VIDEO TERMINAL

Model Z-19-CN

595-2731-01

Operation Manual

ZENITH DATA SYSTEMS
SAINT JOSEPH, MICHIGAN 49085

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NOTE: To begin operation as soon as possible, read the "INTRODUCTION", "SET UP", and "OPERATION" sections first. The other sections are for technical reference.

INTRODUCTION

The Zenith Data Systems Model Z-19-CN Video Terminal is a professional, 25-line, video terminal. It connects to equipment that uses an EIA RS-232C serial interface. The high-quality video display, keyboard, and state-of-the-art logic circuitry make this Video Terminal an outstanding companion unit for your MODEM or computer.

The Terminal has a 12″ diagonal, high-quality, cathode-ray tube (CRT) video display that is capable of displaying 2000 characters at one time (25 rows of 80 characters). The CRT provides superb character definition. Upper-case characters are formed by a 5 × 7 dot matrix. Lower-case characters that have decenders use a 5 × 9 dot matrix. The Terminal can also display 33 special graphic characters that can be arranged and grouped to form any number of graphic displays and effects. The graphic symbols are formed on an 8 × 10 dot matrix.

Special escape sequences allow you to select many functions, including:

- Using either Zenith or ANSI escape sequences.
- Eight user-defined special function keys.
- Alternate keypad output (for sending more user-defined special codes to your computer).
- Shifted keypad (so you can obtain the shifted keypad functions without using the SHIFT key).
- Keyboard enable/disable.
- Keyclick enable/disable.
- Cursor type select (underline or block).
- Auto LF, auto CR.
- Hold screen mode (for scrolling lines and pages).
- Cursor control (left, right, up, down, home).
- Direct cursor addressing.

You can also:

- Transmit page.
- Transmit 25th line.
- Insert and delete characters and lines.
- Enter and exit the graphics and reverse video modes.
- Erase lines or page of text.
- Modify baud rates.

The highly reliable, standard-size electronic keyboard uses the universally accepted typewriter format. Each key stroke is affirmed by an audible key click.

A 12-key keypad duplicates the numeric keys in a calculator format. This lets you rapidly enter numbers in programs that call for just numbers. In addition, the shifted keypad functions allow you to insert and delete lines and characters, and move the cursor. Plus, an alternate mode allows you to interchange the shifted and unshifted function and send special codes to your computer.

These features, along with the stylish molded cabinet, make the Video Terminal a versatile addition to your computer system.

SPECIFICATIONS

CRT	12″ diagonal.
Display Format	25 lines of 80 characters.
Display Size	6.5″ high × 8.5″ wide.
Character Size	0.2″ high × 0.1″ wide (approximate).
Character Set	128 characters (95 ASCII and 33 graphic).
Character Type	5 × 7 dot matrix (upper case), 5 × 9 dot matrix (lower case with decenders).
Keyboard	84 keys (60 alphanumeric, 12 function/control) plus a 12-key numeric pad.
Cursor	Blinking nondestructive underline or block (DIP switch selectable), or disabled (software selectable).
Cursor Controls	Up, down, left, right, home, CR, LF, back space, and tab.
Cursor Addressing	Relative and Direct.
Tab	Standard 8-column tab.
Refresh Rate	60 Hz at 60 Hz line frequency. 50 Hz at 50 Hz line frequency.
Edit Functions	Insert and delete character or line.
Erase Functions	Erase page, erase to end of line, erase to end of page, erase to beginning of line, erase to beginning of page, and erase line.

Scroll	Auto or line/page freeze.
Bell	Audible alarm on receipt of ASCII BEL.
Video	Normal and reverse, by character.
Interface	EIA RS-232C at 110 to 9600 baud.
Communications Mode	Full or half duplex.
Parity	Even, odd, stick, or none.
Operating Temperature	0-40°C ambient.
Power Requirements	120 VAC (105-135 VAC), 50/60 Hz, 37 watts. 240 VAC (210-270 VAC), 50/60 Hz, 37 watts.
Dimensions	13″ high × 17″ wide × 20″ deep. (33 × 43.2 × 50.8 cm.)
Weight	31.0 lbs. (14.1 kg).

Zenith Data Systems reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

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.

If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Move the computing device away from the receiver being interfered with.
- Relocate the computing device with respect to the receiver.
- Reorient the receiving antenna.

If additional help is needed, consult the dealer or ask for assistance from the manufacturer. Customer service information may be found on the inside back cover of this manual or on an insert sheet supplied with this equipment. The user may also find the following booklet helpful: "How to Identify and Resolve Radio-TV Interference Problems." This booklet is available from the US Government Printing Office, Washington, D.C. 20402-Stock No. 004-000-00345-4.

Additional "corrective action" statements to be used, if they apply, include: (See the engineer or Reg. Compl. Labs)

- Plug the computing device into a different AC outlet so that the computing device and receiver are on different branch circuits.
- Disconnect and remove any I/O cables that are not being used. (**Unterminated** I/O cables are a potential source of high RF emission levels.)
- Unplug and remove any serial I/O circuit board cards that are not being used. (Here again, **unterminated** cards can be a source of potential interference.)
- Be certain that the computing device is plugged into grounded outlet receptacles. (Avoid using A/C cheater plugs. Lifting of the power cord ground may increase RF emission levels and may also present a lethal shock hazard to the user.)

SET-UP

POWER LINE CONSIDERATIONS

If you need to change the position of the 120/240 switch (located on the bottom of the Terminal), be sure you change rear panel fuse F1 to the proper value as follows:

> For 120 VAC, use a 1-ampere, 125 volt, slow-blow fuse.
> For 240 VAC, use a 1/2-ampere, 250-volt, slow-blow fuse (not supplied).

The plug on the power cord is for standard 120 VAC outlets. For 240 VAC operation in the U.S.A., cut off and replace the plug in a manner such that your power connection conforms with section 210-21 (b) of the National Electric Code, which reads, in part:

> "Receptacles connected to circuits having different voltages, frequencies, or types of current (AC or DC) on the same premises shall be of such design that attachment plugs used on such circuits are not interchangeable."

When you install the new plug, make sure it is connected according to your local electrical code. Units with three-wire line cords must always have the green wire connected to chassis ground.

CAUTION: Whenever you turn the power on, make sure you wait at least 30 seconds, or until you get a cursor or light raster on the screen, before you turn the power off again. A quick turn-on and turn-off can damage the CRT.

CABINET REMOVAL

Whenever you need to remove the cabinet top:

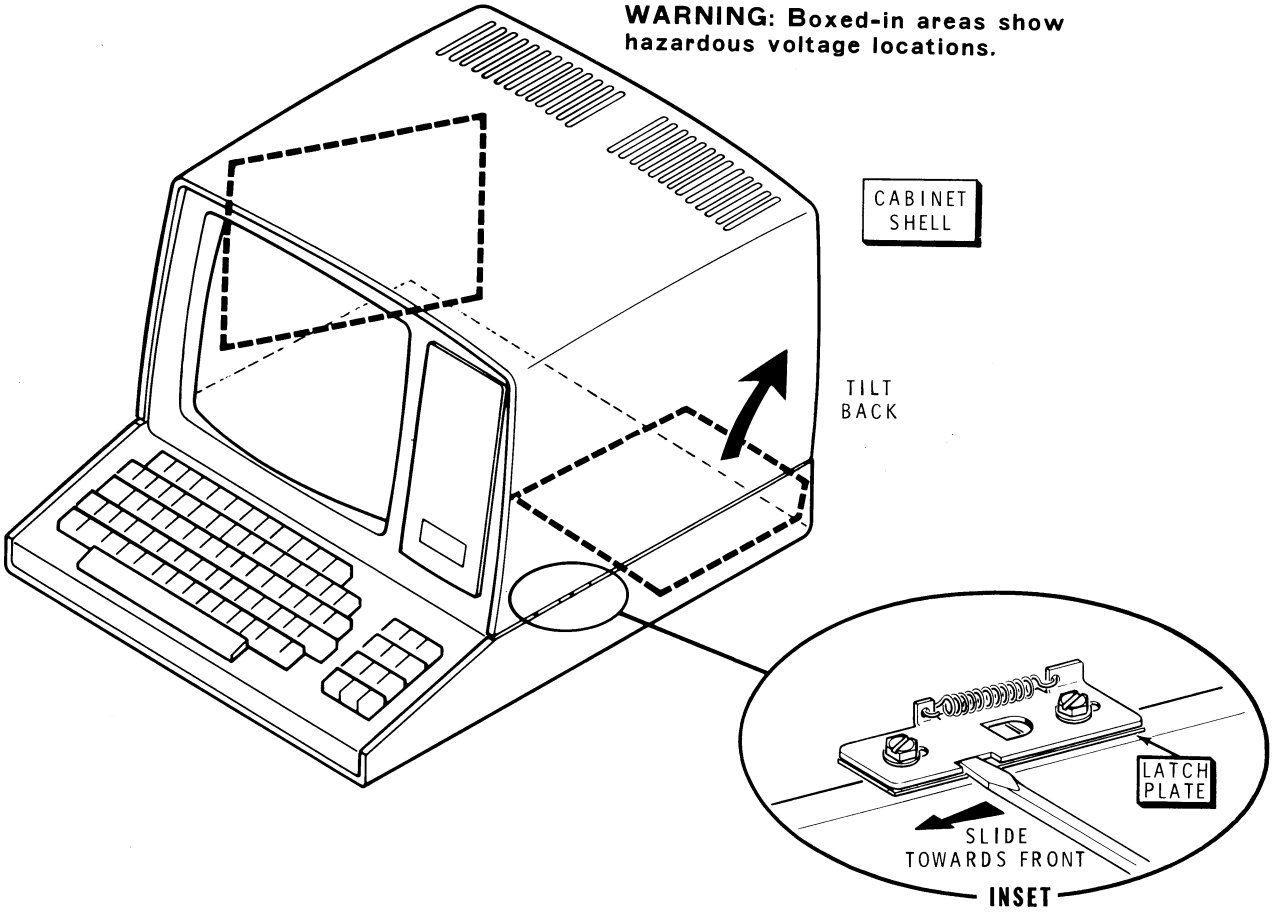
- Refer to the inset drawing on Pictorial 1, insert the blade of a small screwdriver into the notch in the latch plate, and then slide the latch plate toward the front of the Terminal about 1/4".

- Likewise, open the latch plate on the other side of the Terminal.

- **WARNING:** When the line cord is connected to an AC outlet, hazardous voltages can be present inside your Terminal. See Pictorial 1.

- Carefully tilt the cabinet top back. NOTE: The hinges are designed so you can easily remove the top by lifting it straight up once it has been fully opened. Never allow the top to hang open and unsupported.

Simply reverse this procedure to close and lock the cabinet top back on the Terminal.



PICTORIAL 1

HOOKING UP

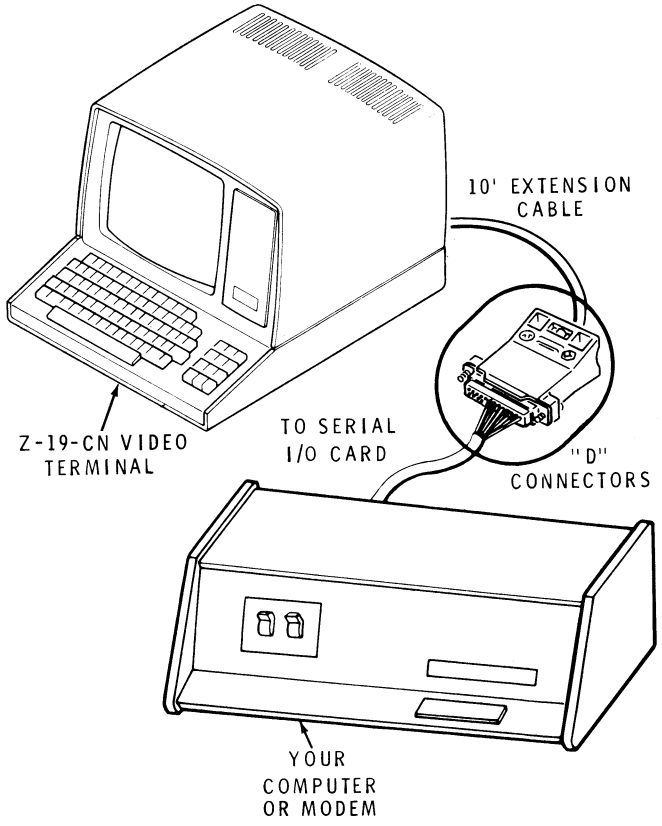
Locate the ten-foot-long extension cable and plug it into the Z-19-CN rear connector (called a D connector). This is shown in Pictorial 2.

Plug the other end of the cable into the proper connector on your computer or MODEM. The proper connector is the one shaped somewhat like a "D" lying on its side. If you have several connectors like this on your computer, use the one that's connected to your computer's serial I/O board. If you don't know which board that is, check your computer manual. The MODEM fortunately, should have only one D connector.

You may have an older computer that doesn't have D connectors. If that is so, your Zenith Data Systems dealer can supply you with adapters.

The computer or MODEM that you've used should meet the RS-232C standard. If your machine doesn't, it won't be able to talk to the terminal. Check to be sure that your machine uses RS-232C signals by consulting the machine's manual. (For a definition of RS-232C and a pin-out of the extension cable, see "RS-232C STANDARD" on Page 10).

Now you must prepare the Z-19-CN Terminal to talk with your computer or MODEM.



PICTORIAL 2

SETTING THE SWITCHES

Remove the cabinet top (see Page 7).

SWITCH S402

Push all of the switch sections on S402 (located on the terminal logic board) up to position 0, as shown in Pictorial 3 (Illustration Booklet, Page 1).

For your information, the switch positions have the following definitions. You may change the switch positions to suit your own applications.

SWITCH SECTION	DESCRIPTION
0	0=underscore cursor; 1=block cursor
1	0=key click; 1=no key click
2	0=discard past end of line; 1=wrap around
3	0=no auto line-feed on carriage return; 1=auto line-feed on carriage return
4	0=no auto carriage return on line feed; 1=auto carriage return on line feed
5	0=Zenith mode; 1=ANSI mode
6	0=keypad normal; 1=keypad shifted
7	0=60 Hz refresh; 1=50 Hz refresh

SWITCH S401

This switch is also located on the terminal logic board. Pictorial 3 shows you where.

Set S401 as follows if you have a Zenith/Heath Computer:

MODE	SWITCH SECTION							
	0	1	2	3	4	5	6	7
9600 baud	0	0	1	1				
No parity					0			
Odd parity						0		
Normal parity							0	
Full duplex								1

The switch's sections have the following definitions:

SWITCH SECTION	DESCRIPTION
0-3	Baud rate
4	0=no parity; 1=parity
5	0=odd parity; 1=even parity
6	0=normal parity; 1=stick parity
7	0=half duplex; 1=full duplex

Remember that as you look at switch S401 from the front of the Terminal, position 0 is up and position 1 is down.

If your computer requires baud rates, parity, or duplex settings other than those needed by Zenith/Heath Computers and MODEMS, refer to the definitions below.

Baud Rate

The baud rate of the Terminal and either computer or MODEM should be the same. With S401, you can select any of 13 different baud rates, from 110 to 19200 baud. The switch section positions are as follows:

BAUD RATE	SWITCH SECTION			
	0	1	2	3
N/A	0	0	0	0
110	1	0	0	0
150	0	1	0	0
300	1	1	0	0
600	0	0	1	0
1200	1	0	1	0
1800	0	1	1	0
2000	1	1	1	0
2400	0	0	0	1
3600	1	0	0	1
4800	0	1	0	1
7200	1	1	0	1
9600	0	0	1	1
19200*	1	0	1	1

*This baud rate is not recommended.

Parity

When you select no parity by pushing section 4 up, the odd and normal parity switch sections may be to either position since they are ignored.

Zenith Software does not check parity.

Half/Full Duplex

Section 7 of switch S401 selects either full or half duplex communications between the Terminal and your computer or MODEM.

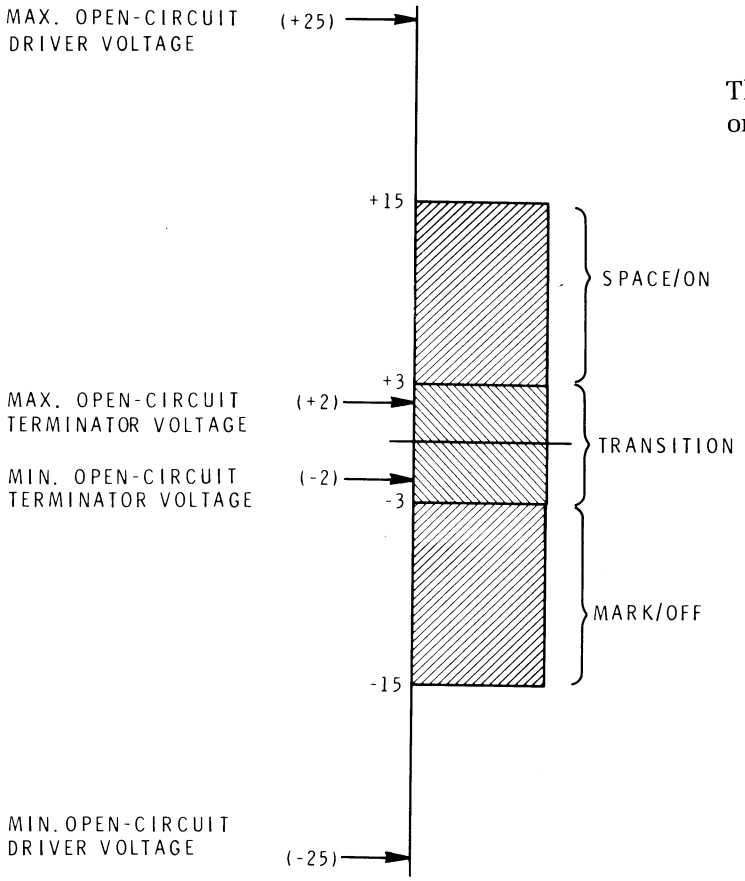
Zenith software uses only full duplex communications for easier and faster operation.

RS-232C STANDARD

This Terminal connects to equipment that uses the RS-232C standard of the Electronic Industries Association (EIA). This standard defines an asynchronous serial interface, its voltages, its impedances, and its physical connectors. Pictorial 4 illustrates the voltage levels needed for RS-232C operation.

RS-232C places all equipment into one of two general categories:

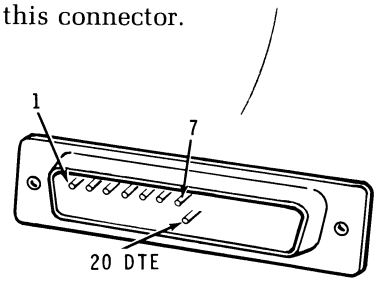
DTE — Date Terminal Equipment
DCE — Data Communication Equipment



PICTORIAL 4

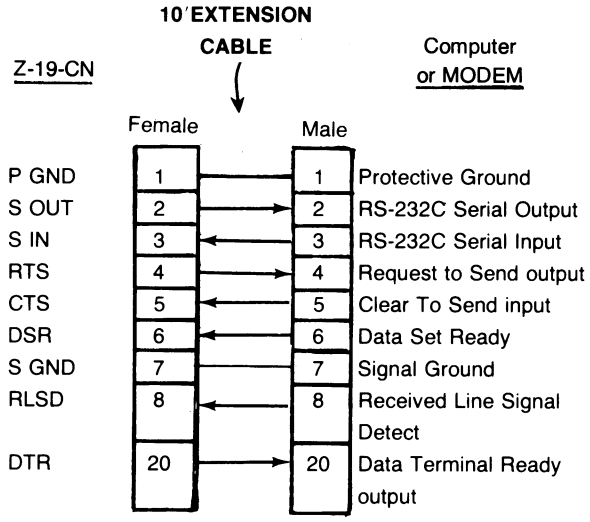
Computers and MODEMS are two types of DCE, while terminals, printers, and most peripherals are DTE's.

The 25-pin "D" connector on the back panel of the Terminal is a DTE connector. Pictorial 5 shows the pin-out of this connector.



PICTORIAL 5

The following chart gives the definition of each pin on the DTE cable:



OPERATION

WARMING UP

Pictorial 6 (Illustration Booklet, Page 1) shows the Terminal. The power ON/OFF switch is located on the right rear corner of the back panel. Whenever you turn on the Terminal, allow the tube about 30 seconds to warm up. You should then see a flashing line (cursor) or block cursor (if a block cursor was selected) in the upper left-hand corner of the screen.

Most of the keys are the same as they are on most typewriters; they type the same alphanumeric characters. A clicking sound tells you that each keystroke has been processed by the Terminal. **You cannot electrically damage the Terminal by just typing on the keys.**

Only one character can occupy a character position at any given time. It will remain there until it is erased or replaced.

When the Terminal is turned on, it clears the screen by placing spaces in all character positions. The cursor is the blinking horizontal line that appears at the home position. It underlines the character position where the next character will be written. (The block cursor will fill the character position).

OFF LINE

In the off line mode, the keyboard is effectively disconnected from the computer and controls the screen directly. This way, you can position the cursor (↑, ↓, →, ←, and HOME), insert or delete characters or lines (IC, DC, IL, and DL), or erase (ERASE), without sending the codes through the computer, which could otherwise disrupt a program. The keys used for controlling the terminal while it is off line are listed under "Special Modes and Keys" (Page 14).

Another way of controlling the screen without sending code to the computer is by using the CTRL key. Example: you want to erase the screen, but you do **not** want to transmit a code to the computer. Press and hold the CTRL key and then type SHIFT ERASE. This tells the Terminal to erase the screen, but not to send the code to the computer. Again, you can use this procedure with the cursor keys (↑, ↓, →, ←, and HOME), the insert line, delete line, insert character, and delete character keys, and erase.

If you use the special escape codes, make sure you enter the lower-case and upper-case letters just as they are called for in this Manual. For instance, type ESC p, not ESC P, to enter reverse video mode.

The "ASCII Characters" and the "Escape Sequences" (see the "Appendix," Page 60) show the commands and special escape sequences that the Terminal sends and responds to. Your computer **must** contain the proper software for it to respond to and generate the codes that use these special features. Different versions of software may support different features.

ON LINE

When the Terminal is on line, the keyboard can transmit any one of the 128 ASCII characters to the computer (see the "ASCII Characters" chart on Page 60). However, some of these characters will not be displayed if the computer sends them back to the Terminal. (See the chart.)

The Terminal has a 128 character input buffer for receiving and holding characters until the Terminal can process them. In some cases (such as when the Terminal is operating at 9600 baud in the "insert character" mode), the buffer can be filled faster than the Terminal can process the characters. In this case, the Terminal will send X OFF (control S) when the buffer has received 112 characters. After the Terminal has processed enough characters so that only 96 characters remain in buffer, it will send X ON, (control Q) to the host computer to indicate that it is ready to accept more characters. (Your host computer must have the software to recognize X OFF and X ON).

When the Terminal sends X OFF, this is only an indication that the buffer is nearly full. Characters will not be lost until after the buffer has received a full 128 characters. At this point, more incoming characters will be lost and the bell will sound.

NORMAL MODES AND KEYS

ALPHABETIC KEYS

These alphabetic keys can be transmitted either lower-case or upper-case. You can hold the SHIFT key down or you can push the CAPS LOCK key to get upper-case letters.

NONALPHABETIC KEYS

The nonalphabetic keys are those with double markings. These include the numbers 0 through 9, punctuation marks, and special characters. The lower marking is generated when both of the SHIFT keys are released, while the upper marking is generated when either or both SHIFT keys are held down. The CAPS LOCK key will not shift these keys.

MISCELLANEOUS

The following descriptions apply only to the Terminal's internal handling of the listed codes. The codes may be overridden by software.

RETURN — Moves the cursor to the first character position of the line that it is currently in. If the cursor is already at the first character position, it remains there. RETURN is a nondisplayable character.

LINE FEED — Moves the cursor down one line. LINE FEED is a nondisplayable character. If the cursor is at the bottom line, a LINE FEED causes it to remain there, but all of the data on the screen moves up one line. Data on the top line is lost as it is shifted up and off the screen.

SPACE BAR — Causes the cursor to move one character position to the right. A Space is a nondisplayable character. If you type the Space Bar when the cursor is positioned below a displayed character, the character is replaced by a space and the cursor moves one character position to the right. If you type the Space Bar when the cursor is at the right end of a line, the cursor will remain there since neither a carriage return nor a line feed is generated.

BACK SPACE — Moves the cursor one space to the left. If the cursor is at the start (left end) of a line, it will not move when you type a BACK SPACE.

DELETE — Transmits the ASCII code 177. It is a nondisplayable character.

TAB — Software controlled to move the cursor to the next tab stop (eight character spaces) to the right. The tab stops are fixed at 9, 17, 25, 33, 41, 49, 57, 65, and 73. If the cursor is at character position 73 through 79, it will only move one character position to the right

each time you type the TAB key. If the cursor is at character position 80, it will not move when you type the TAB key (unless the wrap-around feature has been selected).

ESC (Escape) — A nondisplayable character that transmits the ASCII code 033Q (1BH). This key is used in combination with other keys to enter and exit special modes. See "Special Keys and Modes" on Page 14.

(For a complete listing of Zenith Data System and ANSI codes using escape sequences and their definitions, refer to the "Appendix.")

REPEAT — When you hold this key in, along with another key, it will repeat the function of the other key as long as both keys are held down. The repeat rate is approximately 15-characters per second. However, if the baud rate that has been selected is less than the repeat rate, the repeat function will operate at the slower rate.

SHIFT — When you use this key in conjunction with another key, the character printed on the upper portion of that key will be displayed. When you use the SHIFT keys in conjunction with the alphabetic keys, the upper-case character is displayed.

CAPS LOCK — When this latching key is down, the Terminal will transmit the ASCII code for, and display, upper-case (capital) alphabetic letters. It does not shift the keys with the double markings.

OFF LINE — When this latching key is down, the Terminal is inhibited from transmitting or receiving data. However, any displayable characters that you type on the keyboard will appear on the screen and any control codes that the Terminal can process will be processed.

BREAK — When you type this key, it generates a continuous "space level" at the serial RS-232 output of the Terminal. It is generally used to tell the computer that you wish to interrupt execution.

SCROLL — When this is used with Heath software, in the Hold Screen Mode, you can type the SCROll key to instruct the Terminal to display another line of information onto the screen. You can type SHIFT SCROLL to display another 24 lines of information onto the screen.

THE CONTROL KEY

The CTRL key is held down in conjunction with other keys to send the 32 ASCII control codes to the computer. Refer to the "ASCII Characters" chart in the "Appendix" of this Manual for a listing of the control keys. These are non-displayable characters. The Terminal responds to only seven of the control characters from the keyboard or from the serial input port. These seven characters are:

Bell (BEL or CTRL G) — Causes the Terminal to sound an audible tone through an internal speaker.

Back Space (BS or CTRL H) — Duplicates the BACK SPACE key.

Horizontal Tab (HT or CTRL I) — Duplicates the TAB key.

Line Feed (LF or CTRL J) — Duplicates the LINE FEED key.

Carriage Return (CR or CTRL M) — Duplicates the RETURN key.

Escape (ESC or CTRL [) — Duplicates the ESC key.

(CTRL X) — Cancels the current escape sequence.

SPECIAL MODES AND KEYS

This and the following sections are for technical reference.

NOTE: The following descriptions give Zenith Data System mode escape sequences. For ANSI escape sequences, refer to "Appendix."

CURSOR FUNCTIONS

Cursor Home — ESC H — [Shift 5 (HOME) of keypad]
Moves the cursor to the first character position on the first line (home).

Cursor Forward — ESC C — [Shift 6 (→) of keypad]
Moves the cursor one character position to the right. If the cursor is at the end of the line, it will remain there.

Cursor Backward — ESC D — [Shift 4 (←) of keypad]
Moves the cursor one character position to the left (backspaces). If the cursor is at the start (left end) of a line, it will remain there.

Cursor Down — ESC B — [Shift 2 (↓) of keypad]
Moves the cursor down one line. If the cursor is at the bottom line, it will remain there; however, a scroll will not occur.

Cursor Up — ESC A — [Shift 8 (↑) of keypad]
Moves the cursor up one line. If the cursor is at the top line, it will remain there; however, a scroll will not occur.

Reverse Index — ESC I — This is a reverse line feed. It causes the cursor to move upward one line. If the cursor is at the top line it will remain there. However, any text on the screen will be scrolled downward one line.

Cursor Position Report — ESC n — Reports the position of the cursor in the form of ESC Y line# column#. The following BASIC program gives an example of its use.

NOTE: The computer response in the following example depends on the position of the cursor.

```
00010 PRINT "PRESS RETURN";CHR$(27);"n"
00020 LINE INPUT ;A$
00030 B$=LEFT$(A$,1)
00040 A$=RIGHT$(A$,LEN(A$)-1)
00050 PRINT ASC(B$),
00060 IF LEN(A$)>0 THEN 30
00070 END
```

When you run the program and push the RETURN key, the computer response will be:

```
27      89      55      44
```

Here the 27 equals ESC, 89 equals Y, 55 is the line# (55−31=24), and 44 is the column# (44−31=13). (See "Direct Cursor Addressing.") Therefore, the reported cursor position is:

ESC Y line# 24 column# 13

Save Cursor Position — ESC j — The present cursor position is saved so the cursor can be returned there later on the "Set to previously saved position" command. "Demonstration Program #2" in the "Appendix" of this Manual gives an example of this feature in a BASIC program.

Set to Previously Saved Position — ESC k — Returns the cursor to the position where it was when it received the "Save cursor position" command.

Direct Cursor Addressing — ESC Y — Allows the computer to control the position of the cursor on the screen by entering the escape code, the ASCII character which represents the line number, and the ASCII character which represents the column number.

The first line and the left column are both 32_{10} and increase from there. The number 32_{10} is used because it is the smallest value of the printing characters. All values less than 32_{10} are control codes, which can interfere with operating sequences of some computers.

Since the lines are numbered from 1 to 24 (from top to bottom) and the columns from 1 to 80 (from left to right), you must add the proper line and column numbers to 31_{10}. Then convert these decimal numbers to their equivalent ASCII characters and enter them in the following order:

ESC Y line# (ASCII character) column # (ASCII character)

For example, to place the cursor at line 20, column 40, you will first have to add 31_{10} to the line number to find the value of the line #.

$31 + 20 = 51_{10}$

Then use the "ASCII Characters" chart (in the "Appendix") to find the ASCII character that corresponds to 51_{10}. In this case, it is the number 3. Next, add 31_{10} to the column number to find the actual value of the column #.

$31 + 40 = 71_{10}$

Again, use the ASCII chart to find the ASCII character that corresponds to 71_{10}, which is the symbol G.

To demonstrate this example, make sure the OFF LINE key is down. Then type ESC Y 3 G. The cursor should move to line 20, column 40.

If you specify a line # that does not exist on the screen, the cursor will remain in the line it is presently in. If you specify a column # that does not exist on the screen, the cursor will move to the right-most column.

ERASING AND EDITING

Clear Display (SHIFT ERASE) — ESC E — Erases all the information on the screen. The screen is filled with spaces and the cursor is placed in the home position.

Erase Beginning of Display — ESC b — Erases the display from the start of the screen to the cursor position, and includes the cursor position.

Erase to End of Page (ERASE Key) — ESC J — Erases all the information from the cursor (including the cursor position) to the end of the page.

Erase Entire Line — ESC l — Erases the entire line, including the cursor position.

Erase Beginning of Line — ESC o — Erases from the beginning of the line to the cursor position, and includes the cursor position.

Erase to End of Line — ESC K — Erases from the cursor (including the cursor position) to the end of the line.

Insert Line — ESC L — [Shift 1 (IL) of keypad]
Inserts a new blank line by moving the line that the cursor is on, and all following lines, down one line. Then the cursor is moved to the beginning of the blank line.

Delete Line — ESC M — [Shift 3 (DL) of keypad]
Deletes the contents of the line that the cursor is on, places the cursor at the beginning of the line, moves all the following lines up one line, and adds a blank line at line 24.

Delete Character — ESC N — [Shift 9 (DC) of keypad]
Deletes the character at the cursor position and shifts any existing text that is to the right of the cursor, and on the same line, one character position to the left.

Enter Insert Character Mode — ESC @ — [shift 7 (ID) of keypad]
Lets you insert characters or words into text already displayed on the screen. The first time you type IC, the Terminal enters the Insert Character Mode. You can then use the cursor controls to place the cursor at the point where you want to insert characters. As you type in the desired characters, any existing text directly above and to the right of the cursor is shifted to the right. This feature lets you add letters or words to existing text without having to re-type the whole text. When you finish inserting characters, type IC again to exit the Insert Character Mode. The Terminal transmits an ESC @ to enter, and an ESC O to exit the Insert Character Mode.

Exit Insert Character Mode — ESC O — Exits the Insert Character Mode. See "Enter Insert Character Mode" above.

CONFIGURATION

Reset to Power-Up Configuration — ESC z — Nullifies all previously set escape modes and returns to the power-up configuration set by switches S401 and S402 on the terminal logic circuit board.

NOTE: If characters are sent to the Terminal during the "reset" time, several characters may be lost while the Terminal is resetting. If a basic program, for example, calls for an ESC z to be printed, be sure the computer delays and does not immediately send other characters to the Terminals.

Modify The Baud Rate — ESC r — Initially, the baud rate is set by the switches on the terminal logic circuit board. However, you can change the baud rate from the keyboard. To do this, type ESC r followed by the appropriate letter given below:

A=110	G=2000
B=150	H=2400
C=300	I=3600
D=600	J=4800
E=1200	K=7200
F=1800	L=9600
	M=19200 (not currently supported)

Example: If the baud rate switches on the terminal logic circuit board are set to 4800 baud and you want to communicate with the computer at 9600 baud, just type ESC r L. (The computer must also be set to accept 9600 baud).

The baud rate reverts back to the baud rate set by the switches on the circuit board when you RESET the Terminal (RESET and right-hand SHIFT keys) or when you turn the Terminal off and then back on.

Set Mode — ESC x — Certain operating modes can be enabled and disabled from the keyboard. To enable the functions, type ESC x followed by the appropriate number given below:

1 = Enable 25th line. The 25th line is available as a line that is totally separate from the normally-used 24 lines. You might use this line, for example, to identify the user function keys with labels which correspond to the function that your computer provides when it receives these function key escape codes. Or you might use it to display information concerning the status of your computer while a program is running.

The only way to place the cursor on the 25th line is to enable the 25th line and then use "Cursor Addressing." Once on the 25th line, the terminal acts like a 1-line terminal ("erase in display" commands only operate on the 25th line) until you use cursor addressing to place the cursor on one of the other 24 lines of the Terminal. This is a good place to use the "Save Cursor Position" and the "Set Cursor To Previously Saved Position" routines. With these routines, the current cursor position can be saved, your routine can address the 25th line, write information on the 25th line, and return to the "remembered" cursor location without your program having to remember that location.

2 = No key click. This function turns off the key click.

3 = Hold screen mode. See "Enter Hold Screen Mode" for a description of this function.

4 = Block cursor. Produces a cursor that fills the entire character position.

5 = Cursor off. Turns off the cursor so there is no cursor at all.

6 = Keypad shifted. See "Enter Keypad Shifted Mode" for a description of this function.

7 = Alternate keypad mode. See "Enter Alternate Keypad Mode" for a description of this function.

8 = Auto line feed on receipt of CR. A line feed is automatically performed (in addition to a CARRIAGE RETURN) when a CARRIAGE RETURN is received.

9 = Auto CR on receipt of line feed. A CARRIAGE RETURN is automatically performed (in addition to a line feed) when a line feed is received.

Example: If you want to turn off the cursor, press OFF LINE and type ESC x 5.

These functions default back to their initial states (as set by switches S401 and S402 on the terminal logic circuit board) when the Terminal is reset (RESET and right-hand SHIFT keys) or when you turn the Terminal off and then back on again. You can also reset these functions using the Reset Mode escape codes (ESC y). See below.

Reset Mode — ESC y — Resets the "Set Mode" functions to their initial states. To reset a function, type ESC y followed by the appropriate number given below.

1 = Disable 25th line
2 = Enable key click
3 = Exit hold screen mode
4 = Underscore cursor
5 = Cursor on
6 = Keypad unshifted
7 = Exit alternate keypad mode
8 = No auto line feed
9 = No auto CR

See "Set Modes" above.

Enter ANSI Mode — ESC < — Enters the ANSI mode. See the "Appendix" in the rear of this Manual for the definition and descriptions of the ANSI mode escape codes.

MODES OF OPERATION

Enter Hold Screen Mode — ESC [— The Hold Screen Mode allows you to control when new information is printed on the screen. This is especially useful when you are reading lists or looking for a particular part of a program. Push the OFF LINE key to its down position and then type ESC [to enter the Hold Screen Mode. Then, after you release the OFF LINE key, each time you type the SCROLL key a new line of text will appear on the bottom line and the top line of text will scroll up and off the screen. If you type SHIFT SCROLL, a whole new page (24 lines) of text will be scrolled onto the screen. Press the OFF LINE key to its down position and type ESC \ to exit the Hold Screen Mode. Remember; in this mode, when the cursor is at the start of a line of text, the Terminal is probably waiting for a scroll command.

This mode requires that the host computer respond to XON and XOFF.

Exit Hold Screen Mode — ESC \ — Exits the Hold Screen Mode. See "Enter Hold Screen Mode" above.

Enter Reverse Video Mode — ESC p — The characters displayed on the screen can also be displayed in reverse video, a black character on a white background. Type ESC p to enter the Reverse Video Mode, and ESC q to exit the Reverse Video Mode.

The following BASIC program shows you how to send the escape codes to the Terminal to enter and exit the reverse video mode.

```
00010 REM Reverse Video Demonstration
00020 PRINT "This is a demonstration of the ";
00030 PRINT CHR$(27);"p";
00040 PRINT "reverse video";
00050 PRINT CHR$(27);"q";
00060 PRINT " feature."
00070 END
```

Exit Reverse Video Mode — ESC q — Exits the Reverse Video Mode. See "Enter Reverse Video Mode" above.

Enter Graphics Mode — ESC F — The graphics mode lets you display 33 special symbols. Refer to the "Graphic Mode Symbols" in the "Appendix" of this Manual. Type ESC F to enter the Graphics Mode. Then type any of the 26 lower-case keys or the seven other symbol keys that correspond to the graphic symbols. Type ESC G to exit the Graphics Mode. You can place the Terminal in the Reverse Video Mode while it is in the Graphics Mode to increase the number of graphic symbols.

"Demonstration Program #1" in the "Appendix" of this Manual shows you how this feature is used in a BASIC program.

Exit Graphics Mode — ESC G — Exits the Graphics Mode. See "Enter Graphics Mode" above.

Enter Keypad Shifted Mode — ESC t — The shifted functions that the keypad transmits normally require you to press and hold the SHIFT key when you type one of the keys. You can type ESC t to enter the Shift Keypad Mode so that you do not need to hold the SHIFT key to obtain the shifted functions. However, if you place the Terminal in the Shifted Keypad Mode and you need to use the unshifted functions (numbers), you will have to press and hold the SHIFT key to obtain them. Type ESC u to exit the Shifted Keypad Mode.

Exit Keypad Shifted Mode — ESC u — Exits the Keypad Shifted Mode. See "Enter Keypad Shifted Mode" above.

Enter Alternate Keypad Mode — ESC = — The codes sent to the computer from the Terminal Keypad normally include the numbers, period, ENTER, and (when shifted) some special cursor movement and editing functions. You can change these keypad codes using the Alternate Keypad Mode to transmit specific escape codes that your computer may respond to.

Type ESC = to enter and ESC > to exit the Alternate Keypad Mode.

The following chart lists the escape codes sent by the Terminal in the Alternate Keypad Mode.

KEY	HEATH ESCAPE CODE	ANSI ESCAPE CODE
0	ESC ? p	ESC O p
1	ESC ? q	ESC O q
2	ESC ? r	ESC O r
3	ESC ? s	ESC O s
4	ESC ? t	ESC O t
5	ESC ? u	ESC O u
6	ESC ? v	ESC O v
7	ESC ? w	ESC O w
8	ESC ? x	ESC O x
9	ESC ? y	ESC O y
•	ESC ? n	ESC O n
ENTER	ESC ? M	ESC O M

Exit Alternate Keypad Mode — ESC > — Exits the Alternate Keypad Mode. See "Enter Alternate Keypad Mode" above.

ADDITIONAL FUNCTIONS

Keyboard Disabled — ESC } — Inhibits the output of the keyboard.

Keyboard Enabled — ESC { — A computer-sent code that enables the keyboard after it was inhibited by a "Keyboard Disabled" command.

Wrap Around at End of Line — ESC v — 81st character on a line is automatically placed in the first character position on the next line. The page scrolls up if necessary.

Discard at End of Line — ESC w — After the 80th character in a line, the characters overprint. Therefore, only the last character received will be displayed in position 80.

Identify as VT52® (ESC / K) — ESC Z — The Terminal responds to interrogation with ESC / K to indicate that it can perform as a VT52.

Transmit 25th Line — ESC]

Transmit Page — ESC #
The transmit functions (Transmit 25th Line and Transmit Page) are the same except for the source of the data transmitted. Your computer may have a special routine (which is required for this function to work) so it can accept the transmitted codes.

Basically (assuming that the mode has not changed), the data is transmitted the same as it appears on the CRT. This includes all 1920 characters (24 lines of 80 characters), or the 80 characters of the 25th line. However, it is possible that the actual number of characters transmitted will be more than 1920. If graphic characters, reverse video characters, or both are encountered, the proper escape sequence for entering the respective modes will be transmitted. When one or both of these parameters no longer apply, the appropriate escape sequence will then be sent to exit the mode.

The escape sequence which is sent is determined by whether the Terminal is in the Heath mode or the ANSI mode. The sequence will be the same as that which was sent to the Terminal (or entered from the keyboard) to cause the Terminal to enter and/or exit the reverse video and graphic character modes.

Following the transmission of the last character, a CARRIAGE RETURN is sent and the bell will sound.

If a transmit page is executed (ESC #), only lines 1 through 24 are transmitted. If you want to transmit the 25th line, you must ask for that specifically (ESC]). This operates the same as the transmit page except that only the 80 characters of the 25th line (and any necessary escape sequences) are transmitted and followed by a CARRIAGE RETURN. In the event that the 25th line is not enabled, only a CARRIAGE RETURN will be transmitted.

Special Function Keys

The eight special function keys (f_1, f_2, f_3, f_4, f_5, Blue, Red, and Gray) on the top row of the keyboard transmit two-character escape codes to the computer. You can define the meanings of each of these keys to suit your particular application (your software program must recognize the particular escape codes associated with the keys). See the "Appendix."

SUMMARY OF KEYPAD FUNCTIONS

The keypad can operate in any one of four modes: normal unshifted, normal shifted, alternate unshifted, and alternate shifted. Then, within each of these modes, you can use the SHIFT key shifted or unshifted. (See "Enter Keypad Shifted Mode" and "Enter Alternate Keypad Mode.")

Normal Unshifted — This is the normal operating mode.

Example:	TYPE	TERMINAL TRANSMITS
	3	3
	SHIFT 3	DL (Delete Line)

Normal Shifted — ESC t to enter; ESC u to exit — The normal functions are inverted.

Example:	TYPE	TERMINAL TRANSMITS
	3	DL (Delete Line)
	SHIFT 3	3

Alternate Unshifted — ESC = to enter; ESC > to exit — This is the normal alternate mode.

Example:	TYPE	TERMINAL TRANSMITS
	3	ESC ? s (Zenith Data Systems escape code)
	SHIFT 3	DL (Delete Line)

Alternate Shifted — ESC t ESC = to enter; ESC u ESC > to exit — The normal alternate functions are now inverted.

Example:	TYPE	TERMINAL TRANSMITS
	3	DL (Delete Line)
	SHIFT 3	ESC ? s (Zenith Data Systems escape code)

See the "Appendix" for actual codes sent and for ANSI codes.

PICTURE READJUSTMENT

This section contains several adjustments that you or your dealer can make to properly maintain your Video Terminal. You will have to remove or tilt back the cabinet top in order to reach the controls, coils, and adjustments called for in this section. To do this, refer to the inset drawing on Pictorial 1.

( ) On the terminal logic circuit board (see Pictorial 3), set section 2 of switch S402 down to its 1 position to enable the "wrap around" mode.

NOTE: When power is turned on, do not touch the flyback transformer, the high voltage lead, or the anode socket at the back of the CRT, as it is possible to receive an electrical shock from these areas. Also, to lessen the chances of an electrical shock while you are making adjustments, keep your other hand away from this unit and all other metallic objects.

( ) Plug in the line cord and set the POWER switch to on.

Refer to Pictorial 7 (Illustration Booklet, Page 2) for the locations of controls on the video circuit board.

( ) After a short warm-up time, a light raster should appear on the screen. If it does not, adjust control R128 counterclockwise to cause the raster to appear.

( ) If the display is slanted, loosen the yoke clamp screw slightly and slowly turn the yoke to properly line up the raster on the screen. See Pictorial 8 on Page 24.

( ) Adjust the VERT SIZE control R312 (on the video circuit board) so the display is approximately 6" high.

( ) Refer to Pictorial 8 and rotate the ring magnets on the back of the yoke to center the display on the screen.

( ) Adjust BRIGHTNESS control R1 (on the rear panel) until a blinking cursor (underline) appears at the top left corner of the screen.

( ) Set the OFF LINE and CAPS LOCK keys to their down positions.

( ) Hold the "Z" key and the REPEAT key down and fill the screen with characters.

NOTE: You should make the next adjustment in a darkened room.

( ) Turn control R128 clockwise until the raster just disappears.

( ) If the display width is not approximately 8-1/2", adjust WIDTH coil L101 to correct the width size.

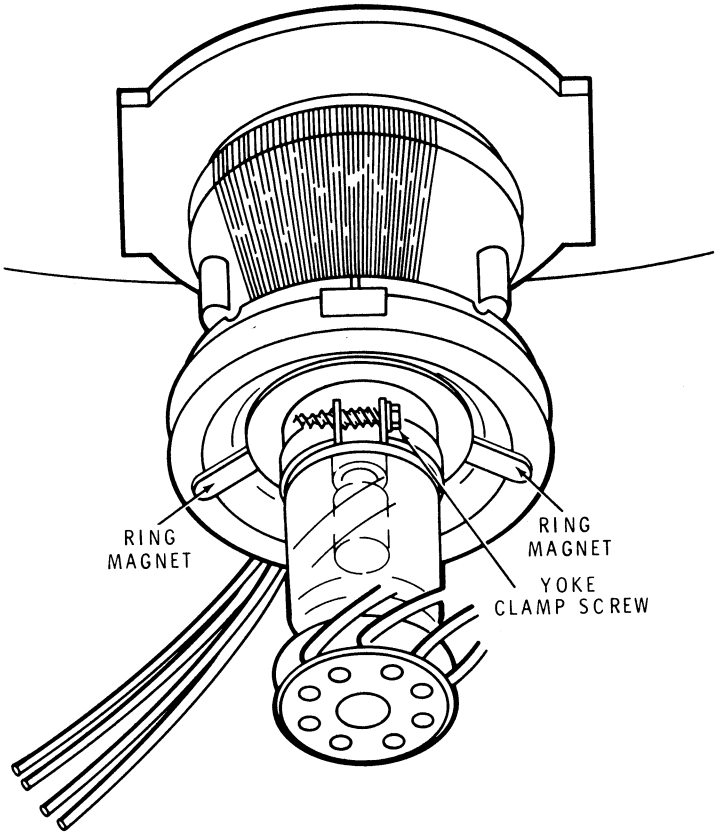
( ) Adjust BRIGHTNESS control R1 (on the rear panel) to obtain the brightness that is most suitable to you.

( ) Adjust FOCUS control R136 for the best focus.

( ) Recheck the display for proper alignment of the screen. If necessary, rotate the yoke a small amount. Then tighten the yoke clamp screw only enough to hold the yoke from turning.

( ) Set the POWER switch to OFF and disconnect the line cord.

( ) Set section 2 of switch S402 (on the terminal logic circuit board) up to its 0 position.



PICTORIAL 8

IN CASE OF DIFFICULTY

SERVICE INFORMATION

If your Video Terminal needs servicing:

- Call your local Zenith Data Systems Dealer, or
- Call the nearest Authorized Zenith Data Systems Service Center (check the list accompanying this product or look in the yellow pages under "Data Processing Equipment"), or
- Call the nearest Heathkit Customer Center, or
- Call Zenith Data Systems, Customer Service Assistance, at
  (312) 671-7550.

IMPORTANT: Be prepared to furnish the following information with your Terminal. It will be helpful in diagnosing and repairing your unit.

A. The problem you are having.

B. Name and model of your computer system.

C. Baud rate.

D. System configuration.

E. Any additional information that will help describe your system.

TROUBLESHOOTING CHARTS

The following chart lists conditions and possible causes of several specific malfunctions. If a particular part is mentioned (fuse F1, for example) as a possible cause, check that part and other components connected to that part.

Refer to the "Circuit Board X-Ray Views" for the physical location of parts on the circuit boards.

CAUTION: Troubleshooting should only be performed by authorized Zenith Data Systems Service Centers. Any abuse of this product will void the warranty.

WARNING: Measure the anode voltage only with an approved high voltage probe.

POWER SUPPLY PROBLEMS

CONDITION	POSSIBLE CAUSE
Nothing happens at turn on.	1. Not plugged in. 2. Fuse FX501 blown. 3. Power transformer T502.
Fuse blows.	1. Diodes CR501 — CR504. 2. C501 — C502. 3. Q501, Q502, Q503. 4. Incorrect fuse. 5. Power transformer T502.
No output from 5 V supplies, or voltage(s) too high or too low.	1. T501. 2. CR507, CR513. 3. C511, C512.
No +12 V, or is too high or too low.	1. CR501 — CR504.
No −12 V, or is too high or too low.	1. C509. 2. CR516. 3. R514.
No −5 V , or is too high or too low.	1. −12 V circuitry.
No +53 V, or is too high or too low.	1. Q501, Q502, Q503. 2. CR501 — CR504.
No anode voltage when other voltages are OK.	1. No sync pulses coming from terminal logic board. 2. Q102, Q103, Q101. 3. Deflection yoke. 4. IC101.
+500 V supply is too high or too low.	1. CR106, CR108. 2. C117, C123.
+50 V supply is too high or too low.	1. CR104. 2. C114. 3. Q401, Q402.

VIDEO RELATED PROBLEMS

CONDITION	POSSIBLE CAUSE
No video (blank screen).	1. Brightness control R1 turned down. 2. Anode voltage incorrect. 3. Grid voltages incorrect (G1, G2, G4). 4. No cathode drive. 5. Q401, Q402. 6. No video signal coming from terminal logic board. 7. Video circuits on logic board. 8. No sync pulses coming from logic board.
Screen all white (raster).	1. Grid voltages. 2. Q401, Q402. 3. Video circuits on logic board. 4. Anode voltage incorrect.
Insufficient brightness	1. Q401, Q402. 2. C401. 3. R1 (brightness control), RX401, R402, R407, R406, R403, R404. 4. Grid voltages.
Too much or too little height.	1. Vertical amplifier or sweep generator. 2. R312.
Too much or too little width.	1. Adjust width coil L101. 2. L102. 3. C112. 4. +50 V or +15 V supplies. 5. Flyback transformer. 6. Q103.
Filament does not glow.	1. No horizontal sync pulses coming from logic board. 2. Filament winding of flyback transformer. 3. R257.
No horizontal sweep, but sync pulses are present.	1. IC101. 2. Q104, Q101, Q102, Q103. 3. +50 V supply. 4. Deflection yoke.

CIRCUIT DESCRIPTION

POWER SUPPLY CIRCUIT BOARD

Power transformer T502 steps down the line voltage to 50 V. This voltage is fed to the bridge rectifiers, which consist of CR502, CR501, CR503, and CR504. The positive output of the rectifiers (the node common to CR502 and CR503) is the unfiltered B+ voltage. C501 and C502 filter the B+ voltage.

Q501, Q502, and Q503 form a voltage regulator. The emitter of Q501 is connected through zener diode CR506 to chassis ground. The base of Q501 is connected to B+ through R507 and R506. Whenever the base to emitter voltage difference grows larger than 0.7 V, Q501 is turned on, reducing the voltage difference to zero. Q502 acts as a current amplifier, feeding small variations in current from Q501 to Q503. Q503, in turn causes more or less current to flow, depending on which way B+ moves with respect to the zener voltage. Adjusting R511 varies B+ from 14 V to 16 V. This voltage drives the unit.

From the video board, the synchronous, low impedance, 15.6 kHz horizontal scan output signal drives the terminal logic power supplies. The voltages derived from this signal are +5 V and −12 V.

Logic transformer T501 isolates the logic board from the rest of the system to provide immunity from transients.

VIDEO CIRCUIT BOARD

HORIZONTAL SIGNAL GENERATION

The horizontal synchronization signal is filtered by C101 and R101. The signal is then amplified by Q104.

The amplified signal is fed to IC101, a 555 timer, acting here as an astable oscillator that creates horizontal pulses whether or not synchronization pulses are present. Q101 and Q102 form a monostable collector to base oscillator. The combination of the astable and monostable oscillators create a delay of approximately one display-line in the synchronization injetion signal. Through R11, synchronization can be adjusted backward or forward in time. Q102 is also the driver for the horizontal output transistor Q103. The horizontal output is fed to the flyback transformer at pin 4 of connector P1.

HORIZONTAL WIDTH

The shunt-series width coil, L102, couples variable inductor L101 to the yoke. L101 controls the width of the display. L102 also shunts across the inductance of the rest of the system, in an amount that varies inversely with the amount of inductance introduced by L101. This maintains a total system inductance, even though L101 is being varied. The constant inductance allows the width to be varied almost twice as much as other systems because system voltages do not drop as the inductance of L101 is dropped.

VERTICAL SIGNAL GENERATION

The vertical synchronization signal is AC-coupled through the filter composed of R301, C301, and C302. Only the leading negative edge of the vertical synchronization pulse is used for synchronization.

Q301 and Q302 make up a quasi-SCR. A small amount of collector voltage change at Q302 causes both Q301 and Q302 to saturate. Once saturated, they charge C303 to the voltage of C304. This is basically a relaxation oscillator with the voltage of C303 draining through resistors R309 and R331. When this voltage drops low enough, it causes the circuit to self-oscillate, but synchronization is normally injected before this happens, creating a sawtooth voltage at C303. Bias for Q301 is provided through R302.

Q303 is the first stage of a three-stage amplifier that is used in S-correction. Q303 is the first stage and Q304 is the second stage. They both provide voltage gain. Q306 and Q307 semetrically comprise the complimentary third stage that supplies the current gain. The emitters of Q306 and Q307 are connected to the yoke. Current developed in the yoke is fed to the emitter of Q303 through R331 and C307. The waveforms of the emitter and base are essentially the same, except that there is a 0.7 V difference because of biasing.

S-correction is used to improve the linearity of the display, which might otherwise be distorted because of the shape of the screen. The linearity feedback circuit consists of R317, R316, R314, C309, C308, and C307. These components integrate the parabolic waveform at C316. This integration creates a small sine wave that is fed into the emitter of Q303. The amplifier produces the correct S waveform at R331. The waveform deviates only 10% to 15% from a perfect sawtooth wave. Considering that component tolerances are from 8% to 12%, the waveform is exact enough for good system linearity.

The amount of S-correction depends on the voltage at C316. That voltage depends on the current in the yoke. As the yoke current drops, S-correction drops.

Q308 speeds the display retrace by doubling the B+ during retrace.

VIDEO OUTPUT

The video signal cascade video is fed into Q402, which acts as a current amplifier. Q402 is in the emitter circuitry of Q401, which acts as voltage amplifier. The sweep circuit creates two voltages. CR104, C114 supply 50 V to the video output, /while CR106, CR108, and C117 supply 500 V (B+) which is connected to G2.

TERMINAL LOGIC CIRCUIT BOARD

The terminal logic board consists of seven functional blocks:

1. Power supplies.
2. Keyboard encoder and configuration logic.
3. Processor/CPU.
4. Master clock and system logic.
5. Communications.
6. CRT and memory control.
7. Display and memory, character generator, and video control logic.

The integrated circuits in each block are numbered as follows:

U401-U405	Power supplies.
U426, U427, U429, U431, U434, U435, U440-U442	Master clock and system logic.
U413, U428, U430, U432, U433, U436-U439	Processor, ROM, RAM, processor control logic.
U443-U450	Keyboard encoder and configuration logic.
U452-U454	Communications and I/O drivers.
U414-U418	CRT and memory control.
U406-U411, U419-U425	Display memory, character generator, and video control logic.

POWER SUPPLIES

U403 supplies +12 volts DC, and U405 supplies −5.2 volts DC. These integrated circuits are internally protected against short circuits, overloads, and high temperatures. Capacitors C402, C404, C407, and C411 at the inputs of the regulators stabilize the supplies, while capacitors C403, C405, C408, C412, and C413 improve the transient response of the regulators. C412 serves as the input stability capacitor for U405.

MASTER CLOCK AND SYSTEM LOGIC

Clock And Scalers

The master clock is a 12.288 MHz crystal-controlled oscillator. Crystal Y401, with C419, C421, and U426E form the oscillator. The series combination of C419 and C421 serve as the load capacitance for the crystal. U426E is the gain stage. Resistors R408 and R409 bias U426E into its linear region, while C418 bypasses any AC feedback through the two resistors. The output of the oscillator is buffered by U426D to prevent loading on the output from changing the oscillator frequency. This output is the "dot clock" and it is used by the shift register to shift dot information to the screen.

The dot clock also drives divide-by-16 counter U427, which generates 1.536 MHz pulses. This is called the character clock. Each pulse corresponds to one character on the screen. U427 is a synchronous presettable counter that is loaded with a binary eight (1000). It counts dot clock pulses until its output reaches binary fifteen (1111). During the fifteenth count, the ripple carry output (pin 15) goes low. This pulse, which is inverted by U426F, puts a logic one on the load input (pin 9). The next positive-going clock

cycle reloads a binary eight back into the counter and the cycle repeats. The Q_C output (pin 12) generates a 1.536 MHz pulse that serves as the clock (pin 2) for CRT controller U417. It is inverted by U412D. These two signals are referred to on the Schematic as C and $\overline{C}$. The Q_B output (pin 13) generates a 3.072 MHz signal that drives the clock input (pin 16) of the ACE (U452).

The dot clock also drives U429. U429 is a divide-by-six and divide-by-two scaler. The clock drives the B input (pin 1), and the Q_D output (pin 8) generates a 2.048 MHz clock signal for CPU U430. The Q_D output (pin 8) also drives the A input (pin 14). The Q_A output (pin 12) in turn drives the input of binary scaler U440.

The output of U440 provides a 128 kHz clock (pin 6) for the keyboard encoder, U444 and a 1 kHz signal (pin 14) for the audible bell signal.

System Control Logic

The system control logic consists of I/O and memory decoding, power-up and manual reset circuits, and the bell and key clock circuits.

I/O and memory decoding are accomplished by three-to-eight line decoders U442 and U435, respectively. U442 decodes address bits A5, A6, and A7 to generate eight I/O addresses:

1. Keyboard encoder .....200 (80_H)
2. Keyboard status .....240 ($A0_H$)
3. CRT controller .....140 (60_H)
4. Power-up configuration (primary) .....000 (00_H)
5. Power-up configuration (secondary) .....040 (20_H)
6. ACE (communications) .....100 (40_H)
7. Bell enable .....340 ($E0_H$)
8. Key click enable .....300 ($C0_H$)

Decoder U442 is enabled only during an I/O read or write operation to eliminate the possibility of false decoding on a refresh address coming from the Z80.

U435 decodes address bits A14 and A15 to generate three memory addresses:

1. Program ROM .....000.000 (00 00_H)
2. Scratchpad RAM .....100.000 (40 00_H)
3. Display memory .....370.000 (F8 00_H)

Whenever the Z80 performs a read or a write operation it will either write to or read from one of these memory I/O addresses.

When the Terminal is first turned on, the CPU, CRT controller, ACE, and keyboard control logic are cleared by the master reset signal. U431A, R412, C422, and D401 form the power-up reset circuit. When power is first turned on, C422 has no charge and temporarily holds pin 2 of U431A at logic zero. The output of U431A goes high and is inverted by U431B. The two outputs are the true and the complimented reset pulses. As C422 charges through R412, it pulls the input of U431A high, turning off the reset pulses.

A manual reset can also be accomplished if you simultaneously press the Reset and right-hand Shift keys on the keyboard. U446E and U446B are connected to those keys and they drive the inputs of U431D. The output of U431D (pin 11) is coupled through R413 to pin 1 of U431A. R413 and C423 form a de-bounce circuit for the Shift and Reset keys. When the output of U431D goes low, the input of U431A is also pulled low. This generates a reset pulse.

The CPU, under the control of the ROM program, can cause a bell tone or a key click to sound through the speaker. When the CPU addresses I/O port 340Q (0E0H), pin 7 of U442 triggers one-half of monostable U441. Its output goes low for about 200 milliseconds, causing the output of U431C to go high. This logic 1 is NANDed in U434C with the 1000 Hz signal coming from U422. The output of U434C drives speaker SP1. Diode D402 keeps the output of U434C from being driven above 5-volts at turn-off by the inductive reactance of the speaker.

When the CPU addresses I/O port 300, pin 9 of U442 triggers the other half of U441. Its output (pin 7) goes low for about six milliseconds and turns on the 1000 Hz tone. This short duration causes the tone to sound like a click.

PROCESSOR

The processor section of the Terminal consists of the Z80 processor (U430), ROM (read only memory), RAM (random access memory), and processor control logic.

Processor/CPU

The heart of the terminal logic circuit board is the Z80 CPU. It acts as a scheduling or dispatching service for the data coming into or originating from the Terminal. It examines the data it receives and determines what, if anything, it should do with it. If the data comes from the ACE (U452), for example, the Z80 will compare the ASCII word with a set of conditions determined by the ROM program, and then write the word into the appropriate memory or I/O port. If the ASCII word is a bell signal, the CPU addresses I/O port 340Q (0E0H), and the bell tone sounds through the speaker. If the word is the letter "B", the CPU performs a memory write to the current cursor position in the display memory. If the data from the ACE is a nonvalid character or a string of characters, the CPU simply ignores the data and does nothing.

The ROM program that directs the CPU is rather long and complex, but the mechanics of the process are easy to follow. The 2.048 MHz clock signal drives the clock input (pin 6) of the CPU through U426A. This steps the CPU through an internal "Machine" cycle that starts with a fetch instruction. It executes the remainder of its instructions by stepping through a precise set of a few basic instructions. These include memory read, memory write, I/O read, I/O write, and interrupt acknowledge. The basic thing to remember is that the ROM program directs the Z80 to make decisions and move data from place to place within the circuit board. Without the CPU and ROM, the decisions and data movement would have to be accomplished with hard-wired logic packages.

ROM

The read only memory, U436 and U437, is a 4K × 8-bit (32768 bit) ROMs. Its twelve address inputs connect to A0 through A11 of the address bus and its eight data outputs connect to D0 through D7 of the data bus. U413A, U413B, and U434D decode the ROM select line coming from memory decoder U435.

RAM

The random access memory for the Z80 scratchpad consists of U438 and U439, 256 × 4-bit RAMs. This scratchpad RAM provides temporary data storage for the Z80. The address inputs to each IC connect to A0 through A7 on the address bus. The lower four bits of data (D0-D3) are provided by U438; the upper four bits (D4-D7) are provided by U439. The select signal comes from U435.

Processor Control Logic

The processor for the Terminal requires some additional circuitry to control the interrupt process, and to provide a wait cycle for the keyboard encoder U444, which is slow in responding to a read cycle.

U432C is a 2-input NOR gate that monitors the INTRPT output of the ACE (U452) and pin 6 of U447B (the keyboard INTRPT). When either INTRPT output goes high, the output of U432C goes low and signals the INT input (pin 16) of the Z80 that data is available from the ACE or keyboard.

U433, U432A, and U432B form a counter that drives the $\overline{\text{WAIT}}$ input (pin 24) of the Z80. Whenever the Z80 performs an I/O read at the keyboard encoder, pin 11 of U442 drives the "reset to zero" inputs (pins 12 and 13) of U433. The Q_A and Q_B outputs (pins 9 and 5) of U433 drive the inputs of U432B, a 2-input NOR gate. The output of U432B holds the Z80 $\overline{\text{WAIT}}$ input low whenever the Q_A or Q_B outputs of the counter are high. This generates a total wait of four clock cycles (one wait cycle is automatically inserted by the Z80 on an I/O instruction) to allow the output buffer of U444 to turn on. When the Q_C output (pin 4) of counter U433 goes high, it drives the input of U432A

high. This forces the output low and turns off the A input (pin 10) of U433. The Q_A and Q_B outputs now go low and the wait signal is no longer present. The Z80 then finishes up the I/O read cycle (pin 11 of U442 goes high) and the counter is reset to zero and held there until the next keyboard read.

U428 provides a nonmaskable-interrupt ($\overline{NMI}$) that operates under the control of the ROM program. The NMI routine is used when the program wants to read something into the CRT Controller (or) CRTC during the vertical blanking period. The data input of U428A is driven by A2 of the address bus. The T, or clock, input is driven by the complemented CRT controller I/O select that comes from pin 12 of I/O decoder U442 through U412C, which provides the complement of the signal. When the program wants to write during vertical retrace, it addresses the CRT controller while holding A2 high. The Q output of U428A is clocked high and drives the reset input of U428B high. The vertical sync signal from U417 drives the T input of U428B and clocks the $\overline{Q}$ output low as soon as the sync signal begins. The $\overline{NMI}$ input of the Z80 goes low and the program immediately jumps to the "update CRTC" routine. Part of that routine will write a zero to the data input of U428A to clear the NMI signal.

KEYBOARD ENCODER AND CONFIGURATION LOGIC

Keyboard Encoder

The keyboard of the Terminal consists of single-pole, single-throw switches in a matrix that is scanned by keyboard encoder U444. Outputs X1 through X9 go high, in sequence, and drive one of the Y1 through Y10 inputs if one of the switches is depressed. The encoder uses the X and Y information to generate a unique binary code for each matrix intersection, and this code is latched internally when a key is depressed. The encoder generates a data strobe (DS), which comes from pin 13 of U444, for each key closure. DS clocks the T input (pin 3) of U448A and the $\overline{Q}$ output of U448A goes low. The $\overline{Q}$ output drives an input of U447B. The output of U447B, an $\overline{INT}$ signal, is coupled to the Z80 (pin 16). When the Z80 services the interrupt at I/O port 200Q (80H), pin 11 of U442 clears U448A (through U447C and U446A) and the $\overline{INT}$ signal is removed. Pin 36 of U444 is also a binary data output and it is latched in U448B by the I/O read at 200Q (80H). The keyboard interrupt routine also checks the keyboard status in another I/O read operation. The keyboard status check reads the state of the following:

1. Control key.
2. Shift keys.
3. Repeat key.
4. Break key.
5. Off-line key.
6. Caps Lock key.
7. Data Strobe.
8. Data bit latched in U448B.

The ROM program uses this information in conjunction with the encoder data to determine the routing of the data within the Terminal. Pin 10 of I/O decoder U442 drives enable inputs (pin 19) of buffers U449 and U450 to put the status information on the bus. The Caps Lock, Break, Off Line, Control, Repeat, and Shift (left) keys are connected directly to the inputs of these buffers. The outputs of U448A and U448B are also connected to the inputs of the buffers.

The binary data outputs of the keyboard encoder drive the address inputs (A0-A7) of ROM U445. U445 converts the binary data from the keyboard encoder to ASCII data. The data outputs of U445 drive the D0-D7 bits of the data bus. The chip select input (pin 18) of U445 is driven by pin 11 of U442 (the I/O decoder).

When the Repeat key is held down, the input of U446D is low and its output is high. This enables the repeat rate oscillator, U447A, R437, C481, and Q402. The repeat frequency, approximately 15 Hz, is determined by R437 and C481. When the Repeat key is released, the output of U446D goes low, forcing the output of U447A high and disabling the repeat function.

The two shift keys are NORed together in U447D. Its output drives the shift input (pin 21) of U444. When the Control key is typed, the output of U446F is forced high, which drives the control input (pin 19) of keyboard encoder U444.

Configuration (Power-up) Logic

When the system is first turned on, the ROM program must program the ACE (U452) for the baud rate and parity that you selected on switches S401 and S402. The program addresses I/O port 000Q (00H) and pin 15 of I/O decoder U442 drives enable inputs of U449 and U450 to put the information selected by the switches on the bus. The program then interprets the data and configures the ACE accordingly. I/O address 040Q (20H) is used in a similar manner. Pin 14 of the I/O decoder U442 enables buffer U443 and puts the data from S402 on the bus.

COMMUNICATIONS AND I/O DRIVERS

The Terminal talks to the outside world through an Asynchronous Communications Element (ACE) and EIA RS-232C compatible line drivers and receivers. The ACE (U452) converts parallel ASCII data to serial data and drives the communications line through line driver U453. The ACE also converts serial data coming from line receiver U454 into parallel ASCII data. The ACE puts this data on the bus when the ROM program requests it.

ACE/UART

U452 is an Asynchronous Communications Element that performs the following functions:

1. Converts data from parallel to serial and vice versa.

2. Divides a master clock frequency by a programmed divisor to generate a desired baud rate.

3. Programs the data characteristics, parity, stop bits, and character length.

The characteristics of the ACE must be programmed into the internal registers of U452 by the ROM program through the address and data busses. Bidirectional data bits (pins 1-8) of U452 connect to the system data bus. The address inputs (pins 28, 27, and 26) connect to the system address bits A0, A1, and A2. When the ROM program addresses I/O port 100Q (40H), pin 13 of I/O decoder U442 selects the $\overline{CS2}$ input (pin 14) of the ACE. The Z80 can then read or write data by enabling the data input and data output strobes at pins 21 and 18 ($\overline{DISTR}$ and $\overline{DOSTR}$) of U452.

When the ACE receives a complete serial word from the EIA interface, it signals the Z80 that there is data available by pulling the Z80 $\overline{INT}$ input (pin 16) low. The Z80 then examines the internal status and data registers of the ACE, reads the data word, and routes it to the proper device within the Terminal.

I/O Drivers

The standard EIA interface communicates by means of a serial stream of voltage levels that correspond to logic ones and zeros. A logic one (or mark) on the data lines is a voltage between −5 and −15 volts. A logic zero on the data lines is a voltage between +5 and +15 volts. On the control lines ($\overline{DTR}$, $\overline{RTS}$, $\overline{RLSD}$, $\overline{DSR}$, CTS), a voltage between +5 and +15 volts is considered to be ON, and a voltage between −5 and −15 volts is considered to be OFF.

U453 is a standard EIA line driver. A logic one on the input of U453C drives the transmit data line to an EIA logic one, or "mark." A zero on the input forces the line to an EIA zero, or "space." U453B and U453D drive control lines DTR (Data Terminal Ready) and RTS (Ready to Send) in a similar manner.

U454 is a standard EIA line receiver. The receive data line drives the input of U454A, which converts the EIA voltages to TTL levels and drives the serial input of the ACE. Likewise, the RLSD, DSR, and CTS line signals drive the inputs of U454B, U454D, and U454C, respectively. The outputs drive the appropriate control inputs of the ACE.

The I/O connector on the back panel of the Terminal is a standard 25-pin D-type plug with the data and signal line connected as follows:

1. Protective or chassis ground.

2. Transmit Data (TX data).

3. Receive Data (RX data).

4. Request To Send (RTS).

5. Clear To Send (CTS).

6. Data Set Ready (DSR).

7. Signal ground.

8. Received Line Signal Detector In (RLSD).

20. Data Terminal Ready (DTR).

CRT AND DISPLAY MEMORY CONTROL

The heart of the video logic system is the CRT controller. This device generates all of the sync and blanking signals and display memory addresses for the video system. The memory control is used to select either the address coming from the CRT controller or the address bus, and to synchronize read and write pulses.

CRT Controller

The CRT controller, U417, is a fully programmable device that is set up by the ROM program during power-up. Its bidirectional data bits (pins 33-26) connect to system data bits D0-D7. Its address or programmng inputs come from the following four input pins:

Pin 22. Read/Write (R/$\overline{W}$) — Determines whether the controller's internal register file is to be written to or read from. A write is a logic zero.

Pin 24. Register Select (RS) — Selects either the address register (RS=0) or one of the data registers (RS=1) of the internal register file.

Pin 25. Chip Select ($\overline{CS}$) — A zero sets the CRT controller to read or write the internal memory file.

Pin 23. Enable (E) — Enables the I/O buffers and clocks data to and from the CRT controller. Data is clocked on the falling edge of the enable signal.

The internal registers are written to or from by means of the address register. The Z80 sets up the programmable registers by first writing a register number into the address register when the register select input is low. It then performs a write operation when the register select input goes high.

Each of the CRT controller's registers is programmed at power-up with appropriate data to generate the SYNC, timing, and refresh signals. The memory address outputs (MA0-MA10) drive the address of the display RAM through multiplexers U414, U415, and U416. The scan row address outputs (RA0-RA3) drive the address inputs of character generator U420. The display enable output (DISPLAY) is a logic one whenever the CRT controller, U417, is addressing a port of the RAM during the time it should be displayed. This serves as a blanking output whenever it is a logic zero. The cursor output goes to a logic one when the RAM location being addressed is equal to the address stored in the cursor address registers.

Controller Read/Write Logic

The $\overline{CS}$ and E inputs of the CRT controller must be selected in a particular sequence to perform read and write operations to and from the controller. The enable input pulse (pin 23) must always be inside the $\overline{CS}$ pulse. When the I/O request for address 140Q (60H) appears at pin 12 of U442, the clear input of U418A goes low, and the Q output immediately drives the $\overline{CS}$ input low. The $\overline{Q}$ output drives the data input of U418B to a logic one. At the same time, U412C puts the Clear input of U418B at a logic one.

The next CPU clock pulse at pin 11 of U418B clocks the logic one at the data input through to the Q output. This delays the leading edge of the enable pulse until approximately one clock cycle after the leading edge of the $\overline{CS}$ pulse. When the I/O request at address 140Q (60H), goes away (returns to logic one), the output of U412C immediately clears U418B. U418B's Q output (pin 9) drives the E input of the CRT controller to zero. The clear input of U418A goes high at the same time, but the Q output remains low until the next CPU clock pulse at U418A (pin 3) clocks the logic one at the data input through to the output, terminating the $\overline{CS}$. This delays the trailing edge of the $\overline{CS}$ pulse until after the trailing edge of the E pulse.

Display Memory Control

The display memory control consists of an address bus multiplexer, a bidirectional bus buffer, and some gates that control the display memory write enable (WE) and chip select ($\overline{CS}$) inputs.

The address bus multiplexer consists of quad 2-input multiplexers U414, U415, and U416. Their select inputs are tied together and controlled by memory decoder U435. When no read or write operations are being performed on the display memory, the select input are at a logic one, and the memory addresses (MA0-MA9) generated by the CRT controller drive the address inputs (A0-A9) of RAMs U408-U411. Memory address A10, generated by the CRT controller, selects either the upper or the lower 1k bank of video RAM.

When the Z80 addresses the memory, pin 9 of U435 pulls the select input to a logic zero, CRT controller memory addresses MA0-MA9 are disconnected from the display RAM, and address bus bits A0-A9 are connected to the RAM address inputs. The Z80 can then read from or write into the display RAM.

Bus buffer U407 isolates the main data bus from the secondary or refresh, bus. During the screen refresh period, the data outputs of the display RAM drive the data inputs of the character generator continuously. This would prevent the processor from having access to the bus except during retrace times. However, by isolating the refresh bus from the main bus, the Z80 can have continuous access to the main bus, and the display RAM and character generator can have continuous access to the secondary bus (refresh bus). When the Z80 needs access to the display RAM, it addresses the memory, which enables U407 through pin 9 of U435, and connects the main bus directly to the secondary bus.

U412A and U412B provide the $\overline{CS}$ signals for the display RAMs. During the screen refresh cycle, pin 11 of U414 is driven by A10 and pins 1 and 4 of U412 are logic one. The output of U412A provides the $\overline{CS}$ for RAMs U408 and U409 and drives input pin 5 of U412B. The output of U412B is the complement of the $\overline{CS}$ signal and it drives the $\overline{CS}$ input of RAMs U410 and U411. During a display RAM read or write cycle, pins 1 and 4 of U412 are driven by the RD+WR signal coming (indirectly) from pin 3 of U434A. This eliminates the possibility of a contention problem on the secondary (refresh) bus between the display RAMs and buffer U407.

The write (WE) inputs of the RAMs are connected together and they are controlled by U413C. The WE (pin 8 of U413C) cannot go low unless pin 9 of U435 is low (memory is selected) and the Z80 WR output is low.

DISPLAY MEMORY, CHARACTER GENERATOR, AND VIDEO CONTROL LOGIC

This section of the terminal logic circuit board essentially runs by itself (in conjunction with the CRT controller) after being programmed by the Z80. The CRT controller continually provides refresh addresses for the display RAM, while the output of the RAM continually provides data for the character generator and the video shift register.

Character Generator

Character generator U420 is a 2048 × 8 (16384 bit) read only memory (ROM) that converts the ASCII data stored in the display memory into dot information for the video shift register. Address inputs A0-A3 (pin 5-8) are driven by the scan row address outputs of the CRT controller (RA0-RA3) to select a particular row of dots within a character space. Address inputs A4-A10 connect to the secondary data bus through 8-bit latch U419. These inputs use ASCII data to address the dot data stored in the ROM. The data outputs (01-08) of U420 supply video dot data to the parallel inputs of video shift register U421.

The inputs of 8-bit latch U419 connect to the secondary data bus. Data bits D0-D6 are latched into U419A and drive the character generator. Data bit D7 is the reverse video bit. It is latched in U419H and drives an input of U423A.

Video shift register U421 latches parallel dot data from the character generator at inputs A-H and shifts it out of output Q_H in synchronism with the dot clock (the dot clock drives the clock input, pin 7). The shift register is loaded (the dot data is latched) on a positive-going transition of the dot clock while the shift/load input is held low by the character clock coming from pin 12 of U426F. The dot data at input H appears immediately at output Q_H. The next leading edge of the dot clock shifts the data that was latched at Q_G. The next edge of the dot clock will shift the data that was latched in Q_F, and so on. After the data from Q_A is shifted to the Q_H output, the load input goes low, and the next character cycle begins.

Video Control Logic

The video control logic consists of two sections: a series, or chain, of gates and latches associated with video, cursor, and reverse video data; and a chain of gates and latches associated with blanking data.

The display enable (blanking) and cursor data from pins 18 and 19 of the CRT controller is coincident with MA0-MA10, which address the display RAM. The display enable bit is latched in U424D (after passing through AND gate U423C) by the complemented character clock pulse coming from pin 11 of U412D. The cursor bit is latched in U424F. This delays the two signals by one character time. They are delayed for one more character time by being latched in U424E and U424G, respectively. The two character delays are necessary to compensate for the delays in the display RAM/character generator "pipeline."

When MA0-MA10 address the RAM, it takes approximately 450 nS for the data to be valid at the outputs. Once it settles down, the next character clock latches it in U419. The data at the output of U419 then addresses character generator U420. The data at the output takes another 450 nS to settle, and it is latched in the shift register by the following clock pulse. (Since the character clock pulses are 650 nS apart, the RAM and character generator outputs have plenty of time to settle). This two-character delay matches the delays for the cursor and display enable, so that everything is synchronized.

The reverse video bit (D7) in the display RAM is latched first in U419, and then in U424H (after passing through AND gate U423A), so that it too arrives coincident with the video, blanking, and cursor data.

The video dot data from pin 13 of video shift register U421 and the cursor data coming from pin 16 of U424G are exclusive-ORed in U425A. This causes the cursor dots to reverse when the cursor happens to be coincident with video information, and keeps the cursor from disappearing when it occupies the same space as a character.

The video/cursor information coming from pin 3 of U425A is then exclusive-ORed in U425B with the reverse video data coming from pin 19 of U424H. When pin 19 is logic zero, the video/cursor data passes through U425B just as it is entered. If pin 19 of U424H is logic one, the data is reversed, and the character appears on the screen as black dots on a white background. The reverse video function can be disabled under the control of the ROM program when a logic zero is written into latch U422B via the address bus. Address bit A3 drives the data input of U422B, and its clock input is clocked when the CRT controller is addressed (I/O address 140Q, 60H). If the reverse video is to be ignored, the Q output (pin 9) of U422B puts pin 1 of AND gate U423A at a logic 0 and disables the reverse video bit coming from pin 19 of latch U424H.

The video/cursor/reverse data coming from pin 6 of U425B is ANDed in U423D with the display enable data coming from pin 12 of U424E. If the display enable is logic 1, the video data goes to the video circuit board; if it is a logic zero, the video is blanked.

When the Z80 performs a read or write operation on the display RAM, it disturbs the pipeline, and the data on the secondary (refresh) bus does not coincide with what should be written on the screen. Consequently, the video is blanked during a read or write. When pin 9 of memory decoder U435 goes low to select the display RAM, it also drives the clear input (pin 1) of U424. The Q output (pin 6) of U424C drives pin 9 of AND gate U423C to a logic zero and disables the display enable. At the same time, the Q output (pin 12) of U424E drives pin 12 of AND gate U423D to a logic zero, blanking the video information coming from the video chain. The screen will blank as long as the RAM is selected.

When pin 9 of U435 goes high to deselect the RAM, U424 is no longer held cleared. The logic one at the D input of U424C is clocked through to its Q output on the next character clock pulse, and it is clocked through U424D and U424E on the next two pulses. This three-character delay gives the pipeline time to reload with valid information before the video is enabled.

The propagation delays through the various gates and latches (U421, U425A, U425B, and U424) from the edge of the character and dot clocks to their various outputs is not always constant, so another delay is used. Latch U422A acts as a mini-pipeline, clocked at the dot rate. The data input to U422A is the composite video/cursor/reverse/blanking data, and its T input is clocked by the dot clock. This 80 nS delay lets all data settle to valid states before it is sent to the video circuit board.

The sync and video signals are buffered before they leave the terminal logic circuit board. U406A inverts and buffers the video data. U406C inverts and buffers the vertical sync signal coming from pin 40 of the CRT controller. U406D buffers the horizontal sync signal coming from pin 39 of the CRT controller.

REPLACEMENT PARTS LIST

POWER SUPPLY CIRCUIT BOARD

RESISTORS

All resistors are 5%, 1/4 watt, unless specified otherwise.

CIRCUIT Comp. No.	ZENITH Part No.	DESCRIPTION
R501	063-07799	2200 Ω, 10%, 1/2 watt
R502	063-10464-56	22 Ω, 10%, 15 watt
R503	063-07757	220 Ω, 10%, 1/2 watt
R504	063-07757	220 Ω, 10%, 1/2 watt
R505	Not used	
R506	063-09922-06	27 kΩ
R507	063-07757	220 Ω, 10%, 1/2 watt
R508	063-09921-95	9100 Ω
R509	063-09922-19	91 kΩ
R510	Not used	
R511	063-10857-09	2500 Ω, 10%, potentiometer
R512	063-10559-36	33 Ω
R513	Not used	
R514	063-01701	10 Ω, 10%, 1/2 watt

CAPACITORS

All capacitors are 10% unless specified otherwise.

CIRCUIT Comp. No.	ZENITH Part No.	DESCRIPTION
C501	022-07489	2200 μF electrolytic
C502	022-07489	2200 μF electrolytic, 35 V
C503	022-07615-10	47000 μF electrolytic, 50 V
C504	022-07151-04	10 μF electrolytic, 16 V
C506	022-07152-09	220 μF electrolytic, 25 V
C509	022-07151-08	100 μF electrolytic, 16 V
C511	022-07151-09	220 μF electrolytic
C512	022-07151-09	220 μF electrolytic

DIODES

See "Semiconductor Identification" (Page 43).

INDUCTORS — TRANSFORMERS

L501	020-03953-01	Choke
T501	095-3556	Isolation transformer
T502		Power transformer

VIDEO CIRCUIT BOARD

RESISTORS

All resistors are 5%, 1/4 watt, unless specified otherwise.

CIRCUIT Comp. No.	ZENITH Part No.	DESCRIPTION
R101	063-09921-90	5600 Ω
R102	Not used	
R103	063-09921-90	5600 Ω
R104	063-09921-72	1000 Ω
R105	063-09922-04	22 kΩ
R106	063-09921-72	1000 Ω
R107	063-09922-04	22 kΩ
R108	Not used	
R109	063-09919-84	3300 Ω, 2%
R110	Not used	
R111	063-10857-08	2200 Ω, 10%, potentiometer
R112	063-09919-94	8200 Ω, 2%
R113	063-09921-72	1000 Ω
R114	063-09921-80	2200 Ω
R115	Not used	
R116	063-09922-02	18 kΩ
R117	063-09919-90	5600 Ω, 2%
RX118	063-10559-48	100 Ω
RX119	063-10559-24	10 Ω
R120	Not used	
R121	063-09921-46	82 Ω
RX122	063-10559-48	100 Ω
R123	063-09921-68	680 Ω
R124	Not used	
R125	Not used	
R126	063-10184-18	82 kΩ, 10%
R127	063-10184-18	82 kΩ, 10%
R128	063-10857-17	100 kΩ, potentiometer
R129-R131	Not used	
R132	063-10184-44	1 MΩ, 10%
R133	Not used	
R134	063-10184-40	680 kΩ, 10%
R135	Not used	
R136	063-10857-24	2 MΩ, potentiometer
R137	Not used	
R138	063-10184	15 kΩ, 10%
R139	063-10183-54	180 Ω, 10%
R201	063-07725	39 Ω, 1/2 watt
R202	Not used	
R203		2200 Ω, 10%
R204		10 kΩ, 10%
R205	Not used	
R206		10 kΩ, 10%
R207		47 kΩ, 10%

Resistor (Cont'd.)

CIRCUIT Comp. No.	ZENITH Part No.	DESCRIPTION
R301	063-09921-90	5600 Ω
R302	063-09922-04	22 kΩ
R303	063-09922-27	200 kΩ
R304	063-10183-40	47 Ω, 10%
R305	Not used	
R306	063-09922-10	39 kΩ
R307	063-09921-92	6800 Ω
R308	063-09922-06	27 kΩ
R309	063-10182-52	2.2 MΩ
R310	Not used	
R311	063-10182-48	1.5 MΩ
R312	063-10857-52	250 kΩ, potentiometer
R313	063-10183-48	100 Ω, 10%
R314	063-09921-98	12 kΩ
R315	Not used	
R316	063-09922-06	27 kΩ
R317	063-09921-80	2200 Ω
R318	063-10183-48	100 Ω, 10%
R319	063-09922-12	47 kΩ
R320	Not used	
R321	063-09921-80	2200 Ω
R322	063-09921-80	2200 Ω
RX323	063-10559-12	3.3 Ω
R324	063-10183-32	22 Ω, 10%
R325	Not used	
R326	063-09921-45	75 Ω
R327	063-09921-84	3300 Ω
R328	063-09921-62	390 Ω
R329	063-09921-68	680 Ω
R330	Not used	
R331	063-09921-10	2.7 Ω
RX332	063-10559-12	3.3 Ω, 10%
RX333	063-10559-12	3.3 Ω, 10%
RX401	063-10559-32	22 Ω
R402	063-10836-70	820 Ω, 2 watt
R403	063-09921-72	1000 Ω
R404	063-09921-72	1000 Ω
R405	Not used	
R406	063-10183-40	47 Ω, 10%
R407-R408	Not used	
R409	063-10183-40	47 Ω, 10%
R410-R411	Not used	
R412	063-10183-40	47 Ω, 10%
R413	063-10183-32	22 Ω, 10%
R414	Not used	
R415	063-09922	15 kΩ, 10%

CAPACITORS

All capacitors are 10%, unless specified otherwise.

CIRCUIT Comp. No.	ZENITH Part No.	DESCRIPTION
C101	022-07742	150 pF, 50 V, ceramic tubular
C102	Not used	
C103	022-07707-07	33 μF, 16 V, electrolytic
C104	022-07773-08	4700 pF, 5%, 100 V, polyester
C105	Not used	
C106	022-07774-12	.01 μF, 100 V, polyester
C107	022-07773-10	6800 pF, 5%, 100 V, polyester
C108	022-07773-16	.022 μF, 5%, 100 V, polyester
C109	022-07774-16	.022 μF, 100 V polyester
C110	Not used	
CX111	022-07530-07	.015 μF, 400 V, polyester
C112	022-07313A	10 μF, 20%, 25 V, polyester
C113	022-07774-16	.022 μF, 100 V, polyester
C114	022-07711-07	33 μF, 63 V
C115	Not used	
C116	022-07797	.001 μF, 1 kV, ceramic
C117	022-07797	.001 μF, 1 kV, ceramic
C118	022-07708-10	220 μF, 25 V
C119-C120	Not used	
C121	022-07774-12	.01 μF, 100 V, polyester
C122	022-07774-12	.01 μF, 100 V, polyester
C123	022-07797	.001 μF, 1 kV, ceramic
C301	022-07742-12	1500 pF, 50 V, ceramic tubular
C302	022-07742	150 pF, 50 V, ceramic tubular
C303	022-07773-24	.1 μF, 5%, 100 V, polyester
C304	022-07389-07	33 μF, 16 V, electrolytic
C305-C306	Not used	
C307	022-07389-14	10 μF, 25 V, electrolytic
C308-C309	022-07713-02	1 μF, 20%, 35 V, electrolytic
C310	Not used	

Capacitors (Cont'd.)

CIRCUIT Comp. No.	ZENITH Part No.	DESCRIPTION
C311	022-07708-05	10 μF, 25 V, electrolytic
C312	022-07708-08	47 μF, 25 V, electrolytic
C313	022-07708-05	10 μF, 25 V, electrolytic
C314	022-07774-16	.022 μF, 100 V, polyester
C315	Not used	
C316	022-07579-12	470 μF, 16 V
C317	022-07708-09	100 μF,25 V, electrolytic
C401	022-07774-12	.01 μF, 100 V, polyester
C402	022-07708-05	10 μF, 25 V, electrolytic
C403	022-07742	150 pF, 50 V, ceramic tubular

DIODES

See "Semiconductor Identification" (Page 43).

INDUCTORS — TRANSFORMERS

L101	020-03943-02	Width control
L102	020-03906	Linearity
L401	020-03907-10	RCF coil
TX101	095-03136-01	Horizontal driver
TX102		Flyback transformer
TX202	095-03397-02	Deflection yoke

TERMINAL LOGIC CIRCUIT BOARD

RESISTORS

NOTE: All resistors are 1/4-watt, 5%.

CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION
R401	6-222-12	2200 Ω
R402	6-470-12	47 Ω
R403	6-101-12	100 Ω
R404	6-222-12	2200 Ω
R405	6-101-12	100 Ω
R406	6-102-12	1000 Ω
R407	6-102-12	1000 Ω
R408	6-561-12	560 Ω
R409	6-561-12	560 Ω
R410	Not used	
R411	6-331-12	330 Ω
R412	6-103-12	10 kΩ
R413	6-102-12	1000 Ω
R414	6-103-12	10 kΩ
R415	6-224-12	220 kΩ
R416	6-102-12	1000 Ω
R417	6-100-12	10 Ω
R420	Not used	
R418-R426	6-103-12	10 kΩ
R427-R435	6-103-12	10 kΩ
R430	Not used	
R436	6-102-12	1000 Ω
R437	6-472-12	4700 Ω
R438	6-272-12	2700 Ω
R439	6-103-12	10 kΩ
R440	Not used	
R441	6-224-12	220 kΩ
R442-R454	6-103-12	10 kΩ
R450	Not used	
R455	6-102-12	1000 Ω
R456	6-101-12	100 Ω
R457	6-102-12	1000 Ω
RP1	9-98	220 kΩ resistor network
RP2	9-98	220 kΩ resistor network

CAPACITORS

CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION
C400	21-176	.01 μF ceramic
C401	21-46	.005 μF ceramic
C402	25-221	2.2 μF tantalum
C403	25-221	2.2 μF tantalum
C404	25-221	2.2 μF tantalum
C405	25-221	2.2 μF tantalum
C406	21-176	.01 μF ceramic

Capacitors (Cont'd.)

CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION
C407	25-276	4.7 μF tantalum
C408	25-221	2.2 μF tantalum
C409	21-176	.01 μF ceramic
C410	21-176	.01 μF ceramic
C411	25-276	4.7 μF tantalum
C412	25-221	2.2 μF tantalum
C413	25-221	2.2 μF tantalum
C414	21-167	39 pF ceramic
C415	21-176	.01 μF ceramic
C416	21-711	470 pF ceramic
C417	21-140	.001 μF ceramic
C418	21-176	.01 μF ceramic
C419	20-101	47 pF mica
C420	21-176	.01 μF ceramic
C421	20-103	150 pF mica
C422	25-223	47 μF tantalum
C423	25-221	2.2 μF tantalum
C424	21-95	.1 μF ceramic
C425	21-95	.1 μF ceramic
C426	25-221	2.2 μF tantalum
C427-C457		
C458	21-176	.01 μF ceramic
C459-C478	Not used	
C479	21-140	.001 μF ceramic
C480	Not used	
C481	25-220	10 μF tantalum
C482	21-46	.005 μF ceramic
C483	25-223	47 μF tantalum
C484	21-176	.01 μF ceramic
C485	21-176	.01 μF ceramic
C486	21-176	.01 μF ceramic
C487	21-176	.01 μF ceramic
C488	21-176	.01 μF ceramic
C489	21-176	.01 μF ceramic
C491	21-56	470 μF ceramic

MISCELLANEOUS

S401	60-621	Dip switch
S402	60-621	Dip switch
Y401	404-613	12.288 MHz crystal

DIODES — TRANSISTORS — IC's

See "Semiconductor Identification."

SEMICONDUCTOR IDENTIFICATION

This section is divided into two parts; "Component Number Index" and "Part Number Index." The first section provides a cross-reference between semiconductor component numbers and their respective Part Numbers. The component numbers are listed in numerical order. The second section provides a lead configuration detail (basing diagram) for each semiconductor Part Number. The Part Numbers in the second section are also listed in numerical order.

COMPONENT NUMBER INDEX

This index shows the Part Number of each semiconductor in the Terminal.

POWER SUPPLY CIRCUIT BOARD

Diodes

CIRCUIT COMPONENT NUMBER	ZENITH PART NUMBER
CR501	103-00315-04
CR502	103-00315-04
CR503	103-00315-04
CR504	103-00315-04
CR505	NOT USED
CR506	103-0279-09A
CR507	103-00316-04A
CR508	NOT USED
CR509	NOT USED
CR510	NOT USED
CR511	NOT USED
CR512	NOT USED
CR513	103-00316-04A
CR514	NOT USED
CR515	NOT USED
CR516	103-00323-02A

Transistors

CIRCUIT COMPONENT NUMBER	ZENITH PART NUMBER
Q501	121-01036
Q502	121-01040
Q503	121-00992-01

VIDEO CIRCUIT BOARD

Diodes

CIRCUIT COMPONENT NUMBER	ZENITH PART NUMBER
CR101	NOT USED
CR102	103-00142-01
CR103	103-00298-03A
CR104	103-00323-03A
CR105	NOT USED
CR106	103-00323-04A
CR107	103-00295-03A
CR108	103-00323-03A
CR109	NOT USED
CR110	103-00254-01
CR111	NOT USED
CR112	103-00142-01
CR301	103-00336-24A
CR302	103-00142-01
CR303	103-00142-01
CR304	103-00254-01
CR401	103-00254-01

Transistors

CIRCUIT COMPONENT NUMBER	ZENITH PART NUMBER
Q101	121-00975A
Q102	121-01040A
Q103	121-01070
Q104	121-00975A

Integrated Circuits

CIRCUIT COMPONENT NUMBER	ZENITH PART NUMBER
IC101	221-00217

TERMNAL LOGIC CIRCUIT BOARD

Diodes

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER
D401	56-56
D402	56-56

Transistor

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER
Q401	417-937
Q402	417-937

Resistor Packs

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER
RP1	9-98
RP2	9-98

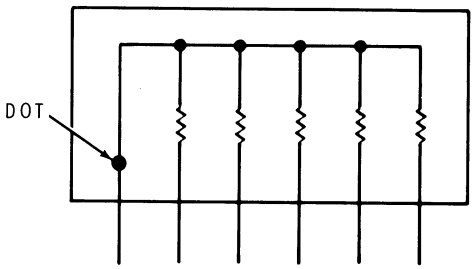
Integrated Circuits

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER
U401	NOT USED
U402	NOT USED
U403	442-663
U404	NOT USED
U405	442-630
U406	443-891
U407	443-885
U408	443-764
U409	443-764
U410	443-764
U411	443-764
U412	443-728
U413	443-875
U414	443-799
U415	443-799
U416	443-799
U417	443-906
U418	443-730
U419	443-805
U420	444-29
U421	443-892
U422	443-900
U423	443-780
U424	443-805
U425	443-915
U426	443-18
U427	443-757
U428	443-730
U429	443-34
U430	443-881
U431	443-792
U432	443-779
U433	443-733
U434	443-228
U435	443-877
U436	NOT USED
U437	444-46
U438	443-721
U439	443-721
U440	443-760
U441	443-727
U442	443-877
U443	443-791
U444	443-913
U445	444-37
U446	443-18
U447	443-792
U448	443-792
U449	443-791
U450	443-791
U451	443-730
U452	443-952
U453	443-794
U454	443-795

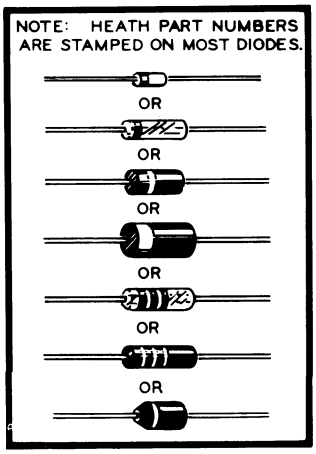
PART NUMBER INDEX

This index shows a lead configuration detail (basing diagram) of each semiconductor part number.

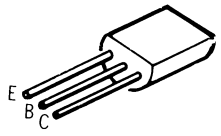
RESISTOR PACK

HEATH PART NUMBER	MAY BE REPLACED WITH	DESCRIPTION	LEAD CONFIGURATION (TOP VIEW)
9-98		220 kΩ resistor network	

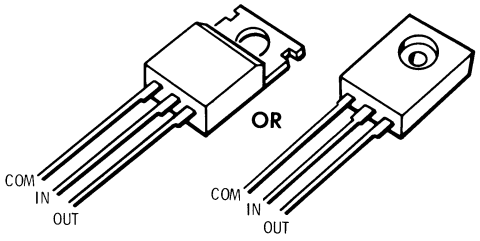
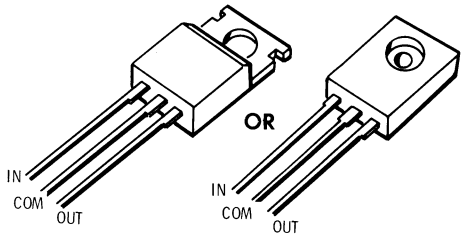
DIODES

HEATH PART NUMBER	MAY BE REPLACED WITH	DESCRIPTION	LEAD CONFIGURATION (TOP VIEW)
56-56	1N4149	10 mA, 75 V	

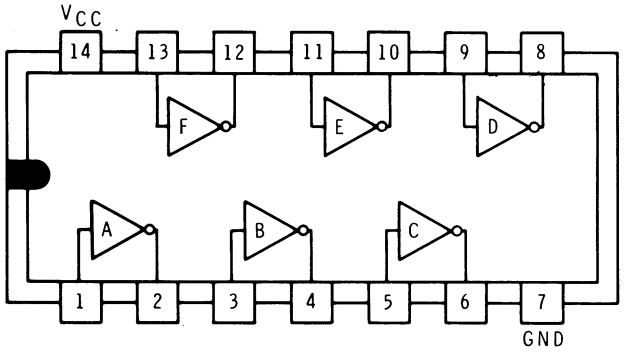
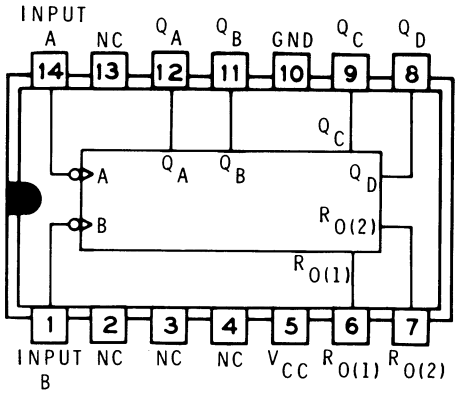
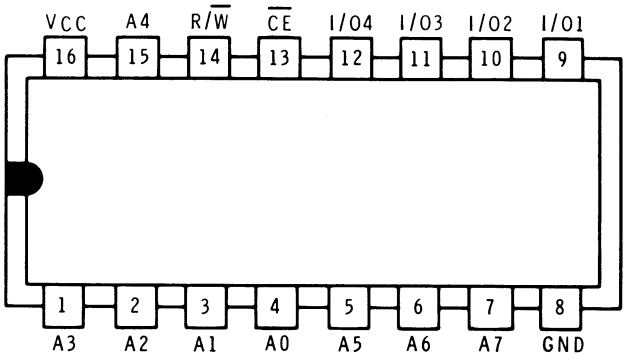
TRANSISTORS

HEATH PART NUMBER	MAY BE REPLACED WITH	
417-927	MPSA93	
417-937		

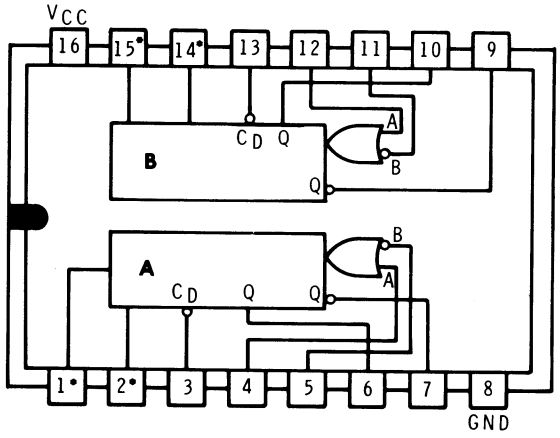
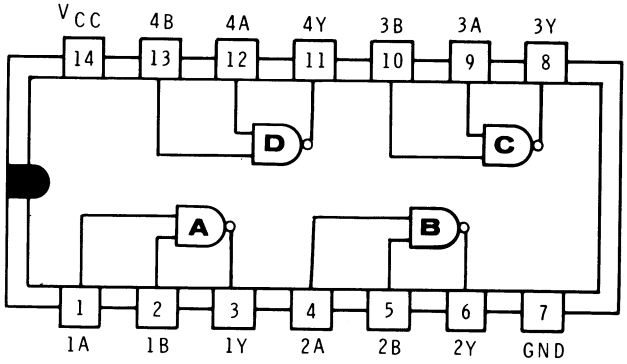
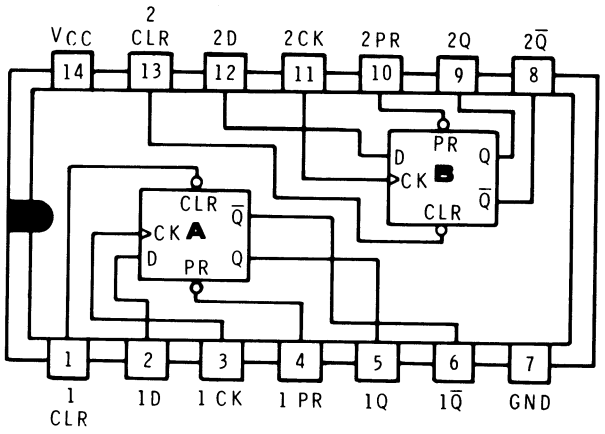
INTEGRATED CIRCUITS

442-630	7905.2	−5.2 V Regulator	
442-663	78M12CKC	+12 V Regulator	

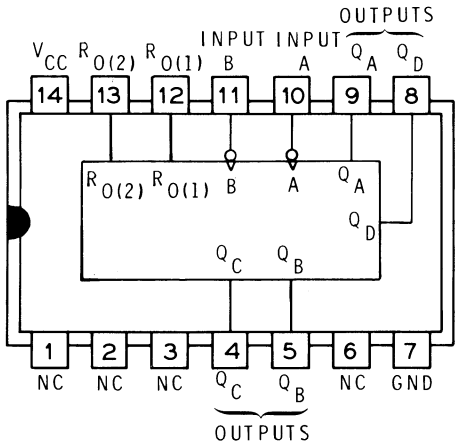
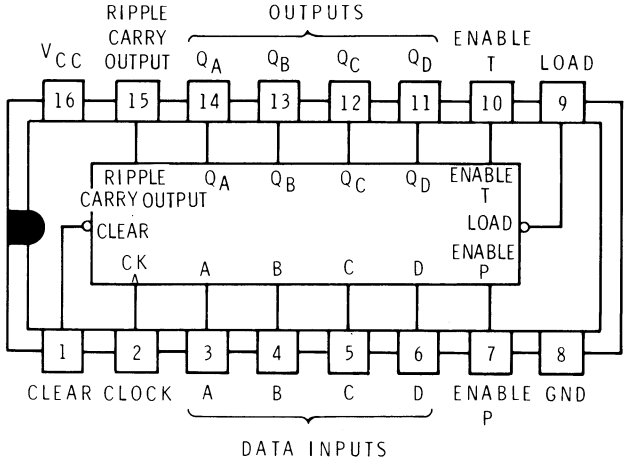
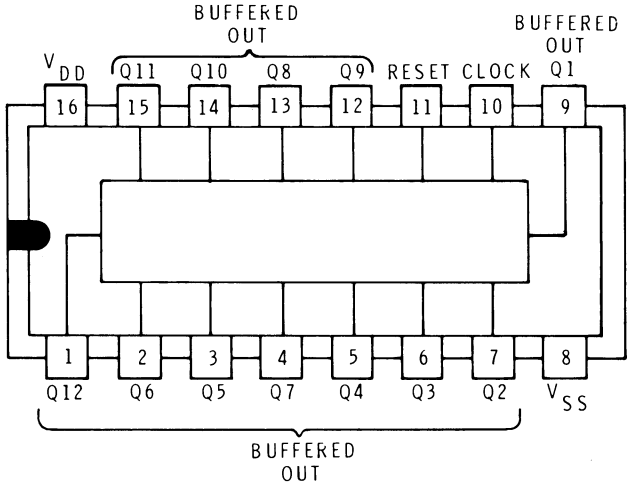
Integrated Circuits (Cont'd.)

HEATH PART NUMBER	MAY BE REPLACED WITH	DESCRIPTION	LEAD CONFIGURATION (TOP VIEW)
443-18	7404	Hex inverter	
443-34	7492	Divide-by-twelve counter	
443-721	2112-2	256×4 RAM	

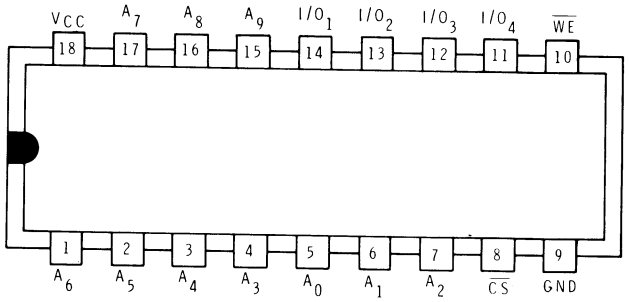
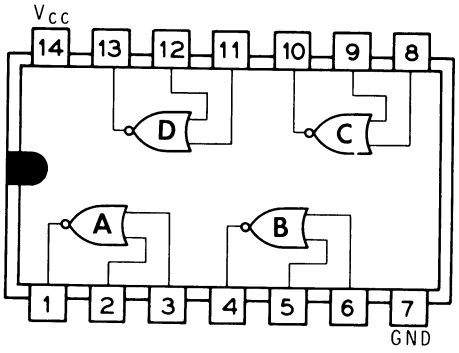
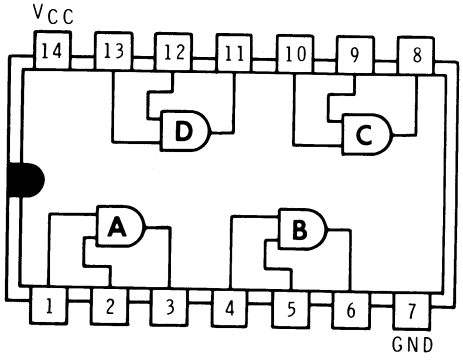
Integrated Circuits (cont'd.)

HEATH PART NUMBER	MAY BE REPLACED WITH	DESCRIPTION	LEAD CONFIGURATION (TOP VIEW)
443-727	96L02	Dual monostable	
443-728	74LS00	Quad 2-input NAND	
443-730	74LS74	Dual D flip-flop	

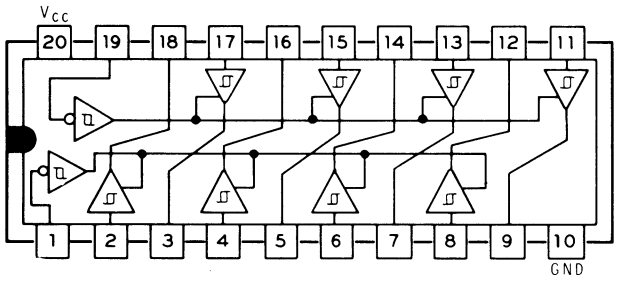
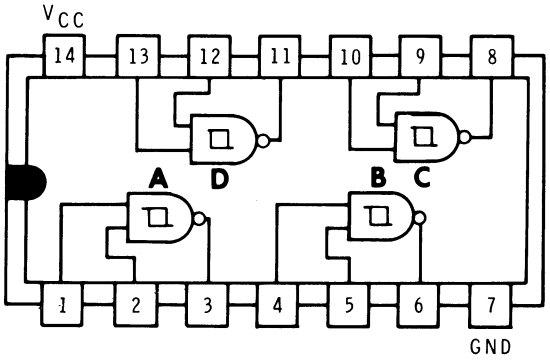
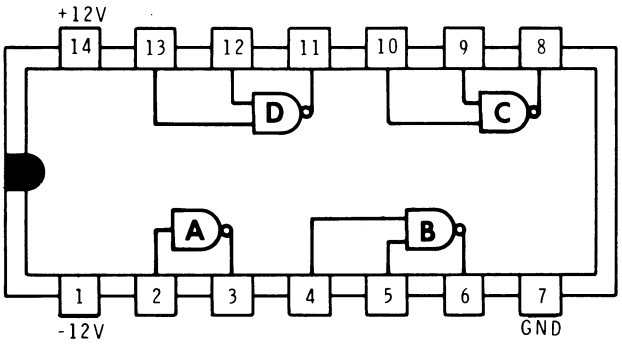
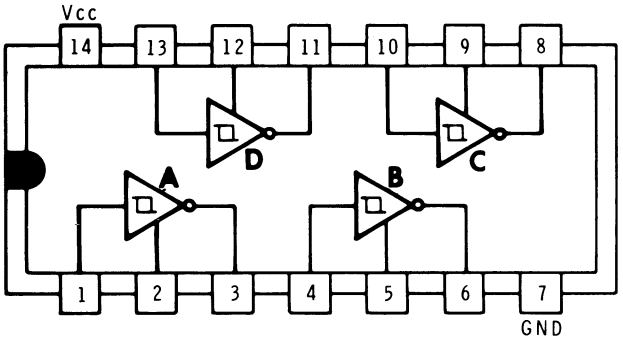
Integrated Circuits (cont'd.)

HEATH PART NUMBER	MAY BE REPLACED WITH	DESCRIPTION	LEAD CONFIGURATION (TOP VIEW)
443-733	74LS293	4-Bit binary counter	
443-757	74LS161	4-Bit binary counter	
443-760	4040	12-Bit binary counter	

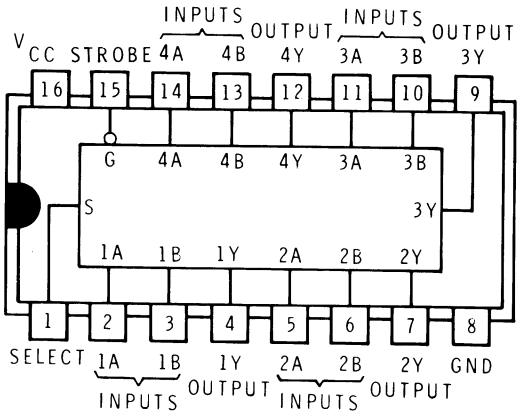
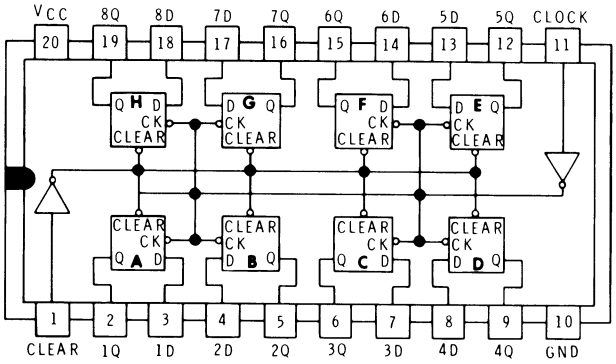
Integrated Circuits (cont'd.)

HEATH PART NUMBER	MAY BE REPLACED WITH	DESCRIPTION	LEAD CONFIGURATION (TOP VIEW)
443-764	2114	1K × 4 RAM	
443-779	74LS02	Quad 2-input positive-NOR gates	
443-780	74LS08	Quad 2-input positive-AND gates	

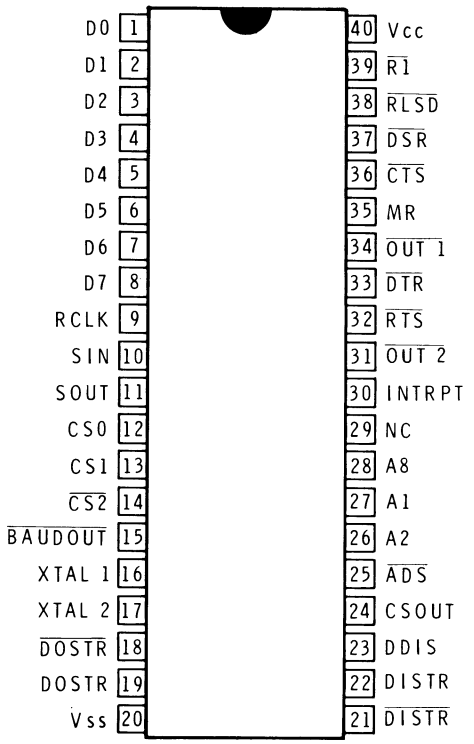
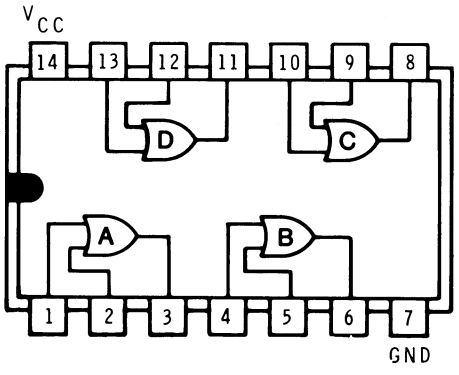
Integrated Circuits (cont'd.)

HEATH PART NUMBER	MAY BE REPLACED WITH	DESCRIPTION	LEAD CONFIGURATION (TOP VIEW)
443-791	74LS244	Non-inverting 3-state output octal buffers	
443-792	74LS132	Quad 2-input positive-NAND Schmitt triggers	
443-794	75188 or 1488	EIA Driver	
443-795	75189 or 1489	EIA Receiver	

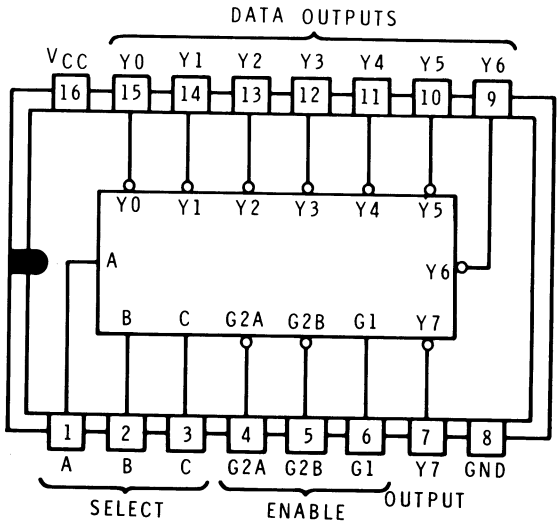
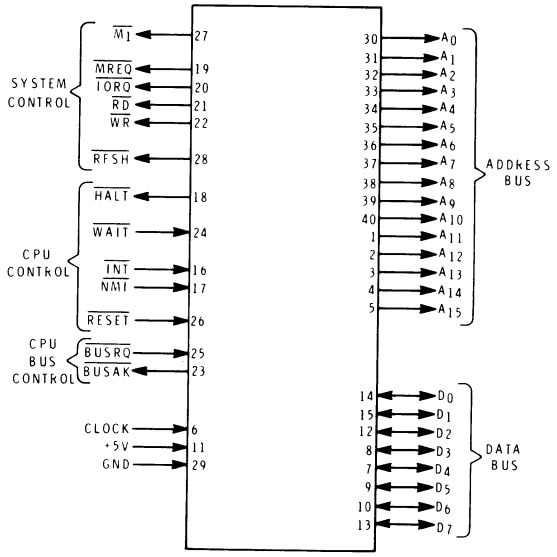
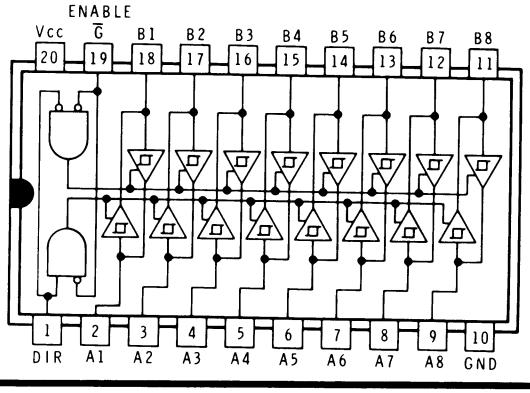
Integrated Circuits (cont'd.)

HEATH PART NUMBER	MAY BE REPLACED WITH	DESCRIPTION	LEAD CONFIGURATION (TOP VIEW)
443-799	74LS157	Quad 2-line-to-1-line multiplexers	
443-805	74LS273	Octal D flip-flop with clear	

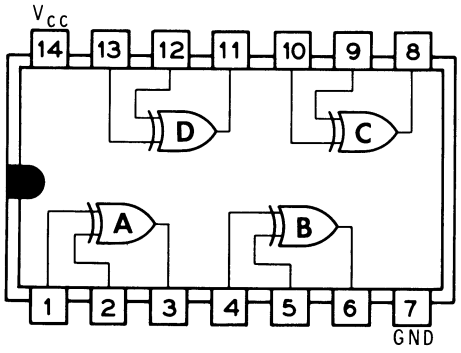
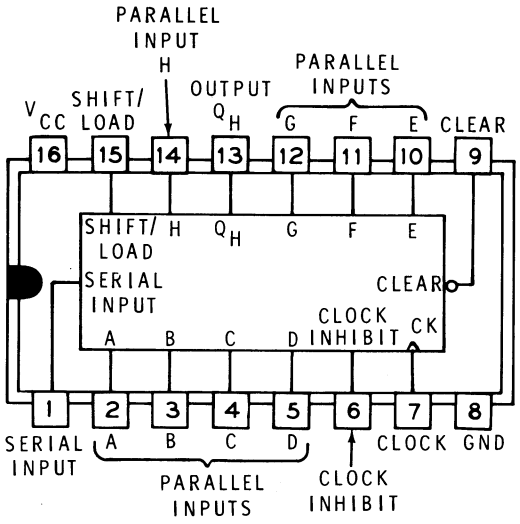
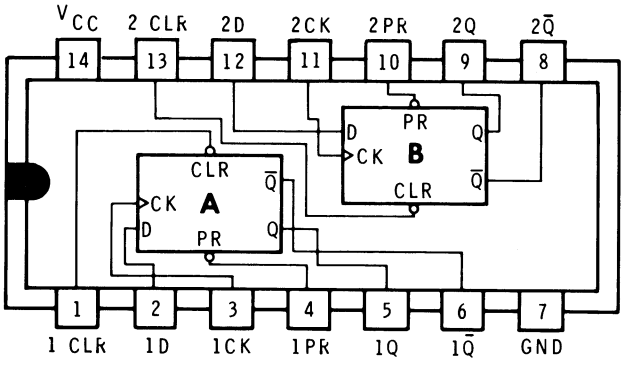
Integrated Circuits (cont'd.)

HEATH PART NUMBER	MAY BE REPLACED WITH	DESCRIPTION	LEAD CONFIGURATION (TOP VIEW)
443-952	8250	ACE	
443-875	74LS32	Quad 2-input positive OR gates	

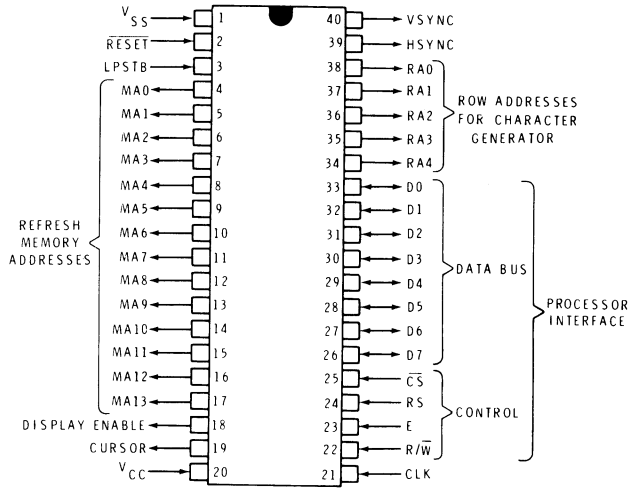
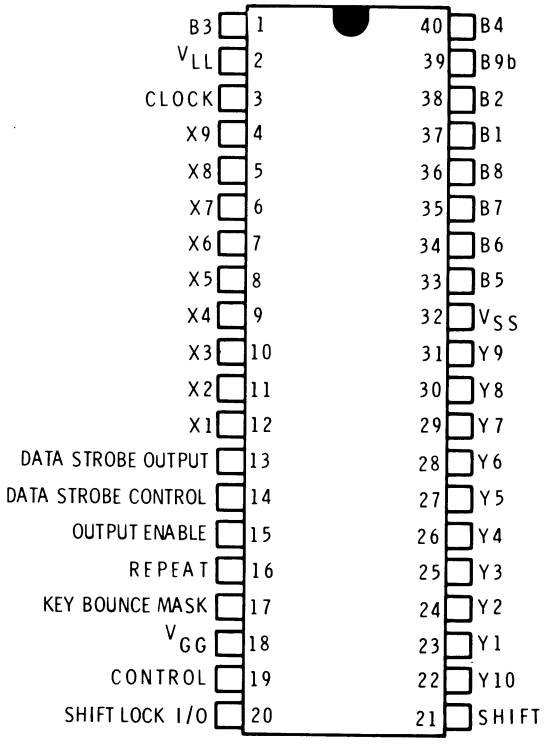
Integrated Circuits (cont'd.)

HEATH PART NUMBER	MAY BE REPLACED WITH	DESCRIPTION	LEAD CONFIGURATION (TOP VIEW)
443-877	74LS138	3-to-8-line decoder	
443-881	Z-80	Microprocessor	
443-885	74LS245	Octal bus transceiver	

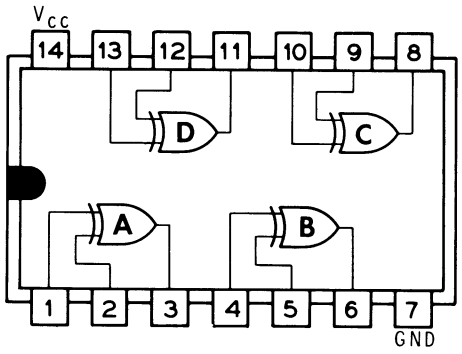
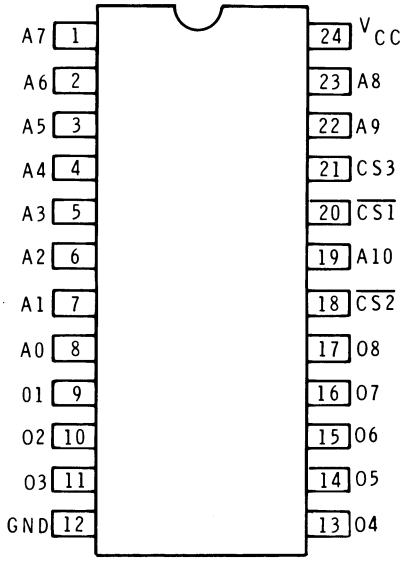
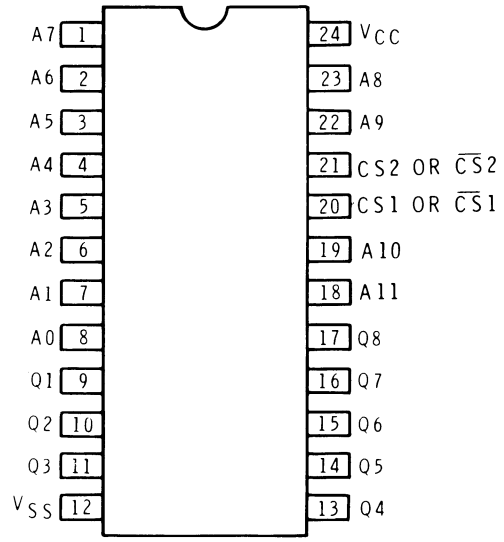
Integrated Circuits (cont'd.)

HEATH PART NUMBER	MAY BE REPLACED WITH	DESCRIPTION	LEAD CONFIGURATION (TOP VIEW)
443-891	74LS86	Quad 2-input Exclusive OR	
443-892	74LS166	8-Bit shift resister	
443-900	74S74	Dual-D Flip-flop	

Integrated Circuits (cont'd.)

HEATH PART NUMBER	MAY BE REPLACED WITH	DESCRIPTION	LEAD CONFIGURATION (TOP VIEW)
443-906	6845	CRT controller	
443-913	5740	Keyboard encoder	

Integrated Circuits (cont'd.)

HEATH PART NUMBER	MAY BE REPLACED WITH	DESCRIPTION	LEAD CONFIGURATION (TOP VIEW)
443-915	74S86	Quad 2-input exclusive OR	
444-29	2316 or 8316	2K × 8-bit ROM (available only from Heath Co.)	
444-37	2316 or 8316		
444-46		Programmed EPROM (available only from Heath Co.)	

APPENDIX

ASCII CHARACTERS

The characters in the shaded areas are not processed by the Terminal.

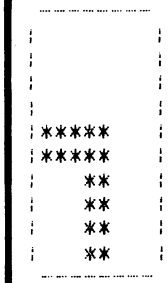
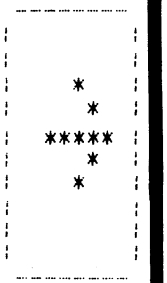
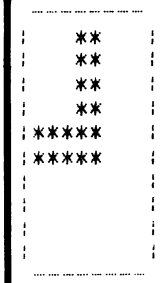
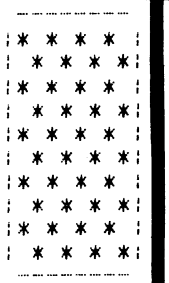
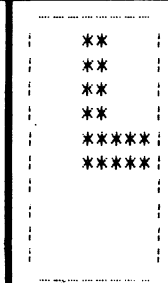
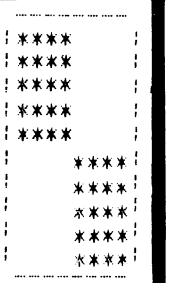
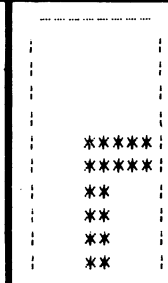
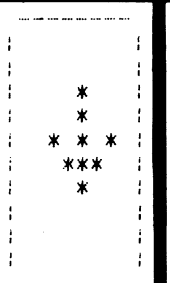
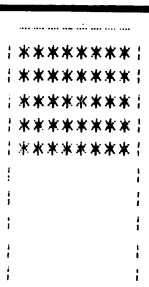
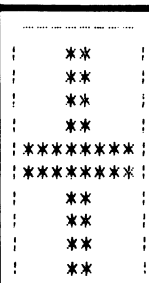
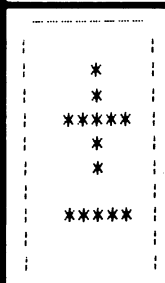
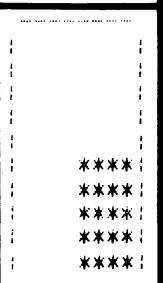
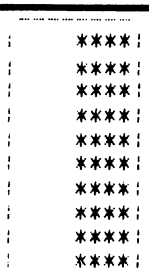
7-BIT OCTAL CODE	DECIMAL CODE	HEX CODE	CHARACTERS	CONTROL KEYS	DESCRIPTION
000	0	0	NUL	@	Null, tape feed.
001	1	1	SOH	A	Start of heading.
002	2	2	STX	B	Start of text.
003	3	3	ETX	C	End of text.
004	4	4	EOT	D	End of transmission.
005	5	5	ENQ	E	Enquiry; also WRU.
006	6	6	ACK	F	Acknowledge; also RU.
007	7	7	BEL	G	Rings the bell.
010	8	8	BS	H	Backspace; also FEB, format effector backspace.
011	9	9	HT	I	Horizontal tab.
012	10	A	LF	J	Line feed: advances cursor to next line.
013	11	B	VT	K	Vertical tab (VTAB).
014	12	C	FF	L	Form feed to top of next page.
015	13	D	CR	M	Carriage return to beginning of line.
016	14	E	SO	N	Shift out.
017	15	F	SI	O	Shift in.
020	16	10	DLE	P	Data line escape.
021	17	11	DC1	Q	Device control 1: turns transmitter on (XON).
022	18	12	DC2	R	Device control 2.
023	19	13	DC2	S	Device control 3: turns transmitter off (XOFF).
024	20	14	DC4	T	Device control 4.
025	21	15	NAK	U	Negative acknowledge: also ERR (error).
026	22	16	SYN	V	Synchronous idle (SYNC).
027	23	17	ETB	W	End of transmission block.
030	24	18	CAN	X	Cancel (CANCL). Cancels current escape sequence.
031	25	19	EM	Y	End of medium.
032	26	1A	SUB	Z	Substitute.
033	27	1B	ESC	[	Escape.
034	28	1C	FS	\	File separator.
035	29	1D	GS	]	Group separator.
036	30	1E	RS	^	Record separator.
037	31	1F	US	-	Unit separator.

7-BIT OCTAL CODE	DECIMAL CODE	HEX CODE	CHARACTERS	DESCRIPTION
040	32	20	SP	Space.
041	33	21	!	Exclamation point.
042	34	22	"	Quotation mark.
043	35	23	#	Number sign.
044	36	24	$	Dollar sign.
045	37	25	%	Percent sign.
046	38	26	&	Ampersand.
047	39	27	'	Acute accent or apostrophe.
050	40	28	(	Open parenthesis.
051	41	29	)	Close parenthesis.
052	42	2A	*	Asterisk.
053	43	2B	+	Plus sign.
054	44	2C	,	Comma.
055	45	2D	–	Hyphen or minus sign.
056	46	2E	.	Period.
057	47	2F	/	Slash.
060	48	30	0	Number 0.
061	49	31	1	Number 1.
062	50	32	2	Number 2.
063	51	33	3	Number 3.
064	52	34	4	Number 4.
065	53	35	5	Number 5.
066	54	36	6	Number 6.
067	55	37	7	Number 7.
070	56	38	8	Number 8.
071	57	39	9	Number 9.
072	58	3A	:	Colon.
073	59	3B	;	Semicolon.
074	60	3C	<	Less than.
075	61	3D	=	Equal sign.
076	62	3E	>	Greater than.
077	63	3F	?	Question mark.

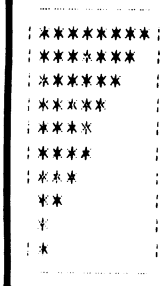
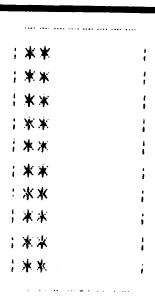
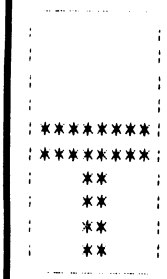
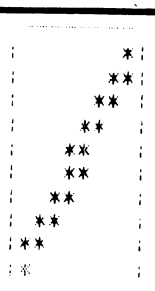
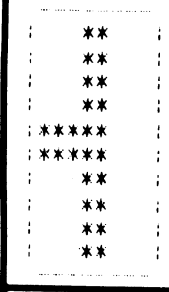
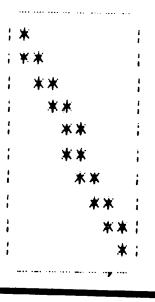
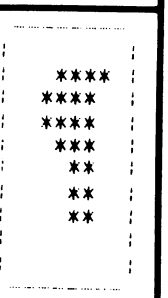
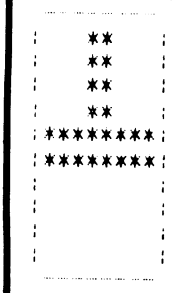
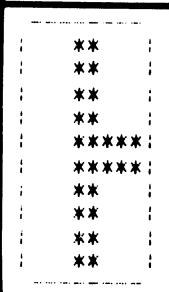
7-BIT OCTAL CODE	DECIMAL CODE	HEX CODE	CHARACTERS	DESCRIPTION	GRAPHIC SYMBOLS
100	64	40	@	At sign.	
101	65	41	A	Letter A.	
102	66	42	B	Letter B.	
103	67	43	C	Letter C.	
104	68	44	D	Letter D.	
105	69	45	E	Letter E.	
106	70	46	F	Letter F.	
107	71	47	G	Letter G.	
110	72	48	H	Letter H.	
111	73	49	I	Letter I.	
112	74	4A	J	Letter J.	
113	75	4B	K	Letter K.	
114	76	4C	L	Letter L.	
115	77	4D	M	Letter M.	
116	78	4E	N	Letter N.	
117	79	4F	O	Letter O.	
120	80	50	P	Letter P.	
121	81	51	Q	Letter Q.	
122	82	52	R	Letter R.	
123	83	53	S	Letter S.	
124	84	54	T	Letter T.	
125	85	55	U	Letter U.	
126	86	56	V	Letter V.	
127	87	57	W	Letter W.	
130	88	58	X	Letter X.	
131	89	59	Y	Letter Y.	
132	90	5A	Z	Letter Z.	
133	91	5B	[	Open brackets.	
134	92	5C	\	Reverse slash.	
135	93	5D	]	Close brackets.	
136	94	5E	↑	Up arrow/caret.	
137	95	5F	_	Underscore.	

7-BIT OCTAL CODE	DECIMAL CODE	HEX CODE	CHARACTERS	DESCRIPTION	GRAPHIC SYMBOLS
140	96	60	\	Grave accent.	
141	97	61	a	Letter a.	
142	98	62	b	Letter b.	
143	99	63	c	Letter c.	
144	100	64	d	Letter d.	
145	101	65	e	Letter e.	
146	102	66	f	Letter f.	
147	103	67	g	Letter g.	
150	104	68	h	Letter h.	
151	105	69	i	Letter i.	
152	106	6A	j	Letter j.	
153	107	6B	k	Letter k.	
154	108	6C	l	Letter l.	
155	109	6D	m	Letter m.	
156	110	6E	n	Letter n.	
157	111	6F	o	Letter o.	
160	112	70	p	Letter p.	
161	113	71	q	Letter q.	
162	114	72	r	Letter r.	
163	115	73	s	Letter s.	
164	116	74	t	Letter t.	
165	117	75	u	Letter u.	
166	118	76	v	Letter v.	
167	119	77	w	Letter w.	
170	120	78	x	Letter x.	
171	121	79	ẏ	Letter y.	
172	122	7A	z	Letter z.	
173	123	7B	{	Left brace.	
174	124	7C	¦	Vertical bar (broken).	
175	125	7D	}	Right brace.	
176	126	7E	~	Tilde.	
177	**127**	**7F**	**DEL**	**Delete (rubout).**	

GRAPHIC SYMBOLS

KEY (OCTAL) [DECIMAL]	SYMBOL	KEY (OCTAL) [DECIMAL]	SYMBOL	KEY (OCTAL) [DECIMAL]	SYMBOL	KEY (OCTAL) [DECIMAL]	SYMBOL
^ (136) [94]		c (143) [99]		h (150) [104]		m (155) [109]	
_ (137) [95]		d (144) [100]		i (151) [105]		n (156) [110]	
` (140) [96]		e (145) [101]		j (152) [106]		o (157) [111]	
a (141) [97]		f (146) [102]		k (153) [107]		p (160) [112]	
b (142) [98]		g (147) [103]		l (154) [108]		q (161) [113]	

Graphic Symbols (cont'd.)

KEY (OCTAL) [DECIMAL]	SYMBOL	KEY (OCTAL) [DECIMAL]	SYMBOL	KEY (OCTAL) [DECIMAL]	SYMBOL
r (162) [114]		w (167) [119]		¡ (174) [124]	
s (163) [115]		x (170) [120]		} (175) [125]	
t (164) [116]		y (171) [121]		~ (176) [126]	
u (185) [117]		z (172) [122]			
v (166) [118]		{ (173) [123]			

TRANSMITTED CODES

The following tables list the octal code or codes transmitted by the Terminal when the indicated keyboard keys are pressed.

KEY	LOWER CASE	UPPER CASE
A	141	101
B	142	102
C	143	103
D	144	104
E	145	105
F	146	106
G	147	107
H	150	110
I	151	111
J	152	112
K	153	113
L	154	114
M	155	115
N	156	116
O	157	117
P	160	120
Q	161	121
R	162	122
S	163	123
T	164	124
U	165	125
V	166	126
W	167	127
X	170	130
Y	171	131
Z	172	132

ALPHABETIC KEYS

KEY	UNSHIFTED	SHIFTED	
0	060	051	)
1	061	041	!
2	062	100	@
3	063	043	#
4	064	044	$
5	065	045	%
6	066	136	↑
7	067	046	&
8	070	052	*
9	071	050	(
–	055	137	_
=	075	053	+
[	133	135	]
;	073	072	:
'	047	042	"
,	054	074	<
.	056	076	>
/	057	077	?
`	140	176	~
\	134	174	¦
{	173	175	}

NONALPHABETIC KEYS

KEYPAD KEYS	UNSHIFTED	ZDS UNSHIFTED ALTERNATE	ANSI UNSHIFTED ALTERNATE	SHIFTED
∅	∅	ESC ? p	ESC O p	∅
1\IL	1	ESC ? q	ESC O q	ESC L (Insert Line)
2\	2	ESC ? r	ESC O r	ESC B (Down arrow)
3\DL	3	ESC ? s	ESC O s	ESC M (Delete Line)
4\←	4	ESC ? t	ESC O t	ESC D (Left arrow)
5\HOME	5	ESC ? u	ESC O u	ESC H (Home)
6\→	6	ESC ? v	ESC O v	ESC C (Right arrow)
7\IC	7	ESC ? w	ESC O w	ESC @ (Enter Insert Character Mode) ESC O (Exit Insert Character Mode)
8\↑	8	ESC ? x	ESC O x	ESC A (Up arrow)
9\DC	9	ESC ? y	ESC O y	ESC N (Delete Character)
•	•	ESC ? n	ESC O n	•
ENTER	RETURN	ESC ? M	ESC O M	RETURN

KEYPAD KEYS

NOTE: The shifted mode and the unshifted (or alternate) mode (if the alternate mode was selected) can be interchanged by entering ESC t or ESC u.

KEY	ZDS ESCAPE CODE	ANSI ESCAPE CODE
∅	ESC ? p	ESC O p
1	ESC ? q	ESC O q
2	ESC ? r	ESC O r
3	ESC ? s	ESC O s
4	ESC ? t	ESC O t
5	ESC ? u	ESC O u
6	ESC ? v	ESC O v
7	ESC ? w	ESC O w
8	ESC ? x	ESC O x
9	ESC ? y	ESC O y
•	ESC ? n	ESC O n
ENTER	ESC ? M	ESC O M

ALTERNATE KEYPAD MODE

KEY	OCTAL CODE	ANSI CODE
RETURN	015	015
LINE FEED	012	012
BACKSPACE	010	010
SPACE BAR	040	040
TAB	011	011
DELETE	177	177
ESC	033	033

MISCELLANEOUS KEYS

KEY	ZDS ESCAPE CODE	ANSI ESCAPE CODE
F1	ESC S	ESC O S
F2	ESC T	ESC O T
F3	ESC U	ESC O U
F4	ESC V	ESC O V
F5	ESC W	ESC O W
BLUE	ESC P	ESC O P
RED	ESC Q	ESC O Q
GRAY	ESC R	ESC O R

SPECIAL FUNCTION KEYS

ZDS ESCAPE SEQUENCES

Summary of Sequences

CURSOR FUNCTIONS

Escape Sequence	Mnemonic	Definition
ESC H	ZCUH	Cursor Home
ESC C	ZCUF	Cursor Forward
ESC D	ZCUB	Cursor Backward
ESC B	ZCUD	Cursor Down
ESC A	ZCUU	Cursor Up
ESC I	ZRI	Reverse Index
ESC n	ZCPR	Cursor Position Report
ESC j	ZSCP	Save Cursor Position
ESC k	ZRCP	Set Cursor to Previously Saved Position
ESC Y	ZDCA	Direct Cursor Addressing (Same as VT52)

ERASING AND EDITING

ESC E	ZCD	Clear Display (Shift Erase)
ESC b	ZBD	Erase Beginning of Display
ESC J	ZEOP	Erase to End of Page (Erase Key)
ESC l	ZEL	Erase Entire Line
ESC o	ZEBL	Erase Beginning of Line
ESC K	ZEOL	Erase to End of Line
ESC L	ZIL	Insert Line
ESC M	ZDL	Delete Line
ESC N	ZDCH	Delete Character
ESC @	ZEIM	Enter Insert Character Mode
ESC O	ZERM	Exit Insert Character Mode

CONFIGURATION

ESC z	ZRAM	Reset to Power-Up Configuration
ESC r B_n	ZMBR	Modify Baud Rate (B_n=; A=110, B=150, C=300, D=600, E=1200, F=1800, G=2000, H=2400, I=3600, J=4800, K=7200, L=9600)
ESC x P_s	ZSM	Set Mode(s): P_s= 1 = Enable 25th line 2 = No key click 3 = Hold screen mode 4 = Block cursor 5 = Cursor off 6 = Keypad shifted 7 = Alternate keypad mode 8 = Auto line feed on receipt of CR 9 = Auto CR on receipt of line feed

ESC y P_s	ZRM	Reset Mode(s): P_s= 1 = Disable 25th line 2 = Enable key click 3 = Exit hold screen mode 4 = Underscore cursor 5 = Cursor on 6 = Keypad unshifted 7 = Exit alternate keypad mode 8 = No auto line feed 9 = No auto CR
ESC <	ZEAM	Enter ANSI Mode

MODES OF OPERATION

ESC [	ZEHS	Enter Hold Screen Mode
ESC \	ZXHS	Exit Hold Screen Mode
ESC p	ZERV	Enter Reverse Video Mode
ESC q	ZXRV	Exit Reverse Video Mode
ESC F	ZEGM	Enter Graphics Mode
ESC G	ZXGM	Exit Graphics Mode
ESC t	ZEKS	Enter Keypad Shifted Mode
ESC u	ZXKS	Exit Keypad Shifted Mode
ESC =	ZAKM	Enter Alternate Keypad Mode
ESC >	ZXAM	Exit Alternate Keypad Mode

ADDITIONAL FUNCTIONS

ESC }	ZDK	Keyboard Disabled
ESC {	ZEK	Keyboard Enabled
ESC v	ZEWA	Wrap Around at End of Line
ESC w	ZXWA	Discard at End of Line
ESC Z	ZID	Identify as VT52 (ESC / K)
ESC]	ZX25	Transmit 25th Line
ESC #	ZXMP	Transmit Page

NOTE: The Terminal will transmit the following sequences, but it will not respond to them if they are received by the Terminal.

ESC S	ZF1	Function Key #1 (f1)
ESC T	ZF2	Function Key #2 (f2)
ESC U	ZF3	Function Key #3 (f3)
ESC V	ZF4	Function Key #4 (f4)
ESC W	ZF5	Function Key #5 (f5)
ESC P	ZF7	Function Key (BLUE)
ESC Q	ZF8	Function Key (RED)
ESC R	ZF9	Function Key (GRAY)

ZDS Escape Sequences Defined

CURSOR FUNCTIONS

ZCUH Cursor Home ESC H
Moves the cursor to the first character position on the first line (home).

ZCUF Cursor Forward ESC C
Moves the cursor one character position to the right. If the cursor is at the right end of the line, it will remain there.

ZCUB Cursor Backward ESC D
Moves the cursor one character position to the left (backspaces). If the cursor is at the start (left end) of a line, it will remain there.

ZCUD Cursor Down ESC B
Moves the cursor down one line without changing columns. The cursor will not move past the bottom (24th) line and no scrolling will take place. Use HDCA (Direct Cursor Addressing) to move the cursor to line 25 — when line 25 is active.

ZCUU Cursor Up ESC A
Moves the cursor up one line. If the cursor reaches the top line, it remains there and no scrolling occurs.

ZRI Reverse Index ESC I
Moves the cursor to the same horizontal position on the preceding line. If the cursor is on the top line, a scroll down is performed.

ZCPR Cursor Position Report ESC n
The Terminal reports the cursor position in the form of ESC Y line# column#.

ZSCP Save Cursor Position ESC j
The present cursor position is saved so the cursor can be returned here later when given the HRCP (Set Cursor to Previously Saved Position) command.

ZRCP Set Cursor to Previously Saved Position ESC k
Returns the cursor to the position where it was when it received the HSCP (Save Cursor Position) command.

ZDCA Direct Cursor Addressing ESC Y
Moves the cursor to a position on the screen by entering the escape code, the ASCII character which represents the line number, and the ASCII character which represents the column number.

The first line and the left column are both 32_{10} (the smallest value of the printing characters) and increase from there. Since the lines are numbered from 1 to 25 (from top to bottom) and the columns from 1 to 80 (from left to right), you must add the proper line and column numbers to 31_{10}. Then convert these decimal numbers to their equivalent ASCII characters and enter them in the following order:

ESC Y line # (ASCII character) column # (ASCII character)

If the line number entered is too high, the cursor will not move. If the column number is too high, the cursor will move to the end of the line.

This is the only way to move the cursor to the 25th line, but the 25th line must first be enabled.

ERASING AND EDITING

ZCD Clear Display (Shift Erase) ESC F
Erases the entire screen, fills the screen with spaces, and places the cursor in the home position.

ZBD Erase Beginning of Display ESC b
Erases from the start of the screen to the cursor, and includes the cursor position.

ZEOP Erase to End of Page (Erase Key) ESC J
Erases all the information from the cursor (including the cursor position) to the end of the page.

ZEL ERASE Entire Line ESC l
Erases all of the line, including the cursor position.

ZEBL Erase Beginning of Line ESC o
Erases from the beginning of the line to the cursor, and includes the cursor position.

ZEOL Erase to End of Line ESC K
Erases from the cursor (including the cursor position) to the end of the line.

ZIL Insert Line ESC L
Inserts a new blank line by moving the line that the cursor is on, and all following lines, down one line. Then the cursor is moved to the beginning of the new blank line.

ZDL Delete Line ESC M
Deletes the contents of the line that the cursor is on, places the cursor at the beginning of the line, moves all the following lines up one line, and adds a blank line at line 24.

ZDCH Delete Character ESC N
Deletes the character at the cursor position and shifts any existing text that is to the right of the cursor one character position to the left.

ZEIM Enter Insert Character Mode ESC @
Lets you insert characters or words into text already displayed on the screen. As you type in new characters, existing text to the right of the cursor shifts to the right. As each new character is inserted, the character at the end of the line is lost.

ZERM Exit Insert Character Mode ESC O
Exits from the insert character mode.

CONFIGURATION

ZRAM Reset to Power-up Configuration ESC z
Nullifies all previously set escape modes and returns to the power-up configuration.

ZMBR Modify Baud Rate ESC r Bn
Modifies the baud rate, where Bn equals:
A=110, B=150, C=300, D=600,
E=1200, F=1800, G=2000, H=2400,
I=3600, J=4800, K=7200, L=9600

ZSM Set Mode(s) ESC x P_s
Sets the following modes, where P_s equals:
1=enable 25th line
2=no key click
3=hold screen mode
4=block cursor
5=cursor off
6=keypad shifted
7=alternate keypad mode
8=auto line feed on receipt of CR
9=auto CR on receipt of line feed

ZRM Reset Mode(s) ESC y P_s
Resets special modes, where P_s equals:
1=disable 25th line
2=enable key click
3=exit hold screen mode
4=underscore cursor
5=cursor on
6=keypad unshifted
7=exit alternate keypad mode
8=no auto line feed
9=no auto CR

ZEAM Enter ANSI Mode ESC <
Enters the ANSI mode.

MODES OF OPERATION

ZEHS Enter Hold Screen Mode ESC [
Controls when new information is printed on the screen.
— Type the SCROLL key and a new line of information will be printed on the bottom line. The top line will scroll off.
— Type SHIFT SCROLL and a whole new page of text will scroll onto the screen and stop as the old page scrolls up and off the screen.

ZXHS Exit Hold Screen Mode ESC
Exits the hold screen mode.

ZERV Enter Reverse Video Mode ESC p
Enters the reverse video mode so that characters are displayed as black characters on a white background.

ZXRV Exit Reverse Video Mode ESC q
Exits the reverse video mode.

ZEGM Enter Graphics Mode ESC F
Enters the graphics mode to display any of the 33 special symbols (26 lower-case keys and seven other keys) that correspond to the graphic symbols.

ZXGM Exit Graphics Mode ESC G
Exits the graphics mode and returns to the display of normal characters.

ZEKS Enter Keypad Shifted Mode ESC 1
Inverts the normal and shifted functions of the keypad. Now, if you hold down the SHIFT key, you will get a normally unshifted character.

ZXKS Exit Keypad Shifted Mode ESC u
Exits the keypad shifted mode.

ZAKM Enter Alternate Keypad Mode ESC =
Enters the alternate keypad mode, which will then allow the keyboard keys to transmit the following escape codes instead of the normal ones.

KEY	ESCAPE CODE
0	ESC ? p
1	ESC ? q
2	ESC ? r
3	ESC ? s
4	ESC ? t
5	ESC ? u
6	ESC ? v
7	ESC ? w
8	ESC ? x
9	ESC ? y
•	ESC ? n
ENTER	ESC ? M

These special escape codes are user defined and must be recognized by your software.

ZXAM Exit Alternate Keypad Mode ESC >
Exits the alternate keypad mode and returns to the transmission of normal character codes.

ADDITIONAL FUNCTIONS

ZDK Keyboard Disabled ESC }
Inhibits the output of the keyboard.

ZEK Keyboard Enabled ESC {
Enables the keyboard after it was inhibited by an HDK (Keyboard Disabled) command.

ZEWA Wrap Around at End of Line ESC v
The 81st character on a line is automatically placed in the first character position on the next line. The page scrolls up if necessary.

ZXWA Discard at End of Line ESC w
After the 80th character in a line, the characters overprint. Therefore, only the last character received will be displayed in position 80.

ZID Identify as VT52 (ESC/K) ESC Z
The Terminal responds to the interrogation with ESC / K to indicate that it can perform as a VT52.

ZX25 Transmit 25th Line ESC]
Transmits the 25th line. (The computer requires a special routine to use this feature.)

ZXMP Transmit Page ESC #
Transmits lines 1 through 24. (The computer requires a special routine to use this feature.)

ZF1 Function Key #1 (F1) ESC S
Transmits a unique escape code to perform a user-defined function. The Terminal will not respond to this code if it is received.

ZF2 Function Key #2 (F2) ESC T
Same as above.

ZF3 Function Key #3 (F3) ESC U
Same as above.

ZF4 Function Key #4 (F4) ESC V
Same as above.

ZF5 Function Key #5 (F5) ESC W
Same as above.

ZF7 Function Key Blue ESC P
Same as above.

ZF8 Function Key Red ESC Q
Same as above.

ZF9 Function Key Gray ESC R
Same as above.

ANSI ESCAPE SEQUENCES

Summary of Sequences

NOTES:

1. In the ANSI mode, the Terminal recognizes and responds only to escape sequences whose syntax and semantics are in accordance with ANSI specifications.

2. "Default" is a value that is assumed when no explicit value, or a value of zero, is specified.

3. P_n — Numeric Parameter. Any decimal value may be substituted for P_n.

4. P_s — Selective Parameter. Any decimal number that is taken from a list and used to select a subfunction. You can select several subfunctions at once by putting one number after another but separating them with delimiters (semicolons).

   Example: To turn off the key click (ESC [> 2 h) and turn on the block cursor (ESC [> 4 h), type:

   ESC [> 2;4 h

Escape Sequence	Mnemonic	Definition
CURSOR FUNCTIONS		
ESC [H or ESC [Ø;Ø H or ESC [1;1 H ESC [f or ESC [Ø;Ø f or ESC [1;1 f	CUP or HUP	Cursor Home
ESC [P_n C	CUF	Cursor Forward
ESC [P_n D	CUB	Cursor Backward
ESC [P_n B	CUD	Cursor Down
ESC [P_n A	CUU	Cursor Up
ESC M	RI	Reverse Index
ESC [6n	CPR	Cursor Position Report
ESC [s	PSCP	Save Cursor Position
ESC [u	PRCP	Set Cursor Position
ESC [P_l;P_c H or ESC [P_l;P_c f	CUP	Direct Cursor Addressing

ERASING AND EDITING

ESC [2 J	ED	Clear Display (Shift Erase)
ESC [1 J	ED	Erase Beginning of Display
ESC [J or ESC [∅ J	ED	Erase to End of Page (Erase Key)
ESC [2 K	EL	Erase Entire Line
ESC [1 K	EL	Erase Beginning of Line
ESC [K or ESC [∅ K	EL	Erase to End of Line
ESC [P_n L	IL	Insert Line
ESC [P_n M	DL	Delete Line
ESC [P_n P	DCH	Delete Character
ESC [4 h	IRM	Insert/Replacement (Insert character) Mode On
ESC [4 l	IRM	Insert/Replacement (Insert Character) Mode Off

CONFIGURATION

ESC [z	PRAM	Reset to Power-Up Configuration
ESC [P_n r	PMBR	Modify Baud Rate (P_n=; 1=110, 2=150, 3=300, 4=600, 5=1200, 6=1800, 7=2000, 8=2400, 9=3600, 10=4800, 11=7200, 12=9600)
ESC [> P_s h	SM	Set Mode(s): P_n= 1 = Enable 25th line 2 = No key click 3 = Hold screen mode 4 = Block cursor 5 = Cursor off 6 = Keypad shifted 7 = Alternate Keypad mode 8 = Auto line feed on receipt of CR 9 = Auto CR on receipt of line feed
ESC [> P_s l	RM	Reset Mode(s): P_n= 1 = Disable 25th line 2 = Enable key click 3 = Exit hold screen mode 4 = Underscore cursor 5 = Cursor on 6 = Keypad unshifted 7 = Exit alternate keypad mode 8 = No auto line feed 9 = No auto CR
ESC [? 2 h	PEZM	Enter ZDS Mode

MODES OF OPERATION

ESC [7 m	SGR	Enter Reverse Video Mode
ESC [m or ESC [∅ m	SGR	Exit Reverse Video Mode
ESC [> 7 h	SM	Enter Alternate Keypad Mode (ESC =)*
ESC [> 7 l	RM	Exit Alternate Keypad Mode (ESC >)*
ESC [10 m	SGR	Enter Graphics Mode
ESC [11 m	SGR	Exit Graphics Mode

*These escape codes may be used, but are not recommended.

ADDITIONAL FUNCTIONS

ESC [2 h	SM	Keyboard Disabled
ESC [2 l	RM	Keyboard Enabled
ESC [? 7 h	SM	Wrap Around at End of Line
ESC [? 7 l	RM	Discard at End of Line
ESC [q	PX25	Transmit 25th Line
ESC [p	PXMT	Transmit Page

NOTE: The Terminal will transmit the following functions, but it will not respond to them if they are received by the Terminal.

ESC O S	SS3	Function Key #1 (F1)
ESC O T	SS3	Function Key #2 (F2)
ESC O U	SS3	Function Key #3 (F3)
ESC O V	SS3	Function Key #4 (F4)
ESC O W	SS3	Function Key #5 (F5)
ESC O P	SS3	Function Key (BLUE)
ESC O Q	SS3	Function Key (RED)
ESC O R	SS3	Function Key (GRAY)

ANSI Mode Summary

The ANSI controls SET MODE (SM) and RESET MODE (RM) are shown on the previous page. The following table shows all parameters which may be set or reset using the SM and RM control sequences.

The control sequence for SET MODE is: ESC [P_s h.
The control sequence for RESET MODE is: ESC [P_s l.

	MODE	P_s	SET (SM)	RESET (RM)
ANSI	KAM	2	Keyboard Disabled	Keyboard Enabled
	IRM	4	Insert Character Mode on	Insert Character Mode Off
	LNM	2ϕ	New Line Mode (Auto Line Feed on CR)	New Line Mode Off
ZDS	L25	>1	Display 25th Line	Disable 25th Line
	KCL	>2	Disable Key Click	Enable Key Click
	HSM	>3	Enable Hold Screen Mode	Disable Hold Screen Mode
	CBL	>4	Blinking Block Cursor	Blinking Underscore Cursor
	CDE	>5	Cursor Off	Cursor on
	KSH	>6	Keypad Shifted	Keypad Unshifted
	KAM	>7	Keypad Alternate Mode	Keypad Normal Mode
	ALF	>8	Auto Line Feed on Return	No Auto Line Feed
	ACR	>9	Auto CR on Line Feed	No Auto CR on Line Feed
	ZMD	?2	Enter ZDS Mode	N/A
	WAR	?7	Wrap Around at End of Line	Discard Past End of Line

ANSI modes which are always considered to be in either the SET or the RESET state, and those which do not apply to this product are as follows:

CRM	Control Representation Mode	RESET
EBM	Editing Boundary Mode	RESET
ERM	Erasure Mode	SET
FEAM	Format Effector Action Mode	RESET
FETM	Format Effector Transfer Mode	RESET
GATM	Guarded Area Transfer Mode	RESET
HEM	Horizontal Editing Mode	RESET
MATM	Multiple Area Transfer Mode	N/A
PUM	Positioning Unit Mode	RESET
SATM	Selected Area Transfer Mode	SET
SRTM	Status Reporting Transfer Mode	N/A
TSM	Tabulation Stop Mode	N/A
TTM	Transfer Termination Mode	SET
VEM	Vertical Editing Mode	RESET
SEM	Set Editing Extent Mode	Edit in Line

ANSI Escape Sequences Defined

NOTES:

1. In the ANSI mode, the Terminal recognizes and responds only to escape sequences whose syntax and semantics are in accordance with ANSI specifications.

2. "Default" is a value that is assumed when no explicit value, or a value of zero, is specified.

3. P_n — Numeric Parameter. Any decimal number that is substituted for P_n.

4. P_s — Selective Parameter. Any decimal number that is taken from a list and used to select a subfunction. You can select several subfunctions at once by putting one number after another but separating them with delimiters (semicolons).

CURSOR FUNCTIONS

CUP Cursor Position	**ESC [H** or **ESC [Ø;Ø H** or
or	**ESC [1;1 H**
HVP Horizontal & Vertical Position	**ESC [f** or **ESC [Ø;Ø f)** or
	ESC [1;1 f

Moves the cursor to the position specified by the parameters. The first parameter specifies the line number and the second parameter specifies the column number. A parameter of zero is considered to be one. If no parameter is given, the cursor is placed in the home position.

Default Value: 1

CUF Cursor Forward ESC [P_n C
Moves the cursor to the right the number of characters determined by the value of P_n. If this number is zero or one, the cursor moves one position. The cursor stops at the right margin.

Default Value: 1

CUB Cursor Backward ESC [P_n D
Moves the cursor to the left the number of characters determined by the value of P_n. If this number is zero or one, the cursor moves one position. The cursor stops at the left margin.

Default Value: 1

CUD Cursor Down ESC [P_n B
Moves the cursor downward without changing columns. The number of lines moved is determined by the value of P_n. If this number is zero or one, the cursor moves down one line. The cursor will stop at line 24. Direct Cursor Addressing must be used to move to line 25.

Default Value: 1

CUU Cursor Up ESC [P_n A
Moves the cursor upward without changing columns. The number of lines moved is determined by the value of P_n. If this number is zero or one, the cursor moves up one line. The cursor will stop at the top line.

Default Value:1

RI Reverse Index ESC M
Moves the cursor to the same position on the preceding line.

CPR Cursor Position Report ESC [6n
The Terminal reports the cursor position in the form of ESC [P_l;P_c R.

PSCP Save Cursor Position ESC [s
The present cursor position is remembered so the cursor can be returned here later when given the PRCP (Return to Previously Saved Position) command.

PRCP Set Cursor to Previously Saved Position ESC [u
Returns the cursor to the position where it was when it received the PSCP (Save Cursor Position) command.

CUP Direct Cursor Addressing ESC [P_l;P_c H or
ESC [P_l;P_c f
Same as CUP and HVP above. If the line number (P_l) entered is too high, the cursor will not move. If the column number (P_c) is too high, the cursor will move to the end of the line.
This is the only way to move the cursor to the 25th line, but the 25th line must first be enabled.
To move the cursor home, enter ∅;∅ or 1;1 or do not enter any values.

Default Values: 1

ERASING AND EDITING

ED Erase in Display ESC [P_s J
Erases some or all of the characters in the display according to the value of P_s.

P_s	Means
∅	Erases from the cursor to the end of the screen and includes the cursor position.
1	Erases from the start of the screen to the cursor and includes the cursor position.
2	Erases all of the screen and the cursor goes to home position.

Default Value: ∅

EL Erase in Line ESC [P_s K
Erases some or all of the characters in the cursor line according to the value of P_s.

P_s	Means
∅	Erases from the cursor to the end of the line and includes the cursor position.
1	Erases from the start of the line to the cursor and includes the cursor position.
2	Erases all of the line including the cursor position.

Default Value: ∅

IL Insert Line ESC [P_n L
Inserts one or more blank lines (depending on the value of P_n) by moving the line that the cursor is on and all the following lines down P_n lines. Then the cursor is moved to the beginning of the new blank line.

DL Delete Line ESC [P_n M
Deletes the line of characters that the cursor is in, and other following lines if P_n is greater than one. The remaining lines below the deleted area then move up the number of lines that were deleted. The cursor is placed at the beginning of the next line.
Default Value: 1

DCH Delete Character ESC [P_n P
Deletes the characters at the cursor position, and other positions on the cursor line to the right of the cursor if P_n is greater than one. Any remaining character to the right of the deleted characters then move left the number of characters that were deleted.
Default Value: 1

IRM Insert/Replacement Mode ON ESC [4 h
Lets you insert characters or words into text already displayed on the screen. As new characters are entered, existing text to the right of the cursor shifts to the right. As each character is inserted, the character at the end of the line is lost.

IRM Insert/Replacement Mode OFF ESC [4 l
Exits from the IRM ON mode.

CONFIGURATION

PRAM Reset to Power-Up Configuration ESC [z
Nullifies all previously set escape modes and returns to the power-up configuration.

PMBR Modify Baud Rate ESC [P_n r
Modifies the baud rate, where P_n equals:
1=110, 2=150, 3=300, 4=600, 5=1200,
6=1800, 7=2000, 8=2400, 9=3600, 10=4800,
11=7200, 12=9600

SM Set Mode(s), ESC [> P_s h
Sets the following modes, where P_n equals:
1=enable 25th line
2=no key click
3=hold screen mode
4=block cursor
5=cursor off
6=keypad shifted
7=alternate keypad mode
8=auto line feed or receipt of CR
9=auto CR on receipt of line feed

Can set one or more modes as determined by the parameter string P_s;P_s;P_s, etc.
Default Value: None

RM Reset Mode(s) ESC [> P_s l
Resets special modes, where P_s equals:

1=disable 25th line
2=enable key click
3=exit hold screen mode
4=underscore cursor
5=cursor on
6=keypad unshifted
7=exit alternate keypad mode
8=no auto line feed
9=no auto CR

Can reset one or more modes as determined by the parameter string $P_s;P_s;P_s$, etc.
Default Value: None

PEZM Enter ZDS Mode ESC [? 2 l
Enters the ZDS mode.

MODES OF OPERATION

SM Enter Hold Screen Mode ESC [> 3 h
Controls when new information is printed onto the screen.

— Type the SCROLL key and a new line of information will be printed on the bottom line. The top line will scroll off.
— Type SHIFT SCROLL and a whole new page of text will scroll onto the screen and stop as the old page scrolls up and off the screen.

RM Exit Hold Screen Mode ESC [> 3 l
Exits the hold screen mode.

SGR Enter Reverse Video Mode ESC [7 m
Enters the reverse video mode so that characters are displayed as black characters on a white background.

SGR Exit Reverse Video Mode ESC [m or ESC [0 m
Exits the reverse video mode.

SGR Enter Graphics Mode ESC [10 m
Enters the graphics mode to display any of the 33 special symbols (26 lower-case keys and seven other keys) that correspond to the graphics symbols.

SGR Exit Graphics Mode ESC [11 m
Exits the graphics mode and returns to the display of normal characters.

SM Enter Keypad Shifted Mode ESC [> 6 h
Inverts the normal and shifted functions of the keypad. Now if you hold down the SHIFT key, you will get a normally unshifted character.

RM Exit Keypad Shifted Mode ESC [> 6 l
Exits the keypad shifted mode.

SM Enter Alternate Keypad Mode ESC = or ESC [> 7 h
Allows you to enter the alternate keypad mode, which will then transmit the following escape codes instead of the normal ones.

KEY	ESCAPE CODE
0	ESC O p
1	ESC O q
2	ESC O r
3	ESC O s
4	ESC O t
5	ESC O u
6	ESC O v
7	ESC O w
8	ESC O x
9	ESC O y
•	ESC O n
ENTER	ESC O M

These special escape codes are user defined and must be recognized by your software.

RM Exit Alternate Keypad Mode ESC > or ESC [> 7 l
Exits the alternate keypad mode and returns to the transmission of normal character codes.

ADDITIONAL FUNCTIONS

SM Keyboard Disabled ESC [2 h
Inhibits the output of the keyboard. To activate the keyboard, send the "enable keyboard" escape sequence from the computer or reset the Terminal.

RM Keyboard Enabled ESC [2 l
Enables the keyboard after it was inhibited by an SM (Keyboard Disabled) command.

SM Wrap Around at End of Line ESC [? 7 h
81st character on a line is automatically placed in the first character position on the next line. The page scrolls up if necessary and permitted.

RM Discard at End of Line ESC [? 7 l
After the 80th character in a line, the characters overprint. Therefore, only the last character received will be displayed in position 80.

PX25 Transmit 25th Line ESC [q
Transmits the 25th line.

PXMT Transmit Page ESC [p
Transmits lines 1 through 24. (The computer requires a special routine to use this feature.)

SS3 Function Key #1 (F1) ESC O S
Transmits a unique escape code to perform a user-defined function. The Terminal will not respond to this code if it is received.

SS3 Function Key #2 (F2) ESC O T
Same as above.

SS3 Function Key #3 (F3) ESC O U
Same as above.

SS3 Function Key #4 (F4) ESC O V
Same as above.

SS3 Function Key #5 (F5) ESC O W
Same as above.

SS3 Function Key (Blue) ESC O P
Same as above.

SS3 Function Key (Red) ESC O Q
Same as above.

SS3 Function Key (Gray) ESC O R
Same as above.

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