

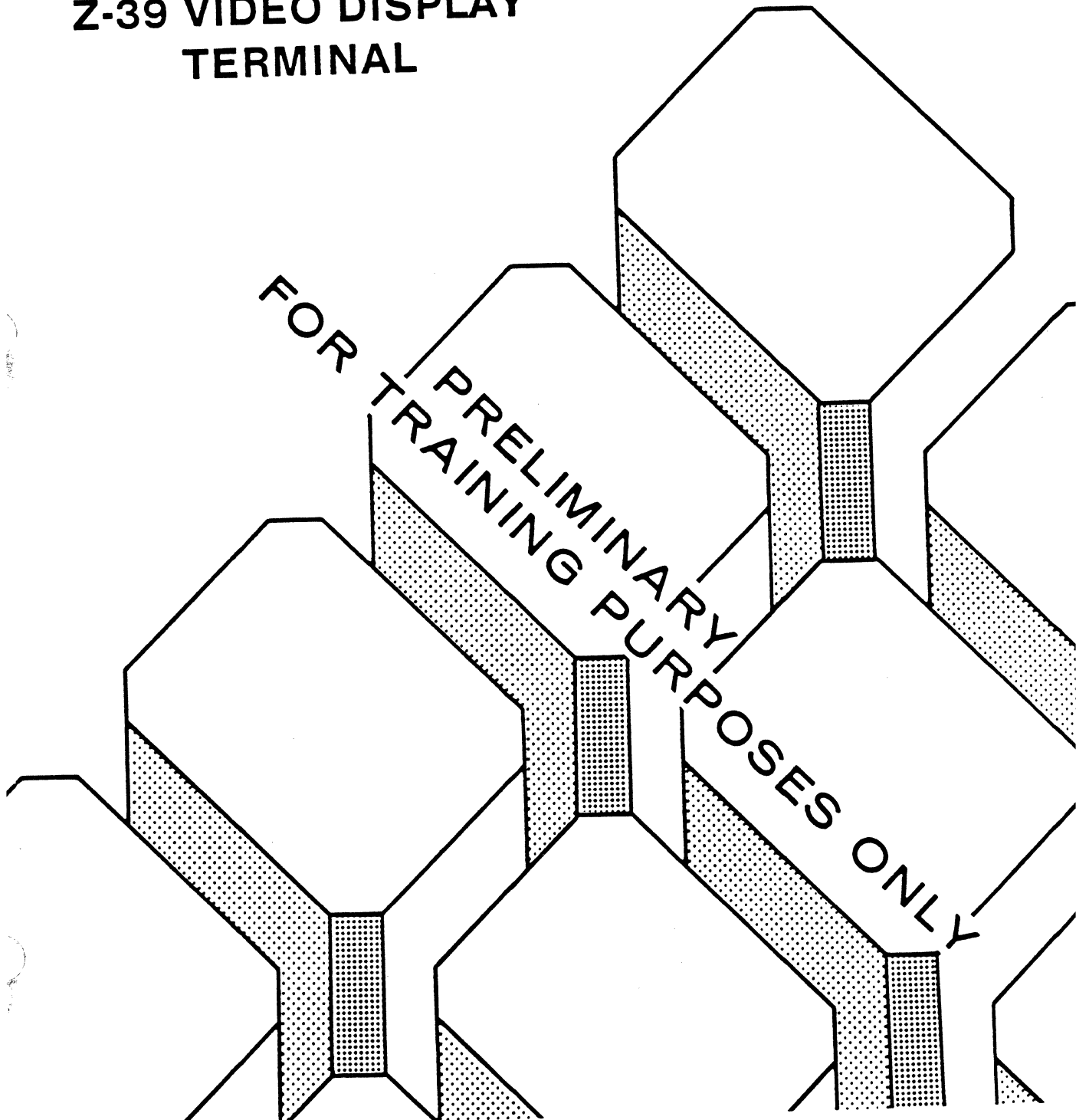
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585-169

# ***Technical Training***

**Z-39 VIDEO DISPLAY  
TERMINAL**



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## Chapter 1: Description and Specifications

### Introduction

The Zenith Data Systems Z-39 Terminal has two main components: a video display and a detached keyboard. The two are connected with a six-foot coiled cord. A Programmer's Data Information sheet and an RS-232 cable are also included with the terminal.

This terminal provides many advanced functions many of which can be programmed from the keyboard.

- \* Automatic self-check upon power up.
- \* Four terminal emulation modes: Zenith, ANSI, Lear Siegler ADM3A, and Hazeltine 1500.
- \* Programmable character attributes and scrolling regions.
- \* Advanced keyboard features: automatic key repeat, "N" key rollover, status indicators, user-defined function keys, and full cursor control keys.
- \* A detached, low-profile keyboard with sculptured keys and a six-foot coiled cable.
- \* All features are selectable through the keyboard.
- \* Special attributes including character-by-character reverse video, half-intensity, blinking, and underline capabilities.
- \* Cabinet with tilt and swivel video display.
- \* Support for the following character sets:

- DANISH
- FRENCH
- GERMAN
- ITALIAN
- NORWEGIAN
- SPANISH
- SWEDISH
- UNITED KINGDOM
- USA

## THE Z-39 SERVICE MANUAL

This manual is divided into the following parts.

INSTALLATION -- Describes the hardware and provides information for configuration, interfacing, and power on.

OPERATION -- Describes the keys, functions, and modes of the terminal.

THEORY OF OPERATION/CIRCUIT DESCRIPTION -- Describes the hardware theory of operation with circuit descriptions.

DETAILED DISASSEMBLY -- Provides instructions for hardware disassembly and reassembly to the circuit board level.

SERVICE INFORMATION -- Provides information on cleaning, inspection, testing, and troubleshooting to the circuit board level.

PARTS LIST -- Provides exploded views with part numbers, board component views, and reference designator index to part numbers.

APPENDIX A -- Provides foreign keyboard information.

APPENDIX B -- Provides escape sequence information.

SCHEMATICS -- Detailed circuit board schematics.

### LIST OF TOOLS

The following list of tools is recommended for servicing the terminal:

- \* Nut driver, 1/4"
- \* Standard screwdriver, 1/4" blade
- \* Phillips screwdriver, #1 and #2 point
- \* Small diagonal cutters
- \* Long-nose pliers
- \* IC puller, HE-490-111 and HE-490-189
- \* Desoldering bulb
- \* Soldering station Weller/Heath GDP-1108

## LIST OF TEST EQUIPMENT

The following list of test equipment is recommended for servicing:

NOTE: Equivalent items of test equipment may be substituted.

- \* Oscilloscope -- DC to 100 MHz, dual-trace, triggered-sweep.
- \* Logic probe -- DC to 20 MHz, capable of detecting 10 ns single pulses, and indicating logic one, logic zero, and high impedance states. Heath Model IT-7410.
- \* Digital voltmeter -- High impedance input, zero to 1000 volts, zero to one megohm. Heath Model SM-2215.
- \* Variable power supply -- Zero to 120 VAC, 3 amperes.
- \* Oscilloscope probe -- Low capacitance, adjustable from 15 pF to 50 pF, 4 ns rise time.
- \* Video monitor -- RGB color and monochrome composite wide band monitor. Zenith Model ZVM-135.
- \* High voltage probe -- Zero to 40 KV. Heath Model IM-5210.

## LIST OF SUPPLIES

The following list of consumable supplies is recommended for servicing.

- \* Heat sink compound, HE-205-0303
- \* Cable ties, HE-354-59
- \* Solder, 60/40, HE-331-13
- \* Desoldering braid, HE-490-185
- \* Lint-free cloths

## SPECIFICATIONS

### DISPLAY

CRT	12"(30.5 cm), P31, green, nonglare video screen
Display Format	25 rows of 80 characters
Display Size	6.0" high x 8.5" wide
Character Type	8 x 10 character cell
Character Size	0.2"(5 mm) high x 0.1"(2.5 mm) wide (approximate)
Character Set	Normal: 128 characters; 95 ASCII, upper- and lowercase, numerics, punctuation, and 33 graphic characters  Alternate: 128 characters; 95 ASCII, superscript, foreign characters, scientific notation, and 33 graphic characters (VT-100)
Video Attributes	Normal or reverse character, normal or underline character, normal or half-intensity character, normal or blinking character
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, low-profile, sculptured-key keyboard conforming to European DIN ergonomic standards with a 6-foot (182 cm) coiled cord
Layout	Split: 77-key standard typewriter style with special function keys and 14-key numeric keypad
Indicators	Visual: POWER ON, KEYBRD LOCK, OFF LINE, and CAPS LOCK (LEDs).  Audible: Key click with each key entry (programmable on/off), beep tone, 1 kHz for 200 ms

## EDITING AND ERASING FUNCTIONS

Editing	Insert or delete character. Insert or delete line
Erasing	Erase page, erase line, erase to end of line, erase to beginning of line, and erase to beginning of page.

## TERMINAL COMMUNICATIONS

Type	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

## PRINTER COMMUNICATIONS

Type	EIA RS-232C
Baud Rates	Rates same as main port setting
Mode	Half-duplex
Code	ASCII
Format	Serial asynchronous
Word Length	7-data bits, one parity bit
Sync	Hardware handshaking only
Parity	Parity same as main port setting

## ENVIRONMENT

Operation	Temperature: 32 to 105 degrees Fahrenheit (0-40 degrees Celsius) Humidity: 10-90% (relative) non-condensing
Storage	Temperature: -40 to 150 degrees Fahrenheit or -40 to 66 degrees Celsius Humidity: 0-95% (relative) non-condensing

## POWER

Voltage Range	90-132 volts
Frequency	60 Hz
Consumption	45 watts

## DIMENSIONS

Video Unit	13.6" high x 12.9" wide x 11.0" deep (34.5 x 33.0 x 28.0 cm)
Keyboard	1.35" high x 18.25" wide x 8" deep (3.3 x 46.3 x 20.5 cm)
Weight	Video unit: 18.9 pounds (8.50 kg) Keyboard: 3.8 pounds (1.73 kg)

## Installation

This section describes the location of controls, indicators, and connectors on the video display and keyboard necessary for basic start-up.

### Voltage Selection

The Z-39 is configured during manufacture for 120 volt operation while the Z-39E is configured for 220 volt operation. Verify that either terminal has not been reconfigured before it is plugged into a power source. To change the terminal to operate on a voltage other than the configured one, refer to the following instructions and Figures 1.1 and 4.2.

**WARNING:** The power supply develops lethal DC voltages. The power cord must be unplugged before proceeding.

1. Place the terminal on its side on the work surface so that the base chassis screws are accessible.
2. Remove the four 6-32 x 5/8" screws at points A, B, C, and D; then remove the base chassis.
3. Remove the 6-32 x 5/8" screw securing the power supply protective shield from the underside of the base chassis.
4. Set the base chassis down on the work surface; then remove the two 4-32 x 1/2" screws securing the shield to the power supply heat sink bracket.
5. Carefully lift the power supply shield until it clears the power supply circuit board.
6. Select the jumper for either 120 or 240 volt terminal operation. Pull the white jumper straight up and reconnect it to the pin corresponding to the desired operating voltage as marked on the circuit board.
7. Replace the power supply shield and the two 4-32 x 1/2" screws that were removed in step 4.
8. Carefully replace the base chassis and the four 6-32 x 5/8" screws that were removed in step 2.
9. Place the terminal upright on its mounting base.



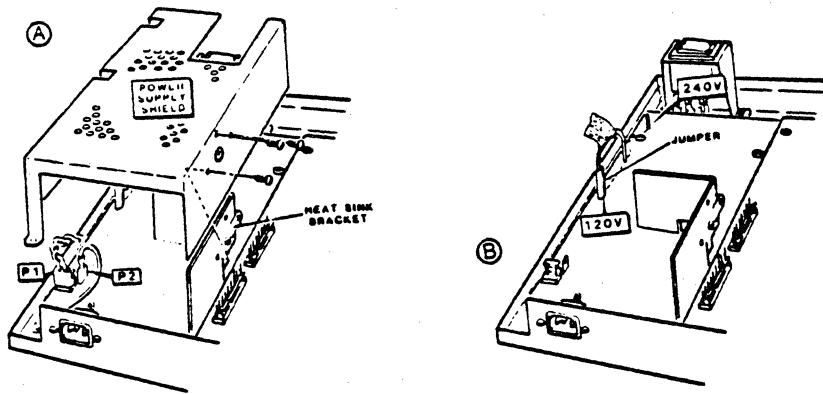


Figure 1.1  
Voltage Selection

### Keyboard

The following is a description of the keyboard. Refer to Figure 1.2.

Keyboard Cable -- Connects the keyboard to the video display.  
 Keyboard -- The keyboard consists of 91 keys, four visual indicators, and is available in several different languages.

Refer to Appendix A, Figures 1 through 6 for foreign keyboard information.

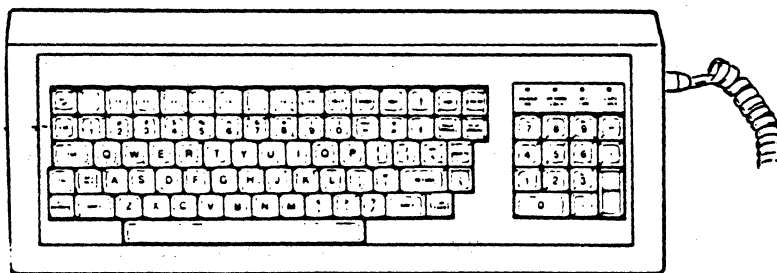


Figure 1.2  
USA Keyboard

## Keyboard Indicators

Refer to Figure 1.3.

**POWER ON** -- Lights when power is ON and the keyboard is properly connected.

**KEYBRD LOCK** -- Lights when the keyboard unit is locked or under host computer control. The keyboard must be enabled to operate.

**OFF LINE** -- Lights when the terminal is off-line from the host computer.

**CAPS LOCK** -- Lights when the CAPS LOCK function is on.

**NOTE:** All LED indicators illuminate red, except for POWER ON (green).

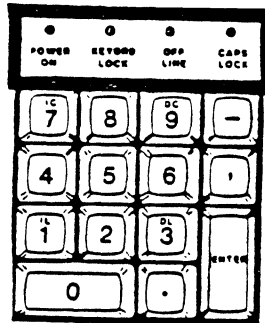


Figure 1.3  
LED Indicators

## Keyboard Tilt Adjustment

Refer to Figure 1.4.

The tilt of the keyboard can be adjusted by pressing the two tabs located at the rear of unit.

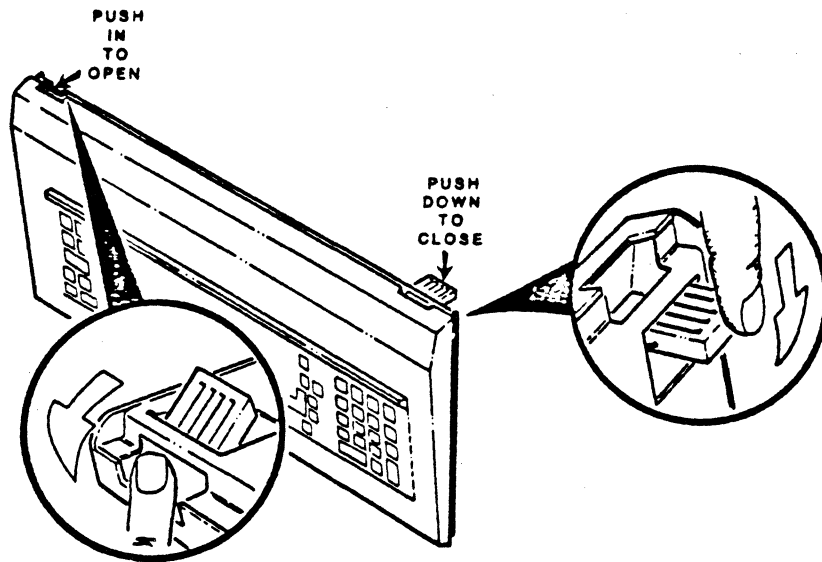


Figure 1.4

Tilt Adjustment

Video Display Unit

The video display unit is a monitor mounted on a swivel base. Refer to figure 1.4 for the location of the following controls.

Power ON/OFF Switch -- Turns the terminal on or off.

Contrast Control -- Adjusts the contrast of the video display.

Rotate the video display on the chassis base and tilt the CRT screen to the desired viewing angle as follows:

1. Grasp both sides of the CRT and swivel it right or left to the desired position. This movement is restricted to 45 degrees in either direction.
2. Grasp both the top and the bottom of the CRT and tilt it up or down to the desired position. This movement is restricted to 22 degrees of overall tilt.

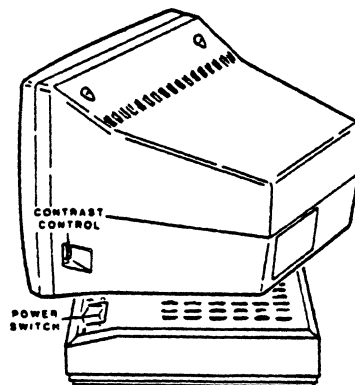


Figure 1.5  
Video Display Unit

## Connections

Place the video display on a solid work surface and turn it until the rear is facing you. The terminal connections are illustrated in figure 1.6.

Keyboard Connector -- Provides the necessary signals for the keyboard.

**CAUTION:** The coiled cable assembly resembles a conventional telephone cord. Do not attempt to connect the keyboard or computer to the telephone system or damage could result.

Locate the coiled keyboard cable. Connect the cable to the keyboard connector on the rear of the video display.

DTE Connector (Main) -- Provides the necessary EIA-standard RS-232 signals to a modem and/or computer.

DCE Connector (Auxiliary) -- Provides the necessary EIA-standard RS-232 signals to data terminal devices or a printer.

**NOTE:** Verify that the DTE and DCE cable connections are tightened securely or improper operation of the terminal may result.

When connecting the terminal directly to a computer, plug the RS-232 cable into the DTE connector and the other end into the computer's DCE connector (refer to the computer hardware manual for the proper connector).

When connecting the terminal to a modem, plug the RS-232 cable into the DTE connector and the other end into the modem's (DCE) connector (refer to the modem hardware manual for the proper connector).

When connecting the terminal to a printer, a null modem cable (HE-134-1454) may have to be used (refer to the printer hardware manual for the proper connection). Plug the printer cable into the auxiliary (DCE) connector. Since the baud rate setting applies to both ports, the printer must operate at the same baud rate as the primary (DTE) port for the host computer.

POWER LINE Connector -- Connects 115V power source via power cord to the terminal.

After verifying that the power switch is off, plug the power cable into the power connector located on the rear of the terminal's base unit.

Turn the video display until the front is facing you.

Plug the power cable into an appropriate power source (AC receptacle); then press the power switch to ON.

## POWER-ON INDICATOR

When you turn on the terminal, the POWER-ON indicator on the keyboard should light. If the POWER-ON indicator is not lit, either the keyboard is not connected to the terminal correctly or the terminal is not connected to an acceptable power source.

After 10 to 30 seconds, a cursor should appear in the upper-left corner of the screen. The 25th line may also display: time 0:00:00 and/or one or more messages such as CAPS LOCK, OFF LINE, or INSERT MODE.

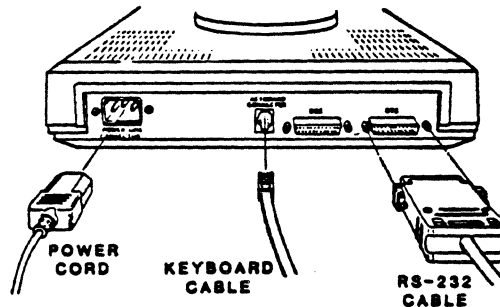


Figure 1.6  
Terminal Connections

## Interfacing

The terminal is designed to be used as an input/output device for a computer system. It may be directly connected or connected through telephone lines (via a modem) to any computer. The following discussion covers the necessary information for proper interface with a computer.

**CAUTION:** FCC regulations require that the terminal be connected to a computer with a shielded cable to minimize spurious RF radiation.

## DTE and DCE Devices

On the rear panel of the terminal, there are two standard connectors, marked DCE (auxiliary) and DTE (main). The DTE connector connects to the host computer or modem and the DCE connector to the printer or other peripheral.

Table 1.1 provides information on the DTE connector and Table 1.2 provides information on the DCE connector.

**NOTE:** The computer or modem used with the terminal must meet RS-232C standards or improper operation may result.

Primary Serial Connector (DTE)

PIN #	SIGNAL NAME	Input/Output	SIGNAL FUNCTION
1	GND	-	Protective Ground
2	XMT	O	Transmitted Data
3	REC	I	Received Data
4	RTS	O	Request to Send
5	CTS	I	Clear to Send
7	GND	-	Signal Ground
20	DTR	O	Data Terminal Ready

Auxiliary Serial Connector (DCE)

PIN #	SIGNAL NAME	Input/Output	SIGNAL FUNCTION
1	GND	-	Protective Ground
2	REC	I	Received Data
3	XMT	O	Transmitted Data
4	RTS	I	Request to Send
5	CTS	I	* Clear to Send
6	DSR	O	* Data Set Ready
7	GND	-	Signal Ground
8	CD	O	* Carrier Detect
20	DTR	O	Data Terminal Ready

NOTE: \* indicates pins tied to line 20

SELF-CHECK TESTS

As soon as you turn on the terminal, a series of internal self-check tests are performed to verify proper operation. If a fault is detected, an appropriate error message will be displayed on the video screen. If no faults are found, a short beep tone will sound. Table 1.3 lists the tests performed and the corresponding error messages. Refer to Chapter 5, "Service Instructions" for further information and instructions.

Self-Check Tests

TEST	ERROR MESSAGE
ROM	ROM Checksum
RAM	RAM Fault
CRT Controller	CRTC Error
Keyboard	Keyboard
non-volatile RAM	NVRAM Checksum



## Chapter 2: General Information

### Theory of Operation

The following paragraphs provide a block diagram description of the terminal's major assemblies.

Refer to Figure 2.1, the overall block diagram.

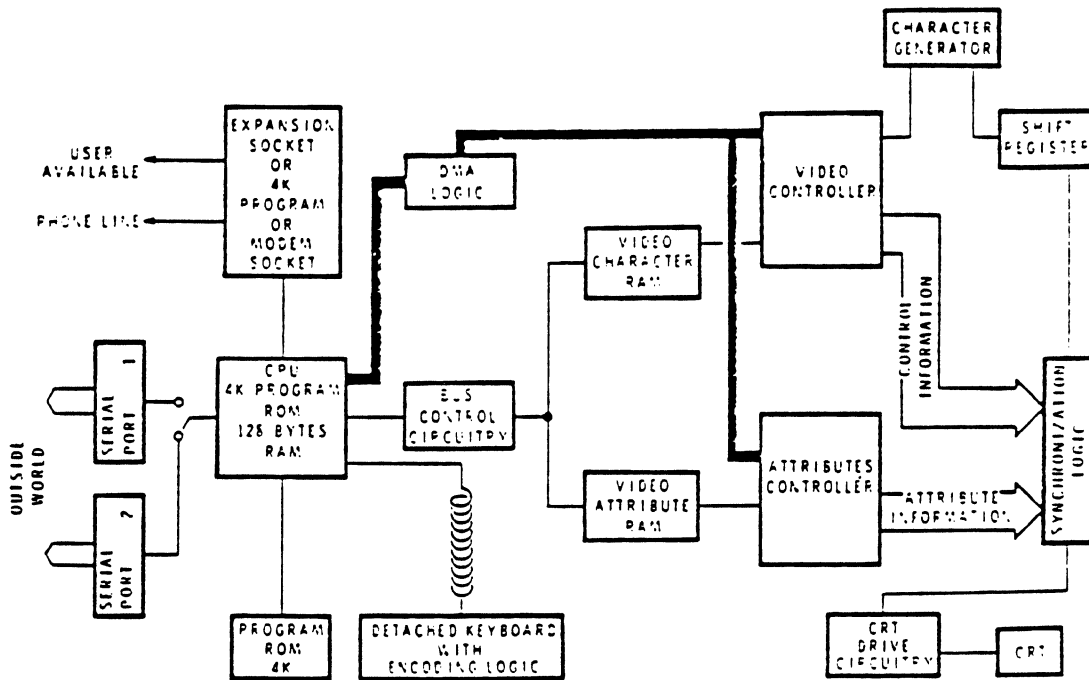


Figure 2-1  
Overall Block Diagram



## Vertical Oscillator

The transistor-transistor logic (TTL) input signal from the terminal logic board (TLB) is coupled to the vertical oscillator to synchronize the vertical frequency with the incoming sync pulse. The oscillator output is applied to a differential amplifier. This in turn, feeds the vertical driver, which drives complementary output amplifiers I and II. This stage develops the sweep current to drive the vertical deflection yoke. The vertical retrace stage generates a fast vertical retrace for the retrace period of the sweep output. The VERT SIZE control is adjusted to provide normal display height on the CRT. The vertical circuits are located on the video deflection board.

## Video Amplifier

The positive video signal from the TLB is applied to the video amplifier stage which consist of two transistors connected in cascade. This stage amplifies the signal to a level necessary to drive the cathode of the CRT. The video amplifier circuit is located on the video driver board.

## Horizontal Oscillator

The positive horizontal sync pulse from the TLB is coupled to the horizontal oscillator which syncs the horizontal frequency with the incoming pulse. The PHASE control is used to center the video information on the CRT screen. The oscillator signal is fed to an inverter stage, which amplifies the signal. The amplified and inverted signal is applied to a driver stage to provide current gain via the coupling transformer. The output signal from the driver is applied to the horizontal output stage. The horizontal output circuit uses a winding on the flyback transformer to develop the ramp voltage for the horizontal deflection yoke of the CRT. The WIDTH coil is adjusted to provide normal width for the CRT raster. The horizontal oscillator circuit is located on the video deflection board.

## Horizontal Scan and Power Supplies

The horizontal output stage functions as an electronic switch. In conjunction with the flyback transformer, the high amplitude of the retrace pulse develops 12 kV for the anode of the CRT. The flyback transformer also provides various supply voltages for the focus and acceleration grids of the CRT. This is accomplished using rectifier diodes at low voltage windings on the transformer. The voltage from the diode rectifiers is the reference voltage for the FOCUS and BRIGHTNESS control potentiometers. The horizontal scan and rectifier diode power supply circuitry is located on the video deflection board.

## DETAILED CIRCUIT DESCRIPTION

This section provides a detailed circuit description of the keyboard assembly, terminal logic board, video circuit board, and the power supply.

### KEYBOARD ASSEMBLY

Refer to the keyboard assembly schematic as you read the following paragraphs.

**NOTE:** The symbols on the schematics in this service manual represent the logic flow of the circuit rather than any specific device's design.

The keyboard assembly contains an 8 x 11 matrix keyboard, a single-chip microcomputer U1, a 1 to 16 decoder/multiplexer U2, and a timer U5. U1 performs keyboard matrix scanning, controls the status indicator LED(s), enables the timer for beeper T1, and provides serial communication with the terminal logic board. The matrix keys are scanned utilizing a strobe scanning technique under control of U1 (refer to data sheets on the 8021 microcomputer for more information).

All the keys except RESET BREAK, CTRL, and the two SHIFT keys comprise a matrix keyboard consisting of eight sense lines and eleven scan lines or an 8 x 11 configuration. A keyswitch and diode are placed at each crossover point. The diodes prevent the generation of phantom key signals due to multiple key closures. The port 2 bits C0 (LSB) through C3 (MSB) of U1 control the scan lines of the 1 of 16 decoder U2. The port 2 bits drive U2 with the selected scan line being driven low. After selecting a scan line, the sense lines are checked for a key closure on the matrix keyboard. Resistors R11 through R18 serve as pullup resistors for the eight sense lines. The active-low sense lines are read by port 0 bits A0 through A7.

The RESET BREAK, CTRL, and the two SHIFT keys are direct-drive, active-low keys utilizing pullup resistors R8, R9, R10, and R21. These keys all have special functions and may be used with other keys to send unique keycodes. The SHIFT keys are ORed together and input to port 1 (B1) of U1.

The output of the SHIFT key(s) and RESET BREAK key are logically NORed together by U3A. The output of U3A is applied to the RESET input of U1 via the RC network composed of R19 and C8. Resistor R19 and capacitor C8 provide a minimum reset pulse width for resetting U1. The output of U3A is also buffered by U4E for hardware reset of the terminal. The RESET BREAK key also is inputted directly to port 1 (B2) and the CTRL key to port 1 (B0) of U1.

The chip U4D buffers the data stream (RCV) signal (serial data sent to the keyboard) to input T1 of U1. Resistor R22 serves as the line pullup resistor. Port 1 (B3) outputs the serial data

generated by the keyboard (XMT) via buffer U4-F to the terminal logic board. Resistor R23 serves as the line pullup resistor.

A 3.579 MHz crystal is connected between XTAL 1 and XTAL 2 of U1 for the internal control and timing references. The port 1 bit B7 drives timer circuit U5 for the piezoelectric beeper T1. Resistors R1 and R2 and capacitor C9 are selected to set the timer interval. Port 1 bits B4, B5, and B6 drive the CAPS LOCK, OFF LINE, and KEYBRD LOCK LED indicators via the buffers U4A, U4B, and U4C. Resistors R4, R5, and R6 are bias resistors for LEDs D2, D3, and D4. Resistor R7 is the bias resistor for LED D1 (POWER ON) fed directly from the +5 volt line. The LEDs D2, D3, and D4 are turned on by U1 in response to commands from the terminal logic board. The LED D1 is turned on by the application of power to the keyboard assembly.

Approximately +9.4 volts DC is applied to the keyboard assembly through pin 8 to voltage regulator U5. U5 regulates the output to +5 volts DC with C1 and C2 used as line filter capacitors. Capacitors C3 through C7 and C10 provide decoupling for the +5 volt (Vcc) to the keyboard's integrated circuits. The keyboard connector ground pins are 1 and 3.

#### TERMINAL LOGIC BOARD

Refer to the terminal logic board schematic as you read the following paragraphs.

##### Power-Up and Reset Circuit

To set the terminal back to its original operating mode after being changed by software escape sequences, U433 must be reset. A reset can be initiated either by a power-up or by simultaneously pressing the SHIFT and RESET keys on the keyboard.

The power-up reset circuit for the terminal consists of diode D401, resistors R408 and R423, capacitor C416, and integrated circuit U406C. When the terminal is first turned on, capacitor C416 is in a discharged condition. This holds one input (pin 10) of NAND gate U406C low and the output (pin 8) high. Resistor R423 pulls this output voltage to a level that insures that microcomputer U433 resets. After this initial reset, capacitor C416 charges through resistor R408. This action causes both inputs for U406C to become high; thus the resulting low at its output allows U433 to exit the reset condition.

Simultaneously pressing the SHIFT and RESET keys on the keyboard also resets U433. Since two keys have to be actuated to reset the terminal, the probability of accidental reset is minimal. At power up, capacitor C435 is in a discharged condition, but immediately begins to charge through resistor R425. This performs the same function as the capacitor and resistor on the other input to U406C. Capacitor C435 finally charges to a level that is sufficient to override the reset condition and allows U433 to operate properly. When the SHIFT and RESET keys are

simultaneously pressed, a logic low from the keyboard (plug P403 pin 2) causes capacitor C435 to discharge. Once this capacitor discharges to a TTL low, the output of U406C goes high and resets the terminal. Because the reset lines float high, the terminal is protected from a false reset in the event that the keyboard is accidentally unplugged from the video display unit.

The low that is sent to the reset circuit from the keyboard is also applied as the clear input to the video suppression circuit (U427). Since the enable input to U427 is pulled high (and inverted by U425D before it is applied to the data input) and the reset input is pulled low, the screen is blanked during reset. Resistors R425 and R401 and capacitor C435 integrate any noise pulses that could otherwise reset the terminal. The network composed of R401, R425, and C435 forms a time constant that is less than the time it takes to actually press the SHIFT and RESET keys together. This reduces the time the two keys must be held down to initiate the reset.

After a reset is complete, firmware causes U433 to begin the initialization routine. This clears the scratch pad and display RAM and initializes the two CRT controllers.

#### Serial Ports

The terminal has two RS-232 compatible ports, one is configured as DTE (Data Terminal Equipment), and the other is configured as DCE (Data Computing Equipment). The DTE port is normally used to connect the terminal to a computer or modem while the DCE port can be connected to a printer.

Microcomputer U433 controls the operation of the serial ports. This IC contains a built-in serial port which enables the terminal to communicate with other peripherals, without the need for an asynchronous communications element. This port is useful for linking peripheral devices using standard, asynchronous protocols.

U433 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 overrun, which could occur if the CPU fails to respond to the receiver's interrupt before the beginning of the next frame. Since U433 can usually maintain the transmit link without a double buffer, only one buffer 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 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 as follows:

Mode	Operation
0	Synchronous I/O expansion using TTL or CMOS shift registers.
1	UART interface with 10-bit frame and variable transmission rate.
2	UART interface with 11-bit frame and variable transmission rate.
3	UART interface with 11-bit frame and variable transmission rate.

Proper timing for the serial I/O data is provided by a transmission rate generator inside U433. Three different methods of transmission rate generation are possible and are dependent upon the operating mode of the serial port. Since this terminal uses transmission mode 1, the transmission rate is generated from U433's 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 consists of U433, a 2-line to 1-line output multiplexer (U431), a quadruple line driver (U442), and a quadruple line receiver (U429).

Pin 4 of multiplexer U431 is connected to a latched I/O pin on U433. When this line is logic 1, U431 sends data received from the auxiliary port to the receive pin of U433's serial port. When this line is a logic 0, U431 sends data received from the computer port to the receive pin of U433's serial port.

The transmit line drivers are tied directly to the transmit pin on U433 through an OR gate (U443C or U443D). The second input to these OR gates is from the port select bit (U448, pin 7). When the port select bit is high, the output of the OR gate U443 is high regardless of the logic level of the data to be transmitted. Therefore, when the port select bit is a logic 1, the DCE port transmits. When the port select bit is a logic 0, the output of OR gate U443D is high regardless of the logic level of the data to be transmitted because of inverter U444C. Thus when the port select bit is low, the DTE port transmits.

The clear to send (CTS) and data terminal ready (DTR) control signals on the DTE port are taken directly from U433 and passed to the line drivers. On the auxiliary port, the CTS, data terminal ready DTR, data set ready (DSR), and the received line signal detect (RLSD) signals are all tied together.

Another feature of the serial ports is a pass through or "Blind Print" mode. This allows data arriving to the terminal from the DTE port to be immediately channeled out the DCE port to a printer. Integrated circuit U448, pin 12 sets a logic 1 or 0 to U432, pin 1. The logic 0 will allow the pass through operation to be enabled. At this time, handshaking from the DCE port will be applied from U432, pin 11 directly to U433, pin 7.

#### CPU and Control Circuitry

The main timing and control for the terminal is established by U433 and its associated circuitry (ROM, RAM, and control logic). U433 contains a 4K x 8 read-only memory (ROM), a 128 x 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. The internal ROM holds approximately one-half of the total terminal firmware. A socket is included on the terminal logic board for installation of additional firmware.

The 32 I/O lines are divided into four 8-bit ports. Port 0 is an open-drain bidirectional port, while ports 1, 2 and 3 are 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 lines. Since the memory and peripheral devices in this terminal do not have on-chip address latching, U433 circuitry must demultiplex the address and data lines onto their respective buses. The address exits at port 0 and, approximately 100 nanoseconds later, the address latch enable (U433, pin 30) goes low. The low at this pin is inverted by U444B before it is applied to address latch U441, where the address is latched on the rising edge of the signal (ALE).

Port 1 -- Port 1 is a general purpose I/O port. Bit 0 (U433 pin 1) is used as the handshake line between the terminal and the keyboard. Bit 1 (U433 pin 2) is used as the input communications line from the keyboard to the terminal logic board. These lines are buffered by U425B and U425F, respectively, and filtered for RFI suppression.

Bit 2 (U433 pin 3) is used as the video enable bit. When at logic 0, this bit inverted by U425D, is connected to U427 pin 13 and allows the video to be displayed. When toggled to logic 1 (high) by U433, this bit causes 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 operation, where the screen is turned off after 15 minutes of inactivity if this feature is enabled in terminal setup. This bit blanks the screen during a manual reset, while all RAM, including video RAM is being initialized.

Bit 3 (U433 pin 4) is used as an output. When jumpered to +5 volts, this bit inhibits the SET UP mode key via firmware. When the bit is pulled up by firmware and recognized as being at a logic 1 (high), information from the keyboard that the SET UP key has been pressed is ignored.

Bit 4 (U433 pin 5) functions as the DTR signal for proper handshaking at the computer DTE port and is applied to port connector P402 through line driver U442B.

Bit 5 (U433 pin 6) functions as the CTS signal for proper handshaking at the computer DTE port and is applied to port connector P402 through line driver U442A.

Bit 6 (U433 pin 7) functions as the RTS input in the "Blind Print" mode.

Bit 7 (U433 pin 8) is used as a initial synchronization signal to the video circuit (U403 pin 1).

For further information regarding the keyboard communication bits, the video enable bit, and the RS-232 handshaking bits, refer to the applicable paragraphs in the keyboard or the terminal logic board circuit descriptions.

Port 2 -- Port 2 (U433 pins 21 to 28) is used only for the higher order address byte when U433 accesses external memory. The combination of ports 0 and 2 form the total 16-bit address bus.

Port 3 -- Port 3 is used as a general purpose I/O port. Bits 0 and 1 (U433 pins 10 and 11, respectively) are part of the the serial port circuitry. Bit 0 functions as the serial port asynchronous receive data input, while bit 1 functions as the asynchronous transmit data output.

Bit 2 (U433 pin 12) is used as the interrupt 0 input from the character CRT controller (U418). A logic 0 level at this port bit indicates that a row buffer is ready for the loading of character data. The logic 1 level buffer ready signal (BRDY) from U418 pin 5 is inverted at gate U401F. This interrupt initiates a DMA transfer at the two CRTCs.

Bit 3 (U433 pin 13) is used as an interrupt 1 input from the character CRT controller (U418). A logic 0 level for this bit indicates the last display row and last retrace character has been handled.

Bit 4 (U433 pin 14) is also connected to the video circuitry. Used as an output, the bit causes the value of the jammed DMA instruction to become 20H. This is used to quickly clear a row of video memory via DMA.

Bit 5 (U433 pin 15) is used as an input to the serial port as the request to send (RTS) signal from the selected port, depending on the PRT CTRL signal.

Bits 6 and 7 (U433 pins 16 and 17) are the WR and RD signals used for transferring data bytes between port 0 and the data bus.

The PSEN signal is the program store enable output control from U433 (pin 29). It enables the external program memory to the bus during normal fetch operations versus using the microcomputers internal program memory.

U433 receives character data and attribute information from either the keyboard interface or the host computer. When a key is pressed, the keyboard's microcomputer (U1) converts it to character data and sends it to the terminal (the attribute data associated with the character data already provided). U433 then sends the attribute data to the attribute display memories (U437 and U438) by enabling bus buffer U446 with the 16K address signal and the write signal (WR), and directly connecting the attribute bus to the primary data bus. The attribute data is a four-bit wide nibble (D0 - D3) applicable to the four possible attributes.

After placing the attribute data in the display memory, U433 then writes the character data out to the character display memory (U436). The 20K address signal and the write signal from U433 enables the memory chip select and the bidirectional bus driver (U428) so that the secondary data bus and the primary data bus are connected. The microcomputer places the character and associated attribute data in display memory chips in an address location equivalent to a video screen position.

After U433 has placed the display data in the appropriate memory, this data must be transferred from the character display memory and the attribute display memory to their corresponding CRT controller (U418 and U419, respectively). This operation occurs by way of direct memory access (DMA), which is described in the video display circuit description.

## Memory Map

Figure 2.2 depicts the terminal's memory map. Address lines A15 through A12 are connected to the memory select circuit (U423) as well as other circuits. Chip U423 is a 3-input to 8-output data selector/demultiplexer and selects 4K increments of the memory map.



ADDRESS LOCATION	USED FOR
0K → 8K	Located in the expansion socket EPROM. It is internal to the microprocessor in later models.
8K → 16K	External program firmware.
16K → 24K	CRT controller registers.
24K → 32K	Control signal latch.
32K → 40K	Attribute display memory.
40K → 48K	Character display memory.
48K → 56K	DMA memory.
56K → 64K	NURAM memory.

Figure 2-2  
Z-39 Memory Map

Octal bus transceiver U428 separates the primary data bus from the secondary data bus. The secondary data bus services the character CRTC (U418) and the character memory (U436). This buffer is addressed at the 16K boundary for access to U418's registers. It is also addressed at the 40K boundary for access to U436. The direction of data flow through this buffer is controlled by the buffered read signal from U433.

Buffers U446 and U447 form eight single-direction bus drivers; four in the direction for a CPU read from the attribute display memory (U437 and U438), and four in the direction for a CPU write to the attribute display memory. The two quad-controlled portions of U446 and U447 are accessed at 16K and 32K. The 16K access is for the attribute CRTC (U419) control registers, and the 32K access is for U437 and U438.

Control functions from U433 are transferred via the primary data bus to a hex D flip-flop (U448). This control function latch is positioned in the memory map at the 12K boundary. Data is transferred from the CPU to the latch when the memory select chip U423 has the 12K signal selected and, at the same time, the write signal from U433 is active. The signals held by the latch are as follows:

Signal	Description
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.
B1	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.
PASSTHRU	This is an I/O bit that is used for the control of the pass through print operation.

The character display memory and the attribute display memory are further accessed at 28K as DMA memory. This is discussed further in the following paragraphs. The 28K signal is ORed at U426D with the WR or RD signals (U443A or U408A) to produce the low level chip select signal required to access the NVRAM (U439).

#### CLOCK CIRCUIT

The main oscillator clock circuit controls all of the timing operations for the terminal. It consists of an inverter (U411A) that is biased by resistors R411 and R412 for linear operation. Crystal Y401 provides positive feedback so the inverter generates a 14.784 MHz clock signal. Decoupling capacitor C439 prevents undesired negative feedback from being introduced from the output to the input and altering the oscillator frequency. Capacitors C428 and C441 provide impedance matching for the crystal circuit. Inverter U411D buffers the high frequency clock signal and provides the necessary current drive for the remaining portion of the clock circuit. The other buffers internal to U411 are not used. This prevents the high frequency signal from being coupled into other circuits.

The buffered 14.784 MHz clock signal is coupled to the dot clock circuit, the main processor clock circuit, and the video timing and synchronization circuits. In the dot clock circuit, the signal is fed directly to the clock input of shift register U415. 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 (U424A) divides the 14.784 MHz signal by a factor of 2

to produce a 7.392 MHz processor clock signal. The remaining signal path is to the counter integrated circuit (U403), which divides the 14.784 MHz signal by a factor of 2, 4, and 8 for use in the video timing and synchronization circuits. The divided by 8 signal is fed directly to CRT controllers U418 and U419 where it is used as the character clock. This signal is used because it matches the eight horizontal video dots per character cell.

Integrated circuit U404A NANDs the three signals from U403 and generates 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. Chip U413 is a high-speed Schottky device 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. In addition, the 7.392 MHz clock rate for the processor (14.784 divided by 2) is ideal for the processor's serial port baud rate generation.

#### CHARACTER GENERATION

The main control for the character generator and display circuits is formed by CRT controllers U418 and U419. U418 operates on the character data while U419 operates on the attribute data. The type of integrated circuits used for the terminal require that the attribute data be in a field-defined format. CRT controller U419, 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 CRTC 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 the internal registers are:

<u>Control Line</u>	<u>Description</u>
BDRY	Buffer ready. This output signal indicates that a row buffer is ready for loading of character data. This output is inverted and sent to pin 12 of U433, where it is used to initiate DMA.
BS	Buffer select. An input signal enabling the write signal for character data into the row buffers.

RD                    Read input. A control signal used to read the registers.

WR                    Write input. A control signal used to write commands to the control registers or to write data into the row buffers.

CS                    Enables read for status registers or write of command, parameters, or data.

Initialization of the CRTC's must be completed before they can function properly. The information that is necessary for the a proper display is as follows: type of cursor (underline, blinking underline, block, and blinking block), cursor home position, all video control data, and synchronization timing.

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 U404C as a high that forces the output low. This output is inverted by U407D and then exclusive ORed with the blink attribute at U414B. 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 manner as long as the blink attribute is set. The blink rate is controlled by U433 and can be varied. The underline is then exclusive ORed (U414C) with the cursor information coming from the LTEN and RVV pins of the CRT controller for the underline and block cursors. Exclusive ORing 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 ORed via U414D 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 ANDed via U409D 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 (normally used for retrace suppression) is not used in this instance, as 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 video information must now be latched so that the reverse video information, the half-intensity attribute, and the horizontal and vertical retrace control signals can be

synchronized. The reverse video output of the latch is exclusive ORed via U414A to create the reverse video for 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 (U402A, B, C, and D) at the same time. This timing allows the circuit to directly drive the video circuit board. 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 circuits are complex. 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 ORed together and then logically ORed 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 signals 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. A 50 Hz refresh, however, requires the addition of an addressable latch. Four lines of unused video must be added and blanked because 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, extra rows are added. These extra rows affect 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 U433 at the same time, it stops the video before it is displayed. This occurs because the line count changes during horizontal retrace so that 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 chip is specifically used to blank rows 26, 27, 28, and 29 on the screen. These are the rows that must be added to achieve 50 Hz refresh. In addition to blanking the extra rows, this circuit provides the screen-saver function. This will disable 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 DEFLECTION/DRIVER CIRCUIT BOARDS

The video deflection/driver circuit boards convert TTL signals, received from the terminal logic board, to the voltages necessary to drive the CRT. These boards contain the vertical, horizontal, video amplifier, and high voltage power supply circuitry.

Refer to the video deflection and video driver schematic for each of the following circuit descriptions.

### Vertical Circuits

Capacitor C301 couples the vertical sync signal from the terminal logic board to synchronize vertical oscillator I and II (Q301 and Q302). Capacitor C303 shapes the 60 Hz output at the emitter of Q301 to help produce a linear sweep.

The shaped 60 Hz oscillator signal is applied to differential amplifier Q303, where the base is the inverting input and the emitter the non-inverting input. Feedback from the collector is provided by resistor R319 to the emitter, providing good linearity.

The output of Q303 drives the vertical driver Q304, which in turn, drives the complementary vertical amplifier I and II (Q306 and Q307). This stage develops the sweep current through the deflection yoke TX202A. Diodes CR302 and CR303 prevent crossover distortion. The RC network composed of R312, R313, R314, R316, R317, C308, and C309 set the gain and frequency of the vertical amplifier.

The vertical-retrace transistor Q308 generates a fast vertical retrace of 850 us maximum for the vertical sweep. This occurs during the retrace period of the vertical scan.

### Horizontal Circuits

Capacitor C101 couples the positive horizontal sync pulse from the terminal logic board to the base of Q101. Resistor R102 and capacitor C102 form an impedance matching network. Diode CR101 serves as a blocking diode, allowing only the positive signal to the base of Q101. Horizontal oscillator II (Q104) is normally conducting, biasing Q101 to an off state. The positive horizontal

sync pulse turns Q101 on, cutting off Q104 at a point on the slope of the pulse, as determined by the phase shift network composed of R103, R104, and C103.

When Q104 cuts off, horizontal oscillator I (Q101) is cutoff, turning Q104 on. This action produces an amplified sync pulse across capacitor C106 and blocking diode CR103 to the horizontal oscillator III and IV (Q106 and Q107). The horizontal oscillator outputs an 15.697 KHz horizontal frequency to the inverter Q108. Diodes CR113 and CR114, resistors R113, R114, R116, and R119 are discharge diodes and resistors. The output of Q108 is fed to the horizontal driver Q102. Resistor R123 and capacitor C114 form a wave shaping network. Driver output transformer TX101 couples the signal from the horizontal driver to the horizontal output transistor Q103. Resistor R128 prevents transformer ringing.

### Horizontal Scan and Power Supplies

Transistor Q103 is used as an electronic switch which is on for approximately 60 to 70 percent of the horizontal scan period. Capacitor CX117 functions as a pseudo B+ for the horizontal deflection yoke TX202B. When Q103 is on, current flows out of CX117, through TX202B, LX102, LX101, and Q103 to ground. This action produces the right side of the scan. Inductor LX102 is a magnetically biased saturable reactor which provides left to right linearity. Inductor LX101 sets the horizontal scan width. The value of CX117 determines the parabolic waveform on the pseudo B+ which controls the center to edge linearity. The network composed of RX129, CR112, R131, and C118 provide suppression of spurious ringing which would cause black vertical lines at the left side of the raster.

When Q103 turns off, the resonant circuit of CX116 and LX101, LX102, and TX202B rings for one-half of a sine wave for a period of time equal to the LC time constant of the resonant circuit CX116 and LX101. This is the retrace pulse which moves the scanning beam from the left to the right side of CRT and also provides a high amplitude pulse for the auxiliary power supplies. Flyback transformer TX102 steps up the pulse to develop 12 kV of high voltage and also steps down and inverts the pulse. The inverted pulse is rectified by CR111 to provide the video B+, clamped by C119 and CR107 to provide a negative voltage supply for the CRT, and rectified by CR106 to provide grid 2 bias for the CRT.

At the end of the retrace the sine wave goes negative, biasing the damper diode CR104 on. Current flowing through the yoke circuit into the damper diode provides the left side of the raster scan. The above scanning cycle is then repeated.

The 12 volts for the horizontal scan is fed through diode CR109 into a tap on TX102 where transformer action increases the voltage to 20 volts for the pseudo B+ necessary for the horizontal deflection

The positive pulse from Q103 saturates the flyback transformer TX102 and charges CX117 through width coil LX101, linearity coil LX102, and horizontal deflection yoke TX202B. When Q103 turns off, the magnetic field of TX102 collapses generating the acceleration voltage to the CRT through an internal rectifier diode. Diode CR106 rectifies the focus voltage, charging C129 to a static level. Diode CR107 is the charge path for C126, which develops the brightness voltage for the CRT. Diode CR104 and CX116 form a damper network to eliminate the ringing effect of flyback transformer TX102. Width coil LX101 and linearity coil LX102 modify the sawtooth waveform generated by TX102, to provide a linear horizontal display.

Resistors RX129 and R131, diode CR112, and capacitor C118 form an arc suppression network. Diode CR109 and C124 rectify and filter the 20 volts DC from the primary of TX102. Diode CR111, capacitor C122, and resistor R132 rectify and filter the 60 VDC from the secondary of TX102. Resistor RX130 is a current limiting resistor for the secondary circuit.

#### Video Amplifier

Video driver Q402 and video output Q401 transistors are connected in cascade to form the video amplifier. This circuit provides high gain, low noise, and low input and output capacitance. The video signal from the terminal logic board is applied to the base of Q402. This causes transistors Q401 and Q402 to conduct, driving the CRT cathode more negative, thereby producing the white information for the video display. Resistor R412 determines the overall stage gain, while capacitor C403 and resistor R413 determine the frequency response.

#### POWER SUPPLY

This unit is designed to accept 120 Vac or 240 Vac inputs. Refer to Chapter 1- Installation for connection instructions.

The switch mode power supply is a proprietary item and is not servicable.







## KEYBOARD

The keyboard consists of 91 keys, a connector, and four status indicators.

### ALPHABETIC KEYS

Refer to Figure 3.2

The keyboard has the standard 26 letters of the alphabet arranged the same as a normal typewriter.

**CAPS LOCK** -- When this key is actuated it will cause all characters typed from the keyboard to appear in uppercase. If the status line on the video display is enabled, a "CAPS LOCK" message will be displayed whenever the function is activated. There is also an indicator above the numerical keypad which will light when the function is activated. This function will only affect the alphabetic keys of the terminal.

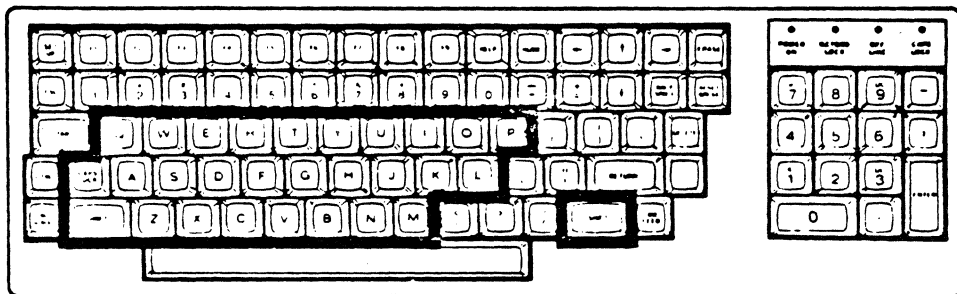


Figure 3-2  
Alphabetic Keys

## NONALPHABETIC KEYS

Refer to Figure 3.3

Nonalphabetic keys include the numbers 0 through 9, punctuation marks, and special characters. The lower marking on each key is generated when the shift keys are not held down. The upper marking is generated when either shift key is held down.

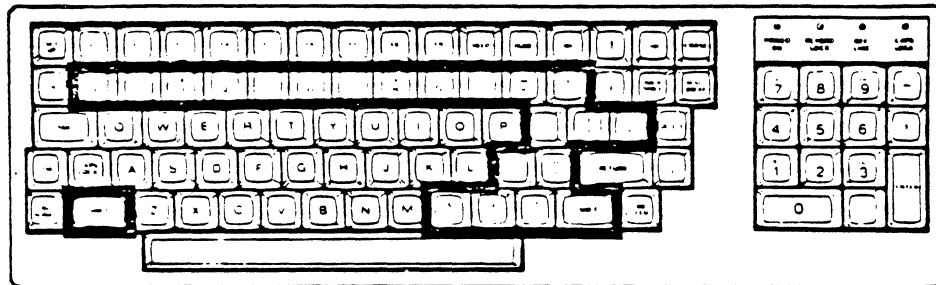


Figure 3-3  
Nonalphabetic Keys

## CONTROL FORMAT KEYS

Refer to Figure 3.4.

**NOTE:** The following paragraphs describe the most common function for each key. However, software 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 for that program.

**Space Bar** -- Functions the same as a typewriter. A blank character (space) can be entered by pressing the space bar.

**BACK SPACE** -- Functions the same as a typewriter. The cursor is moved one space to the left by pressing the BACK SPACE key.

**TAB** -- Positions the cursor to the next tab column as set by software or in the setup mode. If you press either SHIFT key and the TAB key together, the cursor will move to the previous tab column.

RETURN -- Returns the cursor to the first character on the left side of the display.

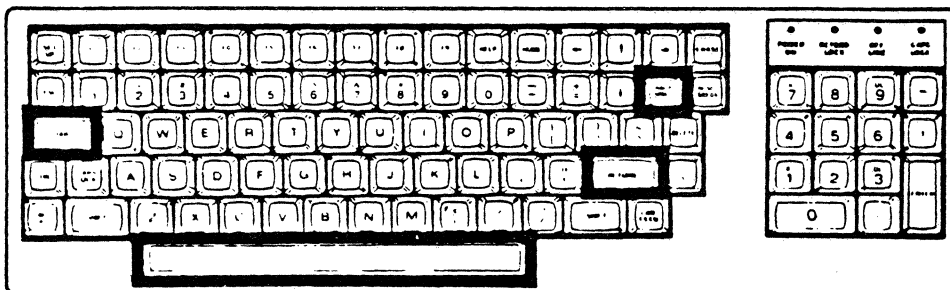


Figure 3-4  
Control Format Keys

#### SPECIAL PURPOSE KEYS

Refer to Figure 3.5.

The following keys are used for special purposes and are nonrepeating. Instructions that tell you how to use them will appear with the software programs.

F1-F9 -- Special function keys may be used by software or they may be user-defined.

RESET BREAK -- This key may be used by software in the normal (unshifted) mode to interrupt program execution. When used with either shift key, it will reset the terminal to the power-up state and cause the initial self-check tests to be run.

ERASE -- This key erases the screen from the cursor to the bottom of the screen. The ERASE key and either SHIFT key are used to erase all unprotected information on the screen.

HELP -- Used by software programs to provide special "prompts" or "helps."

HOME, up arrow, down arrow, left arrow, right arrow, and LINE FEED are cursor control keys used by some programs to control cursor movement and screen presentation.

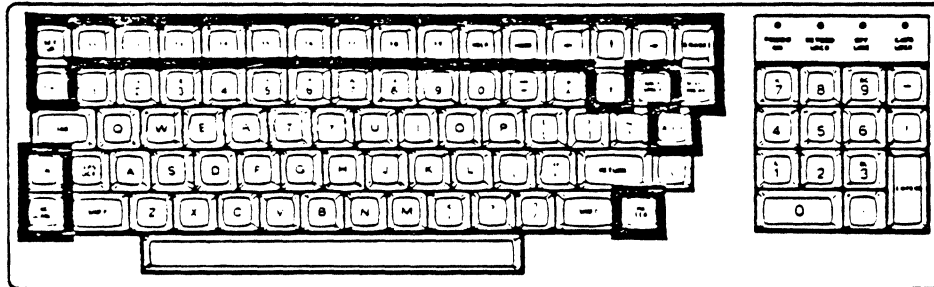


Figure 3-5  
Special Purpose Keys

DELETE -- Deletes one character to the left or sometimes in software duplicates the back space key. A non-displayable character is transmitted.

NO SCROLL -- Pressing the NO SCROLL key displays the next line of data. Pressing the NO SCROLL key and either of the SHIFT keys will display the next full page (24 lines). The NO SCROLL key may also be used to generate XON or XOFF handshaking commands. The NO SCROLL key is disabled during hardware or non-handshaking options.

SET UP -- The terminal's functions are programmed in the setup mode. To enter the setup mode, press the SET UP key. The terminal will display setup menu A and be "off line" with the host computer.

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

**ESC --** The escape (ESC) key generates a control code for escape sequences. The terminal, when "off line" will accept the "literal" escape code designation. This means all characters must be entered exactly as shown in the escape sequence. Refer to Appendix B for more information.

**EXAMPLE:** ESC c

In the above example, press and release the **ESC** key; then press and release the lower case **c** key.

**CTRL --** Pressing the control (CTRL) key and another key at the same time performs a special function. Refer to Appendix B for more information.

## KEYPAD KEYS

Refer to Figure 3.6.

**Calculator Style Keypad --** The group of keys located to the right of the keyboard, are organized somewhat like a calculator and include: numbers 0 through 9, a period for the entry of decimal points, a comma for data entry, a dash for the entry of negative numbers, and an ENTER key for signaling the computer that the entry has been completed. The 5 key has a raised dot to indicate the "home" position of the calculator keypad.

The four keys 1, 3, 7, and 9 are used for special insertion and deletion applications using the shifted mode. Key 1 (IL) is used to insert a line and key 3 (DL) is used to delete a line. Key 7 (IC) is used to enter or exit the insert character mode and key 9 (DC) is used to delete a character.

**Auto Print --** Outputs to the printer the same data displayed on the screen as it is sent from the host computer.

Pressing the CTRL and ENTER keys together will transfer the contents of the screen to the printer.

**Print Screen --** Prints the contents of the screen on the printer. The contents of the screen to be printed is either lines 1 to 24 (not 25) or the current scrolling region.

Pressing the ENTER key and either SHIFT key will turn the auto-print operation on or off.

**NOTE:** For compatibility with other Zenith Data Systems terminals, the numbered keys 5, 8, 2, 4, and 6 on the keypad will perform the same cursor functions as the HOME, up arrow, down arrow, left arrow, and right arrow keys respectively, with the keypad shift enabled.

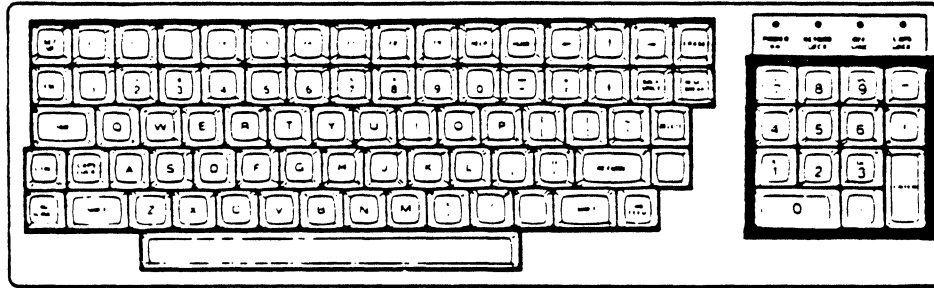


Figure 3-6  
Keypad Keys

### Setup Mode

The terminal's functions are programmed in the setup mode. To enter the setup mode, press the SET UP key. The terminal will display setup menu A and stop communications with the host computer if "on line".

**NOTE:** The terminal will not communicate with the host computer until you exit the setup mode.

You can also program many of the setup procedures by using software escape sequences. Refer to Appendix B for more information.

The setup mode has several 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 menus A through G and T for Tabs Menu.

Each function selected will display the status (current value). You may temporarily change or store the current value as explained in this chapter.

Table 3.1 is a summary of the setup functions, where they are used, and under which menu they are located.



## Setup Functions

FUNCTION	SETUP MENU
Automatic Carriage Return	F
Automatic Line Feed	F
Automatic Repeat	E
Baud Rate Selection	B
Character Sets	G
Clear Tab	A
Cursor Movement	A
Cursor Selection	F
Duplex Mode	B
Fill Screen	G
Handshaking	B
Hold Screen	C
Key Click	E
Keypad Alternate/Shifted	E
Line Frequency Selection	F
Monitor Mode	C
On/Off Line	A
Parity Selection	B
Port Assignment	C
Screen Saver	D
Set Clock	D
Set Tab	A
Status Line	D
Tabs	T
Terminal Modes	C
Video Attributes	G
Wrap On/Off	D

### Entering the Setup Mode

To enter the setup mode, press the SET UP key. The bottom line will indicate the setup menu A display.

### Menu Selection

To select any of the several different setup menu presentations, setup menu A through setup menu G and T for Tabs, press the corresponding alphabetic key.

Each function in the menu is accessed by its associated numeric key. You can access any of these menus from any other setup presentation by simply pressing the alphabetic key associated with that particular menu. Once you have established your particular setup configuration, you may store the menu in nonvolatile memory. To store and exit the setup mode, press and hold either SHIFT key and then press the SET UP key. To exit only, simply press the SET UP key.

## Setup Menu A

To enter setup menu A, press the A key if you are already in the setup mode. If you are not in the setup mode, press the SET UP key. The bottom line of the screen will display setup menu A.

Version -- The first item in setup menu A is the version number of the terminal ROM.

On(off) line -- Your terminal is an input/output device for a host computer whenever it is on line.

When the terminal is off line, it is controlled only through the keyboard, and no information can be received from or is transmitted to the host computer. When the off line mode is selected and the status line is enabled, OFF LINE will be displayed on the bottom line of the screen; also the off line indicator on the keyboard will be lit.

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

Tab Menu -- To enter the Tab Menu, press the T key if you are in the setup mode. If you are not in the setup mode, press the SET UP key and then the T key. The bottom line of the screen will display the current tab settings.

```
#234|678901|3456789012|4567890123456789012345678901234567890|234567890
```

The vertical lines represent tab locations at the 5th, 12th, 23rd, and 71st character positions. You can set and reset the tabs by moving the graphics block (#) left or right with the appropriate arrow keys. To move 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 # left, press the left arrow key. Once the cursor reaches the left side of the display, it will not move any further.

To set a tab, position the # to the desired tab location and press the up arrow key. To clear a tab, position the cursor to the desired location and press the down arrow key.

Exit -- To exit the setup mode without storing the current settings, simply press the SET UP key. When the terminal is reset or turned off and then on again, the previous settings will return to the settings that existed before you made any changes.

To exit and store the current settings in non-volatile memory, press and hold either SHIFT key and then press the SET UP key. The current settings will remain set until changed again in the setup mode.

#### Setup Menu B

To enter setup menu B, press the B key if you are in the setup mode. If you are not in the setup mode, press the SET UP key and then the B key. The bottom line of the screen will display setup menu B.

**Baud --** The terminal can use a variety of baud rates to communicate with the host computer. These rates are 75, 110, 150, 300, 600, 1200, 1800, 2400, 4800, 9600, and 19200 baud. The DTE port on the terminal receives and transmits data at the same baud rate as the DCE port does.

- If a printer is connected to the DTE port of the terminal, it must have its baud rate set the same as the rate being used for the DCE port.
- The number of data bits and stop bits are not programmable at the terminal. Refer to "Specifications" for further information.

To set the baud rate to another value, press the 1 key as many times as is necessary until the desired baud rate is displayed.

**Parity --** The available parity options are: odd, even, mark, and space. Mark and space are usually used in older computer systems.

You can change the parity option by pressing the 2 key on the keyboard until the desired parity option is displayed. The parity setting for the DCE port will be the same as that for the DTE port.

**NOTE:** Heath/Zenith Data Systems operating systems for the H-8, H/Z-89, and Z-90 computers do not check parity.

**Duplex --** The terminal can communicate with the host computer in either the full-duplex or half-duplex mode. You can change the mode of operation by pressing the 3 key on the keyboard.

**NOTE:** The DCE port only supports the half-duplex mode of operation.

Handshake -- The terminal uses two methods of handshaking: software and hardware.

In the software handshake mode, the terminal will automatically generate the XON and XOFF codes.

Hardware handshaking is performed through the use of three control lines via the DTE port connector. The DCE port connector utilizes only one of the control lines.

The three DTE control lines are: CTS (Clear to Send), RTS (Request to Send), and DTR (Data Terminal Ready). The DCE control line is RTS (Request to Send).

**NOTE:** The DCE port only uses hardware handshaking for printer operations regardless of the DTE port setting.

You can change the handshaking mode by pressing the 4 key on the keyboard until the desired mode is displayed. The ports may not be independently configured.

#### Setup Menu C

To enter setup menu C, press the C key if you are in the setup mode. If you are not in the setup mode, press the SET UP key and then the C key. The bottom line of the screen will display setup menu C.

Port -- In the normal mode the terminal will use the primary (DTE) port to communicate with a host computer. The auxiliary (DCE) port is available for connecting a second computer or a printer.

**NOTE:** There are limitations between the two ports for handshaking arrangements and the baud rate has to be the same for both ports. The auxiliary (DCE) port may only be used for printer operations when the primary (DTE) port is selected.

To change the routing of the signals to the DTE and DCE ports, press the 1 key on the keyboard. When the ports are exchanged, the display will indicate:

1. PORT auxil

Mode -- The terminal can emulate four common terminal types:

- \* The Heath/Zenith H/Z-19
- \* The Lear Siegler ADM3A
- \* The Hazeltine 1500
- \* The ANS1 standard X3.64-1979

Each of the four modes responds differently to the codes it receives. Refer to Appendix B for more information.

To change the terminal mode, press the 2 key on the main keyboard. Continue to press the 2 key until the mode you want to use is displayed.

Hold Scrn -- The hold screen function provides the operator with control over scrolling of the display.

- \* When you enable the hold screen function, pressing the NO SCROLL key displays a new line of received information.
- \* You can display an entire new page of received information, by pressing the NO SCROLL key and either SHIFT key at the same time.
- \* When the hold screen function is off, the NO SCROLL key generates a software handshake. Refer to Appendix B for more information.

You can turn the hold screen function on or off by pressing the 3 key on the keyboard.

Monitor -- The monitor mode displays the control character codes as graphic characters in reverse video.

- \* When you use the monitor mode, the WRAP at end of line should be enabled.
- \* The terminal will not respond to any control or escape codes while in this mode but will display the codes on the screen.
- \* Screen formatting is not possible when this feature is enabled.

You can turn the monitor mode function on or off by pressing the 4 key on the keyboard.

#### Setup Menu D

To enter setup menu D, press the D key if you are in the setup mode. If you are not in the setup mode, press the SET UP key and then the D key. The bottom line of the screen will display setup menu D.

Set Clock -- The terminal features a 24-hour clock where the time in hours and minutes is displayed on the status line.

To set the clock, press the 1 key on the keyboard. The bottom line of the screen will display:

Enter hours >

Enter a one-or two-digit number between 0 and 23 from the main keyboard and press the RETURN key. The bottom line of the screen will then display:

Enter minutes >

Enter a one-or two-digit number between 0 and 59 from the main keyboard and press the RETURN key. The clock will be set for the time you entered the moment the entry is completed.

**NOTE:** Any illegal entry will cause the display to return to the menu with no changes made. Press the BACK SPACE or DELETE key to clear the entire entry. The clock is zeroed when the terminal is reset.

**Status Line --** The status line on the CRT displays the following information after you exit from the setup mode: 24-hour clock, CAPS LOCK if the Caps Lock function is enabled, OFF LINE if the terminal is in the off line mode, INSERT MODE if the terminal is in the character insert mode, and PRINTER ON if the terminal is in the process of a print operation.

The clock will always be displayed unless the terminal Status Line is turned off or the 25th line has been turned on by a user-software command.

If the status line is enabled, it will always appear as long as the 25th line is disabled.

You can turn the status line on or off by pressing the 2 key on the keyboard.

**Wrap --** Wrap (wraparound) is a feature that allows you to continue to enter data after reaching the end of a line, without a data loss.

- \* For your terminal a line comprises 80 characters.
- \* When Wrap is on, the next character you enter after reaching the end of the line, will start the next line.
- \* If the line is at the bottom of the screen, the screen will be scrolled (moved) up one line.
- \* When Wrap is off, the character at the end of the line will be overprinted.

You can turn the Wrap function on or off by pressing the 3 key on the keyboard.

Screen Saver -- The screen will be automatically "blanked" (turned off) if no key is pressed or no data is received by the terminal for 15 consecutive minutes. This feature increases the life of the CRT.

The screen can be restored by pressing any key or by the reception of data through either of the serial channels.

You can turn the Screen Saver function on or off by pressing the 4 key on the keyboard. Your selection will become effective immediately.

#### Setup Menu E

To enter setup menu E, press the E key if you are in the setup mode. If you are not in the setup mode, press the SET UP key and then the E key. The bottom line of the screen will display setup menu E.

Keypad Shft -- The Keypad Shft function determines whether the normal (unshifted) keypad produces numeric or cursor control characters.

#### Keypad Shift Off

- \* The numeric characters on the keypad are transmitted by pressing the desired key.
- \* The cursor control characters are transmitted by using the SHIFT key with the desired key.

#### Keypad Shift On

- \* The cursor control characters are transmitted by pressing the desired key.
- \* The numeric characters are transmitted by using the SHIFT key with the desired numeric key.

You can turn the keypad shift function on or off by pressing the 1 key on the keyboard.

Keypad Alt -- When the Alternate Keypad function is on, the keypad transmits alternate function codes to distinguish keypad keys from keyboard keys. Refer to Appendix B for more information.

You can turn the Alternate Keypad function on or off by pressing the 2 key on the keyboard.

Repeat -- When the repeat function is on, pressing and holding any key except the SHIFT, CAPS LOCK, CTRL, SET UP, and RESET BREAK for more than one-half second will cause the key to be repeated.

- \* The longer the key is held down, the faster the repeat rate, until the maximum repeat rate is reached.
- \* The key will continue to repeat until released.

You can turn the repeat function on or off by pressing the 3 key on the keyboard. Your selection will become effective immediately.

Click -- Key click is an audible click indicating that a key entry has been made. Keys which modify other keys such as SHIFT and CTRL will not sound the key click when pressed individually.

You can turn the Key Click function on or off by pressing the 4 key on the keyboard. Your selection will become effective immediately.

#### Setup Menu F

To enter setup menu F, press the F key if you are in the setup mode. If you are not in the setup mode, press the SET UP key and then the F key. The bottom line of the screen will display setup menu F.

Auto CR -- When the auto CR function is on, a carriage return is generated whenever a line feed is received.

You can toggle the auto CR function on or off by pressing the 1 key on the keyboard.

Auto LF -- When auto LF is on, an automatic line feed is generated whenever a carriage return is received.

You can toggle the auto LF function on or off by pressing the 2 key on the keyboard.

Cursor -- The cursor indicates where the next information or key entry will appear on the screen.



You can select any one of four different cursor formats by pressing the 3 key on the keyboard. The different cursor types are:

- \* block (reverse space)
- \* underline
- \* blinking block
- \* blinking underline

Frequency -- The normal line frequency for the United States is 60 Hz. If you live in an area where the line frequency is 50 Hz, be sure to change the line frequency.

You can change the line frequency by pressing the 4 key on the keyboard. The selected mode will become effective immediately.

### Setup Menu G

To enter setup menu G, press the G key if you are in the setup mode. If you are not in the setup mode, press the SET UP key and then the G key. The bottom line of the screen will display setup menu G.

Char Set -- Your terminal is supplied with two character sets. However, eight different character set options are available. These are USA, Danish, French, German, Italian, Norwegian, Spanish, Swedish, and UK (United Kingdom). Refer to Appendix A for more information.

In most instances, you will use the normal character set, but at times you may want to access some of the special characters available in the alternate set.

You can toggle the active character set by pressing the 1 key on the keyboard.

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

You can fill the entire screen with any character you desire by first pressing the 2 key on the keyboard and then the appropriate character key.

To return to setup menu G, press the RETURN key on the keyboard.

Attributes -- There are sixteen different video attribute combinations available on a full-screen or character-by-character basis through software. Refer to Appendix B for more information.

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

Test -- The terminal has a series of internal self-check tests used to verify proper operation during servicing. These tests check the ROM and RAM, filling the screen with all characters from the character set. A short beep tone will sound when the tests are successful. The tests automatically repeat until a failure is detected or you exit from testing by pressing any key on the keyboard.

To enable the continuous self-test (in setup mode G), press the 4 key on the keyboard.

To exit from the self-check tests, press any key on the keyboard.



## Chapter 4: Detailed Disassembly and Reassembly

### Introduction

The following information is provided to assist you in the removal of the cabinet top, chassis base, terminal logic board, power supply, video circuit board, and cathode-ray tube (CRT) for servicing.

**NOTE:** For additional reference, refer to the exploded view of the terminal found in appendix C. This illustration shows how all parts interconnected.

**WARNING:** Verify that the power cord is unplugged from the AC power source before disassembly of the terminal.

### CABINET TOP REMOVAL

To remove the cabinet top refer to figure 4.1, while performing the following steps.

1. Remove the two 6-32 x 5/8" screws from the top rear corners of the cabinet.
2. Remove the two 4-40 x 1/2" screws from the bottom front corners of the cabinet. For easy access to the screw heads, swivel the CRT either left or right.
3. Carefully lift the cabinet top up and off the video display.

To remount the cabinet, reverse the procedure. Be sure the contrast knob is seated properly and the cabinet top is flush with the mounting groove at the front of the unit before tightening the screws.

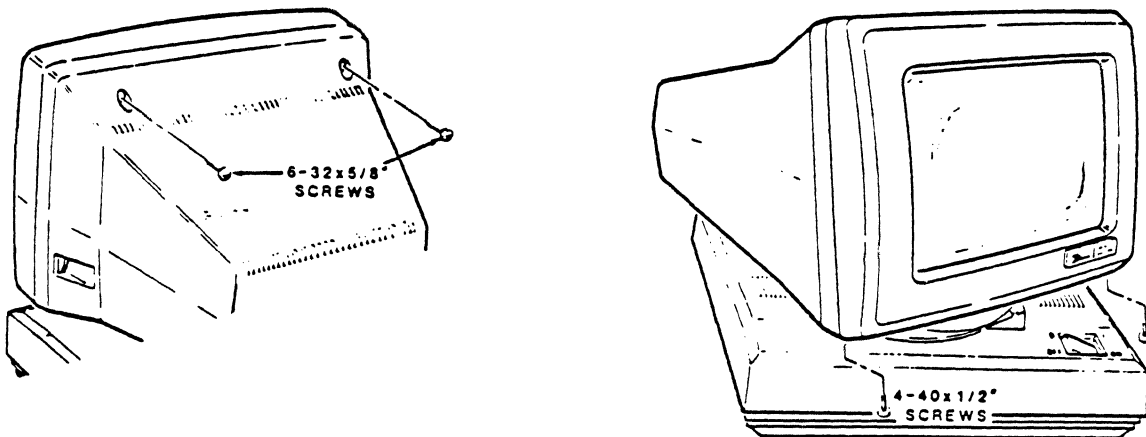


Figure 4.1  
Cabinet Top Removal

## CHASSIS BASE REMOVAL

To remove the chassis base for servicing refer to figure 4-2 while performing the following steps.

**CAUTION:** Verify that all connecting cables are removed from the connectors at the rear of the terminal.

1. Carefully position the video display on its side, to expose the bottom of the base. Remove the four 6-32 x 5/8" screws at points A, B, C, and D; then gently remove the chassis base from the bottom of the cabinet.

**CAUTION:** The power switch protrudes through the cabinet. Exercise care when removing the cabinet from the chassis base so as not to damage the switch.

2. Disconnect the video display cable plug from P404 on the terminal logic board; then set the chassis base down flat on the work surface away from the cabinet.

To install the chassis base, reverse the procedure. Be sure that the power switch is fitted properly before tightening the screws.

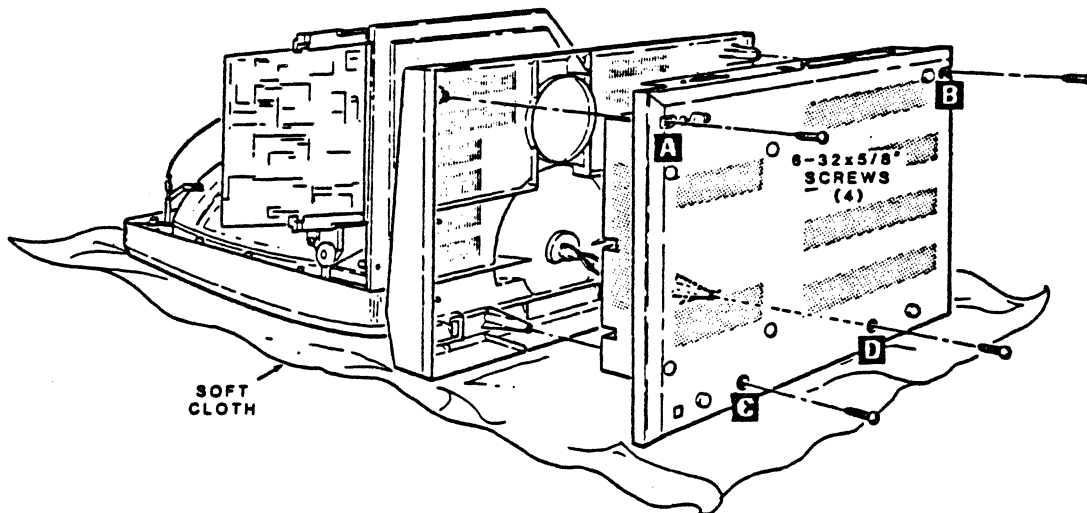


Figure 4-2  
Chassis Base Removal

## TERMINAL LOGIC BOARD REMOVAL

To remove the terminal logic board for servicing, refer to Figure 4.3 while performing the following steps.

**CAUTION:** Verify that all connecting cables are removed from the rear of the chassis base.

1. Remove the chassis base as previously described.
2. Disconnect the power cable plug from P405 on the circuit board.
3. Remove the four 6-32 x 1/4" screws that secure the circuit board to the chassis base.
4. Remove the four connector mounting studs from P401 and P402 at the rear of the chassis base.
5. Carefully remove the circuit board by lifting upward until it clears the connector cutouts in the chassis base.

To install the terminal logic board, reverse the procedure.

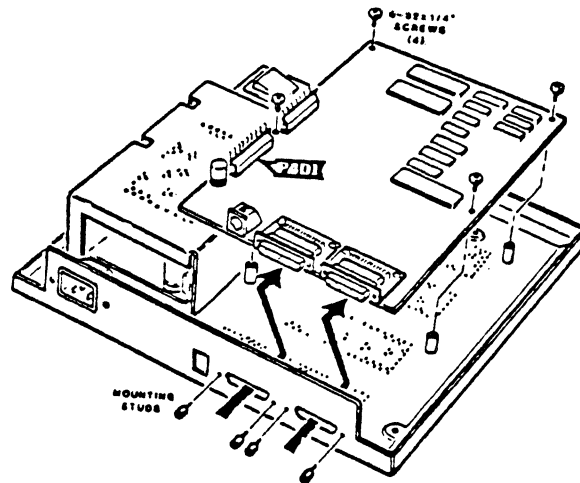


Figure 4-3  
Terminal Board Removal

#### POWER SUPPLY REMOVAL

To remove the power supply for servicing, refer to Figure 4.4 while performing the following steps.

**WARNING:** The power supply generates lethal DC voltages. Verify that the power cord is unplugged from the AC power source.

1. Remove the chassis base as previously described.
2. Remove the 6-32 x 5/8" screw securing the protective shield from the underside of the chassis base.
3. Remove the two 4-32 x 1/2" screws securing the shield to the power supply heat sink bracket.
4. Carefully remove the power supply shield and disconnect plugs P1 and P2 from the power supply circuit board.
5. Disconnect the power cable plug from P405 on the terminal logic board.

6. Remove the four 6-32 x 1/4" screws that secure the power supply to the chassis base.
7. Carefully remove the power supply by lifting upward until it is clear of the chassis base.

To reinstall the power supply, reverse the procedure.

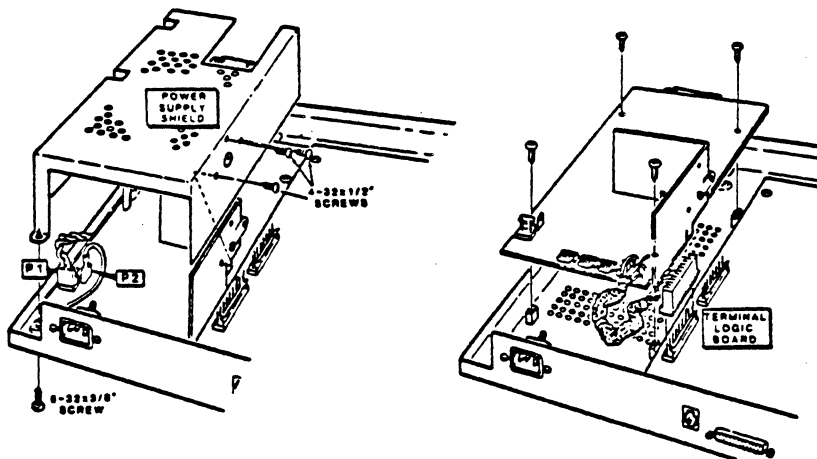


Figure 4-4  
Power Supply Removal

#### VIDEO CIRCUIT BOARD REMOVAL

To remove the video circuit board for servicing, refer to Figure 4.5 while performing the following steps.

**WARNING:** Discharge the high voltage anode lead of the CRT using a jumper lead connected between the chassis and a screwdriver or personnel shock and/or injury may result.

1. Remove the cabinet top as previously described.
2. Refer to the inset drawing #1 on Figure 4.5 and discharge the CRT as shown.
3. Refer to the inset drawing #2 on Figure 4.5 and disconnect the anode lead from the CRT.
4. Carefully unplug the CRT socket board from the neck of the CRT; then disconnect the black ground wire from the CRT ground clip at the upper left-hand corner.
5. Disconnect the power cable plug from the PC board edge connector on the video circuit board.

6. Remove the two 4-32 x 1/4" hex head screws securing the contrast control mounting bracket to the video display cabinet. Position the bracket so the control wires lie over the top of the circuit board.
7. Press in the plastic-locking tabs of the circuit board holder and carefully lift the board upward until it is clear of the holder.
8. Unplug the red/blue two-wire cable from the VERT YOKE and the yellow/black two-wire cable from the HORIZ YOKE on the video circuit board.

**NOTE:** Wires from the CRT socket board to the video circuit board are hardwired as are wires from the contrast control. These components must be removed as an assembly for servicing.

9. Carefully remove the video circuit board, CRT socket board, and contrast control from the video display cabinet.

To reinstall the video circuit board, reverse the procedure. Note: Installation of the black ground wire to the ground clip on the CRT mounting flange is necessary to insure safe operation.

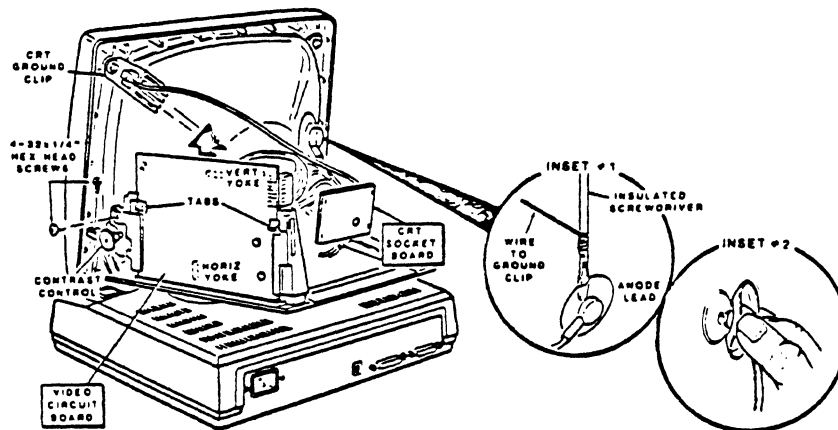


Figure 4-5  
Video Circuit Board Removal

#### CATHODE-RAY TUBE REMOVAL

To remove the CRT for servicing, refer to Figure 4.6 while performing the following steps.

1. Remove the cabinet top as previously described.

**WARNING:** Discharge the high voltage anode lead of the CRT using a jumper lead connected between the chassis and a screwdriver or personnel shock and/or injury may result.

2. Refer to the inset drawing #1 on Figure 4.6 and discharge the CRT as shown.



3. Refer to the inset drawing #2 on Figure 4.6 and disconnect the anode lead from the CRT.
4. Remove the video circuit board as previously described.
5. Carefully place the video display cabinet face down on a smooth flat service.
6. Remove the two 8-32 x 1-1/4" hex head screws and the #8 lock washers securing the bottom of the video display cabinet to the cabinet front at the CRT mounting brackets. Carefully remove the cabinet bottom.
7. Remove the 8-32 x 3/8" hex head screw, the #8 flat washer, and the CRT ground clip from the upper-left CRT mounting bracket.
8. Remove the 8-32 x 3/8" hex head screw and the #8 flat washer from the upper-right CRT mounting bracket.
9. Carefully remove the CRT from the cabinet front; gently set the CRT on a padded work 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.

**WARNING:** To prevent electrical shock after reassembly, perform an AC leakage test on all exposed metal peices in accordance with the safety servicing guidelines explained in Chapter 5.

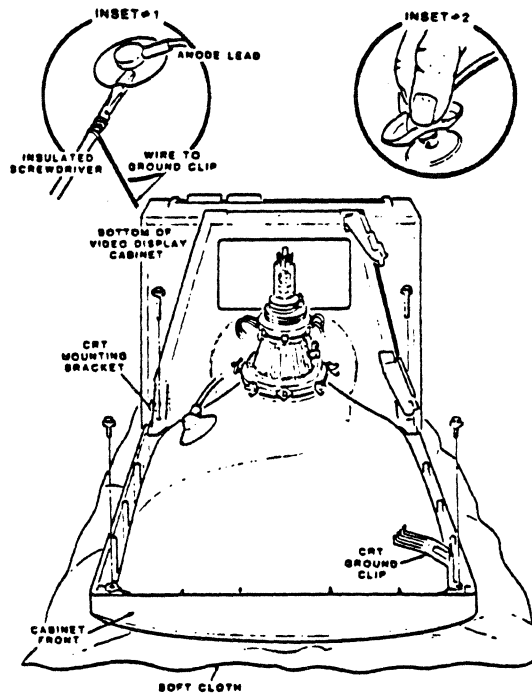


Figure 4-6  
CRT Removal

## Chapter 5: Service Instructions

### Introduction

This chapter provides information to assist in the servicing and troubleshooting of the terminal. Included are safety servicing guidelines, and information on cleaning, adjustments, inspection, testing, and troubleshooting. To aid in troubleshooting, Appendix B (Escape Sequences) is included in this manual.

### Safety Servicing Guidelines

#### WARNINGS:

The terminal contains a switch mode power supply. This power supply develops lethal DC voltages. The power cord must be disconnected before servicing is attempted.

No work should be attempted on any exposed chassis by personnel not familiar with Zenith Data Systems servicing procedures and precautions.

No modification of any circuit should be attempted or injury to the user may result.

Always connect the terminal to an isolation transformer or shock and/or injury may result.

Discharge the high voltage anode lead of the CRT using a jumper lead connected between the chassis and a screwdriver. Failure to comply could result in severe shock and/or personnel injury.

Excessive high voltage produces X-rays from the cathode-ray tube; always check that the voltage is normal when servicing the terminal. Be sure that a terminal with excessive high voltage is not operated longer than necessary.

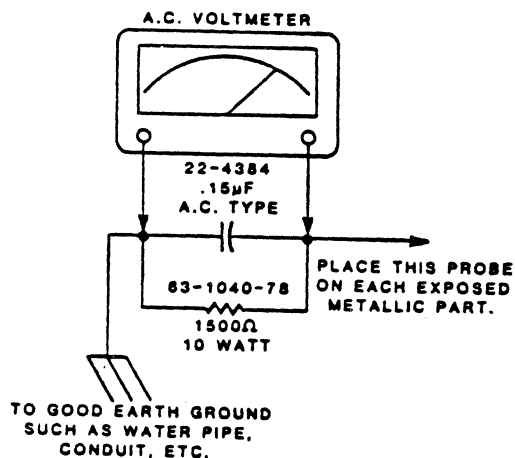
Carefully handle and install the picture tube or injury from implosion may result.

To prevent electrical shock after reassembly, perform an AC leakage test on all exposed metal parts of the cabinet and screws. Do not use an isolation transformer during this test.

Refer to Figure 5.1 while reading the following:

- \* Use an AC voltmeter having at least 5000 ohms per volt sensitivity.
- \* Connect a 1500 ohm 10 watt resistor in parallel with a 0.15 uF capacitor rated at 150 volts AC.

- \* Connect the parallel network to a known good earth ground and the exposed metal parts, one at a time.
- \* Measure the AC voltage across the parallel combination, then reverse the AC plug and repeat the measurements.
- \* Any voltage reading exceeding 0.75 volts rms (0.5 milliamps) constitutes a potential shock hazard and must be corrected immediately.



## AC Leakage Test

### CAUTIONS:

Integrated circuits are electrostatic-sensitive devices. These devices can be damaged by static electricity. When removing an IC from its protective foam packing, do not lay the IC down or let go of it until after the IC is installed. When bending the leads, use a wrist grounding strap or be sure to equalize the static charge before touching the IC.

Verify that all components are positioned in such a manner as to avoid the possibility of component shorts.

Inspect for cold solder joints, frayed leads, damaged insulation, solder splashes, and sharp solder points.

Never release a repair unless all protective devices and other hardware have been installed.

Remove all loose foreign material.

Follow the original lead layout, lead dress, lead length, and lead tension.

Replace all components with exact Zenith Data Systems replacement types or equipment damage and/or faulty operation may result.

### Cleaning Procedures

Use the following suggestions to keep the terminal equipment clean.

**WARNING:** Verify that the power cord is disconnected from the AC power source before attempting to clean the terminal.

- \* Clean the terminal CRT screen with a quality glass cleaner.
- \* Clean the cabinet and keyboard with a clean lint-free cloth mildly dampened with a non-detergent cleaning solution.
- \* Do not use spray liquids or a soaking wet cloth.
- \* Dry the cabinet, keyboard, and CRT screen with a clean lint-free cloth.
- \* Verify that the terminal is thoroughly dry before applying power.

### Adjustments

Before proceeding with troubleshooting, check the adjustments affecting terminal performance. Often a minor adjustment is all that is needed to restore circuits to normal operation. In the event the adjustments do not produce satisfactory results, proceed to the troubleshooting procedures in this chapter.

### Video Circuit Board Adjustments

Refer to Figure 5.2 and perform the following steps:

**NOTE:** This adjustment procedure assumes that the terminal is operating properly.

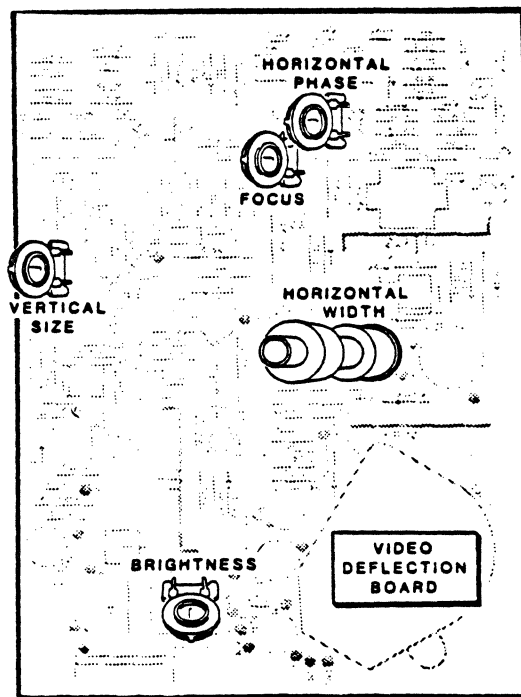
1. Verify that the keyboard is connected to the terminal and that the power cord is plugged into a proper AC outlet.
2. Remove the cabinet top from the terminal.
3. Rotate the BRITE adjust on the video circuit board to the center of its rotation.
4. Press the power switch on the front of the terminal to ON.

**WARNING:** When the terminal is turned on, high voltage is present on the rear of the CRT and on the video circuit boards.

5. Press the SET UP key on the keyboard. The bottom line of the screen will display setup menu A.
6. Press the G key on the keyboard. The bottom line of the screen will display setup menu G.
7. Press the 2 key on the keyboard. The screen will be filled with "E's".

**CAUTION:** Do not make the display too bright, as the screen phosphors may be damaged by too much brightness and "burn" the screen.

8. Adjust the BRITE adjust on the video circuit board until the display is at a comfortable brightness level.
9. Adjust the CONT control on the video circuit board for optimum contrast of the video display.
10. Adjust the FOCUS control on the video circuit board until the display characters are as sharp as possible.
11. Adjust the WIDTH coil on the video circuit board until the sum of the left and right borders is about one inch.



video Circuit Board Adjustments

12. Adjust the LINEarity coil on the video circuit board for a linear display across the screen.
13. Adjust the VERT SIZE control on the video circuit board until the sum of the top and bottom borders is about one inch.

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

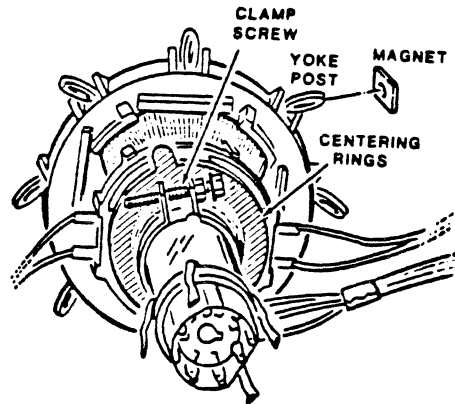
#### CRT Yoke Adjustments

Refer to Figure 5.3 and perform the following steps:

1. Remove any foam magnets that may be present on the CRT yoke.
2. Loosen the yoke clamp screw and rotate the deflection yoke until the display edges are vertical and horizontal; then tighten the clamp screw.
3. Adjust the centering rings on the deflection yoke to the position that best centers the display on the screen.
4. Select the least straight of the four edges of the display and install a foam magnet on the yoke post that is nearest to the greatest bow. Rotate the magnet slowly until the display is as straight as possible.
5. Repeat step 4 as necessary around the perimeter of the yoke at any of the eight post locations where the CRT display requires straightening.

**NOTE:** If only a small effect is desired, reduce the size of the foam magnets by cutting off a corner with diagonal cutters.

6. After making all adjustments, note that the display is of a uniform rectangular shape.



## CRT Yoke Adjustments

### Inspection

The following inspection will assist you in determining possible failures.

- \* Unplug the power cord and check for burnt insulation, broken wires, or loose plug prongs.
- \* Check the AC receptacle (wall outlet) for the proper terminal operating voltage.
- \* Check all connectors and internal circuit board plugs for proper electrical connections.
- \* Check all circuit boards for broken, burnt, or arced over components.
- \* Check all circuit boards for darkened areas as evidence of component overheating.

**WARNING:** If the switch mode power supply fails, the fuse F1 on the power supply circuit board may be blown. Do not attempt to service this power supply as it produces lethal DC voltages.

### Testing and Troubleshooting

Table 5.1 contains general troubleshooting information designed to help localize a fault to a particular section or part of the terminal. The remaining information in the chapter covers troubleshooting down to component and circuit board levels.

## General Troubleshooting

PROBLEM	POSSIBLE CAUSE
Nothing happens at turn-on.	<ol style="list-style-type: none"><li>1. Power cord is not plugged in.</li><li>2. Power not on at AC receptacle</li><li>3. Power switch is not on.</li><li>4. Keyboard is not connected.</li><li>5. Mode switching power supply.</li><li>6. Contrast control turned down.</li></ol>
POWER-ON indicator is not lit, but cursor is evident on the screen. Screen reads "ERROR-KEYBOARD."	<ol style="list-style-type: none"><li>1. Keyboard cable is not plugged into the terminal.</li></ol>
No video (blank screen). POWER-ON indicator lit.	<ol style="list-style-type: none"><li>1. Contrast control turned down or screen saver option enabled.</li><li>2. Terminal logic board.</li><li>3. Video circuit board.</li></ol>
Insufficient contrast.	<ol style="list-style-type: none"><li>1. Contrast control turned down.</li><li>2. Video circuit board.</li></ol>
Terminal resets to power-on point.	<ol style="list-style-type: none"><li>1. Loose power cord or keyboard cable.</li></ol>
Video display does not respond to keyboard.	<ol style="list-style-type: none"><li>1. On line (under host computer control).</li><li>2. Keyboard locked.</li><li>3. Keyboard cable not connected to terminal.</li></ol>
Strange or wrong characters appear on CRT screen.	<ol style="list-style-type: none"><li>1. Wrong terminal mode.</li><li>2. Wrong communications mode (baud rate, parity, duplex) or protocol.</li><li>3. Wrong character font.</li></ol>
<b>NOTE:</b> In order to communicate directly with a host computer or via a modem, the baud rate, parity, and duplex characteristics must agree. Zenith Data Systems software utilizes full-duplex and does not check parity.	
Screen display wavers.	<ol style="list-style-type: none"><li>1. Wrong line frequency selected during setup mode.</li></ol>
Unable to alter setup modes.	<ol style="list-style-type: none"><li>1. Optional "hardware" setup feature has been installed.</li></ol>
Error message received during diagnostic test.	<ol style="list-style-type: none"><li>1. Terminal logic board.</li></ol>
Double-spaced lines.	<ol style="list-style-type: none"><li>1. AUTO LF on CR or AUTO CR on LF configured incorrectly.</li></ol>



-----  
No response to escape (ESC) sequences.

1. Terminal mode is incorrect.

-----  
RS-232C incompatibility.

1. Determine what signals are noncompatible and correct problem.  
-----

### Power Supply Troubleshooting

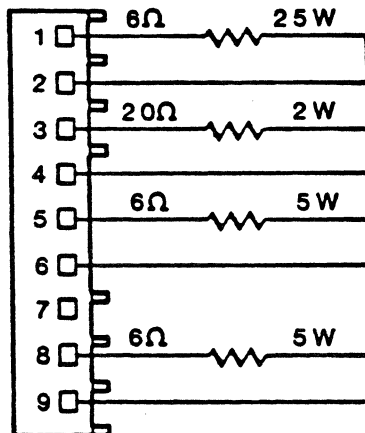
**WARNING:** The switch mode power supply produces lethal DC voltages. Be sure to unplug the power cord before proceeding.

**NOTE:** The switch mode power supply is not servicable. If any voltages are found to be out of tolerance, the power supply will have to be replaced.

Refer to Figure 5.4 when making power supply tests.

**WARNING:** Do not come in contact with the load resistors after power is applied. The resistors will become hot and could cause severe burns.

1. Connect a 120 ohm dummy load resistor rated at 2 watts between pins 3 and 4 of the power supply connector.
2. Connect a 6 ohm dummy load resistor rated at 5 watts or more between pins 5 and 6 of the power supply connector.
3. Connect a 6 ohm dummy load resistor rated at 25 watts between pins 1 and 2 of the power supply connector.
4. Connect a 6 ohm dummy load resistor rated at 5 watts or more between pins 8 and 9 of the power supply connector.
5. Apply power and check the voltages at their respective pins.



### Power Supply Testing

## Terminal Logic Board Troubleshooting

**NOTE:** Error messages appearing on the screen indicate a probable faulty terminal logic board.

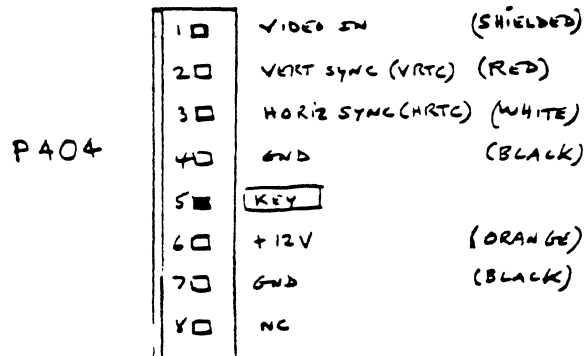
Refer to Table 5.2 for terminal logic board troubleshooting.

## Terminal Logic Board Troubleshooting

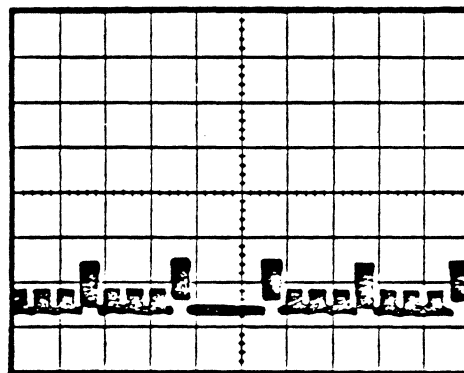
ERROR MESSAGE	POSSIBLE CAUSE
ROM Checksum	U407, U429, U440, U431
RAM Fault	U418, U424, U444, U445
CRTC Error	U420, U422, U446, U447
Keyboard	U409, U411, U412, U414
NVRAM Checksum	U413, U414, U418

## Terminal Logic Board Waveforms

The following waveforms were taken with the terminal off line and the screen filled with E's. Refer to Figure 5.5 for the video interconnect pinout. Refer to Figures 5.6 through 5.8 for waveforms.

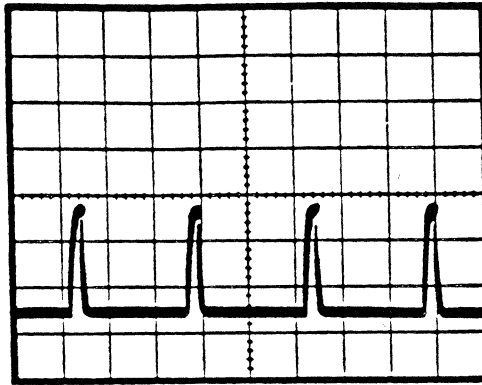


## Video Interconnect Pinout



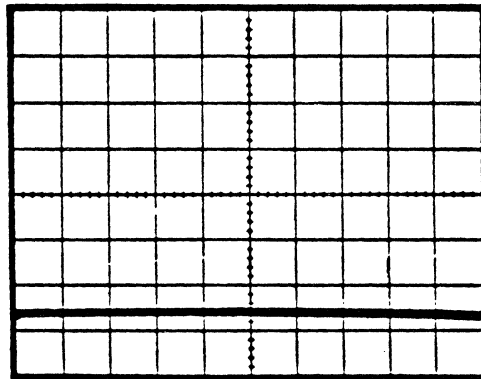
Video Signal Waveform

VIDEO  
 VERTICAL SCALE 2 VOLTS/DIV  
 HORIZONTAL SCALE 100μ SEC/DIV



HORIZONTAL RETRACE  
 VERTICAL SCALE 2 VOLTS /DIV  
 HORIZONTAL SCALE 20μ SEC/DIV

Horizontal Sync Waveform



VERTICAL RETRACE  
 VERTICAL SCALE 2 VOLTS/DIV  
 HORIZONTAL 5m SEC/DIV

Vertical Sync Waveform

## Video Circuit Board Troubleshooting

Refer to Tables 5.3, 5.4, and 5.5, and Figures 5.9 through 5.11 for video circuit board troubleshooting.

## Video Circuit Board Troubleshooting

PROBLEM	POSSIBLE CAUSE
No raster	1. Power supply, VX201, TX102. 2. Check high voltage at anode of CRT. 3. Check emitter to base bias at Q102, Q103, CR104, TX202A, TX202B, R128, Q301, Q302.
Raster, no video	1. Terminal logic board. 2. Q401, Q402, VX201, CR401, CR111. 3. CRT socket.
No vertical deflection	1. R139, Q301, Q302, Q306, Q307.
Vertical off frequency	1. Terminal logic board. 2. Q301, Q302, Q303.
No vertical sync	1. Terminal logic board. 2. C302, CRX301, C301, R301.
Horizontal off frequency	1. Terminal logic board. 2. Q106, Q107, Q108, Q102.
Poor horizontal linearity or foldover	1. TX102, LX101, LX102, CR104. 2. TX202B, Q106, Q107. 3. Q108, Q103, Q102.
Narrow raster	1. Q106, Q107, Q108. 2. Q103, CR104, LX111, CR111.
Characters on screen out of focus	1. CR106, CR107, C129, 2. Potentiometer R148.
Retrace lines visible on screen	1. Vertical retrace Q308.

## Video Circuit Board Waveforms

The following waveforms were taken with the oscilloscope triggered at the beginning of the vertical sync pulse for vertical measurements, and the beginning of the horizontal sync pulse for horizontal measurements.

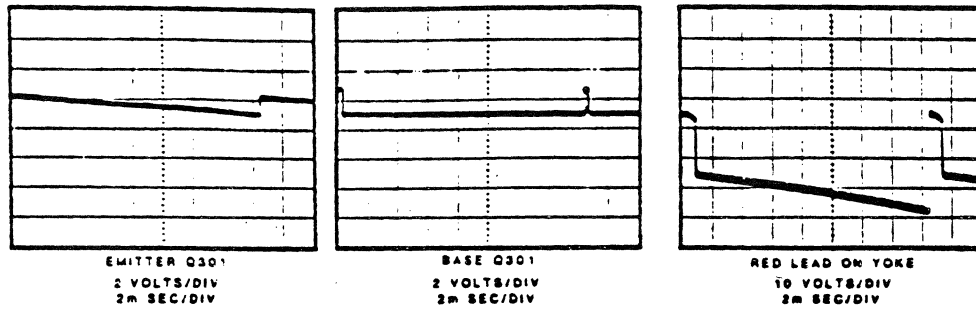


Figure 5.9

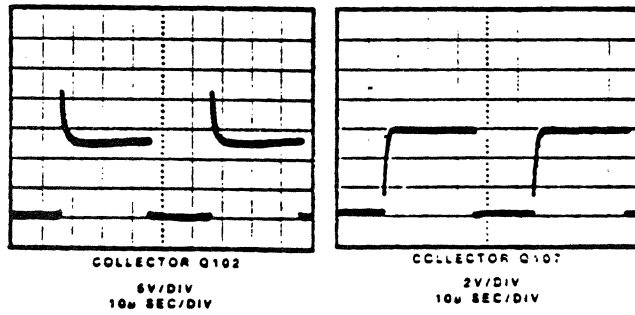


Figure 5.10

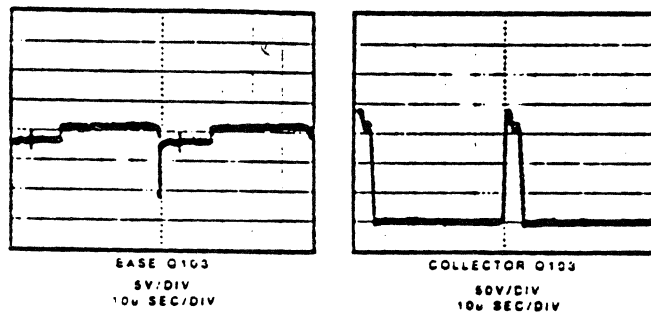


Figure 5.11

### Transistor Voltage Measurements

Refer to Table 5.4 for transistor voltage measurements.

### Transistor Voltage Measurements

TRANSISTOR	EMITTER	BASE	COLLECTOR
Q101	0	0.7V	3.0V
Q102	0	0.8V	9.0V
Q103	0	0.7V	15.0V
Q106	0	0.7V	3.0V
Q107	0	0.7V	3.0V
Q301	7.26V	7.0V	8.35V
Q302	8.78V	8.62V	6.99V
Q303	7.72V	7.3V	0.32V
Q304	0	0.31V	9.0V
Q306	9.44V	9.0V	0
Q307	10.24V	10.64V	0
Q308	6.0V	6.84V	17.15V
Q401	0.03V	0	6.5V
Q402	6.5V	7.2V	50.0V

NOTE: Reference for measurements =  
video circuit board ground.

### CRT Voltage Measurements

Refer to Table 5.5 for CRT voltage measurements.

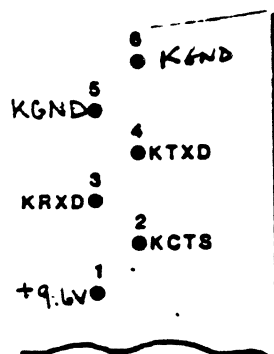
### CRT Voltage Measurements

CRT PIN	VOLTAGE
1	-50V to +12V
2	50V
3	12V
4	0
5	-50V to +12V
6	+500V
7	-50V to +400V

NOTE: Measure 12.5 kV at  
CRT anode, using high voltage  
probe.

## Keyboard Troubleshooting

If you suspect a problem with the keyboard assembly, substitute a known good keyboard. If the problem persists, refer to Figure 5.13 and check the +12 volts DC from the terminal logic board.



## Terminal Logic Board to Keyboard Pinout

## Chapter 6: Replacement Parts

### Introduction

This chapter provides an exploded view of the video display unit and keyboard. Component views of the video deflection board, terminal logic board, and keyboard are included for parts identification and replacement.

### Chassis, Cabinet, and Subassemblies

Refer to Figure 6.1 for the following parts list description.

<u>ITEM NUMBER</u>	<u>ZDS PART NO.</u>	<u>DESCRIPTION</u>
5	011-00357	Line cord
10	014-11604	Cabinet, rear
15	112-02289-02	Screw, 8-32 x 0.375
20	112-02247	Screw, 8-18 x 0.625
25	012-08572-01	PC board guide
30	114-00984	Screw, 6-20 x 0.375
35	012-08572	PC board guide
40	012-08624	Bracket, contrast
45	114-01108	Screw, 6-20 x 0.375
50	046-10296-02	Knob, contrast
55	A-12669	Video board assembly
60	014-11601	Bottom, plastic
65	114-01011-01	Screw, 8-18 x 1.000
70	100-00729-03E	Vacuum tube
75	A-08337	Yoke
80	A-13287	Clamp assembly
85	149-00464	Magnet
90	114-01431-01	Screw 8-18 x 0.750
95	080-02377	Ground spring
100	014-11600	Cabinet front, plastic
105	054-01046	Nut
110	093-02140	Washer
115	080-02449	Spring
120	149-00535	Ferrite core
125	194-01328	Insulating strip
130	004-01423-02	Base pan assembly
135	112-00320	Screw 6-20 x 0.375
140	093-02132	Non-metallic washer
145	157-00074	#6 screw anchor
150	112-02305	Screw



155	054-00355	Nut 6-32 x 0.250
160	085-01624	Switch, slide
165	112-01689	Screw 4-40 x 0.375
170	054-00354	Nut with washer 4-40x 0.250

<u>ITEM NUMBER</u>	<u>ZDS PART NO.</u>	<u>DESCRIPTION</u>
180	064-00001-02	Rivet
185	136-00114-23	Fuse
190	HE-234-554	Power supply
195	114-01108	Screw
200	157-00074-01	Anchor
205	012-08630	Switch bracket
210	085-01639-02	Switch
215	HE-181-5193	Terminal logic board
220	A-12383	Hardware kit
225	093-02079	Split lockwasher
230	096-00894	Base cover
235	012-08631	Plastic guide
240	194-01211	Threaded tubing
245	166-00269-02	Bumper, rubber
250	012-08694	Cover support bracket
255	112-02247	Screw 8-18 x 0.625
260	012-08623	Plastic feedthrough

## Video Deflection Board

Refer to Figure 6.2, for the component view of the video deflection board.

<u>CIRCUIT REFERENCE DESIGNATOR</u>	<u>ZDS PART NO.</u>	<u>DESCRIPTION</u>
<b>Capacitors</b>		
C101	22-7742-04	330 pF
C102	22-7743-30	56 pF
C103	Not used	
C104	Not used	
C105	22-7773	.001 uF
C106	22-7742-07	560 pF
C107	22-7615-08	.022 uF
C108	22-7859-07	33 uF
C109	22-7773	.001 uF
C110	Not used	
C111	Not used	
C112	Not used	
C113	Not used	
C114	22-7615-08	.022 uF
C115	Not used	
C116	Not used	
C117	Not used	
C118	22-7615-08	.022 uF
C119	22-7811	1000 pF
C120	Not used	
C121	22-7811	1000 pF
C122	22-7862-06	22 uF
C123	22-7860-10	220 uF
C124	Not used	
C125	Not used	
C126	22-7774-12	.01 uF
C127	22-7774-12	.01 uF
C128	22-7811	1000 pF
C129	22-7811	1000 pF
C301	22-7613-24	.01 uF
C302	22-7613-18	3300 pF
C303	22-7773-24	.1 uF
C304	22-7859-07	33 uF
C305	Not used	

<u>CIRCUIT REFERENCE DESIGNATOR</u>	<u>ZDS PART NO.</u>	<u>DESCRIPTION</u>
C306	22-7615-06	.01 uF
C307	22-7860-05	10 uF
C308	22-7862-01	1 uF
C309	22-7862-01	1 uF
C310	Not used	
C311	Not used	
C312	22-7860-08	47 uF
C313	22-7860-05	10 uF
C314	22-7615-08	.022 uF
C315	Not used	
C316	22-7859-12	470 uF
C317	22-7860-10	220 uF
C401	22-7862-06	22 uF
C402	22-7860-05	10 uF
C403	22-7749-34	82 pF
C404	Not used	
C405	Not used	
C406	Not used	
C407	Not used	
C408	22-3748	1000 pF
CX116	22-7798-03	.018 uF
CX117	22-7893A	10 uF

**Diodes**

CR101	103-142-01
CR102	Not used
CR103	103-142-01
CR104	103-339-04
CR105	Not used
CR106	103-323-04
CR107	103-295-03
CR108	63-10184-18
CR109	Not used
CR110	Not used
CR111	103-323-04
CR112	103-254-01
CR113	103-142-01
CR114	103-142-01

<u>CIRCUIT REFERENCE DESIGNATOR</u>	<u>ZDS PART NO.</u>	<u>DESCRIPTION</u>
CR301	Not used	
CR302	103-142-01	
CR303	103-142-01	
CR304	Not used	
CR305	Not used	
CR306	Not used	
CR307	Not used	
CR308	Not used	
CR309	Not used	
CR310	Not used	
CR311	Not used	
CR312	Not used	
CR313	Not used	
CR314	Not used	
CR315	Not used	
CR316	Not used	
CR317	Not used	
CR318	Not used	
CR319	Not used	
CR320	Not used	
CR321	Not used	
CR322	103-254-01	
CRX301	103-279-28A	19V Zener
CR401	103-254-01	
<b>Inductors</b>		
L401	20-03907 10A	Coil
LX101	20-3943-04	Coil, width
LX102	20-3906-02	Coil, linearity
<b>Transistors</b>		
Q101	121-975	
Q102	121-1040	
Q103	121-1070	
Q104	Not used	
Q105	Not used	
Q106	121-975	
Q107	121-975	
Q108	121-1093	

<u>CIRCUIT REFERENCE DESIGNATOR</u>	<u>ZDS PART NO.</u>	<u>DESCRIPTION</u>
Q301	121-975	
Q302	121-699	
Q303	121-699	
Q304	121-1040	
Q305	Not used	
Q306	121-1036	
Q307	121-1035	
Q308	121-1040	
Q401	121-1058	
Q402	121-1117	
<b>Resistors</b>		
R101	63-1036	15 kohm
R102	63-1035-66	560 ohm
R103	Not used	
R104	Not used	
R105	63-10235-96	10 kohm
R106	Not used	
R107	63-10235-72	1 kohm
R108	63-10184-18	82 kohm
R109	Not used	
R110	Not used	
R111	63-10235-80	2.2 kohm
R112	63-10235-72	1 kohm
R113	Not used	
R114	63-10938-52	30 kohm
R115	Not used	
R116	63-10938-76	47 kohm
R117	Not used	
R118	63-10183-40	47 ohm
R119	63-10235-72	1 kohm
R120	63-10235-74	1.2 kohm
R121	63-10236-02	18 kohm
R122	63-10235-77	1.6 kohm
R123	63-10183-54	180 ohm
R124	Not used	
R125	63-10235-96	10 kohm
R126	Not used	
R127	Not used	
R128	63-10235-46	82 ohm
R129	Not used	
R130	Not used	

<u>CIRCUIT REFERENCE DESIGNATOR</u>	<u>ZDS PART NO.</u>	<u>DESCRIPTION</u>
R131	63-10235-68	680 ohm
R132	63-10236-04	22 kohm
R133	Not used	
R134	Not used	
R135	Not used	
R136	Not used	
R137	63-10184-18	82 kohm
R138	Jumper	
R139	63-09228-13	100kohmbrightness control
R140	Not used	
R141	Not used	
R142	63-7799	2.2 kohm
R143	Not used	
R144	63-10184-18	82 kohm
R145	Not used	
R146	63-7799	2.2 kohm
R147	Jumper	
R148	63-9228-15	2 megohm focus control
R149	63-10184-30	270 kohm
R150	Not used	
R151	63-7855	47 kohm
R201	63-7736	68 ohm
R202	Not used	
R301	63-10235-96	10 kohm
R302	63-10236-04	22 kohm
R303	63-10236-27	200 kohm
R304	63-10183-40	47 ohm
R305	Not used	
R306	63-10236-10	39 kohm
R307	63-10235-91	6.2 kohm
R308	63-10236-06	27 kohm
R309	63-10236-52	2.2 megohm
R310	Not used	
R311	63-10236-48	1.5 megohm
R312	63-09228-14	250 kohm vertical size
R313	Not used	
R314	63-10236-04	22 kohm
R315	Not used	

CIRCUIT  
REFERENCE  
DESIGNATOR

ZDS  
PART NO.

DESCRIPTION

R316	63-10236-06	27 kohm
R317	63-10235-80	2.2 kohm
R318	Not used	
R319	63-10236-12	47 kohm
R320	Not used	
R321	Not used	
R322	63-07827	10 kohm
R323	Not used	
R324	63-10243-56	220 ohm
R325	Not used	
R326	63-10235-45	75 ohm
R327	63-10235-84	3.3 kohm
R328	63-10235-62	390 ohm
R329	63-10235-68	680 ohm
R330	Not used	
R331	63-10235-10	2.7 ohm
R401	Not used	
R402	63-10836-70	820 ohm
R403	63-10235-72	1 kohm
R404	63-10235-72	1 kohm
R405	Not used	
R406	63-10183-40	47 ohm
R407	63-7763	330 ohm
R408	Not used	
R409	63-10183-40	47 ohm
R410	Not used	
R411	63-10770-15	500 ohm contrast control
R412	63-10183-40	47 ohm
R413	63-10183-32	22 ohm
R414	63-1036	15 kohm
R415	Not used	
R416	Not used	
R417	Not used	
R418	Not used	
R419	Not used	
R420	Not used	
R421	Not used	
R422	Not used	
R423	Not used	
R424	Not used	
R425	Not used	

**CIRCUIT  
REFERENCE  
DESIGNATOR**

**ZDS  
PART NO.**

**DESCRIPTION**

R426	Not used	
R427	63-10183-40	47 ohm
RX124	63-10559-12	3.3 ohm
RX129	63-10559-48	100 ohm
RX130	63-10559-32	22 ohm
RX134	Jumper	
RX323	63-10559-12	3.3 ohm
RX333	63-10559-12	3.3 ohm

**Transformers**

TX101	95-3136-03	Horizontal driver
TX102	95-3575	H.V. sweep
TX202	95-3397-02	Deflection yoke

**Vacuum Tube**

VX201	100-729-33E 078-03233	CRT Socket
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# Terminal Logic Board

Refer to Figure 7.3

<u>CIRCUIT REFERENCE DESIGNATOR</u>	<u>ZDS PART NO.</u>	<u>DESCRIPTION</u>
<b>Capacitors</b>		
C401	HE-21-56	470 pF
C402	HE-21-56	470 pF
C403	HE-21-56	470 pF
C404	HE-21-56	470 pF
C405	HE-21-56	470 pF
C406	HE-21-56	470 pF
C407	HE-21-56	470 pF
C408	HE-21-56	470 pF
C409	HE-21-769	.01 uF
C410	HE-21-715	150 pF
C411	HE-21-769	.01 uF
C412	HE-21-147	47 pF
C413	HE-21-769	.01 uF
C414	HE-21-769	.01 uF
C423	HE-25-915	47 uF
C424	HE-25-915	47 uF
C425	HE-21-769	.01 uF
C426	HE-21-769	.01 uF
C427	HE-21-769	.01 uF
C428	HE-21-769	.01 uF
C429	HE-21-769	.01 uF
C430	HE-21-769	.01 uF
C431	HE-21-769	.01 uF
C432	HE-21-769	.01 uF
C433	HE-21-769	.01 uF
C434	HE-21-769	.01 uF
C435	HE-21-769	.01 uF
C436	HE-21-769	.01 uF
C437	HE-21-769	.01 uF
C438	HE-21-769	.01 uF
C439	HE-21-769	.01 uF
C440	HE-21-769	.01 uF
C441	HE-21-769	.01 uF
C442	HE-21-56	470 pF
C443	HE-21-56	470 pF
C444	HE-21-56	470 pF
C445	HE-21-56	470 pF

<u>CIRCUIT REFERENCE DESIGNATOR</u>	<u>ZDS PART NO.</u>	<u>DESCRIPTION</u>
C446	HE-21-769	.01 uF
C447	HE-21-769	.01 uF
C448	HE-21-769	.01 uF
C449	HE-21-769	.01 uF
C450	HE-21-769	.01 uF
C451	HE-21-769	.01 uF
C452	HE-21-769	.01 uF
C453	HE-21-769	.01 uF
C454	HE-21-769	.01 uF
C455	HE-21-769	.01 uF
C456	HE-21-56	470 pF
C457	Not used	
C701	HE-25-918	100 uF
C702	HE-25-918	100 uF
C703	HE-25-942	220 uF
C704	HE-25-915	47 uF

#### Crystal

Y401	HE-404-635	14.784 MHz
------	------------	------------

#### Diode

D401	HE-56-56	
------	----------	--

#### Inductors

L401	HE-235-229	35 uH
L402	HE-235-229	35 uH
L403	HE-235-229	35 uH
L404	HE-235-229	35 uH
L405	HE-235-229	35 uH
L406	HE-235-229	35 uH
L407	HE-235-229	35 uH
L408	HE-235-229	35 uH
L409	HE-235-229	35 uH
L410	HE-235-229	35 uH
L411	HE-235-229	35 uH
L412	HE-235-229	35 uH
L413	HE-235-229	35 uH
L414	HE-475-11	1 uH
L415	HE-235-229	35 uH

<u>CIRCUIT REFERENCE DESIGNATOR</u>	<u>ZDS PART NO.</u>	<u>DESCRIPTION</u>
L416	HE-235-229	35 uH
L417	HE-235-229	35 uH
L418	HE-235-229	35 uH
L419	HE-235-229	35 uH
<b>Integrated Circuits</b>		
U401	HE-443-875	74LS32
U402	HE-443-89	7409
U403	HE-443-1130	74ALS163
U404	HE-443-797	74LS10
U405	HE-443-780	74LS08
U406	HE-443-728	74LS00
U407	HE-443-755	74LS04
U408	HE-443-780	74LS08
U409	HE-443-780	74LS08
U411	HE-443-755	74LS04
U412	HE-443-983	74S175
U413	HE-443-983	74S175
U414	HE-443-915	74S86
U415	HE-443-892	74LS166
U416	HE-444-248	Character ROM
U417	HE-443-875	74LS32
U418	HE-443-875	74LS32
U419	HE-443-1068	8276
U421	HE-443-780	74LS08
U422	HE-443-780	74LS08
U423	HE-443-877	74LS138
U424	HE-443-730	74LS74
U425	HE-443-755	74LS04
U426	HE-443-875	74LS32
U427	HE-443-804	74LS259
U428	HE-443-885	74LS245
U429	HE-443-795	75189 (MC1489)
U431	HE-443-799	74LS157
U432	HE-443-875	74LS32
U433	HE-443-1025	8031
U434	HE-444-297	Terminal ROM 2
U435	HE-444-296	Terminal ROM 1
U436	HE-443-1027	6116-P4
U437	HE-443-764	2114
U438	HE-443-764	2114
U439	HE-443-1041	2210-30

<u>CIRCUIT REFERENCE DESIGNATOR</u>	<u>ZDS PART NO.</u>	<u>DESCRIPTION</u>
U441	HE-443-805	74LS273
U442	HE-443-794	75188 (MC1488)
U443	HE-443-875	74LS32
U444	HE-443-755	74LS04
U445	HE-443-857	74LS367
U446	HE-443-857	74LS367
U447	HE-443-857	74LS367
U448	HE-443-879	74LS174

### Resistors

R401	HE-6-103-12	10 k ohm
R402	HE-6-200-1	20 ohm, 1-watt
R403	HE-6-331-12	330 ohm
R404	HE-6-271-12	270 ohm
R405	HE-6-331-12	330 ohm
R406	HE-6-102-12	1 k ohm
R407	HE-6-102-12	1 k ohm
R408	HE-6-472-12	4.7 k ohm
R409	HE-6-102-12	1 k ohm
R411	HE-6-561-12	560 ohm
R412	HE-6-561-12	560 ohm
R413	HE-6-102-12	1 k ohm
R414	HE-6-102-12	1 k ohm
R415	HE-6-472-12	
R416	HE-6-472-12	4.7 k ohm
R417	HE-6-102-12	1 k ohm
R418	HE-6-102-12	1 k ohm
R419	HE-6-102-12	1 k ohm
R421	HE-6-102-12	1 k ohm
R422	HE-6-103-12	10 k ohm
R423	HE-6-472-12	4.7 k ohm
R424	HE-6-102-12	1 k ohm
R425	HE-6-103-12	10 k ohm
R426	HE-6-102-12	1 k ohm
R427	HE-6-102-12	1 k ohm
R428	HE-6-102-12	1 k ohm



APPENDIX A

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The following pages show the various foreign keyboard layouts available for the Z-39 Terminal. Where differences from the American standard exist, the equivalent ASCII character codes in both the foreign and American character sets are supplied.

UNITED KINGDOM (UK) LANGUAGE KEYBOARD

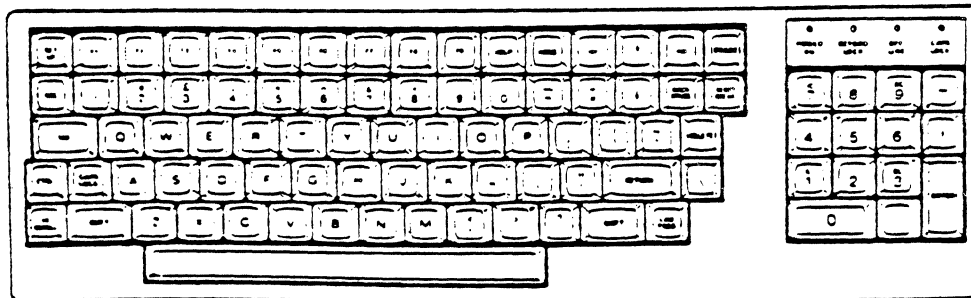


Figure B-1 United Kingdom (UK) Keyboard

ASCII Code				
DECIMAL CODE	OCTAL CODE	HEX CODE	ENGLISH CHARACTER	AMERICAN CHARACTER
35	043	23	£	#

All other ASCII Codes common to American.

NOTE: Outlined keys denote differences from USA Keyboard

FOREIGN KEYBOARDS

---

DANISH/NORWEGIAN LANGUAGE KEYBOARD

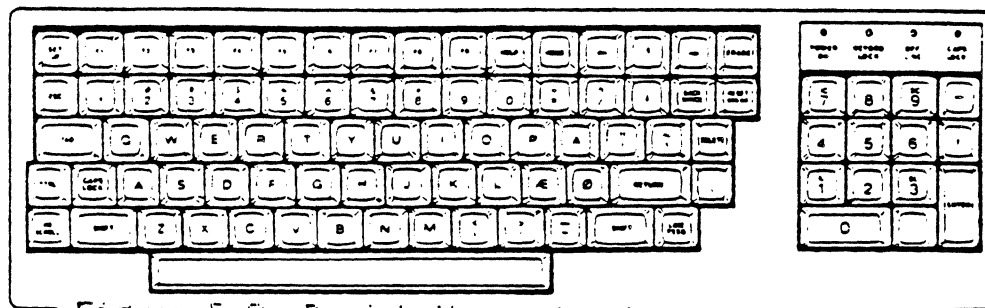


Figure B-2. Danish/Norwegian Language Keyboard

ASCII CODE

DECIMAL CODE	OCTAL CODE	HEX CODE	DANISH/NORWEGIAN CHARACTER	AMERICAN CHARACTER
91	133	5B	Æ	[
92	134	5C	Ø	\
93	135	5D	Å	]
123	173	7B	æ	{
124	174	7C	ø	}
125	175	7D	å	}

All other ASCII Codes common to American.

NOTE: Outlined keys denote differences from USA Keyboard

FOREIGN KEYBOARDS

---

FRENCH LANGUAGE KEYBOARD

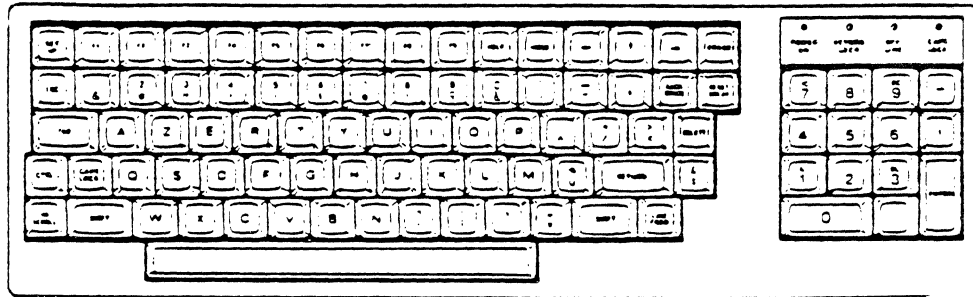


Figure B-3. French Language Keyboard

ASCII CODE

---

DECIMAL CODE	OCTAL CODE	HEX CODE	FRENCH CHARACTER	AMERICAN CHARACTER
35	043	23	£	#
64	100	40	à	@
91	133	5B	°	[
92	134	5C	ç	\
93	135	5D	§	]
123	173	7B	é	{
124	174	7C	ù	;
125	175	7D	è	}
126	176	7E	..	-

All other ASCII codes common to American.

NOTE: Outlined keys denote differences from USA keyboard.



FOREIGN KEYBOARDS

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GERMAN LANGUAGE KEYBOARD

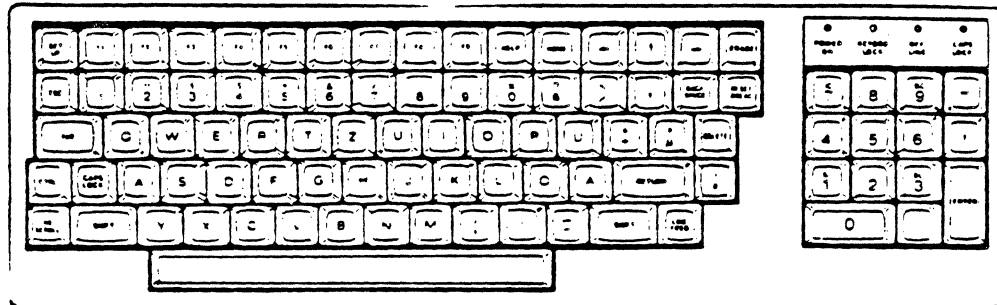


Figure B-4. German Language Keyboard

ASCII CODE

DECIMAL CODE	OCTAL CODE	HEX CODE	GERMAN CHARACTER	AMERICAN CHARACTER
60	074	3C	µ	<
62	076	3E	°	>
64	100	40	§	@
91	133	5B	Ä	[
92	134	5C	Ö	\
93	135	5D	Ü	]
94	136	5E	·	^
123	173	7B	ä	{
124	174	7C	ö	
125	175	7D	ü	}
126	176	7E	ß	~

All other ASCII codes common to American.

NOTE: Outlined keys denote differences from USA keyboard.

BOARDS

ITALIAN LANGUAGE KEYBOARD

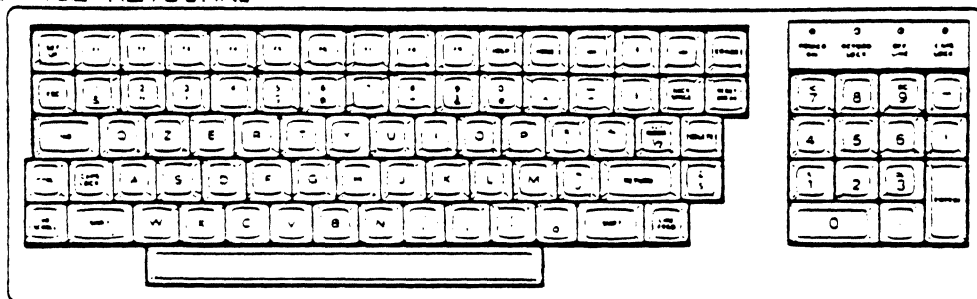


Figure B-5. Italian Language Keyboard

ASCII CODE

DECIMAL CODE	OCTAL CODE	HEX CODE	ITALIAN CHARACTER	AMERICAN CHARACTER
35	043	23	é	#
42	052	2A	ù	•
60	074	3C	à	<
62	076	3E	½	>
64	100	40	ò	@
91	133	5B	è	
92	134	5C	£	/
93	135	5D	ç	
94	136	5E	ì	↑
123	173	7B	^	{
125	175	7D	À M	}
96	140	60	¨	•

All other ASCII codes common to American.

NOTE: Outlined keys denote differences from USA keyboard.

FOREIGN KEYBOARDS

---

SPANISH LANGUAGE KEYBOARD

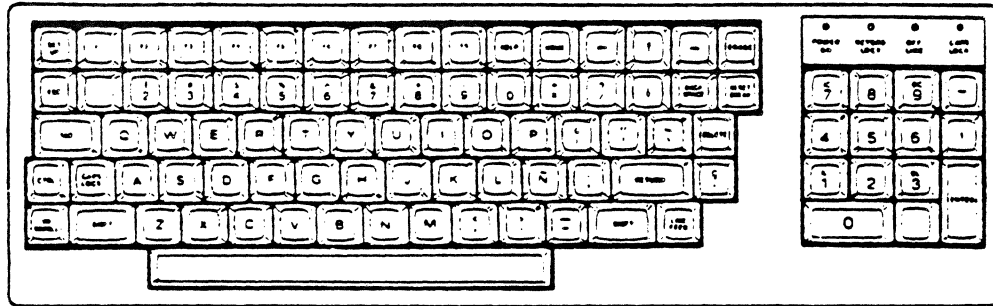


Figure B-6. Spanish Language Keyboard

ASCII CODE

---

DECIMAL CODE	OCTAL CODE	HEX CODE	SPANISH CHARACTER	AMERICAN CHARACTER
64	100	40	§	@
91	133	5B	¡	[
92	134	5C	Ñ	\
93	135	5D	¿	]
123	173	7B	·	{
124	174	7C	ñ	:
125	175	7D	¢	}

All other ASCII Codes common to American.

NOTE: Outlined keys denote differences from USA Keyboard

FOREIGN KEYBOARD

---

SWEDISH LANGUAGE KEYBOARD

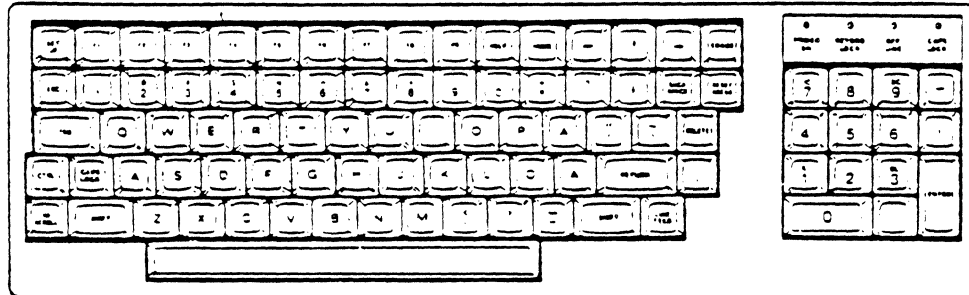


Figure B-7. Swedish Language Keyboard

ASCII CODE

---

DECIMAL CODE	OCTAL CODE	HEX CODE	SWEDISH CHARACTER	AMERICAN CHARACTER
91	133	5B	Ä	[
92	134	5C	Ö	\
93	135	5D	Å	]
123	173	7B	ä	{
124	174	7C	ö	;
125	175	7D	å	}

---

All other ASCII codes common to American.

NOTE: Outlined keys denote differences from USA keyboard.



## ASCII Code Information

### ASCII CONVERSION

DEC	OCT	HEX	ASCII	KEYS	DESCRIPTION
0	000	0	NUL	CTRL-@	Null, tape feed.
1	001	1	SOH	CTRL-A	Start of heading.
2	002	2	STX	CTRL-B	Start of text.
3	003	3	ETX	CTRL-C	End of text.
4	004	4	EOT	CTRL-D	End of transmission.
5	005	5	ENQ	CTRL-E	Enquiry, also WRU.
6	006	6	ACK	CTRL-F	Acknowledge, also RU.
7	007	7	BEL	CTRL-G	Rings the bell.
8	010	8	BS	CTRL-H	Backspace; also format effector backspace (FEB).
9	011	9	HT	CTRL-I	Horizontal Tab.
10	012	A	LF	CTRL-J	Line feed: advances cursor to next line.
11	013	B	VT	CTRL-K	Vertical Tab (VTAB).
12	014	C	FF	CTRL-L	Form feed to top of next page.
13	015	D	CR	CTRL-M	Carriage return to beginning of line.
14	016	E	SO	CTRL-N	Shift-out.
15	017	F	SI	CTRL-O	Shift-in.
16	020	10	DLE	CTRL-P	Data line escape.
17	021	11	DC1	CTRL-Q	Device control 1: turns transmitter on (XON).
18	022	12	DC2	CTRL-R	Device control 2.
19	023	13	DC3	CTRL-S	Device control 3: transmitter off (XOFF).
20	024	14	DC4	CTRL-T	Device control 4.
21	025	15	NAK	CTRL-U	Negative acknowledge; also ERR (error).
22	026	16	SYN	CTRL-V	Synchronous idle (SYNC).
23	027	17	ETB	CTRL-W	End of transmission block.
24	030	18	CAN	CTRL-X	Cancel (CANCL). Cancels current escape sequence.
25	031	19	EM	CTRL-Y	End of medium.
26	032	1A	SUB	CTRL-Z	Substitute.
27	033	1B	ESC	CTRL-[	Escape.
28	034	1C	FS	CTRL-\	File separator.
29	035	1D	GS	CTRL-]	Group separator.
30	036	1E	RS	CTRL-^	Record separator.
31	037	1F	US	CTRL-`	Unit separator.
32	040	20	SP	SPACE BAR	Space.
33	041	21	!	!	Exclamation point.
34	042	22	"	"	Quotation mark.
35	043	23	#	#	Number sign.

DEC	OCT	HEX	ASCII	KEYS	DESCRIPTION
36	044	24	\$	\$	Dollar sign.
37	045	25	%	%	Percent sign.
38	046	26	&	&	Ampersand.
39	047	27	'	'	Acute accent or apostrophe.
40	050	28	(	(	Open parenthesis.
41	051	29	)	)	Close parenthesis.
42	052	2A	*	*	Asterisk.
43	053	2B	+	+	Plus sign.
44	054	2C	,	,	Comma.
45	055	2D	-	-	Hyphen or minus sign.
46	056	2E	.	.	Period.
47	057	2F	/	/	Slash.
48	060	30	0	0	Number 0.
49	061	31	1	1	Number 1.
50	062	32	2	2	Number 2.
51	063	33	3	3	Number 3.
52	064	34	4	4	Number 4.
53	065	35	5	5	Number 5.
54	066	36	6	6	Number 6.
55	067	37	7	7	Number 7.
56	070	38	8	8	Number 8.
57	071	39	9	9	Number 9.
58	072	3A	:	:	Colon.
59	073	3B	;	;	Semicolon.
60	074	3C	<	<	Less than.
61	075	3D	=	=	Equal sign.
62	076	3E	>	>	Greater than.
63	077	3F	?	?	Question mark.
64	100	40	@	@	At sign.
65	101	41	A	A	Letter A.
66	102	42	B	B	Letter B.
67	103	43	C	C	Letter C.
68	104	44	D	D	Letter D.
69	105	45	E	E	Letter E.
70	106	46	F	F	Letter F.
71	107	47	G	G	Letter G.
72	110	48	H	H	Letter H.
73	111	49	I	I	Letter I.
74	112	4A	J	J	Letter J.
75	113	4B	K	K	Letter K.
76	114	4C	L	L	Letter L.
77	115	4D	M	M	Letter M.
78	116	4E	N	N	Letter N.
79	117	4F	O	O	Letter O.
80	120	50	P	P	Letter P.
81	121	51	Q	Q	Letter Q.

DEC	OCT	HEX	ASCII	KEYS	DESCRIPTION
82	122	52	R	R	Letter R.
83	123	53	S	S	Letter S.
84	124	54	T	T	Letter T.
85	125	55	U	U	Letter U.
86	126	56	V	V	Letter V.
87	127	57	W	W	Letter W.
88	130	58	X	X	Letter X.
89	131	59	Y	Y	Letter Y.
90	132	5A	Z	Z	Letter Z.
91	133	5B	[	[	Open brackets.
92	134	5C	\	\	Reverse slash.
93	135	5D	]	]	Close brackets.
94	136	5E	^	^	Up arrow/caret.
95	137	5F	_	_	Underscore.
96	140	60	`	`	Grave accent.
97	141	61	a	a	Letter a.
98	142	62	b	b	Letter b.
99	143	63	c	c	Letter c.
100	144	64	d	d	Letter d.
101	145	65	e	e	Letter e.
102	146	66	f	f	Letter f.
103	147	67	g	g	Letter g.
104	150	68	h	h	Letter h.
105	151	69	i	i	Letter i.
106	152	6A	j	j	Letter j.
107	153	6B	k	k	Letter k.
108	154	6C	l	l	Letter l.
109	155	6D	m	m	Letter m.
110	156	6E	n	n	Letter n.
111	157	6F	o	o	Letter o.
112	160	70	p	p	Letter p.
113	161	71	q	q	Letter q.
114	162	72	r	r	Letter r.
115	163	73	s	s	Letter s.
116	164	74	t	t	Letter t.
117	165	75	u	u	Letter u.
118	166	76	v	v	Letter v.
119	167	77	w	w	Letter w.
120	170	78	x	x	Letter x.
121	171	79	y	y	Letter y.
122	172	7A	z	z	Letter z.
123	173	7B	{	{	Left brace.
124	174	7C			Vertical bar (broken).
125	175	7D	}	}	Right brace.
126	176	7E	~	~	Tilde.
127	177	7F	DEL	DEL	Delete (rubout).



## Keypad Keys

KEYPAD KEYS	UNSHIFTED	SHIFTED ZENITH	ZENITH UNSHIFTED ALTERNATE	ANSI UNSHIFTED ALTERNATE	SHIFTED ANSI
0	0	0	ESC ? p	ESC Op	0
1/IL	1	ESC L	ESC ? q	ESC Oq	ESC [IL
2	2	2	ESC ? r	ESC Or	2
3/DL	3	ESC M	ESC ? s	ESC Os	ESC [IM
4	4	4	ESC ? t	ESC Ot	4
5	5	5	ESC ? u	ESC Ou	5
6	6	6	ESC ? v	ESC Ov	6
7/IC	7	ESC @, ESC O	ESC ? w	ESC Ow	ESC [4h, ESC [4l*
8	8	8	ESC ? x	ESC Ox	8
9/DC	9	ESC N	ESC ? y	ESC Oy	ESC [IP
.	.	.	ESC ? l	ESC Ol*	.
-	-	-	ESC ? m	ESC Om	-
.	.	.	ESC ? n	ESC On	.
ENTER	ENTER	RETURN	ESC ? M	ESC OM	RETURN

\*Character is lower case "L".

## Special Function Keys

KEY	ZENITH ESCAPE CODE	ANSI ESCAPE CODE
F1	ESC S	ESC OS
F2	ESC T	ESC OT
F3	ESC U	ESC OU
F4	ESC V	ESC OV
F5	ESC W	ESC OW
F6 (Blue)	ESC P	ESC OP
F7 (Red)	ESC Q	ESC OQ
F8 (Gray)	ESC R	ESC OR
F9	ESC OI	ESC OX

**NOTE:** Colored keys F6, F7, and F8 are applicable to the Z-19 Terminal.

## Cursor Key Codes

Cursor Key	Zenith MODE	ANSI Mode Cursor Key Reset	ANSI Mode Cursor Key Mode Set
Up ↑	ESC A	ESC{1A	ESC OA
Down ↓	ESC B	ESC{1B	ESC OB
Right →	ESC C	ESC{1C	ESC OC
Left ←	ESC D	ESC{1D	ESC OD
HOME	ESC H	ESC{1;1H	ESC OH

# Zenith Mode Code Information

Your terminal recognizes the following ASCII characters when operating in the Zenith mode.

---

DEC	OCT	HEX	CTRL CHR	CHR	FUNCTIONAL DESCRIPTION OR CHARACTER
7	007	7	BEL	G	Sounds bell tone.
8	010	8	BS	H	Backspace. Moves the cursor one position to the left except at the end of the screen.
9	011	9	HT	I	Tab. Moves the cursor to the next tab stop.
10	012	A	LF	J	Line Feed. Advances the cursor to the next line. At the bottom of the screen, scrolls the text up one line.
13	015	D	CR	M	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.
14	016	E	SO	G1	Shift Out. Selects the G1 character set as designated by SCS control sequence.
15	017	F	SI	G0	Shift In. Selects the G0 character set as designated by SCS control sequence.
24	030	18	CAN	X	Cancel. Cancels the current escape sequence.
27	033	1B	ESC	[	Escape. Introduces a control sequence.

---

## Summary of Zenith Escape Sequences

A space is included between the escape key (ESC) and the actual code for clarity. Do not include this space when entering escape sequences. The term "defined scrolling region" appears in the following listings and means lines 1-24, unless altered by the use of escape code sequences. An explanation for the codes is provided where necessary. The escape sequences are listed by function.

### NOTES:

1. "Default" is the parameter assumed when no parameter, or a value of zero is specified.
2. Pn — Numeric Parameter. A decimal number can be substituted for Pn.

3. Ps — Selective Parameter. Any decimal number selected from a list and used to select a subfunction. Several subfunctions can be selected at once by putting one number after another and separating each number by a semicolon. A maximum of eight parameters may be selected.
4. Bn — Alphanumeric Parameter. Any alphanumeric character selected from a list and used to select a subfunction.

## Cursor Functions

ESCAPE SEQUENCE	MNEMONIC	DEFINITION
ESC H	ZCUH	Cursor home. Moves the cursor to the first column, first line.
ESC A	ZCUU	Cursor up. Moves the cursor vertically up one character position without horizontal displacement. The cursor will not move beyond the top line.
ESC B	ZCUD	Cursor down. Moves the cursor vertically down one character position without horizontal displacement. The cursor will not move beyond the bottom line.
ESC C	ZCUF	Cursor forward (right). Moves the cursor right one character position without vertical displacement. The cursor will not move beyond the right margin.
ESC D	ZCUB	Cursor backward (left). Moves the cursor left one character position without vertical displacement. The cursor will not move beyond the left margin.
ESC I	ZRI	Reverse index. Moves the cursor to the same horizontal position on the preceding line. If the cursor is on the top line, the cursor will scroll down one line.
ESC n	ZCPR	Cursor position report. The terminal indicates the cursor position in the form ESC Y line# column# (ASCII character).
ESC j	ZSCP	Save cursor position. The present cursor position is saved. The cursor returns to the saved position on the escape sequence ESCk
ESC k	ZRCP	Return cursor to previously saved position. Returns the cursor to the previously saved position by the escape sequence ESCj. If the saved position was the 25th line, the cursor will not change lines, but does change columns.
ESC Y	ZDCA	Direct cursor addressing. Moves the cursor to a position on the screen by entering the escape code, the ASCII character representing the line number, and the ASCII character representing the the column number. The first line and column number are both 32. Lines are numbered 1-25 top to bottom. Columns are numbered 1-80 left to right. To address the cursor directly add the line and column numbers to 31. Con-

vert the numbers to the equivalent ASCII characters and enter in the following order:

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

		The cursor will not move if the entered line number is too high. The cursor will move to the end of the line if the entered column number is too high. The 25th line must be enabled to move the cursor to the 25th line.
ESC -	ZCBT	Cursor backward tabulation-Moves cursor backwards to last tab set.
ESC .0	ZCTCP	Clear tab at cursor position. Clears the tab set at the current cursor position.
ESC .3	ZCAT	Clear all tab positions. Clears all previously set tabs.
ESC .8	ZSTCP	Set tabs at current cursor position. Sets a tab at the current cursor position.

## Editing and Erasing

ESCAPE SEQUENCE	MNEMONIC	DEFINITION
ESC E	ZCD	Clear display. Erases the entire display, fills the screen with spaces, and places the cursor at the home position.
ESC b	ZBD	Erase to beginning of display. Erases all information from the start of the display to and including the cursor position.
ESC J	ZEOP	Erase to end of display. Erases all information from and including the cursor position to the end of the display.
ESC I	ZEL	Erase line. Erases the entire line, including the cursor position.
ESC o	ZEBL	Erase to beginning of line. Erases from the beginning of a line to and including the cursor position.
ESC K	ZEOL	Erase to end of line. Erases from and including the cursor position to the end of the line.
ESC L	ZIL	Insert line. Inserts a new blank line by moving the line the cursor is on and all other lines, down one line. The cursor is moved to the beginning of the new blank line. No area outside the scrolling region will be affected.
ESC M	ZDL	Delete line. Deletes the line the cursor is on, moves the cursor to the beginning of the next line, moves all other lines up one line and adds a blank line to the bottom of the defined scrolling region.
ESC N	ZDCH	Delete character. Deletes a character at the cursor position and shifts the text on the line, one character to the left.
ESC @	ZEIM	Enter character insert mode. Inserts characters or words into displayed text. As each new character is inserted the cursor is shifted to the right and the character at the end of the line is lost.
ESC O	ZERM	Exit insert character mode. Exits from the insert character mode, escape sequence ESC@.

## Configuration

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ESCAPE SEQUENCE	MNEMONIC	DEFINITION
ESC z	ZRAM	Reset to power-up configuration. Cancels all previously set escape sequences and returns the terminal to power-up configuration.
ESC rBn	ZMBR	Modify baud rate. Modifies the baud rate where, [Bn = @ = 75 A = 110 B = 150 C = 300 D = 600 E = 1200 F = 1800 G = ignored H = 2400 I = ignored J = 4800 K = ignored L = 9600 M = 19200
ESC xPn	ZSM	Set mode(s). Sets the following modes where, Pn = 1 = Enable 25th line 2 = Disable key click 3 = Enter hold screen mode 4 = Block cursor 5 = Cursor off 6 = Keypad shifted 7 = Enter alternate keypad mode 8 = Auto LF on CR 9 = Auto CR on LF
ESC yPn	ZRM	Reset mode(s). Resets the following modes where, Pn = 1 = Disable 25th Line 2 = Enable key click 3 = Exit hold screen mode 4 = Underscore cursor 5 = Cursor on 6 = Keypad unshifted 7 = Exit alternate keypad mode 8 = No Auto LF on CR 9 = No Auto CR on LF
ESC <	ZEAM	Enter ANSI mode. Selects the ANSI mode of operation.

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## Modes of Operation

ESCAPE SEQUENCE	MNEMONIC	DEFINITION
ESC [	ZEHS	Enter hold screen mode. Determines when new information will be displayed on the screen. Press the NO SCROLL key and a new line of information will be printed on the bottom line. The top line will be scrolled off. Press the SHIFT and NO SCROLL keys and a new page of text will be scrolled onto the screen as the old page scrolls up and off the screen.
ESC =	ZXHS	Exit hold screen mode. Exits the hold screen mode as set by the escape sequence ESC[.
ESC p	ZERV	Enter reverse video mode. Displays dark characters on a light background.
ESC q	ZXRV	Exit reverse video mode. Exits the reverse video mode as set by the escape sequence ESCp.
ESC s	ZSA	Set attribute. The video attributes are: Alternate character font <alt>. Underline <undr>. Half intensity <half>. Blinking <blink>. Reverse video <rev>. The video attributes are set as follows: <alt><undr><half><blink><rev>
<p>Where &lt;attributes&gt; is the ASCII character formed when the ASCII value for 0 (30 hex, 48 decimal) is added to the binary value obtained from each bit position listed above.</p> <p>EXAMPLE: Underline and reverse video are desired.            Binary = 01001            Decimal = 17 17 + 48 = 65            ASCII character for 65 = A            Escape sequence would be ESCsA</p>		
ESC ~ ESC F	ZHLP ZEGM	HELP key. Enter graphics mode. Enters the Zenith mode to display any of the 33 special symbols accessed by the 26 lower-case keys and seven other keys corresponding to the graphic symbols in the selected character set.
ESC G	ZXGM	Exit graphics mode. Exits the Zenith graphics mode set by escape sequence ESCF.
ESC t	ZEKS	Entered keypad shifted mode. Inverts the normal and shifted functions of the keypad.
ESC u	ZXKS	Exit keypad shifted mode. Exits the keypad shifted mode.

ESC =        ZAKM        Enter alternate keypad mode. Transmits the special escape codes used by software instead of normal characters.

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

ESC >        ZXAM        Exit alternate keypad mode. Exits the alternate keypad mode set by escape sequence ESC< and returns to transmission of normal characters.

## Additional Functions

ESCAPE SEQUENCE	MNEMONIC	DEFINITION
ESC }	ZDK	Keyboard disabled. Disables the output of the keyboard.
ESC {	ZEK	Keyboard enabled. Enables the keyboard after being disabled by escape sequence ESC).
ESC v	ZEWA	Wrap around at end of line. Upon receiving the 81st character on a line, the cursor is moved to the next line and the 81st character is the first character displayed.
ESC w	ZXWA	Discard at end of line. Upon receiving the 81st character on a line the 80th character will be overprinted.
ESC Z	ZID	Identify as VT52. The terminal responds to the interrogation with ESC:K indicating performance as a DEC VT52.
ESC iO	ZRTT	Request terminal type. Requests terminal type. The terminal responds to the request with an ESC iBO.
ESC ↑	ZXCL	Transmit current line to host computer.
ESC -	ZXCC	Transmit character at cursor to host computer.
ESC ]	ZX25	Transmit 25th line to host computer.
ESC #	ZXMP	Transmit page to host computer.
ESC x:	DAP	Auto print set. Outputs to the printer the same data displayed on screen as it is sent from the host computer or typed at the keyboard.



ESC y:	DAPO	Auto print reset. Terminates the auto print operation.
ESC ':	DPS	Print screen set. Prints the contents of the screen on the printer. The contents printed is either lines 1 to 24 (not 25) or the current scrolling region.
ESC W:	DPC	Pass thru set. Allows the host computer direct access and control to the local printer without affecting the data on the terminal screen.
ESC X:	DPCO	Pass thru reset. Resets the printer pass through function.
ESC V:	DPCL	Print cursor line. Prints a complete line wherever the cursor is currently positioned.

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## ANSI Mode Code Information

**NOTE:** The terminal transmits the following escape codes to perform a user-defined function. There is no response by the terminal. Colored keys F6, F7, and F8 are applicable to the Z-19 Terminal.

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ESC S	ZF1	Function key (F1)
ESC T	ZF2	Function key (F2)
ESC U	ZF3	Function key (F3)
ESC V	ZF4	Function key (F4)
ESC W	ZF5	Function key (F5)
ESC P	ZF6	Function key (F6) Blue
ESC Q	ZF7	Function key (F7) Red
ESC R	ZF8	Function key (F8) Gray
ESC OI	ZF9	Function key (F9)

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The Terminal recognizes the following ASCII characters when operating in the ANSI mode.

DEC	OCT	HEX	CHR	CTRL CHR	FUNCTIONAL DESCRIPTION OR CHARACTER
7	007	7	BEL	G	Sounds bell tone.
8	010	8	BS	H	Backspace. Moves the cursor one position to the left except at left end of screen.
9	011	9	HT	I	Tab. Moves the cursor to the next tab stop.
10	012	A	LF	J	Line Feed. Advances the cursor to the next line. At the bottom of the screen, scrolls the text up one line.
13	015	D	CR	M	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.
14	016	E	SO	N	Shift Out. Selects the user-defined G1 character set by the select character set (SCS) control sequence.
15	017	F	SI	O	Shift In. Selects the user-defined G0 character set by the SCS control sequence.
24	030	18	CAN	X	Cancel. Cancels the current escape sequence.
27	033	1B	ESC	[	Escape. Introduces a control sequence.

## Summary of ANSI Escape Sequences

A space is included between the escape key (ESC) and the actual code for clarity. Do not include this space. The term "defined scrolling region" appears in the following listings and means lines 1-24 unless altered by the use of escape code sequences. An explanation for the codes is provided where necessary. The escape sequences are listed by function.

### NOTES:

1. "Default" is the parameter assumed when no parameter, or a value of zero is specified.
2. Pn — Numeric Parameter. Any decimal number that is substituted for Pn.
3. Ps — Selective Parameter. Any decimal number selected from a list and used to select a subfunction. Several subfunctions can be selected at once by putting one number after another and separating each number by a semicolon. A maximum of eight parameters may be selected.

4. Bn — Alphanumeric Parameter. Any Alphanumeric character selected from a list and used to select a subfunction.
5. Sequences noted with a subscript "D" emulate the DEC® model VT-100® terminal.

The following modes which are specified by ANSI X3.64-1977 standard are considered to be permanently set, reset, or not applicable.

MODE	MNEMONIC	STATE
Control Representation	CRM	Reset
Editing Boundary	EBM	Reset
Erasure	ERM	Set
Format Effector Action	FEAM	Reset
Format Effector Transfer	FETM	Reset
Guarded Area Transfer	GATM	NA
Horizontal Editing	HEM	NA
Insertion-Replacement	IRM	Reset
Keyboard Action	KAM	Reset
Multiple Area Transfer	MATM	NA
Positioning Unit	PUM	Reset
Selected Area Transfer	SATM	NA
Status Reporting Transfer	SRTM	Reset
Tabulation Stop	TSM	Reset
Transfer Termination	TTM	NA
Vertical Editing	VEM	NA

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## Cursor Functions

ESCAPE SEQUENCE	MNEMONIC	DEFINITION
ESC [H or ESC [0;0H or ESC [1;1H ESC [f or ESC [0;0f or ESC [1;1f	CUP or HVP	Cursor position and horizontal vertical position. Moves the cursor to a position specified by the parameters. The first parameter specifies the line number. The second parameter specifies the column number. When the value zero is used, it is considered to be the value one. If no parameter is given, the cursor is placed in the home position.
ESC [p <sub>1</sub> ; <sub>2</sub> P <sub>c</sub> H or ESC [P <sub>1</sub> ; <sub>2</sub> P <sub>c</sub> f	CUP	Direct cursor addressing. Moves cursor to the first specified line parameter and then the specified column parameter. A parameter may be omitted for a default value of 0. Lines are numbered 1 to 25 from top to bottom, columns are numbered 1 to 80 from left to right. Add the 31 to the line number and 31 to the column number. Convert these decimal numbers to the ASCII equivalent and enter them in the following order:  ESC[ ASCII line character; ASCII column character H or ESC[ ASCII line character; ASCII column character f
ESC [PnA	CUU	Direct cursor addressing and the 25th line must be enabled to move the cursor to the 25th line. If the line number or column number is too high, the cursor will not move.  Cursor up. Moves the cursor up a number of lines determined by the value of Pn. A one or a zero moves the cursor up one line. The cursor stops at the top line of the scrolling region.
ESC [PnB	CUD	Cursor down. Moves the cursor down a number of lines determined by the value of Pn. A zero or one moves the cursor down one line. The cursor will stop at the bottom line of the defined scrolling region.
ESC [PnC	CUF	Cursor forward (right). Moves the cursor right the number of characters determined by the value of Pn. A zero or one moves the cursor one position. The cursor stops at the right-most character position.
ESC [PnD	CUB	Cursor backward (left). Moves the cursor left the number of characters determined by the value of Pn. A zero or one moves the cursor one position. The cursor stops at the left-most position.
ESC D	IND	Index. Moves the cursor down in the same manner as line feed.

ESC M	RI	Reverse index. Moves the cursor to the same horizontal position on the preceding line. If the cursor is on the top line of the defined scrolling region, the lines will move down, but the cursor will not move.
ESC E	NEL	Next line. This sequence causes the active position to move to the first position on the next line downward.
ESC [6n	CPR	Cursor position report. A request from the host of the cursor position. The terminal indicates the cursor position in the form ESC[Pl; PcR where l= line and c= column. The positions are expressed in decimal.
ESC [s	PSCP	Save cursor position. The present cursor position is saved until the escape sequence ESC[u is given.
ESC [u	PRCP	Return cursor to previously saved position. Returns the cursor to the previously saved position set by escape sequence ESC[s.
ESC H	CHT	Cursor horizontal tab set. Sets horizontal tabs at cursor position.
ESC [PnZ	CBT	Cursor backward tabulation — Moves cursor backwards to previous tab set where Pn indicates the number of tabs back from cursor position.
ESC [Psg	CCT	Clear horizontal cursor tab stops. Ps = 0 = Clear horizontal tab at cursor. 3 = Clear all horizontal tab stops.

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## Editing and Erasing

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ESCAPE SEQUENCE	MNEMONIC	DEFINITION
ESC [PnJ	ED	Erase display. Erases the display where: Pn = 0 = Erases from the cursor including the cursor position to the end of screen. 1 = Erases from the cursor including the cursor position to beginning of the display. 2 = Erases all of the display. The cursor moves to the home position.
ESC [PnK	EL	Erase in line. Erases the line where: Pn = 0 = Erases from the cursor including the cursor position to the end of line. 1 = Erases from the cursor including the cursor position to the start of line. 2 = Erase line. Erases all of the line including the cursor position.
ESC [PnL	IL	Insert line. Inserts one or more blank lines depending on the value of Pn. The cursor is moved to the beginning of the new blank line.
ESC [PnM	DL	Delete line. Deletes one or more lines of characters depending on the value of Pn. The lines below the deleted area move up the number of lines deleted and the cursor is moved to the beginning of the next line.
ESC [Pn@	IC	Insert character. Inserts the number of characters depending on the value of Pn. Remaining characters move to the right.
ESC [PnP	DCH	Delete character. Deletes characters at the cursor position depending on the value of Pn. Remaining characters move to the left.
ESC [4h	IRM	Insert/Replacement mode on. Inserts characters or words into displayed text. As each new character is inserted the cursor and characters to the right are shifted to the right and the character at the end of the line is lost.
ESC [4l	IRM	Insert/Replacement mode off. Exits Insert/replacement mode set by escape sequence ESC[4h.

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# Configuration

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ESCAPE SEQUENCE	MNEMONIC	DEFINITION
ESC c or ESC [z	PRAM	Reset to power up configuration. Cancels all previously set escape sequences and returns to power up configuration.
ESC [Pnw	PMBR	Modify baud rate. Changes the baud rates where: Pn = ;0 = 75 1 = 110 2 = 150 3 = 300 4 = 600 5 = 1200 6 = 1800 7 = Ignored 8 = 2400 9 = Ignored 10 = 4800 11 = Ignored 12 = 9600 13 = 19200
ESC [>Pnh	SM	Set mode(s). Sets the modes where: Pn = 1 = Enable 25th line 2 = Disable key click 3 = Enter hold screen mode 4 = Block cursor 5 = Cursor off 6 = Keypad shifted 7 = Enter alternate keypad mode 8 = Auto LF on CR 9 = Auto CR on LF  One or more modes can be set as determined by a parameter string Ps;Ps;Ps;, etc.
ESC [>Pnl	RM	Reset mode(s). Resets the modes set by escape sequence ESC>Pnh where: Pn = 1 = Disable 25th Line 2 = Enable key click 3 = Exit hold screen mode 4 = Underscore cursor 5 = Cursor on 6 = Keypad unshifted 7 = Exit alternate keypad mode 8 = No Auto LF on CR 9 = No Auto CR on LF  One or more modes can be reset as determined by a parameter string Ps;Ps;Ps;, etc.

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ESC [?2l	PEZM	Enter Zenith mode. Selects the Zenith mode of operation.
ESC [20h	LNМ	Enter auto CR on LF. Enables automatic carriage return when a line feed is received.
ESC [20l	LNМ	Exit auto CR on LF. Disables automatic carriage return set by escape sequence ESC[20h.
ESC [Pt;Pbr	SR	Define scrolling region. The scrolling region is equal to the values of Pt and Pb expressed in decimal numbers where: Pt = Top of scrolling region. Pb = Bottom of scrolling region. Minimum size is two lines (top must be less than bottom). The cursor is moved to the home position.
ESC (Pn	SCS	Set character set G0. Character set G0 is set on terminal power-up. To select G0 when in character set G1 type the CTRL character for S1, and then the ESC sequence where: Pn = A = United Kingdom set. B = United States (USACII). C = Danish/Norwegian D = German E = Spanish F = Swedish G = Italian H = French 0 = VT-100 line graphics. 1 = Alternate character ROM. 2 = Alternate character ROM, special graphics characters.
ESC )Pn	SCS	Set character set G1. To select character set G1, type the CTRL character for S0 and then the ESC sequence. Pn = A = United Kingdom set. B = United States (USACII). C = Danish/Norwegian D = German E = Spanish F = Swedish G = Italian H = French 0 = VT-100 line graphics. 1 = Alternate character ROM. 2 = Alternate character ROM, special graphics characters.
ESC [c or ESC [0c	RDA	Report device attributes (VT100/VT101 responds ESC[?1;2c)

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## Modes of Operation

ESCAPE SEQUENCE	MNEMONIC	DEFINITION
ESC [>3h	SM	Enter hold screen mode. Press the NO SCROLL key and a new line of information will be printed on the bottom line. Press the SHIFT and NO SCROLL keys and a new page of text will be displayed.
ESC [>3I	RM	Exit hold screen mode. Disables the hold screen mode set by the escape sequence ESC [>3h. Pressing the CTRL and S keys generates an XOFF, pressing the S and NO SCROLL key generates an XON. Pressing the CTRL and Q keys generates an XON, pressing the NO SCROLL key generates an XOFF.
ESC [Psm	SGR	Enter/Exit select graphic rendition mode. Enters and exits the ANSI graphic mode to display any of the 33 special symbols accessed by the 26 lower-case keys and seven other keys corresponding to the graphic symbols of the selected character set. Ps = 0 = Exit all attributes. 2 = Enter 1/2 intensity. 4 = Enter underline. 5 = Enter blinking. 7 = Enter reverse video.
ESC [>6h	SM	Entered keypad shifted mode. Inverts the normal and shifted functions of the keypad. Holding either SHIFT key down, results in a normally unshifted character.
ESC [>6I	SM	Exit keypad shifted mode. Exits the keypad shifted mode set by the escape sequence ESC [>6h. Holding either SHIFT key down, results in a shifted character.

ESC = SM Enter alternate keypad mode. Transmits the special escape codes used by software instead of normal characters.  
 or  
 ESC [>7h

KEY	ESCAPE CODE
0	ESCOp
1	ESCOq
2	ESCOr
3	ESCOs
4	ESCOt
5	ESCOu
6	ESCOv
7	ESCOw
8	ESCOx
9	ESCOy
-	ESCOM
.	ESCON
,	ESCOI
ENTER	ESCOM

ESC > RM Exit alternate keypad mode. Exits the alternate keypad mode set by escape sequence ESC [>7h and returns to transmit normal character codes.

ESC [>7i  
 ESC {Pn} SPF

Select protective field.  
 Pn = 0 = No fields protected.  
 2 = 1/2 intensity protected.  
 4 = Underline protected.  
 5 = Blinking protected.  
 7 = Reverse video protected.  
 254 = All attributes off-protected.

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ESCAPE SEQUENCE	MNEMONIC	DEFINITION
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ESC {1h	GATM	Set guarded area transfer mode.
ESC {1l	GATM	Reset guarded area transfer mode.
ESC {~	SS3	HELP key.

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## Additional Functions

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ESC [2h	SM	Keyboard disabled. Disables the keyboard output. To enable the keyboard, reset the Terminal or use escape sequence ESC [2l.
ESC [2l	RM	Keyboard enabled. Enables the keyboard output.
ESC [?7h	SM	Wrap-around at end of line. A wrap-around is performed when the first character of the next line (81st or 133rd) is entered.
ESC [?7l	RM	Discard at end of line. After 80 or 132 characters the next characters will overprint. The last character received will be displayed in the 80th or 132nd position.
ESC #7	ZXPP	Transmit page to printer.
ESC [p <sub>n</sub> P	PXMT	Transmit mode, where P <sub>n</sub> = 0 = Transmit page. 1 = Transmit current line. 2 = Transmit character at cursor. 3 = Transmit 25th line.
ESC [<P <sub>n</sub> >v	SM	Set blinking rate in 1/30 second.
ESC [?5i	DAP	Auto print set. Outputs to the printer the same data displayed on screen as it is sent from the host computer.
ESC [?4i	DAPO	Auto print reset. Resets printer output function.
ESC [i	DPS	Print screen set. Prints the contents of the screen on the printer. The contents printed is either lines 1 to 24 (not 25) or the current scrolling region.
ESC [?19l*	DPXR	Printer extent. Print only defined scrolling region during a print page operation.
ESC [?19h	DPXF	Printer extent. Print full screen during a print page operation, except 25th line.
ESC [5i	DPC	Pass thru set. Allows the host computer direct access and control to the local printer without affecting the data on the terminal screen.
ESC [4i	DPCO	Pass thru reset. Resets the printer pass through function.
ESC [?18h	DPTC	Termination character set. A form feed will be sent to the printer at completion of print screen operation.
ESC [?18l*	DPT	Termination character reset. No character will be inserted at completion of a print screen operation.
ESC [?1i	DPCL	Print cursor line. Prints a complete line wherever the cursor is currently positioned.
ESC [15n	DPSR	Determines the operational state of printer interfaced with DCE port. Responses are as follows:  ESC [? 10n - Printer is ready. ESC [? 11n - Printer is not ready. ESC [? 13n - Printer is not connected.

\*Character is lower case "L".

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NOTE: The terminal transmits the following escape codes to perform a user-defined function. There is no response by the terminal. Colored keys F6, F7, and F8 are applicable to the Z-19 Terminal.

ESC O S	SS3	Function key 1 (F1)
ESC O T	SS3	Function key 2 (F2)
ESC O U	SS3	Function key 3 (F3)
ESC O V	SS3	Function key 4 (F4)
ESC O W	SS3	Function key 5 (F5)
ESC O P	SS3	Function key 6 (F6) Blue
ESC O Q	SS3	Function key 7 (F7) Red
ESC O R	SS3	Function key 8 (F8) Gray
ESC O X	SS3	Function key 9 (F9)

NOTE: Function key F1 corresponds to DEC<sup>®</sup> key F4.  
Function key F6 corresponds to DEC key F1.  
Function key F7 corresponds to DEC key F2.  
Function key F8 corresponds to DEC key F3.

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## ANSI Escape Sequences Defined

### NOTES:

1. In the ANSI mode, the Terminal only recognizes and responds to escape sequences 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.  $\langle P_s \rangle$  — 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.

# Lear Siegler ADM 3A Mode Code Information

The Z-39 Terminal recognizes the following ASCII Characters while it is operating in the ADM 3A mode.

DEC	OCT	HEX	CHR	FUNCTION DESCRIPTION OR CHARACTER
7	007	7	BEL	Sounds bell tone.
8	010	8	BS	Backspace. Moves the cursor one position to the left except at left end of screen.
9	011	9	HT	Tab. Moves the cursor to the next tab stop.
10	012	A	LF	Line feed. Advances the cursor to the next line. At the bottom of the screen, scrolls the text up one line.
11	013	B	VT	Moves the cursor up one position. Nothing happens if the cursor is already at the top of the screen.
12	014	C	FF	Moves the cursor one position to the right. Nothing happens if the cursor is already at the right side of the screen.
13	015	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 position.
14	016	E	S0	Enables keyboard entry after it has been disabled by code 0FH.
15	017	F	S1	Disables the keyboard entry. Use code 0EH to enable.
26	032	1A	SUB	Clears the screen and moves the cursor to the home position (first position on the top line).
30	036	1E	RS	Moves the cursor to the home position.

## DIRECT CURSOR ADDRESSING

This command allows you to position the cursor to any line and column on the screen. Legal line numbers are 1 to 24 and column (print position) numbers are 1 to 80. Both are offset by 1FH(31 decimal). For instance, if you want to position the cursor to the third line, the tenth column, the code would be:

$$\text{ESC} = 34_{10}41_{10}$$

Where the desired line ( $3_{10} + 31_{10}$ ) is  $34_{10}$  and the desired column ( $10_{10} + 31_{10}$ ) is  $41_{10}$

Code: ESC = line column

# Hazeltine 1500 Mode Code Information

The Z-39 Terminal recognizes the following ASCII Characters while it is operating in the Hazeltine 1500 mode. Note that this terminal can set up regions which function as independent screens under certain conditions. Also, instead of escape sequences (ESC), the 1500 Mode makes use of tilde (~) sequences.

DEC	OCT	HEX	CHR	FUNCTIONAL DESCRIPTION OR CHARACTER
7	007	7	BEL	Sounds bell tone.
8	010	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.
9	011	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.
10	012	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.
13	015	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.
16	020	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.
27	033	1B	ESC	Escape.

In the following descriptions of special tilde control code sequences, the code is expressed in ASCII format. For instance, ENQ is equal to 5(decimal, hexadecimal, or octal) and DC3 is equal to 19(decimal), 13(hexadecimal), or 23 (octal).

## READ CURSOR ADDRESS

The current position of the cursor is reported in the form: column, line. Column positions  $0_{10}$  to  $31_{10}$  have  $96_{10}$  added to them. Column positions  $32_{10}$  to  $79_{10}$  have  $0_{10}$  added to them. The line numbers ( $0_{10}$  to  $23_{10}$ ) also have  $96_{10}$  added to them. If the cursor is currently on the third line in the tenth column, sending  $\sim$  ENQ will cause the Terminal to reply  $106_{10}99_{10}(10_{10} + 96_{10}, 3_{10} + 96_{10})$ .

If the cursor was at the 35th column of the same row, the Terminal would reply,  $35_{10} 99_{10} (35_{10} + 0_{10}, 3_{10} + 96_{10})$ .

Code:  $\sim$  ENQ

**Enable Keyboard** — The keyboard is enabled after entry has been inhibited by a disable keyboard command.

Code:  $\sim$  ACK

**Down Cursor** — Moves the cursor down one line. If the cursor is already on the bottom line, nothing will happen.

Code:  $\sim$  VT

**Up Cursor** — Moves the cursor up one line. If the cursor is already on the top line, nothing will happen.

Code:  $\sim$  FF

**Erase to end of line** — Clears the remainder of the current line, including the cursor position. The cursor remains at the same position.

Code:  $\sim$  SI

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**Direct Cursor Addressing** — Moves the cursor to the column and line indicated. Column positions may be represented by the decimal numbers  $0_{10}$  to  $79_{10}$ , although columns  $0_{10}$  to  $30_{10}$  may also be represented by  $96_{10}$  to  $126_{10}$ . Line numbers may be represented by the decimal numbers  $0_{10}$  to  $23_{10}$  or  $96_{10}$  to  $119_{10}$ . The higher ranges correspond to the cursor position report; this is the preferred method of cursor addressing for the Hazeltine 1500.

Code: ~ DC1 P<sub>column</sub> P<sub>line</sub>

**Home Cursor** — Moves the cursor to the first position of the first line.

Code: ~ DC2

**Delete Line** — Deletes the current line. The current line is defined as the line which the cursor is located on. The cursor does not move.

Code: ~ DC3

**Disable Keyboard** — Inhibits entry from the keyboard. ~ACK will cancel this command.

Code: ~ NAK

**Clear and set to background to end of screen** — Clears all text from the (and including the) cursor position to the end of the screen. In addition, this command will set the entire area to background spaces and leave the cursor at its current position. If you want to clear the entire screen in this manner, move the cursor to the home position first. See "Home Cursor."

Code: ~ ETB



**Clear and set to foreground to end of screen** — Clears all text from (and including) the cursor position to the end of the screen. In addition, this command will set the entire area to foreground spaces and leave the cursor at its current position. If you want to clear the entire screen in this manner, use the "Clear Screen" command. See "Clear Screen."

Code: ~ CAN

**Background Follows** — All following data will be displayed as background data at half intensity. This condition will remain enabled until a "Foreground Follows" command is received. See "Foreground Follows."

Code: ~ EM

**Insert Line** — All text on the current line (and following) is moved down one line to allow the insertion of a new line of data. If text existed on the 24th line, or the bottom line of the defined scrolling region, it will be lost.

Code: ~ SUB

**Clear Screen** — The entire screen will be cleared and set to foreground spaces. The cursor will be moved to the home position (first position on the top line).

Code: ~ FS

**Clear Foreground** — Clears all foreground areas and moves the cursor to the home position (first position on the first line).

Code: ~ GS

**Foreground Follows** — All following data will be displayed as foreground data at normal intensity. This condition will remain enabled until a "Background Follows" command is received. See "Background Follows."

Code: ~ US

## Software Handshake

The terminal operates at speeds up to 19,200 baud, but may not be able to keep up with incoming data. Incoming characters are stored in a 32-character buffer and processed on a first-in/first-out (FIFO) basis. When the buffer contents reach 22 characters, the terminal transmits 13H (XOFF or DC3). Upon receipt of this signal, the host computer will stop transmitting to the terminal. The terminal will continue to deplete the buffer. When 10 characters are left in the buffer, the terminal transmits 11H (XON or DC1) signaling the host to resume transmission. If the host fails to respond to a XOFF from the terminal in a timely manner, the buffer will continue to fill. When the 32-character capacity of the buffer is exceeded, a buffer overflow will occur. To determine when the buffer will overflow, use the following formula:

$$\text{Time to respond to XOFF} = \frac{[\text{buffer length-XOFF point-worst case}(\text{receive speed}/\text{transmit speed})]}{[\text{bits per character} + \text{parity bits} + \text{stop bit} + \text{start bit}] \times \text{receive speed}}$$

### Example:

The terminal is transmitting and receiving at 9600 baud, 8 bits per character, no parity, buffer length = 32, and XOFF point = 22. The terminal has just sent an XOFF which the host must respond to within ??? milliseconds.

$$\text{Time to XOFF} = \frac{[32-22-3(9600/9600)] \times [8+0+2]}{9600} = 7.29 \text{ millisecs.}$$

When the buffer overflows, the terminal discards the most recent character in the buffer and places the current character into the buffer.

Software that does not support receipt of the XOFF/XON signals can still use the terminal, provided the software never sends the ESC code to the terminal and the baud rate is limited to 4800 baud or less.

Alternately, if XOFF/XON can not be used, a fill character such as NUL (00H) can be used following certain character strings which are sent to the terminal. Table 4.1 provides a list of fill character requirements.

## Fill Character Requirements

Fill characters are required to keep the terminal synchronized with the host computer when the XOFF/XON codes are not used. Table 4.1 shows the terminal fill character requirements for every terminal receive speed. No entry in a column indicates that fill characters are not required. All entries indicate the worst case. In some situations, the Terminal can actually operate with less fill characters.

NUL characters take time for the computer to process. However, if a time delay is available from the host computer and inserted in place of a NUL character the time between characters at baud rates will be reduced.

Another way to transmit XOFF/XON is by using CTRL and S keys for XOFF and CTRL and Q keys for XON. The terminal coordinates the two sources so that the desired effect occurs. For example, if the buffer filling condition has sent an XOFF and the operator presses the CTRL and S keys, a second XOFF is not sent. When the buffer is empty, an XON will not be sent until the operator presses the CTRL and Q keys.

In the Setup mode, the terminal stops taking characters from the buffer and an XOFF is sent if the buffer is nearly full.

When hardware handshaking is used, the buffer filling condition does not transmit an XOFF, CTRL and S keys, and CTRL and Q keys are transmitted as typed.

<sup>B</sup>  
**Table 1. Fill Character Requirements**

RECEIVE BAUD RATE	FUNCTION NUMBER									
	1(a)	1(b)	2(a)	2(b)	3	4(a)	4(b)	5(a)	5(b)	6
19200	1	800	32	220	50	1	25	2	16	4
9600		340	14	100	20	1	15	1	8	2
4800		150	4	42	10		5		3	1
2400		75		20	4		1			
1800		60		15	3		1			
1200		36		8	1					
600		17		2						
300		8								
150		4								
110		3								
75		2								

**Explanation of Function Number:**

- 1(a). All characters except those listed below (including ESC sequences).
- 1(b). Same as 1(a), but with protective fields enabled.
- 2(a). Erase in display.
- 2(b). Same as 2(a), but with protective fields enabled.
- 3. Reset to initial state.
- 4(a). BEL character followed by another BEL character.
- 4(b). BEL character followed by any other character.
- 5(a). Erase in line.
- 5(b). Same as 5(a), but with protective fields enabled.
- 6. Line Feed, reverse index.

