



## DISK ][ TECHNICAL PROCEDURES

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## Disk ][ Technical Procedures

### Section 1

#### Take-apart

#### Contents:

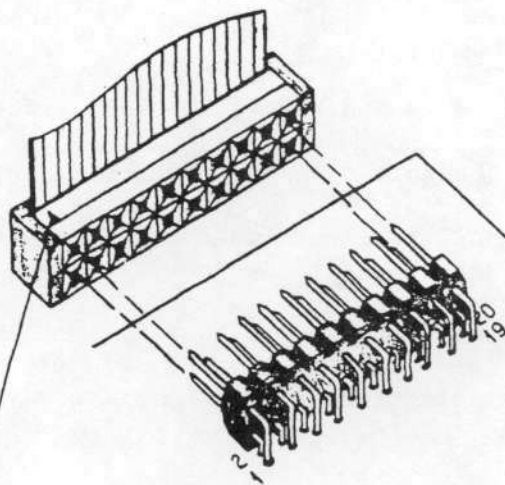
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Replacing the Analog Card.....	1.7
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**A. REMOVING THE DISK DRIVE COVER**

1. Power off the system.
2. Remove the Apple lid.
3. Unplug the disk interface card and lay it gently to one side.
4. Close the disk drive door.
5. Turn the drive upside down and remove the four screws.
6. Set the door end of the unit down on a protective pad.
7. Slide the cover up until it clears the interior parts of the drive. Set cover aside and set the unit down on its base again.

NOTE: If the vent covers (inside the housing) get caught on the frame while you are removing the cover, gently pry them away from the frame while continuing removal. After removal, smooth out any tear or bubble in the covers.



ARROW SHOULD BE UP WHEN CONNECTOR IS INSTALLED.

YOU CAN PERMANENTLY DAMAGE THE DISK DRIVE IF YOU ATTACH THE CABLE INCORRECTLY. HERE IS HOW TO DO IT RIGHT:

1. THE CABLE LEAVES THE CONNECTOR ON THE SIDE **AWAY** FROM THE CARD.
2. MAKE SURE **ALL** PINS GO INTO THEIR MATCHING HOLES.

**FIGURE 1**

**B. REPLACING THE DISK DRIVE CABLE****Removing the Cable:**

1. Power down the Apple. Remove the disk drive cover.
2. Release the catch on the nylon cable holder (mounted on the inside of the back plate) by pressing the tab toward the back of the unit. Disconnect the cable from the analog card and lift the cable free of the drive.
3. Gently disconnect the other end of the ribbon cable from the interface card in the Apple. If the cable is a shielded "RFI" cable, loosen the clamping screw and remove the cable from the clamp.

**Replacing the Cable:**

4. Place the cable into the nylon cable holder so that the toroids (donut-shaped ferrite pieces) are just below the cable holder, and snap the holder shut.
5. Attach the ribbon cable plug to the connector on the analog card, making sure that both rows of pins align with the holes in the plug and that the arrow on the plug points to pin 1 on the connector. (The cable should exit away from the analog card.)
6. Replace the disk drive cover.
7. Then carefully attach the ribbon cable to the interface card, as shown in figure 1.

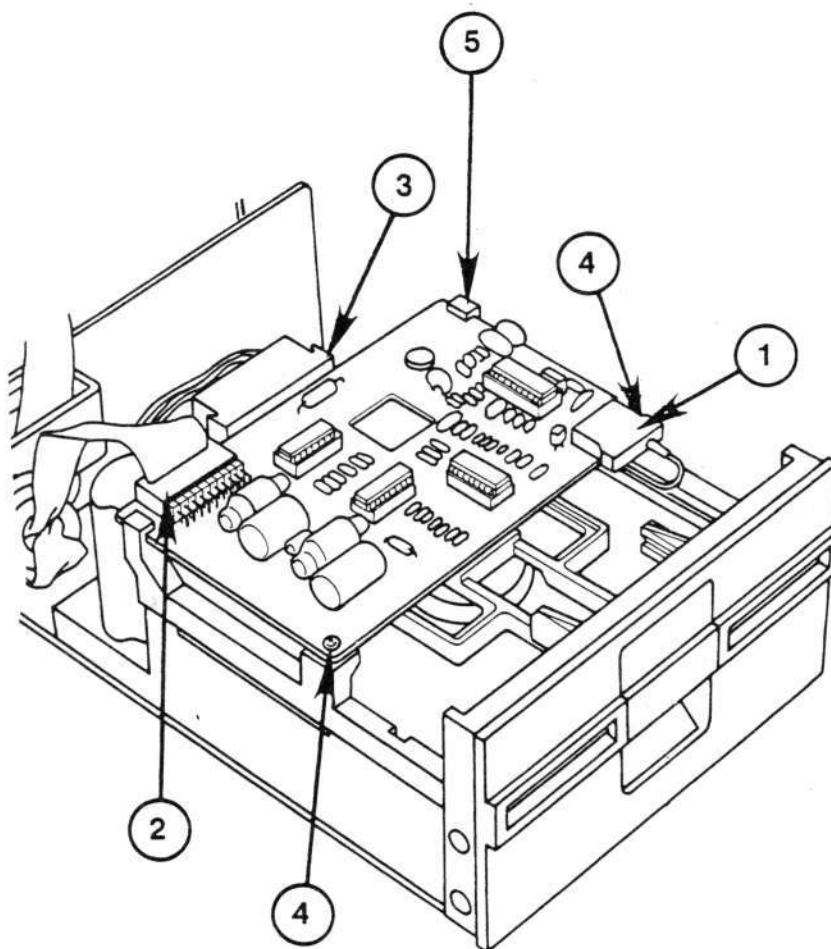


FIGURE 2



## C. REPLACING THE ANALOG CARD

### Removing the Analog Card:

1. Power down.
2. Remove the disk drive cover.
3. Gently remove the read/write head plug from the front of the analog card (Figure 2, #1).
4. Gently remove the ribbon cable plug from the rear of the card (#2).
5. Gently remove the motor plug from the rear of the card (#3).
6. Remove the two screws at the front of the analog card (#4).

NOTE: These screws may have either standard or metric threads. To avoid intermixing, keep the screws with the disk drive they were taken from.

7. Slide the card forward past the retaining slots at the rear (#5), and then lift it out.

### Replacing the Analog Card

8. Slide the card into position in the slots of the rear support posts (Figure 2, #5).
9. Reinstall the two screws (#4) to hold the card in place.
10. Attach the head plug (#1) to the card. Make sure that there is just enough loop in the cable so that it doesn't pull down on the head plug.
11. Attach the motor plug (#3) at the rear of the card.
12. Attach the ribbon cable plug (#2) at the rear of the card, making sure that both rows of pins align with holes in the connector.
13. Replace the disk drive cover.

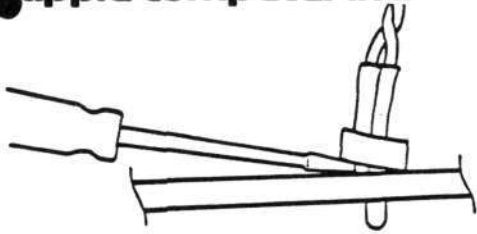


FIGURE 3

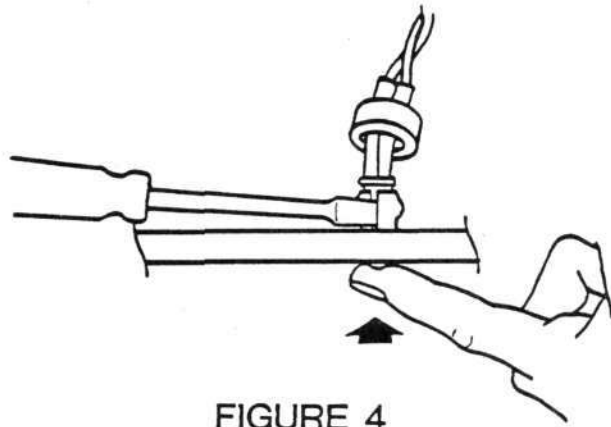


FIGURE 4

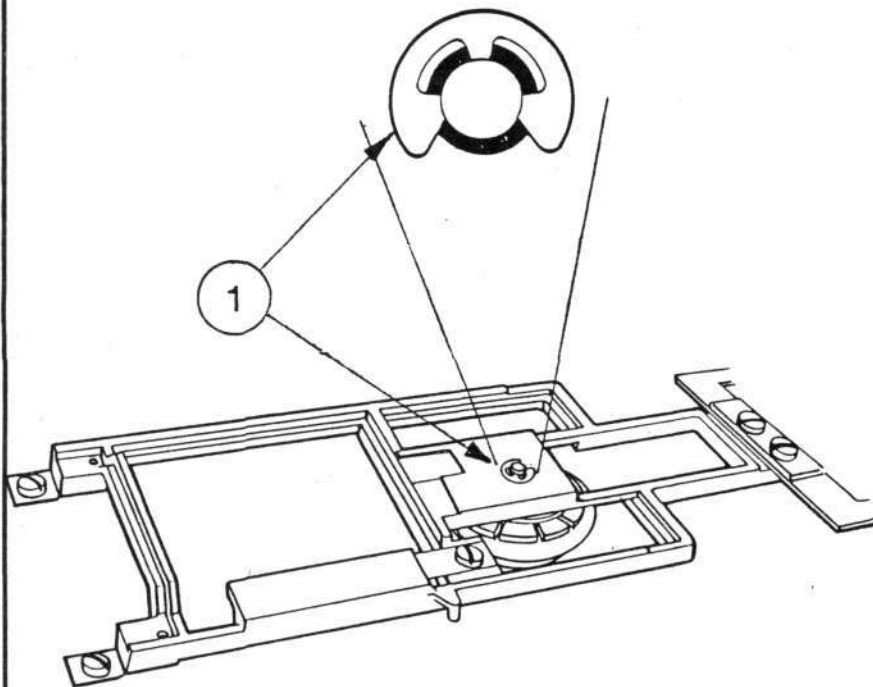


FIGURE 5

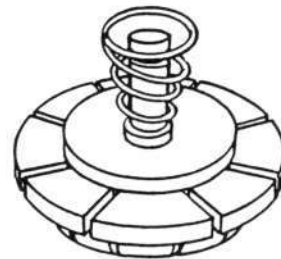


FIGURE 6

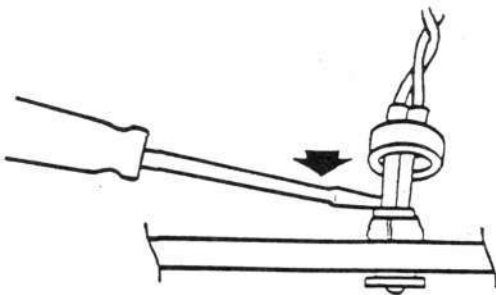


FIGURE 7

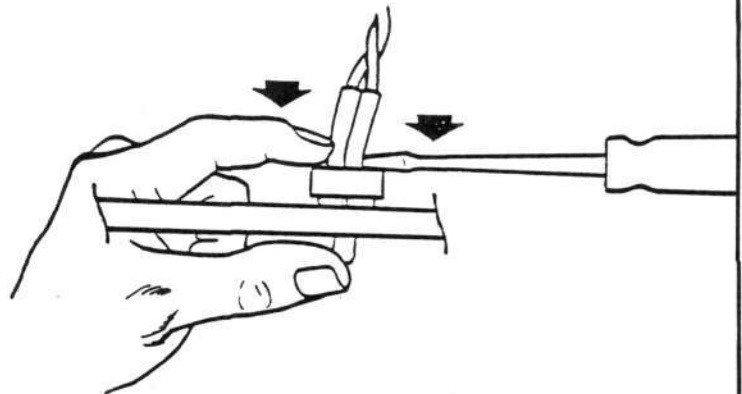


FIGURE 8

#### **D. REPLACING THE COLLET HUB**

##### **Removing the Old Collet Hub**

1. (Power off.) Remove the disk drive cover and analog card.
2. Remove the two screws on each side of the front bezel (front panel) of the unit.
3. Slide the bezel off the unit. If the bezel cannot be removed because the wires connecting the LED are too short, remove the LED as follows:
  - a. Pry the small plastic retaining ring from around the LED holder with a screwdriver (Fig. 3). Slide the retaining ring up the wires and out of the way.
  - b. Press the face of the LED in towards the drive, while gently prying apart the LED holder with a screwdriver (Fig. 4), until the LED snaps free of the bezel.
  - c. Remove the bezel from the unit.
4. With a screwdriver, pry the retaining clip (Fig. 5, #1) off the shaft holding the collet.
5. Remove the collet hub assembly (Fig. 6); remove the spring and washer from the collet hub. (Remove the spring carefully, taking care not to stretch it.)

##### **Installing the New Collet Hub**

6. Place the washer and spring on the shaft of the new collet hub--the spring goes on small end down--and insert into the mounting arm.
7. Install the retaining clip.
8. Replace the bezel.

NOTE: Make sure the door hinge pins fit properly in the slots on the back of the bezel. The hinge pins should be tilted back towards the collet hub during installation of the bezel.

9. If you removed the LED, replace it as follows:
  - a. Slip the LED back in its holder and snap it into place with a screwdriver (Fig. 7).
  - b. Slide the retaining ring down the wires and position it around the LED holder. Push the retaining ring back into place with a screwdriver (Fig. 8).

#### E. REPLACING THE HEAD LOAD BUTTON

The head load button is a small round pad of white felt, mounted in the head load arm (Fig. 9, #1), that holds the diskette surface against the read-write head. The button should sit just above the center of the read-write head, with its surface parallel to the surface of the head.

When the button is severely worn, it will look like a cylinder skewed to the right (as viewed from the front). At that point it should be replaced.

1. Lift up the Head Load Arm (Figure 9, #1), squeeze the top part of the load button with small needle-nose pliers, and let the button drop down.
2. Install a new load button by inserting it into the holder and pushing up until it snaps into place.

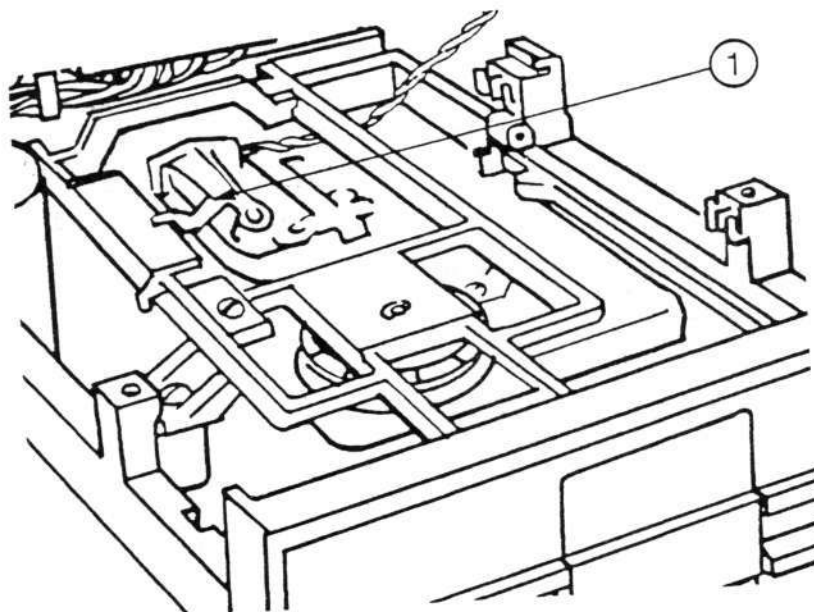


FIGURE 9

**Disk ][ Technical Procedures**

**Section 2**

**Adjustments**

**Contents:**

Collet Hub Adjustment.....	2.3
Drive Door Adjustment.....	2.5
Diskette Stop Guide Adjustment.....	2.7
Drive Speed Adjustment -- The D-Speed Test.....	2.8
Write-Protect Switch Adjustment.....	2.11

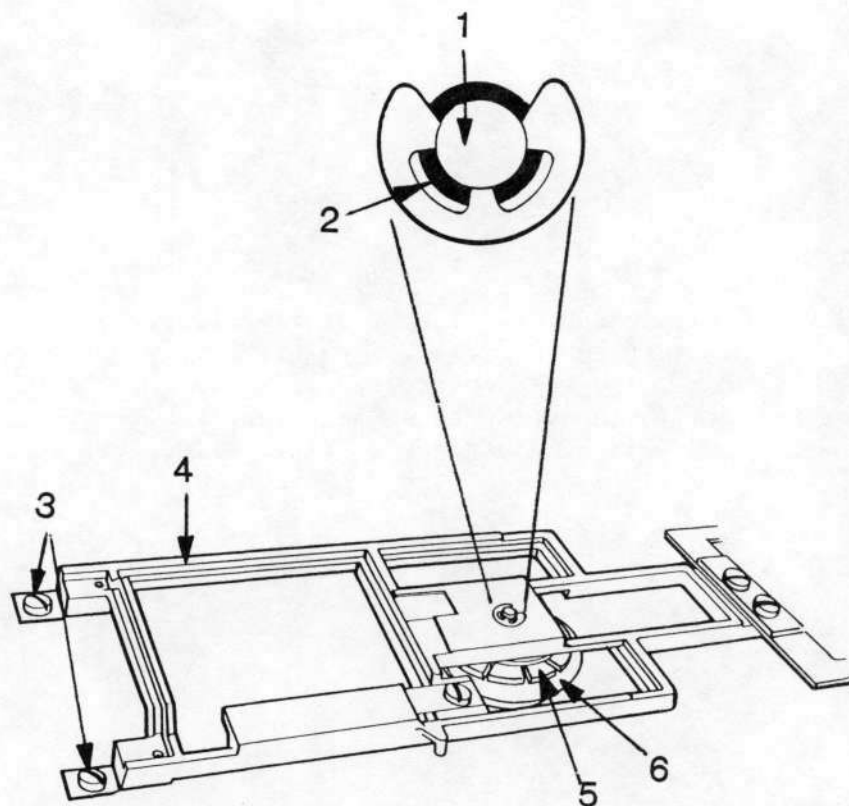


FIGURE 1

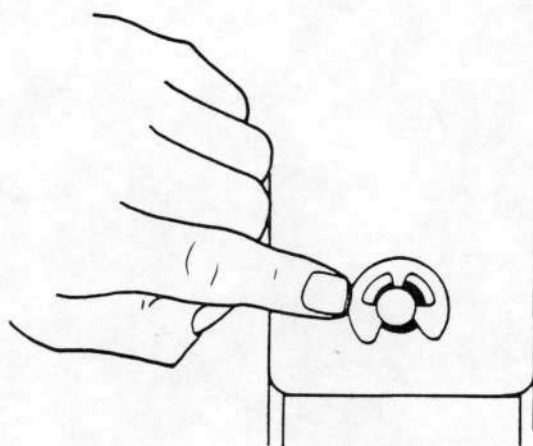


FIGURE 2



## **A. COLLET HUB ADJUSTMENT**

If the diskette will not boot but you are able to get around the problem by opening and closing the drive door a few times, then the collet hub may need adjustment. Check it with the procedure below. If adjustment does not eliminate the booting problems, then the collet hub may need to be replaced (see section D above, p. 1.9).

### **TO CHECK ADJUSTMENT**

1. Remove the analog card.
2. Looking straight down on the collet shaft (Figure 1, #1), close the door. Check to see that the shaft is centered.
3. Open and close the door again, observing to see that the collet hub moves cleanly into the center of its receptacle.
4. If the shaft is not centered (i.e., touches the side of the hole in the casting (Figure 1, #2)), go on to step 5.

### **TO ADJUST**

5. Loosen the four screws (#3) on the bracket (#4): two on the back and two that hold the bracket to the door.
6. Close the door, and make sure that the collet hub (#5) is seated in its receptacle (#6).
7. Looking straight down on the collet shaft, move the bracket (#4) around until the shaft is dead center in the hole (#2).
8. Tighten the rear screws.
9. Check by repeating steps 2 and 3.
10. As a further check, open the door, push the collet shaft off-center (Figure 2), and then close and open the door a few times, making sure that the shaft reseats itself in the center of the hole.
11. As this procedure may affect the drive door adjustment, check the drive door adjustment as per section B (below, p. 2.5); readjust if necessary.

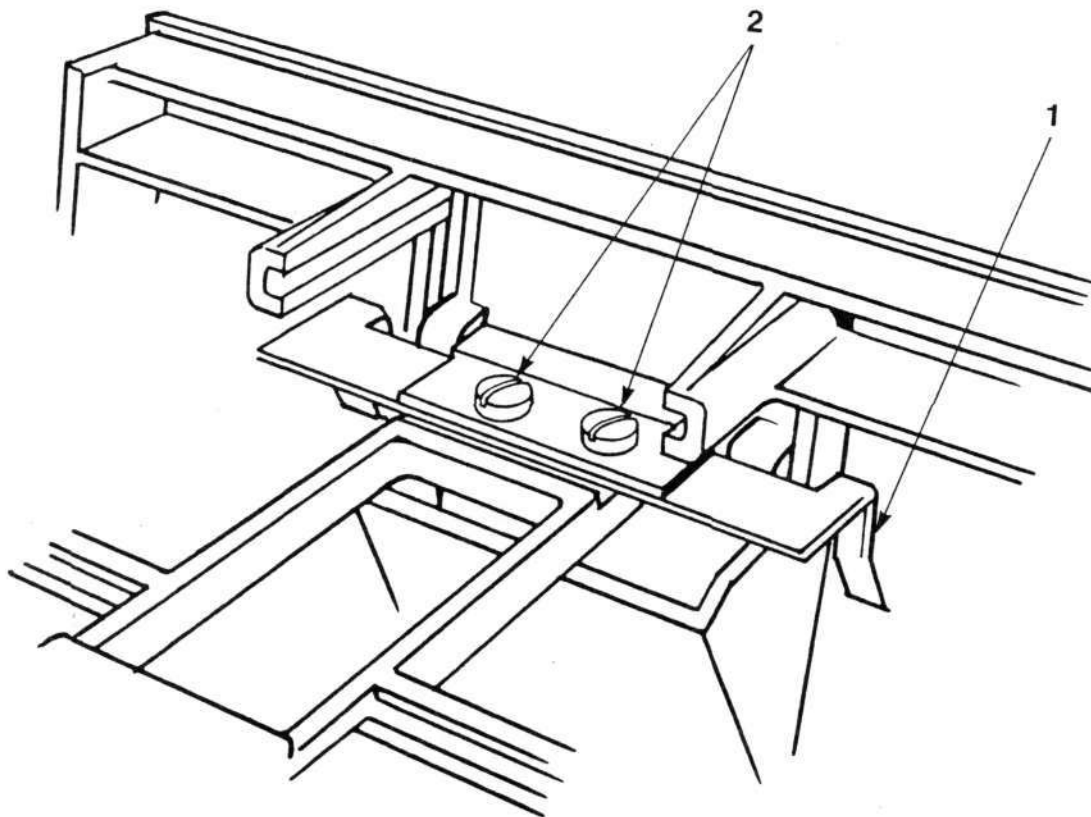


FIGURE 3



**B. DRIVE DOOR ADJUSTMENT**

When the disk drive door is closed, it should be centered in its slot and even with the surface of the bezel (front panel). If it appears out of alignment, or binds against the bezel or the diskette, perform the following adjustments.

1. (Power off.) Disconnect the drive from the Apple. Remove the cover and analog card.
2. Check the collet hub adjustment (see section A above (p. 2.3), step 2). The collet hub must be correctly adjusted before you adjust the door.
3. Loosen the two mounting screws (Fig. 3, #2) and center the door in its opening.
4. Check the door for evenness with the front of the bezel. Adjust the door if necessary; then tighten the door mounting screws.
5. Insert the Adjustment Tool into the drive and allow it to center properly.
6. While gently closing the drive door, observe the two guide bars (Figure 3, #1), which are visible when viewed from the back of the drive looking towards the front. There should be no binding between the guides and the tool.
7. If there is binding, or if the door is crooked, loosen the two door mounting screws (#2), close the door with the Adjustment Tool in place, and tighten the screws so that the guides just touch the tool with no binding.



### C. DISKETTE STOP GUIDE ADJUSTMENT

The diskette stop guide is a piece of plastic that stops the diskette when it is far enough into the drive. It is almost never necessary to adjust it; in fact, on Alps models it has been eliminated as a separate component and incorporated into the casting itself.

Still, the Shugart stop guides get tinkered with, and when they are out of adjustment, the diskette can be so far off-center that it will be damaged when the collet hub seats itself.

#### TO ADJUST

1. (If the disk drive is connected to an Apple ][, power off and disconnect the drive.) Remove the cover and analog card.
2. Insert the Disk Adjustment Tool.
3. See whether the tool is centered by gently closing the drive door and observing the collet hub. (When you close the drive door, the collet hub should seat itself directly in the hole in the center of the Adjustment Tool, and the tool should move very little.)
4. If the tool is too far forward or too far back, the stop guide is out of place. Loosen the stop guide mounting screw (accessible through the small round hole on the left side of the tool) and allow the guide to move back.
5. Center the Adjustment Tool correctly and gently close the drive door.
6. Adjust the stop guide so that it touches the Adjustment Tool; then tighten the mounting screw.
7. Apply Gliptol to the screw after you remove the Adjustment Tool.

#### D. DRIVE SPEED ADJUSTMENT -- THE D-SPEED TEST

If a drive will not boot disks, or gives many I/O error messages, or produces diskettes that other drives cannot read, it may be spinning too quickly or too slowly. This causes its reading and writing to be incompatible with that of other drives. The D-Speed test checks the speed of the drive so that you can adjust it to within standard tolerance.

The test works by writing a pattern to a scratch diskette and then reading it. If the test will not run, you may be using a defective scratch diskette; try another. If the test still will not run, the write-protect switch may be stuck in protect mode (see Write-Protect Switch Adjustment). If the test still will not run, replace the Analog Card with a known good one.

##### Adjusting the Speed:

1. Power down. Disconnect the customer's drive from his Apple.
2. Remove the cover of the customer's drive.
3. Using a known good interface card, connect the customer's drive to the DRIVE 2 position and a known good drive to the DRIVE 1 position. (Make sure all the pins are in the proper holes).
4. Using a known good Apple ][, make sure power is down and then insert the interface card into slot 6.
5. Place the Disk Alignment Aid diskette in the known good drive and boot it.
6. When the menu comes up, SET TARGET DISK will be highlighted. Accept it by pressing A.
7. Set target for slot 6, drive 2, by pressing S, A, A. Press <ESC>.
8. Select D-SPEED test (press S, S, S, A).
9. The screen will warn you that the test will write on the diskette. Put a scratch diskette in the target drive and press A again.

NOTE: At this point, the screen should show a scale with -100 on the left and +100 on the right, with a marker indicating the actual speed of the drive. The acceptable range is + or - 26. If the D-Speed is outside this range, proceed with the adjustment.

10. Look at the BACK of the drive mechanism. Locate the Motor Control Card, mounted on edge, and note the small trimpot with a screwdriver adjustment on the side (Figure 4, #1).

NOTE: Do not confuse this with the trimpot(s) on the analog card!

11. Set the speed so that it indicates between -5 and 0. Press <ESC>, A, A. Allow the drive to run for 128 passes and confirm that the average D-speed is between -5 and 0. Readjust if necessary. Very erratic speed can sometimes be corrected by cleaning the pulleys with alcohol.

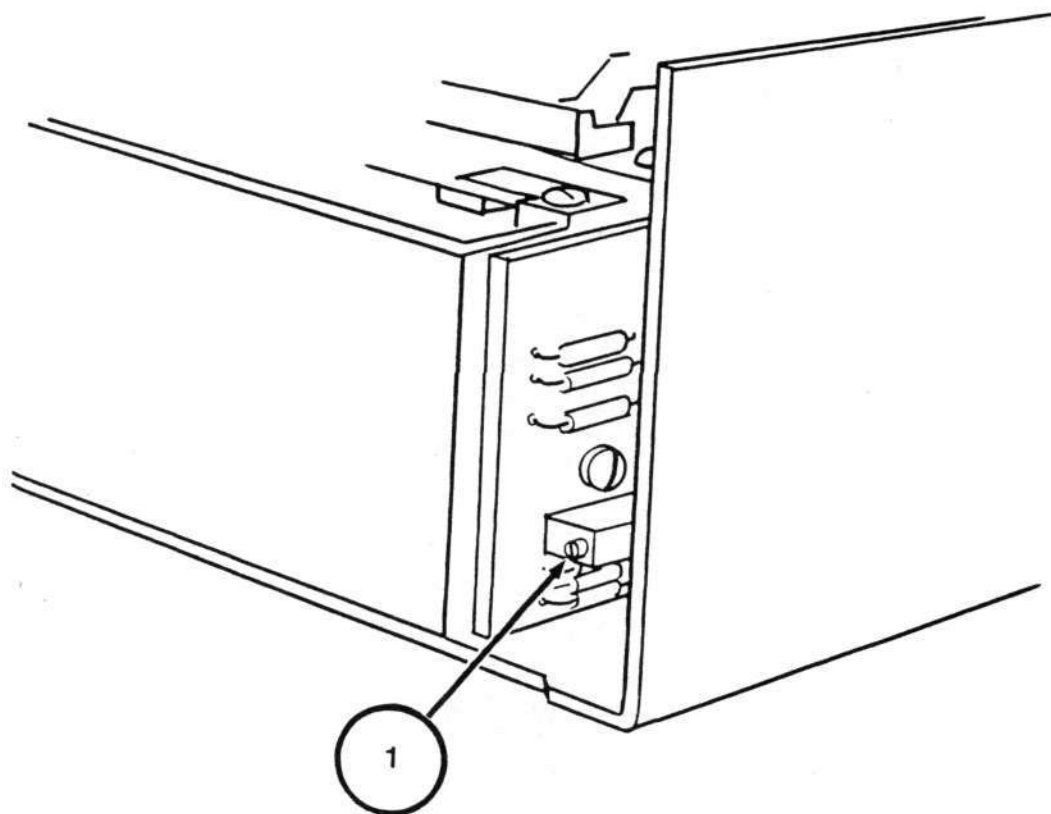


FIGURE 4

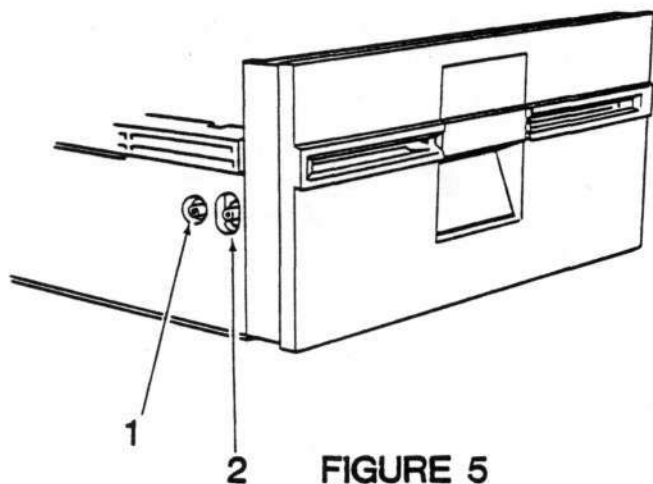


FIGURE 5

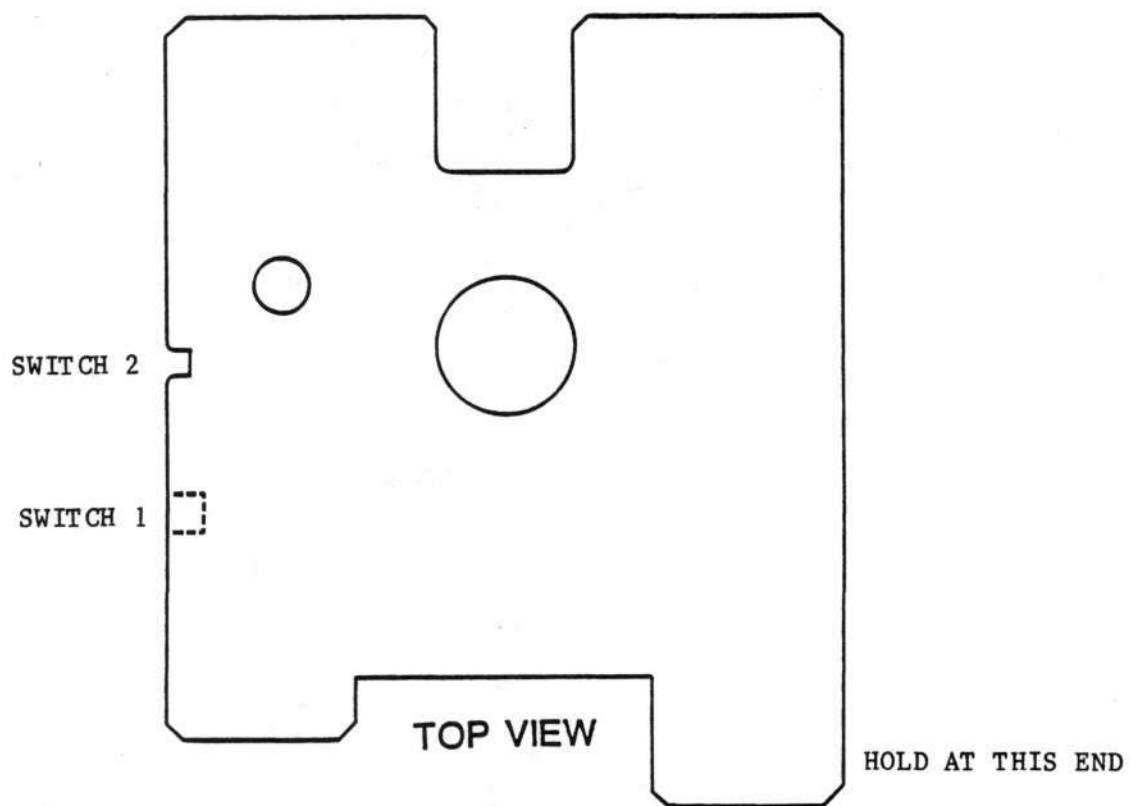


FIGURE 6



**E. WRITE-PROTECT SWITCH ADJUSTMENT**

If a customer complains that his system writes over write-protected diskettes, or refuses to write on non-protected diskettes, calling them "write-protected", then his write-protect switch may need adjustment or replacement. Before you replace it, try to adjust it using the following procedure. You will need: the Disk Alignment Aid diskette; the Disk Alignment Tool (P/N UM 652-0158); an Allen wrench or small screwdriver (depending on the drive); and a known good Apple ][ and interface card.

1. Power down. Disconnect the customer's drive from his Apple.
2. Remove the cover of the customer's drive.
3. Using a known good interface card, connect the customer's drive to the DRIVE 1 position. (Make sure all the pins are in the proper holes).
4. Using a known good Apple ][, make sure power is down and then insert the interface card in slot 6.
5. Boot the Disk Alignment Aid diskette and select WRT PROTECT SWITCH from the menu. When the drive starts running, remove the diskette.
6. The switch is located just inside the front left side of the housing as you face the drive door. Locate the two setscrews holding the write-protect switch in place (Figure 5, #1 & 2). The far setscrew (Figure 5, #1) forms a pivot for the switch; the near setscrew (#2) sets the switch position.
7. Holding the Disk Alignment Tool as in figure 6, insert it all the way into the drive and leave the drive door open; then turn the disk drive upside down.
8. Loosen the rear setscrew; then loosen the front setscrew and allow the switch to rise. The monitor should display the message "SWITCH ENABLED."
9. Press down on the front setscrew (#2) until the monitor displays the message "SWITCH DISABLED", and then tighten it.
10. Tighten rear setscrew (#1).
11. Turn the drive right side up and check the adjustment by withdrawing the Alignment Tool to the switch 2 position. The switch should be enabled. Push the Alignment tool all the way in (switch 1 position). The switch should be disabled.
12. Verify again, using a diskette with a write-protect tab pinched thin (this is a worst-case test).

If steps 8 and 9 do not produce the correct screen displays, replace the switch. If the problem still remains, replace the analog card.







## Disk Drive Technical Procedures

### Section 3

#### Calibration

##### Contents:

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Amplitude Test.....	3.4
Azimuth Test.....	3.7
Carriage Limiter Adjustment.....	3.11
Head Radial Adjustment.....	3.14
Comparator Offset Adjustment.....	3.20



**A. GENERAL**

Before doing any of the procedures, make sure that the head carriage rails are clean. Use alcohol to clean them.

**CAUTION:** DO NOT LUBRICATE THE GUIDE RAILS! USE NO LUBRICANT OF ANY KIND ON THE DRIVE, NO MATTER HOW TEMPTING IT MAY BE!

The amplitude test should be done any time there are problems reading data or programs, especially those that the drive being tested has written. It checks whether the electronics are producing a large enough signal to operate reliably.

The azimuth test should be done any time a drive has problems reading data or programs, or when there is an incompatibility problem between drives (i.e. one has trouble reading what the other writes). It checks whether the head is perpendicular to the track (or radial to the center of the diskette, however you want to look at it). This ensures that it will never be reading part of one bit from the left edge of the track and part of an adjacent bit from the right edge of the track.

The Carriage limiter adjustment should be done when you have trouble booting, or have a compatibility problem between drives (i.e. one has trouble reading what the other writes). It sets the position of the read-write head so that it moves to the correct position whenever the drive seeks track 0. It is a rough adjustment. It should always be followed with the head radial adjustment.

The Head Radial adjustment should be done when you have trouble booting, or have a compatibility problem between drives (i.e. one has trouble reading what the other writes). It should also be done after the carriage limiter adjustment is done. It fine-tunes the head position so that it will move to the exact center of each track.

The comparator offset adjustment should be done if the Analog board is replaced. It ensures that a "one" stored on the disk will be read as a one, and a "zero" as a zero.

The procedures in this section should also be performed whenever you replace the analog card or the disk mechanical assembly, or replace any component on the analog card.

If you are doing more than one test/adjustment, and you probably will be, you should do them in the order in which they appear here.

**B. AMPLITUDE TEST**

The amplitude test should be done any time there are problems reading data or programs, especially those that the drive being tested has written.

This test checks whether the electronics are producing a large enough signal to operate reliably.

Materials needed:

1. Apple ][ system with known-good disk drive and interface.
2. Disk Calibration Diskette (P/N 686-0006)  
or  
Disk Alignment Aid diskette (P/N 652-0199)
3. Scratch (expendable) diskette
4. Drive to be tested
5. Oscilloscope
6. #2 Philips screwdriver

**To run the Amplitude Test:**

Apple and Drive Set-up:

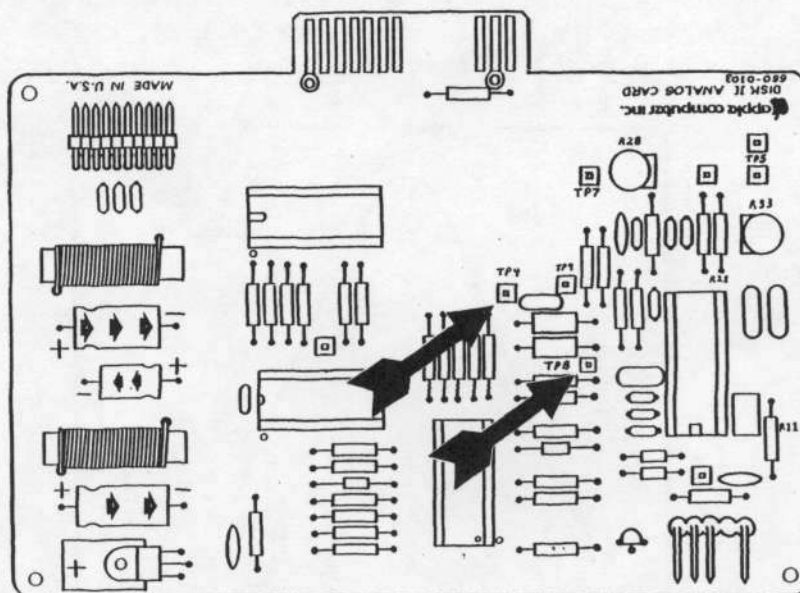
1. Turn the Apple ]['s power off.
2. Install the known good Disk Interface card in slot 6.
3. Connect the known good drive to the Drive 1 position of the Interface card.
4. Remove the cover from the drive to be tested. Connect the drive to the Drive 2 position on the Interface card.

Oscilloscope Set-up:

5. Set the oscilloscope controls as follows:  
SECONDS(or TIME)/DIV = 1 uSEC/DIV  
VOLTS(or AMPLITUDE)/DIV = 50 MV/DIV (5 MV/DIV for 10X probe)  
Trigger source (INT/EXT) = INT  
Trigger slope (POS/NEG) = POS  
Input (AC/DC/GND) = AC  
Display (CH1/CH2 or A/B) = CH1 or A  
Sweep Mode (AUTO/NORM) = AUTO  
Power (ON/OFF) = ON  
INTENSITY and FOCUS for a clear sweep display
6. Connect the probe cable to the channel 1 (or A) input of the oscilloscope.

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7. Connect the probe tip to TP8 and the ground lead to TP4 on the Analog Card of the drive being tested.

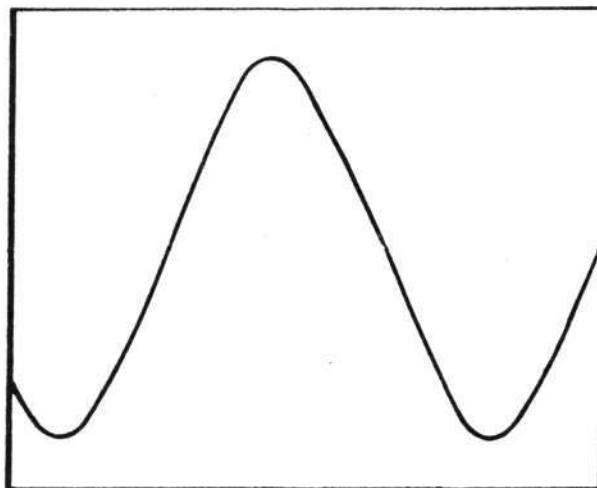


**The Test:**

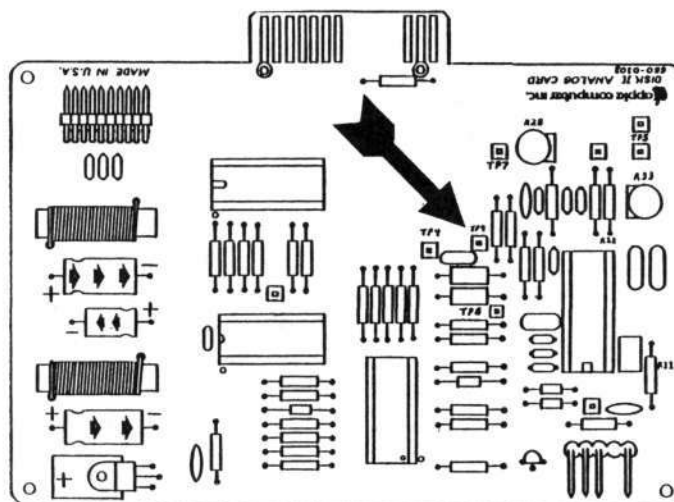
8. Boot the Calibration (or Alignment Aid) Diskette in the known good drive, then remove the diskette (let's not take any chances).
9. Put the scratch diskette in the drive being tested.
10. After the main menu appears, slowly type **ASAA** to select drive 2 as the target disk, then press <ESC>.
11. Slowly type **SSA** to select the Amplitude test.
12. A warning will be displayed on the screen that the test will write on any diskette in the target drive. Type **A** to proceed with the test.

**CONTINUED ON NEXT PAGE**

13. After the test signal has been written to the diskette, a message will be displayed to tell you that you may proceed with the test. Adjust the oscilloscope's trigger LEVEL control for a clear, stable display. The waveform should appear as follows, with a minimum amplitude of 150 MV (3 divisions).



14. Place the probe tip on TP9. Check that the display shows the same waveform as in step 13.



15. Turn the Apple ][ off, then disconnect the customer's drive and (assuming that it is good at this point) re-assemble it.

This concludes the Amplitude Test.

If the amplitude is found to be unacceptable, replace the disk mechanical assembly and run the test again. If the problem persists, replace the analog card (on the customer's mechanical assembly) and run the test again.



### **C. AZIMUTH TEST**

The azimuth test should be done any time a drive has problems reading data or programs, or when there is an incompatibility problem between drives (i.e. one has trouble reading what the other writes).

This test checks whether the head is perpendicular to the track.

Materials needed:

1. Apple ][ system with known-good disk drive and interface.
2. Disk Calibration Diskette (P/N 686-0006)  
or  
Disk Alignment Aid diskette (P/N 652-0199)
3. Alignment diskette (P/N 090-0004)
4. Drive to be tested
5. Oscilloscope
6. #2 Philips screwdriver

#### **To run the Azimuth Test:**

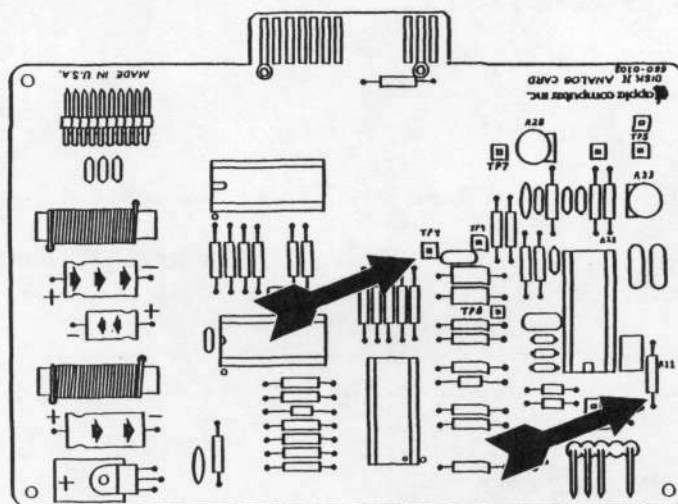
Apple and Drive Set-up:

1. Turn the Apple ]['s power off.
2. Install the known good Disk Interface card in slot 6.
3. Connect the known good drive to the Drive 1 position of the Interface card.
4. Remove the cover from the drive to be tested. Connect the drive to the Drive 2 position on the Interface card.

**CONTINUED ON NEXT PAGE**

# Disk Safety Check

5. Set the oscilloscope controls as follows:  
SECONDS(or TIME)/DIV = 10 MSEC/DIV  
VOLTS(or AMPLITUDE)/DIV = 5 V/DIV (.5 V/DIV for a 10X probe)  
Trigger source (INT/EXT) = INT  
Trigger slope (POS/NEG) = POS  
Input (AC/DC/GND) = GND  
Display (CH1/CH2 or A/B) = CH1 or A  
Sweep Mode (AUTO/NORM) = AUTO  
Power (ON/OFF) = ON  
INTENSITY and FOCUS for the best trace display  
CH1 (or A, or VERT) POSITION to center the trace vertically
6. Connect the probe cable to the channel 1 (or A) input of the oscilloscope.
7. Connect the probe tip to the front end of R11 and the ground lead to TP4 on the Analog Card of the drive being tested.



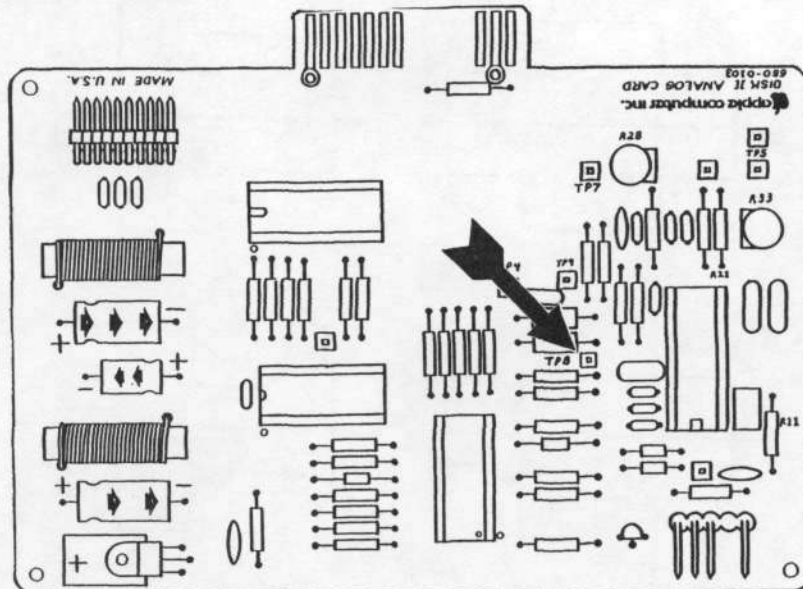
8. Boot the Calibration (or Alignment Aid) Diskette in the known good drive, then remove the diskette (let's not take any chances).
9. After the main menu appears, slowly type **ASAA** to select drive 2 as the target disk, then press <ESC>.
10. Slowly type **SSSSA** to select the Seek function. The drive being tested should recalibrate and spin.
11. While watching the trace, switch the oscilloscope's input selector (AC/DC/GND) to DC. If the trace moves up or down, DO NOT CONTINUE WITH THE TEST. Replace the analog card and start again.

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The Test:

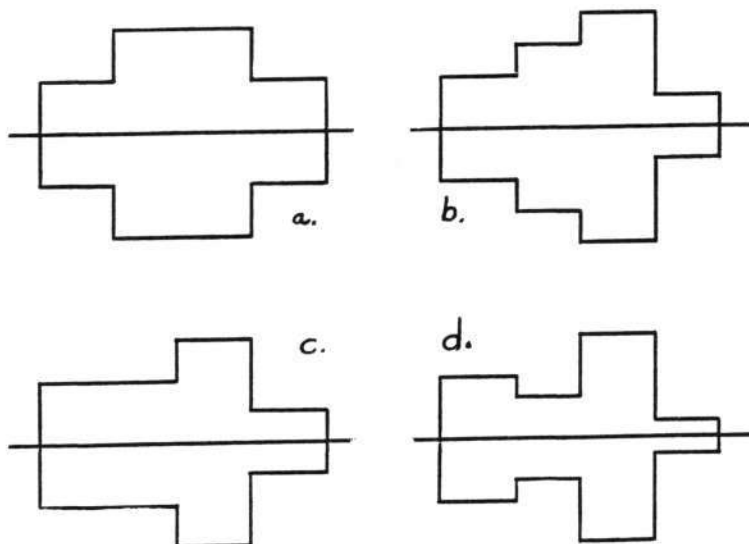
12. Change the oscilloscope controls as follows:  
 SECONDS(or TIME)/DIV = .5 MSEC/DIV  
 VOLTS(or AMPLITUDE)/DIV = 50 MV/DIV (5 MV/DIV for 10X probe)  
 Input (AC/DC/GND) = AC  
 Sweep Mode (AUTO/NORM) = NORM (the trace will disappear)
13. Connect the probe tip to TP8.



14. Put the Alignment diskette (090-0004) in the drive being tested.
15. Slowly type **SSSA34**, then press <RETURN> to move the head to track 34.

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16. Turn the oscilloscope's trigger LEVEL control all the way to the left and then back to the right until you can see the waveform clearly, then adjust the INTENSITY and FOCUS for the best display. The waveform should be a pattern of four bursts. The amplitude of the second should be equal to or greater than the amplitude of the first; the amplitude of the third should be equal to or greater than the amplitude of the fourth. Diagrams a, b, and c show acceptable patterns, diagram d shows an unacceptable one.



17. Slowly type **A1**, then press **<RETURN>** to move the head to track 1. The waveform should be the same as the one observed in step 16.
18. Turn the Apple ][ off, then disconnect the customer's drive and (assuming that it is good at this point) re-assemble it.

This concludes the Azimuth Test.

If the pattern at either or both tracks is found to be unacceptable, replace the disk mechanical assembly and run the test again. If the problem persists, replace the analog card (on the customer's mechanical assembly) and run the test again.

**CAUTION:** If the drive is out of adjustment, disks that it has written to may not be readable in a properly adjusted drive. Before repairing it, test the suspect disks in a known good drive and copy them if necessary (reading them in the mis-adjusted drive and writing the copies in a known good drive).

#### **D. CARRIAGE LIMITER ADJUSTMENT**

The Carriage Limiter adjustment should be done when you have trouble booting, or have a compatability problem between drives (i.e. one has trouble reading what the other writes).

This adjustment sets the position of the read-write head so that it moves to the correct position whenever the drive seeks track 0. It is a rough adjustment. It should always be followed with the head radial adjustment.

Materials needed:

1. Apple ][ system with known-good disk drive and interface.
2. Disk Calibration Diskette (P/N 686-0006)  
or  
Disk Alignment Aid diskette (P/N 652-0199)
3. #0 and #2 Phillips screwdrivers
4. Small flat-bladed screwdriver ("tweaker")
5. Feeler gauge (.020")
6. Drive to be adjusted

#### **To adjust the carriage limiter**

Set-up

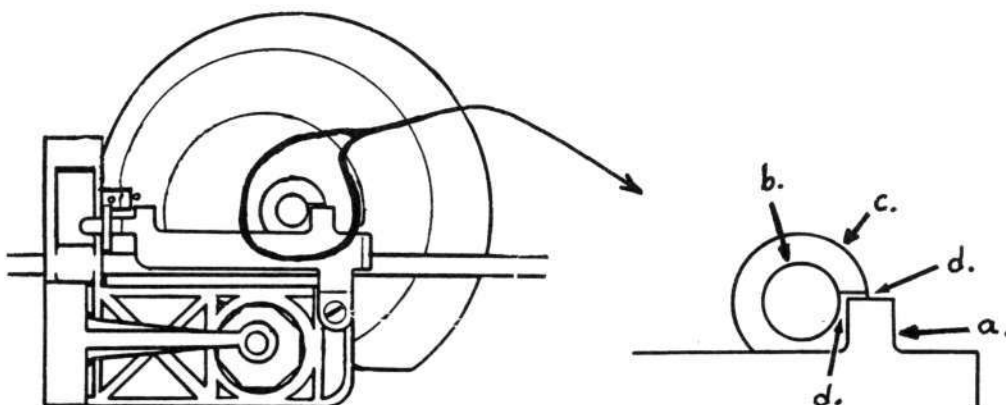
1. Turn the Apple ]['s power off.
2. Install the known good Disk Interface card in slot 6.
3. Connect the known good drive to the Drive 1 position of the Interface card.
4. Remove the cover from the drive to be tested. Connect the drive to the Drive 2 position on the Interface card.
5. Remove the screws that hold the analog card, and remove the read/write head wires from the clips on the right-side analog card supports.
6. Lean the analog card toward the back of the drive (Make sure that the head wires have enough slack to allow the carriage to move to its forward limit. To check, slide the carriage by hand to its forward limit. If the cable is too tight, adjust the position of the analog card.)

**CAUTION:** MAKE SURE THAT THE ANALOG CARD ISN'T TOUCHING ANYTHING THAT MAY CAUSE AN ELECTRICAL SHORT.

CONTINUED ON NEXT PAGE

The Test:

7. Boot the Calibration (or Alignment Aid) diskette in the known-good drive.
8. After the main menu appears, set slot 6, drive 2 as the drive to be tested by slowly typing **ASAA**, then press <ESC>.
9. Slowly type **SSSSA**. The drive will recalibrate to track zero and continue to run.
10. The Carriage Limiter (a) should clear the Stepper Motor Shaft (b), and the Actuator Cam (c), by about .02" (d). Use a .020" feeler gauge to measure the clearance.

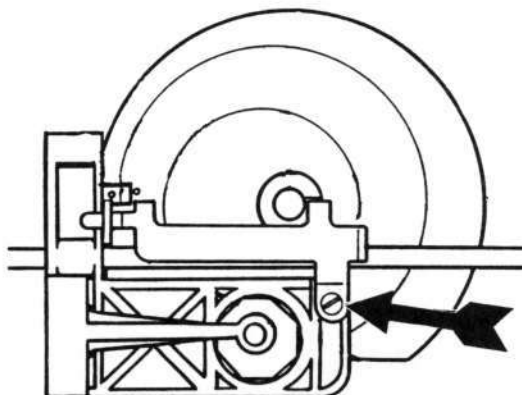


11. If adjustment is necessary, continue with this procedure. Otherwise turn the Apple ][ off, then disconnect and re-assemble the customer's drive.

**CAUTION:** If the drive is out of adjustment, disks that it has written to may not be readable in a properly adjusted drive. Before proceeding, test the suspect disks in a known good drive and copy them if necessary (reading them in the mis-adjusted drive and writing the copies in a known good drive).

The Adjustment:

12. Loosen the adjustment screw and adjust the clearance, then re-tighten the screw.  
**CAUTION:** The carriage limiter screw is easily stripped. Take care when tightening it.



13. Move the carriage forward by hand until you feel the cam rider drop back into the channel of the cam.
14. Type **A** to cause the drive to recalibrate again, then check that the clearance is still correct (see step 10). Re-adjust if necessary.
15. Slowly type **SSSA34** and press **<RETURN>**. Check to see that the head has moved forward almost to its limit but that no contact is made between the Cam Stop Extension (figure above, f) and the Stepper Motor Shaft (figure above, b).
16. Turn the Apple ][ off, re-install the Analog card, then turn to page 3.14 and do the Head Radial Adjustment procedure.

This concludes the Carriage Limiter adjustment.

**E. HEAD RADIAL ADJUSTMENT**

The Head Radial adjustment should be done when you have trouble booting, or have a compatability problem between drives (i.e. one has trouble reading what the other writes). It should also be done after the carriage limiter adjustment is done.

This adjustment fine-tunes the head position so that it will move to the exact center of each track.

Materials needed:

1. Apple ][ system with known-good disk drive and interface.
2. Disk Calibration Diskette (P/N 686-0006)  
or  
Disk Alignment Aid diskette (P/N 652-0199)
3. Disk Alignment diskette (P/N 090-0004)
4. #2 Phillips screwdriver
5. Medium flat-bladed screwdriver
6. Oscilloscope
7. Drive to be adjusted

**To do the head radial adjustment:**

Apple and Drive Set-up

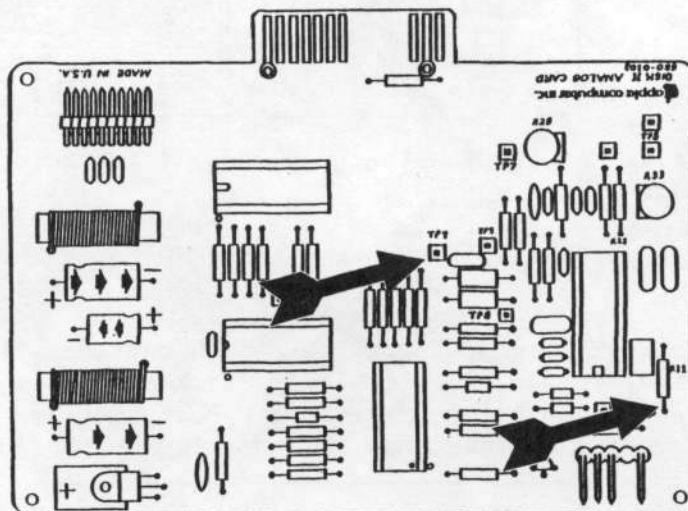
1. Turn the Apple ]['s power off.
2. Install the known good Disk Interface card in slot 6.
3. Connect the known good drive to the Drive 1 position of the Interface card.
4. Remove the cover from the drive to be tested.
5. Connect the drive to the Drive 2 position on the disk interface card.

**CONTINUED ON NEXT PAGE**



## Disk Safety Check

6. Set the oscilloscope controls as follows:  
 SECONDS(or TIME)/DIV = 10 MSEC/DIV  
 VOLTS(or AMPLITUDE)/DIV = 5 V/DIV (.5 V/DIV for a 10X probe)  
 Trigger source (INT/EXT) = INT  
 Trigger slope (POS/NEG) = POS  
 Input (AC/DC/GND) = GND  
 Display (CH1/CH2 or A/B) = CH1 or A  
 Sweep Mode (AUTO/NORM) = AUTO  
 Power (ON/OFF) = ON  
 INTENSITY and FOCUS for the best trace display  
 CH1 (or A, or VERT) POSITION to center the trace vertically
7. Connect the probe cable to the channel 1 (or A) input of the oscilloscope.
8. Connect the probe tip to the front end of R11 and the ground lead to TP4 on the Analog Card of the drive being tested.

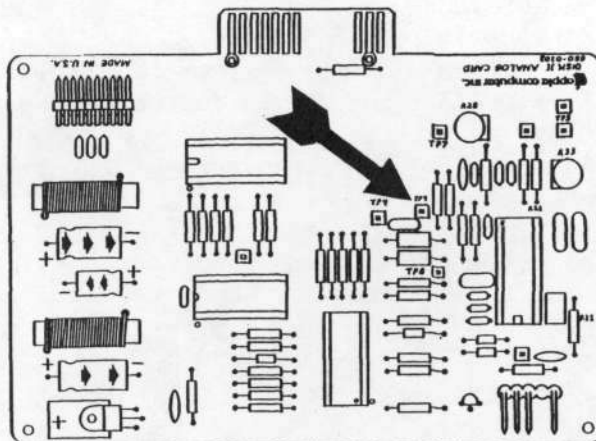


9. Boot the Calibration (or Alignment Aid) diskette in the known-good drive, then remove the diskette.
10. After the main menu appears, slowly type **ASAA** to set slot 6, drive 2 as the drive to be tested, then press <ESC>.
11. Slowly type **SSSSA** to select the Seek function. The target disk will recalibrate and continue to run.
12. While watching the trace, switch the oscilloscope's input selector (AC/DC/GND) to DC. If the trace moves up or down, DO NOT CONTINUE WITH THE TEST. Replace the analog card and start again.

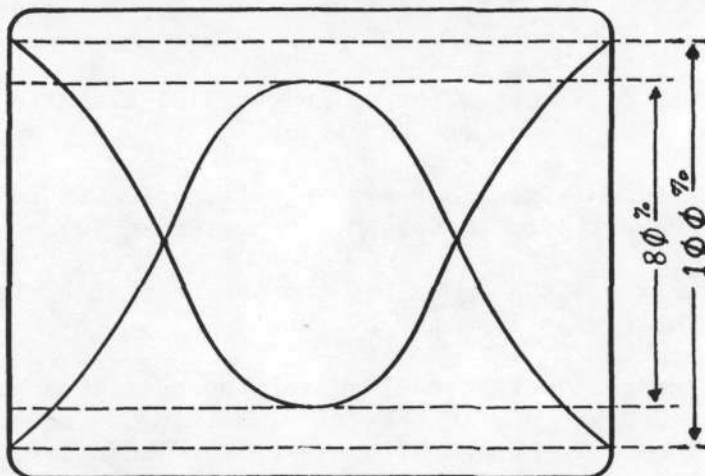
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The Test:

13. Change the oscilloscope controls as follows:  
 SECONDS(or TIME)/DIV = 20 MSEC/DIV  
 VOLTS(or AMPLITUDE)/DIV = 50 MV/DIV (5 MV/DIV for 10X probe)  
 Input (AC/DC/GND) = AC  
 Sweep Mode (AUTO/NORM) = NORM (the trace will disappear)
14. Connect the scope probe tip to TP9.



15. Put the Alignment diskette (090-0004) into the drive to be adjusted.
16. Slowly type **SSSA16**, then press <RETURN> to move the head to track 16.
17. Turn the oscilloscope's trigger LEVEL control all the way counter-clockwise, then rotate it slowly clockwise until a "lobe" pattern appears. Adjacent lobes should be about the same size, with the smaller being no less than 80% the size of the larger.



CONTINUED ON NEXT PAGE



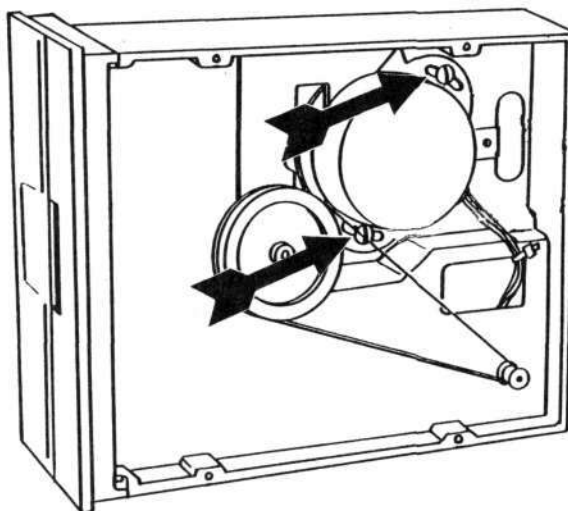
18. If the drive needs adjustment, continue this procedure. Otherwise turn the Apple ][ off, then disconnect the customer's drive and re-assemble it.

**CAUTION:** If the drive is way out of adjustment (e.g. smaller lobe only half the size of the larger lobe), disks that it has written to may not be readable in a properly adjusted drive. Before proceeding, test the suspect disks in a known good drive and copy them if necessary (reading them in the mis-adjusted drive and writing the copies in a known good drive).

The Adjustment:

19. Free the ribbon cable from the cable clip mounted on the inside back plate of the drive.
20. Turn the drive on its side on a non-conducting surface and remove the base plate.
21. Slightly loosen the two mounting screws holding the stepper motor to the casting.

**NOTE:** If the motor is very loose, the adjustment will be difficult to make.



22. Determine what type of drive you have by looking at the label on the bottom of the mechanical assembly. If the drive is labeled "APPLE COMPUTER INC.", it is an ALPS drive. If it is labeled "SHUGART ASSOCIATES", it is a SHUGART drive.

Go to the next page if you have an ALPS drive  
Go to page 3.18 if you have a SHUGART drive

ALPS Drive adjustment:

23. Adjust the relative sizes of adjacent lobes by rotating the stepper motor slightly. When the lobes are as close to the same size as you can get them, hold the stepper motor in place and tighten the mounting screws.
24. Turn the drive to its normal operating position (usually bottom down).
25. Slowly type **SA** to recalibrate the drive.
26. Slowly type **SSSA16**, then press <RETURN> to move the head back to track 16.
27. Wait about thirty seconds for the drive to settle, then re-check the pattern on the scope. If the smaller of the adjacent lobes is not at least 80% as big as the larger, slightly loosen the mounting screws and repeat steps 23-27 (up to two times).
28. If the previous step was successful, slowly type **A34**, then press <RETURN> to move the head to track 34.
29. Slowly type **A16**, then press <RETURN> to move the head back to track 16 from the other direction.
30. Wait about thirty seconds for the drive to settle, then re-check the pattern on the scope. If the smaller of the adjacent lobes is not still at least 80% as big as the larger, slightly loosen the mounting screws and repeat steps 23-30 (up to two times).
31. After you have completed the adjustment, turn the Apple ][ off, disconnect the customer's drive, apply Glyptol to the mounting screws and re-assemble the drive.

This completes the Head Radial Adjustment procedure for ALPS drives.

If you were unable to make the adjustment, replace the mechanical assembly and run the test again.

SHUGART drive adjustment:

23. Rotate the stepper motor slowly counterclockwise until the smaller of the adjacent lobes is about half the size of the larger.
24. Rotate the motor slowly clockwise. When the smaller of the adjacent lobes is as close to 80% as big as the larger as you can get it, hold the stepper motor in place and tighten the mounting screws.
25. Turn the drive to its normal operating position (usually bottom down).
26. Slowly type **SA** to recalibrate the drive.
27. Slowly type **SSSA16**, then press <RETURN> to move the head back to track 16.
28. Wait about thirty seconds for the drive to settle, then re-check the pattern on the scope. If the smaller of the adjacent lobes isn't still at least 80% as big as the larger, loosen the mounting screws and repeat steps 24-28 (up to two times).
29. If the previous step was successful, slowly type **A34**, then press <RETURN> to move the head to track 34.
30. Slowly type **A16**, then press <RETURN> to move the head back to track 16 from the other direction.
31. Wait about thirty seconds for the drive to settle, then re-check the lobe pattern on the scope. If the smaller of the adjacent lobes isn't still at least 80% as big as the larger, loosen the mounting screws and repeat steps 24-31 (up to two times).
32. After you have completed the adjustment, turn the Apple ][ off, disconnect the customer's drive, apply Glyptol to the mounting screws and reassemble the drive.

This completes the Head Radial Adjustment procedure for SHUGART drives.

If you were unable to make the adjustment, replace the mechanical assembly and run the test again.

**F. COMPARATOR OFFSET ADJUSTMENT:**

The comparator offset adjustment should be done if the Analog board is replaced.

It ensures that a "one" stored on the disk will be read as a one, and a "zero" as a zero.

Materials needed:

1. Apple ][ system with known-good disk drive and interface.
2. Disk Calibration Diskette (P/N 686-0006)  
or  
Disk Alignment Aid diskette (P/N 652-0199)
3. Scratch (expendable) diskette
4. Drive to be tested
5. Oscilloscope
6. #2 Philips screwdriver

**To run the Amplitude Test:**

Apple and Drive Set-up:

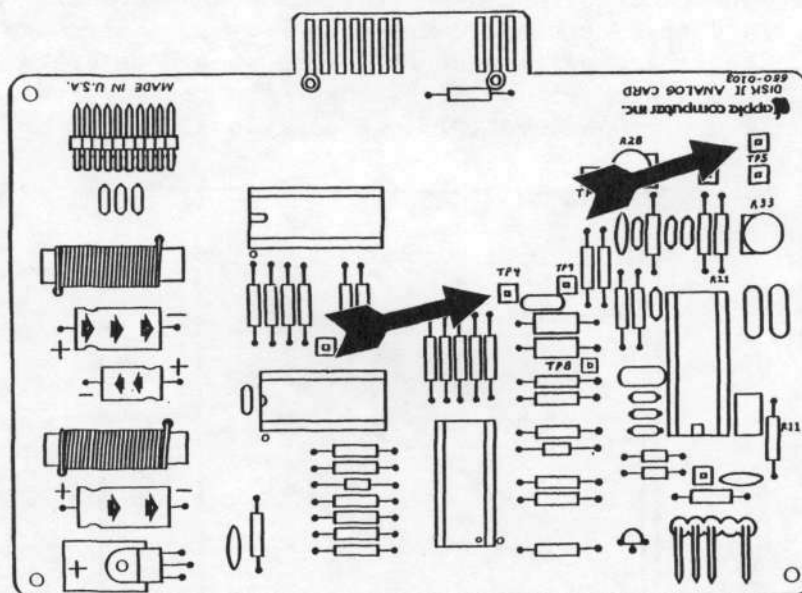
1. Turn the Apple ]['s power off.
2. Install the known good Disk Interface card in slot 6.
3. Connect the known good drive to the Drive 1 position of the Interface card.
4. Remove the cover from the drive to be tested. Connect the drive to the Drive 2 position on the Interface card.

Oscilloscope Set-up:

5. Set the oscilloscope controls as follows:  
SECONDS(or TIME)/DIV = .5 uSEC/DIV  
VOLTS(or AMPLITUDE)/DIV = 1 V/DIV (.1 V/DIV for 10X probe)  
Trigger source (INT/EXT) = INT  
Trigger slope (POS/NEG) = NEG  
Input (AC/DC/GND) = AC  
Display (CH1/CH2 or A/B) = CH1 or A  
Sweep Mode (AUTO/NORM) = AUTO  
Power (ON/OFF) = ON  
INTENSITY and FOCUS for a clear sweep display
6. Connect the probe cable to the channel 1 (or A) input of the oscilloscope.

**CONTINUED ON NEXT PAGE**

7. Connect the probe tip to TP5 and the ground lead to TP4 on the Analog Card of the drive being tested.



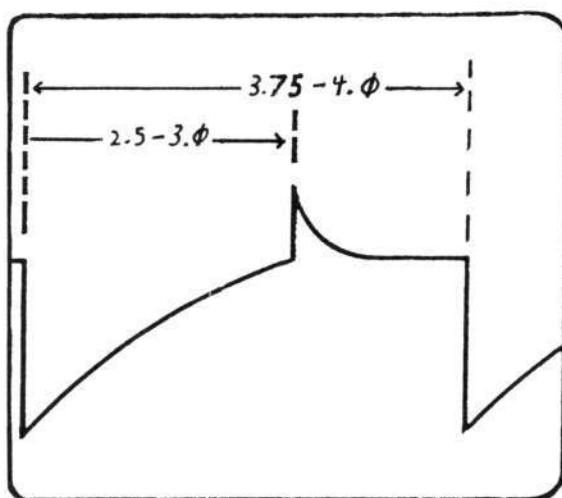
**The Test:**

8. Boot the Calibration (or Alignment Aid) Diskette in the known good drive, then remove the diskette.
9. Put the scratch diskette in the drive being tested.
10. After the main menu appears, slowly type **ASAA** to select drive 2 as the target disk, then press <ESC>.
11. Slowly type **SSA** to select the Amplitude test.
12. A warning will be displayed on the screen that the test will write on any diskette in the target drive. Type **A** to proceed with the test.

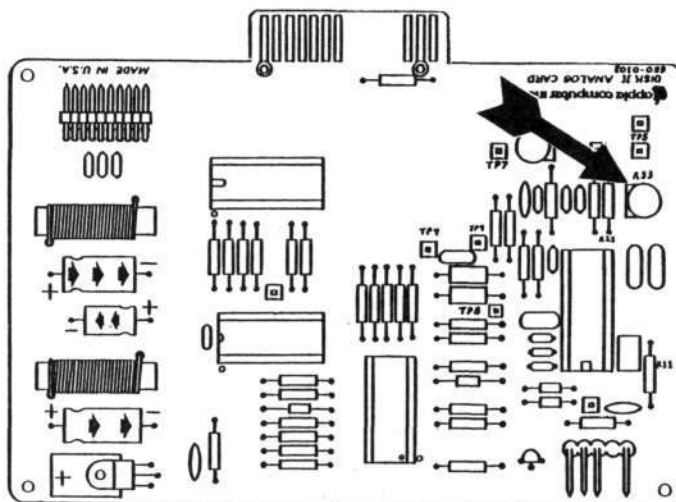
**CONTINUED ON NEXT PAGE**



13. After the test signal has been written to the diskette, a message will be displayed to tell you that you may proceed with the test. Adjust the oscilloscope's trigger LEVEL and INTENSITY controls for a stable display (though some jitter may be present near the right end). The rising portion of the pulse should be 2.5 - 3.0 microseconds wide (5 - 6 divisions). The total pulse width will be 3.75 - 4.0 microseconds (7.5 - 8 divisions).

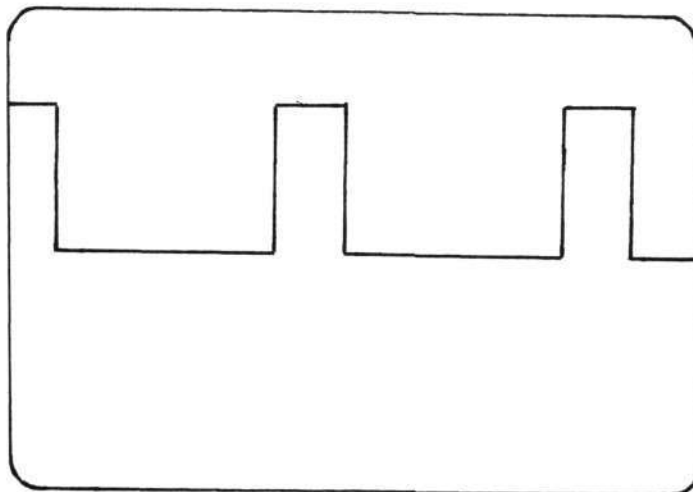


14. If necessary, adjust potentiometer R21 or R33 until the central peak is in the correct position.  
NOTE: On most Analog boards, R21 is a fixed resistor and R33 is the adjustment. On some, R21 is a potentiometer and should be used for the adjustment. On other boards, neither potentiometer is present. In this last case, the board must be replaced if adjustment is indicated.

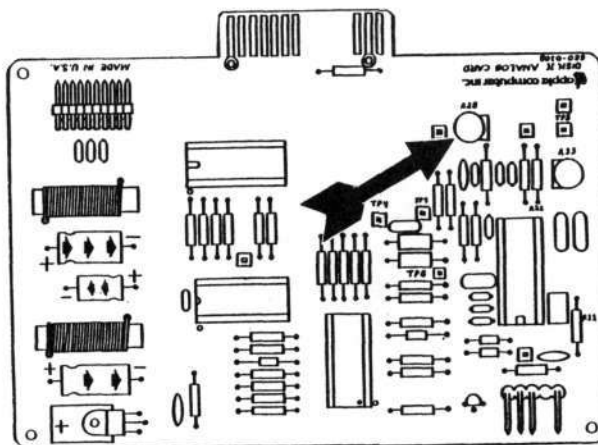


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15. Change the oscilloscope's sweep speed to 1  $\mu\text{SEC}/\text{DIV}$ .
16. Move the scope probe tip to TP7. Adjust the trigger LEVEL control to get a clear display. The pulses at this point should have no dual images on the rising and falling edges (though a certain amount of jitter will be present).



16. If necessary, adjust potentiometer R28 on the analog card until there is a single, stable image with a minimum of jitter.



17. After you have made the adjustments, turn the Apple ][ off. Then disconnect the customer's drive, apply Glyptol to the potentiometers, and re-assemble the drive.

This completes the Comparator Offset adjustment procedure.

If you were unable to make the adjustments, replace the Analog board and run the test again.







Disk ][ Technical Procedures

Section 4

Troubleshooting

Contents:

Disk ][ Troubleshooting Chart.....	4.3
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## Disk ][ Troubleshooting Chart

Symptom	Probable Cause
Disk ][ will not boot; drive comes on. System gives I/O errors during normal operation.	1) Dspeed 2) Head Dirty 3) Interface Cable 4) Disk Analog card 5) Disk Mechanical
Disk ][ will not boot; drive does not come on.	1) Interface Cable 2) Disk Mechanical 3) Disk Analog card
Disk ][ makes high pitched whining sound.	1) Disk Mechanical
Disk ][ writes when diskette is protected.	1) Write Protect switch alignment 2) Disk Analog card
Disk ][ reads but does not write.	1) Disk Analog card





## Disk ][ Technical Procedures

### Section 5

#### Analog Card Procedures

##### Contents:

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Troubleshooting .....	5.5
Drive 1 Will Not Boot .....	5.7
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Drive Has Trouble Reading .....	5.9
Drive Has Trouble Writing .....	5.11
Write-Protect Switch Circuit Malfunctions .....	5.11







## Introduction

This document contains Level 1 repair procedures for the disk ][ analog card. The disk ][ analog card is used in the Disk ][ drive which is used by the Apple ][, ][+ and //e computers. In order to thoroughly test the analog card, follow **ALL** of the procedures in this section. Doing this will insure that no potential problems are overlooked.

## Materials Required

Apple //e Computer  
Disk ][ (complete) with disk controller  
Disk ][ mechanical assembly  
Disk Alignment Aid diskette (p/n: 652-0199)  
Copy of DOS 3.3 System Master diskette (non-write protected)  
Blank diskette  
Disk ][ Interface cable

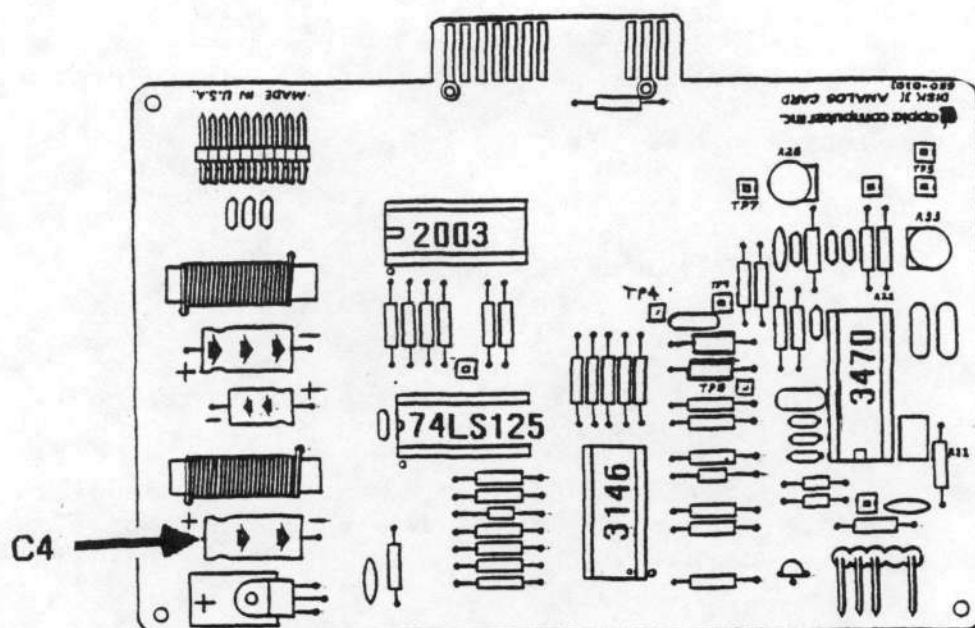
### Replacement ICs (one each):

74LS125 (Apple p/n: 305-0125)  
2003 (Apple p/n: 327-2003)  
3470 (Motorola) (Apple p/n: 355-3470)  
3146 (Apple p/n: 351-3146)

### Capacitor C4:

470 microfarad, 6.3 volts (Apple p/n: 125-6701)

**CAUTION:** Be sure to turn off the power to the computer before replacing any of the components on the analog card.





## System Setup

For the analog card to be correctly diagnosed, it must be the only unknown variable in the test system. Using all known-good, verified components, assemble them as follows:

1. Place the analog card to be tested on the DRIVE 2 mechanical assembly and connect all cables.
2. Place the disk controller card in slot 6 of the Apple //e.

## Visual Inspection

Examine the suspect analog card for visual signs of damage. This may take one of several forms:

1. Burned or melted ICs or sockets. Remove each of the four ICs and closely examine them and the sockets. Replace all damaged ICs with good ones. Return all analog cards with damaged sockets to Apple.
2. Capacitor C4 (large capacitor at corner of card) may be visibly damaged (burned, exploded, melted). Observing correct polarity (match the + of the capacitor to the + on the analog card), replace C4 if it is damaged. If C4 is damaged, the 74LS125 is also damaged and should be replaced.
3. Components other than the four ICs and capacitor C4 may be physically damaged and in need of replacement. These cards should be returned to Apple for repair.

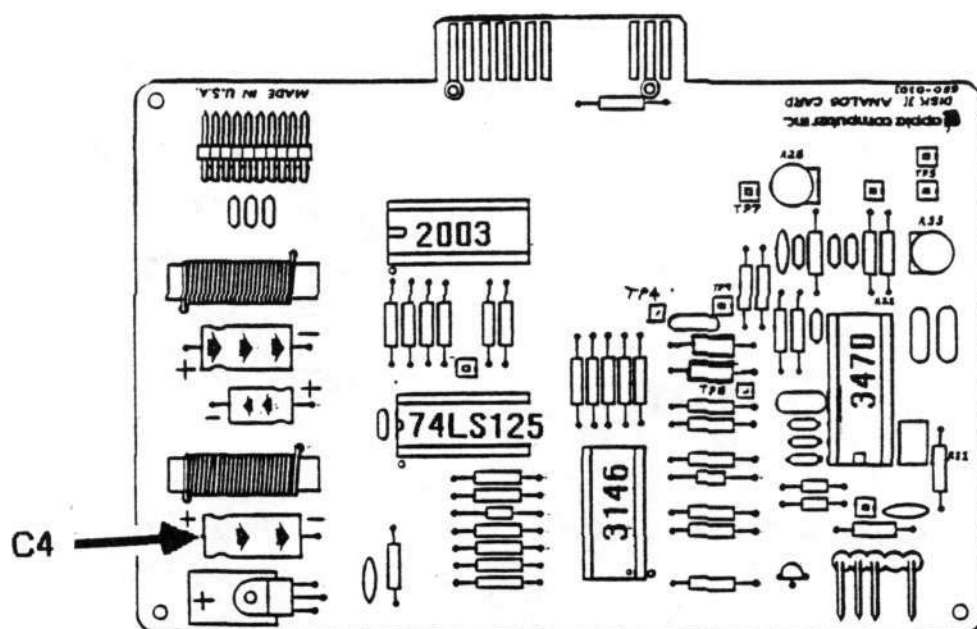
**WARNING:** Do not use an eraser to clean gold contacts. Use only a liquid or spray contact cleaner and a clean cloth.

## Troubleshooting

A malfunctioning analog card may manifest symptoms in one of five ways:

- Drive 1 will not boot (with bad drive 2 analog card connected).
- Drive will not read or write (could destroy data).
- Drive has trouble reading.
- Drive has trouble writing.
- Write protect switch circuit malfunctions.

A troubleshooting procedure for each failure mode follows.





### Drive 1 Will Not Boot

It is possible that an analog card can be damaged in such a way that when it is mounted on drive 2, it keeps drive 1 from booting normally. To test for this condition:

1. Mount the analog card to be tested on the drive 2 mechanical assembly and connect the cables from the mechanical assembly, the read/write head, and the disk controller.
2. Place the DOS 3.3 System Master diskette in drive 1 and a good blank diskette in drive 2.
3. Turn on the power to the Apple //e. The DOS diskette should boot and display a prompt (]) on the screen. If the diskette does not boot, turn off the power to the computer and replace the following devices, one at a time, repeating this step after each until the diskette boots.
  - IC at D4 (labelled 2003)
  - IC at B4 (labelled 74LS125)
  - IC at A3 (labelled CA3146)
  - IC at B1 (labelled 3470)

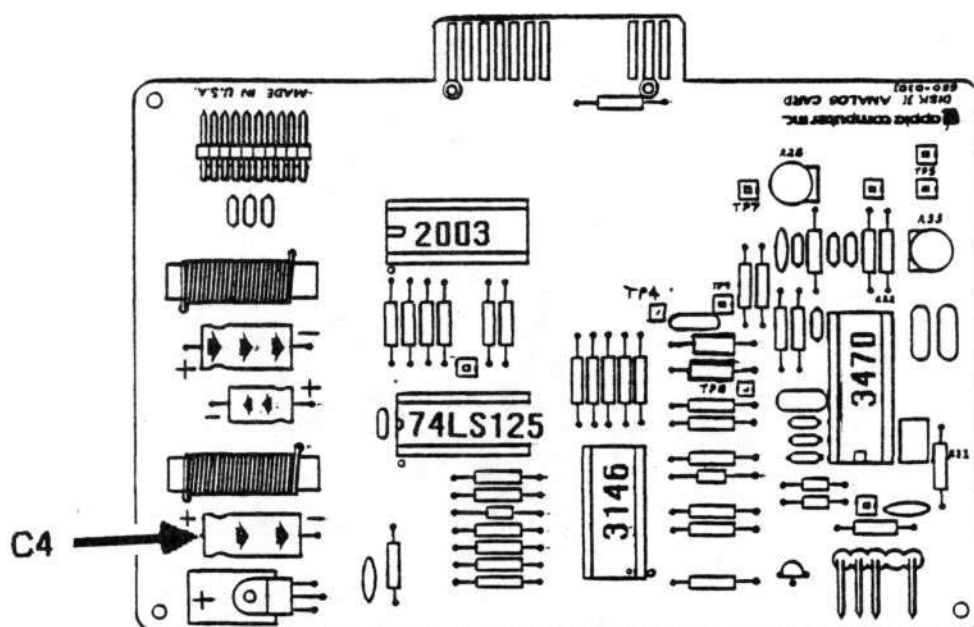
If the DOS diskette still fails to boot, place all original ICs in their sockets and return the analog card to Apple.

### Drive Will Not Read or Write

If the DOS 3.3 System Master diskette boots successfully in drive 1, perform the following steps:

1. Turn off the power to the computer, remove the System Master diskette from the drive 1 and insert the Disk Alignment Aid diskette in drive 1. Turn the power on. The video screen displays the main menu, with **SET TARGET DISK** selection highlighted.
2. Press the A key. The video screen will display the **SET TARGET DISK** menu.
3. Press the S key to highlight the **SET DRIVE** selection.
4. Press the A key to select **SET DRIVE** option.
5. Press the A key to accept drive 2 as the target drive.





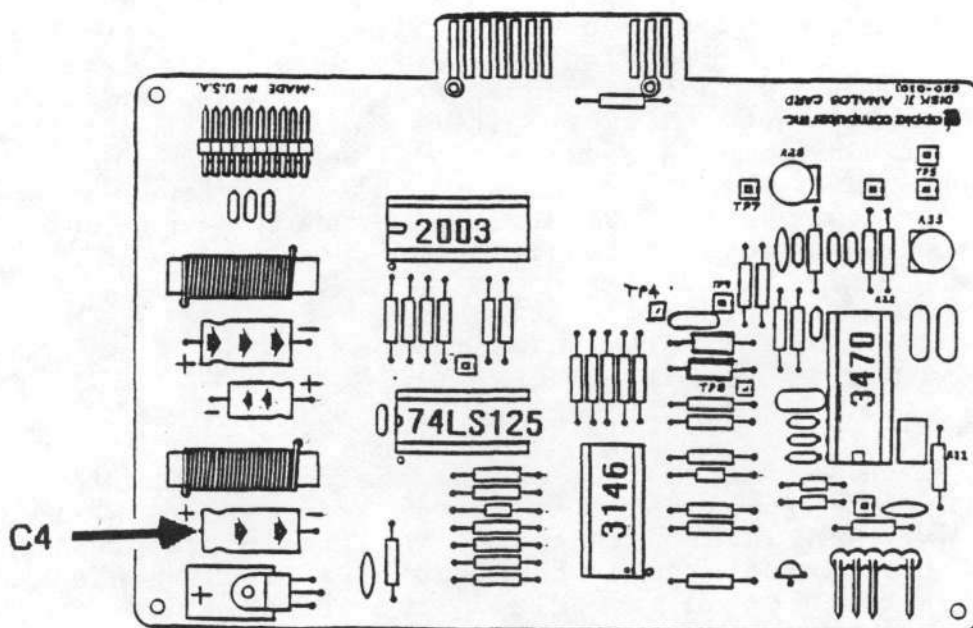
6. Press the **ESCAPE** key to return to the main menu.
7. Press the **S** key until **DSPEED** is highlighted.
8. Insert a blank diskette without a write-protect tab in drive 2. Press the **A** key to accept the **DSPEED** test.
9. Press the **A** key to begin the DSPEED test. The video screen will display a scale with the high, low and current disk speed values. Locate the speed adjustment screw on the motor control PCB under the right front of the mechanical assembly. Adjust this pot while observing the current speed value and indicator (arrow). If the value changes and the arrow moves as you turn the adjustment, this portion of the circuit is functional; proceed to the **Drive Has Trouble Reading** procedure. If the drive speed indicator does not move to reflect the speed adjustment, this circuit is faulty; turn off the power to the computer and replace the following devices (except those which have been replaced previously), one at a time, repeating this test after each device until the indicator moves reflecting the speed changes:
  - IC at B1 (labelled 3470)
  - IC at A3 (labelled 3146)
  - IC at B4 (labelled 74LS125)
  - IC at D4 (labelled 2003)

If you replace all of the ICs on the analog card and the DSPEED indicator still fails to move, perform the **COMPARATOR OFFSET ADJUSTMENT** located in the calibration procedures of the Disk ][ Technical Procedures section. If the analog card still fails to function properly, place all original ICs in their sockets and return the card to Apple.

### **Drive Has Trouble Reading**

If the drive will perform the DSPEED test successfully, perform the following steps:

1. Boot the DOS 3.3 System Master in drive 1, then remove it and place it in drive 2.
2. Type **CATALOG,D2** and press <RETURN> and watch drive 2 closely for activity. The video screen should display the catalog of the DOS 3.3 System Master diskette. If this does not occur, replace the following devices according to the observed symptoms:





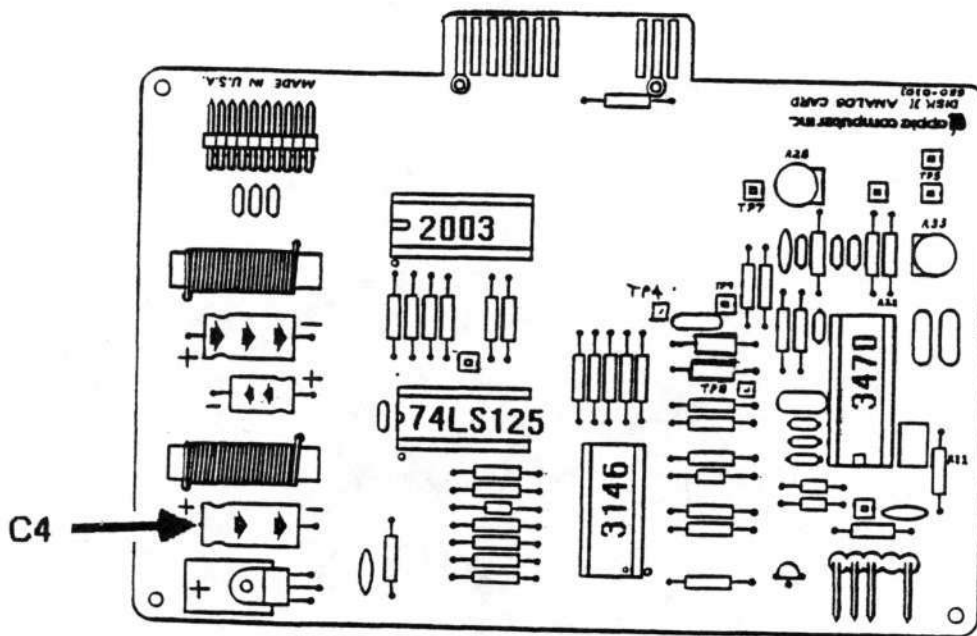
<u>SYMPTOM</u>	<u>IC</u>	<u>LOCATION</u>
Head does not move	2003	D4
Disk does not turn	2003	D4
Recalibrates repeatedly	3470	B1
I/O ERROR	3470	B1
" "	3146	A3
" "	74LS125	B4
" "	2003	D4

If you have replaced all of the ICs on the analog card and the catalog still does not display, perform the **COMPARATOR OFFSET ADJUSTMENT** located in the calibration procedures of the Disk ][ Technical Procedures section. If the analog card still fails to function properly, place all original ICs in their sockets and return the card to Apple.

### Drive Has Trouble Writing

If the analog card correctly displays the catalog of drive 2, perform the following steps:

1. Boot the DOS 3.3 System Master diskette in drive 1, and then move it to drive 2.
2. Type **CATALOG,D2** and press <RETURN>. The catalog will be displayed on the video screen. Files displayed with an asterisk (\*) preceding the filename are locked and may not be deleted. Note that filename HELLO is preceded by an asterisk.
3. Type **UNLOCK HELLO** and press <RETURN>.
4. Type **CATALOG,D2** and press <RETURN>. The catalog will be displayed on the video screen. Verify that filename HELLO is not preceded by an asterisk. If you encounter trouble when attempting to unlock the file, turn off the power to the computer and replace the following devices (except those which have been replaced previously), one at a time, repeating this test after each device until the UNLOCK command executes successfully:
  - IC at B4 (labelled 74LS125)
  - IC at D4 (labelled 2003)
  - IC at A3 (labelled 3146)



5. Type **LOCK HELLO** and press <RETURN> to re-lock the file.

If you have replaced all of the ICs on the analog card and the file still does not unlock, perform the **COMPARATOR OFFSET ADJUSTMENT** located in the calibration procedures of the Disk ][ Technical Procedures section. If the analog card still fails to function properly, place all original ICs in their sockets and return the card to Apple. Otherwise, go on to the next procedure.

#### **Write-Protect Switch Circuit Malfunctions**

1. Place a write-protect tab on the DOS 3.3 System Master diskette and insert the diskette in drive 2.
2. Repeat steps 2 and 3 above (**DRIVE HAS TROUBLE WRITING**). The video screen should display **WRITE PROTECT ERROR**. If this does not occur, replace the following device (unless it has been replaced previously), and repeat this test.

- IC at B4 (labelled 74LS125)

If the screen still does not display **WRITE PROTECT ERROR**, place all original ICs in their sockets and return the analog card to Apple.



