4

Preliminary Service Checks

Conducting preliminary service checks before actually digging into a problem can quickly find minor malfunctions. Most of the time all that you find is a basic problem. Even the most common system problem (disk drive tracking and speed) can be solved by preliminary checks. But there are many other checks that can be made to isolate a failure. Disassembly and reassembly instructions can be found in the appendix.

The first (and probably most important) step to take when troubleshooting a problem is to determine what conditions start (or stop) the failure. A defect can often be started by some action on your part. This helps to localize and isolate the problem much faster. It also beats trying to find problems that start and stop on their own, totally ignoring actions by you. Once this is accomplished, begin conducting preliminary service checks by disconnecting all unneeded external peripherals. This includes display units, printers, joysticks, modems, and mouse tablets. Connect your own service monitor that has been previously verified fully operational. Then check all internal and external interface cables. Look for corrosion or broken pins. Clean all edge connectors on the cards plugged into the expansion slots and disk drives. You're trying to remove these components as problem sources.

Not all the preliminary checks that will be covered in this chapter are necessary in every case. For example, if you turn on the computer and it runs through self test and boots, but no screen display appears, you don't want to waste valuable time verifying the output of the power supply, but you might want to check that the power is present on the video interface card. Don't get snookered into rotating adjustment controls to see if they have any affect on the symptom. Excessive rotation can obscure the symptom you're investigating and possibly cause other nonrelated problems. Even when the point is reached where the control seems to be in need of adjustment, do so carefully with minimum rotation. You don't want the drawbacks to outweigh the advantages. Follow a logical procedure in troubleshooting and you'll seldom go wrong. In fact, you'll find the problem faster and with far fewer headaches. In the following paragraphs, the recommended service checks have been arranged by specific failure symptom.

NO POWER

Turn the PC power on, and check for any indication of power (display screen brightens, beep sound, disk drive light comes on, and so forth). Turn off power to the computer. Unplug the power cables P8, P9, P10, and P11.

Reapply power and check plug P9 for +5 volts on pins 4, 5, and 6, and -5 volts on pin 3. Check plug P8 for +12 volts on pin 3, and -12 volts on pin 4. Check plugs P10 and P11 for +12 volts on pin 1 and +5 volts on pin 4.

If all voltages are missing, check for an open fuse F1 (Fig. 4-1). If F1 is open, replace the fuse, retest, and return the system to service. If F1 is not open, go to Chapter 5, section "Won't Boot, No Fan, Screen Blank."

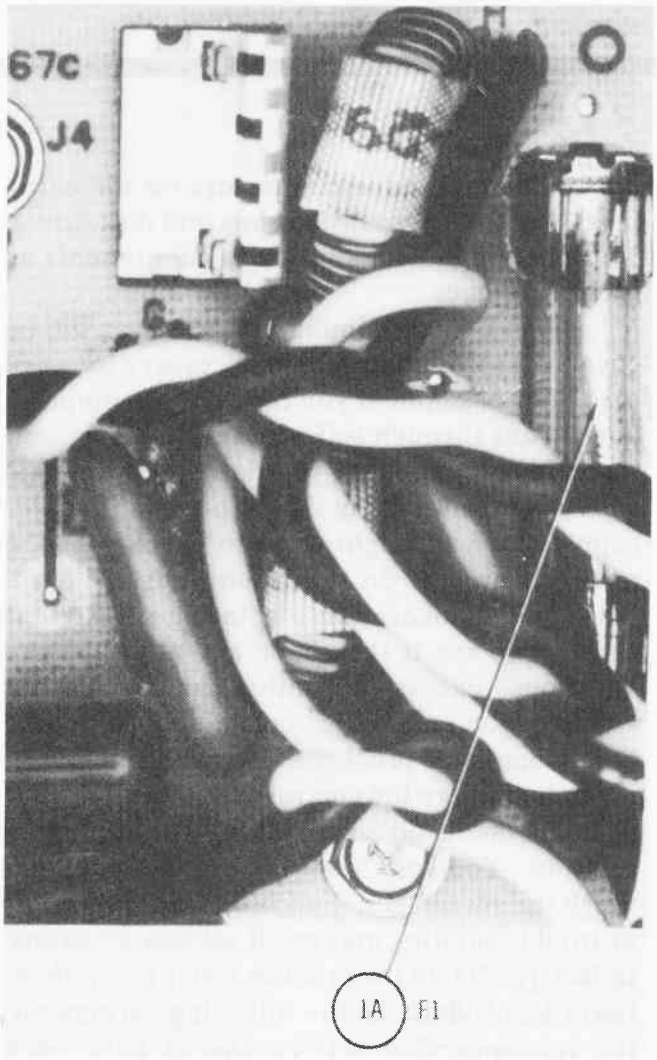

Fig. 4-1. The fuse is plainly visible on the far right.

If one or more voltages are missing, refer to the appropriate power missing symptom section in Chapter 5.

If all the voltages tested good at the plug pins, turn off power and reconnect the power plugs to the system board. Turn power back on and recheck for proper voltages on the same plug pins tested earlier. If the voltages are still present, turn off the power and reinstall one of the peripheral cards. Turn power back on and retest the plug pins for the continued presence of proper voltages. If the test passes, power down and reinstall another peripheral. Power up and retest for the presence of all proper voltages. If the test passes, continue with another peripheral. At some point you will discover that some or all the voltages are lost after reconnecting a peripheral. The last peripheral installed when the power failure occurred has experienced a component failure.

Look for anything that could cause a short on that peripheral's adapter card. Troubleshoot the adapter board and peripheral. See Chapter 5 for analyzing the monochrome display/printer adapter, the color/graphics adapter, and the floppy disk drive adapter cards.

SYSTEM BOARD PROBLEM

System board failures can be caused by the loss of the +5 volt power or by the loss of clock pulses. Therefore, test the clock circuit immediately after power up tests. An absent, jittery, or noisy clock signal can adversely impact the operation of the rest of the system. A bad clock signal can prove fatal to circuit operation or cause marginal operation leading to transient problems that are difficult to find. The best test sequence is to check power, clock, ROM, RAM, the I/O ports, and interrupts and bus control logic. You could divide the system board into two sections containing the CPU circuitry (8088, 8087, clock generator, bus controller, and buffers) and another section containing the standard peripheral I/O devices, RAM, and any analog circuits.

If power loss has not occurred, most start-up failures will result in a system lock with an error code displayed on the screen. If an error code appears, refer to the next section, "Self Test Error Code Displayed." If no error code appears, check for +5 volts on pin 18 of Clock Generator IC U11. Check for +5 volts on pins 31 and 40 of the 8088 CPU U3. Then check for a 14.31818 MHz timing signal on pins 16 and 17 of U11.

Check for 4.77272 MHz on pin 8 of U11 and on pin 19 of U3. Check that the switch settings on the system board are set correctly. These switches are tested by the system board circuitry to identify the hardware configuration and the amount of memory installed. Table 4-1 shows the switch settings.

If the system didn't boot, refer to the Won't Boot, Fan Works, Screen Blank section in Chapter 5. If boot-up occurs, monitor the self-test for audio or visual indications of system problems. Most system board failures can be captured by the self-test error routines located in the bootstrap ROM and identified by a speaker beep code and/or visual error code display.

Table 4-1. Switch Settings

Switch Block 1	Description
1, 7, 8	5¼ Disk drive setting 1 on, 7 on, 8 on = No drives 1 off, 7 on, 8 on = 1 drive 1 off, 7 off, 8 on = 2 drives
2	Presence of coprocessor 2 on = no coprocessor installed 2 off = coprocessor installed
3, 4	Total memory setting 3 off, 4 off = 64k memory or more 3 on, 4 off = 48k memory 3 off, 4 on = 32k memory 3 on, 4 on = 16k memory
5, 6	Monitor type settings 5 on, 6 on = no monitor 5 off, 6 off = monochrome monitor/ printer adapter or more than one monitor 5 off, 6 on = 40 x 25 color monitor 5 on, 6 off = 80 x 25 color monitor

Switch Block 2	Description
1-8	Total memory size setting (works in conjunction with SW1 3,4) 1,2,3,4,5 on, 6,7,8 off = 64k or less 1,3,4,5 on, 2,6,7,8 off = 128k memory 1,2,4,5 on, 3,6,7,8 off = 192k memory 1,4,5 on, 2,3,6,7,8 off = 256k memory

SELF-TEST ERROR CODE DISPLAYED

Turn off the computer, wait 7 seconds and turn power back on. Observe and listen to the system self-test. If no problems occur, the PC speaker will beep once and try to boot the master disk drive. If no disk is installed in the drive (or no drive connected to the PC), the operating system will shift into ROM BASIC. However, any failure of the self-test will generate an error code message and possibly an accompanying audio beep pattern. The audio beep indicators and system error codes are listed in Table 4-2.

If the system self-test detects a RAM failure, a four-character error code followed by the number 201 will appear in the top-left corner of the screen. The value 201 identifies a RAM problem; the four-character code defines the bank and row of memory ICs in which the error occurred. The first two characters refer to the memory bank in which the failure occurred. The last two characters define the bit position of RAM failure in a particular bank of memory. Table 4-3 translates error codes to malfunctioning bank and bit position. For example, a failure in the bit 5 position of bank 1, a code 0420 201 should appear in the upper left corner of the screen.

If the third and fourth characters in the error code don't match the codes in Table 4-3, swap the entire bank of RAM chips and try again. Another technique is to power down and swap each chip in the bad bank one at a time with the same bit position chip in an adjacent bank. Then power up and retest. When the error code shifts to the adjacent bank, the last chip swapped, was bad.

On the 64K/256K boards, a four character code is also displayed when a ROM failure occurs. The self-test routine resides on ROM U33. This ROM does not get tested by the self-test program. Table 4-4 can be used to translate the

Table 4-2. Beep Indicators and Error Codes Associated with the IBM PC Self Diagnostic Program

Beep Indicators

Indicator	Failure Location
No beep, nothing happens	Power, power supply
Continuous beep	Power, power supply
Repeating short beep	System board
1 long, 1 short beep	System board
1 long, 2 short beeps	Display circuit
1 short beep, blank or incorrect display	Display
1 short beep, Casscte BASIC display, no disk boot	Diskette, disk drive

I/O Error Codes

Code	Problem
199	Printer adapter card or printer malfunction
432	Printer adapter card or printer malfunction
7xx	System unit I/O malfunction
9xx	System unit I/O (parallel printer adapter) malfunction
901	Printer adapter card or printer itself is bad
11xx	System unit malfunction
12xx	System unit malfunction
13xx	Game control adapter card malfunction
14xx	Printer interface malfunction
15xx	System unit or communications adapter cable malfunction
18xx	Expansion unit or cable malfunction
1819	Expansion unit malfunction
1820	Expansion unit cable malfunction
1821	Expansion unit cable malfunction
20xx	System unit or communications adapter cable malfunction
21xx	System unit or communications adapter cable malfunction

Other Error Displays

Display	Meaning
Blank display, beep, drive starts to boot, but no Cassette BASIC message on screen	System Monitor BIOS ROM (U33) 8284 clock generator bad
KEYBOARD NOT FUNCTIONAL	Keyboard problem
PARITY CHECK 1	Power supply problem
PARITY ERROR 1	Try reseating RAM chips
PRINTER PROBLEMS	Printer problem, check interface

System Error Codes

These error codes can appear alone or in conjunction with other numbers.

Code	Problem
02X	Power supply problem
100	Option configuration wrong
199 100	Software option configuration installation wrong. Check switches.
101	System board malfunction
131	Cassette port error
201	RAM failure
xxxx = 201	Memory failure
1055 = 201	DIP switches set wrong
2055 = 201	DIP switches set wrong
xxxx = 201	RAM chip malfunction
PARITY CHECK x	
301	Keyboard malfunction, keyboard cable disconnected
xx301	Keyboard circuitry malfunction (xx is a hexadecimal value representing the scan code of the malfunctioning key)
401	Monochrome adapter card malfunction
501	Color/graphics adapter card malfunction
601	Diskette or disk drive interface malfunction (drive adapter, cable, drive A)
606	Drive assembly or drive adapter malfunction
607	Disk is write protected; disk not inserted right; write-protect switch bad, analog card malfunction
608	Diskette is bad
611	Drive data cable or disk drive adapter card is bad
612	Drive data cable or disk drive adapter card is bad
613	Drive data cable or disk drive adapter card is bad
621-626	Drive assembly is bad

four character error code to a specific ROM failure.

To check the ROM, substitute the suspected bad ROM IC with a known good ROM and retest. If the problem remains, refer to Chapter 5.

Table 4-3. RAM Memory Failure Error Codes

XX System Board Memory (Bank xx)	*XX 201 Parity Check 1* Failed Chip
00 = Bank 0 04 = Bank 1 08 = Bank 2 0C = Bank 3	00 = Parity 01 = D0 chip 02 = D1 chip 04 = D2 chip 08 = D3 chip 10 = D4 chip 20 = D5 chip 40 = D6 chip 80 = D7 chip

Table 4-4. ROM Error Codes

Display	Problem
F600 ROM	Cassette BASIC ROM (U29) bad
F800 ROM	Cassette BASIC ROM (U30) bad
FA00 ROM	Cassette BASIC ROM (U31) bad
FC00 ROM	Cassette BASIC ROM (U32) bad

DISPLAY PROBLEMS

During system power-up, one of the BIOS routines initializes and starts the 6845 CRT controller and tests the video read/write storage. The program causes the 8088 CPU to check the setting of the video switch SW1 by reading port A of the 8255 PPI. This port is connected to the two configuration switches SW1 and SW2. The CPU logically ANDs the port data with the hex value 30H thus checking the settings of switch SW1-5 and SW1-6. If they are not off, the program jumps to a subroutine that tests to see which type video card is installed. If SW1-5, 6 are off, the program goes into an I/O memory parity test and then into setting the video mode. If a parity error occurs, a message is displayed. If a problem occurs setting the video mode, another error message is displayed.

The program also conducts a test of the video storage memory. If a failure occurs, the speaker is beeped. By reading the CRT controller status port and logically ANDing the reading with binary 1000, a test is made to see if the video/horizontal line changes state. If it does not go low during this timed test, a timer clocks out and an error message is displayed and the speaker is caused to beep. Several times during this power-up testing, the INT 10H video I/O procedure is called.

Color Display Problems

No Video

The first thing to do is to localize the failure to the display unit or the PC system unit. Do this by connecting your own test monitor with known good cable to the PC and retest. If the problem is corrected, try the original display unit with your good video cable. If it works fine, replace the video cable and return the failed unit to service. If it didn't work, the display unit has a malfunction.

If no video is displayed using your test monitor and cable and no cursor appears, check the configuration switches on the system board, particularly SW1-5 and SW1-6 which configure the system for the particular type monitor adapter board you are using. Clean and examine the pins of the edge connector of the adapter card. On the older adapter cards, the bracket from the adapter must be connected directly to the chassis to provide a suitable system ground for proper operation.

If the display malfunction persists, check for proper +5 volt power on the adapter board. If the voltage is improper, refer to the power supply problems in Chapter 5. If +5 volts is present, refer to Chapter 5 "No video." If the system

seems to work fine without the color card installed, but shuts down when it's mounted in the expansion slot, suspect ICs U26, U42, U60, U66, or U67.

Horizontal or Vertical Sync Problem

If no horizontal or vertical sync is working, suspect ICs U21, U63, U67, and U101. Refer to Chapter 5.

Cursor Problem

If the cursor is not blinking or is missing, suspect U12. Go to Chapter 5.

Fading or Wrong Color

Fading color or the wrong color can be caused by U20, U22, U43, U44, U45, U65, or U67 malfunctioning. Go to Chapter 5.

Video Memory Problem

Video RAM problems can be caused by failure in ICs U50 through U60. The error code 501 defines a malfunction in the color/graphics adapter card. Go to Chapter 5.

Monochrome Display Problems

When failure symptoms occur on systems that have the monochrome display/printer adapter installed, follow these steps when conducting preliminary checks. Connect the system to your test monitor with your own video cable to eliminate the display unit and cable as the problem cause. Did one long and two short beeps occur during power up? Has a 401 error code appeared on the display?

No Video

Check for +5 volts on the adapter board. If the voltage is present, refer to the monochrome video section of Chapter 5. If +5 volts is not present on the adapter board, troubleshoot from the +5 volt power input to the point of loss and correct as appropriate.

Cursor Problem

If there is no cursor on the screen of a system that was just brought to you, check the system board configuration switches SW1 and SW2. Pay particular attention that SW1-5 and SW1-6 are both in the OFF position and have not malfunctioned. Clean, and reseat the monochrome adapter card into the expansion slot.

If the cursor is not blinking or is missing, suspect U55 (DM74LS174N). Go to Chapter 5.

System Shuts Down With Monochrome Card Installed

If the system shuts down, one of the following ICs on the monochrome monitor/printer adapter could be bad. Refer to Chapter 5.

U3–DM74LS08N
U35–MC6845P
U45–74LS74APC
U54–DM74S86N
U64–DM74LS244N
U100–74LS32N
U101–74LS74PC

Printer Problems

As a group, printer problems rank somewhere between a pain in the neck and a minor nuisance depending on how much you depend on printed output. At the least, a malfunctioning printer means you'll have to MODEM over to another machine with a printer, transfer disks to another machine with a printer, or settle for display output only. For a writer like myself, loss of a printer can be catastrophic.

When printing ceases (or never begins), like the video output, you have three possible sources for the problem: the system board, the adapter card, or the printer itself. One of the few preliminary tests that you can accomplish, is conduct a printer self-test to see if the printer itself is functioning properly. Power down the

IBM PC itself. Keep the printer powered-up and, following the printer operating manual, conduct a self-test operation. When you are satisfied the printer itself is good, turn off power to the printer and check the printer cable interface to ensure no pins are corroded or have somehow broken or have become bent. The fastest way to locate a printer problem is to carefully evaluate the configuration and decide if any changes have occurred. Did you recently disconnect the printer? Did you recently replace the ribbon or paper in the printer? Perhaps a limit switch got bent or is sticking. Error codes 199, 432, or 9xx suggest a failure in the printer adapter card or the printer itself. An error code of 14xx defines a failure in the printer interface itself.

If you have a spare, connecting another printer and Centronics-parallel cable to the system unit is a good way to localize the problem to the printer adapter card.

If you suspect a system board failure, check the operation of the other peripherals–the video display and the disk drive interface–because these devices use the same system board signals during operation.

If you've localized the problem to the printer adapter card (or the monochrome monitor/ printer adapter if installed), refer to Chapter 5 for detailed circuit troubleshooting.

System Shuts Down With Printer Card Installed

If the system works fine as long as you don't plug the printer adapter card into an expansion slot, but shuts down whenever you try to boot up with the card installed, suspect U1 data transceiver 74LS245, U9 2-input NOR gate 74LS02, or U11 2-input XOR 74LS86.

A total system shutdown with the monochrome monitor/printer adapter installed can be caused by the failure of U3 2-input AND 74LS08, U35 MC6845 CRT controller (its on the same board with the printer circuitry), U45 D flip-flop 74LS74, U54 2-input XOR 74LS86, U64 tristate octal buffer 74LS244, U100 2-input OR 74LS32, or U101 D flip-flop 74LS74. Go to Chapter 5.

Printer Won't Print

If you are using the standard printer adapter card and the printer just won't print a thing (after successfully conducting a printer self-test) suspect U1 data transceiver 74LS245, U2 line driver 74LS240, U6 1-of-4 decoder 74LS155, U7 flip-flop 74LS174, or U8 open collector hex inverter 7405 (see COMPUTERFACTS pages 7 and 54).

If you have the monochrome monitor/ printer adapter card installed and the printer won't print, suspect U37 tristate buffer 74LS240, U38 open collector hex inverter 7405, U39 D flip-flop 74LS174, U56 hex inverter 74LS04, U57 2-input NOR 74LS02, or U61 1-of-4 decoder 74LS155. Go to Chapter 5.

Prints Garbage

If you are using the printer adapter card and the printer starts printing random, or garbage, characters, suspect U3 data buffer 74LS244, or U4 output latch 74LS374. Refer to Chapter 5 for all circuit board troubleshooting and repair.

Keyboard Problems

This is a tough problem to have because it's your primary means for communicating with the PC.

No Keys Respond

If depressing the keys causes no response, disconnect the keyboard from the system unit and check the keyboard cable for continuity. Look for corrosion or broken pins. Do a continuity test for open wires in the cable. If this is not the problem, disassemble the keyboard, reconnect it to the system board, energize the system and check to +5 volts on pins 26 and 40 of 8048 single chip computer M1 (labelled 8340X7).

If the failure occurs during power-up, the error codes are helpful in localizing the failure. As shown in Table 4-1, keyboard error code 301 describes a keyboard or keyboard cable failure. A xx301 error code defines a keyboard circuitry

failure (xx is hexadecimal value representing scan code of failed key). Go to Chapter 5.

Single Key Won't Work

If a single key malfunctions (and your keyboard keys can be removed), replace the bad key. Otherwise, replace the keyboard.

Get Unwanted Repeat Key Action

If a key is pressed and an unwanted repeat occurs, refer to Chapter 5 for circuit troubleshooting. If many different characters are printed when only one key is depressed, the keyboard is bad or the 8048 inside just blew its silicon and should be replaced.

Disk Drive Problems

When a disk drive fails to boot a system disk, one of several things could have failed, the disk itself is bad, the drive analog card failed, the drive mechanics are out of tolerance, the disk drive adapter card in the expansion slot is bad, or the system board itself has a failure. It could just be that you inadvertently placed configuration switch SW1 positions 1, 7, and 8 ON showing that you don't have *any* $5^1/_4$ inch drives attached.

The boot-up diagnostics are handy here. If you get a short beep, the "Cassette BASIC" display, and no disk boot, the problem is probably the diskette or in the drive itself. An error display of 60X (501, 606, 607, 608, 611, 612, 613, or 621 through 626) indicates that a malfunction has occurred in the disk system (diskette, disk drive, disk drive interface, or the adapter board). Refer to Table 4-2 for the meanings of the 60X error codes.

When a disk-related malfunction occurs during operation, you must verify that the problem is not in the diskette being used. Reboot with a good copy of the system disk. If the disk checks good, try to reboot with the same disk that you were using when the problem occurred. If a failure occurs, the disk is bad (or needs reformatting).

No Disk Boots in Drive A

If no disk will boot-up and run in drive A, power down, unplug the drive data cable from drive A and connect it to drive B–also, swap the jumper at 1E on the analog card between drives A and B. Power up again and reboot using drive B. If drive B boots normally, drive A has a malfunction. If not, power down and check the cable for continuity. Clean and examine the cable and the adapter card edge connectors. Check for +5 volts on pin 4, and +12 volts on pin 1 of the power supply cable. If the power at the plug is normal, troubleshoot the disk drive adapter card.

Both Drive Lights Come On

If both drive run lights come on when reading or writing a disk, check the cables to see if you misconnected the drive A data cable to drive B. An active low signal on any of the MOTOR ON, MOTOR ENABLE (A), DRIVE SELECT (A), or DRIVE SELECT (B) lines can cause the led CR27 to energize (see disk drive CF page 2). Another possible cause could be failure of U16 output NAND 7438 or U17 output D flip-flop 74LS273 on the adapter card.

Seek Error Message

If you get a SEEK ERROR message displayed, a track is unreadable or head misalignment has occurred. Try to read another disk. If this doesn't work, suspect U4 2-input AND gate 74LS08, U6 floppy disk controller D765AC (UPD765), or U18 tristate octal inverter buffer 74LS240. Refer to Chapter 5.

Drive Destroys Write-Protected Data

If a drive destroys data on a write-protected disk, suspect a failure in U6 FDC UPD765, U10 multiplexer 74LS153, U11 D flip-flop 74LS175, or U18 tristate octal inverter buffer 74LS240. Refer to Chapter 5.

Can't Read From Either Drive

If you can't read data from either drive, suspect U6 FDC UPD765, U7 driver MC3487, U9 open

collector 2-input NAND 7438, U18 buffer 74LS240, U22 J-K flip-flop 74LS112, U23 4-Bit counter 74LS112, U25, another 4-bit 74LS112 counter, or U26 2-input NOR 74LS02.

Drive Light On But No Data To Memory

If a disk drive run light is on, but data is not going into memory check that the drive motor is actually running. Another cause could be the motor speed. If it drifts out of tolerance, reset it using speed adjust control (R4A). This will be covered shortly. It's also possible that the motor drive belt is loose. Check the belt and replace it if it appears loose.

Can't Read or Boot DOS Diskette

Switch drives A and B data cables–also, swap the jumper at 1E on the analog card between drives A and B. Reboot the DOS diskette in drive B. If it works, drive A needs track 0 alignment. If the disk won't boot in drive B either, try another DOS disk. Suspect that the original DOS disk lost part of its format or directory data.

Drive Operates Intermittently

This problem can be caused by dirty, clogged write/read heads, speed out of tolerance, or mechanical alignment of the drive mechanics. Conducting periodic head cleaning (after every 40 hours of operation) will help keep debris on the head from destroying data stored on the disk. Periodic maintenance on the disk drive speed will eliminate this as a possible intermittent failure cause.

Drive Writes/Erases Data On Write-Protected Disk

Switch active drives and try another write-protected disk that contains nonimportant information. Try to write to this disk. If the drive writes, suspect a failure on the adapter card. If the drive does not write, a failure has occurred on the original disk drive analog board. Refer to Chapter 5.

Disk Drive Head Cleaning

Heads need cleaning to remove the oxides from the disks building up on the leading edge of the head (the side facing the direction of disk rotation), as shown in Fig. 4-2.

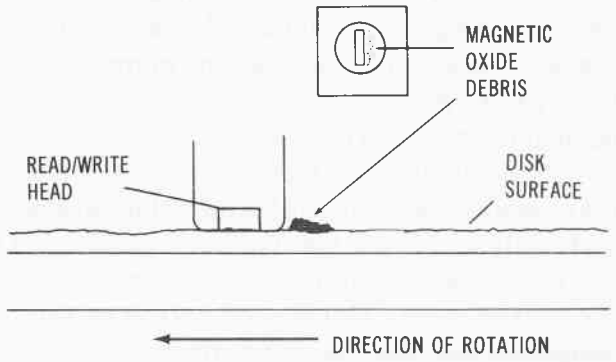

Fig. 4-2. Oxides are wiped off the disk surface and build up on the head surface.

Head cleaning diskettes of various kinds are available. The "wet" diskette kind works with a cleaning solvent. Some head cleaners are abrasive and can damage the head if they are used for too long. With this type of cleaner, you must use the cleaner just long enough to remove the oxide build-up but not long enough to damage the head.

Nonabrasive head cleaners are also being marketed. Two examples are Verbatim's Datalife head-cleaning kit, and Innovative Computer Products' Perfect Data head-cleaning kit. Both products use fabric-covered disks which are dampened with a cleaning solvent. With the one kit, you sprinkle cleaning solvent on the disk fabric and then insert the disk into the drive for spinning action head cleaning. The disk can be used as many as 13 times. The other kit has cleaning disks that are predampened and individually sealed. A cleaning disk is used once and then thrown away, using another the next time. Both of these products work well.

Since any cleaning disk works by rubbing action and chemical action between the disk fabric and the drive head, there is potential for abrasion to occur. So you must be careful not to leave the disk spinning in the drive for too long. A cleaning disk can be allowed to spin in a disk

drive for 30 seconds with no apparent damage. With most cleaning disk kits, 45 seconds is too long to keep the cleaning solvent in contact with the drive head.

Drive heads can also be cleaned with alcohol and a cotton swab wrapped in a lint-free material (see Fig. 4-3). With manual alcohol and swab cleaning, you could accidentally scrub the pressure pads by mistake, causing more problems than you're preventing. But, if you're careful, manual cleaning can be effective.

Special cleaning material such as cellular-foam swabs and chamois leather cloth are good materials to use for manual head cleaning. Or you can use a piece of bed sheet wrapped around the cotton swab. Uncovered cotton swabs are dangerous because the cotton fibers can catch or pull away and lie in the drive or on the head,

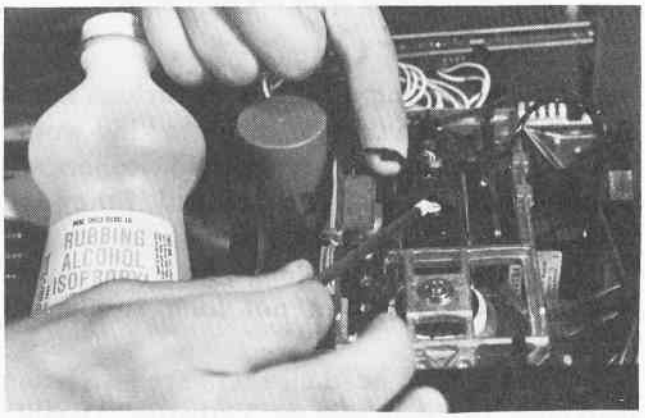

Fig. 4-3. Drive read heads can be cleaned using denatured alcohol and a lint-free swab.

becoming cotton logs on a disk-surface highway, waiting to get swept into the drive head that rides on the surface of the disk. These fibers can also catch on the ferrite chip in the middle of the ceramic head, loosening it from its mounting and ruining the head. Surgical isopropyl alcohol or methanol can be used as the cleaning solvent. The solvent used must not leave a residue when it evaporates, so most other alcohol solvents should be avoided. You can also use typewriter cleaner or trichloroethane. Always use plenty of ventilation and make sure the solvent has evaporated before you operate the drive.

How often the head must be cleaned depends upon how much the drive is used and what type of diskettes are used. A quality diskette is good for about 3 million passes, or rotations, against a read/write head before enough oxide is worn off so that the head needs cleaning. The "bargain" disks are good for one-tenth the rotational life. This means that instead of 167 hours of access time, you might get 16 hours before the head gets caked with oxide or a disk surface gets too worn to write to or read from. This is why bargain disks don't seem to last very long.

A useful rule of thumb for head cleaning is to clean the read/write head every 40 hours of disk operation. This means clean after 40 hours of rotational life if standard disks are being used. A popular approach is to wait until read/write errors start to occur, then replace or clean the head.

Keeping the disk drive door closed unless inserting or removing a disk will help keep dust and dirt out. It also prevents unwelcome visitors (insects and even mice) from climbing into the drive.

To Clean the Drive Head Using a Cleaning Disk:

1. Turn computer power on.
2. Dampen the cleaning disk with the solvent supplied.
3. Insert the dampened cleaning disk in the drive.
4. Close the drive door.
5. If in BASIC, reset the system (warm boot). With the cleaning disk inside the drive, the disk will simply spin, cleaning as it whirs along.
6. After 20 or 30 seconds, open the drive door and remove the disk.
7. Turn off the computer.
8. Let the drive read/write head dry thoroughly before operating the system.

To Clean the Drive Head Manually:

Tools Required:

Flathead screwdriver

Phillips head screwdriver
Protective pad
Adequate lighting
Tray to hold loose screws

1. Turn off power to the computer.
2. Disassemble the computer using the procedures found in Appendix D.
3. Disconnect the disk drive data cable from the back of the drive.
4. Remove the two silver flathead screws holding the drive tight to the chassis, as shown in Fig. 4-4.

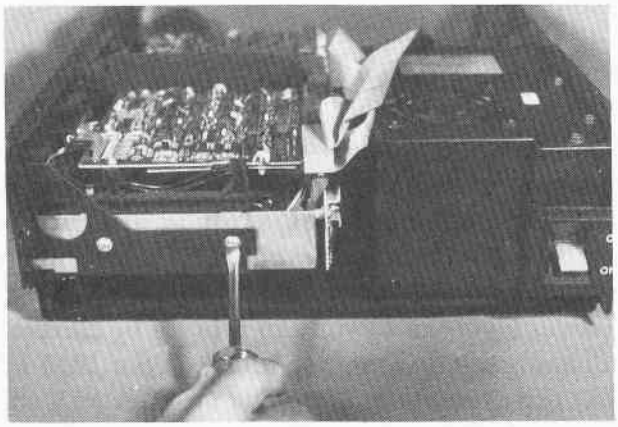

Fig. 4-4. Remove the two flathead screws holding the disk drive to the chassis.

5. Gently pull the drive forward about 2 inches from the front of the chassis.
6. Disconnect the power supply cable from the back of the analog card.
7. Gently remove the drive from the chassis.
8. Carefully remove the head cable(s) from connector (located in the front-right corner).
9. Carefully remove the two Phillips screws holding the analog card on the drive (located in the front on both sides), as shown in Fig. 4-5.
10. Slide the analog card toward the back of the drive until the card is free of the grooves in the drive mechanism. (You may have to wiggle the card gently to get it to slide.)
11. Lift up the analog card from the front.
12. Carefully lift the black head load arm as shown in Fig. 4-6, and look for discoloration (build-up) on the surface of the pad, or on the read/write head below.

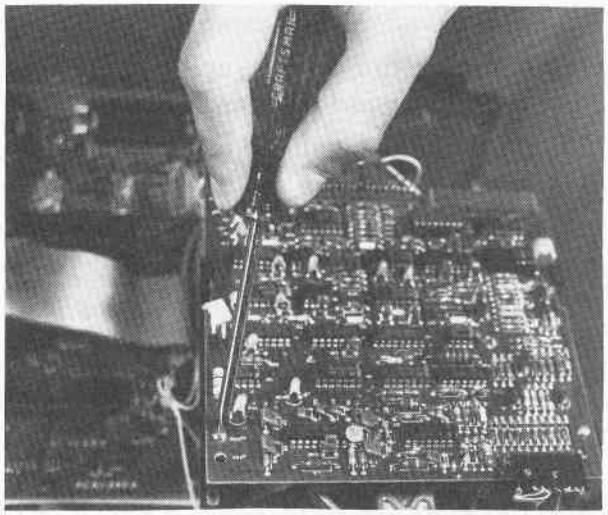

Fig. 4-5. Remove the two Phillips screws holding the analog card on the drive mechanism.

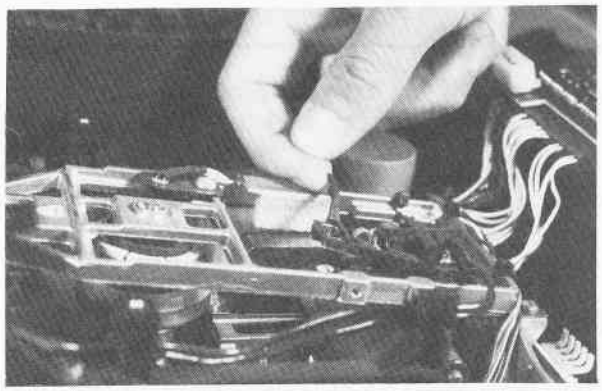

Fig. 4-6. Carefully lift the head load arm to expose the read head below.

13. Using a special foam or wrapped cotton swab dampened with cleaning solvent, gently rub the head and the pad (see Fig. 4-6).
14. Let the surfaces dry completely before reassembling.
15. When the head and pressure pad are dry, carefully slide the analog card back into the grooves in the drive mechanism.
16. Reinstall the two Phillips screws into the analog card (in the front on both sides).

17. Reconnect the head cable(s), being very careful not to break or short connector pins.
18. Carefully push the drive mechanism back into the chassis until about 2 inches of the drive housing is still exposed.
19. Connect the power supply cable to the back underside of the analog card.
20. Push the drive all the way into the chassis housing.
21. Replace the two silver flathead screws on the sides of the drive (refer to Fig. 4-4).
22. Reconnect the ribbon cable to the drive.
23. Power up the computer.
24. When all the surfaces are dry, place a copy of a program disk in the cleaned drive.
25. Close the drive door.
26. Load and run a program.
27. Reassemble the computer.
28. Restore the system to full operation.

> Note: if you have any problems refer to the beginning of the disk preliminary check section.

Disk Drive Head Cleaning Interval

Cleaning a drive head is like changing the oil in a car. It's usually done when you feel you've driven enough miles or when the oil looks dirty. Some software manufacturers recommend cleaning heads every other week. Some repair technicians say clean every six months. Others suggest you don't clean your heads until the disk drive makes mistakes trying to read or write data. Since no hard and fast rule has been offered, refer to Table 4-5 for some recommended head cleaning intervals.

If the drive is used in an area that gets a lot of smog, you may want to clean the heads more often. In any case, it won't hurt to clean at least annually. If read/write errors begin to occur, check the operational time log (if one is being maintained) to see if PMs are due. If the customer doesn't keep an operational time log, recommend that one be started. Some recommended operational log sheets are included in Appendix I.

Table 4-5. Disk Drive Head Cleaning Interval

System Usage	Cleaning Interval
Over six hours each day	Weekly
Daily	Monthly
Light to moderate	Every other month
Occasionally	Every six months

Disk Speed Tests

Variation in speed is caused by normal mechanical drive wear or by excessive moving and reconnecting drives. Just as automobile engines need periodic checkup and engine retuning, disk drives benefit from the TLC (tender loving care) you can provide by correctly adjusting the drive motor speed. Your IBM PC disk drives rotate at 300 rpm and work with soft sectored disks where the computer software identifies the beginning and end of each of the sectors on each of the tracks. No timing holes are used as with hard sectored disks. This makes the speed of rotation critical to the accurate synchronization of the software with the signals stored on the disk. If the speed is off by only 10 rpm, the drive may not be able to correctly read the disk.

Should the speed be incorrect, the data will be written in the wrong location on the disk. The next time an access is made to that area on the track again, the computer will hang up and generate a disk error. While disk speeds between 291 rpm and 309 rpm should be acceptable for read/write operation, speeds outside this range cause intermittent or disastrous results. If the speed becomes slower than 270 rpm or faster than 309 rpm, any write action will erase the synchronization timing marks on the disk making it useless unless the disk is reinitialized (wiping out the data that was already stored on the disk).

There are two ways to tune drive speed. You can adjust the speed using a disk speed test program, or you can adjust the speed using a standard room lamp. Both techniques require your removing the disk cover. A good way to conduct speed adjustments (and alignment of the drive mechanics) is to boot the adjustment/alignment program on a known good drive (like your test monitor, you keep one of these handy also) connected as drive A with the drive to be adjusted configured as drive B. Then you can boot the diagnostic test disk in drive A and control the out-of-tolerance drive even if it no longer will boot a disk itself.

Disk Drive Disassembly

Tools Required

Phillips head screwdriver
Flathead screwdriver
Jewelers flathead screwdriver
Protective pad
Tray to hold loose screws

1. Turn the power off to the computer.
2. Ground yourself to remove any electrostatic charge by touching the metal switch on a nearby lamp, or some other grounded surface.
3. Disassemble the computer as shown in Appendix D.
4. Disconnect the drive data cable from the rear of the drive.
5. Remove the two silver flathead screws holding the drive tight, as shown in Fig. 4-4.
6. Gently pull the drive forward about 2 inches out of the chassis.
7. Disconnect the power supply cable in the back of the analog card.
8. Pull the drive completely out of the chassis.
9. Set the drive mechanism on its side crossways on the top of the power supply.
10. Reconnect the drive cable and the power supply cable to the drive.

You are now ready to conduct drive speed adjustment.

METHOD 1—DISK SPEED PROGRAM

The test disk should have full instructions on how to perform the speed adjustment. The speed should be adjusted to 300 rpm ± 1.5 percent by rotating the 0 to 1000 ohm potentiometer R4A (R23 in some drives) on the analog card in the drive.

1. Locate the speed adjustment control potentiometer (R4A/R23) in the back middle of the drive, as shown in Fig. 4-7.

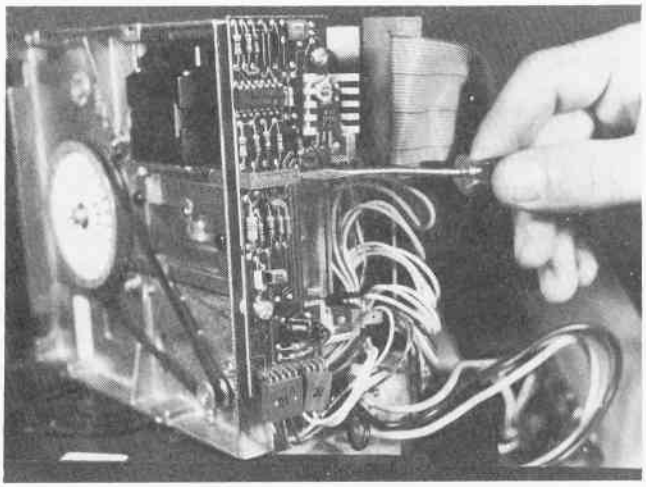

Fig. 4-7. The screwdriver is inserted in the speed adjustment potentiometer.

2. Reconnect the power cord to the computer.

Caution: Be careful not to touch inside the drive mechanism or the electronics with power on.

3. Turn on power to the computer.
4. Insert the disk containing a disk speed test program in the drive to be adjusted.
5. Close the disk drive door.
6. Boot the disk in the drive.
7. Follow the test procedures.

Most speed test programs display a graduated scale of some sort as shown by the example in Fig. 4-8. Using a jewelers screwdriver or a "tweaker" (small screwdriver), slowly turn the speed control adjustment pot screw until the speed display shows the actual rotation time as close to 300 rpm as possible–within plus or minus 6 milliseconds.

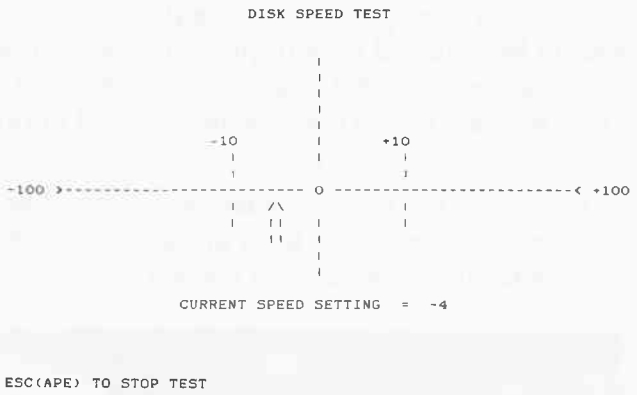

Fig. 4-8. Sample disk-speed test screen display.

8. Remove the disk.
9. Turn off the power to the IBM PC.
10. Disconnect the disk drive data cable and power supply cable from the drive mechanism.
11. Push the drive mechanism into the front of the chassis until about 2 inches of the mechanism is left exposed.
12. Reconnect the power supply cable to the back of the analog card.
13. Push the drive all the way into the chassis.
14. Reinstall the two flathead screws on the side of the drive.
15. Reconnect the disk drive data cable to the drive.
16. Turn on the computer and test operate the drive.
17. Restore the system to full operation.

METHOD 2—TUNING LAMP

The use of a tuning lamp enables speed adjustment without the need for a speed adjust program. This technique can be used if only one drive is available and it is the one in need of maintenance.

1. Disassemble the drive and set it on its side, as shown in Fig. 4-9.

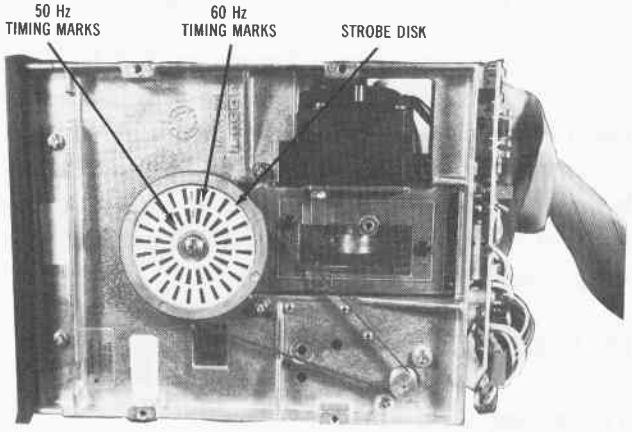

Fig. 4-9. The disk drive set on its side with the strobe wheel facing you.

2. Place a fluorescent light near the drive so the light from the lamp illuminates the speed strobe wheel on the bottom of the drive mechanism. An ordinary incandescent room lamp will work, but a fluorescent light is easier to use.
3. Locate the timing marks on the strobe disk, as shown in Fig. 4-9. The outer circle of markings is used for 60 Hz electrical systems such as are common in the United States. The inner circle of strobe markings is used with 50 Hz line power such as that found in Europe. This concept of speed adjustment is amazingly simple, and quite accurate. When you place the strobe disk in the light of fluorescent light and cause the disk to spin, you will notice that the strobe disk marks slowly rotate in one direction or another, depending on whether the disk speed is fast or slow. This action is much like the effect of movie film when stagecoach wheels seem to be ro-tating in the direction opposite the movement of the coach. The wheels are rotating at a different speed than the film is moving through the projector so you see this strange effect. The marks on the strobe

disk are spaced so they appear stationary when the speed is exactly 300 rpm.

4. With a lighted lamp near the drive, reconnect the disk data interface cable to the computer.
5. Reconnect the power supply cable to the drive in back of the analog card.
6. Power up the computer.
7. Insert a blank, nonformatted disk in the drive and close the drive door.
8. After the computer goes into BASIC, reset the system (warm boot).
9. Observe the strobe wheel as the disk spins in the drive.
10. Using a jeweler's screwdriver or a "technician's tweaker" (small screwdriver), adjust the speed control pot until the strobe disk seems to be sitting still.
11. Open the drive door and remove the disk.
12. Turn off the computer power.
13. Disconnect the disk drive data cable from the drive.
14. Disconnect the power supply cable from the back of the drive.
15. Gently push the drive mechanism into the front of the chassis until about 2 inches of the drive remains exposed.
16. Connect the power supply cable to the back of the drive analog card.
17. Gently push the drive mechanism all the way into the chassis.
18. Reinstall the two screws holding the drive into the chassis.
19. Reconnect the drive data cable to the IBM PC drive.
20. Turn on the computer and test operate the drive.
21. Restore the system to full operation.

DISK DRIVE ALIGNMENT

The alignment adjustments in the IBM drives set the positioning of the read/write head correctly over the tracks on the disk, adjust the disk stop guide, adjust the index hole sensor, or adjust the collet hub that fits in the hole in the disk. A check is also made of the head azimuth compared with the disk track. These procedures require special equipment, including a dual-trace oscilloscope, disk alignment tools, and special alignment disks. Use a Dysan Analog Alignment Diskette 224/2A containing alignment patterns and follow the procedures outlined in the following paragraphs (or described in the SAMS COMPUTERFACT CSCS2 page 43).

The most critical alignment adjustment is the read/write head alignment or tracking. Some programs require very accurate alignment of the head over the track. If the program loads fine but won't read data and the disk just spins, the drive may have tracking out of alignment.

If you have to replace the electronics analog card in the drive, readjust the tracking. Each card is tuned for the drive, and a new card could affect the head tracking.

Alignment should be checked every year. The easiest way to accomplish this is to format two disks on two different drives whose speeds have been verified to be correct. Save some programs on each disk using the same drive on which formatting was done. Read and write each disk with its drive to make sure the individual drives work satisfactorily. Then switch disks and see if each disk works properly in the alternate drive. If one drive reads correctly while the other can't find the data or reads out "garbage," you know you have alignment problems. These steps could be added to your maintenance program for each system you are responsible for.

TRACK 00 ADJUSTMENTS

Adjustment of the track 00 switch (SW2) properly positions the drive write/read head over the disk track 0. A stop screw holds the switch at a setting fixed at track 0. This switch setting rarely needs adjustment–if it does the drive will usually not read at all. If the system doesn't boot and you think that the track 0 alignment may be out of tolerance, then start by setting the radial

head alignment first. Configure a good known drive as drive A and the drive to be aligned as drive B.

To Adjust the Track 00 Switch (SW2)

Tools Required

Flathead screwdriver
Phillips head screwdriver
Protective pad
Adequate lighting
Tray to hold loose screws
Screw retaining cement

1. Turn off power to the computer.
2. Disassemble the computer using the procedures found in Appendix D.
3. Disconnect the disk drive data cable from the back of drive B.
4. Remove the two silver flathead screws holding drive B tight to the chassis, as shown in Fig. 4-4.
5. Gently pull drive B forward about 2 inches out from the front of the chassis.
6. Disconnect the power supply cable from the back of the analog card mounted in drive B.
7. Gently remove drive B from its chassis.
8. Set drive B on its side so that you can get to the adjustment screws at the back of the drive.
9. Connect the power supply cable to the back underside of the analog card.
10. Reconnect the drive data cable to drive B.
11. Insert a blank disk into drive B.
12. Insert the diagnostic disk in drive A and power up the computer.
13. Set the head on drive B to track 01. (Should be described on diagnostic program menu display.)
14. Loosen the retaining screw at the base of the track 0 switch bracket on drive B.
15. Turn the track 00 switch adjustment screw all the way counterclockwise.
16. Turn the screw back in a clockwise direction listening for the switch to click.
17. When the switch clicks, turn the screw clockwise one-half turn more and retighten the bracket screw.
18. Turn off power to the system.
19. Disconnect all cables to the drive.
20. Carefully push the drive mechanism back into the chassis until about 2 inches of the drive housing is still exposed.
21. Connect the power supply cable to the back underside of the analog card on drive B.
22. Push the drive all the way into the chassis housing.
23. Replace the two silver flathead screws on the sides of the drive, as shown in Fig. 4-4.
24. Reconnect the drive data cable to drive B.
25. Power up the computer.
26. Place a *copy* of a program disk in the drive, close the drive door and verify correct operation.

To Set the Track 00 Stop Adjustment Screw

Tools Required

2 channel scope
Flathead screwdriver
Phillips head screwdriver
Protective pad
Adequate lighting
Tray to hold loose screws
Test diskette
Alignment diskette

1. Turn off power to the computer.

   If the computer is not disassembled for maintenance, do the next step; otherwise, go to step 3.
2. Disassemble the computer using the procedures found in Appendix D.

3. Disconnect the disk drive cable from the back of drive B.
4. Remove the two silver flathead screws holding the drive tight to the chassis, as shown in Fig. 4-4.
5. Gently pull the drive forward about 2 inches out from the front of the chassis.
6. Disconnect the power supply cable from the back of the analog card.
7. Gently remove drive B from its chassis.
8. Set the drive on its side so that you can get to the adjustment screws at the back of the drive.
9. Connect the power supply cable to the back underside of the analog card.
10. Reconnect the drive data cable to drive B.
11. Connect scope channel A to TP1 on the analog card.
12. Set the sweep time to 10 microseconds and the voltage per division to 0.5 volt. Trigger on channel A.
13. Insert your alignment diskette in drive B.
14. Power up the computer.
15. Boot the diagnostic test disk in drive A.
16. Set the head on drive B to track 00. You should see a 0.6 volt, 125 kHz signal on the scope.
17. Turn the track 00 stop adjustment screw in a clockwise direction until the signal starts to decrease, then turn the screw one-half turn in a counterclockwise direction.
18. Cement the screw in this setting so it doesn't move during normal operating vibrations. (Some technicians use typewriter correction fluid, others use the green-colored cement to prevent the screw from vibrating out of its setting.)
19. Turn off power to the system.
20. Disconnect all cables to the drive.
21. Carefully push the drive mechanism back into the chassis until about 2 inches of the drive housing is still exposed.
22. Connect the power supply cable to the back underside of the analog card.
23. Push the drive all the way into the chassis housing.
24. Replace the two silver flathead screws on the sides of the drive, as shown in Fig. 4-4.
25. Reconnect the drive data cable to drive B.
26. Power-up the computer.
27. Place a *copy* of a program disk in the drive and operate the system to verify correct drive operation.

RADIAL HEAD ALIGNMENT (TRACKING)

The most critical of the tracking adjustments is radial head tracking alignment. Some commercial programs require very accurate tracking in order to read the program and data stored on the disk. This is especially true for programs that have been protected by writing the program in half and quarter track areas of the diskette.

A drive that loads a program from the disk into the system board RAM, but won't read data from tracks on the disk, or that causes the read head to move to the home position several times in the middle of a disk read operation, producing a BDOS error, probably has a tracking problem. The tracking alignment should always be checked after a replacement analog card is mounted on the drive.

To check the alignment of the read/write head, insert the alignment diskette into the drive and set the head to track 16. Connect channel A of your scope to TP1, channel B to TP2, and the external trigger to TP7. Connect the scope's ground to TP6. Set the scope to *add* mode with channel B inverted. Set the sweep time to 20 milliseconds. Set the trigger to positive slope with the voltage input set to 0.2 volt. A "cats-eye" pattern shown in Fig. 4-10 should be displayed on the screen of the scope. Using the technique described below, adjust the radial head alignment screw so the two lobes are as close to equal size as possible but not so one is less than 80 percent of the other.

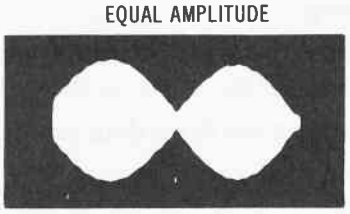

Fig. 4-10. The "cats-eye" screen display.

To Adjust the Radial Head

Tools Required

2 channel scope
Flathead screwdriver
Phillips head screwdriver
Protective pad
Adequate lighting
Tray to hold loose screws
Test diskette
Alignment diskette

1. Turn off power to the computer.
2. Disassemble the computer using the procedures found in Appendix D.
3. Configure the system so the drive to be aligned is set as drive B.
4. Disconnect the disk drive data cable from the back of drive B.
5. Remove the two silver flathead screws holding drive B tight to the chassis, as shown in Fig. 4-4.
6. Gently pull drive B forward about 2 inches out from the front of the chassis.
7. Disconnect the power supply cable from the back of the analog card mounted in drive B.
8. Gently remove drive B out of its chassis.
9. Set drive B on its side so that you can get to the radial head module on the bottom of the drive and connect the scope probes so you can monitor the lobes on the scope.
10. Connect the power supply cable to the back underside of the analog card.
11. Reconnect the disk drive data cable to drive B.
12. Insert the alignment disk in drive B.
13. Boot the test disk in drive A.
14. Set the head on drive B to track 16.
15. Observe the cats-eye pattern for suitability. If the lobes are not within 80 percent of the size of each other, loosen the two head module retaining screws on the bottom of drive B and the one screw on the top next to the radial head alignment screw (see photo on COMPUTERFACTS page 43).
16. Turn the radial head alignment screw until the lobes are as close to equal as possible.
17. Retighten the three retaining screws.

> Note: Reading how to do this is a lot easier than actually doing it. You need plenty of patience and the steady hands of a surgeon. A slight movement of the module can cause a large change in the size of one of the lobes. Even when retightening the retaining screws, the module has a tendency to shift pulling the alignment out of spec again. Go slowly and be patient.

18. After successfully adjusting the lobes, move the head to track 40, back to track 16, then to track 0 and back to track 16 to make sure the lobe pattern remains within specifications when the head is on track 16.
19. Turn off power to the system.
20. Disconnect all cables to the drive.
21. Carefully push the drive mechanism back into the chassis until about 2 inches of the drive housing is still exposed.
22. Connect the power supply cable to the back underside of the analog card.
23. Push the drive all the way into the chassis housing.
24. Replace the two silver flathead screws on the sides of the drive, as shown in Fig. 4-4.
25. Reconnect the drive data cable to drive B.

26. Power up the computer.
27. Place a *copy* of a program disk in the drive and verify normal write and read operation.
28. Return the drive to service.

INDEX SENSOR ADJUSTMENT

The index sensor is another adjustment that is rarely needed, but if you think this is out of alignment, check its adjustment by connecting the scope channel A to TP3, channel B to TP7, and the ground to TP6. Set the scope's time sweep to 50 microseconds per division and the amplitude to 20 millivolts per division. Set the trigger to channel B (noninverted) on the positive slope. Set the head to track 01 using your test disk and then insert the alignment diskette. Check that the leading edge of the burst occurs 150 to 250 microseconds (best case is 200 microseconds) after the leading edge of the index pulse (Fig. 4-11). If the sensor needs adjustment, take the following actions:

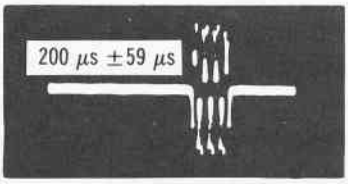

Fig. 4-11. The burst should occur 150 to 250 microseconds after the index pulse.

Tools Required

2 channel scope
Flathead screwdriver
Phillips head screwdriver
Protective pad
Adequate lighting
Tray to hold loose screws
Test diskette
Alignment diskette

1. Turn off power to the computer.
2. Disassemble the computer using the procedures found in Appendix D.
3. Disconnect the disk drive cable from the back of drive B.
4. Remove the two silver flathead screws holding the drive tight to its chassis, as shown in Fig. 4-4.
5. Gently pull the drive forward about 2 inches out from the front of the chassis.
6. Disconnect the power supply cable from the back of the analog card.
7. Gently remove the drive from the chassis.
8. Set the drive on its side so that you can get to the index sensor screw on the bottom of the drive and see the amplitude bursts on the scope.
9. Connect the power supply cable to the back underside of the analog card.
10. Reconnect the drive data cable to drive B.
11. Insert the alignment disk in drive B.
12. Boot the test disk in drive A.
13. Set the head on drive B to track 01.
14. Connect the scope as described in the introductory paragraphs of this section.
15. You should see the same amplitude bursts on the scope that you saw when checking the index sensor setting.
16. Loosen the index sensor retaining screw on the bottom of drive B.
17. Using a flathead screwdriver in the slots on the drive chassis and the sensor (see COMPUTERFACTS page 43), adjust the index sensor until the scope presentation is within specifications (see Fig. 4-11).
18. Retighten the index sensor retaining screw.
19. Turn off power to the system.
20. Disconnect all cables to the drive.
21. Carefully push the drive mechanism back into the chassis until about 2 inches of the drive housing is still exposed.
22. Connect the power supply cable to the back underside of the analog card.

23. Push the drive all the way into the chassis housing.
24. Replace the two silver flathead screws on the sides of the drive, as shown in Fig. 4-4.
25. Reconnect the drive data cable to drive B.
26. Power up the computer.
27. Place a *copy* of a program disk in the drive. Run the system to verify correct operation.

AZIMUTH CHECK

This check verifies the positioning of the head itself. If the azimuth positioning is incorrect, it cannot be adjusted. If this check fails, then the head assembly must be replaced.

To make this check, connect scope channel A to TP1 and channel B to TP2. Connect the external trigger to TP7 and the scope ground to TP6. Set the scope to *add* mode with channel B inverted. The scope sweep time should be set to 0.5 millisecond per division; the voltage amplitude should be set to 0.1 volt per division. Trigger on channel A positive slope. Set the head to track 34 and insert the alignment disk. You should see a pattern like that in Fig. 4-12. If the first and last bursts are not equal to or less than the two middle bursts, the head is bad and should be replaced.

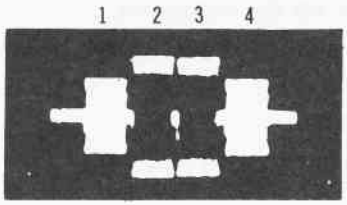

Fig. 4-12. Bursts 1 and 4 should be equal to or less than bursts 2 and 3.

This completes all the preliminary checks that you can conduct on the system before attempting detail troubleshooting checks have been completed, you should proceed to Chapter 5 to trace the failure symptom to a particular area and component. The checks in this chapter are usually enough to find and correct most system failures. Also, by conducting these checks you can eliminate the alignments in this chapter as the problem and use every check that was made as a clue to the failure itself. If the drive still won't read after you successfully completed all the drive checks, you know that the circuitry you checked is not the cause of the problem. Knowing this can lead to other areas not affected by these tests. These areas can then be analyzed to locate the actual cause of the failure. This chapter covered every aspect of preliminary service checks. In Chapter 5, the detailed troubleshooting steps are outlined and described in both classical and flowchart techniques.