WY-99GT Maintenance Manual

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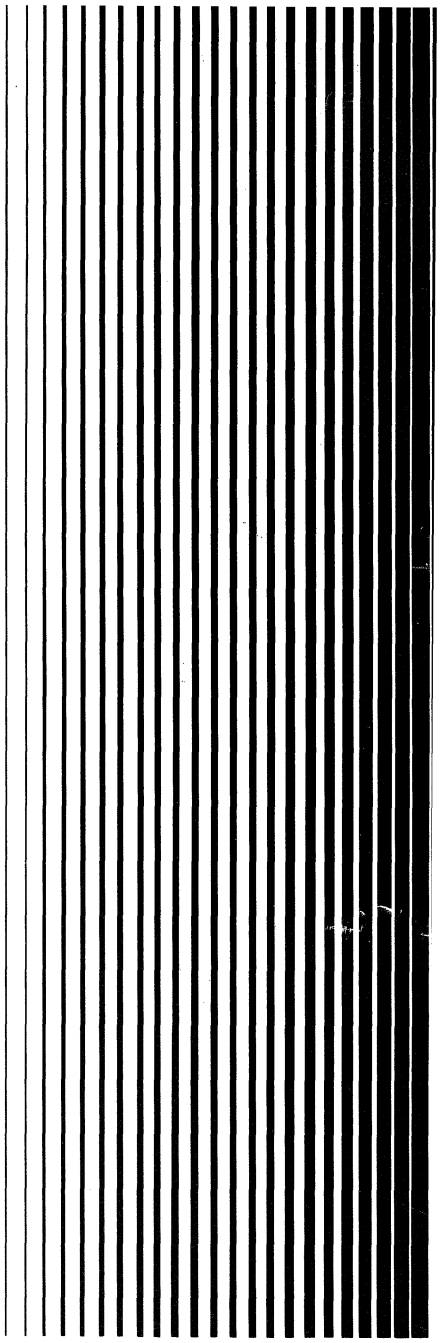

WY-99GT Maintenance Manual

WYSE

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Only devices certified to comply with the limits for a Class A computing device may be attached to this equipment. Operation with noncertified device(s) is likely to result in interference to radio and TV reception.

This equipment is intended for commercial use only and is not suited for operation in Class B environments.

The use of shielded I/O cables is required when connecting this equipment to any and all optional peripheral or host devices. Failure to do so may violate FCC rules.

WY-99GT Maintenance Manual

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Overview

This maintenance manual contains information regarding service and repair of the terminal. We assume that you are a qualified service technician with previous experience in terminal and computer repair. To take full advantage of this manual, we suggest you read the information in the order presented.

HOW TO USE THIS MANUAL

This manual is divided into seven chapters and three appendixes. Chapter one provides important information for any technician who has never serviced this terminal before. If you are already familiar with the terminal, the technical information in Appendix A can serve as an overview of the terminal.

Chapter 1, "General Information," describes the terminal, including internal functions, input/output (I/O), telecommunications, environmental needs, and operator controls.

Chapter 2, "Removal and Replacement Procedures," shows you how to take the terminal apart and put it back together again. This chapter includes instructions on how to change power requirements on the terminal from domestic to international.

Chapter 3, "Theory of Operations," describes terminal operation.

Chapter 4, "Troubleshooting," tells you what to look for and how to fix problems. This chapter includes a list of tools needed for assembly and component-level troubleshooting, a quick reference guide, and several flowcharts.

Chapter 5, "Adjustments and Alignments," describes power supply and monitor adjustments that control the quality of the display.

Chapter 6, "Illustrated Parts List," includes a list of monitor and keyboard assembly parts.

Chapter 7, "Schematics," includes schematic diagrams for the logic, keyboard, and monitor/power supply assemblies.

Appendix A, "Specifications," lists terminal's specifications.

Appendix B, "Connector Pin Assignments," lists the signals on each pin of the MODEM, AUX, and Keyboard ports located on the rear panel of the terminal.

Appendix C, "Test Connectors," describes what connectors, signals connected, and pins you need to make the test connectors referred to in Chapters 3 and 4.

Table of Contents

1 General Information

This chapter is an introduction to the terminal itself. It includes a physical description of the terminal and discusses communications, environmental considerations, operator controls, and setup parameters.

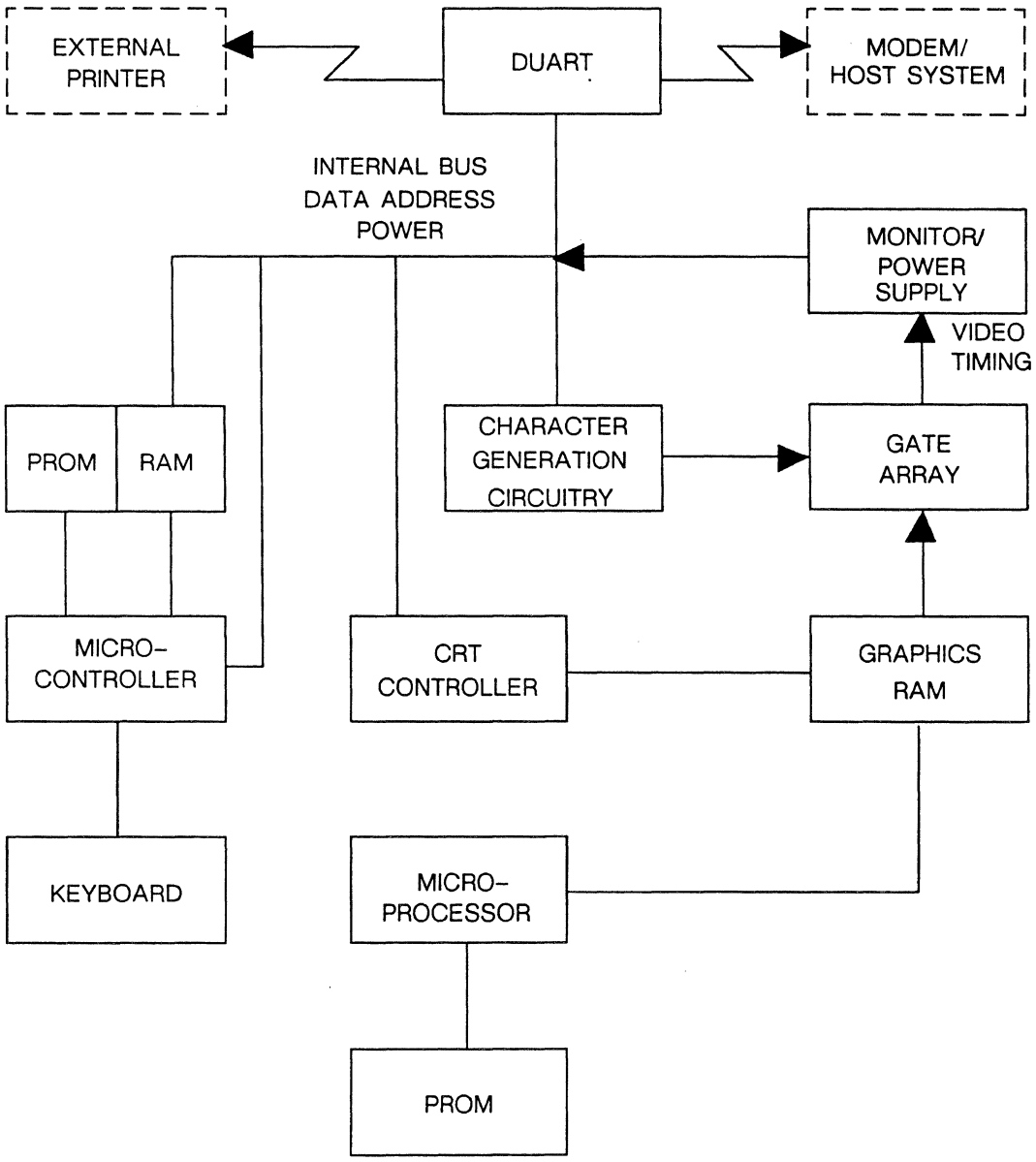
INTRODUCTION

This is a compact, high-performance terminal, designed with a broad range of functions in mind, both ANSI and ASCII. In addition to its native mode, the terminal is compatible the WY-50+, the ADM 31, the ADDS Viewpoint A2, the Hazeltine 1500, the TeleVideo 910+, 920, 925, 950, and the DEC VT52, VT100, and VT220 7-bit and 8-bit terminals. It supports both Tektronix 4010/4014 graphics and a PC Graphics mode. It also contains WyseWorks: a calculator, alarm clock, perpetual calendar, and an ASCII table.

The terminal consists of a monitor console, a logic pedestal console, and a detachable keyboard on which the user enters data to be displayed on the cathode ray tube (CRT). All the electronics needed to support the monitor and keyboard are contained in the monitor and logic pedestal consoles.

Figure 1-1 is a simplified block diagram of the terminal. All components are organized around the microcontroller on the logic printed circuit board (PCB). The microcontroller controls all

Figure 1-1 Simplified Block Diagram



internal data manipulation and processing functions.

In addition to the CRT and keyboard, the terminal contains two independent telecommunications interfaces. A user can connect peripherals, such as a printer or modem, to the terminal through these interfaces.

HIGH-LEVEL FUNCTIONAL DESCRIPTION

The terminal consists of a microcontroller, a CRT controller, associated control logic, and input/output (I/O) devices. The graphics section consists of a microcontroller PROM, graphics memory, and multiplexing logic. This circuitry is mounted on a single PCB called the microcontroller (or logic) PCB in the logic pedestal. The microcontroller controls all basic functions. The microcontroller (logic) PCB generates timing and control signals for the CRT. The deflection, high-voltage, and power supply circuitry are located on the monitor/power supply PCB seated just below the neck of the CRT. Cabling connects the microcontroller PCB and the monitor/power supply PCB.

MICROCONTROLLER

The heart of the terminal is an 8-bit, single-component microcontroller with 128 bytes of random-access memory (RAM), 16 I/O lines, and three 16-bit counter/timers. The microcontroller stores program information in an electronically erasable programmable read-only memory (EEPROM). In addition to EEPROM, a buffer consisting of up to 16K of RAM holds display information: 8K for characters and 8K for attributes. The microcontroller, CRT controller, and universal asynchronous receiver/transmitter (UART) are attached to a bidirectional bus. These circuits can function independently while interfacing with the microcontroller or the memory.

MEMORY

The memory consists of RAM, EPROM, and EEPROM.

The display information stored in RAM is repeatedly read from memory by the CRT controller, then transferred to row buffer RAM to refresh the CRT screen.

The EPROM stores programs and contains the self-test routines.

The EEPROM stores the operator's setup parameters (such as baud rate and parity). The microcontroller has an address range capability of 64K program memory and 64K data.

The microcontroller also contains 4K of ROM. The program stored in this ROM runs when the CRT controller transfers display information from RAM to the row buffers.

Figure 1-2 is a memory map for the terminal. The EPROM is not shown in the figure since it does not occupy I/O or data memory address space.

Two RAMs are standard:

- 8K x 8 character RAM (with an address range of 000H to 1FFFH)
- 8K x 8 attribute RAM (with an address range of 2000H to 3FFFH)

Figure 1-2 Memory Map

0000H - 1FFFH	RAM 0 (Character RAM)
2000H - 3FFFH	RAM 1 (Attribute RAM
4000H - 9FFFH	Not Used
A000H - A700H	CRT Controller 2672
C000H - C300H	Datacomm 2681 Read Registers
D000H - D300H	Datacomm 2681 Write Registers
E000H - FFFFH	Not Used

GRAPHICS

The terminal has Tektronix 4010/4014 graphics capabilities and a PC Graphics mode controlled by an 8088 chip and its corresponding graphics EPROM and RAM. See Chapter 3, "Theory of Operations," for more detailed information.

INPUT/OUTPUT DEVICES

The I/O devices consist of a keyboard, a CRT, and two communications interfaces.

Keyboard

This terminal supports three keyboards: an ASCII keyboard, a VT220 keyboard, and an Enhanced PC keyboard. Each keyboard holds keys mounted on a single-sided PCB. All s have full-travel, hard-contact switches. The microcontroller periodically scans the keys, checking for a key closure. Look for a detailed description of keyboard operation in Chapter 3.

Cathode Ray Tube

The terminal has a 14-inch CRT that displays 26 lines of characters (either 80 or 132 columns.) The CRT controller reads displayed characters from RAM on a DMA basis. The monitor console that sits above the logic pedestal contains a monitor control assembly, integrated with the power supply that provides power for the rest of the terminal.

COMMUNICATIONS

The terminal has two independent, asynchronous interfaces that conform to the EIA standards RS-232C and RS-423. Optionally, the MODEM interface can conform to the RS-422 standard. Data rates can be set independently for either interface. The operator-controlled parameters are defined in the setup procedures in this chapter. The MODEM and AUX interfaces can communicate at data rates up to 38.4K bps.

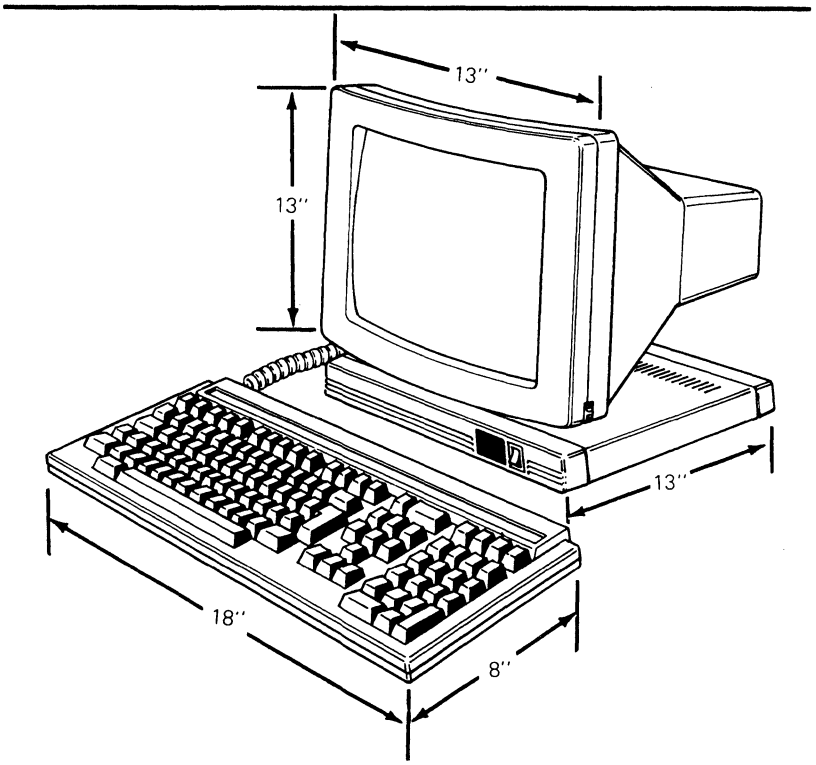
ENVIRONMENTAL CONSIDERATIONS

Users should place the terminal on a desktop or any suitable vibration-free horizontal surface that's free from lint and dust. Don't set it on surfaces that impede air flow. Any terminal installation should include three inches of clearance on all sides for ventilation. Very bright room light or direct sunlight from a

window can hinder the user's view of the display. Direct sunlight can also discolor the terminal's outer case.

Figure 1-3 shows the terminal dimensions.

Figure 1-3 Terminal Dimensions



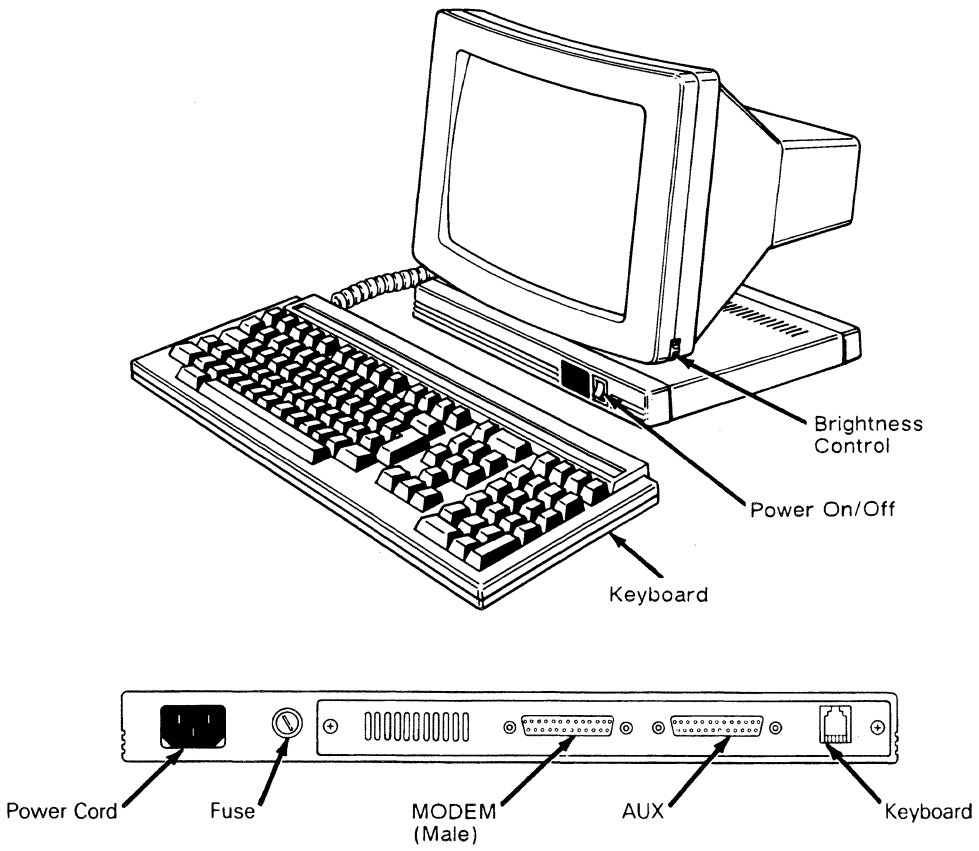
A user can install the terminal next to most other types of electrical or electronic equipment without significant interference. Avoid locations near strong magnetic fields that can distort or interfere with operating or servicing the terminal.

Ambient room temperature should never exceed +35 degrees Centigrade (+95 degrees Fahrenheit) when the terminal is on. No special cooling is necessary.

OPERATOR CONTROLS AND EXTERNAL INTERFACES

Figure 1-4 shows all operator controls and external interfaces, including the keyboard connection, power switch, and brightness control. It also shows the MODEM and AUX interface connectors.

Figure 1-4 Operator Controls and External Interfaces



Keyboard

Users should plug the keyboard into the keyboard connector on the rear panel. The plug fits only one way.

■ **Caution** Avoid unplugging or plugging in the keyboard when the power is on: you could damage the keyboard, the logic PCB, or both. To prevent damaging the terminal, make sure the voltage specified on the configuration label (on the back of the monitor housing) matches the AC power source.

Power Cord

The user plugs the power cord onto the connector on the rear panel, and then plugs the other end of the power cord into the AC power source. The AC plug is keyed so it can only be installed properly.

■ **Caution** To prevent damaging the terminal, make sure the voltage specified on the configuration label (on the back of the monitor housing) matches the AC power source.

Communications Cable

The communications cable should be connected from the computer or modem to the MODEM connector on the rear panel. This port defaults to 9600 baud, no parity, with one stop bit, and eight data bits. You can change these parameters by going into setup mode.

A user can connect a serial printer to the AUX port on the rear panel. This port is configured to operate at 9600 baud, no parity, with one stop bit, and eight data bits. You can change these parameters in setup mode, too.

Fuse

The fuse is located to the right of the power cord receptacle. Both domestic and international versions of the terminal require a standard fuse: 250 volts, 2 amperes. Instructions on changing it are in Chapter 2, "Removing and Replacing Assemblies in the Logic Pedestal Module."

Power Switch

The power switch is on the right front of the logic pedestal. Press the top of the switch to turn on AC power.

Brightness Control

The brightness control is a thumbwheel located on the lower right corner of the bezel. Rotate the wheel clockwise to increase display brightness and counterclockwise to decrease brightness.

SETUP PARAMETERS

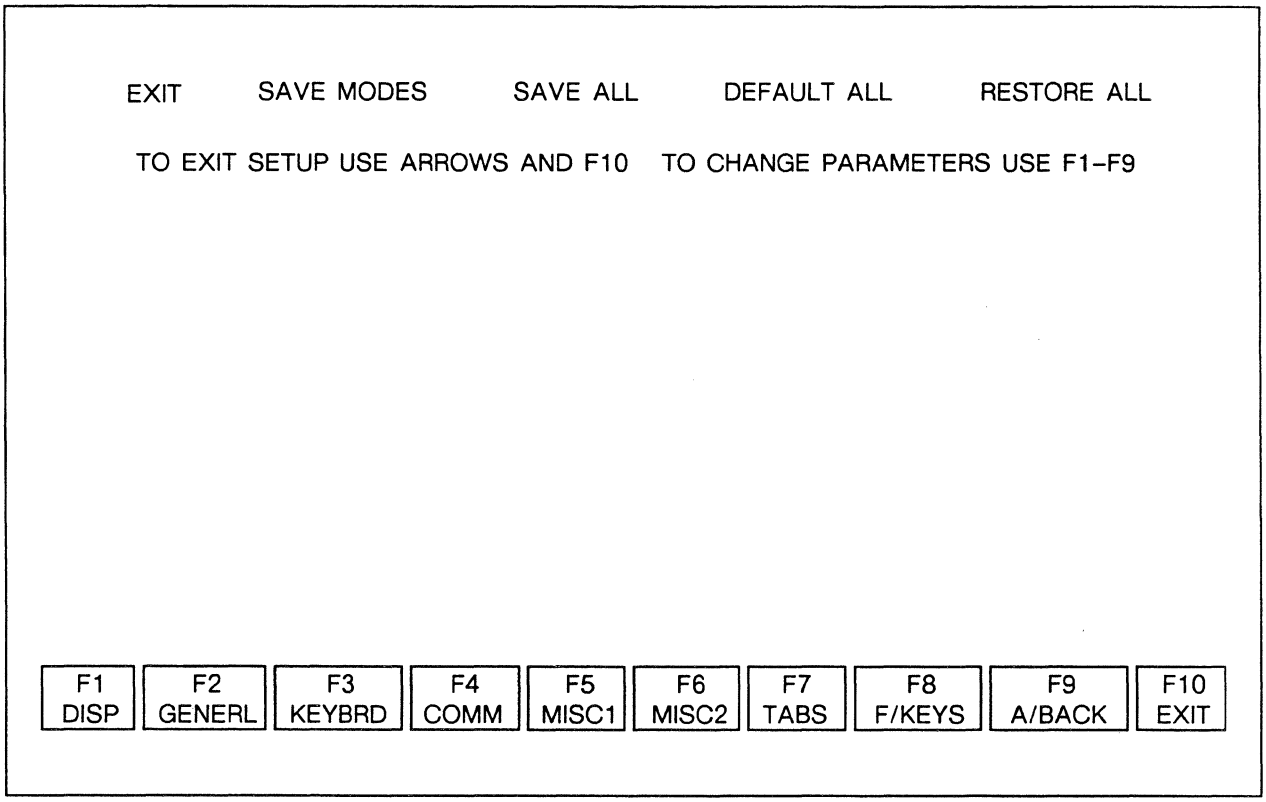
When you turn on the power, the terminal beeps and executes an internal self-test. When the self-test finishes and the CRT is warm (approximately 30 seconds), the cursor appears in the upper left corner of the display. Any time you see the cursor on the screen, you can enter setup mode and change parameters.

Entering and Leaving Setup Mode

To enter setup mode, press [Setup], [Shift][Setup], or [Select] (depending on which keyboard type is attached to the terminal). Data on the screen disappears, and the **top setup level screen** (see the following illustration) appears; the data that was on the screen is restored when the terminal returns to normal operating mode.

■ **Caution** Don't enter setup mode while data is being transmitted. The terminal can't receive data from the computer in setup mode.

Top Setup Level Screen



Top Setup Level

The top level serves as a directory to the other setup levels and to the alternatives for leaving setup mode.

- The fields at the bottom of the screen name the various setup levels where you can change the terminal's operating parameters.
- The fields at the top of the screen show the options for saving or not saving changes in nonvolatile memory when you return the terminal to the normal operating mode.
- The second line identifies the keys that you press to select the fields and activate their functions.

Press the cursor keys to highlight one of the fields at the top of the screen and press F10. Table 1-1 explains the function of each field.

Table 1-1 Top Level Setup Functions

Field	Function
EXIT	Returns terminal to normal operating mode without saving parameter changes for power up.
SAVE MODES	Saves operating parameter changes only and returns terminal to normal operating mode.
SAVE ALL	Saves all changes (operating parameters, tabs, key definitions, and answerback message); returns terminal to normal operating mode.
DEFAULT ALL	Restores all settings (operating parameters, tabs, key definitions, and answerback message) to default values and highlights EXIT field. Default values are *not* saved unless you select the SAVE ALL option to exit setup mode.
RESTORE ALL	Restores all settings and definitions to values last saved in nonvolatile memory and highlights the EXIT field.

Changing the Operation Parameters

To select one of the setup levels named on the bottom line, press the indicated function key.

- The screen for that level appears with the name highlighted.
- The fields in the middle of the screen indicate the current settings for parameters you can change in that level.
- The top line identifies the keys you press to highlight the parameter fields and change the settings. Pressing F10 always returns you to the top level.

See the terminal's User's Guide for detailed explanations of all setup parameters.

2 Removal/Replacement Procedures

We've organized this chapter to help you remove and replace problem modules as quickly as possible. Scan the following table of contents to find the section you need.

OVERVIEW

The terminal has three major modules: the **monitor**, the **logic pedestal**, and the **keyboard**. Figure 2-1 illustrates the terminal's three major modules. This chapter describes how to remove and replace the following assemblies within each module:

- Monitor module
  - Monitor/power supply PCB
  - CRT/yoke assembly
  - Brightness potentiometer (operator control)
- Logic pedestal module
  - Fuse
  - AC power switch
  - Logic PCB
  - Line Filter PCB

- Keyboard module
  - Keyboard
  - Keyboard cable
  - Keyboard PCB

Tools and Materials

You'll need these tools and materials to remove and replace the parts and assemblies in this chapter.

Materials and Tools Required:

- Standard fuse: 250 volts, 2 amperes
- Tie wraps
- Insulated flat-blade screwdriver
- No. 0 Phillips screwdriver
- No. 1 Phillips screwdriver, 12-inch
- No. 2 Phillips screwdriver
- Multimeter (recommended)
- Alligator clips

Before You Start

Before you remove or replace any terminal assemblies:

1 Turn the terminal off.

2 Unplug the terminal's power cord from the wall socket.

3 Disconnect any communications cables from the rear panel.

▲ **Warning** Before you replace any assemblies in the monitor module, be sure to discharge the anode on the CRT. (See "Discharging the Anode" later in this chapter.) **High voltage is present.** Only qualified service personnel should service the monitor.

You can remove all modules within the terminal (see Figure 2-2) for repair or replacement without any special tools.

Figure 2-1 Exploded View of Three Major Modules

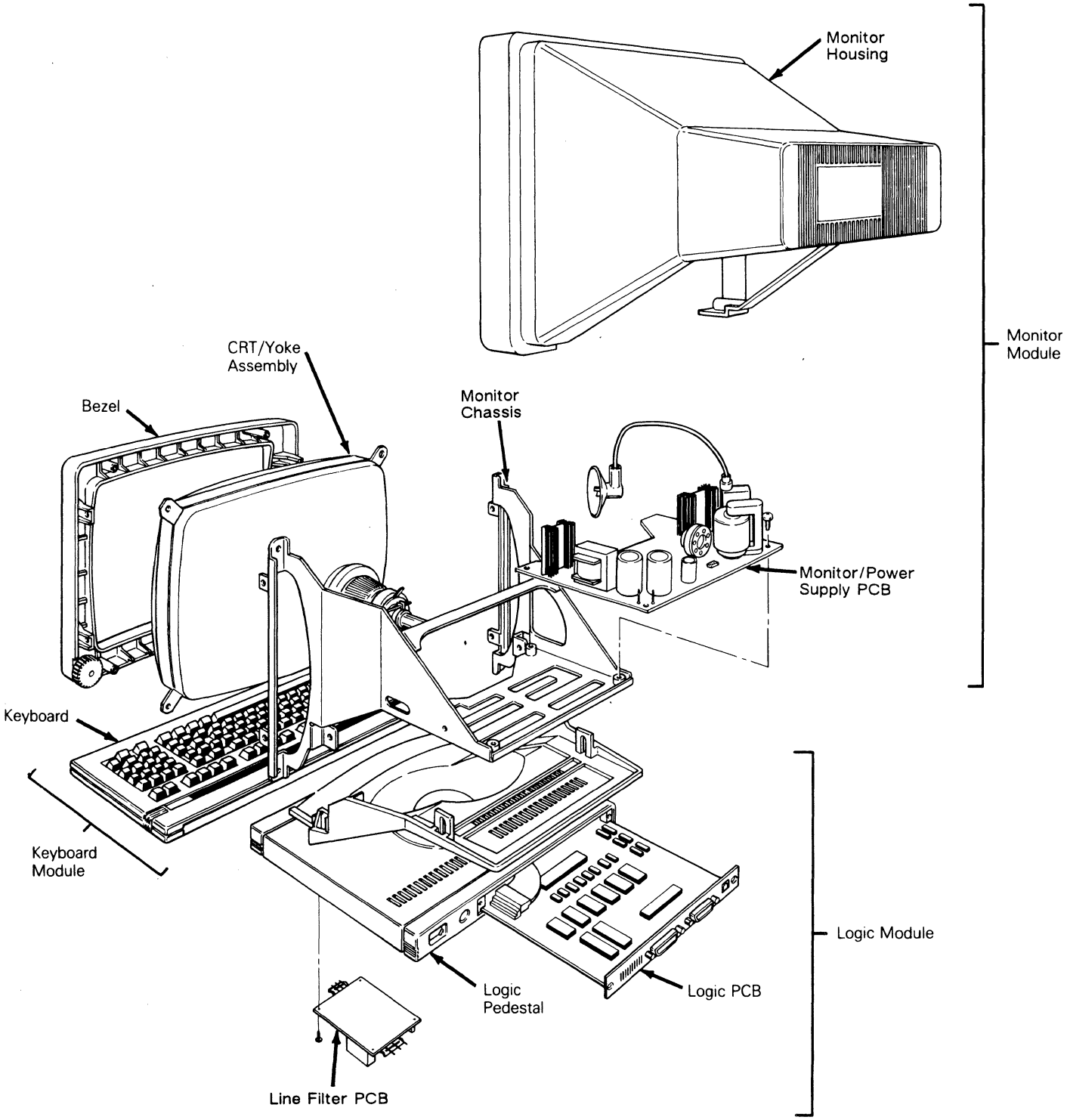
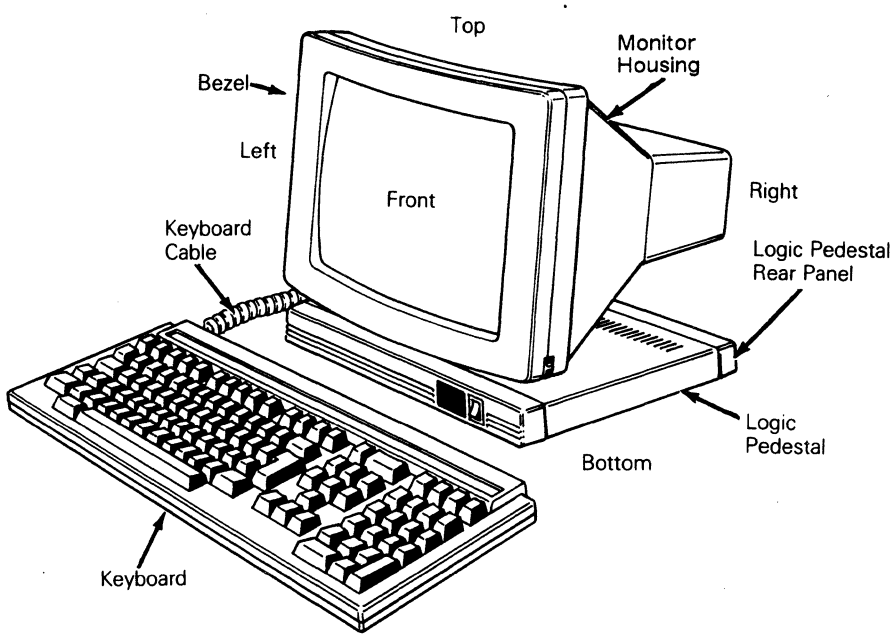


Figure 2-2 Orientation View of Terminal and Components



REMOVING AND REPLACING ASSEMBLIES IN THE MONITOR MODULE

This section describes the safest way to discharge the anode on the CRT and how to replace the monitor/power supply PCB, the CRT/yoke assembly, and the brightness control potentiometer.

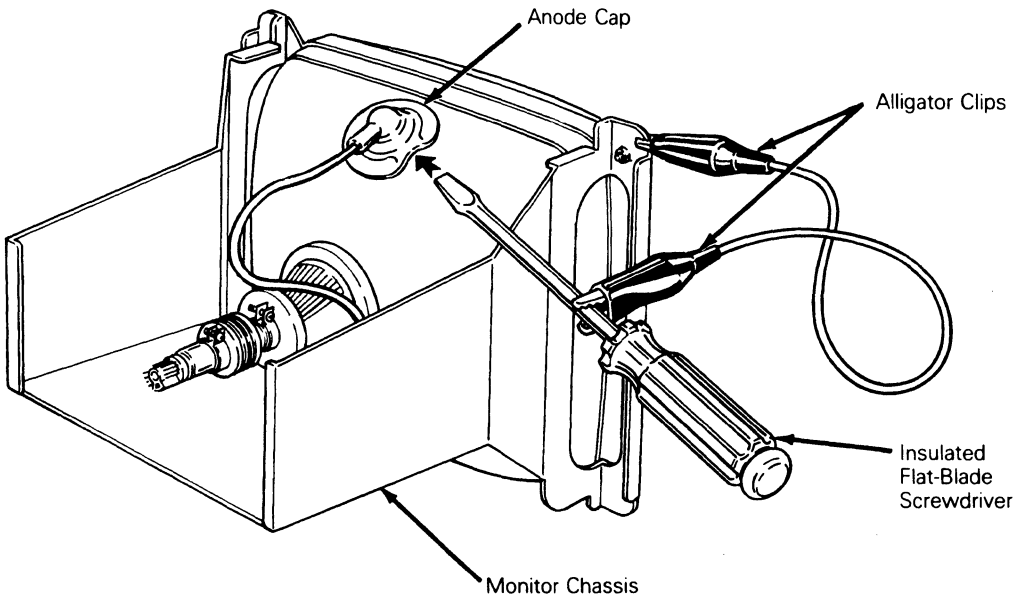
Discharging the Anode

Tools required:

- Insulated flat-blade screwdriver
- Alligator clips

We have written specific warnings throughout this chapter about discharging the anode on the CRT. If you have never discharged the anode or need a review, carefully follow these instructions.

Figure 2-3 Discharging the Anode



To discharge the CRT anode before removing it from the monitor chassis (Figure 2-3), follow these steps:

1 Turn off the terminal and unplug it from its power source.

2 Remove the monitor housing.

3 Ground the shaft of an insulated, flat-blade screwdriver to the monitor chassis with alligator clips.

4 Slip the blade between the anode cap and the anode.

5 Touch the blade to the wire anode leads under the cap.

6 Listen for a popping or crackling sound.

7 Remove the anode lead.

■ **Caution** Because of the capacitive coating on the inside of the CRT, the CRT will collect a charge from the air if left standing free. You should discharge the anode on the CRT before you move it or install it in the monitor chassis.

To discharge the anode before installation (Figure 2-4), follow these steps:

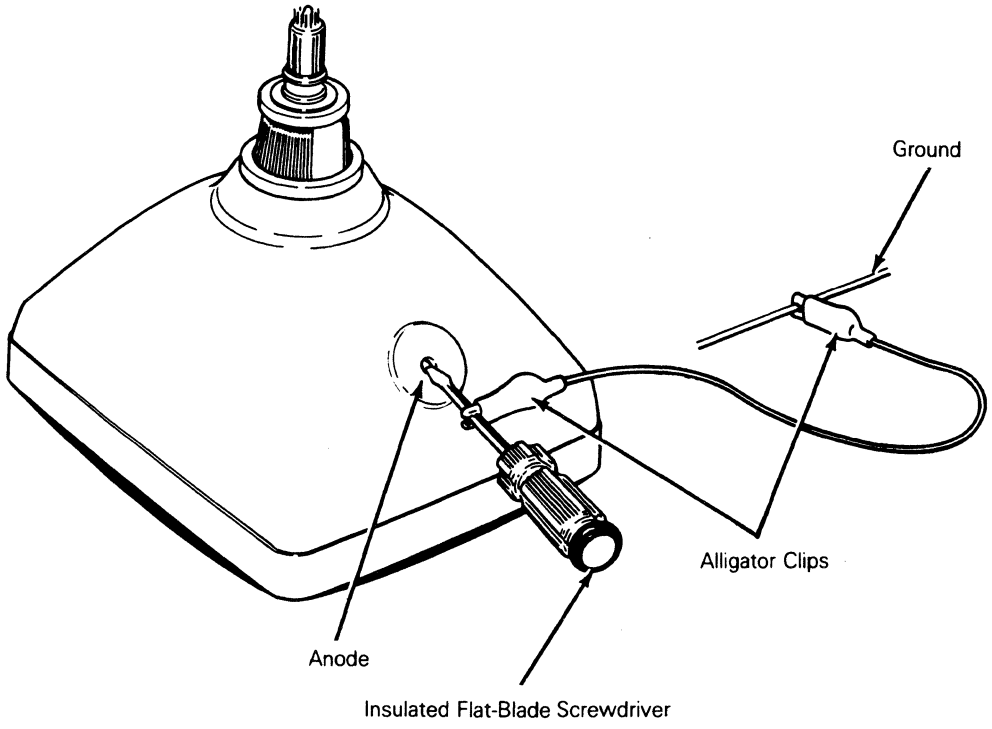
1 Ground the shaft of an insulated flat-blade screwdriver.

2 Touch the blade of the screwdriver to the anode.

3 Listen for a popping or crackling sound.

4 Install the CRT.

Figure 2-4 Discharging the Anode Before Installation



Monitor/Power Supply PCB

Tools Required:

- No. 2 Phillips screwdriver, 12-inch
- Insulated flat-blade screwdriver, 12-inch
- Alligator clips

▲ **Warning High voltage is present.** Only qualified service personnel should service the monitor.

To replace the monitor/power supply:

1 Turn off the terminal and disconnect it from the AC power source.

2 Remove the four No. 1 Phillips screws holding the monitor housing in place (one screw in each corner).

3 Hold the monitor housing by both ends and pull it off.

4 Disconnect the logic PCB wiring harness.

5 Discharge the CRT anode with an insulated flat-blade screwdriver. If you don't know how to discharge an anode, see the procedure in the preceding section.

6 Disconnect the CRT anode.

7 Disconnect the brightness potentiometer wiring harness (see Figure 2-5).

8 Disconnect the filament plug from the neck of the CRT.

9 Disconnect the yoke wiring harness plug.

10 Disconnect the voltage requirement crimp-on connectors.

11 Remove the four Phillips screws that hold the monitor/power supply PCB to the monitor chassis (one in each corner).

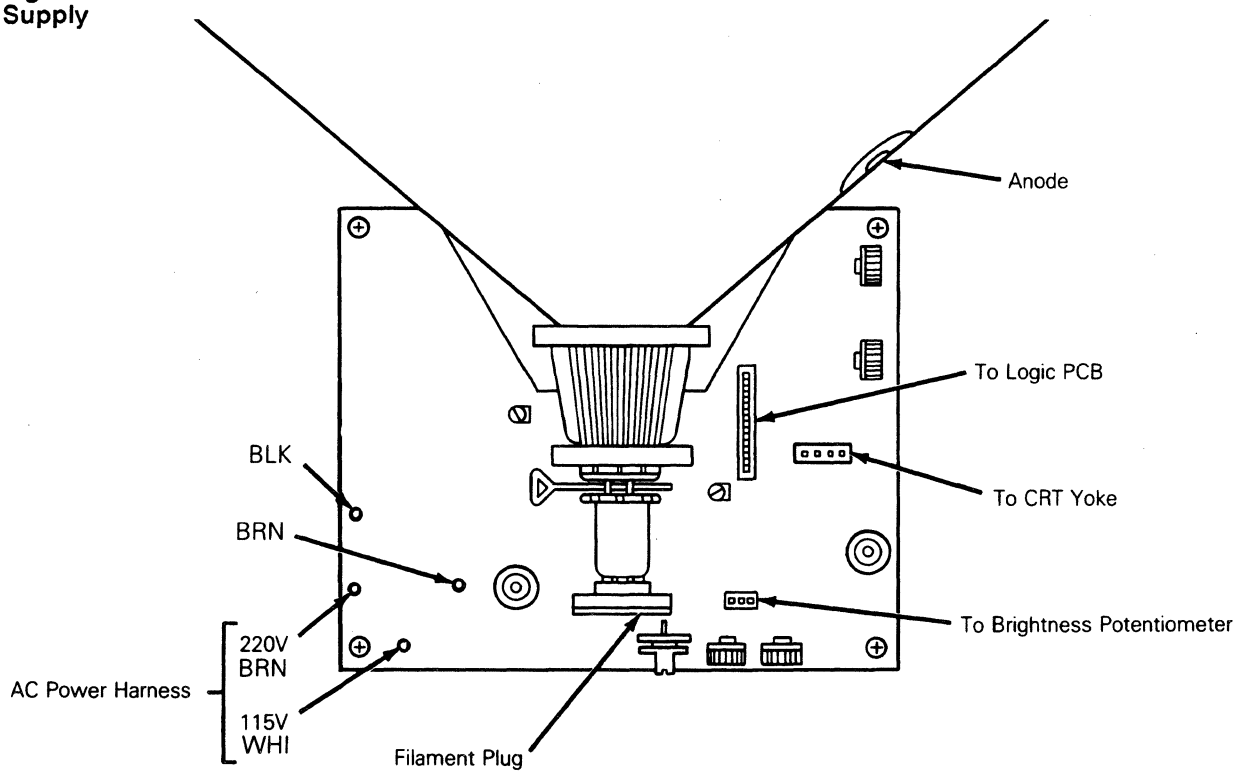
12 Slide the PCB out of the rear of the monitor chassis.

▲ **Warning** Before you reattach the anode cap to the CRT or the logic PCB wiring harness to the monitor/power supply assembly, *discharge the CRT anode again*. Because of the capacitive coating inside the CRT, it may recharge itself. The terminal has a common ground. If there is a residual charge and the logic PCB wiring harness is reconnected, it may damage components on that PCB. If you don't know how to discharge an anode, see the procedure on page 2-4.

13 Install the monitor/power supply PCB by reversing the order of removal.

14 When you replace the monitor/power supply PCB, realign the display. See Chapter 5, "Adjustments and Alignments," for alignment information.

Figure 2-5 Monitor/Power Supply



CRT/Yoke Assembly

Tools Required:

- No. 1 Phillips screwdriver, 12-inch
- Flat-blade screwdriver, 12-inch

▲ **Warning High voltage is present.** Only qualified service personnel should service this device.

To replace the CRT/yoke assembly (see Figure 2-6):

1 Turn off the terminal and disconnect it from its AC power source.

2 Remove the four Phillips screws holding the monitor housing in place (one screw in each corner).

3 Hold the monitor housing by both ends and pull it off.

▲ **Warning High voltage is present.** Do not touch the CRT or CRT anode unless you are a qualified service technician.

4 Discharge the CRT anode with an insulated flat-blade screwdriver. If you don't know how to discharge an anode, see the procedure on page 2-4.

5 Disconnect the anode cap from the CRT.

6 Disconnect the filament plug from the neck of the CRT.

7 Disconnect the yoke wiring harness plug.

8 Disconnect the logic PCB wiring harness.

9 Remove the four No. 2 Phillips screws securing the bezel. Remove the bezel.

▲ **Warning** When you hold the CRT, keep it away from your body and do not carry it by the neck. Hold the screen parallel to the floor. Be especially careful with the CRT neck. If it shatters, it can shoot glass chards for a radius of six to ten feet in unpredictable directions.

10 While supporting the CRT/yoke assembly, remove the four Phillips screws and assorted hardware at each corner of the frame around the CRT screen.

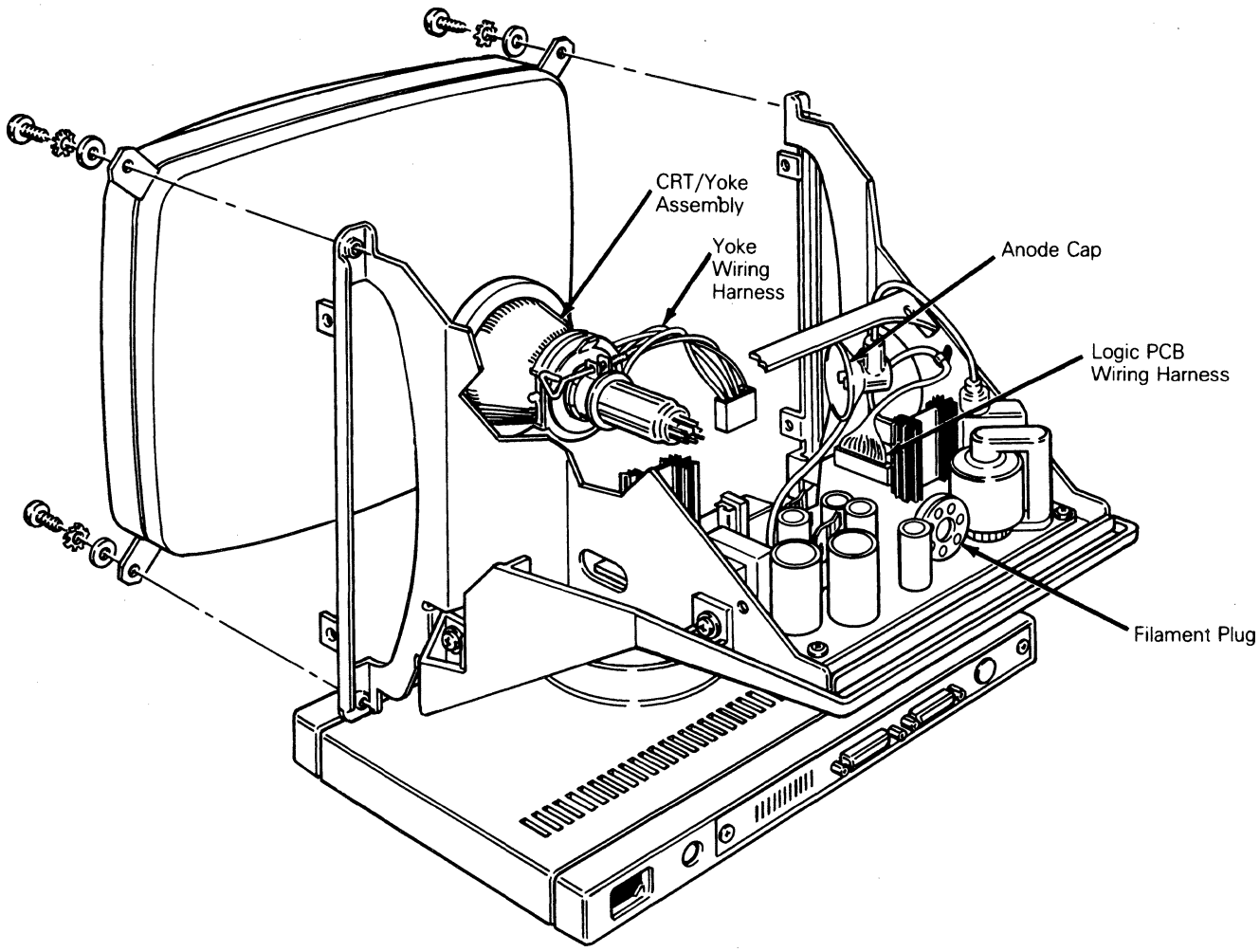
11 Remove the CRT/yoke assembly from the chassis.

▲ **Warning** Before you reattach the anode cap to the CRT or the logic PCB wiring harness to the monitor/power supply assembly, discharge the CRT anode again. Because of the capacitive coating inside the CRT, it may recharge itself. The terminal has a common ground. If there is a residual charge and the microprocessor PCB wiring harness is reconnected, it may damage components on that PCB. If you don't know how to discharge an anode, see the procedure on page 2-5 of this chapter.

12 Install the CRT/yoke assembly by reversing the order of disassembly.

13 When you replace the monitor/power supply PCB, you must realign the display. See Chapter 5 for alignment information.

Figure 2-6 CRT/Yoke Assembly



Brightness Potentiometer

Tools Required:

- No. 1 Phillips screwdriver, 12-inch
- Tie wraps

Follow these steps to replace the operator brightness potentiometer:

1 Disconnect the terminal from its AC power source.

2 Remove four No. 1 Phillips screws holding the monitor housing in place.

3 Hold the CRT housing by both ends and pull it off.

4 Disconnect the brightness potentiometer wiring harness from the monitor/power supply PCB (see Figure 2-6).

5 Clip the tie wraps holding the brightness potentiometer harness to the chassis.

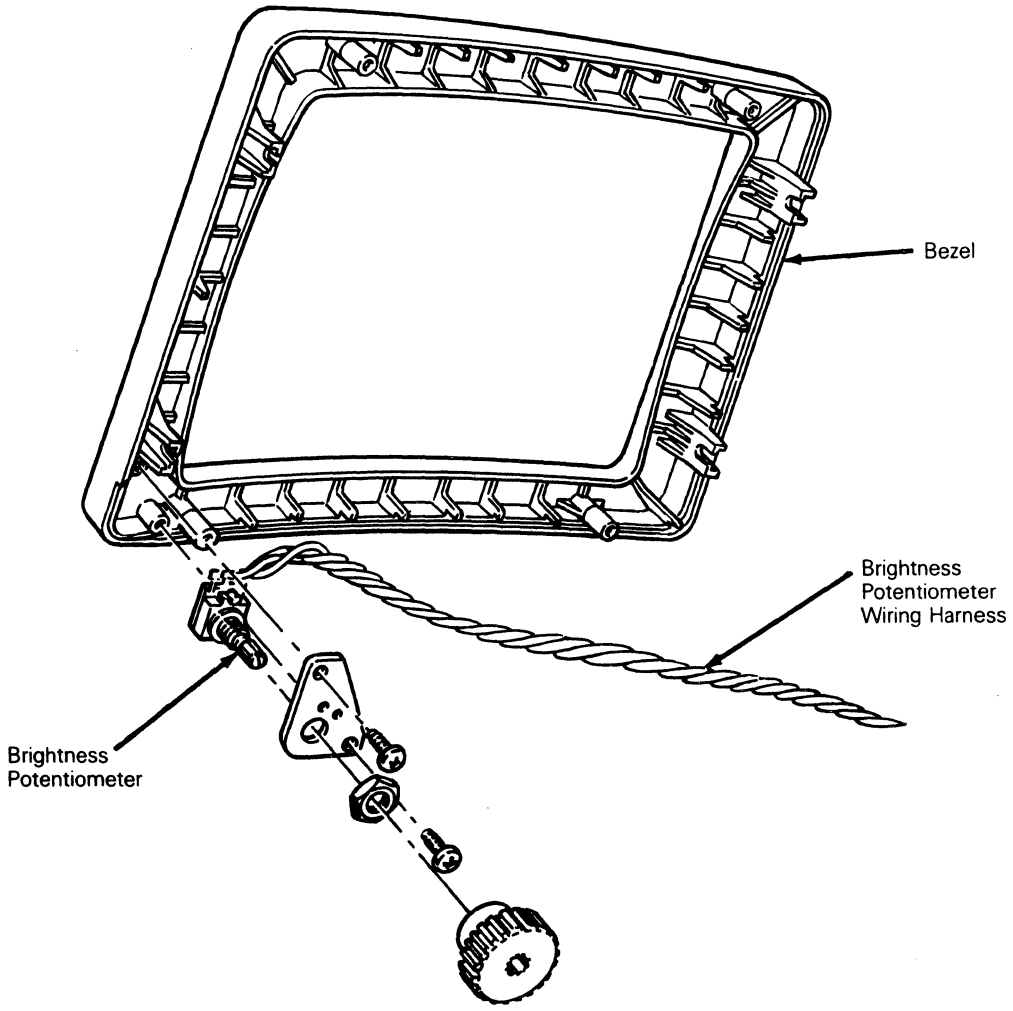
6 Loosen the four No. 2 Phillips screws securing the bezel. Remove the bezel.

7 Remove the two No. 1 Phillips screws that hold the brightness potentiometer to the bezel.

8 Install the new potentiometer.

9 Reassemble the monitor module by reversing the order of disassembly.

Figure 2-7 Brightness Control Potentiometer



REMOVING AND REPLACING ASSEMBLIES IN THE LOGIC PEDESTAL MODULE

This section describes procedures to remove the fuse, the AC power switch, and the logic PCB.

Fuse

Make sure the new fuse is rated 250 volts and 2 amperes.

Tools Required:

- Flat-blade screwdriver
- Multimeter

To replace the fuse (see Figure 2-8):

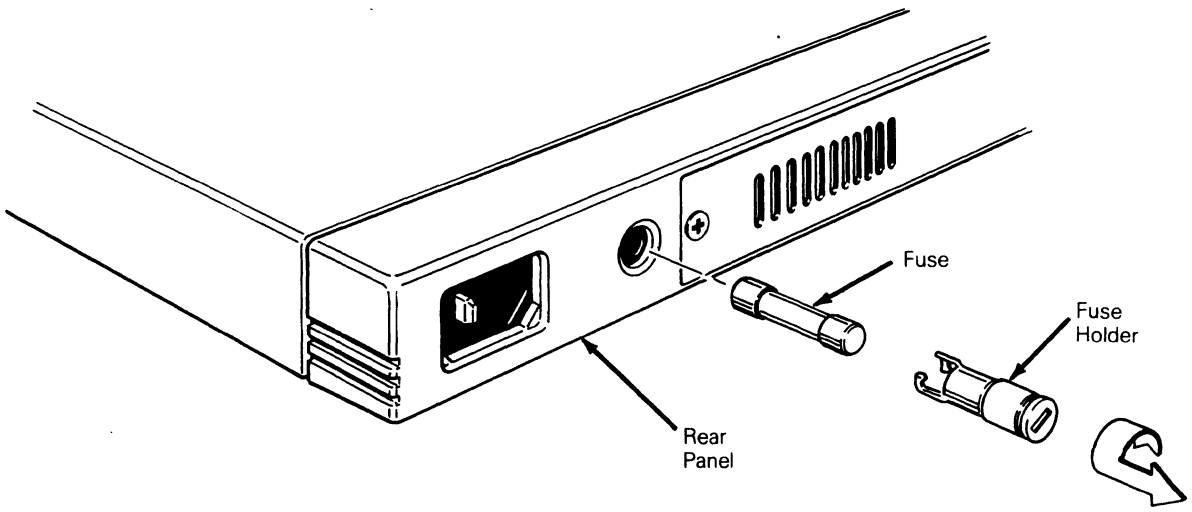
1 Disconnect the terminal from its AC power source.

2 Push the fuse holder in with a flat-blade screwdriver and twist it counterclockwise until it releases.

3 Inspect the fuse. If it is broken or blackened, replace it with a new fuse in the fuse holder. (Check continuity of the new fuse with an ohmmeter.)

4 Push the fuse holder with the new fuse back into the fuse socket with a flat-blade screwdriver. Twist the fuse holder clockwise until it locks in place.

Figure 2-8 Fuse Removal



AC Power Switch

Tools Required:

- No. 1 Phillips screwdriver
- Tie wrap

To replace the AC power switch (see Figure 2-9):

1 Disconnect the terminal from its AC power source.

2 Lay the terminal on its side.

3 Remove the six No. 1 Phillips screws that hold the metal base plate to the logic pedestal.

■ **Caution** The metal base plate tabs can break the logic pedestal plastic if they aren't handled carefully.

4 Remove the metal base plate.

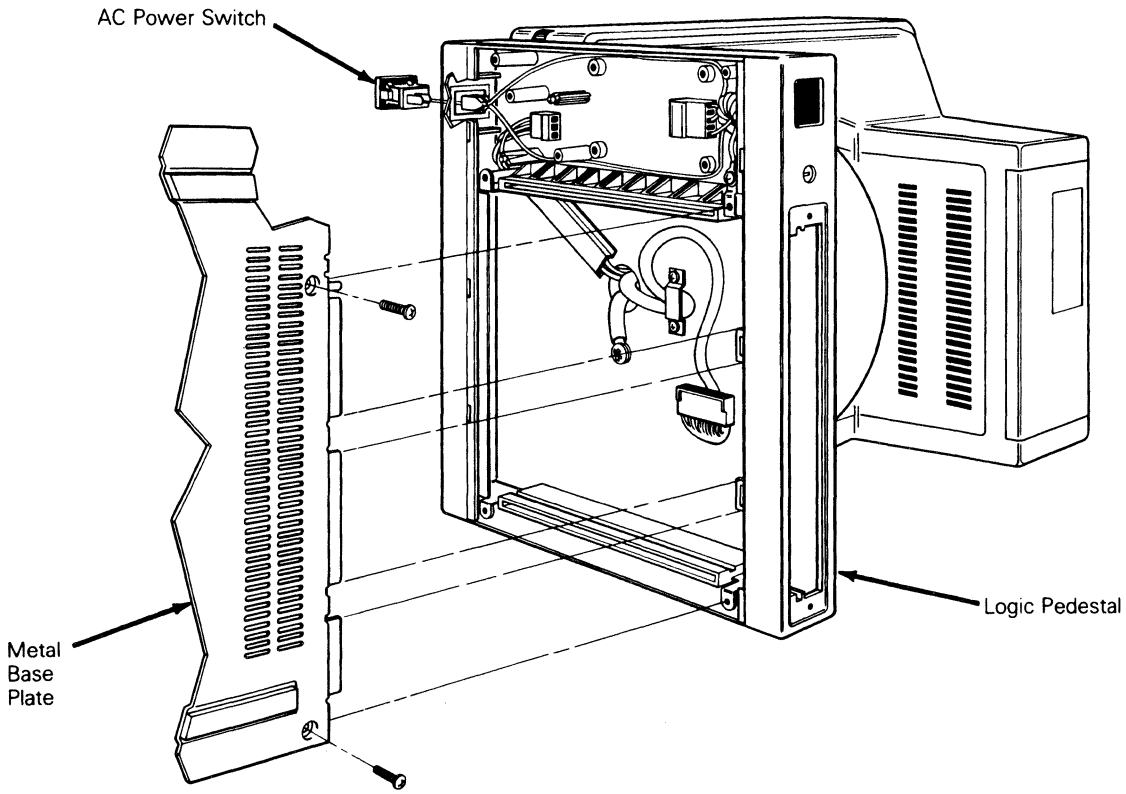
5 Disconnect the slip-on connectors from the rear of the switch.

6 Push the power switch out of the front of the logic pedestal. This is a snap-in switch; you may have to squeeze the snaps to remove it.

7 Install the new switch.

8 Reassemble the logic pedestal module by reversing the order of disassembly.

Figure 2-9 AC Power Switch Removal



Logic PCB

Tools Required:

- No. 1 Phillips screwdriver

To replace the logic PCB:

1 Turn off the terminal and disconnect it from its AC power source.

2 Disconnect the keyboard from the rear panel.

3 Disconnect the printer and modem communications cables (if connected).

4 Remove the two No. 1 Phillips screws that secure the rear panel.

5 Pull the rear panel two inches out of the unit.

6 Disconnect connector **JY** from the logic PCB (see Figure 2-10).

7 Remove the logic PCB.

8 Install the new logic PCB.

9 Reconnect connector JY.

10 Push the Logic PCB into the logic pedestal. Replace and tighten the Phillips screws.

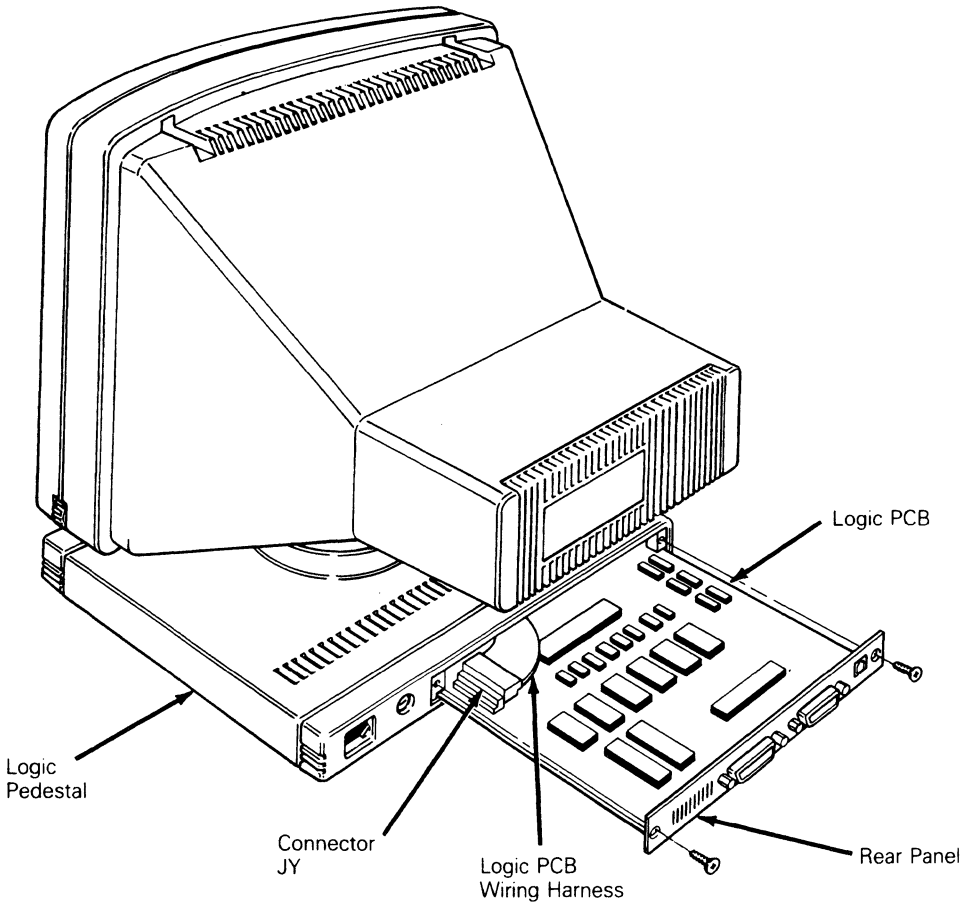
☐ **Note** When you install a new logic board, you must initialize the EEPROM. The terminal will fail the EEPROM checksum test if you don't initialize the Logic PCB (see step 13).

11 Reconnect the terminal's power cord to an AC power source.

12 Reconnect the keyboard to the rear panel.

13 Initialize the EEPROM by pressing the G key while turning on the terminal.

Figure 2-10 Logic PCB Removal



Line Filter PCB

Tools Required:

- No. 1 Phillips screwdriver

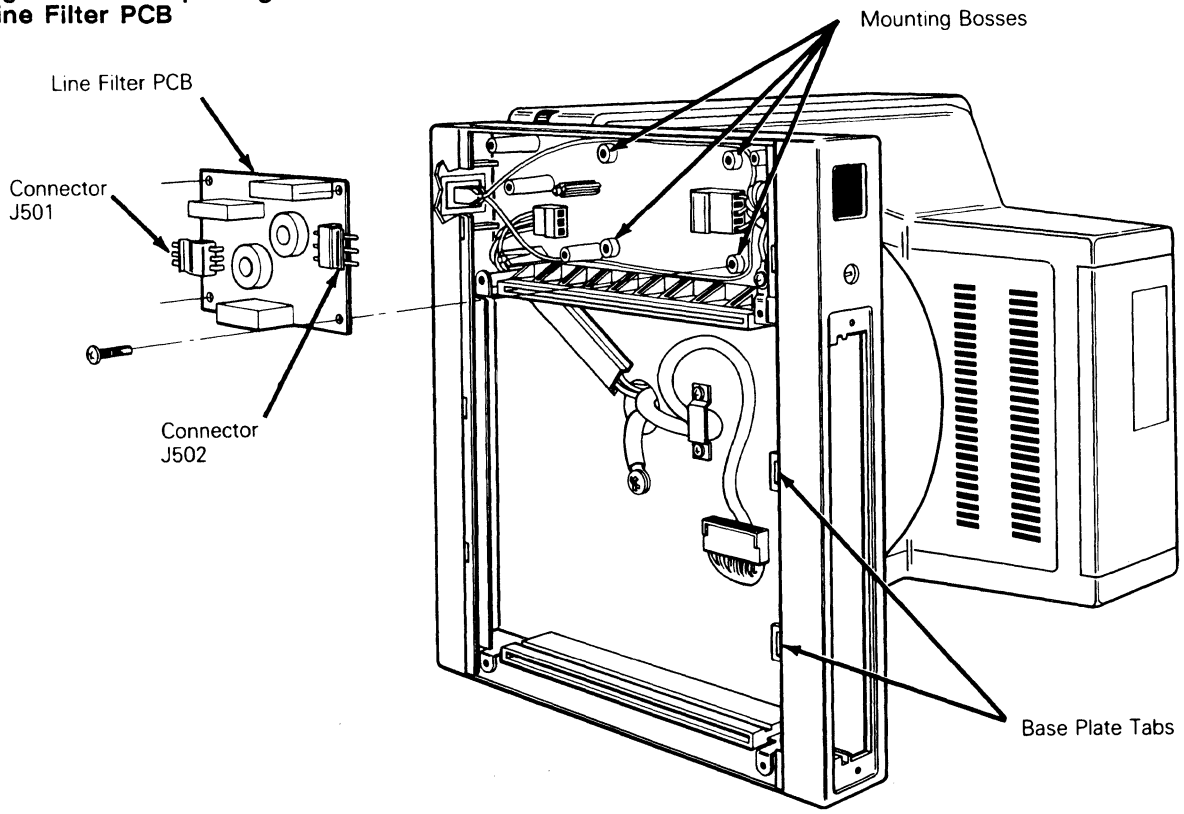
To replace the line filter PCB:

1. Turn off the terminal.
2. Disconnect all communications cables and the power cord from the rear panel.
3. Turn the terminal on its side.
4. Remove six Phillips screws that hold the metal base plate to the logic pedestal.

■ **Caution** The metal base plate tabs can break the logic pedestal plastic if they aren't handled carefully.

5. Remove the metal base plate.
6. Disconnect connectors **J501** and **J502** (see Figure 2-11).
7. Remove four Phillips screws that secure the line filter PCB to the logic pedestal. Remove the PCB.
8. Position the new line filter over the mounting bosses in the logic pedestal. Replace the four Phillips screws.
9. Reconnect **J501** and **J502**.
10. Replace the base plate and six screws.
11. Turn the terminal upright.

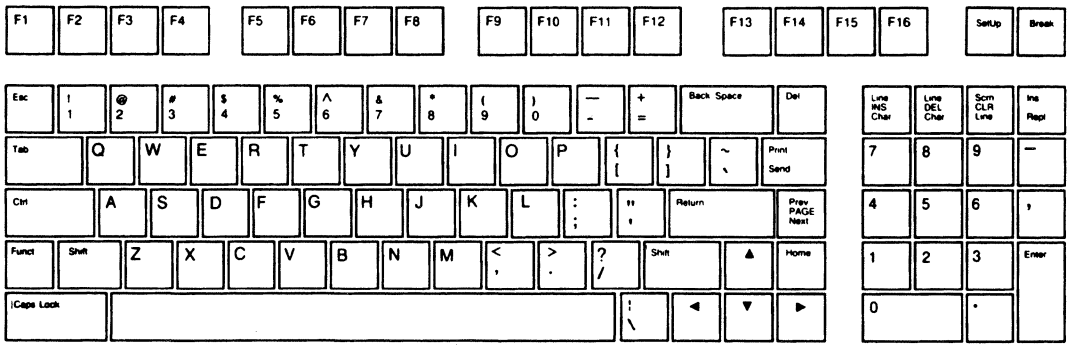
Figure 2-11 Replacing the Line Filter PCB



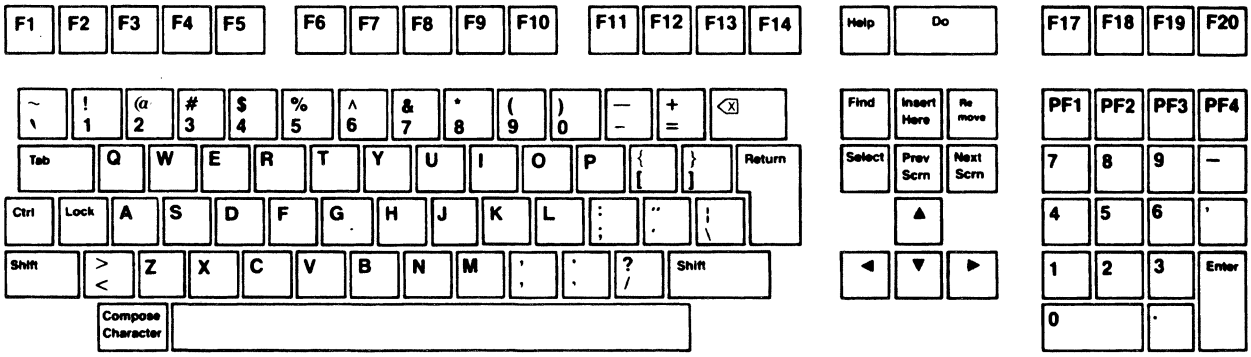
REMOVING AND REPLACING ASSEMBLIES IN THE KEYBOARD MODULE

The terminal has three keyboard options: the ASCII keyboard, the VT220-style keyboard, and the Enhanced PC-style keyboard. See Figure 2-12 if you need to identify your keyboard. Removal and replacement instructions for the ASCII keyboard are first, followed by another set of instructions for the other keyboard styles. Each set of instructions describes procedures to remove and replace the keyboard, keyboard cable, and keyboard PCB.

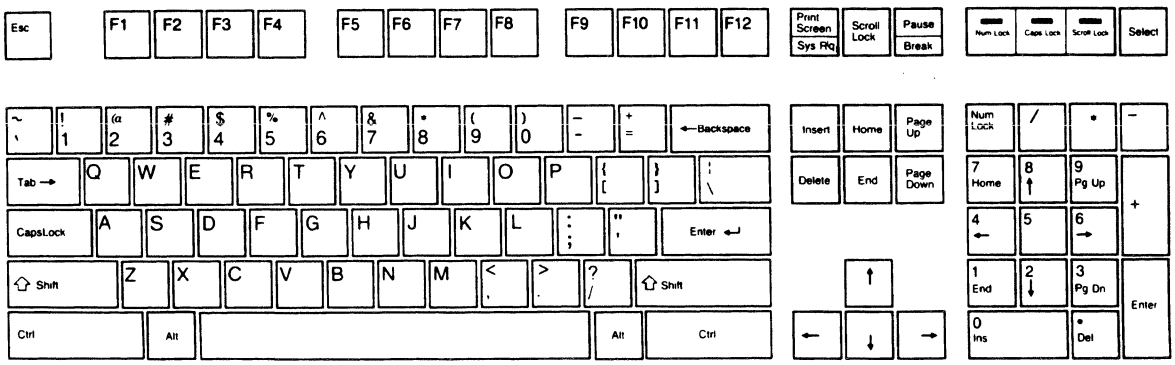
Figure 2-12 Keyboard Styles



ASCII Keyboard Layout



VT220-Style Keyboard Layout



Enhanced PC-Style Keyboard Layout

ASCII Keyboard Replacement

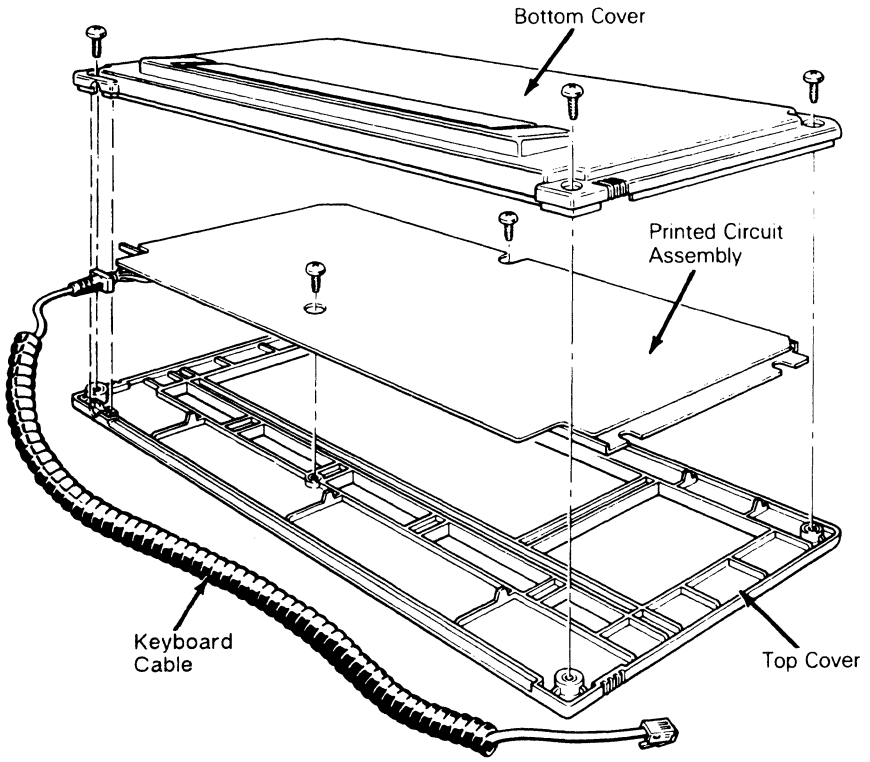
Follow these steps to replace the keyboard (see Figure 2-13):

1 Turn the terminal off.

2 Press the keyboard cable connector tab and pull the keyboard cable out of the KYBD socket on the rear panel of the logic pedestal.

3 Plug the new keyboard into the KYBD socket.

Figure 2-13 ASCII Keyboard Assembly



ASCII Keyboard Cable Replacement

To replace the keyboard cable (see Figure 2-13):

1 Turn the terminal off.

2 Press the keyboard cable connector tab and pull the cable out of the KYBD socket on the rear of the terminal.

3 Unscrew the four No. 2 Phillips screws on the bottom of the keyboard. Remove the bottom cover.

4 Unscrew the two Phillips screws (on the bottom of the exposed keyboard PCB) that hold the PCB to the top cover.

5 Lift the keyboard PCB out of the top cover. Turn it over.

6 Disconnect the keyboard cable from the keyboard cable connector (J1) on the PCB.

7 Connect the new keyboard cable at the keyboard cable connector on the keyboard PCB.

8 Fit the keyboard PCB into the top cover, making sure to fit the keyboard cable into its special slot. Replace the screws that secure the PCB to the top cover.

9 Replace the bottom cover and screws.

10 Plug the free end of the keyboard cable into the keyboard socket on the logic pedestal.

ASCII Keyboard PCB Replacement

To replace the keyboard PCB (see Figure 2-13):

1 Turn the terminal off.

2 Press the keyboard cable connector tab and pull the keyboard cable out of the keyboard socket on the back of the terminal.

3 Unscrew the four No. 2 Phillips screws on the bottom of the keyboard. Remove the bottom cover.

4 Unscrew the two Phillips screws (on the bottom of the exposed keyboard PCB) that hold the PCB to the top cover.

5 Lift the keyboard PCB out of the top cover. Turn it over.

6 Disconnect the keyboard cable connector J1 from the PCB.

7 Reconnect the keyboard cable connector at J1 on the new keyboard PCB.

8 Fit the keyboard PCB into the top cover, making sure to fit the keyboard cable into its special slot. Replace the screws that secure the PCB to the top cover.

9 Replace the bottom cover and screws.

10 Plug the free end of the keyboard cable into the logic pedestal's keyboard socket.

VT220- and Enhanced PC-Style Keyboard Replacement

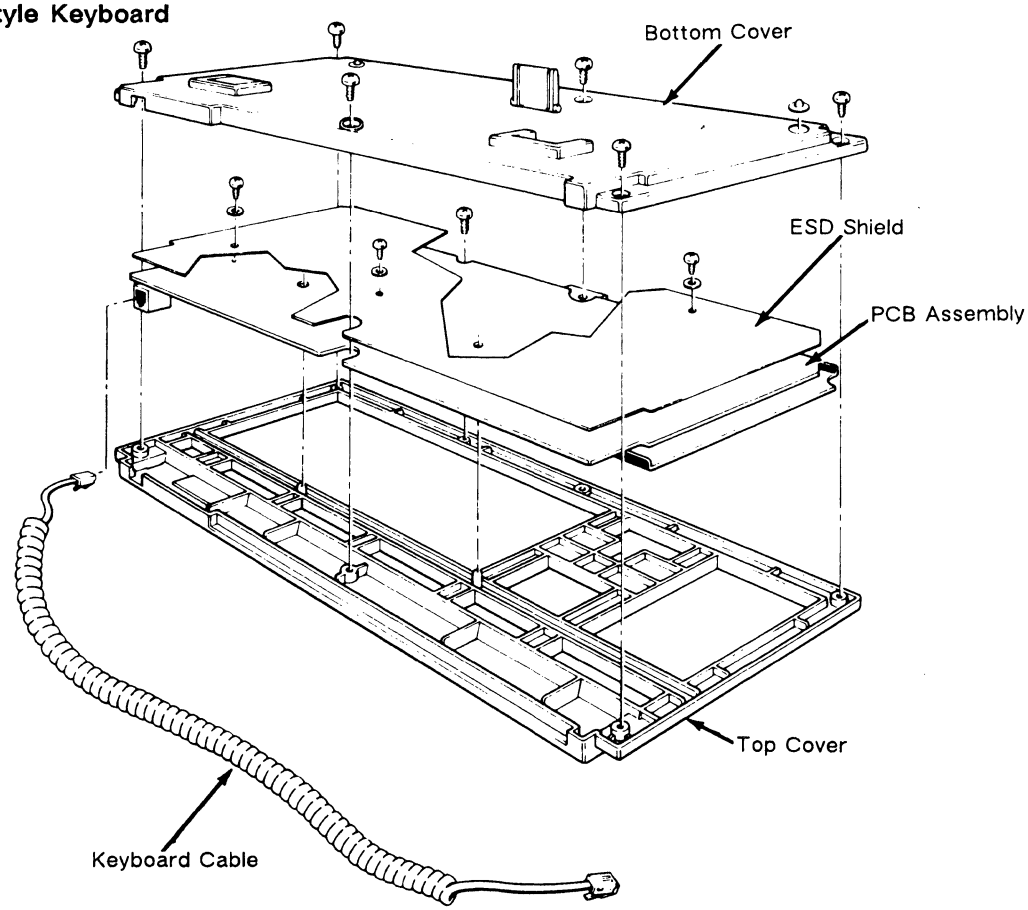
To replace the keyboard (see Figure 2-14), follow these steps:

1 Turn the terminal off.

2 Press the keyboard cable connector tab and pull it out of the keyboard.

3 Plug the keyboard cable into the new keyboard's connector socket.

Figure 2-14 VT220- and Enhanced PC-Style Keyboard Assembly



VT220- and Enhanced PC-Style Keyboard Cable Replacement

To replace the keyboard cable, (see Figure 2-14), follow these steps:

1. Turn the terminal off.
2. Press the keyboard cable connector tab and pull it out of the keyboard.
3. Press the other keyboard cable connector tab and pull the keyboard cable out of the rear of the terminal.
4. Insert one end of the new keyboard cable into the keyboard connector. Insert the other end into the logic pedestal's keyboard socket.

VT220- and Enhanced PC-Style Keyboard PCB Replacement

To replace the keyboard PCB (see Figure 2-14), follow these steps:

1. Turn off the terminal.
2. Unplug the keyboard cable from the keyboard.

3 Turn the keyboard over and remove the six No. 2 Phillips screws that attach the keyboard bottom cover to the keyboard.

4 Lift off the keyboard bottom cover.

5 Remove the No. 0 Phillips screw beneath the SPACEBAR that holds the keyboard top cover to the PCB assembly.

6 Unscrew the three No. 0 Phillips screws and washers that hold the keyboard ESD shield on the keyboard PCB.

7 Lift the PCB assembly out of the keyboard cover.

8 Cover the under side of the new keyboard PCB with the keyboard ESD shield. Replace and tighten the screws and washers.

9 Fit the new keyboard PCB assembly back into the keyboard top cover.

10 Replace the No. 0 Phillips screw that holds the PCB assembly in place.

11 Reattach the bottom cover of the keyboard assembly.

12 Plug the keyboard cable back into the keyboard.

3 Theory of Operations

INTRODUCTION

This section describes the terminal's basic logic functions.

If you're unfamiliar with raster scan techniques, read the brief explanation of raster scan terms, found at the end of the chapter.

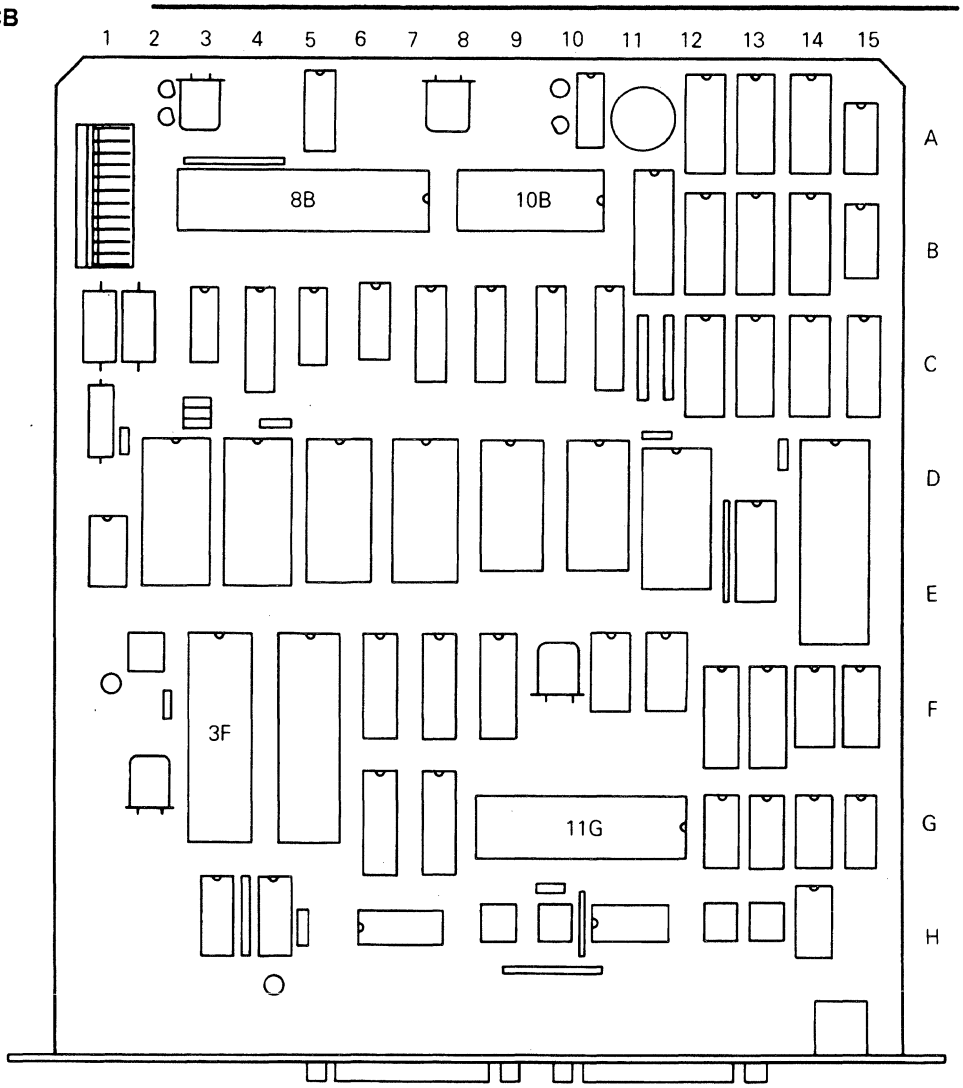
PRINTED-CIRCUIT BOARD LAYOUT AND COMPONENT IDENTIFICATION

When you study the theory of operations for the terminal, you may want to identify certain components as you read about them. The text identifies each component with the X–Y coordinate

system used on all printed circuit boards. This system can help you locate components on the PCB that are referred to in the schematics as well. Here is a brief explanation of the coordinate system:

A set of letters runs along the length of the logic board. A set of numbers runs along the width of the logic board. These coordinates form an X-Y grid. Each component's X-Y coordinate is printed next to it on the PCB. Look at Figure 3-1 for an example of coordinate identification.

Figure 3-1 Logic PCB



FUNCTIONAL DESCRIPTION OF MAJOR COMPONENTS

This section contains a functional description of each significant component on the logic PCB, along with its component coordinate. You can reference both the logic PCB and its schematics when you read this section.

8051 Microcontroller (3F)

The terminal has a single-component control-oriented microcontroller which contains 128 bytes of random-access memory (RAM), 16 input/output (I/O) lines, three 16-bit counter/timers, and a universal asynchronous receiver/transmitter (UART). It has integral interrupt and clock circuitry. The microcontroller uses eight data lines multiplexed with the lower eight address lines. Address information appears on these lines only when the ALE (address latch enable) signal is present. The upper address lines (A8–A15) are nonmultiplexed single-direction lines. The internal UART controls the AUX printer port.

Gate Array (8B)

The gate array contains the following functions:

Beeper Driver

The gate array contains a driver that enables a beep.

Attribute Data Latches

The attribute data latches store both screen and row attributes for each character to be displayed, one at a time, for the attribute generation circuitry. Examples of screen attributes include foreground brightness and blink rate. Examples of row attributes include scan line count, double high, and double wide.

Parallel-to-serial Converter

The output of the character generator is an 8-bit parallel code. The raster scanned CRT is a serial device. The parallel-to-serial converter converts the parallel output of the character generator into a serial format the CRT can display.

Video Drivers and Dot Stretcher

Video drivers allow output from the parallel-to-serial converter to interface with the CRT. In addition, the dot stretcher extends the on time of video dots so that single vertical rows of dots appear to have the same intensity as strings of horizontal dots. The blanking signal disables the driver so that the video output is inhibited during vertical and horizontal retrace.

Soft-font Control

The gate array contains circuitry to control soft-font loading and generate soft-font selection signals.

Presettable Scan Line Counter

The gate array enables smooth scrolling with the presettable scan line counter.

Clock Generators

The gate array generates timing signals for the 8088 and the CRT controller.

Blink Rate Generator

The gate array generates blink rate signals for both characters and cursor.

Graphics RAM Control

The gate array generates control signals for the graphics RAM.

Clock Divider

The 8051 selects the oscillator frequency that goes to the gate array. The gate array divides these frequencies to generate specific clock rates. Table 3-1 lists original dot clock rate (oscillator frequencies), number divided by, the rate it becomes after division, and what it controls.

Table 3-1 Clock Rates

Beginning Clock Rate	Divisor	New Clock Rate	New Clock
34.425 MHz	9	3.825 MHz	CCLK (132-column mode)
34.425 MHz	6	5.74 MHz	8088*
22.95 MHz	10	2.295 MHz	CCLK (80-column mode)
22.95 MHz	8	2.869 MHz	CCLK (100 column graphics)
22.95 MHz	3	7.65 MHz	8088*

*Both 8088 clock frequencies have a one-third time duty cycle.

2672 CRT Controller (4F)

The microcontroller initializes the CRT controller or programmable video timing controller (PVTC) during power-up. The CRT controller interfaces with the video display buffer (RAM) on a direct-memory access (DMA) basis. Display data then moves to the character generation circuitry for processing. The CRT controller chip (PVTC) generates the cursor and also provides the necessary timing and control information for the display logic: horizontal synchronization, vertical synchronization, and blanking.

DUART (11G)

The dual universal asynchronous receiver/transmitter (DUART) takes parallel data from the microcontroller and converts it to a bit-serial format for external communication equipment. In addition, the DUART converts bit-serial information received from an external source to parallel information for the microcontroller. The DUART flags the microcontroller with an interrupt when it needs service. Channel A is the RS-422/-232C MODEM port; channel B is the AUX port.

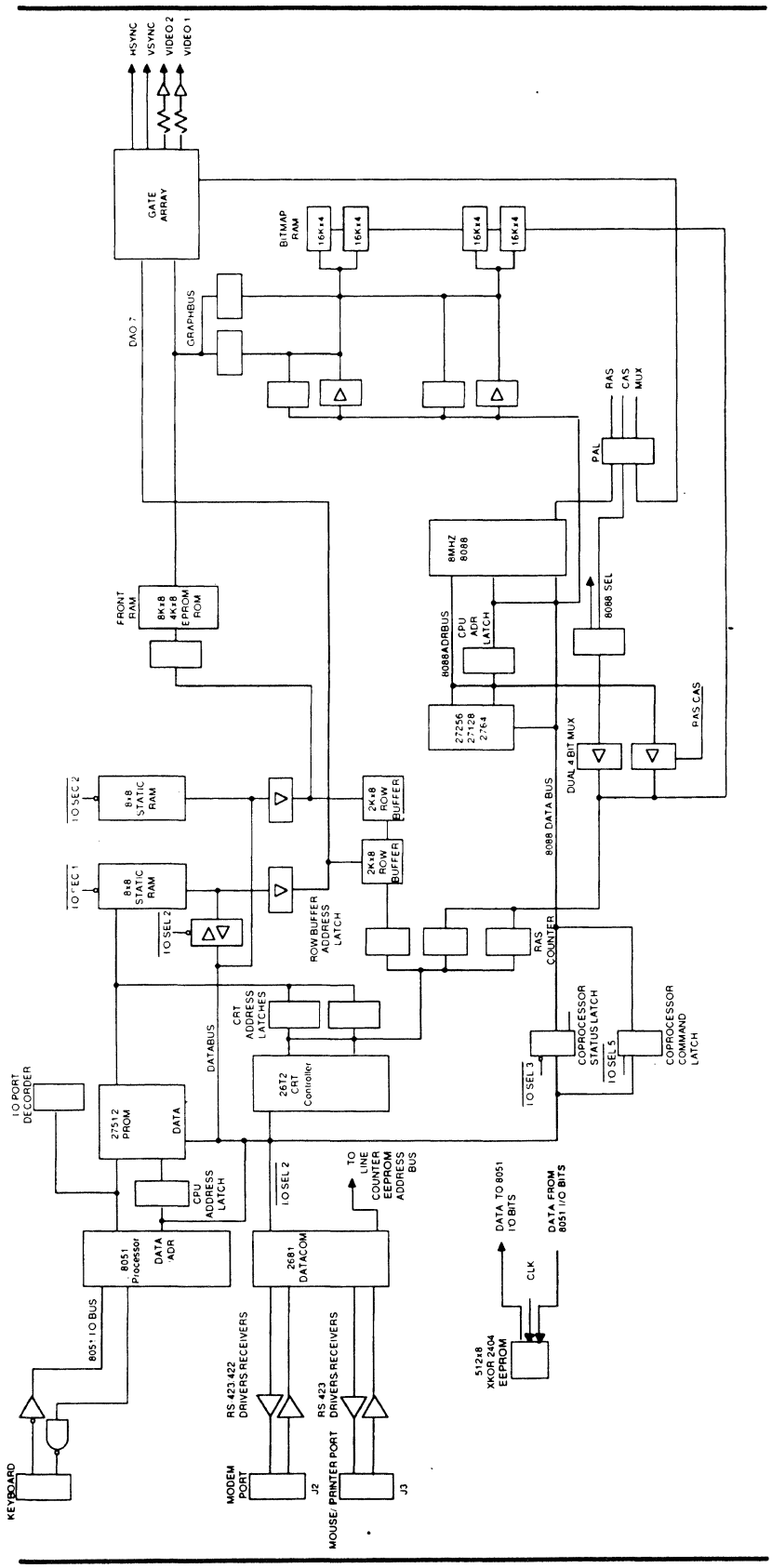
PROM (3D)

The programmable read-only memory (PROM) is nonvolatile memory for program storage. All routines reside in PROM. The terminal PROM is 64K bytes. The PROM does not reside within the RAM memory map because it has a unique enable line (PSEN).

Chip-select Decoder (5C)

The chip-select decoder decodes the higher order address bits (A13, A14, A15) and the Read and Write control lines (RD and WR) from the microcontroller. The decoder generates enable signals for the RAM, DUART, PVTC, EAROM, and soft-font port from these signals.

Figure 3-2 Logic PCB Block Diagram



Low Order Address Latch (4C)	This IC latches and gates the lower order address information from the microcontroller when activated by the microcontroller's address latch enable (ALE) signal. The latch separates data from the address bus when data is present on the microcontroller's multiplexed lower address and data bus interface.
Keyboard Interface (15G)	The logic PCB communicates with the keyboard on two lines. The microcontroller checks to see if a key has been pressed on the keyboard by addressing each key, then examining the keyboard return line on the data bus. The microcontroller looks for the positive key return on port one, bit six.
Row Buffer RAM (8D, 9D)	The row buffer RAMs receive display information from the display RAM. This display data is read from RAM 13 times per row (once for each scan line) and sent to the font RAM/EPROM circuit for decoding. The row buffer RAM located at 8D holds characters. The row buffer RAM located at 9D holds attributes.
Attribute Row Buffer Data Latch (10C)	The attribute row buffer data latch stores each character attribute to be displayed (one at a time) for the character generation circuitry.
Character and Attribute RAM (5D, 4C)	The logic PCB contains two 8Kx8 static RAMs. One of the RAMs stores character data, while the remaining RAM stores attribute data, for hidden (nonembedded) attributes. Attribute memory locations are addressed automatically each time character memory is addressed. This allows the 8-bit microcontroller to read and write 16-bit words.
Soft-font RAM (10B)	This 8Kx8 RAM stores character data for the soft font application. Two bits set in the attribute byte select each of the four fonts in this RAM.
Video Clock Generator (5A)	The clock generator consists of two crystal oscillators: 22.95 MHz for 80-column mode and 34.425 MHz for 132-column mode. The 8051, port 1, bit 0, controls oscillator selection. The oscillator output is the dot clock rate.
Nonvolatile Memory (2F)	The nonvolatile memory consists of an EEPROM that is programmed by the operator in setup. This memory stores setup parameters such as baud rate and parity. The EEPROM retains its data until reprogrammed by the operator. It connects directly with 8051 ports P1.1 (data) and P1.2 (clock).
Level Converters (EIA to TTL) (3H, 7H, 10H)	These level converters change the EIA RS-232C and EIA-423C logic levels to TTL levels for the DUARTs. They also convert RS-422 logic levels to TTL logic levels.

Level Converters (TTL TO EIA) (8H, 9H, 12H, 13H)

These level converters change the TTL logic levels from the DUART to RS-232C and EIA-423C levels for communicating with external equipment. The converter at location 4H converts TTL to RS-422 levels.

DUART Clock (1E)

The DUART clock generator consists of 3.6864-MHz crystal connected to the XTAL inputs of the DUART. The DUART has its own internal clock generation circuitry that divides the basic crystal into baud rates used by the DUART. The DUART is programmed by the user in setup mode for the appropriate baud rate.

Microprocessor, 8088 (14D)

The 8051 sends all graphics commands to the coprocessor command latch, while simultaneously sending a nonmaskable interrupt to the 8088. The interrupt indicates information in the latch. The 8088 retrieves the information from the latch. It decodes information from the 8051 with instructions from the graphics EPROM, and sends an address to the graphics RAM. The 8088 also sends status to the 8051 through the coprocessor status latch.

Graphics EPROM (11D)

The graphics EPROM acts as a command-to-bit translator for the 8088. It holds the full instruction set that enables terminal compatibility with the Tektronix 4010/4014 and PC graphics modes. The 8088 reads the instructions in the graphics EPROM and sends data to the graphics RAM.

Graphics RAM (12C, 13C, 14C, 15C)

The graphics RAM holds screen address information sent from the microprocessor until the CRT controller reads it.

Interprocessor Communications Latches (12F, 13F)

There are two interprocessor communications latches: the coprocessor command latch and the coprocessor status latch. See the 8088 description to understand their functions.

Interprocessor Status Latches (12G)

These latches hold the state of the last interprocessor communication. Both the 8051 and 8088 read these latches through a buffer located at 14H. This information enables both processors to determine whether or not the data in the interprocessor communications latches is current.

Monitor/Power Supply

The monitor module contains a combination monitor/power supply assembly. The power supply provides the voltages for all the logic. These voltages are +12V, −12V, and +5V. The monitor/power supply only uses the +12V supply. Figure 3-3 is a block diagram of the combination monitor/power supply. Note that each block is numbered. This number corresponds with the item number in the following descriptions.

Line Filter (1)

The line filter attenuates noise from the external power source (the AC power cord and wall socket). It also filters any noise

produced by the switching power supply to comply with FCC RFI regulations.

Voltage Doubler (2)
The terminal operates with either a 115 VAC or 230 VAC input. The voltage doubler circuit provides 270 to 300 VDC for the oscillator circuit when 115 VAC is applied, and is passive when the 230 VAC input strap is installed. This ensures that the oscillator (DC to AC converter) always has a 270 to 300 VDC input regardless of the AC input voltage.

Pulse Width Modulator (3)
The pulse width modulator (PWM) consists of a pair of switching transistors. It sends AC input voltage to the main power transformer. The PWM is synchronized with the horizontal synchronization pulses to eliminate beat frequencies.

Main Switching Power Transformer (4)
The main power transformer provides taps for each power supply.

Horizontal Driver (5)
The horizontal driver makes sure that the yoke is driven at the correct frequency so that the electron beam sweeps from left to right at the correct rate. It also provides the signal to drive the flyback transformer. (Refer to Figure 3-4 for horizontal timing information.)

Regulation Circuitry (6)
The regulation circuitry measures the +5 and +12 volt supplies. It generates an error voltage proportional to any error it may find when measuring the supplies. Regulation is accomplished by optically coupling the error signal to the pulse width modulator which controls its duty cycle together with the output voltage of the main switching power transformer.

+5 Volt Supply (7)
The +5V is derived directly from one of the main transformer taps which provides low voltage AC. The output of this tap is rectified and regulated.

-12 Volt Supply (8)
The -12V supply is derived from one of the main transformer taps. The low voltage AC output is rectified and filtered. The -12 volt supply is Vee for the RS-232 drivers.

+12 Volt Supply (9)
The +12 supply is derived from one of the main transformer taps. The low voltage AC output is rectified and filtered. This supply provides filament voltage and Vcc for U26 and U27.

Flyback Transformer (10)
The flyback transformer steps up the output of the horizontal driver to provide the high voltage for the CRT itself. In addition, the flyback transformer generates +50 volts for the video amplifier, the +600 focus voltage, and the brightness bias voltage (-100 VDC.)

Vertical Deflection Circuit (11)

The vertical deflection circuit provides the yoke with the correct vertical drive frequency to ensure that the electron beam scans the face of the CRT at the correct vertical repetition rate. This circuit also controls display height and linearity. Refer to Figure 3-5 for vertical timing information.

Video Amplifier (12)

The video amplifier varies the voltage on the CRT cathode, pin 2. This modulates the beam current. Higher beam current causes a brighter spot on the screen.

CRT (13)

The CRT displays data by receiving a modulated electron beam with the video signal while the beam moves across the face of the screen. The horizontal and vertical drive signals determine the rate of movement.

Figure 3-3 Monitor/Power Supply Block Diagram

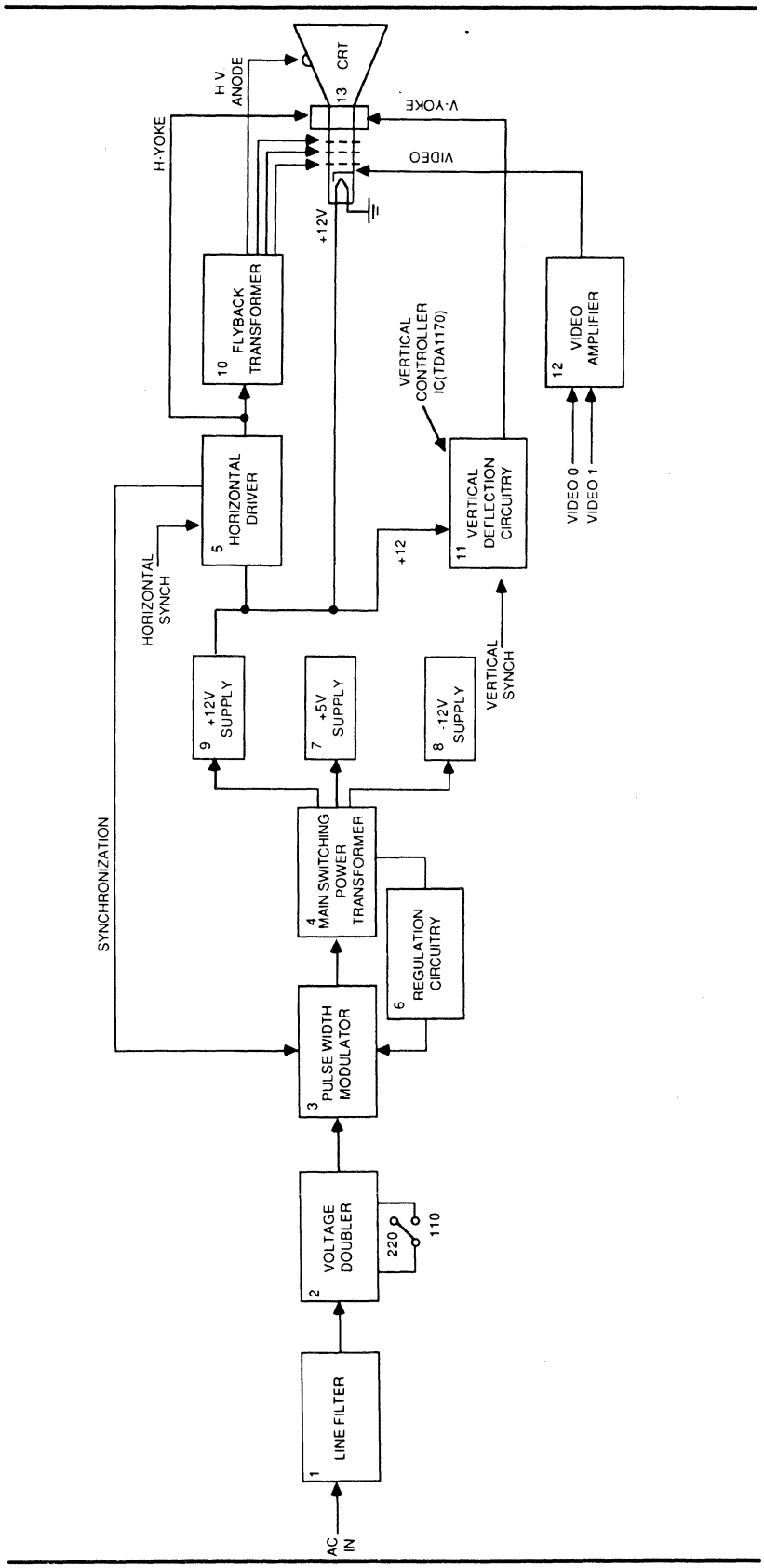
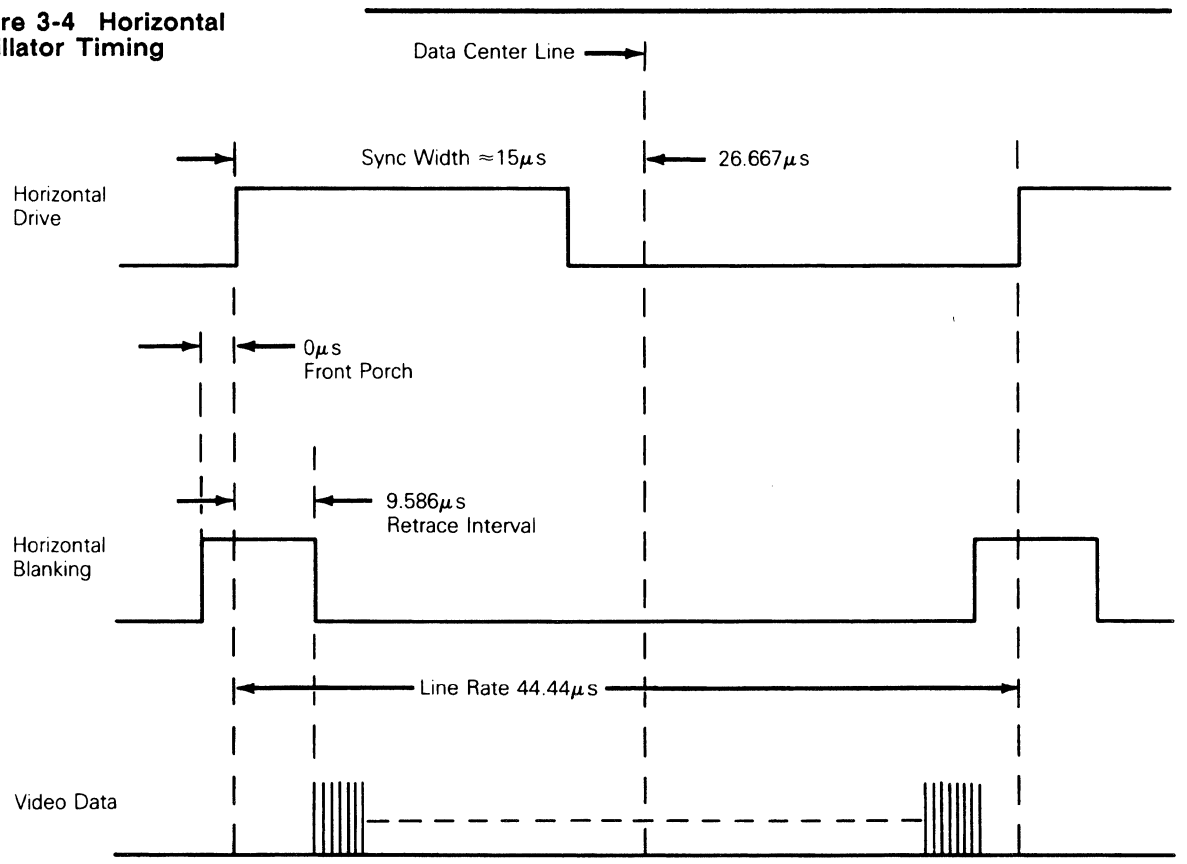
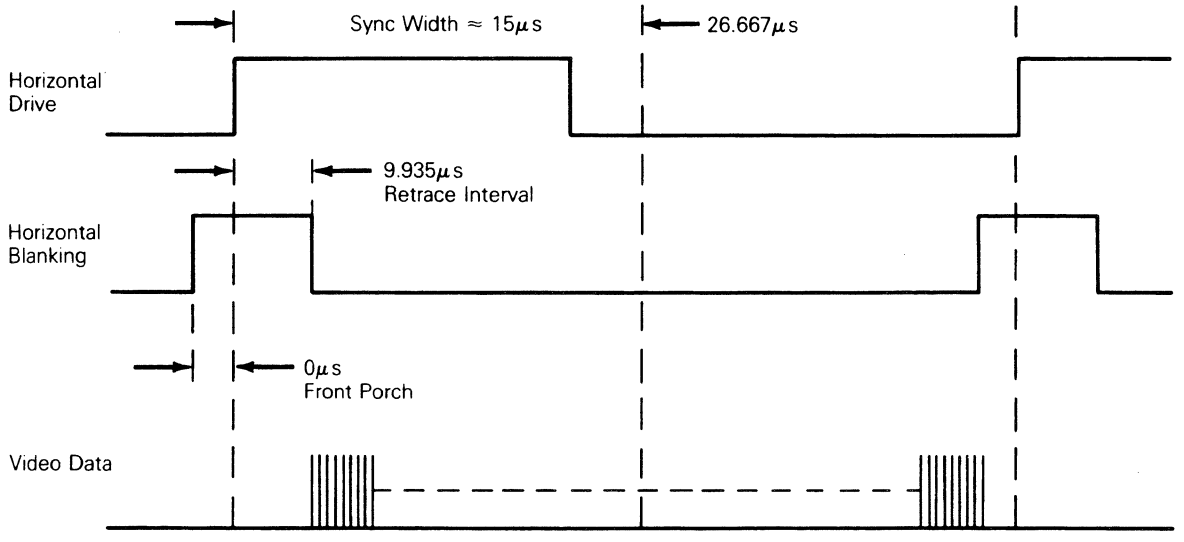


Figure 3-4 Horizontal Oscillator Timing

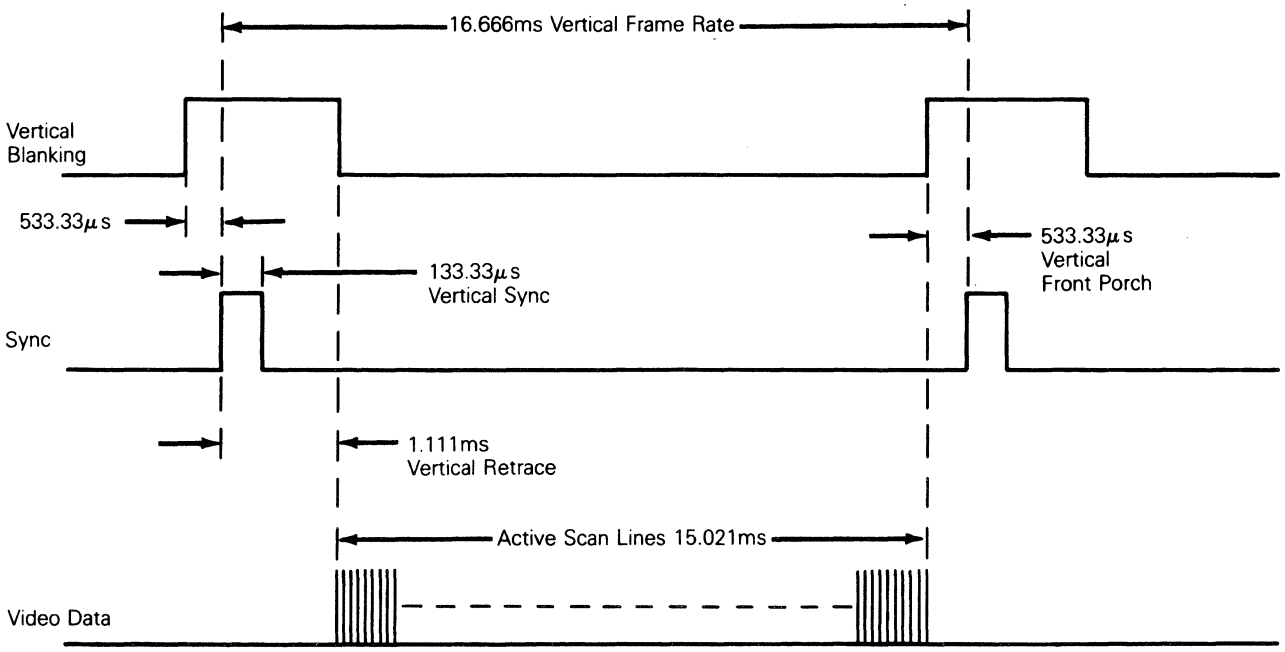


50Hz/60Hz 80 Characters Per Row



50Hz/60Hz 132 Characters Per Row

Figure 3-5 Vertical Timing



50Hz/60Hz 80/132 Column

Keyboard

Figure 3-6 is a block diagram of the terminal keyboard. The logic that interfaces with the keyboard resides on the logic PCB.

Key Switch Matrix

The key switch matrix is arranged as 16 columns and eight rows. Each row is **pulled up** to +5V with a pull-up resistor. A key switch is located at each intersection of a row and a column. Pressing a key switch results in a unique column and row juncture.

Keyboard Encoding

The 8051 sends out a CLOCK strobe (KEY OUT) to a dual 4-bit binary counter (U5) on the keyboard PCB, causing it to count from zero to 15. At each count, seven bits are sent out from the counter and decoded by the U1 and U2 for one of 13 columns, and to row decoder/data selector (U3) to select one of eight rows.

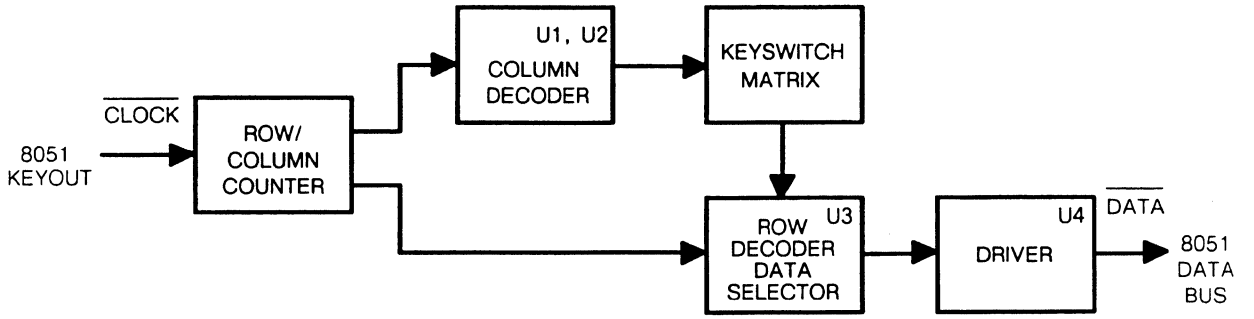
Row Decoder/Data Selector

The row decoder/data selector (U3) will send a pulse through a line driver back to the 8051 if a low level is detected at the correct X input lines. The 8051 will interpret the returning pulse as a positive keyswitch scan and follow with character addressing.

Line Drivers

The keyboard line drivers (15G) provide adequate output to minimize the signal decrease between the keyboard and the logic PCB.

Figure 3-6 Keyboard Block Diagram



FUNCTIONAL DESCRIPTION

The logic board consists of six sections: microcontroller, communications interface, display memory, nonvolatile memory, keyboard interface, and video control.

Microcontroller

The 8051 is a control-oriented microcontroller that contains 128 bytes of RAM, two counter/timers, a full duplex serial port, and two parallel ports. The processor operates at 12 MHz. This allows most instructions to execute in 1.0 microsecond.

The 8051 has separate addresses for program storage and RAM. PSEN selects program storage. The terminal stores programs in an EPROM.

The microcontroller communicates over an 8-bit data bus that has eight lower order address bits multiplexed during bus cycles. The lower address bits are latched into an 8-bit latch by the address latch enable (ALE) signal. The upper eight address bits have a dedicated output port on the 8051.

Table 3-2 lists 8051 pin assignments, and Table 3-3 lists 8051 port assignments.

Table 3-2 8051 Pin Assignments

Pin	Assignment
1-8	Port 1, an 8-bit quasi-bidirectional I/O port; it is the multiplexed low-order address and data bus when using external memory
9	RST/VPD resets the 8051. VPD provides standby power to the RAM if Vcc falls below spec.
10-17	Port 3, an 8-bit quasi-bidirectional I/O port containing the interrupt, timer serial port, /RD, and /WR.
10	RXD, serial port data input receiver
11	TXD, serial port data output tranceiver
12	INT_0, interrupt 0 input or gate control input for counter 0
13	INT_1, interrupt 1 input or gate control input for counter 1
14	T_0, input to counter 0
15	T_1, input to counter 1
16	/WR, write control signal to latch the data bits from port 0 to external data memory
17	/RD, read control signal enabling external data memory
18	$XTAL_1$, 12 MHz
19	$XTAL_2$, 12 MHz
20	Vss, circuit ground
21-28	Port 2, 8-bit quasi-bidirectional I/O port. Emits the high-order address byte when accessing external memory.
29	/PSEN
30	ALE, provides address latch enable output to latch the address into external memory during normal operation. Activated every six oscillator periods except during an external memory access.
31	/EA
32-39	Port 0, 8-bit open drain bidirectional I/O port. Multiplexes the low-order address and data bus when using external memory.
40	Vcc, +5VDC power supply

Table 3-3 8051 Port Assignments

Port	Assignment
P0.0–P0.7	Data bus and lower byte of address bus.
P1.0	80/132 Column Enable. Output from the 8051 to enable the clock rate that selects 80- or 132-column mode. 0 enables the 22.95-MHz clock and 80-column mode. 1 enables the 34.425-MHz clock and 132-column mode.
P1.1	EEPROM serial data/address. Serial data interchange line to and from the EEPROM. Both address and data share this line. Addresses are serially shifted, a bit at a time, into the EEPROM. Data is then read back serially.
P1.2	EEPROM clock. This state, combined with the state on P1.1, determines incoming data types: start/stop bits, acknowledgement, address, or actual data.
P1.3	Keyboard Receive. Input from the keyboard.
P1.4	CMD START. Sends an NMI to the graphics microprocessor.
P1.5	Keyboard Send. Output to the keyboard.
P1.6	Not used
P1.7	Selects MODEM port method of transmission: RS-232 or RS-422.
P2.0–P2.7	Higher byte of address bus
P3.0	Not used
P3.1	Not used
P3.2	2672 BREQ. Input from the 2672 enabling display data transfers from RAM to the row buffers.
P3.3	2681 INTR. Interrupt input from the 2681A. Indicates data in the receive buffer.
P3.4	2672 INTR. Interrupt input indicates the start of vertical synchronization.
P3.5	Not used
P3.6	WR strobe. I/O Write signal output by 8051.
P3.7	RD strobe. I/O Read signal output by 8051.

Communication Interface

Both independent serial ports—the MODEM port and AUX port—are asynchronous. Either can be connected to a computer, modem, or a printer.

MODEM and AUX Ports

The A channel in the 2681A DUART is assigned to the MODEM port. The 9636 drivers (8H, 9H, 12H, 13H) and the 26LS32/3486 receivers (7H, 10H, 3H) are both RS-232 and RS-423 compatible. The 2681A (11G) converts parallel logic PCB data to bit-serial data, while adding stop, start, and parity bits. The serial format is transmitted at a user-selected baud rate.

Display Memory

The display memory in the terminal is dual-ported between the CRT controller and the 8051. There are two 8Kx8 RAM chips installed for single-page operation. During the first scan line of each character row, the 2672 CRT controller (4F) sends an interrupt on INT0 of the 8051 nine microseconds before starting a DMA transfer from the display RAM. The 8051 cannot access the display RAM, the 2672, or the 2681A during DMA transfers.

The 8051 does not stop during the DMA transfer, but cannot access other external devices.

Nonvolatile Memory

The terminal stores all configuration parameters in the 512-byte nonvolatile EEPROM (2F). The memory operates from +5 V. Address and data information are clocked into the EEPROM through the bidirectional SDA pin.

Keyboard Interface

Each key on the keyboard is tested for key depression by advancing the keyboard row/column counter to its address, then testing the line on the 8051. At least six microseconds elapse between outputting an address and testing the key return. Debouncing and multiple key depressions are handled by the 8051.

Video Controller

The video controller consists of the video clock circuitry, programmable video controller, attribute control, character generator, and video-shift register.

Video Clock Circuitry

Either a 22.95-MHz (Y1, for 80-column mode) or a 34.425-MHz (Y2, for 132-column mode) oscillator generates timing for the dot clock and character clock. Both are TTL versions of Pierce oscillators.

The 34.425-MHz oscillator, a single-gate version, uses capacitors C5 and C7 in parallel with crystal Y2, generating 180 degrees of phase shift. The gate itself provides an additional 180 degrees of phase shift, achieving 360 degrees. Resistors R6 and R7 raise the input and gate output impedances. Capacitor C6 blocks any direct current in the circuit path.

The 22.95-MHz oscillator, a dual gate version, generates 180 degrees of phase shift from each gate. R4 and R5 raise input and output impedances. R3 and R12 shift the bias voltage into the linear area of the gates' operation. C3 and C2 are DC blocking capacitors.

The output from the oscillators is buffered by the 74S00. The dot clock from the dividers goes to the gate array.

Within the gate array, the character clock generator includes an up/down counter and combinational logic which divides the dot clock by 10 in 80-column mode for a CCLK rate of 2.295-MHz, by 9 for a CCLK rate of 3.825-MHz in 132-column mode, and by 8 for a CCLK rate of 2.869-MHz in graphics mode.

Programmable Video Controller

The 2672 programmable video timing controller (PVTC) (4F) provides all the timing and control signals for displaying characters on the CRT. The 8051 initializes the 2672 with the display parameters when a user turns the terminal on. Before each displayable character row, the 8051 gives the 2672 the beginning character address for that row. The 2672 fetches characters from the display RAM during the first scan line of each displayable character row. During the following 13 scan lines, the characters are retrieved from the row buffer.

The 2672 warns the 8051 of an impending DMA transfer by asserting BREQ nine microseconds before the DMA transfer begins. After nine microseconds, the 2672 asserts memory bus control (MBC), which ports the display RAM into the row buffer RAM.

Attribute Control

Attribute control determines the way the CRT displays characters. There are seven attributes: normal, bold, dim, blank, reverse, blink, and underline. Attributes are always hidden. This means that data for attribute control doesn't occupy any space in the video RAM that stores character data. Instead, the attribute data or information is stored in separate RAM reserved for attribute data.

The 8051 and the PVTC address a location in attribute RAM each time a character RAM location is addressed, with character data trailing attribute data on the next CCLK transition. The attribute byte is eight bits wide (see Table 3-4).

Table 3-4 Attribute Byte

Bit	Attribute	Remarks
0-1	Brightness	Four possible combinations or blank that select one of four intensities: normal, bold, dim, or blank
2	Double wide	Bit 2, when set, causes characters to appear twice as wide. 0 causes characters to appear at their normal width.
3	Underline	Bit 3, when set, causes characters to be underlined. 0 causes characters to appear without underlining.
4	Reverse	Bit 4, when set, will cause the character's video to reverse and display a negative image.
5	Blink	Bit 5, when set, causes the character to blink.
6-7	Font select	Bits 6 and 7 select the character sets within the font RAM EPROM. Fonts include US ASCII, multinational, graphics, and soft font.

Font RAM

Each character cell is 10 x 13 (80 column), 9 x 13 (132 column), or 10 x 10 (80-column, ANSI mode) with a character matrix of 7 x 10 dots. The font ROM (1H) is a 6264 (8Kx8) RAM that stores both displayable and nondisplayable characters and symbols. Any mode change reinitializes the font RAM, which is reloaded with the font that mode displays.

RASTER-SCAN TERMINOLOGY

The terminal display is a 14-inch cathode ray tube (CRT). Because the terminal has a video output, most of its circuitry provides the appropriate inputs to the CRT display (i.e., clocks and video information).

An electron beam sweeps the face of the CRT. The electron beam begins in the upper left corner of the display and sweeps from left to right. One sweep of the beam is called a **scan line.** When the beam returns from the right side of the screen to the left side, beginning the next scan line, it must be **disabled** (turned off). This prevents a streak from appearing on the face of the CRT. Disabling the beam is called **horizontal blanking.** At the end of 375 scan lines, the electron beam arrives at the lower

right corner of the display. In order to return to the upper left corner, the beam must be **disabled** again so a vertical streak doesn't appear on the face of the CRT. Disabling the beam at this time is called **vertical blanking.** The amount of time it takes the beam to move from the upper left corner of the display and return is a **field.** By convention, field time normally equals the period of the AC power source [e.g., in the United States, field time is 1/60 of a second (60 Hz) and in Europe, 1/50 of a second (50 Hz)]. The terminal uses a 60 Hz field rate in either 60 Hz or 50 Hz AC input.

Displayable characters are defined with a 7 x 10 matrix within a 10 x 13 character cell in the 80-column mode, and 7 x 10 matrix within a 9 x 13 cell in the 132-column mode.

4 Troubleshooting

BEFORE YOU START—SAFETY SUMMARY

▲ **Warning** This terminal contains high voltage. Don't attempt to service the terminal without taking all precautions needed when working with high voltage.

- If you must open the terminal for any reason, first turn off the power and unplug the terminal.
- Remove any jewelry, especially any on your hands and wrists. Also remove jewelry from your neck if it is long enough to hang in the machinery. Avoid wearing clothing that carries static charges.
- Use only insulated or nonconductive tools.

- Whenever you disconnect the anode from the anode lead, make sure to ground the anode as directed in "Discharging the Anode" in Chapter 2.
- If you need to remove or replace the CRT/yoke assembly, remember that the cathode ray tube (CRT) can implode if you drop it or break the neck. The flying glass can injure anyone within a 10-foot radius.

Tools Required

Before you start to repair the terminal, make sure you have the tools and materials listed below:

- No. 2 Phillips screwdriver
- Flat-blade screwdriver, 3/16-inch
- Digital multimeter (or an ohmmeter and a voltmeter)
- Test connectors for the MODEM and AUX ports (follow instructions in Appendix C to make the connectors, or see Chapter 6 for information on ordering sets of connectors).
- Back-to-back test hoods
- Oscilloscope

PRIMARY TROUBLESHOOTING PROCEDURES

You should begin troubleshooting by preparing the terminal properly and running the Power-On Self-Test and the Diagnostic Self-Test. These tests generate error messages, which are identified in Tables 4-1 and 4-2.

Preparing the Terminal for Troubleshooting

- Turn off the terminal.
- Disconnect the computer's communication cables.
- Unplug the power cord from its power source.
- Remove the monitor housing.
- Loosen the rear panel screws on the logic PCB. Pull the logic PCB out of the logic pedestal, but don't disconnect connector **JY**.
- Plug the power cord back into its power source.
- Turn on the terminal. (This initiates the Power-On Self-Test).

Power-On Self-Test

The power-on self-test checks the terminal's random-access memory (RAM), read-only memory (ROM), and electrically erasable programmable read-only memory (EEPROM). The RAM tests area write/read tests that check all RAM banks. The code ROM test checks checksums. The EEPROM test calculates the EEPROM's checksum and compares it to the checksum bit stored in the ROM. While the 8051 microcomputer checks its associated RAM, ROM, and EEPROM, the 8088 checks its associated ROM and RAM. The 8088 sends a status code to the 8051 at the end of its tests.

Each time anyone turns the terminal on, it performs the power-on self-test. If the test detects an error, an error message appears in the lower right corner of the display. Table 4-1 defines these

error messages. If any of these messages appear, go to symptom 7 in the Troubleshooting Flowchart (Figure 4-1).

☐ **Note** If you install a new logic board or a new 2404 EEPROM, the terminal will fail the EEPROM checksum test when you turn it on. To prevent this failure, initialize the EEPROM by holding down the G key when you turn the terminal on.

Table 4-1 Error Messages for the Power-On Self-Test

Error Message	Failure
0	Character RAM read/write error
1	Attribute RAM read/write error
6	8088/8051 mailbox timeout
7	8088/8051 mailbox read/write error
P	External code ROM checksum error
p	Internal code ROM checksum error

Diagnostic Self-Test

The diagnostic self-test starts in setup mode. This test routine includes communications circuitry tests, font ROM, soft font RAM, EEPROM, and row buffer tests. Three special test connectors allow the diagnostic test to function (see Appendix C for connector definitions). After you start it, the diagnostic test continues to run until you stop it. If the test detects an error, an error message appears in the lower right corner of the display (see Table 4-2 for diagnostic self-test error message definitions).

Follow these steps to start the diagnostic self-test:

1 Turn the terminal off.

2 Detach any communications cables on the back of the terminal.

3 Attach the test connectors to the MODEM and AUX ports on the rear panel of the logic pedestal.

☐ **Note** See Appendix C for a description of these connectors and instructions for making them.

4 Turn the terminal on.

5 Press the [Setup] ([F3] [Select]) key.

6 Position the cursor over the **TEST** = field in menu F2.

7 Press the space bar. This toggles the TEST field ON.

8 Press [F10] twice. You should see a flashing test pattern.

9 Look for one of the error messages found in Table 4-2.

☐ **Note** To fully test the font ROM checksum, EEPROM read/write and soft font RAM, let the diagnostic self-test run 5 minutes.

Table 4-2 Error Messages for the Diagnostic Self-Test

Error Message	Failure
0	Character RAM read/write error
1	Attribute RAM read/write error
6	8088/8051 mailbox timeout
7	8088/8051 mailbox read/write error
P	External code ROM checksum error
p	Internal code ROM checksum error
A	MODEM port RTS to CTS error
B	MODEM port DTR to DSR error
C	MODEM port DTR to DCD error
D	AUX port RTS to CTS error
E	AUX port DTR to DSR error
F	AUX port DTR to DCD error
G	SPDS to SPDI error
K	EEPROM checksum error
X	MODEM port RXD to TXD error
Y	AUX port RSD to TXD error
9	EEPROM checksum error

10 If you see an error message, replace the indicated component on the logic PCB or go to the troubleshooting flowchart (Figure 4-1), symptom 7; if you don't see an error, press the F10 key twice.

11 Turn the terminal off. Remove the test connectors, and reattach the communications cables.

TROUBLESHOOTING QUICK REFERENCE GUIDE

Table 4-3 is a troubleshooting quick reference guide. Once you discover the major symptoms, this table can quickly direct you to the most likely problem area. However, don't automatically replace the suggested modules until you've studied the problem or checked the related detail in the troubleshooting flowchart.

Table 4-3 Troubleshooting Quick Reference Guide

Symptom	Possible Problem Area
No beep	Fuse Power cord Logic PCB Line filter PCB Monitor/power supply PCB
No display	Brightness adjustments Monitor/power supply PCB Logic PCB CRT/yoke assembly
Poor display quality Wrong size Crooked Too bright Not in focus	Display adjustments (chapter 5) Monitor/power supply PCB
Fails self-test	Logic PCB
Fails diagnostic test	Logic PCB
Inoperative keys	Keyboard cable Keyboard Logic PCB
Can't communicate with computer	Setup parameters Logic PCB
Isolated letters on the screen	Logic PCB

TROUBLESHOOTING FLOWCHART

Read the following troubleshooting flowchart to match symptoms with suggested solutions. Components referenced on the flowchart can be located on the PCB layout diagrams in Chapter 7. Components also can be studied functionally on the corresponding schematic diagrams in Chapter 7.

Figure 4-1 Troubleshooting Flowchart

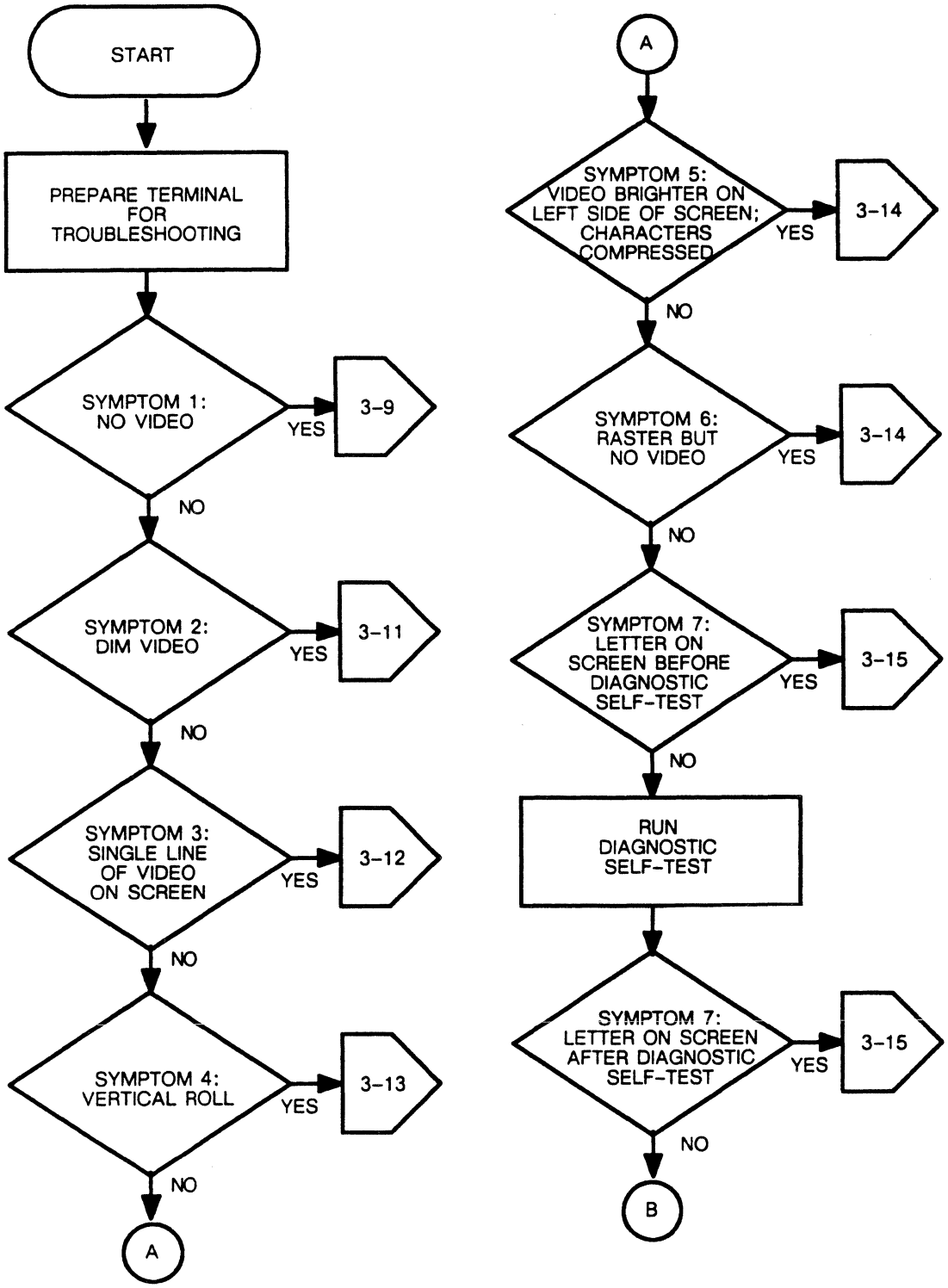
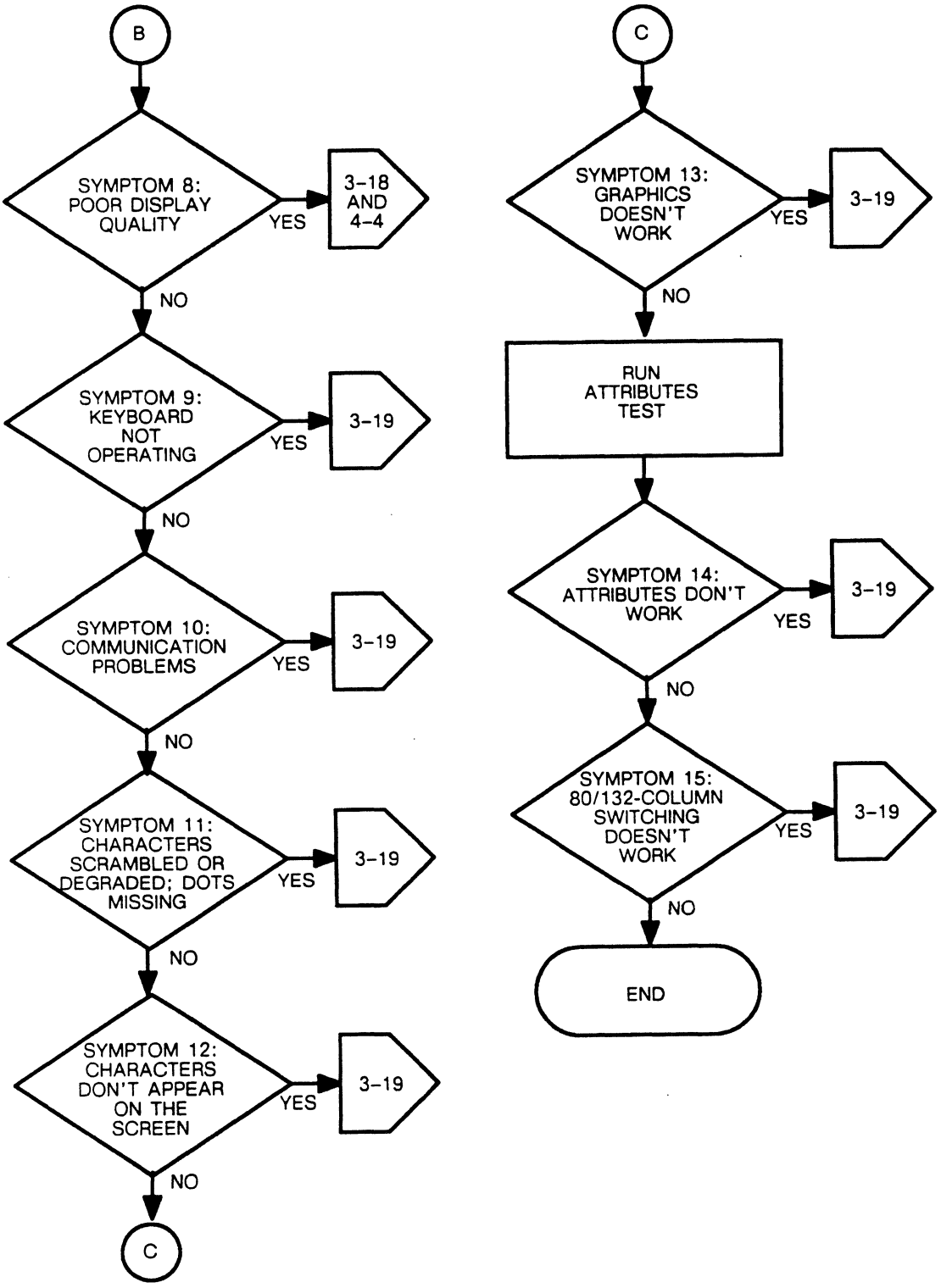


Figure 4-1 Troubleshooting Flowchart, Continued

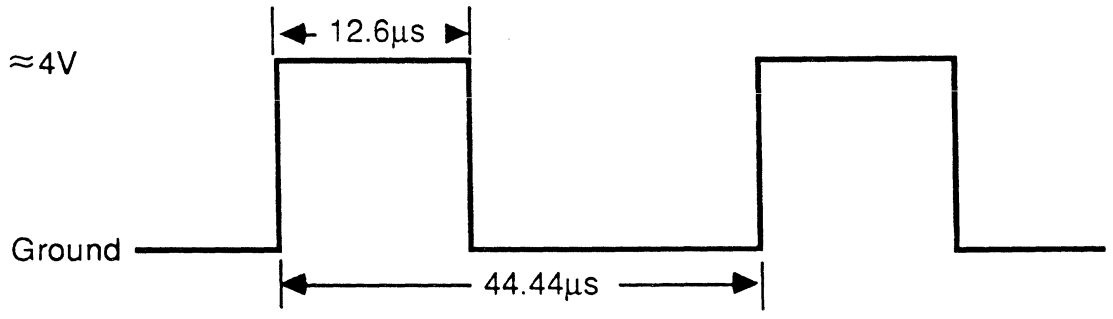


Problem Symptoms and Troubleshooting Procedures

Use this section in conjunction with Figure 4-1 to troubleshoot the symptoms listed below.

Symptom 1: No Video

1 Check Power Cord, On/Off Switch, Communications Cable	Check for continuity and correct connections (see "Checking for Continuity" in this chapter).
2 Check Logic Cable	Is connector **JY** (on the corner of the logic PCB) securely connected to the logic harness? Check the logic harness connection on the monitor/power supply assembly.
3 Check Brightness	Check operator brightness, then perform the brightness alignment (Chapter 5).
4 Check Logic PCB	These components on the logic PCB may be subjected to mechanical stress by the logic harness: **Q1, Q2, D1, D2, FB1,** and **FB2**. If they are stressed or broken, resolder or replace them.
5 Check +8 VDC	Check for +8 VDC at **VR202** on the monitor/power supply PCB (MPS PCB) or at the inboard lead of **C207** on the MPS PCB. If voltage isn't present, go to step 7.
6 Check CRT	If the voltage in step 5 is present, check the CRT socket for any bent or broken pins. Repair if necessary.
7 Check +12 VDC	Check CRT heater bias voltage at **R210** (MPS PCB). Look for +12 VDC ±10%. If the voltage is correct, replace the CRT. If the voltage is incorrect or missing, check the circuitry at and around R210. Repair any shorts or damaged components. Check **J201-6** (MPS PCB). Look for +12 VDC ±10%. If the voltage is correct, go to step 8. If it isn't correct, check **R201** (MPS PCB) for resistance, and repair or replace if necessary.
8 Check HSYNC Signal	Check HSYNC at **J210-4** (MPS PCB). Look for this waveform:

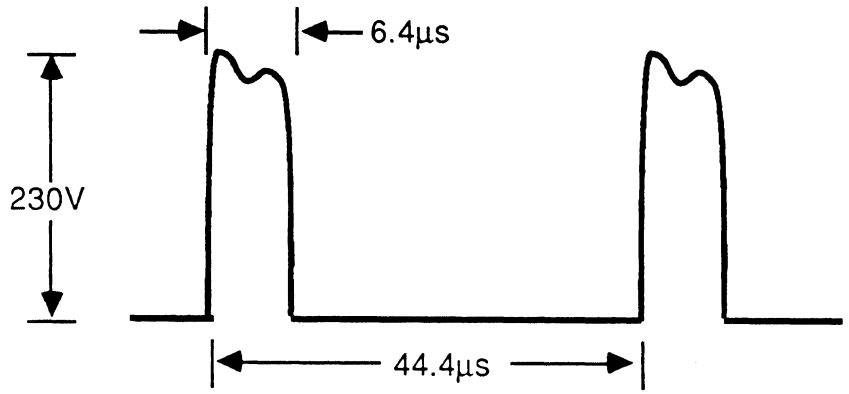


If the waveform isn't present, check **8B-10** (logic PCB) for the HSYNC signal. If it isn't present, replace the gate array. If it is

present, check the circuitry between **8B** and **J210** to find the problem.

9 Check DC Input

Check the DC input signal at the collector of **Q202** (MPS PCB). Look for the following waveform:



If the waveform is missing or incorrect, replace **Q202**. If the waveform is correct, continue to the next step.

▲ **Warning** Working with high voltage is dangerous. Take all standard safety precautions for high voltages when working inside the monitor. Use only a high-voltage probe when measuring the anode voltage.

10 Check Anode Voltage

Measure the anode voltage. Look for 17 kV ±10%.

If the voltage isn't within tolerance, replace the flyback transformer (MPS PCB). If the voltage is within tolerance, continue to the next step.

11 Check G2 Voltage

Measure the G2 voltage at the inboard lead of **R208** (MPS PCB). Look for 650 VDC ±50 volts.

If the voltage is missing, replace the CRT. If the voltage is correct, check the following components on the MPS PCB: **D204**, **C205**, **R205**, and **R206**. Replace any bad components. If all components are good, replace the flyback transformer.

Symptom 2: Dim Video

1 Check Brightness Control

Adjust the external brightness.

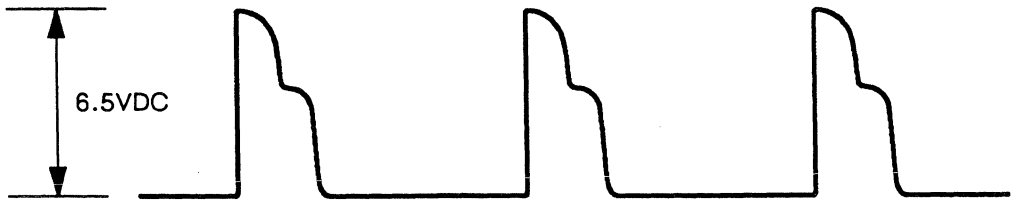
2 Adjust Brightness

Perform the brightness alignment (Chapter 5).

3 Check Brightness Circuitry	Check **VR201, VR202, D401, D405, R409,** and the circuitry around them on the MPS PCB. Repair and replace as necessary.
4 Check +5 VDC	Check the +5 VDC supply at **J201-5** (MPS PCB). **J201-2, -9,** and **-10** are ground. Look for the short and repair if necessary. If you can't find a short and the 5 volt supply is missing, continue to the next step.
5 Check Components	If the 5 volt supply is still missing, check the following components on the MPS PCB, and replace them as necessary: **C115, D103, R114,** and **L102.**
6 +5 VDC Oscillation	If the +5 VDC supply is present, but is oscillating, check these components on the MPS PCB and replace if necessary: **U101, R111, R108, R109,** and **C106.**

Symptom 3: A Single Line of Video on the Screen

1 Check Plugs	Check all wires connected to the CRT neck plug. Check all connections between **J202** and the filament plug on the MPS PCB. If any are loose or broken, repair them. Check these components on the MPS PCB and replace if broken: **R303, R304, C307, C308, R307, R308, C301,** and **R301.**
2 Is It a Vertical Line of Video?	If a single vertical line is still present on the screen, check these components on the MPS PCB: **Q201, R202, Q202, D201,** and **T202.** Replace any that are broken.
3 Is It a Horizontal Line of Video?	If a single horizontal line is still present on the screen, check **U301-12** (MPS PCB) for this waveform:



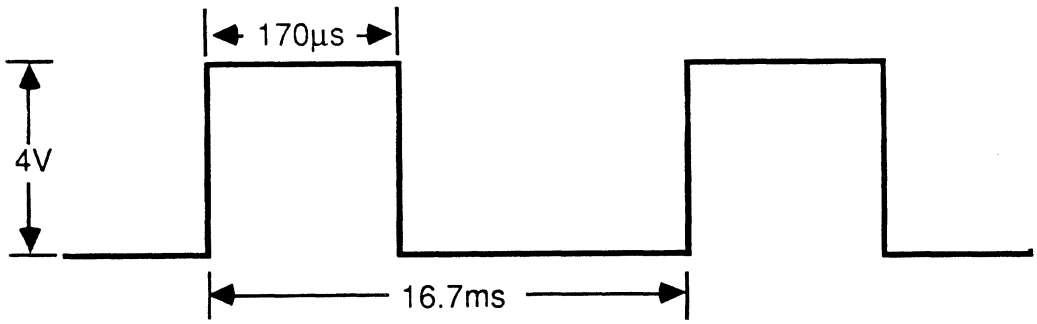
≈59.5Hz

If the waveform is correct, continue to step 4. If the waveform is missing or incorrect, go to step 6.

4 Signal Check	If the waveform in step 4 was correct, check if **U301-6** (MPS PCB) is 6.4 VDC ±10%. If the voltage is within specification, replace the yoke. If the voltage is missing or not within specification, replace U301.
5 Check +12 VDC	If the waveform in step 4 was missing or incorrect, check if **U301-5** (MPS PCB) is +12 VDC ±10%. If the voltage is correct, replace **U301**. If it's incorrect, continue to step 6.
6 Check Voltage Point	If the voltage in step 5 was incorrect, check if **J201-6** (MPS PCB) is 12 VDC ±10%. If the voltage is good, replace **U301** (MPS PCB). If the voltage is bad, check **R201** (MPS PCB). It may be a wrong value or not soldered to the board. If so, repair **R201**.

Symptom 4: Vertical Roll

1 Vertical Roll	Check **J201-5** (MPS PCB). Look for this waveform:



If the waveform is correct, replace **U301** (MPS PCB). If the waveform is incorrect or missing, check the connector and cable for loose wires or broken connections. Repair as required.

Symptom 5: Video Brighter on the Left Side, Characters Compressed

1 Check Flyback Transformer	Check and replace (if necessary) the flyback transformer and **D202** on the MPS PCB.

Symptom 6: Raster; No Video

1 Check Voltage	Check **J201-1** (MPS PCB) with an oscilloscope. Look for a signal that toggles between 0.5 VDC and 3.5 VDC.

If the voltage isn't in spec or isn't toggling, **D404** (MPS PCB) may be installed backwards, or J201 may have a loose wire or broken pin. Repair as required.

2 Check Q402

If the voltage is toggling correctly, check the collector of **Q402** (MPS PCB) with an oscilloscope. Look for a signal that toggles between 20 and 60 volts.

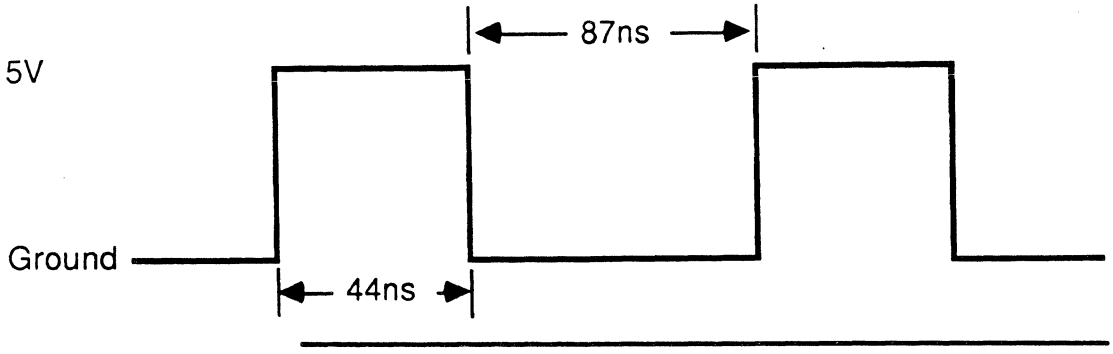
If **Q402** is operating correctly, replace the CRT. If **Q402** isn't operating correctly, replace it.

Symptom 7: Letter on Screen Before or After Diagnostic Self-Test

If a letter appears on screen before or after running the self-test, and one or more letters or numbers have appeared on the screen, look up the error codes in Table 4-4 and take the corresponding recommended actions. All components referred to in these instructions are located on the logic PCB unless otherwise stated.

Table 4-4 Diagnostic Self-Test Error Code Troubleshooting

Error Code	Recommended Actions
0	Check **5D**, the Character RAM.
1	Check **6D**, the Attribute RAM.
6 or 7	a. Reset the EEPROM by holding down the CTRL key and pressing the G key once. Turn the power off, then on again. If this doesn't clear error 6, check the next potential problem areas.
	b. Check **11D** (graphics firmware) against the parts list in this manual. Make sure the revision level is the same or later.
	c. Jumper **6** (**JMP6**) determines which ROM type resides in **11D**. If the two outboard pins are connected, **11D** can only hold a 27512 IC. If the two inboard pins are connected, **11D** can hold all other ROM types. Make sure **JMP6** is correctly positioned.
	d. Check the clock signal at **14D-19**. Look for this waveform:



If this waveform is missing or out of tolerance, check **R19** and **C35** for correct values or shorts. If **R19** and **C35** are fine, replace 8B (the gate array).

Table 4-4 Continued

Error Code	Recommended Actions
	e. Check **14D (8088)**.
	f. Check **RP3**; it might be installed incorrectly.
	g. Check these devices in this order, and replace any if necessary: **14D, 12F, 13F, 12G, 13G, 15B, 14H.**
9 or K	a. Enter setup mode, then select and save DEFAULT parameters in the main directory.
	b. Check **2F**.
P	Check **3D** (8051 firmware) against the parts list. Make sure the revision level is the same or later.
p (lower case)	Check **3F**.
X or Y	a. Check the test connectors on the back of the terminal. They may be missing, switched, or incorrectly wired. X refers specifically to the MODEM port, Y refers to the AUX port. If either test connector is incorrectly seated or wired, fix it, then select and save DEFAULT parameters in the main directory and select TEST:ON again.
	b. Check **JMP7** and **JMP8** for correct position against the table in assembly drawing 990093-01 (see Chapter 7).
A, B, C, D, E, F, G with X	Use an oscilloscope to check the signals listed in the following table. Inputs and outputs both should toggle: Inputs should toggle between 0 and 4 volts (TTL levels), while outputs should toggle between +6 and -6 volts (RS-232C levels). If an input toggles but its corresponding output does not, replace the component in question.

Error Code	Input (TTL)	Output (RS-232C)	Input (RS232-C)	Output (TTL)
A	8H-2	8H-7	7H-7	7H-5
B	9H-2	9H-7	10H-7	10H-5
C	9H-2	9H-7	7H-1	7H-3
D	12H-3	12H-6	10H-9	10H-11
E	13H-3	13H-6	10H-1	10H-3
G	9H-3	9H-6	7H-15	7H-13

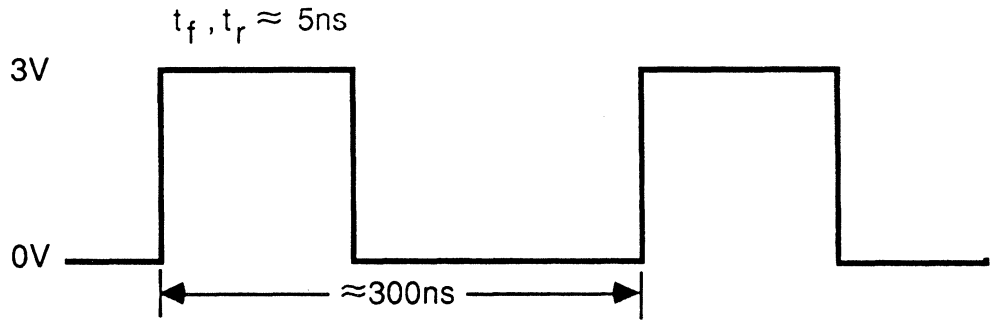
☐ **Note** If any of the inputs and outputs in this table are incorrect, they may generate X errors as well as the specific error codes that are listed.

If any input toggles, but its corresponding output does not toggle, replace the component.

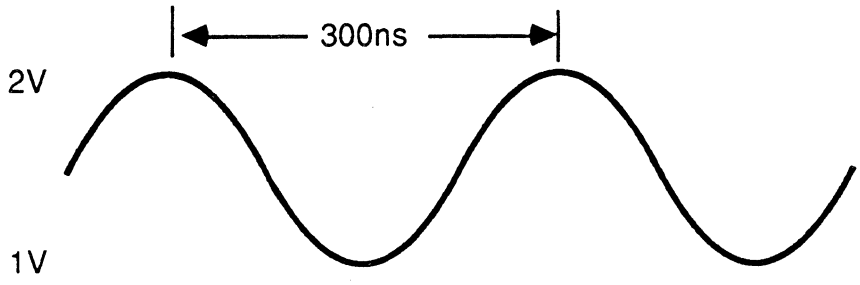
If no inputs on any of the above pins toggle, check **11G-32** and **11G-33** for a 3.6864-MHz clock.

Table 4-4 Continued

Error Code	Recommended Actions
	The waveform at **11G-32** should look like this:



The wave form at **11G-33** should look like this:



If the wave forms are missing or incorrect, check and replace these components as necessary: **Y3**, **C58**, **C59**, and **11G**.

A	Check the loopback connector, **7H**, **8H**, **11G**
B	Check the loopback connector, **9H**, **10H**, **11G**
C	Check the loopback connector, **9H**, **7H**, **11G**
D	Check the loopback connector, **12H**, **10H**, **11G**
E	Check the loopback connector, **13H**, **10H**, **11G**
F	Check the loopback connector, **13H**, **3H**, **11G**
G	Check the loopback connector, **9H**, **7H**

Symptom 8: Poor Display Quality

Perform a full alignment of the display by following the instructions in Chapter 5.

Symptom 9: Keyboard Not Operating

1 Check Cable	Check keyboard cable for continuity.
2 Check **J1**	Check connector **J1** on the keyboard PCB for shorts or breaks; repair if necessary.
3 Check **U1**	Check **U1** (keyboard scanner) on the keyboard PCB for correct operation. Replace if necessary.
4 Check Logic PCB	Check **3F-6** and **3F-7** on the logic PCB. If one or the other line is not toggling, replace **3F**.

Symptom 10: Communication Problems

1 Check Setup	Check setup information against the host's requirements. Change to match.
2 Check Connectors	See information related to Symptom 7 error codes X and Y.

Symptom 11: Characters Scrambled or Degraded, Dots Missing

1 Check **8B**	Replace **8B**.

Symptom 12: Characters Don't Appear on the Screen

1 Check **8B**	Replace **8B**.

Symptom 13: Graphics Doesn't Work

1 Check **14D**	Cycle power to the terminal, then check all components in the order listed: Check **11D**, **11G4**, **12C**, **13C**, **14C**, and **15C**.

Symptom 14: Attributes Don't Work

1 Check **11G**	Replace if necessary.
2 Check **5D**, **4C**	Replace if necessary.
3 Check **10C**	Replace if necessary.

Symptom 15: 80/132-Column Mode Doesn't Work

1 Check **11G**	Replace if necessary.

ADDITIONAL TROUBLESHOOTING PROCEDURES

Although the Troubleshooting Flowchart and Procedures are a self-contained reference that describe symptoms and solutions together, this section explains a few additional procedures that you may find helpful. Some are referred to in the troubleshooting flowchart, others are not.

This section includes an installation checklist and procedures for checking continuity, the power supply, and horizontal synchronization.

Installation Checklist

This installation checklist helps you quickly determine whether the terminal has been installed correctly. Refer to Figure 4-2 if you need help finding connectors.

- Environment
  - ☐ Room temperature is between +40 and +91 degrees Fahrenheit.
  - ☐ Terminal isn't near a magnetic field.
- Keyboard
  - ☐ Keyboard cable is in the KYBD connector on the rear panel of the logic pedestal.
- Power Cord
  - ☐ Female end of the power cord is plugged into the AC power socket on the rear panel of the logic pedestal.
  - ☐ Male end of the power cord is plugged into the wall socket.
- Communication Interface Cable
  - ☐ One end of the RS-232C interface cable is connected to the MODEM port on the logic pedestal's rear panel.
  - ☐ The other end of the interface cable is correctly connected to the computer.
- Computer Interface

☐ **Note** Check the terminal's setup parameters. They should match those found in your computer documentation.

- ☐ Correct baud rate
- ☐ Correct data bits
- ☐ Correct parity type
- ☐ Correct handshaking protocol
- ☐ Correct stop bits

Checking for Continuity

Sometimes you can detect and fix a problem without opening the terminal. The problem could be a damaged cable, fuse, power cord, or the rear-panel assembly. Check each component on this list:

- Fuse
- Power cord
- AC power input receptacle and line filter on the rear panel of the logic pedestal
- Monitor/power supply to logic PCB wiring harness

Check the continuity of each component with an ohmmeter. Hold its probes in place for 5 seconds, or until the ohmmeter settles, to ensure an accurate reading.

If the part in question is open, replace it.

Power Supply Check from the Logic PCB

You can quickly isolate problems if you check voltages at the logic PCB. If all voltages at connector **JY** are within tolerance, replace the logic board (Figure 4-2). If they aren't within tolerance, go to Chapter 5, "Adjustments and Alignments," and

adjust the power supply. If you can't adjust the monitor/power supply to meet the tolerances, replace it.

For quick reference, you can check three of the four power supply voltages on the logic PCB without opening the monitor housing (the fourth, –23 volts, never reaches the logic PCB).

To check the power supply from the logic PCB, follow these steps:

1 Turn the terminal off.

2 Remove the two Phillips screws holding the rear panel in place. Pull the logic PCB two inches out of the unit.

3 Find connector **JY** on the logic PCB.

4 Attach one lead from the voltmeter to **JY-10**, ground.

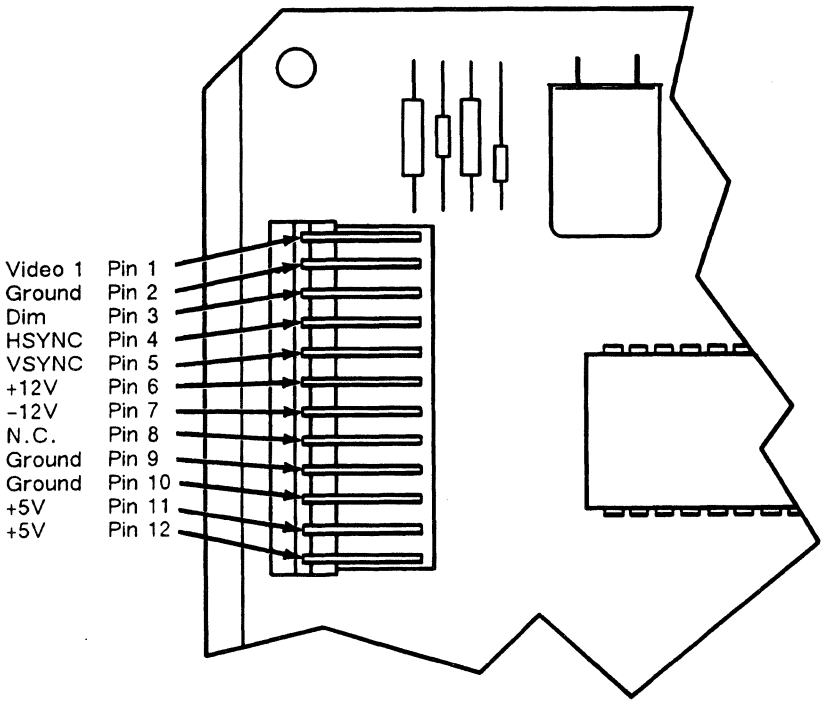
5 Turn the terminal on.

6 Check the +5 V power supply on **JY-12**. Look for +5 V ±5 percent. See the troubleshooting flowchart if the signal isn't within tolerance.

7 Check the +12 V power supply on **JY-6**. Look for +12 V ±5 percent. See the troubleshooting flowchart if the signal isn't within tolerance.

8 Check the –12 V power supply on **JY-7**. Look for –12 V ±5 percent. See the troubleshooting flowchart if the signal isn't within tolerance.

Figure 4-2 Power Connector at the Logic PCB



Checking Horizontal Synchronization

Checking the horizontal synchronization can help you determine which PCB needs to be replaced: the logic PCB or the monitor/power supply PCB (MPS PCB).

1 Find connector **JY** on the logic PCB (see Figure 4-2).

2 Touch **JY-4** with the oscilloscope probe. Look for a 12K microsecond pulse (within ±10 percent) with a repetition rate of 44.5 microseconds. (If the horizontal synchronization signal is within tolerance, replace the monitor/power supply PCB; if it isn't within tolerance, replace the logic PCB. See the troubleshooting flowchart.)

Checking Attributes and 80/132-Column Mode

You can easily check whether or not the attributes and 80/132-column mode are operating by invoking the Attribute Test Pattern. Follow this procedure:

1 Turn the terminal off and disconnect any communications cables.

2 Attach the test connectors to the MODEM and AUX ports on the rear panel of the logic pedestal.

☐ **Note** See Chapter 6 to order sets of test connectors, or Appendix C for a description of these connectors and instructions to make them.

3 Turn the terminal on.

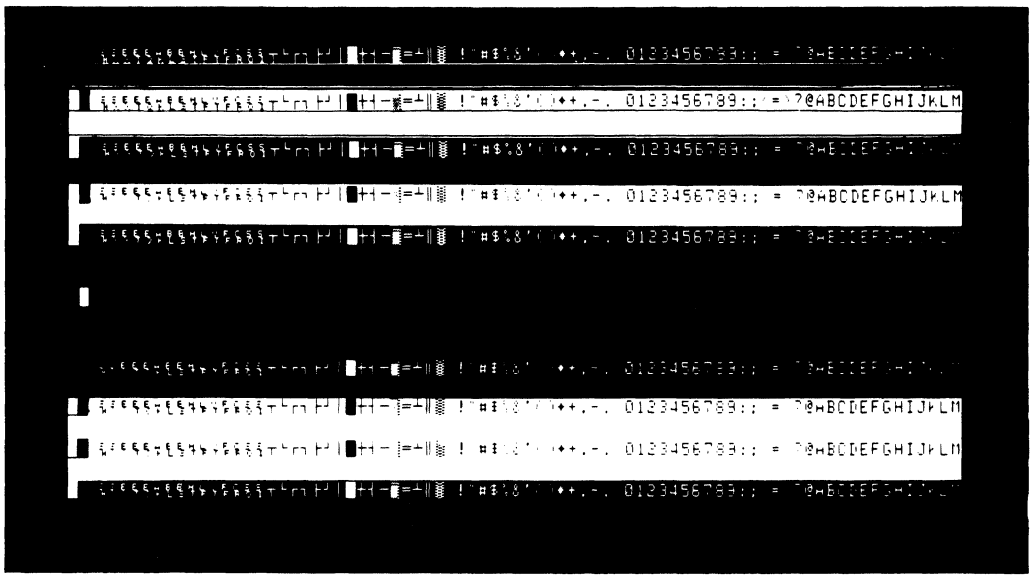
4 Press [Shift] ([F10]) then [Setup].

5 Press the cursor down key five times. Look for the TEST=OFF field in the setup line at the bottom of the screen.

6 Press the space bar. This toggles the TEST field ON.

7 Press [Setup] ([F10]) twice. You will see the flashing test pattern in Figure 4-3.

Figure 4-3 Attribute Test Pattern



8 Hold down the space bar until the test pattern stops flashing. Look at the attributes. If they are not operating, go to Symptom 14 in the Troubleshooting Flowchart.

9 Press [Ctrl] [S] to test the terminal's 132-column capability. If the terminal doesn't toggle between 80 and 132 columns, go to Symptom 15 in the Troubleshooting Flowchart.

10 Press [Setup] twice.

11 Turn the terminal off. Remove the connectors and reattach the communications cables.

5 Adjustments and Alignments

INTRODUCTION

This chapter describes adjustments and alignments for the display. In particular, it discusses voltage adjustments, full display alignment, and individual adjustments. Before you align the display, check the power supply voltages. Adjust them if they aren't in tolerance. You should complete a full monitor/power supply alignment whenever you replace the monitor/power supply PCB or the CRT/yoke assembly.

▲ **Warning The CRT/yoke assembly has high voltages.** Only qualified service personnel should adjust it.

SAFETY SUMMARY

▲ **Warning** This monitor contains high voltage. Don't attempt to service the terminal without taking all the precautions you need for working with high voltage.

- If you must open the terminal for any reason, first turn off the power and unplug the terminal.
- Remove any jewelry, especially any on your hands, wrists, or neck.
- Avoid wearing clothing that carries a static charge.
- Use only insulated or nonconductive tools.
- If you need to remove or replace the CRT/yoke assembly, remember that it can implode if you drop it or break the neck. The flying glass can injure anyone within a radius of ten feet.

TOOLS FOR ALIGNMENT

Before testing the power supply voltages or making any adjustments to the monitor/power supply assembly, make sure you have the tools listed below:

- Nonconductive alignment tool
- No. 2 Phillips screwdriver
- Digital voltmeter (DVM)
- Millimeter ruler

DOES THE TERMINAL MEET THE DISPLAY SPECIFICATION?

Before you adjust the display, measure the screen margins and study the display.

Tools needed to check the specifications:

- Millimeter ruler

Follow this procedure to determine whether or not the display is within specification:

1 Turn the terminal off and disconnect any communications cables.

2 Attach the test connectors to the MODEM and AUX ports on the rear panel of the logic pedestal.

☐ **Note** See Chapter 6 to order sets of test connectors, or Appendix C for a description of these connectors and instructions to make them.

3 Turn the terminal on. Let it run for 30 minutes.

☐ **Note** Before you check the display to determine if the power supply or monitor assembly need adjustments or alignment, let the terminal run for 30 minutes. This "warm-up" period assures you that the display on the screen is stable and will not drift or display other distortion after you measure it.

4 Press the [Setup] ([F3], [Select]) key.

5 Position the cursor over the TEST= field in menu F2.

6 Press the space bar. This toggles the TEST field ON.

7 Press [F10] twice. You will see a flashing test pattern.

8 Hold down the space bar until the test pattern stops flashing.

9 Press [Ctrl] [A] once. You should see test pattern O on the screen. (See "Test Patterns" later in this chapter for a full explanation of the test displays and their uses.)

10 Measure the margins on the top, bottom, and both sides with a millimeter ruler. Each margin should measure 12mm ±3mm. If they don't, see "Aligning the Display" in this section.

11 Look at the display. If there is barreling or pincushioning, if any of the display edges aren't straight, or if there are size or centering problems, see "Aligning the Display."

12 Press [Ctrl] [A] until you see test pattern M on the screen.

13 Look for brightness balance between the three blocks, making sure that the raster doesn't show when operator brightness is turned fully clockwise.

14 Look at the display again. Are the letters on the top of this pattern the same size as the letters at the bottom? Are they the same size throughout? Are there any focus problems on the screen? If there are problems, skip steps 15 and 16. Go to "Aligning the Display."

15 If the display is within specification and looks regular, press F10 twice.

16 Turn the terminal off. Remove the connectors and reattach the communications cables.

ALIGNING THE DISPLAY

The display has several alignments and adjustments. If the display is out of tolerance in one or two areas, make adjustments to correct those problems with individual adjustments suggested in Table 5-1. If you change the CRT, the yoke, the CRT/yoke assembly, or the monitor/power supply assembly, you must perform a full alignment. **Follow these procedures only if the display is out of tolerance and doesn't match the specification.**

▲ **Warning The CRT/yoke assembly has high voltages.** Only qualified service personnel should perform these adjustments.

☐ **Note** If you already have one of the test patterns on the screen, remove the monitor housing and go to Step 10.

To align the display, follow these steps:

1 Turn off the terminal.

2 Remove the monitor housing.

3 Turn on the terminal.

4 Press Setup.

5 Press the CURSOR DOWN key five times. Look for the TEST=OFF field in the setup line at the bottom of the screen.

6 Attach test connectors to the MODEM and AUX ports on the rear panel of the logic pedestal.

☐ **Note** See Chapter 6 if you need to order these test connectors or Appendix C for a description and instructions to make them.

7 Press the space bar. This toggles the TEST field ON.

8 Press Setup twice. You should see a flashing test pattern.

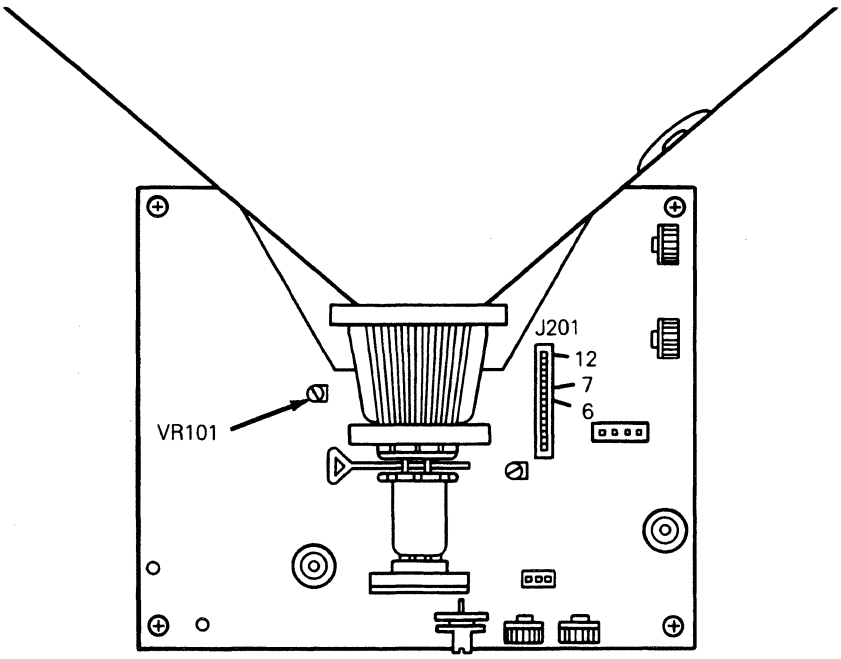
9 Hold down the space bar until the test pattern stops flashing.

10 You will see test pattern M. Call test pattern O by pressing the Ctrl and A keys simultaneously. (You can toggle between patterns O and M with the Ctrl A keystroke command. Both test patterns are described and illustrated in "Test Patterns" in this chapter.)

☐ **Note** When toggling between test pattern O and test pattern M, you will find another pattern: the character/attribute test pattern containing several rows of characters, each displayed with a different attribute. Look at this pattern when you are troubleshooting. You should not depend on measurements from this test pattern during alignment.

11 Use the DVM to check the +5V supply at the jumper adjacent to **J201-12** on the monitor/power supply PCB. The chassis is ground. See Figure 5-1, Power Supply Component Layout.

Figure 5-1 Power Supply Component Layout



12 Adjust **VR101** until the digital voltmeter reads +5V ±2 percent.

☐ **Note** If you can't adjust the power supply into tolerance, see "Troubleshooting," Chapter 4.

13 Check the −12V supply at **J201-7** (logic PCB wiring harness). The digital voltmeter should read −12V ±5 percent. If the −12V supply is not within tolerance after you have adjusted the +5V supply, see Chapter 4, "Troubleshooting."

14 Check the +12V supply at the blue wire on **J201-6** (logic PCB wiring harness). The digital voltmeter should read +12V ±5 percent. If the +12V supply is not within tolerance after you have adjusted the +5V supply, see Chapter 4.

15 Adjust the display. See Table 5-1 for a list of display problems and their adjustments. Check Figure 5-2 for their related component locations.

☐ **Note** Table 5-1 suggests individual adjustments. If you feel a full alignment is needed, make all of the adjustments referred to in Table 5-1, in the order listed in the table.

Table 5-1 Display Problems and Their Adjustments

Test Pattern	Display Problems	Adjustments	Page
O	Too short or too tall	Height	5-6
O	Too wide or too narrow	Width	5-6
O	Tilted	Yoke lock	5-6
O	Not centered	Centering Rings	5-7
O	Pincushioning, barreling, crooked edges, corners sag or move out of specification	Display magnets	5-7
M	Too bright; too dim; raster scan lines show; individual problems with full-bright, dim1, or dim2	Brightness	5-10
M	Fuzzy letters	Focus	5-10
M	Letters at the top of the display aren't the same height as those at the bottom of the display	Linearity	5-10

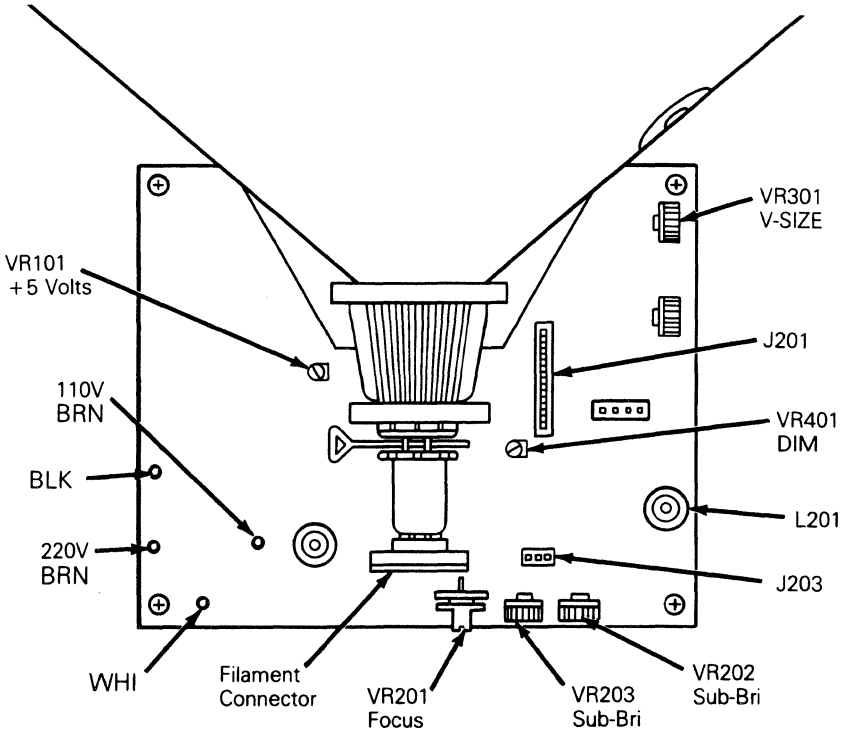
16 If the display is within specification and looks normal, press Setup twice. If you finish both the power and display adjustments, and the display is still not within tolerance, see Chapter 4, "Troubleshooting."

17 Turn the terminal off. Close it, remove the connectors, and reattach the communications cables.

ADJUSTMENTS

This section contains detailed instructions for each adjustment mentioned in Table 5-1 and a cross reference for the test pattern that you should use when making that particular adjustment. Use Figure 5-2 to identify adjustment locations on the monitor/power supply PCB. The order in which we have listed adjustments in Table 5-1 corresponds to the order of full alignment. To perform a full alignment, make all adjustments in the order that follows.

Figure 5-2 Adjustment Locations



Height

The height adjustment is labeled **V-SIZE VR301** on the monitor/power supply board. Use test pattern O.

Adjust **VR301** until the top edge and the bottom edge of the display are both 12mm ±3mm from the edge of the bezel.

Width

The width adjustment is labeled **L201** on the monitor/power supply board. Use test pattern O.

Adjust **L201** until either side of the display is 12mm ±3mm from the edge of the bezel.

■ **Caution** Do not use a metal tool to adjust the width coil. The magnetic properties of a metal tool will affect the adjustment.

Yoke Lock

The yoke lock corrects tilt problems. It is located on the neck of the CRT (see Figure 5-3). Use test pattern O.

1 Loosen the yoke lock on the neck of the CRT.

2 Rotate the yoke until the top and bottom edges of the display are level with the top and bottom of the bezel.

▲ **Warning** Do not tighten the yoke lock too much or the neck of the CRT may break and shoot broken glass for a radius of up to ten feet.

3 Gently tighten the yoke lock.

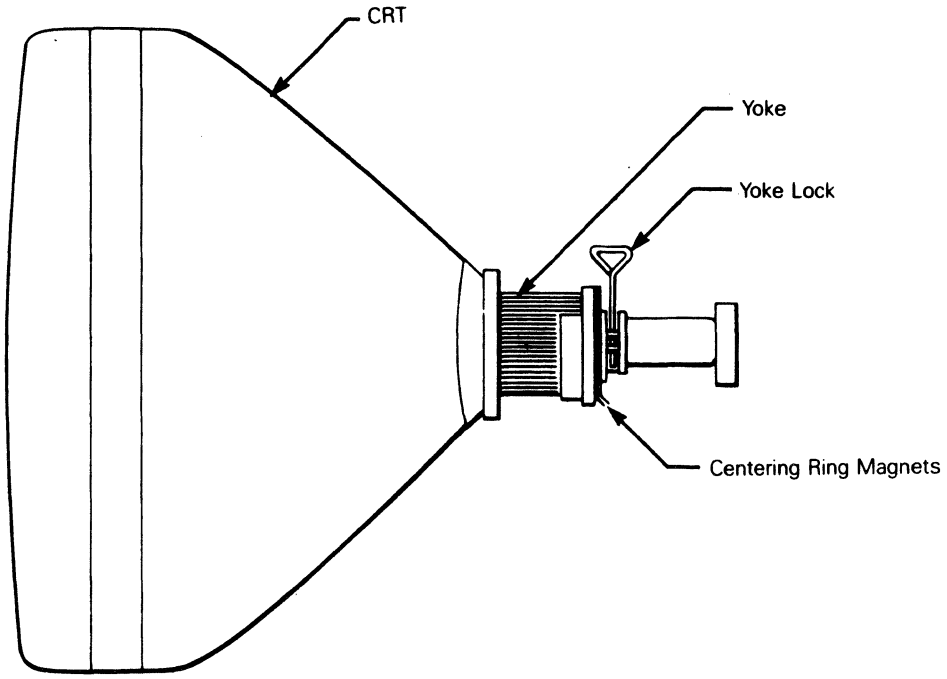
Centering Rings

There are two display centering rings around the yoke. When turned, they move the display position on the screen. Figure 5-4 shows the rings. If the display isn't in the center of the screen, turn the rings until it is.

Display Magnets

There are eight display magnets on a ring around the yoke. When turned, they change the corresponding screen area. They can also affect adjacent areas. Figure 5-5 identifies each magnet; Table 5-2 identifies which portion of the screen each magnet changes.

Figure 5-3 Yoke Lock on the CRT Neck



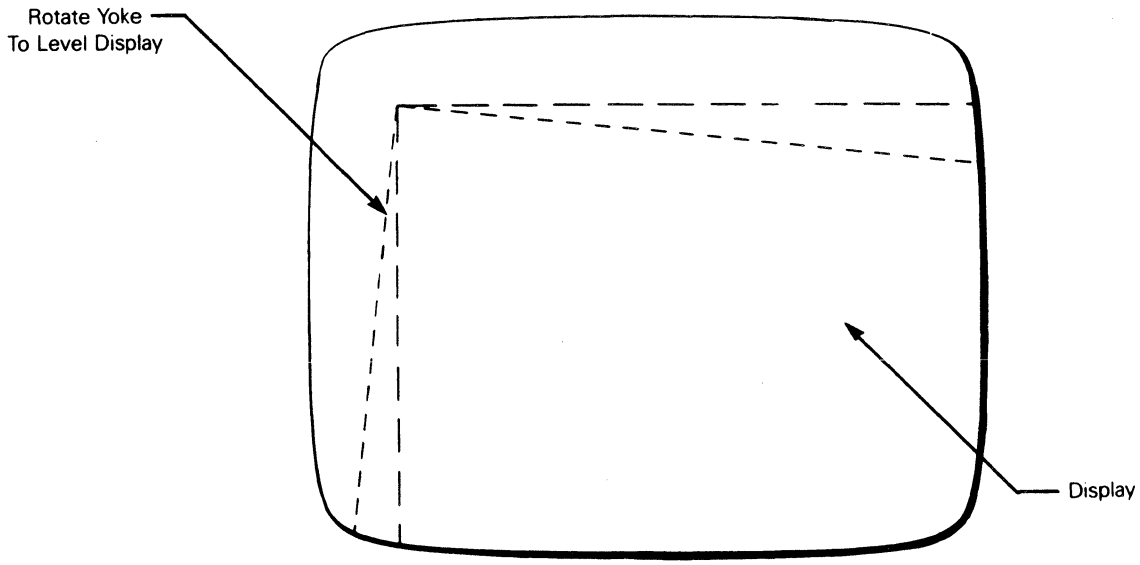


Figure 5-4 Centering Rings

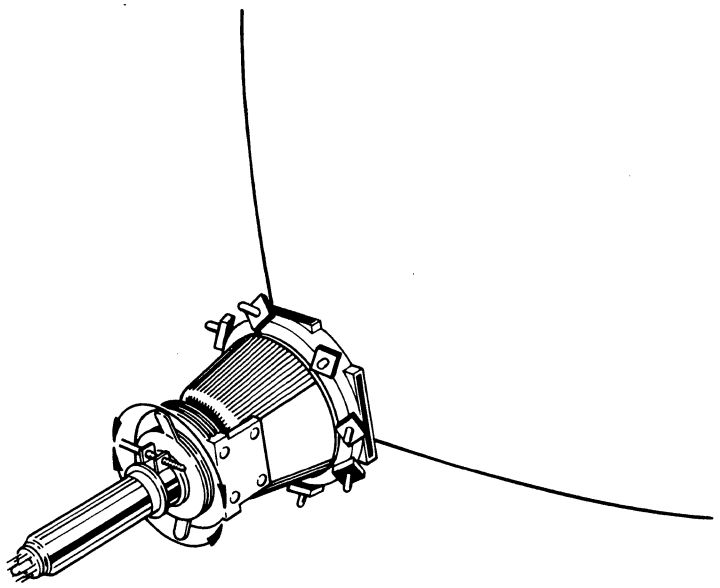


Figure 5-5 Display Magnets

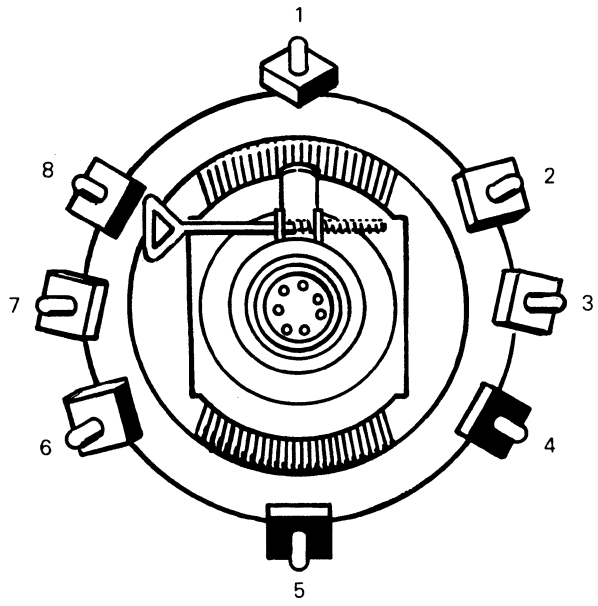


Table 5-2 Screen Areas Affected by Display Magnets

Magnet	Area Affected
1	Top
2	Upper left corner
3	Left
4	Lower left corner
5	Bottom
6	Lower right corner
7	Right
8	Upper right corner

Brightness

Three degrees of brightness can be adjusted: bold, normal, and dim. Although they can be adjusted separately, it's a good idea to adjust bold first, then normal and dim. Use test pattern M to adjust brightness.

1. Turn the operator brightness control as far clockwise as possible.
2. Turn **SUB-BRI**, **VR202**, as far clockwise as possible. You will see the raster lines on the screen.
3. Slowly turn **VR202** just until the raster is no longer visible. (**VR202** adjusts bold.)
4. Look at the brightness blocks in the middle of test pattern M. If normal is too bright or not bright enough, adjust **VR203**. If dim is too bright or not bright enough, adjust **VR401**.

Focus

The focus adjustment is labeled **FOCUS VR201** on the monitor/power supply board. Use test pattern M.

Adjust **VR201** until the characters halfway between the center of the display and the bezel are distinct and clear.

☐ **Note** Do not use the focus control to adjust the outer extremities of the screen. Some focus distortion happens in any CRT.

Linearity

The linearity adjustment is labeled **V-LIN VR302** on the monitor/power supply board. Use test pattern M.

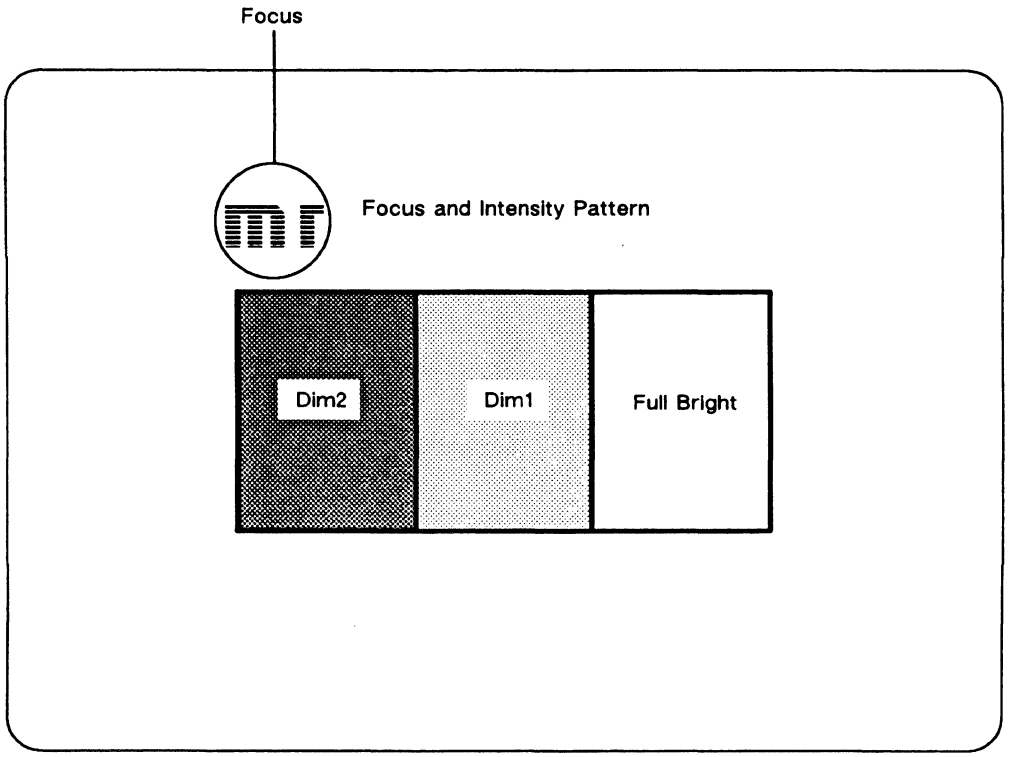
Adjust **VR302** until characters on the bottom of the display are the same height as those on the top.

TEST PATTERNS

Two alignment test patterns are stored in read-only memory (ROM): pattern M and pattern O. Pattern M helps you detect and correct linearity, brightness, and focus (see Figure 5-6).

This pattern is an 80-column display of characters. Three blocks in the center of the pattern indicate brightness: dim, normal, and bright.

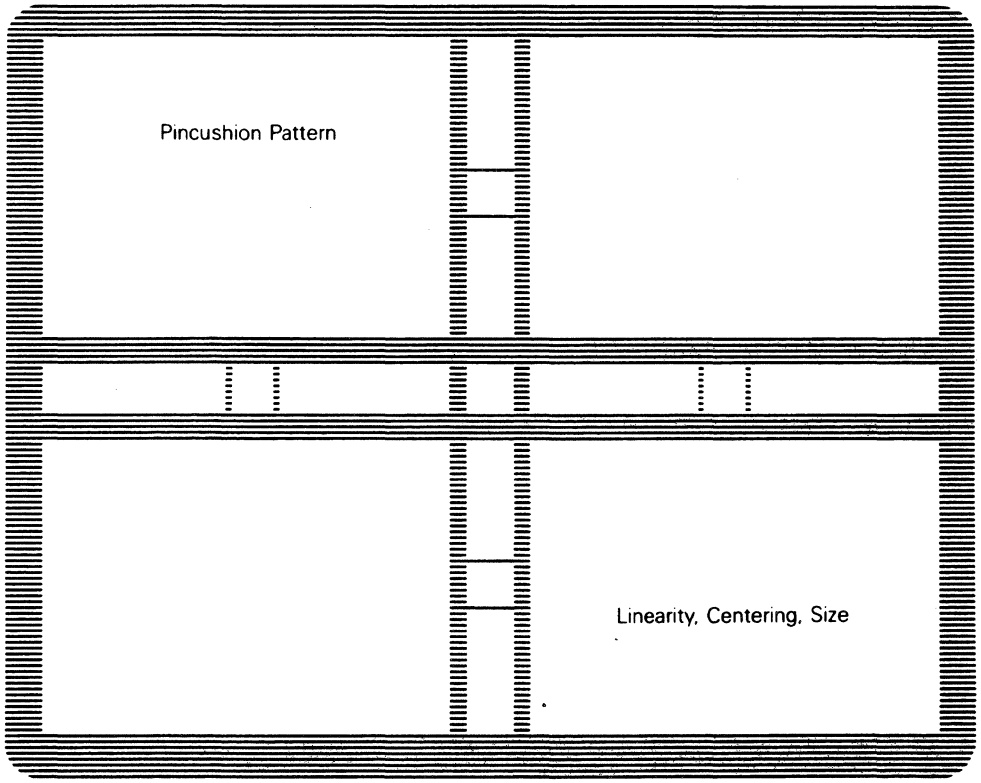
Figure 5-6 Test Pattern M



Pattern O helps you detect and correct pincushion, tilt, centering, and size problems (see Figure 5-7).

This pattern is a full-inverse, normal intensity display in the 80-column format. Two pairs of parallel lines cross in the center, making four quadrants. Two additional vertical lines, one on either side of the pattern, indicate brightness intensity levels.

Figure 5-7 Test Pattern O



6 Illustrated Parts List

This chapter provides the information you need to order assemblies, components, and parts for the terminal.

The first section of this chapter contains information on assemblies that can be ordered. You will find two exploded assembly drawings on the following pages, showing the monitor and keyboard module assemblies. Each replaceable assembly within these modules is labeled with a part name and number. The part name is a description of the part; the part number is the stock number. When you order replacement parts, please cite both the part name and part number.

The second section of the chapter contains lists of orderable components, grouped by the assembly they are found on. When you troubleshoot down to the component level, these lists will enable you to order component replacements. All components are keyed by their reference designator. All reference designators are listed in alphanumeric order. To locate the description and order number for the failed component, simply look up its reference designator.

Figure 6-1 Monitor Module Assembly Exploded View

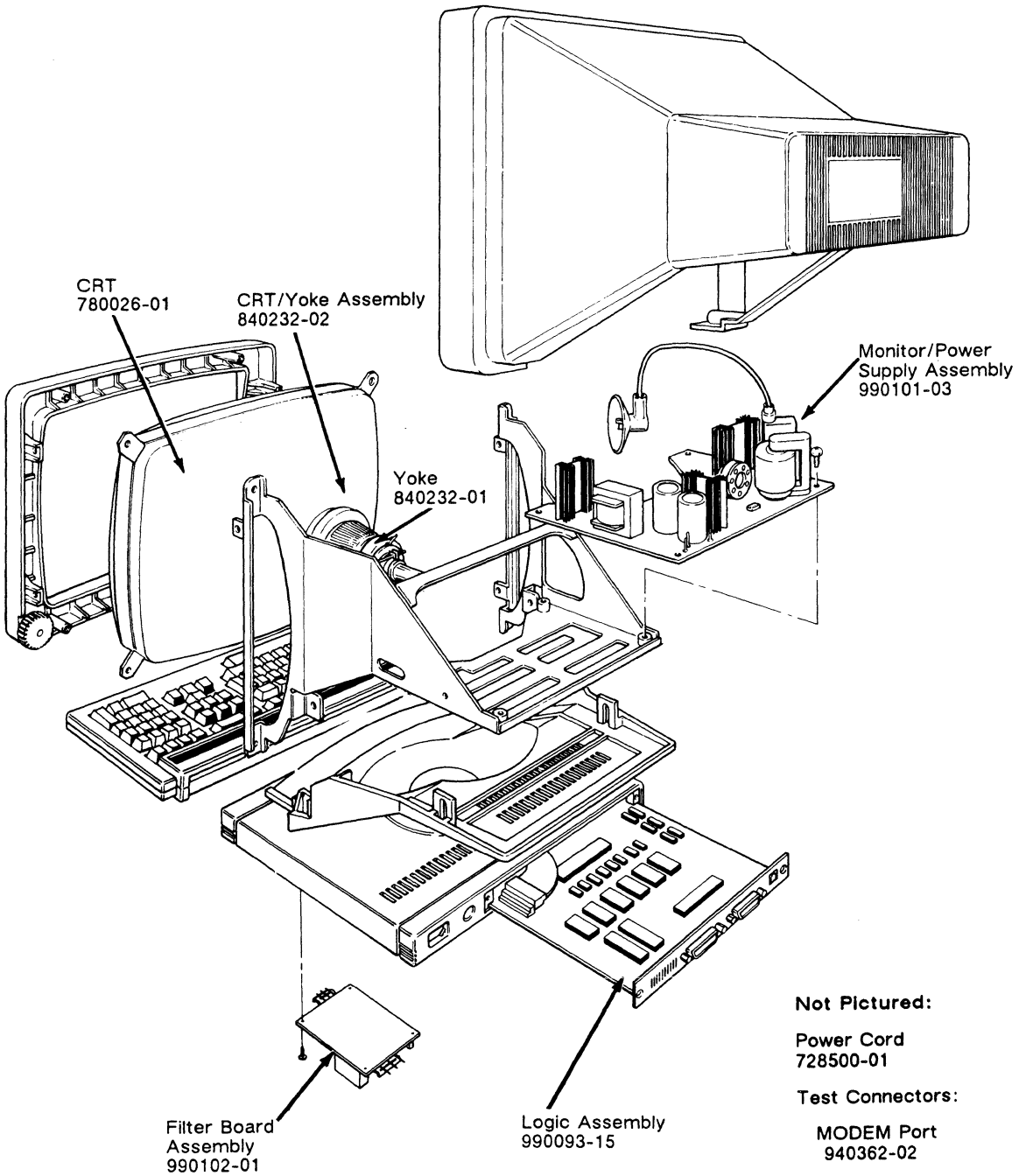
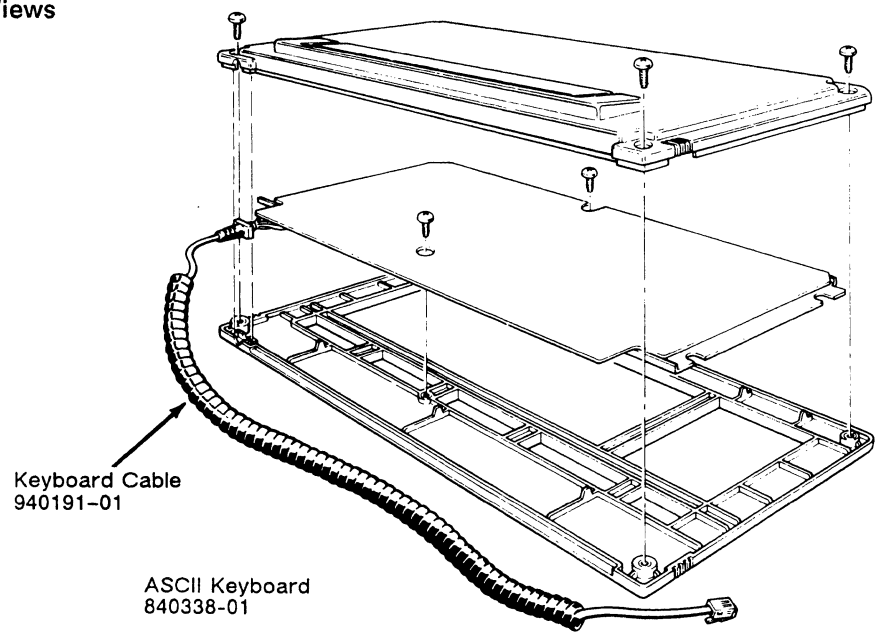


Figure 6-2 Keyboard Assemblies Exploded Views



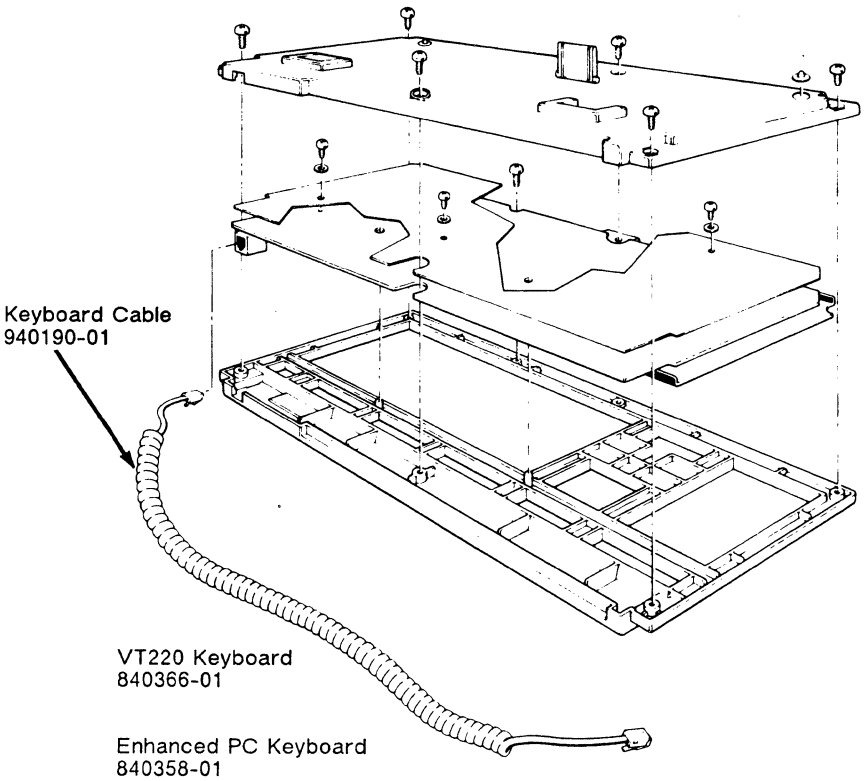


Table 6-1 Logic Assembly Parts List

Reference Designator	Description	Part Number
1E	IC 74LS04	170003-01
2F	IC,2404 EEPROM(4096 BIT) 8P	194011-01
3C	IC 74LS08	170006-01
3D	FIRMWARE, WY99GT DOMESTIC	250302-01
3F	IC,8051AH UCOMP 8BIT MASK ROM 40P	202008-01
3H	IC,MC3486 4X RCVR 3STOUT 16P	226007-01
4C	IC 74LS373	170093-01
4F	IC 2672	205001-01
4H	IC 3487	226008-01
5A	IC,74S00 4X 2INPUT NAND	170112-12
5C	IC 74LS138	170043-01
5D	IC HM6264LP-15 CMOS SRAM 8KX8	192004-02
6C	IC 74LS00	170112-01
6D	IC HM6264LP-15 CMOS SRAM 8KX8	192004-02
6F	IC 74LS374	170094-01
6G	IC 74LS374	170094-01
7C	IC 74LS244	170074-01
7F	IC 74LS374	170094-01
7G	IC 74LS374	170094-01
7H	IC 26LS32	206004-01
8C	IC 74LS245	170075-01
8D	IC, 6116-15 CMOS SRAM 150NS	192002-01
8F	IC 74LS273	170083-01
8H	IC, MA9636AC DUAL LINE DRIVER	206005-01
9C	IC 74LS244	170074-01
9D	IC, 6116-15 CMOS SRAM 150NS	192002-01
9H	IC, MA9636AC DUAL LINE DRIVER	206005-01
10A	IC 74LS00	170112-01
10B	IC HM6264LP-15 CMOS SRAM 8KX8	192004-02
10C	IC 74LS374	170094-01
10F	IC 74LS257	170079-01
10H	IC 26LS32	206004-01
11B	FIRMWARE,WY95 PAL20L10 PROGRAM	250232-01
11D	IC GATE ARRAY REV B	211003-02
11D	FIRMWARE, GRAPHICS VER.01	250337-01
11F	IC 74LS257	170079-01
11G	IC 2681 DUAL UART / COLOR	206000-01
12A	IC 74LS374	170094-01
12B	IC 74LS374	170094-01
12C	IC 4416-16KX4 DRAM,150NS	190003-01
12F	IC 74LS374	170094-01
12G	IC 74LS74	170026-01
12H	IC, MA9636AC DUAL LINE DRIVER	206005-01
13A	IC 74LS374	170094-01
13B	IC 74LS244	170074-01
13C	IC 4416-16KX4 DRAM,150NS	190003-01
13D	IC 74LS373	170093-01
13F	IC 74LS374	170094-01
13G	IC 74LS74	170026-01
13H	IC, MA9636AC DUAL LINE DRIVER	206005-01
14A	IC 74LS374	170094-01
14B	IC 74LS244	170074-01
14C	IC 4416-16KX4 DRAM,150NS	190003-01
14D	IC,8088-2 UPROC 8BIT 8MHZ 40P	200000-02
14F	IC 74LS139	170044-01
14G	IC 74LS10	170007-01
14H	IC 74LS125	170040-01

Table 6-1 Continued

Reference Designator	Description	Part Number
15A	IC 74LS04	170003-01
15B	IC 74LS74	170026-01
15C	IC 4416-16KX4 DRAM,150NS	190003-01
15F	IC 74LS375	170095-01
15G	IC, 74LS368	170092-01
B1	BEEPER, AUDIO TRANSDUCER	522000-01
C1	CAP., MG .1MF 50V AXIAL	320001-25
C2	CAP., 22PF AXIAL 50V	320010-17
C3	CAP, CNA 100PF 5% 100V	320003-25
C5	CAP., MG 68PF 50V (AXIAL)	320010-23
C7	CAP, CNA 100PF 5% 100V	320003-25
C8	CAP, CNA 100PF 5% 100V	320003-25
C9	CAP., MG .1MF 50V AXIAL	320001-25
C10	CAP,AEA 10UF 50/10% 16V	310034-13
C11	CAP,AEA 10UF 50/10% 16V	310034-13
C12	CAP., AEL 100MF 16V	310034-19
C13	CAP., MG .1MF 50V AXIAL	320001-25
C14	CAP., AEL 10MF 16V	310126-13
C15	CAP., MG .1MF 50V AXIAL	320001-25
C16	CAP., MG .1MF 50V AXIAL	320001-25
C17	CAP., MG .1MF 50V AXIAL	320001-25
C18	CAP., MG .1MF 50V AXIAL	320001-25
C19	CAP., MG .1MF 50V AXIAL	320001-25
C20	CAP., MG .1MF 50V AXIAL	320001-25
C21	CAP., MG .1MF 50V AXIAL	320001-25
C22	CAP., MG .1MF 50V AXIAL	320001-25
C23	CAP., MG .1MF 50V AXIAL	320001-25
C24	CAP., MG .1MF 50V AXIAL	320001-25
C25	CAP., MG .1MF 50V AXIAL	320001-25
C26	CAP., MG .1MF 50V AXIAL	320001-25
C27	CAP., MG .1MF 50V AXIAL	320001-25
C28	CAP., MG .1MF 50V AXIAL	320001-25
C29	CAP., AEL 100MF 10V	310002-19
C30	CAP., MG .1MF 50V AXIAL	320001-25
C31	CAP., MG .1MF 50V AXIAL	320001-25
C32	CAP., MG .1MF 50V AXIAL	320001-25
C33	CAP., MC 10PF 100V +-10% NPO	320003-13
C34	CAP,AEA 10UF 50/10% 16V	310034-13
C35	CAP, CNA 100PF 5% 100V	320003-25
C36	CAP., MG .1MF 50V AXIAL	320001-25
C37	CAP., MG .1MF 50V AXIAL	320001-25
C38	CAP., MG .1MF 50V AXIAL	320001-25
C39	CAP., MG .1MF 50V AXIAL	320001-25
C40	CAP., MG .1MF 50V AXIAL	320001-25
C41	CAP., MG .1MF 50V AXIAL	320001-25
C42	CAP., MG .1MF 50V AXIAL	320001-25
C43	CAP., 33PF 50V	320010-19
C44	CAP., 33PF 50V	320010-19
C46	CAP., MG .1MF 50V AXIAL	320001-25
C47	CAP, CNA 100PF 5% 100V	320003-25
C48	CAP., MG .1MF 50V AXIAL	320001-25
C49	CAP., MG .1MF 50V AXIAL	320001-25
C50	CAP., MG .1MF 50V AXIAL	320001-25
C51	CAP., MG .1MF 50V AXIAL	320001-25
C52	CAP., MG .1MF 50V AXIAL	320001-25
C53	CAP., MG .1MF 50V AXIAL	320001-25
C54	CAP., MG .1MF 50V AXIAL	320001-25
C55	CAP,CXA 390PF 10% 50V	320002-04
C56	CAP., MG .1MF 50V AXIAL	320001-25
C57	CAP., MG .1MF 50V AXIAL	320001-25

Table 6-1 Continued

Reference Designator	Description	Part Number
C58	CAP., MC 10PF 100V +-10% NPO	320003-13
C59	CAP., MC 10PF 100V +-10% NPO	320003-13
C60	CAP, CNA 100PF 5% 100V	320003-25
C61	CAP, CNA 100PF 5% 100V	320003-25
C62	CAP., MG .1MF 50V AXIAL	320001-25
C69	CAP,AEA 10UF 50/10% 16V	310034-13
CP1	CAP.NPO,68PF,50V,5%,.10LS	320012-11
CR1	DIODE, IN4148	280001-01
CR2	DIODE, IN4148	280001-01
CR3	DIODE, IN4148	280001-01
CR5	D.ZENER HZ6C2(SUB:80-170-12)	80-170-69
CR6	D.ZENER HZ6C2(SUB:80-170-12)	80-170-69
CR7	D.ZENER HZ6C2(SUB:80-170-12)	80-170-69
CR8	D.ZENER HZ6C2(SUB:80-170-12)	80-170-69
FB1	FERRITE,BEAD,43 MTL,1 HOLE,W/WIRE	400008-01
FB2	FERRITE,BEAD,43 MTL,1 HOLE,W/WIRE	400008-01
FB3	FERRITE,BEAD,43 MTL,1 HOLE,W/WIRE	400008-01
FB4	FERRITE,BEAD,43 MTL,6 HOLE	400007-01
FB5	FERRITE,BEAD,43 MTL,6 HOLE	400007-01
FB6	FERRITE,BEAD,43 MTL,6 HOLE	400007-01
J2	CONN., DB25P .283IN EXTNSION	562500-03
J2	CONN., 25 PIN MALE DB-25 RIGHT ANG	562501-03
J3	CONN., D 25 PIN FEMALE	80-151-77
Q1	TRANSISTOR,(MOTOROLA 2N2222)	270000-01
Q2	TRANSISTOR,(MOTOROLA 2N2222)	270000-01
Q3	TRANSISTOR, 2N3904	270010-01
R1	RES, CF 47 OHM 1/4W 5%	370001-41
R2	RES, CF 47 OHM 1/4W 5%	370001-41
R3	RES, CF 1.5K OHM 1/4W 5%	370001-77
R4	RES, CF 1K OHM 1/4W 5%	370001-73
R5	RES, CF 1K OHM 1/4W 5%	370001-73
R6	RES, CF 680 OHM 1/4W 5%	370001-69
R7	RES, CF 10 OHM 1/4W 5%	370001-25
R8	RES, CF 1K OHM 1/4W 5%	370001-73
R9	RES, CF 2.7K OHM 1/4W 5%	370001-83
R10	RES, CF 2.7K OHM 1/4W 5%	370001-83
R11	RES, CF 1K OHM 1/4W 5%	370001-73
R12	RES, CF 1.5K OHM 1/4W 5%	370001-77
R13	RES, CF 1K OHM 1/4W 5%	370001-73
R14	RES, CF 1K OHM 1/4W 5%	370001-73
R15	RES, CF 1K OHM 1/4W 5%	370001-73
R15	RES, CF 2K OHM 1/4W 5%	370001-80
R16	RES, CF 1K OHM 1/4W 5%	370001-73
R17	RES, CF 1K OHM 1/4W 5%	370001-73
R18	RES, CF 8.2K OHM 1/4W 5%	370001-95
R20	RES, CF 22 OHM 1/4W J	370001-33
R21	RES, CF 1K OHM 1/4W 5%	370001-73
R22	RES, CF 1K OHM 1/4W 5%	370001-73
R23	RES, CF 1K OHM 1/4W 5%	370001-73
R26	RES, CF 2K OHM 1/4W 5%	370001-80
R27	RES, CF 510 OHM 1/4W 5%	370001-66
R28	RES, CF 22 OHM 1/4W J	370001-33
R31	RES, CF 1K OHM 1/4W 5%	370001-73
R32	RES, CF 2K OHM 1/4W 5%	370001-80
R34	RES, CF 100 OHM 1/4W 5%	370001-49
R35	RES, CF 62 OHM 1/4W 5%	370001-44
RJ9	CONN., RJ9 PHONE JACK	563652-01
RP1	RES., 22 OHM SIP 8PIN	371304-01
RP2	RES., 22 OHM SIP 8PIN	371304-01
RP3	RES., 1K OHM SIP 8PIN	371305-41

Table 6-1 Continued

Reference Designator	Description	Part Number
RP4	RNTWK,ISO 330 4R8P 2% SIP	371304-29
RP5	RES., 10K OHM SIP 10PIN	371310-65
RP6	RNTWK,COM 68K 5R6P 2% SIP	371302-85
RP7	RNTWK,ISO,62,10P,SIP	371309-02
XX	IC,27128 EPROM 128K 250NS MAX 28P	194004-02
Y1	XTAL,22.950MHZ .005% HC18/U SER	390000-41
Y2	XTAL,34.425MHZ .005% HC18/U SER	390000-46
Y3	CRYSTAL, 3.6864 MHZ	390000-08
Y4	XSTAL,12MHZ .005% PARL 30PF HC18	391000-16

Table 6-2 Monitor/Power Supply Parts List

Reference Designator	Description	Part Number
C21	CAP., CD .01MF 1KV	320046-49
C30	CAP., MPF .1MFD 100V	320505-15
C101	CAP., AEL 220MF 200V 105 DEGREE C	310098-21
C102	CAP., AEL 220MF 200V 105 DEGREE C	310098-21
C103	CAP., MPF .22MFD 100V	320510-17
C104	CAP,ASE, 47.0 UF, 25 V,T,F	315004-17
C105	CAP,ASE, 10.0 UF, 35 V,T,F	315005-13
C106	CAP., MPF .1MFD 100V	320505-15
C107	CAP,ASE, 2200.0 UF, 25 V,T,N-F	316004-27
C108	CAP., AEL 4700MF 10V VT. MNT.	310002-29
C109	CAP,ASE, 100.0 UF, 25 V,T,F	315004-19
C110	CAP,ASE, 2200.0 UF, 10 V,T,N-F	316002-27
C111	CAP,ASE, 100.0 UF, 25 V,T,F	315004-19
C112	CAP,ASE, 2200.0 UF, 25 V,T,N-F	316004-27
C113	CAP., CD 270PF 500V 10%	320036-30
C114	CAP,CD,.01,100V,80/20%.Z5V,1/4IN	320034-49
C115	CAP,CD,.01,100V,80/20%.Z5V,1/4IN	320034-49
C116	CAP., CD 560PF 1KV K Y5P	320039-34
C201	CAP,ASE, 1.0 UF, 50 V,U,F	315006-07
C202	CAP., .022MF 50V Z5U 20%	320045-53
C203	CAP., PPN .022MFD 400V	320525-10
C204	CAP., ASN 3.3UF 35V M 85 DEGREE C	310027-10
C205	CAP., CD .01MF 1KV	320046-49
C206	CAP., CD .01MF 1KV	320046-49
C207	CAP., AEL 10MF 160V	310132-13
C208	CAP., CD .01MF 1KV	320046-49
C209	CAP,ASE, 47.0 UF, 100 V,T,N-F	316009-17
C210	CAP., MPF .1MFD 100V	320505-15
C211	CAP,ASE, 220.0 UF, 35 V,T,N-F	316005-21
C213	CAP., MPF .1MFD 100V	320505-15
C301	CAP,FPEE,UF,.022, 100V, 5%,F	320565-17
C302	CAP., MPF .1MFD 100V	320505-15
C303	CAP,ASE, 100.0 UF, 25 V,T,F	315004-19
C304	CAP., CD .22MF 50V	320004-29
C305	CAP., CD 33PF 50V	320032-19
C307	CAP., MPF .1MFD 100V	320505-15
C308	CAP., MPF .1MFD 100V	320505-15
C309	CAP,ASE, 10.0 UF, 35 V,T,F	315005-13
C310	CAP,ASE, 1000.0 UF, 16 V,T,N-F	316003-25
C311	CAP,ASE, 1000.0 UF, 16 V,T,N-F	316003-25
C312	CAP., CDY 680PF 50V 20% .25LS Y5P	320054-35
C401	CAP., CD .22MF 50V	320004-29
C402	CAP., MK 150PF 50V J NPO	80-960-06
C403	CAP., CDY 680PF 50V 20% .25LS Y5P	320054-35

Table 6-2 Continued

Reference Designator	Description	Part Number
D10	DIODE, IN4937 1A/600V	283701-01
D101	DIODE, RGP5020	283703-02
D102	DIODE, RGP30G	283704-01
D103	RECT,SBS545T SCHTKY 45V 5A	282206-01
D104	DIODE, IN4937 1A/600V	283701-01
D105	DIODE, IN4937 1A/600V	283701-01
D106	DIODE, IN4937 1A/600V	283701-01
D112	RECT, RGP10M FST RCVY 1KV	283714-01
D201	DIODE, SRP100G	283709-01
D202	DIODE, RGP5020	283703-02
D203	DIODE, RGP30G	283704-01
D204	DIODE, RGP5100	283703-01
D205	DIODE, RGP5100	283703-01
D206	DIODE, RGP5100	283703-01
D301	DIODE, RGP5020	283703-02
D302	DIODE, IN4148	280001-01
D303	DIODE, IN914B	280000-01
D401	DIODE, IN914B	280000-01
D402	DIODE, ZENER6.2V 1/2W	281305-08
D404	DIODE, ZENER HZ3B2	281305-11
D405	DIODE, ZENER HZ3B2	281305-11
J201	HDR., 12 PIN P.C. MNT.	562103-11
J202	CONN., 4 CIR. 3.96MM	562006-03
J203	HDR., 3 CIR. LCKNG. P.C. MNT.	562104-02
L101	COIL,CHOKE 20UH 3A	410511-01
L102	COIL,CHOKE 5 UH 4A	410510-01
L103	COIL, 10UH CHOKE	410502-01
L201	COIL,WY95 HORIZ WIDTH	413512-01
L202	COIL, WY95 HORIZ LINEARITY	411010-01
L401	INDUCTOR, 4.7UH PEAKING COIL	412500-09
Q101	TRANSISTOR, 2SC1213	270018-01
Q102	TRANSISTOR,2SC3153	272010-01
Q104	IC ADJUST SHUNT REGULATOR (TL431C)	221004-01
Q201	TRANSISTOR, 2SC1213	270018-01
Q202	TRANSISTOR, BU406	272000-01
Q301	TRANSISTOR, 2SC1213	270018-01
Q302	TRANSISTOR, 2SA844/2SA733	270503-01
Q401	TRANSISTOR, 2N2369	270001-01
Q402	XSTR,MRF531,NPN,100V,800MHZ,2.5W	270025-01
R20	RES,CF ,1/4W,KOHM,100 , 5%,RDL	370021-25
R101	RES, CF 100K OHM 1/2W 5%	370004-25
R102	RES, CF 100K OHM 1/2W 5%	370004-25
R103	RES,CF , 2W,KOHM,330 , 5%,AXIAL	370008-37
R104	RES,MOF, 2W, OHM, 33, 5%,RDL ,M	370617-37
R105	RES,CF ,1/4W, OHM, 75 , 5%,RDL	370020-46
R106	RES, WW 1.0 5% 3W	370903-25
R107	RES,CF ,1/4W,KOHM, 39 , 5%,RDL	370021-15
R108	RES,CF ,1/4W,KOHM, 4.7 , 5%,VERT	370009-89
R109	RES,CF ,1/4W,KOHM, 12 , 5%,VERT	370010-03
R110	RES,CF ,1/4W,KOHM, 1.5 , 5%,RDL	370020-77
R111	RES, CF 56 OHM 5% 1/4W VERT	370009-43
R112	RES, CF 1K OHM 1/4W 5%	370001-73
R113	RES,CF ,1/2W, OHM, 20, 5%,VERT	370011-32
R114	RES,CF ,1/2W, OHM, 20, 5%,VERT	370011-32
R115	RES,MOF, 5W,KOHM, 1.0, 5%,M	370627-73
R201	RES, MOF 33 OHM 1/2W 5%	370601-61
R202	RES,CF ,1/4W, OHM,470 , 5%,RDL	370020-65
R204	RES,MOF, 1W,KOHM, 1, 5%, ,M	370611-73
R205	RES,CF ,1/4W,KOHM,100 , 5%,RDL	370021-25
R206	RES,CF ,1/4W,KOHM,100 , 5%,RDL	370021-25

Table 6-2 Continued

Reference Designator	Description	Part Number
R207	RES,CF ,1/4W,KOHM,100 , 5%,RDL	370021-25
R210	RES,CF ,1/4W, OHM, 10 , 5%,RDL	370020-25
R211	RES,CF ,1/4W,KOHM, 47 , 5%,RDL	370021-17
R212	RES,CF ,1/4W,KOHM, 22 , 5%,RDL	370021-09
R213	RES,CF ,1/4W,KOHM, 3.0 , 5%,RDL	370020-84
R214	RES,CF ,1/4W, OHM, 10 , 5%,RDL	370020-25
R301	RES,CF ,1/4W,KOHM, 18 , 5%,VERT	370010-07
R302	RES,CF ,1/4W,KOHM,240 , 5%,VERT	370010-34
R302	RES,MF ,1/4W,KOHM,243 , 1%,VERT	370317-38
R303	RES,CF ,1/4W,KOHM,150 , 5%,RDL	370021-29
R304	RES,CF ,1/4W,KOHM,470 , 5%,RDL	370021-41
R305	RES,CF ,1/4W, OHM, 3.3 , 5%,RDL	370020-13
R306	RES,CF ,1/4W,KOHM,220 , 5%,RDL	370021-33
R307	RES,CF ,1/4W,KOHM,470 , 5%,RDL	370021-41
R308	RES,CF ,1/4W,KOHM, 39 , 5%,RDL	370021-15
R309	RES,CF ,1/4W,KOHM, 56 , 5%,RDL	370021-19
R310	RES,CF ,1/4W,KOHM, 56 , 5%,RDL	370021-19
R311	RES, CF 1 OHM 1/2W 5%	370003-01
R312	RES,CF ,1/4W,KOHM, 68 , 5%,RDL	370021-21
R316	RES,CF ,1/4W,KOHM, 2.2 , 5%,RDL	370020-81
R318	RES,CF ,1/4W,KOHM, 2.2 , 5%,RDL	370020-81
R319	RES, CF 1K OHM 1/4W 5%	370001-73
R401	RES,CF ,1/4W, OHM,470 , 5%,RDL	370020-65
R402	RES,CF ,1/4W, OHM,220 , 5%,RDL	370020-57
R403	RES,CF ,1/4W, OHM,680 , 5%,RDL	370020-69
R404	RES,CF ,1/4W, OHM, 47 , 5%,RDL	370020-41
R405	RES,CF ,1/4W, OHM, 10 , 5%,RDL	370020-25
R406	RES,CF ,1/4W, OHM, 56 , 5%,RDL	370020-43
R407	RES,MOF, 2W,KOHM, 1.0, 5%, M	370615-73
R408	RES,CF ,1/4W, OHM,220 , 5%,RDL	370020-57
R409	RES,CF ,1/4W, OHM, 3.3 , 5%,RDL	370020-13
R410	RES, CF 10K OHM 1/4W 5%	370002-01
T101	XFMR, WY95 SW PWR	421516-01
T102	TRANSFORMER, DRIVE	420029-01
T201	XFMR,HORIZ DRV WY95	423015-01
T202	XFMR,FL BCK WY95	420015-01
U101	IC 4N35	290000-01
U301	IC TDA 1170N	222504-01
VR101	RES., VAR. 1K OHM LINEAR	360006-05
VR201	RES., VAR. 2M OHM 1/2W 15MM	360008-18
VR202	RES., VAR. 100K OHM C.C 1/4W 8MM	360001-12
VR203	RES., VAR. 100K OHM C.C 1/4W 8MM	360001-12
VR204	RES., VAR. 50K OHM LINEAR	360006-11
VR301	RES., VAR. 200K OHM C.C. 1.4W 8MM	360001-13
VR302	RES., VAR. 100K OHM C.C 1/4W 8MM	360001-12
VR303	RES., VAR. 200K OHM C.C. 1.4W 8MM	360001-13
VR304	RES., VAR. 100K-B	360007-12
VR401	RES., VAR. 500 OHM LINEAR	360006-04

Table 6-3 Filter Board Parts List

Reference Designator	Description	Part Number
	FUSE, 2 AMP 250V SLOW BLOW	530011-03
C501	CAP, INTERF SUPP .1MFD/250VAC V	329001-07
C502	CAP, INTERF SUPP .1MFD/250VAC V	329001-07
C503	CAP, FMER .15UF 20% 250VAC VDE	320554-09
C504	CAP, .0047MF 250VAC-Y	329003-06
C505	CAP, .0047MF 250VAC-Y	329003-06
C506	CAP, CDZ 1800PF 20% 250VAC Z5U 3/8LS 320050-04	
C507	CAP, CDZ 1800PF 20% 250VAC Z5U 3/8LS 320050-04	
D501	RECT, 1N4006 GP 800V 1A	283200-05
D502	RECT, 1N4006 GP 800V 1A	283200-05
D503	RECT, 1N4006 GP 800V 1A	283200-05
D504	RECT, 1N4006 GP 800V 1A	283200-05
L501	COIL, WY95 CHOKE	410512-01
L502	COIL, CHOKE 1.3MH 20% 16T	410513-01
R501	RES, WW 1.2 OHM 3W 5%	370903-27

Table 6-4 Keyboard Assemblies Parts List

Reference Designator	Description	Part Number
ASCII		
C1	CAP., MG .1MF 50V AXIAL	320001-25
C2	CAP., AEL 47MF 10V	310002-17
C3	CAP., MG .0015MF 50V K X7R	80-960-05
C4	CAP., MG .1MF 50V AXIAL	320001-25
D1	DIODE, IN914B	280000-01
D2	DIODE, IN914B	280000-01
D3	D.ZENER HZ6C2(SUB:80-170-12)	80-170-69
D4	DIODE, IN914B	280000-01
D5	DIODE, IN914B	280000-01
D6	DIODE, IN914B	280000-01
D7	DIODE, IN914B	280000-01
J1	HDR., 4 CIR (5268-04A)	562102-03
R1	RES, CF 10 OHM 1/4W 5%	370001-25
R2	RES, CF 10 OHM 1/4W 5%	370001-25
R3	RES, CF 10 OHM 1/4W 5%	370001-25
R4	RES, CF 10 OHM 1/4W 5%	370001-25
R5	RES, CF 24K OHM 1/4W 5%	370002-10
U1	IC KEYBOARD GATE ARRAY CHIP	211001-01
VT220		
C1	CAP., MG .1MF 50V AXIAL	320001-25
C2	CAP., MG .0015MF 50V K X7R	80-960-05
C3	CAP., AEL 47MF 10V	310002-17
D1	DIODE, IN4148	280001-01
D2	DIODE, IN4148	280001-01
D3	DIODE, IN914B	280000-01
D4	D.ZENER HZ6C2(SUB:80-170-12)	80-170-69
D5	D.ZENER HZ6C2(SUB:80-170-12)	80-170-69
D6	DIODE, IN914B	280000-01
D7	D.ZENER HZ6C2(SUB:80-170-12)	80-170-69
J1	HOLDER, MODULAR JACK	710034-01
J1	MODULE JACK 4P4C	560009-01
R1	RES, CF 24K OHM 1/4W 5%	370002-10
R2	RES, CF 10 OHM 1/4W 5%	370001-25
R3	RES, CF 10 OHM 1/4W 5%	370001-25
R4	RES, CF 10 OHM 1/4W 5%	370001-25
U1	IC KEYBOARD GATE ARRAY CHIP	211001-01

Table 6-4 Continued

Reference Designator	Description	Part Number
PC Enhanced		
C1	CAP., MG .1MF 50V AXIAL	320001-25
C2	CAP., MG .1MF 50V AXIAL	320001-25
C3	CAP., MG .1MF 50V AXIAL	320001-25
C4	CAP., MG .1MF 50V AXIAL	320001-25
C5	CAP., MG .1MF 50V AXIAL	320001-25
C6	CAP., MG .0015MF 50V K X7R	80-960-05
C7	CAP., AEL 470MF 6.3V	310001-23
D1	LED,GRN 1MCD 1X5 RECTGL	287006-01
D1	DIODE, IN914B	280000-01
D2	LED,GRN 1MCD 1X5 RECTGL	287006-01
D2	DIODE, IN914B	280000-01
D3	LED,GRN 1MCD 1X5 RECTGL	287006-01
D4	DIODE, ZENER6.2V 1/2W	281305-08
D5	DIODE, IN914B	280000-01
D6	DIODE, IN914B	280000-01
D7	IC,74HC163 PRESETTABLE COUNTERS	184000-01
D7	DIODE, IN914B	280000-01
D8	DIODE, IN914B	280000-01
Q1	TRANSISTOR, 2N2907	270500-02
Q2	TRANSISTOR, 2N2907	270500-02
Q3	TRANSISTOR, 2N2907	270500-02
R1	RES, CF 10K OHM 1/4W 5%	370002-01
R2	RES, CF 10K OHM 1/4W 5%	370002-01
R3	RES, CF 10K OHM 1/4W 5%	370002-01
R4	RES, MF 100 OHM 1/4W 5%	370344-49
R5	RES, MF 100 OHM 1/4W 5%	370344-49
R6	RES, MF 100 OHM 1/4W 5%	370344-49
R7	RES, CF 10 OHM 1/4W 5%	370001-25
R8	RES, CF 24K OHM 1/4W 5%	370002-10
R9	RES, CF 10 OHM 1/4W 5%	370001-25
R10	RES, CF 10 OHM 1/4W 5%	370001-25
R11	RES, CF 10 OHM 1/4W 5%	370001-25
R12	RES, CF 10 OHM 1/4W 5%	370001-25
U1	IC KEYBOARD GATE ARRAY CHIP	211001-01

7 Schematics

This chapter contains schematic diagrams for the keyboard, logic, monitor/power supply, and filter PCBs. These schematics will help you troubleshoot the terminal.

Table 7-1 Schematic Directory

Schematic	Part Number	Figure
Keyboard PCB—ASCII style	960112-01	7-1
Keyboard PCB—VT220 style	960062-01	7-2
Keyboard PCB—PC Enhanced style	960132-01	7-3
Logic PCB, 1 of 4	960093-01	7-4
Logic PCB, 2 of 4	960093-01	7-4
Logic PCB, 3 of 4	960093-01	7-4
Logic PCB, 4 of 4	960093-01	7-4
Monitor/Power Supply PCB	960101-01	7-5
Filter PCB	960102-01	7-6

Table 7-2 PCB Layout Directory

Schematic	Part Number	Figure
Keyboard PCB—ASCII style	990112-01	7-7
Keyboard PCB—VT220 style	990062-01	7-8
Keyboard PCB—PC Enhanced style	990132-01	7-9
Logic PCB	990093-01	7-10
Monitor/Power Supply PCB	990101-01	7-11
Filter PCB	990102-01	7-12

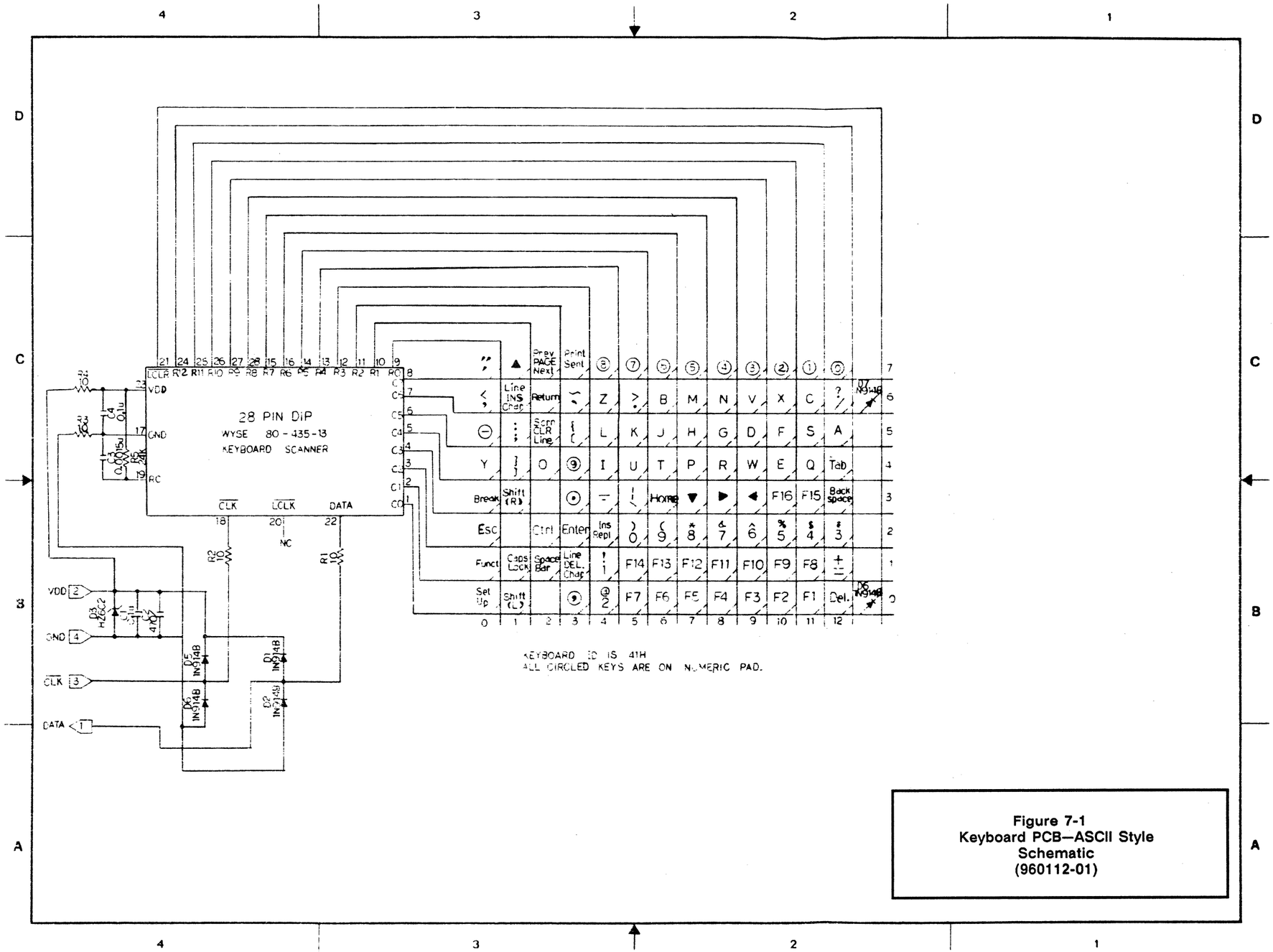


Figure 7-1
Keyboard PCB—ASCII Style
Schematic
(960112-01)

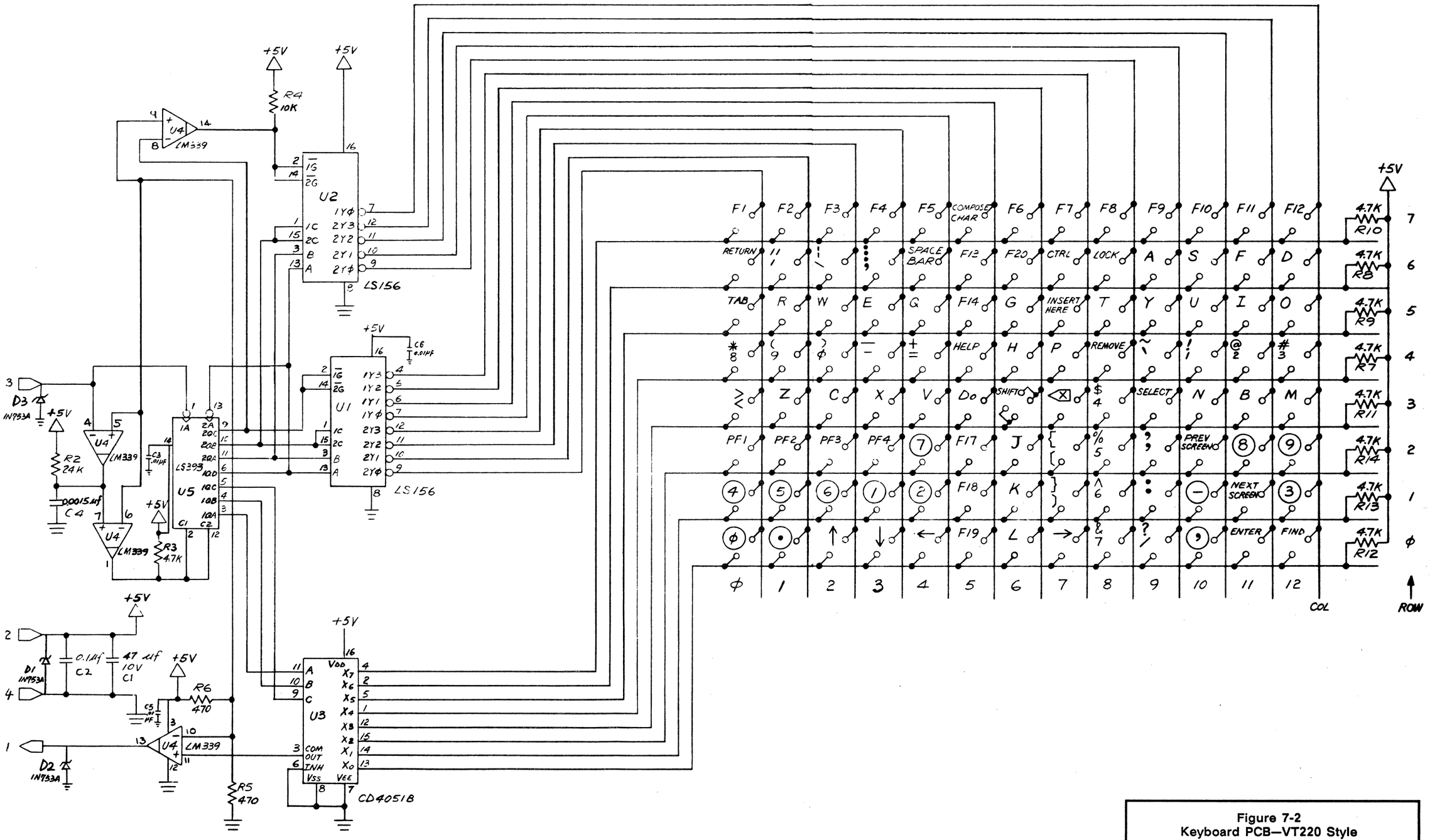
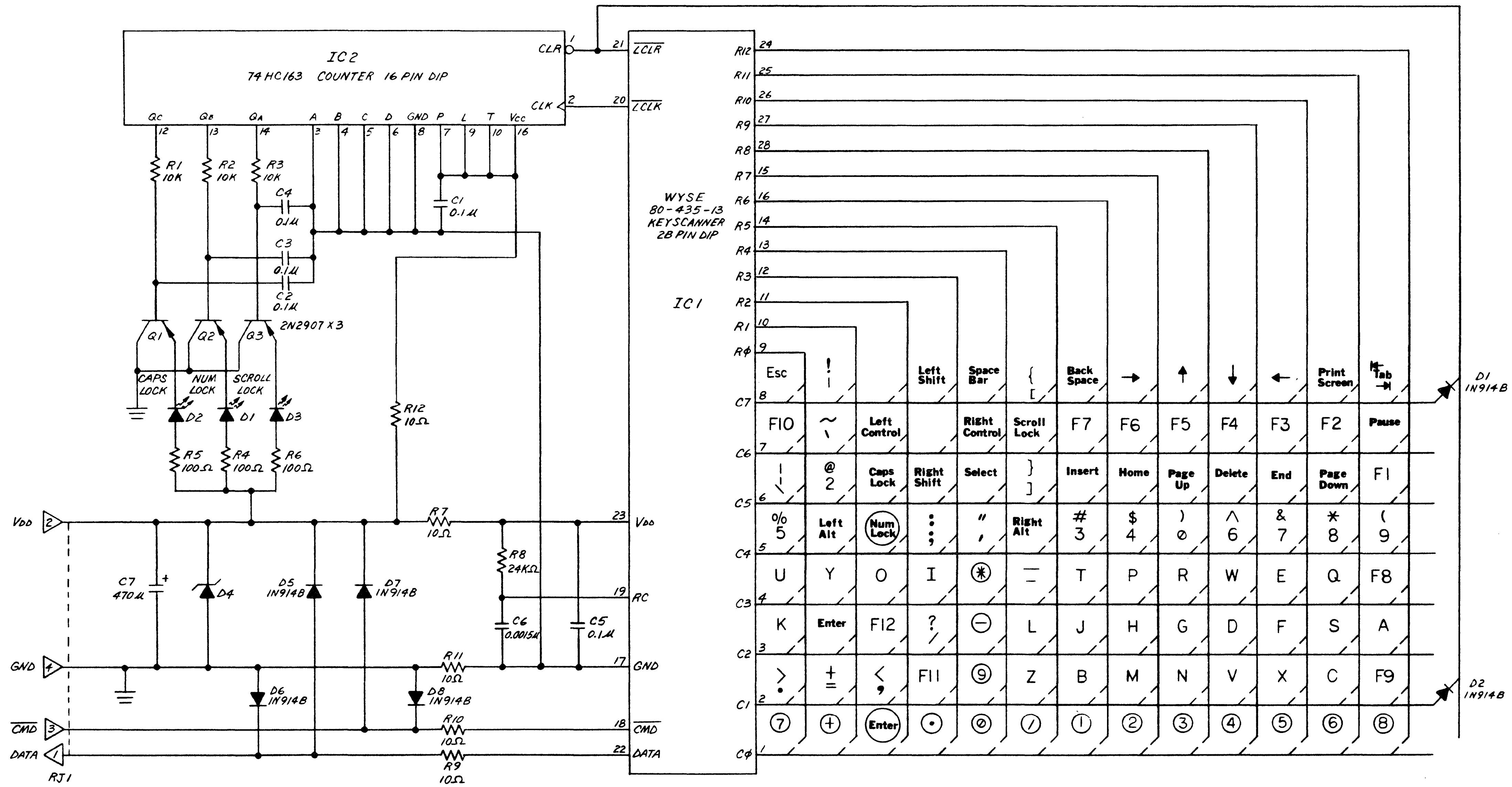


Figure 7-2
Keyboard PCB—VT220 Style
Schematic
(960062-01)



NOTES:

1. CHARACTERS IN KEY MATRIX WITH CIRCLE INDICATES LOCATION IN NUMERIC KEYPAD AREA.

Figure 7-3
Keyboard PCB—PC Enhanced Style Schematic
(960132-01)

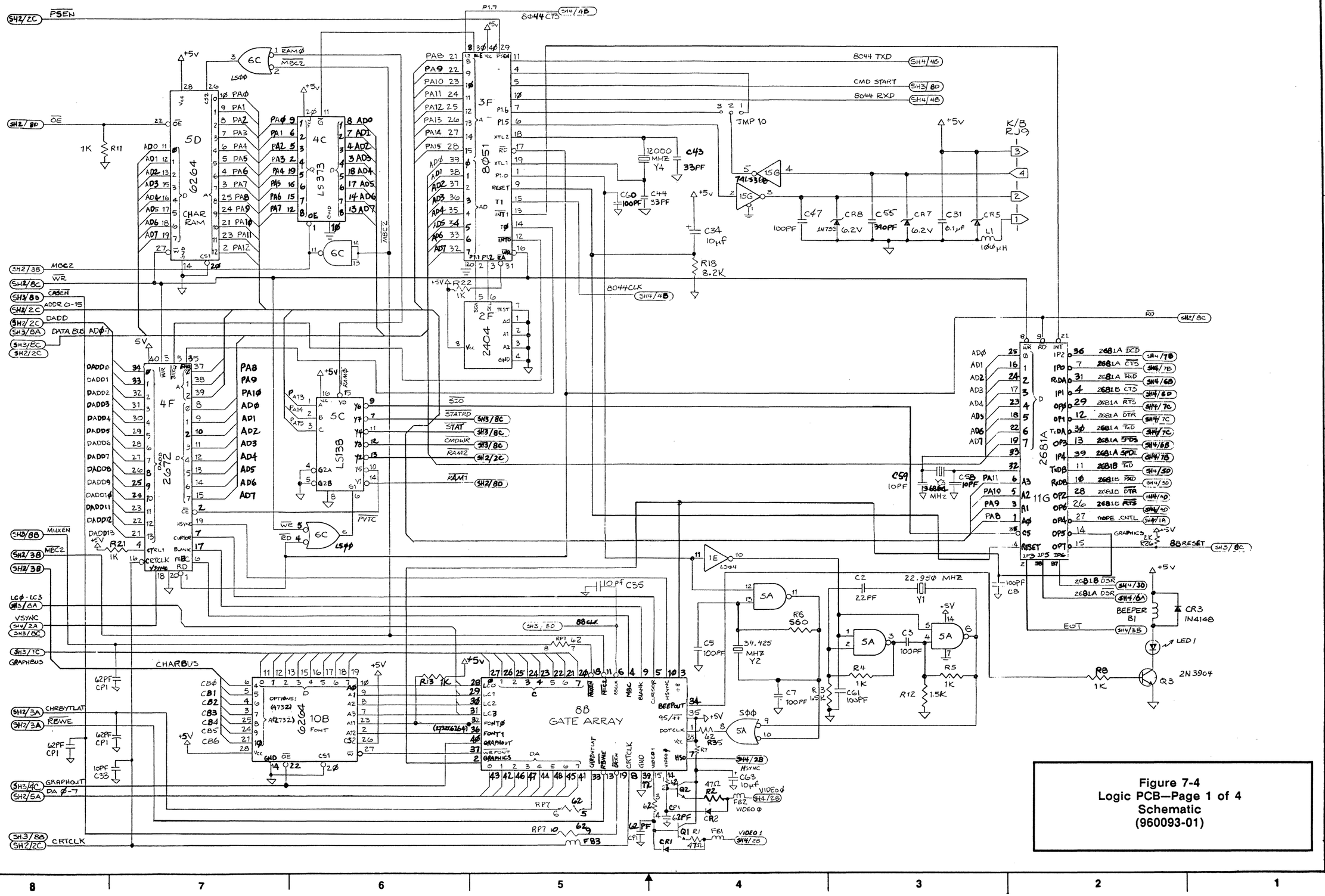


Figure 7-4
Logic PCB—Page 1 of 4
Schematic
(960093-01)

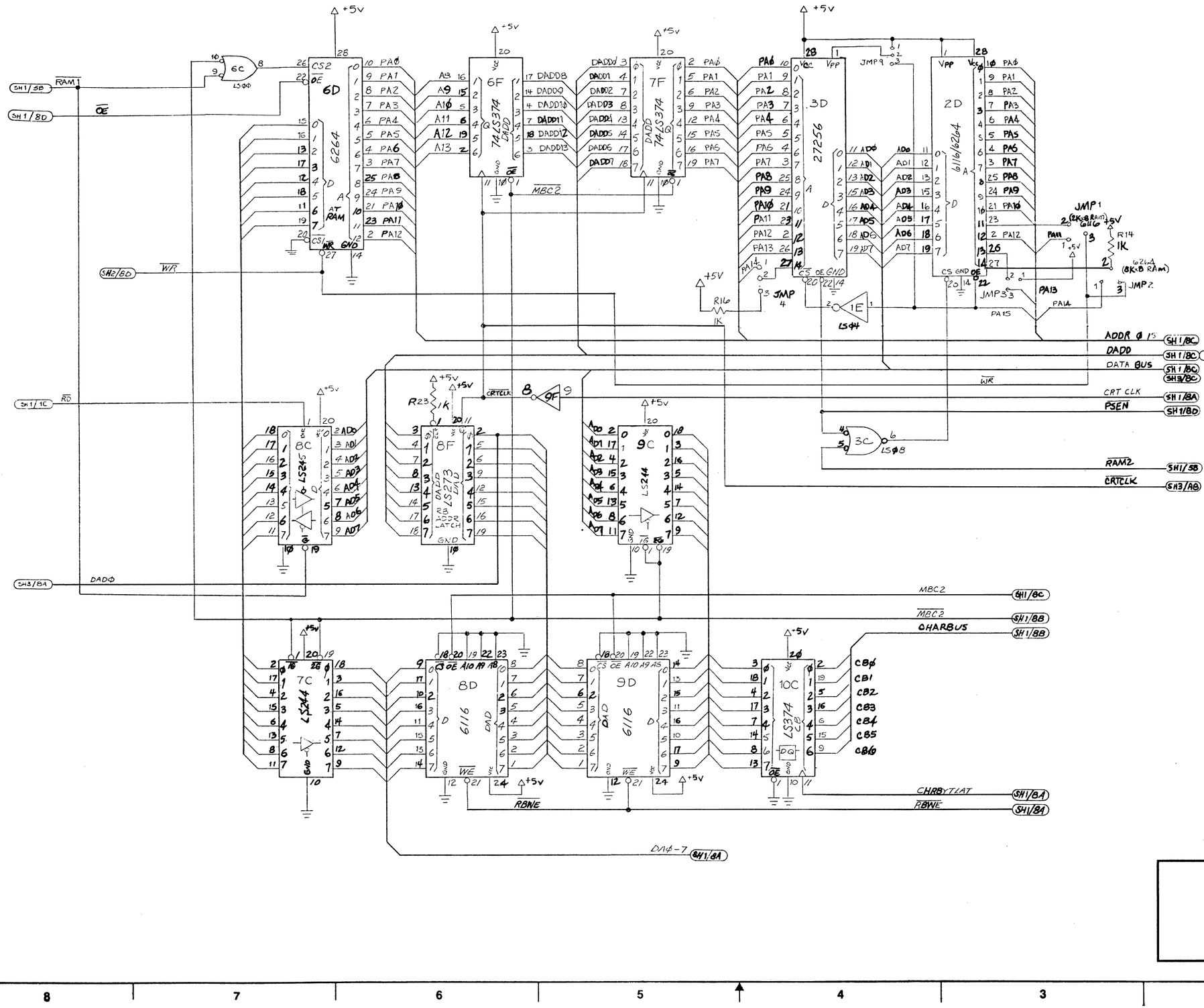


Figure 7-4
Logic PCB—Page 2 of 4
Schematic
(960093-01)

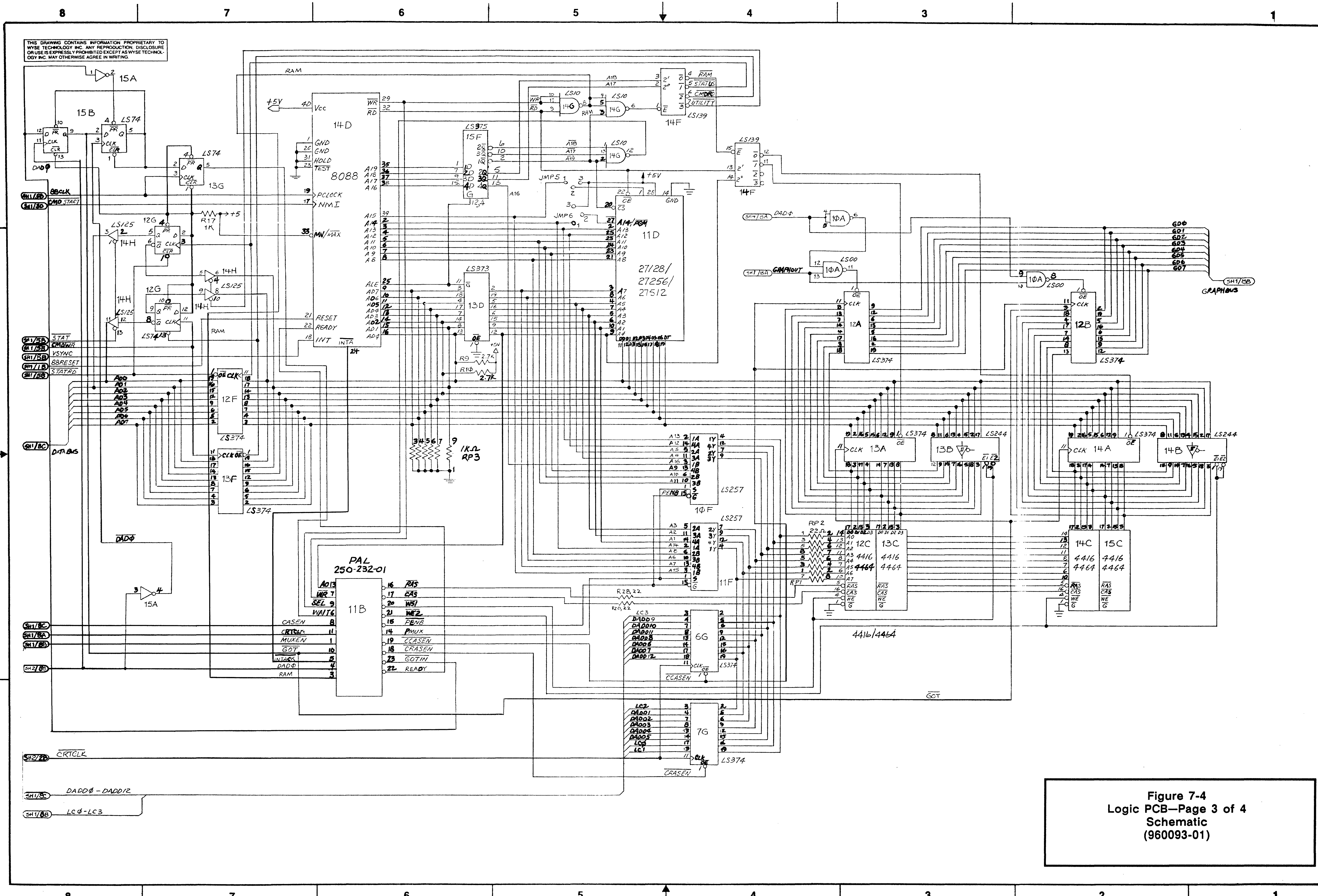


Figure 7-4
Logic PCB—Page 3 of 4
Schematic
(960093-01)

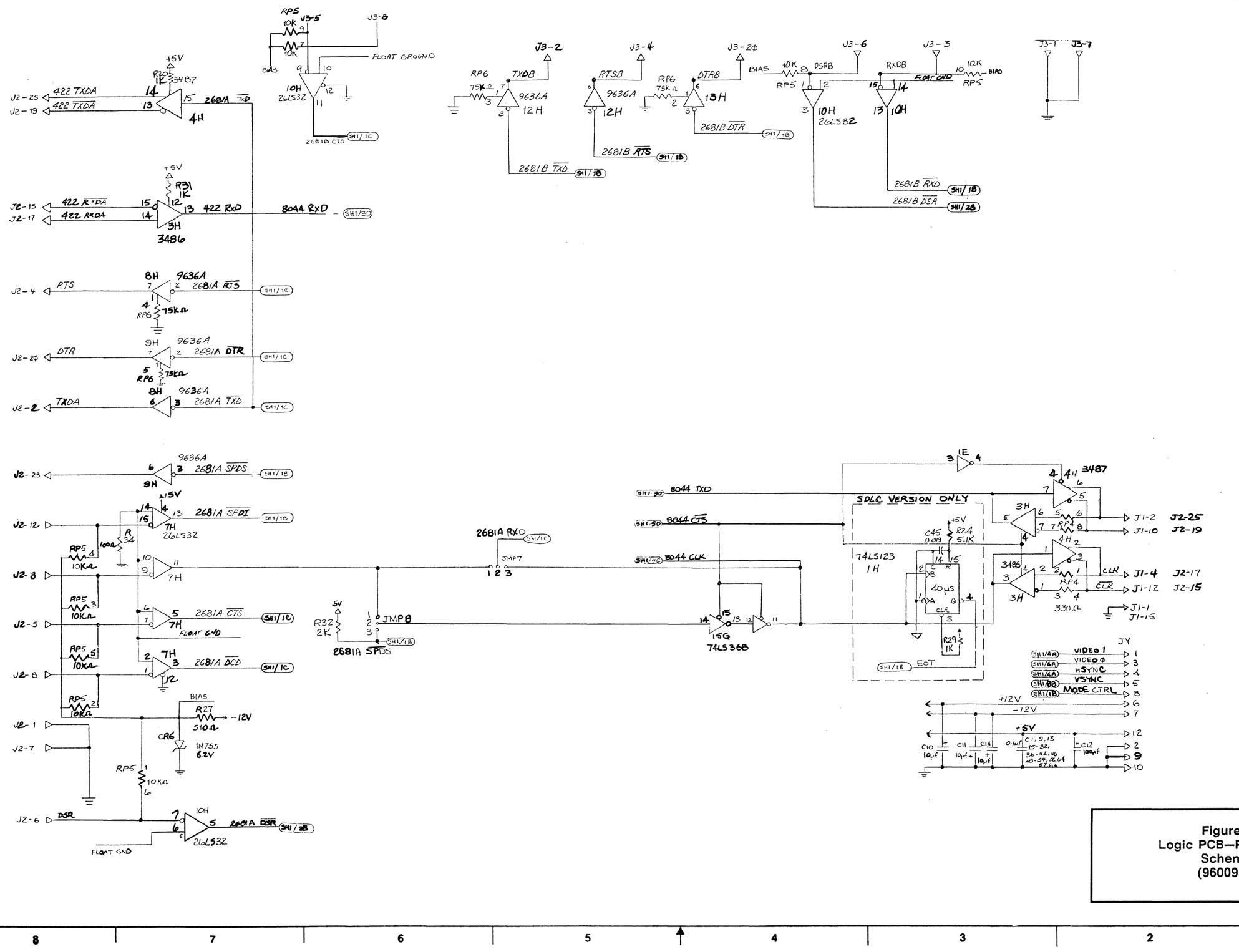


Figure 7-4
Logic PCB—Page 4 of 4
Schematic
(960093-01)

PIN	SIGNAL
1	VIDEO
2	GND
3	DIM
4	H-SYNC
5	V-SYNC
6	+12
7	-12
8	+5V
9	GND
10	GND
11	NC/-23V
12	+5V

Figure 7-5
Monitor/Power Supply PCB Schematic
(960101-01)

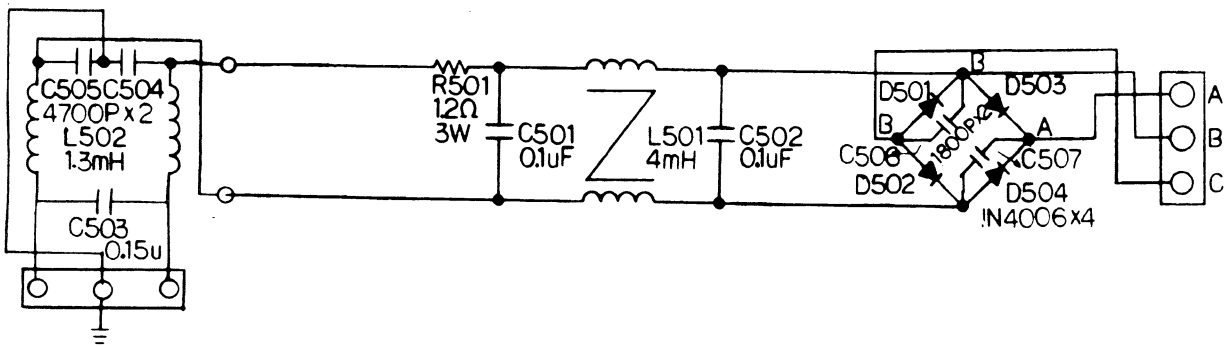


Figure 7-6
Filter PCB
Schematic
(960102-01)

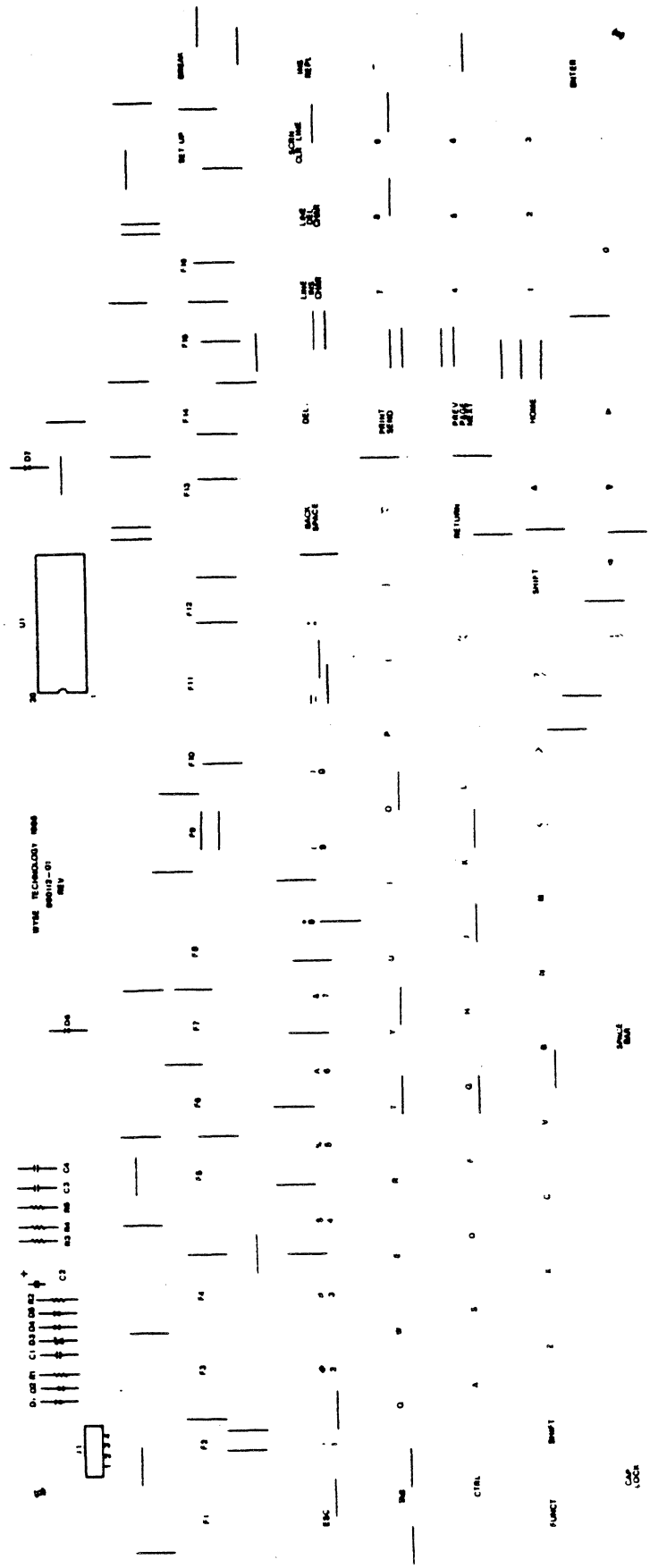


Figure 7-7
Keyboard PCB—ASCII Style
Layout
(990112-01)

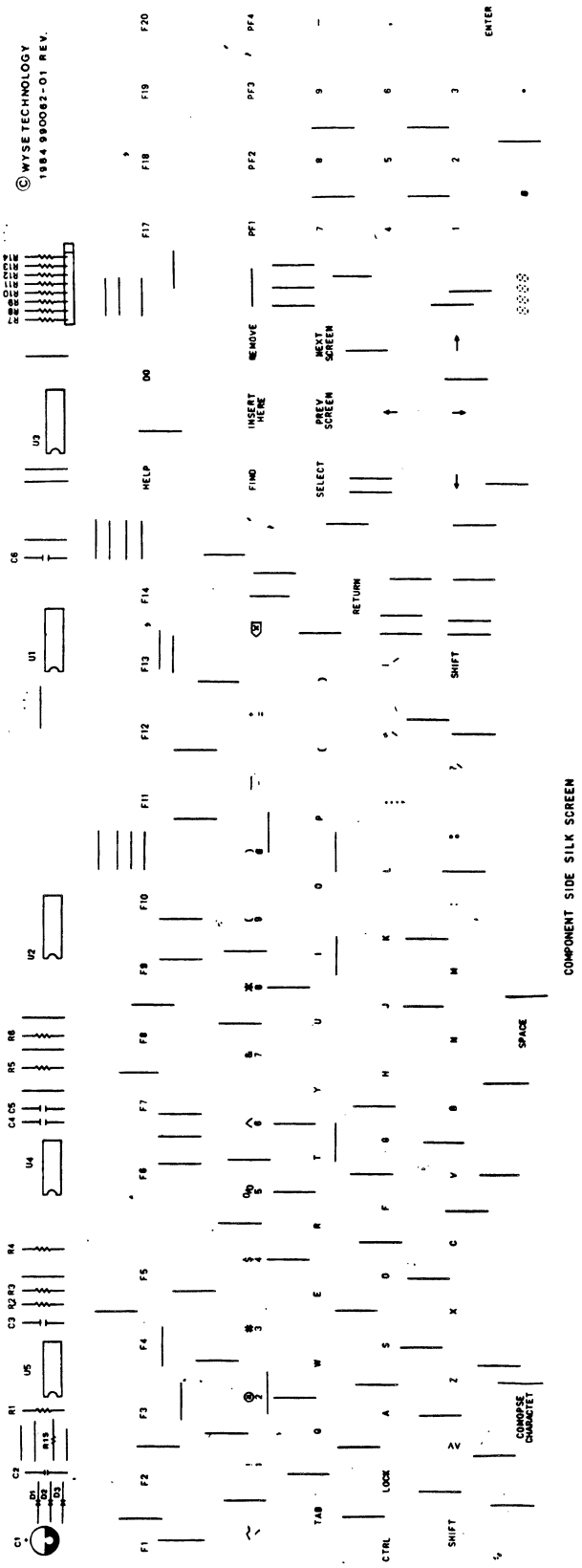


Figure 7-8
Keyboard PCB—VT220 Style Layout
(990062-01)

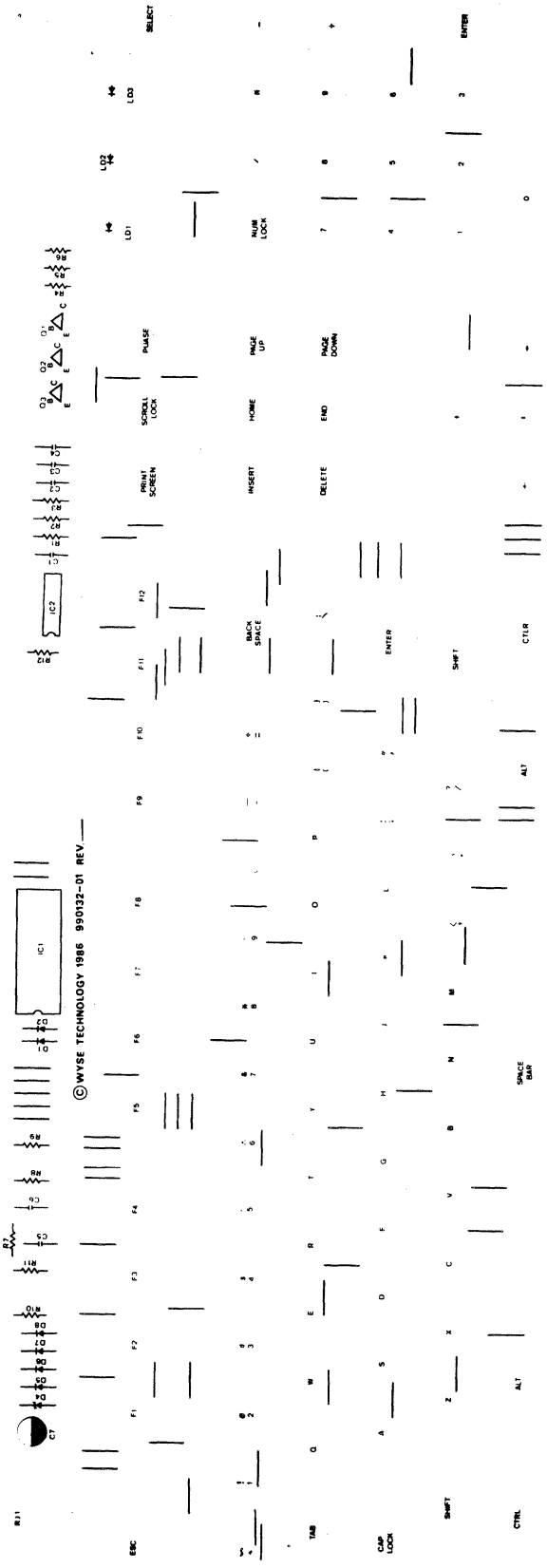


Figure 7-9
Keyboard PCB—PC Enhanced Style
Layout
(990132-01)

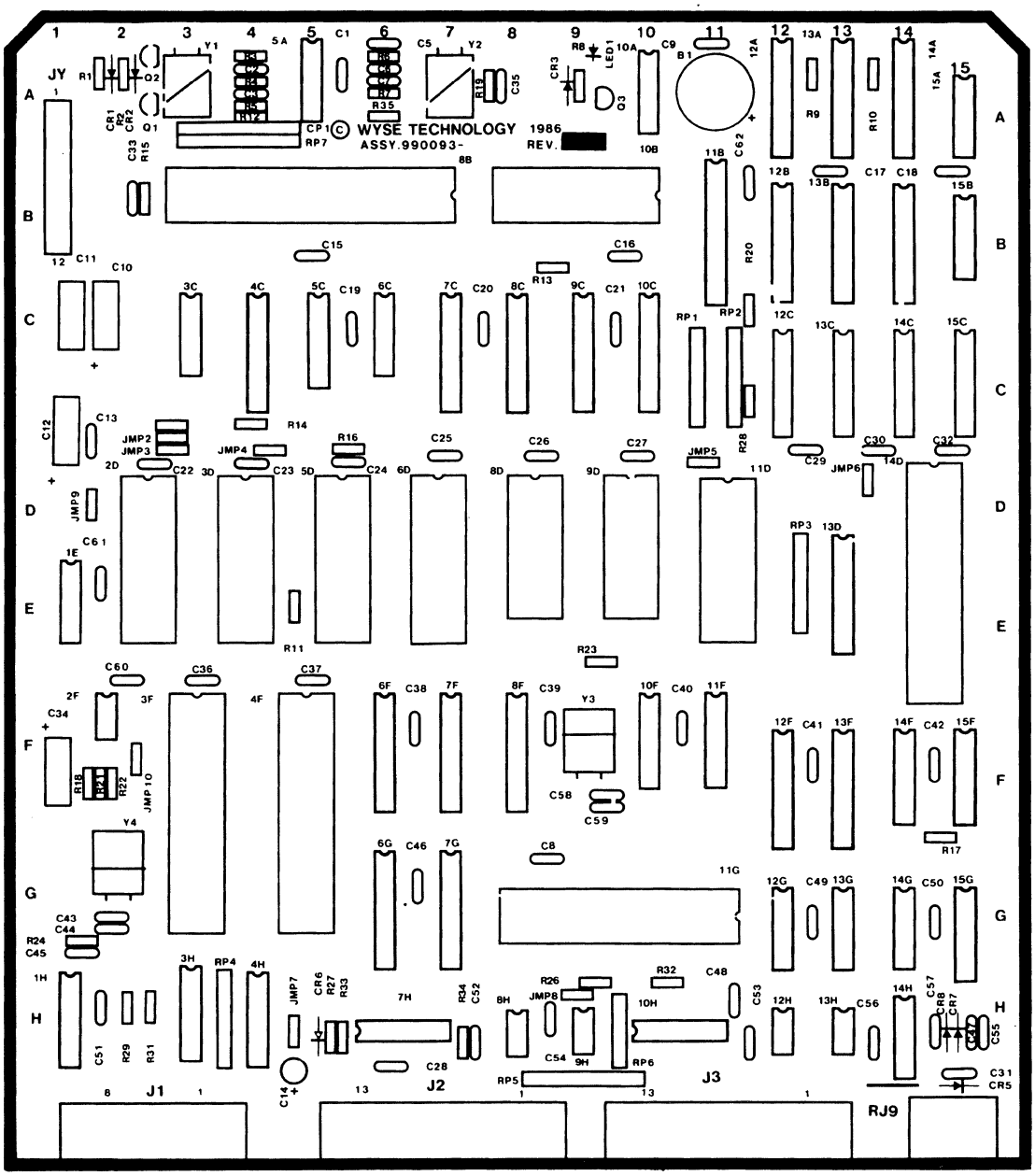


Figure 7-10
Logic PCB
Layout
(990093-01)

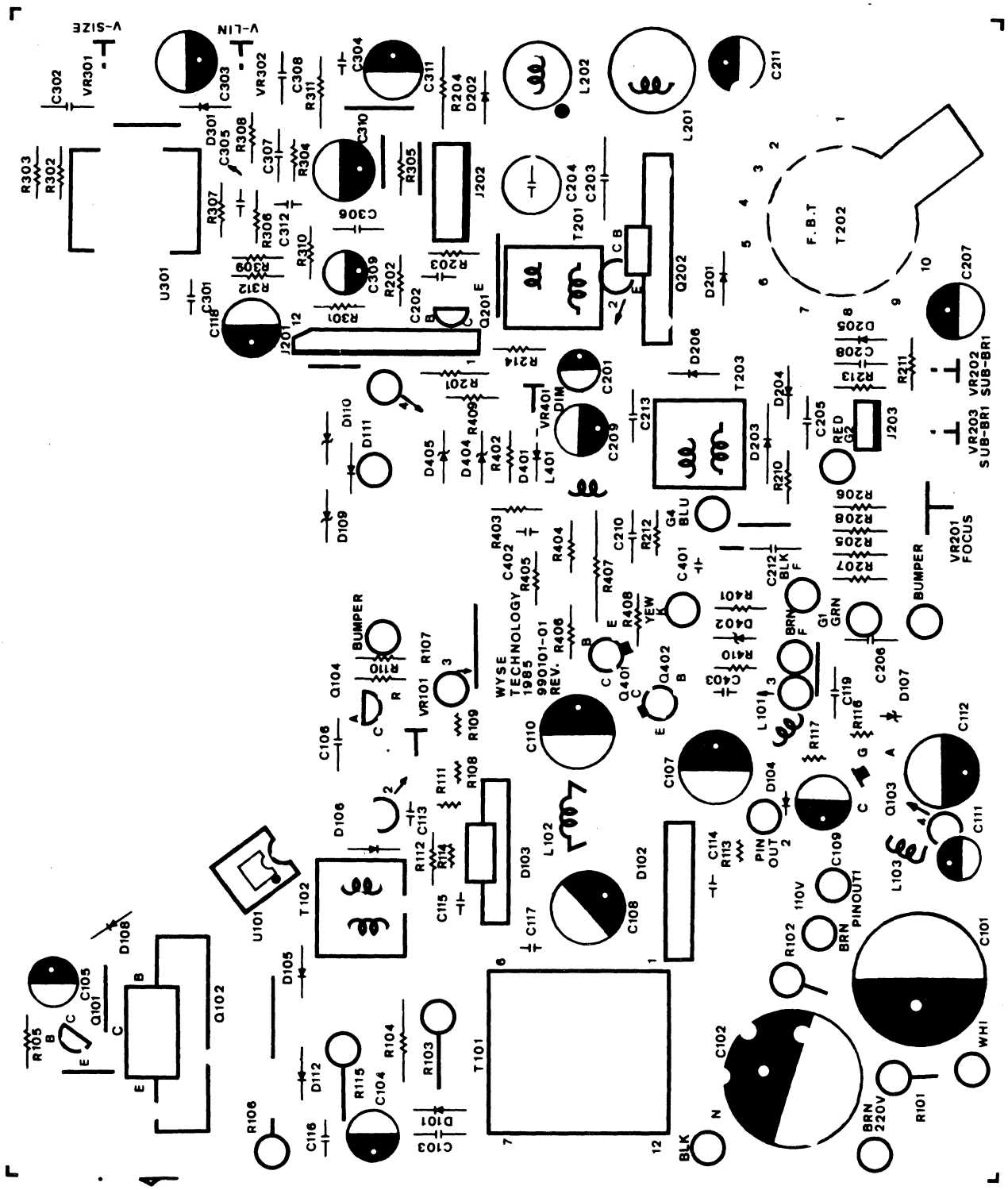


Figure 7-11
Monitor/Power Supply PCB
Layout
(990101-01)

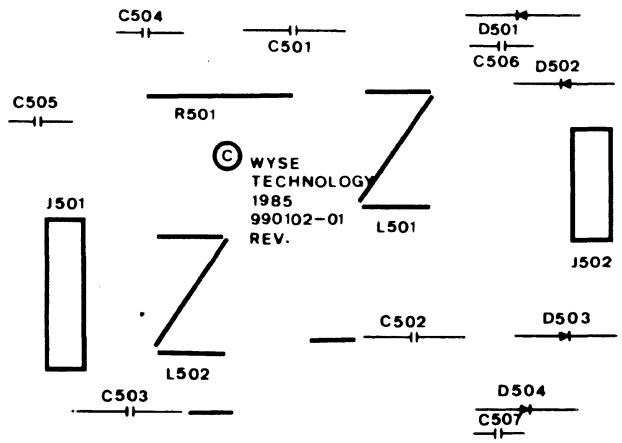


Figure 7-12
Filter PCB
Layout
(990102-01)

Appendix **A**

Specifications

Power Requirements	Line Voltage	115/220 VAC
	Line Frequency	50/60 Hz
	Power Consumption	42 watts
	Fuse	250 V, 2.0 ampere fast blow
Operating Requirements	Ambient Air Temperature	+10 to +35 degrees Centigrade
	Storage Air Temperature	−40 to +60 degrees Centigrade
	Operating Altitude	10,000 feet ASL
	Nonoperating Altitude	40,000 feet ASL
	Environmental Humidity	20 to 80%, noncondensing
Scan Frequency	Horizontal, 60 Hz	22.00 to 23.00 kHz 22.500 kHz nominal
	Vertical, 60 Hz	59.994 to 60.006 Hz 60.000 Hz nominal
	Horizontal, 70 Hz	22.498 kHz to 22.502 kHz 22.5 kHz nominal
	Vertical, 70 Hz	70.086 Hz to 70.100 Hz 70.093 Hz nominal
Display Time	Horizontal, 60 Hz	44.44 µs
	Vertical, 60 Hz	16.66 ms
	Horizontal, 70 Hz	34.9 µs
	Vertical, 70 Hz	11.555 ms
Resolution		
	80-column mode:	
	Horizontal	800 dots
	Vertical	338 lines
	132-column/graphics mode:	
	Horizontal	1188 dots
	Vertical	672 lines
	PC Graphics mode:	
	Horizontal	720 dots
	Vertical	348 lines

Appendix A

	CGA mode:	
	Horizontal	640 dots
	Vertical	200 lines
	Tektronix 4010/4014 mode:	
	Horizontal	800 dots
	Vertical	312 lines
Display Format	80-column mode:	
	Horizontal	80 character columns
	Vertical	26 character rows
	132-column mode:	
	Horizontal	132 character columns
	Vertical	26 character rows

Font Cell	80-column mode:	60 Hz	70 Hz
	Horizontal	10 pixels	10 pixels
	Vertical	13 pixels	10 pixels
	132-column mode:		
	Horizontal	9 pixels	10 pixels
	Vertical	13 pixels	10 pixels

Retrace Time	Horizontal	7.2 μs
	Vertical	1.0 ms
Display Size	Horizontal	238 mm, +2.38 mm
	Vertical	176 mm, +2.38 mm
Display Intensity, Nominal	Bold	50 fL
	Normal	33 fL
	Dim	17 fL

Contrast Bold is at least 8 fL brighter than Normal, Dim is at least 8 fL dimmer than Normal. Bold is never more than 60 fL.

Linearity	Horizontal	12%
	Vertical	10%
Centering	Margin Tolerance	+4.00 mm
	Pincushion and Tilt	+1.19 mm

Warm-up Time 30 minutes

EMI Specifications FCC Rules and Regulations, Part 15, Subpart J, Class A

Specifications

Regulatory Agency Approvals	UL 478 CSA C22.2, no. 154 approved VDE 0871/0806 IEC 380	
Terminal Dimensions	Height Weight Width	12.0 in. 12.5 lbs. 12.75 in.
Movement	Tilt and swivel	
Phosphor	P–134 amber	
Synchronization	TTL levels	
Character Attributes	Blink, underline, reverse, blank, normal, and dim intensities	
Screen Attributes	Blink, underline, reverse, blank, normal, and dim intensities	

Appendix B

Connector Pin Assignments

The MODEM and AUX port connector pin assignments are listed in these tables.

Table B-1 MODEM Port Pin Assignments

Pin	Mnemonic	Signal
1	PGND	Shield Ground
2	TXD	Transmit Data (output) (RS-232/423)
3	RXD	Receive Data (input) (RS-232/423)
4	RTS	Request to Send (output)
5	CTS	Clear to Send (input)
6	DSR	Data Set Ready
7	SGND	Signal Ground
8	DCD	Data Carrier Detect (input)
12	SPDI	Speed Indicator
15	RX-	Receive Data - (RS-422)
17	RX+	Receive Data + (RS-422)
19	TX-	Transmit Data - (RS-422)
20	DTR	Data Terminal Ready (output)
23	SPDS	Speed Select (output)
25	TX+	Transmit Data + (RS-422)

Table B-2 AUX Port Pin Assignments

Pin	Mnemonic	Signal
1	PGND	Shield Ground
2	TXD	Transmit Data (output)
3	RXD	Receive Data (input)
4	RTS	Request to Send (output)
5	CTR	Clear to Send
6	DSR	Data Set Ready (input)
7	SGND	Signal Ground
20	DTR	Data Terminal Ready

Appendix C Test Connectors

This appendix describes the connection, signals connected, and the type of connector hood needed to make the test connectors referred to in Chapters 4 and 5.

MODEM Port

Use a male DB-25 pin connector. Connect these pins (signals):

Pin 2 to Pin 3	(TxD to RxD)
Pin 4 to Pin 5	(RTS to CTS)
Pin 6 to Pin 8	(DSR to DCD)
Pin 8 to Pin 20	(DCD to DTR)
Pin 12 to Pin 23	(SPDI to SPDS)
Pin 15 to Pin 19	(RS-422 RXD– to TXD–)
Pin 17 to Pin 25	(RS-422 RXD+ to TXD+)

AUX Port

Use a male DB-25 pin connector. Connect these pins (signals):

Pin 2 to Pin 3	(TxD to RxD)
Pin 4 to Pin 5	(RTS to CTS)
Pin 8 to Pin 20	(DCD to DTR)

Index

E

F

G

H

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