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1 Introduction

This manual is intended only for qualified repair personnel. You will find specifications for the 990/995/995-65 at the end of this Section and detailed circuit descriptions in Section 2.

Using the procedures in Section 3, and schematics in Section 5, and the User's Guide, you can repair most failures quickly.

If you find that you need parts or service, you will find the information you need in Section 4.

OVERVIEW

The TeleVideo 990/995-65 is a high speed, high performance general purpose terminal, designed to operate in the PC terminal, ASCII, and ANSI environments, providing considerable flexibility.

The TeleVideo 995 is the fastest AlphaWindow terminal available because windowing is controlled by a proprietary ASIC chip. The PS/2 style mouse port and mouse provide quick response when selecting and sizing windows or utilizing the cut and paste features.

The screen is driven at 40Khz to provide a very readable display in 80 or 132 columns.

DESCRIPTION OF THE MODULES

TeleVideo 990, 995 and 995-65 are two board design for increased reliability. It has been broken down to the Logic Board and Video Power Supply (VPS).

Logic Circuitry

The 990, 995 and 995-65 are 68000-based terminals running at 14.97Mhz. There are four basic groups:

- **Main Processor**
- **Random Access Memory**
- **Display Processing**
- **Input/Output Interface**

Details in the next section.

Video Power Supply (VPS)

The video circuitry takes care of horizontal and vertical sweep and video amplification. It produces a non-interlaced raster display on the screen. The video signals created by this circuitry generate a series of pixels to appear at predetermined positions on each scan line.

The power supply is autosensing switching supply. It converts input voltage of 90-260 VAC, 47-63Hz to:

- +5 Vdc for TTL logic circuitry.
- +12 Vdc for the video signals and RS-232C communications.
- -12 Vdc for RS-232C communications.
- +37 for video (when H-Sync present).

KEYBOARD

The keyboard is detachable. The port is compatible with keyboards/wedge devices designed for IBM PS/2 computer systems.

MOUSE (995) 995-65 (Optional)

The mouse port supports PS/2 type mouse. It shares the 8042 processor with the keyboard and or wedge device port.

COMMUNICATIONS

TeleVideo's 990/995/995-65 terminals has two serial ports and a parallel port. Com1 (DTE) has a female 25-pin D-connector, Com2 has a 9-pin male connector, parallel port has a 25-pin female connector with Centronic-compatible signal levels.

Note: Terminal *host* can be toggled between Com1 or Com2.

RS-232C SIGNAL ASSIGNMENTS

Com1 Port (DTE) Signals

Pin	Mnemonic	Function	Direction
1		Frame ground	
2	TXD	Transmit data	Output
3	RXD	Receive data	Input
4	RTS	Request to send	Output
5	CTS	Clear to send	Input
6	DSR	Data set ready	Input
7	GND	Signal ground	
8	DCD	Data carrier detect	Input
20	DTR	Data terminal ready	Output

Com2 Port Signals

Pin	Mnemonic	Function	Direction
1	DCD	Data carrier detect	Input
2	RXD	Receive data	Input
3	TXD	Transmit data	Output
4	DTR	Data terminal ready	Output
5	GND	Signal ground	
6	DSR	Data set ready	Input
7	RTS	Ready to send	Output
8	CTS	Clear to send	Input
9		Not Connected	

Parallel Port Signals

Pin	Mnemonic	Function	Direction
1	STB	Data strobe	Output
2	PD0	Data bit 0	Output
3	PD1	Data bit 1	Output
4	PD2	Data bit 2	Output
5	PD3	Data bit 3	Output
6	PD4	Data bit 4	Output
7	PD5	Data bit 5	Output
8	PD6	Data bit 6	Output
9	PD7	Data bit 7	Output
10	ACK	Acknowledge	Input
11	BUSY	Printer is busy	Input
12	PE	Paper empty	Input
13		No Connection	n/a
14		No Connection	n/a
15	ERR	Printer error state	Input
16		No Connection	n/a
17-25	GND	Signal ground	

990, 995 and 995-65 Terminal Logic Hardware

The 990, 995 and 995-65 video display terminals share the same logic board fabrication, but are different in firmware and a few hardware details. The 990 and 995-65 are general purpose terminals while the 995 is an **Alpha Windows** terminal which allows the user to work in multiple applications concurrently.

This chapter is a section-by-section description of the logic board functions.

⇒ The component reference designations are taken from the revision E logic diagram. Refer to this diagram if you wish to follow the logic descriptions.

⇒ The internals of most of the integrated circuits are not described in detail here. This information may be found in the specifications or data sheets of the individual ICs.

⇒ Most hardware functions are similar between the 990, 995 and 995-65; any differences are indicated in the text.

Kosmos ASIC

This TeleVideo custom integrated circuit (U9) has a part in managing most of the terminal functions. To summarize briefly, it performs these functions:

- System clock generation
- Memory and I/O address decoding
- Management of CRT display timing
- Display memory interfacing
- Font memory interfacing
- Support for windowing
- Support for mouse
- Video attribute processing
- Video signal generation
- Beeper tone generation

The following signals are connected to the Kosmos:

Inputs

- 36.8184-MHz dot clock for 80 column display
- 59.86992-MHz dot clock for 132 column display
- CPU address bus
- CPU control bus

Outputs

- 14.97-MHz. system clock (132 column dot clock divided by 4)
- Display memory address bus
- Font memory address bus
- Chip select and control signals for all memory and I/O devices
- Digital video
- Sweep synchronization signals
- Vertical sweep amplitude control
- Beeper tone and volume control
- Data transfer acknowledge (to CPU)
- Interrupt for display functions (new-line and new-frame)

- Power management control

Bi-directional signals

- CPU data bus
- Display memory data bus
- Font memory data bus

Video Display Management

To display text characters on the terminal screen, the electron beam in the CRT must be scanned vertically and horizontally in a raster pattern while a video signal modulates the intensity of the beam. The Kosmos generates scan synchronization signals and video information in the correct timing relationship to display whatever text is intended to be on the screen at a given moment.

Vertical and horizontal scan synchronization signals are supplied from Kosmos pins 53 and 54 respectively. These signals are buffered and go to the monitor through pins 13 and 17 of J1. Horizontal frequency is 40.02 kHz while vertical frequency may be set by the user to either 60 or 80 Hertz.

The CRT electron beam intensity is modulated by the output of a video amplifier on the CRT socket board. It is a common-base amplifier whose emitter is driven from pins 57 and 58 of the Kosmos through R20, R19 and the video output connector J2. These are open-drain outputs on the Kosmos capable only of sinking current. Pin 57 sinks either zero or ≈30 milliamperes while pin 58 sinks either zero or ≈15 milliamperes. This allows four levels of video drive: 0, 15, 30, and 45 milliamperes—corresponding to CRT intensity levels of black, dim, normal, and highlight respectively. The currents are approximate because they are dependent on the contrast control setting.

These terminals can produce displays with two different vertical sweep frequencies and a variety of different character cell sizes. When frequency or cell size change, it is sometimes necessary to change the amplitude of the vertical sweep to keep the display neatly framed within the CRT screen. Pins 39 and 52 of the Kosmos send digital signals to the monitor to correct display size when frequency or cell size change. These signals go to a vertical amplitude control circuit in the monitor through buffers at U18 and pins 14 and 15 of J1.

The 990, 995 and 995-65 have a screen saver option that can put the monitor into a low power standby mode. This makes it feasible for the user to leave power on continuously, knowing that power consumption and heat generation will be low when he or she is away from the terminal. This power management is controlled from Kosmos pin 48. The signal is buffered and sent to the monitor via J1 pin 16. When the monitor is in this reduced power mode, the logic board remains fully powered so that any user input or communications input can wake up the terminal.

Microprocessor

The central processing unit is a 68000 running at 14.97 MHz. For the most part, the processor interface is typical for a 68000; details can be found in the manufacturer's data sheets. There are some aspects of the I/O interrupt configuration that deserve special mention, however.

After initiating an interrupt, peripherals designed specifically for the 68000 can generate a vector number on the data bus during the CPU's interrupt acknowledge cycle. This vector tells the CPU where to go to service that interrupt. The peripherals in the 990/995/995-65 have no such ability, so a gate is included (U15) which invokes the *autovectored interrupt* function of the 68000. If, during an interrupt acknowledge cycle, the *valid peripheral address* input on pin 21 is asserted but the *data transfer acknowledge* on pin 10

is not, the processor will fetch a vector from a special autovector table in memory. The position in this table is determined by the interrupt level encoded on CPU pins 23, 24 and 25. The processor then uses this vector to call the appropriate routine for whichever peripheral device generated the interrupt.

The interrupt level encoding is accomplished by the 74F148 priority encoder U16. In these terminals the priority sequence from highest to lowest is:

Display interrupt
Primary serial I/O port (COM1) interrupt
Secondary serial I/O port (COM2) interrupt
Parallel printer interrupt
Keyboard interrupt
Mouse interrupt

Memory

System EPROM contains the terminal operating system firmware including resident emulations and fonts. The 990/995/995-65 logic board allows the following EPROM configurations:

Size (kilobytes)	*U3 & U4 chip types*
128	27C512
256	27C010
512	27C020

The 512 kB configuration requires jumper W1 to be in the 1-2 position while the 128 and 256 kB configurations use the 2-3 position of W1. When 28 pin EPROMs (e.g. 27C512) are used, they must be positioned with their pin 1 in the pin 3 position of the 32 pin sockets. Pins 1, 2, 31 and 32 of the socket are unused in this case. The normal EPROM configuration is 128 kB in the 990 terminal and 256 kB in the 995/995-65.

System RAM is made nonvolatile by the use of lithium cell BAT1 and controller U6. It stores setup parameters selected and saved by the user as well as variables, stacks, buffers, etc., used by the operating system. The following system RAM configurations are allowed:

Size (kilobytes)	*U1 & U2 chip types*
16	5864LL
64	58257LL
256	581001LL

The normal system RAM configuration is 16 kB in the 990 and 64 kB in the 995/995-65.

Display RAM stores characters and attributes that can be displayed on the screen. It consists of two 58258 (32k X 8) or two 5863 (8k X 8) type chips at U10 and U13. The 990 normally uses 8k X 8 types and the 995/995-65 uses 32k X 8 types.

Font RAM stores the patterns of pixels that form all the characters and icons that may be contained in display memory. Fonts are normally downloaded to this memory from system EPROM during terminal initialization. Alternative fonts may also be downloaded through the communication ports. Font memory consists of a single 58258 type chip at U7 for the 995/995-65 or a 5863 type for the 990.

Sixteen font option

There is a 32-hole pattern labeled OPT1 which can accommodate a daughter board that extends the font capacity of the 995 from eight to sixteen banks. The daughter board includes a RAM which stores font bank definition data, and some miscellaneous logic. This option is offered only with the 995 terminal.

Serial I/O

There are two serial ports capable of communicating at rates up to 115,200 bits per second. They make use of a 16C452 serial-parallel I/O controller (U22). Hybrid oscillator Y3 provides a 3.6864 MHz communications clock for both ports.

COM1 is an RS-232 DTE type port with a female DB25 connector (P2). The pin assignments on P2 are:

1	Ground	
2	Transmitted Data	output
3	Received Data	input
4	Request To Send	output
5	Clear To Send	input
6	Data Set Ready	input
7	Ground	
8	Data Carrier Detect	input
20	Data Terminal Ready	output

COM2 also has RS-232 signal levels but uses a male DB9 connector (P3). Its pin assignments are:

1	Data Carrier Detect	input
2	Received Data	input
3	Transmitted Data	output
4	Data Terminal Ready	output
5	Ground	
6	Data Set Ready	input
7	Request To Send	output
8	Clear To Send	input
9	No connection	

Parallel Printer Port

The parallel port is also controlled by the 16C452 at U22. It provides full Centronics compatible printer support through female DB25 connector P4. The pin assignments are:

1	Data strobe\	output
2 - 9	Data bits 0 through 7 respectively	outputs
10	Printer acknowledge\	input
11	Printer busy	input
12	Paper empty	input
13	Printer selected	input
14	Auto feed	output
15	Printer error\	input
16	Initialize\	output
17	Select in\	output
18 - 25	Ground	

A backslash (\) after a signal name indicates the signal is asserted by a *low* level, all other signals are asserted by a *high* level.

Keyboard

The keyboard port is compatible with keyboards and keyboard wedge devices designed for IBM PS/2 computer systems. These terminals use a mask programmed 8042 I/O processor (U24) to manage the communications protocol for this port. Details of this interface are in the 8042 data sheets.

Communication to and from the keyboard is through mini-DIN connector P5. Interrupts from the 8042 are latched in flip-flop U20 until serviced by the 68000 CPU.

Mouse (standard in 995, optional in 995-65, not included in 990)

The mouse port supports a PS/2 type mouse. It shares the 8042 I/O processor with the PS/2 keyboard port. Communication to and from the mouse is through mini-DIN connector P1.

Beeper

Audio transducer LS1 can produce a sound to get the user's attention or to indicate that an ASCII *bell* code has been received by the terminal. The programmable frequency tone is developed in the Kosmos and comes out on pin 69. The tone is gated in U28 by a signal from Kosmos pin 50. The gated tone drives the base of transistor Q1 which serves as an impedance matching device for the transducer. In the 995terminals the outputs on pins 47 and 49 of the ASIC control the emitter impedance of Q1 and thus serve as a four level volume control. The 990/995-65 has only two levels of beeper volume and is controlled by the pin 47 output alone.

Power Supply

Operating power is supplied to the logic board through connector J1. The power requirements and connections are:

Nominal voltage (volts)	*Max. current (amps)*	*J1 pin number*
+12	0.2	2
+5	1.2	5, 6
Ground	—	3, 4, 9, 10, 12
-12	0.1	1

These current specifications are for the logic board only. Keyboards and PS/2 keyboard wedge devices draw additional current that must also be supplied through the +5v pins of J1.

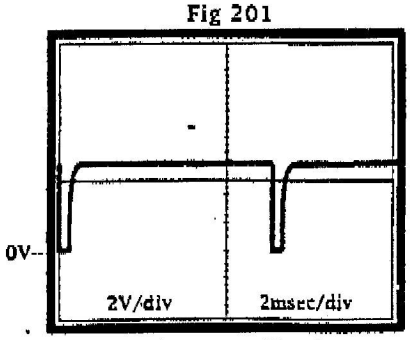
Power-On-Reset

One special requirement in these terminals is that the Kosmos chip must start up before the CPU at system turn-on. This permits the system clock generated by the ASIC to reach a stable frequency so that the first instructions fetched by the 68000 will be in correct timing and will not generate bus errors. To accomplish this, there are two reset signals with different timing: *Kosmos reset* and *system reset*. The Kosmos reset is generated by the TL7705A chip at U21 after the five volt power reaches a stable level. The system reset is delayed a few hundred microseconds after Kosmos reset by the R-C network formed by R15 and C6. This delayed reset is applied through gates of U19 to the reset inputs of U22, U23 and U24 and the halt input of U23.

990/995/995-65 VPS Waveforms

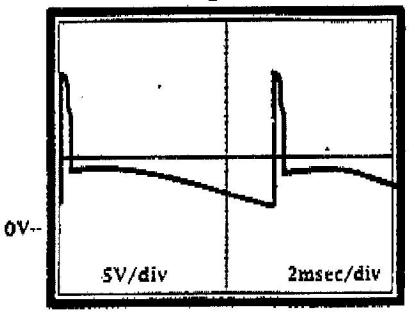
Vertical Sweep

Fig 201



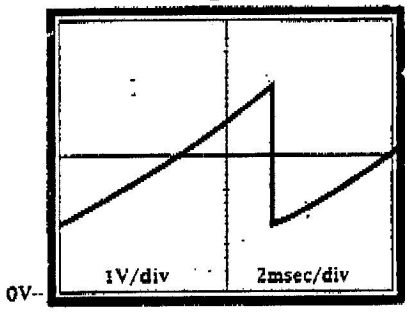
V_SYNC signal @ CN1 pin 13

Fig 202



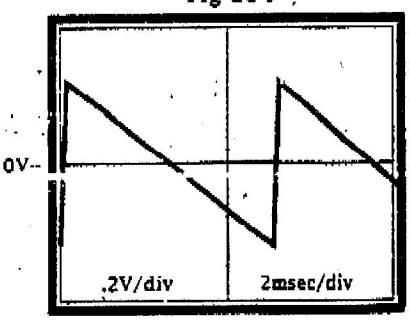
Amplifier Output @ U201 pin 4

Fig 203



Ramp Generator @ U201 pin 12

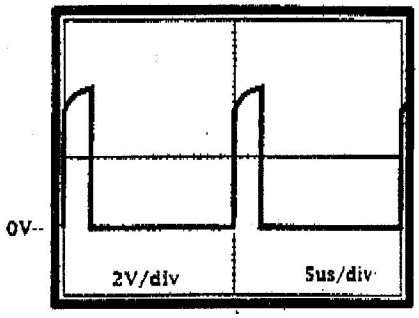
Fig 204



Current across R205

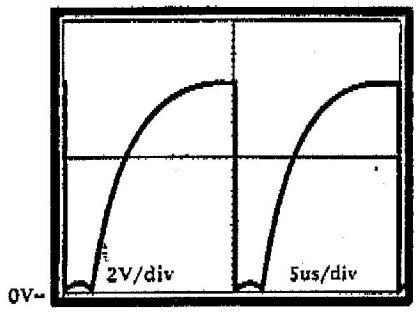
Horizontal Sweep

Fig 301



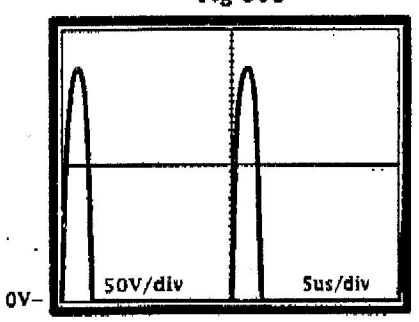
H_SYNC signal @ CN1 pin 17

Fig 302



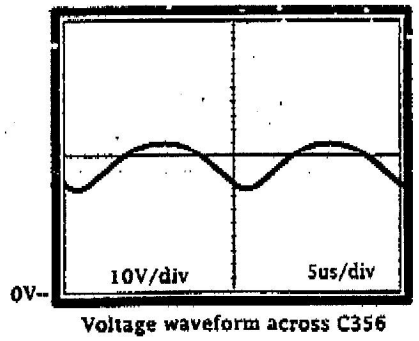
Drive signal @ Q303 gate

Fig 303



Flyback voltage @ Q303 drain

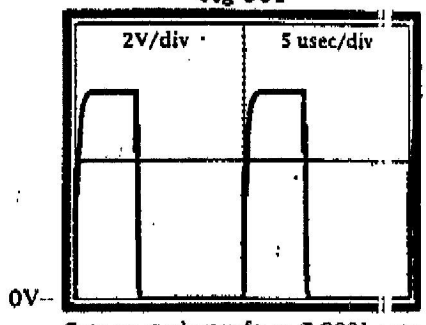
Fig 304



Voltage waveform across C356

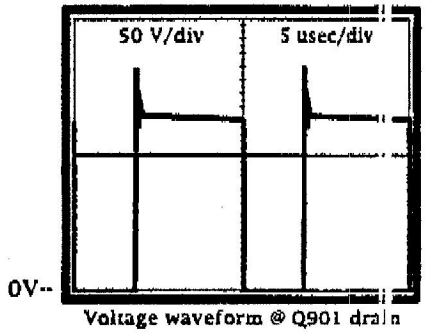
Power Supply

Fig 901



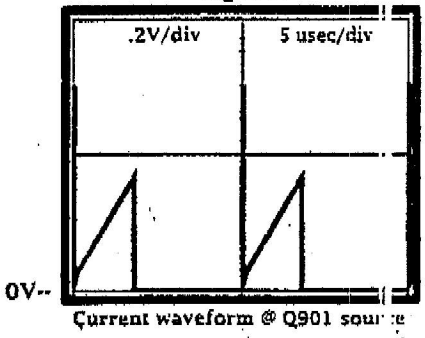
Gate control waveform @ Q901 gate

Fig 902



Voltage waveform @ Q901 drain

Fig 903



Current waveform @ Q901 source

990/995/995-65 Video, Sweep and Power Supply Functional Description

GENERAL:

The circuits on the VPS (Video Power Supply) board are grouped according to their functions. Each circuit group uses a range of reference designators. The following chart shows reference designator ranges and their associated circuit function. We will be referencing components on sheet 1 of the 990/995/995-65 Video Sweep and Power Supply schematic for the next few sections.

Reference numbers:	Circuit group:
201 to 299	Vertical Sweep Amplifier components.
301 to 349	Horizontal Sweep Primary side components.
351 to 399	Horizontal Sweep Secondary side components.
401 to 449	Video Amplifier components.
901 to 949	Power Supply Primary side components. **CAUTION: Use an AC Line Isolation Transformer when troubleshooting this area of the circuitry.**
951 to 999	Power Supply Secondary side components.

For the next few sections, we will be referencing components on sheet 1 of the 990/995/995-65 Video Sweep and Power Supply schematic.

Vertical Amplifier:

After the power up sequence the logic board generates the negative V_SYNC pulse shown in figure 201. This pulse is inverted and applied to pin 9 of the vertical sweep amplifier, U201. This causes U201 to terminate the current sweep and enter its retrace sequence. During this retrace sequence the voltage at pin 5 of the chip is doubled by action of the flyback generator section of U201. This pulse is then superimposed onto the voltage output waveform at pin 4 of U201 as shown in figure 202.

Fig 203 shows the ramp generator waveform at pin 12 of U201. Fig 204 shows the current waveform across R205. The slight curve seen in the current waveform compensates for screen linearity. The V-LINEARITY adjustment VR201 is used to adjust this curvature in the waveform so that the top and bottom sections of the screen show equal sized characters.

The Vertical Sweep section operates in either 80 or 132 column mode and uses either a 60 or 80 hertz vertical scan frequency. The U202 circuitry, the V_SIZE adjustment and the 2 V_SIZE control lines keeps the screen size the same for all 4 operating combinations.

Horizontal Sweep Section:

After the power up sequence the logic board generates the positive H_SYNC pulse shown in figure 301. This pulse turns on Q302 which shorts the gate of Q303 to gnd. This turns off Q303 which terminates the horizontal sweep and starts the retrace period. Figure 302 shows the gate drive signal of Q303 and figure 303 shows the flyback voltage on the drain of Q303. This flyback voltage pulse causes the raster to rapidly retrace back to the left hand side of the screen. This flyback voltage is also used to generate the additional voltages required for proper CRT and video amplifier operation.

The H_WIDTH adjustable slug in L301 provides a screen width adjustment. It also has an effect on the exact output voltage levels derived from the flyback voltage. The schematic lists the nominal voltage levels to be expected on the G1, G2 and the anode of the CRT. **CAUTION: Do not try to measure the high voltage at the CRT anode without a high voltage probe!!**

ZD301 and C302 provide circuit backup protection by limiting the flyback voltage levels in case of a circuit malfunction.

Q301 allows the H_SYNC signal to be disabled when in the power savings mode. It also provides a slow turn on/off function that prevents power supply variations during this transition period.

Figure 304 shows the voltage waveform across C356. This waveform is coupled thru C352 to T351 were it generates a dynamic focus voltage that is used to maintain proper focus at the edges of the screen. It is also used by the sweep circuits to maintain correct horizontal linearity. L302, the Horizontal-linearity coil also helps in this function, however its main effect is on the linearity of the left side of the screen.

Video Amplifier:

Q402 receives a current drive signal from the logic board. At maximum contrast this will result in a voltage at the collector of Q402 of about 30 volts peak to peak. This can be measured with an oscilloscope but will cause the displayed characters to become blurry while the scope probe is attached.

The CONTRAST control VR401 affects the contrast by changing the amplitude of the signal at Q402's collector.

Q401 prevents the vertical retrace lines from showing up on the screen by turning off Q402 during this period (it provides vertical retrace blanking).

Power Supply

In this section we will describe the operation of the Power Supply from the time that the AC switch is switched on to the time that the system has completed its boot-up procedure. We will be referencing components on sheet 2 of the 990/995/995-65 Video Sweep and Power Supply schematic.

Power Applied:

At initial turn on, C904 is charged to the peak of the AC line voltage. R904 and R908 limit the inrush current which reduces the stress on the input filter components, the bridge rectifier and C904. At this time, U901 (the UC3842) is in a low current startup mode which allows the Control Voltage on C919 (a 100uF capacitor) to ramp up via current supplied from R906 and R907. At approximately 16 volts, the UC3842 starts normal operation. The gate drive signal pulse width will increase until the peak voltage across R925 reaches 1.6 volts (this is also the current limit level of the power supply). The power supply output voltages will now ramp up until the feedback control signal from D903 rises to about 12.5 volts. At this point, the width of the gate drive signal is decreased and normal regulation commences. Also at this time we have charged up all the secondary side capacitors to their normal output voltages and we are supplying power to the logic board. Since the logic board is not yet generating an H_SYNC signal, their will be no load on the 24 volt supply (which is setup for 37 volts on the 990/995/995-65 terminals).

After the logic board commences its boot-up routines, the H_SYNC signal is generated. This activates normal horizontal sweep circuit operation and loads the 37 volt supply. The UC3842 increases its gate drive pulse width to maintain proper output voltages levels. Figure 901, 902 & 903 shows the Q901 source, gate and drain waveforms under this condition.

Caution: An Isolation Transformer must be used when working on the primary side of the transformer.

In addition to the normal operating functions, the Power Supply contains an Overvoltage Monitor consisting of SCR 951 ,R956, C957 and ZD951. On an Overvoltage condition, the SCR shorts the output of the 37 volt supply. This causes all output voltages to drop including the control voltage that powers the UC3842. When this control voltage reaches the 10 volt level, the UC3842 switches to its low current startup mode, allowing the control voltage to again ramp up via the current supplied by R906 and R907. During this ramp up the UC3842 output gate drive is off. This allows SCR951 to turn off. When the control voltage has rampped back up to 16 volts, the UC3842 again attempts normal operation. If their is a continuous fault, this sequence will repeat.

3 Maintenance

Visual Inspection

A thorough visual inspection often makes the difference between success and failure in a repair attempt. Often a problem can be located just by close visual inspection.

Terminal, Keyboard and Mouse (995, optional in 995-65) Exterior

Look for signs of accidental damage, abuse, or neglect. Keyboard failures are often caused by spilled liquids, sprayed cleaning solvents, staples, or paperclips. Mouse is opto-mechanical, check ball on underside for foreign material that may effect rollers.

Are there any dents or deep scratches on the exterior of the terminal or keyboard? If so, ask the user how and when the damage occurred. It may contribute to the problem with the unit.

Terminal, Keyboard and Mouse (995, optional in 995-65) Interior

Open the cases and inspect the keyboard and terminal interiors.

- **Wiring Harness**: Check the condition of the wires and look for crushed insulation, exposed wires, and loose or broken connectors.
- **Circuit Board**: Check for loose chips, bent pins on chips, defective chip sockets, defective components and traces, poor solder joints, open fuses, and signs of overheating and burning. Check that devices are properly installed.
- **Keyboard**: Check for signs of spilled liquids, foreign objects, unplugged devices, defective traces, and signs of overheating and burning. Check the mini-din connector.
- **Mouse**: Check for signs of spilled liquids, foreign materials that may effect mechanical parts and optical wheels, rollers. Check the mini-din connector.

Remove all defective modules for closer inspection and repair. When you finish the repairs, replace the module(s) and test them.

TESTS AND ADJUSTMENTS

This section describes how to test the 990/995/995-65 video monitor and how to make internal adjustments.

Power Supply (VPS)

Verify +5V on logic board. Adjust/verify 5.15V +/- .05, adjust ONLY if necessary, as this also effects +12V which has influence on video size. VR901 is the adjustment variable resistor.

You can test the display geometry of the video monitor in the following areas to make sure that its adjusted properly. Be sure to view the screen straight on to avoid any parallax errors.

- Height and width
- Linearity
- Brightness
- Trapezoidal distortion
- Concave and convex distortion
- Display stability
- Focus

For many of these test, you must call up the alignment test display (reverse video, no over-scan border). To do this, make sure your 990/995/995-65 is in its native mode, enter setup mode, and press Ctrl 5.

Height and Width

First measure the height and width of the display. Next, measure brightness (40FL for white and amber, 50FL for green), with the following conditions: reverse video, 80Hz vertical refresh rate, 26 lines (including both status lines), 132 columns. Use setup Ctrl 5, to set these conditions.

For 990/995-65

Height:	173mm (maximum)
	170mm (minimum)
Width:	236mm (maximum)
	233mm (minimum)

For 995

Height:	167mm (maximum)
	164mm (minimum)
Width	224mm (maximum)
	221mm (minimum)

Linearity

Next call up the alignment test display (screen filled with **H**s, use **setup 3**) and measure the horizontal and vertical linearity of the display, using horizontal and vertical slot gauges. Take one reading for at least the first, middle, and last column and for at least the top, middle, and bottom row.

Count ten **H**s across and find the left edge of the eleventh **H**. Then count ten **H**s up and find the bottom edge of the eleventh **H**. The criteria are as follows:

For 990/995-65

Horizontal:	29.1mm (maximum)
	26.3mm (minimum)
Vertical:	33.9mm (maximum)
	30.6mm (minimum)

For 995

Horizontal:	28.0mm (maximum)
	27.6mm (minimum)
Vertical:	32.1mm (maximum)
	31.5mm (minimum)

Brightness

Next test the brightness with a light meter: switch to inverse video, 80Hz refresh, set the contrast to maximum, clear the screen of all characters, and take five readings (one at the center of the screen and one in each corner). The criteria are as follows:

Center:	45-50FL (Green)
	35-40FL (White)
	35-40FL (Amber)
Corner:	Center +/-10%

Trapezoidal Distortion

Measure the height of the display at the left side and at the right side; then measure the width of the display at the top and the bottom. In each case, the pair of measurements must be within 3 mm of each other, or no more than 2 mm in a half-screen.

Concave and Convex Distortion

Then test concave and convex distortion (pincushion and barrel): measure the height of the display at the left side, middle, and right side; measure the width of the display at the top, middle, and bottom. In each case, the curvature of the display must not exceed 2 mm.

Display Stability

Finally, check display stability for the voltage and line frequencies given below. Conduct each test at the minimum, nominal, and maximum value.

AC Voltage:	127V (maximum)
	115V (nominal)
	103V (minimum)
	253V (maximum)
	230V (nominal)
	207V (minimum)
Frequency:	63Hz (maximum)
	60Hz (nominal)
	57Hz (minimum)
	53Hz (maximum)
	50Hz (nominal)
	47Hz (minimum)

Making Adjustments

You can adjust the picture on the terminal using one of the following located on VPS:

Sub-Brightness	VR302
Focus	VR303
V-Size	VR202
H-Width	L302
V-Linearity	VR201

Note: All may be accessed (except H-Width) by removing bezel. H-Width located next to FBT (located inside FBT shield).

Disassembly/ Assembly procedure for 990/995/995-65 terminal

Tools Required : Phillips Screwdriver
Net driver 3/16"

Warning: Before starting disassembly procedure power cord must be disconnected.

- **Logic board module**

1. Remove 2 screws that secure rear cover and remove rear cover.
Screws are located to the left of power connector and to the right of keyboard connector.

2. Removed 6 jack screws that secure COM 1, COM2 and parallel port connectors to the rear panel.

3. Unplug cables at location "CN901" (video power supply module) and "J2"(Logic board module).

4. Remove 4 screws that secure Logic board module. Rear panel can now be removed.

5. Unplug CRT Socket board module and slide the Logic board out towards the rear of unit.

Reassembly

1. Reassembly can be done by following the disassembly procedure in reverse order.

2. All the proper cable connector polarity must be observed and CN1 connector between Logic module and video power supply module must be aligned properly so that proper connection can be made.

3. CRT Socket board module must be aligned properly and glue between socket and CRT tubr can be reheated so that connection between the two units is shock resistant.

Video Power Supply Module

1. Remove Logic board module.

2. Remove front bezel of the unit. The bezel is "snap in" fit and can be removed easily by sharp tap with the plam of your hano on the top edge of bezel.

3. Remove 4 screws that secure module to base of unit. Remove cable connector at location CN201.

4. Remove brightness and contrast control knobs and spade connector at location TAB 1. These are located behind the bottom edge of the front bezel.

5. Video power supply module together with CRT Socket module can now be removed by sliding both units towards the rear of terminal.

6. If CRT Socket module needs to be removed from video power module then a soldering iron must be used to remove wires that connect the two units. care must be taken to ensure that all wires are routed correctly upon reassembly.

Reassembly

1. Reassembly can be done by following the disassembly procedure in reverse order.

2. All cable connectors must have correct polarity. If CRT Socket module was desoldered ensure that wires are soldered correctly and in the right order.

3. After all modules have been installed refer to adjustment procedured for vertical height, vertical linearity, sub-brightness and voltage adjustment to ensure that unit is adjusted properly.

Cathode Ray Tube(CRT)

Disassembly

1. Remove Logic and Video modules.

2. Remove yoke by unscrewing clamp and twisting yoke so that glue seal breaks.

3. Remove 4 screws that secure tube to chassis. (located behind bezel on the front of unit). slide tube out towards the front of unit.

4. Note position of grounding wire and spring for reassembly.

Reassembly

1. Ensure that grounding wire is returned to correct position.

2. After all modules are installed refer to video alignment procedure for correct screen alignment.

Component Level

This section is a guide to component-level repair of the logic board module. Find the symtoms listed below that resemble the problems in the terminal you are repairing. Then locate the suspected defective components. If you are not sure that a component is satisfactory, replace it before proceeding to the next test point. Before replacing a chip or component, check its inputs and outputs for proper levels and signal quality.

Table 3-2

Symptom		
Display/Video	**Component**	**Location**
No Display, No Beep	CPU	U23
	Power Monitor	U21
	System SRAMS	U1,2
	Gate Array	U9
	Firmware	U3,4
	74HC03	U19
	Reset (7705)	U21, C52 (Fabs D & later) C4 (Fab B)
No Beep	Tranducer	LS1
	2N2222	Q1
Looses Setup	Battery	BT1
	Non-Vol Controller	U6
	SRAMs	U1,2
NOTE: Assure Battery is NOT loose, this will cause various problems if loose.		
Character	SRAM	U13
Font	SRAM	U7
Attribute	SRAM	U10
Horizontal Sync	7406	U18
	74HC04	U12
	Gate Array	U9
Vertical Sync	74HC03	U19
	Gate Array	U9
Communication		
NOTE: Make sure that terminal is setup properly (Personality, Com Ports, etc.)		
Com1: Transmit	1488	U11
	16C452	U22
Recieve	1489	U8
	16C452	U22
Hardware Handshake	1488/1489	U11,8
	16C452	U22

Com2: Transmit	1488	U17
	16C452	U22
Receive	1489	U14
	16C452	U22
Hardware Handshake	1488/1489	U17,14
	16C452	U22
Parallel Port	16C452	U22
Keyboard	7406	U18
	8042	U24
Mouse (if applicable)	7406	U25
	8042	U24