WY-85
Maintenance
Manual

WYSE

WY-85 Maintenance Manual

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FCC Notice   **Warning:** this equipment generates, uses, and
can radiate radio frequency energy, and if
not installed and used in accordance with the
instruction manual, may cause interference to
radio communications. It has been tested and
found to comply with the limits for a Class A
computing device pursuant to Subpart J of
Part 15 of FCC Rules, which are designed to
provide reasonable protection against such
interference when operated in a commercial
environment. Operation of this equipment in
a residential area is likely to cause
interference, in which case the user, at his
own expense, will be required to take whatever
measures may be required to correct the
interference. If this equipment does cause
interference to radio or television reception,
which can be determined by turning the equipment
off and on, try to correct the interference by
one or more of the following measures:

o   Reorient the receiving antenna

o   Relocate the terminal in relation to the
       receiver

o   Plug the terminal into a different
       outlet so that terminal and receiver are
       on different branch circuits

OVERVIEW

This maintenance manual contains information regarding service
and repair of the WY-85 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 four appendices.
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.

Here is a summary of the manual:

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, "Troubleshooting," tells you what to look for and how
to fix problems with the terminal. This chapter includes a list
of tools needed for troubleshooting, a quick reference guide, and
a flowchart.

Chapter 4, "Alignment and Adjustments," describes power supply and
monitor adjustments that control the quality of the display.

Chapter 5, "Illustrated Parts List," includes a list of monitor
and keyboard assembly parts.

Chapter 6, "Theory of Operations," describes terminal operation.

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

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

Appendix B, "Connector Pin Assignments," lists the signals on each pin of the COMM, PR, 20mA, TEST, and KYBD 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.

Appendix D, "Display Inspection with the Reticle," describes how to check the display tolerances if you have a video inspection reticle.

REFERENCE MANUALS

These publications provide additional information about the terminal:

WY-85 User's Guide, Document No. 88-060-01

WY-85 Programmer's Guide, Document No. 88-060-02

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1 GENERAL INFORMATION

This chapter consists of an introduction to the WY-85 terminal
and includes a physical description of the terminal as well a
discussion about telecommunications, environmental considerations,
operator controls, and setup parameters.

INTRODUCTION

The WY-85 is a compact, high-performance, low-cost terminal compatible with the VT220. The terminal consists of a monitor console and a detachable keyboard from which data can be entered for display on the cathode ray tube (CRT). All of the electronics needed to support the monitor and keyboard are contained within the monitor console and pedestal.

In addition to the CRT and keyboard, the terminal contains three independent telecommunications interfaces. You can connect peripherals, like a hard-copy printer, to the terminal with these connectors on the rear panel.

All components are organized around the microprocessor found on the logic printed circuit board (PCB). The microprocessor controls all internal data manipulation and processing functions. Figure 1-1 is a simplified block diagram of the terminal.

Figure 1-1 Simplified Block Diagram
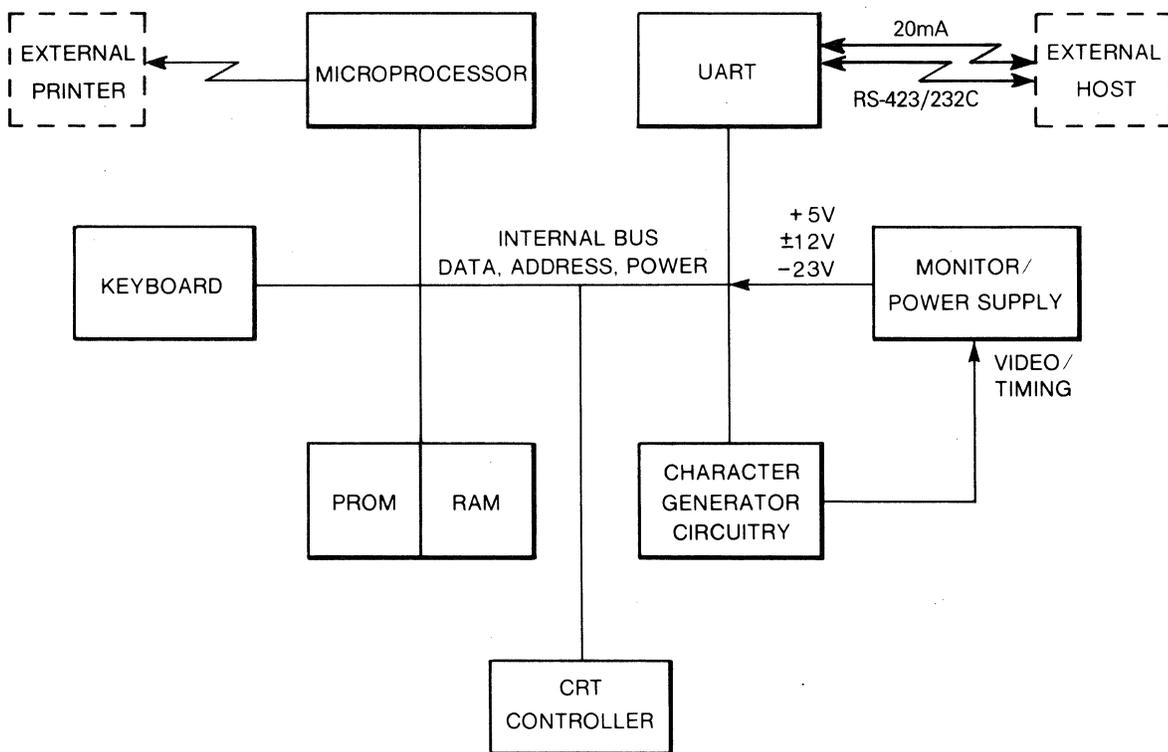
HIGH-LEVEL FUNCTIONAL DESCRIPTION

The terminal consists of a microprocessor, a CRT controller, associated control logic, and input/output (I/O) devices. This circuitry is mounted on a single PCB in the monitor console pedestal. The microprocessor controls all basic functions. The microprocessor PCB generates timing and control signals for the CRT. The deflection, high-voltage, and power supply circuitry are located on a single printed circuit board that sits just below the neck of the CRT. Cabling connects the microprocessor PCB and the monitor/power supply PCB.

MICROPROCESSOR

The heart of the terminal is an 8-bit, single-component microprocessor that has 256 bytes of random-access memory (RAM), 32 I/O lines, three 16-bit counter/timers, a full-duplex universal asynchronous receiver/transmitter (UART), and integral interrupt and clock circuitry. The microprocessor uses an external eraseable programmable read-only memory (EPROM) for program storage. In addition to EPROM, a buffer consisting of up to 8K of RAM holds display information. The microprocessor, CRT controller, and telecommunications interface electronics are attached to a bidirectional bus. These circuits can perform their functions independently while interfacing with the microprocessor or the memory on a direct-memory access (DMA) or interrupt basis.

MEMORY

The memory consists of RAM, EPROM, and electrically aterable read-only memory (EAROM). The RAM stores display information, which is repeatedly read from memory by the CRT controller. This information refreshes the CRT screen. The EPROM stores programs and contains the power-up and self-test routines. The EAROM stores the operator's setup parameters (such as baud rate and parity). The microprocessor has an address range capability of 64K. In addition to this addressing range capability, the microprocessor treats external program storage (EAROM) separately. (It has its own enable line.) This means that an external EPROM can use an additional 64K of memory space without infringing on the space available for I/O or RAM. Figure 1-2 is a memory map for the terminal. Note that the EPROM is not shown in the figure because it does not occupy I/O or memory address space.

Figure 1-2 Memory Map

HEX ADDRESS

0000H	0FFFH	1st K OF RAM
1000H	1FFFH	
4000H	4FFFH	CRT CONTROLLER
5000H	5FFFH	
6000H	6FFFH	S.I.O. (UART)
7000H	7FFFH	
8000H	8FFFH	ROW BUFFER DIAGNOSTIC REGISTER
9000H	9FFFH	
A000H	AFFFH	KEYBOARD LATCH
B000H	BFFFH	
C000H	CFFFH	EAROM
D000H	DFFFH	
E000H	EFFFH	UNASSIGNED
F000H	FFFFH	

RAM

CRT CONTROLLER

UART

ROW BUFFER
DIAGNOSTIC REGISTER

KEYBOARD

EAROM

The standard RAM capacity is 8K and consists of four 2K x 8 RAM. Each 2K x 8 RAM has 2K of address space. The lower RAM address range is 000H to FFFH; the upper RAM address range is from 1000H to 1FFFH. The system firmware addresses RAM from 000H to FFFH in order to access 4K of unique contiguous character locations. The system firmware addresses RAM from 1000H to 1FFFH in order to access 4K of unique contiguous attribute locations.

INPUT/OUTPUT DEVICES

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

Keyboard

The keyboard consists of 105 keys mounted on a single-sided printed-circuit board. All keys have full-travel, hard-contact switches. The microprocessor periodically scans the keys, checking for a key closure. Figure 1-3 illustrates the terminal's keyboard. Look for a detailed description of its operation in Chapter 6.

Figure 1-3   Keyboard
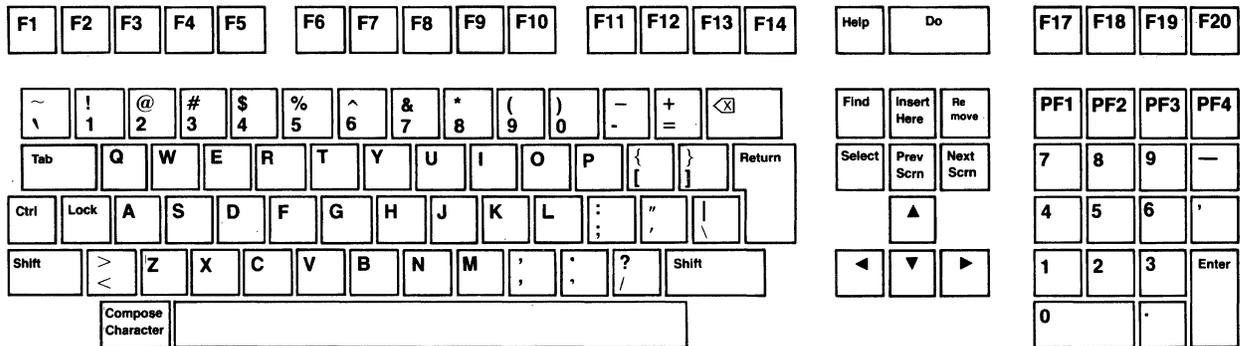
CRT

The terminal has a 14-inch CRT that displays 24 lines of characters (either 80 or 132 columns) and two control lines (one for terminal status and the other for setup fields). The CRT controller reads displayed characters from RAM on a DMA basis. The CRT/monitor housing contains an integral power supply that provides power for the rest of the logic board.

TELECOMMUNICATIONS

The terminal has two independent, asynchronous interfaces that conform to the EIA standard RS-232C/RS-423. Data rates can be set independently for either interface. The operator-controlled parameters are defined in the setup procedures in this chapter. The primary (COMM) interface can communicate at data rates up to 38.4K bps. The PR interface can communicate at data rates up to 19.2K bps.

ENVIRONMENTAL CONSIDERATIONS

The terminal can be placed on a table, desktop, or any other vibration-free horizontal surface free from lint and dust. Very bright room light or direct sunlight from a window can hinder the user's view of the display.

Figure 1-4 shows the terminal dimensions. Three inches of clearance are needed on all sides for ventilation.

Figure 1-4 Terminal Dimensions
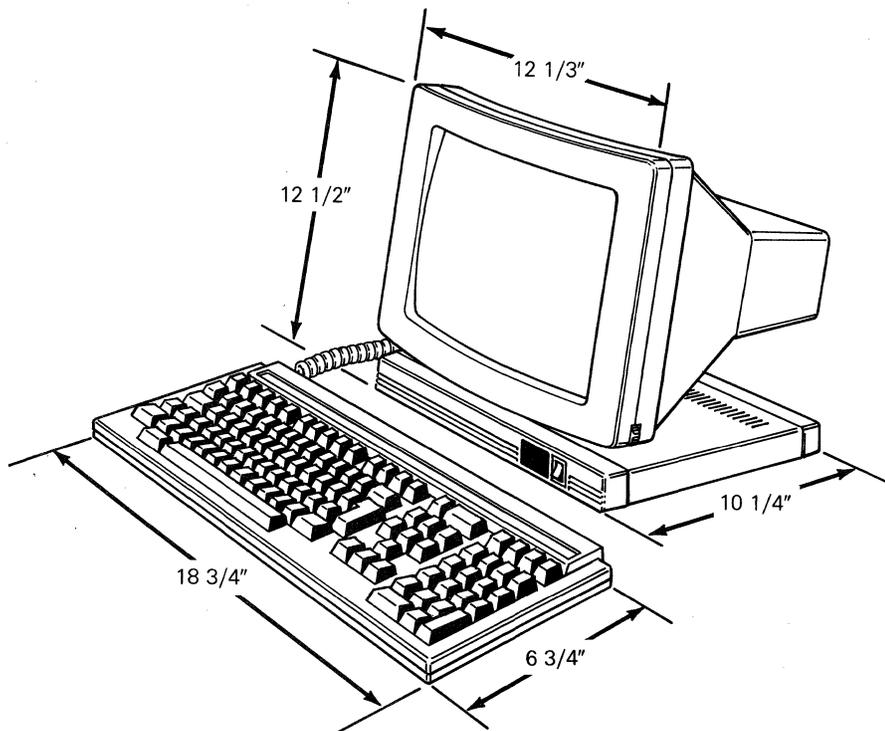
You can install the terminal next to most other types of electrical or electronic equipment without serious interference. Avoid locations near strong magnetic fields that can distort or interfere with operating or servicing the terminal.

Ambient room temperature should never exceed +35 degrees Celsius (+95 degrees Fahrenheit) when the terminal is on. No special cooling is necessary. Make sure the rear of the terminal has a free flow of air. Don't set it on sound-deadening devices that impede cooling air.

OPERATOR CONTROLS AND EXTERNAL INTERFACE

Figure 1-5 shows all operator controls and external interfaces, including the keyboard, power, and display brightness. It also points out the COMM and PR interface connectors.

Figure 1-5   Operator Controls

Operator Brightness

Power On/Off

Keyboard

Power Cord

FUSE   COMM   PR   20mA   TEST

KYBD
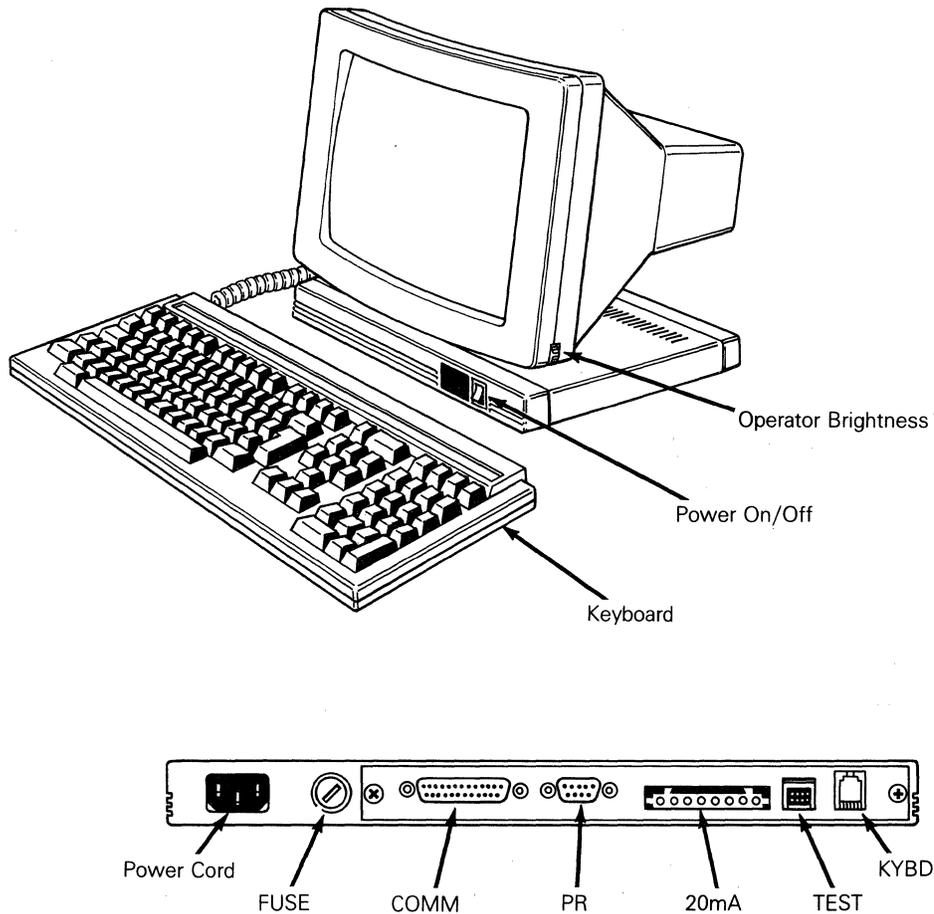
Keyboard

The keyboard should be plugged 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 microprocessor board, or both.

Caution--To prevent damaging the terminal, compare the voltage specified on the configuration label (on the back of the CRT enclosure) with the AC power source; they should match.

Power Cord

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

Communications Cable

Connect the communications cable from the computer or modem to
the COMM 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.

Connect a serial printer (if available) to the PR connector 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. You can find instructions
to change it in Chapter 2, "Removing and Replacing Components."

Power Switch

The power switch is on the right of the console pedestal.
Pressing the top of the switch turns on AC power.

Brightness Control

The brightness control is a thumbwheel located on the lower
right-hand corner of the CRT bezel. Rotating the wheel clockwise
increases the display brightness. Rotating it counterclockwise
decreases the 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-hand corner of the display. Any time you see the cursor on the screen, you can enter setup mode and change parameters.

Press the SETUP key (F3) to enter the setup mode. When entering setup mode, the terminal sends a handshake signal (either X-on/X-off or DTR, if enabled) to the computer; no data is lost. All screen data is saved and displayed during setup mode. The first setup level is the directory, from which you can enter all other major setup levels. From directory level, modes can be saved in nonvolatile memory or reset to their default values. This is the only level from which you can enter or leave setup mode.

In the directory level, the top screen line indicates the function of the keys active at that time; these functions may differ in the subsequent setup levels. (For example, in the directory level, the ENTER key selects the setup level you wish to enter; whereas, in another setup level, the ENTER key selects the next parameter choice for a highlighted field.) The bottom screen line displays modes (exit, save, recall, and default) and a list of setup levels.

To go from the directory to another setup level in which you wish to change a parameter, press the arrow left or arrow right key to choose the desired setup level. Once this setup level is high-lighted, press the ENTER key.

The terminal has 44 setup levels: levels zero through 43. Table 1-1 lists all the setup levels. Once in a setup level, the top screen line again indicates the function of the keys active at that level. The bottom screen line displays fields in which you may change the parameters in that particular setup level. You may also define data strings for specific functions if you have chosen the function key setup level.

Table 1-1 Setup Levels

Level	Display	Function
0	Directory	Main level; accesses other menus, saves data, and exits
1	Display One	Changes the visual display mode
2	Display Two	of the terminal
3	General One	Sets general terminal operating
4	General Two	characteristics [e.g., how the terminal interprets a pound (#) sign]

Table 1-1 Continued

Level	Display	Function
5	Communications One	Sets communications modes
6	Communications Two	and protocols
7	Printer One	Sets printer modes and protocols
8	Printer Two	
9	Keyboard One	Sets keyboard modes
10	Keyboard Two	
11	Send	Sets function keys and data transmission mode
12	Answerback	Defines answerback message
13	Tabs	Defines tab stops
14-28	F6 S to F20 S	Defines the shifted (S) function keys
29-43	F6 U to F20 U	Redefines the unshifted (U) function keys

To leave the setup mode from a setup level other than the directory, press the SETUP key once to get to the directory level and again to leave the setup mode. If you are already in the directory, press the SETUP key only once to leave the setup mode.

See the WY-85 User's Guide for more comprehensive setup instructions.

2 REMOVAL/REPLACEMENT PROCEDURES

We have organized this chapter to help you remove and replace
problem components and modules as quickly as possible.

OVERVIEW

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

1. Monitor module

    o   Monitor/power supply printed circuit board (PCB)

    o   Cathode ray tube (CRT)/yoke assembly

    o   External brightness potentiometer (operator control)

2. Keyboard module

    o   Keyboard

    o   Keyboard cable

    o   Keyboard PCB

3. Logic pedestal module

    o   Fuse

    o   AC power switch

    o   Logic PCB

Tools and Materials

If you have the materials and tools listed here, you will be prepared to remove and replace any of the parts or assemblies in this chapter.

Materials and Tools Required:

o   Standard fuse: 250 volts, 2 amperes

o   Tie wraps

o   Insulated flat-blade screwdriver, 12-inch

o   No. 1 Phillips screwdriver, 12-inch

o   No. 2 Phillips screwdriver

o   Multimeter (recommended)

o   Alligator clips

Figure 2-1 Three Major Modules Exploded View

Top Cover

CRT/Yoke Assembly

Bezel

Monitor/Power Supply

Keyboard

Keyboard Module

Monitor Module

Logic Pedestal

Logic PCB

Logic Module
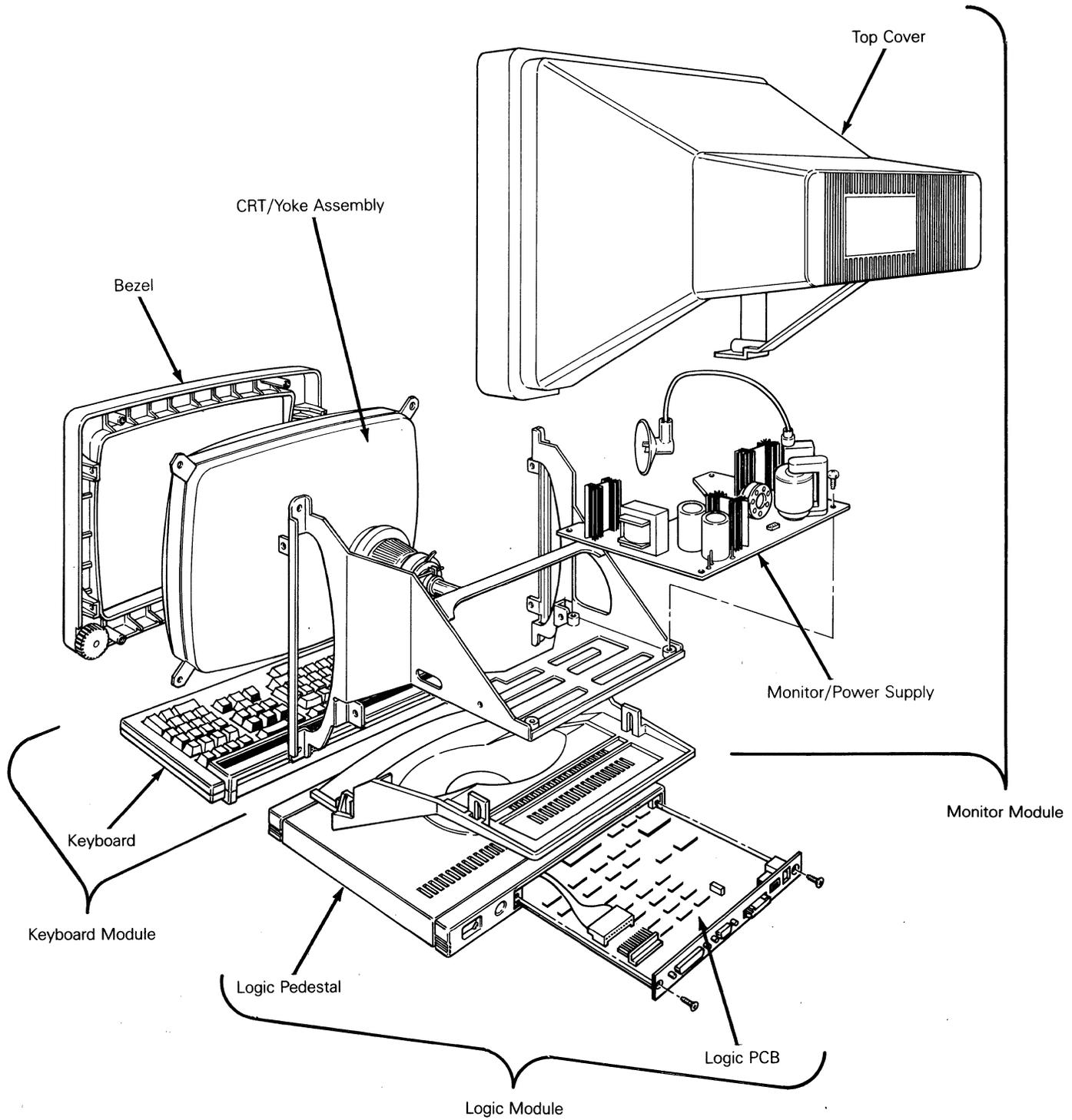
Before You Start

Before you remove or replace any terminal assemblies, take these steps:

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.

4. If you replace any modules in the monitor assembly, be sure to discharge the anode on the CRT beforehand. (See "Discharging the Anode," page 2-5.)

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

Figure 2-2   Orientation View of Terminal and Components
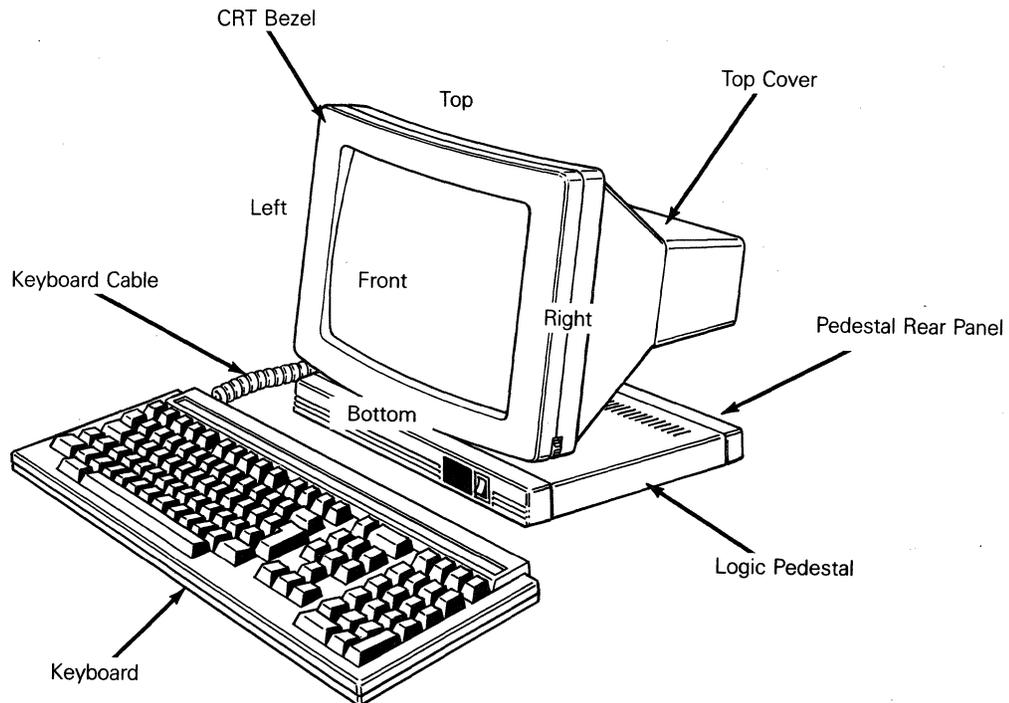
REMOVING AND REPLACING ASSEMBLIES IN THE MONITOR MODULE

This section describes procedures to remove the monitor/power supply PCB, the CRT/yoke assembly, and external brightness potentiometer. It is preceeded by an explanation of how to discharge the anode on the top of the CRT.

Discharging the Anode

If you have never discharged the anode, or need a review, see Figure 2-3 and follow the instructions below.

Figure 2-3 Discharging the Anode
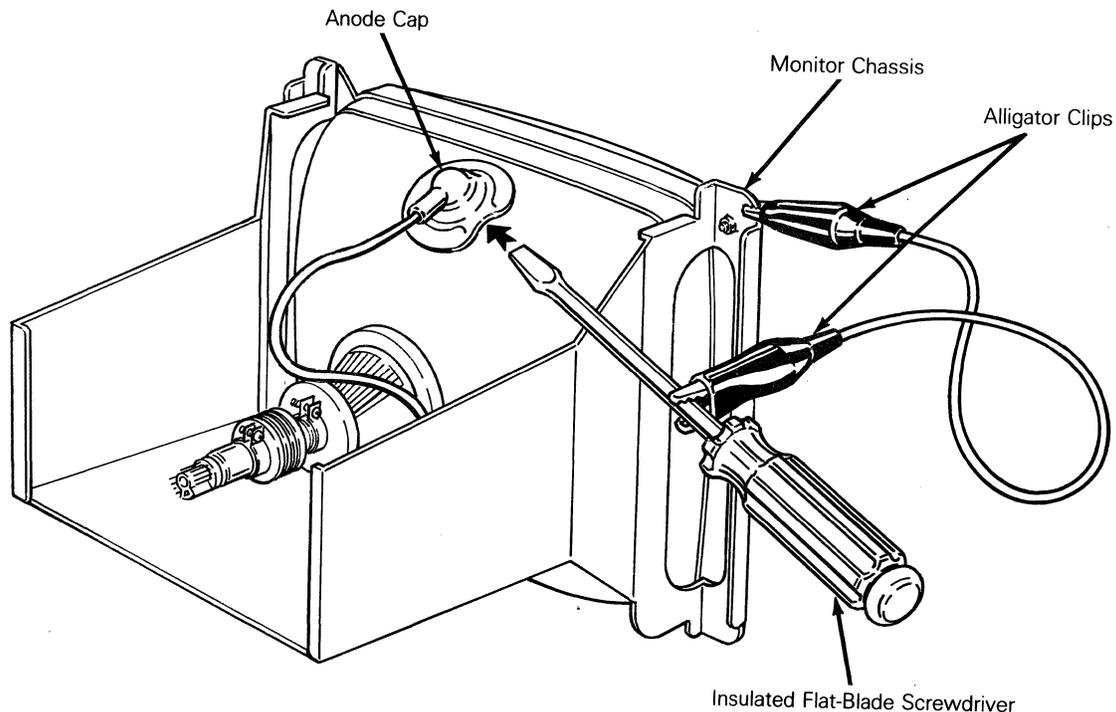
Before removing the CRT/yoke assembly from the chassis:

1.   Make sure to turn off the terminal and unplug it from its power source.

2.   Ground the shaft of a flat-bladed screwdriver to the terminal chassis with alligator clips.

3.   Slip the blade between the anode cap and the anode. Touch the blade to the wire anode leads under the cap. Listen for a popping or crackling sound.

4.   Remove the anode lead.

Before replacing the CRT/yoke assembly in the chassis:

1. 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 2-5.

2. Put the CRT/yoke assembly back into the chassis.

Monitor/Power Supply PCB

Tools Required:

o   No. 2 Phillips screwdriver, 12-inch

o   Insulated flat-blade screwdriver, 12-inch

o   Alligator clips

Warning--High voltage is present. Only qualified service personnel should service the terminal.

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 CRT cover in place (one screw in each corner).

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

4. Disconnect the logic PCB wiring harness.

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

5. 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 2-5.

6. Disconnect the CRT anode.

7. Disconnect the brightness potentiometer wiring harness (Figure 2-4).

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 CRT frame (one in each corner).

12.   Slide the PC board out of the rear of the CRT frame.

      Caution--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 2-5.

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

14.   When you replace the monitor/power supply PCB, realign the
      CRT. See Chapter 4, "Adjustments and Alignments," for
      alignment information.

Figure 2-4   Monitor/Power Supply and Chassis
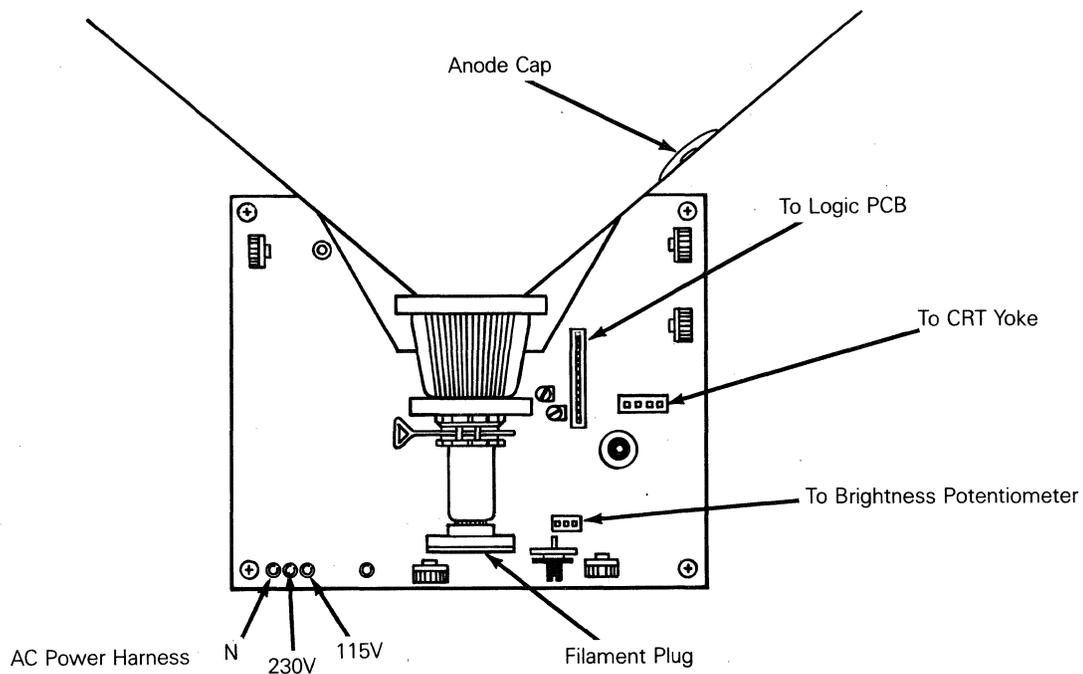
CRT/Yoke Assembly

Tools Required:

o   No. 1 Phillips screwdriver, 12-inch

o   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 2-5):

1.   Disconnect the terminal from its AC power source.

2.   Remove the four Phillips screws which hold the CRT cover in place (one screw in each corner).

3.   Hold the CRT cover 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 2-5.

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 with 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 chassis around the CRT screen.

11. Remove the CRT/yoke assembly from the chassis.

Caution--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.

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 CRT. See Chapter 6, "Theory of Operations," for
alignment information.

Figure 2-5 CRT/Yoke Assembly
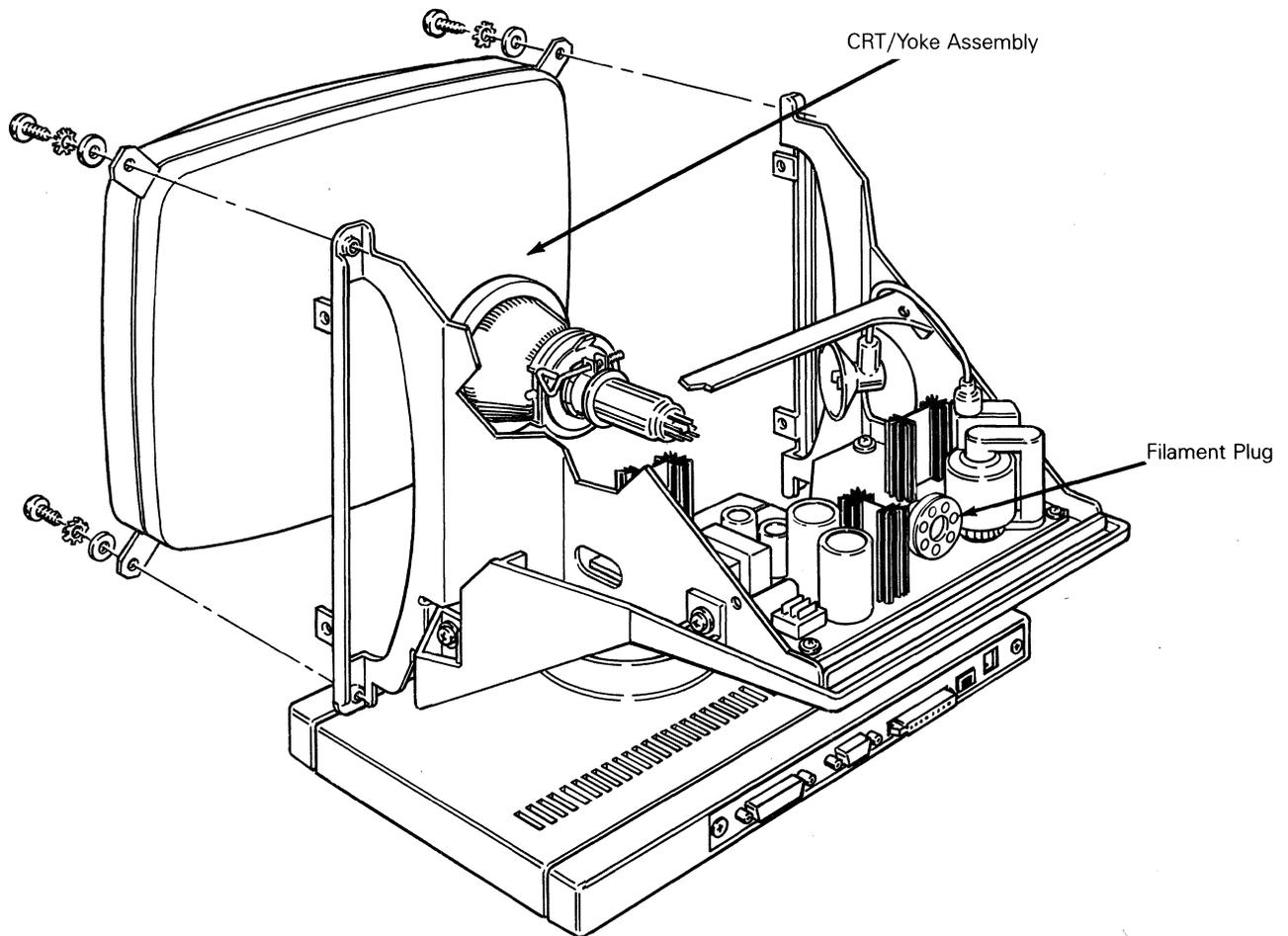
External Brightness Potentiometer

Tools Required:

o   No. 1 Phillips screwdriver, 12-inch

o   Tie wraps

To replace the brightness potentiometer:

1.   Disconnect the terminal from its AC power source.

2.   Remove the four No. 1 Phillips screws holding the CRT cover in place.

3.   Hold the CRT cover 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 CRT 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 by reversing the order of disassembly.

Figure 2-6   Operator Brightness Potentiometer

Bezel

Brightness Potentiometer Wiring Harness

Brightness Potentiometer
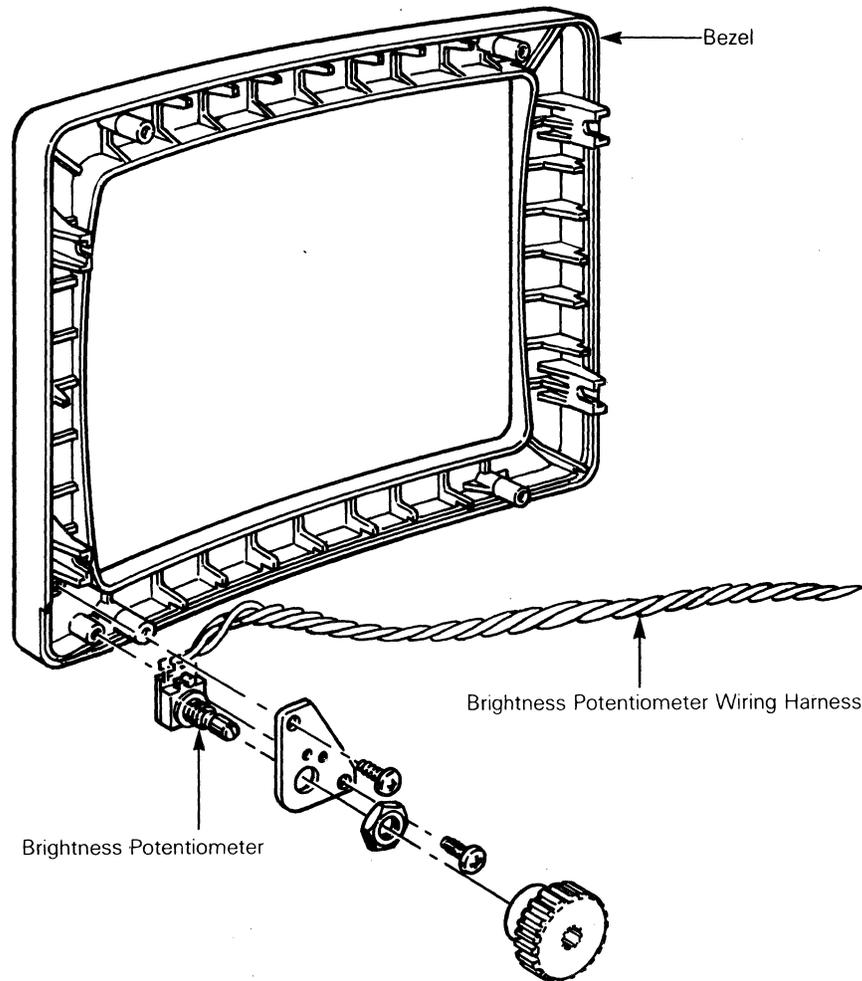
REMOVING AND REPLACING ASSEMBLIES IN THE KEYBOARD MODULE

This section describes procedures to remove the keyboard, keyboard cable, and keyboard PCB.

Keyboard

Tools Required: none

To replace the keyboard (see Figure 2-7):

1.   Disconnect the terminal from its AC power source.

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

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

Figure 2-7 Keyboard Assembly

Adjustable Foot

Bottom Cover

Printed Circuit Board

Rubber Foot

Cable Connector

Top Cover

Function Label
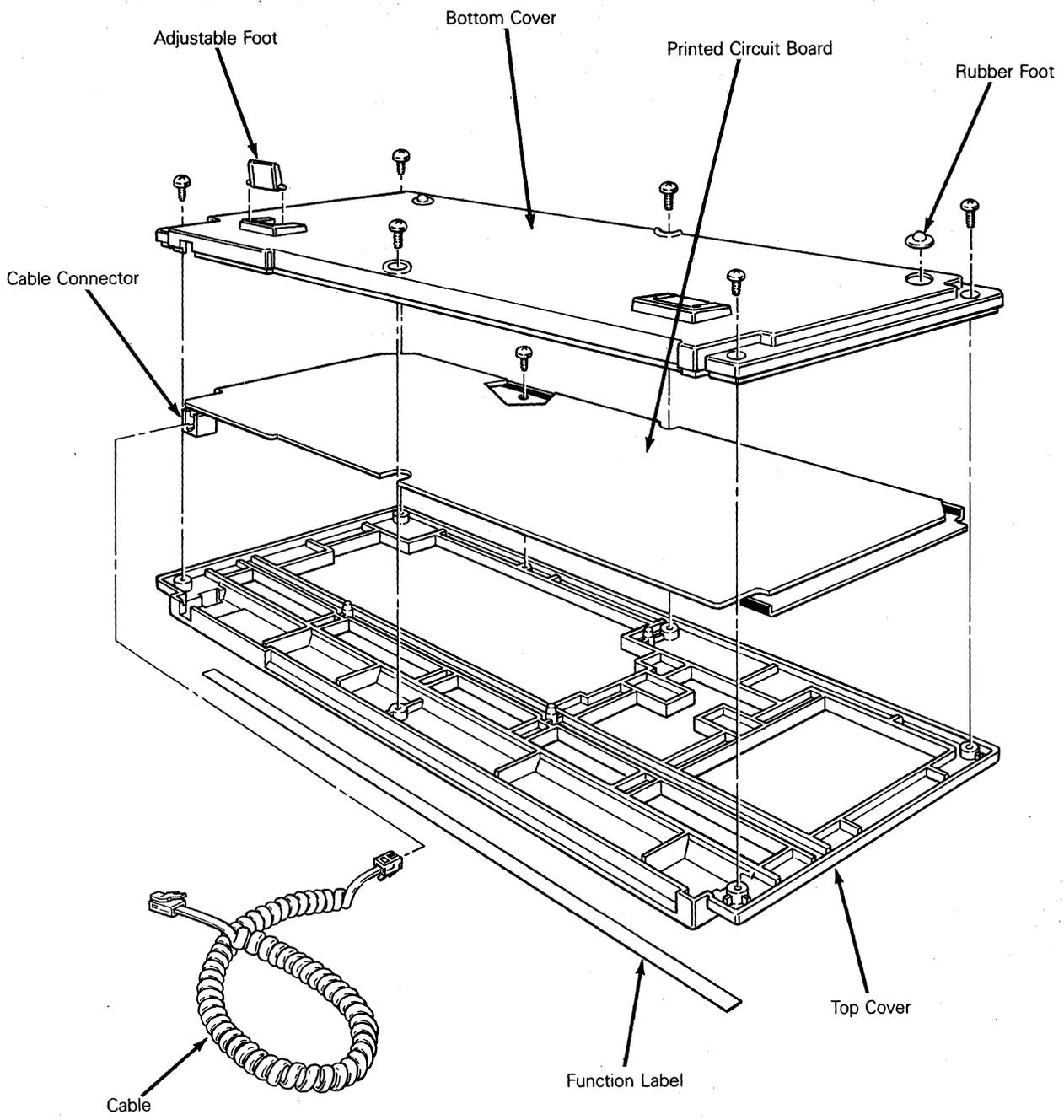
Cable

Keyboard Cable

Tools Required: none

To replace the keyboard cable (see Figure 2-7):

1. Turn the terminal off.

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

3. Press the other keyboard cable connector tab and pull the keyboard cable out of the rear panel of the logic pedestal.

4. Insert one end of the new keyboard cable into the keyboard connector. Insert the other end into the rear panel of the logic pedestal.

Keyboard PCB

Tools Required: No. 2 Phillips screwdriver

To replace the keyboard PCB (see Figure 2-7):

1. Turn the terminal off.

2. Unplug the keyboard cable from the keyboard.

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

4. Lift off the keyboard bottom cover.

5. Remove the No. 2 Phillips screw beneath the space bar holding the keyboard top cover to the PCB assembly. Lift the PCB assembly out of the keyboard cover.

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

7. Replace the No. 2 Phillips screw that holds the PCB assembly in place.

8. Reattach the bottom cover of the keyboard assembly.

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

Tools Required:

o   Flat-blade screwdriver

o   Standard fuse: 250 volts, 2 amperes

o   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 slotted screwdriver. Twist the fuse holder clockwise until it locks in place.

Figure 2-8   Fuse Location

Rear Panel

Fuse

Fuse Holder
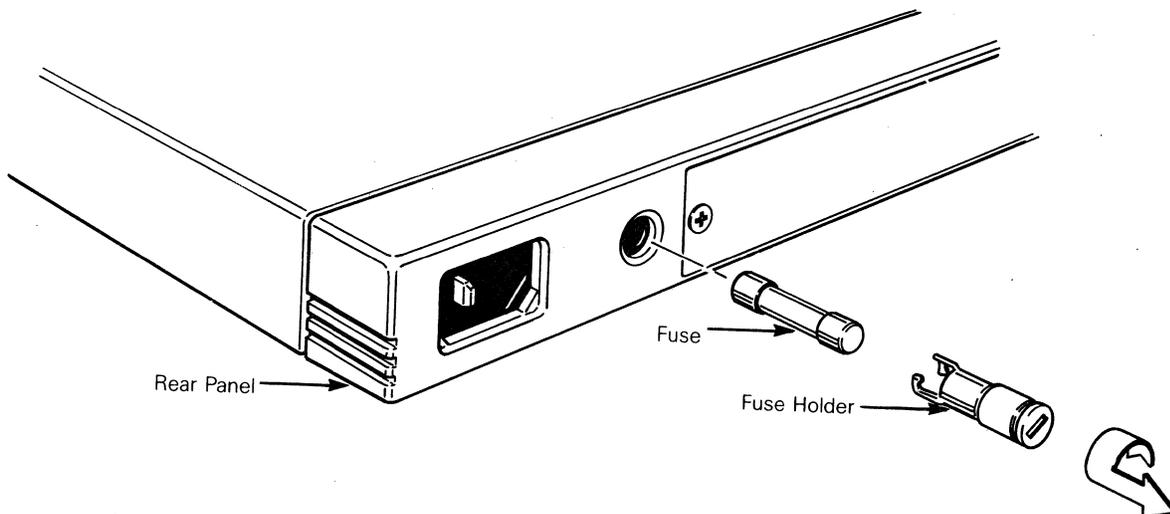
AC Power Switch

Tools Required:

o   No. 1 Phillips screwdriver

o   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 display pedestal.

Figure 2-9   AC Power Switch Removal

AC Power Switch

Metal Base Plate

Display Pedestal
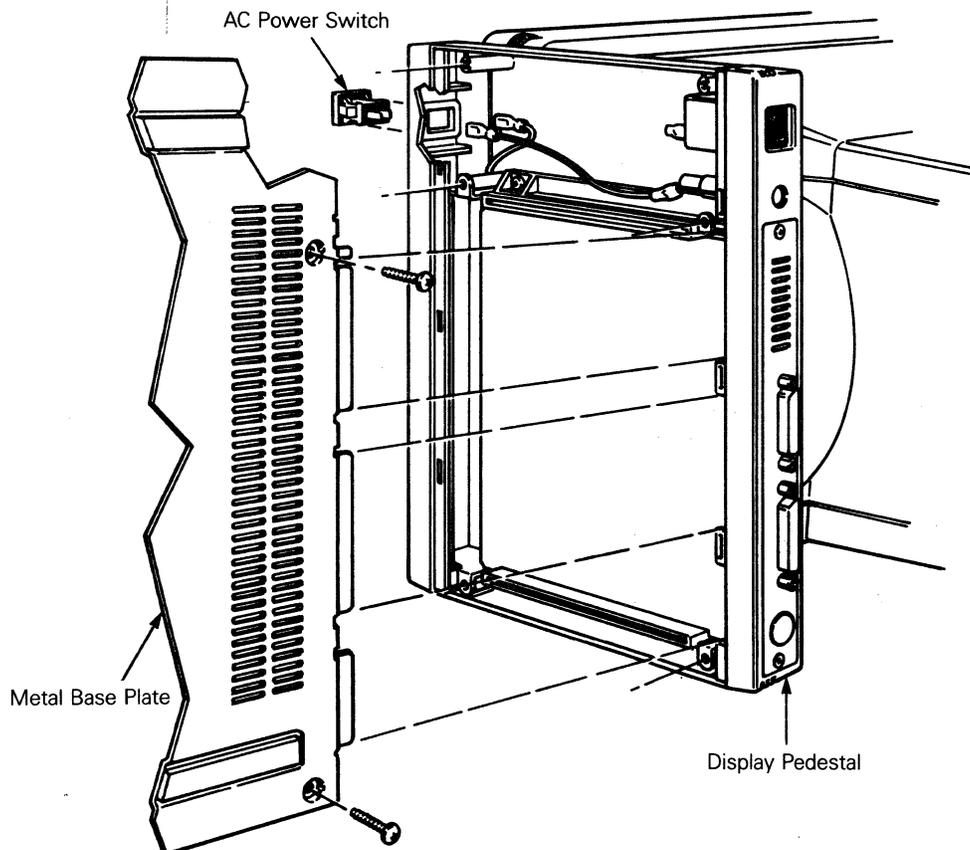
4.   Lift the metal base plate free.

     Caution--The metal base plate tabs can break the display
     console plastic if they aren't handled carefully.

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

6.   Push the power switch out of the front of the display
     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 by reversing the order of
     disassembly.

Logic PCB

Tools required: No. 1 Phillips screwdriver

To replace the logic PCB:

1.   Disconnect the terminal from its AC power source.

2.   Disconnect the keyboard from the rear panel.

3.   Disconnect the printer and modem communications cables.

4.   Remove two No. 1 Phillips screws holding the rear panel in
     place.

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

6.   Disconnect connector J5 from the logic PCB. See Figure 2-10.

7.   Remove the logic PCB.

8.   Install the new logic PCB.

9.   Reassemble the logic pedestal by reversing the order of
     disassembly.

Figure 2-10 Logic Board Removal

Logic PCB

Display Pedestal

Rear Panel
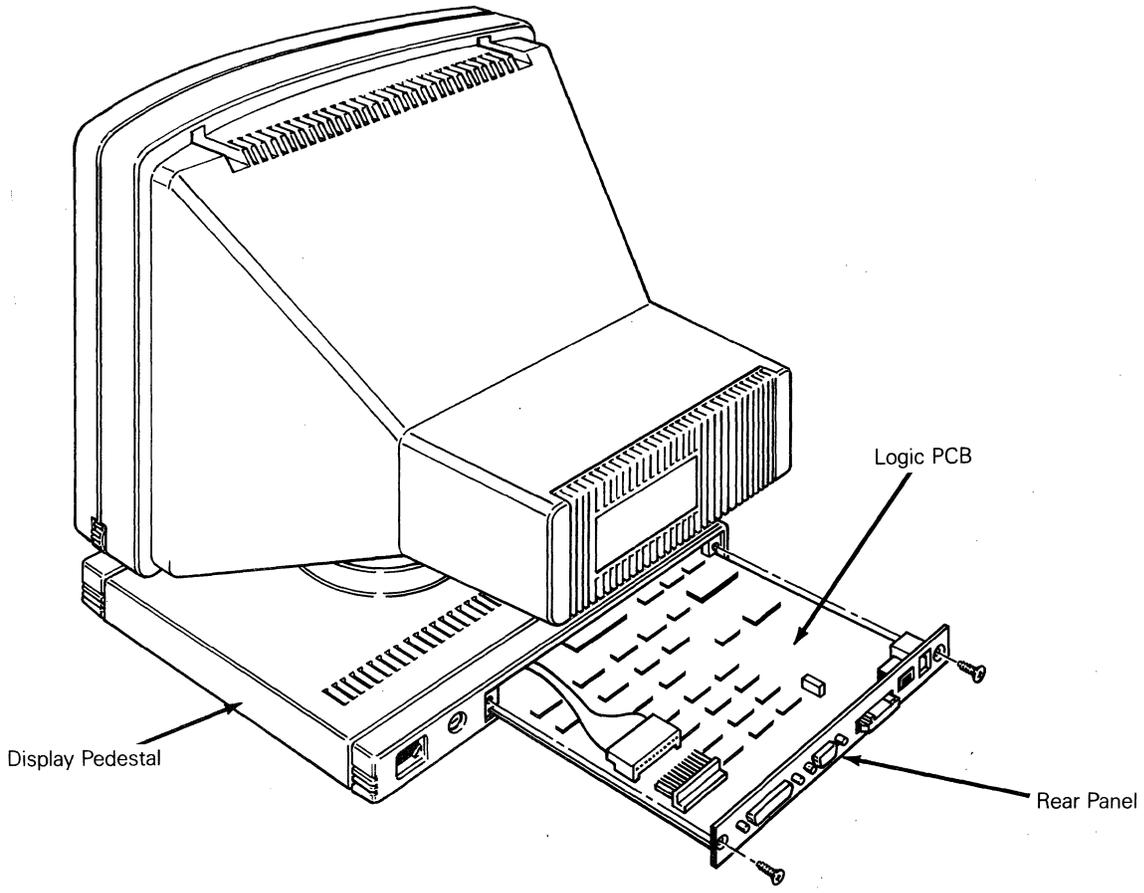
3 TROUBLESHOOTING

This chapter describes symptoms and solutions for many problems
you will encounter when servicing the terminal. We have organized
this chapter to help you repair the terminal as quickly as possible.
A troubleshooting quick reference guide and flowchart appear after
the list of required tools. The flowchart references locations of
the procedures you need for troubleshooting, several of which are
in this chapter.

BEFORE YOU START

Safety

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

o   If you must open the terminal for any reason, first turn off the power and unplug the terminal.

o   Remove any jewelry, especially any on your hands or wrists. Avoid wearing clothing that carries static charges.

o   Use only insulated or nonconductive tools.

o   Whenever you disconnect the anode from the anode lead, make sure to ground the anode as directed in chapter 2.

o   If you need to remove or replace the cathode ray tube (CRT)/yoke assembly, remember that the CRT can implode if you drop it or break the neck. The flying glass can injure anyone within a radius of six to ten feet.

Required Tools

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

o   No. 2 Phillips screwdriver

o   Flat-blade screwdriver, 3/16-inch

o   Digital multimeter (or an ohmmeter and voltmeter)

o   Test connectors for the COMM, PR, and 20mA ports (see Appendix C for instructions for making them)

o   Oscilloscope

TROUBLESHOOTING QUICK REFERENCE GUIDE

Table 3-1 is a troubleshooting 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 related detail in the troubleshooting flowchart.

Table 3-1   Troubleshooting Quick Reference Guide

Symptom	Problem Area
No beep	Fuse, power cord, logic board, line filter, or monitor/power supply
No display	Logic PCB, monitor/power supply PCB, CRT/yoke assembly

Poor display quality
  Wrong size
  Crooked
  Too bright
  Not in focus
	Adjustments, monitor/power supply PCB

Fails self-test	Logic PCB
Fails diagnostic test	Logic PCB
Inoperative keys	Keyboard, logic PCB
Can't communicate with computer	Setup parameters, logic PCB
Isolated letters on the screen	Logic PCB

TROUBLESHOOTING FLOWCHART

Read the troubleshooting flowchart and match the symptoms with the suggested solutions. Any block of the flowchart that requires a procedure is keyed to the legend which is found on the last page of the flowchart (page 3-7). The legend numbers provide the procedure name and page number where you can find the procedure.

Figure 3-1 Troubleshooting Flowchart, page 1 of 4
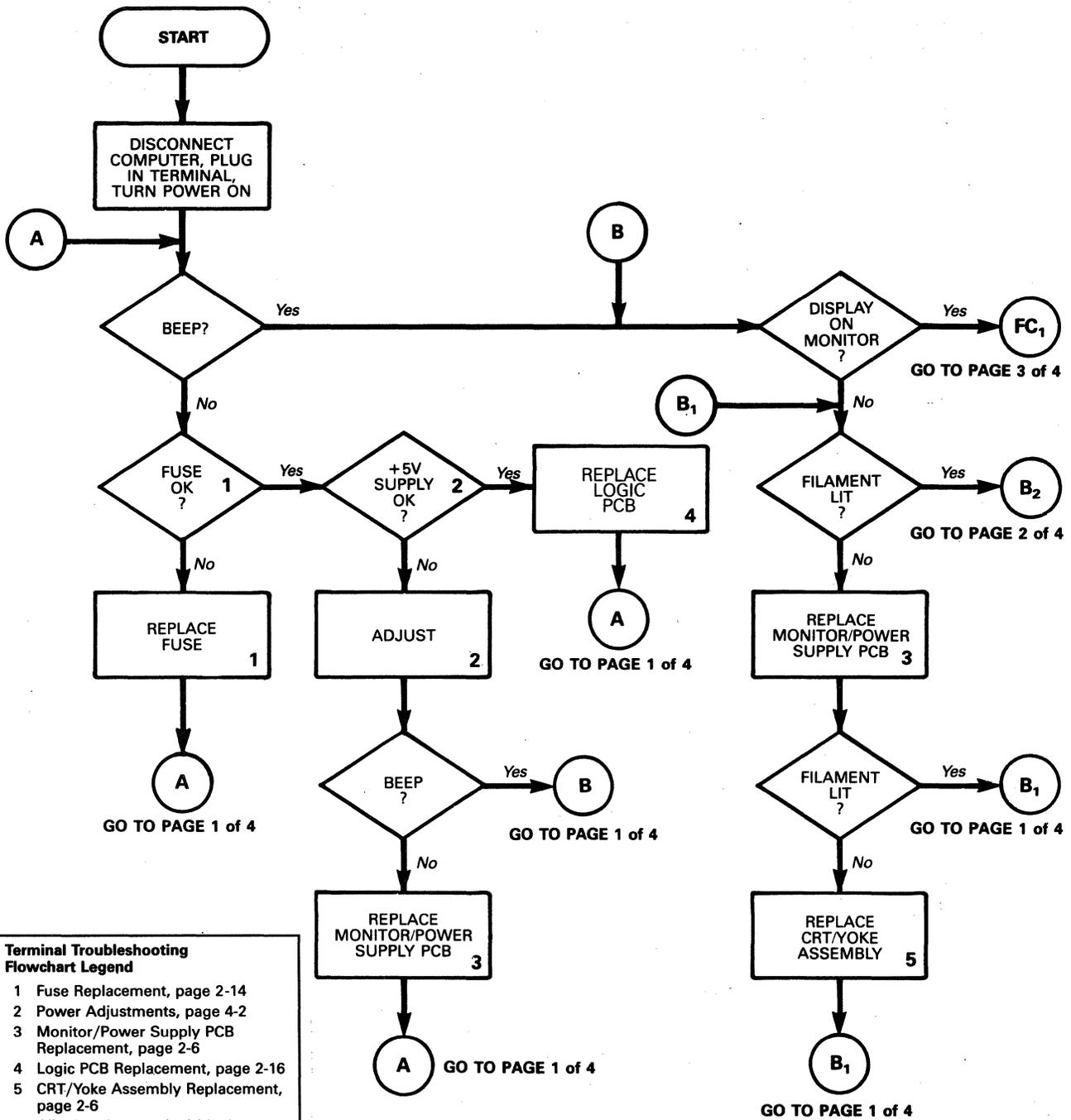
Terminal Troubleshooting Flowchart Legend

1 Fuse Replacement, page 2-14
2 Power Adjustments, page 4-2
3 Monitor/Power Supply PCB Replacement, page 2-6
4 Logic PCB Replacement, page 2-16
5 CRT/Yoke Assembly Replacement, page 2-6
6 Aligning the Terminal Display, page 4-5
7 External Brightness Potentiometer Replacement, page 2-10
8 Power Supply Check from the Logic PCB, page 3-9
9 Checking Horizontal Synchronization, page 3-10
10 Power-On Self-Test, page 3-11
11 Diagnostic Self-Test, page 3-12
12 Display Alignments and Adjustments, page 4-4
13 Keyboard Replacement, page 2-11

Figure 3-1 Troubleshooting Flowchart, page 2 of 4

Figure 3-1 Troubleshooting Flowchart, page 2 of 4

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Figure 3-1   Troubleshooting Flowchart, page 3 of 4

B₄

+24.5
SUPPLY   2
OK
?

Yes → B
GO TO PAGE 1 of 4

No

FULL POWER
SUPPLY
ADJUSTMENT   2

FIXED
?

Yes → B₄
GO TO PAGE 3 of 4

No

REPLACE
MONITOR/POWER
SUPPLY PCB   3

FIXED
?

Yes → B₄
GO TO PAGE 3 of 4

No

REPLACE
LOGIC
PCB   4

B₄
GO TO PAGE 3 of 4

FC₁

C →

VERTICAL
HOLD
OK
?

Yes → FC₂
GO TO PAGE 4 of 4

No

REPLACE
LOGIC
PCB   4

C
GO TO PAGE 3 of 4

**Terminal Troubleshooting
Flowchart Legend**

1 Fuse Replacement, page 2-14
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4 Logic PCB Replacement, page 2-16
5 CRT/Yoke Assembly Replacement,
   page 2-6
6 Aligning the Terminal Display,
   page 4-5
7 External Brightness Potentiometer
   Replacement, page 2-10
8 Power Supply Check from the
   Logic PCB, page 3-9
9 Checking Horizontal
   Synchronization, page 3-10
10 Power-On Self-Test, page 3-11
11 Diagnostic Self-Test, page 3-12
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Figure 3-1 Troubleshooting Flowchart, page 4 of 4

Figure 3-1 Troubleshooting Flowchart, page 4 of 4

**Terminal Troubleshooting
Flowchart Legend**

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   Adjustments, page 4-4
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INSTALLATION CHECKLIST

The checklist in Table 3-2 helps you quickly determine whether
the terminal is installed correctly. Look at Figure 3-2 for help.

Table 3-2   Terminal Installation Checklist

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 terminal.

____   Keyboard cable is in the connector on the rear panel of the
       keyboard.

AC Power Cord

____   Female end of the power cord is plugged into the AC power
       socket on the rear panel of the terminal.

____   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
       COMM port on the terminal's rear panel.

____   The other end of the interface cable is correctly connected
       to the computer.

Computer Interface
(You'll need to check the computer's documentation to determine
this information.)

____   Correct baud rate.

____   Correct data bits.

____   Correct parity type.

____   Correct handshaking protocol.

____   Correct stop bits.

CHECKING FOR CONTINUITY

Sometimes you can fix the problem without opening the terminal. The problem could be a damaged cable, fuse, power cord, or the rear-panel assembly. Check this list, then check the continuity of the components listed with an ohmmeter:

o   Fuse

o   Power cord

o   AC power input receptacle and line filter on the rear panel of the logic pedestal

o   Monitor/power supply to logic PCB wiring harness

Hold the probes in place for five 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 J5 are within tolerance, replace the logic board (Figure 3-2). If they aren't within tolerance, go to Chapter 4, "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 four of the five power supply voltages on the logic PCB without opening the cover on the monitor (the fifth, +23.5V, 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 J5 on the logic PCB.

4.   Attach one lead from the DVM to J5-10, ground.

5.   Turn the terminal on.

6.   Check the +5V power supply on J5-12. Look for +5V, +2 percent. See the troubleshooting flowchart if the signal isn't within tolerance.

7.   Check the +12V power supply on J5-6. Look for +12V, +5 percent. See the troubleshooting flowchart if the signal isn't within tolerance.

8. Check the -12V power supply on J5-7. Look for -12V, +5 percent. See the troubleshooting flowchart if the signal isn't within tolerance.

9. Check the -23V power supply on J5-11. Look for -23V, +5 percent. See the troubleshooting flowchart if the signal isn't within tolerance.

Figure 3-2 Power Connector at the Logic PCB


```
12 +5V
11 -23V
10 Dim 2
9 GND
8 +5V
7 -12V
6 +12V
5 V-Sync
4 H-Sync
3 Dim 1
2 GND
1 Video
```
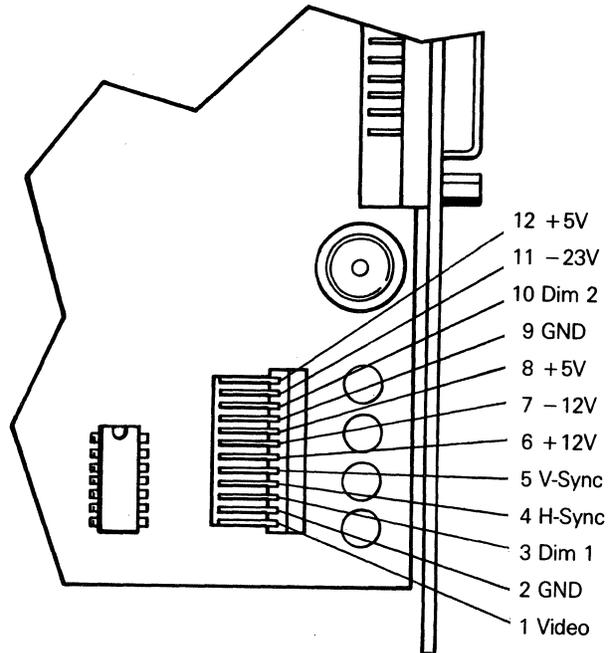
CHECKING HORIZONTAL SYNCHRONIZATION

Checking the horizontal synchronization helps determine which PCB to replace: either the logic PCB or the monitor/power supply PCB.

1. Find connector J5 on the logic PCB (see Figure 3-3).

2. Touch J5-4 with the oscilloscope probe. Look for a 59-microsecond pulse (within +10 percent) with an amplitude of 4.8 to 5V p-p.

   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.

POWER-ON SELF-TEST

The power-on self-test checks the terminal's random-access memory
(RAM), code read-only memory (ROM), and electrically alterable
read-only memory (EAROM). The RAM tests area write/read tests
that check all RAM banks. The code ROM test checks checksums.
The EAROM test calculates the EAROM's checksum and compares it to
the checksum bit stored in the ROM.

Each time anyone turns the terminal on, it performs the power-on
self-test. If the test detects an error, an error message appears
on the display. Table 3-3 defines these error messages. If any
of these messages appear, replace the logic PCB.

Note--If you install a new logic board or a new ER1400 EAROM, the
terminal will fail the EAROM checksum test when you turn it on.
To prevent this failure, initialize the EAROM by holding down the
SETUP key when you turn the terminal on.

Table 3-3 Power-On Self-Test Error Messages

Error Message	Failure
0	RAM bank 0
1	RAM bank 1
2	RAM bank 2
3	RAM bank 3
K	EAROM checksum
P	Code ROM checksum
Z	Processor RAM

DIAGNOSTIC SELF-TEST

The terminal diagnostic self-test routine starts in setup mode.
This test routine includes communications circuitry tests, font
ROM, soft font RAM, EAROM, 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-
hand corner of the screen (see Table 3-4 for 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. Turn the terminal on.

4. Press the SETUP key.

5. Press the down cursor four times. Look for the TEST:OFF
    field in the setup line at the bottom of the screen.

6. Attach the test connectors to the COMM, PR, and 20mA ports
    on the rear panel of the logic pedestal.

    Note--see Appendix C for a description of these connectors
    and instructions for making them.

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

8. Press the SETUP key twice. You should see a flashing test
    pattern.

9. Look for one of the error messages found in Table 3-4.

    Note--To fully test the font ROM checksum, EAROM read/write
    and soft font RAM, let the diagnostic self-test run five
    minutes.

10. If you see an error message, replace the logic PCB; if you
    don't see an error, press the SETUP key twice.

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

Table 3-4   Diagnostic Self-Test Error Messages

Error Message	Failure
8	Soft font ROM
9	EAROM read/write
A	Communication port, RTS-CTS
B	Communication port, DTR-DSR
C	Communication port, DTR-DSD
D	Communication port, SPDI-SPDS
E	PR port, DTR-DSR
F	PR port, internal RTS
Q	Font ROM checksum
R	Row buffer
W	20mA port
X	COMM port, RXD-TXD
Y	PR Port, RXD-TXD

4 ADJUSTMENTS AND ALIGNMENTS

This chapter describes adjustments and alignments for the terminal. In particular, it discusses power adjustments, and monitor alignment and adjustments. Before you align the monitor, check the power supply voltages. Adjust them if they aren't in tolerance. You should complete a full monitor/power supply adjustment and alignment whenever you replace the monitor/power supply printed circuit board (PCB) or the cathode ray tube (CRT)/yoke assembly.

WARNING--The CRT/yoke assembly has high voltages. Only qualified service personnel should adjust it.

SAFETY SUMMARY

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

o   If you must open the terminal for any reason, first turn off the power and unplug the terminal.

o   Remove any jewelry, especially any on your hands or wrists. Avoid wearing clothing that carries a static charge.

o   Use only insulated or nonconductive tools.

o   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 six to ten feet.

TOOLS REQUIRED

Before you test the power supply voltages or make any adjustments to the power supply or monitor assemblies, make sure you have the tools listed below:

o   Nonconductive alignment tool

o   No. 2 Phillips screwdriver

o   Digital voltmeter

o   Oscilloscope

o   Millimeter ruler

o   Reticle (optional--see Appendix D for instructions on how to use the reticle when you align the terminal display)

Note--Before you make any adjustments on the power supply or monitor assembly, make sure to let the terminal run for a 30 minute "warm-up" period.

POWER ADJUSTMENTS

The monitor/power supply PCB provides all of the voltages for the logic PCB (+5V, +12V, -12V, and -23V). It also supplies +23.5V for the CRT monitor. You can adjust the +23.5V and +5V supplies.

Note--You can find the locations of all components and test points referred to in this chapter in Figure 4-1.

Figure 4-1 Power Supply Component Layout
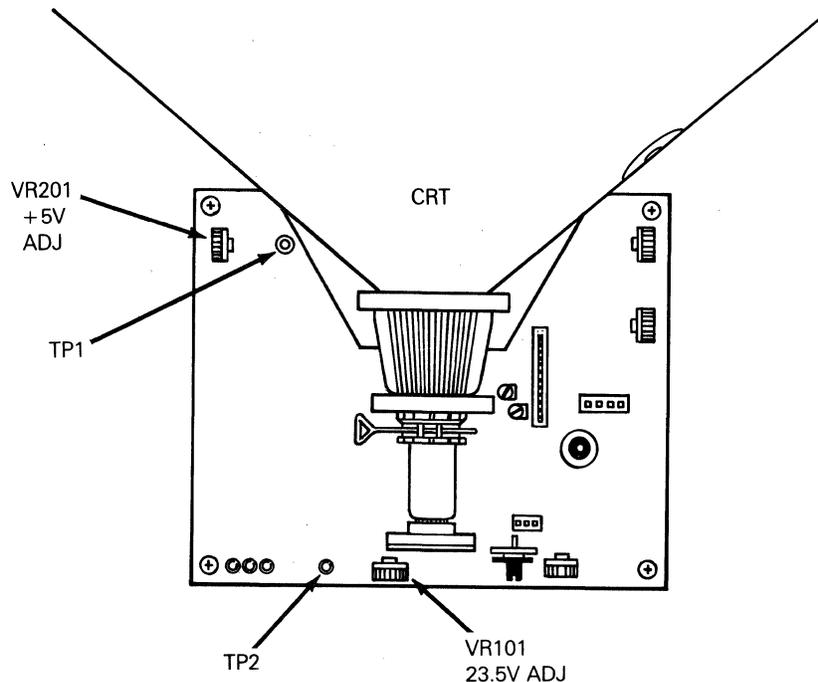
To align the power supply, follow the steps below:

1. Turn the terminal off.

2. Unplug the terminal from its AC power source. If communications cables are attached to the back of the terminal, detach those, too.

3. Remove the four No. 1 Phillips screws that hold the CRT cover in place (one in each corner).

4. Gently pull the CRT cover off.

5. Plug the terminal into an AC power source.

6. Turn the terminal on.

7. Check the +5V supply at TP1 on the monitor/power supply PCB, using the chassis as ground.

    Note--The monitor/power supply PCB holds two VR201 components: one in the power supply circuit and one in the video circuit. Look for the VR201 in the left front of the PCB to adjust the power supply voltages.

8. Adjust VR201 until the digital voltmeter reads +5V ±2 percent.

9. Check the +23.5V supply at TP2 on the monitor/power supply PCB, using the chassis as ground.

10. Adjust VR101 until the digital voltmeter reads +23.5V ± 2 percent.

   Note--If you can't bring either the +5V supply or the +23.5V supply into tolerance, see Chapter 3, "Troubleshooting."

11. Check the -12V supply at the gray wire on JP3-7 (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 +5 and +23.5V supplies, see Chapter 3, "Troubleshooting."

12. Check the +12V supply at the blue wire on JP3-6 (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 +5 and +23.5V supplies, see Chapter 3.

13. Check the -23V supply at the purple wire on JP3-11 (logic board wiring harness). The digital voltmeter should read -23V ± 5 percent. If the -23V supply is not within tolerance after you have adjusted the +5 and +23.5V supplies, see Chapter 3.

14. Check to see if the display needs alignment. See "Does the Terminal Meet the Display Specification?" If it doesn't need alignment, turn off the terminal, unplug it, and replace the top cover.

   If the display does need alignment, go to "Aligning the Terminal Display."

DOES THE TERMINAL MEET THE DISPLAY SPECIFICATIONS

Before you adjust the display on the monitor, measure the screen margins and study the display. Following the procedure below:

Note--If you have just finished checking and adjusting the power supplies, go to Step 4.

1. Turn the terminal off.

2. If any communications cables are attached to the back of the terminal, detach them.

3. Attach the test connectors to the COMM, PR, and 20mA 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. Let it run for 30 minutes.

5.   Press the SETUP key.

6.   Press the down cursor four times. Look for the TEST=OFF
      field in the setup line at the bottom of the screen.

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

8.   Press the SETUP key twice. You should see a flashing test
      pattern.

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

10.   Press CTRL A twice. You should see test pattern 0 on
      the screen. (See "Test Patterns" on page 4-12 for a full
      explanation of the test displays and their uses.)

11.   Margins on the top, bottom, and both sides should measure
      12mm +3mm. If they don't, see the next section.

12.   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 Terminal Display."

13.   Press the CTRL and A keys simultaneously. You should see
      test pattern M on the screen.

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 brightness
      or focus problems on the screen? If there are problems, see
      "Aligning the Terminal Display."

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

16.   Turn the terminal off. If the terminal was opened, you can
      close it, remove the connectors, and reattach the
      communications cables.

ALIGNING THE TERMINAL DISPLAY

The monitor has several alignments and adjustments. If the
terminal display is out of tolerance in one or two areas, only
make adjustments to correct those problems. If you change 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, go to Step 7. This procedure assumes that you have just checked or adjusted the power supply voltages, the top cover is off, and the power is on.

Table 4-1 describes the display problems that test patterns M and test pattern O identify.

To align the terminal display, follow the steps below:

1.   Press the SETUP key.

2.   Press the down cursor four times. Look for the TEST=OFF field in the setup line at the bottom of the screen.

3.   Attach the test connectors to the COMM, PR, and 20mA ports on the rear panel of the logic pedestal.

     Note--See Appendix C for a description of these connectors and instructions to make them.

4.   Press the space bar. This toggles the TEST field to ON.

5.   Press the SETUP key twice. You should see a flashing test pattern.

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

7.   You will see test pattern M. To call test pattern O, or toggle between O and M: press the CTRL and A keys simultaneously. (Both test patterns are described in "Test Patterns" in this chapter and illustrated in Figures 4-5 and 4-6.)

8.   Adjust the display. Check Figure 4-1 for component locations.

     Note--If you finish both the power and display adjustments, and the display is still not within tolerance, see Chapter 3, "Troubleshooting."

9.   If the display is within specification and looks regular, press the SETUP key twice.

10. Turn the terminal off. If the terminal was opened, you can close it, remove the connectors, and reattach the communications cables.

Table 4-1   Test Pattern Problems and Adjustments

Test Pattern	Display Problems	Adjustments	Page
M	Letters at the top of the display aren't the same height as those at the bottom of the display	Linearity	4-8
M	Fuzzy letters	Focus	4-8
M	Too bright; too dim; raster scan lines show; individual problems with full-bright, dim1, or dim2	Brightness	4-9
O	Display too short or too tall	Height	4-8
O	Too wide or too narrow	Width	4-8
O	Not centered	Centering	4-8
O	Not level	Yoke lock	4-8
O	Pincushioning, barreling, crooked edges, corners sag or move out of specification	Display magnets	4-10

ADJUSTMENTS

This section contains detailed instructions for each adjustment mentioned in Table 4-1 and a cross reference for the test pattern that you should use when making that particular adjustment. Use Figure 4-2 to identify adjustment locations on the monitor/power supply PCB.

Height

The height adjustment is labeled HGT VR302 on the monitor/power supply board. Use test pattern O.

Adjust VR302 until the top edge and the bottom edge of the display are both 12mm $\pm$3mm from the edge of the bezel.

Linearity

The linearity adjustment is labeled LIN VR303 on the monitor/power supply board. Use test pattern M.

Adjust VR303 until characters on the bottom of the display are the same height as those on the top.

Figure 4-2 Adjustment Locations
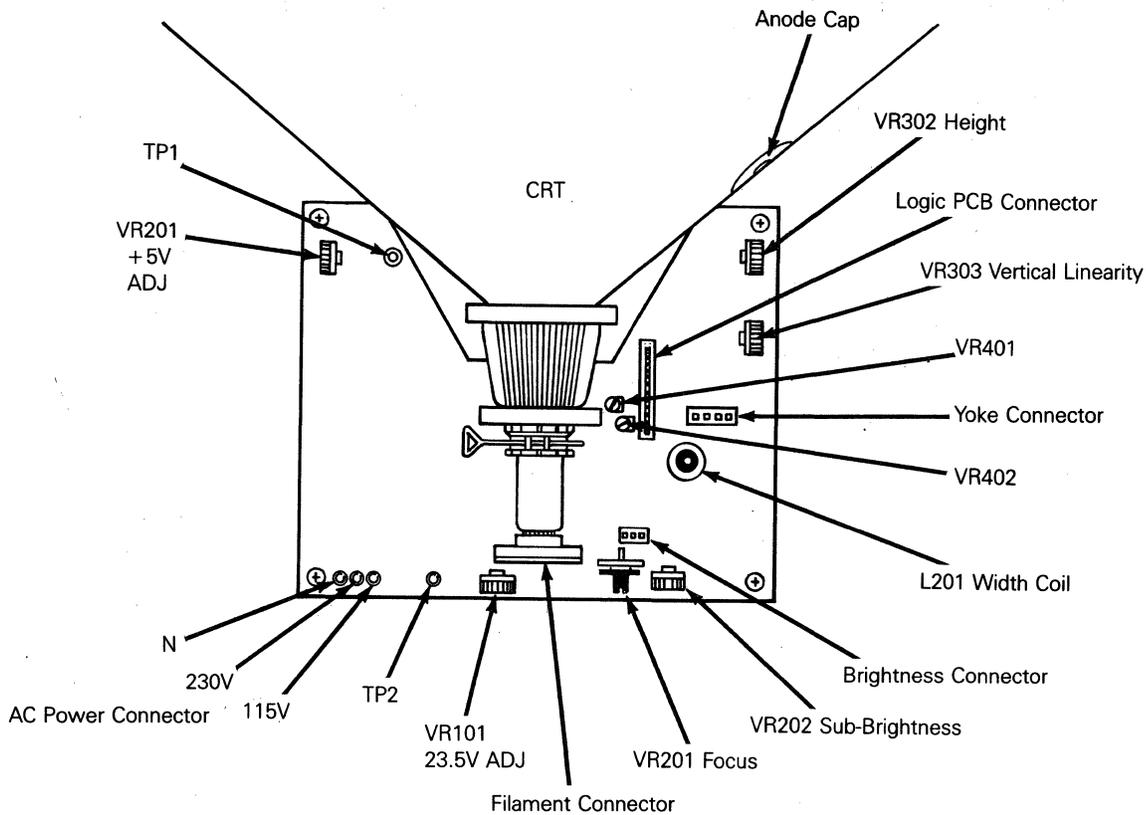
Focus

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

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.

Width

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

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 $\pm$3mm from the edge of the bezel.

Display Leveling

The yoke lock is located on the neck of the CRT (See Figure 4-3). Use test pattern 0.

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.

3.   Tighten the yoke lock.

Warning--Do not tighten the yoke lock too much or the neck of the CRT will break, and shoot broken glass for a radius of six to ten feet.

Brightness

Three degrees of brightness may be adjusted: full bright, dim1, and dim2. Although they can be adjusted separately, it's a good idea to adjust full bright first, and then dim1 and dim2. Use test pattern M.

1.   Turn the operator brightness control as far clockwise as possible.

2.   Turn SUB-B, VR202 on the monitor/power supply board, as far counterclockwise as possible. You should see the raster lines on the screen.

3.   Slowly turn SUB-B clockwise, just until the raster is no longer visible. SUB-B adjusts full brightness.

4.   Look at the brightness blocks in the middle of test pattern M. If dim1 (normal brightness) or dim2 (half-intensity) are either too bright or not bright enough, adjust VR402 (dim1) or VR404 (dim2).

Figure 4-3 Yoke Lock on the CRT Neck

CRT

Yoke

Yoke Lock

Centering Ring Magnets

Rotate Yoke
To Level Display
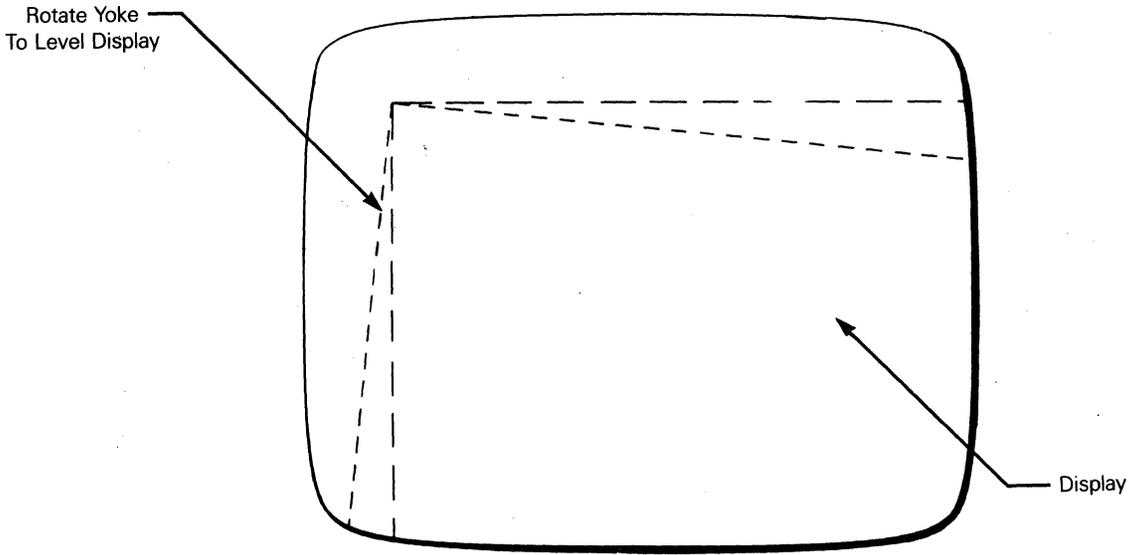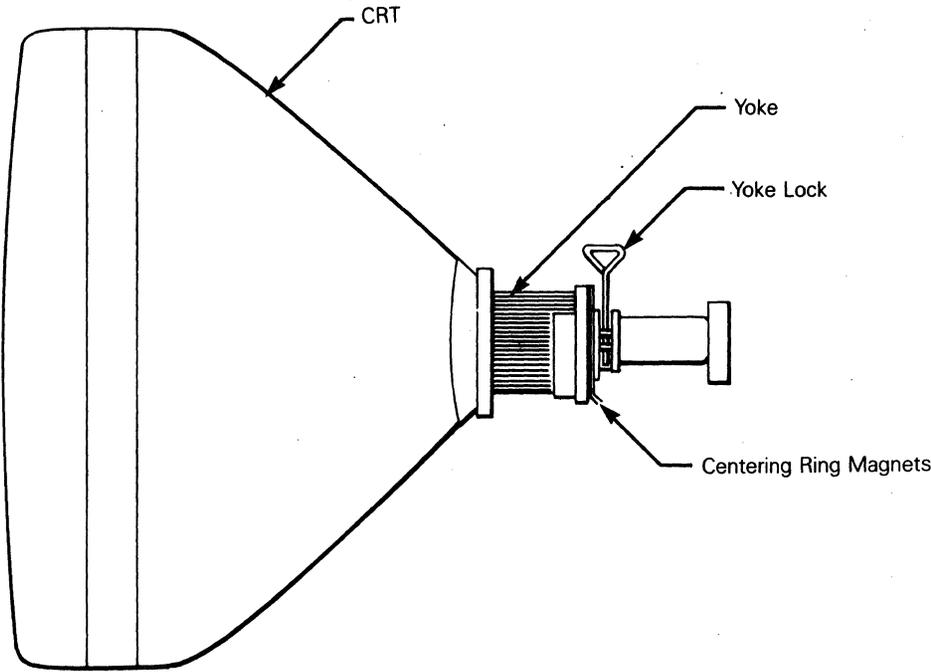
Display

Display Magnets

There are eight display magnets on a ring around the yoke. When turned, they change corresponding screen area. They can also affect adjacent areas. Figure 4-4 identifies each magnet; Table 4-2 identifies which portion of the screen each changes.

Figure 4-4   Display Magnets
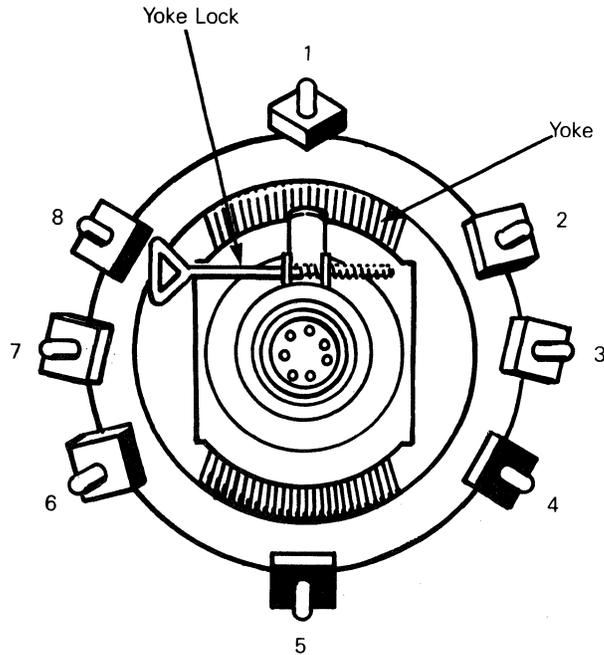
Table 4-2   Screen Areas Affected by Display Magnets

Magnet Number	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

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 4-5.

This pattern is an 80-column display of characters. Three blocks in the center of the pattern indicate brightness: full bright, dim1, and dim2.

Figure 4-5   Pattern M

Focus

Focus and Intensity Pattern

Full Bright   Dim1   Dim2
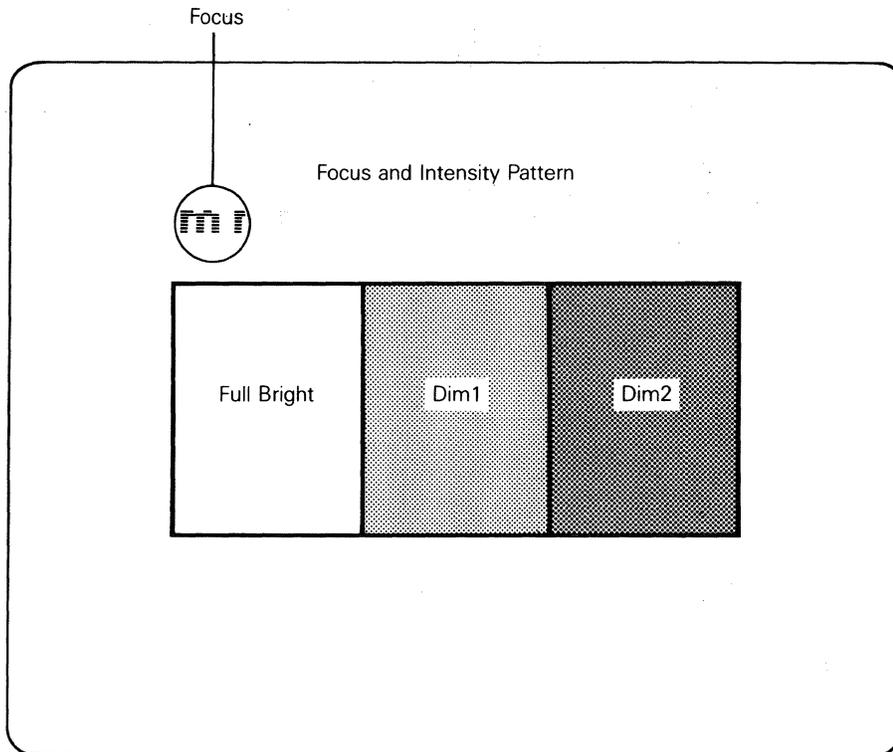
Pattern O helps you detect and correct pincushion, tilt, centering, and size problems. See Figure 4-6.

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 4-6   Pattern 0

Pincushion Pattern

Linearity, Centering, Size
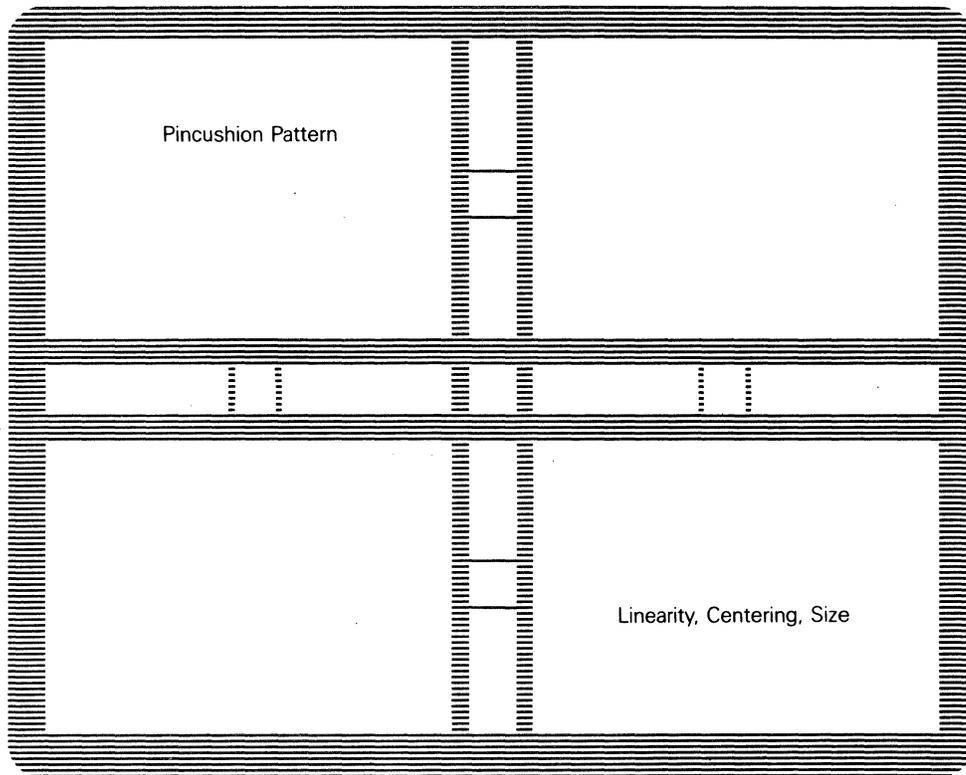
You can verify the display tolerances using both patterns along with a display reticle. See Appendix D for reticle instructions.

5   ILLUSTRATED PARTS LIST

This chapter provides the information you need to order parts for the terminal.

You will find two exploded assembly drawings in this chapter: the terminal display and the keyboard. Each replaceable part is labeled with a part name and number. The part name indicates the description of the part. The part number is the official stock number. When you order replacement parts, please use both the part name and part number.

Figure 5-1   Terminal Display Assembly Exploded View

44-002-03
Top Cover

88-001-08
Tube

44-004-03
Bezel

840007-01
Yoke

99-061-01
Monitor
Power Supply PCBA

44-010-02
Knob

94-025-01
Monitor Brightness
Harness

44-007-04
Front Panel

44-005-02
Pedestal

44-001-03
Base

44-007-05
Rear Panel

32-005-09
Logic PCBA
(includes phone jack)
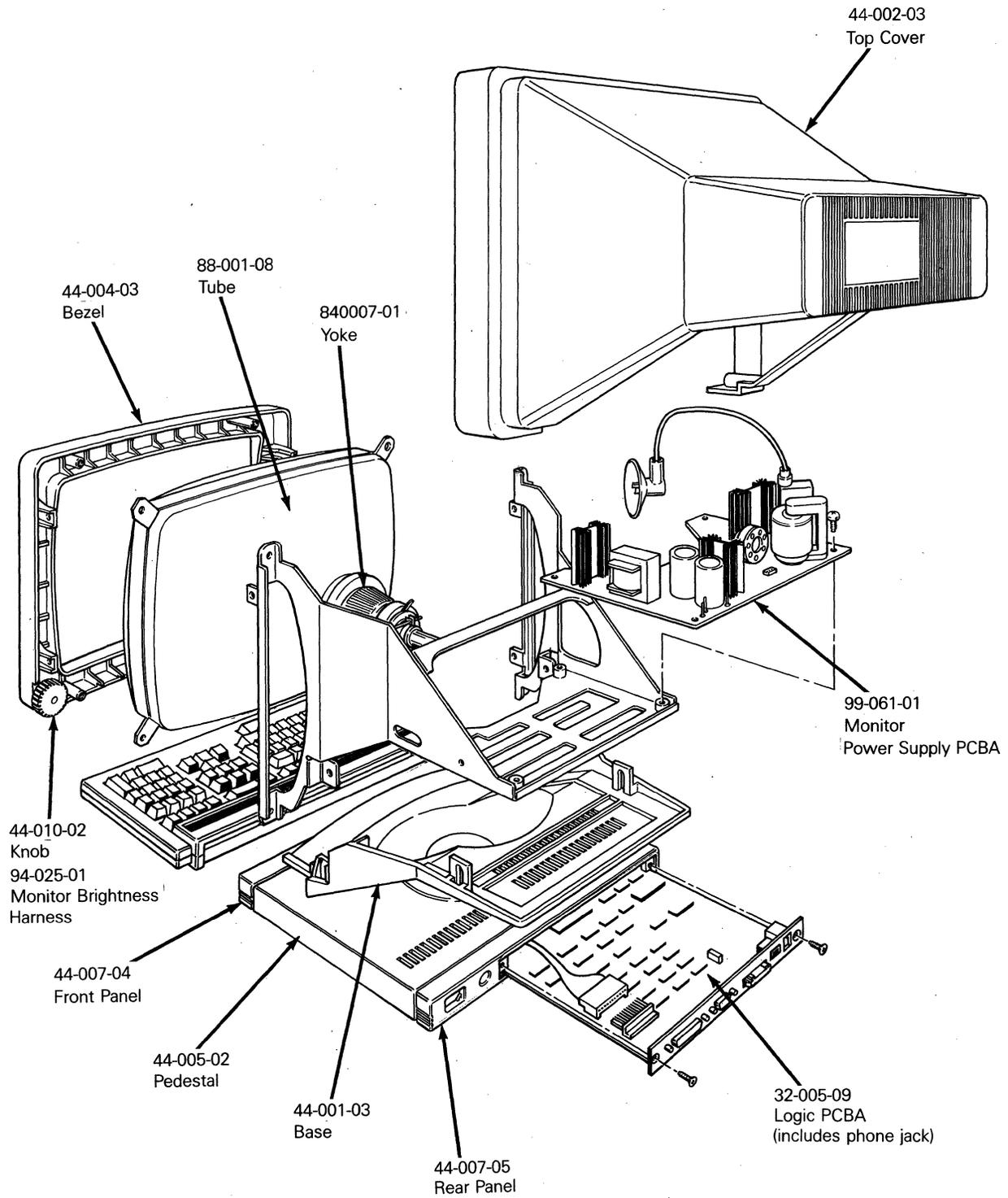
Figure 5-2 Keyboard Assembly Exploded View

99-062-01
Keyboard PCBA

80-150-26
Phone Jack Connector

94-038-03
Keyboard Cable
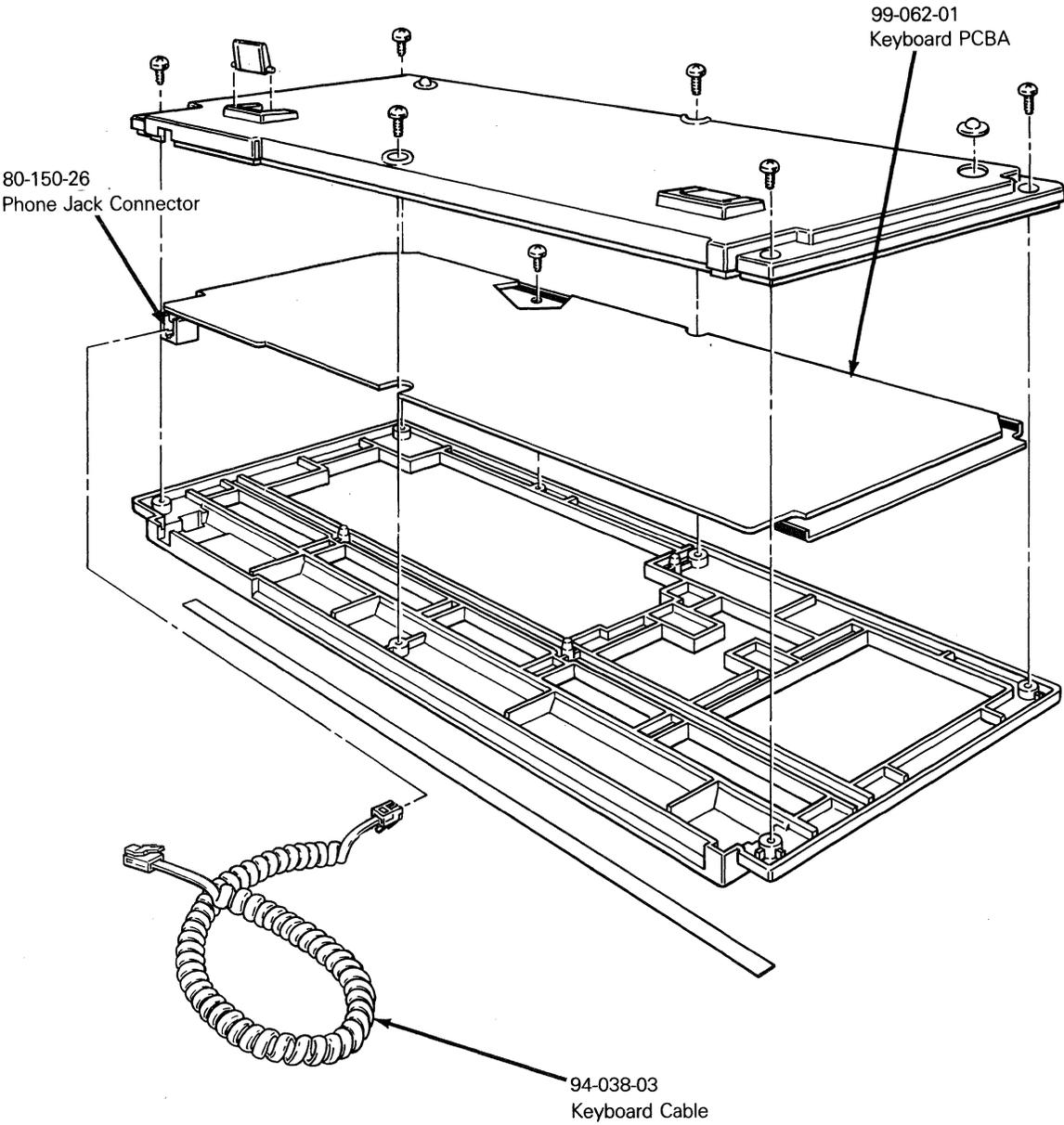
6 THEORY OF OPERATIONS

This section describes the terminal's basic logic functions.
If you are unfamiliar with raster scan techniques, read the brief
explanation of raster scan terms below.

RASTER SCAN TERMINOLOGY

The terminal has a 14-inch cathode ray tube (CRT) display. 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-hand 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 260 scan lines, the electron beam arrives at the
lower right-hand corner of the display. In order to return to
the upper left-hand 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-hand 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 using a 7 x 10 matrix within a
10 x 10 character cell in the 80 column mode, and 7 x 10 matrix
within a 9 x 10 cell in the 132 column mode.

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
that you use 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 alphabetical coordinates (A, B, C, etc.) runs the length
of the terminal microprocessor board. A set of numerical
coordinates (1, 2, 3, etc.) runs along the width of the
microprocessor 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 6-1 for an example of coordinate identification.

Figure 6-1 Logic PCB
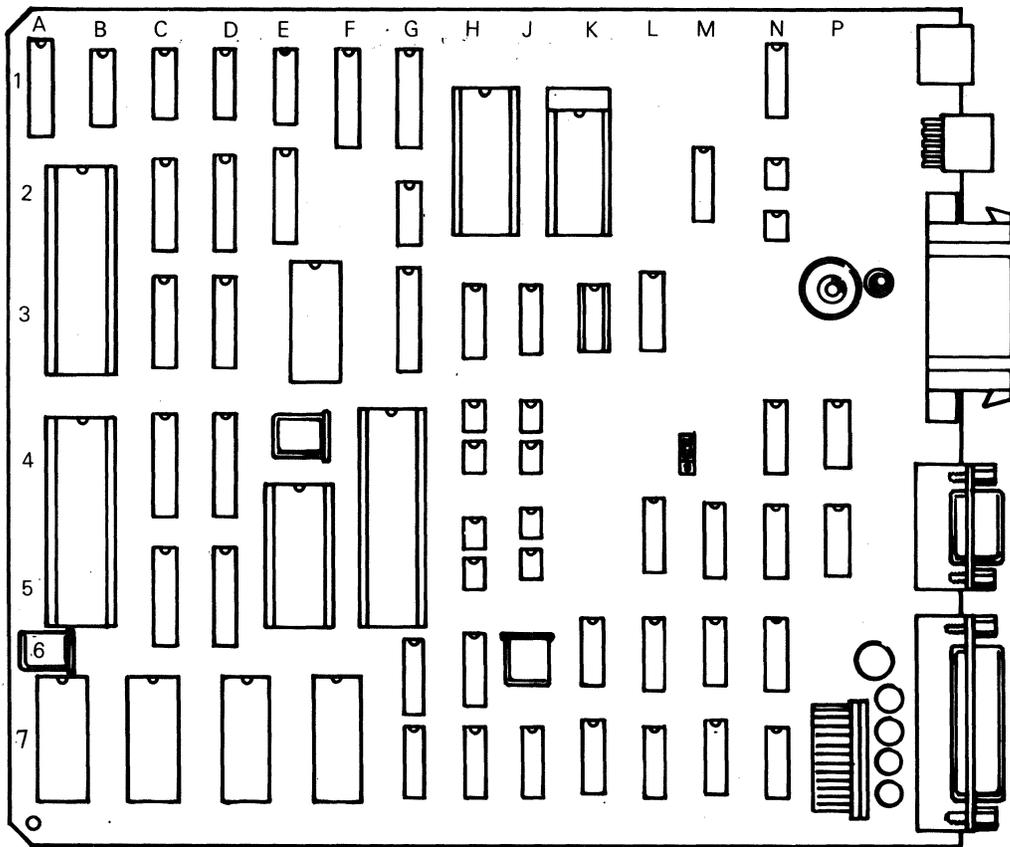
MAJOR COMPONENTS FUNCTIONAL DESCRIPTION

A functional description of each significant component on the
logic PCB is given along with the component coordinate. You can
reference both the logic PCB and its schematics when you read
this section.

8032 Microcomputer (4A)--The terminal has a single-component
control-oriented microprocessor which contains 256 bytes of
random-access memory (RAM), 32 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 microprocessor 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 is used for the PR
printer port.

CRT controller (2A)--The microprocessor initializes the
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:
scan line count, horizontal synchronization, vertical
synchronization, and blank.

DUART (5F)--The dual asynchronous receiver/transmitter (DUART)
takes parallel data from the microprocessor 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
microprocessor. The DUART flags the microprocessor with an
interrupt when it needs service. Channel A is the RS422/232C
COMM port, channel B is the 20mA current loop port.

PROM (5E)--The programmable read-only memory (PROM) is
nonvolatile memory for program storage. All routines reside in
PROM. The terminal PROM can be either 16K or 32K bytes. The
PROM does not reside within the RAM memory map because it has a
unique enable line (PSEN).

Chip select decoder (1B)--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 microprocessor. The decoder
generates enable signals for the RAM, DUART, PVTC, EAROM, and
soft font port from these signals.

Low order address latch (4D)--This IC latches and gates the lower
order address information from the microprocessor when activated by
the microprocessor's address latch enable (ALE) signal. The latch
separates data from the address bus when data is present on the
microprocessor's multiplexed lower address and data bus interface.
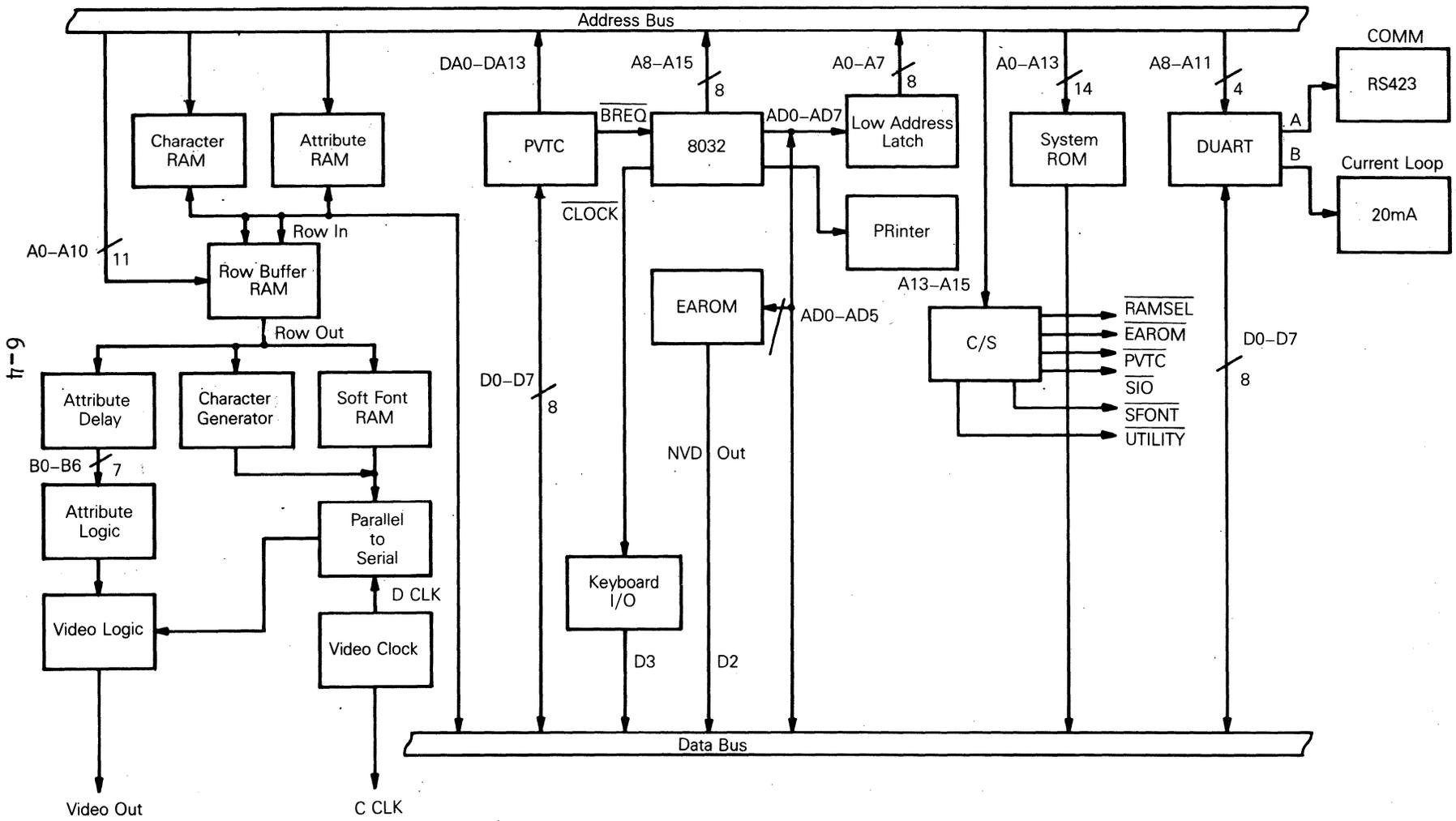
Figure 6-2 Logic PCB Block Diagram

6-4

Bidirectional bus driver (5D)--This driver gates data from the microprocessor to RAM, or data from RAM to the microprocessor.

Keyboard interface (4J)--The logic PCB communicates with the keyboard on two lines. The microprocessor 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 microprocessor looks for the positive key return on data bus bit three.

Row buffer RAM (3E)--The row buffer RAM receives display information from the display RAM. This display data is read from RAM 10 times per row (once for each scan line) and sent to the character generation circuit for decoding.

Row buffer latch (3D)--The row buffer latch holds the display data from the video buffer (part of the display RAM) until it can be loaded into the row buffer RAM.

Row address latches (2D)--The row address latches hold the video buffer addresses during a DMA.

Character row buffer data latch (1G)--The character row buffer data latch stores each character to be displayed (one at a time) for the character generation circuitry.

Attribute row buffer data latch (1F)--The character row buffer data latch stores each character to be displayed, one at a time, for the attribute generation circuitry.

Character and Attribute RAM (4A, 4B, 4D, 4E)--The logic PCB contains four 2Kx8 static RAMs. Two of the RAMs store character data, while the remaining two RAMs store attribute data. This enables hidden (non-embedded) attributes. Attribute memory locations are addressed automatically each time character memory is addressed. This allows the 8-bit microprocessor to read and write 16-bit words. Because attribute data is read from RAM before the character data, the attribute data is fed through a delay circuit to time character and attribute data together.

Character generator (1H)--The character generator provides a unique bit pattern output for each character.

Soft font RAM (1J)--This 2Kx8 RAM stores character data for the soft font application. Two bits set in the attribute byte select this RAM.

Parallel-to-serial converter (5L)--The output of the character generator PROM 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 use.

Video drivers and dot stretcher (7M, 7N, 5P, 5M)--This circuitry allows output from the parallel-to-serial converter to interface with the CRT. In addition, a dot stretching circuit 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.

Video clock generator (6L, 7K, 7M)--The clock generator consists of a 48.556 MHz crystal oscillator circuit that is divided by three for the DCLK (dot clock) rate of 16.2 MHz. The DCLK is primarily used for clocking serial bit-stream data to the video drive circuitry. The 16.2 MHz is divided by ten for a CCLK (character clock) rate of 1.62 MHz in the 80 column mode, and divided by six for a CCLK rate of 2.7 MHz in the 132 column mode.

Command latch (3H)--The command latch is attached directly to the microprocessor's data bus. When enabled, the command latch latches data bits zero through five and uses them to send control/data to the EAROM.

Nonvolatile memory (3K)--The nonvolatile memory consists of an EAROM that is programmed by the operator in setup. This memory stores setup parameters such as baud rate and parity. The EAROM retains its data until reprogrammed by the operator.

Level converters (EAROM) (B2)-The EAROM requires voltage levels of +12V and -23V to operate. The level conversion logic provides these logic levels to the input circuitry and converts the EAROM's output to TTL levels.

Level converters (EIA to TTL) (4J, 5J)--These level converters change the EIA RS-232C and EIA-423C logic levels to TTL levels for the DUARTs.

Level converters (TTL TO EIA) (4H, 5H)--These level converters change the TTL logic levels from the DUART to RS-232C and EIA-423C levels for communicating with external equipment.

DUART clock (1Y)--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 for the appropriate baud rate.

CPU clock generator (2Y)--The CPU clock generator consists of a 11.000 MHz crystal connected to the XTAL inputs of the CPU. The CPU has its own internal clock generation circuitry that divides the basic crystal frequency into frequencies usable by the CPU.

MONITOR/POWER SUPPLY BLOCK DIAGRAM

The terminal contains a combination monitor/power supply
assembly. The power supply provides the voltages for all the
logic. These voltages are +12V, -12V, +5V, -23V, and +23.5V.
The -23V is used exclusively by the EAROM. Only the
monitor/power supply uses the +23.5V supply. Figure 6-3 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.

Voltage doubler (1)--The terminal operates with either a 115 VAC
or 230 VAC input. The voltage doubler circuit provides 350 VDC
for the oscillator circuit when 115 VAC is applied, and is
passive when the 230 VAC input strap is installed. This assures
that the oscillator (DC to AC converter) always has a 350 VDC
input regardless of the AC input voltage.

DC to AC converter (2)--The converter consists of a pair of
switching transistors. It sends AC input voltage to the main
power transformer. The DC to AC inverter is synchronized with
the horizontal oscillator to eliminate beat frequencies.

Main switching power transformer (3)--The main power transformer
provides taps for the power supply regulator circuitry and the
horizontal oscillator.

Horizontal oscillator (4)--The horizontal oscillator provides the
signal to drive the flyback transformer at the correct frequency.
It also 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. Refer to Figure 6-4 for the horizontal
oscillator timing information.

+5 volt supply (5)--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. Regulation is
accomplished by optically coupling a signal back to the DC to AC
inverter which controls its duty cycle, and hence the output
voltage of the main switching power transformer.

-12 volt supply (6)--The -12V supply is derived from one of the
main transformer taps. The low voltage AC output is rectified
and regulated.

+12 volt supply (7)--The +12V supply is derived from the +23.5
VDC. It uses a linear regulator.

Flyback transformer (8)--The flyback transformer steps up the
output of the horizontal oscillator to provide the high voltage
for the CRT itself. In addition, the flyback transformer has
taps that provide filament power and low voltage AC input to the
-23V supply.
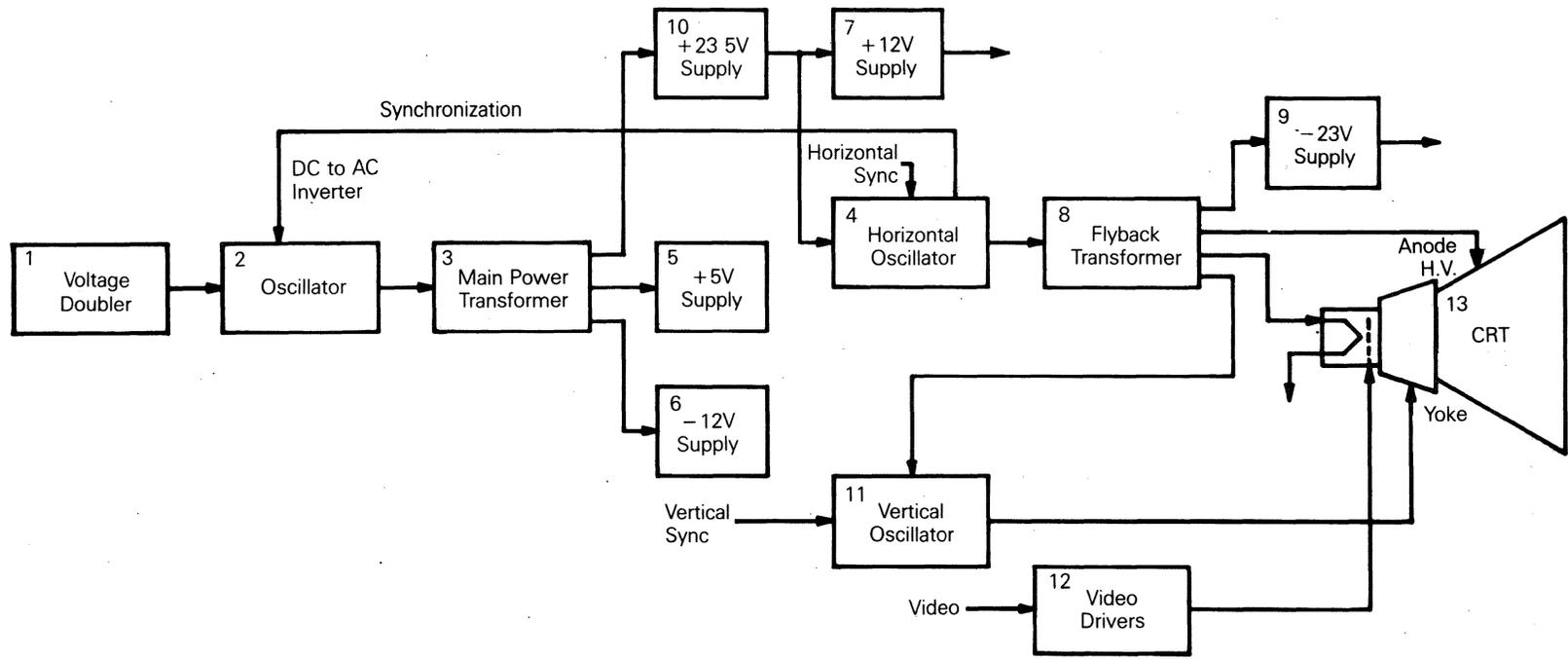
Figure 6-3 Monitor/Power Supply Block Diagram

-23 volt supply (9)--The -23V supply receives its low voltage AC input from the flyback transformer. This voltage is then rectified and filtered to provide the -23V for the EAROM.

+23.5 volt supply (10)--The +23.5V supply is derived from one of the main transformer taps. The low voltage AC output is rectified and then regulated by a linear regulator. This supply drives the monitor.

Vertical oscillator (11)--The vertical oscillator 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. Refer to Figure 6-5 for vertical timing information.

Video drivers (12)--The video drivers provide the video input to the CRT with the correct voltage to bias the CRT grid.

CRT (13)--The CRT displays data by modulating the 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 6-4   Horizontal Oscillator Timing

Data Center Line ⟶

Sync Width ≈ 20 μs

34.7 μs

Horizontal Drive

0 μs
Front Porch

10 μs
Retrace Interval

Horizontal Blanking

Line Rate 59.31 μs

Video Data

50Hz/60Hz   80 Character Per Row

Sync Width ≈ 20 μs

34.7 μs

Horizontal Drive

9.8 μs
Retrace Interval

Horizontal Blanking

0 μs
Front Porch

Video Data

50 Hz/60Hz 132 Character Per Row
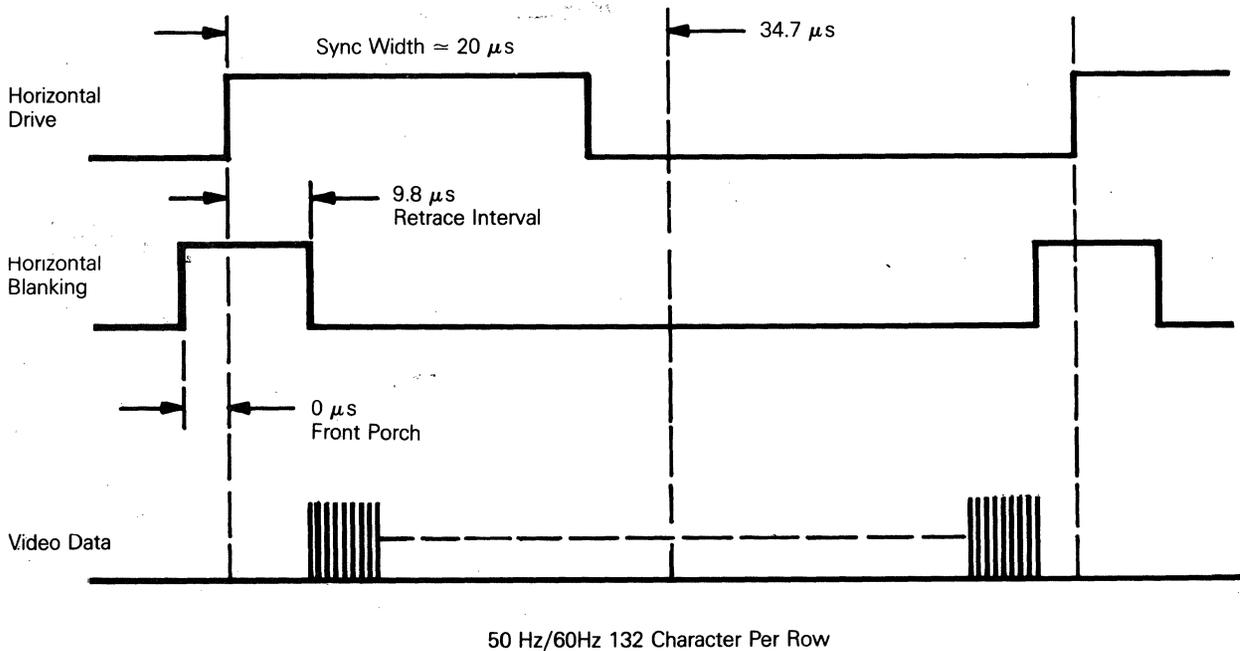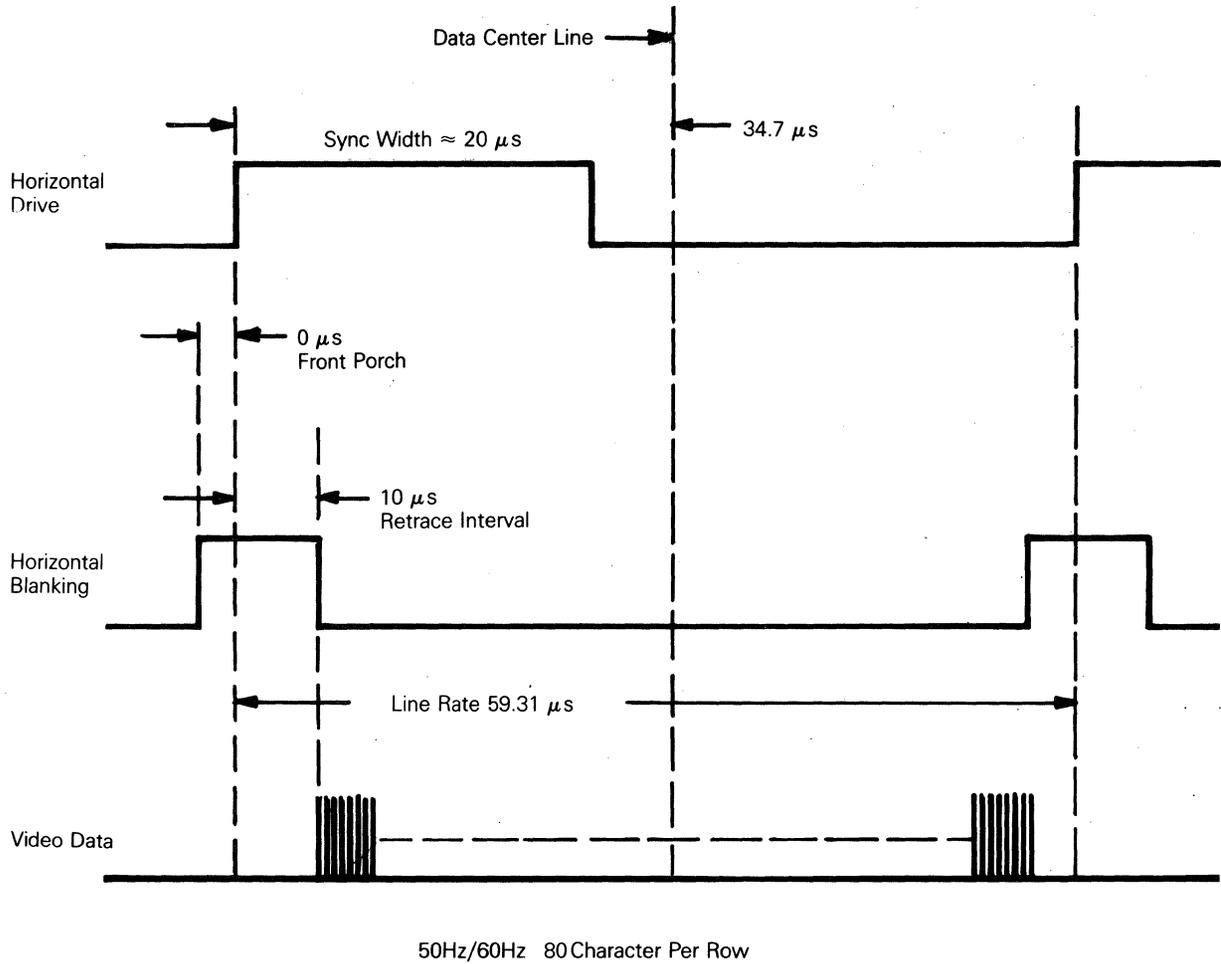
Figure 6-5 Vertical Timing

50Hz/60Hz 80/132 Column
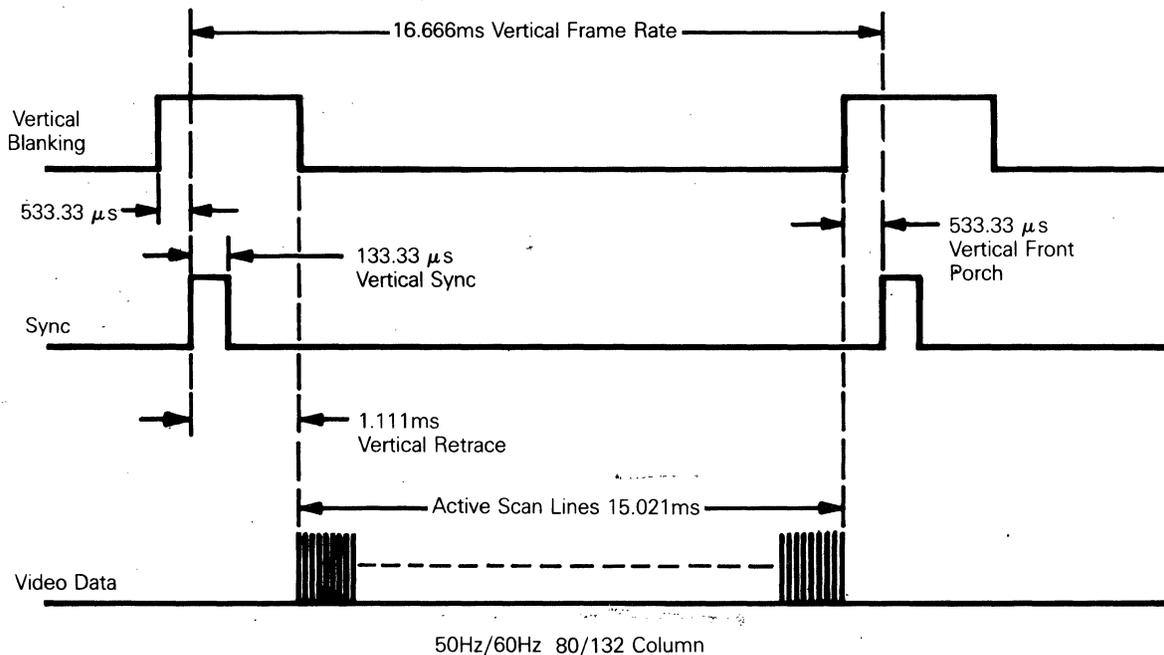
KEYBOARD BLOCK DIAGRAM

Figure 6-6 is a block diagram of the terminal keyboard. The
logic that interfaces with the keyboard resides on the
logic PCB. Note that some blocks on the diagram are numbered;
this number corresponds to the numbers given in the following
descriptions.

Key switch matrix--The key switch matrix is arranged as 16
columns and eight rows. Each row is "pulled up" to +5 V 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 8032 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 8032 if a low
level is detected at the correct 'X' input lines. The 8032 will
interpret the returning pulse as a positive keyswitch scan and
follow with character addressing.

Line drivers--The keyboard line drivers (U4) provide adequate
output to minimize the signal decrease between the keyboard and
the logic PCB.

Figure 6-6 Keyboard Block Diagram
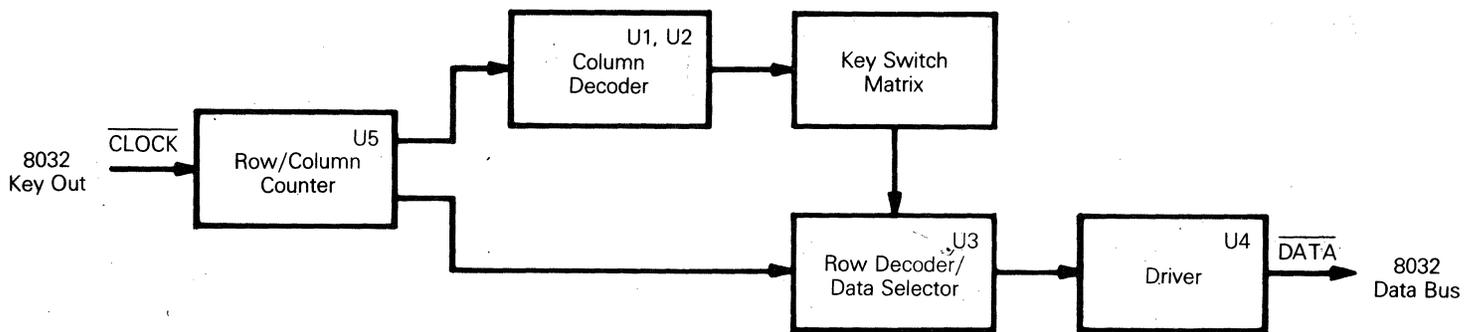
FUNCTIONAL DESCRIPTION

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

Microprocessor

The 8032 is a control-oriented microprocessor that contains 256 bytes of RAM, two counter/timers, a full duplex serial port, and two parallel ports. The processor operates at 11 MHz. This allows most instructions to execute in 1.1 microseconds.

The 8032 has separate addresses for program storage and RAM. PSEN selects program storage. The terminal uses 16K of program storage in a 16Kx8 EPROM.

The microprocessor communicates over an 8-bit data bus which has eight lower order address bits multiplexed during bus cycles. The lower address bits are latched into an 8-bit latch by the ALE signal (address latch enable). The upper eight address bits have a dedicated output port on the 8032.

Table 6-1 is a list of 8032 port assignments.

Table 6-1   8032 Port Assignments

Port	Assignment
P0.0-P0.7	Data bus and lower byte of address bus.
P1.0	AUX DTR. Input ready signal from the serial device attached to the PR port.
P1.1	NVDOUT. Input from nonvolatile memory. Data is shifted in serially from memory.
P1.2	Pass-through. Output from 8032 sends data received from the MODEM port out through the PR port.
P1.3	AUX RTS. Output Request To Send signal to the serial device attached to the PR port.
P1.4	AUX DSR. Input ready signal from the serial device attached to the PR port.
P1.5	BELL. Output by 8032 to sound tone generator.
P1.6	TRU INV. Output by 8032 to define true inverse video.
P1.7	80/132. Output by 8032 to select 80-column or 132-column display by changing CCLK rate.
P2.0-P2.7	Address bits 8-15 output by 8032 during bus cycles.
P3.0	RXD. Data received at the PR port.
P3.1	TXD. Data output through the PR port.
P3.2	INTO (BREQ). Interrupt input from CRT controller during DMA transfers.
P3.3	INT1 (SIOIR). Interrupt input from the DUART. Indicates data in the receive buffer.
P3.4	TO (VTIR). Vertical timing interrupt from the PVTC.
P3.5	T1 (GRAPHICS). Output by 8032 to turn on graphics interface signals.
P3.6	WR. I/O Write signal output by 8032.
P3.7	RD. I/O Read signal output by 8032.
RST	Reset. High input resets 8032.

Table 6-1 Continued

Port	Assignment
EA	External access. Low signal forces 8032 to make program fetches from external ROM.
ALE	Address latch enable. Latches multiplexed lower order address output into address bus.
PSEN	Program store enable. Enables external ROM during program fetch.

Communication Interface

All three independent serial ports (the COMM port, PR port, and the 20mA port) are asynchronous. The COMM port connects a computer or modem. The PR port connects a printer. The 20mA port allows the terminal to communicate in current-loop applications.

COMM Port--The "A" channel in the 2681 DUART is assigned to the COMM port. The 9636 drivers (4J1, 4J2) and the 9639 receivers (5J1, 5J2) are both RS232 and RS423 compatible. The 2681 (5F) converts parallel logic PCB data to bit-serial data, while adding stop, start, and parity bits. The serial format is transmitted at the user selected baud rate.

PR port--The PR port uses the 8032 UART. The 11 MHz processor clock is divided internally by timer one to provide baud rates.

20mA port--The "B" channel in the 2681 DUART is assigned to the 20mA current-loop port. The user selects one port, 20mA or EIA COMM, at a time. Logic highs and lows are expressed by changes in current.

Display Memory

The display memory in the terminal is dual-ported between the CRT controller and the 8032. There are four 2Kx8 RAM chips installed for single-page operation. During the first scan line of each character row, the 2672 CRT controller (2A) sends an interrupt on INTO of the 8032 nine microseconds before starting a DMA transfer from the display RAM. The 8032 may not access the display RAM while this signal is being sent. The 8032 does not stop during the DMA transfer. It can service other devices at this time.

Nonvolatile Memory

The terminal stores all configuration parameters in the 100 x 14-bit nonvolatile EAROM (3K). The memory operates from +12 V and -23 V. To generate these voltages, the monitor power/supply receives a horizontal frequency signal 250 milliseconds before trying to read from or write to the nonvolatile RAM.

The EAROM requires a command code on the C1, C2, and C3 inputs in order to erase, read, or write. Address and data information are clocked into the EAROM through the bidirectional D pin.

The 8032 controls the EAROM through a control latch (3H). The control latch signal levels are translated by 7406 open collector inverters (3J) to the 12 V levels required by the ER1400 EAROM. A comparator translates data read from EAROM into TTL levels before the 8032 reads it.

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 8032. At least six microseconds elapse between outputting an address and testing the key return. Debouncing and multiple key depressions are handled by the 8032.

Video Controller

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

Video Clock Circuitry--A 48.5568 MHz oscillator generates timing for the dot clock and character clock. A 48.5568 MHz crystal (Y3) provides the positive feedback around a 74S04 (6K) inverter. The crystal is used in a series resonant overtone mode. The inverters in the oscillator circuit are connected back to back. The inverters are biased in the linear region by resistors R57, and R58. Blocking is achieved by capacitor C35. Inductor L1 and capacitor C39 form a parallel resonant circuit to reduce the oscillator's feedback if it attempts to oscillate at the wrong overtone frequency. C38 provides an AC path to ground for the resonant circuit.

The output from the oscillator is buffered by another 74S04, divided by three through 6L for a DCLK rate of 16.2 MHz. The dot clock from the divider goes to the video shift register and the character clock generator.

The character clock generator consists of an up/down counter and combinational logic which divides the dot clock by ten in 80-column mode for a CCLK rate of 1.62 MHz, and by 6 for a CCLK rate of 2.7 MHz in 132-column mode.

Programmable Video Controller--The 2672 programmable video timing controller (PVTC) (2A) provides all the timing and control signals for displaying characters on the CRT (3J). The 8032 initializes the 2672 with the display parameters when a user turns the terminal on. Before each displayable character row, the 8032 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 ten scan lines the characters are retrieved from the row buffer.

The 2672 warns the 8032 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 and disconnects the display RAM from the 8032 bus. Since DMA transfers do not stop the 8032, there is an additional 1.7 milliseconds of program execution time available during each video frame (26 row x 60 microseconds horizontal period).

Besides character addressing, the 2672 also generates the scan line count and attribute control signals. The scan line count, and blink rate signals are multiplexed on the 2672's character address lines. At the beginning of each scan line these multiplexed signals are clocked by the falling edge of the blank signal into a latch (1E).

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 non-embedded and 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 8032 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 seven bits wide. See Table 6-2.

Table 6-2   Attribute Byte

Bit	Attribute	Remarks
0-1	Normal, bold, dim, or blank	Four possible combinations that select one of four intensities
2	Inverse	Bit 2, when set, will cause the character's video to reverse and display a negative image.

Table 6-2 Continued

Bit	Attribute	Remarks
3	Underline	Bit 3, when set, is triple ANDed with bits L0 and L3 at the Character Line Counter's output, specifying the desired scanline for the Underline attribute.
4	Blink	Bit 4, when set, is NANDed with the blink rate from the PVTC's DA11 output.
5-6	Font select	Bits 5 and 6 select the character sets within the character generator ROM, or the soft font RAM.

Character Generator--Each character cell is 10 x 10 (80 column) or 9 x 10 (132 column) with a character matrix of 7 x 10 dots. The character generator (1H) is a 2764A (8Kx8) EPROM that stores both displayable and non-displayable characters and symbols. Character address bits A11 and A12 select from three possible character sets.

Video Shift Register--The video shift register (5L) sends the serial bit stream to the video input of the monitor/power supply PCB. The shift register loads parallel character data from the character generator ROM at the CCLK rate, and shifts the data out serially at the DDLK rate to the video drive circuitry on the monitor/power supply PCB.

7 SCHEMATICS

This chapter contains schematic diagrams for the terminal's keyboard PCB, logic PCB, and monitor/power supply PCB. They will help you troubleshoot the terminal.

Schematic	Part Number	Figure Number	Location
Keyboard PCB	96-062-01	Figure 7-1	page 7-3
Logic PCB	96-055-01	Figure 7-2	page 7-5
Monitor/power supply PCB	96-061-01	Figure 7-3	page 7-11

Figure 7-1 Keyboard PCB Schematic

Figure 7-2 Continued
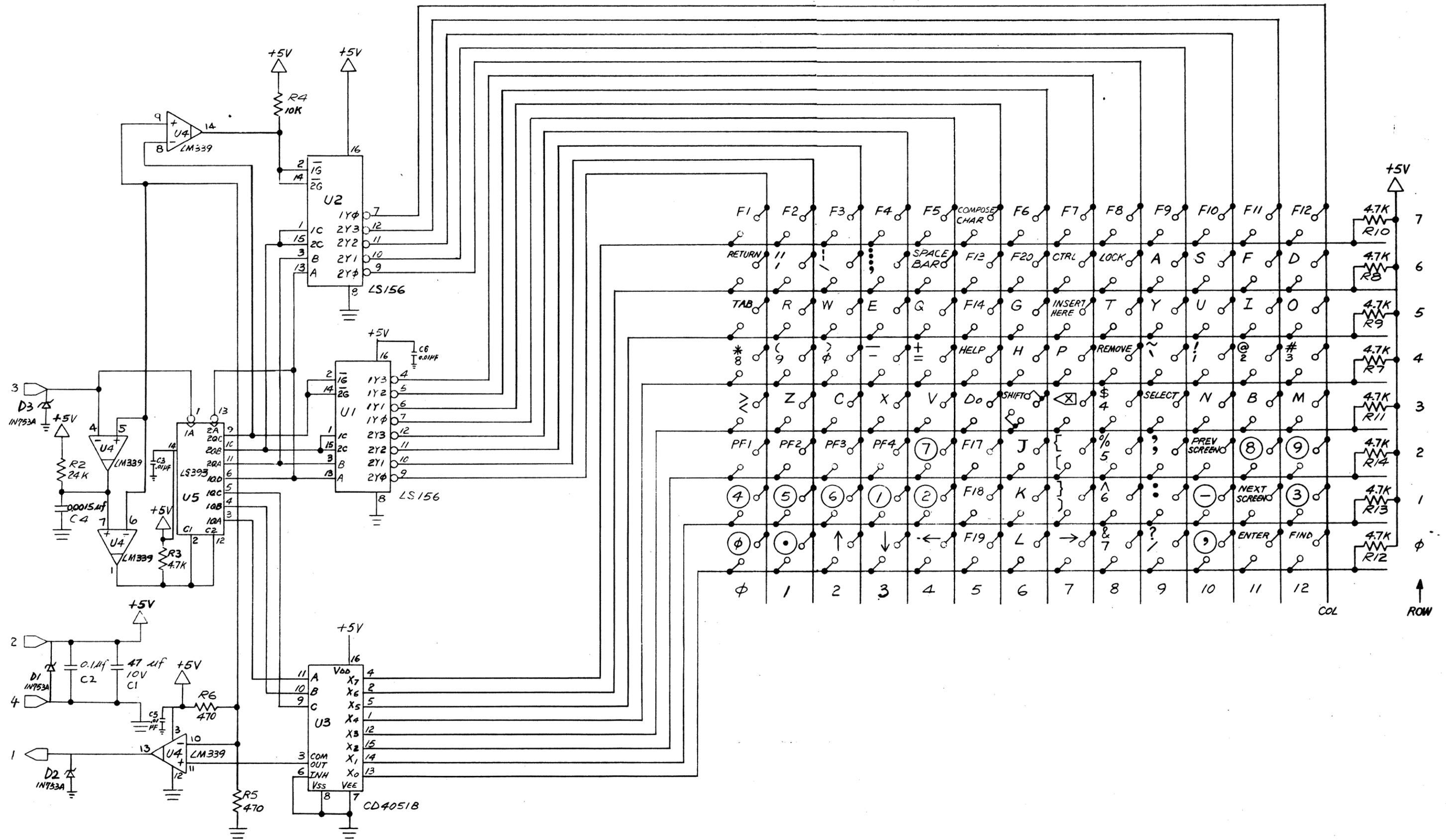
Figure 7-2 Logic PCB Schematic

Figure 7-2 Continued
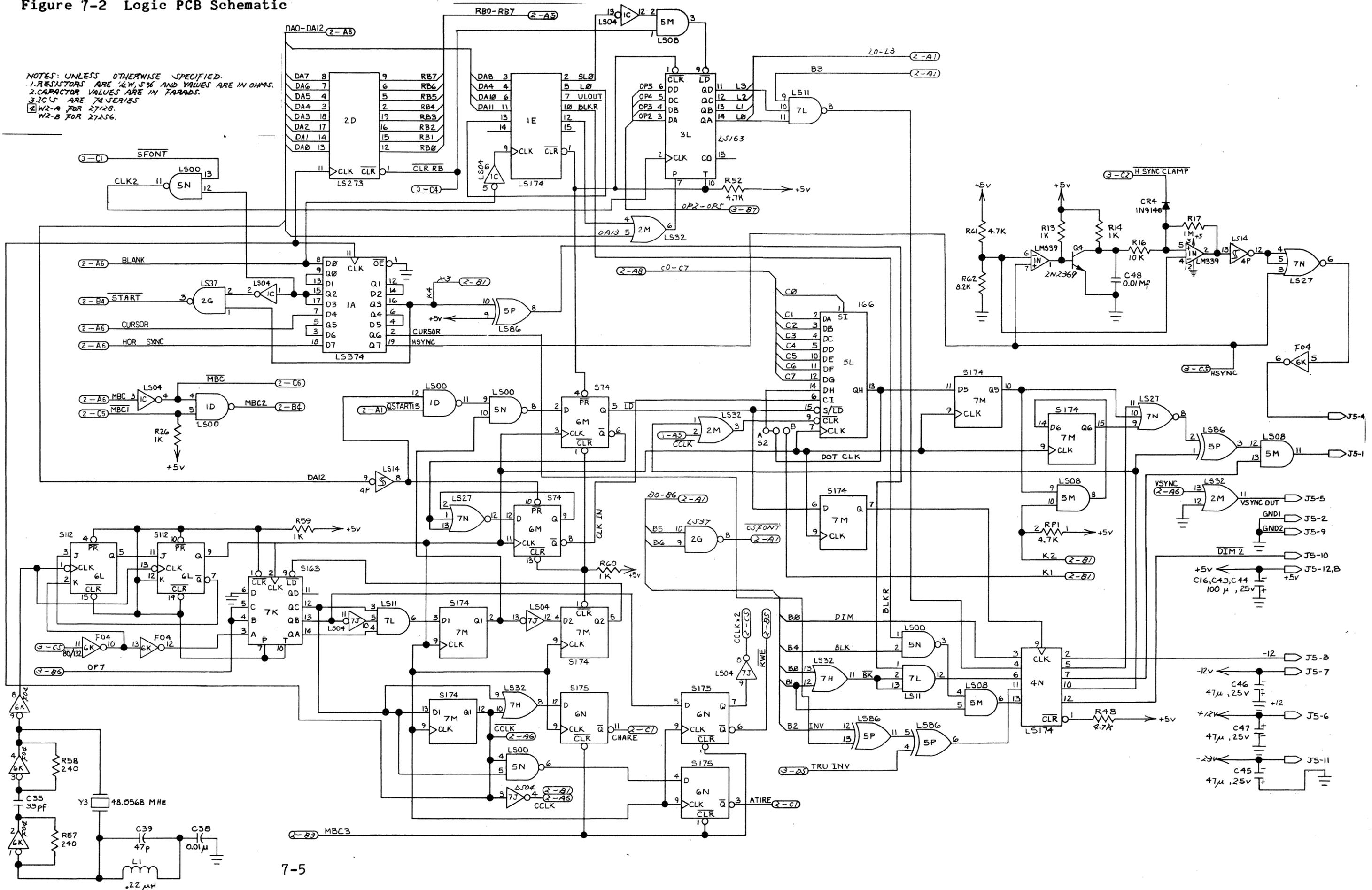
Figure 7-3 Monitor/Power Supply PCB
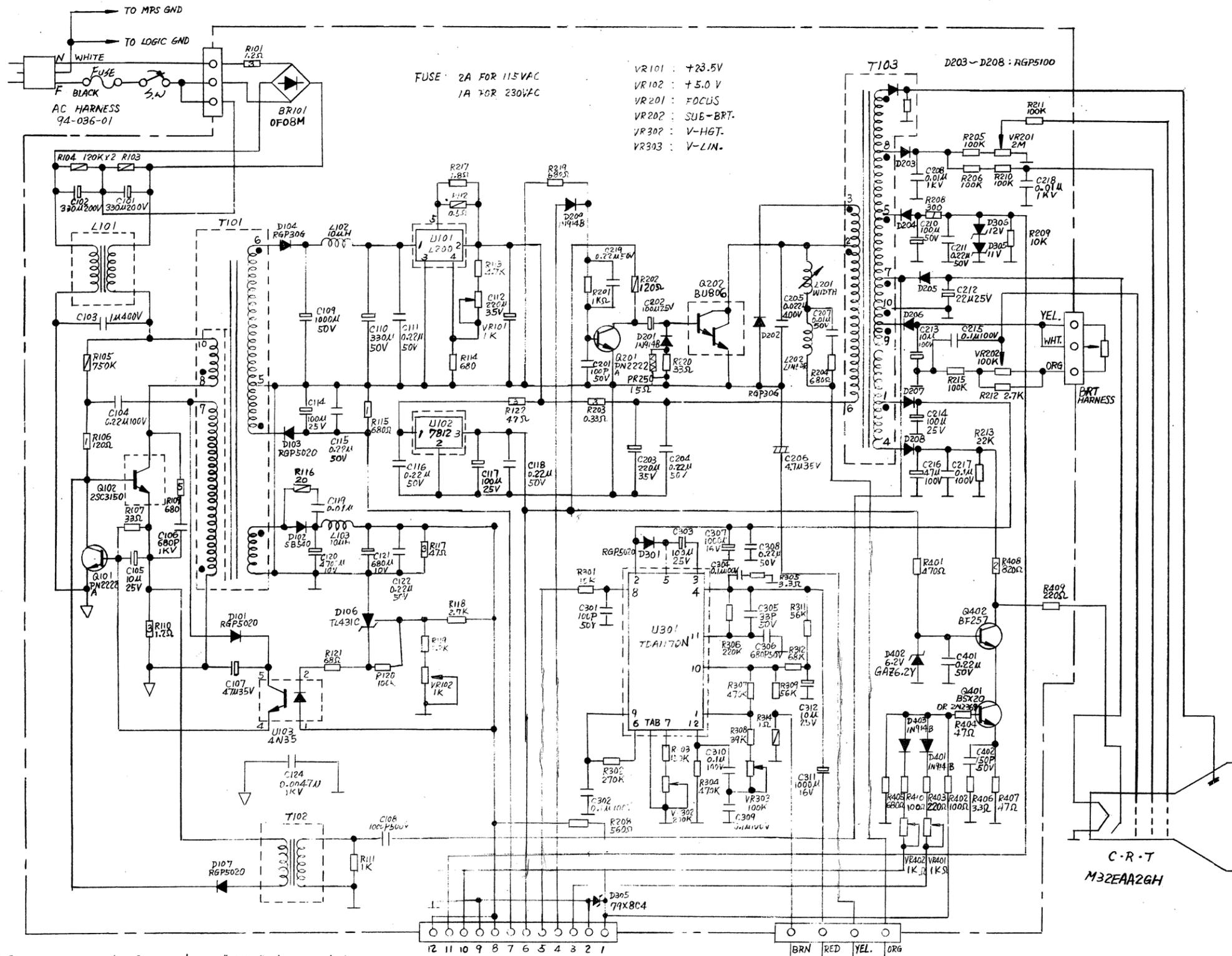
NOTE: 1. The unit of resistance "OHM" is omitted
         (K-1000 OHMS, and M-1 MegOHM)

      2. All resistors are 1/4 Watt unless otherwise
         noted.

      3. The unit of capacitance "μFD" is omitted
         unless otherwise noted pf.

1 BOLD
2. GND
3. NORMAL
4. H-SYNC
5 V-SYNC
6 +12V
7 -12V
8 +5V
9 GND
10 DIM
11 -23V
12 +5V

LOGIC HARNESS

YOKE HARNESS

APPENDIX A SPECIFICATIONS

Power Requirements

Line Voltage	115/220 VAC
Line Frequency	50/60 Hz
Power Consumption	42 watts
Fuse	250V, 2.0 ampere fast blow

Operating Requirments

Ambient Air Temperature	+10 to +35 degrees Centigrade
Nonoperating 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	16.858 to 16.862 kHz 16.860 kHz, nominal
Vertical	59.994 to 60.006 Hz 60.000 Hz, nominal

Display Time

Horizontal	47.45 to 47.92 us
Vertical	15.42 ms

Resolution

Horizontal	640 dots
Vertical	260 lines

Display Format

80 column mode:

Horizontal	640 pel
Vertical	260 scan lines

132 column mode:

Horizontal	1188 pel
Vertical	260 scan lines

Font Density

    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:
Horizontal   10 pel
Vertical   10 pel

    132 column mode:
Horizontal   9 pel
Vertical   10 pel

Retrace Time

    80 column mode:
Horizontal   7.78 us (max)
Vertical   1.008 us (max)

    132 column mode:
Horizontal   8.27 us (max)
Vertical   1.008 us (max)

Display Size

    Horizontal   238 mm, $\pm$2.38 mm
    Vertical   176 mm, $\pm$2.38 mm

Display Intensity, Nominal

    Bold   50 fL, $\pm$10 fL
    Normal   33 fL, $\pm$6 fL
    Dim   17 fL, $\pm$6 fL

Contrast

    Bold > Normal   10%
    Normal > Dim   10%

Focus   50%

Linearity

    Horizontal   12%
    Vertical   10%

Centering

Margin Tolerance	± 4.00 mm
Pincushion and Tilt	± 1.19 mm

Measurement Direction

Neck north

Warmup Time

30 minutes

Meets EMI Specifications

FCC Rules and Regulations, Part 15, Subpart J, Class A
UL 478 and CSA C22.2, no. 154 approved

Terminal Dimensions

Height	12.0 in.
Weight	12.5 lbs.
Width	12.75 in.

Movement

Tilt and swivel

Phosphor

P31 green

Synchronization

TTL levels

Attributes

Blink, underline, reverse, blank, normal, and dim intensities

APPENDIX B CONNECTOR PIN ASSIGNMENTS

The COMM and PR (printer) port connector pin assignments are listed
below. The interface cables must **not** have any wires running to
pins 9, 10, 11, 12, 14, 18, 19, 24, and 25 of the COMM port.

Table B-1 COMM Port Pin Assignments (DTE)

Pin No.	Mnemonic	Signal
1	PGND	Shield Ground
2	TXD	Transmit Data (output)
3	RXD	Receive Data (input)
4	RTS	Request to Send (output)
*5	CTS	Clear to Send (input)
6	DSR	Data Set Ready
7	SGND	Signal Ground
*8	DCD	Data Carrier Detect (input)
9		
10		Not Used
11		Not Used
12	SPDI	Speed Indicator
14		
18		
19		
20	DTR	Data Terminal Ready (output)
23	SPDS	Speed Select (output)
24		
25		

* Don't connect these pins. If they receive low signals, the
   terminal will not operate.

Table B-2 PR Port Pin Assignments (DTE)

Pin No.	Mnemonic	Signal
1	PGND	Shield Ground
*2	TXD	Transmit Data (output)
3	RXD	Receive Data (input)
4	RTS	Request to Send (output)
5	DTR	Data Terminal Ready (output)
6	DSR	Data Set Ready (input)
7	SGND	Signal Ground
8		
9		

* For handshaking purposes. X-on/X-off protocol (received from printer)

Table B-3 20mA Port Pin Assignments

Pin No.   **Signal**

1   -12 V
2   Negative Transmit
3   Negative Receive
5   Positive Transmit
7   Positive Receive
8   Ground

APPENDIX C TEST CONNECTORS

This appendix describes connections, signals connected, and the connector hood types needed for making the test connectors referenced in Chapters 3 and 4.

COMM PORT

Use a female 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 20 to Pin 6   (DTR to DSR)

      Pin 20 to Pin 8   (DTR to DCR)

      Pin 23 to Pin 12   (SPDS to SPDI)

PR PORT

Use a female DB-9 pin connector. Connect these pins (signals):

      Pin 2 to Pin 3   (TxD to RxD)

      Pin 5 to Pin 6   (DTR to DSR)

20mA PORT

Use a male current loop connector. Connect these pins (signals):

      Pin 1 to Pin 3   (-12V to -RCV)

      Pin 8 to Pin 5   (GND to +XMT)

      Pin 2 to Pin 7   (-XMT to +RCV)

APPENDIX D   DISPLAY INSPECTION WITH THE RETICLE

The video inspection reticle, a sheet of milled plastic with markings, helps you measure the 14-inch monochrome display to determine whether or not the display is within specification. Figure D-1 shows the reticle and its markings.

Figure D-1   Video Inspection Reticle
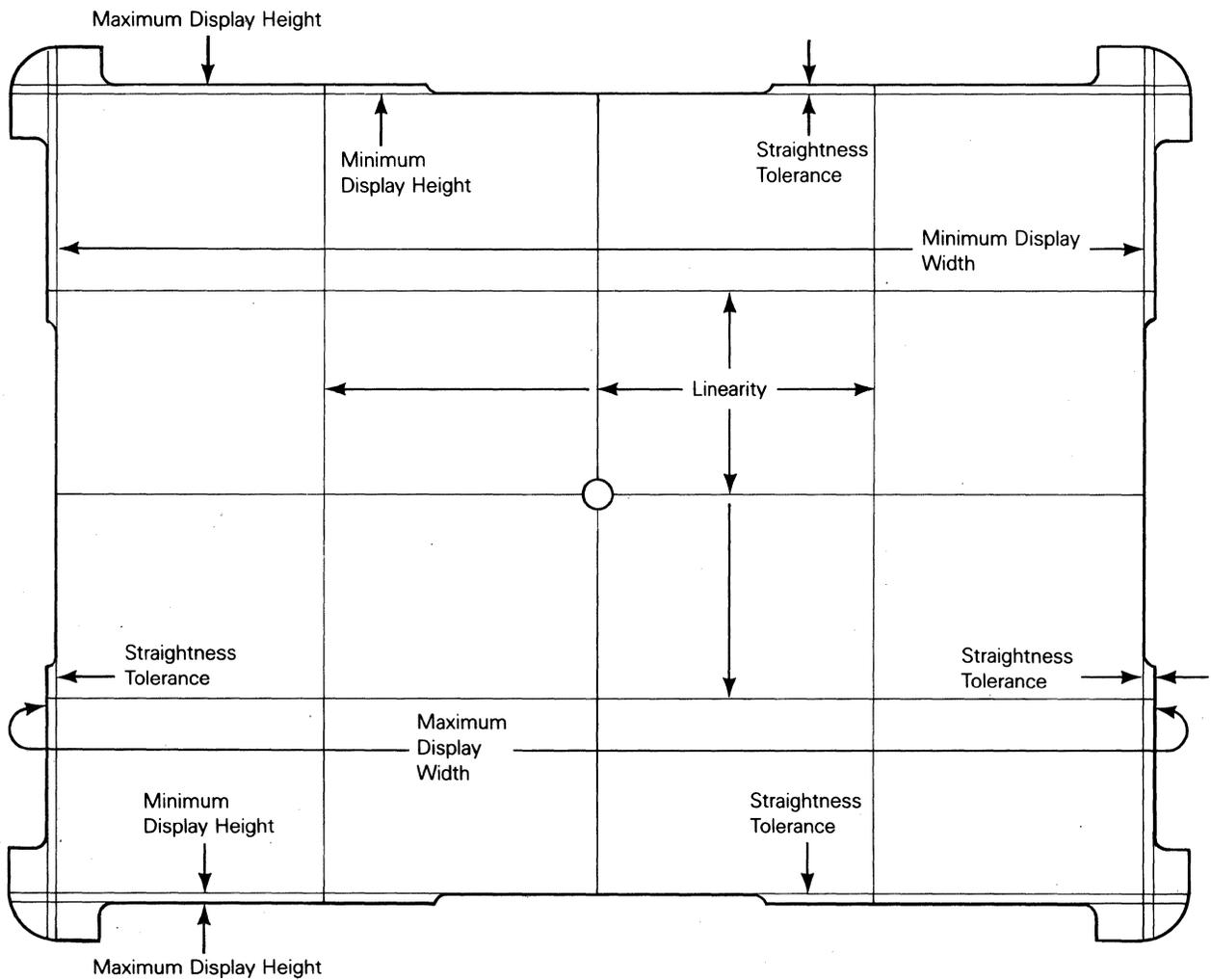
DEFINITIONS

Before checking the display, make sure you understand these terms:

Bezel--the front-piece of the display case that "frames" the face of the CRT.

Display--the portion of the screen where the video display alignment pattern appears.

Linearity--a comparison of character height and width ranges in the display. You can check both vertical and horizontal linearity by comparing character height and width within the display. True linearity results in characters that are the same height and width range everywhere. See Appendix A for linearity tolerances.

Pincushion and Barrel Distortion--distortion that results if deflection is not uniform at the raster edges when compared with the center of the display. Scan lines bowed inward are called **pincushion distortion.** Scan lines bowed outward are called **barrel distortion.**

Video Display Alignment Pattern--a test pattern to measure display alignment.

BEFORE YOU START

Before you check the alignment, do the following:

1.   At least 30 minutes before you check the display, turn on the terminal. This warm-up period settles the display and gives you an accurate test pattern to measure.

2.   Generate test pattern 0 on the terminal screen (as discussed in Chapter 4).

3.   Point the neck of the CRT toward magnetic north to minimize the effects of the earth's magnetic field.

4.   Have the video display reticle on hand to inspect the display.

CHECKING THE DISPLAY WITH THE RETICLE

Checking Width

To check the display's width:

1.   Rest the reticle along the lower horizontal edge of the bezel.

2. Check the left vertical edge, then the right vertical edge, of the alignment pattern by moving the reticle along the edge of the bezel. Both edges should fall between the minimum and maximum display width bands on the reticle. See Figure D-2.

3. If either edge falls outside the bands, adjust the display. See the alignment instructions in Chapter 4.

Figure D-2   Checking Width and Height

* Maximum Height
* Minimum Height
Reticle
Bezel
Display
* Maximum Width
* Minimum Width
* Maximum Width
* Minimum Width
* Minimum Height
* Maximum Height
* The display must lie between these lines
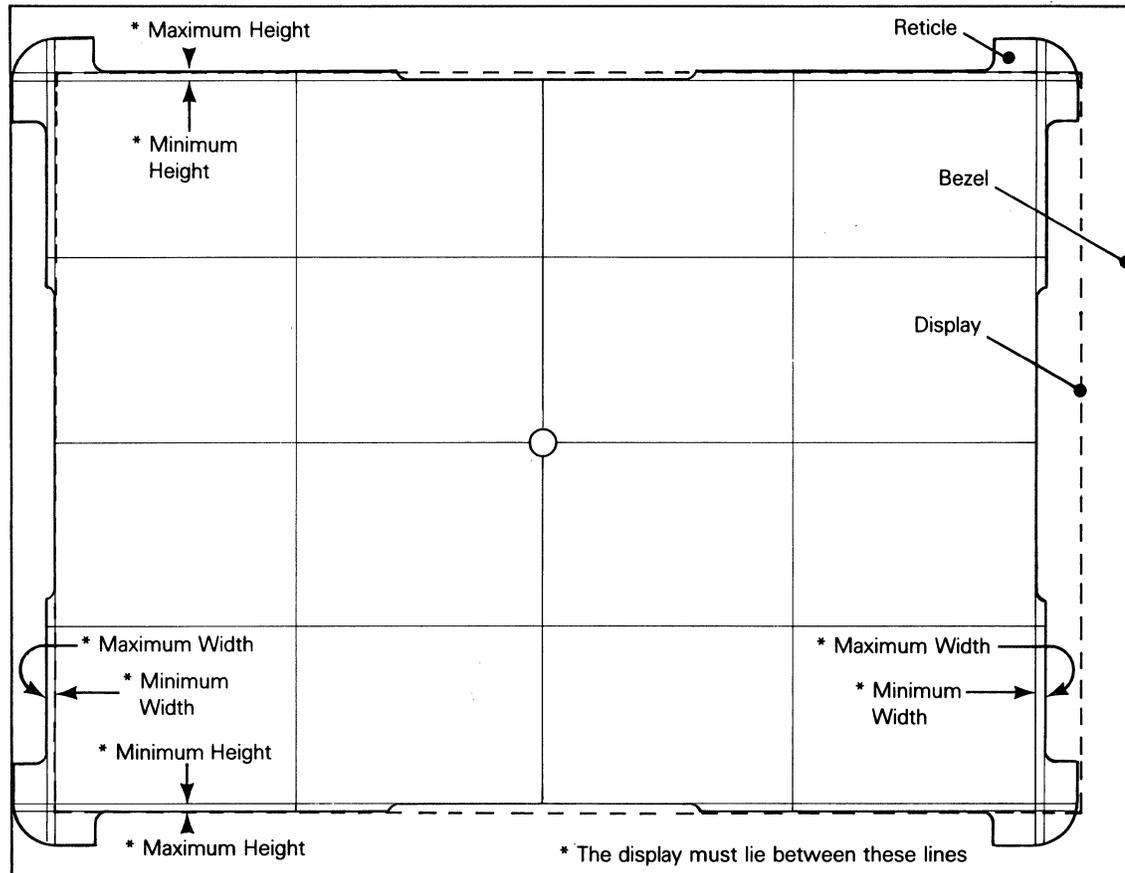
Checking Height

To check the display height:

1. Rest the reticle on the left vertical edge of the bezel.

2. Move the reticle up and down along the edge. Check the top edge, then the bottom edge, of the alignment pattern. Both edges should fall between the minimum and maximum display height bands on the reticle. See Figure D-2.

3. If one or the other edge falls outside the bands, adjust the display. See the alignment instructions in Chapter 4.

Checking Straightness and Pincushioning

To check straightness and pincushioning:

1. Move the reticle along a horizontal edge of the bezel. Check the right vertical edge, then the left vertical edge, against the straightness lines etched on the perimeter of the reticle. See Figure D-3.

2. Move the reticle along a vertical edge of the bezel. Check the top edge, then the bottom edge, against the straightness lines etched on the perimeter of the reticle.

3. Position the upper right corner of the display between the etched markings on the upper right corner of the reticle. The display corner edge should fall within the scribed markings on the corner of the reticle.

4. Repeat the same procedure for the other corners of the display.

5. If an edge or corner doesn't fall within the markings, adjust the display. See Chapter 4.

Figure D-3 Checking Straightness, Pincushioning, Centering, and Linearity
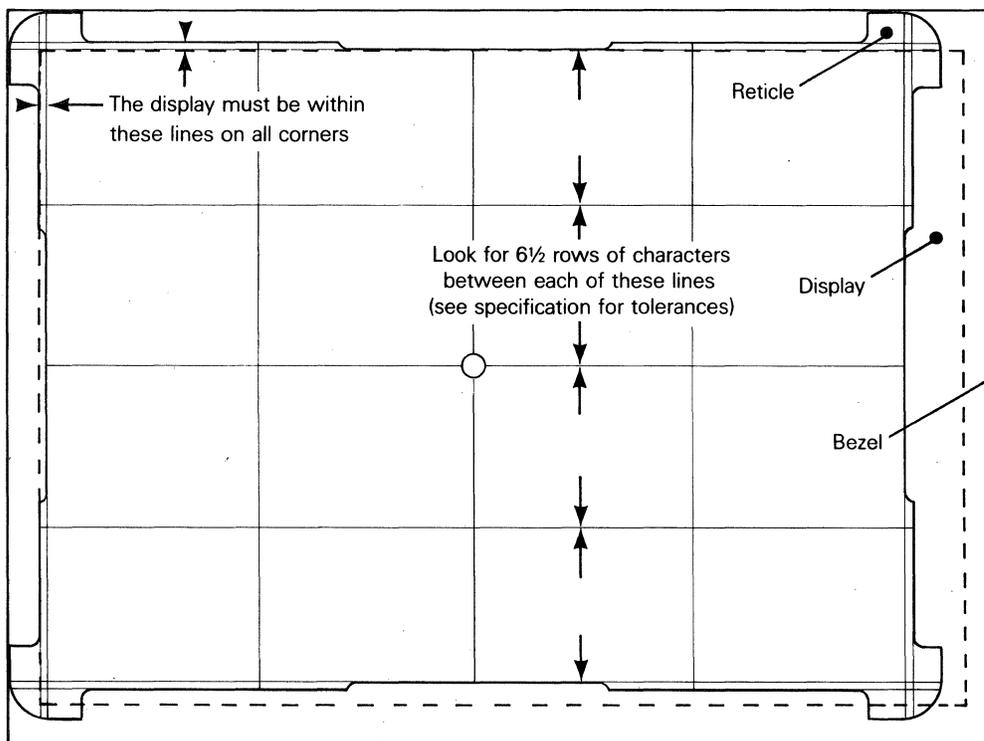
Checking Centering

To check the centering:

1. Hold the reticle over the center of the alignment pattern.

2. Move the reticle against the right edge of the bezel, then the left edge of the bezel. If the right and the left edges of the alignment pattern are inside the etched lines on the left and right sides of the reticle, the display is horizontally centered. See Figure D-3.

3. If the alignment pattern on the display isn't horizontally centered, adjust the display. See Chapter 4.

4. Move the reticle against the top bezel edge, then the bottom bezel edge. If the top and the bottom edges of the alignment pattern are inside the etched lines on the top and bottom sides of the reticle, the display is vertically centered.

5. If the alignment pattern on the display isn't vertically centered, adjust the display. See the instructions in Chapter 4.

Verifying Linearity

To vertify linearity:

1. Place the center hole of the reticle in the center of the alignment pattern. The measurement points for horizontal and vertical linearity are the small squares (one font cell wide) located halfway to the center of the display along the parallel lines, as shown in Figure D-3.

2. If the etched lines on the reticle fail to fall within the small squares, make the linearity adjustment outlined in Chapter 4.

Checking Intensity and Focus

1. Generate test pattern M. This generates an eighty-column screen display of focus characters and three square inverse video brightness adjustment areas. These squares represent dim1 (normal, 40 fL), dim 2 (XX fL) and full bright (60fL). See Figure D-4.

2. Use a photometer to measure the center area of the display. If the intensity fails to meet the specifications outlined in Step 1 of this procedure, refer to the brightness adjustment procedure in Chapter 4.

3. Rotate the brightness control thumbwheel, located on the
    lower right-hand corner of the CRT bezel, to get a dim
    display. Check the characters located on a diagonal line
    halfway between the display center and the bezel corner. If
    they are not distinct and clear, refer to the focus
    adjustment procedure in Chapter 4.

4. If the display is within specification and looks regular,
    press the SETUP key twice.

5. Turn the terminal off.

Figure D-4   Checking Intensity and Focus

The display must be within these edges

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