



**Instrumentation  
Laboratory**

***The Pixel 100/AP<sup>TM</sup>  
Service Manual***

***Maintenance***

**THE PIXEL 100/AP SERVICE MANUAL**

**II**  
**MAINTENANCE**

**Part No. 160451-01 Rev. 0**

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## Section 1

### INTRODUCTION

This manual is intended to help field engineers maintain and repair the Pixel 100/AP general purpose microcomputer in the field.

The user of this manual should be familiar with the theory of operation of the 100/AP hardware (contained in a separate volume of the 100/AP Service Manual: "Theory of Operation," IL part no. 160451-00). Some familiarity with the operating system and other software in use is also essential. More information on Pixel software can be found in Appendix B.

Because of the modular design of the 100/AP, field repair will consist primarily of modular replacement, cabling, video adjustments, and similar operations. This type of field service will be referred to as "Level 1" repair. More detailed operations including board troubleshooting and component replacement will be referred to as "Level 2" repair.

This book supports level 1 repair only. The Access and Replacement section contains the information needed to identify, remove and replace the individual modules. The Cabling and Connectors section contains information on the power wiring, diskette and Winchester disk drive cabling, and cable routing. It also includes diagrams which identify the signals present at the connector pins throughout the system. The Maintenance section covers preventive maintenance (including a functional check), cleaning, and adjustments. The Troubleshooting section includes a step-by-step method for isolating errors and correcting them.

Some information normally found in maintenance manuals proper has been placed in appendices to permit easy updating. In particular, the section on required tools and spare parts (Appendix A) should be of interest.



## Section 2

### ACCESS AND REPLACEMENT

#### 2.0 GENERAL

This section covers assembly and disassembly procedures for the following components:

- Computer enclosure
- Terminal
- Diskette drives
- Winchester disk drives

Each subsection includes information on parts identification and hardware options which can be used in conjunction with the parts list in Appendix A for ordering.



## 2.1 REPLACEMENT PROCEDURES FOR THE COMPUTER MODULES

### 2.1.1 Removing the Back Panel

To access the interior of the computer enclosure and service the components inside, it is necessary to remove the back panel of the computer.

#### WARNING

Line voltage is present at the EMI filter/interlock wiring, at the on/off switch, at the terminal strips above the fans, and at the disk drives when the power is on. Observe standard safety precautions when working around equipment which is plugged in.

The power supply in the card cage may maintain some voltage for up to one minute after AC is removed.

#### CAUTION

Static electricity can damage the MOS ICs which are used on many of the boards. Danger of damage by static electricity is greatest for sites with low humidity (<40%) and carpet flooring. Handling PCBs by the edges or card ejectors and handling them only when necessary will help guard against static damage.

- a. Using a 9/64-inch Allen hex wrench (3,5 mm), remove the seven bolts which secure the back panel to the computer. The open circles in Figure 2-1 shown the locations of the bolts.
- b. Slide the back panel down, then out. Remove the ground wires (the plastic connectors slide together) at the bottom right and center of the panel.

- c. Slide the top of the computer back (about an inch), then lift it off. Remove the ground wire at the front left corner (looking from the back).
- d. To reassemble the unit, reverse the process. Note that the notches in the top fit over the two circular plastic guides on the sides of the enclosure. The washers are slid onto the back panel bolt first (split lockwasher, then flat washer), then the bolt-washer assembly holds the back to the computer.

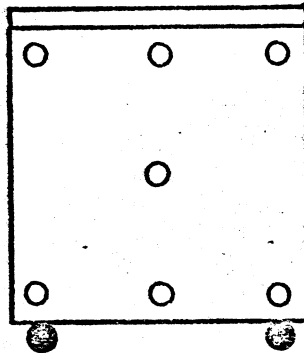


Figure 2-1. Back Panel Bolt Locations

### 2.1.2 Parts Identification

Figures 2-2 and 2-3 show the interior of the computer module. The printed-circuit-card modules mount in the card cage in the top half of the computer next to the fan assembly (the black metal angled part with the terminal strips on top). The three fans mount on the underside of the fan assembly. A metal partition separates the top half of the computer from the bottom half.

Cabling between the top and bottom half is fed through three cable ports: a small one in the bottom of the card cage for DC power, a large one underneath the fan assembly at the rear of the partition used for disk drive data cables, and a smaller one

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Figure 2-2. Interior of Computer

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Figure 2-3. Interior of Computer

under the fan assembly near the rear of the partition for AC power to the on/off switch.

Diskette and Winchester disk drives mount in the bottom half of the computer. The AC line cord is fed through a port in the floor of the housing, connected to a EMI filter on the right wall, and an interlock switch on the floor of the housing.

Table 2-1 identifies the printed-circuit-card modules and lists the hardware options available.

Table 2-1

Printed-Circuit-Card Modules

Module	Identifying Features	Options
IOP Board	No ribbon-cable connectors on top. Largest chip is TMS9900.	128K/256K of RAM
AP Board	Two sixty-pin ribbon-cable connectors on top. Largest chip is MC68000.	none
AP/Memory Board	(Up to 6 may be installed.) Two sixty-pin ribbon cables on top. Large regular arrays of gold-topped RAM chips.	.25/.50/.75/1 Meg of RAM
Serial Board	Dedicated position--rearmost in card cage. Two top ribbon-cable connectors, parallel, serial, and terminal ports on card itself.	4-1-8 or 8-2-8 ser.-par.-terminal ports.
Terminal Cont.	Single ribbon-cable connector on top. Densely populated board.	#0 or #1 50/60 Hz.
Diskette Cont.	Single ribbon-cable connector on top. Sparsely populated board. Largest chip is FD1771.	

Table 2-1  
(cont'd)

Module	Identifying Features	Options
Winch. Cont.	Wide ribbon-cable connector at top; smaller ones on the face of the board. Red and green LED on top of board.	
Power Supply	Dedicated position--wide slot in card cage with 37-pin connector. Wide board.	115/220 v.

The only dedicated positions in the card cage are the serial board's (rearmost) and the power supply's (the wide one). All of the other positions may be used by any of the cards. In practice, the terminal controllers (which have to connect to the serial board) are usually mounted in the positions near the serial board, while the diskette and Winchester controllers are mounted on the other end of the card cage.

### 2.1.3 Replacing Printed Circuit Card Modules

- a. Open the back and top of the computer (Section 2.1.1).
- b. Locate the module to be removed (Section 2.1.2).
- c. Remove the ribbon cable(s), if any, from the module to be replaced. Note the orientation of the cable (a colored stripe on one edge of the cable. Some diskette signal cables have a patten on one side of the cable; note that there is a heavier mark on one edge of these cables as well). In a properly wired system, the colored edges of all the cables will point towards the fan assembly.
- d. When removing the power supply, remove the AC and DC power connectors shown in Figure 2-4.
- e. Pull up on the white plastic card ejectors and remove the card.

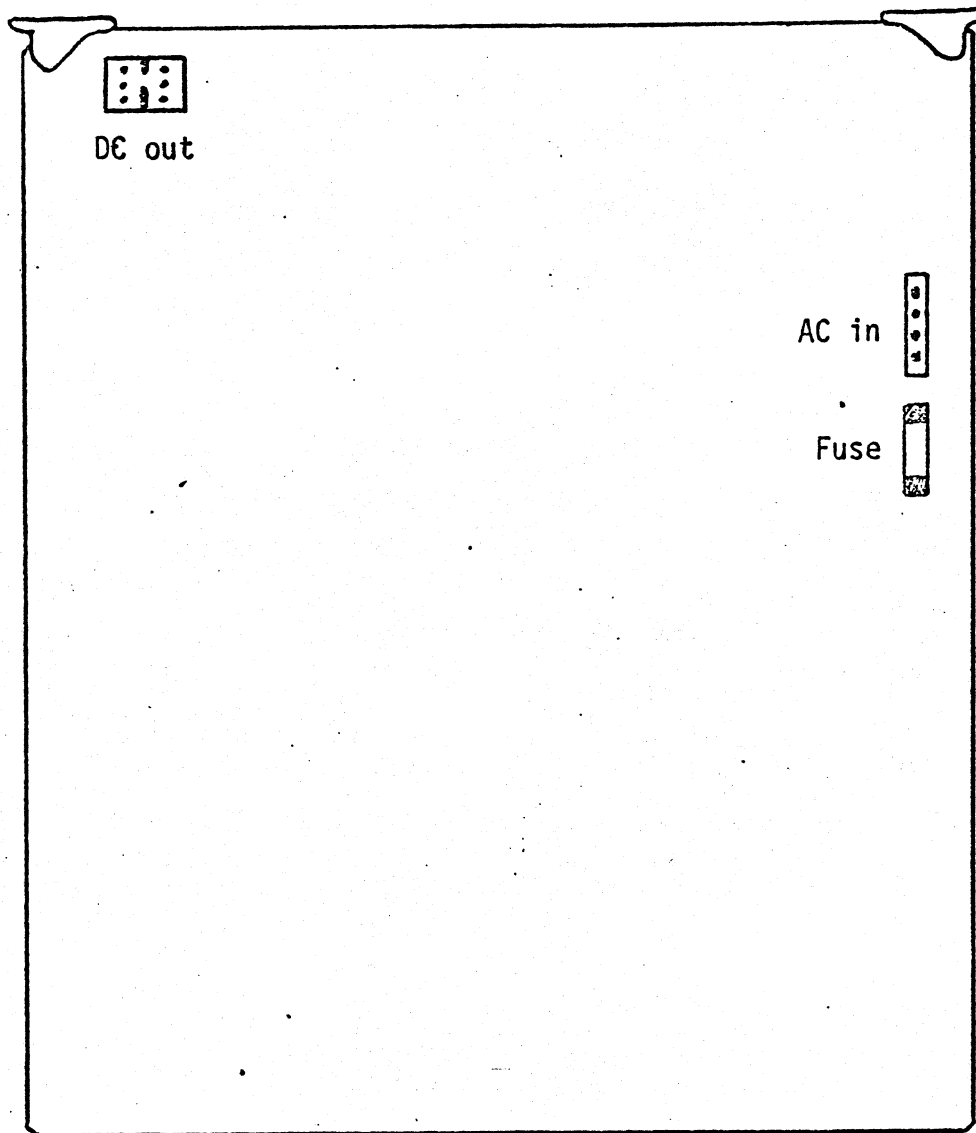


Figure 2-4. Power Supply Connector and Fuse Locations

- e. Install the replacement module, making sure it goes in straight. The component side of the board faces the back of the computer. Push the card down into the backplane connector, making sure that it is seated completely and resting on the card ejectors.

**CAUTION**

The backplane edge connectors may be damaged if the board is not inserted correctly. The replacement procedures for these connectors are lengthy. Do not attempt to force the card if it does not seem to be seating correctly.

The power supply may be damaged if it is connected to improper line voltage. Be especially careful when the line voltage is 220 volts.

- f. Reconnect the ribbon cables, if any. If you have forgotten how they were connected, refer to Section 3 of this manual.

#### 2.1.4 Replacing the On/Off Switch

The on/off switch assembly also contains the unit circuit breaker and power indicator lamp.

- a. Open the back panel and top (Section 2.1.1).
- b. Unplug the quick-connect connectors (translucent plastic) on the back of the switch.
- c. Using a 1/4-inch nutdriver, unscrew the mounting nuts on either side of the switch housing.
- d. Remove the switch assembly.
- e. Squeeze the mounting tabs on the top and bottom of the switch assembly to remove it from the mounting plate. Replace the switch.



- f. Remount the switch assembly and reconnect as shown in Figure 2-5.

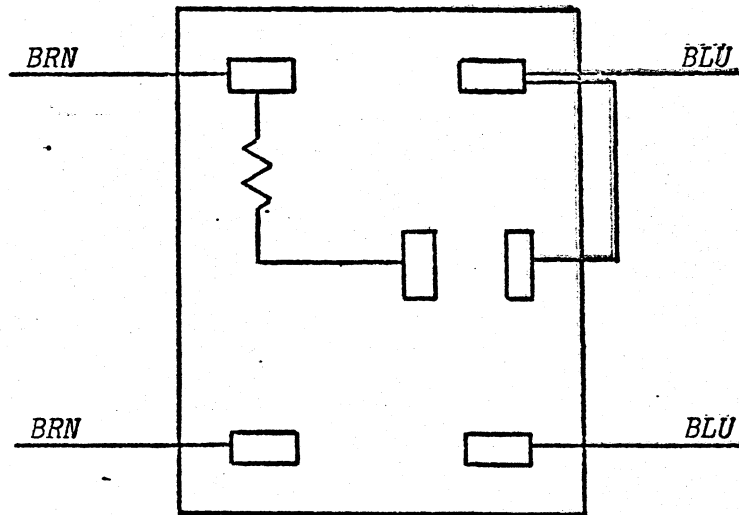


Figure 2-5. On/Off Switch Connections  
(back view)

### 2.1.5 Replacing the AC Line Cord, Filter, and Interlock

These components are wired as shown in Figure 2-6. To replace, use a slotted screwdriver to remove the component, then install the replacement. Rewire as before.

When replacing the filter, be sure that the three-terminal end of the filter is down.

When replacing the line cord, be sure that the metal braid covers the cord completely from its input port to the filter ground (center) terminal.

Notes: Ground A is on the floor of the housing, near the AC line cord port. A ground wire for the power supply is also connected at A.

Ground B is on the floor of the housing, in the corner near the EMI/RFI filter. Ground wires for the disk drives and the rear panel ground connector are also attached to ground B.

The center terminal on the EMI/RFI filter is connected to ground B and to a metal braid used to shield the AC line cord between its input port and the filter.

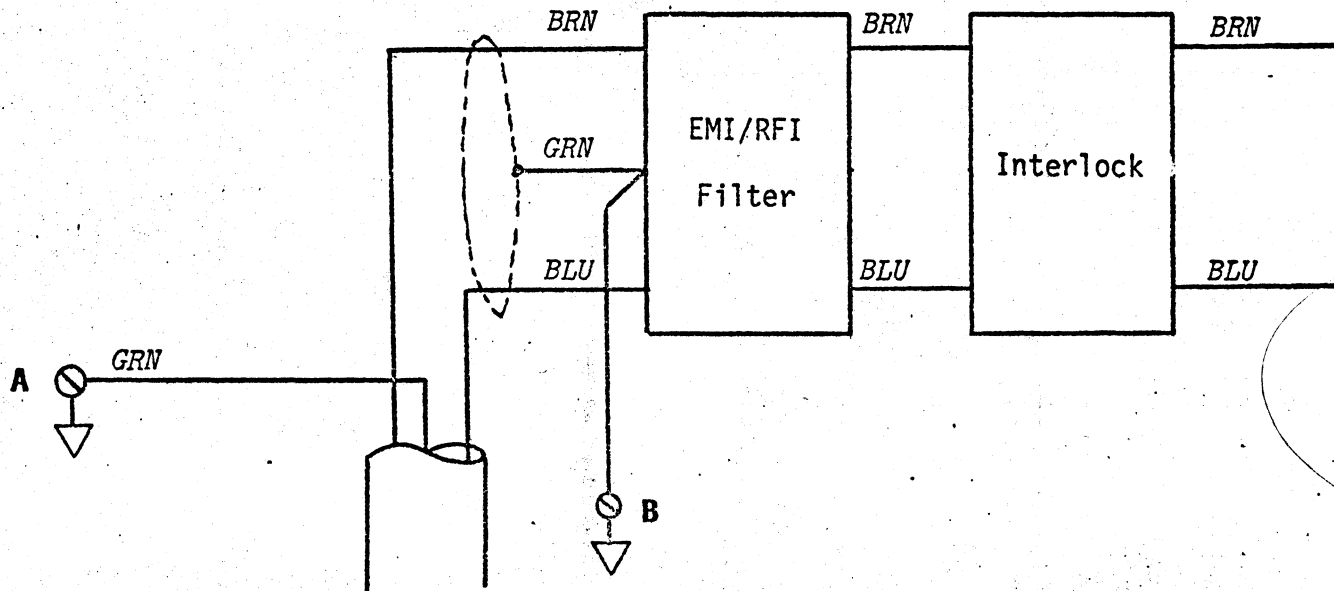


Figure 2-6. AC Line Cord Wiring

### 2.1.6 Removing the Card Cage and Fan Assembly

The card cage is attached at one side to the computer housing. The black angled metal part on the other side, the "fan assembly," serves as a mounting surface for the two AC terminal blocks and 5-amp circuit breaker (on top) and the three cooling fans (underneath). The backplane serves as the floor of the card cage; underneath it, the whole assembly rests on rubber feet which in turn rest on the metal partition which spans the computer enclosure at the middle.

The card cage and fan assembly must be removed before the backplane or fans can be removed.

- a. Open the back panel and top (Section 2.1.1).
- b. Remove all of the circuit boards and the cables attached to them.
- c. Remove the two 5-amp circuit breaker wires (brown) from the terminal blocks on top of the fan assembly.
- d. Remove the terminal block mounting screws and the terminal blocks. (There are two mounting screws per block. They also secure the plexiglas shields.) Refer to Figure 2-7.
- e. Remove the four screws which hold the card cage to the Z-rails welded to the side of the housing. As you lift the card cage out, unplug the black connectors which supply power to the fans; this will free the card cage so that you can lift it out completely. Be careful so as not to snag the DC power cable as you lift the cage out.
- f. To reinstall, reverse the process. Be sure to thread the DC power cable back through the hole in the backplane. Do not tighten the terminal block mounting screws too tightly (more than hand tight) or you may crack the plexiglas shield.

### 2.1.7 Removing the Fans

If you have very small or angle-driven nutdrivers you may be able to replace a fan without removing the card cage first.

Note: All 6 screws in each terminal-block half are connected.

Power supply ground is on floor of housing near AC cord input.

Disk drive ground is on floor of housing near EMI filter.

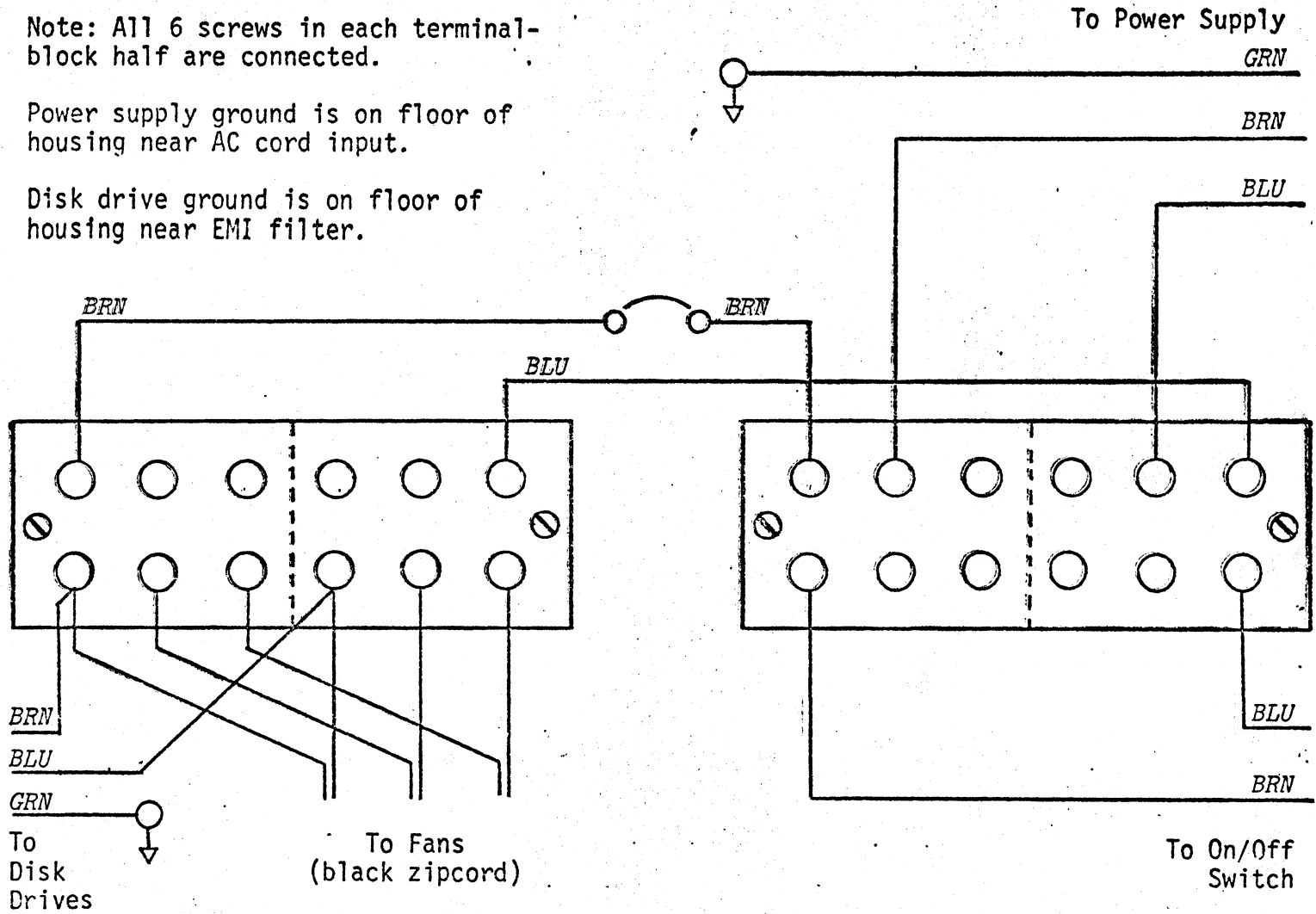


Figure 2-7. Terminal Block Wiring

- a. Remove the fan assembly and card cage (Section 2.1.6) (see note above).
- b. Using a 1/4-inch nutdriver (7 mm), unscrew the fan from the fan assembly.
- c. Attach the replacement fan. The black power connector can be connected either way.

#### 2.1.8 Replacing the Backplane

If one of the connectors on the backplane has been damaged by contamination or improper insertion of a PC board, the backplane must be replaced. Replacement takes a while, so it is wise to attempt to clean the connector with Dust-off, a soft brush, or some other contact cleaning method before replacing the backplane if there is no obvious physical damage.

- a. Remove the card cage (Section 2.1.6).
- b. Unscrew the four screws which hold the backplane and rubber feet to the corners of the card cage. Refer to Figure 2-8.
- c. To reinstall, reverse the process.

#### 2.1.9 Fuses and Circuit Breakers

The 100/AP is protected by one fuse and two circuit breakers.

The fuse is located on the power supply board. This board is protected by current-limiting circuitry which is able to withstand even a direct short across its output. The fuse provides an extra measure of protection. Should the power supply fuse blow, it indicates a malfunction of the power supply which warrants the return of the power supply to the factory for testing. Refer to Figure 2-4 for the fuse location.

The unit on/off switch contains a circuit breaker which is reset by turning the machine off for two minutes and then turning it back on.

The 5-amp circuit breaker on the fan assembly will interrupt

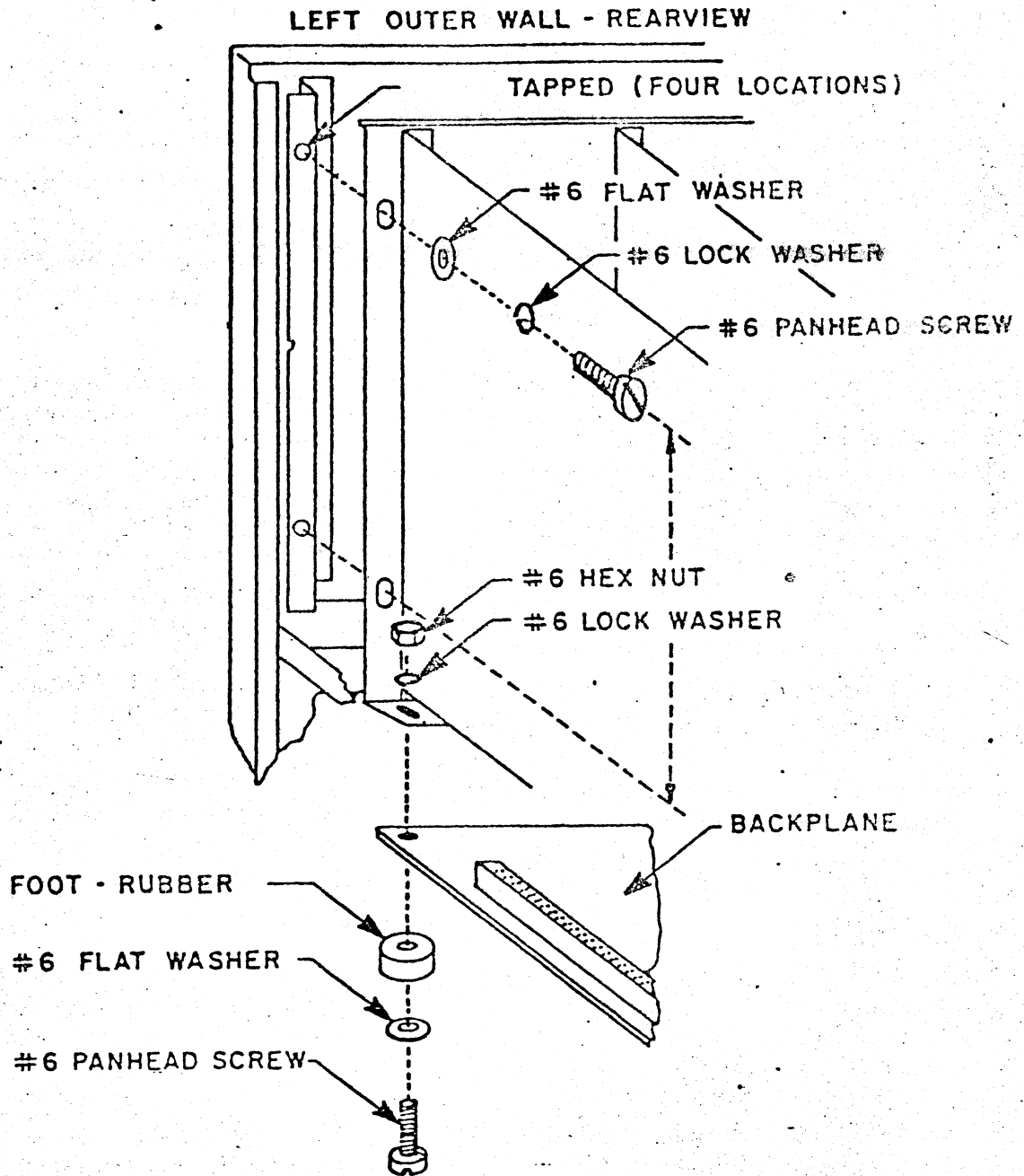


Figure 2-8. Attaching the Backplane

AC power to the disk drives and fans. It will not interrupt DC power to the system. It is reset by pulling the knob out, then pushing it in.

#### 2.1.10 Setting AP/Memory DIP Switches

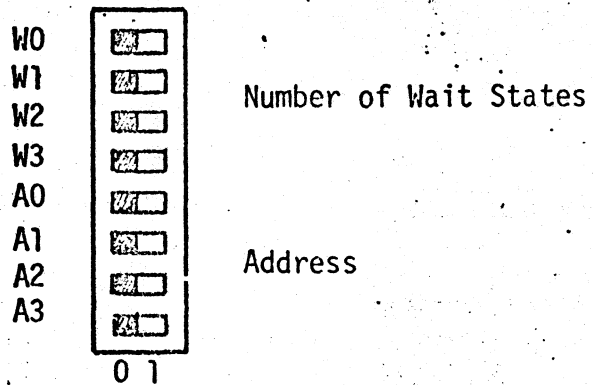
DIP (dual-inline-pin) switches, a bank of ~~single-pole~~ ~~single-throw~~ switches in a package the size and shape of an IC, are used to set the address of a particular AP/memory board, and the number of wait states.

The upper four switches in the DIP switch govern the number of wait states. The number of wait states will normally be one; any deviation from this figure (due to system configuration or application) will be specified by Pixel.

The lower four switches set the board address; each board will respond to a specific combination of the four most significant bits of the AP RAM address bus (RAMA20..RAMA23).

In practice, of course, when replacing a board the DIP switches should simply be set in the same way as the board being replaced.

The DIP switch settings are shown in Figure 2-9.



A3	A2	A1	A0	Board Address (hex)	W3	W2	W1	W0	Waits
0	0	0	0	000000	0	0	0	0	8
0	0	0	1	080000	0	0	0	1	7
0	0	1	0	100000	0	0	1	0	6
0	0	1	1	180000	0	0	1	1	5
0	1	0	0	200000	0	1	0	0	4
0	1	0	1	280000	0	1	0	1	3
0	1	1	0	300000	0	1	1	0	2
0	1	1	1	380000	0	1	1	1	1
1	0	0	0	400000	1	x	x	x	0
1	0	0	1	480000					
1	0	1	0	500000					
1	0	1	1	580000					

x = don't care

Figure 2-9. AP/Memory DIP Switch Settings



## 2.2 REPLACEMENT PROCEDURES FOR THE TERMINAL

### 2.2.1 Opening the Display Housing

The display housing is opened by removing the four screws at the bottom corners of the display housing. The molded top can then be removed.

#### WARNING

CRTs retain some of their high voltage even after power has been turned off. Always ground the anode by slipping a grounded metal blade screwdriver under the boot on CRT anode before working around the CRT or display driver circuitry.

CRTs can implode if subjected to shocks or stress. Always handle CRTs carefully.

### 2.2.2 Parts Identification

The interior of the display unit is shown in Figure 2-10, 2-11, and 2-12.

### 2.2.3 Replacing the Receiver Board

The receiver board is mounted on the base of the display housing. Connectors to the computer and the keyboard are mounted directly on the receiver board; they face out through the back panel of the display unit.

- a. Open the display housing (Section 2.2.1).
- b. Unplug the two translucent plastic connectors which connect the receiver board to the display driver and the power

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Figure 2-10. Terminal (Display Driver)

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Figure 2-11. Terminal (Back View)

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Figure 2-12. Terminal (Power Supply).

supply.

- c. Remove the four screws at the corners of the receiver board which hold it onto the display housing.
- d. To install, reverse the process. Make sure the connectors are firmly seated.

#### 2.2.4 Replacing the Display Driver Board

The display driver board is mounted over the base of the CRT.

NOTE: The display driver may have to be adjusted after installation according to Section 4.4 of this manual. If the horizontal size needs adjustment, a special hex alignment tool is required.

- a. Open the display housing (Section 2.2.1).
- b. Short out the high voltage lead to the CRT by slipping a grounded metal-blade screwdriver (with an insulated handle) under the clear plastic boot.
- c. Pull back the clear plastic boot on the high-voltage lead and remove the lead.
- d. Pull off the tube socket at the end of the CRT.
- e. Disconnect the ground lead connected to one of the "bell" speaker's mounting bolts.
- f. Unplug the connectors which connect the display driver to the receiver board and the CRT yoke.
- g. Unscrew the four mounting screws at the corners of the display driver board.
- h. To reinstall, reverse the process (it is not necessary to short the anode again). Adjust according to Section 4.4, if necessary.

### 2.2.5 Replacing the CRT

- a. Remove the display driver (Section 2.2.4).
- b. Loosen the screws at the corners of the CRT screen.
- c. Hold the CRT with one hand, and with the other remove the four screws at the corners of the CRT screen, the long tension spring, and the ground wire.
- d. To install, reverse the procedure.

#### WARNING

Do not tighten the screws on the CRT corners more than hand tight. Doing so may cause an implosion.

### 2.2.6 Replacing Power Supply Components

The power wiring is shown in Figure 2-13. Individual components of the power supply are replaced by unbolting them (in the case of the capacitor, loosening the clamp), removing the wires, and replacing. Be sure to observe polarity at the filter capacitor.

The transformer can be wired for either 115 or 220 volt operation. If the primary coils are wired in parallel as shown in Figure 2-13, the power supply will accept 115 volt line voltage. If the primary coils are wired in series (Figure 2-14) the power supply will accept 220 volt line voltage.

### 2.2.7 Replacing the Contrast Control

The contrast control is a potentiometer mounted on the front of the display housing in such a way that the operator can turn the knob through a cutout in the base of the housing.

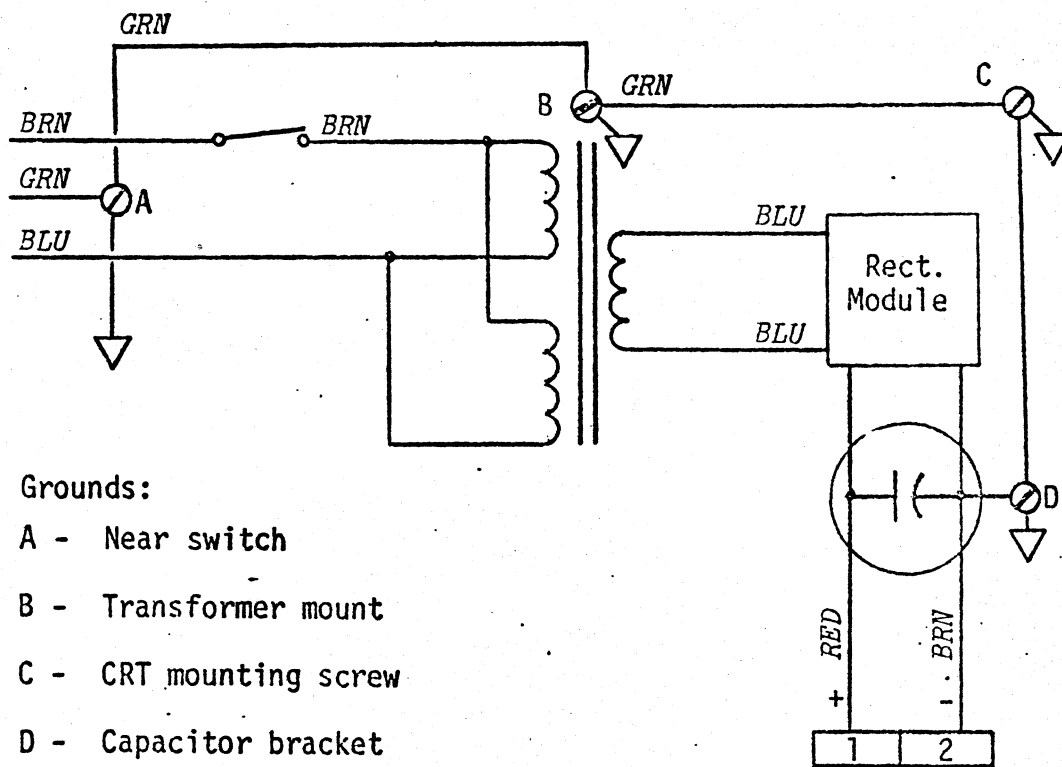


Figure 2-13. Terminal Power Supply

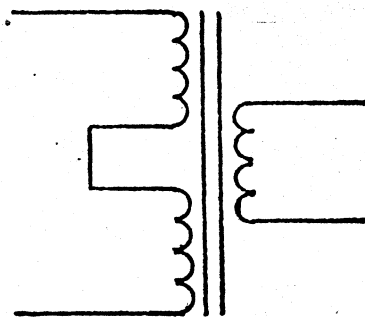


Figure 2-14. Transformer Wiring—220 Volt

- a. Remove the 10-wire connector from the display driver and extract the three wires which run from the contrast control to the display driver. The wires can be extracted with a special extraction tool or with a thin tool such as a paper clip.
- b. Remove the two contrast control mounting screws with a 1/4-inch nutdriver (7 mm). Replace the control.
- c. Insert the wires into the display driver connector. The center wire on the control goes to the center hole (#3) in the connector.

#### 2.2.8 Replacing the Bell

The bell is actually a small speaker mounted on the left side (from the front) of the display unit.

- a. Remove the 10-position connector from the receiver board.
- b. Extract the bell wires (#2-white, #3-white) from the connector, using either an extraction tool or a thin tool such as a paper clip.
- c. Remove the speaker.
- d. To install, reverse the process. Make sure that the ground lug from the display driver board (black) is connected to one of the mounting screws.

#### 2.2.9 Replacing the Keyboard

In the field, the keyboard and keyboard housing are normally carried and replaced as a unit. The coiled cord is removed by squeezing the plastic locking pin which points down from the plug. The connector snaps back in.



## 2.3 REPLACEMENT PROCEDURES FOR THE DISKETTE DRIVES

### 2.3.1 Replacing the Drive Unit

Diskette drives mount on a shelf inside the computer housing, immediately below the card cage. If there are Winchester disk drives installed below a drive to be replaced, the lower drive will have to be removed (Section 2.4.1 or 2.5.1) in order to access the mounting screws of the upper drive.

NOTE: If you have a long ratchet dogbone wrench (1/4 in -- 7 mm) you might be able to remove upper drives without removing lower drives. This maneuver takes practice.

- a. Open the back panel and top (Section 2.1.1).
- b. Unplug the power connectors from the drive: there are four-in (AC) and six-pin (DC) connectors made of white translucent plastic. You do not need to note the orientation of these connectors as they are keyed.
- c. Unplug the gray ribbon cable. Note the orientation of the cable, either by the embossed trademark on the connector (which will be right-side-up or upside-down), or by the stripe indicating pin 1. In a properly wired system (with the cables in the card cage all pointing toward the fans), pin 1 should be to the right.
- d. Using a screwdriver or a 1/4-inch (7 mm) nutdriver, loosen the four mounting screws underneath the drive to be removed. These screws fit into keyways in the computer housing. To remove the drive, pull it back (about a half an inch) and lift it up and out. If you wish, you may remove the mounting screws completely and then slide the drive back.
- e. To replace the drive, reverse the process.

### 2.3.2 Parts Identification

The parts of the diskette drive are shown in Figures 2-15, 2-16, and 2-17.

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Figure 2-15. Diskette Drive (PCB Side)

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Figure 2-16. Diskette Drive (Pulley Side)

PHOTO NOT AVAILABLE AT  
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Figure 2-17. Diskette Drive (Motors)

### 2.3.3 Replacing the Drive PCB

The electronics which control many of the functions of the diskette drive are packaged on a printed circuit board mounted on the drive.

- a. Remove the drive from the computer (Section 2.3.1).
- b. Remove the three connectors attached to the drive PCB. They are labeled P2, P3, and P6 in Figure 2-15.
- c. Remove the four mounting screws and remove the PCB.
- d. To install, reverse the process. Be sure the drive is jumpered correctly (Section 2.3.7).

### 2.3.4 Replacing the Drive Motor Assembly

The drive motor assembly rotates the diskette through a belt-drive system. Motors are available for either 115 or 220 volt operation, and are stamped with the voltage on the side.

- a. Unplug the motor AC power connector (at the rear of the drive).
- b. Locate the two screws which hold the motor capacitor to the drive. Remove the rubber boot over the capacitor leads (if there is one). Note the orientation of the leads.
- c. Remove the drive PCB (Section 2.3.3).
- d. Remove the belt from the drive pulley (refer to Figure 2-16).
- e. Remove the four screws which hold the drive motor to the base casting and remove the motor.
- f. Reverse the procedure for installation. Be sure that the ground lead is connected between the capacitor clamp and the base casting.

### 2.3.5 Replacing the Motor Drive Pulley and Belt

The motor drive pulley and belt are changed to accommodate 50 or 60 Hz operation.

- a. Remove the drive PCB (Section 2.3.3).
- b. Remove the belt from the drive pulley (refer to Figure 2-16).
- c. Using a 1/16-inch Allen hex wrench (1,5 mm), loosen the pulley set screw and remove the pulley.
- d. To install a new pulley, reverse the procedure. The drive pulley must be aligned with the spindle pulley (by eye) so that the belt tracks correctly.
- e. A new belt may be installed after step (b) above.

### 2.3.6 Replacing the Cartridge Eject Spring

The cartridge eject spring is the spring most likely to become weak with continuous use. (Refer to Figure 2-17: "eject mechanism.") It consists of a T-shaped leaf spring and a coil spring attached to a plastic part which the diskette pushes against.

To replace the T-shaped pressure spring, remove the two mounting screws and replace the spring.

To replace the coil spring, it is best to replace the entire spring-and-plastic-part assembly. Remove the T-spring as above, then remove the coiled spring from the post at the front end. Reverse the procedure to install.

### 2.3.7 Jumpering the Drives.

The diskette drives are jumpered for three reasons: to make the diskette drive match the attributes required by the 100/AP, to allow the diskette controller to differentiate between two drives connected to a common cable, and to provide proper impedance termination for certain control lines.

The jumper is a plastic-covered sleeve which fits over and shorts the gold-colored square posts on the drive PCB (the jumper at location TS, however, is an actual wire jumper).

The chart which follows provides the jumpering instructions for the drive PCB. In a one-drive system, the drive must be selected as "drive 1" and terminated. In a two-drive system, the left drive (from the front) must be selected as "drive 1" and the right drives as "drive 2." The last drive--that is, the drive at the end of the daisy-chained ribbon cable--must also be terminated.

Table 2-2. Diskette Drive Jumpering

Location	Jumper
DC	out
D	in
I	out
R	in
S	out
DS1	in to select as "drive 1" otherwise out
DS2	in to select as "drive 2" otherwise out
DS3 } DS4 }	out
T2 } T3 } T4 } T5 } T6 }	in to terminate otherwise out
RI } RR } TS }	wire jumpers always in
NFO	out

Table 2-2  
(cont'd)

Location	Jumper
DS	in
HL	out
A	in
B	in
X	out
T1	in to terminate otherwise out
800	in
801	out
Y	in
Z	out



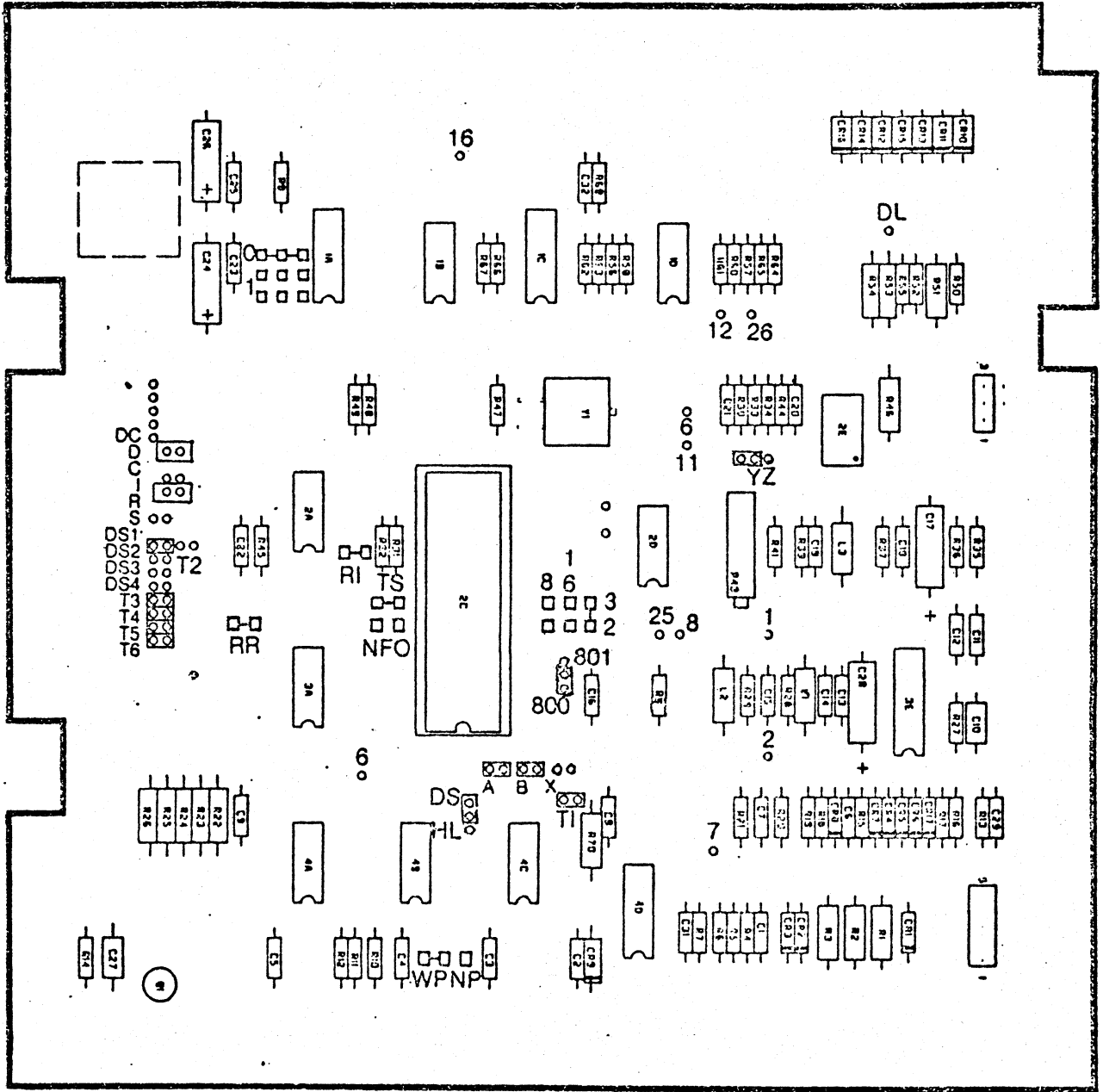


Figure 2-18. Diskette Jumper Locations

## 2.4 REPLACEMENT PROCEDURES FOR 5 AND 10 MEGABYTE WINCHESTER DISK DRIVES

### 2.4.1 Replacing the Drive Unit

#### CAUTION

Winchester disk drives are particularly susceptible to damage by shock or by the inadvertent rotation of the disks. Always handle Winchester disk drives carefully. Never ship or transport them without adequate padding. Install the shipping locks before shipping or transporting the drive.

Do not attempt to unseal the media and heads chamber. A class 100 clean room is necessary to ensure against contamination.

Winchester disk drives mount either on the shelf inside the housing (where diskette drives can also be mounted) or on the floor of the housing. If there is a drive immediately beneath a drive to be moved, the lower drive must be removed first.

- a. Open the back panel and top (Section 2.1.1).
- b. Locate and unplug the AC and DC power cables (white translucent plastic) connected to the drive.
- c. Unplug the 50-conductor ribbon cable (signal) and the 20-conductor ribbon cable (data). Note the orientation of the cables. In a properly cabled system, pin 1 (the marked edge) of both these cables is to the left.
- d. Using a 1/4-inch nutdriver (7 mm), loosen the four mounting screws which secure the drive to the housing. Pull the drive back towards you, then lift it up and out. If you wish, you may remove the four screws and slide the drive back and out.

e. To install, reverse the process.

#### 2.4.2 Parts Identification

The Winchester disk drive is illustrated in Figure 2-19. A product label on the drive will identify its nominal capacity.

#### 2.4.3 Jumpering

The Winchester drives installed in a 100/AP must be jumpered to allow the Winchester controller to enable a specific drive by asserting a unique drive select signal on the common 50-conductor signal cable. This signal must correspond to the data cable number as well. Data cable numbers are silkscreened onto the Winchester controller board--connectors J1 through J4 are connected to data cables 1 through 4.

The drive select jumpers are installed as follows:

<u>Drive number</u>	<u>DS1</u>	<u>DS2</u>	<u>DS3</u>	<u>DS4</u>
1	in	out	out	out
2	out	in	out	out
3	out	out	in	out
4	out	out	out	in

In addition, a termination resistor pack must be installed on the drive at the end of the daisy-chained signal cable. This drive may or may not have the highest number. The termination pack should not be installed on any other drive.

The locations of the jumpers and termination pack are shown in Figure 2-20.

#### 2.4.4 Shipping Locks

In many cases, it will not be necessary to remove the drive unit from the computer to install or remove shipping locks. Before

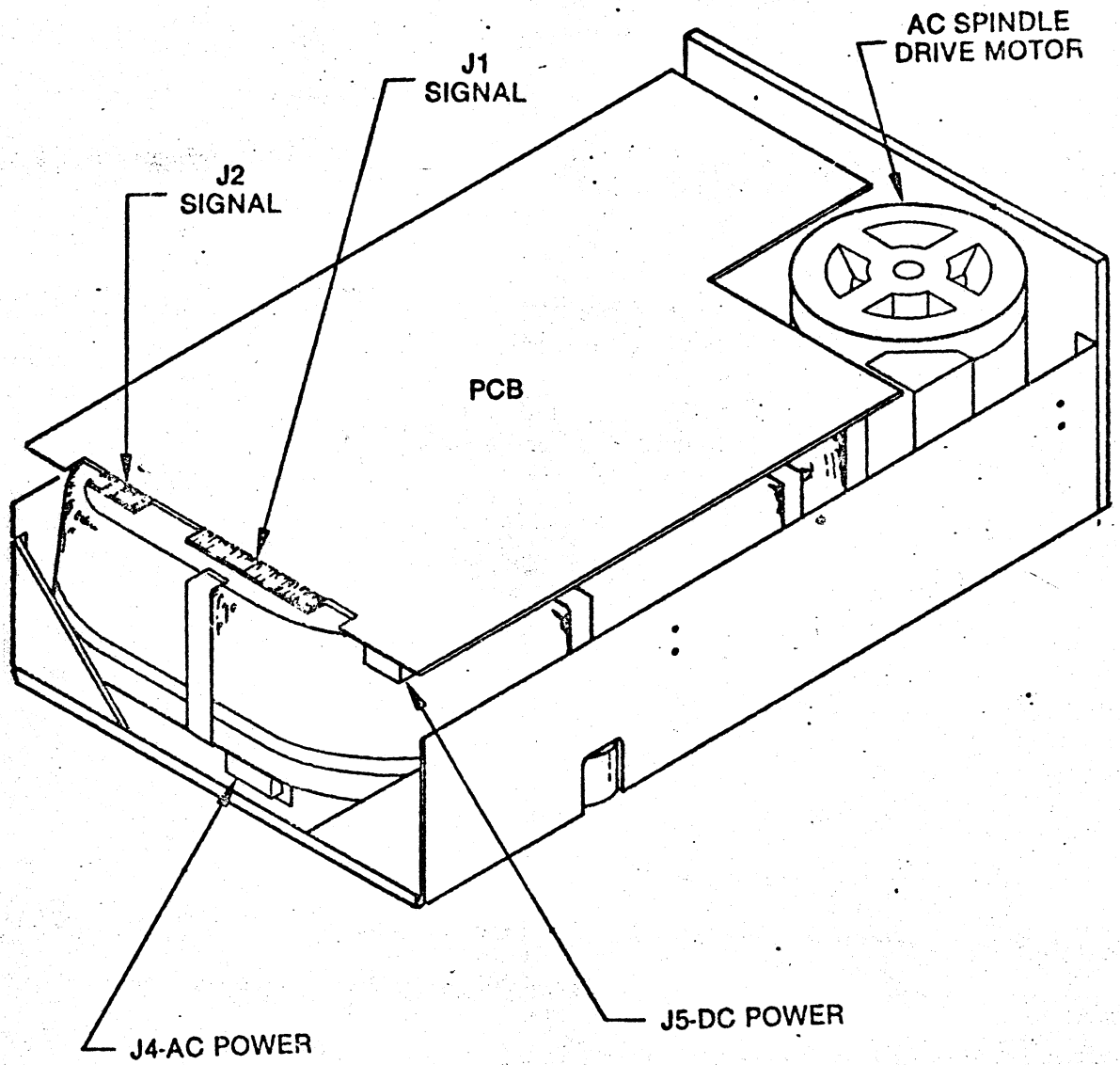


Figure 2-19. Winchester Disk Drive

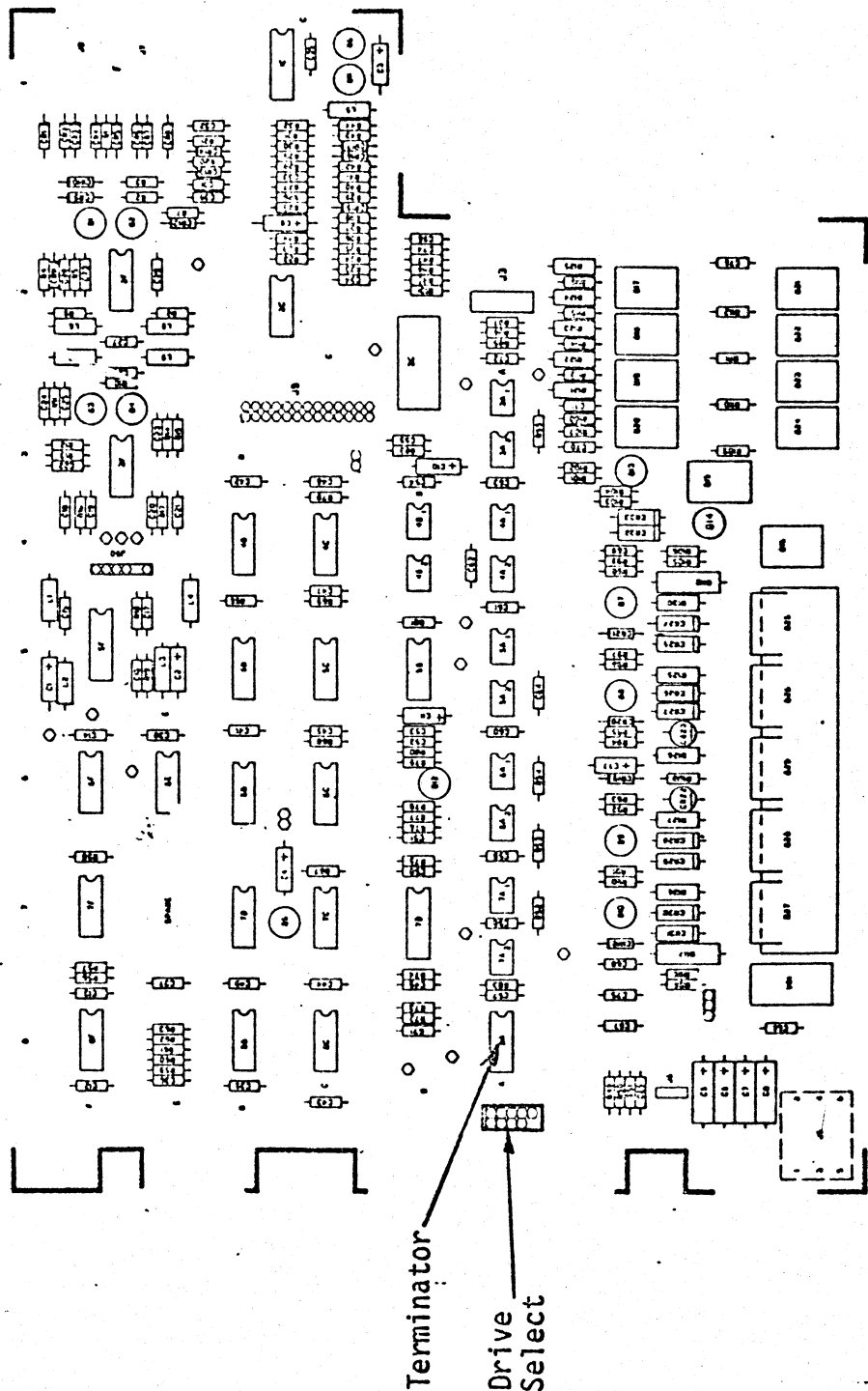


Figure 2-20. Winchester Drive Jumper Locations

removing the drive, check to see if there is a cutout in the computer housing through which the shipping lock can be removed or installed.

The shipping locks are shown in Figure 2-21. The purpose of the lock is to prevent rotation of the drive motor or the disks which could result in damage to the disks.

- a. Remove the drive from the computer if necessary (Section 2.4.1).
- b. Locate the shipping lock on the underside of the drive. Refer to Figure 2-21. The lock consists of a rectangular piece of metal with a bolt on one end and a small key in the other which fits into the motor drive pulley.
- c. To remove: Loosen the bolt with a 1/4-inch nutdriver (7 mm), rotate the lock (not the drive motor) 180 degrees and retighten.
- d. To install: Loosen the bolt with a 1/4-inch nutdriver (7 mm). Rotate the drive motor pulley clockwise in order to fit the key on the shipping lock into one of the holes in the pulley. Tighten the lock bolt.

**CAUTION**

Counterclockwise rotation may damage the heads or media.

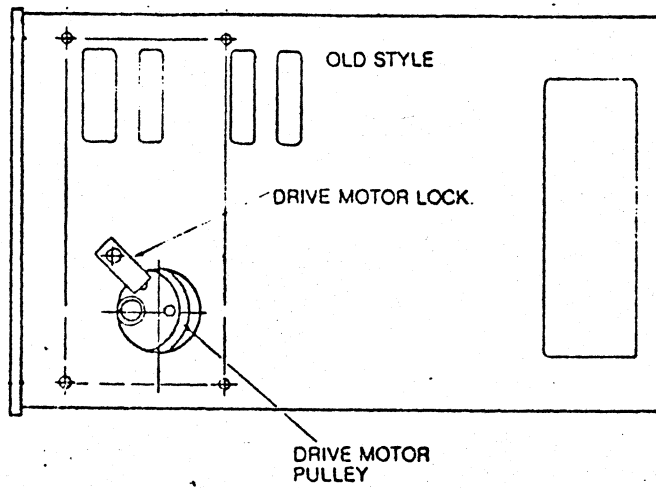
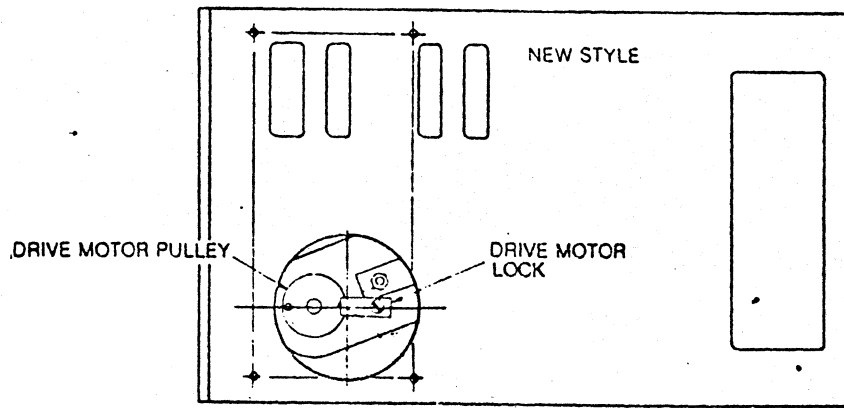


Figure 2-21. Shipping Locks--5 and 10 MB Winchesters

## 2.5 REPLACEMENT PROCEDURES FOR 20, 30, AND 40 MEGABYTE WINCHESTER DISK DRIVES

### 2.5.1 Replacing the Drive Unit

(Same as for smaller Winchester drives, Section 2.4.1.)

### 2.5.2 Parts Identification

(Same as for smaller Winchester drives, Section 2.4.2.)

### 2.5.3 Jumpering

The Winchester drives installed in a 100/AP must be jumpered to allow the Winchester controller to enable a specific drive by asserting a unique drive select signal on the common 50-conductor signal cable. This signal must correspond to the data cable number as well. Data cable numbers are silkscreened onto the Winchester controller board--connectors J1 through J4 are connected to data cables 1 through 4.

The drive select jumpers are installed as follows:

<u>Drive number</u>	<u>DS1</u>	<u>DS2</u>	<u>DS3</u>	<u>DS4</u>
1	in	out	out	out
2	out	in	out	out
3	out	out	in	out
4	out	out	out	in

In addition, a termination resistor pack must be installed on the drive at the end of the daisy-chained signal cable. This drive may or may not have the highest number. The termination pack should not be installed on any other drive.

The location of the jumpers and termination pack are shown in Figure 2-22.



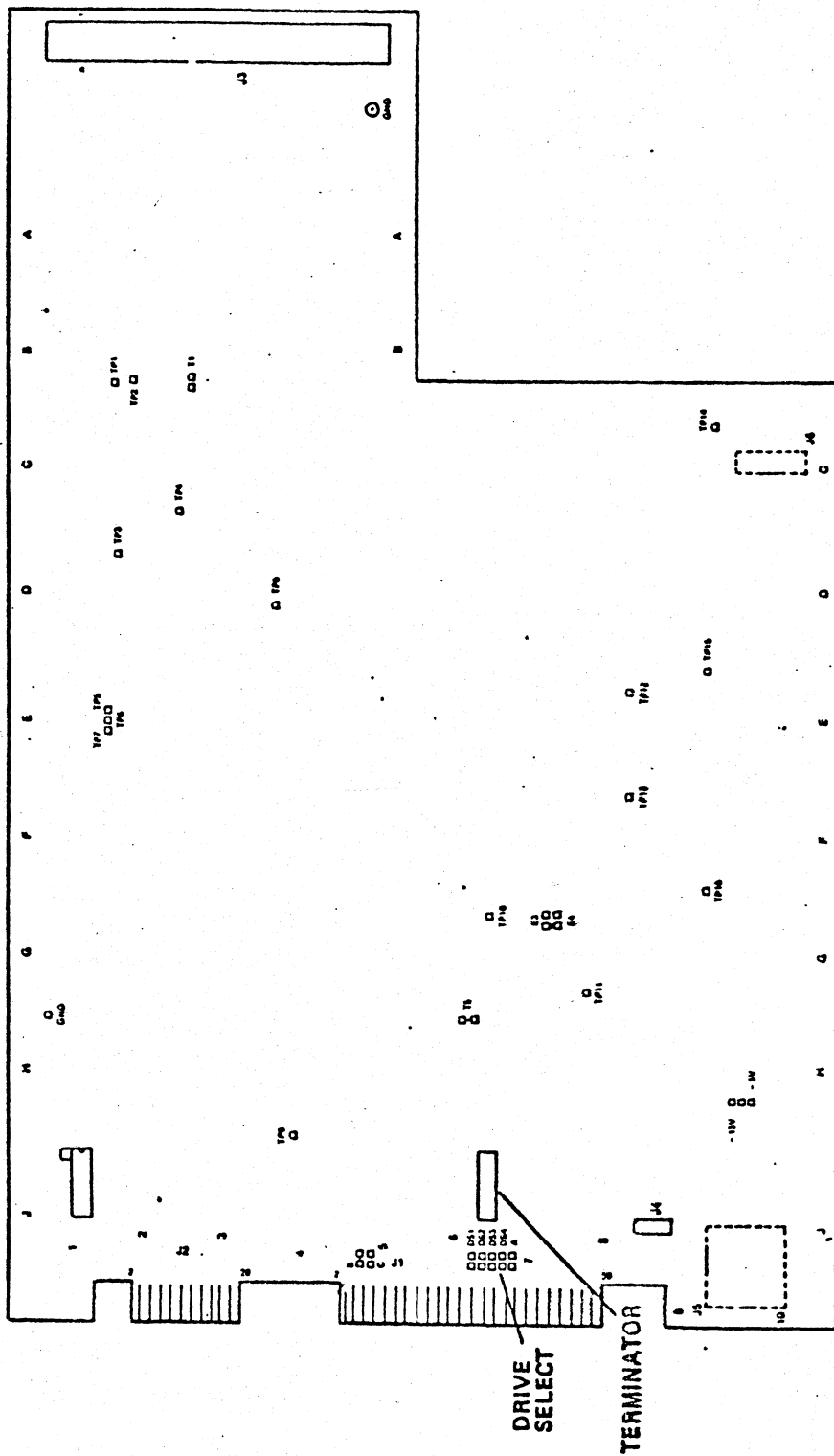
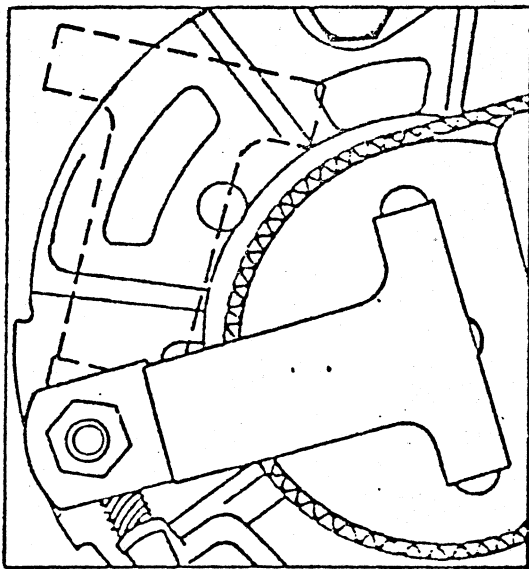
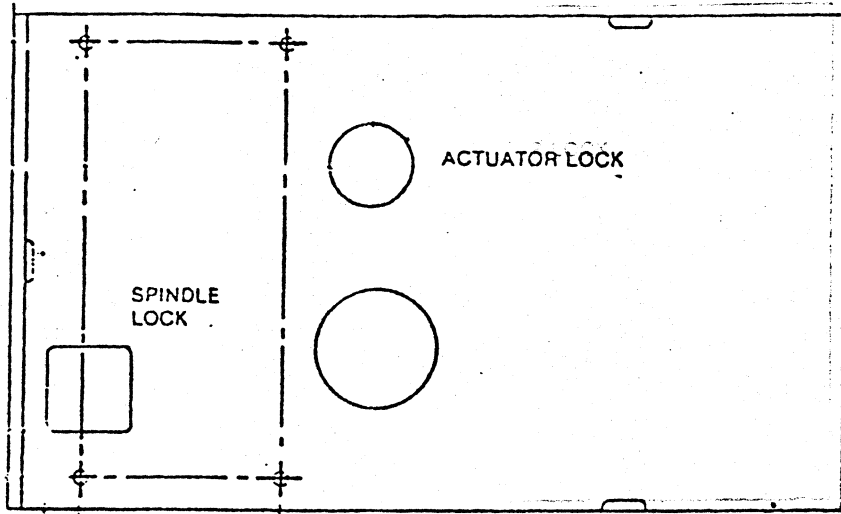


Figure 2-22. Winchester Drive Jumper Locations

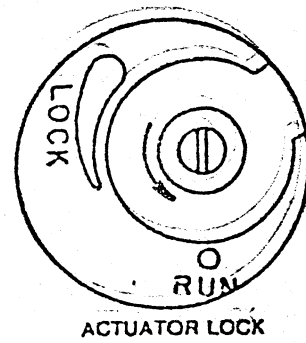
#### 2.5.4 Shipping Locks

The purpose of the shipping locks are to prevent rotation of the drive motor which could result in damage to the disks, and to prevent the head actuator from jostling the heads out of the special shipping and landing zone inside track 511. The locks are located on the bottom of the drive.

- a. Remove the drive unit (Section 2.4.1).
- b. Locate the two shipping locks on the underside of the drive. The spindle lock is a T-shaped piece of metal near the front panel. The actuator lock is a screw which can be turned to "lock" or "run;" it is located near the middle of the drive.
- c. To unlock: Stand the drive on its side. Loosen the 11/32-inch hex nut (9 mm) on the spindle locking clip. Without rotating the pulley, rotate the locking clip away from the pulley. Tighten the hex nut. Unlock the actuator by rotating the actuator lock counterclockwise as far as it will go (about 1/2 turn), but do not force.
- d. To lock: Lock the actuator by rotating the actuator lock clockwise as far as it will go (about 1/4 turn), but do not force. To lock the spindle, loosen the 11/32-inch hex nut (9 mm) on the T-shaped locking clip. Rotate the locking clip until it is engaged in the pulley, then tighten the nut. The locks are illustrated in Figure 2-23.



SPINDLE LOCK



ACTUATOR LOCK

Figure 2-23. Shipping Locks--20, 30, and 40 MB Winchester

## Section 3

### CABLES AND CONNECTORS

#### 3.0 GENERAL

This section contains information on power wiring, diskette and Winchester disk drive cabling, ribbon cabling, and connector pinouts for the 100/AP.

Part numbers and dimensions contained in this section are for the convenience of field service personnel and should not be interpreted as a specification nor used for ordering.

### 3.1 WIRING DIAGRAMS

This section contains the following diagrams:

- An AC wiring diagram for the computer enclosure.  
(Figure 3-1)
- A general wiring diagram for the terminal.  
(Figure 3-2)

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Figure 3-1. Computer AC Power Wiring

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Figure 3-2. Terminal Wiring Diagram

### 3.2 DISKETTE AND WINCHESTER DRIVE CABLING

Four types of cables are used to connect diskette and Winchester disk drives to the power supply and controller boards. They are:

- AC power cables. A separate cable is supplied for each drive. AC power is used to operate the drive motors.
- DC power cables. A common connector at the system power supply feeds two daisy-chain cables. One is connected to all of the diskette drives in the system, the other is connected to all of the Winchester disk drives in the system. DC power is used for logic and mechanical functions.
- Signal cables. (50 conductor). A daisy-chain cable is connected to each controller and to all of the devices that controller operates. The cable carries control and signal information from the Winchester controller to the Winchester drives. The cable carries control, signal, and data from the diskette controller to the diskette drives.
- Data cables. (20 conductor). Used in the Winchester drive subsystem only. One data cable is required for each Winchester drive. The cable carries data between the Winchester controller and a particular Winchester drive.

The DC cables are routed from the power supply through a hole in the backplane near the power supply connector, and from that hole to the drives.

The AC cables are routed through the same port as the ribbon cables. The ribbon cables are connected to the controller boards in the card cage; the cables are brought over the front edge of the card cage (towards the on/off switch), then brought around underneath the fan assembly. Clips hold the cables to the metal partition underneath the fan assembly; the cables are then brought through a three-inch cable port underneath the rearmost fan.



The diagrams which follow illustrate the disk drive cabling.

- Figure 3-3 describes the AC cabling.
- Figure 3-4 describes the DC cabling.
- Figure 3-5 describes the signal cabling.

All of the twenty-conductor Winchester data cables are the same length (4' IL p/n 51918-00), so they will not be covered further in this section.

The cabling diagrams refer to drive positions, physical locations in the housing where a drive (diskette or Winchester) might be installed. The drive positions are numbered as follows:

Position #1	Position #2
Position #3	Position #4

From the front

Position #2	Position #1
Position #4	Position #3

From the back

AC Cabling (one 3-cond. cable per drive)

<u>Part Number</u>	<u>Length</u>	<u>Drive Position</u>
160168-00	3.0'	1
160168-01	2.1'	2
160168-02	2.5'	4
160168-03	3.5'	3

Cables go from terminal strip on top of fan assembly to plastic connectors at the drives. Diskette and Winchester power cables are interchangeable.

Figure 3-3. Disk Drive AC Cabling

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Figure 3-4. Disk Drive DC Cabling

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Figure 3-5. Disk Drive Signal Cabling  
One-drive systems

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Figure 3-5 (cont'd). Disk Drive Signal Cabling  
Two-drive systems

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Figure 3-5 (cont'd). Disk Drive Signal Cabling  
Three-drive systems

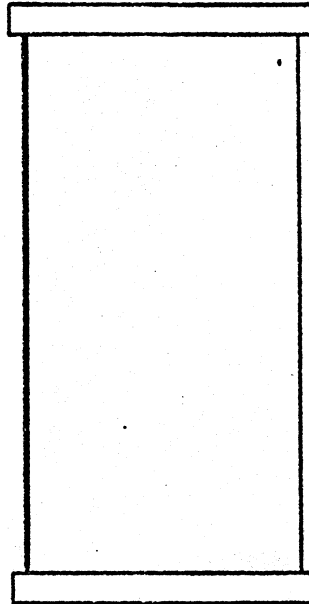
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Figure 3-5 (cont'd). Disk Drive Signal Cabling  
Four-drive systems

### 3.3 OTHER CABLING

Figures 3-6 and 3-7 provide information on the cables used to connect the tops of the printed-circuit-card modules in the card cage.

Marked edge (pin 1)  
points toward the fans



Nominal length 9"

40 conductors

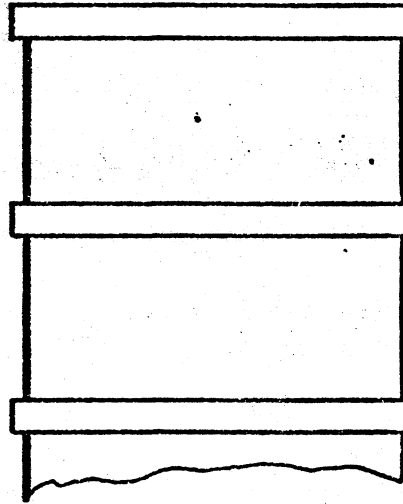
Pixel p/n 51921-00

<u>Number of Terminal Controllers</u>	<u>Number of Cables Required</u>
1	1
2	2

Cables plug into the 40-pin connector at the center top of each terminal controller. The cable from terminal controller #0 plugs into the off-center 40-pin connector JVO0 on the serial board. The cable from terminal controller #1, if present, plugs into the centered 40-pin connector JVO1 on the serial board.

Figure 3-6. Terminal Cont. to Serial Cabling

Marked edge (pin 1)  
points toward the fans



2" nominal

60 conductors

<u>Number of AP/Memory Boards</u>	<u>Number of Cables Required</u>	<u>Number of Connectors per Cable</u>	<u>Pixel Part Number</u>
1	2	2	160303-00
2	2	3	160303-01
3	2	4	160303-02
4	2	5	160303-03
5	2	6	160303-04
6	2	7	160303-05

Figure 3-7. AP to AP/Memory Cabling



### 3.4 CONNECTOR PINOUTS

The figures on the following pages list the signals present at the connectors in the 100/AP system. An index to these connectors is provided below.

J2	AP to AP/Memory. . . .	.3-11
J3	AP to AP/Memory. . . .	.3-12
J2	AP/Memory to AP. . . .	.3-11
J3	AP/Memory to AP. . . .	.3-12
	Backplane to Power Supply. . . .	.3-10
J1	Backplane to Serial. . . .	.3-9
	Backplane undedicated. . . .	.3-8
	CRT. . . .	.3-21
	Diskette Cont. to Diskette. . . .	.3-22
P1	Diskette to Diskette Cont.. . . .	.3-22
P4, P5	Diskette to Power Supply. . . .	.3-26
	Display Driver to CRT. . . .	.3-21
	Display Driver to CRT Yoke. . . .	.3-19
	Display Driver to Receiver. . . .	.3-18
	Keyboard to Terminal. . . .	.3-17
JPP0, JPP1	Parallel Port. . . .	.3-14
	Power Supply to Backplane. . . .	.3-10
	Power Supply to Diskette. . . .	.3-26
	Power Supply to Winchester. . . .	.3-26
	Receiver to Display Driver. . . .	.3-20
JR0-JR7	RS232-C Port. . . .	.3-13
JPP0, JPP1	Serial Board Parallel Port. . . .	.3-14
JR0-JR7	Serial Board RS232-C Port. . . .	.3-13
	Serial Board to Terminal Controller. . . .	.3-16
JV0-JV7	Serial Board Terminal Port. . . .	.3-15
JV0-JV7	Terminal Connector. . . .	.3-15
	Terminal Controller to Serial Board. . . .	.3-16
	Winchester Data Cable. . . .	.3-28
	Winchester Power Cable. . . .	.3-26
	Winchester Signal Cable. . . .	.3-27

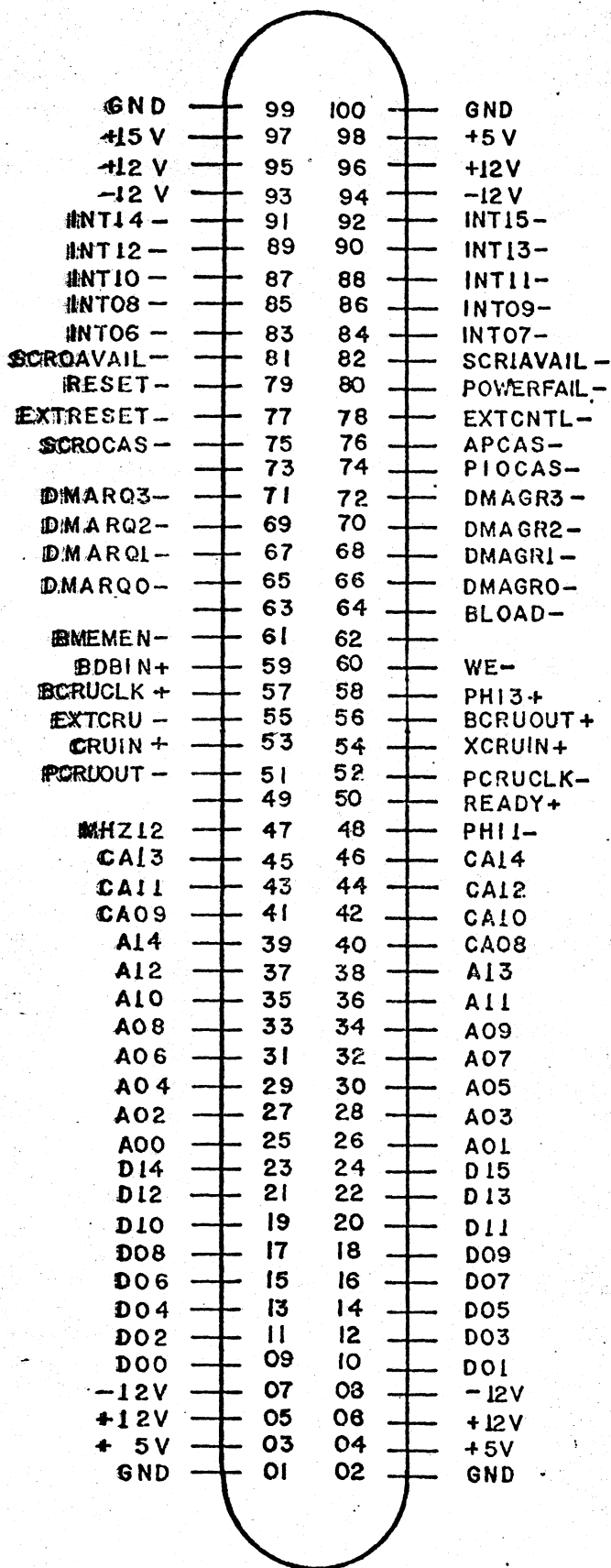


Figure 3-8. Backplane Undedicated Positions

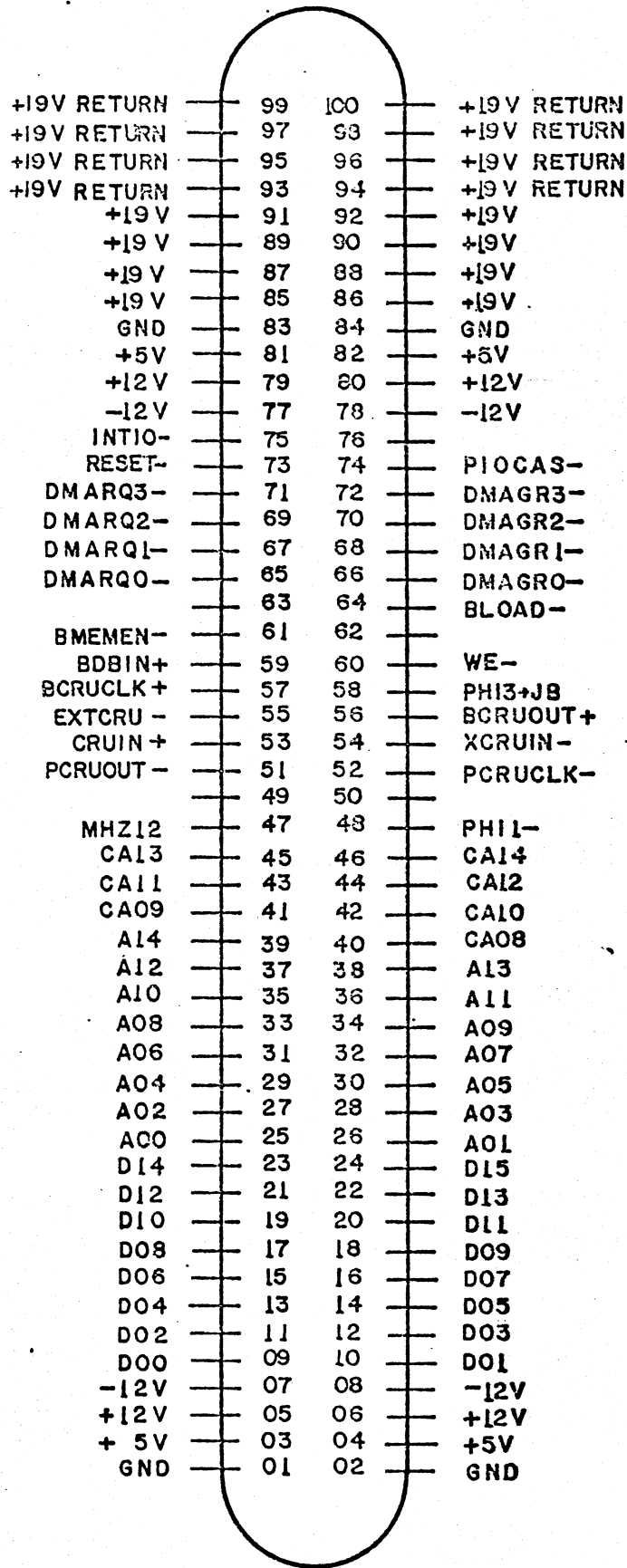


Figure 3-9. Backplane to Serial Board

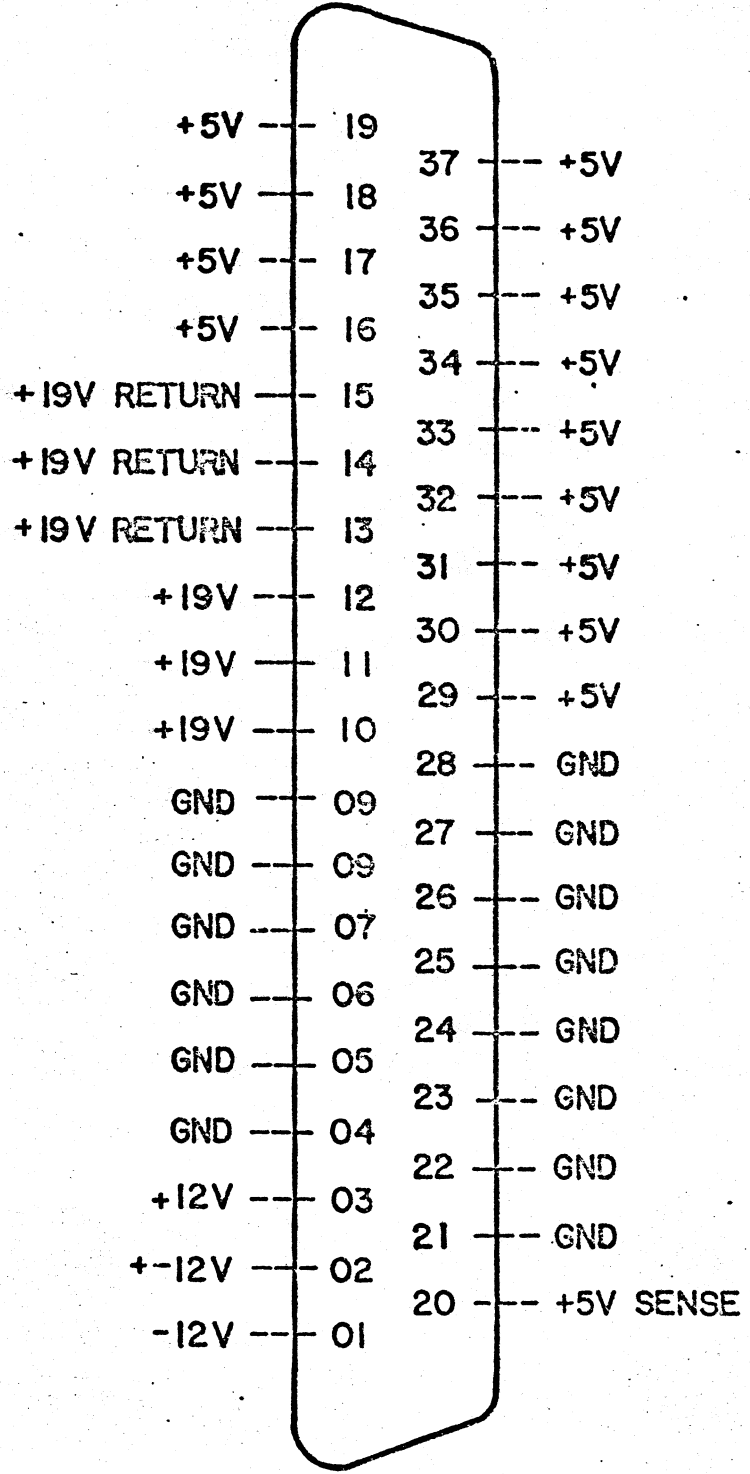


Figure 3-10. Backplane to Power Supply

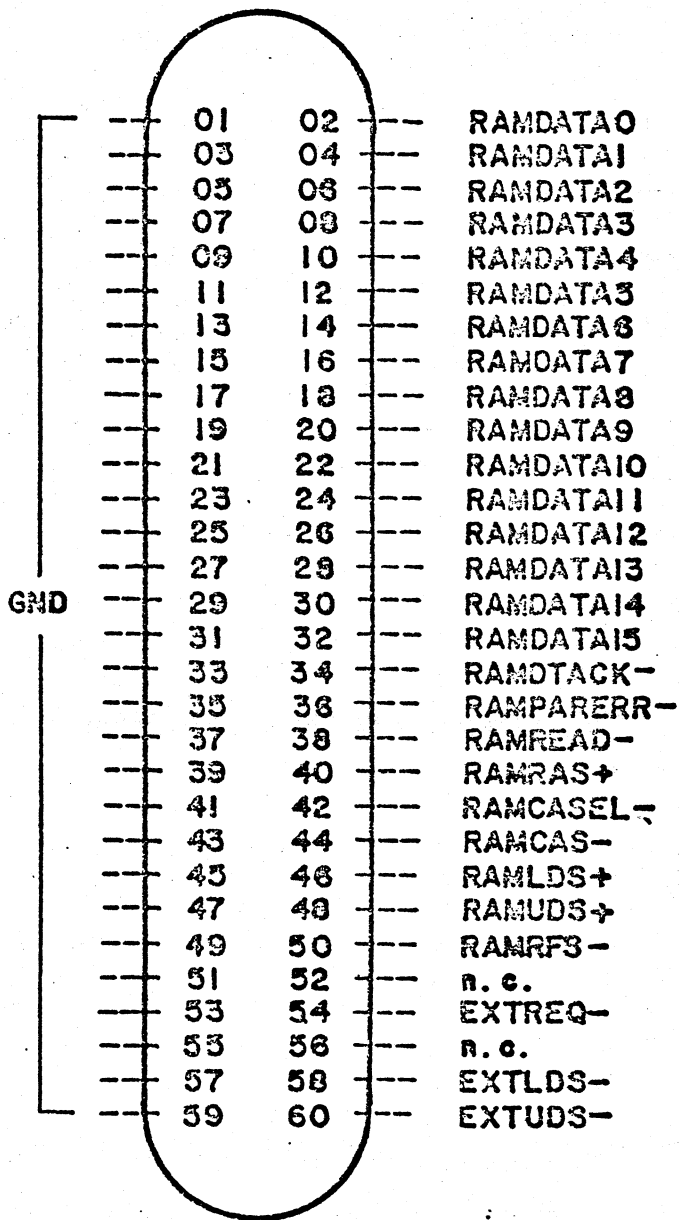


Figure 3-11. AP to AP/Memory Cable #1

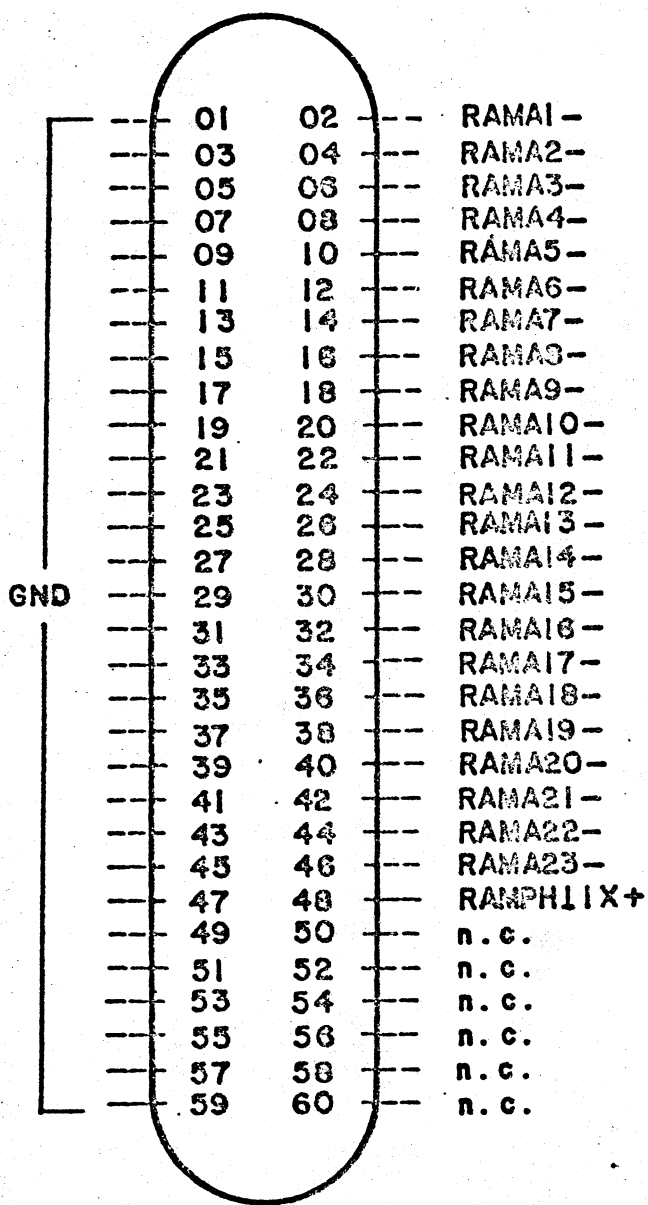
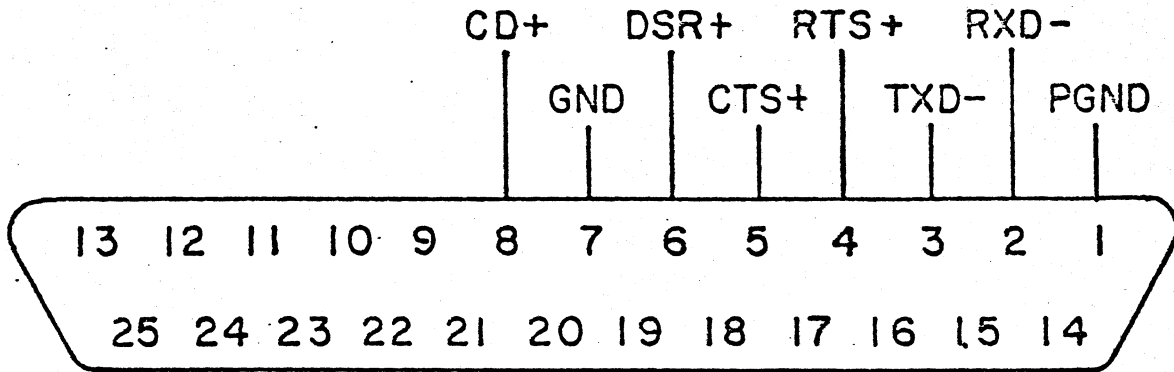


Figure 3-12. AP to AP/Memory Cable #2



<u>Pin #</u>	<u>Mnemonic</u>	<u>Description</u>
1	PGND	Protective ground. Tied to ground through a 100Ω resistor.
2	RXD	Received Data
3	TXD	Transmitted Data
4	RTS	Request to send
5	CTS	Clear to send
6	DSR	Data set ready. Tied to 5V through 680Ω.
7	GND	Ground
8	CD	Carrier detect. Tied to 5V through 680Ω.

Figure 3-13. RS232-C Port

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Figure 2-12. Terminal (Power Supply)



supply.

- c. Remove the four screws at the corners of the receiver board which hold it onto the display housing.
- d. To install, reverse the process. Make sure the connectors are firmly seated.

#### 2.2.4 Replacing the Display Driver Board

The display driver board is mounted over the base of the CRT.

NOTE: The display driver may have to be adjusted after installation according to Section 4.4 of this manual. If the horizontal size needs adjustment, a special hex alignment tool is required.

- a. Open the display housing (Section 2.2.1).
- b. Short out the high voltage lead to the CRT by slipping a grounded metal-blade screwdriver (with an insulated handle) under the clear plastic boot.
- c. Pull back the clear plastic boot on the high-voltage lead and remove the lead.
- d. Pull off the tube socket at the end of the CRT.
- e. Disconnect the ground lead connected to one of the "bell" speaker's mounting bolts.
- f. Unplug the connectors which connect the display driver to the receiver board and the CRT yoke.
- g. Unscrew the four mounting screws at the corners of the display driver board.
- h. To reinstall, reverse the process (it is not necessary to short the anode again). Adjust according to Section 4.4, if necessary.

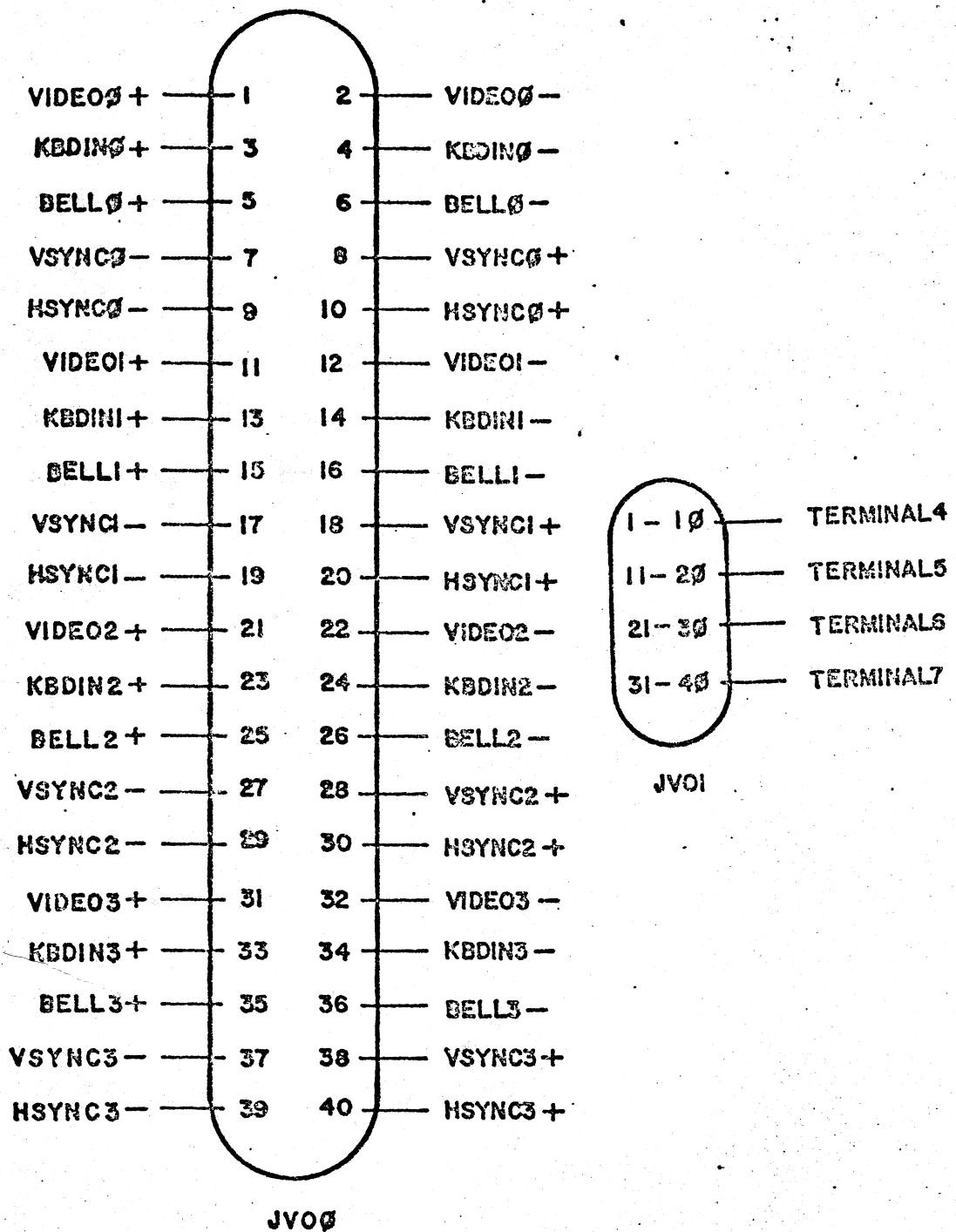
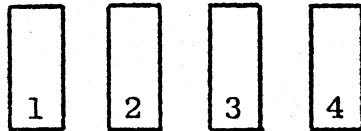
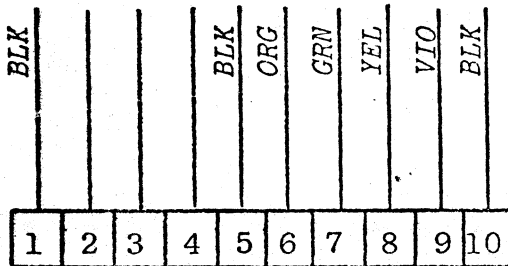


Figure 3-16. Terminal Cont. to Serial Board



- 1 +15 volts
- 2 Keyboard+
- 3 Keyboard-
- 4 +15 volt return (grounded)

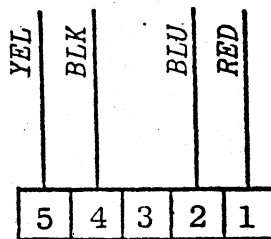
Figure 3-17. Keyboard Connector



Edge Connector

<u>pin #</u>	<u>color</u>	<u>purpose</u>
1	BLK	Horizontal return (connected to pin 10)
2		Contrast control
3		
4		
5	BLK	Ground
6	ORG	Horizontal drive
7	GRN	DC power
8	YEL	Video
9	VIO	Vertical drive
10	BLK	Vertical return (connected to pin 1)

Figure 3-18. Display Driver to Receiver



Yoke  
Connector

- 1,2 -- Vert. Yoke
- 3 -- n.c.
- 4,5 -- Horiz. Yoke

Figure 3-19. Display Driver to CRT Yoke

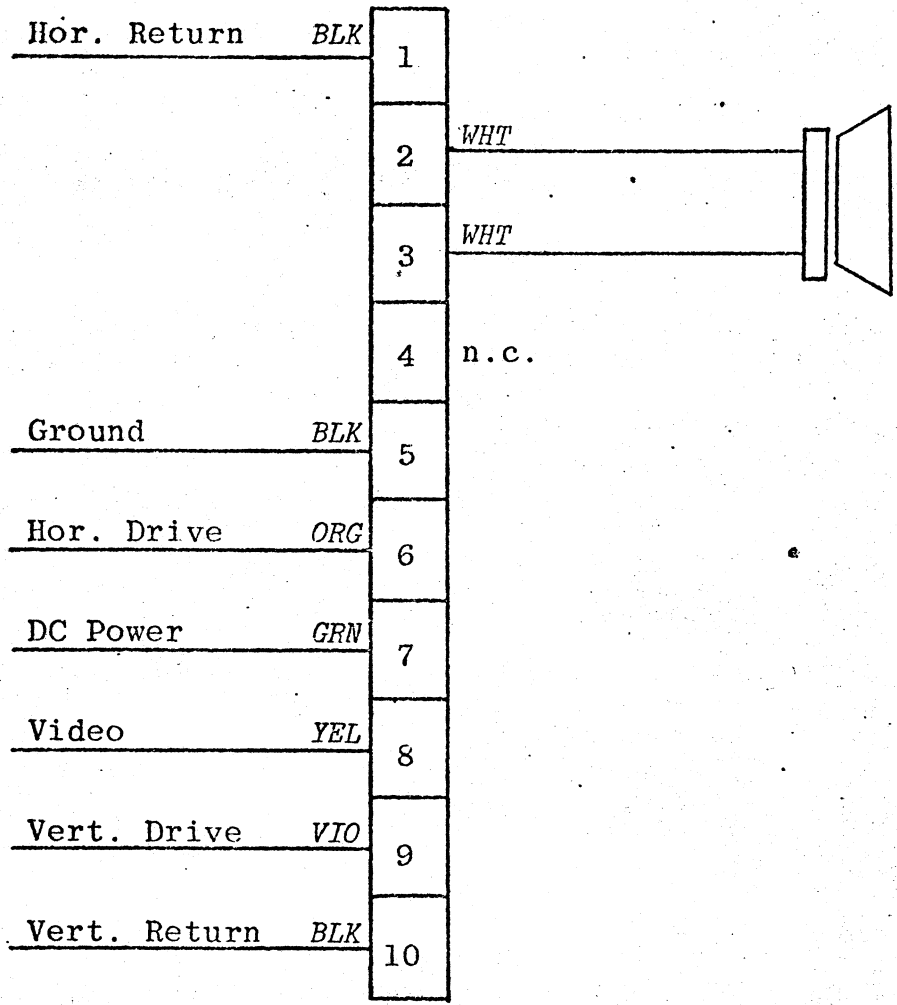
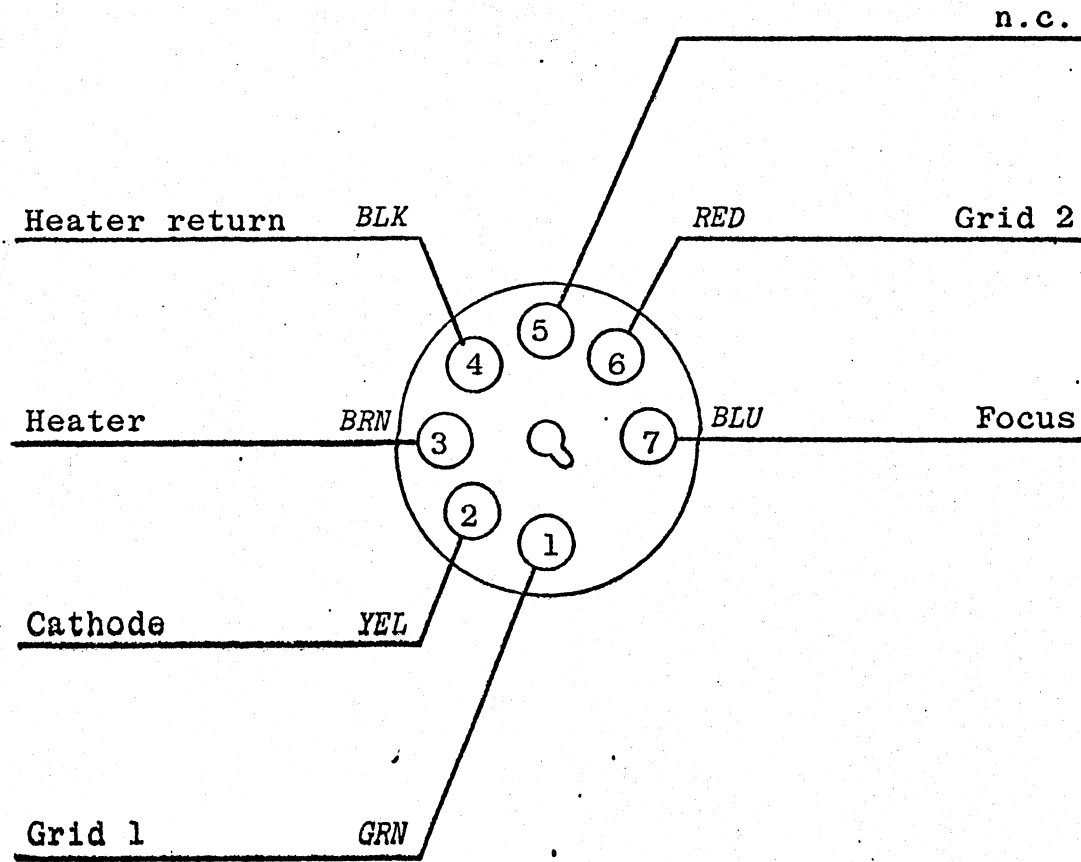


Figure 3-20. Receiver Board 10-Position Connector

Figure 3-21. CRT Socket



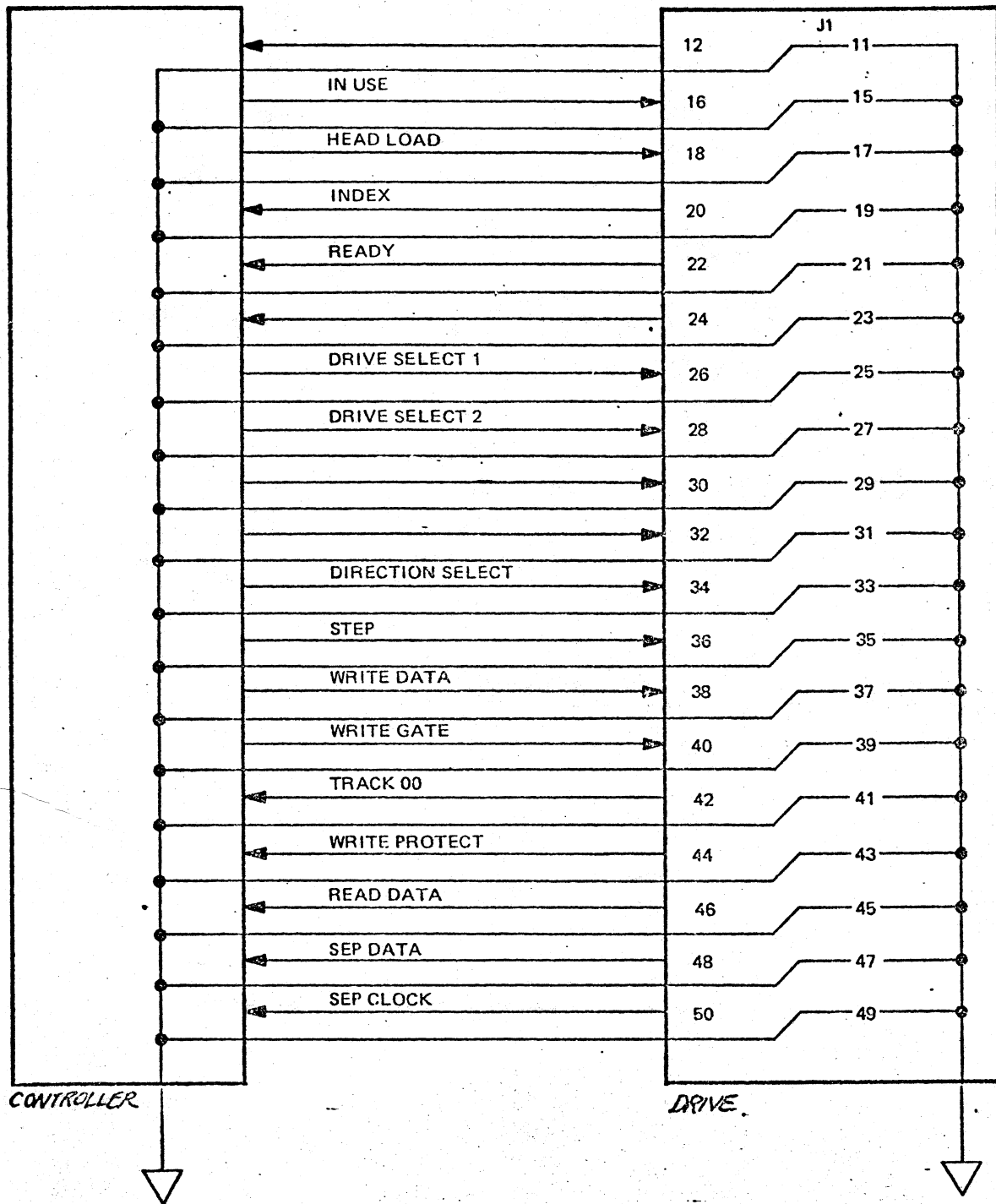
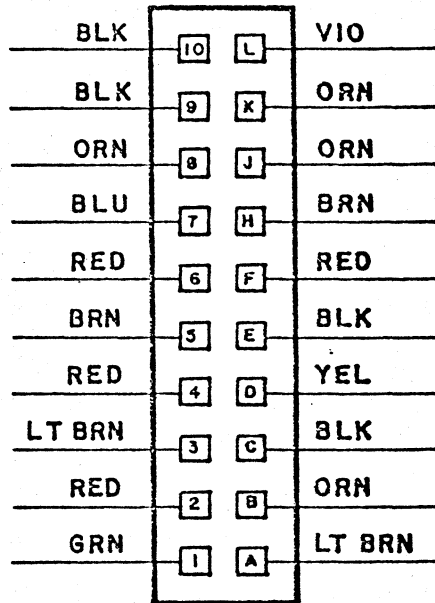


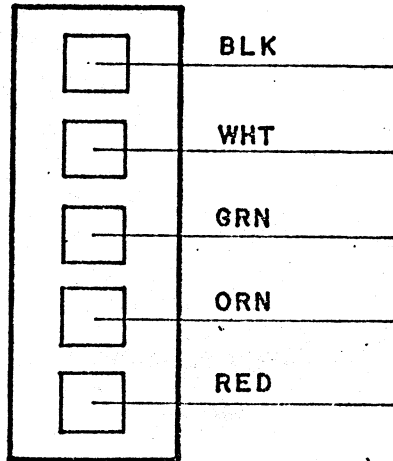
Figure 3-22. Diskette Logic Cable





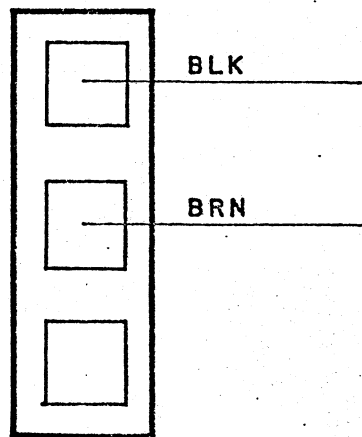
<u>Pin #</u>	<u>Color</u>	<u>Purpose</u>
1	GRN	(Index) Ground
2	RED	To Stepper Phase 3
3	BRN	(Write Protect) Ground, (or RED)
4	RED	+Write Protect (or GRY)
5	BRN	To Stepper Phase 2
6	RED	-Door Closed
7	BLU	Head Load Solenoid
8	ORG	To Stepper Phase 1
9	BLK	(Index) +5V
10	BLK	To Stepper 24 V
A	BRN	(Track 00) Ground
B	ORG	(Door Closed) Ground
C	BLK	+Track 00 LED
D	YEL	+Index LED
E	BLK	+Write Protect LED
F	RED	-Track 00
H	BRN	+Index
J	ORG	(Write Protect) +5v (or WHT)
K	ORG	(Track 00) +5V
L	VIO	(Head Load Solenoid) 24V

Figure 3-23. Diskette Connector "P2"



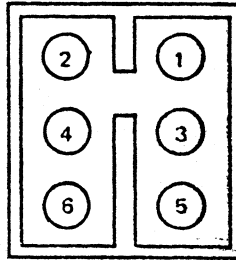
<u>Pin</u>	<u>Color</u>	<u>Purpose</u>
1	RED	+Read/Write Coil 1
2	ORN	Ground
3	GRN	Erase
4	WHT	Ground
5	BLK	+Read/Write Coil 2

Figure 3-24. Diskette Connector "P3"



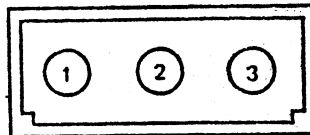
<u>Pin</u>	<u>Color</u>	<u>Purpose</u>
1		n.c.
2	BRN	In Use LED
3	BLK	(In Use) Ground

Figure 3-25. Diskette Connector "P6"



DC Connector

- 1 +24V DC
- 2 +24V Return
- 3 Ground
- 4 DC Return
- 5 +5V DC
- 6 Ground



AC Connector

- 1 AC (Drive Motor)
- 2 Ground
- 3 AC Return (Drive Motor)

Figure 3-26. Diskette/Winchester Power Connectors

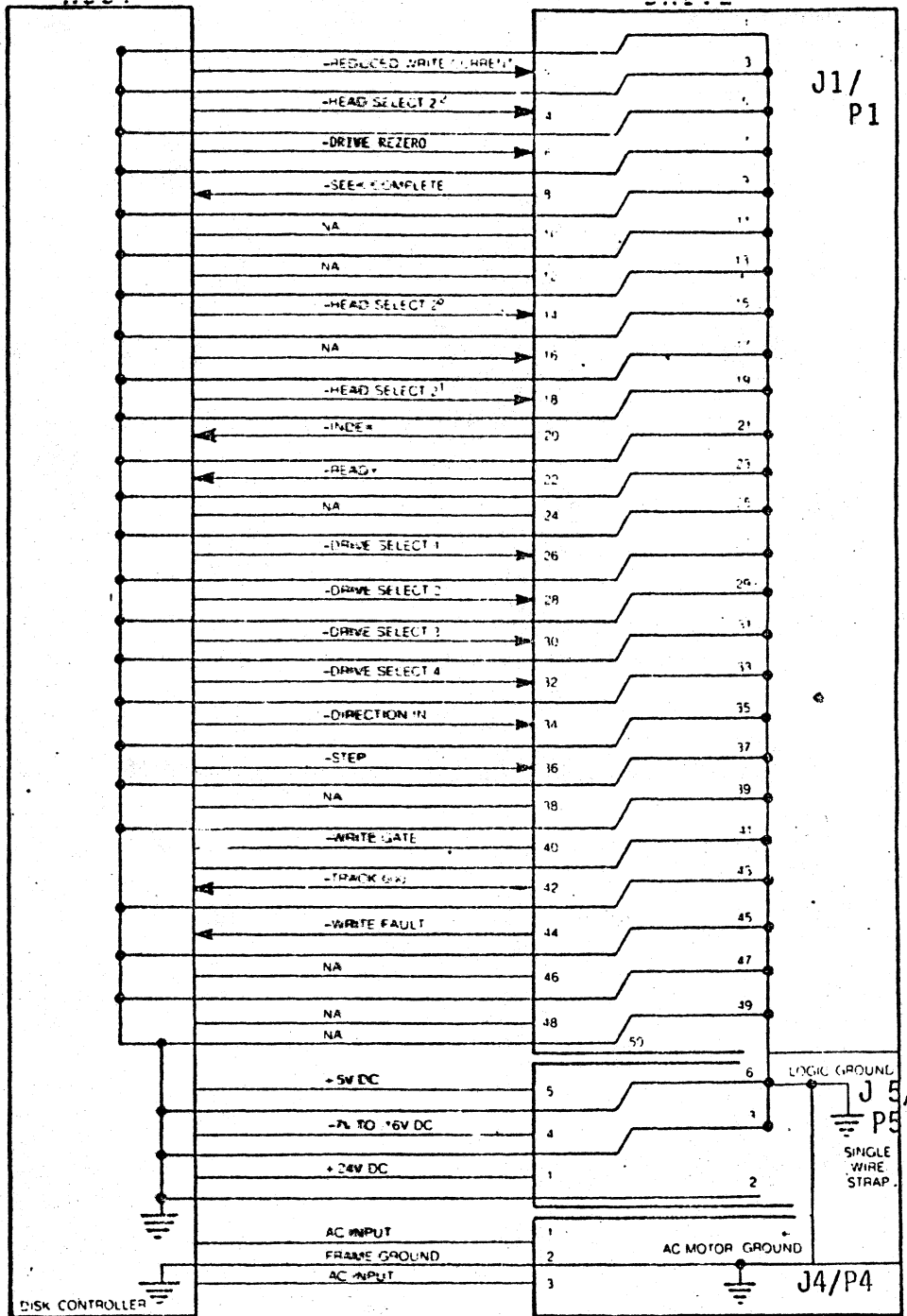


Figure 3-27. Winchester Signal Cable

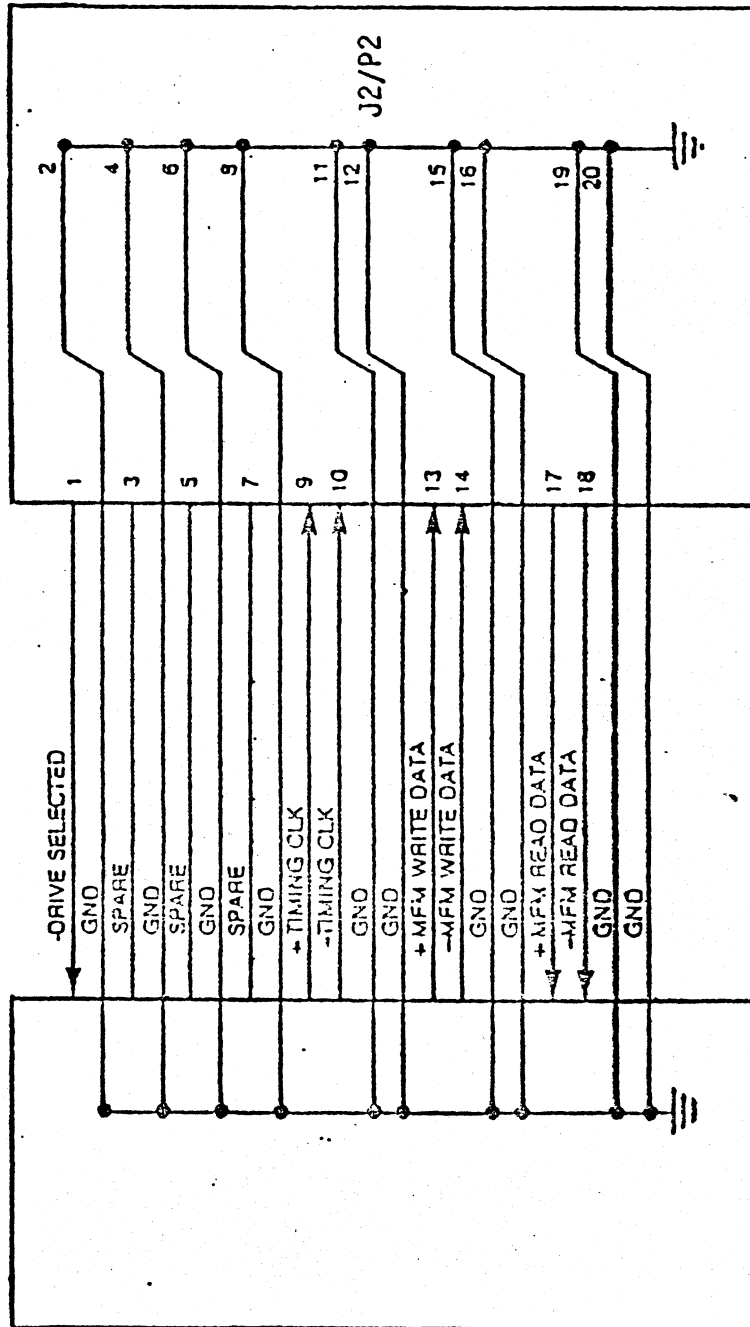


Figure 3-28. Winchester Data Cable

## Section 4

### MAINTENANCE

#### 4.0 GENERAL

The section covers preventive maintenance, cleaning and adjustment procedures for the "level 1" maintenance of 100/AP machines in the field. For more information on levels of maintenance, refer to the introduction of this manual.

This section also includes an electrical/mechanical functional check to be supplemented by diagnostics and tests corresponding to the machine's environment and application.

#### 4.1 FUNCTIONAL CHECK

This functional check serves to check the mechanical operation of the machine and the probable reliability of the power supply.

- a. Look at the machine and terminal carefully for any signs of possible damage. Check to see if the terminal cover, keyboard housing, and computer enclosure back and top are securely fastened. Also look for foreign material in the keyboard.
- b. Check the AC line cord and any peripheral cables for wear at the strain reliefs and along the length of the cord.
- c. Check the serial board, terminal back panel, and keyboard connectors for bent pins, wear or other damage.
- d. Plug the machine in and operate the on/off switch several times, checking its operation and the power indicator lamp for normal operation.
- e. With the machine off, insert a diskette into each diskette drive and eject it several times to check for proper operation.
- f. Turn the machine on, and listen to the startup of the diskette and Winchester drive motors. If you hear these motors and the fan operating, it indicates that the AC is reaching these components.
- g. Check DC operation by inserting a diskette into the upper left diskette drive. The red LED can be used to check the operation of the +5 volt supply and the head load mechanism will check the 24 volt supply. The tests in (f) and (g) are not meant to be comprehensive tests, just quick checks.

## 4.2 PREVENTIVE MAINTENANCE

The actual preventive maintenance performed on a particular machine will depend on the system configuration, application, environment, and load.

- a. Perform the functional check (Section 4.1).
- b. Insert a system diskette and boot the operating system most frequently used on the system. Listen for the disk accesses.
- c. Place some text onto the screen(s) of the display(s) to check the video quality. Check the operation of the contrast control and the screen tilt adjustment.
- d. Transfer data to and from the disk subsystems and peripherals. (Again, this step will depend quite a bit on the system configuration.)
- e. Clean the exterior of the computer and display and any connectors which require it.
- f. If the diskette drive heads have not been cleaned in 12 months (6 months under heavy use), clean them.
- g. If time permits, open up the computer and check to make sure that all connectors are firmly seated, especially at the power supply and on the disk drives.



## 4.3 CLEANING PROCEDURES

### 4.3.1 Electrical Connectors

**CAUTION**

Never use an abrasive on any connector. Be especially careful of plated connectors.

Generally, cleaning internal electrical connectors is not necessary. Some dust may accumulate on unused serial board connectors, or on unused backplane connectors over a period of time.

To clean connectors, brush with a soft brush or use Dust-off (or equivalent) to blow away residues. A good grade of methyl alcohol on a lint-free cloth or cotton swab can also be used.

### 4.3.2 Exterior Surfaces

**CAUTION**

Never use a petroleum-based solvent to clean plastic or painted surfaces.

Normally, the user will keep the exterior of the equipment clean.

The exterior of the video display and the computer can be cleaned using a mild cleaner, such as "Windex," on a lint-free cloth. The keyboard can be cleaned by spraying cleaner on a cloth and then wiping the unit.

### 4.3.3 Cleaning Diskette Drive Read/Write Heads

The diskette drive read/write heads should be cleaned whenever there are signs of oxide buildup (the head looks dirty). Under normal usage, this might be once every twelve months; under heavy usage, once every six months.

Use of a cleaning diskette such as the Innovative Computer Products' FD-08 is recommended, although the heads can be cleaned with nearly pure (99.98%) isopropyl alcohol on a cotton swab. Instructions for both methods are given below.

- a. To use the cleaning diskette: Squeeze some of the cleaning solution onto the cleaning material according to the manufacturer's instructions.
  - b. Turn the 100/AP on and boot the operating system. A good program to use for cleaning is the diskette formatting program.
  - c. Insert the cleaning diskette large cut-out up and "format" it--or execute any other operation which will load the head for thirty seconds or so.
  - d. Be sure to record the use on the diskette's label.
- 
- a. To use isopropyl alcohol: Remove the drive from the machine (Section 2.3.1).
  - b. Rotate the stepper shaft so that the carriage is about halfway between the innermost and outermost position.
  - c. Lift the read/write head load pad away from the read/write head. Do not pull it out more than 90 degrees or it may break. (While you're at it, check the head load pad for wear.)
  - d. Clean the read/write head with 99.98% pure isopropyl alcohol on a cotton swab. Rough cloth or any other cleaning fluids could damage the head or leave contaminants.
  - e. Replace the drive in the machine.

#### 4.4 VIDEO QUALITY ADJUSTMENTS

A number of adjustments can be made to the display driver in order to obtain optimum display. Most of the adjustments can be made with a screwdriver; only one, horizontal size, requires a special tool.

In addition, the centering magnets on the CRT yoke can be adjusted to correct picture skew.

The potentiometers are clearly indicated on the silkscreen on the display driver PCB; this is also reproduced in Figure 4-1.

##### 4.4.1 Brightness

Purpose: Brightness refers to the background illumination of the screen during display, as opposed to contrast (which can be set by the user) which refers to the brightness of a displayed character relative to the blank screen.

- a. With the terminal operating but with no displayed video characters, adjust the BRIGHTNESS potentiometer (R41) until the raster is just visible.

##### 4.4.2 Vertical Height

Purpose: To adjust both the height of individual characters and the total vertical display area. If the top of the first line displayed on the screen or the bottom of the last line begin to disappear, this should be adjusted.

- a. Fill the terminal screen with reverse video blanks (using the terminal diagnostic disk) or with characters.
- b. Adjust the VERT HEIGHT or VERT SIZE potentiometer (R22) until the display completely fills the screen in the vertical direction. Note, however, that if you are using a screen full of characters that the screen should not be completely filled; check by positioning the cursor at all four corners to make sure rows of scan aren't being lost.

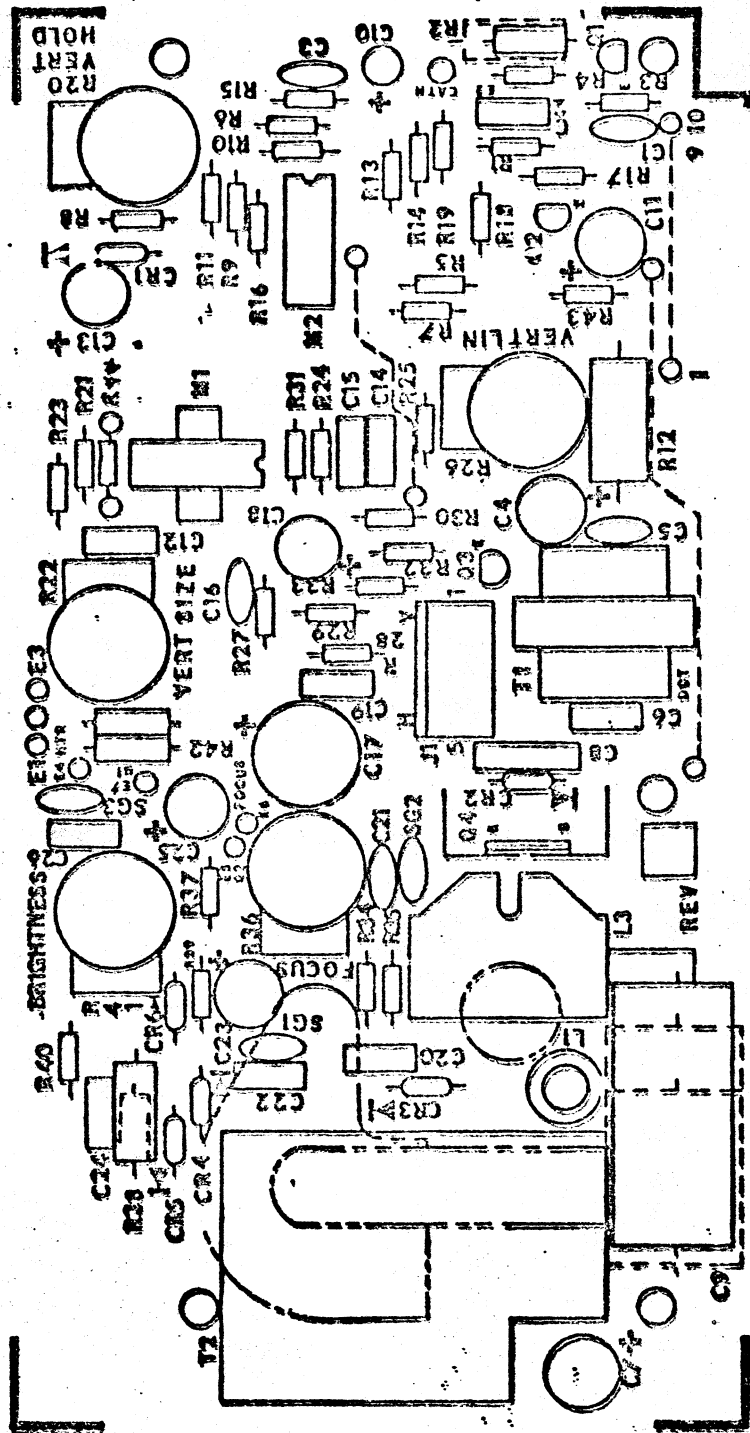


Figure 4-1. Display Driver Component Location

#### 4.4.3 Vertical Hold

Purpose: To keep the display from rolling vertically.

- a. Adjust the VERT HOLD potentiometer (R20) until rolling stops.

#### 4.4.4 Vertical Linearity

Purpose: To make character height constant on both sides of the terminal screen. Should be adjusted when character lines appear to grow or shrink as they approach the right edge of the display.

- a. Fill the terminal screen with rows of characters.
- b. Adjust VERT LIN (R26) until the character size stays constant throughout a row of text.

#### 4.4.5 Focus

Purpose: To adjust the sharpness of the displayed image.

- a. Fill the terminal screen with characters.
- b. Adjust the FOCUS potentiometer (R36) until the characters are sharply focused in the center of the screen.
- c. Slightly defocus these center characters. This is done because when the center of the screen is sharp, the edges are not focussed well. The best overall appearance and least fatiguing display for the user is obtained when the whole screen is slightly out of focus.

#### 4.4.6 Horizontal Size

Purpose: To adjust both the width of characters and the total horizontal display area. If characters are being cut off in columns 1 and 80 of the display, the horizontal size needs adjustment.

- a. Fill the terminal screen with reverse video blanks (using a diagnostic diskette) or characters.
- b. Adjust the horizontal size coil (L1) by inserting a 1/16 inch plastic hex alignment tool (1,5 mm) into the coil slug and turning. Note that if you are using a screen filled with characters you should check with the reverse video cursor to make sure you haven't cut off the first or last column of the character matrix.

#### 4.4.7. Centering

Purpose: To center the display in the screen; also to correct any skew (rotation) of the displayed text.

- a. The yoke magnets are located on the neck of the CRT. They can be adjusted while the power is on provided you watch out for the high-voltage lead nearby. To rotate a skewed display, rotate the magnets around the axis of the CRT until the display is level.
- b. To center the display, move the magnets independently. The idea is to make the axis of the yoke magnets correspond to the axis of the CRT.



## Section 5

### TROUBLESHOOTING

#### 5.0 GENERAL

There are two types of system failures: those which prevent the system bootstrap, and those which do not prevent the system bootstrap but interfere with some normal system function. The failures which prevent to boot are referred to as "fatal failures," while the others are referred to as "nonfatal failures."

Nonfatal failures can be further subdivided into five groups:

- Processing failures
- Diskette drive failures
- Winchester disk drive failures
- Terminal failures
- Serial/parallel communication failures

Section 5.1.1 of this manual deals with fatal failures, while sections 5.1.2 through 5.1.6 will deal with nonfatal failures.



### 5.1.1 Unit Fails to Bootstrap

There are four sets of procedures to be followed when the system fails to boot:

- Make sure that the boot actually is failing. If, for example, the terminal has failed, the blinking cursor will not appear on the screen, and this may be mistaken for a bootstrap failure.
- Check obvious things: make sure that the unit is plugged in, that a known functional system diskette is being used, that the diskette isn't upside down, and so forth.
- Check for telltale symptoms.
- Test the individual modules to isolate the one responsible for the failure.

#### Bootstrap Activity

The presence of the blinking cursor and the operating system menu is a certain sign that the system is booting, but the lack of the cursor and OS menu is not a certain sign that the boot is failing. •

This is because only three modules are required (in addition to an operating power supply) for booting: the I/O processor module, a disk drive controller, and a disk drive. (The "disk drive" can be either a diskette drive with a functioning systems disk mounted, or a Winchester disk drive with the OS stored on it.) The only reliable sign that the system is not booting is a lack of bootstrap activity--whirring and clicking noises from the diskette drive containing the systems diskette; or (in the case of Winchester boots) the system will not automatically search the diskette drive when a disk is inserted and the door closed.

The lack of a blinking cursor, then, may be a terminal failure (discussed in Section 5.1.5).

## Obvious Causes

The second set of procedures involves checking for "obvious" errors. These errors include:

- Unit not plugged in, or no power at outlet
- Diskette not properly inserted (diskette boot)
- Wrong diskette (diskette boot)
- Damaged diskette (diskette boot)
- OS not on Winchester (Winchester boot)
- Back panel not securely fastened
- A connector not firmly seated

## Telltale Symptoms

These symptoms include:

- On-off switch light off. This indicates that power is not getting past the filter/interlock switch area. The problem could be no power at the outlet, an open wire in the line cord, or the interlock may not be closing. If these check out, the unit's circuit breaker may be tripped. Turn the unit off, wait two minutes, then turn it back on again. The on-off switch light should come on.
- Diskette drive light on immediately and it stays on. This usually means that the diskette drive logic cable is on upside down. If not, the controller or the drive is bad.
- Smoke or noise.
- Signs of physical damage.
- Recent repairs.

## Isolating the Problem

The fault tree, Figure 5-1, is a step-by-step method of isolating a bootstrap failure to a particular module. The module can then be replaced.

There are two elementary test methods used: attempting to boot an AP operating system, and attempting to boot and IOP operating system.

First, the system is reduced to its absolute essentials: the IOP board, the diskette controller, and the diskette drive. If the system does not boot with this configuration, then the problem is in one of these three modules (or the power supply). If the system does boot, then modules are added, one by one, until the failure is repeated. The module which causes the failure is then replaced.

The one break from this logical procedure is a timesaving maneuver: if a Winchester boot fails to work, attempt to boot from the diskette. If the diskette boot works, then the Winchester volumes can be checked for OS code, and the problem quickly isolated to the Winchester drive or controller.

AP OPERATING SYSTEM WILL NOT BOOT

TEST "A"

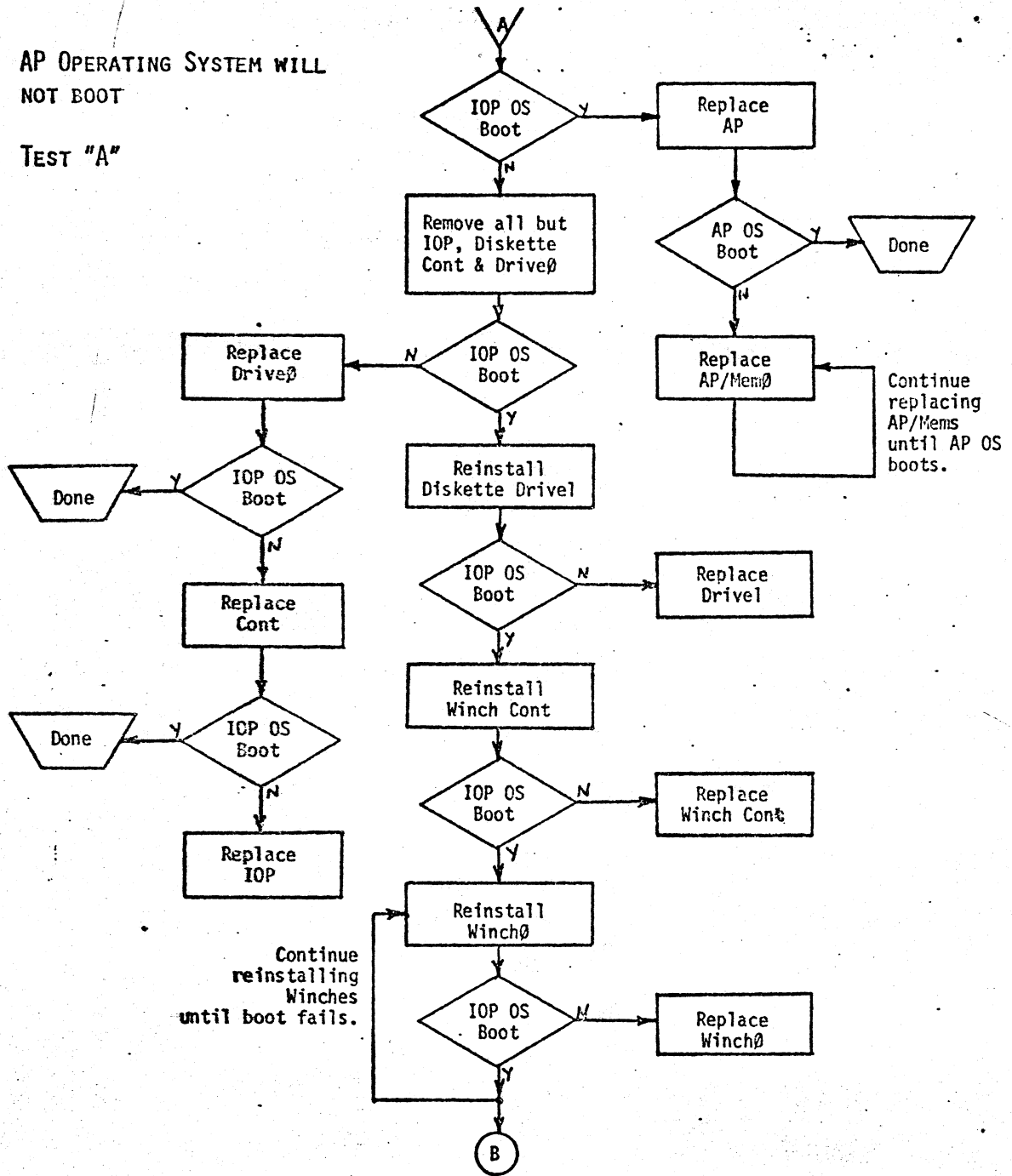


Figure 5-1. Troubleshooting Guide  
Fatal Failures--Diskette Boots

TEST "B"  
 (TEST "A" CONT'D.)

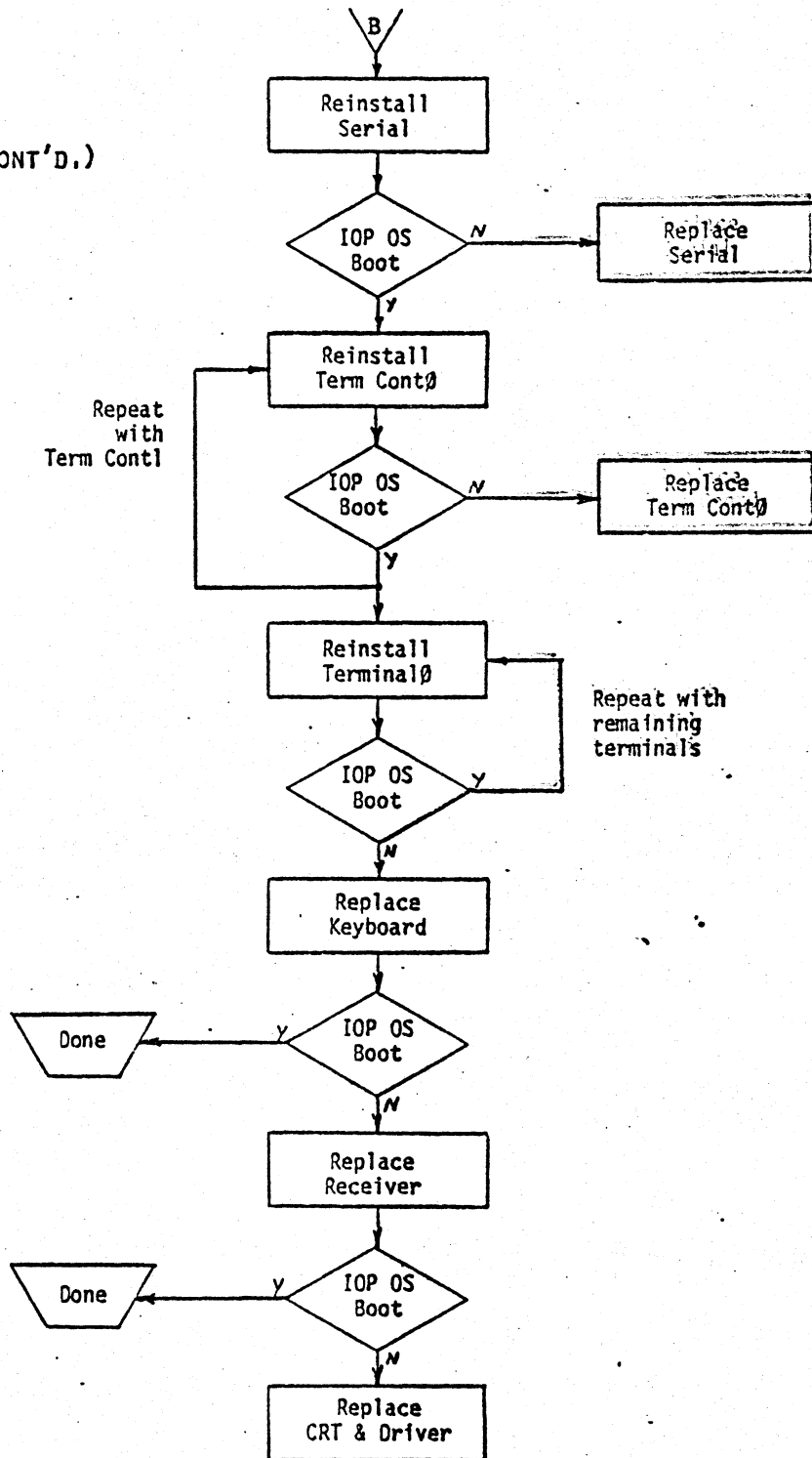
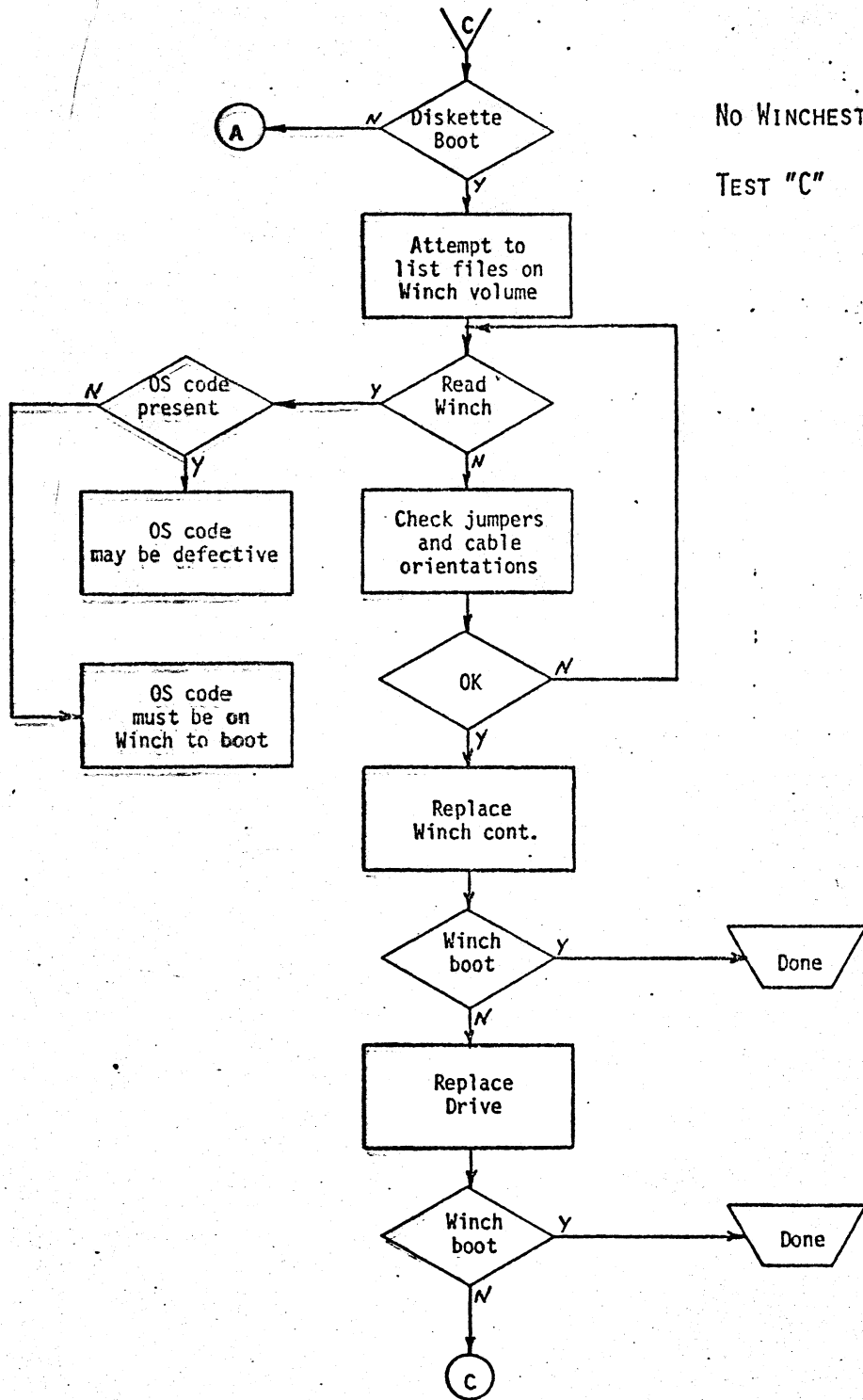


Figure 5-1 (cont'd)



NO WINCHESTER BOOT

TEST "C"

Figure 5-2. Troubleshooting Guide  
Fatal Failures--Winchester Boots

### 5.1.2 Processing Failures

This category of nonfatal failures includes malfunctions within the following modules:

IOP	AP/Memory2
AP	AP/Memory3
AP/Memory0	AP/Memory4
AP/Memory1	AP/Memory5

and their associated cabling.

These errors are extremely difficult to pin down, and often appear as glitches during the use of the machine. They can also appear to be malfunctions of another category; for example, if the DMA controllers fail, the error will appear to be an error in the Winchester or diskette subsystem.

### 5.1.3 Diskette Subsystem Failures

This category of nonfatal failures includes malfunctions within the following modules:

Diskette Cont.  
Diskette0  
Diskette1

The consequences of failures within this subsystem range from erroneous data transfers to the destruction of media.

The first step in the case of a suspected bad drive or controller is to recheck the cabling--the orientations of the cables and the jumpering and termination of the drives. In particular, remember that

- each drive must have a unique drive select line enabled (DS1 or DS2), and
- the final drive in the daisy-chain must be properly terminated.

Familiarity with jumpering and termination can also be put to advantage when attempting to isolate failures by swapping drives.

#### 5.1.4 Winchester Subsystem Failures

This category of nonfatal failures includes malfunctions within the following modules:

Winch. Cont.	Winch1
Winch0	Winch2
	Winch3

Malfunctions in the Winchester subsystem generally involve difficulty in transferring data--particularly reading data due to the technical difficulties involved.

#### 5.1.5 Terminal Failures

This category of nonfatal failures includes malfunctions within the following modules:

Term. Cont.0	Terminal3
Term. Cont.1	Terminal4
Terminal0	Terminal5
Terminal1	Terminal6
Terminal2	Terminal7

Errors which are common to a group of terminals connected to one terminal controller, or errors which persist when a terminal is replaced can generally be attributed to the terminal controller.

Problems with the display quality at a particular terminal can be blamed on the display driver board.

Problems with data input, such as the continuous transmission of garbage by a particular keyboard, or missed or doubled letters can be repaired by replacing the keyboard assembly. Glitches in keyboard operation can also be caused by a faulty keyboard cable.



## 5.1.6 Serial and Parallel Communication Failures

This category of nonfatal failures includes malfunctions within the following modules:

Serial Board  
<Remote Serial Devices>  
<Remote Parallel Devices>

Failures in this category will either effect the operation of every port on the Serial Board, or a certain port or ports, or a certain device, no matter which port it is connected to.

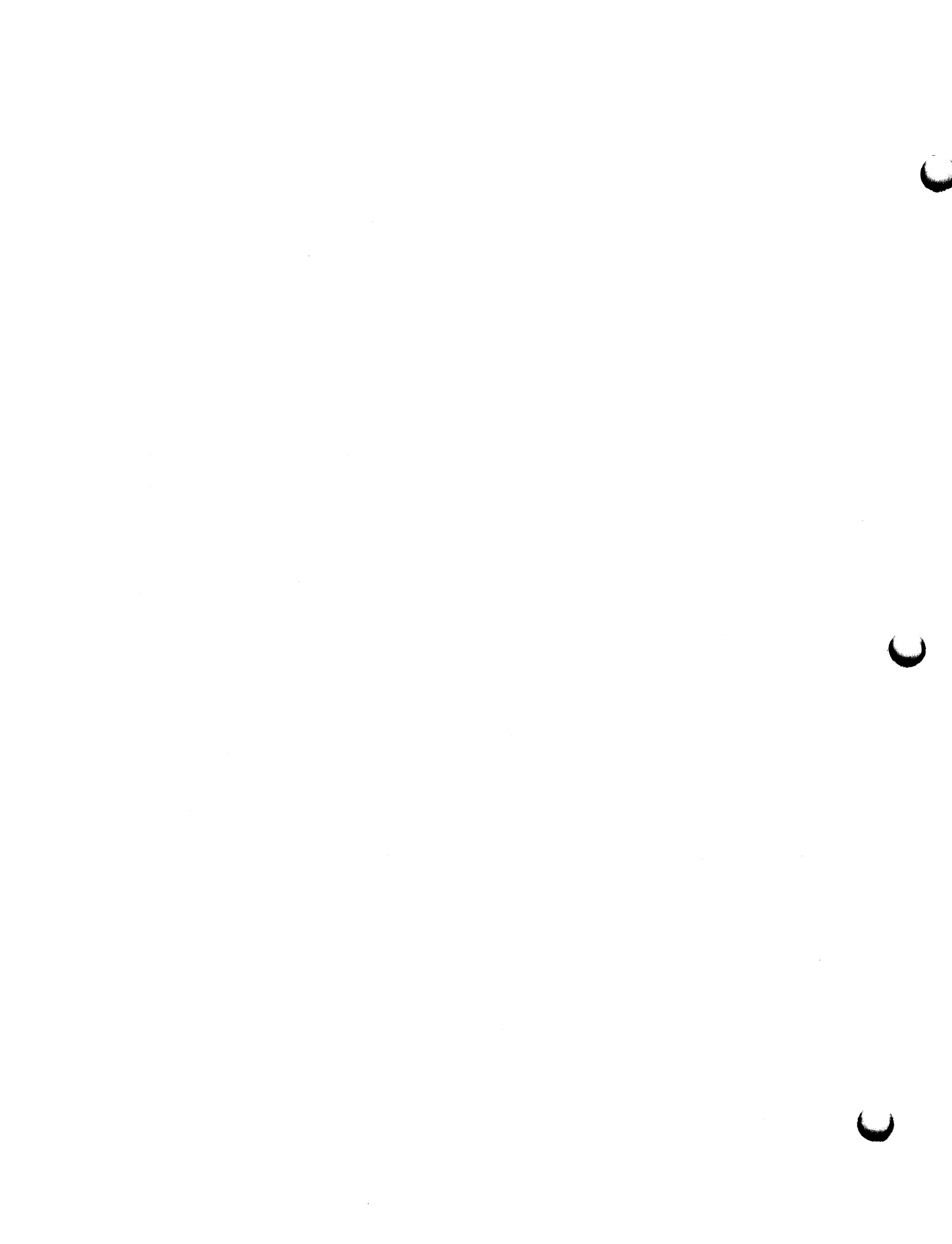
In the first case, the failure can generally be traced to either the serial board itself or the software used to program the serial board devices.

In the case of a single port or a few ports not working, the problem is again likely to be the serial board's. In this case, however, correct data transfer between the computer and the peripheral can take place to confirm that the peripheral is indeed functioning properly.

In the case of a device failure, the first task is to check any interface parameters set on the device with the parameters expected by the communications port (for example, using the program CONFIGURE). Then the device should be checked per the manufacturer's instructions for possible trouble.

5.2 DIAGNOSTICS

(INSTRUCTIONS FOR RUNNING DIAGNOSTICS  
WILL BE SUPPLIED WITH THE  
RELEASE VERSION OF THE DIAGNOSTIC SOFTWARE)



Section 6

**SERVICE NOTES and UPDATES**

