ON/OFF switch to OFF, waiting 10 seconds, then setting the switch to ON. All display and other volatile memory is erased when powering down. Upon power up, the unit is subject to the complete Power Turn-On procedure specified in Section II.

3.11 SELF-TEST

When the Morrow Terminal is reset the terminal Self-Test will be executed. Self-Test will verify the integrity of the display memory, the program memory, non-volatile memory and the associated internal control logic. Upon completion of Self-Test the terminal will sound the audible alarm and the cursor will appear in the upper left corner of the screen.

**APPENDIX A
OPERATORS
QUICK REFERENCE
CHARTS**

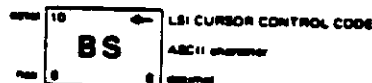
SPECIAL KEYS:

<u>KEY</u>	<u>HEX</u>
F1	C0
F2	C1
F3	C2
F4	C3
F5	C4
F6	C5
F7	C6
PRINT	8D
↑	8B
↓	8A
←	88
→	8C
HOME	89
BREAK	8E
SAVE	97
ENTER	87
CHAR INS	8F
CHAR DEL	90
LINE INS	91
LINE DEL	92

ASCII CODE CHART

BITS	0 0 0 0				0 1 0 1				1 0 1 0				1 1 0 1			
	CONTROL				NUMBERS & SYMBOLS				UPPER CASE				LOWER CASE			
84 83 82 81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65
0 0 0 0	NUL	DLE	SP	0	@	P	'	p								
0 0 0 1	SOH	DC1	!	1	A	Q	a	q								
0 0 1 0	STX	DC2	"	2	B	R	b	r								
0 0 1 1	ETX	DC3	#	3	C	S	c	s								
0 1 0 0	EOT	DC4	\$	4	D	T	d	t								
0 1 0 1	ENQ	NAK	%	5	E	U	e	u								
0 1 1 0	ACK	SYN	&	6	F	V	f	v								
0 1 1 1	BEL	ETB	'	7	G	W	g	w								
1 0 0 0	BS	CAN	(	8	H	X	h	x								
1 0 0 1	HT	EM	)	9	I	Y	i	y								
1 0 1 0	LF	SUB	*	:	J	Z	j	z								
1 0 1 1	VT	ESC	+	;	K	[	k	{								
1 1 0 0	FF	FS	,	<	L	\	l	!								
1 1 0 1	CR	GS	-	=	M	]	m	}								
1 1 1 0	SO	RS	.	>	N	^	n	~								
1 1 1 1	SI	US	/	?	O	_	o	DEL RUBOUT								

KEY



Get familiar with ASCII and LSI control codes with the help of this handy table.

ABSOLUTE CURSOR ADDRESSING OPERATION CODES

Keys Used: ESC ▣ ROW ASCII COL ASCII

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

STATUS LINE CODE SUMMARY

Write Status Line	ESC % X ¹ X ² X ³....X ¹⁰
Read Status Line	ESC \$
Response	X ¹ X ² X ³....X ¹⁰ CR
Where X ¹ thru X ¹⁰ correspond to nybbles 1 thru 10. The lower four bits of each character represents the set (1) or reset (0) state of the associated nybble. The control codes used are depicted below with the various bit state combinations.	
<div>Must Be</div> <div>Low</div> <div>BIT</div> <div>6 5 4 3 2 1 0</div> <div>0 0 0 0 0 0 0</div> <div>0 0 0 0 0 0 1</div> <div>0 0 0 0 0 1 0</div> <div>0 0 0 0 0 1 1</div> <div>0 0 0 0 1 0 0</div> <div>0 0 0 0 1 0 1</div> <div>0 0 0 0 1 1 0</div> <div>0 0 0 0 1 1 1</div> <div>0 0 0 1 0 0 0</div> <div>0 0 0 1 0 0 1</div> <div>0 0 0 1 0 1 0</div> <div>0 0 0 1 0 1 1</div> <div>0 0 0 1 1 0 0</div> <div>0 0 0 1 1 0 1</div> <div>0 0 0 1 1 1 0</div> <div>0 0 0 1 1 1 1</div>	<div>ASCII CHARACTER</div> <div>NUL - 00 Hex</div> <div>SOH - 01 Hex</div> <div>STX - 02 Hex</div> <div>ETX - 03 Hex</div> <div>EOT - 04 Hex</div> <div>ENQ - 05 Hex</div> <div>ACK - 06 Hex</div> <div>BEL - 07 Hex</div> <div>BS - 08 Hex</div> <div>HT - 09 Hex</div> <div>LF - 0A Hex</div> <div>VT - 0B Hex</div> <div>FF - 0C Hex</div> <div>CR - 0D Hex</div> <div>SO - 0E Hex</div> <div>SI - 0F Hex</div>

ADM 22 ESCAPE SEQUENCES

HEX	2	3	4	5	6	7
0		0	@ PRINT PAGE UNPROTECTED	P PRINT PAGE ALL	,	p
1	!	1	A COPY PRINT WITH DISPLAY	Q INSERT CHAR	a	q
2	" KEYBOARD UNLOCK	2	B SET BLOCK MODE	R DELETE LINE	b	r
3	" KEYBOARD LOCK	3	C SET COPY MODE	S	c	s
4	\$ READ STATUS LINE*	4	D SET H/F DUPLEX	T ERASE TO END OF LINE UNPROTECTED	d	t ERASE TO END OF LINE ALL
5	% WRITE STATUS LINE*	5	E INSERT LINE	U SET PROGRAM MODE	e	u
6	& SET PROTECT MODE	6	F	V	f	v
7	' RESET PROTECT MODE	7	G SET GRAPHICS MODE	W DELETE CHAR	g	w
8	(RESET WRITE PROTECT	8	H RESET GRAPHICS MODE	X RESET PROGRAM MODE	h	x SEND CHARACTER AT CURSOR
9	) SET WRITE PROTECT	9	I BACK TAB	Y ERASE TO END OF PAGE UNPROTECTED	i TAB	y ERASE TO END OF PAGE ALL
A	° CLEAR ALL TO NULL	:	J	Z	j	z
B	+ CLEAR UNPROTECT TO SPACES	:	K	[	k	{
C	.	<	L	\	l	|
D	-	= ADDRESS CURSOR RC**	M SET MONITOR MODE	]	m	}
E	.	> ERASE LINE ALL	N	^	n AUXILIARY PORT WITHOUT DISPLAY	~
F	/	? READ CURSOR RC**	O	—	o RESET TERMINAL	del

*MULTIPLE CHARACTERS REQUIRED. SEE TABLE 3-3.

**MULTIPLE CHARACTERS REQUIRED. SEE FIGURE 3-2.

APPENDIX B

EMULATION COMMAND CODE SUMMARY **(Operations are as described in Table 3-2 and 3-3)**

OPERATION	HAZELTINE 1500 EMULATION The Lead-In Code (LI) is selectable in Set-Up Mode to be either an ESC (1B Hex) or a TILDE (7E Hex)		ADDS REGENT 25 EMULATION	
	COMMAND	HEX CODE	COMMAND	HEX CODE
Cursor Right	DEL	10	ACK	06
Cursor Down	(LI) LF/VT	XX 0A/0B	LF	0A
Cursor Up	(LI) FF	XX 0C	SUB	1A
Cursor Left	BS	08	BS/NAK	08/15
Cursor Home	(LI) DC2	XX 12	SOH	01
Bel	BEL	07	BEL	07
Carriage Return	CR	0D	CR	0D
Tab	HT	09		
Keyboard Lock	(LI) NAK	XX 15	ESC 5	1B 35
Keyboard Unlock	(LI) ACK	XX 06	ESC 6	1B 36
Clear All To Spaces	(LI) FS	XX 1C	FF	0C
Reset Write Protect	(LI) US	XX 1F		
Set Write Protect	(LI) EM	XX 19		
Enable Aux Port With Display			DC2	12
Enable Aux Port Without Display			ESC 3	1B 33
Disable Aux Port With/Without Display			DC4	14
Clear Unprotect To Spaces	(LI) GS	XX 1D		
Direct Cursor Address	(LI) DC1 (COL) (ROW)	XX 11 XX XX	ESC Y (ROW) (COL)	1B 59 XX XX
Read Cursor Address	(LI) ENQ	XX 05		
Insert Line	(LI) SUB	XX 1A		
Delete Line	(LI) DC3	XX 13		
Erase To End Of Line All	(LI) SI	XX 0F	ESC K	1B 4B
Erase To End Of Line Unprotected			ESC K	1B 6B
Erase To End of Display All	(LI) CAN	XX 18		
Erase To End of Display With Protected Spaces	(LI) ETB	XX 17		

(continued on following page)

EMULATION COMMAND CODE SUMMARY (continued)

NOTE: In Add Regent 25 Emulation the following functions and codes are not supported:

ESC ; - Enter Function Keypad Mode 1

ESC < - Enter Function Keypad Mode 2

ESC = - Enter Function Keypad Mode 3

DLE - Code for Address Horizontal

VT - Code for Address Vertical

APPENDIX C.
ADM 22 MNEMONICS