

Hazeltine 1520

VIDEO DISPLAY TERMINAL
REFERENCE MANUAL



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Computer Peripheral Equipment
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Telex 96-1435

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SAFETY SUMMARY

WARNING

Dangerous voltages (15,000 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 (eg, wear safety glasses) when handling the cathode-ray tube to avoid risk of implosion. The internal phosphor coating is toxic. If the cathode-ray tube breaks and skin or eyes are exposed to this phosphor, rinse with water and consult a physician.

This manual is published and distributed by Hazeltine Corporation, Computer Terminal Equipment Product Line. The information presented herein may not reflect latest changes in the product. Confirmation and any required clarification of this information can be obtained from Hazeltine.

Warning: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. As temporarily permitted by regulation it has not been tested for compliance with the limits for Class A computing devices pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

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SECTION 1

INTRODUCTION

The Hazeltine 1520 Video Display Terminal (also referred to as the Hazeltine 1520), 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 1520, are normally found only in CRT's of greater cost. Speed, silence, and flexibility, coupled with the operator-oriented features of the Hazeltine 1520 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 1520. 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. The printer interface allows connection of either serial or parallel printers.

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

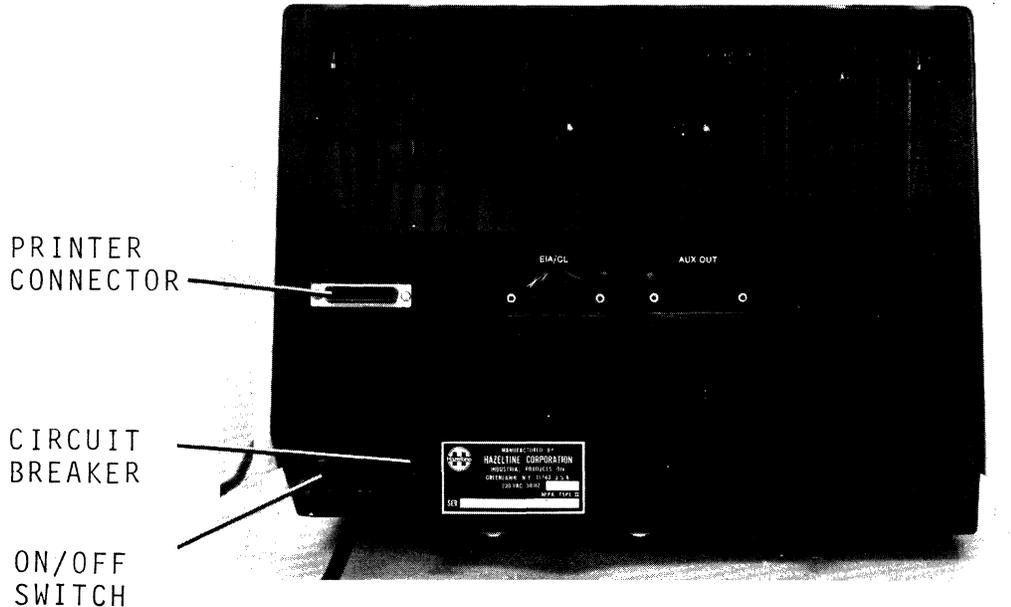
Dirt and smudges can be removed from the cabinet with any number of common household spray cleaners and a soft cloth. The faceplate should be cleaned only with a soft, damp cloth or tissue to avoid scratching.

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



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Figure 2-1. Hazeltine 1520 Terminal, Rear View

POWER ON indicator does not light, the terminal should be 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 HOME and CLEAR keys located on the keyboard. If after depressing the RESET and CLEAR keys, proper display/operation is still not obtained, turn the power off, wait 30 seconds, and turn power on again. If proper operation is still not obtained, 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

Twenty-three switches used for selecting the operating characteristics of the Hazeltine 1520 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. A ninth speed (600 baud) is available by placing the 1200 baud switch to the OFF (rear) position and all other switches to the ON position.

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.
------	---

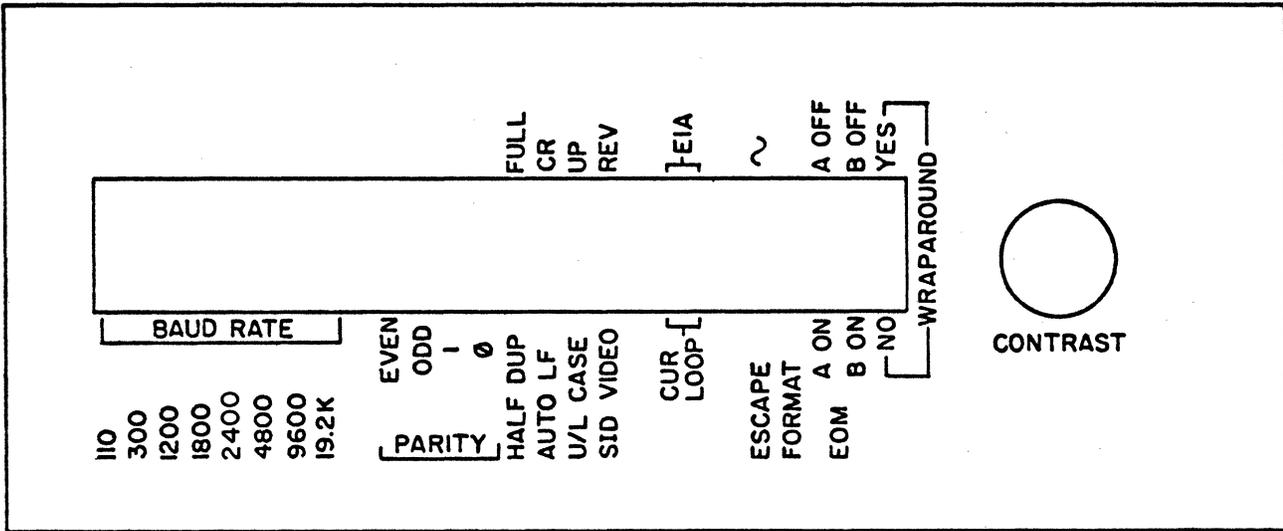


Figure 3-1. Legend Plate (Under Access Panel)

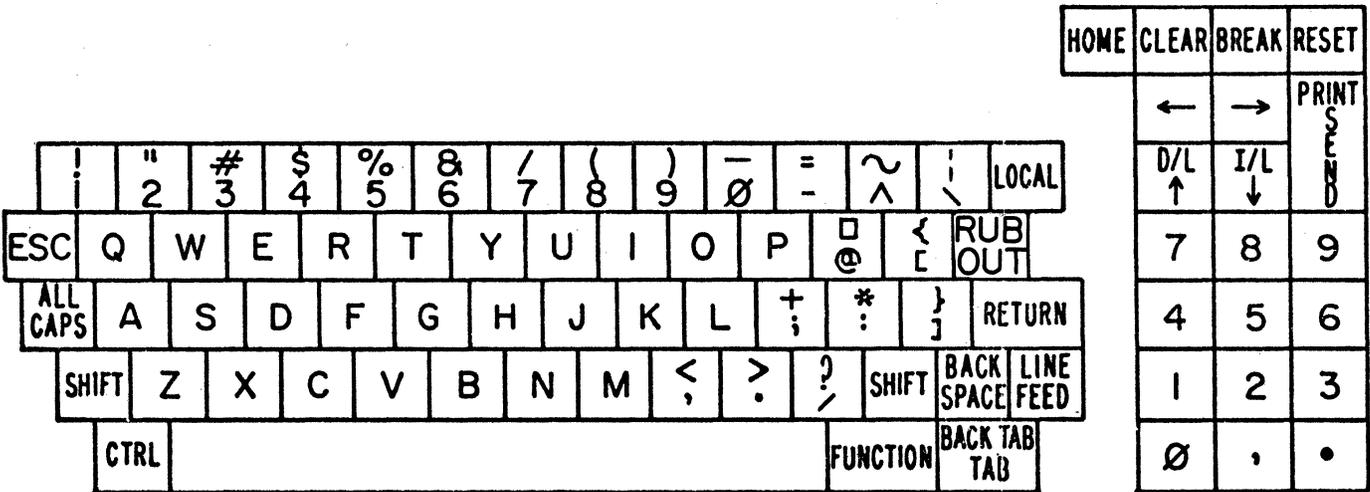


Figure 3-2. Keyboard Controls (for reference only)

- ODD Checks for odd parity on received data and generates odd parity on outgoing data.
- 1 The parity bit of each character transmitted is set to a one. No parity check is done on received data.
- ∅ 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 1520 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). Received carriage return codes (ASCII CR column 0, row 13) are only stored in the display memory in format mode. If the cursor was on the last displayable character row, received carriage returns will cause the display to scroll (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, received Line Feed characters will cause the display to scroll (refer to section 4.4 for a description of scrolling). Received LF codes are 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 rear position of these switches selects EIA RS232 communications at the modem interface located on the rear panel.

(2) CUR LOOP

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

h. ESC - ~

The remote commands of the Hazeltine 1520 as defined in section 4.5 require a lead-in code to flag the microprocessor that a remote command will follow. The ESC - ~ switch allows the selection of either the ESC code or the ~ code as the lead-in character. The forward position of the switch selects ESC and the rear position selects ~ (tilde).

i. FORMAT

The forward position of this switch overrides half and full duplex and selects format mode operation for keyboard entry and transmission. The format indicator is lit when the Hazeltine 1520 is set for format mode. In format mode data entered on the display can be edited before the contents of the display is transmitted.

j. EOM (2 switches)

The two EOM (End of Message) switches select the character which will be inserted at the end of read cursor address, function, batch, line and PAGE transmissions to signal the end of message.

<u>Inserted Character</u>	<u>A</u>	<u>B</u>
No Character	OFF	OFF
CR	ON	ON
EOT	OFF	ON
ETX	ON	OFF

k. Wraparound

In the rear position this switch sets the terminal for wraparound mode. In wraparound mode, the cursor is automatically positioned to the first position of the next line when a keyboard or I/O entry is made at the 80th position on the first 23 lines. On the 24th line "scrolling" and wraparound occur for all entries except keyboard entry in format mode for which the cursor remains in the 80th position.

In the forward position this switch inhibits wraparound from keyboard and I/O entries at the 80th position of any line. The cursor remains at the 80th position until moved by a carriage return or line feed.

l. Unused Switches

The switch located between CUR LOOP and ESCAPE (fig 3-1) is not used on the Hazeltine 1520.

m. 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.

n. Keyboard

The cursor movement keys, tab key, and 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 of function to repeat at an approximate rate of 15 times/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 format, half duplex or in full duplex mode 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.

(1) Alphanumeric Cluster

The keys in this cluster generate for transmission 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 transmits the ESC code (ASCII ESC, column 1 row 11) which is the lead-in code for remote commands if the ESC - ~ switch is in the ESC position.

(b) RUB OUT (DEL)

When depressed, it causes a character of all "one" bits to be transmitted (ASCII DEL, column 7, row 15). Usually DEL's are used as "filler" characters when program execution delays are required.

(c) RETURN

The operation of the key in half and full duplex with echo is governed by the AUTO LF-CR switch located

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

Key Stroke	Format	Half Duplex	Full Duplex	Operation in format half duplex or in full duplex if "echoed"	Operation in full duplex with no "echo"
ESC	ESC	ESC	ESC	Transmission Only	Transmission Only
RUB OUT (DEL)	DEL	DEL	DEL	Transmission Only	Transmission Only
RETURN	CR	CR	CR	See Description	Transmission Only
LINE FEED	LF	LF	LF	See Description	Transmission Only
SHIFT LINE FEED	None	None	LI, FF	Cursor Up	Transmission Only
BACK SPACE	BS	BS	BS	Cursor Left	Transmission Only
SHIFT BACK SPACE	DLE	None	DLE	Cursor Right	Transmission Only
ALL CAPS	None	None	None	See Description	See Description
TAB	None	HT	HT	TAB	Transmission Only
BREAK	(Break Signal)	(Break Signal)	(Break Signal)	Transmission Only; See Description	Transmission Only; See Description
RESET	None	None	None	See Description	See Description
HOME	None	None	LI, DC2	Cursor Home	Transmission Only
CLEAR	None	None	LI, FS	Clear Screen	Transmission Only
SHIFT CLEAR	None	None	LI, GS	Clear Foreground	Transmission Only
CONTROL CLEAR	None	None	LI, SI	Clear-End-of-Line	Transmission Only
CONTROL-SHIFT CLEAR	None	None	LI, CAN	Clear-End-of-Screen	Transmission Only
ALPHANUMERIC FUNCTION	A/N	A/N	A/N	See Description	Transmission Only
	ESC, A/N, End of Message Char.	ESC, A/N, End of Message Char.	ESC, A/N, End of Message Char.	See Description	Transmission Only
↑	None	None	LI, FF	Cursor Up	Transmission Only
SHIFT ↑ (D/L)	None	None	LI, DC3	Delete Line	Transmission Only
↓	None	None	LI, VT	Cursor Down	Transmission Only
SHIFT ↓ (I/L)	None	None	LI, SUB	Delete Line	Transmission Only
←	None	None	BS	Cursor Left	Transmission Only
→	None	None	DLE	Cursor Right	Transmission Only

LI = Lead In.

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. In format mode, depression of CR moves the cursor to the beginning of the next line and stores the CR for transmission. On the 24th line, the cursor goes to the beginning of the line and no scroll occurs.

(d) LINE FEED

Operation of this key in half and full duplex 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. In format mode the depression of the line feed key will store the line feed code as a non-displayable character at the cursor position. The cursor will increment as with any other alphanumeric character.

(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 are only displayed as upper case; depressing other keys causes the transmission of the unshifted characters.

(f) BACK SPACE

When depressed in half duplex or in full duplex with echo, 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 results. In format mode, depressing the BACK SPACE key stores the back space code as a non-displayable character at the cursor position. The cursor increments as with any alphanumeric character.

(g) TAB/BACK TAB

When depressed in half or full duplex, this key transmits the HT code (ASCII HT, column 0 row 9) and moves the cursor to the first position of the next foreground field. If a new foreground field is not present by the end of the 24th line, the cursor does not move. In format mode the TAB function occurs but the HT code is not transmitted.

When SHIFT and TAB are depressed, a BACK TAB function is performed. BACK TAB moves the cursor to the first position of the foreground field in which the cursor is located or if the cursor is in the first position of the foreground field or in a background position, to the first position of the preview foreground field. If no previous foreground field exists, the cursor does not move. TAB and BACK TAB operate in typamatic mode.

(h) FUNCTION

Depressing the function key conditions the terminal for a three-character transmission which has no effect on the display. Upon depressing the function key, the audible alarm sounds and the format indicator begins to blink. The blink continues until an ASCII entry is made causing the three-character function sequence (ESC, ASCII code, End of Transmission character) to be transmitted. This permits up to 128 user defined functions. If the function key is erroneously depressed, a second depression terminates this feature.

(i) LOCAL

The depression of the local key, when the terminal is set for format mode, prevents the received data from reaching the display screen. The local indicator on the keyboard is illuminated whenever the terminal is placed in the local state. Local is normally used to allow an operator to prepare and edit a full display of data with the assurance that the CPU will be unable to destroy the prepared text. The local state is terminated by a redepression of the local key or transmission of the prepared text.

(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. The SEND KEY is conditioned for batch transmission of unprotected (foreground) data

and the transmit mode is determined by the operator switches. This key is independent of 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. In format mode the cursor must be positioned at HOME before a clear will occur.
- Clear Foreground - depressing SHIFT and CLEAR keys clears all foreground displayed data; cursor goes to first unprotected 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.

3.1.3 CURSOR CONTROL Cluster

The four cursor control keys operate in format or half duplex mode as follows:

a. Up Cursor (↑) - Depressing the Up cursor key causes the cursor to move up one line. If the cursor is on the first line of the display, it does not move.

b. Down Cursor (↓) - Depressing the Down cursor key causes the cursor to move down one line. If the cursor is on the bottom line of the display, it does not move.

c. Right Cursor (→) - Depressing the right cursor key causes the cursor to increment one "X" position and if at the 80th character position of the line, it does not move.

d. Left Cursor (←) - Depressing the left cursor key causes the cursor to decrement one "X" position and on the first character position of the line, it does not move.

e. All cursor keys operate in typamatic.

f. Insert Line (I/L) - Depressing the SHIFT and I/L keys in format and half duplex mode causes an insert line function as defined in paragraph 4.5.2.p.

g. Delete Line (D/L) - Depressing the SHIFT and D/L keys in format and half duplex keys causes a delete line function as defined in paragraph 4.5.2.p.

h. SEND Key - Depressing the SEND key in Format mode initiates either batch, line or page transmission of unprotected only or unprotected/protected data as conditioned by remote command (see paragraph 4.6). On power up and reset, the SEND key is conditioned for batch transmission of unprotected data. Independently of the SEND key definition established by remote command, in Format mode, depressing the CTRL and SEND keys initiates line transmit; depressing the CTRL, SHIFT, and SEND keys initiates page transmission. Depressing the SHIFT and SEND keys causes a print operation in any communication mode. All other combinations of SEND in Half or Full duplex cause the alarm to be sounded. See Section 4 "Operation" for Description of Transmit Modes.

SECTION 4

OPERATION

4.1 INTRODUCTION

The basic mode of operation for the Hazeltine 1520 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 4.6). 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 function is included in paragraph 4.6.2.

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 and wrap-around operation is selected, 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 OPERATION IN FORMAT MODE

In the format mode of operation, the terminal becomes a buffered editing terminal, allowing the operator to enter data with characters transmitted to the computer only after the SEND key is depressed. Thus, before any data is actually transmitted, the operator may review it for errors, omissions and misplaced data, and take corrective action. After making the corrections, the operator may initiate a serial buffered transmission of data to the computer by depressing the SEND key.

Selection of format mode is both switch selectable (as is half and full duplex) and computer controlled by remote command. When format mode is enabled, the Format indicator located on the access panel will be illuminated. In format mode, background data will be protected and foreground data will be unprotected. Protected data cannot be altered from the keyboard in format mode. Attempted keyboard entry at a protected position will activate the audible alarm and cause the cursor to tab to the first position of the next unprotected field. If there are no further unprotected fields, only the audible alarm will be activated. Keyboard entry can be made in unprotected

fields only and will be entered at the cursor position in foreground intensity (unprotected), displayed and the cursor will be incremented one position.

In Format mode, six forms of transmission are available. The first mode of transmission is batch and consists of a partial screen transmission. The second mode of transmission is page mode and results in the transmission of all transmittable data on the total 24 lines of the screen. The third mode of transmission is line transmission. In addition to these three modes of transmission, remote commands exist which enable the computer to define transmitted data as either only unprotected or both protected and unprotected. Utilizing the five remote commands defined in paragraph 4.7, the SEND key is under CPU control as to which of the six transmit modes will be initiated by depression of the SEND key. On power up or reset, the Send key will be initialized to batch transmit of unprotected data only.

Batch Transmission. Batch transmission is initiated via a remote command or by depressing the SEND key in format mode. The first operation is to post a block transmit symbol (■) at the cursor position if the cursor is at an unprotected location. The keyboard becomes locked (except for reset which terminates all operations) and the cursor scans back until Home or a previous xmit symbol is reached. This operation may take up to 200 ms. If a xmit symbol is encountered, transmission begins on the next line. Once the beginning is located, data is transmitted without interruption between characters of fields. When the transmission reaches the posted xmit symbol, a new line function takes place (except on the last line when the cursor returns to the beginning of the line and scroll does not take place) and a CR code (or specified End of Message character) is transmitted. The format light will blink for the duration of transmit.

NOTE

If there is a CR or xmit symbol on the same line as, but prior to, the posted transmit symbol, incorrect data may result.

Line Transmission. Line transmission is initiated via a remote command or by depressing the SEND key in Format mode if it has been set for line transmit by remote command. In line transmit the transmitted data field consists of all transmittable data as defined by remote command from the CPU from the beginning of the line on which the cursor is located to the last non-space character located on that line. No transmit symbol will be stored on the display. The final character to be transmitted is the end of message character as defined by the operation of switches on the front of the keyboard. With the exception of transmission of the 24th line, the cursor will be located at the first position of the following line at the end of transmission. Transmission of the 24th line will cause a scroll of the display if no protected character is located on the 24th line. If a protected character exists on the 24th line, the cursor will go to the beginning of the line at the end of transmission.

PAGE Transmission. Page Transmission is initiated via a remote command or by depressing the SEND KEY in format mode if it has been set for page transmit by remote command. In page transmission, no transmit symbols are stored on the screen. The cursor will go to the home position at the start of transmit and all data for transmission between home and the end of the 24th line will be sent. Data to the right of CR's will not be transmitted. At the end of transmission the cursor will be placed at the beginning of the 24th line. No scroll will occur. The format light will blink for the full transmission period.

Form Fill Applications. Form fill applications optimize the power of CRT terminals. In establishing the data string required to place a form on the screen, the first decision to be made is whether

clearing to foreground or background spaces will minimize the string (use Clear screen or HOME & CLEAR TO END of SCREEN BACKGROUND respectively. The following example uses clear screen.

Example:

Once the screen is cleared, all character positions are filled with foreground spaces. It is therefore not necessary to write blanks in the variable entry fields. Only the form or background fields need be generated. If the form is to be sent to the display from an external source, each background field must then be addressed to its screen location by using the cursor address commands. The cursor address sequence is lead-in code, cursor address code, x-coordinate, y-coordinate.

In the following example, it is desired to generate a form on a system storage device using the keyboard of the Hazeltine 1520. The intent is to play back this form from storage from time to time and once retrieved, fill it in.

```

                                COLUMN
                                0 1 2 3 4 5 6 7 8 9 - - - 43 44 45 46 47 48 49 - - - 80
Line 0 N A M E(1)                P H O N E(2)
    1 A D D R E S S(3)
    2 C I T Y(4)                  S T A T E(5)
    3 C O M M E N T S(6)

```

There are 80 columns starting with column zero and going up to column 79. There are 24 lines, zero through 23.

The above layout may be rewritten in tabular form as follows:

Field No.	Field Title	Column No.	Line No.
1	NAME	0	0
2	PHONE	45	0
3	ADDRESS	0	1
4	CITY	0	2
5	STATE	43	2
6	COMMENTS	0	3

The Cursor Address Chart indicates the necessary keystrokes to generate the ASCII characters for a given screen location determined by column and line number intersection. By referencing this chart, the above table can be expanded to appear as follows:

Field Title	Column	Keystroke	Line	Keystroke
NAME	0	C _{SP}	0	C _{SP}
PHONE	45	-	0	C _{SP}
ADDRESS	0	C _{SP}	1	C _A
CITY	0	C _{SP}	2	C _B
STATE	43	+	2	C _B
COMMENTS	0	C _{SP}	3	C _C

^CDepress the Control key while striking the character.

The user is now ready to key in the address of each field followed by the field title. Remember each address begins with a lead-in and cursor address character.

<u>Field Number</u>	<u>User Types These Characters</u>				
1	~	C _Q	C _{SP}	C _{SP}	NAME
2	~	C _Q	-	C _{SP}	PHONE
3	~	C _Q	C _{SP}	C _A	ADDRESS
4	~	C _Q	C _{SP}	C _B	CITY
5	~	C _Q	+	C _B	STATE
6	~	C _Q	C _{SP}	C _C	COMMENTS

If the Hazeltine 1520 was set to Half Duplex, the addressing of each field would have taken place while the user was keying in the format. If in format mode, all the keyed-in characters would appear in a continuous string and the actual formatting would only take place when this string was played back to the terminal.

4.6 PRINTER BUFFER

The Hazeltine 1520 contains a microprocessor-controlled printer buffer which allows data transfer to the H1520 from the CPU to be independent of the printer speed. Operationally, this means that data can be transferred to a slow printer at any speed with no time outs or fill characters for carriage returns, line feeds, or tab's. The printer buffer will store up to 2K data characters and ensures that all data is transferred to the printer at the optimum speed of the printer. Data for printer must be limited to 2K blocks to ensure no loss of data. (See paragraph 4.7.2 ad, Send Status.) Three different modes of print are available.

Print. The printing of data on the H1520 display on the depression of the SHIFT and PRINT keys.

On-line Print with Display. The printing of all H1520 received or transmitted data. Received data will be displayed as well as printed. On-line print can be selected by remote command or by a manual switch located on Hazeltine printers. See section 4.6.3 for a detail description of the on-line print operation.

On-line Print with No Display. Printing of only received data. Transmitted data will not be printed. This mode can only be selected by remote command.

The printer buffer will support all Hazeltine printers and printers with Centronics parallel or serial interfaces. Selection of operational mode will be made by dip switches located on the printer buffer logic board. The switches select parallel or serial operation and serial speed of 110, 300 or 1200 baud.

4.6.1 Switch Controls

Switches to select serial or parallel operation and printer speed are located on the right hand side of the printer buffer board located under the main logic board.

	Switch			
	S1	S2	S3	S4
Parallel	Up	Up	Up	X
Serial 110 baud	Up	Up	Down	X
Serial 300 baud	Up	Down	Down	X
Serial 1200 baud	Down	Down	Down	X

Note

S1 - Is the switch closest to the front of the terminal

X - Don't care

4.6.2 Print

Print Mode is activated by depressing the SHIFT and SEND keys located on the keyboard. A print symbol (■) is stored at the initial cursor position. In the PRINT mode the terminal reads out selected data to the printer interface. The data to be copied consists of all data, protected and unprotected, between the initial cursor position and the first character position of the line following the previous print symbol or between the initial cursor position and the beginning of the screen if there are no intervening print symbols. If any of the character lines contain a carriage return code, then only data to the left of the carriage return and the carriage return code reads out.

4.6.2.1 Print Cycle

The print mode is executed as follows:

a. The Print Symbol, consisting of two transmit symbols, is posted, one at the initial cursor position and one symbol at the next adjacent character position. It is possible for the Print Symbol to wraparound.

b. The cursor moves to the first character position of the line following the previous print symbol or Home if there are no intervening Print Symbols.

c. From the starting point, all data is read out to the printer buffer at a very rapid rate independent of the printer rate. Transfer of data to the printer at the print rate is under the control of the printer buffer.

d. At the end of each character line the terminal generates a Carriage Return code followed by a Line Feed code before reading the first character of the following line. If the cursor encounters a Carriage Return code in the Print Field, the terminal generates the Carriage Return code followed by a Line Feed code before the first character of the following line is read out. Single transmit symbols are processed as carriage returns.

e. Readout continues until the cursor encounters the Print Symbol posted at the beginning of the cycle. Readout then stops and the cursor moves to the first character position of the following line.

f. Print Symbol may wrap around (i.e., occupy the last character position on a line and the first character position of the following line). The cursor always begins and ends the Print Mode on the line beneath the second rectangle of the Print Symbol. The Print Mode is disabled if there is no printer connected.

g. A carriage return and line feed is outputted to the printer in exchange for the print symbols posted at the beginning of the cycle.

4.6.3 On-Line Print Modes

Two modes of On-Line Print operation exist in the terminal. In on-line print, received and transmitted data is sent to a printer buffer at the speed of the I/O channel and processed to the printer at the printer rate. The buffer is 2K characters in size to allow the buffer to store up to a full page of data for printing. All printer time delays are accommodated by the printer buffer (i.e., no time fill characters are required to prevent the loss of data). Carriage Returns and Line Feeds in received data to provide the desired printed format must be inserted by the CPU.

4.6.3.1 On-Line Print With Display

On-Line Print With Display mode can be initiated by a remote command (Lead In, /) or by the on-line switch on Hazeltine printers. The printer on-line light located on the printer illuminates to indicate on-line operation.

In On-Line Print With Display mode, all data transmitted and/or received by the terminal's Data I/O is transferred to the printer buffer as well as being displayed. In block, page, line or half duplex transmission mode, the terminal inserts to the printer buffer only a line feed code following each carriage return in the transmitted message. In full duplex transmission, the line feed character must be inserted from the keyboard with the carriage returns. This mode of print operation is effective at I/O rates up to 9600 baud. All remote commands for the display using the ~ character for Lead In is filtered out of the data processed to the printer. ESC commands are processed to allow for the use of printer features offered by various printer manufacturers. This mode of print is terminated by redepressing the on-line switch on the printer or sending an off-line print command (Lead In, ?)

4.6.3.2 On-Line Print Without Display

On-Line Print Without Display is initiated by remote command (Lead In, *) and is operational at speeds up to 19,200 baud. This mode of on-line print sends only received data to the printer buffer. The display recognizes only the status command. All other commands and data are ignored. Full keyboard operation for data entry is enabled during on-line print operation but transmission to the CPU can only be accomplished on a full duplex system or when the CPU is not sending to the printer buffer. Filtering of Remote Commands, on-line light control and printer control are identical to On-Line Print With Display. On-Line Print Without Display is terminated by remote command (Lead In, ?) or by depressing the reset button.

4.6.4 Printer Interface

The following signals are provided for Printer Interface. All signals are T²L compatible positive true, unless otherwise noted as described below:

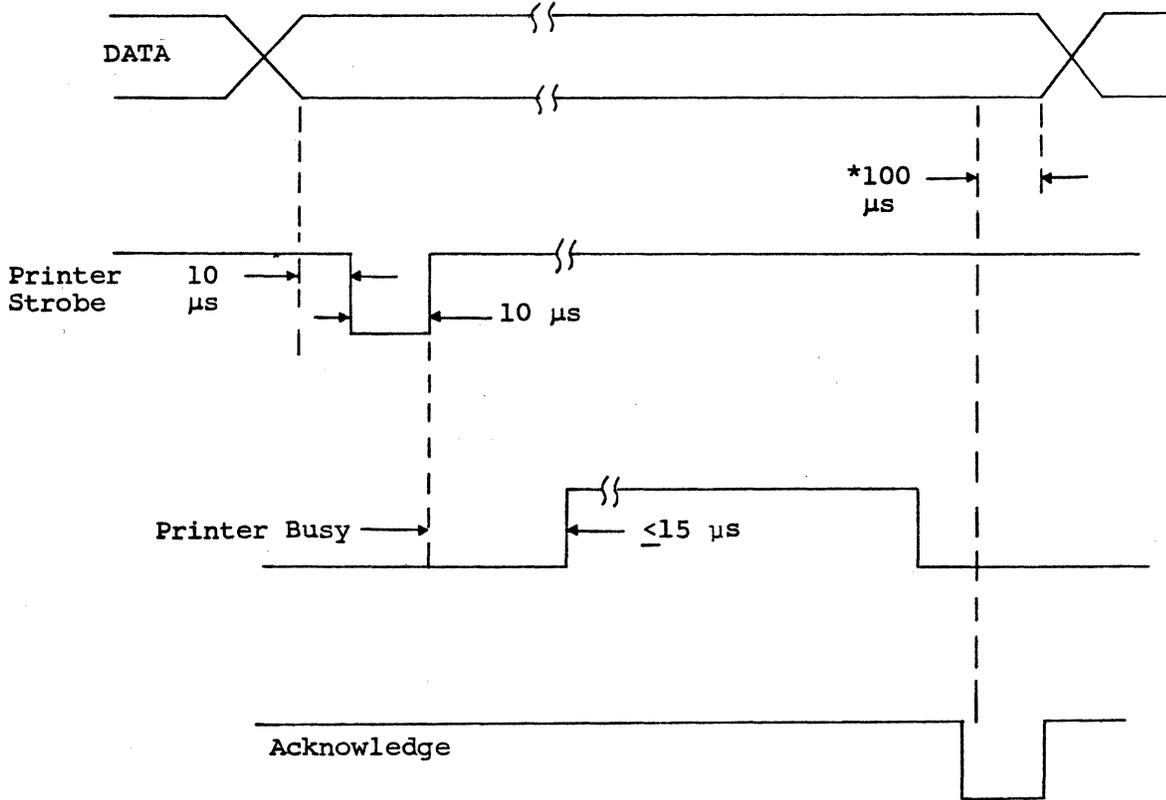
Input Signals

False level	0.0 to 0.8 volts
True level	2.0 to 5.0 volts

Output Signals

False level	0.0 to 0.4 volts
True level	2.4 to 5.0 volts

- (1) Parallel Data Out - Seven bit ASCII encoded data. The parallel data out timing waveforms are as shown in figure 4-1. Data remains unchanged for the entire duration of printer strobe.
- (2) Printer Strobe - A 10- μ s false pulse used to clock data from the terminal to a parallel printer.
- (3) Parallel Printer Busy - When the printer busy input to the terminal is true, the data output is inhibited. When printer busy goes false, the next character is output. The terminal is slaved to the printer busy signal.
- (4) Acknowledge - A false signal on this line into the terminal is used to indicate the printer has completed the input of a character into the printer or the end of a functional operation. This line must go low after each character or be held low for parallel printer operation.
- (5) Paper Out - A low level to the terminal indicates the printer is out of paper. Terminals with operating program H20S-001-10-0/H20S-20-0 (U22/U23) will sound an alarm if an attempt is made to print while the "out-of-paper" signal is low and will not output the data to the printer. Terminals with operating program H20S-008-11-0/H20S-008-21-0 or H20S-001-10-1/H20S-001-20-1 (units manufactured after January 1979) ignore the "out-of-paper" signal.
- (6) Printer On-Line Switch - A false signal on this line to the terminal will enable permanent on-line operation. All received and transmitted data will be copied to the printer.
- (7) Printer On-Line Light - Low signal on output indicates the printer is "On-Line". This signal is usable as a lamp driver. To set On-Line Light signal low (lamp on), the CPU sends a Lead-In followed by ASCII "/" or "*". To set On light signal high (lamp off), the CPU sends Lead In followed by ASCII "?".
- (8) EIA Serial Data - If the H1520 is set for serial printer operation, an EIA RS232 data signal will be supplied on this line.
- (9) EIA Serial Busy - When serial printer operation is selected, if the serial printer busy input to terminal is EIA true (+5 V to +25 V), the data output is inhibited.



*If Acknowledge is grounded, data access is initiated from drop in Printer Busy.

Figure 4-1. Parallel Printer Interface

If a character is being transferred to the printer the character will be completed before output is halted.

Pin Interface Assignments

The printer connector is a 25 pin DB25S assigned as follows:

Pin 1	GND	14	Data Bit 2
3	EIA Serial Data	15	Data Bit 3
6	+V	16	Data Bit 4
7	GND	17	Data Bit 5
8	+V	18	Data Bit 6
9	Parallel Printer Busy	19	Data Bit 7
10	Acknowledge	21	Printer On-Line Switch
11	Serial Printer Busy	22	Printer On-Line Light
12	Printer Strobe	24	Paper Out
13	Data Bit 1		V = +5 to 25 V EIA

4.7 REMOTE COMMANDS

4.7.1 General

The remote command features of the Hazeltine 1520 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 or, if selected, ASCII ESC, column 1, row 14 - Decimal 27) 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 is not stored and the cursor does 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.

4.7.2 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 is 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 ($Y=230$), there is 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 left-most column ($X=0$), it wraps backward to the row above and the right-most column ($X=79$). If the cursor is in the home position ($X=Y=0$), it does 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 right-most column ($X=79$), it wraps around

to the beginning of the following row. If the cursor is in row 23 and column 79, there is 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 the selected EOM code. The X and Y coordinates transmitted can be found in Appendix II. The cursor position and the display is not 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 is capable of receiving data after transmitting the EOM 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 are 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, are replaced by foreground spaces. The cursor does 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, are replaced by foreground spaces. The cursor does not move.

1. 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).

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.

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.

u. Set Format Mode (lead-in required)

Upon receipt of the SET FORMAT command (ASCII # column 2, row 3), the terminal is automatically set for format operation. This command overrides the operator switches located under the front access panel and the format indicator light is illuminated. In format mode, all keyboard entries go directly to the display without being transmitted to the CPU. Transmission to the CPU occurs upon depressing the SEND key which results in the transmission.

v. Return to Switches (lead-in required)

Upon receipt of the RETURN TO SWITCHES command, (ASCII \$ column 2, row 4) the terminal returns to either full duplex, half duplex or format mode as defined by the switches located under the access panel. The format indicator is not illuminated unless the terminal switches are set for format.

w. Set Batch Transmit (lead-in required)

Upon receipt of the SET BATCH TRANSMIT command (ASCII % column 2, row 5), depressing the SEND key results in a batch transmission when the terminal is set, either remotely or by the operator switches, into format mode.

x. Set Line Transmit (lead-in required)

Upon receipt of the SET LINE TRANSMIT command, (ASCII ., column 2, row 14), depressing the SEND key in format mode results in a line transmit.

y. Set Page Transmit (lead-in required)

Upon receipt of the SET PAGE TRANSMIT command, (ASCII (, column 2, row 8), depression of the send key in format mode will result in a page transmit.

z. Set Unprotected (lead-in required)

Upon receipt of the SET UNPROTECTED command, (ASCII ', column 2, row 12), transmissions in format mode will contain only unprotected data located in the area of transmission as defined for line, page or batch transmission.

aa. Set Protected and Unprotected (lead-in required)

Upon receipt of the SET PROTECTED AND UNPROTECTED command, (ASCII +, column 2, row 11), both protected and unprotected data will be transmitted in format mode. Transmission of both protected and unprotected data in format mode will be terminated by depression of the reset key or by the remote command set unprotected.

ab. Remote Transmit (lead-in required)

Upon receipt of the REMOTE TRANSMIT command, (ASCII S0, column 0, row 14), the terminal shall enter a format transmit operation, the method of transmit shall be that mode of transmit for which the send key is initialized for at that instant.

Transmission will be delayed for 10 milliseconds before it is initiated and will be performed as if the send key had been depressed.

ac. Back Tab (lead-in required)

Upon receipt of the BACK TAB command, (ASCII DC4, column 1, row 4), the cursor is repositioned to the first unprotected position in the field in which it is located. In the event that the cursor is located in the first position of an unprotected field or in a protected field the cursor moves back to the first character of the previous unprotected field. The back tab command is ignored if the cursor is in the first position of the first unprotected field on the display.

ad. Send Status (lead-in required)

Upon receipt of the SEND STATUS COMMAND, ASCII -, column 2, row 13), a two character sequence is transmitted which defines the status of the terminal. The first character of the sequence contains the status where each bit defines the condition of a particular parameter of the terminal. The second character of the transmission is the end of message character as defined by the operator switches. The meaning of each bit in the status character is the following:

Bit 0 Buffer Empty - a high state on this bit signifies that the printer buffer is empty. If the printer has been unable to accept data for an extended period of time (6 sec), this status bit signifies buffer not empty. A continuous buffer not empty condition should result in an equipment down message to the CPU console for repair action. In normal operation, this bit would be interrogated by the CPU after a transfer of up to 2K characters to the printer to determine when the next text could be transferred to the printer.

Bit 1 Printer On-line - a high state on this bit signifies that the terminal has been conditioned into a printer on-line state. In the on-line mode,

all data received by the terminal is sent to the printer. The printer on-line condition can be initiated by a switch on the printer or by a remote command.

Bits 2 and 3

Transmit mode

	Bit 2	Bit 3
Half duplex/full duplex	0	0
Format Mode Batch Transmission	0	1
Format Mode Page Transmission	1	0
Format Mode Line Transmission	1	1

Bit 4 Parity Error - a high condition on this bit indicates that one or more characters in the previous transmission was received by the terminal with a parity error. The parity error bit will be set low upon the first keyboard entry after the parity error has occurred and after each status transmission.

Bits 5 and 6 Terminating Character

	Bit 5	Bit 6
No terminating character	1	1
EOT	1	0
ETX	0	1
Carriage Return	0	0

ae. Remote Print (lead-in required)

Upon receipt of the remote print command, (ASCII RS, column 1, row 14), the terminal performs a print operation as if the operator had depressed the SHIFT and SEND keys.

af. On-Line Print with Display (lead-in required)

Upon receipt of the on-line print with display command, (ASCII /, column 2, row 15), all received data is transmitted to the printer buffer as well as to the display. Received data in this mode can be up to 9600 baud independently of the speed at which the printer is capable of printing data. The printer

buffer in this mode stores the data to be printed and controls the speed of transmit to the printer to a rate defined by the busy condition coming from the printer. No timing characters are required from the CPU. The on-line print mode terminates upon receiving the terminate on-line print command from the CPU or upon depressing the RESET button. The formatting of data on the printer is the total responsibility of the CPU which must supply all carriage returns, line feeds, tab characters and any other remote commands recognized by the particular printer used with the Hazeltine 1520.

ag. On-Line Print with No Display (lead-in required)

Upon receipt of the ON-LINE PRINT WITH NO DISPLAY command, (ASCII *, column 2, row 10), the terminal sends all received data to the printer buffer and processes no commands or data to the display until on-line print with no display is terminated. Received data can be processed from the CPU at rates up to and including 19.2 kb. The printer buffer controls the rate of data to the printer by monitoring the printer busy and therefore requires no timing characters from the CPU. Upon receiving the terminate on-line print command or upon depressing the RESET key, the terminal receives and processes data to the display. The formatting of data on the printer is the total responsibility of the CPU which must supply all carriage returns, line feeds, tab characters, and any other remote commands recognized by the particular printer used with the Hazeltine 1520.

NOTE

When using this feature in half-duplex systems, it is recommended that data sent to the terminal to be printed be preceded by a keyboard lock-out (lead-in control U) and followed by keyboard unlock (lead-in control F). This will prevent interruption of received data by transmission of the keyboard entry.

ah. Terminate On-Line Print (lead-in required)

Upon receipt of the TERMINATE ON-LINE PRINT command, (ASCII ?, column 3, row 15), the terminal ceases processing received data to the printer buffer and processes all data only to the display.

ai. Non-Stored Carriage Return (lead-in required)

Upon receipt of a carriage return, (ASCII CR, column 0, row 13), the cursor moves as defined in section 3.1.2 but the CR code will not be stored under any circumstances.

4.8 Timing Considerations

The Hazeltine 1520 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 1520 Application Note on timing considerations for proper use of fill characters to overcome the timing constraints.

COMMUNICATIONS INTERFACE

5.1 ASCII

The Hazeltine 1520 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. If a character is received with an incorrect parity bit, a parity error symbol ($\frac{D}{E}$) 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	Bit	Bit	Bit	Bit	Bit	Parity	Stop	Stop Bit
Bit	1	2	3	4	5	6	7	Bit	Bit	for 110 Baud Only

5.3 FULL DUPLEX/HALF DUPLEX

Full duplex operation requires the ability to communicate in two directions simultaneously. For telecommunications, this means that the modem involved is capable of simultaneous bi-directional data transmission and reception. Half duplex operation requires that communications alternate between transmit and receive. For telecommunications, this means that the modem involved is switched between the transmit mode and receive mode by the terminal. Operation of the Hazeltine 1520 requires that communications take place at the same baud rate for both receive and transmit.

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.

<u>Pin Number</u>	<u>Direction of Signal</u>	<u>Designation</u>	<u>Function</u>
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

5.4.1 Aux Output Connector

The Aux Output Connector located on the rear panel adjacent to the EIA connector provides the signals listed below. All signals are at an EIA RS232C voltage level.

<u>Pin Number</u>	<u>Direction of Signal</u>	<u>Designation</u>	<u>Function</u>
1	=	AA	Protective Ground (Chassis)
*3	To device	Aux BA	Transmitted Data
6	To device	Aux CC	Data Set Ready
7	=	AB	Signal Ground
8	To device	Aux CF	Data Carrier Detect

* During Half-Duplex operation all Transmitted Data and Received Data is presented to Pin 3. In Full-Duplex operation, only Received Data is presented on Pin 3.

The Aux Connector provides duplicate signals as indicated, of those provided on the E.I.A. connector for use by a receive only, voltage level (RS232C) compatible device, such as a Serial Printer.

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.

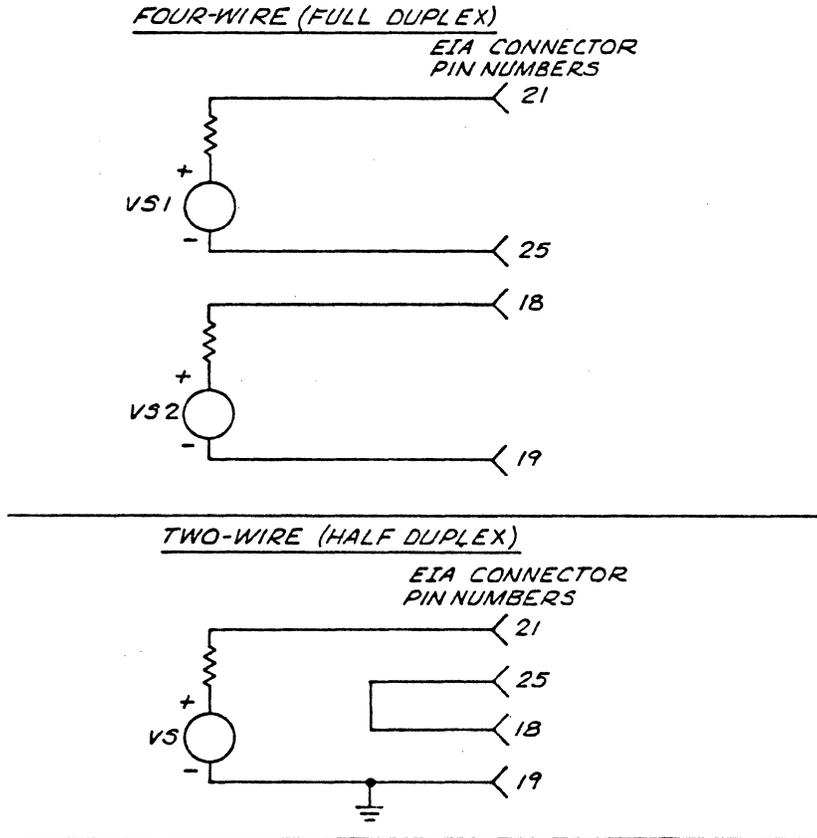
The maximum ratings are:

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.



Note that the current loop connectors must follow the polarities indicated and that there is a maximum 50 volt open circuit limitation on voltages applied to the current loop interface. The current source must be external to the terminal.

7706024

Figure 5-1. Current Loop Interface

5.6 HARDWIRED INTERFACE

The Hazeltine 1520 can be connected directly to a computer by connecting pins 2, 3, and 7 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 1520 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 1520 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.

5.7.2.1 Half Duplex

a. Upon depression of the first key, the Hazeltine 1520 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.

5.7.2.2 Format

Modem control is automatic in format mode. The operator must select for automatic insertion the proper turnaround character for his computer system (CR, EOT, ETX).

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)	Tab
Incremental cursor control	Set Format Mode
Read cursor address	Return to Switch
Clear screen	Mode
Clear Foreground	Set Batch Transmit
Clear to End of line	Set Line Transmit
Clear to End of screen	Set Page Transmit
Clear to End of screen	Transmit
(Background spaces)	Unprotected Only
Home Cursor	Transmit All
Set hi/lo intensity	Remote Transmit
Audible alarm	Back Tab
Backspace	Send Status
Keyboard Lock	Remote Print
Keyboard Unlock	Remote I/O Print
Insert line	with or without
Delete line	Display

C. COMMUNICATION INTERFACE

Full or Half Duplex (W.E. modem 103A, 202 compatible).
 EIA RS232C connector, or Current Loop connector, 20 mA externally sourced
 Nine Baud Rates: 110, 300, 600, 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	U/L Case enable
Power On/Off	Standard or Reverse
Half Duplex/Full Duplex	Video
Auto LF/CR control	Lead-In select
Baud Rate	End of Message (EOM)
Parity	Select
EIA/Current Loop	Wraparound Select

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)
LOCAL Mode-LED
FORMAT Mode-LED

I. USER DEFINED FUNCTIONS

FUNCTION key permits up to 128 user defined functions

APPENDIX I

ASCII CHARACTER CODE CHART FOR HAZELTINE 1520

BITS					COL		ROW	
b ₇	b ₆	b ₅	b ₄	b ₃	b ₂	b ₁	COL	ROW
0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	1
0	0	0	1	0	0	0	2	0
0	0	0	1	0	1	0	3	0
0	0	1	0	0	0	0	4	0
0	0	1	0	1	0	0	5	0
0	1	1	0	0	0	0	6	0
0	1	1	1	0	0	0	7	0
1	0	0	0	0	0	0	8	0
1	0	0	0	1	0	0	9	0
1	0	1	0	0	0	0	10	0
1	0	1	1	0	0	0	11	0
1	1	0	0	0	0	0	12	0
1	1	0	1	0	0	0	13	0
1	1	1	0	0	0	0	14	0
1	1	1	1	0	0	0	15	0

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

**Lead-In switch selectable,

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 ... b ₁	Dec. Value	ASCII Char.	Key Stroke	Coordinates	
				Col. No. (X)	Line No. (Y)
0000000	0	NUL	cs _P	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	RETURN	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	

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Bit Pattern b ₇ ... b ₁	Dec. Value	ASCII Char.	Key Stroke	Coordinates	
				Col. No. (X)	Line No. (Y)
0011111	31	US	cs ₀	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	45	-	-	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 ... b ₁	Dec. Value	ASCII Char.	Key Stroke	Coordinates	
				Col. No. (X)	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	7
1001000	72	H	H	72	8
1001001	73	I	I	73	9
1001010	74	J	J	74	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	-	so		
1100000	96	`	█	0	0
1100001	97	a	a	1	1
1100010	98	b	b	2	2
1100011	99	c	c	3	3
1100100	100	d	d	4	4
1100101	101	e	e	5	5
1100110	102	f	f	6	6
1100111	103	g	g	7	7
1101000	104	h	h	8	8

Bit Pattern b ₇ ... b ₁	Dec. Value	ASCII Char.	Key Stroke	Coordinates	
				Col. No. (X)	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
1110000	112	p	p	16	16
1110001	113	q	q	17	17
1110010	114	r	r	18	18
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	RUB OUT	31	

Output
Read
Cursor
Address

*Lead-in Code

APPENDIX III

SUMMARY OF REMOTE COMMANDS (Sheet 1 of 2)

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
Set Format Mode	X	#	#	35
Return to Switches (Format, Half, Full)	X	\$	\$	36
Batch Transmit	X	%	%	37
Line Transmit	X	.	. (period)	46
Page Transmit	X	(	(	40
Unprotected	X	,	, (comma)	44
Protected and Unprotected	X	+	+	43
Back Tab	X	C _T	DC4	20
Send Status	X	-	-	45
Remote Xmit	X	C _N	SO	14
Non Stored Return	X	Return	CR	13

SUMMARY OF REMOTE COMMANDS (Sheet 2 of 2)

REMOTE COMMANDS	LEAD-IN REQD (X)*	KEY STROKE **	ASCII CODE	DECIMAL
Remote Print	X	CS _N	RS	30
On-line Print-Display	X	/	/	47
On-line Print- No Display	X	*	*	42
Printer Off Line	X	?	?	63

* Lead-in Code = ASCII ~, column 7, row 14 - DECIMAL 126 or
 or = ASCII ESC, column 1, row 11 - DECIMAL 27

** 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 1520.

This subroutine converts decimal value X and Y coordinates to their ASCII equivalent and sends the cursor address function to the Hazeltine 1520.

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 POSITING 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 1520"
- - - - -
- - - - -

```

The prior example will display the "I AM THE HAZELTINE 1520" on line 7 starting in position #10.



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