Whizzard® 1600 Family

Whizzard 1645
Operator's Guide

Making History out of
State-of-the-Art.

MEGATEK
CORPORATION
A UNITED TELECOM COMPANY

WHIZZARD 1645
OPERATOR'S GUIDE

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Change 1

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PREFACE

Whizzard 1645 Introduction

The Whizzard 1645 is a terminal graphics display system. It has a variety of applications, including CAD/CAM, simulation, real-time data analysis, and design engineering. Options available are:

- Tablet for plotting and data manipulation
- Printer for hard-copy outputs
- Joystick
- Valuators

How To Use This Manual

The Whizzard 1645 Operator's Guide provides description of the various features and capabilities of the terminal from the operator's point of view. It also provides information for installing and setting up the system.

The Operator's Guide discusses Whizzard 1645 setup and operation when used as an alphanumeric terminal. The Whizzard 1645 Graphics Protocol manual (Megatek number 0251-0012) describes those commands used to produce graphic images on the screen.

The guide is divided into four sections:

Section One - Provides the general description of the Whizzard 1645, interface information, installation requirements, and power-up procedures.

Section Two - Provides a description of the keyboard.

Section Three - Discusses set-up, operation functions, and diagnostics menus.

Section Four - Provides information for terminal programming.

Appendices - Provide a quick reference guide for character codes, remote terminal parameter setup, and control sequence summary.

Additional documentation is included in the following manual:

- Whizzard 1645 Graphics Protocol Manual

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1.0 WHIZZARD 1645 TERMINAL OPERATION

1.1 System Description

This section provides an overview of the Whizzard 1645. It also includes interface and installation information.

1.1.1 General

This manual provides detailed information on the Whizzard 1645 terminal operation. The Whizzard 1645 provides both alphanumeric editing capabilities and monochromatic raster graphics. When used in the alphanumeric mode, the Whizzard 1645 terminal is like a regular terminal. When used in the graphics mode, it is a powerful graphics display terminal.

The terminal is contained in a handy table-top unit and is easy to operate. All of the terminal electronics are packaged on a single board providing increased reliability.

The Whizzard 1645 uses display list architecture that provides the capabilities for real-time manipulation of screen graphics with minimum host CPU intervention. For example, such functions as zoom or scale, translate, clip, rotate, pick, or polygon fill can be executed on the screen without extensive host CPU intervention.

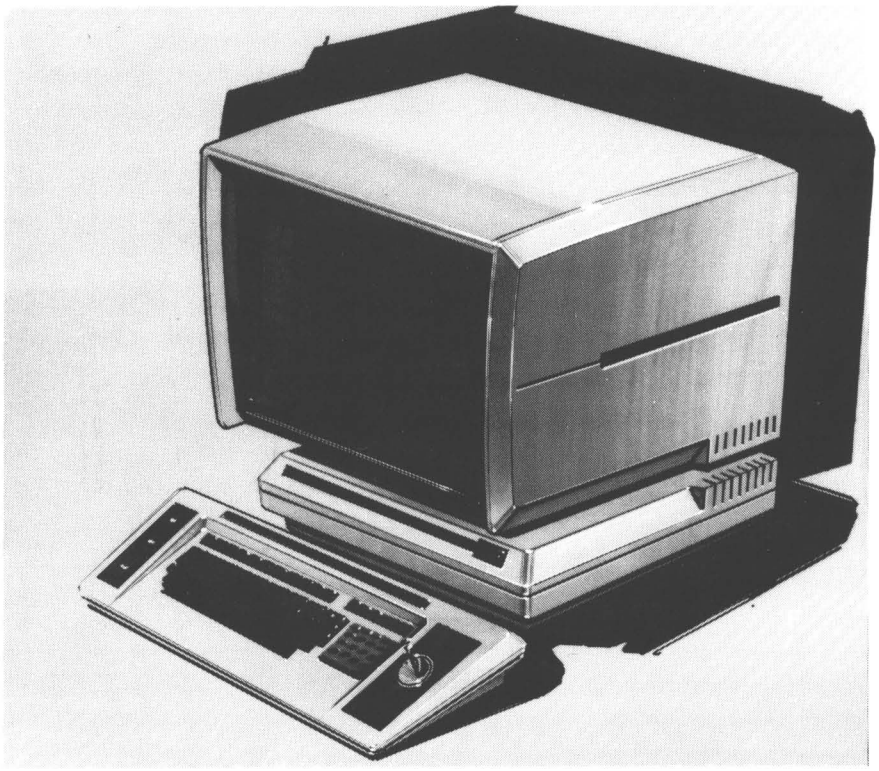

Figure 1-1. Whizzard 1645 Terminal

1.1.2 General Functional Description

A simple block diagram of the Whizzard 1645 is shown in Figure 1-2. A 16-bit data bus is used for overall communication between the Whizzard 1645 internal peripheral devices and the microprocessor, and among the various major circuits of the terminal. The terminal communicates with the host CPU via the RS-232C interface, full-duplex and half-duplex, at speeds of 50 to 19.2K baud.

The 16-bit data bus interfaces the keyboard and the terminal electronics via Universal Asynchronous Receiver/Transmitter (UART). Optional devices, such as the tablet and printer, are also interfaced to the system through the 16-bit data bus.

The keyboard is standard equipment and contains 16 programmed tone generators, 16 programmable function keys, 16 programmable LEDs, and a 10-key data entry keypad.

By storing display lists in RAM, the Whizzard 1645 relieves the host computer of most of the processing chores related to the graphics system. Display list memory is contained in RAM on the terminal electronics board and can be 128KB to 512KB. The display lists are stored and maintained under control of the host.

Operation of the terminal is controlled primarily by the 8086 graphics processor. The graphics processor contains logic to traverse the structured display file and to pass information to the Digital Vector Generator (DVG). The DVG processes the data and passes it to the pixel map where color information is added. The output is then routed to the video mixing circuitry where the data is combined with information from character overlay memory before being routed to the monitor. The Whizzard 1645 utilizes a raster scan technique with a screen resolution of 1024 × 960 or 1280 × 960.

1.2 Interface Information

1.2.1 Communication

The Whizzard 1645 communicates with the host computer or modem over a full- or half-duplex, asynchronous communication line. The terminal connects to the line through a connector mounted on the rear of the electronic base marked HOST (Figure 1-4). This 25-pin connector meets the requirements of EIA specifications RS-232C. Table 1-1 summarizes the pin positions and their signals.

Table 1-1. EIA RS-232C Connector Signals

Pin Number	Description	Pin Number	Description
1	Protective Ground	7	Signal Ground (common return)
2	Transmitted Data		
3	Received Data	8	Carrier Detect
4	Request To Send	9	(not used)
5	Clear To Send	10	(not used)
6	Data Set Ready	11	(not used)

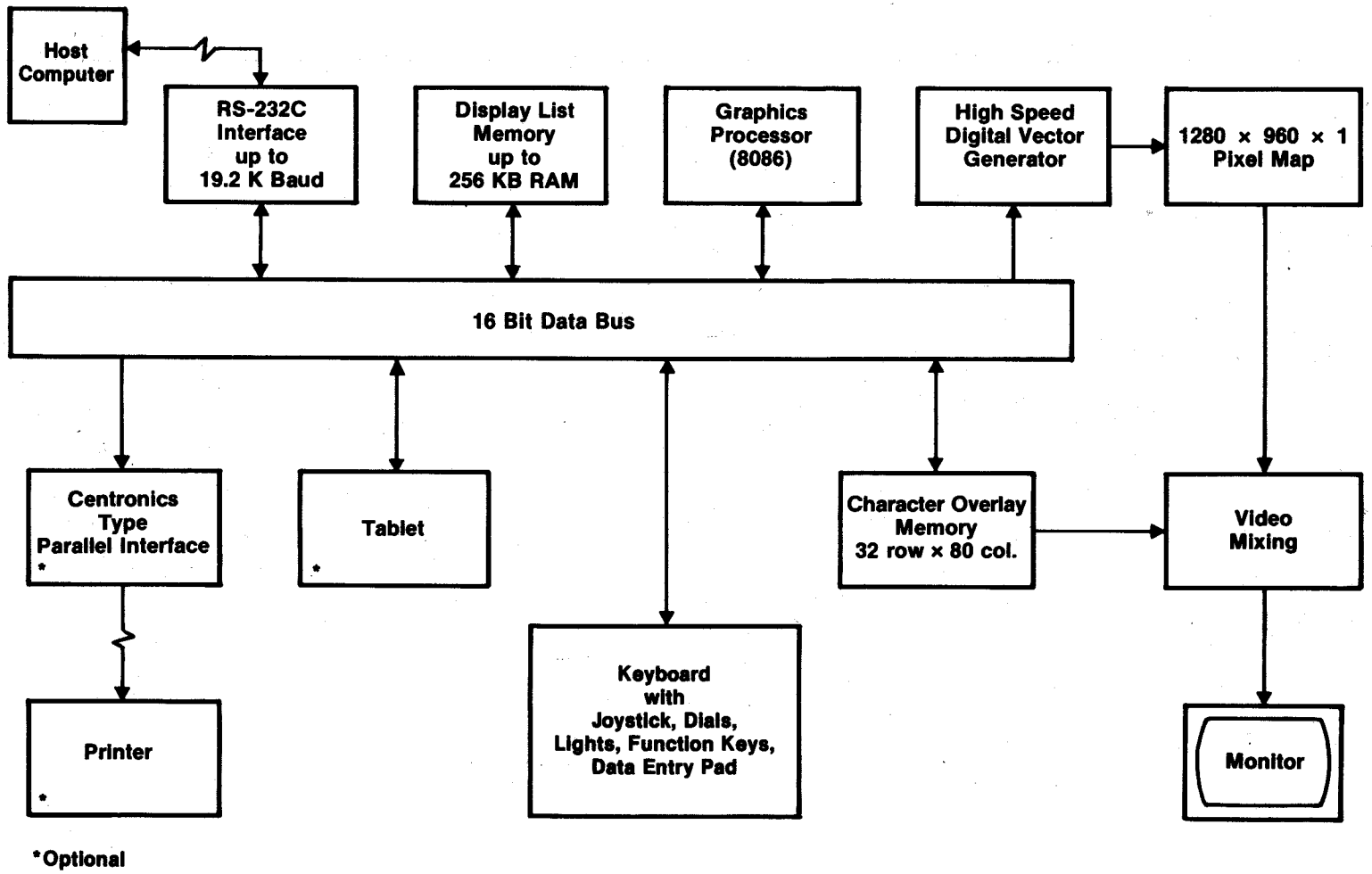

Figure 1-2. Whizzard 1645 Functional Block Diagram

Table 1-1. EIA RS-232C Connector Signals - Continued

Pin Number	Description	Pin Number	Description
12	(not used)	19	(not used)
13	(not used)	20	Data Terminal Ready
14	(not used)	21	(not used)
15	(not used)	22	(not used)
16	(not used)	23	(not used)
17	(not used)	24	(not used)
18	(not used)	25	(not used)

The following describes the EIA RS-232C signals (pin connections).

Pin 1 Protective Ground
This conductor is attached to the Whizzard 1645 chassis. Do not use this conductor as a reference potential

Pin 2 Transmitted Data (to host computer)
The Whizzard 1645 transmits serially encoded data over this circuit. It is held in mark state when data is not being transmitted

Pin 3 Received Data (from host computer)
The Whizzard receives serially encoded data generated by the host computer over this circuit

Pin 4 Request To Send (to host computer)
Asserted at all times when terminal is powered

Pin 5 Clear To Send (from host computer)
Must be asserted to allow transmission from the Whizzard 1645

Pin 6 Data Set Ready (from host computer)
Ignored at all times

Pin 7 Signal Ground
The common ground reference potential for all voltages on the connector is established on this conductor. It is connected to the Whizzard 1645 chassis

Pin 8 Carrier Detect (from host computer)
Must be asserted to allow transmission from the Whizzard 1645

Pin 20 Data Terminal Ready (to host computer)
Data Terminal Ready is asserted at all times when the terminal is powered except during the interval following the pressing of the hard-reset button on the rear of the keyboard.

1.2.2 Electrical Characteristics

Output Voltages

On signals designated "To Host Computer", the mark, or unasserted state is −6.0V to −12.0V; the space or asserted state is +6.0V to +12.0V.

Input Voltages

On signals designated "From Host Computer", −25.0V to +0.75V or an open circuit is interpreted as a mark or unasserted state, and +25.0V to +2.25V is interpreted as a space or asserted state. These levels are compatible with EIA RS-232C and CCITT Recommendation V.28.

CAUTION

Voltages greater than +25.0V will damage the Whizzard 1645 Interface.

1.2.3 External Video Connections

The Whizzard 1645's video output is connected to external video devices through a BNC connector located on the rear of the monitor (Figure 1-3). The video output provides a composite signal carrying sync.

The use of dc-coupling in the Whizzard 1645 does not conform to the RS-170 standard since the 2 mA dc short circuit current requirement is violated. To agree with the RS-170 standard, the output load requires a 10 microfarad capacitor in series with the output. Most monitors are ac-coupled and the Whizzard 1645's output is acceptable.

The Whizzard 1645's output contains all video data appearing on the screen. Refer to Table 1-2 for nominal characteristics.

Table 1-2. Video Characteristics

Video	
• Output impedance	= 75 ohms, dc-coupled
• Sync amplitude	= 0.35 V
• Sync tip	= +0.05 V
• Black level	= 0.45 V when loaded with 75 ohms
• Video amplitude	= 1.0 V with a 75 ohm load
• Rise time	= 5 nanoseconds
• Pixel time	= 20 nanoseconds
• Pixels/line	= 1280
Horizontal Timing	
• Frequency	= 30.69 kHz
• Blanking	= 6.517 microseconds
• Front porch	= 0.978 microseconds
• Back porch	= 4.236 microseconds
• Sync	= 1.303 microseconds
• Active	= 26.067 microseconds
• Line Time	= 32.584 microseconds

Table 1-2. Video Characteristics - Continued

Vertical Timing - Interlaced	
• Field frequency	= 86 Hz
• Total lines	= 1023
• Active lines	= 966
• Bottom blanking	= 173 microseconds
• Sync	= 130 microseconds
• Blanking lines to top	= 780 microseconds
• Vertical blanking	= 1.1 milliseconds

1.2.4 Whizzard 1645 Specifications

MONITOR

Display Area:	19 inch diagonal measure, long persistence phosphors
ANSI Mode Text Format:	42 lines of 80 characters
ANSI Mode Character:	16 × 33 dot matrix with descenders
ANSI Mode Character Size:	0.262 inch H × 0.175 inch W (6.65 mm × 4.45 mm)
ANSI Mode Character Set:	96 character displayable ASCII subset (upper and lower-case, numeric and punctuation)
Cursor Type:	Blinking block character or underline, SETUP selectable
Active Display Size:	11.0 inch H × 14.0 inch W (280 mm × 360 mm)

KEYBOARD [93-key detachable unit with 1.9 m (6 ft) coiled cord]

Key Layout:	62-key arrangement and sculpturing similar to standard typewriter keyboard
Data Entry Keypad:	14-key numeric pad with period, comma, minus, and ENTER
Function Keys:	17-key function strip with sixteen user-programmable general-purpose function keys
Visual Indicators:	20 LEDs (4 LEDs dedicated to GRPH ON, BUSY, KYBD LOCK, and CUSR MODE, 16 LEDs are user-programmable)
Audible Signals:	Click on key press simulates typewriter 16 programmed selectable tones Beep sounds on receipt of BEL code Beep sounds eight characters from right margin if selected in SETUP Multiple beep sounds during power-up self-check

COMMUNICATION EIA RS-232C

Speeds:	Full-duplex and half-duplex: 50, 75, 110, 134.5, 150, 200, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 9600, and 19,200
Code:	ASCII
Character Format:	Asynchronous
Character Length:	7 or 8 bits: SETUP selectable (if 8-bit length is selected, eighth bit is always space)
Parity:	Even, odd, zero, or one. SETUP selectable
Synchronization:	SETUP selectable through automatic generation of XON and XOFF control codes

1.3 Installation

1.3.1 Site Consideration

The Whizzard 1645 is designed for operator ease and comfort. It is small enough to sit on most desks (Table 1-3). The monitor can be tilted and swiveled to provide good screen visibility under most conditions.

Table 1-3. Dimensions

Overall Dimensions	25″W × 22″H × 35″D (635 × 559 × 889mm)
Weight	79 lbs
MONITOR	
Dimensions	21″W × 16″H × 24″D (533 × 406 × 610mm)
Weight	51 lbs
Display Area	19″ diagonal measurement
ELECTRONIC BASE	
Dimensions	21″W × 5″H × 21″D (533 × 127 × 533mm)
Weight	17 lbs
KEYBOARD	
Dimensions	25″W × 3″H × 12″D (635 × 76.2 × 305mm)
Weight	11 lbs

The Whizzard 1645 terminal can be installed in almost any environment in which the terminal operator would be comfortable. Avoid extreme temperature and humidity conditions for terminal site installation (Table 1-4).

Table 1-4. Environment and Humidity Ranges

Condition	Operating	Non-Operating
Temperature	32 to 140°F (0 to 60°C)	−40 to 185°F (−40 to 85°C)
Relative Humidity	10 to 90%	0 to 95%
Maximum Wet Bulb	82°F (28°C)	N/A
Minimum Dew Point	36°F (2°C)	N/A
Maximum Altitude	8,000 ft (2.4 km)	30,000 ft (9.1 km)

1.3.2 Unpacking and Installation

The Whizzard 1645 carton contains the following:

- Monitor and monitor power cord
- Monitor video cable assembly
- Electronics base and power cord
- Detached keyboard and cable
- Operator's Guide

Assembly of the Whizzard 1645 requires only a small flat-blade screwdriver to insure tight cable connections. Refer to Figures 1-3 and 1-4 for connector locations.

To install the Whizzard 1645:

1. Remove the packing foam and electronic base from the shipping carton and put the electronic base in the work area.

2. Remove the next layer of packing foam and the keyboard. Set keyboard aside.

3. Remove the monitor and place it on the electronic base, fitting the ball on the bottom of the monitor into the socket depression in the electronic base.

4. Verify that the monitor's power requirement label matches the electronic base power requirement label and that they are the correct supply voltage (115V/230V, 115V is the standard in the U.S.). Make sure that the electronic base power switch is off (Figure 1-5).

5. Connect one end of the monitor's power cord to the power cord receptacle on the rear of the monitor. Connect the other end into the AC OUT receptacle on the rear of the electronic base.

6. Connect the monitor's video cable assembly to the receptacle on back of the monitor. Attach the other end of the video cable to the receptacle on the rear of the electronic base (J13).

7. Place the keyboard in front of the terminal and plug the coiled cord into the KEYBOARD receptacle (J-5) on the rear of the electronic base. Secure the plug to the electronic base using the two screws on the plug.

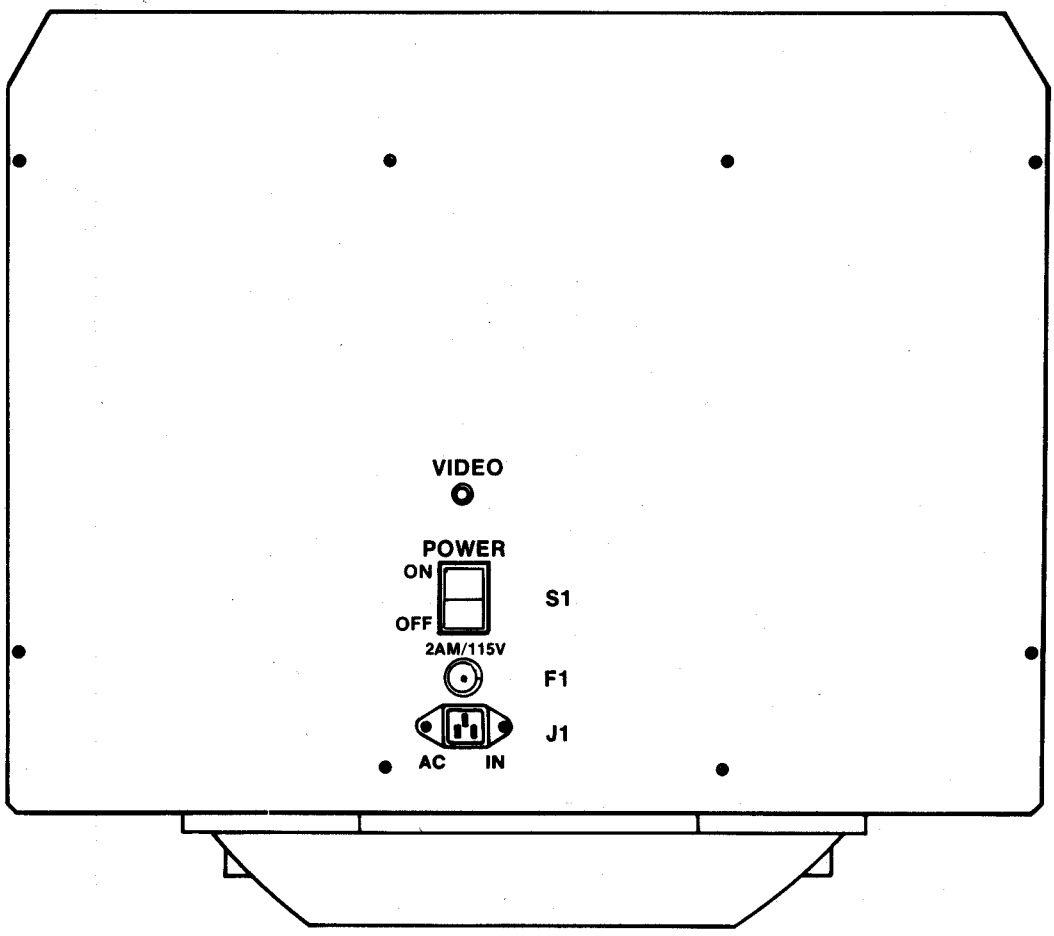

Figure 1-3. Monitor Rear View

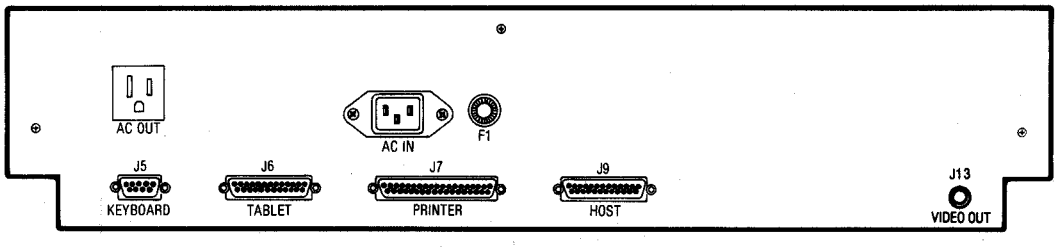

Figure 1-4. Electronic Base Rear View

8. Connect one end of the electronic base power cord into the AC IN receptacle on the rear of the electronic base. Connect the other end of the power cord to an approved ac power source outlet (Table 1-5).

9. Connect the communications cable from your host computer or modem to the HOST receptacle (J-9) on the rear of the electronic base. Secure the plug to the electronic base using the two screws on the plug.

10. If you have the optional data tablet, connect its data cable to the TABLET receptacle (J-6) on the rear of the electronic base. Secure the plug to the electronic base using the two screws on the plug. Plug the data tablet's power supply into the ac power source. Do not connect the power cord to the tablet until after the rest of the system has been tested and operated.

11. If you have the optional printer, connect its data cable to the PRINTER receptacle (J-7) on the rear of the electronic base. Secure the plug to the electronic base using the two screws on the plug. Plug the printer's power cord into the ac power source. Do not turn the printer on until after the rest of the system has been tested and operated.

12. Turn on the power switch located on the back of the monitor.

The Whizzard 1645 is now physically connected. Power for the complete Whizzard 1645 system (except peripherals) is controlled by the MASTER power switch (red rocker) located on the lower right side of the electronic base near the front.

Table 1-5. AC Power Requirements

POWER SOURCE	
Line voltage	115V RMS single phase, 2 wire with ground 230V RMS single phase, 2 wire with ground
Line frequency	50/60 Hz
Input power	270 VA
MONITOR	
Current	1.2 Amps
ELECTRONIC BASE	
Current	1.2 Amps
Current limiting (F1)	4A, 115V normal blow fuse 2A, 230V normal blow fuse

Turn the master power switch on. The switch illuminates when the power is turned on. The Whizzard 1645 will automatically perform the power-up self-test. The keyboard function lamps will light sequentially then turn off. You will hear a two-tone beep and the CUSR MODE lamp located on the keyboard will come on. If the keyboard doesn't light up and beep, make sure both ends of the coiled cord connecting the keyboard to the electronic base are tight. Turn off the power and try again.

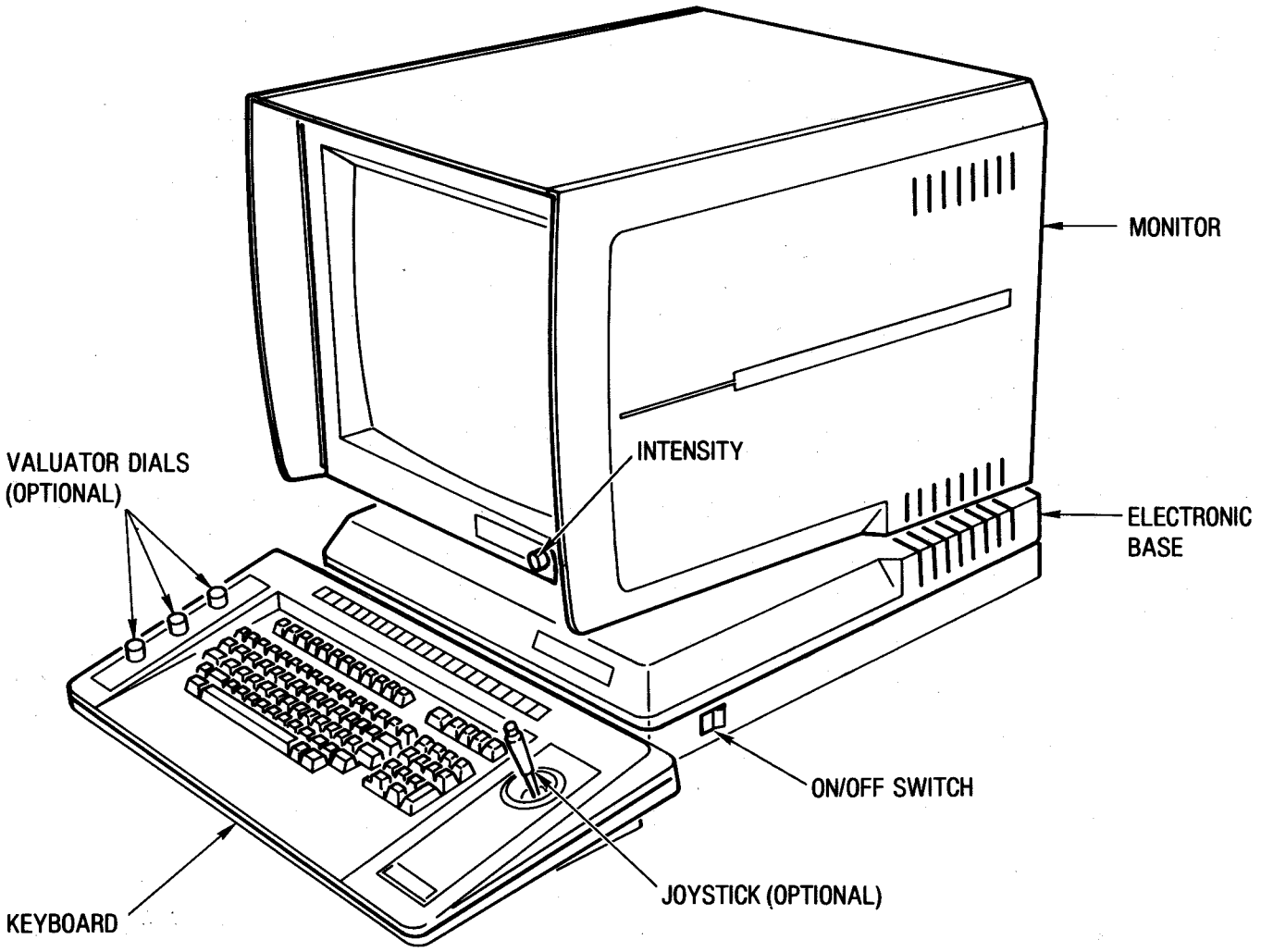

Figure 1-5. Whizzard 1645 Components and Controls

A cursor should appear in the upper-left corner of the screen about the time the keyboard beeps. If the screen is blank, make sure the monitor's power switch is on. Try adjusting the gain and brightness controls on the front of the monitor (Figure 1-5). If you still do not see a cursor, call Megatek's Customer Service Department for assistance.

Selection of SETUP features is discussed in the next section.

1.3.3 Maintenance

The swivel/tilt ball-and-socket (between the monitor and electronic base) and the keyboard are the only moving parts of the terminal and require no preventive maintenance by the operator. The Whizzard 1645's surface may be cleaned with a soft cloth dampened with a mild detergent or with soap and water. Do not remove the keycaps (removing the keycaps might damage the small plastic stems which support them). Abrasive cleaners and cleaners with solvents may damage the housings and should never be used.

CAUTION

Do not put drinks or small objects on the Whizzard 1645. There are several openings through which objects can pass which may damage the electronic components and affect the Whizzard 1645's operation.

Ventilation slots on the sides toward the rear of the monitor and electronic base must be free from obstructions. Blocking these slots may cause the Whizzard 1645 to overheat.

2.0 KEYBOARD FUNCTIONS

2.1 Keyboard (Figure 2-1)

The Whizzard 1645 uses an ergonomically designed keyboard with an alphabetic key arrangement like that of an ordinary office typewriter. Light emitting diodes (LEDs) across the top of the keyboard indicate which user programmable functions are enabled and the current status of the terminal. In addition to the standard typewriter keys, the Whizzard 1645 keyboard has additional keys used to access SETUP, built in functions, and generate control sequences and cursor control commands.

2.1.1 LED Indicators (Figure 2-2)

The keyboard has four LEDs which indicate terminal status. When the BUSY lamp is lit, the Whizzard 1645 is receiving data from the host computer. When the GRPH ON lamp is lit, either the GRPH ON/OFF key has been turned on to allow the display of graphics, or the host computer has enabled the display of graphics. When the CUSR MODE lamp is lit, pressing the cursor movement keys (F9-F12) sends code sequences to the host computer which are used to move the cursor. When not in CUSR MODE, the function codes are transmitted to the host computer. When the KYBD LOCK lamp is lit, the keyboard has been "turned off" automatically because the Whizzard 1645's output buffer is full.

The sixteen remaining LEDs are user programmable and can be turned on, blinked fast or slow, and turned off to indicate a meaning in a specific application. The codes used to manipulate these LEDs are discussed in Section Four.

2.1.2 Tone Generator

The tone generator is a frequency BAUD rate generator producing 16 preset tones (Table 2-1). The duration of the tones can be selected from 0 to 1.5 seconds. The Whizzard 1645 terminal references tone registers in the keyboard allowing a series of tones to be "played" back.

Table 2-1. Selectable Tones

Address	Tone	Address	Tone
0	24.7Hz	8	888.0Hz
1	37.0Hz	9	989.2Hz
2	54.3Hz	10	1184.1Hz
3	66.4Hz	11	1776.1Hz
4	74.0Hz	12	2368.2Hz
5	148.0Hz	13	3552.3Hz
6	296.0Hz	14	4736.4Hz
7	592.0Hz	15	9768.8Hz

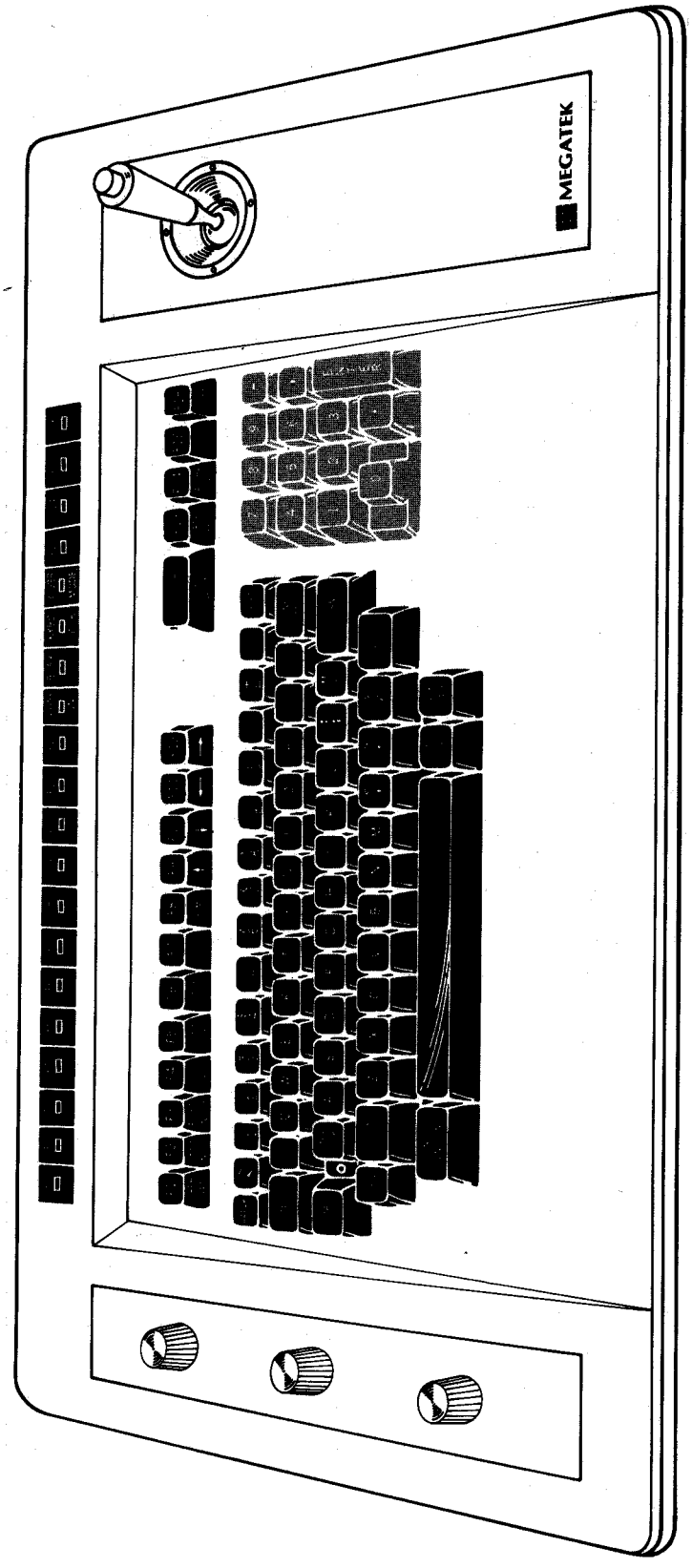

Figure 2-1. Whizzard 1645 Keyboard

2.1.3 Keyboard Operation

When you press most keys on the keyboard, the Whizzard 1645 transmits codes to the host computer. Some keys transmit one or more codes immediately. 2ND FUNCTION and the red keys with white mnemonic phrases on the front initiate local functions. Others, such as CTRL and SHIFT, do not transmit codes themselves, but modify the codes transmitted when other keys are pressed. When a code-transmitting or local function key is pressed, the keyboard can make a click sound to let you know that the key-stroke has been processed by the terminal. Key-click sounds are turned on or off in ASCII terminal setup.

If the 2ND FUNCTION key is pressed but not followed by a valid local function key, the keyboard beeps to let you know a mistake has been made.

If two or more code-transmitting keys are pressed at the same time, the code will be transmitted without waiting for the keys to be lifted. Key codes will continue to be sent as more keys are pressed. No pressed key will repeat, even if automatic key repeat has been enabled in SETUP.

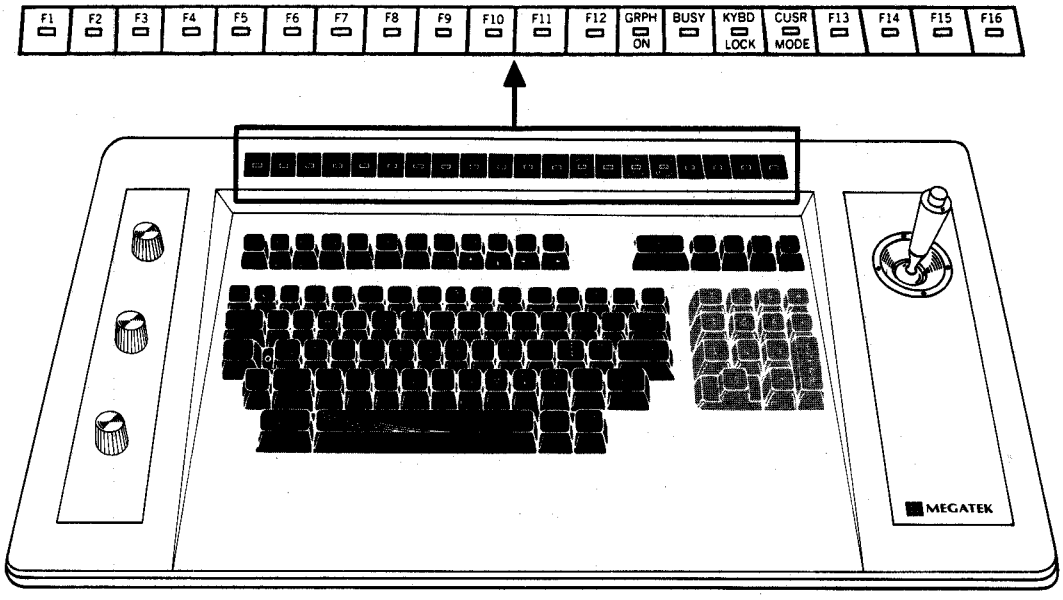

Figure 2-2. Whizzard 1645 Keyboard LED Indicators

2.1.4 Alphabetic Keys

The Whizzard 1645 transmits the codes for the lower-case letters unless one or both of the SHIFT keys are down, or unless the CAPS LOCK mode is on. Pressing the CAPS LOCK key turns the CAPS LOCK mode on and off. When the CAPS LOCK light is on, the 26 alphabetic keys send the codes for the upper-case letters unless either or both of the SHIFT keys are down. Holding down the SHIFT key and pressing any alphabetic key when the CAPS LOCK light is on sends the lower-case code for that key. Table 2-2 shows the codes generated by the alphabetic keys.

Table 2-2. Alphabetic Key Codes

Key	Upper-case Code (hex)	Lower-case Code (hex)	Key	Upper-case Code (hex)	Lower-case Code (hex)
A	41	61	N	4E	6E
B	42	62	O	4F	6F
C	43	63	P	50	70
D	44	64	Q	51	71
E	45	65	R	52	72
F	46	66	S	53	73
G	47	67	T	54	74
H	48	68	U	55	75
I	49	69	V	56	76
J	4A	6A	W	57	77
K	4B	6B	X	58	78
L	4C	6C	Y	59	79
M	4D	6D	Z	5A	7A

2.1.5 Non-alphabetic Keys

Like the alphabetic keys, the non-alphabetic standard typewriter keys generate two different codes depending on whether or not one or both of the SHIFT keys are down. Unlike the alphabetic keys, the non-alphabetic keys are not affected by CAPS LOCK mode. The shift key must be held down to generate the second code. Table 2-3 shows the non-alphabetic keys and the codes they generate.

Table 2-3. Non-alphabetic Key Codes

Character	Code (hex)	Shift Character	Code (hex)
` accent	60	~ tilde	7E
1	31	!	21
2	32	@	40
3	33	#	23
4	34	$	24
5	35	%	25
6	36	↑ up arrow	5E
7	37	&	26
8	38	*	2A
9	39	(	28
0	30	)	29
- hyphen	2D	_ underscore	5F
=	3D	+	2B
\ back slash	5C	| vertical bar	7C
[	5B	{ open brace	7B

Table 2-3. Non-alphabetic Key Codes - Continued

Character	Code (hex)	Shift Character	Code (hex)
]	5D	} close brace	7D
;	3B	:	3A
' apostrophe	27	"	22
, comma	2C	< left arrow	3C
. period	2E	> right arrow	3E
/	2F	?	3F

2.1.6 Special Graphics Characters

In addition to the characters shown on the key caps, the host computer can access the Special Graphics character set, through the SCS control sequence while in terminal mode, to display graphics for ASCII codes 5F(Hex) through 7E(Hex). Table 2-4 shows the representation of these codes for US/UK characters and special graphics.

Table 2-4. Special Graphics Characters

Code (hex)	US/UK Sym	Special Graphics Symbol & Name	Code (hex)	US/UK Sym	Special Graphics Symbol & Name
5F	_	Blank	6B	k	┐ Upper-rt Corner
60	`	◆ Diamond	6C	l	┌ Upper-left Corner
61	a	⁞ Half-tone Block (error)	6D	m	└ Lower-left Corner
			6E	n	+ Cross Lines
62	b	HT Horizontal Tab	6F	o	⎺ Horiz Linescan Scan 1
63	c	FF Form Feed			
64	d	CR Carriage Return	70	p	─ Horiz Linescan Scan 3
65	e	LF Line Feed	71	q	─ Horiz Linescan Scan 5
66	f	° Degree Mark			
67	g	± Plus/Minus	72	r	─ Horiz Linescan Scan 7
68	h	NL New Line	73	s	_ Horiz Linescan Scan 9
69	i	VT Vertical Tab			
6A	j	┘ Lower-rt Corner	74	t	├ Left T

Table 2-4. Special Graphics Characters - Continued

Code	US/UK Sym	Special Graphics Symbol & Name	Code	US/UK Sym	Special Graphics Symbol & Name
75	u	⊣ Right T	7A	z	⩾ Greater Than or Equal To
76	v	⊥ Bottom T	7B	{	π Pi
77	w	T Top T	7C	|	≠ Not Equal
78	x	| Vertical Bar	7D	}	£ Sterling
79	y	⩽ Less Than or Equal To	7E	~	· Center Dot

2.1.7 Operation Keys

Several keys carry names instead of symbols. These keys generate control codes which do not produce displayable characters but which may be interpreted by the host computer and by the Whizzard 1645. When these codes are received by the Whizzard 1645, the action indicated in Table 2-5 occurs.

Table 2-5. Operation Key Codes

Key	Code (hex)	Action
RETURN	0D	Returns cursor to beginning of line
LINEFEED	0A	Moves cursor down one line or scrolls screen up one line if cursor is on last screen line. May move current position to first position in the new line depending on SETUP
BACKSPACE	08	Moves cursor one position to the left
TAB	09	Moves cursor to the next tab position
SPACE BAR	20	Moves cursor one position to the right eliminating any previous character in that position
DELETE	7F	Places a half-tone block in the next position to the right eliminating any previous character in that position
ESC	1B	Indicates that a special command sequence follows

Table 2-5. Operation Key Codes - Continued

Key	Code (hex)	Action
SCROLL	11 13	Generates an XON or XOFF code to start or stop screen scrolling so that data on the screen may be easily examined. If the host computer's software recognizes XOFF, transmission of data stops until the SCROLL key is pressed again, generating XON, to allow scrolling
BREAK		Forces the communication line to its zero state for approximately 3 seconds

2.1.8 Control Keys

If the CTRL key is held down while one of the characters in Table 2-6 is typed, a control code is generated. The SHIFT key must also be held down to type the upper-case characters. These control codes may have a special meaning to the software on your host computer. The codes transmitted are in the range 00 (Hex) — 1F (Hex).

Table 2-6. Control Codes

Character	Code (hex)	ANSI Mnemonic	Character	Code (hex)	ANSI Mnemonic
@	00	NUL	P or p	10	DLE
A or a	01	SOH	Q or q	11	DC1 or XON
B or b	02	STX	R or r	12	DC2
C or c	03	ETX	S or s	13	DC3 or XOFF
D or d	04	EOT	T or t	14	DC4
E or e	05	ENQ	U or u	15	NAK
F or f	06	ACK	V or v	16	SYN
G or g	07	BEL	W or w	17	ETB
H or h	08	BS	X or x	18	CAN
I or i	09	HT	Y or y	19	EM
J or j	0A	LF	Z or z	1A	SUB
K or k	0B	VT	[	1B	ESC
L or l	0C	FF	backslash	1C	FS
M or m	0D	CR	]	1D	GS
N or n	0E	SO	tilde	1E	RS
O or o	0F	SI	?	1F	US

2.1.9 Control Characters

The control characters recognized by the Whizzard 1645 are shown in Table 2-7. Other control codes have no effect.

Table 2-7. Control Characters

BIN	DEC	OCT	HEX	CHAR	ACTION
0000000	000	000	00	NUL	Ignored by Whizzard 1645
0000101	005	005	05	ENQ	Sends answerback message
0000111	007	007	07	BEL	Keyboard beeps
0001000	008	010	08	BS	Moves current position one character position to left. At left margin, moves to last character position on previous line but not past top margin
0001001	009	011	09	HT	Moves current position to next tab position to right or to (but not past) right margin
0001010	010	012	0A	LF	Moves current position to next line down, but not past bottom margin. May move current position to first position in the new line depending on SETUP
0001011	011	013	0B	VT	Interpreted as LF
0001100	012	014	0C	FF	Interpreted as LF
0001101	013	015	0D	CR	Moves current position to left margin on current line. May move current position to first position in the new line depending on SETUP
0001110	014	016	0E	SO	Shifts Out of normal character set, see SCS sequence
0001111	015	017	0F	SI	Shifts In normal character set, see SCS sequence
0010001	017	021	11	XON	Enables data communication between the Whizzard 1645 and the host computer
0010011	019	023	13	XOFF	Disables data communication between the Whizzard 1645 and the host computer
0011000	024	030	18	CAN	Stops action of current control sequence, display half-tone block
0011010	026	032	1A	SUB	Same action as CAN
0011011	027	033	1B	ESC	Introducer Control Character

Table 2-7. Control Characters - Continued

BIN	DEC	OCT	HEX	CHAR	ACTION
0011101	029	035	1D	GS	Puts 1645 in graphics mode
0011111	031	037	1F	US	Puts 1645 in alphanumeric mode
1111111	127	177	7F	DEL	Deletes the previous character

2.1.10 Data Entry Keypad Codes

When the Whizzard 1645 is not in Data Entry Keypad Mode, the keys on the data entry keypad transmit the codes for the numerals, decimal point, minus sign, and comma as shown on the key caps. In addition, the key labeled ENTER transmits the same code as the RETURN key. Software applications using numeric data need not be rewritten to use the data entry keypad since the codes are the same as those generated by the numeric, period, hyphen, comma, and RETURN keys on the main keyboard. Normally, the SHIFT or CTRL keys have no effect on the codes generated.

When the Whizzard 1645 is in the Data Entry Keypad Mode, pressing a key on the data entry keypad generates a sequence of control codes if the SHIFT or CTRL keys (either both or neither) are held down. Each of these sequences may be recognized as a user-defined function. The code sequences are shown in Table 2-8.

Table 2-8. Data Entry Keypad Code Sequences

Key	VT52 Normal	ANSI Normal	SHIFT key Pressed	CTRL key Pressed	SHIFT and CTRL key pressed
0	ESC ? p	ESC O p	ESC 1 p	ESC 2 p	ESC 3 p
1	ESC ? q	ESC O q	ESC 1 q	ESC 2 q	ESC 3 q
2	ESC ? r	ESC O r	ESC 1 r	ESC 2 r	ESC 3 r
3	ESC ? s	ESC O s	ESC 1 s	ESC 2 s	ESC 3 s
4	ESC ? t	ESC O t	ESC 1 t	ESC 2 t	ESC 3 t
5	ESC ? u	ESC O u	ESC 1 u	ESC 2 u	ESC 3 u
6	ESC ? v	ESC O v	ESC 1 v	ESC 2 v	ESC 3 v
7	ESC ? w	ESC O w	ESC 1 w	ESC 2 w	ESC 3 w
8	ESC ? x	ESC O x	ESC 1 x	ESC 2 x	ESC 3 x
9	ESC ? y	ESC O y	ESC 1 y	ESC 2 y	ESC 3 y
-	ESC ? m	ESC O m	ESC 1 m	ESC 2 m	ESC 3 m
,	ESC ? l	ESC O l	ESC 1 l	ESC 2 l	ESC 3 l
.	ESC ? n	ESC O n	ESC 1 n	ESC 2 n	ESC 3 n
ENTER	ESC ? M	ESC O M	ESC 1 M	ESC 2 M	ESC 3 M

2.1.11 Function Keys (Figure 2-3)

Across the top of the keyboard are 16 red keys labeled (in white) F1 through F16. When pressed, these keys generate sequences of control characters that may be recognized as user-defined functions by the host computer software. The code generated by each function key depends on whether the SHIFT or CTRL key (either both or neither) is pressed while pressing a function key as shown in Table 2-9.

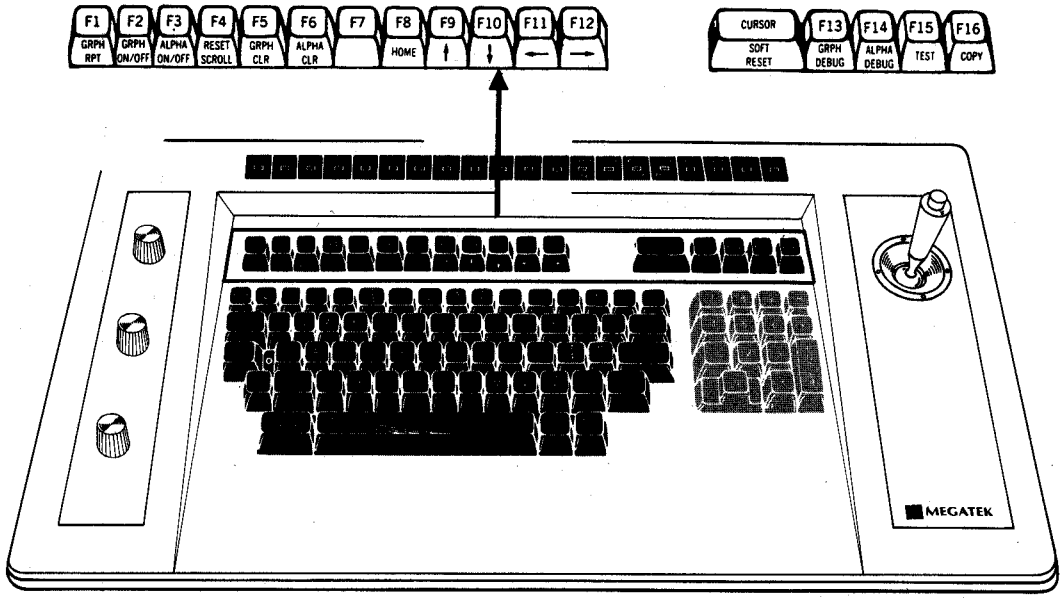

Figure 2-3. Whizzard 1645 Function Keys

Table 2-9. Function Keys Code Sequences

Key	Normal	SHIFT Key Pressed	CTRL Key Pressed	SHIFT and CTRL Key Pressed
F1	ESC 1 D	ESC 2 D	ESC 3 D	ESC 4 D
F2	ESC 1 E	ESC 2 E	ESC 3 E	ESC 4 E
F3	ESC 1 F	ESC 2 F	ESC 3 F	ESC 4 F
F4	ESC 1 G	ESC 2 G	ESC 3 G	ESC 4 G
F5	ESC 1 H	ESC 2 H	ESC 3 H	ESC 4 H
F6	ESC 1 I	ESC 2 I	ESC 3 I	ESC 4 I
F7	ESC 1 J	ESC 2 J	ESC 3 J	ESC 4 J
F8	ESC 1 K	ESC 2 K	ESC 3 K	ESC 4 K
F9	ESC 1 L	ESC 2 L	ESC 3 L	ESC 4 L
F10	ESC 1 M	ESC 2 M	ESC 3 M	ESC 4 M
F11	ESC 1 N	ESC 2 N	ESC 3 N	ESC 4 N
F12	ESC 1 O	ESC 2 O	ESC 3 O	ESC 4 O
F13	ESC O P	ESC 2 P	ESC 3 P	ESC 4 P
F14	ESC O Q	ESC 2 Q	ESC 3 Q	ESC 4 Q
F15	ESC O R	ESC 2 R	ESC 3 R	ESC 4 R
F16	ESC O S	ESC 2 S	ESC 3 S	ESC 4 S

If the Whizzard 1645 has been put in DEC VT52 emulation mode (ASCII terminal setup) in SETUP, the codes generated are slightly different, as shown in Table 2-10.

Table 2-10. VT52 Emulation Differences

Key	Normal	SHIFT Key Pressed	CTRL Key Pressed	SHIFT and CTRL Key Pressed
F13	ESC P	ESC 2 P	ESC 3 P	ESC 4 P
F14	ESC Q	ESC 2 Q	ESC 3 Q	ESC 4 Q
F15	ESC R	ESC 2 R	ESC 3 R	ESC 4 R
F16	ESC S	ESC 2 S	ESC 3 S	ESC 4 S

Cursor Control (Figure 2-4)

Five of the function keys can also be used to control cursor positioning. They are the keys F8-F12 labeled on the front in black with HOME and four arrow keys. The cursor can also be moved with the optional joystick.

When the cursor key has been used to turn on the CUSR MODE lamp and places the Whizzard 1645 in cursor key mode, these keys transmit control sequences different from the normal sequences for F8 through F12. When the CUSR MODE lamp is off, these keys generate function key codes. Different codes are generated for ANSI and VT52 emulation.

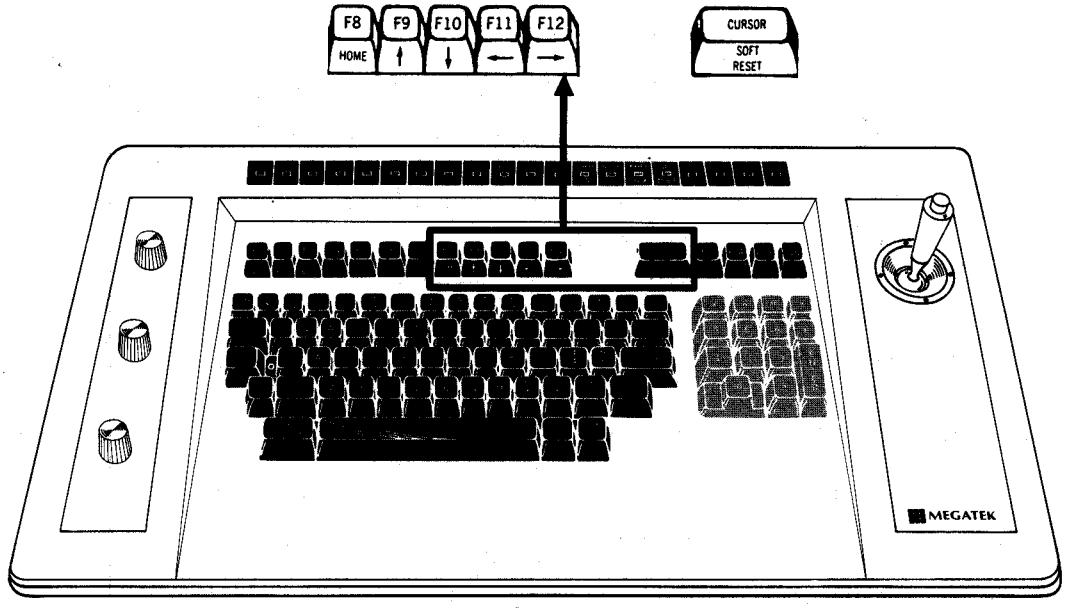

Figure 2-4. Whizzard 1645 Cursor Control

The host computer moves the cursor by sending control sequences to the Whizzard 1645. If cursor mode is on, the same control sequence that a key generates can be returned to the Whizzard 1645 by the host computer to move the cursor. The cursor is moved one character

up, down, left, or right for the arrow keys. If the Whizzard 1645 is emulating a VT52, the cursor is moved to the upper left corner of the screen for the HOME key. When the CUSR MODE lamp is off and the terminal is in ANSI mode, other control sequences are used to move the cursor position.

Table 2-11 shows the control sequences generated by each key and the positioning codes sent by the host computer.

Table 2-11. Cursor Control Codes

Cursor Key	Cursor Mode On		Cursor Mode Off
	VT52	ANSI	VT52 and ANSI
HOME	ESC H	ESC H	ESC 1 K
Up Arrow	ESC A	ESC [A	ESC 1 L
Down Arrow	ESC B	ESC [B	ESC 1 M
Right Arrow	ESC C	ESC [C	ESC 1 O
Left Arrow	ESC D	ESC [D	ESC 1 N

Local Functions

Refer to Figure 2-5 for the following functions. Several functions local to the Whizzard 1645 are listed in white on the front of the function keys. These functions are accessed by pressing the 2ND FUNCTION key and the selected function. A keyboard click indicates that the function is legal and is being performed. Selecting an illegal function causes the keyboard to beep.

a. Graphics Repaint. Pressing the 2ND FUNCTION key and then the GRPH RPT key causes all graphics data stored in graphics memory and that received from the host computer, to be processed and placed in display memory.

b. Graphics Display. Pressing the 2ND FUNCTION key and then the GRPH ON/OFF key turns on or off the graphics data display. The GRAPH MODE lamp is lit if the graphics display is on.

c. Alphanumeric Display. Pressing the 2ND FUNCTION key and then the ALPHA ON/OFF key turns on or off the display of alphanumeric data received from the host computer.

d. Screen Length. Pressing the 2ND FUNCTION key and then the RESET SCROLL key restores the full screen for alphanumeric display after any use which sets the top and bottom margins to create a scrolling area of less than thirty-two lines.

e. Graphics Erase. Pressing the 2ND FUNCTION key and then the GRPH CLR key causes all graphics data received from the host computer to be erased from graphics and display memory.

f. Alphanumeric Erase. Pressing the 2ND FUNCTION key and then the ALPHA CLR key erases all alphanumeric data received from the host computer and places the cursor in the upper left corner of the scrolling area.

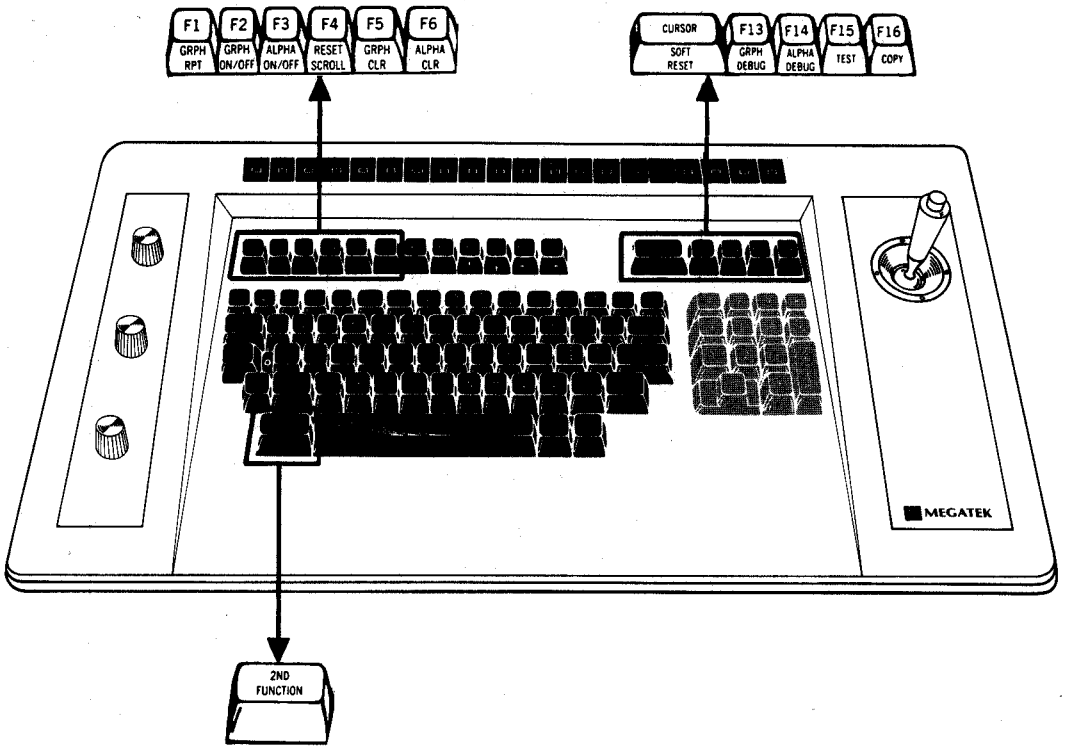

Figure 2-5. Whizzard 1645 Local Functions

g. Soft Reset. Pressing the 2ND FUNCTION key and then the SOFT RESET key erases all alphanumeric data and graphics commands received from the host computer. It causes all graphics data received from the host computer to be erased from display memory, resets all peripherals, and performs the power-up check of the keyboard.

h. Line Analyzer Debugging. The Whizzard 1645 can monitor and display the actual ANSI codes transmitted to and from the host computer over the communications line. This feature is extremely helpful during program development if an unwanted result occurs using either the alphanumeric or graphics capabilities of the Whizzard 1645. Use of the line analyzer is discussed in Section Four.

   Pressing the 2ND FUNCTION key and then the GRPH DEBUG key invokes the communication line analyzer to display graphic commands and data received from and sent to the host computer.

   Pressing the 2ND FUNCTION key and then the ALPHA DEBUG key is used to display ANSI terminal commands, VT100 and VT52 emulation commands, and alphanumeric data received from and sent to the host computer.

i. Keyboard Test. After selecting keyboard test from the diagnostic menu, pressing the 2ND FUNCTION key and then the TEST key initiates keyboard testing.

j. Hardcopy. Pressing the 2ND FUNCTION key and then the COPY key brings up a copy menu on the screen. Communications with the host computer are temporarily suspended using XOFF when XON/OFF has been enabled separately. The menu (Table 2-12) shows the following copy functions available.

Table 2-12. Copy Menu

Menu Selections
COPY FUNCTIONS AVAILABLE 1. GRAPHICS 2. ALPHA OVERLAY 3. GRAPHICS AND ALPHA 4. LINE PRINTER 5. DEBUG OUTPUT 6. EXIT ENTER DESIRED FUNCTION NUMBER:

1. Graphics. Copies the contents of the video display memory to the color printer. A submenu asks if you want black/white reversal which reverses the grey scale used. Black becomes white, dark green becomes light green, and so forth.

2. Alpha Overlay. Copies the text content of the alphanumeric buffer to the color printer.

3. Graphics and Alpha. Copies the contents of the video display memory to the color printer followed by the text content of the alphanumeric buffer. Grey scale reversal is available.

4. Line Printer. Copies incoming text to the color printer. If Auto Wraparound has been turned off in ANSI terminal SETUP, up to 132 columns will be printed across the paper.

5. Debug Output. Copies the output of the line analyzer to the color printer. Colors are used to identify the data and its transmission direction (Table 2-13).

Table 2-13. Transmission Direction

Color	Data	Direction
Green	Alphanumeric	To Host Computer
Magenta	Alphanumeric	To Whizzard 1645
Black	Graphic	To Host Computer
Cyan	Graphic	To Whizzard 1645

6. Exit. Exits the copy menu without initiating a copy.

To stop a copy before it completes, or to stop line printer operation, press the 2ND FUNCTION key and then the COPY key again. Another copy can then be initiated or the COPY function exited.

2.2 Tektronix 4014 Emulation

The Whizzard 1645 emulation functions with minor differences between the two systems.

2.2.1 Operational Differences

The operational differences between the Whizzard 1645 and Tektronix 4014 are as follows:

1. Three of the Tektronix 4014 keyboard control switches are emulated within the Setup Menu under TEK-4014 Setup Control. These are the Local/Line, Margin Control, and Auto Print switches. The Whizzard 1645 emulates the margin control and auto print settings together. The Whizzard 1645 settings are:
   - Auto print off
   - Auto print on - margin 1 full
   - Auto print on - margin 2 full
2. The Tektronix 4014 reset key is emulated by the reset scroll key.
3. The Tektronix 4014 page key is emulated by the graphics repaint key, the graphics clear key, and the alpha clear key. Any of these keys will perform the same function.
4. The following entries for control characters are entered differently on the Whizzard 1645 keyboard as shown in Table 2-14. Programs generating these codes will work correctly.

Table 2-14 Control Character Differences

Control	Tektronix 4014	Whizzard 1645
ESC	CTL-Shift K	CTL [
FS	CTL-Shift L	CTL \
GS	CTL-Shift M	CTL]
RS	CTL-Shift N	CTL ^
US	CTL-Shift O	CTL _
NUL	CTL-Shift P	CTL @

5. The strap options for CR effect, LF effect, and Graphics Input (GIN) mode terminator are included in the Setup Menu under TEK 4014 Setup Control.
6. The Whizzard 1645 copy key emulates the make copy switch on the Tektronix 4014 keyboard.
7. The Joystick emulates the Tektronix 4014 thumbwheels.

8. The Whizzard 1645 cross hair does not stretch across the screen from top to bottom nor side to side.

9. The Whizzard 1645 alpha cursor is an underscore (without blink) instead of a block.

10. A bell will occur if a copy is requested when in Tektronix 4014 mode, and the selected printer is not on-line. Tektronix 4014 does not have this feature.

11. The Whizzard 1645 emulates the Tektronix 4014 graphics area without using the top 20 percent of the screen. Since the alpha mode uses all of the available area on the Whizzard 1645 screen, 20 percent more lines per page can be achieved. The Whizzard 1645 can do the same number of alpha lines within the Tektronix 4014 graphics area as on the Tektronix 4014.

12. The TEK 4014 emulation cannot be entered remotely. It must be entered manually by the operator.

2.2.2 Emulation Exceptions

The Whizzard 1645 emulates the Tektronix 4014 system with the following exceptions:

1. The reduced intensity hold status for retaining data on the display screen is not supported. The display on the screen remains on with normal intensity.

2. The page full light function is not supported.

3. Defocused vectors and character displays are not supported.

4. The write-through mode is not supported.

5. The Tektronix 4014 enhanced graphics module has 12-bit (4096X by 4096Y/4096X by 3120Y viewable) addressability. The Whizzard 1645 emulates the 12-bit addressability, but it only has 512 by 480 pixels. This difference in resolution will cause a mismatch between the two systems.

6. The following Tektronix 4014 compatible peripherals are not emulated:

    - Paper tape reader/performed
    - Flexible disc memory
    - Graphics tablet
    - Mechanical plotter

7. The Whizzard 1645 cannot do Tektronix 4014 emulation involving intensity settings.

3.0 SETUP AND OPERATION

This section deals with setting up the terminal configuration to meet your host computer's communication requirements and with the codes generated by the keyboard. You must use the control sequences outlined in the next section before the codes can get to the host computer. Default settings must be defined.

3.1 Setup

Once you have physically set up the Whizzard 1645, you are ready to logically set it up to talk to the computer on which you create and run programs. Unlike many other terminals, the Whizzard 1645 does not use hardware switches or jumpers or bit settings in control registers to turn terminal features on or off. Instead, the Whizzard 1645 uses self-explanatory English-word menus to select features.

NOTE

If the alpha plane has been turned off, MENUs do not appear.

The terminal configuration selected can be a temporary one or you can store the selected features in Electronically Alterable Read-Only Memory (EAROM). In either case, the terminal operation reflects the features currently in effect. Whenever a Reset is performed in the following situations, all temporary settings are replaced by the features that have been stored in EAROM.

- Using the SETUP menu
- Resetting the terminal through 2ND FUNCTION SOFT RESET
- Pressing the hardware reset button on the rear of the keyboard
- Turning off the terminal power

The host computer can also remotely set up terminal characteristics through the control sequences shown in Appendix B (except when the terminal is in VT52 mode).

To modify the terminal configuration, press the SETUP key next to the space bar. This takes the Whizzard 1645 off the communications line and puts it in SETUP mode. The main SETUP menu has seven categories to choose from:

- Host Interface
- ASCII Terminal
- Graphics Terminal
- Diagnostics
- Retain New Settings
- Reset To Default Settings
- TEK-4014 Setup Control

Setup menus are in a tree structure: from normal operation you go to the main SETUP menu, then to sub-menus and sometimes to sub-sub-menus. To get the main SETUP menu, press the SETUP key. The active category is shown in reverse video.

The CUSR MODE lamp must be lit (by pressing the CURSOR key) to enable the positioning arrow keys. Press the up-arrow and down-arrow keys to move the selector block up and down the list changing the active category. Press the RETURN key in the main menu to select the active category for modification. To return to a previous menu, press the ESC key. To leave SETUP mode, press the SETUP key again.

In sub-menus, the up-arrow and down-arrow keys move the category selector block up and down the list changing the active category. Options available in the category are listed with the option currently in effect shown in reverse video. Like the category selector block, the option selector block is positioned by moving the left-arrow or right-arrow.

3.2 Host Interface Setup

The Host Interface category contains features which must be set correctly so that the Whizzard 1645 can communicate with the host computer. Errors in these settings may cause incorrect data to be sent to (or receive from) the computer. An error may prevent the Whizzard 1645 from communicating with the host computer. Since a great many combinations of settings are possible, the correct option settings must be obtained from personnel at the host computer site. These Host Interface settings are normally changed only when there is a need to communicate with a different host computer or software package.

The Host Interface Setup menu (Table 3-1) shows the following items:

Table 3-1. Host Interface Setup Menu

Menu Items	Selections
BAUD RATE	[45 50 75 110 134.5 300 600 1200 1800 2000 2400 4800 9600 19.2K]
INTER-CHARACTER DELAY TIME (MS)	[0 2 4 8 16 32 64 128]
TURN-AROUND DELAY TIME (MS)	[0 10 20 50 100 200 500 1000]
DUPLEX	[FULL HALF]
PARITY	[EVEN ODD ZERO ONE] (for 8 bit length, one or zero is no parity)
STOP BITS	[1 2]
WORD LENGTH	[8 7]
AUTO XON/XOFF	[OFF ON]

3.2.1 Baud Rate

The baud rate is the speed at which data is sent to and from the host computer and must be set to match the computer's speed. The Whizzard 1645 is capable of communicating at any one of the preselected speeds (45, 50, 75, 110, 134.5, 150, 300, 600, 1200, 1800, 2000, 2400, 4800, 9600, and 19,200 baud). Receive and transmit rates are the same. Incoming data is stored in a 1024-byte circular buffer and processed in the order received.

3.2.2 Inter-character Delay Time

The inter-character delay time, given in milliseconds, is the amount of time between successive characters sent by the Whizzard 1645. This option adjusts the transmission rate to match the rate at which the host computer can process data from the terminal.

3.2.3 Turn-around Delay Time

The turn-around delay time, given in milliseconds, is the time the Whizzard 1645 waits before responding to a request from the host computer. The delay provides time for host computer processing and for changing from transmit mode to receive mode (and vice versa) when communicating at half-duplex.

3.2.4 Duplex

Duplex is set to match simultaneous-receive-and-transmit (FULL) or alternate-receive-and-transmit (HALF). In FULL duplex, codes generated by the keyboard are sent to the host computer but are not displayed on the screen. Only those text characters sent from the host computer are displayed on the screen. In HALF duplex, codes for text characters are displayed on the screen at the same time they are sent to the host computer.

3.2.5 Parity

The parity setting must be set to select parity checking to match that of the host computer. Parity is sent by the Whizzard 1645 but is ignored by the Whizzard 1645 on receipt. Eight bits are sent for each character from the Whizzard 1645. Parity settings include odd or even for seven bit character lengths, or always zero, or always one. For eight bit character lengths, zero or one are no parity. The terminal's sending parity setting must match the parity the computer is receiving. If the parity option does not match, most characters sent to the computer will be rejected even though the character was sent correctly by the Whizzard 1645.

3.2.6 Stop Bits

Stop bits are set to match the host computer's communications protocol.

3.2.7 Word Length

Word length establishes whether characters contain 7 bits or 8 bits. When word length is set for 8-bit operation, bit 8 is set to a space (or 0) for all characters transmitted and is ignored for all characters received.

3.2.8 Auto XON/XOFF

The Auto XON/XOFF setting is used to synchronize communications to prevent buffer overflow of either the Whizzard 1645 or the host computer. When XOFF is received, the Whizzard 1645 stops transmitting any codes except XOFF and XON regardless of the Auto XON/XOFF option setting. An output buffer of 128 bytes holds key codes and sequences. If

the output buffer is filled, the KYBD LOCK lamp lights and keyclicks stop. When an XON is received from the host computer, the Whizzard 1645 resumes sending data. Pressing the 2ND FUNCTION key and then the SOFT RESET key clears the keyboard-locked condition.

When 128 bytes of the Whizzard 1645's input buffer have been filled, the terminal automatically transmits an OFF [13(Hex)] if Auto XON/XOFF is on. The host computer should suspend transmission to the Whizzard 1645 on receipt of this code. The terminal continues to process the received data and when the buffer has only 10 bytes remaining, it transmits an XON [11(Hex)] to signal to the host computer that transmission may resume.

The host computer must respond to an XOFF from the terminal in a timely manner or the buffer will continue to fill until the capacity of the buffer is exceeded and buffer overflow occurs. The following formula may be used to determine the speed of response needed to prevent buffer overflow.

Time (seconds) to respond to XOFF =

$$\frac{895 \times (\text{bits per character} + \text{parity bit} + \text{stop bits} + 1)}{(\text{baud rate})}$$

Example - The Whizzard 1645 is using 8-bit characters, no parity, two stop bits and is communicating at 9600 baud. The terminal has just sent an XOFF to which the host computer must respond in time to avoid buffer overflow.

Time to respond to XOFF =

$$\frac{895 \times (8+0+2+1)}{9600} = 1.0255 \text{ seconds}$$

If buffer overflow occurs, incoming data overwrites the last byte in the buffer and the error character is displayed.

With Auto XON/XOFF enabled, Whizzard 1645 generates an XOFF when:

1. The Whizzard 1645 input buffer is 128 bytes full.
2. The SCROLL key is pressed.
3. The terminal is placed in SETUP mode or a 2ND FUNCTION is being selected.
4. CTRL is held down and the S key is pressed.

When the buffer empties to 10 bytes, the SCROLL key is pressed again, the terminal is taken out of SETUP mode, a local function is enabled, or by holding CTRL down and pressing the Q key, the Whizzard 1645 will transmit the XON code to resume transmission from the computer to the terminal.

If the host computer software does not support the XON/XOFF codes, data sent during buffer-full conditions (or when the terminal is in SETUP) may be lost. Host computer software which does not support receipt of the XON/XOFF signals can still use the Whizzard 1645 provided the baud rate is limited to 4800 or less, or pad characters (sent after characters of character strings) are sent to the Whizzard 1645.

XOFF/XON protocol is preferable to the insertion of delays or pad characters in the data stream. It ensures that every character or command sent to the Whizzard 1645 will be processed in correct order. It requires a minimum of software support and frees interface programs from timing considerations, resulting in more reliable operation.

The SOFT RESET function, pressing the Hardware Reset button (Figure 3-1) on the rear of the keyboard, and some diagnostic tests accessed through SETUP, reinitialize the terminal and clear the buffer. If data is received from the host computer before such an action is complete, the data is lost.

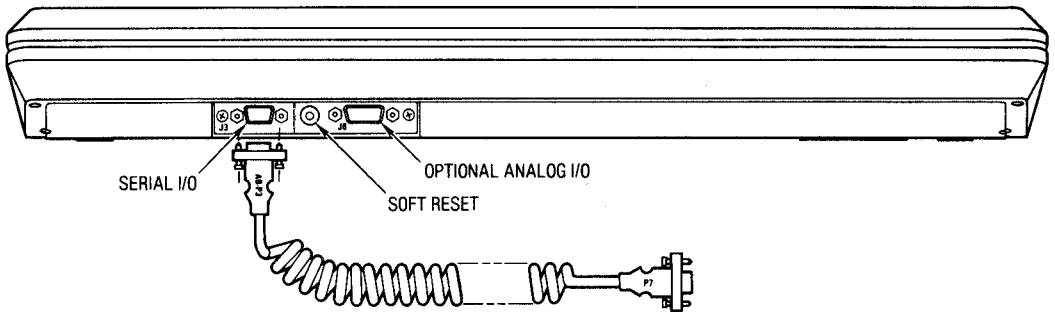

Figure 3-1. Keyboard Rear View

If the XON/XOFF feature is disabled, filling the input buffer above 128 bytes does not cause an XOFF, but the SCROLL key, CTRL-S and CTRL-Q continue to generate XON/XOFF codes. If you transmit an XOFF to the host computer by typing CTRL-S or by pressing the SCROLL key, the host computer should not echo any further typed-in data until you send an XON by typing CTRL-Q or pressing the SCROLL key again. The operator is responsible for preventing overflow of the host computer's input buffer.

3.3 ASCII Terminal Setup

The characteristics of the alphanumeric operation of the Whizzard 1645 are selected through the ASCII TERMINAL SETUP menu. Some features must be matched to the communications of the host computer you use and other features are for your comfort. Table 3-2 shows the ASCII setup menus.

Table 3-2. ASCII Terminal Setup Menu

Menu Items	Selections
AUTO LINE FEED	[OFF ON]
AUTO WRAPAROUND	[OFF ON]
AUTO REPEAT	[OFF ON]
KEYBOARD CLICK	[OFF ON]
MARGIN BELL	[OFF ON]
EMULATION MODE	[VT100 VT52 TEK-4014]

Table 3-2. ASCII Terminal Setup Menu - Continued

Menu Items	Selections
CHARACTER SET	[US UK]
CURSOR TYPE	[BLOCK UNDERSCORE]
CURSOR BLINK	[OFF ON]
TAB SETTINGS	
ANSWERBACK MESSAGE:	

3.3.1 Auto Line Feed

Auto line feed, when ON, causes the cursor to move to the left margin on the next line down when a CR code is received from the host computer. If the current line is at the bottom of the scrolling region, the screen scrolls up one line when the CR code is received. If auto line feed is OFF, it causes the cursor to move to the next line, maintaining the current column position.

3.3.2 Auto Wraparound

Auto wraparound, when ON, causes characters which would otherwise be placed to the right of the right margin to be displaced on the next line. The first character which would be beyond the margin is automatically placed in the first character position of the next line. If wrap-around is OFF, characters overwrite the last character position of the current line.

3.3.3 Auto Repeat

The auto repeat option, when ON, allows a character to be automatically repeated at the rate of about 30 characters per second when the key is held down for more than three-fourths of a second. This option affects all keys except:

- SETUP
- BREAK
- SCROLL
- 2ND FUNCTION and any Local Function key

3.3.4 Keyboard Click

To make the keyboard sound a click when a code-transmitting or local-function key is pressed, set Keyboard click ON. You may turn the click on or off to suit yourself, but most people are more accurate when there is an audible feedback from the keyboard. The click loudness is not adjustable.

3.3.5 Margin Bell

When the margin bell is on, the bell sounds when the cursor moves into the eighth column preceding the right margin. Margin bell loudness is not adjustable.

3.3.6 Emulation Mode

The Whizzard 1645 normally generates and responds to control sequences specified in ANSI standards x3.41-1974 and x3.64-1977. It can also be set to respond to the non-ANSI control sequences used by Digital Equipment Corporation VT52 and Tektronix 4014 by selecting those modes. The codes and responses of the Whizzard 1645 terminal in Emulation modes are outlined in the next section.

3.3.7 Character Set

The U.S. or U.K. character set can be selected as standard. The only difference between the two character sets is one symbol, the # or £ symbol. In the standard U.S. character set the symbol displayed when the SHIFT key and the 3 key on the main keyboard are pressed is the # character. In the U.K. character set, the £ symbol is displayed.

3.3.8 Cursor Type

The Whizzard 1645 offers a choice of two cursor types to indicate the active position where the next character will be placed on the screen. The cursor may be displayed either as an underline (_) or a block (⣿).

3.3.9 Cursor Blink

If cursor blink is ON, the cursor selected will blink about twice per second.

3.3.10 Tab Setting

When the tab settings category is selected, pressing RETURN enters a sub-sub-menu to set horizontal tabs as shown below.

- Use the cursor keys to position the pointer
- Type S for set and C for clear
- Type A to clear all tabs
- Type a number followed by a CR to set tabs at NUMBER intervals

Like a typewriter, the Whizzard 1645 can tab to pre-selected positions on a line through the use of the HT control character and control sequences explained in the next section. Tab stops may be individually changed by using the cursor keys to position the pointer to the column in which you want to put (or clear) a tab stop. Or they can be totally cleared and then set at specific numeric intervals, for example, at every fifth position.

3.3.11 Answerback Message

The host computer can ask the Whizzard 1645 to identify itself using the Answerback facility. Selecting the last category on ASCII terminal setup and pressing RETURN enters a menu or instruction to change the answerback message. The correct answerback message for your host computer, if one is required, should be obtained from the user consultant at the host computer center. The entire request and answerback sequence takes place automatically without affecting the screen or requiring any operator action.

To examine the current answerback message, choose the Answerback message category and press RETURN. Pressing the ESC key returns to the previous menu without changing the answerback message. Pressing any other key changes the answerback message. Follow the instructions on the screen to change the answerback message.

3.4 Graphics Setup

Table 3-3 shows the five categories in the Graphics Setup menu:

Table 3-3. Graphics Setup Menu

Menu Items	Selections
BACKGROUND COLOR	[0 1]
MESSAGE TERMINATOR	[CR CR LF CR EOT CR ETX]
CR EQUALS US	[OFF ON]
SCREEN SIZE	[1024 × 960 1280 × 960]
VALUATOR CLICK	[OFF ON]

3.4.1 Background Color

The background color can be set to black or green by selecting the index (0 or 1).

Colors followed by the word text are the colors in which text characters can appear, as selected in ASCII terminal setup.

3.4.2 Message Termination

The sequence used to terminate a graphics response can be selected from four possibilities:

- CR character only
- CR character followed by LF character
- CR character followed by EOT character
- CR character followed by ETX character

The response terminator should be set to match the requirements of your host computer.

3.4.3 CR Equals US

Entering a CR takes you out of the graphics mode.

3.4.4 Screen Size

The number of picture elements (pixels) on the screen can be set to 1024 horizontal by 960 vertical, or to 1280 horizontal by 960 vertical. The relationship between the 4096 × 4096 virtual units (VU) in the display space to the pixels is 4 VU per pixel for 1026 × 960 and 2 VU per pixel for 1280 × 960. Figure 3-2 illustrates the comparative mapping.

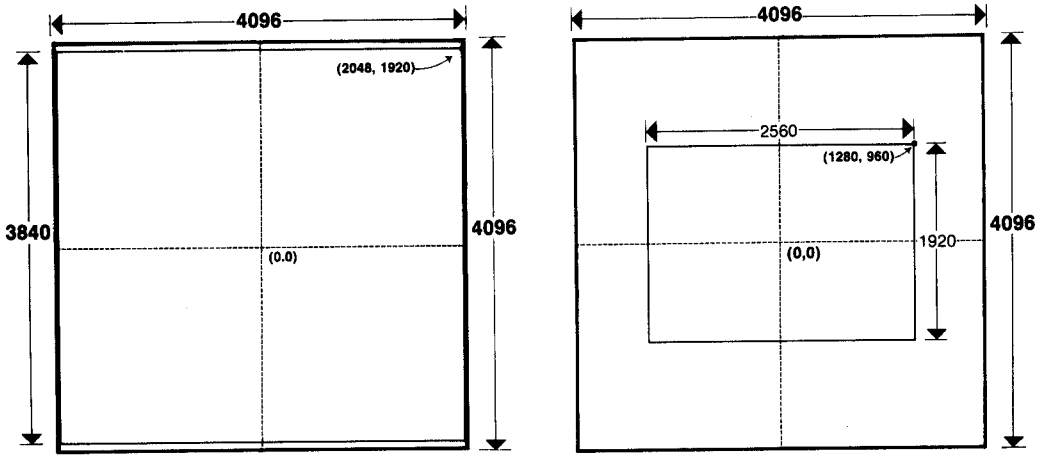

Figure 3-2. Screen Size

3.4.5 Valuator Click

Allows you to enable click for the valuators (control dials, cursor keys, etc.). There will be an audible signal each time a valuator is turned past the current threshold.

3.5 Diagnostic Menu

The Whizzard 1645 system diagnostics consist of a group of thirteen tests as shown in Table 3-4.

These tests are primarily used by servicing personnel in diagnosing possible defects in the Whizzard 1645. They can also be used by the operator to verify system function. In the event of a test failure, service should always be referred to Megatek Customer Service. No user-serviceable parts are contained in the Whizzard 1645.

A self-test capability is built into the Whizzard 1645 that automatically, or on command, tests the condition of the terminal. The automatic self-test program executes tests A, B, C, and F whenever the terminal is turned on. Any failure detected is indicated on the CRT monitor for several seconds before the operating system exits the diagnostic mode.

Table 3-4. Diagnostic Menu

```
                    DIAGNOSTIC MENU

ENTER THE LETTERS OF THE TESTS TO BE RUN IN THE DESIRED ORDER. IF
AN ASTERISK IS THE LAST CHARACTER, THE TEST SEQUENCE WILL LOOP
UNTIL A KEY IS DEPRESSED. IF A QUESTION MARK IS IN THE SEQUENCE,
THE TEST DATA WILL BE LOGGED ON THE PRINTER. AN ESC OR SETUP WILL
TERMINATE THIS MENU.

    A   PROGRAMMABLE VIDEO TIMING CONTROLLER TESTS
    B   UART TESTS
    C   INTERRUPT AND PROGRAMMABLE TIMER TESTS
    D   DIGITAL VECTOR GENERATOR TESTS
    E   GRAPHICS RAM TESTS
    F   CPU RAM TESTS
    G   CONVERGENCE TESTS (GRID PATTERN)
    H   PRINTER TESTS
    I   TABLET TESTS
    J   LIGHT PEN TESTS
    K   KEYBOARD TESTS
    L   PROM CHECKSUMS
    M   DISPLAY OPTIONS

            ENTER SELECTIONS:_____
```

In addition, any system diagnostics can be run on command by selecting Diagnostics from the main Setup Menu. There are several options pertaining to the way in which selected tests are executed. The optional printer can be enabled to obtain hard-copy diagnostic messages. You have the choice of:

- Running a single test
- Running a series of tests
- Running selected tests more than once automatically

Test results are displayed on the CRT monitor. The command syntax for these options is as follows:

Entering a question mark (?) before a test or series of tests to be run will send all displayed information to the printer for obtaining hard-copy.

> Example - Entering ?ABC (CR) will run tests A, B, and C in sequence and print any messages displayed for these tests. Operation returns to the menu at the end of the last test.

Entering an asterisk (*) at the end of a test or series of tests to be run will send displayed data to the printer only in the event of a failure. When the test or series of tests is completed, execution starts over where it initially began. This looping function continues until it is aborted by depressing any keyboard key (normal operation resumes after the last test in the loop is executed).

> Example - Entering ?ABC* (CR) will continuously run a sequence of tests A, B, and C (until aborted) sending any failure data to the printer for hard-copy.

Entering only the asterisk (*), example ABC*(CR), will run a sequence of these tests continuously until aborted. In this condition, data will not be sent to the printer.

Whenever any data is printed, the following identifier appears at the beginning of the print-out:

Whizzard 1645 Identifier: (number)

Where (number) might be the customer purchase order number, a manufacturing code number, etc. This is entered as a fifteen character answerback message.

The following Subsections provide a brief description of each diagnostic test:

3.5.1 CPU RAM

The write/read-back function of the processor Random Access Memory (RAM) is tested. If testing is completed without any failures, a PASS message is displayed, and the test is terminated. Nine or less failures allows the test to continue and will display the failure data on the monitor. Any time the number of failures exceed nine, the test terminates and the failure data is displayed on the monitor.

3.5.2 Convergence (Grid pattern)

This test displays the green convergence grid. Pressing any key will exit the test.

3.5.3 Display Options

Displays the amount of program RAM present in the system, the printer option available, whether the Basic or Extended Keyboard is being used, and the current revision of the firmware.

3.5.4 DVG (Digital Vector Generator)

This is a visual test, using the monitor to verify proper DVG function. The monitor illustrates the various functions of the DVG. The Save/Restore function of the Dash pattern circuitry is also tested here.

a. A series of five scaling tests are accomplished. One in each screen quadrant and one referenced to the center of the screen. This draws the figures using Absolute Move and Absolute Draw.

b. DVG's Viewport Erase function is checked.

c. The screen is cleared to black and then an eight-sided figure is drawn using Relative Move and Relative Draw. This also tests the Dash pattern and Dash resolution.

d. The figure is written over using the Complemented mode.

e. Or-Pixel and Replace-Pixel functions are tested by drawing 16 alternating horizontal and vertical bars.

f. The screen is then cleared and the dash pattern Save/Restore test is accomplished.

A PASS message will appear on the monitor if there are no failures. A failure message is displayed for the pattern component (up to ten) that restores incorrectly. Each dash pattern has a PAT and SQRT component, and FFFF:0000 will be displayed for every PAT failure and 0000:FFFF for every SQRT failure.

3.5.5 Interrupt/Timer

Tests the function of the Programmable Interrupt Controllers in conjunction with the Programmable Timer. If the interrupts operate properly, a PASS message is displayed to end the test. Any failure will cause a failure message to be displayed.

3.5.6 Keyboard

Selecting this test initiates a series of five Extended Keyboard diagnostics:

1. LEDs/TONES - Activates all visual and audible indicators.
2. RAM - Tests the 2K byte static RAM used by the 8085 CPU.
3. USART - Tests the 266-serial communications IC using loop-back.
4. Keyboard Scan - Key depression generates audible indication of function.
5. A-to-D Channels - Verifies valuators, joystick, auxiliary input function.

To run tests 1, 2, 3, and 4, press SECOND FUNCTION key and then the TEST key. To exit the test, press the ~ key. Tests 1, 2, and 3 are executed automatically. Depress the RETURN to exit test 4. To continue the test cycle through the A-to-D channels, depress and hold for at least a half second the F12 key and (CR) at the same time. Tones and lights should change as valuators and joystick are manipulated. Exit Keyboard Test by depressing RETURN and holding for at least a half second. Diagnostic menu should reappear.

Keyboard Test status is transmitted to and displayed by the monitor during the execution of these five tests.

NOTE

The test for the Basic Keyboard consists simply of pressing the various keys and using the monitor to verify transmission of the proper character or symbol. Some keys transmit no displayable symbol.

3.5.7 Light Pen

Not supported on the Whizzard 1645.

3.5.8 Printer

With the printer correctly connected, the printer prints 96 lines of 132 characters so that each character position prints a complete character set. Any fault condition found are displayed on the monitor and the test terminates. If all lines are printed without any failures occurring, the END message will appear and the test terminates.

The possible fault conditions and messages displayed in the event of their occurrence are:

1. Time-Out
2. Off Line
3. Out of Paper
4. Other Fault Condition

3.5.9 PROM Checksums

Displays the identifier (starting address in memory) and the corresponding checksum (in Hex) of the 12 operating system PROMs. It also displays current firmware revision.

3.5.10 PVTC/Character Memory

Tests Programmable Video Timing Controller circuitry by displaying a complete character set on the monitor. Also tests storage/read-back capability of the character memory. If there are no failures, a PASS message is displayed, and the test is terminated. Nine or less failures allows the test to continue and will display the failure data on the monitor. Any time the number of failures exceed nine, the test terminates and the failure data is displayed on the monitor.

3.5.11 Tablet

With the tablet correctly connected, the cross hair displayed by the monitor should track the movement of the pen over the table surface. Pressing any key exits the test.

3.5.12 UART (Universal Asynchronous Receiver/Transmitter)

Tests the transmit/receive capabilities of the Whizzard 1645's three UARTs for serial communication with the host computer, the tablet, and the keyboard. An ASCII character is simultaneously transmitted and received using the loop-back mode of operation. All three devices are tested and if there are no failures, the PASS message is displayed on the monitor. A failure message is issued in the event that proper UART status does not occur. The number of the device that failed will be displayed.

#1 - Keyboard UART
#2 - Tablet ART
#3 - Host Computer

3.5.13 Graphics RAM

The write/read/display capabilities of the Video RAM is checked by this test. Locations in the Video RAM are written to by drawing enough one-pixel-wide

vertical vectors to fill the screen. Each memory location is then read back horizontally using the DVG's pixel-readback function. If there are no failures, a PASS message is displayed, and the test is terminated. Nine or less failures allows the test to continue and will display the failure data on the monitor. Any time the number of failures exceed nine, the test terminates and the failure data is displayed on the monitor.

3.6 Retain New Settings

Changes to Setup items are temporary unless retained by selecting Retain New Settings in the main Setup menu. When this category is selected, The Whizzard 1645 responds:

Do you really want to retain new settings? (Y/N)

This question allows you to change your mind. If you press the N key followed by RETURN, the changes are not made. If you press the Y key and RETURN, the changes to the settings are retained in EAROM until subsequently changed. In either case, the main Setup menu is again displayed.

3.7 Reset to Default Settings

To return the Whizzard 1645 to the Setup parameters previously retained, you can select Reset to Default Settings in the main Setup menu. All settings are instantly restored.

3.8 TEK-4014 Setup Control

Table 3-5 shows the five categories in the Tektronix 4014 Setup Control Menu. The TEK 4014 emulation cannot be entered remotely, it must be entered manually by the operator.

Table 3-5. TEK-4014 Setup Control Menu

Menu Items	Selections
LOCAL / ON LINE	[LOCAL ON LINE]
TEKTRONIX MODE	[NORMAL ENHANCED]
TERMINATOR	[NONE CR EOT CR]
AUTO COMMANDS	[NONE AUTO CR AUTO LF AUTO CR LF]
AUTO PRINT SETTINGS	[OFF MARGIN 1 FULL MARGIN 2 FULL]

These Tektronix 4014 menu selections are not saved within the Whizzard 1645 on power down or hardware resets. The defaults on power up or hardware reset are:

- ON LINE
- ENHANCED
- NONE
- NONE
- OFF

3.8.1 Local/On Line

This sequence is used to select:

- LOCAL - isolates the terminal from the host computer and causes the terminal to execute keyboard inputs
- ON LINE - permits exchange of data between the host computer and the terminal

3.8.2 Tektronix Mode (ENHANCED)

The Tektronix Mode is used for selecting the operating mode. The enhanced TEK-4014 contains the enhanced graphics module options of the TEK-4014. These include 12-bit graphic input, different vector line formats, incremental plot mode, point plot mode, and the special point plot mode.

3.8.3 Terminator

This selection determines the character(s) sent after an address transmission, if any, while in the TEK-4014 Graphics Input (GIN) mode. The sequence used to terminate a graphics response can be one of three possibilities:

- NONE - no termination after status
- CR character only - send CR after status
- CR character followed by EOT character - send CR and EOT after status

The response terminator should be set to match the requirements of the host computer.

3.8.4 Auto Commands

The four auto commands controlling CR and LF effecting strap options are:

- NONE - LF or CR only
- AUTO CR - perform CR after any LF (not presently installed)
- AUTO LF - perform LF after any CR
- AUTO CR LF - perform CR after LF, or LF after CR

3.8.5 Auto Print Settings

The three auto print selections are:

- OFF - do not generate hardcopy when margins are full
- MARGIN 1 FULL - generate a hardcopy when TEK-4014 alpha mode, before a linefeed is performed, after the last line in margin 1
- MARGIN 2 FULL - generate a hardcopy after the last line in margin 2

4.0 PROGRAM COMMANDS

This section provides the commands used in terminal programming. Each command is listed by the function name and its mnemonic and provides a description of what the command does.

4.1 Terminal Programming

The Whizzard 1645 can be used as an alphanumeric input/output device for a host computer. Information entered on the keyboard is sent to the computer and text data coming from the host computer is displayed on the screen.

This section discusses:

- Data flow between the Whizzard 1645 and the host computer, including the codes generated by the keyboard
- The operation of the Whizzard 1645 in response to control codes
- The transmission protocol followed by the terminal in both ANSI and Digital Equipment Corporation VT100/VT52 terminal emulation modes of operation

4.2 Line Analyzer Debugging

4.2.1 Debugging

Pressing the 2ND FUNCTION key and then the GRPH DEBUG key invokes the communication line analyzer to display graphics commands and data received from and sent to the host computer. Pressing the 2ND FUNCTION key and then the ALPHA DEBUG key is used to display ANSI terminal commands, VT100 and VT52 commands, and alphanumeric data received form and sent to the host computer.

When the line analyzer is used, an XOFF code is sent to the host computer to stop transmission. The bottom eight lines of the screen are used to display alphanumeric and graphics data transmitted between the Whizzard 1645 and the host computer. The Whizzard 1645 displays a prompting message at the top of the debug scroll area indicating whether the ALPHA DEBUG or GRPH DEBUG mode, or both, has been selected. The message is in the form shown below.

---ALPHA: [FROM HOST] (TO HOST)---GRAPHICS: <FROM HOST> {TO HOST}---

Immediately after debug mode has been selected by pressing the 2ND FUNCTION key followed by the ALPHA DEBUG or GRPH DEBUG key, the line analyzer is ready to receive commands and displays a message below the line analyzer mode indication line. Typing an H followed by a carriage return displays the available commands selections. Pressing the ALPHA DEBUG or GRPH DEBUG key again turns on or off that debugger. Pressing the RETURN key continues the previously set breakpoints.

TABLE 4-1. Debugging Commands

Code	Function
S	Step through transmission. An XON is generated when the SCROLL key is pressed and an XOFF is generated after each line of information is processed
K	Clear all breakpoints previously set
H	Display helpful information explaining selection choices
T	When a breakpoint is encountered, stop with the breakpoint at the top of the debug scroll area
M	When a breakpoint is encountered, stop with the breakpoint at the middle of the debug scroll area
B	When a breakpoint is encountered, stop immediately. The breakpoint is near or at the bottom of the debug scroll area

To set breakpoints, type a mode indicator followed by the break data. If the data is an ANSI character, it must be preceded by an apostrophe ('), otherwise the data following the mode indicator is interpreted as byte data. Refer to Table 4-2 for the mode indicators.

TABLE 4-2. Mode Indicators

Indicator	Mode
[	Host computer to Whizzard 1645 in alphanumeric
(	Whizzard 1645 to host computer in alphanumeric
<	Host computer to Whizzard 1645 in graphics
{	Whizzard 1645 to host computer in graphics

All commands must be followed by a space or carriage return. Table 4-3 provides examples of breakpoints.

TABLE 4-3. Examples of Breakpoints

Mode Indicator	Function
(0A or (A	Break when the hex value 0A (the ASCII line feed character) is sent from the Whizzard 1645 to the host computer in alpha-numeric analyzer mode
['A	Break when the ASCII code for the letter A (41_{16}) is sent from the host computer to the Whizzard 1645 in alphanu-meric analyzer mode

Table 4-3. Examples of Breakpoints - Continued

Mode Indicator	Function
{ }	Break when any graphics data is sent from the Whizzard 1645 to the host computer in graphics analyzer mode
A	Break when the ASCII code for the letter A (41_{16}) is sent from the host computer to the Whizzard 1645 in graphics mode
[ ]	Break when anything is sent from the host computer to the Whizzard 1645 in alphanumeric analyzer mode

4.2.2 Copy Menu

Pressing the 2ND FUNCTION key and then the COPY key brings up a copy menu on the screen. Selection Five copies the output of the line analyzer to the color printer. Colors are used to identify the data and its transmission direction. Refer to Table 2-13 for color identification and transmission direction.

The mode indicators precede the printed analyzer output to further aid in distinguishing data type and direction. To stop a hard copy of the line analyzer output, press the 2ND FUNCTION key and then the COPY key again. Another copy can then be initiated or the COPY function exited.

4.3 Terminal Control Commands

The Whizzard 1645 recognizes control commands which are used by the host computer to position the cursor, light function lamps, sound a beep, enter, and exit Whizzard 1645 graphics mode. The American National Standards Institute (ANSI) has standardized escape and control sequences for terminals in documents X3.41-1974 and X3.64-1977.

The actions of various command sequences depend on the terminal emulation mode selected. The following paragraphs discuss the command sequences recognized by the Whizzard 1645. When the label (VT100) follows an action's name, the action is performed for DEC VT100 compatability. When the label (VT52) follows an action's name, the action is performed for DEC VT52 compatability. Actions without a label are defined in ANSI standards. All new software should be designed around the Whizzard 1645 "ANSI mode" features.

4.4 ANSI Mode Control Sequence Definitions

The following words and phrases define the basic elements of the ANSI control sequences. Certain other definitions are included for clarity.

NOTE

Characters are followed by their Hex code identifier XX_{16}.

4.4.1 Introducer Control Character (ICC)

The ANSI defined escape character ESC ($1B_{16}$), pronounced "escape". In the Whizzard 1645, the ICC is followed by the character [($5B_{16}$) to provide a Control Sequence Introducer (CSI) for supplementary controls. These two characters form a prefix which affects the interpretation of a limited number of following contiguous characters.

4.4.2 Intermediate Character

A character following the CSI in the range 20_{16} through $2F_{16}$. Intermediate characters make up the parameter or parameter string of a control sequence.

4.4.3 Pn (Numeric Parameter)

A parameter that represents a number and which consists of a string of zero or more decimal characters, in the range of 0 (30_{16}) through 9 (39_{16}), which represents a single value. Leading zeros are ignored.

4.4.4 Ps (Selective Parameter)

A parameter used to select a subfunction from a specified list of subfunctions which is in the range 0 (30_{16}) through 9 ($3B_{16}$).

4.4.5 Parameter String

A string of parameters separated by a (semicolon) ($3B_{16}$).

4.4.6 Default

A function-dependent value that is used when no explicit value is specified.

4.4.7 Final Character

A character which indicates the end of an escape or control sequence. It lies in the range 30_{16} through $7E_{16}$ for escape sequences and in the range 40_{16} through $7E_{16}$ for control sequences.

4.4.8 Alphanumeric Terminal Mode

The operation of the Whizzard 1645 as a standard alphanumeric input/output terminal, not utilizing its graphics capabilities. The Whizzard 1645 is in alphanumeric terminal mode after the receipt of the US ($1F_{16}$) control character.

4.4.9 Character Position

The line and column in which a character appears. Character positions may be absolute in a field 32 lines vertically by 80 columns horizontally, or may be relative to current margin settings.

4.4.10 Cursor

A block or underline symbol which indicates the character position that the next character placed on the screen will occupy. The cursor symbol is selectable in SETUP and may be made to blink or be steady.

4.4.11 Cursor Control

The ability to move the cursor to a character position by using the five keys labeled with HOME, ↑, ↓, ←, and →. The host computer uses the control sequences produced by these keys to move the cursor.

4.4.12 Editor Function

A control sequence that affects the positioning of text on the screen but which is not part of the text data.

4.4.13 Format Effector

A control sequence that affects the positioning of text on the screen and which may be part of the text data.

4.4.14 Graphic Character

A displayable character. A special character not part of the standard characters appearing on the keyboard.

4.4.15 Graphics Mode

The operation of the Whizzard 1645 as a graphics terminal for the display of lines, characters, and objects. The Whizzard 1645 is in graphics mode after the receipt of the GS ($1D_{16}$) control character.

4.4.16 Text Character

A displayable character, one of the standard alphanumeric characters found on the keyboard.

A parameter string in a control sequence with more than one parameter usually has the same effect as several control sequences, each with one parameter.

For example: ESC [Ps1; Ps2; Ps3 F
Has the same function as:
ESC [Ps1 F, ESC [Ps2 F, ESC [Ps3 F

If a control character in the range 0_{16} through $1F_{16}$, other than the character ESC ($1B_{16}$), occurs in a control sequence, the sequence currently being processed is terminated and the function of the control character is executed. If the character ESC ($1B_{16}$) appears, the sequence being processed is terminated and the sequence introduced by the ESC begins to be processed. The control character CAN (18_{16}) and SUB ($1A_{16}$) abort the currently executing control sequence.

4.5 ANSI Control Sequences

The following escape and control sequences are usually sent from the host computer to the Whizzard 1645 but some are sent in both directions and some are sent to the host computer on its request. The sequences are a subset of ANSI X3.64-1977 and ANSI X3.41-1974 standards. Table 4-4 lists the function of the escape and control sequences.

Table 4-4. Escape and Control Sequences

Function	Mnemonic
Cursor Position Report	CPR
Cursor Backward	CUB
Cursor Down	CUD
Cursor Forward	CUF
Cursor Position	CUP
Cursor Up	CUU
Device Attributes	DA
Device Status Report	DSR
Erase In Display	ED
Erase In Line	EL
Horizontal Tabulation Set	HTS
Horizontal and Vertical Position	HVP
Index	IND
Next Line	NEL
Reverse Index	RI
Reset To Initial State	RIS
Reset Mode	RM
Select Character Set	SCS
Select Graphic Rendition	SGR
Set Mode	SM
Tabulation Clear	TBC

Following is a description of each of the escape and control sequences.

4.5.1 Cursor Position Report - CPR

Whizzard 1645 to Host Computer

ESC [Pn; Pn R Default: Pn = 1

This control sequence is requested by the host computer through a device status report (DSR) sequence. The CPR sequence reports the current position using two parameter values. The first specifies the line and the second specifies the column. The default condition with no parameters present, or parameters of 0, is equivalent to a cursor at home position. Line numbering depends on Origin Mode state.

4.5.2 Cursor Backward - CUB

Editor Function
Host Computer to Whizzard 1645
Whizzard 1645 to Host Computer

ESC [Pn D Default: Pn = 1

The CUB sequence moves the current position to the left by the number of character positions specified by the parameter. If the parameter value is zero or one, the current position is moved one position to the left, otherwise, the current position is moved the specified number of positions to the left. The cursor will not move beyond the left margin.

4.5.3 Cursor Down - CUD

Editor Function
Host Computer to Whizzard 1645
Whizzard 1645 to Host Computer

ESC [Pn B Default: Pn = 1

The CUD sequence moves the current position down within the current column by the number of lines specified by the parameter. Parameter values of zero or one move the current position one line downward. Other values move the current position down by the specified number of lines. The cursor will not move below the bottom margin.

4.5.4 Cursor Forward - CUF

Editor Function
Host Computer to Whizzard 1645
Whizzard 1645 to Host Computer

ESC [Pn C Default: Pn = 1

The CUP sequence moves the current position to the right within the current line. Parameter values of zero or one move the current position one position to the right. Other values move the current position the specified number of character positions to the right. The cursor will not move to the right of the right margin.

4.5.5 Cursor Position - CUP

Editor Function
Host Computer to Whizzard 1645

ESC [Pn; Pn H Default: Pn absent

The CUP sequence moves the current position to the line and the column specified by the two parameter values. A value of 0 or 1 for the first parameter moves the current position to the first line in the display. A value of 0 or 1 for the second parameter moves the current position to the first column in the display. With no parameters, the default condition moves the cursor to the home position. This control sequence produces results identical to those of the format effector counterpart HVP. Line numbering depends on Origin Mode state.

4.5.6 Cursor Up - CUU

Editor Function
Host Computer to Whizzard 1645
Whizzard 1645 to Host Computer

ESC [Pn A Default: Pn = 1

Moves the current position up within the current column. Parameter values of 0 or 1 move the current position one line up. Other values move the current position up by the specified number of lines. The cursor will not move above the top margin.

4.5.7 Device Attributes - DA

Host Computer to Whizzard 1645
Whizzard 1645 to Host Computer

ESC [Pn c Default: See below

The parameter value differs depending on the direction sent.

The host computer requests the Whizzard 1645 to send a device attributes (DA) control sequence by sending the DA control sequence with no parameter or with a parameter of 0.

The Whizzard 1645 responds to the host computer's request by generating the following DA control sequence:

ESC [? 1; 5 c

4.5.8 Device Status Report - DSR

Host Computer to Whizzard 1645
Whizzard 1645 to Host Computer

ESC [Ps n Default: Ps = 0

This sequence is used by the host computer to request status and by the Whizzard 1645 to report the general status of the terminal by using the parameters listed in Table 4-5.

Table 4-5. Device Status Report

Parameter	Parameter Meaning
0	Response from Whizzard 1645 - Terminal ready (default)
5	Command from host computer - Report terminal status using a DSR control sequence
6	Command from host computer - Report current position using a CPR control sequence

The Whizzard 1645 responds with a DSR sequence with a parameter value of 0 whenever a DSR request from the host computer is received with a parameter value of 5.

4.5.9 Erase In Display - ED

Editor Function
Host Computer to Whizzard 1645

ESC [Ps J Default: Ps = 0

This sequence erases characters in the display according to the parameter sent as listed in Table 4-6.

Table 4-6. Erase In Display

Parameter	Parameter Meaning
0	Erase from the current position to the end of the line, including the current position (default)
1	Erase from start of the line to and including the current position
2	Erase entire display. All lines are erased and the cursor does not move

4.5.10 Erase In Line - EL

Editor Function
Host Computer to Whizzard 1645

ESC [Ps K Default: Ps = 0

Erases characters in the current line according to the parameter listed in Table 4-7.

Table 4-7. Erase In Line

Parameter	Parameter Meaning
0	Erase from the current position to the end of the line, including the current position (default)
1	Erase from the start of the line to the current position, including the current position
2	Erase the entire line

4.5.11 Horizontal Tabulation Set - HTS

Screen Format Function
Host Computer to Whizzard 1645

ESC H

Places one horizontal tab stop in the current column.

4.5.12 Horizontal and Vertical Position - HVP

Screen Format Function
Host Computer to Whizzard 1645

ESC [Pn; Pn f Default: Pn absent

This sequence moves the current position to the position specified by the parameters. The first parameter specifies the line position and the second parameter specifies the column. Parameter values of 0 or 1 move the current position to the first line or column in the display, respectively. With no parameters present (default condition) the current position is moved to the home position. This sequence acts exactly like the Whizzard 1645 editor function CUP. Numbering of lines and columns depends on the state of the origin mode.

4.5.13 Index - IND

Screen Format Function
Host Computer to Whizzard 1645

ESC D

This sequence moves the current position down one line within the current column. If the current position is at the bottom margin, the display is scrolled up one line.

4.5.14 Next Line - NEL

Screen Format Function
Host Computer to Whizzard 1645

ESC E

This sequence moves the current position to the first position on the next line down. If the current position is at the bottom margin, the screen is scrolled up one line. This is the same action as CR LF sequence.

4.5.15 Reverse Index - RI

Screen Format Function
Host Computer to Whizzard 1645

ESC M

This sequence moves the current position up one line to the same horizontal position on the preceding line. If the current position is at the top margin, the display is scrolled down one line.

4.5.16 Reset to Initial State - RIS

Host Computer to Whizzard 1645

ESC c

The alphanumeric portion of the Whizzard 1645 is reset to the settings retained in EAROM.

4.5.17 Reset Mode - RM

Host Computer to Whizzard 1645

ESC [Ps; Ps; ...; Ps l Default: Ps absent

This sequence allows one or more Whizzard 1645 modes to be reset as specified by each selective parameter in the parameter string. Each mode to be reset is specified by a separate parameter. See Set Mode (SM) control sequence and the list of ANSI mode settings following this section for a list of modes affected. VT100 terminal emulation modes may also be reset through this control sequence. Refer to the list of VT100 modes following the VT100 Control Sequence.

4.5.18 Select Character Set - SCS

Host Computer to Whizzard 1645

The character set selected for display can be altered through the use of the codes SI and SO (Shift In and Shift Out). To select a particular character set after one of these control codes is sent, the control sequences listed in Table 4-8 are used.

Table 4-8. Select Character Set

SI Uses Sequence	SO Uses Sequence	Designates Character Set
ESC (A	ESC) A	United Kingdom Set
ESC (B	ESC) B	ASCII Character Set
ESC (0	ESC) 0	Special Graphics

The United Kingdom and ASCII sets conform to the "ISO international register of character sets to be used with escape sequences". Special Graphics means that the graphic characters for the codes $5F_{16}$ to $7E_{16}$ are replaced with other characters as shown in Table 2-3. The selected character set is used until another SCS is received.

4.5.19 Select Graphic Rendition - SGR

Screen Format Function
Host Computer to Whizzard 1645

ESC [Ps; . . .; Ps m Default: Ps = 0

This sequence affects the appearance of characters and special graphics as specified, and the background color for both text and graphics. All text characters following the SGR sequence are rendered as specified until the next SGR is received. The background color set through SGR remains until reset by another SGR or SETUP command from the host computer. Table 4-9 lists the SGR parameters.

Table 4-9. Select Graphic Rendition

Parameter	Parameter Meaning
0	Attributes off
7	Reverse video image
30	Text shown in black
37	Text shown in white
All other parameter values are ignored	

4.5.20 Set Mode - SM

Host Computer to Whizzard 1645

ESC [Ps; ...; Ps h Default: Ps absent

Sets one or more modes of operation in the Whizzard 1645 as specified by each selective parameter in the parameter string. The setting of each mode is specified by a separate parameter. A mode is set until another SM sequence is used or until the mode is reset by a reset mode (RM) control sequence. Refer to the list of ANSI mode settings following this section. VT100 terminal emulation modes may also be set through this control sequence. Refer to Table 4-14 for VT100 modes following the VT100 Control Sequence.

4.5.21 Tabulation Clear - TBC

Screen Format Function
Host Computer to Whizzard 1645

ESC [Ps g Default: Ps = 0

This sequence is used to clear horizontal tab stops placed with the HTS sequence. The parameters sent determine the sequence action as shown in Table 4-10.

Table 4-10. Tabulation Clear

Parameter	Parameter Meaning
0	Clear the horizontal tab stop in current column (default case)
3	Clear all horizontal tab stops
Any other parameter values are ignored	

4.6 ANSI Modes

The following modes, specified in the ANSI X3.64-1977 standard, should be considered permanently set, permanently reset, or not applicable, as shown in Table 4-11.

Table 4-11. ANSI Modes

Mode Mnemonic	Mode Function	State
CRM	Control representation	Reset
EBM	Editing boundary	Reset
ERM	Erasure	Set
FEAM	Format effector action	Reset
FETM	Format effector transfer	Reset
GATM	Guarded area transfer	N/A
HEM	Horizontal editing	N/A
IRM	Insertion-replacement	Reset
KAM	Keyboard action	Reset
MATM	Multiple area transfer	N/A
PUM	Positioning unit	N/A
SATM	Selected area transfer	Reset
SRTM	Status reporting transfer	Reset
TSM	Tabulation stop	Reset
TTM	Transfer termination	N/A
VEM	Vertical editing	N/A

The only ANSI Mode which may be changed with Set Mode (SM) and Reset Mode (RM) controls is the New Line Mode (LNM).

Mode Mnemonic - LNM
Mode Function - Line feed/New line mode
ESC - [20]

When the LNM mode is reset, the interpretation of the Line Feed (LF) character implies only vertical movement of the current position. The RETURN key sends the single code CR. When LNM is set, the LF character implies movement to the first position of the following line and causes the RETURN key to send the two codes CR LF.

4.7 VT100 Emulation Control Sequences

The following escape and control sequences are used to emulate certain functions of the Digital Equipment Corporation VT100 terminal. The sequences are usually sent from the host computer to the Whizzard 1645. In some sequences they are sent in both directions and some are sent to the host computer on its request. To insure that the keypad mode for the VT100 is operational, the emulation mode under the ASCII terminal menu needs to be selected and permanently saved by selecting the RETAIN NEW SETTINGS option in the top menu. Table 4-12 lists the escape and control sequences.

Table 4-12. VT100 Escape and Control Sequences

Function	Sequence
Screen Alignment Display	ESC #8
Identify Terminal	ESC Z
Data Entry Keypad	ESC =
Data Entry Keypad Mode	ESC >
Load LEDs	ESC [Ps q
Restore Cursor	ESC 8
Save Cursor	ESC 7
Save Top and Bottom Margins	ESC [Pn; Pn r

4.7.1 Screen Alignment Display

Host Computer to Whizzard 1645

ESC #8

4.7.2 Identify Terminal

Host Computer to Whizzard 1645

ESC Z

This sequence is functionally the same as the ANSI Device Attributes (DA) sequence, returning the same information. The ANSI sequence should be used in new program development.

4.7.3 Data Entry Keypad

Host Computer to Whizzard 1645

ESC = (equal)

This sequence causes the data entry keypad to transmit control sequences as defined in Table 2-8.

4.7.4 Data Entry Keypad Mode

Host Computer to Whizzard 1645

ESC > (greater than)

This sequence causes the data entry keypad to send the normal ASCII codes which correspond with the characters shown on the keys, as shown in Table 2-8.

4.7.5 Load LEDs

Host Computer to Whizzard 1645

ESC [Ps q

This sequence controls the sixteen programmable LEDs across the top of the keyboard as indicated in Table 4-13. The LED numbers are shown on the keyboard.

Table 4-13. Programmable LEDs Meanings

Parameter	Meaning	Parameter	Meaning
0	Turn off all LEDs	19	Turn off F3
1	Turn on F1	20	Turn off F4
2	Turn on F2	21	Turn off F5
3	Turn on F3	22	Turn off F6
4	Turn on F4	23	Turn off F7
5	Turn on F5	24	Turn off F8
6	Turn on F6	25	Turn off F9
7	Turn on F7	26	Turn off F10
8	Turn on F8	27	Turn off F11
9	Turn on F9	28	Turn off F12
10	Turn on F10	29	Turn off F13
11	Turn on F11	30	Turn off F14
12	Turn on F12	31	Turn off F15
13	Turn on F13	32	Turn off F16
14	Turn on F14	33	Blink slowly F1
15	Turn on F15	34	Blink slowly F2
16	Turn on F16	35	Blink slowly F3
17	Turn off F1	36	Blink slowly F4
18	Turn off F2	37	Blink slowly F5

Table 4-13. Programmable LEDs Meanings - Continued

Parameter	Meaning	Parameter	Meaning
38	Blink slowly F6	59	Blink rapidly F11
39	Blink slowly F7	60	Blink rapidly F12
40	Blink slowly F8	61	Blink rapidly F13
41	Blink slowly F9	62	Blink rapidly F14
42	Blink slowly F10	63	Blink rapidly F15
43	Blink slowly F11	64	Blink rapidly F16
44	Blink slowly F12	65	Change F1
45	Blink slowly F13	66	Change F2
46	Blink slowly F14	67	Change F3
47	Blink slowly F15	68	Change F4
48	Blink slowly F16	69	Change F5
49	Blink rapidly F1	70	Change F6
50	Blink rapidly F2	71	Change F7
51	Blink rapidly F3	72	Change F8
52	Blink rapidly F4	73	Change F9
53	Blink rapidly F5	74	Change F10
54	Blink rapidly F6	75	Change F11
55	Blink rapidly F7	76	Change F12
56	Blink rapidly F8	77	Change F13
57	Blink rapidly F9	78	Change F14
58	Blink rapidly F10	79	Change F15
		80	Change F16

4.7.6 Restore Cursor

Host Computer to Whizzard 1645

ESC 8

This sequence restores the previously saved cursor position.

4.7.7 Save Cursor

Host Computer to Whizzard 1645

ESC 7

This sequence saves the current cursor position, graphic rendition, and character set.

4.7.8 Set Top and Bottom Margins

Host Computer to Whizzard 1645

ESC [Pn; Pn r Default: See below

This sequence defines the top and bottom margins of the screen scrolling area. The first parameter specifies the first line in the scrolling area. The second parameter specifies the bottom line. The default is the entire screen, no margins, 42 lines. The minimum length of the scrolling area is two lines. The top margin must be less than the bottom margin. This sequence places the cursor in the new home position.

4.7.9 Define a Tone Register

Host Computer to Whizzard 1645

ESC [1; REG; TONE; TIME; TONE; TIME; ...; t

REG is in the range 0 to 7. The pair TONE; TIME can appear up to eight times in the control sequence. A time of zero ends the cycle through the tones. Table 4-14 lists the tone frequencies and time durations.

Table 4-14. Programmable Tone Frequency and Duration

Tone	Frequency	Time	Duration (Seconds)
0	24.7Hz	0	0
1	37.0Hz	1	.1
2	54.3Hz	2	.2
3	66.4Hz	3	.3
4	74.0Hz	4	.4
5	148.0Hz	5	.5
6	296.0Hz	6	.6
7	592.0Hz	7	.7
8	888.0Hz	8	.8
9	989.2Hz	9	.9
10	1184.1Hz	10	1.0
11	1776.1Hz	11	1.1
12	2368.2Hz	12	1.2
13	3552.3Hz	13	1.3
14	4736.4Hz	14	1.4
15	9768.8Hz	15	1.5

Example: ESC [1; 0; 0; 1; 1; 3; 2; 2; t
Sets register zero with tone 0, time 1, tone 1, time 3, tone 2, time 2.

4.7.10 Play a Tone Register

Host Computer To Whizzard 1645

ESC [0; REG; REG; .....; t

The registers (REG) range from 0 to 7. Any given REG can appear only once in the parameter string. In this case the execution of the tone registers starts with REG and ends when a time of zero is encountered.

4.8 VT100 Emulation Modes

Several VT 100 terminal emulation modes can be set or reset through the SM and RM control sequences. If the first character in the parameter string is a question mark ($3F_{16}$), refer to Appendix C, a VT 100 terminal emulation mode is affected as follows in Table 4-15.

Table 4-15. VT100 Emulation Modes

Parameter	Mode Function
1	Cursor key
2	VT52 emulation
6	Origin
7	Auto wrap-around
8	Auto repeating
Any other parameter values are ignored	

The mode functions are explained in the following paragraphs.

4.8.1 Cursor Key Mode

If the cursor key mode is reset when the Whizzard 1645 is in data entry keypad mode (ESC=) and the ANSI/VT52 mode is set (ANSI mode), the cursor function keys send ANSI cursor control sequences. If the cursor key mode is set, the cursor function keys send function key sequences.

4.8.2 VT52 Emulation Mode Select

When this parameter is reset, only VT52 compatible control sequences are interpreted and executed. When set, only ANSI and VT100 control sequences are interpreted and executed.

4.8.3 Origin Mode

The origin to which left and right, top and bottom margins reference is affected by this mode. Lines and columns are numbered consecutively, with the origin being line 1, column 1.

Resetting the mode puts the origin at the upper-left character position on the screen. Line and column numbers become independent of current margin settings. The cursor may be positioned outside the margins with a cursor position (CUP) or horizontal and vertical position (HVP) control.

When this mode is set, the origin is put at the upper-left character position within the margins. Line and column numbers become relative to the current margin settings. The cursor is not allowed to be positioned outside the margins.

When this mode is set or reset, the cursor is moved to the new home position.

4.8.4 Autowrap Mode

When autowrap mode is reset, text characters received when the cursor is at the right margin write over any previous characters there and the cursor does not advance. Setting autowrap mode moves the current position to the start of the next line if the cursor is at the right margin and more text characters are received. The display will scroll up if required and permitted. Refer to the previous section on SETUP.

4.8.5 Auto-Repeat Mode

When auto-repeat mode is reset, keyboard keys do not repeat when held down. When set, keys send out their codes repeatedly when held down. Refer to the previous section on SETUP.

4.9 Unsupported VT100 Emulation Sequences and Modes

Table 4-16 lists the control sequences used to manipulate the Digital Equipment Corporation VT100 terminal that are not supported on the Whizzard 1645.

Table 4-16. Unsupported VT100 Emulation Sequences and Modes

Mnemonic	Description
DECDHL	Double height line
DECDWL	Double width line
DECREPTPARM	Report terminal parameters
DECREQTPARM	Request terminal parameters
DECSWL	Single width line (not selectable)
DECTST	Invoke confidence test
DECCOLM	Column mode (132/80)
DECSCLM	Smooth scroll
DECSCNM	Screen mode
DECINLM	Interlace selection

4.10 VT52 Emulation Mode Sequences

The following control sequences are used by the Whizzard 1645 to emulate a Digital Equipment Corporation VT52 terminal. They are effective only when VT52 mode has been set through the VT100 emulation mode sequence which sets VT52 emulation mode. These control sequences should not be used when developing new terminal control software. Table 4-17 lists the VT52 Emulation Mode Sequences.

Table 4-17. VT52 Emulation Mode Sequences

Function	Sequence
Cursor Up	ESC A
Cursor Down	ESC B
Cursor Right	ESC C
Cursor Left	ESC D
Select Special Graphics Character Set	ESC F
Select Standard Character Set	ESC G
Cursor to Home	ESC H
Reverse Line Feed	ESC I
Erase to End of Screen	ESC J
Erase to End of Line	ESC K
Direct Cursor Address	ESC Y Pn Pn
Identify	ESC Z
Enter Data Entry Keypad Mode	ESC =
Exit Data Entry Keypad Mode	ESC >
Exit VT52 Mode	ESC <

4.10.1 Cursor Up

Editor Function
Host Computer to Whizzard 1645
Whizzard 1645 to Host Computer

ESC A

This sequence moves the current position up one line within the current column. The cursor stops at the top margin. Refer to CUU sequence.

4.10.2 Cursor Down

Editor Function
Host Computer to Whizzard 1645
Whizzard 1645 to Host Computer

ESC B

This sequence moves the current position down one line within the current column. The cursor stops at the bottom margin. Refer to CUD sequence.

4.10.3 Cursor Right

Editor Function
Host Computer to Whizzard 1645
Whizzard 1645 to Host Computer

ESC C

This sequence moves the current position one position to the right within the current line. The cursor stops at the right margin. Refer to CUF sequence.

4.10.4 Cursor Left

Editor Function
Host Computer to Whizzard 1645
Whizzard 1645 to Host Computer

ESC D

This sequence moves the current position one position to the left within the current line. The cursor stops at the left margin. Refer to CUB sequence.

4.10.5 Select Special Graphics Character Set

Host Computer to Whizzard 1645

ESC F

Alphanumeric graphics character set (Table 2-3) is used. This command accesses VT100 graphics character set which is different from the VT52 character set. The VT52 character set is not supported.

4.10.6 Select Standard Character Set

Host Computer to Whizzard 1645

ESC G

The standard ASCII character set (selected in the setup menu) is used after this sequence is received.

4.10.7 Cursor to Home

Editor Function
Host Computer to Whizzard 1645
Whizzard 1645 to Host Computer

ESC H

The cursor is moved to the home position.

4.10.8 Reverse Line Feed

Editor Function
Host Computer to Whizzard 1645
Whizzard 1645 to Host Computer

ESC I

This sequence moves the current position up one line within the current column. The cursor stops at the top margin. Refer to CUU sequence.

4.10.9 Erase to End of Screen

Editor Function
Host Computer to Whizzard 1645
Whizzard 1645 to Host Computer

ESC J

All characters from the current position to the end of the screen are erased. The current position is not changed. Refer to ED sequence.

4.10.10 Erase to End of Line

Editor Function
Host Computer to Whizzard 1645
Whizzard 1645 to Host Computer

ESC K

All characters from the current position to the end of the current line are erased. The current position is not changed. Refer to EL sequence.

4.10.11 Direct Cursor Address

Editor Function
Host Computer to Whizzard 1645
Whizzard 1645 to Host Computer

ESC Y Pn Pn

This sequence moves the current position to the position specified by the parameters. The first parameter specifies the line position and the second parameter specifies the column. Each line or column number is sent as a single ASCII character whose value is the number plus $1F_{16}$.

Example: "!" (21_{16}) refers to the second line or column, "0" (30_{16}) refers to the 17th line or column, and so forth. Refer to CUP sequence.

4.10.12 Identify

Host Computer to Whizzard 1645
Whizzard 1645 to Host Computer

ESC Z

When this sequence is received from the host computer, the Whizzard 1645 responds with:

ESC / Z

4.10.13 Enter Data Entry Keypad Mode

Host Computer to Whizzard 1645

ESC = (equal)

The numeric keypad keys send control sequences for use by applications programs as defined in Table 2-8.

4.10.14 Exit Data Entry Keypad Mode

Host Computer to Whizzard 1645

ESC > (greater than)

This sequence causes the numeric keypad keys to send the normal ASCII codes which correspond with the characters shown on the keys as defined in Table 2-8.

4.10.15 Exit VT52 Mode

Host Computer to Whizzard 1645

ESC < (less than)

Following this control sequence all subsequent sequences will be interpreted as ANSI or VT100 control sequences. The VT52 sequence listed in this section will be ignored.

APPENDIX A - ANSI CHARACTER CODES

BIN	DEC	OCT	HEX	CHAR
0000000	000	000	00	NUL
0000001	001	001	01	SOH
0000010	002	002	02	STX
0000011	003	003	03	ETX
0000100	004	004	04	EOT
0000101	005	005	05	ENQ
0000110	006	006	06	ACK
0000111	007	007	07	BEL
0001000	008	010	08	BS
0001001	009	011	09	HT
0001010	010	012	0A	LF
0001011	011	013	0B	VT
0001100	012	014	0C	FF
0001101	013	015	0D	CR
0001110	014	016	0E	SO
0001111	015	017	0F	SI
0010000	016	020	10	DLE
0010001	017	021	11	DC1
0010010	018	022	12	DC2
0010011	019	023	13	DC3
0010100	020	024	14	DC4
0010101	021	025	15	NAK
0010110	022	026	16	SYN
0010111	023	027	17	ETB
0011000	024	030	18	CAN
0011001	025	031	19	EM
0011010	026	032	1A	SUB
0011011	027	033	1B	ESC
0011100	028	034	1C	FS
0011101	029	035	1D	GS
0011110	030	036	1E	RS
0011111	031	037	1F	US
0100000	032	040	20	SP
0100001	033	041	21	!
0100010	034	042	22	"
0100011	035	043	23	#

BIN	DEC	OCT	HEX	CHAR
0100100	036	044	24	$
0100101	037	045	25	%
0100110	038	046	26	&
0100111	039	047	27	'
0101000	040	050	28	(
0101001	041	051	29	)
0101010	042	052	2A	*
0101011	043	053	2B	+
0101100	044	054	2C	,
0101101	045	055	2D	–
0101110	046	056	2E	.
0101111	047	057	2F	/
0110000	048	060	30	0
0110001	049	061	31	1
0110010	050	062	32	2
0110011	051	063	33	3
0110100	052	064	34	4
0110101	053	065	35	5
0110110	054	066	36	6
0110111	055	067	37	7
0111000	056	070	38	8
0111001	057	071	39	9
0111010	058	072	3A	:
0111011	059	073	3B	;
0111100	060	074	3C	<
0111101	061	075	3D	=
0111110	062	076	3E	>
0111111	063	077	3F	?
1000000	064	100	40	@
1000001	065	101	41	A
1000010	066	102	42	B
1000011	067	103	43	C
1000100	068	104	44	D
1000101	069	105	45	E
1000110	070	106	46	F
1000111	071	107	47	G
1001000	072	110	48	H
1001001	073	111	49	I
1001010	074	112	4A	J
1001011	075	113	4B	K

BIN	DEC	OCT	HEX	CHAR
1001100	076	114	4C	L
1001101	077	115	4D	M
1001110	078	116	4E	N
1001111	079	117	4F	O
1010000	080	120	50	P
1010001	081	121	51	Q
1010010	082	122	52	R
1010011	083	123	53	S
1010100	084	124	54	T
1010101	085	125	55	U
1010110	086	126	56	V
1010111	087	127	57	W
1011000	088	130	58	X
1011001	089	131	59	Y
1011010	090	132	5A	Z
1011011	091	133	5B	[
1011100	092	134	5C	\
1011101	093	135	5D	]
1011110	094	136	5E	^
1011111	095	137	5F	_
1100000	096	140	60	`
1100001	097	141	61	a
1100010	098	142	62	b
1100011	099	143	63	c
1100100	100	144	64	d
1100101	101	145	65	e
1100110	102	146	66	f
1100111	103	147	67	g
1101000	104	150	68	h
1101001	105	151	69	i
1101010	106	152	6A	j
1101011	107	153	6B	k
1101100	108	154	6C	l
1101101	109	155	6D	m
1101110	110	156	6E	n
1101111	111	157	6F	o
1110000	112	160	70	p
1110001	113	161	71	q
1110010	114	162	72	r
1110011	115	163	73	s

BIN	DEC	OCT	HEX	CHAR
1110100	116	164	74	t
1110101	117	165	75	u
1110110	118	166	76	v
1110111	119	167	77	w
1111000	120	170	78	x
1111001	121	171	79	y
1111010	122	172	7A	z
1111011	123	173	7B	{
1111100	124	174	7C	|
1111101	125	175	7D	}
1111110	126	176	7E	~
1111111	127	177	7F	DEL

APPENDIX B - REMOTE SETUP

The host computer can change terminal parameters normally set by the user in SETUP. The remote setup routine accepts the following control sequence as input to change these settings:

ESC [Ps; ...; Ps s

The parameters are usually sent as a triplet specifying a menu number, category number, and option number. Some options may require fewer than three parameters and some may need more. Several parameter settings may be set using one control sequence. The categories and options for each menu are listed below with examples illustrating how to set the options using remote setup.

There are seven menus available:

1. Host interface
2. ASCII terminal
3. Graphics terminal
4. Diagnostics
5. Retain new settings
6. Reset to default settings
7. TEK-4014 setup control

MENU 1 - HOST INTERFACE

CATEGORY 1	-	**BAUD RATE**
OPTION 1	-	45
OPTION 2	-	50
OPTION 3	-	75
OPTION 4	-	110
OPTION 5	-	134.5
OPTION 6	-	150
OPTION 7	-	300
OPTION 8	-	600
OPTION 9	-	1200
OPTION 10	-	1800
OPTION 11	-	2000
OPTION 12	-	2400
OPTION 13	-	4800
OPTION 14	-	*9600
OPTION 15	-	19.2K

*indicates default setting

CATEGORY 2	-	**INTER-CHARACTER DELAY TIME (ms)**
OPTION 1	-	*0
OPTION 2	-	2
OPTION 3	-	4
OPTION 4	-	8
OPTION 5	-	16
OPTION 6	-	32
OPTION 7	-	64
OPTION 8	-	128

MENU 1 - HOST INTERFACE - Continued

CATEGORY 3	-	**TURN-AROUND DELAY TIME (ms)**
OPTION 1	-	*0
OPTION 2	-	10
OPTION 3	-	20
OPTION 4	-	50
OPTION 5	-	100
OPTION 6	-	200
OPTION 7	-	500
OPTION 8	-	1000

CATEGORY 4	-	**DUPLEX**
OPTION 1	-	*FULL
OPTION 2	-	HALF

CATEGORY 5	-	**PARITY**
OPTION 1	-	EVEN
OPTION 2	-	ODD
OPTION 3	-	*ZERO
OPTION 4	-	ONE

For 8 bit word length, options 3 and 4 are no parity.

CATEGORY 6	-	**STOP BITS**
OPTION 1	-	1
OPTION 2	-	*2

CATEGORY 7	-	**WORD LENGTH**
OPTION 1	-	8
OPTION 2	-	*7

CATEGORY 8	-	**AUTO XON/XOFF**
OPTION 1	-	OFF
OPTION 2	-	*ON

Examples:

1. To set a baud rate of 9600:

   ESC [1; 1; 14 s

2. To set the baud rate to 9600 and also set auto XON/XOFF to ON.

   ESC [1; 1; 14; 1; 8; 2 s

MENU 2 - ASCII TERMINAL

CATEGORY 1	-	**AUTO LINE FEED**
OPTION 1	-	OFF
OPTION 2	-	*ON
CATEGORY 2	-	**AUTO WRAP-AROUND**
OPTION 1	-	OFF
OPTION 2	-	*ON
CATEGORY 3	-	**AUTO REPEAT**
OPTION 1	-	OFF
OPTION 2	-	*ON
CATEGORY 4	-	**KEYBOARD CLICK**
OPTION 1	-	OFF
OPTION 2	-	*ON
CATEGORY 5	-	**MARGIN BELL**
OPTION 1	-	*OFF
OPTION 2	-	ON
CATEGORY 6	-	**EMULATION MODE**
OPTION 1	-	*VT100 EMULATION MODE
OPTION 2	-	VT52 EMULATION MODE
OPTION 3	-	TEK-4014 EMULATION MODE (cannot be entered externally)
CATEGORY 7	-	**CHARACTER SET**
OPTION 1	-	*US
OPTION 2	-	UK
CATEGORY 8	-	**CURSOR TYPE**
OPTION 1	-	*BLOCK
OPTION 2	-	UNDERSCORE
CATEGORY 9	-	**CURSOR BLINK**
OPTION 1	-	OFF
OPTION 2	-	*ON
CATEGORY 10	-	**TAB ROUTINE**
OPTION 1	-	NO RESPONSE
CATEGORY 11	-	**ANSWERBACK MESSAGE**
OPTION n	-	LENGTH OF MESSAGE, MESSAGE CHARACTERS

MENU 2 - ASCII TERMINAL - Continued

To set the answerback message, specify as the value "n" the number of characters in the message (maximum of fifteen) followed by the decimal value for each character in the message.

Example of answerback message input:

ESC [2; 11; 3; 65; 66; 67 s

This sequence selects MENU 2, ASCII TERMINAL, and CATEGORY 11, ANSWERBACK MESSAGE, then specifies that the number of characters in the message is three. The answerback message is set to "ABC by specifying 65; 66; 67 (65 = "A"), 66 = "B", 67 = "C").

MENU 3 - GRAPHICS TERMINAL

CATEGORY 1	-	**BACKGROUND COLOR**
OPTION 1	-	*INDEX 0
OPTION 2	-	INDEX 1
CATEGORY 2	-	**MESSAGE TERMINATOR**
OPTION 1	-	*CR
OPTION 2	-	CR LF
OPTION 3	-	CR EOT
OPTION 4	-	CR ETX
CATEGORY 3	-	**CR EQUALS US**
OPTION 1	-	OFF
OPTION 2	-	*ON
CATEGORY 4	-	**SCREEN SIZE**
OPTION 1	-	1024 X 960
OPTION 2	-	1280 X 960
CATEGORY 5	-	**VALUATOR CLICK**
OPTION 1	-	OFF
OPTION 2	-	*ON

MENU 4 - DIAGNOSTICS

CATEGORY 1	-	**PROGRAMMABLE VIDEO TIMING CONTROLLER TEST**
OPTION 1	-	NUMBER OF TIMES TO RUN TEST
CATEGORY 2	-	**UART TESTS**
OPTION 1	-	NUMBER OF TIMES TO RUN TEST
CATEGORY 3	-	**INTERRUPT AND PROGRAMMABLE TIMER TESTS**
OPTION 1	-	NUMBER OF TIMES TO RUN TEST

MENU 4 - DIAGNOSTICS

CATEGORY 4 - **DIGITAL VECTOR GENERATOR TESTS**
OPTION 1 - NUMBER OF TIMES TO RUN TEST

CATEGORY 5 - **GRAPHICS RAM TESTS**
OPTION 1 - NUMBER OF TIMES TO RUN TEST

CATEGORY 6 - **CPU RAM TESTS**
OPTION 1 - NUMBER OF TIMES TO RUN TEST

CATEGORY 7 - **CONVERGENCE TESTS**
OPTION 1 - NUMBER OF TIMES TO RUN TEST

CATEGORY 8 - **PRINTER TESTS**
OPTION 1 - NUMBER OF TIMES TO RUN TEST

CATEGORY 9 - **TABLET TESTS**
OPTION 1 - NUMBER OF TIMES TO RUN TEST

CATEGORY 10 - **LIGHT PEN TESTS**
OPTION 1 - NUMBER OF TIMES TO RUN TEST

CATEGORY 11 - **KEYBOARD TESTS**
OPTION 1 - NUMBER OF TIMES TO RUN TEST

CATEGORY 12 - **PROM CHECKSUMS**
OPTION 1 - NUMBER OF TIMES TO RUN TEST

CATEGORY 13 - **DISPLAY OPTION**
OPTION 1 - NUMBER OF TIMES TO RUN TEST

Example:

To run the UART tests 3 times and then run the digitizer tablet tests 4 times:

ESC [4; 2; 3; 4; 9; 4 s

When the tests are complete, a carriage return is sent to the WHIZZARD 1645.

MENU 5 - RETAIN NEW SETTINGS

OPTION 0	-	RETURN CONTROL TO TERMINAL
OPTION 1	-	RETAIN NEW SETTINGS

Examples:

To return control to the terminal:

ESC [5; 0 s

To retain the new settings in EAROM and make them permanent until reset through SETUP or by another remote setup sequence from the host computer:

ESC [5; 1 s

No other remote SETUP option may be combined with this control sequence.

MENU 6 - RESET DEFAULT SETTINGS

OPTION 0	-	RETURNS CONTROL TERMINAL
OPTION 1	-	RESET TO DEFAULT SETTINGS

Examples:

To return control to the terminal:

ESC [6; 0 s

To reset to the settings in EAROM:

ESC [6; 1 s

No other remote SETUP option may be combined with this control sequence.

MENU 7 - TEK-4014 SETUP CONTROL

CATEGORY 1 - LOCAL/ON LINE
OPTION 1 - LOCAL
OPTION 2 - ON LINE

CATEGORY 2 - TEKTRONIX MODE
OPTION 1 - NORMAL
OPTION 2 - ENHANCED

CATEGORY 3 - TERMINATOR
OPTION 1 - NONE
OPTION 2 - CR
OPTION 3 - EOT CR

CATEGORY 4 - AUTO COMMANDS
OPTION 1 - NONE
OPTION 2 - AUTO CR
OPTION 3 - AUTO LF
OPTION 4 - AUTO CR LF

CATEGORY 5 - PRINT SETTINGS
OPTION 1 - OFF
OPTION 2 - MARGIN 1 FULL
OPTION 3 - MARGIN 2 FULL

APPENDIX C - CONTROL SEQUENCE SUMMARY

ANSI and VT100 Emulation Modes

CURSOR MOVEMENT COMMANDS

Cursor up	ESC [Pn A
Cursor down	ESC [Pn B
Cursor forward (right)	ESC [Pn C
Cursor backward (left)	ESC [Pn D
Direct cursor addressing	ESC [Pl; Pc H or ESC [Pl; Pc f
Index	ESC D
New line	ESC E
Reverse index	ESC M
Save cursor and attributes	ESC 7
Restore cursor and attributes	ESC 8

Pl = line number; Pc = column number.

Pn refers to a decimal parameter expressed as a string of ASCII digits. Multiple parameters are separated by semicolon characters ($3B_{16}$). If a parameter is omitted or specified to be 0, the default parameter value is used. For the cursor movement commands, the default parameter value is 1.

ERASING

From cursor to end of line	ESC [K or ESC [0 K
From beginning of line to cursor	ESC [1 K
Entire line containing cursor	ESC [2 K
From cursor to end of screen	ESC [J or ESC [0 J
From beginning of screen to cursor	ESC [1 J
Entire screen	ESC [2 J

CHARACTER ATTRIBUTES

ESC [Ps; Ps; Ps; ...; Ps m

Ps refers to a selective parameter. Multiple parameters are separated by semicolons ($3B_{16}$). The parameters are executed in order and have the following meanings:

Parameter	Parameter Meaning
0	Attributes off
7	Reverse video image
30	Text shown in black
37	Text shown in white

All other parameter values are ignored.

PROGRAMMABLE LEDs

ESC [Ps; Ps; ...Ps q

Parameter	Parameter Meaning	Parameter	Parameter Meaning
0	Turn off all LEDs		
1	Turn on F1	41	Blink slowly F9
2	Turn on F2	42	Blink slowly F10
3	Turn on F3	43	Blink slowly F11
4	Turn on F4	44	Blink slowly F12
5	Turn on F5	45	Blink slowly F13
6	Turn on F6	46	Blink slowly F14
7	Turn on F7	47	Blink slowly F15
8	Turn on F8	48	Blink slowly F16
9	Turn on F9	49	Blink rapidly F1
10	Turn on F10	50	Blink rapidly F2
11	Turn on F11	51	Blink rapidly F3
12	Turn on F12	52	Blink rapidly F4
13	Turn on F13	53	Blink rapidly F5
14	Turn on F14	54	Blink rapidly F6
15	Turn on F15	55	Blink rapidly F7
16	Turn on F16	56	Blink rapidly F8
17	Turn off F1	57	Blink rapidly F9
18	Turn off F2	58	Blink rapidly F10
19	Turn off F3	59	Blink rapidly F11
20	Turn off F4	60	Blink rapidly F12
21	Turn off F5	61	Blink rapidly F13
22	Turn off F6	62	Blink rapidly F14
23	Turn off F7	63	Blink rapidly F15
24	Turn off F8	64	Blink rapidly F16
25	Turn off F9	65	Change F1
26	Turn off F10	66	Change F2
27	Turn off F11	67	Change F3
28	Turn off F12	68	Change F4
29	Turn off F13	69	Change F5
30	Turn off F14	70	Change F6
31	Turn off F15	71	Change F7
32	Turn off F16	72	Change F8
33	Blink slowly F1	73	Change F9
34	Blink slowly F2	74	Change F10
35	Blink slowly F3	75	Change F11
36	Blink slowly F4	76	Change F12
37	Blink slowly F5	77	Change F13
38	Blink slowly F6	78	Change F14
39	Blink slowly F7	79	Change F15
40	Blink slowly F8	80	Change F16

CHARACTER SETS (SI and SO selected)

The alternate character sets are selected as follows:

Character set	SI selected	SO selected
United Kingdom (UK)	ESC (A	ESC) A
United States (USASCII)	ESC (B	ESC) B
Special graphics characters	ESC (0	ESC) 0

SCROLLING REGION

ESC [Pt ; Pb r

Pt is the number of the top line of the scrolling region; Pb is the number of the bottom line of the scrolling region and must be greater than Pt.

TAB STOPS

Set tab at current column	ESC H
Clear tab at current column	ESC [g or ESC [0 g
Clear all tabs	ESC [3 g

MODES

	To Set		To Reset	
Mode Name	**Mode**	**Sequence**	**Mode**	**Sequence**
Line feed/new line	New line	ESC [20 h	Line feed	ESC [20 l
Function key mode	Functions	ESC [? 1 h	Cursor	ESC [? 1 l
VT52 select mode	ANSI	N/A	VT52	ESC [? 2 l
Origin mode	Relative	ESC [? 6 h	Absolute	ESC [? 6 l
Wraparound	On	ESC [? 7 h	Off	ESC [? 7 l
Auto repeat	On	ESC [? 8 h	Off	ESC [? 8 l
Keypad mode	Functions	ESC =	Numeric	ESC >

REPORTS

Cursor Position Report

Invoked by	ESC [6 n
Response is	ESC [Pl; Pc R

Pl = line number: Pc = column number

Status Report

Invoked by	ESC [5 n
Response is	ESC [0 n (terminal ok)
	ESC [3 n (terminal not ok)

What Are You

Invoked by	ESC [c or ESC [0 c
Response is	ESC [? 1; 5 c

Also invoked by ESC Z, but use is discouraged. Response is the same.

RESET

ESC c

Resets alphanumeric terminal settings to those stored in EAROM.

CONFIDENCE TESTS

Fill Screen with "E"s	ESC # 8

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