A P P L E

Service/Support Training Programs

LaserWriter

to

Apple IIe

Super Serial Cd. — LaserWriter

SW 1	SW 2	
0001011	1001100	Special Setting

Use Apple Works Software

in Diablo Emulation Mode

Table 1.4 Water Heater Technical Processes

	Error	Correction
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

Errata

for

Apple LaserWriter Printer Technical Procedures

PRELIMINARY

Page	Error	Correction
2.50, Figure 2-35	"Side View of Printer..."	"Front View of Printer..."
2.66, Figure 2-49	"Left Side of Printer..."	"Right Side of Printer..."
2.68, Figure 2-53	"Left Side of Printer..."	"Right Side of Printer..."
2.65, Figure 2-65	"Left Side of Printer..."	"Right Side of Printer..."

APPLE LASERWRITER PRINTER
TECHNICAL PROCEDURES

TABLE OF CONTENTS

This is a preliminary version of the LaserWriter Printer Technical Procedures, for internal use only. Comments and corrections should be sent to Technical Information Materials Development, Apple Computer, 20525 Mariani Avenue, Cupertino, CA 95014, Mailstop 27-V, attn. Tom Devine.

(Items marked * are included in the videotapes that accompany this manual.)

CONTINUED ON NEXT PAGE

Section 2 - Take-Apart (continued)

2.B - Upper Main Body of Printer

2.C - Lower Main Body of Printer

2.D - Printer Pedestal

Section 3 - Adjustments

Section 4 - Troubleshooting

II- Electromechanical Problems (continued)

GENERAL INTRODUCTION: THIS MANUAL

The service procedures contained in this manual cover Level I troubleshooting and repairs for the Apple® LaserWriter Printer. Three videotapes accompany the manual: Tape 1 is the **LaserWriter Introductory Service Procedures** tape that you received with the Introductory Service Procedures manual. Tapes 2 and 3 are available separately.

Installation instructions for the LaserWriter and the AppleTalk™ Personal Network are given in the Macintosh Office Quick Reference Guides and the videotape Macintosh Office Setup and Operation. **Familiarize yourself with those materials before using this manual.**

Also familiarize yourself with the LaserWriter user's manual. It contains instructions on use and operator-level maintenance of the printer which all service personnel should be aware of.

In this manual, read section 1, **Basics**, before doing any work inside the printer. It explains how the printer works and gives diagrams locating its major assemblies. It also explains the printer's test prints and status lights and gives specifications for printer use and maintenance.

Sections 2 and 3, **Take-Apart** and **Adjustments**, contain step-by-step instructions for replacements and adjustments. Section 2 also contains **important safety information and Electrostatic Discharge precautions** that you need to know before working inside the printer. **Don't ignore these precautions. The printer's laser light can damage your eyes severely unless you observe the safety precautions, and static discharge can cause real problems with expensive printed circuit boards.**

Section 4, **Troubleshooting**, contains a list of quick fixes and a complete set of troubleshooting tables. **In order to use the Troubleshooting section, you must know how to use a multimeter to measure voltages and resistances and to check electrical continuity.**

Appendix A contains schematic diagrams that are referred to in the Troubleshooting section.

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CONTINUED ON NEXT PAGE

Section 2 - Take-Apart (continued)

2.B - Upper Main Body of Printer

2.C - Lower Main Body of Printer

Apple LaserWriter Printer
Technical Procedures

Section 1 - Basics

Contents:

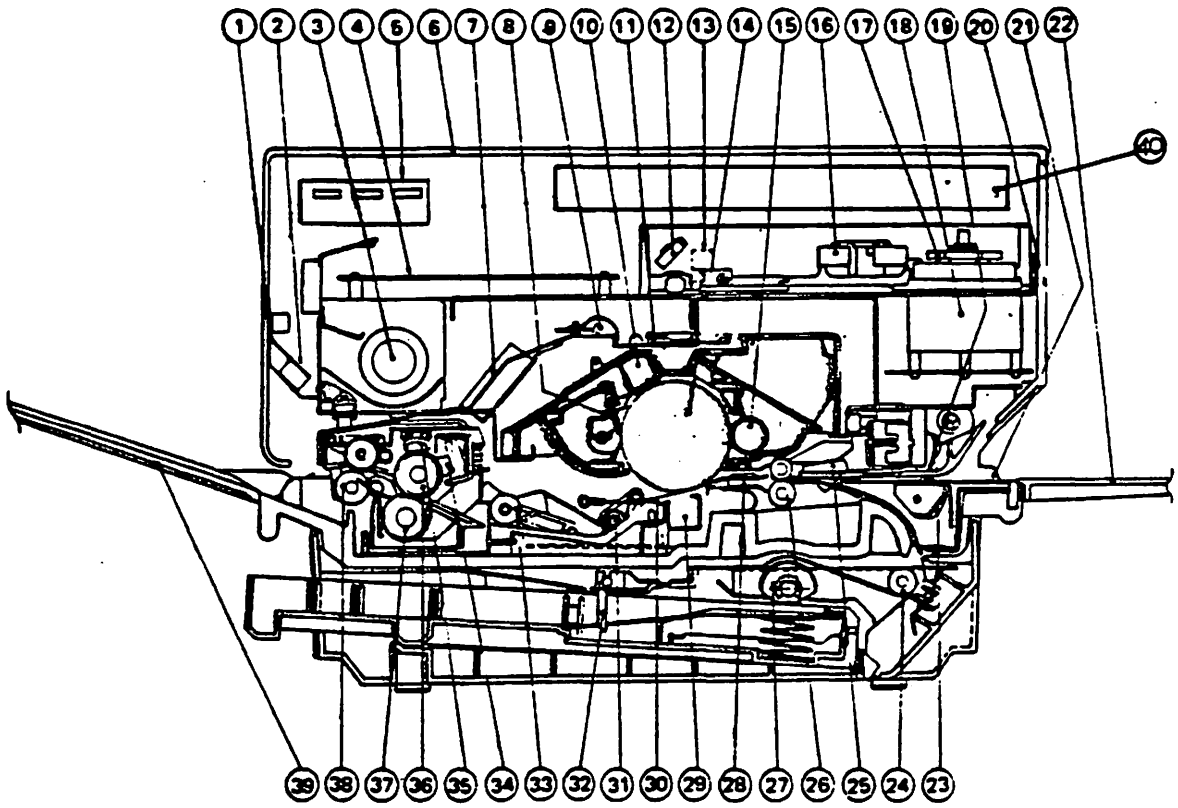


Figure 1-1 : Cross Section of the Printer (Front View)

1. Front cover
2. Duct
3. Fan
4. DC controller PCB
5. Display panel
6. Top cover
7. Ozone filter
8. Cleaning blade
9. Preconditioning exposure lamps
10. Primary corona assembly
11. Laser beam-blocking shutter
12. Beam-to-drum mirror
13. Stationary mirror
14. Photosensitive drum
15. Developing cylinder
16. Focusing lenses
17. Scanner mirror
18. Scanner motor
19. Upper manual pickup roller
20. Rear panel
21. Manual paper feed guide
22. Manual feed tray
23. Lower manual pickup roller
24. Cassette feed roller
25. Registration shutter
26. Feeder roller
27. Cassette pickup roller
28. Transfer guide assembly
29. Transfer corona assembly
30. Separation belt
31. Separation feeder unit
32. Paper detection arm
33. Feeder (pinch) roller
34. Thermistor
35. Fuser roller cleaner felt
36. Upper fuser roller
37. Lower fuser roller
38. Delivery roller
39. Print tray
40. LaserWriter I/O board

1.A - THEORY OF OPERATION

The LaserWriter printer uses laser light, a sophisticated optical system, and a plastic powder called **toner** to produce its images. Using a dot matrix of 300 dots per inch (6.8 million per page), it can produce a variety of high-quality print fonts and graphics, either separately or on the same page. Computers can be connected to the printer either through the AppleTalk network or through the RS232/422 port.

The **LaserWriter I/O board** controls communications between the printer and external computers. It contains 1.5 megabytes of RAM and 500 kilobytes of ROM, plus a 68000 microprocessor. During printing, when a document is sent to the printer from an attached computer, the I/O board receives a description of each page in a language called PostScript™. (ASCII files can also be accepted, but this discussion will be confined to normal printing from a Macintosh.) It then converts the PostScript commands into a bit image which it stores in RAM and then sends to the printer's **DC Controller board.** The DC Controller board controls the operation of the print mechanism and the **laser/scanner unit** to produce the actual printed page.

The semiconductor **laser** produces a beam of infrared light which is directed toward a rotating hexagonal mirror in the **scanner unit.** The scanner mirror reflects the beam across a revolving light-sensitive **drum** in the **Toner Cartridge.** As the drum rotates, the result is a raster scan, very much like that which forms the picture in a television set.

The drum is given a positive charge by the **primary corona wire** inside the toner cartridge. Wherever the light beam hits the drum, it neutralizes this positive charge on a tiny "dot" on the drum's surface. The pattern of dots produced by the laser's beam forms the image.

After being exposed to the laser scan, the drum rolls through the toner powder, which is contained in the same unit (the toner cartridge). The toner is positively charged, so it avoids the positive ("white") areas of the drum surface, but is attracted to the neutral (slightly negative) dots where the laser beam has struck the drum.

The drum, with its load of toner, then comes in contact with the paper. At this point, the paper is given a strong negative charge by the **Transfer Corona Wire.** This negative charge causes the toner to stick to the paper. As the paper travels forward, it is stripped off the drum by the **separation belt.** It then passes between two heated rollers in the **Fuser Assembly,** and the combination of heat and pressure fuses the toner onto the paper permanently.

1.B - LOCATIONS OF MAJOR ASSEMBLIES

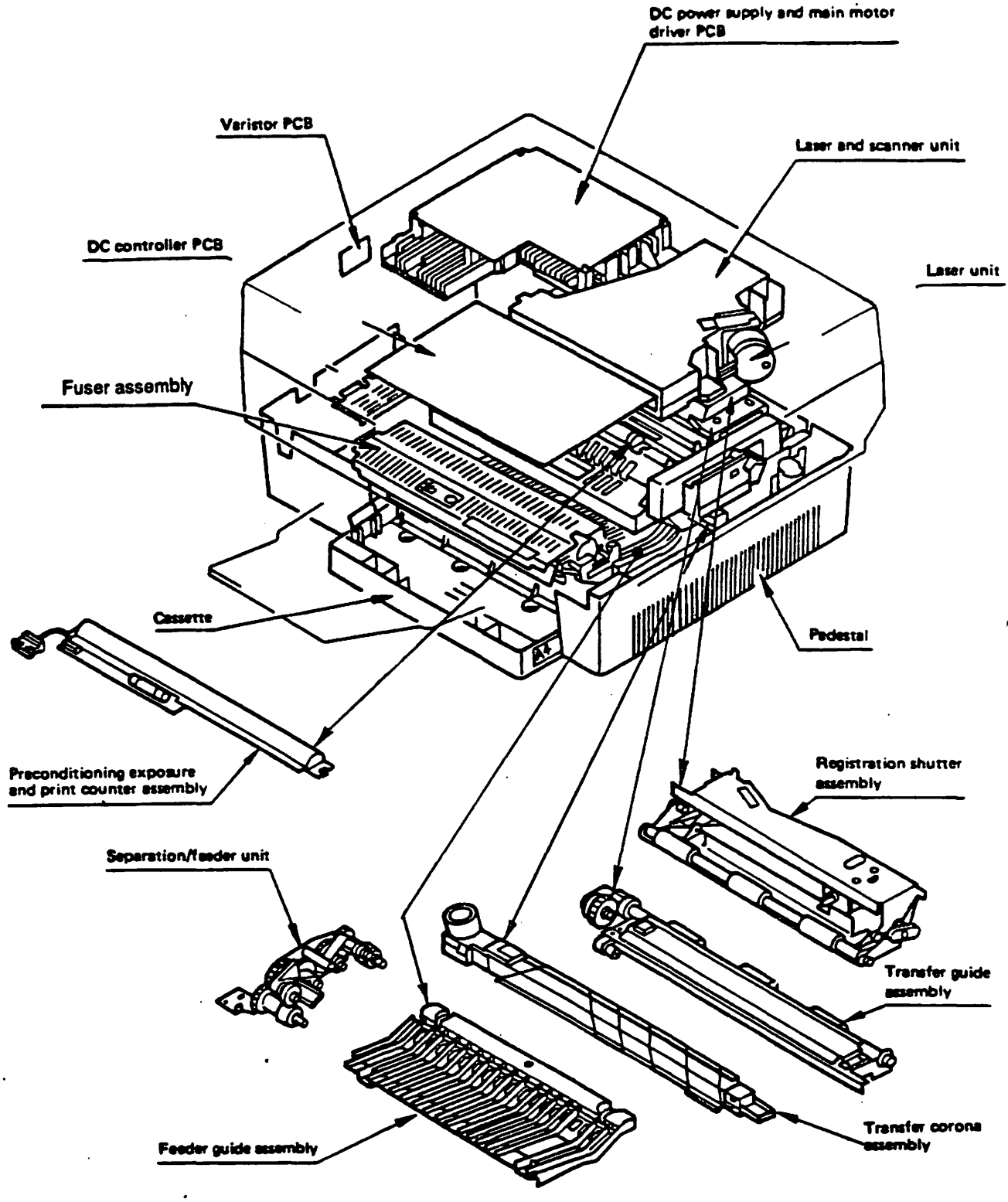


Figure 1-2

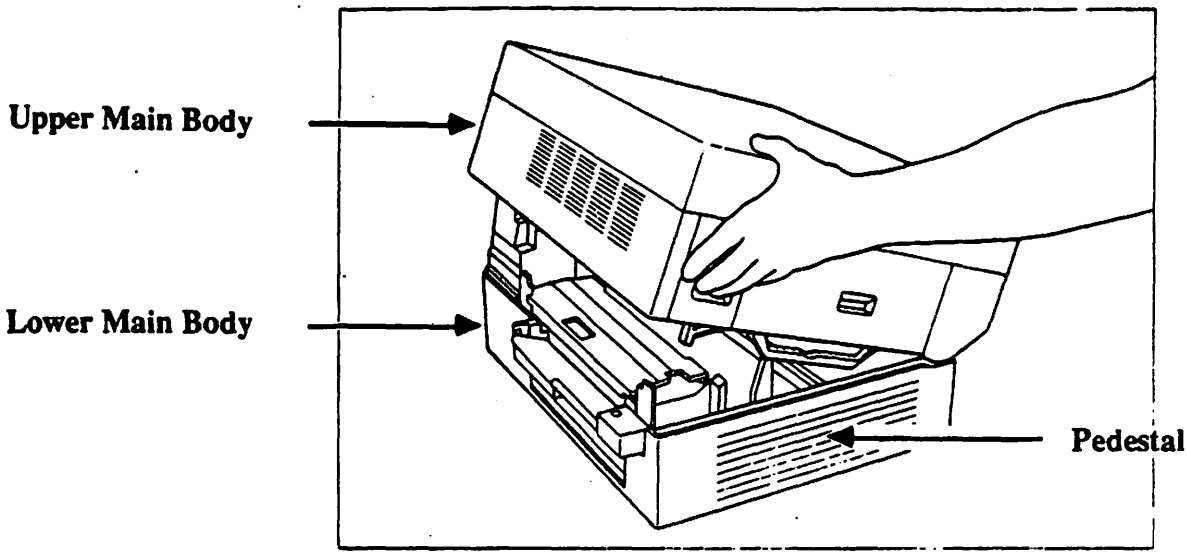


Figure 1-3

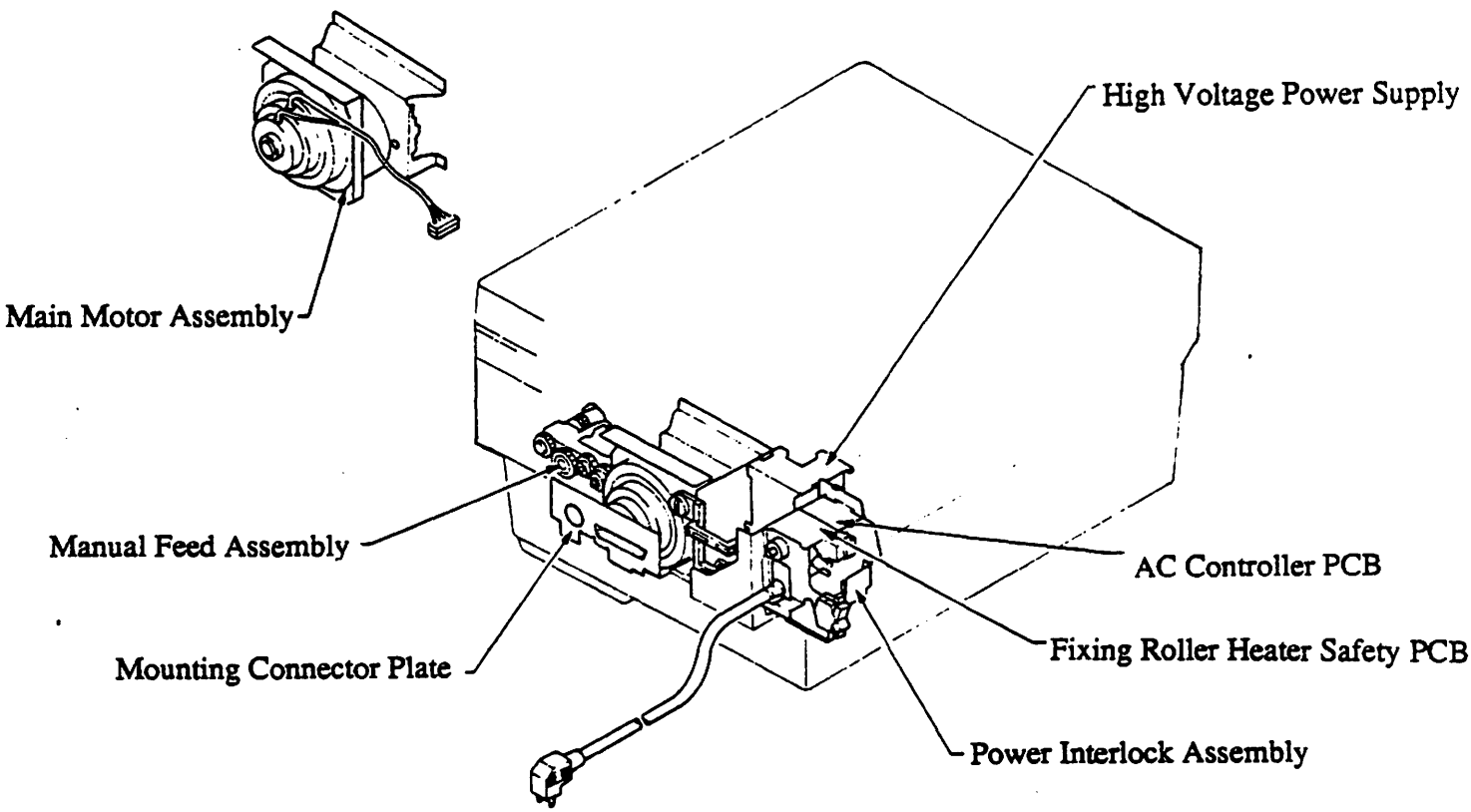


Figure 1-4

1.C - PRINTER SPECIFICATIONS

Recommended Weights of Paper

Cassette feed: 16-21 lb.

Manual feed: Single-sided printing: 11-33 lb.
Double-sided printing: 16-33 lb.

Cassette-Feed Information

1. Maximum paper load: 0.4 inches

2. Load paper with curl-side up, as in an office photocopier. Before loading paper, fan through the stack to ensure proper feeding.

3. Store paper in its package in a dry location. Do not open a package of paper until you are ready to use it.

Manual-Feed Information

1. It is possible to use paper sizes from 4" x 5.5" to 8 1/2" x 14" in manual feed operation.

2. Do not pull the paper from the manual feed guide when the printer begins feeding paper. Pulling the paper out does not abort printing, and it can damage the printer.

Double-sided printing

Double-sided printing is possible if manual feed is used for the second side. (Attempting to print on the second side of a printed page using cassette feed is likely to cause paper jams.) Insert paper lengthwise along the guide on the manual feed tray, with the side to be printed facing up.

Electrical Specifications

Line voltage: 115 Volts + or - 10% (North American model)
Line frequency: 60 Hz + or - 2 Hz. (North American model)
Power consumption:
Operating: Max. 690 Watts
Standby: Typical average is 120 Watts

Environment

1. Temperature: 50° F to 90.5° F.

2. Humidity: 20% to 80% relative humidity for optimum performance.

1.D - SETUP, OPERATION, AND PREVENTIVE MAINTENANCE

Setup and operation instructions for the LaserWriter are given in the Macintosh Office Quick Reference Guides. They include the following topics:

1. Planning an AppleTalk network installation.
2. Setting up AppleTalk.
3. LaserWriter Components
4. Setting Up the LaserWriter: includes installing the toner cartridge and its cleaning pad, the paper trays, and the paper cassette.
5. Connecting devices to AppleTalk.
6. Using the Macintosh Office to Print: includes installing LaserWriter software on an application disk, fixing a "disk full" condition, and printing a document.
7. Print Quality Guide: a preventive maintenance and troubleshooting guide for users.

The Quick Reference Guides can help you guide users over the telephone in troubleshooting problems that users can fix on their own.

Operator-level preventive maintenance instructions are given in the LaserWriter user's manual. They include instructions for the following:

1. Replacements:

   a) the separation belt.
   b) the toner cartridge and its cleaning pad (fuser roller cleaner).

2. Cleaning:

   a) the transfer corona wire
   b) the transfer guide
   c) the primary corona wire in the toner cartridge
   d) the fuser assembly rollers, and
   e) the separation belt.

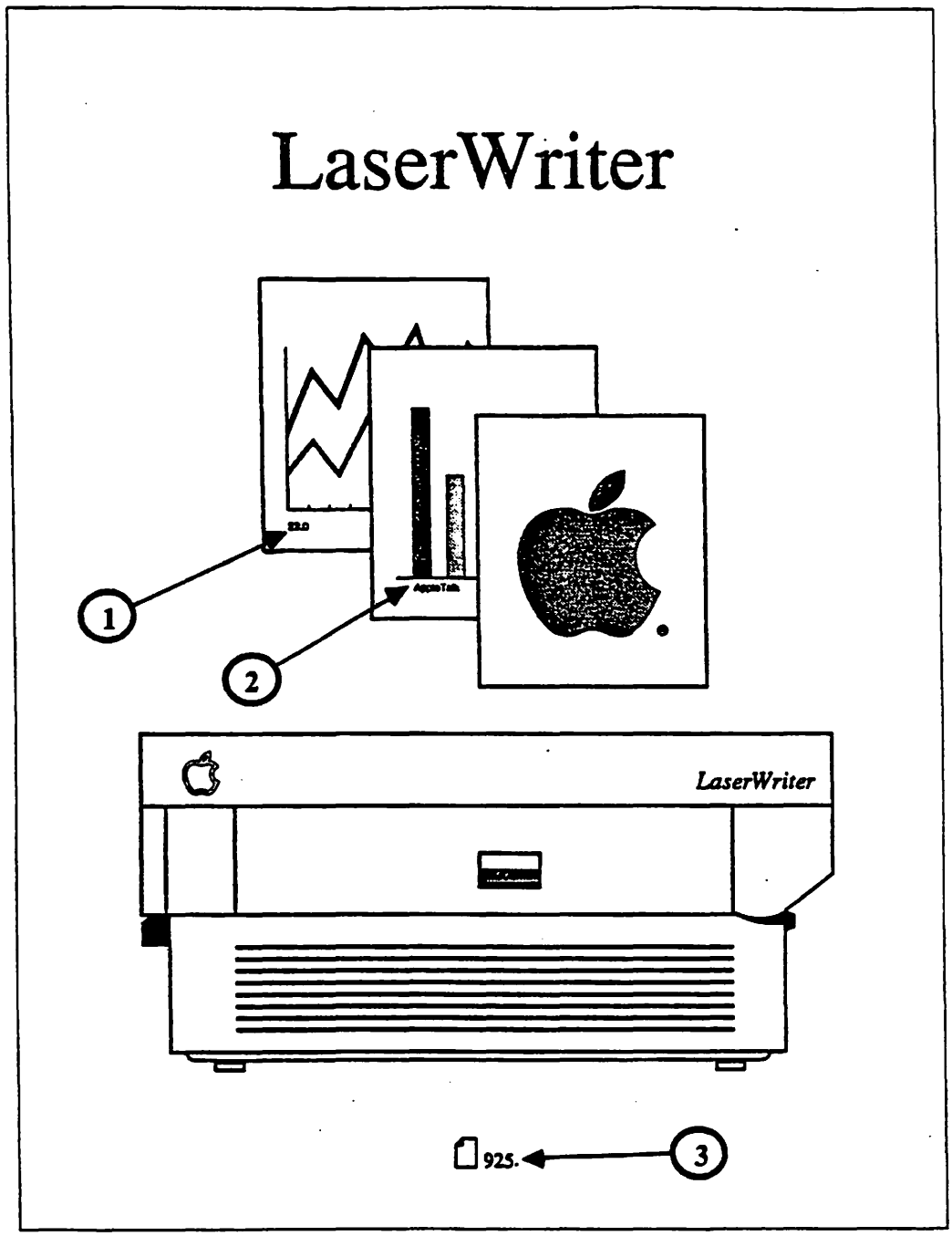


Figure 1-5 : User Test Print

1.E - PERFORMANCE EVALUATION: THE PRINTER TEST PRINTS

The LaserWriter has two test prints. The service test print can be produced by jumpering two pins on the DC Controller board. This print exercises the LaserWriter's printing functions but does not involve the LaserWriter I/O board. It is useful in service situations where a test print is required but the I/O board has been removed. Instructions for generating this print are given in the body of the manual where appropriate. The print consists of black stripes on a white background, covering the entire printing area of the page. (See **Image Skew Adjustment** for further information.)

The **user test print**, reproduced in Figure 1-5, is produced each time the printer's power switch is turned on. This test print exercises the LaserWriter I/O board and contains several types of information about the printer's performance. The numbered items below refer to the numbered arrows in Figure 1-5.

1. The number printed here indicates the revision level of the printer's ROM.

2. This square indicates the setting of the selector switch at the rear of the printer. If the selection is not "AppleTalk," the Baud rate appears at the top of the bar graph and the I/O port being used (9-pin or 25-pin) is specified at the bottom of the graph.

3. This number represents the number of pages printed so far on this printer.

Aside from these items, the user test print can also tell you:

1. whether the printer is functioning: If the user test print is produced without problems, the printer is working correctly.

2. whether the image is properly aligned to the paper: by measuring from the square border to the edge of the paper, you can tell whether the image is tilted further than is acceptable according to Apple's specifications. (See "Image Skew Adjustment" in Section 3.)

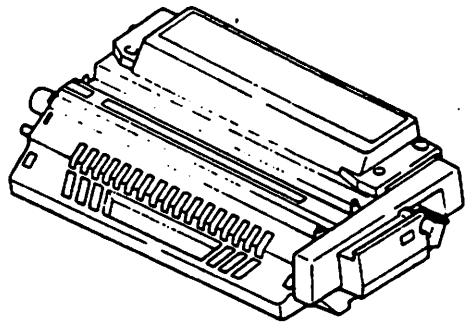


Figure 1-6 : Toner Cartridge

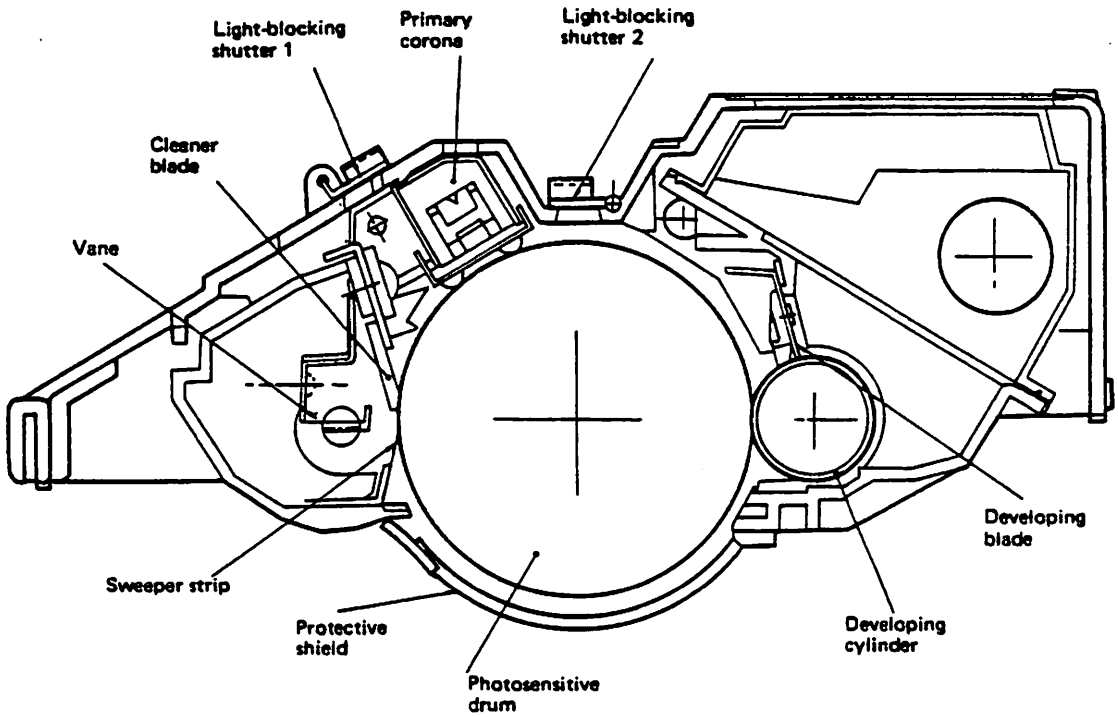


Figure 1-7 : Toner Cartridge (Cross-Section)

1.F - THE TONER CARTRIDGE

The toner cartridge (Figures 1-6 and 1-7) is a self-contained unit that includes the photosensitive drum, the primary corona wire (which charges the drum), a developing unit, toner hopper, and drum cleaner (see Figure 1-7). The cartridge cannot be disassembled.

The printing life of a cartridge is approximately 3,000 pages, but may vary according to the type of printing done: for instance, graphics that include large black or shaded areas will use more toner than ordinary text.

a. Protective Shield

The toner cartridge has a protective shield over the area where the paper comes into contact with the drum. When the cartridge is removed from the printer, this shield shuts automatically, preventing light from entering. (If the drum is exposed to light, blank areas and faint black stripes may appear on prints.)

The shield is opened automatically when the toner cartridge is inserted into the printer and the printer is closed. Do not open the shield manually unless necessary, and do so only in dim light.

b. Light-blocking Shutters

The two light blocking shutters protect the areas where the preconditioning lamps "erase" the drum surface and where the laser beam "paints" the image on the drum. These shutters open automatically when the cartridge is inserted into the printer. If the shutters do not close by themselves when you remove a cartridge from the printer, close them manually.

c. Storage

1. The toner cartridge should be stored at a temperature between 32 and 95 degrees F in a relative humidity of 35% to 85%. Higher or lower temperatures or humidities may reduce the storage life of the cartridge, as will storage in air pressure lower than 0.6 atmospheres or higher than 1 atmosphere.

   NOTE: The expiration date of the cartridge is specified on the cartridge box. The usable lifetime of a toner cartridge is 2 1/2 years from the date of manufacture. Cartridges more than 2 1/2 years old may give poor print quality.

2. Do not place cartridges in direct sunlight or near a window. Do not leave them inside an automobile for a long period in warm weather, even if the cartridges are still in their storage boxes.

3. Avoid storing cartridges in places where the temperature or humidity may change suddenly (for example, near an air conditioner or heater).

4. Avoid storing cartridges in dusty locations and places where they might be exposed to ammonia fumes or organic solvents. (Inform your cleaning staff not to use ammonia near the printer or near stored cartridges.)

d. Handling Suggestions

1. When installing a cartridge, hold it horizontally and rock it slowly back and forth 45°, to distribute the toner. (See Figure 1-8.)

2. If white areas occur on prints due to lack of toner, rock the cartridge back and forth to redistribute the toner. This can sometimes coax extra life out of a cartridge that is almost empty.

   CAUTION: To avoid toner spillage after a toner cartridge's seal is broken, hold it by the handle and rear only, as shown in Figure 1-8.

3. Never touch the surface of the photosensitive drum. If the surface of the drum becomes dirty, open the protective shield and wipe it clean with a piece of flannel that has been liberally sprinkled with toner. Never wipe it with a dry cloth or paper towel, and never use solvent.

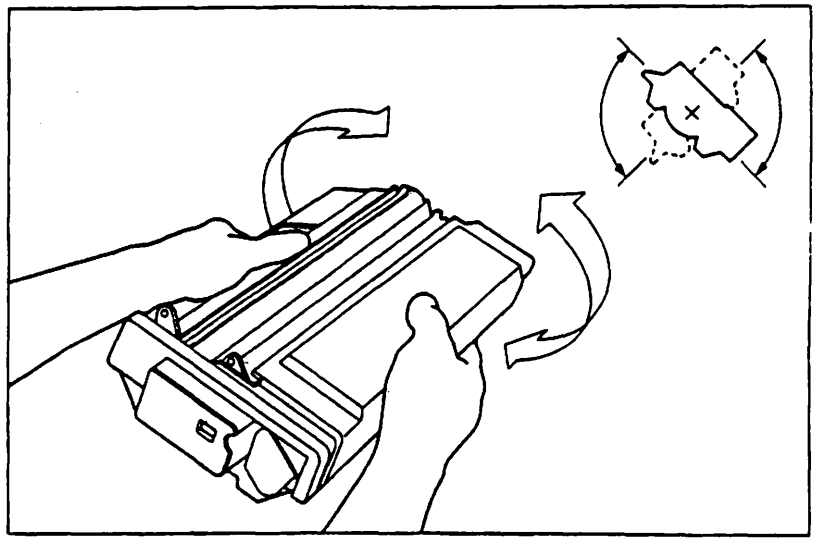


Figure 1-8

4. If the cartridge is left in strong light for a long time, white blanks or white stripes will appear on prints (even if the protective shield and shutters are closed.) If this happens, stop the printer and wait a few minutes: the cartridge should be able to "recover" within this time.

   NOTE: Normal room light, measured a few meters from a window on an average day, is about 1,500 lux. Do not expose the photosensitive drum to light of this intensity for more than 5 minutes. If the drum is placed under these conditions accidentally, the cartridge can be stored in a dark place to "recuperate," although an image may be retained on the drum for some time. Direct sunlight is 10,000 to 30,000 lux. A drum exposed to direct sunlight may be ruined.

1.G - STATUS LIGHTS

The printer has four status lights, three on the display panel at the front of the machine and one on the rear (I/O) connector plate.

1. The TEST light on the rear (I/O) connector plate (Figure 1-9) comes on continuously (either steady or blinking) if the LaserWriter I/O board is malfunctioning. (If the board is functioning correctly, this light will blink once and then go out when the printer is turned on.)

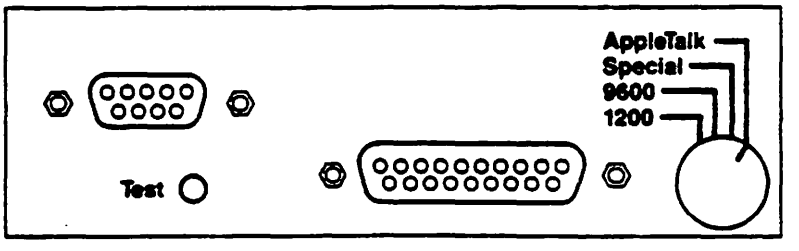


Figure 1-9 : Rear (I/O) Connector Plate

2. Display panel LEDs (Figure 1-10):

a) The green READY light blinks while the printer is warming up and then stays on continuously when the printer is ready to operate.

b) The yellow PAPER OUT light stays on continuously when there is no paper in the paper cassette, or when the paper cassette is not installed. This light blinks when the printer is preparing to print a page. (With manual feed, this LED lights steadily if there is no paper on the manual feed tray.)

c) The red PAPER JAM light stays on continuously when a paper jam occurs. Printing is not possible until the jammed paper is removed.

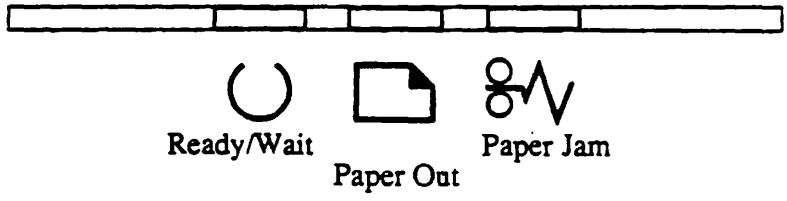


Figure 1-10 : Display panel LEDs

Apple LaserWriter Printer
Technical Procedures

Section 2 - Take-Apart

Contents:

(Items marked * are included in the videotapes that accompany this manual.)

2.A - GENERAL INFORMATION

2.A.1 - EQUIPMENT NEEDED FOR LASERWRITER SERVICE

Phillips screwdrivers, magnetized:
- #2 head, stubby (1.25-inch shaft, 3-inch maximum total length)
- #2 head, medium (4-inch shaft)
- #2 head, long (6-inch shaft)

Long nose pliers (preferably curved)
diagonal cutting pliers
Medium flathead screwdriver (or other tool for prying)
snap-ring pliers, external, 19-30 mm
cable ties
Electrostatic discharge equipment (3M Velostat 8012 Field Service Kit or equivalent)
spring hook (optional)

2.A.2 - MAIN SCREW TYPES USED

NOTE: Screws of types A, B, C, and D (See Figure 2-1) occur both as "black" (anodized) and "silver" (conductive) screws in the chassis. To preserve proper grounding and continuity, replace "silver" screws only with other silver screws, and black screws with black screws. Whenever you remove screws from the printer, mark on the chassis which type of screw you have removed, so that you can replace it with the same type.

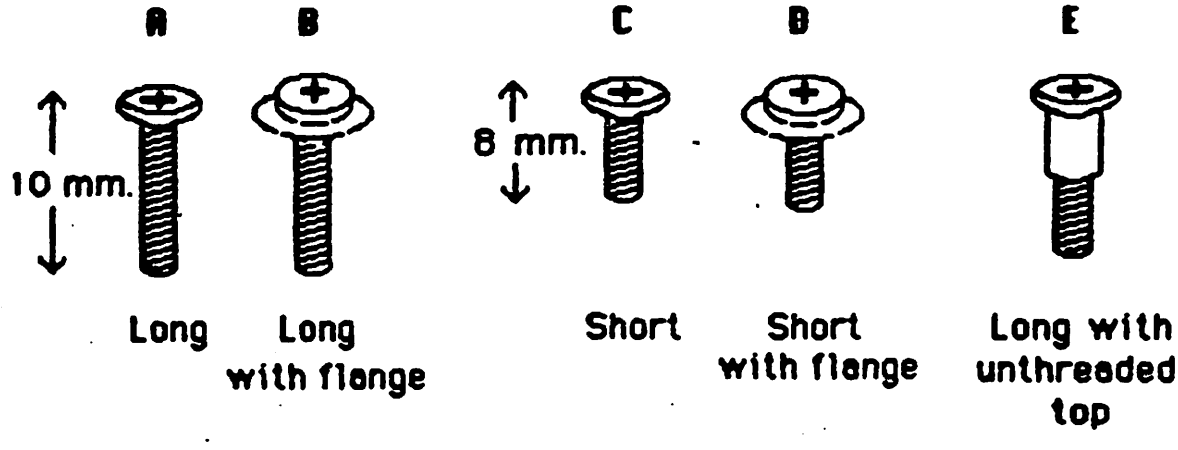


Figure 2-1

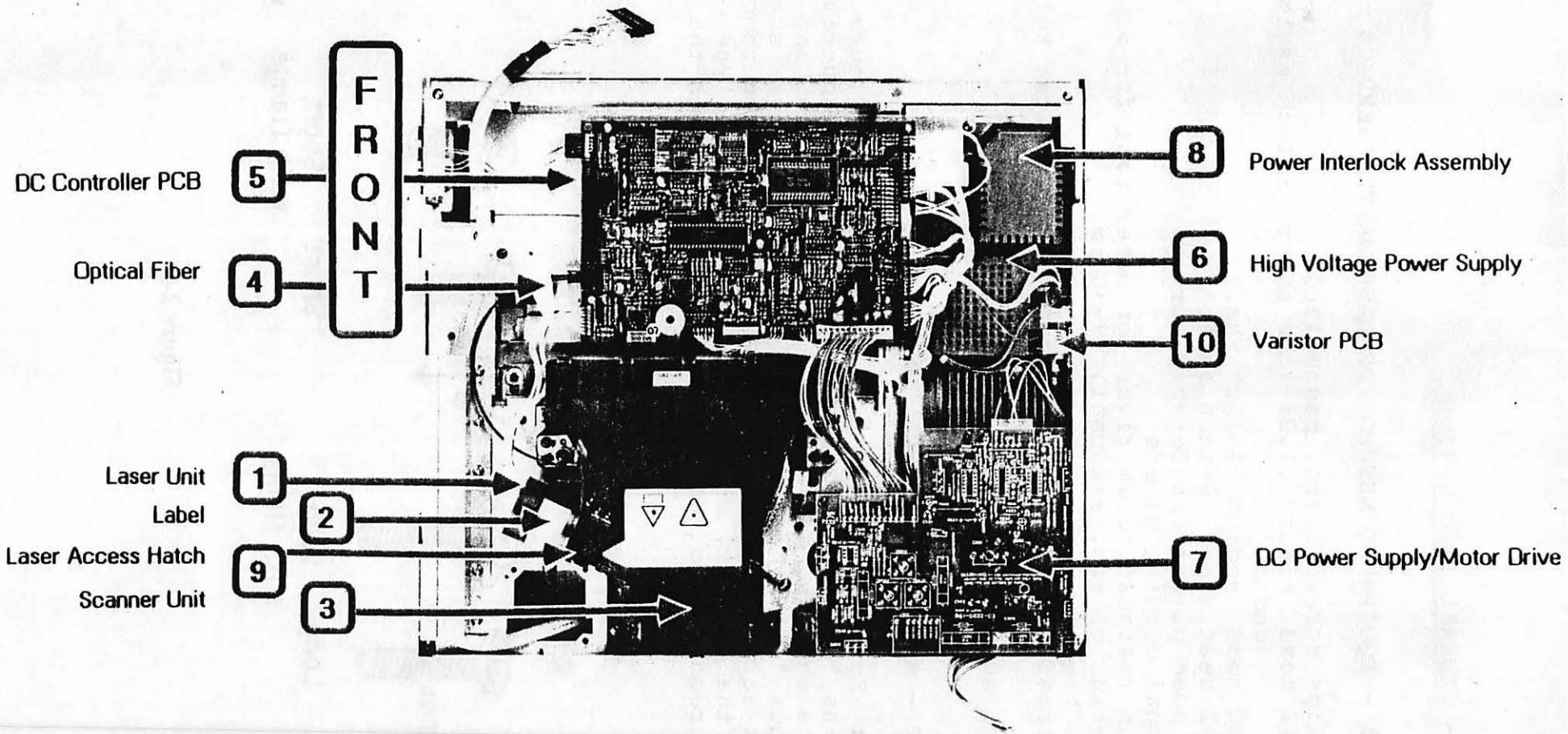


Figure 2-2 : Top View of LaserWriter With I/O Board Removed

2.A.3 - SAFETY PRECAUTIONS

1. Always unplug the printer before taking it apart, unless you are testing the electronic assemblies.

2. **Never disconnect the optical fiber (Figure 2-2, #4) from the DC Controller board when the printer is running.** The fiber carries infra-red laser radiation, which you cannot see but which can permanently damage your eyes or your neighbor's eyes. Even if you don't look directly at the fiber, the light can enter your eyes by bouncing off reflective surfaces.

3. For the same reasons, **never open the laser access hatch (Figure 2-2, #9) or the scanner unit (Figure 2-2, #3) when the printer is running.** (Never open the scanner unit under any circumstances: it contains optical assemblies that must be protected from dust.)

4. The LaserWriter weighs over sixty pounds: Be careful in lifting it!

5. When the printer is running with its covers or panels removed, be careful where you put your hands. There are dangerous voltages on the DC Power Supply (Figure 2-2, #7) and the High Voltage Power Supply (Figure 2-2, #6).

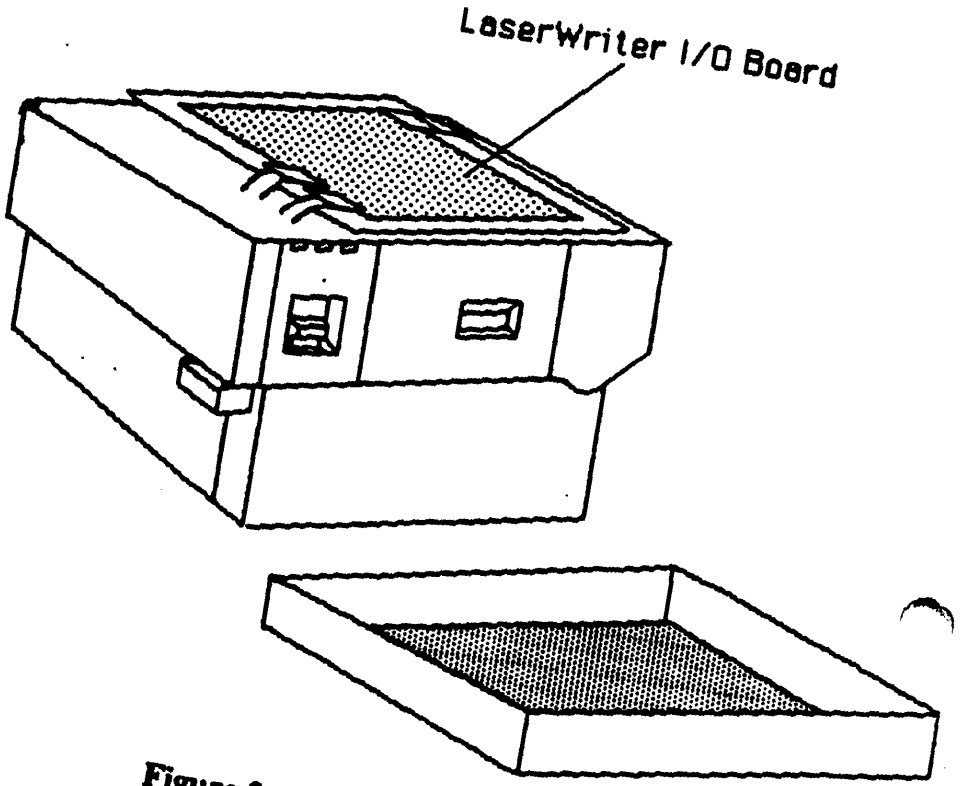


Figure 2-3

2.A.4 - ELECTROSTATIC DISCHARGE (ESD) PRECAUTIONS

The LaserWriter I/O board (See Figure 2-3) is the most expensive single module in the printer, and its components are soldered into place. It is therefore very important to protect the chips on the board from damage. Electrostatic discharge can be an important factor in causing board failures: even if the failures are not immediate and dramatic, static zaps can degrade chips in such a way that they fail weeks or months after exposure.

APPLE WILL SOON BE RECOMMENDING MORE COMPREHENSIVE ESD PROCEDURES. Until that time, abide by the following basic precautions to help minimize the possibility of board failure.

1. Whenever possible, handle and transport boards safely enclosed in antistatic bags.

2. NEVER walk around with a board unless it is safely enclosed in an antistatic bag.

3. While handling a circuit board, do not touch another person, or anything else you do not need to touch, for that matter.

4. Do NOT place a bare board on any metal surface or on any other circuit board.

5. Do NOT bring ordinary plastic bags, foams (yes, **especially** those foam cups carrying our caffeine-laden brew!), or cushioning into the work area, and certainly never near a work station. The static fields generated by these items in particular carry enough voltage to damage sensitive circuitry.

6. Ideally, boards should be touched only by people wearing proper grounding apparatus. UNTIL SUCH APPARATUS IS AVAILABLE AT YOUR WORKSITE, discharge yourself by touching the metal part of the LaserWriter chassis before removing or replacing any board.

More comprehensive ESD information and related service procedures will soon replace some of the interim items listed above.

2.A.5 - OTHER PRECAUTIONS

1. Always remove the LaserWriter toner cartridge before removing anything else from the printer, to prevent damage to the cartridge. When you remove it, be sure the light-blocking shutters are closed, and cover the cartridge so that light will not damage it.

2. Use recommended weights and grades of paper for all tests. For best results, use 16-21 lb. paper, such as the standard paper used in office photocopiers. (See section 1.C for further paper specifications.)

3. Do not pull the paper from the manual feed guide when the printer begins feeding paper. Pulling the paper out does not abort printing, and it can damage the printer.

4. Never open the scanner unit under any circumstances: it contains optical assemblies that must be protected from dust. **Apple will not accept a scanner unit for exchange if it has been opened.**

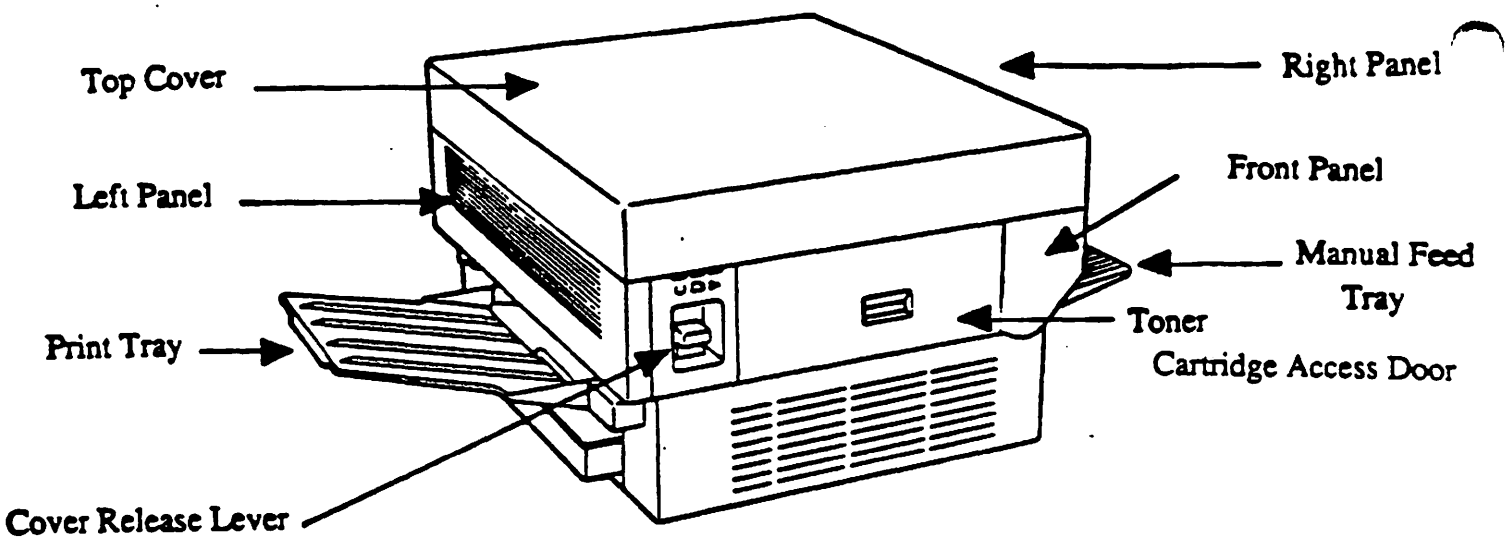


Figure 2-4

2.B - UPPER MAIN BODY OF PRINTER

2.B.1 - COVERS AND PANELS

A. Top Cover (See Figure 2-4)

1. Open the printer (raise the upper main body by pressing up on the release lever).
2. Open the cartridge access door and remove the toner cartridge. Leave the cartridge access door open.
3. Remove the two top-cover screws inside the cartridge door.
4. Remove the two screws on the other side of the top cover.
5. Lift off the top cover.

B. Front Panel (See Figure 2-4)

1. Open the printer and the cartridge access door. Remove the toner cartridge.
2. Remove the four screws.
3. Lift off the panel, carefully disengaging it from the case-opening lever.

C. Right Panel (See Figure 2-4)

1. Remove the front panel.
2. Close the printer.
3. Remove the two right-panel screws.
4. Lift off the panel.

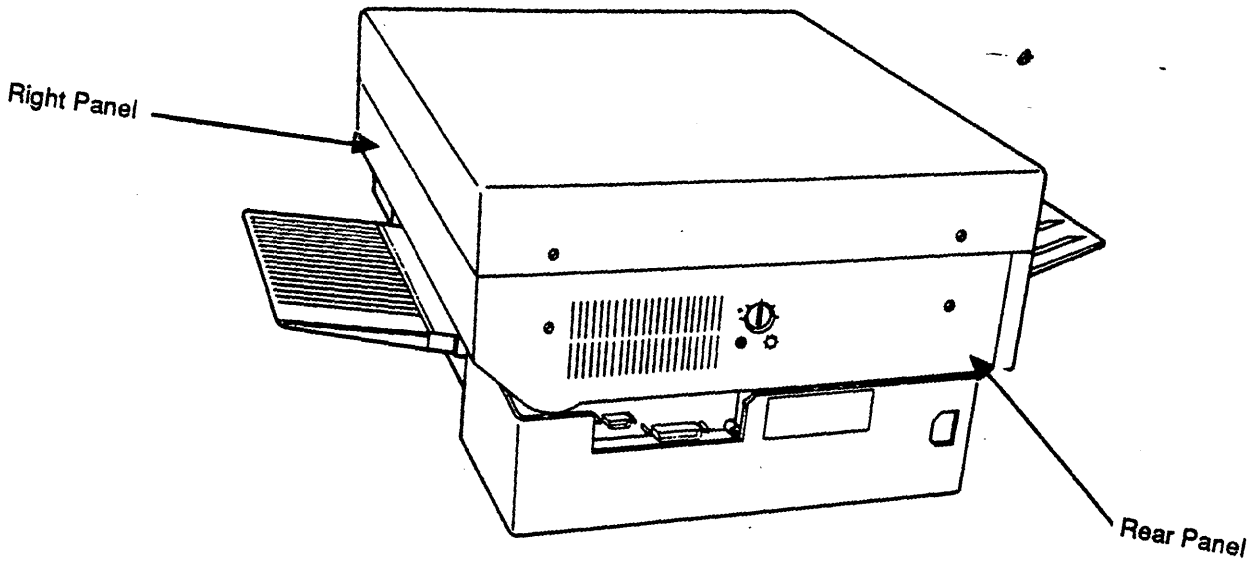


Figure 2-5 : Rear View

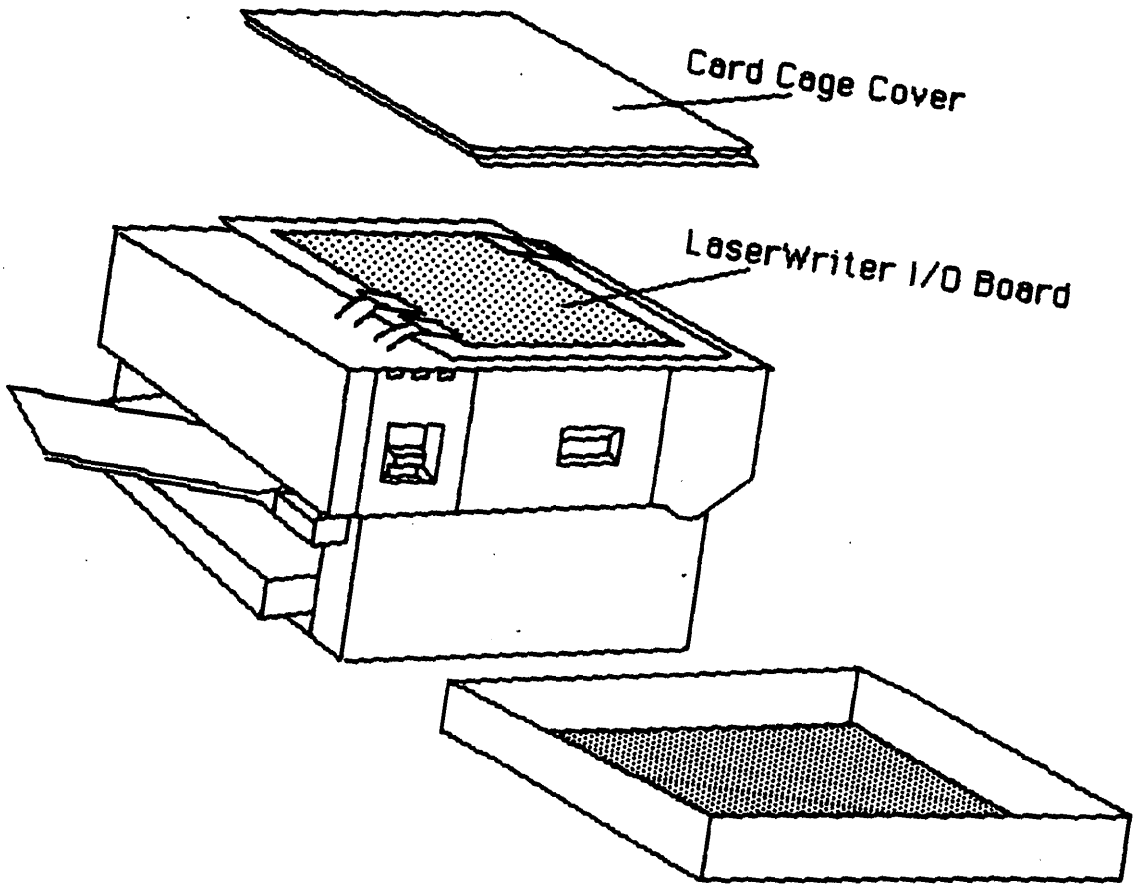


Figure 2-6

D. **Rear Panel** (See Figure 2-5)

1. Remove the front panel and right panel.

2. Remove the two screws and lift off the panel.

E. **Left Panel**

1. Remove the front, right, and rear panels.

2. Remove the four screws and lift off the panel.

To replace panels:

1. Fit the left panel on the chassis and install the four screws.

2. Do likewise for the rear panel, right panel, front panel and top cover.

   NOTE: The Apple logo on the top cover faces the front of the printer.

2.B.2 - LASERWRITER I/O BOARD (P/N 665-0270)

The LaserWriter I/O board (Figure 2-6) contains a 68000 microprocessor, 1.5 megabytes of RAM and 500K bytes of ROM. It controls communications between the printer and outside devices (computers and file servers) and contains the electronics that construct the printer's fonts.

1. Remove the Top Cover.

2. Remove the screws that hold the top of the card cage in place.

3. Lift the card cage cover off.

   CAUTION: Before touching any board, make sure you are properly grounded. **Static electricity can destroy expensive boards in an instant.**

4. Disconnect the three cables. **PULL ON THE CONNECTORS ONLY**, not on the cables.

If you are replacing the I/O board, go to step 5A. If you are removing the I/O board to gain access to other parts of the printer, skip to step 5B.

5A. To replace the I/O board:

NOTE: The I/O board is held down by plastic standoffs. On later versions of the LaserWriter, some plastic stand-offs may be replaced by metal fasteners. Remove any metal fasteners before trying to lift the board.

a) Pinch the plastic stand-offs to disengage the board.

b) Lift the board out, holding it **by the edges only,** and place it in a static-protective bag or on a workpad grounded to the LaserWriter. **Always make sure you are grounded to the LaserWriter before touching this board.**

c) Put the new I/O board into place, push it down so that the standoffs engage it, re-fasten any metal fasteners, and reconnect the three cables.

5B. **To remove the I/O board assembly to gain access to other parts of the printer**

a) Remove the screws that hold the card cage to the chassis.

b) Lift the board and card cage out carefully.

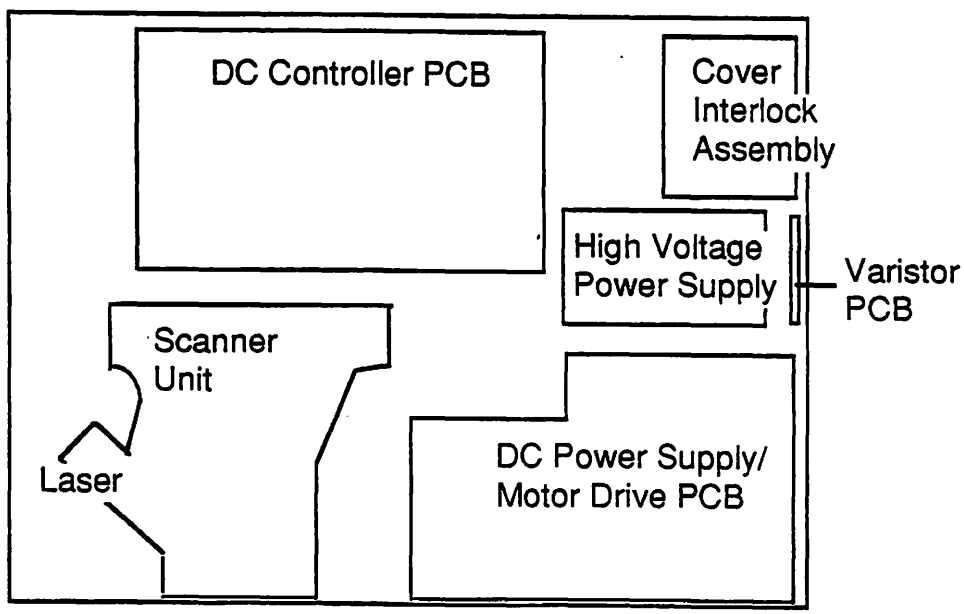


Figure 2-7: Top View with LaserWriter I/O Board Removed

2.B.3 - DC CONTROLLER PCB

The DC Controller board (see Figure 2-7) controls most of the print functions in the LaserWriter.

IMPORTANT: Replace the DC Controller board only with another Apple DC Controller board.

Remove

1. Remove top cover and LaserWriter I/O Board.
2. **CAUTION:** In this step, do not bend the optical fiber that comes from the laser. The fiber is part of the left-margin-detect circuitry. If bent, the fiber can break, and the printer will not be able to detect when the laser has reached the left margin of the page.

   Unplug all the connectors on the DC Controller PCB.
3. Release the board from its five nylon stand-offs and remove it.

Replace

1. Place the board on its five nylon connectors and push it down until they hold it in place.
2. Connect all cables to the board. The connectors are of different sizes: if you match them to their sockets exactly, you will have no problem. (The sockets labelled J213 and J205 are not used at this time.)
3. Reconnect the laser optical fiber and the eight-wire laser cable to the DC Controller board.
4. Replace the LaserWriter I/O Board and the top cover.

NOTE: When you install a new DC Controller Board in a printer, you must adjust the laser power. See the Laser Power Adjustment in **Section 3.**

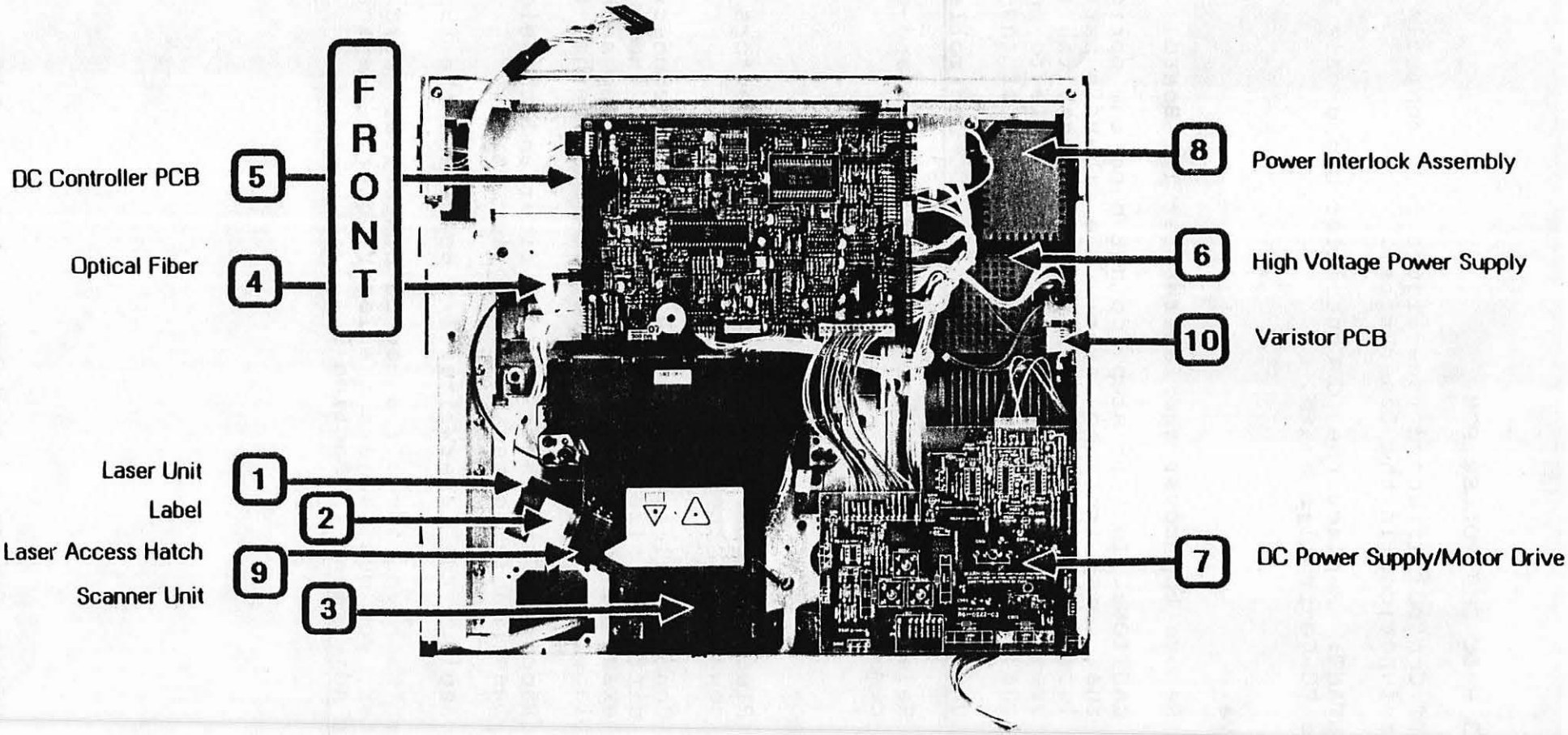


Figure 2-8 : Top View of LaserWriter With I/O Board Removed

2.B.4 - DC POWER SUPPLY/MOTOR DRIVE PCB (Figure 2-8, #7)

1. Remove the top cover and the LaserWriter I/O Board.

2. Open the printer and remove the toner cartridge and front panel.

3. Close the printer and remove the right panel and rear panel.

4. Remove the three connectors from the unit. **NOTE:** If necessary, use a flatblade screwdriver to help pry off the connectors, but do not pull on the wires.

5. Remove the five mounting screws on the metallic part of the assembly (**not** the five screws on the PCB) and lift the unit off the printer.

Replace

1. **IMPORTANT:** In this step, take care not to pinch the motor cable.

   Put the unit in position and replace the five long black mounting screws.

2. Connect the three cables to the unit. Make sure to connect the large cable to the DC Controller board.

3. Restore the panels and covers.

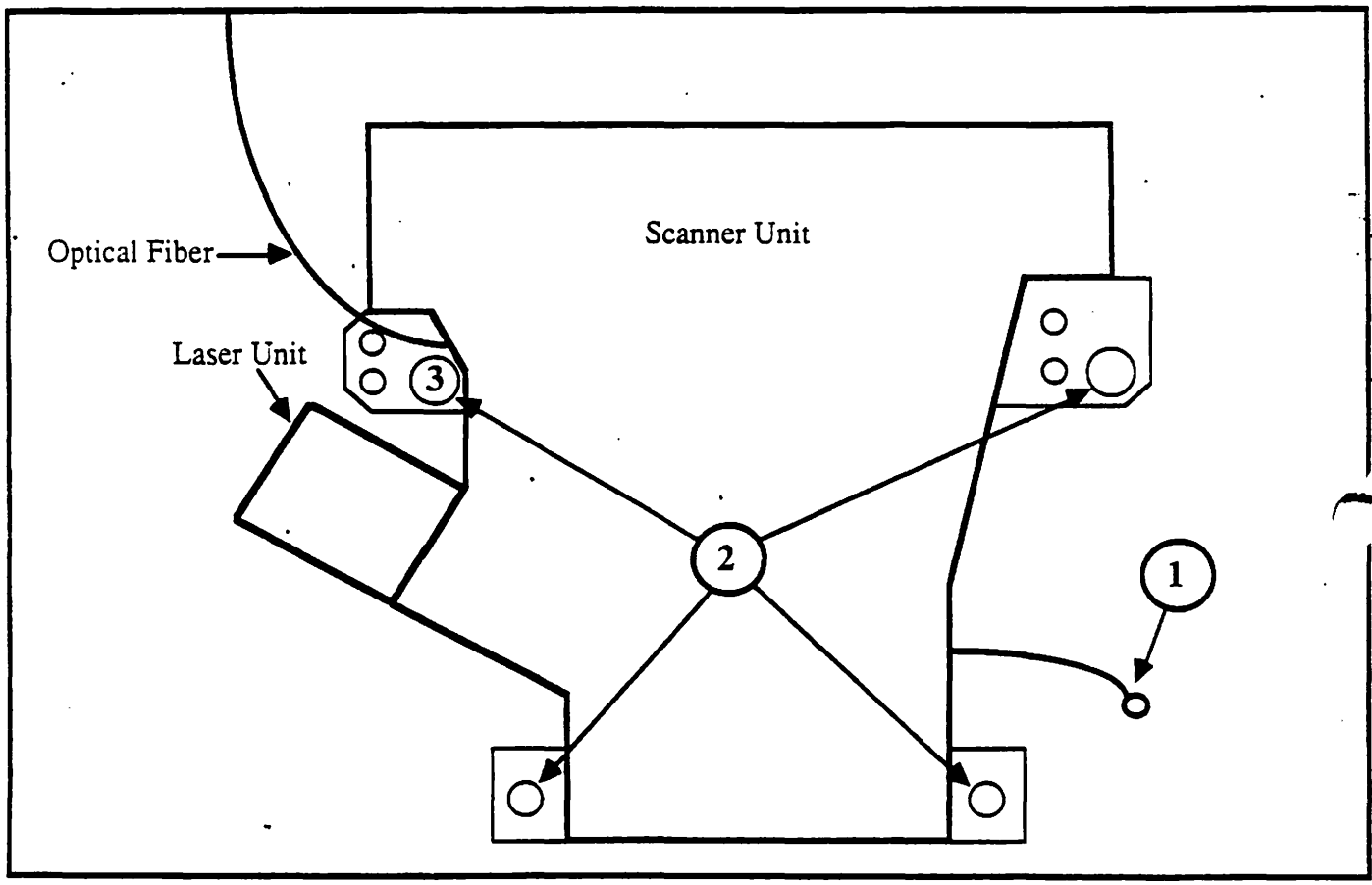


Figure 2-9

2.B.5 - LASER/SCANNER ASSEMBLY

Remove

1. Remove the top cover and the LaserWriter I/O Board.

2. Unplug connectors J203 (the optical fiber), J204, and J206 from the DC Controller board.

3. Disconnect the ground cable (Figure 2-9, #1). Make sure to capture the star washer under the lug.

4. Remove the four large mounting screws (Figure 2-9, #2). Make sure to remove the spacer and washers with the long screw nearest the laser (Figure 2-9, #3).

5. VERY CAREFULLY lift the laser and scanner unit straight up and out of the printer. Rest it upside down on a stable, static-free surface.

IMPORTANT: When you receive a new laser/scanner unit from Apple, it will be shipped with a laser shorting connector on the end of the laser cable. Install this connector on the old laser unit before shipping it back to Apple for repair. It prevents static electricity from damaging the laser unit.

Remove Laser Unit from Scanner Unit

To remove the laser unit, pull back the rubber cap and remove the two Allen screws. Then pull the laser unit free.

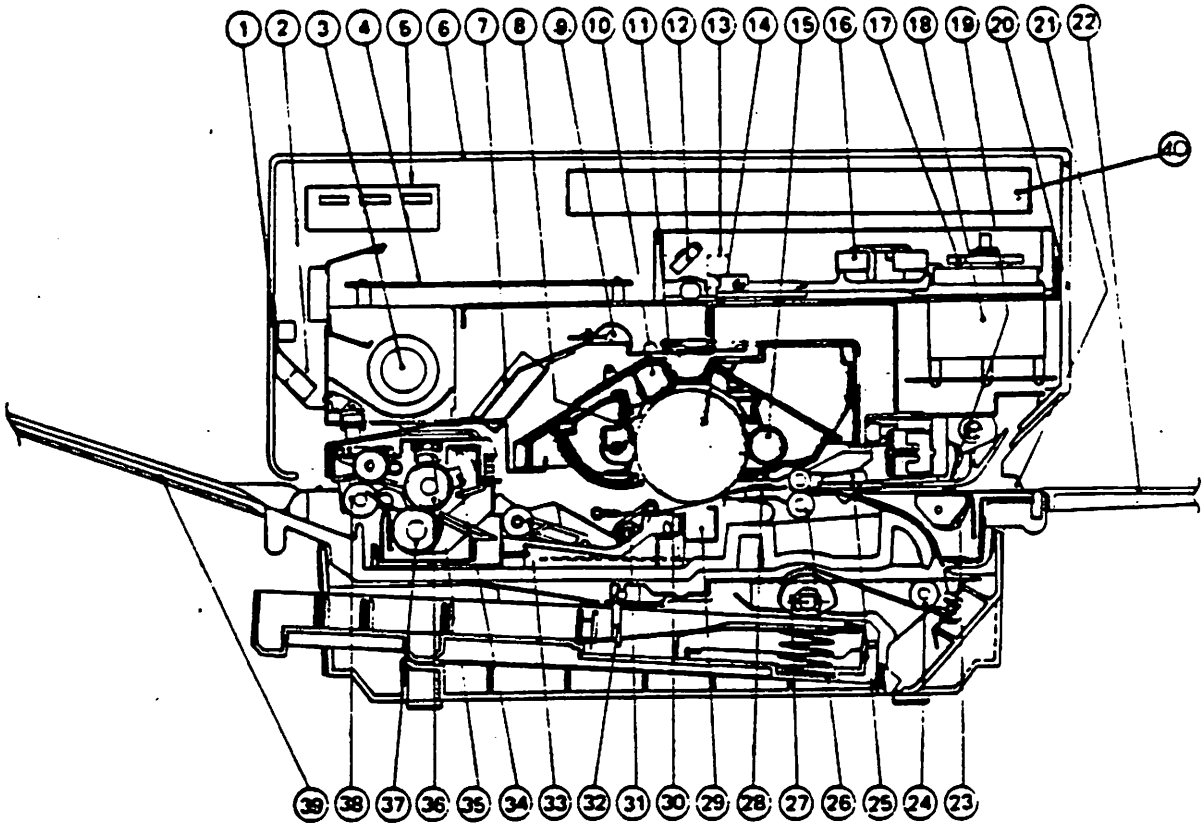
Replace Laser Unit

1. Put the laser unit into position on the scanner unit; make sure the cable marked **TB3** comes out on the same side as the optical fiber.

2. Put the two Allen screws in loosely, and then tighten them alternately so that the unit fits firmly into place.

Replace Laser/Scanner Unit

1. Put the laser/scanner unit back into place. Make sure no cables are trapped beneath the unit.



1. Left panel
2. Duct
3. Fan
4. DC controller PCB
5. Display panel
6. Top cover
7. Ozone filter
8. Cleaning blade
9. Preconditioning exposure lamps
10. Primary corona assembly
11. Laser beam-blocking shutter
12. Beam-to-drum mirror
13. Stationary mirror
14. Photosensitive drum
15. Developing cylinder
16. Focusing lenses
17. Scanning mirror
18. Scanner motor
19. Upper manual pickup roller
20. Right panel
21. Manual paper feed guide
22. Manual feed tray
23. Lower manual pickup roller
24. Cassette feed roller
25. Registration shutter
26. Feeder roller
27. Cassette pickup roller
28. Transfer guide assembly
29. Transfer corona assembly
30. Separation belt
31. Separation feeder unit
32. Paper detection arm
33. Feeder (pinch) roller
34. Thermistor
35. Fuser roller cleaner felt
36. Upper fuser roller
37. Lower fuser roller
38. Delivery roller
39. Print tray
40. LaserWriter I/O board

Figure 2-10 : Cross Section of the Printer (Front View)

2. Connect the ground cable to the hole nearest the right panel, making sure the star washer is under the lug.

3. Replace the four large mounting screws. **NOTE:** The long screw goes through the spacer and washers in the hole nearest the laser unit (Figure 2-9, #3).

4. Reconnect the cables to DC Controller Board jacks J203, J204, and J206.

5. If this is a replacement unit, perform the Laser Power Adjustment (see Section 3, **Adjustments**).

2.B.6 - LASER BEAM BLOCKING SHUTTER

This shutter (Figure 2-10, #11) is located beneath the laser and scanner units. It is opened mechanically when the toner cartridge is inserted into the printer, and should not need repair. To check it for cleaning and/or lubrication, remove the laser/scanner assembly, locate the shutter and make sure that it moves freely.

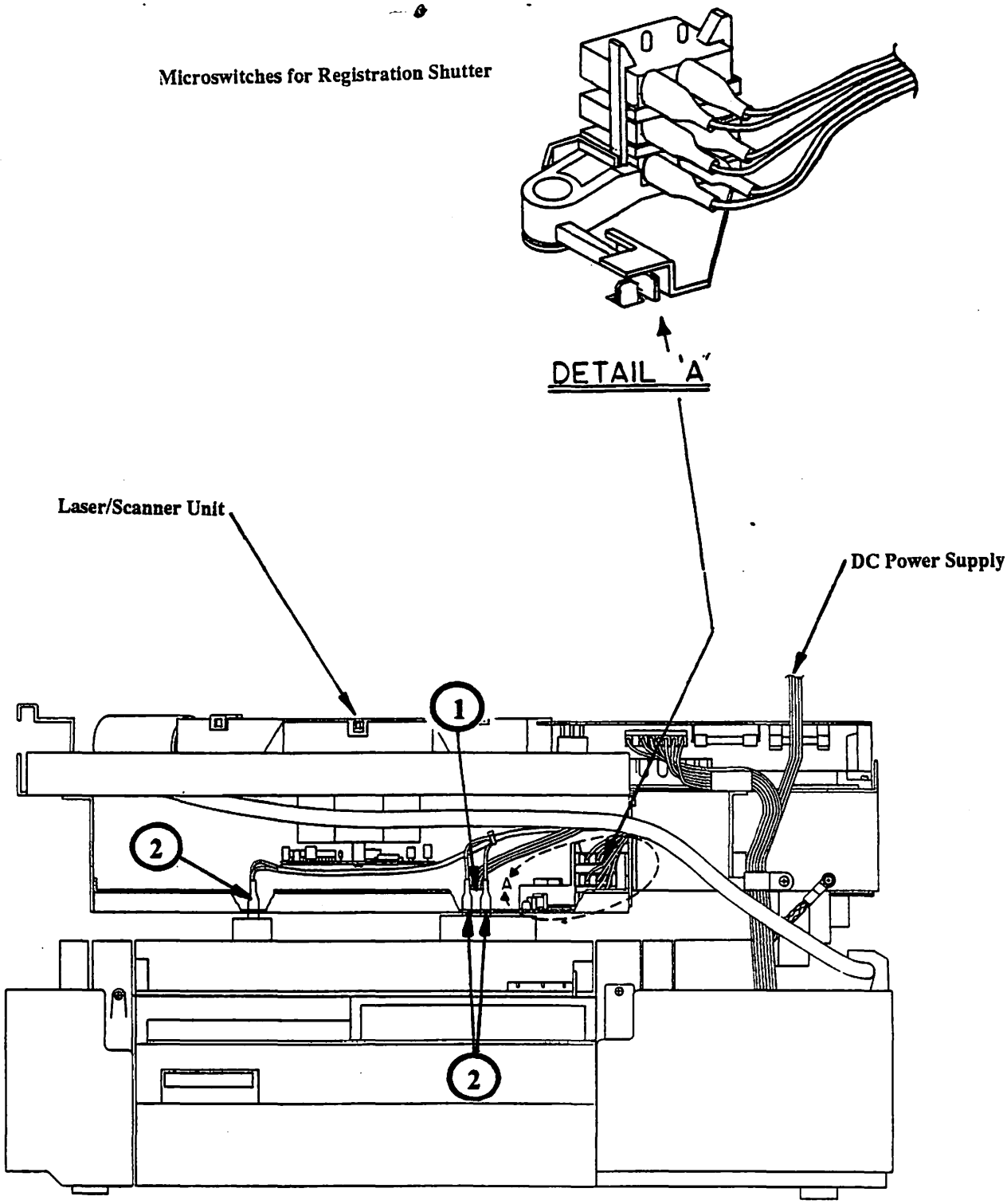


Figure 2-11 : Right Side of Printer With Panel Removed

2.B.7 - REGISTRATION SHUTTER ASSEMBLY

The registration shutter assembly is located in the upper "jaw" of the printer, near the hinges. When paper is fed into the paper path, either from the cassette or from the manual feed tray, the registration shutter stops the paper until all systems are synchronized and the edge of the paper is straight. Then the printer energizes the registration solenoid, which lifts the shutter and allows the paper to pass on to the toner cartridge.

Remove:

IMPORTANT: Before starting, locate the cartridge-detect microswitch assembly and note how the white plastic arm is seated between two metal tabs (see Figure 2-11, Detail A). This is your test for whether the assembly has been replaced correctly. If the white plastic arm is not properly seated, the printer will not function: it will "think" that the toner cartridge is not installed and the green READY light on the front panel will not come on.

1. Remove the Laser/Scanner Unit.

2. Remove the DC Power Supply/Motor Drive PCB Assembly.

3. Using long-nose pliers, remove the three-wire connector (Figure 2-11, #1) and the four fast-on connectors (Figure 2-11, #2).

4. Remove the two silver screws visible from the top through the two access slots (one on either side of the assembly).

5. Open the printer. The registration shutter assembly should be resting on the lower body of the printer.

6. Remove the green ground wire from the front side of the registration shutter, and lift the assembly out of the printer.

Replace

1. Put the shutter assembly in place on the lower body of the printer, and reconnect the ground wire.

2. Lift the shutter assembly into its place in the top of the printer. Check the white plastic arm of the microswitch unit to make sure it is correctly seated. (See Figure 2-11, detail A.)

3. Holding the assembly in place with one hand, replace the two short flanged silver screws. **CAUTION:** You should not have to force the assembly into position. If the screw holes are not aligned correctly, reposition the whole unit.

4. Test for correct installation by closing and opening the printer. There should be no binding.

5. Replace the cable connector and the fast-on connectors.

6. Replace the DC Power/Motor Drive PCB.

7. Replace the Laser/Scanner Unit and all panels and covers.

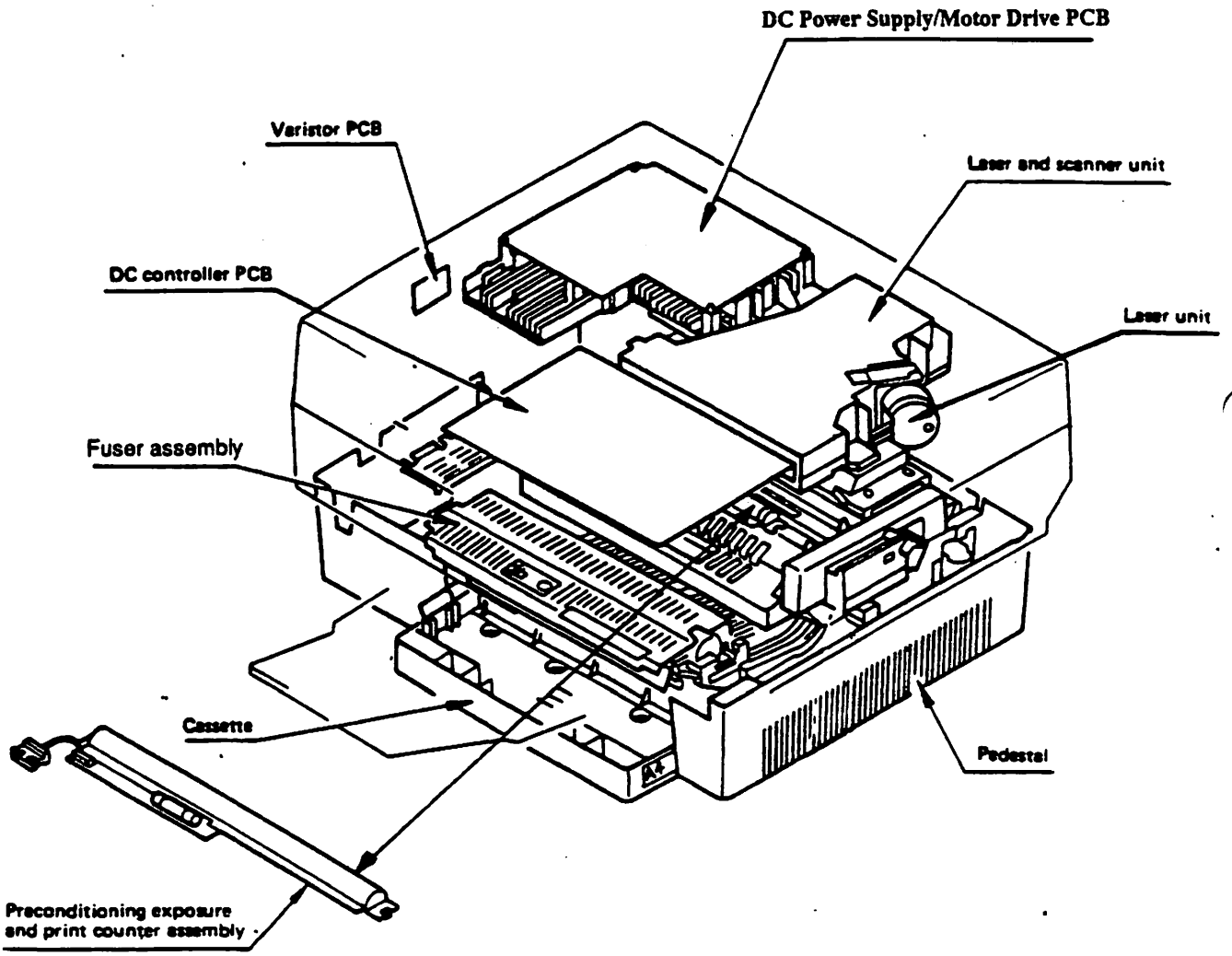


Figure 2-12

2.B.8 - PRECONDITIONING EXPOSURE ASSEMBLY

The preconditioning exposure assembly (Figure 2-12 and 2-13) prepares the print drum in the toner cartridge for a new image. The lamps expose the print drum to a uniform light that neutralizes any leftover charges from the last print cycle, thus "erasing" the previous image from the drum.

The print counter (a fuse-like component that is part of the assembly) shows how many prints have been made on the printer since the counter was installed. Each numbered mark on the counter represents approximately 10,000 pages. When the mercury bubble in the counter reaches "10," the counter should be replaced.

It is not necessary to remove the assembly to view the counter; you can see it if you remove the ozone filter (see instructions for removing the ozone filter).

In these instructions, right and left are used with reference to Figure 2-13.

Remove

1. Remove the DC Controller PCB.
2. Remove the single mounting screw (Figure 2-13, #1).
3. To remove the assembly, put one finger on the right side of the assembly and push to the left until the tab at the right comes free.
4. Lift the assembly out of the printer.

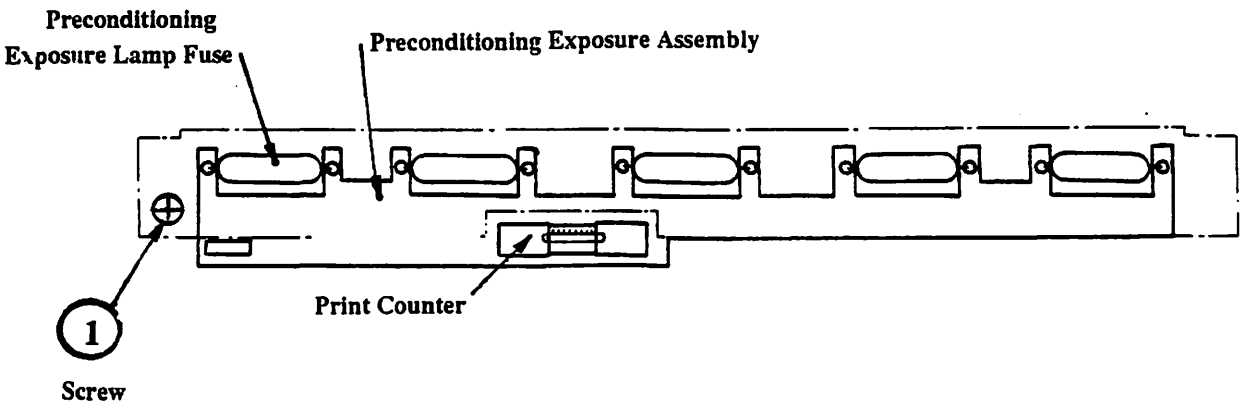


Figure 2-13

Replace

When replacing this assembly, transfer the old print counter (which looks like a fuse) from the old assembly to the new, unless the old print counter reads "10." If the print counter reads "10," replace it.

1. Put the assembly in place. To seat it, gently push down on the tab at the right (using a pencil or similar pointed tool) while pushing the assembly to the right.

2. When the assembly is properly seated, replace the mounting screw.

3. Replace the DC Controller PCB.

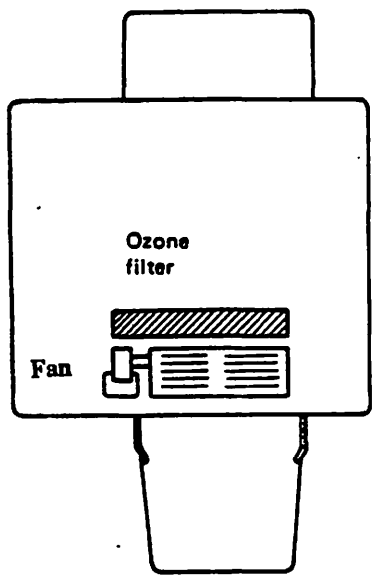


Figure 2-14

2.B.9 - FAN

The fan is located along the left side of the upper main body (see Figure 2-14).

Remove Fan

1. Remove the top cover, front panel, right panel, rear panel, and left panel.

2. Remove the LaserWriter I/O board and the DC Controller PCB.

3. Remove the left side-frame by removing its six silver screws.

4. To remove the fan cover (the metal plate above the fan), remove the three screws and lift the fan cover out of the chassis.

5. Unplug the white fan cable at the rear of the fan and free it from its clamp. (**Don't** free the grey-and-white cable.)

6. Remove the two fastening screws and take out the fan.

Remove Paper-Detect Optical Sensor

1. Remove the fan.

2. Free the sensor cable from its clamp.

3. Open the printer.

4. The optical sensor assembly is attached to the side frame in the center of the left side of the printer. Remove the single screw and the small metal plate, press the plastic clips together, and lift the assembly out.

Replace Sensor

1. With the printer open, place the sensor assembly in its slot so that the plastic clips snap into place.

2. Put the small metal plate in place (the tab points toward the rear of the printer), and install the screw.

3. Replace the fan.

Replace Fan

1. Put the fan into place.

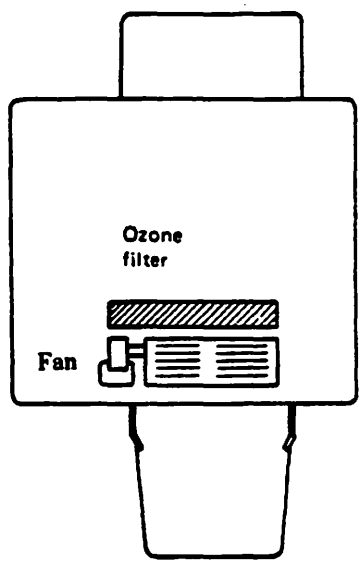


Figure 2-15

2. Put the fan cable into its clamp and reconnect it to its mate.

3. Install and tighten the two fastening screws.

4. Put the fan cover into place (try different positions until you are sure it fits correctly: the tab for the side screw fits outside the chassis frame) and install the three screws.

   NOTE: The screw on the side is easy to drop into the mechanism. To avoid that, start the screw by hand.

5. Replace the side frame and its six short silver screws.

6. Replace the DC Controller board, the LaserWriter I/O board, and all panels and covers.

2.B.10 - OZONE FILTER

Remove

1. Open the printer and remove the toner cartridge.

2. Locate the ozone filter: it is a grey plastic piece located just above the toner cartridge, between the fan and the red plastic preconditioning exposure window (see Figure 2-15).

3. Remove the fastening screw, move the ozone filter slightly up, and pull it out.

Replace

Put the ozone filter in place and install the single screw.

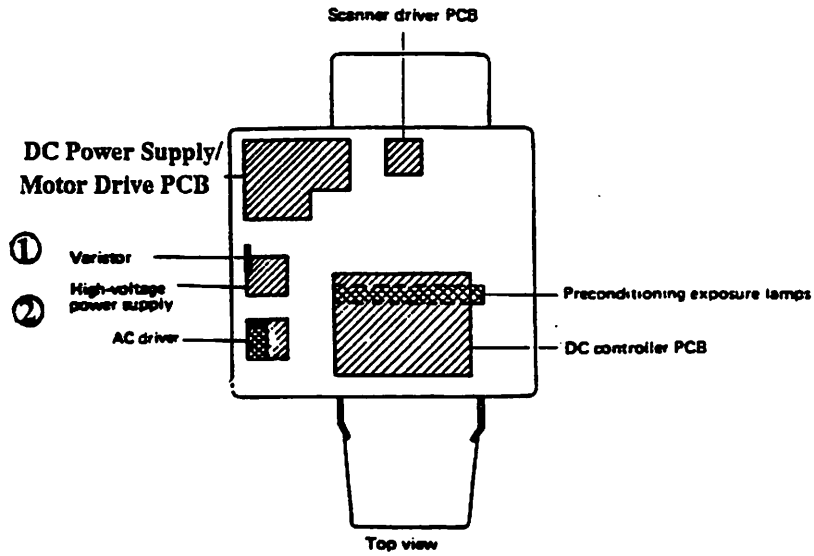

Scanner driver PCB
DC Power Supply/
Motor Drive PCB
①
Varistor
②
High-voltage
power supply
AC driver
Preconditioning exposure lamps
DC controller PCB
Top view

Figure 2-16

2.B.11 - HIGH VOLTAGE POWER SUPPLY

Remove

1. Remove the top cover, front panel, right panel, and rear panel.

2. Remove the rear chassis frame as follows:

   a) Remove the three connectors from the Varistor PCB (see Figure 2-16, #1).

   b) Mark the type of screw at each location on the frame with a pencil (e.g. "short silver," "long black"). Then remove screws and lift off the frame-piece.

3. Open the printer.

4. Remove the black flanged fastening screw from the High Voltage Power Supply cover and remove the cover -- wiggle it off: it's held on by friction from the wires trapped beneath it.

5. Disconnect the two connectors with thick red wires from the High Voltage Power Supply (use a screwdriver to help pry them off), and disconnect J211 from the DC Controller board.

6. With the printer open, remove the single mounting screw and remove the power supply.

(IF PRACTICING THESE PROCEDURES, GO TO MAIN MOTOR REMOVAL BEFORE REPLACING THE HIGH VOLTAGE POWER SUPPLY.)

Replace

1. Attach the power supply to the chassis using a short black screw.

2. Attach the two large connectors to the power supply, and attach the eight-pin connector to J211 on the DC Controller board.

3. Put the power supply's cover into place. The edge of the cover fits into the white plastic guides on the chassis, and the two-wire Varistor cable fits beneath the cover. (The single green wire should <u>not</u> be beneath it.)

4. Replace the cover screw (short, black, with flange).

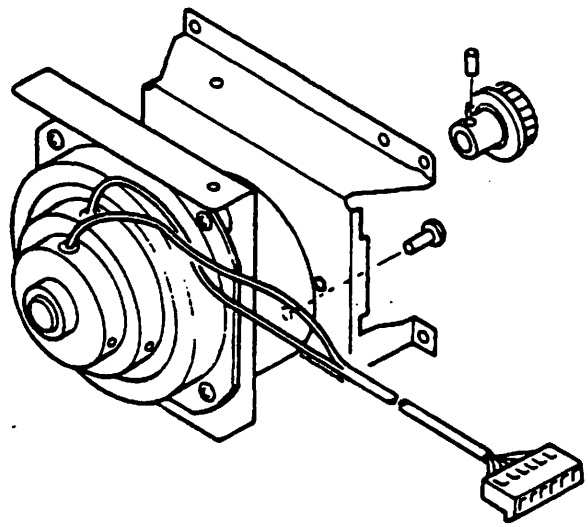


Figure 2-17 : Main Motor

5. Replace the rear chassis frame, using the correct screws as you noted them on the frame. **NOTE:** The white plastic stud on the High Voltage Power Supply fits through a hole on the frame. This helps to position the frame.

6. Reconnect the three connectors to the Varistor PCB.

7. Replace the panels and covers.

2.B.12 - MAIN MOTOR

The main motor (Figure 2-17) turns the gears that run the paper feed mechanism, as well as the gear for the toner cartridge drum.

Remove

1. Remove the High Voltage Power Supply.

2. Unplug the motor connector from the DC Power Supply/Motor Drive PCB.

3. Remove the four large screws from the chassis.

4. Hold the motor as you remove the one small screw from the metal plate above the motor. Then free the cables by using long-nose pliers to release the cable clamp from the motor, and lift the motor out of the printer.

Replace

1. Attach the cable clamp to the motor, put the motor in place (be careful not to catch any wires beneath the motor), and install the small screw (long black type).

2. Install the four large screws.

3. Replace the High Voltage Power Supply.

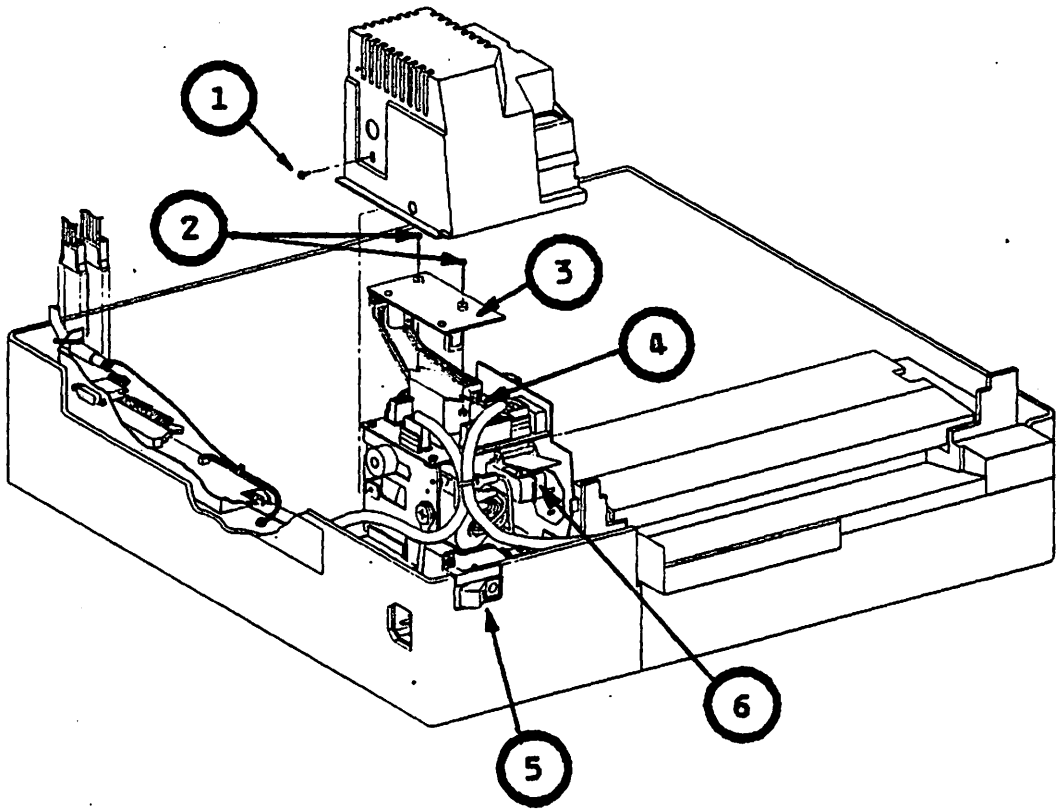


Figure 2-18 : Power Interlock Assembly (Exploded)

2.C - LOWER MAIN BODY OF PRINTER

2.C.1 - POWER INTERLOCK ASSEMBLY

The power interlock assembly consists of the AC Driver PCB, which is a two-board assembly (Figure 2-18, #3 and 4); the main power switch (Figure 2-18, #5); and the two microswitches (Figure 2-18, #6), which cut off power to the printer when the printer is opened (upper main body raised).

AC DRIVER PCB

Remove

1. Remove the black flanged screw near the circuit breaker (Figure 2-18, #1) and lift off the plastic assembly cover. The cover swings up and to the rear in an awkward manner, but don't worry -- just keep gently working at it and it will come off.

2. Unplug connectors J104 and J106.

3. Remove the two fastening screws (Figure 2-18, #2).

4. Lift off the upper PCB. Clip the cable tie that holds the cable from the upper PCB and take the upper PCB out of the printer.

5. Unplug the four connectors to the lower PCB.

6. Remove the two screws from the lower board and slide the lower board out of its slot.

Replace

1. Put the assembly in place, inserting the appropriate side of the lower board into the slot in the chassis.

2. Install the two lower-board screws (black).

3. Plug in the four connectors to the lower PCB and the one connector to the upper PCB.

4. With a cable tie, tie together the cables to J106, J102, and the connector that goes to the upper board.

5. Slide the plastic assembly cover over the assembly, making sure that all cables are beneath the cover. Make sure that the cover fits under the four metal tabs on the chassis and under the harness cover tab, and is properly seated. (See Figure 2-43, page 2.58.)

6. Install the short black flanged screw in the cover.

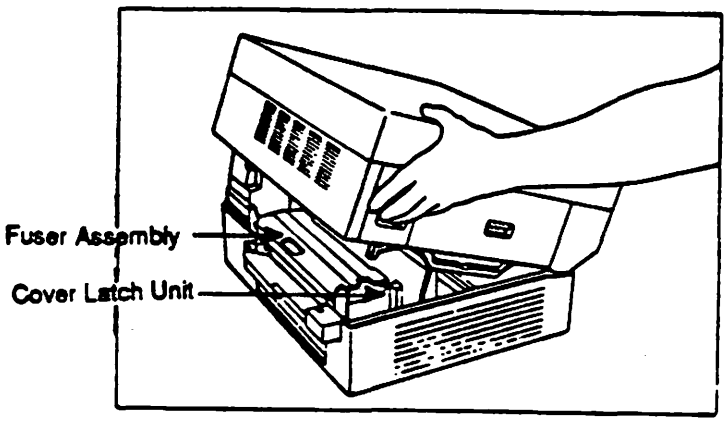


Figure 2-19

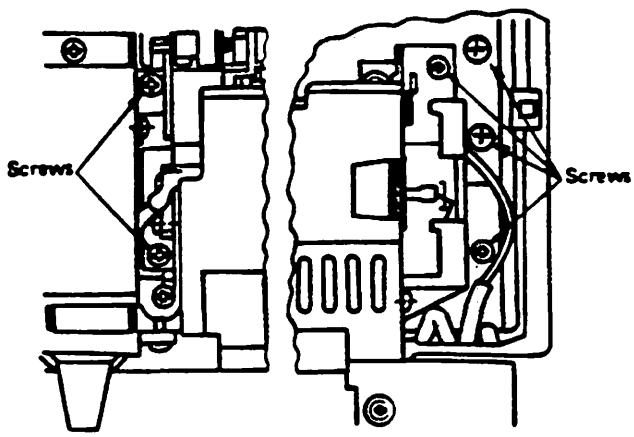


Figure 2-20

2.C.2 - FUSER ASSEMBLY (699-0306)

The Fuser Assembly (see Figure 19) consists mainly of two rollers and a heater bulb. The combination of heat and pressure provided by this assembly fuses the toner onto the paper. The assembly also contains two sensors (the thermistor and the thermoprotector) which allow the printer to regulate the temperature of the rollers.

Remove Fuser Assembly

WARNING: If the printer has been in use, the fuser assembly will be very hot. Wait until it cools down before working with it.

1. Open the printer. Open the green cover of the fuser assembly and remove the cleaning felt by sliding it out to the right (see Figure 2-19).

2. Locate the cover latch unit (a grey plastic piece at the front end of the assembly -- see Figure 2-19). Remove the two black screws at the base of the cover latch unit and lift the unit out of the printer.

3. Remove the two black screws at the front end of the fuser assembly (next to the cover latch unit).

4. Remove the harness cover (a flat grey plastic piece: see Figure 2-42, #3, p.2.58) by removing the single screw and prying back on the plastic tab next to the Power Interlock Assembly (see Figure 2-42, #4).

5. Pull out and disconnect the fuser assembly connector from beneath the Power Interlock Assembly.

6. Remove the two screws from the brass-colored tabs at the rear end of the fuser assembly (Figure 2-20).

7. Lift up the assembly enough to remove the spade connector on the rear end.

8. Disconnect the spade connector at the front that comes from the white plastic-sheathed wire. (It is connected to a double lug that holds a spade connector from another wire. If the lug itself comes off, work the connector from the white plastic-sheathed wire free of the lug and replace the lug on its brass lug.)

9. Lift the assembly out of the printer.

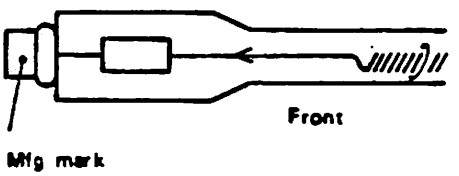


Figure 2-21

Replace Heater Bulb (Fuser Roller Heater)

CAUTION: When replacing the heater bulb, be careful. If the bulb has broken, there will be sharp glass shards in the upper roller.

To remove the bulb:

1. Remove the black plastic end-piece from the front end of the fuser assembly by removing its two screws.

2. Carefully remove the bulb. (IF REMOVING A GOOD BULB, HANDLE IT BY THE ENDS ONLY. **NEVER** TOUCH THE BODY OF THE BULB.)

To install the bulb:

CAUTION: Be careful of the following things:

   a) Do not touch the body of the bulb with your hands: oil from your hands can cause hot spots and weaken the bulb.

   b) The glass nipple on the bulb should face downward, away from the cover of the assembly.

1. Holding the bulb by the end with the manufacturer's name (see Figure 2-21), insert it into the roller tube. Make sure that the leading end is seated on the small copper electrode at the far end of the assembly.

2. Replace the black plastic end-piece, seating its copper electrode in the end of the heater bulb. Replace the two short black screws in the end-piece.

IMPORTANT: The bulb must be securely seated on the copper electrodes at both ends. Otherwise, the AC Driver PCB may be damaged when you turn on the printer.

Replace Fuser Assembly

1. Put the assembly into place.

2. Attach the spade connectors (one at either end). Make sure to tuck the wires at the front end under the lip of the assembly, so that they do not interfere with installation of the cover latch unit in step 6.

3. Reconnect the cable and tuck it beneath the Power Interlock Assembly.

4. Reinstall the harness cover and its short black screw.

5. Reinstall the two long black screws at the rear of the assembly.

6. Put the cover latch unit back into place and reinstall the four long black screws at the front of the assembly.

7. Install the cleaning felt.

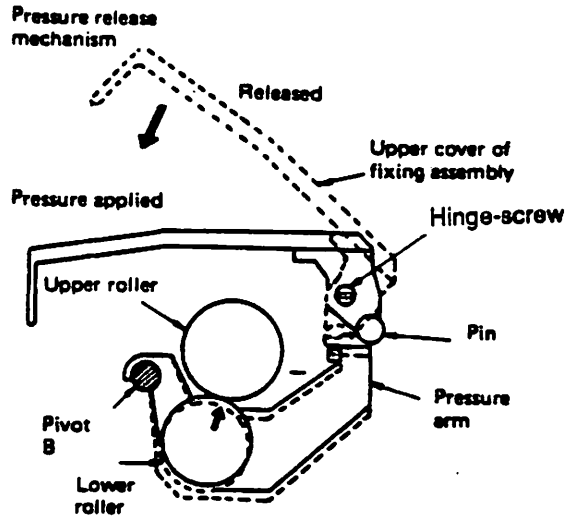


Figure 2-22: Cross-section of Fuser Assembly, Simplified

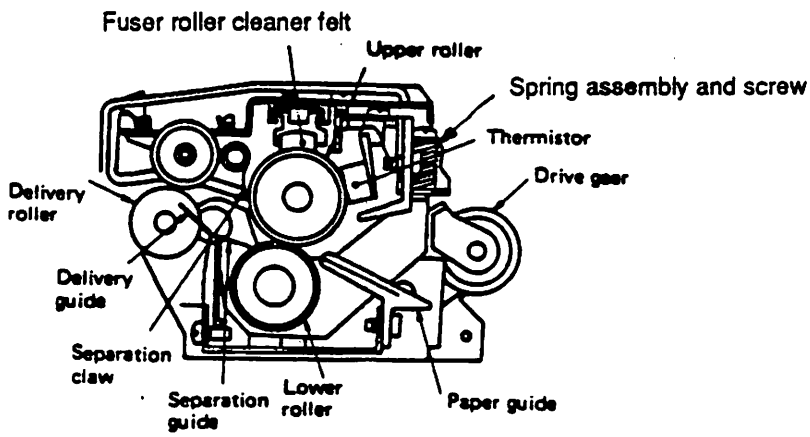


Figure 2-23: Cross-section of Fuser Assembly, detailed

THERMISTOR

The thermistor (Figure 2-30, #1) senses the upper fuser roller's surface temperature. This allows the DC Controller board to regulate the heater bulb.

Remove

1. Remove the upper roller (see instructions above).

2. Remove the upper crossmember assembly (containing the thermistor and thermoprotector, Figure 2-30, #1 and 2) as follows:

   a) Remove the two screws (one at each end) (Figure 2-30, #3).

   b) Disengage the white cable from the fuser assembly and lift out the crossmember assembly.

3. Remove the black cover of the crossmember assembly by removing its two screws.

4. Remove the thermistor by disengaging one of its two tabs from its hole, using needlenose pliers.

Replace

1. Install the new thermistor gently, using needlenose pliers to help seat its tabs in their holes.

2. Replace the black cover on the crossmember assembly and install its two screws (black screws with unthreaded top).

3. Reinstall the crossmember assembly as follows:

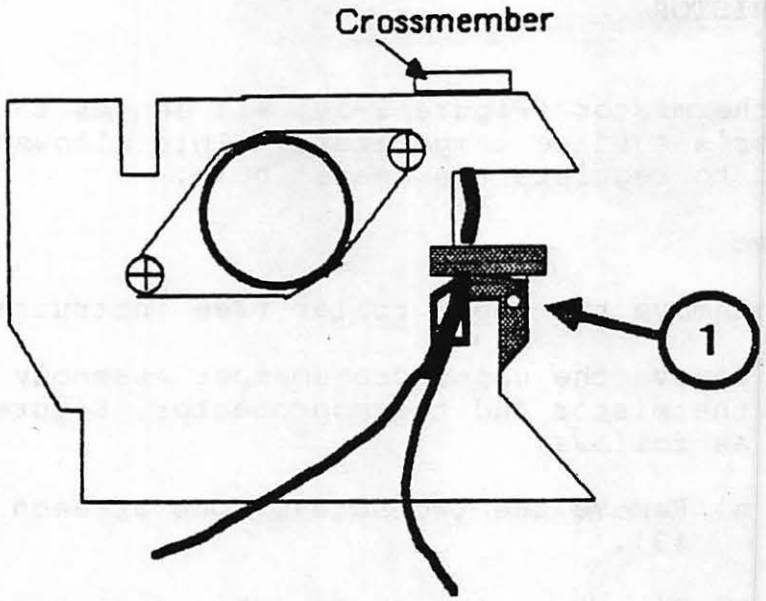
   a) Seat the assembly on the fuser assembly.

   b) Route the small cable under the small half-clamp at the gear-end of the crossmember assembly.

   c) Route the large cable attached to the black plastic end-piece as shown in Figure 2-31, #1.

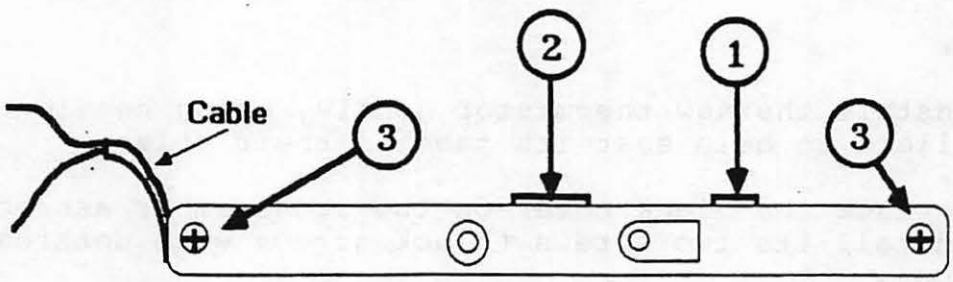
   d) Install the two small black screws, one at either end of the crossmember.

4. Reinstall the upper roller (see instructions above).

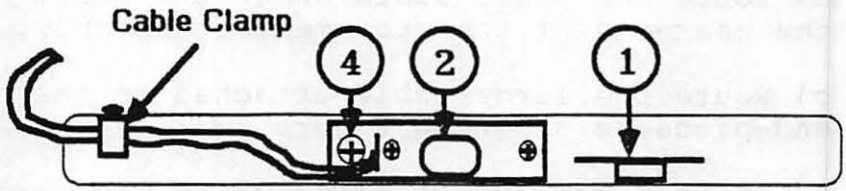


Fuser Assembly: Front view

Figure 2-32



Crossmember Assembly — Top View



Crossmember AssemblyBottom View

Figure 2-33

THERMOPROTECTOR

The thermoprotector (Figure 2-33, #2) protects the fuser assembly from excessive temperatures (over 245° C) by acting as a thermostat for the unit, shutting off the current to the heater bulb when the assembly gets too hot.

Remove

1. Remove the upper roller (see instructions above).

2. Remove the upper crossmember assembly (Figure 2-32) as follows:

   a) Remove the two screws (one at each end) (Figure 2-33, #3).

   b) Disengage the white cable from the fuser assembly and lift out the crossmember assembly.

3. Remove the black cover of the crossmember assembly by removing its two screws.

4. Remove the cable clamp by removing its one screw.

5. Remove the thermoprotector by removing the screw farthest from the thermistor (Figure 2-33, #4) and lifting the thermoprotector assembly out of the crossmember assembly.

Replace

1. Seat the new thermoprotector assembly in the crossmember, and install the single short black screw.

2. Attach the cable connector to the last screw hole in the crossmember, so that it holds the cable in place.

3. Replace the black cover on the crossmember assembly and install its two screws.

4. Reinstall the crossmember assembly as follows:

   a) Seat the assembly on the fuser assembly.

   b) Route the small cable under the small half-clamp at the gear-end of the crossmember assembly.

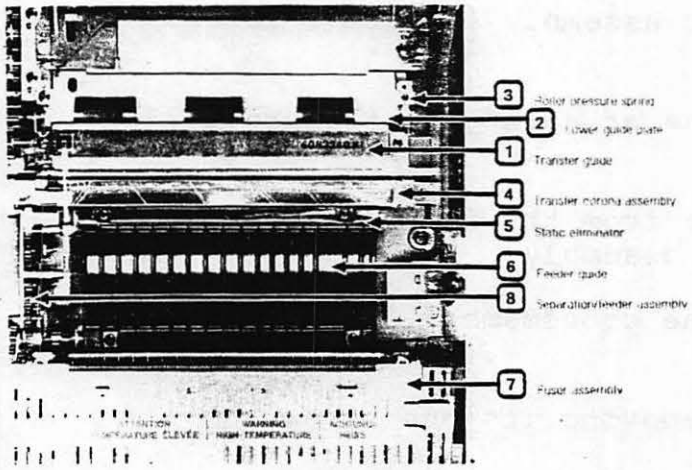
   c) Route the large cable attached to the black plastic end-piece as shown in Figure 2-32, #1.

d) Install the two small black screws, one at either end of the crossmember.

5. Reinstall the upper roller (see instructions above).

CLEANING AND LUBRICATION

The tnermistor and thermoprotector can be cleaned with alcohol.



LOWER MAIN BODY
OF PRINTER

Figure 2-34

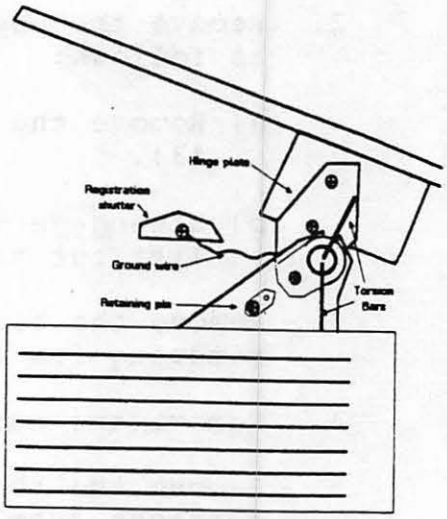
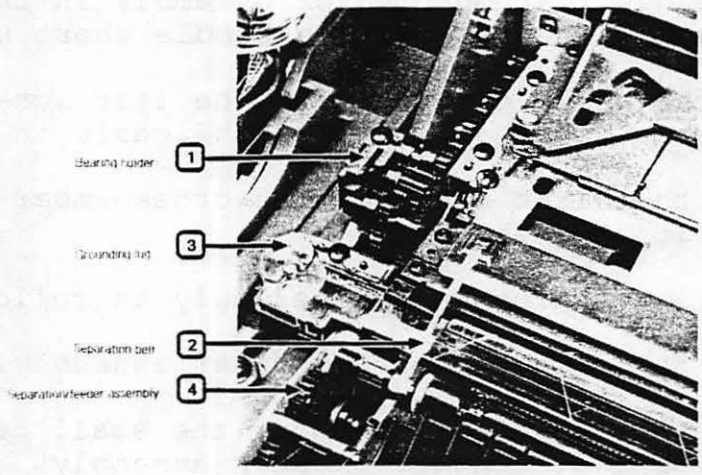


Figure 2-35 : Side View of Printer With Top Open



LOWER MAIN BODY
NEAR SEPARATION BELT

Figure 2-36

2.C.3 - TRANSFER GUIDES

The transfer guides (Figure 2-34, #1) consist of plates and rollers that guide the paper toward (and between) the toner cartridge drum and transfer corona assembly.

NOTE: If you do not have a stubby screwdriver, you will have to remove all panels, the rear frame, and the high voltage power supply and main motor before performing this removal and replacement.

1. Open the printer and remove the toner cartridge.

2. Remove the separation belt.

3. To allow the printer to open wider, remove the two retaining pins (one at each side) (see Figure 2-35). **HINT:** Push down on the upper main body while removing the pins, to relieve pressure on them.

4. Remove the two screws and lift out the lower guide plate (Figure 2-34, #2). (The roller pressure spring, Figure 2-34, #3, comes off when you do this.)

5. Loosen the screw on the bearing holder (Figure 2-36, #1), move the bearing holder to the side, and lift out the transfer guide.

Replace

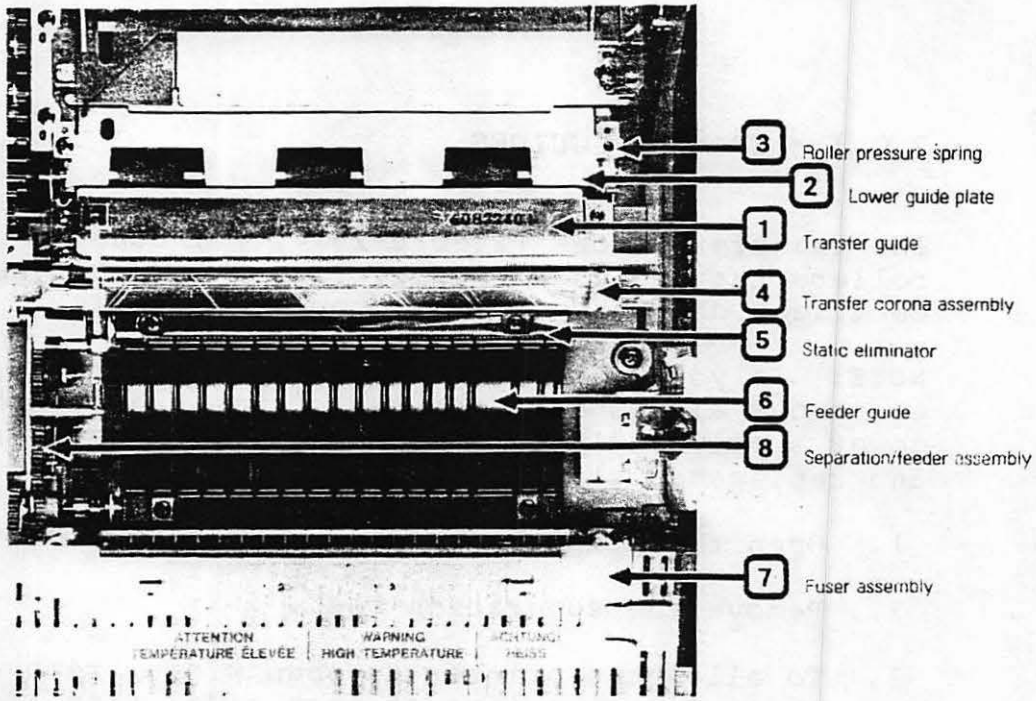
1. Put the transfer guide back into place, reposition the bearing holder, and tighten the screw on the bearing holder.

2. Put the lower guide plate back into place. **Reinstall the roller pressure spring and the ground wire above it, and then the screw.**

   NOTE: There are two important grounding elements for the transfer guides: 1) the roller pressure spring and the ground wire that connects to it (see Figure 2-34), and 2) the ground wire that connects (via a faston connector) to the lug just behind the transfer corona (Figure 2-36, #3).

3. Restore the two retaining pins to their places. **HINT:** Push down on the upper main body while replacing the pins.

4. Install the separation belt.



LOWER MAIN BODY OF PRINTER

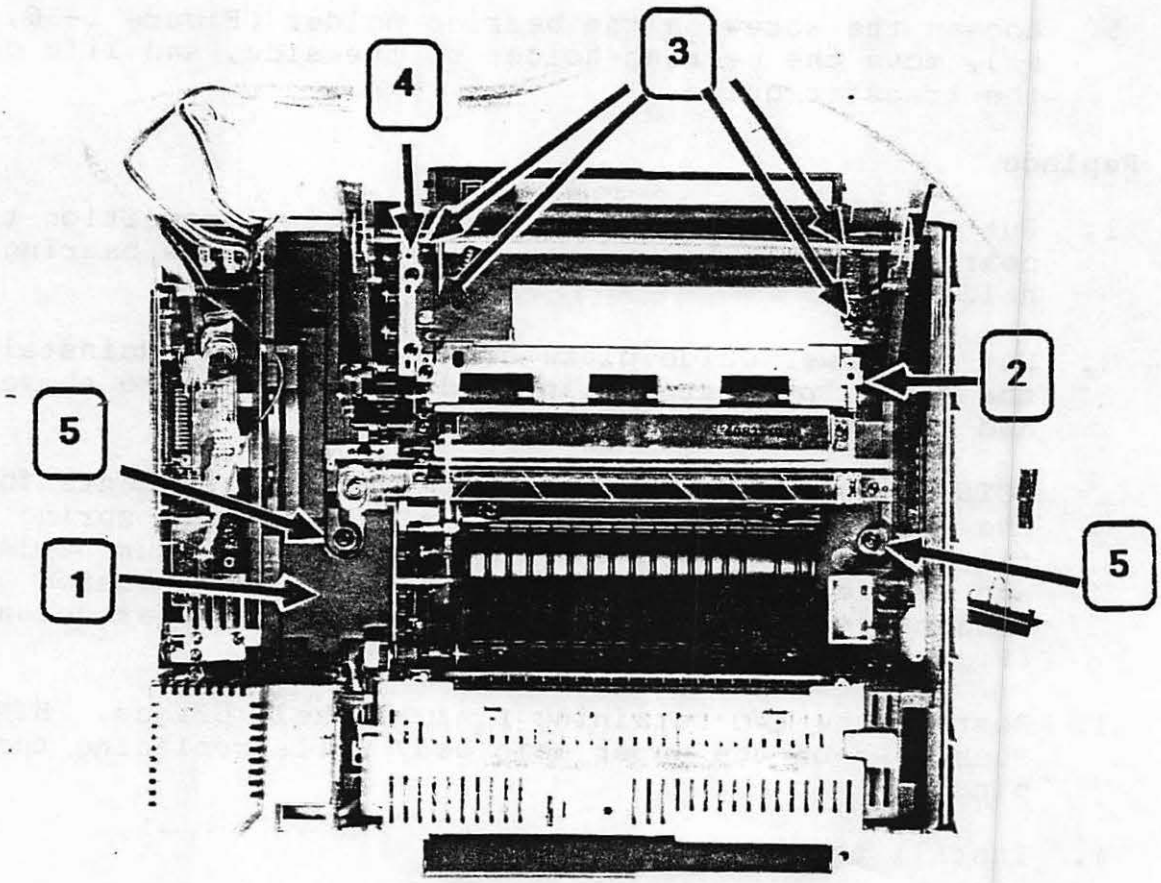


Figure 2-38

2.C.4 - FEEDER GUIDE

At one end of the feeder guide is the static eliminator (Figure 2-37, #5), a row of metal teeth that removes excess static charge from the print material. (Some high-resistant print material, such as mylar [transparencies], develops a high electric charge on its rear surface during transfer. When the print separates from the drum at a high speed, this charge can be rearranged, causing toner particles on the other side to move around, producing what look like "water spots" on the print. The static eliminator prevents this.)

Remove

1. Open the printer and remove the toner cartridge.
2. Remove the four screws and lift out the Feed Guide.

Replacement is the reverse of removal.

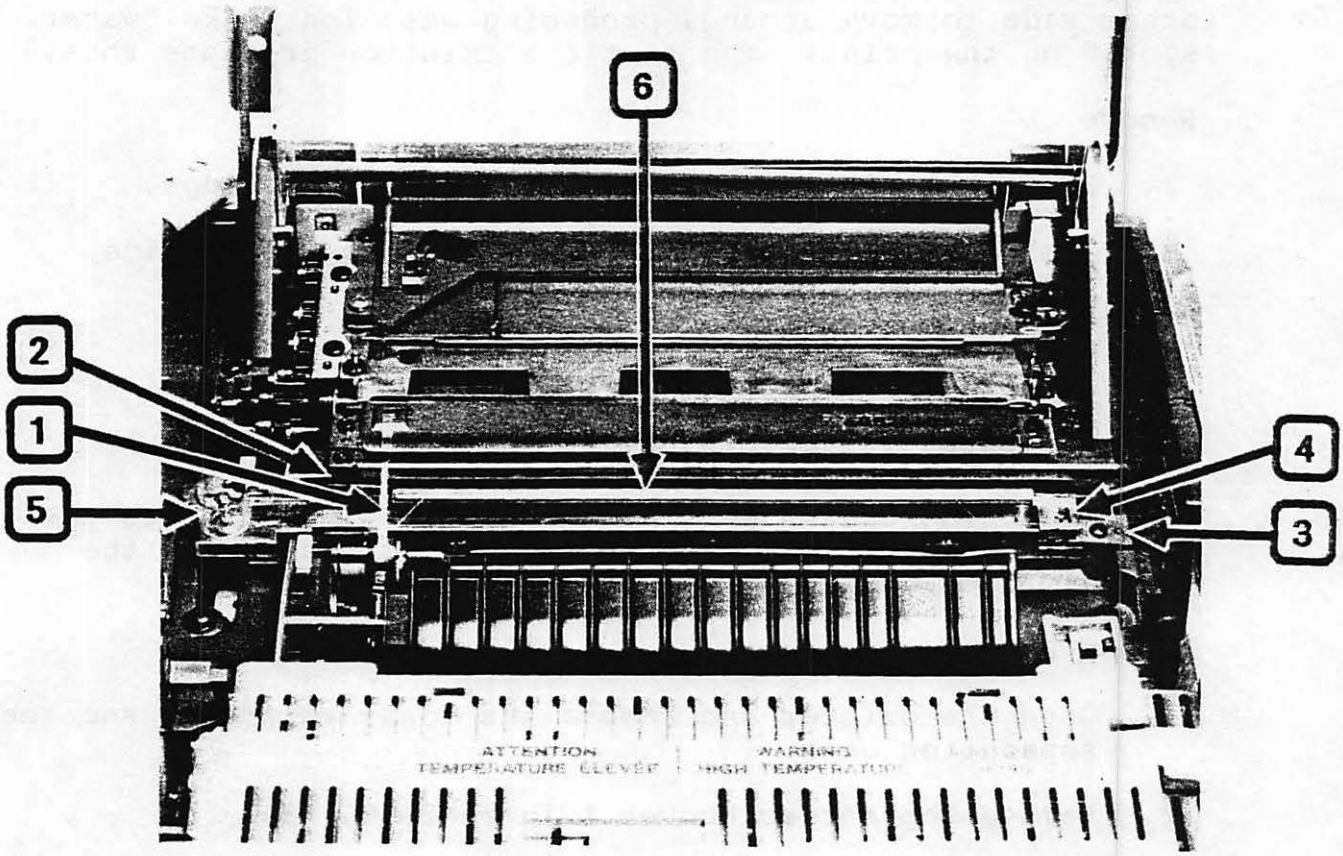
2.C.5 - SEPARATION/FEEDER UNIT

The Separation/Feeder Unit (Figure 2-37, #8) separates the paper from the toner cartridge print drum and guides the paper to the Fuser Assembly.

Remove

1. Open the printer and remove the toner cartridge and the separation belt.
2. Remove the harness cover (Figure 2-38, #1).
3. Remove the fuser assembly (Section 2.C.2.)
4. Remove the feeder guide. (Section 2.C.4.)
5. Remove the ground wire from the separation/feeder unit (short silver flanged screw).
6. Remove the two large black screws; then remove the separation/feeder unit.

Replacement is the reverse of removal. Take care not to damage the separation belt when installing it.



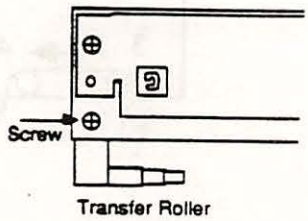
LOWER MAIN BODY

Figure 2-39

2.C.6 - TRANSFER CORONA ASSEMBLY

As the paper passes over the transfer corona (Figure 2-39, #6), the corona wire gives the paper a static charge which attracts the toner from the print drum. If the corona wire breaks, the printing will be too light across the entire page. You can replace the entire assembly, or just the wire.

Remove Assembly



1. Open the printer.
2. Remove the separation belt (Figure 2-39, #1).
3. Remove the transfer roller (Figure 2-39, #2) by removing its one screw and lifting out the transfer roller.
4. Remove the screw at the front end of the assembly (Figure 2-39, #3) and lift the assembly toward the front of the printer and out.

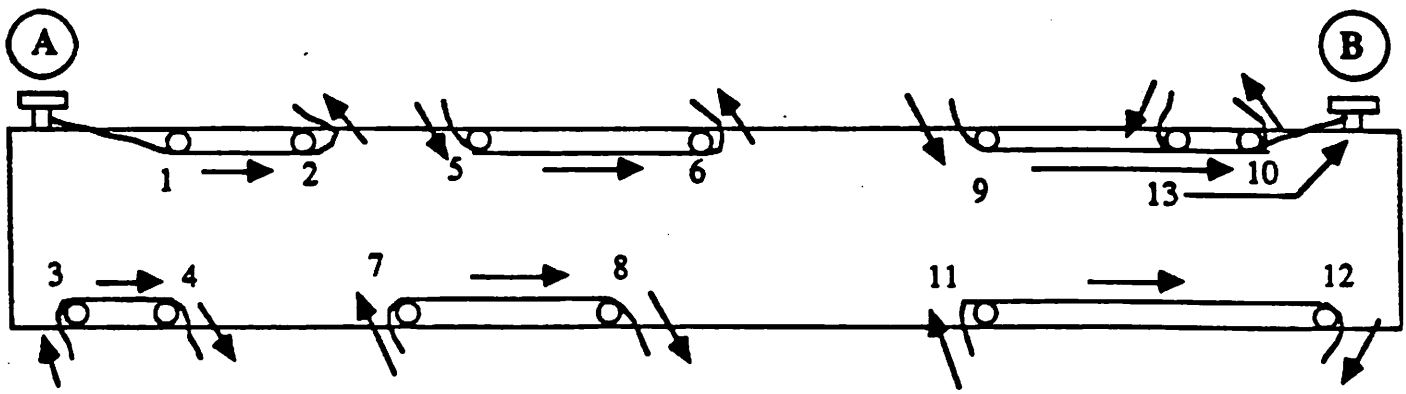
Replace Assembly

1. Put the assembly back into place and install the long black screw. **WARNING:** Be careful not to cut your fingers on the anti-static teeth next to the assembly: they are sharp!
2. Put the transfer roller in position (its two studs fit into holes in the brass-colored plate above it) and install its black self-tapping screw.
3. Reinstall the separation belt.

Restring Corona Wire

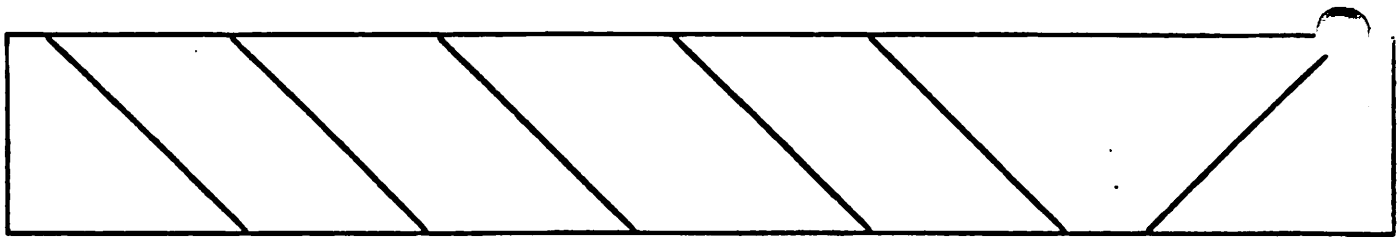
You will need corona wire and, for the guide wire, nylon wire. You will also need a spring hook, needlenose pliers, and diagonal cutters.

1. Remove the corona assembly from the laser printer.
2. Place the unit in front of you so that the corona terminal (Figure 2-39, #5) is on the right hand side.
3. Remove both the corona wire termination covers (Figure 2-39, #4 and 5) by unsnapping them and lifting them clear of the assembly.



CORONA ASSEMBLY -- BOTTOM VIEW

1. Fasten the guide wire with screw A.
2. Pass wire around Pin 1 and Pin 2 to Pin 3.
3. Continue routing the guide wire as shown in the diagram.
4. Pass the wire from pin 13 to screw B, and tighten screw B.



CORONA ASSEMBLY-TOP VIEW AFTER GUIDE WIRE RESTRINGING
(TERMINAL END IS ON RIGHT HAND SIDE)

Figure 2-40

4. Remove the tension spring from the end of the broken corona wire and set it aside.

5. Remove the guide wire (nylon wire) from around the corona assembly.

6. Remove the broken corona wire from the corona assembly.

7. Take the new corona wire, fold back approximately a 1/4" length, and make six to eight half-turns to form a loop at the end of the wire.

8. Hook the loop over the plastic retaining pin at the left end of the assembly. (See figure below.)

9. Stretch the wire along the length of the corona assembly until it just reaches the leftmost brass-colored part of the corona wire terminal, and cut off any excess wire.

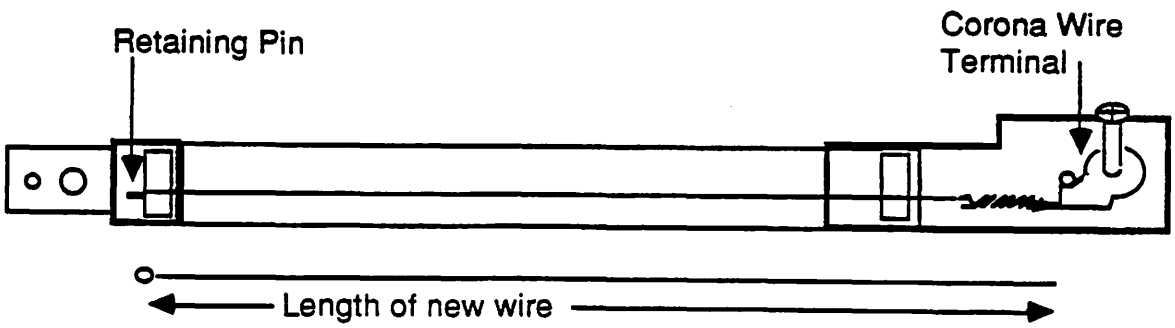
10. Using the same procedure as in step #7 above, form a loop at the end of the corona wire.

11. Hook one end of the spring onto the loop and the other end onto the corona wire terminal (see figure below). **The wire should be taut enough to remain straight, and should have no kinks.**

12. Replace the corona wire termination covers.

13. Restring the guide wire as shown in Figure 2-40.

14. Install the corona assembly in the laser printer.



Restringing the Transfer Corona Wire

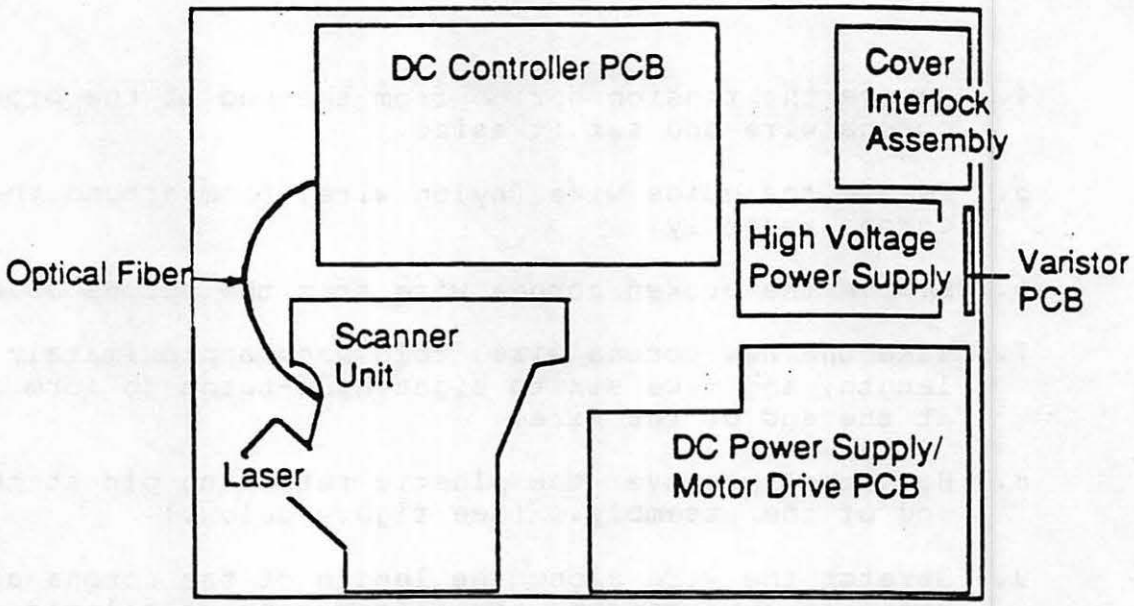
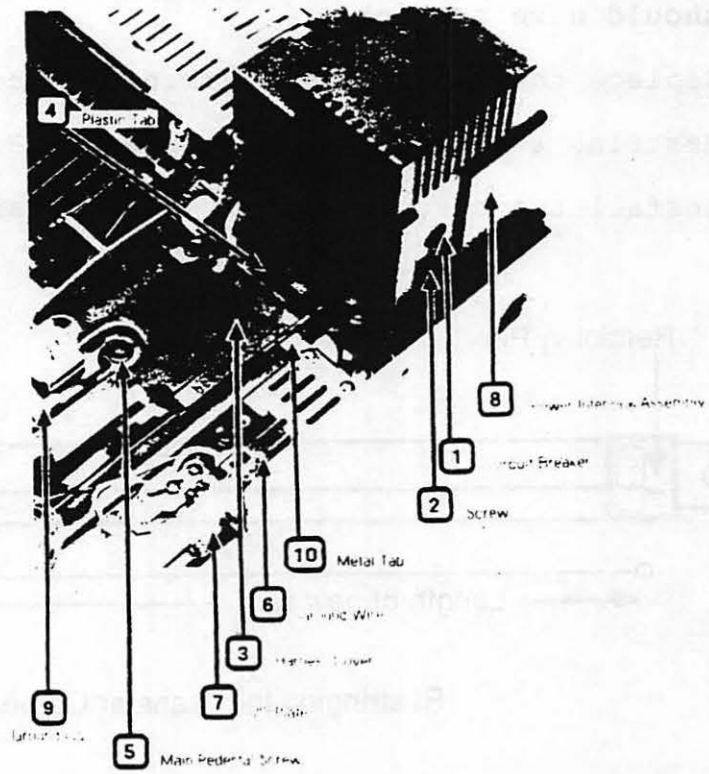


Figure 2-41: Top View with LaserWriter I/O Board Removed



LEFT REAR CORNER OF PRINTER

Figure 2-42

Apple LaserWriter Printer
Technical Procedures

Section 3 - Adjustments

Contents:

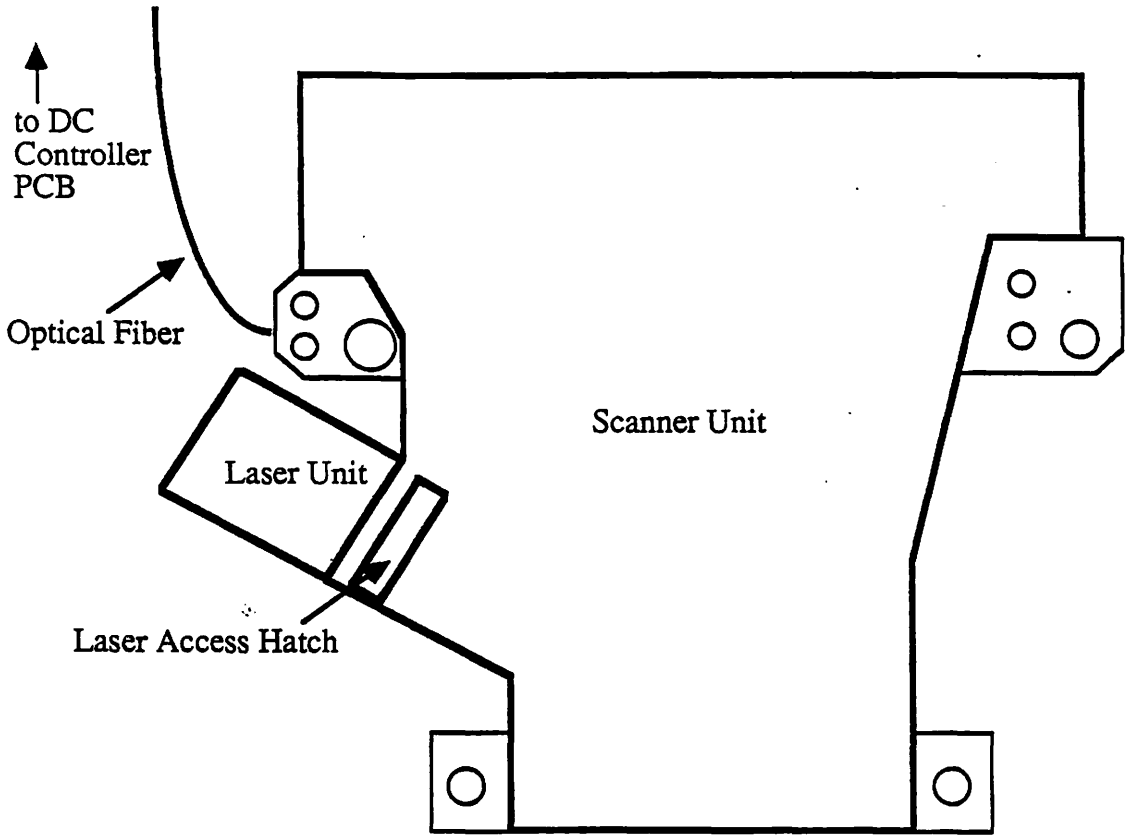


Figure 3-1

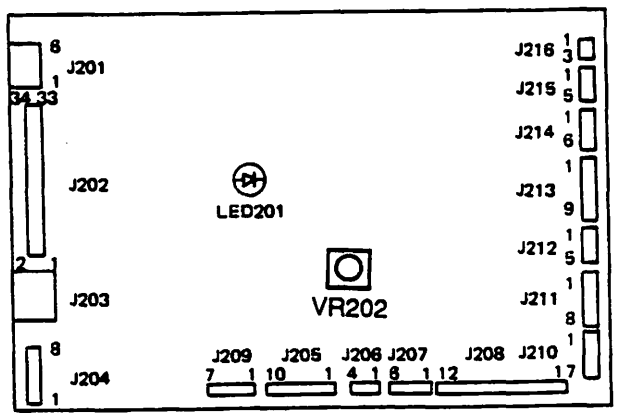


Figure 3-2 : Connector Locations on the DC Controller PCB

3.A LASER POWER ADJUSTMENT (P/N 011-7052)

Laser power should be adjusted after replacing the DC Controller board or the laser unit (see Figure 3-1). It should also be adjusted if the image is consistently too light or too dark and if that problem cannot be fixed by using the print density adjustment dial or changing the toner cartridge. (In general, however, adjust laser power as seldom as possible. Frequent adjustment increases the chances of damaging the laser chip.)

This procedure requires a multimeter and the laser power checker that comes in your LaserWriter Spares Kit.

WARNING: Review the Safety procedures in section 2.A.3 before continuing, and remove all jewelry (including dangling necklaces) before performing this adjustment.

1. **IMPORTANT: Switch the power off.**

2. Remove the top cover and the LaserWriter I/O board and card cage.

3. Open the laser access hatch on the scanner unit.

4. Insert the Laser Power Checker into the access hatch with the detector facing the laser. **WARNING:** Make sure the Laser Power Checker is fully inserted, so that none of the laser light can escape from the access hatch.

5. Connect the Laser Power Checker to a digital multimeter as follows:

   a. Connect the black lead from the Laser Power Checker to the multimeter socket marked "COMMON."

   b. Connect the red lead from the checker to the multimeter socket marked "VOLTS" or "V."

   c. Select the "VOLTS" button on the multimeter, set the multimeter range to 200mv, and turn the multimeter on.

   NOTE: If the multimeter does not make good contact, or if the meter range is wrong, the power of the laser cannot be measured accurately. Be sure the leads are plugged in correctly.

6. Disconnect the cable from J209 on the DC Controller board (see Figure 3-2).

7. Connect a jumper between pins 5 and 6 on J209.

8. If a new DC Controller board is being installed, turn VR202 (see Figure 3-2) all the way counterclockwise, to start with the lowest possible setting.

9. Switch the power on and wait about one and a half minutes for the printer to warm up. The green power light should flash during the warm-up period. You may proceed to the next step when the green light stays on steadily.

10. Momentarily connect a jumper between J209 pin 7 and pin 6; record the reading on the meter and remove the jumper. (**CAUTION:** Leaving the jumper on too long may burn out the laser.)

11. Repeat step 10 two more times. Calculate the average of the three readings to determine the laser power output.

12. Compare the averaged reading to the reading shown on the laser label (see Figure 3-3).

13. If the laser output is within the range indicated on its label (the voltage indicated next to the figure "300," plus or minus 1 millivolt), no adjustment is necessary, so you may skip the next three steps (step 14, 15, and 16) and continue with step 17.

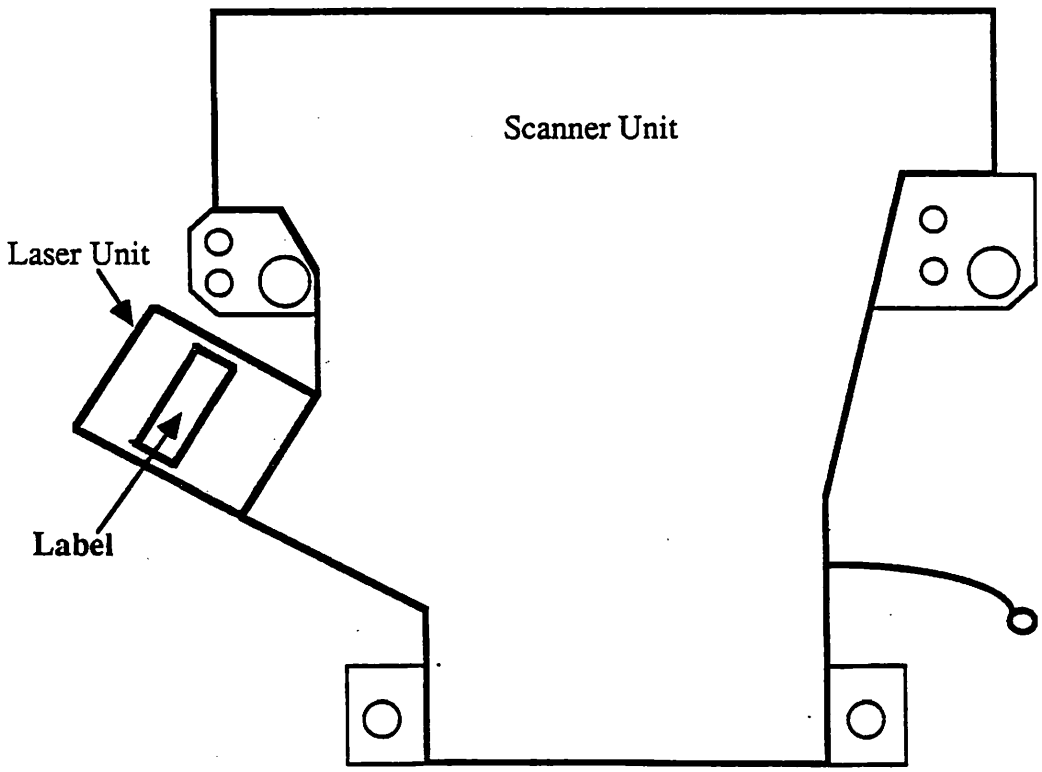


Figure 3-3

14. Before making any adjustment, make sure that the jumper between J209 pin 7 and pin 6 is removed. Then, if the laser output is too high, turn VR202 a little counterclockwise. If the laser output is too low, turn VR202 a little clockwise. Move the resistor in very small increments.

15. Install the jumper and measure the laser output as before (steps 10, 11, and 12).

16. If the laser output is now within the range indicated, no further adjustment is required. If it is not, repeat steps 14 and 15 until the adjustment is within the indicated range.

17. **Turn power off** and remove all jumper wires.

18. Remove the Laser Power Checker and **close the access hatch securely.**

19. Reconnect J209 to the DC Controller board.

20. Reinstall the LaserWriter I/O board and the top cover.

21. Turn the printer on and verify correct operation by waiting for the automatic test print to be generated.

3.B IMAGE SKEW ADJUSTMENT (P/N 011-7051)

If there is a large registration problem -- that is, if the image on the page looks very skewed -- the cause is probably the paper cassette or some other part of the paper feed path. But if it is a small skew -- just a millimeter or two -- you can fix it by adjusting the position of the laser/scanner unit. If the problem appears when using the types and weights of paper recommended for the LaserWriter, the adjustment is covered under warranty. If the problem only occurs with paper that is outside the recommended types or weights, be sure to warn the user that adjusting the printer for unusual weights of paper is not covered under warranty and that it may cause skewing problems when the recommended types of paper are used.

To Check Adjustment:

1. Make sure the type of paper recommended by the user's guide is loaded into the paper cassette (ordinary duplicator paper is acceptable). Then generate a user test print by turning the printer off and then on again.

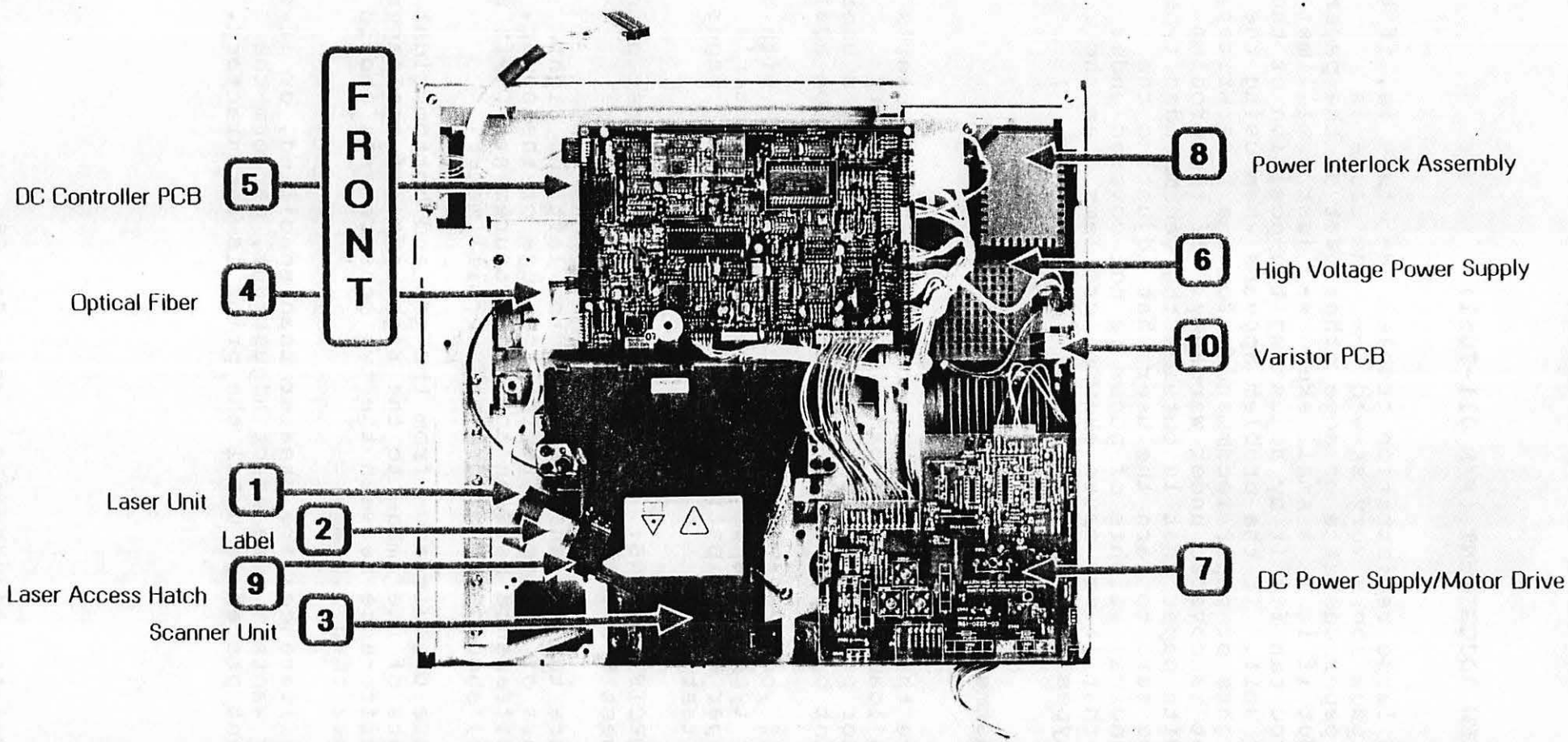
   NOTE: If you are adjusting the printer to work with a specific type of paper that is outside the printer's usual paper specifications, be sure to use that paper for the test.

2. **IMAGE SPECIFICATIONS:** The border around the test print should meet the following criteria:

   a) Measure the distance from the top left and right corners of the image to the top edge of the paper. The difference between the two measurements (left and right) should be no more than 1 millimeter.

   b) Measure the distance from the top and bottom right corners of the image to the right edge of the paper. The difference between the two measurements should be no more than 1.5 mm.

   If the differences are greater than specified, or if the customer wants a more exact adjustment, perform the adjustment procedure until the print is satisfactory.



TOP VIEW OF LASERWRITER WITH I/O BOARD REMOVED

To Adjust the Image:

1. Switch the printer OFF and remove the top cover.

2. Remove the LaserWriter I/O board.

WARNING: Make sure the laser access hatch is securely closed and the optical fiber is attached to the DC Controller board before continuing. When the power is on, remember not to touch the DC Power Supply board or the High Voltage Power Supply area (see Figure 3-4).

3. Turn on the power.

4. Make a service test print by momentarily jumpering pins 1 and 2 on J205 on the DC Controller board -- just touch the two pins together with the end of an insulated screwdriver. Only do this for an instant: otherwise the prints will keep coming out.

5. Turn off power to the printer.

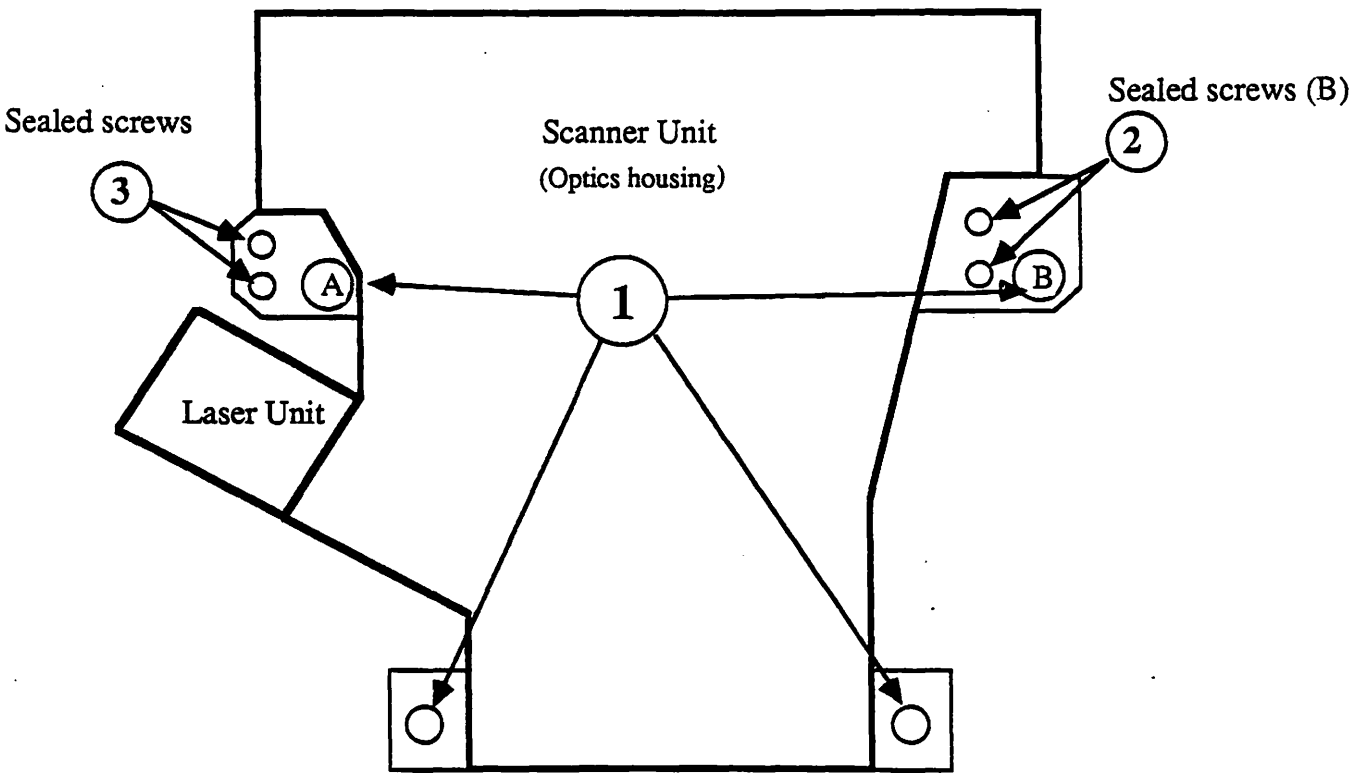

Sealed screws
Scanner Unit
(Optics housing)
Sealed screws (B)
3
2
A
1
B
Laser Unit

Figure 3-5

6. To make the scanner unit movable, loosen the four large mounting screws (Figure 3-5, #1) and the two sealed screws farthest from the laser (Figure 3-5, #2).

7. Move the scanner unit: rotating the unit clockwise makes the image rotate counterclockwise, and vice versa.

8. Make another service test print by turning on power and jumpering pins 1 and 2 on J205. Then measure the image skew as directed above.

   Repeat steps 7 - 8 until the adjustment is satisfactory or until you are unable to move the unit any further.

Stage Two

If you cannot achieve optimum adjustment using steps 1-8, continue with the following steps.

9. Turn off the printer power.

10. Tighten the two sealed screws you had loosened earlier on the far side of the scanner (Figure 3-5, #2) and loosen the two sealed screws near the laser unit (Figure 3-5, #3).

11. Rotate the scanner unit around the screw on the far side of the scanner unit: rotating the unit clockwise makes the image rotate counterclockwise, and vice versa.

12. Make another service test print by turning on power and jumpering pins 1 and 2 on J205. Then measure the image skew as directed above.

    Repeat steps 11 - 12 until the adjustment is satisfactory. If necessary, return to steps 6-8 for further adjustments.

Final check

When the adjustment is satisfactory, carefully tighten all screws. Turn off the power to the printer and put back the LaserWriter I/O board. To verify your adjustment, generate a user test print by turning on the power, and measure the image skew as directed above.

Apple LaserWriter Printer
Technical Procedures

Section 4 - Troubleshooting

Contents:

II- Electromechanical Problems (continued)

How to Use the Troubleshooting Section

Use this section as a guide to diagnosing and repairing LaserWriter Printer failures. To troubleshoot the LaserWriter printer, follow these steps:

1. Use the Quick Fix Guide (on the next page) to check for proper LaserWriter Printer installation and set up.
2. Attempt a test print (make sure cartridge and paper are installed, then turn the power on).
3. Note the symptoms and refer to the Troubleshooting Tables (the pages following the Quick Fix Chart).
4. Verify all repairs by making a test print.

Quick Fix Guide

Installation Checklist

* Line Voltage OK (115VAC plus or minus 10%)
* Printer installed on solid level surface
* Room temperature between 50 - 90 F (10 - 32.5 C)
* Humidity between 20% and 80%
* Printer not located near: water tap
  boiler
  humidifier
  open flame
  dusty location
* Printer not exposed to ammonia gas (produced by Diazo copiers or cleaning solutions)
* Printer not exposed to direct sunlight
* Printer is installed in a well-ventilated area

Initial Checks

* Cables and connectors ok
* Toner cartridge ok (replace if indicator is red)
* Print density adjustment dial set correctly
* Protocol selector switch (on back of printer) set correctly
* Paper is 16-21 lb. standard photocopier paper
* Fixing roller cleaner felt in place and not dirty
* Paper cassette properly loaded with paper (not more than 10mm high)
* Transfer corona wire ok (check for broken or dirty wire)
* Separation belt ok (check for nicks or broken belt)

Indicator Lamps

Ready lamp (green) - flashes for approximately 90 seconds on power up and thereafter stays lit if all of the following conditions are met:

- laser chip temperature correct
- upper fixing roller temperature correct
- toner cartridge installed
- cassette loaded with paper or paper is placed on manual feed tray if in manual feed mode
- there are no jams
- pickup sensor (PS1) does not detect paper
- printer is not in pause
- main motor is rotating properly

Paper lamp (yellow) - normally off - if lit steadily indicates an out of paper condition - will flash intermittently after a print command is given while the printer computes the print image

Jam lamp (red) - normally off - if lit indicates a paper jam has been detected

Test lamp (green) - normally off - if flashing, the Laserwriter I/O board should be replaced (the test lamp is located on the back of the printer, underneath the AppleTalk connector)

LED 201 - lights continuously when the laser beam is turned on at more than the specified intensity (located in the center of the DC controller board)

LED 401 - lights continuously when the scanner motor is rotating at the specified speed (located on the scanner/driver PCB - can be viewed from the right hand side of the printer when the top cover is removed)

LED 501 - lights continuously when the main motor is rotating at the specified speed (located on the component side, facing down, of the DC power supply and main motor driver PCB near connector J503)

How to Read the Troubleshooting Tables

The troubleshooting tables are explanations of the general servicing procedure. The example below shows how to read the tables.

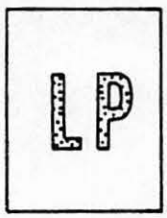
(Example) - THERE IS NO POWER

Step	Check	Result	Action
1	Is the printer plugged in?	NO	Plug in the printer
2	Is the printer firmly closed?	NO	Close the printer
3	Is the required voltage supplied at the AC outlet?	NO	Nothing is wrong with the printer. Take steps to provide an adequate power supply
4	Is circuit breaker CB1 open?	YES	Reset the circuit breaker. If the breaker trips as soon as reset there is a short that will have to be located
		NO	Make sure the power is off. Unplug the printer. Open the printer and disconnect J105 on the AC driver PCB. Make sure that circuit breaker CB1 is reset and has continuity. If the circuit breaker is defective replace it.

To solve a problem, begin at step one and perform the check explained there. If the result is not as indicated in the "Result" column, go to the next step number. But if the result is as indicated in the Result" column, perform the action indicated in the "Action" column and observe what happens. If the problem is not eliminated, continue to the next step.

IMAGE DEFECTS

Examples of Image Defects



Light image

Dark image

Blank print

Black image

Stained separation strip

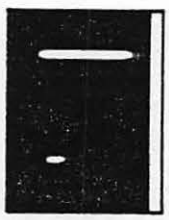
Stains on back of paper

Dark vertical lines

Sharp horizontal black lines

Vertical fogged stripes

Horizontal fogged stripes

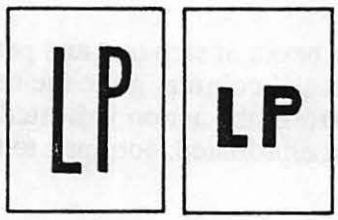


White horizontal lines/ other shapes on a black print

Thin vertical white lines/stripes

Faulty registration

Poor fixing



Distortion

Waviness

I- IMAGE DEFECTS (Refer to Figure 4-1)

I.A- LIGHT IMAGE (WHOLE PRINT)

Step	Check	Result	Action
1	Is the print density adjustment dial set with its dot at the top?	NO	Set the dial so that its dot is at the top.
2	Is the toner cartridge indicator red?	YES	Replace the toner cartridge.
3	Do prints improve when new paper is used?	YES	Replace the paper with approved paper (16-21 Lb. standard photocopier paper).
4	Is the transfer corona wire broken?	YES	Replace the transfer corona wire.
5	Is connector J211 on the DC Controller board securely connected?	YES	Replace the DC Controller board.
6	Is the print still light?	YES	Replace the high voltage power supply.
7	Does the voltage between J209-1 and J209-2 (GND) on the DC Controller vary from +5VDC to 0V when microswitch MS3 (the middle one) is pressed? Does the voltage between J209-3 and J209-4 (GND) on the DC Controller vary from +5VDC to 0V when microswitch MS4 (the lower one) is pressed? Do microswitches actuate normally when a toner cartridge is inserted?	NO	Replace the faulty microswitch. Reposition the microswitch holder if the microswitches do not actuate normlly when a toner cartridge is inserted.
8	Is laser power output normal?	NO	Adjust laser power (refer to Laser Power Adjustment procedure).
9	Is the print still light?	YES	Replace the varistor PCB.

I.B- DARK IMAGE (WHOLE PRINT)

Step	Check	Result	Action
1	Is the print density adjustment dial set with its dot at the top?	NO	Set the dial so that its dot is at the top.
2	With a toner cartridge in place, is there continuity between J21-1 on the varistor PCB and the metal frame of the upper main body?	NO	Check whether the grounding spring is in place in the middle of the drum drive gear (on the main motor).
3	Does the voltage between J209-1 and J209-2 (GND) on the DC Controller vary from +5VDC to 0V when microswitch MS3 (the middle one) is pressed? Does the voltage between J209-3 and J209-4 (GND) on the DC Controller vary from +5VDC to 0V when microswitch MS4 (the lower one) is pressed? Do microswitches actuate normally when a toner cartridge is inserted?	NO	Replace the faulty microswitch. Reposition the microswitch holder if the microswitches do not actuate normlly when a toner cartridge is inserted.
4	Is power output normal?	NO	Adjust laser power (refer to Laser Power Adjustment procedure).
5	Is the print still dark?	YES	Replace the varistor PCB.

I.C- BLANK PRINT

Step	Check	Result	Action
1	Is the toner cartridge indicator red?	YES	Replace the toner cartridge.
2	Has the sealing tape been removed?	NO	Remove it.
3	Do the toner cartridge protective shield and the light-blocking shutters open when a toner cartridge is inserted? Does the laser beam-blocking shutter open?	NO	Locate the cause of the trouble and repair. If the cause is in the toner cartridge, replace the cartridge.
4	Is connector J211 on the DC Controller board securely connected?	YES	Replace the DC Controller board.
5	Is the print still blank?	YES	Replace the high voltage power supply.
6	Is laser power output normal?	NO	Adjust laser power (refer to Laser Power Adjustment procedure).
7	Does the green test light on the rear (I/O) connector plate blink continuously when printer power is turned on?	YES	Replace the LaserWriter I/O board.

I.D- BLACK IMAGE

Step	Check	Result	Action
1	Is the primary corona wire inside the toner cartridge broken?	YES	Replace the toner cartridge.
2	Is connector J211 on the DC Controller board securely connected?	YES	Replace the DC Controller board.
3	Is the print still black?	YES	Replace the high voltage power supply.
4	Does the green test light on the rear (I/O) connector plate blink continuously when printer power is turned on?	YES	Replace the LaserWriter I/O board.

I.E- STAINED SEPARATION STRIP

Step	Check	Result	Action
1	Are the separation belt, separation roller, or pinch roller (near the separation belt) dirty?	YES	Clean them.
		NO	Replace the toner cartridge.

I.F- SCRAMBLED IMAGE ("GARBAGE")

Step	Check	Result	Action
1	Turn printer off and then on again. Does green test light on rear (I/O) connector plate blink continuously and/or is self-test printout scrambled?	YES	Replace LaserWriter I/O board.

I.G- STAINS ON BACK OF PAPER

Step	Check	Result	Action
1	Is the fuser roller cleaner felt dirty?	YES	Replace the fuser roller cleaner felt.
2	Is there any toner on the underside of the toner cartridge	YES	Clean with a damp cloth, then with a dry cloth.
3	Is there toner on the transfer guides or are the guides dirty?	YES	Clean with a damp cloth, then with a dry cloth.
4	Is there any toner on the transfer corona assembly feeder guides?	YES	Clean with a damp cloth, then with a dry cloth.
5	Is there any toner on the separation belt, separation roller, or pinch roller?	YES	Clean with a damp cloth, then with a dry cloth.
6	Is the manual paper feed guide dirty or not grounded?	YES	Clean with a damp cloth, then with a dry cloth. Ground it if it is not correctly grounded.
7	Does the leading-edge blank area on printed pages measure about 5mm?	NO	Replace the DC Controller PCB.
8	Are the transfer guides correctly grounded via 15MΩ resistance when the printer upper unit is closed?	NO	Ground them correctly.
9	Is the Fuser Assembly correctly grounded?	NO	Ground it correctly.

I.H- DARK VERTICAL LINES (PAPER FEED DIRECTION)

Step	Check	Result	Action
1	Is the fuser roller cleaner felt dirty?	YES	Replace the fuser roller cleaner felt.
2	Turn the printer off in the middle of printing and open the upper half of the printer. Open the protective shield on the toner cartridge. Can you see a vertical line on the drum? (Make this check as quickly as possible and in dim light, to prevent light from damaging the drum)	YES	Replace the toner cartridge.

I.I- SHARP HORIZONTAL BLACK LINES (CROSS FEED DIRECTION)

Step	Check	Result	Action
1	Is the laser power set properly?	NO	Adjust laser power (refer to Laser Power Adjustment procedure).
2	Execute a test print while the printer is in the ready state by jumpering pins 1 and 2 on J205 on the DC Controller board. Does the scanner motor start and LED401 on the scanner driver PCB light continuosly?	YES	Proceed to step 6.
3	Are J401 on the scanner driver PCB and J206 on the DC Controller board securely connected?	NO	Connect J401 or J206.
4	Is +24VDC supplied between J401-1 and J401-2(GND) on the scanner driver PCB?	NO	Check J502 on the DC power supply and J208 on the DC Controller board for secure contact. If contact is good replace the DC Power Supply/Motor Drive PCB.
5	Does the voltage between J206-4 and J206-2(GND) vary from about +7VDC procedure to about OVDC when the same as in step 3 is performed?	NO	Replace the DC Controller PCB.
		YES	Replace the scanner unit. If this does not correct the problem go step 7.
6	Perform step 2, then wait 3 minutes. Does the voltage between J401-3 and J401-2(GND) on the scanner driver PCB vary from about +3VDC to about OVDC?	YES	Replace the DC Controller PCB. If the problem is not solved put the old PCB back in the printer and replace the scanner unit.
		NO	Replace the scanner unit.

I.J- VERTICAL FOGGED STRIPES (PAPER FEED DIRECTION)

Step	Check	Result	Action
1	Clean the primary corona wire. Does the print image improve after cleaning the primary corona wire?	NO	Replace the toner cartridge.

I.K- HORIZONTAL FOGGED STRIPES (CROSS FEED DIRECTION)

Step	Check	Result	Action
1	Check the distance of the stripes from the edge. Are they about 188mm or 66mm from the edge of the prints? (The circumference of the drum is 188.5mm, that of the developing cylinder, 66mm)	YES	Replace the toner cartridge.

I.L- WHITE HORIZONTAL LINES OR OTHER SHAPES ON A BLACK PRINT

Step	Check	Result	Action
1	Is approved paper being used?	NO	Replace with approved paper (16-21 Lb. standard photocopier paper). Explain to user that use of non-approved paper may cause poor quality prints.
2	Is paper damp?	YES	Replace the paper. Instruct the user to store paper in its package in a dry place and not to open packages before ready to use paper.

I.M- THIN VERTICAL LINES OR STRIPES (PAPER FEED DIRECTION)

Step	Check	Result	Action
1	White stripes are being produced?	YES	If toner cartridge indicator is green, rock the cartridge to spread the toner evenly. If the indicator is red, replace the toner cartridge.
2	Is the fuser roller cleaner felt dirty?	YES	Replace the fuser roller cleaner felt.
3	Do prints improve after the transfer corona wire is cleaned?	YES NO	Finished. Replace the toner cartridge. If that does not work replace the original cartridge and go to next step.
4	Remove the toner cartridge and manually open the laser beam blocking shutter in the printer (above the cartridge). Check the area for obstacles or blockages. Are there any?	YES	Remove the obstacles or clean the area with a fine brush.
5	Remove the laser/scanner unit. Is the dustproofing glass on the laser/scanner unit dirty?	YES	Clean the dustproofing glass with lint-free cloth. Dust should not be left on the glass.

I.N- FAULTY REGISTRATION

Step	Check	Result	Action
1	Is the paper cassette loaded with too much paper (more than 10mm high)?	YES	Remove the excess paper.
2	Has either guide spring (located at ends of the feed roller shaft on (the registration shutter ass'y) come loose?	YES	Reinstall the guide springs.
3	Is the leading edge of the paper showing excessive curl?	YES	Straighten paper edges or replace paper.
4	Is approved paper being used?	NO	Replace with approved paper (16-21 Lb. standard photocopier paper).
5	Are the feed rollers dirty? (cassette pickup assembly)	YES	Clean with a damp cloth, then with a dry cloth.

(Continued on next page.)

I.N- FAULTY REGISTRATION (continued)

6	Disconnect J214 from the DC Controller. Actuate the cassette size microswitches MS5 (upper), MS6(middle), and MS7 (lower) manually in that order while checking the resistance between the connector pins listed below. Does the resistance drop from infinity to 0 ohms? 1) J214-1 to J214-2 (MS5) 2) J214-3 to J214-4 (MS6) 3) J214-5 to J214-6 (MS7)	NO	Check for wiring or connector problems between the DC Controller PCB and the microswitches. If none, replace any microswitch that didn't drop to 0 ohms on activation.
7	Is the problem still there?	YES	Replace the DC Controller board.

I.O- POOR FIXING (IMAGE SMEARS EASILY)

Step	Check	Result	Action
1	Is approved paper being used?	NO	Replace paper with approved paper (16-21 Lb. standard photocopier paper).
2	Are the upper and lower fuser rollers worn?	YES	Replace as necessary.
3	Is the nip width correct? (Correct values are 2-3mm at center and a difference of plus or minus 0.5mm at both edges.)	NO	Replace the lower roller. If the problem is still there, replace the pressure springs.

I.P- DISTORTION

Step	Check	Result	Action
1	Does LED 501 on the DC Power Supply/Motor Drive PCB flash or go out?	YES	Perform the following actions until the problem is solved: 1) Check all parts of the drive mechanism. 2) Replace the DC Power Supply/ Motor Drive PCB. 3) Reinstall the original DC Power Supply/ Motor Drive PCB in the printer and replace the main motor.

I.Q- WAVINESS

Step	Check	Result	Action
1	Does LED 401 on the scanner driver PCB light continuosly?	NO	Replace the scanner unit. If the problem is not solved, reinstall the scanner unit back in the printer and replace the DC Controller PCB.

II- ELECTROMECHANICAL PROBLEMS

II.A- THERE IS NO POWER

(If air is blowing through the louver when the power is switched on, start at step 7.)

Step	Check	Result	Action
1	Is the printer plugged in?	NO	Plug in the printer.
2	If the printer firmly closed?	NO	Close the printer.
3	Is the required voltage supplied at the AC outlet?	NO	Nothing is wrong with the printer. Take steps to provide an adequate power supply.
4	Is circuit breaker CB1 open?	YES	Reset the circuit breaker. If the breaker trips as soon as reset, there is a short that will have to be located.
		NO	Make sure the power is off. Unplug the printer. Open the printer and disconnect J105 on the AC driver PCB. Make sure that circuit breaker CB1 is reset and has continuity. If the circuit breaker is defective replace it.
5	With J105 disconnected, plug the printer in and turn it on. Is line voltage supplied between TB101-1 and TB102-1 located elsewhere on the AC driver PCB? (CAUTION: Be sure to set the multimeter to the correct voltage range or it will be destroyed.)	NO	Check noise filter NF1, main switch SW1 and the power cord and plug. Replace as necessary.
6	Switch the power off and unplug the printer. Reconnect J105 on the AC driver PCB. Plug the printer in and turn it on. Is AC voltage supplied between J105-1 and J105-2 when the door switch is activated with a screwdriver?	NO	Replace MS1 and/or MS2.
7	Is AC voltage supplied between J103-1 and J103-2 when the door switch is activated with a screwdriver?	NO	Replace the AC driver PCB.

II.A- THERE IS NO POWER (Continued)

Step	Check	Result	Action
8	Shut the printer and remove the top cover. Are the DC voltages listed below supplied between the J502 pins on the DC Power Supply/ Motor Drive PCB? 1) J502-4 and J502-8(GND) 24-35VDC 2) J502-9 and J502-8(GND) 24VDC 3) J502-7 and J502-6(GND) 5VDC 4) J502-5 and J502-6(GND) -5VDC 5) J502-2 and J502-3(GND) 20-30VDC	YES	Go to step 21.
9	Switch the printer off and disconnect J501 on the DC Power Supply/ Motor Drive PCB. Turn on the printer. Are the AC voltages listed below supplied between the J501 pins (cable attached) on the DC Power Supply/Motor Drive PCB? (CAUTION: Set the multimeter to the correct voltage range or it will be destroyed.) 1) J501-1 and J501-2 29-37VAC 2) J501-3 and J501-4 10-14VAC 3) J501-4 and J501-5 10-14VAC 4) J501-6 and J501-7 18-24VAC	NO	Replace the low voltage transformer (PT1).
10	Switch the printer off. Disconnect J502 on the DC Power Supply/ Motor Drive PCB and reconnect J501. Turn the printer on. Are the DC voltages shown below supplied at J502 on the DC Power Supply/ Motor Drive PCB? 1) J502-4 and J502-8(GND) 24-35VDC 2) J502-9 and J502-8(GND) 24VDC 3) J502-7 and J502-6(GND) 5VDC 4) J502-5 and J502-6(GND) -5VDC 5) J502-2 and J502-3(GND) 20-30VDC	NO	Replace the DC Power Supply/Motor Drive PCB.

(Continued on next page)

II.A- THERE IS NO POWER (Continued)

Step	Check	Result	Action
11	Turn the printer off. Make sure that J502 is connected to the DC Power Supply/Motor Drive PCB. Disconnect all connectors on the DC Controller PCB except J208. Are any of the J502 pins listed below shorted? (Measure resistance on connector pins on the Power Supply/Motor Drive board.) 1) J502-4 and J502-8 2) J502-9 and J502-8 3) J502-7 and J502-6 4) J502-5 and J502-6 5) J502-2 and J502-3	YES	Check the wiring between J502 and J208 for a short. If there is no short, replace the DC Controller PCB.
12	Reconnect all the connectors on the DC Controller PCB. Are any of the J502 pins on the DC Power Supply/ Motor Drive PCB shorted now? 1) J502-4 and J502-8 2) J502-9 and J502-8 3) J502-7 and J502-6 4) J502-5 and J502-6 5) J502-2 and J502-3	NO	Go to step 21.
13	Were J502-4 and J502-8 shorted?	NO	Go to next step.
		YES	Check the wiring between J207 and TB5 for a short. If there is no short replace the preconditioning exposure assembly.
14	Were J502-9 and J502-8 shorted?	NO	Go to step 17.
15	Disconnect connectors J215, J212; J210; J216; J213; J211; J208 and J206. Reconnect them in the sequence shown below. After each connector is replaced check for shorts between the pins shown below. Are any shorts found? J215-3 and J215-1; J215-5 and J215-1 J210-1 and J210-5; J210-3 and J210-5 J210-7 and J210-5 J216-3 and J216-1 J213-8 and J213-1 J211-6 and J211-1 J206-1 and J206-2	YES	Replace the load attached to the shorted connector.

(Continued on next page.)

II.A- THERE IS NO POWER (Continued)

Step	Check	Result	Action
16	Reconnect J212. Are J212-2 and J212-3 shorted?	YES	Check the wiring between J104 and J212 for a short. If no short is found replace the AC driver PCB.
17	Are J502-7 and J502-6 shorted?	NO	Go to step 19.
18	Disconnect J201 and J204 on the DC Controller PCB. Are J201-1 and J208-8 shorted, or are J204-4 and J204-5 shorted?	YES	If the circuit between J201-1 and J208-8 is shorted check the wiring between J201 and TB18 on the display PCB for a short. If OK replace the display PCB. If the circuit between J204-4 and J204-5 is shorted, check the wiring between J204 and TB3 and TB4 on the laser unit for a short. If there are no shorts, replace the laser unit.
19	Are J502-2 and J502-3 shorted?	NO	Go to step 21.
20	Disconnect J204 on the DC Controller PCB. Are J201-1 and J208-8 or J204-1 and J204-4 of the connector on the cable shorted?	YES	Check the wiring between J204 and TB3 and and TB4 for a short. If there are no shorts, replace the laser unit.
21	Plug in all the connectors on the DC Power Supply/Motor Drive PCB and DC Controller PCB. Check that the circuit breaker has been reset and the printer is closed. Switch the printer on. Are the DC voltages shown in the table below supplied between the pins on the DC Controller PCB? 1) J208-4 and J208-8(GND) 24-35VDC 2) J208-9 and J208-8(GND) 24VDC 3) J208-7 and J208-6(GND) 5VDC 4) J208-5 and J208-6(GND) -5VDC 5) J208-2 and J208-8(GND) 20-30VDC	NO YES	Check wiring between J502 on DC Power Supply/Motor Drive PCB and J208 on the DC Controller PCB for poor contact or wiring damage. Replace the DC Controller PCB.

II.B- THE MAIN MOTOR DOES NOT ROTATE

Step	Check	Result	Action
1	Remove the rear panel of the printer. Does the main motor begin to rotate when making a test print?	YES	Check that all gears mesh correctly.
2	Does the voltage between J208-1 and J208-3(GND) on the DC Controller PCB vary from about +8VDC to about 0V when making a test print?	YES	Check J208 on the DC Controller PCB and J502 on the DC Power Supply/ Motor Drive PCB for good contact. If the problem is not solved go to step 4.
		NO	Replace the DC Controller PCB.
3	Does the voltage between J503-6 and J503-5(GND) on the DC Power Supply /Motor Drive PCB vary from about 0V to about +13VDC when making a test print?	YES	Replace the main motor.
		NO	Check all connections and wires to the main motor. If the problem is not solved, go to the next step.
4	Does the voltage between J502-1 and J502-3(GND) on the DC Power Supply/Motor Drive PCB vary from about +8VDC to about 0V when making a test print?	YES	Replace the DC Power Supply/ Motor Drive PCB.

II.C- THE HIGH VOLTAGE POWER SUPPLY DOES NOT PROVIDE POWER

Step	Check	Result	Action
1	Remove the rear panel of the printer. Does the main motor begin to rotate as soon a test print is started?	NO	Go to "MAIN MOTOR DOES NOT ROTATE."
2	Do the voltages between the J601 pins on the high voltage power supply vary as follows when making a test print? a) J601-8 and J601-1(GND) from about +18VDC to about +1VDC immediately after starting a test print? b) J601-2 and J601-1(GND) and between J601-4 and J601-1(GND) from about +20VDC to about 0VDC a few seconds after starting a test print? c) J601-5 and J601-1(GND) from about +17VDC to about 0VDC a few seconds after making a test print?	YES	Check J601, J3, J4, and J5 for good contact. Repair any problems. If the high voltage power supply still does not function, replace the high voltage power supply.
3	Do the voltages between the J211 pins on the DC Controller PCB vary as follows when making a test print? a) J211-8 and J211-1(GND) from about +18VDC to about +1VD immediately after making a test print? b) J211-2 and J211-1(GND) and between J211-4 and J211-1(GND) from about +20VDC to about 0VDC a few seconds after making a test print? c) J211-5 and J211-1(GND) from about +17VDC to about 0VDC a few seconds after making a test print?	NO	Replace the DC Controller PCB.

II.D- THE FUSER ROLLER HEATER DOES NOT OPERATE

Step	Check	Result	Action
1	Turn the printer off. Unplug J101 on the AC driver PCB. Measure the resistance between J101-1 and J101-2 of the connector. Is it between 1-5 ohms? (Reconnect J101 after measurement.)	NO	Check whether the circuit has continuity at both ends of thermoprotector TP1. If it does not, replace the thermoprotector. If it does, replace the fuser roller heater H1 and continue on to the next step.
2	Unplug J212 on the DC Controller PCB. Measure the thermistor resistance between J212-5 and J212-4 of the connector. Is it in the range of 100-400 k-ohms at room temperature? (Reconnect J212 after measurement.)	NO	Check the wiring between thermistor TH1 in the fuser assembly and the DC Controller PCB. Clean the thermistor if it is dirty. If the problem is still there, go on to the next step.
3	Does the voltage between J104-1 and J104-3 on the AC driver PCB go from about +24VDC to about +22VDC approximately one second after power is turned on?	NO	Check the wiring between J212 on the DC Controller PCB and J104 on the AC driver PCB. If the problem still exists, replace the DC Controller PCB.
4	Do the line voltages between the following connectors on the AC driver PCB vary as listed below about one second after power is turned on? a) 0VAC between J105-7 and J105-3 b) 0VAC between J101- and J101-2	NO	Replace the AC driver PCB. If the problem still exists, reinstall the AC driver PCB and replace triac Q1.

II.E- CANNOT FEED PAPER MANUALLY

Step	Check	Result	Action
1	Has a manual feed command been sent to the printer?	NO	Send a manual feed command to the printer from the attached computer.
2	Does the voltage between J210-4 and J210-5(GND) on the DC Controller PCB go from about +24VDC to about 0VDC approx. 8 seconds after the main motor begins to rotate, and does it remain at 0 volts for about 1.5 seconds?	NO	Replace the DC Controller PCB.
3	Does the upper manual pickup roller descend and feed the paper about 8 seconds after the main motor begins to rotate?	YES	Check the lower roller for wear and rotation. Check that the upper roller presses against the paper firmly.
4	Does the voltage between J210-6 and J210-5(GND) on the DC Controller PCB go from about 0VDC to +5VDC when paper is set on the manual feed tray?	NO	Check J4 of the pickup sensor and J210 on the DC Controller PCB for poor contact. If no problems are found, replace pickup sensor PS1.
5	Unplug J210 on the DC Controller PCB. Is there continuity between J210-4 and J210-3 on the connector attached to the cable?	NO	Check the wiring and connectors for the manual pickup roller clutch solenoid. If the problem still exists, replace the manual pickup roller clutch solenoid SL2.
6	Is a pulse applied between J208-12 and J208-3(GND) on the DC Controller PCB when printing occurs? Check with a scope or logic probe.	NO	Check the wiring between J502 on DC Power Supply/Motor Drive PCB and J208. If no problems are found, replace the DC Power Supply/ Motor Drive PCB. Check fuse FU504 on the DC Power Supply/ Motor Drive PCB. If it is blown, replace it and reinstall the DC Power Supply /Motor Drive PCB. If the fuse blows again, replace the main motor.

II.F- PAPER IS NOT FED FROM THE CASSETTE

Step	Check	Result	Action
1	Has a manual feed command been sent to the printer?	NO	Send a cassette feed command to the printer from the attached computer.
2	Does the cassette feed roller begin rotating when a test print is executed from the READY state?	YES	Check that the paper pickup guide is closed firmly. Check for smooth rotation of the cassette feed roller. If the cassette feed roller is worn, replace it.
		NO	Go to "THE MAIN MOTOR DOES NOT ROTATE." If the problem still exists, go to the next step.
3	Does the voltage between J215-4 and J215-1(GND) on the DC Controller PCB drop from +24VDC to 0VDC when a test print is executed from the READY state?	YES	Remove the main printer body from the pedestal. Activate cassette pickup roller clutch solenoid SL3 and rotate the idler gear (both manually). Does the paper pickup roller clutch function normally and cause the pickup roller to rotate one time? If the pickup roller clutch operates correctly check the connector on SL3 for good contact. If no problem is found there, replace the cassette pickup roller clutch solenoid SL3. If the cassette feed roller is worn, replace it.
4	Disconnect J214 from the DC Controller. Actuate the cassette size microswitches MS5 (upper), MS6 (middle), and MS7 (lower) manually in that order while checking the resistance between the cable connector pins listed below. Does the resistance drop from infinity to 0 ohms? 1) J214-1 to J214-2 (MS5) 2) J214-3 to J214-4 (MS6) 3) J214-5 to J214-6 (MS7)	NO	Check for wiring or connector problems between the DC Controller PCB and the microswitches. If none, replace any microswitch that didn't drop to 0 ohms on activation.
		YES	Replace the DC Controller PCB.

II.G- JAMS ARE DETECTED WHEN THERE ARE NO JAMS

Step	Check	Result	Action
1	Does the JAM indicator light on the display unit when the printer is switched on?	YES	Check the wiring between J201 on the DC Controller PCB and TB18 on the display unit. If it is OK, replace the DC Controller PCB.
2	Is a paper fragment or some other obstacle caught in the delivery unit?	YES	Remove the obstruction.
3	Does the voltage between J210-6 and J210-5(GND) on the DC Controller PCB go from about 0VDC to +5VDC when paper is set on the manual feed tray?	NO	Check J4 of the pickup sensor PS1 and J210 on the DC Controller PCB for poor contact. Also check that the paper detection arm functions smoothly. If no problems are found, replace pickup sensor PS1.
4	Open the upper half of the printer and activate the door switch with a screwdriver. Shield the light from delivery sensor PS3 with paper. Does the voltage between J216-2 and J216-2(GND) on the DC Controller PCB vary from about 0VDC to +5VDC?	NO	Check J5 of the pickup sensor PS3 and J216 on the DC Controller PCB for poor contact. Also check that the paper delivery sensor arm functions smoothly. If there are no problems, replace delivery sensor PS3.

II.H- JAMS ARE NOT DETECTED

Step	Check	Result	Action
1	Does the JAM indicator on the display unit light when the circuit between J201-4 and J208-6(GND) on the DC Controller PCB is shorted?	NO	Check J201 on the DC Controller PCB and TB18 on the display unit for good contact. If the contact is good, check whether +5VDC is supplied between J201-4 and J208-6(GND) on the DC Controller PCB. If +5VDC is there, replace the display unit. If it is not there, go to "THERE IS NO POWER."
2	Does the voltage between J210-6 and J210-5 (GND) on the DC Controller PCB go from about 0VDC to +5VD when paper is set on the manual feed tray?	NO	Check J4 of the pickup sensor PS1 and J210 on the DC Controller PCB for poor contact. Also check that the paper detection arm functions smoothly. If no problems are found, replace pickup sensor PS1.
3	Open the upper half of the printer and activate the door switch with a screwdriver. Shield the light from delivery sensor PS3 (below fan) with paper. Does the voltage between J216-2 and J216-1 (GND) on the DC Controller PCB vary from about 0VDC to +5VDC?	NO	Check J6 of delivery sensor PS3 and J216 on the DC Controller PCB for poor contact. Also check that the paper delivery sensor arm functions smoothly. If there are no problems, replace delivery sensor PS3.
4	Is a pulse applied between J208-12 and J208-3 (GND) on the DC Controller PCB when printing is occurring? Check with a scope or logic probe.	NO	Check the wiring between J502 on DC Power Supply/Motor Drive PCB and J208. If no problems are found, replace the DC Power Supply/ Motor Drive PCB. If the problem is not fixed, replace the main motor.

II.I- THE PAPER OUT INDICATOR LIGHTS WHEN THERE IS STILL PAPER

Step	Check	Result	Action
1	Has a manual feed command been sent to the printer?	YES	For printing with manual feed, put the paper in along the manual feed guide. For cassette feed, send a cassette feed command to the printer from the attached computer.
2	Does the voltage between J215-2 and J215-1 (GND) on the DC Controller vary from about +5VDC to 0VDC when the paper detection arm lifts?	NO	Check J5 on the paper-out sensor in the pedestal, J215 on the DC Controller, and the wiring in between for good contact. Also check that the paper detection arm moves smoothly. If no problems are found, replace the paper-out sensor PS2.
3	Disconnect J214 from the DC Controller. Actuate the cassette size microswitches MS5 (upper), MS6 (middle) and MS7 (lower) manually in that order while checking the resistance between the connector pins (connector and cable cable attached) listed below. Does the resistance drop from infinity to 0 ohms? 1) J214-1 to J214-2 (MS5) 2) J214-3 to J214-4 (MS6) 3) J214-5 to J214-6 (MS7)	NO	Check for wiring or connector problems between the DC Controller PCB and the microswitches. If none are found, replace any microswitch that didn't drop to 0 ohms on activation.
4	Does the PAPER OUT indicator go out when a cassette with paper is installed?	NO	Replace the DC Controller PCB.

II.J- THE PAPER OUT INDICATOR DOES NOT LIGHT WHEN THERE IS NO PAPER

Step	Check	Result	Action
1	Has a manual feed command been sent to the printer?	YES	For cassette feed, send a cassette feed command to the printer from the attached computer.
2	Does the PAPER OUT indicator on the display unit light up when the circuit between J201-3 and J208-6 (GND) on the DC Controller PCB is shorted?	NO	Check J201 on the DC Controller PCB and TB18 on the display unit for good contact. If the contact is good, check whether +5VDC is supplied between J201-1 and J208-6(GND) on the DC Controller PCB. If +5VDC is there, replace the display unit. If it is not there, go to "THERE IS NO POWER."
3	Does the voltage between J215-2 and J215-1 (GND) on the DC Controller vary from about +5VDC to 0VDC when the paper detection arm in the pedestal lifts?	NO	Check J5 on the paper sensor, J215 on the DC Controller, and the wiring in between for good contact. Also check that the paper detection arm moves smoothly. If no problems are found, replace the paper sensor PS2.
4	Disconnect J214 from the DC Controller. Actuate the cassette size microswitches MS5 (upper), MS6 (middle), and MS7 (lower) manually in that order while checking the resistance between the cable connector pins listed below. Does the resistance drop from infinity to 0 ohms? 1) J214-1 to J214-2 (MS5) 2) J214-3 to J214-4 (MS6) 3) J214-5 to J214-6 (MS7)	NO	Check for wiring or connector problems between the DC Controller PCB and the microswitches. If none, replace any microswitch that didn't drop to 0 ohms on activation.
5	Does the PAPER OUT indicator light when a cassette with paper is removed?	NO	Replace the DC Controller PCB.

II.K- THE PRECONDITIONING EXPOSURE LAMPS DO NOT LIGHT

Step	Check	Result	Action
1	Is it at least one lamp lit? Open the upper half of the printer and take out the toner cartridge. Switch the printer on. Activate the door switch using a screwdriver. Do all lamps flash momentarily?	YES	Replace the Preconditioning Exposure Assembly if lamp intensity is low or lamps are burned out.
2	Execute a printing cycle from the ready state. Does the voltage between J207-1 (+24 to +30VDC) and J207-2 on the DC Controller vary from 0V to between +24VDC and +35VDC?	YES	Check J207 on the DC Controller PCB for good contact.
3	Is the voltage between J207-1 and J208-6 (GND) on the DC Controller PCB within the range of +24-30VDC and is the voltage between J208-7 and J208-8(GND) on the DC Controller PCB at +5 VDC?	YES	Replace the DC Controller PCB.
		NO	Check J502 on the DC Power Supply/ Motor Drive PCB and J208 on the DC Controller PCB for good contact. If OK, replace the DC Power Supply/Motor Drive PCB. If the problem is not solved, replace the DC Controller PCB.

II.L- LASER OR SCANNER MALFUNCTION

Step	Check	Result	Action
1	Is the laser power set properly?	NO	Adjust laser power to the proper level. If this can't be done, go to "LASER OR FUSER HEATER MALFUNCTION," step 3.
2	Make a test print while the printer is in the ready state by momentarily jumpering pins 1 and 2 of J205 on the DC Controller. Does the scanner motor start and does LED401 on the scanner driver PCB light continuously?	YES	Proceed to step 6.
3	Are J401 on the scanner driver PCB and J206 on the DC Controller board securely connected?	NO	Connect J401 or J206.
4	Is +24VDC supplied between J401-1 and J401-2 (GND) on the scanner driver PCB?	NO	Check J502 on the DC Power Supply and J208 on the DC Controller board for secure contact. If contact is good, replace the DC Power Supply/ Motor Drive PCB.
5	Execute step 2 and wait 3 minutes. Does the voltage between J206-4 and J206-2 (GND) vary from about +7VDC to about OVDC?	NO	Replace the DC Controller PCB.
		YES	Replace the scanner unit. If this does not correct the problem, go to step 6.
6	Does the voltage between J401-3 and J401-2 (GND) on the scanner driver PCB vary from about +3VDC to about OVDC a few minutes after the same procedure as in step 2 is performed?	YES	Replace the DC Controller PCB. If the problem is not solved, put the old PCB back in the printer and replace the scanner unit.
		NO	Replace the scanner unit.

II.M- LASER OR FUSER HEATER MALFUNCTION

Step	Check	Result	Action
1	Switch the printer on and wait one minute. Open the printer and lift the cover of the fuser assembly. Has the temperature of the upper roller increased?	NO	Go to "THE FUSER ROLLER HEATER DOES NOT OPERATE."
2	Is the voltage between J204-1 and J204-4 (GND) in the range of +20-30VDC and is the voltage between J204-5 and J204-4 (GND) in the laser unit +5VDC?	NO	Check that the voltage between J208-2 and J208-3 (GND) is +20-30VDC and +5VDC between J208-7 and J208-6 (GND). If not, check the wiring between J502 on the DC Power Supply/ Motor Drive PCB and J208 for poor contact. If contact is good, replace the DC Power Supply/Motor Drive PCB.
3	Switch the printer off. Disconnect J204 on the DC Controller PCB. Measure the resistance between J204-1 and J204-2 of the connector on the cable. Is it 40-55 ohms?	NO	Replace the laser unit.
4	Measure the resistance between J204-3 and J204-4 of the connector on the cable. Is it 5-15 k-ohms when the laser is at room temperature?	YES NO	Replace the DC Controller PCB. Replace the laser unit.

II.N- ALL LEDs ON THE DISPLAY PANEL DO NOT LIGHT

Step	Check	Result	Action
1	Is a toner cartridge installed in the printer?	NO	Install a toner cartridge.
2	Turn the printer off and then on again. Is the problem solved?	YES	Finished. Occasionally a momentary flicker will cause a beam detect signal malfunction. Turning the power off and then on again re-initializes the circuit and solves the problem. If this problem occurs frequently, go to "LASER OR SCANNER MALFUNCTION."
3	Is a pulse applied between J208-12 and J208-3 (GND) on the DC Controller PCB when printing occurs? Check with a scope or logic probe.	NO	Go to "THE MAIN MOTOR DOES NOT ROTATE." Is the problem solved? If not, replace the DC Power Supply/ Motor Drive PCB.
4	Is +5VDC supplied between J201-1 and J208-6 (GND) on the DC Controller PCB.	NO	Go to "THERE IS NO POWER."

II.O- THE READY/WAIT INDICATOR DOES NOT STOP FLASHING

Step	Check	Result	Action
1	Does the rear (I/O) connector plate's test light blink continuously?	YES	Replace the LaserWriter I/O board.
		NO	Replace the DC Controller PCB.

II.P- THE READY/WAIT INDICATOR DOES NOT LIGHT

Step	Check	Result	Action
1	Do any of the other LEDs light steadily?	YES	If the PAPER OUT indicator is lit, put paper in the cassette. If the JAM indicator is lit, find and remove the paper jam.
2	Have all the LEDs on the display gone out?	YES	Go to "ALL LEDs ON THE DISPLAY PANEL DO NOT LIGHT." Is the problem solved? If not, go on to the next step.
3	Does the READY/WAIT indicator light steadily when the circuit between J201-2 and J208-6 (GND) on the DC Controller PCB is shorted?	YES	Replace the DC Controller PCB.
		NO	Check J201 on the DC Controller PCB and TB18 on the display PCB for good contact. If contact is good, check whether +5VDC is supplied between TB18 and J208-6(GND) on the DC Controller PCB. If so, replace the display PCB. If not, go to "THERE IS NO POWER."

II.Q- PRINTING DOES NOT START WHEN A FILE IS SENT TO THE PRINTER

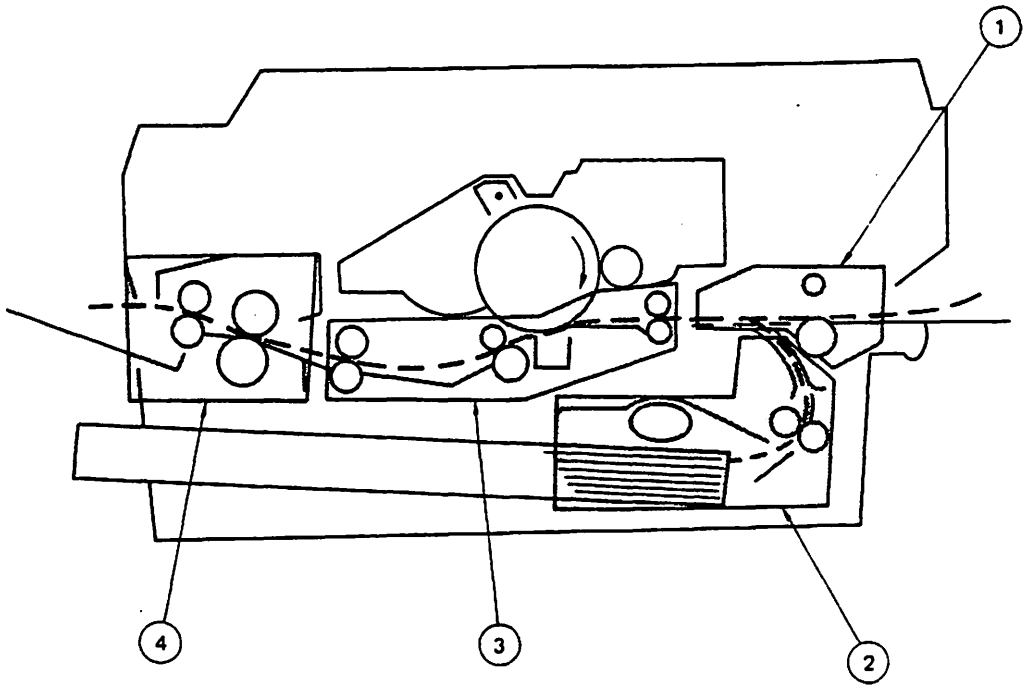
Step	Check	Result	Action
1	Is protocol selector switch on back of printer set correctly?	NO	Set switch to correct position.
2	Is appropriate network software and printer software installed on the application disk?	NO	Install the correct software.
3	Is the Macintosh defective? (Run MacTest?)	YES	Repair the defective Macintosh.
4	Is there a network problem? (Run test disk supplied with laser printer)	YES	Refer to Appletalk troubleshooting material.
5	Does the green test light on the rear (I/O) plate blink continuously when printer power is turned on?	YES	Replace the LaserWriter I/O board.

II.R- READY/WAIT INDICATOR COMES ON BUT NO TEST PRINT IS PRODUCED

Step	Check	Result	Action
1	Is green "TEST" LED on rear connector plate of printer blinking continuously?	YES	Replace LaserWriter I/O board
2	Is 5VDC supplied to pins 3 and 4 of connector J3 on the LaserWriter I/O board?	NO	Check wiring between connector J3 and I/F regulator located in the pedestal of the printer for continuity and shorts. If the wiring is good, check whether the fuse on the I/F regulator is blown. Replace as necessary. If it blows again, there is a short that must be located and repaired.
3	Does only the fuse on the I/F regulator blow, with the rest of the printer still receiving power?	YES	The short is located in the wiring between the I/F regulator and the LaserWriter I/O board or on the LaserWriter I/O board itself.
4	Are other major subassemblies not receiving power or is circuit breaker CB1 blown?	YES	Go to "THERE IS NO POWER."

III- PAPER JAMS

Paper in the printer passes through four main areas: (1) manual feed area (2) cassette feed area (3) separation/feed area and (4) fuser/delivery area. Frequent jams in any area indicate that the area should be checked and repaired or cleaned and lubricated.



III.A- MANUAL FEED UNIT

Step	Check	Result	Action
1	Is approved print paper being used?	NO	Use approved paper (16-21 Lb. standard photocopier paper).
2	Is the paper wrinkled or curled?	YES	Replace the paper and make sure that the paper is stored correctly.
3	Does the paper detection arm move smoothly?	NO	Adjust the arm motion until it is smooth.
4	Is the lower feed roller dirty?	YES	Clean with alcohol.
5	Does the lower feed roller show deformation due to wear?	YES	Replace the roller if worn.
6	Are the paper guides deformed?	YES	Replace deformed guides as necessary.
7	Open the upper half of the printer and switch the power on. Actuate the door switch with a screwdriver.	NO	Check the wiring between J210 on the DC Controller PCB and the registration shutter solenoid SL1 for continuity. Also check the connectors. If no problems are found replace the registration shutter solenoid.

III.B- CASSETTE PICKUP ASSEMBLY

Step	Check	Result	Action
1	Is the internal cassette loaded with more than 10mm of paper?	YES	Remove the excess paper.
2	Is approved print paper being used?	NO	Use approved paper (16-21 Lb. satandard photocopier paper).
3	Is the paper wrinkled or curled?	YES	Replace the paper and make sure that the paper is stored correctly.
4	Is the cassette installed properly in the printer?	NO	Install the cassette properly.
5	Is the cassette spring lifting force as specified?	NO	Check the movement of the cassette plate. If OK, replace the cassette springs.
6	Is the right or left cassette hold-down tab deformed?	YES	Replace the hold-down tabs as necessary.
7	Does the paper pickup guide close firmly?	NO	Replace the paper pickup guide springs (front and rear).
8	Are any of the feed rollers dirty?	YES	Clean with a damp cloth, then with a dry cloth.
9	Are any pickup rollers dirty or deformed or worn?	YES	Clean rollers with alcohol or replace as necessary.
10	Is the pickup clutch spring deformed or rusty or worn?	YES	Replace the clutch spring.

III.C- SEPARATION/FEEDER UNIT

Step	Check	Result	Action
1	Is the separation belt damaged or twisted?	YES	Replace the separation belt.
2	Is the separation belt inside out?	YES	Reinstall correctly. The notched side of the belt should be facing away from the I/O connector plate.
3	Is any roller dirty or worn?	YES	Clean dirty rollers as necessary. Replace separation/feeder unit if rollers are badly worn.
4	Do pinch rollers press firmly against separation and feeder rollers?	NO	Replace the pinch roller spring.
5	Are the feeder rollers dirty or worn?	YES	Clean with alcohol if dirty and replace if worn.
6	Are the transfer guides deformed in any way?	YES	Replace the transfer guides.
7	Is the guide wire on the transfer corona assembly broken?	YES	Restring the guide wire.
8	Are the two strips of mylar tape located on the transfer corona wire termination covers loose or missing?	YES	Replace the corona assembly wire termination covers as necessary.

III.D- FUSER/DELIVERY AREA

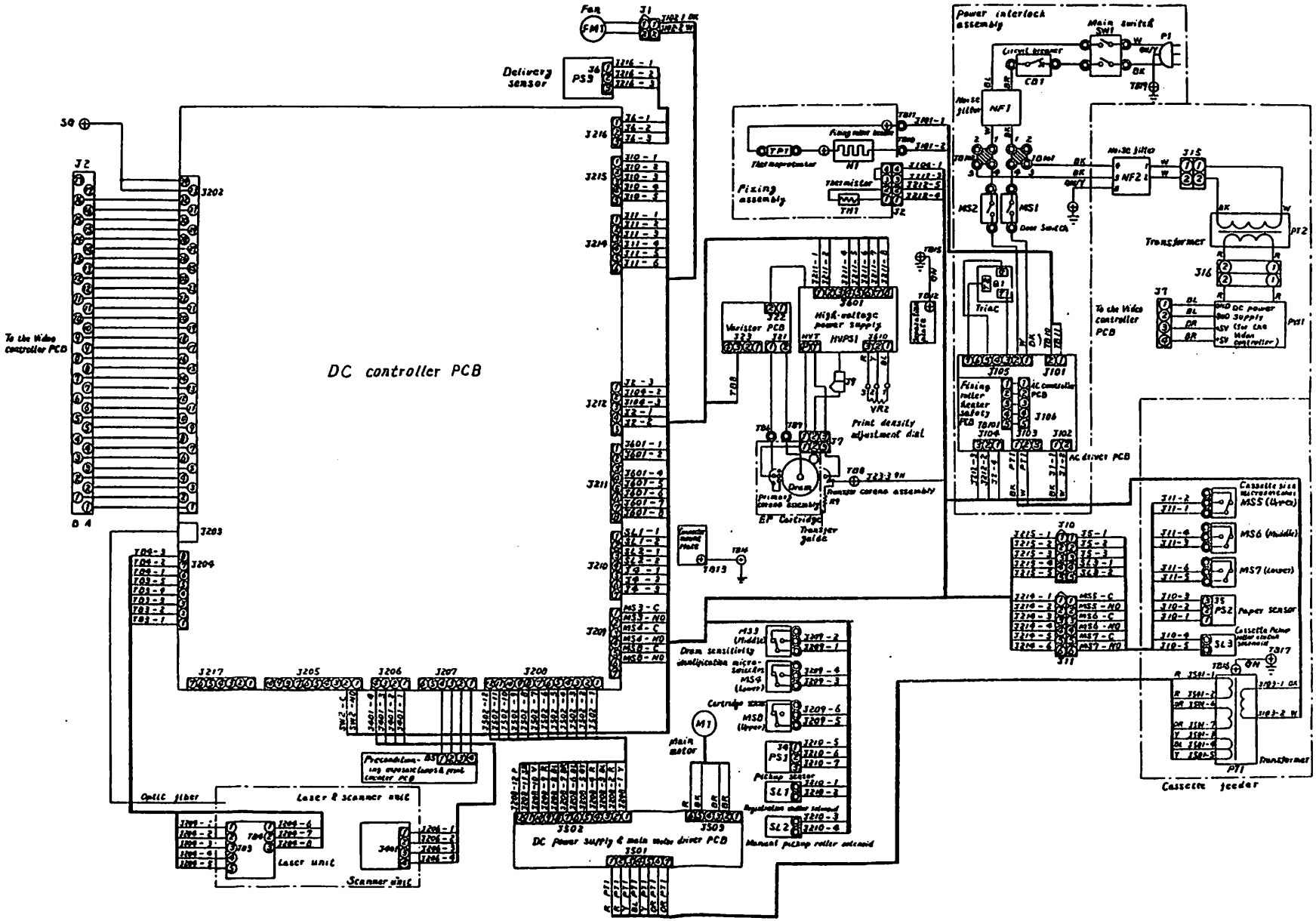
Step	Check	Result	Action
1	Is the fuser roller cleaner felt dirty?	YES	Replace the fuser roller cleaner felt.
2	Are the entrance guides dirty?	YES	Clean the guides.
3	Are the separation claws worn?	YES	Replace claws as necessary.
4	Are the lower delivery guides dirty?	YES	Clean the guides.
5	Are the upper delivery guides dirty?	YES	Clean the guides.
6	Does the paper delivery sensor arm move freely?	NO	Repair to restore free motion.

III.E- INCOMPLETE FEED-SHEETS STUCK TOGETHER

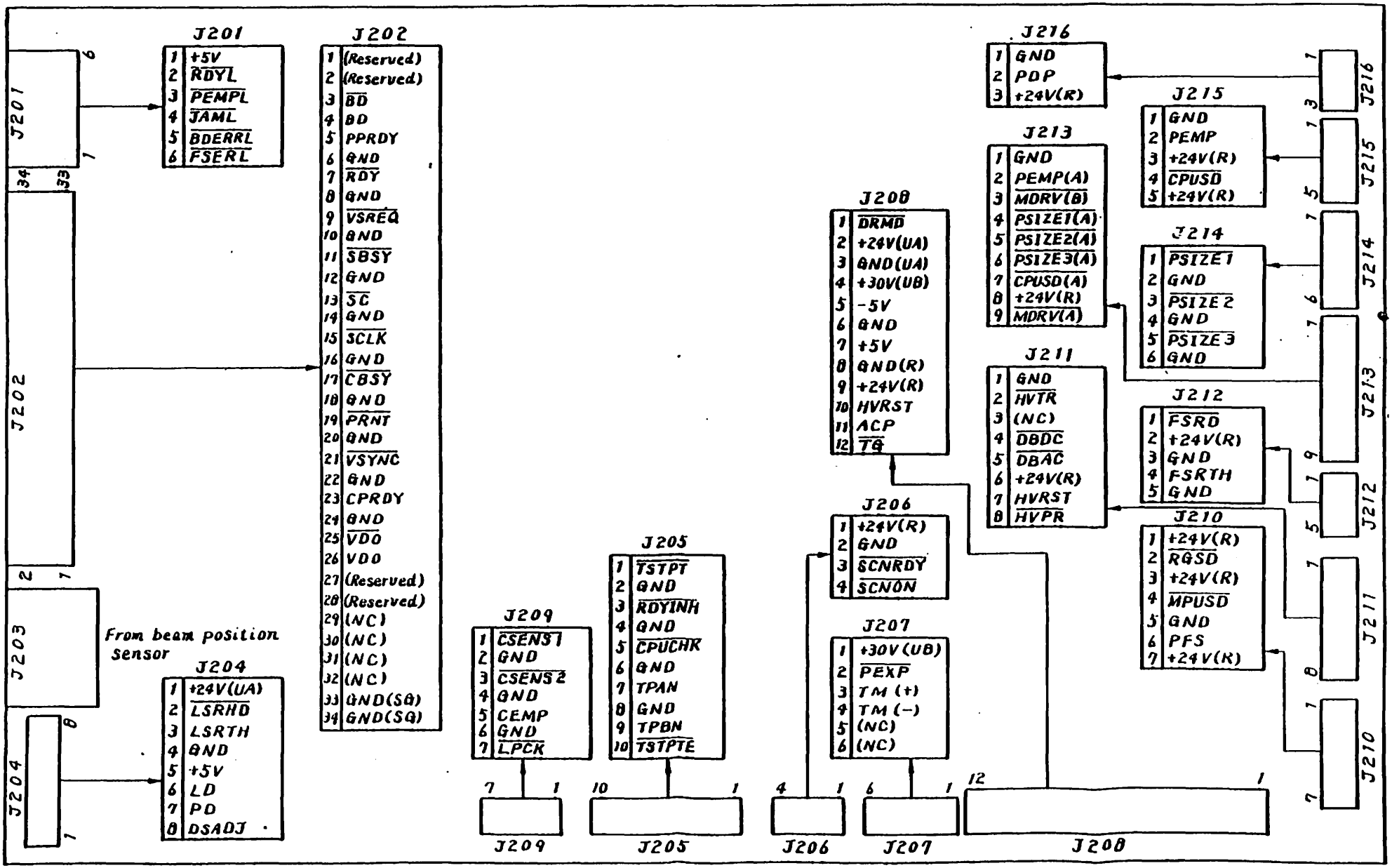
Step	Check	Result	Action
1	Is approved print paper being used?	NO	Use approved paper (16-21 Lb. standard photocopier paper).
2	Is the cassette spring lifting force as specified?	NO	Check the movement of the cassette plate. If OK, replace the cassette springs.
3	Are the cassette side plates worn?	YES	Replace as necessary.

Appendix

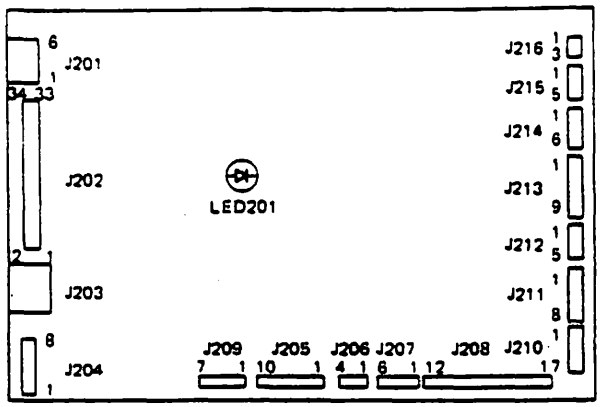
Contents:



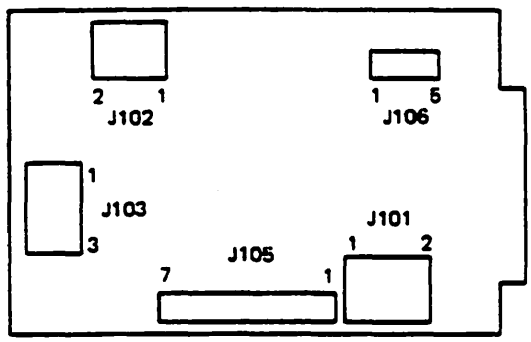
Wiring Diagram



DC Controller Board Signals and Connectors

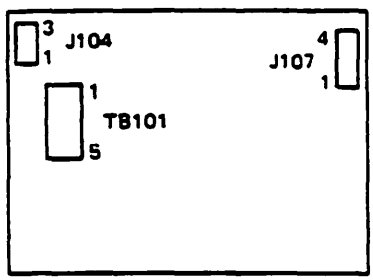


Connector Locations on the DC Controller PCB



Lower Board

Upper Board



Connector Locations on the AC Driver PCB

MACINTOSH OFFICE (APPLETALK)
TECHNICAL PROCEDURES

TABLE OF CONTENTS

Section 1: Macintosh Office Troubleshooting

Appendix A: AppleTalk Hardware Description

MACINTOSH OFFICE (APPLETALK)
TECHNICAL PROCEDURES

SECTION 1

Macintosh Office Troubleshooting

Contents:

MACINTOSH OFFICE TROUBLESHOOTING GUIDE

To Troubleshoot Your Macintosh™ Office:

(A) Collect the Following Items:

AppleTalk Installation Guide
LaserWriter (Owner's) Manual
2 Known Good LaserWriter Test Disks
AppleTalk™ Personal Network Components

(B) Familiarize Yourself With AppleTalk Components.

Refer to the Appendix to make sure you can identify the AppleTalk Personal Network components.

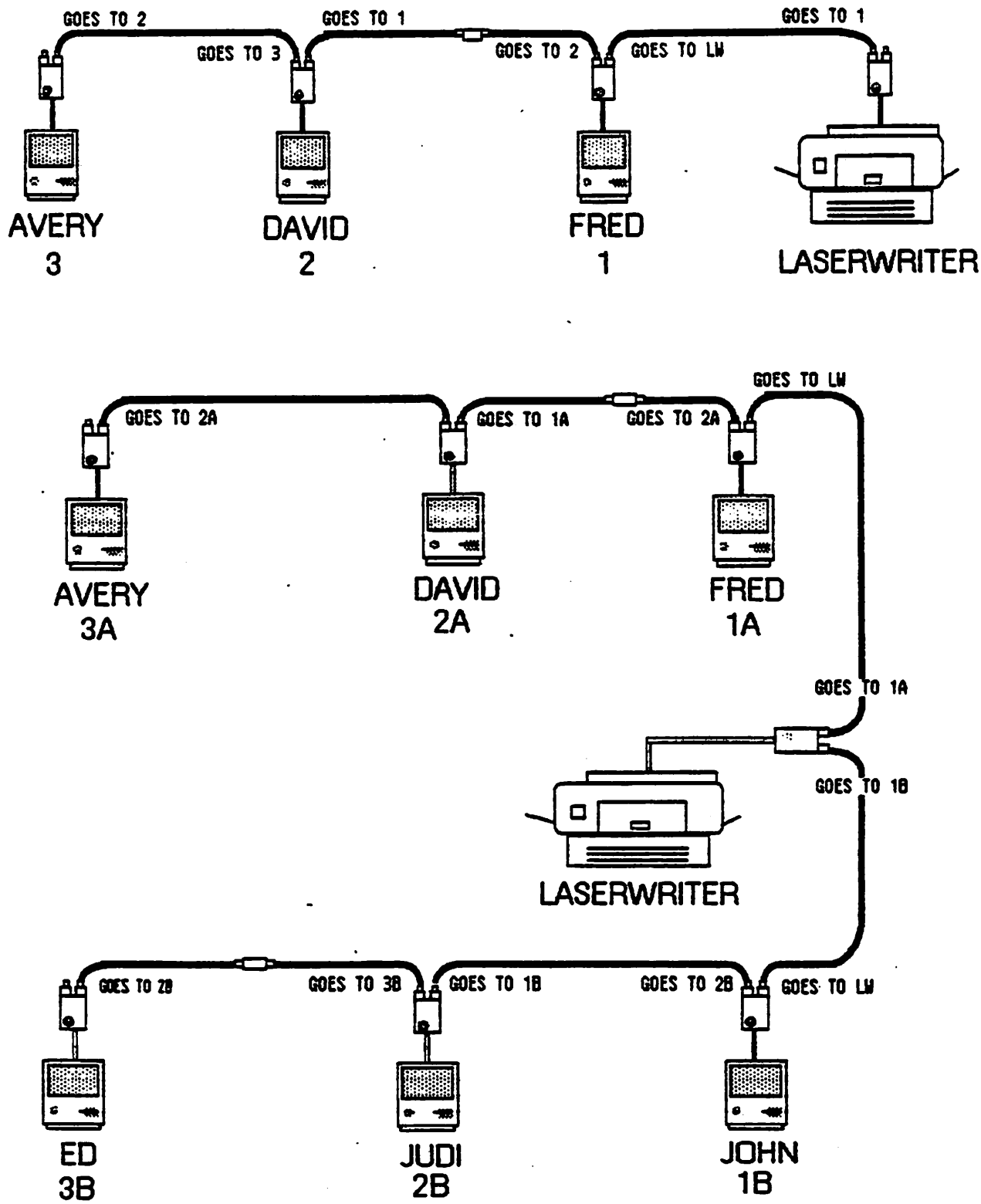
(C) Draw a Node Location Diagram.

In order to isolate a problem to a particular node or connection, you need to know where each node is located in relation to the LaserWriter printer.

If you don't have an accurate diagram, turn the page and follow the directions.

If you already have an up to date diagram, then go to (D) "Perform the Troubleshooting Procedure".

NODE LOCATION DIAGRAM



Ⓒ Draw a Node Location Diagram. (continued)

A *node* is an AppleTalk connector and the device attached to it (Macintosh, Macintosh XL, LaserWriter, etc.).

A *Node Location Diagram* is a drawing of a Macintosh Office installation showing the location of all the devices on the network (Macintoshes, file servers, LaserWriters, etc.).

1. Number each node according to its sequence away from the LaserWriter (see the illustration on the opposite page).

   If the LaserWriter is somewhere in the middle of the network, number one side 1A, 2A, 3A etc. and the other side 1B, 2B, etc.

   Distances are not important for the diagram.
   The main reason for the diagram is to show which node is the first one connected to the LaserWriter, which is second, etc., and where the cable extenders are located.

2. Label all of the connector boxes in the network with their respective node numbers.

3. Label the plugs on both ends of every network cable with the node to which the cable leads (see the illustration on the opposite page).

Go to Ⓓ "Perform the Troubleshooting Procedure".

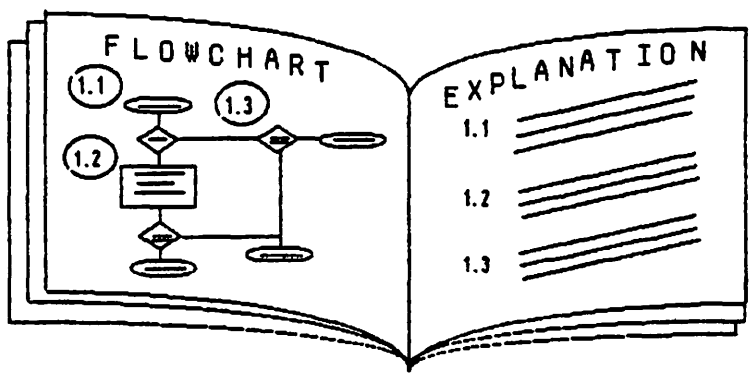
(D) Perform the Troubleshooting Procedure.

IMPORTANT: 1. You need to know that:
A *node* is an AppleTalk connector and the device attached to it (Macintosh, LaserWriter, etc.).

A *network bus* is the entire connected length of network cables and connection boxes.

2. Troubleshooting may interfere with the customers use of the network — so, if possible, perform this procedure when there is little or no activity (for example, at lunch time or after work).

3. Each troubleshooting procedure is made up of flowcharts. If you have a question about one of the steps in a flowchart, you can find an explanation of that step on the opposite page.



Find the Proper Flowchart.

Macintosh Office problems become apparent when attempting to print to the LaserWriter. These printing problems may present themselves in a variety of ways. They may be seen on a node computer as a system error message, system hang, constantly running disk drive, etc.

On the following page, determine which symptom best describes the problem. Then perform the suggested procedure.

SYMPTOM: Problems Printing to a LaserWriter Due To Installation Error.

Mistakes made during installation include:

* Connecting the AppleTalk Network cable so that it forms a closed loop (circular network).
* Not terminating the network cable into a connection box (dangling cable).
* Starting up an AppleTalk device before connecting it to the network.

If you have problems with a recently installed network, refer to the Troubleshooting section in the *AppleTalk Installation Guide*.

SYMPTOM: Only One Node Has Problems Printing to the LaserWriter.

This problem is usually caused by a loose connection but could be a malfunctioning computer. Go to the ONE NODE flowchart.

SYMPTOM: Two or More, But Not All Nodes Have Problems Printing to the LaserWriter.

This problem is usually a result of:

* Starting up AppleTalk on a device before connecting it to the Network OR
* A disconnected or broken network cable.

Go to the TWO OR MORE, BUT NOT ALL flowchart.

SYMPTOM: All Nodes on the Network Have Problems Printing to the LaserWriter.

This problem condition is usually a result of:

* A malfunctioning LaserWriter printer OR
* An improperly terminated network cable (broken or not terminated into a connection box) OR
* A malfunctioning node putting electronic noise on the AppleTalk network cable.

Go to the ALL NODES flowchart.

ONE NODE

1.1

1. CHECK THAT THE NETWORK CABLES ARE FIRMLY INSERTED INTO THE BAD NODE'S CONNECTOR MODULE.

2. a. *IF THE COMPUTER IS A MACINTOSH:*
   (1) CHECK THAT THE CABLE FROM THE APPLETALK CONNECTOR IS FIRMLY INSERTED INTO THE PRINTER PORT.
   (2) TURN OFF THE MACINTOSH, LOAD THE LASERWRITER TEST DISK, THEN TURN THE MACINTOSH BACK ON.

   b. *IF THE COMPUTER IS A MACINTOSH XL:*
   (1) CHECK THAT THE APPLETALK CONNECTOR IS FIRMLY INSERTED INTO PORT B.
   (2) START UP MACWORKS.
   (3) INSERT THE LASERWRITER TEST DISK.

3. PRINT THE LASERWRITER TEST DOCUMENT. (SEE COMMENTS 1 AND 2)

COMMENT 1

THE LASERWRITER TEST DISK IS A KNOWN GOOD PRECONFIGURED PROGRAM WHICH ELIMINATES DISK CONFIGURATION AS A POSSIBLE PROBLEM.

COMMENT 2

PRINTING PROBLEMS CAN BE INDICATED BY A SYSTEM ERROR MESSAGE, CONSTANTLY RUNNING DISK DRIVE, SYSTEM HANG, ETC.

COMMENT 3

IF THE NODE PRINTS CORRECTLY WITH THE TEST DISK, THE HARDWARE MUST BE OK. THE CONFIGURATION OF THE ORIGINAL DISK SHOULD NOW BE CHECKED SINCE IT MAY HAVE BEEN THE CAUSE OF THE PROBLEM.

1.2

TEST PRINT OK ? (SEE COMMENT 2)

N → REPLACE THE APPLETALK CONNECTOR THEN RETRY THE PRINT.

REPLACE THE APPLETALK CONNECTOR THEN RETRY THE PRINT.

TEST PRINT OK ?

N → REPLACE THE NODE'S COMPUTER. REFER TO THE APPROPRIATE LEVEL I TECHNICAL PROCEDURE TO REPAIR THE COMPUTER.

Y → REFER TO THE LASERWRITER OWNER'S MANUAL TO CHECK THE CONFIGURATION OF THE APPLICATION DISK USED WHEN THE PROBLEM WAS ENCOUNTERED (SEE COMMENT 3).

Y

EXIT

Explanation for the ONE NODE Flowchart

(1.1) This procedure should be performed if only one user node has problems printing to the LaserWriter.

The first step is to make sure that the AppleTalk connector is inserted into the correct socket for the type of computer used.

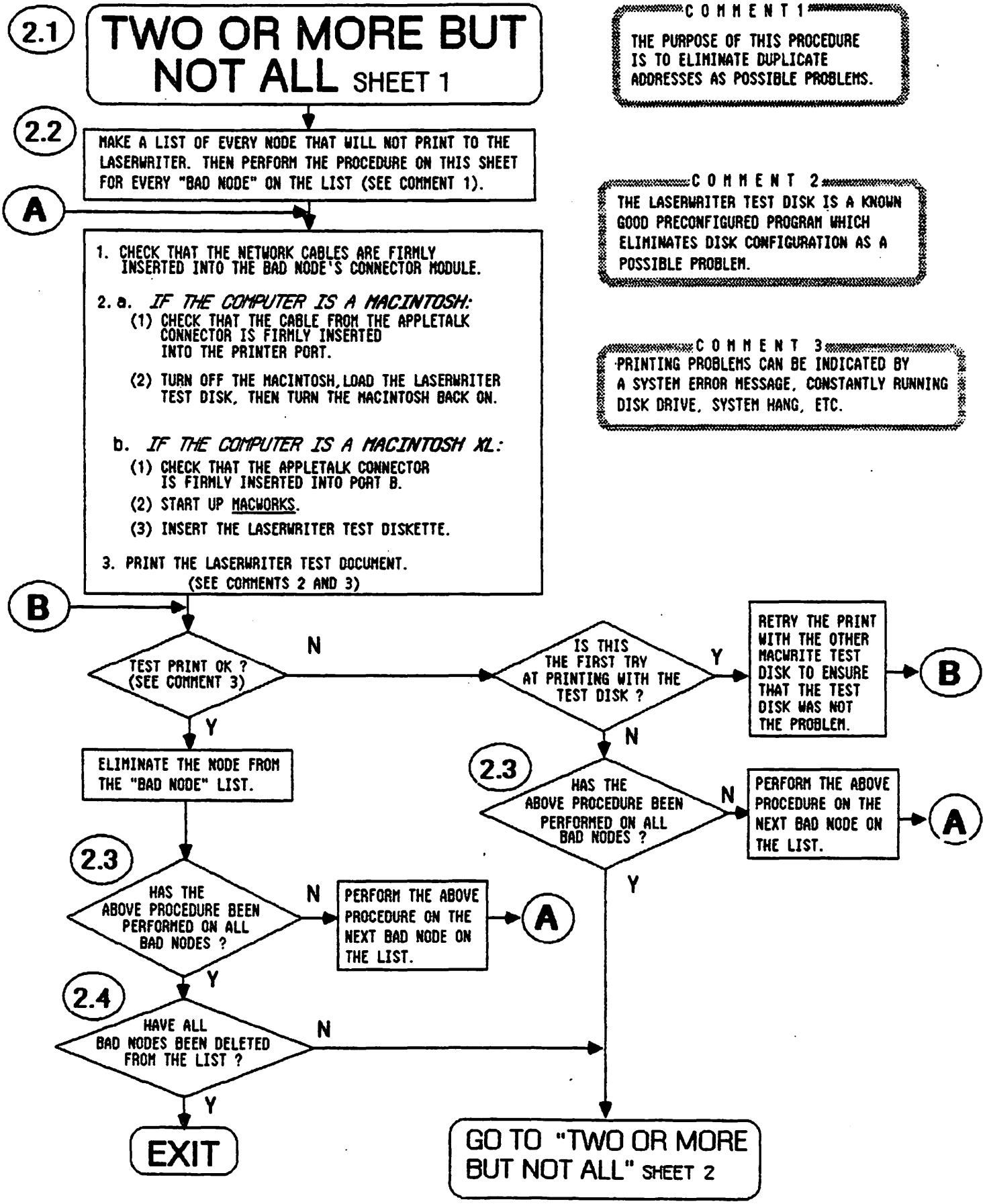
Using the LaserWriter Test Disk eliminates the possibility that the problem is being caused by a bad disk.

(1.2) If you can't print with the preconfigured test disk, there is a hardware problem, which may be a bad AppleTalk connector or a malfunctioning computer.

The LaserWriter is not at fault since the other nodes in the network are not affected.

Usually the problem is not in the network cable because they are connected serially through the AppleTalk connectors, and if a network cable is broken, all of the nodes beyond the break are affected. However, if there were a bad network cable for a node on either end of the bus, then it would probably only affect the one end node.

If the print is successful with the test disk, the node computer is properly connected to the network and is working properly. In this case, suspect the application disk used when the original failure occurred.


2.1
TWO OR MORE BUT NOT ALL SHEET 1
2.2
MAKE A LIST OF EVERY NODE THAT WILL NOT PRINT TO THE LASERWRITER. THEN PERFORM THE PROCEDURE ON THIS SHEET FOR EVERY "BAD NODE" ON THE LIST (SEE COMMENT 1).
A
1. CHECK THAT THE NETWORK CABLES ARE FIRMLY INSERTED INTO THE BAD NODE'S CONNECTOR MODULE.
2. a. IF THE COMPUTER IS A MACINTOSH:
(1) CHECK THAT THE CABLE FROM THE APPLETALK CONNECTOR IS FIRMLY INSERTED INTO THE PRINTER PORT.
(2) TURN OFF THE MACINTOSH, LOAD THE LASERWRITER TEST DISK, THEN TURN THE MACINTOSH BACK ON.
b. IF THE COMPUTER IS A MACINTOSH XL:
(1) CHECK THAT THE APPLETALK CONNECTOR IS FIRMLY INSERTED INTO PORT B.
(2) START UP MACWORKS.
(3) INSERT THE LASERWRITER TEST DISKETTE.
3. PRINT THE LASERWRITER TEST DOCUMENT. (SEE COMMENTS 2 AND 3)
B
TEST PRINT OK ? (SEE COMMENT 3)
N
IS THIS THE FIRST TRY AT PRINTING WITH THE TEST DISK ?
Y
RETRY THE PRINT WITH THE OTHER MACWRITE TEST DISK TO ENSURE THAT THE TEST DISK WAS NOT THE PROBLEM.
B
Y
ELIMINATE THE NODE FROM THE "BAD NODE" LIST.
N
2.3
HAS THE ABOVE PROCEDURE BEEN PERFORMED ON ALL BAD NODES ?
N
PERFORM THE ABOVE PROCEDURE ON THE NEXT BAD NODE ON THE LIST.
A
Y
2.3
HAS THE ABOVE PROCEDURE BEEN PERFORMED ON ALL BAD NODES ?
N
PERFORM THE ABOVE PROCEDURE ON THE NEXT BAD NODE ON THE LIST.
A
Y
2.4
HAVE ALL BAD NODES BEEN DELETED FROM THE LIST ?
N
Y
EXIT
GO TO "TWO OR MORE BUT NOT ALL" SHEET 2
COMMENT 1
THE PURPOSE OF THIS PROCEDURE IS TO ELIMINATE DUPLICATE ADDRESSES AS POSSIBLE PROBLEMS.
COMMENT 2
THE LASERWRITER TEST DISK IS A KNOWN GOOD PRECONFIGURED PROGRAM WHICH ELIMINATES DISK CONFIGURATION AS A POSSIBLE PROBLEM.
COMMENT 3
PRINTING PROBLEMS CAN BE INDICATED BY A SYSTEM ERROR MESSAGE, CONSTANTLY RUNNING DISK DRIVE, SYSTEM HANG, ETC.

Explanation for the TWO OR MORE BUT NOT ALL Flowchart

(2.1) This procedure should be performed if more than one, but not all, of the nodes are having problems printing to the LaserWriter.

The most probable cause of this type of problem is duplicate addresses or a dangling/broken network cable.

A disk configuration problem is not likely since more than one node is involved. In any event, by using the LaserWriter Test Disk to perform the test print, you eliminate the possibility of a bad disk.

Nor can the problem be with the LaserWriter because if it were, then all the nodes would be affected.

(2.2) Whenever a node starts up on the network, it assigns itself an address number so other nodes will have a means of directing messages to it.

Before a node can assign itself an address number, it must check to make sure there is no other node on the network with the same address.

To do this, the node transmits an inquiry message onto the network, containing the address the node wants to use for itself.

If there is another node on the network with that address, the other node will respond to the inquiry.

(Continued on the next page).

(2.2) (continued)

If the original node receives a response, it will select another address to test. This will go on until the node finds an address that is not being used by any other node on the network.

When the node finds an unused address it will claim that address as its own until it is taken off the network. When the node is started up again it will repeat the above process to find a usable address.

Once a node has obtained an address on the network, it will compare it to the address in every message that is sent by the other nodes on the network.

When the node recognizes its own address, it will read the message attached to the address.

Starting up a node while it is not connected to the network and then connecting it afterwards can cause redundant addresses. This is because if a node is not connected to the network when started up, then the rest of the nodes cannot respond to its address inquiry.

In the case described above, the node will always assume the first address it tests is OK. Yet another node on the network may be using that same address.

(Continued on the next page).

(2.2) (continued)

When two nodes have the same address, both will respond when the address is used. Since no more than one node can be transmitting on the network at a time, these responses collide and are unintelligible, much the same as when two people are speaking at the same time.

Starting up each bad node while it is connected to the network will cause it to perform a proper address inquiry, thereby eliminating possible duplicate addresses.

(2.3) Duplicate addresses or a dangling/broken network cable are the most common reasons for performing the "TWO OR MORE BUT NOT ALL" flowchart.

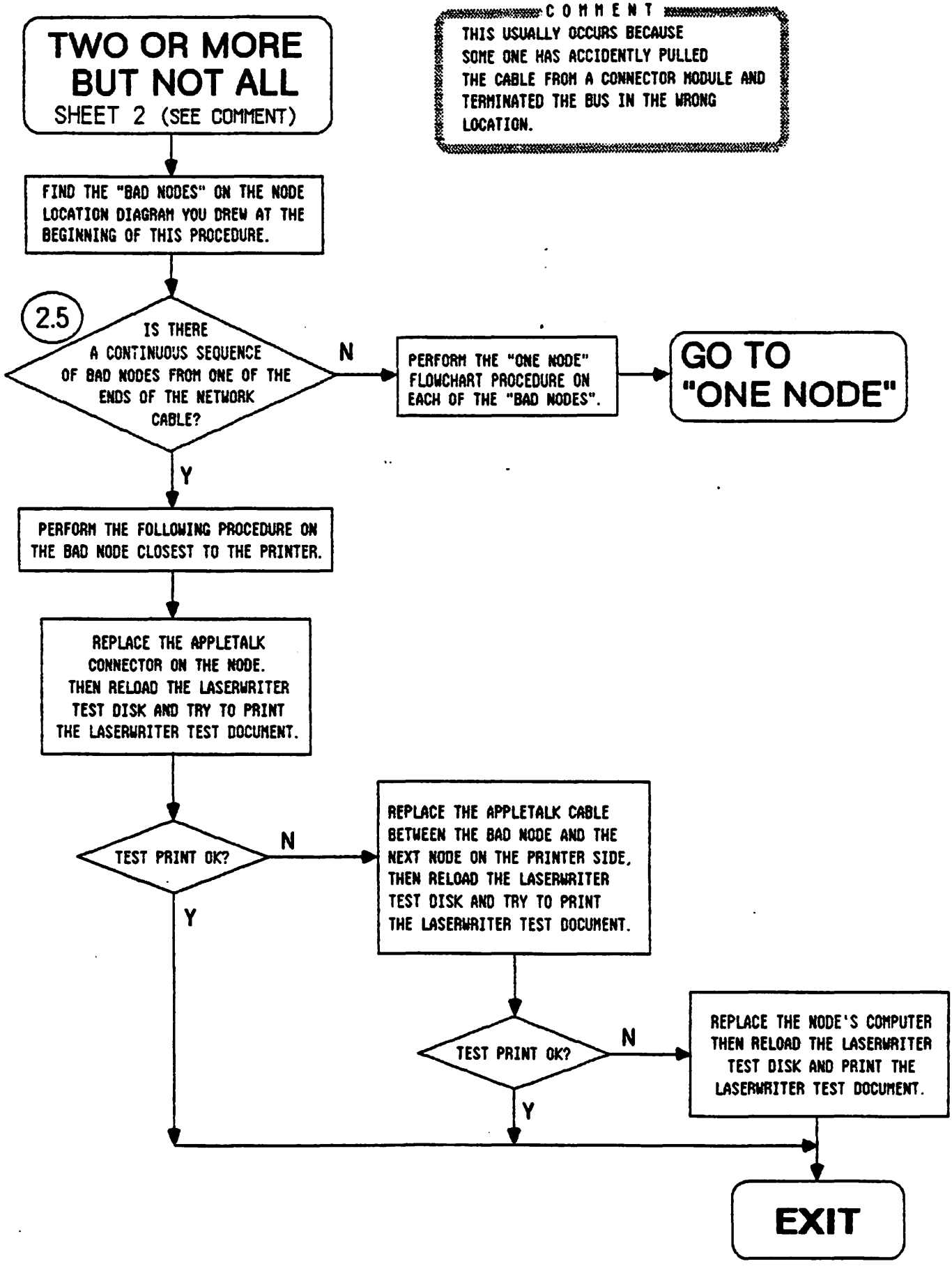
Sheet 1 is concerned with eliminating duplicate addresses while Sheet 2 is directed at hardware problems.

Sheet 2 requires that you know the location of all the bad nodes with hardware problems.

Because duplicate address problems can be confused with hardware problems Sheet 1 has you eliminate **all** duplicate address problems (see 2.2 above) first before going to Sheet 2.

(2.4) If all the bad nodes can print after the procedure to eliminate duplicate addresses (see 2.2 above) then that must have been the only problem.

(Continued on the next page).


TWO OR MORE BUT NOT ALL
SHEET 2 (SEE COMMENT)
COMMENT
THIS USUALLY OCCURS BECAUSE SOME ONE HAS ACCIDENTLY PULLED THE CABLE FROM A CONNECTOR MODULE AND TERMINATED THE BUS IN THE WRONG LOCATION.
FIND THE "BAD NODES" ON THE NODE LOCATION DIAGRAM YOU DREW AT THE BEGINNING OF THIS PROCEDURE.
2.5
IS THERE A CONTINUOUS SEQUENCE OF BAD NODES FROM ONE OF THE ENDS OF THE NETWORK CABLE?
N
PERFORM THE "ONE NODE" FLOWCHART PROCEDURE ON EACH OF THE "BAD NODES".
GO TO "ONE NODE"
Y
PERFORM THE FOLLOWING PROCEDURE ON THE BAD NODE CLOSEST TO THE PRINTER.
REPLACE THE APPLETALK CONNECTOR ON THE NODE. THEN RELOAD THE LASERWRITER TEST DISK AND TRY TO PRINT THE LASERWRITER TEST DOCUMENT.
TEST PRINT OK?
N
REPLACE THE APPLETALK CABLE BETWEEN THE BAD NODE AND THE NEXT NODE ON THE PRINTER SIDE, THEN RELOAD THE LASERWRITER TEST DISK AND TRY TO PRINT THE LASERWRITER TEST DOCUMENT.
Y
TEST PRINT OK?
N
REPLACE THE NODE'S COMPUTER THEN RELOAD THE LASERWRITER TEST DISK AND PRINT THE LASERWRITER TEST DOCUMENT.
Y
EXIT

Explanation for the TWO OR MORE BUT NOT ALL Flowchart

(2.5) Since the network cables are connected serially through the AppleTalk connectors, if a network cable is broken, all of the nodes beyond the break will be affected.

The idea at this point is to determine whether the nodes are bad due to a broken or dangling network cable, or due to node specific problems that are unrelated to each other.

If there is a broken or dangling cable, then the bad nodes will be located in sequence from one end of the network bus. The "TWO OR MORE BUT NOT ALL" flowchart procedure checks each hardware component that could be causing this kind of problem.

If the bad nodes are not in sequence, their problems are probably unrelated. By performing the "ONE NODE" flowchart procedure on each bad node, you check each hardware component that could be causing this type of problem.

ALL NODES
SHEET 1

3.1

1. TURN OFF THE LASERWRITER, THEN TURN IT ON AND ***WAIT*** FOR A TEST PRINT.
2. COMPARE THE TEST PRINT WITH FIGURE 1 ON THE OPPOSITE PAGE.
3. CONFIRM THAT THE PRINTOUT IS CLEAR AND THAT THE "COMMUNICATIONS INDICATOR" IS "APPLETALK" AS SHOWN IN THE DIAGRAM. (SEE COMMENT 1)

3.2

TEST PRINT OK?

N → GO TO THE "LASERWRITER TROUBLESHOOTING PROCEDURE".

Y

STEPS 1 AND 2 ISOLATE THE LASERWRITER AND ONE NODE FROM THE REST OF THE NETWORK (SEE COMMENT 2).

1. IF THERE ARE NODES CONNECTED TO BOTH SIDES OF THE PRINTER, THEN GO TO THE PRINTER: DISCONNECT THE NODES ON ONE SIDE AND LEAVE THE OTHER SIDE CONNECTED.
2. FIND THE FIRST NODE NOW CONNECTED TO THE PRINTER. FIND THE NODE'S APPLETALK CONNECTOR. UNPLUG THE NETWORK CABLE FROM THE NODE'S APPLETALK CONNECTOR WHICH LEADS AWAY FROM THE PRINTER. LEAVE THE CABLE GOING TO THE PRINTER CONNECTED (SEE FIGURE 2 ON PAGE 21).
3. CHECK THAT THE NETWORK CABLE PLUG IS FIRMLY INSERTED INTO THE NODE'S CONNECTOR MODULE.
4. *a. IF THE COMPUTER IS A MACINTOSH:*
   (1) CHECK THAT THE CABLE FROM THE APPLETALK CONNECTOR IS FIRMLY INSERTED INTO THE PRINTER PORT.
   (2) TURN OFF THE MACINTOSH, LOAD THE LASERWRITER TEST DISK, THEN TURN THE MACINTOSH BACK ON.

   b. *IF THE COMPUTER IS A MACINTOSH XL:*
   (1) CHECK THAT THE APPLETALK CONNECTOR IS FIRMLY INSERTED INTO PORT B.
   (2) START UP MACWORKS.
   (3) INSERT THE LASERWRITER TEST DISK.
3. PRINT THE LASERWRITER TEST DOCUMENT FROM THE TEST DISK (SEE COMMENTS 3 AND 4).

3.3

TEST PRINT OK ? (SEE COMMENT 4)

N → RETRY THE PRINT WITH THE OTHER LASERWRITER TEST DISK TO ENSURE THAT THE TEST DISK WAS NOT THE CAUSE OF THE PROBLEM. → GO TO "FIRST NODE"

Y → GO TO "ALL NODES" SHEET 2

COMMENT 1

IF THE PRINTER IS DOWN, THE WHOLE NET WILL APPEAR TO BE MALFUNCTIONING. A PRINT FUNCTION PROBLEM MIGHT CAUSE THIS SYMPTOM. THIS STEP IS MEANT TO PROVE WHETHER OR NOT THE PRINT FUNCTIONS ON THE PRINTER ARE OK.

COMMENT 2

BY DISCONNECTING THE REST OF THE BUS FROM THE NODE CLOSEST TO THE PRINTER, YOU ELIMINATE ANY EFFECTS A FAULTY BUS MIGHT HAVE ON COMMUNICATIONS BETWEEN THE FIRST NODE AND THE PRINTER.

IF YOU CAN NOW PRINT FROM THE FIRST NODE, THE PRINTER'S COMMUNICATIONS FUNCTION MUST BE OK.

COMMENT 3

THE LASERWRITER TEST DISK IS A KNOWN GOOD PRECONFIGURED PROGRAM WHICH ELIMINATES DISK CONFIGURATION AS A POSSIBLE PROBLEM.

COMMENT 4

PRINTING PROBLEMS CAN BE INDICATED BY A SYSTEM ERROR MESSAGE, CONSTANTLY RUNNING DISK DRIVE, SYSTEM HANG, ETC.

Explanation for the ALL NODES Flowchart

(3.1) Problems which cause all nodes on the network to malfunction include:

* A LaserWriter malfunction.
* A communications problem between the LaserWriter and the closest node.
* A network bus problem common to all nodes on the network.

The ALL NODES flowchart is concerned with isolating the problem to one of the three possibilities above.

(3.2) The print functions of the LaserWriter are those electromechanical operations that must be performed in order for a print to occur. Every time the LaserWriter is turned on, it will produce a test print to test these functions. If the printout is clear, then the hardware which performs the print functions is operating correctly.

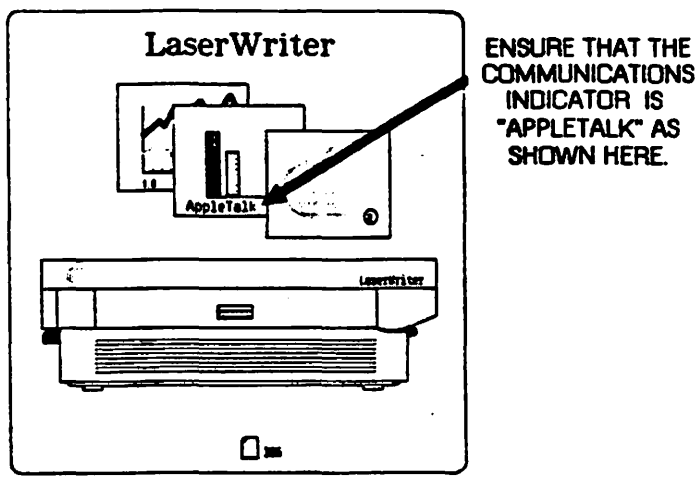
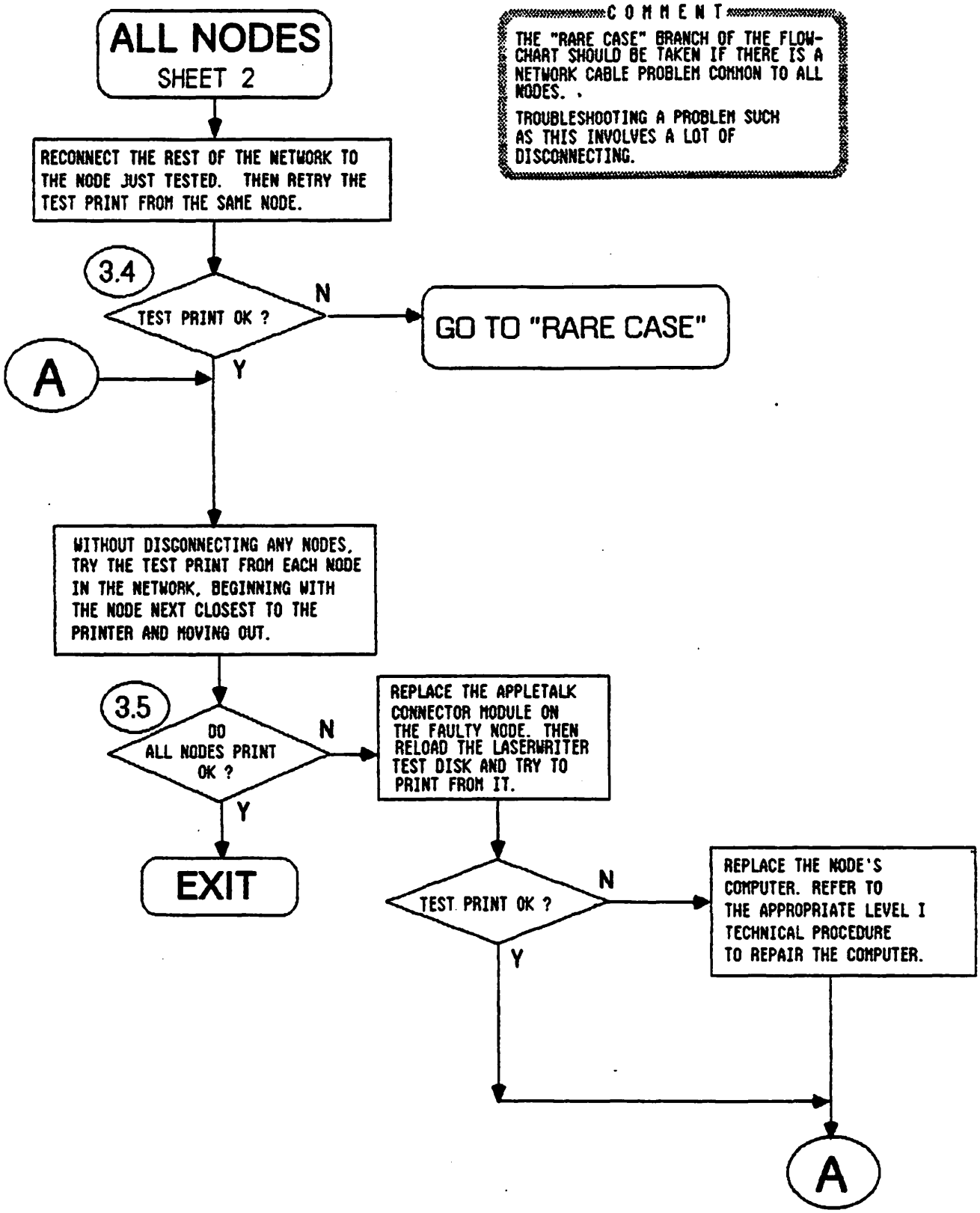


FIGURE 1

(3.3) A successful test print eliminates LaserWriter malfunction as the source of the problem (see 3.2). Nor can the problem be caused by a faulty bus since the rest of the network has been disconnected. The only remaining potential cause is a communications problem between the first node and the LaserWriter.

The FIRST NODE flowchart addresses the LaserWriter - first node communication problem.

(Continued on the next page).


ALL NODES
SHEET 2
COMMENT
THE "RARE CASE" BRANCH OF THE FLOW-CHART SHOULD BE TAKEN IF THERE IS A NETWORK CABLE PROBLEM COMMON TO ALL NODES.
TROUBLESHOOTING A PROBLEM SUCH AS THIS INVOLVES A LOT OF DISCONNECTING.
RECONNECT THE REST OF THE NETWORK TO THE NODE JUST TESTED. THEN RETRY THE TEST PRINT FROM THE SAME NODE.
3.4
TEST PRINT OK ?
N
GO TO "RARE CASE"
A
Y
WITHOUT DISCONNECTING ANY NODES, TRY THE TEST PRINT FROM EACH NODE IN THE NETWORK, BEGINNING WITH THE NODE NEXT CLOSEST TO THE PRINTER AND MOVING OUT.
3.5
DO ALL NODES PRINT OK ?
N
REPLACE THE APPLETALK CONNECTOR MODULE ON THE FAULTY NODE. THEN RELOAD THE LASERWRITER TEST DISK AND TRY TO PRINT FROM IT.
Y
EXIT
TEST PRINT OK ?
N
REPLACE THE NODE'S COMPUTER. REFER TO THE APPROPRIATE LEVEL I TECHNICAL PROCEDURE TO REPAIR THE COMPUTER.
Y
A

(3.4) If a node works when isolated from the rest of the network but doesn't work when reconnected to the network, a network bus problem is indicated.

The RARE CASE flowchart addresses this situation.

(3.5) At this point, you have proven that the print functions of the LaserWriter, the communications between the LaserWriter and the closest node, and the network cable bus all operate properly.

The rest of the ALL NODES flowchart is concerned with checking that the remainder of the nodes in the network operate correctly.

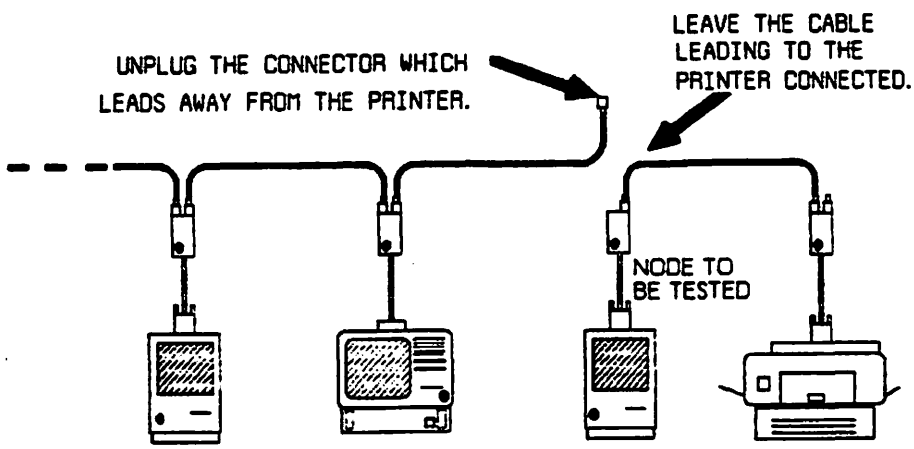
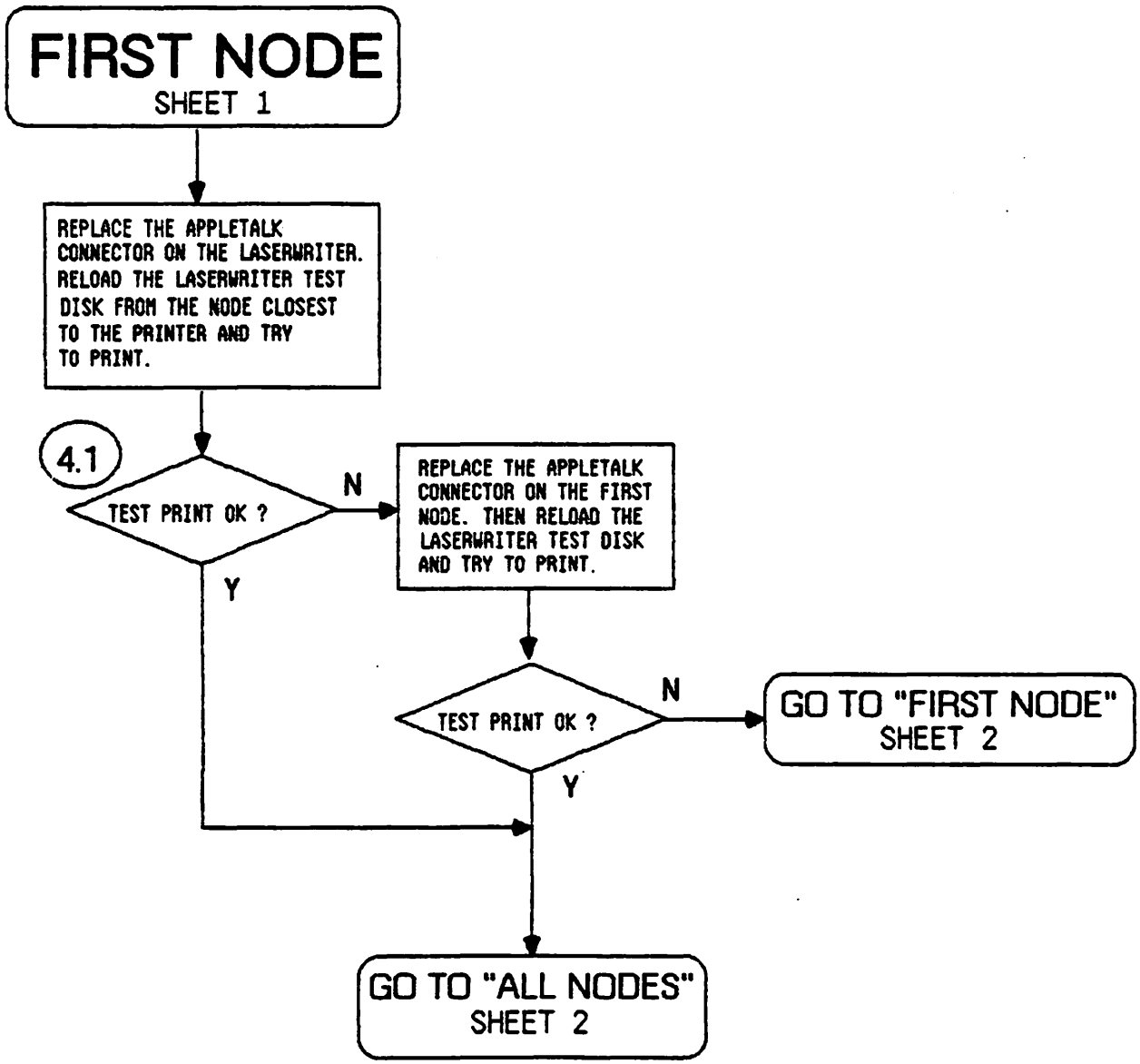


FIGURE 2

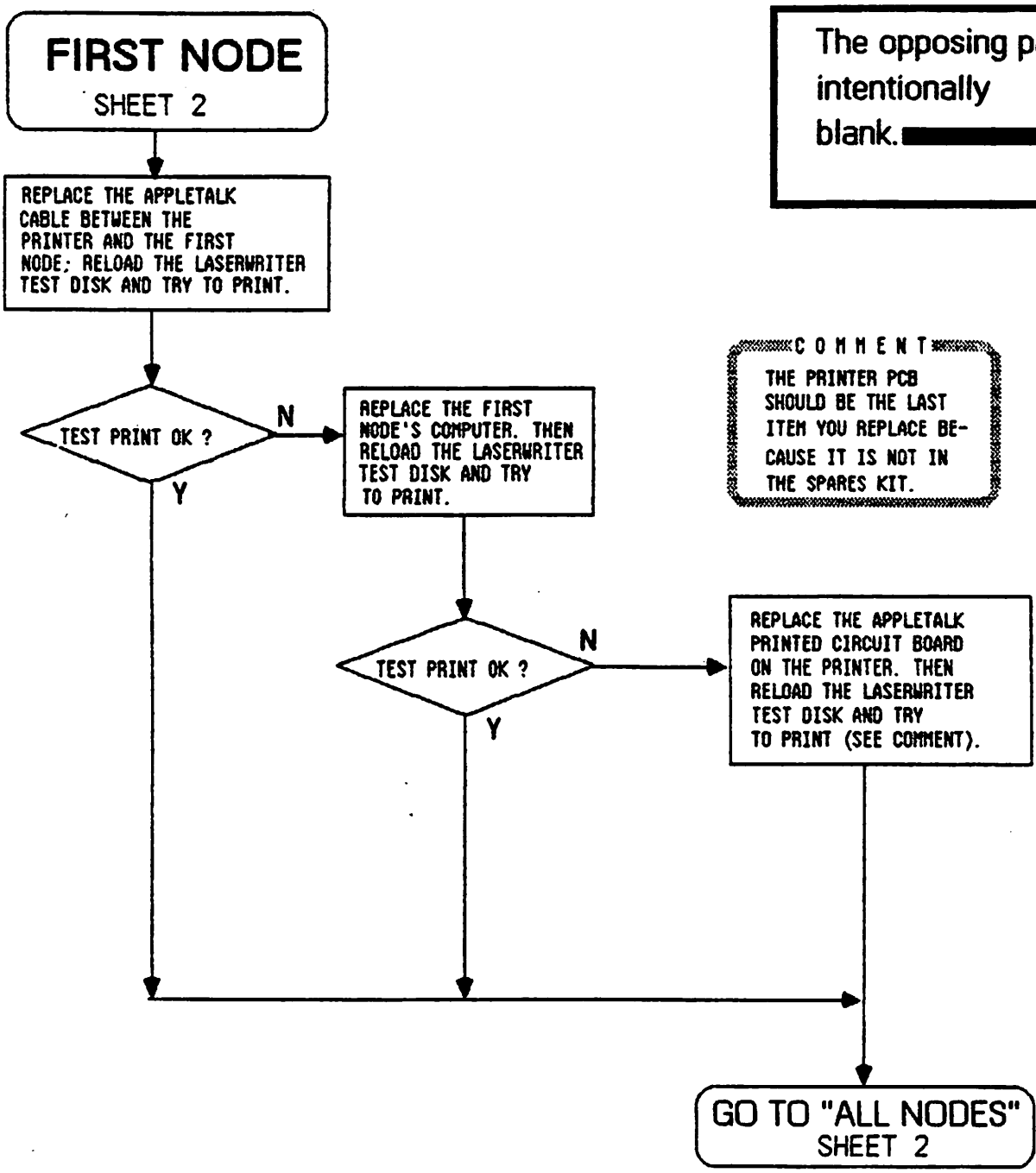
Figure 2 is referred to by Sheet 1 of the ALL NODES flowchart.

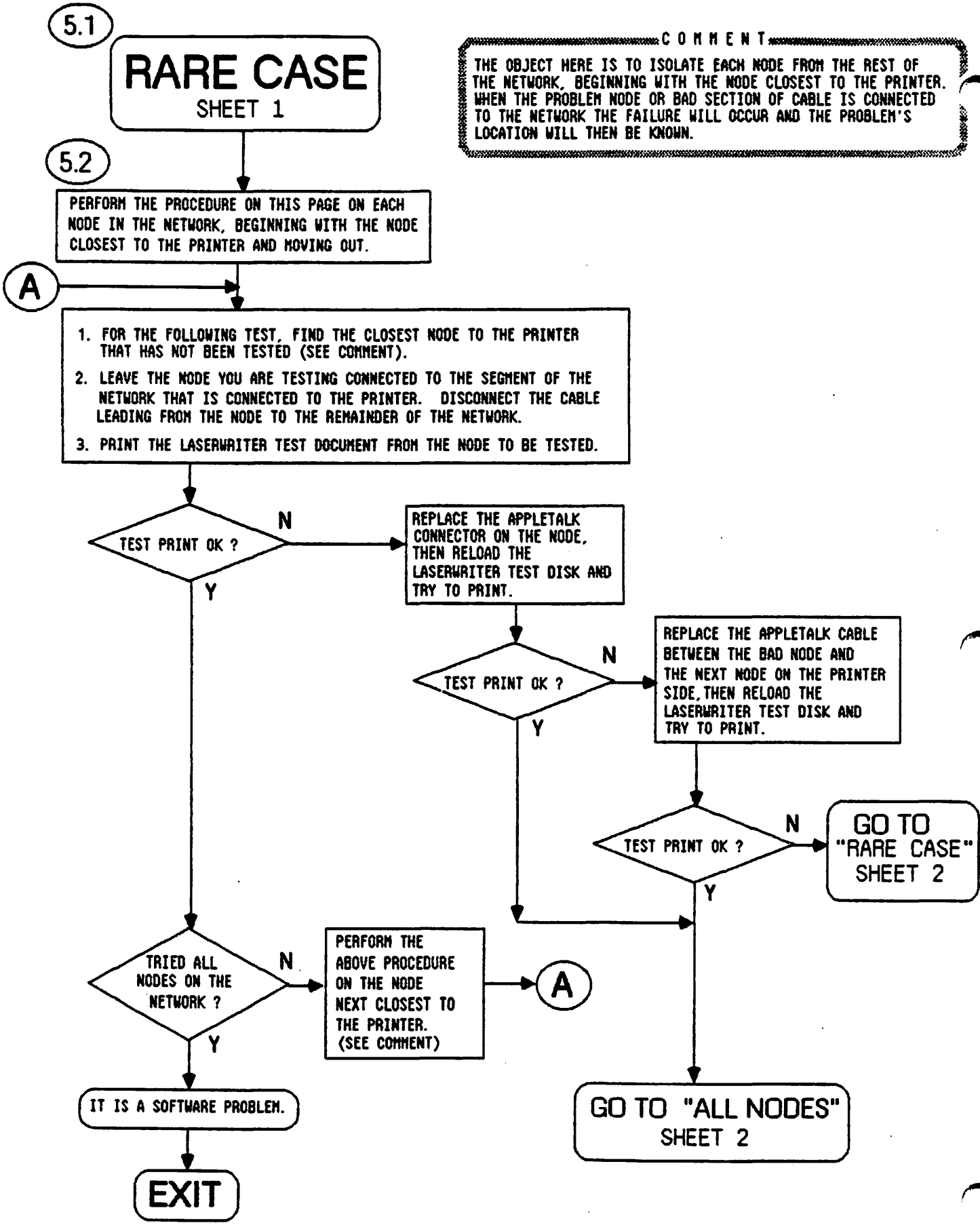

FIRST NODE
SHEET 1
REPLACE THE APPLETALK CONNECTOR ON THE LASERWRITER. RELOAD THE LASERWRITER TEST DISK FROM THE NODE CLOSEST TO THE PRINTER AND TRY TO PRINT.
4.1
TEST PRINT OK ?
N
Y
REPLACE THE APPLETALK CONNECTOR ON THE FIRST NODE. THEN RELOAD THE LASERWRITER TEST DISK AND TRY TO PRINT.
TEST PRINT OK ?
N
Y
GO TO "FIRST NODE" SHEET 2
GO TO "ALL NODES" SHEET 2

Explanation for the FIRST NODE Flowchart

(4.1) This procedure should be used if the communications between the LaserWriter and the node closest to it are isolated and an attempt to print from the node is still unsuccessful.

The "FIRST NODE" flowchart procedure has you replace each hardware item that could possibly cause the problem.


FIRST NODE
SHEET 2
The opposing page intentionally blank.
REPLACE THE APPLETALK CABLE BETWEEN THE PRINTER AND THE FIRST NODE; RELOAD THE LASERWRITER TEST DISK AND TRY TO PRINT.
TEST PRINT OK ?
N
Y
REPLACE THE FIRST NODE'S COMPUTER. THEN RELOAD THE LASERWRITER TEST DISK AND TRY TO PRINT.
COMMENT
THE PRINTER PCB SHOULD BE THE LAST ITEM YOU REPLACE BECAUSE IT IS NOT IN THE SPARES KIT.
TEST PRINT OK ?
N
Y
REPLACE THE APPLETALK PRINTED CIRCUIT BOARD ON THE PRINTER. THEN RELOAD THE LASERWRITER TEST DISK AND TRY TO PRINT (SEE COMMENT).
GO TO "ALL NODES"
SHEET 2

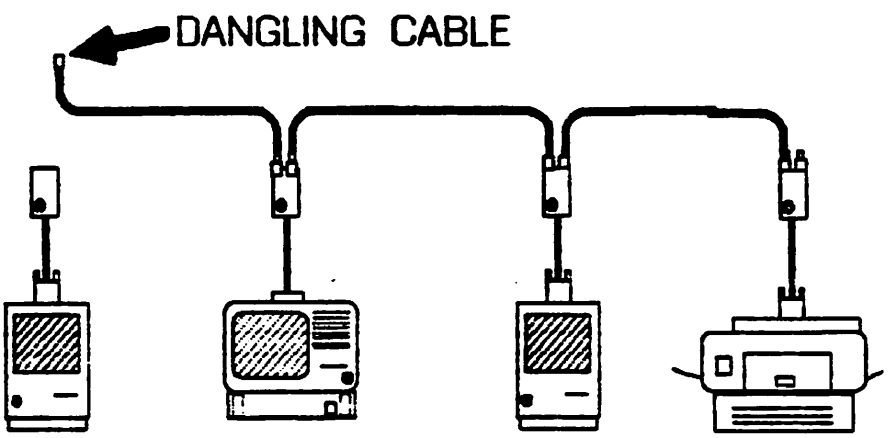

5.1
RARE CASE
SHEET 1
COMMENT
THE OBJECT HERE IS TO ISOLATE EACH NODE FROM THE REST OF THE NETWORK, BEGINNING WITH THE NODE CLOSEST TO THE PRINTER. WHEN THE PROBLEM NODE OR BAD SECTION OF CABLE IS CONNECTED TO THE NETWORK THE FAILURE WILL OCCUR AND THE PROBLEM'S LOCATION WILL THEN BE KNOWN.
5.2
PERFORM THE PROCEDURE ON THIS PAGE ON EACH NODE IN THE NETWORK, BEGINNING WITH THE NODE CLOSEST TO THE PRINTER AND MOVING OUT.
A
1. FOR THE FOLLOWING TEST, FIND THE CLOSEST NODE TO THE PRINTER THAT HAS NOT BEEN TESTED (SEE COMMENT).
2. LEAVE THE NODE YOU ARE TESTING CONNECTED TO THE SEGMENT OF THE NETWORK THAT IS CONNECTED TO THE PRINTER. DISCONNECT THE CABLE LEADING FROM THE NODE TO THE REMAINDER OF THE NETWORK.
3. PRINT THE LASERWRITER TEST DOCUMENT FROM THE NODE TO BE TESTED.
TEST PRINT OK ?
N
Y
REPLACE THE APPLETALK CONNECTOR ON THE NODE, THEN RELOAD THE LASERWRITER TEST DISK AND TRY TO PRINT.
TEST PRINT OK ?
N
Y
REPLACE THE APPLETALK CABLE BETWEEN THE BAD NODE AND THE NEXT NODE ON THE PRINTER SIDE, THEN RELOAD THE LASERWRITER TEST DISK AND TRY TO PRINT.
TEST PRINT OK ?
N
Y
GO TO "RARE CASE" SHEET 2
TRIED ALL NODES ON THE NETWORK ?
N
Y
PERFORM THE ABOVE PROCEDURE ON THE NODE NEXT CLOSEST TO THE PRINTER. (SEE COMMENT)
A
IT IS A SOFTWARE PROBLEM.
EXIT
GO TO "ALL NODES" SHEET 2

Explanation for the RARE CASE Flowchart

5.1 This procedure should be performed if the communications between the LaserWriter and the node closest to it worked correctly when isolated, but a test print failed when the network bus was reconnected, indicating a bad network bus.

5.2 There are two problems which result in a bad network bus:

(1) An improperly terminated (dangling or broken) network cable anywhere on the bus. For example, a network cable which has been accidently disconnected from its AppleTalk connection box (the dangling cable below) could result in an unbalanced impedance which could cause the whole bus to fail.

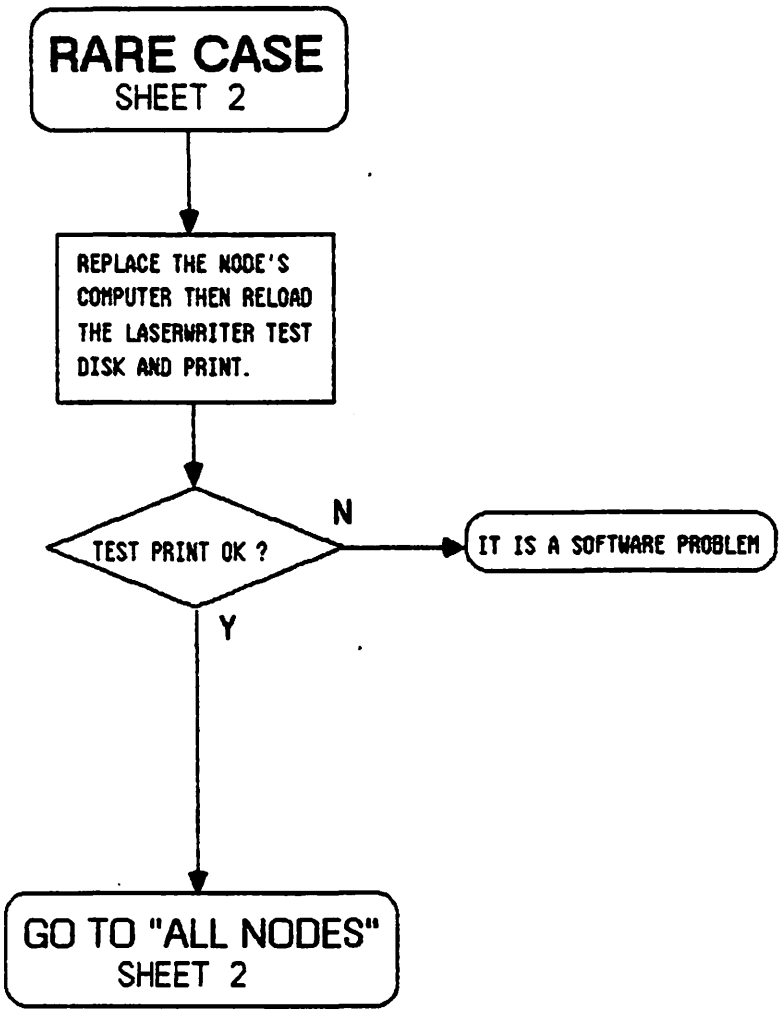


A broken network cable could cause the same problem.

(2) A malfunctioning node that puts a constant level of electric noise on the network bus. In this case no other node would try to transmit because the system appears "busy".

NOTE: For more information on noisy node problems and bus termination problems (i.e. dangling cables and circular networks) refer to the Appendix.

(Continued on the next page).


RARE CASE
SHEET 2
REPLACE THE NODE'S COMPUTER THEN RELOAD THE LASERWRITER TEST DISK AND PRINT.
TEST PRINT OK ?
N
IT IS A SOFTWARE PROBLEM
Y
GO TO "ALL NODES" SHEET 2

(5.2) Two problems which result in a bad network bus: (continued)

For Sheet 1 of RARE CASE, each node in the network is tested sequentially, beginning with the node closest to the LaserWriter.

As each node is being tested, it is connected to the nodes that have proven that they can print. The known good nodes and the node being tested are disconnected from the rest of the network.

When the node causing the network bus problem is connected, the test print will fail.

Once the bad node is found, the flowchart procedure checks each of the hardware components between the bad node and the nearest known good node.

MACINTOSH OFFICE (APPLETALK)
TECHNICAL PROCEDURES

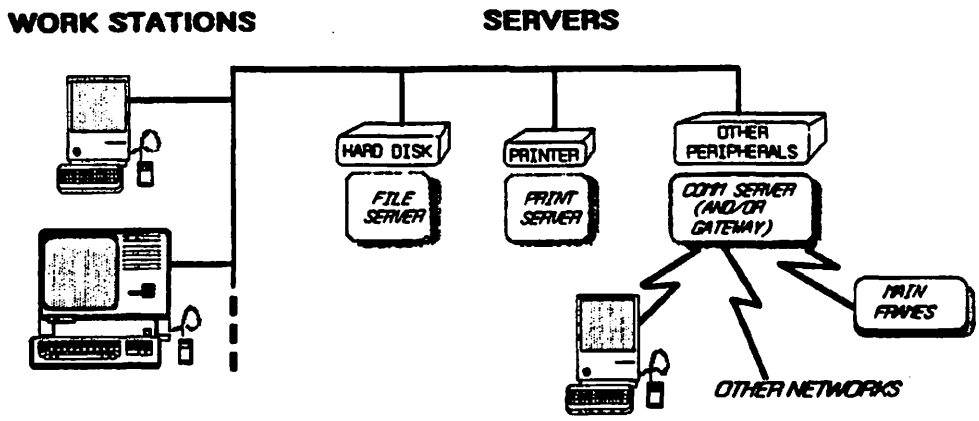
APPENDIX

TABLE OF CONTENTS

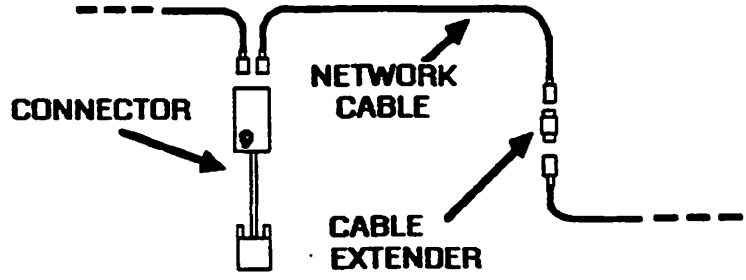
Contents:

WHAT IS THE APPLETALK PERSONAL NETWORK?

The AppleTalk Personal Network allows any Macintosh, or Macintosh XL user to share the use of a single LaserWriter Printer. In the future, other devices such as **file servers** (large capacity disk drives) and **communication servers** (devices that provide access to other computer networks) will be added to the network (shown below). Macintosh, and Macintosh XL users will also be able to communicate instantaneously with each other over the network when the appropriate software becomes available.



The AppleTalk Personal Network has three physical components: the **network cable**, the **AppleTalk connector**, and the **cable extender**, (shown below).



The AppleTalk connector is attached to a computer or other device; the individual AppleTalk connectors are then linked by means of the network cables. When all of the lengths of network cable are connected, they form a **network bus.**

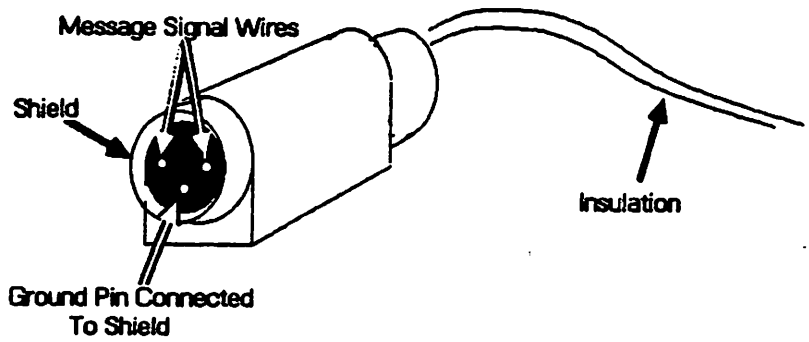
Each device location on an AppleTalk network is called a **node.** When we refer to a node, we mean the device itself and the AppleTalk connector attached to it.

The AppleTalk Components

AppleTalk Network Cable is sold in two and ten meter lengths with preassembled connector plugs. It is also sold in kit form for custom installations. The kit contains a one hundred meter spool of cable with unassembled connector plugs. The installer cuts the length of cable needed and then attaches a plug to each end.

The network cable is made up of two wires wrapped in a metal shield, which is then wrapped in electric insulation (shown below).

NETWORK CABLE



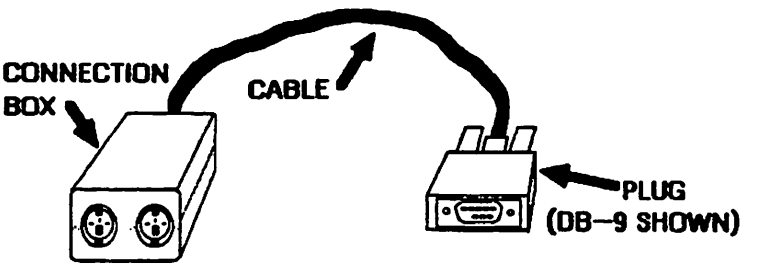
The two wires conduct the electric message signal to the AppleTalk connectors around the network.

The conductive metal shield covering the wires in the network cable protects them from electronic noise that may come from other devices in the area. Without the shield, the noise would interfere with communications on the network. It also provides a common electrical ground for all of the nodes.

The third pin on the network cable plug connects the cable shield (the network ground) through each AppleTalk connector to the ground lines of the attached devices.

An AppleTalk Connector is composed of a **plug** that fits into the back of the computer, a **cable** leading from the computer to the network, and a **connection box** (see the illustration below).

APPLETALK CONNECTOR



The **AppleTalk connector cable** permanently attaches the plug to the connection box. The plug for the Macintosh is a 9 pin DB type connector. For the Macintosh XL, the plug is a standard DB-25 connector.

The **connection box** provides the node with a connection point onto the network. The connection box has electronic components inside and two sockets for network cable plugs.

The sockets on the connection box are interchangeable. It makes no difference which one a network cable is plugged into.

An AppleTalk Cable Extender is a small double ended connector that allows two pieces of network cable to be joined together to form a longer cable. A cable extender should <u>not</u> be used to terminate the cable.

WHY NOISY NODES CAN CAUSE NETWORK BUS PROBLEMS

Only one node may transmit (put message signals on the network cable) at a time. If two nodes were allowed to transmit at the same time, their signals would collide and be incoherent to the rest of the network. This is similar to two people speaking at the same time preventing anyone from understanding them.

To make sure that only one node is transmitting on the bus at a time, all AppleTalk nodes follow a set of rules called Carrier Sense, Multiple Access with Collision Avoidance (CSMA/CA).

Carrier Sense means that before a node can transmit anything on the network, it will check the network cable to see if another node is transmitting. If there is, the node that is trying to transmit will wait for a designated period of time and then listen again; if the network is still busy, it will wait again, and so on. This will go on until the node detects that the bus is idle (no node is transmitting on the network). At this time the node will wait for a period of time to make sure that no other node is going to transmit and then begin its own transmission (see collision avoidance below).

Multiple Access means that every node has equal access to the network cable through its connection box.

Collision Avoidance means that AppleTalk tries to minimize collisions by having each node wait a different amount of time after the bus becomes idle before they transmit.

If the interface electronics in a node failed and put electric noise on the bus, the other nodes might sense the noise and assume that the bus was always busy. If this were to happen the other nodes would never transmit any messages.

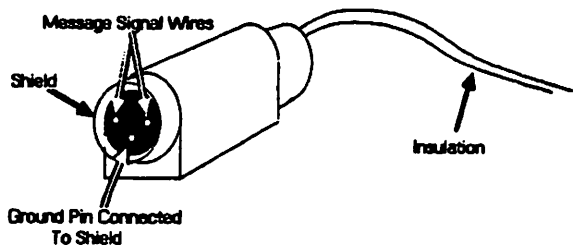
APPLETALK BUS TERMINATION PROBLEMS

The Circuit on the AppleTalk Network Cable

NOTE: For the following explanations, many of the terms and concepts have been simplified.

The network cable is made up of two message signal wires wrapped in a metal shield, which is then wrapped in electric insulation (shown below).

NETWORK CABLE



The two wires carry the message signals around the network.

The message signals have a maximum **frequency** of 230.4 KHz. That means that a transition from the most positive to the most negative voltage levels of the signal can happen up to 230.4 thousand times a second.

There is an electronic component called a **transformer** in every connection box. Each node's transformer couples the node to the network bus. When a node transmits, it sends the message signal to the transformer which conveys it onto the message signal wires of the network cable. The transformers in the other node's connection boxes allow them to read the message signal from the bus.

The message signal is put on the network cable in a differential fashion. That means that at any given time if the message signal voltage on one of the wires is positive, then the other wire will be negative, and vice versa.

Since electric current is often thought of as flowing from negative to positive, we will call the negative wire the **source** wire and the positive wire the **return** wire.

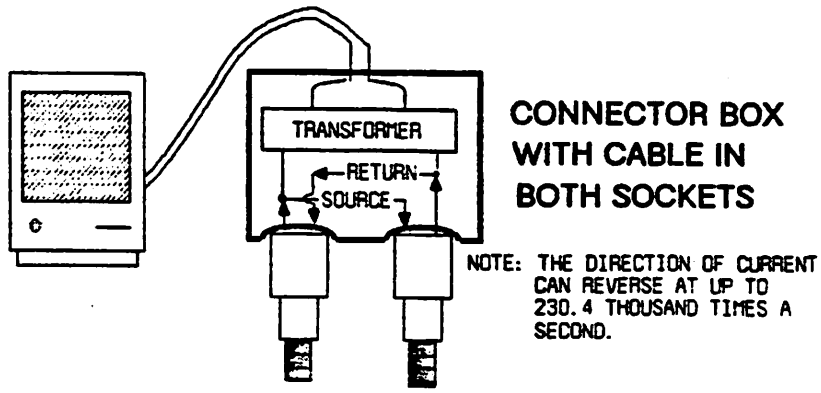
When the voltages change, the direction of current will change, thus the role of the wires alternate. However, at any given instant during a transmission, one wire will be the source and one the return.

NOTE: The AppleTalk bus conforms to the electrical interface specifications defined in the Electronic Industries Association's RS-449/422 Standard. For more detailed information on the RS-449/422 interface, refer to that document.

When a signal enters a connection box from a length of network cable, it will do one of two things depending on whether or not a network cable is plugged into the other socket.

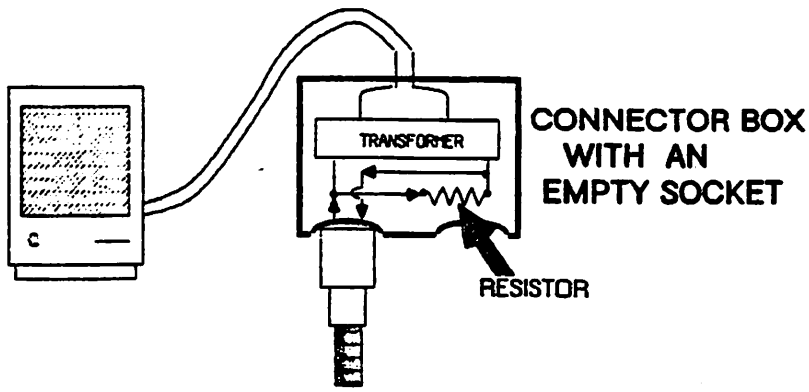
(1) **Cables plugged into both sockets.**

All of the nodes except those on the two ends of the network bus will have cables plugged into both sockets. In this case the signal flows from one socket through to the other into the next length of cable (shown below).



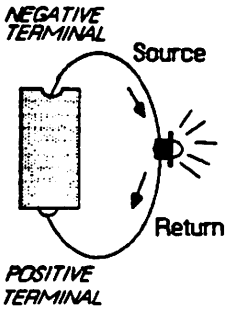
(2) **Cable plugged into only one socket.**

The end nodes will have a cable plugged into only one socket. Each connection box is designed so that if a socket is empty, a switch inside the box connects the signal wires from the other socket to a terminating resistor. The message signal current in the source wire flows through the terminating resistor back to the return wire completing the circuit (shown below).

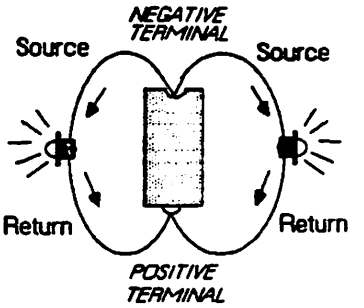


The AppleTalk Network Bus circuit is like the circuit in a flashlight.

FLASHLIGHT CIRCUIT WITH ONE BULB



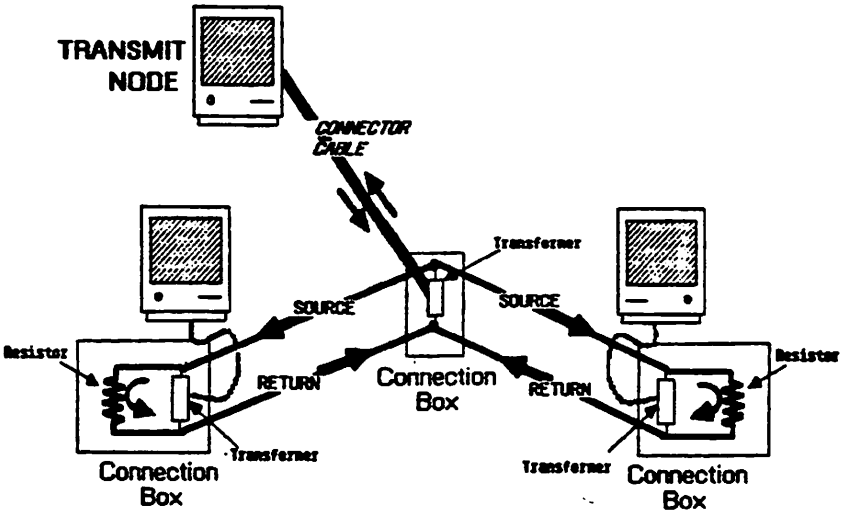
FLASHLIGHT CIRCUIT WITH TWO BULBS



The current from the source (negative) wire flows through something called a load (a bulb for the flashlight and a terminating resistor for the AppleTalk bus) to the return (positive) wire. In the flashlight example above, two bulbs are shown to demonstrate that the current can be split at its source to travel through two loads and arrive at the same return point. In the AppleTalk bus example below the same thing occurs. The only difference is that the current is going through two terminating resistors instead of two bulbs.

In the flashlight the battery provides the power, while in the AppleTalk bus the transmitting node provides the power in the form of the message signal.

APPLETALK CIRCUIT

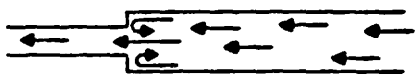


Impedance on the AppleTalk Network Cable

For the message signal current to flow smoothly and accurately, the impedance (explained below) throughout the network must be constant.

Electric current is commonly compared to water flowing through a pipe. Impedance is like the resistance that the walls of a pipe present to flowing water. As long as the circumference of the pipe remains the same, the impedance to the flow of water is the same.

If at some point the pipe's circumference is made smaller, the impedance to the flow will increase at that point and part of the water will be reflected back.



In an AppleTalk network the message signal current flows through the source message wire the way water flows through the pipe. It is important to avoid changes in impedance since that can cause reflections of the message signal similar to the reflections that occurred when the water encountered the narrower pipe.

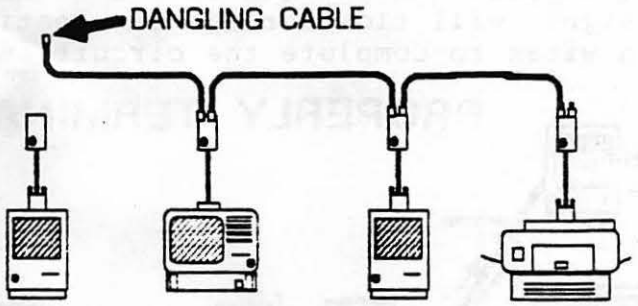
If an AppleTalk network bus is terminated properly, the network cable on each end of the bus will be plugged into a connection box with an empty socket.

The connection box with an empty socket channels the message signal on the network cable's source wire through a terminating resistor to the return wire.

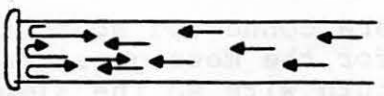
The terminating resistor provides the same amount of impedance as the network cable so there will be no reflections of the message signal on the bus.

Dangling Cables

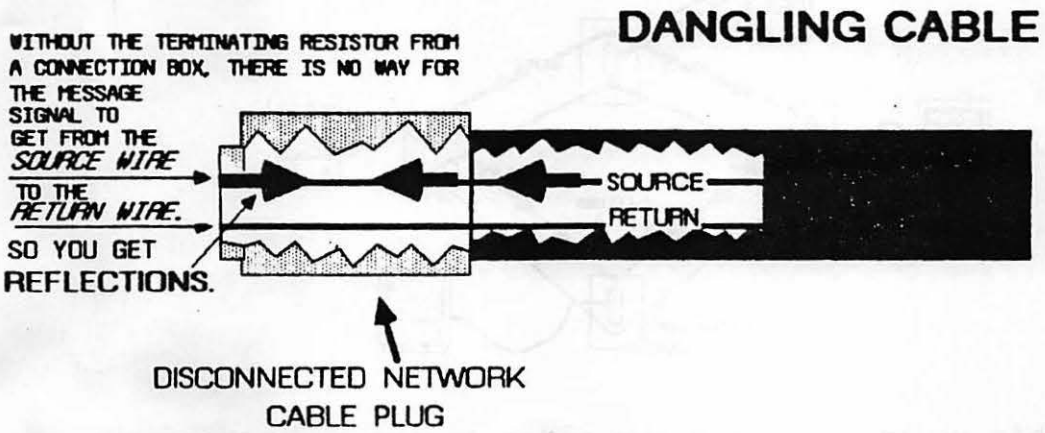
If a network cable is left dangling (shown below), when the current on the source wire reaches the unterminated end, it has no channel to take to the return wire.



The message signal in a dangling cable has no place to flow once it reaches the end of the cable so it is reflected back on to the source wire, just like a flow of water run into a capped pipe (shown below).



The reflections would bounce back along the source wire and mix with the original message signal (shown below). This would look like two nodes trying to talk at the same time, and that would interfere with communications.

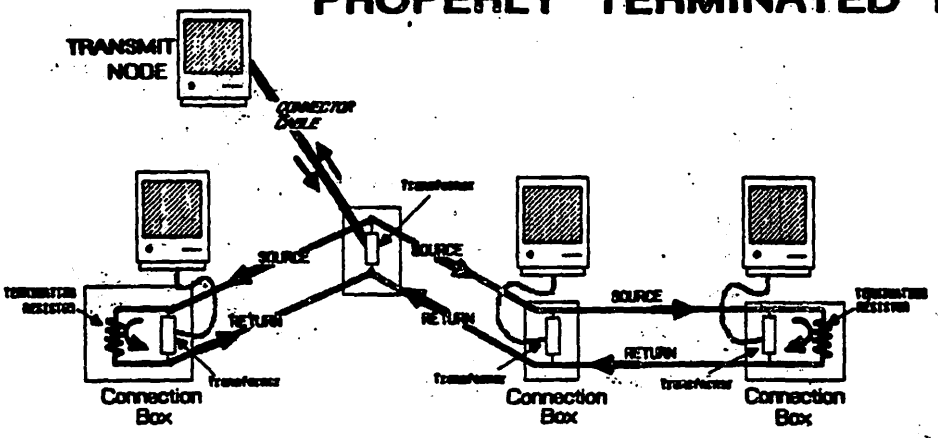


To prevent reflections of the message signal on the network, it is very important to always terminate the ends of the network cable into a connection box.

Circular Networks

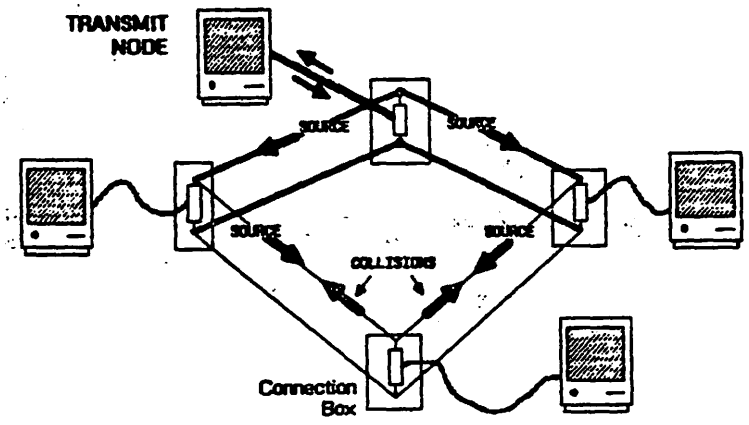
When a signal is transmitted onto the network cable by a node somewhere in the center of a bus, the source signal is sent to both sides of the bus. If both ends are properly terminated (i.e. each end plugged into a connection box), the message signal will flow through terminating resistors to the return wires to complete the circuit (shown below).

PROPERLY TERMINATED BUS



If the network cables are connected so as to form a closed loop, there is no way for the message signal on the source wire to flow to the return wire so the signals on both sides of the bus will collide with each other (shown below).

CIRCULAR NETWORK



This would look like two nodes trying to talk at the same time, and that would interfere with communications. Therefore, it is very important to always terminate the ends of the network cable into connection boxes so that it does not form a closed loop.

DUODISK TECHNICAL PROCEDURES

TABLE OF CONTENTS

DuoDisk Technical Procedures

Section 1

Troubleshooting

Contents:

General Information

The Apple® DuoDisk™ disk drive is effectively two disk drives in one case. Both drives are attached to a single analog card, with the drive on the left side defined as Drive 1.

There are four main modules which can be replaced: the interface card, the interface cable, the analog card, and the mechanical assembly. Chip swapping on the analog card is recommended before replacing the card.

Using the Troubleshooting Flowchart

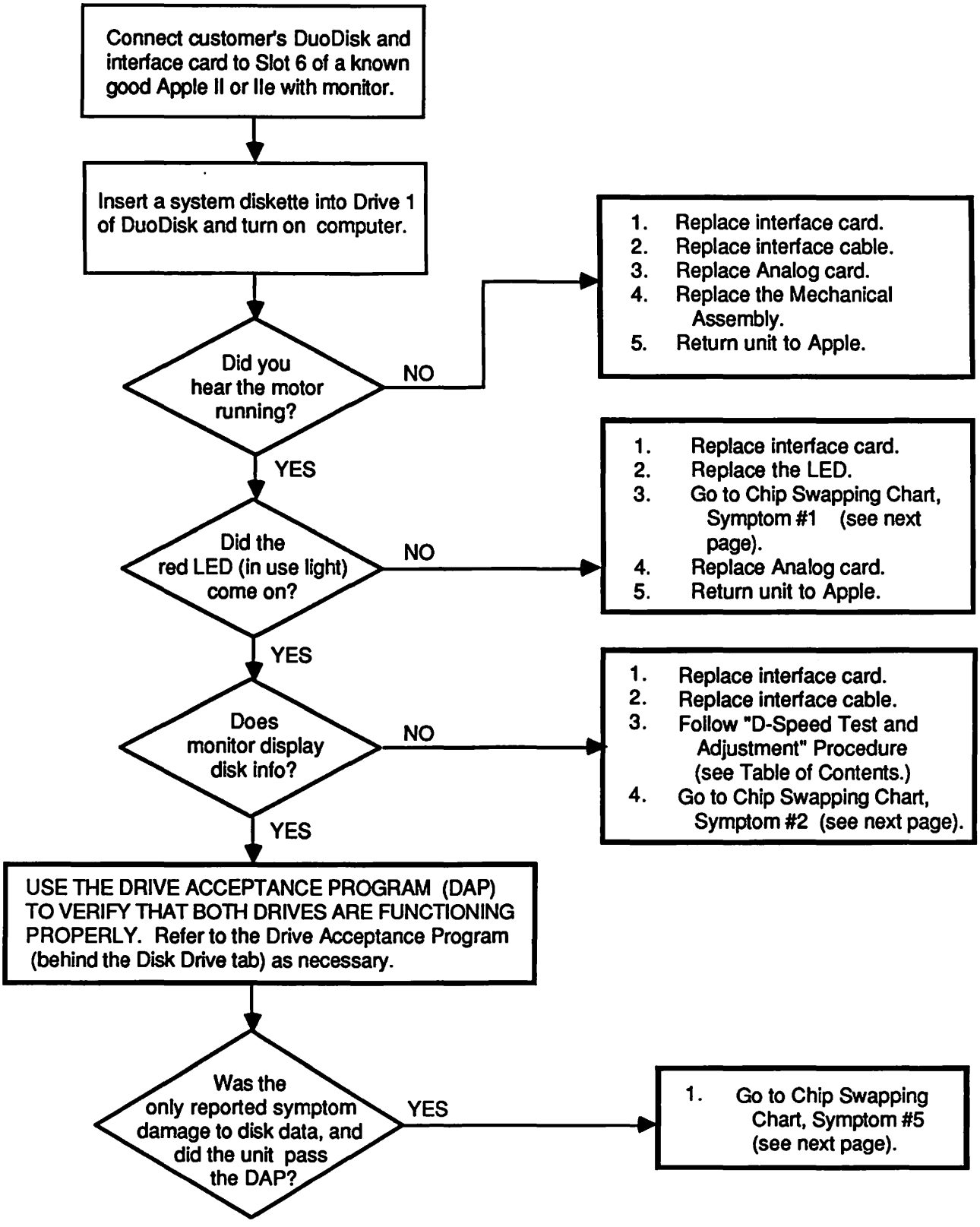
Whenever a customer brings in a presumably bad Duodisk, use the flowchart on the following page to begin troubleshooting. Begin with the box in the upper left corner of the page. When you get to one of the answer boxes (boxes with dark borders), swap the modules/components, one at a time, in the order in which they are listed. Each time you swap out a module/component, turn on the computer and see if you can boot a system diskette (preferably the DOS 3.3 System Master).

Remember, once you are able to boot a diskette, be sure to run the Drive Acceptance Program (P/N 077-8101A) performing any adjustments necessary. Reinstall the customer's modules/components, one at a time, testing after each exchange to isolate the bad part(s).

NOTE: There is a chance for data on the diskette to be lost in operating the DuoDisk. This can occur in attempting the "Open Apple CTL-Reset" technique for rebooting, or when using software with certain copyright protection schemes. If a unit exhibits this problem and passes the Drive Acceptance Program, check the analog board. Analog boards with part numbers 676-[]101 and 676-[]102 may have this problem. The fix is to carefully identify and cut two capacitors off the board. The capacitors are labeled C29 and C30 in zones B1 and A1 (refer to the DuoDisk Analog Card Chip Swapping Chart and Figure 1, #4 and #5). Use small wire clippers or simply jiggle the capacitors to snap the connections.

NOTE: If you do not know how to connect the DuoDisk to an Apple computer, refer to the DuoDisk Owner's Manual for instructions.

DUODISK TROUBLESHOOTING FLOWCHART



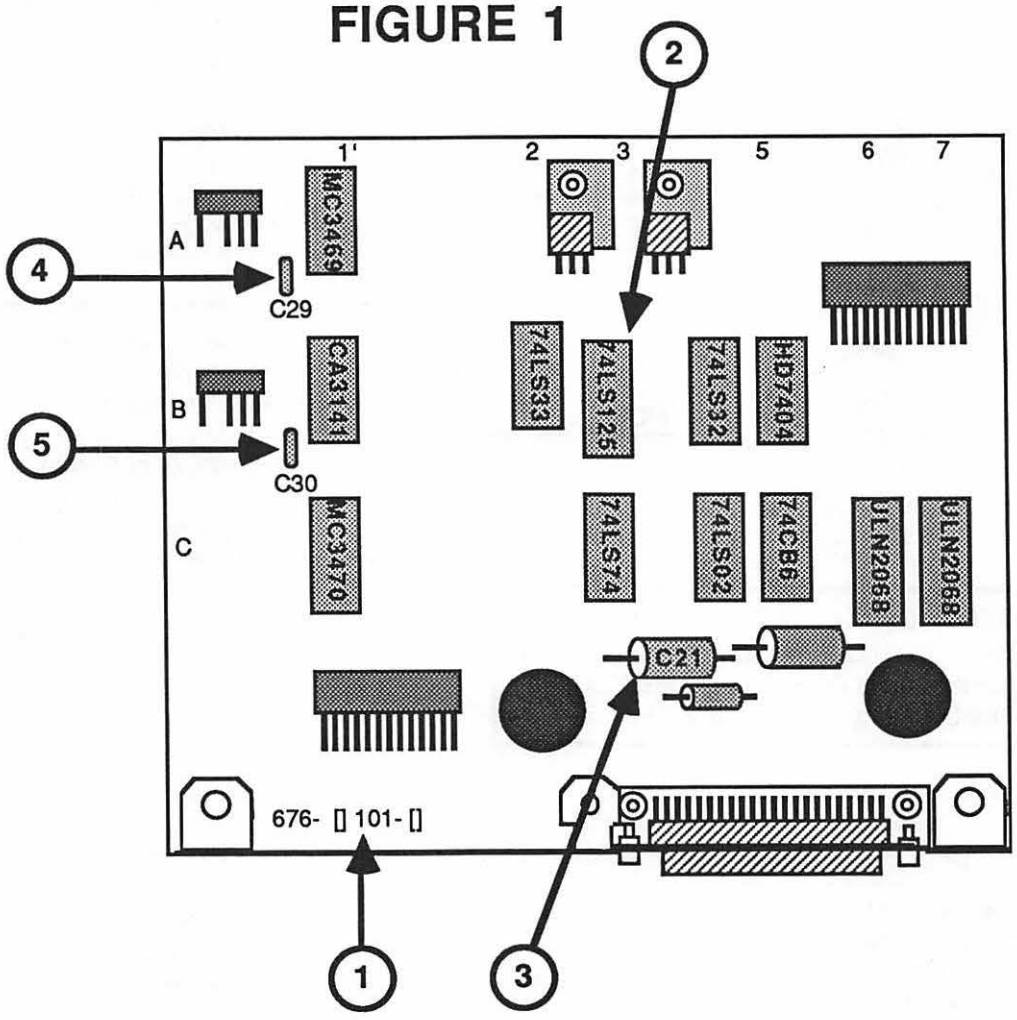
DuoDisk Analog Card Chip Swapping Chart

The chip swapping chart on the opposite page can be used for drive 1 and/or drive 2. To access the analog card chips, remove the DuoDisk cover and shield (see Section 3, "Take-Apart").

IMPORTANT: Locate the engineering number (see Figure 1, #1). Symptoms 1 through 4 on the chip swapping chart apply only to DuoDisk analog cards with Engineering # 676-[]101. Symptom 5 on the chart applies to DuoDisk analog cards with Engineering # 676-[]101 or 676-[]102.

Before replacing any chips carefully inspect the card for melted or broken components, particularly the 74LS125 (see Figure 1, #2) and C21 (see Figure 1, #3). If you notice fuzz on the card, return the card to Apple. This usually means that the card was connected to a computer with the power on, and capacitor C21 has exploded.

FIGURE 1



Here's What To Do

Identify the symptom and replace the related chips, one at a time, in the order in which they are listed. Each time you replace a chip, turn the computer back on to see if the problem is gone. If the problem still exists after you have replaced all the chips related to the problem, go to the next step listed in the answer box (where you left off) on the troubleshooting flowchart.

	Symptom	Location	Defective Chip Type
1.	Motor runs, but LED is off Won't boot	A1 B4 B5	3469 74LS32 74LS07
2.	Motor and LED are on Won't boot	B1 B3 A1 C1 B2 B5 C3 C4 C6 C7	CA3141 74LS125 MC3469 MC3470 74LS33 7407 74LS74 74LS02 ULN2068 ULN2068
3.	Drive reads but does not write	A1 B1 B2 B3 C5 B5	MC3469 CA3141 74LS33 74LS125 74C86 7407
4.	Drive writes when diskettes are write protected	A1	MC3469
5.	Data on disk is damaged when using "Open Apple-CTL-Reset" for rebooting, or when using software with certain copyright protection schemes. AND: **Unit passes DAP.** AND: Analog board PN is 676-[]101 or 676-[]102.	A1 B1	Capacitor C29 Capacitor C30 (remove both, do not replace)

DuoDisk Technical Procedures

Section 4

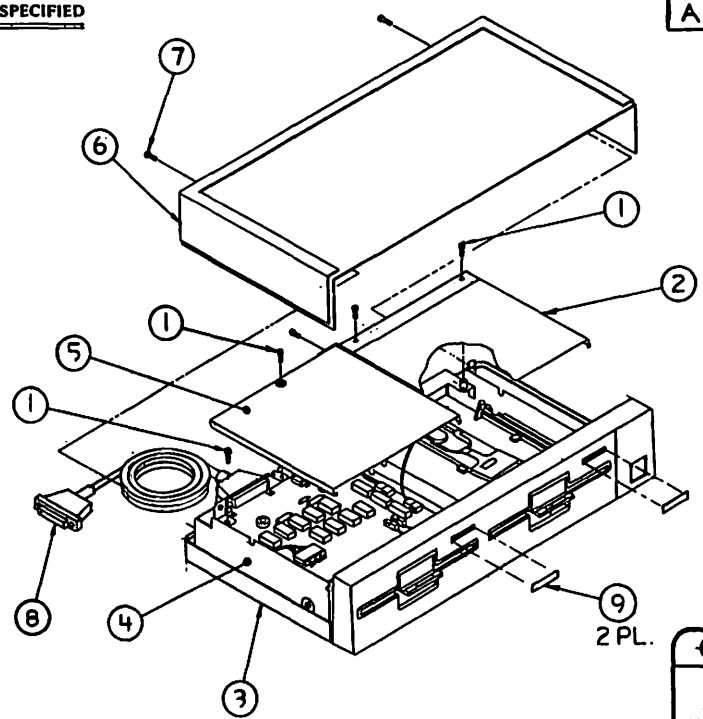
Illustrated Parts List

The figures and lists below include all piece parts that can be purchased separately from Apple for the DuoDisk, along with their part numbers. These are the only parts available from Apple. Refer to your Apple Service Programs manual for prices.

Contents:

REV.	ZONE	ECO #	REVISION	APPD
A		S493	INITIAL RELEASE	

NOTE: UNLESS OTHERWISE SPECIFIED



PARTS LIST HELD BY APPLE SERVICE TRAINING.

DRAWING NUMBER 070-0204-A SHT 1/3

METRIC

DIMENSIONS ARE IN MILLIMETERS
TOLERANCES
.X ± — .XX ± —
ANGLES ± —
MATERIAL: —
FINISH: —

DRFT	TOM	8/8	DEPT CK
ENG APPVL			MFG APPVL
RELEASE			MRKT DIV: SERV
DESIGNER			SCALE: N/A

apple computer inc.

TITLE: ILLUSTRATED PARTS LIST
DUODISK

SIZE B | DRAWING NUMBER 070-0204-A | SHT 1/3

DUODISK (Figure 1)

Item	Part No.	Description
1	400-1604	Screw, 6-32x1/4
2	805-5002	Shield, Top, Drive 2
3	676-5101	Subassembly, Bottom Cover
4	805-5000	Shield, DuoDisk
5	805-5001	Shield, Top, Drive 1
6	676-5103	Top Cover Assembly
7	415-1410	Screw, M3.5x6x10MM. PN
8	590-0114	Duodisk Cable
9	825-0548	Label, Drive #, Uni/DuoDisk

NOTE: UNLESS OTHERWISE SPECIFIED

REV.	ZONE	ECO #	REVISION	APPD

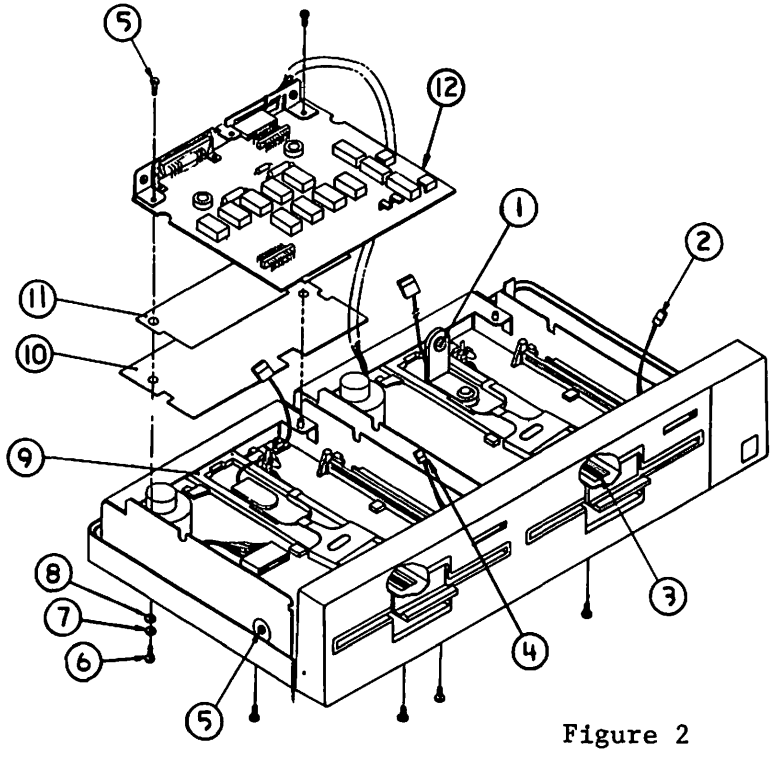


Figure 2

METRIC	apple computer inc.
DIMENSIONS ARE IN MILLIMETERS TOLERANCES .X ± .XXIN ± .XX ± ANGLES ± (UNLESS OTHERWISE SPECIFIED ON FINAL DRAWING)	NOTICE OF PROPRIETARY PROPERTY THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE COMPUTER, INC. THE POSSESSOR AGREES TO THE FOLLOWING: (i) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE (ii) NOT TO REPRODUCE OR COPY IT (iii) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
MATERIAL: — FINISH: —	
DRAFT 6/84 DEPT CH	TITLE ILLUSTRATED PARTS LIST DUODISK
ENG APPVL MFG APPVL	
RELEASE PROJ. ENG SERV	
DRAWN SCALE N/A	SIZE B DRAWING NUMBER 070-0204-A SHT 2/3

UniDisk Technical Procedures

Section 4

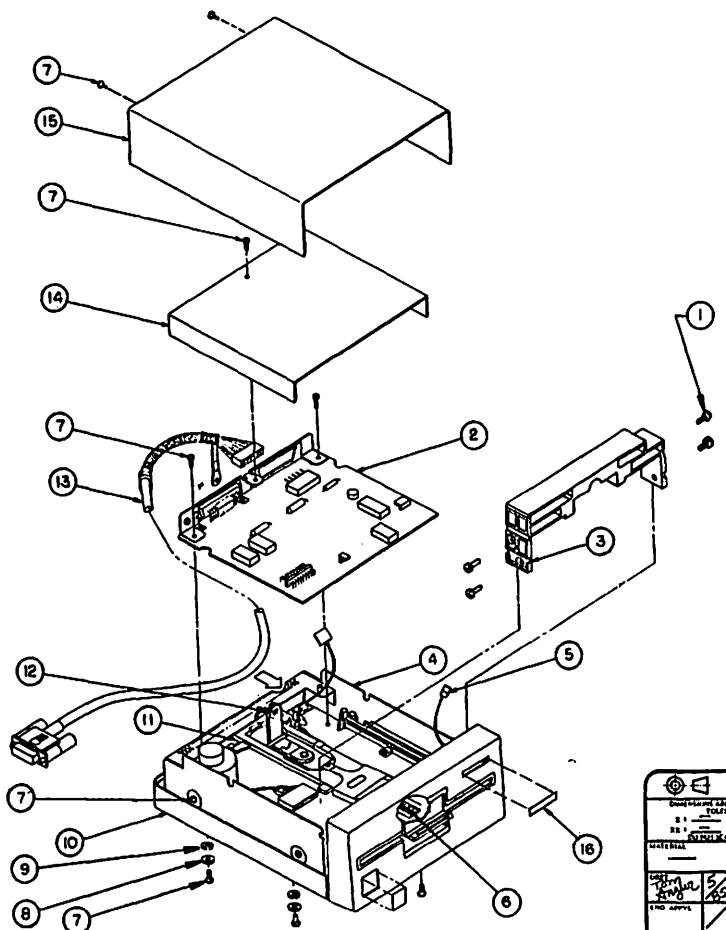
Illustrated Parts List

The figures and lists below include all piece parts that can be purchased separately from Apple for the Unidisk, along with their part numbers. These are the only parts available from Apple. Refer to your Apple Service Programs manual for prices.

Contents:

NOTE: UNLESS OTHERWISE SPECIFIED

REV	ZONE	ECO #	REVISION	APPD	DATE
A		S493	INITIAL RELEASE		



PARTS LIST HELD BY APPLE SERVICE TRAINING.

070-0237-A 1/1

METRIC

SERVICE

NONE

apple computer inc.

TITLE: ILLUSTRATED PARTS LIST UNIDISK

SIZE C | 070-0237-A | 1/1

UNIDISK

Item	Part No.	Description
1	400-3604	Screw, 6-32x 1/4, Pozi-Dr. Flt.
2	661-0287	Analog Card, UniDisk
3	970-1258	Sub-bezel Uni/DuoDisk
4	805-0890	Shield, Bottom
5	590-0140	Assembly, Cable, LED, Dl
6	870-0023	Spring
7	400-1604	Screw, 6-32x 1/4
8	860-0242	Washer, M3.5x 4.0 I.D. x 7.0 O.D.
9	860-0053	Washer, Split Lock Metric, 3.5m
10	675-5101	Subassembly Bottom Cover
11	661-72128	Uni/DuoDisk Disk Mech Assembly
12	U815-0064	Load Button
13	590-0327	Assembly, Cable Drive to CPU
14	675-5103	Top Case Assembly
15	805-0891	Shield, Top
16	825-0548	Label, Drive #, Uni/DuoDisk

TECHNICAL PROCEDURES MANUAL

August, 1985 Edition

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DOT MATRIX PRINTER (Figure 1)

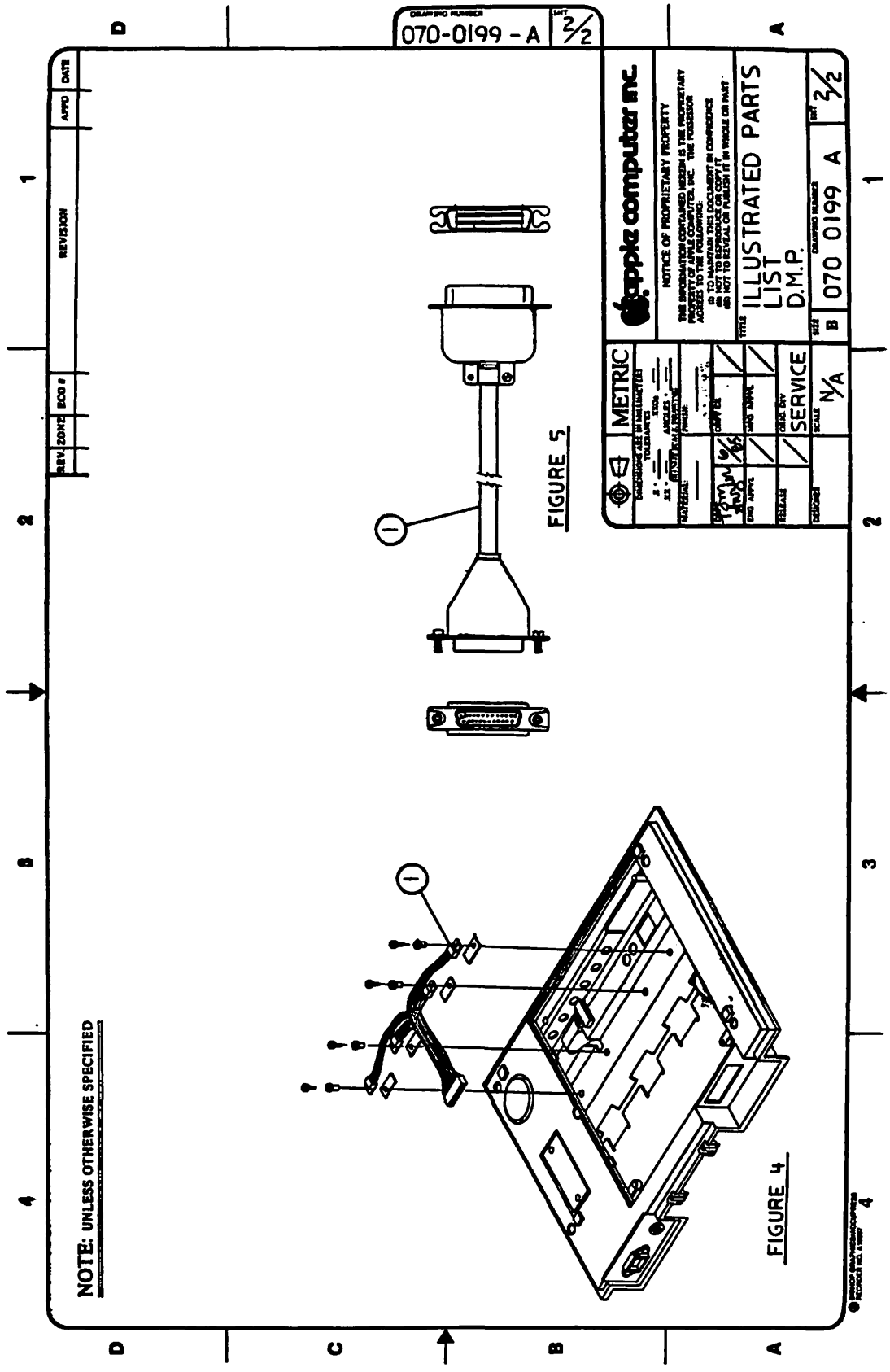
Item	Part No.	Description
1	970-0008	Knob, Platen
2	699-0092	Print Head Assembly
3	970-0007	PCB Front Panel w/harness
4	970-0080	Wire Carriage Drive
5	699-0093	Carriage Drive Motor, Complete
6	970-0009	Lever, Paper Release
7	740-0101	Fuse, 2 Amp, 3AG

DOT MATRIX PRINTER (Figure 2)

1	970-0011	Switch, AC Line (115V)
2	699-0095	Transformer/Switch Assembly

DOT MATRIX PRINTER (Figure 3)

1	740-0022	Fuse, 5 Amp
2	740-0021	Fuse, 3 Amp
3	661-75091	DMP CPU Card


070-0199 - A
2/2
apple computer inc.
NOTICE OF PROPRIETARY PROPERTY
METRIC
ILLUSTRATED PARTS LIST D.M.P.
070 0199 A
SERVICE
N/A
FIGURE 5
FIGURE 4
NOTE: UNLESS OTHERWISE SPECIFIED

MACINTOSH OFFICE (APPLETALK)
TECHNICAL PROCEDURES

SECTION 1

Macintosh Office Troubleshooting

Contents:

To Troubleshoot Your Macintosh™ Office:

(A) Collect the Following Items:

AppleTalk Installation Guide
LaserWriter (Owner's) Manual
2 Known Good LaserWriter Test Disks
AppleTalk™ Personal Network Components

(B) Familiarize Yourself With AppleTalk Components.

Refer to the Appendix to make sure you can identify the AppleTalk Personal Network components.

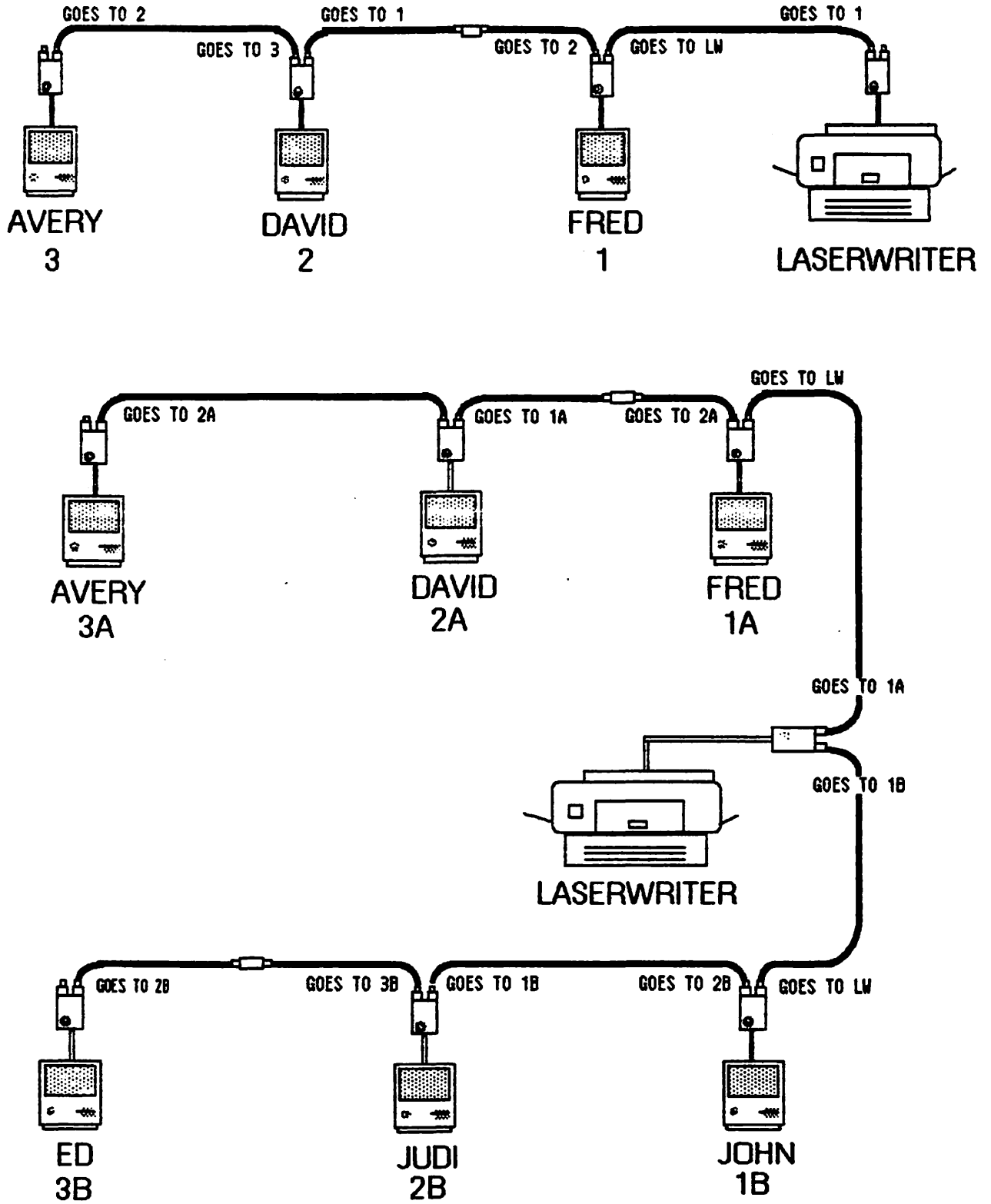
(C) Draw a Node Location Diagram.

In order to isolate a problem to a particular node or connection, you need to know where each node is located in relation to the LaserWriter printer.

If you don't have an accurate diagram, turn the page and follow the directions.

If you already have an up to date diagram, then go to (D) "Perform the Troubleshooting Procedure".

NODE LOCATION DIAGRAM



Ⓒ Draw a Node Location Diagram. (continued)

A *node* is an AppleTalk connector and the device attached to it (Macintosh, Macintosh XL, LaserWriter, etc.).

A *Node Location Diagram* is a drawing of a Macintosh Office installation showing the location of all the devices on the network (Macintoshes, file servers, LaserWriters, etc.).

1. Number each node according to its sequence away from the LaserWriter (see the illustration on the opposite page).

   If the LaserWriter is somewhere in the middle of the network, number one side 1A, 2A, 3A etc. and the other side 1B, 2B, etc.

   Distances are not important for the diagram.
   The main reason for the diagram is to show which node is the first one connected to the LaserWriter, which is second, etc., and where the cable extenders are located.

2. Label all of the connector boxes in the network with their respective node numbers.

3. Label the plugs on both ends of every network cable with the node to which the cable leads (see the illustration on the opposite page).

Go to Ⓓ "Perform the Troubleshooting Procedure".

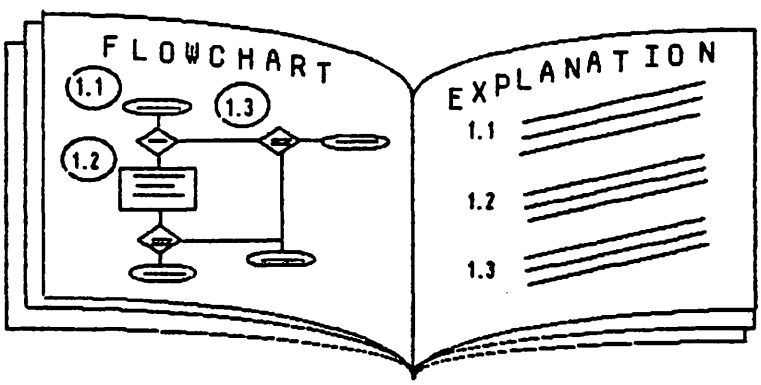
(D) Perform the Troubleshooting Procedure.

IMPORTANT: 1. You need to know that:
A *node* is an AppleTalk connector and the device attached to it (Macintosh, LaserWriter, etc.).

A *network bus* is the entire connected length of network cables and connection boxes.

2. Troubleshooting may interfere with the customers use of the network — so, if possible, perform this procedure when there is little or no activity (for example, at lunch time or after work).

3. Each troubleshooting procedure is made up of flowcharts. If you have a question about one of the steps in a flowchart, you can find an explanation of that step on the opposite page.



Find the Proper Flowchart.

Macintosh Office problems become apparent when attempting to print to the LaserWriter. These printing problems may present themselves in a variety of ways. They may be seen on a node computer as a system error message, system hang, constantly running disk drive, etc.

On the following page, determine which symptom best describes the problem. Then perform the suggested procedure.

SYMPTOM: Problems Printing to a LaserWriter Due To Installation Error.

Mistakes made during installation include:

* Connecting the AppleTalk Network cable so that it forms a closed loop (circular network).
* Not terminating the network cable into a connection box (dangling cable).
* Starting up an AppleTalk device before connecting it to the network.

If you have problems with a recently installed network, refer to the Troubleshooting section in the *AppleTalk Installation Guide.*

SYMPTOM: Only One Node Has Problems Printing to the LaserWriter.

This problem is usually caused by a loose connection but could be a malfunctioning computer. Go to the ONE NODE flowchart.

SYMPTOM: Two or More, But Not All Nodes Have Problems Printing to the LaserWriter.

This problem is usually a result of:

* Starting up AppleTalk on a device before connecting it to the Network OR
* A disconnected or broken network cable.

Go to the TWO OR MORE, BUT NOT ALL flowchart.

SYMPTOM: All Nodes on the Network Have Problems Printing to the LaserWriter.

This problem condition is usually a result of:

* A malfunctioning LaserWriter printer OR
* An improperly terminated network cable (broken or not terminated into a connection box) OR
* A malfunctioning node putting electronic noise on the AppleTalk network cable.

Go to the ALL NODES flowchart.

ONE NODE

1.1

1. CHECK THAT THE NETWORK CABLES ARE FIRMLY INSERTED INTO THE BAD NODE'S CONNECTOR MODULE.

2. a. *IF THE COMPUTER IS A MACINTOSH:*
   (1) CHECK THAT THE CABLE FROM THE APPLETALK CONNECTOR IS FIRMLY INSERTED INTO THE PRINTER PORT.
   (2) TURN OFF THE MACINTOSH, LOAD THE LASERWRITER TEST DISK, THEN TURN THE MACINTOSH BACK ON.

   b. *IF THE COMPUTER IS A MACINTOSH XL:*
   (1) CHECK THAT THE APPLETALK CONNECTOR IS FIRMLY INSERTED INTO PORT B.
   (2) START UP MACWORKS.
   (3) INSERT THE LASERWRITER TEST DISK.

3. PRINT THE LASERWRITER TEST DOCUMENT. (SEE COMMENTS 1 AND 2)

COMMENT 1

THE LASERWRITER TEST DISK IS A KNOWN GOOD PRECONFIGURED PROGRAM WHICH ELIMINATES DISK CONFIGURATION AS A POSSIBLE PROBLEM.

COMMENT 2

PRINTING PROBLEMS CAN BE INDICATED BY A SYSTEM ERROR MESSAGE, CONSTANTLY RUNNING DISK DRIVE, SYSTEM HANG, ETC.

COMMENT 3

IF THE NODE PRINTS CORRECTLY WITH THE TEST DISK, THE HARDWARE MUST BE OK. THE CONFIGURATION OF THE ORIGINAL DISK SHOULD NOW BE CHECKED SINCE IT MAY HAVE BEEN THE CAUSE OF THE PROBLEM.

1.2

TEST PRINT OK ? (SEE COMMENT 2)

N → REPLACE THE APPLETALK CONNECTOR THEN RETRY THE PRINT.

REPLACE THE APPLETALK CONNECTOR THEN RETRY THE PRINT.

TEST PRINT OK ?

N → REPLACE THE NODE'S COMPUTER. REFER TO THE APPROPRIATE LEVEL I TECHNICAL PROCEDURE TO REPAIR THE COMPUTER.

Y → REFER TO THE LASERWRITER OWNER'S MANUAL TO CHECK THE CONFIGURATION OF THE APPLICATION DISK USED WHEN THE PROBLEM WAS ENCOUNTERED (SEE COMMENT 3).

Y

EXIT

Explanation for the ONE NODE Flowchart

1.1 This procedure should be performed if only one user node has problems printing to the LaserWriter.

The first step is to make sure that the AppleTalk connector is inserted into the correct socket for the type of computer used.

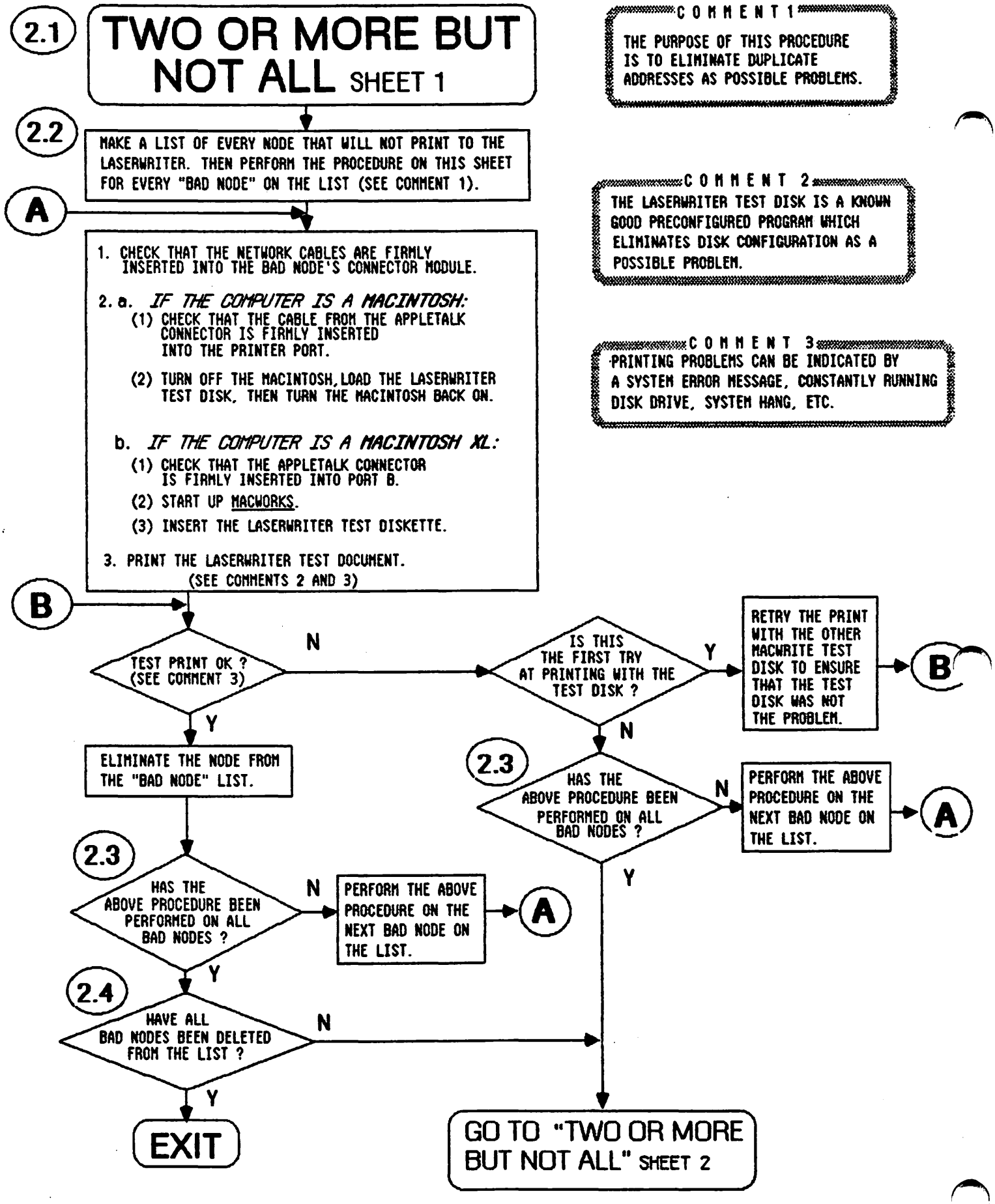
Using the LaserWriter Test Disk eliminates the possibility that the problem is being caused by a bad disk.

1.2 If you can't print with the preconfigured test disk, there is a hardware problem, which may be a bad AppleTalk connector or a malfunctioning computer.

The LaserWriter is not at fault since the other nodes in the network are not affected.

Usually the problem is not in the network cable because they are connected serially through the AppleTalk connectors, and if a network cable is broken, all of the nodes beyond the break are affected. However, if there were a bad network cable for a node on either end of the bus, then it would probably only affect the one end node.

If the print is successful with the test disk, the node computer is properly connected to the network and is working properly. In this case, suspect the application disk used when the original failure occurred.


2.1
TWO OR MORE BUT NOT ALL SHEET 1
COMMENT 1
THE PURPOSE OF THIS PROCEDURE IS TO ELIMINATE DUPLICATE ADDRESSES AS POSSIBLE PROBLEMS.
2.2
MAKE A LIST OF EVERY NODE THAT WILL NOT PRINT TO THE LASERWRITER. THEN PERFORM THE PROCEDURE ON THIS SHEET FOR EVERY "BAD NODE" ON THE LIST (SEE COMMENT 1).
COMMENT 2
THE LASERWRITER TEST DISK IS A KNOWN GOOD PRECONFIGURED PROGRAM WHICH ELIMINATES DISK CONFIGURATION AS A POSSIBLE PROBLEM.
A
1. CHECK THAT THE NETWORK CABLES ARE FIRMLY INSERTED INTO THE BAD NODE'S CONNECTOR MODULE.
2. a. IF THE COMPUTER IS A MACINTOSH:
(1) CHECK THAT THE CABLE FROM THE APPLETALK CONNECTOR IS FIRMLY INSERTED INTO THE PRINTER PORT.
(2) TURN OFF THE MACINTOSH, LOAD THE LASERWRITER TEST DISK, THEN TURN THE MACINTOSH BACK ON.
b. IF THE COMPUTER IS A MACINTOSH XL:
(1) CHECK THAT THE APPLETALK CONNECTOR IS FIRMLY INSERTED INTO PORT B.
(2) START UP MACWORKS.
(3) INSERT THE LASERWRITER TEST DISKETTE.
3. PRINT THE LASERWRITER TEST DOCUMENT. (SEE COMMENTS 2 AND 3)
COMMENT 3
PRINTING PROBLEMS CAN BE INDICATED BY A SYSTEM ERROR MESSAGE, CONSTANTLY RUNNING DISK DRIVE, SYSTEM HANG, ETC.
B
TEST PRINT OK ? (SEE COMMENT 3)
N
IS THIS THE FIRST TRY AT PRINTING WITH THE TEST DISK ?
Y
RETRY THE PRINT WITH THE OTHER MACWRITE TEST DISK TO ENSURE THAT THE TEST DISK WAS NOT THE PROBLEM.
B
Y
N
ELIMINATE THE NODE FROM THE "BAD NODE" LIST.
2.3
HAS THE ABOVE PROCEDURE BEEN PERFORMED ON ALL BAD NODES ?
N
PERFORM THE ABOVE PROCEDURE ON THE NEXT BAD NODE ON THE LIST.
A
2.3
HAS THE ABOVE PROCEDURE BEEN PERFORMED ON ALL BAD NODES ?
N
PERFORM THE ABOVE PROCEDURE ON THE NEXT BAD NODE ON THE LIST.
A
Y
Y
2.4
HAVE ALL BAD NODES BEEN DELETED FROM THE LIST ?
N
Y
EXIT
GO TO "TWO OR MORE BUT NOT ALL" SHEET 2

Explanation for the TWO OR MORE BUT NOT ALL Flowchart

(2.1) This procedure should be performed if more than one, but not all, of the nodes are having problems printing to the LaserWriter.

The most probable cause of this type of problem is duplicate addresses or a dangling/broken network cable.

A disk configuration problem is not likely since more than one node is involved. In any event, by using the LaserWriter Test Disk to perform the test print, you eliminate the possibility of a bad disk.

Nor can the problem be with the LaserWriter because if it were, then all the nodes would be affected.

(2.2) Whenever a node starts up on the network, it assigns itself an address number so other nodes will have a means of directing messages to it.

Before a node can assign itself an address number, it must check to make sure there is no other node on the network with the same address.

To do this, the node transmits an inquiry message onto the network, containing the address the node wants to use for itself.

If there is another node on the network with that address, the other node will respond to the inquiry.

(Continued on the next page).

(2.2) (continued)

If the original node receives a response, it will select another address to test. This will go on until the node finds an address that is not being used by any other node on the network.

When the node finds an unused address it will claim that address as its own until it is taken off the network. When the node is started up again it will repeat the above process to find a usable address.

Once a node has obtained an address on the network, it will compare it to the address in every message that is sent by the other nodes on the network.

When the node recognizes its own address, it will read the message attached to the address.

Starting up a node while it is not connected to the network and then connecting it afterwards can cause redundant addresses. This is because if a node is not connected to the network when started up, then the rest of the nodes cannot respond to its address inquiry.

In the case described above, the node will always assume the first address it tests is OK. Yet another node on the network may be using that same address.

(Continued on the next page).

(2.2) **(continued)**

When two nodes have the same address, both will respond when the address is used. Since no more than one node can be transmitting on the network at a time, these responses collide and are unintelligible, much the same as when two people are speaking at the same time.

Starting up each bad node while it is connected to the network will cause it to perform a proper address inquiry, thereby eliminating possible duplicate addresses.

(2.3) Duplicate addresses or a dangling/broken network cable are the most common reasons for performing the "TWO OR MORE BUT NOT ALL" flowchart.

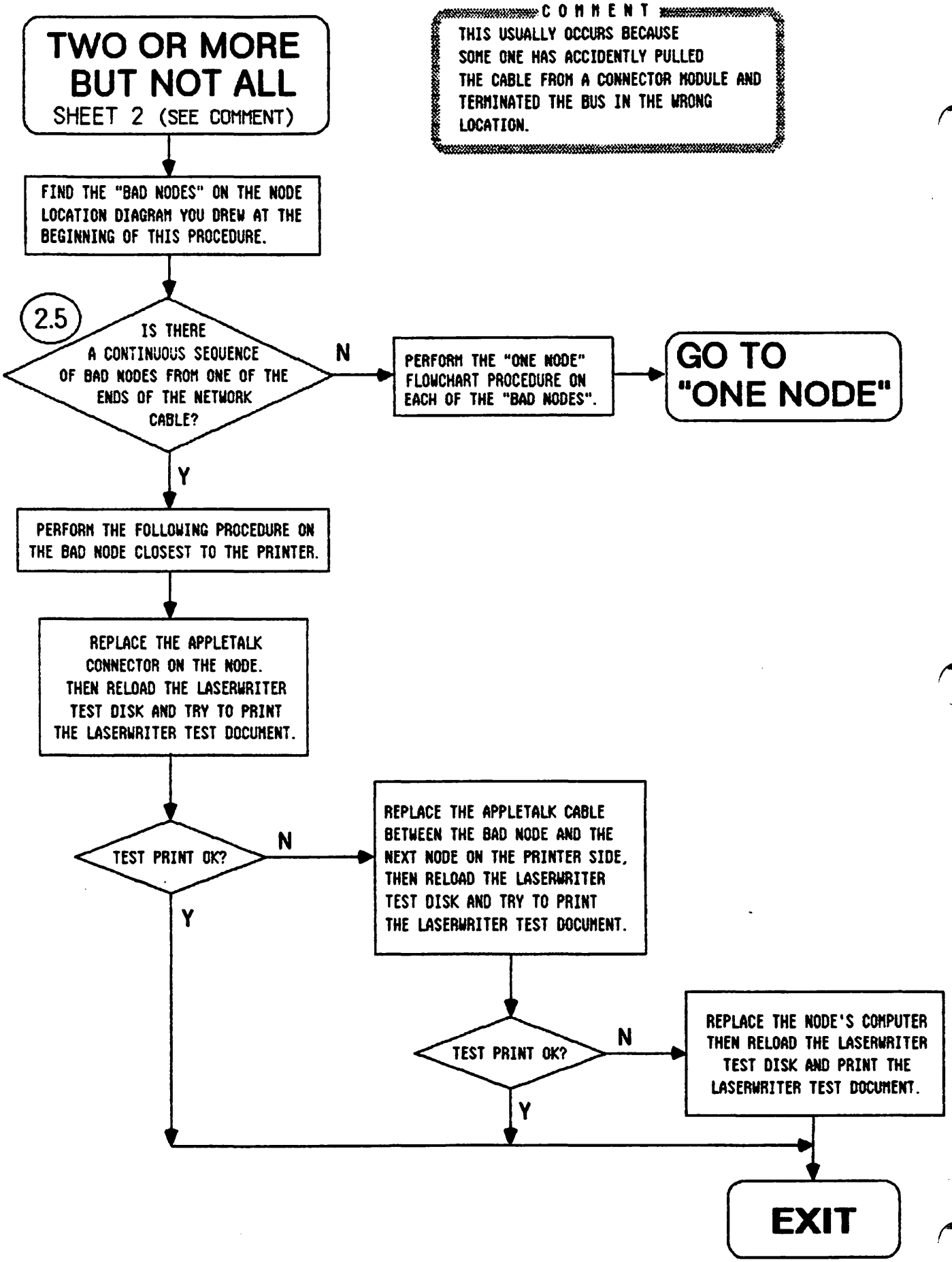
Sheet 1 is concerned with eliminating duplicate addresses while Sheet 2 is directed at hardware problems.

Sheet 2 requires that you know the location of all the bad nodes with hardware problems.

Because duplicate address problems can be confused with hardware problems Sheet 1 has you eliminate **all** duplicate address problems (see 2.2 above) first before going to Sheet 2.

(2.4) If all the bad nodes can print after the procedure to eliminate duplicate addresses (see 2.2 above) then that must have been the only problem.

(Continued on the next page).


TWO OR MORE BUT NOT ALL
SHEET 2 (SEE COMMENT)
COMMENT
THIS USUALLY OCCURS BECAUSE SOME ONE HAS ACCIDENTLY PULLED THE CABLE FROM A CONNECTOR MODULE AND TERMINATED THE BUS IN THE WRONG LOCATION.
FIND THE "BAD NODES" ON THE NODE LOCATION DIAGRAM YOU DREW AT THE BEGINNING OF THIS PROCEDURE.
2.5
IS THERE A CONTINUOUS SEQUENCE OF BAD NODES FROM ONE OF THE ENDS OF THE NETWORK CABLE?
N
PERFORM THE "ONE NODE" FLOWCHART PROCEDURE ON EACH OF THE "BAD NODES".
GO TO "ONE NODE"
Y
PERFORM THE FOLLOWING PROCEDURE ON THE BAD NODE CLOSEST TO THE PRINTER.
REPLACE THE APPLETALK CONNECTOR ON THE NODE. THEN RELOAD THE LASERWRITER TEST DISK AND TRY TO PRINT THE LASERWRITER TEST DOCUMENT.
TEST PRINT OK?
N
REPLACE THE APPLETALK CABLE BETWEEN THE BAD NODE AND THE NEXT NODE ON THE PRINTER SIDE, THEN RELOAD THE LASERWRITER TEST DISK AND TRY TO PRINT THE LASERWRITER TEST DOCUMENT.
Y
TEST PRINT OK?
N
REPLACE THE NODE'S COMPUTER THEN RELOAD THE LASERWRITER TEST DISK AND PRINT THE LASERWRITER TEST DOCUMENT.
Y
EXIT

Explanation for the TWO OR MORE BUT NOT ALL Flowchart

(2.5) Since the network cables are connected serially through the AppleTalk connectors, if a network cable is broken, all of the nodes beyond the break will be affected.

The idea at this point is to determine whether the nodes are bad due to a broken or dangling network cable, or due to node specific problems that are unrelated to each other.

If there is a broken or dangling cable, then the bad nodes will be located in sequence from one end of the network bus. The "TWO OR MORE BUT NOT ALL" flowchart procedure checks each hardware component that could be causing this kind of problem.

If the bad nodes are not in sequence, their problems are probably unrelated. By performing the "ONE NODE" flowchart procedure on each bad node, you check each hardware component that could be causing this type of problem.

ALL NODES
SHEET 1

3.1

1. TURN OFF THE LASERWRITER, THEN TURN IT ON AND ***WAIT*** FOR A TEST PRINT.
2. COMPARE THE TEST PRINT WITH FIGURE 1 ON THE OPPOSITE PAGE.
3. CONFIRM THAT THE PRINTOUT IS CLEAR AND THAT THE "COMMUNICATIONS INDICATOR" IS "APPLETALK" AS SHOWN IN THE DIAGRAM. (SEE COMMENT 1)

3.2

TEST PRINT OK?

N → GO TO THE "LASERWRITER TROUBLESHOOTING PROCEDURE".

Y

STEPS 1 AND 2 ISOLATE THE LASERWRITER AND ONE NODE FROM THE REST OF THE NETWORK (SEE COMMENT 2).

1. IF THERE ARE NODES CONNECTED TO BOTH SIDES OF THE PRINTER, THEN GO TO THE PRINTER; DISCONNECT THE NODES ON ONE SIDE AND LEAVE THE OTHER SIDE CONNECTED.

2. FIND THE FIRST NODE NOW CONNECTED TO THE PRINTER. FIND THE NODE'S APPLETALK CONNECTOR. UNPLUG THE NETWORK CABLE FROM THE NODE'S APPLETALK CONNECTOR WHICH LEADS AWAY FROM THE PRINTER. LEAVE THE CABLE GOING TO THE PRINTER CONNECTED (SEE FIGURE 2 ON PAGE 21).

3. CHECK THAT THE NETWORK CABLE PLUG IS FIRMLY INSERTED INTO THE NODE'S CONNECTOR MODULE.

4. *a. IF THE COMPUTER IS A MACINTOSH:*
   (1) CHECK THAT THE CABLE FROM THE APPLETALK CONNECTOR IS FIRMLY INSERTED INTO THE PRINTER PORT.
   (2) TURN OFF THE MACINTOSH, LOAD THE LASERWRITER TEST DISK, THEN TURN THE MACINTOSH BACK ON.

   b. *IF THE COMPUTER IS A MACINTOSH XL:*
   (1) CHECK THAT THE APPLETALK CONNECTOR IS FIRMLY INSERTED INTO PORT B.
   (2) START UP MACWORKS.
   (3) INSERT THE LASERWRITER TEST DISK.

3. PRINT THE LASERWRITER TEST DOCUMENT FROM THE TEST DISK (SEE COMMENTS 3 AND 4).

3.3

TEST PRINT OK ? (SEE COMMENT 4)

N → RETRY THE PRINT WITH THE OTHER LASERWRITER TEST DISK TO ENSURE THAT THE TEST DISK WAS NOT THE CAUSE OF THE PROBLEM. → GO TO "FIRST NODE"

Y → GO TO "ALL NODES" SHEET 2

COMMENT 1

IF THE PRINTER IS DOWN, THE WHOLE NET WILL APPEAR TO BE MALFUNCTIONING. A PRINT FUNCTION PROBLEM MIGHT CAUSE THIS SYMPTOM. THIS STEP IS MEANT TO PROVE WHETHER OR NOT THE PRINT FUNCTIONS ON THE PRINTER ARE OK.

COMMENT 2

BY DISCONNECTING THE REST OF THE BUS FROM THE NODE CLOSEST TO THE PRINTER, YOU ELIMINATE ANY EFFECTS A FAULTY BUS MIGHT HAVE ON COMMUNICATIONS BETWEEN THE FIRST NODE AND THE PRINTER.

IF YOU CAN NOW PRINT FROM THE FIRST NODE, THE PRINTER'S COMMUNICATIONS FUNCTION MUST BE OK.

COMMENT 3

THE LASERWRITER TEST DISK IS A KNOWN GOOD PRECONFIGURED PROGRAM WHICH ELIMINATES DISK CONFIGURATION AS A POSSIBLE PROBLEM.

COMMENT 4

PRINTING PROBLEMS CAN BE INDICATED BY A SYSTEM ERROR MESSAGE, CONSTANTLY RUNNING DISK DRIVE, SYSTEM HANG, ETC.

Explanation for the ALL NODES Flowchart

3.1 Problems which cause all nodes on the network to malfunction include:

* A LaserWriter malfunction.
* A communications problem between the LaserWriter and the closest node.
* A network bus problem common to all nodes on the network.

The ALL NODES flowchart is concerned with isolating the problem to one of the three possibilities above.

3.2 The print functions of the LaserWriter are those electromechanical operations that must be performed in order for a print to occur. Every time the LaserWriter is turned on, it will produce a test print to test these functions. If the printout is clear, then the hardware which performs the print functions is operating correctly.

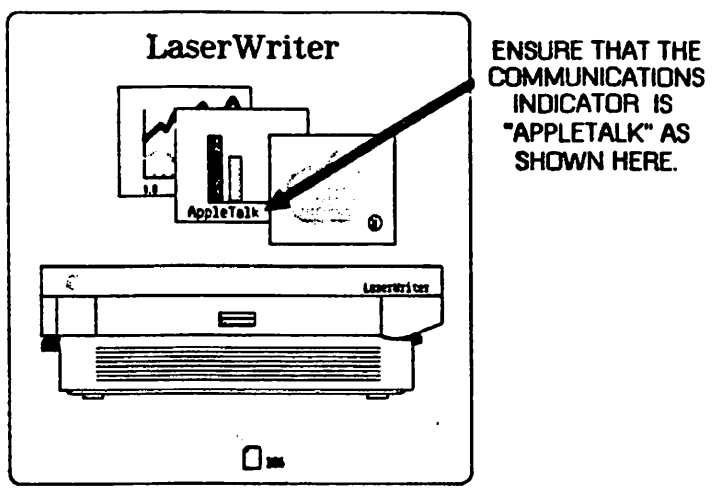
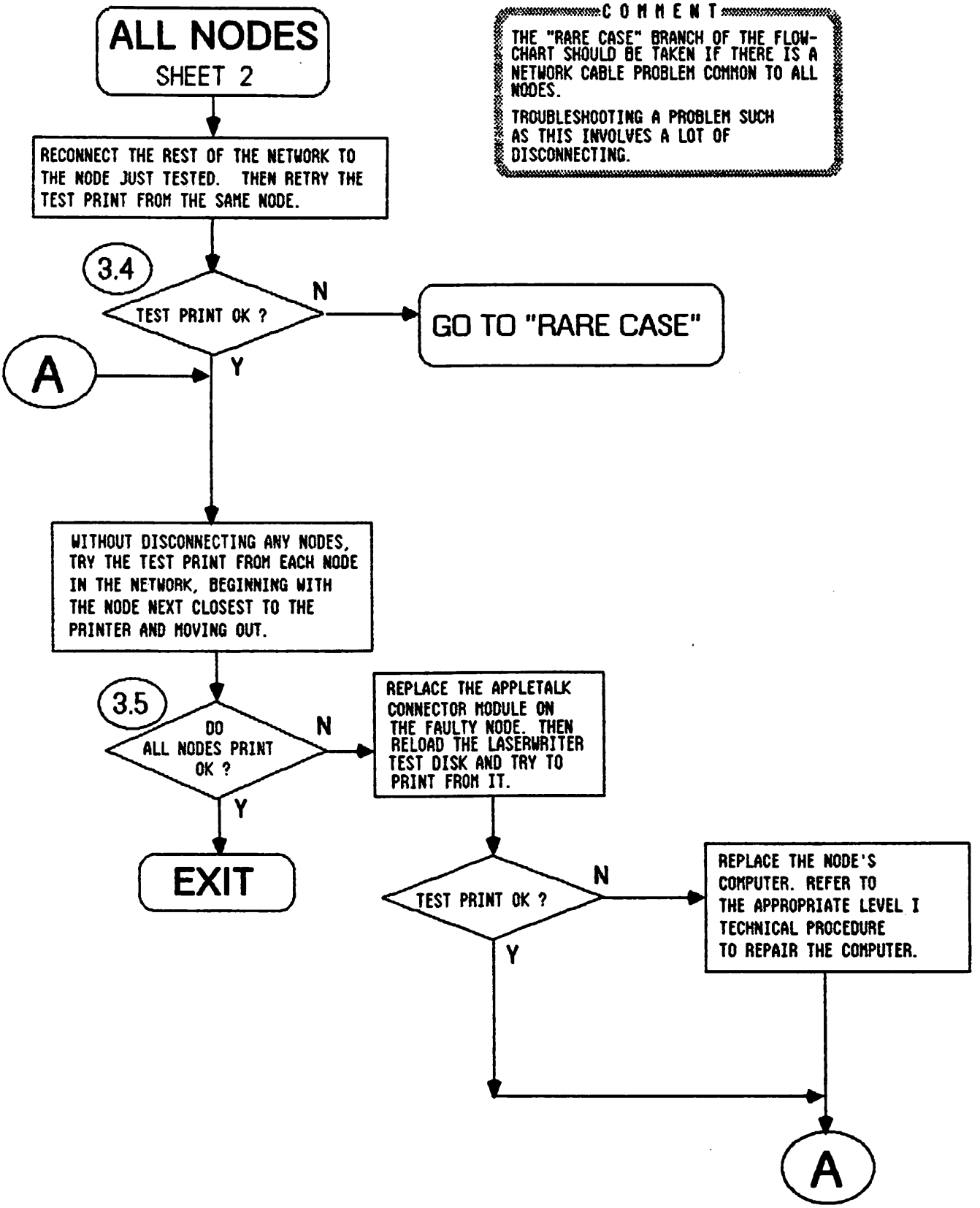


FIGURE 1

3.3 A successful test print eliminates LaserWriter malfunction as the source of the problem (see 3.2). Nor can the problem be caused by a faulty bus since the rest of the network has been disconnected. The only remaining potential cause is a communications problem between the first node and the LaserWriter.

The FIRST NODE flowchart addresses the LaserWriter - first node communication problem.

(Continued on the next page).


ALL NODES
SHEET 2
COMMENT
THE "RARE CASE" BRANCH OF THE FLOW-CHART SHOULD BE TAKEN IF THERE IS A NETWORK CABLE PROBLEM COMMON TO ALL NODES.
TROUBLESHOOTING A PROBLEM SUCH AS THIS INVOLVES A LOT OF DISCONNECTING.
RECONNECT THE REST OF THE NETWORK TO THE NODE JUST TESTED. THEN RETRY THE TEST PRINT FROM THE SAME NODE.
3.4
TEST PRINT OK ?
N
GO TO "RARE CASE"
A
Y
WITHOUT DISCONNECTING ANY NODES, TRY THE TEST PRINT FROM EACH NODE IN THE NETWORK, BEGINNING WITH THE NODE NEXT CLOSEST TO THE PRINTER AND MOVING OUT.
3.5
DO ALL NODES PRINT OK ?
N
REPLACE THE APPLETALK CONNECTOR MODULE ON THE FAULTY NODE. THEN RELOAD THE LASERWRITER TEST DISK AND TRY TO PRINT FROM IT.
Y
EXIT
TEST PRINT OK ?
N
REPLACE THE NODE'S COMPUTER. REFER TO THE APPROPRIATE LEVEL I TECHNICAL PROCEDURE TO REPAIR THE COMPUTER.
Y
A

(3.4) If a node works when isolated from the rest of the network but doesn't work when reconnected to the network, a network bus problem is indicated.

The RARE CASE flowchart addresses this situation.

(3.5) At this point, you have proven that the print functions of the LaserWriter, the communications between the LaserWriter and the closest node, and the network cable bus all operate properly.

The rest of the ALL NODES flowchart is concerned with checking that the remainder of the nodes in the network operate correctly.

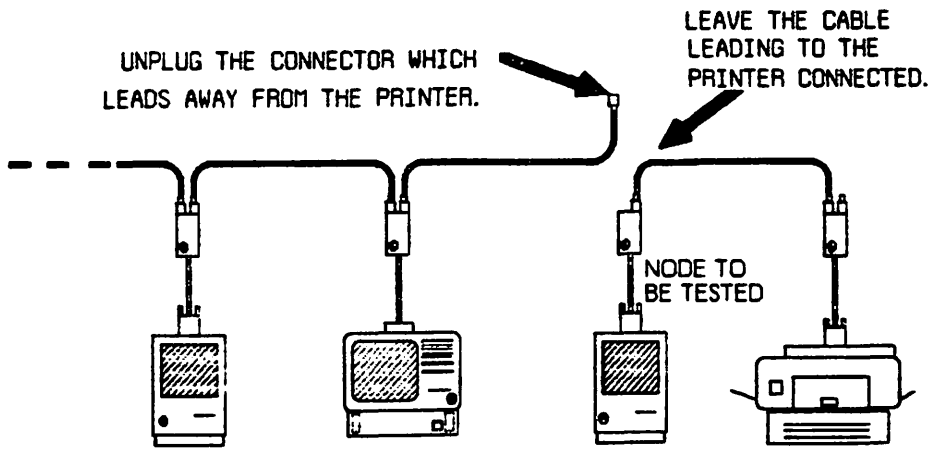
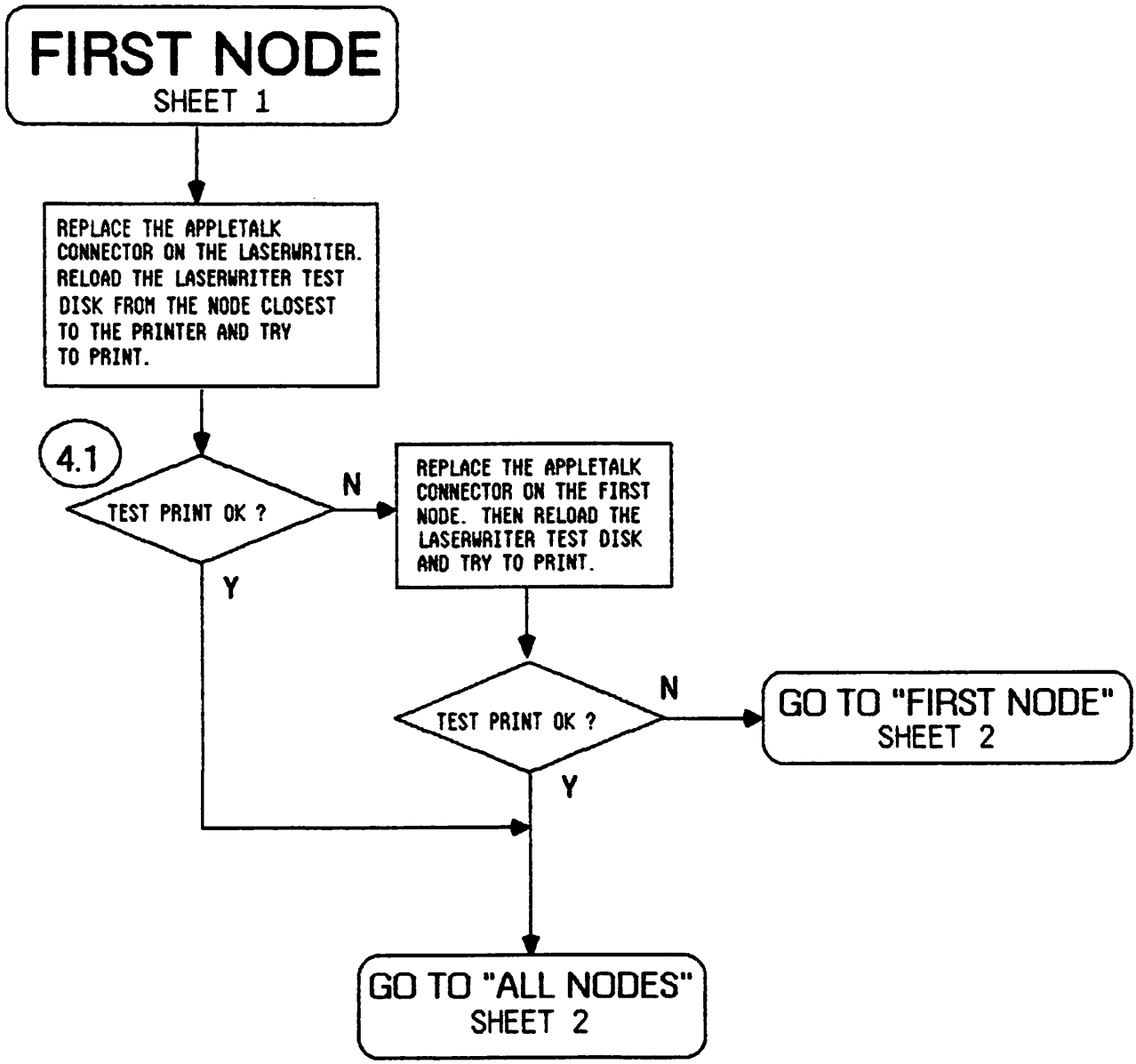


FIGURE 2

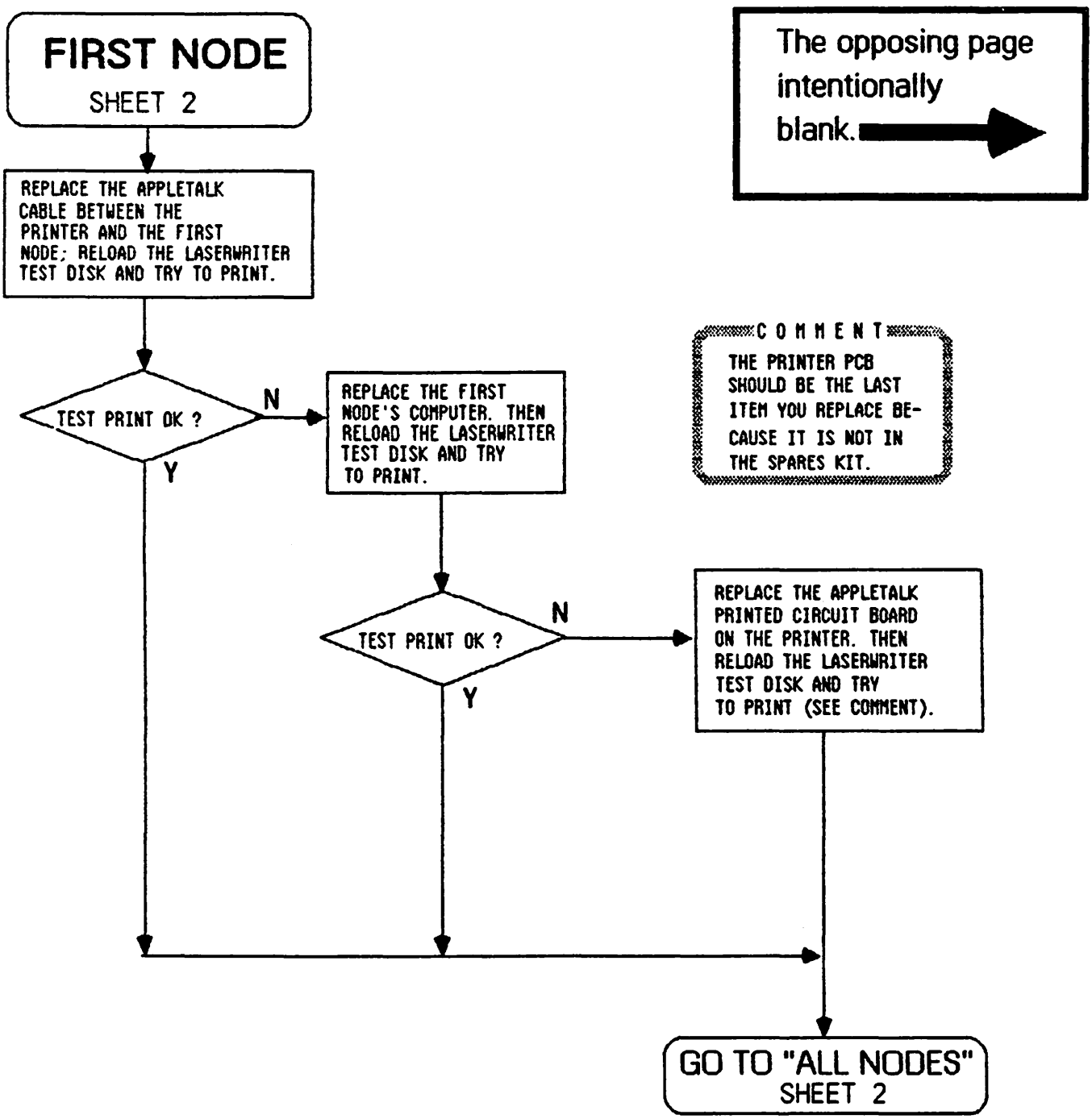
Figure 2 is referred to by Sheet 1 of the ALL NODES flowchart.

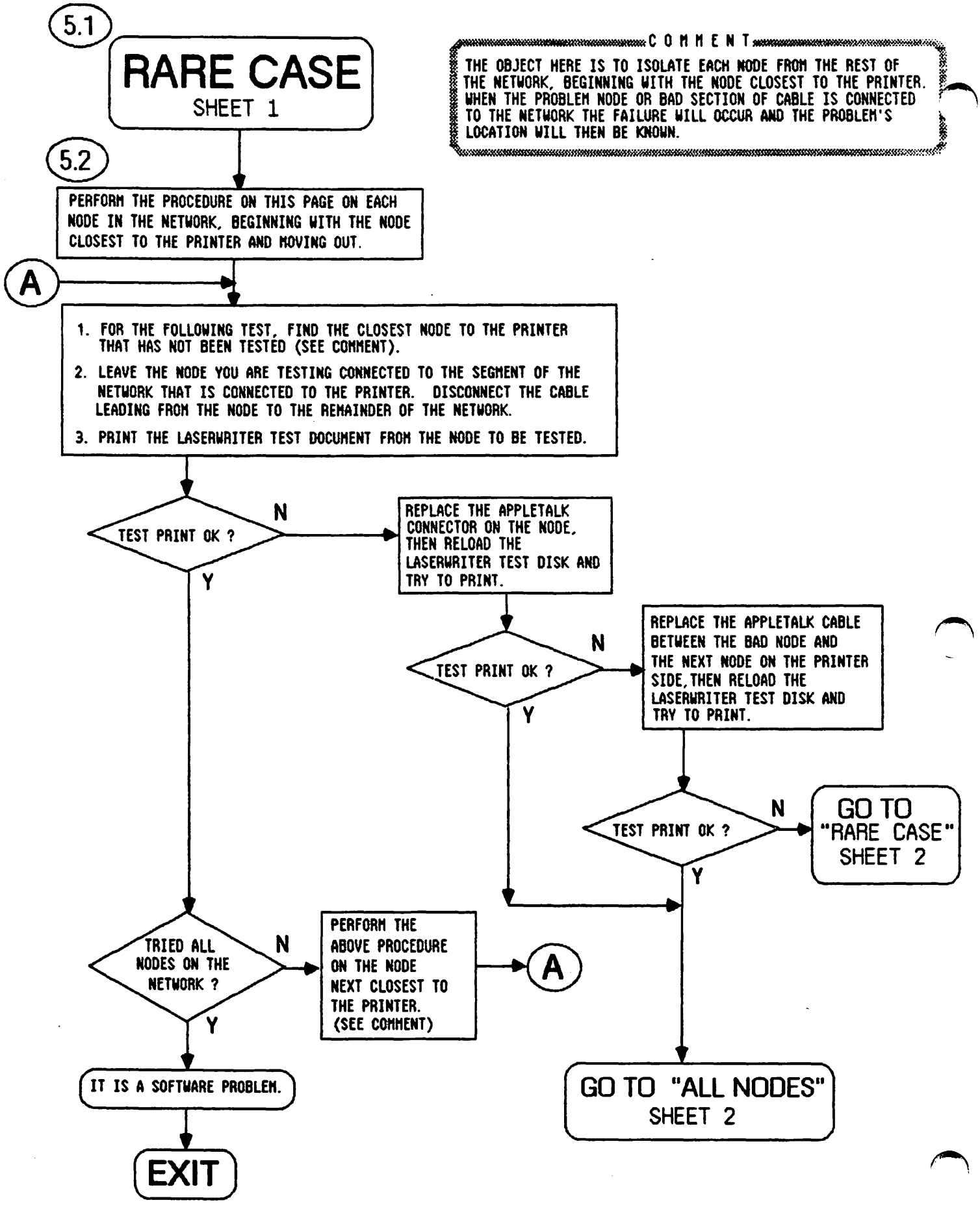

FIRST NODE
SHEET 1
REPLACE THE APPLETALK CONNECTOR ON THE LASERWRITER. RELOAD THE LASERWRITER TEST DISK FROM THE NODE CLOSEST TO THE PRINTER AND TRY TO PRINT.
4.1
TEST PRINT OK ?
N
Y
REPLACE THE APPLETALK CONNECTOR ON THE FIRST NODE. THEN RELOAD THE LASERWRITER TEST DISK AND TRY TO PRINT.
TEST PRINT OK ?
N
Y
GO TO "FIRST NODE" SHEET 2
GO TO "ALL NODES" SHEET 2

Explanation for the FIRST NODE Flowchart

(4.1) This procedure should be used if the communications between the LaserWriter and the node closest to it are isolated and an attempt to print from the node is still unsuccessful.

The "FIRST NODE" flowchart procedure has you replace each hardware item that could possibly cause the problem.


FIRST NODE
SHEET 2
The opposing page intentionally blank.
REPLACE THE APPLETALK CABLE BETWEEN THE PRINTER AND THE FIRST NODE; RELOAD THE LASERWRITER TEST DISK AND TRY TO PRINT.
TEST PRINT OK ?
N
Y
REPLACE THE FIRST NODE'S COMPUTER. THEN RELOAD THE LASERWRITER TEST DISK AND TRY TO PRINT.
COMMENT
THE PRINTER PCB SHOULD BE THE LAST ITEM YOU REPLACE BECAUSE IT IS NOT IN THE SPARES KIT.
TEST PRINT OK ?
N
Y
REPLACE THE APPLETALK PRINTED CIRCUIT BOARD ON THE PRINTER. THEN RELOAD THE LASERWRITER TEST DISK AND TRY TO PRINT (SEE COMMENT).
GO TO "ALL NODES" SHEET 2

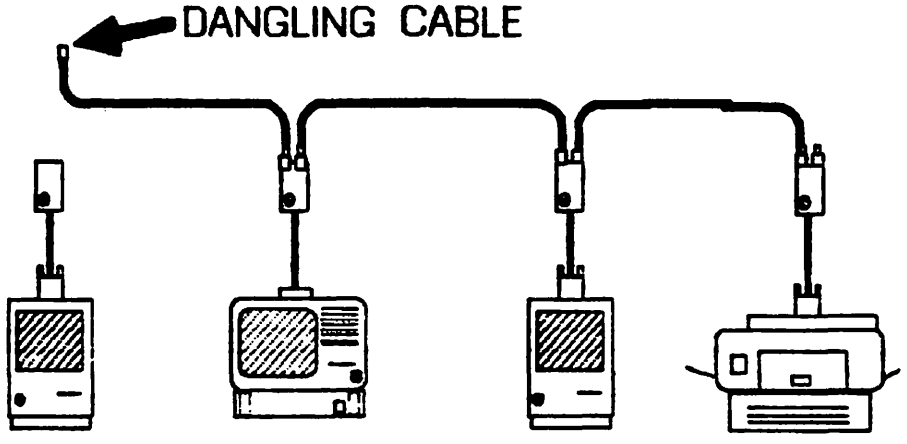

5.1
RARE CASE
SHEET 1
COMMENT
THE OBJECT HERE IS TO ISOLATE EACH NODE FROM THE REST OF THE NETWORK, BEGINNING WITH THE NODE CLOSEST TO THE PRINTER. WHEN THE PROBLEM NODE OR BAD SECTION OF CABLE IS CONNECTED TO THE NETWORK THE FAILURE WILL OCCUR AND THE PROBLEM'S LOCATION WILL THEN BE KNOWN.
5.2
PERFORM THE PROCEDURE ON THIS PAGE ON EACH NODE IN THE NETWORK, BEGINNING WITH THE NODE CLOSEST TO THE PRINTER AND MOVING OUT.
A
1. FOR THE FOLLOWING TEST, FIND THE CLOSEST NODE TO THE PRINTER THAT HAS NOT BEEN TESTED (SEE COMMENT).
2. LEAVE THE NODE YOU ARE TESTING CONNECTED TO THE SEGMENT OF THE NETWORK THAT IS CONNECTED TO THE PRINTER. DISCONNECT THE CABLE LEADING FROM THE NODE TO THE REMAINDER OF THE NETWORK.
3. PRINT THE LASERWRITER TEST DOCUMENT FROM THE NODE TO BE TESTED.
TEST PRINT OK ?
N
Y
REPLACE THE APPLETALK CONNECTOR ON THE NODE, THEN RELOAD THE LASERWRITER TEST DISK AND TRY TO PRINT.
TEST PRINT OK ?
N
Y
REPLACE THE APPLETALK CABLE BETWEEN THE BAD NODE AND THE NEXT NODE ON THE PRINTER SIDE, THEN RELOAD THE LASERWRITER TEST DISK AND TRY TO PRINT.
TEST PRINT OK ?
N
Y
GO TO "RARE CASE" SHEET 2
TRIED ALL NODES ON THE NETWORK ?
N
Y
PERFORM THE ABOVE PROCEDURE ON THE NODE NEXT CLOSEST TO THE PRINTER. (SEE COMMENT)
A
IT IS A SOFTWARE PROBLEM.
EXIT
GO TO "ALL NODES" SHEET 2

Explanation for the RARE CASE Flowchart

(5.1) This procedure should be performed if the communications between the LaserWriter and the node closest to it worked correctly when isolated, but a test print failed when the network bus was reconnected, indicating a bad network bus.

(5.2) There are two problems which result in a bad network bus:

(1) An improperly terminated (dangling or broken) network cable anywhere on the bus. For example, a network cable which has been accidently disconnected from its AppleTalk connection box (the dangling cable below) could result in an unbalanced impedance which could cause the whole bus to fail.

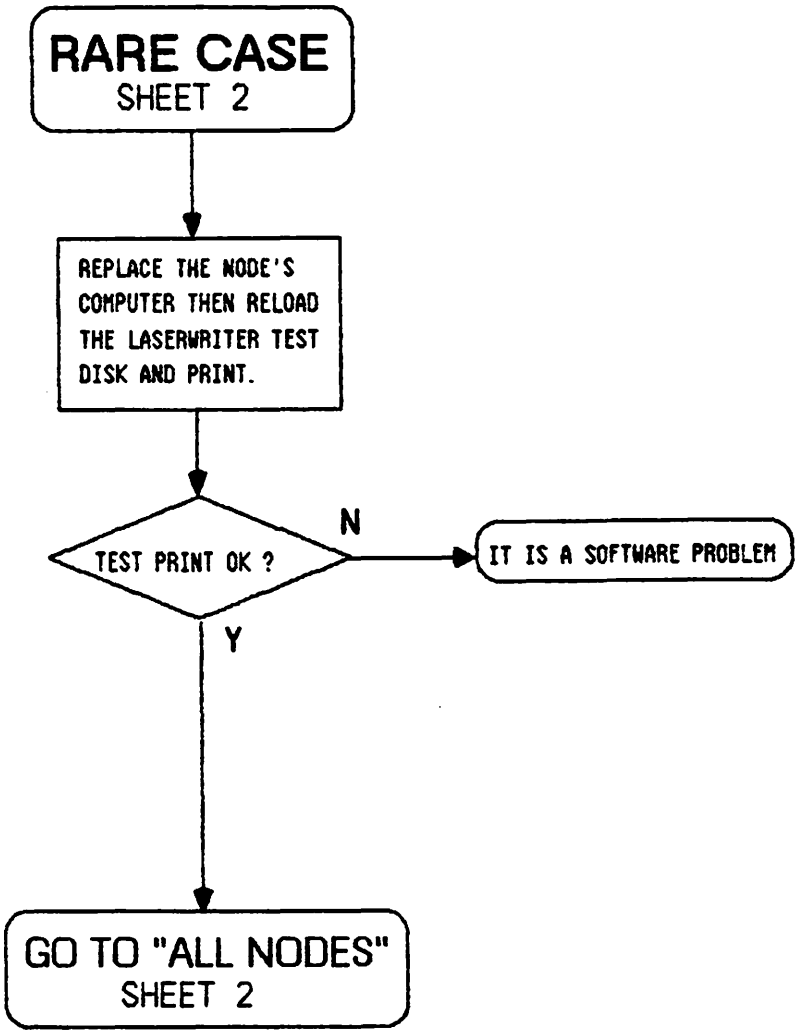


A broken network cable could cause the same problem.

(2) A malfunctioning node that puts a constant level of electric noise on the network bus. In this case no other node would try to transmit because the system appears "busy".

NOTE: For more information on noisy node problems and bus termination problems (i.e. dangling cables and circular networks) refer to the Appendix.

(Continued on the next page).


RARE CASE
SHEET 2
REPLACE THE NODE'S COMPUTER THEN RELOAD THE LASERWRITER TEST DISK AND PRINT.
TEST PRINT OK ?
N
IT IS A SOFTWARE PROBLEM
Y
GO TO "ALL NODES"
SHEET 2

(5.2) Two problems which result in a bad network bus: (continued)

For Sheet 1 of RARE CASE, each node in the network is tested sequentially, beginning with the node closest to the LaserWriter.

As each node is being tested, it is connected to the nodes that have proven that they can print. The known good nodes and the node being tested are disconnected from the rest of the network.

When the node causing the network bus problem is connected, the test print will fail.

Once the bad node is found, the flowchart procedure checks each of the hardware components between the bad node and the nearest known good node.

MACINTOSH OFFICE (APPLETALK)
TECHNICAL PROCEDURES

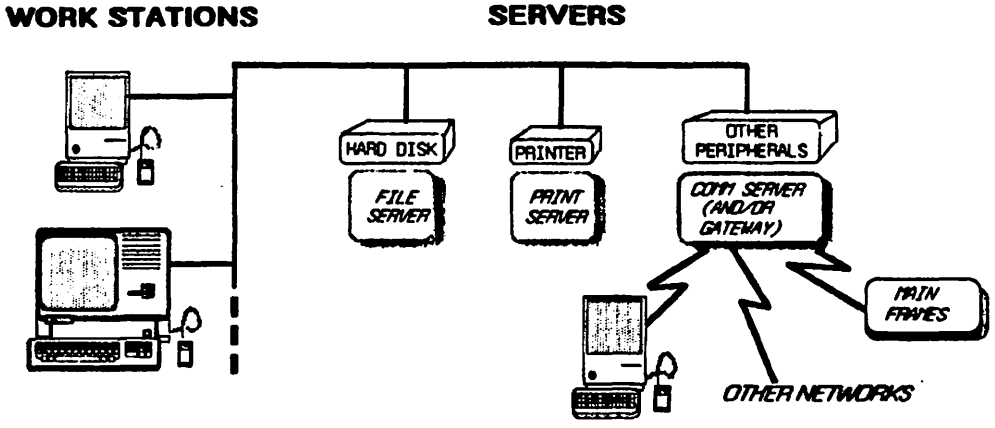
APPENDIX

TABLE OF CONTENTS

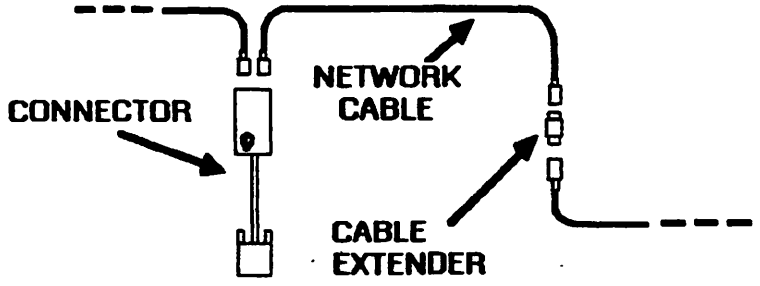
Contents:

WHAT IS THE APPLETALK PERSONAL NETWORK?

The AppleTalk Personal Network allows any Macintosh, or Macintosh XL user to share the use of a single LaserWriter Printer. In the future, other devices such as **file servers** (large capacity disk drives) and **communication servers** (devices that provide access to other computer networks) will be added to the network (shown below). Macintosh, and Macintosh XL users will also be able to communicate instantaneously with each other over the network when the appropriate software becomes available.



The AppleTalk Personal Network has three physical components: the **network cable**, the **AppleTalk connector**, and the **cable extender**, (shown below).



The AppleTalk connector is attached to a computer or other device; the individual AppleTalk connectors are then linked by means of the network cables. When all of the lengths of network cable are connected, they form a **network bus.**

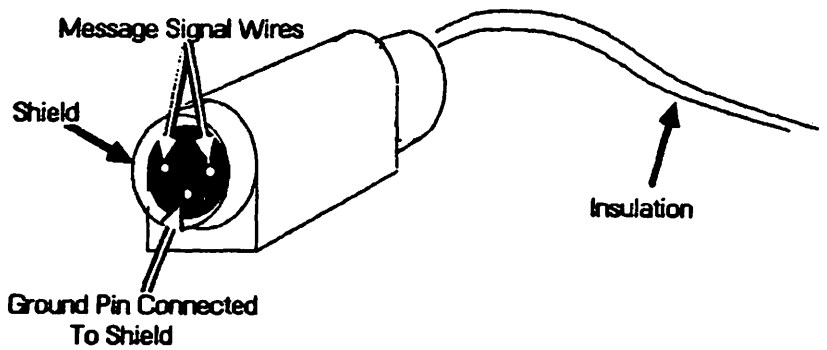
Each device location on an AppleTalk network is called a **node.** When we refer to a node, we mean the device itself and the AppleTalk connector attached to it.

The AppleTalk Components

AppleTalk Network Cable is sold in two and ten meter lengths with preassembled connector plugs. It is also sold in kit form for custom installations. The kit contains a one hundred meter spool of cable with unassembled connector plugs. The installer cuts the length of cable needed and then attaches a plug to each end.

The network cable is made up of two wires wrapped in a metal shield, which is then wrapped in electric insulation (shown below).

NETWORK CABLE



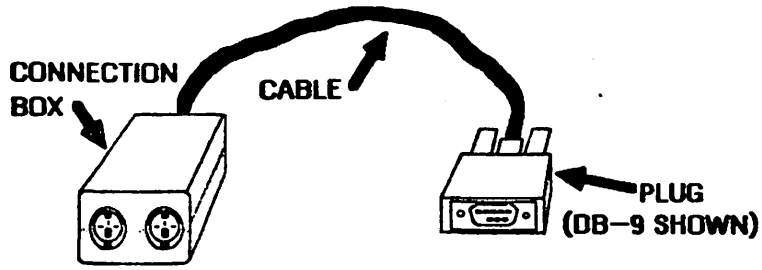
The two wires conduct the electric message signal to the AppleTalk connectors around the network.

The conductive metal shield covering the wires in the network cable protects them from electronic noise that may come from other devices in the area. Without the shield, the noise would interfere with communications on the network. It also provides a common electrical ground for all of the nodes.

The third pin on the network cable plug connects the cable shield (the network ground) through each AppleTalk connector to the ground lines of the attached devices.

An AppleTalk Connector is composed of a **plug** that fits into the back of the computer, a **cable** leading from the computer to the network, and a **connection box** (see the illustration below).

APPLETALK CONNECTOR



The **AppleTalk connector cable** permanently attaches the plug to the connection box. The plug for the Macintosh is a 9 pin DB type connector. For the Macintosh XL, the plug is a standard DB-25 connector.

The **connection box** provides the node with a connection point onto the network. The connection box has electronic components inside and two sockets for network cable plugs.

The sockets on the connection box are interchangeable. It makes no difference which one a network cable is plugged into.

An AppleTalk Cable Extender is a small double ended connector that allows two pieces of network cable to be joined together to form a longer cable. A cable extender should <u>not</u> be used to terminate the cable.

WHY NOISY NODES CAN CAUSE NETWORK BUS PROBLEMS

Only one node may transmit (put message signals on the network cable) at a time. If two nodes were allowed to transmit at the same time, their signals would collide and be incoherent to the rest of the network. This is similar to two people speaking at the same time preventing anyone from understanding them.

To make sure that only one node is transmitting on the bus at a time, all AppleTalk nodes follow a set of rules called Carrier Sense, Multiple Access with Collision Avoidance (CSMA/CA).

Carrier Sense means that before a node can transmit anything on the network, it will check the network cable to see if another node is transmitting. If there is, the node that is trying to transmit will wait for a designated period of time and then listen again; if the network is still busy, it will wait again, and so on. This will go on until the node detects that the bus is idle (no node is transmitting on the network). At this time the node will wait for a period of time to make sure that no other node is going to transmit and then begin its own transmission (see collision avoidance below).

Multiple Access means that every node has equal access to the network cable through its connection box.

Collision Avoidance means that AppleTalk tries to minimize collisions by having each node wait a different amount of time after the bus becomes idle before they transmit.

If the interface electronics in a node failed and put electric noise on the bus, the other nodes might sense the noise and assume that the bus was always busy. If this were to happen the other nodes would never transmit any messages.

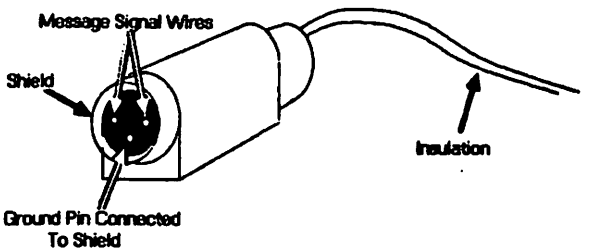
APPLETALK BUS TERMINATION PROBLEMS

The Circuit on the AppleTalk Network Cable

NOTE: For the following explanations, many of the terms and concepts have been simplified.

The network cable is made up of two message signal wires wrapped in a metal shield, which is then wrapped in electric insulation (shown below).

NETWORK CABLE



The two wires carry the message signals around the network.

The message signals have a maximum **frequency** of 230.4 KHz. That means that a transition from the most positive to the most negative voltage levels of the signal can happen up to 230.4 thousand times a second.

There is an electronic component called a **transformer** in every connection box. Each node's transformer couples the node to the network bus. When a node transmits, it sends the message signal to the transformer which conveys it onto the message signal wires of the network cable. The transformers in the other node's connection boxes allow them to read the message signal from the bus.

The message signal is put on the network cable in a differential fashion. That means that at any given time if the message signal voltage on one of the wires is positive, then the other wire will be negative, and vice versa.

Since electric current is often thought of as flowing from negative to positive, we will call the negative wire the **source** wire and the positive wire the **return** wire.

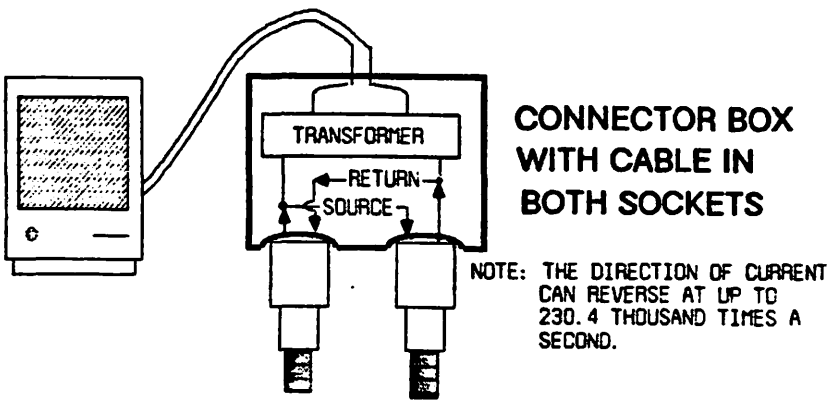
When the voltages change, the direction of current will change, thus the role of the wires alternate. However, at any given instant during a transmission, one wire will be the source and one the return.

NOTE: The AppleTalk bus conforms to the electrical interface specifications defined in the Electronic Industries Association's RS-449/422 Standard. For more detailed information on the RS-449/422 interface, refer to that document.

When a signal enters a connection box from a length of network cable, it will do one of two things depending on whether or not a network cable is plugged into the other socket.

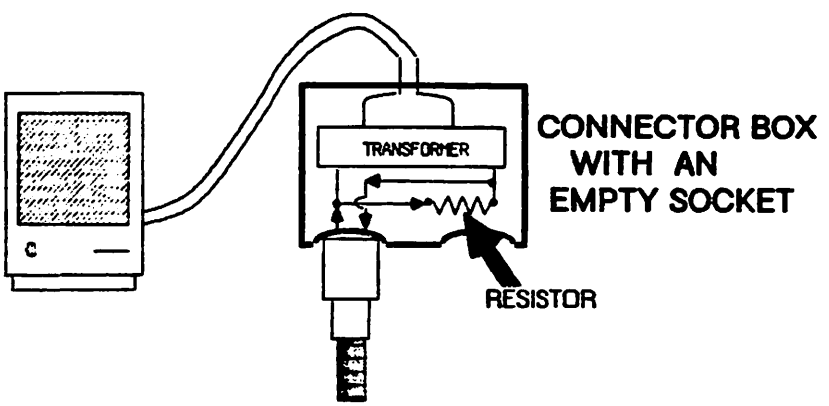
(1) **Cables plugged into both sockets.**

All of the nodes except those on the two ends of the network bus will have cables plugged into both sockets. In this case the signal flows from one socket through to the other into the next length of cable (shown below).



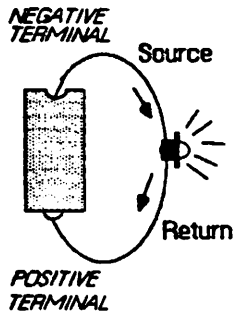
(2) **Cable plugged into only one socket.**

The end nodes will have a cable plugged into only one socket. Each connection box is designed so that if a socket is empty, a switch inside the box connects the signal wires from the other socket to a terminating resistor. The message signal current in the source wire flows through the terminating resistor back to the return wire completing the circuit (shown below).

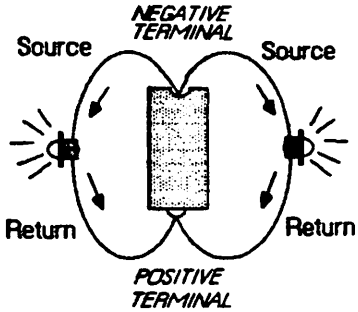


The AppleTalk Network Bus circuit is like the circuit in a flashlight.

FLASHLIGHT CIRCUIT WITH ONE BULB



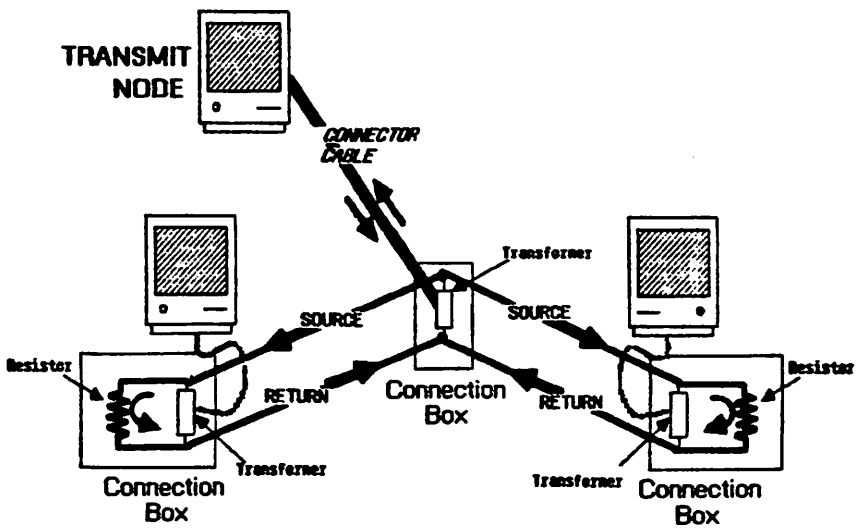
FLASHLIGHT CIRCUIT WITH TWO BULBS



The current from the source (negative) wire flows through something called a load (a bulb for the flashlight and a terminating resistor for the AppleTalk bus) to the return (positive) wire. In the flashlight example above, two bulbs are shown to demonstrate that the current can be split at its source to travel through two loads and arrive at the same return point. In the AppleTalk bus example below the same thing occurs. The only difference is that the current is going through two terminating resistors instead of two bulbs.

In the flashlight the battery provides the power, while in the AppleTalk bus the transmitting node provides the power in the form of the message signal.

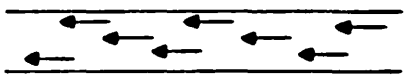
APPLETALK CIRCUIT



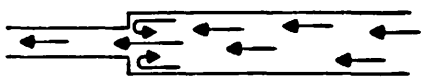
Impedance on the AppleTalk Network Cable

For the message signal current to flow smoothly and accurately, the impedance (explained below) throughout the network must be constant.

Electric current is commonly compared to water flowing through a pipe. Impedance is like the resistance that the walls of a pipe present to flowing water. As long as the circumference of the pipe remains the same, the impedance to the flow of water is the same.



If at some point the pipe's circumference is made smaller, the impedance to the flow will increase at that point and part of the water will be reflected back.



In an AppleTalk network the message signal current flows through the source message wire the way water flows through the pipe. It is important to avoid changes in impedance since that can cause reflections of the message signal similar to the reflections that occurred when the water encountered the narrower pipe.

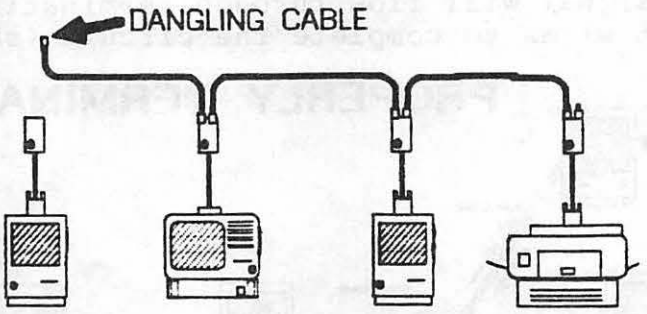
If an AppleTalk network bus is terminated properly, the network cable on each end of the bus will be plugged into a connection box with an empty socket.

The connection box with an empty socket channels the message signal on the network cable's source wire through a terminating resistor to the return wire.

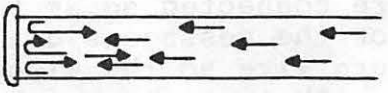
The terminating resistor provides the same amount of impedance as the network cable so there will be no reflections of the message signal on the bus.

Dangling Cables

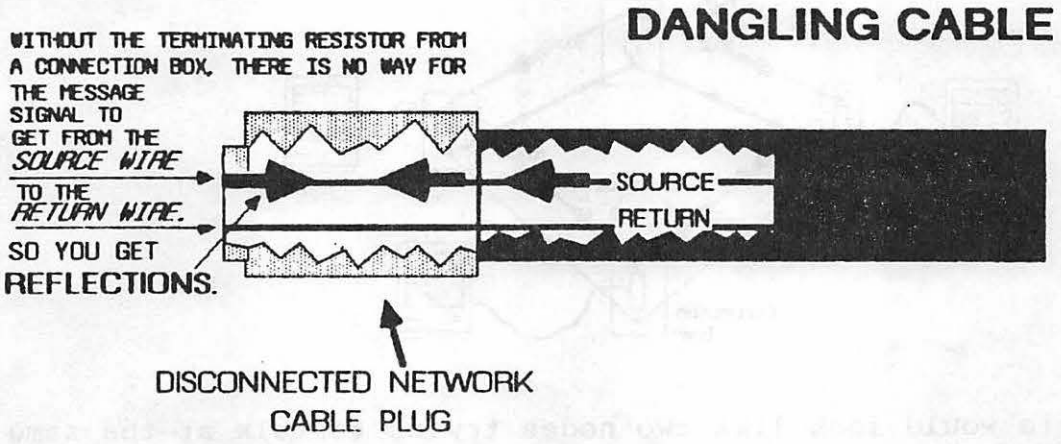
If a network cable is left dangling (shown below), when the current on the source wire reaches the unterminated end, it has no channel to take to the return wire.



The message signal in a dangling cable has no place to flow once it reaches the end of the cable so it is reflected back on to the source wire, just like a flow of water run into a capped pipe (shown below).



The reflections would bounce back along the source wire and mix with the original message signal (shown below). This would look like two nodes trying to talk at the same time, and that would interfere with communications.

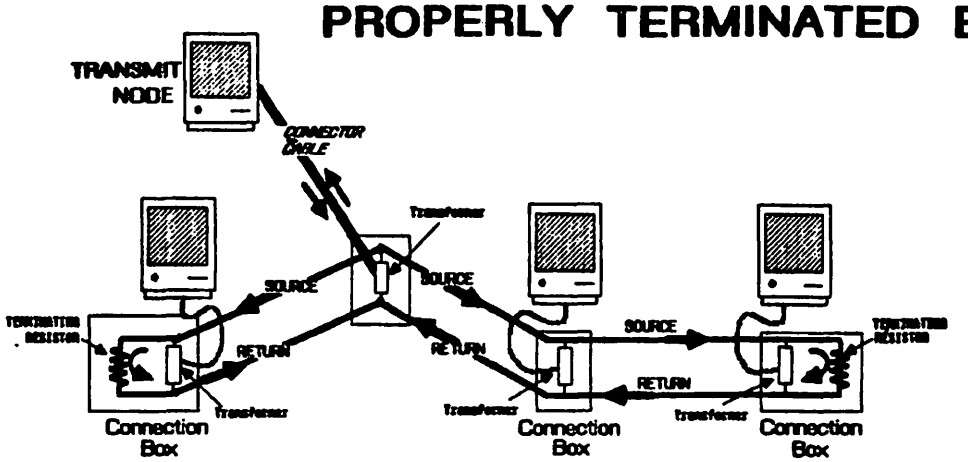


To prevent reflections of the message signal on the network, it is very important to always terminate the ends of the network cable into a connection box.

Circular Networks

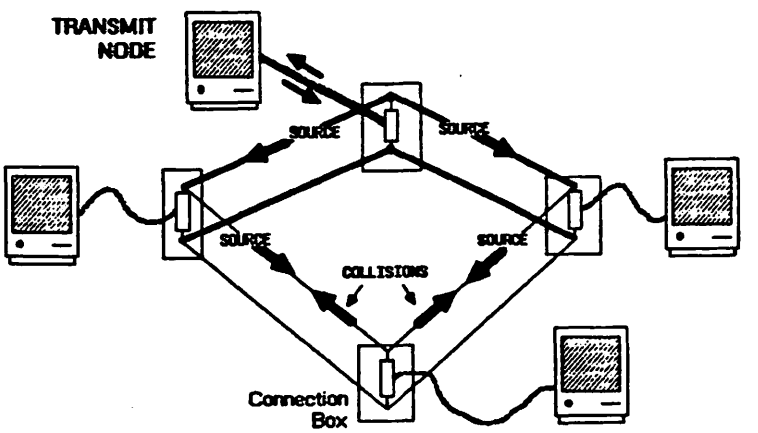
When a signal is transmitted onto the network cable by a node somewhere in the center of a bus, the source signal is sent to both sides of the bus. If both ends are properly terminated (i.e. each end plugged into a connection box), the message signal will flow through terminating resistors to the return wires to complete the circuit (shown below).

PROPERLY TERMINATED BUS



If the network cables are connected so as to form a closed loop, there is no way for the message signal on the source wire to flow to the return wire so the signals on both sides of the bus will collide with each other (shown below).

CIRCULAR NETWORK



This would look like two nodes trying to talk at the same time, and that would interfere with communications. Therefore, it is very important to always terminate the ends of the network cable into connection boxes so that it does not form a closed loop.

II.J- THE READY/WAIT INDICATOR DOES NOT STOP FLASHING

Step	Check	Result	Action
1	Does the rear (I/O) connector plate's test light come on?	YES	Replace the LaserWriter I/O board.
		NO	Replace the DC Controller PCB.

II.K- THE READY/WAIT INDICATOR DOES NOT LIGHT

Step	Check	Result	Action
1	Do any of the other LEDs light steadily?	YES	If the PAPER OUT indicator is lit, put paper in the cassette. If the JAM indicator is lit, find and remove the paper jam.
2	Have all the LEDs on the display gone out?	YES	Go to "ALL LEDs ON THE DISPLAY PANEL DO NOT LIGHT". Is the problem solved? If not, go on to the next step.
3	Does the READY/WAIT indicator light steadily when the circuit between J201-2 and J208-6(GND) on the DC Controller PCB is shorted?	YES	Replace the DC Controller PCB.
		NO	Check J201 on the DC Controller PCB and TB18 on the display PCB for good contact. If contact is good check whether +5VDC is supplied between TB18 and J208-6(GND) on the DC Controller PCB. If so replace the display PCB. If not go to "THERE IS NO POWER."
4	Does the rear (I/O) connector plate's test light come on?	YES	Replace the LaserWriter I/O board.

II.L- PRINTING DOES NOT START WHEN A FILE IS SENT TO THE PRINTER

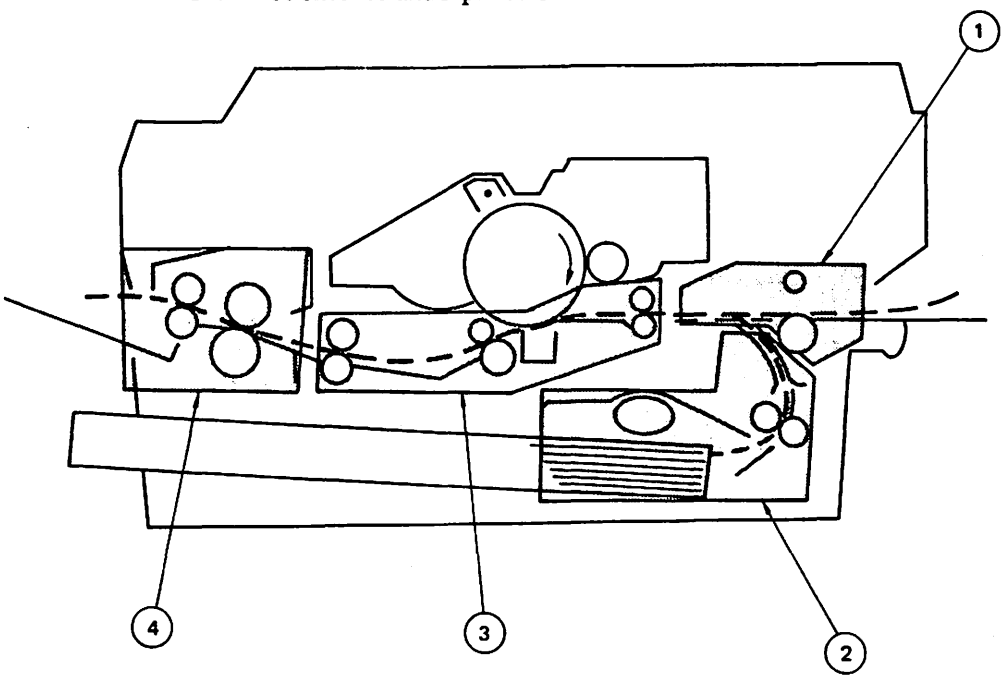
Step	Check	Result	Action
1	Is protocol selector switch on back of printer set correctly?	NO	Set switch to correct position.
2	Is appropriate network software and printer software installed on the application disk?	NO	Install the correct software.
3	Is the Macintosh defective? (Run MacTest.)	YES	Repair the defective Macintosh.
4	Is there a network problem? (Run test disk supplied with laser printer.)	YES	Refer to Macintosh Office troubleshooting.

II.M- READY/WAIT INDICATOR COMES ON BUT NO TEST PRINT IS PRODUCED

Step	Check	Result	Action
1	Is green "TEST" LED on rear (I/O) connector plate blinking?	YES	Replace LaserWriter I/O board.
2	Are major subassemblies not receiving power or is circuit breaker CB1 blown?	YES	Go to "THERE IS NO POWER"

III- PAPER JAMS

Paper in the printer passes through four main areas: (1) manual feed area; (2) cassette feed area; (3) separation/feed area; and (4) fuser/delivery area. Frequent jams in any area indicate that the area should be checked and repaired or cleaned and lubricated.



III.A- MANUAL FEED UNIT

Step	Check	Result	Action
1	Is approved print paper being used?	NO	Use approved paper (16-21 Lb. standard photocopier paper)
2	Is the paper wrinkled or curled?	YES	Replace the paper and make sure that the paper is stored correctly. Instruct the user.
3	Does the paper detection arm on the Registration Shutter Assembly move smoothly?	NO	Adjust the arm motion until it is smooth.
4	Is the lower feed roller dirty?	YES	Clean with alcohol.

III.B- CASSETTE PICKUP ASSEMBLY

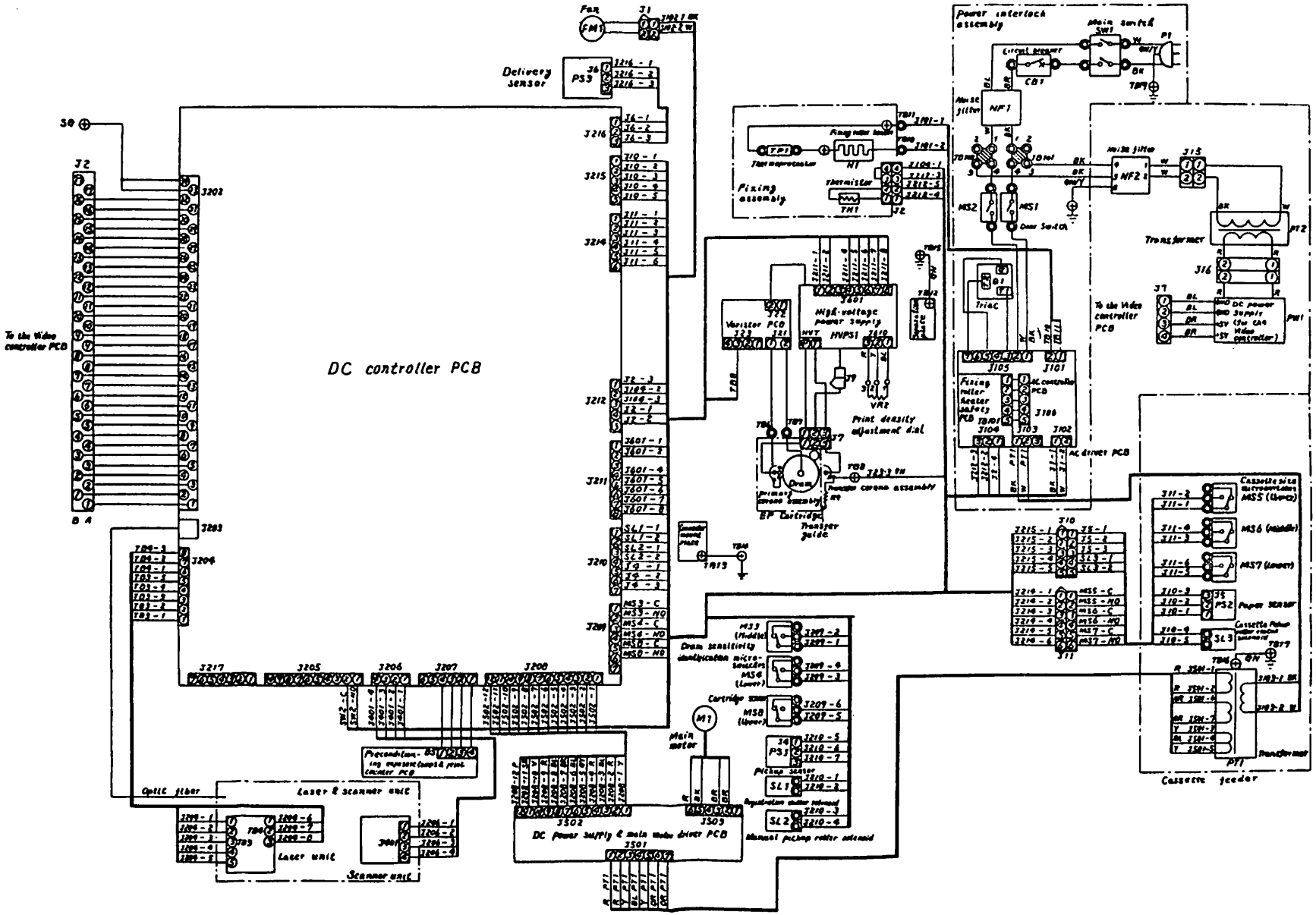
Step	Check	Result	Action
1	Is the internal cassette loaded with more than 10mm of paper?	YES	Remove the excess paper
2	Is approved print paper being used?	NO	Use approved paper (16-21 Lb. standard photocopier paper).
3	Is the paper wrinkled or curled?	YES	Replace the paper and make sure that the paper is stored correctly.
4	Is the cassette installed properly in the printer?	NO	Install the cassette properly.
5	Are any of the feed rollers on the assembly dirty?	YES	Clean with a damp cloth, then with a dry cloth.
6	Are any of the pickup rollers on the assembly dirty?	YES	Clean rollers with alcohol.

III.C- SEPARATION/FEEDER UNIT

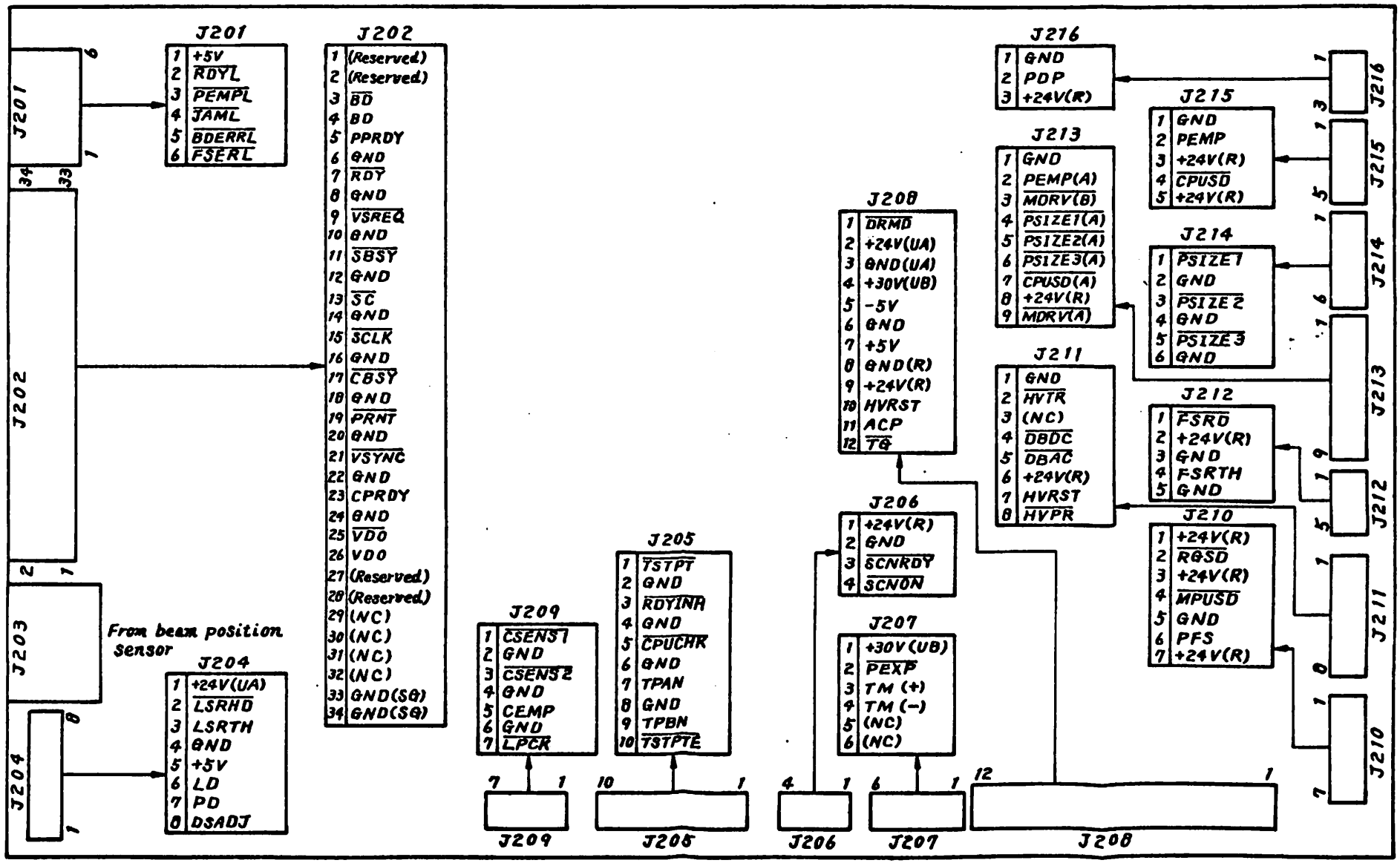
Step	Check	Result	Action
1	Is the separation belt damaged or twisted?	YES	Replace the separation belt.
2	Is the separation belt inside out?	YES	Reinstall correctly. The notched side of the belt should be facing away from the I/O connector plate.
3	Is any roller dirty or worn?	YES	Clean dirty rollers as necessary. Replace separation/feeder unit if rollers are badly worn.
4	Are the feeder rollers behind the Transfer Corona Assembly dirty?	YES	Clean with alcohol if dirty.
5	Is the guide wire on the Transfer Corona Assembly broken?	YES	Restring the guide wire.

Appendix

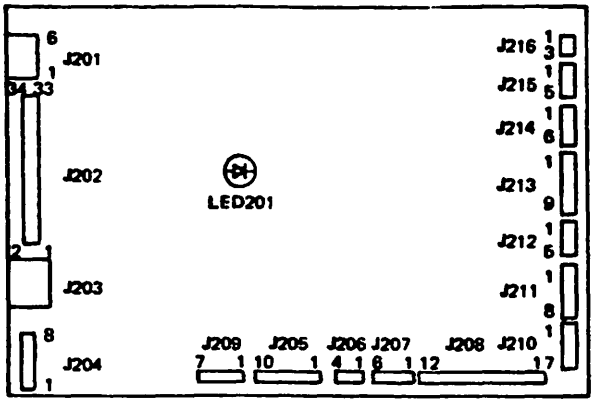
Contents:



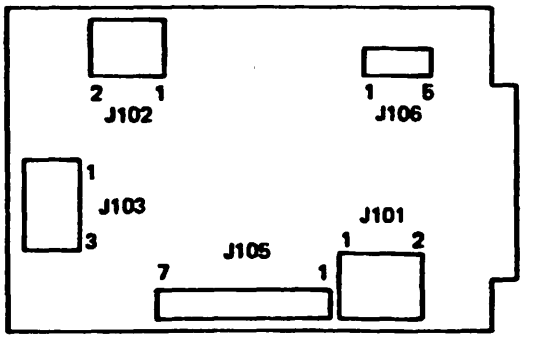
Wiring Diagram



DC Controller Board Signals and Connectors

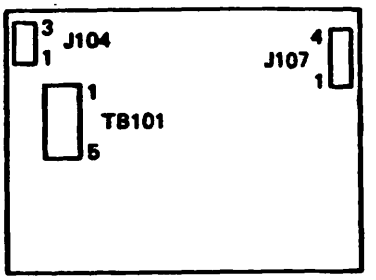


Connector Locations on the DC Controller PCB



Upper Board

Lower Board



Connector Locations on the AC Driver PCB

START-UP REPAIR PROCEDURES AND ERROR TONES

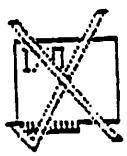
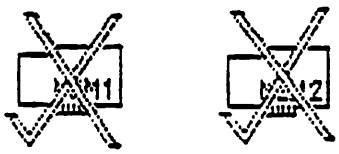
NOTE: Prior to diagnosing any problems in this section you should remove any expansion cards or other attachments from your Lisa and then push the reset button on the back. If the problem still occurs then proceed to the trouble shooting chart shown below. If the problem disappears then replace the cards or attachments one at a time re-starting the system after each replacement. When the problem occurs again the last module replaced is the module causing it.

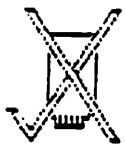
SYMPTOM	PROBABLE FAILURE
Incorrect or no video, no "clicks" and no error tones.	- CPU - I/O - Go to Video Repair Procedures - Motherboard
No "clicks" and the display indicates that the Kernel Test found no problems.	- Speaker connections - I/O - Speaker
Blank screen and start-up "clicks."	- Video Repair Procedures
Error tones with incorrect or no video.	
Lo	CPU Memory 1 Memory 2
Lo,Lo	Memory 2
Lo, Hi	Card Cage (can swap out boards)
Lo, Lo, Hi	CPU
Lo, Hi, Lo	I/O

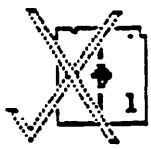
SYMPTOM	PROBABLE FAILURE
Lo, Hi, Hi	Memory 1
Hi, Lo, Lo	Expansion Boards
Hi, Lo, Hi	Keyboard
Hi, Hi, Lo	Keyboard or Mouse disconnected

START-UP ERROR ICONS

Swap out the module indicated by the Icon. If that is not successful swap out the subsequent modules listed here or look up the message code number in Start-up Error Codes.

ICON	MODULE AND OTHER POSSIBLE REPLACEMENTS
	- CPU
	- I/O
	- Memory
	- Keyboard - I/O - Cable from motherboard to softswitch/keyboard assembly - Motherboard
	- Check Profile with LisaTest. If unsuccessful: - Replace profile - Replace I/O - Replace Motherboard

ICON	MODULE AND OTHER POSSIBLE REPLACEMENTS
	- Reseat Expansion Card - Try card in other slot - Swap in new card

	- Bad diskette
	- If other drive works replace:
	  - Drive
	  - Cable
	  - I/O
	  - Motherboard
	- If other drive fails try back-up diskette
	- If still fails then replace:
	  - I/O
	  - Cable
	  - Drive

	- Insert diskette

APPENDIX D
START-UP ERROR CODES

NUMBER	PROBLEM	FIX
22	Unable to clamp diskette	Refer to start-up error messages for "bad diskette icon"
23	Unable to read diskette	" "
25	Unable to unclamp diskette	" "
38	No boot file on diskette	" "
39	Disk controller timeout	1. Replace I/O board 2. Replace CPU board 3. Replace Motherboard
40	MMU	Replace CPU board
41	CPU selection logic	Replace CPU board
42	Video circuitry	Replace CPU board
43	Parity circuitry	1. Replace CPU board 2. Replace Memory board 1 3. Replace Memory board 2 4. Replace Motherboard
44	NMI error	1. Replace CPU board 2. Replace I/O board 3. Replace Motherboard
45	BUS error	1. Replace I/O board 2. Replace CPU board 3. Replace Motherboard

NUMBER	PROBLEM	FIX
46	Address error	1. Replace CPU board 2. Replace Memory board 1 3. Replace Memory board 2
47	Exception	1. Replace CPU board 2. Replace Motherboard
48	Illegal instruction	1. Replace CPU board 2. Replace Memory board 1 3. Replace Memory board 2
49	1010 or 1111 trap	1. Replace CPU board 2. Replace Memory board 1 3. Replace Memory board 2
50	COPs VIA	1. Replace I/O board 2. Replace CPU board 3. Replace Motherboard
51	Parallel port VIA	1. Replace I/O board 2. Replace CPU board 3. Replace Motherboard
52	I/O board COPs	Replace I/O board
53	Keyboard COPs	1. Replace Keyboard 2. Replace I/O board 3. Replace Keyboard cable 4. Replace Motherboard
54	Clock error	Replace I/O board
55	RS232 port A	Replace I/O board
56	RS232 port B	Replace I/O board

VIDEO REPAIR PROCEDURES

WARNING: If you have never been taught how to adjust and replace the Lisa video modules do not attempt to do video repairs.

If you do not remember how to make one of the following video adjustments or replacements refer to the Video Adjustments job aid.

If the proposed procedures do not work see second note at the end of the table.

SYMPTOM	FIX
A sizzling noise coming from LISA	Adjust brightness Adjust contrast Replace power supply Replace videoboard Replace flyback
Power supply trips (turns off & on)	Adjust brightness Adjust contrast Replace power supply Replace videoboard Replace flyback
Blank screen and the CRT filament is NOT on when the LISA power is on	Check connections * Adjust brightness & contrast Replace videoboard Replace CPU board Replace I/O board Replace power supply Replace flyback Replace CRT Replace motherboard
Blank screen and the CRT filament IS on when LISA power is on	Check connections * Adjust contrast to middle range Replace power supply Replace videoboard Replace CRT Replace flyback Replace CPU board Replace motherboard

* See notes at the end of this table.

NUMBER	PROBLEM	FIX
57	Disk controller	1. Replace I/O board 2. Replace Disk Drive 3. Replace Disk Drive cables 4. Replace CPU board 5. Replace Motherboard
58	I/O board access	1. Replace I/O board 2. Replace CPU board 3. Replace Motherboard
59	I/O board COPs code	Replace I/O board
60	I/O or Keyboard error	1. Replace Keyboard 2. Replace I/O board 3. Replace Keyboard cable 4. Replace Motherboard
70 71	Memory data or Memory parity	Replace the Memory board specified by the icon displayed.
75	Boot failure	Refer to start-up error messages for the icon shown
80-85	Profile errors	Refer to start-up error messages for "bad profile icon"
90-93	Expansion card error	Refer to start-up error messages for "bad expansion card icon"

SYMPTOM	FIX
Picture locked in wrong vertical position (i.e., picture begins in the middle of the screen)	Replace videoboard Check connections * Adjust yoke Replace CRT
Small picture on CRT	Adjust height & width Adjust brightness & contrast Replace videoboard Replace flyback
Unable to adjust height with video pot	Replace videoboard Replace CPU board Replace I/O board Replace CRT Replace motherboard
Unable to adjust width	Replace videoboard Replace CRT Replace CPU board Replace I/O board
Only a horizontal line on screen	Adjust brightness & contrast Replace videoboard Replace flyback
Unable to adjust horizontal phase	Replace videoboard Replace CPU board Replace I/O board Replace CRT Replace flyback Replace motherboard
Unable to adjust vertical linearity	Replace videoboard Replace CPU board Replace I/O board Replace CRT board Replace motherboard

* See notes at the end of this table.

SYMPTOM	FIX
CRT too bright or too dim	Power LISA off & on again. Adjust brightness & contrast pots (Do not adjust contrast via software until the brightness and contrast are adjusted.)
Unable to adjust brightness	Replace power supply Replace videoboard Replace CRT Replace flyback Replace CPU board
Unable to adjust contrast on the videoboard	Replace videoboard Check the connections * Replace CRT Replace flyback Replace CPU board Replace power supply
Unable to adjust contrast by the software	Replace CPU board Replace I/O board Check keyboard with keyboard diagnostics Replace videoboard Replace motherboard
Blurred screen	Adjust focus
Unable to adjust focus	Replace power supply Replace videoboard Replace CRT Check connections Replace flyback
Rolling screen	Adjust vertical hold
Unable to adjust vertical hold (Picture keeps flipping or will not flip at all)	Replace videoboard Replace CPU board Replace I/O board Replace motherboard

* See notes at the end of this table.

SYMPTOM	FIX
Scalloped picture	Adjust video controls Replace videoboard Replace flyback Make magnetic adjustments
Image on CRT not centered or not straight	Adjust yoke controls and magnets
Bad deflection	Replace videoboard Replace CRT
No horizontal stability (out of phase)	Replace videoboard Replace CPU board Replace I/O board Replace CRT
Double images	Replace CPU board Check connections
Inverse video	Replace CPU board
No video content	Replace CPU board Replace I/O board Replace videoboard Check connections
Smeared screen	Replace CPU board Replace I/O board Replace videoboard Check connections
Burns on screen	Replace CRT and turn down contrast, brightness, and software

Notes will be found on following page.