

**Computer System
Problem Isolation Manual**

Computer System Problem Isolation Manual

Second Edition (October 1983).

The contents of this edition are subject to change. Any changes will be included in subsequent editions of this publication.

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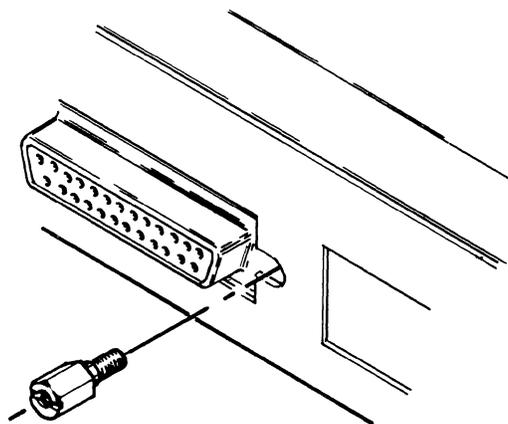
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PROCESSOR BACK PANEL REMOVAL AND REPLACEMENT

The current edition of the Computer System Problem Isolation Manual, GC22-9192-1 describes removal of the processor back panel by loosening four retaining screws (Figure 4-4, page 4-4). Once these screws are removed, however, it is necessary to remove the eight standoff screws that attach the back panel to the I/O connectors as shown below:



The back panel can then be removed; put the standoff screws in a safe place until the panel is reattached.

PREFACE

This publication provides information on diagnosing problems occurring with the IBM Instruments, Inc. Computer System. Its only purpose is to assist you in isolating the source of a Computer System problem to a "customer-replaceable unit", not determining the failing component within a unit. Instructions are given for removing the unit and shipping it to IBM Instruments for repair and/or replacement. There are four chapters:

- Chapter 1 -- "Introduction" briefly describes the service facilities provided for the IBM Instruments Computer System, lists those items that are considered "customer-replaceable units", and provides general directions for problem isolation.
- Chapter 2 -- "Problem Isolation Procedures" asks simple questions about the nature of the system problem; these questions can be used to narrow down the source of the problem before running the diagnostic programs.
- Chapter 3 -- "Running the Diagnostics" describes the diagnostics that are available, how to request that a specific test be run, and what information to save for the IBM Instruments Customer Support Center.
- Chapter 4 -- "Removal and Replacement Procedures" describes, with illustrations, how to remove all of the customer-replaceable units and replace those units after repair.

You need not know programming to use this book and the only tool required is a screwdriver.

The following Computer System publications may be of use in problem isolation:

Computer System Operator's Manual, GC22-9186

is useful for gaining an understanding of how the individual units operate; it is also useful when you are operating various functions of the Computer System with system commands.

CS-OS Reference Manual, Part 2: Logical I/O, GC22-9200

will be useful when programming interface information is required to isolate a problem related to a connected device.

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1.0 INTRODUCTION

The IBM Instruments Computer System is designed to provide reliable, trouble-free service in a variety of environments. However, in the event that a unit does fail, we want to work together with you to find the source of the problem quickly, so you can continue with your work. A number of service facilities are available to help us isolate the source of a problem. These include:

- Toll-free telephone assistance from the Customer Support Center
- Problem isolation procedures
- Built-in diagnostic programs

These facilities will help you isolate the failing area of the Computer System to what is known as a "Customer Replaceable Unit" or CRU, which can then be sent to IBM Instruments for repair and/or replacement. Each of these service facilities is briefly discussed below.

1.1 TELEPHONE ASSISTANCE

Service, programming, and applications specialists are available at the Customer Support Center to provide telephone assistance during normal business hours. They can help determine whether the source of a problem is a device connected to the Computer System, programming, or the Computer System hardware. There is no charge for this assistance.

1.2 PROBLEM ISOLATION PROCEDURES

These preliminary questions, found in Chapter 2 of this manual, are designed to eliminate certain error possibilities. By answering these questions you will get a clearer picture of where the problem's source can be before running any diagnostic programs. The answers will also provide a better idea of which diagnostics may be needed.

1.3 DIAGNOSTICS

Some diagnostics are automatically run each time the Computer System is turned on. If an error is detected by these diagnostics, information about the error is presented on the keypad LED's and on the CRT display before the operating system is activated. In addition, the following message is displayed:

PUSH RESET SWITCH ON BACK PANEL TO RETRY, OR
PRESS STOP KEY THEN EXECUTE KEY TO START MANUAL DIAGNOSTICS

In addition, there are extended diagnostics that can be controlled from the keypad or keyboard, allowing you to request specific tests or subtests by number. Instructions for running these manual tests as well as a brief description of each test are found in Chapter 3.

1.4 "CUSTOMER REPLACEABLE UNITS" - CRU'S

The service facilities above are aimed at tracing the problem to one of the following customer replaceable units of the Computer System:

- planar board
- printer/plotter control board
- prom plug-in
- power supply
- CRT display
- keyboard
- keypad
- printer/plotter
- optional feature boards (sensor I/O, hard disk controller, etc.)
- optional 5 1/4- or 8-inch diskette units
- optional hard disk units
- processor chassis

Instructions for removing and replacing these CRU's are provided in Chapter 4.

2.0 PROBLEM ISOLATION PROCEDURES

As discussed in Chapter 1, a series of diagnostic tests is automatically run when the Computer System is switched on. These tests take from 20 seconds to 4 minutes and 45 seconds to complete, depending upon the amount of storage in your Computer System. When the Computer System is switched on, some of the LEDs shown below will come on momentarily and then go out.

(NOTE: The keys in which the LED'S appear are fully functional.)

If the diagnostic tests complete successfully, that is, if no errors are detected,

- The "Test Complete" LED shown in Figure 2-1 will flash and then go off.
- You will hear a short "beep" and, if a diskette is inserted in the diskette drive, the operating system power on menu will appear on the CRT display.

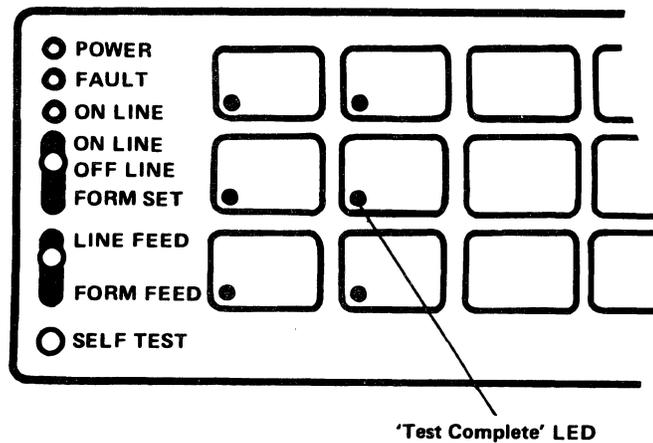
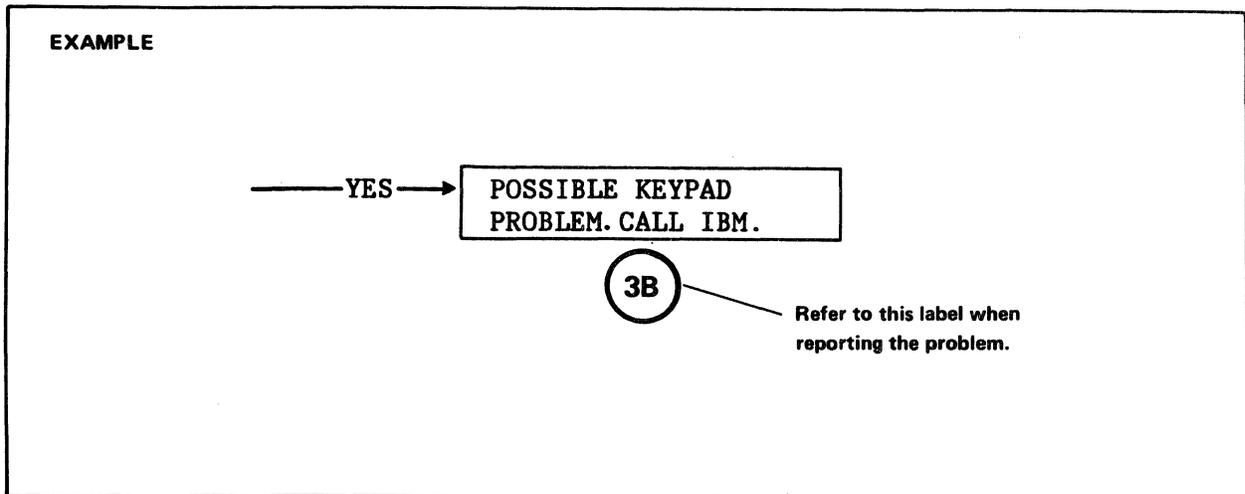


Figure 2-1. Keypad LED'S.

If one of the tests finds a fault in the Computer System, that test number will be displayed on the CRT. Record the number and any other displayed information then call the IBM Instruments Customer Support Center to report the error. In addition, the following message will be displayed:

PUSH RESET SWITCH ON BACK PANEL TO RETRY, OR
PRESS STOP KEY THEN EXECUTE KEY TO START MANUAL DIAGNOSTICS

If anything else happens, (that is, if the three items above do not occur and no test number or message is displayed on the CRT, follow the problem isolation procedures that follow. They will help you to determine what further tests should be run. When you reach the end of a procedure you will be instructed to call the IBM Instruments Customer Support Center ("CALL IBM") for further assistance or to report what you have found. Each of the possible "ends" of the procedures is labeled; use this label to let the service personnel know where the procedures led you.

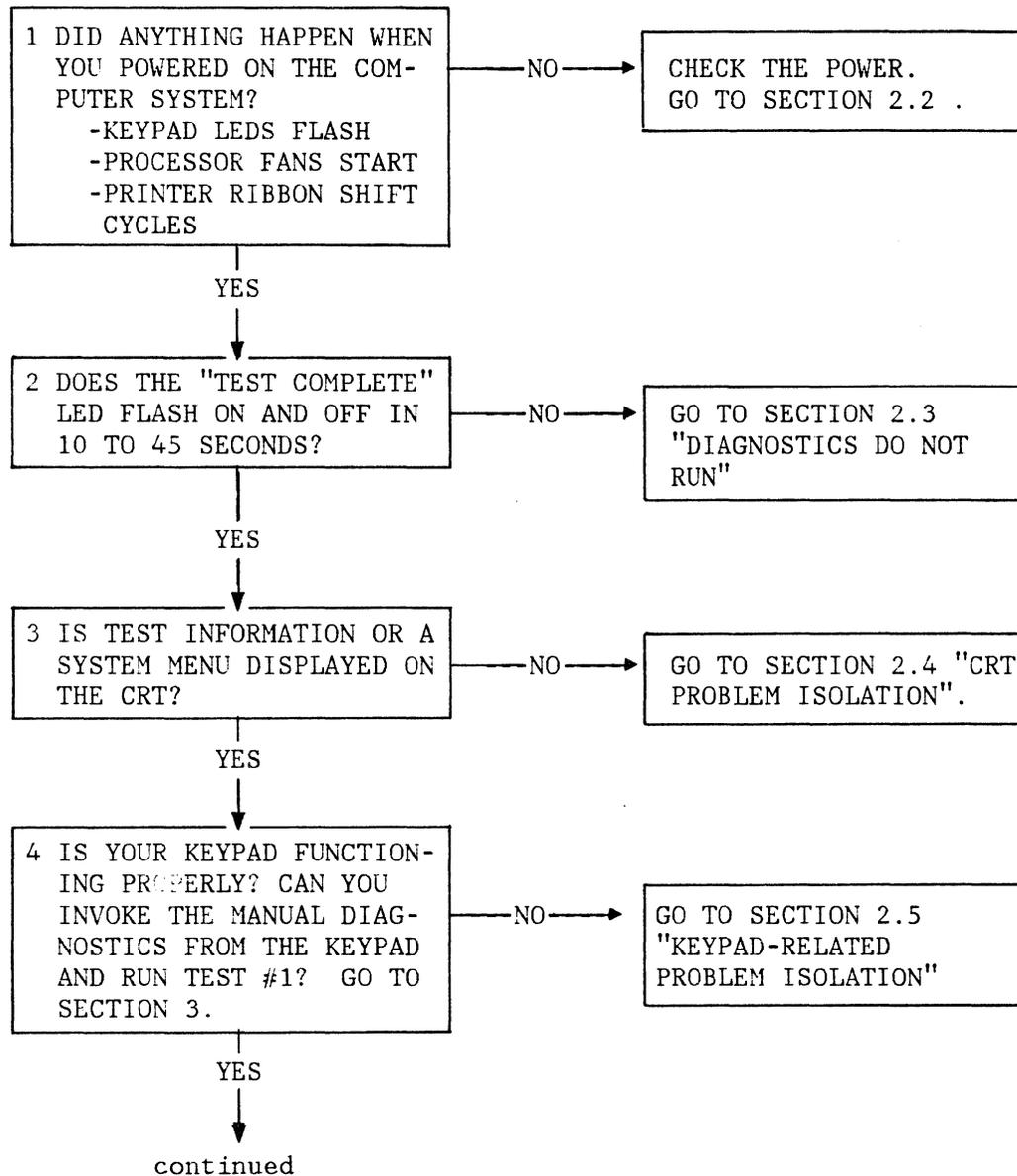


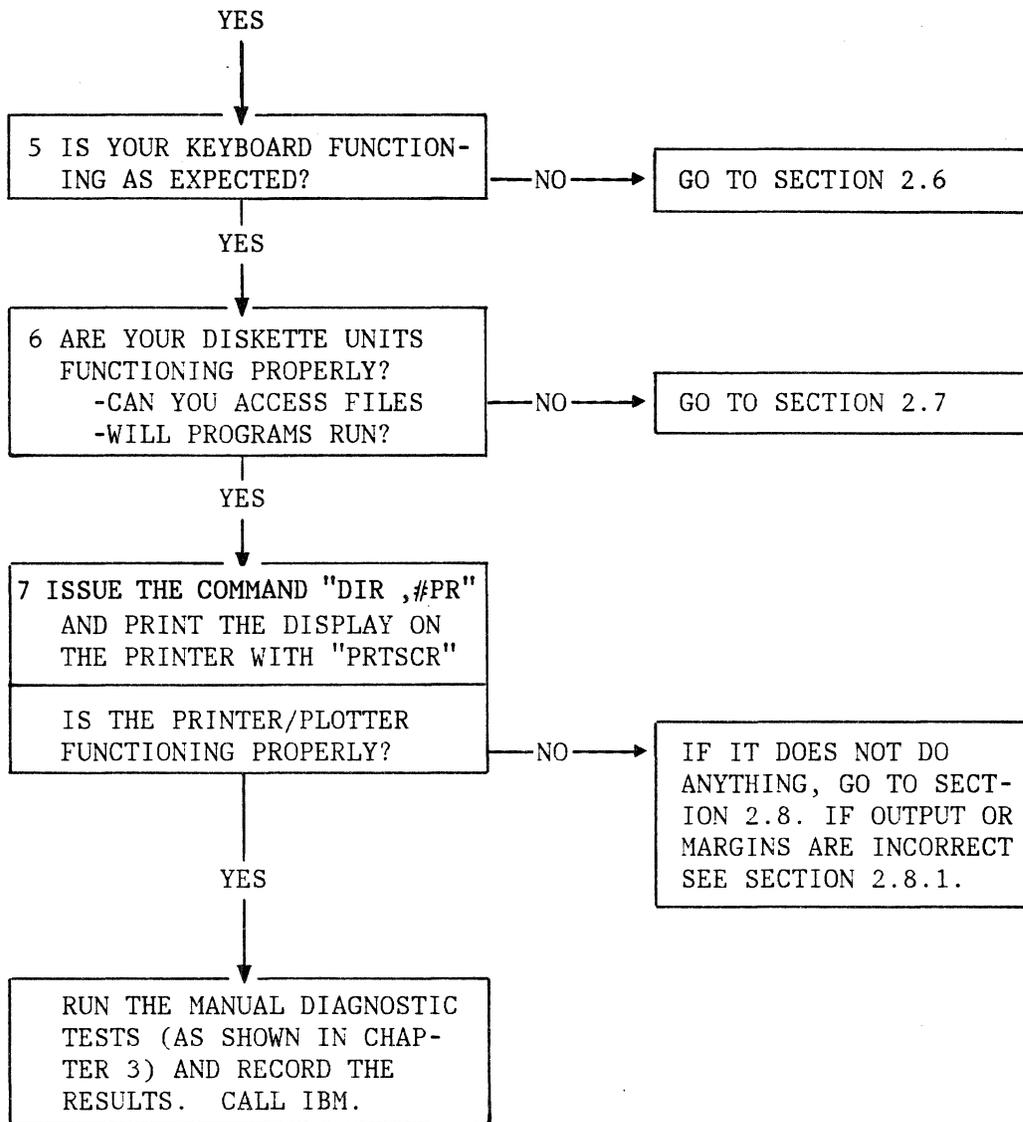
NOTE: If you did not record a test number or are not sure of the results of the power-on tests,

1. Remove any diskettes from the Computer System
2. Switch the Power Off.
3. Wait 10 seconds.
4. Switch the Power On and note the results.

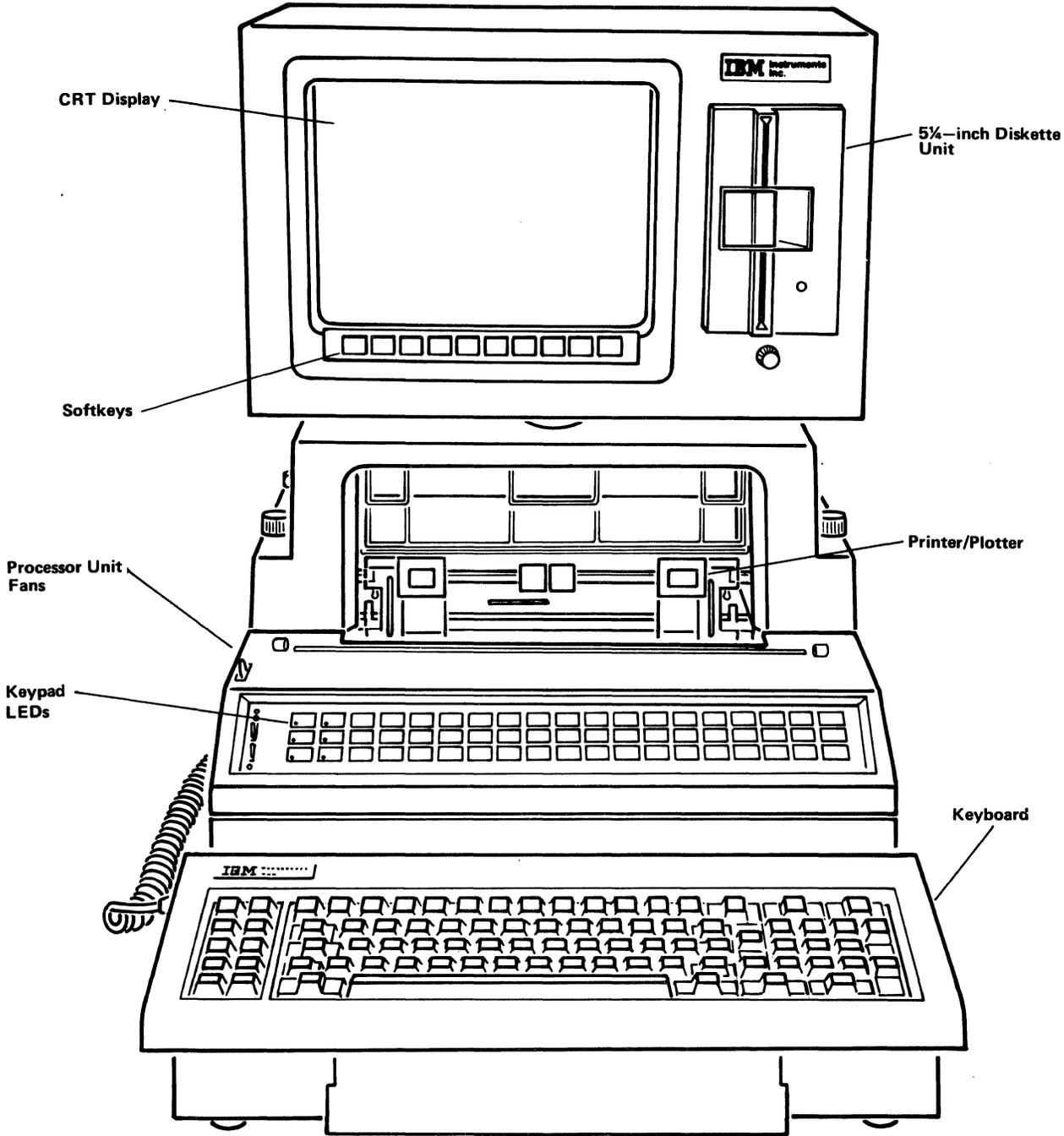
2.1 GENERAL PROBLEM ISOLATION

The procedures below are a first step only. They will assist you in isolating the problem to a major area of the Computer System. Procedures for each of these areas will help you to determine which CRU is the likely source of the problem. Boxes that ask questions are numbered for cross-reference by other procedures.

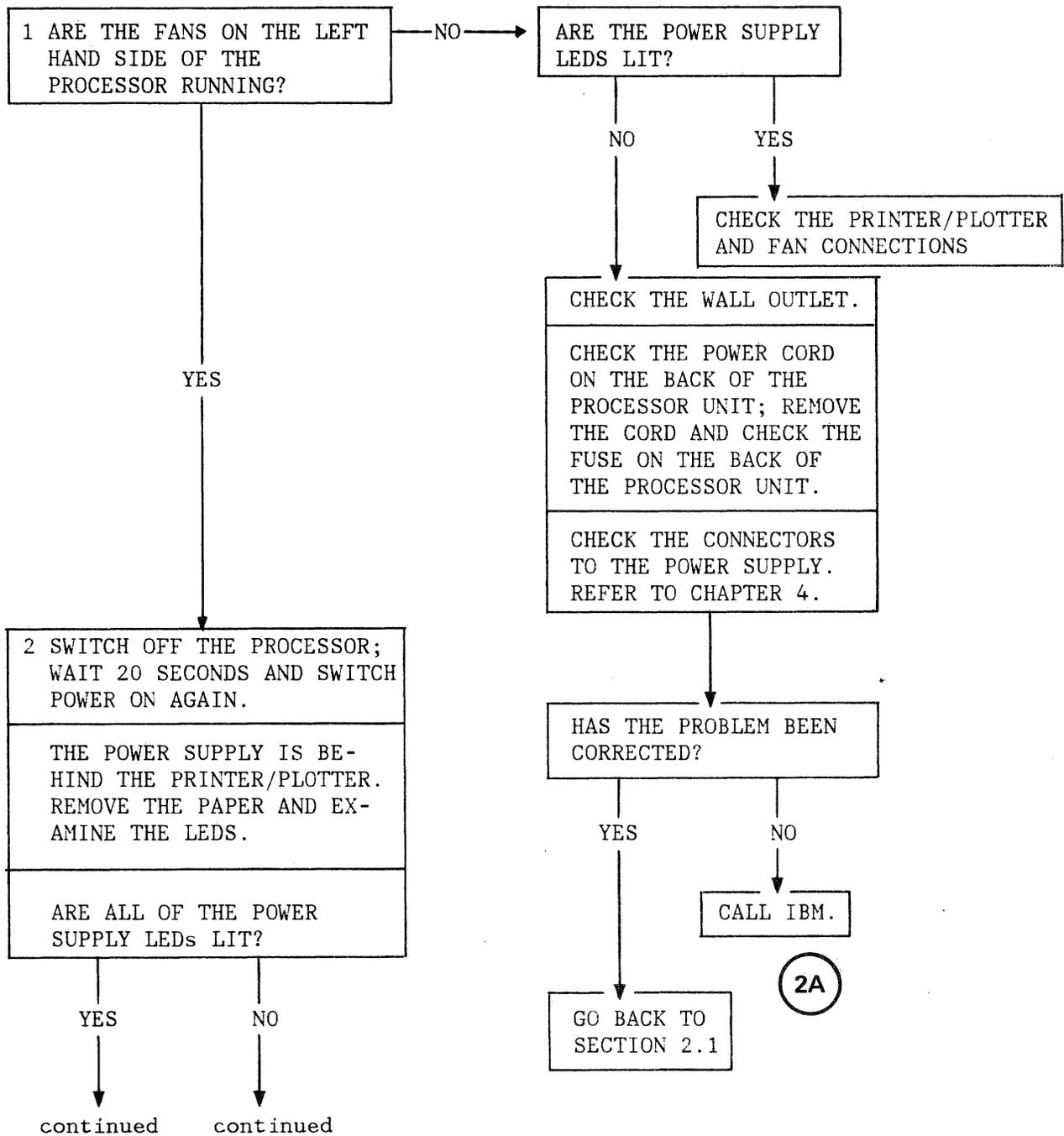


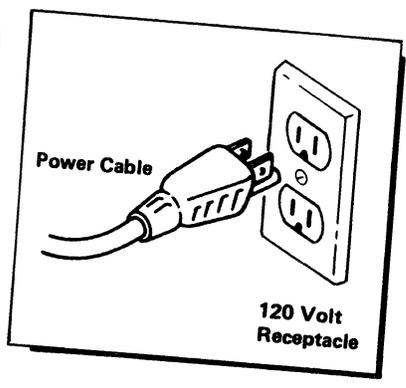
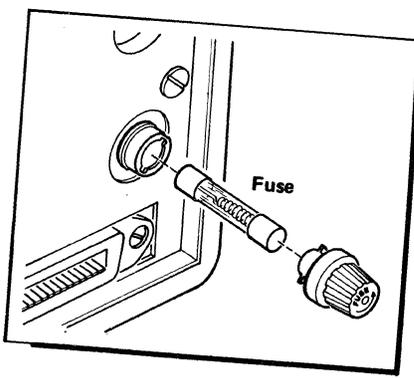
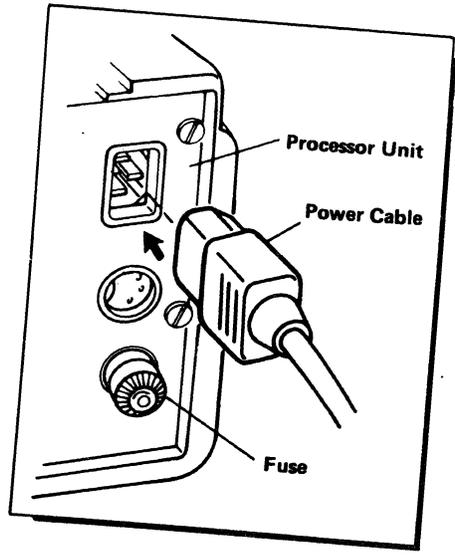
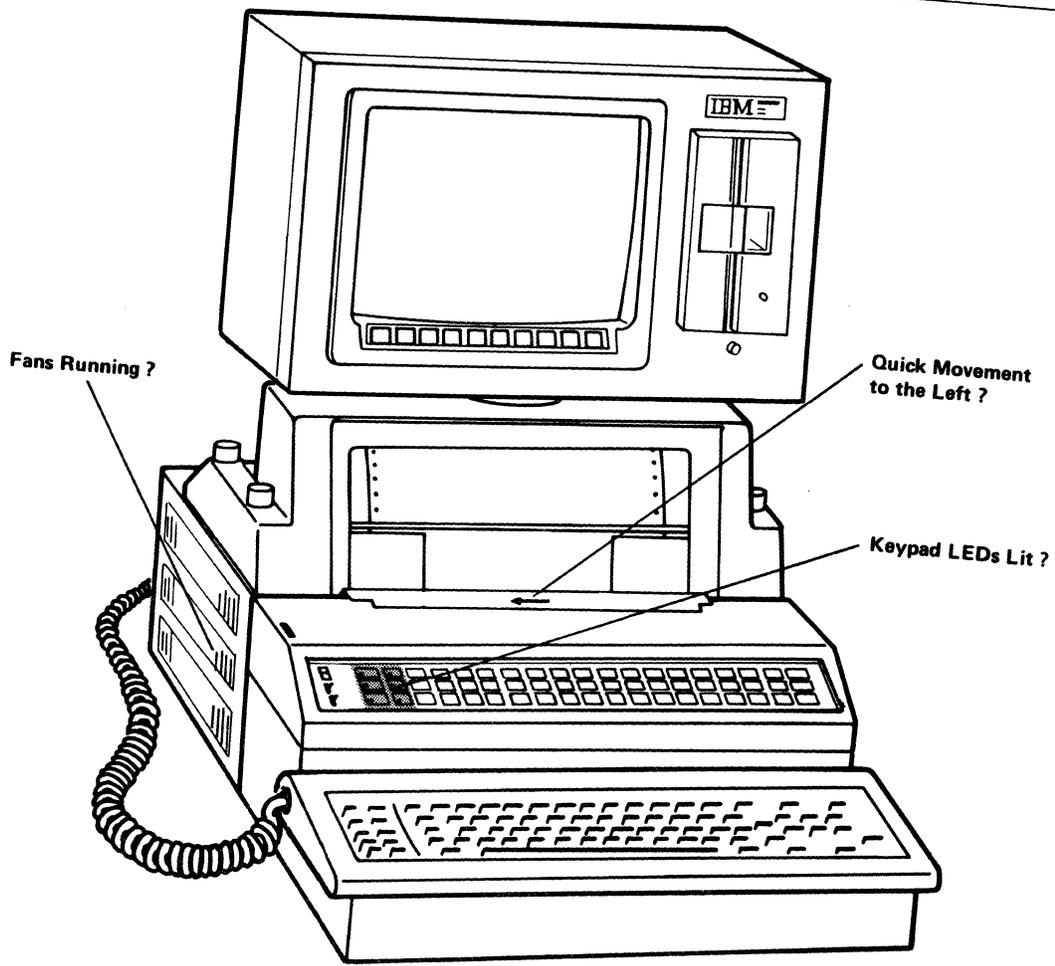


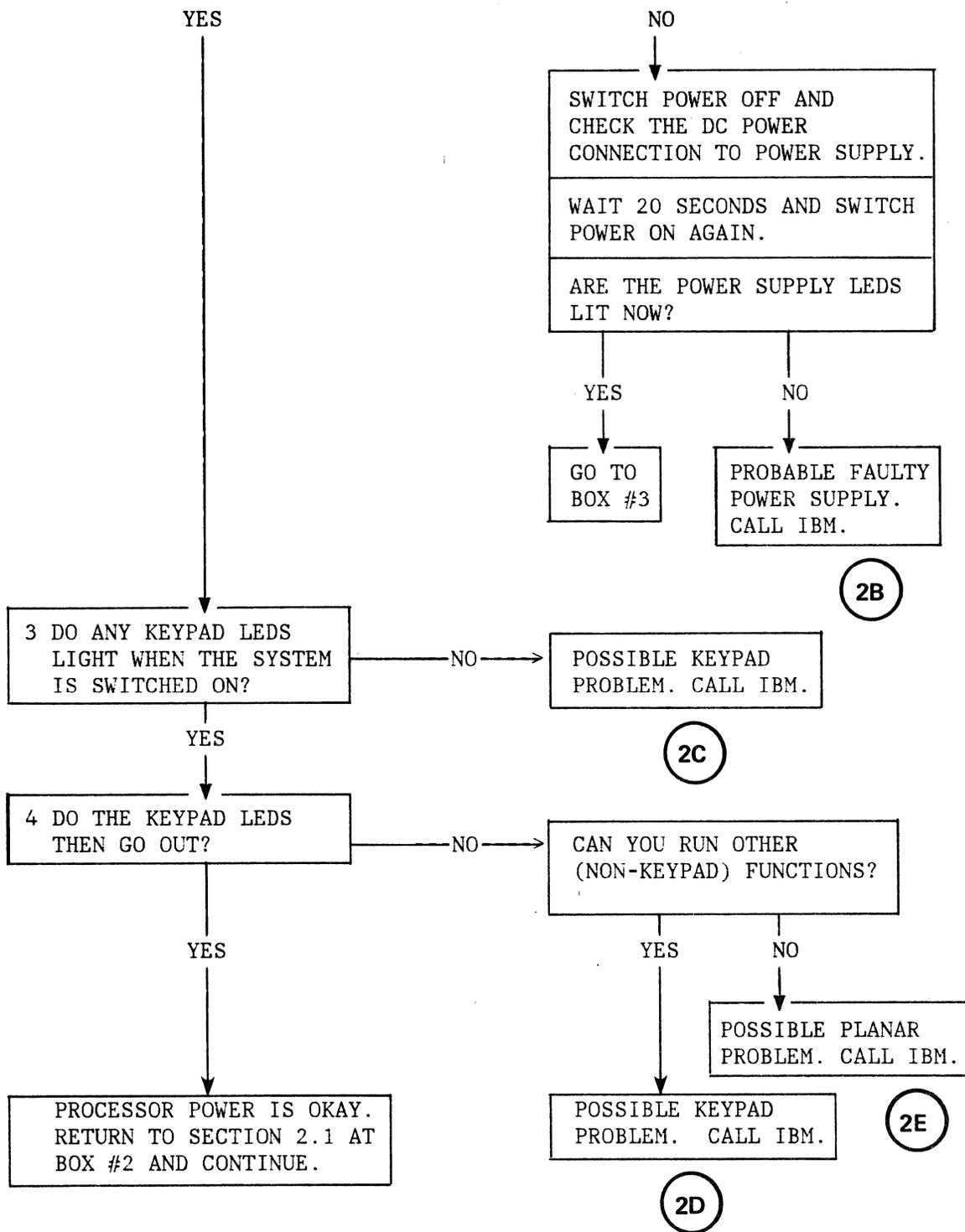
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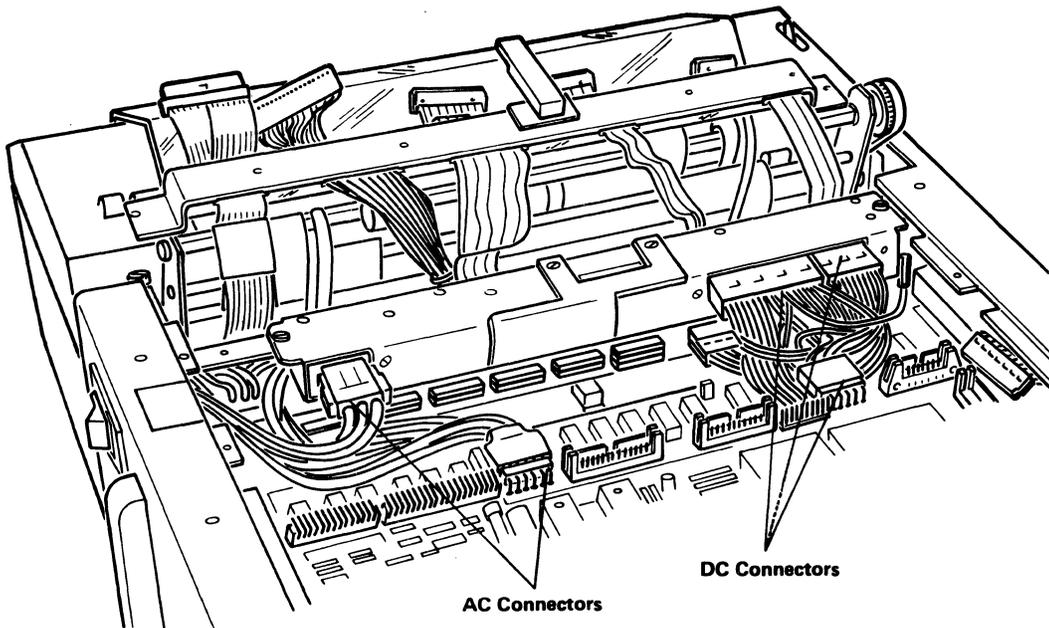


2.2 POWER-RELATED PROBLEM ISOLATION

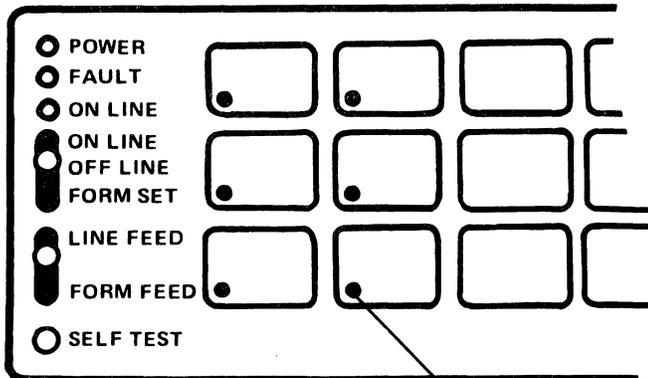






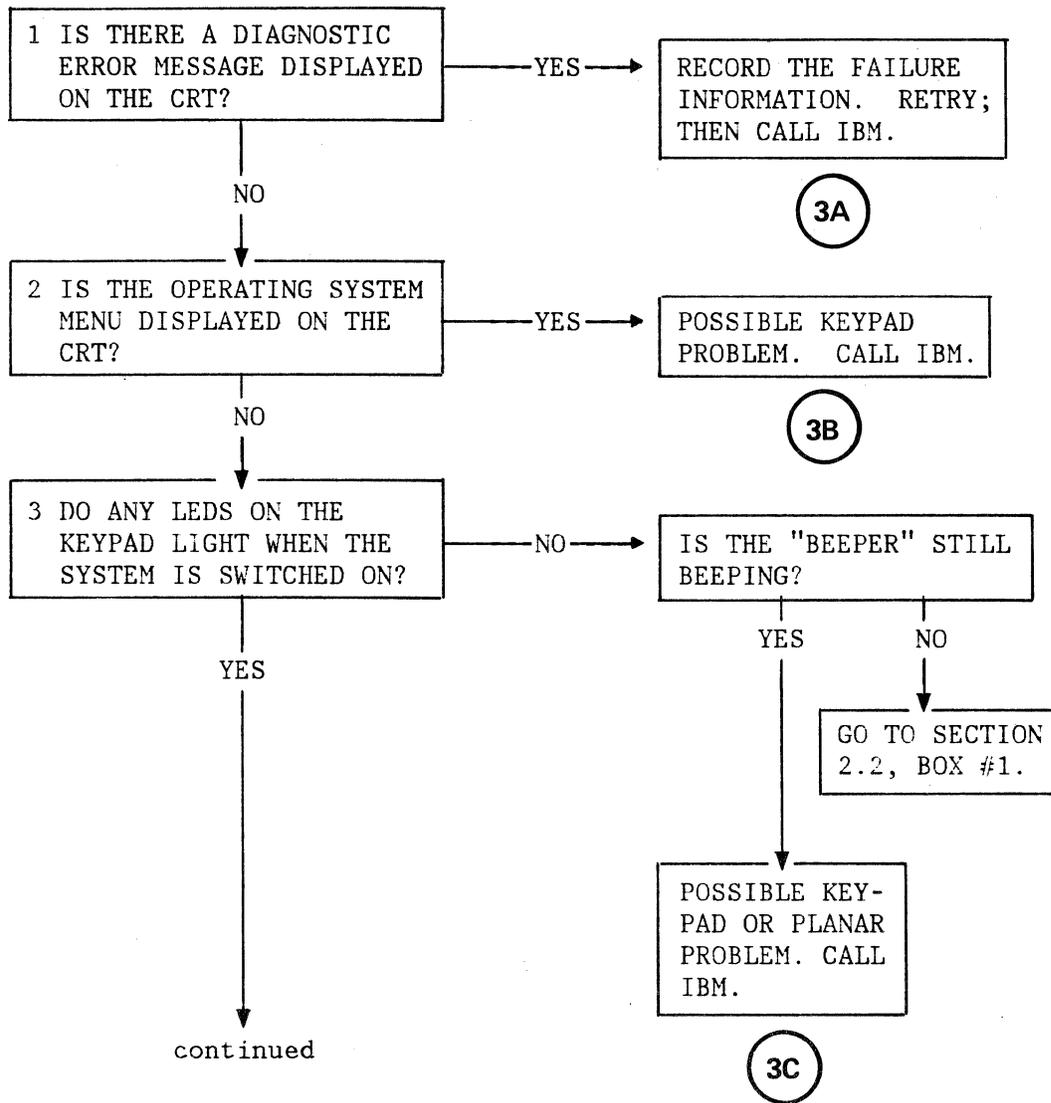


NOTE: Refer to Chapter 4, Section 4-1 to gain access to this component.



Any Keypad LEDs Lit ?

2.3 DIAGNOSTICS DO NOT RUN

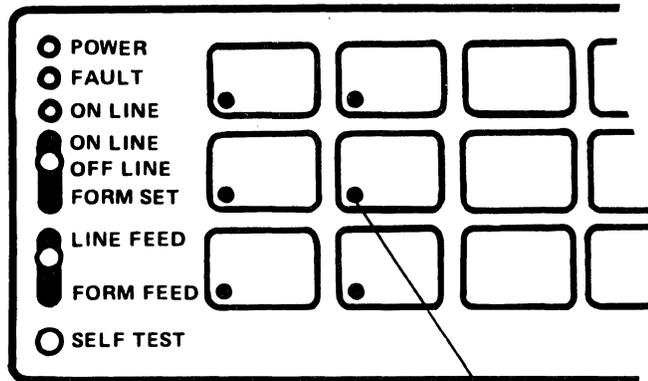


FUNCTION KEYS ARE ASSIGNED AS FOLLOWS:

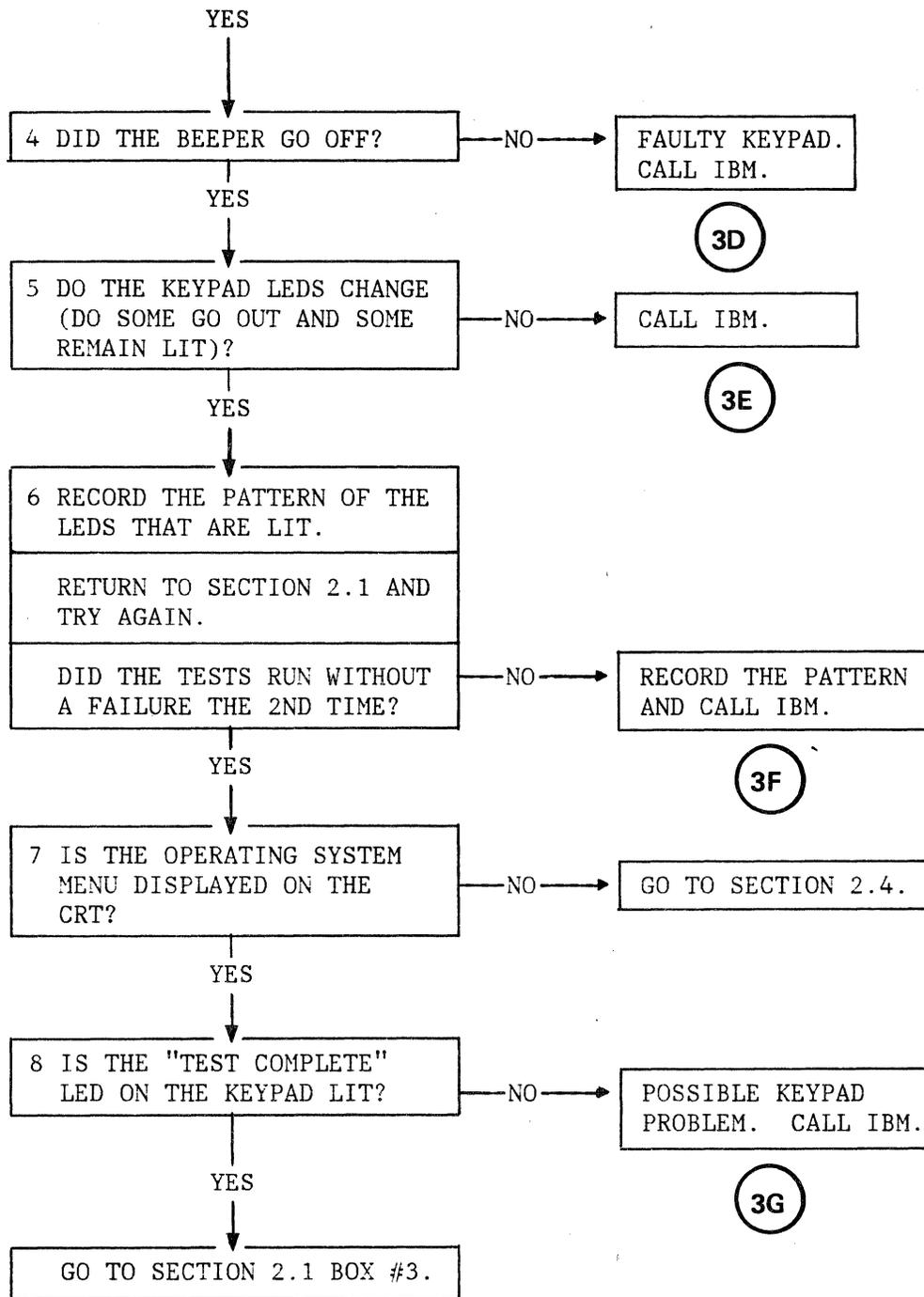
 F1	DIR 0:	 F2	DIR 1:
 F3	HELP	 F4	FORMAT
 F5	SYSMAP	 F6	DISKCOPY
 F7	MENU	 F8	COPY
 F9	CLS	 10	PAGE

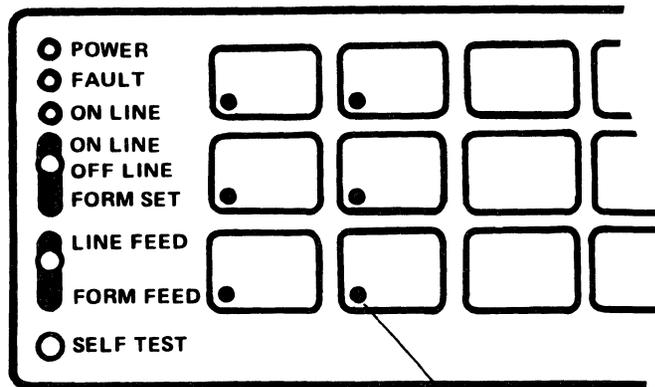
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Operating System Menu



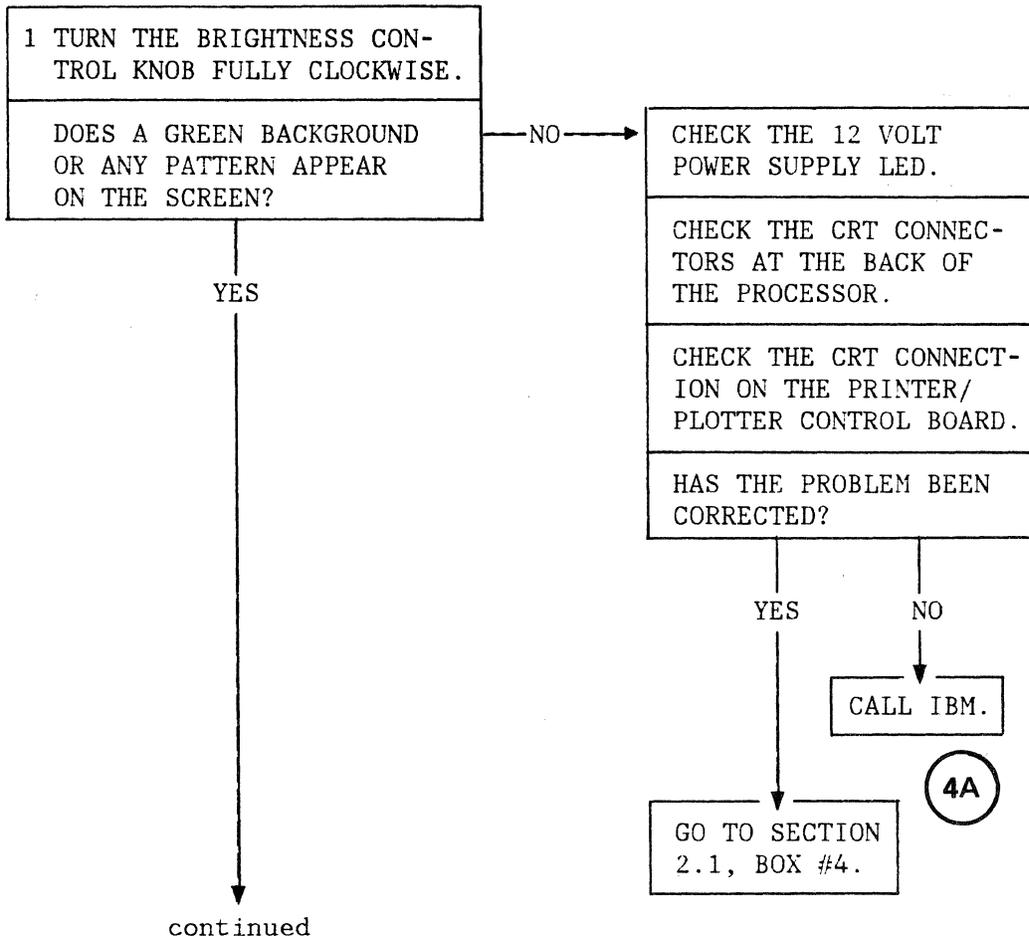
'Test Complete' LED

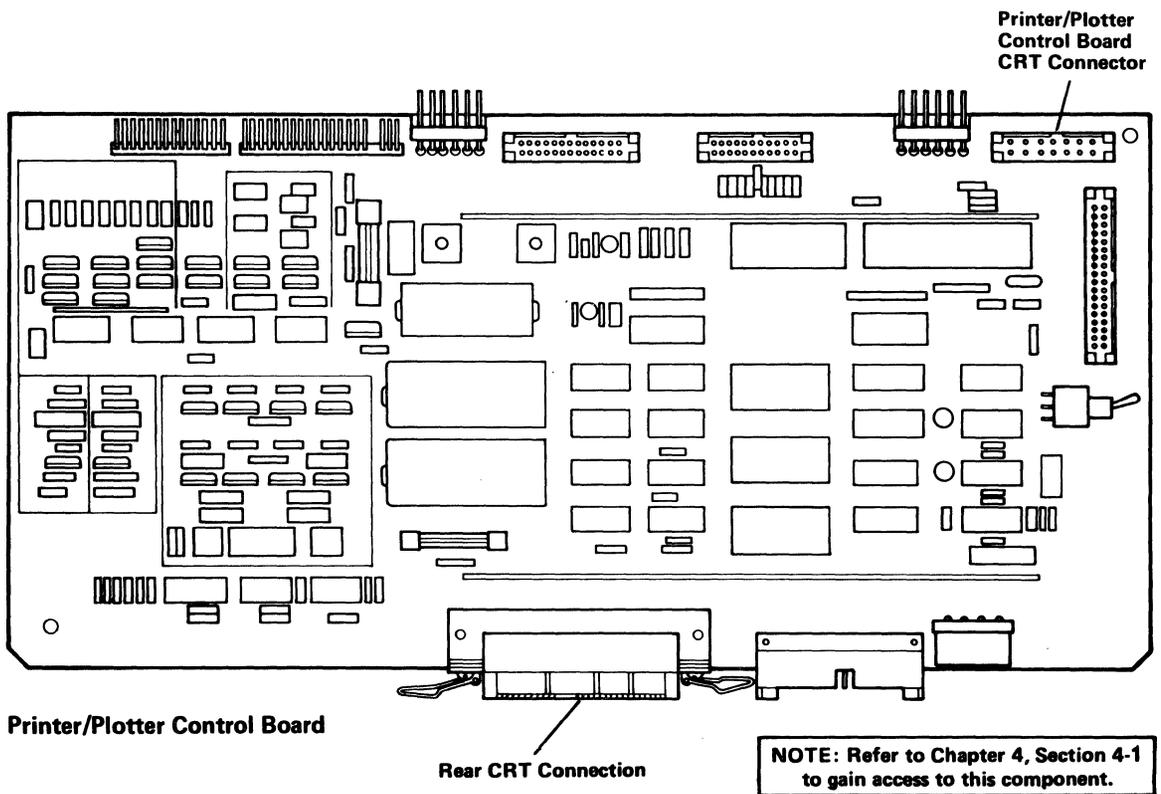
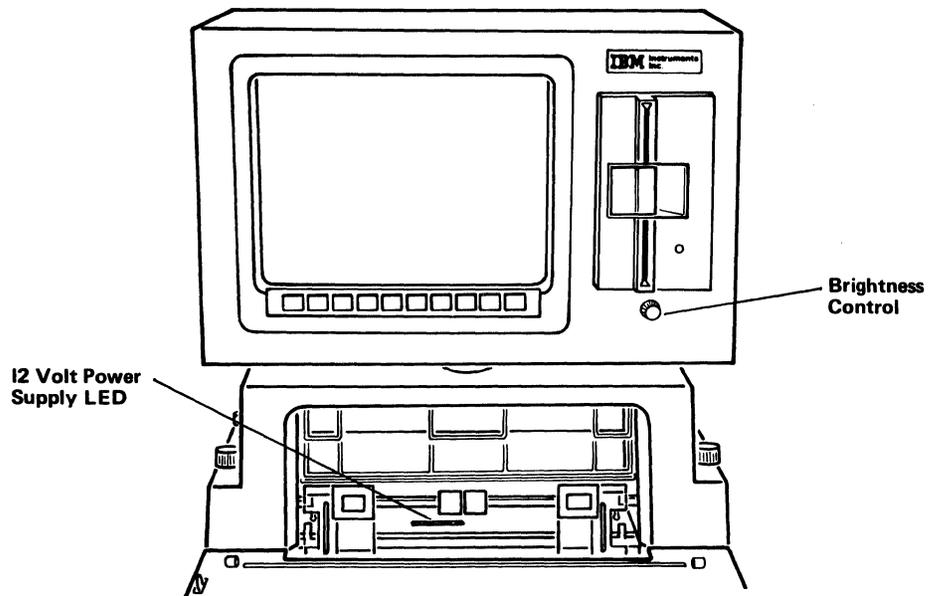


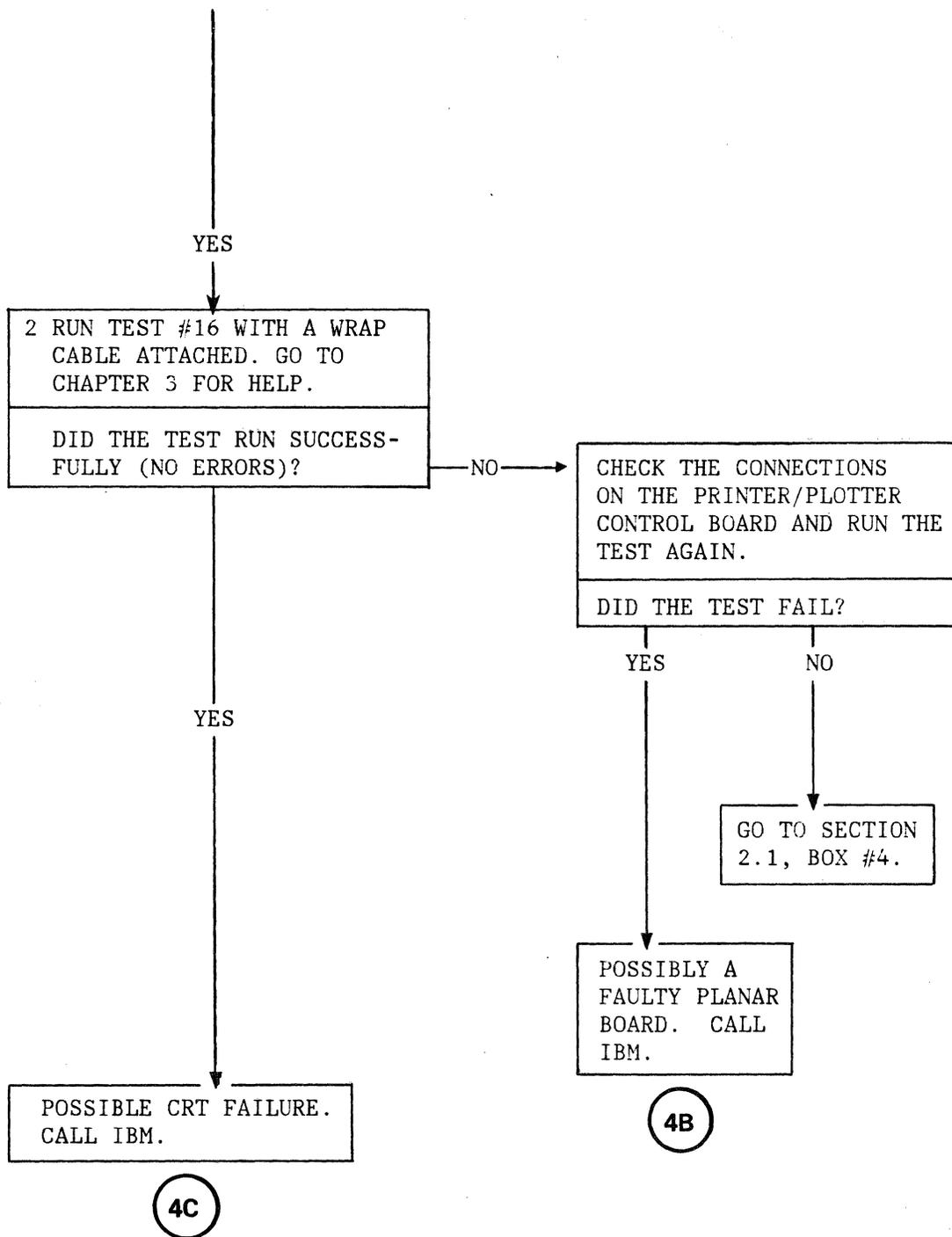


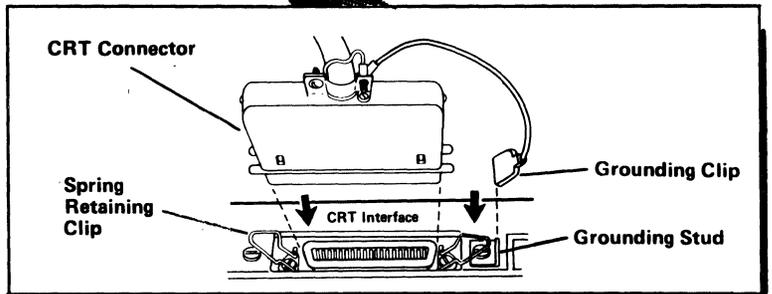
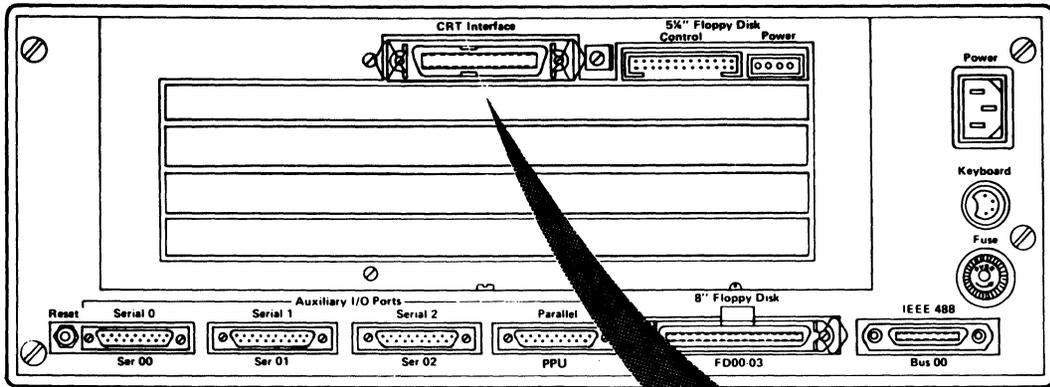
Any Keypad LEDs Lit ?

2.4 CRT-RELATED PROBLEM ISOLATION

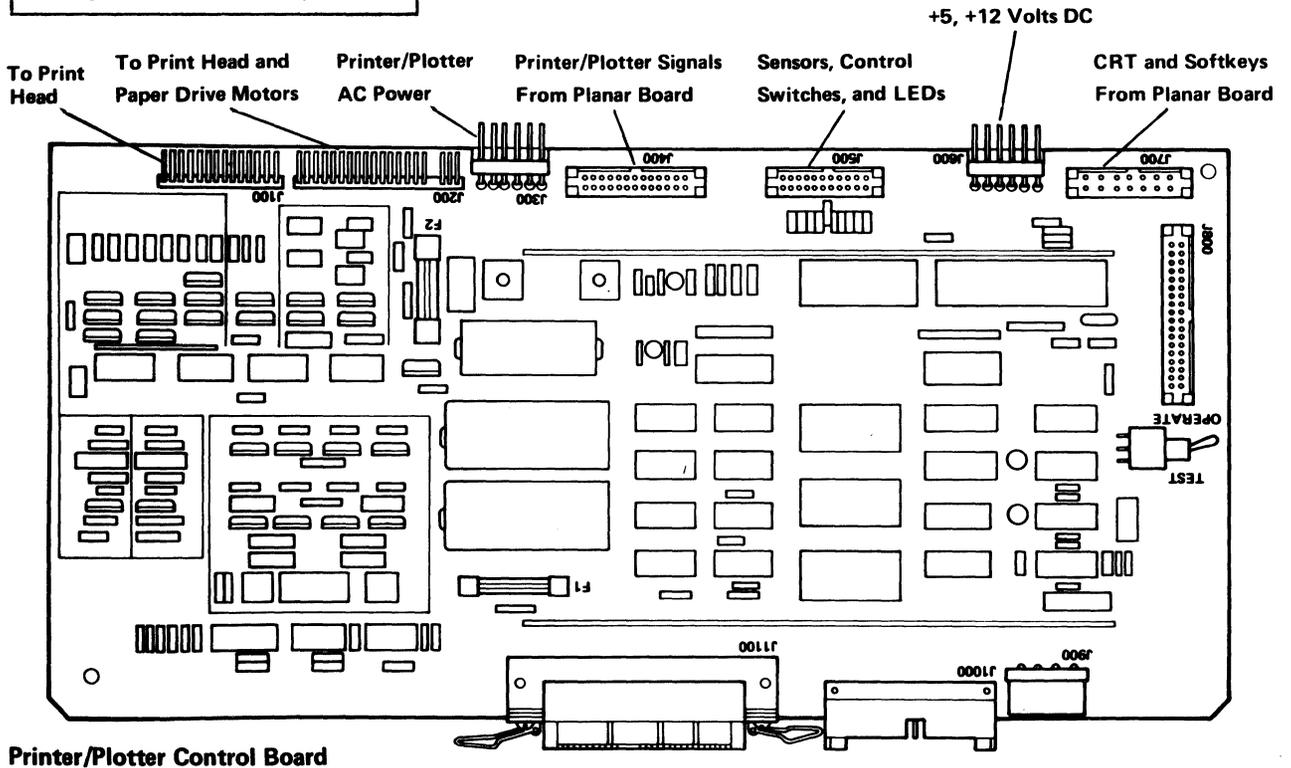




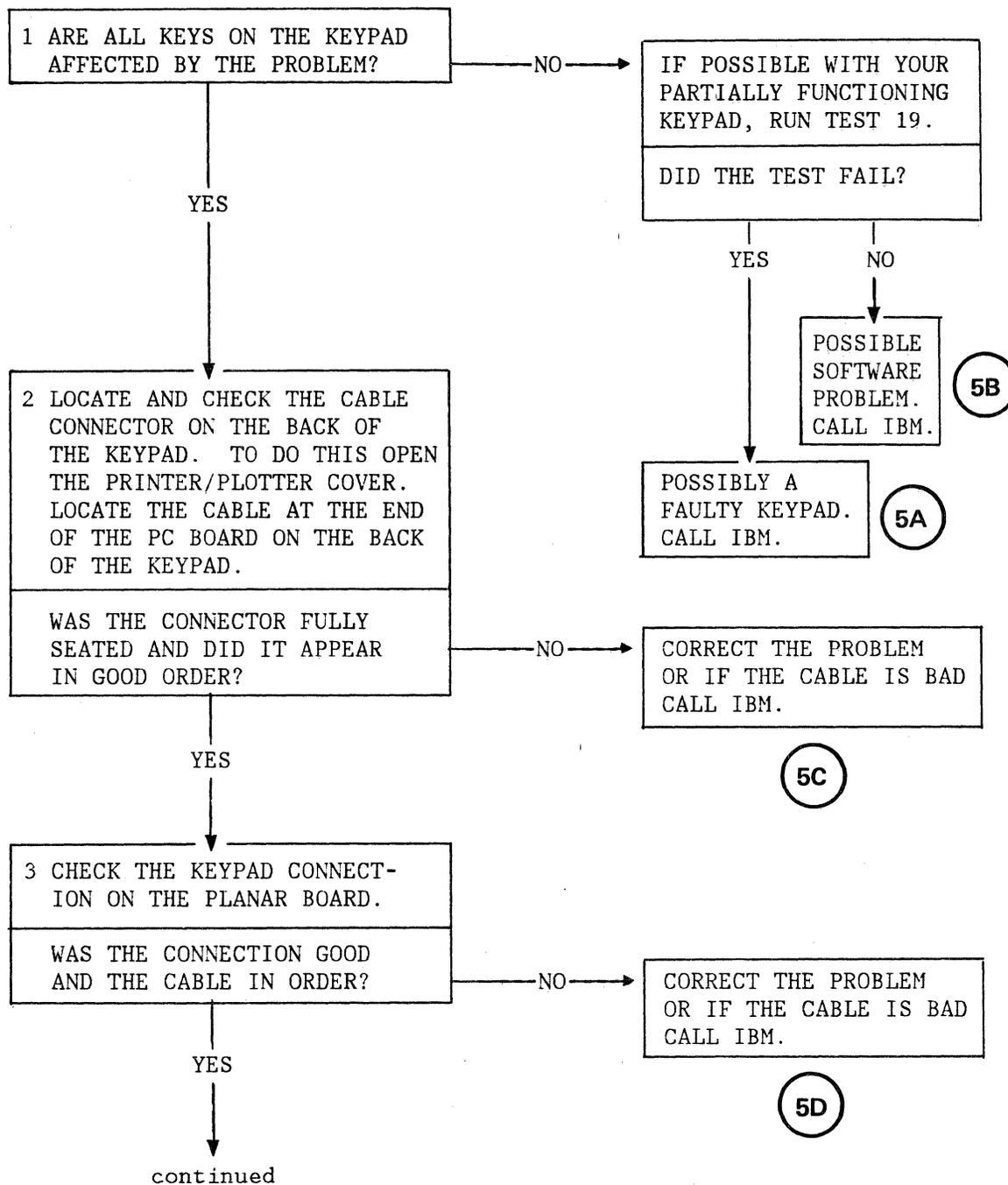


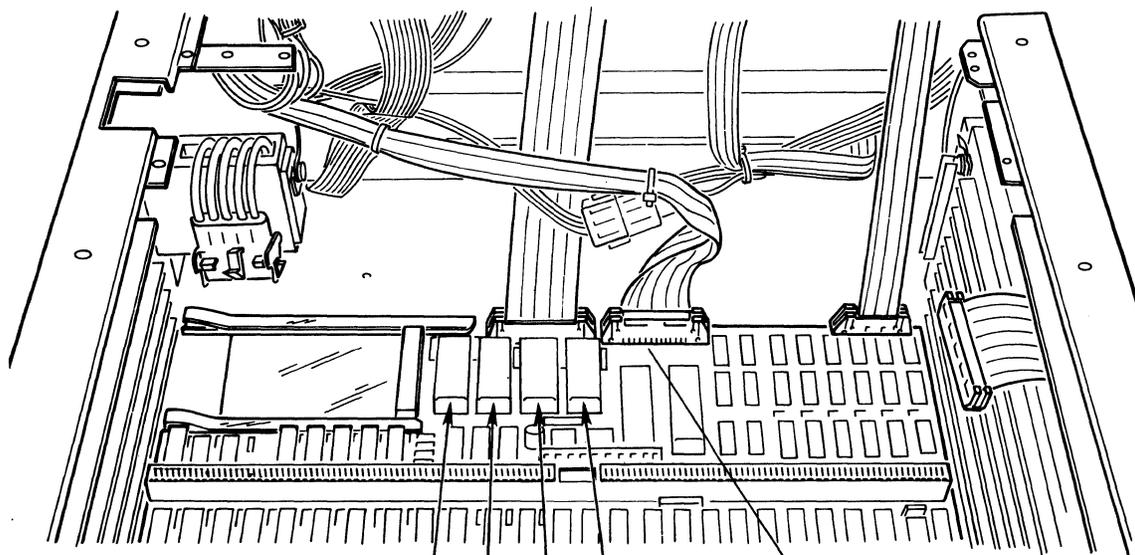
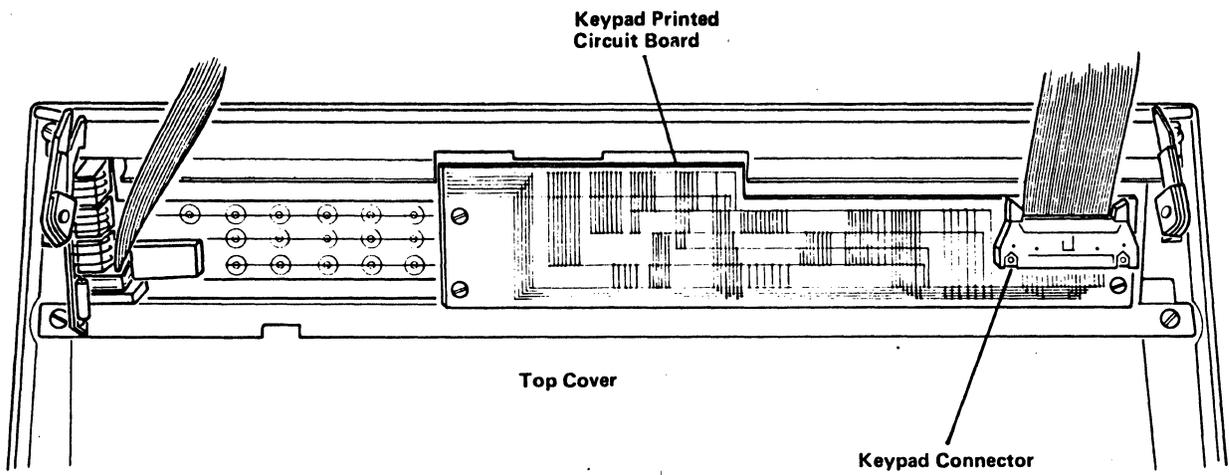


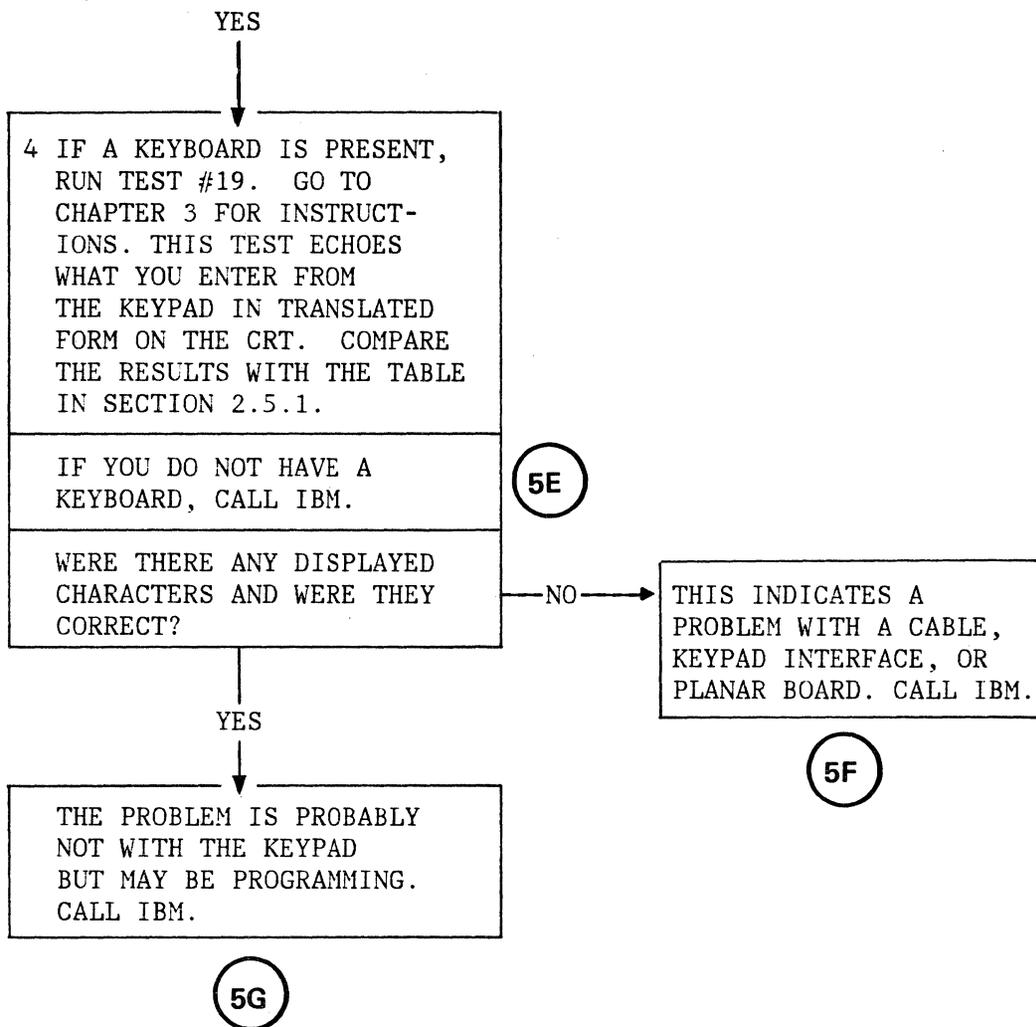
NOTE: Refer to Chapter 4, Section 4-1 to gain access to this component.



2.5 KEYPAD-RELATED PROBLEM ISOLATION







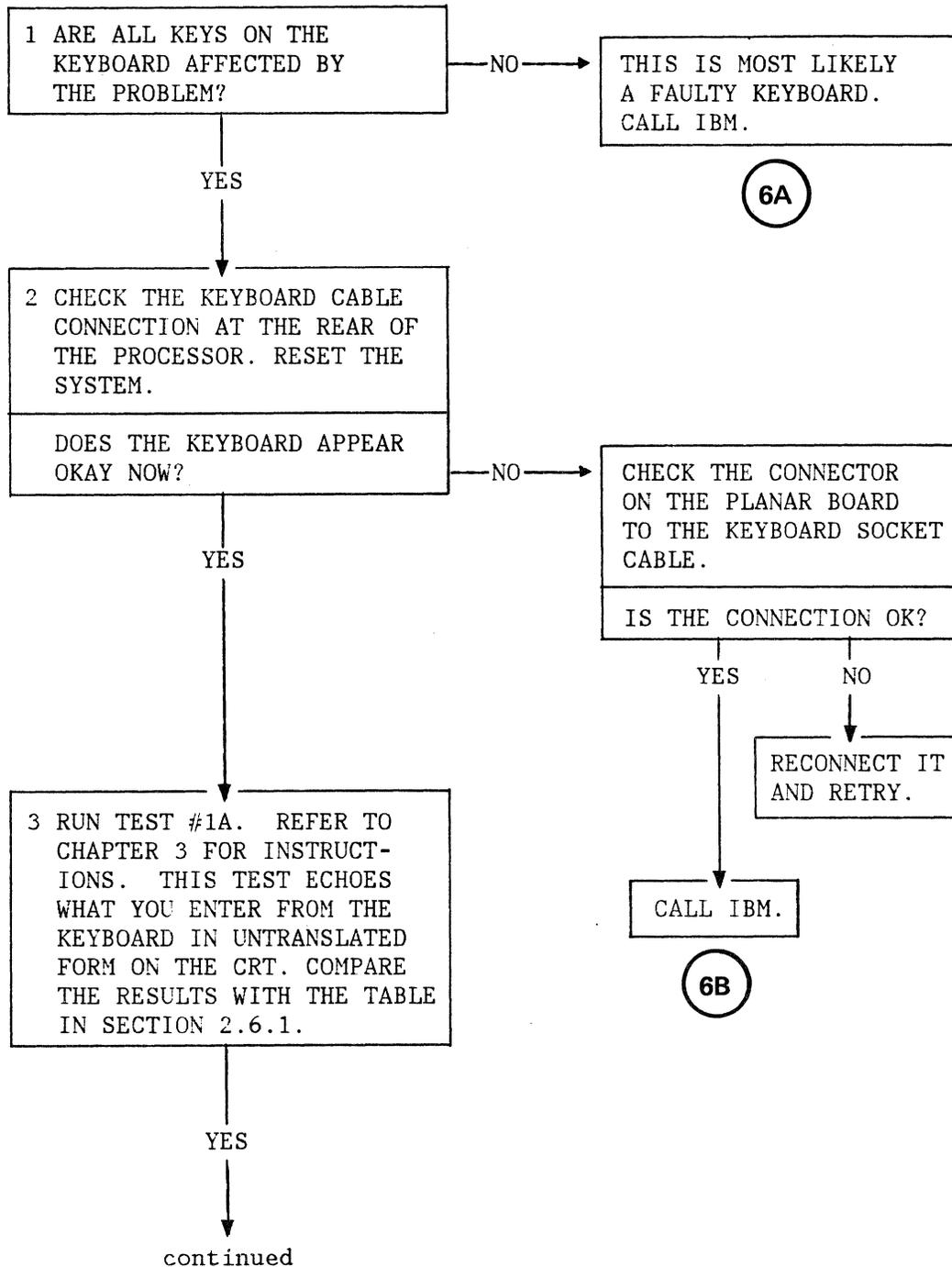
2.5.1 KEYPAD-CRT ECHO TEST

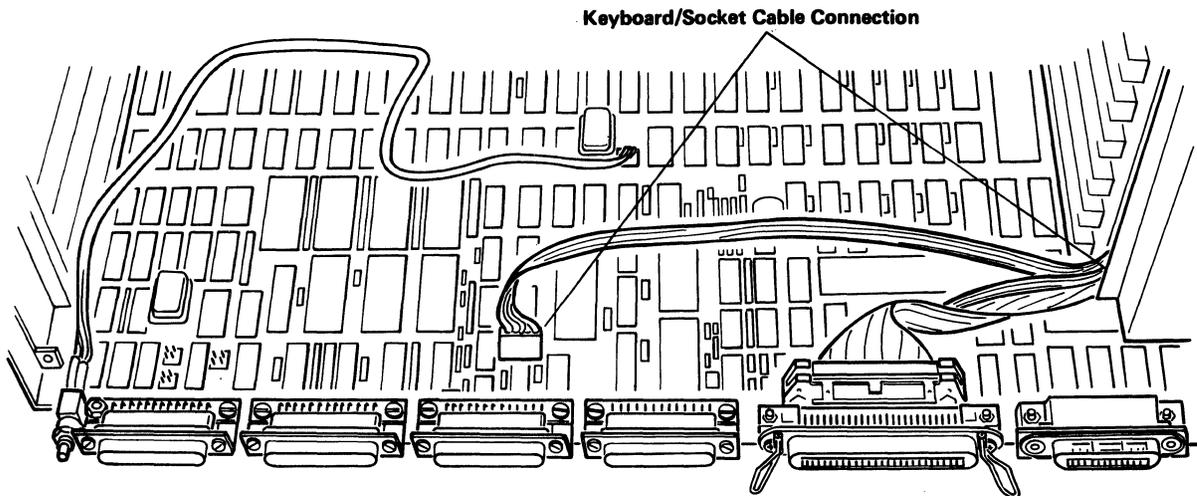
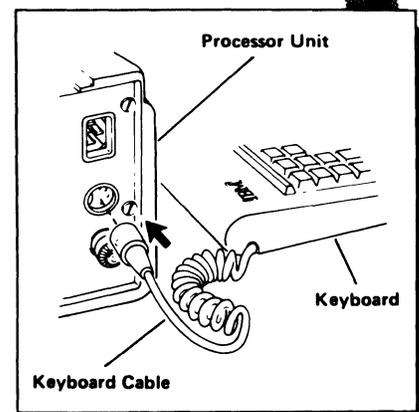
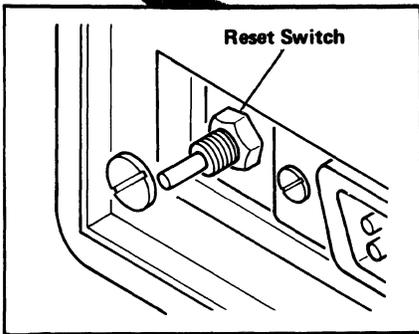
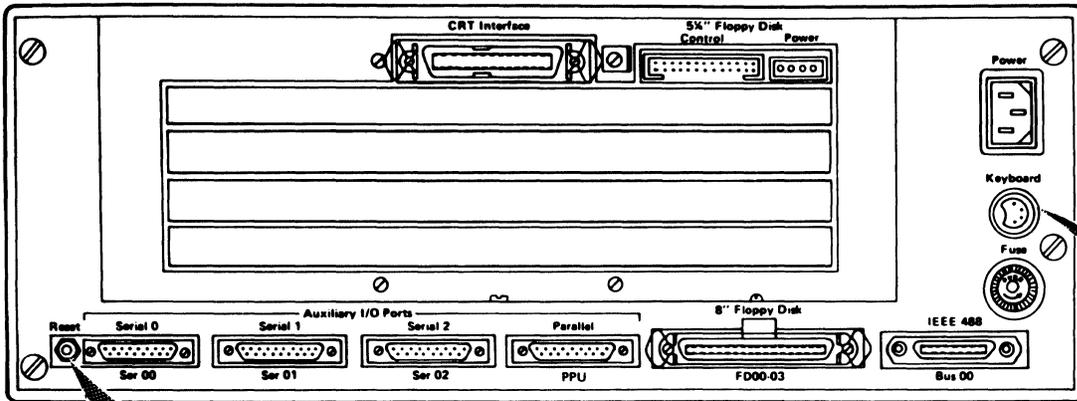
Use the drawing below to compare the data that you see on the CRT with the data associated with keypad keys. Note any differences and report them to IBM Instruments.

6E	6F	AF	A9	70	4C	79	68	9D	0A
----	----	----	----	----	----	----	----	----	----

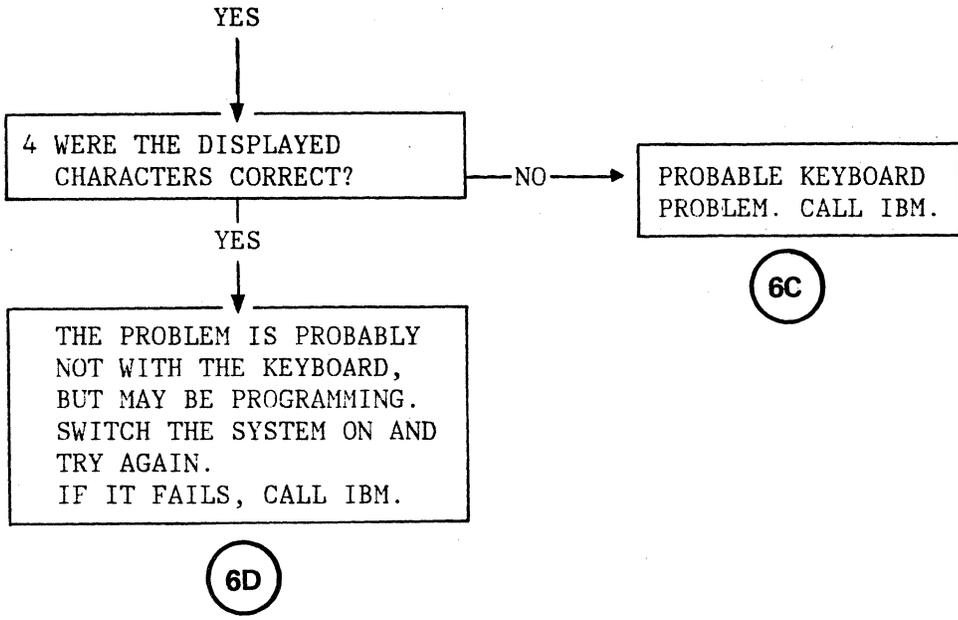
75	B4	A7	B6	03	FD	7F	69	6D	0B	77	FB	0D	58	60	A6	B2	74	62
72	B7	B3	BB	1E	65	AD	AE	0F	1F	*76	8C	64	9F	A3	A4	A5	73	AB
71	B1	A1	BA	09	88	6B	B0	4E	00	6A	7B	7E	7A	A2	A8	B9	*76	61

2.6 KEYBOARD-RELATED PROBLEM ISOLATION



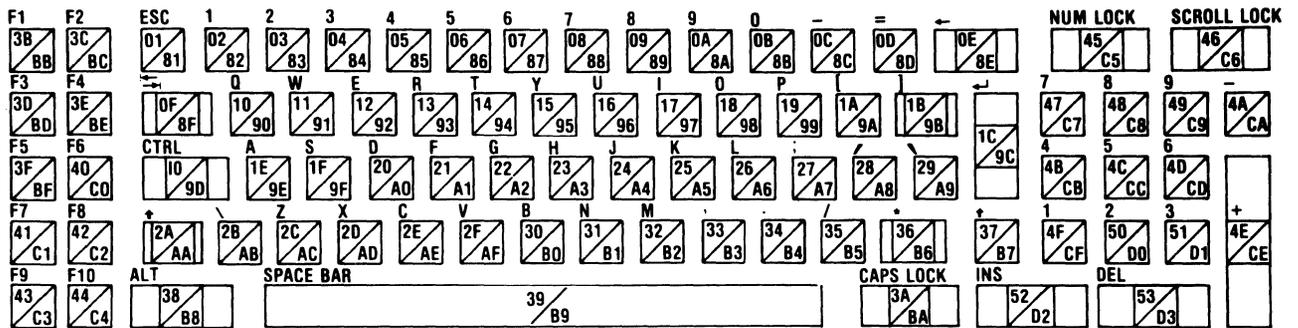


NOTE: Refer to Chapter 4, Section 4-1 to gain access to this component.



2.6.1 KEYBOARD-CRT ECHO

Use the drawing below to compare the data that you see on the CRT with the data associated with keyboard keys. Note any differences and report them to IBM Instruments.

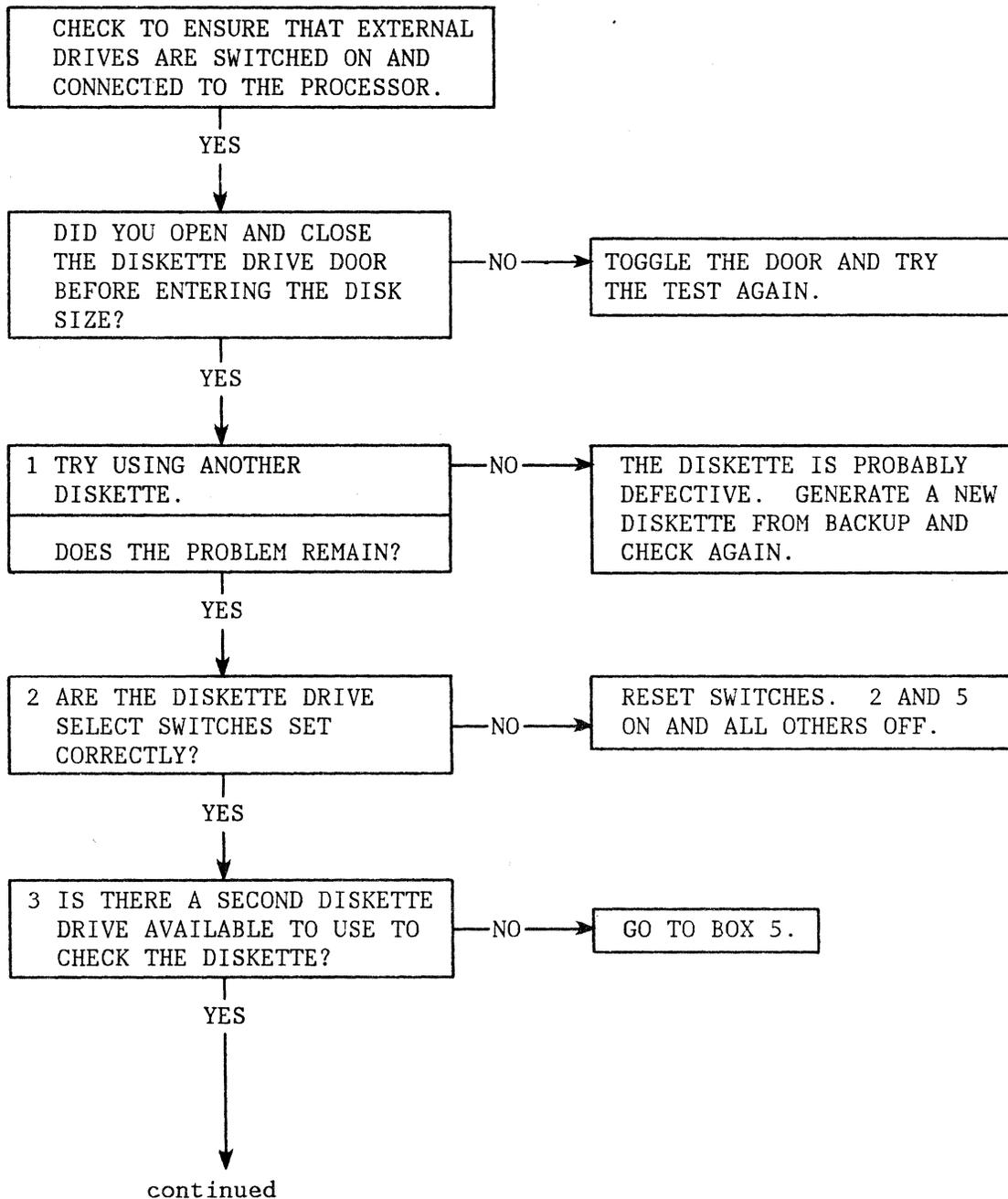


Scan Code When
key is pressed

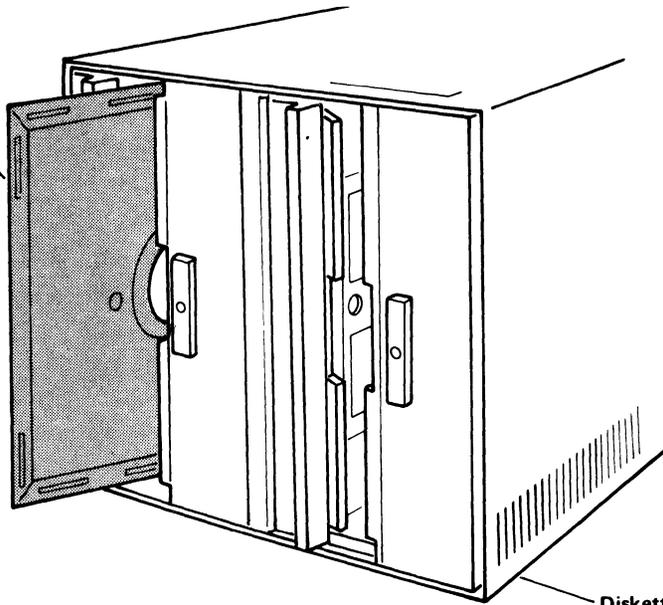


Scan Code when
key is released

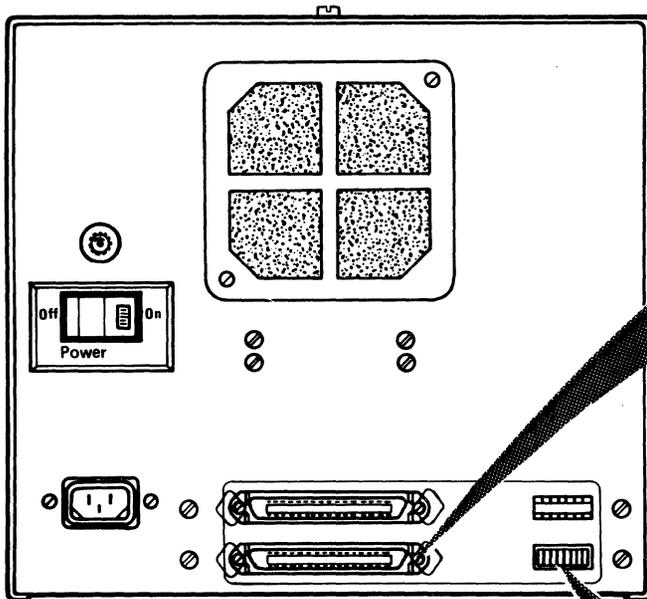
2.7 DISKETTE-RELATED PROBLEM ISOLATION



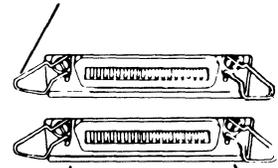
Diskette



Diskette Units

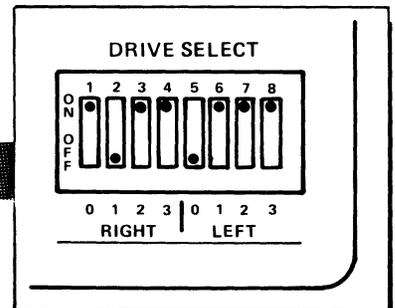


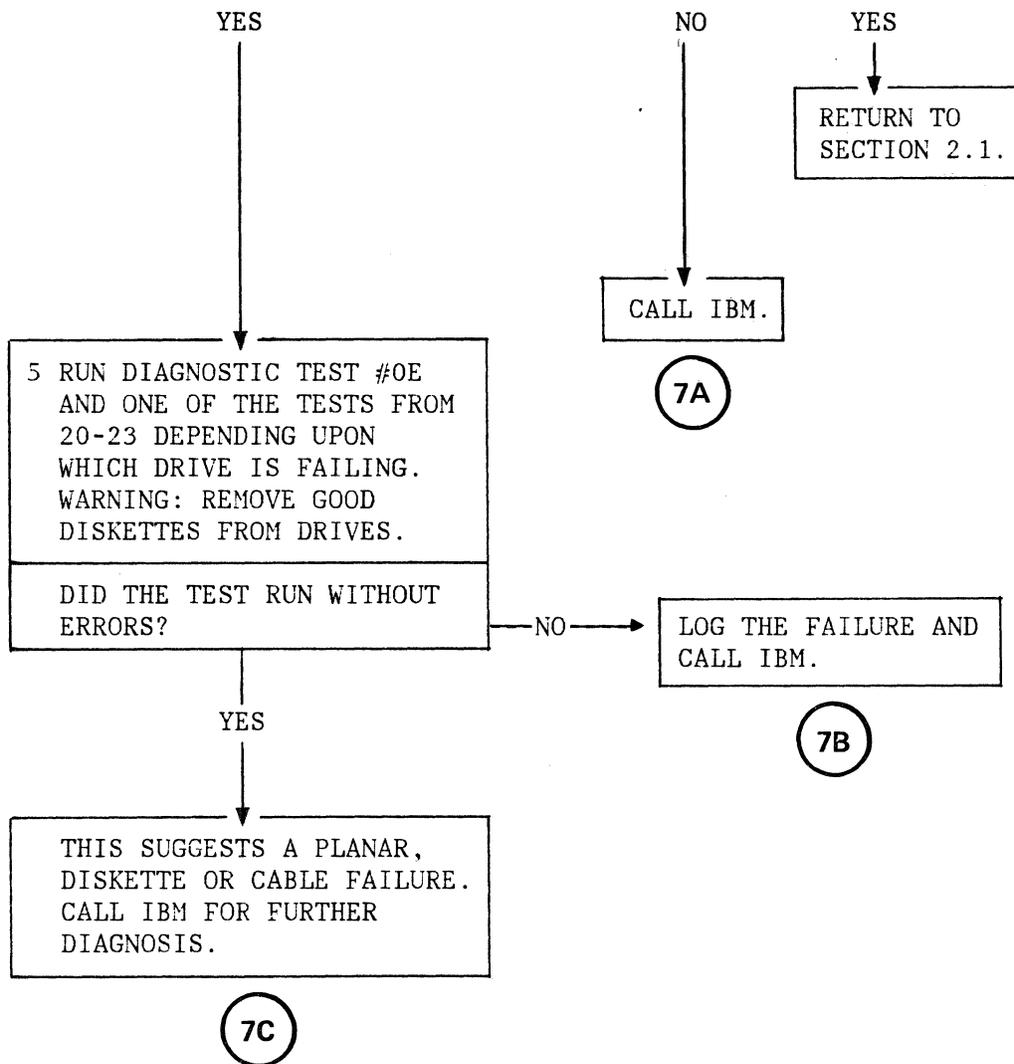
Spring Retaining Clips



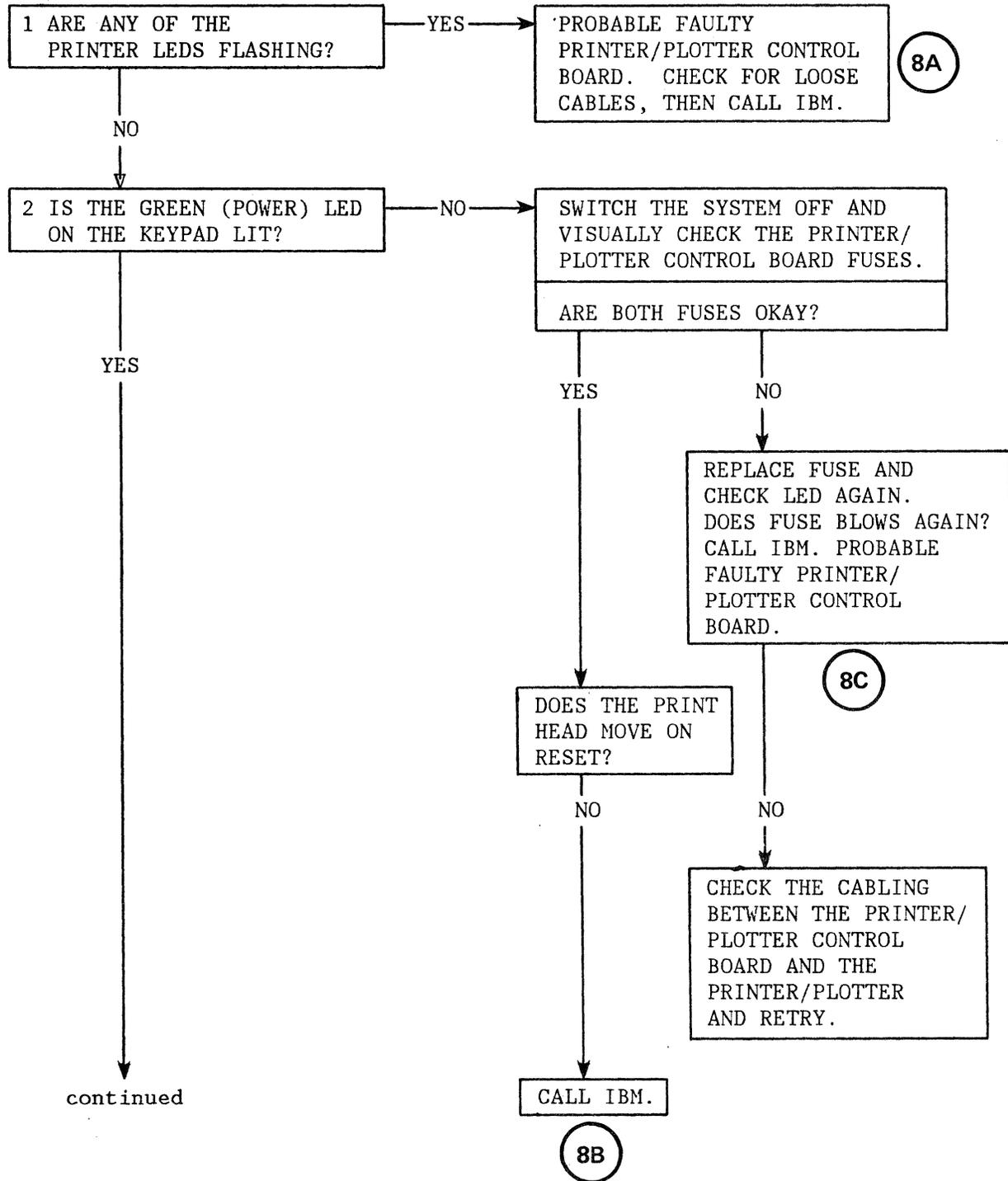
Diskette Unit

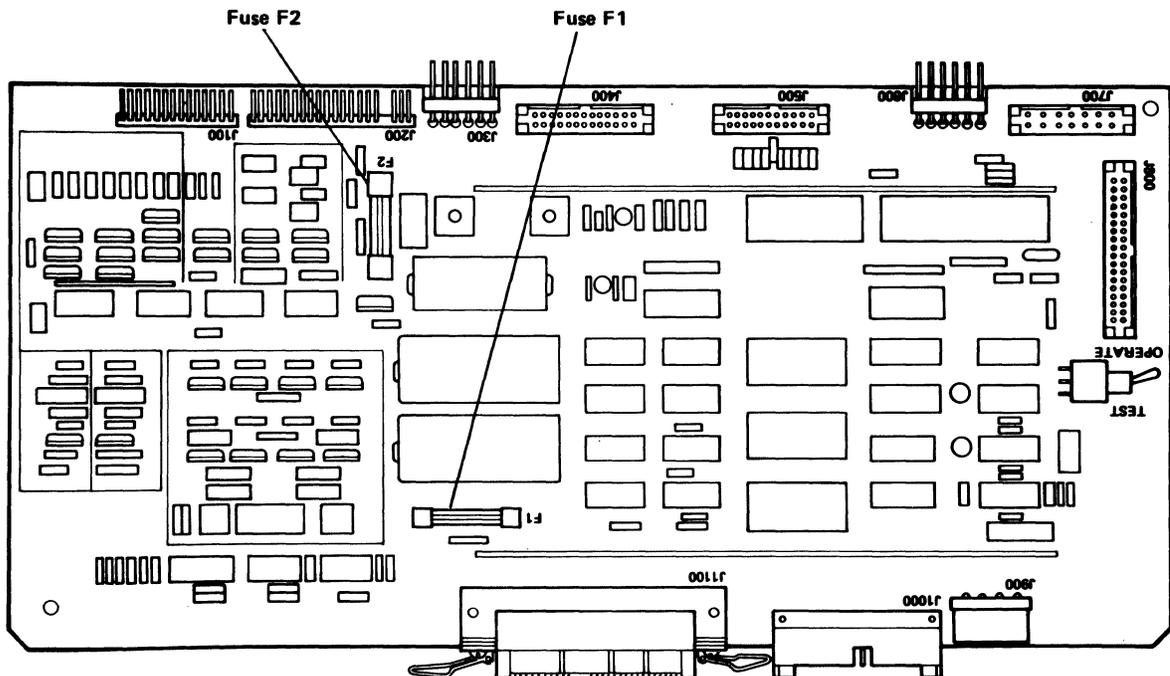
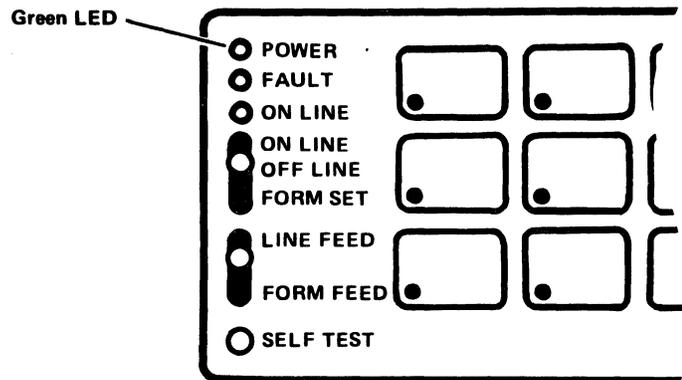
Diskette Drive Cable





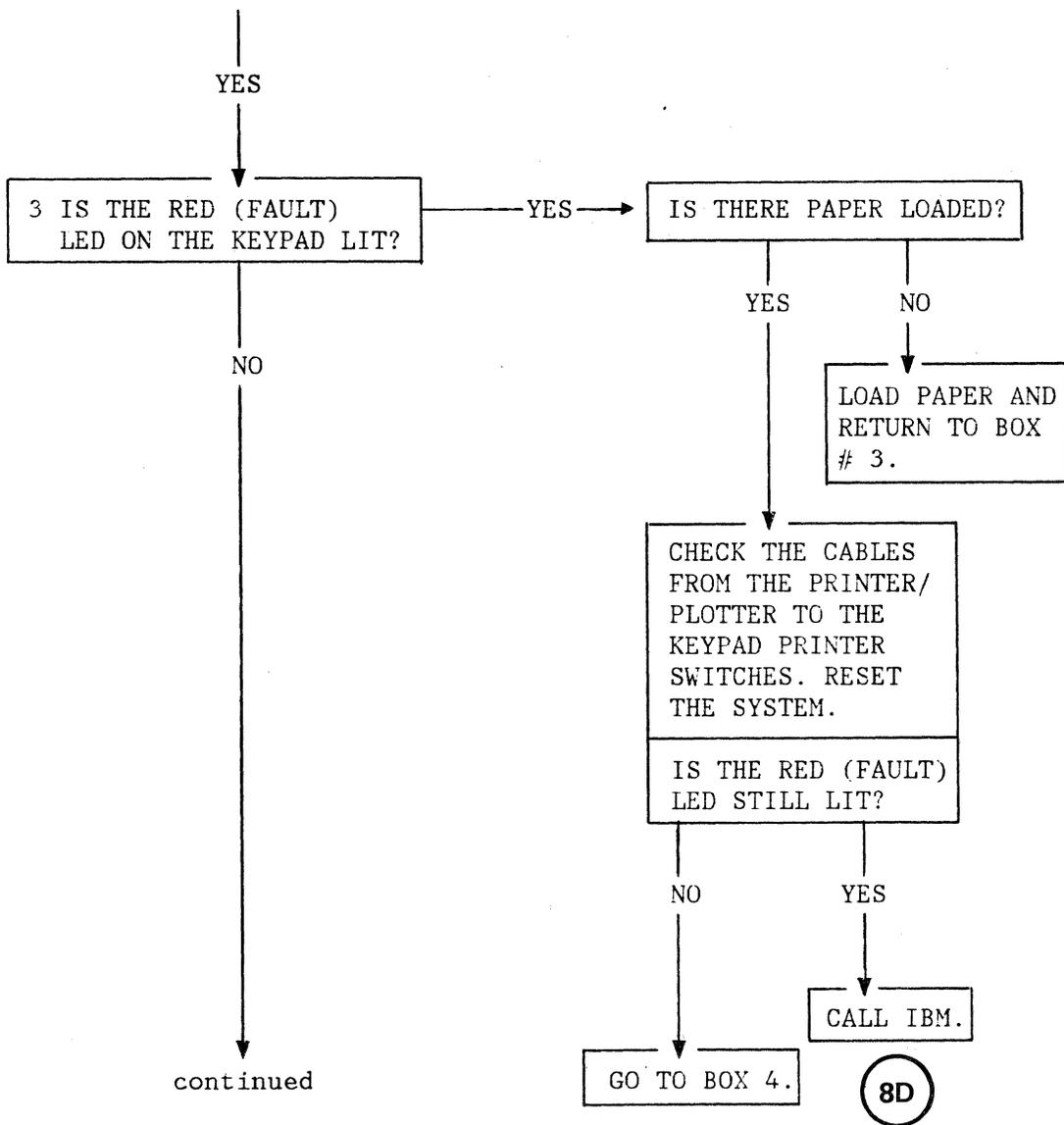
2.8 PRINTER/PLOTTER-RELATED PROBLEM ISOLATION

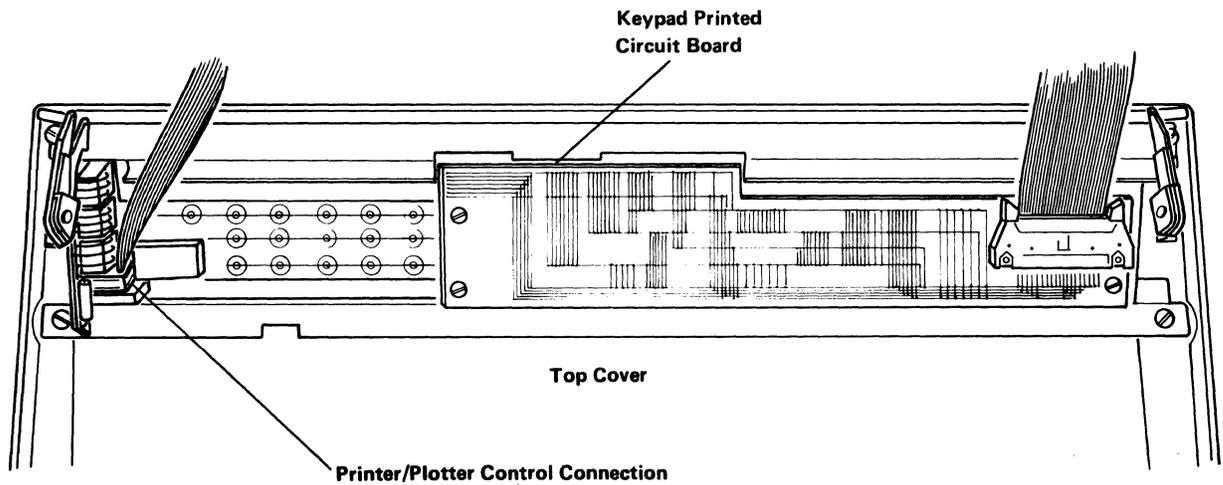
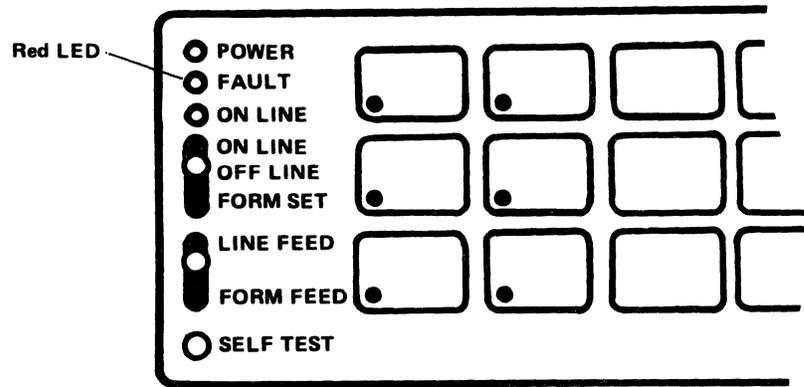


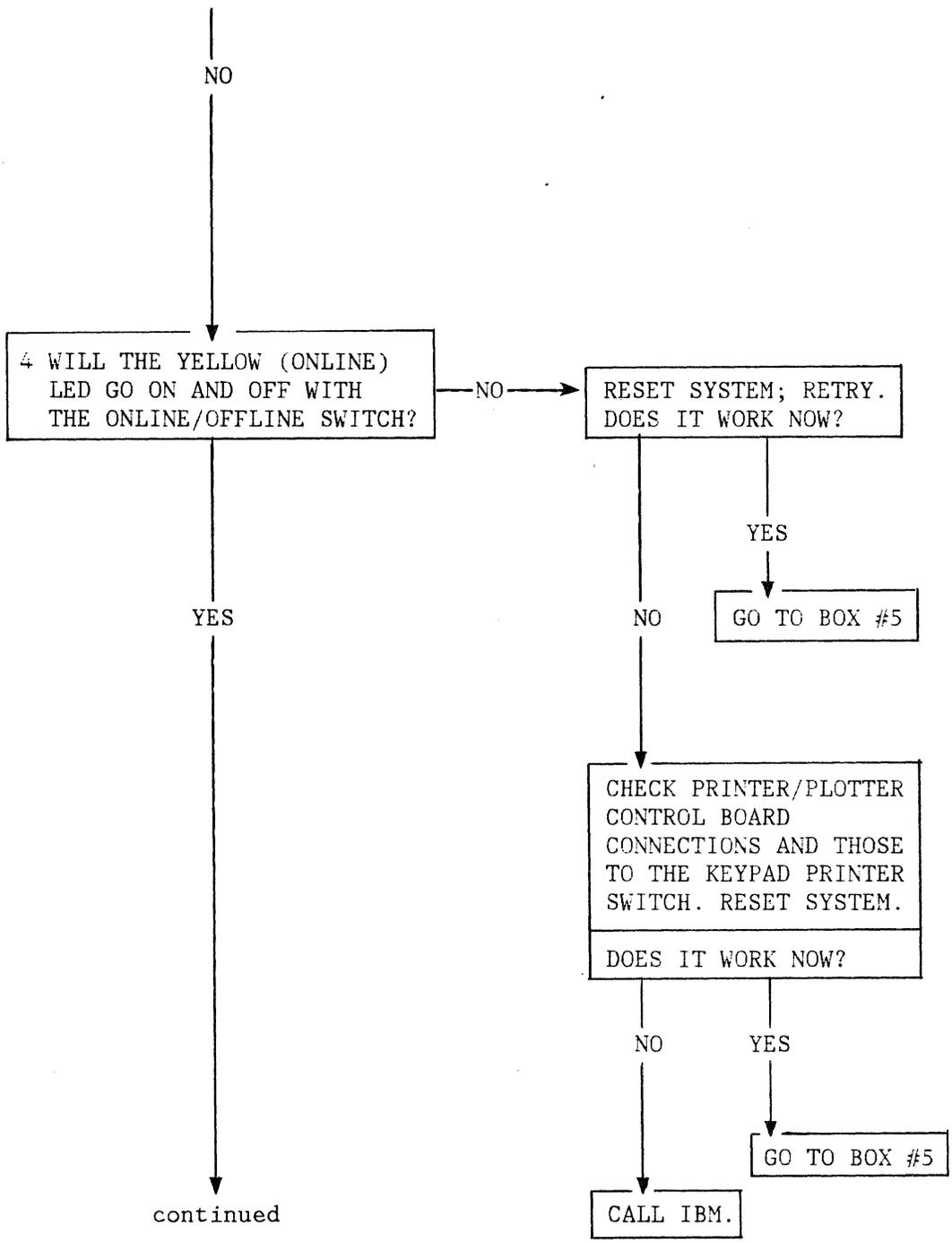


Printer/Plotter Control Board

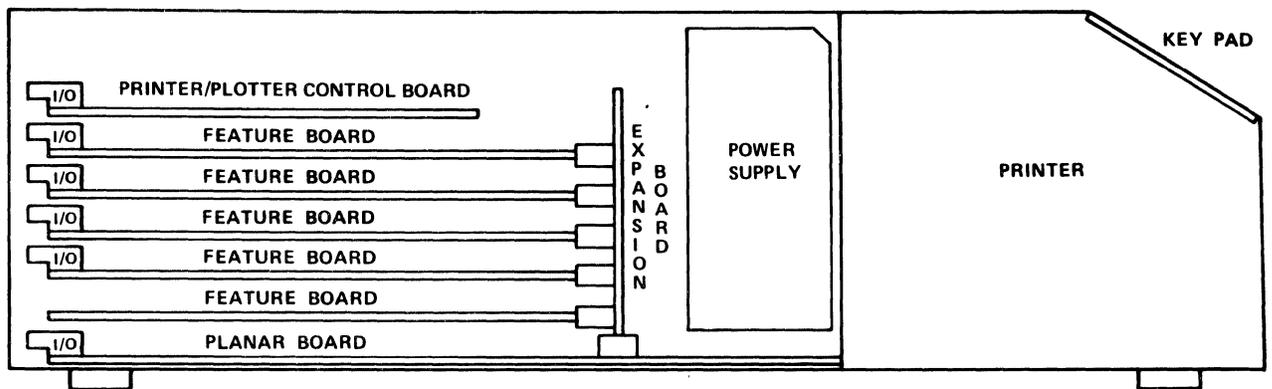
NOTE: Refer to Chapter 4, Section 4-1 to gain access to this component.





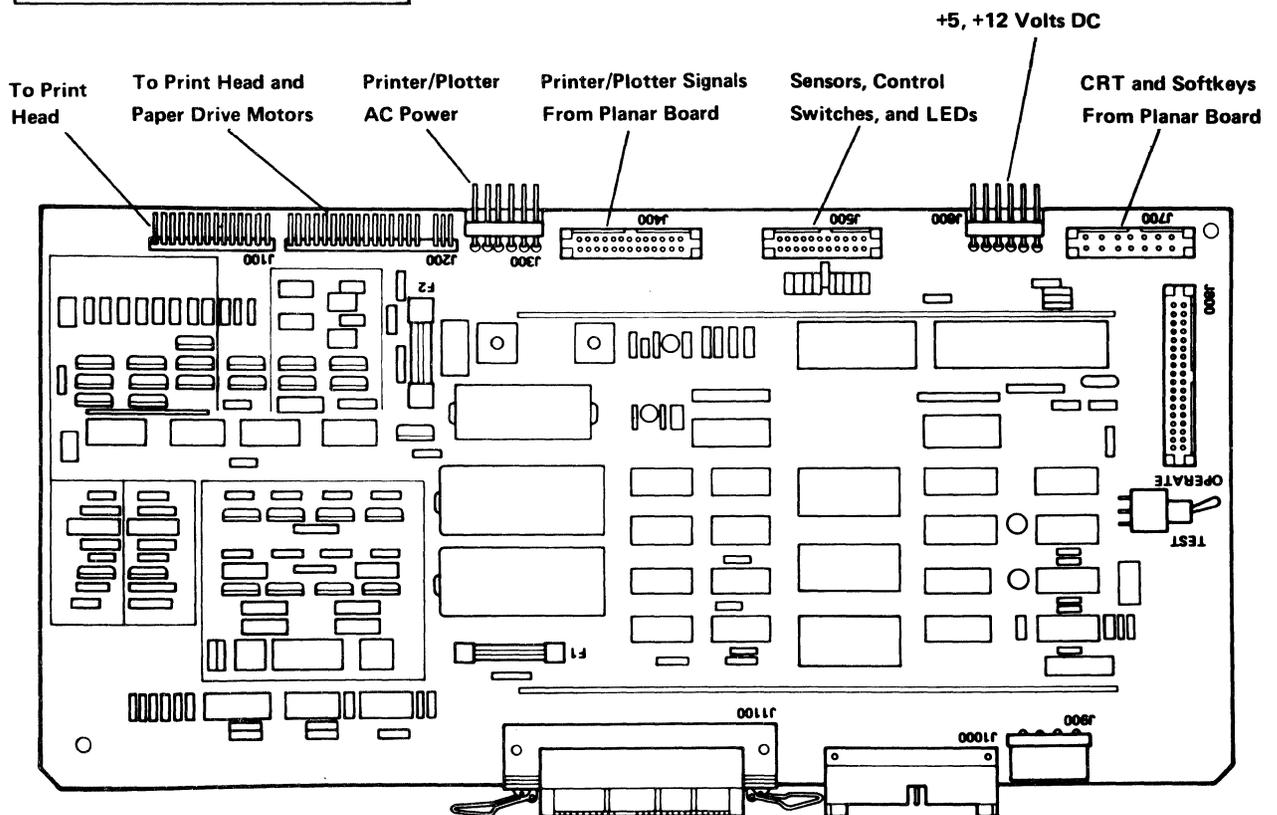


8E

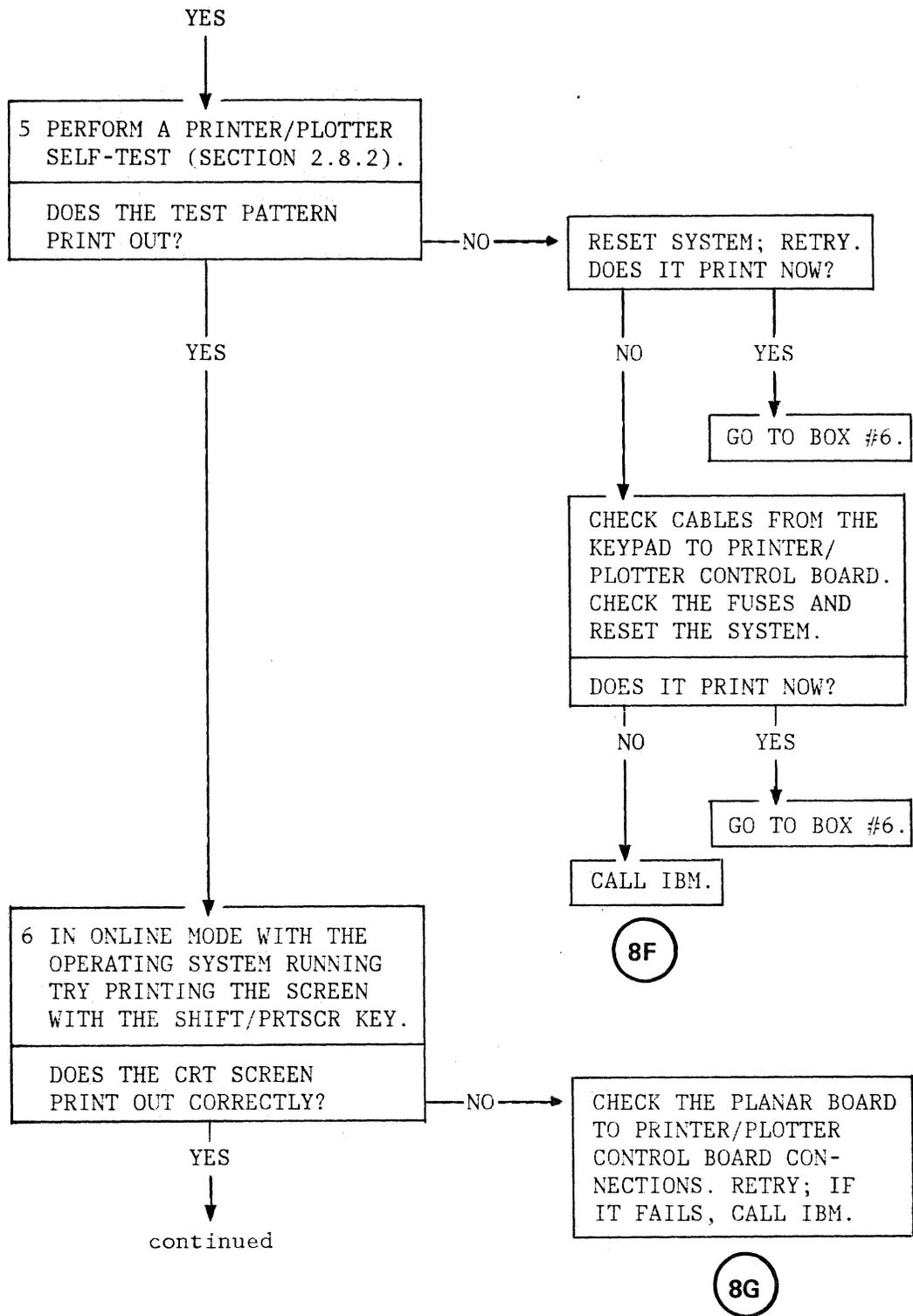


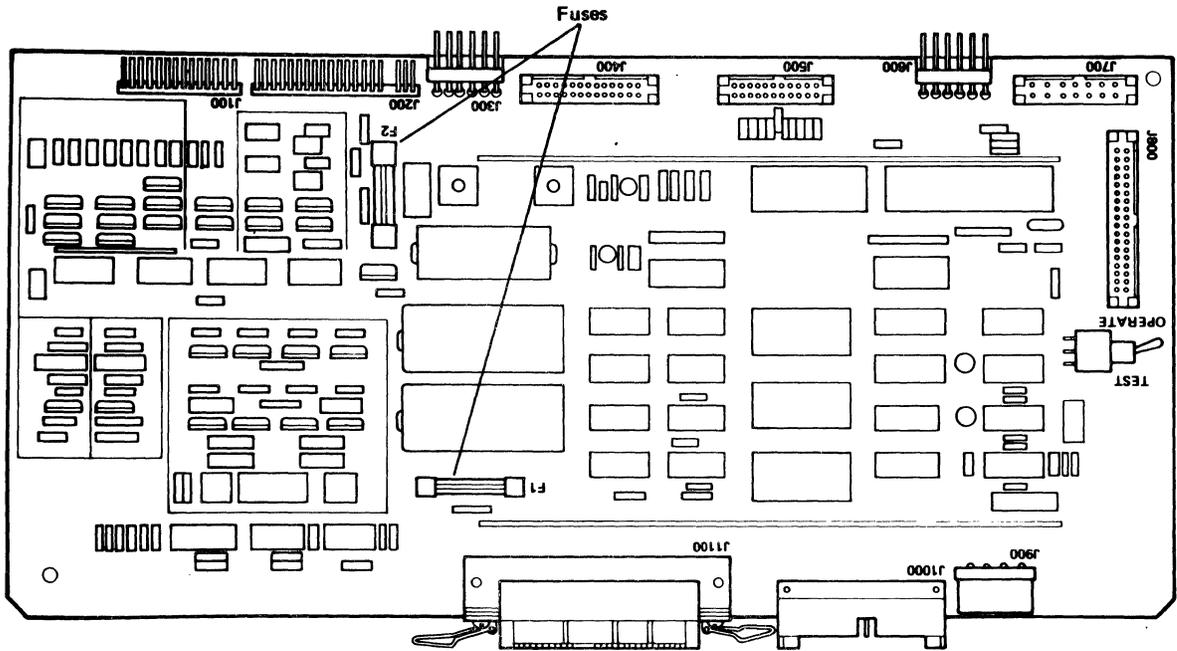
Main Processor Unit (Side View)

NOTE: Refer to Chapter 4, Section 4-1 to gain access to this component.



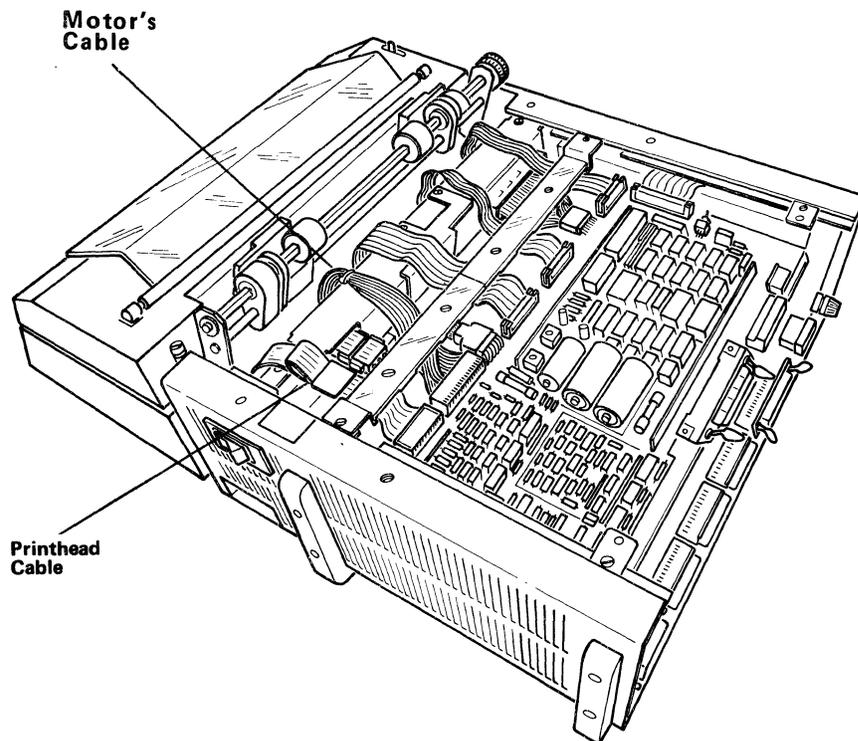
Printer/Plotter Control Board

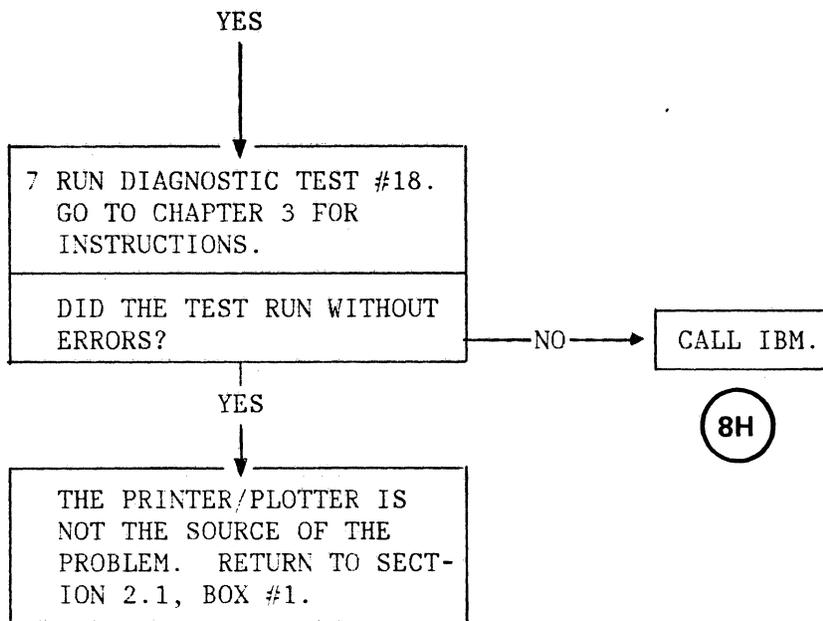




Printer/Plotter Control Board

NOTE: Refer to Chapter 4, Section 4-1 to gain access to this component.





8H

2.8.1 PRINTER SYMPTOM CHART

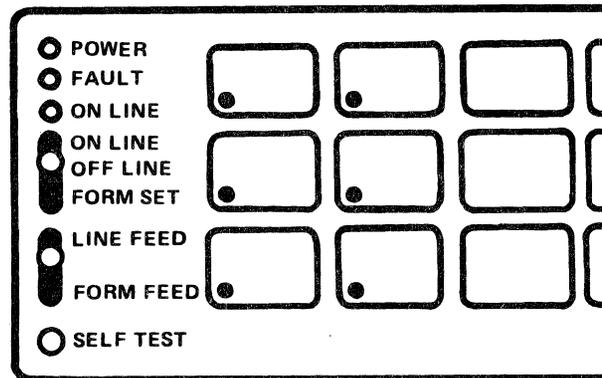
SYMPTOM	ACTION/CHECK-OUT
Can't get output to print on printer/plotter	<ol style="list-style-type: none">1. Check device assignments (issue the system command: LISTDEV).2. Refer to Section 2.8.2 to run printer/plotter self test. If the test runs but the printer/plotter still does not operate online, check the cable between the printer/plotter control board and the planar board
Ragged or uneven characters on printer	<ol style="list-style-type: none">1. Adjust Forms Thickness Control Lever. (Righthand side of printer/plotter)2. Check for worn ribbon and replace as required.3. Check carriage shaft; clean if necessary.
Faded or missing dots on plotter	<ol style="list-style-type: none">1. Adjust Forms Thickness Control Lever. (Righthand side of printer/plotter)2. Check for worn ribbon and replace as required.3. Check that the ribbon is not binding as it exits the cartridge.4. Check that ribbon is threaded correctly.5. Check to see if the ribbon motor is running (blue knob turning during printing.)
Margins are uneven	<ol style="list-style-type: none">1. Adjust Forms Thickness Control Lever. (Righthand side of printer/plotter)2. Check carriage shaft for dirt.3. Check to see if the carriage moves freely to the left and right.4. Check carriage drive belt tension (it may be too loose).

2.8.2 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.

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



Keypad

3. 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 it is released). If the test does not work, do the following:

2.9 EXTERNAL MEMORY BOARDS

MEMORY BOARD ADDRESSES

When an error is encountered in the external memory diagnostics (test 4), the switches should be checked to verify that each board has unique addresses and that no gaps exist in memory. (Remember, the planar board has 128K of memory. Therefore, the first external board should begin addressing at 20000 HEX.) If the switch settings are correct, the failing memory board can be identified by the address value displayed on the CRT. If there is more than one external memory board in the system, the switch settings on the remaining board(s) with higher addresses must be changed to eliminate a memory gap which will exist when the failing board is removed. Test 4 should be run again to verify that the correct memory board has been removed.

There are presently three types of memory boards used in the Computer System. The address settings for each board are as follows:

The 128K Memory Board

There are four ten-bit switches. Each switch designates the start address for a 32K bank of memory. Therefore, address bits 15 through 23 must be set. After the first switch is set, each additional switch should be set at one plus the setting of the previous switch. For example, if the first switch is set at 4 (0000000100 - bit 17 high and all others low) the first address on the board is HEX 20000. The first bank of memory will begin at HEX 20000 and end at HEX 27FFF. The second bank should begin at 28000 and, therefore, the second switch is set at 5 (0000000101 - bits 17 and 15 high). Failure to set the switches in increments of one will result in a gap in memory. The order of the switch settings on this board does not matter. The memory addresses contained on this board are XXXX XXXX X000 0000 0000 0000 (where X denotes the switch settings of the first switch) to XXXX XXXX XFFF FFFF FFFF FFFF where X denotes the switch settings of the fourth switch.

The 1/2M Memory Board

This can also be used as a 1/4M board when not fully populated. Three switches are used to set the address bits 12 through 23 on this board. SW1 is a four-bit switch which sets address bits 20 through 23. The other two switches are the start (SW5) and end (SW6) address bits 12 through 19. The end switch should be set HEX 7F higher than the start switch for 1/2M and HEX 3F higher than the start switch for 1/4M. For example, if the start switch is set at HEX 20 (start address 20000 assuming the SW1 is set at zero), then the end switch should be set for HEX 9F (end address 9FFFF) for a 1/2M board and HEX 5F (end address 5FFFF) for a 1/4M board.

The 1M Memory Board

This can also be used as a 1/2M board when not fully populated. There are two switches on the board designating the start (SW1) and stop (SW2) address bits 16 through 23. Use the following table to set the addresses of this board.

CONFIGURATION DATA FOR CS9000 MEMORY EXPANSION
USING IBM 1/4, 1/2, 3/4, 1 MEG. MEMORY BOARDS

<u>DESIRED EXTRA MEMORY</u>	<u>REQUIRED BOARDS</u>	<u>START ADDRESS</u>	<u>STOP ADDRESS</u>
1/4 MEG	1/4 MEG BOARD 6133044	20000	5FFFF
1/2 MEG	1/2 MEG BOARD 6133045	20000	9FFFF
3/4 MEG	3/4 MEG BOARD 6133046	20000	DFFFF
1 MEG	1 MEG BOARD 6133047	20000	11FFFF
1-1/4 MEG	1 MEG BOARD 6133047 1/4 MEG BOARD 6133044	20000 12000	11FFFF 15FFFF
1-1/2 MEG	1 MEG BOARD 6133047 1/2 MEG BOARD 6133045	20000 120000	11FFFF 19FFFF
1-3/4 MEG	1 MEG BOARD 6133047 3/4 MEG BOARD 6133046	20000 120000	11FFFF 1DFFFF
2 MEG	1 MEG BOARD 6133047 1 MEG BOARD 6133047	20000 120000	11FFFF 21FFFF
2-1/4 MEG	1 MEG BOARD 6133047 1 MEG BOARD 6133047 1/4 MEG BOARD 6133044	20000 120000 220000	11FFFF 21FFFF 25FFFF
2-1/2 MEG	1 MEG BOARD 6133047 1 MEG BOARD 6133047 1/2 MEG BOARD 6133047	20000 120000 220000	11FFFF 21FFFF 29FFFF
2-3/4 MEG	1 MEG BOARD 6133047 1 MEG BOARD 6133047 3/4 MEG BOARD 6133046	20000 120000 220000	11FFF 21FFFF 2DFFFF
3 MEG	1 MEG BOARD 6133047 1 MEG BOARD 6133047 1 MEG BOARD 6133047	20000 120000 220000	11FFFF 21FFFF 31FFFF
3-1/4 MEG	1 MEG BOARD 6133047 1 MEG BOARD 6133047 1 MEG BOARD 6133047 1/4 MEG BOARD 6133044	20000 120000 220000 2E0000	11FFFF 21FFFF 2DFFFF 35FFFF
3-1/2 MEG	1 MEG BOARD 6133047 1 MEG BOARD 6133047 1 MEG BOARD 6133047	20000 120000 220000	11FFFF 21FFFF 2DFFFF

	1/2 MEG BOARD 6133045	2E0000	39FFFF
3-3/4 MEG	1 MEG BOARD 6133047	20000	11FFFF
	1 MEG BOARD 6133047	120000	21FFFF
	1 MEG BOARD 6133047	220000	2DFFFF
	3/4 MEG BOARD 6133046	2E0000	3DFFFF
4 MEG	1 MEG BOARD 6133047	20000	11FFFF
	1 MEG BOARD 6133047	120000	21FFFF
	1 MEG BOARD 6133047	220000	2DFFFF
	1 MEG BOARD 6133047	2E0000	41FFFF

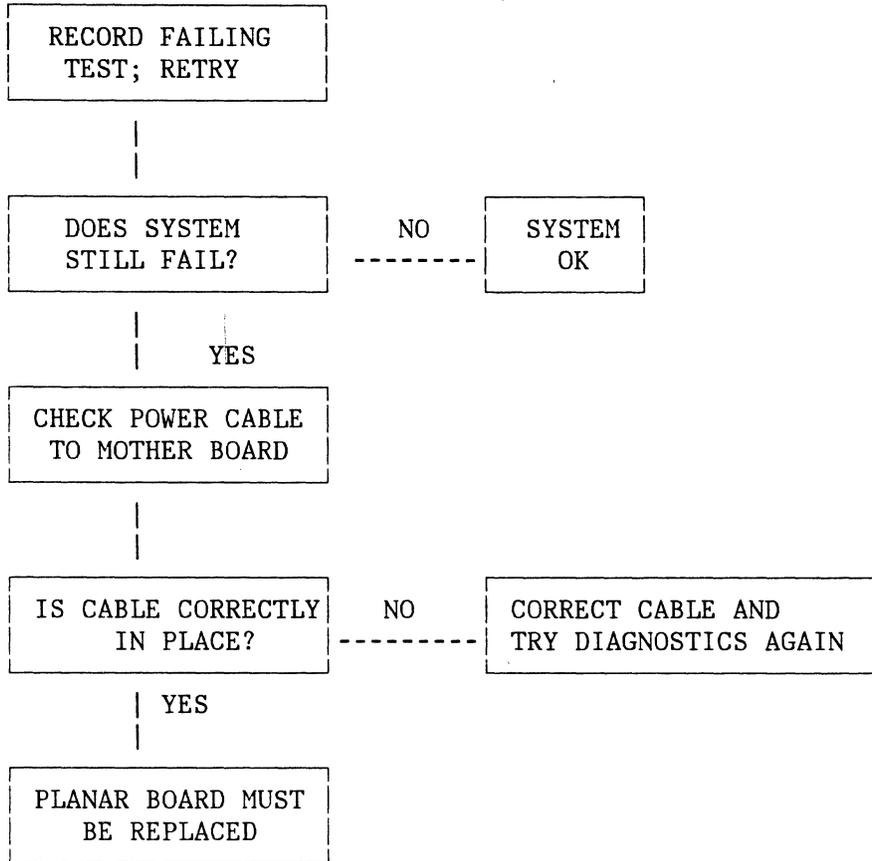
SWITCH 1 SETTINGS OPEN = 1 CLOSED = 0

<u>START ADDRESS</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>
20000	1	0	0	0	0	0	0	0
120000	1	0	0	0	1	0	0	0
220000	1	0	0	0	0	1	0	0
32000	1	0	1	1	0	1	0	0

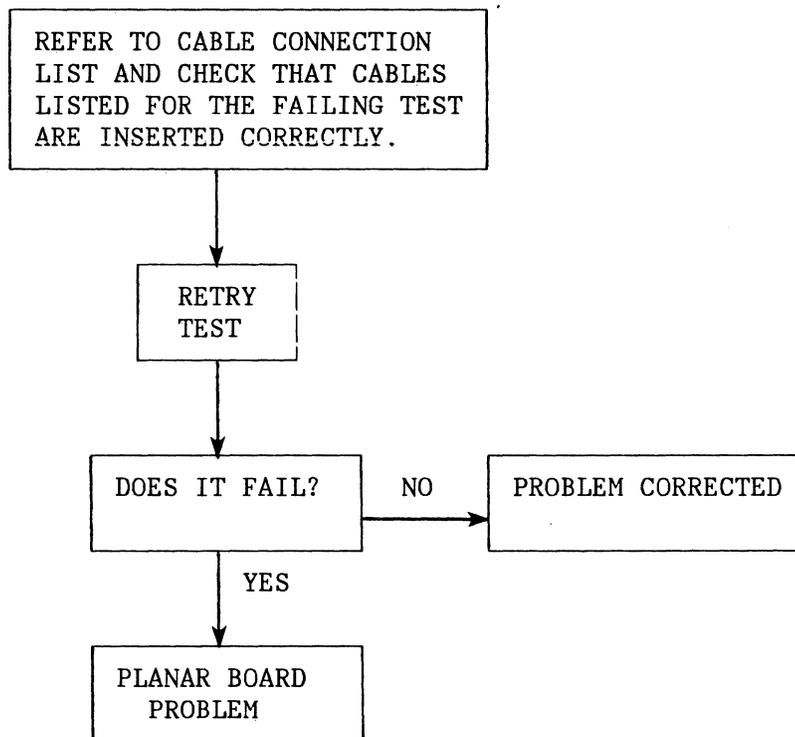
SWITCH 2 SETTINGS OPEN = 1 CLOSED= 0

<u>STOP ADDRESS</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>
5FFFF	0	1	1	0	0	0	0	0
9FFFF	0	1	0	1	0	0	0	0
DFFFF	0	1	1	1	0	0	0	0
11FFFF	0	1	0	0	1	0	0	0
15FFFF	0	1	1	0	1	0	0	0
19FFFF	0	1	0	1	1	0	0	0
1DFFFF	1	1	1	1	1	0	0	0
21FFFF	0	1	0	0	0	1	0	0
25FFFF	0	1	1	0	0	1	0	0
29FFFF	0	1	0	1	0	1	0	0
2DFFFF	1	1	1	1	0	1	0	0
31FFFF	0	1	0	0	1	1	0	0
35FFFF	0	1	1	0	1	1	0	0
39FFFF	0	1	0	1	1	1	0	0
3DFFFF	1	1	1	1	1	1	0	0
41FFFF	0	1	0	0	0	0	1	0

2.10 PLANAR BOARD PROBLEM ISOLATION



2.11 WRAP TEST PROBLEM ISOLATION



CABLE CONNECTION LIST

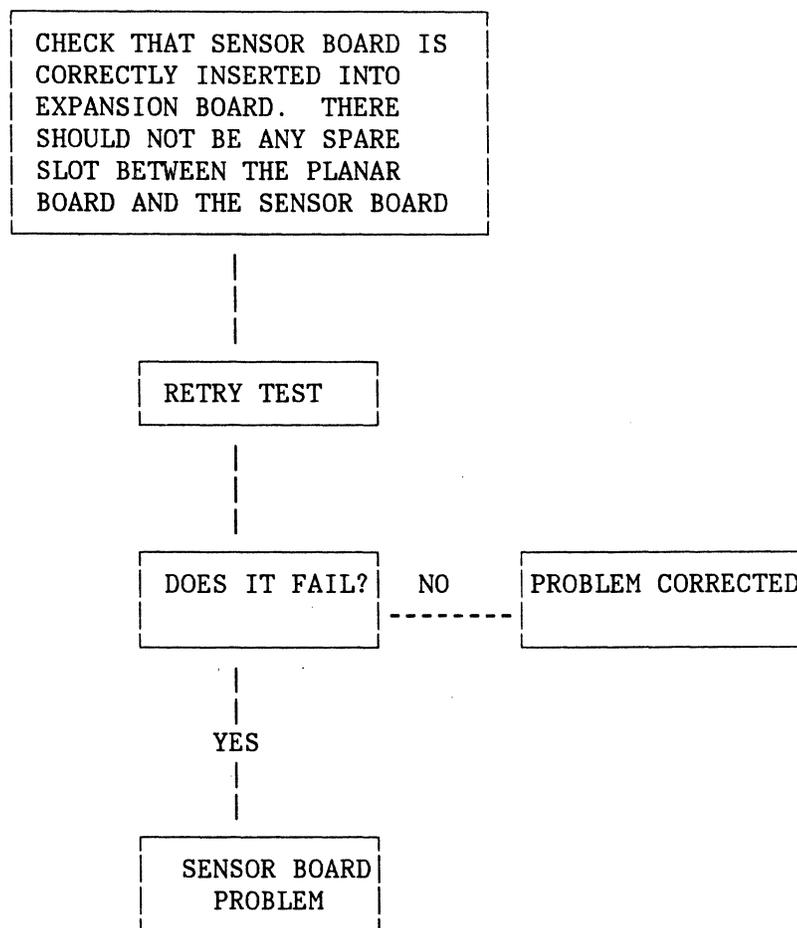
	Power	AC: To power supply (see page 2-9) and to fans (see figure 4-22) to printer/plotter board J300 (see page 2-17) DC: Power Supply to Expansion Board, Power Supply to Printer Board J600 (see page 2-17)
Test 1	CPU	Planar
Test 2	Prom	Planar, EPROM drawer - If display is normal, the EPROM drawer is correctly inserted.
Test 3	On Board Memory	Planar
Test 4	External Memory	Memory Boards, Expansion Board, Planar Boards
Test 5	Interrupt	Planar
Test 7	Memory Protect	Planar, External Memory Boards and Expansion Boards. (If problem is external memory or expansion board, Test 4 should also fail.)
Test 8	DMA	Planar
Test 9	8253 Timer	Planar
Test A	Video Memory	Planar
Test B	6845 CRT Controller	Planar
Test C	Holt 8000 Clock/Cal	Planar
Test D	8255	Planar
Test E	Floppy Controller	Planar
Test F	2661 RS232-0	Planar
Test 10	2661 RS232-1	Planar
Test 11	2661 RS232-2	Planar
Test 12	2653 Polynomial Generator	Planar
Test 18	Printer	Planar J14 Planar to J400 Printer Board J100 Printer Board to Printer Head J200 Printer Board to Printer Motor J500 Printer Board to Printer Sensor J300 Printer/Plotter AC Cable J600 Printer Board To Power Supply (See diagram on page 2-35)
Test 19	Keypad	Planar J15 Planar to Keypad
	Softkeys	Planar

Softkeys	Planar J8 Planar to CRT on printer board J700 Printer Board CRT
Test 1A Keyboard	Planar Cable from Planar to back of Processor Unit Keyboard with Cable
<u>Wrap Test</u>	
Test 16 CRT	Planar J8 on Planar to J700 Printer Printer Board Wrap from J1100 Printer Board to User Port Planar
Test 17 Floppy	Planar Wrap from Floppy Port to User Port (both on Planar Board)
Test 1C IEEE	Planar Wrap from IEEE to User Port (both on Planar Board)
Test 1D Serial Port 1-2 Wrap	Planar Wrap from Serial Port 1 to Serial Port 2 (both on Planar Board)
Test 1E Serial Port 0 to 1 or 2	Planar Wrap from Serial Port 0 to Serial Port 1 <u>or</u> Serial Port 2
Test 1F DMA Serial Port Wrap	Planar Wrap cable from test 1E
Test 20- Disk 23	8" Floppy: Planar Cable from J4 Planar to 8" Floppy Drive Disk Drive
	5-1/4" Floppy Planar J800 Printer to J3 Planar Printer Board External - J900 Printer Board 5-1/4" drive power J1000 Printer Board to 5-1/4"

Test 35 Sensor Board

Planar
Expansion Board
Sensor Board
Wrap Connectors for Sensor Board

2.12 SENSOR BOARD PROBLEM ISOLATION





3.0 RUNNING THE DIAGNOSTICS

The extended diagnostic programming allows you to choose which tests will be run. All commands in the manual mode are executed by using the softkeys and the keypad. The keyboard may also be used if the unit is so equipped.

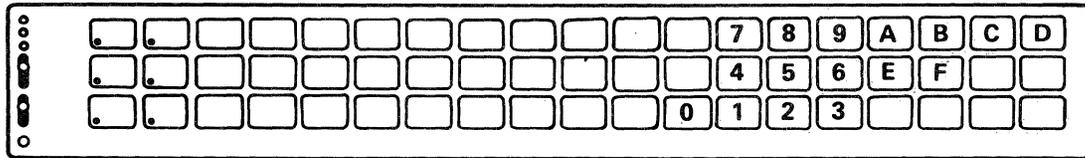
3.1 INVOKING THE MANUAL DIAGNOSTICS MODE

In the manual diagnostics mode all tests may be run including those that are run automatically when the system is switched ON. If the power-on tests complete without encountering an error, manual mode can be invoked by typing DIAG, followed by a carriage return. The message: "PRESS STOP KEY THEN EXECUTE KEY TO START MANUAL DIAGNOSTICS" will be displayed. Press the STOP and EXECUTE soft keys to begin. Refer to Figure 3-1 for the location of these keys. (If your system is not equipped with a keyboard, you can enter the manual diagnostics by pressing the STOP softkey while the power-on diagnostics are running.)

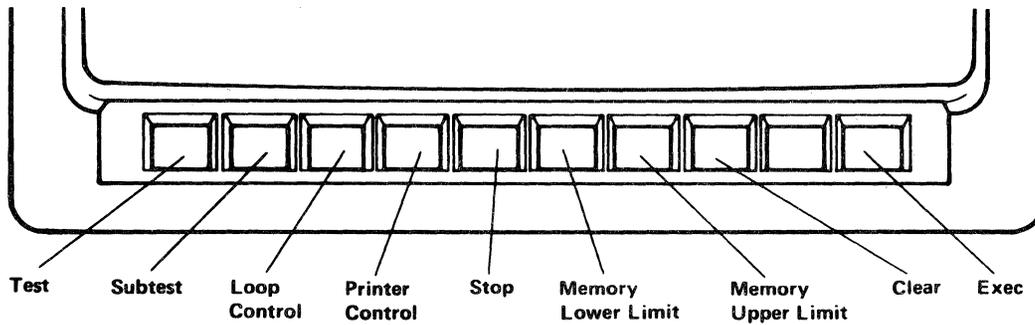
NOTE: Only one of the two entry options may be selected. If the keyboard is selected, the system must be reset to use the keypad, and vice-versa. So if you begin entering diagnostic commands on the keypad and softkeys, you must continue to do so.

In addition to the ROM diagnostics described above, there is a set of RAM diagnostics on the Operating System Extensions diskette. These RAM diagnostics contain everything in the ROM version, plus hard disk diagnostics. To run the RAM diagnostics, insert the Operating System Extensions diskette into Drive 0 and type "RAMDIAGS". The system will prompt you to press the "ESC" and EXECUTE keys.

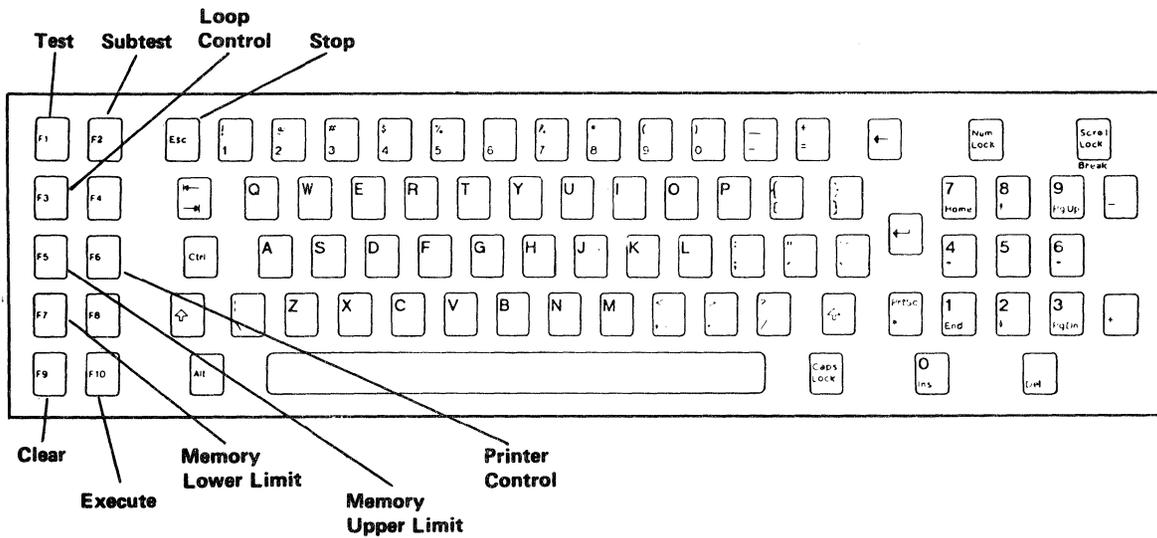
To exit the diagnostics run Test FE, Subtest 0 or 1.



Keypad



Softkeys



Keyboard

Figure 3-1. Keypad, Softkeys, and Keyboard.

3.2 CONTROLLING THE TEST ENVIRONMENT

The following commands can be entered to enable or disable units, control loops, or set memory limits.

- Printer/Plotter ON/OFF. Enter a 1 (ON) or a 0 (OFF) from the keypad or keyboard and press the Printer Control softkey or function key.
- Loop Control. To control looping for tests, enter a 0 for a single execution, a 1 for execution until failure, or a 2 for "loop forever" and press the Loop Control softkey or function key.
- Memory Test Limits. This allows you the flexibility of limiting a series of tests to a subset of available memory. Enter the desired limit in hexadecimal notation from the keypad or keyboard and press the Memory Test Upper Limit or Memory Test Lower Limit softkey (or function key) as applicable.

3.3 SELECTING AND EXECUTING TESTS AND SUBTESTS

Individual tests can be selected simply by entering the test number and pressing the Test softkey or function key. Zero indicates that all available tests are to be executed. Some tests will require extra set up (for example, connecting special test cables). A prompt to set up is issued by each test that requires it. Only one such opportunity is allowed per test (or subtest) so that you will be prompted only once, even if looping is requested.

Similarly, individual subtests can be chosen by entering the subtest number and pressing the Subtest softkey or function key. In this case, zero indicates that all of the subtests in a test are to be executed.

Selecting Test 0 will cause all tests to be executed except those for optional equipment that is not installed. If looping is specified, all tests that require operator setup or interaction will also be shipped.

Executing a test and/or subtest is done by pressing the EXECUTE key. This key is also used to restart execution after a pause for an operator setup operation. The STOP key can be used to discontinue a test loop that is being executed. Execution will be stopped at the end of the current subtest.

So, to select and execute Test 19, for example, press the following keys:

1...9...TEST...EXECUTE

3.4 HOW TEST INFORMATION IS DISPLAYED

Information about the tests can be presented on the CRT, on the printer/plotter, or at the keypad via the LEDs and the audible alarm ("beeper").

3.4.1 AT THE CRT

When the CRT is active as the output device, the information is presented as follows:

PRINTER ON/OFF	FAILURE DATA
LOOP CONTROL:	TEST:
MEMORY TEST LOWER LIMIT:	SUBTEST:
MEMORY TEST UPPER LIMIT:	ERROR CODE:
SELECTED TEST NUMBER:	EXPECTED VALUE:
SELECTED SUBTEST NUMBER:	ACTUAL VALUE:
	ADDRESS VALUE:
TEST:	OK/FAILED/EXECUTING
operator prompt when required	
ENTRY:	

Failure data will only be present immediately after a failure is detected; so you should record the information as quickly as possible.

3.4.2 AT THE PRINTER/PLOTTER

When the printer/plotter is chosen as an output device, it will echo each keyed entry and begin a new line when a function key such as EXECUTE or STOP is pressed. The test number, subtest number, error code, expected value, actual value, and address value will be printed upon failure of the test or subtest.

3.4.3 AT THE KEYPAD

When the keypad is used as the output device, the presentation is limited to the six LEDs and an audible alarm. Although this limits the amount of information that can be presented, it can still be determined what test failed as a result of a failure. This will normally be used only in case of a CRT failure and when a printer is unavailable.

Each entry from the keypad will be acknowledged by a single "beep" from the alarm. After entry is complete and before the requested test begins, the least-significant-digit of the test number will be displayed by the LEDs and the CPU TEST LED will be lit. If a test fails, the alarm will sound for one full second and the lights will remain lit and unchanged. If a test completes successfully, the CPU TEST LED goes out and the CPU OK LED is lit.

3.4.4 RETURNING TO THE OPERATING SYSTEM

To exit the diagnostics and return to the operating system, execute Test FE, Subtest 0 or 1.

3.4.5 TEST DESCRIPTIONS

The list below describes each of the diagnostic tests that can be run. If the first test with a wrap cable fails, run another wrap cable test which uses one of the first two connections. This will determine which of the two original ports is bad.

NOTE: Some of the diagnostics described in this chapter require the use of wrap cables. These cables are shipped with the Computer System.

Test 01 - CPU Test

This test checks the microprocessor chip and its basic control circuits.

Test 02 - ROM Test

This test performs a checksum on the ROM to verify the readability of its data.

Test 03 - Main Memory Test

This test exercises all of the program memory on the planar board.

Test 04 - RAM Extension Test

This test verifies operation of the RAM extensions. The upper limit address indicates how much memory the processor sees as available.

Test 05 - Interrupt Controller Test

This test checks each of the interrupt channels. If a failure occurs, the address value is set to indicate which channel has failed.

Subtest 1 is a Read/Write register test.

Subtests 2 - 9 force software interrupts on each interrupt control channel.

Subtest 10 forces eight simultaneous interrupts on each channel, thereby testing the interrupt priority arbitration and vectoring.

Test 07 - Memory Protect Function

Each subtest of this test write-disables a page of RAM and verifies that it cannot be changed.

Test 08 - DMA Controller Test

This test exercises each of the DMA controller channels to verify their operation.

Test 09 - Programmable Timer Test

Each subtest of this test performs an identical set of steps on each of the three timers.

Test 0A - Video Memory Test

This test exercises the 12-bit by 64K dynamic random access memory that holds the information for display on the CRT. Each subtest consists of filling the memory with a test pattern and then reading it back.

Test 0B - CRT Controller Test (Passive)

This test checks the cursor registers in the CRT controller.

Test 0C - Clock/Calendar Test

Subtest 1 tests the Read/Write ability of the 16-bit timer/counter register.

Subtest 2 checks the clock/calendar's lowest order counter for proper incrementing. The time and date are not changed.

Test 0D - Programmable Parallel Interface Test

Subtest 1 tests the printer ports.

Test 0E - Diskette Controller Test

Each subtest of this test checks several functions of the diskette controller. The diskette drive itself is not required for this test.

Subtest 1 checks the registers of the diskette controller.

Subtest 2 checks error generation on a restore operation.

Subtest 3 checks the interrupt signal from the diskette controller to the interrupt controller.

Test 0F - Serial Port 0 Test

Each subtest of this test checks progressively higher functions of the serial interface.

-
- Subtests 1 - 6 write and read information to and from the various registers to verify their operation.
- Subtest 7 is an interrupt generation test to verify that the port is able to interrupt the processor.
- Subtest 8 tests the transmit and receive logic in asynchronous mode.
- Subtest 9 tests the transmit and receive logic in synchronous mode.

Test 10 - Serial Port 1 Test

This test performs the same operations on Port 1 as Test 0F does on Port 0.

Test 11 - Serial Port 2 Test

This test performs the same operations on Port 2 as Test 0F does on Port 0. In addition, Subtest 0A checks the receive logic of the DMA.

Test 12 - Polynomial Generator Check Test

- Subtests 1 - 6 check the Read/Write function of the various registers.
- Subtest 7 checks interrupt logic.
- Subtest 8 checks generate logic in transmit mode.
- Subtest 9 checks logic in receive mode.

Test 13 - Hard Disk Controller Test

This test is available only on the Operating System Extensions diskette. It tests the optional hard disk controller card.

Test 14 - IEEE-488 Interface Test

This test exercises the IEEE-488 address registers.

Test 16 - CRT Controller Test (Active)

This test requires the attachment of a wrap cable (labeled "Test 16") from the user parallel port to the CRT output connector. It checks the vertical, horizontal, and video signals of the CRT controller. Refer to page 2-17 for a diagram of the connector locations.

Subtest 1 checks the validity of the vertical sync signal.

Subtest 2 checks the horizontal sync signal.

Subtest 3 checks the video output signal of the controller.

Test 17 - Floppy Disk Controller/User Port Wraparound Test

This test checks the output of the floppy disk controller.

Subtest 1 checks the drive control signal.

Subtest 2 checks the stepping functions.

At the start of Subtest 1 you will be prompted to connect a cable labeled "Test 17" between the diskette drive connector and the user parallel port. When this has been done, press the EXECUTE key and the test will continue. If this test fails, run Test 0A to verify that the user parallel port is okay. If Test 0A also fails, the user part or the planar board may be bad. Remove test cable when test is completed.

Test 18 - Printer/Plotter Test

This test consists of 7 subtests that present distinct test patterns to the printer. Refer to Figure 3-2 for a sample of this pattern.

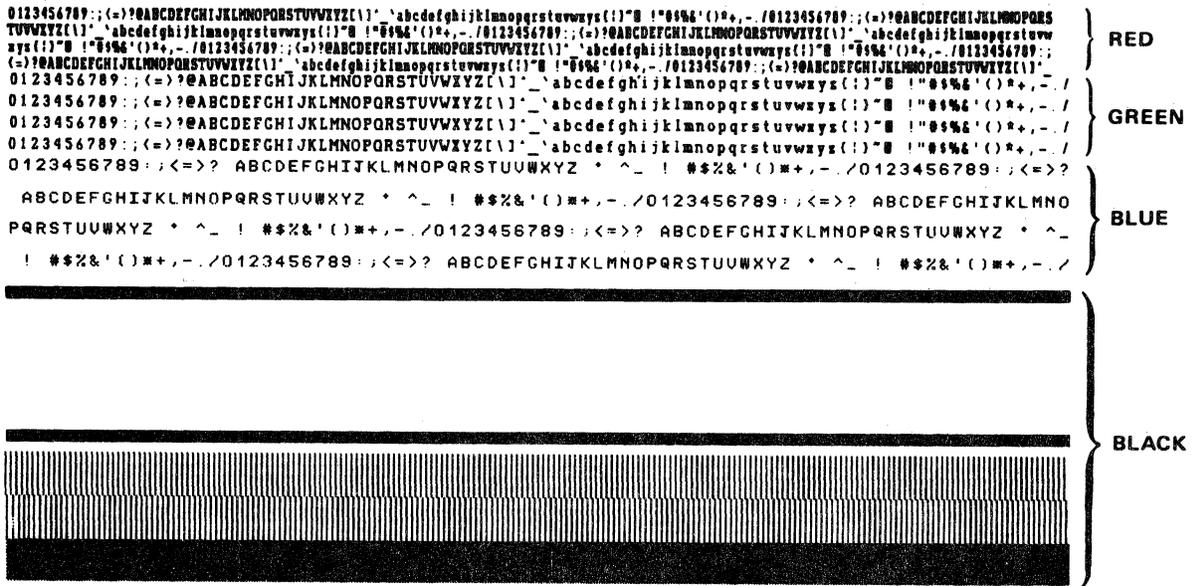


Figure 3-2. Printer/Plotter Pattern.

Test 19 - Keypad and Softkey-to-CRT Echo Test

This test takes input from the keypad and presents it (in hexadecimal notation) on the CRT display. This test stops when the STOP then EXECUTE keys on the keyboard are pressed. (If your system is not equipped with a keyboard, press the STOP key on the keypad.) Figure 3-3 shows the keypad and soft keys marked with the data that should appear on the CRT.

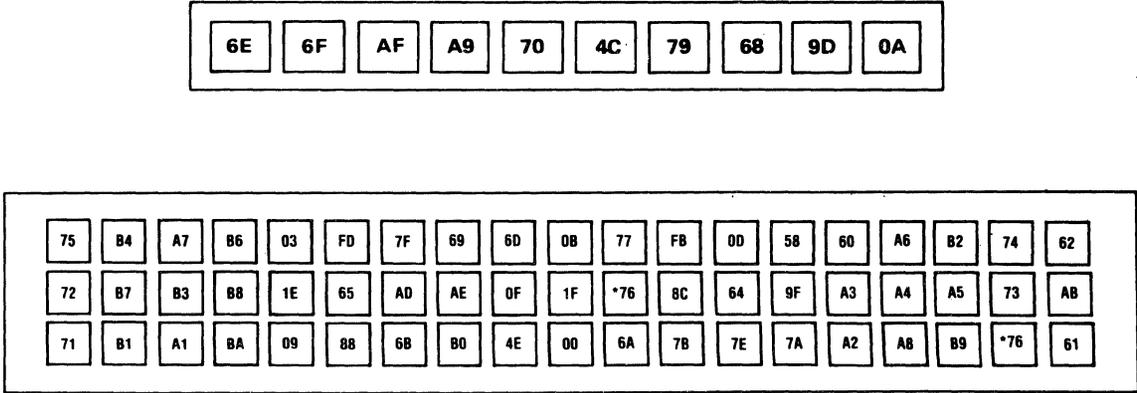


Figure 3-3. Keypad and Softkeys.

Test 1A - Keyboard-to-CRT Echo Test

This test takes input from the keyboard and presents it (in hexadecimal notation) on the CRT display. This test stops when the STOP and then the EXECUTE key is pressed. Figure 3-4 shows the keyboard keys marked with the data that should appear on the CRT.

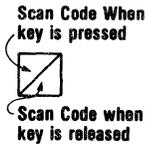
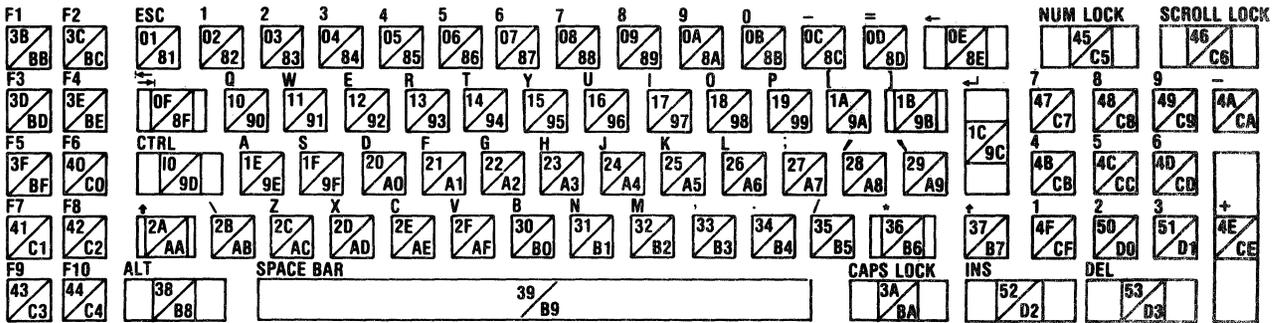


Figure 3-4. Keyboard (Keys Marked).

Test 1C - IEEE-488 User Port Wraparound Test

This test will prompt you to connect a cable labeled "Test 1C" between the IEEE port and the IEEE user port and then press the EXECUTE key. Remove the test cable when the test is completed.

Subtest 1 transmits data from the user port to the IEEE port.

Subtest 2 transmits data from the IEEE port to the user port.

TEST 1D-Serial Port 1-2 Wraparound Test

This test will prompt you to connect a cable labeled "Test 1D" between serial ports 1 and 2 and then press the EXECUTE key. The test will check the status of each port and then send characters in each direction.

TEST 1E-Serial Port 0-1 or 0-2 Wraparound Test

This test will check serial port 0 with serial port 2. This test assumes that Port 0 is configured as a modem (as the system is shipped). If the option jumpers have been changed to configure Port 0 as a terminal, this test will not pass. Press the EXECUTE key when you are ready. The test operates the same as Test 1D. Remove the Test cable when test is completed.

TEST 1F DMA-Serial Port Wraparound Test

This tests the DMA (Direct Memory Access) operation of serial port 0.

Test 20 - Floppy Disk Drive 0 Test

WARNING: The following tests destroy all data on the diskette. Remove all good diskettes from all drives and insert a scratch diskette into the drive being tested before executing the test.

This test will first check the door open/close status lines. Therefore the door of the disk drive should be opened and closed before the drive size is entered.

These tests check the Read/Write/Seek integrity of the selected diskette drive. You will be asked for the information below:

DRIVE SIZE = 5 (for 5 1/4")	FORMAT DENSITY = 1 (for single)
8 (for 8")	2 (for double)
0 (for no drive)	SINGLE/DOUBLE SIDED = (1 or 2)

Enter the correct numbers and press the EXECUTE key to continue.

EXAMPLE: Type 822 for an 8-inch double-sided double-density diskette.

NOTE: These tests can take up to 30 minutes to execute fully.

Test 21 - Floppy Disk Drive 1 Test

This test is the same as Test 20, but for Drive #1.

Test 22 - Floppy Disk Drive 2 Test

This test is the same as Test 20, but for Drive #2.

Test 23 - Floppy Disk Drive 3 Test

This test is the same as Test 20, but for Drive #3.

Test 30 - Sensor I/O Board 0 Test (Passive)

This test performs a series of power on tests for the Sensor I/O Board; no cable connections are required.

Test 31 - Sensor I/O Board 1 Test (Passive)

This test operates the same as Test 30, but for Sensor I/O Board 1.

Test 32 - Sensor I/O Board 2 Test (Passive)

This test operates the same as Test 30, but for Sensor I/O Board 2.

Test 33 - Sensor I/O Board 3 Test (Passive)

This test operates the same as Test 30, but for Sensor I/O Board 3.

Test 35 - Sensor I/O Board 0 Test (Active)

This test will prompt you to connect a set of wrap connectors labeled "Test 35" to the edge of the Sensor I/O Board and then press the EXECUTE key. The test will check the various I/O functions of the board.

Test 36 - Sensor I/O Board 1 Test (Active)

This test operates the same as Test 35, but for Sensor I/O Board 1.

Test 37 - Sensor I/O Board 2 Test (Active)

This test operates the same as Test 35, but for Sensor I/O Board 2.

Test 38 - Sensor I/O Board 3 Test (Active)

This test operates the same as Test 35, but for Sensor I/O Board 3.

Test 40 - Hard Disk Drive 0 Test

This test is available only on the Operating System Extensions diskette; it tests Drive 0.

Test 41 - Hard Disk Drive 1 Test

This test is available only on the Operating System Extensions diskette; it tests Drive 1.

Test 42 - Hard Disk Drive 2 Test

This test is available only on the Operating System Extensions diskette; it tests Drive 2.

Test 43 - Hard Disk Drive 3 Test

This test is available only on the Operating System Extensions diskette; it tests Drive 3.

Test 97 - Memory Confirmation Test

This test confirms that all information stored in memory by subtest 8 of test 3 and 4 is still correct.

NOTE: If Test 97 is executed before other diagnostics, it will fail.

Test 98 - CRT Test Pattern

This test clears the CRT memory, initializes the CRT controller, and then displays a test pattern on the screen. It will also display the amount of memory in the system; if this amount is incorrect, refer to Section 2-9.

Test FE - Return to the Operating System

Entering this test number with subtest 0 or 1 will return you to the Computer System Operating System.

Executing subtest 2 of this test will cause the power on sequence of the diagnostics to be executed.

4.0 REMOVAL AND REPLACEMENT PROCEDURES

The only tool that is required for any of these removal or replacement procedures is a screwdriver.

4.1 PLANAR BOARD

The planar board is located within the processor unit (as shown in Figure 4-1).

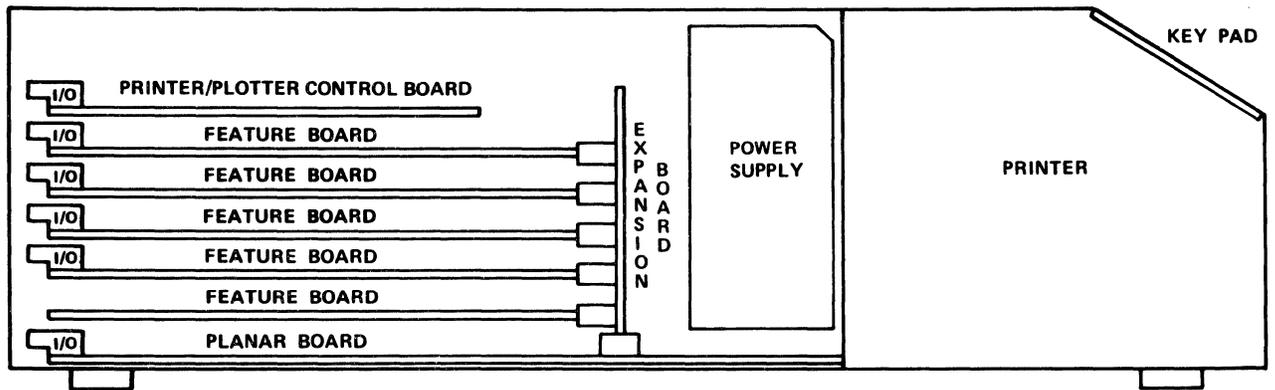


Figure 4-1. Main Processor Unit (Side View).

4.1.1 REMOVAL

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.

1. Position the Computer System Power switch Off and unplug the main power cord from the wall outlet (See Figure 4-2).

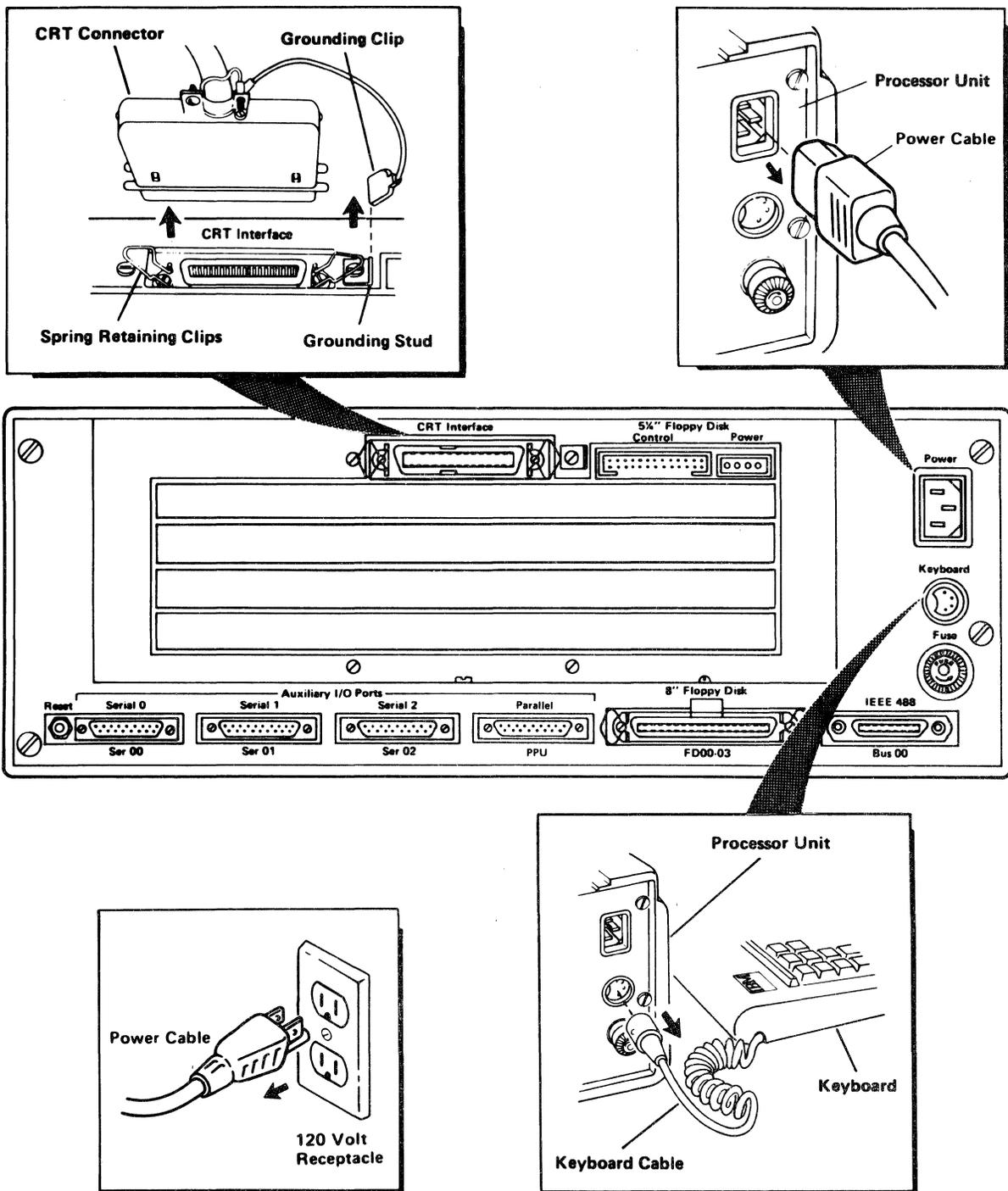


Figure 4-2. Processor Rear Panel Connections

-
2. Remove the main power cord from the back of the processor unit. (See Figure 4-2).
 3. Remove the keyboard connector from the back of the processor unit and move the keyboard to another area to provide work space (See Figure 4-2).

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 move the paper tray to another area to provide access to the printer/plotter.
5. Disconnect the CRT cable assembly by spreading the spring retaining clips holding the connector in place disconnecting the grounding clip, and pulling the connector away from the rear of the processor unit. (See Figure 4-2).

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

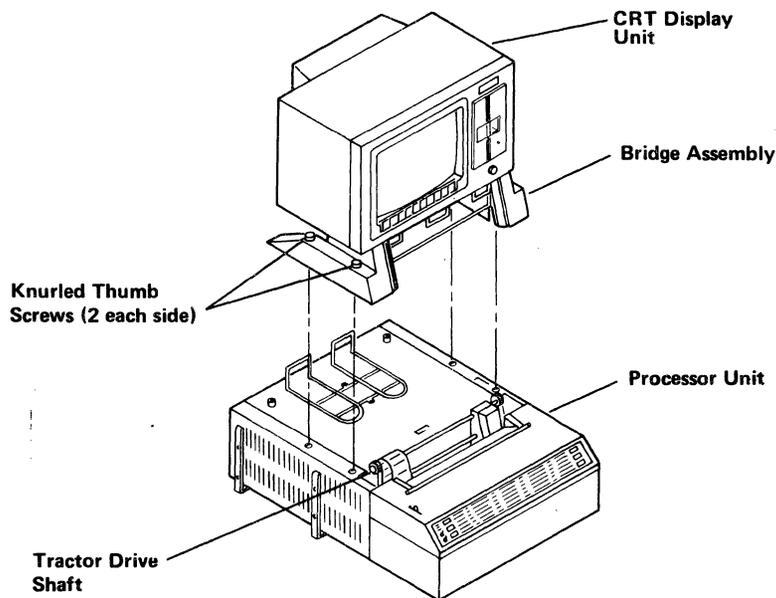


Figure 4-3. CRT Display Unit and Bridge Assembly.

6. Remove the CRT display unit and bridge assembly by loosening the four (4) knurled thumb screws, and lifting the entire assembly. Move the entire assembly out of your way. (See Figure 4-3).
7. Remove the back plate from the processor unit by loosening the four (4) retaining screws at the four corners of the plate and pulling it away (See Figure 4-4).

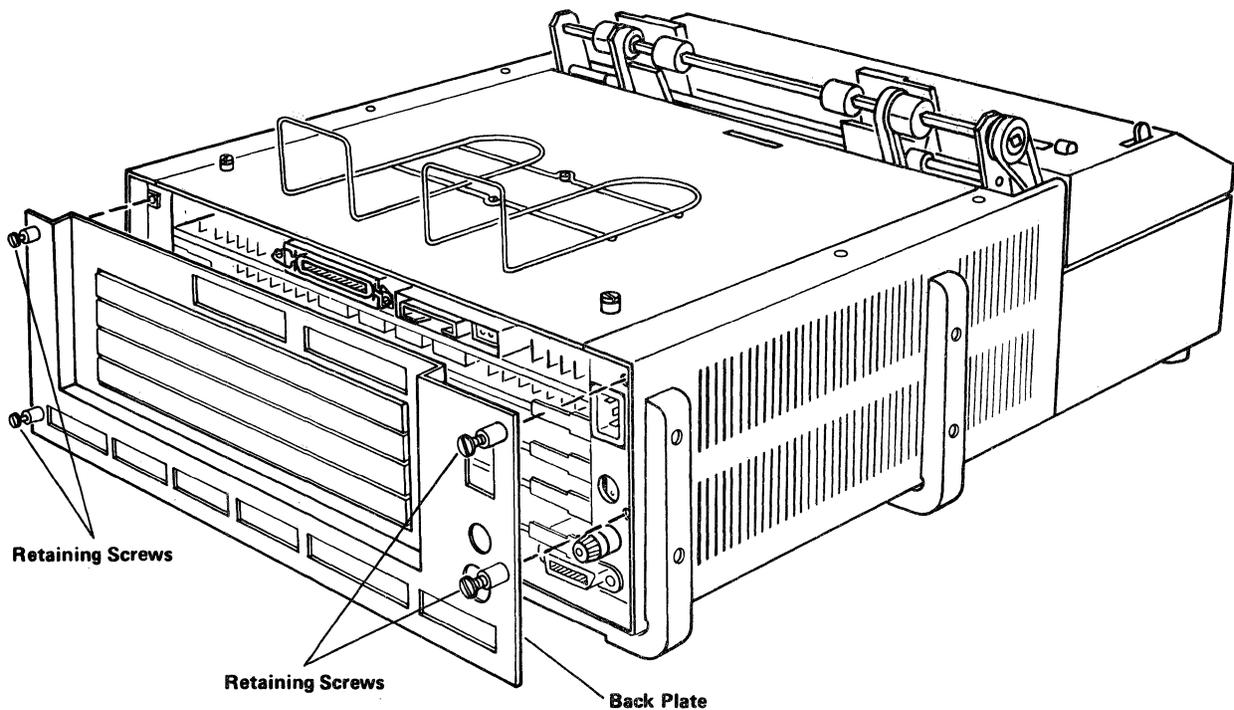


Figure 4-4. Processor Unit Back Plate.

8. Remove the ROM plug-in (See Figure 4-5).
9. Remove the processor unit top cover by loosening the two (2) retaining screws, sliding the cover straight back toward the rear of the processor unit, and lifting. (See Figure 4-6). Put the cover in a safe place.

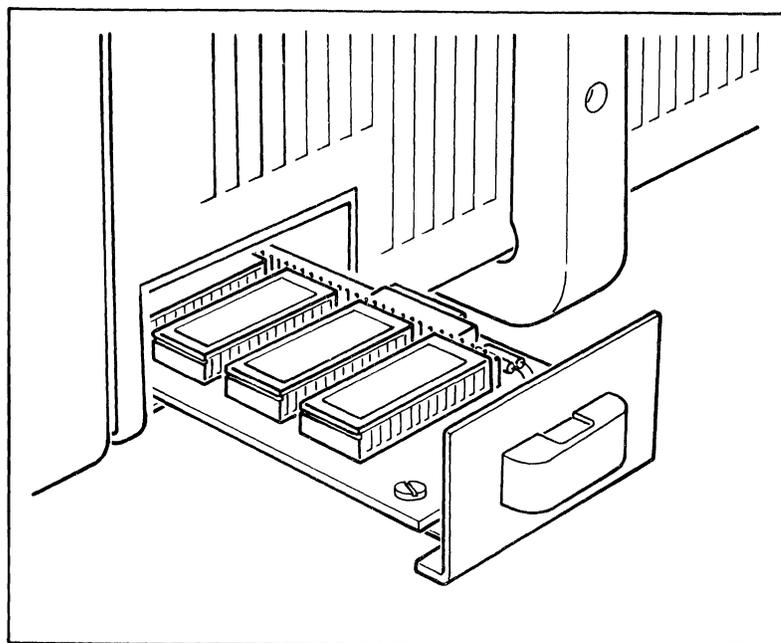


Figure 4-5. ROM Plug-in Drawer.

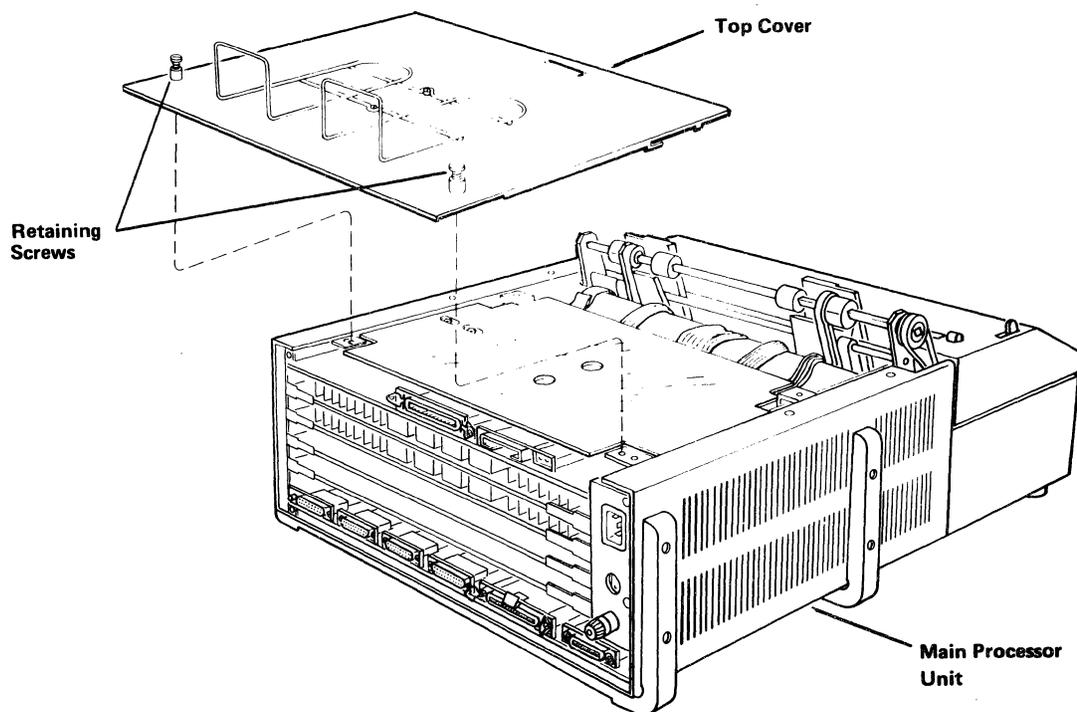


Figure 4-6. Processor Unit Top Cover

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10. Remove the plastic protector shield above the printer/plotter control board by loosening two (2) screws and sliding the plastic mount retainers inward toward the center of the unit. Then slide the shield assembly toward the rear of the unit, removing it (See Figure 4-7).

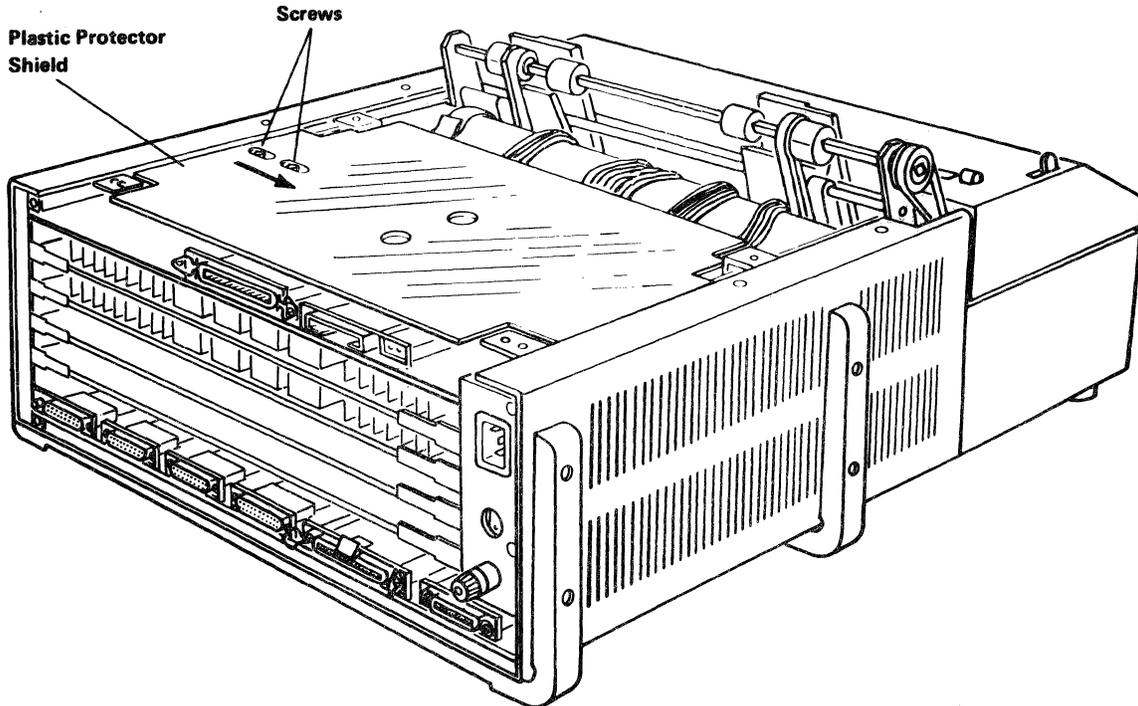


Figure 4-7. Plastic Protector Shield.

11. Disconnect all the harnessed connectors and the 5 1/4-inch floppy disk connector from the printer/plotter control board (or the dummy board in the top position if no printer/plotter is installed). (See Figure 4-8).
12. Remove the two (2) cable harness retaining screws and place the cable harness bar out of the way towards the front of the processor unit over the tractor bar.

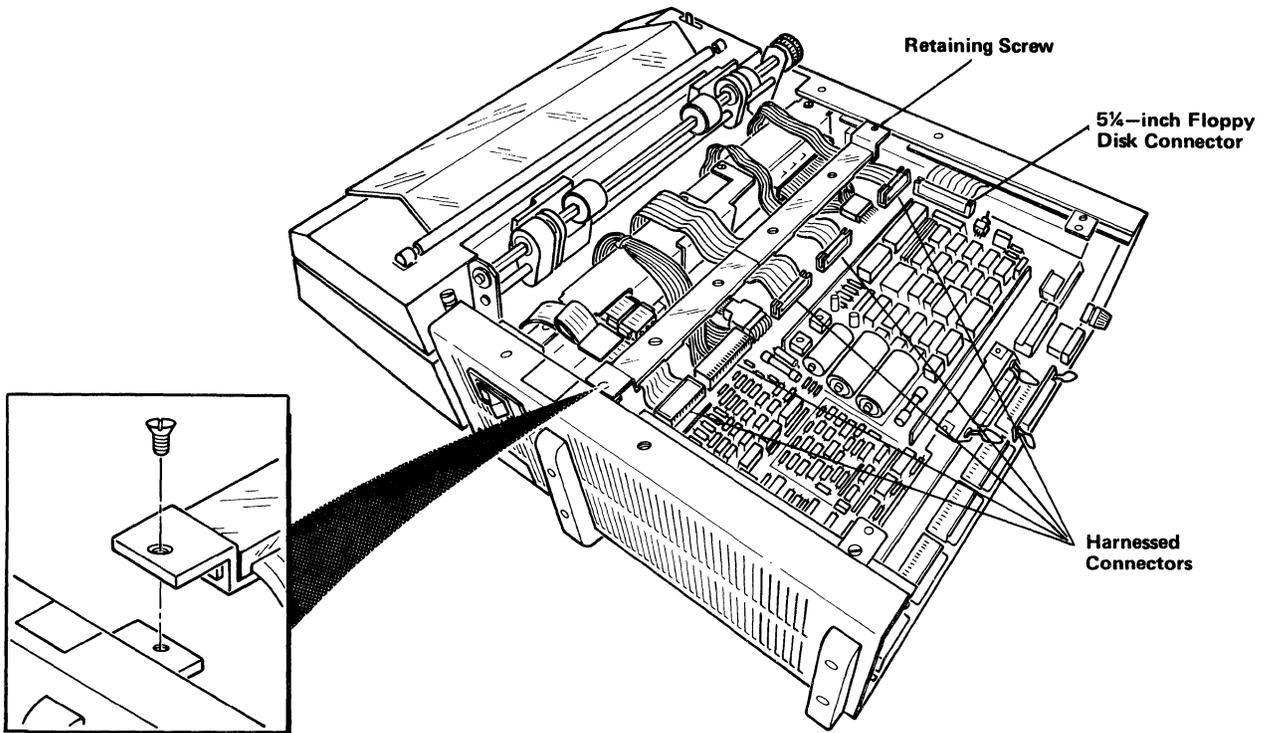
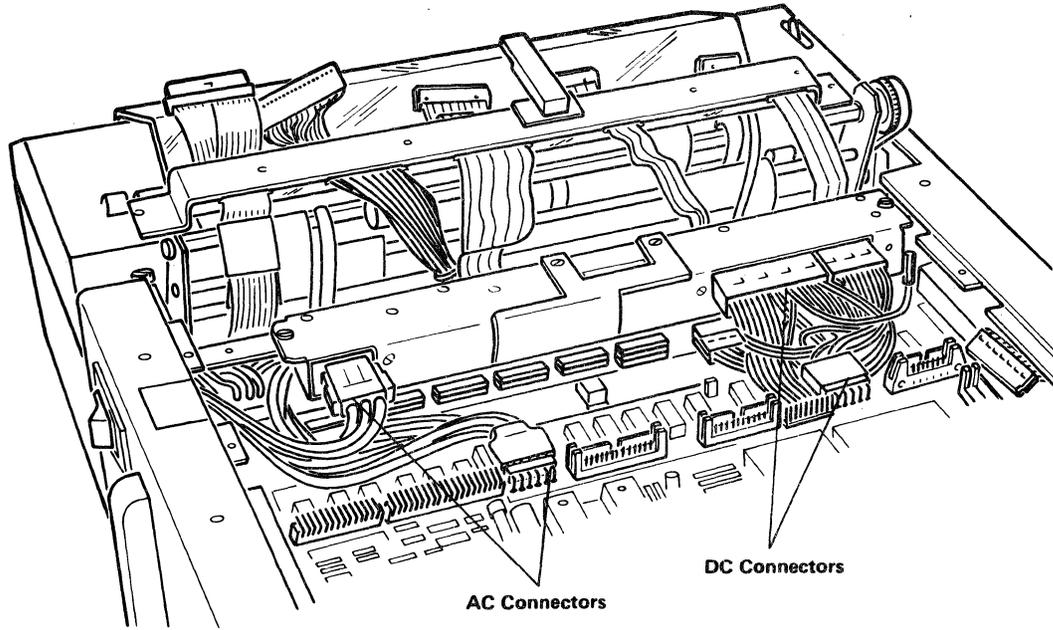


Figure 4-8. Processor Unit (Top View)

13. Disconnect the two (2) AC and two (2) DC connectors from the power supply (See Figure 4-9).
14. Disconnect the printer/plotter AC connectors.
15. Remove the printer/plotter control board (or dummy board). (See Figure 4-10).
16. If any feature boards are installed, remove them using the ejector levers (See Figure 4-11).
17. Remove the frame cutout insert on the left side of the chassis frame (See Figure 4-12).
18. Remove the two (2) screws securing the power supply to the frame (See Figure 4-13).



NOTE: Refer to Chapter 4, Section 4-1 to gain access to this component.

Figure 4-9. Power Supply Connections.

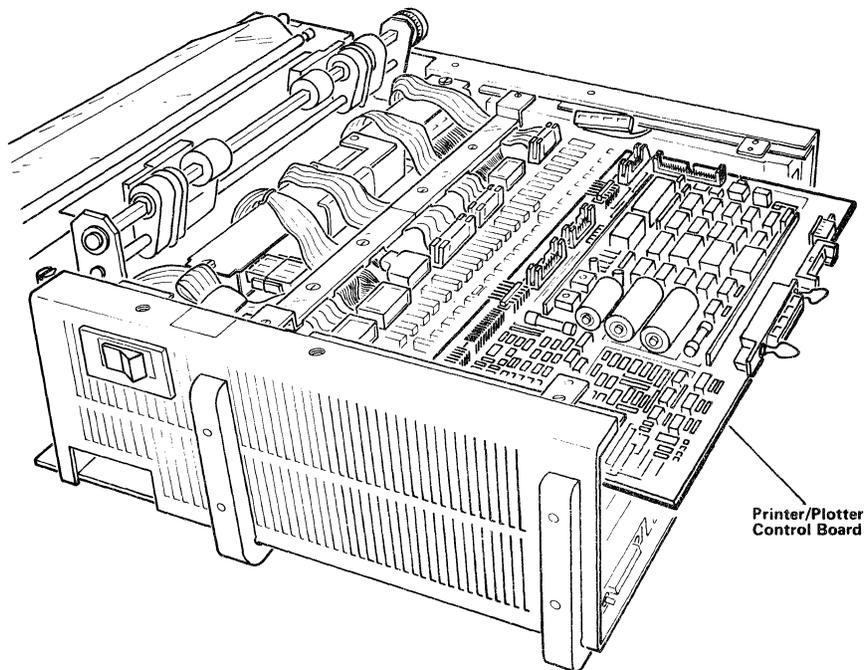


Figure 4-10. Printer/Plotter Control Board.

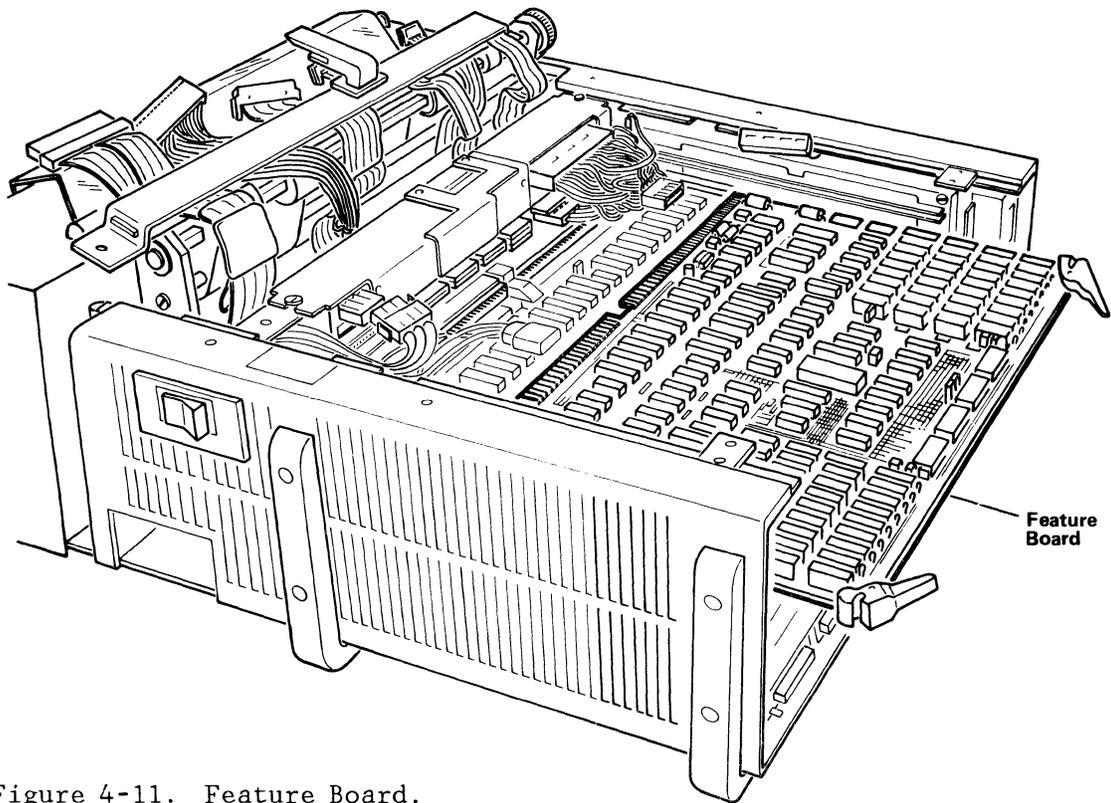


Figure 4-11. Feature Board.

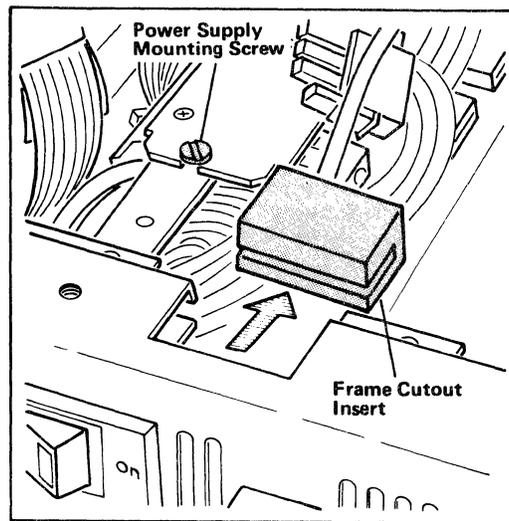


Figure 4-12. Frame Cutout Insert.

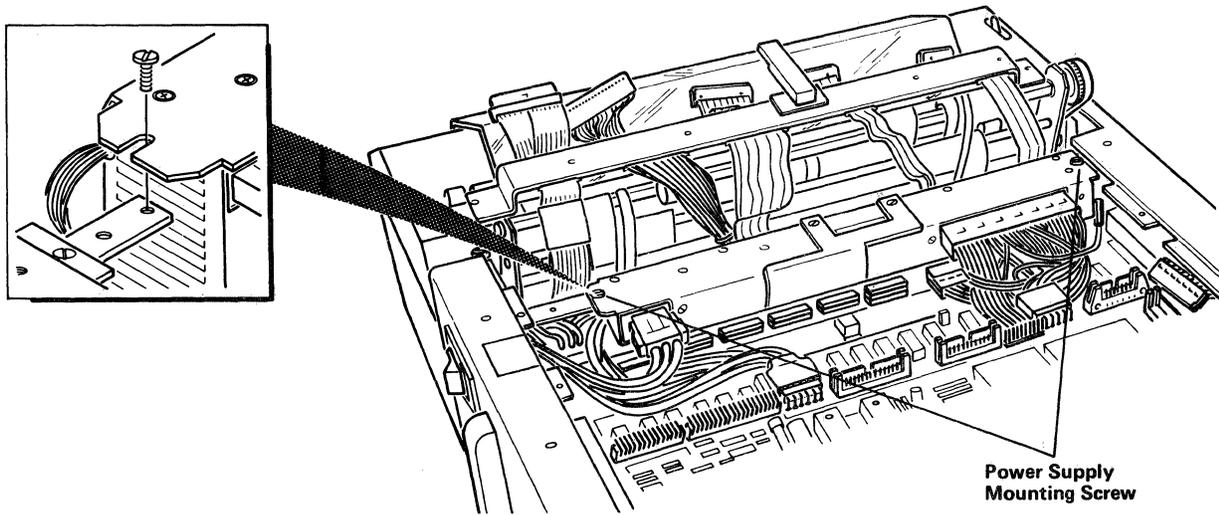


Figure 4-13. Power Supply Mounting Screws.

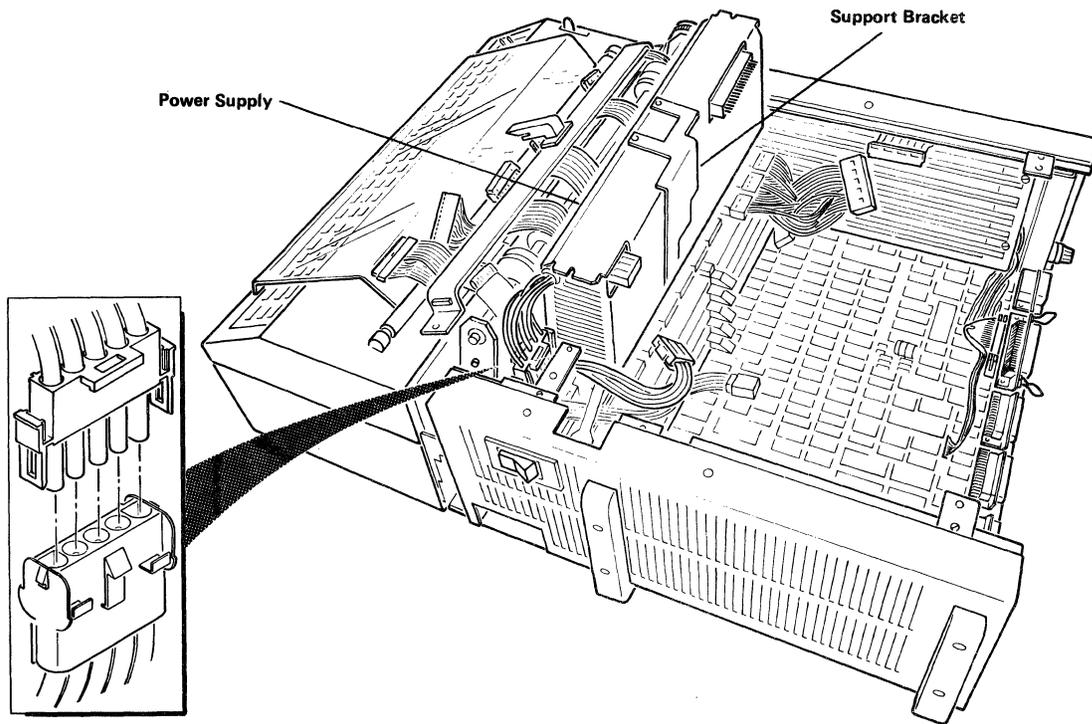


Figure 4-14. Power Supply and AC Line Connector.

-
19. Disconnect the power supply AC line connector and gently lift the power supply up and out of the chassis. Place the power supply to one side (See Figure 4-14).
 20. Disconnect the grounding clip connected to the frame ground lug on the side of the processor unit (See Figure 4-15).
 21. Remove the expansion board using the ejector levers and place it to one side (See Figure 4-16).
 22. Slide the planar board straight back a few inches and unplug the connectors on the top of the planar board (See Figure 4-17). (These attach to the keyboard and socket receptacle, keypad, 5 1/4-inch floppy disk, and two (2) printer/plotter connectors.).
 23. The planar board is now completely disconnected; carefully slide it out of the processor unit.

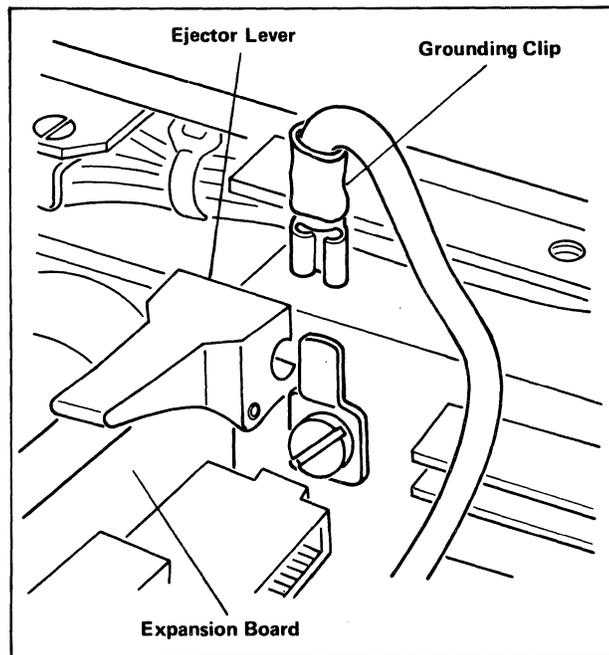


Figure 4-15. Grounding Clip

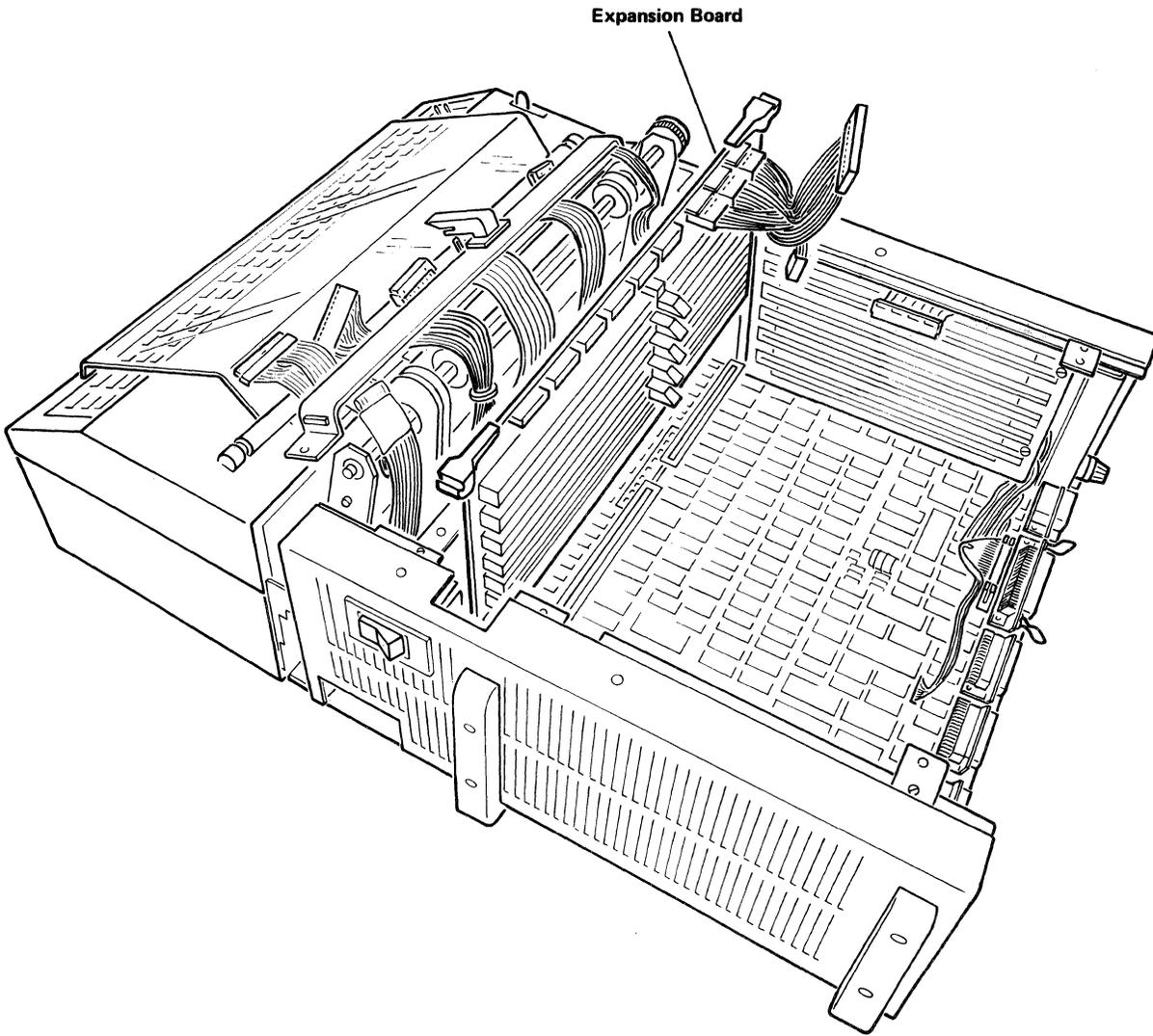


Figure 4-16. Expansion Board.

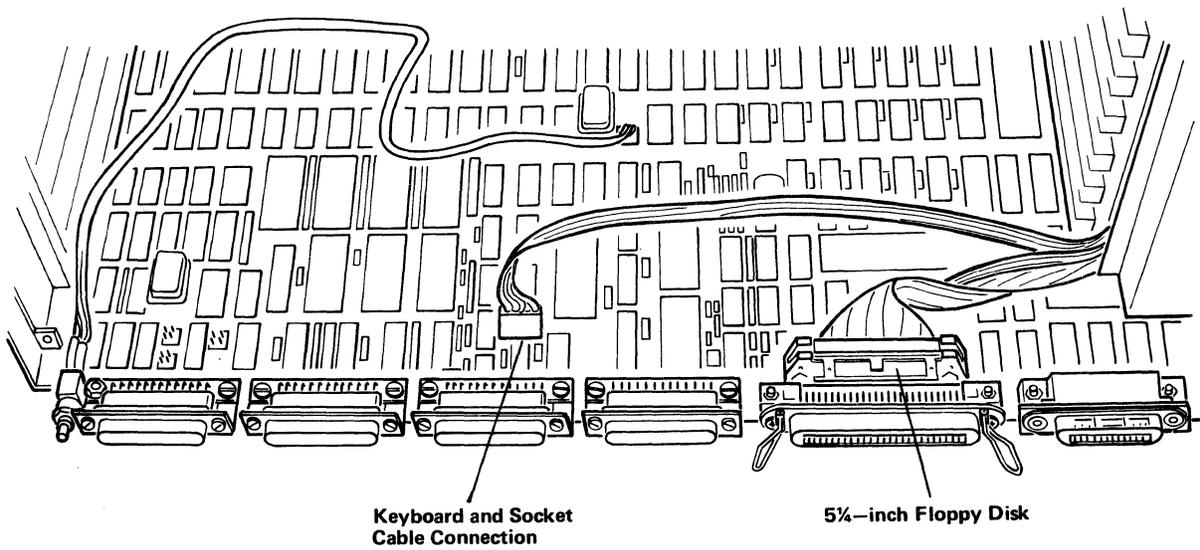
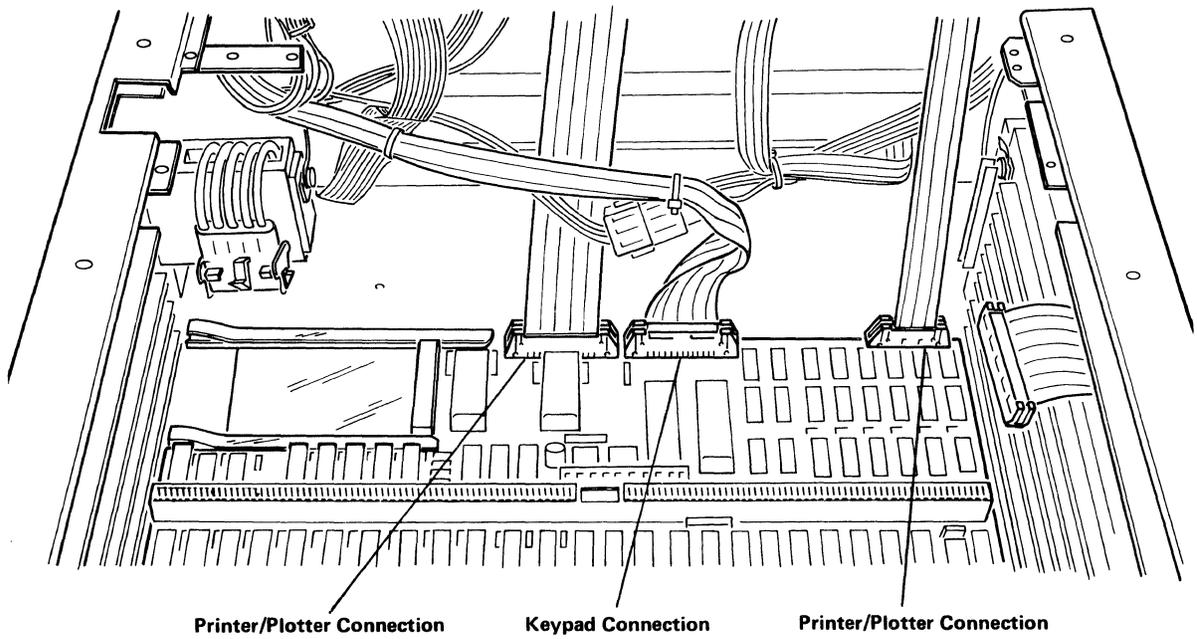


Figure 4-17. Planar Board Connections.

4.1.2 REPLACEMENT

NOTE: When replacing any printed circuit board be sure that it fits, snugly into position.

1. Slide the new planar board straight in on its tracks to within a few inches of the end of its travel and replace the connectors on the top of the planar board (See Figure 4-17) (keyboard and socket cable, keypad, 5 1/4-inch floppy disk, and two (2) printer/plotter connectors).
2. Carefully slide the planar board in the rest of the way.
3. Slide the expansion board back into position. Be sure that the board is seated into the planar board correctly (See Figure 4-16).
4. Reconnect the grounding clip to the ground lug on the side of the processor unit frame (See Figure 4-15).
5. Replace the power supply by gently lowering it back into position, being sure that the printer/plotter AC cable is positioned under the power supply support bracket and the bracket on the power supply interlocks with the bracket on the expansion board (See Figure 4-14).
6. Reconnect the power supply AC line connector (See Figure 4-14).
7. Position the power supply on its mounting brackets and secure it using the two (2) screws (See Figure 4-13).
8. Replace the frame cutout insert on the side of the chassis frame (See Figure 4-12).
9. Replace the two (2) AC and two (2) DC connectors on the power supply (See Figure 4-9).
10. Replace any feature boards which may have been removed (See Figure 4-13).
11. Slide the printer/plotter control board into position. (See Figure 4-12).
12. Reconnect the printer/plotter AC connectors (See Figure 4-11).
13. Position the cable harness assembly over its mounting holes and secure it with the two (2) cable harness retaining screws (See Figure 4-8).

-
14. Reconnect all the harnessed connectors and the 5 1/4-inch floppy disk connector to the printer/plotter control board. (See Figure 4-8). Be sure all the connections are correctly seated.
 15. Replace the plastic protector shield above the printer/plotter control board and secure it using the two (2) screws (See Figure 4-7).
 16. Replace the processor unit cover by placing the cover on the unit and sliding it forward toward the printer/plotter. Secure the cover in place by tightening the two (2) retaining screws on top of the cover (See Figure 4-6).
 17. Place the back plate on the processor unit and secure it using the four (4) retaining screws at the four corners of the plate. Be sure that the connector spring clips are not behind the back plate. (See Figure 4-4).

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

18. 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 (4) knurled thumb screws on the bridge assembly. (See Figure 4-3).
19. Reconnect the CRT cable assembly, the keyboard connector, main power cord, and any other connector that was connected to the system. (See Figure 4-2).
20. Replace the ROM plug-in unit. (See Figure 4-8).
21. Do an operational check of the system.

4.2 CHANGING ROM CARDS

The ROM card is located in a small drawer on the right side of the processor unit as shown in Figure 4-18. To remove the ROM card, simply pull the drawer straight out and remove the card from the drawer by unscrewing the two (2) mounting screws. The ROM card can be replaced by screwing a new card in and pushing the drawer straight in making sure that the drawer is flush with the cover of the processor unit.

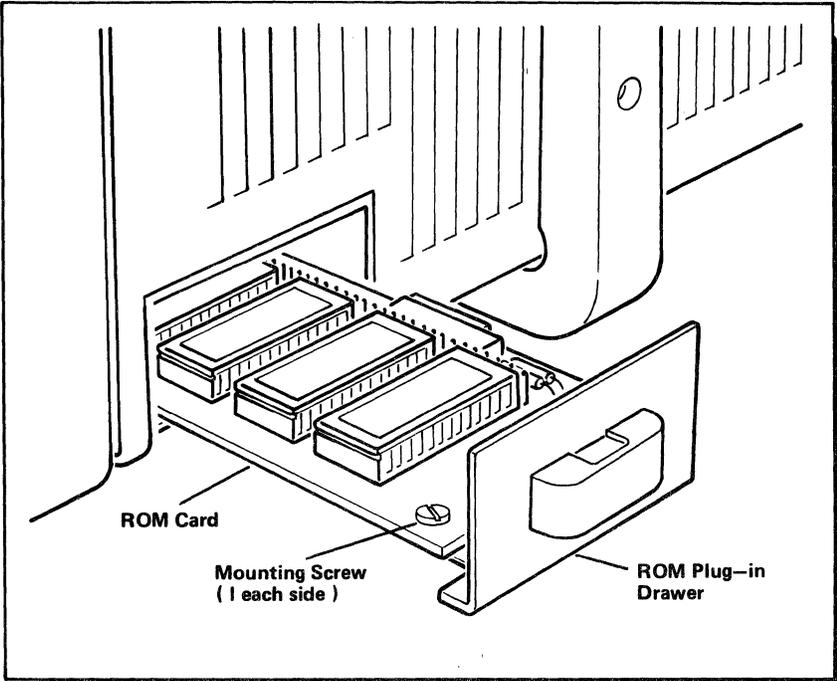


Figure 4-18. ROM Card Replacement.

4.3 POWER SUPPLY

The power supply is located within the main processor unit (as shown in Figure 4-1).

4.3.1 REMOVAL

1. Position the Computer System Power switch Off and unplug the main power cord from the wall outlet. (See Figure 4-2).
2. Remove the main power cord from the back of the processor unit. (See Figure 4-2).
3. Remove the keyboard connector from the back of the processor unit and move the keyboard to another area to provide work space (See Figure 4-2).

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 move the paper tray to another area to provide access to the printer/plotter.
5. Disconnect the CRT cable assembly by spreading the spring retaining clips holding the connector in place and pulling it away from the rear of the processor unit. (See Figure 4-2).

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.

6. Remove the CRT display unit and bridge assembly by loosening the four (4) knurled thumb screws, and lifting the entire assembly. Move the CRT display unit and bridge assembly out of your way. (See Figure 4-3).
7. Remove the ROM plug-in (See Figure 4-5).

8. Remove the processor unit top cover by loosening the two (2) retaining screws, sliding the cover straight back toward the rear of the processor unit and lifting. Move the cover to a safe place. (See Figure 4-19).
9. Remove the plastic protector shield above the printer/plotter control board by loosening two (2) screws and sliding the plastic mount retainer inward toward the center of the unit. Then slide the shield assembly toward the rear of the housing and remove it. (See Figure 4-19).

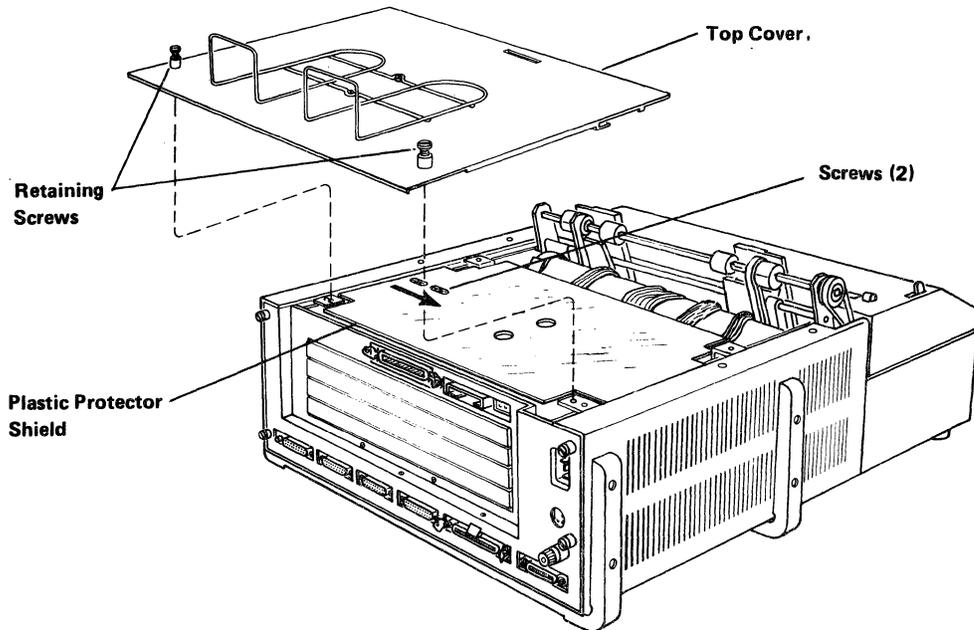


Figure 4-19. Processor Unit Top Cover and Plastic Protector Shield.

10. Disconnect all the harnessed connectors from the printer/plotter control board (or the dummy board in the top position if no printer/plotter is installed.) (See Figure 4-8).
11. Remove the two (2) cable harness retaining screws and place the cable harness out of the way, towards the front of the processor unit, over the tractor bar.

-
12. Disconnect the two (2) AC and two (2) DC connectors from the power supply. (See Figure 4-9).
 13. Remove the two (2) screws securing the power supply to the frame (See Figure 4-13).
 14. Disconnect the AC line connector and gently lift the power supply up and out of the chassis (See Figure 4-20).

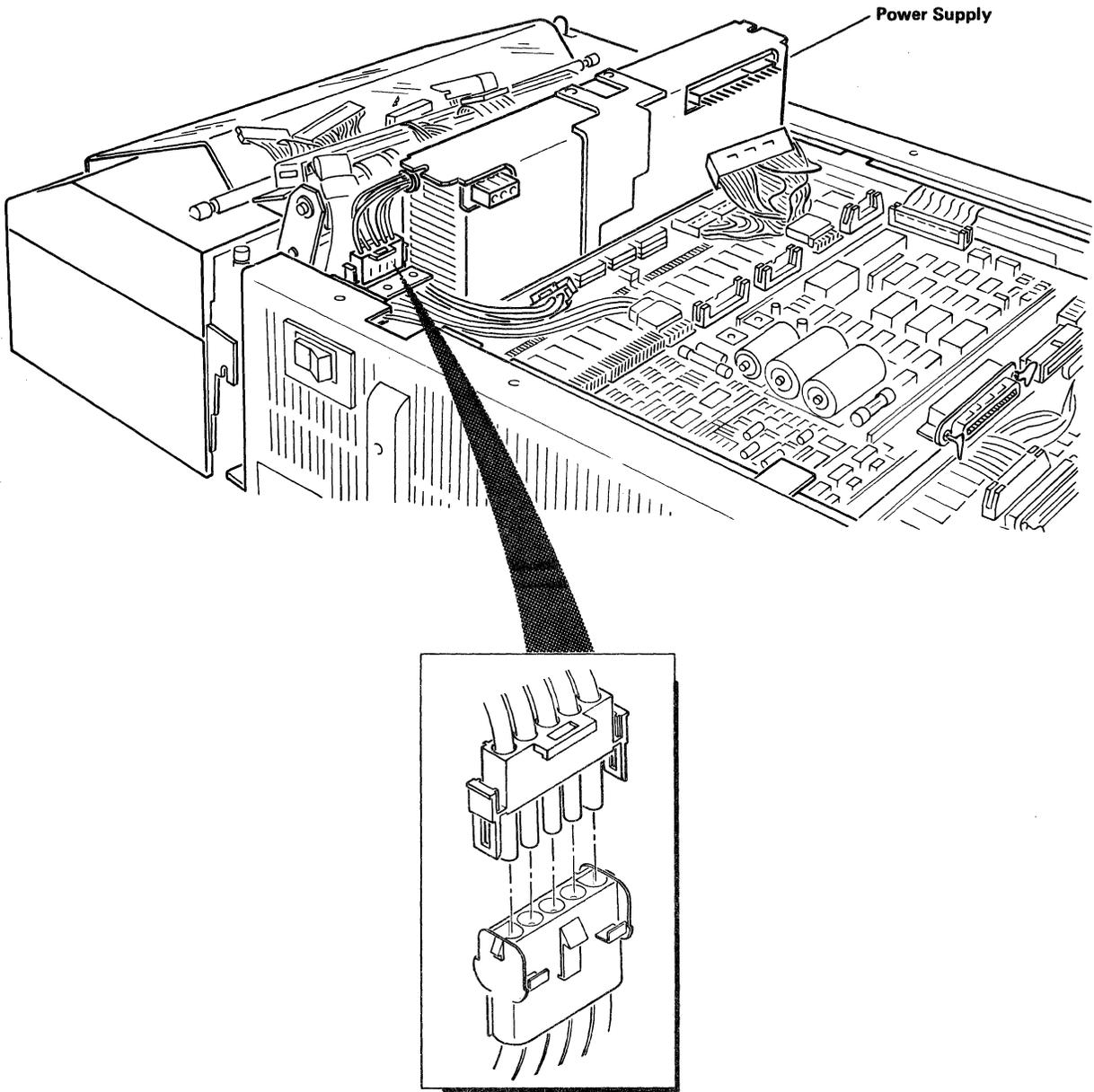


Figure 4-20. Power Supply Removal.

4.3.2 REPLACEMENT

1. Reconnect the AC line connector and replace the power supply by gently lowering it back into position being sure that the printer/plotter AC cable is positioned under the power supply support bracket and the bracket on the power supply interlocks with the bracket on the expansion board (See Figure 4-20).
2. Position the power supply on its mounting brackets and secure it using the two (2) screws (See Figure 4-13).
3. Reconnect the two (2) AC and two (2) DC connectors to the power supply. (See Figure 4-9).
4. Position the cable harness assembly over its mounting holes and secure it with the two (2) cable harness retaining screws. (See Figure 4-6).
5. Reconnect all the harnessed connectors to the printer/plotter control board. Be sure all the connectors are correctly seated.
6. Replace the plastic protector shield above the printer/plotter control board and secure it using the two (2) retaining screws. (See Figure 4-19).
7. Replace the processor unit cover by placing the cover on the unit and sliding it forward toward the printer/plotter. Secure the cover in place by tightening the two (2) retaining screws on top of the cover. (See Figure 4-19).
8. Replace the ROM plug-in unit (See Figure 4-5).

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

9. Place the CRT display unit and bridge assembly on the processor unit over the bridge mounting holes and secure the assembly to the unit by tightening the four (4) knurled thumb screws on the bridge assembly. (See Figure 4-3).
10. Reconnect the CRT cable assembly, the keyboard connector, main power cord, and any other connector that was connected to the system. (See Figure 4-2).
11. Do an operational check of the system.

4.4 KEYPAD

The keypad is located on the top front cover of the printer/plotter as shown in Figure 4-21. The keypad, top cover, and circuit board are a complete unit. Simply rotate the cover up and disconnect the circuit board connector (and printer/plotter connector if so equipped). Lift the cover straight up until it snaps out of its retaining clips and remove it. To replace the keypad, snap the new unit into position and reconnect the connectors.

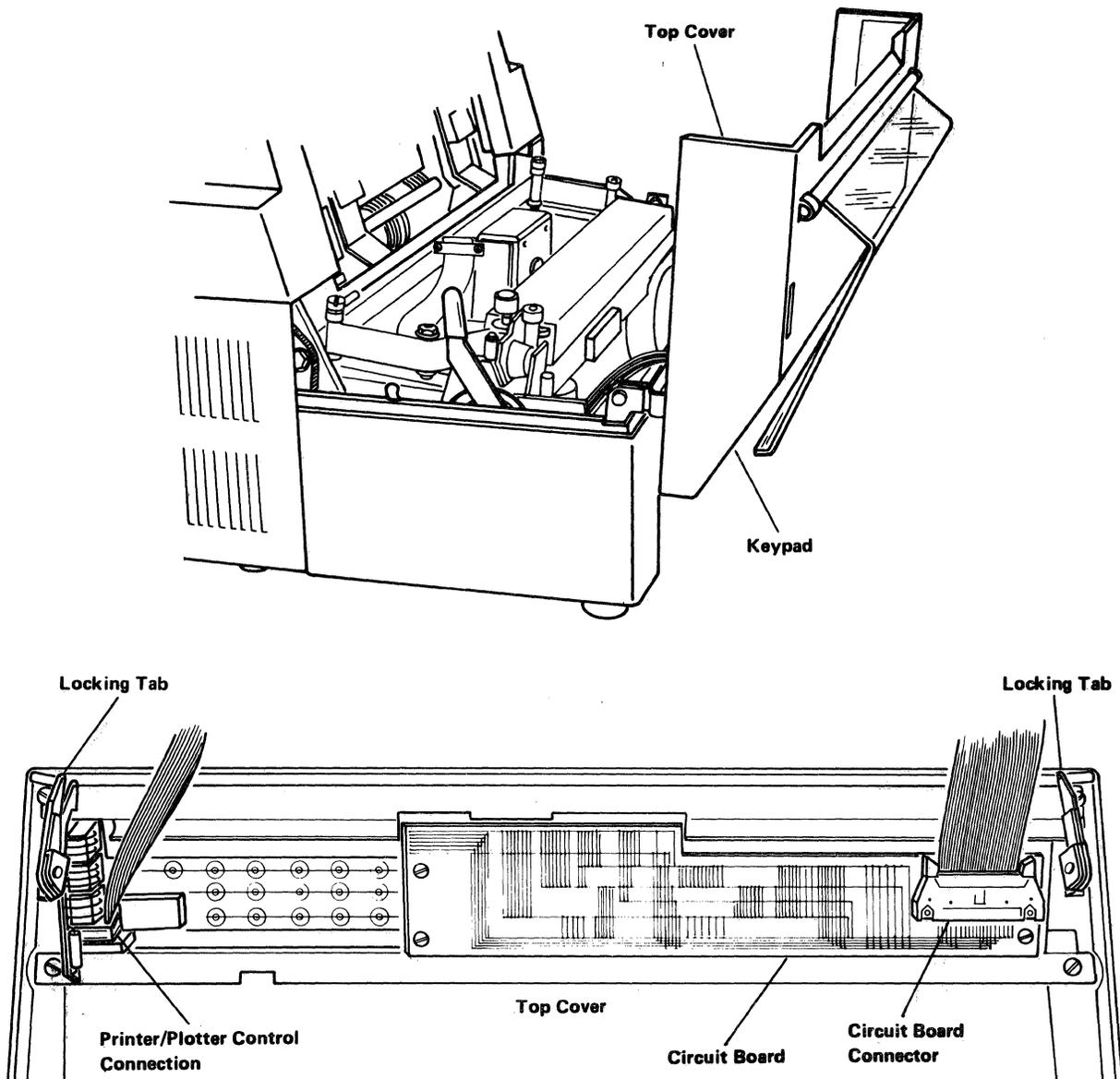


Figure 4-21. Keypad.

4.5 KEYBOARD

The keyboard is a separate unit attached to the processor unit by a six-foot long coiled cable. To remove the keyboard, simply disconnect the multipin connector at the back of the processor unit (See Figure 4-2). Replace the keyboard by inserting the connector firmly in place.

NOTE: The keyboard connector is keyed for proper positioning. The screw on the side of the connector should face the right side of the processor unit as viewed from the rear.

4.6 DISPLAY

For Computer Systems without a printer/plotter the CRT display unit is mounted directly on the processor unit (See Figure 4-22).

For Computer Systems equipped with a printer/plotter, the CRT display unit is mounted on a bridge mount assembly above the processor unit (See Figure 4-23). In both cases, the CRT display unit is attached with a threaded collar on a gimbal (as shown in the inset of Figure 4-24).

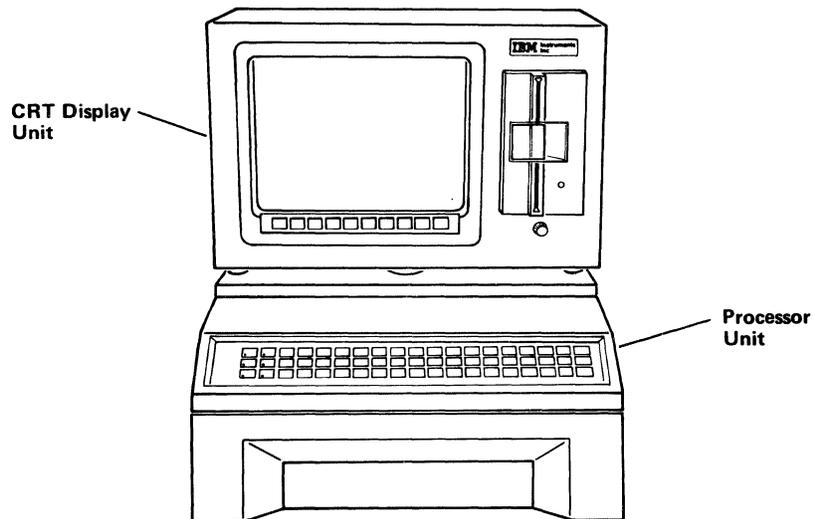


Figure 4-22. Computer System Without Printer/Plotter.

4.6.1 REMOVAL

1. Position the Computer System POWER switch OFF and unplug the main power cord from the wall outlet (See Figure 4-2).
2. Disconnect the CRT cable assembly by spreading the spring retaining clips, holding the connector in place, and pulling it away from the rear of the processor unit (See Figure 4-2).

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

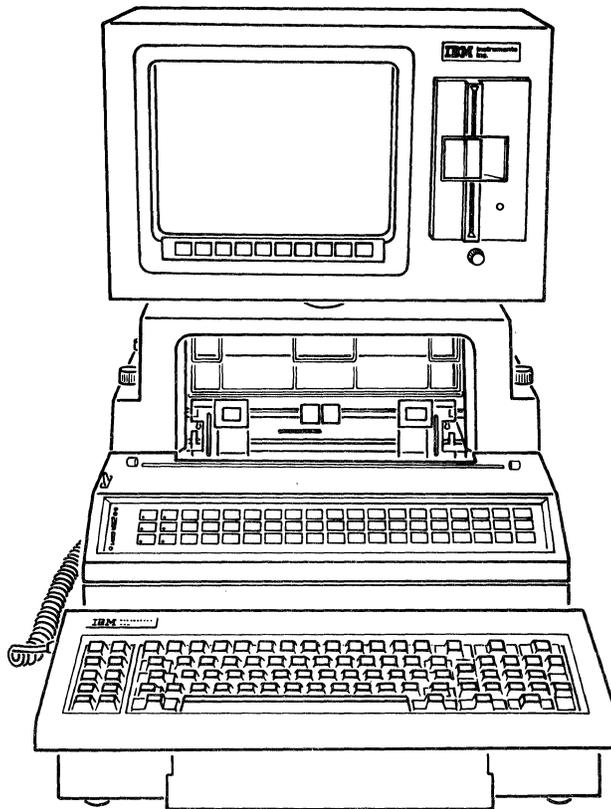


Figure 4-23. Computer System With Printer/Plotter.

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3. Remove the CRT display unit and bridge assembly by loosening the four (4) knurled thumb screws and lifting the entire assembly up and off the processor unit. Place the entire assembly upside down on a flat surface (See Figure 4-24).
 4. Using the adjusting handle loosen the gimbal until the bridge assembly is free to move on the gimbal.
 5. Remove the adjusting handle from the gimbal and turn the gimbal counterclockwise until the bridge assembly is completely free.
 6. Lift the bridge assembly from the CRT display unit and place it to one side.

4.6.2 REPLACEMENT

1. Place the new CRT display unit upside down on a flat surface (See Figure 4-24).

NOTE: The threaded collar shown in the inset of Figure 4-24 is attached to the CRT housing. This is shown this way for clarity only. Do not disconnect the collar from the CRT housing.

2. Place the gimbal mount of the bridge assembly onto the threaded collar of the CRT display unit and turn the gimbal clockwise until the unit is tight. This can be done by hand.

NOTE: The bridge mount assembly must be placed over the tractor drive shaft when mounting the unit on the processor unit.

3. Turn the CRT display unit with the attached bridge assembly rightside up and attach the bridge assembly to the processor unit with the four (4) knurled thumb screws.

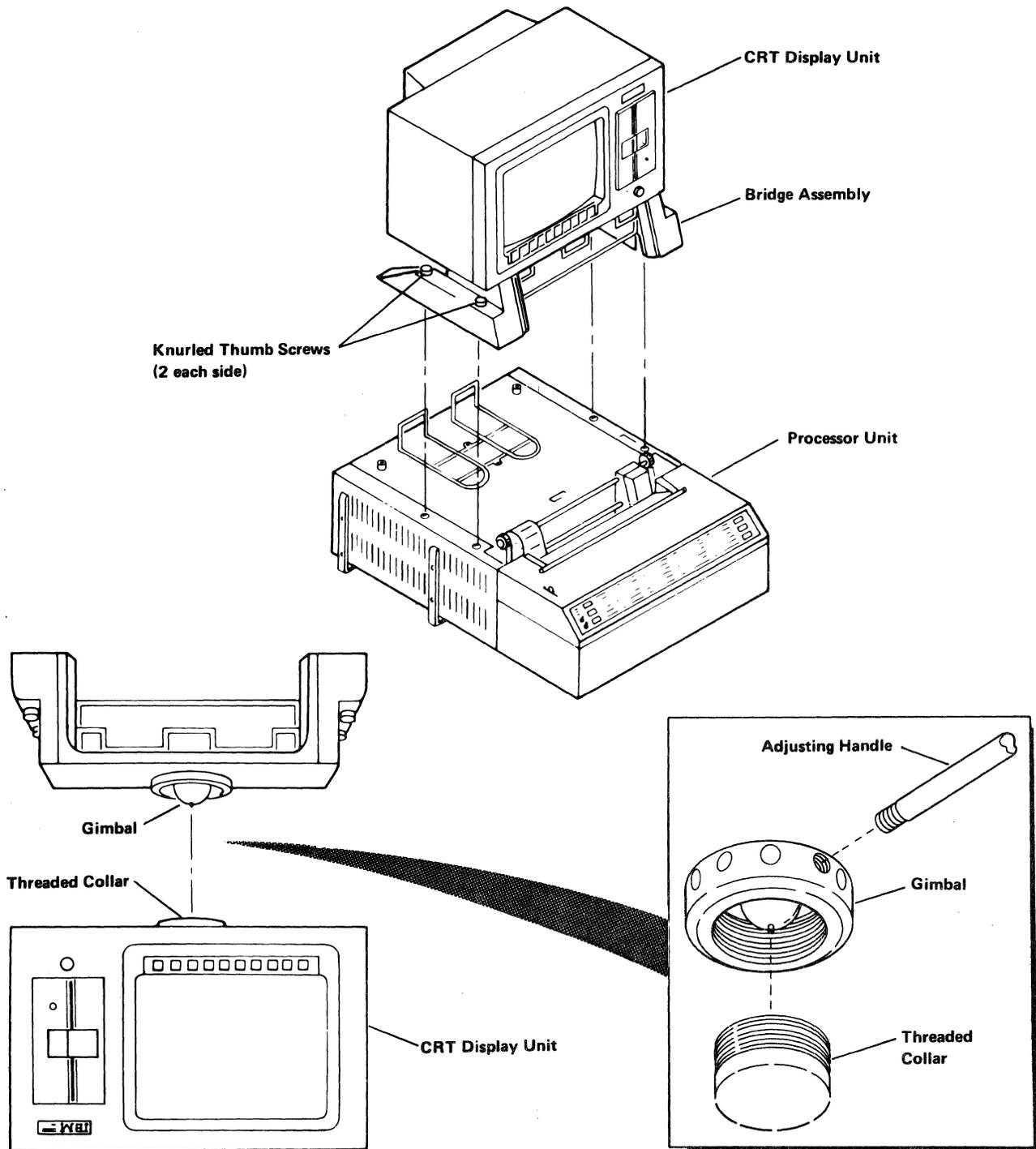


Figure 4-24. CRT Display Unit Mounting.

4. Screw the adjustment handle into the gimbal mount (any of 12 positions) until it is tightly seated. Adjust the CRT screen for convenient use, then firmly tighten the gimbal mount using the adjustment handle, until the display is steady and cannot tip. Check the handle occasionally to ensure that it is tightly seated.
5. Reconnect the CRT display cable assembly to the back of the processor unit by pushing the connector into position until it fits snugly, snap the spring retaining clips into position, and push the ground wire clip onto the grounding stud (See Figure 4-25).

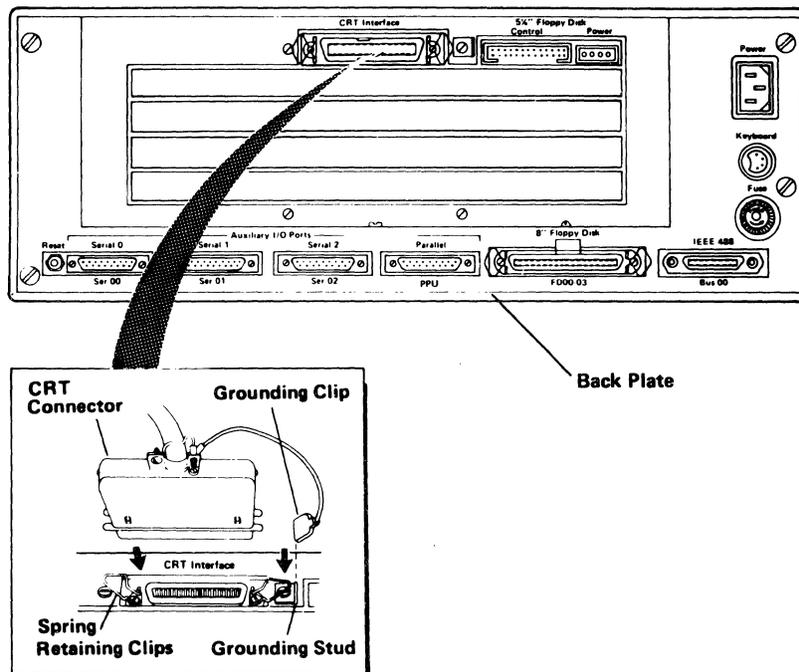


Figure 4-25. CRT Display Unit Connections.

4.7 PRINTER/PLOTTER

The printer/plotter is located within the processor main housing, as shown in Figure 4-1.

4.7.1 REMOVAL

1. Position the Computer System Power switch Off and unplug the main power cord from the wall outlet (See Figure 4-2).
2. Remove the main power cord from the back of the processor unit.
3. Remove the keyboard connector from the back of the processor unit and move the keyboard to another area to provide work space.
4. Tear off and remove any paper remaining in the paper tray and move the tray to another area to provide access to the printer/plotter.
5. Disconnect the CRT cable assembly by spreading the spring retaining clips, holding the connector in place, and pulling it away from the rear of the processor unit.

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

6. Remove the CRT display unit and bridge assembly by loosening the four (4) knurled thumb screws, and lifting the entire assembly. Move the CRT display unit and bridge assembly out of your way (See Figure 4-3).
7. Remove the processor unit top cover by loosening the two (2) retaining screws, sliding the cover straight back toward the rear of the processor unit, and lifting the entire assembly (See Figure 4-6).

8. Remove the plastic protector shield above the printer/plotter control board by loosening the two (2) screws and sliding the plastic mount retainers inward toward the center of the unit. Then slide the shield assembly toward the rear of the processor unit and remove it (See Figure 4-7).
9. Remove the two (2) cable harness retaining screws that hold the cable harness retaining bar in place (See Figure 4-26).
10. Disconnect the motors and printhead connectors from printer/plotter control board and 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 will be removed with that assembly.
11. Disconnect the printer/plotter AC connector and the printer/plotter control board AC connector (J 300).

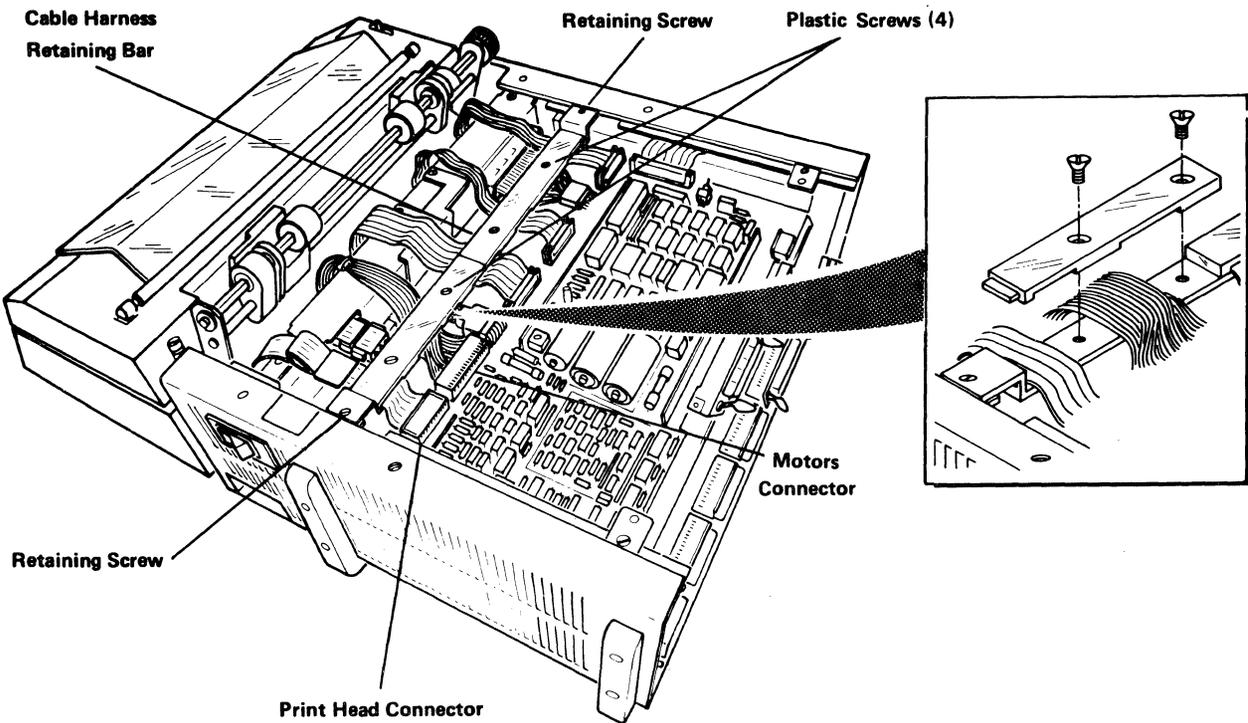


Figure 4-26. Processor Unit Cable Harness (Top View).

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.

12. Remove the two (2) printer/plotter thumbwheel mounting screws located on the underside of the unit. Refer to Figure 4-27 for the location of these screws; DO NOT turn the processor on its side!

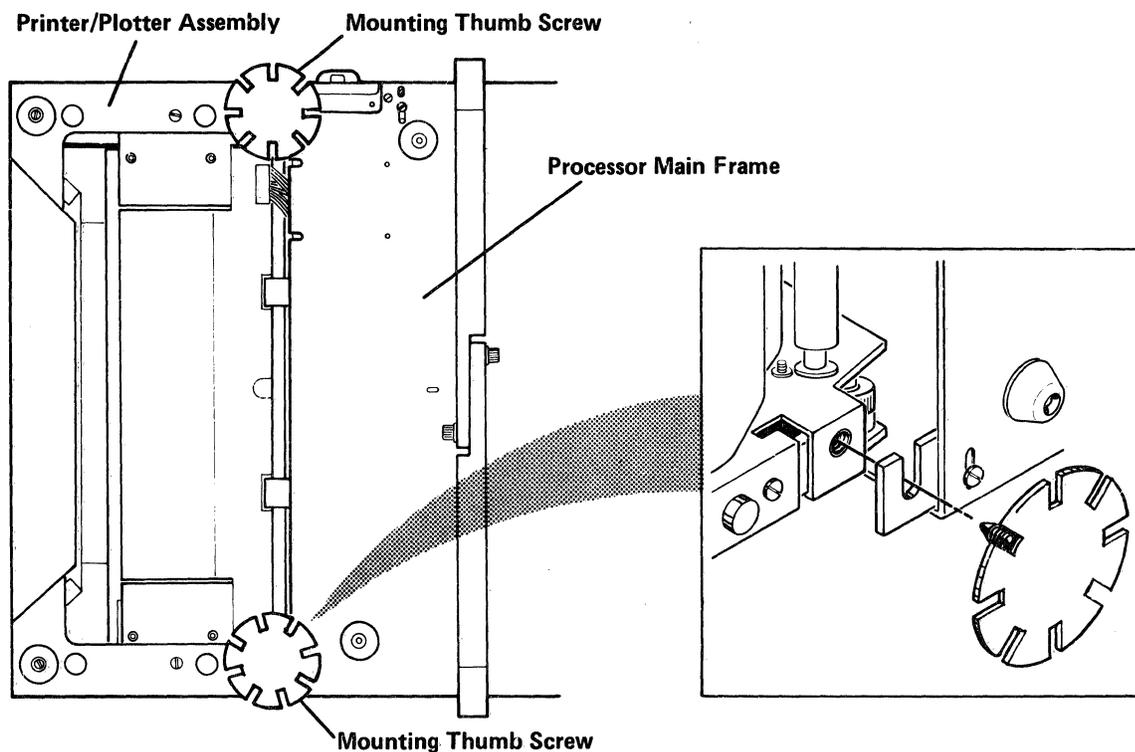


Figure 4-27. Location of Printer/Plotter Thumbwheel Mounting Screws.

-
13. Holding the printer/plotter by the front, tilt the front up, then lift until the hooks at the top release from the processor unit. Move the printer/plotter forward two or three inches away from the processor unit (See Figure 4-28).

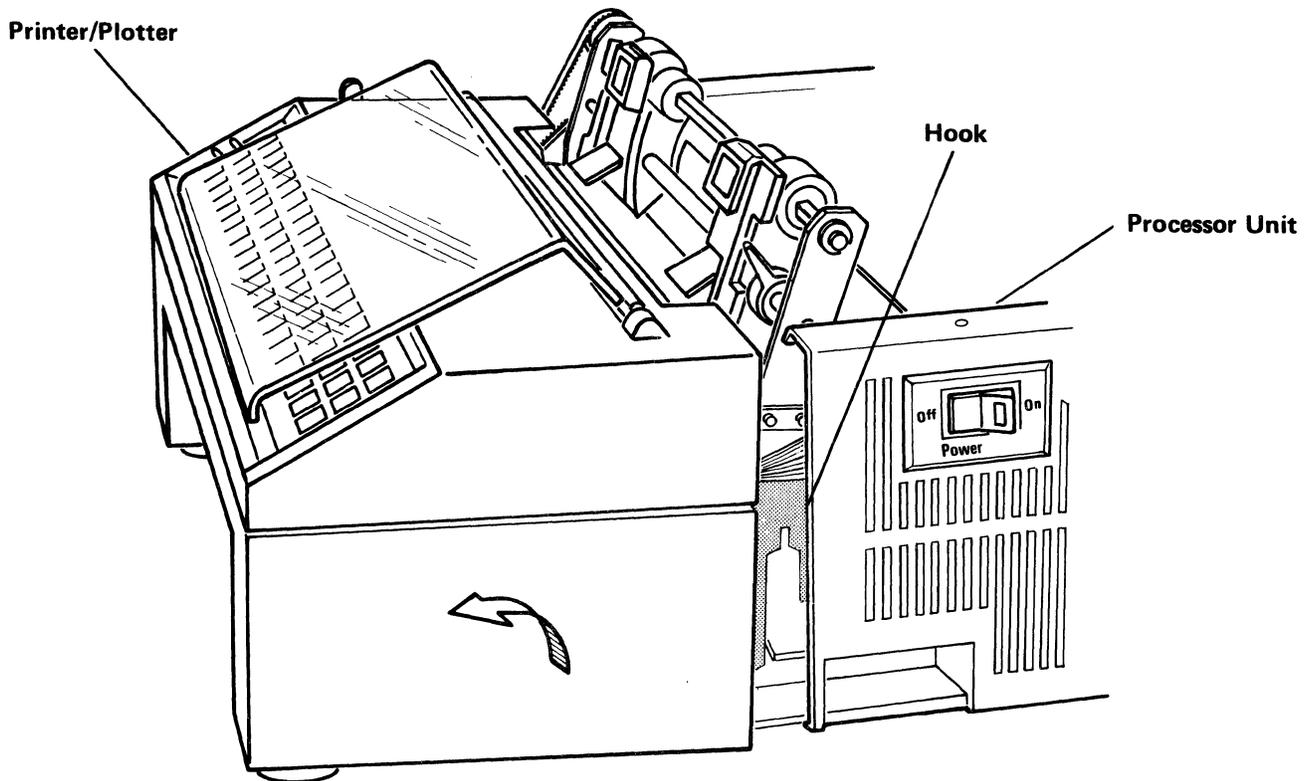


Figure 4-28. Separating Printer/Plotter from Processor Unit.

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14. Carefully pull the printer/plotter control board AC power cable out of the processor unit. This is shown in Figure 4-29. DO NOT turn the printer/plotter or processor on its side.
 15. Disconnect the fan AC connector.
 16. Remove the left-hand printer cable from the rear of the printer/plotter.
 17. Disconnect the keypad connector at the keypad printed circuit board in the top cover and separate the cable from the printer/plotter (See Figure 4-23).
 18. Carefully separate the printer/plotter from the processor unit taking care that the cables are free of the processor unit.

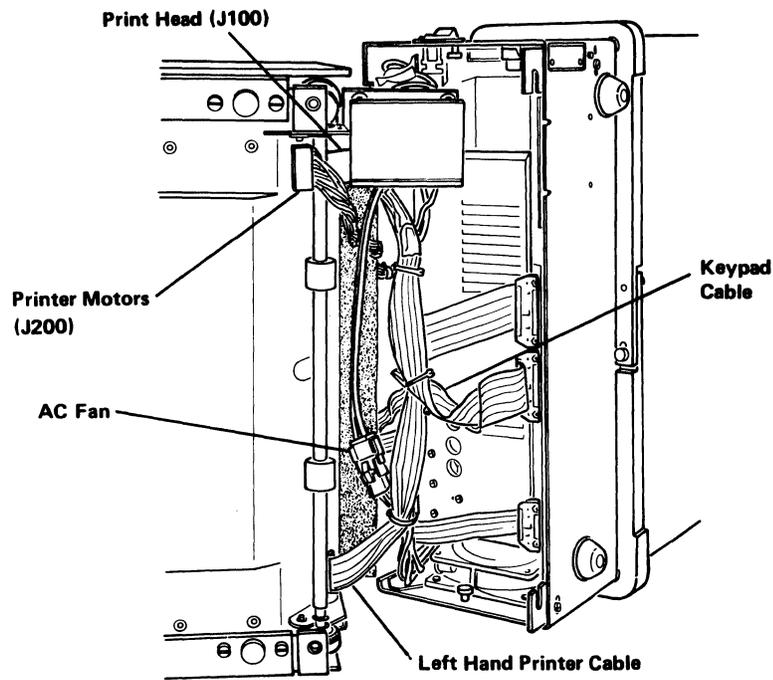


Figure 4-29. Printer/Plotter and Processor Unit (Bottom View).

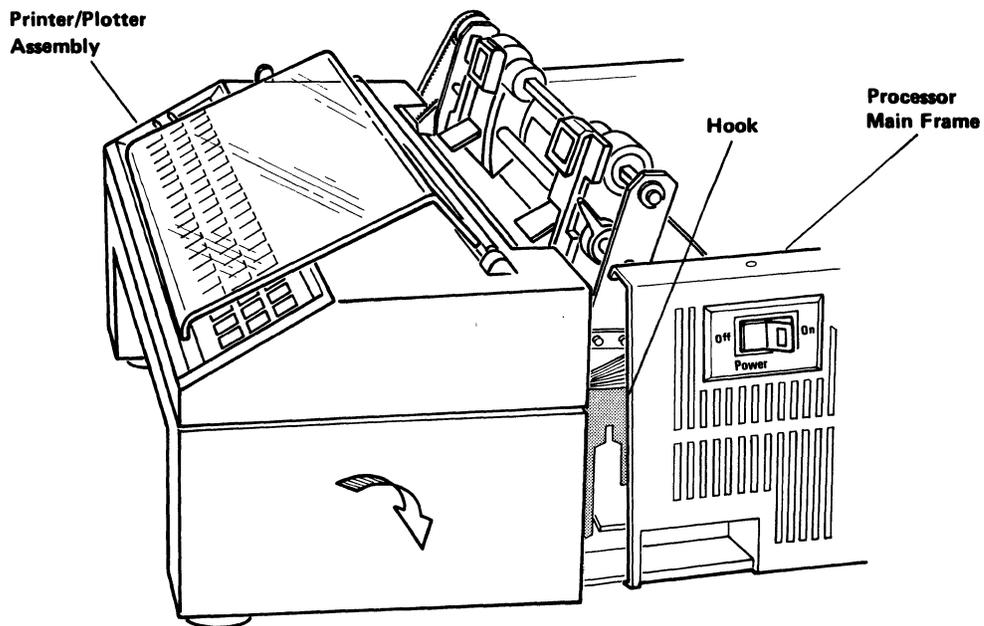


Figure 4-30. Printer/Plotter-Replacement.

4.7.2 REPLACEMENT

1. Place the new printer/plotter next to the processor unit.
2. Replace the left-hand printer cable connector at the back of the printer/plotter (Refer to Figure 4-29).
3. Replace the fan AC connector.
4. Replace the keypad connector cable and connect it to the printed circuit board (See Figure 4-21).
5. Carefully route the printer/plotter control board AC; the printer motors, and printhead cables through the processor unit (See Figure 4-26).
6. Reconnect the printer/plotter control board AC connector to the power supply.
7. Replace the printer motors cable and the printhead cable on the cable harness retaining bar and replace the top portion of the bar.
8. Reconnect the printer motors connector (J 200) and printhead connector (J 100) to the printer/plotter control board.
9. Holding the printer/plotter by the front, lift the assembly and push forward 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 4-30).
10. Replace the two (2) screws that secure the printer/plotter to the processor unit (See Figure 4-27).
11. Position the cable harness assembly over its mounting holes and secure it with the two (2) cable harness retaining screws (See Figure 4-8).
12. Reconnect all the harnessed connectors to the printer/plotter control board. Be sure all the connections are correctly seated.
13. Replace the plastic protector shield above the printer/plotter control board and secure it using the two (2) screws (See Figure 4-7).
14. Replace the processor unit cover by placing the cover on the unit and sliding it forward toward the printer/plotter. Secure the cover in place by tightening the two (2) retaining screws on top of the cover (See Figure 4-6).

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

15. Place the CRT display unit and bridge assembly on the processor unit over the bridge mounting holes and secure the assembly to the processor unit by tightening the four (4) knurled thumb screws on the bridge assembly. (See Figure 4-3).
16. Reconnect the CRT cable assembly, the keyboard connector, main power cord, and any other connector that was connected to the system. (See Figure 4-2).
17. Do an operational check of the system.

4.8 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 4-1).

4.8.1 REMOVAL

1. Position the Computer System Power switch Off and unplug the main power cord from the wall outlet (See Figure 4-2).
2. Remove the main power cord and any other connectors from the back of the processor unit (See Figure 4-2).
3. Remove the back plate of the processor unit by loosening the four (4) retaining screws at the corners of the plate and pulling it away (See Figure 4-4).
4. Loosen the four (4) knurled thumb screws on the bridge assembly (See Figure 4-3).
5. Remove the processor unit top cover by loosening the two retaining screws, lifting the bridge assembly slightly, sliding the cover straight back toward the rear of the processor unit, and lifting the cover off. Put the cover in a safe place (See Figure 4-6).

-
6. Remove the plastic protector shield above the printer/plotter control board by loosening two (2) screws and sliding the plastic retainers inward toward the center of the unit. Then slide the shield assembly toward the rear of the processor unit and remove it (See Figure 4-7).
 7. Disconnect all the harnessed connectors and the 5 1/4-inch floppy disk connector from the printer/plotter control board (or the dummy board in the top position if no printer/plotter is installed) (See Figure 4-8).
 8. Carefully remove the printer/plotter control board from the processor unit (See Figure 4-12).

4.8.2 REPLACEMENT

1. Slide the new printer/plotter control board carefully into position. Be sure that the board is positioned properly (See Figure 4-12).
2. Reconnect all the harnessed connectors and the 5 1/4-inch floppy disk connector to the printer/plotter control board (See Figure 4-8). Be sure all the connectors are correctly seated.
3. Replace the plastic protector shield above the printer/plotter control board and secure it using the two (2) screws (See Figure 4-7).
4. Replace the processor unit cover by placing the cover on the unit, lifting the bridge assembly slightly, and sliding it forward toward the printer/plotter under the bridge assembly. Secure the cover in place by tightening the two (2) retaining screws on top of the cover (See Figure 4-6).
5. Place the back plate on the processor unit and secure it using the four (4) retaining screws at the four corners of the plate. Be sure that the connector spring clips are not behind the back plate (See Figure 4-4).
6. Check to be sure the bridge assembly is in the proper position then tighten the four (4) knurled thumb screws on the bridge assembly (See Figure 4-3).

-
7. Reconnect the main power cord and any other connector that was removed (See Figure 4-2).
 8. Do an operational check of the system.

4.9 5 1/4-INCH DISKETTE UNIT

The single 5 1/4-inch diskette unit is located in the CRT display unit housing to the right of the display (as shown in Figure 4-31.)

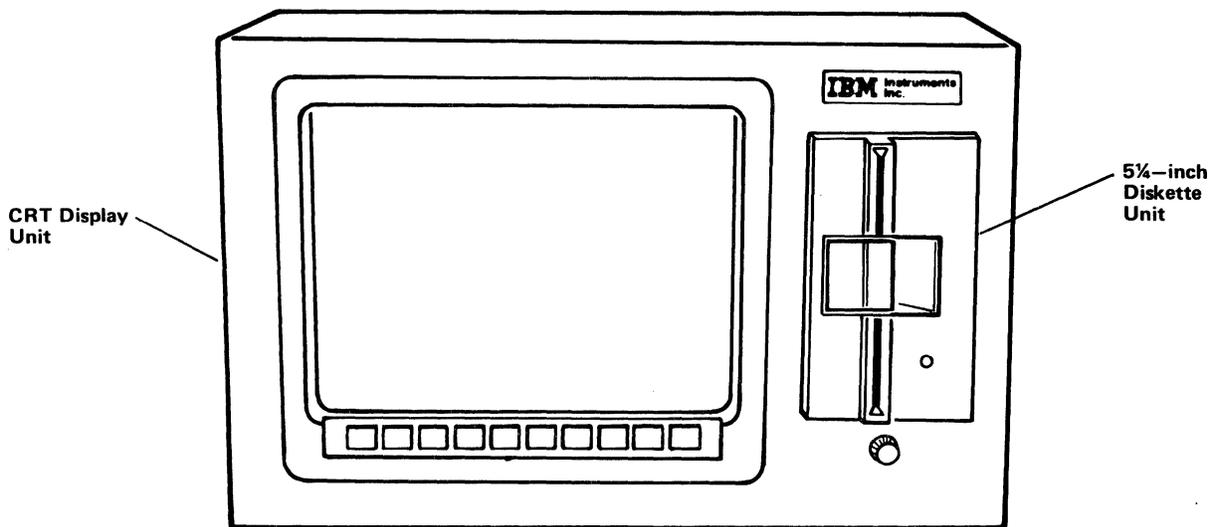


Figure 4-31. CRT Display Unit With 5 1/4" Diskette Unit.

4.9.1 REMOVAL

1. Stop all diskette activity and remove the diskette.
2. Position the Computer System Power switch Off and unplug the main power cord from the wall outlet (See Figure 4-2).

-
3. Remove the main power cord, from the processor unit back panel.

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

4. Disconnect the CRT cable assembly by spreading the spring retaining clips, holding the connector in place, and pulling it away from the rear of the processor unit (See Figure 4-2).
5. Remove the CRT display unit and bridge assembly by loosening the four (4) knurled thumb screws, and lifting the entire assembly. (See Figure 4-3).
6. Carefully place the entire assembly upside down on a flat surface so that the two (2) diskette mounting screws under the unit are visible (See Figure 4-32). It may be necessary to loosen the gimbal and rotate the bridge to gain access to the mounting screws.
7. Loosen the two (2) mounting screws and slide the diskette unit out through the front of the display (See Figure 4-33).
8. Disconnect the two connectors and remove the diskette unit.

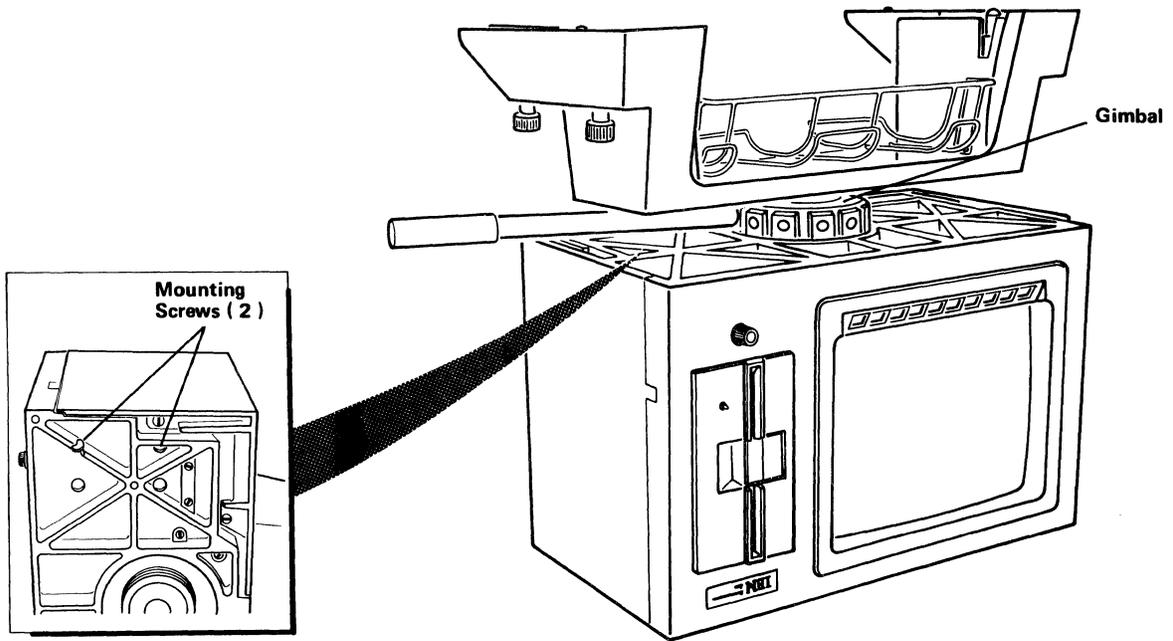


Figure 4-32. Diskette Mounting Screws.

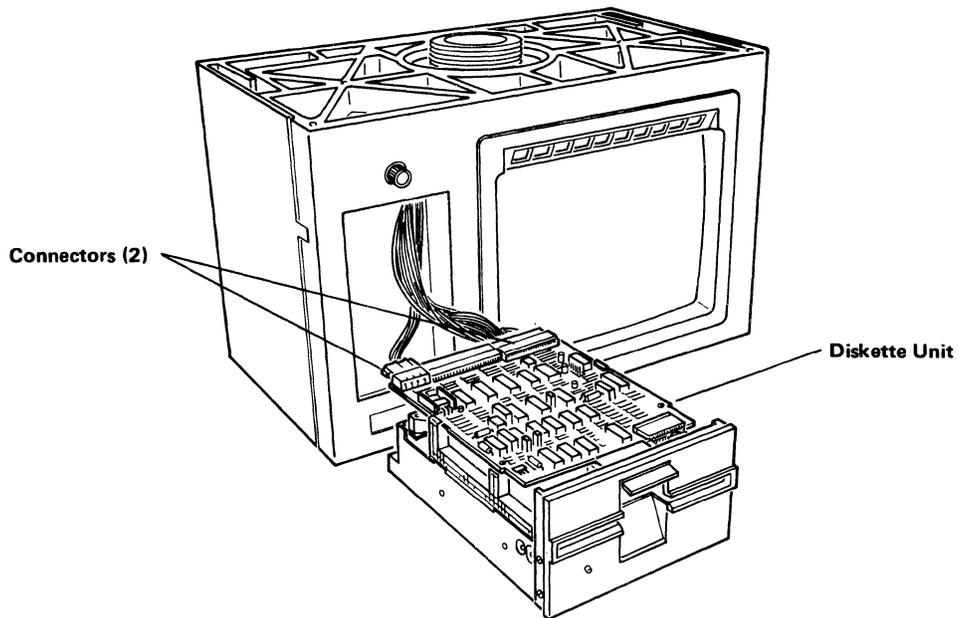


Figure 4-33. 5 1/4" Diskette Unit.

4.9.2 REPLACEMENT

1. Connect the two connectors to the new diskette unit. Be sure the connectors are correctly seated (See Figure 4-33).
2. Carefully slide the new diskette unit into the CRT display unit housing and secure it with the two (2) mounting screws (See Figure 4-33).
3. Align the bridge assembly to the same position it was in when removed from the processor unit and tighten the gimbal (See Figure 4-32).

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

4. Place the CRT display unit and bridge assembly on the processor unit over the bridge mounting holes and secure the assembly to the processor unit by tightening the four (4) knurled thumb screws on the bridge assembly. (See Figure 4-3).
5. Reconnect the CRT cable assembly, main power cord, and any other connector that was removed from the system. (See Figure 4-2).
6. Do an operational check of the system.

4.10 8-INCH DISKETTE UNIT

8-inch diskette units are located in a separate housing connected to the Computer System (as shown in Figure 4-34).

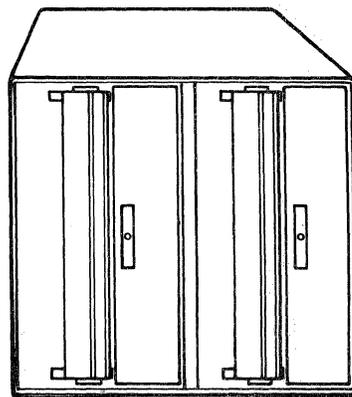


Figure 4-34. 8" Diskette Units.

4.10.1 REMOVAL

1. Remove any diskettes, if present (See Figure 4-35).

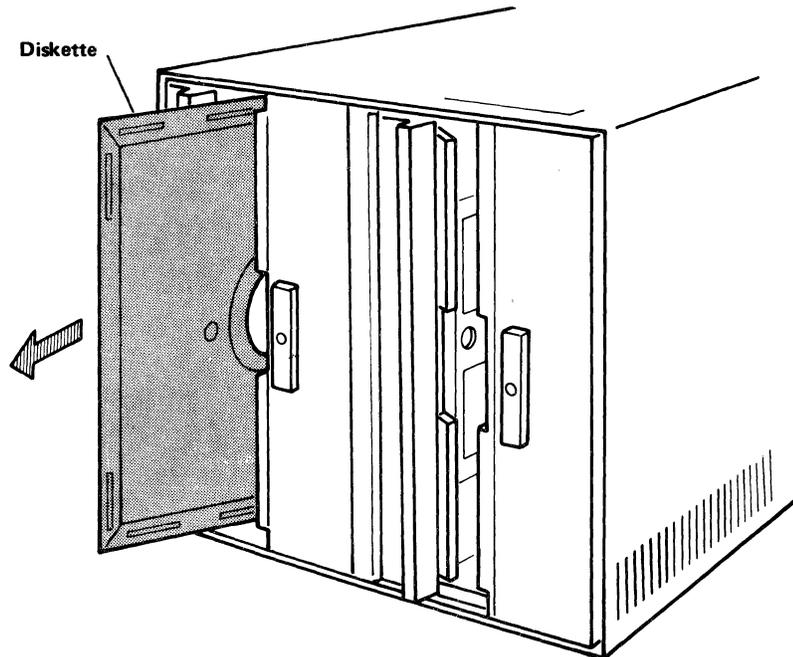


Figure 4-35. 8" Diskette Removal.

2. Position the diskette units POWER switch OFF and unplug the main power cord from the wall outlet (See Figure 4-36).
3. Remove the main power cord and any other connectors from the back of the diskette unit.
4. Remove the diskette unit s top cover by carefully laying the unit on its side and removing the five(5) screws holding the cover in place (See Figures 4-36 and 4-37).

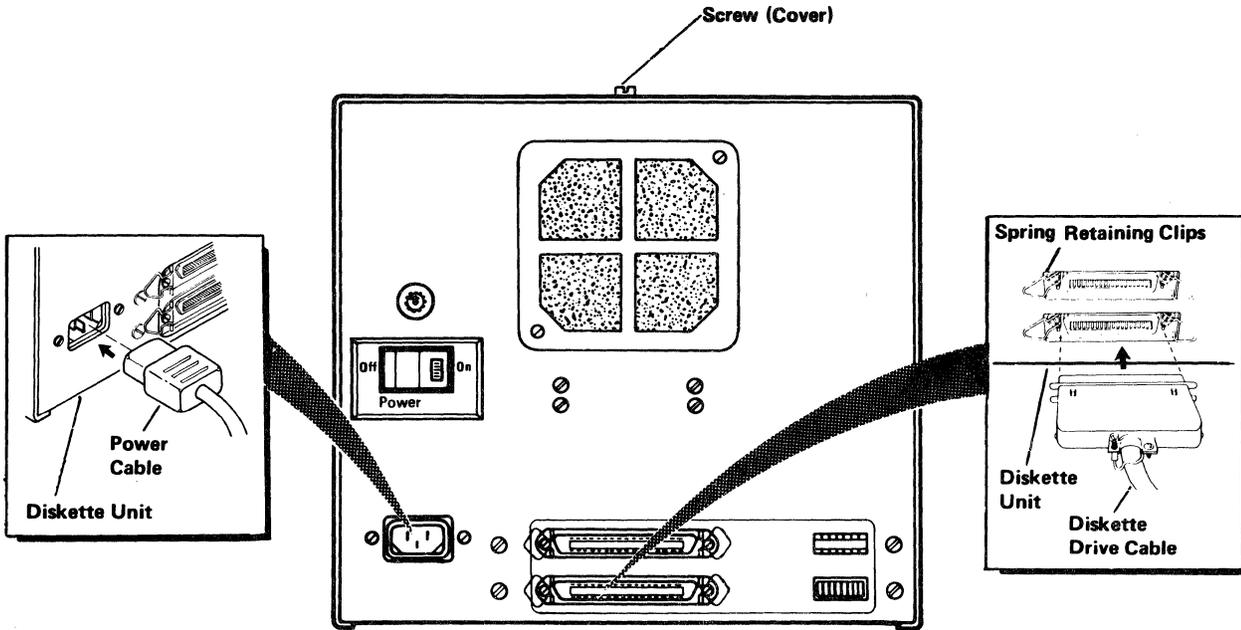


Figure 4-36. 8" Diskette Unit Connections.

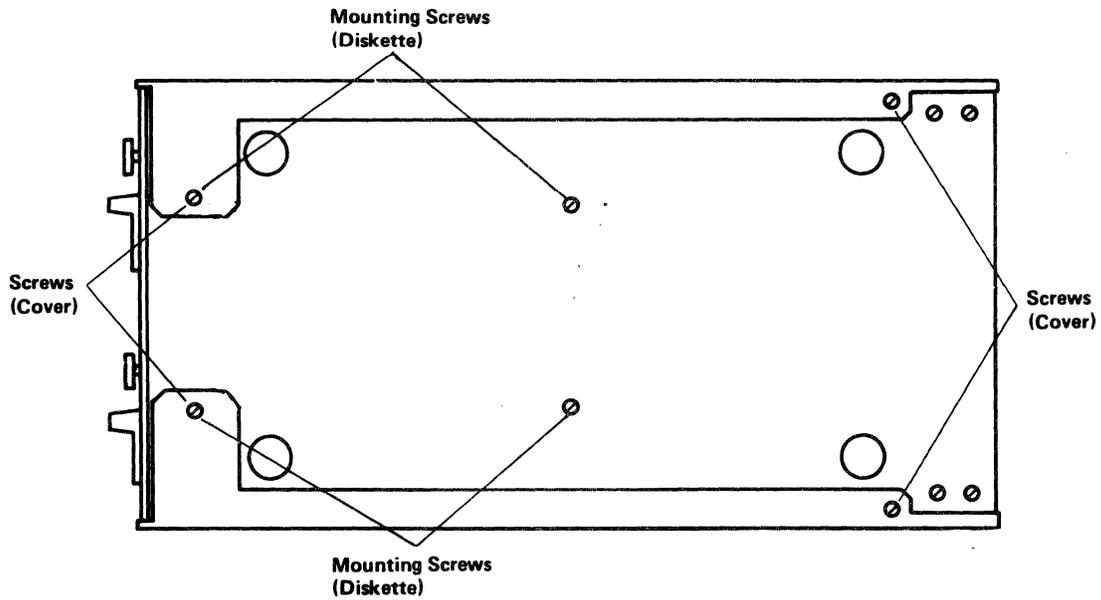


Figure 4-37. Location of Screws (Cover and Diskette).

-
5. Return the unit to its upright position and slide the cover gently forward by grasping the cover at the rear or sides and remove the cover.
 6. Carefully lay the unit on its side again. If removing the bottom drive temporarily install a screw in the top drive as shown in (See Figure 4-37) to keep that drive from dropping down. If removing the top drive locate and remove the remaining screw for that unit (See Figure 4-37).
 7. While holding onto that drive unit, return the entire unit to its upright position.
 8. Slide the drive unit out slightly and disconnect the three connectors on the back (AC, DC, and CONTROL) and remove the drive unit.

4.10.2 REPLACEMENT

1. Slide the new drive unit onto the housing until the three connectors on the back can be reconnected. Then push it back all the way.
2. While supporting the drive unit place the assembly on its side and replace the screw that holds the new unit in place. Also remove the screw that was installed to hold the unit not being removed (See Figure 4-37).
3. Return the unit to its upright position and replace the cover by gently sliding it back into place.
4. Place the unit with the cover installed on its side again and replace the five (5) screws holding the cover in place (See Figure 4-36 and 4-37).
5. Return the unit to its upright position and replace the main power cord and any other connectors that were removed (See Figure 4-36).
6. Do an operational check of the system.

4.11 FEATURE BOARDS (SENSOR I/O, ADDITIONAL MEMORY, ETC.)

The optional feature boards plug into the expansion board below the printer/plotter control board (as shown in Figures 4-1).

4.11.1 REMOVAL

1. Position the Computer System POWER switch OFF and unplug the main power cord from the wall outlet (See Figure 4-2).
2. Remove the main power cord and all other connectors from the back of the processor unit (See Figure 4-2).
3. Remove the back plate from the processor unit by loosening the four (4) retaining screws at the four corners of the plate and pulling it away (See Figure 4-4).
4. Using the ejector levers free the affected feature board from the expansion board and carefully slide it out of the processor unit (See Figure 4-13).

4.11.2 REPLACEMENT

1. Slide the new feature board into position in the processor unit and using the ejector levers be sure the board is seated properly (See Figure 4-13).
2. Place the back plate on the processor unit and secure it using the four (4) retaining screws at the four corners of the plate. Be sure that the connector spring clips are not behind the back plate. (See Figure 4-4).
3. Reconnect the CRT cable assembly, the keyboard connector, main power cord, and any other connector that was removed from the system. (See Figure 4-2).
4. Do an operational check of the system.

4.12 SENDING THE CUSTOMER REPLACEABLE UNIT (CRU) TO IBM INSTRUMENTS

Once you have isolated the source of a problem to a CRU and removed the failing unit, notify your IBM Instruments representative by calling toll free 1-800-243-9435. You will be given a service authorization number and you will be asked to provide your system's serial number, your location, and the results you obtained from the diagnostics described in this manual. You then must complete a Repair Center Authorization Form. These forms are packaged with the Computer System at delivery time and with a CRU when it is sent to you.

Use the instructions in Chapter 4 to remove the failing CRU. You should remove all devices or features not sold by IBM Instruments from the CRU. Prepare the malfunctioning CRU for shipment using the original or equivalent container and send it together with the Repair Center Authorization form and any supporting documentation about the nature of the problem (postage prepaid) to:

IBM Instruments, Inc.
Customer Support Center
P.O. Box 332
Orchard Park
Danbury, CT 06810

IBM will at its option, adjust, repair or replace a malfunctioning CRU. It is IBM's intent to ship, generally within 24 hours, replacement CRUs or other parts where IBM elects to replace a malfunctioning CRU or part. You should unpack, set up, and check out the replacement CRU upon receipt. Use the instructions earlier in this chapter.

Service charges will vary depending upon the service agreement in effect (as outlined in the Terms and Conditions). For questions on warranty and maintenance offerings, including charges and terms, or to place a Computer System under maintenance service, contact your IBM Instruments representative.

A.0 APPENDIX A: DIAGNOSTIC TESTS

TEST#	TEST NAME
01	CPU Test
02	ROM Test
03	Main Memory Test
04	RAM Extension Test
05	Interrupt Controller Test
07	Memory Protect Function Test
08	DMA Controller Test
09	Programmable Timer Test
0A	Video Memory Test
0B	CRT Controller Test (Passive)
0C	Clock/Calendar Test
0D	Programmable Parallel Interface Test
0E	Floppy Disk Controller Test (Passive)
0F	Serial Port 1 Test
10	Serial Port 2 Test
11	Serial Port 0 Test
12	Polynomial Generator Check Test
13	Hard disk controller
14	IEEE-488 Interface Test
16	CRT Controller Test Active

17	Floppy Disk Controller/User Port Wraparound Test
18	Printer/Plotter Test Pattern
19	Keypad and Softkey to CRT Echo Test
1A	Keyboard to CRT Echo Test
1B	New IEEE/488 user port wraparound
1C	IEEE-488 User Port Wraparound Test
1D	Serial Port 1-2 Wraparound Test
1E	Serial Port 1-3 or 2-3 Wraparound Test
1F	1F DMA Serial Port Wraparound Test
20	Floppy Disk Drive 0 Test
21	Floppy Disk Drive 1 Test
22	Floppy Disk Drive 2 Test
23	Floppy Disk Drive 3 Test
30	Sensor I/O Board 0 Test (Passive)
31	Sensor I/O Board 1 Test (Passive)
32	Sensor I/O Board 2 Test (Passive)
33	Sensor I/O Board 3 Test (Passive)
35	Sensor I/O Board 0 Test (Active)
36	Sensor I/O Board 1 Test (Active)

37	Sensor I/O Board 2 Test (Active)
38	Sensor I/O Board 3 Test (Active)
40	Hard disk drive 0 active test
41	Hard disk drive 1 active test
42	Hard disk drive 2 active test
43	Hard disk drive 3 active test
97	Memory Confirmation Test
98	CRT Test Pattern
FE	Return to Operating System

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. This is essential for ensuring the integrity of the financial statements and for providing a clear audit trail. The records should be kept up-to-date and should be easily accessible to all relevant parties.

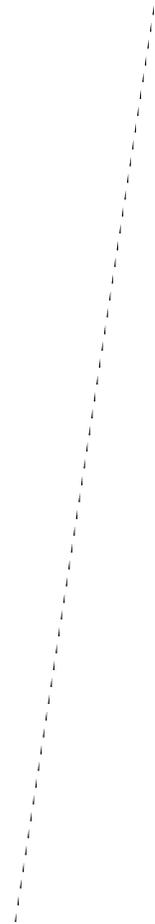
2. The second part of the document outlines the various methods used to collect and analyze data. These methods include interviews, surveys, and focus groups. Each method has its own strengths and weaknesses, and it is important to choose the most appropriate method for the specific research objectives.

3. The third part of the document describes the process of data analysis. This involves identifying patterns and trends in the data, and then interpreting these findings in the context of the research objectives. It is important to be transparent about the methods used for data analysis, and to provide a clear explanation of how the findings were derived.

4. The fourth part of the document discusses the importance of reporting the findings of the research. This involves presenting the results in a clear and concise manner, and providing a detailed explanation of the implications of the findings. It is important to be honest and objective in the reporting, and to avoid making any unsupported claims.

5. The fifth part of the document concludes the report and provides a summary of the key findings. It also includes a list of references and a list of appendices. The references should include all sources used in the research, and the appendices should include any additional information that is relevant to the study.

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B.0 APPENDIX B: DIAGNOSTIC ERROR CODES

The following error codes are issued by the diagnostic tests:

TEST #	MESSAGE #	MEANING
	40-5F 60 80	These messages can be issued by any test if the planar board is malfunctioning.
01	101 102	CPU register failure CPU conditional bit failure
02	201 202	Stored checksum all zeroes Stored checksum not equal to calculated checksum
03 04	401 402	Data read not equal to data written Address cross-talk error
05	501 502	Register read/write failure Controller failed to interrupt
07	701 702	Protected page was changed Unprotected page failed to clear
08	801	Register read/write error
09	901 902 903	Counter gave wrong value Counter interrupted when it should not have Counter failed to interrupt
0A	0A01	Address of defective byte, word, long word
0B	0B01 0B02	Data compare error, cursor low Data compare error, cursor high
0C	0C01 0C02	Timer/counter read/write failure Clock not incrementing properly
0D	0D01	Expected value is byte written, actual value is byte read and address value is zero.

OE	OE01 OE02 OE03 OE04 OE05 OE07 OE08 OE09	Sector register data error Track register data error Controller busy Restore time out Incorrect number of seek pulses Controller busy Interrupt request bit will not clear Interrupt request bit will not set
OF 10 11	OF01 OF02 OF03 OF04 OF05 OF06 OF07 OF08 OF09 OFOA FOFB FOFC FOFD FOFE FOFF	Incorrect data from command register Incorrect data from Mode Register 1 Incorrect data from Mode Register 2 Interrupt request will not release 2661 will not generate interrupt Interrupt not detected by AM9519 Transmitter time out Receiver time out Error status on receive Data compare error Initial synch failure Transmitter time out Receiver time out Error status on receive Data compare error
11	1101 1102 1103 1104 1105 1106	Transmitter time out Receiver time out Error on receive DMA time out DMA buffer compare error DMA count error
12	1201 1202 1203 1204 1205 1206	Incorrect data from Character Register Incorrect data from Mode Register Incorrect data from BCC lower Incorrect data from BCC upper VRC error will not release VRC error generated at wrong time

12 cont.)	1207 1208 1209 120A 120B 120C 120D 120E	VRC error not generated AM9519 does not detect interrupt PEC error detected Transmitter time out BCC error Transmitter time out Receiver time out PEC status error
13	1301	Register R/N Failure
14	1401 1402	Address 1 read not equal to address 1 written Address 2 read not equal to address 2 written
16	1601 1602 1603 1604 1605	Vertical syn frequency wrong Vertical syn width wrong Horizontal syn frequency wrong Horizontal syn width wrong Video output invalid
17	1701 1702 1703 1704 1705	Floppy control register error Floppy controller error Controller busy Step rate incorrect Step count incorrect
18	1801	Printer failed to accept a byte of data for 200 mseconds
1C	1C01 1C02 1C03	UPD 7210 failed to give parallel poll complete Data read from IEEE port not equal to data written to user port. Data read from user port not equal to data written to IEEE port.
1D	1D01 1D02 1D03 1D04 1D05 1D06	Transmitter not ready Receiver not ready Status error on receive Data comparison error Transmitter time out Receiver time out

20	2001	DRO not received for read
21	2002	DRO not received for write
22	2003	INTRO not received for restore
23	2004	INTRO not received for seek
	2005	INTRO not received for read
	2006	INTRO not received for write
	2007	Status error on restore
	2008	Status error on seek
	2009	Status error on read
	200A	Status error on write
	200B	Data compare error
30	3001	A/R control, status read/write failure
31	3002	Interrupt controller (9519) read/write failure
32	3003	Parallel port (8255) read/write failure
33	3004	Serial port (7201) register read/write failure
	3008	Controller failed to interrupt (time out error)
	3010	EOC flag failed to occur (time out error) Subtest 3
	3011	Timer overrun failed to occur (time out) Subtest 3
	301A	Premature countdown (Subtest 4)
	301B	Late countdown (Subtest 4)
35	3501	Sense switch input failure
36	3502	Sense switch interrupt failure
37	3508	Port A transmission error
38	3509	Port B transmission error
	350A	Port C transmission error
	350B	Parallel port interrupt failure
	3510	Transmitter not ready
	3511	Receiver not ready
	3512	Status error on receive
	3513	Data comparison error
	3514	Transmitter time out
	3515	Receiver time out
	351A	Bad analog measurement
	351B	Incorrect autorange operation
	351C	Data ready (EOC) time out

40	200C	Invalid buffer address
41	4001	Controller/drive error
42	4002	Volume label read error
43	4003	Volume label compare error
	4004	File indel read error
	4005	File index compare error
	4006	Bad sector table read error
	4007	Bad sector verify error
	4008	Sector read error
	4009	Controller/Drive error
	400A	Bad sector table error
	400F	Sector read error
	4010	Sector Write error
	4011	Controller drive error
	4012	ECC Failed to reput an irrecoverable condition
	4013	ECC reeated error for a recoverable condition
	4014	ECC Failed to correct a recoverable condition
97	9701	Data read not equal to data written
Any	FFmm	Bus Error, mm = Bus Error Register. Can be caused by addressing non-existant devices or memory.



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