SM-Z-29

Terminal

Service Manual

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WARNING

This equipment has been certified to comply with the limits for a Class B computing device, persuant to Subpart J of Part 15 of FCC Rules. Only computers certified to comply with the Class B limits may be attached to this equipment. Operation with non-certified computers is likely to result in interference to radio and TV reception.

This equipment uses radio frequency energy for its operation and if not installed and used properly, that is, in strict accordance with the instruction manual, may cause interference to radio and television reception. It has been type tested and found to comply with the RF emission limits for a Class B computing device which is intended to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio and 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.
- Plug the computing device into a different AC outlet so that the computing device and receiver are on different branch circuits.
- 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.)

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Introduction

The Zenith Data System Model Z-29 Terminal represents a truly state-of-the-art design that is capable of satisfying both your business and personal needs. Some of the features included in this Terminal are:

- Built-in power-up diagnostics.
- Four terminal emulation modes: Zenith, ANSI, Lear Siegler ADM 3A, and Hazeltine 1500.
- Programmable character attributes and scrolling regions.
- Advanced keyboard features: automatic key repeat, "N" key rollover, status indicators, user function keys, and full cursor control keys.
- A detached keyboard with an eight-foot coiled cable.
- No switches to set: all features are accessable through the keyboard and a nonvolatile memory to remember your settings.
- A professional screen with 24 rows of 80 characters, a 25th status line, and special attributes including character-by-character inverse video, half intensity, blinking, and underlining capabilities.

With this Terminal, the future is here today. The built-in flexibility and ease-of-operation make the Model Z-29 Terminal one of the most versatile units available today. It can serve as the heart, or a remote unit, of a powerful and expandable business automation package.

Specifications

DISPLAY

CRT	12″ (30.5 cm), P31, green, nonglare video screen.
Display Format	25 rows of 80 characters.
Display size	6.0″ high × 8.5″ wide.
Character Type	80 × 10 character cell.
Character Size	0.2″ (5 mm) high × 0.1″ (2.5 mm) wide (approximate).
Character Set	Normal: 128 characters; 95 ASCII, upper and lower case, numerics and punctuation, and 33 graphic characters. Alternate: 128 characters; 95 ASCII, superscript and subscript, scientific notation, and 33 graphic characters.
Video Attributes	Normal or reverse character, normal or underlined character, normal or half-intensity character, and normal or blinking.
Refresh Rate	60 Hz.

CURSOR

Type	Underline or reverse (solid) video block.
Attributes	On, off, or blinking.
Controls	Up, down, left, right, backspace, tab, back tab, home, carriage return (CR), and line feed (LF).
Addressing	Direct or relative.

KEYBOARD

Unit	91-key, detached keyboard unit with eight-foot (1.9 M), coiled cable.
Layout	Split; 77-key standard typewriter style with special function keys, and 14-key numeric keypad.
Indicators	Visual: Power, locked keyboard, off-line, and caps lock (LED). Audible: Key click with each key entry (programmable on/off). Beep tone, 1 kHz for 200 msec.

EDITING AND ERASING FUNCTIONS

Editing	EIA RS-232C.
Baud Rates	75, 110, 150, 300, 600, 1200, 1800, 2400, 4800, 9600, or 19200 baud.
Mode	Half or full duplex.
Code	ASCII.
Format	Serial asynchronous.
Word Length	7 data bits, one parity bit.
Stop bits	2 at 75 and 110 baud rates; 1 at all other baud rates.
Sync	Auto XON and XOFF.
Parity	Even, odd, mark, or space.

ENVIRONMENT

Operation	Temperature: 32- to 105-degrees Fahrenheit (0- to 40-degrees Celsius). Humidity: 10 to 90% (relative) noncondensing.
Storage	Temperature: −40 to +150 degrees (F) or −40 to +66 degrees (C). Humidity: 0 to 95% (relative) noncondensing.

POWER

Voltage Range	105- to 127-volts AC.
Frequency	60 Hz.
Fuse	3/4-ampere, slow-blow.
Consumption	45 watts.

DIMENSIONS

Monitor	13-5/8″ high × 15-3/8″ wide × 14-1/2″ deep (34.6 × 34.4 × 36.2 cm).
Keyboard	3″ high × 18″ wide × 7-1/4″ deep (7.6 × 45.7 × 18.4 cm).

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.

Installation & Power-up

The Model Z-29 Terminal is easiest to use if all of the components are located in the same general area. A good solid work surface (like you would use for a typewriter) that is near a power source and a telephone is best. This Terminal will operate satisfactorily over a wide range of temperature and humidity, as noted in the "Specifications" section of this Manual. Never block the ventilation slots in the cabinet.

The Zenith Data Systems Z-29 Terminal has two main components: a video monitor and a detached keyboard. An eight-foot coiled cable connects the components together. One RS-232 cable is also supplied with this Terminal for connection to your other equipment. Other cables and connectors are available from your local Zenith Data Systems dealer.

CONNECTIONS

Perform the following steps to connect the video monitor to the keyboard:

1. Position the monitor on your work surface so you are viewing the rear panel as shown in Figure 3-1.

2. Note that one end of the coiled cable has a longer flat portion than the other end. This allows you to route the cable under the monitor, if you desire.

3. Plug the end of the coiled cable with the longer flat portion into the KEYBOARD CONNECTOR on the rear panel of the monitor.

4. Plug the free end of the coiled cable into the connector on the side of the keyboard.

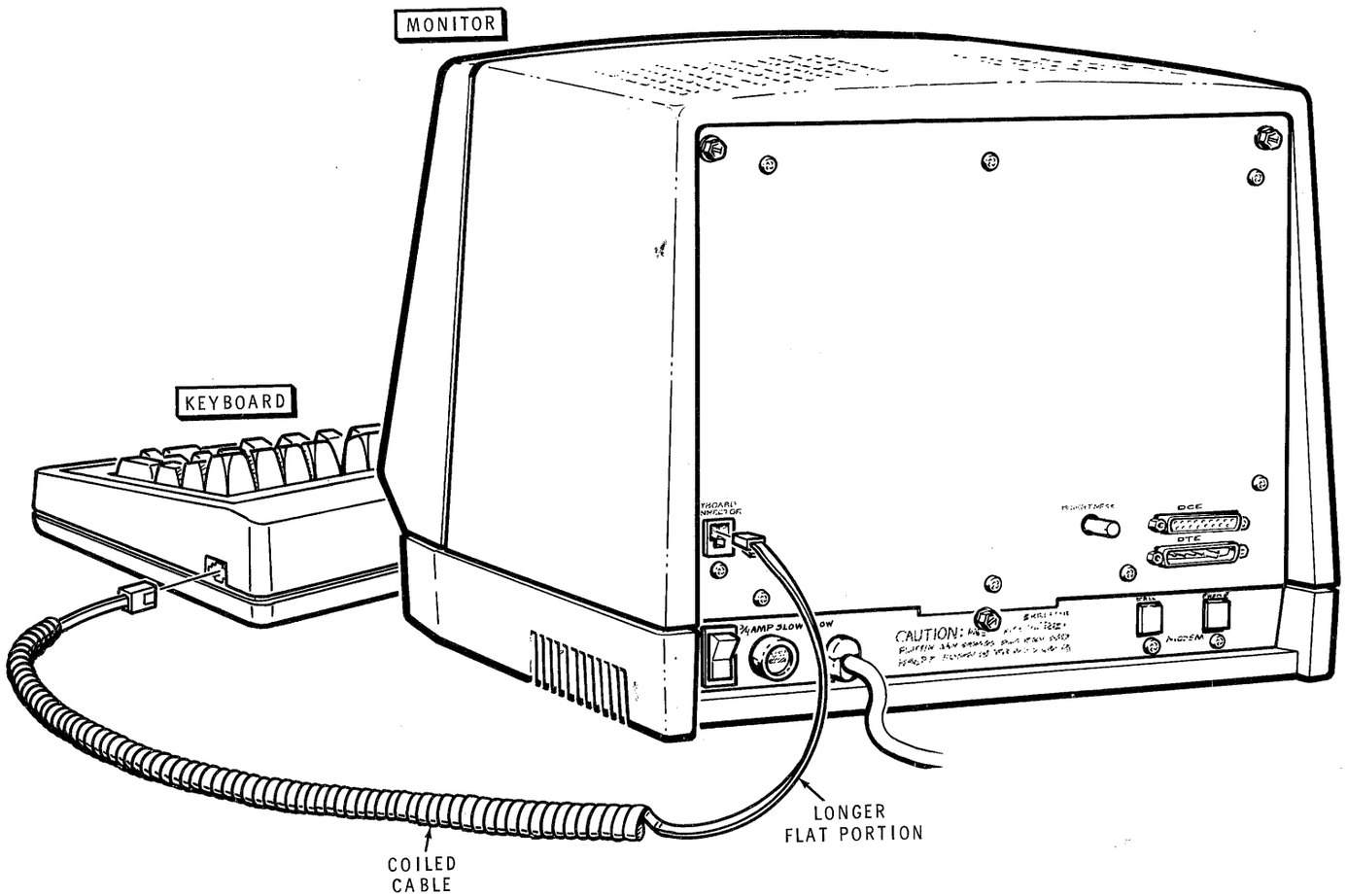


Figure 3-1

INTERFACING THE TERMINAL TO OTHER EQUIPMENT

The Model Z-29 Terminal is designed to be used as an Input/Output (I/O) device for a computer system. It may be connected directly or through telephone lines (via a modem) to any size computer.

WARNING: Never connect the coiled cable supplied with the Terminal to a telephone outlet.

The following information describes some of the things you need to consider before you connect the Terminal to a computer.

DTE and DCE DEVICES

The rear panel of the video monitor contains two standard connectors labeled DCE and DTE, which match the classifications established by RS-232C standards. DCE (Data Communication Equipment) devices are computers and modems or other similar products. DTE (Data Terminal Equipment) devices are terminals, printers, and most other peripherals.

DTE drivers are always connected to DCE drivers and vise-versa. Never connect similar (two DTE or two DCE) devices together.

Use the DTE connector on the rear panel of the monitor for connection to a computer, either by direct wiring or through a modem. The DCE connector provides an output for other DTE devices, such as a printer. Table 3-1 shows the wiring and signals present at each connector.

Table 3-1

DTE	DCE	SIGNAL	DESCRIPTION
1	1	PGND	Protective Ground.
2	3	XMT	RS-232C serial output. This is the output for the serial data signals.
3	2	REC	RS-232C serial input. This is the input for the serial data signals.
4	4	RTS	Request To Send. This line telis the other equipment that there is data to send.
5	—	CTS	Clear To Send. This line tells the other equipment that the device is ready to receive data.
7	13	SGND	Signal Ground.
20	20	DTR	Data Terminal Ready.
—	5		Tied to line 20.
—	6		Tied to line 20.
—	8		Tied to line 20.

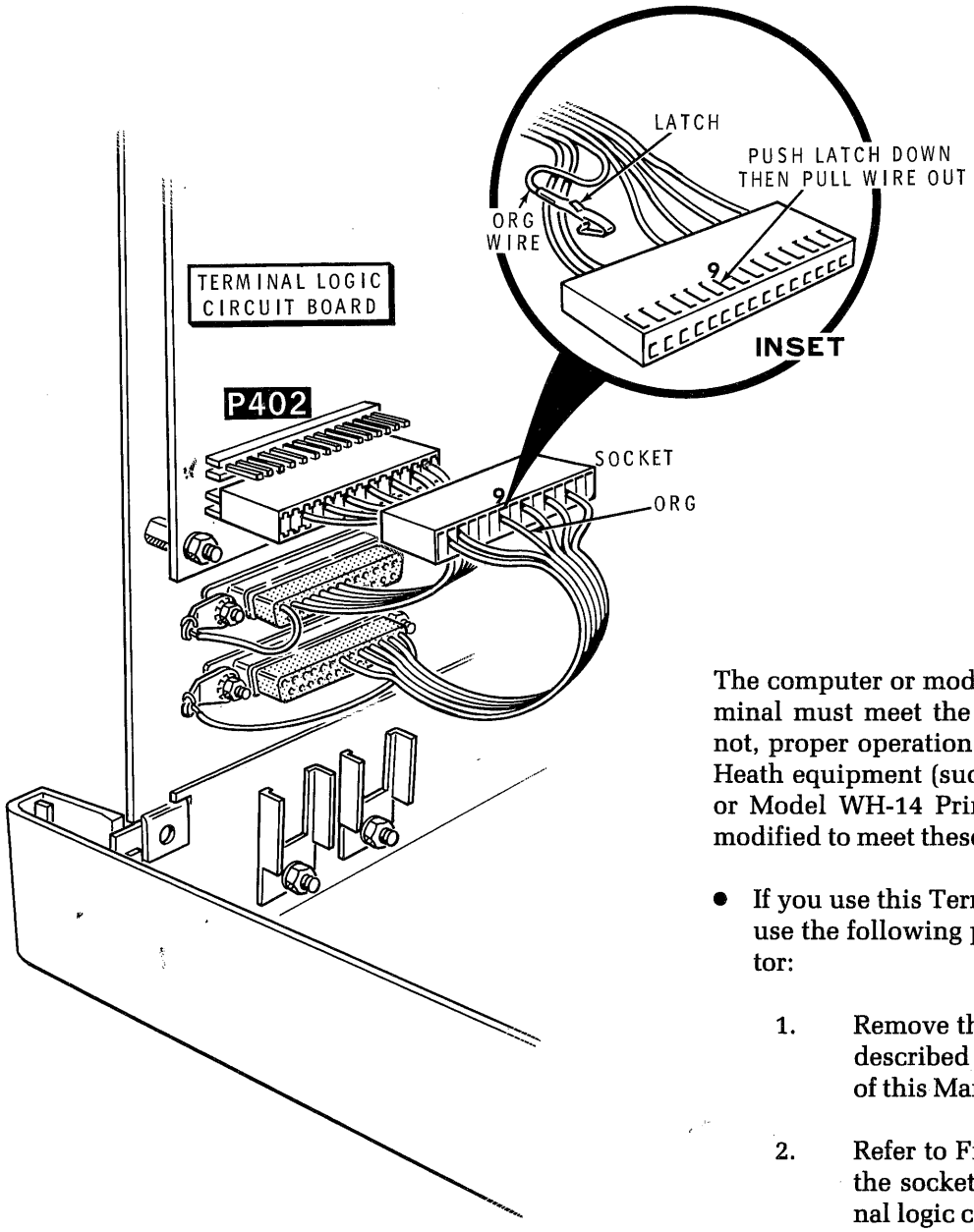


Figure 3-2

Plug P402

The computer or modem that you use with this Terminal must meet the RS-232C standards. If it does not, proper operation may be inhibited. Some early Heath equipment (such as the Model H-8 Computer or Model WH-14 Printer) must have their outputs modified to meet these standards.

- If you use this Terminal with a Heath Model H-8, use the following procedure to modify the monitor:

  1. Remove the cabinet from the monitor, as described in the "Disassembly" section of this Manual.

  2. Refer to Figure 3-2 and carefully unplug the socket from plug P402 on the terminal logic circuit board.

  3. Refer to the inset drawing on Figure 3-2 and carefully remove the orange wire from pin 9 of this socket.

  4. Plug the socket back onto its socket on the terminal logic circuit board.

  5. Reinstall the cabinet onto the monitor.

- If you use this Terminal with a computer in a local installation (wired directly to the computer), plug one end of the RS-232 cable into the lower of the two RS-232 connectors (DTE) on the monitor, and plug the other end into the computer's terminal connector (see your computer hardware manual for the proper connector.

- If you use this Terminal with a computer in a remote installation (not wired directly to the computer), plug one end of the RS-232 cable into the lower of the two RS-232 connectors (DTE) on the monitor, and plug the other end into a telephone modem.

- If you use this Terminal with a separate printer, plug the printer cable into the upper of the two RS-232 connectors (DCE) on the monitor.

- Make sure the POWER switch on the monitor is off. Then plug the line cord into a 120-volt AC, 60 Hz power source.

- Rotate the monitor so the screen is facing you.

- Position the keyboard in front of the monitor. Be sure the keyboard is connected to the monitor as described earlier.

- Turn the POWER switch to ON.

CAUTION: Whenever you turn the power on, be sure to wait at least 10 seconds before you turn the power off again. If you turn the power on and off rapidly, you could damage the power supply circuits.

POWER ON

BUILT-IN DIAGNOSTICS

As soon as you turn this Terminal on, it quickly performs a series of diagnostic tests to ensure proper operation. If it finds any faults, it displays an appropriate error message. If it does not find any faults, a short beep is sounded. The tests performed and the error messages produced are as follows. Refer to "Service Information" in this Manual for information on correcting a problem.

TEST	ERROR MESSAGE IF FAULT IS DETECTED
ROM	ROM Checksum
RAM	RAM Fault
CRT Controller	CRTC Error
Keyboard	Keyboard
Nonvolatile RAM	NVRAM Checksum

These same diagnostic tests are repeated each time you reset the Terminal. To reset the The Terminal, simultaneously press the SHIFT and RESET BREAK keys.

POWER-ON INDICATION

When you turn the POWER switch on, the POWER-ON LED (Light Emitting Diode) on the keyboard should light. If it does not, either the keyboard is not properly connected to the monitor, or the Terminal is not properly connected to an acceptable AC outlet.

After a few seconds, a cursor will appear in the upper left corner of the screen. A display may also appear on the 25th line of the screen. If this display does appear, it will show time (beginning at 0:00:00) and/or one or more other messages, such as CAPS LOCK, OFF LINE, or INSERT MODE.

This completes the "Installation and Power-up" of your Terminal. Proceed to the "Operation" section to configure the Terminal.

Operation

The following description provides you with a brief summary of how the Terminal operates. The Block Diagram in Figure 4-1 shows the major component relationships. A more detailed description is provided in the "Circuit Description."

The keyboard and the monitor form the Terminal and are connected together by means of a coiled cable. The monitor contains four circuit boards that correspond to the four blocks inside the dashed lines on the Block Diagram.

An RF trap is connected between the AC line input and the power supply. This trap filters out any line-conducted RF interference, both in and out of the monitor. The power supply provides all of the DC voltages required to operate the entire Terminal.

The terminal logic circuit (TLB) accepts input from the keyboard and other computer equipment. This circuit processes the information in and out of the Terminal and controls the operation of the Terminal.

A video driver circuit accepts the information from the terminal logic circuit and processes it for viewing on the CRT (cathode ray tube).

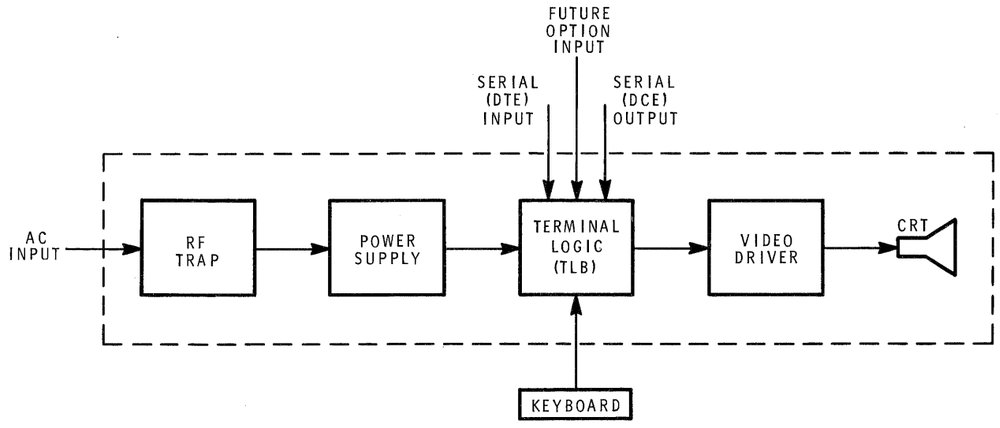


Figure 4-1

Block diagram

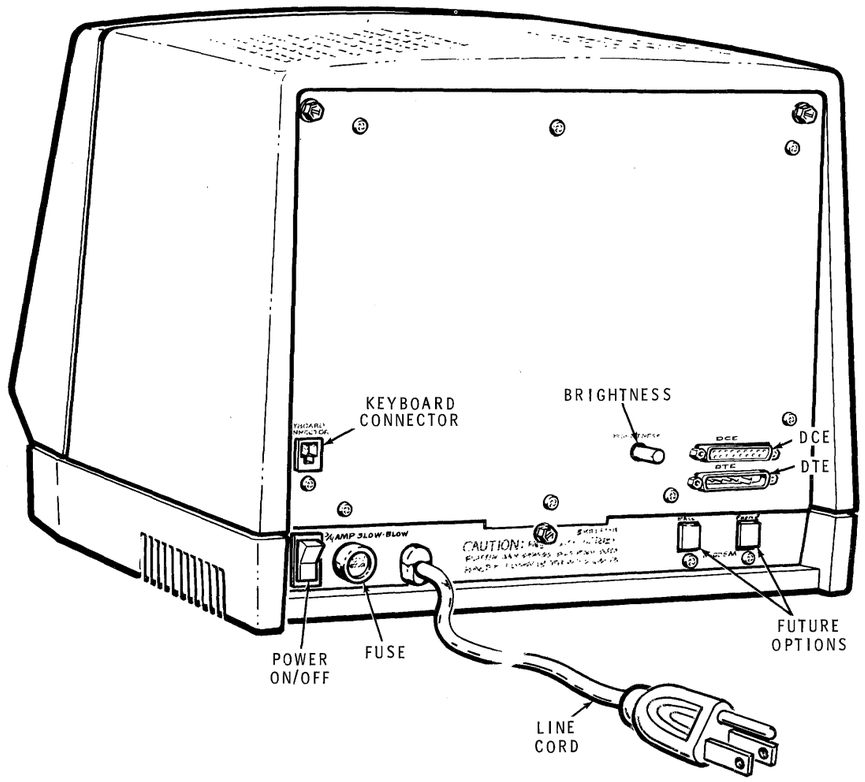


Figure 4-2

Monitor rear view

CONTROLS & INDICATORS

The following paragraphs describe each plug, connector,and control on the Terminal. Before you read the following information, be sure the Terminal is off and unplugged.

REAR PANEL

Refer to Figure 4-2 for the locations of the following controls and connectors.

KEYBOARD CONNECTOR — Provides the necessary signals for the separate keyboard.

BRIGHTNESS — Adjusts the brightness of the video display. Use this control to adjust the brightness level that suits you.

DCE — Provides the necessary EIA-standard RS-232 signals for a printer.

DTE — Provides the necessary EIA-standard RS-232 signals for a modem and/or a computer.

POWER ON/OFF switch — Turns the Terminal on and off.

FUSE — Provides protection against line voltage surges and/or component failure. Be sure to replace this fuse only with a 3/4-ampere, slow-blow fuse.

LINE CORD — Connects the Terminal to a 120-volt AC line through a common wall or floor outlet.

NOTE: There are currently two unused positions on the rear panel of the monitor. These are provided for future options.

KEYBOARD

The keyboard consists of 91 keys, a connector, and four status indicators. These are described separately below.

Refer to Figure 4-3 for the locations of the Terminal, connector, and status indicators on the keyboard.

Connector

TERMINAL CONNECTOR — Provides the necessary signal and power connections for the keyboard.

Indicators

Power On — Provides a visual indication that power is applied to the Terminal and the keyboard is properly connected.

KEYBRD Lock — Provides a visual indication that the keyboard is in a locked-up condition (lit) and that you must reset the Terminal.

Off Line — Provides a visual indication that the Terminal is on- line (not lit) or off-line (lit) with the host equipment.

Caps Lock — Provides a visual indication that the Caps Lock function in on (lit) or off (not lit).

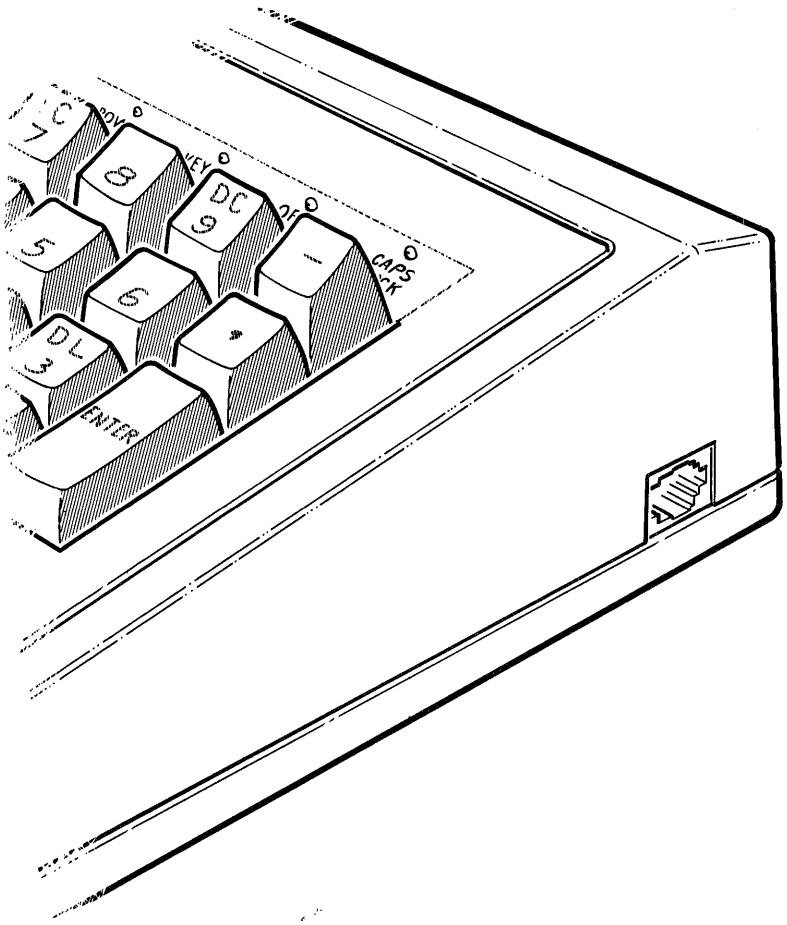


Figure 4-3

Terminal connector and
status indicators

Alphabetic Keys

Refer to Figure 4-4 as you read the following information.

The keyboard has the standard 26 letters of the alphabet arranged just as they are on a conventional typewriter. These keys, like their counterparts on a typewriter, function in either upper or lower case. For uppercase, press either SHIFT key or the CAPS LOCK key.

The CAPS LOCK key lights an indicator on the keyboard whenever it is energized. If the status indicator line on the video display is active, it also displays a Caps Lock message. NOTE: This function affects only the alphabetic keys.

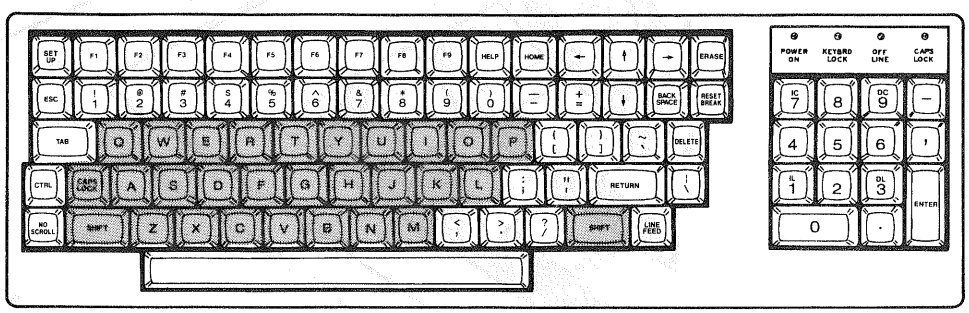


Figure 4-4

Alphbetic keys

Nonalphabetic Keys

Nonalphabetic keys, see Figure 4-5, serve two purposes. In the "unshifted mode", they display conventional numbers and a portion of the punctuation marks and special characters. If you press either SHIFT key, the character printed above the number or special character is printed. This is the same function you find on a conventional typewriter. The Caps Lock function, however, does not shift these keys.

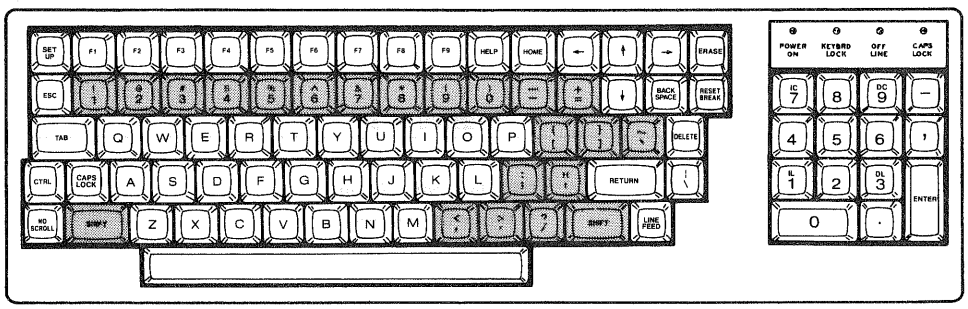


Figure 4-5

Nonalphabetic keys

Other Keys

Refer to Figure 4-6 as you read the following information.

SET UP — Used to enter or exit the Setup Mode. This is explained in more detail later.

NOTE: The following information describes the normal function for each key. Software (a program), however, may direct any key to cause some other function to take place. Any key that has a special function is usually described in the documentation accompanying the program.

SPACE BAR — Functions just as it does on a typewriter. You can enter a blank character (space) by pressing this bar.

BACK SPACE — Functions just as it does on a typewriter, by moving the cursor one space to the left.

TAB — Causes the position of the cursor to move to the next tab column as set by software, or in the Setup Mode. If you press either SHIFT key and the TAB key, the cursor will return to the previous tab column. This is explained in more detail later.

RETURN — Returns the cursor to the left side of the display.

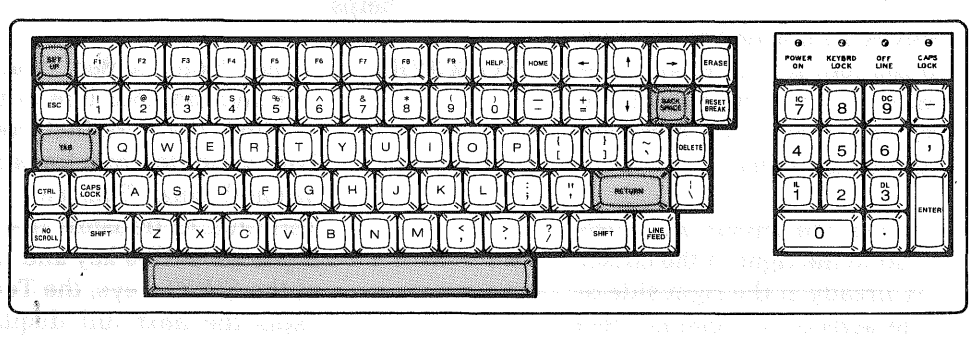


Figure 4-6

Other keys

Refer to Figure 4-7 as you read the following information.

The following keys are used for special purposes. Instructions that tell you how to use them appear with the programs that employ their functions.

F1 – F9 (special function keys) — Used for special purposes by software definition.

HOME — Moves the cursor to the "home" position, the upper left corner of the screen (the first position on the first line).

LINE FEED — Moves the cursor down one line. If the cursor is on the bottom line of the scrolling region, it remains there but the screen scrolls (moves up one line), unless the Hold Screen function is enabled.

← (left arrow key) — Moves the cursor one position to the left. If the cursor is already at the left side of the screen, it remains there and nothing happens.

→ (right arrow key) — Moves the cursor one position to the right. If the cursor is already at the right side of the screen, it remains there and nothing happens.

↑ (up arrow key) — Moves the cursor up one line. If the cursor is already at the top of the screen, it remains there and nothing happens.

↓ (down arrow key) — Moves the cursor down one line. If the cursor is already at the bottom of the screen, it remains there and nothing happens.

DELETE — Some software causes this key to duplicate the Back Space key, but it may also be used for other purposes. This key produces a nondisplayable character.

RESET BREAK — May be used by software in the normal (unshifted) mode to interrupt program execution. When this key is used with either SHIFT key, it resets the Terminal to the power-up state and causes the initial diagnostic tests to run.

HELP — Used by some programs to provide operator aid in the form of special "prompts" or "helps".

NO SCROLL — If the "Hold Screen" feature is active and the 25th line of the screen is filled, the Terminal prevents the host computer from transmitting additional data. This key causes the Terminal to transmit the next line. If you press this key and hold either of the SHIFT keys, the Terminal accepts the next full display "page" (twenty- four lines).

ERASE — Erases all unprotected information on the screen by filling the areas erased with spaces. If you press this key and either SHIFT key at the same time, the Terminal clears the entire screen.

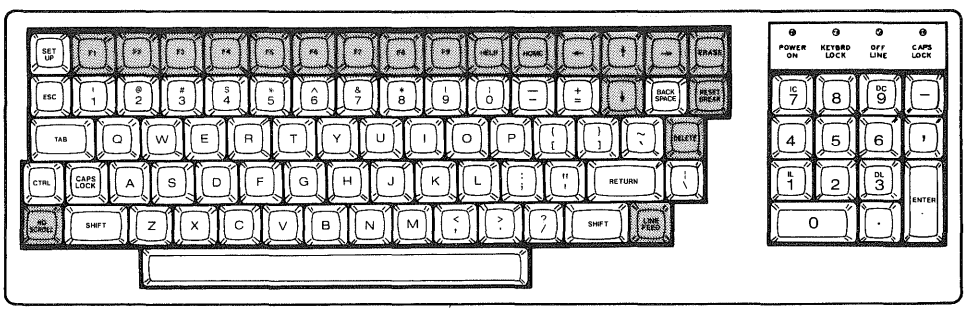


Figure 4-7

Special purpose keys

Refer to Figure 4-8 as you read the following information.

NOTE: The following keys are used in combination with other keys to perform a function.

ESC — The ESCape key performs special functions. When you press the ESCape key and another key in sequence, a predetermined event occurs. For example, if you want an event governed by ESCape E, you first press and release the ESCape key and then press the E key. It is important to note that, unlike normal computer operations, the Terminal accepts the "literal" escape code designation. In other words, if a chart of escape sequences designates a sequence as "ESC c", this is **exactly** the way you must enter the sequence. You cannot enter an uppercase c when the escape sequence requires a lowercase c. For a complete listing of the Escape Codes for this Terminal, refer to "Programming" at the end of this section.

CTRL — The ConTRoL key. You can use this key to perform special functions by pressing it and another key at the same time. For example, if you want to enter the CTRL-C combination, you press and hold the CTRL key and then press the C key, or you may press both keys at the same time. If you want to enter the CTRL-S key combination, you press and hold the CTRL key and then press the S key, or you may press both keys at the same time. CONTROL ENTER (CTRL ENTER) connects the entire contents of the screen to the printer port.

NOTE: The following keys are used to speed up the entry of data.

Calculator-style keypad — This group of keys, located to the right of the main keyboard, is organized similar to a calculator and includes: the numbers 0 through 9; a period for entry of decimal points; a comma for data entry; a dash for entry of negative numbers; and an ENTER key for signaling the computer that the entry is complete.

In addition, four keys (1, 3, 7, and 9) are used in applications requiring special insertion and deletion operations of characters and lines.

NOTE: For compatibility with older Zenith Terminals, the numbers 2, 4, 5, 6, and 8 keys on the keypad perform the same cursor functions as the up, left, home, right, and down arrows respectively when you enable the keypad shift.

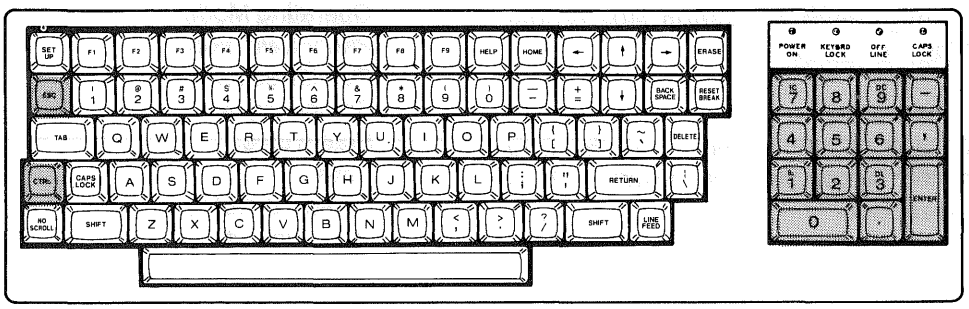


Figure 4-8

Other keys

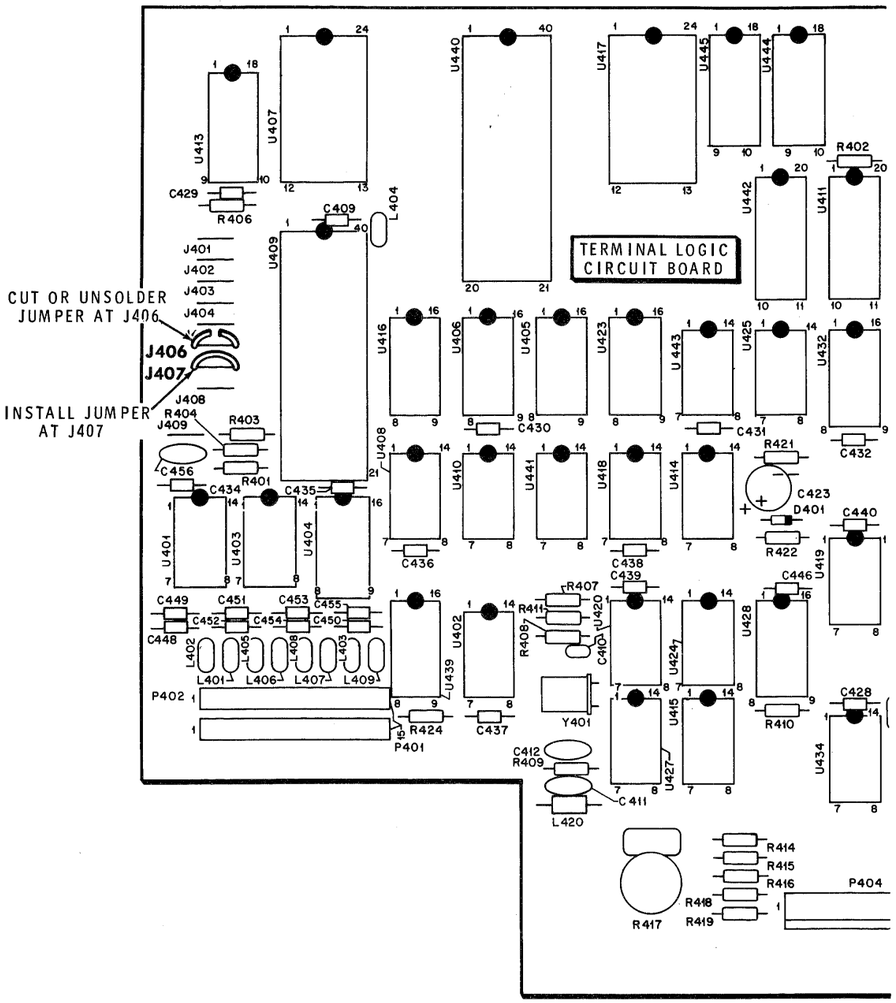


Figure 4-9

Terminal logic board

SET-UP

This Terminal makes use of the latest in solid-state technology for setting up and maintaining vital communication parameters. Instead of using switches and jumpers (as is the case in many other terminals), this Terminal uses a nonvolatile memory IC. This allows you to quickly and easily enter all of the parameters through the keyboard without any disassembly. This section explains all of the features you may establish in this manner.

Use the SET UP key to activate the Setup Mode when you want to program the Terminal's parameters. After you establish the parameters, you can choose either to use them on a temporary basis or store them into the nonvolatile memory in the Terminal. This memory retains your instructions even when you turn the Terminal off or unplug the line cord. You can use escape sequences to set several setup procedures. Refer to "Programming" at the end of this section for more information.

There is an optional hardware modification that prevents the Terminal operator from entering the Setup Mode. If you desire to add this protection, refer to fold-out Figure 4-9 and perform the following steps:

1. Refer to the "Disassembly" section of this Manual and remove the cabinet from the monitor.

2. Locate jumper J406 in the terminal logic circuit board (TLB) and carefully cut or unsolder this jumper wire.

3. Install a jumper wire at location J407 on the terminal logic circuit board.

4. Reinstall the cabinet onto the monitor. NOTE: You will have to move this jumper back to location J406 before you can again perform the Setup function.

NOTE: When you place the Terminal in the Setup Mode, it is in an "off line" state. It does not communicate with a host computer until you exit the Setup Mode.

The Setup Mode has eight different displays that are shown in reverse video (black on green) on the 25th line of your screen. The displays are referred to as Setup Menu A through Setup Menu G and T. Each of these displays show the status of various features.

Table 4-1 is a quick summary of the setup functions, where they are used, and which Setup Mode they are found in.

Table 4-1

FEATURE	SETUP MENU
Automatic Carriage Return	F
Automatic Line Feed	F
Automatic Repeat	E
Baud Rate Selection	B
Character Sets	G
Clock	D
Communications Mode	B
Cursor Selection	F
Fill Screen	G
Hold Key	C
Key Click	E
Keypad Alternate/Shifted	E
Line Frequency Selection	F
Monitor	C
Off Line/On Line	A
Operating Mode	C
Parity Selection	B
Port Selection	C
Screen Saver	D
Status Line	D
Tabs	T
Video Attributes	G
Wraparound	D

ENTERING THE SETUP MODE

To enter the Setup Mode, press the SET UP key. The bottom line of the screen will show Setup Menu A's display.

MENU SELECTION

To select any of the eight different Setup Menu presentations, Setup A through Setup G, and Setup T, press the corresponding alphabetic key. You can access any of these menus from any other setup presentation by simply pressing the alphabetic key associated with that particular menu. Each function in the menu is accessed by its associated numeral. Once you establish your particular setup configuration, you may save this menu in nonvolatile memory; just exit the Setup Mode by pressing either SHIFT key and the SET UP key.

SETUP MENU A

To enter Setup Menu A, simply press the A key if the Terminal is already in the Setup Mode. If the Terminal is not already in the Setup Mode, press the SET UP key. The bottom line of the screen will display:

```
**SETUP MENU A** (Ver 0.85)     1. on line
MENUS -A- to -G- or -T- for TABS
```

On/Off Line

Whenever the Terminal is "on line", it is an input/output device for a host machine. If the Terminal is "off line", it can not transmit to or receive information from the host computer, but is controlled through its own keyboard.

When the mode selected is off line, and the Status Line is enabled, the OFF LINE is displayed on the bottom line of the screen.

You can change the state of the on/off line status by pressing the 1 key on the main keyboard.

TAB MENU

To enter the Tab Mode, simply press the T key if the Terminal is already in the Setup Mode. If the Terminal is not in the Setup Mode, press the SET UP key and then the T key. The bottom line of the screen will display:

```
#234|678901|3456789012|
456789012345678901234567890123456789012345678901
|234567890
```

In this example, the vertical lines represent tab locations at the 5th, 12th, 23rd, and 71st character positions. You can set and reset tabs by moving the graphics block left or right with the appropriate arrow keys.

Cursor Movement

To move the cursor to the right, press the right arrow (→) key. Once the cursor reaches the right side of the display, it will not move any further.

To move the cursor to the left, press the left arrow (←) key. Once the cursor reaches the left side of the display, it will not move any further.

Set Tab

To set a tab, position the cursor to the desired location and press the up arrow (↑) key.

Clear Tab

To reset (clear) a tab, position the cursor to the desired location and press the down arrow (↓) key.

Exit

To exit the Tab Mode without storing the tab settings, just press the SET UP key. When the Terminal is reset, or turned off and then on again, the tab stops will return to the settings that existed before you made any changes.

To exit and store the tab stop settings in nonvolatile memory, press and hold the SHIFT key and then press the SET UP key. The tab stops will remain set until you change them again in the Setup Mode.

SETUP MENU B

To enter Setup Menu B, simply press the B key if the Terminal is already in the Setup Mode. If the Terminal is not already in the Setup Mode, press the SET UP key and then the B key. The bottom line of the screen will display:

```
*MENU B*   1. BAUD 9600   2. PARITY Space
3. DUPLEX full   4. HANDSHAKE software
```

Baud Rate

This Terminal can use a wide number of baud rates to communicate with its host computer: 75, 110, 150, 300, 600, 1200, 1800, 2400, 4800, 9600, and 19200 baud. The sample shown above shows that 9600 baud is selected.

You can change the baud rate by pressing the 1 key. The current baud rate will step to the next available baud rate. If you do not want that rate, continue pressing the 1 key until you obtain the baud rate that you desire. When the Terminal reaches 19200 baud, the next rate is 75 baud.

IMPORTANT: The number of data bits and the number of stop bits are not programmable at the Terminal. This Terminal uses seven data bits and one stop bit at all baud rates except 75 and 110 baud. These last two utilize two stop bits.

Parity

The available parity options are: space, odd, even, or mark (continuously on). You can change the parity (shown as a space in the above example) by pressing the 2 key, which changes the parity to the next selection and displays it. If you do not want that selection, continue pressing the 2 key until you obtain the selection that you desire.

NOTE: Heath/Zenith Data Systems operating systems on the Models H-8, Z-89, and Z-90 computers do not check parity with the Terminal. The Terminal ignores parity on all incoming data.

Duplex Mode

This Terminal can communicate in either full or half duplex. You can change the mode of operation by pressing the 3 key.

Handshaking

Two methods of "handshaking" are used in this Terminal. These methods are described separately below.

In the software handshake mode, the Terminal automatically generates the XON or XOFF codes. XOFF signals that data transmission from the computer to the Terminal should cease. XON signals that transmission may resume. This Terminal automatically generates the XOFF code when its internal buffer is almost full.

The hardware handshake is performed via the RS-232 interface in conjunction with the CTS, RTS, and DTR lines. The DTE connector makes use of all three lines, while the DCE connector can utilize the RTS line only.

You can use the 4 key to change the mode of handshaking.

SETUP MENU C

To enter Setup Menu C, simply press the C key if the Terminal is already in the Setup Mode. If the Terminal is not already in the Setup Mode, press the SET UP key and then the C key. The bottom line on the screen will display:

```
*MENU C*   1. PORT normal   2. MODE Zenith
3. HOLD SCRN off   4. MONITOR off
```

Port Assignment

In normal operation, this Terminal uses the DTE port to communicate with the computer. The DCE port could be connected to an optional printer. Occasionally, you may want to exchange ports. Or, you may wish to connect the Terminal to two different computers and selectively use one or the other without making any wiring changes. This feature allows you to send the signals to one port or the other. Be aware, however, that there are limitations between the two ports for handshaking arrangements, and the baud rate used by one port must be the same for the other port.

You can change the routing of the signals to the DTE and DCE ports by pressing the 1 key. When these signals are swapped, the display will show:

```
1. PORT auxil
```

Terminal Modes

This Terminal can emulate four common terminal types: The Heath/Zenith Z-19, the Lear Siegler ADM 3A, the Hazeltine 1500, or the ANSI (American National Standards Institute) standard X3.64-1979 (similar to the VT100). Each of the four modes responds differently to codes it receives. For more information, refer to "Programming" at the end of this section.

You can change the Terminal Mode by pressing the 2 key on the main keyboard. The next Terminal emulated is displayed. If you do not want to use that mode, continue pressing the 2 key until you obtain the mode you desire.

Hold Screen

The HOLD SCRN (Hold Screen) function offers the operator control over the scrolling of the display. When this is activated, you must press the NO SCROLL key to allow each new line to be displayed. To display an entire new page of information, simulataneously press either SHIFT key and the NO SCROLL key.

You can enable or disable the Hold Screen function by pressing the 3 key on the main keyboard.

Monitor Mode

The MONITOR function puts the screen of the Terminal into a state where it will display all control characters in reverse video. Normally, control characters (such as Escape) are not displayed even though they are received and processed. Be aware, however, that the screen formatting is not possible when this feature is enabled.

You can enable or disable the Monitor function by pressing the 4 key on the main keyboard.

SETUP MENU D

To enter Setup Menu D, simply press the D key if the Terminal is already in the Setup Mode. If the Terminal is not already in the Setup Mode, press the SET UP key and then the D key. The bottom line of the screen will display:

```
*MENU D*   1. SET CLOCK   2. STATUS LINE on
3. WRAP on   4. SCRN SAVER on
```

Clock

This Terminal has a 24-hour clock, which is displayed on the status line. To set the clock, press the 1 key. The bottom line of the screen will display:

```
Enter hours >
```

Use the main keyboard to enter a 1- or a 2-digit number that is between 0 and 23. Then press the RETURN key. The bottom line of the screen will display:

```
Enter minutes >
```

Use the main keyboard to enter a 1- or a 2-digit number that is between 0 and 59. Then press the RETURN key. The clock will be set to the time you entered the moment you complete the entry.

NOTE: Any illegal entry causes the display to return to the menu with no changes.

Status Line

The Status Line on the CRT displays the following information for operator convenience: 24-hour clock; CAPS LOCK if the caps lock is on; OFF LINE if the Terminal is in the Off Line Mode; and INSERT MODE if the Terminal is in the Insert Mode.

The clock is always displayed unless the status line is turned off, or the 25th line is turned on by a software command in a program. If the status line is enabled, it always appears as long as the 25th line is disabled.

You can turn the Status Line display on or off by pressing the 2 key on the main keyboard.

Wrap On/Off

When the wraparound feature is enabled and you enter the 81st character of any line, it is automatically printed at the first character position of the next line. If the line is the last line of the designated scrolling region, the screen is "scrolled" up one line and a new bottom line is started with your character in the first position. If this feature is disabled, any characters you type after the 80th character replaces the 80th character on that line.

You can enable or disable the wraparound feature by pressing the 3 key on the main keyboard.

Screen Saver

The screen is automatically blanked out if no key is pressed or the Terminal receives no data from the computer for 15 minutes. This feature helps increase the life of the CRT. You can restore the screen by pressing the CAPS LOCK key.

You can enable or disable the screen saver feature by pressing the 4 key on the main keyboard.

SETUP MENU E

To enter Setup Menu E, simply press the E key if the Terminal is already in the Setup Mode. If the Terminal is not already in the Setup Mode, press the SET UP key and then the E key. The bottom line of the screen will display:

```
*MENU E*   1. KEYPAD SHFT off
2. KEYPAD ALT off   3. REPEAT on
4. CLICK on
```

Keypad Shift

In normal operation, shifted characters on the numeric keypad may be transmitted only when you press the SHIFT key along with the corresponding key. This function reverses the operation, requiring you to use the SHIFT key to transmit unshifted characters.

You can enable or disable the shifted keypad function by pressing the 1 key on the main keyboard.

Alternate Keypad

Normally, the codes generated on the numeric keypad are the ASCII numerals for 0 through 9, the comma, the dash (hyphen, or minus sign), the period (or decimal point), and ENTER. In the Alternate Keypad Mode, other codes are transmitted. Refer to the "Appendixes" for the codes that are transmitted in this mode.

You can enable or disable the alternate keypad function by pressing the 2 key on the main keyboard.

Key Repeat

When the Key Repeat feature is enabled, holding any key except the SHIFT, CAPS LOCK, CTRL, SET UP, and RESET BREAK keys for more than about 1/2-second causes that key to be repeated. The longer you hold the key down, the faster the repeat rate. The key continues to repeat until you release it.

You can enable or disable the Key Repeat function by pressing the 3 key on the main keyboard.

Key Click

An audible "click" is provided to let you know that a key entry has been made. Some keys, such as the SHIFT and CTRL keys, do not sound the key "click" when you press them, as they modify other keys when pressed in conjunction with them.

You can enable or disable the Key Click function by pressing the 4 key on the main keyboard.

SETUP MENU F

To enter Setup Mode F, simply press the F key if the Terminal is already in the Setup Mode. If the Terminal is not already in the Setup Mode, press the SET UP key and then the F key. The bottom line of the screen will display:

```
*MENU F*   1. AUTO CR off   2. AUTO LF off
3. CURSOR blnk line   4. FREQ 60 Hz
```

Auto CR

When this feature is enabled, a carriage return (CR 0DH) is also generated whenever a line feed is received.

You can enable or disable this feature by pressing the 1 key on the main keyboard.

Auto LF

When this feature is enabled, a line feed (LF – 0AH) is generated whenever a CR (0DH) is received.

You can enable or disable this feature by pressing the 2 key on the main keyboard.

Cursor Selection

The cursor shows you where the next information or key will appear on the screen. You can change the characteristics of this indicator with this setup feature.

You may select any one of four different cursor formats by pressing the 3 key on the main keyboard. The cursor type and display are as follows:

CURSOR TYPE	DISPLAY
block (reverse space)	block
underline	underline
blinking block	blnk blck
blinking underline	blnk line

Line Frequency

The display scan rate of the display depends upon your local AC line frequency: 60 Hz in areas served by 60 Hz AC lines and 50 Hz in areas served by 50 Hz AC lines. The normal line frequency in the United States is 60 Hz. If you have any doubts, or if you plan to use your Terminal in a foreign (other than US) location, consult your local power company.

You can change the scan rate frequency by pressing the 4 key on the main keyboard.

SETUP MENU G

To enter Setup Menu G, simply press the G key if the Terminal if the Terminal is already in the Setup Mode. If the Terminal is not already in the Setup Mode, press the SET UP key and then the G key. The bottom line of the screen will display:

```
*MENU G*   1. CHAR SET normal   2. FILL SCREEN
3. ATTRIBUTES   4. TEST
```

Character Sets

This Terminal is supplied with two character sets. Both sets are illustrated in the "Programming" section of this Manual. In most instances, you will use the normal charactered set. There may be times, however, when you will want to access some of the special characters available in the alternate set.

You can enable or disable the alternate character set by pressing the 1 key on the main keyboard.

Fill Screen

The Fill Screen function allows you to fill the entire screen with any one character. This function is used primarily for service of the video monitor and character generator within the Terminal.

After you press the 2 key on the main keyboard, you can fill the entire screen with any character you select by pressing the appropriate key. You may change the displayed character as many times as you desire. To return to Setup Menu G, press the RETURN key.

Video Attributes

There are sixteen different attributes available on a full screen or character-by-character basis through software. For programming information, refer to "Programming" at the end of this section.

You may step through the attributes of the entire screen by pressing the 3 key on the main keyboard.

The sixteen attributes are as follows:

1. Normal display at normal intensity.
2. Reverse video at normal intensity.
3. Normal video underlined at normal intensity.
4. Reverse video underlined at normal intensity.
5. Same as number 1 but blinking.
6. Same as number 2 but blinking.
7. Same as number 3 but blinking.
8. Same as number 4 but blinking.
9. Same as number 1 but half intensity.
10. Same as number 2 but half intensity.
11. Same as number 3 but half intensity.
12. Same as number 4 but half intensity.
13. Same as number 5 but half intensity.
14. Same as number 6 but half intensity.
15. Same as number 7 but half intensity.
16. Same as number 8 but half intensity.

Test

This Terminal has tests built-in for servicing. This specific test checks the ROM, RAM, and fills the screen with all characters from the character set and sounds a beep if the test is successful. The test automatically repeats until it detects a failure, or you press any key to exit from the test.

To activate this test function (of Setup Menu G), press the 4 key. To exit from the test, press any key.

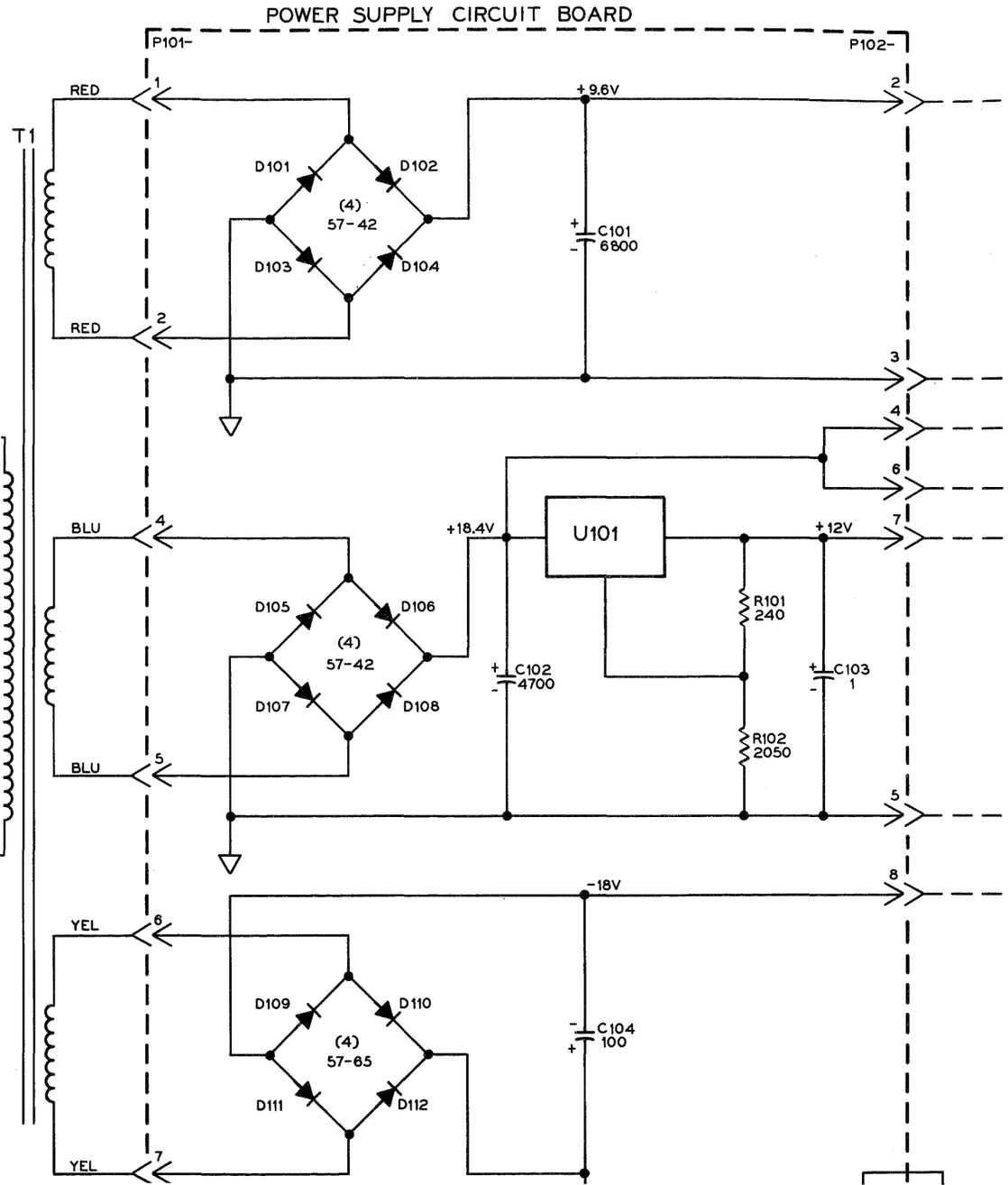
If you press CTRL ENTER (Control Enter), the screen display will print out of the port that you did not select during the setup configuration.

NOTE: If you experience a failure during the "test", refer to the "Service Information" section of this Manual.

PROGRAMMING

Information that you may find useful in establishing programs for use with this Terminal is included in "Appendixes A through E" at the rear of this Manual. This information is arranged as follows:

Appendix A	ASCII Mode Code Information
Appendix B	Zenith Mode Code Information
Appendix C	ANSI Mode Code Information (Std.X3.64-1979)
Appendix D	Lear Siegler ADM 3A Mode Code Information
Appendix E	Hazeltine 1500 Mode Code Information



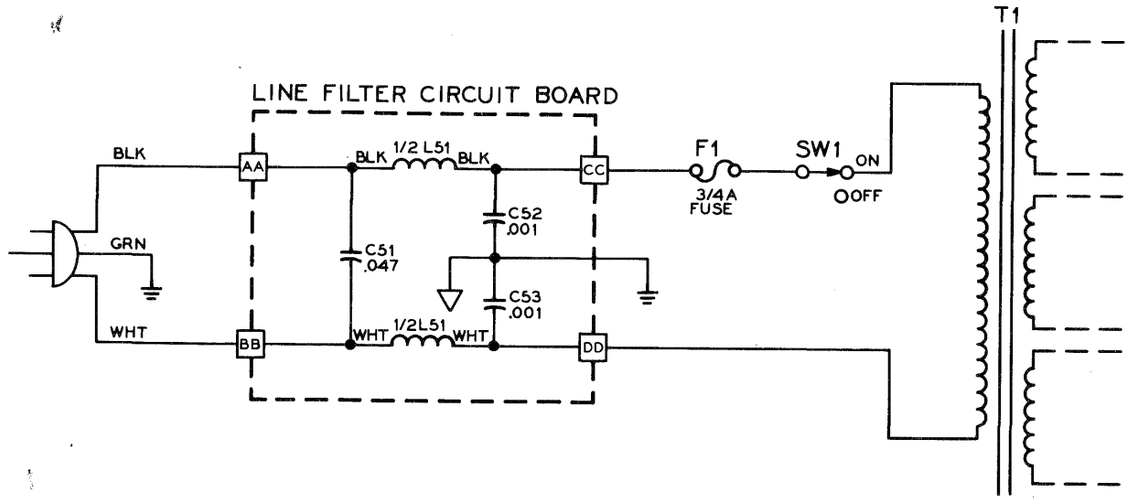


Figure 5-1

Power supply – primary circuit

Circuit Description

Refer to the Block Diagram and the Schematic Diagram while you read this Circuit Description. This description deals with groups of components by addressing each group as a functional block.

POWER SUPPLY

The primary circuit of the power supply (refer to Figure 5-1) consists of the line filter circuit board, fuse F1, On/Off switch SW1, and the primary windings of transformer T1.

Components L51, C51, C52, and C53 form the line filter. This trap circuit filters out any line-conducted RF interference both in and out of the Terminal. Fuse F1 protects the Terminal from overloads and voltage surges.

The secondary circuit of the power supply (refer to Figure 5-2) consists of three secondary power transformer windings and the power supply circuit board.

The red secondary winding of transformer T1 supplies AC to the full-wave bridge rectifier circuit formed by diodes D101 through D104. This circuit produces approximately 9.6-volts DC, which is filtered by capacitor C101. The resultant DC is passed to the terminal logic circuit board, where it is split into three separate supplies for use by the circuits there.

Another secondary winding of the transformer (blue wires) supplies AC to the full-wave bridge rectifier formed by diodes D105 through D108. This circuit produces approximately 18.4 volts DC, which is filtered by capacitor C102. Part of the voltage at this point is passed to the terminal logic circuit board, where it is used to produce the 12-volt supply needed there. Another part of this voltage is applied to regulator integrated circuit U101. Resistors R101 and R102 set the current on U101 so that it produces a regulated 12-volts DC. This voltage is further filtered by capacitor C103 before it is passes through the terminal logic circuit board to the video circuit board.

A third secondary winding of the transformer (yellow wires) supplies AC to the full-wave bridge rectifier formed by diodes D109 through D112. This produces approximately −18 volts DC, which is filtered by capacitor C104 before it is passed to the terminal logic circuit board for use there.

TERMINAL LOGIC CIRCUIT BOARD

This circuit board contains the microprocessor integrated circuit and controls the operation of the entire Terminal. Each circuit on this circuit board are described below separately.

REGULATOR CIRCUITS

Four on-board regulators are included on the terminal logic circuit board (refer to Figure 5-3). These regulators accept voltage from the power supply circuit board and convert it into the +12 volt (U435), −12 volt (U436), and +5 volt (U437 and U438) supplies needed for the circuits on this circuit board. Capacitors C415 through C422, and C443 through C445 help stabilize the regulators and improve their transient response.

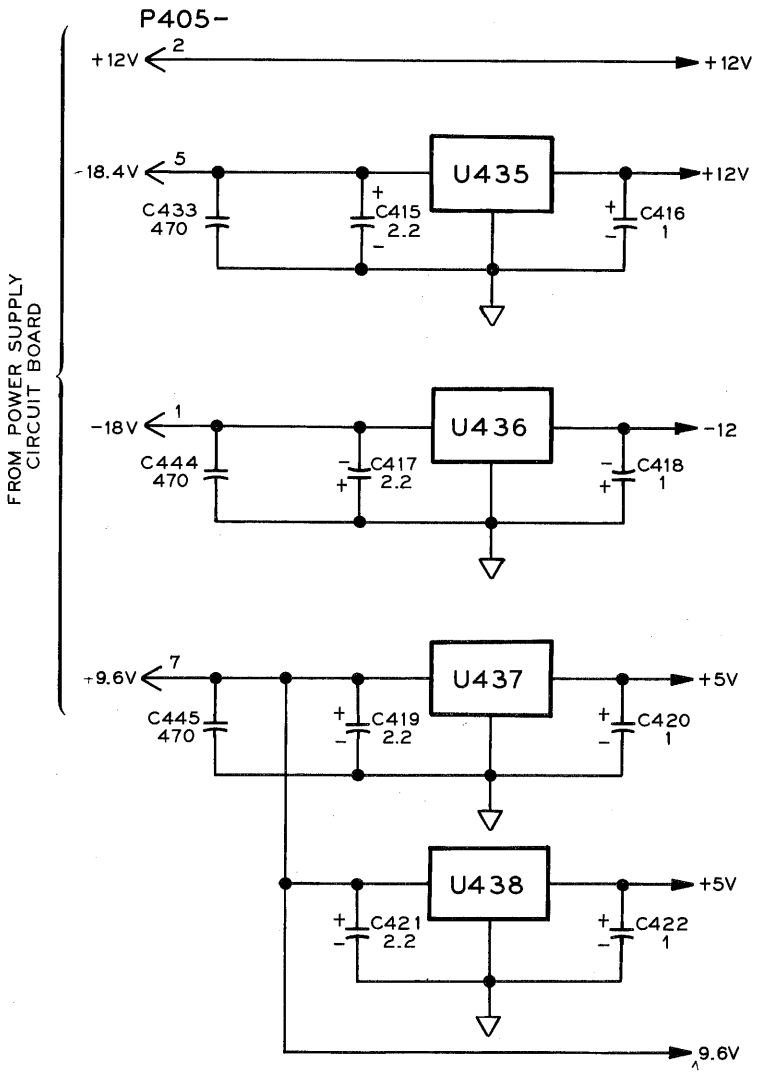


Figure 5-3

Regulator circuits

POWER-UP and RESET CIRCUIT

To set this Terminal back to its original operating mode, when it has been changed by software escape sequences, the microprocessor must be reset. A reset can be accomplished either by a power-up or by simultaneously pressing the Shift and Reset keys on the keyboard.

The power-up reset circuit (refer to Figure 5-4) consists of diode D401, resistors R421 and R422, capacitor C423, and integrated circuit U414C. Each time the Terminal is turned on, capacitor C423 is in a discharged condition. This holds one input (pin 9) of nand gate U414C low and the output (pin 8) high. Resistor R422 pulls this output voltage to a level that insures that microprocessor U409 resets. After this initial reset, capacitor C423 charges through resistor R421. This causes both inputs to U414C to be high and the resulting low at its output allows the microprocessor to exit the reset condition.

Simultaneously pressing the Shift and Reset keys on the keyboard also resets the microprocessor. Since two keys have to be pushed to reset the Terminal in this manner, this helps reduce the chances of accidental reset. At power up, capacitor C424 is in a discharged condition, but immediately begins to charge through resistor R423. This performs the same function as the capacitor and resistor on the other input to U414C. Capacitor C424 finally charges to a level that is sufficient to override the reset condition and allows the microprocessor to operate properly. When the Shift and Reset keys are simultaneously pressed, a logic low from the keyboard (plug P403 pin 2) causes capacitor C424 to discharge. Once this capacitor discharges to a TTL low, the output of U414C goes high and resets the Terminal. Because the reset lines float high, this protects the Terminal from becoming reset if the keyboard is unplugged from the monitor.

The low that is sent to the reset circuit from the keyboard is also applied to the clear input to the video suppression circuit (U432). Since the enable input to this integrated circuit is pulled high during reset (and inverted by U412D before it is applied to the data input) and the reset input is pulled low, this insures that the screen is blanked during the reset. Resistors R423 and R405 together with capacitor C424 integrate out any noise pulses that could otherwise reset the Terminal. The combination of resistor R405 and capacitor C424 form a time constant that is less than the time it takes you to actually press the Shift and Reset keys. This reduces the time you must hold the two keys down to cause a reset.

After a reset is complete, firmware causes the microprocessor to begin the initialization routine. This clears the scratch pad and display memory RAM and initializes the two CRT controllers.

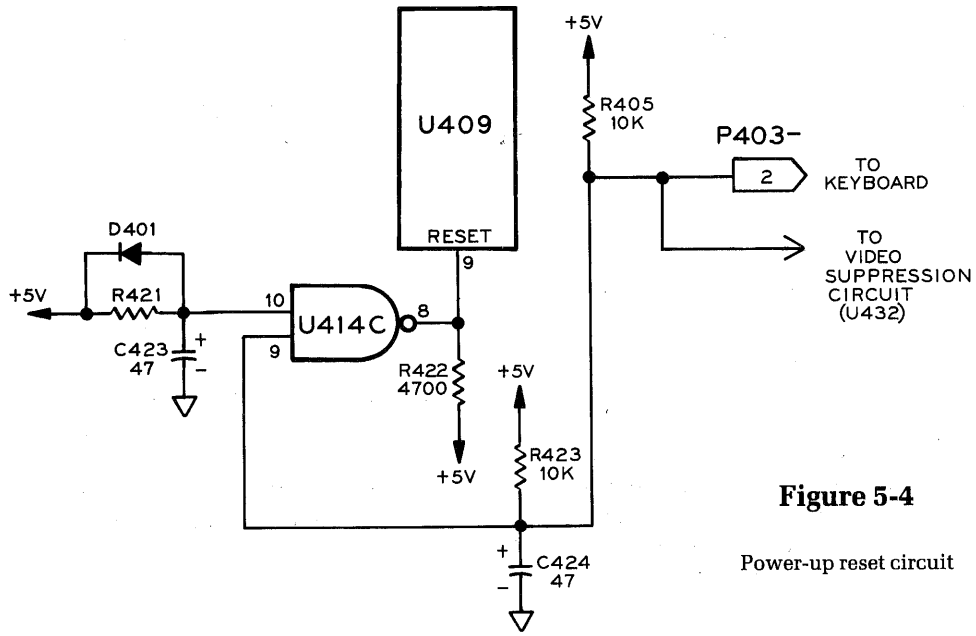


Figure 5-4

Power-up reset circuit

SERIAL PORTS

There are two user-available ports on this Terminal (refer to Figure 5-5). One is the computer port and the other is the auxiliary port. The computer port is a standard RS-232, DTE connector. The auxiliary port is a standard RS-232, DCE connector. The pin-outs for these connectors is shown in Table 5-1 below.

Table 5-1

DTE COMPUTER PORT

PIN#	FUNCTION
1	Ground
2	Transmit data
3	Receive data
4	Request to send output
5	Clear to send input
7	Signal ground
20	Data terminal ready

DCE AUXILIARY PORT

PIN#	FUNCTION
1	Ground
2	Receive data
3	Transmit data
4	Request to send input
7	Signal ground
20	Data terminal ready
5	Clear to send *
6	Data set ready *
8	Received line signal detect *

* Tied to pin 20

Microprocessor U409 controls the operation of the serial ports. This integrated circuit contains a serial port that enables the Terminal to communicate with other peripherals, without the need for an asynchronous communications element. This serial port is useful for serial linking peripheral devices through standard, asynchronous protocols, with full duplex operations.

The microprocessor responds to a serial port interrupt request by either reading or writing to the serial port's buffer. This full duplex serial I/O port provides asynchronous modes to facilitate communications with standard UART devices, such as other terminals, printers, or computers. The receiver input to this port contains two buffers to eliminate the possibility of over-run, which could occur if the CPU fails to respond to the receiver's interrupt before the beginning of the next frame. Since the microprocessor can usually maintain the serial link without a double buffer, only one is used at the transmitter output.

In the asynchronous modes, false start bit rejection is provided on the received frames. For noise rejection, a majority of two out of three samples taken near the center of each received bit must agree.

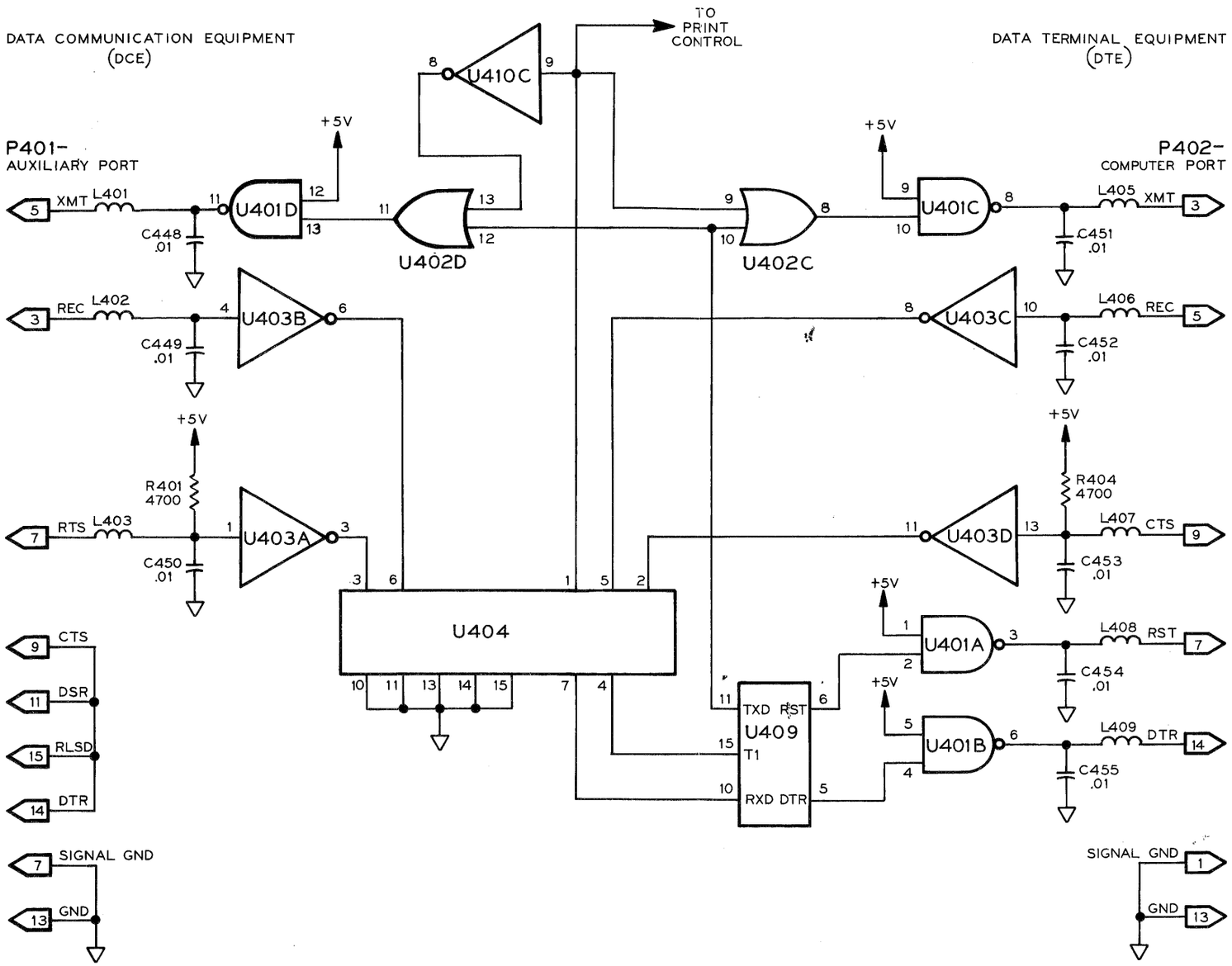
The I/O port may be programmed to function in any of the four operation modes shown below:

Mode 0 Synchronous I/O expansion using TTL or CMOS shift registers.

Mode 1 UART interface with 10-bit frame and variable transmission rate.

Mode 2 UART interface with 11-bit frame and fixed transmission rate.

Mode 3 UART interface with 11-bit frame and variable transmission rate.

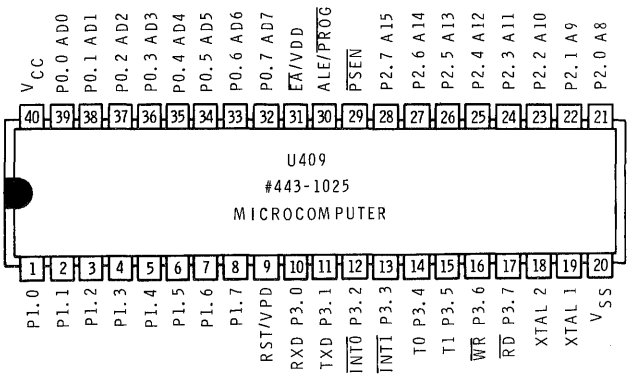

DATA COMMUNICATION EQUIPMENT
(DCE)
DATA TERMINAL EQUIPMENT
(DTE)
TO
PRINT
CONTROL
P401-
AUXILIARY PORT
P402-
COMPUTER PORT
U410C
U401D
U402D
U402C
U401C
U403B
U403C
U403A
U403D
U404
U401A
U401B
U409
TXD RST
T1
RXD DTR
+5V
XMT
REC
RTS
CTS
DSR
RLSD
DTR
SIGNAL GND
GND
L401
L402
L403
L405
L406
L407
L408
L409
C448 .01
C449 .01
C450 .01
C451 .01
C452 .01
C453 .01
C454 .01
C455 .01
R401 4700
R404 4700

Proper timing for the serial I/O data is provided by a transmission rate generator inside the microprocessor (U409). Three different methods of transmission rate generation are possible and the achievable transmission rate is dependent upon the operating mode of the serial port. Since this Terminal uses transmission mode 1, the transmission rate is generated from the microprocessor clock frequency. In this mode, the oscillator frequency is divided by 12 (or the T1 input is divided by 256, minus the value in TH1 if counter 1 is configured in the auto- reload mode by software). This frequency is then divided by 32 to provide the transmission rate. The baud rates that this Terminal will support are 75, 110, 150, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 7200, 9600, and 19200 baud.

The hardware required to complete the serial link is made up by the microprocessor (U409), a 2-line to 1-line output multiplexer (U404), a quadruple line driver (U401), and a quadruple line receiver (U403).

Both of the serial ports meet the EIA standards for RS-232C. Since the serial port on the microprocessor has only one receive and one transmit data line, the two user-available ports cannot be used simultaneously. U404 switches between the auxiliary port and the computer port and, therefore, alternates between the two ports. Pin 1 on multiplexer U404 is connected to a latched I/O pin on the microprocessor and toggles between the two ports. When this line is a logic 1, the microprocessor is set up to receive data from the auxiliary port. When this line is a logic 0, it is set up to receive data from the computer port.

The transmit line drivers are tied directly to the transmit pin (11) on the microprocessor (U409) through an OR gate (U402C or U402D). The second inputs to these OR gates are tied to the port select bit (U416, pin 7). When the port select bit is high, the output of the OR gate U402 is high regardless of the logic level of the data to be transmitted. Therefore, when the port select bit is logic 1, the auxiliary port (DCE) transmits. When the port select bit is low, the output of OR gate U402D is high regardless of the logic level of the data to be transmitted because of inverter U410C. Thus, when the port select bit is low (logic 0), the computer port (DTE) transmits.



The clear to send (CTS) and data terminal ready (DTR) control signals (handshaking) on the computer port (DTE) are taken directly from the microcomputer and passed to the line drivers. On the auxiliary port the clear to send (CTS), data terminal ready (DTR), data set ready (DSR), and the received line signal detect (RLSD) signals are all tied together.

CPU AND CONTROL CIRCUITRY

The heart of this Terminal is the microprocesser integrated circuit (U409) and its associated circuitry (ROM, RAM, and control logic). Microprocesser U409 contains a non-volatile 4K × 8 read-only-memory (ROM), a volatile 128 × 8 random-access-memory (RAM), 32 I/O lines, two 16-bit timer/counters, a five-source two-priority level nested interrupt structure, an on-chip oscillator/clock circuit, and a high performance full-duplex serial channel which was previously discussed. The internal ROM holds approximately one-half of the total monitor firmware. An expansion socket is included on the terminal logic circuit board for installation of an additional 4K × 8 of ROM or other options. More information about this expansion socket is included later in this Circuit Description.

The 32 I/O lines are divided into four 8-bit ports. Port 0 is an open-drain bi-directional I/O port, while ports 1, 2, and 3 are quasi-bidirectional I/O ports. Each of the ports will be described separately.

Port 0

Port 0 functions as the multiplexed data bus and low order address line. Since the memory and peripheral devices in this Terminal do not have on-chip address latching, the microprocessor circuitry must demultiplex the address and data lines into their respective buses. The address exits at port 0 and, approximately 100 nanoseconds later, the address latch enable (U409 pin 30) goes low. The low at this pin is inverted by U410B before it is applied to address latch U411, where the address is latched at the rising edge of the signal (ALE).

Port 1

Port 1 is a general purpose I/O port. Bit 0 (P1.0, U409 pin 1) is used as the handshake line between the terminal and the keyboard. Bit 1 (P1.1, U409 pin 2) is used as the input communication line from the keyboard to the terminal logic board. Both of these lines are properly buffered by U412B and U412F respectively, and filtered for RFI suppression.

Bit 2 (P1.2, U409 pin 3) is used as the video enable bit. When logic low, this bit, inverted by U412D, is connected to U432 pin 13 and allows the video to be displayed. When toggled to logic high by microcomputer U409, this bit casues the video information to be inhibited. This feature is particularly useful in blanking the extra unused logical rows of video in 50 Hz operation. It is also used during the screen saver option, where the screen is turned off after 15 minutes of inactivity if this feature is enabled in setup. This bit blanks the screen during a manual reset, while all RAM including video RAM is being initialized.

Bit 3 (P1.3, U409 pin 4) is used as an output. When jumpered to +5 volts, this bit inhibits the Setup mode key via firmware. When the bit is pulled up by firmware and recognized as being at a logic high, information fromt he keyboard that the Setup key has been pressed is ignored.

Bit 4 (P1.4, U409 pin 5) acts as the data terminal ready ($\overline{\text{DTR}}$) signal for proper handshaking at the comptuer DTE port and is applied to port connector P402 through line driver U401B.

Bit 5 (P1.5, U409 pin 6) acts as the clear to send ($\overline{\text{CTS}}$) signal for proper handshaking at the computer DTE port and is applied to port connector P402 through line driver U401B.

Bit 6 (P1.6, U409 pin 7) is routed to expansion socket U440 pin 37 and is an unused I/O bit in the present configuration. It may be used in future expansions or in user-designed options.

Bit 7 (P1.7, U409 pin 8) is used as an initialization synchronization signal to the video circuit (U428 pin 1). This signal is also routed to expansion socket U440 pin 38 in case it is needed in expansion circuits. The bit is firmware controlled to stop the video circuit clock and start it at a specified time after the two CRTC controllers have been properly initialized.

NOTES:

1. Further information about the keyboard communication bits is provided in the "Keyboard" section.

2. Futher information about the video enable bit is provided in the "Character Generation" section.

3. Further information about the RS-232 handshaking bits is provided in the "Serial Ports" section.

Port 2

Port 2 (P2.0 - P2.7, U409 pins 21 - 28) is used only for the higher order address byte when the microprocessor accesses external memory. The combination of ports 0 and 2 form the total 16-bit address bus and the primary address bus.

Port 3

Port 3 is used as a general purpose I/O port. Bits 0 and 1 (P3.0 and P3.1, U409 pins 10 and 11 respectively) are used in the serial port. Bit 0 acts as the serial port asynchronous receive data input, while bit 1 acts as the asynchronous transmit data output.

Bit 2 (P3.2, U409 pin 12) is used as the interrupt 0 input from the character CTR controller (U422). A logic low level at this port bit indicates that a row buffer is ready for the loading of character data. The logic high level buffer ready signal (BRDY) (U422 pin 5) is inverted at gate U401F. This interrupt initiates a DMA transfer at the two CRTCs.

Bit 3 (P3.3, U409 pin 13) is used as the interrupt 1 input from the character CRT controller (U422). A logic low level at this bit indicates the last display row and last retrace character has been handled. For the domestic version this indicates the 25th display line and is used as a reference for both 50 Hz and 60 Hz models.

Bit 4 (P3.4, U409 pin 14) is also connected to the video circuitry. Used as an output, the bit causes the jammed DMA instruciton to become 20 hex. This is used to clear a row of video memory quickly via DMA.

Bit 5 (P3.5, U409 pin 15) is used as an input to the serial port as the request to send ($\overline{RTS}$) signal from the selected port, depending on the PRT CTRL signal.

Bit 6 and 7 (P3.6 and P3.7, U409 pins 16 and 17) are the $\overline{WR}$ and $\overline{RD}$ signals for latching data bytes from port 0 to the data bus or vise versa, respectively.

$\overline{PSEN}$ stands for program store enable output and is a control signal from the microprocessor (U409 pin 29). It enables the external program memory to the bus during normal fetch operations versus using the microprocessors internal program memory.

The microprocessor (U409) receives character data and attribute information from either the keyboard interface or the host. When a key is pressed on the keyboard, the microprocessor at the keyboard (U1) converts it to character data to send to the Terminal. The attribute data associated with the character data already provided. The microprocessor then sends the attribute data to the attribute display memories (U444 and U445) by enabling bus buffer U405 with the $\overline{16K}$ address signal and the write signal ($\overline{WR}$), and directly connecting the attribute data bus to the primary data bus. The attribute data bus to the primary data bus. The attribute data is a four-bit-wide nibble (D0 - D3) appropriate to the four possible attributes.

After placing the attribute data in the display memory, the microprocessor now writes the character data out to the character display memory (U417). The $\overline{20K}$ address signal and the write signal from the microprocessor enables the memory chip select and the bi-directional bus driver (U442) so that the secondary data bus and the primary data bus are connected. The microprocessor places the character and associated attribute data in display memory chips in an address location equivalent to a video screen position.

After the microprocessor has placed the display data in the appropriate memory, this data must be transferred from the character display memory and the atrribute display memory to their corresponding CRT controller (U422 and U446 respectively). This operation occurs by way of direct memory access (DMA), which is described in the "Video Display" section.

MEMORY MAP (refer to Figure 5-6)

Address lines A15 through A12 are connected to the memory select circuit (U439) as well as other circuits. U439 is a 3-input to 8-output data selector/demultiplexer and selects 4K increments of the memory map. The $\overline{0K}$ signal is provided to the expansion socket (U440 pin 26) for use by earlier models. Later units have that portion of memory "on chip" on the microcomputer (U409). The $\overline{4K}$ signal is routed to J405 and J402 for proper connection to external program memory ROM U407.

Octal bus transceiver U442 separates the primary data bus from the secondary data bus. The secondary data bus services the character CRTC (U422) and the character memory (U417). This buffer is accessed at the $\overline{8K}$ boundary for access to the character CRTC (U422) registers. It is also accessed at the $\overline{20K}$ boundary for access to the character display memory (U417). The direction of data flow through this buffer is controlled by the buffered read signal from microcomputer U409.

Buffers U405 and U423 form eight single-direction bus drivers: four in the direction for a CPU read from attribute display memory U444 and U445, and four in the direction for a CPU write to attribute display memory. The two quad-controlled portions of hex bus drivers used in this circuit (U405 and U423) are accessed at $\overline{8K}$ and $\overline{16K}$. The $\overline{8K}$ access is for the attribute CRTC (U446) control registers, and the $\overline{16K}$

access is for the attribute display memory (U444 and U445).

Control functions from microprocessor U409 are transferred via the primary data bus to a hex D flip-flop (U416). This control function latch is positioned in the memory map at the $\overline{12K}$ boundary. Data is transferred from the CPU to the latch when the memory select IC (439) has the $\overline{12K}$ signal selected and, at the same time, the write signal from the microcomputer is active. The signals held by the latch are as follows.

$\overline{\text{EAROMSTORE}}$: When this bit is set, the current setup information is stored in the ROM portion of the EAROM. Therefore, if the Terminal is powered down, the setup information remains.

BI : When this bit is set, the blink attribute is activated.

PRT CNTL : This bit controls the selection between the auxiliary and computer ports.

EAROMRECALL : When this bit is set, the information stored in the ROM portion of the EAROM is brought into the RAM portion and is ready to use.

I/O 1 : This is an I/O bit that is used for future options. It is brought out through the expansion socket (U440 pin 4).

I/O 2 : This is an I/O bit that is used for control lines in future options. It is brought out through the expansion socket (U440 pin 5).

Both of the previously discussed circuits, the character display memory and the attribute display memory, are further accessed at $\overline{24K}$ as DMA memory. See further discussion on under the "DMA" section.

The $\overline{28K}$ signal is ORed at U419D with the $\overline{WR}$ or $\overline{RD}$ (U402A or U408A) to produce the low level chip select signal required to access the NVRAM (U413).

ADDRESS LOCATION	USED FOR
0K--4K	Physically located in the expansion socket EPROM. It is internal to the microprocessor in later models.
4K--8K	External program firmware.
8K--12K	CRT controller registers.
12K--16K	Control signal latch.
16K--20K	Attribute display memory.
20K--24K	Character display memory.
24K--28K	DMA memory.
28K--32K	NVRAM memory.
32K--64K	The upper half of the memory map is completely open. All devices in the lower 32K of memory are disabled by an address above 32K. This opens the expansion socket for an infinite number of user-implementable options, or for future design options. All 16 address lines are available to the user to do the proper decoding, and Terminal functions. The 0K decoding signal on pin 26 of this socket must not be used. This decoding is only used in earlier models, where the 0K--4K boundary is filled by program memory.

Figure 5-6

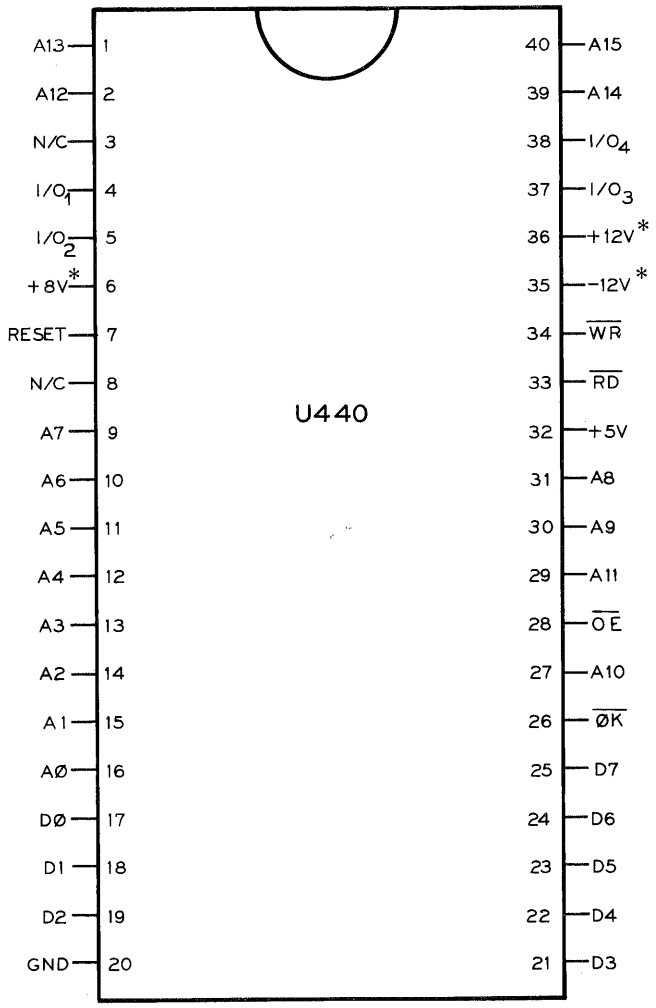
Memory map

EXPANSION SOCKET

A 40-pin expansion socket (refer to Figure 5-7) is available on the terminal logic circuit board (at U440). This socket may be used for future design options, or as the connection point for user-expandable options (in early models, pins 9 through 32 of this socket can directly handle a 4K × 8 EPROM). The additional memory IC should be installed so that pin 1 of the IC is in socket pin 9 etc. Pins 1 through 8 and pins 33 through 40 are not used. In later models, this 4K of firmware is internal to the microprocessor and allows the entire socket to be used for other optional functions.

Unregulated +9.6 volts DC as well as +5, +12, and −12 volts DC is available at this socket. In addition, the socket has three I/O pins latched from the microprocessor, the full 8-bit data bus, the full 16-bit address bus, read and write lines from the microprocessor, the reset line, the $\overline{OE}$, and one memory map decoding signals available.

Pin 26 of this socket decodes the 0K--4K boundary and is only used in early models to decode the 4K firmware EPROM. This pin must not be used for any other function. As noted earlier, the memory map of this Terminal is completely filled from 0K up to 32K. This leaves the the entire second half of the memory map for user options. Address line A15 is available at pin 40 of this socket for decoding. When line A15 is a logic 1, the expansion socket may be used for options. When this line is a logic 0, the basic Terminal is addressed. Any additional buffering of signals that are not used in Zenith Data Systems options are the responsibility of the user.



*UNREGULATED SUPPLY

Figure 5-7

40-pin expansion socket

PROGRAM ROM SOCKET

An extremely useful 24-pin program ROM socket (refer to Figure 5-8) is available on the terminal logic circuit board at U407. Jumpers are provided so the socket can accept either a 2K or a 4K ROM or EPROM. This allows you to use many different brands of IC in the socket by simply installing the correct jumpers. The following chart shows the jumper pinouts that are possible:

JUMPER	PIN USE
J1 installed	Pin 21 is high.
J2 installed	Pin 21 is the chip select.
J3 installed	Pin 21 is address line A11.
J4 installed	Pin 18 is address line A11.
J5 installed	Pin 18 is the chip select.

For this circuit to operate properly, a jumper must be installed at either J1, J2, or J3 and at either J4 or J5. In addition, the access time for this chip can be a maximum of 350 nanoseconds to insure that, in the worst case, there are no timing errors. The second 4K of memory is, in early models, installed in the expansion socket. In later models, this lower 4K of memory is internal to the microprocessor.

These ROMS's are accessed when the microprocessor exits an address and it is latched into UA on the leading edge of the ALE pulse. Once the address is latched, it is on the address bus where it is decoded by integrated circuit U439. IC U439 is a 3-line to 8-line decoder that has its outputs limited to 4K boundaries.

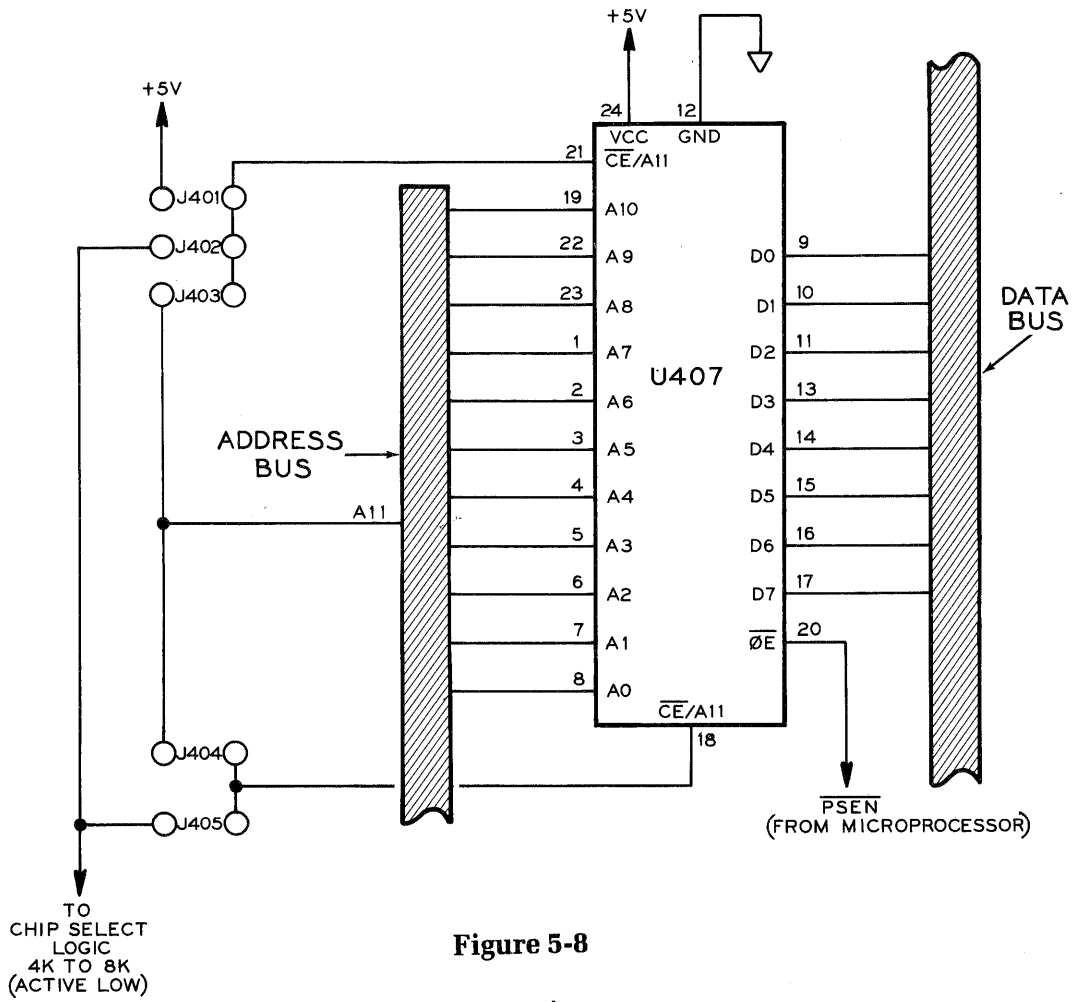


Figure 5-8

ROM socket

CLOCK CIRCUIT

The main oscillator clock circuit (refer to Figure 5-9) controls all of the time operations of the Terminal. It consists of an inverter (U427A) that is biased by resistors R408 and R409 to operate linearly. Crystal Y401 provides positive feedback to the inverter generates a 14.784 MHz clock signal. Decoupling capacitor C411 prevents unwanted negative feedback from being fed back from the output to the input and altering the oscillator frequency, and capacitors C410 and C412 provide impedance matching for the crystal. Inverter U427D buffers the high-frequency clock signal and provides the necessary current drive for the remainder of the clock circuitry. The remaining buffers inside U427 are not used, which prevents the high-frequency signal from being coupled into other circuits and possibly causing radio frequency interference.

The buffered 14.784 MHz clock signal is coupled to the dot clock circuit, the main processor clock, and the video timing and synchronization circuits. In the dot clock circuit, the signal is fed directly to the clock input of the shift register (U431). This allows the video dots to be shifted out at the 14.784 MHz rate. In the main processor clock circuit, a D-type flip-flop (U420A) divides the high-frequency clock signal by two to produce a 7.392 MHz processor clock signal. The remaining signal path is to the counter (UE) integrated circuit (U428), which divides the high-frequency signal by two, four, and eight for use in the video timing and synchronization circuits. The divided-by-eight signal is fed directly to the two CRT controllers (U422 and U446) and is used as the character clock. This signal is used because it matches the eight horizontal video dots per character cell.

Integrated circuit U419A NANDS the three signals from U428 and produces a signal that is used to clear the counter and signal the shift register to accept the parallel load of character data from the character ROM. U447 is a high-speed Schottky integrated circuit that features synchronous edge-triggered flip-flops, along with an internal look-ahead carry. The high-speed and synchronous triggering of these flip-flops is necessary for the precise video timing to function properly. The 14.784 MHz clock is used so that the screen refresh could be programmed for exactly 50 or 60 Hz. Also, the 7.392 MHz clock rate for the processor (14.784/2) is ideal for the processor's serial port baud rate generation. Refer to "CPU and Control Circuitry" for more information about the screen refresh circuitry.

CHARACTER GENERATION

The heart of the character generator and display circuits is formed by CRT controllers U422 and U446. One of these CRT controllers operates on the character data while, the other operates on the attribute data. The type of integrated circuits used in this Terminal requires that the attribute data be in a field-defined format. The second CRT controller, however, allows the Terminal to use attribute data in a character by character basis. Both controllers are connected to the same clock bus, which makes special synchronization unnecessary.

The CRT controller is used to determine when data should be transferred from the display RAM to the character generating circuitry. The five control lines that are used for the transfer of data on the data bus both to and from one of the internal registers are:

BDRY –Buffer ready. This output signal indicates that a row buffer is ready for the loading of character data. This output is inverted and sent to pin 12 of the microprocessor, where it is used to initiate DMA.

$\overline{BS}$ – Buffer select. Input signal enabling the write signal for character data into the row buffers.

$\overline{RD}$ – Read input. A control signal used to read the registers.

$\overline{WR}$ –Write input. A control signal used to write commands to the control registers or to write data into the row buffers.

$\overline{CS}$ – Enables the read of the status registers or the write of command, parameters, or data.

Initialization of the CRT controllers must be completed before they can function properly. The information that is necessary for the controllers to display correctly is: type of cursor (underline, blinking underline, block, and blinking block), cursor home position, all video control information, and synchronization timing.

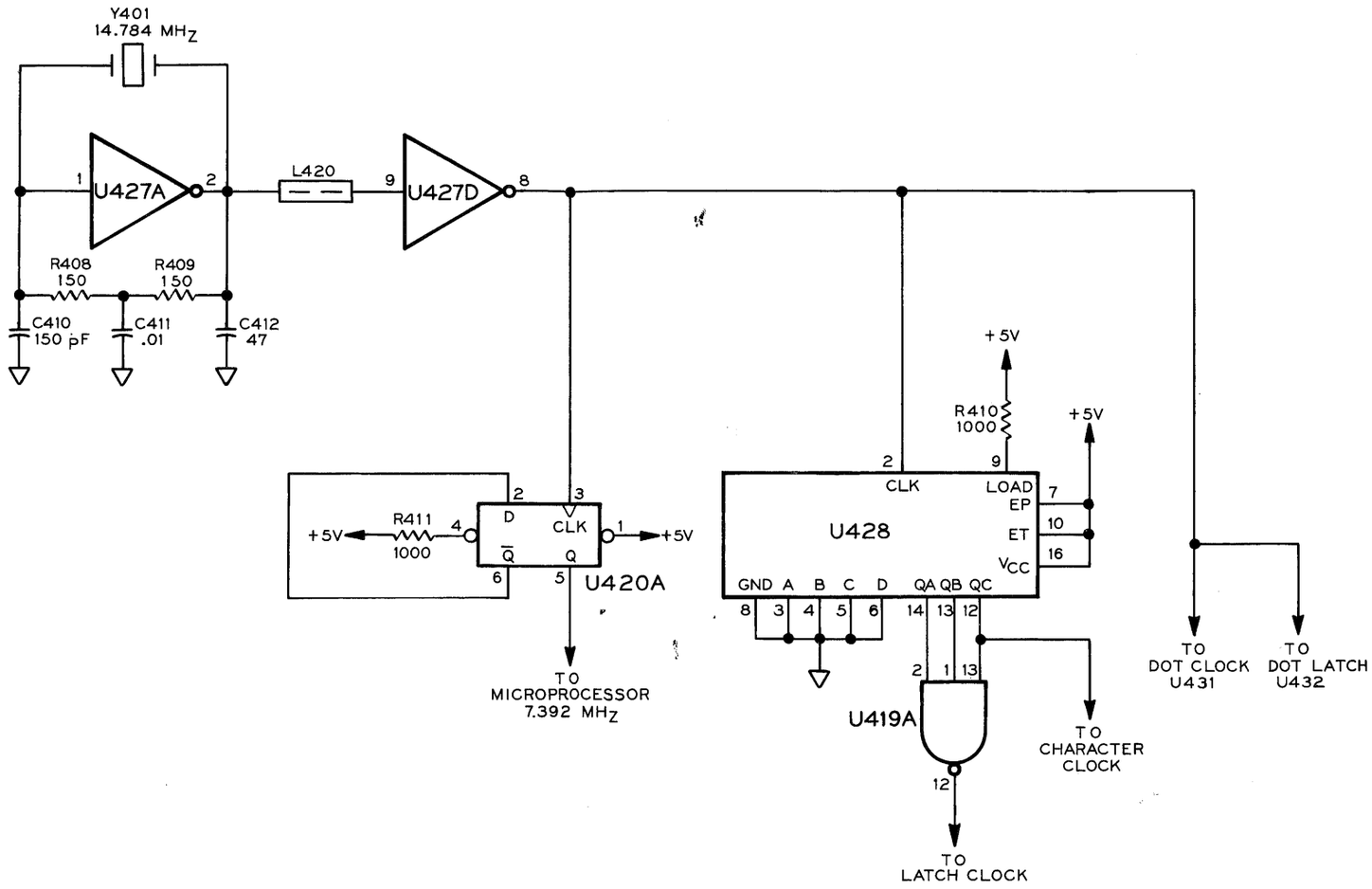

Y401
14.784 MHz
U427A
L420
U427D
R408
150
R409
150
C410
150 pF
C411
.01
C412
47
+5V
R411
1000
D
CLK
Q
U420A
TO
MICROPROCESSOR
7.392 MHz
R410
1000
U428
CLK
LOAD
EP
ET
VCC
GND A B C D QA QB QC
U419A
TO
CHARACTER
CLOCK
TO
LATCH CLOCK
TO
DOT CLOCK
U431
TO
DOT LATCH
U432

Figure 5-9

All character data, attributes, and synchronization pulses are supplied from the two controllers directly to the video logic. The underline attribute, if set (active high), allows the tenth scan line in that particular character cell to be decoded through the line count outputs of the CRT controller. The LC3, LC0, and underline bits are fed to three-input NAND gate U419C as a high that forces the output low. This output is inverted by U424D and then exclusive OR'ed with the blink attribute in U430B. If the blink attribute is not set, or if it is in an off blink position, the underline information passes through. (If the blink attribute is set, it turns off the underline and creates the blink effect until the blink line returns to the low state, allowing the video information to pass through. The blink line continues to toggle in this fashion as long as the blink attribute is set. The blink rate is controlled by the microprocessor and can be varied.) The underline is then exclusive OR'ed with the cursor information (in U430C) with the cursor information coming from the LTEN and RVV pins of the CRT controller for the underline and block cursors. Exclusive OR'ing these two signals (underline and cursor) enables the normal video cursor to be visible through the underline by blanking it for that interval.

Next, the information is exclusive OR'ed (by U430D) with the reverse video attribute. This disables the underline information, so it is visible as a blank line through the reverse video information in that character cell. The video information is now logically AND'ed (by U421D) with the inverted HRTC and VRTC control lines from the controller. This causes all video to be suppressed during horizontal and vertical retraces. The VSP output of the controller (which is normally used for retrace suppression) is not used here, since it would also blank the first and last scan lines of each row. This would not work well with graphic characters that must connect from one row to the next.

The next step is to latch the video information so that the reverse video information (explained above), the half-intensity attribute (fed directly from the second controller to the latch), and the horizontal and vertical retrace control signals can be synchronized exactly. The reverse video output of the latch is exclusive OR'ed (by U430A) to create the reverse video of the characters. This information is again latched with the half- intensity attribute and the horizontal and vertical retrace control signals. All of the video information is now present at the open collector AND gates (U430A, B, C, and D) at exactly the same time. This exact timing allows the circuit to directly drive the video circuit board. Since there is no delay from the end of a line of characters to the horizontal retrace pulse going active, the same is true for the vertical pulses with respect to the end of the screen. The open-collector gates increase the drive capability, increase the noise immunity, and increase the rise and fall times of the video dots. This creates crisper dots and improves the overall video picture. The open-collector gates also enable the half-intensity attributes to be obtained by a resistor divider network using only the required pull-up resistors.

Compared to the actual video character circuitry, the attribute circuitry is complicated. The CC0 through CC6 outputs of the controller contain the character code information coming from the row buffers. These outputs, along with the line count outputs, form the 10 address lines for the character generator. Address line A11 selects from the upper or lower 2K of the character ROM (selects between a domestic and a foreign character set). Once the ROM presents the valid data on its bus, the eight bits of information are latched into the shift register on the low pulse that is derived from the dot clock. The video characters are suppressed by the blink attribute or the retrace control signals.

These three signals are logically OR'ed together and then logically OR'ed with the clock signal that creates the load action of the shift register. If any of the control signals (the blink attribute or vertical or horizontal retrace) are active through the chain of OR gates, the load pin of the shift register is held high and disables the load function of the shift register. This shifts out zeros that translate into video blanks. Dots are shifted at the main clock frequency of 14.784 MHz. This clock rate, along with the timing controls from the controller, enables the screen to be refreshed at exactly 60 Hz intervals and insures that the screen displays a steady frame without beating with the line frequency.

Both domestic and foreign models are capable of 60 Hz refresh. 50 Hz refresh, however, requires the addition of an addressable latch. Four lines of unused video must be added and blanked to make up for the inefficiency of the controller. The controller only has the ability to control the vertical retrace times

at an accuracy of 1, 2, 3, or 4 row times. In order to change the screen refresh rate without drastically altering the horizontal scan frequency or changing the dot clock circuitry, extra rows are added. These extra rows effect the video exactly as added vertical retrace lines would.

The addressable latch blanks the video at the proper time by decoding the line count for the first scan line. If there is a disable video command coming from the microprocessor at the same time, it stops the video before it is displayed. This occurs because the line count changes during horizontal retrace and so line zero can be decoded before the line begins. If the video command is present at the beginning of the row, the entire row is blanked even if the disable video command goes inactive before the line count changes to zero again. This IC is specifically used to blank rows 26, 27, 28, and 29 on the screen (these are the rows that are added to achieve 50 Hz refresh). In addition to blanking the extra rows, this circuit accomplishes the screen- saver function. This function disables the video after 15 minutes of inactivity and saves the screen phosphor. The screen reappears as soon as any key on the keyboard is pressed.

VIDEO CIRCUIT BOARD

Refer to the Video Circuit Board Schematic as you read the following paragraphs.

The video circuit board converts TTL signals, coming from the terminal logic circuit board, to the voltages necessary to drive the CRT (cathode ray tube). This circuit board contains the vertical circuits, horizontal circuits, video amplifier, and the high-voltage power supply.

VERTICAL CIRCUITS

Capacitor C301 couples the vertical sync signal (from the terminal logic circuit board) to synchronize vertical oscillator transistors Q301 and Q302. Capacitor C303 shapes the output of this oscillator at the emitter of Q301 to help produce a linear sweep.

The shaped oscillator signal is applied to differential transistor Q303, where the base acts as the inverting input and the emitter as the noninverting input. Feedback from the output of this amplifier stage is applied to the emitter of Q303 to ensure good linearity. An RC network formed by resistors R312 through R317 and capacitors C307 through C309 sets the gain and frequency response of the vertical amplifier stage.

The output of Q303 drives the vertical driver (Q304) and amplifier (Q306 and Q307). This stage develops the sweep current through vertical deflection yoke TX202A. Transistor Q308 ensures a fast vertical retrace.

HORIZONTAL CIRCUITS

Capacitor C101 couples the horizontal sync pulse (from the terminal logic circuit board) to sync amplifier Q104. Transistor Q104 amplifies this signal and applies it to timer IC101. The timer circuit shapes and retimes the signal before it is applied to horizontal driver Q102. Transformer TX101 couples the signal from the horizontal driver to horizontal output transistor Q103. Resistor R127 and capacitor C114 shape the signal, while resistor R128 dampens any ringing that may occur. The collector current from Q103 couples through flyback transformer TX102, width coil L101, and linearity coil L102 to drive horizontal deflection yoke TX202B.

HIGH VOLTAGE POWER SUPPLY

Flyback transformer TX102 uses the signal coming from Q103 to generate the acceleration voltage for the CRT. A diode inside the flyback transformer rectifies this acceleration voltage before it leaves the transformer. The secondary of TX102 develops focus, blanking, and bias voltages for CRT through C121, CR106, and CR109.

The secondary of TX102 also develops bias voltages for the horizontal circuits (+12 volts) and the video amplifier (+70 volts).

VIDEO AMPLIFIER

Transistors Q401 and Q402 are connected in cascode to form the video amplifier. This circuit has high gain, low noise, and low input and output capacitances.

The video signal enters the base of Q402, where a positive voltage produces white information. Transistors Q401 and Q402 conduct to make the CRT cathode more negative.

Resistor R412, in the emitter circuit of Q402, sets the overall stage gain, while C403, R413, and L401 set the frequency response.

POWER SUPPLY

Power for the video circuit board is provided by a single 12-volt source coming from the main power supply circuit board.

KEYBOARD ASSEMBLY

Refer to the Keyboard Schematic as you read the following paragraphs.

The keyboard assembly is connected to the monitor portion of the Terminal through a 6-conductor coiled cable. Pin 1 of the connector supplies +9.6-volts DC (coming from the terminal logic circuit board in the monitor) to the keyboard assembly, where U6 regulates this down to +5 volts for use by the keyboard circuits. Pin 6 provides the return ground connection for the power supply.

Data from pin 21 of microprocessor U1 is transmitted back to the monitor through the cable via pin 4. Microprocessor U1 is a totally self-sufficient 8-bit parallel computer. Besides being low cost, this integrated circuit features a 1K × 8 program memory ROM, a 64K × 8 data memory RAM, an 8-bit timer event counter, an internal oscillator and clock circuit, and 21 I/O lines.

Microprocessor I/O pins 20 and 21 pass data back and forth between the terminal logic circuit board in the monitor and the keyboard microprocessor. These I/O pins are quasi-bidirectional interfaces, which allow buffered outputs and external inputs. A logic low written to these ports causes a large pull-down device to sink an external TTL load. A logic high supplies a large current through the pull-up device to allow fast data transfer. After less than one instruction cycle, the large device is turned off and a small pull-up device maintains the high level indefinitely. Any data written can also be read. By writing a high to any pin, that pin can serve either as a true high level latched output pin or as a pull-up resistor on an input.

The terminal logic circuit board in the monitor supplies data flow control information to pin 13 of U1. This is the important handshaking signal that synchronizes data between the CPU on the terminal logic circuit board and the microprocessor in the keyboard assembly. ASCII data from pin 21 of the microprocessor is inverted (by U3) and buffered (by U4) before it is sent over the coiled cable. Keyboard reset information is sent over pin 2 of the connector. This reset is activated when the Shift and Reset keys are pressed simultaneously. The outputs of these two keys are logically NOR'ed, which presents a high when both are depressed. When a key is released, the circuit opens and the outputs are pulled high by pull-up resistors. Whenever a key is depressed, it closes the circuit and ties the output to ground. The reset signal is inverted (by U3) and buffered (by U4) before it is sent over the cable to the terminal logic circuit board. The inverting is done to produce an active low, which ensures that you cannot reset the Terminal by unplugging the keyboard cable. A pull-up resistor on the terminal logic circuit board pulls the unconnected reset line up to +5 volts.

Disassembly

The following information shows you how to remove the cabinet top from the monitor and how to remove the circuit boards and the cathode ray tube for servicing.

REMOVING THE CABINET TOP

Refer to Figure 6-1 as you perform the following steps.

NOTE: Be sure the line cord is unplugged.

1. Remove the two 8-32 × 1-1/4″ screws from the bottom of the cabinet.
2. Position the monitor as shown. Then remove the two 6-32 × 3/8″ screws in the top corners of the rear panel.
3. Remove the #6 × 1/4″ sheet metal screw from the bottom center hole in the rear panel.
4. Carefully lower the rear panel to its fully open position.
5. Pull the cabinet top up and off of the monitor.

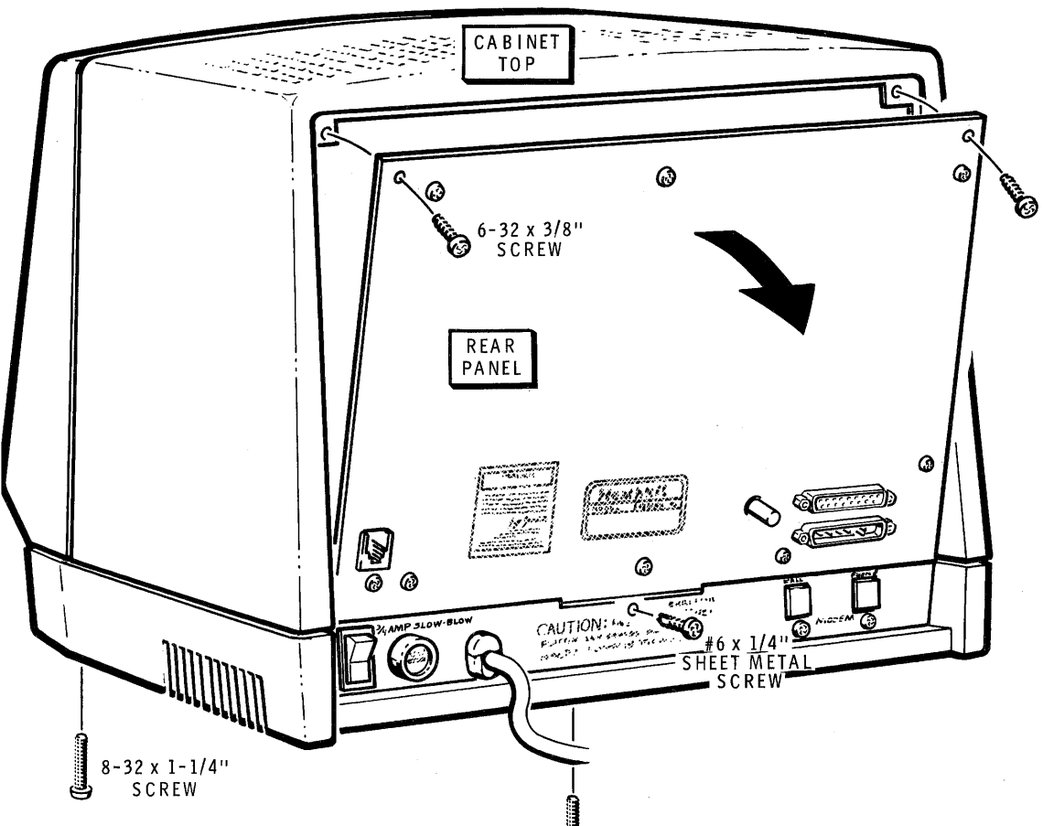
To remount the cabinet, reverse the procedure. Be sure the cabinet top is between the rear panel and the ends of the support brackets.

REMOVING THE POWER SUPPLY CIRCUIT BOARD

To remove the power supply circuit board from the chassis for servicing, refer to Figure 6-2 and perform the following steps:

1. Unplug the line cord from the AC outlet.
2. Remove the cabinet top as described above.
3. Unplug the connectors from plugs P101 and P102 on the power supply circuit board.
4. Remove the 6-32 × 3/8″ nylon screw, #6 lockwasher, and 6-32 nut from U101.
5. Remove the four 6-32 × 3/8″ hex head screws from the corners of the power supply circuit board. Then remove the circuit board from the chassis. NOTE: The insulator on U101 may stick to the chassis or to U101.

To remount the circuit board, reverse the procedure. Be sure to plug the socket coming from the power transformer into plug P101 and the socket coming from the terminal logic circuit board into plug P102 on the power supply circuit board. These sockets are designed to fit together only the correct way.


CABINET TOP
6-32 x 3/8" SCREW
REAR PANEL
2½ AMP SLOW-BLOW
CAUTION:
#6 x 1/4" SHEET METAL SCREW
8-32 x 1-1/4" SCREW

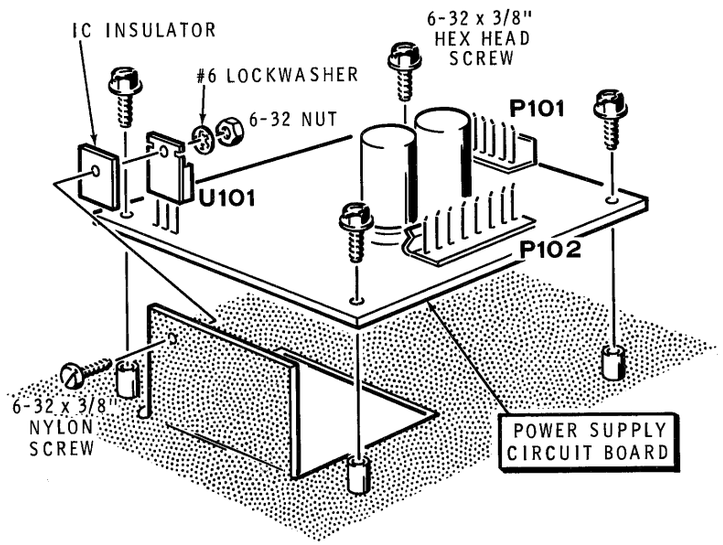

IC INSULATOR
6-32 x 3/8" HEX HEAD SCREW
#6 LOCKWASHER
6-32 NUT
P101
U101
P102
6-32 x 3/8" NYLON SCREW
POWER SUPPLY CIRCUIT BOARD

Figure 6-2

REMOVING THE VIDEO CIRCUIT BOARD

To remove the video circuit board from the chassis for servicing, refer to Figure 6-3 and perform the following steps:

1. Unplug the line cord from the AC outlet.
2. Remove the cabinet top as described above.
3. Refer to the inset drawing #1 on Figure 6-3 and discharge the CRT as shown. Then refer to inset drawing #2 and disconnect the second anode lead from the tube.
4. Carefully unplug the CRT socket from the neck of the tube. Then unplug the black ground wire from the ground clip at the lower corner of the CRT mounting flange.
5. Unplug the red/blue 2-wire cable from the VERT YOKE socket on the video circuit board.
6. Unplug the yellow/black 2-wire cable from the HORIZ YOKE socket on the video circuit board.
7. Unplug the large 10-pin socket from the video circuit board.
8. Remove the four 6-32 × 3/8″ hex head screws from the video circuit board. Then remove the circuit board from the chassis.

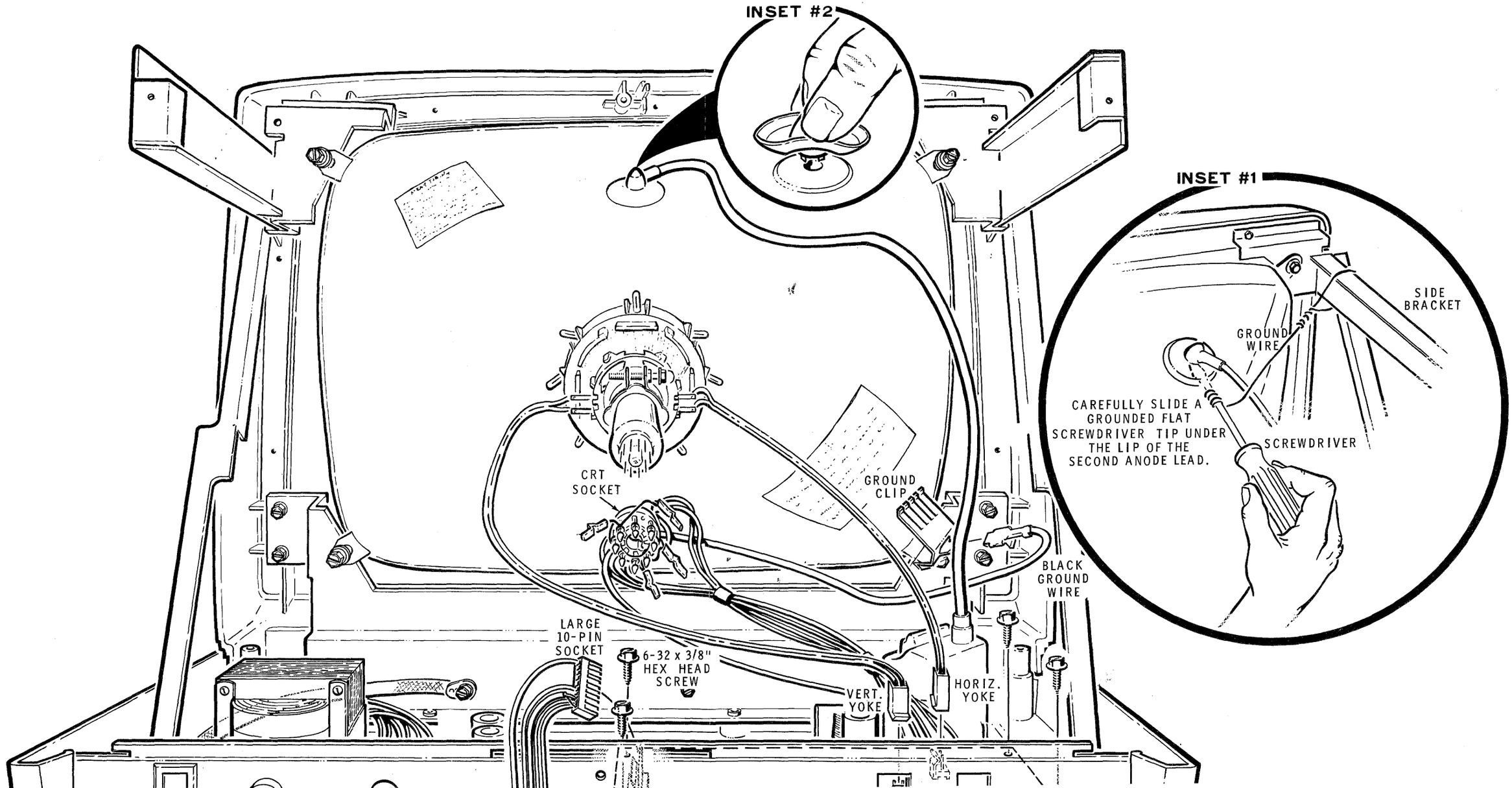
To remount the video circuit board, reverse the procedure. The yoke sockets, CRT socket, and large 10-pin socket are designed to fit together only the correct way. Do not forget to reconnect the black ground wire to the ground clip on the CRT mounting flange.

REMOVING THE CATHODE RAY TUBE (CRT)

To remove the CRT from the cabinet, refer to Figure 6-4 and perform the following steps:

1. Unplug the line cord from the AC outlet.
2. Remove the cabinet top as described earlier.
3. Refer to inset drawing #1 on Figure 6-4 and discharge the CRT as shown. Then refer to inset drawing #2 and disconnect the second anode lead from the tube.
4. Carefully unplug the CRT socket from the neck of the tube.
5. Unplug the red/blue 2-wire cable from the VERT YOKE socket on the video circuit board.
6. Unplug the yellow/black 2-wire cable from the HORIZ YOKE socket on the video circuit board.
7. Unplug the black ground wire from the ground clip at the lower corner of the CRT mounting flange.
8. Loosen the #8 × 5/16″ hex head screw at the top of the left and right support brackets.
9. Remove the three 8-32 × 3/8″ screws from the bottom of the cabinet that secure the cabinet front to the cabinet bottom. Then carefully remove the cabinet front and set it face down on a flat surface.
10. Remove the four 8-32 × 3/8″ hex head screws, flat washers, and ground clip from the mounting flanges at the corners of the CRT. Then remove the CRT from the cabinet front. Be sure to set the CRT on a padded surface so it cannot become scratched.

To reinstall the CRT, reverse the procedure. Be sure to connect all cables and wires to their correct points.


INSET #2
INSET #1
SIDE BRACKET
GROUND WIRE
CAREFULLY SLIDE A GROUNDED FLAT SCREWDRIVER TIP UNDER THE LIP OF THE SECOND ANODE LEAD.
SCREWDRIVER
CRT SOCKET
GROUND CLIP
BLACK GROUND WIRE
LARGE 10-PIN SOCKET
6-32 x 3/8" HEX HEAD SCREW
VERT. YOKE
HORIZ. YOKE

REMOVING THE RF TRAP CIRCUIT BOARD

To remove the RF trap circuit board for servicing, refer to Figure 6-5 and perform the following steps:

1. Unplug the line cord from the AC outlet.
2. Remove the cabinet top as described earlier.
3. Remove the two #8 × 5/16" hex head screws that secure the insulator paper to the chassis. Then remove the insulator paper.

WARNING: Hazardous voltages are present in the area of the RF trap circuit board when the line cord is connected to an AC outlet. Be absolutely sure the line cord is disconnected from the AC outlet. For added protection, we suggest that you tie (loosely) the plug end of the line cord to one of the support brackets on the monitor while you perform the following steps.

4. Carefully unplug the white and black wires from the RF trap circuit board.
5. Remove the #6 × 1/4" sheet metal screw that holds the circuit board angle bracket to the chassis. Then remove the circuit board.

To reinstall the circuit board, reverse the procedure. Be sure to connect the wires and leads to the circuit board as follows:

1. Wire coming from the fuseholder to CC.
2. Black wire coming from the power transformer to DD.
3. Black line cord lead to AA.
4. White line cord lead to BB.

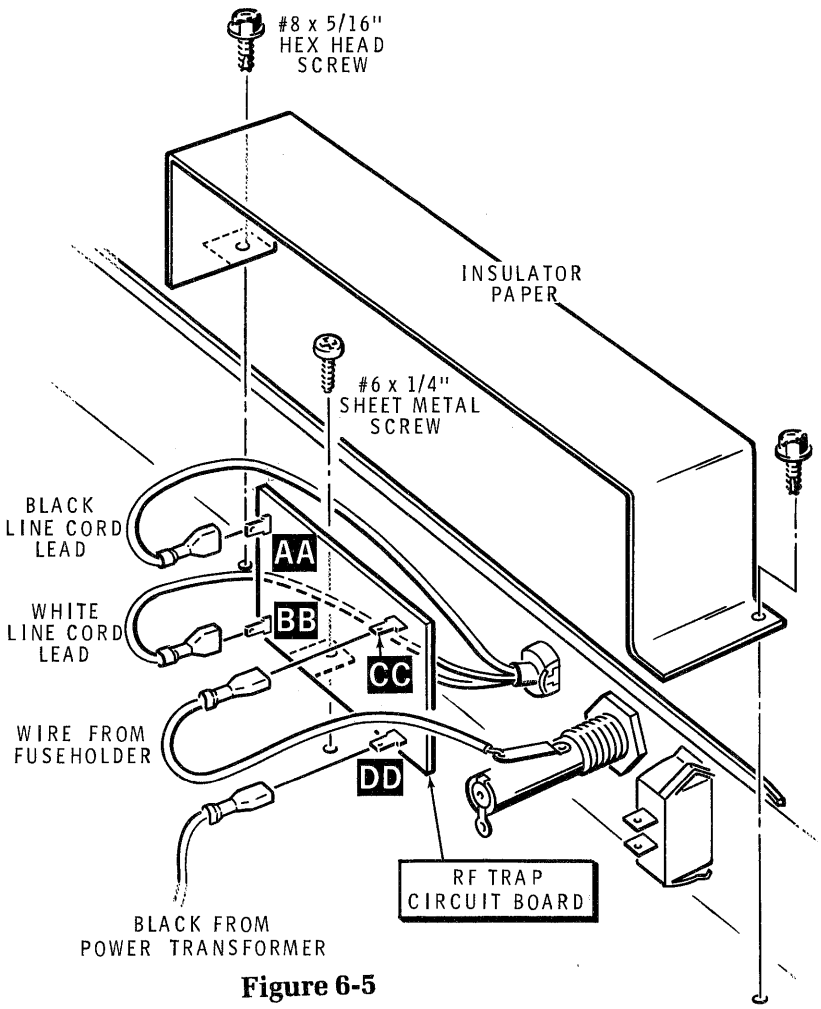
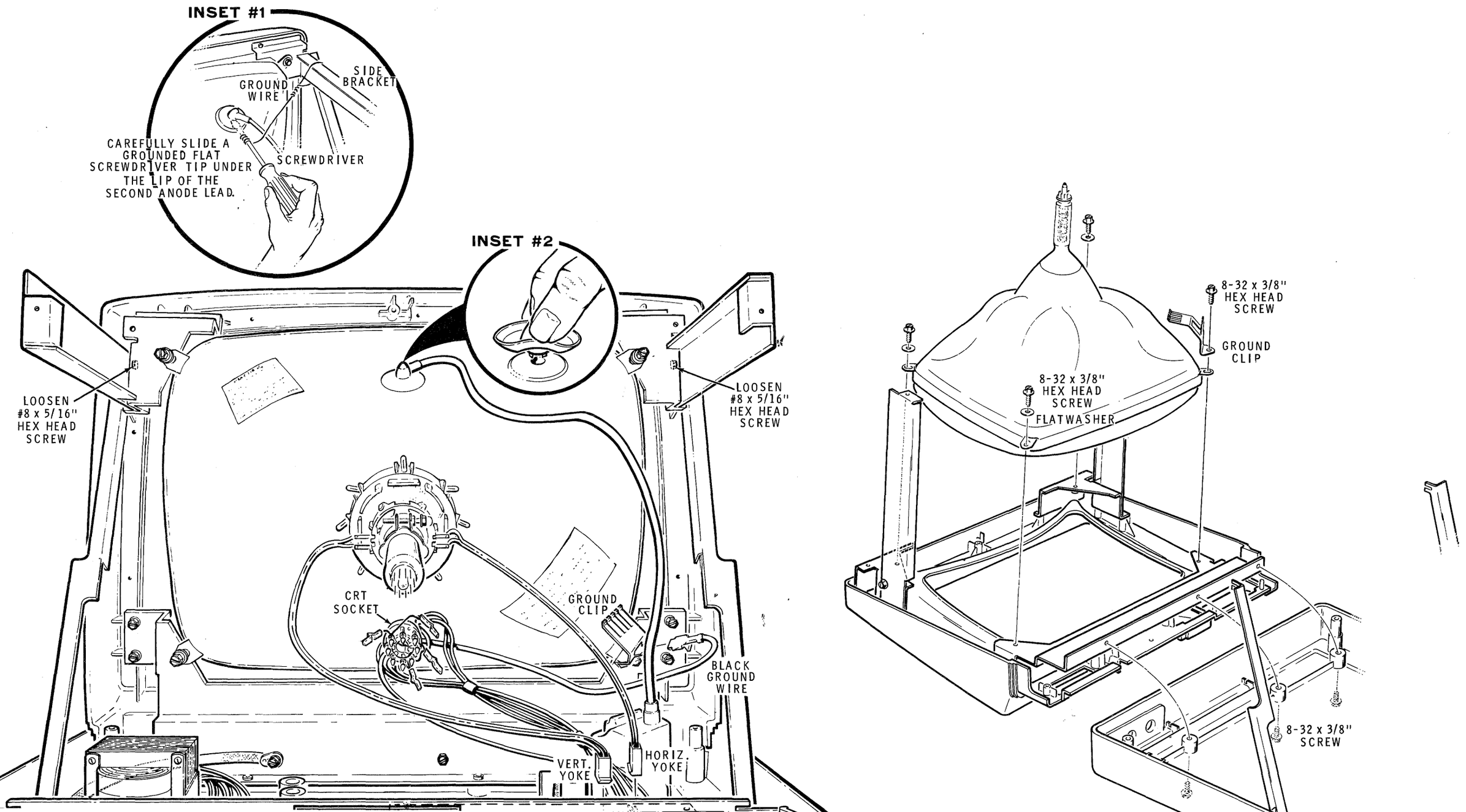


Figure 6-5

RF trap board removal


INSET #1
SIDE BRACKET
GROUND WIRE
CAREFULLY SLIDE A GROUNDED FLAT SCREWDRIVER TIP UNDER THE LIP OF THE SECOND ANODE LEAD.
SCREWDRIVER
INSET #2
LOOSEN #8 x 5/16" HEX HEAD SCREW
LOOSEN #8 x 5/16" HEX HEAD SCREW
CRT SOCKET
GROUND CLIP
BLACK GROUND WIRE
VERT. YOKE
HORIZ. YOKE
8-32 x 3/8" HEX HEAD SCREW
GROUND CLIP
8-32 x 3/8" HEX HEAD SCREW
FLATWASHER
8-32 x 3/8" SCREW

REMOVING THE TERMINAL LOGIC CIRCUIT BOARD (TLB).

To remove the terminal logic circuit board from the rear panel for servicing, refer to Figure 6-6 and perform the following steps:

1. Unplug the line cord from the AC outlet.
2. Remove the cabinet top as described earlier.
3. Unplug the socket from plug P403 on the circuit board.
4. Unplug the sockets from P404 and P405 on the circuit board.
5. Unplug the sockets from P401 and P402 on the circuit board.
6. Remove the seven 6-32 nuts and #6 lockwashers that hold the circuit board to the rear panel. Then remove the circuit board.

To reinstall the circuit board, reverse the procedure. Be sure to connect the sockets to the circuit board as follows:

1. Push the socket on the free end of the cable coming from the DCE socket to P401. Be sure the black wire in this socket is at pin 15.
2. Push the socket on the free end of the cable coming from the DTE socket to P402. Be sure the blue wire in this socket is at pin 13.
3. Push the socket on the free end of the cable coming from the video circuit board to P404. This socket is designed to fit only the correct way.
4. Push the socket on the free end of the cable coming from the power supply circuit board to P405. This socket is designed to fit only the correct way.
5. Push the socket on the free end of the cable coming from the keyboard socket to P403. This socket is polarized to fit only the correct way.

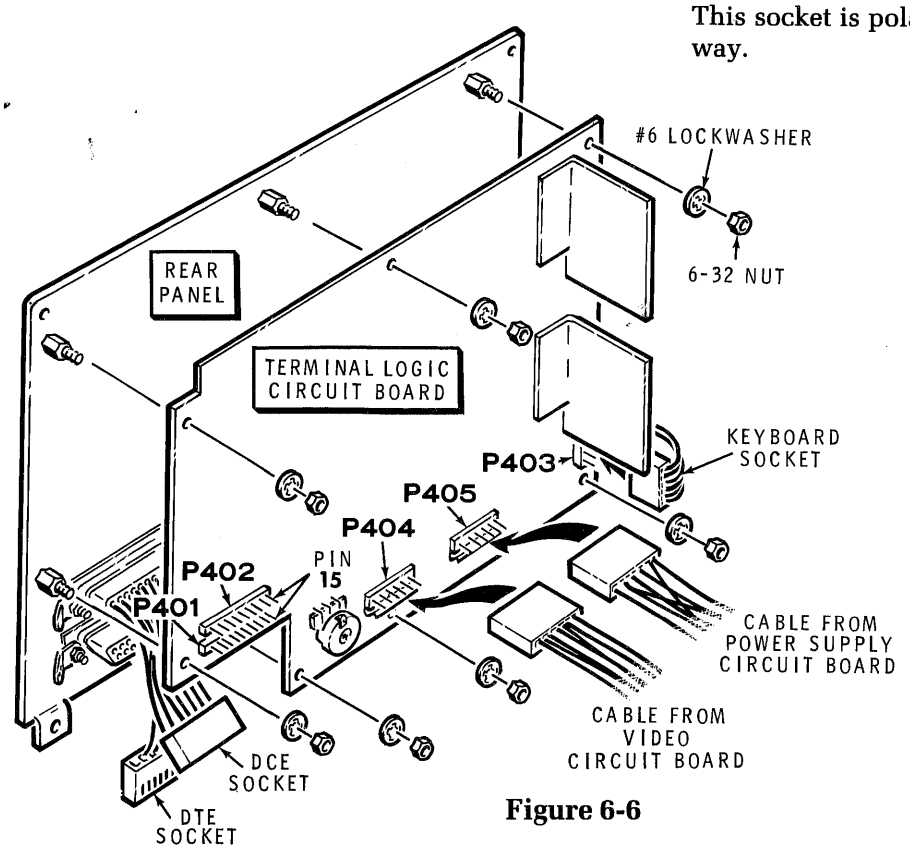


Figure 6-6

TLB removal

Service

QUICK SERVICE CHECKS

- Check to see that the power cord is plugged into the proper AC outlet.
- Check to see that the coiled cable is properly connected between the monitor and the keyboard.
- Complete the following self-test. NOTE: The Terminal does not need to be connected to any other equipment to perform this test.

1. Push the POWER switch to ON. The POWER indicator on the keyboard will light. After a few seconds, a cursor will appear in the upper left corner of the screen. A display may also appear on the 25th line of the screen. This display will show the time (beginning at 0:00:00) and/or one or more other messages, such as CAPS LOCK, OFF LINE, or INSERT MODE.

When you turn the Terminal on, it quickly performs a series of diagnostic tests to ensure proper operation. If it finds any faults, it displayes an appropriate error message. If it does not find any faults, a short beep is sounded. The tests performed and the error messages produced are as follows:

TEST	ERROR MESSAGE IF FAULT IS DETECTED
ROM	ROM Checksum
RAM	RAM Fault
CRT Controller	CRTC Error
Keyboard	Keyboard
Nonvolatile RAM	NVRAM Checksum

NOTE: These diagnostic tests are repeated each time you reset the Terminal.

2. Turn the POWER switch to OFF.

LOCATING THE DIFFICULTY

The following troubleshooting procedure shows you how to trace a problem to a particular circuit board in a logical manner. The procedure assumes that the Terminal appears to be completely dead (no "beep" from the speaker upon turn-on and no display on the screen.) All voltages provided were taken on an operating unit with a high-impedance input voltmeter and you may consider them as typical.

RF TRAP CIRCUIT BOARD

Refer to Figure 7-1 as you perform the following steps.

1. Be sure the line cord is **NOT** plugged in.

2. Push the POWER switch on the rear of the monitor to ON.

3. Use an ohmmeter to check for continuity between pins CC and DD. This is the primary winding of the power transformer and should measure very close to zero ohms. If you do not obtain the correct indication, check the fuse, the Power switch, and the power transformer itself.

4. Use the ohmmeter to check for continuity between pins AA and CC. This should measure zero ohms. If you do not obtain the correct indication, the problem is on the RF trap circuit board.

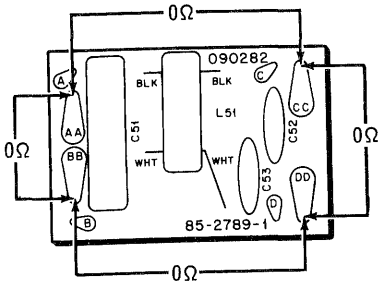


Figure 7-1

RF trap board

5. Use the ohmmeter to check for continuity between pins BB and DD. This should measure zero ohms. If you do not obtain the correct indication, the problem is on the RF trap circuit board.

6. Use the ohmmeter to check for continuity between pins AA and BB. This should measure very close to zero ohms. If you do not obtain the correct indication, the problem is on the RF trap circuit board.

If all of the above measurements were correct, proceed to "Power Supply Circuit Board."

POWER SUPPLY CIRCUIT BOARD

Refer to Figure 7-2 as you perform the following steps.

1. Make sure the keyboard is properly connected to the monitor.

2. Connect the line cord to the proper AC outlet and push the POWER switch on the rear of the monitor to ON.

3. Set your voltmeter to read approximately 20 volts AC.

4. Measure the voltage between plug P101 pins 1 and 2. You should measure 9.6 volts AC. If you do not obtain the correct indication, check the red wires between the power transformer and plug P101. If the wiring appears to be okay, suspect the power transformer itself.

5. Measure the voltage between plug P101 pins 4 and 5. You should measure 18.4 volts AC. If you do not obtain the correct indication, check the blue wires between the power transformer and plug P101. If the wiring appears to be okay, suspect the power transformer itself.

6. Measure the voltage between plug P101 pins 6 and 7. You should measure 18 volts AC. If you do not obtain the correct indication, check the yellow wires between the power transformer and plug P101. If the wiring appears to be okay, suspect the power transformer itself.

7. Connect the common voltmeter lead to the heat sink on the power supply circuit board.

8. Set your voltmeter to read approximately +12 volts DC. Then measure the voltage at plug P102 pin 2. You should measure +12 volts DC. If you do not obtain the correct indication, unplug P102 and measure the voltage at the power supply circuit board plug pin. If you still do not obtain the correct indication, the problem is on the power supply circuit board.

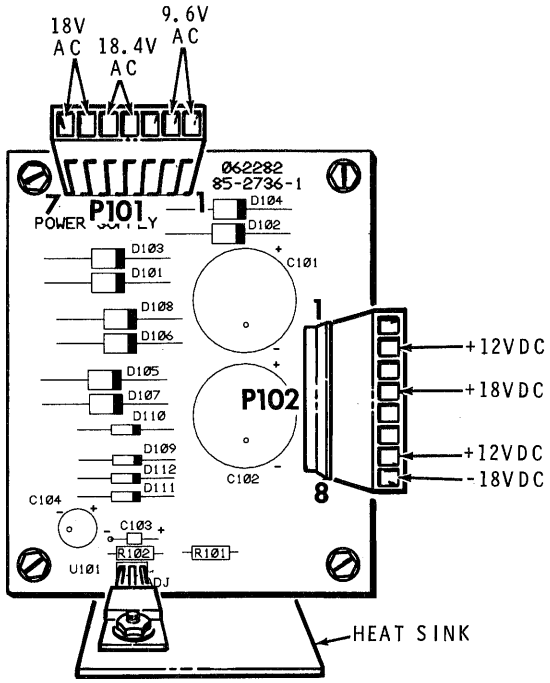


Figure 7-2

Power supply board

9. Set the voltmeter to read approximately +18 volts DC. Then measure the voltage at plug P102 pin 4. You should measure +18 volts DC. If you do not obtain the correct indication, unplug P102 and measure the voltage at the power supply circuit board pin. If you still do not obtain the correct indication, the problem is on the power supply circuit board.

10. Set the voltmeter to read approximately +12 volts DC. Then measure the voltage at plug P102 pin 7. You should measure +12 volts DC. If you do not obtain the correct indication, unplug P102 and measure the voltage at the power supply circuit board pin. If you still do not obtain the correct indication, the problem is on the power supply circuit board.

11. Set the voltmeter to read approximately −18 volts DC. Then measure the voltage at plug P102 pin 8. You should measure −18 volts DC. If you do not obtain the correct indication, unplug P102 and measure the voltage at the power supply circuit board pin. If you still do not obtain the correct indication, the problem is on the power supply circuit board.

If all of the above measurements were correct, proceed to "Terminal Logic Circuit Board."

TERMINAL LOGIC CIRCUIT BOARD

Refer to Figure 7-3 as you perform the following steps.

1. Be sure the line cord is connected to the proper AC outlet and the POWER switch is pushed to ON.

2. Connect the common voltmeter lead to the metal chassis (not the rear panel).

3. Measure the voltages at pins of plug P405 on the terminal logic circuit board. The correct voltages are listed below. If you do not obtain the correct indication at any pin, unplug P405 and check for the correct voltage at the socket pin. If you now obtain the correct indication, the problem is on the terminal logic circuit board. If you still do not obtain the correct indication, first check the cable assembly that connects the terminal logic circuit board to the power supply circuit board. Then recheck the power supply circuit board.

Pin 1	−18 VDC
Pin 2	+12 VDC
Pin 5	+18 VDC
Pin 7	+13 VDC

4. Use an oscilloscope to check for the proper waveforms at plug P404 on the terminal logic circuit board. The correct waveforms are shown on Figure 7-3B. If you do not obtain the correct waveform at any of the plug pins, first make sure the Terminal is set for the proper line frequency (in Setup Menu F). If you still do not obtain the correct waveforms, the problem is on the terminal logic circuit board.

5. Check for +12 volts DC at plug P404 pin 5. If you do not obtain the correct indication at this pin, the problem is on the terminal logic circuit board.

6. Connectors P401 and P402 transmit information from the Terminal to either a computer or a printer. You can use an oscilloscope to quickly check these connectors. Connect the oscilloscope to the transmit pin on the selected port connector and try to transmit information to the computer or printer. If this test fails, make sure the Terminal is on-line (Setup Menu A) and make sure the correct port is selected (Setup Menu C). If the terminal logic circuit board still will not transmit information, the problem is on the terminal logic circuit board.

7. If you obtained the correct results in all of the above checks, proceed to "Video Circuit Board."

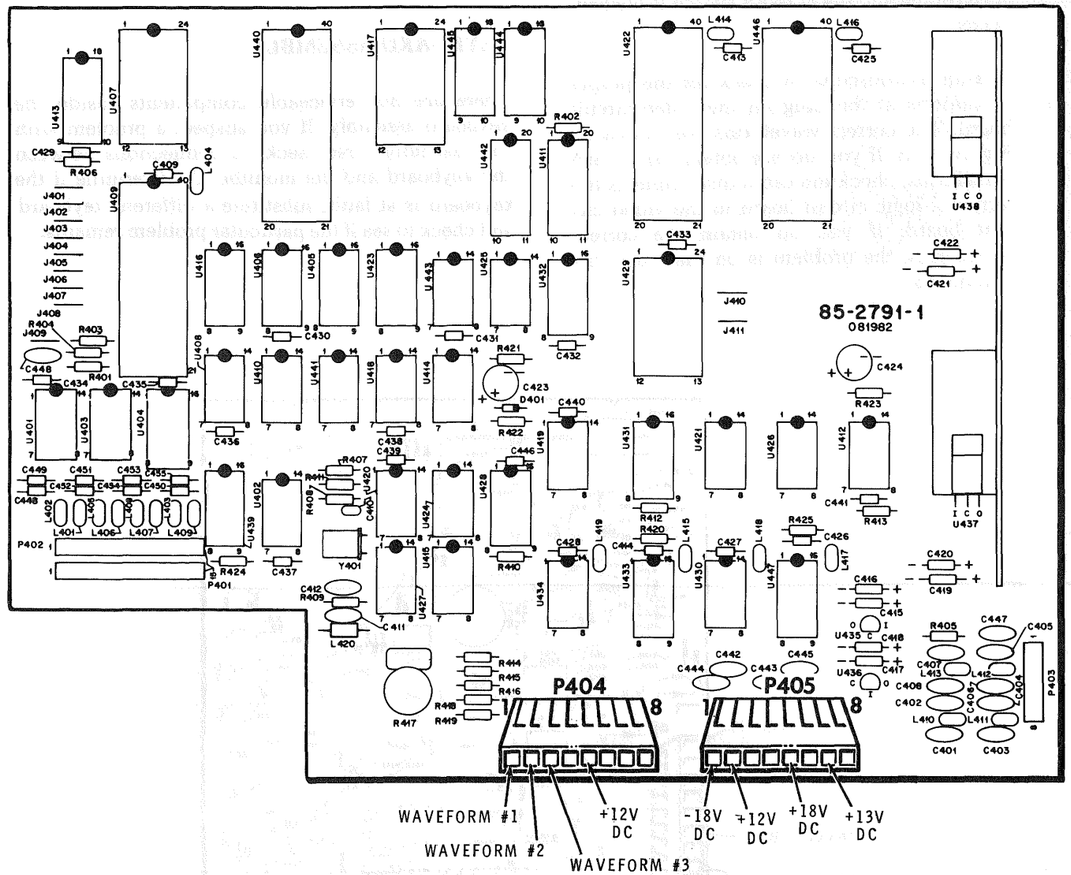
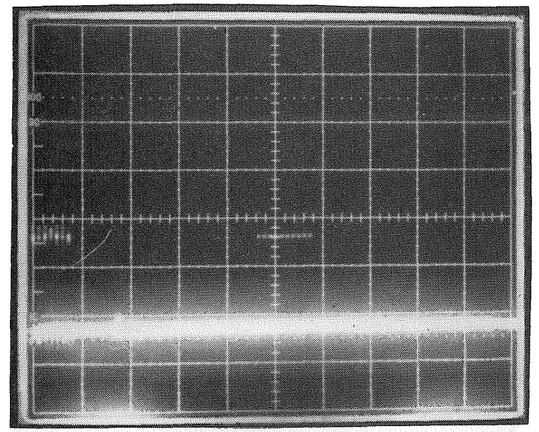
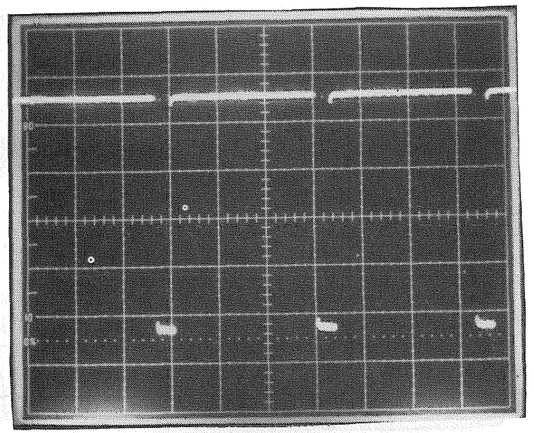


Figure 7-3A

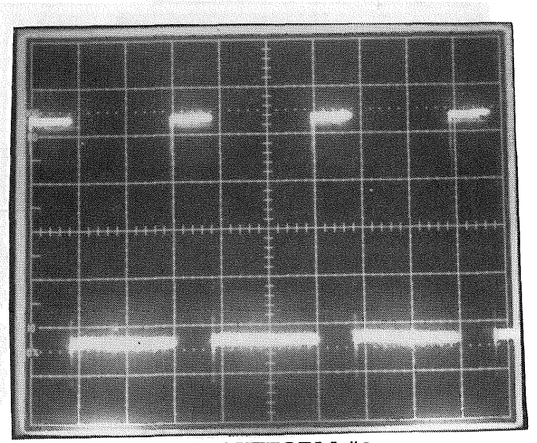
Terminal logic board



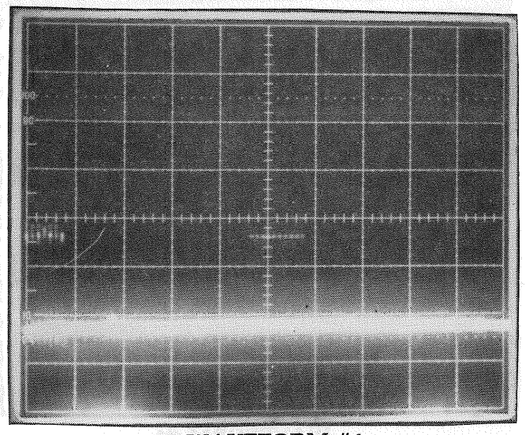
WAVEFORM #1



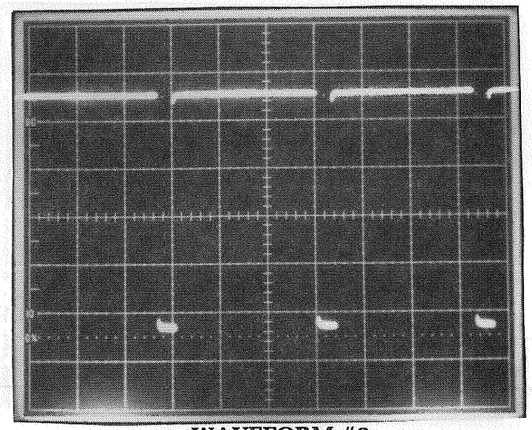
WAVEFORM #2



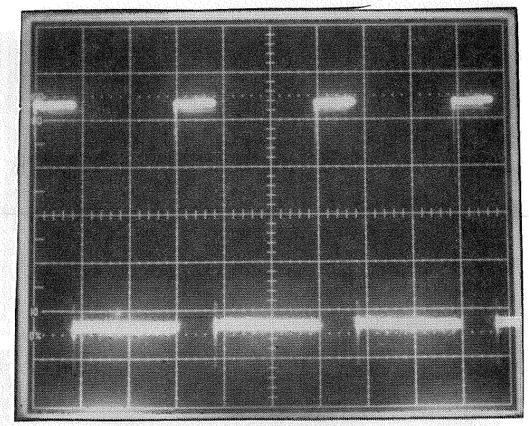
WAVEFORM #3



WAVEFORM #1



WAVEFORM #2



WAVEFORM #3

Figure 7-3B

Waveforms

VIDEO CIRCUIT BOARD

Refer to Figure 7-4 as you perform the following steps.

1. Be sure the line cord is connected to the proper AC outlet and the POWER switch is pushed to ON.

2. Use an oscilloscope to check for the proper waveforms at the plug on the video circuit board. The correct waveforms are shown on Figure 7-4B. If you do not obtain the correct waveforms, check the cable that connects the terminal logic circuit board to the video circuit board. If you do obtain the correct waveforms, the problem is on the video circuit board.

3. Check for +12 volts DC at indicated pin of the plug on the video circuit board. If you do not obtain the correct indication, check the cable assembly.

KEYBOARD ASSEMBLY

There are no serviceable components inside the keyboard assembly. If you suspect a problem with the assembly, first check all connections between the keyboard and the monitor. To determine if the keyboard is at fault, substitute a different keyboard and check to see if the particular problem remains.

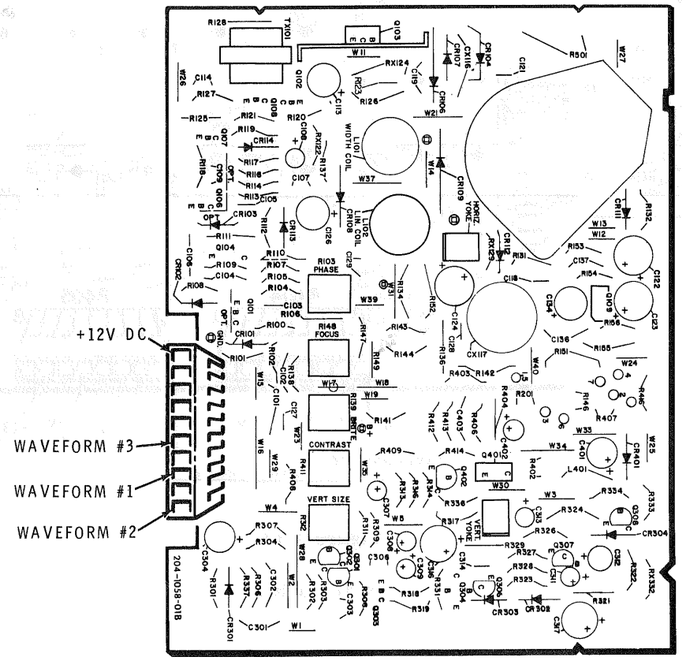


Figure 7-4

Video board

TROUBLESHOOTING CHART

The following chart is divided into two sections. First is "Terminal Problems", which could result from improper adjustment or a faulty component on one of the circuit boards. The "Operating Problems" section shows problems that could be caused by improper parameter setup.

TERMINAL PROBLEMS

CONDITION	POSSIBLE CAUSE
Nothing happens at turn-on (Power-on LED not lit).	1. Line cord not connected. 2. Power switch not pushed to ON. 3. Open fuse. 4. Power transformer. 5. RF trap circuit board. 6. Coiled cable not connected between the keyboard and the monitor.
Screen is blank (Power-on is lit).	1. Misadjusted Brightness control. 2. Screen Saver option is enabled. 3. Power supply circuit board. 4. Cathode ray tube.
Bright screen.	1. Misadjusted Brightness control. 2. Misadjusted Brite control on the video circuit board.
Poor focus.	1. Misadjusted Focus control on the video circuit board. 2. Video circuit board.
Insufficient width.	1. Misadjusted Width coil on the video circuit board.
No vertical deflection (horizontal line only).	1. Video circuit board.
Unstable vertical.	1. Video circuit board.
Terminal resets itself.	1. Loose line cord connections. 2. Loose coiled cable connections.
Fuse blows.	1. Power supply circuit board.
CRT filament not lit.	1. Power supply circuit board (+12 volt supply). 2. Brown or black CRT wires. 3. CRT socket. 4. Cathode ray tube.
No CRT anode voltage. CAUTION: Use a high-voltage probe to check this.	1. Power supply circuit board (+12 volt supply). 2. Video circuit board.

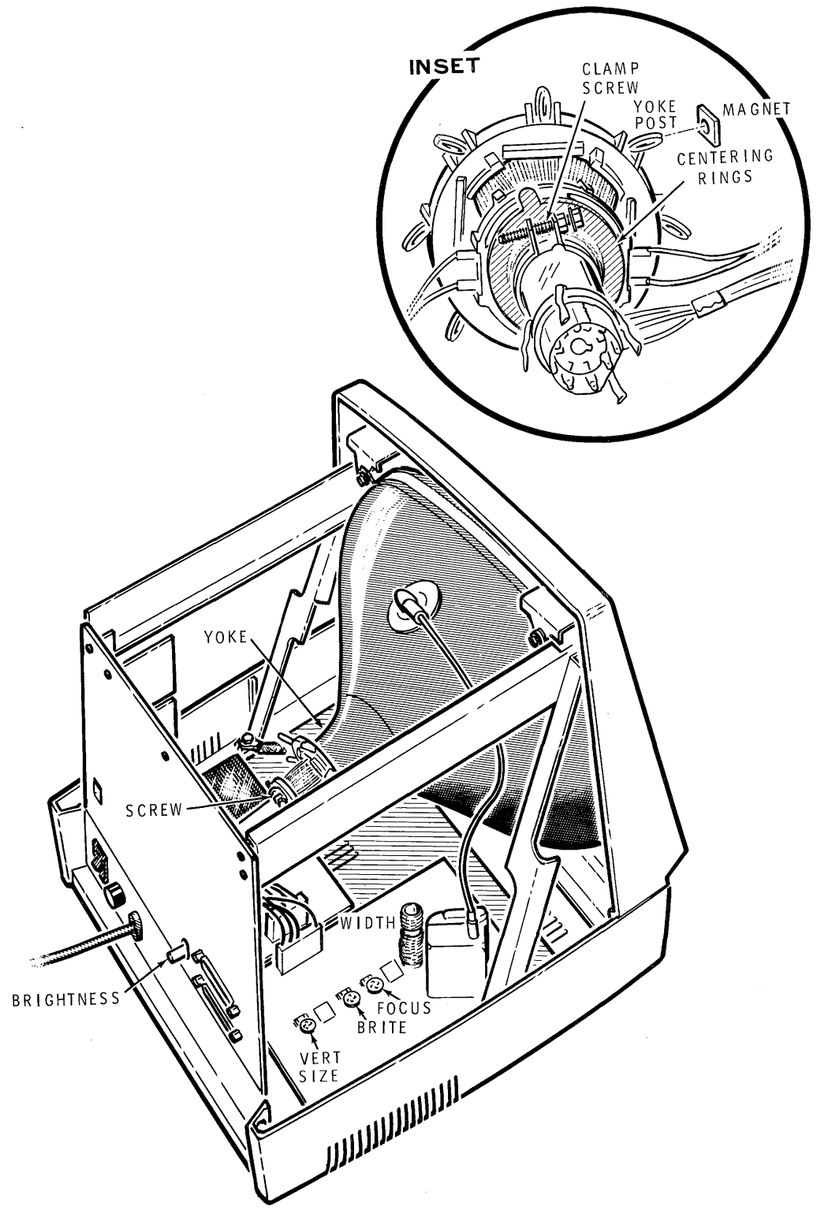


Figure 7-5

Video adjustments

OPERATING PROBLEMS

The following problems could result from operating error such as improper programming, wrong "Setup" of parameters, etc. Refer to the "Operation" section of this Manual and check the "Setup" menus to see if the baud rate, parity, duplex, line frequency, and other parameters are correct.

PROBLEM	POSSIBLE CAUSE
Strange or wrong characters appear on the screen.	1. Wrong terminal mode. 2. Wrong communications mode (baud, parity, duplex, etc.).
Wavy lines appear on the screen.	1. Wrong line frequency selected during setup.
Monitor does not respond to the keyboard.	1. On-line (under host control). 2. Keyboard locked-reset. 3. Coiled cord not connected.
Unable to alter Setup Modes.	1. Optional "hardware" setup feature installed.

VIDEO ADJUSTMENTS

The following adjustment procedure assumes that the Terminal is operating properly.

Refer to Figure 7-5 for the locations of the controls and adjustments on the video circuit board and the neck of the CRT.

1. Connect the keyboard to the monitor.

2. Preset the BRIGHTNESS control on the rear panel to the center of its rotation.

WARNING: When the Terminal is plugged in and turned on, high voltage is present on the back of the CRT and on the video circuit board.

3. Plug the line cord into the proper AC outlet.

4. Push the POWER switch on the rear panel to ON. The POWER ON indicator on the keyboard should light and you should hear a short "beep." After a few seconds, the cursor will appear near the upper left corner of the screen. A display may also appear near the bottom of the screen. If it does, it will display the time (beginning at 0:00:00) and one or more other messages, such as CAPS LOCK, OFF LINE, or INSERT MODE.

NOTE: For the best results, perform the following adjustments in a dimly lit room.

5. Turn the BRITE control, on the video circuit board, until a large portion of the screen becomes bright. Then turn the control counterclockwise until this bright area just disappears.

6. Press the SET UP key on the keyboard. The bottom line of the screen will display:

```
**SETUP MENU A** (VER 0.85)
1. on line MENUS -A- to -G- or -T- for TABS
```

7. Press the G key on the keyboard. The bottom line of the screen will display:

```
*MENU G*   1. CHAR SET normal
2. FILL SCREEN   3. ATTRIBUTES   4. TEST
```

8. Press the 2 key on the keyboard. The screen will fill with "E's."

9. Adjust the BRIGHTNESS control on the rear panel until the display is at a comfortable brightness level. Do not make the display too bright, as the screen phosphors may be damaged by too much brightness and "burn" the screen.

10. Remove any foam magnets that may be present on the yoke posts.

11. If necessary, loosen the indicated screw and rotate the deflection yoke until the edges of the display are vertical and horizontal. Then retighten the screw. Do not be concerned if the display is not centered on the screen at this time.

12. Adjust the FOCUS control, on the video circuit board, until the display characters are as sharp as possible (this may be at one end of the range).

13. Adjust the WIDTH COIL, on the video circuit board, until the display nearly fills the width of the screen. Allow approximately one-half inch of screen outside the edges of the display.

14. Adjust the VERTICAL SIZE control, on the video circuit board, for a one-half inch border at the top and bottom of the screen.

    At this point, the display may not be centered on the screen. The border at the left side added to the border at the right side should be about the same as the addition of the top and bottom borders.

15. Adjust the centering rings on the deflection yoke to the position that best centers the display on the screen.

16. Locate the one area of the four edges of the display that is the least straight. Install a foam magnet on the yoke post that is nearest to the greatest bow in the display. Rotate the magnet slowly until the display is as straight as possible.

17. Repeat this procedure as necessary all around the yoke at any of the eight locations which require straightening. The closer the magnets are to the CRT, the greater the effect they will have. Install only those magnets that will adequately correct the bowing and display a uniform rectangular-shaped display. NOTE: If you only want a little effect, you can reduce the magnets in size by cutting them with a pair of diagonal cutters.

18. Simultaneously press the SHIFT and RESET keys on the keyboard to clear the screen.

19. Push the POWER switch on the rear panel to OFF. Then unplug the line cord.

20. Reinstall the cabinet top on the monitor.

This completes the "Video Adjustments."

Replacement Parts List

RF Trap Circuit Board 8-1
Power Supply Circuit Board 8-2
Terminal Logic Circuit Board 8-2
Video Circuit Board 8-4
Cabinet Front 8-6
Rear Panel 8-7
Cabinet Base 8-8
Cabinet Top 8-9
Keyboard Assembly 8-10

RF TRAP CIRCUIT BOARD
(Assembled part number HE 181-4325)

CIRCUIT Comp. No.	ZDS Part No.	DESCRIPTION
C51	HE 27-127	.047 µF Mylar*
C52	HE 21-71	.001 µF ceramic
C53	HE 21-71	.001 µF ceramic
L51	HE 45-615	RF choke
	HE 432-1279	Male connector

* DuPont Registered Trademark

POWER SUPPLY CIRCUIT BOARD
(Assembled part number HE 181-3887)

CIRCUIT Comp. No.	ZDS Part No.	DESCRIPTION

RESISTORS

NOTE: All resistors are rated at 1/4-watt unless otherwise listed.

R101	HE 2-759-12	240 Ω, .5% precision
R102	HE 2-760-12	2050 Ω, .5% precision

CAPACITORS

C101	HE 25-947	6800 μF electrolytic
C102	HE 25-946	4700 μF electrolytic
C103	HE 25-197	1 μF tantalum
C104	HE 25-948	100 μF electrolytic

CIRCUIT Comp. No.	ZDS Part No.	DESCRIPTION

SEMICONDUCTORS

See "Semiconductor Identification Charts."

MISCELLANEOUS

P101	HE 432-828	7-pin plug
P102	HE 432-730	8-pin plug

TERMINAL LOGIC CIRCUIT BOARD
(Assembled part number HE 181-3755)

CIRCUIT Comp. No.	ZDS Part No.	DESCRIPTION

RESISTORS--CONTROL

NOTE: All resistors are rated at 1/4-watt and have a tolerance of 5% unless otherwise listed.

R401	HE 6-472-12	4700 Ω resistor
R402	HE 6-102-12	1000 Ω resistor
R403	HE 6-103-12	10 kΩ resistor
R404	HE 6-472-12	4700 Ω resistor
R405	HE 6-103-12	10 kΩ resistor
R406	HE 6-103-12	10 kΩ resistor
R407	HE 6-102-12	1000 Ω resistor
R408	HE 6-561-12	560 Ω resistor
R409	HE 6-561-12	560 Ω resistor
R410	HE 6-102-12	1000 Ω resistor
R411	HE 6-102-12	1000 Ω resistor

CIRCUIT Comp. No.	ZDS Part No.	DESCRIPTION

R412	HE 6-102-12	1000 Ω resistor
R413	HE 6-102-12	1000 Ω resistor
R414	HE 6-271-12	270 Ω resistor
R415	HE 6-331-12	330 Ω resistor
R416	HE 6-331-12	330 Ω resistor
R417	HE 10-1190	500 Ω control
R418	HE 6-222-12	2200 Ω resistor
R419	HE 6-222-12	2200 Ω resistor
R420	HE 6-102-12	1000 Ω resistor
R421	HE 6-472-12	4700 Ω resistor
R422	HE 6-472-12	4700 Ω resistor
R423	HE 6-103-12	10 kΩ resistor
R424	HE 6-102-12	1000 Ω resistor
R425	HE 6-102-12	1000 Ω resistor

Terminal Logic Circuit Board (Cont'd)

CAPACITORS

CIRCUIT Comp. No.	ZDS Part No.	DESCRIPTION
C401	HE 21-56	470 pF ceramic
C402	HE 21-56	470 pF ceramic
C403	HE 21-56	470 pF ceramic
C404	HE 21-56	470 pF ceramic
C405	HE 21-56	470 pF ceramic
C406	HE 21-56	470 pF ceramic
C407	HE 21-56	470 pF ceramic
C408	HE 21-56	470 pF ceramic
C409	HE 21-769	.01 μF glass ceramic
C410	HE 21-715	150 pF ceramic
C411	HE 21-176	.01 μF ceramic
C412	HE 21-147	47 pF ceramic
C413	HE 21-769	.01 μF glass ceramic
C414	HE 21-769	.01 μF glass ceramic
C415	HE 25-949	2.2 μF, 25V tantalum
C416	HE 25-197	1 μF tantalum
C417	HE 25-949	2.2 μF, 25 V tantalum
C418	HE 25-197	1 μF tantalum
C419	HE 25-195	2.2 μF, 15 V tantalum
C420	HE 25-197	1 μF tantalum
C421	HE 25-195	2.2 μF, 15 V tantalum
C422	HE 25-197	1 μF tantalum
C423	HE 25-915	47 μF electrolytic
C424	HE 25-915	47 μF tantalum
C425	HE 21-769	.01 μF glass ceramic
C426	HE 21-769	.01 μF glass ceramic
C427	HE 21-769	.01 μF glass ceramic
C428	HE 21-769	.01 μF glass ceramic
C428	Not used	
C429	HE 21-769	.01 μF glass ceramic
C430	HE 21-769	.01 μF glass ceramic
C431	HE 21-769	.01 μF glass ceramic
C432	HE 21-769	.01 μF glass ceramic
C433	HE 21-769	.01 μF glass ceramic
C434	HE 21-769	.01 μF glass ceramic
C435	HE 21-769	.01 μF glass ceramic
C436	HE 21-769	.01 μF glass ceramic
C437	HE 21-769	.01 μF glass ceramic
C438	HE 21-769	.01 μF glass ceramic
C439	HE 21-769	.01 μF glass ceramic
C440	HE 21-769	.01 μF glass ceramic
C441	HE 21-769	.01 μF glass ceramic
C442	HE 21-56	470 pF ceramic
C443	HE 21-56	470 pF ceramic
C444	HE 21-56	470 pF ceramic
C445	HE 21-56	470 pF ceramic
C446	HE 21-769	.01 μF glass ceramic
C447	HE 21-176	.01 μF ceramic
C448	HE 21-769	.01 μF glass ceramic
C449	HE 21-769	.01 μF glass ceramic
C450	HE 21-769	.01 μF glass ceramic
C451	HE 21-769	.01 μF glass ceramic
C452	HE 21-769	.01 μF glass ceramic
C453	HE 21-769	.01 μF glass ceramic
C454	HE 21-769	.01 μF glass ceramic
C455	HE 21-769	.01 μF glass ceramic
C456	HE 21-769	.01 μF glass ceramic

INDUCTORS

CIRCUIT Comp. No.	ZDS Part No.	DESCRIPTION
L401	HE 235-229	35 μH RF choke
L402	HE 235-229	35 μH RF choke
L403	HE 235-229	35 μH RF choke
L404	HE 235-229	35 μH RF choke
L405	HE 235-229	35 μH RF choke
L406	HE 235-229	35 μH RF choke
L407	HE 235-229	35 μH RF choke
L408	HE 235-229	35 μH RF choke
L409	HE 235-229	35 μH RF choke
L410	HE 235-229	35 μH RF choke
L411	HE 235-229	35 μH RF choke
L412	HE 235-229	35 μH RF choke
L413	HE 235-229	35 μH RF choke
L414	HE 235-229	35 μH RF choke
L415	HE 235-229	35 μH RF choke
L416	HE 235-229	35 μH RF choke
L417	HE 235-229	35 μH RF choke
L418	HE 235-229	35 μH RF choke
L419	HE 235-229	35 μH RF choke
L420	HE 475-11	Ferrite bead

SEMICONDUCTORS

See "Semiconductor Identification Charts."

MISCELLANEOUS

P401	HE 432-1039	15-pin plug
P402	HE 432-1039	15-pin plug
P403	HE 432-1149	8-pin plug
P404	HE 432-730	8-pin plug
P405	HE 432-730	8-pin plug
Y401	HE 404-635	14.784 MHz crystal
	HE 215-674	Heat sink
	HE 250-1325	6-32 × 1/4" screw
	HE 252-3	6-32 nut
	HE 254-1	#6 lockwasher

VIDEO CIRCUIT BOARD
(Assembled part number HE 234-203)

RESISTORS--CONTROLS

NOTE: All resistors are rated at 1/4-watt and have a tolerance of 5% unless otherwise listed.

CIRCUIT Comp. No.	ZDS Part No.	DESCRIPTION
R101	HE 6-102-12	1000 Ω resistor
R102	Not used	
R103	HE 6-102-12	1000 Ω resistor
R104	Not used	
R105	Not used	
R106	HE 6-223-12	22 kΩ resistor
R107	HE 6-102-12	1000 Ω resistor
R108	Not used	
R109	HE 6-4701-12	4700 Ω, 1% resistor
R110	Not used	
R111	Not used	
R112	Not used	
R113	HE 6-1002-12	10 kΩ, 1% resistor
R114	Not used	
R115	Not used	
R116	Not used	
R117	Not used	
R118	HE 6-102-12	1000 Ω resistor
R119	Not used	
R120	Not used	
R121	Not used	
RX122	HE 234-282	22 Ω resistor
R123	Not used	
RX124	HE 234-305	10 Ω resistor
R125	Not used	
R126	Not used	
R127	HE 6-181-12	180 Ω resistor
R128	HE 6-820-12	82 Ω resistor
R129	HE 234-283	100 Ω resistor
R130	Not used	
R131	HE 6-681-12	680 Ω resistor
R132	HE 6-153-12	15 kΩ resistor
R133	Not used	
R134	Not used	
R135	Not used	
R136	Not used	
R137	HE 6-103-12	10 kΩ resistor
R138	HE 6-103-12	10 kΩ resistor
R139	HE 234-288	100 kΩ control
R140	Not used	
R141	Not used	
R142	HE 6-222	2200 Ω, 1/2-watt resistor
R143	HE 6-274	270 kΩ, 1/2-watt resistor
R144	HE 6-274-12	270 kΩ resistor
R145	Not used	
R146	HE 6-103	10 kΩ, 1/2-watt resistor
R147	HE 6-683-12	68 kΩ resistor
R148	HE 234-287	2 MΩ control
R149	HE 6-274-12	270 kΩ resistor
R150	Not used	
R151	HE 6-473	47 kΩ, 1/2-watt resistor
R301	HE 6-562-12	5600 Ω resistor
R302	HE 6-223-12	22 kΩ resistor
R303	HE 6-204-12	200 kΩ resistor
R304	HE 6-470-12	47 Ω resistor
R305	Not used	
R306	HE 6-273-12	27 kΩ resistor
R307	HE 6-682-12	6800 Ω resistor
R308	HE 6-273-12	27 kΩ resistor
R309	HE 6-225-12	2.2 MΩ resistor
R310	Not used	
R311	HE 6-155-12	1.5 MΩ resistor
R312	HE 234-289	250 kΩ resistor
R313	HE 234-283	100 Ω resistor
R314	HE 6-123-12	12 kΩ resistor
R315	Not used	
R316	HE 6-273-12	27 kΩ resistor
R317	HE 6-222-12	2200 Ω resistor
R318	HE 234-263	100 Ω resistor
R319	HE 6-473-12	47 kΩ resistor
R320	Not used	
R321	HE 6-222-12	2200 Ω resistor
R322	HE 6-222-12	2200 Ω resistor
R323	HE 234-281	3.3 Ω resistor
R324	HE 6-221	220 Ω, 1/2-watt resistor
R325	Not used	
R326	HE 6-750-12	75 Ω resistor
R327	HE 6-332-12	3300 Ω resistor
R328	HE 6-391-12	390 Ω resistor
R329	Not used	
R330	Not used	
R331	HE 6-391-12	2.7 Ω resistor
R332	Not used	
R333	HE 234-282	22 Ω resistor
R334	Not used	
R335	Not used	
R336	Not used	
R337	HE 234-283	100 Ω resistor
R401	Not used	
R402	HE 1-50-2	820 Ω, 2-watt resistor
R403	HE 6-102-12	1000 Ω resistor
R404	HE 6-102-12	1000 Ω resistor
R405	Not used	
R406	HE 6-470-12	47 Ω resistor
R407	HE 6-331	330 Ω, 1/2-watt
R408	Not used	
R409	HE 6-470-12	47 Ω resistor
R410	Not used	
R411	Not used	
R412	HE 6-470-12	47 Ω resistor
R413	HE 234-282	22 Ω resistor
R414	HE 6-153-12	15 kΩ resistor

Video Circuit Board (Cont'd)

CAPACITORS

CIRCUIT Comp. No.	ZDS Part No.	DESCRIPTION
C101	HE 234-285	105 pF ceramic
C102	Not used	
C103	Not used	
C104	Not used	
C105	Not used	
C106	HE 27-161	.01 μF Mylar
C107	HE 27-105	.0068 μF Mylar
C108	Not used	
C109	HE 25-898	33 μF electrolytic
C110	Not used	
C111	Not used	
C112	HE 25-942	220 μF electrolytic
C113	Not used	
C114	HE 27-161	.01 μF Mylar
C115	Not used	
CX116	HE 27-27	.022 μF Mylar
CX117	HE 25-284	10 μF non-polarized electrolytic
C118	HE 27-128	.002 μF Mylar
C119	HE 21-43	.001 μF ceramic
C120	Not used	
C121	HE 21-43	.001 μF ceramic
C122	HE 25-898	33 μF electrolytic
C123	Not used	
C124	HE 25-942	220 μF electrolytic
C125	Not used	
C126	HE 27-161	.01 μF Mylar
C127	HE 27-161	.01 μF Mylar
C128	HE 21-43	.001 μF ceramic
C129	HE 21-43	.001 μF ceramic
C301	HE 234-286	1500 pF ceramic
C302	HE 234-285	105 pF ceramic
C303	HE 27-77	.1 μF Mylar
C304	HE 25-898	33 μF electrolytic
C305	Not used	

Capacitors (Cont'd)

CIRCUIT Comp. No.	ZDS Part No.	DESCRIPTION
C306	Not used	
C307	HE 25-917	10 μF electrolytic
C308	HE 25-900	1 μF electrolytic
C309	HE 25-900	1 μF electrolytic
C310	Not used	
C311	HE 25-917	10 μF electrolytic
C312	HE 25-883	47 μF electrolytic
C313	HE 25-917	10 μF electrolytic
C314	Not used	
C315	Not used	
C316	HE 25-905	470 μF electrolytic
C317	HE 25-942	220 μF electrolytic
C401	HE 25-912	3.3 μF electrolytic
C402	HE 25-917	10 μF electrolytic
C403	HE 234-285	105 pF ceramic

SEMICONDUCTORS

See "Semiconductor Identification Charts."

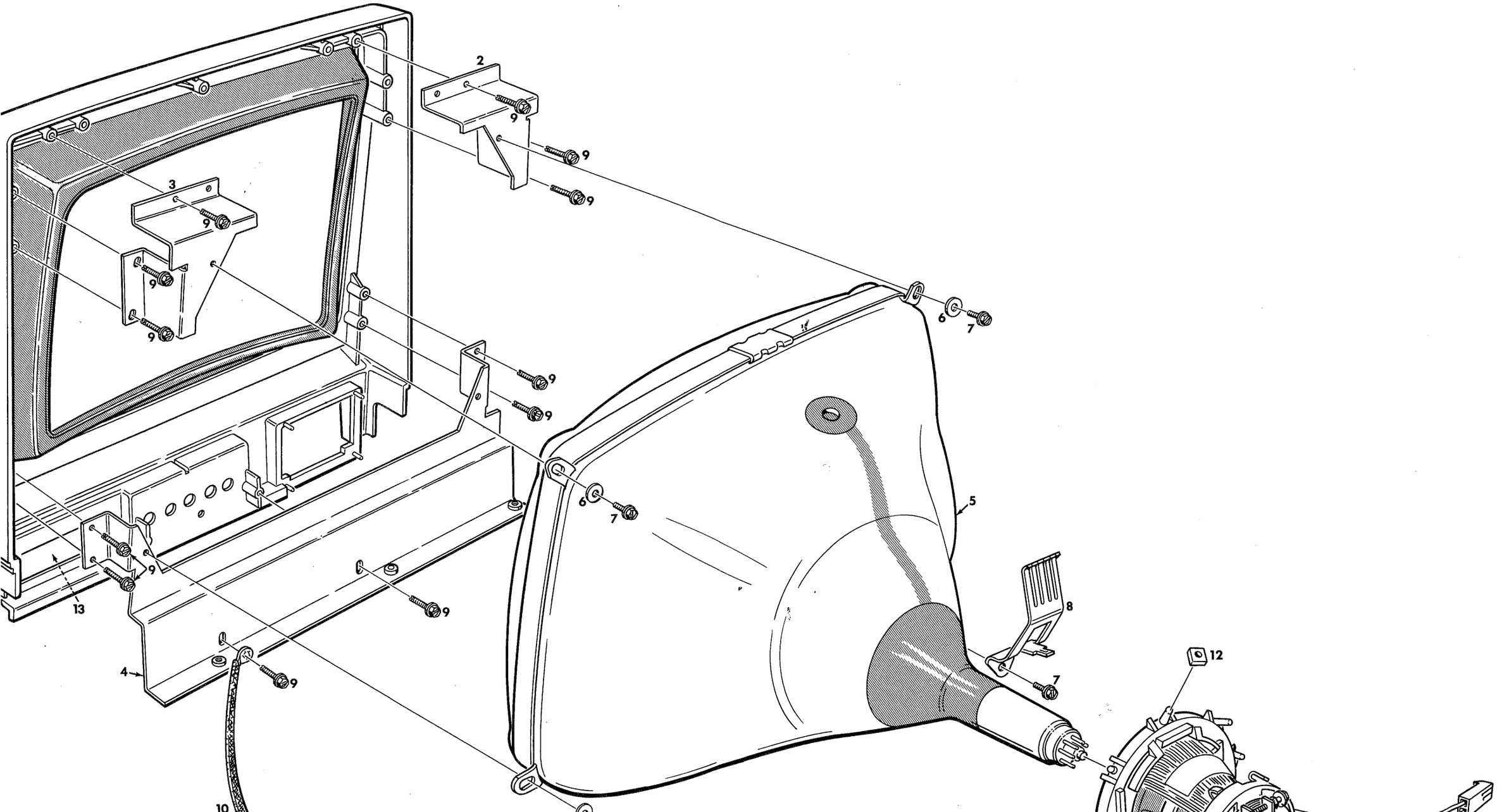
INDUCTORS

L101	HE 234-259	Width coil
L102	HE 234-260	Linearity coil
L401	HE 234-258	6.8 μH coil
TX101	HE 234-261	Horizontal drive transformer
TX102	HE 234-262	Sweep transformer
	HE	10-pin plug
	HE	2-pin plug (horiz. yoke)
	HE	2-pin plug (vert. yoke)
	HE 234-278	CRT socket assembly

CABINET FRONT

NOTE: The following key numbers correspond to the key numbers on Figure 8-1.

KEY No.	ZDS Part No.	DESCRIPTION
1	HE 92-767	Cabinet front
2	HE 204-2616	Top left CRT bracket
3	HE 204-2637	Top right CRT bracket
4	HE 204-2617	Bottom CRT bracket
5	HE 234-307	CRT (cathode ray tube)
6	HE 253-45	#8 flat washer
7	HE 250-1314	8-32 × 3/8" hex head screw
8	HE 234-292	CRT ground clip
9	HE 250-1138	#8 × 5/8" self-tapping screw
10		Braid strap
		consisting of:
	HE 345-1	*Wire braid*
	HE 259-2	*#8 solder lug (2 req'd)*
11	HE 234-291	Yoke
12	HE 234-268	Foam magnet
13	HE 391-648	Name label


2
3
9
6
7
5
8
12
13
4
10

REAR PANEL

NOTE: The following key numbers correspond to the numbers on Figure 8-2.

KEY No.	ZDS Part No.	DESCRIPTION
1	HE 203-2122	Rear panel
2	HE 134-1277	DCE connector assembly
3	HE 134-1278	DTE connector assembly
4	HE 259-9	#4 solder lug
5	HE 255-757	4-40 hex stud
6	HE 254-9	#4 lockwasher
7	HE 434-370	6-conductor cable assembly
8	HE 204-2662	Connector bracket
9	HE 432-1150	8-pin socket shell
10	HE 432-866	Small spring connector
11	HE 250-1325	6-32 × 1/4" screw
12	HE 255-745	6-32 hex stud
13	HE 254-1	#6 lockwasher
14	HE 252-3	6-32 nut

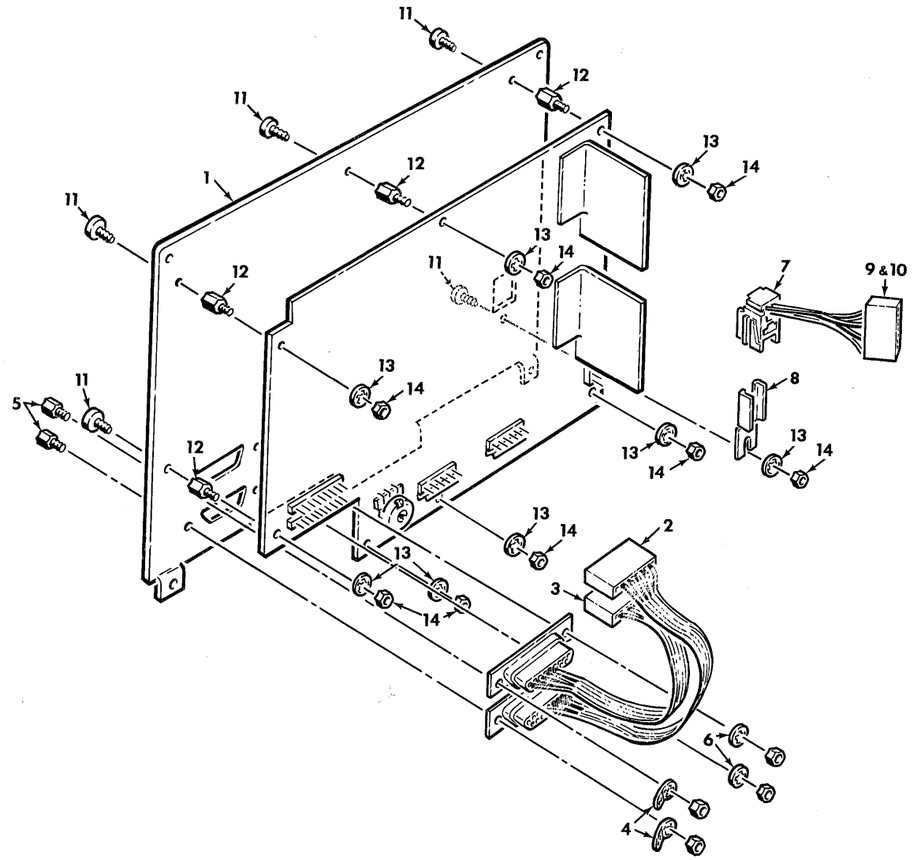


Figure 8-2

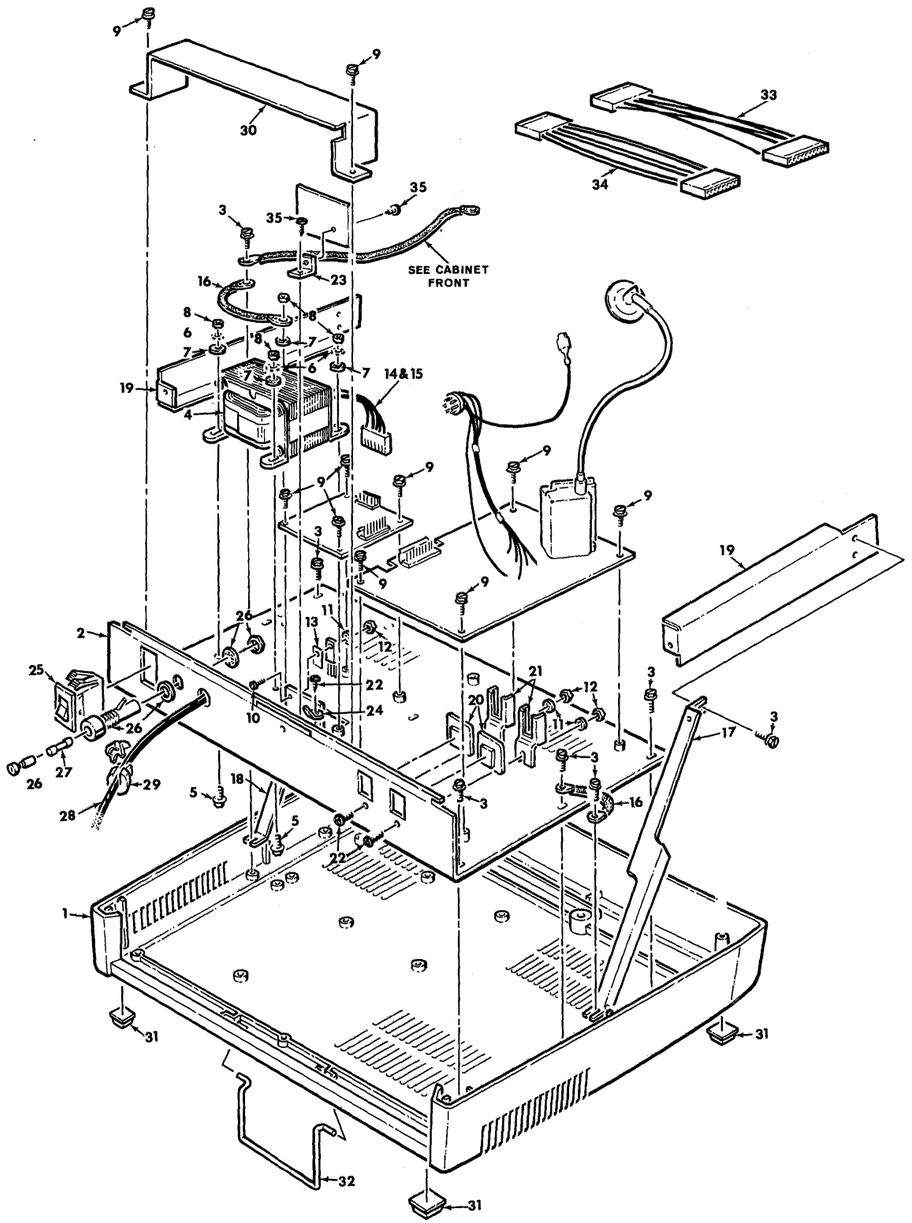


Figure 8-3

CABINET BASE

NOTE: The following key numbers correspond to the numbers on Figure 8-3.

KEY No.	ZDS Part No.	DESCRIPTION
1	HE 92-766	Cabinet base
2	HE 203-2128	Power supply chassis
3	HE 250-1232	#8 × 5/16″ hex head screw
4	HE 54-1000	Power transformer
5	HE 250-1314	8-32 × 3/8″ hex head screw
6	HE 254-28	1/2″ lockwasher
7	HE 253-45	#8 flat washer
8	HE 252-4	8-32 nut
9	HE 250-1264	6-32 × 3/8″ hex head screw
10	HE 250-357	6-32 × 3/8″ nylon screw
11	HE 254-1	#6 lockwasher
12	HE 252-3	6-32 nut
13	HE 75-204	Transistor insulator
14	HE 432-750	Large 8-pin socket shell
15	HE 432-750	Large spring connector
16		Braid strap consisting of:
	HE 345-1	*Wire braid*
	HE 259-2	*#8 solder lug (2 req'd)*
17	HE 204-2635	Left support bracket
18	HE 204-2636	Right support bracket
19	HE 204-2681	Cabinet top mounting bracket
20	HE 485-45	Plug button
21	HE 204-2662	Connector bracket
22	HE 250-1325	6-32 × 1/4″ screw
23	HE 204-1200	Angle bracket
24	HE 259-11	#6 solder lug
25	HE 60-619	Rocker switch
26	HE 423-11	Fuseholder
27	HE 421-23	1-ampere, 3AG, slow-blow fuse
28	HE 89-54	Line cord
29	HE 75-209	Strain relief
30	HE 75-828	Insulator paper
31	HE 261-34	Square foot
32	HE 266-1205	Tilt stand
33	HE 134-1249	Cable assembly (TLB to video)
34	HE 134-1250	Cable assembly (TLB to PS)

CABINET TOP

NOTE: The following key numbers correspond to the numbers on Figure 8-4.

KEY No.	ZDS Part No.	DESCRIPTION
1	HE 92-765	Cabinet top
2	HE 250-1280	6-32 × 3/8" screw
3	HE 250-1307	#6 × 1/4" sheet metal screw
4	HE 250-1476	8-32 × 1/2" flat head screw
5	HE 204-2634	Large "L" bracket
6	HE 250-1477	6-32 × 1-1/4" screw

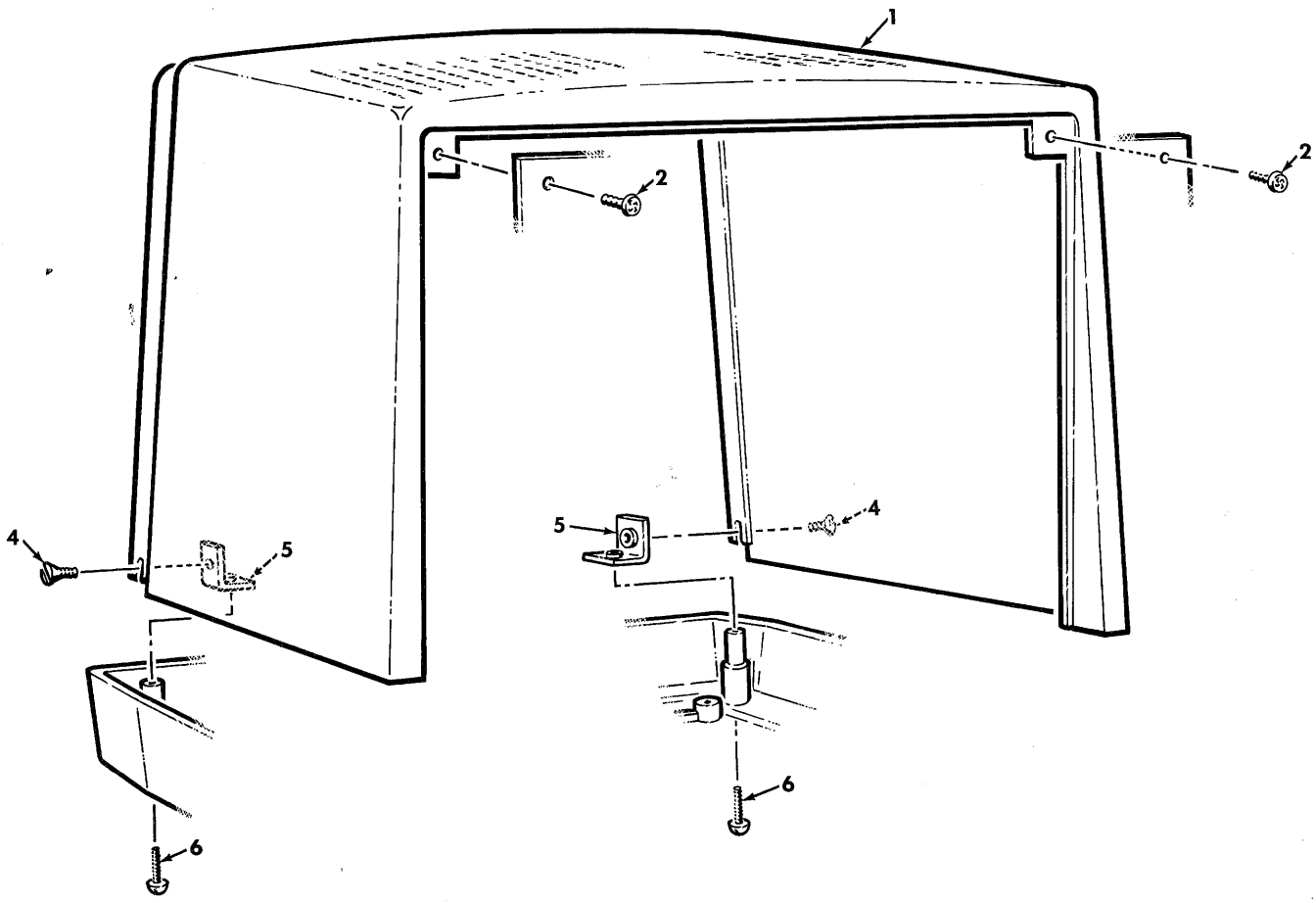


Figure 8-4

KEYBOARD ASSEMBLY
(Assembled part number HE 191-3425)

RESISTORS

NOTE: All resistors are rated at 1/4-watt and have a tolerance of 5% unless otherwise listed.

CIRCUIT Comp. No.	ZDS Part No.	DESCRIPTION
R1	HE 6-511-12	510 Ω
R2	HE 6-511-12	510 Ω
R3	HE 6-101-12	100 Ω
R4	HE 6-151-12	150 Ω
R5	HE 6-151-12	150 Ω
R6	HE 6-151-12	150 Ω
R7	HE 6-151-12	150 Ω
R8-R18	HE 9-124	4700 Ω resistor (pack of 10) (may be replaced individually with HE 6-472-12 resistors)
R19	HE 6-103-12	10 kΩ resistor
R20	HE 6-105-12	1 MΩ resistor
R21	HE 6-562-12	5600 Ω resistor
R22	HE 6-562-12	5600 Ω resistor

CAPACITORS

C1	Not used	
C2	Not used	
C3	HE 21-761	.01 μF glass ceramic
C4	HE 21-761	.01 μF glass ceramic
C5	HE 21-761	.01 μF glass ceramic
C6	HE 21-761	.01 μF glass ceramic
C7	HE 21-761	.01 μF glass ceramic
C8	HE 25-900	1 μF electrolytic
C9	HE 25-900	1 μF electrolytic
C10	HE 21-761	.01 μF glass ceramic

SEMICONDUCTORS

See "Semiconductor Identification Charts."

MISCELLANEOUS

CIRCUIT Comp. No.	ZDS Part No.	DESCRIPTION
T1	HE 473-29	Transducer
Y1	HE 404-238	3.579545 MHz crystal

CABINET PARTS

NOTE: The following key numbers correspond to the key numbers on Figure 8-5.

KEY No.	ZDS Part No.	DESCRIPTION
1	HE 64-900	Keyboard assembly
2	HE 92-768	Cabinet top
3	HE 92-769	Cabinet bottom
4	HE 134-1209	Coiled cable
5	HE 250-1434	#6 × 3/8" self-tapping screw
6	HE 250-1435	#6 × 1/2" self-tapping screw
7	HE 250-1478	#6 × 7/8" self-tapping screw
8	HE 261-34	Square foot

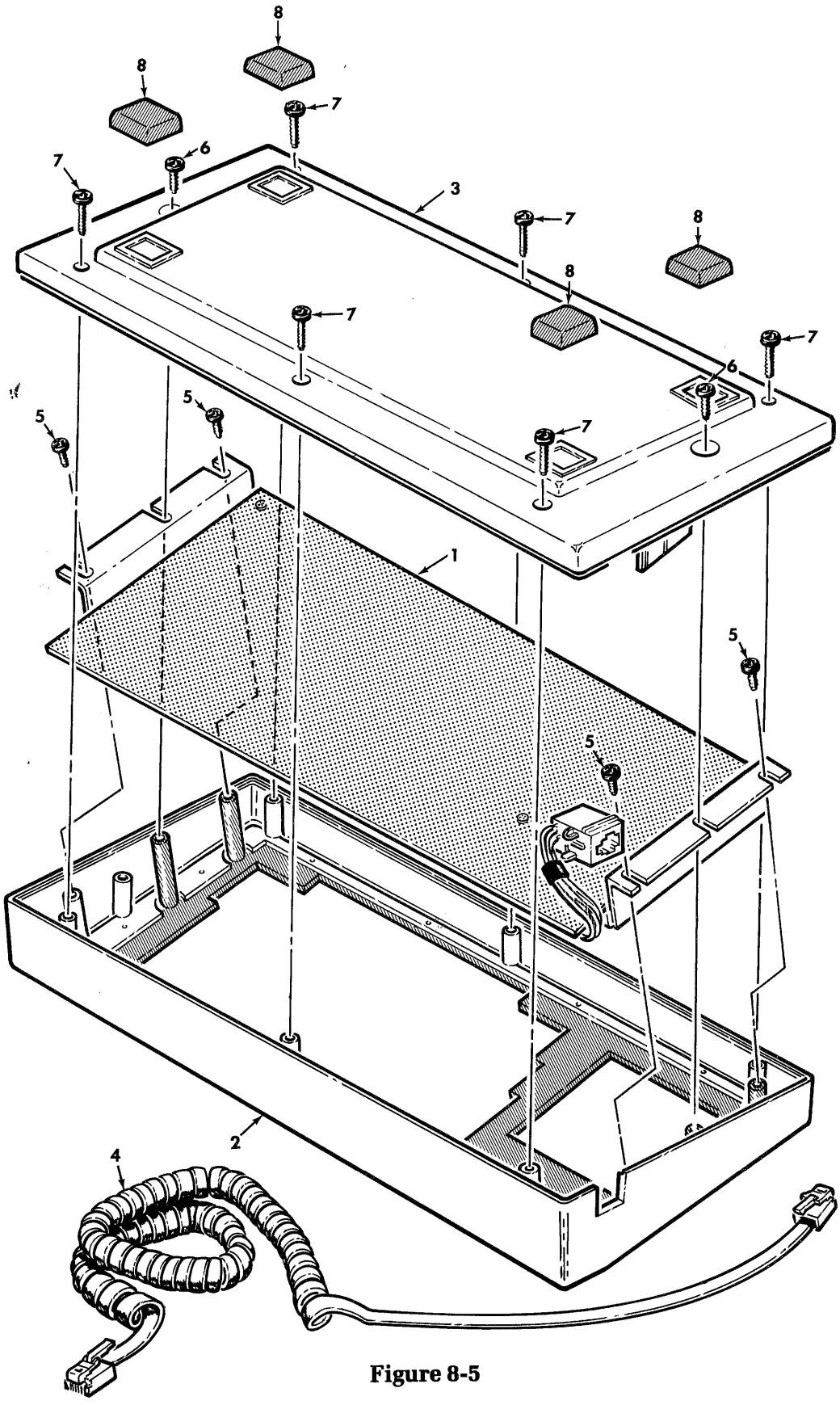


Figure 8-5

Semiconductor Identification Charts

This section is divided into two parts: "Component Number Index" and "Part Number Index." The first section provides a cross-reference between semiconductor 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 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

CIRCUIT COMPONENT NUMBER	ZDS PART NUMBER
D101-D108 D109-D112 U101	HE 57-42 HE 57-65 HE 442-739

VIDEO CIRCUIT BOARD

Diodes

CIRCUIT COMPONENT NUMBER	ZDS PART NUMBER
CR102	HE 234-299
CR104	HE 234-264
CR106	HE 234-263
CR107	HE 57-27
CR109	HE 234-265
CR111	HE 234-263
CR112	HE 234-267
CR301	HE 234-266
CR302	HE 234-299
CR303	HE 234-299
CR304	HE 234-267
CR401	HE 234-267

Transistors--Integrated Circuit (IC)

CIRCUIT COMPONENT NUMBER	ZDS PART NUMBER
Q102	HE 234-270
Q103	HE 234-276
Q104	HE 234-275
Q301	HE 234-275
Q302	HE 234-274
Q303	HE 234-274
Q304	HE 234-270
Q306	HE 234-272
Q307	HE 234-271
Q308	HE 234-270
Q401	HE 234-273
Q402	HE 234-290
IC101	HE 234-269

TERMINAL LOGIC CIRCUIT BOARD (TLB)

Diode--Integrated Circuits (IC's)

CIRCUIT COMPONENT NUMBER	ZDS PART NUMBER
D401	HE 56-56
U401	HE 443-794
U402	HE 443-875
U403	HE 443-795
U404	HE 443-799
U405	HE 443-857
U406	HE 443-657
U407	HE 444-135
U408	HE 443-780
U409	HE 443-1025
U410	HE 443-755
U411	HE 443-805
U412	HE 443-755
U413	HE 443-1041
U414	HE 443-728
U415	HE 443-780
U416	HE 443-879
U417	HE 443-1027
U418	HE 443-875
U419	HE 443-797
U420	HE 443-730
U421	HE 443-780
U422	HE 443-1068
U423	HE 443-857
U424	HE 443-755
U425	HE 443-780
U426	HE 443-875
U427	HE 443-780
U428	HE 443-924
U429	HE 444-136
U430	HE 443-915
U431	HE 443-892
U432	HE 443-804
U433	HE 443-983
U434	HE 443-89
U435	HE 442-644
U436	HE 442-646
U437	HE 442-54
U438	HE 442-54
U439	HE 443-877
U440	HE 444-134
U441	HE 443-780
U442	HE 443-885
U443	HE 443-875
U444	HE 443-764
U445	HE 443-764
U446	HE 443-1068
U447	HE 443-983

KEYBOARD ASSEMBLY

Light-emitting Diodes (LED's)-- Integrated Circuits (IC's)

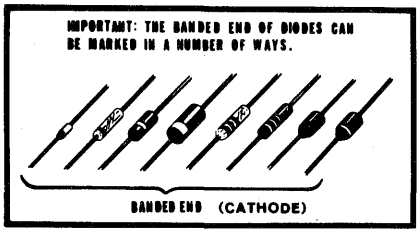
CIRCUIT COMPONENT NUMBER	ZDS PART NUMBER
D1	HE 412-637
D2	HE 412-637
D3	HE 412-637
D4	HE 412-637
U1	HE 444-100
U2	HE 443-768
U3	HE 443-779
U4	HE 443-1042
U5	HE 442-53
U6	HE 442-54

PART NUMBER INDEX

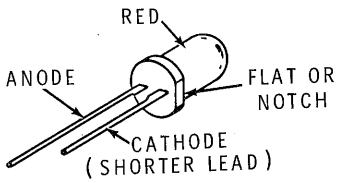
This index shows a lead configuration detail (basing diagram) of each semiconductor part number.

DIODES

ZDS PART NUMBER	MAY BE REPLACED WITH	DESCRIPTION	LEAD CONFIGURATION (TOP VIEW)
HE 56-56	1N4149	10 mA, 75V	
HE 57-27	1N2071	1A, 600V	
HE 57-42	3A1	3A, 100V	
HE 57-65	1N4002	1A, 100V	
HE 234-263	(none)	750 mA, 1.1V	
HE 234-264	(none)	1.5A, 1.2V	
HE 234-265	(none)	3A, 1.6V	
HE 234-266	(none)	(none)	
HE 234-267	(none)	(none)	
HE 234-299	(none)	(none)	

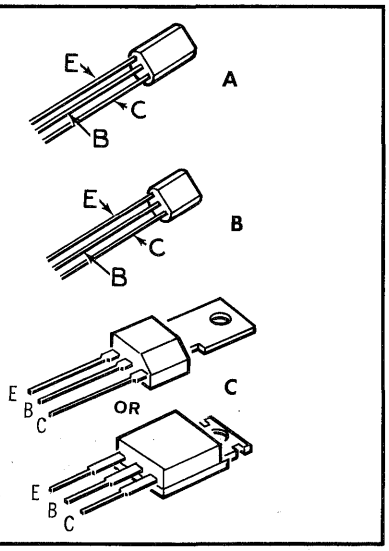


Diodes (Cont'd)

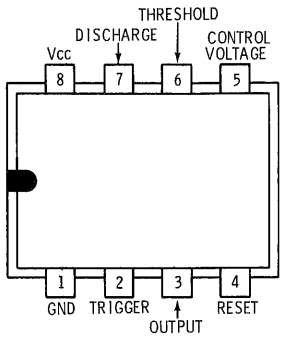
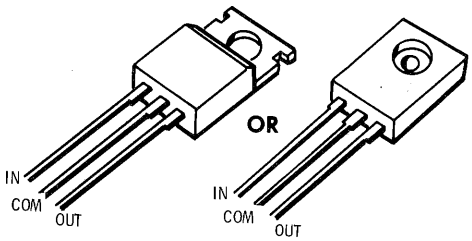
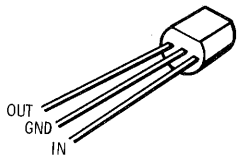
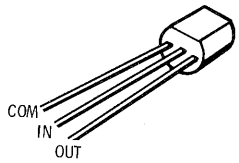
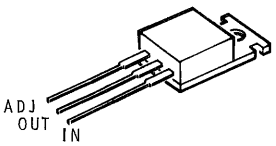
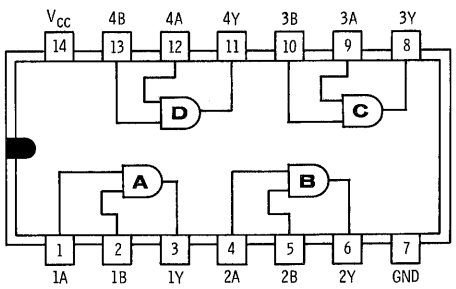
ZDS PART NUMBER	MAY BE REPLACED WITH	DESCRIPTION	LEAD CONFIGURATION (TOP VIEW)
HE 412-637	(none)	(LED)	

TRANSISTORS

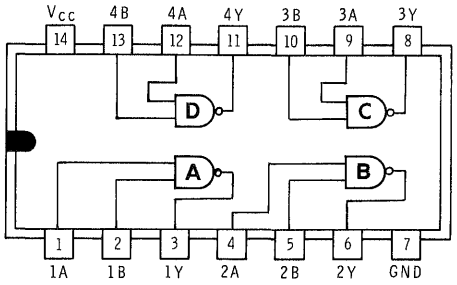
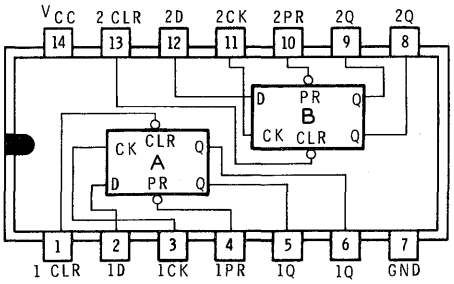
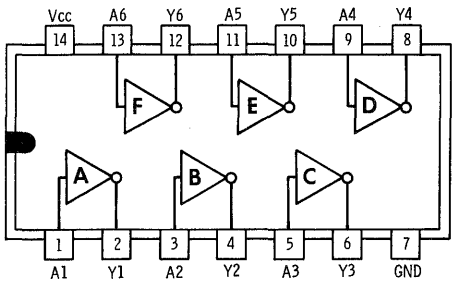
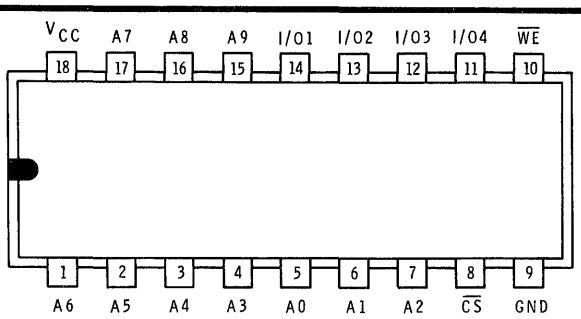
ZDS PART NUMBER	MAY BE REPLACED WITH	BASING DIAGRAM
HE 234-270	(none)	B
HE 234-271	(none)	A
HE 234-272	(none)	A
HE 234-273	(none)	C
HE 234-274	(none)	B
HE 234-275	(none)	B
HE 234-276	(none)	C
HE 234-290	(none)	B



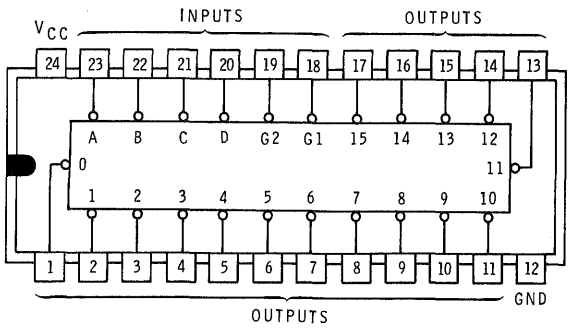
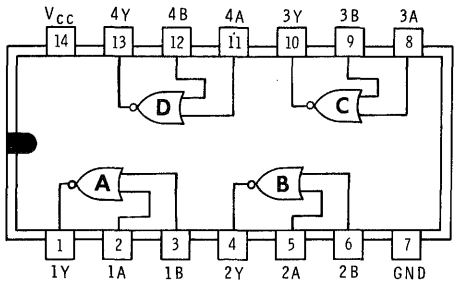
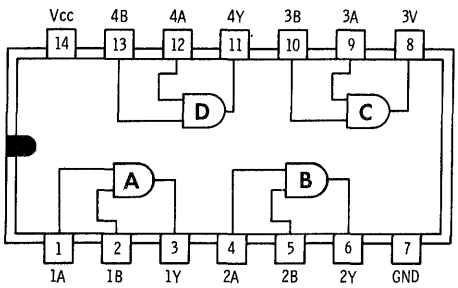
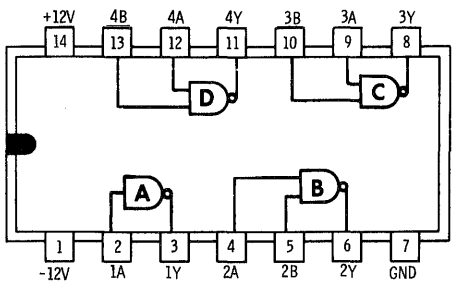
INTEGRATED CIRCUITS (IC's)

ZDS PART NUMBER	MAY BE REPLACED WITH	DESCRIPTION	LEAD CONFIGURATION (TOP VIEW)
HE 442-53	555	Timer	
HE 442-54	7805	+5V regulator	
HE 442-644	78L12	+12V regulator	
HE 442-646	79L12	−12V regulator	
HE 442-739	LM380T	Adjustable +12V regulator	
HE 443-89	7409	Quad AND gate	

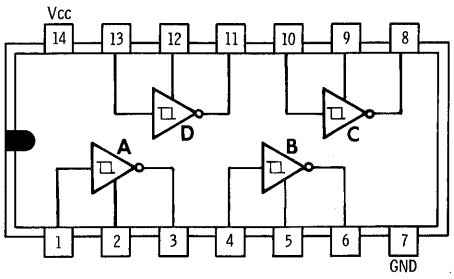
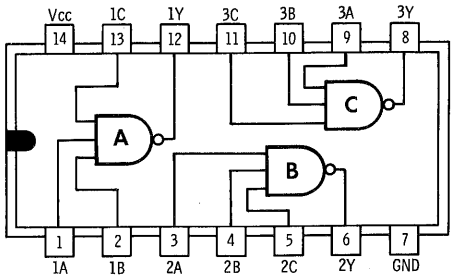
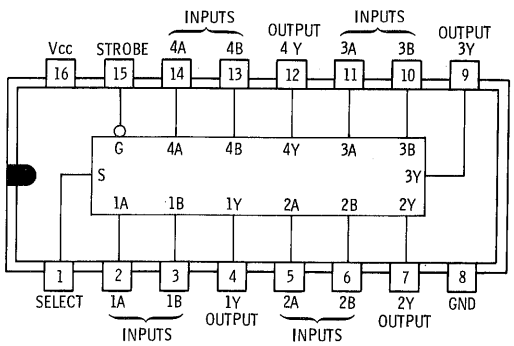
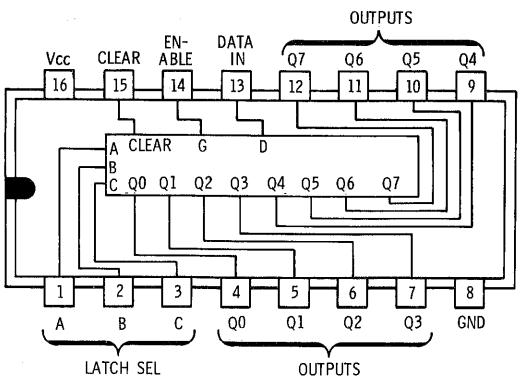
Integrated Circuits (IC's)(Cont'd)

ZDS PART NUMBER	MAY BE REPLACED WITH	DESCRIPTION	LEAD CONFIGURATION (Top View)
HE 443-728	74LS00	Quad 2-input NAND gate	
HE 443-730	74LS74	Dual D-type flip-flop	
HE 443-755	74LS04	Hex buffer	
HE 443-764	2114	1k × 4 RAM	

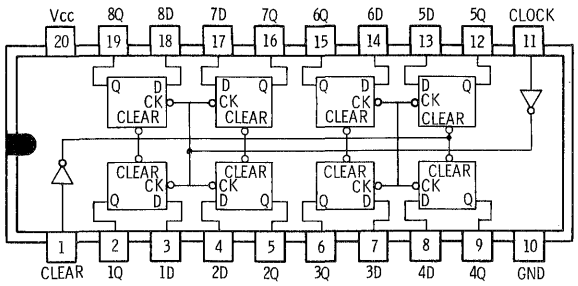
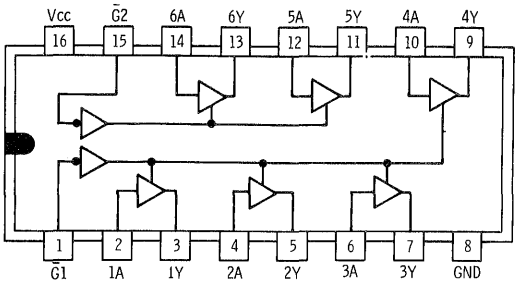
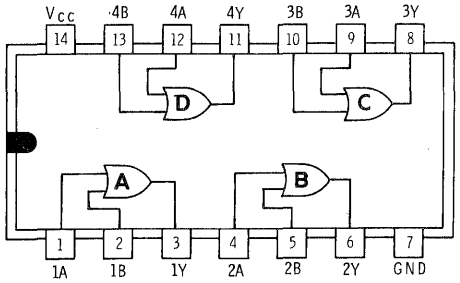
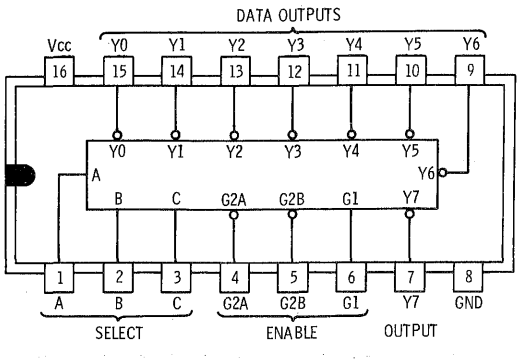
Integrated Circuits (IC's)(Cont'd)

ZDS PART NUMBER	MAY BE REPLACED WITH	DESCRIPTION	LEAD CONFIGURATION (Top View)
HE 443-768	74159	4-line to 16-line decoder/ multiplexer	
HE 443-779	74LS02	Quad 2-input positive NOR gate	
HE 443-780	74LS08	Quad 2-input Positive AND gate	
HE 443-794	75188 or 1488	EIA driver	

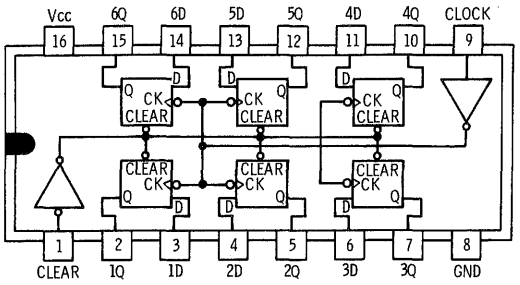
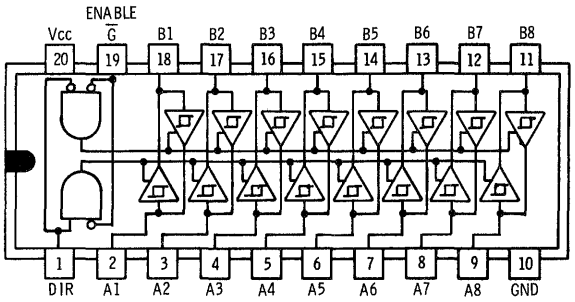
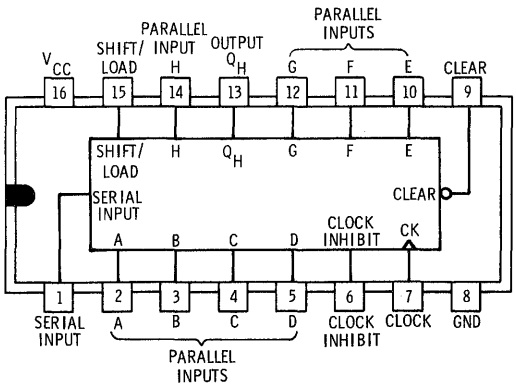
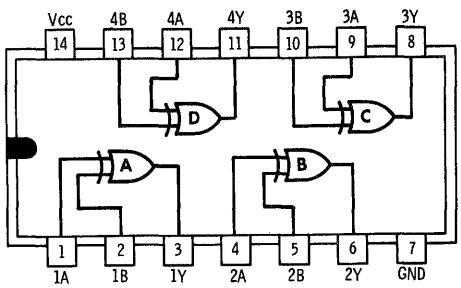
Integrated Circuits (IC's)(Cont'd)

ZDS PART NUMBER	MAY BE REPLACED WITH	DESCRIPTION	LEAD CONFIGURATION (Top View)
HE 443-795	75189 or 1489	EIA receiver	
HE 443-797	74LS10	Triple 3-input positive NAND gate	
HE 443-799	74LS157	Quad 2-line to 1-line multiplexer	
HE 443-804	74LS259	8-bit latch	

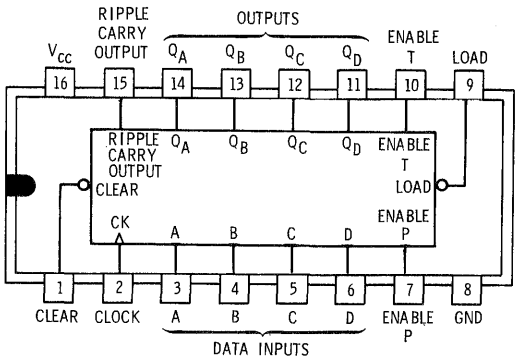
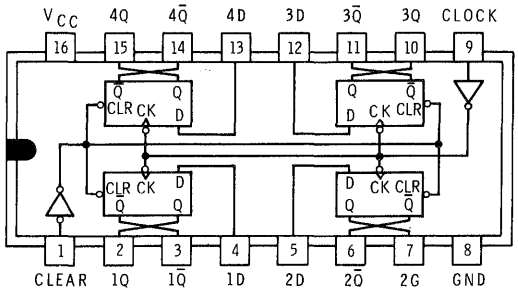
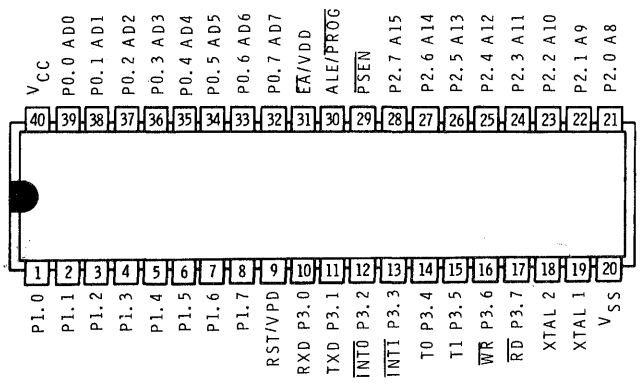
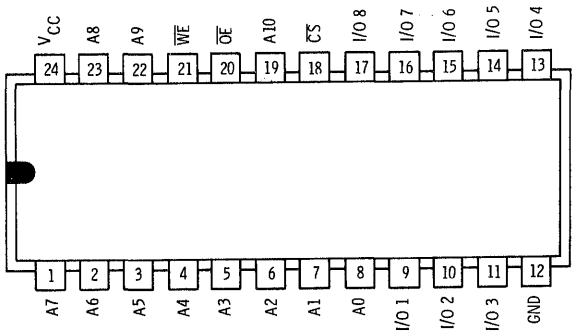
Integrated Circuits (IC's)(Cont'd)

ZDS PART NUMBER	MAY BE REPLACED WITH	DESCRIPTION	LEAD CONFIGURATION (Top View)
HE 443-805	74LS273	Octal D-type flip-flop with clear	
HE 443-857	74LS367	Hex bus drivers	
HE 443-875	74LS32	Quad 2-input positive OR gate	
HE 443-877	74LS138	3-line to 8-line decoder	

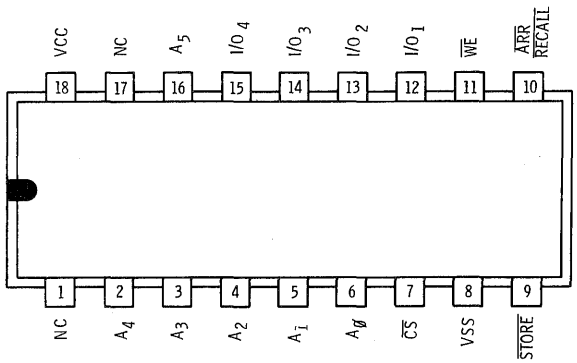
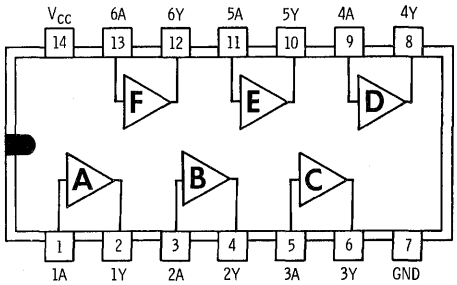
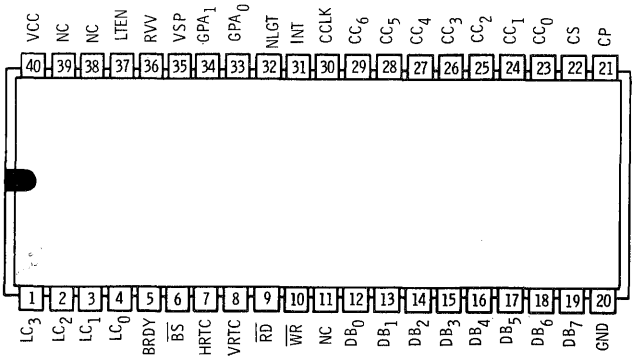
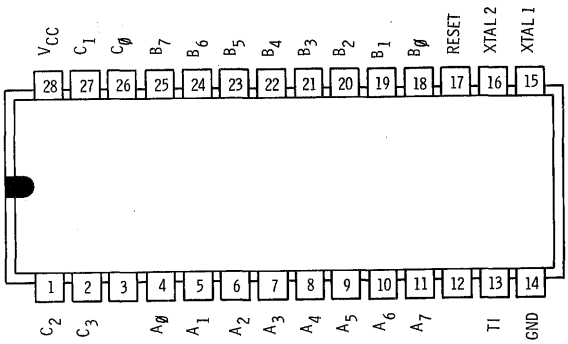
Integrated Circuits (IC's)(Cont'd)

ZDS PART NUMBER	MAY BE REPLACED WITH	DESCRIPTION	LEAD CONFIGURATION (Top View)
HE 443-879	74LS174	Hex decoder flip-flop	
HE 443-885	74LS245	Octal bus transceiver	
HE 443-892	74LS166	8-bit shift register	
HE 443-915	74S86	Quad 2-input exclusive-OR gate	

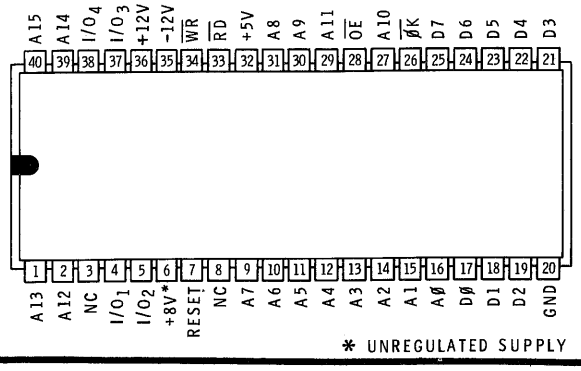
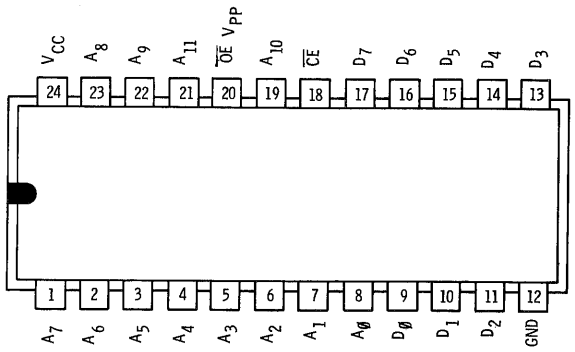
Integrated Circuits (IC's)(Cont'd)

ZDS PART NUMBER	MAY BE REPLACED WITH	DESCRIPTION	LEAD CONFIGURATION (Top View)
HE 443-934	74LS163	Binary counter	
HE 443-983	74175	Quad D-type flip-flop	
HE 443-1025	8031	Microprocessor	
HE 443-1027	6116-P4	2k × 8 RAM (200 ns)	

Integrated Circuits (IC's)(Cont'd)

ZDS PART NUMBER	MAY BE REPLACED WITH	DESCRIPTION	LEAD CONFIGURATION (Top View)
HE 443-1041	2210-30	NMOS RAM	
HE 443-1042	7407	Hex buffer	
HE 443-1068	8276	NMOS CRT controller	
HE 444-100	8021	Microprocessor	

Integrated Circuits (IC's)(Cont'd)

ZDS PART NUMBER	MAY BE REPLACED WITH	DESCRIPTION	LEAD CONFIGURATION (Top View)
HE 444-134	2732A-2	4k × 8 programmable ROM	
HE 444-135	2732A-2	4k × 8 programmable ROM	
HE 444-136	2732A-3	4k × 8 programmable ROM	

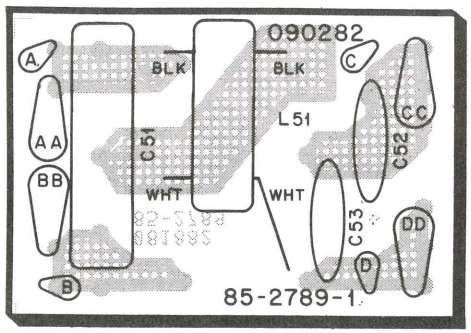
Circuit Board X-Ray Views

NOTE: To find the PART NUMBER of a component for the purpose of ordering a replacement part:

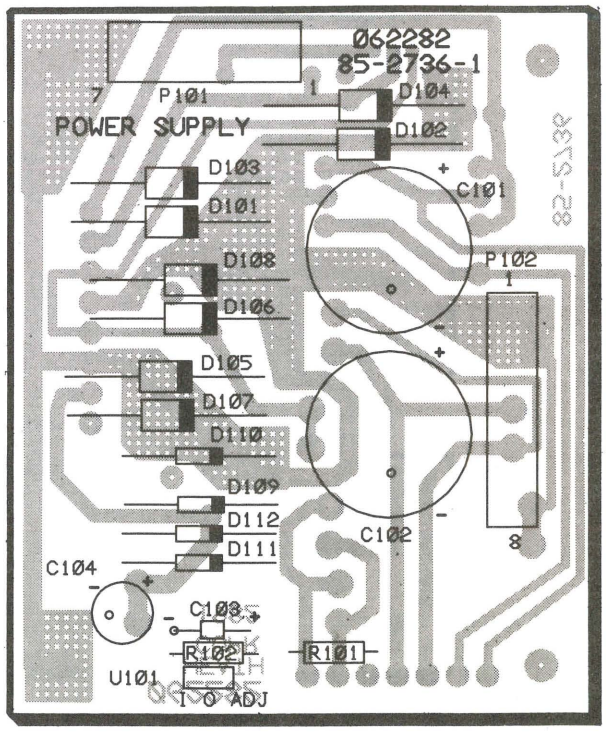
A. Find the circuit component number (R5, C3, etc.) on the "X-Ray View."

B. Locate this same number in the "Circuit Component Number" column of the "Replacement Parts List."

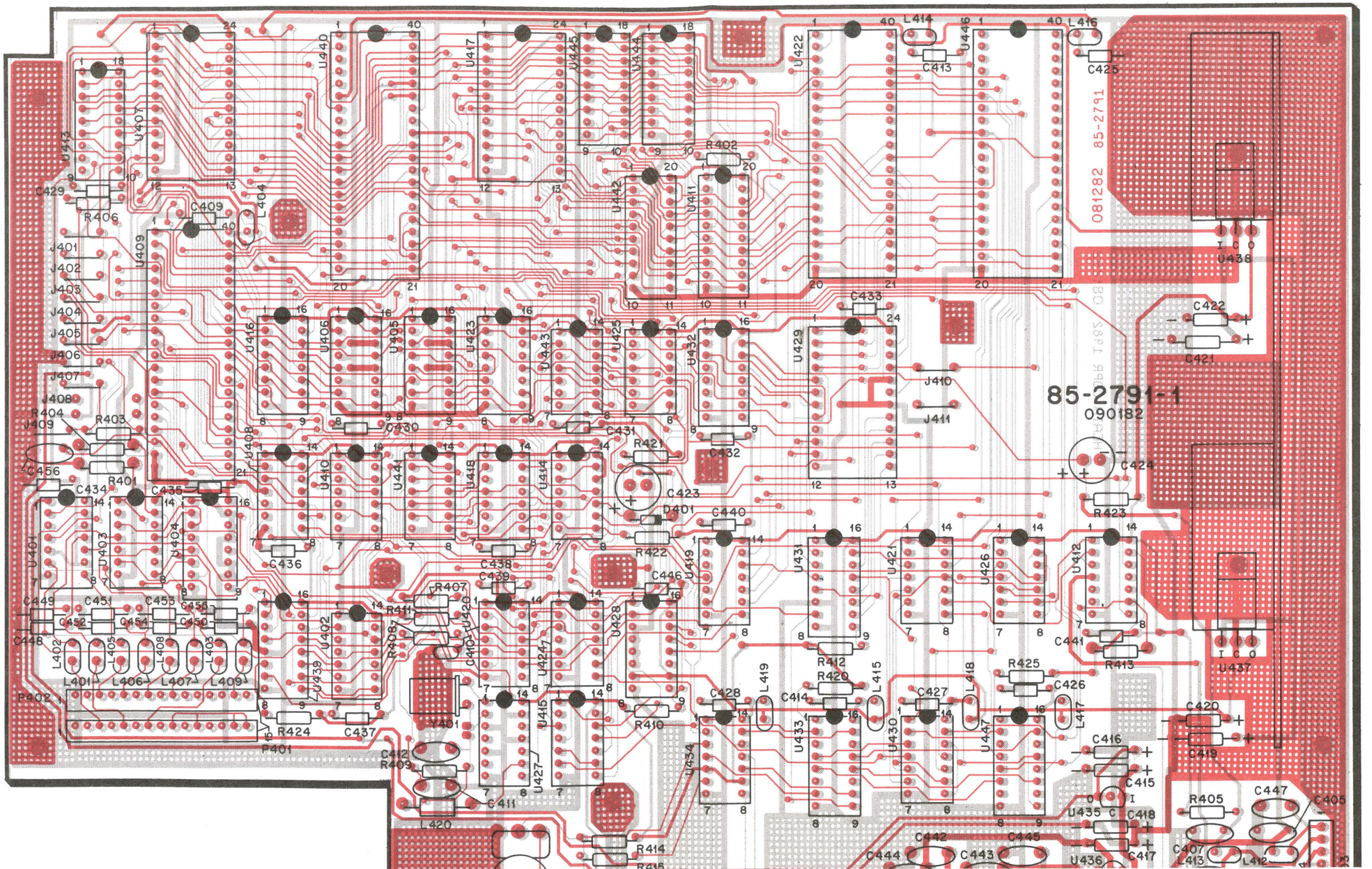
C. Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which must be supplied when you order a replacement part.

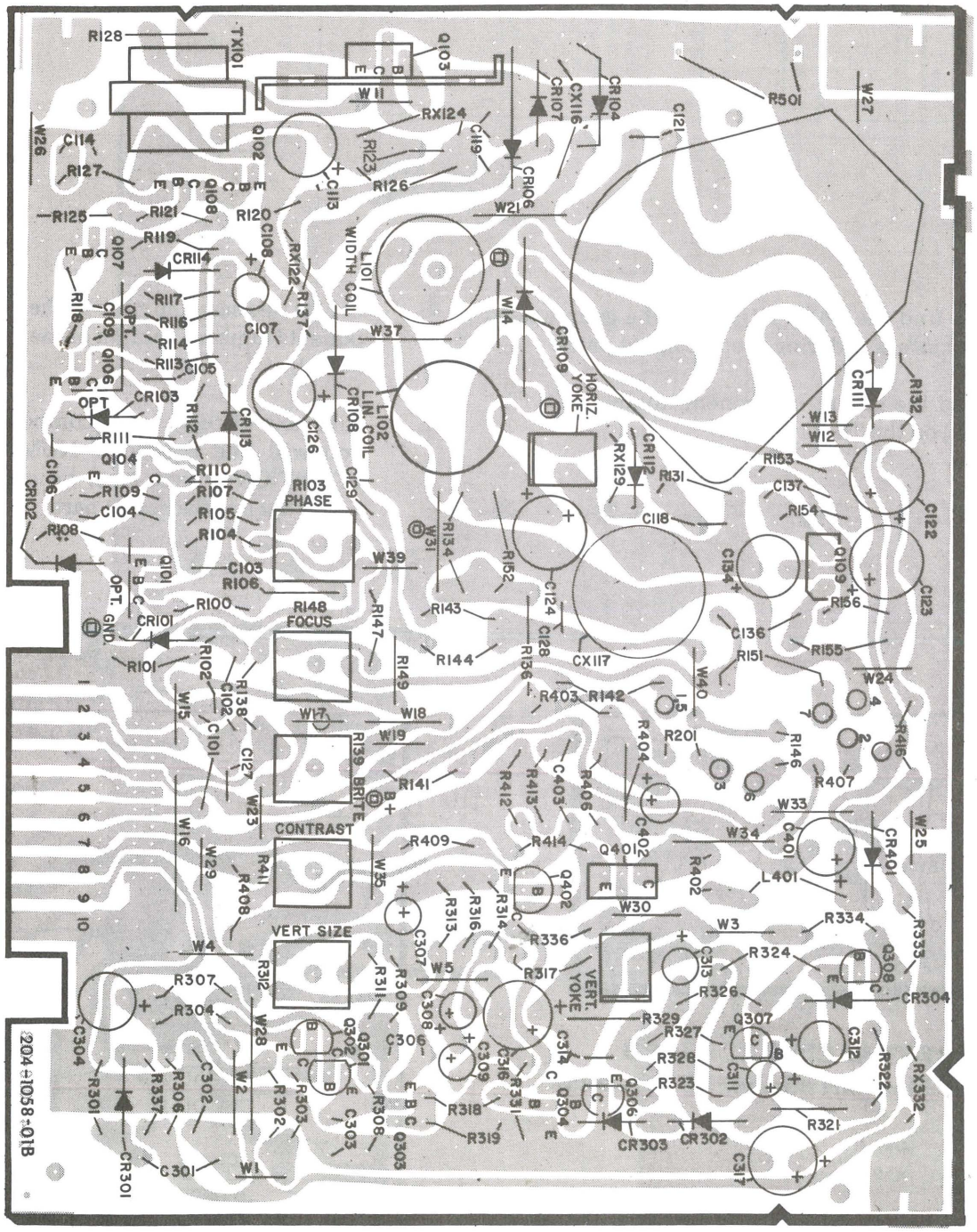


RF TRAP CIRCUIT BOARD
(Assembled part number HE 181-4325)



POWER SUPPLY CIRCUIT BOARD
(Assembled part number HE 181-3887)


85-2791-1
090182
081282 85-2791



VIDEO CIRCUIT BOARD
(Assembled part number HE 234-203)

Appendix A

ASCII Conversion Chart

OCT	DEC	HEX	ASCII	KEYS	DESCRIPTION
000	0	0	NUL	CTRL-@	Null, tape feed.
001	1	1	SOH	CTRL-A	Start of heading.
002	2	2	STX	CTRL-B	Start of text.
003	3	3	ETX	CTRL-C	End of text.
004	4	4	EOT	CTRL-D	End of transmission.
005	5	5	ENQ	CTRL-E	Enquiry, also WRU.
006	6	6	ACK	CTRL-F	Acknowledge, also RU.
007	7	7	BEL	CTRL-G	Rings the bell.
010	8	8	BS	CTRL-H	Backspace; also format effector backspace (FEB).
011	9	9	HT	CTRL-I	Horizontal Tab.
012	10	A	LF	CTRL-J	Line feed: advances cursor to next line.
013	11	B	VT	CTRL-K	Vertical Tab (VTAB).
014	12	C	FF	CTRL-L	Form feed to top of next page.
015	13	D	CR	CTRL-M	Carriage return to beginning of line.
016	14	E	SO	CTRL-N	Shift-out.
017	15	F	SI	CTRL-O	Shift-in.
020	16	10	DLE	CTRL-P	Data line escape.
021	17	11	DC1	CTRL-Q	Device control 1: turns transmitter on (XON).
022	18	12	DC2	CTRL-R	Device control 2.
023	19	13	DC3	CTRL-S	Device control 3: transmitter off (XOFF).
024	20	14	DC4	CTRL-T	Device control 4.
025	21	15	NAK	CTRL-U	Negative acknowledge; also ERR (error).
026	22	16	SYN	CTRL-V	Synchronous idle (SYNC).
027	23	17	ETB	CTRL-W	End of transmission block.
030	24	18	CAN	CTRL-X	Cancel (CANCL). Cancels current escape sequence.
031	25	19	EM	CTRL-Y	End of medium.
032	26	1A	SUB	CTRL-Z	Substitute.
033	27	1B	ESC	CTRL-[	Escape.
034	28	1C	FS	CTRL-\	File separator.

Appendix B

Zenith Mode Code Information

The Z-29 Terminal recognizes the following ASCII characters while it is operating in the Zenith mode.

OCT	DEC	HEX	Chr	FUNCTIONAL DESCRIPTION OR CHARACTER
007	7	7	BEL	Sounds a tone.
010	8	8	BS	Backspace. Moves the cursor one position to the left. If it is at the left end of the screen, nothing happens.
011	9	9	HT	Tab. Moves the cursor to the next tab stop.
012	10	A	LF	Line Feed. Advances the cursor to the next line. At the bottom of the screen, it scrolls text up one line.
015	13	D	CR	Carriage Return. Moves the cursor to the first character position in the current line. Nothing happens if the cursor is already at the first character position.
030	24	18	CAN	Cancel. Cancels the current escape sequence.
033	27	1B	ESC	Escape.

SUMMARY OF ZENITH ESCAPE SEQUENCES

In the following listings of escape sequences, we have elected for the purpose of clarity to include a space between the escape key (ESC) and the actual code. Under no circumstances **should you include** this space. The term "defined scrolling region" appears several times in these listings and means lines 1-24 of the screen unless you have specifically altered this region through the use of escape sequences and codes.

Appendix C

ANSI Mode Code Information

The Z-29 Terminal recognizes the following ASCII characters while it is operating in the ANSI mode.

OCT	DEC	HEX	Chr	FUNCTIONAL DESCRIPTION OR CHARACTER
007	7	7	BEL	Sounds a tone.
010	8	8	BS	Backspace. Moves the cursor one position to the left. If it is at the left end of the screen, nothing happens.
011	9	9	HT	Tab. Moves the cursor to the next tab stop.
012	10	A	LF	Line Feed. Advances the cursor to the next line. At the bottom of the screen, it scrolls text up one line.
015	13	D	CR	Carriage Return. Moves the cursor to the first character position in the current line. Nothing happens if the cursor is already at the first character position.
030	24	18	CAN	Cancel. Cancels the current escape sequence.
033	27	1B	ESC	Escape.

SUMMARY OF ANSI ESCAPE SEQUENCES

NOTES:

1. In the ANSI mode, the Terminal only recognizes and responds to escape codes whose syntax and semantics are in accordance with ANSI specifications.
2. "Default" is the value 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 taken from a list and used to select a subfunction. You can select several subfunctions at once by putting one number after another, separating them with delimiters (semicolons), to a maximum of eight parameters.

Appendix D

Lear Siegler ADM3A Mode Code Information

The Z-29 Terminal recognizes the following ASCII Characters while it is operating in the ADM3A mode.

OCT	DEC	HEX	Chr	FUNCTIONAL DESCRIPTION OR CHARACTER
007	7	7	BEL	Sounds a tone.
010	8	8	BS	Backspace. Moves the cursor one position to the left. If it is at the left end of the screen, nothing happens.
011	9	9	HT	Tab. Moves the cursor to the next tab stop.
012	10	A	LF	Line Feed. Advances the cursor to the next line. At the bottom of the screen, it scrolls text up one line.
013	11	B	VT	Moves the cursor up one position. If the cursor is already at the top of the screen, nothing else will happen.
014	12	C	FF	Moves the cursor one position to the right. If the cursor is already at the right side of the screen, nothing else will happen.
015	13	D	CR	Carriage Return. Moves the cursor to the first character position in the current line. Nothing happens if the cursor is already at the first character position.
016	14	E	SO	Enables keyboard entry after it has been disabled by code 0FH.
017	15	F	SI	Disables the keyboard entry. Use code 0EH to enable.
032	26	1A	SUB	Clears the screen and moves the cursor to the home position (first position on the top line).
036	30	1E	RS	Moves the cursor to the home position.

Appendix E

Hazeltine 1500 Mode Code Information

The Z-29 Terminal recognizes the following ASCII Characters while it is operating in the Hazeltine 1500 mode. Note that this Terminal can set up regions which act line independent screens under certain conditions. Also, instead of escape sequences (ESC), the 1500 Mode makes use of tilde (~) sequences.

OCT	DEC	HEX	Chr	FUNCTIONAL DESCRIPTION OR CHARACTER
007	7	7	BEL	Sounds a tone.
010	8	8	BS	Backspace. Moves the cursor one position to the left. If it is at the left end of the screen, nothing happens. If the line is not at the top of a scrolling region, the cursor will move up one line and be positioned to the right end of that new line.
011	9	9	HT	Tab. Moves the cursor to the beginning of the next field (foreground region — normal intensity). If there are no more fields, the cursor will not move.
012	10	A	LF	Line Feed. Moves the cursor down one line. If the cursor is on the last line of a scrolling region, the cursor will remain there and all data within the scrolling region will move up one line. Data on the top line of the scrolling region will be lost as it is scrolled out of the region. If the cursor is at the bottom of a fixed region, no action will take place.

015	13	D	CR	Carriage Return. Moves the cursor to the first character position in the current line. Nothing happens if the cursor is already at the first character position.
020	16	10	DLE	Moves the character one position to the right. If the cursor is at the right end of the line and the line is not the last line of a region, the cursor will move down one line and be placed at the first character position of the new line. If the cursor is already on the last line of the region, nothing else will happen if it is at the right end of the line.
033	27	1B	ESC	Escape.