



IBM System 9000

Troubleshooting and Servicing the IBM 9001 Benchtop Computer



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This manual applies to the IBM System 9001 Benchtop Computer and replaces the Computer System Problem Isolation Manual, GC22-9192.

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Note on IBM System 9000 Diagnostics

Error messages displayed on the screen during power-on diagnostics direct the user to a section in IBM System 9000 Problem Isolation. That manual has been replaced by Troubleshooting and Servicing the IBM 9001 Benchtop Computer, GC22-9338.

The list below cross-references sections in the problem isolation manual to the corresponding sections in the troubleshooting-and-servicing manual. However, before proceeding to the section indicated, you should first review Section 2.2 of the new manual.

PROBLEM ISOLATION	TROUBLESHOOTING AND SERVICING
Section 2.5	Section 2.5
Section 2.6	Section 2.4
Section 2.7	Section 2.8
Section 2.8	Section 2.6, 2.10
Section 2.9	Section 3.11
Section 2.10	Section 2.3
Section 2.11	Section 3.12
Section 2.12	Section 2.11
Section 2.13	Section 2.9

Note: The new manual describes potential faults in the order in which they would be detected during normal operation. If this information does not enable you to resolve the problem, return to page 2-1 of the new manual and proceed from there.

PREFACE

This Publication contains Troubleshooting and Servicing information for users of the IBM 9001 Desktop Computer System. It consists of 5 Chapters.

Chapter 1 -- "Introduction" -- contains a brief explanation of the contents of the manual.

Chapter 2 -- "Fault Detection" -- contains operations and observations that you can perform to determine where a fault is occurring in the IBM 9001.

Chapter 3 -- "Optional Diagnostic, Voltage and Resistance Checks" -- contains further optional checks that you may perform to isolate problems in the IBM 9001.

Chapter 4 -- "Cable Checks" -- contains information that can assist you to check the replaceable cables of the IBM 9001.

Chapter 5 -- "Removal and Replacement Procedures" -- contains detailed information for the removal and replacement of all Customer Replaceable Units (CRUs).

Related Publications:

Computer System Operator's Manual, GC22-9186

Computer System Customer Setup Manual, GC22-9193

Installing and Naming Disk Drives Manual, GC22-9265

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SAFETY PRACTICES

All service representatives are expected to take every safety precaution possible while maintaining IBM Instruments Inc. equipment. Observe the following safety practices at all times:

Never work alone under hazardous conditions or around equipment with dangerous voltage.

Disconnect the instrument line cord from the outlet when:

- Removing or assembling major components
- Working in the immediate area of power supplies
- Performing mechanical inspections of power supplies
- Installing changes in instrument circuitry

When it is absolutely necessary to work on equipment having exposed operating mechanical parts or exposed live electrical circuitry anywhere in the instrument, the following precautions must be followed:

- Another person familiar with power off controls must be in the immediate vicinity.
- Rings, wristwatches, chains, bracelets, and metal cuff links must not be worn.
- Use insulated pliers and screwdrivers exclusively.
- Use one hand whenever possible. Avoid leaning on or over the frame or cabinet and contacting grounded supports.
- When using test instruments, be certain that all controls are set correctly and that insulated probes are used.
- Functional subassemblies, power supplies, etc. should never be powered on when they are physically separated or removed from the instrument housing unless service procedures specifically indicate this technique. When this technique is used it, is essential that you be certain that the removed assembly remains grounded to the instrument and that defeated covers and interlocks and rerouted cables do not create a safety hazard.

-
- Avoid contacting ground potential (metal floor strips, machine frames, etc. -- use suitable rubber mats purchased locally if necessary).

Safety Glasses must be worn when you are:

- Using a hammer for driving pins, riveting, staking, etc.
- Power hand drilling, reaming, grinding, etc.
- Using spring hooks, attaching springs
- Soldering, wire cutting, removing steel bands
- Parts cleaning, using solvents, sprays, cleaners, chemicals, etc.
- Servicing energized instruments
- Doing anything that may be hazardous to your eyes. REMEMBER, YOUR EYES ARE IRREPLACEABLE.

Special safety instructions for handling cathode ray tubes and extremely high voltages must be followed as outlined in OEMs and the safety section of the appropriate maintenance manuals.

- Do not lift any load that compromises your safety or the safety of others. When in doubt, consult with local management.
- All safety devices such as guards, shields, signs, groundwires, etc. must be restored after maintenance.
- Place removed machine covers in a safe, out-of-the-way place where no one can trip over them.
- All machine covers must be in place before machines are returned to the customer.
- Always place CE tool kits out of the way of office traffic. Keep them away from walking lanes or intersections. Place them under a desk or table, for example.
- Maintain good housekeeping around machines while working and after completing maintenance.
- Avoid touching mechanical moving parts (that is, when lubricating, checking for play, etc.).
- Replace worn or broken tools and test equipment.

1.0 INTRODUCTION

This manual helps you isolate malfunctions in an IBM 9001 Benchtop Computer to a customer-replaceable unit (CRU). It also provides removal and replacement procedures so you can exchange a failing CRU.

The manual is organized so that faults are described in the order that they are detected during normal operation of the IBM 9001. Operator observations and diagnostic routines are used to isolate faulty CRUs. For trained service personnel, optional checks are provided some of which require a high-impedance (at least 40,000 ohms/volt) volt ohm multimeter (VOM). The VOM is used to determine which CRU is at fault when the diagnostic routines are only capable of narrowing the problem to two CRUs.

2.0 FAULT DETECTION

2.1 SCOPE

This chapter covers operations and observations that you can perform to determine where a fault is occurring in the IBM 9001. Section 2.2, "Computer Startup" assists you in determining the causes of faults that occur during the computer startup. Section 2.3, "Automatic Diagnostic Testing" helps you isolate a malfunctioning CRU from the results of the automatic diagnostic testing. The remaining sections cover faults that may not be indicated during these initial stages of operation. If Sections 2.2 and 2.3 do not isolate the cause of your system's problem, refer to the section that covers the particular device. For example, the keyboard, on which the fault is indicated or a malfunction appears.

In many cases, observation is sufficient to determine the CRU to be replaced. In other cases, you are referred to optional checks in other sections of the manual. When a fault is detected and isolated to a CRU, refer to Chapter 5, "Removal and Replacement Procedures."

2.2 COMPUTER STARTUP

Prior to powering on the IBM 9001, inspect it to ensure that all cables are connected, all fuses are in good order, and the ROM plug-in drawer is seated properly. See Figure 5-12.

When you power on the IBM 9001, you should observe these three fairly distinct sets of events (most events within a set occur simultaneously):

<u>Set 1</u>	<u>Set 2</u>	<u>Set 3</u>
Fans start	"Beep" stops	Quick "beep" is heard
"Beep" is heard	Online LED goes out	Printer justifies to left
Online LED lights	Keypad LEDs flash	Test Complete LED lights
Printer justifies left	Test results displayed	CRT flashes RAM size
Ribbon shifts		CRT displays CSOS label
Power Supply LEDs light		

To power ON:

- Set the Online/Offline/Form Set switch on the keypad to Offline.
- Set the Power switch on the computer to ON.

Now observe these events listed. If any event (or events) do not occur, use this chart to determine what procedure to follow to correct the problem. Use the number at the bottom of each column in the Symptom chart to reference the Cause/Solution. When two numbers are listed, the Cause/Solution may be either one. The order of the cause/solution numbers does not signify an order of probability. Where more than one cause/solution is shown, the one(s) that are easiest to perform should be done first. Where necessary, refer to optional checks in other sections of the manual to narrow the fault to one CRU.

SYMPTOM(S)

Fans fail to start	•		•																	
"Beep" is not heard	•		•																	
Power LED fails to light	•			•		•														
Online LED fails to light	•				•	•														
Printer does not left justify							•	•												
"Beep" does not stop										•										
Online LED does not go out										•										
Keypad LEDs do not flash											•									
CRT fails to display results of automatic testing												•		•						
Quick "beep" not heard				•																
Printer does not left justify							•													
Test Complete LED fails to light																			•	
CRT does not flash RAM size																				•
CRT fails to display operating system label														•				•		
	1							5				8		8	10					
	2	3	4	5	5	6	7	8	11	8	9	11	8	8	12					

CAUSE/SOLUTION

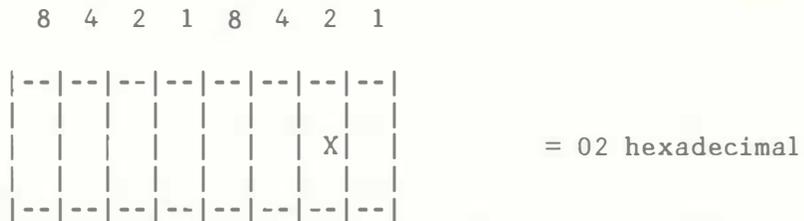
- 1 Lack of power. Check to see that power is available, that the power cord is attached, and that the processor unit fuse is not blown. See Figure 5-1.
- 2 Possible power cord defect or defective power switch. See Section 3.2, "Power Cord Check" and Section 3.3, "Power Switch Check."
- 3 Possible cabling defect or defective fan. See Chapter 4, "Cable Checks." Replace the fan assembly or return the processor unit to IBM for repair.
- 4 Defective beeper. Replace the keypad.
- 5 Possible defective vertical board assembly, defective wiring or P500 cabling. See Section 3.4, "Vertical Board Check" and Chapter 4, "Cable Checks."
- 6 Power supply failure. See Section 3.5, "Power Supply Check."
- 7 Possible printer malfunction or defective printer/plotter control board. See Section 2.10, "Printer/Plotter Problems," Section 2.6, "Printer/Plotter Control Problems," and Section 3.13, "Printer/Plotter Self Test."
- 8 Perform feature loading check. Replace the feature board if it is malfunctioning. If it is not, replace the planar board. See Section 3.11.2, "Feature Board Loading Check."
- 9 Possible keypad defect or an automatic diagnostic test failed. See Section 2.5, "Keypad and Softkey Problems" and Section 2.3, "Automatic Diagnostic Testing."
- 10 Possible CRT display unit failure or defective cable. See Section 2.7, "CRT Display Problems" and Chapter 4, "Cable Checks."
- 11 Defective planar board or defective Memory Management Unit (MMU) board if so equipped. Observe the yellow LED on the MMU board through the opening in the processor unit back plate. See Figure 5-1. If the yellow LED is on, replace the MMU interface assembly and the planar board. If the yellow LED is off, replace the MMU board and the MMU interface assembly. If the LED is flashing, replace the planar board, the MMU board, and the MMU interface assembly. Return the processor unit to IBM for repair.

Note: If a test 6 error occurs and a MMU board and/or a Planar board requires replacement, the interface assembly should also be replaced.

- 12 Incorrect memory capacity or defective memory expansion board. Replace the memory expansion board. The following chart lists switch settings for the memory boards.

Memory Boards P/N 6636289 through 6636292

Switch bank 1 is used to set the starting address of the board. This is done by entering the actual starting address as a hexadecimal number. Therefore, a starting address of 20000 is entered as 20000-1 or IFFFF. Since switch 1 of bank 1 represents address bit 16 and switch 2 of bank 1 represents bit 17, a value of hexadecimal 02 is set as:



ADDRESS	2	2	2	2	1	1	1	1
BITS	3	2	1	0	9	8	7	6

X indicates that the switch is set to the open position.

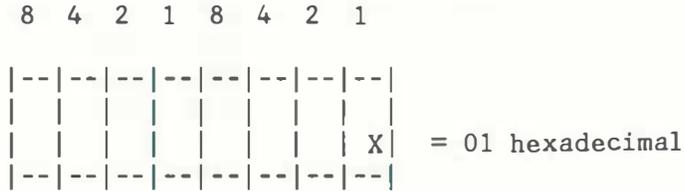
To set a bit on, the appropriate switch must be set to the open position as shown here. Switch bank 2 is used to set the ending address on the board. This is done by entering the actual ending address plus one. The chart that follows shows the switch settings for different amounts of memory installed on each board.

MEMORY BOARD SWITCH SETTINGS

	SWITCH BANK 1		SWITCH BANK 2		MEMORY SIZE	
	8765	4321	8765	4321		
START ADDRESS FIRST BOARD	0000	0010	0000	0101	256K	1=OPEN 0=CLOSED
			0000	1001	512K	
			0000	1101	768K	
			0001	0001	1.00M	
START ADDRESS SECOND BOARD	0001	0010	0001	0101	1.25M	
			0001	1001	1.50M	
			0001	1101	1.75M	
			0010	0001	2.00M	
START ADDRESS THIRD BOARD	0010	0010	0010	0101	2.25M	
			0010	1001	2.50M	
			0010	1101	2.75M	
			0011	0001	3.00M	
START ADDRESS FOURTH BOARD	0011	0010	0011	0101	3.25M	
			0011	1001	3.50M	
			0011	1101	3.75M	
			0100	0001	4.00M	
START ADDRESS FIFTH BOARD	0100	0010	0100	0101	4.25M	
			0100	1001	4.50M	
			0100	1101	4.75M	
			0101	0001	5.00M	

Memory Boards P/N 6404313 through 6404316

Switch bank 1 is used to set the starting address of the board. This is done by entering the actual starting address minus one as a hexadecimal number. Therefore, a starting address of 20000 is entered as 20000-1 or 1FFFF. Since switch 1 of bank 1 represents address bit 16 and switch 2 of bank 1 represents bit 17, a value of hexadecimal 01 is set as:



ADDRESS	2	2	2	2	1	1	1	1
BITS	3	2	1	0	9	8	7	6

X indicates that the switch is set to the open position.

To set a bit on, the appropriate switch must be set to the open position as shown here. Switch bank 2 is used to set the ending address on the board. This is done by entering the actual ending address plus one. The chart that follows shows the switch settings for different amounts of memory installed on each board.

MEMORY BOARD SWITCH SETTINGS

	SWITCH BANK 1		SWITCH BANK 2		MEMORY SIZE	
	8765	4321	8765	4321		
START ADDRESS FIRST BOARD	0000	0001	0000	0110	256K	
			0000	1010	512K	
			0000	1110	768K	
			0001	0010	1.00M	
START ADDRESS SECOND BOARD	0001	0001	0001	0110	1.25M	1= OPEN 2= CLOSED
			0001	1010	1.50M	
			0001	1110	1.75M	
			0010	0010	2.00M	
START ADDRESS THIRD BOARD	0010	0001	0010	0110	2.25M	
			0010	1010	2.50M	
			0010	1110	2.75M	
			0011	0010	3.00M	
START ADDRESS FOURTH BOARD	0011	0001	0011	0110	3.25M	
			0011	1010	3.50M	
			0011	1110	3.75M	
			0100	0010	4.00M	
START ADDRESS FIFTH BOARD	0100	0001	0100	0110	4.25M	
			0100	1010	4.50M	
			0100	1110	4.75M	
			0101	0010	5.00M	

2.3 AUTOMATIC DIAGNOSTIC TESTING

The IBM 9001 performs automatic diagnostic testing each time the power is turned ON. Failure of one of the automatic diagnostic tests is usually the first indication of a fault in the system. When an automatic diagnostic test fails, the test number is displayed in the message "TEST N SUBTEST M FAILED" or "TEST N SUBTEST M," and the test does not complete. Table 1 lists the tests that are performed and either indicates which CRU you need to replace or refers to a more detailed section of the manual where you may perform further fault isolation.

If Table 1 calls for a retest of an automatic diagnostic test, reset the IBM 9001 by turning the Power switch to OFF and back to ON. The automatic diagnostic tests begin again.

Test numbers are shown on the CRT while automatic diagnostic testing is being performed. The second (least significant) digit of each test number is shown in binary form on the test number LEDs on the keypad. See Figure 2-1. A Test Complete LED lights on the keypad when the last automatic diagnostic test has been completed. See Figure 3-2.

Test #	Faulty CRU
01	Planar board
02	Planar board
03	Planar board
04	Remove memory board and repeat test 4. If retest passes, replace memory board. If retest fails, replace planar board.
05	Planar board
06	Defective planar board or defective MMU board (if so equipped). Observe the yellow LED on the MMU board through the opening in the processor unit back plate. See Figure 5-1. If the yellow LED is on, replace the MMU interface assembly and the planar board. If the yellow LED is off, replace the MMU board and the MMU interface assembly. If the LED is flashing, replace the planar board, the MMU board, and the MMU interface assembly. Return the processor unit to IBM for repair.
07	Remove memory board and repeat test 7. If retest passes, replace memory board. If retest fails, replace planar board.
08	Planar board
09	Planar board
0A	Planar board
0B	Planar board
0C	Planar board
0D	Planar board
0E	Planar board
0F	Planar board
10	Planar board
11	Planar board
12	Planar board
14	Planar board
18	Refer to Section 2.10, "Printer/Plotter Problems" for isolation of printer faults.
30	Remove sensor I/O board and repeat test 30. If retest passes, replace memory board. If retest fails, replace planar board.
97	Planar board
98	Refer to Section 2.7, "CRT Display Problems" to isolate the fault to the planar board or to the CRT display unit.

Table 1. Automatic Diagnostic Tests -- Faulty CRUs

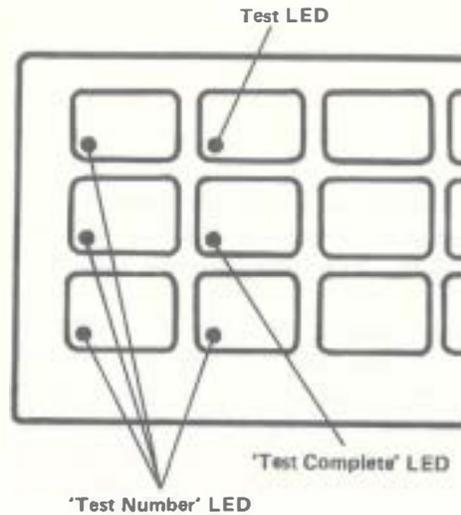


Figure 2-1. Keypad

2.4 KEYBOARD PROBLEMS

Keyboard problems may result from malfunctions in the keyboard, its interconnecting cable, or the planar board. Keys that are "dead" or "sticky" or that produce wrong characters indicate that you need to replace the keyboard and its interconnecting cable. When the D and G keys both produce the letter D, the planar board is faulty and needs replacing. A totally "dead" keyboard could be the result of either a faulty keyboard or planar board.

To test if each key on the keyboard is operating properly, a keyboard "echo" test is provided in the system as test 1A. You may call for test 1A on the keyboard or on the keypad assembly. See Section 3.6.1, "Keyboard Echo Test -- Test 1A." After the echo test is called, each key on the keyboard as it is pressed and released should produce the same codes on the CRT as are found in Figure 3-3. An optional voltage check can distinguish between a "dead" keyboard and a malfunctioning planar board. See Section 3.6.2, "Voltage Check."

2.5 KEYPAD AND SOFTKEY PROBLEMS

Keypad or softkey problems may result from malfunctions in the keypad, its interconnecting cable, the softkeys, the CRT display unit, the CRT's interconnecting cables, or the planar board. Keys that are intermittent or "dead" or that produce wrong characters indicate that you need to replace the keypad or softkeys and the interconnecting cables. A softkey fault requires replacement of the CRT display unit. A totally "dead" keypad and softkeys is probably due to a malfunction in the planar board but can be simultaneous failures in both CRUs. An optional softkey resistance check can distinguish between a "dead" softkey assembly and a malfunctioning planar board. See Section 3.7.2, "Softkey Resistance Check."

To test if each key of the keypad and CRT is operating properly, a keypad and softkey "echo" test is provided in the system as test 19. You may call for test 19 on the keypad and softkeys or on the keyboard. See Section 3.7.1, "Keypad and Softkey Echo Test -- Test 19." After the echo test is called, each key on the keypad and softkey assembly as it is pressed and released should produce the same codes on the CRT as are found in Figure 3-4.

2.6 PRINTER/PLOTTER CONTROL PROBLEMS

Printer/plotter control problems including malfunctioning of the Online/OffLine/Form Set, Line Feed/Form Feed, and Self Test switches and the Power, Fault, and Online LEDs. These problems may be due to malfunctions in the vertical board part of the printer/plotter cover assembly, in the cable that connects the vertical board to the processor unit, or in the planar board or printer controller board.

Use the symptoms listed in the following chart to isolate a fault to one or more CRUs. Where necessary, you are referred to optional checks in other sections of the manual to narrow the fault to one CRU. Use the number at the bottom of each column in the Symptom chart to reference the Cause/Solution. Where more than one number is listed, the Cause/Solution may be any one. The bullets in the chart signify that the symptom listed is true.

SYMPTOM(S)

Power lamp does not light
 Power lamp flashes
 Fault lamp stays lit
 Fault lamp flashes
 Online lamp does not light
 Online lamp flashes
 Line Feed/Form Feed switch
 does not function
 Self Test switch does
 not function

•						
			•			
	•					
			•			
		•				
			•			
				•		
					•	
						•
	1	3	1	5	1	1
		4	2	2	2	2
		6	6		5	5

CAUSE/SOLUTION

- 1 Vertical board malfunction. See Section 3.4, "Vertical Board Check."
- 2 Defective vertical board cable. See Chapter 4, "Cable Checks."
- 3 Planar board malfunction. Replace the planar board.
- 4 Defective paper sensor (part of the printer/plotter). See Section 2.6, "Printer/Plotter Control Problems" and Section 2.10, "Printer/Plotter Problems."
- 5 Printer/plotter control board malfunction. Replace the printer/plotter control boards.
- 6 Printer/plotter may be out of paper.

2.7 CRT DISPLAY PROBLEMS

CRT display problems are revealed through distorted, faulty, or missing video. These problems may be caused by faults in the CRT display unit, in the interconnecting cable, in the planar board, in the power supply, or in the printer/plotter control board. Electromagnetic fields in the environment may be responsible for some display problems also.

This chart lists possible CRT display problems, identifies one or more CRUs capable of causing the problem, and informs you of what corrective action you need to take. Where the problem is isolated to more than one CRU, references to optional checks are given to further narrow the fault to one CRU.

Problem	CRU -- Corrective Action
No video, screen dark	Power supply, feature board, printer/plotter control board, CRT display unit, planar board, cabling -- Set brightness control clockwise. If raster appears, go to "No video with raster." If not, check +12V light ON power supply. If OFF, replace power supply. If ON, perform test 16. See Section 3.9, "CRT Controller Test -- Test 16." If test passes, replace CRT display unit. If test fails, perform the feature board loading check. See Section 3.11.2, "Feature Board Loading Check." Replace feature board if malfunctioning. If not, check printer/plotter control board wiring and CRT display cabling. Replace if defective. If not, replace planar board. See Chapter 4, "Cable Checks."
No video, with raster	CRT display unit, printer/plotter control board, cabling -- Perform test 16. See Section 3.9, "CRT Controller Test -- Test 16." If test fails, check printer/plotter control board wiring and CRT display cabling. See Chapter 4, "Cable Checks." Replace if defective. If test passes, replace CRT display unit.

Blooming video	CRT display unit -- replace
Double image	CRT display unit -- replace
Fluttering or shifting image	Resulting from alternating magnetic field caused by rotating machinery or power lines. Move or shield the CRT.
Flickering screen or intermittent image	Loose connection, CRT display unit, planar board -- Check that connections are tight. If problem persists, perform test 16. See Section 3.9, "CRT Controller Test -- Test 16." If test fails, replace planar board. If test passes, replace CRT display unit.
Fuzzy or out-of-focus image	CRT display unit -- Replace
Missing or broken characters	CRT display unit, planar board -- print screen. If print copy has missing or broken characters, replace planar board. If not, replace CRT display unit.
Roll or tear	CRT display unit, planar board -- Perform test 16. See Section 3.9, "CRT Controller Test -- Test 16." If test passes, replace CRT display unit. If test fails, replace planar board.
Too bright, no brightness control	CRT display unit -- replace
Vertical lines on screen	Planar board, CRT display unit, feature board -- Perform test 16. See Section 3.9, "CRT Controller Test -- Test 16." If test passes, replace CRT display unit. If test fails, perform feature board loading check. See Section 3.11.2, "Feature Board Loading Check." Replace feature board if malfunctioning. If not, replace planar board.
Vertical lines on character	Planar board -- replace
Single line of numbers	Planar board -- replace
Smeared or multiple image	Planar board -- replace

1/2 of screen vertical green
bands, other half dots

Feature board, planar board --
perform feature board loading check.
See Section 3.11.2, "Feature Board
Loading Check." Replace feature board
if malfunctioning. If not, replace
planar board.

Unreadable characters

CRT display unit, planar board -- Print
screen. If print copy has unreadable
characters, replace planar board. If
not, replace CRT display unit.

Screen displays "garbage"

CRT display unit, planar board, MMU
board -- If MMU board is installed,
check yellow LED on the MMU board. If
LED is off, replace MMU board. If LED
is on or flashing or if no MMU board
is installed, print screen and perform
test 16. See Section 3.9, "CRT Con-
troller Test -- Test 16. If test
fails, replace planar board. If test
passes and print copy is readable,
replace CRT display unit. If test
passes and print copy is "garbage",
replace planar board.

2.8 DISKETTE PROBLEMS

Both 5¼" and 8" diskette problems are indicated through error messages on the CRT when a diskette is addressed or are indicated by mechanical faults during the diskette drive operation. Since the diskette drives are controlled by the planar board in response to the programmed data, diskette problems may be caused by a fault in the diskette drive in the diskette drive assembly in the processor unit or in the software or data.

If you are continuously receiving error messages with the 5¼" and 8" diskettes as well as hard disks, the fault may be in the P3-P800 cable. See Figure 5-35. If your system is equipped with disk or diskette assemblies, disconnecting the P3-P800 cable may allow them to function. If so, you need to have the cable replaced. The cable also has an optional check. See Chapter 4, "Cable Checks." If the P3-P800 cable should need replacing, the system has to be returned to IBM for repair. The cable is not a customer-replaceable unit. Section 2.8.1, "Mechanical Faults" covers possible mechanical problems involving the diskette, and Section 2.8.2, "Failure To Function" addresses possible nonmechanical diskette problems.

2.8.1 MECHANICAL FAULTS

Diskette mechanical faults occur on the diskette itself or on the diskette drive. Use the symptoms listed in the following chart to isolate a fault to one or more CRUs. Where necessary, you are referred to optional checks in other Sections of the manual to narrow the fault to one CRU. Use the number at the bottom of each column in the Symptom chart to reference the Cause/Solution. The bullets in the chart signify that the symptom listed is true.

SYMPTOM(S)

Damaged diskette
Diskette drive door will not open
Diskette drive is not turning
Fans are not running

•				
	•			
		•	•	
		•		•
--	--	--	--	--
1	2	3	4	5

CAUSE/SOLUTION

- 1 Defective diskette or malfunctioning diskette drive. Try another diskette. If damaged again, replace diskette drive.
- 2 Malfunctioning planar board or malfunctioning diskette drive. Unplug drive. If drive door opens, replace planar board. If not, replace diskette drive.
- 3 Lack of power or defective diskette drive assembly. Check for defective fuse. Check for defective base. Check for presence of diskette drive power. See Chapter 4, "Cable Checks." If power is present, replace diskette drive assembly.
- 4 Defective diskette drive or diskette drive assembly. See Section 3.8, "Diskette and Disk Checks."
- 5 Defective diskette drive assembly. Replace diskette drive assembly.

Note: Make certain of switch drive settings, see IBM Installing and Naming Disk Drives Manual, GC22-9265.

2.8.2 FAILURE TO FUNCTION

When a diskette drive fails in operation, type SET EC=Y and press the return key on the keyboard. Enter DIR *: (the asterisk must be the failed disk drive number. This causes the appropriate failure codes to be displayed on the CRT.

Failure Code	CRU	Corrective Action
\$000A	Device (diskette drive) not ready	Check drive assembly power switch, power cord, and fuse. Repeat command. If fault persists, replace diskette drive assembly.
\$0010	Diskette Planar board	Diskette damaged or improperly formatted. Replace diskette. Replace planar board.
\$0011	Diskette Data	Diskette damaged or improperly formatted. Replace diskette. Check data and commands, repeat instruction.
\$0012	Diskette Diskette drive or planar board	Diskette was changed during operation. Perform optional check. See Section 3.8, "Diskette and Disk Checks."
\$0014	Diskette drive or planar board	Perform optional check. See Section 3.8, "Diskette and Disk Checks."
\$0016	Software error	Buffer address crossed 64K boundary. System limitation.
\$0017	Diskette	Diskette improperly formatted. Reformat diskette.
\$0018	Diskette	Diskette is write-protected.
\$0019	Software error	Buffer transfer length is smaller than diskette section size.
\$001B	Planar board	CRC value does not match data value. Replace planar board.

\$001C	Diskette or planar board	Bad format or damaged diskette. Try another diskette. If error persists, perform optional check. See Section 3.8, "Diskette and Disk Checks."
\$001F	Software error	Volume identifier incorrect.

2.9 HARD DISK PROBLEMS

Hard disk problems are indicated by error messages on the CRT when the disk is addressed or are indicated by mechanical faults during the disk drive operation. Since the disk drive is controlled by the planar board in response to the programmed data, disk problems may be caused by a fault in the disk drive, in the disk drive assembly, in the processor unit, in the software or data or in the cables. Section 2.9.1, "Mechanical Faults" covers possible mechanical problems involving the hard disk and Section 2.9.2, "Failure to Function" addresses possible nonmechanical hard disk problems.

If you are continuously receiving error messages with the hard disks as well as the 5¼" and 8" diskettes, the fault may be in the P3-P800 cable. See Figure 5-35. If your system is equipped with disk or diskette assemblies, disconnecting the P3-P800 cable may allow them to function. If so, you need to have the cable replaced. The cable also has an optional check. See Chapter 4, "Cable Checks." If the P3-P800 cable should need replacing, the system has to be returned to IBM for repair. The cable is not a customer-replaceable unit.

2.9.1 MECHANICAL FAULTS

IMPORTANT:

DO NOT power-off the IBM 9000 while the hard disk drive is running. If you do, you may cause unrecoverable loss of part or all of your data on the hard disk. To power on, first turn on the IBM 9000, and then immediately turn on the hard disk units. To power off, first shut down the hard disk units and then the IBM 9000.

Use the symptoms listed on the chart below to isolate a fault to one or more CRUs. Where necessary, you are referred to optional checks in other Sections of the manual to narrow the fault to one CRU. Use the numbers at the bottom of each column in the Symptom chart to reference the

Cause/Solution. Where more than one number is listed, the Cause/Solution may be any one. The bullets in the chart signify that the symptom listed is true.

SYMPTOM(S)

Fans do not run
Red light on disk drive
does not light when drive
is selected

•		
•		•
--		--
1		
2		4
3		

CAUSE/SOLUTION

- 1 Disconnected or defective power cord. See Section 3.2, "Power Cord Check."
- 2 Blown disk drive assembly fuse. Replace the fuse.
- 3 Fault in disk drive assembly. Fans do not run. Replace the disk drive assembly.
- 4 Defective disk drive. Replace the disk drive.

Note: Make certain of correct switch drive settings.
See IBM Installing and Naming Disk Drives Manual, GC22-9265.

2.9.2 FAILURE TO FUNCTION

When a disk drive fails in operation, type SET EC=Y and press the return key on the keyboard. Enter Dir *: the asterisk must be the failed disk drive number. This causes the appropriate failure codes to be displayed on the CRT.

Failure Code	CRU	Corrective Action
\$000A	Device (disk drive) not ready	Check drive assembly power switch, power cord, and fuse. Repeat command. If fault persists, replace disk drive assembly.
\$0010	Disk or disk drive	Disk improperly formatted or fault in disk drive. Reformat disk and repeat operation. Replace disk drive if fault persists.
\$0011	Disk Data	Disk improperly formatted. Reformat disk and repeat operation. Check data and command and repeat operation.
\$0017	Disk Data	Disk improperly formatted. Reformat disk and repeat operation. Check software for cause of improper formatting.
\$0019	Software error	Sector buffer too small. Check software.
\$001A	Operating error	Deselect this drive; then reselect it.
\$001B	Planar board	CRC value does not match data value. Replace planar board.
\$001C	Disk or planar board	Reformat disk and repeat operation. If fault persists, replace planar board.
\$0070	Disk or planar board	Reformat disk. If fault persists, perform optional check. See Section 3.8, "Diskette and Disk Checks."

\$0072	Disk or planar board	Reformat disk and repeat operation. If fault persists, perform optional check. See Section 3.8, "Diskette and Disk Checks."
\$0076	Disk or planar board	Reformat disk and repeat operation. If fault persists, perform optional check. See Section 3.8, "Diskette and Disk Checks."
\$0077	Disk or disk drive	Reformat disk and repeat operation. If fault persists, replace disk drive.
\$0078	Hard disk controller board	Verify presence of hard disk controller board. Make sure board is plugged in. Repeat operation. If fault persists, replace hard disk controller board.

2.10 PRINTER/PLOTTER PROBLEMS

Printer/plotter problems may arise from a printer/plotter control board malfunction, from a mechanical malfunction in the printer/plotter, or from loose or defective cabling.

When a fault is narrowed to the printer/plotter control board, the board must be replaced. When the fault is narrowed to the printer/plotter, the printer/plotter must be replaced unless the fault is due to a worn or damaged ribbon or guide wire. The ribbon and the guide wire are the only customer-replaceable units on the printer/plotter.

Use the symptoms listed on this chart to isolate a fault to one or more CRUs. Where necessary, refer to optional checks in other sections of the manual to narrow the fault to one CRU. Use the numbers at the bottom of each column of the chart to reference the Cause/Solution. Where more than one number is listed, the Cause/Solution may be any one. The bullets in the chart signify that the symptom listed is true.

SYMPTOM(S)

Ribbon moves up and down	1																				
Head will not move		3																			
Fault LED lights			4																		
Offline, Online, Power LEDs do not light				5																	
Device is not ready					5																
Printer self-tests from keypad, printer does not print when accessed						6															
Head moves but no printing appears							7														
Broken letters								7													
No line feed									9												
Pale or faded letters										11											
Text is wrong color or multicolored											12										
Printer prints in one color only																				9	
Printer prints illegible character																					8
	1	3	4	5	5	6	7	7	9	11	12	9	8								
	2				13		8	8		14		10	10								
							10	10													
							11														

CAUSE/SOLUTION

- 1 No DC power. See Section 3.5, "Power Supply Checks."
- 2 Printer/plotter control board malfunction. Replace the board.
- 3 Possibly no AC power to printer/plotter control board. or blown 60V fuse on printer/plotter control board. See Chapter 4, "Cable Checks."
- 4 No AC power to transformer. See Chapter 4.
- 5 Check J500 connector/cable. See Chapter 4.
- 6 Check J600 connector/cable. See Chapter 4.
- 7 Check J100 connector/cable. See Chapter 4.
- 8 Printer/plotter control board malfunction. Check for blown fuse and replace board if fuse is blown.
- 9 Check J200 connector/cable. If connector/cable functions properly, replace printer/plotter control board. See Chapter 4.

-
- 10 Printer/plotter malfunction. Replace printer/plotter.
 - 11 Replace printer/plotter ribbon.
 - 12 Replace guide wire. If problem persists, replace printer/plotter.
 - 13 Malfunction in printer/plotter control board. Replace board.
 - 14 Check impression adjustment lever.

2.11 SENSOR I/O PROBLEMS

If an analog peripheral device is malfunctioning, the fault may be in the device in the IBM 9001 sensor I/O board or in the interconnecting cables. Since analog peripheral devices connected to the IBM 9001 may or may not be products of IBM Instruments, Inc., this approach is suggested for fault isolation:

1. Perform fault isolation procedures suggested by the manufacturer of the peripheral device.
2. Verify the presence of the analog inputs to the system.
3. If Step 1 or 2 does not isolate the fault, perform the optional check to isolate problems on the sensor I/O board. See Section 3.10, "Sensor I/O Board Test -- Test 35. Also perform the optional check to verify that no faults on other feature boards are affecting the operation of the sensor I/O board. See Section 3.11, "Feature Board Checks." If the fault has not been isolated after completion of these checks, then return to Step 4.
4. If Step 1, 2, or 3 does not isolate the cause of the problem, perform the optional check of the run/ready and analog break-out boxes. See Chapter 4, "Cable Checks."

2.12 DIGITAL INPUT/OUTPUT PROBLEMS

If a digital peripheral device is malfunctioning, the fault may be in the device, in the processor unit, or in the interconnecting cables. Since digital peripheral devices connected to the IBM 9001 may or may not be products of IBM Instruments, Inc., this approach is suggested for fault isolation:

-
1. Perform fault isolation procedures suggested by the manufacturer of the peripheral device.
 2. If Step 1 does not isolate the fault, perform the optional check for the auxiliary I/O port that is connected to the malfunctioning peripheral. See Section 3.12, "Auxiliary I/O Port Checks."
 3. If Step 1 or 2 does not isolate the source of the problem, verify the integrity of the interconnecting cabling. See Chapter 4, "Cable Checks."

3.0 OPTIONAL DIAGNOSTIC, VOLTAGE, AND RESISTANCE CHECKS

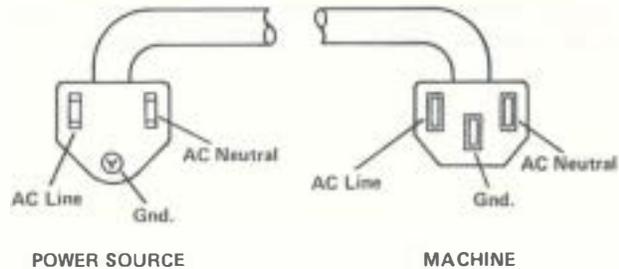
3.1 PURPOSE

WARNING: Only electronic technicians and others who have been trained in the safe handling of solid-state electronic circuits and who are familiar with operating a volt-ohm multimeter should conduct the checks in this chapter.

The optional checks in this chapter are provided so that you may eliminate possible causes of a fault or malfunction in the IBM 9001. By using the voltmeter scale on a high-impedance volt-ohm multimeter (VOM), you are able to verify the presence of power in the computer and to verify the presence of certain logic signals. The ohmmeter scale on the VOM is used primarily for continuity checks to verify the integrity of switches, connectors, and interconnecting cables.

3.2 POWER CORD CHECK

The diagram to the right represents the power cord with both connectors facing you. Perform continuity testing of the wires as specified in this table.



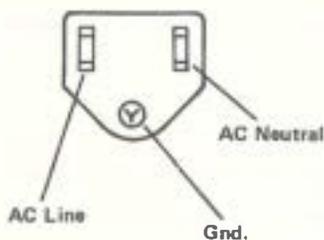
Wire	Resistance
AC LINE -- AC LINE	0 Ohms
NEUTRAL -- NEUTRAL	0 Ohms
GROUND -- GROUND	0 Ohms

3.3 POWER SWITCH CHECK

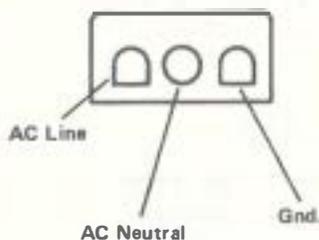
The power switch check requires disassembly of the IBM 9001 as far as step 4 in Section 5.5.1, "Removal." The diagram following shows the power cord (facing you) and the connector on the power supply. Disconnect the power-supply AC connector. Verify that the resistance readings between the power-supply AC connector and the power cord are those shown in this table.

Switch Position	Line Cord Plug and AC Connector Position	Ohms
ON	AC LINE -- AC LINE	0
ON	NEUTRAL -- NEUTRAL	0
ON	GROUND -- GROUND	0
OFF	AC LINE -- AC LINE	∞
OFF	NEUTRAL -- NEUTRAL	∞
OFF	GROUND -- GROUND	0

If your readings differ from these, replace the power switch or return the processor unit to IBM for repair.



MALE PLUG
(CONNECTED TO MACHINE)



POWER SUPPLY CONNECTOR

3.4 VERTICAL BOARD CHECK

These resistance checks verify the proper functioning of the vertical board installed in the printer/plotter cover assembly. See Figure 3-1A and Figure 3-1B. To perform these checks, disconnect the ribbon cable from J2 and measure the resistance between the points indicated in this chart. Compare the value you observe with the expected value listed on the chart. The value you observe should be within $\pm 20\%$ of the expected value. If not, replace the keypad.

Conditions	Measure Between	Expected Value-OHMS
TEST push button <u>not</u> pressed	J2-2 J2-8	∞
TEST push button pressed	J2-2 J2-8	0
Take measurement, exchange probes, and measure again	J2-3 J2-10	∞, ∞
Take measurement, exchange probes, and measure again	J2-4 J2-10	∞, ∞
Line Feed/Form Feed set to Form Feed	J2-5 J2-8 J2-6 J2-8	∞ ∞
Line Feed/Form Feed set to Line Feed	J2-5 J2-8 J2-6 J2-8	0 ∞
Line Feed/Form Feed released	J2-5 J2-8 J2-6 J2-8	∞ ∞
Online/Off Line/Form Set set to On Line	J2-7 J2-8 J2-9 J2-8	∞ 0
Online/Off Line/Form Set set to Off Line	J2-7 J2-8 J2-9 J2-8	∞ ∞
Online/Off Line/Form Set set to Form Set	J2-7 J2-8 J2-9 J2-8	0 ∞
Take measurement, exchange probes, and measure again	J2-8 J2-10 J2-8 J2-10	∞ ∞

Take measurement, LEDS	J1-2	J2-4	∞
Take measurement, LEDS	J1-3	J2-3	∞
Take measurement resistance	J2-8	J1-5	150

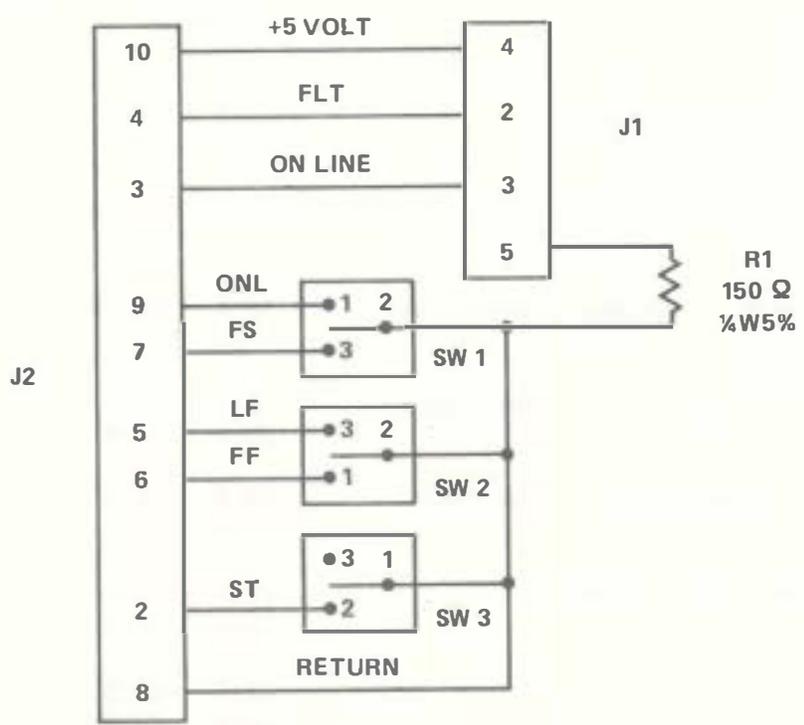


Figure 3-1A. Diagram - Vertical Board Check

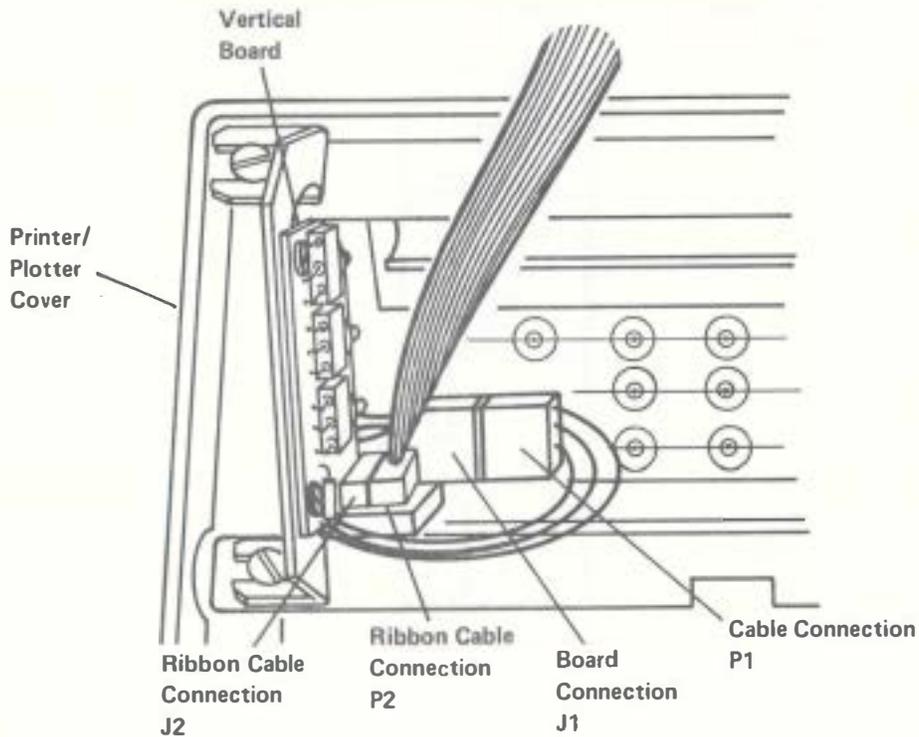


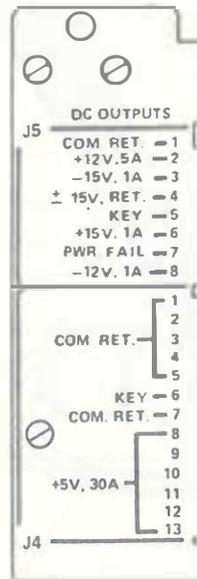
Figure 3-1B. Vertical Board Check

3.5 POWER SUPPLY CHECK

The power supply check verifies the availability of necessary power for the computer. To perform this check:

1. Check the fuse on the rear of the processor unit. Replace if blown.
2. Remove the covers on the IBM 9001. See Section 5.1, "Covers."
3. Loosen the DC connectors (P4 and P5) on the rear of the power supply. See Figure 5-9.
4. Connect the power cable to the processor unit.
5. Set the power switch to "ON."

6. With the VOM, verify the presence of the voltages within $\pm 2\%$ shown in the chart below.



7. Set the power switch to "OFF."
8. Reseat the DC connectors (P4 and P5).
Note: If voltages are not verified, continue with the procedure.
9. Loosen the AC connector (P1) on the power supply. See Figure 5-9.
10. Set the power switch to "ON."
11. With the VOM, verify the presence of AC voltages at (P1) connector. Set the meter to record AC voltage and measure from AC line to AC neutral 115-120 vac. See power supply connector diagram on page 3-2.
12. Set the power switch to "OFF."
13. Reseat the AC connector (P1).
14. If voltages in Step 11 are verified, replace the power supply. Re-assemble the IBM 9001.

3.6 KEYBOARD CHECKS

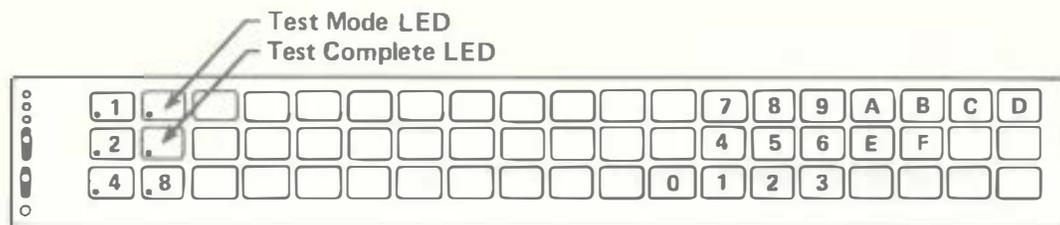
3.6.1 KEYBOARD ECHO TEST -- TEST 1A

The keyboard echo test may be called for either on the softkey assembly and keypad or on the keyboard. See Figure 3-2. To call for the keyboard echo test on the softkey assembly and keypad and to perform the test:

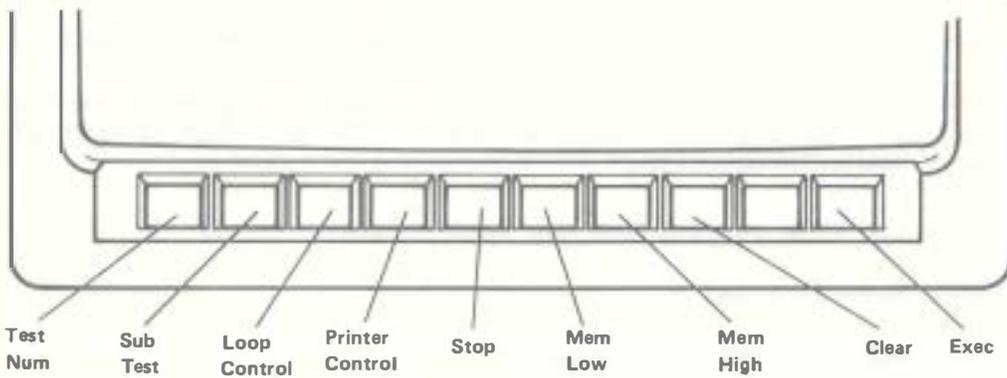
1. Reset the IBM 9001 by switching the computer to OFF and back to ON.
2. Press the STOP softkey while the automatic diagnostic testing is running. The computer responds "PRESS STOP KEY THEN EXECUTE KEY TO START MANUAL DIAGNOSTICS".
3. Press the STOP softkey and the EXEC softkey.
4. Press keypads 1 and A.
5. Press softkeys TEST NUM and EXEC.
6. Press each key on the keyboard and observe that the appropriate code appears on the CRT. See Figure 3-3.
7. End the test by either resetting the IBM 9001 or by pressing the STOP softkey. You may return to the operating system label by pressing the F and E keypads and pressing the TEST NUM and the EXEC softkeys.

To call for the keyboard echo test on the keyboard and to perform the test:

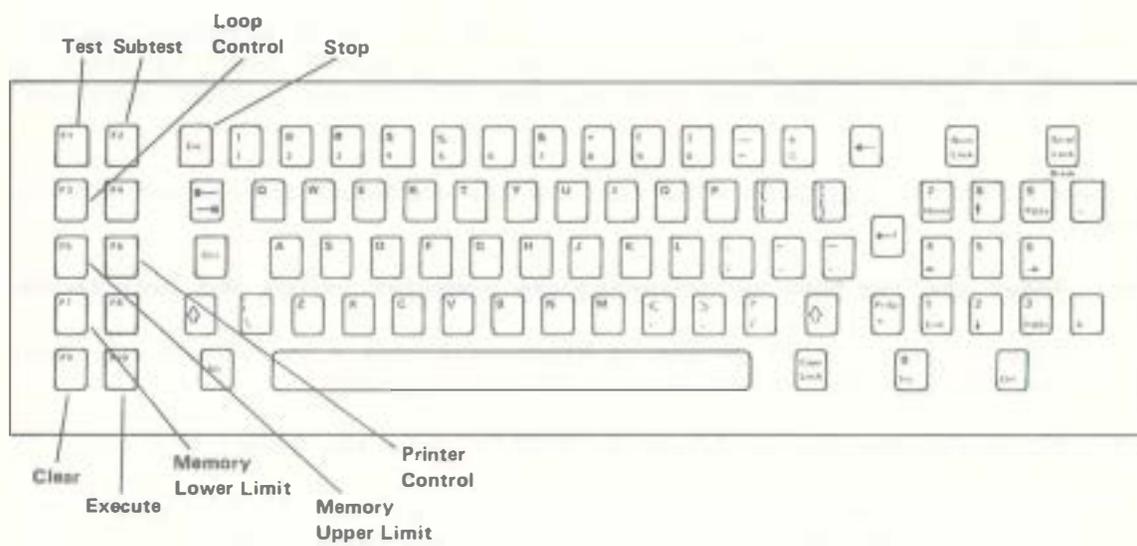
1. Reset the IBM 9001 by switching the computer to OFF and back to ON.
2. Wait at least until automatic diagnostic test 4 is running and press the ESC key. The operating system label appears.
3. Place the diagnostic diskette, DIAG77, into the disk drive.
4. Type DIAG77 and press the return key. The computer responds "PRESS STOP KEY THEN EXECUTE KEY TO START MANUAL DIAGNOSTICS".
5. Press the ESC key and the F10 key.
6. Type 1A and press the F1 key and the F10 key.



Keypad



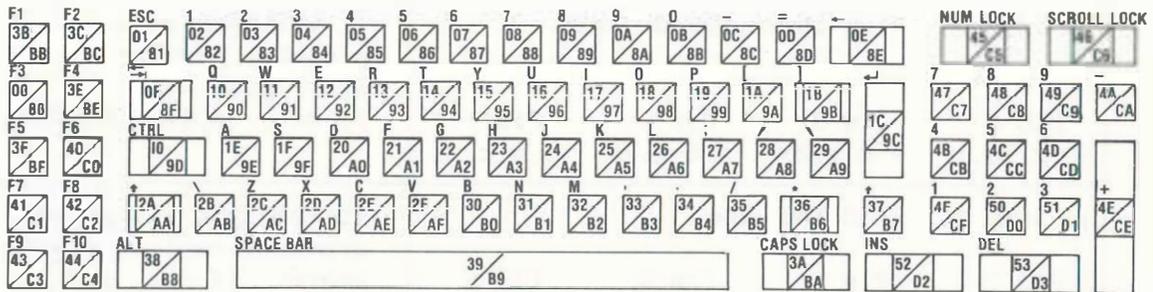
Softkeys



Keyboard

Figure 3-2. Keypad, Softkeys, and Keyboard

7. Press each key on the keyboard and observe that the appropriate code appears on the CRT. See Figure 3-3.
8. End the test by either resetting the IBM 9001 or by pressing the ESC key and the F10 key. You may return to the operating system label by typing FE and pressing the F1 key and F10 key.



Scan Code When key is pressed

Scan Code when key is released

Figure 3-3. Keyboard Key Codes

3.6.2 VOLTAGE CHECK

Using the VOM set to a scale to read 20 Vdc, connect the negative probe to Pin 1 of the keyboard connector on the planar board. See Figure 5-13B and Figure 4-1. Read the voltage on the other four pins (2, 3, 4, and 6) as instructed in the following chart. Use the chart to determine further procedures to follow. Remove feature boards to gain access to planar board connectors J1 and keyboard cable connectors on processor rear plate. See Figure 5-13B and Figure 5-1.

Keyboard Check Chart

<p>Step 1. Unplug keyboard cable from connector on processor unit back plate.</p> <p>Pin 2 Pin 3 Pin 4 Pin 6 $5.0 \pm .25$ $5.0 \pm .25$ 0.1 ± 0.1 $5.0 \pm .25$</p>	<p style="text-align: center;">Procedure</p> <p>If voltages listed are present, perform Step 2. See Figure 4-1. If not, replace planar board.</p>
<p>Step 2. Plug in keyboard cable.</p> <p>Pin 2 Pin 3 Pin 4 Pin 6 0.2 ± 0.1 $4.8 \pm .25$ $4.8 \pm .25$ $5.0 \pm .25$</p>	<p>If voltages listed are present, perform Step 3. See Figure 4-1. If not, replace keyboard.</p>
<p>Step 3. Hold key down.</p> <p>Pin 2 Pin 3 Pin 4 Pin 6 0.2 ± 0.1 $4.8 \pm .25$ $4.8 \pm .25$ $5.0 \pm .25$</p>	<p>If voltages listed are present, replace planar board. If not, replace keyboard.</p>

3.7 KEYPAD AND SOFTKEY CHECKS

3.7.1 KEYPAD AND SOFTKEY ECHO TEST -- TEST 19

The keypad and softkey echo test may be called for either on the keyboard or on the keypad and softkey assembly. To call for the keypad and softkey echo test on the keyboard and to perform the test:

1. Reset the IBM 9001 by switching the computer to "OFF" and back to "ON."
2. Wait at least until automatic diagnostic Test 4 is running and press the ESC key. The operating system label appears.
3. Place the diagnostic disk, DIAG77, into the disk drive.
4. Type DIAG77 and press the return key. The computer responds "PRESS STOP KEY THEN EXECUTE KEY TO START MANUAL DIAGNOSTICS".
5. Press the ESC key and the F10 key.

-
6. Type 19 and press the F1 key and the F10 key.
 7. Press the keys on the keypad and softkey assembly and observe that the appropriate codes appear on the CRT. See Figure 3-4.
 8. End the test by either resetting the IBM 9001 or by pressing the ESC key. You may return to the operating system label by typing FE and pressing the F1 and F10 keys.

Note: Other manual diagnostic tests may be called for in the same manner. To call another test, follow Steps 1-4. Type the test number and press the F1 key. If you wish to call for a specific subtest, enter the subtest number and press the F2 key. Press the F10 key to execute the test.

Important: Any other diagnostic commands that need to be entered must be done on the keyboard.

To call for the keypad and softkey echo test on the keypad and softkey assembly and to perform the test:

1. Reset the IBM 9001 by switching the computer to "OFF" and back to "ON."
2. Press the STOP softkey while the automatic diagnostic test is running. The computer responds "PRESS STOP KEY AND EXECUTE KEY TO START MANUAL DIAGNOSTICS".
3. Press the STOP softkey and the EXEC softkey.
4. Press keypads 1 and 9.
5. Press softkeys TEST NUM and EXEC.
6. Press the keys on the keypad and softkey assembly and observe that the appropriate codes appear on the CRT. See Figure 3-4.
7. End the test by either resetting the IBM 9001 or by pressing the STOP and then the EXEC softkeys. You may return to the operating system label by pressing the F and E keypads and pressing the TEST NUM and EXEC softkeys.

Note: Other manual diagnostic tests may be called for in the same manner. To call another test, follow steps 1-3. Then enter the test number by pressing the appropriate numbers on the keypad. Press the TEST NUM softkey. If you wish to call for a specific subtest, enter the subtest number and press the subtest softkey. Press the EXEC softkey to execute the test.

Important: Any other diagnostic commands that need to be entered must be done on the keypad and softkey assembly.

Keypad

75	B4	A7	B8	03	FD	7F	69	6D	0B	77	FB	0D	5E	60	A5	B2	74	62
72	B7	B3	B0	1E	65	AD	AE	0F	1F	*76	BC	64	9F	A3	A4	A5	73	AB
71	B1	A1	BA	09	88	6B	9D	4E	00	6A	7B	7E	7A	A2	AB	B9	*78	G1

Softkeys

6E	6F	AF	A9	7D	4C	79	68	8D	0A
----	----	----	----	----	----	----	----	----	----

Figure 3-4. Keypad and Softkey Codes

3.7.2 SOFTKEY RESISTANCE CHECK

To verify that the softkeys are functioning properly, use table to check for continuity between the following points on the CRT display cable (J1100) when the corresponding softkey is pressed. Keys are numbered from left to right. There should be an open circuit when the corresponding key is not pressed. If the softkey resistance check shows no fault, verify the internal wiring integrity by performing a cable check between J8 and J700. See Figure 5-6 and Figure 5-13A. See Chapter 4, "Cable Checks" and Figure 4-2.

Softkey	J1100	
	From	To
1	24	25
2	24	50
3	49	25
4	49	50
5	23	25
6	23	50
7	47	25
8	47	50
9	48	25
10	48	50

3.8 DISKETTE AND DISK CHECKS

The diskette and disk checks isolate a fault to a diskette or disk drive, the planar board, or the interconnecting cable when a fault occurs that could be caused by any one of them.

3.8.1 8" DISKETTE AND DISKETTE DRIVE TESTS -- TESTS 17 AND 20-23

The 8" diskette drives are connected to the IBM 9001 at port FD00-03 on the processor unit back plate. Test 17, using the wrap cables provided with the IBM 9001, isolates the planar board or cabling as a possible source of a diskette fault. The diskette drive tests 20, 21, 22, and 23 verify the proper functioning of the diskette drives.

To perform the 8" diskette and diskette drive tests:

1. If there is a cable connected to the processor parallel PPU port, disconnect it and connect the wrap cable labeled TEST 17 to the Parallel PPU port on the processor unit back plate and to the unused connector on the diskette drive assembly back plate.
2. Call for Test 17. See notes in Section 3.7.1, "Keypad and Softkey Echo Test -- Test 19." After you receive the "CONNECT TEST 17 CABLE" message, press the F10 key or the EXEC softkey.

-
3. If the test passes, proceed to Step 4. If the test fails, perform the check on the cable. See Chapter 4, "Cable Checks." Replace if defective. If the cable is functioning properly, replace the planar board.
 4. Remove the wrap cable installed in Step 1 and reconnect any other cable that may have been removed in step 1.
 5. Place a non write protected scratch diskette in the drive to be tested.
 6. Call for Test 2n (n = number of diskette drive). Test 20 tests diskette drive 0, Test 21 tests diskette drive 1, etc. See notes in Section 3.7.1, "Keypad and Softkey Echo Test -- Test 19."
 7. Respond to prompt on the CRT by entering 8 for 8", 1 or 2 for single- or double-density, and 1 or 2 for single- or double-sided. Press the F10 key or the EXEC softkey. The test results are displayed on the CRT.
 8. Repeat Steps 5 and 6 for all 8" diskette drives in your system.
 9. If one diskette drive fails, replace that drive. If all diskette drives in a diskette drive assembly fail, replace the diskette drive assembly.

3.8.2 HARD DISK AND HARD DISK CONTROLLER BOARD TESTS -- TESTS 40-43 AND 13

The hard disk drive is connected to the IBM 9001 through the ports on the hard disk controller board. Test 13 checks the functioning of the hard disk controller board. To call for the test, see notes in Section 3.7.1, "Keypad and Softkey Echo Test -- Test 19." If Test 13 fails and your system is equipped with a sensor I/O board, remove the sensor I/O board, and repeat Test 13. If the test passes, replace the sensor I/O board. If the test fails, replace the hard disk controller board.

If the hard disk controller board is not at fault and the hard disk is continues to malfunction, the fault may be on the disk drive or in the interconnecting cable. Call for Tests 40 through 43 to check hard disk drives 0 through 3 respectively. See notes in Section 3.7.1, "Keypad and Softkey Echo Test -- Test 19." Also check the interconnecting cable. See Chapter 4, "Cable Checks."

3.8.3 5-1/4" DISKETTE AND DISKETTE DRIVE TESTS -- TESTS 17 AND 20-23

The 5¼" diskette drive is connected to the IBM 9001 either at the 5¼" Floppy Disk Control port on the processor unit back plate or through the CRT display cable to the port behind the display-mounted diskette drive.

Control signals originating in the planar board are the same as those used for the 8" diskette but are brought to the control port by internal cabling. This cabling may be checked between the 8" Floppy Disk and 5¼" Floppy Disk ports by a cable check. See Chapter 4, "Cable Checks."

Test 17 using the wrap cables provided with your IBM 9001 isolates the planar board as a possible cause of a diskette fault. The diskette drive tests 20, 21, 22, and 23 verify the proper functioning of the diskette drives.

To perform the 5¼" diskette and diskette drive tests:

1. If a cable is connected to the processor parallel PPU port, disconnect it and connect the wrap cable labeled TEST 17 to the Parallel PPU port and the 8" Floppy Disk port on the processor unit back plate.
2. Call for Test 17. See notes in Section 3.7.1, "Keypad and Softkey Echo Test -- Test 19." After you receive the "CONNECT TEST 17 CABLE" message, press the F10 key or the EXEC softkey.
3. If the test passes, proceed to Step 4. If the test fails, replace the planar board.
4. Remove the wrap cable installed in Step 1 and reconnect any cable that may have been removed in Step 1.
5. Place a nonwrite protected scratch diskette in the drive to be tested.
6. Call for Test 2n (n = number of diskette drive). Test 20 tests diskette drive 0, test 21 tests diskette drive 1, etc.
7. Respond to prompt on the CRT by entering 5 (for 5¼"), 1 or 2 for single- or double-density, and 1 or 2 for single- or double-sided. Press the F10 key or the EXEC softkey. The test results are displayed on the CRT.
8. Repeat Steps 5-7 for all 5¼" diskette drives in your system.

-
9. If one diskette drive fails, replace that drive. If all diskette drives in a diskette drive assembly fail, replace the diskette drive assembly. If every 5¼" diskette drive fails, perform the check on 5¼" diskette internal wiring. See Chapter 4, "Cable Checks." If the wiring is faulty, return the processor unit to IBM for repair.

3.9 CRT CONTROLLER TEST -- TEST 16

Test 16 checks the vertical, horizontal, and video signals of the CRT controller. It requires the attachment of the wrap cable labeled TEST 16 to the Parallel PPU port and the CRT output connector on the processor unit back plate.

Subtest 1 checks the vertical sync signal.

Subtest 2 checks the horizontal sync signal.

Subtest 3 checks the video output signal.

Since Test 16 replaces the CRT with a wrap cable, a keyboard is necessary to control the test, a printer is needed, and the printer control has to be set to On Line. The three subtests must be called for manually.

To call for and perform the CRT Controller test using the printer in place of the CRT:

1. Reset the IBM 9001 by switching the computer to OFF and back to ON.
2. Wait at least until automatic diagnostic Test 4 is running and press the ESC key. Wait until Test Complete LED lights.
3. Type DIAG and press the return key.
4. Press the ESC key and the F10 key.
5. Enter 1, press the F6 key.
6. Type 16 and press the F1 key and the F10 key.
7. The printer responds with "EXECUTE", and the next line is "CONNECT TEST 16 CABLE." Press the F10 key.

When the subtest is called for, the printer echoes the entry. If the subtest passes, the printer outputs "EXECUTE." If the subtest

fails, the printer outputs "SUBTEST FAILURE," the subtest number, an error code, and the actual and expected values.

Note: To call a different subtest, enter the subtest number and press the F2 key. Press the F10 key to execute the subtest.

3.10 SENSOR I/O BOARD TEST -- TEST 35

Test 35 locates a fault on the sensor I/O board and locates faulty operation of the sensor I/O board caused by a malfunction on other subassemblies of the IBM 9001. If test 35 fails, you should perform the feature board checks. See Section 3.11, "Feature Board Checks" before replacing the sensor I/O board. See Figure 3-5.

To conduct test 35:

1. Connect the TEST 3502, TEST 3503, and TEST 3501/3504 wrap cables to the sensor I/O board connectors JA1 through JA3 respectively. JA3 is on the right, JA1 is on the left.
2. Call for Test 35. See notes in Section 3.7.1, "Keypad and Softkey Echo Test -- Test 19." After you receive the "INSTALL SENSOR I/O WRAP CONNECTORS" message, press the F10 key or the EXEC softkey.
3. Observe whether Test 35 is passed (OK) or FAILED. If the test failed, perform the feature board checks. See Section 3.11, "Feature Board Checks."
4. Disconnect the wrap cable installed in step 1.

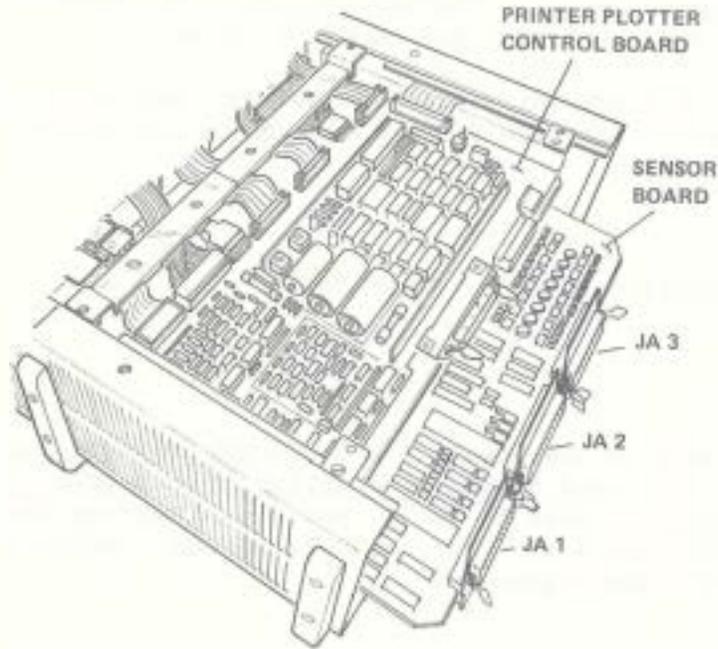


Figure 3-5. Sensor Board

3.11 FEATURE BOARD CHECKS

All of the feature boards in the IBM 9001 are interconnected through a common bus in the expansion board, and they all use a common power supply distributed through the expansion board. A feature board malfunction may be caused by the loading of the common bus by another (apparently functioning) feature board. The following checks determines whether the loading of the common bus by another board or a faulty expansion board is the cause of the problem.

3.11.1 POWER SOURCE VERIFICATION

Using the VOM, verify that the +5 Volt supply to the malfunctioning feature board is at least 4.8 Volts. This is done by measuring between pins 7(-) and 14(+) on a 14-pin integrated circuit (IC) or between pins 8(-) and 16(+) on a 16-pin IC. Figure 3-6 identifies pins 7 and 14 on a 14-pin IC, and 8 and 16 on a 16-pin IC.

If this check shows a 5-Volt supply at less than 4.8 Volts, perform the checks in Sections 3.11.2, "Feature Board Loading Check" and 3.11.3, "Expansion Board Check." If the low voltage is not caused by loading from another feature board, the power supply should be replaced.

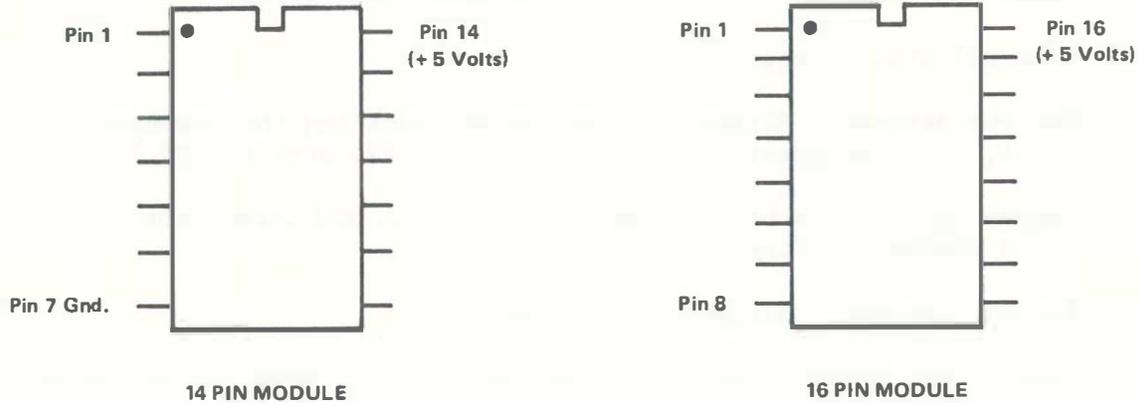


Figure 3-6. Pin Identification

3.11.2 FEATURE BOARD LOADING CHECK

For this check, each feature board is removed one at a time and the automatic diagnostic testing is run between each removal.

CAUTION: The MMU board is not a feature board. If your system is equipped with an MMU board, do not remove it as part of this check.

Note: If a memory board is removed in this check, any memory boards above it should have their addresses changed to eliminate gaps in the addressing scheme. When the memory board is reinserted, the addresses should be restored.

Remove each feature board and test individually to conduct feature board loading check. A feature board is defective and should be replaced during the check if the fault disappears when the board is removed and reappears when it is reinserted. Use the following procedure to verify removal/insertion board continuity at each slot level. The procedure following assumes that the processor unit is fully populated. If you have fewer boards, stop when the last board has been tested.

procedure assumes that the processor unit is fully populated. If you have fewer boards, stop when the last board has been tested.

To conduct the feature board loading check:

1. Remove the bottom feature board from the processor unit.
2. Move all other feature boards down one slot.
3. Run the automatic diagnostic testing by resetting the computer. To reset, push the power switch to "OFF" and then back to "ON."
4. Remove the feature board from the bottom slot and insert the feature board removed in Step 1 in its place.
5. Run the automatic diagnostic testing.
6. Remove the feature board from the second slot from the bottom and insert the feature board removed in Step 4 in its place.
7. Run the automatic diagnostic testing.
8. Remove the feature board from the third slot from the bottom and insert the feature board removed in Step 6 in its place.
9. Run the automatic diagnostic testing.
10. Remove the feature board from the fourth slot from the bottom and insert the feature board removed in Step 8 in its place.
11. Run the automatic diagnostic testing.
12. Remove the feature board from the fifth slot from the bottom and insert the feature board removed in Step 10 in its place.
13. Run the automatic diagnostic testing.
14. Insert the feature board removed in Step 12 into the sixth slot from the bottom.

3.11.3 EXPANSION BOARD CHECK

A feature board can malfunction because of a poor connection with the expansion board, damaged conductors, or a defect in the feature board. Check the expansion board by positioning the malfunctioning feature board directly above the planar board (the bottom slot) and repeating the

voltage check in Section 3.11.1, "Power Source Verification" on the malfunctioning feature board. If the feature board passes the check in this position, replace the expansion board. If the check is failed, replace the feature board.

3.12 AUXILIARY I/O PORT CHECKS

The auxiliary I/O port checks locates a fault on the planar board circuits associated with the I/O port being tested. The following sections provide tests for serial ports 00 through 02 and the Parallel PPU port. Wrap cables supplied with the IBM 9001 are required for these tests.

3.12.1 SERIAL PORTS 00 AND 02 TESTS -- TESTS 1E AND 1F

Test 1E checks serial port 00 with serial port 02. Test 1F tests the DMA (DIRect Memory Access) operation of serial port 00. These tests assume that port 00 is configured as a modem as it is when the system is purchased from IBM Instruments, Inc. If port 00 has been changed, this test does not pass.

These tests require the attachment of the wrap cable labeled TEST 1D 1E 1F. Test data put through port 00 is routed to or from port 02 by the wrap cable. A failed test indicates a malfunction in port 00 and/or port 02. In either case, the planar board should be replaced.

To conduct these tests:

1. Connect the TEST 1D 1E 1F wrap cable to ports 00 and 02 on the processor unit back plate.
2. Call for Test 1E. See notes in Section 3.7.1, "Keypad and Softkey Echo Test -- Test 19."
3. After you receive the "CONNECT SERIAL WRAP CABLE TO PORTS 0 & 2" message, press the F10 key or EXEC softkey.
4. Observe whether the test is passed (OK) or FAILED. If the test fails, replace the planar board.

-
5. If you are entering from the keyboard, type 1F and press the F1 key and the F10 key. If you are entering from the keypad and softkey assembly, press the 1 and F keypads and press the TEST NUM and EXEC softkeys.
 6. Observe whether the test is passed (OK) or FAILED. If the test fails, replace the planar board.
 7. Disconnect the wrap cable installed in Step 1.

3.12.2 SERIAL PORTS 01 AND 02 TEST -- TEST 1D

Test 1D checks serial port 01 with serial port 02 and requires the attachment of the wrap cable labeled TEST 1D 1E 1F. A failed test indicates a malfunction in port 01 and/or port 02. In either case, the planar board should be replaced.

To conduct test 1D:

1. Connect the TEST 1D 1E 1F wrap cable to ports 01 and 02 on the processor unit back plate.
2. Call for test 1D. See notes in Section 3.7.1, "Keypad and Softkey Echo Test -- Test 19."
3. After you receive the "CONNECT SERIAL WRAP CABLE TO PORTS 1 & 2" message, press the F10 key or EXEC softkey.
4. Observe whether the test is passed (OK) or FAILED. If the test fails, replace the planar board.
5. Disconnect the wrap cable installed in Step 1.

3.12.3 IEEE-488 BUS PORT 00 AND PARALLEL PPU PORT TEST -- TEST 1C

Test 1C checks the IEEE-488 BUS port 00 with the Parallel PPU port and requires the installation of the wrap cable labeled IEEE/USER PORT WRAP TEST #1C. A failed test indicates a malfunction in the PPU port and/or the IEEE port. In either case, the planar board should be replaced.

To conduct test 1C:

-
1. Connect the IEEE/USER PORT WRAP TEST #1C wrap cable to the BUS 00 and PPU ports on the processor unit back plate.
 2. Call for test 1C. See notes in Section 3.7.1, "Keypad and Softkey Echo Test-- Test 19."
 3. After you receive the "INSTALL IEEE/USER PORT PASSIVE WRAP CABLE" message, press the F10 key or EXEC softkey.
 4. Observe whether the test is passed (OK) or FAILED. If the test fails, replace the planar board.
 5. Disconnect the wrap cable installed in Step 1.

3.13 PRINTER/PLOTTER SELF-TEST

The printer/plotter self-test can be used to determine whether the printer/plotter and the printer/plotter electronics are working correctly. This is done by printing out a character pattern on the printer/plotter, independent of the processor. A self-test switch is located on the front panel as well as on the printer/plotter control board located within the processor unit. See Figure 3-7.

If there is no paper in the printer/plotter, load paper following the instructions in Section 2.6 of the Computer System Operator's Manual, GC22-9186. Then proceed as follows:

1. Set the FORMSET/OFFLINE/ONLINE switch to OFFLINE.

- Set the Power On/Off switch to "On." The Power indicator will light and the print head will move to the left.

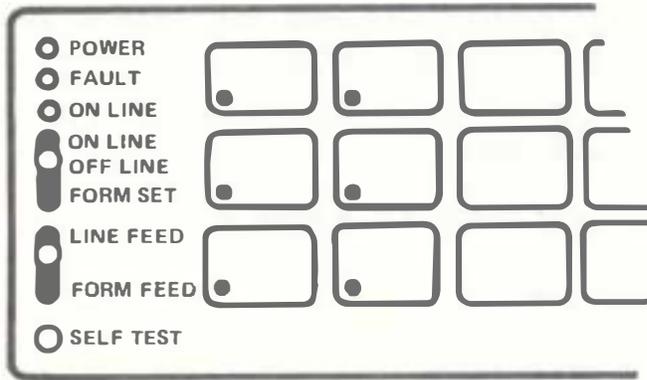


Figure 3-7. Keypad, Printer/Plotter Self Test.

- Press and hold the self-test switch on the front panel; the printer should print a test pattern while the switch is held (and for one or two lines after its is released). See Figure 3-8.

```

!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ[\]^_`abcdefghijklmnop
pqrstuvwxyz{|}~ !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ[\]^_`
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pqrstuvwxyz{|}~ !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ[\]^_`

```

Figure 3-8. Sample Test Pattern

If the test does not work, do the following:

- Loosen the two knurled thumb screws on the processor top cover; slide the processor top cover toward the back of the processor unit, and remove it. Remove the plastic shield.
- Disconnect connector P500 (sensor connector) on the printer/plotter control board. See Figure 5-6.
- Position the self-test switch on the printer/plotter control board to the TEST position. The printer/plotter should print a repetitive test pattern of all printable characters. If the paper runs out, the printer/plotter will automatically stop printing.
- Position the self-test switch to the OPERATE position to stop the printer. (The printer will continue printing for one or two lines after the switch is moved.)

Note: If the switch is left in the TEST position the printing changes color at the end of each page.

4.0 CABLE CHECKS

This chapter provides information that can assist you in checking the replaceable cables in the IBM 9001. You need the volt-ohm multimeter to perform these checks. First, visually inspect the cables to determine whether there are any broken wires, frayed or cut insulation, or bent or broken connector pins. If you discover any of these problems, the cable must be replaced.

This chart provides a cross reference of replaceable cables to specific sections of this chapter where point-to-point data is provided. Interconnections between the planar board connectors and those on the printer/plotter control board are also shown; these permit you to check an assembled system. For connector pin identification and location, see Figure 4-1. For cable diagram of cable checks, see Figure 4-2.

Note: The printer/plotter control board is abbreviated in the chart as "P/P ctrl board," and diskette drive is "d. drive."

Origin		Destination		Section
Device	Connector	Device	Connector	
CRT		P/P ctrl board	P/J 1100	4.1
Softkeys		P/P ctrl board	P/J 1100	"
D. drive in CRT		P/P ctrl board	P/J 1100	"
5¼" d. drive		8" d. drive	P/J 1100	"
5¼" d. drive		Planar board	P/J 3	"
5¼" d. drive		Planar board	P/J 4	"
8" d. drive	Signal	Planar board	P/J 3	"
8" d. drive		Planar board	P/J 4	"
8" d. drive		Planar board	P/J 8	4.1
Keyboard	J 1	Planar board	P/J 5	4.3

(Continued on next page)

Origin		Destination		Section
Device	Connector	Device	Connector	
Vertical board	J 2	P/P ctrl board	P/J 500	4.2
Vertical board	J 2	Left prntr con	P/J 510	"
Printer/plotter	J510 Left side	P/P ctrl board	J500	"
Printer/plotter	J210 Right side	P/P ctrl board	J200	4.2
P/P ctrl board	P/J 1100	P/P ctrl board	P/J 1000	4.1
P/P ctrl board	P/J 1100	P/P ctrl board	P/J 900	"
P/P ctrl board	P/J 1100	P/P ctrl board	P/J 800	"
P/P ctrl board	P/J 1100	P/P ctrl board	P/J 600	"
P/P ctrl board	P/J 1000	P/P ctrl board	P/J 800	4.1
P/P ctrl board	P/J 900	P/P ctrl board	P/J 600	"
P/P ctrl board	P/J 700	P/P ctrl board	P/J 1100	4.1
P/P ctrl board	P/J 800	Planar board	P/J 3	4.1
P/P ctrl board	P/J 800	Planar board	P/J 4	4.1
P/P ctrl board	P/J 700	Planar board	P/J 8	"
P/P ctrl board	P/J 400	Planar board	J/P 14	4.2
P/P ctrl board	P/J 800	5¼" d. drive		"
Planar board	P/J 3	P/P ctrl board	P/J 1000	"
Planar board	P/J 3	P/P ctrl board	P/J 1100	4.1
Planar board	P/J 4	Planar board	P/J 3	4.1

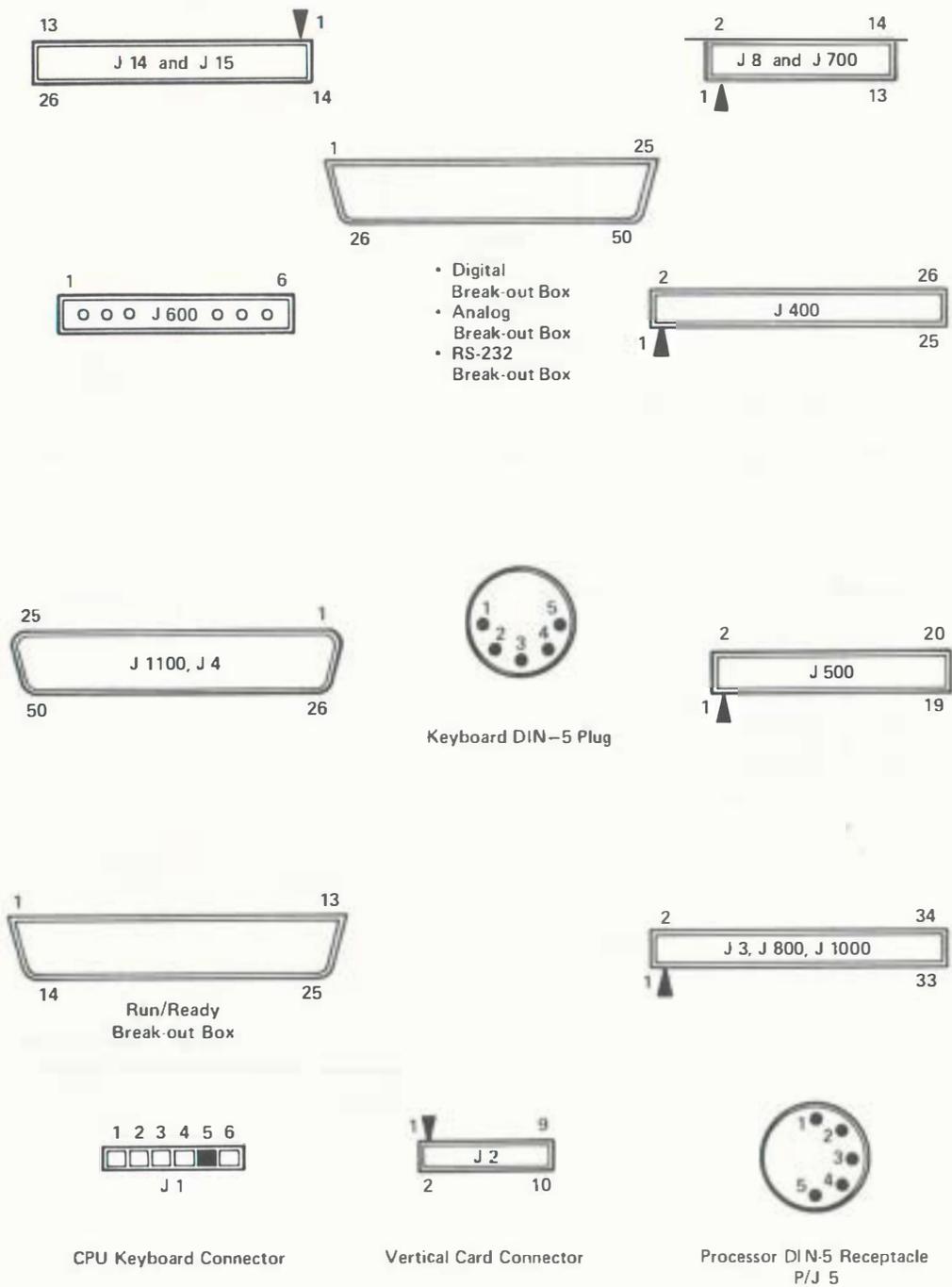


Figure 4-1. Connector Pin Identification and Location

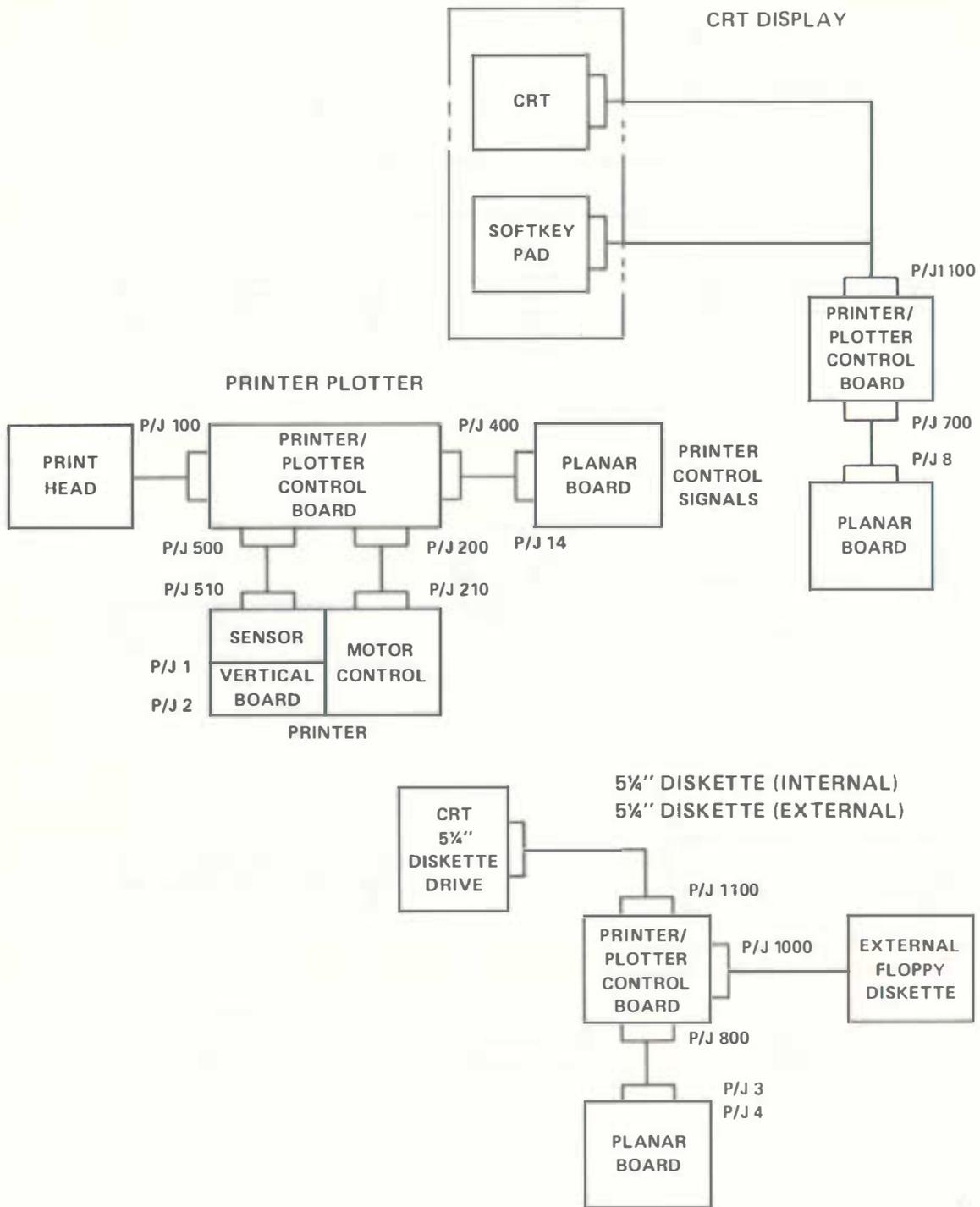


Figure 4-2. Cable Diagrams

4.1 PLANAR BOARD - PRINTER/PLOTTER CONTROL BOARD WIRING

This chart shows the connections between the planar board and the printer/plotter control board. See Figure 4-1 for connector pin identification and location, and Figure 4-2 for for the Cable Diagram.

CRT Display	Printer/Plotter Ctrl Board					Planar Board			8"	5½"
Dsktte Drive	P/J	P/J	P/J	P/J	P/J	P/J	P/J	P/J	Dsktte Drive	Dsktte Drive-J1
	1100	1000	900	800	700	600	3	4	8	

1	1	-1	-1	-1	-1	-1	-1	-1	1	1
3	2	-3	-3	-3	-3	-3	-3	-3	2	3
5	3	-5	-5	-5	-5	-5	-5	-5	3	5
7	4	-7	-7	-7	-7	-7	-7	-7	4	7
9	5	-9	-9	-9	-9	-9	-9	-9	5	9
11	6	-11	-11	-11	-11	-11	-11	-11	6	11
13	7	-13	-13	-13	-13	-13	-13	-13	7	13
15	8	-15	-15	-15	-15	-15	-15	-15	8	15
17	9	-17	-17	-17	-17	-17	-17	-17	9	17
19	10	-19	-19	-19	-19	-19	-19	-19	10	19
21	11	-21	-21	-21	-21	-21	-21	-21	11	21
23	12	-23	-23	-23	-23	-23	-23	-23	12	23
25	13	-25	-25	-25	-25	-25	-25	-25	13	25
27	14	-27	-27	-27	-27	-27	-27	-27	14	27
29	15	-29	-29	-29	-29	-29	-29	-29	15	29
31	16	-31	-31	-31	-31	-31	-31	-31	16	31
33	17	-33	-33	-33	-33	-33	-33	-33	17	33

+5V -----18-----4-----1,2

+12V ret-----19-----2-----5

|20|

video-----21-----3-----3

|22|

Y8 softkey-----23-----12-----12

Y4 softkey-----24-----8-----8

X7 softkey-----25-----11-----11

26---2-----2-----2-----19-----2

27---4-----4-----4-----20-----4

28---6-----6-----6---32-----21-----6

29---8-----8-----8---20-----22-----8

30---10-----10-----10---26-----23-----10

31---12-----12-----12---28-----24-----12

(continued on next page)

CRT Display Dsktte Drive	Printer/Plotter Ctrl Board						Planar Board			8"	5¼"
	P/J	P/J	P/J	P/J	P/J	P/J	P/J	P/J	P/J	Dsktte Drive	Dsktte Drive
	1100	1000	900	800	700	600	3	4	8		
	32	14		14			14	30		25	14
	33	16		16			16			26	16
	34	18		18			18	34		27	18
	35	20		20			20	36		28	20
	36	22		22			22	38		29	22
	37	24		24			24	40		30	24
	38	26		26			26	42		31	26
	39	28		28			28	44		32	28
	40	30		30			30	46		33	30
	41	32		32			32	14		34	32
	42	34		34			34			35	34
+5V Ret	43		3				3,4				
+12V	44		1				6				
vertical	45				1						1
horizontal	46				5						5
Y9 softkey	47				14						14
Y6 softkey	48				10						10
Y1 softkey	49				13						13
X8 softkey	50				9						9
							24				40
							32				38

Note: Delineated box around pin designations on connectors are pins grounded.

4.2 PRINTER/PLOTTER - PRINTER/PLOTTER CONTROL BOARD WIRING

This chart traces interconnections between the printer/plotter and the printer/plotter control board through the two plug-in ribbon cables on the bottom of the printer/plotter. Some internal wiring of the printer/plotter is shown to aid in your troubleshooting. See Figure 4-1 for connector pin identification and location.

Printer/Plotter Control Board		PLANAR	Printer/Plotter		Vertical Board	
J/P 400	J/P 500	JP 14	Right	Left	J 2	J 1

1	-----	1
2	-----D0-----	2
3	----- <u>RESET</u> -----	3
4	-----D6-----	4
5	-----STROBE-----	5
6	-----	6
7	-----ONLINE-----	7
8	-----+5V-----	8
9	-----	9
10	----- <u>FAULT</u> -----	10
11	-----	11
12	-----BUSY-----	12
13	-----GND-----	13
14	-----	14
15	-----	15
16	-----	16
17	-----D5-----	17
18	----- <u>ACK</u> -----	18
19	-----D4-----	19
20	-----PGSLCT-----	20
21	-----D3-----	21
22	-----POUT-----	22
23	-----D2-----	23
24	-----	24
25	-----D1-----	25
26	-----	26 key

(Continued on next page)

Printer/Plotter		Control Board	Printer/Plotter		Vertical Board	
J/P 200	J/P 400	J/P 500	Right	Left	J 2	J 1
			J/P 210	J/P 510		

1	-----	1		
2	-----	2	-----	5
3	-----	3		
4	-----	4	-----	6
5	-----	5		
6	-----	6	-----	9
7	-----	7		
8	-----	8	-----	7
9	-----	9		
10	-----	10	-----	2
11	-----	11		
12	-----	12	-----	10
13	-----	13		
14	-----	14	-----	8
15	-----	15		
16	-----	16	-----	4
17	-----	17		
18	-----	18	-----	3
19	-----	19		
20	-----	20	-----	1 key

1	-----	+10Ret	-----	1
2	-----	+5VRet	-----	2
3	-----	+10V	-----	3
4	-----	Not used	-----	4
5	-----	Logic GND	-----	5
6	-----	+5V	-----	6
7	-----	Motor	-----	7
8	-----	Color Sted	-----	18
9	-----	MTR 3 (Carriage)	-----	19
10	-----	MTR 2 (Carriage)	-----	10
11	-----	MTR 1 (Carriage)	-----	11
12	-----	MTR 0 (Carriage)	-----	12
13	-----	LF4 (Paper)	-----	13
14	-----	LF3 (Paper)	-----	14
15	-----	LF2 (Paper)	-----	15
16	-----	LF1 (Paper)	-----	16
17	-----	+10V (Ribbon)	-----	17
18	-----	+10V Ret (Ribbon)	-----	18
19	-----	LFC (Paper)	-----	19
20	-----	LFC (Paper)	-----	20

4.3 PLANAR BOARD - KEYBOARD WIRING

This chart shows the wiring from the planar board to the keyboard. See Figure 4-1 for connector pin identification and location.

J1	Processor Pin
1-----	2
2-----	3
3-----	1
4-----	5
5 key	
6-----	4

4.4 RUN/READY BREAK-OUT BOX

Connector See Figure 4-1.	PC Board	Terminal Strip
1-----	Shield-----	GND
2-----	RDY(+) LED	
3-----	RUN(+) LED	
4-----	A1(+)-----	A1(+)
5-----	GND-----	GND
6-----	START NC	
7-----	STOP NC	
8-----	A2(+)-----	A2(+)
9		
10		
11		
12		
13		
14-----	RDY(-)-----	RDY
15-----	RUN(-)	
16-----	A1(-)-----	A1(-)
17-----	A1 GND-----	A1 G
18-----	START-----	STT
19-----	STOP-----	STP
20-----	A2(-)-----	A2(-)
21-----	A2 GND-----	A2 G
22		
23		
24		
25		

4.5 ANALOG BREAK-OUT BOX

Connector See Figure 4-1	CH 1	CH 2	CH 3	CH 4
1-----	2			
2-----	3			
3-----	4			
4-----	5			
5-----	7			
6-----	7			
7-----		2		
8-----		3		
9-----		4		
10-----		5		
11-----		6		
12-----		7		
13-----			2	
14-----			3	
15-----			4	
16-----			5	
17-----			6	
18-----			7	
19-----				2
20-----				3
21-----				4
22-----				5
23-----				6
24-----				7
25				
Shield				
26-----	14			
27-----	15			
28-----	16			
29-----	17			
30-----	18			
31-----	19			
32-----		14		
33-----		15		
34-----		16		
35-----		17		

(Continued on next page)

Connector See Figure 4-1	CH 1	CH 2	CH 3	CH 4
36	-----	-----18		
37	-----	-----19		
38	-----	-----	-----14	
39	-----	-----	-----15	
40	-----	-----	-----16	
41	-----	-----	-----17	
42	-----	-----	-----18	
43	-----	-----	-----19	
44	-----	-----	-----	-----14
45	-----	-----	-----	-----15
46	-----	-----	-----	-----16
47	-----	-----	-----	-----17
48	-----	-----	-----	-----18
49	-----	-----	-----	-----19
50				

4.6 RS-232 BREAK-OUT BOX

Connector See Figure 4-1	CH 1	CH 2	CH 3	CH 4	Timer
26-----	1 GND				
27-----	3				
28-----	5				
29-----	7				
30-----	20				
31-----		1			
32-----		3			
33-----		5			
34-----		7			
35-----		20			
36-----			1		
37-----			3		
38-----			5		
39-----			7		
40-----			20		
41-----				1	
42-----				3	
43-----				5	
44-----				7	
45-----				20	
46-----					
47-----					4
48-----					6
49-----					8
50-----					10
1-----	2				
2-----	4				
3-----	6				
4-----	8				
5-----	11				
6-----		2			
7-----		4			
8-----		6			
9-----		8			
10-----		11			

(Continued on next page)

Connector See Figure 4-1.	CH 1	CH 2	CH 3	CH 4	Timer
11					2
12					4
13					6
14					8
15					11
16					2
17					4
18					6
19					8
20					11
21					1
22					3
23					5
24					7
25					9
Shield					

4.7 DIGITAL BREAK-OUT BOX

Connector See Figure 4-1.	CH 1	CH 2	CH 3	CH 4
1-----	13			
2-----		2		
3-----		4		
4-----		6		
5-----		8		
6-----		10		
7-----	1			
8-----	3			
9-----	5			
10-----	7			
11-----	9			
12-----	11			
13-----			12	
14-----				2
15-----				4
16-----				6
17-----				8
18-----				10
19-----			1	
20-----			3	
21-----			5	
22-----			7	
23-----			9	
24-----			11	
25-----				12
Shield				
26-----	1			
27-----	3			
28-----	5			
29-----	7			
30-----	9			
31				
32-----	2			
33-----	4			

(Continued on next page)

Connector

See Figure 4-1.

	CH 1	CH 2	CH 3	CH 4
34-----	6			
35-----	8			
36-----	10			
37-----	12			
38-----				1
39-----				3
40-----				5
41-----				7
42-----				9
43-----				11
44-----			3	
45-----			4	
46-----			6	
47-----			8	
48-----			10	
49-----			12	
50				
Shield-----	13			13

5.0 REMOVAL AND REPLACEMENT PROCEDURES

The only tools that are required for the removal and replacement procedures are a straight-edge screwdriver and an Allen wrench.

5.1 COVERS - PROCESSOR

This procedure is to be performed prior to servicing the planar board, printer/plotter, control board, power supply, expansion board, printer/plotter, planar board, MMU board, power switch, or fan assembly.

5.1.1 REMOVAL

1. Position the IBM 9001 power switch to OFF and unplug the main power cord from the wall outlet. See Figure 5-1.
2. Remove the main power cord from the processor unit back plate. See Figure 5-1.
3. Remove the keyboard connector from the processor unit back plate and move the keyboard to another area to provide workspace. See Figure 5-1.

Note: If a printer/plotter is not installed, proceed to Step 5.

4. Tear off and remove any paper remaining in the paper tray and remove the paper tray to another area to provide workspace.
5. Disconnect the CRT display cable by pushing back on the spring-loaded retaining clips that hold the connector in place disconnecting the grounding clip and pulling the connector away from the processor unit back plate. See Figure 5-1.
6. Remove any other connectors from the processor unit back plate.

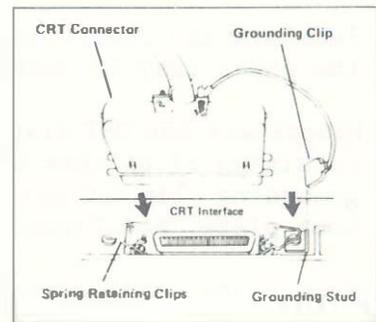
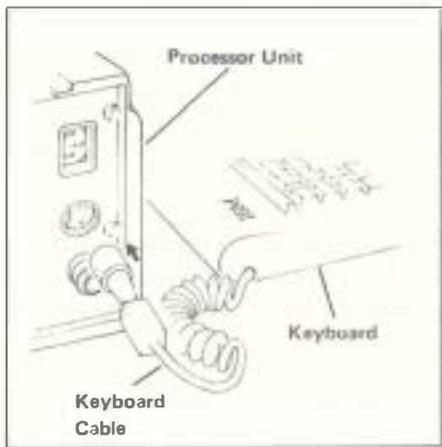
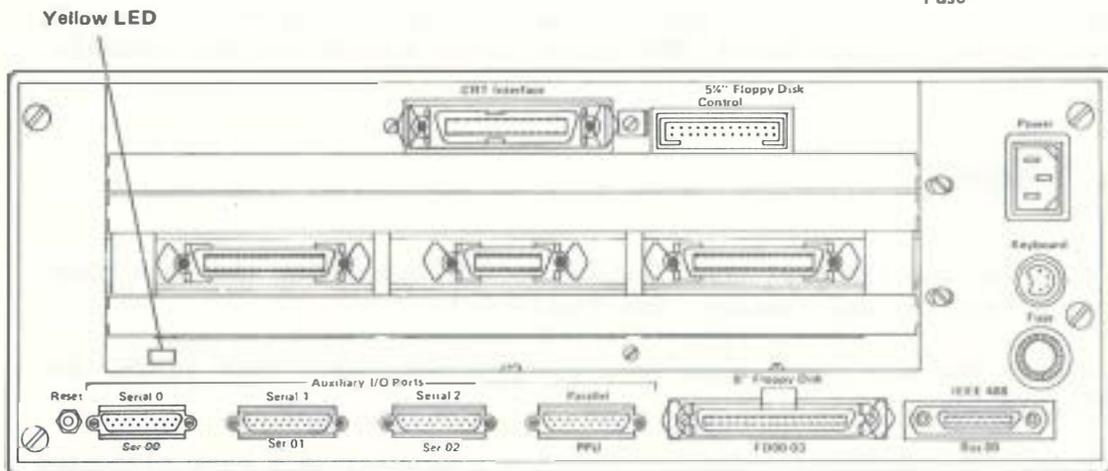
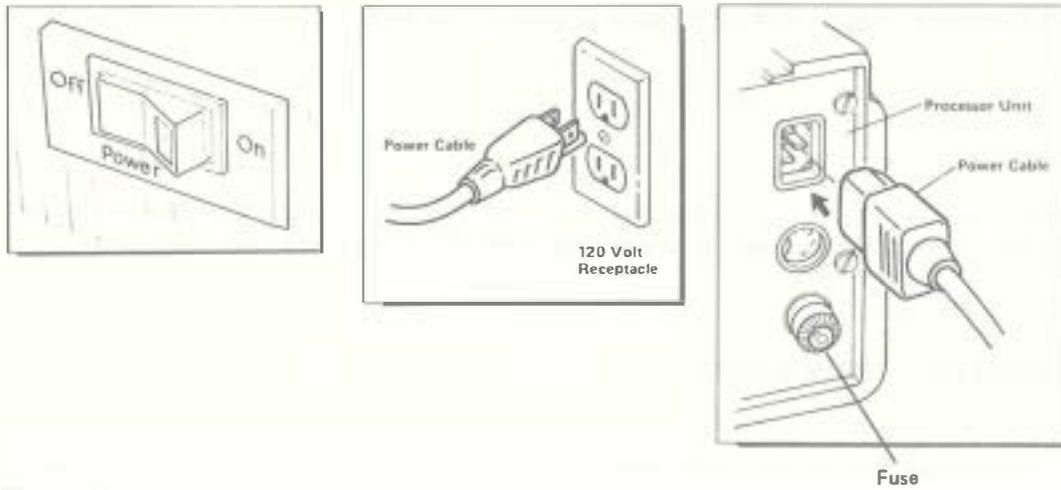


Figure 5-1. Processor Unit Back Plate Connections

Note: When removing the CRT display unit and bridge assembly, note the placement of the bridge over the tractor drive shaft on the printer/plotter. The bridge must be placed over the tractor drive shaft when replacing the assembly.

7. Remove the CRT display unit and bridge assembly by loosening the four knurled thumb screws on the bridge and lifting the assembly. Move the assembly out of your way. See Figure 5-2.

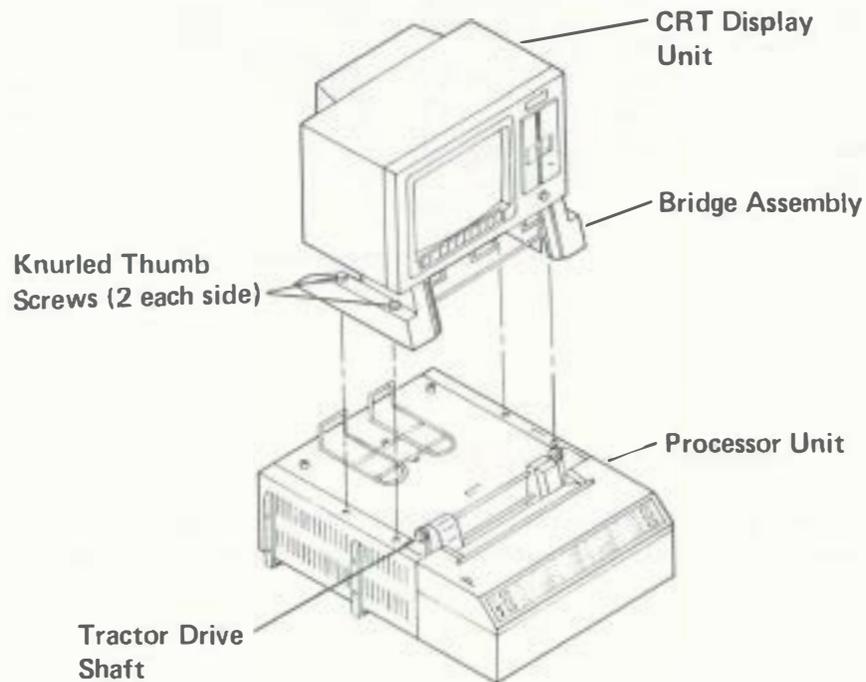


Figure 5-2. CRT Display Unit and Bridge Assembly

8. Remove the processor unit back plate by loosening the four retaining screws in the plate (all processor units). (On earlier processor units you also have to remove the eight screws on the serial and parallel ports.) Pull the back plate away from the processor unit. See Figure 5-3.

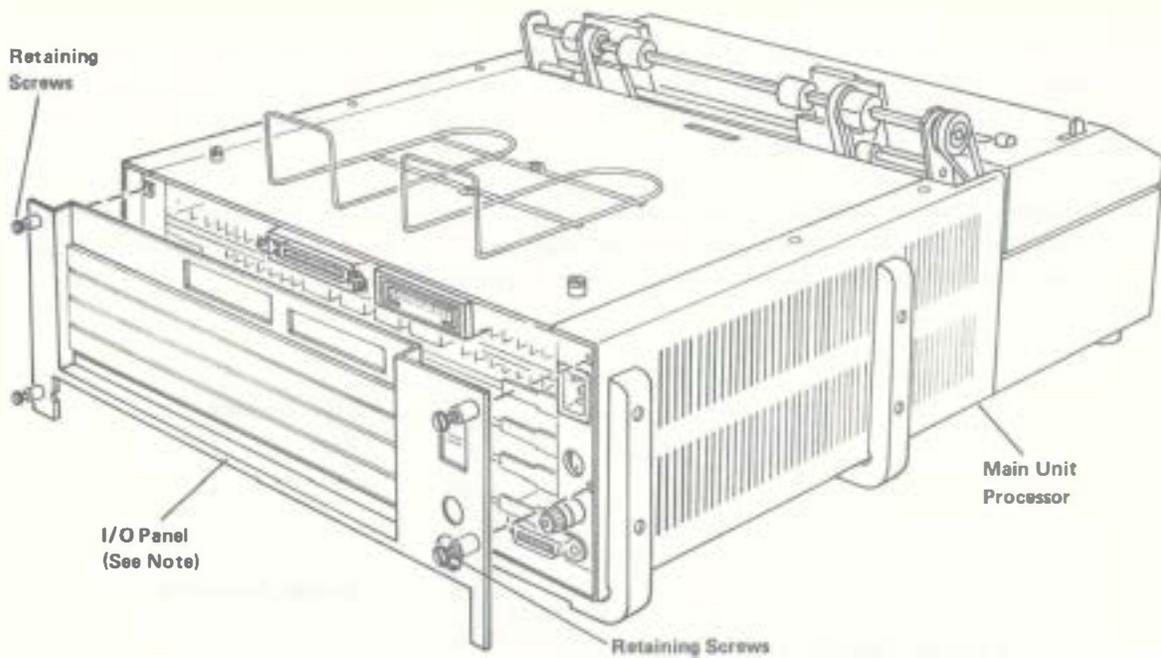


Figure 5-3. Processor Unit Back Plate.

Note: Earlier processor units included eight screws on the serial and parallel ports mounting the ports to the back plate (I/O panel).

9. Remove the processor unit top cover by loosening the two retaining screws and sliding the cover toward the rear of the processor unit. See Figure 5-4. Lift the cover out of your way.

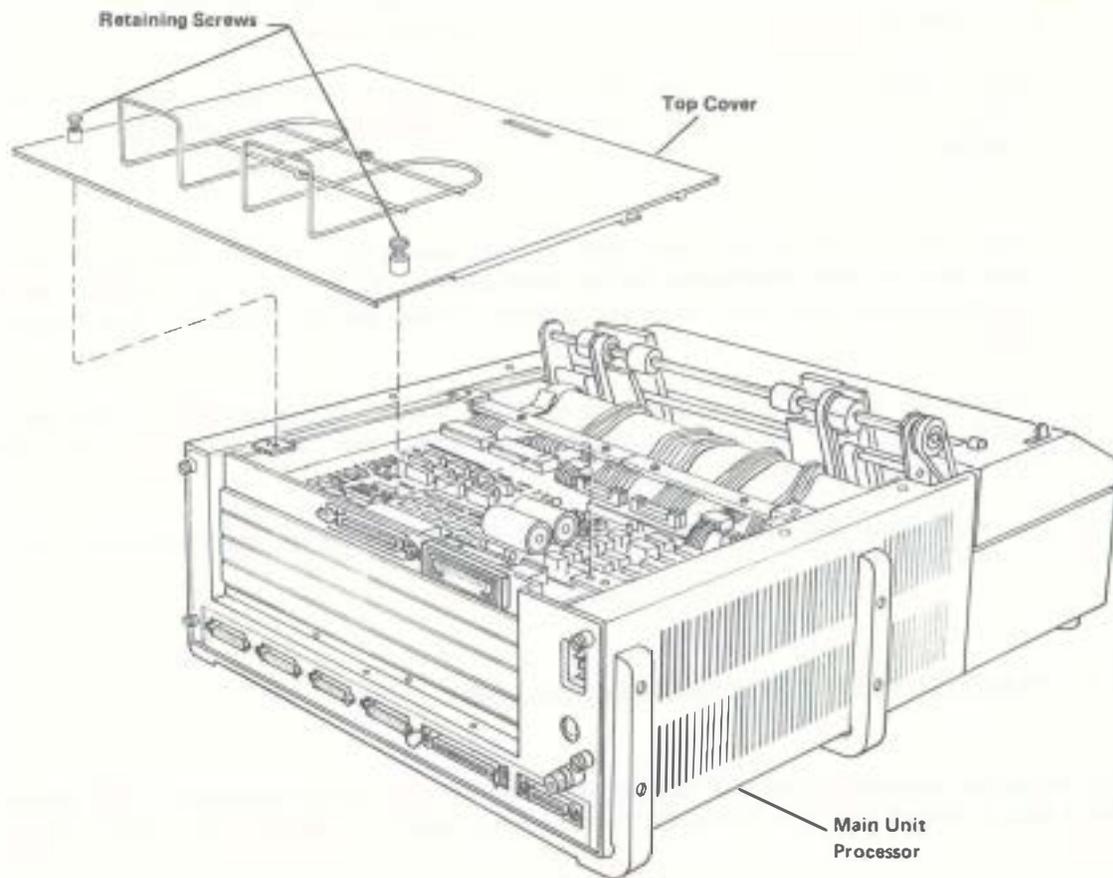


Figure 5-4. Processor Unit Top Cover

5.1.2 REPLACEMENT

1. Replace the processor unit top cover by setting the cover on the unit and sliding it toward the front of the system. Secure the cover in place by tightening the two retaining screws on top of the cover. See Figure 5-4.
2. Place the back plate on the processor unit. Be sure that the spring-loaded CRT display cable retainer clips are not behind the back plate and secure the plate by tightening the retaining screw.

See Figure 5-1 and Figure 5-3. Replace the eight screws on the serial and parallel ports (earlier processor units).

Note: When replacing the CRT display unit and bridge assembly, the bridge must be placed over the tractor drive shaft on the printer/plotter.

3. Place the CRT display unit and bridge assembly on the processor unit over the bridge mounting holes and secure it to the processor unit by tightening the four knurled thumb screws on the bridge. See Figure 5-2.
4. Reconnect the CRT display cable, the keyboard connector, the main power cord, and any other connector that was attached to the IBM 9001. See Figure 5-1.
5. Position the IBM 9001 power switch to ON and do an operational check of the system.

5.2 PRINTER/PLOTTER CONTROL BOARD

The printer/plotter control board is located in the processor unit above the planar board and any feature boards that may be installed. See Figure 5-5.

Note: Systems that do not have the printer/plotter feature have a feed-through board instead of a printer/plotter control board. The same removal and replacement procedures apply to both boards.

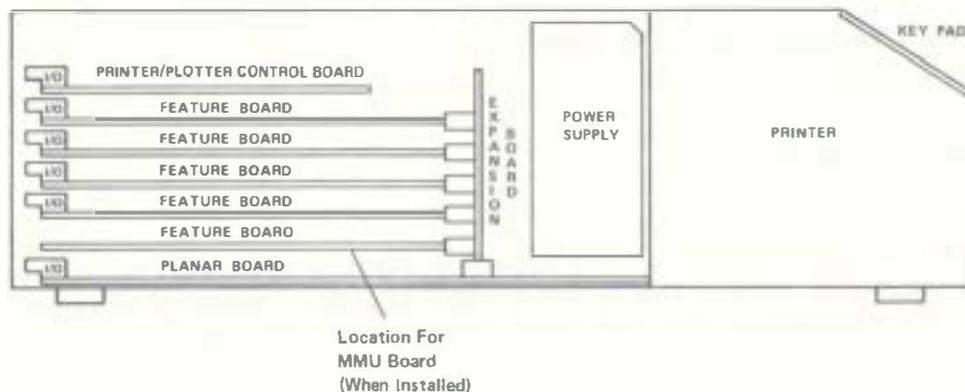


Figure 5-5. Processor Unit (Side View)

5.2.1 REMOVAL

1. Remove the covers. See Section 5.1.1, "Removal."
2. Disconnect all the harnessed connectors and the 5¼" diskette connector from the printer/plotter control board. See Figure 5-6.
3. Remove the printer/plotter control board by carefully sliding it toward the rear of the processor unit. See Figure 5-7.

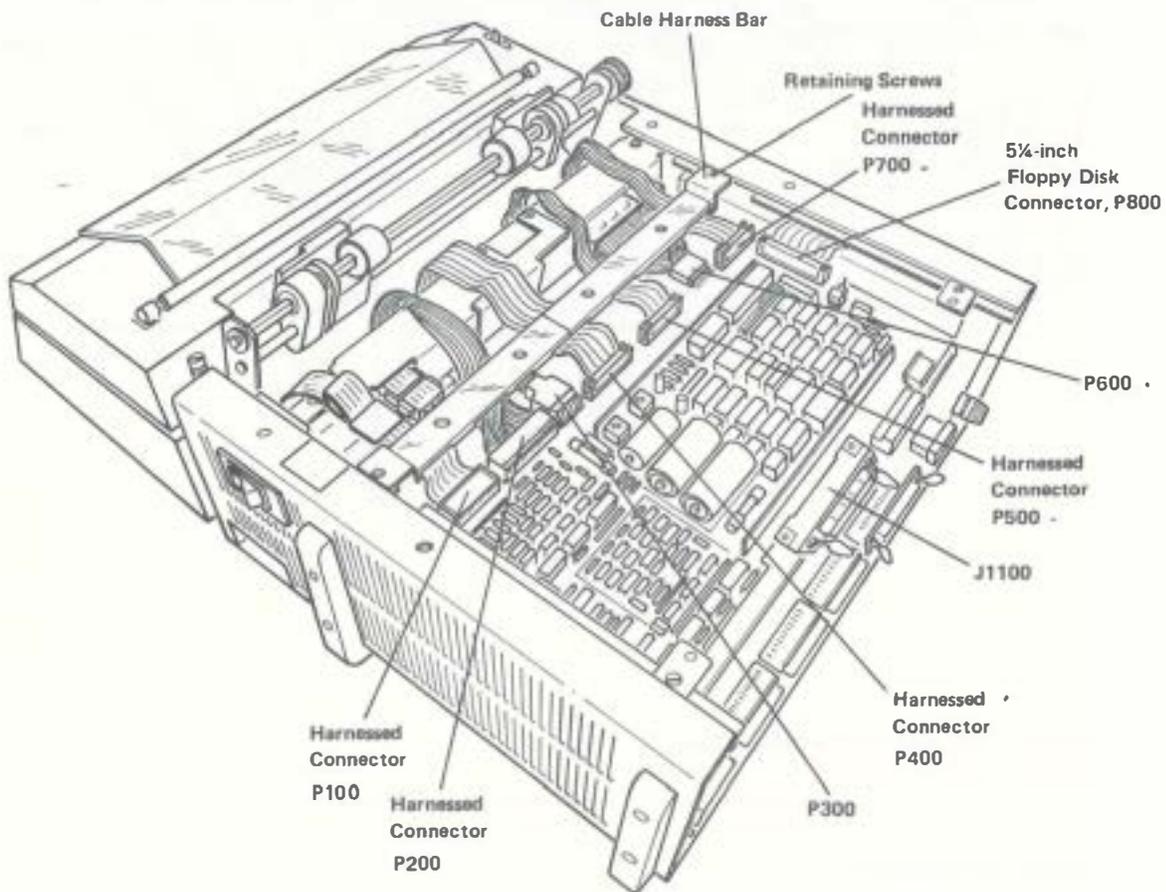


Figure 5-6. Processor Unit (Top View)

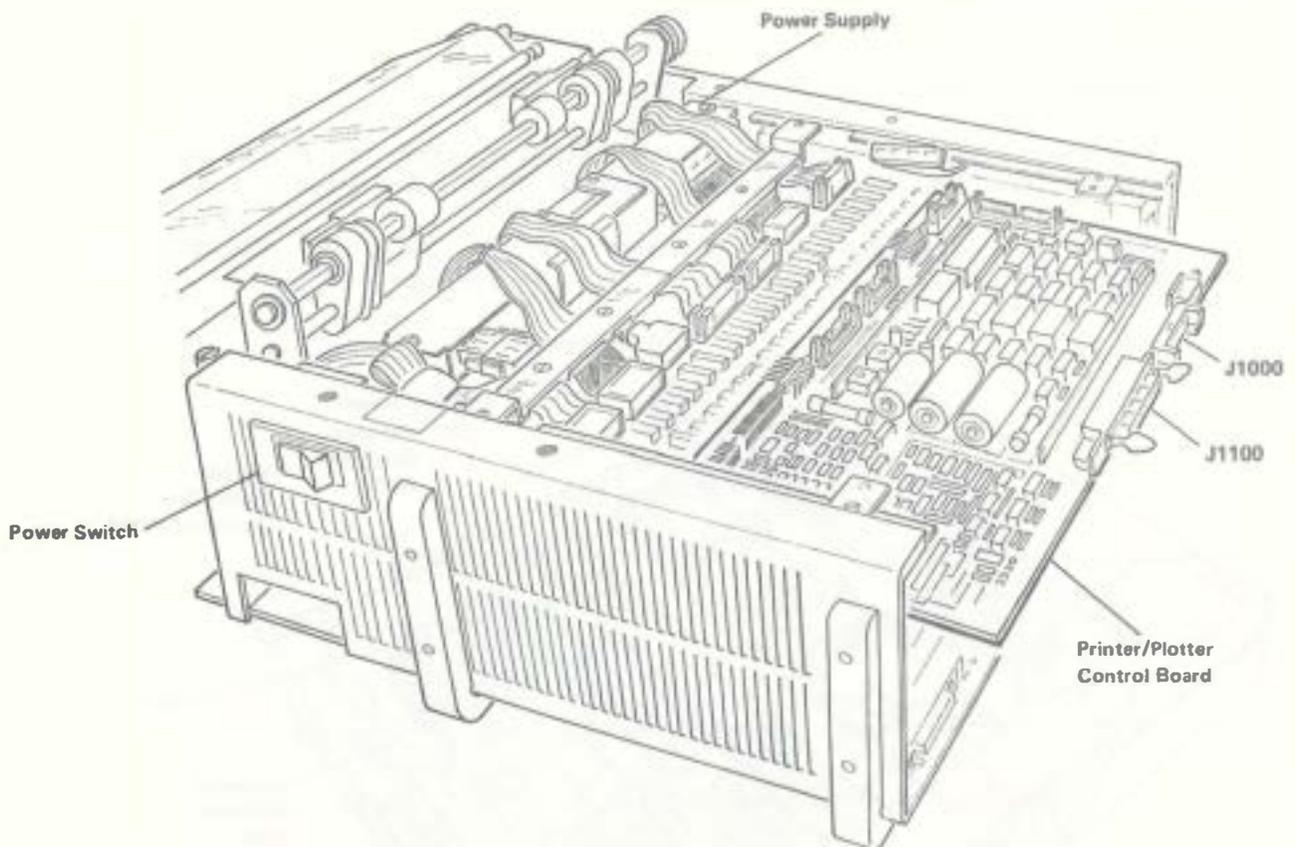


Figure 5-7. Printer/Plotter Control Board

5.2.2 REPLACEMENT

1. Carefully slide the printer/plotter control board into the processor unit. See Figure 5-7. Be sure it is positioned properly.
2. Reconnect all the harnessed connectors and the 5¼" diskette connector to the printer/plotter control board. See Figure 5-6.
3. Replace the covers. See Section 5.1.2, "Replacement."

5.3 FEATURE BOARDS

The feature boards (sensor I/O, additional memory, etc.) plug into the expansion board and are located in the slots above the planar board. Up to five feature boards can be installed in the processor unit.

5.3.1 REMOVAL

1. Position the IBM 9001 power switch to OFF and unplug the main power cord from the wall outlet. See Figure 5-1.
2. Remove the main power cord and all other connectors from the processor unit back plate. See Figure 5-1.
3. Remove the processor unit back plate by loosening the four retaining screws in the plate (all processor units) or removing the eight screws on the serial and parallel ports (earlier processor units). See Figure 5-3. Pull the back plate away from the processor unit.
4. Remove the feature board by grasping the ejector levers at the sides of the feature board and pulling toward the rear of the processor unit. See Figure 5-8.

5.3.2 REPLACEMENT

Note: There can be no empty slots between a sensor I/O board and the planar board or MMU board if so equipped.

1. Slide the feature board into a slot above the planar board until the feature board's ejector levers hook onto the sides of the processor unit frame. See Figure 5-8.
2. Grasp the ejector levers and push them toward the front of the processor unit until the feature board is firmly seated in the expansion board.
3. Place the back plate on the processor unit. Be sure that the spring-loaded CRT display cable connector clips are not behind the back plate and then secure the plate by tightening the retaining screws. See Figure 5-3. Replace the eight screws on the serial and parallel ports (earlier processor units).

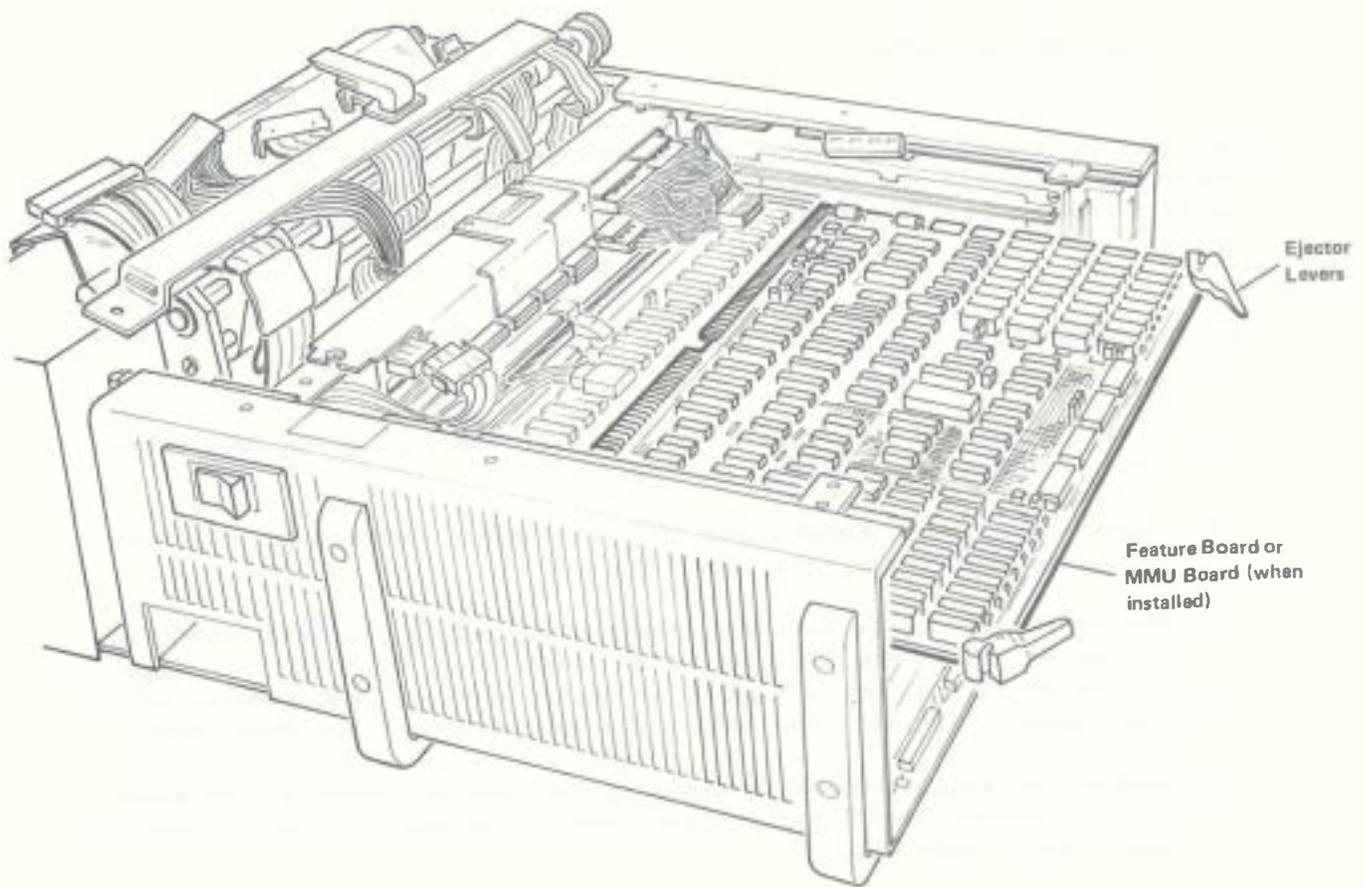


Figure 5-8. Feature Board

4. Reconnect the main power cord and all other connectors removed from the processor unit back plate. See Figure 5-1.
5. Plug the main power cord into the wall outlet. See Figure 5-1.
6. Position the IBM 9001 power switch to ON and do an operational check of the system.

5.4 MEMORY MANAGEMENT UNIT (MMU)

The MMU plugs into the expansion board and into a interface assembly installed on the planar board in place of the 68000 minicomputer chip. See Figure 5-38. The MMU must occupy the slot immediately above the planar board. See Figure 5-5.

5.4.1 REMOVAL

1. Remove cover. See Section 5.1.1, "Removal."
2. Remove the MMU by grasping the ejector lever at each side of the board and pulling toward the rear of the processor. See Figure 5-8.

5.4.2 REPLACEMENT

1. Slide the MMU board into the slot immediately above the planar board until the ejector levers at each side hook onto the side frame of the processor. Grasp the ejector levers and push forward toward the front of the processor until the MMU board is firmly seated in the expansion board and interface assembly. See Figure 5-38.
2. Replace processor covers, display/bridge assembly, and back plate connectors. See Section 5.1.2, "Replacement."

5.5 POWER SUPPLY

The power supply is located in the processor unit between the expansion board and the printer/plotter. See Figure 5-5.

5.5.1 REMOVAL

1. Remove the covers. See Section 5.1.1, "Removal."
2. Disconnect all the harnessed connectors from the printer/plotter control board. See Figure 5-6.

3. Remove the two cable harness retaining screws and place the cable harness out of the way toward the front of the processor unit and over the tractor bar. See Figure 5-6.
4. Disconnect the two AC connectors and the two DC connectors from the power supply. See Figure 5-9.

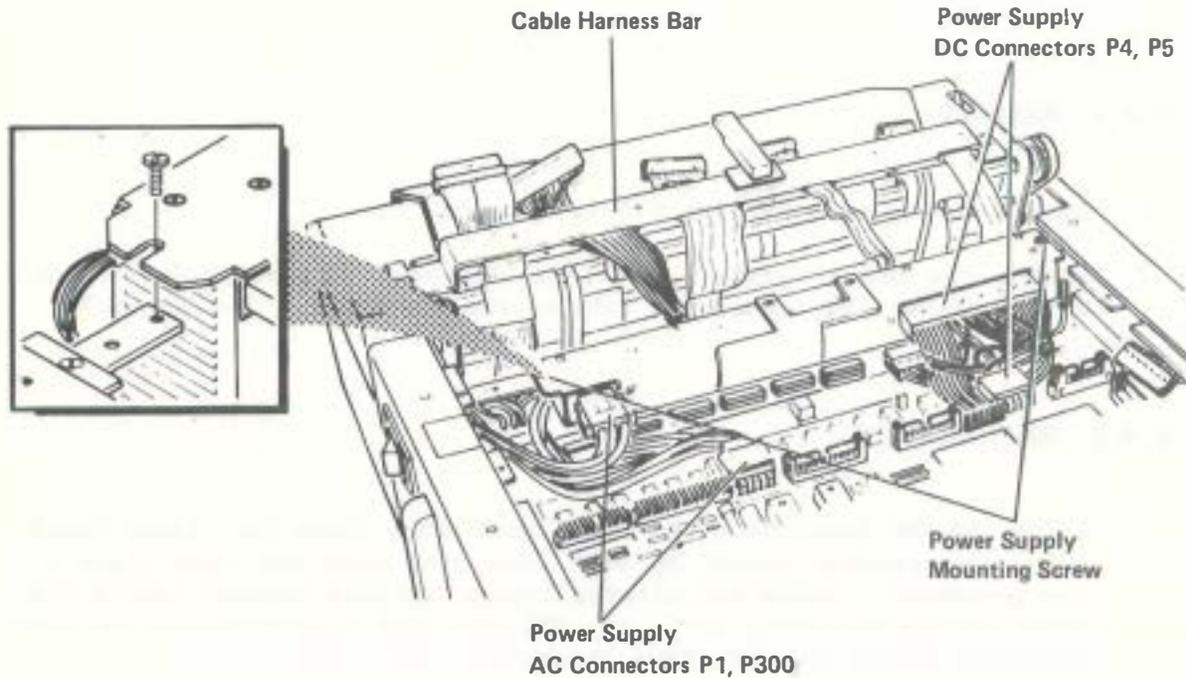


Figure 5-9. Power Supply Connections

5. Remove the two screws securing the power supply to the frame. See Figure 5-9.
6. Disconnect the AC line connector and gently lift the power supply out of the processor unit. See Figure 5-11.

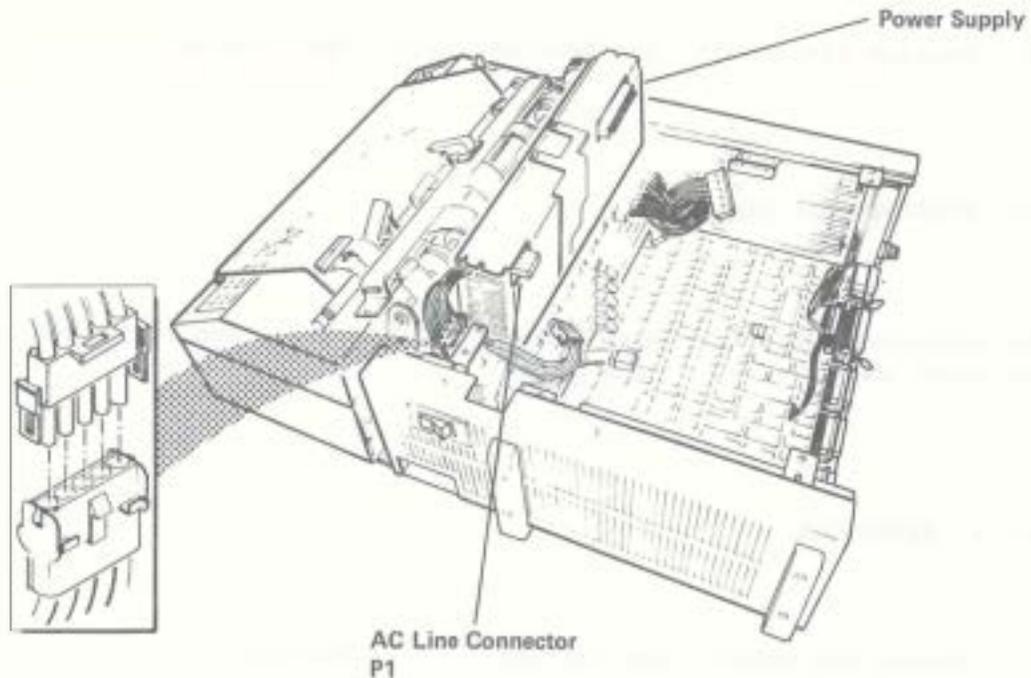


Figure 5-10. Power Supply and AC Line Connector

5.5.2 REPLACEMENT

1. Reconnect the AC line connector and replace the power supply by gently lowering it back into position. Be sure that the printer/plotter AC cable is positioned under the power supply support bracket, and that this bracket interlocks with the bracket on the expansion board. See Figure 5-11.
2. Secure the power supply to the support bracket with the two screws. See Figure 5-9.
3. Reconnect the two AC connectors and the two DC connectors to the power supply. See Figure 5-9.
4. Position the cable harness clamp assembly over its mounting holes and secure it with the two screws. See Figure 5-6.
5. Reconnect the three harnessed connectors to the printer/plotter control board. Be sure all the connectors are seated properly.

-
6. Replace the covers. See Section 5.1.2, "Replacement."

5.6 EXPANSION BOARD

The expansion board is plugged into the planar board and is located behind the power supply. See Figure 5-5.

5.6.1 REMOVAL

1. Remove the covers. See Section 5.1.1, "Removal."
2. Remove the printer/plotter control board. See Section 5.2.1, "Removal."
3. Remove all feature boards by grasping the ejector levers at the sides of each one and pulling toward the rear of the processor unit. See Figure 5-8.
4. Remove MMU board if installed. See Section 5.4.1, "Removal."
5. Remove the power supply. See Section 5.5.1, "Removal."
6. Disconnect the three DC connectors from the expansion board. See Figure 5-12.
7. Disconnect the grounding clip from the processor unit frame and remove the DC cable assembly. See Figure 5-11.
8. Remove the frame cutout insert on the right side of the processor unit above the Power switch. See Figure 5-11.
9. Remove the expansion board by grasping the ejector levers located on each side of the expansion board and pulling up.

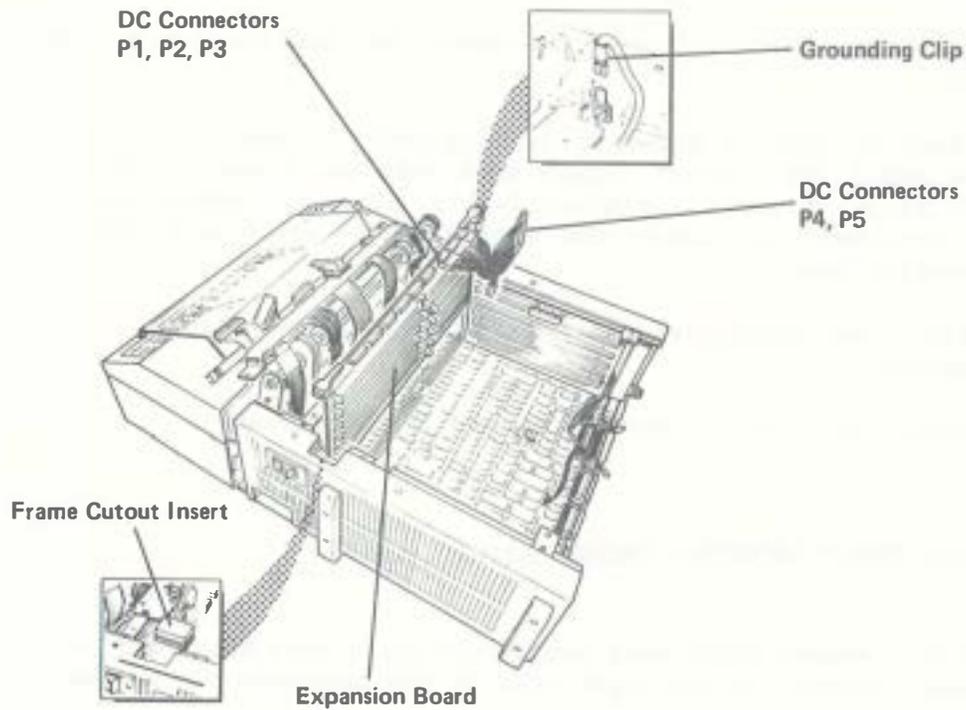


Figure 5-11. Expansion Board

5.6.2 REPLACEMENT

1. Slide the expansion board into the processor unit until the expansion board's ejector levers hook onto the sides of the processor unit frame.
2. Grasp the ejector levers and push them down until the expansion board is firmly seated in the planar board.
3. Replace the frame cutout insert. See Figure 5-11.
4. Reconnect the grounding clip to the processor unit frame. See Figure 5-11.
5. Reconnect the three DC connectors to the expansion board. See Figure 5-11.

-
6. Replace the power supply. See Section 5.5.2, "Replacement."
 7. Install the MMU board if so equipped. See Section 5.4.2, "Replacement."
 8. Replace all feature boards by sliding each of them into the processor unit until the ejector levers hook onto the sides of the processor unit frame. Grasp the ejector levers and push toward the front of the processor unit until the feature boards are firmly seated in the expansion board.
 9. Replace the printer/plotter control board. See Section 5.2.2, "Replacement."
 10. Replace the covers. See Section 5.1.2, "Replacement."

5.7 READ ONLY MEMORY (ROM) CARD

The Read Only Memory (ROM) card plugs into the planar board and is located in the small drawer on the right side of the processor unit. See Figure 5-12.

5.7.1 REMOVAL

1. Position the IBM 9001 power switch to OFF.
2. Position the processor unit so that there is at least 12 inches of clearance on the right side.
3. Grasp the drawer's handle and pull the drawer straight out of the processor unit. See Figure 5-12.
4. Remove the ROM card from the drawer by unscrewing the two mounting screws and lifting it out. See Figure 5-12.

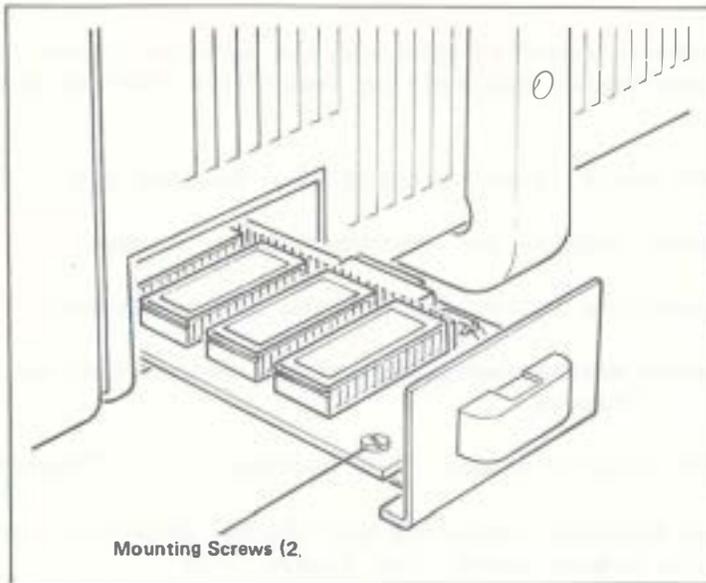


Figure 5-12. Read Only Memory (ROM) Plug-In Drawer

5.7.2 REPLACEMENT

1. Place the ROM card in the drawer and secure it with the two mounting screws. See Figure 5-12.
2. Slide the drawer back into the processor unit until it is firmly seated.

5.8 PLANAR BOARD

The planar board is located in the base of the processor unit. See Figure 5-5.

5.8.1 REMOVAL

1. Remove the covers. See Section 5.1.1, "Removal."
2. Remove the printer/plotter control board. See Section 5.2.1, "Removal."

-
3. Remove all feature boards by grasping the ejector levers at the sides of each feature board and pulling toward the rear of the processor unit.
 4. Remove the MMU board if so equipped. See Section 5.4.1, "Removal."
 5. Remove the power supply. See Section 5.5.1, "Removal."
 6. Remove the expansion board. See Section 5.6.1, "Removal."
 7. Remove the interface assembly from planar board if so equipped. See Section 5.18.1, "Removal."
 8. Remove the ROM plug-in drawer. See Section 5.7.1, "Removal."
 9. Disconnect the keyboard connector and the 5¼" diskette connector from the rear of the planar board. See Figure 5-15.
 10. Remove the three screws at the rear of the planar board that secure the board to the processor unit. See Figure 5-13B.

Note: If your IBM 9001 is not equipped with a printer/plotter, the printer/plotter connectors referred to in the next step are not present.

11. Slide the planar board straight back a few inches and disconnect the keypad connector the printer/plotter connector and the CRT connector from the front of the planar board. See Figure 5-13A.
12. Remove the planar board by carefully sliding it out the rear of the processor unit.

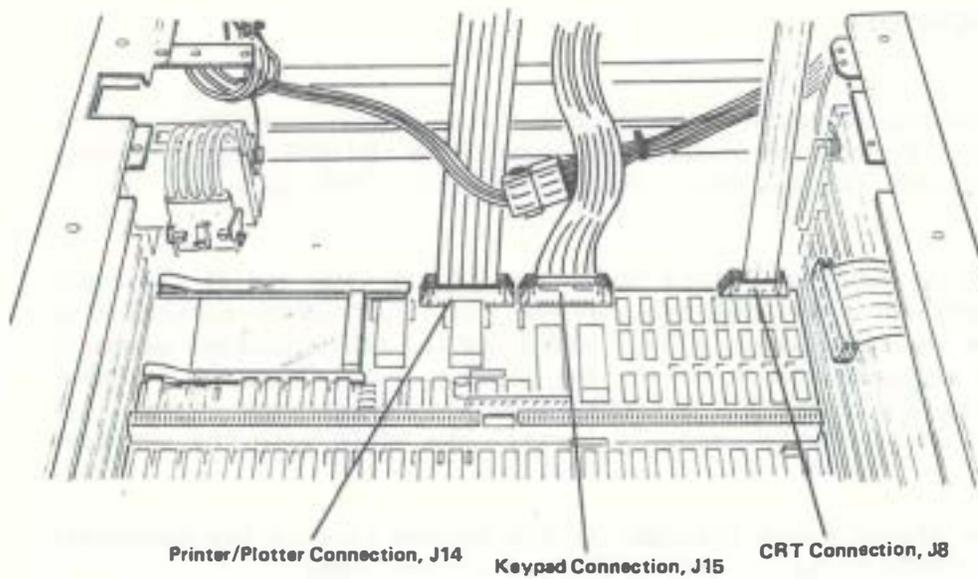


Figure 13A. Planar Board Connections (Front)

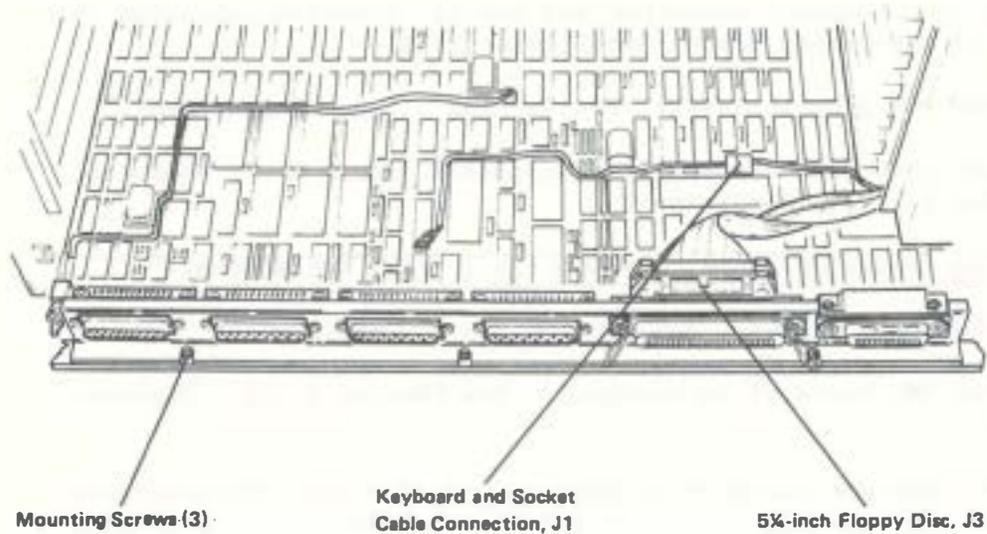


Figure 13B. Planar Board Connections (Rear)

5.8.2 REPLACEMENT

Note: If a new planar board is being installed, remove the ROM card from the new board. Remove the current ROM card from the ROM plug-in drawer and replace it with the new one. See Section 5.6, "ROM Card."

1. If the CPU is equipped with a Memory Management Unit and if the board being replaced is not the one removed, lift the 68000 minicomputer chip from the replacement planar board and the MMU interface assembly from the replaced planar board. See Section 5.18, "Removal." Carefully plug the interface assembly into the replacement board. See Section 5.18.2, "Replacement." Install the 68000 with the replaced board.
2. Slide the planar board straight in the bottom slot of the processor unit to within a few inches of the end of its travel.
3. Reconnect the keypad connector and the two printer/plotter connectors (if present) to the front of the planar board. See Figure 5-14A.
4. Slide the planar board the rest of the way in.
5. Secure the planar board to the processor unit with the three screws. See Figure 5-13B.
6. Reconnect the keyboard connector and the 5 $\frac{1}{4}$ " diskette connector to the rear of the planar board. See Figure 5-13B.
7. Replace the ROM plug-in drawer. See Section 5.7.2, "Replacement."
8. Replace the interface assembly on the planar board if so equipped. See Section 5.18.2, "Replacement."
9. Replace the expansion board. See Section 5.6.2, "Replacement."
10. Replace the power supply. See Section 5.5.2, "Replacement."
11. Replace the MMU board if so equipped. See Section 5.4.2, "Replacement."
12. Replace all feature boards by sliding each of them into the processor unit until the ejector levers hook onto the sides of the processor unit frame. Then grasp the ejector levers and push toward the front of the processor unit until the feature boards are firmly seated in the expansion board.
13. Replace the printer/plotter control board. See Section 5.2.2, "Replacement."

14. Replace the covers. See Section 5.1.2, "Replacement."

5.9 KEYPAD (PRINTER/PLOTTER COVER ASSEMBLY)

The keypad is located on the top front cover of the printer/plotter. See Figure 5-14A. The keypad, top cover, and keypad circuit board are a complete unit. See Figure 5-14B.

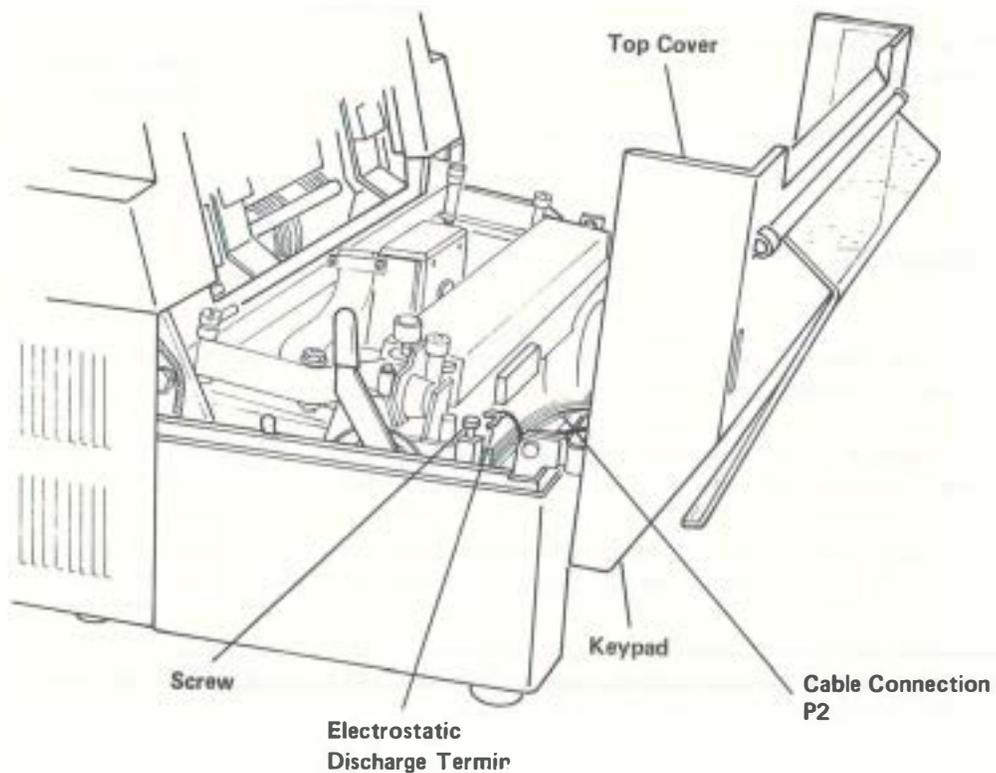


Figure 5-14A. Printer/Plotter Top Cover.

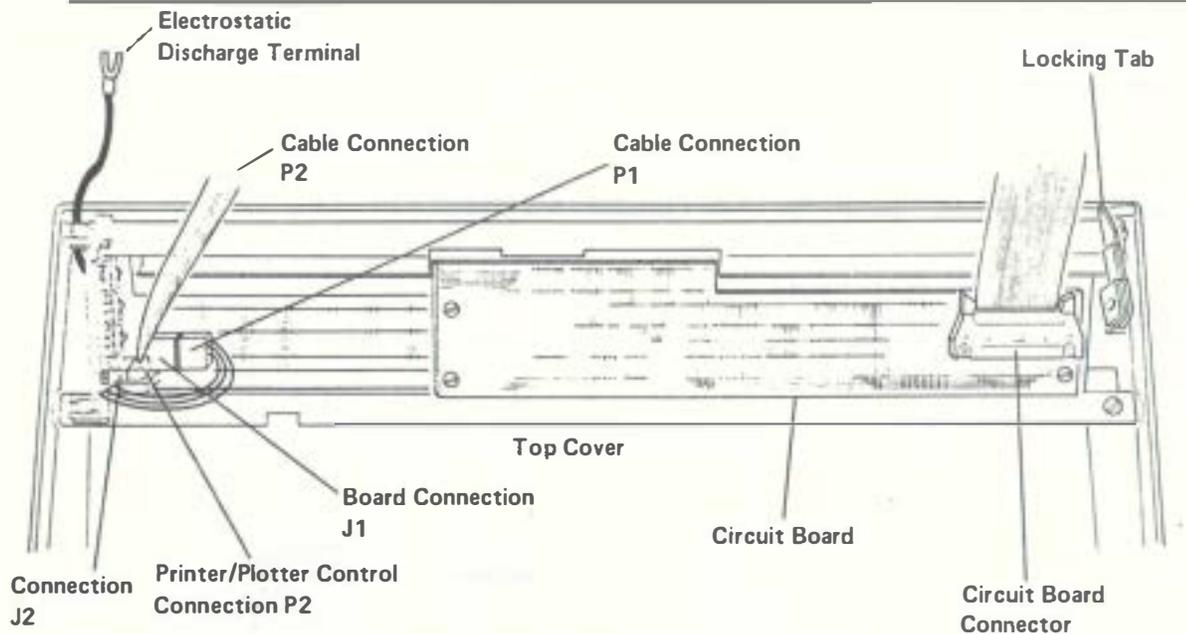


Figure 5-14B. Keypad and Connections

5.9.1 REMOVAL

1. Position the power switch to OFF and unplug the main power cord from the wall outlet.
2. Disconnect the electrostatic discharge spade terminal by loosening screw located on the block. See Figure 14A.
3. Fold down the clear printer/plotter cover (if present) and open the printer/plotter cover by lifting it from the rear. See Figure 5-14A.
4. Disconnect the circuit board connector from the right side of the circuit board by spreading apart the two retaining clips on each side of the connector. See Figure 5-14B.
5. Disconnect the printer/plotter control connector on the left side of the keypad. See Figure 5-14B.
6. Remove the top cover by pulling it straight up until it snaps out of its retaining clips.

5.9.2 REPLACEMENT

1. Snap the printer/plotter cover into its retaining clips.

-
2. Reconnect the electrostatic discharge terminal. See Figure 14A.
 3. Reconnect the printer/plotter control connector (J2). See Figure 5-14B.
 4. Reconnect the keypad circuit board connector and press the two retaining clips on each side of the connector back into place. See Figure 5-11.
 5. Close the printer/plotter cover.

5.10 PRINTER/PLOTTER

The printer/plotter is located at the front of the processor unit. See Figure 5-5.

5.10.1 REMOVAL

1. Remove the covers. See Section 5.1.1, "Removal."
2. Remove the ROM plug-in drawer. See Section 5.6.1, "Removal."
3. Remove the two retaining screws that hold the cable harness bar in place. See Figure 5-15.
4. Disconnect the motors connector and print head connector from the printer/plotter control board. Remove these connectors from the cable harness retaining bar by removing the plastic screws that hold that portion of the cable harness retaining bar in place. These connectors are part of the printer/plotter and are removed with it. See Figure 5-15.
5. Disconnect the 5-pin AC line connector. See Figure 5-10.
6. Disconnect the printer/plotter control board AC connector. See Figure 5-15.

WARNING: Use extreme care when moving and supporting the processor unit and its attached components. The complete unit can weigh more than 50 pounds without the CRT display unit, and personal injury or damage to the equipment can occur if the unit slips off the desk or bench. Make sure that the rear cable connections are clear and free of obstruction.

CAUTION: At no point in this procedure should you turn the processor unit on its side or on its back.

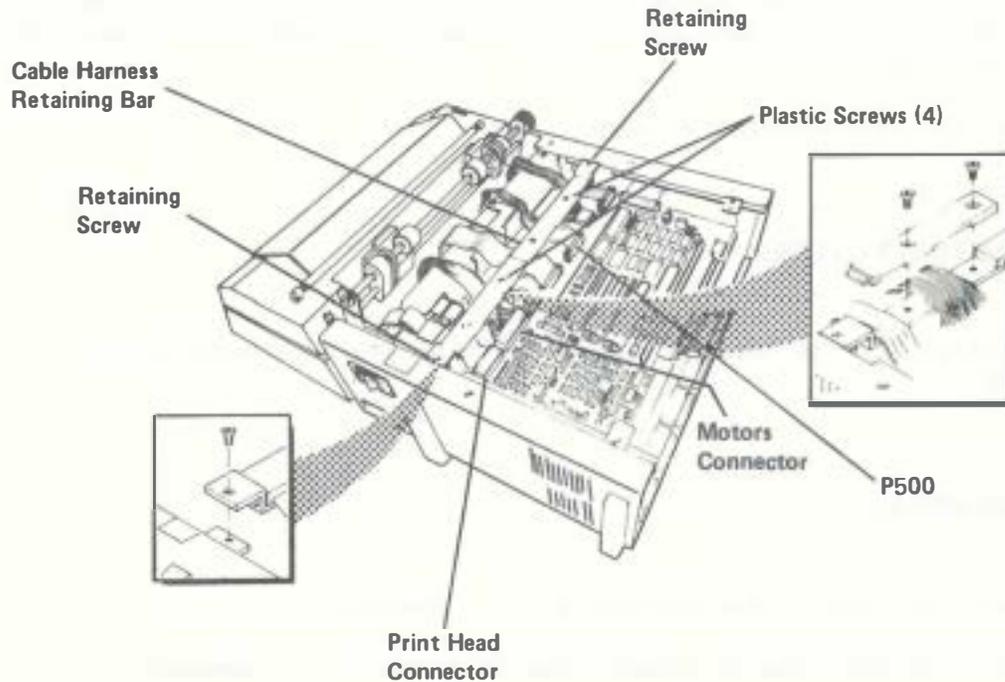


Figure 5-15. Processor Unit Cable Harness (Top View)

7. Remove the two printer/plotter thumbwheel mounting screws located on the underside of the unit. See Figure 5-16.
8. Holding the printer/plotter by the front, tilt the front up and lift until the hooks at the top release from the processor unit. Move the printer/plotter out two or three inches from the processor unit. See Figure 5-18.
9. Carefully pull the control board AC cable out of the processor unit. See Figure 5-15.
10. Disconnect the fan AC connector. See Figure 5-19.

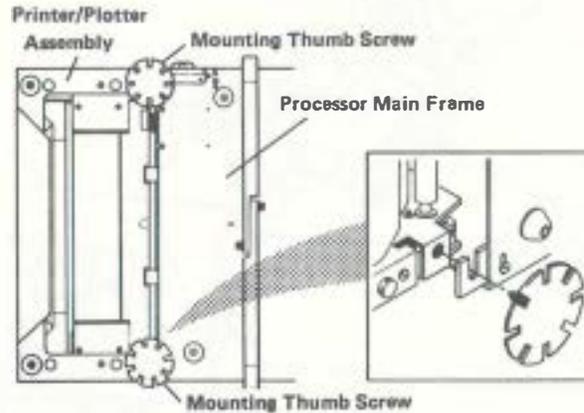


Figure 5-16. Printer/Plotter Thumbwheel Mounting Screws

11. Remove the printer cable from the left rear of the printer/plotter. See Figure 5-18.
12. Remove the print head cable and motors cable from the right rear of the printer/plotter. See Figure 5-18.
13. Remove the keypad. See Section 5.8.1, "Removal."

5.10.2 REPLACEMENT

1. Place the printer/plotter next to the processor unit.
2. Reconnect the printer cable to the left rear of the printer/plotter. See Figure 5-18.
3. Reconnect the fan AC connector. See Figure 5-18.
4. Route the control board AC cable through the processor unit and connect it to the power supply. See Figure 5-15.

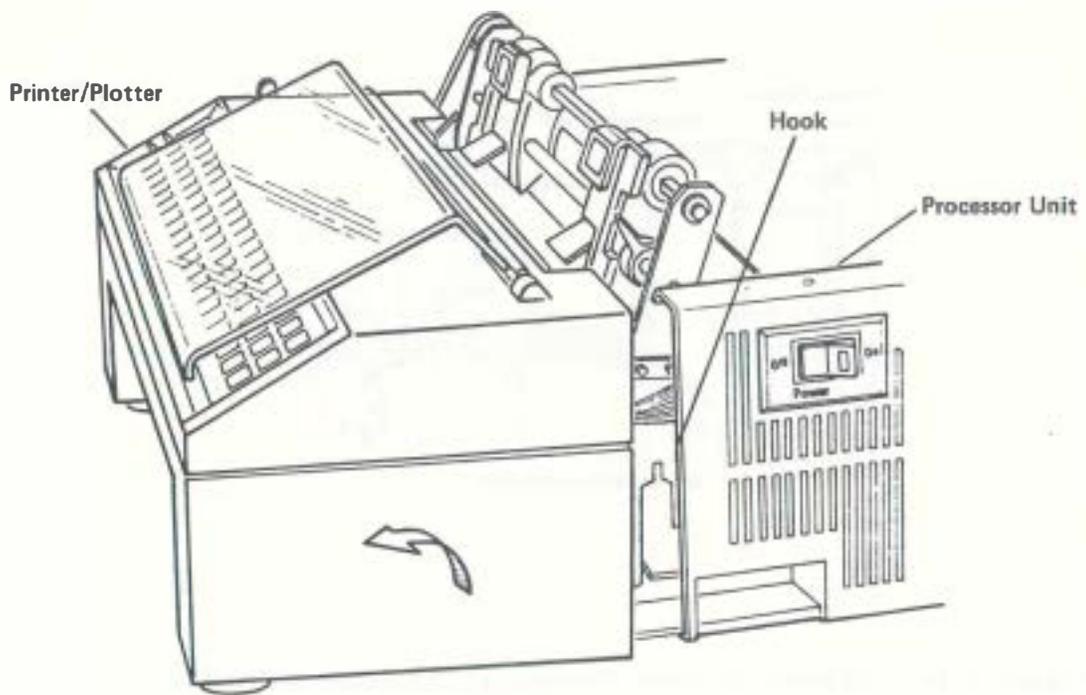


Figure 5-17. Separating the Printer/Plotter from the Processor Unit

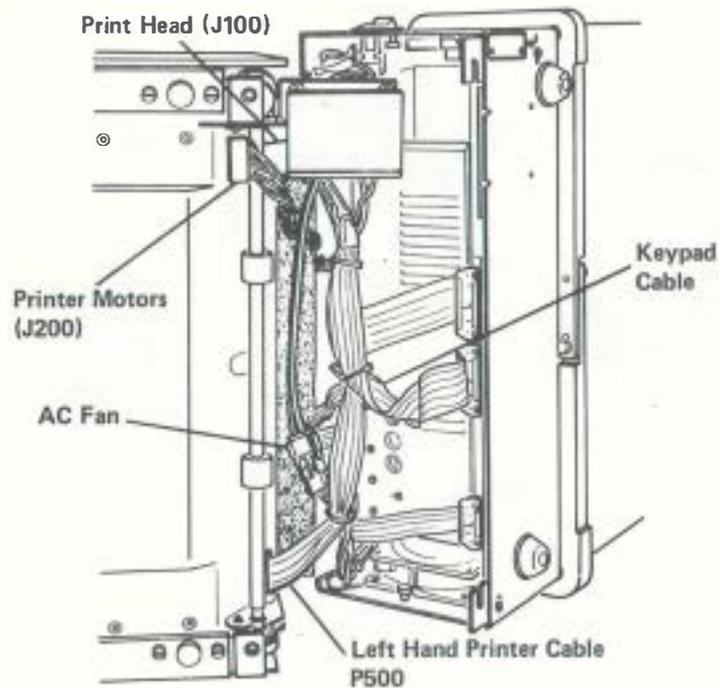


Figure 5-18. Printer/Plotter and Processor Unit (Bottom View)

5. Route the print head cable and motors cable through the right rear of the processor unit. See Figure 5-18.
6. Replace the print head cable and motors cable on the cable harness retaining bar and install the top portion of the bar with the plastic screws. See Figure 5-15.
7. Holding the printer/plotter by the front, lift the assembly and push forward and then down until the hooks latch onto the studs on the processor unit. Check that the cables are not crimped between the assemblies. See Figure 5-19.

Printer/Plotter
Assembly

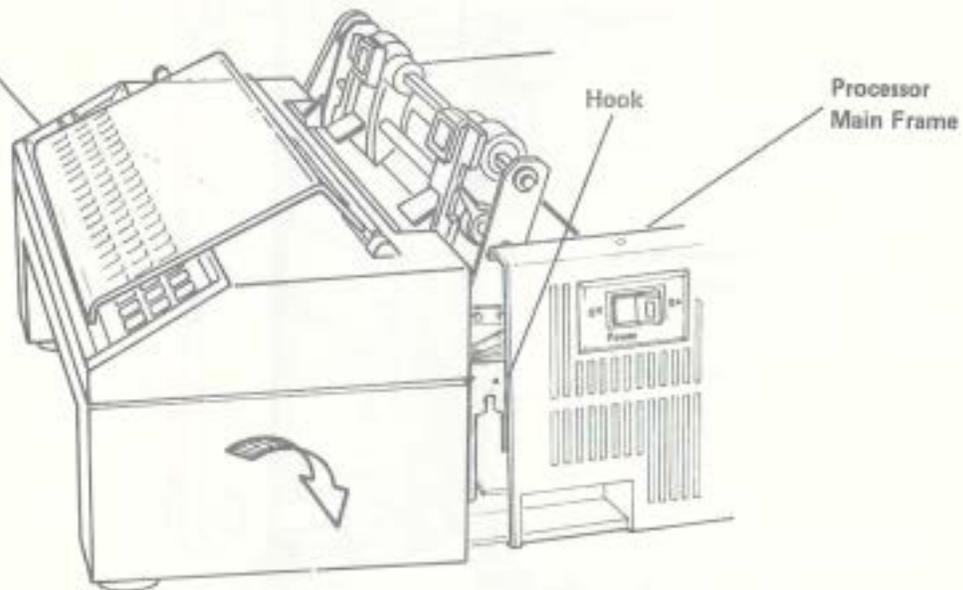


Figure 5-19. Printer/Plotter Replacement

8. Replace the two thumbwheel mounting screws that secure the printer/plotter to the processor unit. See Figure 5-16.
9. Position the cable harness assembly over its mounting holes and secure it with the two retaining screws. See Figure 5-15.
10. Reconnect all the harnessed connectors to the printer/plotter control board. Be sure all the connections are seated properly.
11. Reconnect the 5-pin AC line connector. See Figure 5-10.
12. Replace the keypad. See Section 5.9.2, "Replacement."
13. Replace the ROM plug-in drawer. See Section 5.7.2, "Replacement."
14. Replace the covers. See Section 5.1.2, "Replacement."

5.11 PRINTER/PLOTTER RIBBON

Ribbon for the printer/plotter is supplied in a snap-in cartridge that makes changing clean and easy. For best results, use only IBM Instruments ribbon cartridges.

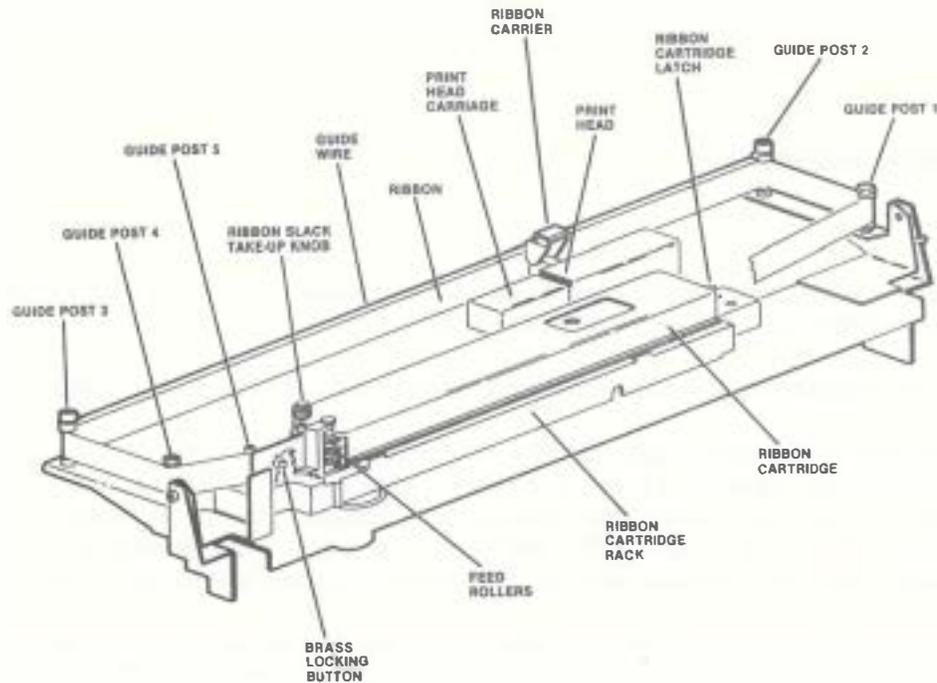


Figure 5-20. Parts Identification for Ribbon and Guide Wire Changing

5.11.1 REMOVAL

1. Position the IBM 9001 power switch to OFF.
2. Position the On Line/Off Line/Form Set switch on the front panel to Off Line.
3. Fold the clear printer/plotter cover down and open the printer/plotter cover by lifting it from the rear.
4. Open the feed rollers by pulling them forward until they latch out.
5. Slide the print head mechanism to the middle of the writing line.

-
6. Push down on the spring-loaded lever (the Ribbon Cartridge Latch) near the right side of the ribbon cartridge. This releases the cartridge.
 7. Slide the cartridge about an inch to the right.
 8. Remove the ribbon from the ribbon guide on the print head. Lift the ribbon off the corner guides and discard the ribbon cartridge.

5.11.2 REPLACEMENT

1. Remove the ribbon cartridge from its package. Discard the cardboard insert from the end of the cartridge.
2. Pull 4 inches of ribbon from the right end of the cartridge.
3. Position the cartridge on the cartridge rack about 1 inch to the right of the feed rollers its final position. The rack has small runners, and the cartridge itself has ridges in the bottom. Insert the ribbon from the left end of the cartridge between the feed rollers but not around any of the other ribbon posts at this time.
4. Press the cartridge down on the rack and slide it to the left until it snaps into position. Pull up slightly on the cartridge to ensure that it is locked in place.
5. Working from the right to the left, bring the ribbon around guide posts 1 and 2 between the nylon ribbon carrier and the print head hooks and under the hooks and finally around guide posts 3, 4, and 5.
6. Press down the small brass locking button on the left side of the cartridge rack. This allows the front and rear feed rollers to engage.
7. Use the blue ribbon slack take-up knob to take up any slack in the ribbon.
8. The new ribbon cartridge is now ready for use. Replace the printer/plotter cover, set the On Line/Off Line/Form Set switch on the front panel to On Line to continue operation.

5.12 PRINTER/PLOTTER GUIDE WIRE

The printer/plotter guide wire supports the ribbon carrier. If it develops slack and no longer supports the ribbon carrier, you should replace it. See Figure 5-20.

5.12.1 REMOVAL

1. Lift the guide wire loop off guide post 2.
2. Remove the guide wire from the slot on top of the ribbon carrier.
3. Lift the guide wire ring terminal off guide post 3.

5.12.2 REPLACEMENT

1. Place the guide wire ring terminal on guide post 3.
2. Place the guide wire in the slot on top of the ribbon carrier.
3. Grasp the guide wire by the spring housing on the loop end and stretch the wire loop over guide post 2.

5.13 5-1/4" DISKETTE DRIVE

A 5¼" diskette drive may be located in the CRT display unit housing or in an assembly connected to the 5¼" Floppy Disk Control port on the processor unit back plate.

5.13.1 REMOVAL FROM CRT DISPLAY UNIT

1. Stop all diskette activity and remove the diskette.
2. Position the IBM 9001 power switch to OFF and unplug the main power cord from the wall outlet.

-
3. Disconnect the CRT display cable by pushing back on the spring-loaded retaining clips that hold the connector in place disconnecting the grounding clip and pulling the connector away from the processor unit back plate. See Figure 5-1.

Note: When removing the CRT display unit and bridge assembly note the placement of the bridge over the tractor drive shaft on the printer/plotter. The bridge must be placed over the tractor drive shaft when replacing the assembly.

4. Remove the CRT display unit and bridge assembly by loosening the four knurled thumb screws and lifting the assembly. See Figure 5-2.
5. Carefully place the assembly upside down on a flat surface so that the two diskette mounting screws under the CRT are visible. It may be necessary to loosen the gimbal and rotate the bridge to gain access to the mounting screws. See Figure 5-21.
6. Loosen the two mounting screws and slide the diskette drive out through the front of the CRT display unit housing.
7. Disconnect the two connectors and remove the diskette drive. See Figure 5-22.

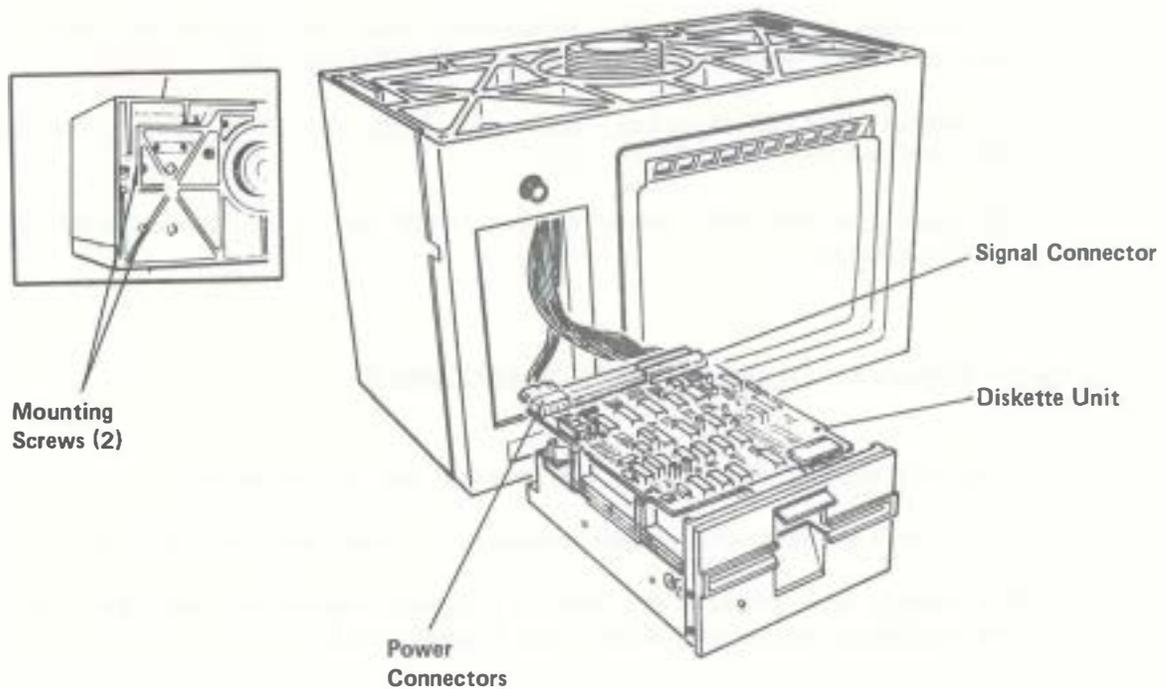


Figure 5-21. 5 1/4" Diskette Drive

5.13.2 REPLACEMENT

1. Reconnect the two connectors to the diskette drive. Be sure the connectors are seated properly. See Figure 5-21.
2. Carefully slide the diskette drive into the CRT display unit housing and secure it with the two mounting screws. See Figure 5-21.
3. Realign the bridge with the CRT display unit and tighten the gimbal.

Note: When replacing the CRT display unit and bridge assembly, the bridge must be placed over the tractor drive shaft on the printer/plotter.

-
4. Place the CRT display unit and bridge assembly on the processor unit over the bridge mounting holes. See Figure 5-2.
 5. Secure the assembly to the processor unit by tightening the four knurled thumb screws on the bridge. See Figure 5-2.
 6. Reconnect the CRT display cable and plug the main power cord into the wall outlet. See Figure 5-1.
 7. Position the IBM 9001 power switch to ON and do an operational check of the system.

5.13.3 REMOVAL DISKETTE DRIVE ASSEMBLY

1. Stop all diskette activity and remove the diskette(s).
2. Position the diskette drive assembly's power switch to "OFF."
3. Disconnect the power cord and all other connectors on the rear of the diskette drive assembly. See Figure 5-22.
4. Remove the four screws securing the diskette drive assembly's cover. Remove the cover. See Figure 5-23.
5. Disconnect the power connector, ground clip, and ribbon connectors from the back of the diskette drive being removed. See Figure 5-24.
6. Remove the two screws securing the diskette drive to the housing. See Figure 5-23.
7. Slide the diskette drive toward the front and out of the housing.
8. To remove the other diskette drive, repeat steps 5-7.

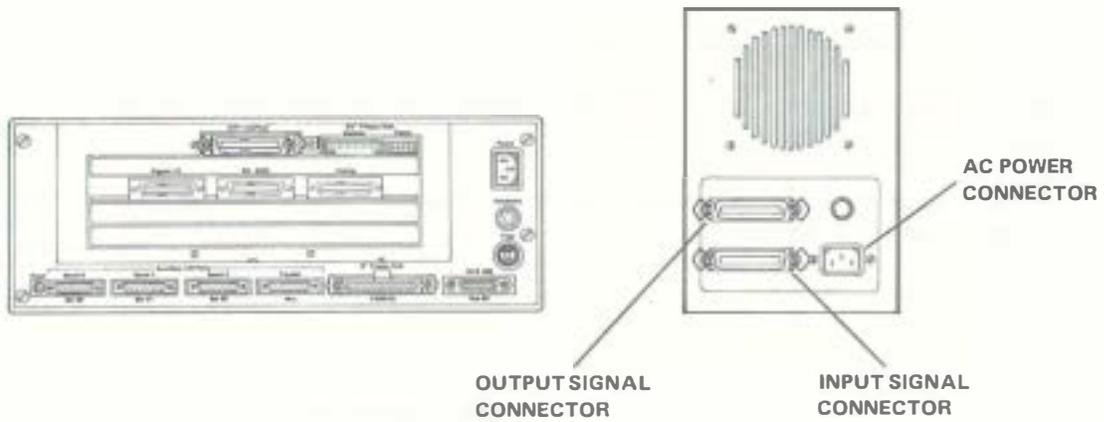


Figure 5-22. 5 1/4" Diskette Drive Assembly Connections

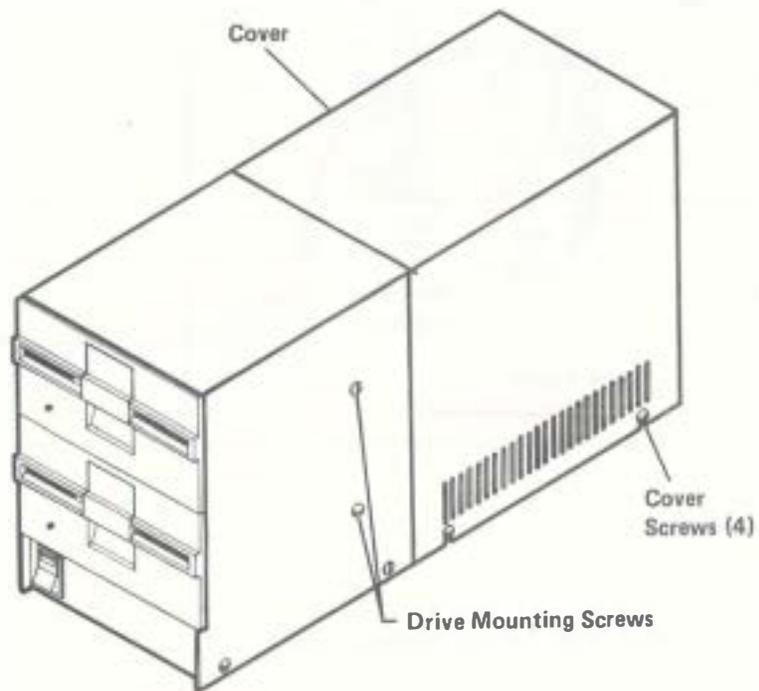


Figure 5-23. 5 1/4" Diskette Drive Assembly

5.13.4 REPLACEMENT

1. Place the diskette drive in the housing and slide it into position.
2. Secure the diskette drive to the housing with the two screws. See Figure 5-23.
3. If both diskette drives were removed, repeat Steps 1 and 2 for the second diskette drive.

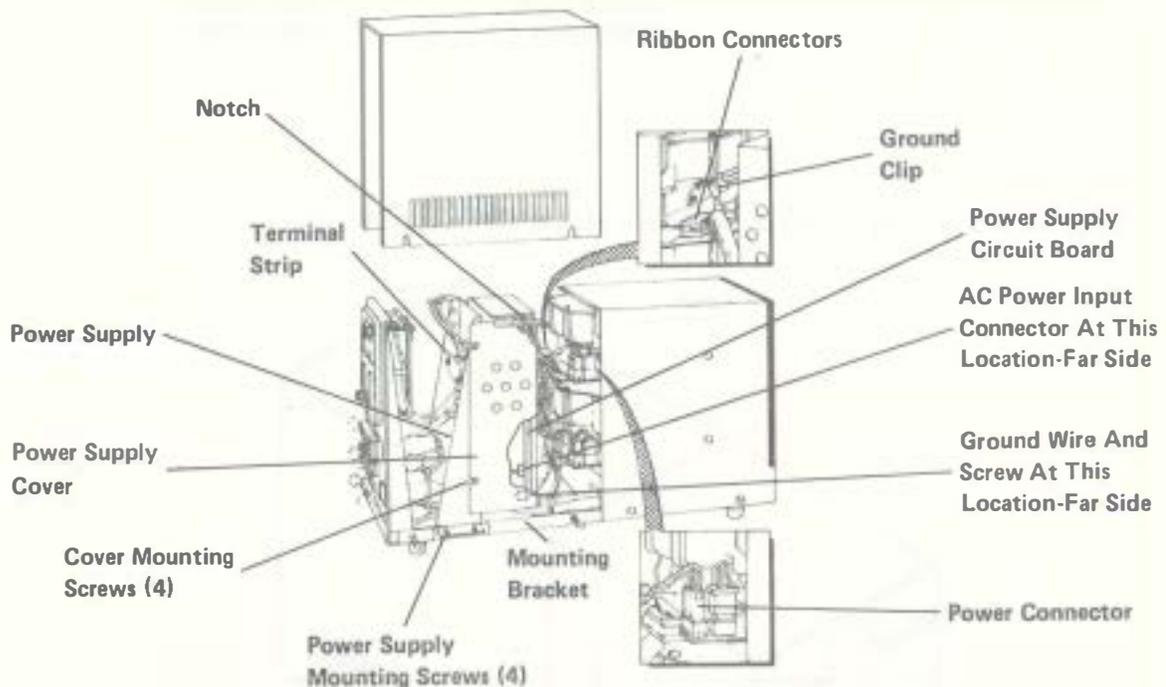


Figure 5-24. 5 1/4" Diskette Drive Connections

4. Reconnect the power connector, ground clip, and ribbon connector to the rear of the diskette drive. Make sure the connectors to the other diskette drive are also attached. See Figure 5-24.
5. Place the cover on the diskette drive assembly. Secure the cover with the four screws. See Figure 5-23.

-
6. Reconnect the power cord and all other connectors that were removed from the rear of the diskette drive assembly. See Figure 5-22.
 7. Position the diskette drive assembly's power switch to ON.
 8. Insert diskettes and do an operational check of the diskette drive assembly.

5.13.5 POWER SUPPLY REMOVAL

1. Remove 5¼" Diskette Drive Assembly. See Section 5.13.3, "Removal."
2. Remove the screw and star washer securing the ground wire to the cover. Remove the ground wire. See Figure 5-24.
3. Remove the four screws securing the power supply and bracket to the chassis. Remove the power supply. See Figure 5-24.
4. Remove the four screws securing the power supply.
5. Slide the power connector harness through the notch on the cover very carefully and remove the power supply cover. See Figure 5-24.
6. Lift power supply assembly up and rotate the assembly with circuit board facing away from the chassis.
7. Disconnect AC power input connector on power supply circuit board. See Figure 5-24.
8. Remove four mounting screws securing circuit board to mounting bracket and remove the circuit board.

5.13.6 REPLACEMENT

1. Position circuit board over four threaded standoffs on mounting bracket. Position AC power input connector towards the chassis and facing the diskette drive. Secure the circuit board to the mounting bracket with the four screws.
2. Reconnect AC power input connector to receptacle on circuit board. See Figure 5-24.
3. Position the circuit board and mounting bracket in place for mounting to the chassis.

-
4. Install the power supply mounting cover and secure the cover to the mounting bracket and circuit board assembly with the four mounting screws. See Figure 5-24.
 5. Slide the power connector harness through the notch in the cover ready for connecting to the disk drive(s). See Figure 5-24.
 6. Install four mounting screws and secure power supply assembly to chassis. See Figure 5-24.
 7. Install ground wire terminal with external tooth star washer and screw securing the ground wire to the cover. See Figure 5-24. Make certain star washer is located at face of power supply cover to ensure proper grounding.

Caution: Check all wires including wiring to terminal strip on power supply mounting bracket and make certain all connections are tight.

8. Install diskette drive assembly. See Section 5.13.4, "Replacement."

5.14 8" DISKETTE DRIVE

The 8" diskette drives are located in an assembly connected to the 8" Floppy Disk port on the processor unit back plate.

5.14.1 REMOVAL

1. Stop all diskette activity and remove the diskette(s).
2. Position the diskette drive assembly's power switch to OFF.
3. Disconnect the power cord and all other connectors on the rear of the diskette drive assembly. See Figure 5-25.

- Carefully lay the diskette drive assembly on its side and remove the five screws holding its cover in place. See Figures 5-25 and 5-26.

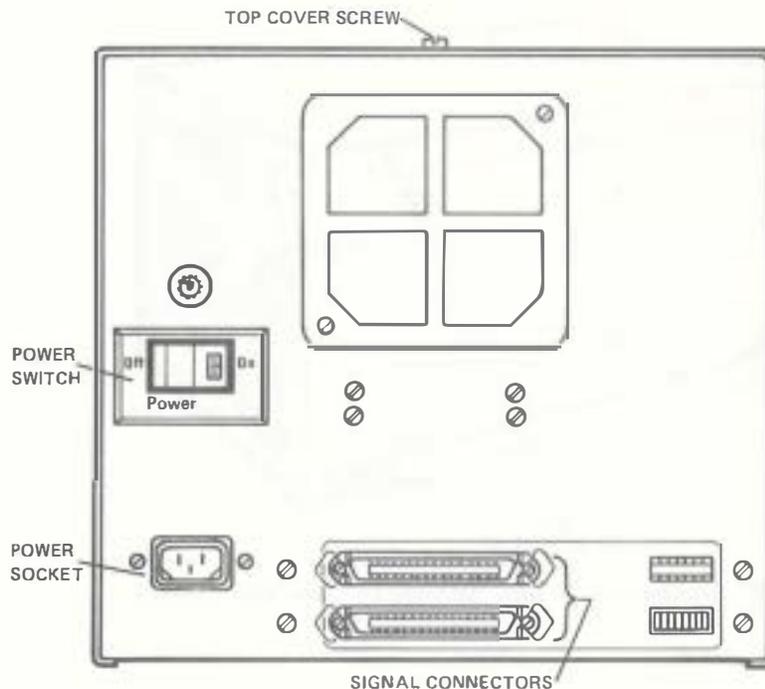


Figure 5-25. 8" Diskette Drive Assembly Connections

- Return the assembly to its upright position and slide the cover toward the front. Remove the cover.
- Carefully lay the assembly on its side again so that the diskette drive to be removed is on the top.
- Locate and remove the mounting screw securing the diskette drive to the housing. See Figure 5-26.
- Slide the diskette drive out a few inches and disconnect the three connectors on the rear of the diskette drive. See Figure 5-27.
- Remove the diskette drive.

10. If the bottom diskette drive is to be removed also, repeat steps 7-9.

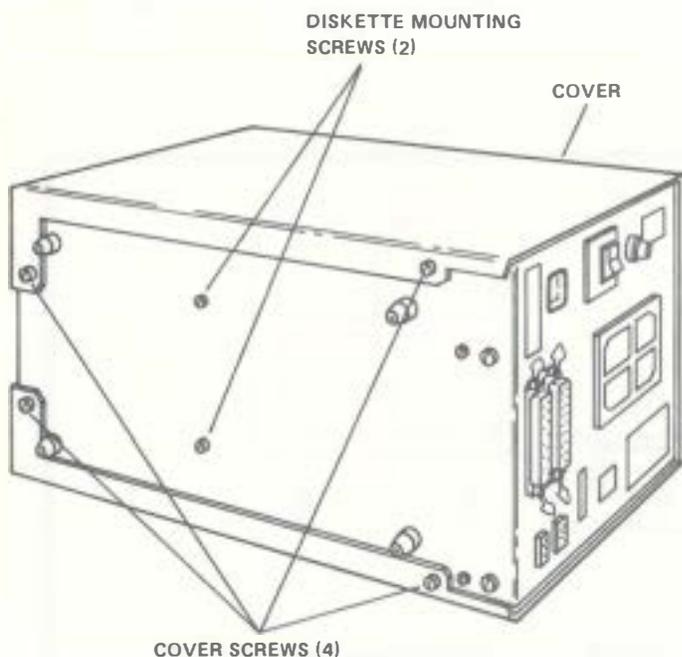


Figure 5-26. 8" Diskette Drive Assembly (Bottom View)

5.14.2 REPLACEMENT

1. Place the diskette drive housing on its side with the installed diskette drive (if any) on the bottom.
2. Slide the diskette drive into the housing until the three rear connectors can be replaced. Replace the connectors. See Figure 5-27.

3. Replace the mounting screw that secures that diskette drive to the housing. See Figure 5-26.
4. If both diskette drives were removed, repeat Steps 2 and 3 for the other drive.
5. Return the assembly to its upright position and replace the cover by sliding it back into position.
6. Replace the screw that secures the top of the cover to the housing. See Figure 5-25.
7. Place the diskette drive assembly on its side again and replace the four cover mounting screws on the bottom. See Figure 5-26.
8. Return the diskette drive assembly to its upright position. Reconnect the power cord and all other connectors that were removed. See Figure 5-25.
9. Position the power switch to ON, insert diskettes, and do an operational check of the diskette drive assembly.

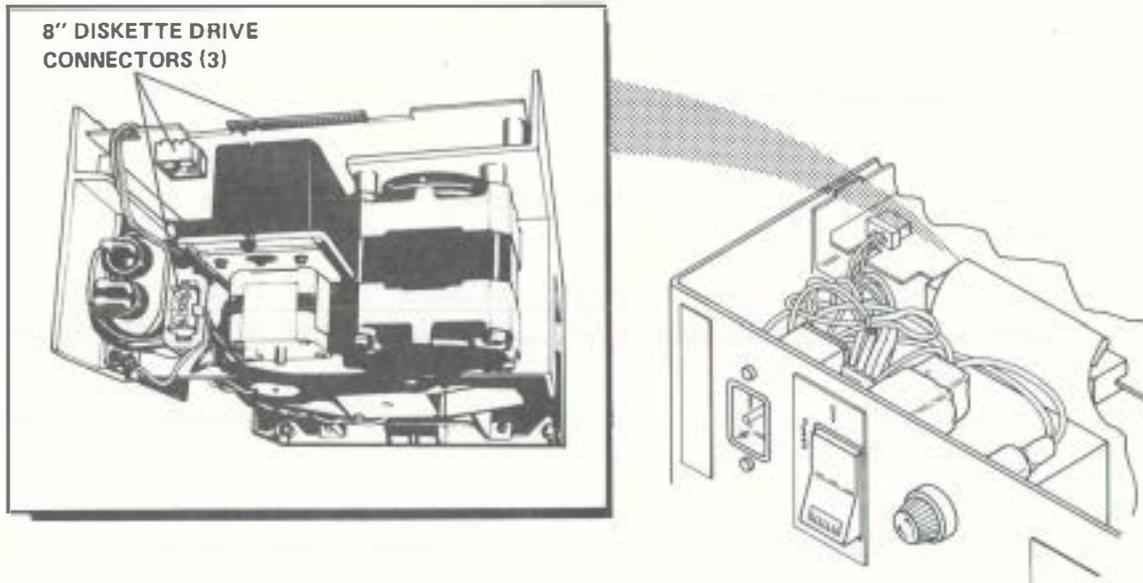


Figure 5-27. 8" Diskette Drive Connections

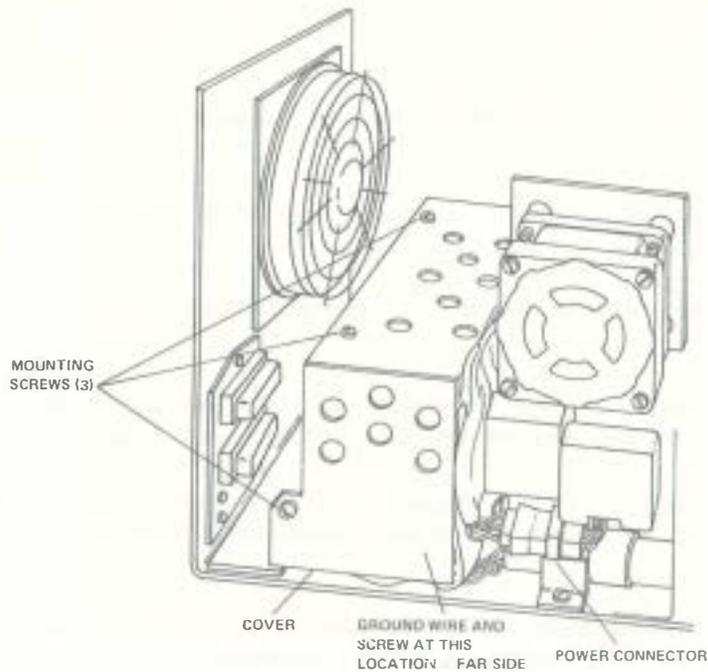


Figure 5-28. 8" Diskette Drive Power Supply Cover

5.14.3 POWER SUPPLY REMOVAL

1. Remove the 8" Diskette Drive Assembly. See Section 5.14.1, "Removal."
2. Remove the three screws securing the power supply cover. Remove the power supply cover to the side. Only the ground wire terminal remains attached to the cover. See Figure 5-28.
3. Disconnect power AC connector J1 and power DC connector J2. See Figure 5-30.
4. Remove the four mounting screws securing the circuit board to the mounting bracket. Remove the circuit board. See Figure 5-29.

Note: The top right side circuit board mounting screw is also used to fasten the two ground terminals. Retain grounding star washer reinstallation.

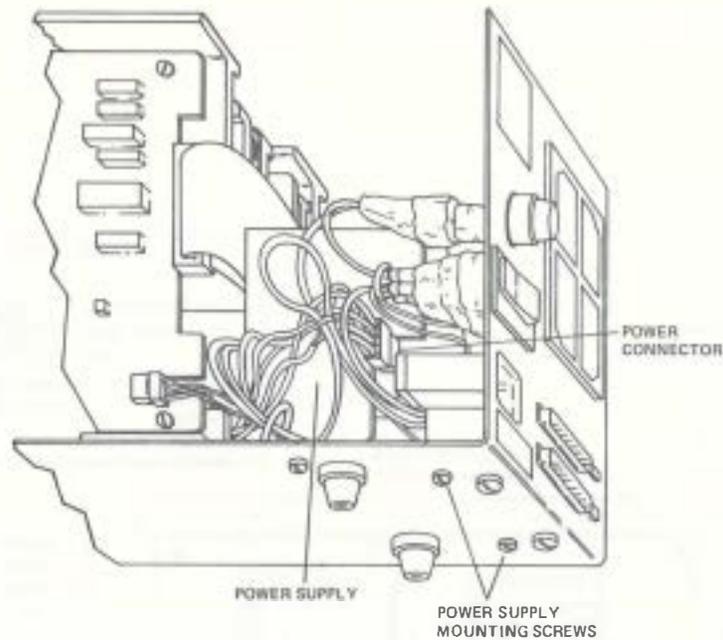


Figure 5-29. 8" Diskette Drive

5.14.4 REPLACEMENT

1. Position the circuit board over four mounting standoffs, position J1 AC power receptacle to the lower left and J2 DC power receptacle to the right as viewed from the front of the diskette assembly. Secure the circuit board to the mounting bracket with three screws. See Figure 5-30.
2. Install two ground ring terminals with star washer and nut to circuit board mounting screw at top right side and secure ground terminals. Make certain star washer is located at face of mounting bracket to ensure proper grounding. See Figure 5-30.
3. Reconnect J1 and J2 power connectors to the receptacles on the circuit board. See Figure 5-30.
4. Install the power supply cover with three mounting screws, securing the cover in place. See Figure 5-28.

Caution: Make certain terminal ground wire from chassis to the power supply cover is tight to ensure proper grounding.

5. Install diskette drive assembly. See Section 5-14.2, "Replacement."

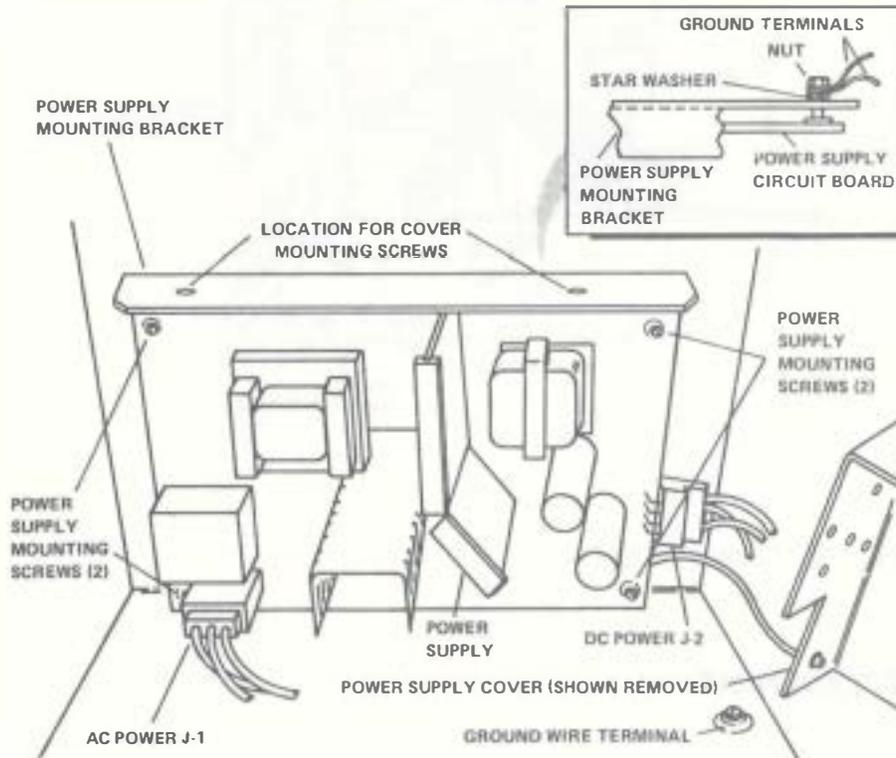


Figure 5-30. Power Supply - 8" Diskette (Viewing rear of diskette)

5.15 HARD DISK DRIVE

Hard disk drives are located in an assembly connected to the hard disk controller board ports on the processor unit back plate.

5.15.1 REMOVAL

1. Stop all disk activity.
2. Position the disk drive assembly's power switch to Power OFF.
3. Disconnect the power cord and all other connectors on the rear of the disk drive assembly. See Figure 5-31.

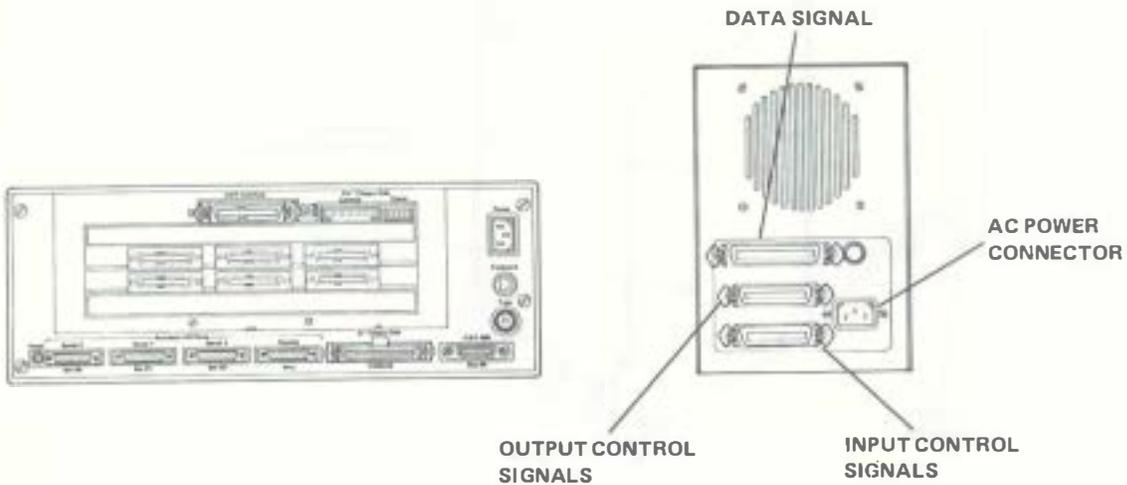


Figure 5-31. Hard Disk Drive Assembly External Connections

-
4. Remove the four screws securing the disk drive assembly's cover. Remove the cover. See Figure 5-32.

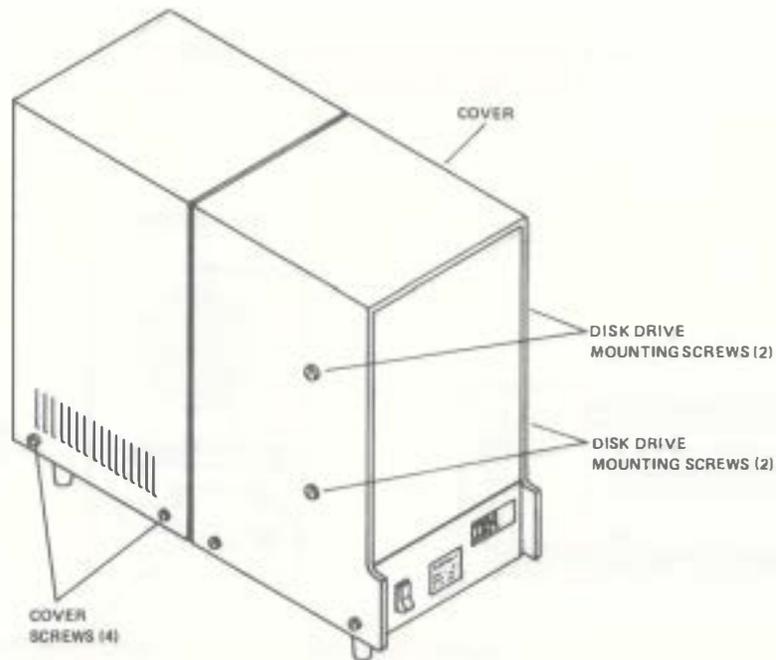


Figure 5-32. Hard Disk Drive Assembly (Side View)

5. Disconnect the four connectors on the rear of each hard disk drive. See Figure 5-33.
6. Remove the two screws securing the disk drive to the housing. See Figure 5-32.
7. Slide the disk drive toward the front and out of the housing.
8. If both disk drives are to be removed, repeat steps 6 and 7.

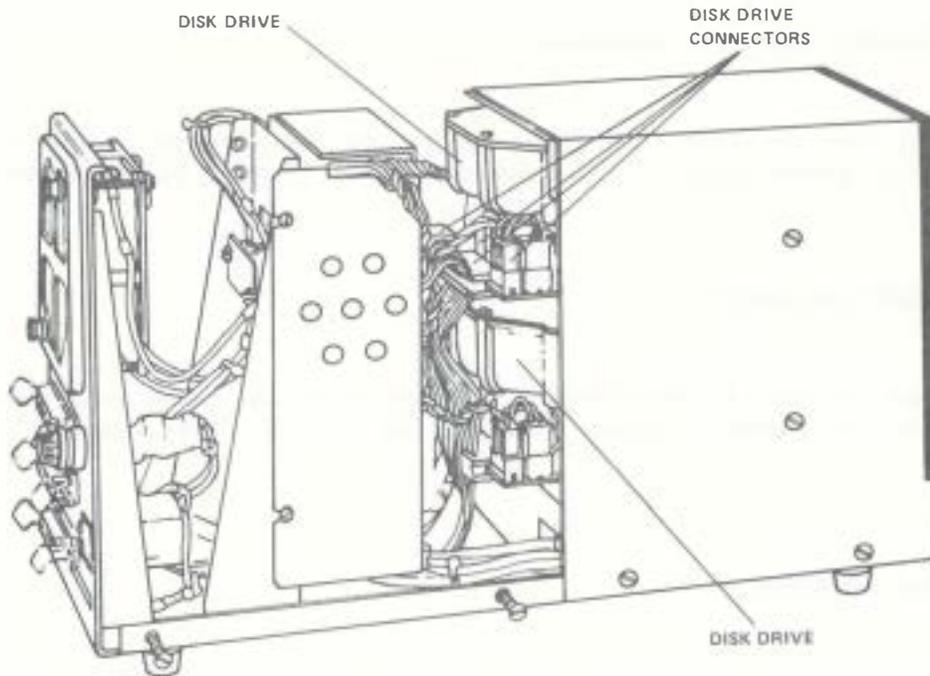


Figure 5-33. Hard Disk Drive Connections

5.15.2 REPLACEMENT

1. Place the disk drive in the housing and slide it into position.
2. Secure the disk drive to the housing with the two screws. See Figure 5-32.
3. If both disk drives were removed, repeat Steps 1 and 2 for the other disk drive.
4. Reconnect the four connectors to the rear of each of the disk drives. See Figure 5-33.
5. Replace the disk drive assembly's cover and secure it with the four screws. See Figure 5-32.
6. Reconnect the power cord and all other connectors that were removed. See Figure 5-31.
7. Position the disk drive assembly's power switch to power ON and do an operational check of the hard disk drive assembly.

5.15.3 POWER SUPPLY REMOVAL

Removal of the 5¼" Hard Disk power supply is the same as removal of the 5¼" Diskette power supply. See Section 5.13.5, "Power Supply Removal."

5.15.4 REPLACEMENT

Replacement of the 5¼" Hard Disk power supply is the same as removal of the 5¼" Diskette power supply. See Section 5.13.6, "Replacement."

5.16 FAN ASSEMBLY

The fan assembly is located on the left side of the processor unit.

CAUTION: Fan assembly removal and replacement should be performed only by trained electronics technicians.

5.16.1 REMOVAL

1. Remove the covers. See Section 5.1.1, "Removal."
2. Remove the printer/plotter control board. See Section 5.2.1, "Removal."
3. Remove all feature boards by grasping the ejector levers at the sides of each feature board and pulling toward the rear of the processor unit.
4. Remove the power supply. See Section 5.5.1, "Removal."
5. Remove the expansion board. See Section 5.6.1, "Removal."
6. Remove the ROM plug-in drawer. See Section 5.7.1, "Removal."
7. Remove the planar board. See Section 5.8.1, "Removal."
8. Remove the four Allen screws on the left side of the processor unit. See Figure 5-34.

9. Remove the nuts, wire terminals, and star washers from the ground terminal studs located below the processor top flange. See Figure 5-34.
10. Lift the fan assembly out of the processor unit and lay it on your work table next to the fan assembly to be installed.
11. Transfer the 5¼" diskette cable to the fan assembly to be installed. See Figure 5-35.

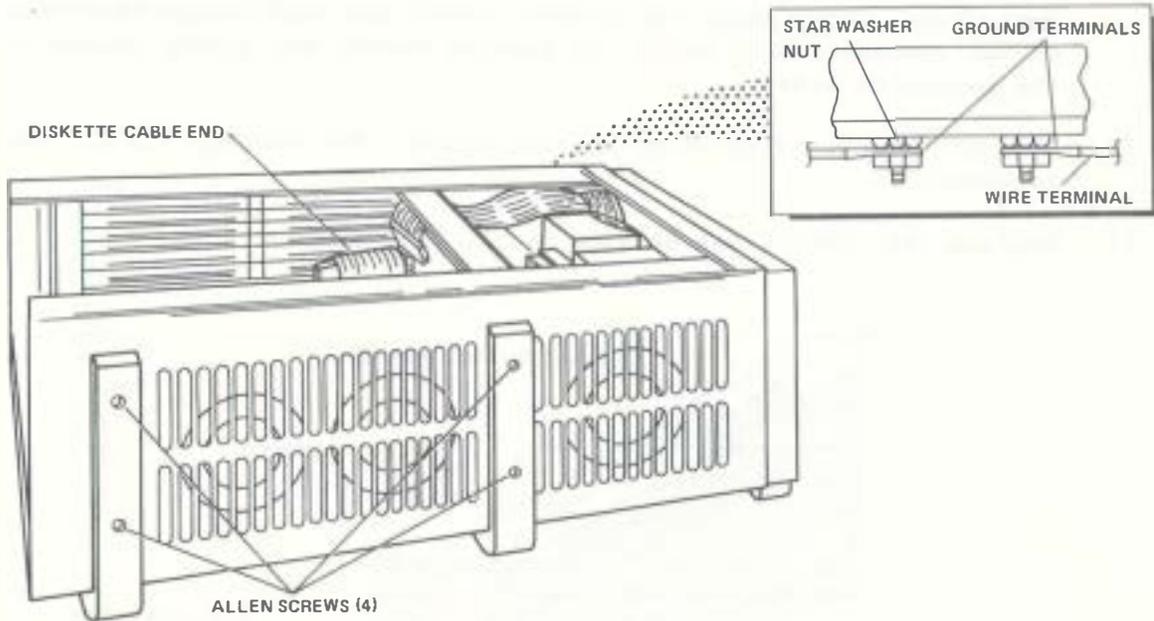


Figure 5-34. Fan Assembly

5.16.2 REPLACEMENT

1. Make certain the 5¼" diskette cable is installed on the fan assembly.
2. Position the fan assembly so that the threaded holes in its bracket line up with the holes in the left side of the processor unit. See Figure 5-34.
3. Secure the fan assembly to the processor unit with the four Allen screws. See Figure 5-34.
4. Install wire terminals on two grounding studs and secure in place with star washer and nuts. Make certain star washer is placed at processor top flange to ensure proper grounding.

5. Replace the planar board. See Section 5.8.2, "Replacement."
6. Replace the ROM plug-in drawer. See Section 5.7.2, "Replacement."
7. Replace the expansion board. See Section 5.6.2, "Replacement."
8. Replace the power supply. See Section 5.5.2, "Replacement."
9. Replace all feature boards by sliding each of them into the processor unit until the ejector levers hook onto the sides of the processor unit frame. Then grasp the ejector levers and push toward the front of the processor unit until the feature boards are firmly seated in the expansion board.
10. Replace the printer/plotter control board. See Section 5.2.2, "Replacement."
11. Replace the covers. See Section 5.1.2, "Replacement."

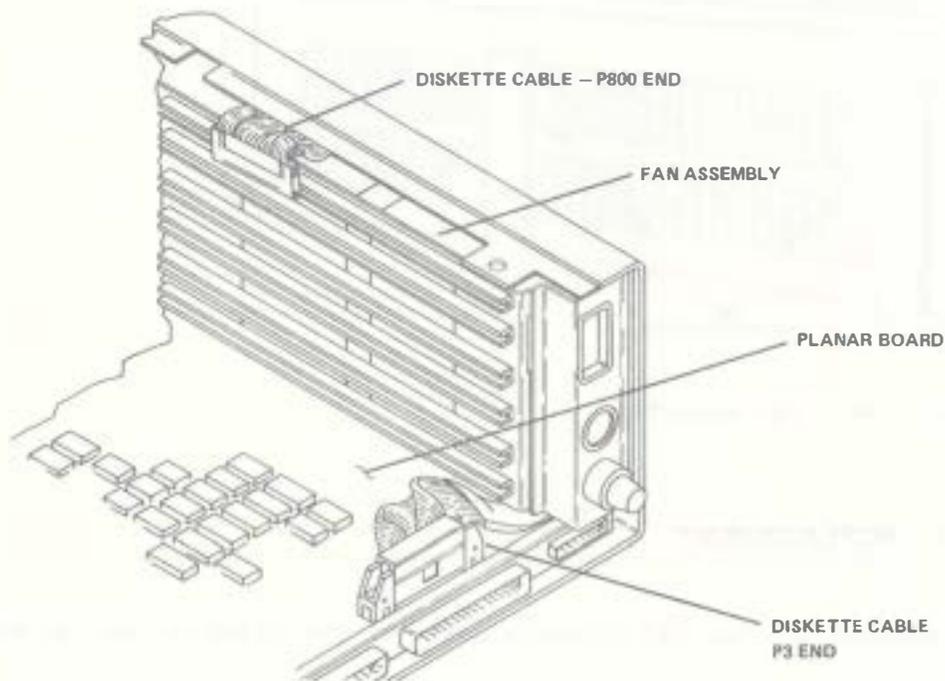


Figure 5-35. Diskette Cable

5.17 MMU INTERFACE ASSEMBLY

An MMU interface assembly is installed on planar boards in systems equipped with the MMU option. The interface assembly is installed in

place of the 68000 processor chip on the planar board. See Figures 5-36 and 5-37.

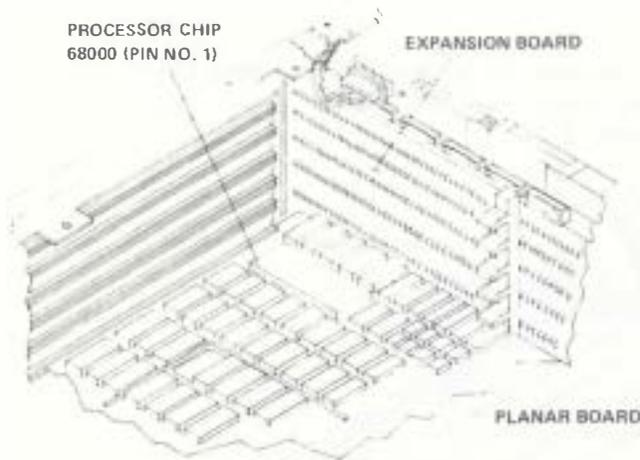


Figure 5-36. Planar Board
(with Processor Chip)

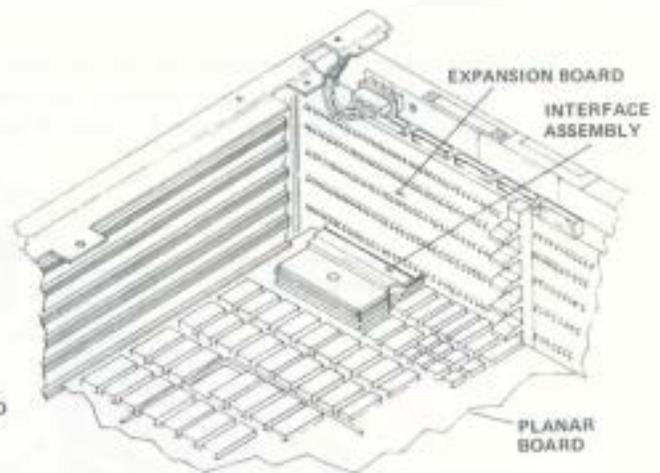


Figure 5-37. Planar Board
(with Interface Assembly)

5.17.1 REMOVAL

1. Remove the MMU board. See Section 5.4.1, "Removal."
2. Remove the interface assembly from the planar board by alternately prying the ends very carefully with a small screwdriver. See Figure 5-37.

5.17.2 REPLACEMENT

1. Position the interface assembly over the 68000 processor chip socket with the female connector end facing away from the expansion board.
2. Taking care that all pins are aligned with the corresponding hole in the connector, seat the interface assembly by pressing down with both thumbs.
3. The 68000 processor chip is positioned in place (180° opposite normal planar board installation) onto the MMU board. Note position of pin 1. See Figure 5-38.

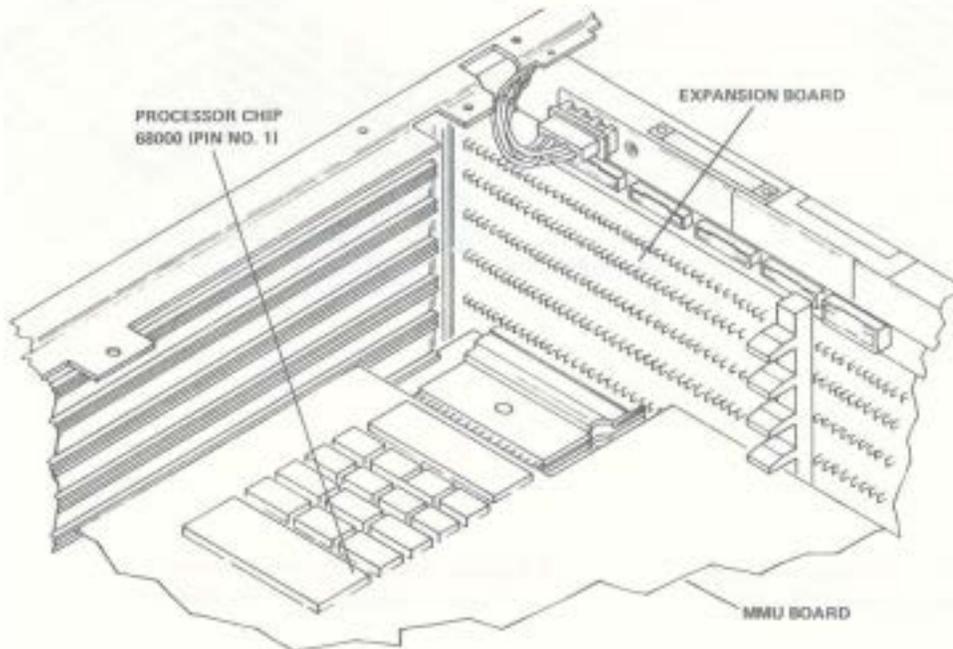


Figure 5-38. MMU Board with Processor Chip

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