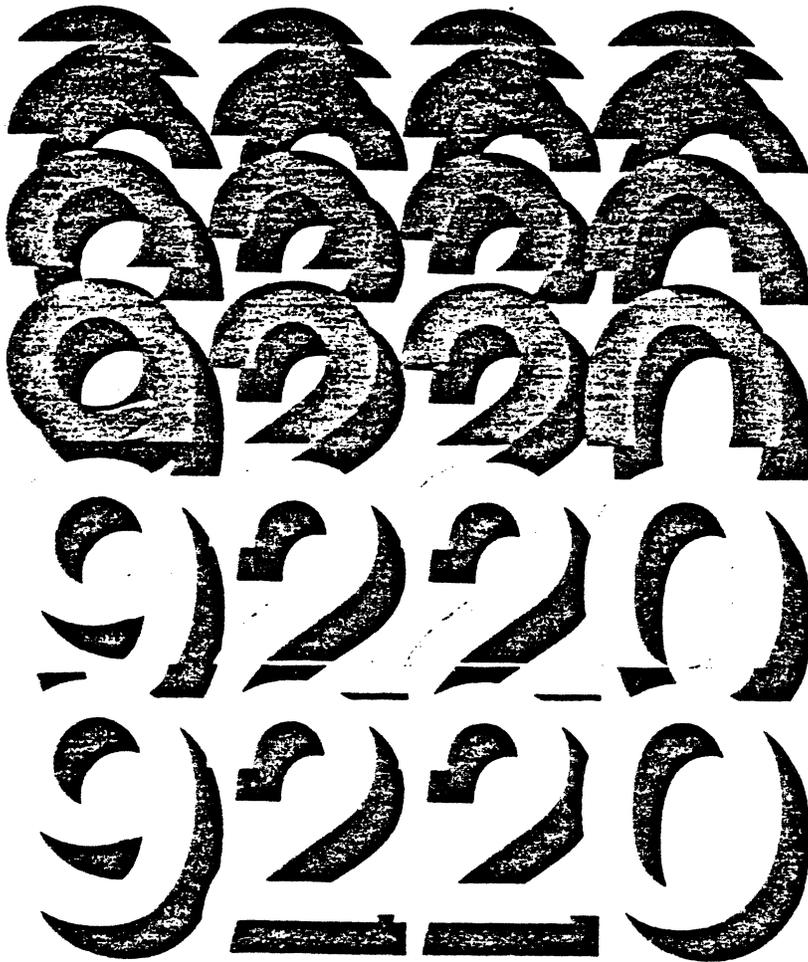


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*TeleVideo®  
Video Display Terminal  
Maintenance Manual*

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**ATTENTION**

**TO RECEIVE UPDATES TO THIS MANUAL, CHECK THE APPROPRIATE BOX ON THE ENCLOSED READER COMMENT CARD AND RETURN IT TO TELEVIDEO. YOU MAY ALSO CALL TELEVIDEO TECHNICAL PUBLICATIONS AT 408/745-7760, EXTENSION 460. INTERNATIONAL CUSTOMERS MAY TELEX 474-5041 TVISYS.**



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## TROUBLESHOOTING GUIDE

This troubleshooting guide was designed for qualified repair personnel. Using this guide, the schematics, and an Operator's Manual, you can repair most failures quickly.

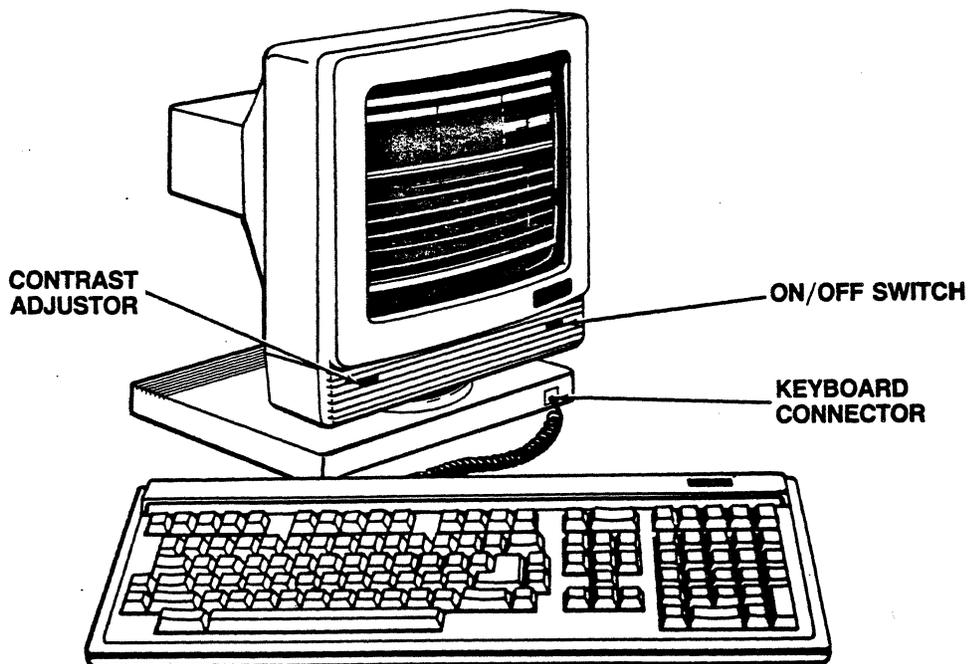
**STOP!** Do not open the case as described in this manual unless you are a qualified service technician. The components exposed during this procedure retain hazardous voltages that are present even after the power cord has been disconnected.

### OVERVIEW

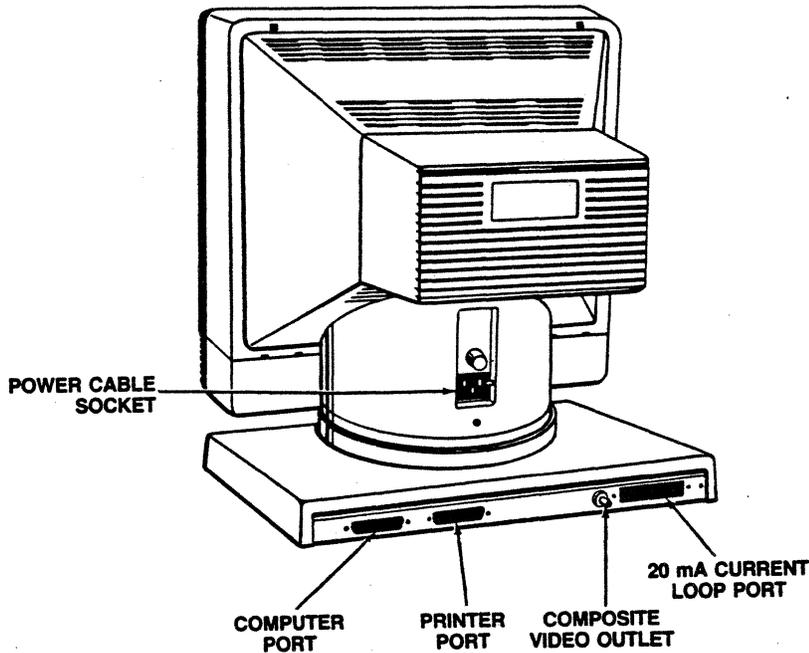
TeleVideo's 9220, a general-purpose ANSI terminal, is fully code-compatible with our 922 terminal. The main element in the system is a 65C02 microprocessor. For CRT control, the 9220 uses an advanced alphanumeric VLSI CRT controller chip.

Figures 1-1 and 1-2 show front and rear views of the terminal. Ports, switches and connectors are marked.

**Figure 1-1**  
**9220 Terminal, Front View**



**Figure 1-2**  
**9220 Terminal, Rear View**



Terminal hardware is divided into four main modules:

Main logic board

Power supply

Video module

Keyboard

This design permits fast fault isolation and keeps repair time to a minimum. To isolate a faulty module, swap a suspected module with a known-good one.

#### **DESCRIPTION OF THE MODULES**

##### **Logic Board**

The logic board fits inside a tray that slides into the base of the terminal. It is easily reached by removing two screws from the base.

The 65C02 microprocessor-based control circuitry on the logic board, acting on its own internal system program, stores and processes data received and data to be transmitted. The circuitry also generates the video and sync signals needed to display data on the screen.

The logic board has four distinct interconnected divisions which are discussed in this manual's Theory of Operation section. They are:

Main processor

Display circuitry-processor

Random Access Memory (RAM)

Interface for external input/output

### **Power Supply**

A switching power supply is located in the pedestal below the CRT. It provides the following voltages for the terminal's electronic circuitry:

+ 5V for the logic board

+12V for the line drivers/receivers and the current loop circuit on the logic board; for the video module and the keyboard

-12V for the line drivers/receivers and current loop circuit on the logic board

Two user-replaceable fuses--F1 on the power supply and a line fuse in back of the terminal--protect the circuitry.

### **Video Module**

The video module is located behind the CRT. It contains horizontal and vertical sweep and video amplification circuitry. This circuitry produces a television-type noninterlaced raster display. The video signals generated by the display circuitry cause pixels to appear at designated positions across scan lines. These pixels form a character when selectively combined in a 7 X 9 dot matrix.

### **Keyboard**

The 9220 has a detachable keyboard that is connected to the terminal by a coiled keyboard cable.

The keyboard consists of an array of keyswitches mounted on a printed circuit board with an 8049 microcomputer and other IC's.

The 8049 microcomputer on the keyboard scans the keyboard matrix, encodes the data and transmits two bytes per character requested. Data is sent through a 6-wire coiled cable over an asynchronous serial channel at 9600 baud to the main logic board.

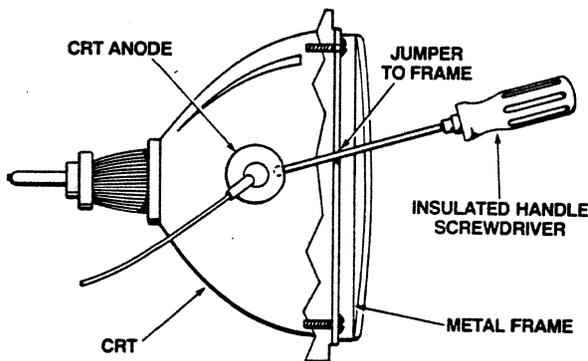
This design effectively eliminates the need for a ribbon-type or other bulky cable. On the main logic board, the serial data is converted to parallel data and decoded by the main microprocessor and its firmware. The keyboard microprocessor also activates an audio transducer for the bell and the simulated keyclick.

## REMOVING THE MODULES

### Opening the Case

**STOP!** The CRT and capacitors retain high voltages even after power has been turned off. As soon as you open the case, discharge the CRT by connecting one end of a grounding lead to the metal chassis and the other end to a screwdriver with an insulated handle. Slip the metal end of the screwdriver under the plastic cap of the anode, as shown in Figure 1-3. Be careful not to touch the metal portion of the screwdriver or the ground lead.

Figure 1-3  
Discharging Voltages



Use Figure 1-4 as reference for opening the case.

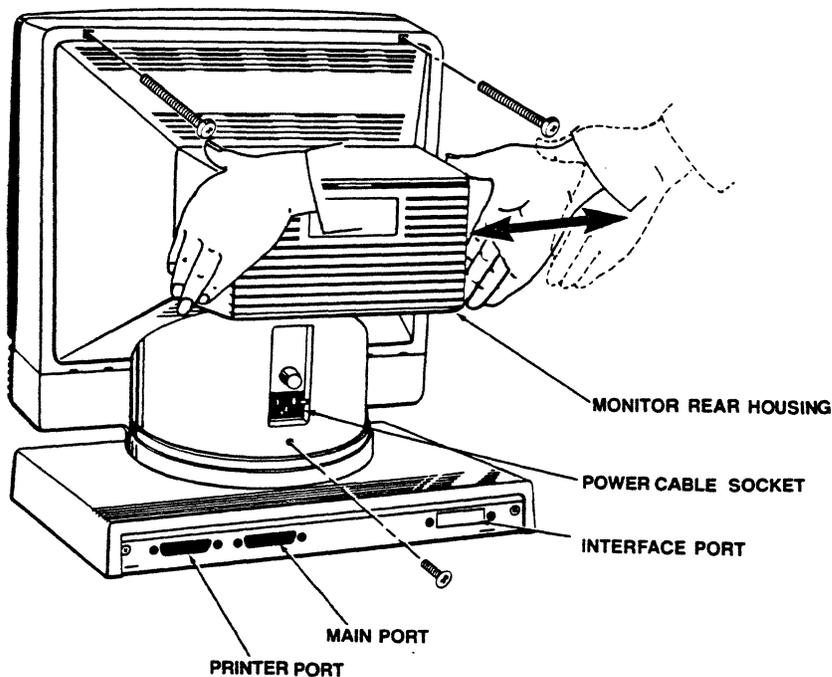
1. Turn off the terminal.
2. Disconnect the power cord and data cable(s) from the back of the terminal; disconnect the keyboard cable from the front of the terminal.
3. Turn the terminal so the screen faces away from you.

4. Remove the three screws that secure the monitor rear housing to the case (remove the screw under the power cord first, then remove the two screws near the top of the housing).

**NOTE:** Remove the screws completely. If necessary, tip the unit backwards slightly.

5. To release the clamp holding the bezel and monitor rear housing together (See Figure 1-4):
  - a. Grasp the housing with your left hand.
  - b. Sharply tap the right side of the housing with the heel of your right hand.
6. Lift off the monitor rear housing.

**Figure 1-4**  
**Opening the Case**



## Removing the Power Supply

**STOP!** The CRT retains high voltages, even after the power has been turned off, and poses a potential shock hazard. Follow the CRT discharge procedure on page 1-4 of this section before removing and replacing the power supply.

Use Figure 1-5 as reference for removing and replacing the power supply.

1. Turn off the terminal and open the case (See page 1-4).
2. With the screen facing away from you, remove the two Phillips screws that secure the bezel to the case (the screws are located inside the case, one on each side of the power supply).
3. Disconnect the Ground connector, the power connector (P4) and the DC connectors (P1, P2 and/or P3) from the power supply.

**NOTE:** Only two connectors are attached at P1, P2 and P3. Pay close attention to the polarity for reference during reassembly.

4. Turn the unit so the screen faces you and remove the two Phillips screws (one on each side of the power supply) that secure the power supply to the case.
5. Slide the power supply toward you to remove it from the case.

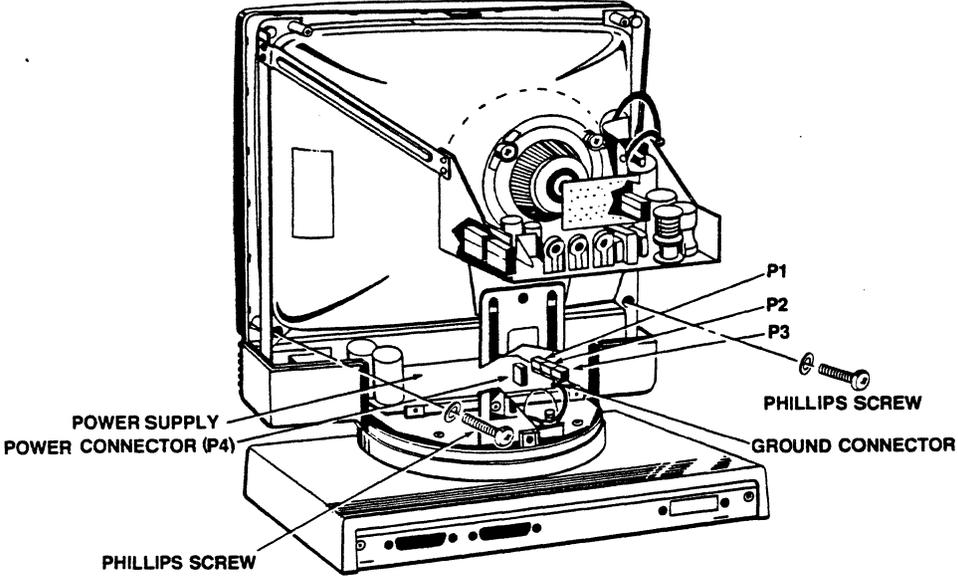
## Replacing the Power Supply

1. With the screen facing you, slide the power supply into the terminal until it locks into the plastic support bracket.
2. Reconnect the Ground connector, the power connector (P4) and the DC connectors (P1, P2 and P3).

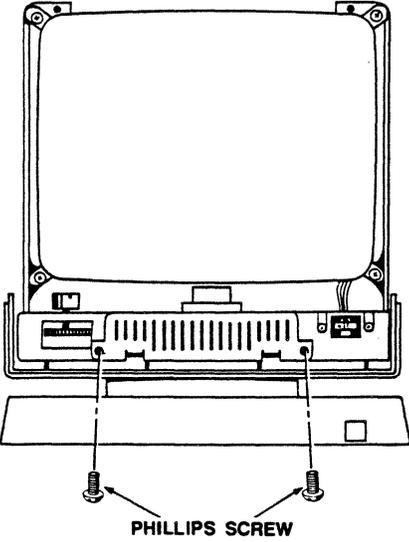
**NOTE:** Any of the three connectors may be used. For example, you may take the connectors off P1 and P2 and replace them on P2 and P3.

3. Insert and tighten the two Phillips screws that secure the power supply to the case.
4. Replace the bezel and close the case (See page 1-11).

**Figure 1-5**  
**Removing the Power Supply**



**BACK VIEW**



**FRONT VIEW**

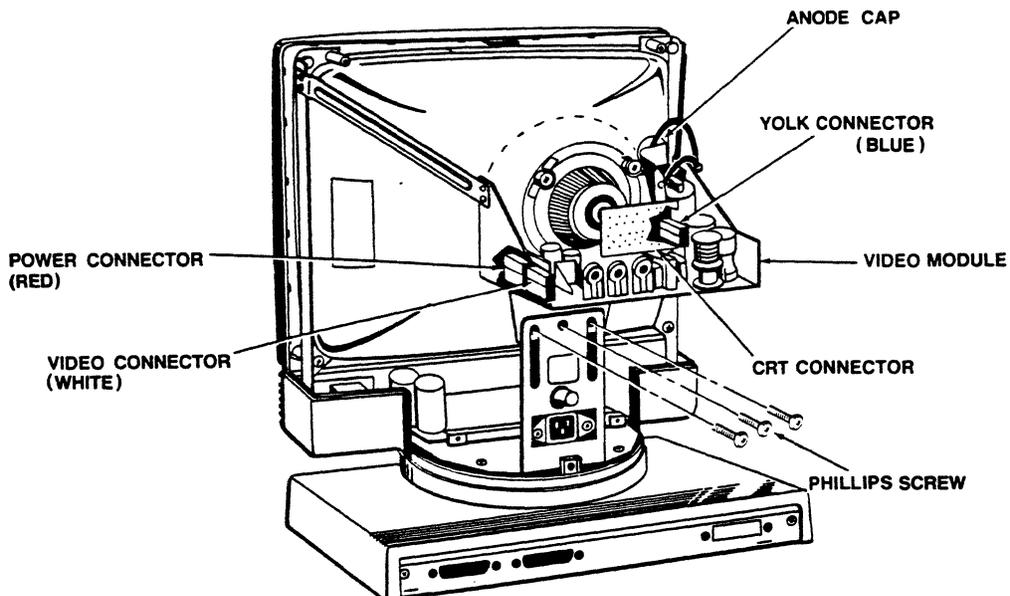
## Removing the Video Module

**STOP!** The CRT retains high voltages, even after the power has been turned off, and poses a potential shock hazard. Follow the CRT discharge procedure on page 1-4 of this section before removing and replacing the video module.

Use Figure 1-6 as reference for removing and replacing the video module.

1. Turn off the terminal and open the case (See page 1-4).
2. Turn the unit so the screen faces away from you.
3. Disconnect the voltage lead at the anode by gently lifting the rubber cap and unhinging the metal lead.
4. Carefully remove the CRT connector (small PCB at the back of the CRT).
5. Remove the power connector (red), the video connector (white) and the yoke connector (blue) from the video board.
6. Loosen the four Phillips screws (one on each support bracket) that secure the video module base.
7. Remove the four Phillips screws that hold the video board to its base and slide the board out of the terminal.

**Figure 1-6**  
**Removing the Video Module**



### **Replacing the Video Module**

1. Turn the terminal so the screen faces away from you.
2. Slide the video module onto its base (See Figure 1-6) until the four screw holes in the board line up with the four screw holes in the base.
3. Insert and tighten the four Phillips screws that hold the video module to its base.
4. Reconnect the power connector (red), the video connector (white) and the yoke connector (blue) on the video module.
5. Carefully replace the CRT connector (small PCB at the back of the CRT).
6. Replace the anode cap:
  - a. Pull back the rubber portion of the anode cap, exposing the metal leads.

- b. Pinch the two leads together and insert them into the opening for the anode cap in the CRT. Release the leads.
  - c. Secure the rubber portion of the anode cap.
7. Tighten the four Phillips screws (one on each support bracket) that secure the video module base.
8. Replace the bezel and close the case (See page 1-11).

#### **Removing the Logic Board and Shroud**

Use Figure 1-7 as reference for removing and replacing the logic board and shroud.

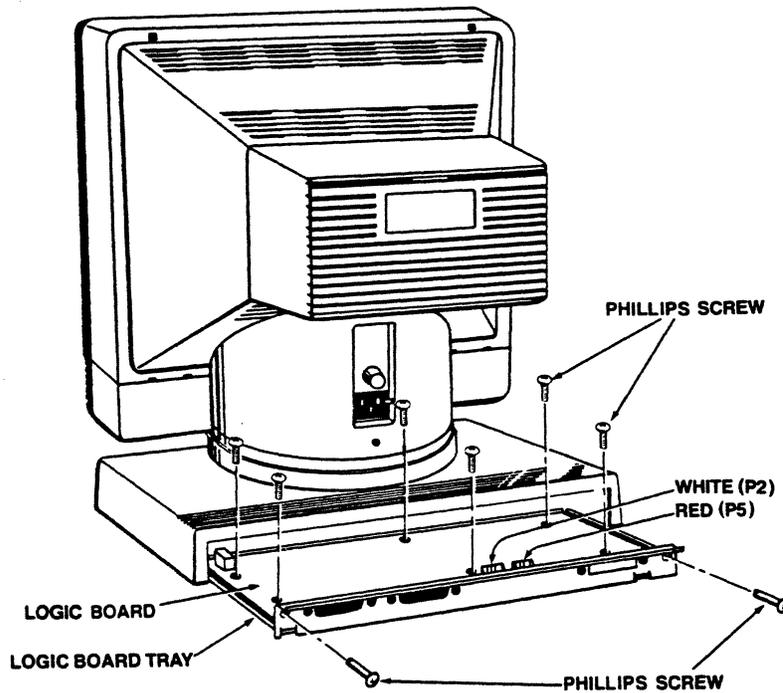
1. Turn off the terminal. Disconnect the power cord and data cable(s) from the back of the terminal; disconnect the keyboard cable from the front of the terminal.
2. Rotate the complete unit so the back faces you. Remove the two Phillips screws (in the base) that hold the logic board tray in place.
3. Grasp the logic board tray by its center tab and pull the tray toward you to remove it. Disconnect the red (P5) and white (P2) logic board connectors to slide the tray completely out of the terminal.
4. Remove the four brass screws securing the shroud to the logic board; remove the six Phillips screws securing the logic board to the tray.
5. Lift the logic board out of the tray.

#### **Replacing the Logic Board and Shroud**

1. Align the six screw holes in the logic board with the screw holes in the tray.
2. Loosely mount the six Phillips screws that hold the logic board in place; insert and tighten the four brass screws that hold the shroud to the logic board, then tighten the six Phillips screws securing the logic board.
3. Replace the logic board tray in the base:
  - a. Fit the metal flanges on the logic board tray into the guides at the back of the terminal. Hold the connector cables up so they do not interfere as you replace the tray.
  - b. Reattach the red connector (P5) and the white connector (P2) on the logic board.

- c. Align the keyboard connector with the opening in the front of the terminal.
4. Insert and tighten the two Phillips screws that hold the logic board tray in the base.

**Figure 1-7**  
**Removing the Logic Board and Shroud**



### **Closing the Case**

1. Replace the bezel:
  - a. Place the bezel face down in front of the terminal. Raise the bezel slightly and hook its two bottom tabs into the openings (one under the contrast adjustor; one under the ON/OFF switch) in the lower case.
  - b. Swing the bezel up to frame the screen, matching the ON/OFF switch and contrast adjustor with the openings in the bezel.

- c. Carefully turn the screen away from you while holding the bezel in place. Insert and tighten the two Phillips screws (located inside the case, one on each side of the power supply) that secure the bezel to the case.
2. Replace the monitor rear housing:
    - a. Position the monitor rear housing on the case, as shown in Figure 1-4.
    - b. Align the screw hole under the power cord with the lower screw hole in the housing.
    - c. Fit the four tabs in the housing over the edge of the lower case.
    - d. Fit the tab in the top of the bezel into the slot in the top of the monitor rear housing. Squeeze the bezel and housing together.
    - e. Insert and tighten the Phillips screw under the power cord and the two Phillips screws near the top of the housing.

#### **Opening the Keyboard Case**

1. Turn off the terminal.
2. Disconnect the coiled keyboard cable from the front of the terminal.
3. Turn the keyboard upside down and remove the six Phillips screws.
4. Turn the keyboard rightside up and remove the top cover.

#### **Removing the Keyboard Circuit**

1. Remove the four Phillips screws securing the keyboard circuit.
2. Lift the entire assembly out of the keyboard case.

#### **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 examination.

#### **Terminal and Keyboard Exterior**

Look for signs of accidental damage, abuse, or neglect. Keyboard failures are often caused by spilled liquids, sprayed cleaning solvents, staples, or paperclips.

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 and Keyboard Interior**

Open the cases and inspect the keyboard and terminal interiors.

**Keyboard:** Check for signs of spilled liquids, foreign objects, unplugged devices, defective traces, and signs of overheating and burning. Check the telephone-style connectors (located on the back of the keyboard case and on the front of the terminal).

**Wiring Harness:** Check the condition of the wires and look for crushed insulation, exposed wires, and loose or broken connectors. Unplug the connectors and check that the pins are intact.

**Logic Board:** Check for loose chips, bent pins on chips, defective chip sockets, signs of overheating and burning, defective traces, and poor solder joints. Check that devices are properly installed.

**Power Supply:** Check for open fuses, defective components, and signs of overheating and burning.

**Video Module:** Check for defective components, signs of overheating, and defective traces.

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

### **FAULT ISOLATION AT THE MODULE LEVEL**

TeleVideo's modular terminal design makes isolating a problem to a particular module easy. You can either follow Table 1-1, Fault Isolation Guide, or replace each module in turn until the fault is corrected.

To use Table 1-1, find the description that resembles the problem in the terminal. Then refer to the troubleshooting guide for the suspected module.

**Table 1-1  
Fault Isolation Guide**

<b>Symptom</b>	<b>Suspected Module</b>
No beep on power up	Logic board Line fuse Power supply Keyboard

**Table 1-1 (Continued)  
Fault Isolation Guide**

<b>Symptom</b>	<b>Suspected Module</b>
No video, no cursor	Logic board Power supply Video module
No external communication	Cable to host Logic board
Incorrect characters	Logic board Keyboard
Incorrect attributes	Logic board
No keyboard communication	Logic board Keyboard cable
No baud-rate selection	Logic board
Power supply fuses blowing	Video module Power supply
High-pitched whine	Video module
Distorted video	Video module Power supply Logic board Deflection coil
Characters missing dots	Logic board Defective CRT
Display too dim/can't adjust	Video module Power supply
Online communication problem	Logic board Cable to host Host
Jittery screen	Video module Hertz setting
Wavy screen	Video module External interference
Incorrect voltages	Power supply Short in other modules

**Table 1-1 (Continued)  
Fault Isolation Guide**

<b>Symptom</b>	<b>Suspected Module</b>
No light at cathode filament	Video module Power supply Defective CRT
Display not equal to key entry	Logic board Keyboard cable Cable to host Host
Visible retrace scanlines	Brightness adjustment Video module Logic board
Keyboard locked up	Keyboard and cable Logic board Software command
Fails self test	Logic board Keyboard Power supply
Some keys inoperative	Keyboard Logic board
Horizontal bar across screen	Logic board Video module
Poor linearity	Video module
Cursor moves, no characters	Logic board
Vertical line across screen	Logic board Video module
Crackling sound with distorted video	Logic board Video module

## TROUBLESHOOTING THE LOGIC BOARD AND KEYBOARD

This section is a guide to component-level repair of the logic board and keyboard modules. Find the symptoms in Table 1-2 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.

**NOTE:** Before referring to Table 1-2, test and/or swap the power supply, CRT and video module with their associated circuitry to eliminate these modules as the source of the problem.

**Table 1-2**  
**Logic Board and Keyboard Troubleshooting Guide**

Symptom	Component	Location	Schematic Page
<b>Display/Video</b>			
No display, no beep, fails self test	65C02	U3	2
	G/A-B	U12	2
	G/A-A	U31	3
	2674	U2	3
	Sys. Eprom	U5, U7	2
Distorted video	2674	U2	3
	2732	U30	4
	6116	U21	3
	6116	U22	3
	74LS157	U1, 14, 16	3
	G/A-B	U12	2
	2675	U34	4
Incorrect characters	2732	U30	4
	8049	U2 on Kybd	KYBD
	G/A-B	U12	2
	6116	U21	3
	6116	U22	3
	2675	U34	4
	Sys. Eprom	U5, U7	2
Horizontal bar across screen	2674	U2	3
	2675	U34	4
	74LS04	U20	4
	2N2222	Q2	4
No vertical sync	2674	U2	3
	74LS04	U20	2, 4
	G/A-B	U12	2
	65C02	U3	2
	FPLA	U25	3
	2N2222	Q2	4

**Table 1-2 (Continued)**  
**Logic Board and Troubleshooting Guide**

<b>Symptom</b>	<b>Component</b>	<b>Location</b>	<b>Schematic Page</b>
<b>Display/Video</b>			
No cursor	2674	U2	3
	65C02	U3	2
	2675	U34	4
	2N2222	Q2	4
Loss of attributes	2674	U2	3
	G/A-A	U31	3
	G/A-B	U12	2
	Sys. Eprom 65C02	U5, U7 U3	2 2
<b>Communications</b>			
No full-duplex communication (FDX) at P3	2681	U13	5
	9636	U40	5
	9639	U26	5
No full-duplex communication (FDX) at P4	2681	U13	5
	9639	U32	5
	9639	U33	5
No status signal transmitted (DSR, DCD, CTS, DTR)	9636	U32	5
	2681	U13	5
No status signal received (DCD, CTS) (RTS, DSR, DTR)	9639	U33	5
	2681	U13	5
	9639	U26	5
<b>Keyboard</b>			
All keys inoperative	8049	U2 on Kybd	KYBD
	7414	U1 on Kybd	KYBD
	74LS08	U38	2, 4, 5
	G/A-A	U31	3
One or more row of keys inoperative	8049	U2 on Kybd.	KYBD
	74LS145	U3,4 on Kybd	KYBD
One key inoperative	8049 Keyswitch	U2 on Kybd	KYBD

**Table 1-2 (Continued)**  
**Logic Board and Keyboard Troubleshooting Guide**

<b>Symptom</b>	<b>Component</b>	<b>Location</b>	<b>Schematic Page</b>
<b>Keyboard</b>			
SHIFT, CTRL, ALPHA LOCK, and function keys inoperative	8049	U2 on Kybd	KYBD
	74LS145	U3,4 on Kybd	KYBD
No keyclick/no beep	Transducer	LS1 on Kybd	KYBD
	2N4401	Q1 on Kybd	KYBD
	MC14040	U5 on Kybd	KYBD
	8049	U2 on Kybd	KYBD

## TROUBLESHOOTING THE VIDEO MODULE

**STOP! HIGH VOLTAGES ARE PRESENT ON THE VIDEO MODULE.  
USE EXTREME CARE DURING TROUBLESHOOTING.**

### Visual Inspection

Turn the terminal off and remove the monitor rear housing, as described in Section 1 of this manual (Removing the Modules). Check the following possible problem areas before removing the video module from the terminal.

- a. Connectors: check for loose or damaged connectors, dirty contacts or bad crimps.
- b. Wires: check for any broken, loose or frayed wires.
- c. Components: check for any deformed, leaking or discolored components.

Correct any defects, then retest the terminal before continuing.

Remove the video module from the terminal, as described on page 1-8. Inspect the video module for:

- a. Deformed, leaking, or discolored components.
- b. Damaged components.
- c. Cracked or lifted traces.
- d. Poor solder joints (loose solder lumps, solder bridges, or cold solder joints).

### Adjustments

Four adjustments can be made to the video module: height, linearity, brightness and focus. The controls for height, linearity and brightness are labeled on the back of the video module; the control for focus (VR2) is on the front of the video module. Use the following chart to determine the proper control to adjust.

Symptom	Control
Character intensity too bright or too dim	Brightness
Whole screen is too tall or too short	Height
Characters are not even in height from the top to the bottom of the screen	Linearity
Characters are not in focus	Focus

This section is a guide to component-level repair of the video module. When in doubt regarding the proper operation of a component, 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.

**Symptom:** No vertical deflection

1. Check IC-1 for vertical sync at IC1, pin 8.
2. If the signal is improper or missing, trace back to P10 for vertical sync at pin 5.
3. If the signal is good, trace forward to IC-1 (pin 4) for deflection drive, and related components up to the vertical yoke.

**Symptom:** No horizontal deflection

1. Check the base of Q301 or the cathode of D301 for horizontal sync.
2. If the signal is improper or missing, trace back to P10 for horizontal sync at pin 1.
3. If the signal is good, check the output of the horizontal drive transformer T301 and the base of Q302. Trace for the presence of horizontal deflection through Q302, C306, L301, and L302 up to the horizontal yoke.

**Symptom:** Audible high-pitched whine

1. Check coils L301, L302, and flyback transformer.

## SCHEMATICS

Table 2-1 gives a brief description of the chip at each location on the logic board. Refer to Table 3-1 for the part number of components at each location.

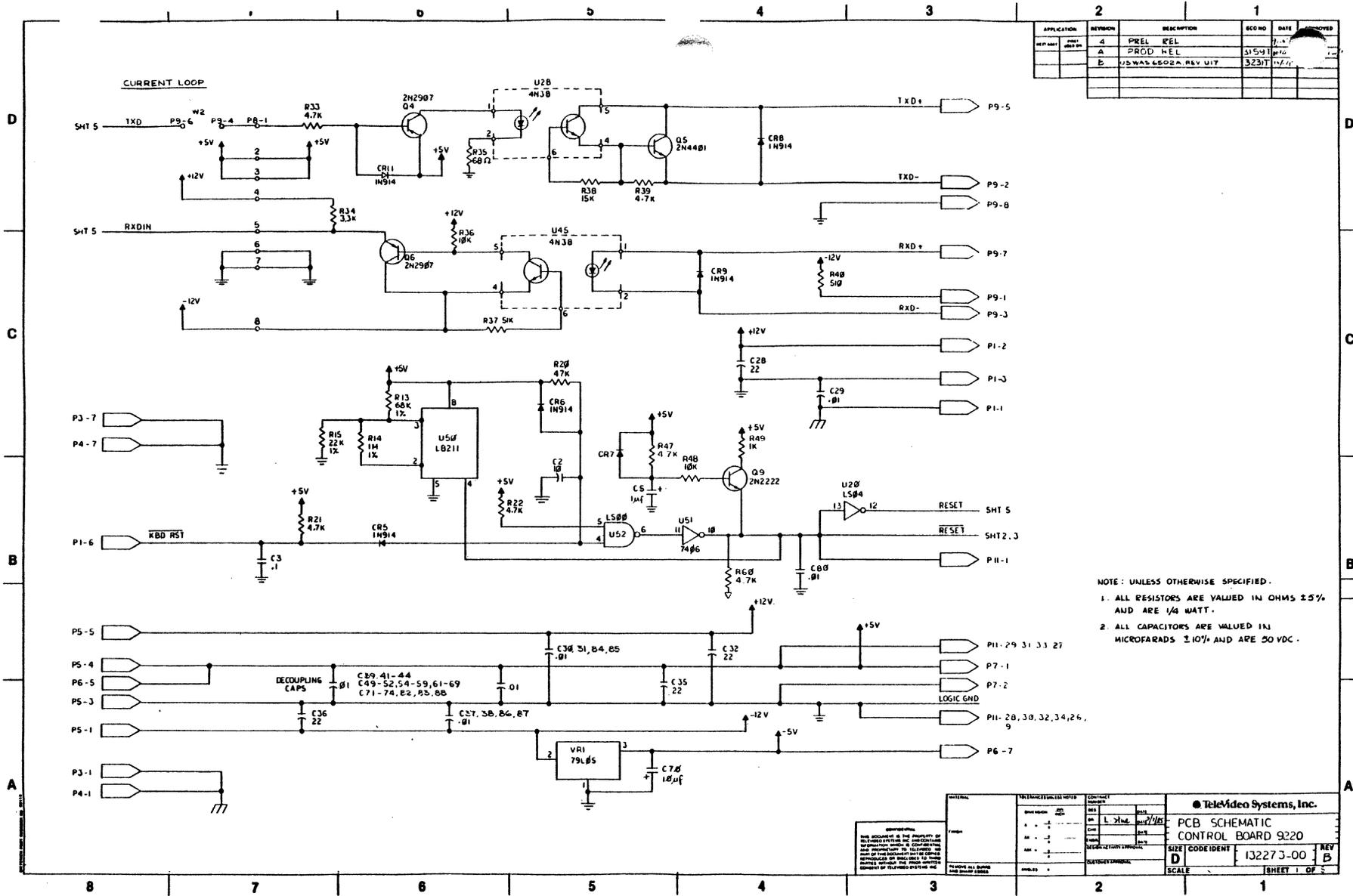
**Table 2-1**  
**IC Reference by Board Location**

Location	Schematic Page	Type/Description
U1	3	IC 74LS157 4X 2-IN DATA SELECT MULTIPLEXER
U2	3	IC 2674 ADVANCED VIDEO DISPLAY CONTROLLER (AVDC) 4-MHZ
U3	2	IC 65C02 MICROPROCESSOR 3-MHZ
U5	2	IC EPROM SYSTEM 9220
U7	2	IC EPROM SYSTEM 9220
U8	2	IC 2K X 8 CMOS STATIC RAM
U9	4	IC 74LS374 8X D-TYPE FLIP-FLOP
U10	2	IC STATIC RAM 2K X 8 100ns
U11	4	IC 74LS245
U12	2	IC GATE ARRAY PKG B
U13	5	IC 2681 DUAL ASYNCHRONOUS RECEIVER/ TRANSMITTER (DUART)
U14	3	IC 74LS157 4X 2-IN DATA SELECT MULTIPLEXER
U15	4	IC 74LS244 8X BUFFER/L DRIVER/L
U16	3	IC 74LS157 4X 2-IN DATA SELECT MULTIPLEXER
U17	4	IC 74LS374 8X D-TYPE FLIP-FLOP
U18	4	IC 74LS244 8X BUFFER/L DRIVER/L
U19	3	IC 74LS157 4X 2-IN DATA SELECT MULTIPLEXER
U20	1, 2, 4	IC 74LS04 6X INVERTER
U21	3	IC STATIC RAM 2K X 8 100ns
U22	3	IC STATIC RAM 2K X 8 100ns
U23	3	IC STATIC RAM 2K X 8 100ns
U24	3	IC STATIC RAM 2K X 8 100ns
U25	3	IC FIELD PROGRAMMABLE LOGIC ARRAY 82S153A
U26	5	IC 9639 DUAL LINE RECEIVER
U27	5	IC 9639 DUAL LINE RECEIVER
U28	1	IC 4N38 OPTO COUPLER
U29	4	IC STATIC RAM 2K X 8 100ns
U30	4	IC ROM 9220 CHARACTER GENERATOR
U31	3	IC GATE ARRAY PKG A
U32	5	IC 9639 DUAL LINE RECEIVER
U33	5	IC 9639 DUAL LINE RECEIVER
U34	4	IC COLOR/MONO ATTRIBUTE CONTROLLER (CMAC)
U35	4	IC 74LS163 SYN 4-BIT COUNTER
U36	4	IC 74LS374 8X D-TYPE FLIP-FLOP
U38	2, 4, 5	IC 74LS08 4X 2-IN AND GATE
U39	4	IC 74LS174 6X D-FLIP FLOP
U40	5	IC 9636 DUAL LINE DRIVER
U41	4	IC 74LS51 2X AND-OR-INVERTER GATE
U42	4, 5	IC 74S04 6X INVERTER
U45	1	IC 4N38 OPTO COUPLER

**Table 2-1 (Continued)**  
**IC Reference by Board Location**

<b>Location</b>	<b>Schematic Page</b>	<b>Type/Description</b>
U46	5	IC 9636 DUAL LINE DRIVER
U47	2,4,5	IC 74LS32 4X 2-IN OR GATE
U48	5	IC 9636 DUAL LINE DRIVER
U49	4	IC 74LS139 2X 1 OF 4 DECODER
U50	1	IC 8211 PROGRAMMABLE VOLTAGE REGULATOR
U51	1,2,4,5	IC 7406 6X INVERTER/BUFFER/DRIVER
U52	1,2,4,5	IC 74LS00 4X 2-IN NAND GATE
U53	5	IC 74LS08 4X 2-IN AND GATE
U54	5	IC 9636 DUAL LINE DRIVER
U55	5	IC 74LS32 4X 2-IN OR GATE
U56	2,4,5	IC 74LS08 4X 2-IN AND GATE

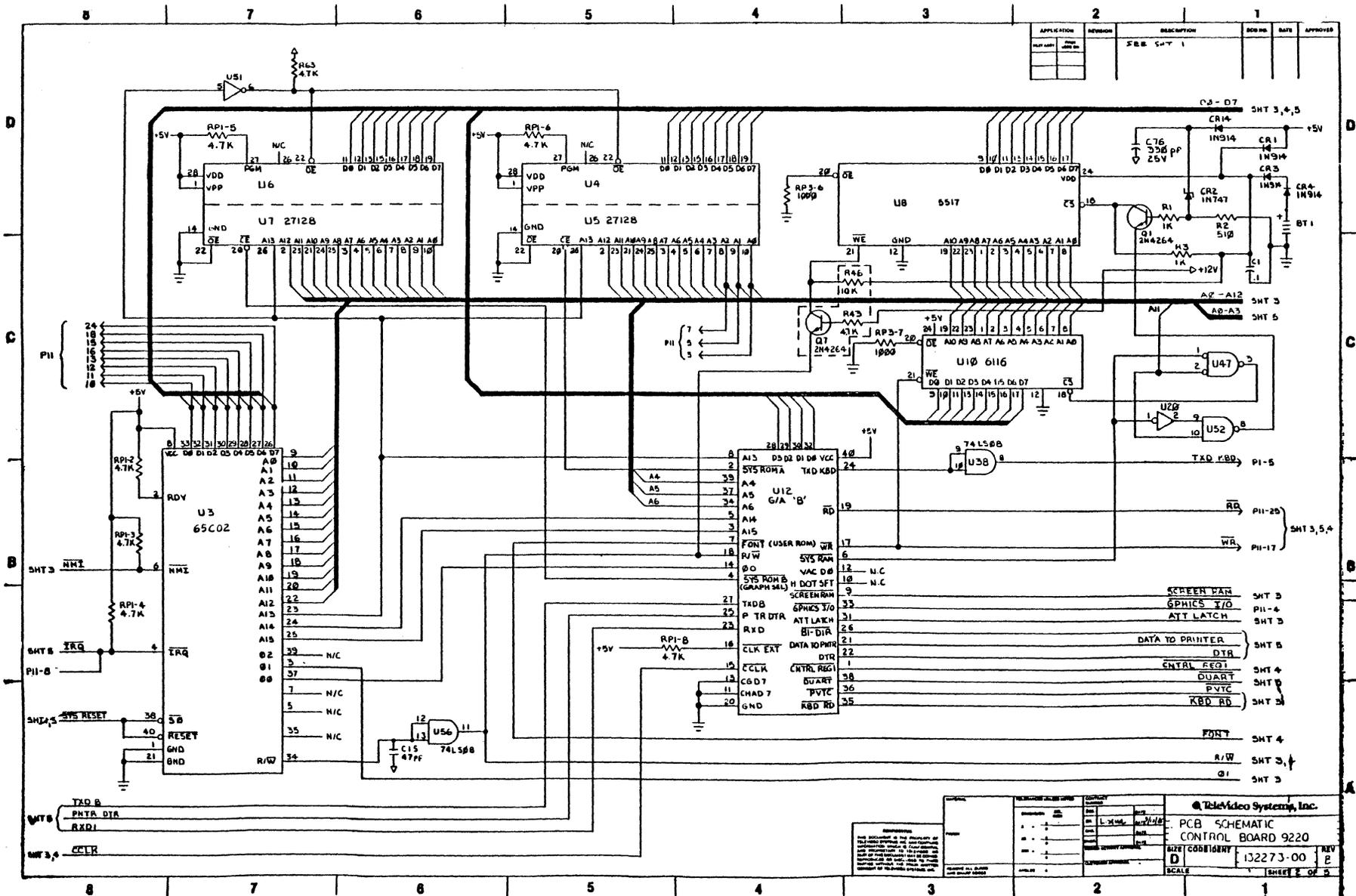
APPLICATION	REVNO	DESCRIPTION	ECO NO	DATE	APPROVED
	4	PREL REL		11/11/71	
	A	PROD REL		3/15/81	
	B	USWA6602A REV U17		3/23/81	



NOTE: UNLESS OTHERWISE SPECIFIED.  
 1. ALL RESISTORS ARE VALUED IN OHMS ±5%  
 AND ARE 1/4 WATT.  
 2. ALL CAPACITORS ARE VALUED IN  
 MICROFARADS ±10% AND ARE 50VDC.

TITLE: PCB SCHEMATIC CONTROL BOARD 9320 DATE: 11/11/71 DRAWN BY: [ ] CHECKED BY: [ ] APPROVED BY: [ ]		TELEVISION SYSTEMS, INC. 13227 J-00 SCALE: 1:1 SHEET 1 OF 2
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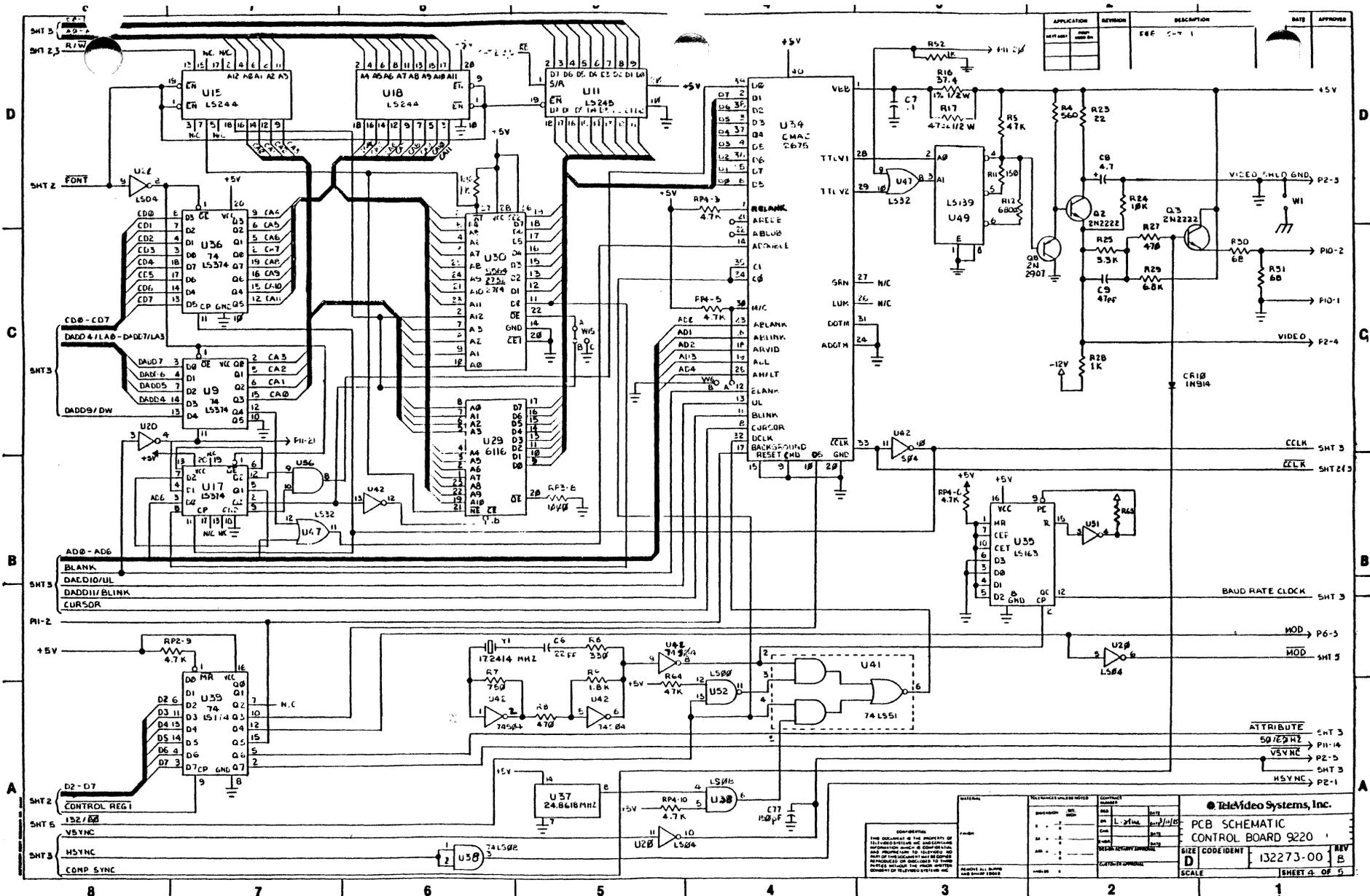
APPLICATION	REVISION	DESCRIPTION	DOCS	DATE	APPROVED
		S.B.B. SHT 1			



REV	DATE	BY	CHKD	APP'D
1				

PCB SCHEMATIC  
 CONTROL BOARD 9220  
 132273-00 REV E  
 SCALE 1:1 SHEET 2 OF 5





APPLICATION	REVISION	DESCRIPTION	DATE	APPROVED
REV 001	001	PCB SCHEMATIC		

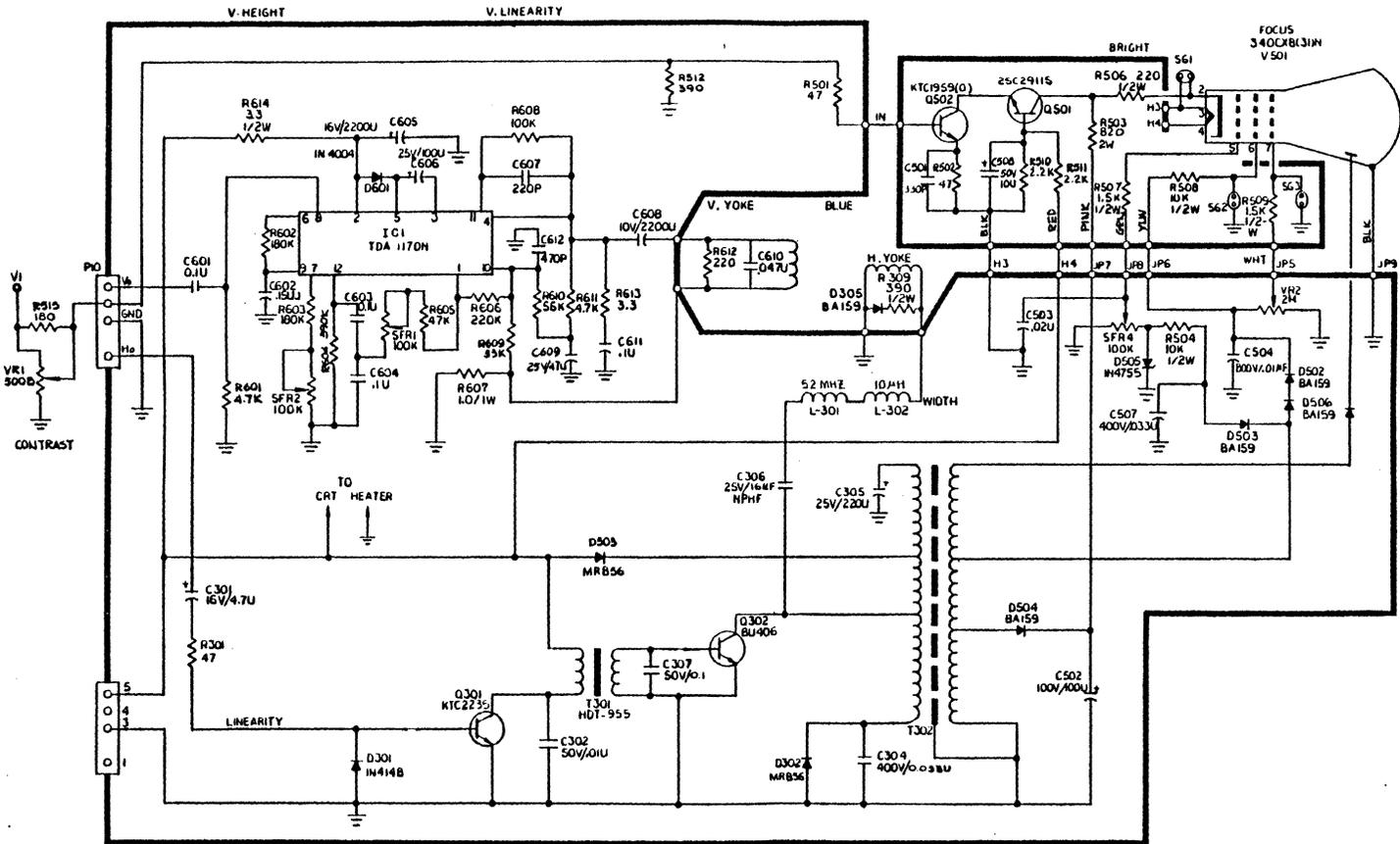
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REV	DATE	DESCRIPTION
001	02/10/85	PCB SCHEMATIC
002	03/10/85	REVISION
003	04/10/85	REVISION
004	05/10/85	REVISION
005	06/10/85	REVISION

The Video Systems, Inc.  
 PCB SCHEMATIC  
 CONTROL BOARD 9220  
 SIZE CODE IDENT 132273-00  
 SCALE SHEET 4 OF 5



A	PROD REL		
B	IMPROVE VIDEO		
C	UPDATE VIDEO, ADD NOTE		



- NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS ARE 1/4W, ±5%, RESISTANCE IS IN OHMS.
  2. D502, D506 CONNECTED IN SERIES.

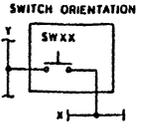
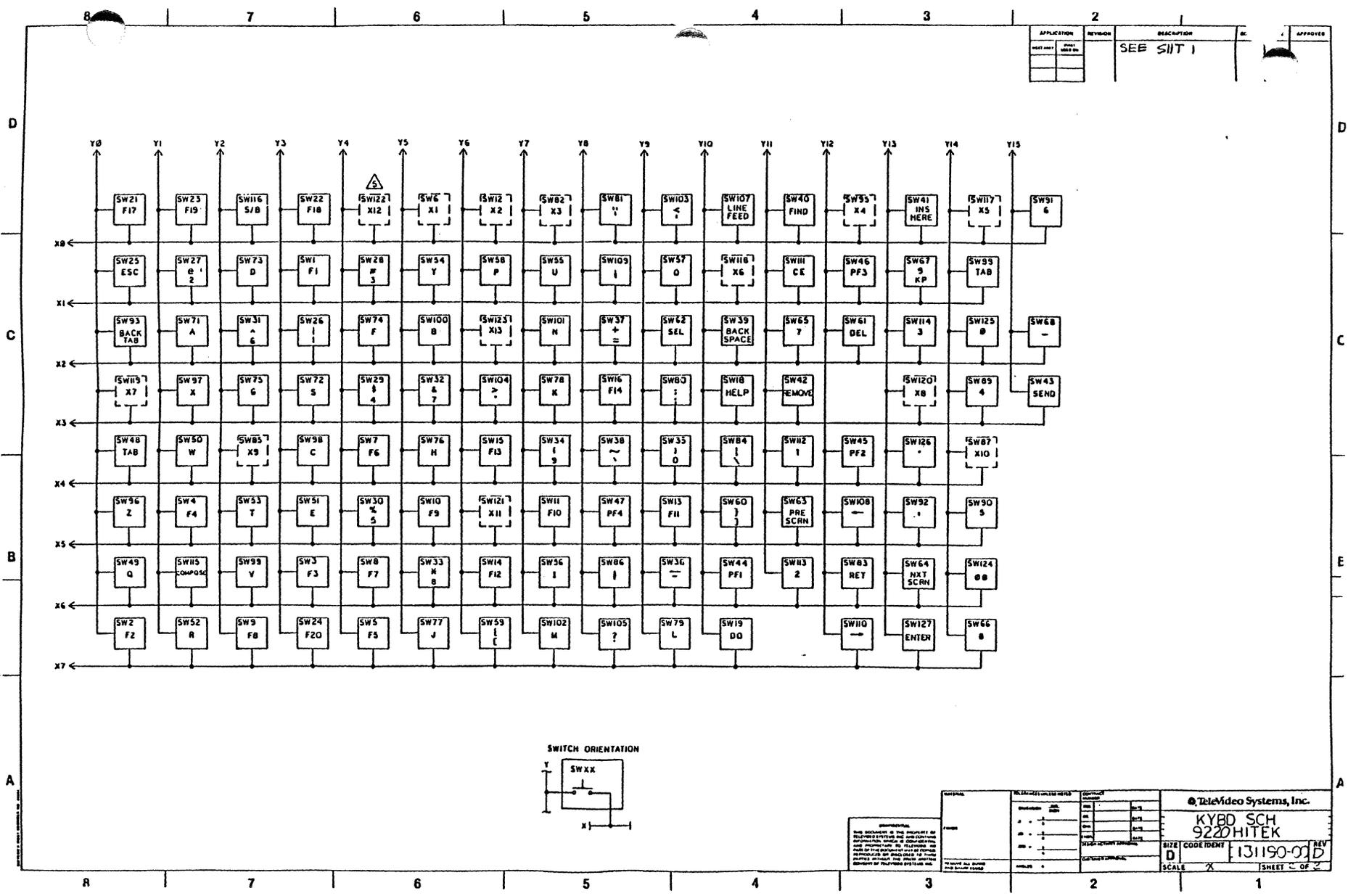
REVISIONS

NO.	DATE	DESCRIPTION
1		
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PCB SCHEMATIC 9220 VIDEO MONITOR		CODE IDENT 131849-00	REV C
SCALE 1:1		SHEET 1 OF 1	



APPLICATION	REVISION	DESCRIPTION	DATE	APPROVED
		SEE SHIT 1		



REVISIONS

NO.	DATE	DESCRIPTION
1		
2		
3		
4		
5		

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KYBD SCH  
9220HITEK

SIZE CODE IDENT 1131190-00B

SCALE X SHEET 2 OF 2

## ORDERING SPARE PARTS

You can order spare parts by telephone\*, telex or by written purchase order. To place an order, contact the TeleVideo Regional Sales Office in your area, or contact our Corporate Spare Parts Order Entry Department at the following address:

TeleVideo Systems, Inc.  
1170 Morse Avenue  
P.O. Box 3568  
Sunnyvale, CA 94088-3568

or call

Sunnyvale:	408-745-7760
Telex:	474-5041 TVISYS
Fax:	408-734-1927
TWX	910-338-7633

All orders are shipped F.O.B. our designated site.

## TERMINALS SPARE PARTS PRICE LIST

For spare part prices, refer to the Terminals Spare Parts Price List in Section 7 (Addenda) of this manual.

\*All telephone orders must be followed by a confirming purchase order clearly marked "Confirming Purchase Order".

**Table 3-1  
9220 Parts List**

**PCB ASSEMBLY LOGIC BOARD - PART NUMBER 132270-00**

<b>Part Number</b>	<b>Description</b>	<b>Location</b>
<b>Integrated Circuits</b>		
120274-00	IC 74LS157 4X 2-IN DATA SEL/MLT	U1, 14, 16, 19
130234-00	IC 2674 AVDC 4-MHZ	U2
130236-00	IC 65C02 MICROPROCESSOR 3-MHZ	U3
180002-82	IC EPROM SYS 9220 C000	U5
180002-81	IC EPROM SYS 9220 4000	U7
121387-00	IC 2K X8 CMOS STATIC RAM	U8
120290-00	IC 74LS374 8X D-TYPE FF	U9, 17, 36
131615-00	IC STAT RAM 2K X 8 100ns	U10, 21-24, 29
120362-00	IC 74LS245, N8T245N	U11
130180-00	IC GATE ARRAY PKG B	U12
130222-00	IC 2681 DUAL UART	U13
120442-00	IC 74LS244 8X BFR/L DRVR/L RCV	U15, 18
120248-00	IC 74LS04 6X INVTR	U20
130920-00	IC FPLA 82S153A	U25
131636-00	IC 9639 DUAL LINE RECEIVER	U26, 27, 32, 33
120350-00	IC 4N38 OPTO CPLR	U28, 45
180002-90	IC ROM 9220 CHAR GEN	U30
130170-00	IC GATE ARRAY PKG A	U31
130238-00	IC COLOR/MONO AT CONT (CMAC)	U34
120276-00	IC 74LS163 SYN 4-BIT CNTR	U35
120252-00	IC 74LS08 4X 2-IN AND GATE	U38, 53, 56
120282-00	IC 74LS174 6X D-FLIP FLOP	U39
131635-00	IC 9636 DUAL LINE DRIVER	U40, 46, 48, 54
120262-00	IC 74LS51 2X AND-OR-INVTR GATE	U41
120246-00	IC 74S04 6X INVTR	U42
120258-00	IC 74LS32 4X 2-IN OR GATE	U47, 55
120272-00	IC 74LS139 2X 1 OF 4 DECODER	U49
131614-00	IC 8211 PROG VOLT REG	U50
120348-00	IC 7406 6X INVTR BFR/DRVR	U51
120242-00	IC 74LS00 4X 2-IN NAND GATE	U52

**Resistors and Pots**

120521-00	RES CF 1000 OHM 1/4W 5%	R1, 3, 10, 28, 49, 52, 65
120519-00	RES CF 510 OHM 1/4W 5%	R2,40
120375-00	RES CF 560 OHM 1/4W 5%	R4
120531-00	RES CF 4700 OHM 1/4W 5%	R5, 21, 22, 33, 36, 39, 43, 47, 60, 61, 63, 64
120515-00	RES CF 330 OHM 1/4W 5%	R6
120317-00	RES CF 750 OHM 1/4W 5%	R7
120517-00	RES CF 470 OHM 1/4W 5%	R8, 27
120523-00	RES CF 1800 OHM 1/4W 5%	R9
120339-00	RES CF 150 OHM 1/4W 5%	R11
120371-00	RES CF 680 OHM 1/4W 5%	R12

**Table 3-1 (Continued) - 9220 Parts List**

**PCB ASSEMBLY LOGIC BOARD - PART NUMBER 132270-00**

<b>Part Number</b>	<b>Description</b>	<b>Location</b>
126183-00	RES MF 68K OHM 1/4W +/-1%	R13
126184-00	RES MF 1M OHM 1/4W +/-1%	R14
126182-00	RES MF 22K OHM 1/4W +/-1%	R15
130192-00	RES WW 37.40 OHM 1/2W 1%	R16
270702-00	RES MF 47.5 OHM 1/2W 1%	R17
120337-00	RES CF 47K OHM 1/4W 5%	R20
130194-00	RES CF 22 OHM 1/2W 5%	R23
120341-00	RES CF 10K OHM 1/4W 5%	R24, 46, 48
120527-00	RES CF 3300 OHM 1/4W 5%	R25, 34
121440-00	RES CF 82 OHM 1/4W 5%	R26
120391-00	RES CF 6.8K OHM 1/4W 5%	R29
120511-00	RES CF 68 OHM 1/4W 5%	R30, 31, 35
120323-00	RES CF 51K OHM 1/4W 5%	R37
123482-00	RES CF 15K OHM 1/4W 5%	R38
120325-00	RES CF 75K OHM 1/4W 5%	R44, 53, 54, 62
120363-00	RES CF 22K OHM 1/4W 5%	R50, 51
120413-00	RES PK 4.7K OHM 10 PIN SIP	RP1, 4
120427-00	RES PK 1K OHM 8 PIN SIP	RP3

**Capacitors**

130172-00	CAP GL PK .1uF 25V +80%	C1, 3, 7
130174-00	CAP GL PK .01uF 25V +80% -20%	C30, 31, 37-39, 41-44, 49-52, 54-59, 61-69, 71-74, 80, 82-88
130176-00	CAP ELECT 10uF 16V +80%	C2, 70
122614-00	CAP ELEC 1uF 10V	C5
130196-00	CAP MONO 22pF 50V +/-10%	C6
130177-00	CAP TANT 4.7uF 16V +/-20%	C8, 33, 45
130179-00	CAP GL PK 47pF 50V	C9, 15
130171-00	CAP GL PK 10pF 25V +/-20%	C14
130173-00	CAP GL PK 330pF 25V +/-20%	C23-27, 76
130175-00	CAP ELECT 22uF 16V +80%	C28, 32, 35, 36
130202-00	CAP GL PK 150pF 50V +/-10%	C77
130183-00	CAP GL PK 100pF 50V +/-10%	C81

**Miscellaneous**

120475-00	DIODE 1N914	CR1, 3, 4-11, 14
122070-00	DIODE ZENER 3.6V	CR2
131551-00	TRAN 2N4264 NPN	Q1, 7
120469-00	TRAN 2N2222A NPN/SILICON	Q2, 3, 9
120459-00	TRAN 2N2907A PNP/SILICON	Q4, 6, 8
120455-00	TRAN 2N4401/2SC1166 NPN/SIL	Q5

**Table 3-1 (Continued) - 9220 Parts List**

**PCB ASSEMBLY LOGIC BOARD - PART NUMBER 132270-00**

<b>Part Number</b>	<b>Description</b>	<b>Location</b>
121262-00	VOLT REG 79L05AC	VR1
131386-00	BATTERY LITHIUM CYLINDER	B1
270667-00	CRY 17.2414-MHZ	Y1
122168-00	CRY 3.6864-MHZ	Y2
270721-00	CRY 24.8618 MHZ CLOCK OSC	U37
122084-00	CONN 6P MOD JACK RJ12 RT-ANG	P1
120988-02	CONN 4P HDR WT (5P W/#2P OUT)	P2
121653-01	CONN 25P D-SUB FEM THRD	P3, 4
122639-00	CONN 4P HDR RED (5P W/#2P OUT)	P5
120988-00	CONN 2P STR WAF	P10
120984-02	SOCKET 40P IC DIP	U2, 3, 12, 13, 31, 34
120984-04	SOCKET 28P IC DIP	U5, 7, 22, 23, 30
120984-01	SOCKET 24P IC DIP	U8, 10, 21, 24, 29
120984-06	SOCKET 20P IC DIP	U25
120017-00	SCREW JACK 4-40 .125 PNL BRS	P3, 4

Table 3-1 (Continued) - 9220 Parts List

PCB ASSEMBLY VIDEO MONITOR - PART NUMBER 247726-00

Part Number	Description	Location
270884-00	TRAN KTC2235(O)	Q301
270883-00	TRAN BU406	Q302
120485-00	DIODE 1N4148 SWITCH	D301
241301-00	DIODE MR856	D302, 303
241300-00	DIODE BA159	D502-504, 506
270882-00	DIODE 1N4755	D505
122022-00	DIODE 1N4004 MOT	D601
120441-00	POT TRIM 100K OHM TOP-ADJ PCMT	SFR1, 2, 4
121801-00	POT FOCUS 2M OHM	VR2
242817-00	TRANS H DRIVE HDT	T301
130746-00	TRANSFORMER FLYBACK	T302
130134-00	COIL LINEARITY 52-MHZ	L301
130838-00	COIL WIDTH 10uH +40%	L302
242000-00	IC VERT AMP TDA-1170N	IC1
120377-00	RES CF 47 OHM 1/4W +/- 5%	R301, 501
121768-00	RES CF 10K OHM 1/2W 5%	R504
120403-00	RES CF 220 OHM 1/4W	R512
120531-00	RES CF 4700 OHM 1/4W 5%	R601, 611
131582-00	RES CF 200K OHM 1/4W	R602
240102-00	RES CF 180K OHM 1/4W	R603
240103-00	RES CF 390K OHM 1/4W	R604
120337-00	RES CF 47K OHM 1/4W 5%	R605
240104-00	RES CF 220K OHM 1/4W	R606
240108-00	RES MF 1.0 OHM 1W	R607
131502-00	RES CF 68KOHM 1/4W 5%	R608
249700-01	RES CF 33K OHM 1/4W	R609
240105-00	RES CF 56K OHM 1/4W	R610
240106-00	RES CF 3.3K OHM 1/4W	R613
240107-00	RES CF 3.3 OHM 1/2W	R614
121967-00	CAP ELEC 4.7uF 16V	C301
249017-00	CAP PF 0.01uF 50V	C302
241124-00	CAP POLYPRO 0.033uF 630V	C304
130127-00	CAP ELEC 220uF 25V	C305
122800-00	CAP ELEC 16uF 25V (NON-P)	C306
240907-00	CAP PF 0.1uF 50V	C307, 601, 603, 604, 611
130827-00	CAP ELEC 100uF 100 RADIAL LDS	C502
130186-00	CAP CER .02uF 50V	C503
270880-00	CAP MF .01uF 800V 10% RAD	C504
130126-00	CAP MYL .033uF 400V	C507
240908-00	CAP PF 0.15uF 50V	C602
249015-00	CAP ELEC 2200uF 16V 16X25MM	C605
249003-00	CAP ELECT 100uF 25V 8X11.5MM	C606
121959-00	CAP CER 220pF 50V	C607
121962-00	CAP ELEC 2200uF 10V	C608
249027-00	CAP ELECT 47uF 25V 6.3X11MM	C609
240700-00	CAP CER 470pF 50V	C612

**Table 3-1 (Continued) - 9220 Parts List**

**PCB ASSEMBLY VIDEO MONITOR - PART NUMBER 247726-00**

<b>Part Number</b>	<b>Description</b>	<b>Location</b>
122174-01	CONN 4P HDR W/LOCK WHITE	
122173-01	CONN 4P HDR W/LOCK BLUE	
122172-01	CONN 4P HDR W/LOCK RED	
123059-01	SCREW M3X8MM SELF TAP PH PHL	
132329-00	CVR SHIELD FBT	
131862-00	PCB ASY SOCKET 9220	
249078-00	SCREW M3X6 BH	
121078-00	WASHER M3 FLAT ST ZN	
123107-00	WASHER M3 STAR EXT LOCK ST ZN	

**PCB ASSEMBLY POWER SUPPLY - PART NUMBER 132324-00**

Table 3-1 (Continued) - 9220 Parts List

ADDITIONAL PARTS

Part Number	Description	Location
<b>Keyboard</b>		
130932-00	KEYBOARD ASSEMBLY	
130936-00	HSG KYBD BOTTOM	
130935-00	HSG KYBD TOP	
130175-00	CAP ELECT' 22uF 16V +80%	C1, 4
130178-00	CAP CER .01uF 50V +/- 10%	C3, 5, 8, 9
120265-00	CAP ELEC 2.2uF 25V 10%	C2
120245-00	CAP MICA 20pF 50V 2%	C6, 7
120986-01	CRYSTAL 5.7143 MHZ	Y1
122450-00	IC 14040B 12-BIT BINARY COUNTR	U5
121700-00	IC 74LS145 BCD TO DECI DECODER	U3, 4
121390-00	IC 8049 MICROCOMPUTER	U2
120354-00	IC 7414 6X SCHMITT TRIG	U1
120373-00	RES CF 27K OHM 1/4W 5%	R8
120319-00	RES CF 1200 OHM 1/4W 5%	R1
120527-00	RES CF 3300 OHM 1/4W 5%	R2-7
270846-00	RES PK 6.8K OHM 10P SIP	RP1
122151-00	TRANSDUCER AUDIO	LS1
120455-00	TRAN 2N4401/2SC1166 NPN/SIL	Q1
120475-00	DIODE 1N914	CR1, 2
121261-00	VOLT REG 78 M05	VR1
131159-00	KEYSWITCH NONLOCKING MAR	
131158-00	KEYSWITCH NONLOCKING	
131157-00	KEYSWITCH LOCKING	
122161-00	CBL ASY 6 CONDUCTOR RJ12	
122084-00	CONN 6P MOD JACK RJ12 RT-ANG	J2
121063-10	SCREW 6-32x 1/4" PH PHL ST ZN	
121074-00	SCREW M3 X 6MM PH PHL ST ZN	
121752-03	NUT 6-32 HEX ST ZN	
<b>Case</b>		
131853-00	CASE ASSEMBLY	
131747-00	TUBE CRT 14" AMBER	
122187-00	TUBE CRT 14" GREEN	
132337-00	CBL BRAIDED EMI	
132165-00	BEZEL	
132166-00	HSG REAR	
132155-00	BASE MONITOR	
132148-00	GUIDE DISH	
132147-00	PIVOT	
132146-00	NUT PIVOT	
121076-07	SCREW M5 X 12MM PH PHL ST ZN	
121074-00	SCREW M3 X 6MM PH PHL ST ZN	
121074-09	SCREW M3 X 7MM PH PHL ST ZN	
121074-02	SCREW M3 X 10MM PH PHL ST ZN	
121074-03	SCREW M3 X 16MM PH PHL ST ZN	
123059-00	SCREW M3 X 6MM SELF TAP PH PHL	

Table 3-1 (Continued) - 9220 Parts List

**ADDITIONAL PARTS**

<b>Part Number</b>	<b>Description</b>	<b>Location</b>
121078-00	WASHER M3 FLAT ST ZN	
121079-01	WASHER M4 LOCK ST ZN	
121078-02	WASHER M5 FLAT ST ZN	

**Chassis**

122985-01	FUSE .75 AMP 250V SLOW-BLOW (230V ONLY)	
122985-03	FUSE 1.5 AMP 250 V SLOW-BLOW (115V ONLY)	
132195-00	FUSE HOLDER	
132172-00	POT CONTRAST	
132167-00	KNOB BRIGHTNESS	
132541-00	GUIDE PWR SPLY BD	
121074-00	SCREW M3 X 6MM PH PHL ST ZN	
121080-02	NUT M5 HEX ST ZN	
121078-02	WASHER M5 FLAT ST ZN	
123107-02	WASHER M5 STAR EXT LOCK ST ZN	

**Pedestal**

132159-00	HSG PEDESTAL	
132157-00	SHIELD PEDESTAL	
132149-00	GUIDE LOGIC BD	
132184-00	FOOT RUBBER	
121074-00	SCREW M3 X 6MM PH PHL ST ZN	
122156-02	SCREW M3 X 8MM FH PHL ST ZN	
121074-05	SCREW M3 X 12MM PH PHL ST ZN	

**Rear Panel**

132156-00	BASE PEDESTAL	
131854-00	PANEL REAR	
131593-00	BUMPER PLASTIC	
120017-00	SCREW JACK 4-40	
121074-00	SCREW M3 X 6MM PH PHL ST ZN	
123114-00	SCREW M3 X 6MM PH PHL ST BLK	
121080-00	NUT M3 HEX ST ZN	

**Miscellaneous**

131977-00	OPERATOR'S MANUAL 9220	
131979-00	MAINTENANCE MANUAL 9220	
131165-00	SHIPPING CARTON OUTER	
131166-00	SHIPPING CARTON STYROFOAM RIGHT	
131167-00	SHIPPING CARTON STYROFOAM LEFT	
122911-00	POWER CORD 6 FT	

**Table 3-2  
9220 Keycaps Parts List**

Description	Printed	Blank	Degree
1X1 BRN F1	130703-13		0
1X1 BRN F2	130703-14		0
1X1 BRN F3	130703-15		0
1X1 BRN F4	130703-16		0
1X1 BRN F5	130703-17		0
1X1 BRN F6	130703-18		0
1X1 BRN F7	130703-19		0
1X1 BRN F8	130703-20		0
1X1 BRN F9	130703-21		0
1X1 BRN F10	130703-22		0
1X1 BRN F11	130703-23		0
1X1 BRN F12	130703-24		0
1X1 BRN F13	130703-25		0
1X1 BRN F14	130703-26		0
1X1 BRN HELP	130703-33		0
1X2 BRN DO	130711-01		0
1X1 BRN RESET	130703-11		0
1X1 BRN F17	130703-29		0
1X1 BRN F18	130703-30		0
1X1 BRN F19	130703-31		0
1X1 BRN F20	130703-32		0
1X1 BRN LOC/ESC/LINE/ESC	130703-12		0
1X1 WHT !/1	130702-01		0
1X1 WHT @/2	130702-02		0
1X1 WHT #/3	130702-03		0
1X1 WHT \$/4	130702-04		0
1X1 WHT %/5	130702-05		0
1X1 WHT ^/6	130702-06		0
1X1 WHT &/7	130702-07		0
1X1 WHT */8	130702-08		0
1X1 WHT (/9	130702-09		0
1X1 WHT )/0	130702-10		0
1X1 WHT _/-	130702-11		0
1X1 WHT +/=	130702-12		0
1X1 WHT ~/'	130702-13		0
1X1.5 BRN BACK/SPACE	130707-01		0
1X1 BRN FIND	130703-35		0
1X1 BRN INSERT/HERE	130703-34		0
1X1 BRN REMOVE	130703-36		0
1X1 BRN SEND	130703-06		0
1X1 BRN PF1	130703-37		0
1X1 BRN PF2	130703-38		0
1X1 BRN PF3	130703-39		0
1X1 BRN PF4	130703-40		0
1X1.5 BRN TAB	130708-01		5
1X1 WHT Q	130701-12		5
1X1 WHT W	130701-11		5
1X1 WHT E	130701-10		5
1X1 WHT R	130701-09		5
1X1 WHT T	130701-08		5

Table 3-2 (Continued) - 9220 Keycaps Parts List

Description	Printed	Blank	Degree
1X1 WHT Y	130701-07		5
1X1 WHT U	130701-06		5
1X1 WHT I	130701-05		5
1X1 WHT O	130701-04		5
1X1 WHT P	130701-03		5
1X1 WHT {/[	130701-17		5
1X1 WHT }/]	130701-18		5
1X1 BRN DELETE	130704-05		5
1X1 BRN SELECT	130704-02		5
1X1 BRN PREV/SCREEN	130704-03		5
1X1 BRN NEXT/SCREEN	130704-04		5
1X1 WHT 7	130701-13		5
1X1 WHT 8	130701-14		5
1X1 WHT 9	130701-15		5
1X1 BRN -	130704-06		5
1X1 BRN CTRL	130705-02		10
1X1.5 BRN LOCK	130709-01		10
1X1 WHT A	130700-08		10
1X1 WHT S	130700-09		10
1X1 WHT D	130700-10		10
1X1 WHT F	130700-11		10
1X1 WHT G	130700-07		10
1X1 WHT H	130700-06		10
1X1 WHT J	130700-05		10
1X1 WHT K	130700-04		10
1X1 WHT L	130700-03		10
1X1 WHT :/;	130700-02		10
1X1 WHT "/'	130700-01		10
BRN RETURN L-SHAPED	130717-01		
1X1 BRN  /\	130705-01		10
1X1 BRN ARROW (WD) UP	130705-04		10
2X1 BRN TAB	130716-01		10
1X1 WHT 4	130700-16		10
1X1 WHT 5	130700-15		10
1X1 WHT 6	130700-14		10
1X1 BRN ,	130705-05		10
1X1 BRN BACK/TAB	130706-02		18
1X2 BRN SHIFT	130712-01		18
1X1 WHT Z	130699-12		18
1X1 WHT X	130699-11		18
1X1 WHT C	130699-10		18
1X1 WHT V	130699-09		18
1X1 WHT B	130699-08		18
1X1 WHT N	130699-07		18
1X1 WHT M	130699-06		18
1X1 WHT </,	130699-05		18
1X1 WHT >/.	130699-04		18
1X1 WHT ?//	130699-03		18

**Table 3-2 (Continued) - 9220 Keycaps Parts List**

<b>Description</b>	<b>Printed</b>	<b>Blank</b>	<b>Degree</b>
1X1 BRN LINE/FEED	130706-14		18
1X1 BRN ARROW (WD) LFT	130706-13		18
1X1 BRN ARROW (WD) DWN	130706-12		18
1X1 BRN ARROW (WD) RT	130706-11		18
1X1 BRN CE	130706-10		18
1X1 WHT 1	130699-16		18
1X1 WHT 2	130699-15		18
1X1 WHT 3	130699-14		18
1X2 BRN COMPOSE/CHARACTER	130712-02		
WHT SPACEBAR		130718-00	
1X1 WHT 00	130699-01		18
1X2 WHT 0	130713-01		18
1X1 WHT .	130699-13		18
2X1 BRN ENTER	130714-01		18

Table 3-3 lists recommended spare parts for the 9220 terminal.

**Table 3-3  
9220 Terminal Recommended Spare Parts**

**Recommended Modules**

Logic Board  
(part no. 132270-00): One spare per 15 terminals

Video Monitor Board  
(part no. 247726-00): One spare per 15 terminals

Power Supply  
(part no. 132324-00): One spare per 15 terminals

Keyboard Assembly  
(part no. 130932-00): One spare per 15 terminals

CRT (14" Amber)  
(Part no. 131747-00): One spare per 15 terminals

CRT (14" Green)  
(Part no. 122187-00): One spare per 15 terminals

**Recommended Logic Board Components per 15 Terminals**

Description	Part No.	Location
IC 4N38 OPTO COUPLER	120350-00	U28, 45
IC 74LS244 8X BFR/L DRVR/L	120442-00	U15, 18
VOLTAGE REGULATOR 79L05AC	121262-00	VR1
IC 2K X 8 CMOS STATIC RAM	121387-00	U8
CRYSTAL 3.6864-MHz	122168-00	Y2
IC GATE ARRAY PKG A	130170-00	U31
IC GATE ARRAY PKG B	130180-00	U12
IC 2681 DUAL UART	130222-00	U13
IC 2674 AVDC 4-MHz	130234-00	U2
IC 65C02 MICROPROCESSOR 3-MHz	130236-00	U3
IC COLOR/MONO AT CONT (CMAC)	130238-00	U34
IC FPLA 82S153A	130920-00	U25
BATTERY LITHIUM CYLINDER	131386-00	B1
IC 8211 PROG VOLT REG	131614-00	U50
IC STATIC RAM 2K X 8 100ns	131615-00	U10, U21-24, 29
IC 9636 DUAL LINE DRIVER	131635-00	U40, 46, 48, 54
IC 9639 DUAL LINE RECEIVER	131636-00	U26, 27, 32, 33
IC EPROM SYS 4000	180002-81	U7
IC EPROM SYS C000	180002-82	U5
IC ROM CHARACTER GENERATOR	180002-90	U30
CRYSTAL 17.2414-MHz	270667-00	Y1
CRYSTAL OSC. 24.8618-MHz	270721-00	U37

**Table 3-3 (Continued)**  
**9220 Terminal Recommended Spare Parts**

**Recommended Video Monitor Components per 15 Terminals**

<b>Description</b>	<b>Part No.</b>	<b>Location</b>
TRAN KTC2235(O)	270884-00	Q301
TRANSFORMER FLYBACK	130746-00	T302
TRAN 2SC2911(S) HI VOL SW	131823-00	Q501
TRAN KTC-1959(O)	241102-00	Q502
TRAN BU406	270883-00	Q302
IC VERT AMP TDA-1170N	242000-00	IC1
TRANS H DRIVE HDT	242817-00	T301
FUSE .75 AMP 250V SLOW BLOW	122985-01	IT 4 (230V ONLY)
FUSE 1.5 AMP 250V SLOW BLOW	122985-03	IT 4 (115V ONLY)

**Recommended Keyboard Assembly Components per 15 Terminals**

<b>Description</b>	<b>Part No.</b>	<b>Location</b>
CABLE ASSEMBLY 6-CONDUCTOR RJ12	122161-00	
KEYBOARD ASSEMBLY	130932-00	
IC 8049 MICROCOMPUTER	121390-00	U2
CRYSTAL 5.7143-MHz	120986-01	Y1
VOLTAGE REGULATOR 78M05	121261-00	VR1
KEYSWITCH, LOCKING	131157-00	
KEYSWITCH, NONLOCKING	131158-00	
KEYSWITCH, NONLOCKING MAR	131159-00	
RES PK 6.8K OHM 10P SIP	270846-00	RP1

## **THEORY OF OPERATION**

### **OVERVIEW**

The 9220 terminal logic is based on a 65C02 8-bit CMOS microprocessor operating at 3MHz, capable of addressing 65K bytes of memory. Figure 4-1 shows a block diagram of the 9220.

Refer to the schematic diagram in Section 2 while reading the Theory of Operation that follows.

### **DISPLAY FUNDAMENTALS**

#### **2674 Advanced Video Display Controller (AVDC), Board Location U2**

A 2674 Advanced Video Display Controller (AVDC) is used for video display timing. The AVDC generates programmable horizontal and vertical sync signals necessary for data display, timing and character address generation for up to 16K of display RAM.

A character clock (CCLK) sent from the 2675 Color/Mono Attribute Controller (CMAC - U34) to the AVDC is used to count the programmable number of characters per row. Refresh addresses for the display and attribute RAMs are generated while the AVDC counts the CCLK transitions. At the end of each scan line, the AVDC generates a horizontal sync pulse.

The number of scan lines per character row, the number of character rows per frame, and the vertical sync pulse position and duration are all programmable. Cursor output and video blanking are also provided.

#### **2675 Color/Mono Attribute Controller (CMAC), Board Location U34**

Cursor and video blanking signals are sent to the CMAC to be combined with character and attribute data. The CMAC takes this data on a character-by-character basis and produces the video drive for the video module.

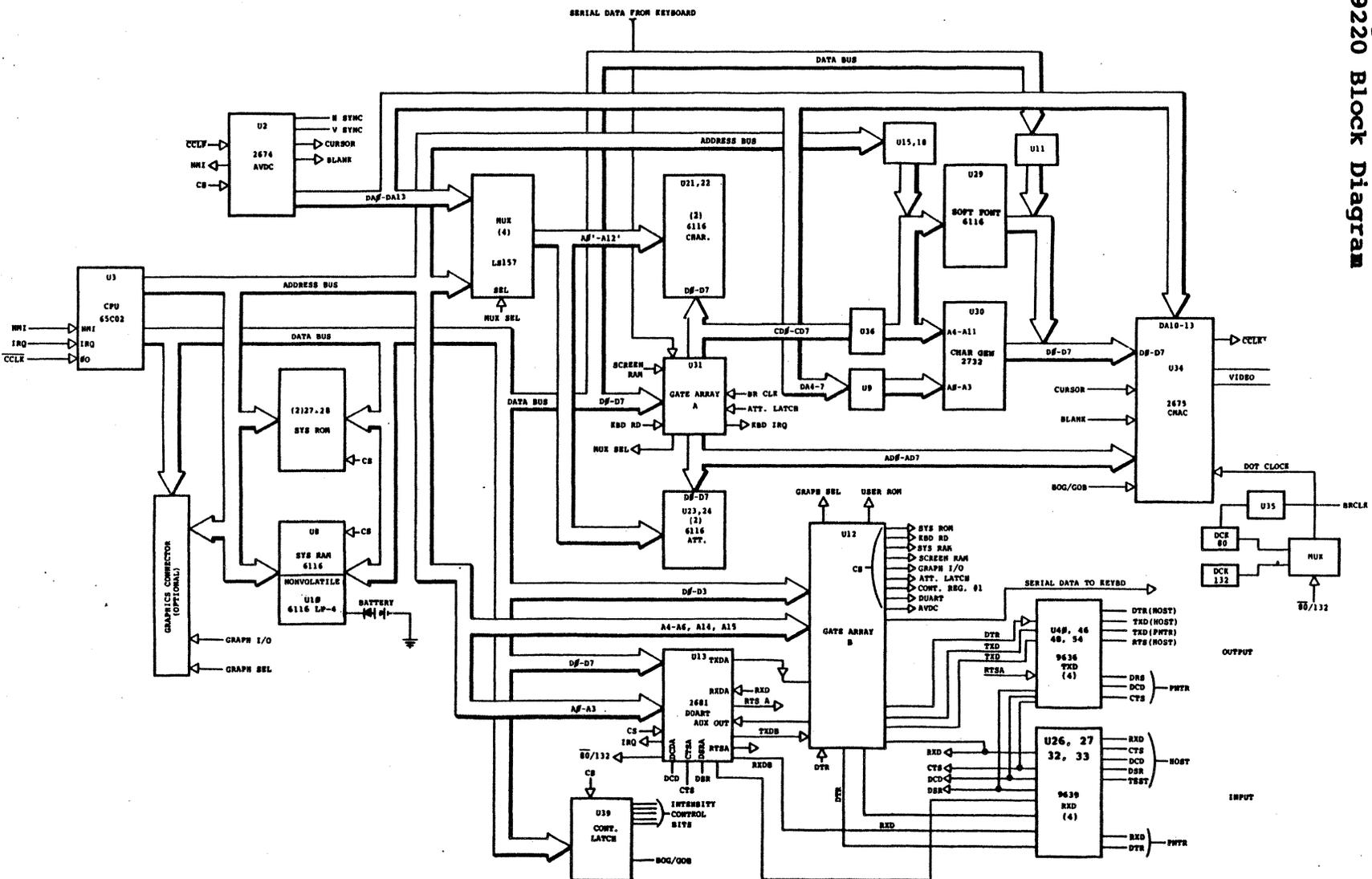
The address lines from the AVDC and the 65C02 are multiplexed, allowing both devices to access the display and attribute RAMs without wait states or bus contention problems. This feature results in maximum display RAM update speed without undesirable screen effects.

#### **Gate Array A, Board Location U31**

The character and attribute data lines are routed through gate array A (U31), allowing the microprocessor to read the character and address RAMs separately although they occupy the same space in the memory map.

This gate array also enables the microprocessor to write different data into the two RAMs during a write-to-display-RAM operation. Essentially, the 8-bit microprocessor is writing

Figure 4-1  
9220 Block Diagram



16-bit wide words. Speed is increased because there is no need to write to two locations for each character on the screen.

The microprocessor and the AVDC address the character and attribute RAMs during alternate phases of the clock.

Data at the selected location is output as a 16-bit word containing 8 bits of character data and 8 bits of attribute data. The character data is routed through gate array A (U31) to the character latch (U36). The attribute data is routed to the CMAC.

The AVDC's address lines are always enabled in the READ condition.

#### **Gate Array B, Board Location U12**

U12 decodes the microprocessor's address bus to provide sufficient chip selects for all the memory chips and the programmable AVDC, CMAC and Dual Asynchronous Receiver/Transmitter (DUART - U13) support chips.

One of the two 8-bit system control registers resides in this gate array chip. The other register is a hex D-type flip-flop at location U39.

These additional registers are used by the system program to control switches that determine the direction of the serial data paths for the various communications modes, screen background and screen intensity modes.

#### **COMMUNICATIONS**

##### **2681 Dual Asynchronous Receiver/Transmitter (DUART), Board Location U13**

The 2681 DUART is a single MOS-LSI chip with two programmable, independent, full duplex channels for asynchronous data communications.

The 2681 also contains a parallel input port and latched output port. Four of the input port lines can be used to detect changes (low to high or high to low transitions). In addition, a change detection can be programmed to automatically generate an interrupt through the 2681's interrupt output. This effectively uses the DUART as a programmable interrupt controller and a dual serial port.

The 2681 monitors DSR (Data Set Ready) and CTS (Clear To Send) on the host port (P3), as well as DTR (Data Terminal Ready) on the printer port and the keyboard interrupt from gate array A (U31).

One of the 2681's latched outputs is also used to select the proper clock for 80-column or 132-column mode.

There are only two serial channels on the DUART and three sources must be accommodated. One of the two channels serves a dual purpose. The programmed assignments are:

Channel A receiver always receives from the computer.

Channel B receiver always receives from the printer.

Channel A transmitter only transmits to the computer.

Channel B transmitter normally sends data to the printer, but is also used to send to the keyboard via gate array B (U12) whenever the bell must sound, and to enable or disable the keyclick. Program control assigns the destinations.

Data from the keyboard is received through gate array B (U12), which contains a fixed baud rate receiver channel. Communication between the keyboard and the main logic is serial asynchronous at 9600 baud, half-duplex.

## **KEYBOARD**

### **Keyboard Encoder 8049, Keyboard Location U2**

The keyboard encoder is an 8049 single-chip microcomputer that can scan an 8 x 16 keyboard matrix and perform keyswitch debouncing and N-key rollover. Thus, any number of keys can be pressed in rapid succession and the encoder will recognize all of them.

The keyswitch circuitry is arranged in an X-Y matrix, with each keyswitch having its own unique position. The keyboard encoder on the keyboard circuit scans the matrix by sending a low level to each line on the Y axis during a scan routine.

By reading the X lines, a depressed keyswitch is detected coincidentally because a low level is routed back to the encoder. The encoder scans each Y line in turn by this method.

The encoder validates that a key has been pressed by detecting a keyswitch for three scan routines. The mechanical keyswitches are debounced when the encoder determines that a key is NOT pressed for three scan routines after a key has been validated.

When a key is validated, a short pulse is sent to the speaker drive to simulate a keyclick. Also, two codes are sent to the control board; one code indicates whether or not any modifier keys (Control, Shift, Alpha-lock) are depressed; the second code indicates which key on the matrix is held down.

## CHARACTER GENERATION

The 9220 uses a raster scan technique to create its display. The data from either U30 or U29 is loaded into a shift register within the 2675 CMAC (U34) and shifted out one pixel at a time to produce the characters as the electron beam sweeps the face of the CRT.

Character cells, rather than a full bit-map, are used to produce characters on the screen. Instead of the display processor defining each pixel on the screen, the pixels are prearranged in blocks (character cells 10 wide by 10 high) that reside in the character generator ROM.

The entire display is composed of 25 rows of either 80 or 132 character cells.

The display processor (65C02 - U3) can change the display by defining which character will be displayed within each character cell. This allows the most efficient handling of alpha-numeric data, as well as easily providing special video effects, such as video attributes and smooth data scrolling.

A total of 384 different characters can be displayed simultaneously on the screen. Two hundred and fifty-six of these characters reside in an EPROM or ROM (U30). The remainder of the characters reside in RAM (U29), which provides the "soft font" feature.

In normal operation, U29 is an extension of the character generator, and is accessed when bit 6 (AD6) from the attribute RAMs is high.

Unlike data in U30, which is fixed, the data in U29 can be modified under firmware control to produce special characters. The VT220 emulation mode provides an escape sequence to do this.

The 65C02 accesses U29 through tri-state buffers (U11, U15 and U18). When the 65C02 is accessing U29, the outputs from the character address latch (U36), the scan line address latch (U9), and the character generator ROM (U30) are disabled.

## MPU MEMORY ALLOCATION

The 65C02's address decoder divides the internal memory into four 16K blocks. Following is the basic memory layout, starting with the highest 16K block:

System ROM A; 16K  
Soft Font 8K; screen RAM 8K  
System ROM B; 16K  
Peripherals and system control 8K; system RAM 8K

Total memory including options: 65K

## **System EPROMS, Board Locations U5 and U7**

System ROM consists of two EPROMs with a total capacity of 32K bytes.

System firmware subsections are initialization, main program loop, and two interrupt routines.

### **Initialization Routine**

On power up, the stack pointer is set, scratch pad and display memories are cleared, and set-up memory is tested for initialization.

If not initialized, the terminal configuration and function keys are set to factory default values. The CRT controller and DUART are initialized, and the interrupts are enabled.

### **Main Program**

The main program is a loop routine that processes data transfers from the computer or the keyboard.

Data to be displayed is written into the display RAM at the cursor position along with the current video attribute. A function is performed if the input data is a control character or an ESC character. Then, the cursor position is updated.

This routine also performs transparent and copy print by fetching data from the terminal buffer and loading it into the printer buffer.

### **Interrupt Routines**

Interrupt requests (IRQs) originate from the keyboard, host computer or the printer when data is transmitted or received.

The high priority device is the keyboard, and the low priority device is the printer. The interrupt routines check the status of the DUART to determine the interrupt source.

If the interrupt source is the host computer, a routine further checks to see whether it is a receive or transmit interrupt. During a receive interrupt from the host computer, it checks the receive buffer.

Depending on the protocol selected, it sends X-OFF to the host or lowers DTR (Data Terminal Ready), instructing the host to halt data transmission until the almost full condition of the buffer (224 bytes out of 256 bytes) reverses.

The printer interrupt also checks for receive or transmit mode. Depending on the protocol selected (X-ON or DTR), X-ON/X-OFF is sent or DTR is raised or lowered to accommodate the full receive buffer.

The keyboard sends two bytes for each key stroke: the control byte and the data byte. Each byte generates an interrupt, using the DUART input port.

Non-maskable interrupts (NMIs) come from the 2674 AVDC (U2). They occur at the beginning of a new character row and are used by the firmware to manipulate the AVDC to produce smooth scrolling, line inserts and deletes, and double-wide/double-high character rows.

### **OPERATING CLOCKS**

There are two basic modes of operation: 80-column and 132-column. Two dot clocks, which are switched under firmware control, accommodate these modes (see sheet 4 of the schematic).

The output of U41 (pin 6) is fed into pin 32 of the CMAC, where it is divided by eight and output at pin 33 as CCLK BAR\*.

This clock is inverted by U42 and applied to pin 23 of gate array A (U31), where it is used to generate a select input for the character and attribute RAM address multiplexers and to produce phase 0, which is the system clock for the 65C02.

CCLK BAR is also connected directly to the 2674 AVDC where it is used as a character clock.

For communications, the 2681 DUART needs only a crystal connected to its internal oscillator. The keyboard receive channel within U31 needs a 1.7-MHz clock which is provided by U35, which divides the 80-column dot clock by eight (see sheet 4 of the schematic).

\*Signals referred to as "SIGNAL BAR" appear on the schematic as SIGNAL.



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Products may be returned by Buyer only after a Return Material Authorization number ("RMA") has been obtained from TeleVideo by telephone or in writing. Buyer will prepay all freight charges to return any products to the repair facility designated by TeleVideo and include the RMA number on the shipping container. TeleVideo will, at its option, either repair the defective products or parts or deliver replacements for defective products or parts on an exchange basis to Buyer, freight prepaid to the Buyer. Products returned to TeleVideo under this warranty will become the property of TeleVideo. With respect to any product or part thereof not manufactured by TeleVideo, only the warranty, if any, given by the manufacturer thereof, applies.

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If the firmware or hardware is altered or modified by the Buyer, this firmware and hardware is not covered within this limited warranty and the Buyer bears sole responsibility and liability for that firmware and hardware.

## SPECIFICATIONS

### I. Physical

#### VDT Dimension:

Height: 38.10 cm (15.0 in.)  
Width : 32.55 cm (12.8 in.)  
Depth : 32.55 cm (12.8 in.)

VDT Net Weight: 30 lbs.

Case Foot Print: 12.5 in. by 11.5 in. max.

#### Case Features:

Tilt: -5 to +15 degrees

Swivel: 270 degrees left and right

Cooling: Convection system

Connectors: One RS423 communication port (25-pin)  
One 8-pin 20 mA communication port  
One RS423 printer port (25-pin)  
One RJ12 keyboard port  
One BNC (composite video out)  
One AC receptacle-type quick disconnect

CRT: Matsushita 340CXB(QA)N  
or Samsung 14BBY(LA)N type B

Diagonal Measure: 35.56 cm (14 in.)

Fluorescence: Orange

Phosphor: Orange

Bulb: EIAJ No. J340D1 Samsung  
EIAJ No. BCQA Matsushita  
Implosion protection type

Face-plate: Filterglass

Screen: Aluminized

Persistence: Medium short  
300ns decay time

## II. Electrical

### AC Supply

Frequency: 50/60 Hertz +/- 3 Hz

#### Source Current:

115V Line: 420 mA (typical)

230V Line: 210 mA

Phase: Single phase, 3-wire

Wattage: 40 DC max.

#### Power

Cord: Gray, detachable, straight connect,  
3-conductor, ground Kawasaki KS-16A  
7A 125V

### DC Supply:

5V : +/- .1 volt at 3.0 Amp (1.3A typical)

12V : +/- .2 volt at 2.0 Amp (1.2A typical)

-12V : +/- .5 volt at 200 mA (15 mA typical)

Ripple and  
Spike Noise: 100mV peak to peak all DC outputs

## III. Display

Horizontal  
Scanning Frequency: 16.2 Khz

Horizontal Drive: TTL pos.  
Width: 8 to 10 micro sec.

Horizontal Blanking: 15.08us, 13.764us (132)

Vertical Scanning  
Frequency: 50/60 Hertz

Vertical Drive: TTL neg.  
Width: 185 micro sec.

Vertical Blanking: 1.29ms  
21 scan lines

Columns per line: 80/132

Cell Size (Character Block): Dot Matrix

Width: 10 (80), 9 (132)

Height: 10

Video Amplifier Input: TTL, white pos.

Video Amplifier Overshoot: 10% max.

Video Amplifier Output at 28V Swing:

Rise and Fall Time Measured at 10 and 90 Percent Points: 30 nanosec. max.

Video Amplifier Output Capability: 28V pp min.

Video Amplifier Gain: 8

High Voltage (at Dark Screen): 13.5 KV +/- 500V

High Voltage Regulation (from Dark Screen to Full Bright): 500V

Picture Brightness at Maximum Contrast at Video HIGH LIGHT: 30 Foot Lamberts +/- 3 (No Retrace to be Visible at Normal Video) at 115V Line Voltage

Retrace Time:

Vertical Retrace Time: 1300 micro sec. max.

Horizontal Retrace Time: 15 micro sec. max.

Geometric Distortion (Deviation from Straight Line. Pin Cushion or Barrel Distortion): +/- 1.5 mm max. Negative for pin cushion; positive for barrel

Trapezoidal Distortion: 2 mm max.

Parallelogram  
Distortion (Skewing): 2 mm max.

Linearity:

Vertical: +/- 3% max.

Horizontal: +/- 3% max.

Picture Size (Active  
Display):

Format: 25 lines of 80 characters

Width: 235 mm +/- 2 mm (80 char/line)

Height: 180 mm +/- 3 mm

Picture Size  
Adjustment Range: +/- 5% of size min.

Spot Size at  
Maximum Brightness: .25 mm

Spot Growth Center  
to Corners: + 30% max.

Contrast Ratio: 1:10 min.

Levels of Gray: Dark, Half Bright,  
Full Bright, Highlight

Flyback Transformer  
Ringing Ratio: 1:10 min.

Brightness Variation  
of Picture Area at  
18 Foot Lamberts  
Reference: +/- 10% max.

#### IV. Keyboard

Style: Low Profile

Height: 4.699 cm (1.85 in.)

Home Row DIN std.: 30 mm untilted

Width: 53.3 cm (21 in.)

Depth: 18.5 cm (7.3 in.)

Net Weight: 2 Kg. (4.5 lbs.)

Keyswitch Pressure: 60 g.  
 Microcontroller: 8049  
 Layout: Included in this section, following specifications  
 Tilt: Normal 8 or tilted 14 degrees from horizontal level  
 Operating Life: 10 million keystrokes min.

V. Environmental

Operating:

Temperature: 0 to 45 degrees C  
 (32 to 113 degrees F)  
 Humidity: 10 to 85% non-condensing  
 Altitude: 3,000 m./ (10,000 ft.)

Non-operating:

Temperature: -40 to 60 degrees C  
 Humidity: 10 to 85%  
 Altitude: 5,000 m./ (10,000 ft.)

MTBF: 10,000 hours min.

MTTR: 30 minutes

Vibration: 0.3G 5 to 100 Hz operational

VI. CRT Controller Format

	<u>80</u>	<u>132</u>
1. Dot Frequency	17.2414 MHz	24.8618 MHz
2. Character Cell		
2.1 Number of Dots per Character	10	9
2.2 Number of Scan Lines per Character	10	10

	<u>80</u>	<u>132</u>
3. Character Frequency (Dot Freq/Step 2.1)	1.72414 MHz	2.762422 MHz
4. Screen Format		
4.1 Number of Characters per Row	80	132
4.2 Number of Rows per Screen	25	25
5. Character Time (1/Step 3)	580 nSec	362 nSec
6. Horizontal Blank Characters	26	38
Horizontal Front Porch (char.)	7	7
Horizontal Sync Width (char.)	16	24
Horizontal Back Porch (char.)	3	7
7. Total Characters per Line (add 4.1 & 6)	106	170
8. Horizontal Scan Rate (Step 3/ Step 7)	16.265 KHz	16.249 KHz
Horizontal Time (1/Step 8)	61.480 uSec	61.54 uSec
Horizontal Active Time	46.400 uSec	47.780 uSec
Horizontal Front Porch Time	9.28 uSec	8.69 uSec
Horizontal Sync Width Time	9.28 uSec	9.28 uSec
Horizontal Back Porch Time	1.74 uSec	1.74 uSec
9. Vertical Active Scan Lines	250	250

	<u>80</u>	<u>132</u>
10. Vertical Blank		
Scan Lines	21	21
Vertical Front		
Porch Scan Lines	4	4
Vertical Sync Porch		
Scan Lines	3	3
Vertical Back Porch		
Scan Lines	14	14
11. Vertical Total		
Scan Lines (add		
Step 9 & 10)	271	271
12. Vertical Scan Rate		
(Step 8/Step 11)	60.02 Hz	59.96 Hz
Total Vertical		
Time	16.6611 ms	16.6772 ms
Vertical Active		
Time (Step		
8.1 x Step 9)	15.370 mSec	15.385 mSec
Vertical Front		
Porch Time	0.2459 mSec	0.2462 mSec
Vertical Sync		
Width Time	0.184 mSec	0.1846 mSec
Vertical Back		
Porch Time	1.2911 mSec	1.2923 mSec

CRTC Registers:

	<u>80</u>	<u>132</u>
Scan Lines per		
Character Row (R0)	CA	DA
Equalizing		
Constant (R1)	14	24
Horizontal Sync		
Pulse Width (R2)	39	5A
Horizontal Back and		
Front Porch (R3)	05	05
Character Rows per		
Screen (R4)	18	18

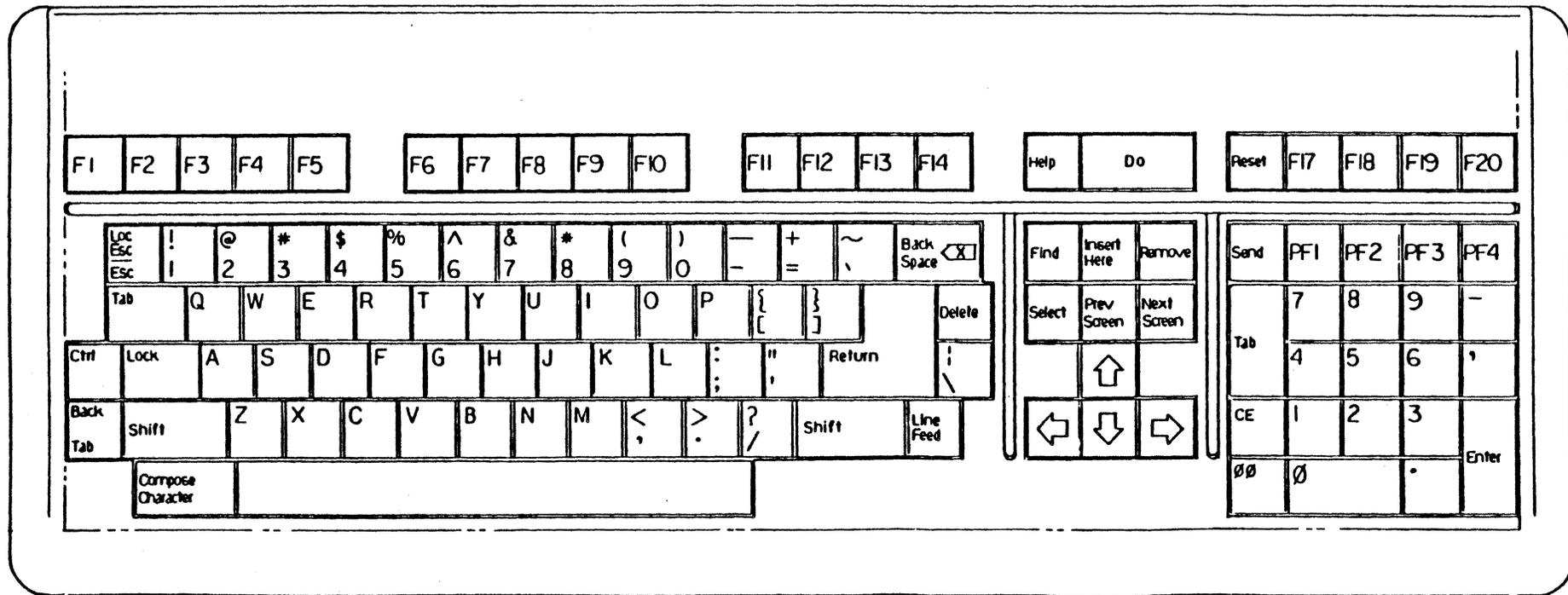
	<u>80</u>	<u>132</u>
Active Characters per Row (R5)	4F	83
First and Last Scan Lines of Cursor (R6)	09	09
Vertical Sync Pulse Width (R7)	29	29
Display Buffer First Address (R8) (R9)	FC	FC

#### VII. Control Board

Type:	2-sided, includes power and ground
Length:	10.95 in. (27.8 cm)
Width:	8.25 in. (21.0 cm)
Thickness:	1.54 mm (.062 in.)
Signal Trace Size:	0.304 mm (.012 in.)
Microprocessor:	65C02
Advanced Video Display Controller (AVDC):	2674BC4N40 (4 MHz)
Color/Monochrome Attribute Controller (CMAC):	2675BC5N40 (25 MHz)
Gate Array:	Part number 130180-00 Part Number 130170-00
Battery:	3V min, Lithium
Current Loop:	Built-in 20mA (P6)
Graphics Board Connector:	26-pin (P11)
Current Load (std.):	1.3 Amp
Current Load with Options:	2.5 Amp
Printer Port:	RS423 (P4)
Main Port:	RS423 (P3)

Baud Rate:	50/19.2K bit/sec
Parity:	None, Odd, Even, Mark, Space, Check, No Check
Data Bits:	7 or 8 bits
Handshaking:	No, X-on/X-off, DTR, Both
System ROM:	32K bytes
System RAM:	2K to 8K bytes
Display RAM:	4K to 8K bytes

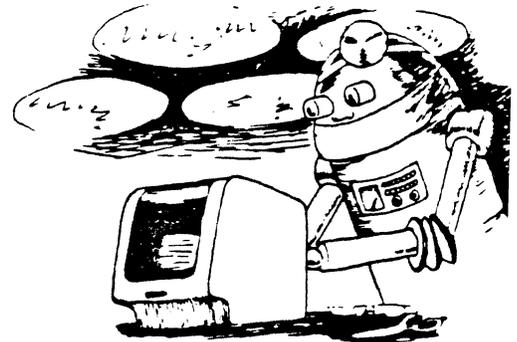
**Figure 7-1  
Keycap Layout**



## TESTING THE 6502 ADDRESS LINE

With a 6502 address line tester, you can test all address lines on any logic board that uses a 6502 chip.

When the 6502 receives instruction hex EA (a NOP), it does nothing except increment the program counter and read the next instruction. If the next instruction is also a NOP, the microprocessor is forced to count through all 65,536 possible addresses on its 16-bit address bus.



If you then monitor the address bus lines with an oscilloscope, each address line will display a square wave, with a period twice that of the next lower address line. This gives you a predictable set of signals to trace.

## TOOLS REQUIRED

1. Wire cutters
2. Soldering iron
3. Solder

## PARTS REQUIRED

1. 40-pin wire wrap socket (not available from TeleVideo)
2. 6502 microprocessor (Part No. 2049600)
3. Jumper wire

## PROCEDURE

Construction of test assembly:

1. Cut pins 26 through 33 on the bottom of the wire wrap socket by about 1/4 inch. This will prevent them from making contact with the pins in the socket of the pcb (see Figure 24-1).
2. Wire pins 29, 31, and 33 to pin 1 (ground), and pins 26, 27, 28, 30, and 32 to pin 8 (+5V) to force the hex EA instruction on the data bus (see Figure 24-1).
3. Plug the 6502 into the wire wrap socket. Make sure that its notch faces in the same direction as the notch on the wire wrap socket (see Figure 24-1).

Operation of test assembly:

1. Remove the 6502 CPU from the board to be tested and set it aside.
2. Install the test assembly (with a known good 6502) in the wire wrap socket. Make sure that the notch faces in the same direction as that on the other chips.
3. Apply power to the logic board.
4. Inspect the address lines for the wave forms listed in Table 24-1.
5. If you do not detect any pulses on the address lines, check for the following signals:

Pin	2	Ready (should be high)
	8	+5V
	37	Phase 0 clock
	38	Set overflow (should be high)
	40	Reset (should be high)

If any of these inputs are held in an incorrect state, the microprocessor will not work. Before continuing, correct any problems with these lines.

Figure 24-1 shows a top and a bottom view of the wire wrap socket.

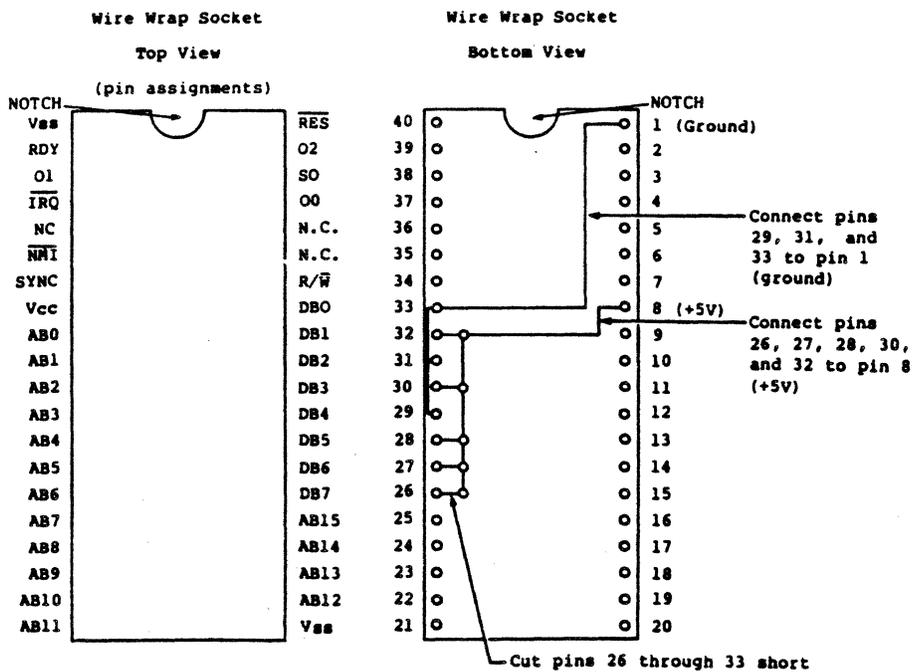


Figure 24-1 Wire Wrap Socket

Table #1

## Expected Wave Forms

Pin No	Name	Wave form
1	Vss	Ground
2	RDY	+5V
3	O1 (out)	.6u second period square wave
4	IRQ	+5V noisy
5	N.C.	Ground
6	NMI	+5V noisy
7	SYNC	1.2u second period square wave
8	Vcc	+5V
9	AB0	2.4u second period square wave
10	AB1	4.8u second period square wave
11	AB2	9.6u second period square wave
12	AB3	19.2u second period square wave
13	AB4	38.4u second period square wave
14	AB5	76.8u second period square wave
15	AB6	150u second period square wave
16	AB7	.3m second period square wave
17	AB8	.6m second period square wave
18	AB9	1.2m second period square wave
19	AB10	2.4m second period square wave
20	AB11	4.8m second period square wave
21	Vss	Ground
22	AB12	9.6m second period square wave
23	AB13	19.2 second period square wave
24	AB14	38.4m second period square wave
25	AB15	76.8m second period square wave
26	DB7	Tied high
27	DB6	Tied high
28	DB5	Tied high
29	DB4	Tied low
30	DB3	Tied low
31	DB2	Tied low
32	DB1	Tied high
33	DB0	Tied low
34	R/W	4V to 4.5V noisy
35	N.C.	Ground noisy
36	N.C.	Ground noisy
37	O0 (in)	.6u second period square wave with ringing
38	S.O.	+5V noisy
39	O2 (out)	.6u second period square wave
40	RES	+5V noisy

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# *Service Bulletin*

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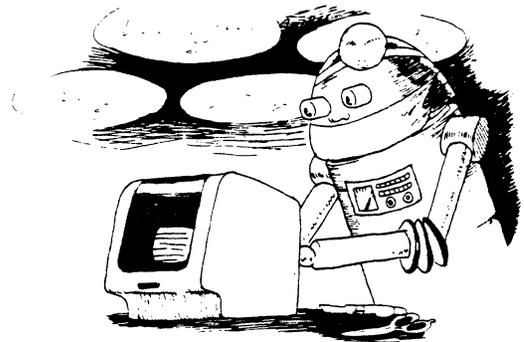
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Issue No 32

## WAS THAT CHIP DEFECTIVE, OR JUST A VICTIM OF ESD?

Is your normally reliable terminal suddenly suffering from mysterious glitches and component failures? If so, electrostatic discharge (ESD) could be the culprit.

ESD is by far the most common cause of component failure. The released static charge can damage or destroy circuitry both before and after you install a component. And while some electronic components are less susceptible to ESD than others, most can be affected. ESD can even damage input-protected devices such as EPROMs.



ESD does not always cause instant failure. Because it often causes miniscule degradations of a circuit, a component may function for some time before it mysteriously fails or causes glitches.

Even small amounts of voltage can affect components. A 100-volt charge is enough to damage EPROMs, but you probably would not realize ESD was causing any damage. Most people can not hear or feel ESD unless it's above 3,000 volts. You can generate and hold a charge ten times that amount just by walking across a synthetic carpet.

Avoid ESD damage by setting up your workstation to minimize static build-up. We recommend the following precautions:

1. Wear a wrist grounding strap, grounded through a 1-megohm resistor, when handling components. Be sure it's attached to a metal conduit, pipe, or building frame.
2. Hold boards by their edges to avoid touching pins, traces, connectors, etc. Never slide or throw boards or components.
3. Wear antistatic smocks and cotton gloves. Keep clothing (especially synthetic clothing) away from static-sensitive devices.
4. Use equipment that helps prevent static charge build-up--conductive table mats, for example. Use only static-protective bags and containers.
5. Avoid using parts you know have been mishandled or improperly stored.

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# **Service Bulletin**

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December 1985  
Issue No. 60

## **REMOVING AND REPLACING THE 955 CASE-STYLE LOGIC BOARD**

This procedure explains how you can remove and replace the 955 case-style logic board.

### **TOOLS REQUIRED**

1. Phillips screwdriver

### **PROCEDURE**

**WARNING!** When you open the terminal case you expose components that are potential shock hazards (even after the terminal has been disconnected from the wall outlet). **DO NOT ATTEMPT TO REMOVE THE LOGIC BOARD UNLESS YOU ARE A QUALIFIED TECHNICIAN.**

**CAUTION!** To protect against electrostatic discharge (ESD) damage, wear a wrist grounding strap and handle the logic board and components in a static-free environment. **IF YOU DAMAGE THE LOGIC BOARD OR COMPONENTS, FACTORY REPAIR OR REPLACEMENT COULD BE EXPENSIVE.** For more information about avoiding ESD damage, see Service Bulletin 32.

### **Removing the Logic Board Tray**

1. Turn off the terminal.
2. Disconnect the power cord and data cable(s) from the rear of the terminal. Disconnect the keyboard cable from the front of the terminal.
3. Turn the terminal so the screen faces away from you. Remove the two Phillips screws that hold the logic board tray in place. The screws are located at the rear of the terminal. The logic board tray slides into the base.
4. Carefully pull the logic board tray toward you to remove it. You must disconnect the red (P5) and white (P2) logic board connectors to slide the tray completely out of the terminal.

### **Replacing the Logic Board Tray**

1. Fit the metal flanges on the logic board tray into the guides at the rear of the terminal. Hold the connector cables up so they do not interfere with replacing the tray.
2. Reconnect the red connector (P5) and the white connector (P2) on the logic board.

3. Align the keyboard connector with the opening in the front of the terminal.
4. Replace the two Phillips screws in the rear of the terminal.
5. Reconnect the power cord, data cable(s) and the keyboard cable.

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# *Service Bulletin*

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December 1985  
Issue No. 61

## **REMOVING THE MONITOR REAR HOUSING AND BEZEL ON THE 955 CASE-STYLE TERMINAL**

This bulletin tells you how to remove the monitor rear housing and bezel on the 955 case-style terminal.

### **TOOLS REQUIRED**

1. Phillips screwdriver

**WARNING!** When you open the terminal case you expose components that are potential shock hazards (even when the terminal is unplugged from the wall outlet). **DO NOT ATTEMPT TO OPEN THE TERMINAL'S CASE UNLESS YOU ARE A QUALIFIED TECHNICIAN.**

### **Opening the Case**

See Figure 61-1 as reference for opening the case.

1. Turn off the terminal.
2. Disconnect the power cord and data cable(s) from the back of the terminal. Disconnect the keyboard cable from the front of the terminal.
3. Turn the terminal so the screen faces away from you.
4. Remove the three screws that secure the monitor rear housing to the case, (remove the screw under the power cord first, then remove the two screws near the top of the housing).

**NOTE!** Remove the screws completely. If necessary, tip the unit backwards slightly.

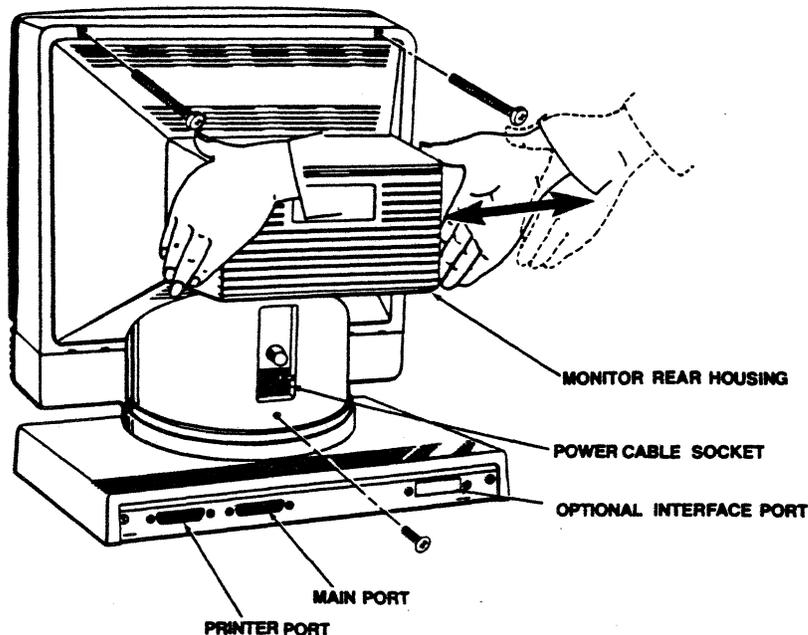
5. To release the clamp holding the bezel and monitor rear housing together (See Figure 61-1):
  - a. Grasp the housing with your left hand.
  - b. Sharply tap the right side of the housing with the heel of your right hand.
6. Lift off the monitor rear housing.
7. Carefully turn the screen away from you while holding the bezel in place. Remove the two Phillips screws (located inside the case, one on each side of the power supply) securing the bezel to the case.

### **Closing the Case**

1. Replace the bezel:

- a. Place the bezel face down in front of the terminal. Raise the bezel slightly and hook its two bottom tabs into the openings (one under the contrast adjustor; one under the ON/OFF switch) in the lower case.
  - b. Swing the bezel up to frame the screen, matching the ON/OFF switch and contrast adjustor with the openings in the bezel.
  - c. Carefully turn the screen away from you while holding the bezel in place. Insert and tighten the two Phillips screws (located inside the case, one on each side of the power supply) securing the bezel to the case.
2. a. Position the monitor rear housing on the case, as shown in Figure 61-1.
  - b. Align the screw hole under the power cord with the lower screw hole in the housing.
  - c. Fit the four tabs in the housing over the edge of the lower case.
  - d. Fit the tab in the top of the bezel into the slot in the top of the monitor rear housing. Squeeze the bezel and housing together.
  - e. Insert and tighten the Phillips screw under the power cord and the two Phillips screws near the top of the housing.

**Figure 61-1**  
Opening the Case



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# **Service Bulletin**

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Issue No. 65

## **CORRECTING KEYBOARD RESET IN 905, 955 and 922 TERMINALS**

In some 905, 955 and/or 922 terminals the keyboard microcomputer fails to reset properly when CTRL RESET is pressed. To correct this problem, short out R1 resistor on the keyboard printed circuit board, as described in this bulletin.

### **TOOLS REQUIRED**

1. 25-watt soldering iron, solder and solder vacuum
2. Small pair of needle-nose pliers
3. Wire cutters (diagonals)
4. Flux remover

### **PARTS REQUIRED**

1. Jumper wire (min. size, 36 gauge; max. size, 26 gauge)

### **PROCEDURE**

**WARNING! DO NOT OPEN THE CASE UNLESS YOU ARE A QUALIFIED TECHNICIAN. OPENING THE CASE EXPOSES YOU TO POTENTIAL SHOCK HAZARDS, EVEN AFTER POWER HAS BEEN TURNED OFF AND THE POWER CORD DISCONNECTED.**

BE CAREFUL WHEN YOU REMOVE AND MODIFY THE KEYBOARD CIRCUITRY. ANY DAMAGE INCURRED WHILE PERFORMING THIS MODIFICATION MAY RESULT IN EXPENSIVE FACTORY REPAIR.

NEVER DISCONNECT OR ATTACH THE KEYBOARD CABLE WHILE THE POWER IS ON; THE VOLTAGE TRANSIENTS CREATED MAY CAUSE A COMPONENT FAILURE.

1. Turn off the terminal and disconnect the keyboard cable.
2. Turn the keyboard upside down and remove the six recessed Phillips screws.
3. Turn the keyboard rightside up and remove the top cover.
4. Locate resistor R1 on the keyboard printed circuit board (5 and 1/2 inches from the upper left corner).
5. Short out R1 by laying the jumper wire across the body of the resistor; connect one end of the wire to each lead on the resistor. Be sure the wire does not touch the circuit board.
6. Solder the wire in place, making sure that the solder build-up does not touch the printed circuit board and short out. Remove the solder flux.
7. Replace the top cover. Turn the keyboard upside down; replace and tighten the six recessed Phillips screws that secure the top and bottom covers.

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