# Hazeltine 1500

## VIDEO DISPLAY TERMINAL REFERENCE MANUAL


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# SAFETY SUMMARY

**WARNING**

Dangerous voltages (15 K vdc and 115 vac) are present in the Video Display Terminal and may remain present in the monitor circuits after power is removed. Use caution when working on internal circuits. Do not work alone.

Use caution when handling the cathode-ray tube (eg, wear safety goggles) to avoid risk of implosion. The internal phosphor coating is toxic; if the tube breaks and skin or eyes are exposed to phosphor, rinse with cold water and consult a physician.

This manual is published and distributed by Hazeltine Corporation, Computer Terminal Equipment Product Line. The contents of this manual are subject to change at any time and without prior notice by Hazeltine. The information presented herein may not reflect latest changes in the product. Confirmation and any required clarification of this information can be obtained from your local Hazeltine sales representative.

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# SECTION 1

# INTRODUCTION

The Hazeltine 1500 Video Display Terminal (also referred to as the Hazeltine 1500), is a product of advanced microprocessor technology, which offers quiet, reliable, and economic operation to the user. The expanded set of features, all standard on the Hazeltine 1500, are normally found only in CRT's of the buffered or editing variety. Speed, silence, and flexibility, coupled with the operator-oriented features of the Hazeltine 1500 improve the efficiency of both the software and programmer in data input/output operations. The terminal can also be made compatible with European voltages and frequencies.

This manual describes the operation and features of the Hazeltine 1500. It provides programming and application information for programmers and system designers. If additional technical assistance is needed, contact your Hazeltine representative.

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# SECTION 2

# INSTALLATION

## 2.1 SET-UP AND CONNECTIONS

Following unpacking, place the unit so that free air circulates around the rear, base and top. Ensure that cables are free of kinks or tight bends.

### 2.1.1 Interface Connection

The standard Electronic Industries Association/Current Loop (EIA/CL) connector (figure 2-1) located on the rear of the unit, provides the connection to the appropriate data set or the acoustic coupler. The connector has provisions for either voltage level (EIA RS232) or current loop interface. The Aux Out connector (figure 2-1) allows connection of a serial EIA receive-only device, such as a printer.

### 2.1.2 Power Cords

Power cords must be plugged into properly grounded power outlets. Do not use adapters which would prevent the terminal unit from being properly grounded.

### 2.1.3 Cleaning

Dirt and smudges can be removed from the cabinet with any number of common household spray cleaners and a soft cloth. The faceplate should be cleaned only with a soft, damp cloth or tissue to avoid scratching.

## 2.2 TURN ON AND WARM UP

A display unit brought in from a substantially colder environment should be allowed at least a one-hour warm up period to reach room temperature prior to power turn-on.

### 2.2.1 Power Turn-On

A power-on slide switch is located at the rear of the terminal. When power is on, the POWER ON indicator located on the keyboard is lit. Allow at least 15 seconds to elapse between power off and power on in the event of unit power recycling. If the POWER ON indicator does not light, the terminal should be

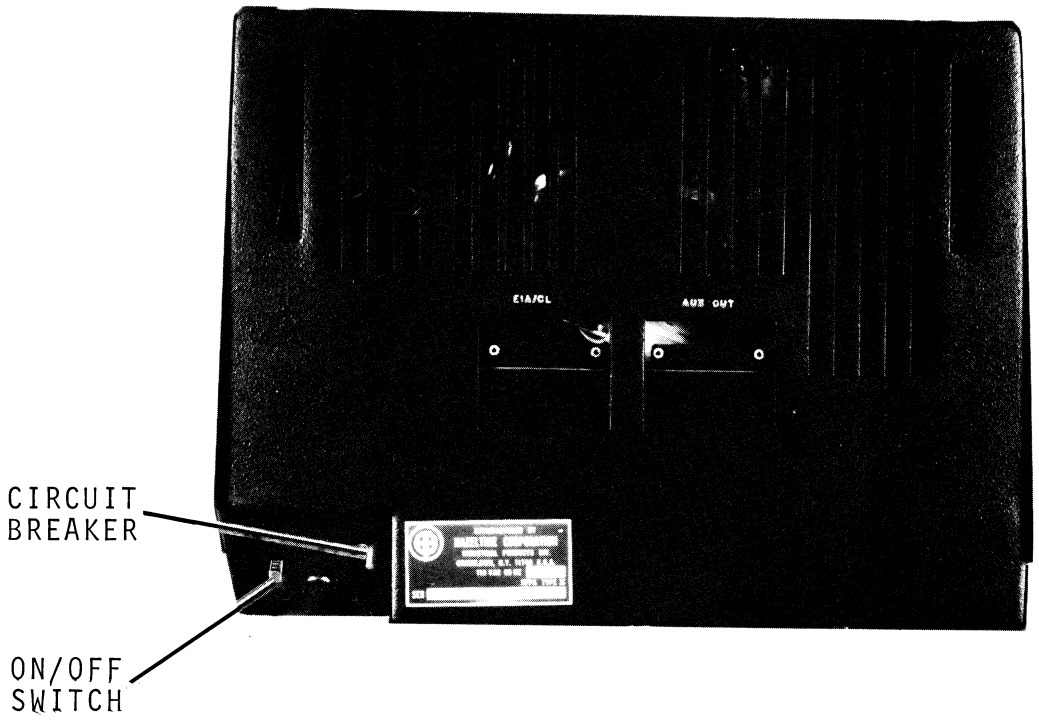


Figure 2-1. H1500 Terminal, Rear View

turned off. After 15 seconds depress the red circuit breaker located in the rear, next to the power switch, and again apply power to the terminal. If the POWER ON indicator still does not light, turn power off and call your authorized service representative.

2.2.2 Warm Up

Allow 30 seconds for display warm up. At the end of this period the terminal is ready to operate.

a. If extraneous data appears and/or the cursor is not displayed in the upper left corner (HOME), depress the RESET key, followed by the CLEAR key located on the keyboard. If after depressing the RESET and CLEAR keys, and proper display/ operation is still not obtained, turn the power off and contact your authorized service representative.

b. If the cursor does not appear after the display has warmed up for a reasonable time (no more than three minutes) and the power indicator is lit, adjust the contrast control located under the access panel on the top of the keyboard (see section 3.1.1). If the cursor still does not appear, turn the power off and contact your authorized service representative.

# SECTION 3

# KEYBOARD AND CONTROLS

## 3.1 FRONT PANEL SWITCHES

### 3.1.1 General

Eighteen switches used for selecting the operating characteristics of the Hazeltine 1500 are accessible to the operator without having to open or remove power from the terminal. To gain access to these switches, remove the front access panel engraved with the POWER ON legend by lifting up the catches located on each side of the panel. Replacement of the panel is accomplished by placing it in the recessed area with the power on indicator on the left, and gently pressing each catch into position. The function of each switch and function key is described in the paragraphs that follow. The legend plate is visible when the access panel is removed (see figures 3-1 and 3-2).

### 3.1.2 Front Panel Switches

a. Baud Rate

The communication speed is selected by sliding the switch next to the desired baud rate forward to the ON position. Only one switch for each baud rate is allowed to be in the ON position. Eight speeds ranging from 110 baud to 19,200 baud are available.

b. Parity

Four switches are supplied for selecting the parity compatible with the system. Slide the switch next to the desired parity of operation forward to the ON position. Only one switch for parity should be in the ON position. The four parity possibilities are:

| | |
|---|---|
| EVEN | Checks for even parity on received data and generates even parity on outgoing data. |
| ODD | Checks for odd parity on received data and generates odd parity on outgoing data. |

NOTE

Legend plate for logic/keyboard assembly 4DTD155202 shown. For logic/keyboard assembly 4DTD155246-( ) the EIA/CUR LOOP positions are the reverse of those shown.

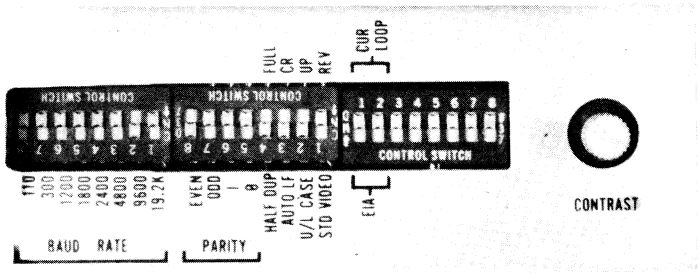


Figure 3-1. Legend Plate (Under Access Panel)

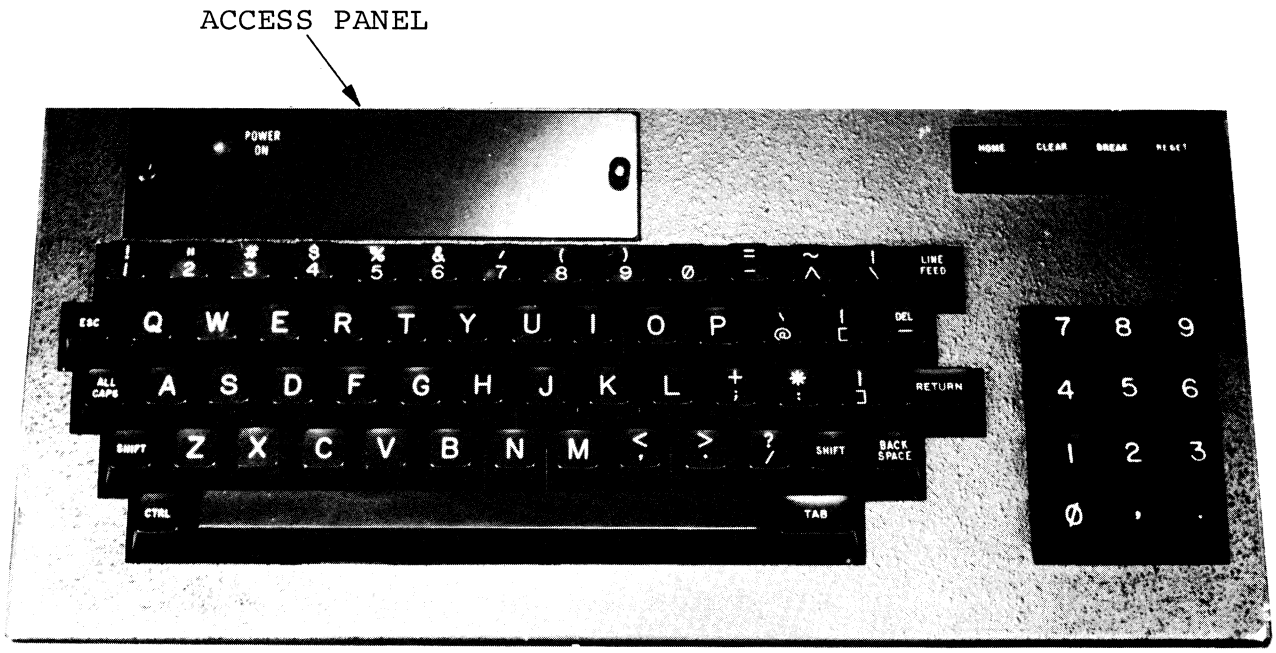


Figure 3-2. Keyboard Controls (for reference only)

1 The parity bit of each character transmitted is set to a one. No parity check is done on received data.

Ø The parity bit of each character transmitted is set to a zero. No parity check is done on received data.

NOTE

If a character is received with a parity error when EVEN or ODD parity is selected, the character will be replaced on the display with a $P_E$ symbol.

c. HALF DUP-FULL

(1) FULL (Duplex)

The rear position of this switch selects the full duplex mode of communications which is typically used when the communications system is capable of simultaneous two-way transmission. In this mode, data entered from the keyboard is sent directly to the computer system. Upon reaching the computer, the data is typically "echoed" back to the Hazeltine 1500 screen at the discretion of the program (ie, it may not be desirable to echo back special codes, passwords, etc). If modems are used, they must be set for full duplex operation. Only received or "echoed" data is displayed or acted upon.

(2) HALF (Duplex)

The forward position of this switch selects the half-duplex mode of communications. In this mode, data entered from the keyboard is sent directly to the computer system and is treated as received data by the terminal via an internal connection. Echoing, as in full duplex mode, is not required; if used, it would likely cause each transmitted character to be displayed twice.

d. AUTO LF-CR

(1) AUTO LF (Automatic Line Feed)

In the forward position of this switch, all received carriage returns automatically cause the cursor to move to the first character position of the next line (new line function). The carriage return code (ASCII CR column 0, row 13) shall not be stored in the display memory. If the cursor was on the last displayable character row, carriage returns will scroll the display (refer to section 4.4 for a description of scrolling). Received line feed characters (ASCII LF column 0, row 10) are ignored.

(2) CR (Carriage Return)

In the rear position of this switch, received carriage returns move the cursor to the first character position of the same line. The CR code is not stored in the display memory. Received LF characters move the cursor down one line. If the cursor was on the last displayable character row, Line Feed characters will cause the display to scroll (refer to section 4.4 for a description of scrolling). The LF code is not stored in the display memory.

e. U/L CASE-UP

(1) UP (Upper case)

The rear position of this switch selects only upper case operation. All lower alpha characters generated from the keyboard are converted to upper case for transmission and display. All received lower case alpha characters are displayed as upper case. In this position, the ALL CAPS key is logically disabled.

(2) U/L CASE (Upper and lower case)

The forward position of this switch selects the full 128 character ASCII codes for transmission and 94 character alpha/numeric character set for display. In this position, the ALL CAPS key in the down position may be used for upper case operation.

f. STD VIDEO-REV

(1) STD VIDEO

The forward position of this switch selects a display of white characters on a black background.

(2) REV (Reverse Video)

The rear position of this switch selects a display of black characters on a white background.

g. EIA-CUR LOOP

Both switches must be positioned for the same selection.

(1) EIA

The forward position of these switches selects EIA RS232 communications at the modem interface located on the rear panel.

(2) CUR LOOP

The rear position of these switches selects 20 mA current loop communications at the modem interface located on the rear panel.

h. Unused Switches

Six switches are provided on the unit for expansion possibilities. These switches are inoperative on the Hazeltine 1500 and its operation is independent of the position of these switches.

i. Contrast Control

This control is located to the right of the switch array under the access panel. It allows a wide range of contrast to facilitate viewing ease of the high resolution display.

j. Keyboard

All keys and key combinations generating ASCII codes operate as typamatic. Depressing any of these keys for more than 0.75 seconds causes the character to repeat at an approximate rate of 15 characters/second with transmission at the selected baud rate. The typamatic feature is designed with a memory that

allows the SHIFT and CTRL keys to be released without altering the data after the typamatic feature has been initiated.

The descriptions below define the operation of the particular key depression in the half duplex mode or in full duplex if "echoing" is being performed by the computer. Table 3-1 indicates the actual character(s) that is being transmitted. The last two columns of the table give a brief description of the operation described in detail below.

Table 3-1. Transmitted Characters in Half and Full Duplex Operation

| Key Stroke | Transmitted Character(s)* | | Operation in half duplex or in full duplex if "echoed" | Operation in full duplex with no "echo" |
|---|---|---|---|---|
| | Half Duplex | Full Duplex | | |
| ESC | ESC | ESC | Transmission Only | Transmission Only |
| DEL (SHIFT_) | DEL | DEL | Transmission Only | Transmission Only |
| RETURN | CR | CR | AUTO LF - New Line<br>CR - Line Return | Transmission Only |
| LINE FEED | LF | LF | AUTO LF - Transmission Only<br>CR - Line Feed | Transmission Only |
| SHIFT LINE FEED | None | ∿, FF | Cursor Up | Transmission Only |
| BACK SPACE | BS | BS | Cursor Left | Transmission Only |
| SHIFT BACK SPACE | None | DLE | Cursor Right | Transmission Only |
| ALL CAPS | None | None | See Description | See Description |
| TAB | HT | HT | TAB | Transmission Only |
| BREAK | (Break Signal) | (Break Signal) | Transmission Only; See Description | Transmission Only; See Description |
| RESET | None | None | See Description | See Description |
| HOME | None | ∿, DC2 | Cursor Home | Transmission Only |
| CLEAR | None | ∿, FS | Clear Screen | Transmission Only |
| SHIFT CLEAR | None | ∿, GS | Clear Foreground | Transmission Only |
| CONTROL CLEAR | None | ∿, SI | Clear-End-of-Line | Transmission Only |
| CONTROL-SHIFT CLEAR | None | ∿, CAN | Clear-End-of-Screen | Transmission Only |
| ALPHANUMERIC | Alphanumeric | Alphanumeric | See Description | Transmission Only |

* See Appendix I for the ASCII code set

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(1) Alphanumeric Cluster

The keys in this cluster transmit the ASCII codes (see Appendix I) associated with the engraved legends shown in figure 3-2. When used in conjunction with the CTRL and SHIFT keys, it is possible to transmit all 128 codes in the ASCII chart.

(a) ESC (Escape)

When depressed, this key will transmit the ESC code (ASCII ESC, column 1 row 11) which is commonly used to generate a program interrupt signal.

(b) DEL (Rubout)

When depressed in conjunction with the SHIFT key, it causes a character of all "one" bits to be transmitted (ASCII DEL, column 7, row 15).

(c) RETURN

The operation of this key is governed by the AUTO LF-CR switch located under the access panel. When the AUTO LF-CR switch is in AUTO LF, depressing the RETURN key transmits the carriage return (CR) code and causes the cursor to move to the first character position of the next line. If the cursor is on the bottom line, scrolling occurs (see Section 4.4). When the AUTO LF-CR switch is in CR, depressing the RETURN key transmits a CR code and causes the cursor to move to the beginning of the same line.

(d) LINE FEED

Operation of this key is governed by the position of the AUTO LF-CR switch. With the switch in AUTO LF, depressing LINE FEED key transmits the line feed code but has no effect on the display or cursor position. With the switch in CR, depressing LINE FEED key transmits the line feed code and causes the cursor to move down one line. If the cursor is on the bottom line, scrolling occurs (see Section 4.4). If the LINE FEED key is depressed in conjunction with the SHIFT key, the cursor moves up one line.

(e) ALL CAPS

Operates in conjunction with the lower case feature.

When in the up position, the keyboard operates as a standard typewriter. Typed characters are displayed as lower case; upper case characters or symbols are displayed when the SHIFT key is used simultaneously with the character entry.

In the down position, the keyboard operates like a TTY. Alpha characters only are displayed as upper case; depressing other keys causes the transmission of the unshifted characters.

(f) BACK SPACE

When depressed, this key transmits the BS code (ASCII BS, column 0 row 8) and moves the cursor one position to the left. When the BACK SPACE key is depressed in conjunction with the SHIFT key, the cursor moves one position to the right (non-destructive space - ASCII DLE, column 1 row 0). If the cursor were in the first position of a row, other than the HOME position, depressing the BACK SPACE key causes an up-wraparound to the last character position of the next higher row. If in HOME, no action will result.

(g) TAB

When depressed, this key transmits the HT code (ASCII HT, column 0 row 9) and moves the cursor to the next foreground field. If a new foreground field is not present by the end of the 24th line, the cursor will not move.

(2) Standard Functions

Keys in this cluster provide commonly used functions.

(a) BREAK

Depressing this key generates a break signal to the computer which is equivalent to the corresponding button on a conventional teletype terminal.

(b) RESET

Depressing this key blanks the display until the key is released. After reset, all subsequent received data is displayed in background intensity or as controlled by subsequent remote commands. This key is independent of the Half-Full Duplex Mode setting.

(c) HOME

Depressing this key moves the cursor to the home position (upper left corner).

(d) CLEAR

This key is used in conjunction with the SHIFT and CTRL keys to generate four different clear functions. All of these clear to foreground spaces. The four are:

| | |
|---|---|
| CLEAR | - depressing this key alone clears the total display; cursor goes to home position. |
| Clear Foreground | - depressing SHIFT and CLEAR keys clears all foreground displayed data; cursor goes to home position. |
| Clear End of Line | - depressing CTRL and CLEAR keys clears all data from cursor position to end of line; cursor does not move. |
| Clear End of Screen | - depressing CTRL, SHIFT, and CLEAR keys clears all data from the cursor to the end of screen; cursor does not move. |

(3) Numeric Cluster

A separate numeric key cluster is provided for added operator convenience. These keys operate in exactly the same manner as the alphanumeric keys except that they are not affected by the SHIFT or CTRL keys.

# SECTION 4

# OPERATION

## 4.1 INTRODUCTION

The basic mode of operation for the Hazeltine 1500 Video Display Terminal is character-by-character (switch setting at HALF or FULL DUPLEX). Data which is entered via the keyboard is sent directly to the computer. A wide variety of editing and formatting functions are available through the use of the various remote commands (see Section 4.5). As an example, most computer based software packages recognize special characters and have subroutines for backspacing and, in some cases, line and character replacement.

## 4.2 OPERATION IN FULL DUPLEX

The full duplex mode of communication is typically used when the communication system is capable of simultaneous two-way transmission. Data entered via the keyboard is routed directly to the computer without display. The display is comprised only of alphanumeric data "received" by or "echoed" back to the terminal. Each display function key (ie, HOME, CLEAR, etc) generates a code that is transmitted to the computer, and, under computer control, is "echoed" back to the terminal. The ASCII code for each of these display functions is included in paragraph 4.5.2.

## 4.3 OPERATION IN HALF DUPLEX

The Half Duplex mode of communication is used when the communication system is not capable of simultaneous two-way transmission, or the "echoed" back operation is undesirable. Data keyed from the keyboard is transmitted and displayed simultaneously. The data displayed is processed as if it were data transmitted by the computer. Display function keys do not generate codes in Half Duplex.

## 4.4 SCROLLING

If a displayable ASCII code is received at the last character position of the last displayable character row, the data moves

up one row, the top row of data is removed, and the cursor moves to the first character position (left margin) of the last (bottom) character row. Data from the last character row is replaced with spaces. This type of manipulation and cursor movement operation is referred to hereafter as scrolling and requires no fill characters at any baud rate. Scrolling also occurs when the cursor is on the bottom line and a line feed (ASCII LF) is received in CR operation or a carriage return (ASCII CR) is received in AUTO LF operation as selected by the AUTO LF-CR switch.

## 4.5 REMOTE COMMANDS

### 4.5.1 General

The remote command features of the Hazeltine 1500 provide the user with the capability to fully control the terminal via the CPU software. In order to call a terminal function from software, it is necessary to precede the function code with a lead-in code (except as noted). The lead-in code (ASCII~, column 7, row 14 - Decimal 126) alerts the terminal that a special function follows. The lead-in code and the command following the lead-in code when received, is not stored in display memory and does not advance the cursor. If the code following the lead-in code is not one of the valid command codes (a second lead-in is invalid), that code will not be stored and the cursor will not advance.

NOTE

1. The command code must immediately follow the lead-in code without any intervening characters (including NUL or DEL).

2. Terminology: X represents the column on the screen 0 through 79 ($0 \leq X \leq 79$)
   Y represents the row on the screen 0 through 23 ($0 \leq Y \leq 23$)

3. Appendix III summarizes the remote commands described below; Appendix IV gives a programming example using the cursor addressing remote command; the ASCII code chart is shown in Appendix I.

4.5.2 Commands

a. Home Cursor (lead-in required)

On receipt of the HOME CURSOR command (ASCII DC2, column 1, row 2 - Decimal 18), the cursor moves to the upper left corner of the display (coordinates X = 0, Y = 0). This has no effect on data displayed.

b. Up Cursor (lead-in required)

On receipt of the UP CURSOR command (ASCII FF, column 0, row 12 - Decimal 12), the cursor increments up one row without altering the display. If the cursor is located in the top row (Y=0), there will be no cursor movement.

c. Down Cursor (lead-in required)

On receipt of the DOWN CURSOR command (ASCII VT, column 0, row 11 - Decimal 11), the cursor increments down one row without altering the display. If the cursor is located in the bottom row (Y=23), there will be no cursor movement.

d. Left Cursor (no lead-in required)

On receipt of the LEFT CURSOR command (ASCII BS, column 0, row 8 - Decimal 8), the cursor moves back one character position and does not alter the display. If the cursor is in the leftmost column (X=0), it will wrap backward to the row above and the right-most column (X=79). If the cursor were in the home position (X=Y=0), it would not move.

e. Right Cursor (no lead-in required)

On receipt of the RIGHT CURSOR command (ASCII DLE, column 1, row 0 - Decimal 16), the cursor advances one character position to the right and does not alter the display (non-destructive space). The code is not stored in display memory. If the cursor is in the rightmost column (X=79), it wraps around

to the beginning of the following row. If the cursor were in row 23 and column 79, there will be no cursor movement upon receipt of the command.

f. Address Cursor (lead-in required)

On receipt of the ADDRESS CURSOR command (ASCII DC1, column 1, row 1 - Decimal 17), the cursor prepares to move to one of the 1920 character positions as defined by the command format below:

| Lead-in Code | DC1 | X | Y |
|---|---|---|---|

The cursor coordinate system is the simple rectangular system. The range of values for the X coordinate is 0 through 79 to access all 80 character positions on a line. Addresses above 79 access X=79. The range of values for the Y coordinate is 0 through 23. Addresses above 23 access Y=23. The first character following the "Y" address is recognized and acted upon as a valid ASCII entry .

In order to address the columns X=0 through X=79, the decimal codes 0 through 79 may be transmitted for X. The preferred alternate is to address columns X=0 through X=30 by transmitting the decimal codes 96 through 126.

In order to address the rows Y=0 through Y=23, the decimal codes 0 through 23 may be transmitted for Y. The preferred alternate is to address rows Y=0 through Y=23 by transmitting the decimal codes 32 through 55 or 64 through 87 or 96 through 119 for Y.

See Appendix II for the cursor address chart.

g. Read Cursor Address (lead-in required)

On receipt of the READ CURSOR ADDRESS command (ASCII ENQ, column 0, row 5 - Decimal 5), the terminal responds with the cursor address. The X coordinate

position is followed by the Y coordinate followed by a CR code. The X and Y coordinates transmitted can be found in Appendix II. The cursor position and the display will not be altered. In the full-duplex mode of operation, the terminal is capable of receiving data during the transmission of the coordinates. In the half-duplex mode, the terminal will be capable of receiving data after transmitting the CR code.

h. Clear Screen (lead-in required)

On receipt of the CLEAR SCREEN command (ASCII FS, column 1, row 12 - Decimal 28), the screen is cleared to foreground spaces. The cursor moves to the home position (coordinates X=0, Y=0).

i. Clear Foreground (lead-in required)

On receipt of the CLEAR FOREGROUND command (ASCII GS, column 1, row 13 - Decimal 29), all foreground (high intensity) data will be replaced with foreground spaces. The cursor moves to the home position (coordinates X=0, Y=0).

j. Clear to End of Line (lead-in required)

On receipt of the CLEAR TO END OF LINE command (ASCII SI, column 0, row 15 - Decimal 15), all data from the cursor to the end of the line, including the character residing at the cursor position, will be replaced by foreground spaces. The cursor will not move.

k. Clear to End of Screen (lead-in required)

On receipt of the CLEAR TO END OF SCREEN command (ASCII CAN, column 1, row 8 - Decimal 24), all data from the cursor to the end of the screen (coordinates X=79, Y=23), including the character residing at the cursor position, will be replaced by foreground spaces. The cursor will not move.

l. Clear to End of Screen - Background Spaces (lead-in required)

On receipt of the CLEAR TO END OF SCREEN - BACKGROUND SPACES command (ASCII ETB, column 1, row 7 - Decimal 23), all data from the cursor to the end of the screen (coordinates X=79, Y=23), including the character at the cursor position, is replaced by background spaces. The cursor does not move.

NOTE

This command can be used to clear the entire screen with background spaces. This can be accomplished by sending the HOME command followed by the CLEAR TO END OF SCREEN - BACKGROUND SPACES command.

NOTE

By using this command alternately in conjunction with the CLEAR TO END OF SCREEN command or CLEAR TO END OF LINE commands, the screen can be formatted into a series of foreground and background areas on the display, which can be useful for bar graphs and other enhanced presentations.

m. Background Follows (lead-in required)

On receipt of the BACKGROUND FOLLOWS command (ASCII EM, column 1, row 9 - Decimal 25), the terminal displays all subsequent data as background (low intensity). This is the initial state of the terminal so that from the keyboard, the operator can have the terminal enter this mode by depressing the RESET key.

n. Foreground Follows (lead-in required)

On receipt of the FOREGROUND FOLLOWS command (ASCII US, column 1, row 15 - Decimal 31), the terminal displays all subsequent data as foreground (high intensity). The foreground mode may be

terminated by a BACKGROUND FOLLOWS command or by depressing the RESET key.

o. Delete Line (lead-in required)

On receipt of the DELETE LINE command (ASCII DC3, column 1, row 3 - Decimal 19), the line of data where the cursor is positioned is deleted and all data below the cursor scrolls up. The cursor moves to the beginning of the line (coordinates X=0, Y=no change). The line of data at the bottom of the screen (Y=23) is replaced by foreground spaces.

p. Insert Line (lead-in required)

On receipt of the INSERT LINE command, (ASCII SUB, column 1, row 10 - Decimal 26), the data from the line where the cursor is positioned moves down one line; all other lines below the cursor also move down one line. In effect, data scrolls down, allowing a new line of data to be entered. The new line consists of foreground spaces and the cursor is positioned at the beginning of that line (coordinate X=0, Y=no change). Since data is scrolling down, the bottom line of the screen is removed.

q. Keyboard Lock (lead-in required)

On receipt of the KEYBOARD LOCK command (ASCII NAK, column 1, row 5 - Decimal 21), the keyboard is inhibited. That is, data is not allowed to be entered on the screen from the keyboard. This mode is reset by a KEYBOARD UNLOCK command or by depressing the RESET key.

r. Keyboard Unlock (lead-in required)

On receipt of the KEYBOARD UNLOCK command (ASCII ACK, column 0, row 6 - Decimal 6), the keyboard is enabled. That is, data is allowed to be entered on the screen from the keyboard. This is the initial state of the terminal.

s. Audible Alarm (no lead-in required)

On receipt of the AUDIBLE ALARM command (ASCII BEL, column 0, row 7 - Decimal 7), the audible alarm is sounded for a period of approximately 0.2 second.

t. Tab (no lead-in required)

On receipt of the TAB command (ASCII HT, column 0, row 9 - Decimal 9), the cursor moves to the first character position of the next foreground (high intensity) field. If there are no new foreground fields, the cursor does not move.

## 4.6. TIMING CONSIDERATIONS

The Hazeltine 1500 is equipped with an input buffer so that under control of most applications programs the terminal does not require the insertion of fill characters (ASCII NUL or DEL) after remote commands. If timing problems are encountered, contact your salesperson for the Hazeltine 1500 Application Note on timing considerations for proper use of fill characters to overcome the timing constraints.

# SECTION 5

# COMMUNICATIONS INTERFACE

## 5.1 ASCII

The Hazeltine 1500 terminal communicates with the ASCII code shown in Appendix I. Parity, as selected, is added to make an 8 bit code.

## 5.2 ASYNCHRONOUS DATA

The format for received and transmitted data is asynchronous serial ASCII. Each character is preceded by a start bit and followed by 1 stop bit (2 stop bits are transmitted at 110 baud). The parity bit can be selected (see Section 3) to be even, odd, always one, or always zero. Odd or even parity enable the terminal to assess the integrity of received data. When a character is received with an incorrect parity bit, a parity error symbol ($\underline{P}_E$) is placed on the screen at the cursor position and the alarm is sounded. This indicates to the terminal operator that erroneous data was received. Switches are provided (see Section 3) to select the baud rate (110, 300, 1200, 1800, 2400, 4800, 9600, or 19,200) and parity (even, odd, one, or zero).

| Start Bit | Bit 1 | Bit 2 | Bit 3 | Bit 4 | Bit 5 | Bit 6 | Bit 7 | Parity Bit | Stop Bit | Stop Bit for 110 Baud Only |
|---|---|---|---|---|---|---|---|---|---|---|

## 5.3 FULL DUPLEX/HALF DUPLEX

Full duplex data communications facilities imply the ability for data communications in two directions simultaneously. For telecommunications, this means that the modem involved is capable of simultaneous bi-directional data transmission and reception. Full duplex operation with the Hazeltine 1500 requires that communications take place at the same baud rate for both receive and transmit. Half duplex communications facilities imply that data communications alternate between receive and transmit. For telecommunications, this means that the modem involved is controlled by the terminal as to whether it is in a transmitting state or a receiving state.

## 5.4 EIA INTERFACE

The standard EIA connector located on the rear of the unit provides the connection to the appropriate data set or acoustic coupler. The connector can be used for either voltage level (EIA RS232C) or current loop interface. The interface connections are listed below. See Section 3 for instructions on how to select the EIA Interface.

| Pin Number | Direction of Signal | Designation | Function |
|---|---|---|---|
| 1 | -- | AA | Protective Ground (Chassis) |
| 2 | (From Terminal) | BA | Transmitted Data |
| 3 | (To Terminal) | BB | Received Data |
| 4 | (From Terminal) | CA | Request to Send |
| 5 | (To Terminal) | CB | Clear to Send |
| 6 | (To Terminal) | CC | Data Set Ready |
| 7 | -- | AB | Signal Ground |
| 8 | (To Terminal) | CF | Data Carrier Detect |
| 13 | (From Terminal) | | 16X Clock Output (TTL level) |
| 18 | -- | | + Current Loop Input |
| 19 | -- | | - Current Loop Input |
| 20 | (From Terminal) | CD | Data Terminal Ready |
| 21 | -- | | Current Loop Output |
| 25 | -- | | Current Loop Output |

## 5.5 CURRENT LOOP INTERFACE

The current loop interface converts the standard EIA RS232 voltage level interface to a 20 mA current switching interface. The current loop interface switching states are "mark" (Current flow) or "space" (no current flow). The "data out" line (BA) on pin 2 of the modem connector controls a circuit closure. In the Mark condition, the circuit is closed while in the Space condition the circuit is open. See figure 5-1 for the external current loop configuration for either a four-wire (full duplex) facility or two-wire (half duplex) facility.

Input data represented by the presence or absence of current is converted to input data (BB) appearing on pin 3 of the connector.

The maximum ratings are:

| | | |
|---|---|---|
| Current | : | 20 mA minimum |
| Open Loop Voltage | : | 50 V maximum |
| Cable Interface | : | 1000 ft maximum at 9600 baud |

NOTE

The current source must be provided external to the terminal.

See section 3 for instructions on how to select the correct loop interface.

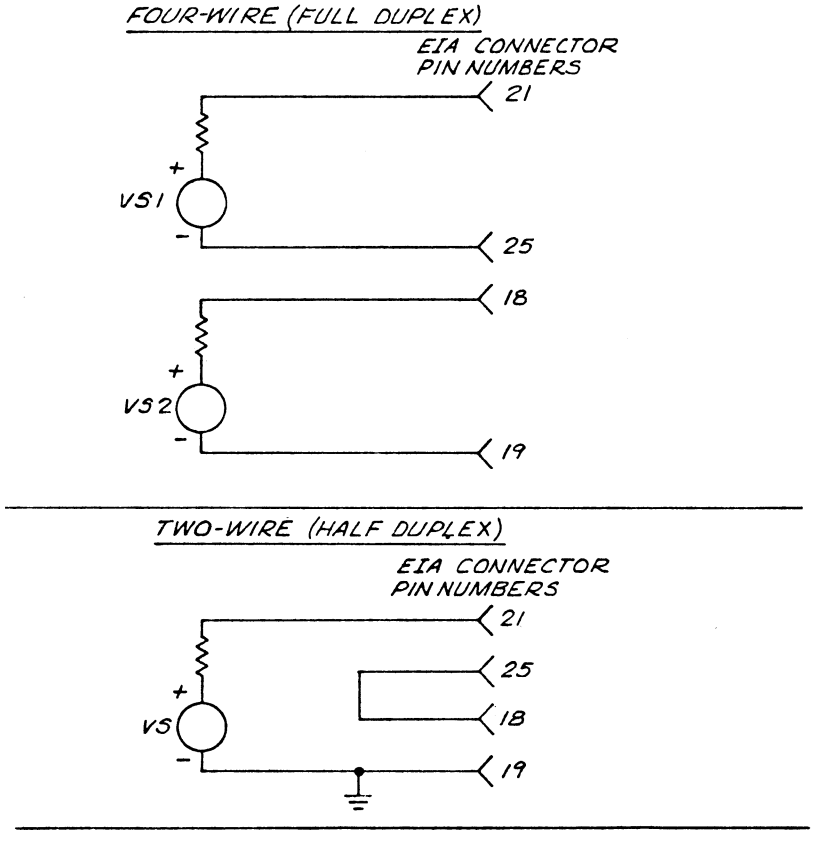


Figure 5-1. Current Loop Interface

## 5.6 HARDWIRED INTERFACE

The Hazeltine 1500 can be connected directly to a computer by connecting pins 1, 2, and 3 from the modem connector on the rear panel (note that pins 2 and 3 may have to be crossed with the corresponding pins on the computer). No wiring changes are required at the terminal to simulate the presence of a modem. Refer to your computer supplier for any special wiring at the computer interface.

## 5.7 DATA SETS

### 5.7.1 103A Modem

The Hazeltine 1500 connects directly to a 103A modem through an optional interface cable which is available through your Hazeltine representative.

### 5.7.2 202 Modem

The Hazeltine 1500 connects to a 202 modem as specified for the 103A. The following procedure should be followed for proper operation with a half duplex 202 modem.

a. Upon depression of the first key, the Hazeltine 1500 conditions the modem for transmission. This can take up to 1/5 of a second. A very fast typist should take care to ensure that the first character reaches the screen before additional entries are made.

b. To complete the transmission to the computer system, either a carriage return (RETURN), ETX (CTRL C) or EOT (CTRL D) should be entered. The termination character used is determined by the computer software. Upon sending the termination character, the 202 modem switches into the receive mode.

c. The depression of the next character for transmission returns operation to step a.

# SECTION 6

# TECHNICAL SUMMARY

## A. DISPLAY CHARACTERISTICS

Characters per line: 80
Lines per display: 24
Screen Capacity: 1920 characters
Character format: 7 x 10 dot matrix
Character Set: 94 ASCII
Character Size: .204" high, .088" wide, nominal
Refresh rate: 60 frames/sec non-interlaced
CRT Screen: 12 inch diagonal; P4 phosphor
Display: White on Black or Black on White
Display Area: 6.0" x 9.0"
Cursor: Block
Dual Intensity
Memory Type: 2048 x 8 Random Access Memory

## B. REMOTE COMMANDS

Cursor address (absolute)
Incremental cursor control
Read cursor address
Clear screen
Clear Foreground
Clear to End of line
Clear to End of screen
Clear to End of screen (Background spaces)
Home Cursor
Set hi/lo intensity
Audible alarm
Backspace
Keyboard Lock
Keyboard Unlock
Insert line
Delete line
Tab

## C. COMMUNICATION INTERFACE

Full or Half Duplex (W.E. modem 103A,202 compatible).
EIA RS232C connector, or Current Loop connector, 20 mA externally sourced
Eight Baud Rates: 110, 300, 1200, 1800, 2400, 4800, 9600, 19,200
Parity: Odd, Even, 1 or 0
No. of Stop Bits: two at 110
one - all other rates.

D. CONTROLS

Contrast
Power On/Off
Half Duplex/Full Duplex
Auto LF/CR control
Baud Rate
Parity
EIA/Current Loop
U/L Case enable
Standard or Reverse Video

E. MECHANICAL

Size: 13.5" (34.3 cm) high,
15.5" (40.0 cm) wide,
20.5" (52.1 cm) deep
Weight: 35 lbs. (15.9 kg)

F. ENVIRONMENTAL

Operating Temperature: 10° C to 40° C
Storage Temperature: -20° C to 65° C
Humidity: Up to 95° relative non-condensing
Shock: Up to 40 g on three axes (in the shipping carton)

G. ELECTRICAL

Power consumption: 115 watts nominal
Power input: 115 V 60 Hz

H. INDICATORS

Power On LED (Light Emitting Diode)

# APPENDIX I

## ASCII CHARACTER CODE CHART

| $b_7$ → | | | | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $b_6$ → | | | | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| $b_5$ → | | | | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| BITS $b_4$ ↓ | $b_3$ ↓ | $b_2$ ↓ | $b_1$ ↓ | COL → / ROW ↓ | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | | |
| 0 | 0 | 0 | 0 | 0 | NUL | DLE | SP | 0 | @ | P | ` | p | | | |
| 0 | 0 | 0 | 1 | 1 | SOH | DC1 | ! | 1 | A | Q | a | q | | | |
| 0 | 0 | 1 | 0 | 2 | STX | DC2 | " | 2 | B | R | b | r | | | |
| 0 | 0 | 1 | 1 | 3 | ETX | DC3 | # | 3 | C | S | c | s | | | |
| 0 | 1 | 0 | 0 | 4 | EOT | DC4 | $ | 4 | D | T | d | t | | | |
| 0 | 1 | 0 | 1 | 5 | ENQ | NAK | % | 5 | E | U | e | u | | | |
| 0 | 1 | 1 | 0 | 6 | ACK | SYN | & | 6 | F | V | f | v | | | |
| 0 | 1 | 1 | 1 | 7 | BEL | ETB | ' | 7 | G | W | g | w | | | |
| 1 | 0 | 0 | 0 | 8 | BS | CAN | ( | 8 | H | X | h | x | | | |
| 1 | 0 | 0 | 1 | 9 | HT | EM | ) | 9 | I | Y | i | y | | | |
| 1 | 0 | 1 | 0 | 10 | LF | SUB | * | : | J | Z | j | z | | | |
| 1 | 0 | 1 | 1 | 11 | VT | ESC | + | ; | K | [ | k | { | | | |
| 1 | 1 | 0 | 0 | 12 | FF | FS | , | < | L | \ | l | ¦ | | | |
| 1 | 1 | 0 | 1 | 13 | CR | GS | - | = | M | ] | m | } | | | |
| 1 | 1 | 1 | 0 | 14 | SO | RS | . | > | N | ^ | n | ~ | | | |
| 1 | 1 | 1 | 1 | 15 | SI | US | / | ? | O | — | o | DEL | | | |

LEAD IN

# APPENDIX II

## CURSOR ADDRESS CHART

This table provides row (Y) and column (X) coordinate information for direct cursor address and read cursor address. To address the cursor it is necessary to precede the X and Y coordinates by a lead in (~) followed by a DC1 code. It is recommended to avoid use of codes in column 0 and 1 of the ASCII Chart (Appendix I). For read cursor address, the terminal will transmit the row and column coordinates indicated by the brackets.

| Bit Pattern $b_7 \ldots b_1$ | Dec. Value | ASCII Char. | Key Stroke | Coordinates Col. No. (X) | Coordinates Line No. (Y) |
|---|---|---|---|---|---|
| 0000000 | 0 | NUL | $cs_0$ | 0 | 0 |
| 0000001 | 1 | SOH | $c_A$ | 1 | 1 |
| 0000010 | 2 | STX | $c_B$ | 2 | 2 |
| 0000011 | 3 | ETX | $c_C$ | 3 | 3 |
| 0000100 | 4 | EOT | $c_D$ | 4 | 4 |
| 0000101 | 5 | ENQ | $c_E$ | 5 | 5 |
| 0000110 | 6 | ACK | $c_F$ | 6 | 6 |
| 0000111 | 7 | BEL | $c_G$ | 7 | 7 |
| 0001000 | 8 | BS | BACKSPACE | 8 | 8 |
| 0001001 | 9 | HT | $c_I$ | 9 | 9 |
| 0001010 | 10 | LF | LF | 10 | 10 |
| 0001011 | 11 | VT | $c_K$ | 11 | 11 |
| 0001100 | 12 | FF | $c_L$ | 12 | 12 |
| 0001101 | 13 | CR | CR | 13 | 13 |
| 0001110 | 14 | SO | $c_N$ | 14 | 14 |
| 0001111 | 15 | SI | $c_O$ | 15 | 15 |
| 0010000 | 16 | DLE | $c_P$ | 16 | 16 |
| 0010001 | 17 | DC1 | $c_Q$ | 17 | 17 |
| 0010010 | 18 | DC2 | $c_R$ | 18 | 18 |
| 0010011 | 19 | DC3 | $c_S$ | 19 | 19 |
| 0010100 | 20 | DC4 | $c_T$ | 20 | 20 |
| 0010101 | 21 | NAK | $c_U$ | 21 | 21 |
| 0010110 | 22 | SYN | $c_V$ | 22 | 22 |
| 0010111 | 23 | ETB | $c_W$ | 23 | 23 |
| 0011000 | 24 | CAN | $c_X$ | 24 | |
| 0011001 | 25 | EM | $c_Y$ | 25 | |
| 0011010 | 26 | SUB | $c_Z$ | 26 | |
| 0011011 | 27 | ESC | ESC | 27 | |
| 0011100 | 28 | FS | $cs_L$ | 28 | |
| 0011101 | 29 | GS | $cs_M$ | 29 | |
| 0011110 | 30 | RS | $cs_N$ | 30 | |

| Bit Pattern $b_7 \ldots b_1$ | Dec. Value | ASCII Char. | Key Stroke | Coordinates Col. No. (X) | | Line No. (Y) |
|---|---|---|---|---|---|---|
| 0011111 | 31 | US | $cs_O$ | 31 | | |
| 0100000 | 32 | SP | SP | 32 | | 0 |
| 0100001 | 33 | ! | ! | 33 | | 1 |
| 0100010 | 34 | " | " | 34 | | 2 |
| 0100011 | 35 | # | # | 35 | | 3 |
| 0100100 | 36 | $ | $ | 36 | | 4 |
| 0100101 | 37 | % | % | 37 | | 5 |
| 0100110 | 38 | & | & | 38 | | 6 |
| 0100111 | 39 | ' | ' | 39 | | 7 |
| 0101000 | 40 | ( | ( | 40 | | 8 |
| 0101001 | 41 | ) | ) | 41 | | 9 |
| 0101010 | 42 | * | * | 42 | | 10 |
| 0101011 | 43 | + | + | 43 | | 11 |
| 0101100 | 44 | , | , | 44 | | 12 |
| 0101101 | 43 | - | - | 45 | | 13 |
| 0101110 | 46 | . | . | 46 | | 14 |
| 0101111 | 47 | / | / | 47 | | 15 |
| 0110000 | 48 | 0 | 0 | 48 | | 16 |
| 0110001 | 49 | 1 | 1 | 49 | Output | 17 |
| 0110010 | 50 | 2 | 2 | 50 | Read | 18 |
| 0110011 | 51 | 3 | 3 | 51 | Cursor | 19 |
| 0110100 | 52 | 4 | 4 | 52 | Address | 20 |
| 0110101 | 53 | 5 | 5 | 53 | | 21 |
| 0110110 | 54 | 6 | 6 | 54 | | 22 |
| 0110111 | 55 | 7 | 7 | 55 | | 23 |
| 0111000 | 56 | 8 | 8 | 56 | | |
| 0111001 | 57 | 9 | 9 | 57 | | |
| 0111010 | 58 | : | : | 58 | | |
| 0111011 | 59 | ; | ; | 59 | | |
| 0111100 | 60 | < | < | 60 | | |
| 0111101 | 61 | = | = | 61 | | |
| 0111110 | 62 | > | > | 62 | | |
| 0111111 | 63 | ? | ? | 63 | | |
| 1000000 | 64 | @ | @ | 64 | | 0 |
| 1000001 | 65 | A | A | 65 | | 1 |
| 1000010 | 66 | B | B | 66 | | 2 |
| 1000011 | 67 | C | C | 67 | | 3 |

| Bit Pattern $b_7 \ldots b_1$ | Dec. Value | ASCII Char. | Key Stroke | Coordinates Col. No. (X) | | Coordinates Line No. (Y) | |
|---|---|---|---|---|---|---|---|
| 1000100 | 68 | D | D | 68 | | 4 | |
| 1000101 | 69 | E | E | 69 | | 5 | |
| 1000110 | 70 | F | F | 70 | | 6 | |
| 1000111 | 71 | G | G | 71 | Output | 7 | |
| 1001000 | 72 | H | H | 72 | Read | 8 | |
| 1001001 | 73 | I | I | 73 | Cursor | 9 | |
| 1001010 | 74 | J | J | 74 | Address | 10 | |
| 1001011 | 75 | K | K | 75 | | 11 | |
| 1001100 | 76 | L | L | 76 | | 12 | |
| 1001101 | 77 | M | M | 77 | | 13 | |
| 1001110 | 78 | N | N | 78 | | 14 | |
| 1001111 | 79 | O | O | 79 | | 15 | |
| 1010000 | 80 | P | P | | | 16 | |
| 1010001 | 81 | Q | Q | | | 17 | |
| 1010010 | 82 | R | R | | | 18 | |
| 1010011 | 83 | S | S | | | 19 | |
| 1010100 | 84 | T | T | | | 20 | |
| 1010101 | 85 | U | U | | | 21 | |
| 1010110 | 86 | V | V | | | 22 | |
| 1010111 | 87 | W | W | | | 23 | |
| 1011000 | 88 | X | X | | | | |
| 1011001 | 89 | Y | Y | | | | |
| 1011010 | 90 | Z | Z | | | | |
| 1011011 | 91 | [ | [ | | | | |
| 1011100 | 92 | \ | \ | | | | |
| 1011101 | 93 | ] | ] | | | | |
| 1011110 | 94 | ^ | ^ | | | | |
| 1011111 | 95 | - | - | | | | |
| 1100000 | 96 | ` | $c_{SP}$ | 0 | | 0 | |
| 1100001 | 97 | a | a | 1 | | 1 | |
| 1100010 | 98 | b | b | 2 | | 2 | |
| 1100011 | 99 | c | c | 3 | | 3 | Output |
| 1100100 | 100 | d | d | 4 | | 4 | Read |
| 1100101 | 101 | e | e | 5 | | 5 | Cursor |
| 1100110 | 102 | f | f | 6 | | 6 | Address |
| 1100111 | 103 | g | g | 7 | | 7 | |
| 1101000 | 104 | h | h | 8 | | 8 | |

| Bit Pattern $b_7 \ldots b_1$ | Dec. Value | ASCII Char. | Key Stroke | Coordinates Col. No. (X) | Coordinates Line No. (Y) | |
|---|---|---|---|---|---|---|
| 1101001 | 105 | i | i | 9 | 9 | |
| 1101010 | 106 | j | j | 10 | 10 | |
| 1101011 | 107 | k | k | 11 | 11 | |
| 1101100 | 108 | l | l | 12 | 12 | |
| 1101101 | 109 | m | m | 13 | 13 | |
| 1101110 | 110 | n | n | 14 | 14 | |
| 1101111 | 111 | o | o | 15 | 15 | Output |
| 1110000 | 112 | p | p | 16 | 16 | Read |
| 1110001 | 113 | q | q | 17 | 17 | Cursor |
| 1110010 | 114 | r | r | 18 | 18 | Address |
| 1110011 | 115 | s | s | 19 | 19 | |
| 1110100 | 116 | t | t | 20 | 20 | |
| 1110101 | 117 | u | u | 21 | 21 | |
| 1110110 | 118 | v | v | 22 | 22 | |
| 1110111 | 119 | w | w | 23 | 23 | |
| 1111000 | 120 | x | x | 24 | | |
| 1111001 | 121 | y | y | 25 | | |
| 1111010 | 122 | z | z | 26 | | |
| 1111011 | 123 | { | { | 27 | | |
| 1111100 | 124 | ¦ | ¦ | 28 | | |
| 1111101 | 125 | } | } | 29 | | |
| 1111110 | 126 | *~ | ~ | 30 | | |
| 1111111 | 127 | DEL | | (see note below) | | |

*Lead-In Code

NOTE: DECIMAL 127 is output for read cursor address for column 31 (X = 31).

# APPENDIX III

## SUMMARY OF REMOTE COMMANDS

| REMOTE COMMANDS | LEAD-IN REQD (X)* | KEY STROKE ** | ASCII CODE | DECIMAL |
|---|---|---|---|---|
| Home Cursor | X | Control-R | DC2 | 18 |
| Up Cursor | X | Shift-Line Feed | FF | 12 |
| Down Cursor | X | Control-K | VT | 11 |
| Left Cursor | | Back Space | BS | 8 |
| Right Cursor | | Shift-Backspace | DLE | 16 |
| Address Cursor | X | Control-Q | DC1,X,Y*** | 17,X,Y |
| Read Cursor Address | X | Control-E | ENQ | 5 |
| Clear Screen | X | Control/Shift-L | FS | 28 |
| Clear Foreground | X | Control/Shift-M | GS | 29 |
| Clear to End-of-Line | X | Control-O | SI | 15 |
| Clear to End-of-Screen | X | Control-X | CAN | 24 |
| Clear to End-of-Screen - background spaces | X | Control-W | ETB | 23 |
| Background Follows | X | Control-Y | EM | 25 |
| Foreground Follows | X | Control/Shift-O | US | 31 |
| Delete Line | X | Control-S | DC3 | 19 |
| Insert Line | X | Control-Z | SUB | 26 |
| Keyboard Lock | X | Control-U | NAK | 21 |
| Keyboard Unlock | X | Control-F | ACK | 6 |
| Audible Alarm | | Control-G | BEL | 7 |
| TAB | | TAB | HT | 9 |

* Lead-in Code = ASCI ∿, column 7, row 14 - DECIMAL 126

** Control-"Key" is generated by depressing the control key and striking the character.

Shift-"Key" is generated by depressing the shift key and striking the character.

Control/shift-"Key" is generated by simultaneously depressing the control and shift keys and striking the character.

*** See Section 4.5.2f.

# APPENDIX IV

## Programming Example

The following subroutine is written in basic for cursor addressing on the Hazeltine 1500.

This subroutine converts decimal value X and Y coordinates to their ASCII equivalent and sends the cursor address function to the Hazeltine 1500.

Routine

```
200 REM ::::::::::::::  CURSOR ADDRESS SUBROUTINE  ::::::::::::::
201 REM      INPUT VARIABLES ARE A(3) - X COORD
                                 A(4) - Y COORD
202 REM
203 REM ROUTINE ENDS BY POSITINING CURSOR AT DEFINED SCREEN ADDR.
204 DIM A(4)
205 A(0) = 4            CURSOR ADDRESS SUB. VARIABLES
206 A(1) = 126
207 A(2) = 17
208 A1$ = ""
209 IF A(3) <80 GOTO 220
210 PRINT "CUR. ADDR.*****VALUE >79 ENTERED AS X COORD";A(3);
215 A1$ = "ERROR"
220 IF A(4) <24 GOTO 232
225 PRINT "CUR. ADDR.*****VALUE >23 ENTERED AS Y COORD";A(4);
230 A1$ = "ERROR"
232 IF A1$ = "ERROR" GOTO 260
236 C2 = A(3)
238 C1 = A(4)
239 IF A(3) > 30 GOTO 245
240 A(3) = A(3) + 96
245 A(4) = A(4) + 96
250 CHANGE A TO A$
255 PRINT A$;
257 A(3) + C2
259 A(4) + C1
260 RETURN
```

Example of coding to utilize cursor address subroutine:

```
- - - - -
- - - - -
A(3) = 10
A(4) = 7
GOSUB 200
PRINT "I AM THE HAZELTINE 1500"
- - - - -
- - - - -
```

The prior example will display the "I AM THE HAZELTINE 1500" on line 7 starting in position #10.