

IBM

IBM System/23 Service Library Volume 1

IBM 5322 Computer Service Manual

Chapter 1. Using the IBM System/23
Service Library

Chapter 2. Processor, processor features
and power supply
Maintenance procedures 1200-1299
Theory of operation

Chapter 3. Keyboard
Maintenance procedures 1300-1399
Theory of operation

Chapter 4. CRT display unit
Maintenance procedures 1400-1499
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Chapter 5. Diskette drive
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Appendix A. Parts catalog

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Glossary

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Preface

This service manual, which is Volume 1 of the IBM System/23 Service Library, is intended to be used for servicing the IBM 5322 computer. Service personnel using this manual are assumed to have completed the 5322 computer training course.

The manual contains the maintenance procedures, theory of operation, and parts catalog for the 5322 computer, including the processor, processor features, power supply, CRT display unit, keyboard, and internal diskette drives.

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The service library

Processor power supply

Keyboard

CRT display unit

Diskette drive

Parts catalog

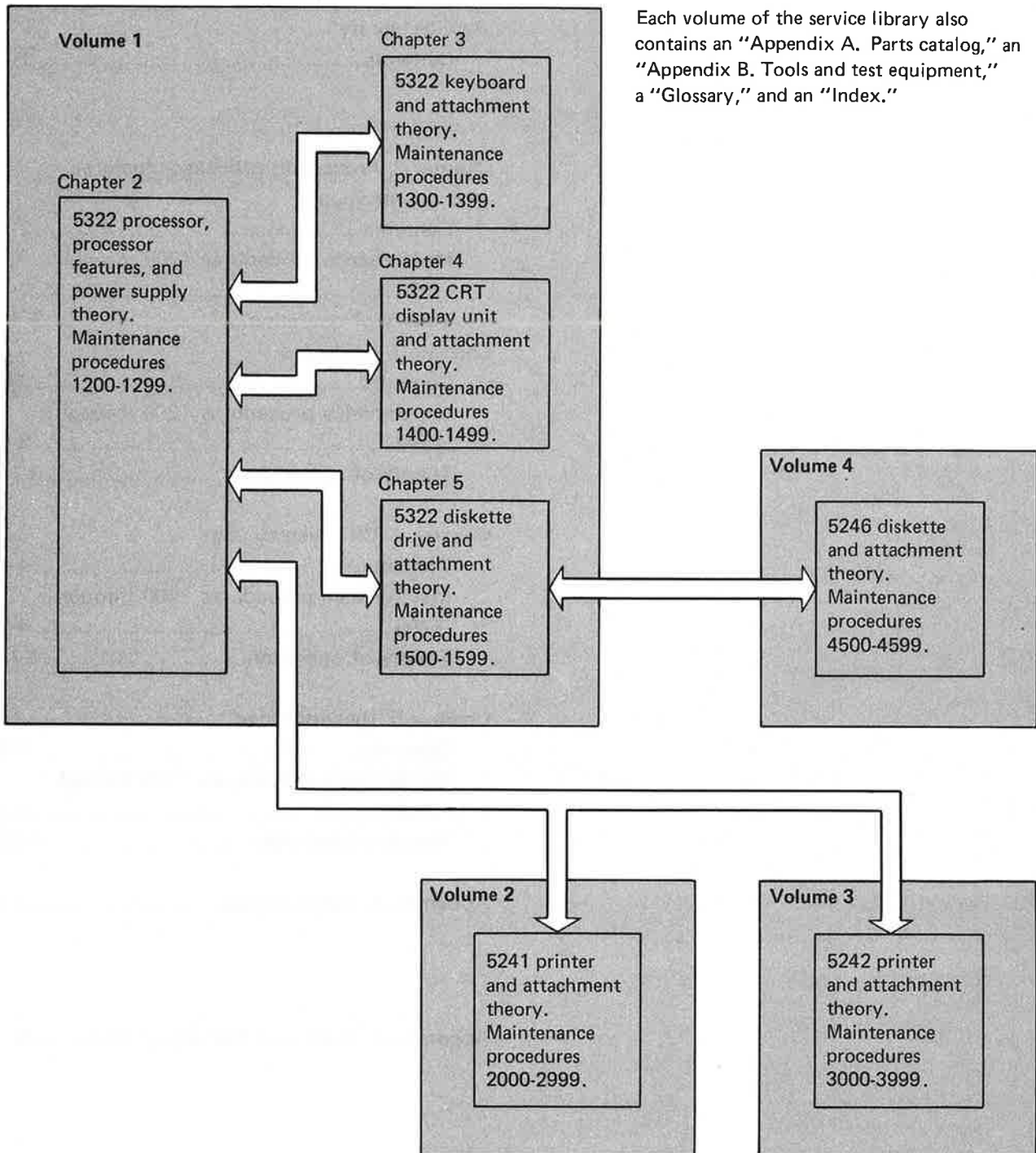
Tools/test equipment

Glossary

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Organization of the service library



Safety

Personal Safety

Refer to the handbook, *Electrical Safety for IBM Customer Engineers, S229-8124*, for additional safety information.

CE SAFETY PRACTICES

All Customer Engineers are expected to take every safety precaution possible and observe the following safety practices while maintaining IBM equipment:

1. You should not work alone under hazardous conditions or around equipment with dangerous voltage. Always advise your manager if you **MUST** work alone.
2. Remove all power, ac and dc, when removing or assembling major components, working in immediate areas of power supplies, performing mechanical inspection of power supplies, or installing changes in machine circuitry.
3. After turning off wall box switch, lock it in the Off position or tag it with a "Do Not Operate" tag, Form 229-1266. Pull power supply cord whenever possible.
4. When it is absolutely necessary to work on equipment having exposed operating mechanical parts or exposed live electrical circuitry anywhere in the machine, observe the following precautions:
 - a. Another person familiar with power off controls must be in immediate vicinity.
 - b. Do not wear rings, wrist watches, chains, bracelets, or metal cuff links.
 - c. Use only insulated pliers and screwdrivers.
 - d. Keep one hand in pocket.
 - e. When using test instruments, be certain that controls are set correctly and that insulated probes of proper capacity are used.
 - f. Avoid contacting ground potential (metal floor strips, machine frames, etc.). Use suitable rubber mats, purchased locally if necessary.
5. Wear safety glasses when:
 - a. Using a hammer to drive pins, riveting, staking, etc.
 - b. Power or hand drilling, reaming, grinding, etc.
 - c. Using spring hooks, attaching springs.
 - d. Soldering, wire cutting, removing steel bands.
 - e. Cleaning parts with solvents, sprays, cleaners, chemicals, etc.
 - f. Performing any other work that may be hazardous to your eyes.**REMEMBER — THEY ARE YOUR EYES.**
6. Follow special safety instructions when performing specialized tasks, such as handling cathode ray tubes and extremely high voltages. These instructions are outlined in CEMs and the safety portion of the maintenance manuals.
7. Do not use solvents, chemicals, greases, or oils that have not been approved by IBM.
8. Avoid using tools or test equipment that have not been approved by IBM.
9. Replace worn or broken tools and test equipment.
10. Lift by standing or pushing up with stronger leg muscles—this takes strain off back muscles. Do not lift any equipment or parts weighing over 60 pounds.
11. After maintenance, restore all safety devices, such as guards, shields, signs, and grounding wires.
12. Each Customer Engineer is responsible to be certain that no action on his part renders products unsafe or exposes customer personnel to hazards.
13. Place removed machine covers in a safe out-of-the-way place where no one can trip over them.
14. Ensure that all machine covers are in place before returning machine to customer.
15. Always place CE tool kit away from walk areas, where no one can trip over it; for example, under desk or table.
16. Avoid touching moving mechanical parts when lubricating, checking for play, etc.
17. When using stroboscope, do not touch ANYTHING — it may be moving.
18. Avoid wearing loose clothing that may be caught in machinery. Shirt sleeves must be left buttoned or rolled above the elbow.
19. Ties must be tucked in shirt or have a tie clasp (preferably nonconductive) approximately 3 inches from end. Tie chains are not recommended.
20. Before starting equipment, make certain fellow CEs and customer personnel are not in a hazardous position.
21. Maintain good housekeeping in area of machine while performing and after completing maintenance.

**Knowing safety rules is not enough.
An unsafe act will inevitably lead to an accident.
Use good judgment—eliminate unsafe acts.**

ARTIFICIAL RESPIRATION

General Considerations

1. Start Immediately — Seconds Count
Do not move victim unless absolutely necessary to remove from danger. Do not wait or look for help or stop to loosen clothing, warm the victim, or apply stimulants.
2. Check Mouth for Obstructions
Remove foreign objects. Pull tongue forward.
3. Loosen Clothing — Keep Victim Warm
Take care of these items after victim is breathing by himself or when help is available.
4. Remain in Position
After victim revives, be ready to resume respiration if necessary.
5. Call a Doctor
Have someone summon medical aid.
6. Don't Give Up
Continue without interruption until victim is breathing without help or is certainly dead.

Rescue Breathing for Adults

1. Place victim on his back immediately.
2. Clear throat of water, food, or foreign matter.
3. Tilt head back to open air passage.
4. Lift jaw up to keep tongue out of air passage.
5. Pinch nostrils to prevent air leakage when you blow.
6. Blow until you see chest rise.
7. Remove your lips and allow lungs to empty.
8. Listen for snoring and gurglings — signs of throat obstruction.
9. Repeat mouth to mouth breathing 10-20 times a minute. Continue rescue breathing until victim breathes for himself.



Thumb and finger positions



Final mouth-to-mouth position

Safety

Installation warning

Warning: The 5322 computer can contain diskette units that use magnetic reading and writing methods. Electromagnetic devices such as television sets or other display terminals can cause interference with the operation of the system. To ensure that the system will operate correctly, do not install any electromagnetic devices in a radius of 0.61 m (2 ft) of the 5322.

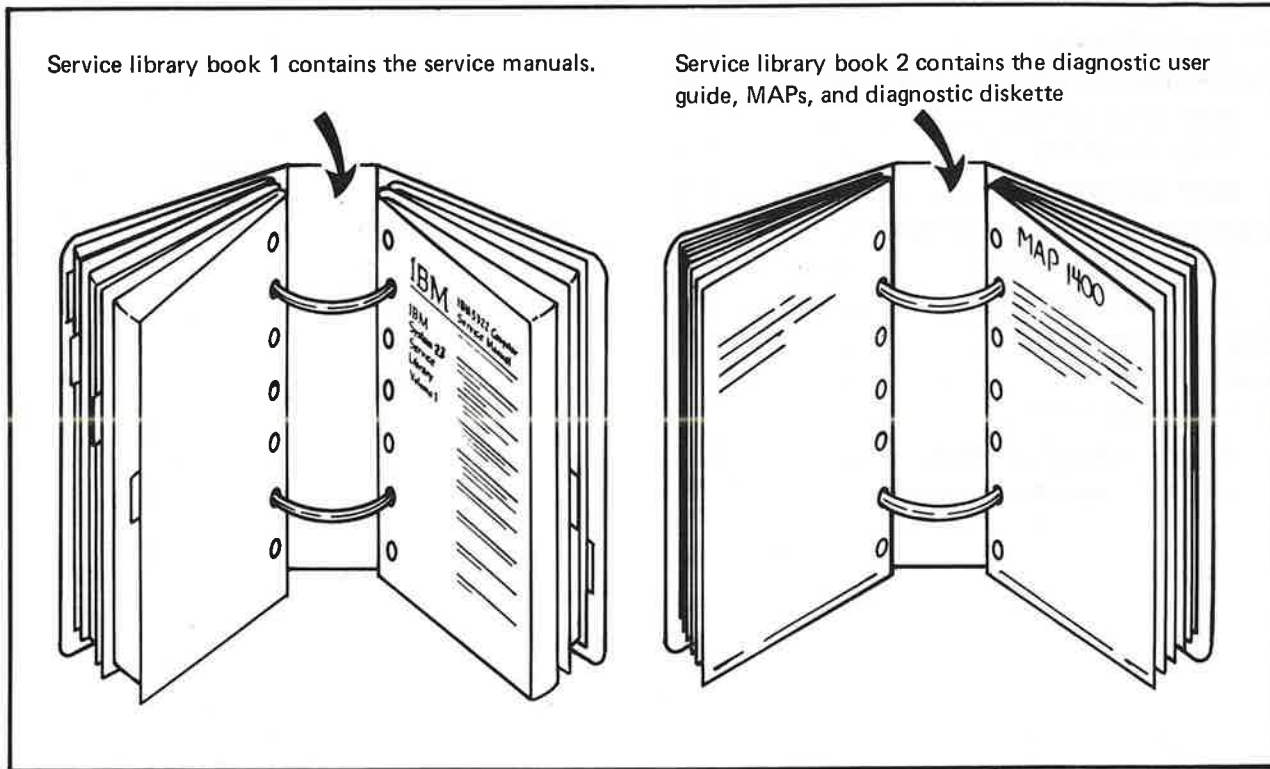
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Using the IBM System/23 Service Library

The service library

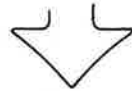


The service library contains the maintenance documents and the diagnostic-program diskette that will aid you in locating and repairing problems in the IBM System/23.

The service library contains the:

- Maintenance analysis procedures (MAPs)
- CE diagnostic diskette
- Diagnostic user guide
- Service manuals

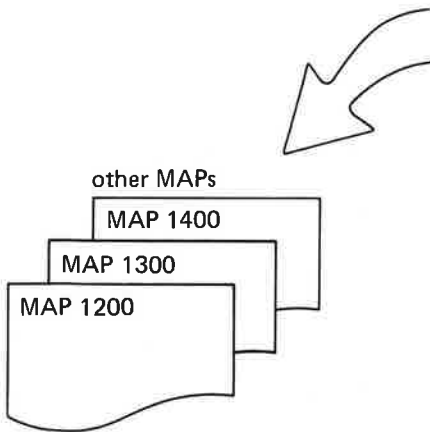
The procedures for using the contents of the service library are described in this chapter; however, if you already understand these procedures, you can use the flowchart on the next page as a review.



Always begin each service call with the START MAP.



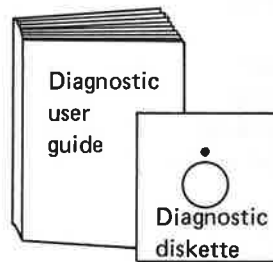
Depending on your answers to the MAP questions about the failure indications, the START MAP directs you to:



The MAPs guide you through the service call by asking questions about error codes, diagnostic program results, logic-probe levels, and service checks.



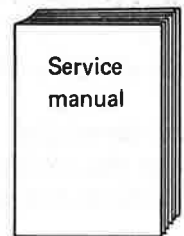
run a diagnostic program



The diagnostic user guide tells you how to run the diagnostic programs and how to interpret the results.



a procedure in a service manual



The service manuals provide information about machine locations, service checks, adjustments, removal, and replacement procedures, and theory of operation.

Using the IBM System/23 Service Library

Maintenance analysis procedures (MAPs)

The MAPs use step-by-step instructions for testing and locating failures in the IBM 5322 Computer and the input/output (I/O) devices. The MAPs guide you through the service call with questions about error codes, diagnostic program results, logic-probe levels, and service checks. The MAPs use a logical method for locating the possible causes of a machine problem and point you to that part of the 5322 computer or I/O device that needs adjustment or replacement.

You should always use the START MAP (MAP 1000) as the entry point for any service call.

MAP entry points

Always use the entry points of the MAPs. The entry points are specified by references in other MAPs or by a Failure Index (at the start of the MAP) that contains error codes or failure symptoms.

Using the MAPs

When using the MAPs, you must:

Read carefully. The MAPs can aid you in finding the problem only if you follow instructions and answer questions carefully.

Follow the sequence. Follow the MAP sequence at all times. Sometimes the MAP instructions do not seem important; however, you must follow them in order to determine the exact error conditions.

Follow instructions. MAP instructions must be carried out exactly in the order given. Questions are relative to instructions immediately preceding the questions. Do not change the conditions set by the instructions before answering the questions. Do not operate any switch or key until you are requested to do so.

When the MAPs request you to probe a line, the line name and its active level are given. For example:

Probe H2 G06 (- machine check).

The - (minus) in front of machine check indicates that this line is active at a minus (down) level.

MAP example

An example of an IBM System/23 MAP is shown on the next two pages. Comments have been added to describe the MAP format and statements.

MAP name: FILE MAP MAP number: MAP 1500-1

MAIN STRATEGY
PAGE 1 OF 3

ENTRY POINTS

FROM	ENTER THIS MAP		
MAP NUMBER	ENTRY POINT	PAGE NUMBER	STEP NUMBER
1000	A	1	001
1530	B	2	007

EXIT POINTS

EXIT THIS MAP		TO	
PAGE NUMBER	STEP NUMBER	MAP NUMBER	ENTRY POINT
3	014	1000	B
3	016	1000	B
3	017	1225	A
2	006	1530	A
2	010	1530	A
3	012	1540	A

001 (ENTRY POINT A)
DID POWER-ON TEST RUN OK?
Y N

002
HALT 38?
Y N

003
NO 24V TO DRIVE 1
CHECK PIN B03 ON CABLE FOR VOLTAGE AND CONTINUITY

004
PROGRAM SENSES DRIVE 1 NOT ATTACHED
CHECK PIN A18 AND CABLE FOR GROUND AND CONTINUITY
(SEE SM 1212) REPLACE IF NEEDED

2
A

MAP 1500-1

Entry and exit points—shows all entry and exit points to and from this MAP.

Step number

Entry point—indicates a possible starting point in this MAP. This point is usually referenced from a step within a MAP.

Question—answer either yes or no. Continue from your answer to the next question or instruction.
Y=Yes, N=No

Reference number—refers to a location graphic, maintenance procedure, chart, or other pertinent information in a service manual.

Off-page reference—identifies the page and trace on which this MAP leg continues. The 2 indicates that this leg continues on page 2. The A indicates that this leg continues at trace A.

(Continued on next page)

Using the IBM System/23 Service Library

Maintenance analysis procedures (MAPs) (continued)

On-page reference—indicates the trace and page from which this MAP leg came. The 1 indicates that this leg came from page 1. The A indicates that this leg came from trace A.

```
A  
1  
FILE MAP  
MAP 1500-2  
MAIN STRATEGY  
PAGE 2 OF 3  
005  
1. POWER OFF.  
2. POWER ON.  
3. WHEN 'READY' APPEARS AT THE  
BOTTOM OF THE CRT  
PRESS 'CMD TEST' TO SELECT THE  
ROS RESIDENT  
DISKETTE PID 1500.  
4. SELECT DISKETTE DRIVE '1'.  
5. SELECT 'DISK WITHOUT LOOP'  
OPTION TO RUN  
TEST ON DISKETTE DRIVE 1  
TEST RUN OK?  
Y N  
006  
PID 1500 DISKETTE FAILURE.  
GO TO MAP 1530, ENTRY POINT A.  
007  
(ENTRY POINT B)  
1. LOAD DCP PROGRAM  
2. WHEN DCP MENU IS DISPLAYED  
ENTER OPTION '0' TO LOAD PID 1505  
DISKETTE FLT (PART 1).  
3. RUN PID 1505 WITHOUT LOOP ON  
DRIVE 1.  
DOES DISPLAY INDICATE  
PROPER NUMBER OF DRIVES  
INSTALLED?  
Y N  
008  
CHECK PIN A18 AND CABLE FOR  
GROUND AND CONTINUITY, REPLACE  
IF NEEDED. (SEE SM 1212)  
009  
TEST RUN OK?  
Y N  
010  
GO TO MAP 1530, ENTRY POINT A.  
3  
B
```

External exit point—indicates the MAP and entry point to go to.

Instruction—establishes conditions for answering the next question.

Action—possible fixes for the failure. Replace, repair, or adjust in the order given. (Check/replace means to check first, then replace if defective.)

Diagnostic and CE utility programs

Diagnostic programs

There are three types of diagnostic programs to aid you in observing and locating failures in the IBM System/23. They are:

- Power-on diagnostics
- ROS resident diskette diagnostics
- CE diskette resident diagnostics

Power-on diagnostics. The power-on diagnostics are contained in ROS (read-only storage) and are run automatically when the system is powered-on. If an error is found, an error code is displayed to describe the failure. Descriptions of the routines and error codes used by the power-on diagnostics are located in the diagnostic user guide.

ROS resident diskette diagnostics. The ROS resident diskette diagnostics are diagnostic routines for the diskette drives. These routines aid you in locating failures on a diskette drive when the diskette resident diagnostics cannot be loaded. The instructions for using these ROS resident diskette routines are located in the diagnostic user guide.

CE diskette resident diagnostics. The CE diskette resident diagnostics are located on the diagnostic program diskette. These diagnostics contain the diagnostic control program (DCP) and the device diagnostics to aid you in locating and repairing problems of the smallest field replaceable unit (FRU). The diagnostic program diskette is located in service library book 2. The instructions for using these diskette resident diagnostics are located in the diagnostic user guide.

CE utility programs

The CE utility programs are located on the diagnostic program diskette and are loaded under control of the diagnostic control program (DCP). The functions performed by the utility programs are:

- Diskette format
- Diskette copy
- Diskette read/verify
- Diskette VTOC display
- Engineering change (EC) and program temporary fix (PTF) support
- Error log display
- Configuration display

The instructions for using the CE utility programs are located in the diagnostic user guide.

Using the IBM System/23 Service Library

Diagnostic user guide

The diagnostic user guide, located in service library book 2, contains the information you need to use the diagnostic and CE utility programs. Program descriptions, operating procedures, options, halt codes, and error codes are included in the guide.

The descriptions for the halt and error codes can be useful when you are diagnosing difficult or intermittent machine failures.

An example of a page from the guide is shown on the next page.

DUG1300

KEYBOARD TEST

PAGE 3 OF 4

2.4 PROGRAM RUN INSTRUCTIONS

2.4.1 END COMMAND

2.4.1.1 A "9" KEY ENTRY ON THE NUMERIC KEYPAD RETURNS CONTROL TO DCP.

2.4.2 EXIT ROUTINE PROCEDURE

2.4.2.1 ROUTINE 1 - MAY BE EXITED BY DEPRESSING THE "TEST" KEY TWICE.

2.4.2.2 ROUTINE 2 - MAY BE EXITED BY FORCING 2 ERRORS (HITTING THE WRONG KEY ON PURPOSE) AND THEN DEPRESSING THE TEST KEY.

2.4.3 LOOP ROUTINE COMMAND - N/A

2.5 CONTROL PROGRAM HALTS

2.5.1 ROUTINE 1 - THERE ARE NO HALTS.

2.5.2 ROUTINE 2 - ONE RETRY IS ALLOWED AFTER EACH OF THESE HALTS.

```

*****
*HALT *                               * ACTION *
*CODES*                               * REQUIRED *
*****
* 110 * INCORRECT SCAN CODE           * RE-ENTER KEY *
*-----*
* 120 * NO SCAN CODE RECEIVED         * RE-ENTER KEY *
*-----*
* 130 * MORE THAN ONE SCAN CODE RECEIVED ON MAKE- * RE-ENTER KEY *
* * ONLY KEYS *
*-----*
* 140 * CORRECT SCAN CODE RECEIVED BUT TYPAMATIC *RE-TRY OPERATION *
* * FUNCTION FAILED *
*****

```

3.0 INDEX OF HALTS AND PRINTOUTS

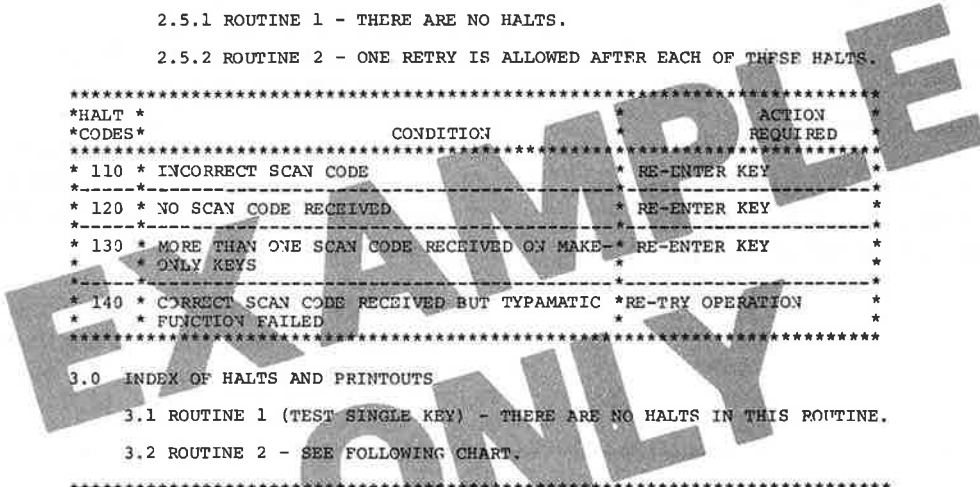
3.1 ROUTINE 1 (TEST SINGLE KEY) - THERE ARE NO HALTS IN THIS ROUTINE.

3.2 ROUTINE 2 - SEE FOLLOWING CHART.

```

*****
*                               *
*                               * HALT IDENTIFIER TABLE *
*                               *
*****
*HALT*                               *
* ID *                               * ACTION *
* * *                               *
*****
* 150 * AN INVALID SCAN CODE WAS RECEIVED FROM KEYBOARD * REPLACE KEYBD *
* * *                               *
*-----*
* 160 * AN INCORRECT SCAN CODE WAS RECEIVED ON THE SECOND* REPLACE *
* * ATTEMPT * * KEYBOARD *
* * *                               *
*-----*
* 170 * NO INPUT RECEIVED ON SECOND ATTEMPT * REPLACE KEYBD *
* * *                               *
*-----*
* 180 * MULTIPLE SCAN CODES WERE RECEIVED FROM A KEY THAT* REPLACE *
* * SHOULD HAVE ONLY PRESENTED A SINGLE INTERRUPT * KEYBOARD *
* * *                               *
*-----*
* 190 * TYPAMATIC FUNCTION FAILED ON SECOND ATTEMPT * REPLACE KEYBD *
* * *                               *
*-----*

```



Using the IBM System/23 Service Library

Service manuals

The service manuals, which are located in book 1 of the IBM System/23 Service Library, contain additional reference information you need to diagnose and repair machine failures.

Volume numbers

Each service manual is assigned a volume number, as follows:

- Volume 1—5322 computer, including the power supply, CRT display unit, keyboard, and internal diskette drives
- Volume 2—5241 printer
- Volume 3—5242 printer
- Volume 4—5246 diskette unit

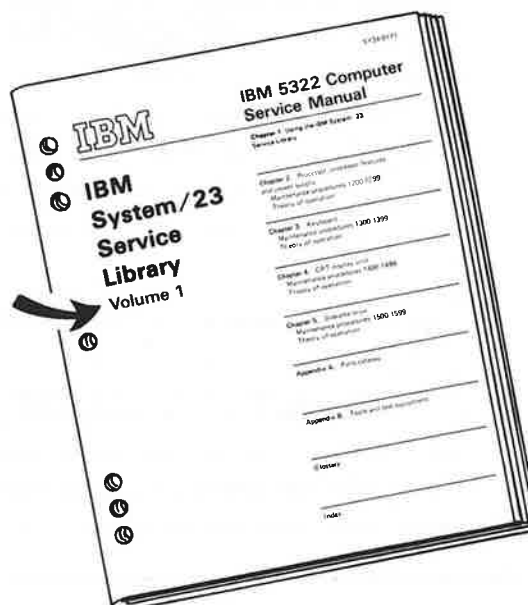
The MAPs use the volume number as the first digit of a four-digit number, which is the reference number of a maintenance procedure in the service manual.

Service manual contents

Each service manual contains information about:

- Maintenance procedures—describes and shows how to do the service checks, adjustments, and removal/replacement procedures requested by the MAPs
- Location diagrams—shows the location of the field replaceable units (FRUs), test points, and jumper pins
- Theory of operation—describes how the machine operates
- Parts catalog—contains the part numbers for the FRUs
- Tools and test equipment—describes and shows how to use the tools and test equipment needed to diagnose and repair machine failures
- Glossary—defines the abbreviations, acronyms, and terms that are used in the service manual

The volume number is used by the MAPs as the first digit of the maintenance procedure number.



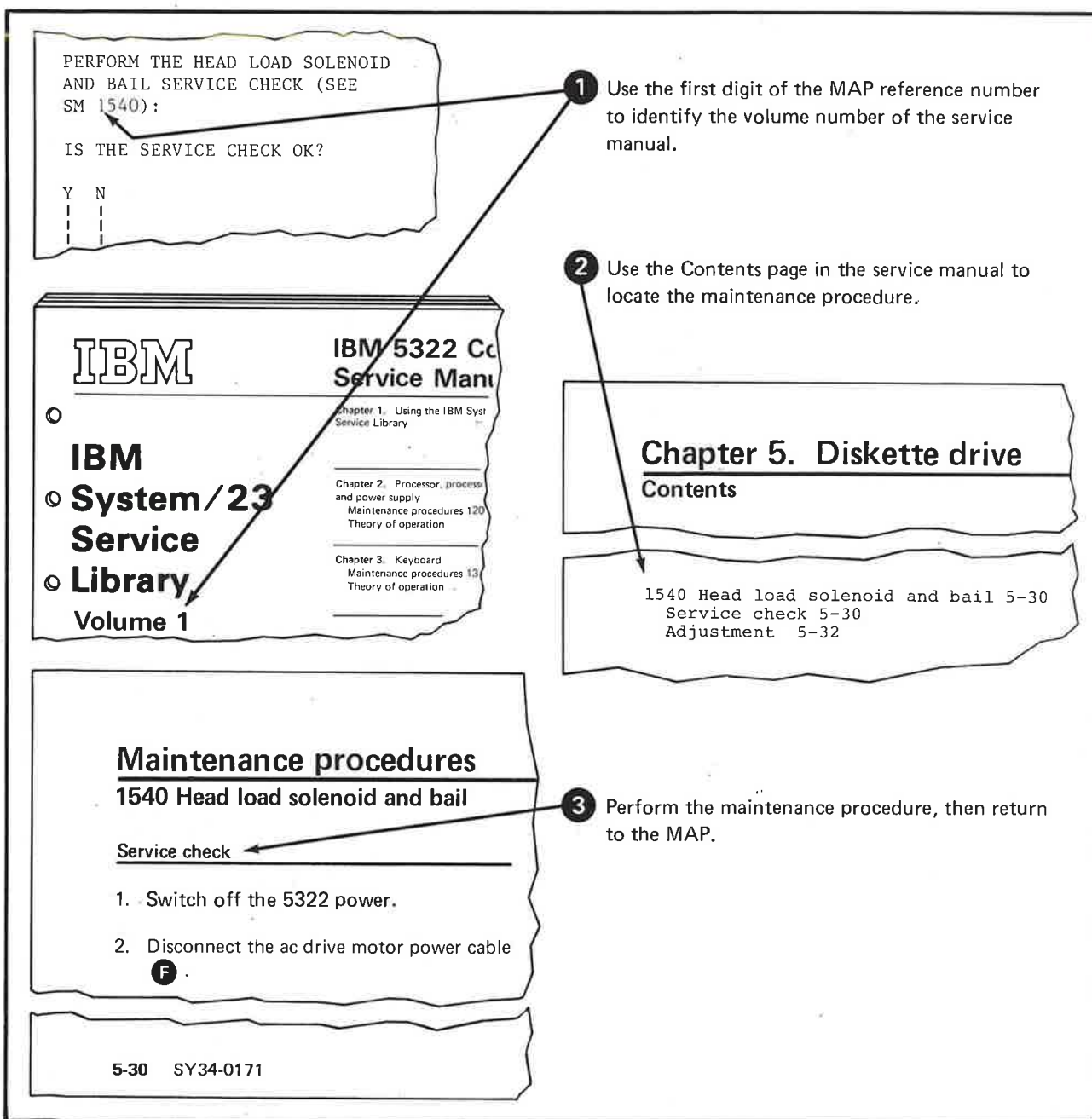
Using the service manuals

Your primary use of the service manuals is in the sections for maintenance procedures. The maintenance sections contain location diagrams and the service check, adjustment, and removal/replacement procedures.

The MAPs use a four-digit number to guide you to a location diagram or a maintenance procedure in a service manual.

The first (high-order) digit identifies the volume number of the service manual. The three remaining digits identify either a location diagram or a field replaceable unit (FRU) procedure in that volume.

The following diagram shows how the MAPs guide you to a specific maintenance procedure:





Chapter 2. Processor, processor features, and power supply

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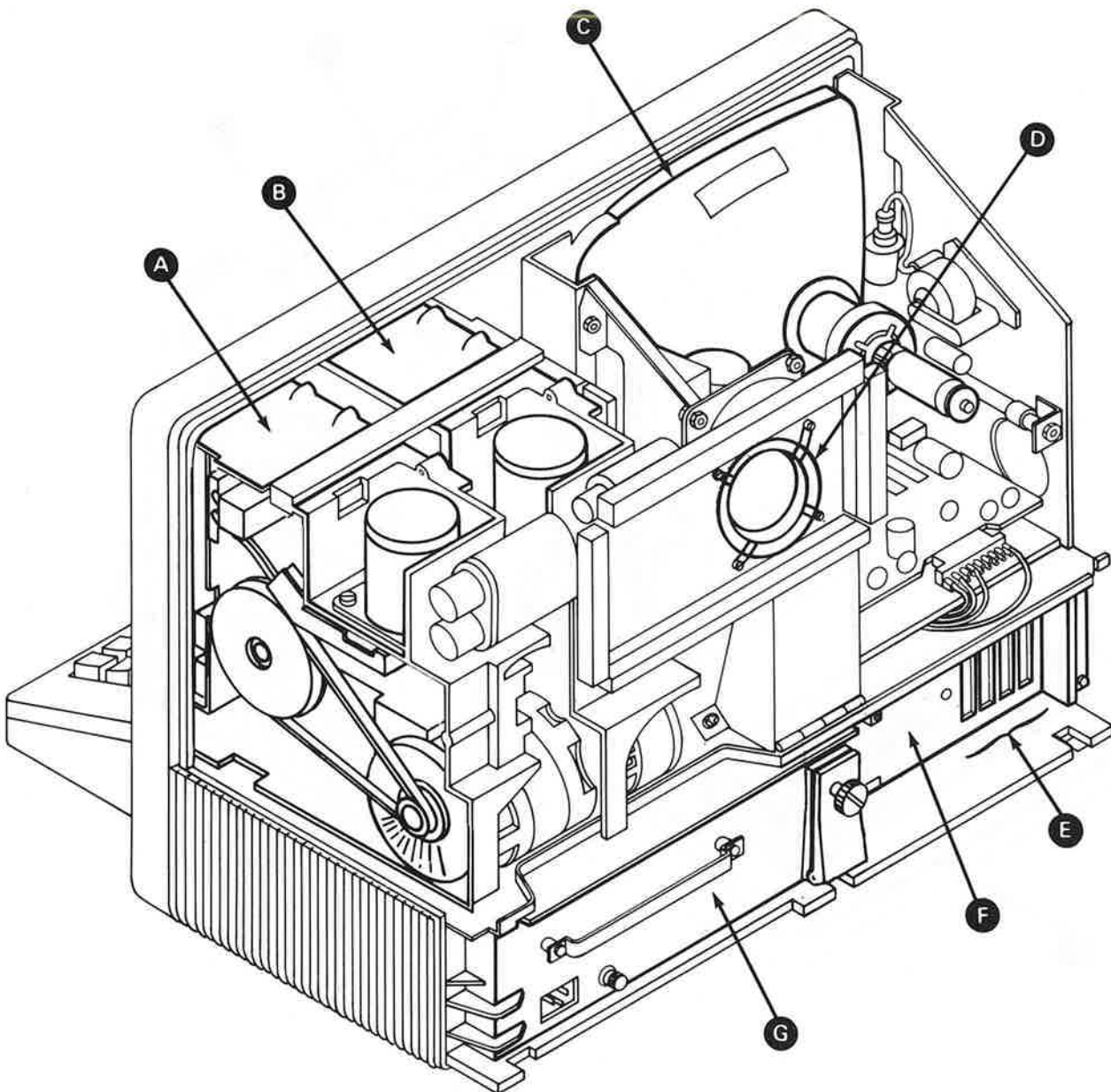
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Maintenance procedures

1200 Locations (continued)

Functional units (rear view)

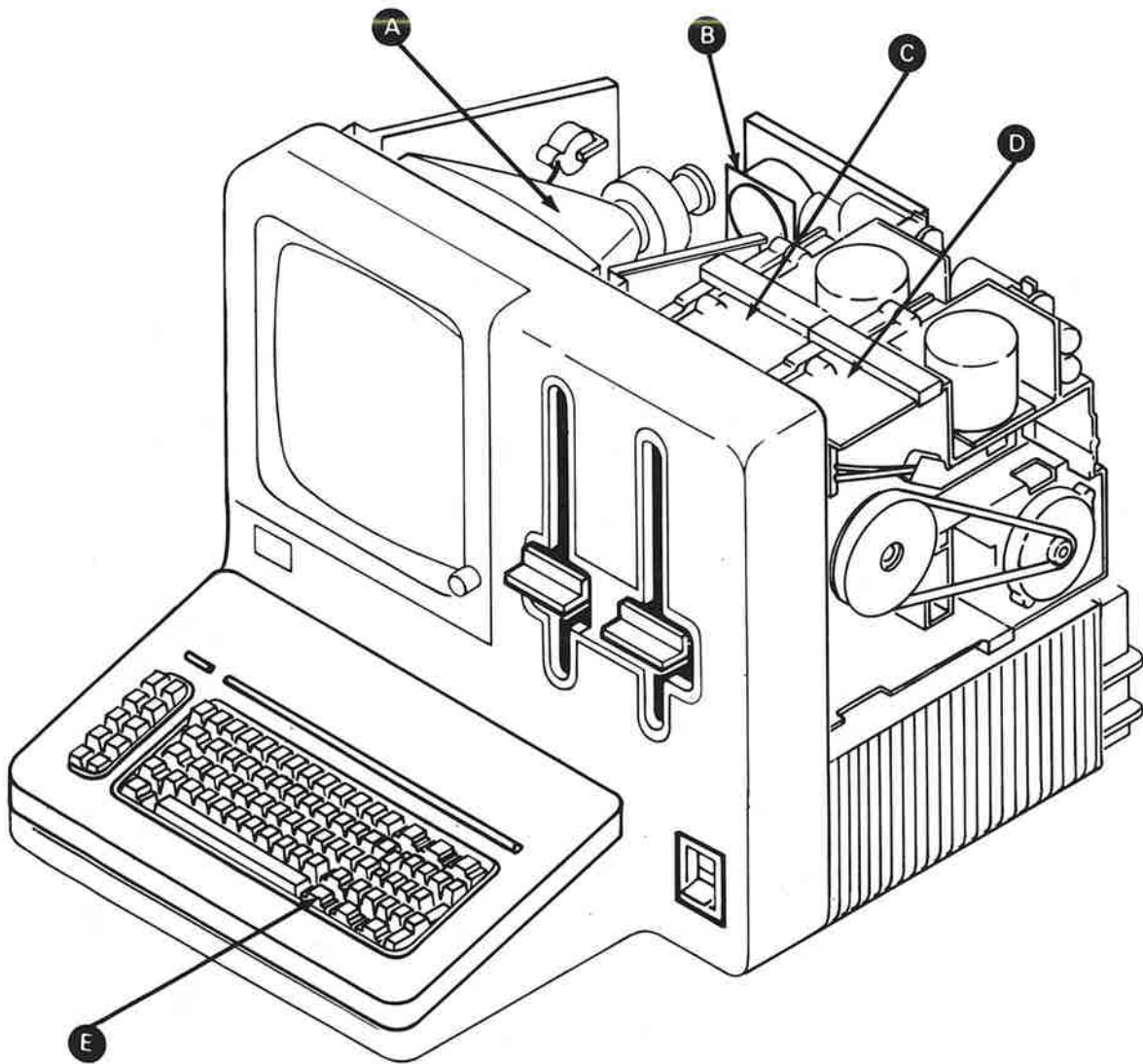
- A** Diskette drive 2
- B** Diskette drive 1
- C** CRT display unit
- D** Cooling fan
- E** I/O cable connectors
- F** CPU planar board drawer
- G** Power supply



1200 Locations

Functional units (front view)

- A** CRT display unit
- B** Cooling fan
- C** Diskette drive 1
- D** Diskette drive 2
- E** Keyboard

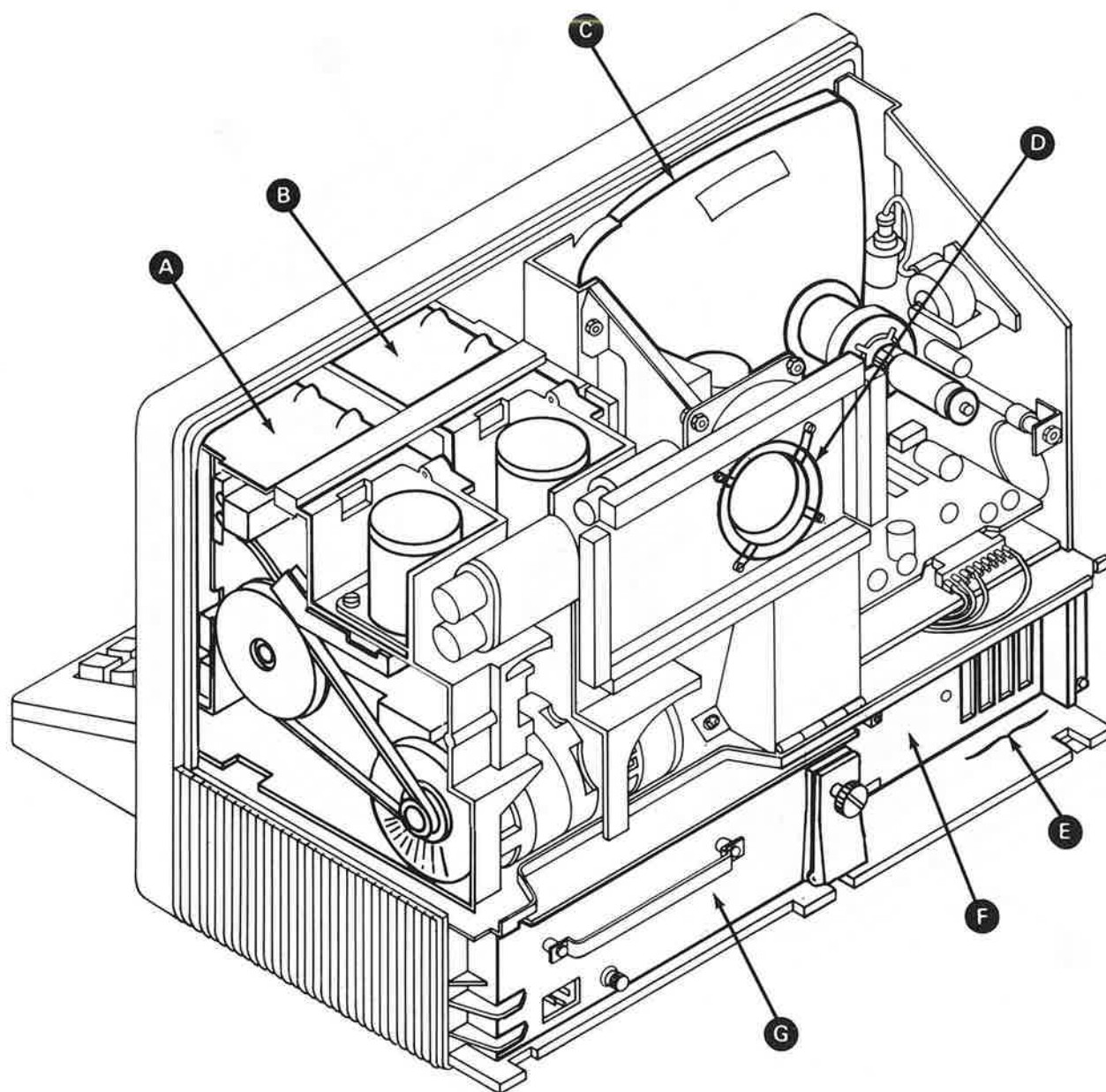


Maintenance procedures

1200 Locations (continued)

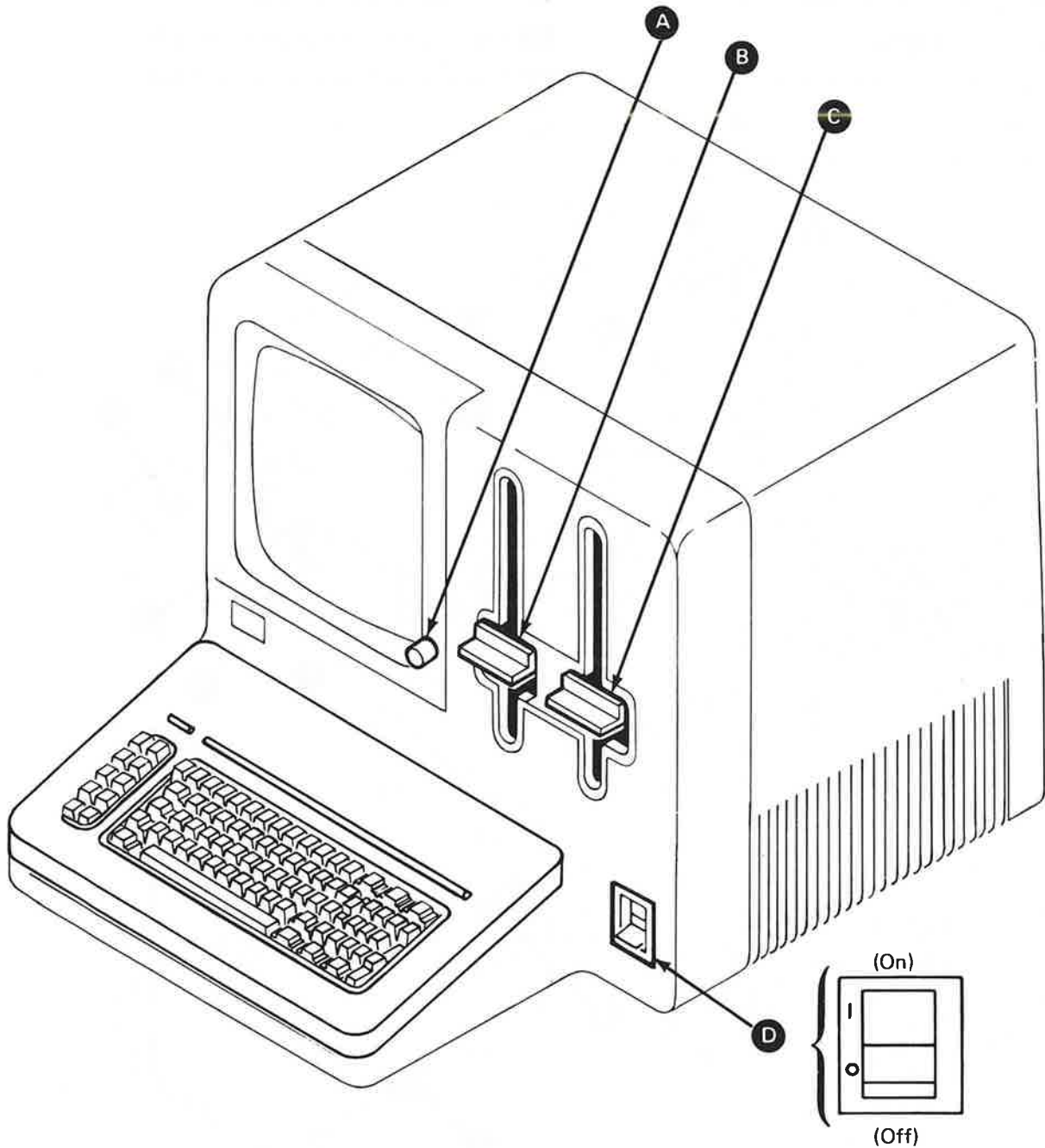
Functional units (rear view)

- | | |
|---------------------------|----------------------------------|
| A Diskette drive 2 | E I/O cable connectors |
| B Diskette drive 1 | F CPU planar board drawer |
| C CRT display unit | G Power supply |
| D Cooling fan | |



Operator switches and controls

- A** Display screen brightness control
- B** Diskette drive 1 latch
- C** Diskette drive 2 latch
- D** Power switch



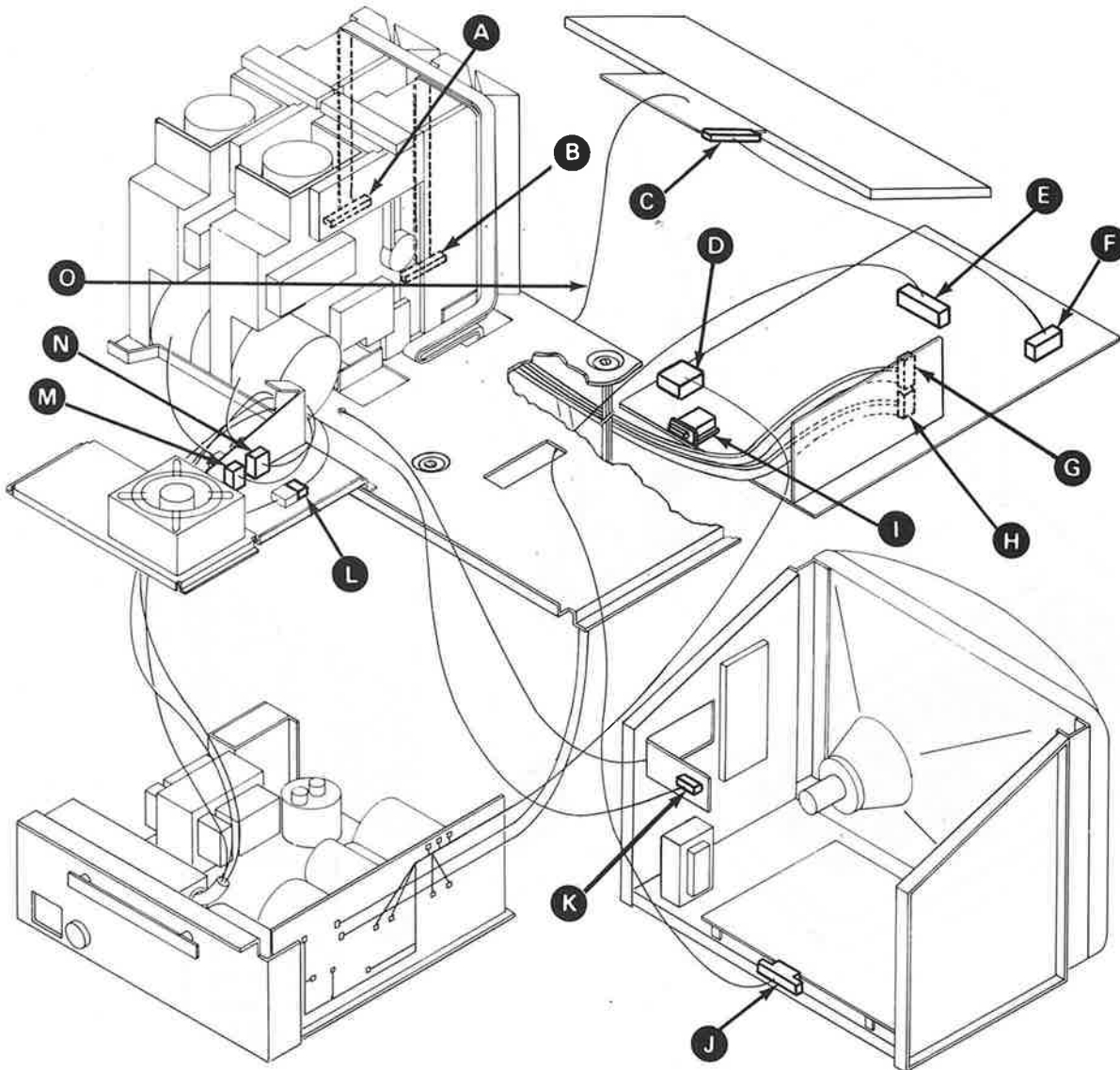
Processor
power supply

Maintenance procedures

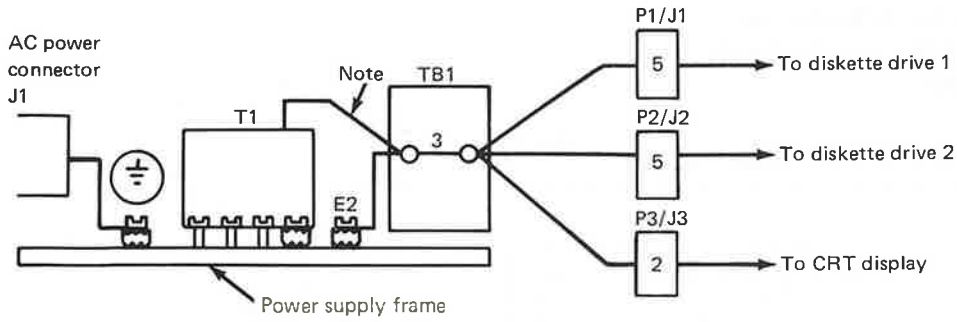
1200 Locations (continued)

Cables and connectors

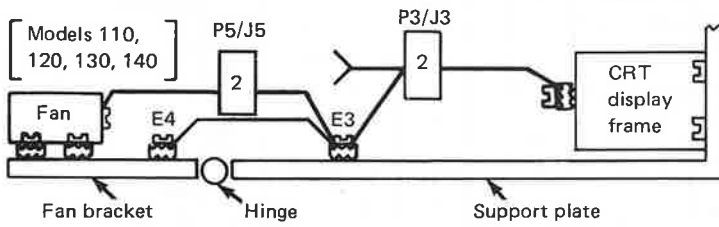
- A** Diskette drive 2 attachment cable connector
- B** Diskette drive 1 attachment cable connector
- C** Keyboard cable connector
- D** Planar board power connector P4/J4
- E** CRT/planar cable connector
- F** Keyboard/planar cable connector
- G** Diskette drive 1 attachment cable connector
- H** Diskette drive 2 attachment cable connector
- I** Printer port cable connector
- J** CRT signal cable connector
- K** CRT power connector P3/J3
- L** Fan power connector P5/J5
- M** Diskette drive 2 power connector P2/J2
- N** Diskette drive 1 power connector P1/J1
- O** Keyboard ground wire






AC safety ground locations

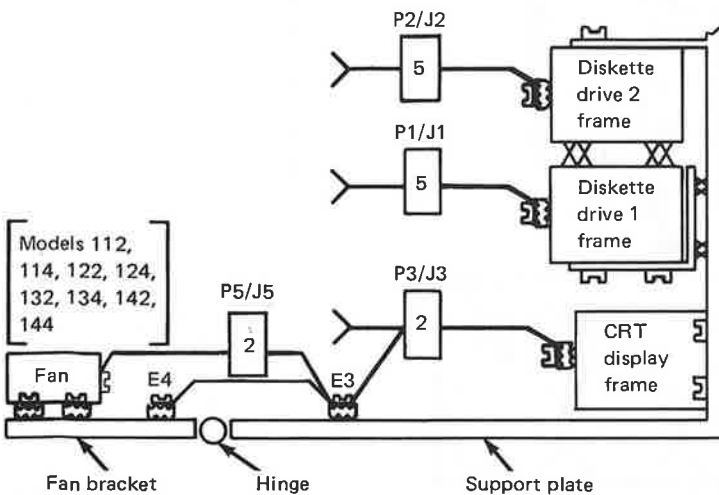
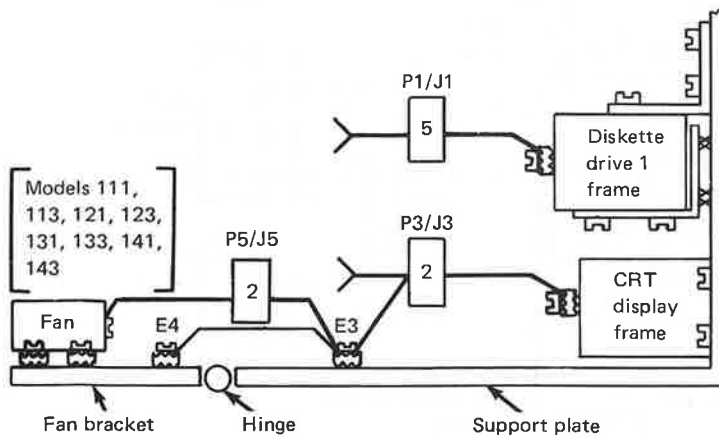


Note: 50-Hz GBG/I machines only



Grounding symbols:

-  = Screw and external-tooth starwasher
-  = Metal-to-metal contact via screw
-  = Metal-to-metal contact

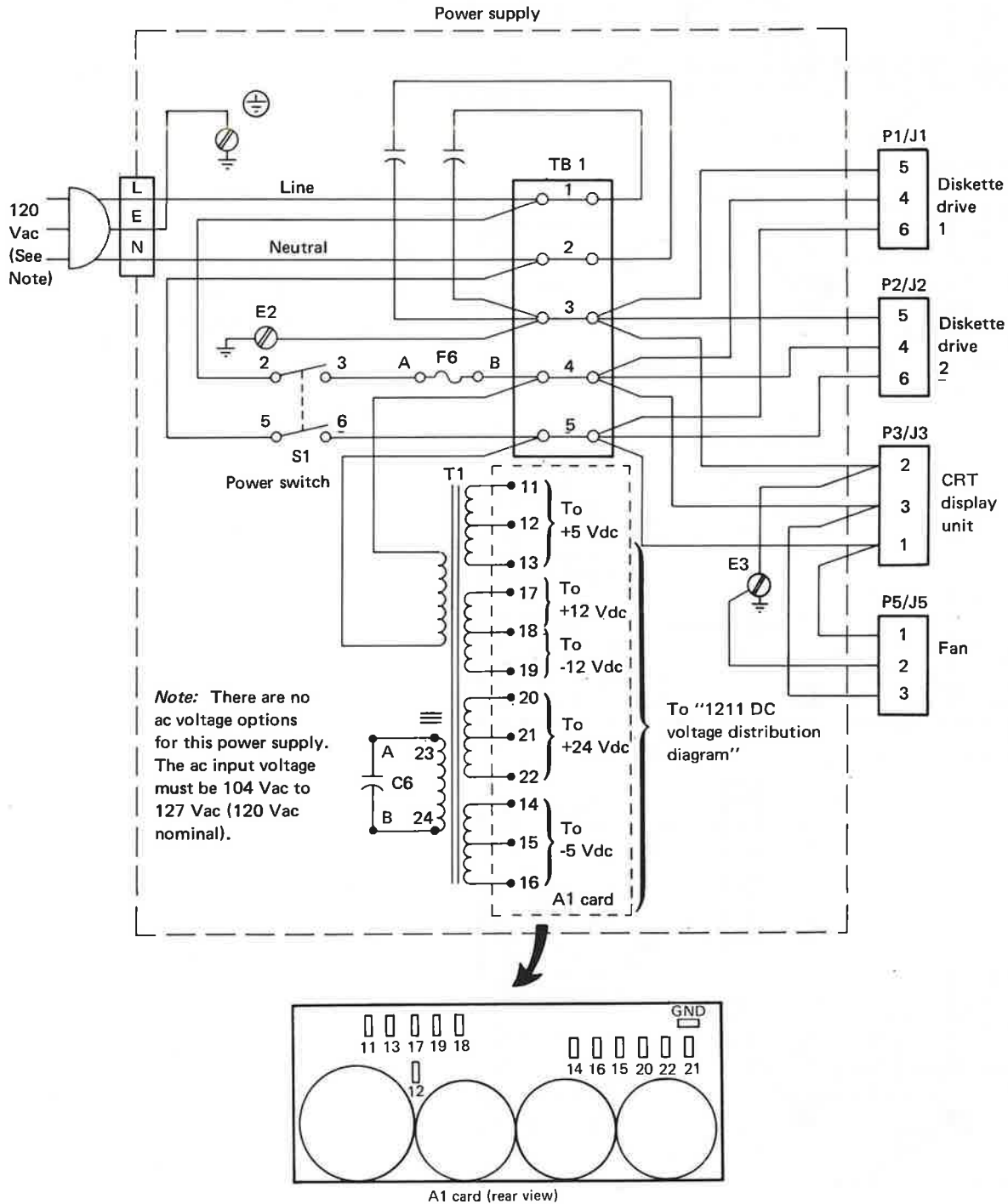


Maintenance procedures

1210 AC voltage distribution diagrams

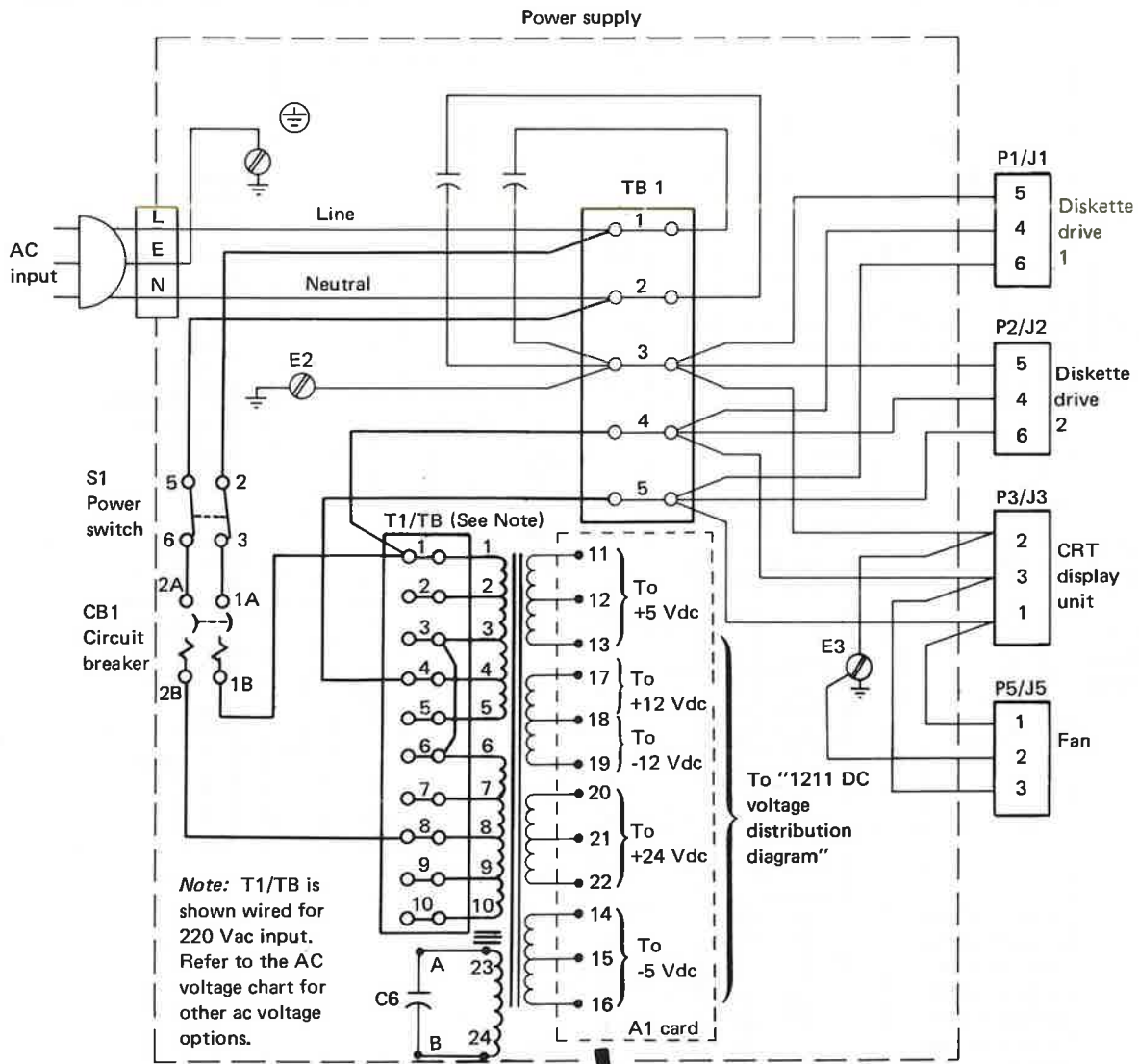
60-Hz power supply (Canada and U.S.)

This diagram is for power supply PN 6838279 *only*. If a power supply with a different part number is installed in the 5322, see the labels attached to that power supply.



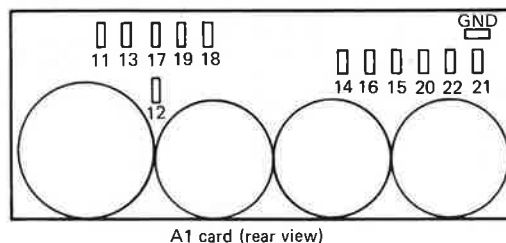
60-Hz power supply (GBG/I*)

This diagram is for power supply PN 6838280 *only*. If a power supply with a different part number is installed in the 5322, see the labels attached to that power supply.



AC voltage chart

AC input voltage	T1/TB line connection	T1/TB jumpers
100	1-7	1-6, 2-7, 4-9
110	1-8	1-6, 3-8, 4-9
120	1-9	1-6, 4-9
127	1-10	1-6, 5-10, 4-9
200/208	1-7	2-6
220	1-8	3-6
240	1-9	4-6



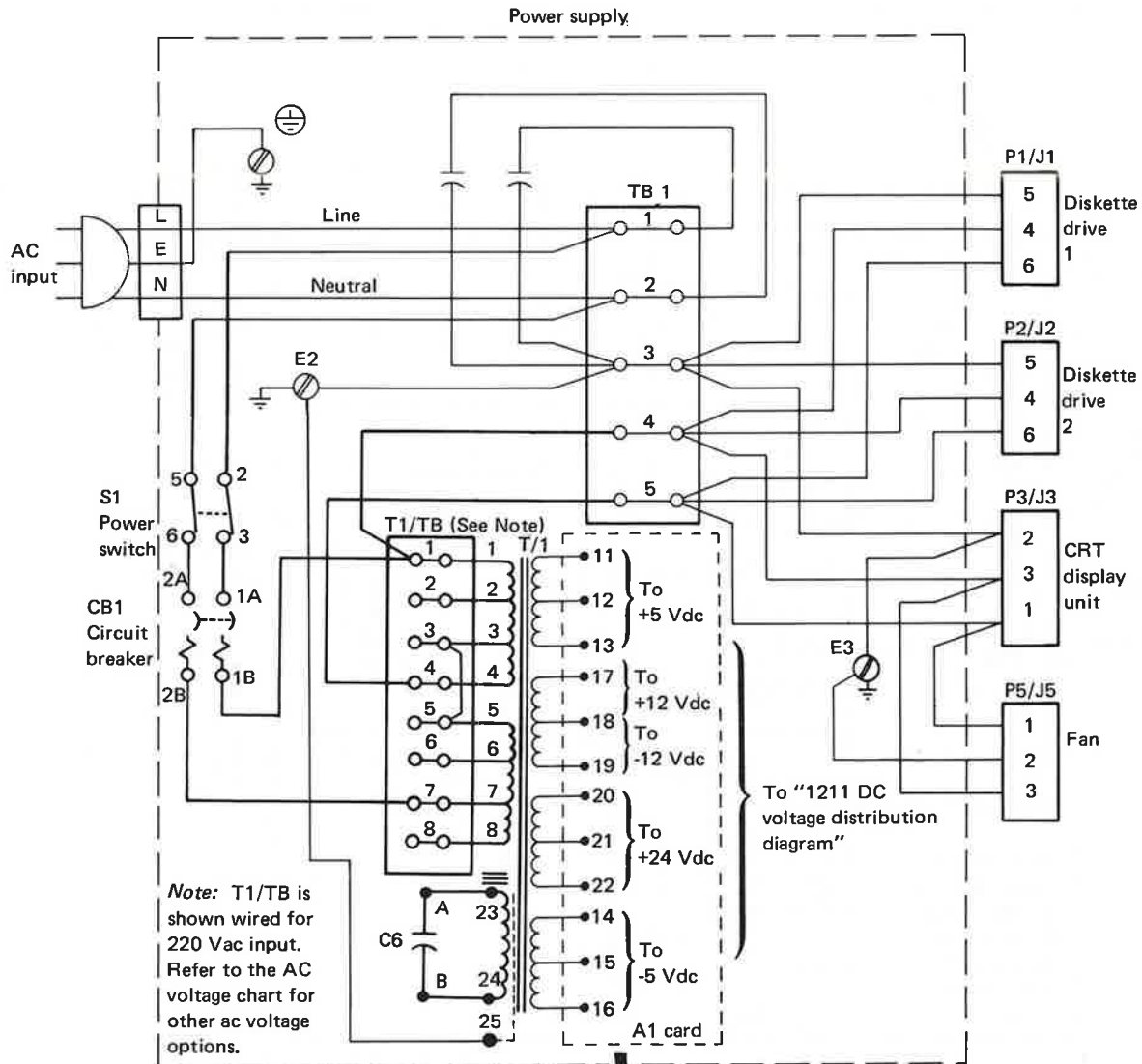
* GBG/I—General Business Group/International

Maintenance procedures

1210 AC voltage distribution diagrams (continued)

50-Hz power supply (GBG/I)

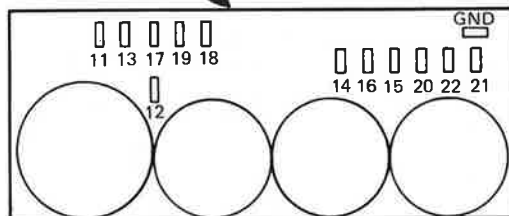
This diagram is for power supply PN 6838281 *only*. If a power supply with a different part number is installed in the 5322, see the labels attached to that power supply.



Note: T1/TB is shown wired for 220 Vac input. Refer to the AC voltage chart for other ac voltage options.

AC voltage chart

AC input voltage	T1/TB line connection	T1/TB jumpers
100	1-6	1-5, 2-6, 4-8
110	1-7	1-5, 3-7, 4-8
200	1-6	2-5
220	1-7	3-5
230	1-8	3-5
240	1-8	4-5

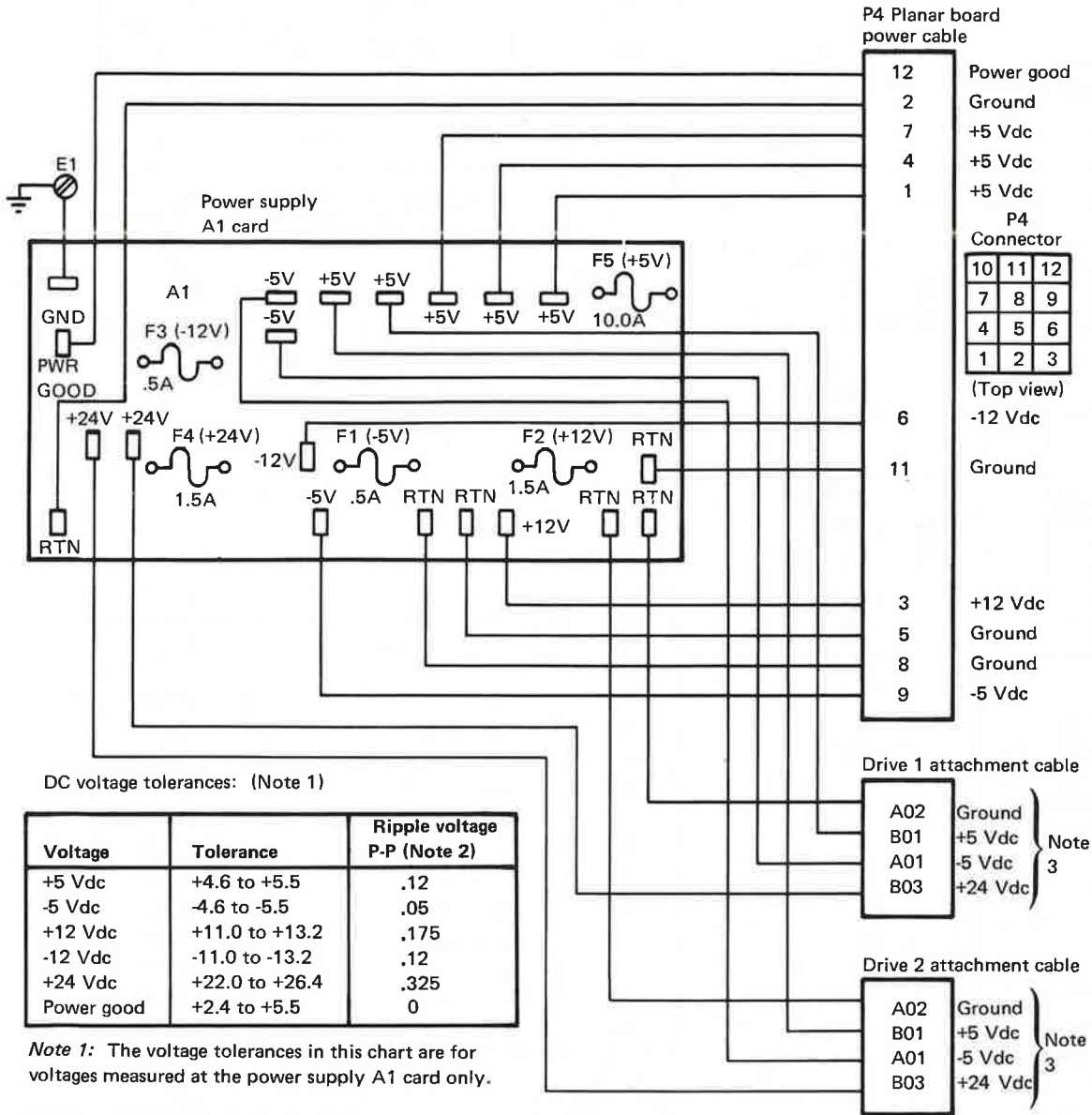


A1 card (rear view)

1211 DC voltage distribution diagram

This diagram is for power supplies PN 6838279, 6838280, and 6838281. If a power supply with a different part number is installed

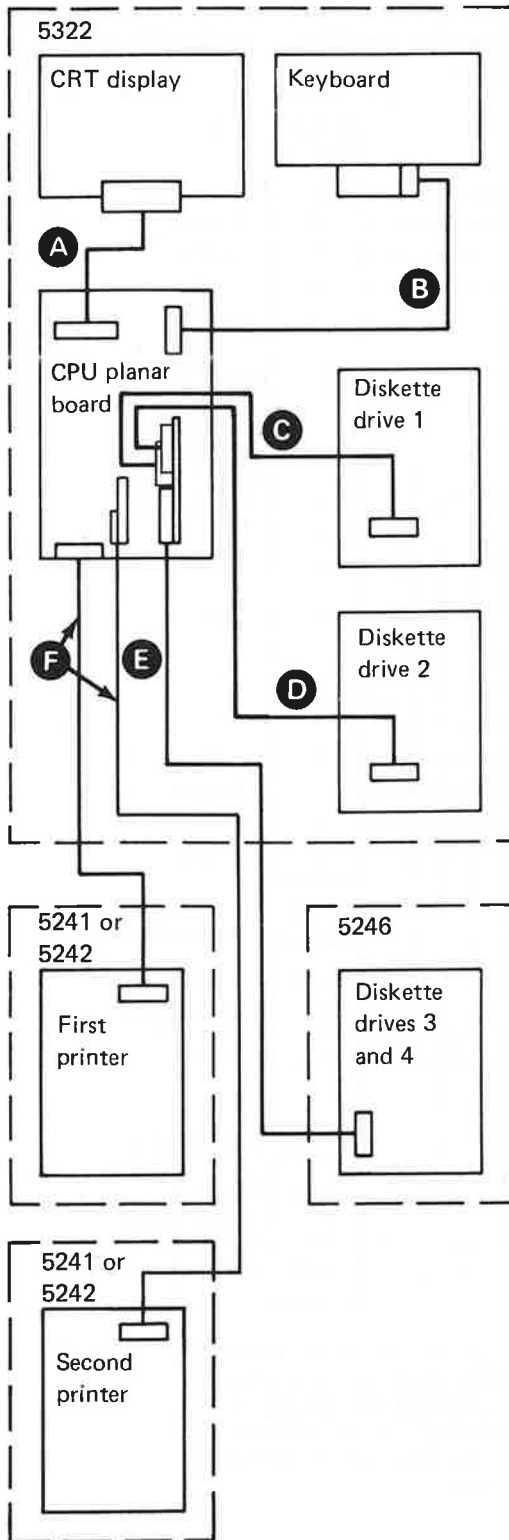
in the 5322, see the labels attached to that power supply for the locations of the voltage test points that are shown on the A1 card in this diagram.



Processor power supply

Maintenance procedures

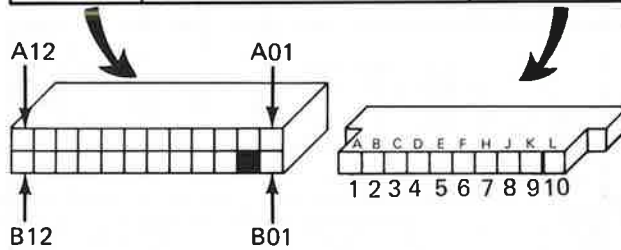
1212 Signal cable distribution diagram



A CRT display cable

CPU planar board CRT display

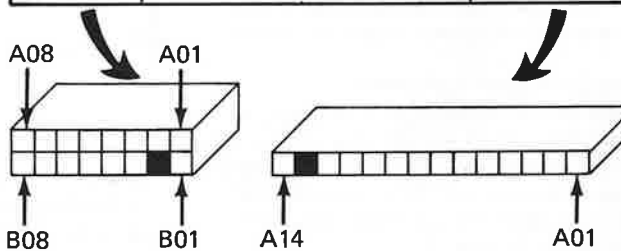
Pin	Line name	Pin
A05	Horizontal retrace return	A/1
A06	Video drive signal	J/8
A07	Vertical retrace return	L/10
B05	Horizontal retrace signal	F/6
B06	Video drive return	L/10
B07	Vertical retrace signal	K/9



B Keyboard cable

CPU planar board Keyboard

Pin	Line name	Pin
A02	Delay strobe	A09
A05	Scan code 0	A01
A06	+5 Vdc	A02
A07	Scan code 1	A03
A08	Ground	A04
B01	Programmed reset	A12
B03	Data strobe	A14
B04	Scan code 6	A10
B05	Scan code 5	A08
B06	Scan code 4	A07
B07	Scan code 3	A06
B08	Scan code 2	A05



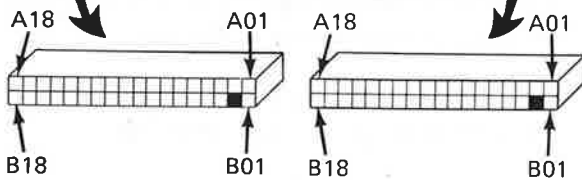
C D Diskette drive cable

(Diskette attachment card on CPU planar board)

Internal diskette drives

Pin	Line name	Pin
Not used	-5 Vdc *	A01
Not used	Ground *	A02
Not used	+5 Vdc *	B01
B03	+24 Vdc *	B03
A04		A04
Through	Ground (twisted pair)	Through
A17		A17
A18	Sense ground	A18
B04	Index	B04
B05	Diskette sense	B05
B06	Write/erase enabled	B06
B07	File data	B07
B08	Inner tracks	B08
B09	Erase gate	B09
B10	Access 0	B10
B11	Select head 1	B11
B13	Access 1	B13
B14	Write gate	B14
B15	Head engage	B15
B16	Switch filter	B16
B17	Write data	B17

*From power supply A1 card



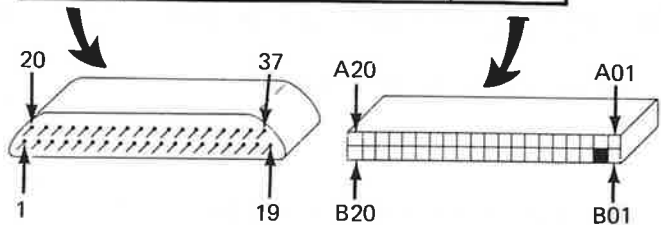
E 5246 diskette drive cable

(Diskette attachment card on CPU planar board)

5246 MPX card

Pin	Line name	Pin
1	Load access	B10
2	Drive 3/4 write data	B01
3	Drive 3/4 access 0	B03
4	Drive 3/4 access 1	B09
5	Inner tracks	B14
6	Drive 3/4 head engage	B08
7	Drive 3/4 diskette sense	B11
8	Switch filter	B13
9	Read/write drive 4	B05
10	Drive 3 attached	B06
11	Seek drive 4	B04
12	Drive 4 index	B12
13	Select head 1	B15
14	Drive 3 index	B17
15	Drive 3/4 file data	B16
16	Not used	
17	Drive 3/4 current enabled	B07
18	Drive 3/4 erase gate	B19
19	Drive 3/4 write gate	B18
-	Port 1 attached/port 2 attached	B20*
-	+5 Vdc	A02
20	Ground (twisted pair)	A01
Through		A03
37		Through
		A20

*A jumper is installed between A20 and B20

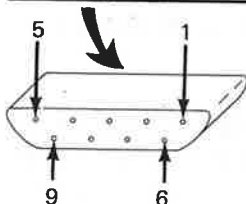


F 5241 or 5242 printer cable

(CPU 1st or 2nd printer port)

Printer

Pin	Line name	Pin
1	Xmit printer data return	*
2	Xmit printer data	*
3	Rcv printer data	*
4	Rcv printer data return	*
5	Ground	*
6	Ground	*
7	Printer baud rate 1	*
8	Printer baud rate 2	*
9	Printer baud rate 4	*



*Refer to printer service manual

Maintenance procedures

1220 Covers

Keyboard cover removal and replacement

1. Switch off the 5322 power.
2. Remove the two cover screws **K**.
3. Lift the front edge of the keyboard cover **C** and pull the cover toward the front of the 5322.
4. Install the cover by reversing the order of the removal procedure.

Rear access cover removal and replacement

1. Switch off the 5322 power.
2. Pull the rear access cover **F** toward the rear of the 5322 until the pressure latches release the cover.
3. Install the cover by reversing the order of the removal procedure.

Top cover removal and replacement

1. Switch off the 5322 power.
2. Remove the rear access cover **F**.
3. Remove the two cover screws **A**.
4. Pull the top cover **B** toward the rear of the 5322 to disengage the front locating tabs, and then remove the cover.
5. Install the cover by reversing the order of the removal procedure.

Front cover removal and replacement

1. Switch off the 5322 power.
2. Remove the rear access cover **F**, the top cover **B**, and the keyboard cover **C**.
3. Remove the keyboard (1330).

DANGER

Up to 800 Vac is generated in the power supply. Ensure that the power cable is disconnected from the ac service outlet.

4. Place the power supply in the service position (1240, 1250, or 1260).
5. Place the planar board in the service position (1230).
6. Remove the CRT display brightness control knob by pulling it from the control shaft. When replacing the control knob, observe that it has a key that aligns with the control shaft.
7. Turn the diskette latches to the horizontal position.
8. Remove the five screws **D** that hold the front cover **E** to the 5322 main support plate and center bracket. These five screws are located on the rear of the front cover.
9. Remove the 11 screws **G** that hold the front cover to the bottom cover **H**.
10. Remove the front cover by pulling it toward the front of the 5322. Ensure that the diskette latches do not bind in the cover openings.
11. Install the front cover by reversing the order of the removal procedure.

Bottom cover removal and replacement

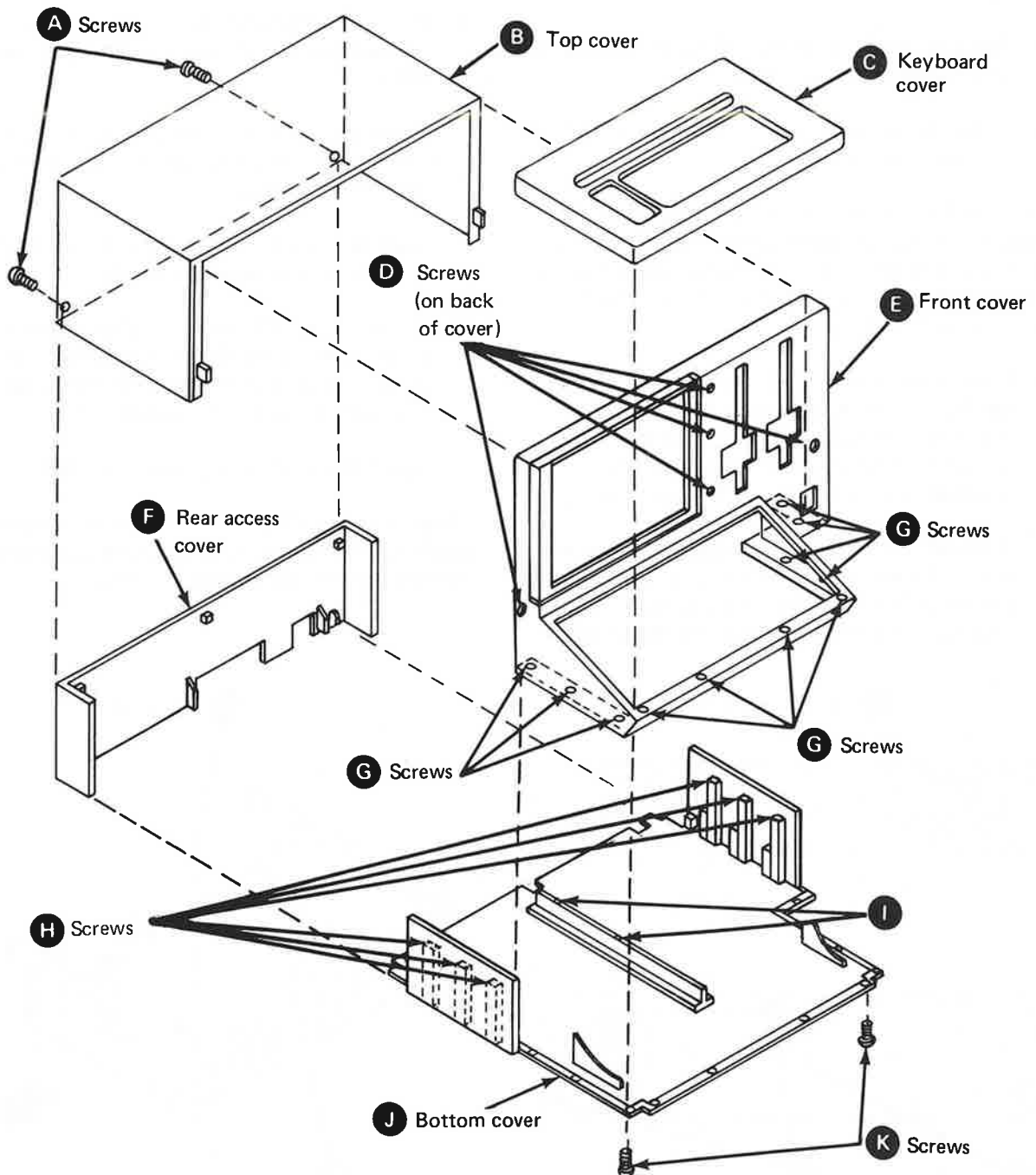
1. Switch off the 5322 power.
2. Remove the rear access cover **F**, the top cover **B**, the keyboard cover **C**, and the front cover **E**.
3. Remove the two screws **I** that hold the center support bracket to the bottom cover **J**.

4. Remove the six screws **H** that hold the bottom cover to the 5322 main support plate.

5. Place the new bottom cover next to the old cover. Lift the 5322 from the old cover and carefully place it into position in the new cover.

Note: In step 5, aid is needed to move the power supply and planar board assemblies while the 5322 is moved from the old cover to the new cover.

6. Assemble the 5322 and covers by reversing the order of the removal procedure.



Maintenance procedures

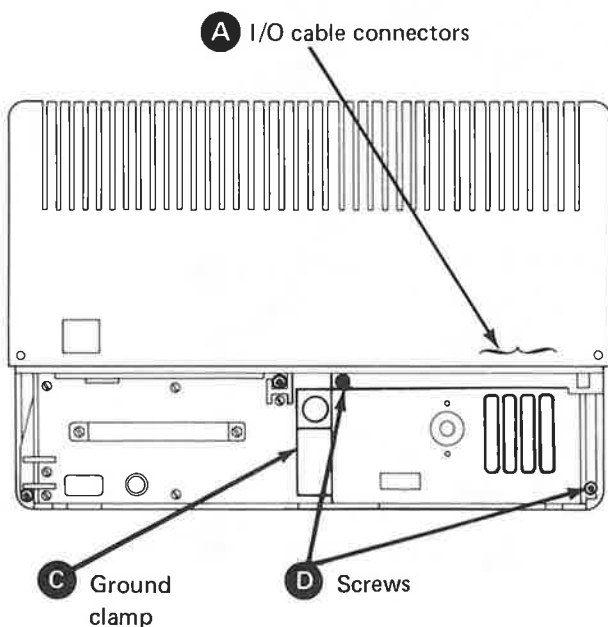
1230 CPU planar board

Removal

1. Switch off the 5322 power.
2. Remove the 5322 rear access cover (1220).
3. Disconnect any I/O device cables that are connected to the I/O cable ground clamp **C**.
4. Remove the two screws **D** from the rear of the planar board drawer.
5. Slide the planar board drawer **E** out to the service position.

Note: When the drawer is in the service position, the attachment cards, cables, CE test pins, and feature jumper pins are accessible. If a new planar board is being installed, continue with the following steps:

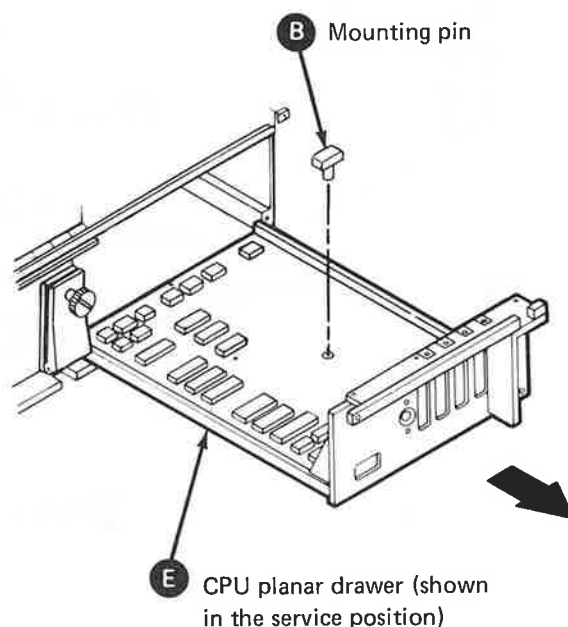
6. Label and remove all I/O attachment cards **H**, R/W storage cards **G**, and cables from the planar board and the I/O cable connectors **A**. See the planar board diagram for card and cable locations.
7. Remove the mounting pin **B** that holds the planar board to the drawer and remove the planar board. (The mounting pin can be pushed up from the bottom of the drawer.)



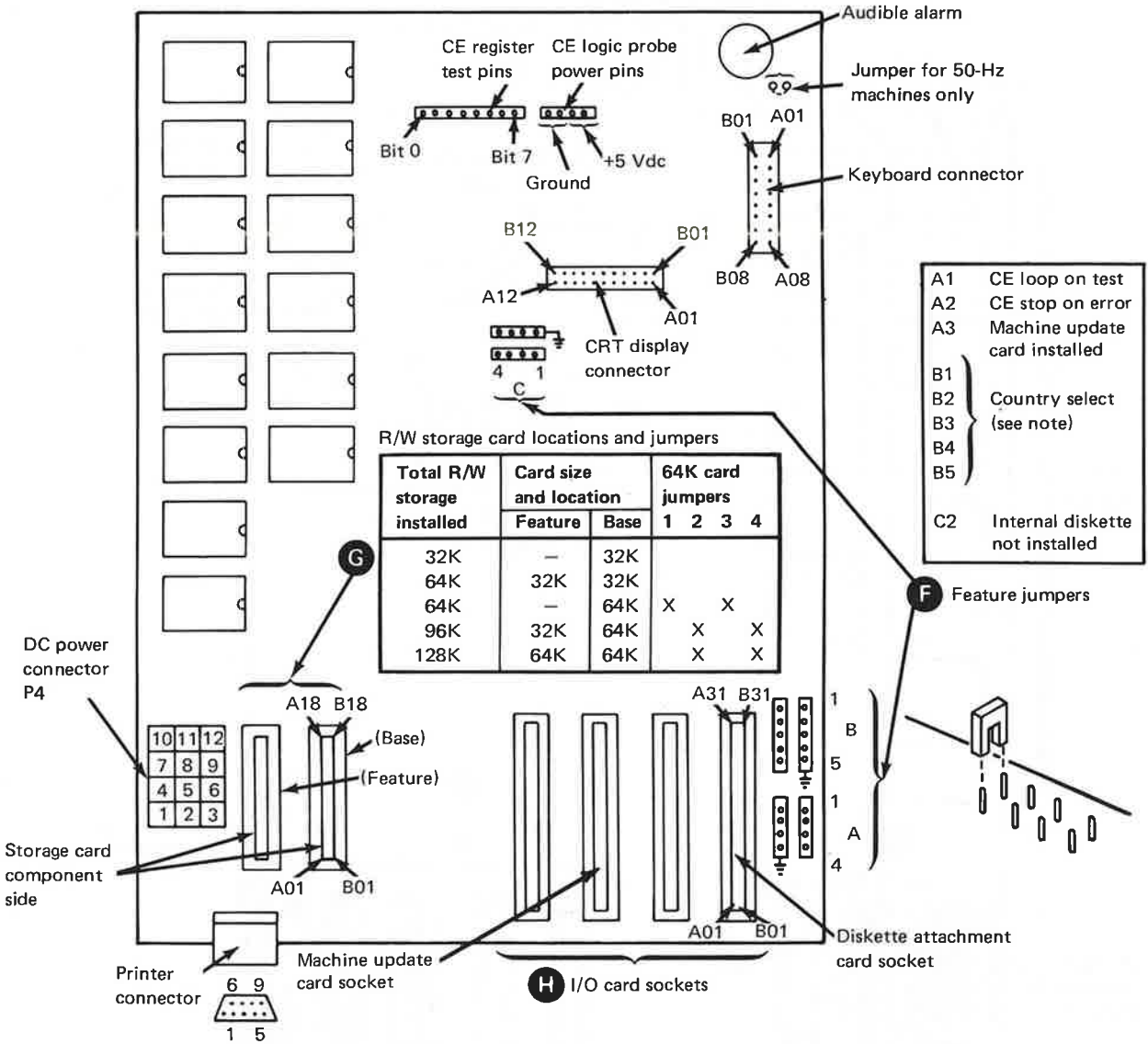
Replacement

1. Remove any feature jumpers **F** from the old planar board and install them on the *same* pin positions on the new board.
2. Place the new planar board into the drawer and install the mounting pin **B**.
3. Install the attachment and read/write storage cards that were removed from the old board.
4. Place the drawer in the service position and connect all cables to the planar board and attachment cards.
5. Slide the planar drawer **E** into the 5322 and install the two screws **D**.
6. Connect the I/O device cables to the I/O cable connectors **A** and clamp the cable ground shields in the ground clamp **C** on the rear of the power supply.
7. Install the rear access cover (1220).

Note: If a new CPU planar board is installed, check the display unit "Horizontal centering potentiometer" adjustment (1440).



CPU planar board diagram



Note: Install jumpers as indicated by a "1" for country select.

Country	B1	B2	B3	B4	B5	Country	B1	B2	B3	B4	B5
Austria/Germany	1	0	0	0	0	Japan	0	0	0	0	1
Belgium	1	0	0	1	0	Norway	1	1	1	0	0
Belgium (French)	0	1	1	1	0	Spain/Spanish	1	1	0	0	0
Canada (French)	0	1	1	0	0	Sweden	1	1	0	1	0
Denmark	1	0	1	1	0	Switzerland (French)	0	1	0	1	0
Finland	1	1	1	1	0	Switzerland (German)	1	0	1	0	0
France	0	0	0	1	0	United Kingdom	0	0	1	0	0
International	0	0	1	1	0	United States	0	0	0	0	0
Italy	0	1	0	0	0						

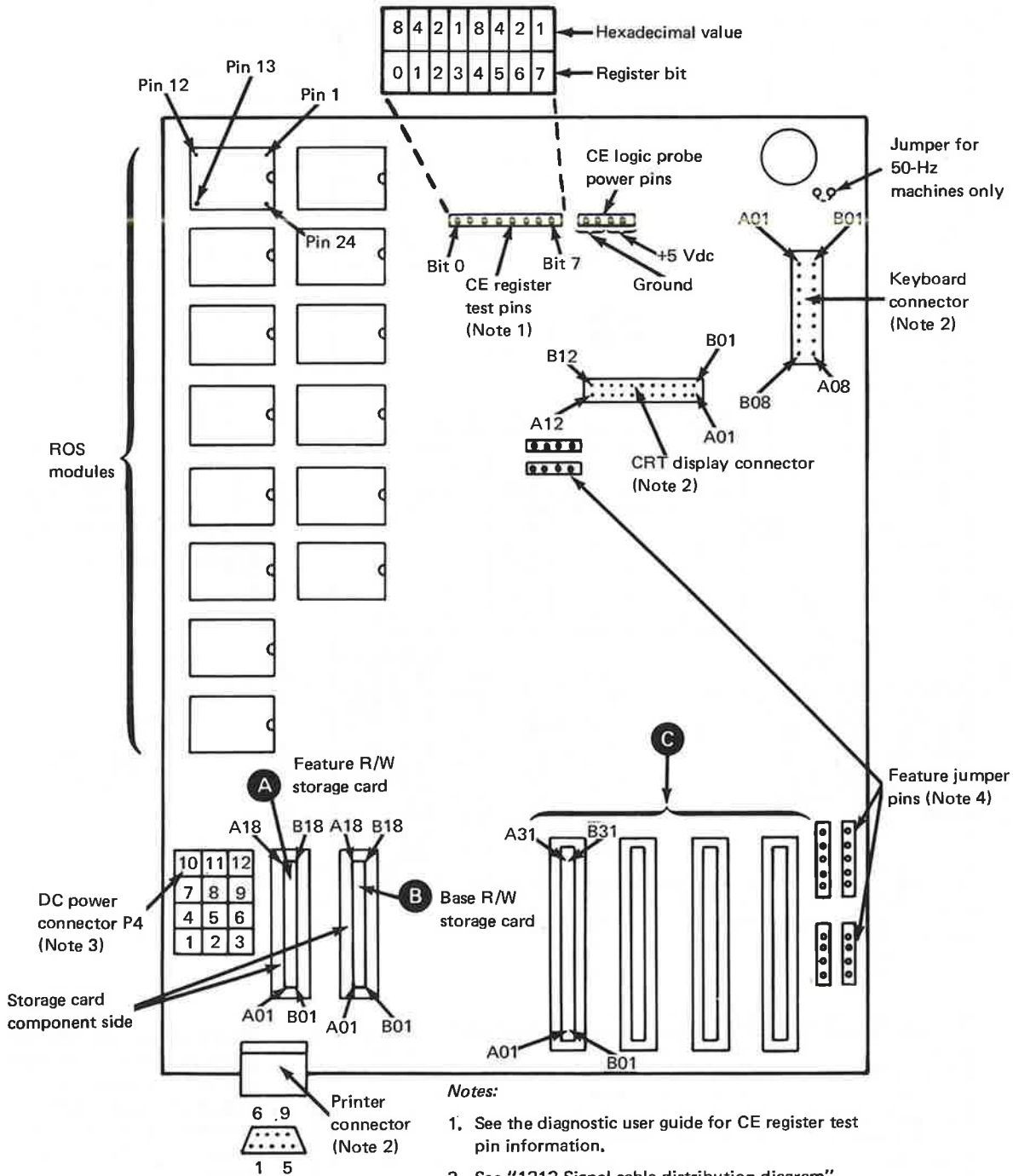
WARNING: There are additional jumper pins on the planar board that are not shown in this diagram; these pins are for manufacturing use only and are not jumpered for normal operation.

Processor power supply

Maintenance procedures

1230 CPU planar board (continued)

CPU planar board connector pin assignments



A Feature R/W storage card socket

Pin	Line name	Pin	Line name
A01	Storage data bit 4	B01	Storage data bit 3
A02	Storage data bit 2	B02	Storage data bit 1
A03	Storage data bit 0	B03	Column address strobe 2
A04	Not used	B04	Row address strobe 1
A05	Storage 2 64K	B05	Row address strobe 1
A06	Write enable	B06	Row address strobe 1
A07	Column address strobe 3	B07	Row address strobe 1
A08	Storage address bit 1	B08	Not used
A09	Ground	B09	Not used
A10	-5 Vdc	B10	Ground
A11	+12 Vdc	B11	Storage 2 installed
A12	Storage address bit 2	B12	Storage address bit 5
A13	Storage address bit 0	B13	Storage address bit 4
A14	Storage address bit 6	B14	Storage address bit 3
A15	Column address strobe 6	B15	+5 Vdc
A16	Column address strobe 7	B16	Not used
A17	Storage data bit 6	B17	Storage data bit 5
A18	Storage data bit P	B18	Storage data bit 7

B Base R/W storage card socket

Pin	Line name	Pin	Line name
A01	Storage data bit 4	B01	Storage data bit 3
A02	Storage data bit 2	B02	Storage data bit 1
A03	Storage data bit 0	B03	Column address strobe 0
A04	Column address strobe 2	B04	Row address strobe 1
A05	Storage 1 64K	B05	Row address strobe 1
A06	Write enable	B06	Row address strobe 0
A07	Column address strobe 1	B07	Row address strobe 1
A08	Storage address bit 1	B08	Not used
A09	Ground	B09	Column address strobe 3
A10	-5 Vdc	B10	Ground
A11	+12 Vdc	B11	Storage 1 installed
A12	Storage address bit 2	B12	Storage address bit 5
A13	Storage address bit 0	B13	Storage address bit 4
A14	Storage address bit 6	B14	Storage address bit 3
A15	Column address strobe 4	B15	+5 Vdc
A16	Column address strobe 5	B16	Not used
A17	Storage data bit 6	B17	Storage data bit 5
A18	Storage data bit P	B18	Storage data bit 7

C I/O card sockets

Pin	Line name	Pin	Line name
A01	I/O check	B01	Ground
A02	Data bus bit 7	B02	Reset I/O
A03	Data bus bit 6	B03	+5 Vdc
A04	Data bus bit 5	B04	Not used
A05	Data bus bit 4	B05	-5 Vdc
A06	Data bus bit 3	B06	-DMA request 0
A07	Data bus bit 2	B07	-12 Vdc
A08	Data bus bit 1	B08	Advance storage read
A09	Data bus bit 0	B09	+12 Vdc
A10	I/O ready	B10	I/O cycle
A11	I/O address enable	B11	Storage write to I/O
A12	Page bit 3	B12	Storage read to I/O
A13	Page bit 2	B13	I/O write
A14	Page bit 1	B14	I/O read
A15	Page bit 0	B15	DMA acknowledge 3
A16	Address bus bit 15	B16	DMA request 3
A17	Address bus bit 14	B17	DMA acknowledge 1
A18	Address bus bit 13	B18	DMA request 1
A19	Address bus bit 12	B19	+DMA acknowledge 0
A20	Address bus bit 11	B20	DMA request 0
A21	Address bus bit 10	B21	TP tx interrupt
A22	Address bus bit 9	B22	TP rec interrupt
A23	Address bus bit 8	B23	Interrupt request 5
A24	Address bus bit 7	B24	Diskette interrupt
A25	Address bus bit 6	B25	Interrupt request 3
A26	Address bus bit 5	B26	Not used
A27	Address bus bit 4	B27	Terminal count
A28	Address bus bit 3	B28	I/O address latch enable
A29	Address bus bit 2	B29	+5 Vdc
A30	Address bus bit 1	B30	Clock to I/O
A31	Address bus bit 0	B31	Ground

Processor
power supply

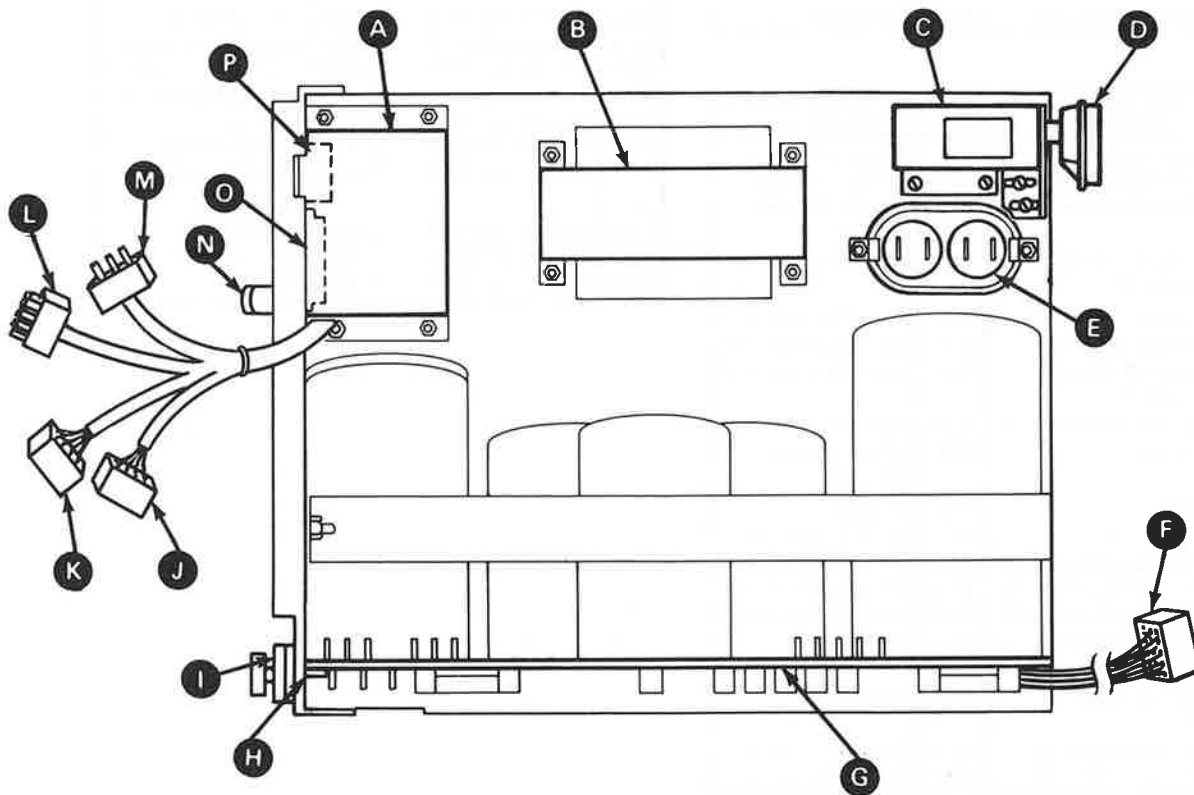
Maintenance procedures

1240 60-Hz power supply (Canada and U.S.)

Layout diagram

This diagram is for power supply PN 6838279 *only*. If a power supply with a different part number is installed in the 5322, see the labels attached to that power supply for locations.

- | | |
|---------------------------------|---------------------------------|
| A AC distribution box | I I/O cable ground clamp |
| B Transformer T1 | J AC power plug P1 |
| C AC power switch box | K AC power plug P2 |
| D AC power On/Off switch | L AC power plug P3 |
| E Resonant capacitor C6 | M AC power plug P5 |
| F DC power plug P4 | N AC input fuse F6 |
| G A1 card assembly | O Terminal block TB1 |
| H Power-good LED | P Power cable jack J1 |



Power supply (top view)

DANGER

Up to 800 Vac is generated in the power supply. Before removing the power supply or any power supply part, switch off the 5322 power and disconnect the power cable from the ac service outlet.

Removal

1. Switch off the 5322 power. Disconnect the power cable from the ac service outlet and from the power supply jack J1 **B**.
2. Remove the 5322 rear access cover and top cover (1220).
3. Open the ground clamp **D** and remove the I/O cables from the clamp.
4. Remove the two screws **A** from the rear of the power supply.
5. Slide the power supply **C** out from the rear of the 5322.
6. The power supply is now in the service position. If it is necessary to switch on the 5322 power with the power supply in this service position, use the CE meter (ohms RX1 scale) to first ensure that grounding continuity exists between the 5322 main base plate and the power supply frame.

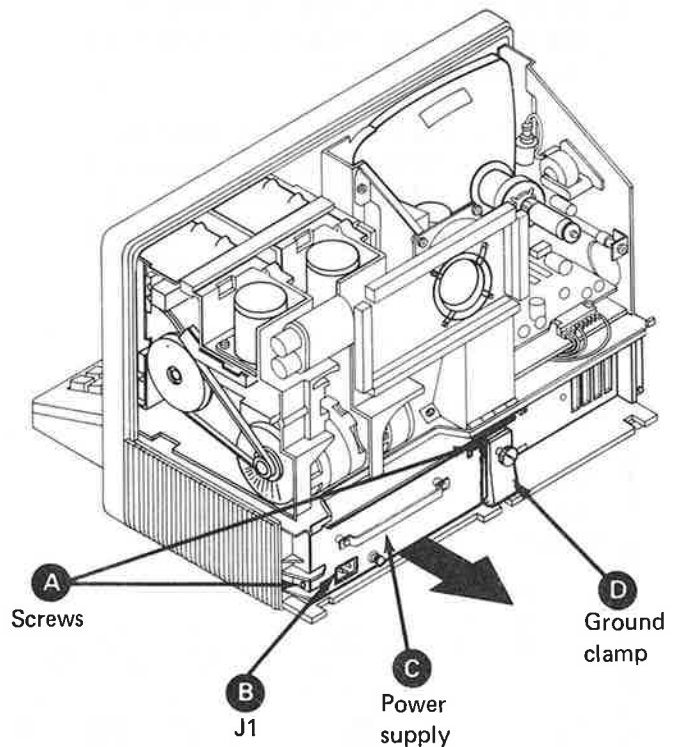
Note: When the power supply is in the service position, the fuses, voltage test points, power supply parts, and power switch are accessible. To remove the power supply completely, continue with the following steps:

7. Disconnect the cable plugs P1 through P5 from the connectors in the 5322 (1200).
8. Label and then disconnect the voltage wires of the diskette drive attachment cable(s) from the +5 Vdc, -5 Vdc, +24 Vdc, and ground terminals on the power supply (1211).

Note: If removal of the power supply cables from the 5322 required removing the cable ties, ensure that these cable ties are replaced.

Replacement

1. If cable plugs P1 through P5 and the diskette drive attachment cable(s) were disconnected during the removal procedure, reconnect these cables.
2. Slide the power supply **C** into the 5322 and install the two screws **A**.
3. Place the I/O cable ground shields in the ground clamp **D** and close and tighten the clamp.
4. Install the 5322 top cover and rear access cover (1220).
5. Connect the ac power cable to the power supply jack J1 **B**.



Maintenance procedures

1241 Fuses (60-Hz power supply, Canada and U.S.)

DANGER

Up to 800 Vac is generated in the power supply. Before removing the power supply or any power supply part, switch off the 5322 power and disconnect the power cable from the ac service outlet.

Note: The diagram at the bottom of this page shows the fuse locations for power supply PN 6838279. If a power supply with a different part number is installed in the 5322, see the labels attached to that power supply for the fuse locations.

F1-F5 removal and replacement

1. Switch off the 5322 power and disconnect the power cable from the ac service outlet.
2. Place the power supply in the service position (1240).
3. To remove a fuse from the power supply, use a fuse puller. Fuses 1 through 5 are identified as follows:

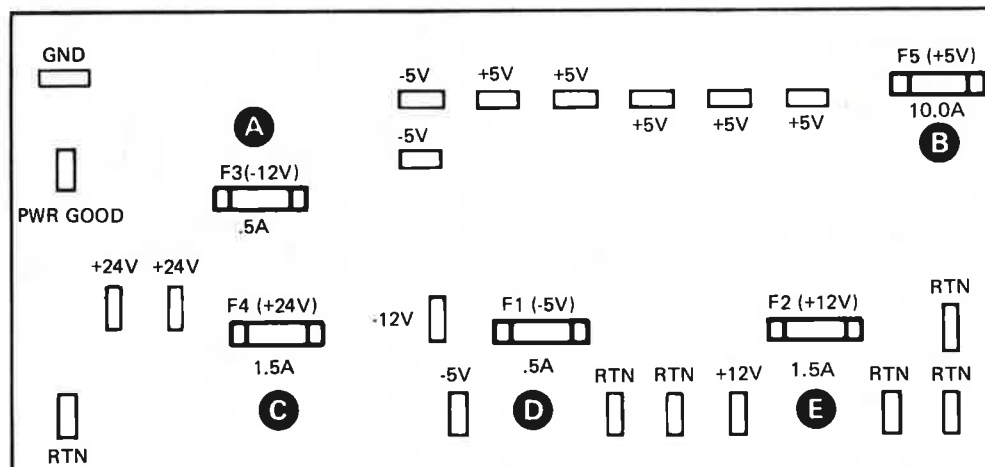
- F1 is the -5 Vdc fuse (0.5 ampere) **D**
- F2 is the +12 Vdc fuse (1.5 amperes) **E**
- F3 is the -12 Vdc fuse (0.5 ampere) **A**
- F4 is the +24 Vdc fuse (1.5 amperes) **C**
- F5 is the +5 Vdc fuse (10 amperes) **B**

Warning: Never replace a fuse with one of a higher ampere rating. Machine circuit damage can occur.

4. Install the fuse and power supply by reversing the order of the removal procedure.

F1-F5 service check

1. Remove the fuse from the power supply.
2. Use the CE meter set to the ohms RX1 position to check fuse continuity. If the meter does not indicate a short circuit (0 ohms), install a new fuse of the same ampere rating.



Power supply A1 card

DANGER

AC line voltage is located in the fuse socket. Before removing the fuse, switch off the 5322 power and disconnect the power cable from the ac service outlet.

Warning: Never replace a fuse with one of a higher ampere rating. Machine circuit damage can occur.

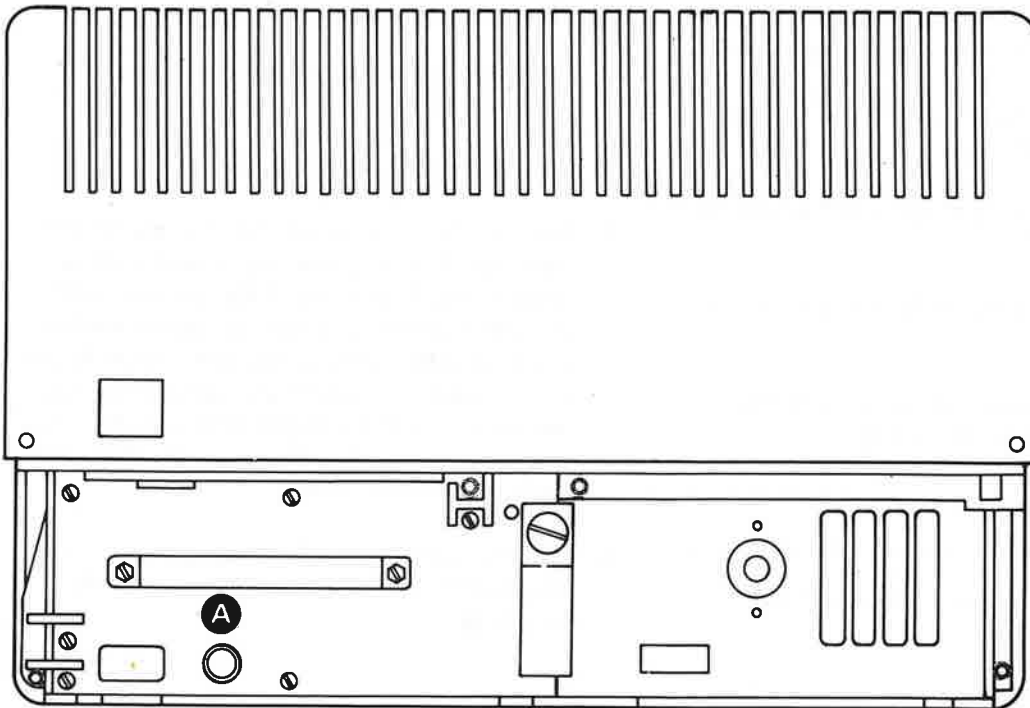
5. Install the fuse and rear access cover by reversing the order of the removal procedure.

F6 removal and replacement

1. Switch off the 5322 power and disconnect the power cable from the ac service outlet.
2. Remove the 5322 rear access cover (1220).
3. Turn the fuse holder cap **A** counterclockwise and remove the cap and the fuse.

F6 service check

1. Remove the fuse from the 5322.
2. Use the CE meter set to the ohms RX1 position to check the fuse continuity. If the meter does not indicate a short circuit (0 ohms), install a new fuse of the same ampere rating (5 amperes, slow-blow).



Rear view

Maintenance procedures

1245 Power switch (60-Hz power supply, Canada and U.S.)

DANGER

AC line voltage is located on the power switch terminals even when the switch is in the off position. Before removing the power supply and the switch, disconnect the power cable from the ac service outlet.

Note: The power switch maintenance procedures on this page are for power supply PN 6838279 *only*. If a power supply with a different part number is installed in the 5322, the power switch is not replaceable; replace the power supply.

Removal

1. Switch off the 5322 power and disconnect the power cable from the ac service outlet.
2. Place the power supply in the service position (1240).
3. Remove the two screws **H** and the switch cover **G**.
4. Remove the two screws **C** and the power switch **A**.
5. Label and disconnect the four wires from the switch terminals **I** and **J**.

Replacement

1. Connect the four wires to the switch terminals **I** and **J**.
2. Position the switch in the switch bracket and install the two screws **C**.
3. Install the switch cover **G** and the two screws **H**. Before tightening the screws, ensure that the grommet is positioned in the opening at the rear of the switch cover.
4. Slide the power supply into the 5322. If the switch bezel does not align with the opening in the 5322 front cover, loosen the

screws **B** and **D** and realign the switch bracket **E** and the mounting bracket **F**.

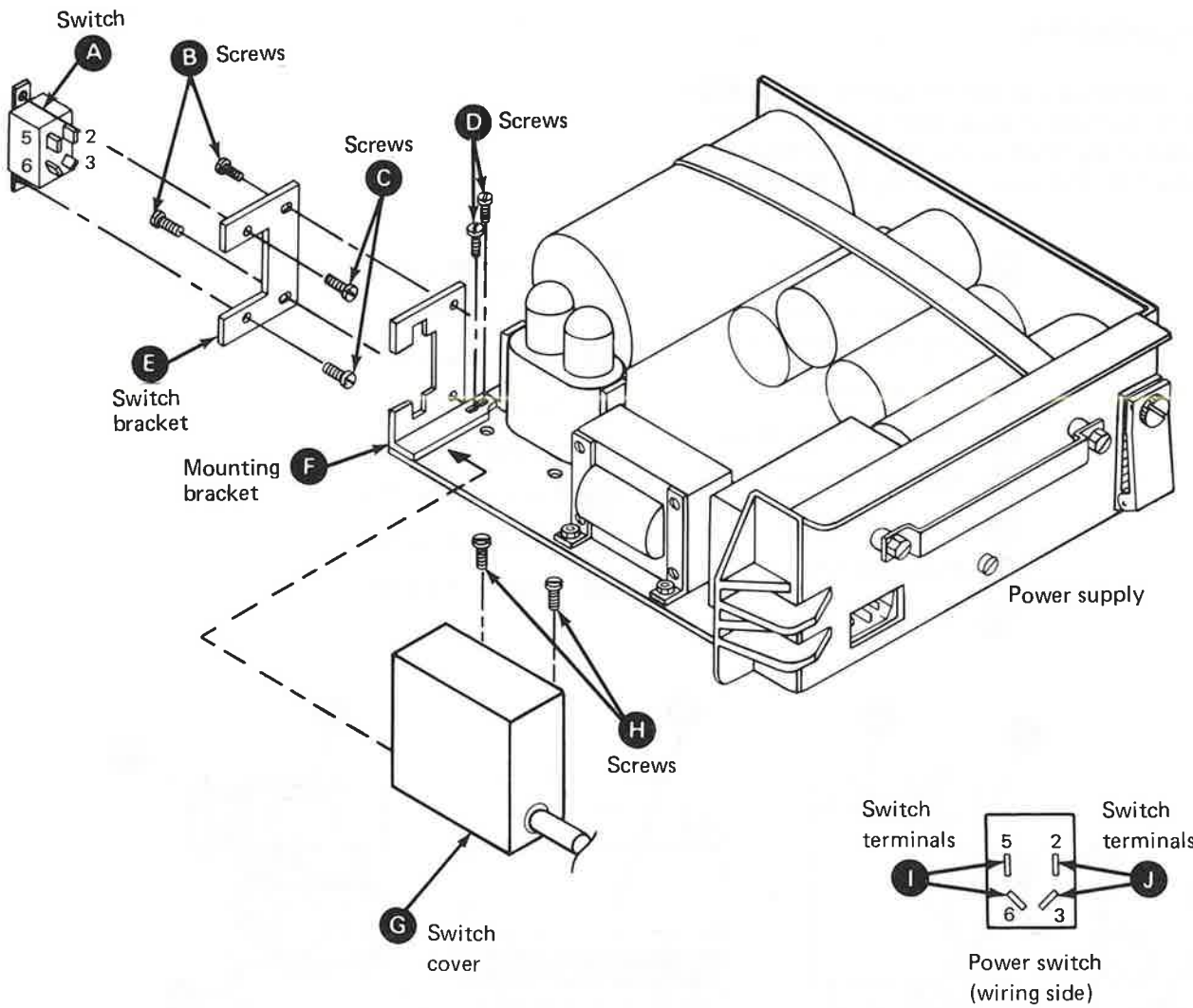
5. Install the power supply (1240) and the rear access cover (1220).

Service check

DANGER

AC line voltage is located on the power switch terminals even when the switch is in the off position. Before removing the power supply and the switch cover, disconnect the power cable from the ac service outlet.

1. Switch off the 5322 power and disconnect the power cable from the ac service outlet.
2. Place the power supply in the service position (1240).
3. Remove the power switch cover.
4. Set the CE meter switch to the ohms RX1 position. Connect one meter test lead to power switch terminal 2 **K**, and connect the other meter test lead to power switch terminal 3 **L**. With the power switch in the off position, the CE meter should indicate an open circuit. With the power switch in the on position, the CE meter should indicate a short circuit.
5. Use the same procedure as in Step 4 and check between power switch terminals 5 and 6 **M**.



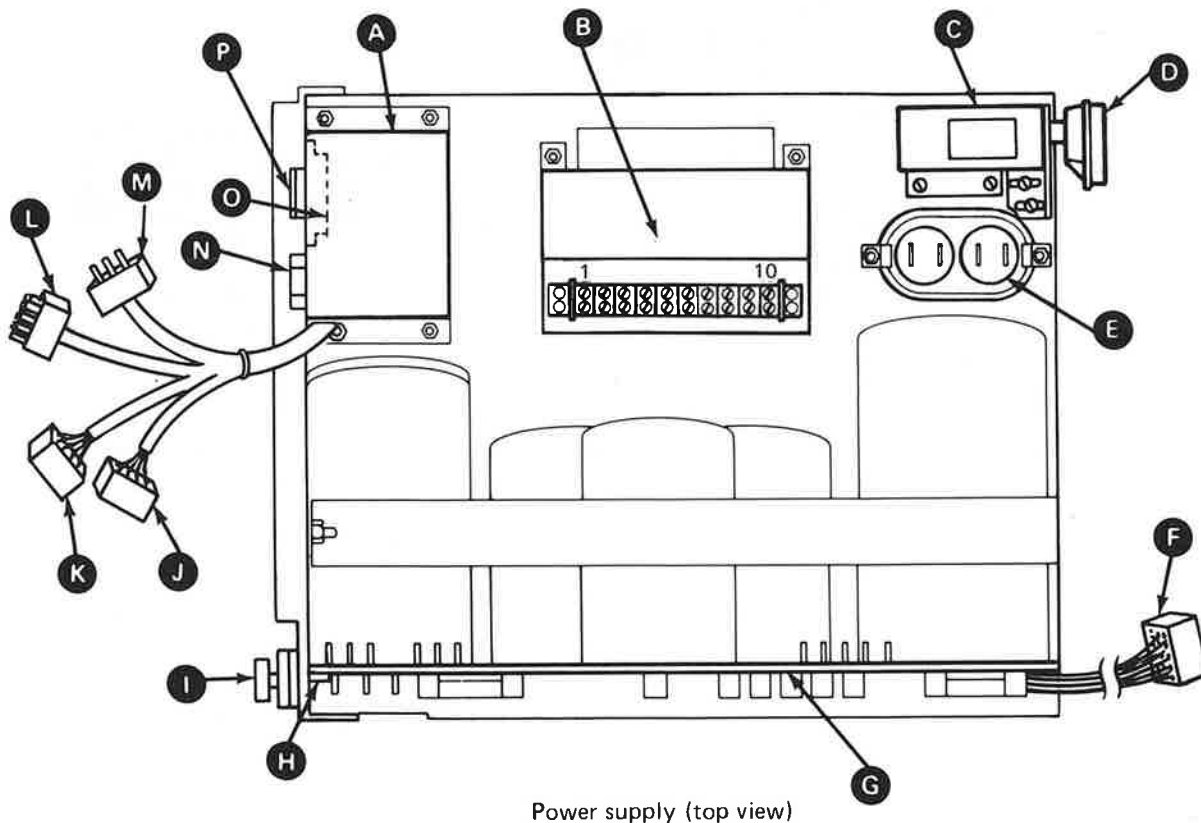
Maintenance procedures

1250 60-Hz power supply (GBG/I*)

Layout diagram

This diagram is for power supply PN 6838280 *only*. If a power supply with a different part number is installed in the 5322, see the labels attached to that power supply for locations.

- | | |
|--|---------------------------------|
| A AC distribution box | I I/O cable ground clamp |
| B Transformer T1 and terminal block T1/TB | J AC power plug P1 |
| C AC power switch box | K AC power plug P2 |
| D AC power On/Off switch | L AC power plug P3 |
| E Resonant capacitor C6 | M AC power plug P5 |
| F DC power plug P4 | N Circuit breaker CB1 |
| G A1 card assembly | O Terminal block TB1 |
| H Power-good LED | P Power cable jack J1 |



Power supply (top view)

DANGER

Up to 800 Vac is generated in the power supply. Before removing the power supply or any power supply part, switch off the 5322 power and disconnect the power cable from the ac service outlet.

Removal

1. Switch off the 5322 power. Disconnect the power cable from the ac service outlet and from the power supply jack J1 **B**.
2. Remove the 5322 rear access cover and top cover (1220).
3. Open the ground clamp **D** and remove the I/O cables from the clamp.
4. Remove the two screws **A** from the rear of the power supply.
5. Slide the power supply **C** out from the rear of the 5322.
6. The power supply is now in the service position. If it is necessary to switch on the 5322 power with the power supply in this service position, use the CE meter (ohms RX1 scale) to first ensure that grounding continuity exists between the 5322 main base plate and the power supply frame.

Note: When the power supply is in the service position, the fuses, voltage test points, power supply parts, and power switch are accessible. To remove the power supply completely, continue with the following steps:

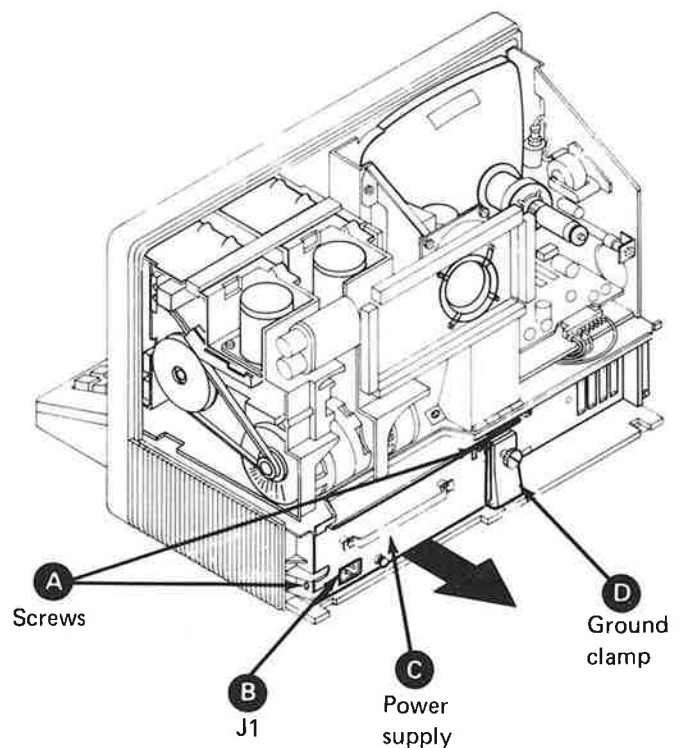
7. Disconnect the cable plugs P1 through P5 from the connectors in the 5322 (1200).
8. Label and then disconnect the voltage wires of the diskette drive attachment cable(s) from the +5 Vdc, -5 Vdc, +24 Vdc, and ground terminals on the power supply (1211).

Note: If removal of the power supply cables from the 5322 required removing the cable ties, ensure that these cable ties are replaced.

Replacement

Note: If a new power supply is being installed, ensure that it is wired for the correct ac line voltage. See "AC line voltage selection" on the following page.

1. If cable plugs P1 through P5 and the diskette drive attachment cable(s) were disconnected during the removal procedure, reconnect these cables.
2. Slide the power supply **C** into the 5322 and install the two screws **A**.
3. Place the I/O cable ground shields in the ground clamp **D** and close and tighten the clamp.
4. Install the 5322 top cover and rear access cover (1220).
5. Connect the ac power cable to the power supply jack J1 **B**.



Maintenance procedures

1250 60-Hz power supply (GBG/I*) (continued)

AC line voltage selection

1. Do Steps 1 through 6 of the power supply removal procedure.
2. Measure the ac input voltage at the customer's ac power outlet.
3. See the AC voltage chart on the GBG/I 60-Hz power supply diagram (1210) and make the wiring changes for the ac voltage measured in Step 2.
4. Install the power supply.

1251 Fuses (60-Hz power supply, GBG/I)

DANGER

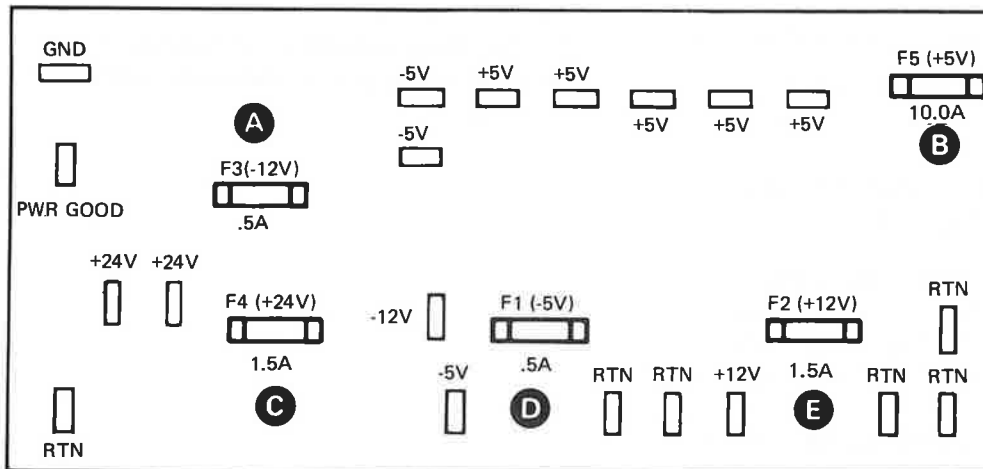
Up to 800 Vac is generated in the power supply. Before removing the power supply or any power supply part, switch off the 5322 power and disconnect the power cable from the ac service outlet.

Note: The diagram at the bottom of this page shows the fuse locations for power supply PN 6838280. If a power supply with a different part number is installed in the 5322, see the labels attached to that power supply for the fuse locations.

F1–F5 removal and replacement

1. Switch off the 5322 power and disconnect the power cable from the ac service outlet.
2. Place the power supply in the service position (1250).
3. To remove a fuse from the power supply, use a fuse puller. Fuses 1 through 5 are identified as follows:

F1 is the -5 Vdc fuse (0.5 ampere) **D**
F2 is the +12 Vdc fuse (1.5 amperes) **E**
F3 is the -12 Vdc fuse (0.5 ampere) **A**
F4 is the +24 Vdc fuse (1.5 amperes) **C**
F5 is the +5 Vdc fuse (10 amperes) **B**



Power supply A1 card

Warning: Never replace a fuse with one of a higher ampere rating. Machine circuit damage can occur.

4. Install the fuse and power supply by reversing the order of the removal procedure.

F1–F5 service check

1. Remove the fuse from the power supply.
2. Use the CE meter set to the ohms RX1 position to check the fuse continuity. If the meter does not indicate a short circuit (0 ohms), install a new fuse of the same ampere rating.

Maintenance procedures

1255 Power switch (60-Hz power supply, GBG/I)

DANGER

AC line voltage is located on the power switch terminals even when the switch is in the off position. Before removing the power supply and the switch, disconnect the power cable from the ac service outlet.

Note: The power switch maintenance procedures on this page are for power supply PN 6838280 *only*. If a power supply with a different part number is installed in the 5322, the power switch is not replaceable; replace the power supply.

Removal

1. Switch off the 5322 power and disconnect the power cable from the ac service outlet.
2. Place the power supply in the service position (1250).
3. Remove the two screws **H** and the switch cover **G**.
4. Remove the two screws **C** and the power switch **A**.
5. Label and disconnect the four wires from the switch terminals **I** and **J**.

Replacement

1. Connect the four wires to the switch terminals **I** and **J**.
2. Position the switch in the switch bracket and install the two screws **C**.
3. Install the switch cover **G** and the two screws **H**. Before tightening the screws, ensure that the grommet is positioned in the opening at the rear of the switch cover.
4. Slide the power supply into the 5322. If the switch bezel does not align with the opening in the 5322 front cover, loosen the

screws **B** and **D** and realign the switch bracket **E** and the mounting bracket **F**.

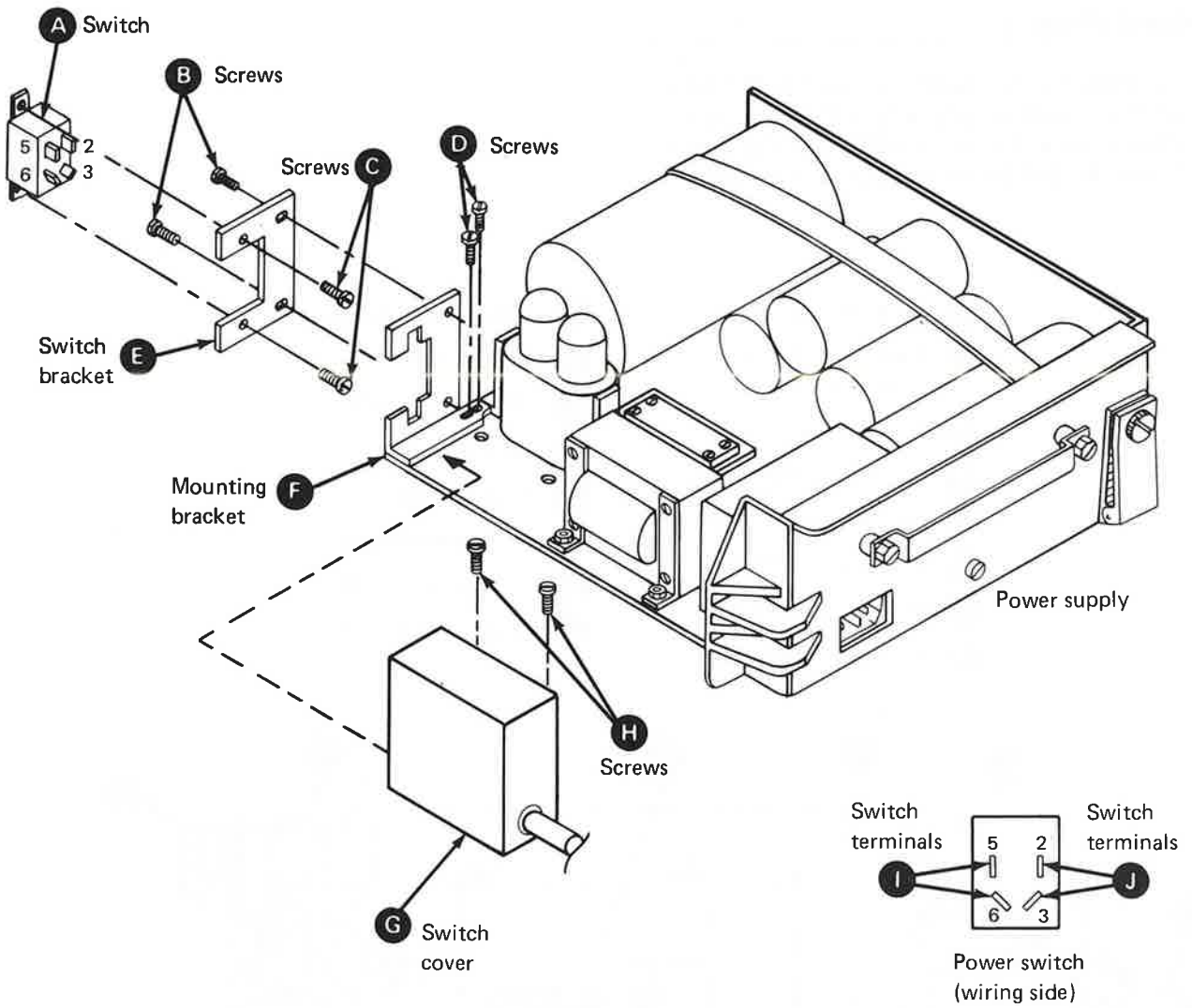
5. Install the power supply (1250) and the rear access cover (1220).

Service Check

DANGER

AC line voltage is located on the power switch terminals even when the switch is in the off position. Before removing the power supply and the switch cover, disconnect the power cable from the ac service outlet.

1. Switch off the 5322 power and disconnect the power cable from the ac service outlet.
2. Place the power supply in the service position (1250).
3. Remove the power switch cover.
4. Set the CE meter switch to the ohms RX1 position. Connect one meter test lead to power switch terminal 2 **J**, and connect the other meter test lead to power switch terminal 3 **I**. With the power switch in the off position, the CE meter should indicate an open circuit. With the power switch in the on position, the CE meter should indicate a short circuit.
5. Use the same procedure as in Step 4 and check between power switch terminals 5 and 6 **I**.



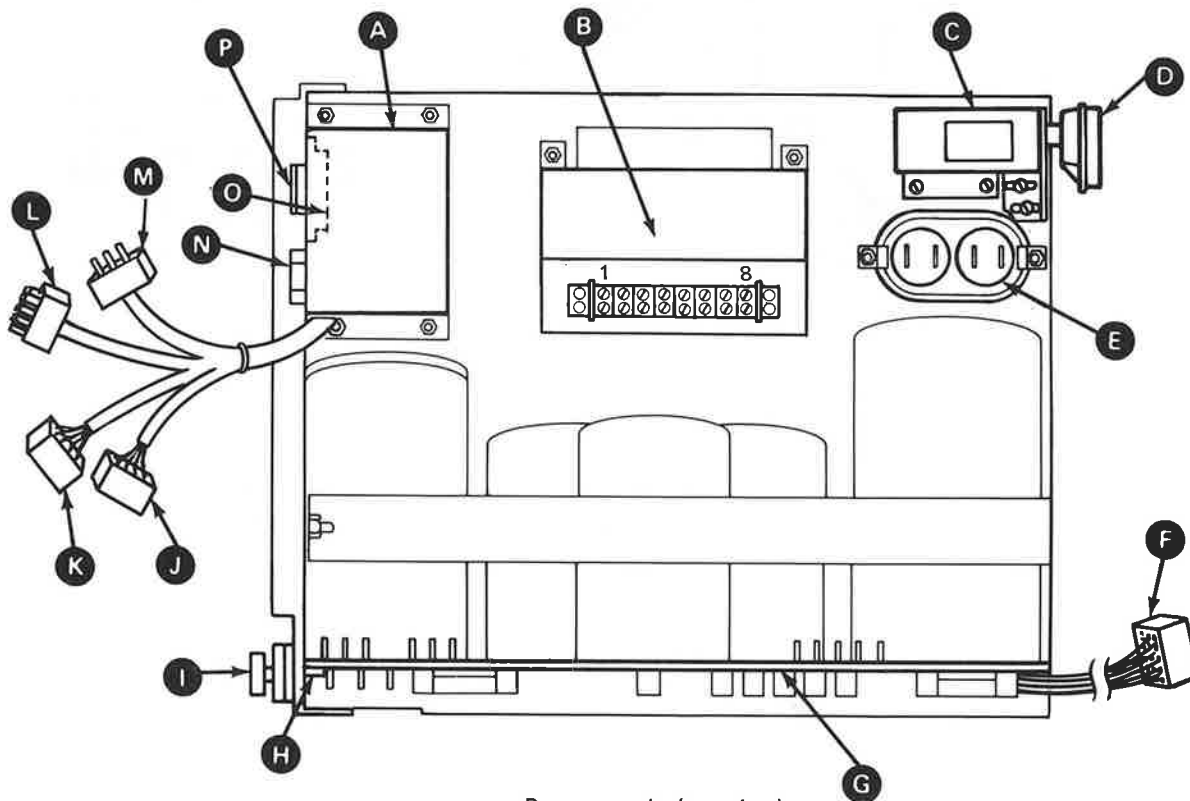
Maintenance procedures

1260 50-Hz power supply (GBG/I)

Layout diagram

This diagram is for power supply PN 6838281 *only*. If a power supply with a different part number is installed in the 5322, see the labels attached to that power supply for locations.

- | | |
|--|---------------------------------|
| A AC distribution box | I I/O cable ground clamp |
| B Transformer T1 and terminal block T1/TB | J AC power plug P1 |
| C AC power switch box | K AC power plug P2 |
| D AC power On/Off switch | L AC power plug P3 |
| E Resonant capacitor C6 | M AC power plug P5 |
| F DC power plug P4 | N Circuit breaker CB1 |
| G A1 card assembly | O Terminal block TB1 |
| H Power-good LED | P Power cable jack J1 |



DANGER

Up to 800 Vac is generated in the power supply. Before removing the power supply or any power supply part, switch off the 5322 power and disconnect the power cable from the ac service outlet.

Removal

1. Switch off the 5322 power. Disconnect the power cable from the ac service outlet and from the power supply jack J1 **B**.
2. Remove the 5322 rear access cover and top cover (1220).
3. Open the ground clamp **D** and remove the I/O cables from the clamp.
4. Remove the two screws **A** from the rear of the power supply.
5. Slide the power supply **C** out from the rear of the 5322.
6. The power supply is now in the service position. If it is necessary to switch on the 5322 power with the power supply in this service position, use the CE meter (ohms RX1 scale) to first ensure that grounding continuity exists between the 5322 main base plate and the power supply frame.

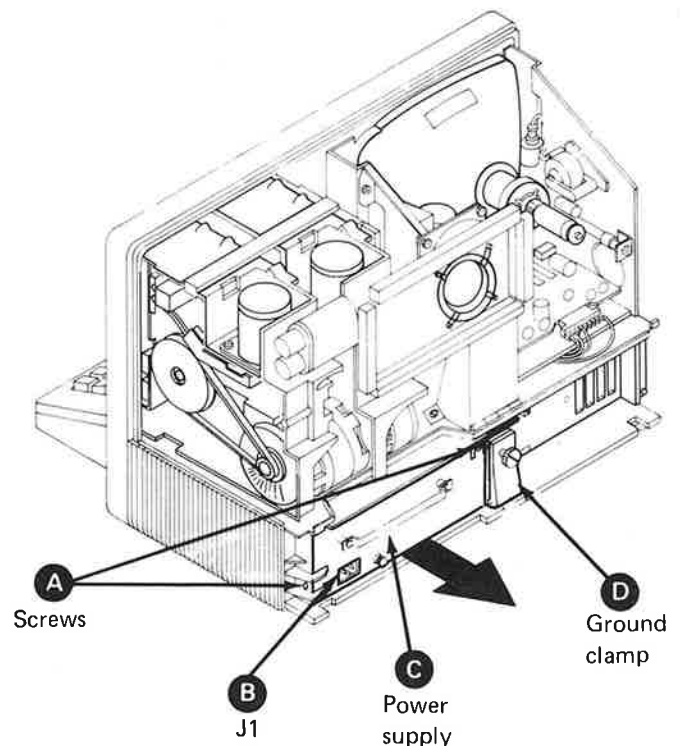
Note: When the power supply is in the service position, the fuses, voltage test points, power supply parts, and power switch are accessible. To remove the power supply completely, continue with the following steps:
7. Disconnect the cable plugs P1 through P5 from the connectors in the 5322 (1200).
8. Label and then disconnect the voltage wires of the diskette drive attachment cable(s) from the +5 Vdc, -5 Vdc, +24 Vdc, and ground terminals on the power supply (1211).

Note: If removal of the power supply cables from the 5322 required removing the cable ties, ensure that these cable ties are replaced.

Replacement

Note: If a new power supply is being installed, ensure that it is wired for the correct ac line voltage. See "AC line voltage selection" on the following page.

1. If cable plugs P1 through P5 and the diskette drive attachment cable(s) were disconnected during the removal procedure, reconnect these cables.
2. Slide the power supply **C** into the 5322 and install the two screws **A**.
3. Place the I/O cable ground shields in the ground clamp **D** and close and tighten the clamp.
4. Install the 5322 top cover and rear access cover (1220).
5. Connect the ac power cable to the power supply jack J1 **B**.



Maintenance procedures

1260 50-Hz power supply (GBG/I) (continued)

AC line voltage selection

1. Do steps 1 through 6 of the power supply removal procedure.
2. Measure the ac input voltage at the customer's ac power outlet.
3. See the ac voltage chart on the 50-Hz power supply diagram (1210) and make the wiring changes for the ac voltage measured in Step 2.
4. Install the power supply.

1261 Fuses (50-Hz power supply, GBG/I)

DANGER

Up to 800 Vac is generated in the power supply. Before removing the power supply or any power supply part, switch off the 5322 power and disconnect the power cable from the ac service outlet.

Note: The diagram at the bottom of this page shows the fuse locations for power supply PN 6838281. If a power supply with a different part number is installed in the 5322, see the labels attached to that power supply for the fuse locations.

F1–F5 removal and replacement

1. Switch off the 5322 power and disconnect the power cable from the ac service outlet.
2. Place the power supply in the service position (1260).
3. To remove a fuse from the power supply, use a fuse puller. Fuses 1 through 5 are identified as follows:

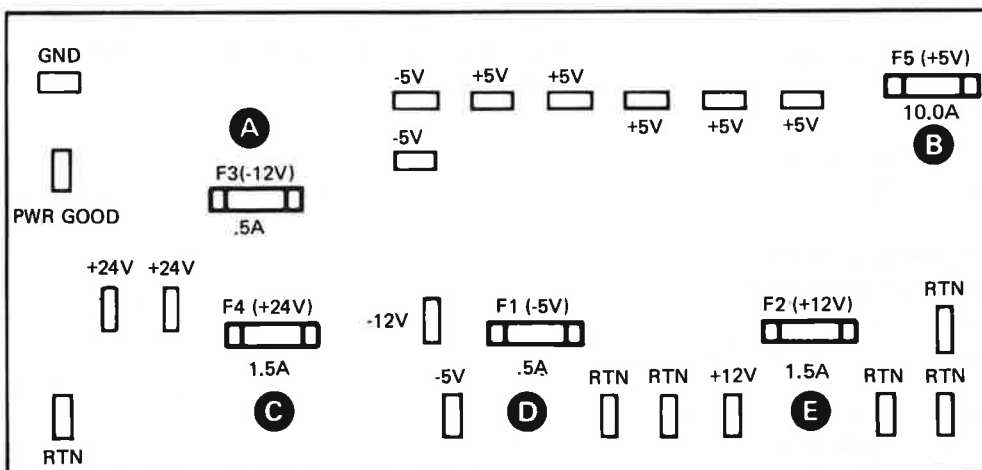
- F1 is the -5 Vdc fuse (0.5 ampere) **D**
- F2 is the +12 Vdc fuse (1.5 amperes) **E**
- F3 is the -12 Vdc fuse (0.5 ampere) **A**
- F4 is the +24 Vdc fuse (1.5 amperes) **C**
- F5 is the +5 Vdc fuse (10 amperes) **B**

Warning: Never replace a fuse with one of a higher ampere rating. Machine circuit damage can occur.

4. Install the fuse and power supply by reversing the order of the removal procedure.

F1–F5 service check

1. Remove the fuse from the power supply.
2. Use the CE meter set to the ohms RX1 position to check the fuse continuity. If the meter does not indicate a short circuit (0 ohms), install a new fuse of the same ampere rating.



Power supply A1 card

Maintenance procedures

1265 Power switch (50-Hz power supply, GBG/I)

DANGER

AC line voltage is located on the power switch terminals even when the switch is in the off position. Before removing the power supply and the switch, disconnect the power cable from the ac service outlet.

Note: The power switch maintenance procedures on this page are for power supply PN 6838281 *only*. If a power supply with a different part number is installed in the 5322, the power switch is not replaceable; replace the power supply.

Removal

1. Switch off the 5322 power and disconnect the power cable from the ac service outlet.
2. Place the power supply in the service position (1260).
3. Remove the two screws **H** and the switch cover **G**.
4. Remove the two screws **C** and the power switch **A**.
5. Label and disconnect the four wires from the switch terminals **I** and **J**.

Replacement

1. Connect the four wires to the switch terminals **I** and **J**.
2. Position the switch in the switch bracket and install the two screws **C**.
3. Install the switch cover **G** and the two screws **H**. Before tightening the screws, ensure that the grommet is positioned in the opening at the rear of the switch cover.
4. Slide the power supply into the 5322. If the switch bezel does not align with the opening in the 5322 front cover, loosen the

screws **B** and **D** and realign the switch bracket **E** and the mounting bracket **F**.

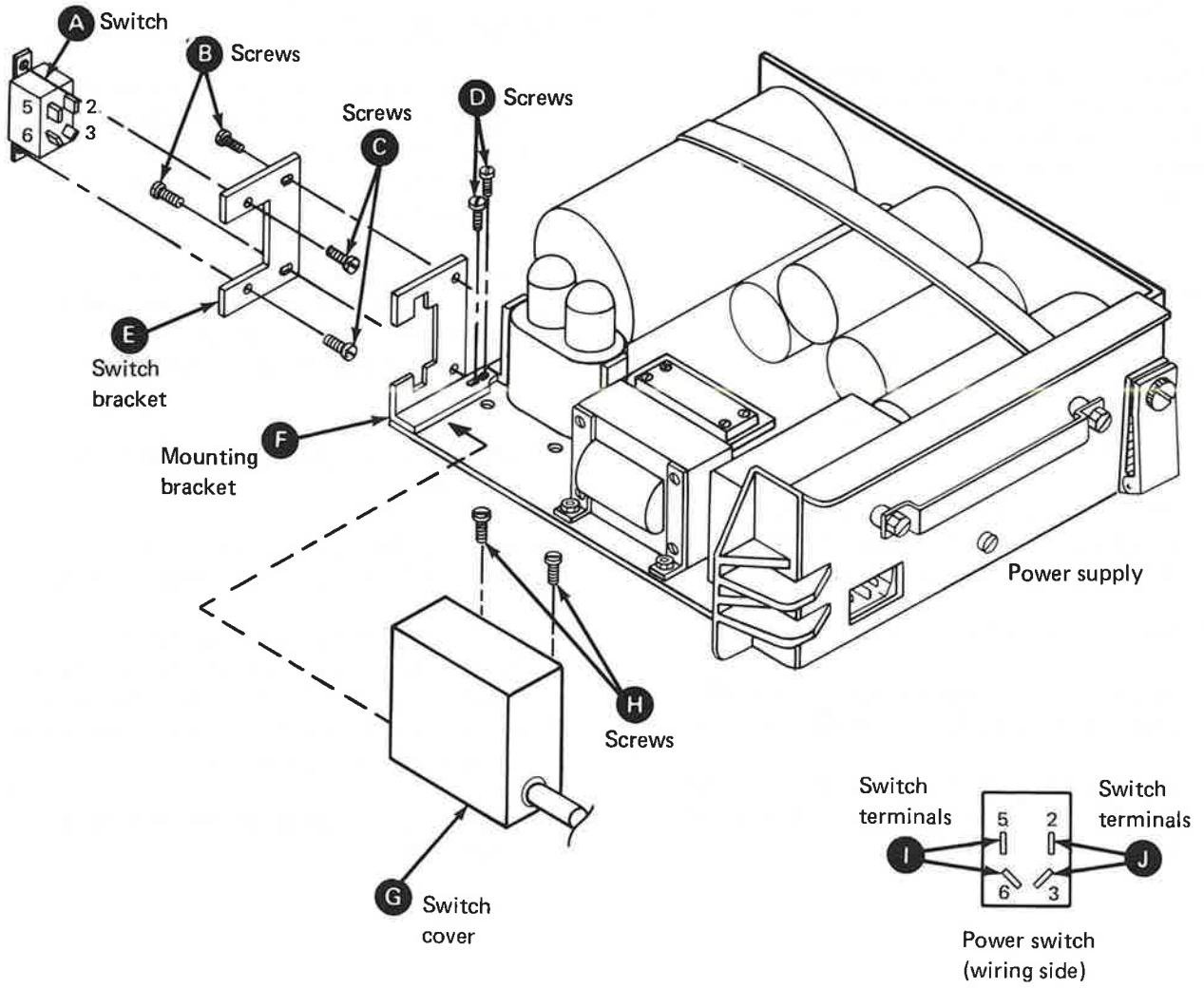
5. Install the power supply (1260) and the rear access cover (1220).

Service check

DANGER

AC line voltage is located on the power switch terminals even when the switch is in the off position. Before removing the power supply and the switch cover, disconnect the power cable from the ac service outlet.

1. Switch off the 5322 power and disconnect the power cable from the ac service outlet.
2. Place the power supply in the service position (1260).
3. Remove the power switch cover.
4. Set the CE meter switch to the ohms RX1 position. Connect one meter test lead to power switch terminal 2 **K**, and connect the other meter test lead to power switch terminal 3 **L**. With the power switch in the off position, the CE meter should indicate an open circuit. With the power switch in the on position, the CE meter should indicate a short circuit.
5. Use the same procedure as in Step 4 and check between power switch terminals 5 and 6 **M**.



Maintenance procedures

1270 Cooling fan

DANGER

The fan housing is grounded by its connection to the fan bracket. To prevent possible electrical shock, do not turn on power to the fan when it is removed from the fan bracket.

Removal

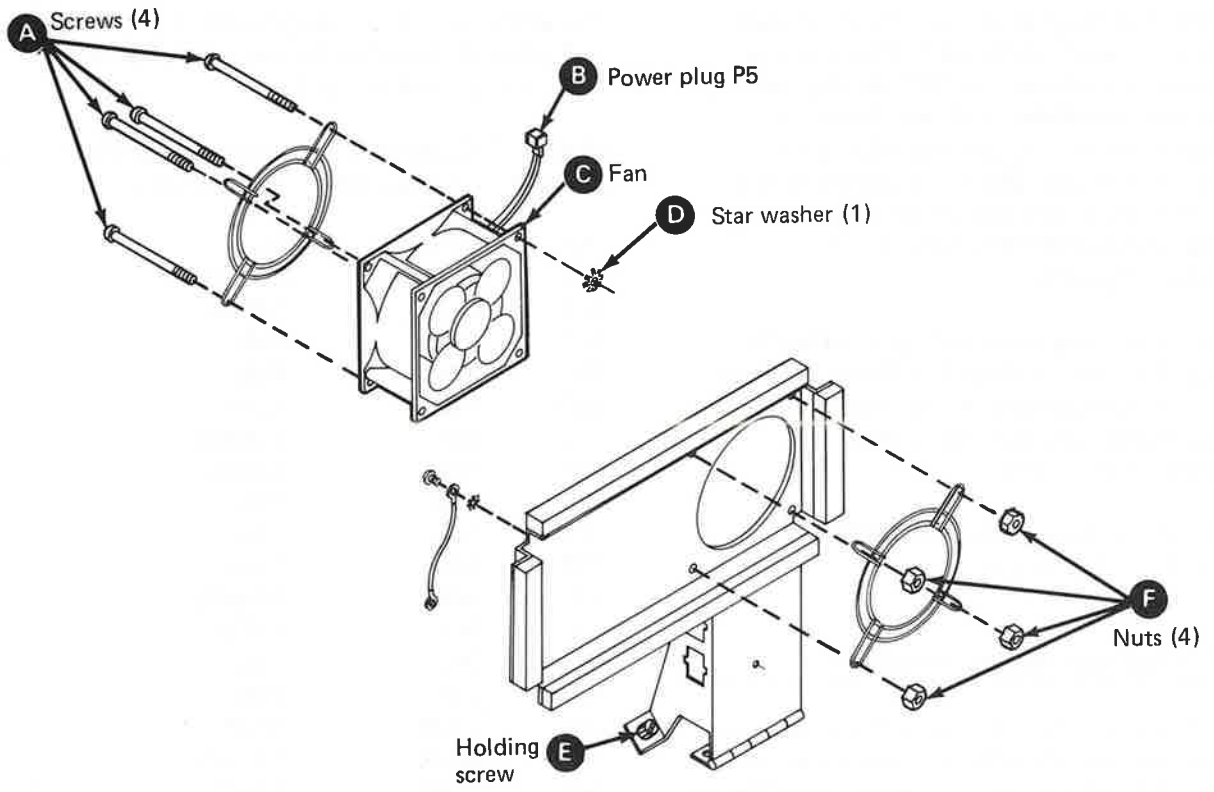
1. Switch off the 5322 power.
2. Remove the 5322 rear access cover and top cover (1220).
3. The fan bracket is hinged. Loosen the holding screw **E** and swing the bracket down to permit access to the fan **C**.
4. Disconnect the fan power plug P5 **B**.
5. Remove the four screws **A** and nuts **F**. Ensure that the star washer **D** is not lost.
6. Observe the position of the fan as to the direction of air flow. Remove the fan and fan guards.

Replacement

1. Install the fan and fan guards on the fan bracket, using the four screws **A** and nuts **F**. Ensure that the star washer **D** is placed between the fan and bracket as shown in the diagram.

Note: Position the fan to place the fan power cable and plug at the upper right corner as shown. This position generates the least ac voltage interference to the display unit.

2. Connect the fan power plug P5 **B** to its connector.
3. Swing the fan bracket up to its normal position and tighten the holding screw **E**.
4. Switch on the 5322 power and check the direction of air flow from the fan. Air flow should be to the outside of the 5322; if it is not, switch off the 5322 power, remove the fan, and reverse its position.
5. Install the 5322 top cover and rear access cover (1220).



Theory of operation

Introduction

The IBM 5322 Computer is a small, general purpose, business computer. It contains a processor, a keyboard, a CRT display, and up to two internal diskette drives. External devices, such as printers and additional diskette drives can also be attached to the 5322. The 5322, and the attached external devices, is called the IBM System/23 Computing System.

Programs that are entered into read/write storage from the keyboard or from a diskette drive, and microprograms located in read-only storage (ROS), are used to control the operation of the 5322.

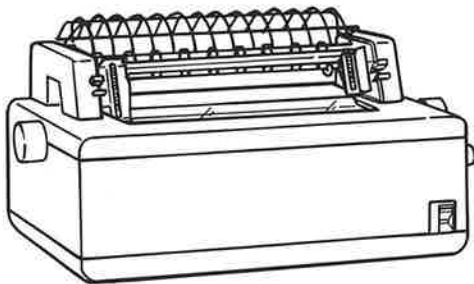
The 5322 computer uses the BASIC programming language.

5322 computer model numbers

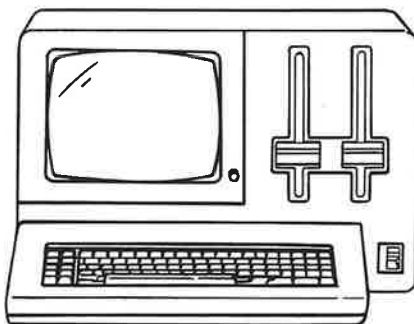
5322 model numbers describe the read/write storage size and diskette storage capacity. The second digit of the model number identifies the storage size: 1=32K, 2=64K, 3=96K, and 4=128K. (K=1,024 bytes of storage.) The third digit of the model number identifies the number of internal diskette drives and diskette storage capacity: 0=no internal diskette drives, 1=one diskette drive and 0.25Mb capacity, 2=two diskette drives and 0.5Mb capacity, 3=one diskette drive, and 1Mb capacity, and 4=two diskette drives and 2Mb capacity. (Mb=1,000,000 bytes.)

The model numbers, read/write storage sizes, and internal diskette storage capacities are shown in the following table:

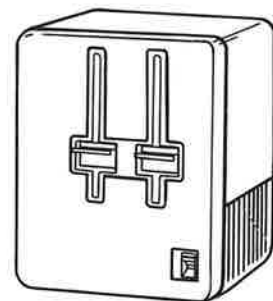
Model number	Read/write storage size	Internal diskette storage capacity
110	32K	None
111	32K	0.25Mb
112	32K	0.5Mb
113	32K	1Mb
114	32K	2Mb
120	64K	None
121	64K	0.25Mb
122	64K	0.5Mb
123	64K	1Mb
124	64K	2Mb
130	96K	None
131	96K	0.25Mb
132	96K	0.5Mb
133	96K	1Mb
134	96K	2Mb
140	128K	None
141	128K	0.25Mb
142	128K	0.5Mb
143	128K	1Mb
144	128K	2Mb



5241 or 5242 Printer



5322 Computer



5246 Diskette Unit

Standard features

Keyboard. The keyboard contains 83 keys and is used to enter alphameric and numeric data, BASIC program statements, and control functions into the 5322 computer. The keyboard is described in "Chapter 3. Keyboard."

CRT display unit. The CRT display unit has a 305 mm (12 in.) video screen and is used to display program information, data, and system status information. The display screen can display 24 lines of 80 characters (a total of 1920 characters). The CRT display unit is described in "Chapter 4. CRT display unit."

Diskette drives. Up to two internal diskette drives can be used to store and retrieve data and programs. The diskette drives write data on, and read data from, flexible diskettes. Two types of diskette drives, which differ in storage capacity and the types of diskettes that can be used, can be installed in the 5322. The diskette drives are described in "Chapter 5. Diskette drives."

First printer attachment port. The first printer attachment port is used to attach an external printer and its printer attachment logic. The IBM printers are described in Volumes 2 and 3 of the IBM System/23 Service Library.

Read/write storage. Read/write storage of 32K, 64K, 96K, or 128K bytes is available to store programs and data. The read/write (R/W) storage is located on circuit cards that plug into the R/W storage card sockets on the 5322 CPU planar board.

Read-only storage. Read-only storage (ROS) contains the microprograms used to decode the BASIC program language functions, control the operation of the I/O devices and features, and control the general operation of the computing system.

Audible alarm. The audible alarm is a programmable device that is used to signal the operator when the computing system needs operator intervention.

User library. The user library contains the manuals that the customer needs to install, operate, and learn how to program the 5322.

Service library. The service library contains the maintenance documents—service manuals, maintenance analysis procedures (MAPs), diagnostic user guide, and diagnostic diskette—that are needed to service and repair the 5322.

Optional features

Second printer attachment port. This feature permits a second printer and its attachment logic to be connected to the 5322.

External diskette attachment. This feature, which must be installed in 5322 Models 110, 120, 130, and 140 but is optional for all other 5322 models, permits the 5322 to be attached to an IBM 5246 Diskette Unit. One or two 5322s can be attached to a single 5246; however, the 5246 must have the second port feature installed in order to attach the second 5322.

External I/O devices

IBM 5242 Printer (Models 1 and 2). The 5242 is a matrix printer that can be connected to the 5322 printer port. The Model 1 prints at 160 characters per second. The Model 2 prints at 160 characters per second (standard print) and 40 characters per second (high-density print). The printer power supply and attachment logic are contained in the printer. The 5242 is described in Volume 3 of the IBM System/23 Service Library.

IBM 5241 Printer. The 5241 is an 80 character-per-second matrix printer that can be connected to the 5322 printer port. The printer power supply and attachment logic are contained in the printer. The 5241 is described in Volume 2 of the IBM System/23 Service Library.

IBM 5246 Diskette Unit. The 5246 is a stand-alone diskette drive unit that can be

Theory of operation

Introduction (continued)

connected to one or two 5322 computers through external cables. The 5246 contains its own power supply and one or two 1Mb diskette drives that provide up to 2Mb of additional diskette storage capacity for the computing system. The 5246 is described in Volume 4 of the IBM System/23 Service Library.

Functional description

Operator switches and controls

Power switch. Switching the power switch to the on position causes the ac and dc voltages to become active in the 5322. The power-on diagnostics are run automatically each time the 5322 is powered-on, and the diagnostic routine numbers are displayed on the display screen after each routine executes. For a description of the diagnostic routines and error indications, see "PID 1200 Power-on Test" in the diagnostic user guide.

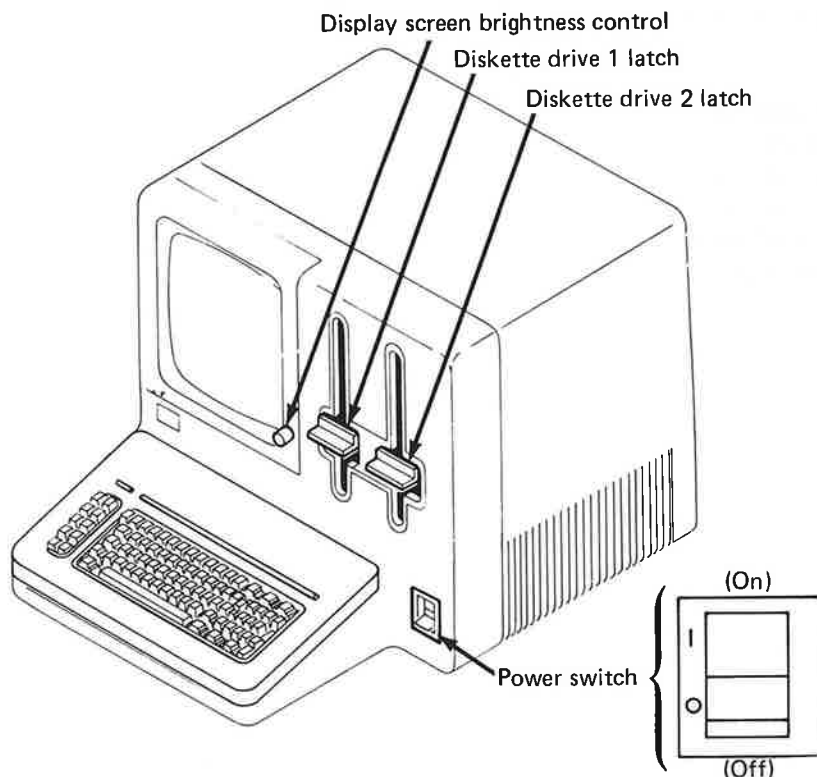
If no errors are sensed by the diagnostic routines, the 5322 enters BASIC mode and a "READY INPUT" message is displayed on the display screen.

Display screen brightness control.

Turning this control clockwise increases the brightness of the characters on the display screen. Do not operate the 5322 with the brightness control in the full clockwise position for long periods of time; the display screen could be damaged.

Diskette latches. When a diskette latch is in the vertical position, a flexible diskette can be inserted into, or removed from, the 5322 diskette drive. Turning the diskette latch clockwise to the horizontal position causes the diskette drive spindle to engage the diskette and the diskette to turn inside its outer envelope.

Keyboard. The operator uses the keyboard to control the operation of the computing system. The keyboard operations are described in "Keyboard operations" in Chapter 3 of this service manual.



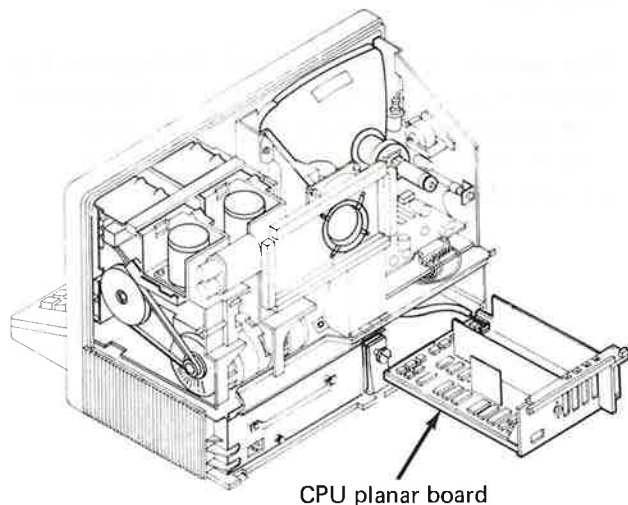
Processor
power supply

Theory of operation

Functional description (continued)

5322 central processing unit

The 5322 computer contains the central processing unit (CPU) for the IBM System/23 Computing System. The CPU circuits are located on the CPU planar board.

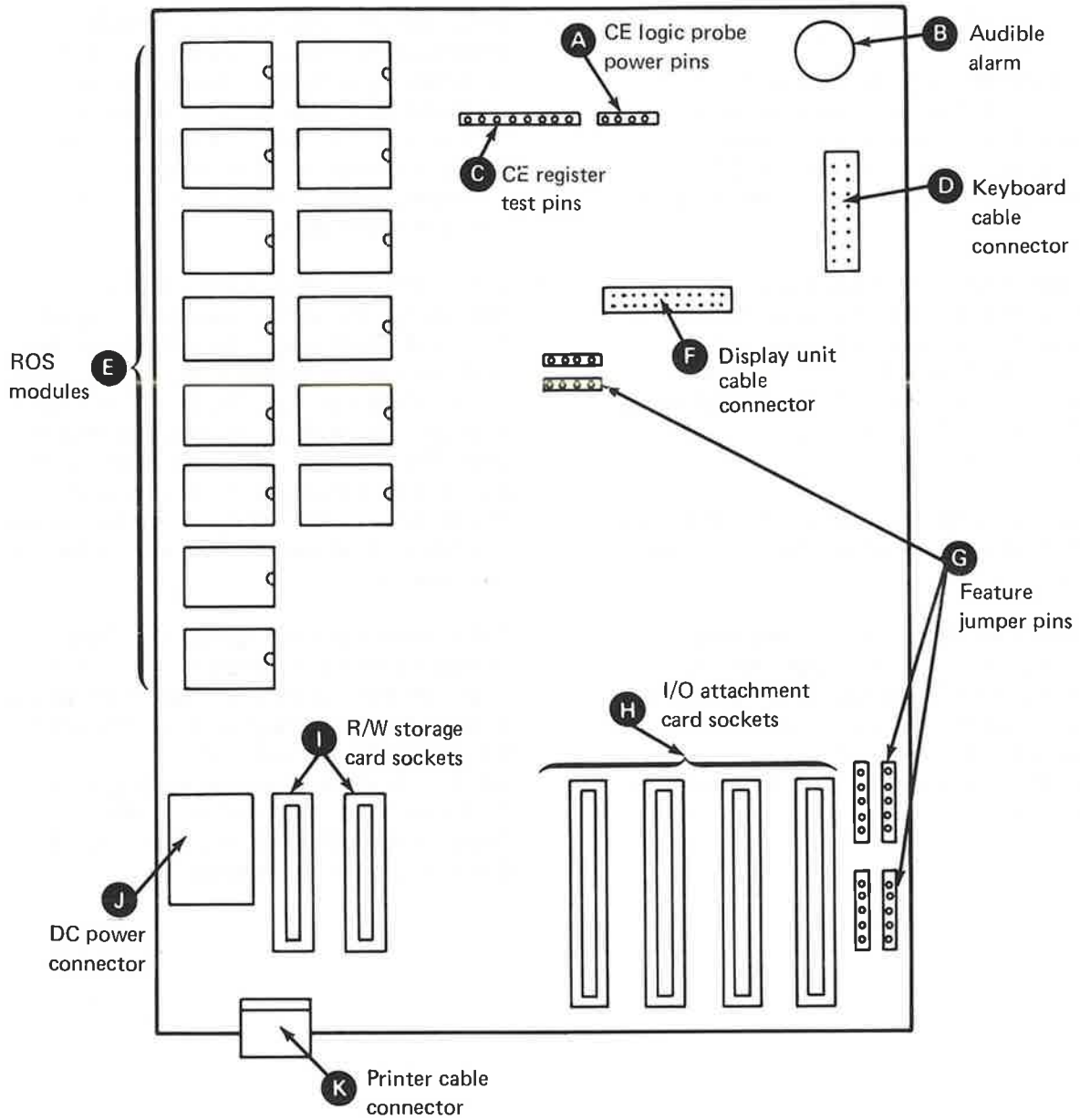


The CPU planar board diagram, located on the next page, shows the locations of the following units:

- Ⓐ CE logic probe power pins
- Ⓑ Audible alarm
- Ⓒ CE register test pins
- Ⓓ Keyboard cable connector
- Ⓔ Read-only storage (ROS) modules
- Ⓕ Display unit cable connector
- Ⓖ Feature jumper pins
- Ⓗ I/O attachment card sockets
- Ⓘ Read/write (R/W) storage card sockets
- ⓷ DC power connector
- Ⓚ Printer cable connector

CPU planar board. The CPU planar board, which is approximately 228 x 355 mm (9 x 14 in.), is a field replaceable unit (FRU). It contains the:

- Central processing unit—microprocessor unit (MPU), I/O address decoder, timers, interrupt control, storage page registers, sense and control registers, error checking, direct memory access (DMA) control, bus control, and the control, data, and address buses
- Keyboard attachment
- Display attachment
- First printer attachment port
- Audible alarm
- Read-only storage
- Read/write storage card sockets
- I/O attachment card sockets



Processor power supply

Theory of operation

Functional description (continued)

Processing unit operations

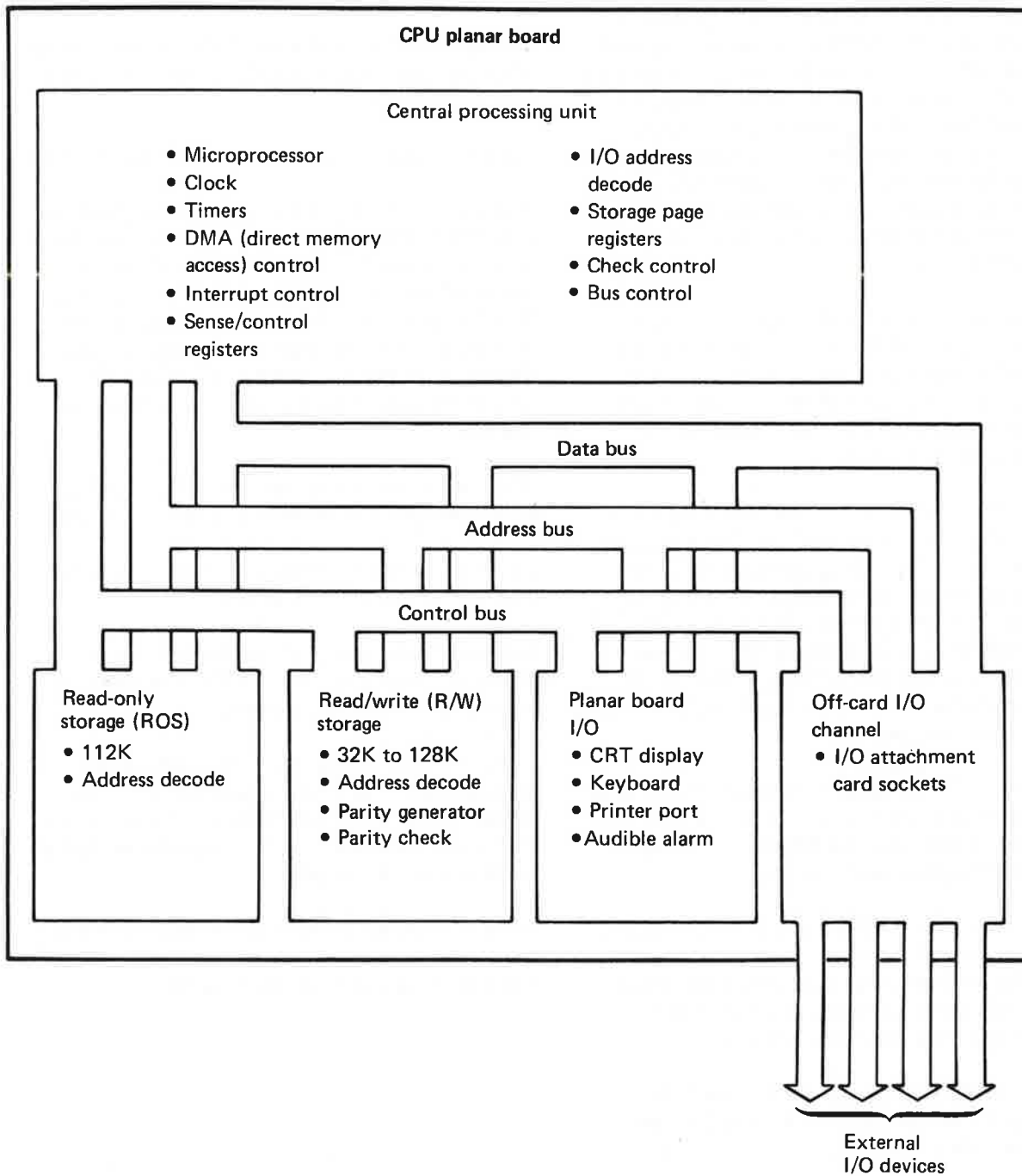
The operation of the 5322 computer and I/O devices is controlled by internal machine programs called microprograms. These microprograms are located in the 5322 read-only storage (ROS) and on IBM-supplied diskettes.

Microprograms. The 5322 cannot directly execute the user's BASIC program statements. These program statements must first be decoded by the 5322 microprograms into a series of microinstructions that are used by the processing unit of the 5322 to perform the requested operations.

The various microprograms that are used in the 5322, and the locations where they are stored, are as follows:

- ROS-resident (CPU planar board ROS) microprograms—These microprograms include the BASIC interpreter, I/O control (diskette, keyboard, CRT display, first printer port, and timer), power-on diagnostics, and the ROS-resident diskette diagnostics.
- ROS-resident (attachment card ROS) microprograms—The I/O feature attachment cards (except diskette), which plug into I/O card sockets on the CPU planar board, contain the I/O control microprograms for the feature devices. (The diskette microprograms are located in the CPU planar board ROS.)
- Machine update microprograms—These microprograms, which are used to update functions of the 5322 microprograms, are read from the Customer Support Function diskette and are stored in the read/write storage contained on the machine update card. The machine update card plugs into an I/O card socket on the CPU planar board. See "1230 CPU planar board" in the maintenance section of this chapter for the card location.
- Diskette-resident microprograms—These microprograms are stored on removable diskettes and can be read from the diskette drive into read/write (R/W) storage when needed. Some examples of diskette-resident microprograms are the Customer Support Functions (Diskette Copy, Diskette Prepare, etc.) and the CE diskette-resident diagnostics.

CPU planar board functional data flow



Processor power supply

Theory of operation

Functional description (continued)

Functional units

Microprocessor. The microprocessor (MPU) is the central arithmetic and logic unit of the 5322 computer. The MPU contains timing and control circuits, a program instruction counter, an instruction decoder, an arithmetic logic unit, an accumulator, and a group of temporary storage registers (registers A through E, H, and L). The MPU operates under control of the 5322 microprograms and generates and decodes the information on the data, address, and control buses.

Address bus. The 5322 address bus has sixteen lines (A0–A15) and is used by the MPU to address storage and the I/O devices. It is also used by the direct memory access (DMA) circuits to address storage during DMA I/O read and write operations.

Although the 5322 address bus has sixteen lines (A0–A15), the MPU address bus has only eight lines (A0–A7). During address time, the other eight address lines (A8–A15), which are needed for the 5322 address bus, are read from the MPU data/address buffer and are sent to the address A8–A15 latch. During the remainder of the MPU cycle, the data/address buffer is used for data.

Data bus. The 5322 data bus has eight lines (D0–D7) and is used to move data between the MPU and I/O devices, the MPU and storage, and the I/O devices and storage.

Control bus. The 5322 control bus contains the control lines that are used to time and control the movement of data and addresses between the MPU, storage, and I/O devices. The functions of the control lines are:

I/O read—indicates that the addressed I/O location is to be read from and that the data bus is available for the data.

I/O write—indicates that the data on the data bus is to be written into the addressed I/O location.

Storage read—indicates that the addressed storage location is to be read from and that the data bus is available for the data.

Storage write—indicates that the data on the data bus is to be written into the addressed storage location.

Clock—clock output for use as a system clock.

Reset in—sets the MPU program instruction counter to 0000 and resets interrupt enable and hold acknowledge. The MPU is held in the reset condition as long as 'reset-in' is active. The 'reset-in' line follows the status of the power-good signal from the power supply. During a power-on sequence, 'reset-in' is active until the power-good signal becomes active.

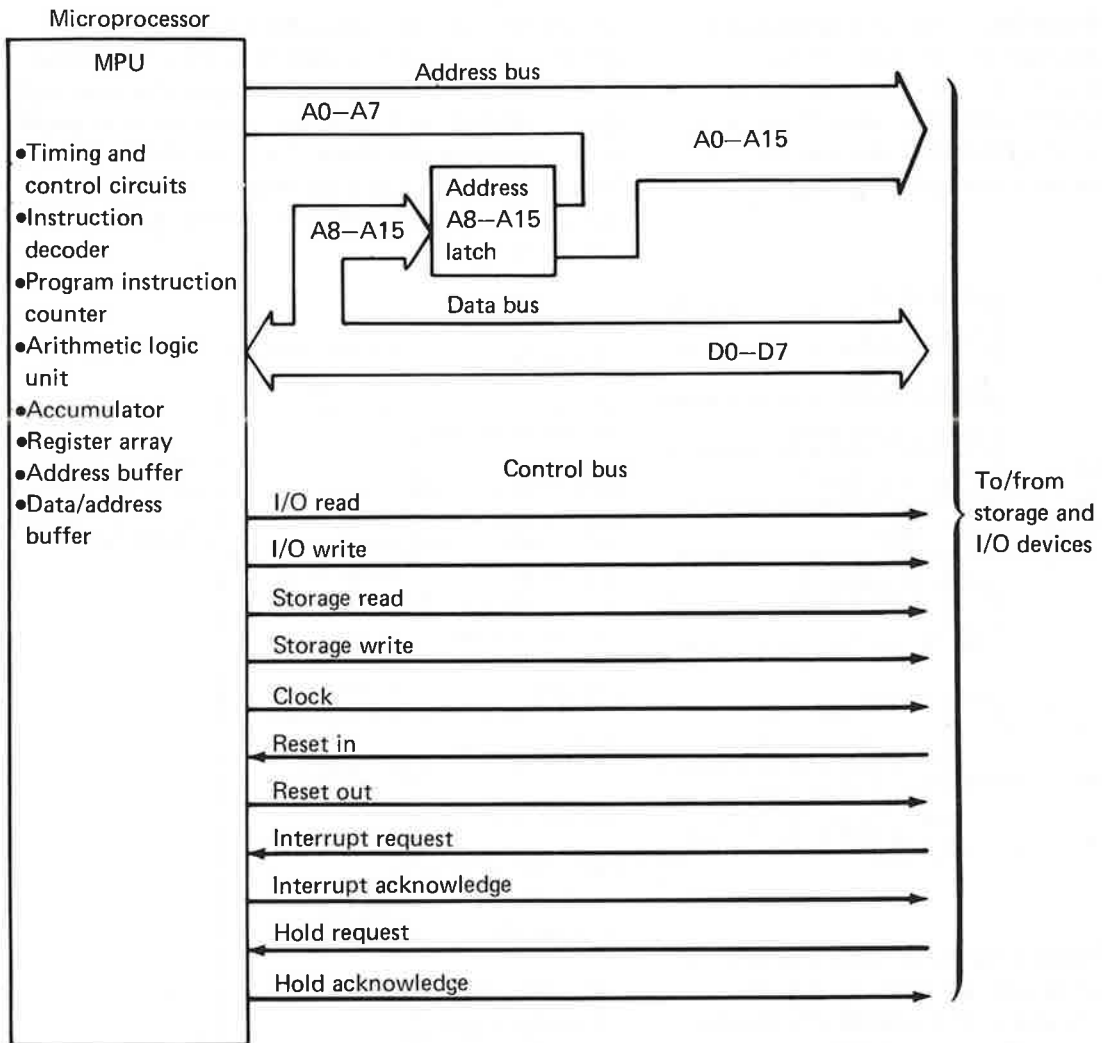
Reset out—indicates that the MPU is being reset. 'Reset-out' is used as a system reset.

Interrupt request—indicates that an interrupt request to the MPU is active.

Interrupt acknowledge—indicates to the interrupt controller that the MPU is ready to service the interrupt request.

Hold request—indicates that a device is requesting the use of the address and data buses. When the MPU receives 'hold request', it releases the buses to the requesting device on the next clock cycle.

Hold acknowledge—indicates that the MPU has received a 'hold request' and will release the buses on the next clock cycle.

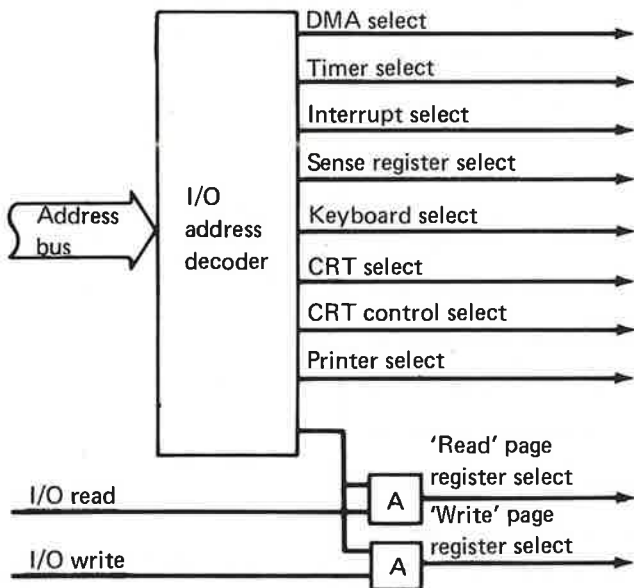


Processor power supply

Theory of operation

Functional description (continued)

I/O address decoder. When processing a microprogram instruction, the 5322 must address storage or a device to read or write data. The I/O address decoder uses the information from the 5322 address bus to select the device or a storage page register.



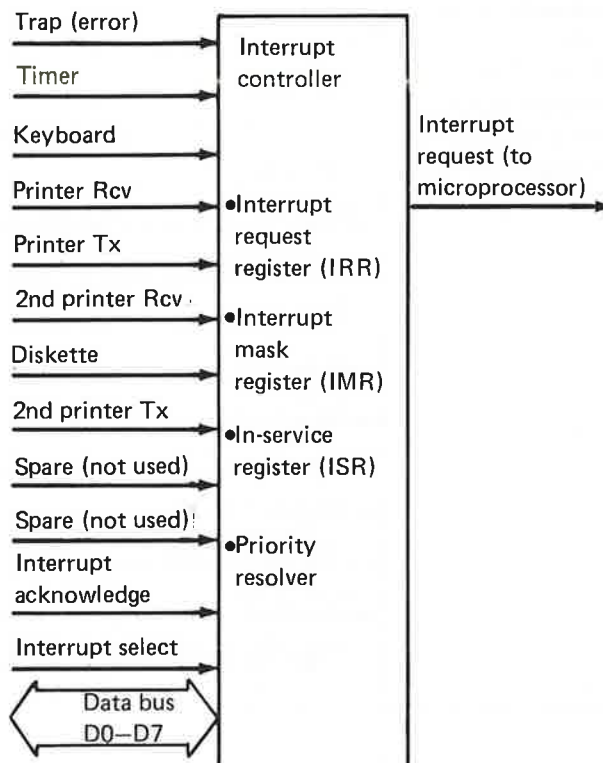
The device addresses, which are used only by the microprograms, are not described in this service manual. Options in the 5322 diagnostic programs permit the Customer Engineer to select the device(s) to be tested during diagnostic procedures.

Interrupts. Interrupts permit more efficient operation of the 5322 computer and I/O devices by letting the processing unit and I/O devices perform asynchronous operations until a device requests service from the processing unit.

The device informs the processing unit that it needs service by sending an interrupt request. This interrupt request informs the processing unit that it should complete the instruction being executed and to go to a specific program routine to service the requesting device.

An example of using interrupts is when a key is pressed on the 5322 keyboard. The keyboard

sends an interrupt request to inform the processing unit that it has a character to send. The processing unit acknowledges the interrupt and branches to the program routine that reads and translates the character from the keyboard. The processing unit then returns to, and continues execution of, the interrupted program.



Interrupt service routines. The interrupt controller, after sending an interrupt request, must give the processing unit the information needed to find the service routine for the interrupting device. When the interrupt controller receives an interrupt acknowledge (INTA) signal from the processing unit, it places a "Call" instruction on the data bus. This instruction causes the processing unit to send two more INTA signals. The interrupt controller responds to these two INTA signals by placing the high and low halves of an address on the data bus. This address is that of the location in storage containing the address of the device's service routine. When the service routine is completed, the

processing unit returns to the next sequential instruction of the program that was in process at the time the interrupt occurred.

Interrupt priority. Interrupts are assigned priorities, which means that a device with a higher interrupt priority is serviced by the processing unit before a device with a lower priority. Also, an active lower priority interrupt service routine can be interrupted to branch to the service routine for a higher priority device.

The interrupt assignments, starting with the highest priority interrupt are as follows:

- Trap (error)
- Timer
- Keyboard
- Printer receive ready (first printer)
- Printer transmit ready (first printer)
- Printer receive ready (second printer)
- Diskette
- Printer transmit ready (second printer)

Program control of interrupts. Interrupts can be enabled, disabled, or selectively masked by the 5322 microprograms. Interrupt masking gives the microprogram the ability to enable or disable one or more specific interrupt levels. Masking of a higher priority level does not affect the interrupt request lines of lower priority.

Trap interrupts. Trap (error) interrupts cannot be masked and are used to report machine checks that occur during the running of a BASIC or diagnostic program. When a trap interrupt occurs, the error information is displayed on the bottom lines of the display screen. The diagnostic user guide contains a description of the information that is displayed when a trap interrupt occurs.

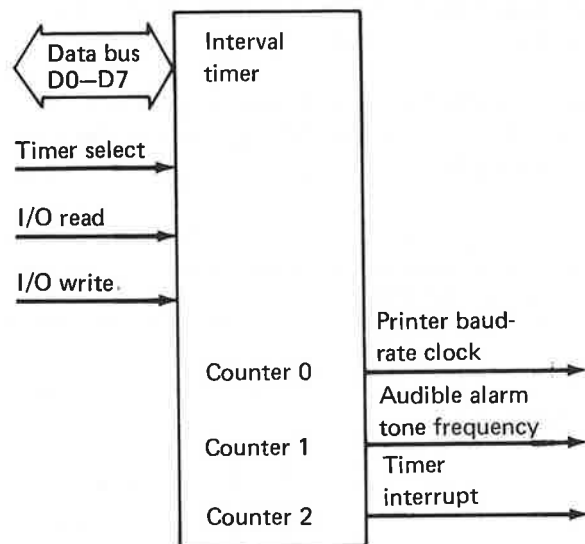
Interval timer. The 5322 interval timer supplies three separate counting functions for

the IBM System/23 Computing System. Each of the three counters can be addressed and controlled by the microprograms. These counter functions are:

Counter 0—used as a programmable baud-rate generator for the printer port.

Counter 1—used to generate the audible frequency tone for the 5322 audible alarm.

Counter 2—used as a general purpose system timer. A value can be loaded into the counter by program control. The counter then decreases this value by one each timer clock cycle. When the value in the counter reaches zero, a timer interrupt is sent to the processing unit.



Theory of operation

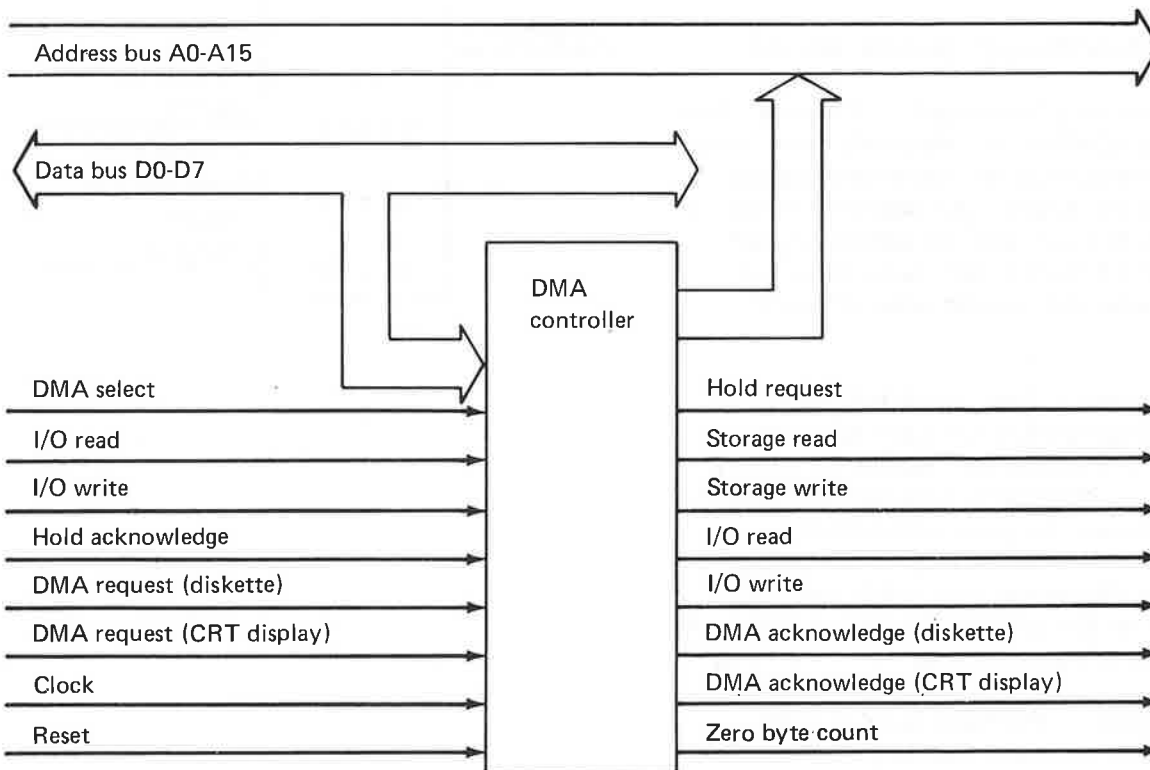
Functional description (continued)

Direct memory access. Direct memory access (DMA) is used to move blocks of data between storage and the CRT display and diskette drive attachments. The DMA controller must first be initialized by the microprogram with a storage address where the data transfer is to start and with a byte count that specifies the number of data bytes to be moved. The DMA controller can then move this block of sequentially addressed data between storage and the device without needing intervention from the processing unit.

DMA operations. The DMA controller has two modes of operation—DMA read and DMA write. DMA read causes data to be moved from storage to the requesting device, and DMA write causes data to be moved to storage from the requesting device. The diskette attachment uses both DMA read and write operations; the CRT display attachment uses only DMA read operations.

When the DMA controller receives a DMA request from either the CRT display or diskette attachment, it:

- Requests control of the 5322 data and address buses—The DMA controller activates the 'hold request' line to the processing unit to request the use of the data and address buses. The processing unit responds to 'hold request' by activating the 'hold acknowledge' line to indicate that it will release the buses to the DMA controller on the next clock cycle.
- Acknowledges the DMA request—The DMA controller activates the 'DMA acknowledge' line to the requesting device. If the CRT display and diskette attachments have 'DMA request' lines active concurrently, the diskette attachment is given priority and is acknowledged first.
- Activates the address bus—The DMA controller places an address, which is the address of the first storage location that is to be accessed for the DMA operation, on the address bus. This address is increased by one for each following DMA storage cycle until either the byte count reaches zero or the device deactivates its 'DMA request' line.



- Generates the I/O and storage read/write control signals—The DMA controller activates the 'I/O read,' I/O write,' 'storage read,' and 'storage write' lines in the correct sequence to cause the data transfer between the device and the addressed location in storage.

Internal storage. The 5322 contains two types of internal storage—read-only storage (ROS) and read/write (R/W) storage.

Read-only storage (ROS). ROS contains microprograms and data that are used to control the operation of the 5322. The microprograms and data are written into ROS during the manufacturing process and cannot be changed (written) during 5322 operations.

Fourteen ROS modules are located on the CPU planar board. Additional ROS modules can also be located on the I/O attachment cards that plug into the I/O card sockets on the CPU planar board. Each ROS module contains 8K bytes of storage, and each storage byte contains eight bit positions (for data bits 0–7).

ROS is addressed using the information from the 5322 address bus and page registers (see "Storage addressing" later in this chapter), and the data byte read from ROS is placed on the 5322 data bus.

ROS is not checked for parity during normal 5322 operations; however, each time the 5322 is powered on, the power-on diagnostic performs a cyclic redundancy check (CRC) of the data in the ROS modules. Each ROS module contains a CRC check character, which the diagnostic compares with the CRC value that it calculates as it reads the ROS module during the diagnostic test.

Read/write (R/W) storage. Programs and data that are read from I/O devices and ROS can be stored in R/W storage. R/W storage is located on circuit cards that plug into the R/W storage card sockets on the 5322 CPU planar board. The storage cards are available in either 32K or 64K byte sizes. Minimum R/W storage in the 5322 is 32K bytes.

Additional storage cards can be installed to increase R/W storage to 64K, 96K, and 128K bytes as follows:

Total R/W storage	Base card socket*	Feature card socket*
32K	32K card	--
64K	32K card	32K card
64K	64K card	--
96K	64K card	32K card
128K	64K card	64K card

* See "1230 CPU planar board" in the maintenance section of this chapter for the locations of the R/W storage card sockets.

Each byte of R/W storage contains nine bit positions (for data bits 0–7 and a parity bit). The parity bit is used to generate an odd bit count for each data byte that is written into R/W storage. For example:

- If the eight bits of the data byte to be written into storage are 00101010 (odd bit count), then no parity bit is added by the parity generator circuit before the storage write operation.
- If the eight bits of the data byte to be written into storage are 01101010 (even bit count), then a parity bit is added by the parity generator circuit before the storage write operation.

When a data byte is read from R/W storage, it is checked by the parity check circuit for an odd bit count. This test can sense most storage read or write failures. If a data byte is read from storage and contains an even bit count, the storage parity check is set and a trap interrupt is sent to the processing unit to indicate that a machine error occurred.

R/W storage is addressed using the information from the 5322 address bus and page registers (see "Storage addressing" later in this chapter), and the 5322 data bus is used to move the data byte that is written to, or read from, R/W storage. Storage parity bits are not sent to the data bus.

Theory of operation

Functional description (continued)

Storage addressing. The 5322 can contain 240K bytes of internal storage (112K bytes of ROS and 128K bytes of R/W storage) plus additional ROS that can be located on the I/O attachment cards. The sixteen lines of the 5322 address bus (A0 through A15) permit a maximum addressing range of 64K bytes; therefore, page registers are used to expand the address range of the 5322.

The 64K-byte addressing range of the 5322 is divided into four equal blocks of 16K addresses each, as follows:

Note: All address values are in hexadecimal.

- 0000 through 3FFF—this block addresses the first 16K bytes of ROS, and page registers are not used.
- 4000 through 7FFF—this block addresses ROS and selects a page register that can address up to 256K bytes of ROS in this address space.
- 8000 through BFFF—this block addresses the first 16K bytes of R/W storage, and page registers are not used.
- C000 through FFFF—this block addresses R/W storage and selects a page register that addresses up to 112K bytes of R/W storage in this address space.

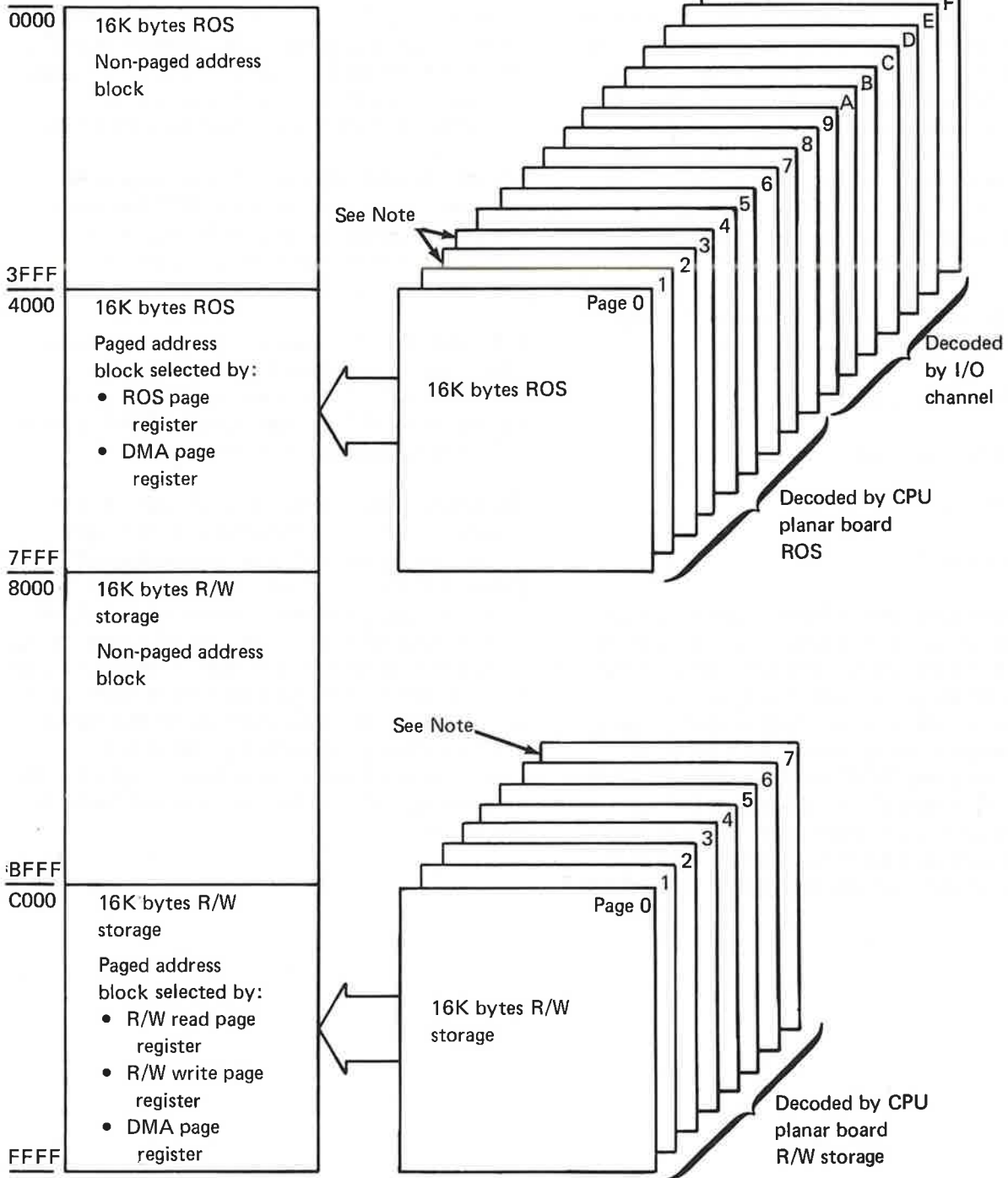
Storage page registers. The four storage page registers, which can be read and written by microprogram control, are the:

- ROS page register—selected when the address on the address bus is 4000 through 7FFF
- R/W write page register—selected when the address on the address bus is C000 through FFFF and the storage operation is a write operation
- R/W read page register—selected when the address on the address bus is C000 through FFFF and the storage operation is a read operation
- DMA page register—selected when the storage operation is a direct memory access (DMA) operation

Each of the page registers contains four addressing bits that can be written by the microprograms. The four bits can contain a value (0–F) to select up to sixteen pages of 16K bytes of storage. The separate read and write page registers permit data to be moved from one page to another (read from one page and written to another page) without changing the page value in the page registers.

The following diagram shows the relationship of the 16K-byte storage address blocks, the page registers, and the 16K-byte storage pages.

Storage addresses (hexadecimal)



Note: ROS storage pages 2 and 3 and R/W storage page 7 are not used.

Theory of operation

Functional description (continued)

Error checking

When a machine error occurs during the running of either a customer BASIC program or a diagnostic program, a trap interrupt is sent to the processing unit. The trap interrupt causes the 5322 to sense information about the error and to display the trap information at the bottom of the CRT display screen. MAP 1220 is used by the Customer Engineer to interpret this trap information and determine the cause of the error. A description of the trap data display is also in the diagnostic user guide.

Four types of machine errors cause the trap interrupt to be generated. They are:

- R/W storage parity check
- Write-to-ROS check
- I/O check
- Power check

R/W storage parity check. All data bytes in the 5322 read/write (R/W) storage contain nine bit positions (eight data bits and a parity bit). The parity bit is used, if needed, to generate an odd bit count (odd parity) on every R/W storage write operation, and parity is checked on every R/W storage read operation. (See "R/W storage" in this chapter for the description of parity generating and checking.) If a data byte is read from R/W storage that contains an even bit count (even parity), a R/W

storage parity check occurs and a trap interrupt is sent to the processing unit.

Note: During the 5322 power-on sequence, the parity check is cleared and held reset until the power-on diagnostic writes to all R/W storage locations. This is done to ensure that all positions of R/W storage contain odd parity.

Write-to-ROS check. If a storage write operation is attempted into a ROS (read-only storage) location, a write-to-ROS check is generated and a trap interrupt is sent to the processing unit.

I/O check. I/O check is a general purpose check that is specified by the I/O devices attached to the 5322. See the I/O device's service manual for a description of the specific I/O checks generated by the device.

Power check. When the +5 Vdc, -5 Vdc, +12 Vdc, and -12 Vdc voltages in the 5322 power supply are within approximately 80 percent of their nominal operating levels, the power supply generates a power-good signal to the processing unit. Loss of the power-good signal, indicating a power supply failure, causes a trap interrupt request and a reset to be sent to the processing unit. Because of this reset, the trap interrupt caused by loss of the power-good signal is not acknowledged by the processing unit and the power check indicator is not set.

Power supplies

The 5322 computer can contain either a ferroresonant or a transistor-switching-regulator (TSR) power supply. These two types of power supplies are functionally interchangeable and supply the same output voltages for the internal operation of the 5322.

Ferroresonant power supply description.

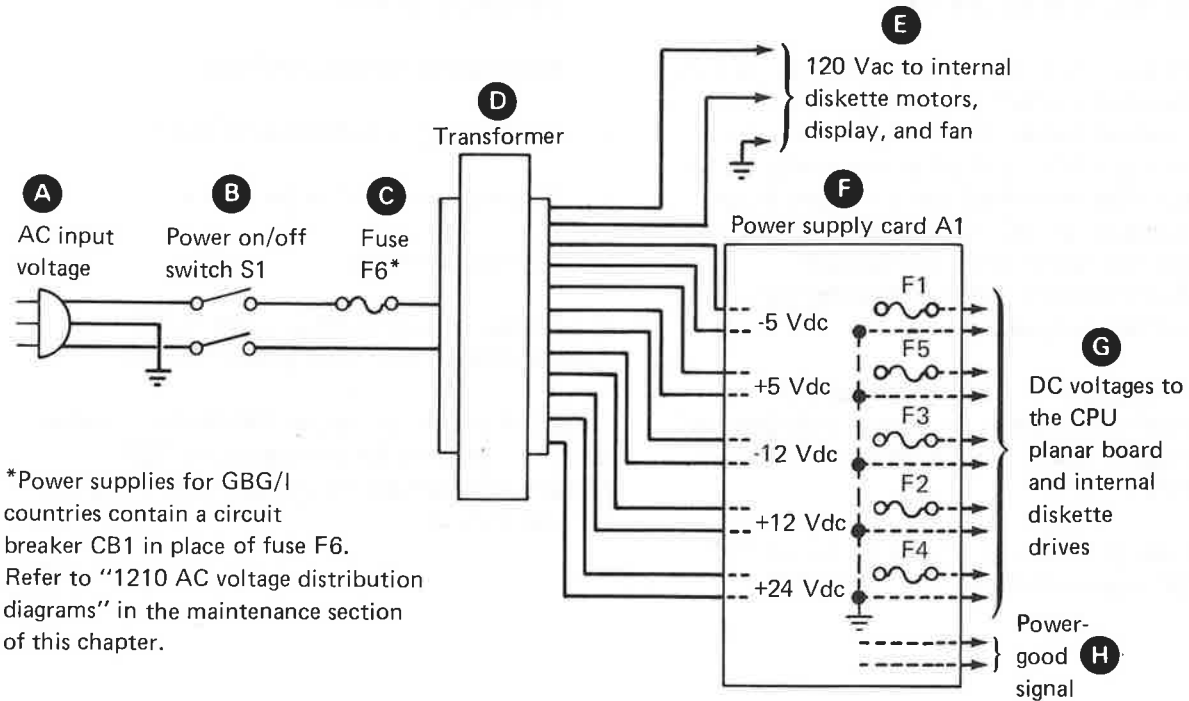
The ac input voltage connects to the power supply through a three-prong, grounded connector **A**. When the power switch **B** is set to the on position, the ac input voltage is supplied to the primary side of the transformer **D**. Fuse F6 **C** is the overcurrent protection for the ac input voltage.

Six output voltages are available from the power supply. Five of these voltages are converted to dc voltages and filtered by the power supply A1 card **F**. The dc output voltages **G** from the A1 card are -5, +5, -12, +12, and +24 Vdc. The sixth output voltage,

120 Vac **E**, is used to operate the internal diskette motors, the CRT display unit, and the cooling fan.

The power-good signal **H** becomes active when the -5, +5, -12, and +12 Vdc voltage levels are within approximately 80 percent of their nominal operating levels (see "Output voltages" later in this chapter). A light emitting diode (LED), which is visible from the rear of the power supply, indicates the status of the power-good signal. The power-good LED is on when the power-good signal is active.

Transistor-switching-regulator (TSR) power supply description. The description for the operation of the TSR power supply is similar to that for the ferroresonant power supply except that the TSR type contains a transistor-switching-regulator card instead of card A1 **F**.



Theory of operation

Functional description (continued)

Input voltages. The ac input voltage options that can be used to power the 5322 are as follows:

Canada and United States

- 60 Hz (59.5 to 60.5 Hz)
 - 120 Vac (102 to 127 Vac)

General Business Group/International (GBG/I)

- 50 Hz (49.5 to 50.5 Hz)
 - 100 Vac (90 to 110 Vac)
 - 110 Vac (96.5 to 119 Vac)
 - 200 Vac (180 to 220 Vac)
 - 220 Vac (193 to 238 Vac)
 - 230 Vac (202 to 249 Vac)
 - 240 Vac (210 to 259 Vac)
- 60 Hz (59.5 to 60.5 Hz)
 - 100 Vac (90 to 110 Vac)
 - 110 Vac (96.5 to 119 Vac)
 - 120 Vac (104 to 127 Vac)
 - 127 Vac (111 to 137 Vac)
 - 200 Vac (180 to 220 Vac)
 - 208 Vac (180 to 220 Vac)
 - 220 Vac (193 to 238 Vac)
 - 240 Vac (208 to 254 Vac)

Note that there is only one input voltage option for machines manufactured for use in Canada and the United States. Machines manufactured for use in the GBG/I countries are designed to permit the Customer Engineer to select input voltage options of 100 Vac to 240 Vac (see the ac voltage charts in "1210 AC voltage distribution diagrams" in the maintenance section of this chapter).

Output voltages. The power supply generates the following six output voltages and a power-good signal for the internal operation of the 5322:

- 120 Vac (101 to 130 Vac at 50 Hz, or 101 to 130 Vac at 60 Hz)

- -5 Vdc (-4.6 to -5.5 Vdc)
- +5 Vdc (+4.6 to +5.5 Vdc)
- -12 Vdc (-11.0 to -13.2 Vdc)
- +12 Vdc (+11.0 to +13.2 Vdc)
- +24 Vdc (+22.0 to +26.4 Vdc)
- Power-good signal (+2.4 to +5.5 Vdc when active; 0.0 to +0.4 Vdc when not active)

The CRT display unit, which contains its own power supply, does not use any of the 5322 power supply dc voltages.

Grounding. The importance of a correctly grounded electrical circuit cannot be over emphasized. The IBM System/23 Computing System will not operate correctly and can be a safety hazard if it is not grounded.

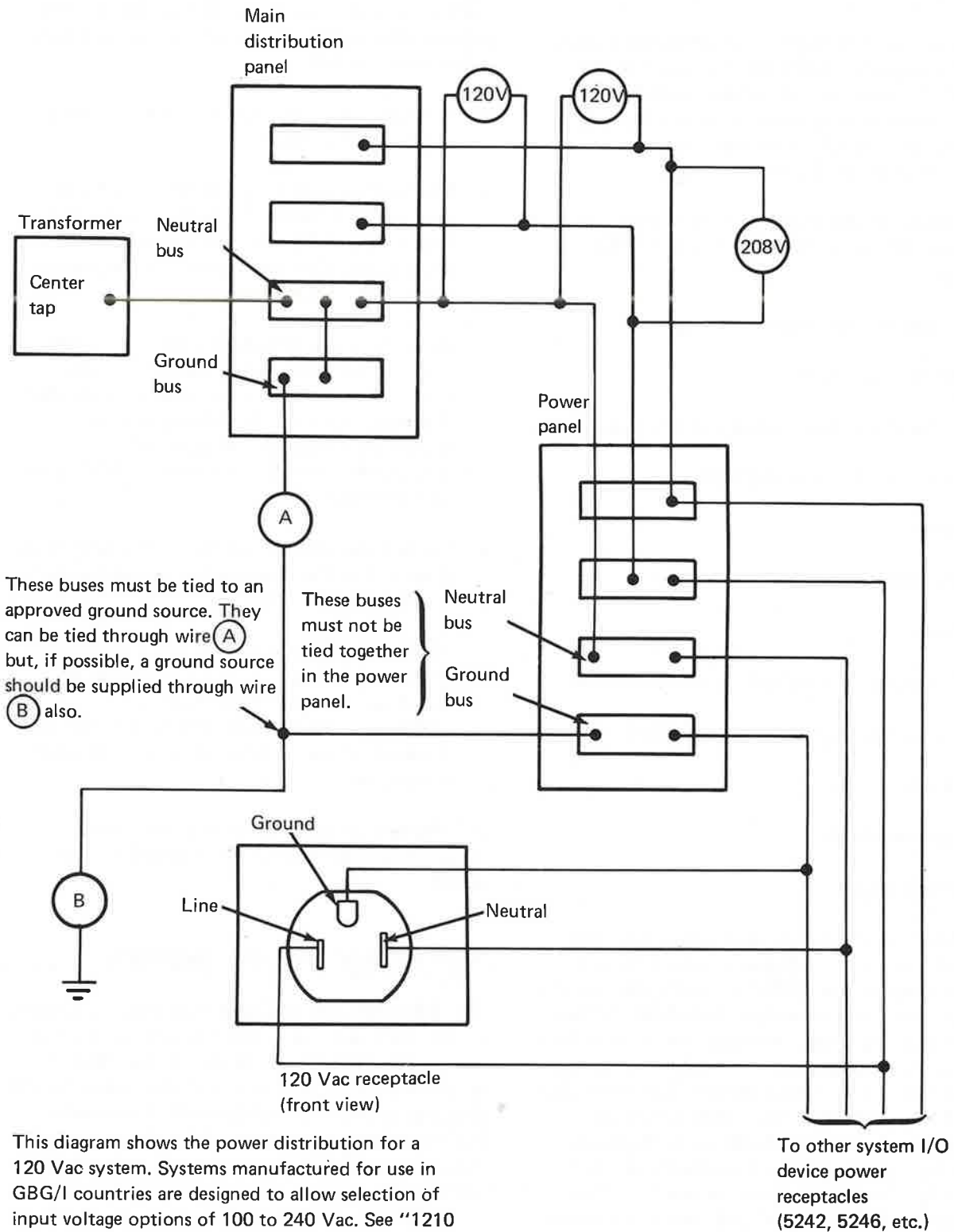
Symptoms of a system that is not correctly grounded can be:

- Electrical shock to machine operators and service personnel
- Intermittent machine failures
- Programs not operating correctly
- Diskette read and write errors
- Machine damage

All system devices (5322, 5242, 5246, etc.) should share a common ground source.

A typical office ac power distribution system that can be used for powering an IBM System/23 Computing System is shown on the following page.

AC power distribution in a typical commercial building



This diagram shows the power distribution for a 120 Vac system. Systems manufactured for use in GBG/I countries are designed to allow selection of input voltage options of 100 to 240 Vac. See "1210 AC voltage distribution diagrams" in the maintenance section of this chapter.

Theory of operation

5322 computer diagnostics

Power-on diagnostic

The power-on diagnostic is located in the 5322 read-only storage (ROS) and executes (1) at every 5322 power-on, (2) when the ROS resident diskette diagnostic is ended by a "g" key command, or (3) when the diagnostic control program (DCP) is terminated.

The purpose of this diagnostic is to test and verify the base operating units of the 5322, including:

- CPU planar board microprocessor
- Read-only storage
- Read/write storage (data and addresses)
- Direct memory access (DMA)
- Interrupt
- Translator
- Timers
- CRT vertical, horizontal, and video drives
- Keyboard microprocessor and ROS
- Diskette adapter
- Printer controller
- Printer wrap

The power-on diagnostic is divided into test routines. Errors sensed during a test routine are identified by two different methods. During the first test routines of the diagnostic (before the CRT display unit is started), an error causes the 5322 to stop and set the active test routine number into the CE test register. The eight pins of the CE test register represent a two-digit hexadecimal number and can be probed with the CE logic probe. The CE register test pins and hexadecimal values are shown in "1230 CPU planar board" in the maintenance section of this chapter.

After the CRT display unit is started, the test routine numbers are displayed on the display screen. The ending status of each of the tests is indicated as follows:

- Normal display number—the test routine ran without error.
- Flashing reverse video number—an error was sensed during the test of a system unit that is critical to system operation. The 5322 stops after the power-on diagnostic sequence is completed.
- Reverse video display number—an error was sensed during the test of a system unit that is not critical to system operation. Pressing the Error Reset key when the power-on diagnostic sequence is completed permits the system initialization to continue.
- Underlined display number—the feature or device that this test routine checks is not attached to the 5322.
- Trap message (displayed at the bottom of the display screen)—a machine check occurred during the running of the diagnostic. The failure occurred in the test routine following the last routine number displayed.

A complete description of the power-on diagnostic is located in the diagnostic user guide.

ROS resident diskette diagnostic

The ROS resident diskette diagnostic is located in the 5322 read-only storage and is used to test and verify the operation of the diskette attachment card and the read data path for the diskette drives. This diagnostic is normally used to isolate failures in the diskette drives that prevent the diskette resident diagnostics from being loaded.

A complete description of the ROS resident diskette diagnostic is located in the diagnostic user guide.

CE diskette resident diagnostics

The CE diskette resident diagnostics are located on the CE diagnostic diskette and execute under control of the diagnostic control program (DCP). These diagnostics are mainly fault locating tests (FLT) and are used to sense and isolate failures in the processing unit, storage, feature attachments, and I/O

devices. CE utility programs (copy diskette, format diskette, configuration display, etc.) are also on the CE diagnostic diskette.

The instructions for using these diagnostics and utility programs are in the diagnostic user guide.

Chapter 3. Keyboard

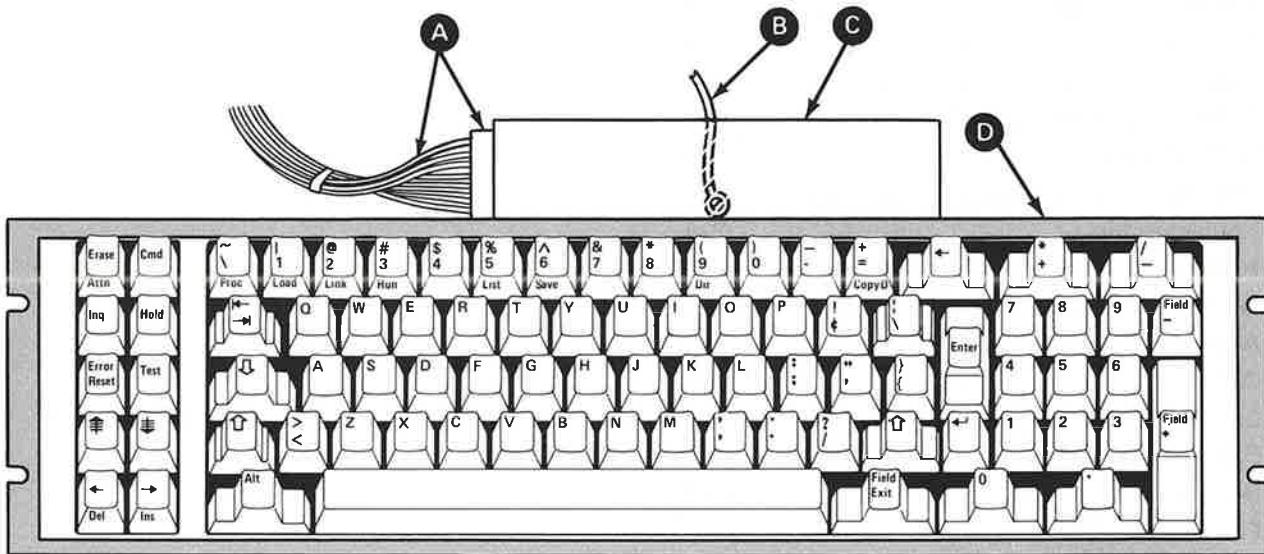
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Maintenance procedures

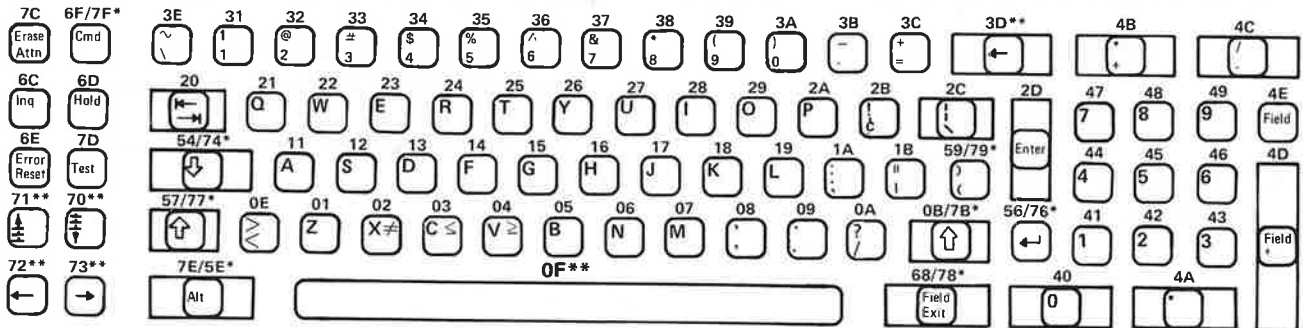
1300 Locations

- A** Cable and connector
- B** Ground wire
- C** Circuit card
- D** Base and capacitive matrix



1310 Keyboard scan codes

Note: All keyboard models provide the same hexadecimal scan codes.



*Make/break key
 **Typamatic key

Hexadecimal value to scan code bit conversion:

The scan codes shown in this diagram are hexadecimal values. Scan codes are transferred from the keyboard to the processing unit on scan code bit lines 0 – 6. To determine the relationship of the hexadecimal value to the actual scan code bits, use the following chart:

Hexadecimal value	4	2	1	8	4	2	1
Scan code bits	0	1	2	3	4	5	6

Example:
 The A key (hex 11) → X X
 is represented by
 scan code bits 2 and 6.

Maintenance procedures

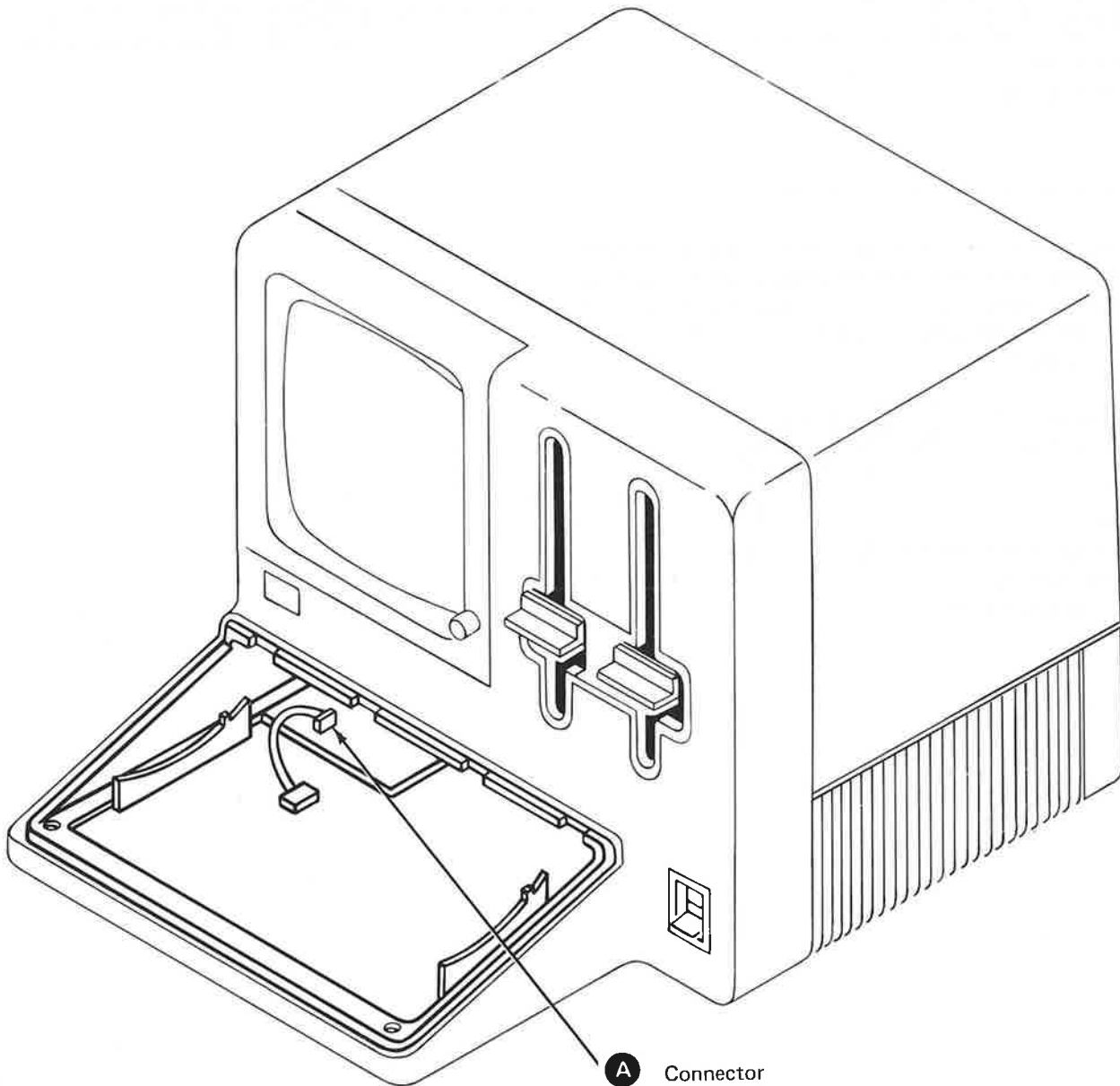
1320 Keyboard cable

Removal

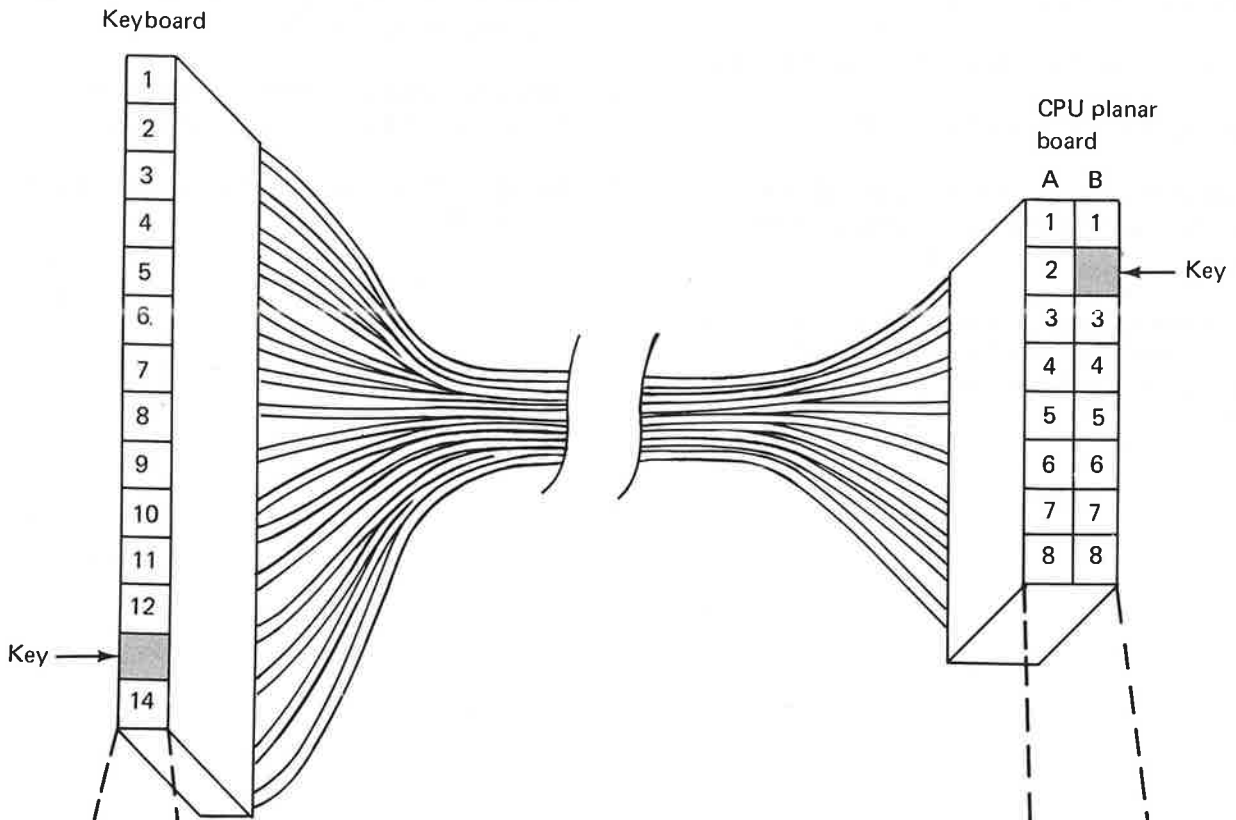
1. Switch off the 5322 power.
2. Remove the keyboard (1330).
3. Disconnect the keyboard cable from the connector **A** on the CPU planar board.

Replacement

1. Connect the keyboard cable to the connector **A** on the CPU planar board.
2. Install the keyboard and keyboard cover (1330).



Cable pin assignments



Pin number	Line name	Signal direction	Pin number
1	Scan code bit 0	→	A5
2	+5 Vdc	←	A6
3	Scan code bit 1	→	A7
4	Ground	←	A8
5	Scan code bit 2	→	B8
6	Scan code bit 3	→	B7
7	Scan code bit 4	→	B6
8	Scan code bit 5	→	B5
9	Delay strobe	←	A2
10	Scan code bit 6	→	B4
11	Not used		
12	Program reset	←	B1
Key			Key
14	Data strobe	→	B3

Keyboard

Maintenance procedures

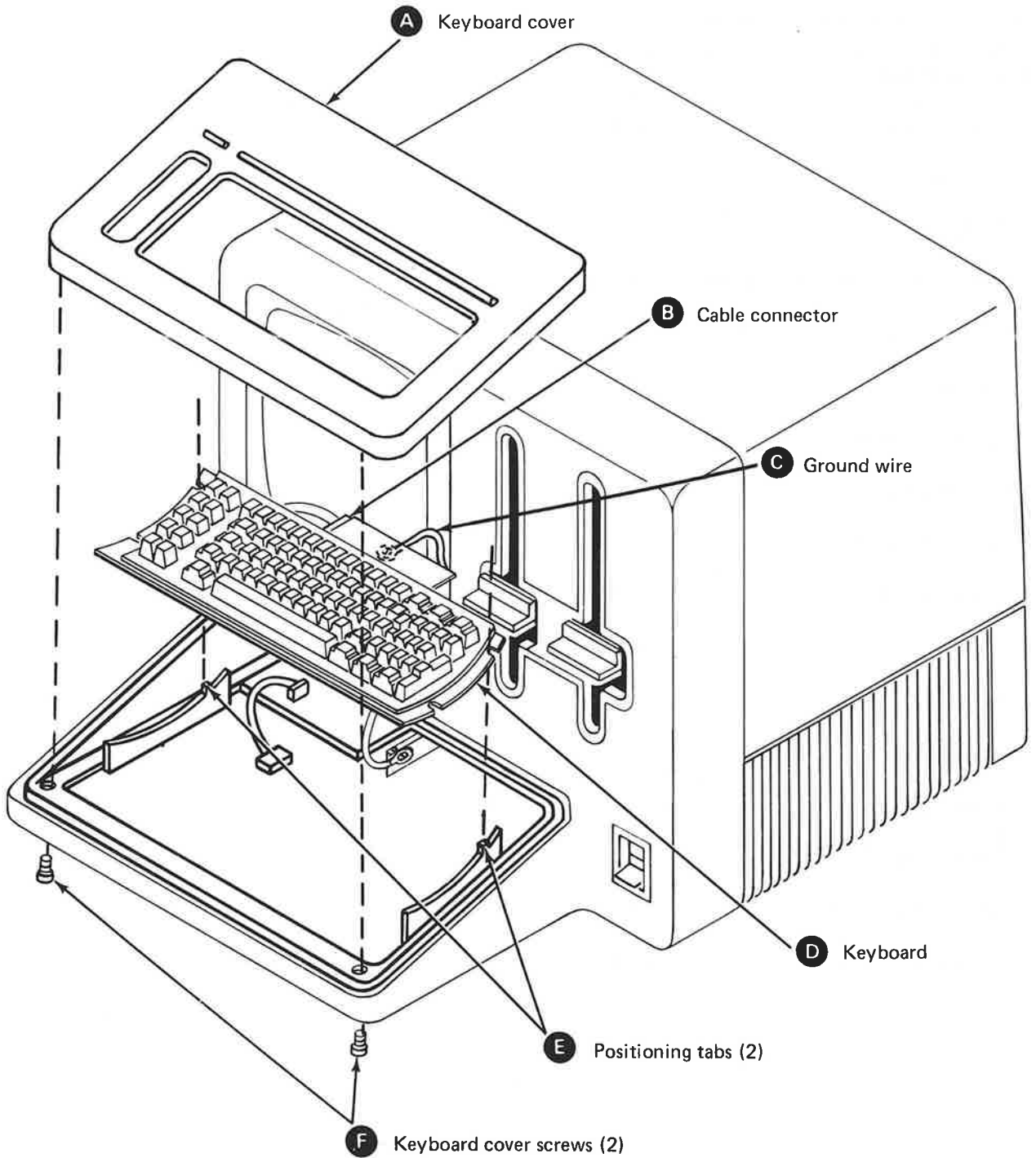
1330 Keyboard

Removal

1. Switch off the 5322 power.
2. Remove the two keyboard cover screws **F**.
3. Remove the keyboard cover **A**.
4. Disconnect the cable connector **E** and the ground wire **C** from the keyboard circuit card.
5. Lift the keyboard **D** upward and remove it from the 5322. Notice that the keyboard is held in place by the two positioning tabs **E**.

Replacement

1. Place the keyboard **D** into position on the two positioning tabs **E**.
2. Connect the cable connector **E** and the ground wire **C** to the keyboard circuit card.
3. Install the keyboard cover **A** and two cover screws **F**.



Keyboard

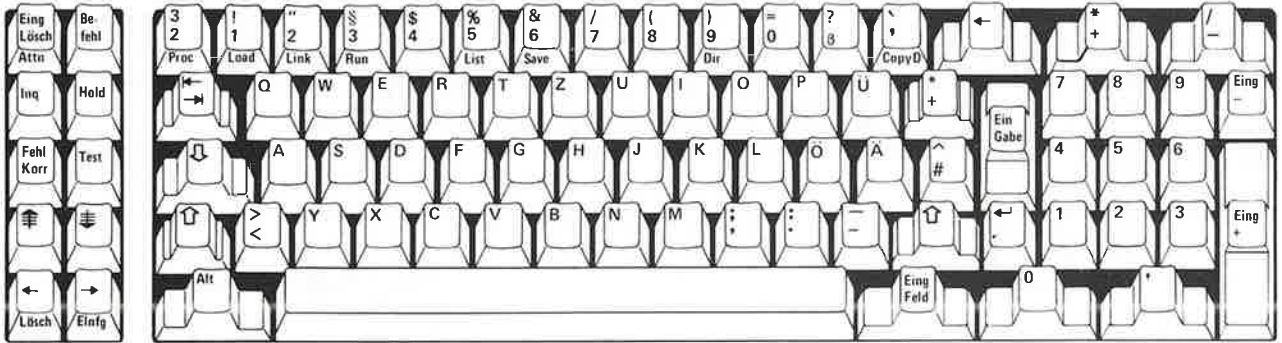
Maintenance procedures

1340 Keyboard/language arrangement diagrams

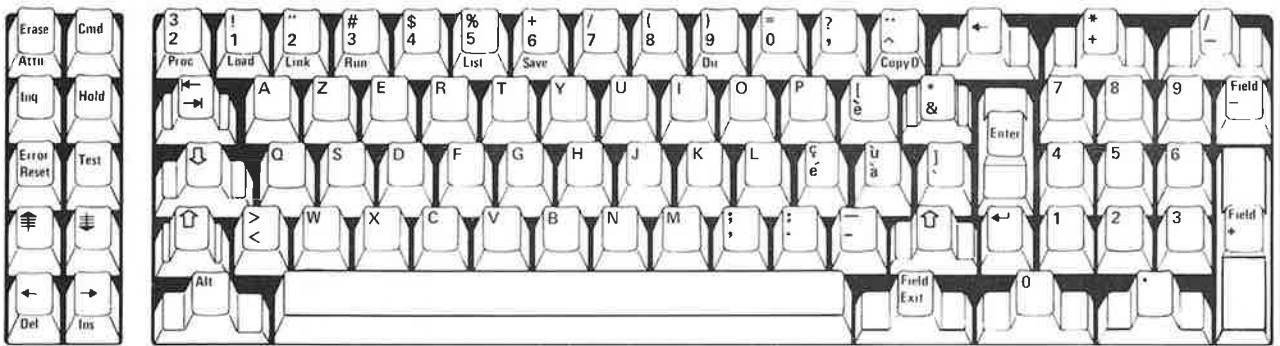
This section contains the arrangement diagrams for the various keyboard language groups, as follows:

Language group	Page
• Austria/Germany	3-9
• Belgium	3-9
• Canada (English)/United States	3-9
• Canada (French)	3-10
• Denmark	3-10
• Finland/Sweden	3-10
• France (AZERTY)	3-11
• France (QWERTY)	3-11
• International	3-11
• Italy	3-12
• Japan	3-12
• Norway	3-12
• Spain/Spanish	3-13
• Switzerland (French)	3-13
• Switzerland (German)	3-13
• United Kingdom	3-14

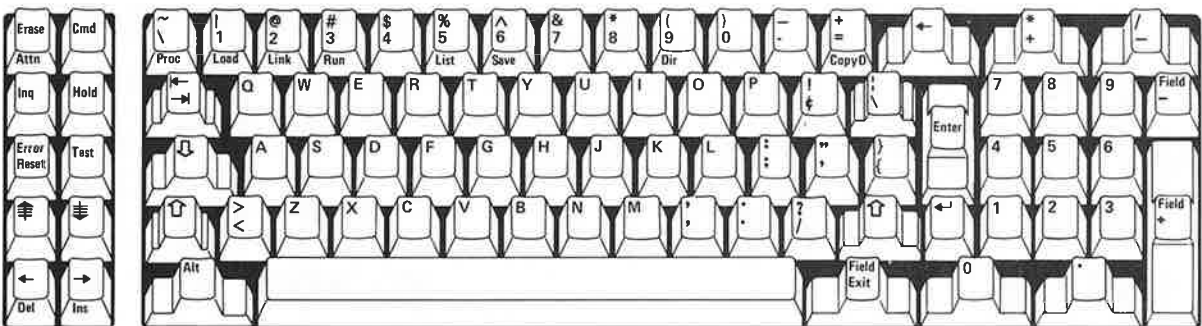
Austria/Germany



Belgium



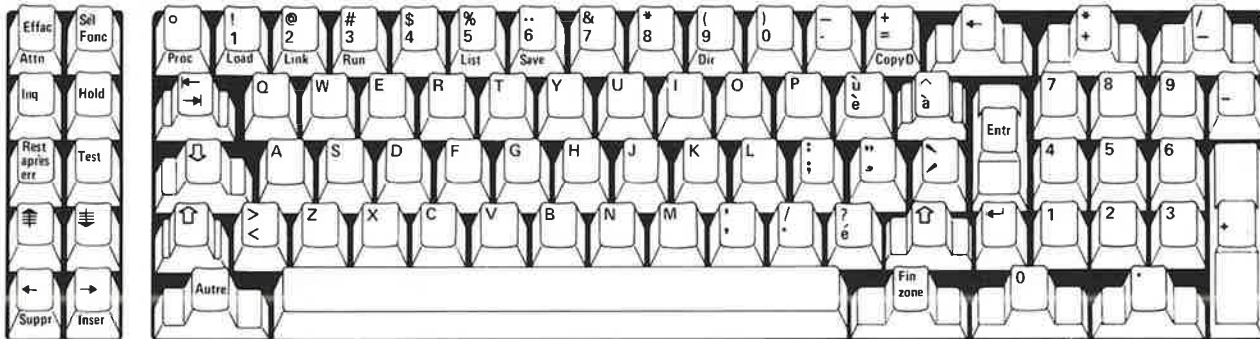
Canada (English)/United States



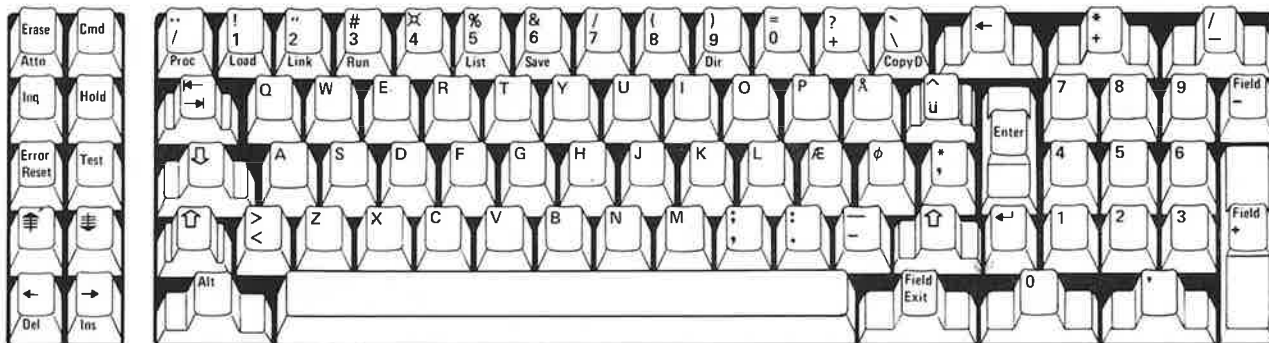
Maintenance procedures

1340 Keyboard/language arrangement diagrams (continued)

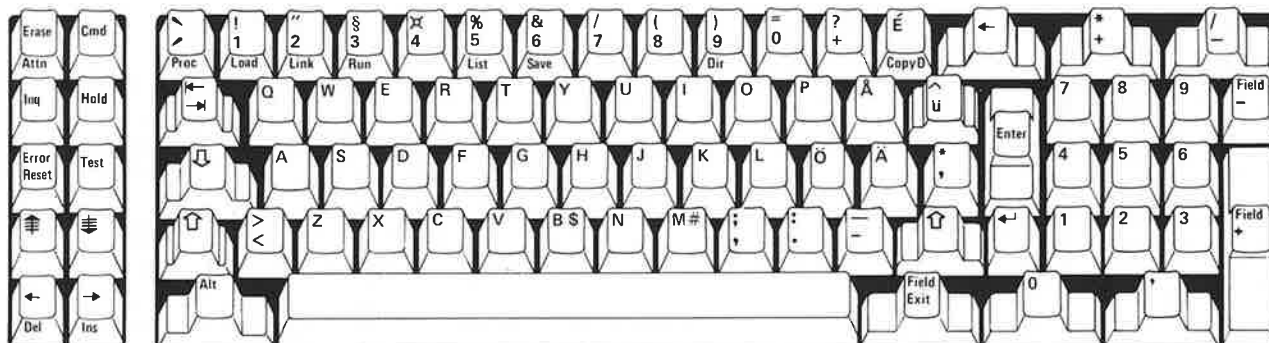
Canada (French)



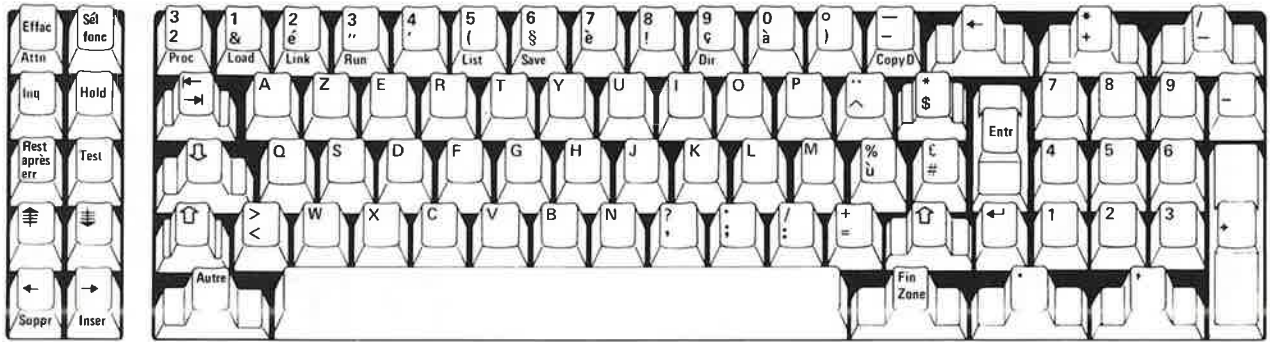
Denmark



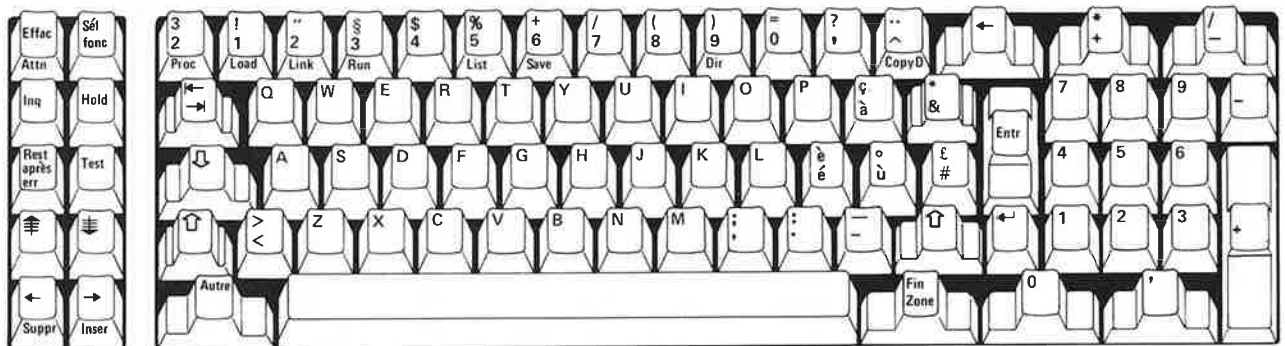
Finland/Sweden



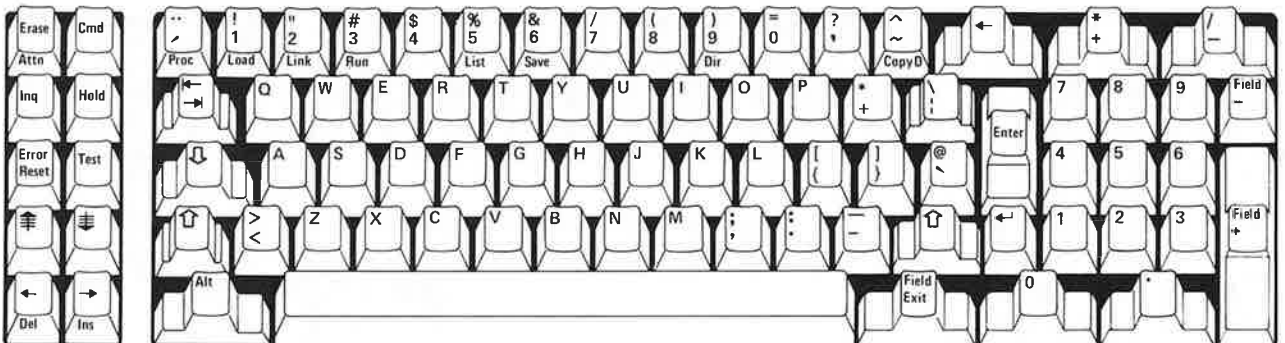
France (AZERTY)



France (QWERTY)



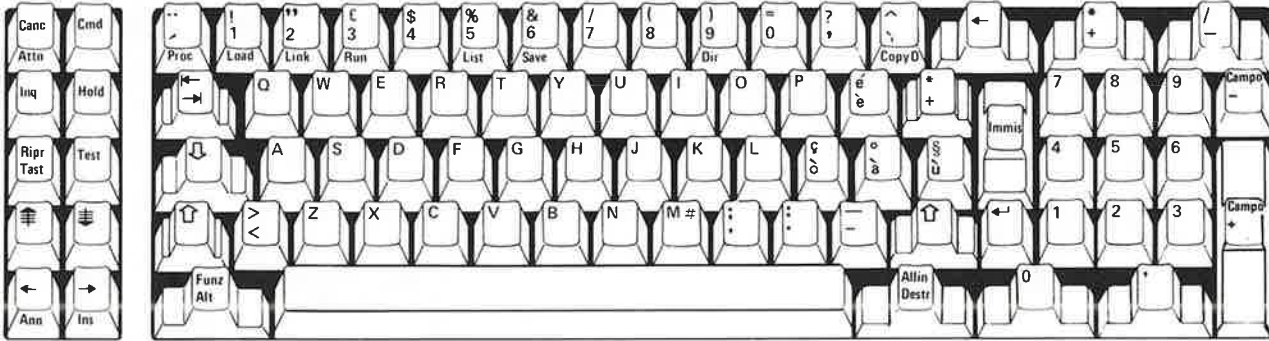
International



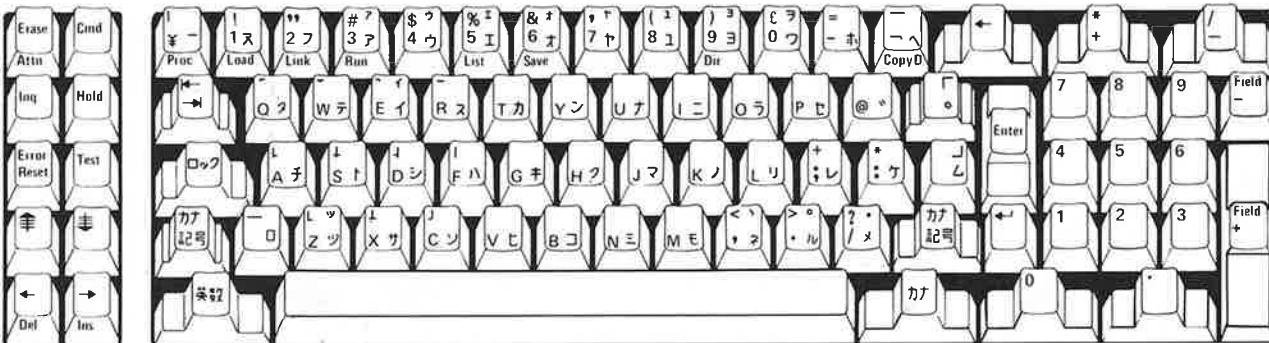
Maintenance procedures

1340 Keyboard/language arrangement diagrams (continued)

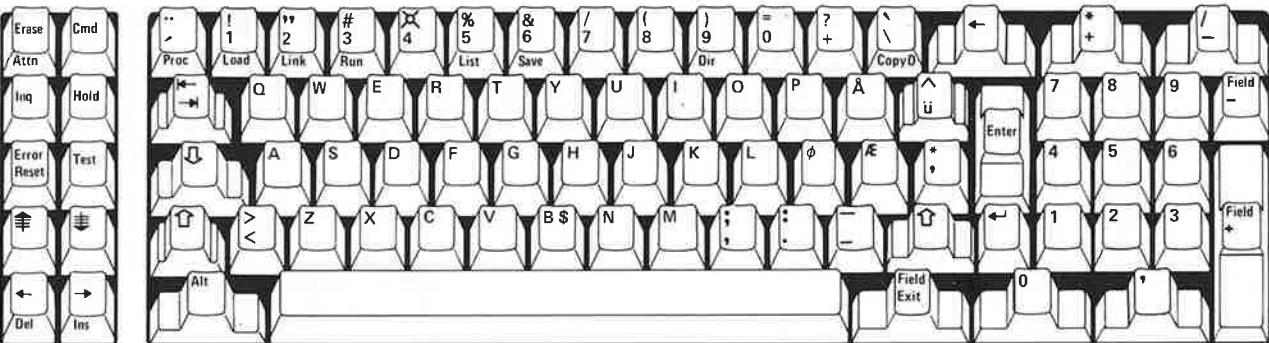
Italy



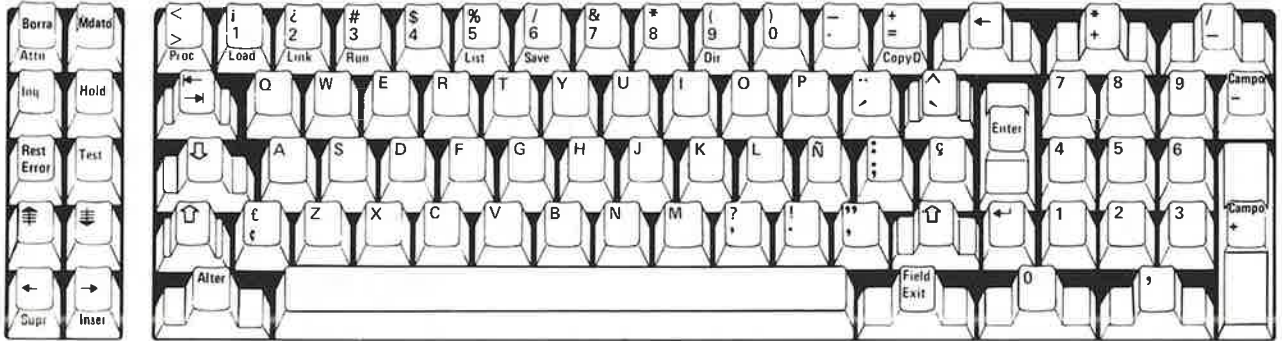
Japan



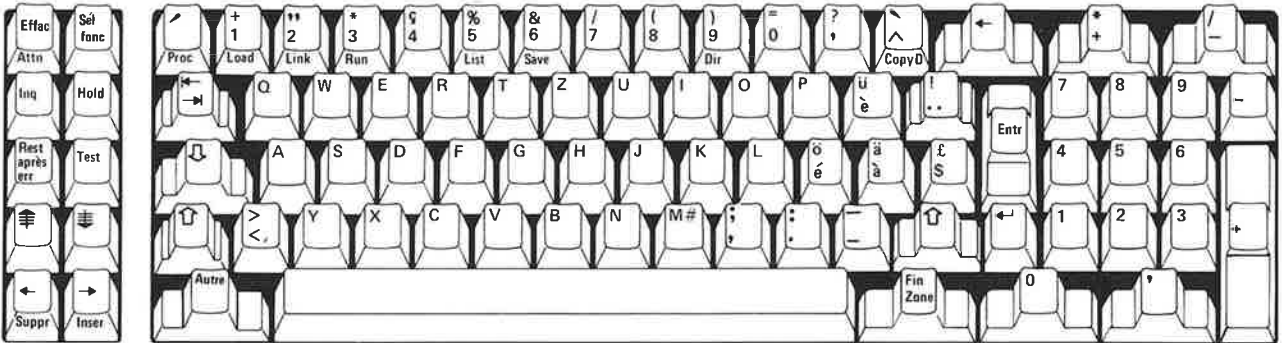
Norway



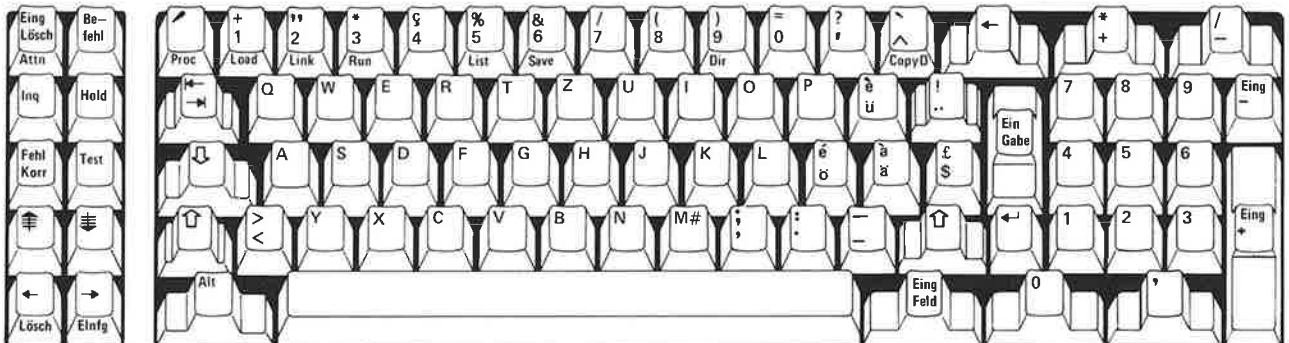
Spain/Spanish



Switzerland (French)



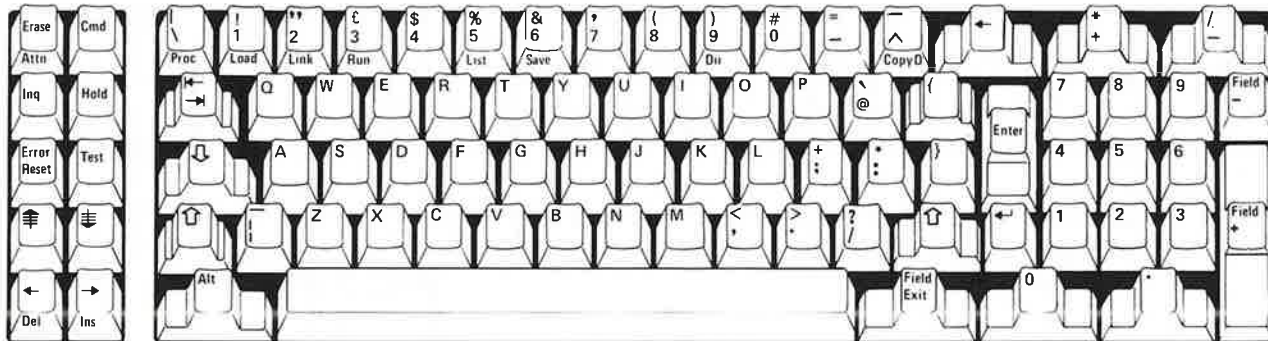
Switzerland (German)



Maintenance procedures

1340 Keyboard/language arrangement diagrams (continued)

United Kingdom



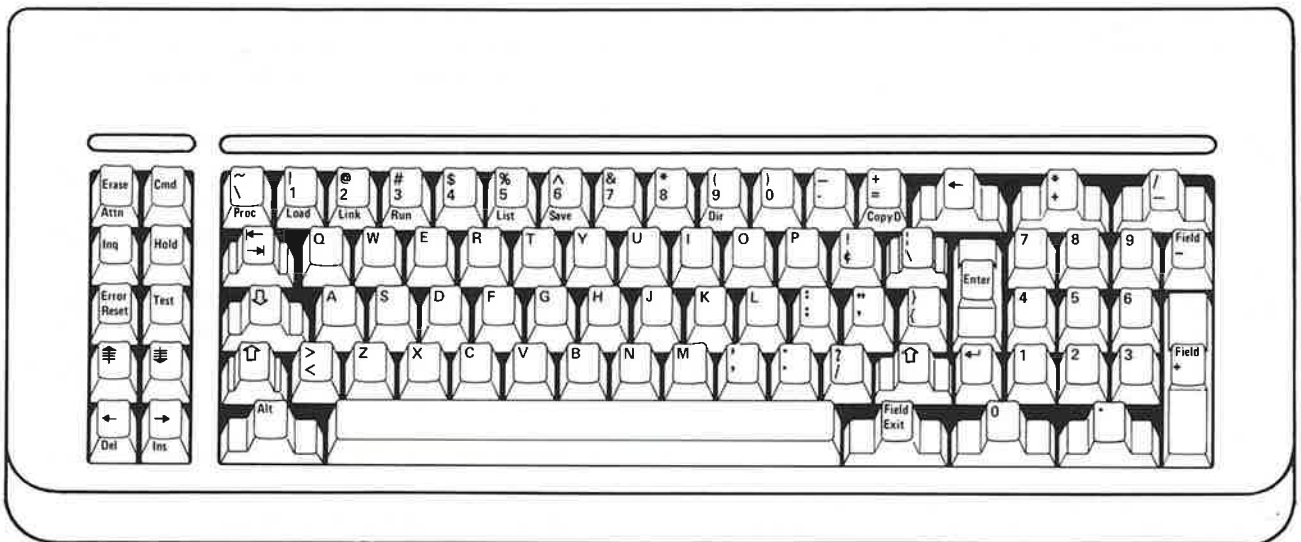
Theory of operation

Introduction

The keyboard is used to enter data, BASIC program commands, and control functions into the 5322 computer. The keyboard contains 83 keys, which are divided into three groups:

- Standard typewriter (alphanumeric) keys
- Numeric keys
- Function and control keys

When the 5322 is powered-on and operating under control of the BASIC control program, the keyboard permits the operator to enter programs and data, communicate with the executing program, and control the operation of the system. When the 5322 is operating under control of the diagnostic control program, the keyboard is used to call, enter responses to, and control the diagnostic programs.



Keyboard

Theory of operation

Keyboard operations

Keyboard operations in BASIC mode

In BASIC mode, the keyboard is fully operational, and all keys (alphameric, numeric, function, and control) can be used. A complete description of BASIC keyboard operations is located in the User Library manual, *Operator Reference*, SA34-0108.

BASIC mode can be canceled and the 5322 put into diagnostic mode by holding down the Cmd (Command) key **G** and pressing the Test key **H**, then by holding down the Cmd key again and pressing the Error Reset key. Only a 5322 power-on will restart BASIC.

Keyboard operations in diagnostic mode

In diagnostic mode, keyboard operations are limited, and only the keys described in this section are used to communicate with the diagnostic programs. The United States keyboard is shown in the diagram. See "1340 Keyboard/language arrangement diagrams," in this chapter, for the keyboard arrangements used in other countries.

A Attention key. This key (Attn) is used, as described in the diagnostic user guide, to

interrupt or control the executing sequence of the diagnostic programs.

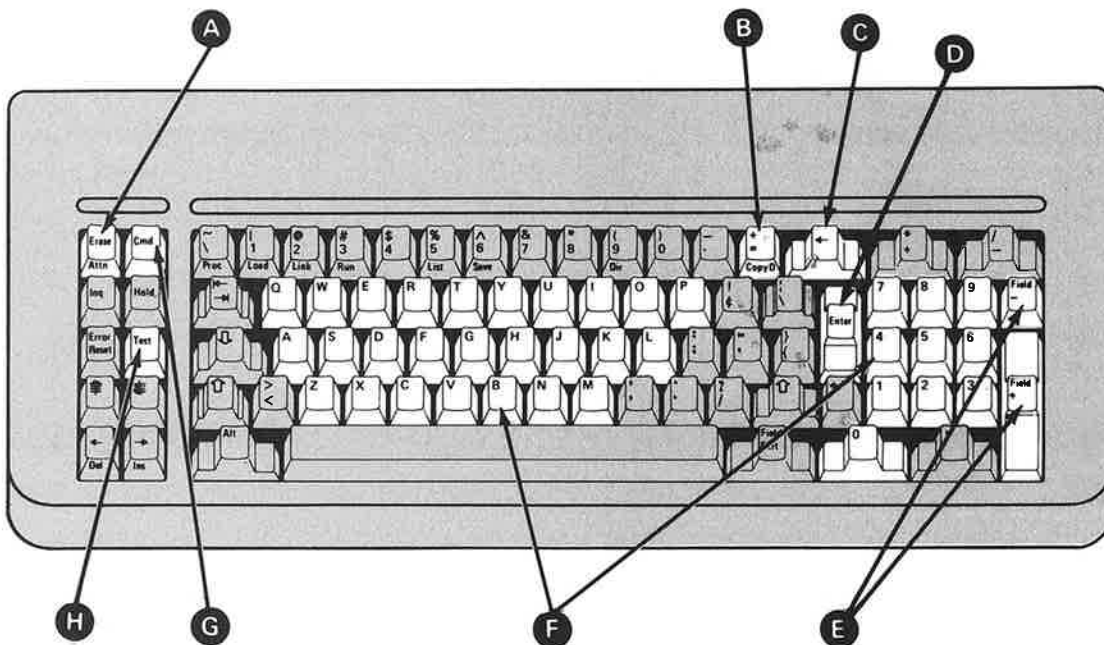
B Copy Display key. This key sets the alternate print option in the diagnostic control program. Pressing the Attn (Attention) and the Copy D (Copy Display) key causes all following CRT screen displays to print on the system printer (if attached). The alternate print option can be canceled by pressing the Attn (Attention) and the 0 (Zero) key.

C Backspace key. This key causes the cursor, which is displayed on the display screen, to move one position to the left. If there is a character above the cursor, it is erased.

D Enter key. This key causes the 5322 to either start processing data entered from the keyboard or to restart an interrupted operation.

E Field - and field + keys. These keys are used for the ROS resident diskette diagnostic (PID 1500) and are described in that section of the diagnostic user guide.

F Alphabetic and numeric keys. These keys are used to select the diagnostic programs and program options.



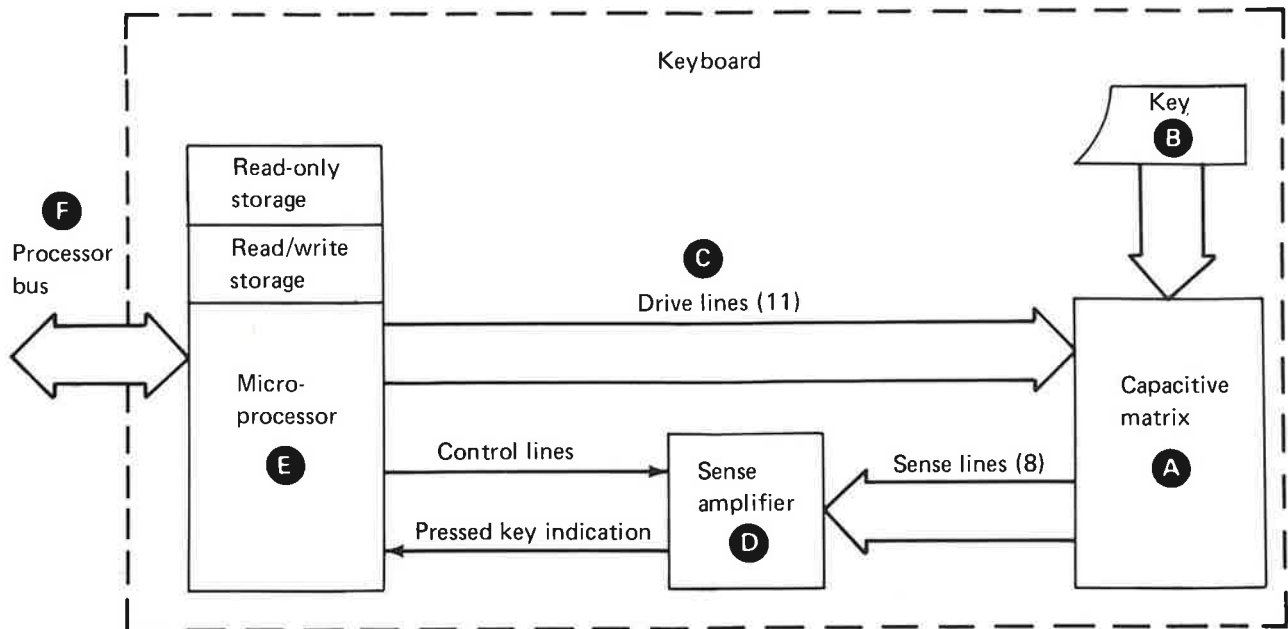
Functional description

Keyboard data flow

The keyboard assembly contains 83 keys, a keyboard base, capacitive matrix, and an electronic circuit card. The electronic circuit card contains a sense amplifier, a microprocessor with read-only and read/write storage, and the circuits needed to communicate with the 5322 data, address, and control buses. The complete keyboard assembly is a field replaceable unit (FRU).

The following sequence describes the data flow for a keyboard operation:

- A** The capacitive matrix contains a capacitor for each key. The capacitors are located under the keys and are part of the keyboard base.
- B** When a key is pressed, the capacitance of the key's capacitor increases.
- C** The keyboard microprocessor uses eleven drive lines to repeatedly scan the capacitive matrix.
- D** The increased capacitance of the active key's capacitor permits the drive-line scan pulse to appear at one of the eight input lines to the sense amplifier.
- E** The keyboard microprocessor uses the combination of the active drive line and sense amplifier input line to generate a scan code character (1 of 88) to determine which key was active when the scan pulse was sensed. Only 83 of the 88 scan codes are used for the 5322 keyboard.
- F** An interrupt request, indicating that the scan code character is available, is sent to the 5322 processing unit. Any additional keyboard interrupts are inhibited until this interrupt is serviced and the scan code character is read by the 5322.



Theory of operation

Functional description (continued)

Key types

Three types of keys are used in the 5322 keyboard: make-only, make/break, and typamatic.

Make-only keys. A make-only key causes one scan code character and interrupt to be generated when the key "makes."

Make/break keys. A make/break key causes one scan code character and interrupt to be generated when the key "makes" and a second scan code character and interrupt to be generated when the key "breaks."

Typamatic keys. A typamatic key causes a scan code character and interrupt to be generated repeatedly at the rate of approximately 10.4 characters-per-second for as long as the key is pressed down.

Keyboard scan codes

A scan-code chart is located in "1310 Keyboard scan codes" in the maintenance section of this chapter. The chart also indicates the type of key (make-only, make/break, or typamatic).

Keyboard diagnostics

Power-on diagnostic

The power-on diagnostic is contained in the 5322 read-only storage (ROS) and executes (1) at every system power-on, (2) when the ROS resident diskette diagnostic is ended by a "9" key command, or (3) when the diagnostic control program is terminated.

The keyboard section of the power-on diagnostic issues a program reset to the keyboard. This reset causes the keyboard microprocessor to perform a "self-test," which checks the operation of the keyboard's microprocessor, read-only storage, and read/write storage. The test also includes a keyboard scan to check for any active (binding) keys. When the test ends, the keyboard starts normal scanning operations.

See the diagnostic user guide for a description of the power-on diagnostic error codes.

CE diskette resident diagnostics

The CE diskette resident diagnostics for the keyboard are located on the CE diskette and execute under control of the diagnostic control program. These tests permit you to verify the manual keyboard operations and to display the scan code character as each key is operated.

A complete description of the CE diskette resident diagnostics is located in the diagnostic user guide.



Chapter 4. CRT display unit

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Maintenance procedures

Safety

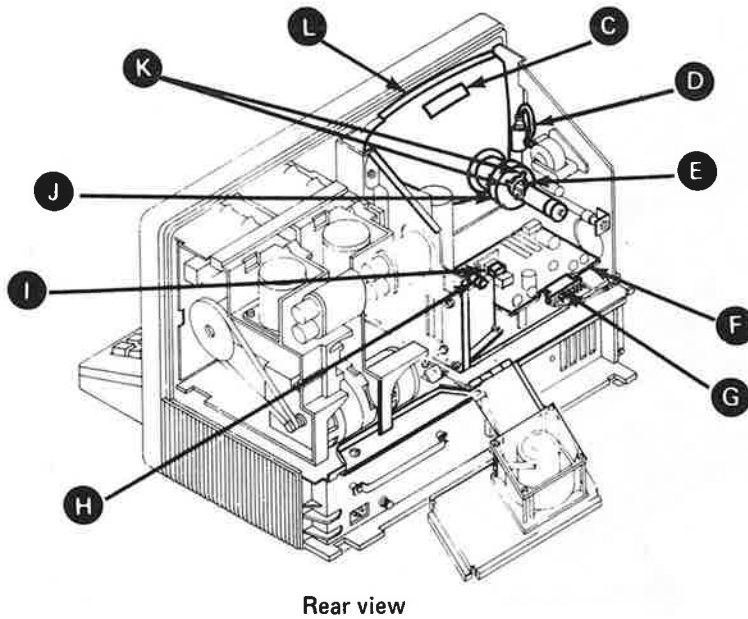
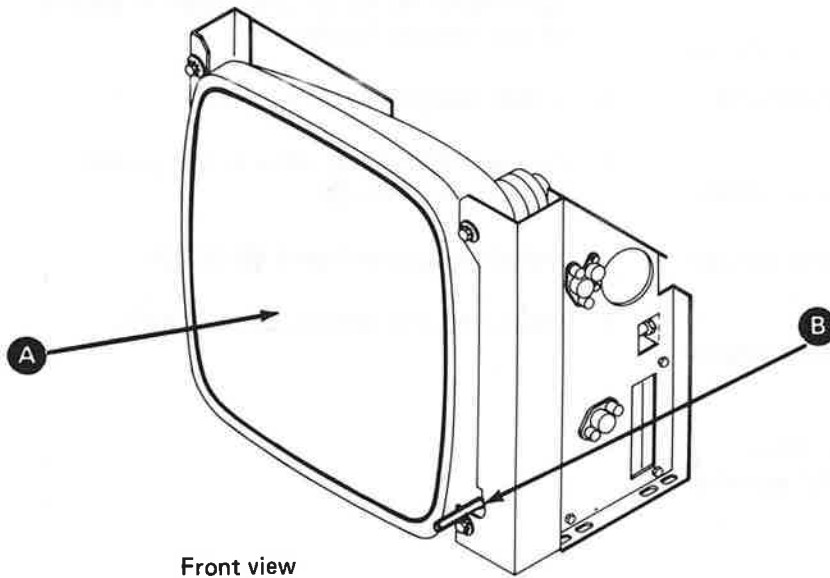
DANGER

To ensure your safety, you must be especially careful of the dangerous voltages contained in the display unit power supply and cathode ray tube (CRT).

Use care when working near an uncovered CRT. Do not place unusual pressure on the CRT; it contains a high vacuum and is subject to implosion that can propel broken glass and cause personal injury.

1400 Display unit locations

- A** CRT screen
- B** Operator's brightness control
- C** Adjustment label
- D** High-voltage anode lead
- E** Yoke clamping screw
- F** Circuit board
- G** Signal cable connector
- H** AC fuse
- I** Power cable plug P3
- J** Deflection yoke
- K** Centering rings
- L** Cathode-ray tube (CRT)



Maintenance procedures

1411 Display unit signal cable

DANGER

The CRT high-voltage anode lead contains 15,000 volts. Keep hands and tools away from this lead.

The CRT contains a high vacuum and could implode if unusual pressure is placed on it.

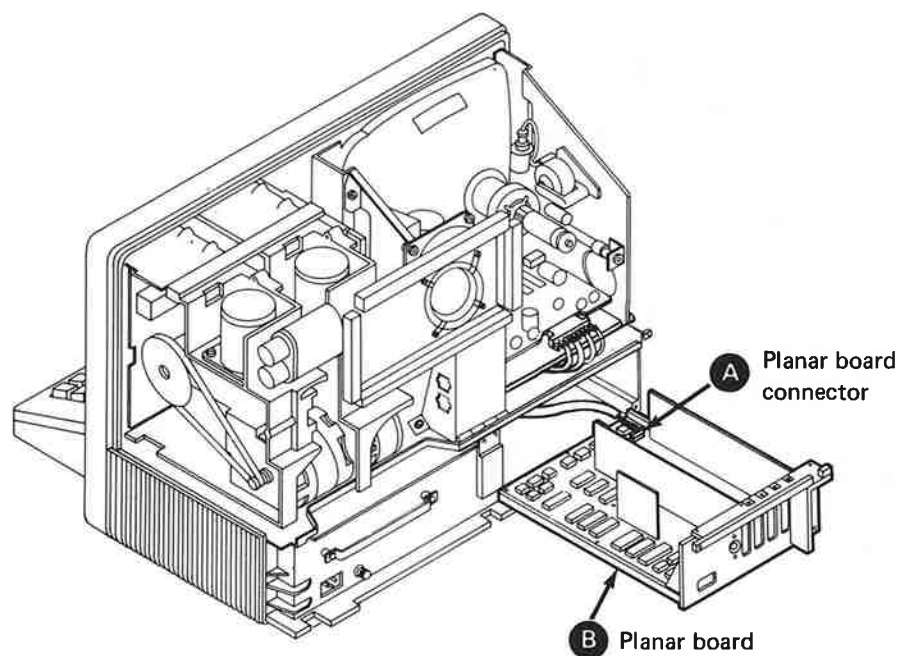
Removal

1. Do Steps 1–7 of the display unit removal procedure (1430).
2. Remove the 5322 rear access cover (1220).
3. Slide the planar board **B** out to the service position (1230).
4. Disconnect the signal cable from the planar board connector **A**.
5. Slide the display unit to the rear of the 5322 only enough to disengage it from the front mounting pins.

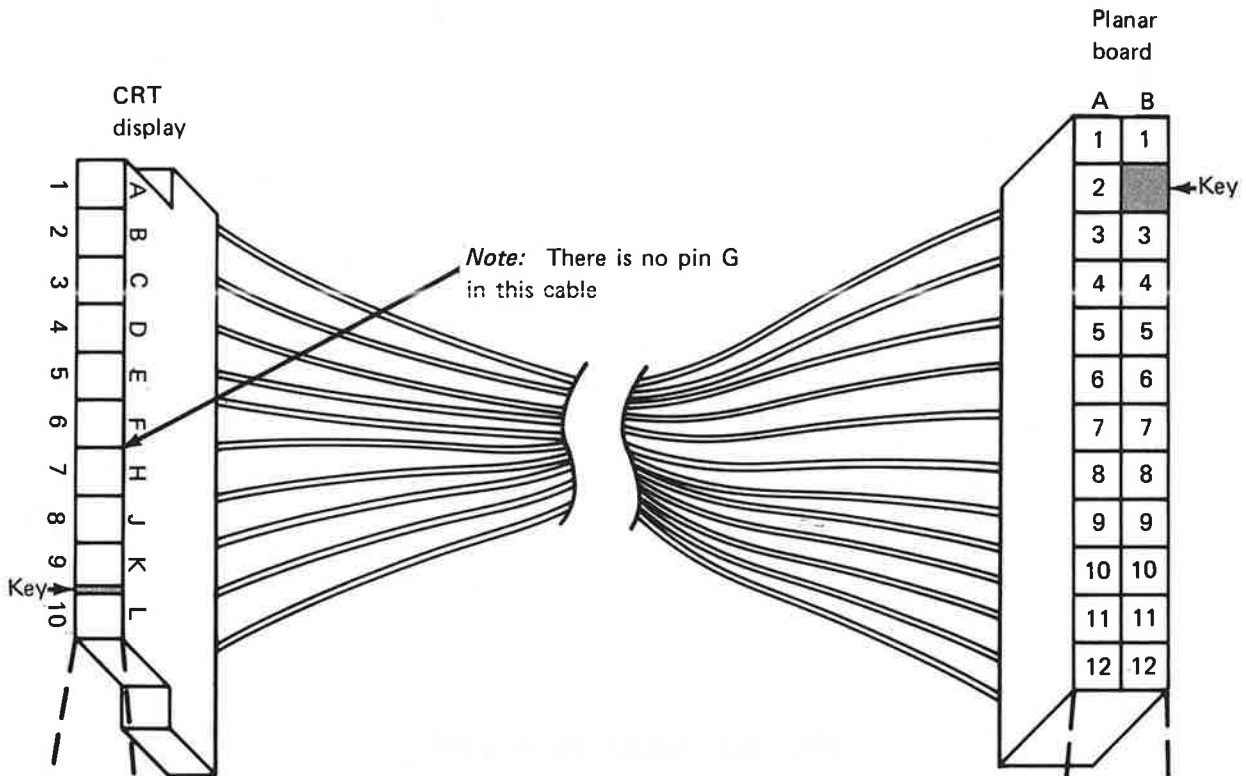
6. The signal cable access opening is under the display unit. Hold the display unit by the side frames and lift it to permit the cable to be pulled through the access opening.

Replacement

1. Install the cable through the access opening by using the procedure in Step 6 of the removal section.
2. Install the display unit (1430).
3. Connect the signal cable to the planar board connector **A**.
4. Install the planar board **B** (1230).
5. Install the rear access cover (1220).



Cable pin assignments



Pin number	Line name	Signal direction	Pin number
A/1	Horizontal retrace return	←	A5
B/2	Not used		
C/3	Not used		
D/4	Not used		
E/5	Not used		
F/6	Horizontal retrace signal	←	B05
H/7	Not used		
J/8	Video drive signal	←	A6
K/9	Vertical retrace signal	←	B7
L/10	Vertical retrace/video drive return	←	A7/B6

CRT display unit

Maintenance procedures

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1420 Display unit ac fuse

DANGER

*The CRT high-voltage anode lead contains 15,000 volts. Keep hands and tools away from this lead.
The CRT contains a high vacuum and could implode if unusual pressure is placed on it.*

Notes:

1. On some display units, which are manufactured for use in GBG/! countries, the ac fuse may be located on the display unit printed-circuit board.
2. If a label with the ac fuse part number is installed near the display unit fuse holder, use the fuse part number given on the label instead of the part number in the parts catalog.

Removal

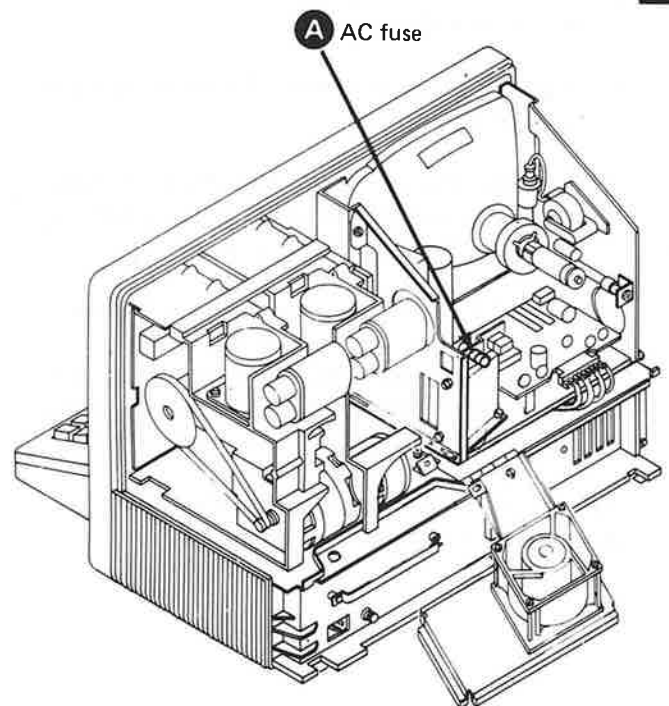
1. Switch off the 5322 power and disconnect the power cable from the ac service outlet.
2. Remove the 5322 rear access cover and top cover (1220).
3. Loosen the fan bracket holding screw and swing the hinged fan assembly away from the display unit (1270).
4. Turn the fuse cap counterclockwise and remove the cap and the ac fuse **A**.

Replacement

1. Insert the fuse into the fuse cap.
2. Insert the fuse cap and fuse **A** into the fuse holder and turn the fuse cap clockwise.
3. Swing the cooling fan up into position and tighten the holding screw (1270).
4. Install the 5322 top cover and rear access cover (1220).

Service check

1. Remove the fuse.
2. Use the CE meter set to the ohms RX1 position to check the fuse continuity. If the meter does not indicate a short circuit (0 ohms), install a new fuse of the *same* ampere rating.



CRT display
unit

Maintenance procedures

1430 Display unit

DANGER

The CRT high-voltage anode lead contains 15,000 volts. Keep hands and tools away from this lead.

The CRT contains a high vacuum and could implode if unusual pressure is placed on it.

Removal

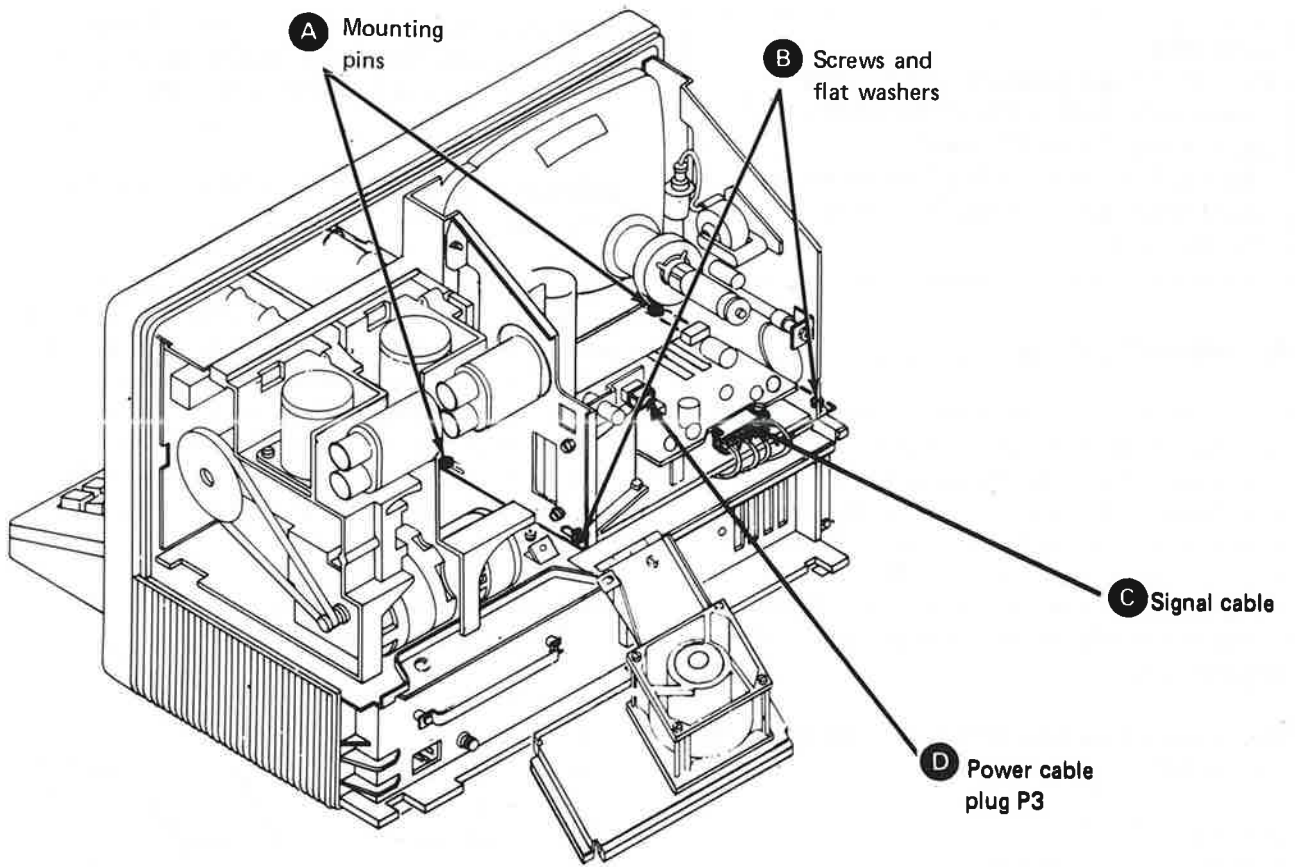
1. Switch off the 5322 power and disconnect the power cable from the ac service outlet.
2. Remove the 5322 rear access cover and top cover (1220).
3. Loosen the fan bracket holding screw and swing the hinged fan assembly away from the display unit (1270).
4. Disconnect the power cable plug P3 **D** from the display unit cable connector.
5. Disconnect the signal cable **C** from the circuit board.
6. Remove the two mounting screws and flat washers **E**.
7. Remove the operator's brightness control knob (located on the front of the 5322) by pulling it from the control shaft.
8. Hold the display unit by the side frames and slide it to the rear of the 5322 to disengage it from the front mounting pins **A**. Carefully lift the display unit out of the 5322 and place it on a safe, flat surface.

Note: Follow local regulations, if any, for disposal of cathode-ray tubes.

Replacement

Note: The new display unit may appear different than the old unit. Several manufacturers' display units are used in the 5322, and they are interchangeable.

1. Place the display unit into position and slide it to the front of the 5322 to engage the front mounting pins **A**.
2. Install, but do not tighten, the two screws and flat washers **E**.
3. Install the operator's control knob on the control shaft. Notice that the knob has a key that aligns with the control shaft.
4. Center the face of the display screen in the 5322 front cover opening and tighten the two screws **B**.
5. Connect the signal cable **C** to the circuit board.
6. Connect the power cable plug P3 **D** to the display unit cable connector.
7. Swing the cooling fan up into position and tighten the holding screw (1270).
8. Install the 5322 top cover and rear access cover (1220).



CRT display
unit

Maintenance procedures

1440 Display unit adjustments

DANGER

The CRT high-voltage anode lead contains 15,000 volts. Keep hands and tools away from this lead.

The CRT contains a high vacuum and could implode if unusual pressure is placed on it.

Adjustment preface

Several manufacturers' types of display units are used in the 5322 computer and are interchangeable with the originally installed unit. Some of the electrical adjustments in this section may not apply to all types of display units. The label on top of the CRT, which indicates the adjustment locations, shows which of the adjustments are present in the installed unit.

The adjustments that affect the display image on the CRT screen are:

Display image	Adjustment
Brightness	Operator's brightness control Brightness potentiometer Video drive potentiometer
Focus	Focus potentiometer
Tilt and centering	Horizontal centering potentiometer Centering rings Deflection yoke
Size	Vertical size potentiometer Horizontal width coil Deflection yoke
Vertical stability	Vertical hold potentiometer
Linearity (equal character height)	Vertical linearity phase potentiometer Vertical linearity amplitude potentiometer

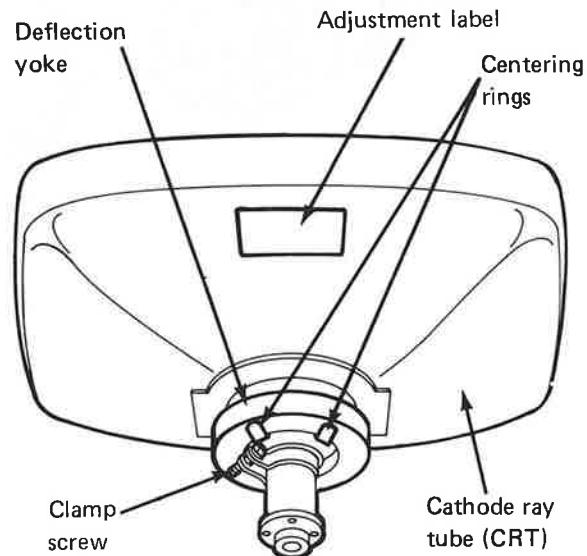
Many display adjustments affect other display adjustments. The procedures in this section

describe these related adjustments; however, always visually check the display image and make any other corrections which may be needed.

Adjustment tool. Use the fiber screwdriver (IBM part 460811).

Adjustment locations. The operator's brightness control is located at the lower right side of the display screen on the front of the 5322. The potentiometers are located on the circuit board inside the display unit. The horizontal width coil may be located on the side plate of the display unit in some models. See the label on top of the CRT for the exact locations of the adjustments.

For access to the adjustments, remove the 5322 top cover (1220).



Operator's brightness control

1. Turn the operator's brightness control fully counterclockwise. No video image should be visible on the display screen.
2. Turn the operator's brightness control fully clockwise. The horizontal retrace lines of the video beam should just become visible on the display screen. (The retrace lines

may be difficult to see if the 5322 is located in a brightly lighted area.)

3. If the adjustment is not correct, perform the "Brightness potentiometer" adjustment.

Brightness potentiometer

1. Turn the operator's brightness control fully clockwise.
2. Observe the display screen and adjust the brightness potentiometer until the horizontal retrace lines of the video beam are just visible.
3. Turn the operator's brightness control counterclockwise to obtain a normal brightness level on the display screen.
4. Check the "Video drive potentiometer" and "Focus potentiometer" adjustments.

Video drive potentiometer

1. Execute diagnostic PID 1400 (Screen Image Test Patterns) and select option 8 to display the attribute test pattern.
2. Observe the brightness difference between the normal reverse-video pattern and the highlighted reverse-video pattern on the display screen. Adjust the video drive potentiometer for maximum brightness difference between these two patterns.

Focus potentiometer

1. Execute diagnostic PID 1400 (Screen Image Test Patterns) and select option 0 to display the alignment pattern.
2. Turn the operator's brightness control to obtain a normal brightness level on the display screen.

3. Observe one of the character/dot patterns near the center of the display screen and adjust the focus potentiometer for a good character/dot definition. Compare the characters at the center of the screen with the characters at the edges of the screen. If there is a difference in focus, adjust for best focus over the complete screen.

Deflection yoke

DANGER

The CRT high-voltage anode lead contains 15,000 volts. Keep hands and tools away from this lead.

The CRT contains a high vacuum and could implode if unusual pressure is placed on it. Do not overtighten the deflection yoke clamp or scratch the CRT surface when moving the deflection yoke.

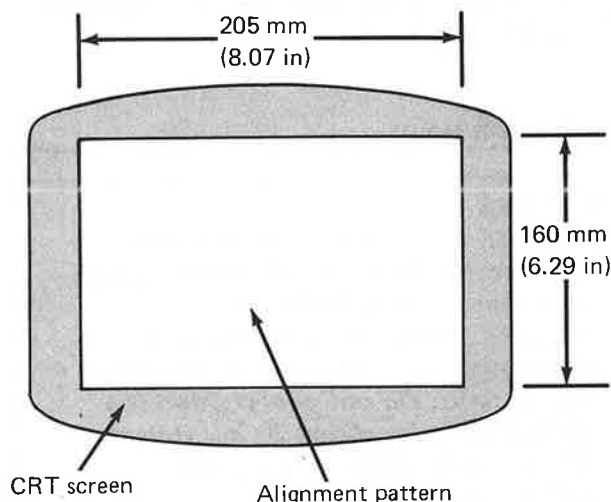
Tilt adjustment. When turning the deflection yoke for this adjustment, do not allow the yoke to move either forward or backward on the CRT.

1. Execute diagnostic PID 1400 (Screen Image Test Patterns) and select option 0 to display the alignment pattern.
2. Loosen the deflection yoke clamp screw enough to permit the yoke to be turned. Observe the display screen and turn the yoke until the alignment pattern is parallel with the upper and lower screen edges.
3. Before tightening the clamp screw, check that the display image size is correct. If not, perform the deflection yoke "Size adjustment." Tighten the clamp screw only enough to fasten the yoke to the CRT. **DO NOT OVERTIGHTEN.**
4. If the alignment pattern is not centered, perform the "Centering rings" adjustment.

Maintenance procedures

1440 Display unit adjustments (continued)

Size adjustment. Use the deflection yoke to adjust the display image size only if the correct size cannot be obtained with the "Vertical size potentiometer" and "Horizontal width coil" adjustments.



1. Execute diagnostic PID 1400 (Screen Image Test Patterns) and select option 0 to display the alignment pattern.
2. Turn the vertical size potentiometer and the horizontal width coil to approximately the center of their adjustment range.
3. Loosen the deflection yoke clamp screw enough to permit the yoke to slide easily on the CRT surface. Observe the display screen and move the yoke toward the front of the CRT until the alignment pattern completely fills the display screen. Move the yoke toward the rear of the CRT until the alignment pattern is approximately 205 mm (8.07 in.) wide or 160 mm (6.29 in.) high.
4. Turn the yoke, if necessary, until the alignment pattern is parallel with the upper and lower screen edges. Tighten the clamp screw only enough to fasten the yoke to the CRT. DO NOT OVERTIGHTEN.
5. Perform the "Vertical size potentiometer" and "Horizontal width coil" adjustments.

Centering rings

1. Execute diagnostic PID 1400 (Screen Image Test Patterns) and select option 0 to display the alignment pattern.
2. Observe the rectangular pattern on the CRT screen and turn the centering rings until the pattern is centered vertically and horizontally. It may be necessary to move each ring several times until the pattern is centered.
3. Perform the "Horizontal centering potentiometer" adjustment.

Horizontal centering potentiometer

1. Execute diagnostic PID 1400 (Screen Image Test Patterns) and select option 0 to display the alignment pattern.
2. Turn the operator's brightness control fully clockwise until the horizontal trace lines of the video beam are visible on the display screen.
3. Observe the display screen and adjust the horizontal centering potentiometer to center the alignment pattern horizontally inside the rectangular pattern made by the horizontal trace lines.
4. Turn the operator's brightness control counterclockwise until the horizontal trace lines of the video beam are no longer visible. If the alignment pattern is not horizontally centered between the left and right edges of the screen, repeat the "Centering rings" adjustment.

Horizontal width coil

1. Execute diagnostic PID 1400 (Screen Image Test Patterns) and select option 0 to display the alignment pattern.
2. Adjust the horizontal width coil for a horizontal dimension of 205 ± 4.5 mm (8.07 ± 0.18 in.) of the alignment pattern.
3. Check the "Horizontal centering potentiometer" adjustment.

Vertical size potentiometer

1. Execute diagnostic PID 1400 (Screen Image Test Patterns) and select option 0 to display the alignment pattern.
2. Adjust the vertical size potentiometer for a vertical dimension of 160 ± 4.5 mm (6.29 ± 0.18 in.) of the alignment pattern.
3. Check the "Vertical linearity phase potentiometer," "Vertical linearity amplitude potentiometer," and "Vertical hold potentiometer" adjustments.

Vertical hold potentiometer

1. Turn the vertical hold potentiometer clockwise until the image on the display screen becomes unstable. Note the position of the potentiometer.
2. Turn the vertical hold potentiometer counterclockwise until the image on the display screen again becomes unstable. Note the position of the potentiometer.
3. Set the vertical hold potentiometer at the center of the positions noted in Steps 1 and 2.

Vertical linearity phase potentiometer

1. Execute diagnostic PID 1400 (Screen Image Test Patterns) and select option 0 to display the alignment pattern.
2. Adjust the vertical linearity phase potentiometer for equal character height at the top and bottom of the display screen.
3. Check the "Vertical linearity amplitude potentiometer" and "Vertical size potentiometer" adjustments.

Vertical linearity amplitude potentiometer

1. Execute diagnostic PID 1400 (Screen Image Test Patterns) and select option 0 to display the alignment pattern.
2. Adjust the vertical linearity amplitude potentiometer for equal character height at the center and the top and bottom of the display screen.
3. Check the "Vertical size potentiometer" adjustment.

High voltage adjust potentiometer

DO NOT ADJUST. This potentiometer is adjusted at the factory, and the CE should not attempt to adjust it.

Maintenance procedures

1450 Display/language character sets

This section contains the display character sets for the various language groups, as follows:

Character set	Page
Character set 1 (United States/English)	4-15
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Character set 3 (Australia, Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Sweden, Switzerland, and United Kingdom)	4-16
Character set 4 (Nordic)	4-16
Character set 5 (Spanish)	4-17
Character set 6 (Not assigned)	
Character set 7 (Japan/Katakana)	4-17

Character set 1 (United States/English)

ABCDEFGHIJKLMNOPQRSTUVWXYZ023456789+-*/^=²<>½³#\$\$!,:;.,?&"()%&é'\
¡abcdefghijklmnopqrstuvwxyz{ }[]îüéâãçñïþÛÇÑø«»±°ºµιζθφρ\$#%&*&óõú

Character set 2 (Canadian French)

ABCDEFGHIJKLMNOPQRSTUVWXYZ023456789+-*/^=²<>½³#\$\$!,:;.,?&"()%&é'\
¡abcdefghijklmnopqrstuvwxyz{ }[]îüéââçéèèîËÀÇÉÊËÈÏÎ«»°µφ\$óúùýòÙÚ

CRT display
unit

Maintenance procedures

1450 Display/language character sets (continued)

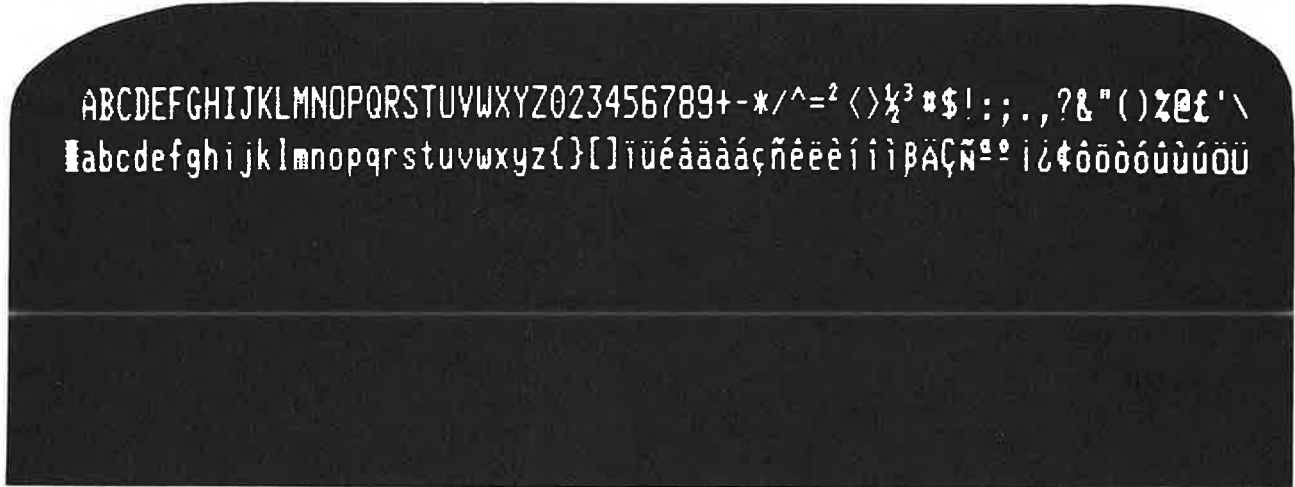
Character set 3 (Australia, Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Sweden, Switzerland, and United Kingdom)

ABCDEFGHIJKLMNOPQRSTUVWXYZ023456789+-*/^=² <>½³ *\$! : ; , . ? & " () % @ £ ' \
¡ ¢ £ ¤ ¥ ¦ § ¨ © ª « ¬ ® ¯ ° ± ² ³ ´ µ ¶ · ¸ ¹ º » ¼ ½ ¾

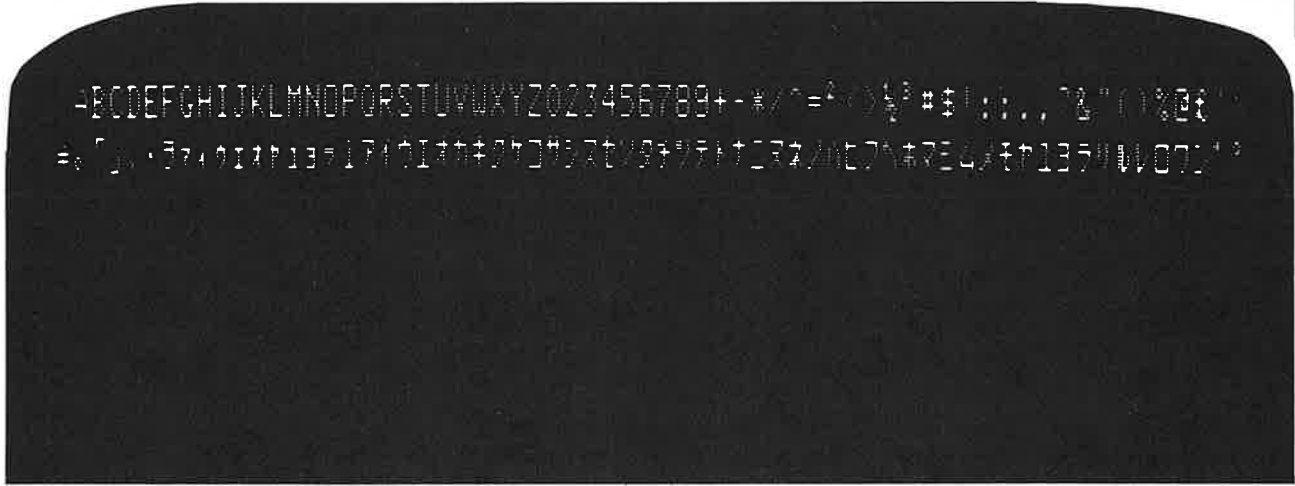
Character set 4 (Nordic)

ABCDEFGHIJKLMNOPQRSTUVWXYZ023456789+-* / ^ = ² < > ½ ³ * \$! : ; , . ? & " () % @ £ ' \
¡ ¢ £ ¤ ¥ ¦ § ¨ © ª « ¬ ® ¯ ° ± ² ³ ´ µ ¶ · ¸ ¹ º » ¼ ½ ¾

Character set 5 (Spanish)



Character set 7 (Japan/Katakana)



CRT display
unit

Theory of operation

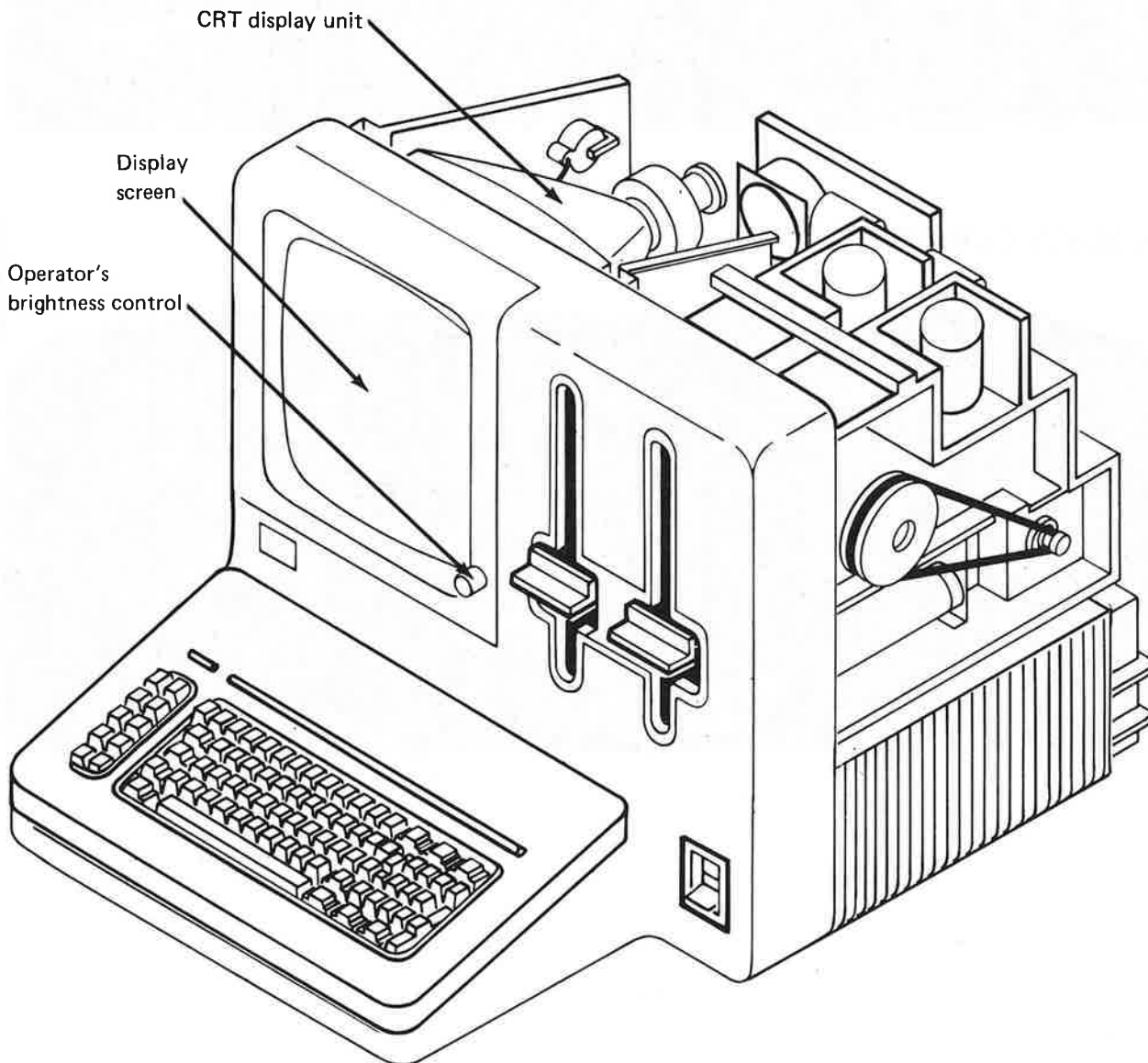
Introduction

The CRT display unit of the 5322 computer is used to display data, program information, and system status. The display screen size is 305 mm (12 in.) measured diagonally. A total of 1920 characters (24 rows of 80 characters) can be displayed in the display image area.

The display unit is a field replaceable unit (FRU). The parts of the display unit are not replaceable. Adjustments for the display unit are in "1440 Display unit adjustments" in the maintenance section of this chapter.

Operator's brightness control.

The only operator control for the display unit is the brightness control, which is located at the right of the display screen. Turning this control clockwise increases the brightness of the images on the display screen. Do not leave the control in the fully clockwise position for long periods of time because this can damage the screen.



Functional description

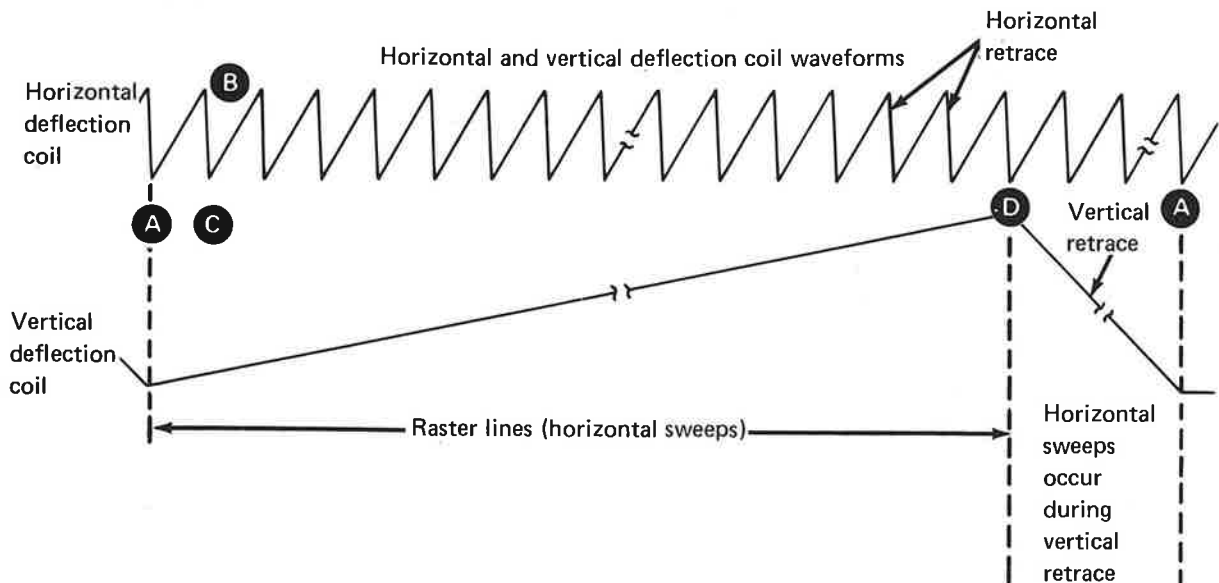
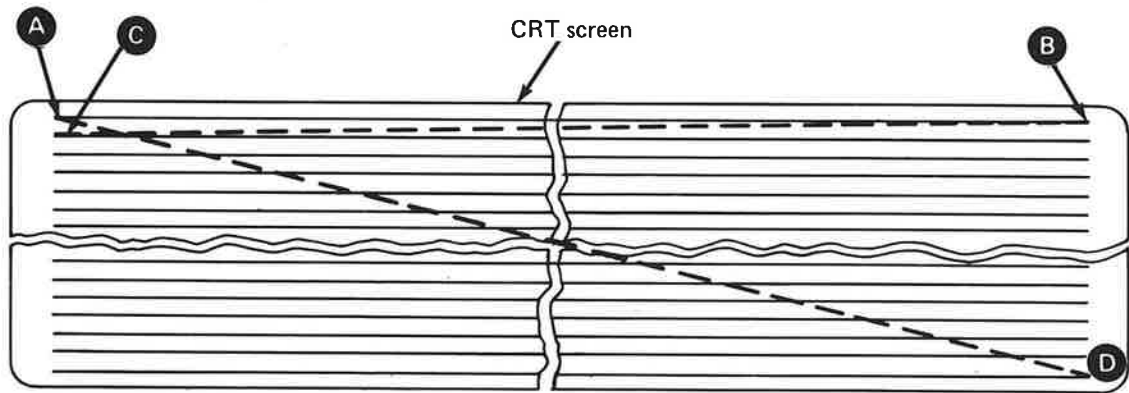
Display screen

Images are generated on the display screen by increasing the energy of the electron beam as it moves across the face of the screen. When the energy is increased, it causes the phosphor on the inside of the screen to activate and form a dot or line at the position of the electron beam. The path of the electron beam, as it moves horizontally and vertically across the screen, can be seen if the operator's brightness control is turned fully clockwise. This pattern is the screen *raster*.

The raster is evenly spaced and rectangular as shown in the diagram. The pattern is made by varying the magnetic field generated by the

horizontal and vertical deflection coils. The changing polarity of these magnetic fields causes the electron beam to move.

The effective starting point for the electron beam is at **A**. As the vertical and horizontal deflection coils are activated, the electron beam follows the path from **A** to **B**. The beam then retraces to the left **C**, where it starts the next line. This scanning action of the electron beam continues until the beam reaches the bottom of the screen **D**. The beam then retraces to **A** to generate the raster again by the same method. During normal display operations, blanking of the electron beam occurs for the retrace intervals.



Theory of operation

Functional description (continued)

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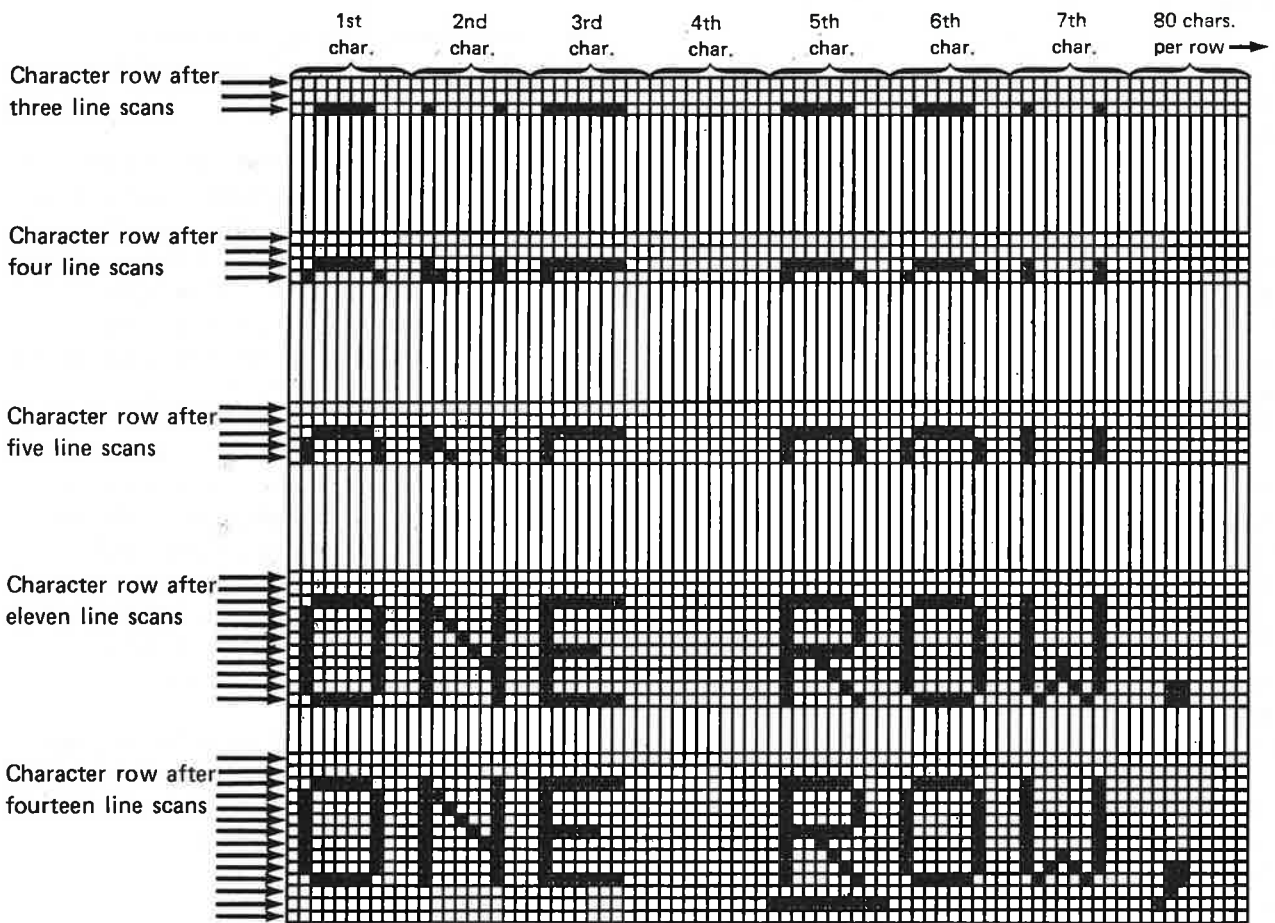
Screen and character formats

Screen format. The screen image area has 24 character rows. Each of these character rows is made up of 14 horizontal lines. Eighty characters can be displayed in a character row.

Character format. Each of the 24 character rows is divided into 80 character boxes. A character box is a dot matrix, 10 dots wide by

14 dots high. The characters are displayed by a dot matrix, 7 dots wide by 9 dots high, in the character box. The remaining space in the character box is used to display character ascenders, descenders, and the cursor.

The following diagram shows how the lines, rows, and characters are generated on the display screen.



Theory of operation

Functional description (continued)

Data flow

The display data is read from the 5322 read/write storage **A** and displayed row by row on the display screen. The display attachment, which is located on the 5322 CPU planar board, has two row buffers **C** and **D**. While one row buffer is being used for display, the other is being filled with the display data for the next display row. The attachment uses direct memory access (DMA) cycles to read the data from the 5322 storage into the row buffers.

Before the start of a display frame, the DMA controller **F** requests DMA cycles to fill one row buffer. When the first horizontal line on the display screen starts, the characters in the row buffer are addressed sequentially by the character counter **K** and are sent to the character generator **H**. The character generator is an 8K read-only storage (ROS) unit that contains the dot patterns for each of the display language sets used in the 5322. (The language set is selected by feature jumpers on the 5322 CPU planar board.)

As the electron beam moves across the display screen, the characters in the row buffer and the value in the line counter **L** are used to address specific bytes of the character generator ROS, which contains the dot patterns for each line of the display characters. This dot pattern is sent to the video control circuits **I** and is displayed on the screen of the display unit **E**.

When the character counter has addressed all 80 character positions of the display line, the line counter is incremented by 1. The characters in the row buffer and the new value

in the line counter are used to address the character generator ROS, and the second line of character dot patterns is displayed on the screen.

The line counter is incremented by 1 until all 14 lines of the character row are displayed. The row counter **M** is then incremented by 1, and the row buffer that was filled while the preceding character row was being displayed is used for the next character row. Up to 24 character rows can be displayed on the screen.

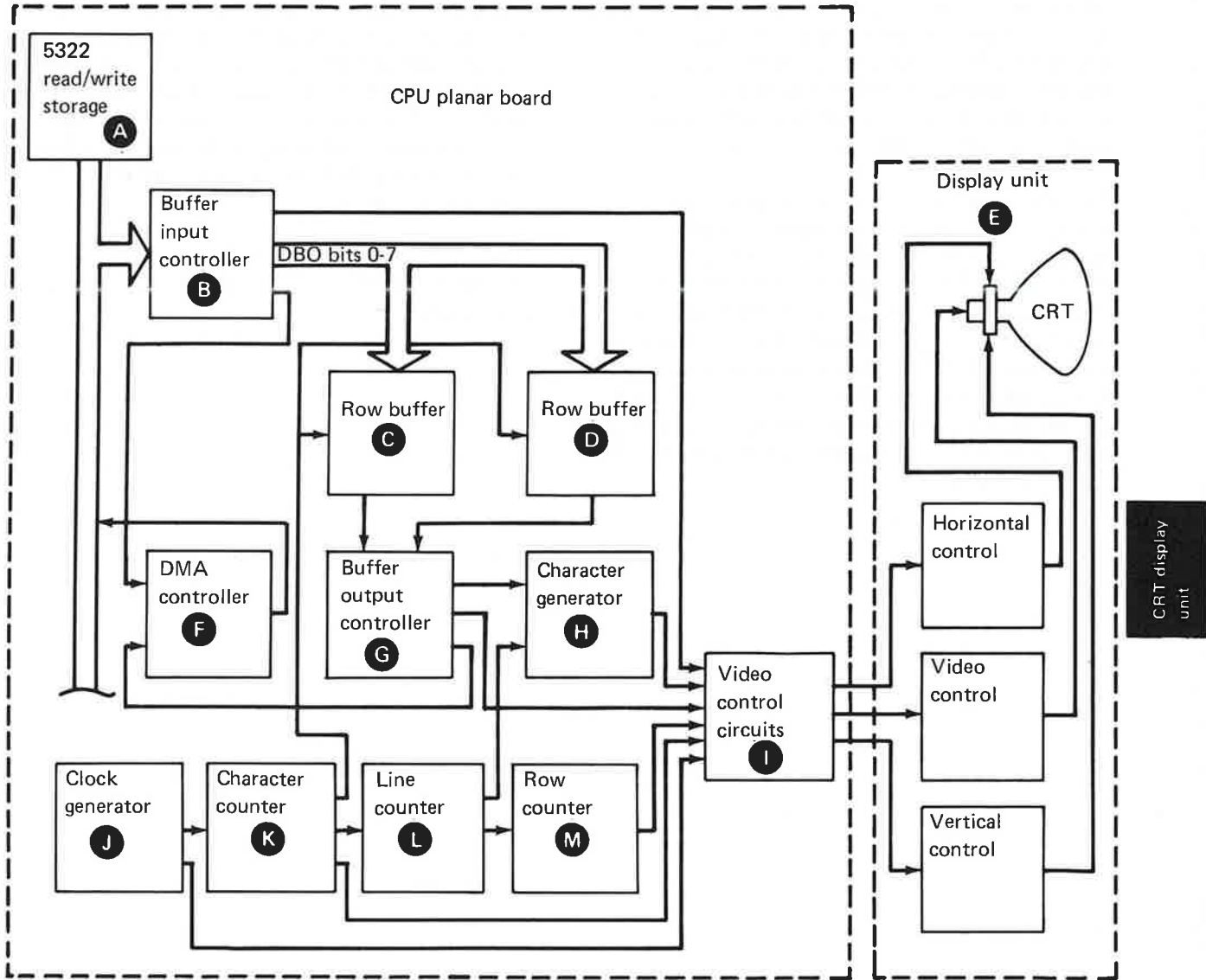
The clock generator **J** supplies the timing signals for the character counter and the video control circuits.

The buffer input controller **B** inspects the data that is loaded into the row buffers for special character codes that control the operation of the display unit. For example, an end-of-screen stop-DMA code causes the buffer input controller to stop DMA requests and to suppress video output for the remainder of the display frame.

The buffer output controller **G** inspects the data from the output of the row buffers for special character codes, character attributes, and field attributes that control the displayed image on the screen. For example, a highlight-field attribute causes the buffer output controller to activate the highlight output of the video control circuits.

The commands and character codes that are used to control the operation of the display unit are part of the microprograms and are not described in this service manual.

Simplified data flow diagram.



Theory of operation

Display unit diagnostics

Power-on diagnostic

The power-on diagnostic is located in the 5322 read-only storage (ROS) and executes (1) at every system power-on, (2) when the ROS resident diskette diagnostic is ended by a "9" key command, or (3) when the diagnostic control program (DCP) is terminated.

The display unit section of the power-on diagnostic performs an initialization and synchronization test of the display unit controller circuits located on the 5322 CPU planar board. The display unit interface lines (horizontal, vertical, and video) are tested at the planar board. The display unit interface lines that leave the planar board are not checked by the diagnostic, but can be verified by probing the display unit signal cable connector with the CE logic probe.

CE diskette resident diagnostics

The CE diskette resident diagnostics for the display unit are located on the CE diskette and execute under control of the diagnostic control program (DCP). These tests permit you to verify the attribute functions (video highlight, reverse video, underline, blink, and blank field), and to display the language sets and the alignment pattern.

A complete description of the CE diskette resident diagnostics is located in the diagnostic user guide.

Chapter 5. Diskette drive

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Diskette drive

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Maintenance preface

Electromagnetic devices such as television sets or other display terminals can cause interference in the operation of the diskette drives. To ensure that the diskette drives will operate correctly, do not install any electromagnetic devices in a radius of 0.61 meter (2 feet) of the 5322 computer.

There is no preventive maintenance for the diskette drive. Repair the diskette drive by adjusting the internal assemblies or installing the field replaceable units (FRUs) as instructed by the maintenance analysis procedures (MAPs). Always use the machine diagnostics to verify machine repairs.

All procedures assume that two diskette drives are installed in the 5322 computer. All procedures also assume that the diskette drives have been removed from the 5322 and are fully accessible on a work surface. Ensure that the diskette drive casting does not damage or scratch the work surface.

The head/carriage assembly and the drive hub and pulley assembly are adjusted and tested at the factory. The drive hub and pulley assembly are not field replaceable. If either the track 40 adjustment surface or the drive hub and pulley assembly is damaged, replace the complete diskette drive assembly. The head/carriage assembly is replaceable in the field. However, do not repair or clean any part of this assembly.

The only differences between the 31SD diskette drive (one read/write head) and the 51TD diskette drive (two read/write heads) are in the head/carriage assembly and the arrangement of the diskette drive control card. Maintenance procedures that are affected by such differences are indicated by two distinct sets of instructions in the affected step. These differences are indicated as (31SD) and (51TD), as in the following example:

1. Disconnect the cables.
2. (31SD) Remove the head/carriage assembly.

(51TD) Insert a clean strip of paper between the read/write heads and remove the head/carriage assembly.

Where a figure is not affected by the differences between the drives, the 51TD drive will be used.

The internal diskette drives are not in 5322 Models 110, 120, 130, or 140.

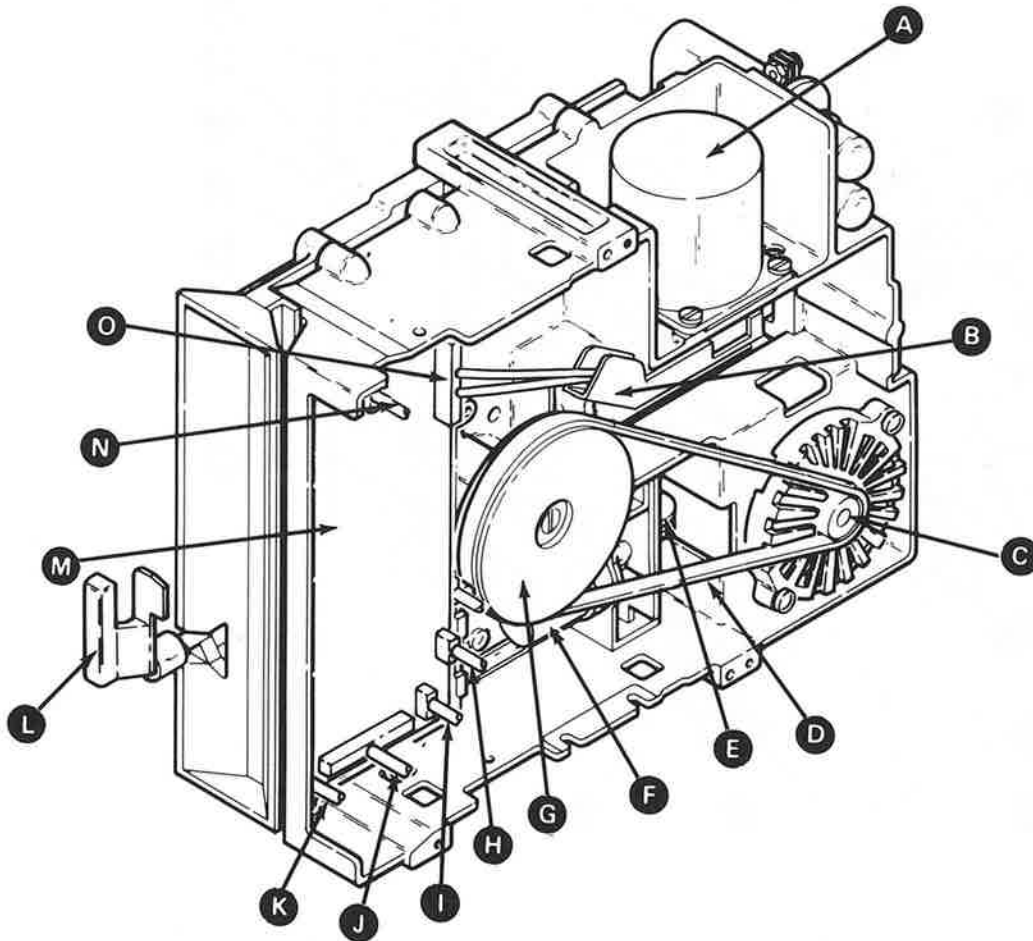
Maintenance procedures

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1501 Locations

Diskette drive (right side)

- | | |
|------------------------------|--------------------------------------|
| A Stepper motor | H Solenoid cable |
| B Cable guide | I LED cable |
| C AC drive pulley/fan | J Attachment cable |
| D AC drive belt | K PTX cable |
| E Solenoid idler | L Diskette latch |
| F Head load solenoid | M Diskette drive control card |
| G Spindle pulley | N Stepper motor cable |
| | O Head cable |

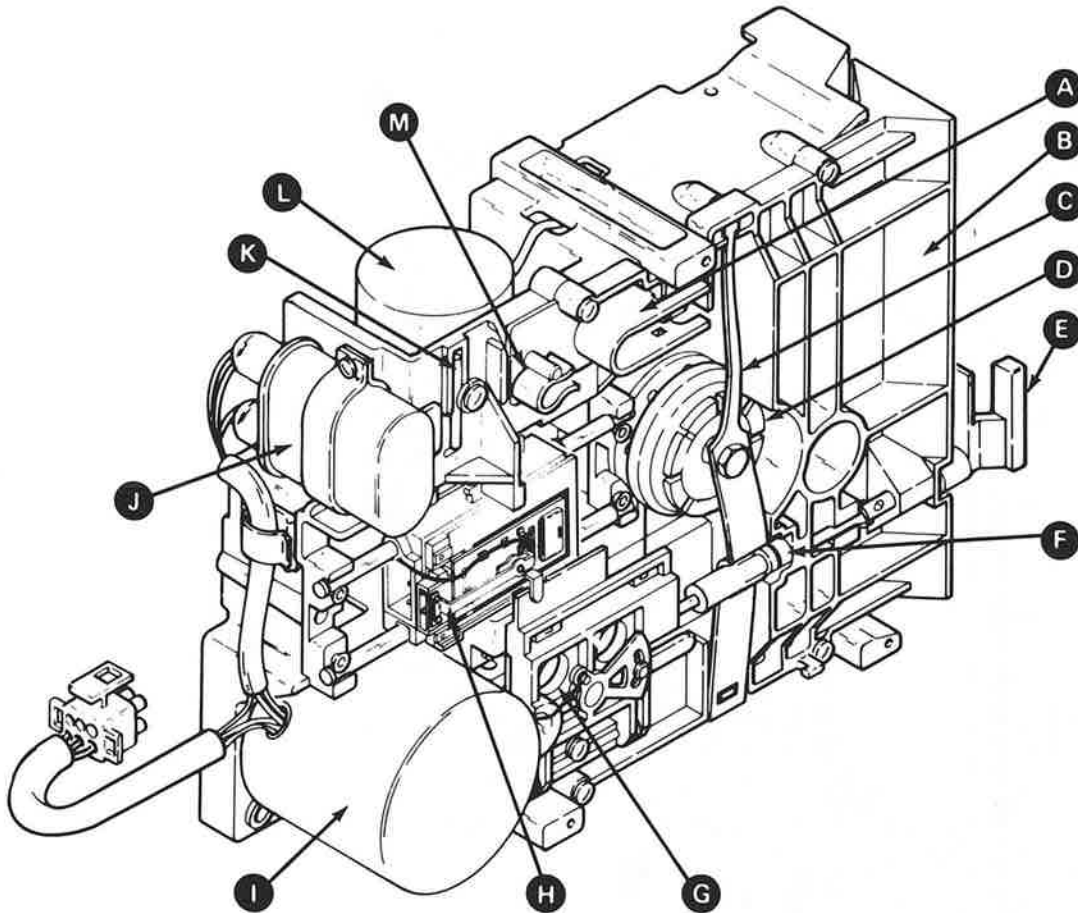


Maintenance procedures

1501 Locations (continued)

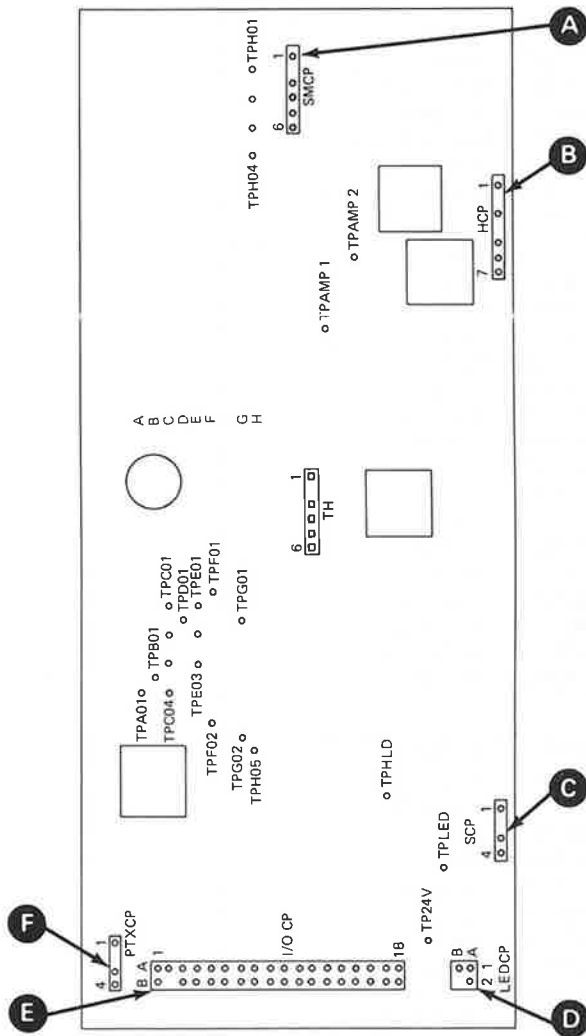
Diskette drive (left side)

- | | |
|--|---------------------------------|
| A Carriage pressure spring (tool) | H Head/carriage assembly |
| B Diskette guide | I AC drive motor |
| C Collet flat spring | J AC capacitor |
| D Collet | K Timing pin (tool) |
| E Diskette latch | L Stepper motor |
| F Pressure roll | M Retaining clip (tool) |
| G Head load bail | |



1502 Locations

Diskette drive control card (31SD)



TPG01	File data
TPG02	Erase gate
TPH01	MC 3
TPH02	MC 2
TPH04	MC 0
TPH05	+Write gate
TPAMP1	Preamp TP1
TPAMP2	Preamp TP2
TPHLD	Head load
TP24V	+24 Vdc
TPLED	31SD LED voltage

TH01	Diff read B
TH02	Blank
TH03	Diff read A
TH04	Blank
TH05	Disable stepper motor
TH06	+18V

TPA01	+5 Vdc *
TPB01	-5 Vdc
TPC01	Access 1
TPC02	D1PTX
TPC03	Write data
TPC04	Ground*
TPD01	Inner tracks
TPE01	Access 0
TPE02	Head engage
TPE03	Index
TPF01	Ground*
TPF02	Write/erase enabled

*Connection for general logic probe power pin

- A** Stepper motor connector
- A01 +24 Vdc common
 - A02 Blank (key)
 - A03 MC-3
 - A04 MC-2
 - A05 MC-1
 - A06 MC-0

- B** Head connector
- A01 Not used
 - A02 Blank (key)
 - A03 Erase coil
 - A04 Blank
 - A05 Read/write coil
 - A06 Read/write coil
 - A07 Ground

- C** Solenoid connector
- A01 Not used
 - A02 Blank (key)
 - A03 +24 Vdc
 - A04 Head load

- D** LED connector
- A01 Ground
 - A02 Not used
 - B01 LED anode
 - B02 Blank (key)

- E** Attachment cable connector
- A01 -5 Vdc
 - A02 Power supply ground
 - A03 to A18 ground
 - B01 +5 Vdc
 - B02 Blank (key)
 - B03 +24 Vdc
 - B04 Index
 - B05 Diskette sense
 - B06 Write/erase enabled
 - B07 File data
 - B08 Inner tracks
 - B09 Erase gate
 - B10 Access 0
 - B11 Not used
 - B12 Not used
 - B13 Access 1
 - B14 Write gate
 - B15 Head engage
 - B16 Not used
 - B17 Write data
 - B18 Not used

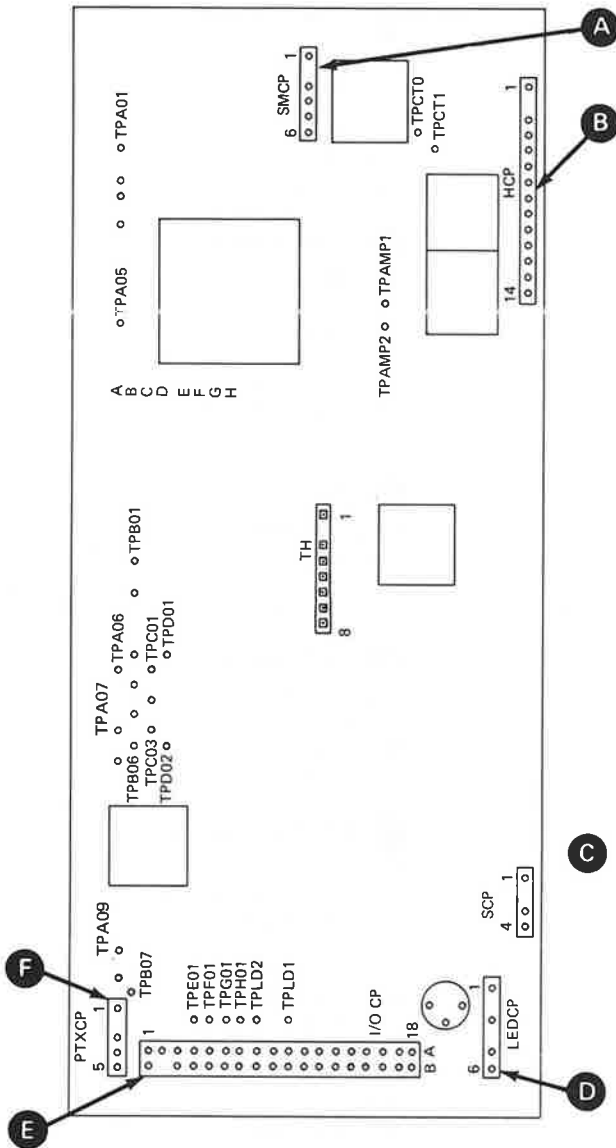
- F** PTX connector
- A01 PTX collector (+5 Vdc)
 - A02 Blank (key)
 - A03 PTX emitter
 - A04 Not used

Diskette drive

Maintenance procedures

1503 Locations

Diskette drive control card (51TD)



TH01	Diff read B
TH02	Blank
TH03	Diff read A
TH04	High gain
TH05	Disable stepper motor
TH06	+14V
TH07	Access clamp voltage
TH08	Oscillator

TPA01	MC-3
TPA02	MC-1
TPA03	MC-2
TPA04	MC-0
TPA05	Ground*
TPA06	Erase gate
TPA07	Ground*
TPA08	Head load
TPA09	+5 Vdc*
TPA10	D2 PTX
TPB01	+24 Vdc
TPB02	Ground
TPB03	Select head 1
TPB04	Write gate
TPB05	Head engage
TPB06	Write data

TPB07	D1 PTX
TPC01	Access 0
TPC02	Inner tracks
TPC03	-5 Vdc
TPD01	Access 1
TPD02	Switch filter
TPE01	Index
TPF01	Diskette sense
TPG01	Write/erase enabled
TPH01	File data
TPLD2	D2 LED voltage
TPLD1	D1 LED voltage
TPAMP2	Preamp TP2
TPAMP1	Preamp TP1
TPCT0	Center tap head 0
TPCT1	Center tap head 1

*Connection for general logic probe power pin

A Stepper motor connector

A01 +24 Vdc common
A02 Blank (key)
A03 MC-3
A04 MC-2
A05 MC-1
A06 MC-0

B Head connector

A01 Not used
A02 Blank (key)
A03 Head 0 read/write coil
A04 Head 0 center tap
A05 Head 0 read/write coil
A06 Head 0 erase
A07 Head 0 erase common
A08 Ground
A09 Ground
A10 Head 1 erase common
A11 Head 1 erase
A12 Head 1 read/write coil
A13 Head 1 center tap
A14 Head 1 read/write coil

C Solenoid connector

A01 Not used
A02 Blank (key)
A03 +Head load
A04 -Head load

D LED connector

A01 Diskette 2, 2D ground
A02 Blank (key)
A03 Diskette 2, 2D anode
A04 Not used
A05 Diskette 1 ground
A06 Diskette 1 anode

E Attachment cable connector

A01 -5 Vdc
A02 Power supply ground
A03 to A18 ground
B01 +5 Vdc
B02 Blank (key)
B03 +24 Vdc
B04 Index
B05 Diskette sense
B06 Write/erase enabled
B07 File data
B08 Inner tracks
B09 Erase gate
B10 Access 0
B11 Select head 1
B12 Not used
B13 Access 1
B14 Write gate
B15 Head engage
B16 Switch filter
B17 Write data
B18 Not used

F PTX connector

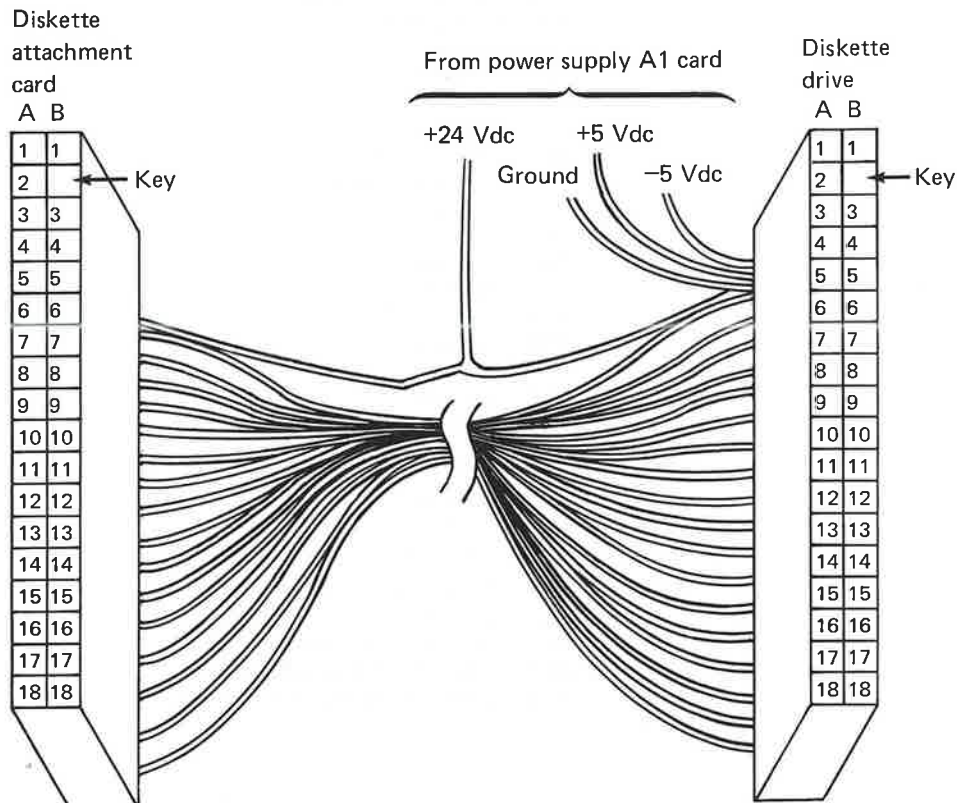
A01 Diskette 1 collector (+5 Vdc)
A02 Blank (key)
A03 Diskette 1 PTX emitter
A04 Diskette 2, 2D PTX emitter
A05 Diskette 2, 2D collector (+5 Vdc)

Diskette
drive

Maintenance procedures

1505 Locations

Diskette attachment cable



Pin	Line name	Pin
Not used	-5 Vdc	A01
Not used	Ground	A02
Not used	+5 Vdc	B01
B03	+24 Vdc	B03
A03 through A17	Ground (twisted pair)	A03 through A17
A18		Sense ground
B04	Index	B04
B05	Diskette sense*	B05
B06	Write/erase enabled	B06
B07	File data	B07
B08	Inner tracks	B08
B09	Erase gate	B09
B10	Access 0	B10
B11	Select head 1†	B11
B13	Access 1	B13
B14	Write gate	B14
B15	Head engage	B15
B16	Switch filter†	B16
B17	Write data	B17

*Signal is + (51TD) or - (31SD)

†Wire is in the cable; used only with 51TD

1510 Diskette drive

Removal

1. Switch off the 5322 power.
2. Remove the top cover (1220).
3. Loosen the holding screw **C** in the fan mounting bracket; swing the hinged fan assembly down.

Note: Remove the reusable cable tie **G** to permit slack in the diskette attachment cables.

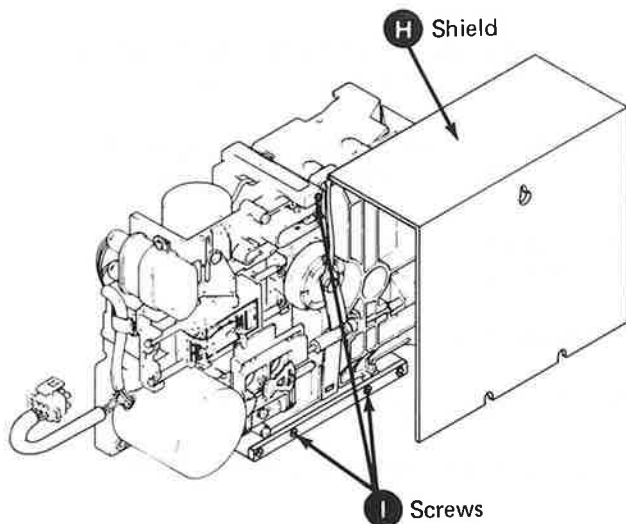
Warning: Before removing the diskette drives from the 5322, close the diskette latches to prevent damaging the latches and the front of the 5322. Protect the work surface so it will not be damaged or scratched.

4. Remove the rear screw **D**; slide the diskette drives out of the 5322 (screws **F** fit into the front slots **A** of the rails **B**).
5. Loosen the screws **I**; remove the shield **H**.

CAUTION

To avoid injury, do not let the clips fly up when you remove them.

6. Remove the three clips **E** to separate the diskette drives.

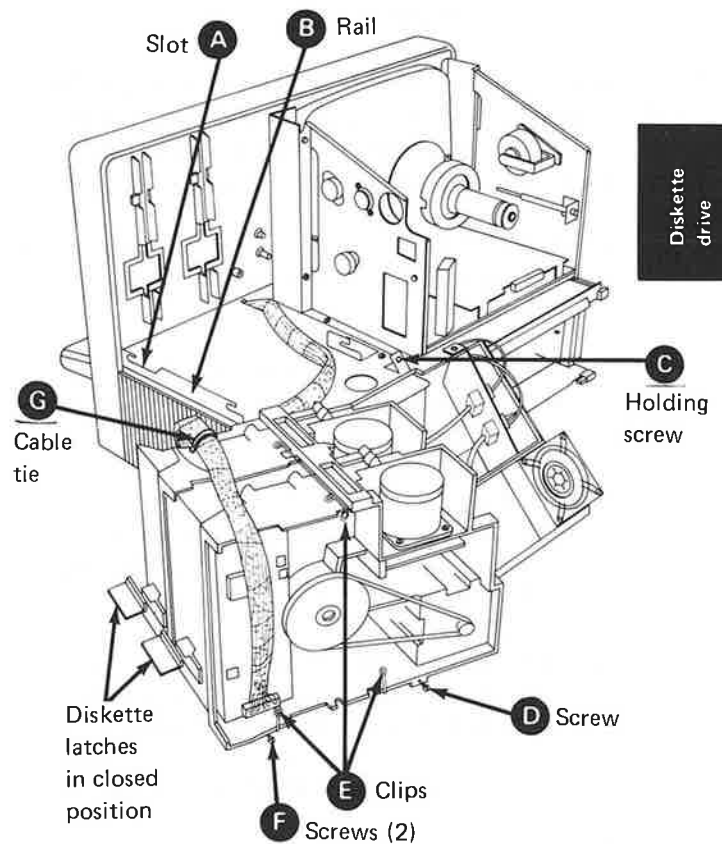


Replacement

1. Install the three clips **E** to hold the diskette drives together.

Warning: Before installing the diskette drives in the 5322, close the diskette latches to prevent damaging the latches.

2. Install the shield **H**; tighten the screws **I**.
3. Slide the front screws **F** into the slots **A** of the rails **B**.
4. Tighten the rear screw **D**.
5. Install the cable tie on the diskette attachment cable.
6. Swing the fan assembly up; tighten the holding screw **C** in the fan mounting bracket.



Maintenance procedures

1511 Diskette attachment cable/diskette attachment card

Removal

To remove the diskette attachment cable:

1. Switch off the 5322 power; disconnect the ac power cable.
 2. Remove the keyboard (1330).
 3. Place the CPU planar board **E** in the service position (1230).
 4. Disconnect diskette attachment cable 1 **A** or cable 2 **B** from the diskette attachment card **C**.
 5. Remove any cable ties that may be holding the diskette attachment cable in place; pull the loose end of the cable out through the keyboard opening.
 6. Place the power supply **F** in the service position (1240).
- Note:* If one of the diskette attachment cables is still connected to the diskette attachment card, push in the CPU planar board drawer (before pulling out the power supply drawer).
7. Disconnect the wires (+24 Vdc, +5 Vdc, -5 Vdc, ground) from the power supply A1 board.
 8. For a 5322 with two diskette drives:
 - a. To remove the diskette attachment cable from drive 4, disconnect the cable from the diskette drive control card at connector **G**.
 - b. To remove the diskette attachment cable from drive 3, remove the diskette drives from the 5322 (1510).
 9. Remove the diskette attachment cable through the front of the 5322 (note the cable path through the 5322 frame).

To remove the diskette attachment card:

1. Switch off the 5322 power; disconnect the ac power cable.

2. Place the CPU planar board **E** in the service position (1230).
3. Disconnect diskette attachment cable 1 **A** and cable 2 **B** from the diskette attachment card **C**.
4. Remove the screw **D**; remove the diskette attachment card.

Replacement

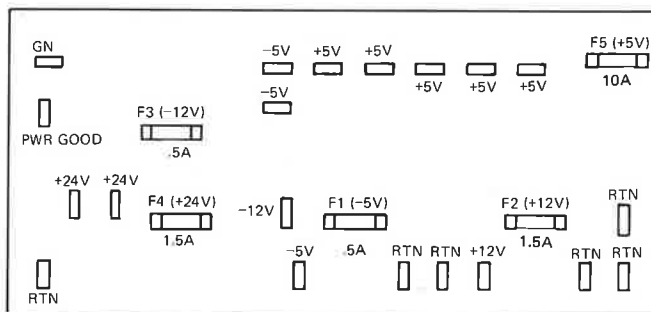
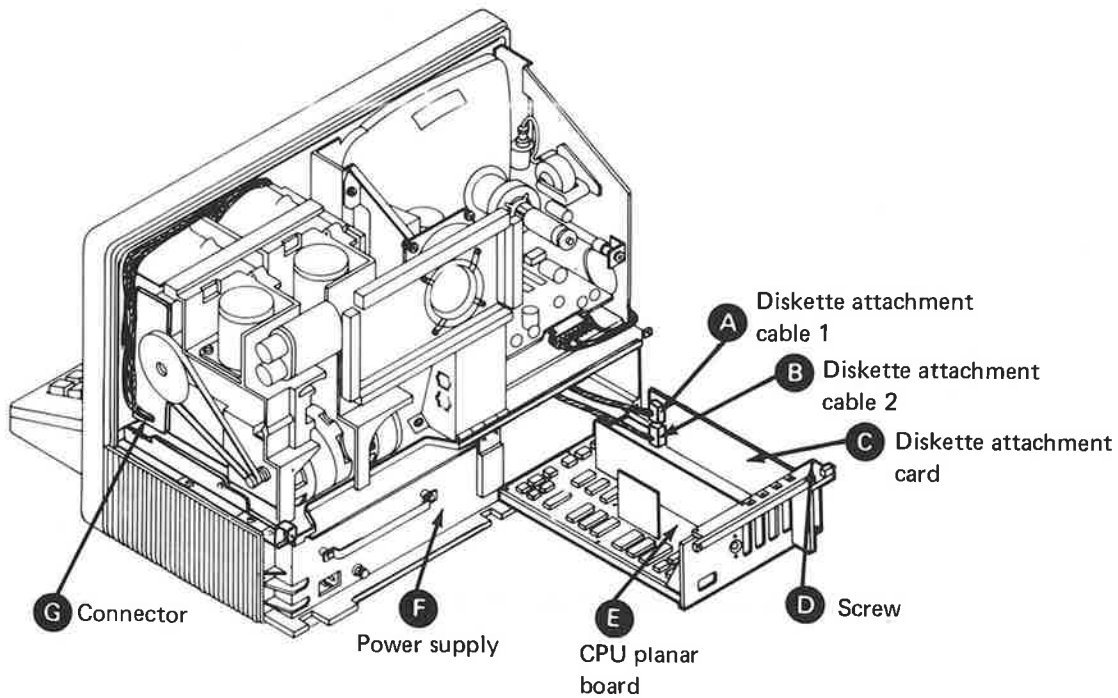
To install the diskette attachment cable:

1. Install the diskette attachment cable **A** or cable **B** in the 5322. (Ensure that the cable path through the 5322 frame is correct.)
2. With the power supply **F** in the service position, connect the wires (+24 Vdc, +5 Vdc, -5 Vdc, ground) to the power supply A1 card (see 1211).
3. Place the power supply in the operating position (1240).
4. Pull out the CPU planar board drawer **E**; connect the diskette attachment cable **A** or **B** to the diskette attachment card **C**.
5. Place the CPU planar board in the operating position (1230).
6. Connect the diskette attachment cable to the diskette drive control card.
7. If the diskette drives were removed from the 5322, install the drives (1510).
8. Install any cable ties that were removed from the diskette attachment cable.
9. Install the keyboard (1330).
10. Connect the ac power cable.

To install the diskette attachment card:

1. Plug in the diskette attachment card **C**; replace the screw **D**.

2. Connect the diskette attachment cables 1 **A** and 2 **B** to the diskette attachment card.
3. Place the CPU planar board in the operating position (1230).
4. Connect the ac power cable.



Power supply A1 card

Diskette drive

Maintenance procedures

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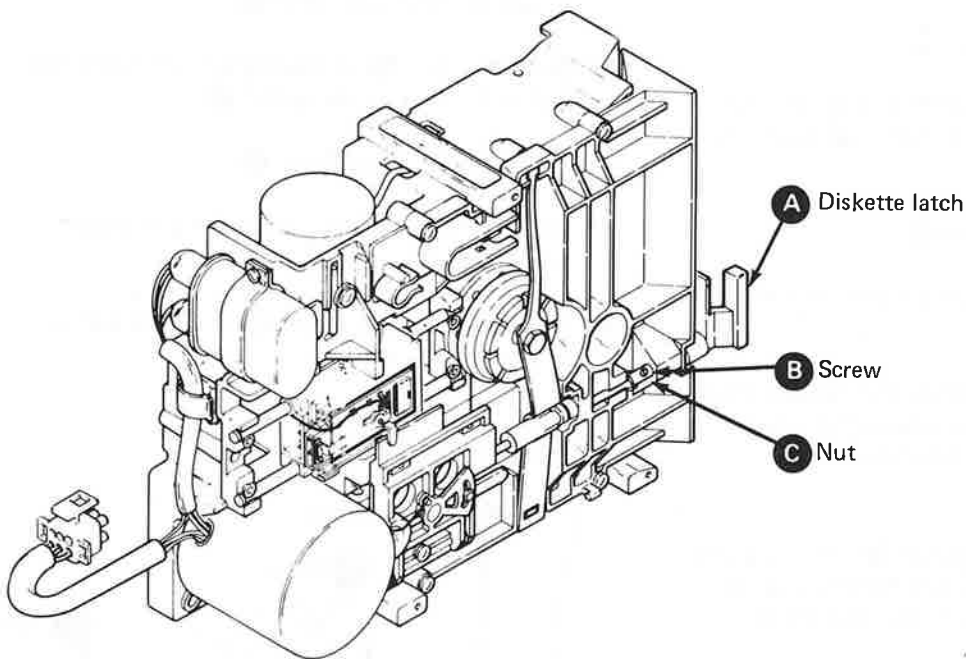
1512 Diskette latch

Removal

1. Switch off the 5322 power.
2. Remove the diskette drives from the 5322 (1510).
3. Remove the screw **B** and nut **C** from the diskette latch **A**; remove the diskette latch.

Replacement

1. Install the diskette latch **A** with screw **B** and nut **C**. Adjust the diskette latch for a maximum gap of 0.1 mm (0.004 in.) between the latch and the front surface of the diskette guide.
2. Install the diskette drives in the 5322 (1510).



Maintenance procedures

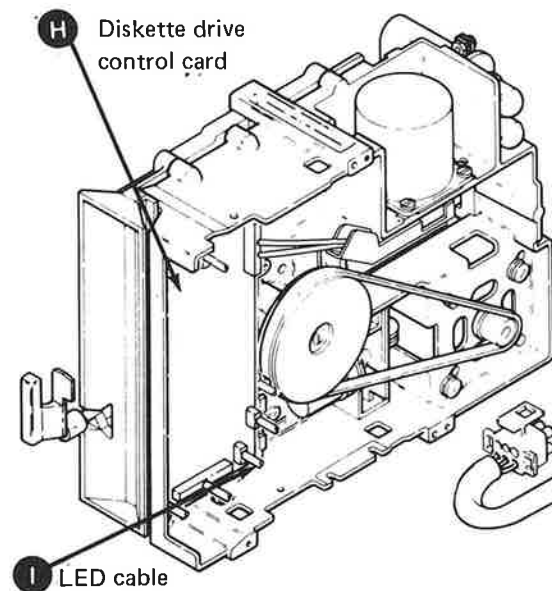
1520 Diskette guide

Removal

1. Switch off the 5322 power; move the head/carriage to the rear of the machine.
2. Disconnect the LED cable **I** from the diskette drive control card **H**; note the cable path for the replacement.
3. (51TD) Insert a clean strip of paper between the heads **A**.
4. Close the diskette latch **D**.
5. Push the bail **G** in slightly and disconnect the bail actuating cable eyelet **F** from the bail.
6. Open the diskette latch **D**.
7. Remove the four diskette guide mounting screws **E**.

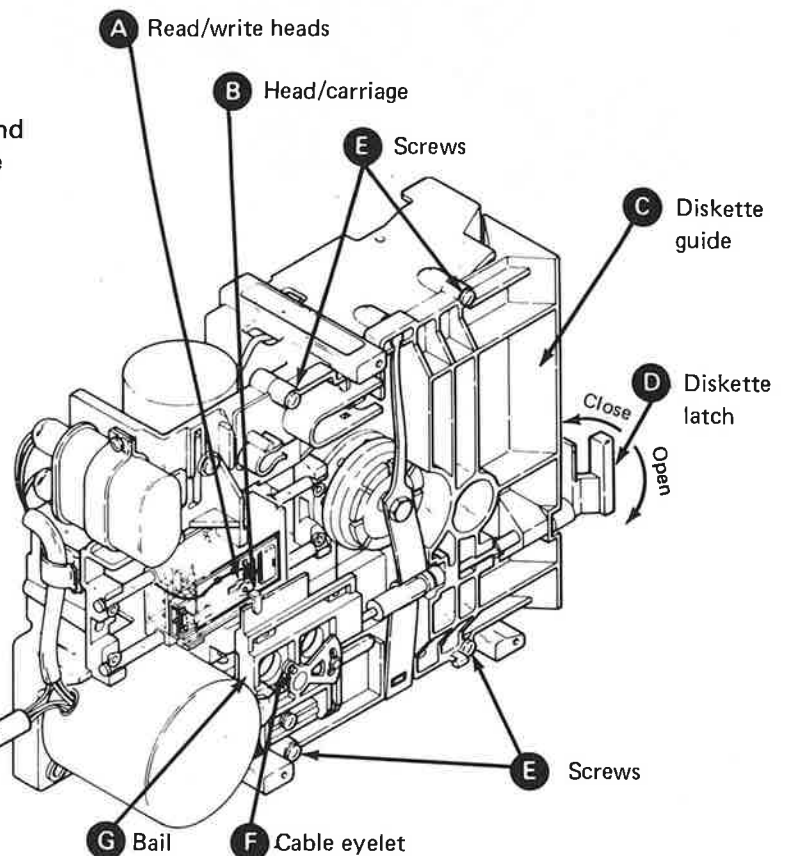
Warning: (51TD) Do not let the heads snap together when the bail is removed from under the tab **B on the head/carriage assembly.**

8. Remove the diskette guide **C**; lift it up and carefully slide the bail out from under the tab **B** on the head/carriage assembly.



Replacement

1. Open the diskette latch **D**.
2. Install the diskette guide **C**; carefully slide the bail **G** under the tab **B** on the head/carriage assembly.
3. Install the four diskette guide mounting screws **E**.
4. Close the diskette latch **D**.
5. Push the bail **G** in slightly and connect the bail actuating cable eyelet **F**.
6. Open the diskette latch **D**.
7. (51TD) Remove the paper from between the heads **A**.
8. Connect the LED cable **I** to the diskette drive control card **H**.



1521 Collet and spring assembly

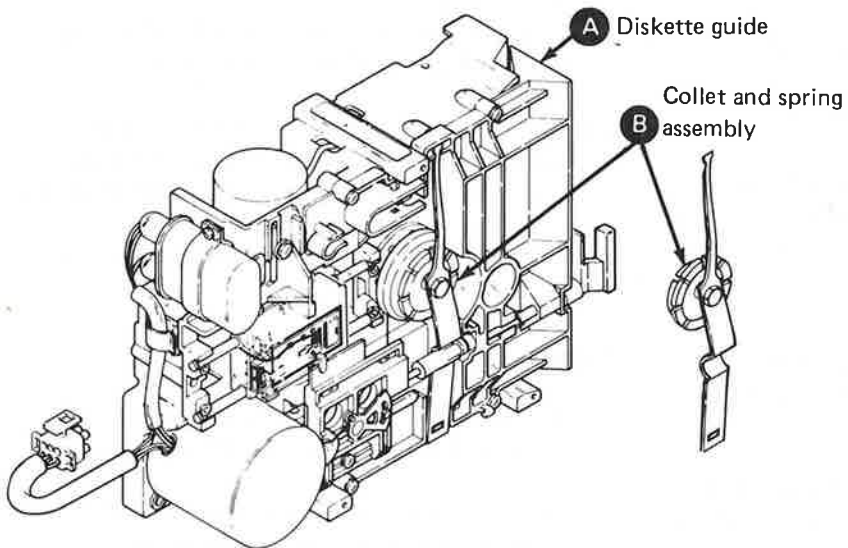
Removal

1. Remove the diskette latch (1512).
2. Remove the head load bail (1541).
3. Remove the collet and spring assembly **B** from the diskette guide **A**.

Note: If the collet and spring assembly is damaged, exchange the assembly.

Replacement

1. Install the collet and spring assembly **B** on the diskette guide **A**.
2. Install the head load bail (1541).
3. Install the diskette latch (1512).



Maintenance procedures

1530 Head/carriage assembly

Service check (using PID 1500)

Note: This procedure uses PID 1500 of the ROS resident diskette diagnostics to move the head/carriage between cylinders 39 and 40.

Warning: Perform the head/carriage service check with the diskette drive installed (or in the same position as when installed) or the service check may not be accurate.

1. Switch off the 5322 power.
2. Disconnect the ac drive motor power cable **D**.

DANGER

Voltage is present at connector J1 and J2 when the 5322 power is switched on.

3. Switch on the 5322 power.
4. Select the "MAP chart support" option from PID 1500 (see the Diagnostic User Guide).
5. Move the head/carriage to align the timing pointer with the timing block on the casting (use option 7); the head/carriage is now at cylinder 40.

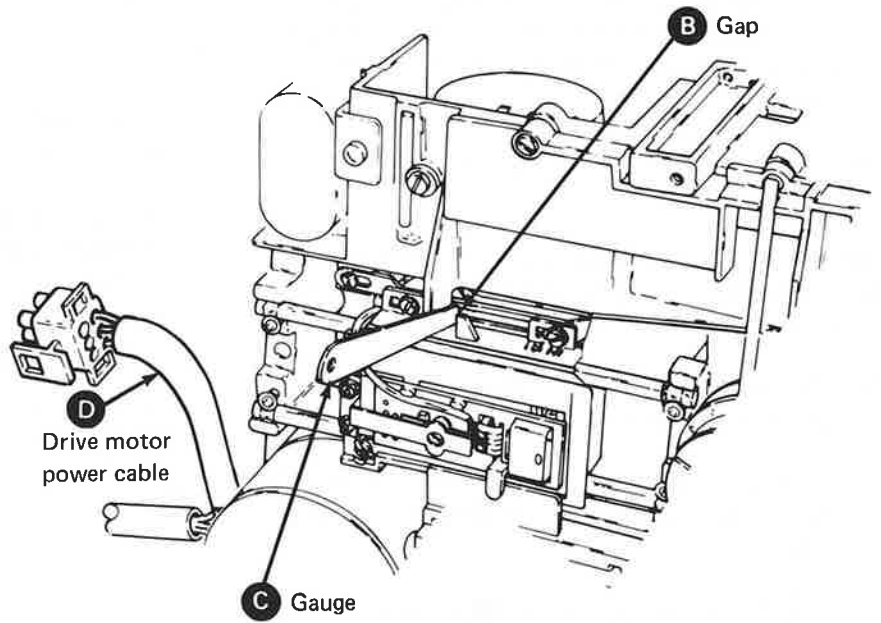
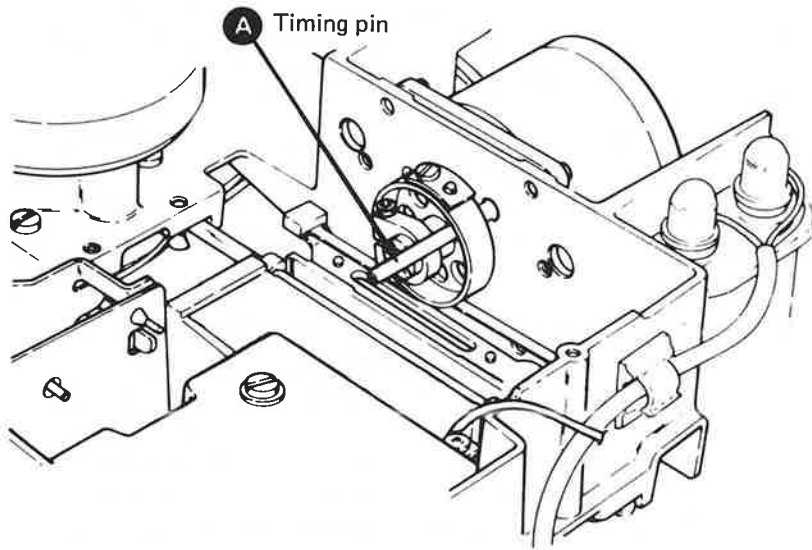
ENTER	KEY(S)	FUNCTION
0		RECAL.
1	(AND) FIELD +	SEEK IN ONE TRACK
4	(AND) FIELD +	SEEK IN FOUR TRACKS
4	(AND) FIELD -	SEEK OUT FOUR TRACKS
1	(AND) FIELD -	SEEK OUT ONE TRACK
7		HEAD ALIGN (TRK 40,39,40)
9		END, GO TO POWER-ON DIAGNOSTICS

6. Check that the timing pin **A** passes freely through the stepper motor pulley into the timing slot in the casting. If it does not, remove the timing pin and perform the head/carriage adjustment, starting with Step 3.
7. If the timing pin passes freely through the stepper motor pulley into the slot in the casting, remove the timing pin.

8. Move the stepper motor to cylinder 39 (use option 1, Field-).
9. Verify that this is cylinder 39 by checking for no gap **B** between the timing pointer and the timing block. If there is a gap, perform the head/carriage adjustment, starting with Step 12.
10. Move the stepper motor back to cylinder 40 (use option 1, Field+).
11. Verify that this is cylinder 40 by checking that the timing hole in the pulley lines up with the timing slot in the casting.
12. Check the gap **B** between the timing pointer and the timing block as follows:
 - a. A 0.51-mm (0.020-in.) gauge **C** should fit tightly.
 - b. A 0.53-mm (0.021-in.) gauge should not fit.

Notes:

1. To ensure an accurate measurement, remove the gauges from the holder.
2. Because of the torque characteristics of the stepper motor, if Step 12 must be repeated, start the sequence with Step 8 of this service check.
13. If the gap **B** between the timing pointer and the timing block is correct, switch off the 5322 power and connect the ac drive motor power cable **D**.



Diskette
drive

Maintenance procedures

1530 Head/carriage assembly (continued)

Service check (using jumpers)

Note: This procedure uses jumpers on the diskette drive control card to move the head/carriage between cylinders 39 and 40.

Warning: Perform the head/carriage service check with the diskette drive installed (or in the same position as when installed) or the service check may not be accurate.

1. Switch off the 5322 power.
2. Disconnect the ac drive motor power cable **G**.

DANGER
Voltage is present at connectors J1 and J2 when the 5322 power is switched on.

3. Move the head/carriage to approximately align the timing pointer with the timing block on the casting; the head/carriage is now at cylinder 40. Insert the timing pin **F**; ensure that the timing pin goes into the slot in the casting.
4. Remove the timing pin **F**; switch on the 5322 power.

Warning: To prevent damaging the card, the jumpers to be inserted in the following steps must be on the correct pins.

5. Connect a jumper from **D** (ground) to **C** (disable stepper motor).
6. Detent the stepper motor at cylinder 40 by connecting a jumper from **E** (ground) to **B** (MC-0).
7. Check that the timing pin **F** passes freely through the stepper motor pulley into the timing slot in the casting. If it does not, remove the timing pin and perform the head/carriage adjustment, starting with Step 3.
8. If the timing pin passes freely through the stepper motor pulley into the slot in the casting, remove the timing pin **F**.

9. Remove the jumper end from **B** (MC-0) and install it on **A** (MC-3); this moves the stepper motor to cylinder 39.
10. Verify that this is cylinder 39 by checking for no gap **I** between the timing pointer and the timing block. If there is a gap, perform the head/carriage adjustment, starting with Step 12.
11. Remove the jumper end from **A** (MC-3) and install it on **B** (MC-0); this again moves the stepper motor to cylinder 40.
12. Verify that this is cylinder 40 by checking that the timing hole in the pulley lines up with the timing slot in the casting.
13. Check the gap **I** between the timing pointer and the timing block as follows:
 - a. A 0.51-mm (0.020-in.) gauge **H** should fit tightly.
 - b. A 0.53-mm (0.021-in.) gauge should not fit.

Notes:

1. To ensure an accurate measurement, remove the gauges from the holder.
2. Because of the torque characteristics of the stepper motor, if Step 13 must be repeated, start the sequence with Step 9 of this service check.
14. If the gap **I** between the timing pointer and the timing block is correct, remove the jumpers, switch off the 5322 power, and connect the ac drive motor power cable **G**.

Maintenance procedures

1530 Head/carriage assembly (continued)

Adjustment (using PID 1500)

Note: This procedure uses PID 1500 of the ROS resident diagnostics to move the head/carriage between cylinders 39 and 40.

Warning: Adjust the head/carriage assembly with the diskette drive installed (or in the same position as when installed) or the adjustment may not be accurate.

1. Switch off the 5322 power.
2. Disconnect the ac drive motor power cable **J**.
3. Remove the cable guide **B** (squeeze at **A**); push the cable guide down.
4. Measure and record the gap **E** between the stepper motor pulley and the casting.
5. Loosen the pulley clamp screw **C** so the stepper motor shaft can turn inside the pulley.
6. Move the head/carriage, by hand, to approximately align the timing pointer with the timing block on the casting; the head/carriage is now at cylinder 40. Insert the timing pin **D**.
7. Switch on the 5322 power.
8. Select the "MAP chart support" option from PID 1500 (see the Diagnostic User Guide).
9. Detent the stepper motor at cylinder 40 (use option 7).

DANGER

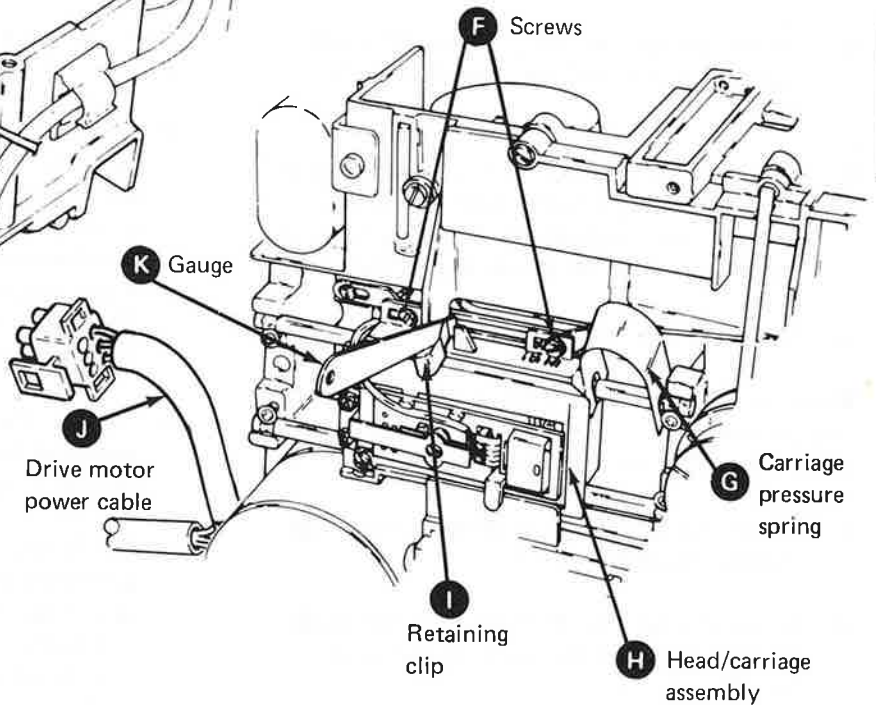
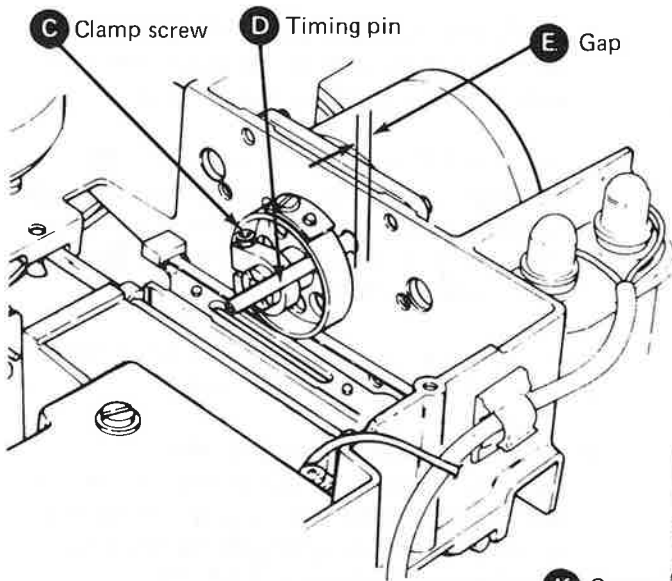
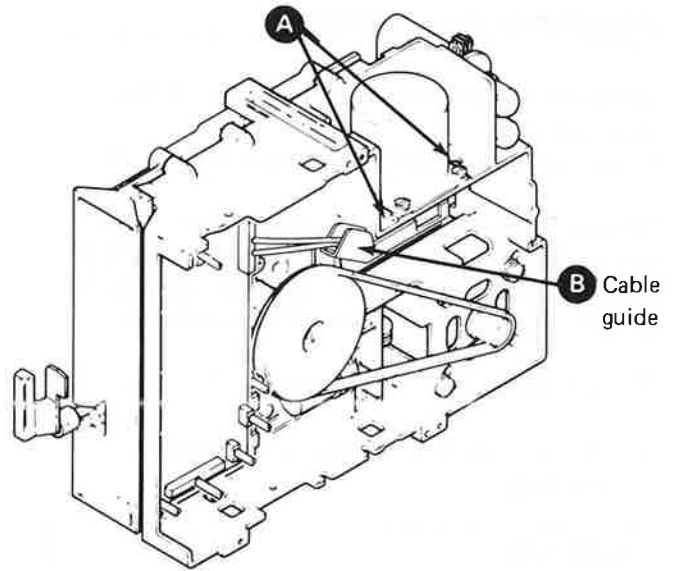
Voltage is present at connectors J1 and J2 when the 5322 power is switched on.

10. Maintain the gap **E** at the casting (recorded in Step 4); tighten the pulley clamp screw **C**. Ensure that the timing pin **D** passes freely through the stepper motor pulley into the timing slot in the casting.
 11. Remove the timing pin.
 12. Loosen the two carriage clamping screws **F**.
 13. Move the stepper motor to cylinder 39 (use option 1, Field-).
 14. Move the stepper motor back to cylinder 40 (use option 1, Field+).
 15. Verify that this is cylinder 40 by checking that the timing hole in the pulley lines up with the timing slot in the casting.
 16. Insert a 0.51-mm (0.020-in.) gauge **K** between the timing pointer on the carriage and the timing block. Fasten the gauge to the casting with the retaining clip **L** (the clip is stored on the diskette guide).
- Note:* To ensure an accurate measurement, remove the gauges from the holder.
17. Press lightly at the front of the head/carriage **H** so it just touches, but is not forced against, the gauge. Insert the carriage pressure spring **G** between the casting and carriage to hold the head/carriage assembly against the gauge (the pressure spring is stored on the diskette guide).
 18. Tighten the two screws **F** that hold the carriage to the bracket; remove the carriage pressure spring **G** and the retaining clip **L**.
 19. Verify the gap between the timing pointer and the timing block as follows:
 - a. A 0.51-mm (0.020-in.) gauge **K** should fit tightly.
 - b. A 0.53-mm (0.021-in.) gauge should not fit.

ENTER	KEY (S)	FUNCTION
0		RECAL.
1	(AND) FIELD +	SEEK IN ONE TRACK
4	(AND) FIELD +	SEEK IN FOUR TRACKS
4	(AND) FIELD -	SEEK OUT FOUR TRACKS
1	(AND) FIELD -	SEEK OUT ONE TRACK
7		HEAD ALIGN (TRK 40,39,40)
9		END, GO TO POWER-ON DIAGNOSTICS

Note: Because of the torque characteristics of the stepper motor, if Step 19 must be repeated, start the sequence with Step 13.

20. Switch off the 5322 power; remove the jumpers.
21. Snap the cable guide **B** into the holes in the casting.
22. Connect the ac drive motor power cable **J**.
23. Store the retaining clip **I**, the carriage pressure spring **G** and the timing pin **D** on the diskette guide.



Diskette
drive

Maintenance procedures

1530 Head/carriage assembly (continued)

Adjustment (using jumpers)

Note: This procedure uses jumpers on the diskette drive control card to move the head/carriage between cylinders 39 and 40.

Warning: Adjust the head/carriage assembly with the diskette drive installed (or in the same position as when installed) or the adjustment may not be accurate.

1. Switch off the 5322 power.
2. Disconnect the ac drive motor power cable **N**.
3. Remove the cable guide **G** (squeeze at **F**; push the cable guide down).
4. Measure and record the gap **J** between the stepper motor pulley and the casting.
5. Loosen the pulley clamp screw **H** so the stepper motor shaft can turn inside the pulley.
6. Move the head/carriage to approximately align the timing pointer with the timing block on the casting; the head/carriage is now at cylinder 40. Insert the timing pin **I**.
7. Switch on the 5322 power.

Warning: To prevent damaging the card, the jumpers to be inserted in the following steps must be on the correct pins.

8. Connect a jumper from **D** (ground) to **C** (disable stepper motor).
9. Connect a jumper from **E** (ground) to **B** (MC-0) to detent the stepper motor at cylinder 40.
10. Maintain the gap **J** at the casting (recorded in step 4); tighten the pulley clamp screw **H**. Ensure that the timing

pin **I** passes freely through the stepper motor pulley into the timing slot in the casting.

11. Remove the timing pin **I**.
 12. Loosen the two carriage clamping screws **K**.
 13. Remove the jumper end from **B** (MC-0); install it on **A** (MC-3) to move the stepper motor to cylinder 39.
 14. Remove the jumper end from **A** (MC-3); install it on **B** (MC-0). This moves the stepper motor back to cylinder 40.
 15. Verify that this is cylinder 40 by checking that the timing hole in the pulley lines up with the timing slot in the casting.
 16. Insert a 0.51-mm (0.020-in.) gauge **O** between the timing pointer on the carriage and the timing block. Fasten the gauge to the casting with the retaining clip **P** (the clip is stored on the diskette guide).
- Note:* To ensure an accurate measurement, remove the gauges from the holder.
17. Press lightly at the front of the head/carriage **M** so it just touches, but is not forced against, the gauge. Insert the carriage pressure spring **L** between the casting and carriage to hold the head/carriage assembly against the gauge (the pressure spring is stored on the diskette guide).
 18. Tighten the two screws **K** that hold the carriage to the bracket; remove the carriage pressure spring **L** and the retaining clip **P**.
 19. Verify the gap between the timing pointer and the timing block as follows:
 - a. A 0.51-mm (0.020-in.) gauge **O** should fit tightly.
 - b. A 0.53-mm (0.021-in.) gauge should not fit.

Note: Because of the torque characteristics of the stepper motor, if Step 19 must be repeated, start the sequence with Step 13.

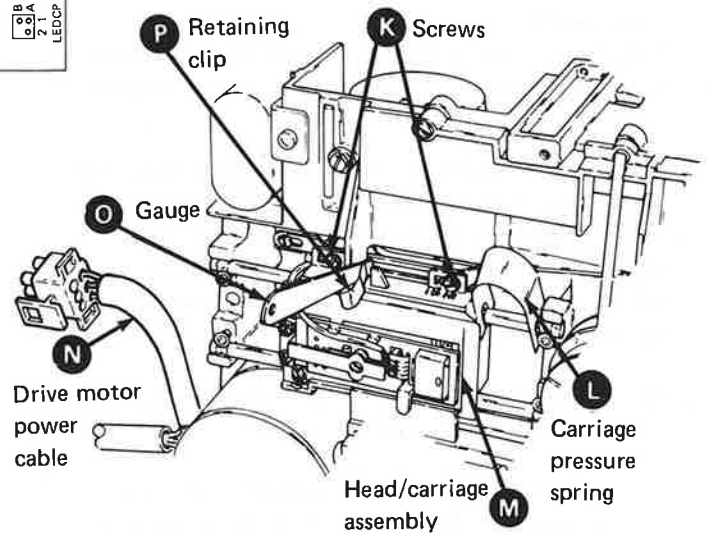
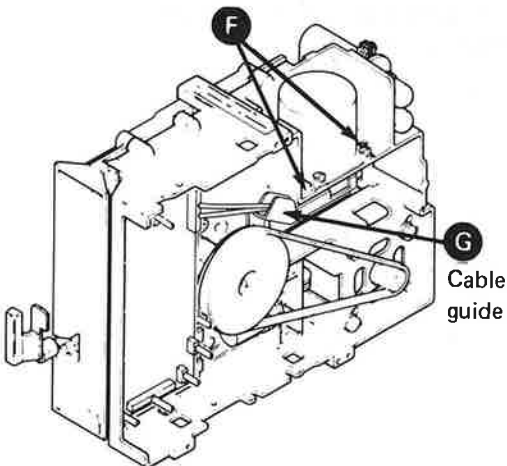
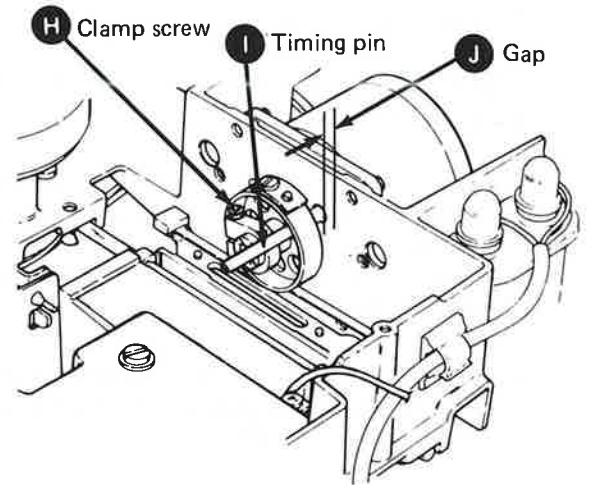
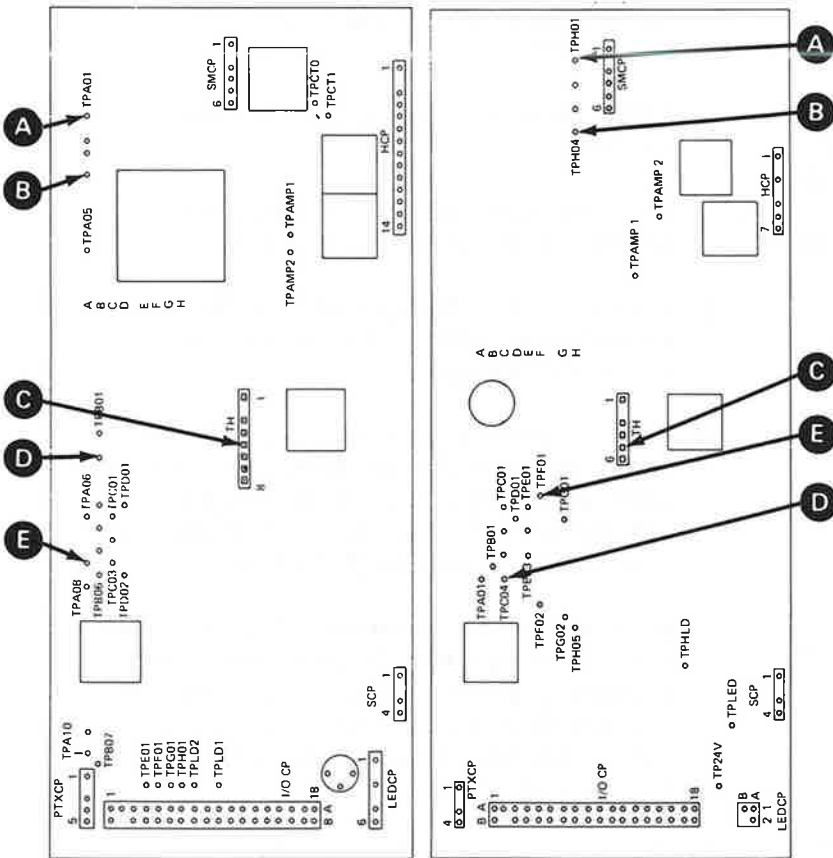
20. Switch off the 5322 power; remove the jumpers.

21. Snap the cable guide **G** into the holes in the casting.

22. Connect the ac drive motor power cable **N**.

23. Store the retaining clip **P**, the carriage pressure spring **L**, and the timing pin **I** on the diskette guide.

Diskette drive control card - 51TD Diskette drive control card - 31SD



Diskette drive

Maintenance procedures

1530 Head/carriage assembly (continued)

Removal

1. Switch off the 5322 power.
2. (51TD) Insert a clean strip of paper between the heads.
3. Remove the cable guide **C** from the casting (squeeze at **B** and push the guide down); carefully disconnect the head cable **A** from the drive control card.

Warning: The drive band must not be bent or damaged in any way.

4. Remove the two screws **L** that hold the head/carriage **K** to the carriage bracket **F**. To prevent damaging the drive band, give support to the carriage bracket **F** when the screws **L** are removed.
5. Remove the allen screws **M** (one at each end of the upper guide rod); slide the upper guide rod **G** out.
6. Carefully lift and turn the head/carriage assembly **K**; remove it from the lower guide rod **H**.

Replacement

1. Disconnect the ac drive motor power cable **O**.

DANGER

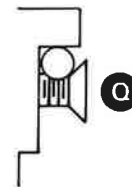
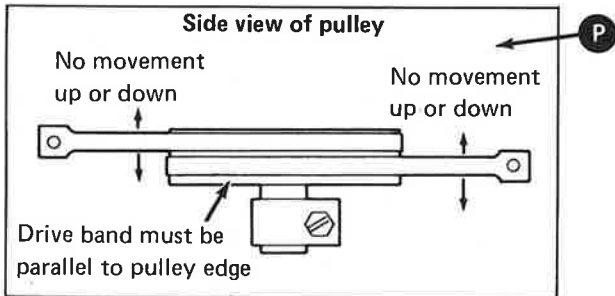
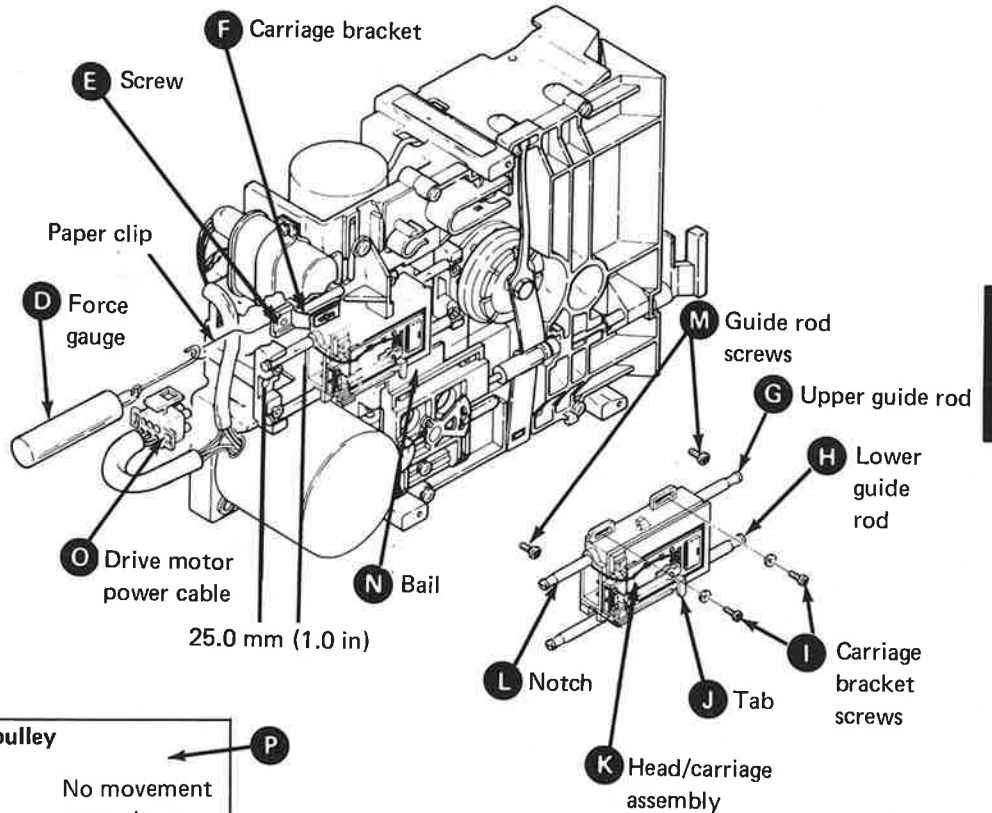
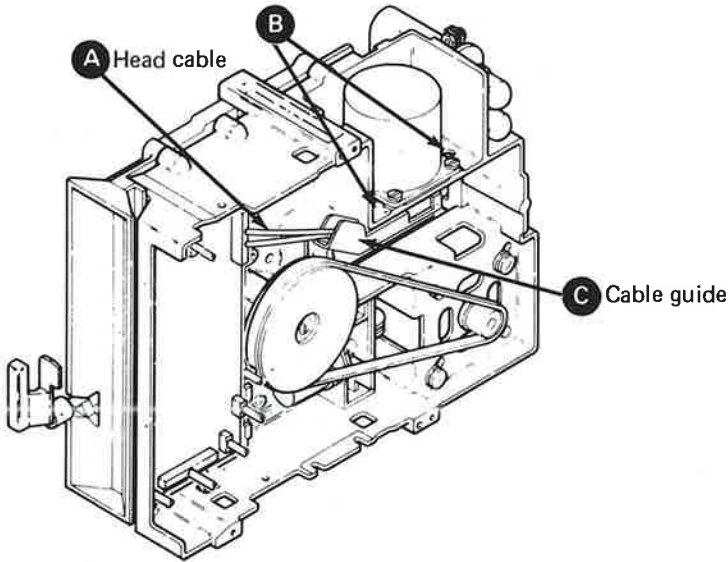
Voltage is present at connectors J1 and J2 when the 5322 power is switched on.

Warning: When installing the head/carriage assembly, ensure that the bail **N** is under the tab **J** of the carriage assembly. (51TD) To prevent damaging the heads, insert a strip of clean paper between the head surfaces during installation.

2. Carefully install the head/carriage assembly **K** on the lower guide rod **H**.
3. Install the upper guide rod **G**; tighten the two screws **M**. Ensure that the guide rod

notch **L** is aligned with the screw and is seated as shown in **O**.

4. Move the head/carriage assembly to approximately align the timing pointer with the timing block on the casting.
5. Install the screws **L** in the carriage bracket **F** so the screws are centered in the slots.
6. Connect the head cable **A** to the drive control card.
7. (51TD) Remove the paper from between the heads.
8. Loosen the drive band screw **E** (at the slotted end of the carriage bracket).
9. Block the head/carriage assembly **K** approximately 25.0 mm (1.0 in) from the rear of the casting.
10. With the force gauge **D** (part 460870), pull on the slotted end of the drive band with 0.907 ± 0.113 kg (2.5 ± 0.25 lb) of force; tighten the band clamping screw **E**. Ensure that the band is parallel to the bracket.
11. Move the head/carriage assembly back and forth and ensure that the drive band tracks correctly and that there is no movement up or down **P**. If the drive band tracking is not correct, adjust the drive band (1562), starting with Step 3.
12. If the drive band tracking is correct, perform the head/carriage adjustment, starting with Step 4.



Diskette drive

Maintenance procedures

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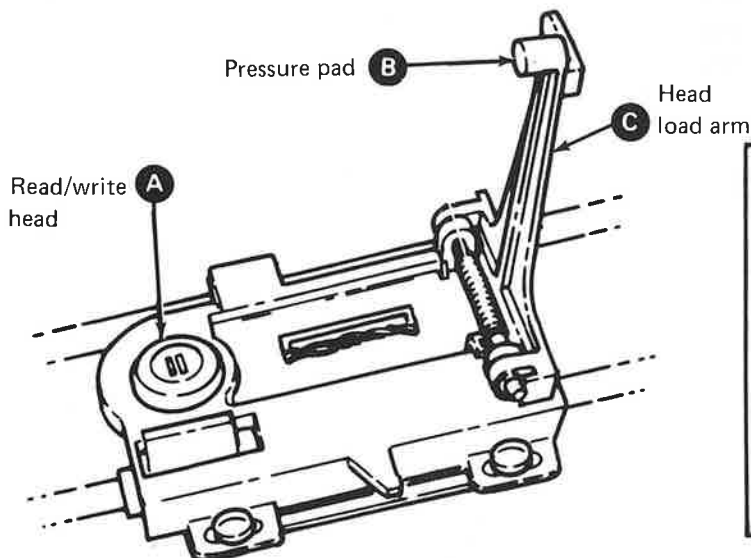
1531 Head/carriage pressure pad (31SD only)

If the pressure pad is worn so it is even with the surface of the head load arm, exchange the pad. Use the pad replacement kit (part 2200751), which includes the pressure pad tool (part 2200750).

Warning: The head area can be easily damaged or contaminated. Ensure that your tools are clean; do not touch the pressure pad with your fingers or let the adhesive touch the pad surface that will contact the diskette. Do not use damaged pads or let the head load arm hit the read/write head.

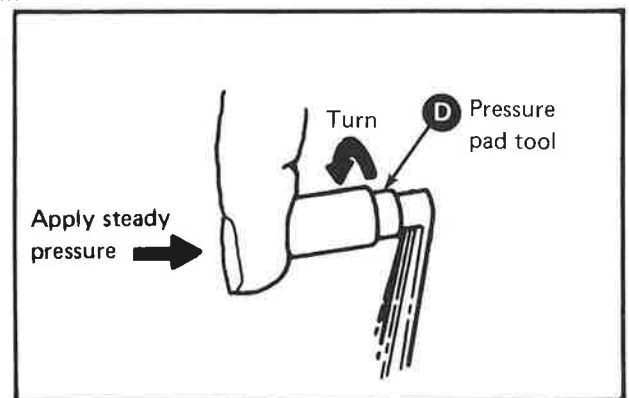
Removal

1. Move the head load arm **C** away from the read/write head **A**.
2. Use the scissor clamp (part 9900233) to pull the worn pressure pad **B** off the head load arm.
3. Carefully remove any adhesive that remains on the pressure pad mounting surface; use tissue (part 2162567) moistened with isopropyl alcohol (part 2200200) or an alcohol pad (part 9900679). If the surface is not completely clean, the new pad may not seat correctly.



Replacement

1. Lift off the paper cover that protects the adhesive layer on the new pad.
2. Use the scissor clamp to remove the new pressure pad from the other new pads.
3. Place the new pressure pad **B** in the center of its location on the head load arm **C**.
4. Use the small end of the pressure pad tool **D** (part 2200750); press the pressure pad into the head load arm.
5. Turn the tool one revolution in one direction only.
6. Carefully move the head load arm back to its operational position.



Maintenance procedures

1540 Head load solenoid and bail

Service check

1. Switch off the 5322 power.
2. Disconnect the ac drive motor power cable **F**.
3. Insert a diskette; close the diskette latch.

DANGER

Voltage is present at connectors J1 and J2 when the 5322 power is switched on.

4. Switch on the 5322 power.

Warning: To prevent damaging the card, the jumpers to be inserted in the following steps must be on the correct pins.

5. Connect a jumper from **B** (ground) to **C** (head load); the head load solenoid should be activated.
6. Connect a jumper from **A** (ground) to **D** (disable stepper motor).

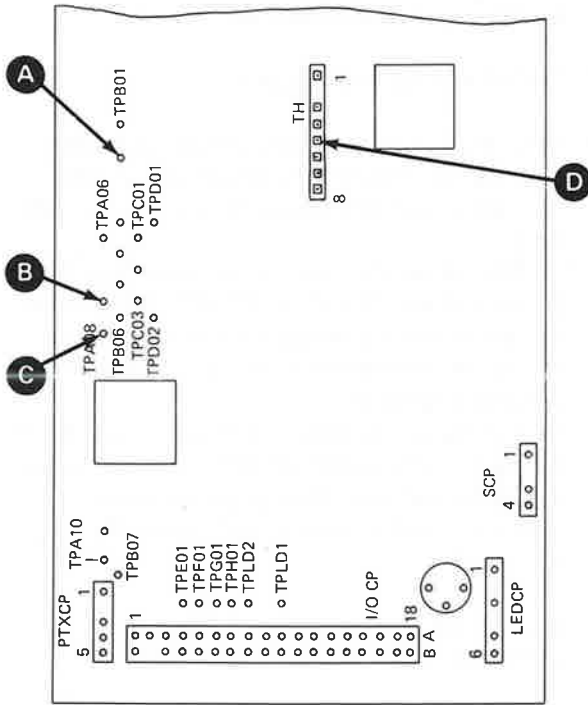
CAUTION

The solenoid case becomes hot after continuous use.

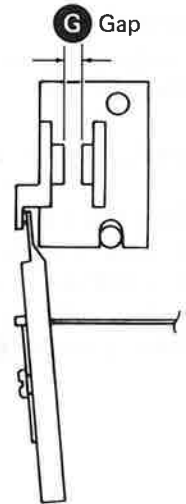
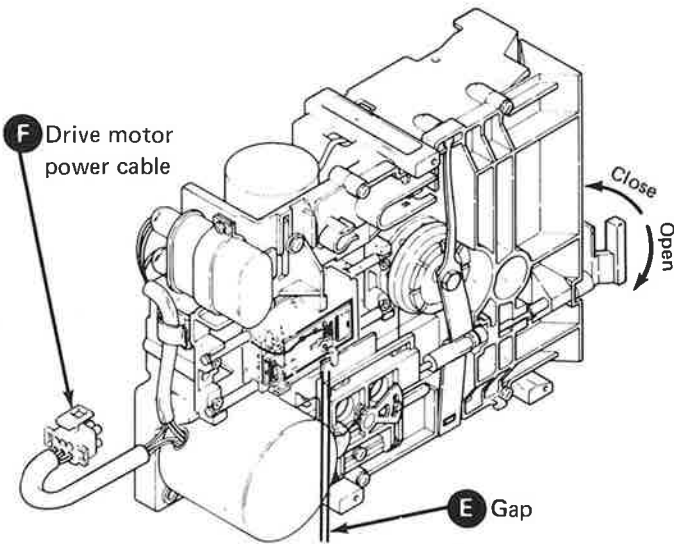
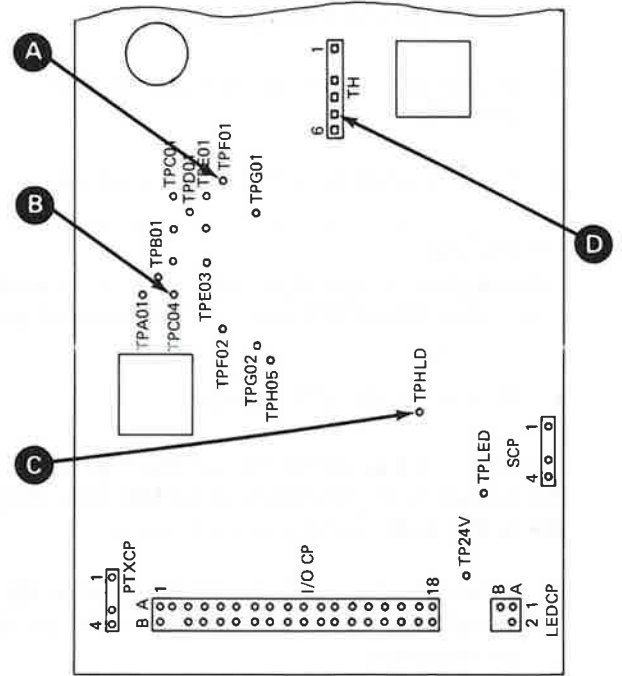
7. Check for a 0.3 to 0.7-mm (0.012 to 0.028-in.) gap **E** between the bail and the tab on the carriage assembly for all of the carriage movement (cylinder 00 to cylinder 76).

8. Remove the jumpers installed in Steps 5 and 6; remove the diskette.
9. Switch off the 5322 power.
10. With the head load solenoid de-activated and the diskette latch closed:
(31SD) Visually check for a gap **G** of 3.0 to 4.0 mm (0.118 to 0.157 in.) between the head and the head load arm.
(51TD) Visually check for a gap **G** of 2.0 to 3.0 mm (0.079 to 0.118 in.) between the head surfaces.
11. Connect the ac drive motor power cable **F**.

Diskette drive control card - 51TD



Diskette drive control card - 31SD



Diskette drive

Maintenance procedures

1540 Head load solenoid and bail (continued)

Adjustment

1. Switch off the 5322 power.
2. Disconnect the ac drive motor power cable **G**.
3. Insert a diskette; close the diskette latch.

DANGER
Voltage is present at connectors J1 and J2 when the 5322 power is switched on.

4. Switch on the 5322 power.

Warning: To prevent damaging the card, the jumpers to be installed in the following steps must be on the correct pins.

5. Connect a jumper from **E** (ground) to **C** (head load); the head load solenoid should be activated.
6. Connect a jumper from **A** (ground) to **D** (disable stepper motor).

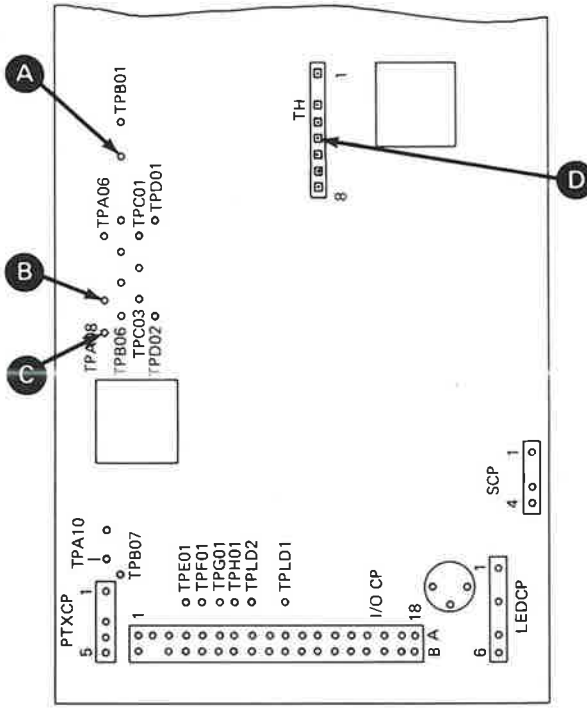
CAUTION

The solenoid case becomes hot after continuous use.

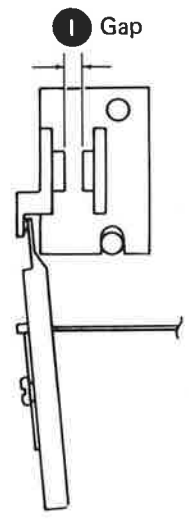
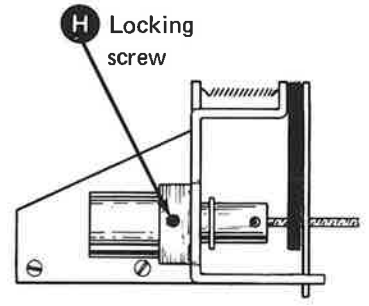
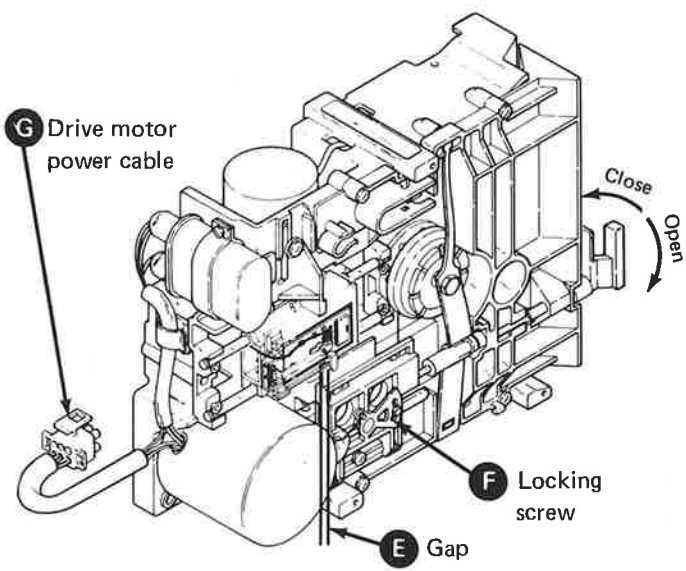
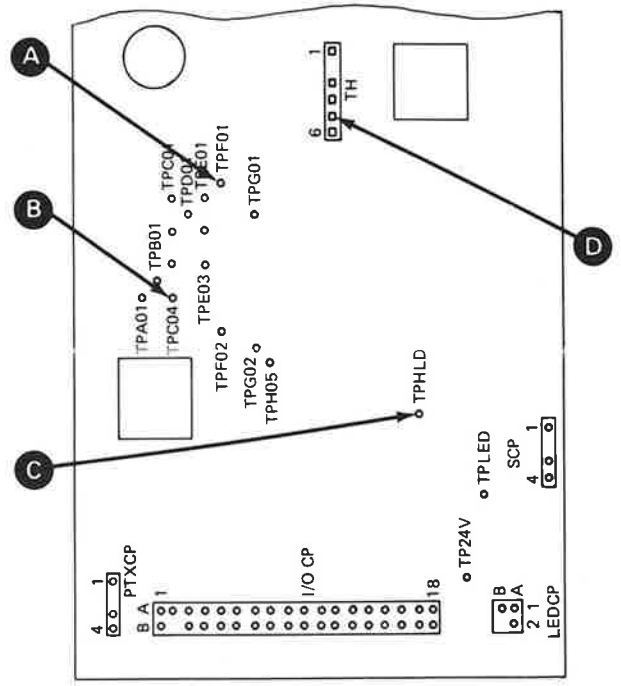
7. Loosen the solenoid locking screw **H**.
8. Turn the solenoid in the mounting bracket to obtain a gap **E** of 0.3 to 0.7 mm (0.012 to 0.028 in.) between the bail and the tab on the carriage assembly. Tighten the locking screw **H**.

9. Remove the jumpers installed in Steps 5 and 6; remove the diskette.
10. Switch off the 5322 power.
11. With the head load solenoid de-activated and the diskette latch closed, loosen the adjustment lever locking screw **F** one-half turn.
(31SD) Move the lever to obtain a gap **I** of 3.0 to 4.0 mm (0.118 to 0.157 in.) between the head and the head load arm (this gap cannot be measured and should only be visually checked).
(51TD) Move the lever to obtain a gap **I** of 2.0 to 3.0 mm (0.079 to 0.118 in.) between the head surfaces (this gap cannot be measured and should only be visually checked).
12. Tighten the adjusting lever locking screw **F**.
13. Connect the ac drive motor power cable **G**.

Diskette drive control card - 51TD



Diskette drive control card - 31SD



Diskette drive

Maintenance procedures

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1541 Head load bail

Removal

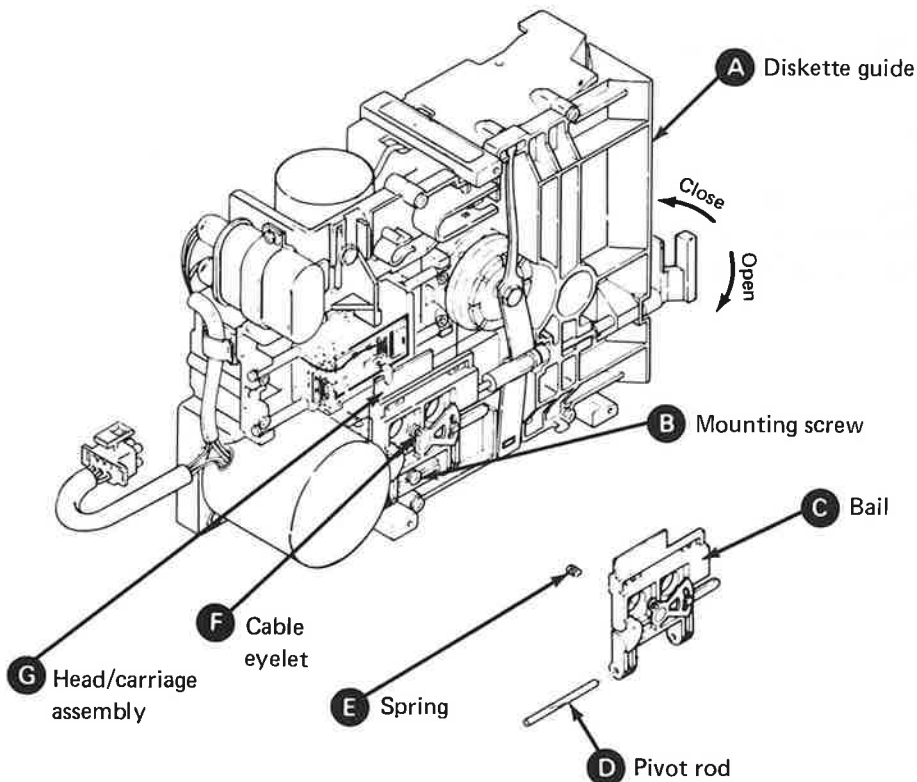
1. Switch off the 5322 power; move the head/carriage to the rear of the machine.
2. (51TD) Insert a clean strip of paper between the heads.
3. Close the diskette latch.
4. Push the head load bail **C** in slightly, and disconnect the bail actuating cable eyelet **F** from the bail.

Warning: Do not let the bail return spring **E**, located between the head load bail and the diskette guide **A**, fall out. (51TD) Do not let the heads snap together when the bail is removed from under the tab **G** on the head/carriage assembly.

5. Remove the mounting screw **B** and washer; remove the head load bail **C**, with the pivot rod **D**, from under the tab **G** on the head/carriage assembly.

Replacement

1. Install the head load bail **C** and the pivot rod **D** under the tab **G** on the head/carriage assembly. Ensure that the bail return spring **E** is placed correctly between the bail and the diskette guide.
2. Push the head load bail in slightly and connect the bail actuating cable eyelet **F**.
3. (51TD) Remove the paper from between the heads.
4. Perform the head load solenoid and bail service check (1540).



Maintenance procedures

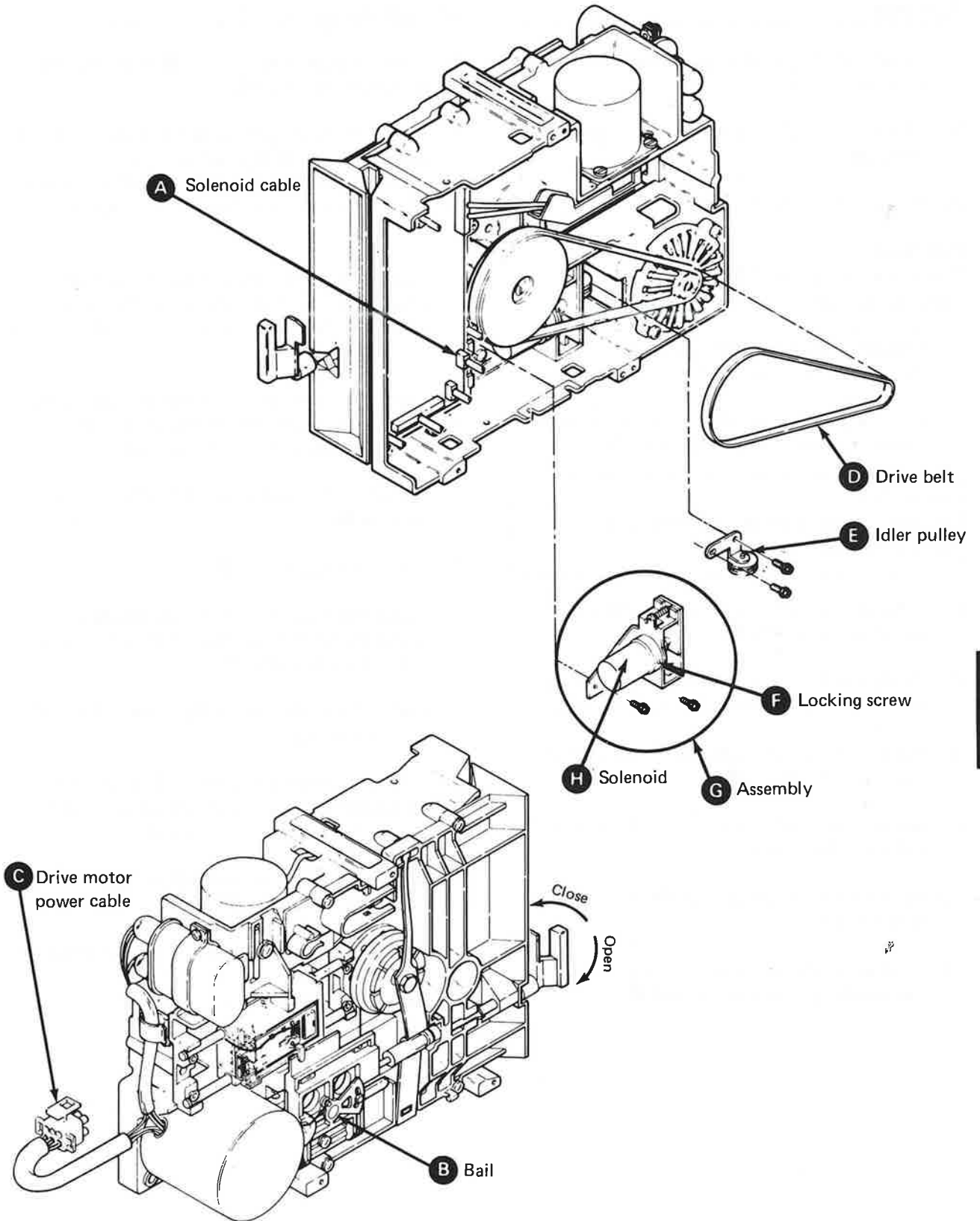
1542 Head load solenoid and idler

Removal

1. Switch off the 5322 power.
 2. Disconnect the ac drive motor power cable **C**.
- DANGER**
Voltage is present at connectors J1 and J2 when the 5322 power is switched on.
3. Close the diskette latch.
 4. (51TD) Insert a clean strip of paper between the heads.
 5. Push the bail **E** in slightly and disconnect the bail actuating cable eyelet from the bail.
 6. Open the diskette latch.
 7. Remove the ac drive motor belt **D**.
 8. Disconnect the solenoid cable **A** from the diskette drive control card.
 9. Remove the solenoid, bracket, and cable as a unit **G**.
 10. Remove the idler pulley **E**.
 11. Loosen the solenoid locking screw **F**; unscrew the solenoid **H** from the bracket (the solenoid and bail actuating cable are one unit).

Replacement

1. Install the solenoid idler **E**.
2. Install the solenoid and bail actuating cable **H** on the bracket.
3. Install the solenoid, bracket, and cable as a unit **G**.
4. Connect the solenoid cable **A** to the diskette drive control card.
5. Install the ac drive motor belt **D**.
6. Close the diskette latch.
7. Push the bail in slightly and connect the bail actuating cable eyelet to the bail **E**; ensure that the cable is around the solenoid idler pulley.
8. Adjust the head load solenoid and bail (1540), starting with Step 2.



Diskette drive

Maintenance procedures

1550 AC drive motor

Removal

1. Switch off the 5322 power; disconnect the ac power cable.
2. Disconnect the ac drive motor power cable **E**.
3. Remove the drive belt **I**.

CAUTION

The drive motor case becomes hot after continuous use.

4. Remove the two enclosure mounting screws **J**; remove the fan enclosure **H**.
5. Loosen the setscrew **F**; remove the drive motor fan and pulley assembly **G**.

DANGER

High voltage may be present at the capacitor terminals.

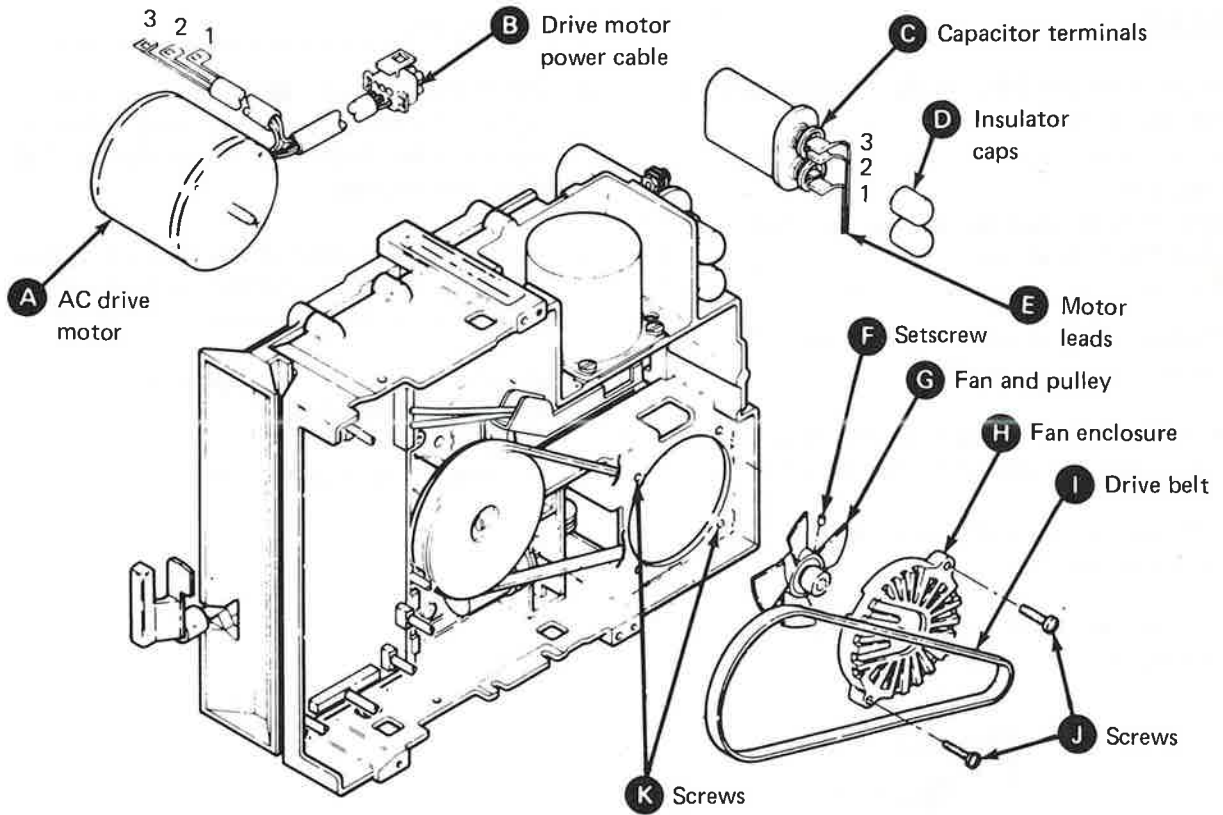
6. Remove the two insulator caps **D** from the capacitor terminals **C**.
7. Discharge the capacitor by shorting out its terminals with an insulated screwdriver.
8. Remove the drive motor leads **E** from the capacitor terminals **C**.
9. Remove the motor leads from the cable guide on the casting.
10. Remove the insulator caps **D** from the motor leads.
11. Remove the two remaining mounting screws **K**; remove the motor **A**.

Replacement

1. Install the ac drive motor **A** with the two mounting screws **K**.
2. Install the drive motor fan and pulley **G** on the motor shaft. Ensure that the setscrew **F** is centered on the flat surface of the motor shaft; leave the setscrew loose.
3. Position the fan and pulley on the motor shaft with a gap of 0.5 mm (0.020 in.) between the motor and the fan hub; tighten the setscrew.

Warning: Ensure that the fan enclosure is installed so the drive belt fits into the recessed portion of the enclosure.

4. Install the fan enclosure **H** with the two screws **J**.
5. Install the drive belt **I**.
6. Install the two insulator caps **D** on the motor leads **E** (one cap on lead 1 and one cap on leads 2 and 3).
7. Install the motor leads **E** in the cable guide on the casting.
8. Connect motor leads 2 and 3 to the top capacitor terminal; connect motor lead 1 to the bottom capacitor terminal.
9. Install the insulator caps **D** on the capacitor terminals **C**.
10. Connect the ac drive motor power cable **E**.
11. Connect the ac power cable.



Diskette drive

Maintenance procedures

1551 Capacitor

Removal

1. Switch off the 5322 power; disconnect the ac power cable.

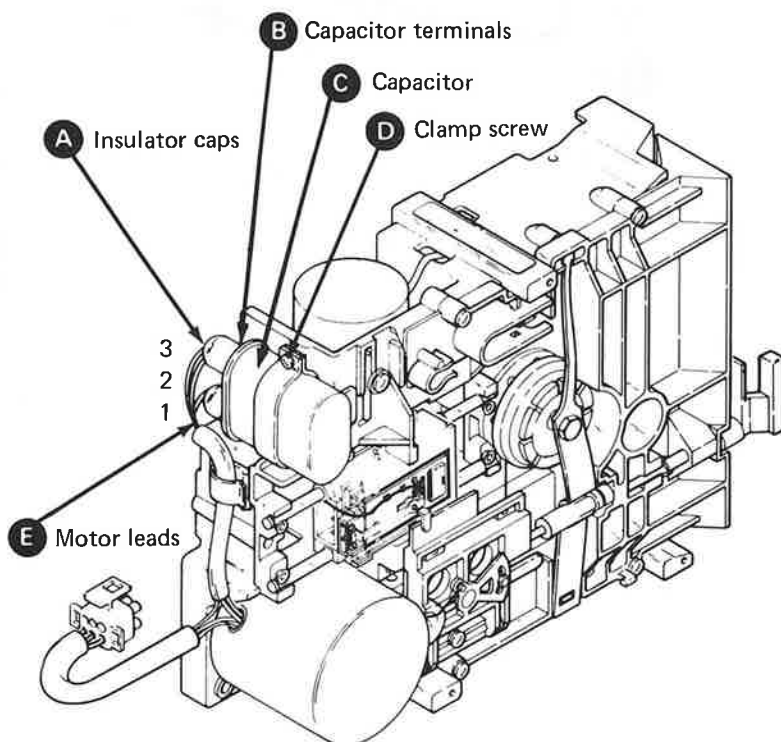
DANGER

High voltage may be present at the capacitor terminals.

2. Remove the insulator caps **A** from the capacitor terminals **E**.
3. Discharge the capacitor by shorting out its terminals with an insulated screwdriver.
4. Disconnect the motor leads **E** from the capacitor terminals.
5. Loosen the capacitor clamp screw **D**; remove the capacitor **C**.

Replacement

1. Install the capacitor **C** in its clamp and tighten the clamp screw **D**; ensure that the capacitor terminals face the pulley side of the diskette drive.
2. Connect motor leads 2 and 3 to the upper capacitor terminal; connect motor lead 1 to the lower capacitor terminal.
3. Install the insulator caps **A** on the capacitor terminals **E**.
4. Connect the ac power cable.



1552 AC drive belt and pulley

Removal

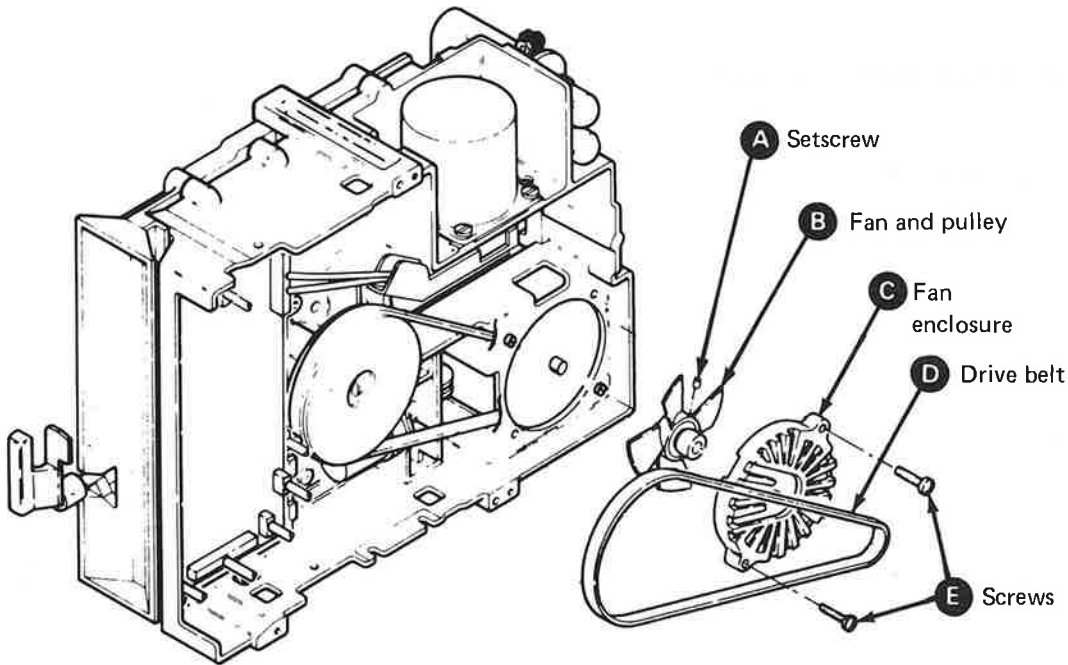
1. Switch off the 5322 power.
2. Remove the drive belt **D**.
3. Remove the two enclosure mounting screws **E**; remove the fan enclosure **C**.
4. Loosen the setscrew **A**; remove the drive motor fan and pulley assembly **B**.

Replacement

1. Install the drive motor pulley and fan **B** on the motor shaft, with the setscrew **A** centered on the flat surface of the shaft (leave the setscrew loose).
2. Position the fan and pulley on the motor shaft with a gap of 0.5 mm (0.020 in.) between the motor and the fan hub; tighten the setscrew.

Warning: Ensure that the fan enclosure is installed so the drive belt fits into the recessed portion of the enclosure.

3. Install the fan enclosure **C** with the two screws **E**.
4. Install the drive belt **D**.



Maintenance procedures

1560 Stepper drive motor

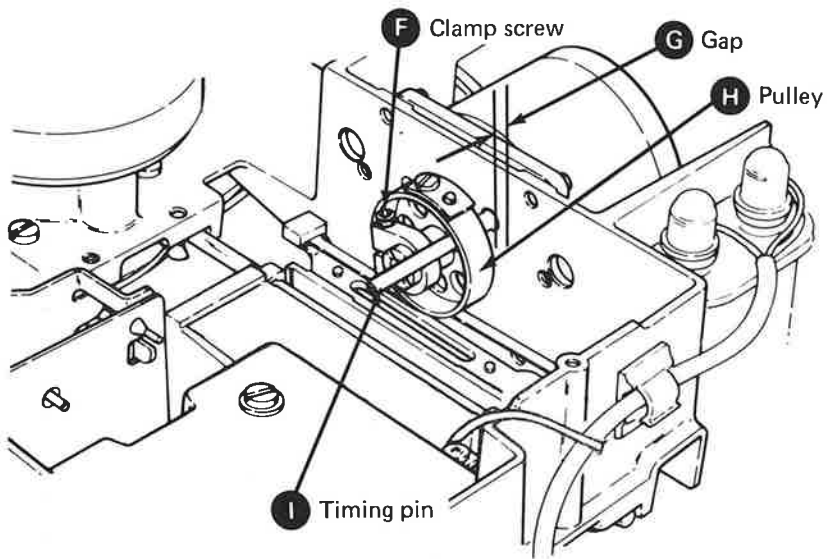
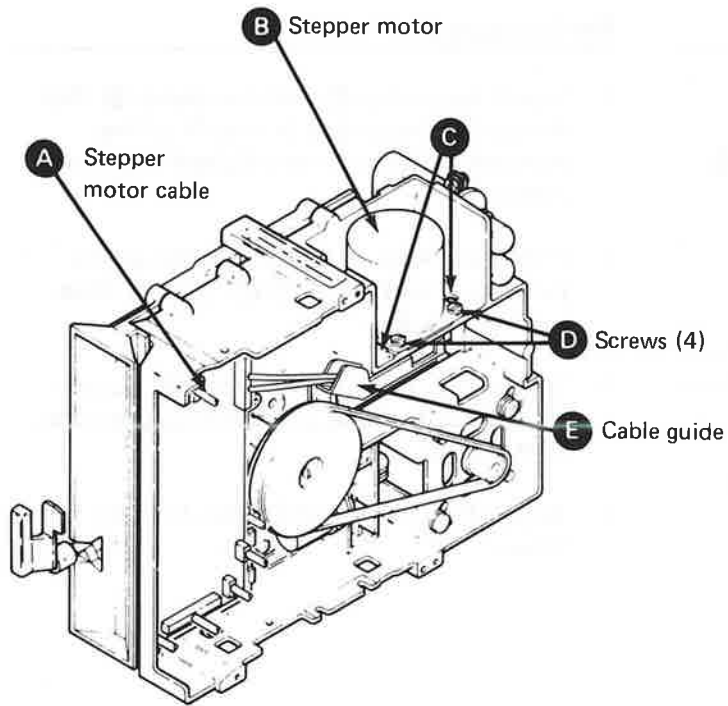
Removal

Warning: The drive band assembly can be easily damaged. Be careful not to bend the drive band.

1. Switch off the 5322 power.
2. Disconnect the stepper motor cable **A** from the diskette drive control card.
3. Remove the cable guide **E**: squeeze at **C** and push the cable guide down.
4. Measure and record the gap **G** between the stepper motor pulley **H** and the casting.
5. Loosen the clamp screw **F**. To prevent damaging the drive band, give support to the pulley **H** before removing the stepper motor.
6. Remove the four stepper motor mounting screws **D**.
7. Remove the stepper motor **B**.

Replacement

1. Install the stepper motor **B** with the four mounting screws **D**; position the motor cable toward the diskette drive control card.
2. Connect the stepper motor cable **A** to the diskette drive control card.
3. Set the gap **G** (recorded in step 4 of the removal procedure) and tighten the clamp screw **F**.
4. Snap the cable guide **E** into the casting.
5. Perform the head/carriage assembly service check (1530).



Diskette
drive

Maintenance procedures

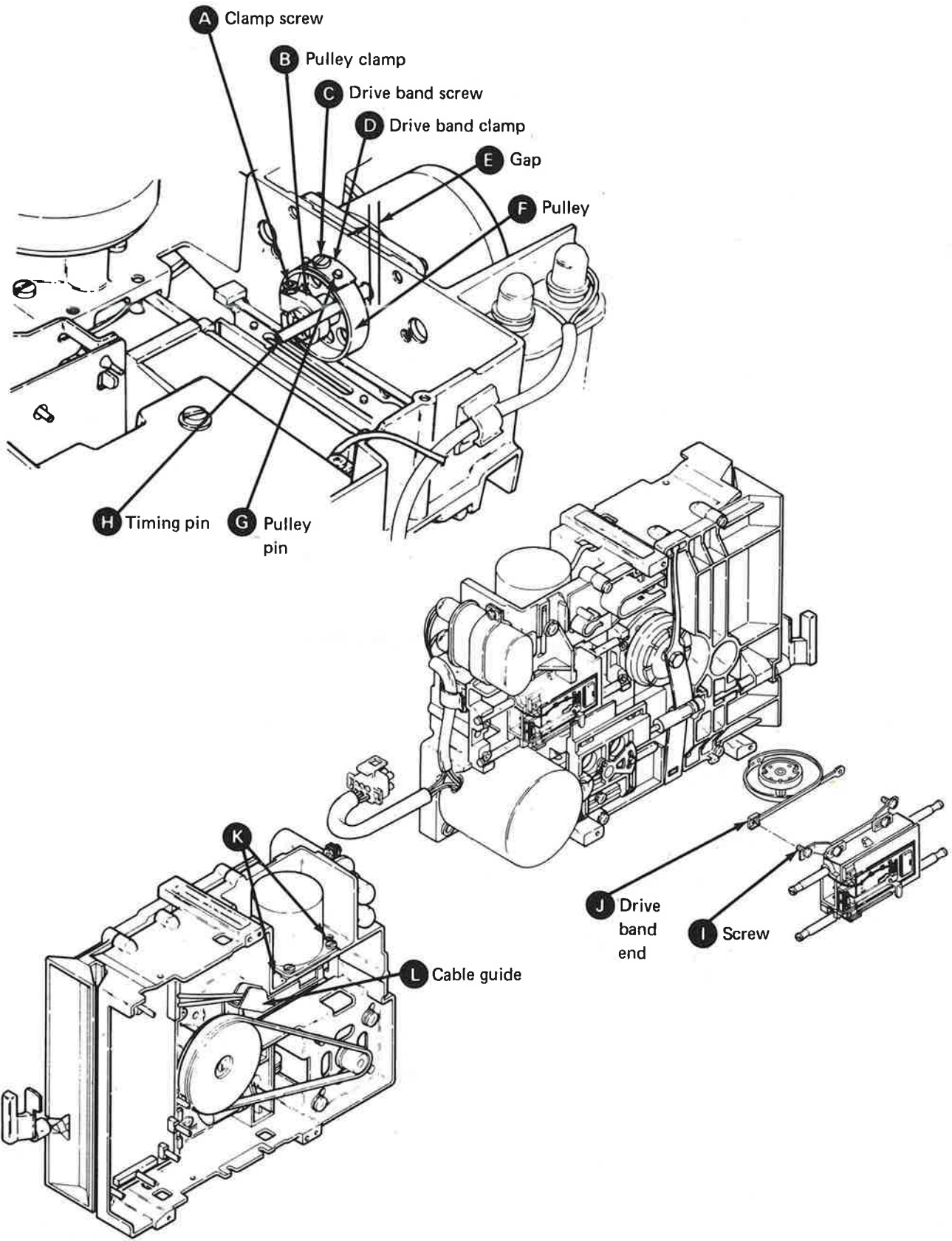
1561 Stepper motor pulley and clamp

Removal

1. Switch off the 5322 power.
2. Remove the cable guide **L** (squeeze at **K**; push the cable guide down).
3. Remove the drive band screw **C** and clamp **D**.
4. Loosen the drive band screw **H**; leave the drive band end **J** loose to release the drive band tension on the pulley pin **G**.
5. Measure and record the gap **E** between the stepper motor pulley **F** and the casting.
6. Loosen the clamp screw **A**; remove the clamp **B** and the pulley **F**.

Replacement

1. Install the pulley **F** and the clamp **B**. Set the gap **E** (recorded in Step 5 of the removal procedure) and tighten the clamp screw **A**.
2. Install the drive band end on the pulley pin **G**; install the clamp **D** and the drive band screw **C**.
3. Tighten the drive band screw **H**; ensure that the drive band is parallel to the edge of the pulley **F**.
4. Adjust the drive band (1562), starting with Step 7.



Diskette drive

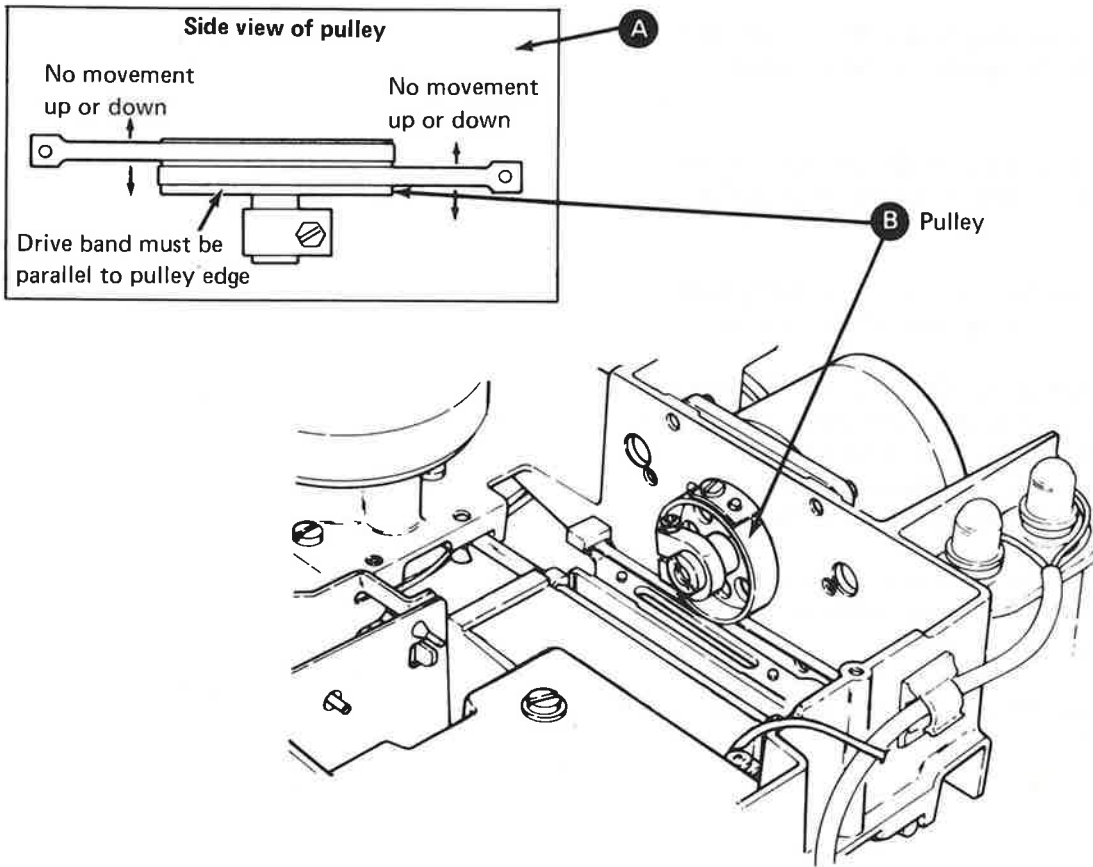
Maintenance procedures

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1562 Drive band

Service check

1. Switch off the 5322 power.
2. Move the head/carriage assembly by hand between cylinders 00 and 76. The drive band should track without moving up or down on the pulley **B** as shown in **A**.
3. If the drive band does not track correctly, adjust the drive band.
4. Exchange the drive band if it is damaged.

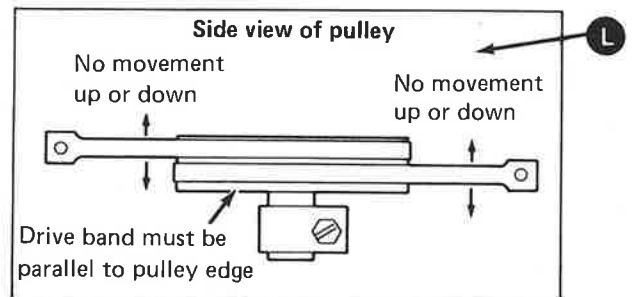
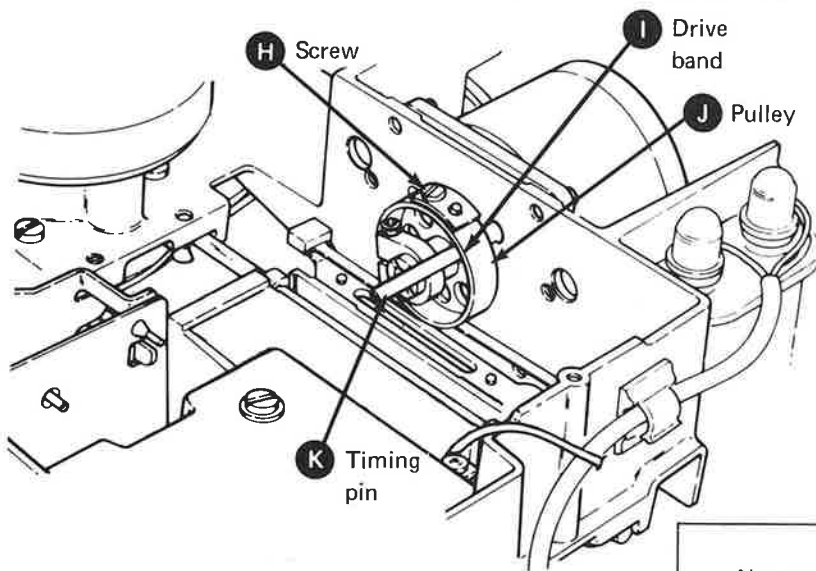
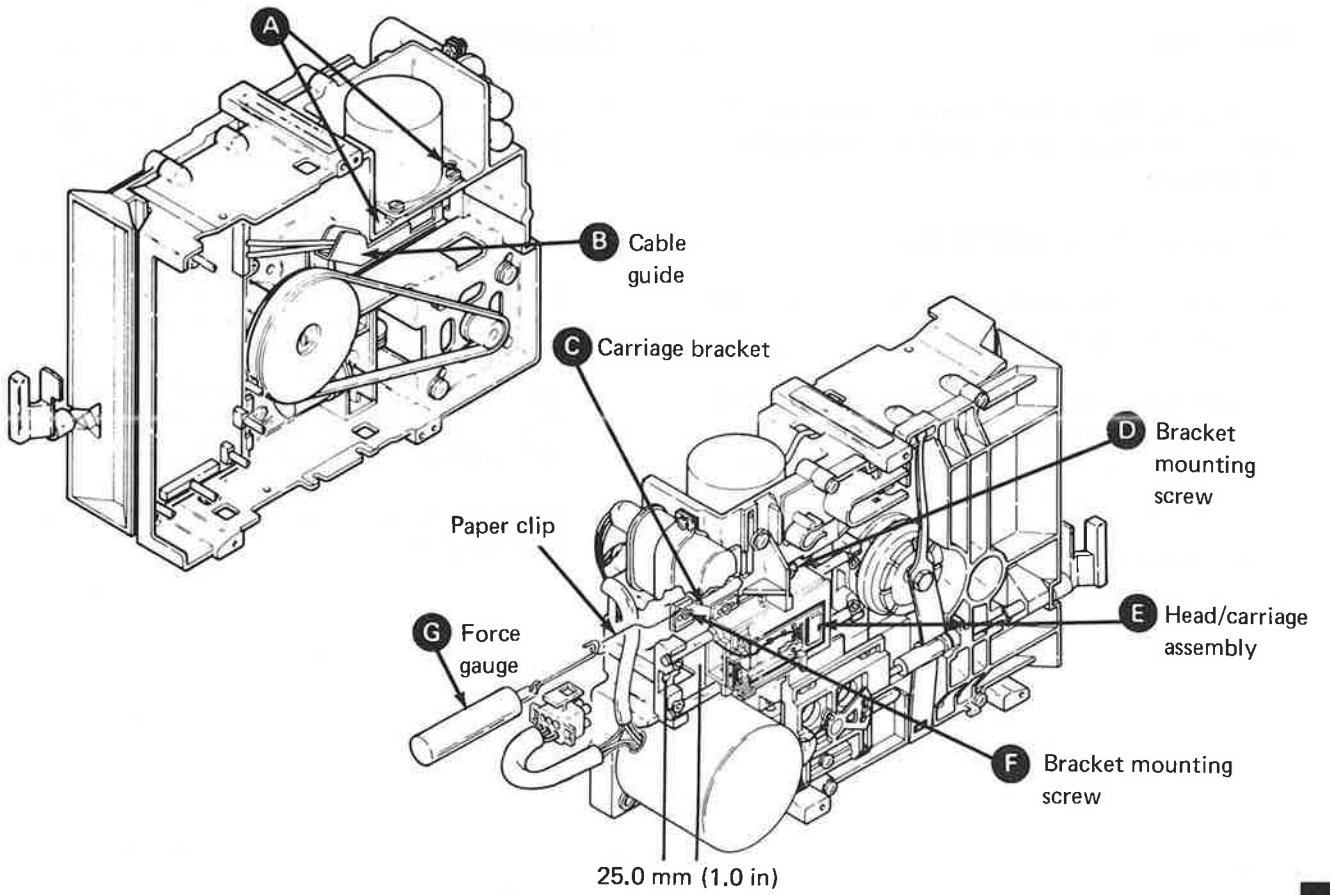


Maintenance procedures

1562 Drive band (continued)

Adjustment

1. Switch off the 5322 power.
2. Remove the cable guide **B** (squeeze at **A**; push the guide down).
3. Move the head/carriage assembly **E** to approximately align the timing pointer with the timing block on the casting (cylinder 40).
4. Loosen the two carriage bracket mounting screws **D** and **F** and the pulley screw **H**.
5. Tighten the mounting screw **D**; ensure that the drive band is parallel to the carriage bracket **C**.
6. Tighten the pulley screw **H**; ensure that the drive band **I** is parallel to the edge of the pulley **J**.
7. Block the head/carriage approximately 25.0 mm (1.0 in.) from the rear of the casting.
8. With the force gauge **G** (part 460870), pull on the loose end of the drive band with 0.907 ± 0.113 kg (2.5 ± 0.25 lb) of force. Tighten the screw **F**; ensure that the drive band is parallel to the carriage bracket **C**.
9. Move the carriage back and forth; ensure that the drive band tracks correctly as shown in **L**.
10. Adjust the head/carriage (1530), starting with Step 4.



Diskette drive

Maintenance procedures

1562 Drive band (continued)

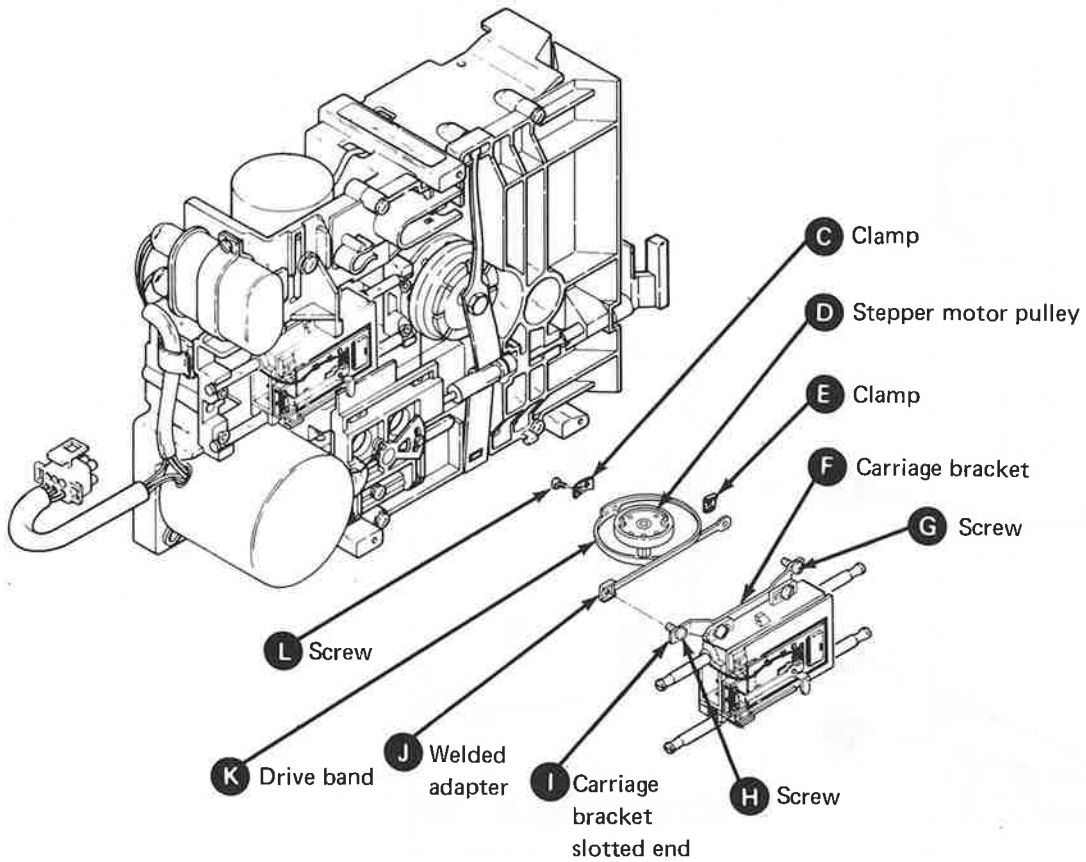
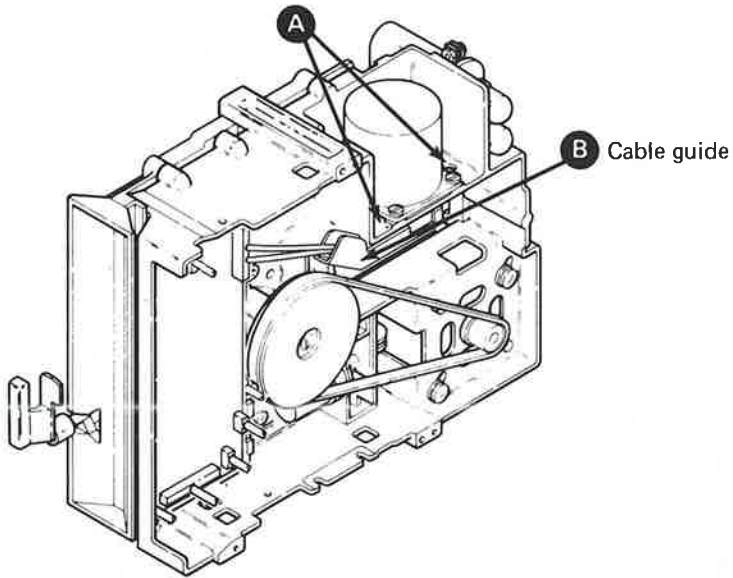
Removal

Warning: The drive band assembly can be easily damaged. Be careful not to bend the drive band.

1. Switch off the 5322 power.
2. Remove the cable guide **B** (squeeze at **A**; push the guide down).
3. Remove the three mounting screws **G**, **L**, and **H**; remove the clamps **C** and **E** that attach the drive band **K** to the stepper motor pulley **D** and the carriage bracket **F**.
4. Remove the drive band **K**.

Replacement

1. Attach the end of the drive band with the welded adapter **J** to the slotted end **I** of the carriage bracket; leave the screw **H** loose.
2. Attach the drive band to the stepper motor pulley **D** with the screw **L** and the clamp **C**; leave the screw **L** loose.
3. Attach the other end of the drive band to the carriage bracket **F** with screw **G** and clamp **E**; leave the screw **G** loose.
4. Perform the drive band adjustment, starting with Step 5.



Diskette
drive

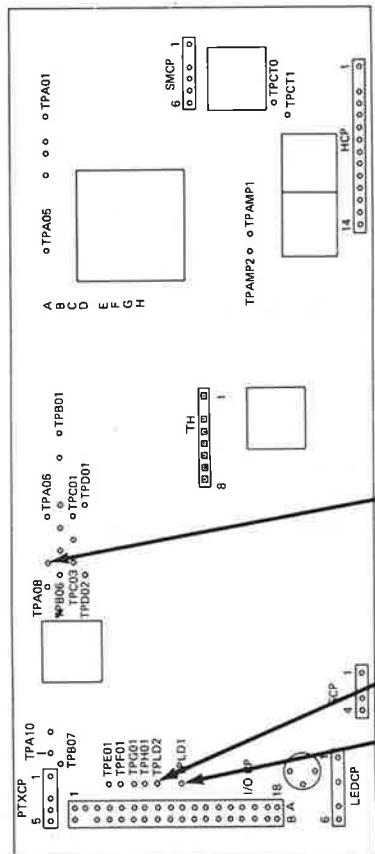
Maintenance procedures

1570 LED assembly

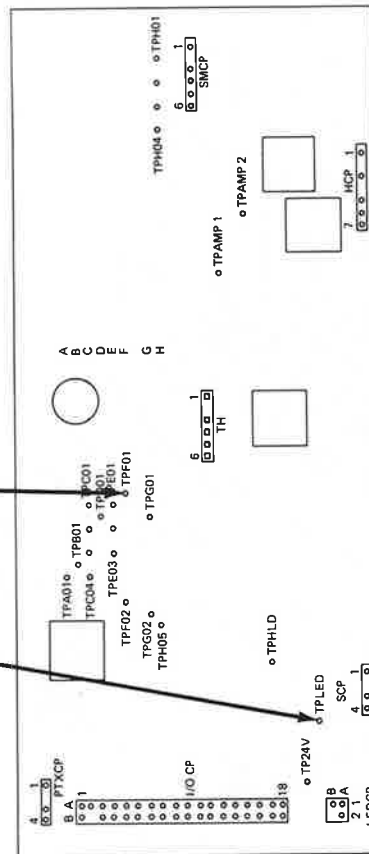
Output service check

1. Connect the negative probe of the CE meter to **A** (ground).
2. Set the CE meter scale to 5 Vdc.
3. (31SD) Connect the positive probe to **B** (31SD LED voltage).
(51TD) Connect the positive probe to **C** (D2 LED voltage).
4. Check for a voltage level of 1 Vdc to 2 Vdc.
5. (51TD) Move the positive probe to **D** (D1 LED voltage).
6. (51TD) Check for a voltage level of 1 Vdc to 2 Vdc.

Diskette drive control card - 51TD



Diskette drive control card - 31SD

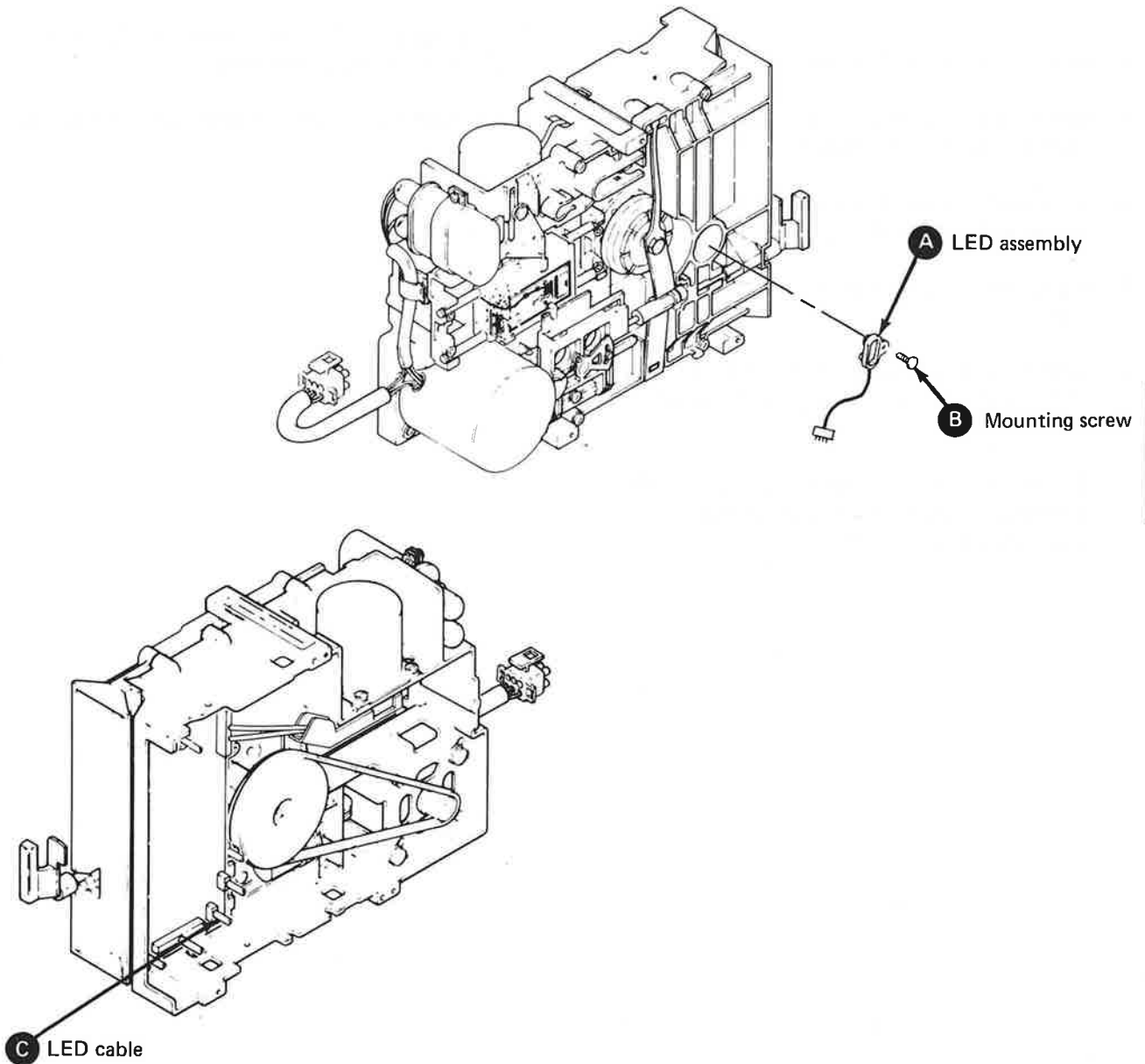


Removal

1. Switch off the 5322 power.
2. Remove the LED cable **C** from the diskette drive control card.
3. Remove the LED mounting screw **B**.
4. Remove the LED assembly **A** and the cable (note the cable path to make the replacement easier).

Replacement

1. Install the LED cable in the diskette guide; install the LED assembly **A** and the mounting screw **B**.
2. Connect the LED cable **C** to the diskette drive control card.



Maintenance procedures

1571 PTX assembly

Output service check

1. Switch off the 5322 power.
2. Disconnect the ac drive motor power cable **F**.
3. Disconnect the PTX cable connector **G** from the diskette drive control card.

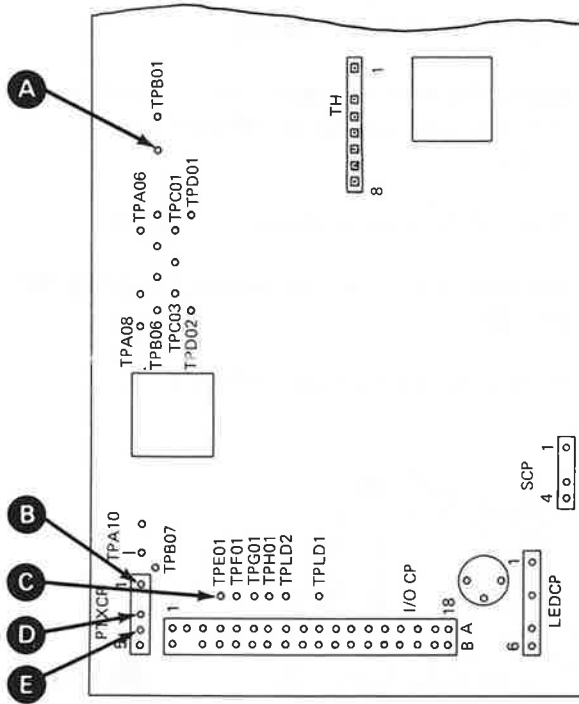
DANGER

Voltage is present at connectors J1 and J2 when the 5322 power is switched on.

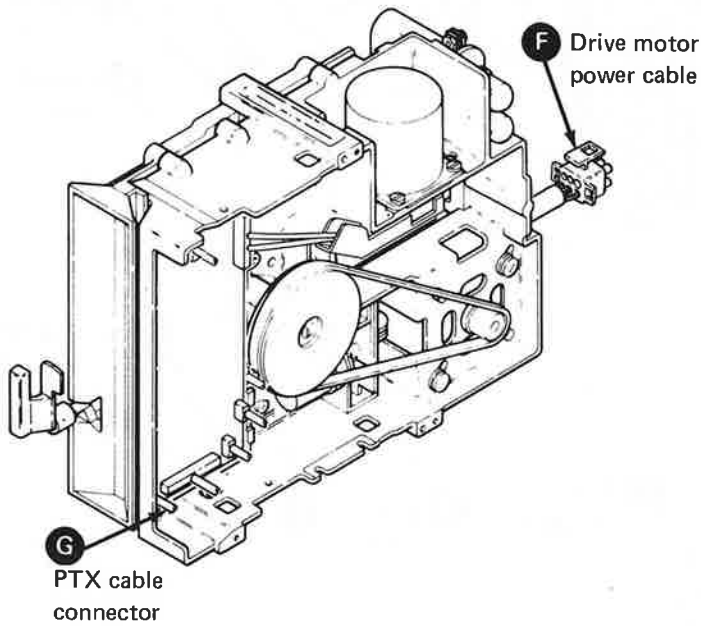
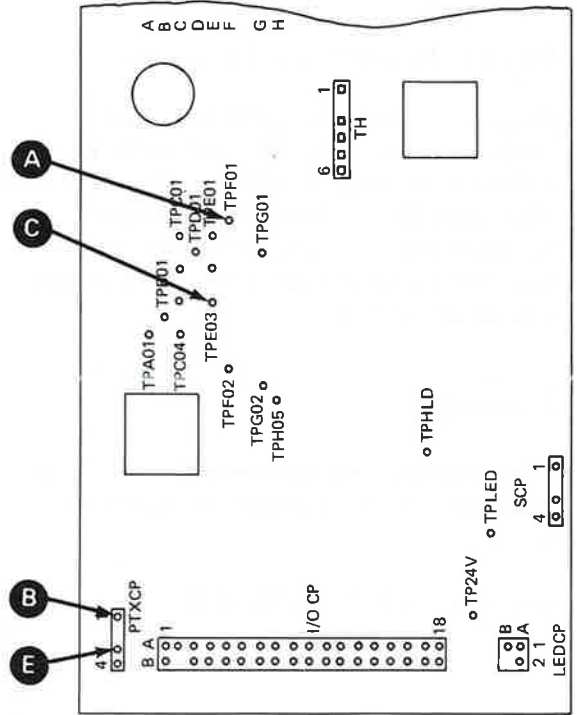
4. Switch on the 5322 power.
5. Set the CE meter scale to 5 Vdc and connect the positive probe to **C** (index).
6. Connect the negative probe of the CE meter to **A** (ground).
7. Check for a voltage level of less than 1 Vdc.
8. (31SD) Connect one end of a jumper to **E** (PTX emitter); do not connect the other end.

(51TD) Connect one end of a jumper to **E** (Diskette 2, 2D PTX emitter), do not connect the other end.
9. Watch the CE meter; touch the other end of the jumper to **B** Diskette 1 collector (51TD) or **B** PTX collector (31SD) several times. The CE meter should read 2.5 Vdc or more when **B** is touched (a false reading can occur the first time).
10. (51TD) Repeat steps 8 and 9 with the jumper on **D** (Diskette 1 PTX emitter).
11. Switch off the 5322 power.
12. Remove the jumper.
13. Connect the PTX cable connector **G** to the diskette drive control card.
14. Connect the ac drive motor power cable **F**.

Diskette drive control card - 51TD



Diskette drive control card - 31SD



Diskette drive

Maintenance procedures

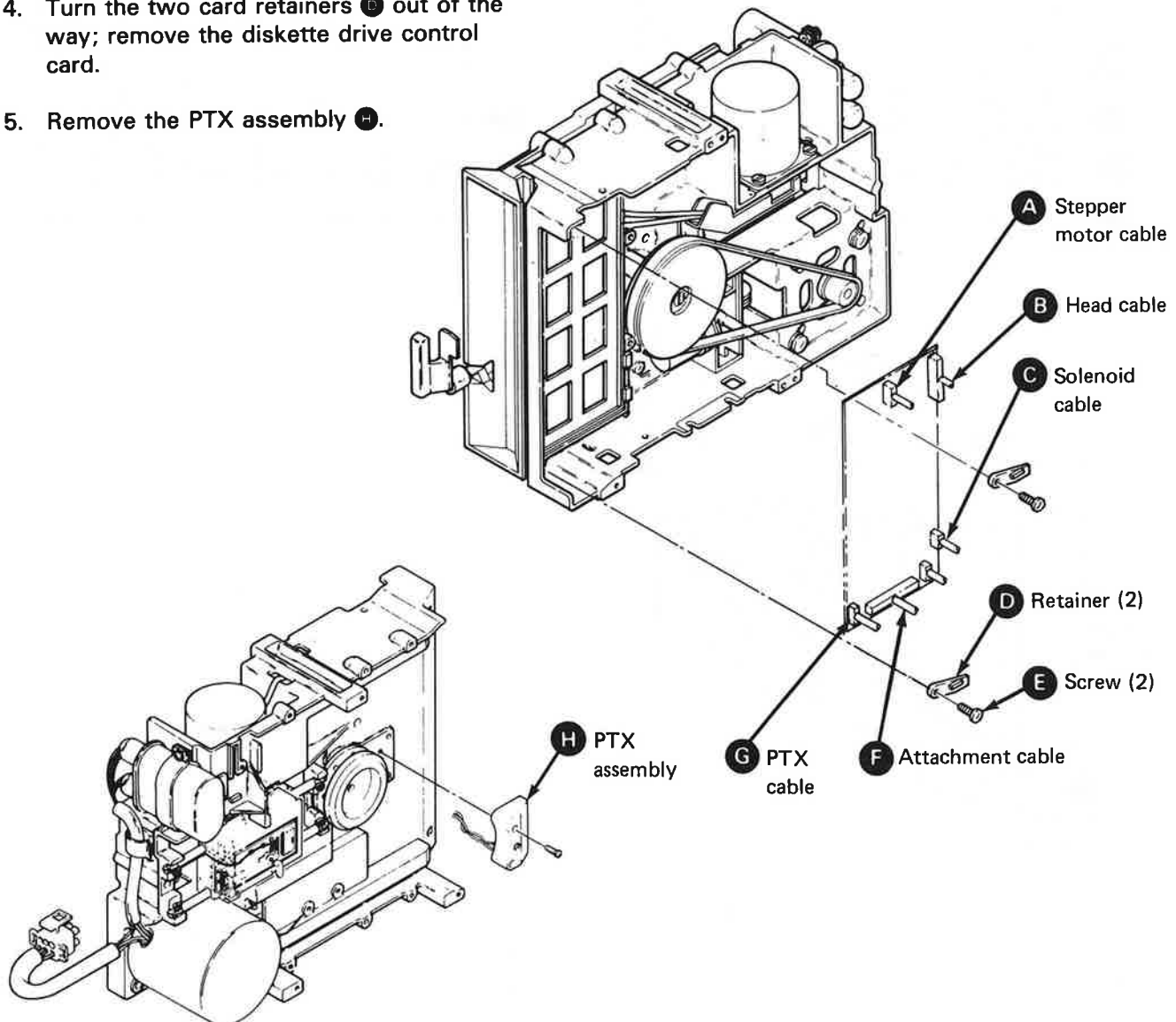
1571 PTX assembly (continued)

Removal

1. Remove the diskette guide (1520).
2. Remove the remaining cable connectors (stepper drive motor **A**, head cable **B**, solenoid cable **C**, attachment cable **F**, and PTX cable **G**) from the diskette drive control card. Note the connector locations and cable paths to make the replacement procedure easier.
3. Loosen the two control card retaining screws **E**.
4. Turn the two card retainers **D** out of the way; remove the diskette drive control card.
5. Remove the PTX assembly **H**.

Replacement

1. Install the PTX assembly **H**.
2. Install the diskette drive control card; turn the two retainers **D** to hold the card in place.
3. Tighten the two retaining screws **E**.
4. Connect the cable connectors **A**, **B**, **C**, **F**, and **G**.
5. Install the diskette guide (1520).



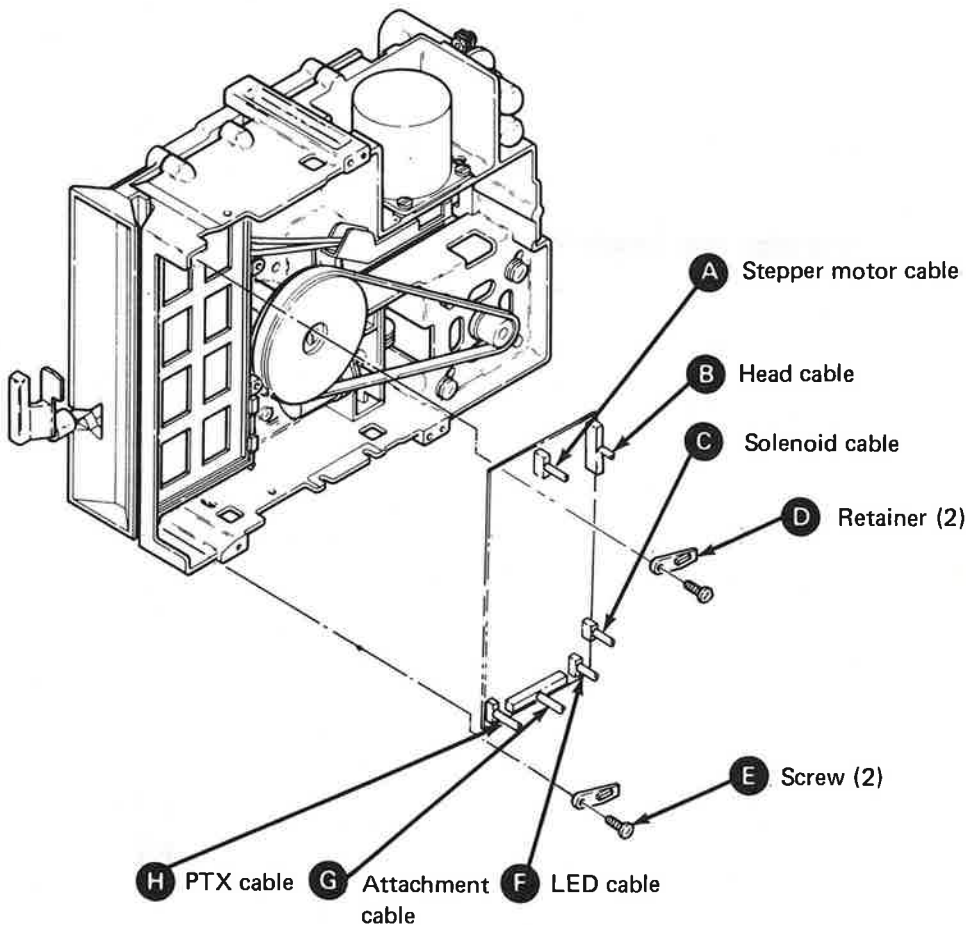
1572 Diskette drive control card

Removal

1. Switch off the 5322 power.
2. Remove the cable connectors (stepper drive motor cable **A**, head cable **B**, solenoid cable **C**, LED cable **F**, attachment cable **G**, and PTX cable **H**) from the control card. Note the connector locations and cable path to make the replacement procedure easier.
3. Loosen the two card retaining screws **E**.
4. Turn the two card retainers **D** out of the way; remove the diskette drive control card.

Replacement

1. Install the diskette drive control card; turn the two retainers **D** to hold the card in place.
2. Tighten the two retaining screws **E**.
3. Connect the cable connectors **A**, **B**, **C**, **F**, **G**, and **H**.



Maintenance procedures

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Theory of operation

Introduction

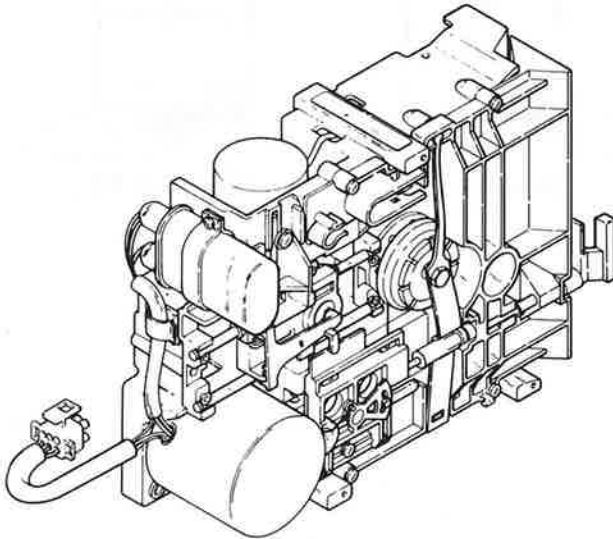
Diskette drive

IBM diskette drives are direct-access, read/write, data-storage devices. These drives use the flexible magnetic diskette for data entry, data exchange, and data storage.

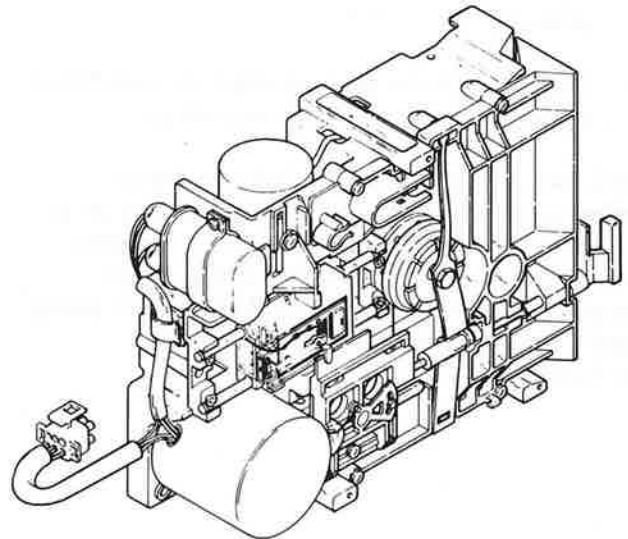
The 31SD diskette drive can only read from, and write to, a diskette 1. The 31SD diskette drive can read and write in Frequency modulated (FM) only. If a diskette 2 or a diskette 2D is inserted into a 31SD diskette drive, the drive will not be activated.

The 51TD diskette drive can read from and write to one side of a diskette 1, and both sides of a diskette 2 or diskette 2D. The 51TD diskette drive can read and write in either Frequency modulated (FM) or Modified frequency modulated (MFM).

31SD diskette drive



51TD diskette drive



Theory of operation

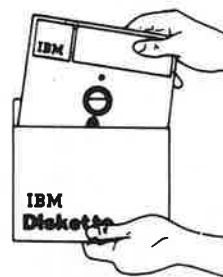
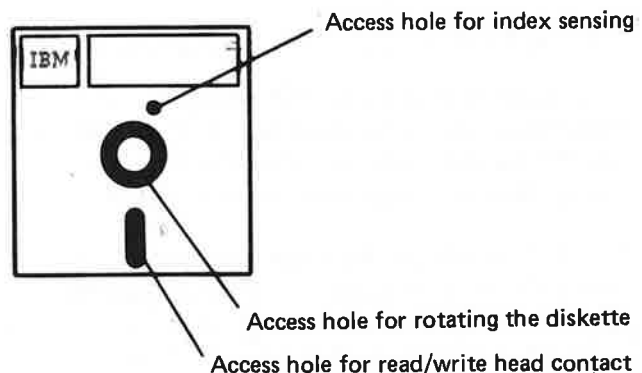
Diskette

The IBM diskette is a thin, flexible disk housed in a protective jacket. Information is stored magnetically on the diskette surface, which is coated with magnetic oxide. The diskette is free to rotate inside the jacket. As the diskette rotates, the inner surface of the jacket cleans the diskette. The jacket has access holes for rotating the diskette, for read/write head contact, and for index hole sensing.

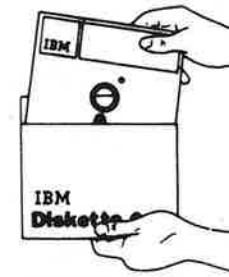
There are three types of diskettes on which data can be recorded and retrieved:

- Diskette 1 can be formatted on side 0 only.
- Diskette 2 can be formatted on side 0 and side 1.
- Diskette 2D can be formatted on side 0 and side 1 with FM or MFM recordings.

The location of the access hole for index sensing on a diskette 1 differs from that on a diskette 2 and diskette 2D. When a diskette 1 is inserted in a 51TD diskette drive, index sensing circuits sense that a diskette 1 is being used, and the use of the blank side is prevented.



Diskette 1



Diskette 2, 2D

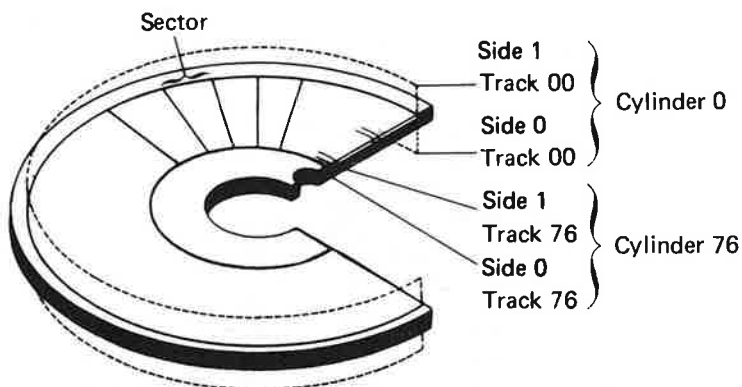
Diskette format

Information is written on the diskette in tracks. A *track* is a circular path on the diskette surface. A *sector*, determined during diskette initialization, is a division of each track of the diskette. Each sector is used to write one record. As the diskette rotates, information is magnetically written to and read from a track by a read/write head.

There are 77 tracks on each side of a diskette. Track 00, which is the outside track, is reserved as a label track and cannot be used for data. Tracks 75 and 76, which are the two innermost tracks, are reserved as replacement tracks and can be used for data only if another track becomes damaged.

The diskette 1 has 74 tracks available for recording data. The diskette 2 or diskette 2D has 74 tracks available on each side of the diskette, resulting in a total of 148 tracks of data. When data is recorded on only one side of a diskette, each addressed circle of data is called a track. When data is recorded on both sides of a diskette, however, each pair of tracks (one upper and one lower) is referred to as a *cylinder*. For example, cylinder 0, the outside cylinder, is made up of upper and lower track 00.

When a diskette 1 is used, the most data that can be read or written on a track without moving the read/write head is the data on that track over which the read/write head is positioned. When a diskette 2 or 2D is used, the most data that can be read or written on two tracks (one on each side of the diskette), without moving the read/write head assembly, is the data on the two tracks over which the read/write head is positioned. When two tracks are used, the total amount of area that can be accessed is referred to as a cylinder.

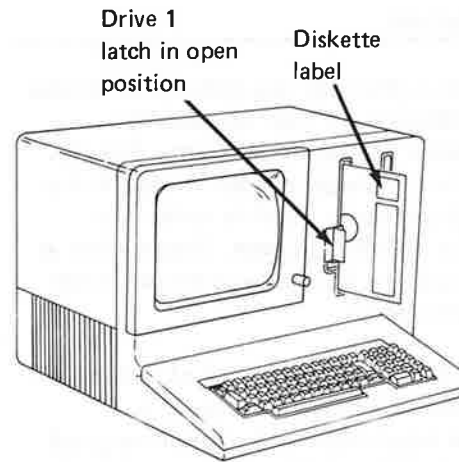


Theory of operation

Diskette handling

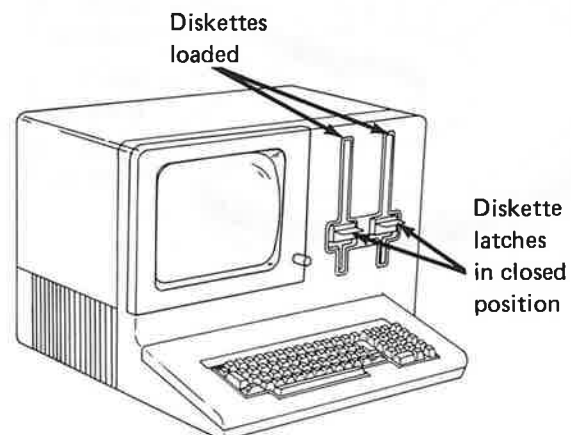
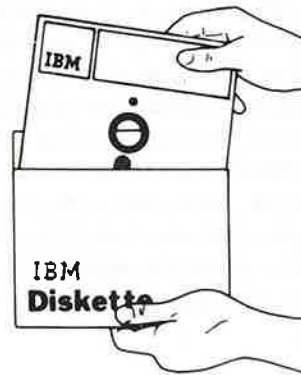
Diskette insertion

1. Open the diskette latch.
2. Remove the diskette from its protective envelope.
3. Switch on the 5322 power.
4. Place the diskette squarely into the diskette drive (with the label facing the latch).
5. Close the diskette latch.



Diskette removal

1. Open the diskette latch.
2. Remove the diskette.
3. Insert the diskette into its protective envelope.



Environment

Temperature: 10°C to 51°C (50°F to 125°F)

Relative humidity: 8% to 80%

Maximum wet bulb temperature: 29°C (185°F)

Short-term storage

Store often-used diskettes flat in their envelopes, in stacks of up to 10. If storing vertically, give support to the diskettes so they do not lean or sag.

Long-term storage

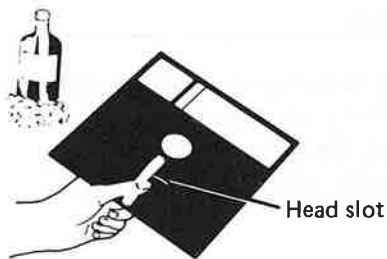
Store seldom-used diskettes in their original shipping cartons. Put each diskette in its protective envelope. Shipping cartons can be stored either vertically or horizontally.

Shipping and receiving

Ship diskettes only in shipping cartons. Additional shipping cartons are available at IBM branch offices. With the diskette in place, the package weighs 280 grams (10 ounces). Be sure to label the package: **DO NOT EXPOSE TO HEAT OR SUNLIGHT**. Save the carton for diskette storage or for later shipment.

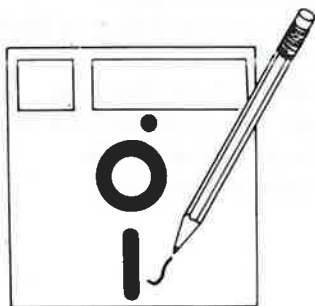
Theory of operation

Diskette handling (continued)



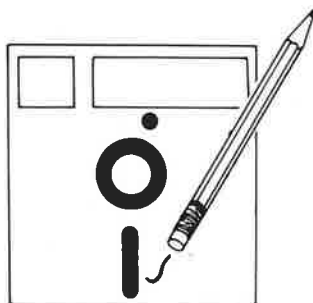
DO NOT touch the head slot or any other unprotected surface of the diskette. Body oils and perspiration cause diskette damage.

DO NOT try to clean the surface of the diskette. Contaminated diskettes should no longer be used.



DO NOT write on the diskette outside the label area.

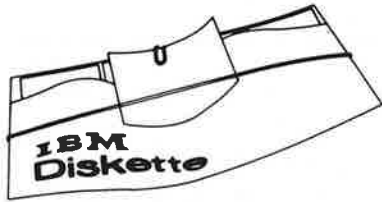
DO NOT write on the diskette label with pencil. It is best to mark the diskette label with a fiber-tip pen or ballpoint pen before attaching it to the diskette.



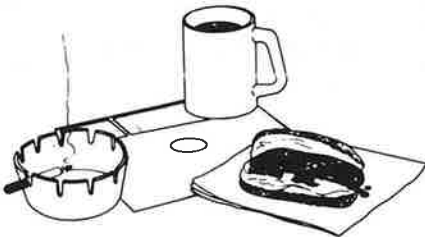
DO NOT erase labels on the diskette, or make erasures on or near the diskette. Eraser crumbs on the diskette surface will make the diskette unusable.



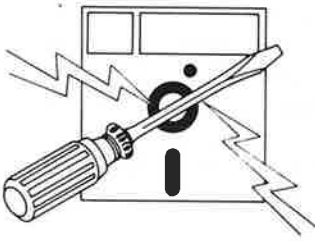
DO NOT place heavy objects on the diskette. The weight can seriously damage the surface.



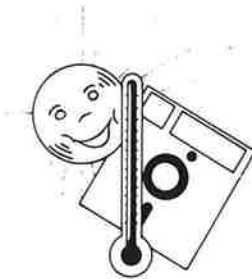
DO NOT use clips or rubber bands on the diskette or bend it in any way.



DO NOT lay a diskette near food, drinks, or ashtrays where foreign materials can contaminate the diskette surface.



DO NOT allow the diskette to be near anything that might be magnetized. A magnetic field can cause data loss. Magnetic fields can be found near fluorescent lights, electronic calculators, dictation equipment, and especially telephones.



DO NOT expose the diskette to heat greater than 51° C (125° F) or to direct sunlight.

Note: If a diskette has been exposed to temperatures outside the range of 10° C to 51° C (50° F to 125° F), keep the diskette at room temperature for approximately five minutes before inserting it into a diskette drive.

Theory of operation

Functional description

Physical characteristics

- Weight: 5.0 kg (11.0 lb)
- Diskette speed: 360 revolutions per minute (rpm)

Electrical characteristics

The 5322 supplies all the power needed to operate the diskette drives:

DC voltage

Voltage	Tolerance (see note 1)	Maximum operating current
+5 Vdc	+4.6 Vdc to +5.5 Vdc	0.50A
-5 Vdc	-4.6 Vdc to -5.5 Vdc	0.08A
+24 Vdc	+22.0 Vdc to 26.4 Vdc	0.50A

Note 1: The voltage tolerances in this chart are for voltages measured at the power supply A1 card.

60-Hz, single phase ac voltage

Voltage	Range	Average operating current
100 Vac	90-110 Vac	0.30A
110 Vac	96.5-119 Vac	0.30A
120 Vac	104-127 Vac	0.30A
127 Vac	111-137 Vac	0.30A
200 Vac	180-220 Vac	0.20A
208 Vac	180-220 Vac	0.20A
220 Vac	193-238 Vac	0.20A
240 Vac	208-254 Vac	0.20A

50-Hz, single phase ac voltage

Voltage	Range	Average operating current
100 Vac	90-110 Vac	0.30 A
110 Vac	96.5-119 Vac	0.30A
200 Vac	180-220 Vac	0.25A
220 Vac	193-238 Vac	0.20A
230 Vac	202-249 Vac	0.20A
240 Vac	210-259 Vac	0.20A

Environmental characteristics

The diskette drives can be operated or stored in the following temperatures and humidity ranges:

	Temperature		Relative humidity
	Celsius	Fahrenheit	
Operated (power on)	10° to 40.6°	50° to 105°	8% to 80%
Stored (power off)	10° to 51.7°	50° to 125°	8% to 80%

Functional characteristics

The format of the data on a diskette is changed when the number of bytes written in a sector is changed. Diskettes are used with the following formats:

Sectors per track		Bytes per sector
FM	MFM	
26	—	128
15	26	256
8	15	512
—	8	1,024

Specifications

- Data capacity: The following chart shows the capacity in formatted data bytes for the three diskette types.

Bytes per sector	Diskette 1	Diskette 2	Diskette 2D
128	246,272	492,544	—
256	284,160	568,320	985,088
512	303,104	606,208	1,136,640
1,024	—	—	1,212,416

- Data rate: 250,000 bits (31,250 bytes) per second for FM recordings and 500,000 bits (62,500 bytes) per second for MFM recordings.
- Cylinder-to-cylinder seek time: 5 milliseconds, plus 35 milliseconds for the head/carriage assembly to stop. The total seek time is the number of cylinders the heads move across multiplied by 5 milliseconds, plus 35 milliseconds settle time.
- Tracks per diskette side: 77 (cylinder 00 is the label cylinder; cylinders 01 through 74 are for data; cylinders 75 and 76 are reserved as replacement tracks).

Theory of operation

Frequency modulated (FM) format principles

FM format is a method of recording data on a diskette surface. The frequency of pulses is changed (modulated) to represent data.

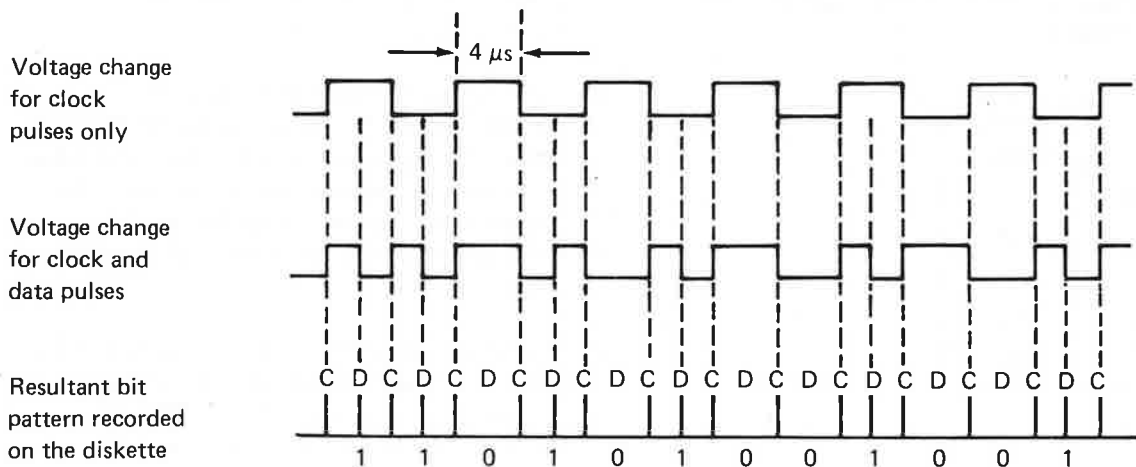
When no data is present (all 0 bits), only clock pulses are present. These pulses occur at a frequency of every 4 microseconds.

When data is present, the pulse frequency changes. Each 1-bit pulse is inserted halfway between adjacent clock pulses so there is double the pulse frequency. If a 0 bit is recorded, no pulse is between the clock pulses; therefore, the pulse frequency is not changed.

The raw data rate in FM format is 250,000 bits (31,250 bytes) per second.

Read data

Each clock pulse or 1-bit pulse is recorded on the diskette surface as a change in magnetic direction (flux) from the bit immediately preceding it. As this change in flux passes the read/write heads, the current in the read/write heads changes direction. This change in current direction is recognized by the attachment as either a clock pulse or a 1-bit pulse. If there is no change in the direction of the current between two adjacent clock pulses, the attachment recognizes that a 0 bit is present.



The C and D above the line show the clock and data bit times.

The numbers under the line show whether a 1 bit or a 0 bit is recorded.

Modified frequency modulated (MFM) format principles (51TD only)

MFM format is another method of recording data on a diskette surface. The frequency of pulses is changed (modulated) to represent data.

With no data present (all 0 bits), the only pulses present are clock pulses. These pulses occur at a frequency of every 2 microseconds.

When data is present, the pulse frequency changes. Each 1-bit pulse is inserted halfway between adjacent clock times. The clock pulses are suppressed, however, so the frequency remains the same. All clock pulses will be suppressed unless two 0 bits (no pulse) occur next to each other. When this happens, the clock pulse that would normally occur at the clock time between the 0 bits is not suppressed. (For that particular time, the pulse frequency changes.)

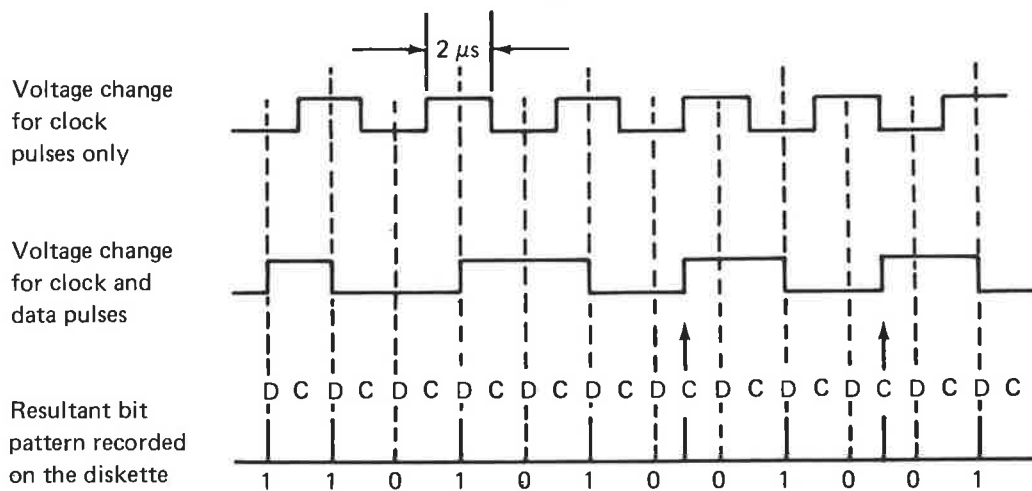
Therefore, a pulse appears between any consecutive 0 bits (the clock pulses) and for each 1 bit.

The raw data rate in MFM format is 500,000 bits (62,500 bytes) per second.

MFM format can record twice as much data on a diskette surface as FM format.

Read data

Each clock pulse or 1 bit is recorded on the diskette surface as a change in magnetic direction (flux) from the bit immediately preceding it. As a change in flux passes the read/write heads, the current in the read/write heads changes direction. This change in current direction is recognized by the attachment as either a clock pulse or a 1-bit pulse. If there is no change in the direction of current at data time, the attachment recognizes that a 0 bit is present.



The C and D above the line show the clock and data bit times.

The numbers under the line show whether a 1 bit or a 0 bit is recorded.

Theory of operation

Stepper motor

Stepper motor description

The dc stepper motor consists of a permanent-magnet rotor and pairs of two-phase stator windings. The motor is a sealed unit that has no gears or commutators and requires no maintenance. Do NOT disassemble the stepper motor.

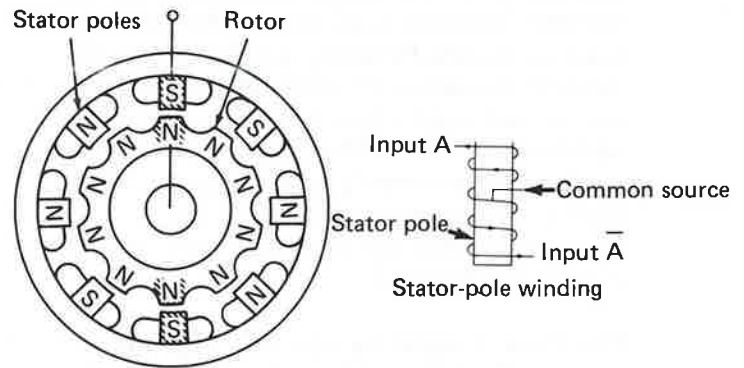
When current flows through a pair of stator windings, a magnetic field that is set up in the stator poles provides torque to the rotor shaft. This torque turns the rotor shaft only a part of a revolution. The direct current in the stator windings, acting on the permanent-magnet rotor, then holds the shaft in an electrically detented position. Shaft rotation is continuous only if the stepper motor is continuously pulsed.

You cannot turn the rotor easily turned by hand with the machine power switched on. When the power is switched off, you may hear a clicking sound as you turn the shaft.

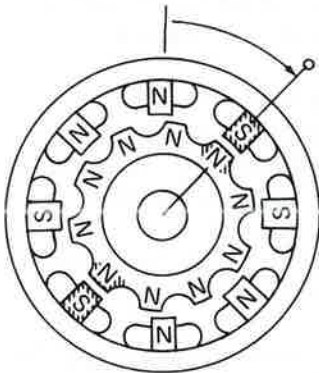
Stepper motor operation

For ease of understanding, the motor used in this example turns 9° per step; the actual motor turns 1.8° per step.

This simplified stepper motor consists of eight coil-wound stator poles and a ten-pole permanent-magnet rotor.

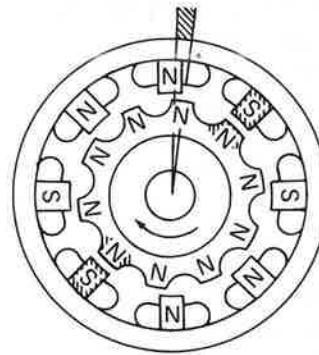


If the stator is rotated in either direction, the rotor maintains its detented position and follows the stator as shown. Both the stator poles and the rotor are shown rotated 45° clockwise.



Note: Current flows only in one-half of the winding at a time. Polarity of the stator poles is determined by the half of the winding that has current flow.

When the stepper motor operates, the stator's magnetic field is electrically rotated by switching the current to the next stator winding. The rotor turns until the closest opposite-polarity (shaded) magnetic poles are attracted into alignment. Note that the polarity of the poles has rotated one position clockwise from that shown in the first figure. The logic circuits provide the sequence of phase pulses that determine the direction of rotation.



In the diskette drive, the stepper motor drive band is attached to the head/carriage assembly. As the motor turns, the drive band moves the head/carriage assembly. A clockwise movement of the rotor moves the assembly toward the hub of the diskette.

Diskette
drive

Theory of operation

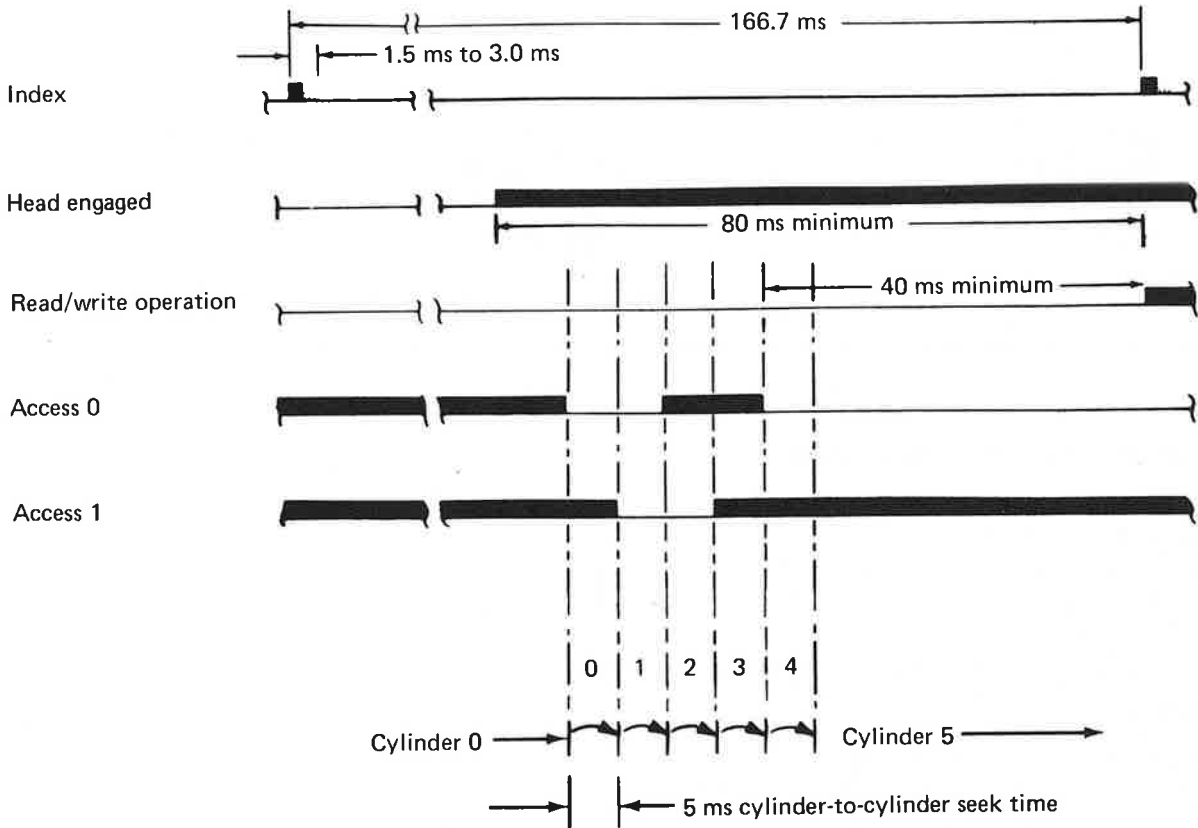
Diskette drive operation

To operate the internal diskette drive, insert a diskette into the diskette drive and close the diskette latch. With the system power on, the following occurs (see "Timing sequence") in this chapter.

1. The diskette begins to turn; in approximately 10 seconds, the diskette reaches operating speed (360 rpm).
2. Index pulses are sensed every revolution (166.7 milliseconds) by the LED/PTX. For the 51TD diskette drive, the type of diskette inserted is identified on the diskette sense line. An up level indicates that a diskette 2 or a diskette 2D has been inserted; a down level indicates a diskette 1.
3. To seek to the selected track, access line 0 and access line 1 are activated alternately. The stepper motor turns, moving the read/write heads across the diskette surface a distance of one track. The access line that is activated at the time the read/write heads reach the desired track remains activated as long as the heads remain at that track. It takes 40 milliseconds for the heads to settle to a complete stop after a seek operation. Therefore, data is not valid for at least 40 milliseconds after a seek operation.
4. A head load command can be issued before or during a seek operation to activate the head load solenoid. Because of head settling time, the read or write operation cannot begin until 80 milliseconds after a head load operation, or until 40 milliseconds after a seek operation.
5. To reduce the wear on the diskette and the read/write heads, the heads are unloaded after the read/write operation if another command is not issued by the computer within two revolutions of the diskette.

Timing sequence

This timing sequence shows a typical seek operation from cylinder 00 to cylinder 05. Cylinder 05 is the cylinder that is to be read from or written to.



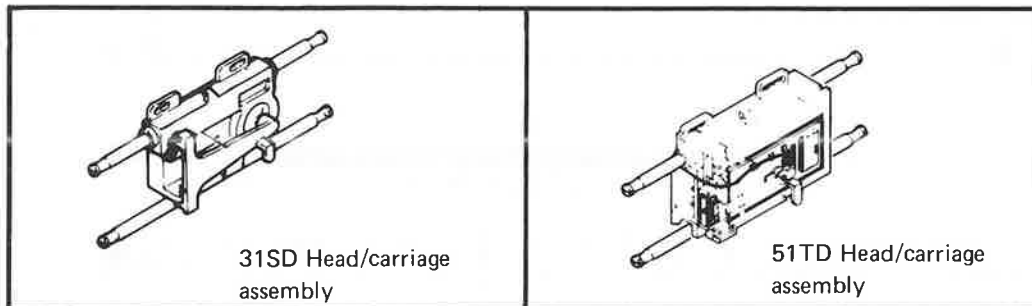
Note: Seeking and head loading are not timed to the index.

Theory of operation

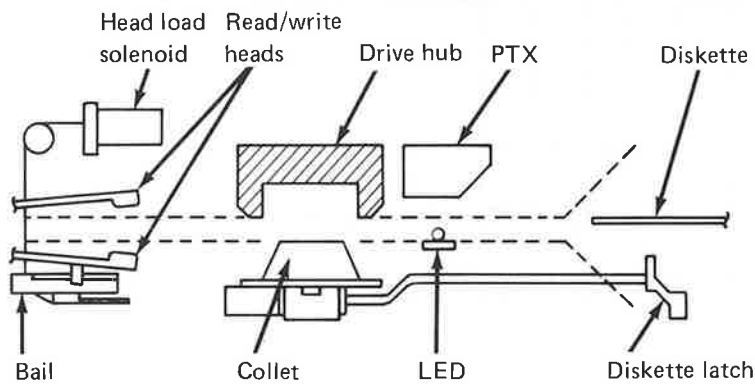
Diskette drive operation (continued)

Mechanical sequence

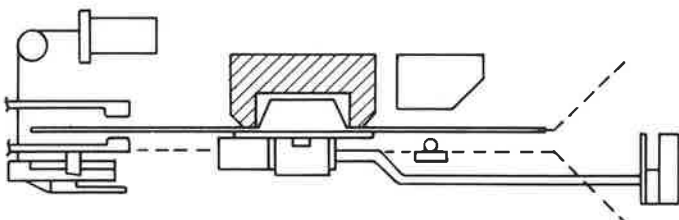
The mechanical sequence is shown for the 51TD drive, which has two read/write heads. The operation of the 31SD is the same, except that the 31SD has a pressure pad instead of the second read/write head.



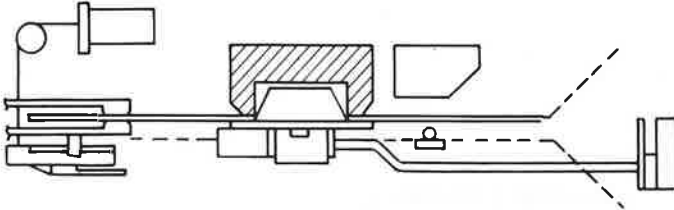
1. The diskette is ready to be inserted.



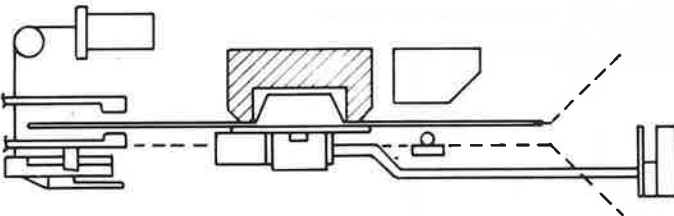
2. The operator inserts the diskette into the diskette guide and closes the diskette latch. The collet is clamped (the read/write heads are now much closer to the diskette).



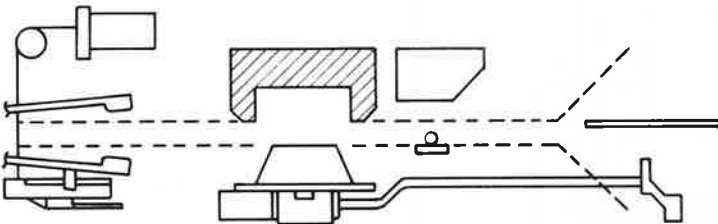
-
-
3. The head load solenoid is activated and the cable pulls the head load bail, thereby loading the read/write heads. The heads now touch the surface of the diskette.



-
-
-
4. The read/write operation takes place. The heads are moved to the desired cylinder on the diskette by activating the two stepper motor access lines in a specific sequence.
5. The heads are released (the solenoid is de-activated).



-
-
-
-
-
6. The operator opens the diskette latch and removes the diskette from the diskette drive.



Diskette
drive

Theory of operation

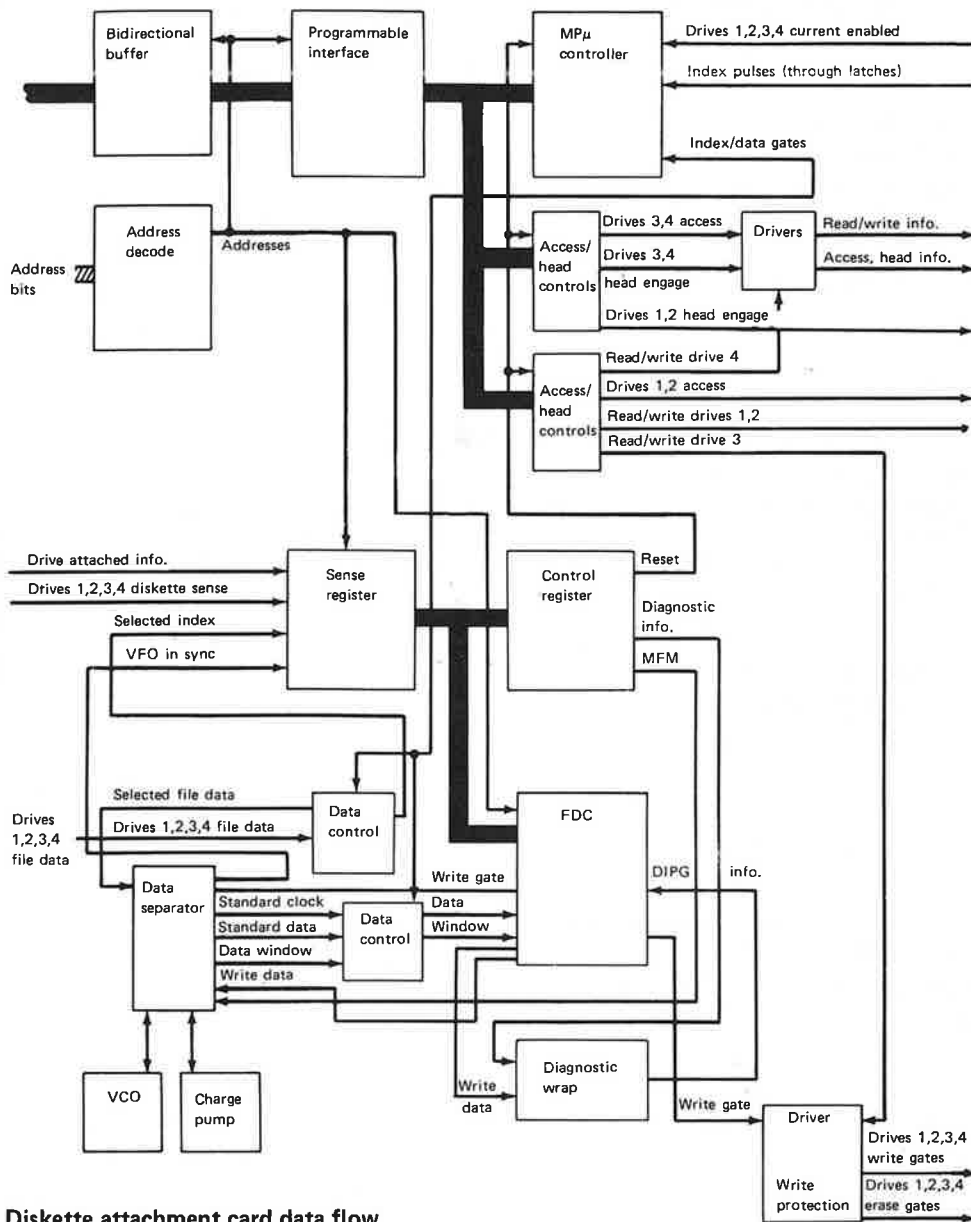
Diskette attachment

Diskette attachment card

The diskette attachment is packaged on one card. This 2-drive diskette attachment card plugs into the diskette attachment card slot in the 5322 planar board.

attachment accepts access, read, and write commands from the 5322 and activates the proper control lines to the diskette drive. The attachment assembles the sense information and data and sends them back to the 5322.

The diskette attachment provides an interface between the 5322 and the diskette drives. The



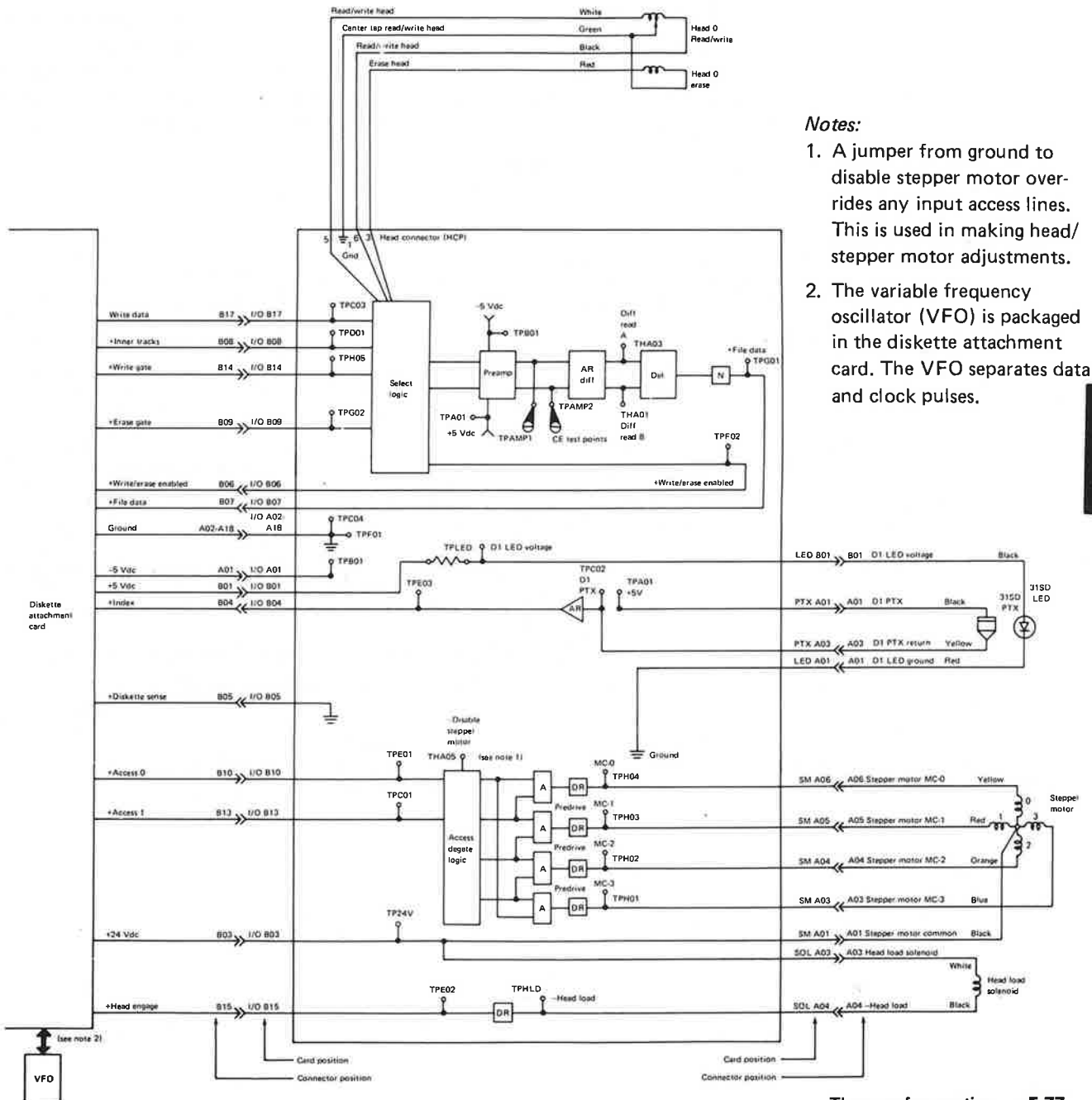
Diskette attachment card data flow

Diskette drive control card

The diskette drive control card, mounted on the diskette drive, is connected to the diskette attachment card with the diskette attachment cable. The dc voltages (+5, -5, and +24 volts) and ground are supplied by the 5322 power supply. These four wires are tied to the attachment cable, and are connected to the power supply A1 card.

The following figures show the differences between the 31SD and 51TD diskette drive control card circuits.

Diskette drive control card circuit (31SD)



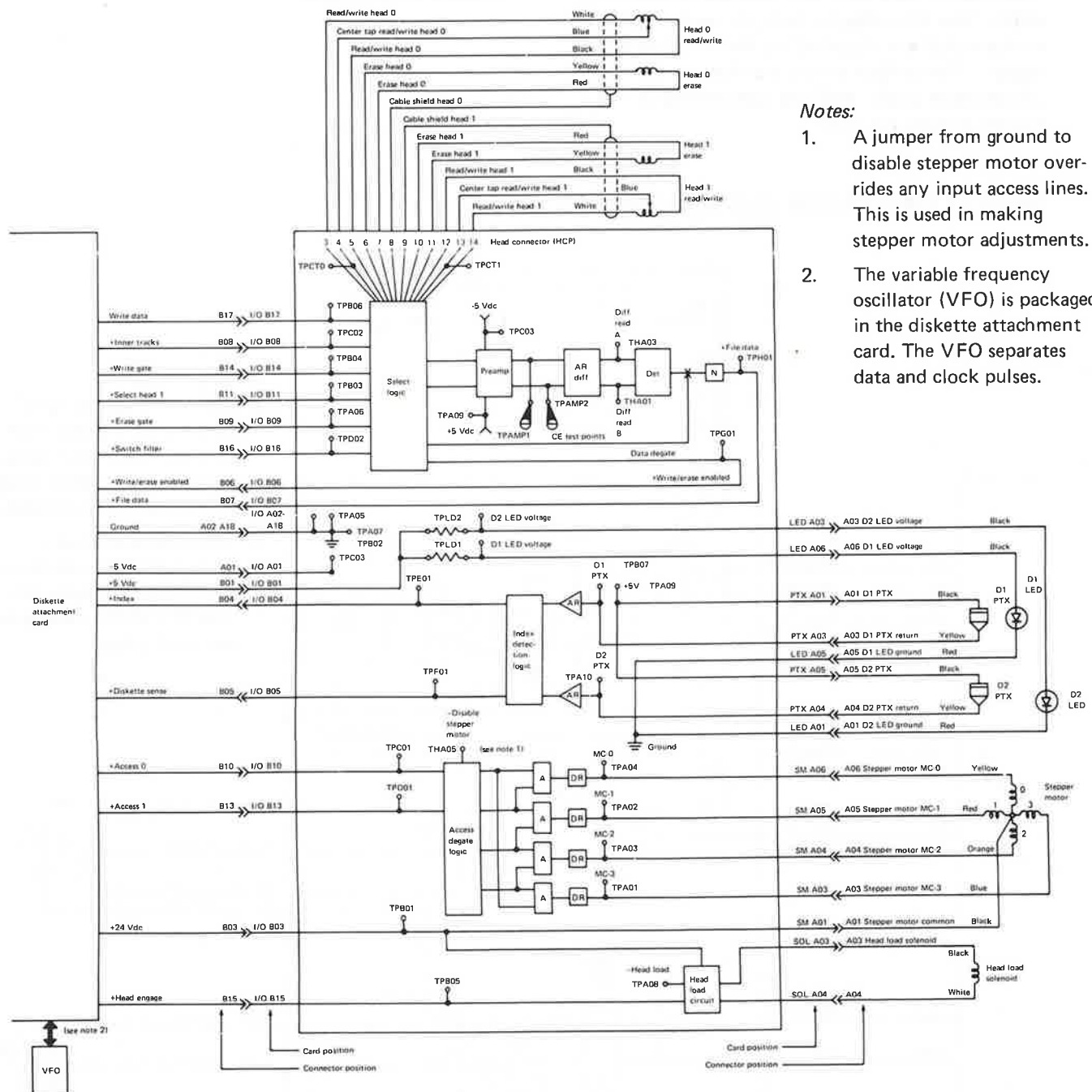
- Notes:**
1. A jumper from ground to disable stepper motor overrides any input access lines. This is used in making head/stepper motor adjustments.
 2. The variable frequency oscillator (VFO) is packaged in the diskette attachment card. The VFO separates data and clock pulses.

Diskette drive

Theory of operation

Diskette drive control card (continued)

Diskette drive control card circuit (51TD)



- Notes:**
1. A jumper from ground to disable stepper motor overrides any input access lines. This is used in making stepper motor adjustments.
 2. The variable frequency oscillator (VFO) is packaged in the diskette attachment card. The VFO separates data and clock pulses.

Signal lines

The following is a description of the signal lines between the diskette attachment card and the diskette drive control card. The direction of each signal is also given.

Write data (output from the attachment).

For each change of the 'write data' signal, the current switches in the read/write head. This current switching records the data on the diskette.

+Inner tracks (output from the attachment). On a write operation beyond the middle cylinders, this line is used to reduce the amount of recording current. On a read operation beyond the middle cylinders, this line is used to compensate for bit shifting. The '+inner tracks' line is active from track 43 through track 76.

+Write gate (output from the attachment). The 'write gate' line activates the write circuits and de-activates the read circuits for a write operation.

+Select head 1 (output from the attachment-51TD). When this line is active, head 1 is selected. When it is inactive, head 0 is selected.

+Erase gate (output from the attachment). The 'erase gate' line activates the erase circuits during a write operation to erase the edges of the track just recorded. This erasing prevents crosstalk between tracks during later read operations.

+Switch filter (output from the attachment-51TD). The 'switch filter' line is used, beyond cylinder 60, with the 'inner tracks' line to further compensate for bit shifting for MFM encoding. This line is used only during a read operation.

+Write/erase enabled (input to the attachment). When this line is active, current is present in the write/erase windings of the diskette drive. This line is used by the attachment for error detection.

File data (input to the attachment). The 'file data' line is a series of clock and data pulses that represents the data read from the diskette surface. The VFO circuits separate the clock pulses from the data pulses.

+Index (input to the attachment). This line indicates the start of a track. This 1.5 to 3.0-millisecond pulse occurs every 166.7 milliseconds.

Diskette sense (input to the attachment-31SD). This line is tied to ground to always indicate a diskette 1.

Diskette sense (input to the attachment-51TD). An active level on this line indicates that a diskette 2 or 2D is being used. This line is not activated by a diskette 1.

+Access lines 0 and 1 (output from the attachment). The read/write heads are moved from one cylinder to the next by sequentially activating the access lines.

As shown in the following chart, the sequence for activating the access lines is repeated every four cylinders. The drive control card decodes 'access 0' and 'access 1' into four motor control (MC) pulses (MC-0 through MC-3) for the four stepper motor poles. Refer also to the diskette drive control card circuit for the representation of MC-0 through MC-3.

Cylinder location	In →				← Out					
	0	1	2	3	4	5	40	74	75	76
Access 0	1	0	0	1	1	0	1	0	1	1
Access 1	1	1	0	0	1	1	1	0	0	1
MC-0	1	0	0	1	1	0	1	0	1	1
MC-1	1	1	0	0	1	1	1	0	0	1
MC-2	0	1	1	0	0	1	0	1	0	0
MC-3	0	0	1	1	0	0	0	1	1	0

+Head engage (output from the attachment). When this line is active, it loads the read/write heads.

Theory of operation

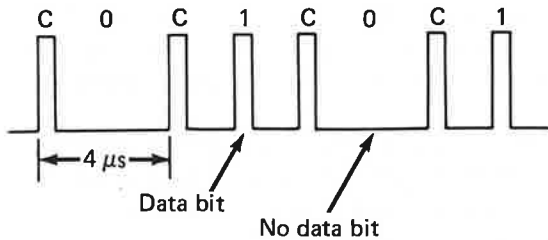
Read/write principles

FM encoding

The data bits are written 4 microseconds apart. They are recorded on the diskette as follows:

Data bit to be recorded	Recorded as:	
	Clock bit	Data bit
1	1	1
0	1	0

Data bits 0101 appear as follows:



Read data. 'Read data' is the encoded read head signal (FM or MFM) that can be observed at TPAMP1 and TPAMP2 on the diskette drive control card.

Typical measurements for FM encoding are:

125 kHz: 120 to 300 mV (all 0's)

250 kHz: 100 to 250 mV (all 1's)

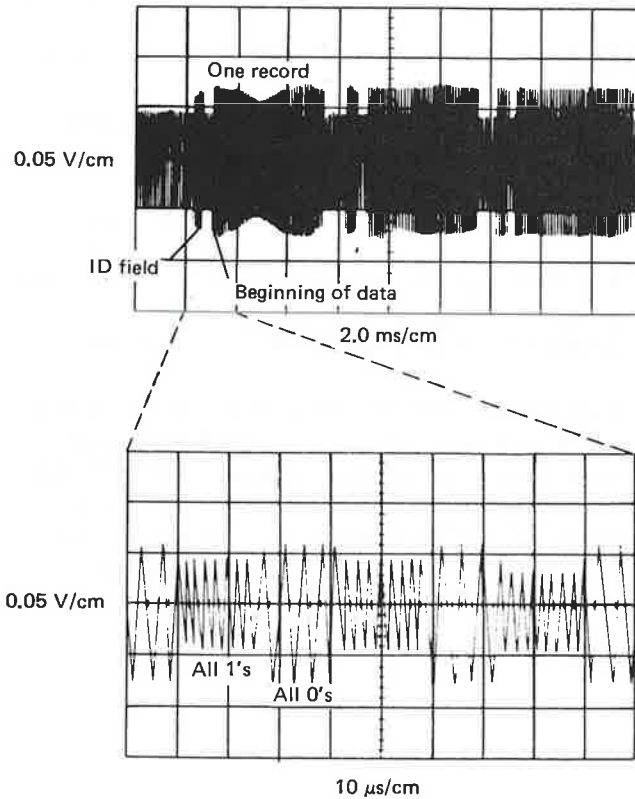
The voltage is higher at the outer tracks because of the higher track speeds and lower bit density.

An all 0's pattern has a higher voltage amplitude and it is half the frequency of an all 1's pattern.

File data. The 'file data' signal is a series of clock and data pulses that represent the read data. These pulses can be observed at TPG01 (31SD) or TPH01 (51TD) on the diskette drive control card. These pulses are from 150 to 500 nanoseconds long. The VFO circuits (on the diskette attachment card) separate the clock pulses from the data pulses.

Read data: FM encoded

Read head signal at TPAMP1 and TPAMP2 on the diskette drive control card



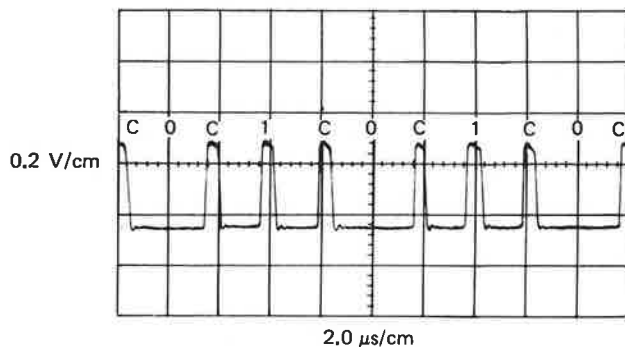
Scope setup

Note: Use a Tektronix 453, 454, or similar oscilloscope with x10 probes.

Channel A sweep mode	Normal
Channel A level	+
Channel A coupling	DC
Channel A slope	+
Channel A source	External
Trigger	Normal
Mode	Add
Channel 1 volts/division	0.05 V/cm
Channel 2 volts/division	0.05 V/cm
Channel 1 input	AC
Channel 2 input	AC
Invert	Pull out
Times per division	2 ms/cm
Connect channel 1 to	TPAMP1
Connect channel 2 to	TPAMP2
Connect trigger to	+Index test pin

Observe: The amplitude of the read signal should be between 6.5 to 560 mV.

File data signal at TPH01 (51TD) or TPG01 (31SD) on the diskette drive control card
 Example: 01010



Scope setup

Note: Use a Tektronix 453, 454, or similar oscilloscope with x10 probes.

Channel A sweep mode	Normal
Channel A level	+
Channel A coupling	DC
Channel A slope	+
Channel A source	Internal
Trigger	Normal
Mode	Channel 1
Channel 1 volts/division	0.2 V/cm
Channel 1 input	DC
Times per division	2 μs/cm
Connect channel 1 to	+File data

Observe: Clock pulses every 4 μs. Pulse duration should be between 100 and 500 ns. Pulse amplitude should be between 2.4 and 4.2 volts.

Diskette drive

Theory of operation

Read/write principles (continued)

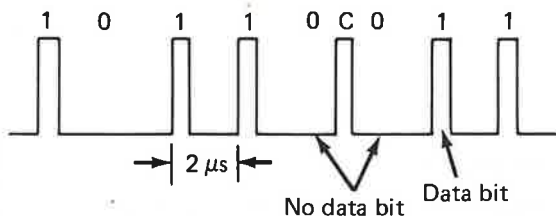
MFM encoding (51TD only)

The constant clock pulse is removed. A clock bit is recorded only when a 0 (no-data bit) is followed by another 0. Therefore, the time between data bits is only 2 microseconds. Either a data bit for a 1 or a no-data bit for a 0 is recorded in this 2-microsecond period. They are recorded on the diskette as follows:

Data bit to be recorded	Recorded as:	
	Clock bit	Data bit
1	0	1
0	(X)	0

Note: (X) is a 0 bit if the preceding bit is a 0 bit, or a 1 bit if the preceding bit is a 1 bit.

Data bits 10110011 appear as follows:



Read data. 'Read data' is the encoded read head signal that can be observed at TPAMP1 and TPAMP2 on the diskette drive control card.

Typical measurements for MFM encoding are:

125 kHz: 120 to 300 mV (alternating 0's and 1's)

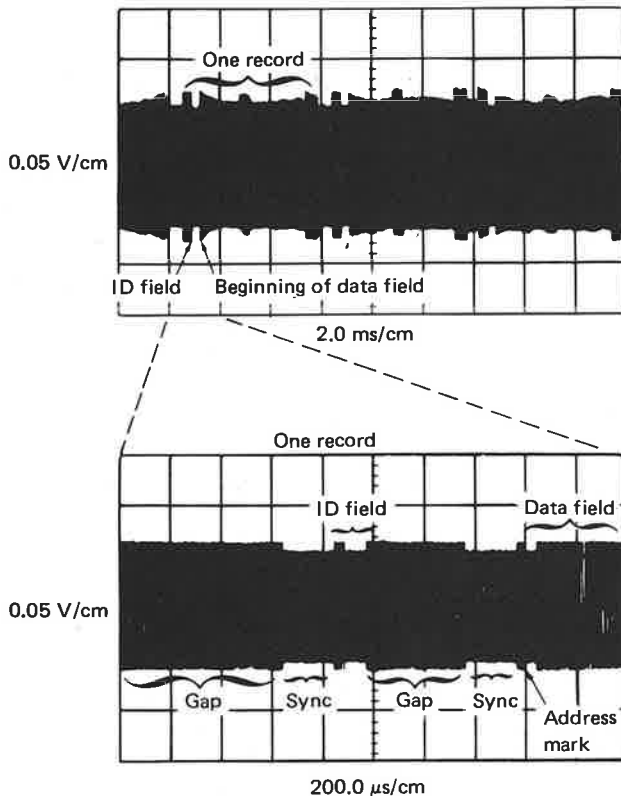
250 kHz: 100 to 250 mV (all 0's or all 1's)

For MFM, an alternating 0's and 1's pattern has a higher voltage amplitude and is half the frequency of an all 0's or an all 1's pattern.

File data. The 'file data' signal is a series of clock and data pulses that represent the read data. These pulses can be observed at TPG01 (31SD) or TPH01 (51TD). These pulses are from 150 to 500 nanoseconds long. The VFO circuits (on the diskette attachment card) separate the clock pulses from the data pulses.

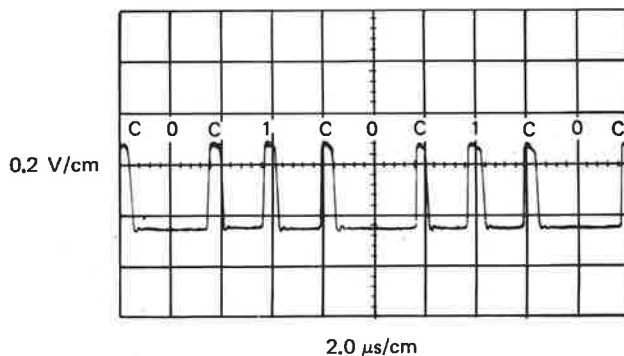
Read data: MFM encoded (51TD only)

Read head signal at TPAMP1 and TPAMP2 on the diskette drive control card



MFM file data at TPH01 (51TD only) on the diskette drive control card

Example: 0101111001



Scope setup

Note: Use a Tektronix 453, 454, or similar oscilloscope with x10 probes.

Channel A sweep mode	Normal
Channel A level	+
Channel A coupling	DC
Channel A slope	+
Channel A source	External
Trigger Mode	Normal
Channel 1 volts/division	0.05 V/cm
Channel 2 volts/division	0.05 V/cm
Channel 1 input	AC
Channel 2 input	AC
Invert	Pull out
Times per division	2 ms/cm
Connect channel 1 to	TPAMP1
Connect channel 2 to	TPAMP2
Connect trigger to	+Index test pin

Observe: The amplitude of the read signal should be between 6.5 to 560 mV.

Scope setup

Note: Use a Tektronix 453, 454, or similar oscilloscope with x10 probes.

Channel A sweep mode	Normal
Channel A level	+
Channel A coupling	DC
Channel A slope	+
Channel A source	External
Trigger Mode	Normal
Channel 1 volts/division	0.2 V/cm
Channel 1 input	DC
Times per division	2 μ s/cm
Connect channel 1 to	+File data
Connect trigger to	+Index test pin

Observe: Clock or data pulses every 2 to 4 μ s. Pulse duration should be between 100 and 500 ns. Pulse amplitude should be between 2.4 and 4.2 volts.

Diskette drive

Appendix A. Parts catalog

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Parts catalog

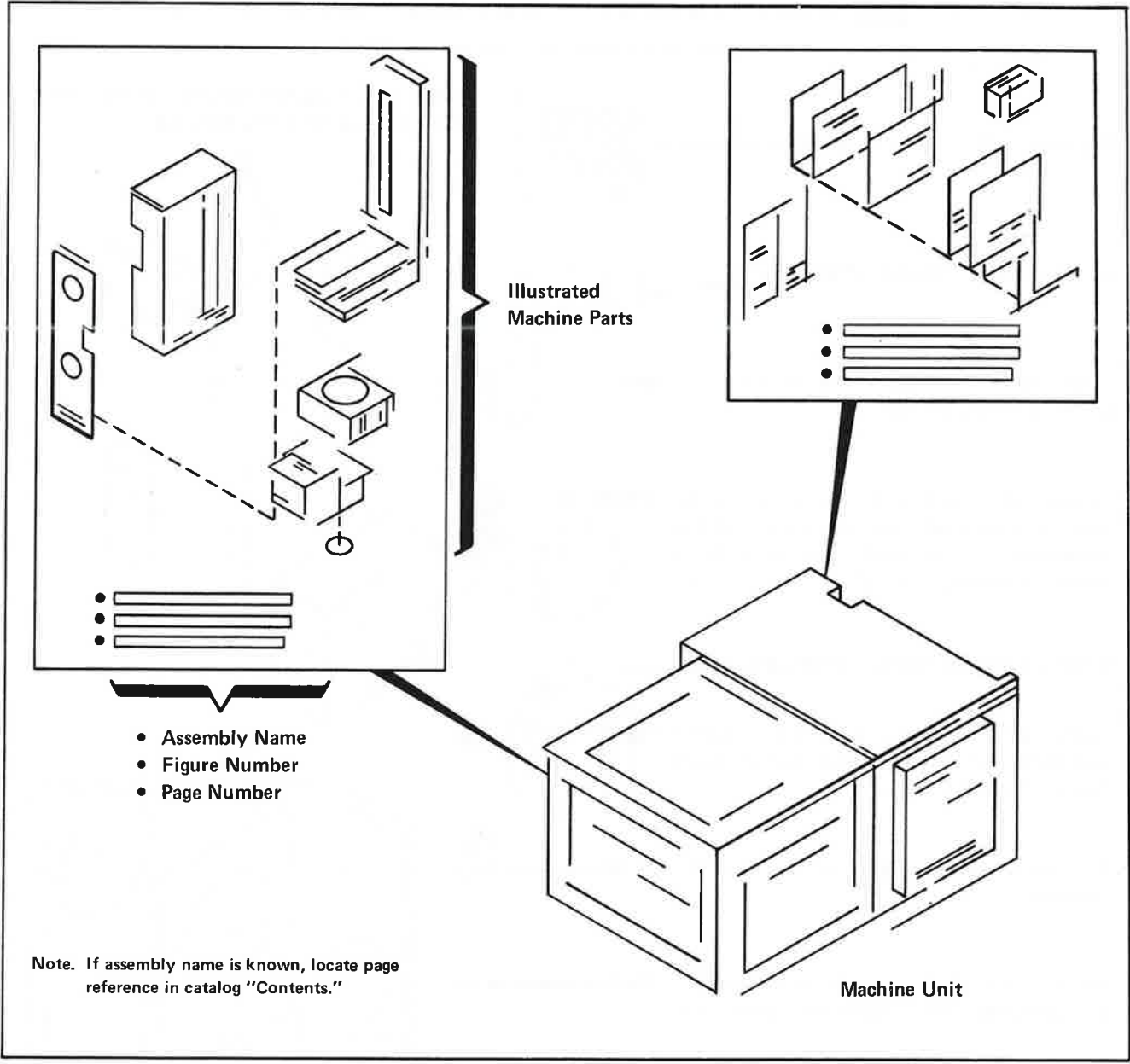
How to use a parts catalog

Parts catalog structure

To find parts quickly, you should have a general understanding of the three major sections of this catalog:

- 1** Visual Index (machine assembly illustrations and page locations within the Catalog Section)
- 2** Catalog Section (assembly illustrations with accompanying parts lists)
- 3** Numerical Index (parts listed in numerical order with cross-references to applicable figure numbers within the Catalog Section)

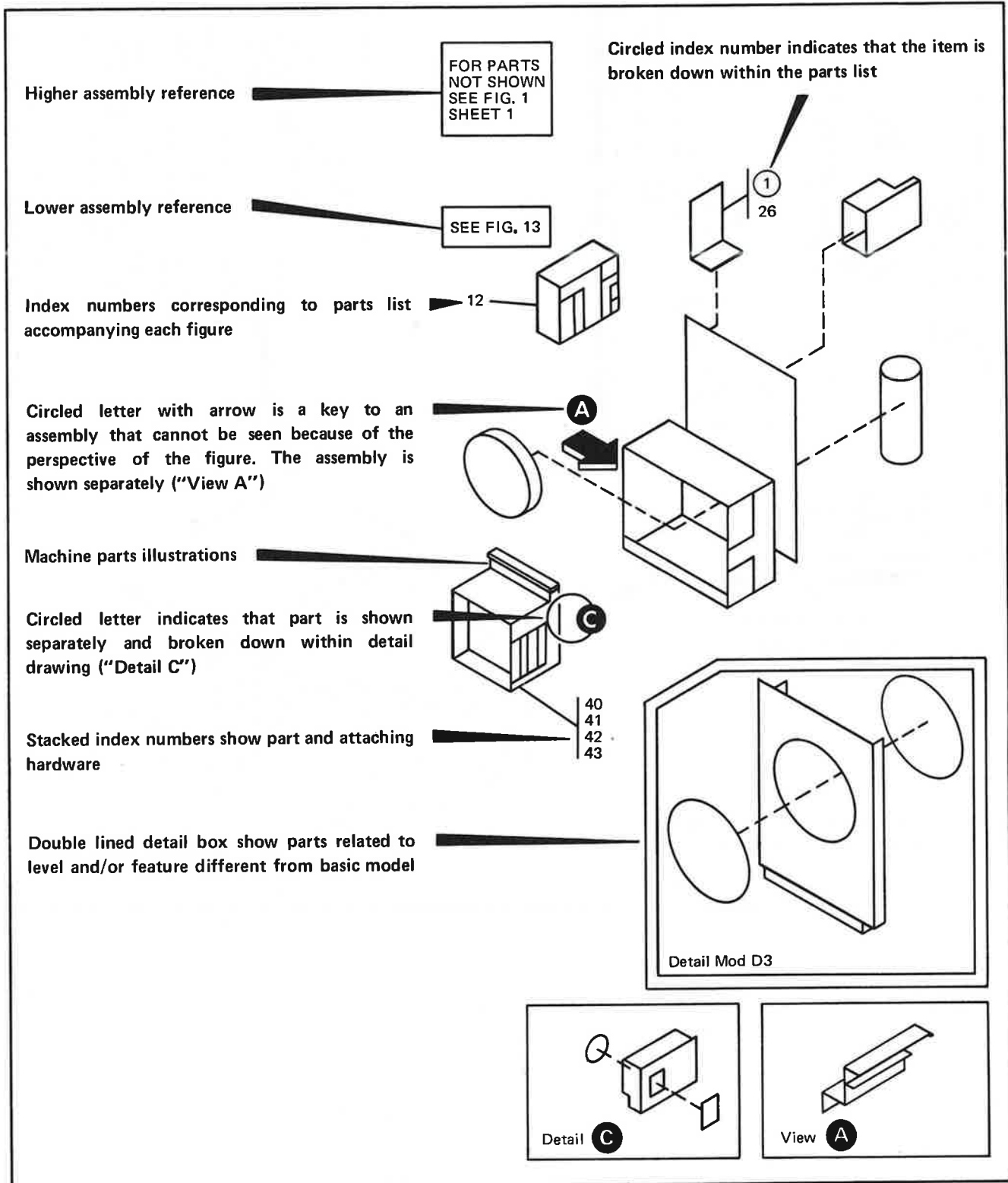
1 **VISUAL INDEX** This is a starting point for locating a part in the Catalog Section



Parts catalog

How to use a parts catalog (continued)

2 CATALOG SECTION (illustrated parts breakdown)



2 CATALOG SECTION (parts lists)

POWER SUPPLY

FIGURE- INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION				
			1	2	3	4	
3 -	5892856	1	REF	POWER SUPPLY ASM,NO.1- 110V 50 AND 60 HZ			
-	5892858	1	REF	POWER SUPPLY ASM,NO.1- 208V 50 AND 60 HZ			
-	1553193	1	REF	POWER SUPPLY ASM,NO.1 AND 3- 60 HZ LV			
-	1553194	1	REF	POWER SUPPLY ASM,NO.1 AND 3- 60 HZ HV			
-	1553195 NP	1	REF	POWER SUPPLY ASM,NO.1 AND 3- 50 HZ LV			
-	1553196 NP	1	REF	POWER SUPPLY ASM,NO.1 AND 3- 50 HZ HV			
-	1631389	1	REF	PWR SPLY ASM,NO.1 AND 3-50 HZ LV-UK ONLY			
-	1631390	1	REF	PWR SPLY ASM,NO.1 AND 3-50 HZ HV-UK ONLY			
				FOR NEXT HIGHER ASM SEE LIST 2-21 AND 23 AND FOR ILLUSTRATION FIG. 3			
- 1	NO NO.	1		• LABEL			
- 2	845762	1		• LABEL			
- 3	5891299	1		• COVER			
- 4	"COMM"	4		• SCREW,MACH BIND HD 8-32 NC-2A X .250 LG			
- 5	1632336	1		• FUSE,7A-USED ON 208V POWER SUPPLY NC. 1 NO FUSE REQUIRED ON 110V POWER SUPPLY			
- 6	512137	1		• FUSE,5A-USED ON 110V POWER SUPPLY NC. 1			
- 6	1632336	1		• FUSE,7A-USED ON 208V POWER SUPPLY NO. 1			
- 7	5130278 NR	1		• LABEL-USED ON 208V POWER SUPPLY NO. 1			
- 8	5130277	1		• LABEL-USED ON 110V POWER SUPPLY NC. 1			
- 8	5130278	1		• LABEL-USED ON 208V POWER SUPPLY NO. 1			
- 9	1553738	1		• POWER INPUT ASM			
				FOR DETAIL BREAKDOWN SEE LIST 4			
- 10	58207	AR		• SCREW,MACH BIND HD 8-32 NC-2A X .250 LG			ATT PT
- 11	5130276	1		• BRACKET			
- 12	58207	3		• SCREW,MACH BIND HD 8-32 NC-2A X .250 LG			ATT PT
- 13	2546652	5		• TIE,CABLE			
- 14	2100264	2		• RELIEF, CABLE STRAIN			
- 15	55901	3		• WASHER,LOCK EXT T .176DIA			
- 16	58207	3		• SCREW,MACH BIND HD 8-32 NC-2A X .250 LG			

ITEM	MEANING
1 Similar Assemblies	Two assemblies having majority of identical parts are broken down on same list (common parts have same index number).
2 NP	Nonprocurable — parts not available separately; order next higher assembly.
3 Indenture	Shows the relationship of a part to its next higher assembly. For example: <i>Indenture</i> 1 2 3 4 MAIN ASSEMBLY • Detail parts of main assembly • Assembly within main assembly • • Detail part of one-dot assembly • • Assembly within one-dot assembly • • • Detail parts of two-dot assembly
4 NO NO.	No number — order detail parts separately.
5 "COMM"	Commercial hardware — order from commercial hardware source, not IBM.
6 NR	Not recommended — not recommended for field replacement; order next higher assembly.
7 REF	Reference — see complete assembly on a previous drawing for parts quantities.
8 ATT PT	Attaching parts — used to attach two-dot assembly to one-dot assembly. They are listed following part to be attached.
9 AR	As required — use quantity as required.

Parts catalog

How to use a parts catalog (continued)

3 NUMERICAL INDEX

NUMERICAL INDEX

The numerical index follows the catalog section. Use it to locate a part when you know the part number only. The index lists part numbers in numerical order along with all applicable figures and parts lists.

Part numbers in numerical order

References to figure, parts list, and part index number

PART NO.	LIST AND INDEX NO.	PART NO.	LIST AND INDEX NO.	PART NO.	LIST AND INDEX NO.	PART NO.	LIST AND INDEX NO.
453	6 - 77	6935-CONT	12 - 4	10170-CONT	8 - 18	25627	6 - 17
	6 - 83		14 - 127		9 - 41		8 - 15
	6 - 93		14 - 132		9 - 84		15 - 93
455	11 - 31		15 - 77		10 - 42		15A - 75
845	1 - 69		15 - 81		11 - 2		24 - 8
2032	7 - 8	15 - 85	11 - 9	25891	2 - 49		2 - 101
3550	1 - 28	15A - 66	13 - 11			26380	14 - 110
	1 - 55	15A - 70	14 - 18				

ORDERING PARTS

Refer to the Catalog Section when ordering parts. The example shown here should help guide you through a typical situation.

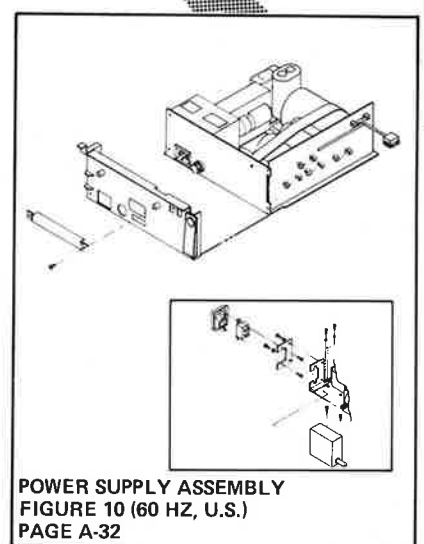
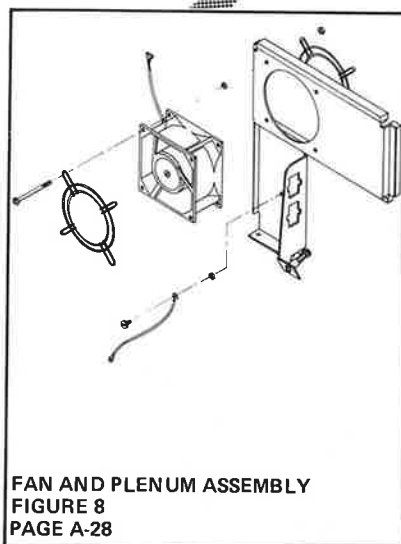
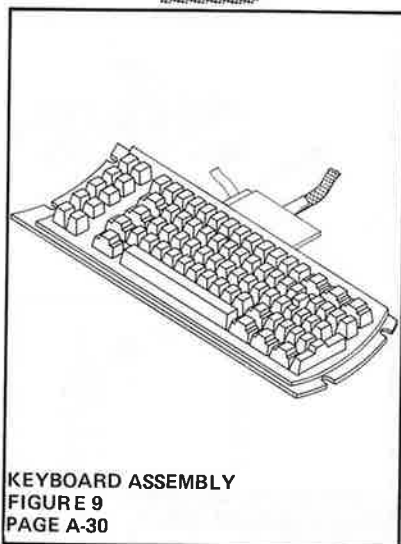
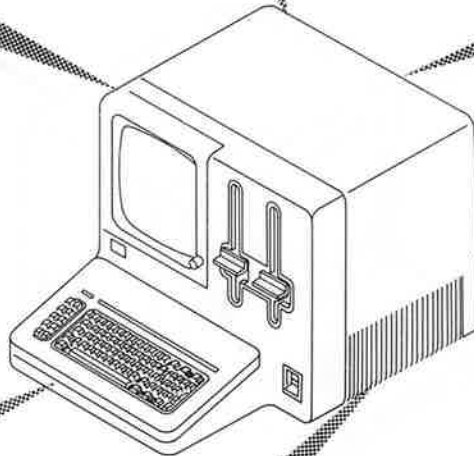
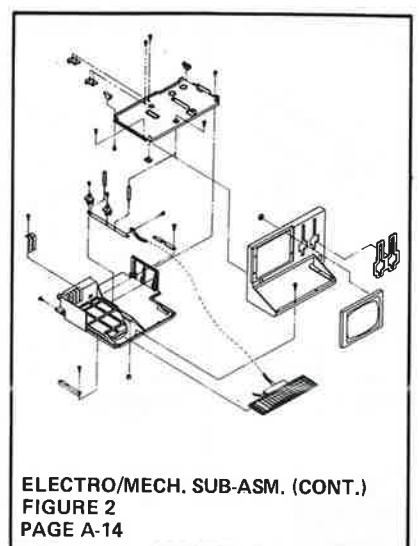
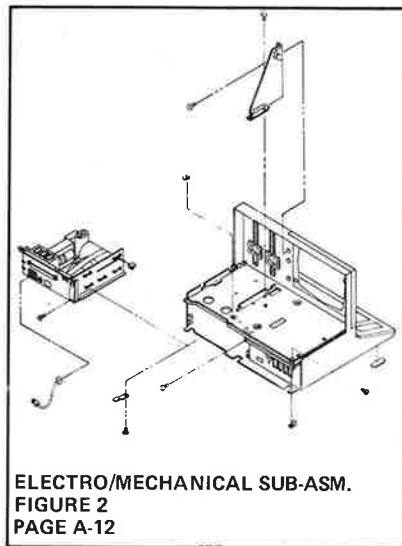
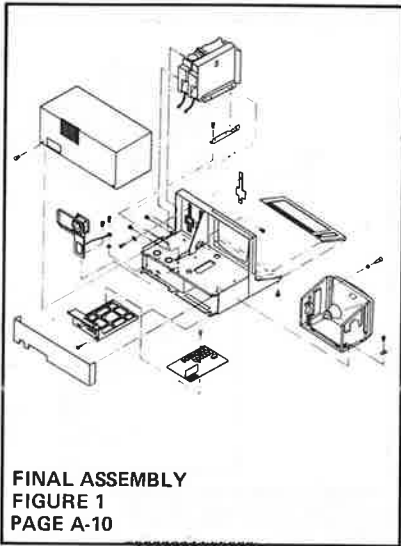
FIGURE-INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION			
			1	2	3	4
5 -	5891860 A	REF				
-	5892846	REF				
-	1631386	REF				
- 1	475124	1				
- 2	58207	2				
- 3	5252807	1				
- 4	526378	2				
- 5	2701001	1				
- 5	2701011	1				
- 5	5130347 B	1				
- 6	236849	4				
- 7	56079	1				
- 8	351237	1				
- 9	10170	2				
- 10	322766	1				

If, for example, you need the *power supply, no. 3, 60 HZ*, order part number 5891860 **A** (all one-dot items will also be received). See the explanation of the Catalog Section for information on how the leading dots are used in the parts listings. If you need the *transformer, 50 HZ-UK only*, order part number 5130347 **B** (all two-dot items will also be received). Each part may also be ordered separately except in the following cases:

- Many detail parts are unavailable if they are part of an inseparable assembly or if they are part of an assembly that is ordered as a unit. In such cases they are noted "Assembly components are not replaceable."
- Parts found on purchased assemblies may not have IBM part numbers. These parts are noted "Assembly components not available."

In either case, order the assembly rather than the detail parts.

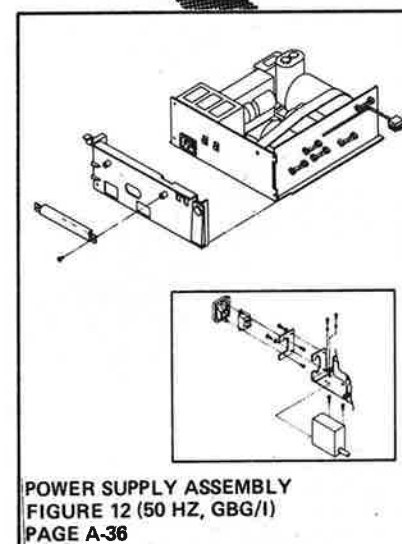
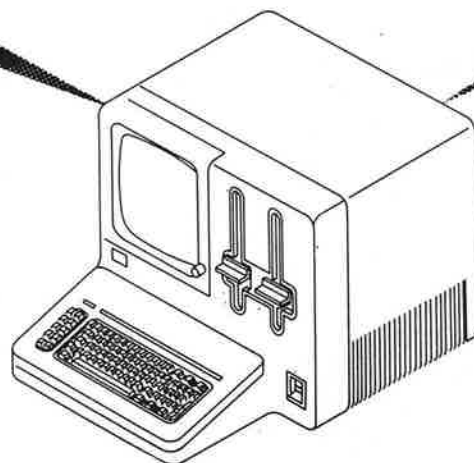
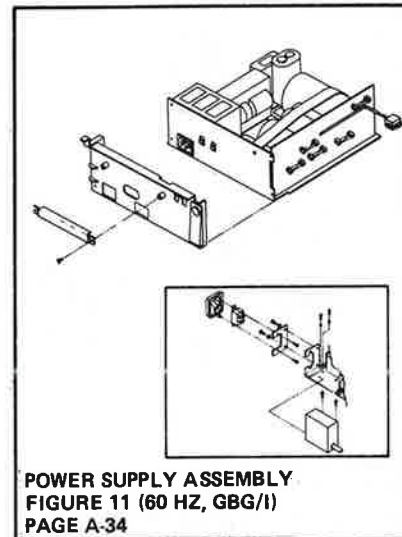
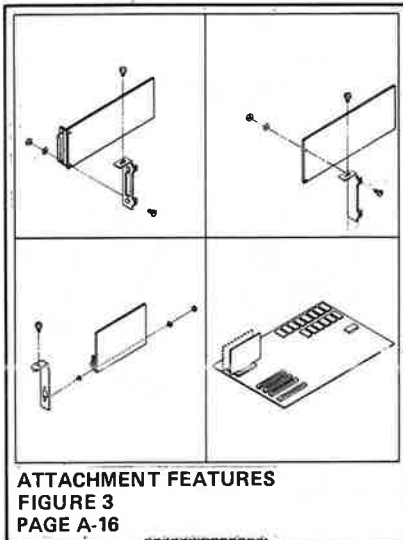
Visual index I



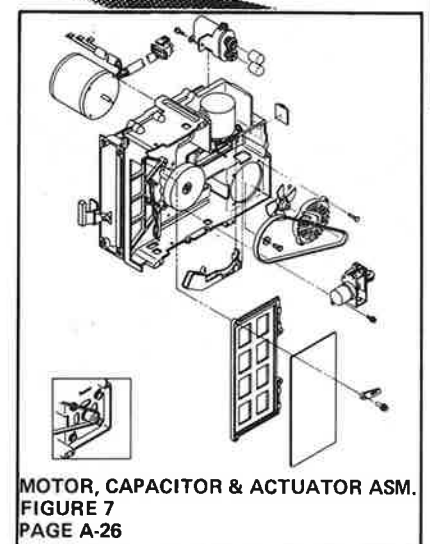
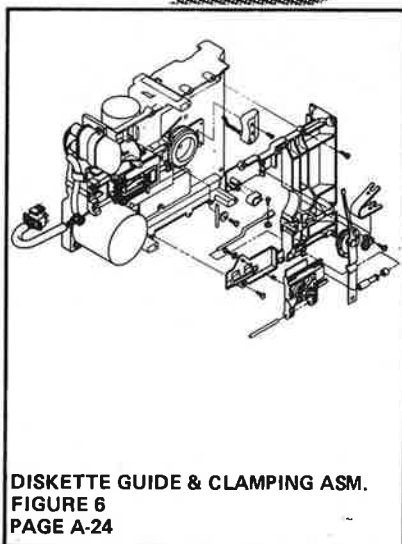
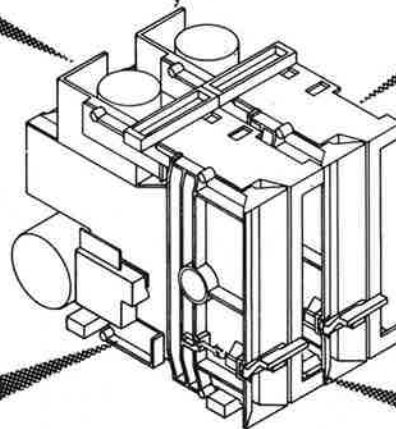
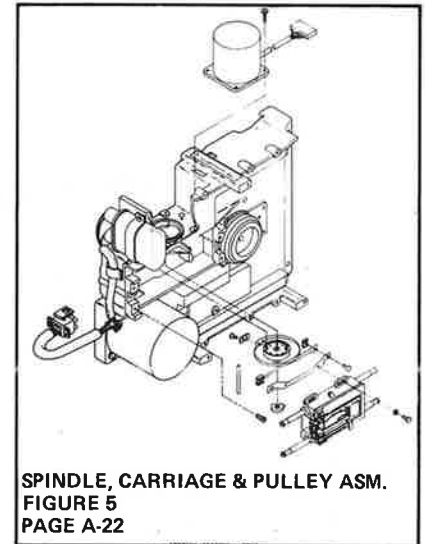
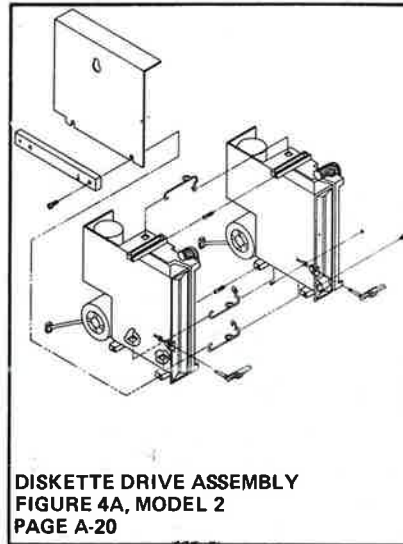
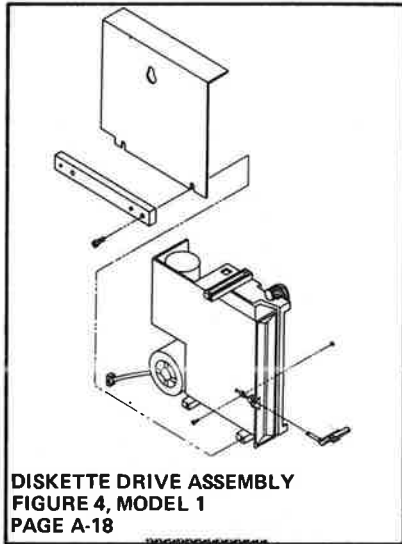
Parts
 catalog

Parts catalog

Visual index II



Visual index III



Parts
catalog

Parts catalog

Figure 1. Final assembly

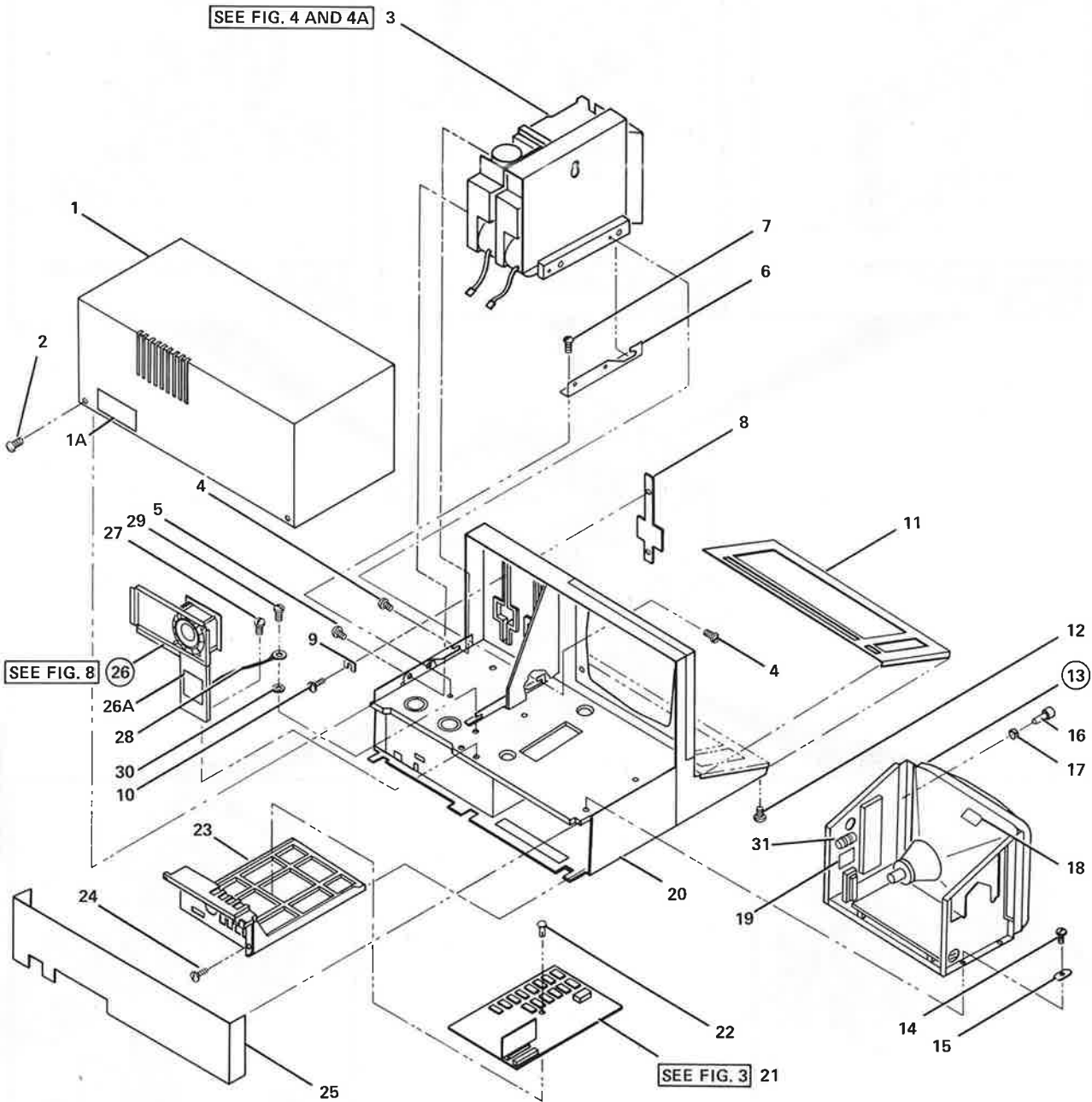


FIGURE 1. FINAL ASSEMBLY. SEE LIST 1.

FIGURE- INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION			
			1	2	3	4
1 -	NO NO. NP	REF	FINAL ASM			
- 1	6838221	1	FOR ILLUSTRATION SEE FIGURE 1			
- 1A	4468955	1	. COVER ASM, TOP			
- 2	9395349	2	. LOGO, MACHINE TYPE			
- 3	NO NO.	REF	. SCREW			
- 3	NO NO.	REF	. DISKETTE DRIVE ASM, MODEL 1			
- 4	6843262	3	FOR DETAIL BREAKDOWN SEE FIGURE 4			
- 5	1621509	1	. DISKETTE DRIVE ASM, MODEL 2			
- 6	6842373	1	FOR DETAIL BREAKDOWN SEE FIGURE 4A			
- 7	7362385	3	. SCREW, SHOULDER			
- 8	6838235	1	. SCREW, SOCKET HD- M4 X 8 LG			
- 9	6841471	2	. BRACKET, SINGLE DISKETTE MOUNTING			
- 10	2451197	2	MODEL 1 ONLY			
- 11	6841479	1	. SCREW, THD FORM HEX WSHR HD- M4 X 8 LG			
- 12	1621511	2	. INSERT, PLUG BEZEL DISKETTE DRIVE			
- 13	6837718	1	MODEL 1 ONLY			
- 13	2426474	1	. MOUNTING PLATE, BEZEL INSERT			
- 14	1621190	2	. SCREW, THD FORM HEX WSHR HD- 6-19 X .312L			
- 15	6846850	2	. COVER ASM, KEYBOARD			
- 16	6838236	1	. SCREW			
- 17	6841539	1	. MONITOR ASM, 50/60 HZ LOW VOLTAGE-U.S.			
- 18	4499223	1	. MONITOR ASM, 50/60 HZ LOW VOLTAGE-GBG/I			
- 19	4499224	1	. SCREW, MACH PAN HD- M4 X 8 LG			
- 20	6837731	1	. WASHER, CRT MOUNTING			
- 20	6837732	1	. . KNCB, MONITOR BRIGHTNESS			
- 20	6838295	1	. . CLIP, FASTENER			
- 20	6838294	1	. . LABEL, 17,000V, ALL LANGUAGES			
- 21	NO NO.	1	. . LABEL, FUSE, ALL LANGUAGES			
- 22	2632773	1	. ELECTRO/MECHANICAL SUB-ASM			
- 23	6841570	REF	120V 60 HZ-U.S.			
- 24	1621510	2	. ELECTRO/MECHANICAL SUB-ASM			
- 25	6838220	1	120V 60 HZ-GBG/I AND CANADA			
- 26	6838213	1	. ELECTRO/MECHANICAL SUB-ASM			
- 26A	4499218	1	100-240V 60 HZ-GBG/I NOT CANADA			
- 27	1621197	2	. ELECTRO/MECHANICAL SUB-ASM			
- 28	5759502	1	100-240V 50 HZ-GBG/I NOT CANADA			
- 29	7362385	1	. PLANAR BOARD			
- 30	1622346	1	FOR ATTACHMENT FEATURES SEE FIGURE 3			
- 31	111264	1	. CLIP			
			. STIFFENER ASM			
			. SCREW			
			. COVER ASM, REAR			
			. FAN AND PIENUM ASM			
			FOR DETAIL BREAKDOWN SEE FIGURE 8			
			. LABEL, HAZARDOUS AREA, ALL LANGUAGES			
			. SCREW, MACH PAN HD- M4 X 6 LG			
			. JUMPER			
			. SCREW, THD FORM HEX WSHR HD- M4 X 8 LG			
			. WASHER, LOCK EXT T- 4.3 ID X 8 OD			
			. FUSE, CRT			

Parts
catalog

Parts catalog

Figure 2. Electro/mechanical sub-assembly

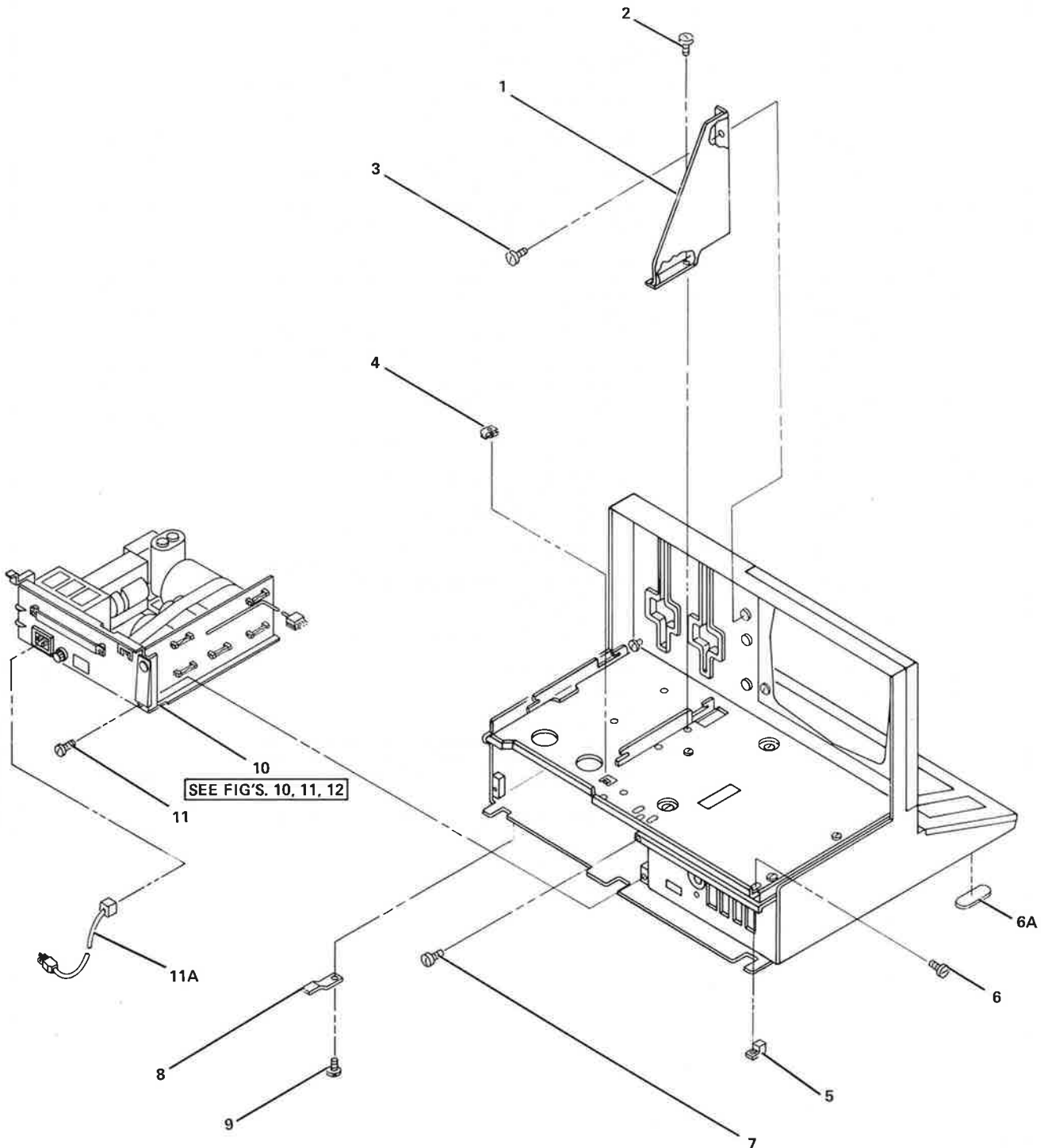


FIGURE 2. ELECTRO/MECHANICAL SUB-ASSEMBLY. SHEET 1 OF 2. INDEX NOS. 1-11A. SEE LIST 2.

FIGURE- INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION				
			1	2	3	4	
2	NO NO.		ELECTRO/MECHANICAL SUB-ASM FOR ILLUSTRATION SEE FIGURE 2				REF
- 1	6841115	1	. SHIELD, MONITOR				
- 2	7362385	2	. SCREW, THD FORM HEX WSHR HD- M4 X 8 LG				ATT PT
- 3	2451224	3	. SCREW, THD FORM HEX WSHR HI- 8-16 X 7/16L				ATT PT
- 4	6844699	1	. RECEPTACLE, CLIP-CN				
- 5	6838225	3	. CLIP, REAR COVER				
- 6	2451224	3	. SCREW, THD FORM HEX WSHR HD- 8-16 X 7/16L				ATT PT
- 6A	6838224	4	. FOOTPAD				
- 7	1621510	1	. SCREW				
- 8	6838288	3	. DETENT				
- 9	2451197	3	. SCREW, THD FORM HEX WSHR HD- 6-19 X .312L				ATT PT
- 10	6838279	1	. POWER SUPPLY ASM, 73 W 60 HZ-U.S. FOR DETAIL BREAKDOWN SEE FIGURE 10				
- 10	6838280	1	. POWER SUPPLY ASM, 73 W 60 HZ-GBG/I FOR DETAIL BREAKDOWN SEE FIGURE 11				
- 10	6838281	1	. POWER SUPPLY ASM, 73 W 50 HZ-GBG/I FOR DETAIL BREAKDOWN SEE FIGURE 12				
- 11	1621510	2	. SCREW				ATT PT
- 11A	6838234	1	. POWER CORD, 1.8 M (6 FT)-U.S.				
- 11A	6841461	1	. POWER CORD, 2.4 M (8 FT)-U.S.				
- 11A	6841720	1	. POWER CORD, AUSTRIA, FINLAND, GERMANY, NETHERLAND, NORWAY, SPAIN, SWEDEN				
- 11A	6841722	1	. POWER CORD, SWITZERLAND				
- 11A	6841724	1	. POWER CORD, BELGIUM, FRANCE				
- 11A	6841726	1	. POWER CORD, UK				
- 11A	6841728	1	. POWER CORD, AUSTRALIA, ARGENTINA, COLUMBIA, VENEZUELA				
- 11A	6841730	1	. POWER CORD, ITALY				
- 11A	6841732	1	. POWER CORD, DENMARK				
- 11A	6842371	1	. POWER CORD, GBG/I 50 HZ, NO PLUG				
- 11A	5642989	1	. POWER CORD, GBG/I 60 HZ, NO PLUG				

Parts
catalog

Parts catalog

Figure 2. Electro/mechanical sub-assembly (continued)

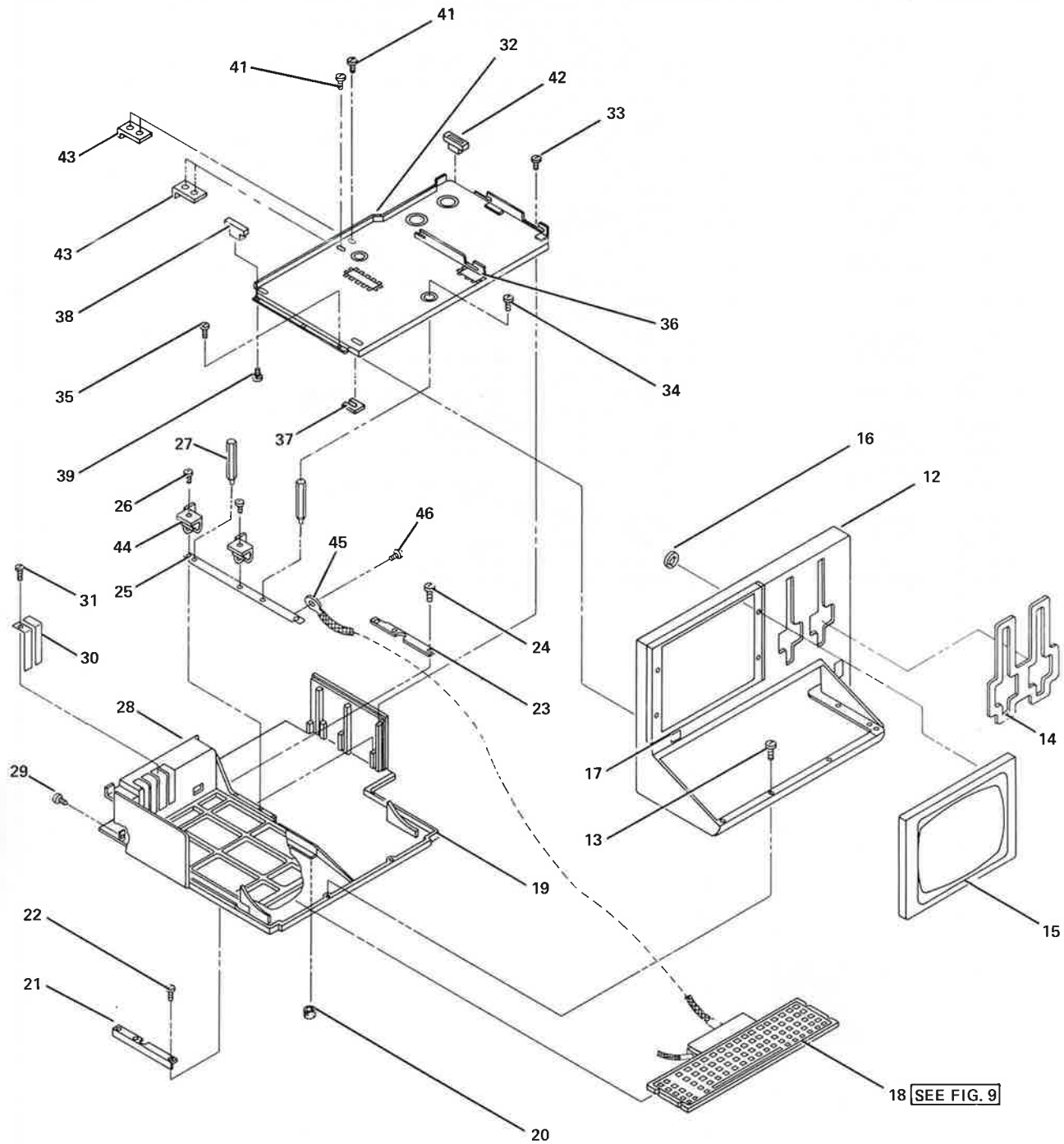


FIGURE 2. ELECTRO/MECHANICAL SUB-ASSEMBLY. SHEET 2 OF 2. INDEX NOS. 12-46. SEE LIST 2.

FIGURE- INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION			
			1	2	3	4
2 - 12	6838219	1	. PANEL ASM, FRONT			
- 13	5552875	11	. SCREW, THD FORM HEX WSHR HD- 8-16 X 9/16L			
- 14	6841071	1	. BEZEL, DISKETTE DRIVE			
- 15	6841569	1	. BEZEL ASM, MCNITCK			
- 16	848865	7	. CLIP			
- 17	6841119	1	. NAMEPLATE			
- 18	NO NO.	REF	. KEYBOARD ASM			
			FOR PART NUMBER SEE FIGURE 9			
- 19	6838218	1	. LOWER STRUCTURE ASM			
- 20	1608441	2	. INSERT, SECURITY			
			U.S./CANADA			
- 20	6841964	2	. INSERT, SECURITY			
			GEG/I			
- 21	6840705	1	. RETAINER, RH			
- 22	2451224	3	. SCREW, THD FORM HEX WSHR HD- 8-16 X 7/16L			
- 23	6840706	1	. RETAINER, LH			
- 24	2451224	3	. SCREW, THD FORM HEX WSHR HD- 8-16 X 7/16L			
- 25	6840704	1	. RETAINER, CENTER			
- 26	2451224	2	. SCREW, THD FORM HEX WSHR HD- 8-16 X 7/16L			
- 27	6840710	2	. STANDOFF			
- 28	6841570	1	. STIFFENER ASM			
- 29	1621510	2	. SCREW			
- 30	6840707	2	. PLATE, BLANK			
- 31	6846445	2	. SCREW			
- 32	6840703	1	. SUPPORT ASM			
- 33	2451224	6	. SCREW, THD FORM HEX WSHR HD- 8-16 X 7/16L			
- 34	1621190	2	. SCREW, MACH PAN HD- M4 X 8 LG			
- 35	2451224	2	. SCREW, THD FORM HEX WSHR HD- 8-16 X 7/16L			
- 36	473442	2	. GROMMET, CATERPILLAR- 12.62 LG			
- 37	6841074	1	. GUIDE ASM, DISKETTE CARD			
- 38	6841543	2	. BLOCK ASM, TOP COVER MTG LH			
- 39	2451224	2	. SCREW, THD FORM HEX WSHR HD- 8-16 X 7/16L			
- 41	1621197	4	. SCREW, MACH PAN HD- M4 X 6 LG			
- 42	6841544	1	. BLOCK ASM, TOP COVER MTG RH			
- 43	6846469	2	. BRACKET, STIFFENER			
- 44	6846468	2	. CLIP			
- 45	6846470	1	. JUMPER ASM			
- 46	1621197	1	. SCREW, MACH PAN HD- M4 X 6 LG			

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Figure 3. Attachment features

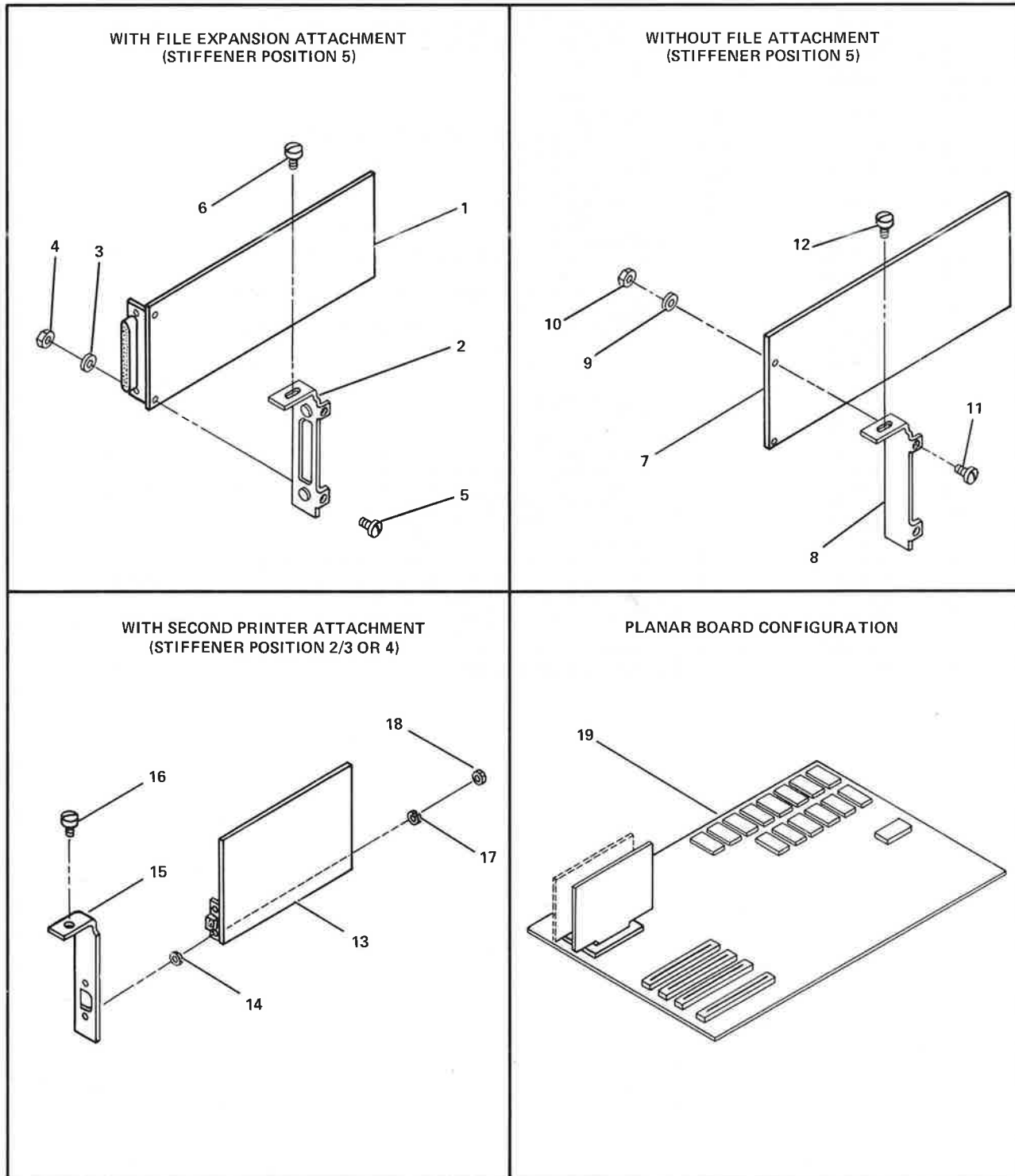


FIGURE 3. ATTACHMENT FEATURES. SEE LIST 3.

FIGURE- INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION			
			1	2	3	4
3 -	NO NO.	REF	ATTACHMENT FEATURES FOR NEXT HIGHER ASM SEE FIGURE 1-21 AND FOR ATTACHMENT FEATURES FIGURE 3			
- 1	NO NO.	REF	. CARD, DISKETTE ATTACHMENT W/CONNECTOR FOR PART NUMBER SEE CARD			
- 2	6841609	1	. BRACKET/STANDOFF ASM			
- 3	1622316	2	. WASHER, LOCK SPRING- 3.1 ID X 6.2 OD			
- 4	1622401	2	. NUT, HEX- M3 X 5.5			
- 5	1621172	2	. SCREW, MACH PAN HD- M3 X 10 LG			
- 6	6846445	1	. SCREW			
- 7	NO NO.	REF	. CARD, DISKETTE ATTACHMENT W/O CONNECTOR FOR PART NUMBER SEE CARD			
- 8	6846471	1	. BRACKET			
- 9	1622316	2	. WASHER, LOCK SPRING- 3.1 ID X 6.2 OD			
- 10	1622401	2	. NUT, HEX- M3 X 5.5			
- 11	1621172	2	. SCREW, MACH PAN HD- M3 X 10 LG			
- 12	6846445	1	. SCREW			
- 13	NO NO.	REF	. CARD, PRINTER ATTACHMENT FOR PART NUMBER SEE CARD			
- 14	1622302	2	. WASHER, FLAT- 3.2 ID X 7 OD X 0.5 THK			
- 15	6841611	1	. BRACKET/STANDOFF ASM			
- 16	6846445	1	. SCREW			
- 17	1622316	2	. WASHER, LOCK SPRING- 3.1 ID X 6.2 OD			
- 18	1622401	2	. NUT, HEX- M3 X 5.5			
- 19	NO NO.	REF	. PLANAR BOARD FOR PART NUMBER SEE BOARD			

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Figure 4. Diskette drive assembly, model 1

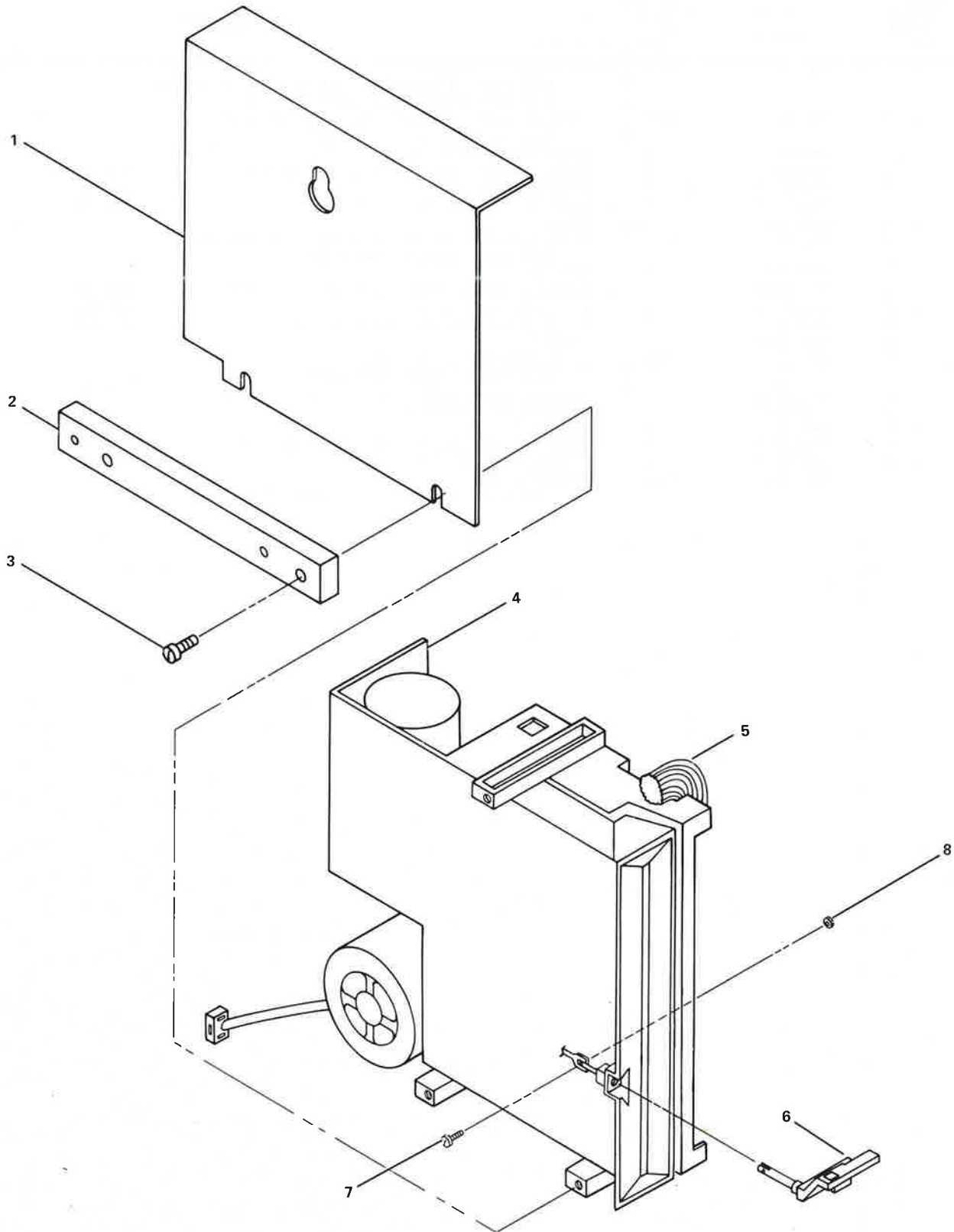


FIGURE 4. DISKETTE DRIVE ASSEMBLY, MODEL 1. SEE LIST 4.

FIGURE- INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION			
			1	2	3	4
4 -	NO NO.	REF	DISKETTE DRIVE ASM,MODEL 1 FOR NEXT HIGHER ASM SEE FIGURE 1-3 AND FOR ILLUSTRATION FIGURE 4			
- 1	6843258	1	. SHIELD			
- 2	6843261	1	. BAR			
- 3	1621310	2	. SCREW,MACH FLAT HD- M4 X 12 LG			
- 4	4240518	1	. DISKETTE DRIVE,0.25 MB			
			60 HZ			
- 4	4240504	1	. DISKETTE DRIVE,0.25 MB			
			50 HZ			
- 4	4240516	1	. DISKETTE DRIVE,1.0 MB			
			60 HZ			
- 4	4240512	1	. DISKETTE DRIVE,1.0 MB			
			50 HZ			
- 5	6837742	1	. CABLE ASM			
- 6	6846849	1	. LATCH NO. 1			
- 7	1621182	1	. SCREW,MACH PAN HD- M3.5 X 8 LG			
- 8	1622402	1	. NUT,HEX- M3.5 X 6			
			ATT PT			
			ATT PT			

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Figure 4A. Diskette drive assembly, model 2

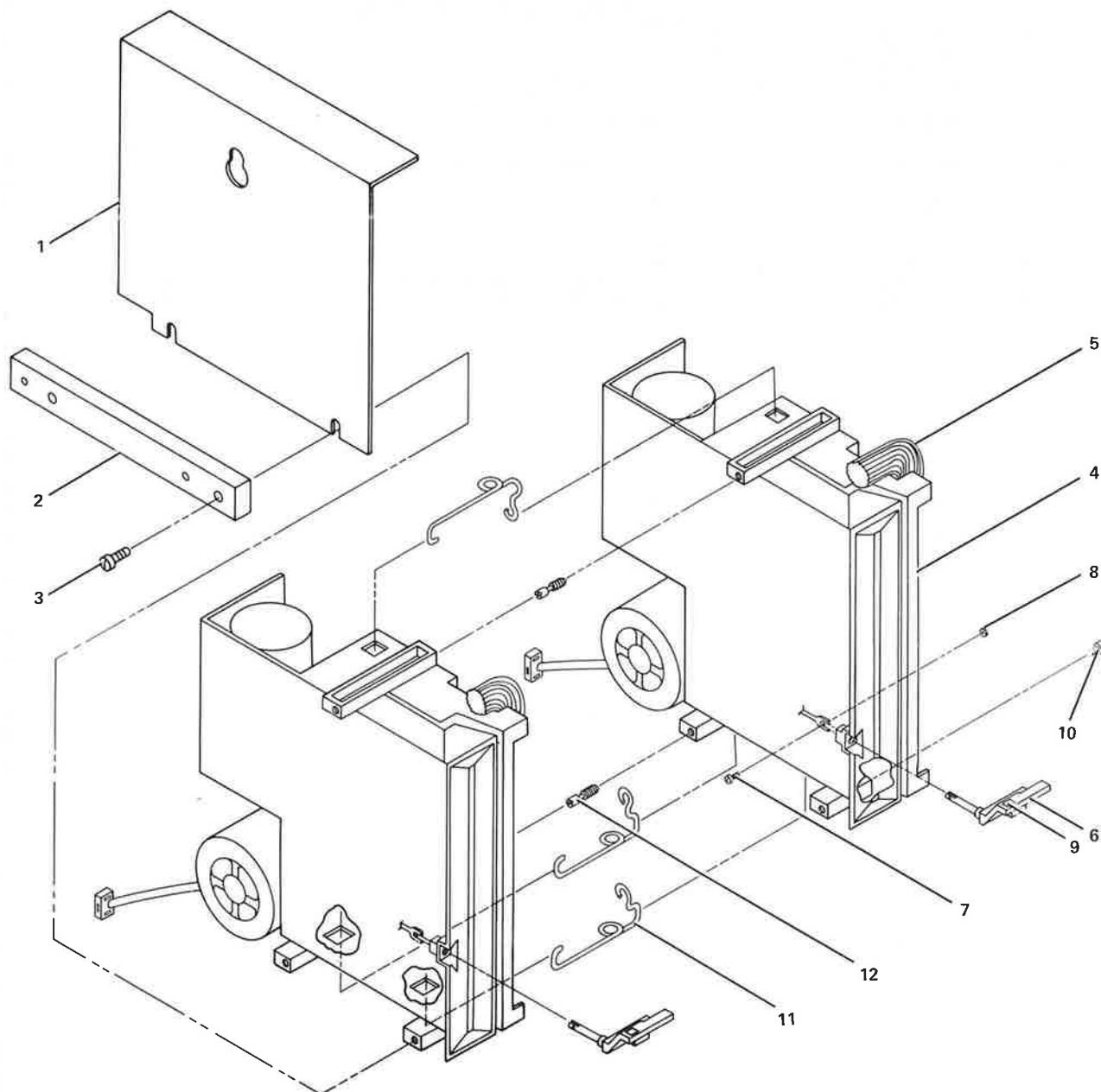


FIGURE 4A. DISKETTE DRIVE ASSEMBLY, MODEL 2. SEE LIST 4A.

FIGURE- INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION			
			1	2	3	4
4a-	NO NO.	REF	DISKETTE DRIVE ASM, MODEL 2 FOR NEXT HIGHTEC ASM SEE FIGURE 1-3 AND FOR ILLUSTRATION FIGURE 4A			
- 1	6843258	1	. SHIELD			
- 2	6843260	1	. BAR			
- 3	1621310	2	. SCREW, MACH FLAT HD- M4 X 12 LG			
- 4	4240508	2	. DISKETTE DRIVE, 0.25 MB 60 HZ			
- 4	4240504	2	. DISKETTE DRIVE, 0.25 MB 50 HZ			
- 4	4240516	2	. DISKETTE DRIVE, 1.0 MB 60 HZ			
- 4	4240512	2	. DISKETTE DRIVE, 1.0 MB 50 HZ			
- 5	6837742	2	. CABLE ASM			
- 6	6838229	2	. LATCH ASM			
- 7	1621182	2	. SCREW, MACH PAN HD- M3.5 X 8 LG			
- 8	1622402	2	. NUT, HEX- M3.5 X 6			
- 9	6844682	1	. LABEL, LATCH			
- 10	6838357	1	. PIN, GUIDE			
- 11	4240586	3	. CLIP, SPRING			
- 12	4240585	2	. PIN			

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Figure 5. Spindle, carriage and pulley assembly

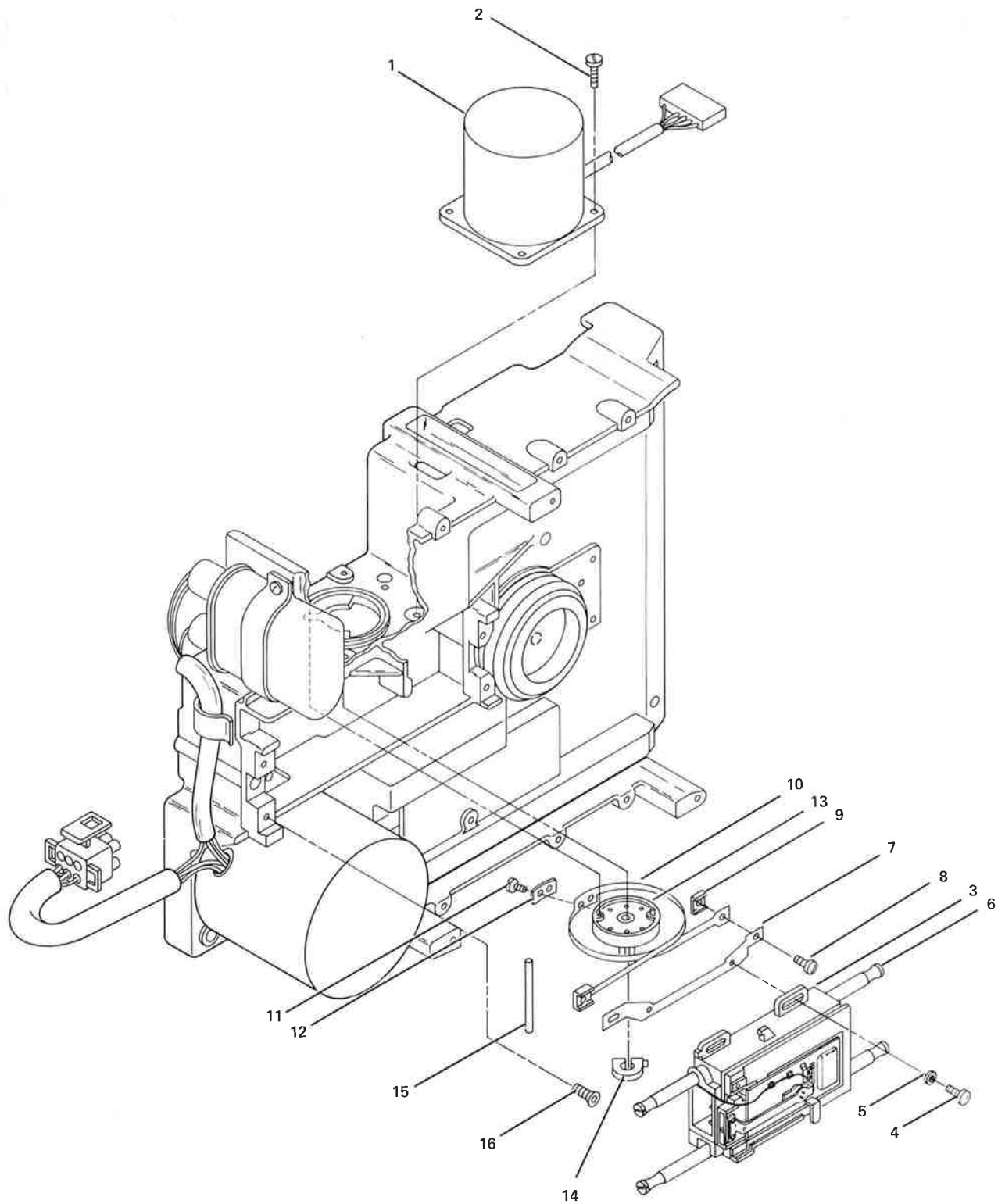


FIGURE 5. SPINDLE, CARRIAGE AND PULLEY ASSEMBLY. SEE LIST 5.

FIGURE- INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION			
			1	2	3	4
5 -	NO NO.	1	SPINDLE, CARRIAGE AND PULLEY ASM FOR NEXT HIGHER ASM SEE FIGURE 4 AND 4A AND FOR ILLUSTRATION FIGURE 5			
- 1	424^593	1	. MOTOR, STEPPER			
- 2	2462685	4	. SCREW, THD PCRM- M4 X 10 LG ATT PT			
- 3	424^615	1	. CARRIAGE, HEAD (31SD)			
- 3	4240620	1	. CARRIAGE, HEAD (51TD)			
- 4	1621170	2	. SCREW, MACH PAN HD- M3 X 6 LG ATT PT			
- 5	1622302	2	. WASHER, FLAT- 3.2 ID X 7 OD X 0.5 THK ATT PT			
- 6	424^573	2	. ROD, GUIDE			
- 7	4240600	1	. BRACKET, MOUNTING			
- 8	1621170	2	. SCREW, MACH PAN HD- M3 X 6 LG ATT PT			
- 9	4240601	2	. CLAMP ATT PT			
- 10	424^596	1	. BAND, DRIVE			
- 11	1621170	1	. SCREW, MACH PAN HD- M3 X 6 LG ATT PT			
- 12	424^599	1	. CLAMP ATT PT			
- 13	4240594	1	. PULLEY ASM			
- 14	23^5493	1	. CLAMP ATT PT			
- 15	5562019	1	. PIN, TIMING			
- 16	424^642	4	. SCREW, FL HD- M4 X 12 LG			

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Figure 6. Diskette guide and clamping assembly

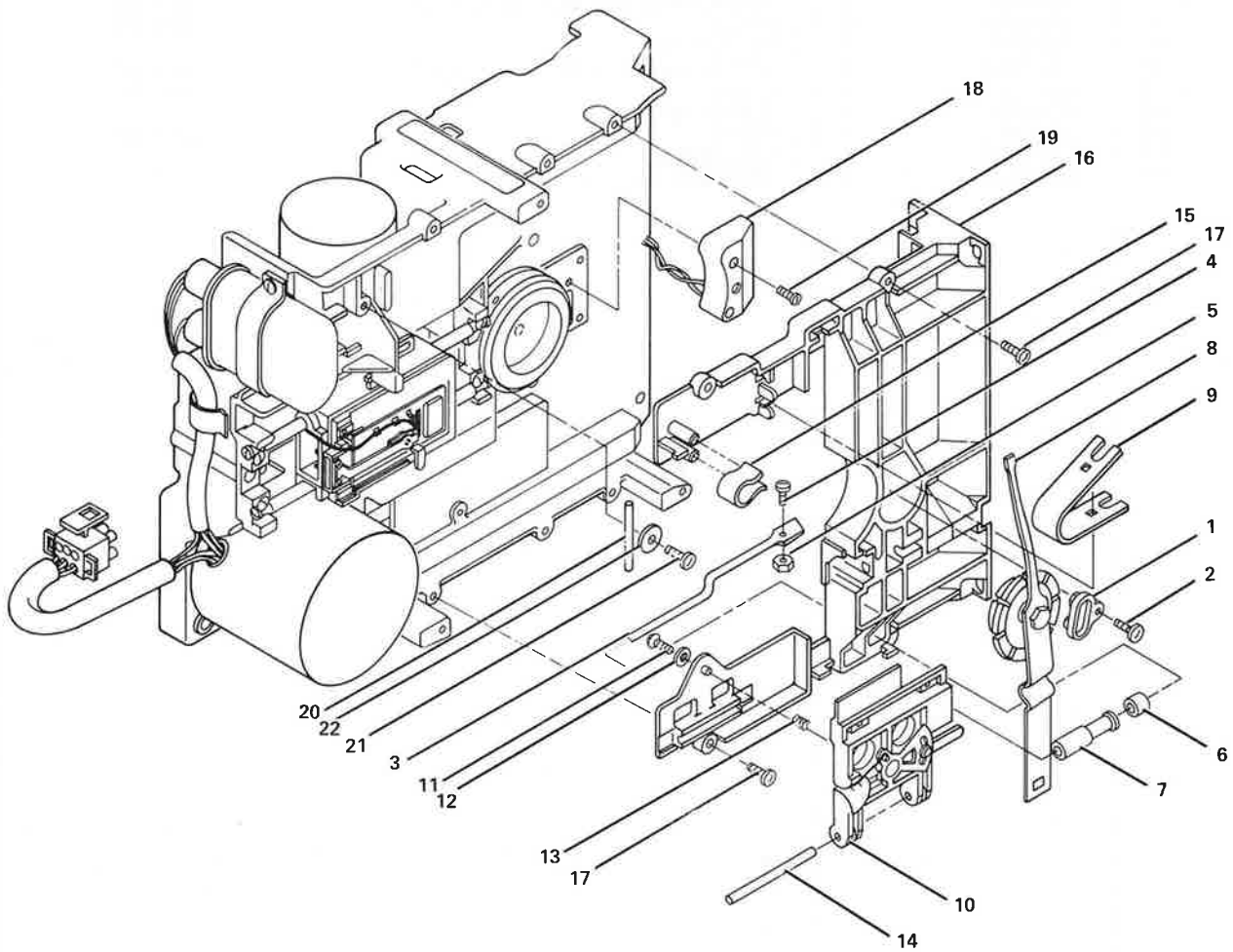


FIGURE 6. DISKETTE GUIDE AND CLAMP ASSEMBLY. SEE LIST 6.

FIGURE- INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION			
			1	2	3	4
6 -	NO NO.	1	DISKETTE GUIDE AND CLAMPING ASM FOR NEXT HIGHER ASM SEE FIGURE 4 AND 4A AND FOR ILLUSTRATION FIGURE 6			
- 1	4240662	1	. LED ASM (31SD)			
- 1	4240661	1	. LED ASM (51TD)			
- 2	1621672	1	. SCREW, THD FORM- M4 X 12 LG ATT PT			
- 3	4240592	1	. LEVER			
- 4	1621182	1	. SCREW, MACH PAN HD- M3.5 X 8 LG ATT PT			
- 5	1622402	1	. NUT, HEX- M3.5 X 6 ATT PT			
- 6	4240644	1	. ROLL			
- 7	4240614	1	. ROLLER			
- 8	4240589	1	. COLLET ASM			
- 9	4240631	1	. SPRING, TENSION			
- 10	4240580	1	. BAIL ASM			
- 11	1621672	1	. SCREW, THD FORM- M4 X 12 LG ATT PT			
- 12	49374	1	. WASHER, FLAT NO. 10- .53 OD X .78 THK ATT PT			
- 13	4240582	1	. SPRING (31SD)			
- 13	4240583	1	. SPRING (51TD)			
- 14	2462574	1	. PIN			
- 15	4240632	1	. CLIP, RETAINER			
- 16	4240663	1	. GUIDE			
- 17	1621193	4	. SCREW, MACH PAN HD- M4 X 16 LG ATT PT			
- 18	4240574	1	. PIX ASM (31SD)			
- 18	4240576	1	. PIX ASM (51TD)			
- 19	2462686	1	. SCREW, THD FORM- M4 X 16 LG ATT PT			
- 20	5562019	1	. PIN, TIMING			
- 21	2462685	1	. SCREW, THD FORM- M4 X 10 LG ATT PT			
- 22	35229	1	. WASHER, 11/64 ID X 7/16 OD ATT PT			

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Figure 7. Motor, capacitor and actuator assembly

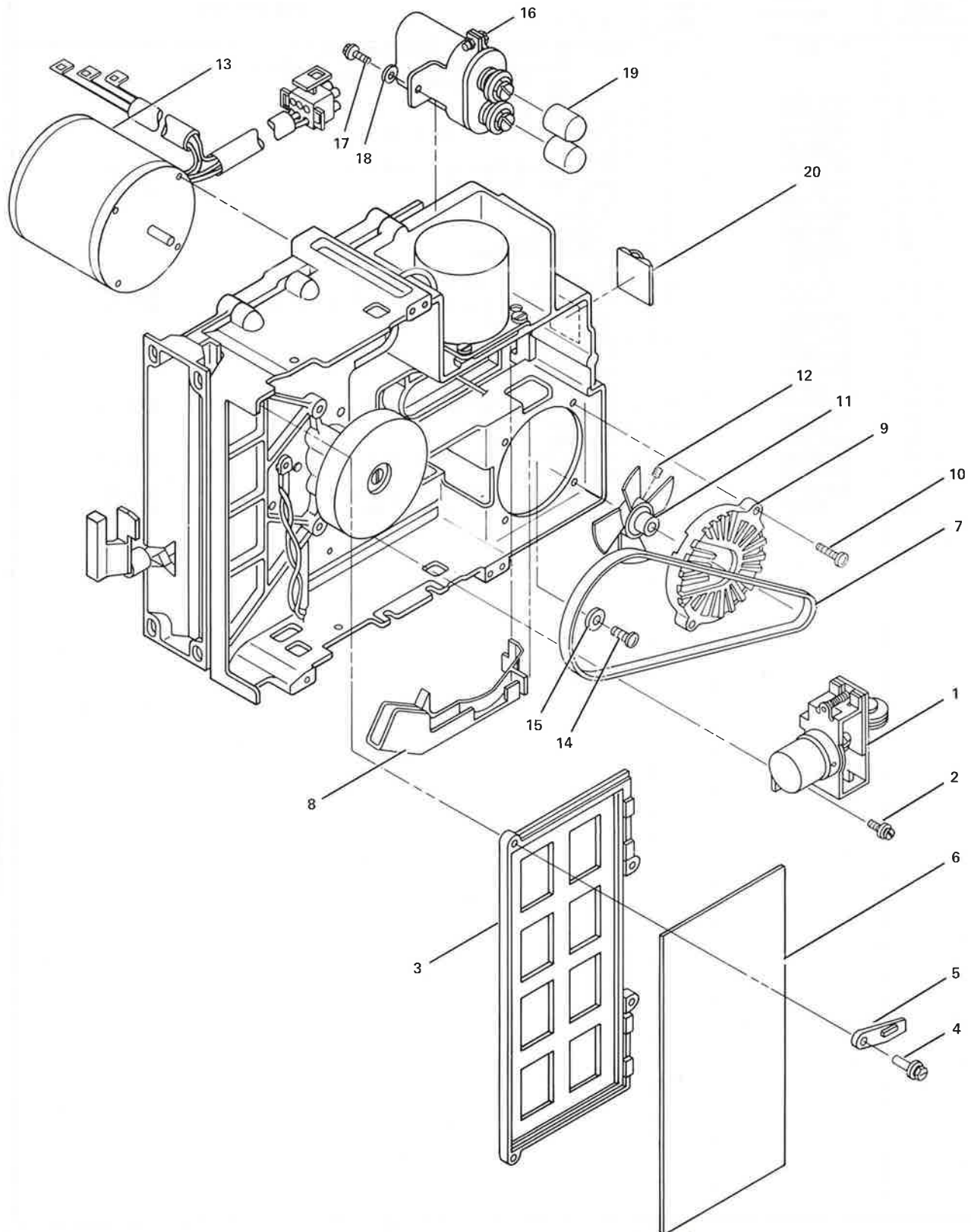


FIGURE 7. MOTOR, CAPACITOR AND ACTUATOR ASSEMBLY. SEE LIST 7.

FIGURE- INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION			
			1	2	3	4
7 -	NO NO.	1	MOTOR, CAPACITOR AND ACTUATOR ASM FOR NEXT HIGHER ASM SEE FIGURE 4 AND 4A AND FOR ILLUSTRATION FIGURE 7			
- 1	4240667	1	. ACTUATOR ASM (31SD)			
- 1	4240666	1	. ACTUATOR ASM (51TD)			
- 2	2462685	2	. SCREW, THD FORM- M4 X 10 LG ATT PT			
- 3	4240638	1	. CARD HOLDER			
- 4	2462686	4	. SCREW, THD FORM- M4 X 16 LG ATT PT			
- 5	4240584	2	. CARD RETAINER			
- 6	4240724	1	. CARD, FILE CONTROL (31SD)			
- 6	4240722	1	. CARD, FILE CONTROL (51TD)			
- 7	4240605	1	. BELT			
- 7	4240604	1	. BELT USED ON 60 HZ MACHINES			
- 8	4240610	1	. BELT USED ON 50 HZ MACHINES			
- 9	4240671	1	. GUIDE, HD LEAD			
- 9	4240671	1	. ENCLOSURE			
- 10	1621194	2	. SCREW, MACH PAN HD- M4 X 20 LG ATT PT			
- 11	4240675	1	. PULLEY ASM, 60 HZ			
- 11	4240673	1	. PULLEY ASM, 50 HZ			
- 12	1621719	1	. SETSCREW ATT PT			
- 13	4240677	1	. MOTOR ASM, 110 V 50-60 HZ			
- 13	4240679	1	. MOTOR ASM, 220 V 50-60 HZ			
- 14	1621192	2	. SCREW, MACH PAN HD- M4 X 12 LG ATT PT			
- 15	22478	2	. WASHER, FL- 0.170 ID X 3/8 OD X 1/32 THK ATT PT			
- 16	4240681	1	. CAPACITOR ASM			
- 17	2462685	1	. SCREW, THD FORM- M4 X 10 LG ATT PT			
- 18	35229	1	. WASHER, 11/64 ID X 7/16 OD ATT PT			
- 19	526378	2	. COVER			
- 20	2596291	1	. CLAMP			

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Figure 8. Fan and plenum assembly

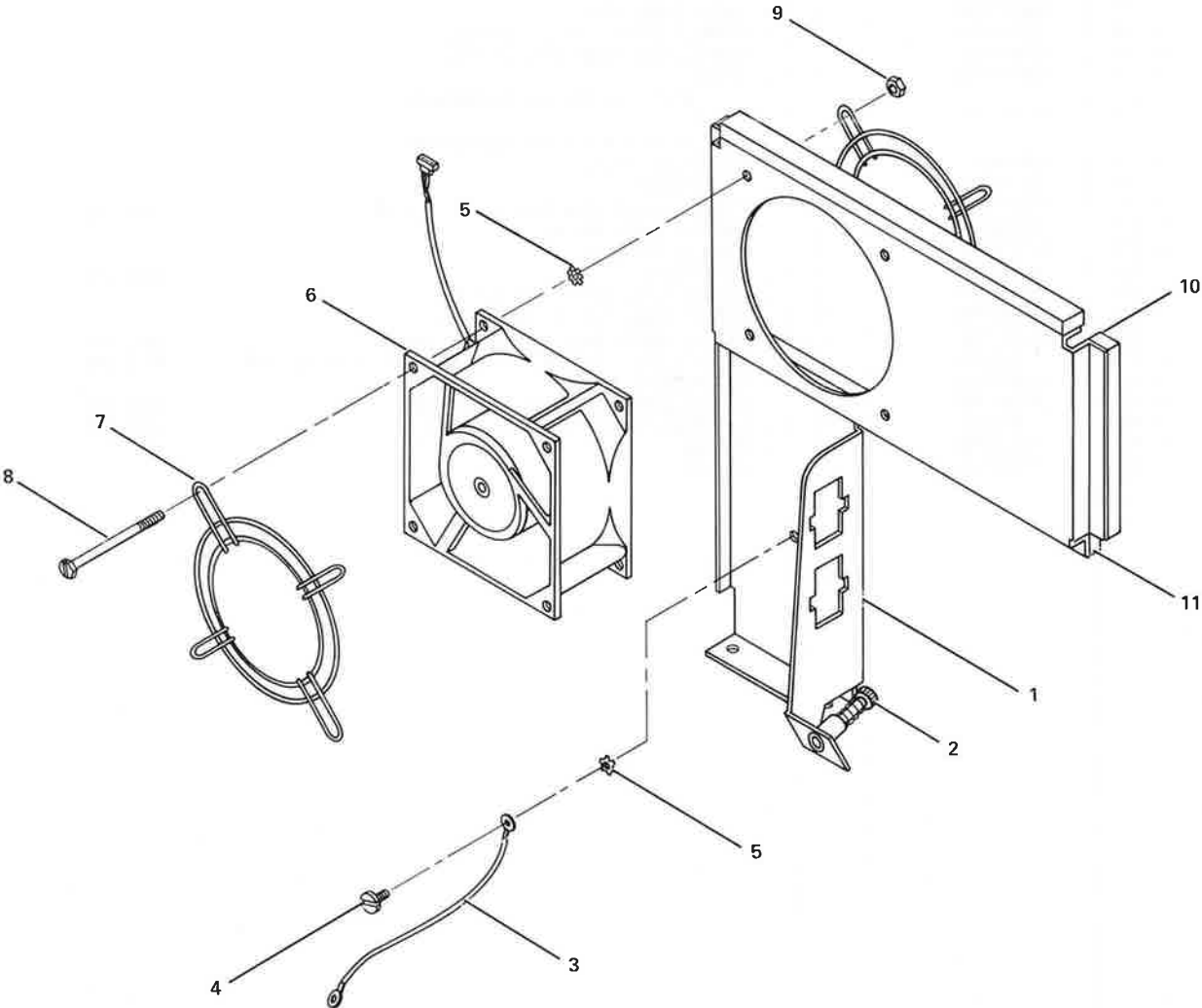


FIGURE 8. FAN AND PLENUM ASSEMBLY. SEE LIST 8.

FIGURE- INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION			
			1	2	3	4
8 -	6838213	1	FAN AND PLENUM ASM FOR NEXT HIGHER ASM SEE FIGURE 1-26 AND FOR ILLUSTRATION FIGURE 8			
- 1	6838217	1	. PLENUM			
- 2	6844700	1	. SCREW, SPRING-EJECTED ATT PT			
- 3	5759502	1	. JUMPER			
- 4	1621197	1	. SCREW, MACH PAN HD- M4 X 6 IG ATT PT			
- 5	1622346	2	. WASHER, LOCK EXT T- 4.3 ID X 8 OD ATT PT			
- 6	6838352	1	. FAN ASM, 100-115 V 50-60 HZ			
- 7	5136688	2	. GUARD, FAN			
- 8	5145492	4	. SCREW ATT PT			
- 9	1622403	4	. NUT, HEX- M4 X 7 ATT PT			
- 10	6841458	2	. PCAM			
- 11	6841457	2	. FOAM			

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Figure 9. Keyboard assembly

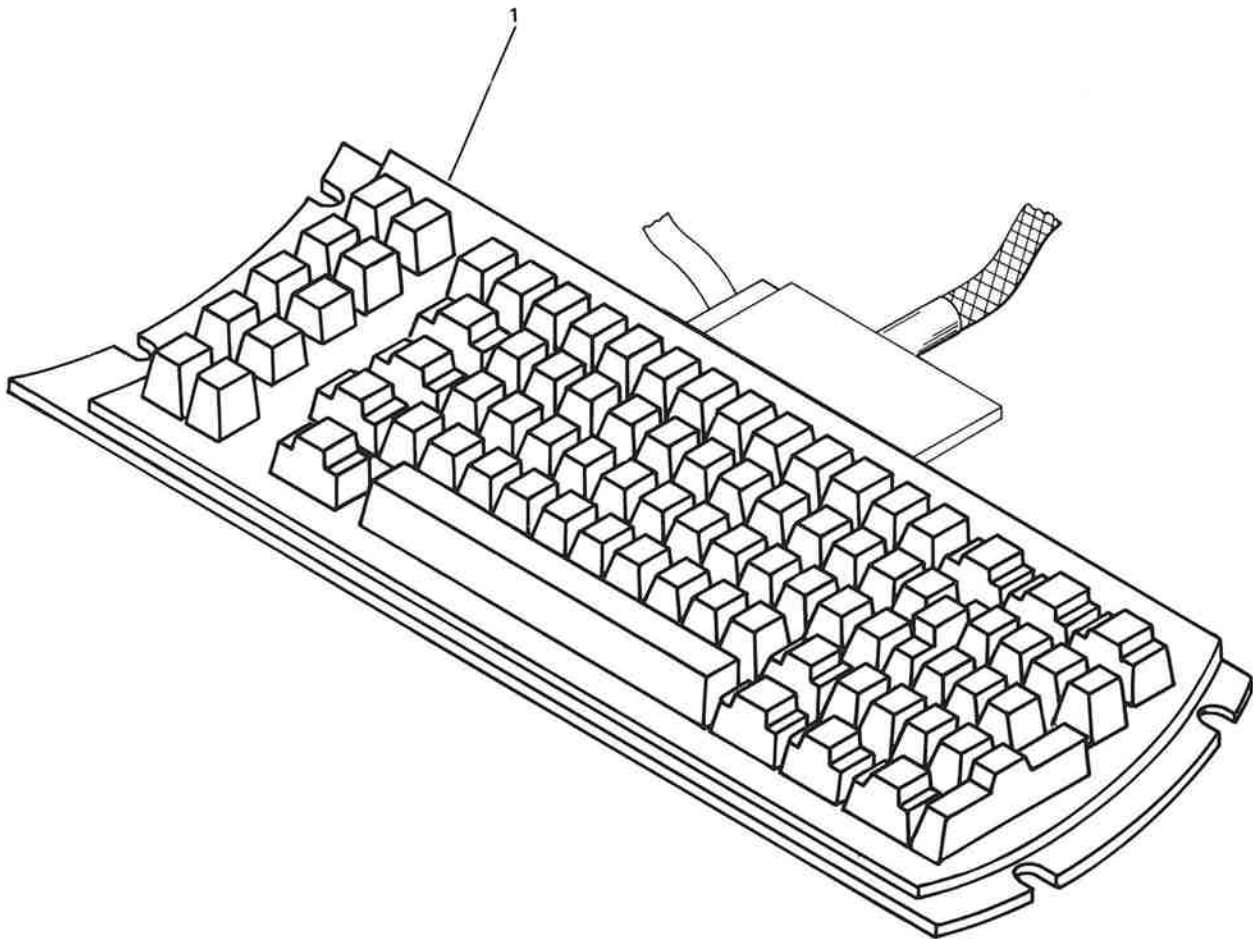


FIGURE 9. KEYBOARD ASSEMBLY. SEE LIST 9.

FIGURE- INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION			
			1	2	3	4
9 -	NO NO.	REF	KEYBOARD ASM			
			FOR NEXT HIGHER ASM SEE FIGURE 2-18			
			AND FOR ILLUSTRATION FIGURE 9			
- 1	1643374	1	.	KEYBOARD		
				U.S./CANADA		
- 1	1643383	1	.	KEYBOARD		
				AUSTRIA/GERMANY		
- 1	1643386	1	.	KEYBOARD		
				BELGIUM		
- 1	1860786	1	.	KEYBOARD		
				SWITZERLAND/FRANCE		
- 1	1643377	1	.	KEYBOARD		
				CANADA/FRANCE		
- 1	1643389	1	.	KEYBOARD		
				DENMARK		
- 1	1643392	1	.	KEYBOARD		
				FINLAND		
- 1	1860765	1	.	KEYBOARD		
				FRANCE/AZERTY		
- 1	1643395	1	.	KEYBOARD		
				FRANCE/QWERTY		
- 1	1860771	1	.	KEYBOARD		
				INTERNATIONAL		
- 1	1860768	1	.	KEYBOARD		
				ITALY		
- 1	1643380	1	.	KEYBOARD		
				JAPAN/KATAKANA		
- 1	1860774	1	.	KEYBOARD		
				NORWAY		
- 1	1860789	1	.	KEYBOARD		
				SWISS GERMAN		
- 1	1860777	1	.	KEYBOARD		
				SPAIN/SPANISH SPEAKING		
- 1	1643392	1	.	KEYBOARD		
				SWEDEN		
- 1	1860783	1	.	KEYBOARD		
				UK		

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Figure 10. Power supply assembly (60 Hz – U.S./Canada)

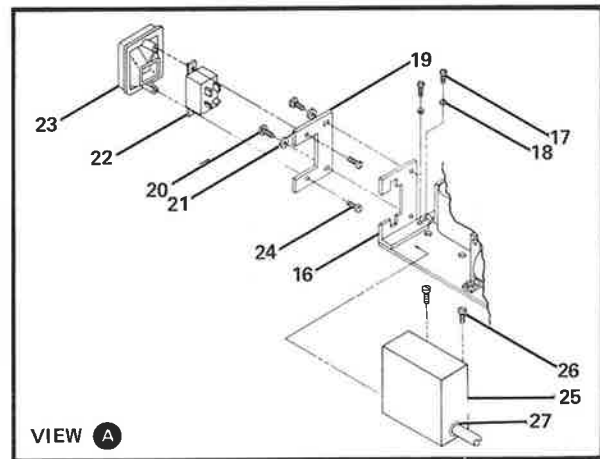
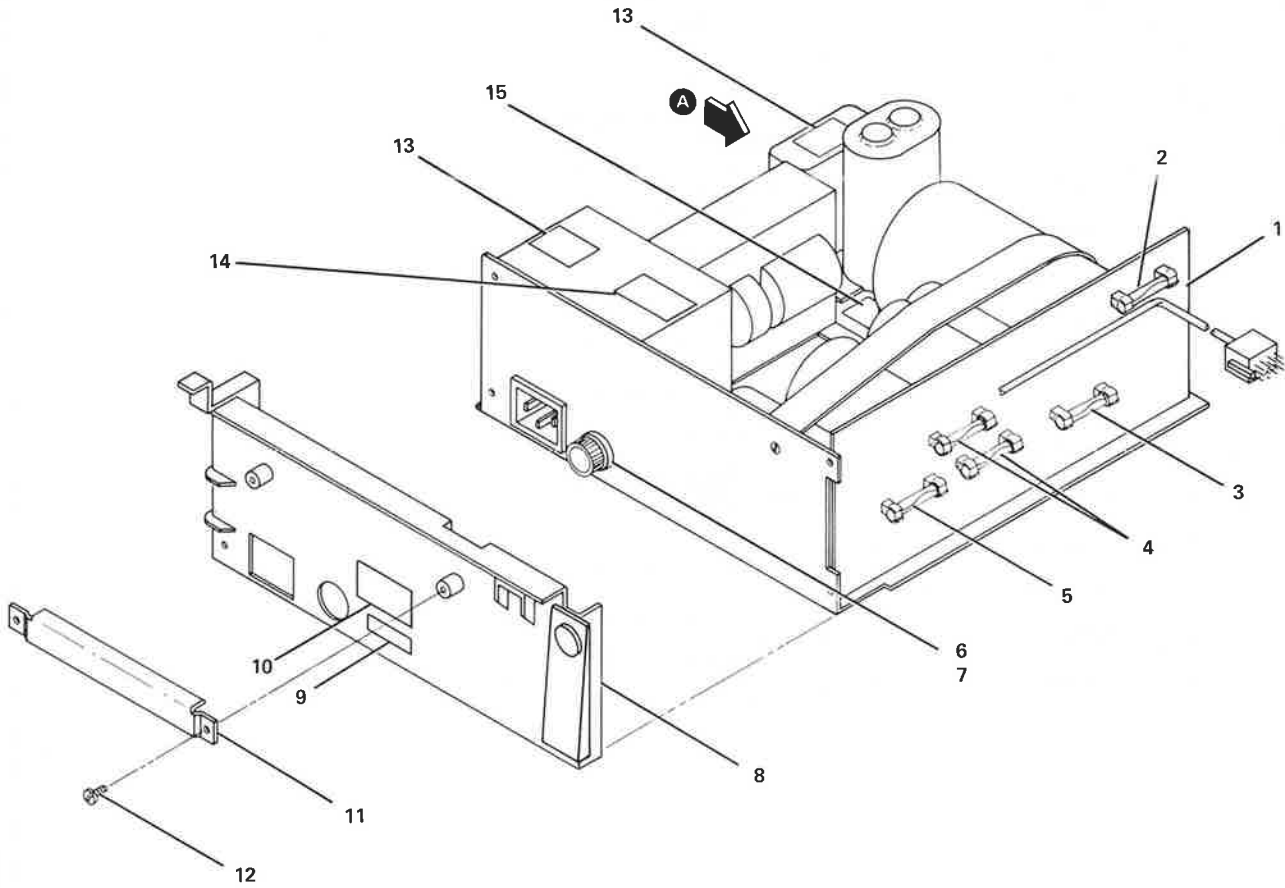


FIGURE 10. POWER SUPPLY ASSEMBLY, 73W 60HZ - U.S./CANADA. SEE LIST 10.

FIGURE- INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION			
			1	2	3	4
10 -	6838279	1	POWER SUPPLY ASM 73 W 60 HZ-U.S. FOR NEXT HIGHER ASM SEE LIST 2-10 AND FOR ILLUSTRATION FIGURE 10			
- 1	NO NO.	1	. CARD ASM FOR PART NUMBER SEE CARD			
- 2	511063	1	. FUSE, 10 A			
- 3	111256	1	. FUSE, 1.5 A			
- 4	3577	2	. FUSE, .5 A			
- 5	1176668	1	. FUSE, 1.5 A			
- 6	512137	1	. FUSE, 5 A			
- 7	4412938	1	. FUSE HOLDER			
- 8	6838237	1	. SHIELD			
- 9	5130277	1	. LABEL			
- 10	4499222	1	. LABEL, WARNING FUSE, ALL LANGUAGES			
- 11	6838290	1	. HANDLE			
- 12	1622541	2	. SCREW			
- 13	4499219	2	. LABEL, LINE VOLTAGE PRESENT, ALL LANGUAGE			
- 14	4499218	1	. LABEL, HAZARDOUS AREA, ALL LANGUAGES			
- 15	4468640	1	. LABEL, 500 TO 800 V			
- 16	6846461	1	. PLATE, SWITCH MOUNTING			
- 17	1621197	2	. SCREW, MACH PAN HD- M4 X 6 LG			
- 18	1622304	2	. WASHER, FLAT- 4.3 ID X 9 OD X 0.8 THK			
- 19	6838249	1	. BRACKET, SWITCH			
- 20	1621187	2	. SCREW			
- 21	1622302	2	. WASHER, FLAT- 3.2 ID X 7 OD X 0.5 THK			
- 22	6837597	1	. SWITCH, POWER ON/OFF			
- 23	6837729	1	. BEZEL, SWITCH			
- 24	6841070	2	. SCREW			
- 25	6838282	1	. COVER, SWITCH			
- 26	1621176	2	. SCREW, MACH PAN HD- M3 X 4 LG			
- 27	749062	1	. GROMMET			
			ATT PT			
			ATT PT			
			ATT PT			
			ATT PT			
			ATT PT			
			ATT PT			
			ATT PT			
			ATT PT			
			ATT PT			
			ATT PT			
			ATT PT			
			ATT PT			

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Figure 11. Power supply assembly (60 Hz - GBG/I)

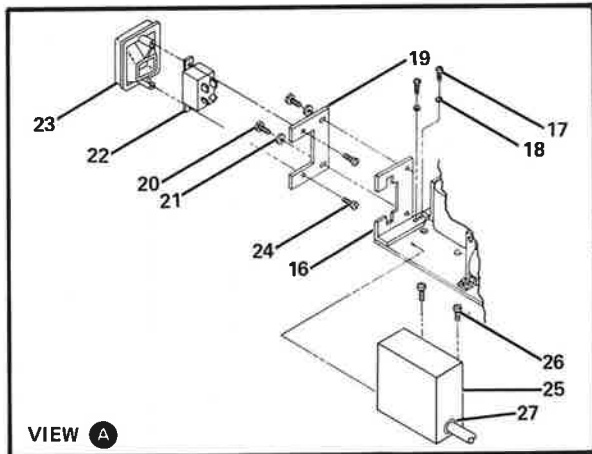
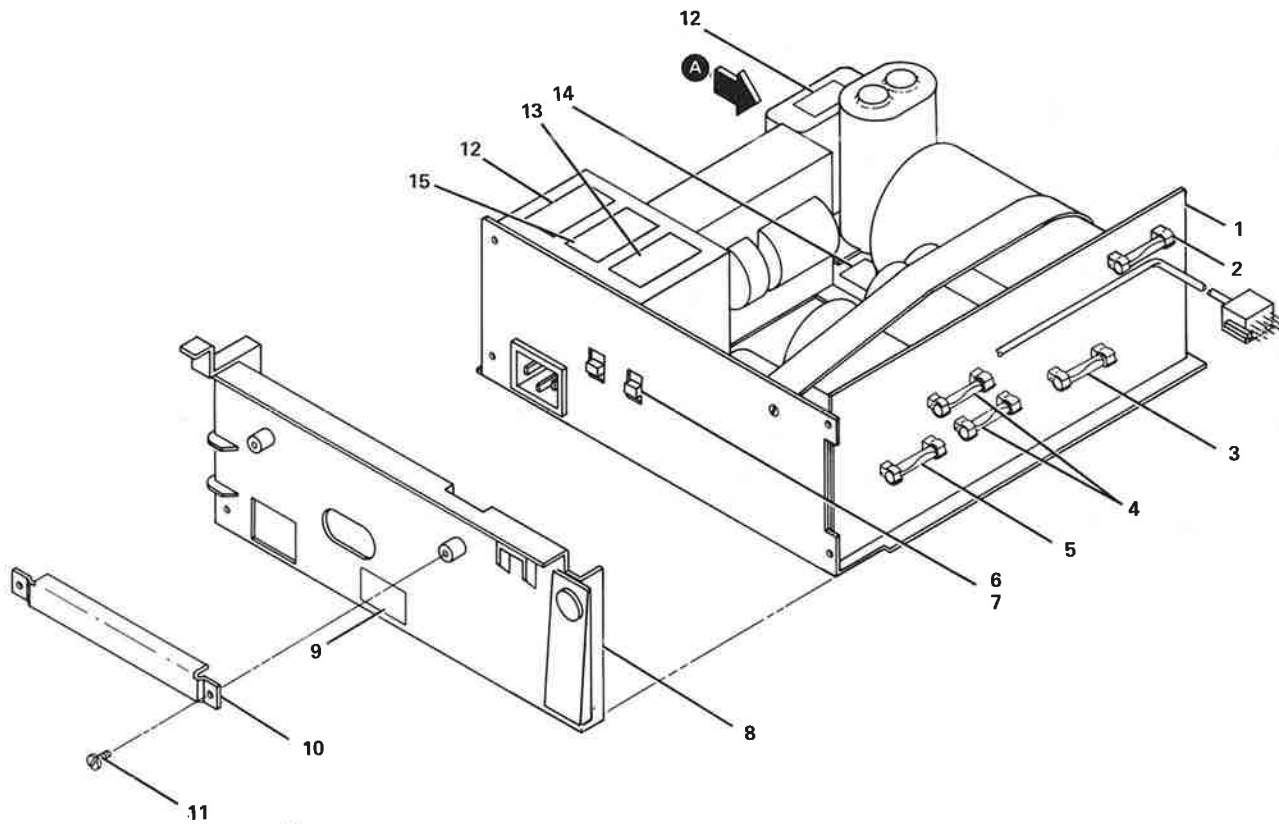


FIGURE 11. POWER SUPPLY ASSEMBLY, 73W 60HZ - GBG/I. SEE LIST 11.

FIGURE- INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION			
			1	2	3	4
11 -	6838280	1	POWER SUPPLY ASM 73 W 60 HZ-GBG/I FOR NEXT HIGHER ASM SEE LIST 2-10 AND FOR ILLUSTRATION FIGURE 11			
- 1	NO NO.	1	. CARD ASM FOR PART NUMBER SEE CARD			
- 2	511063	1	. FUSE,10 A			
- 3	111256	1	. FUSE,1.5 A			
- 4	3577	2	. FUSE,.5 A			
- 5	1176668	1	. FUSE,1.5 A			
- 6	1821987	1	. CIRCUIT BREAKER			
- 7	38442	4	. SCREW,MACH FLAT CSK HD- 6-32 X 1/4 LG			
- 8	6841075	1	. SHIELD			
- 9	4499222	1	. LABEL,WARNING FUSE, ALL LANGUAGES			
- 10	6838290	1	. HANDLE			
- 11	1622541	2	. SCREW			
- 12	4499219	2	. LABEL,LINE VOLTAGE PRESENT, ALL LANGUAGE			
- 13	4499218	1	. LABEL,HAZARDOUS AREA, ALL LANGUAGES			
- 14	4468640	1	. LABEL,500 TO 800 V			
- 15	4499221	1	. LABEL,MACHINE WIRED, ALL LANGUAGES			
- 16	6846461	1	. PLATE,SWITCH MOUNTING			
- 17	1621197	2	. SCREW,MACH PAN HD- M4 X 6 LG			
- 18	1622304	2	. WASHER,FLAT- 4.3 ID X 9 OD X 0.8 THK			
- 19	6838249	1	. BRACKET,SWITCH			
- 20	1621187	2	. SCREW			
- 21	1622302	2	. WASHER,FLAT- 3.2 ID X 7 OD X 0.5 THK			
- 22	6837597	1	. SWITCH,POWER ON/OFF			
- 23	6837729	1	. BEZEL,SWITCH			
- 24	6841070	2	. SCREW			
- 25	6838282	1	. COVER,SWITCH			
- 26	1621176	2	. SCREW,MACH PAN HD- M3 X 4 LG			
- 27	749062	1	. GROMMET			

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Figure 12. Power supply assembly (50 Hz - GBG/I)

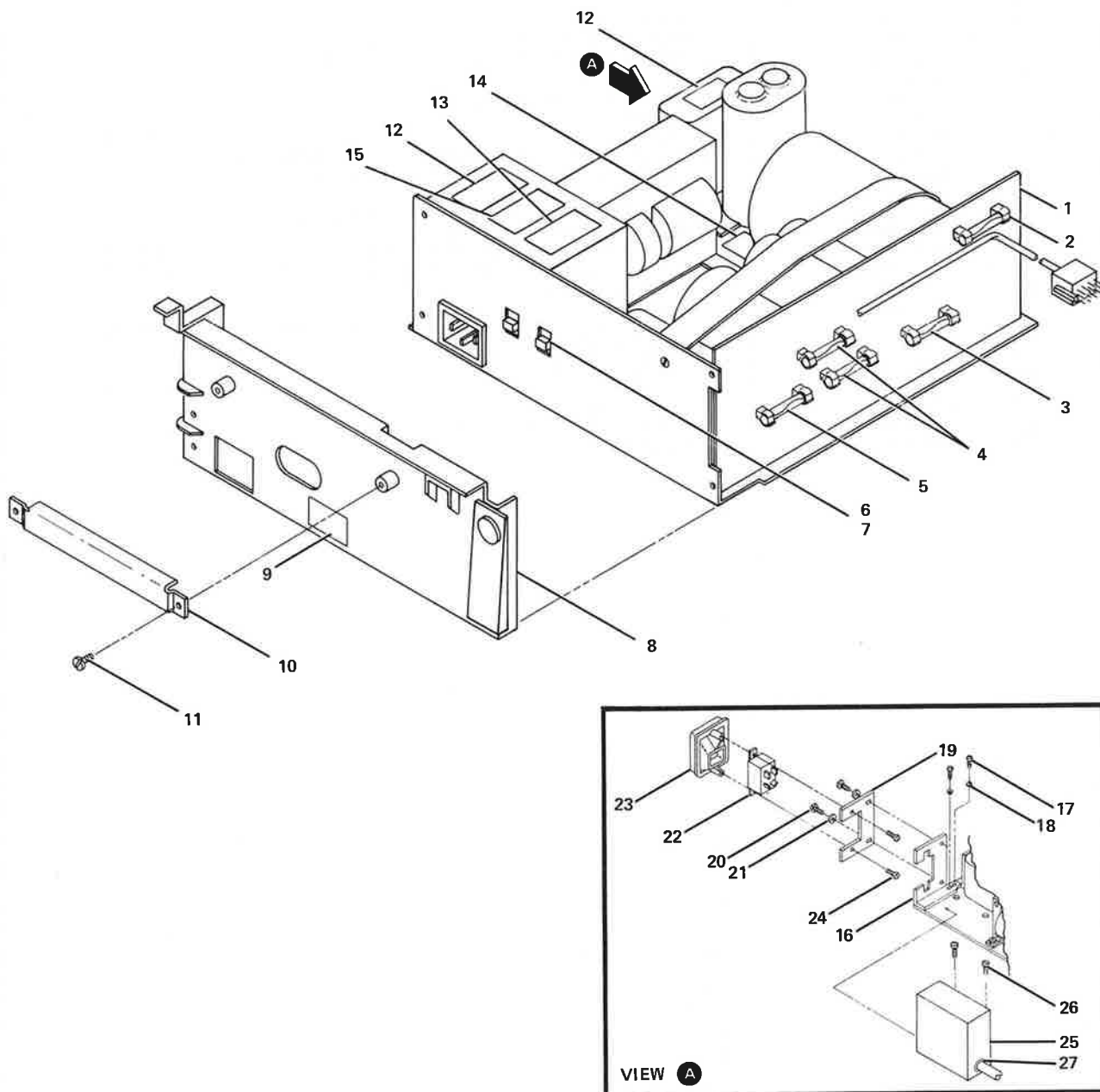


FIGURE 12. POWER SUPPLY ASSEMBLY, 73W 50HZ - GBG/I. SEE LIST 12.

FIGURE- INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION			
			1	2	3	4
12 -	6838281	1	POWER SUPPLY ASM 73 W 50 HZ-GBG/I FOR NEXT HIGHER ASM SEE LIST 2-10 AND FOR ILLUSTRATION FIGURE 12			
- 1	NO NO.	1	. CARD ASM FOR PART NUMBER SEE CARD			
- 2	511063	1	. FUSE,10 A			
- 3	111256	1	. FUSE,1.5 A			
- 4	3577	2	. FUSE,.5 A			
- 5	1176668	1	. FUSE,1.5 A			
- 6	1821987	1	. CIRCUIT BREAKER			
- 7	38442	4	. SCREW,MACH FLAT CSK HD- 6-32 X 1/4 LG			
- 8	6841075	1	. SHIELD			
- 9	4499222	1	. LABEL,WARNING FUSE, ALL LANGUAGES			
- 10	6838290	1	. HANDLE			
- 11	1622541	2	. SCREW			
- 12	4499219	2	. LABEL,LINE VOLTAGE PRESENT, ALL LANGUAGE			
- 13	4499218	1	. LABEL,HAZARDOUS AREA, ALL LANGUAGES			
- 14	4468640	1	. LABEL,500 TO 800 V			
- 15	4499221	1	. LABEL,MACHINE WIRED, ALL LANGUAGES			
- 16	6846461	1	. PLATE,SWITCH MOUNTING			
- 17	1621197	2	. SCREW,MACH PAN HD- M4 X 6 LG			
- 18	1622304	2	. WASHER,FLAT- 4.3 ID X 9 OD X 0.8 THK			
- 19	6838249	1	. BRACKET,SWITCH			
- 20	1621187	2	. SCREW			
- 21	1622302	2	. WASHER,FLAT- 3.2 ID X 7 OD X 0.5 THK			
- 22	6837597	1	. SWITCH,POWER ON/OFF			
- 23	6837729	1	. BEZEL,SWITCH			
- 24	6841070	2	. SCREW			
- 25	6838282	1	. COVER,SWITCH			
- 26	1621176	2	. SCREW,MACH PAN HD- M3 X 4 LG			
- 27	749062	1	. GROMMET			

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Figure 13. Cable assemblies with component parts

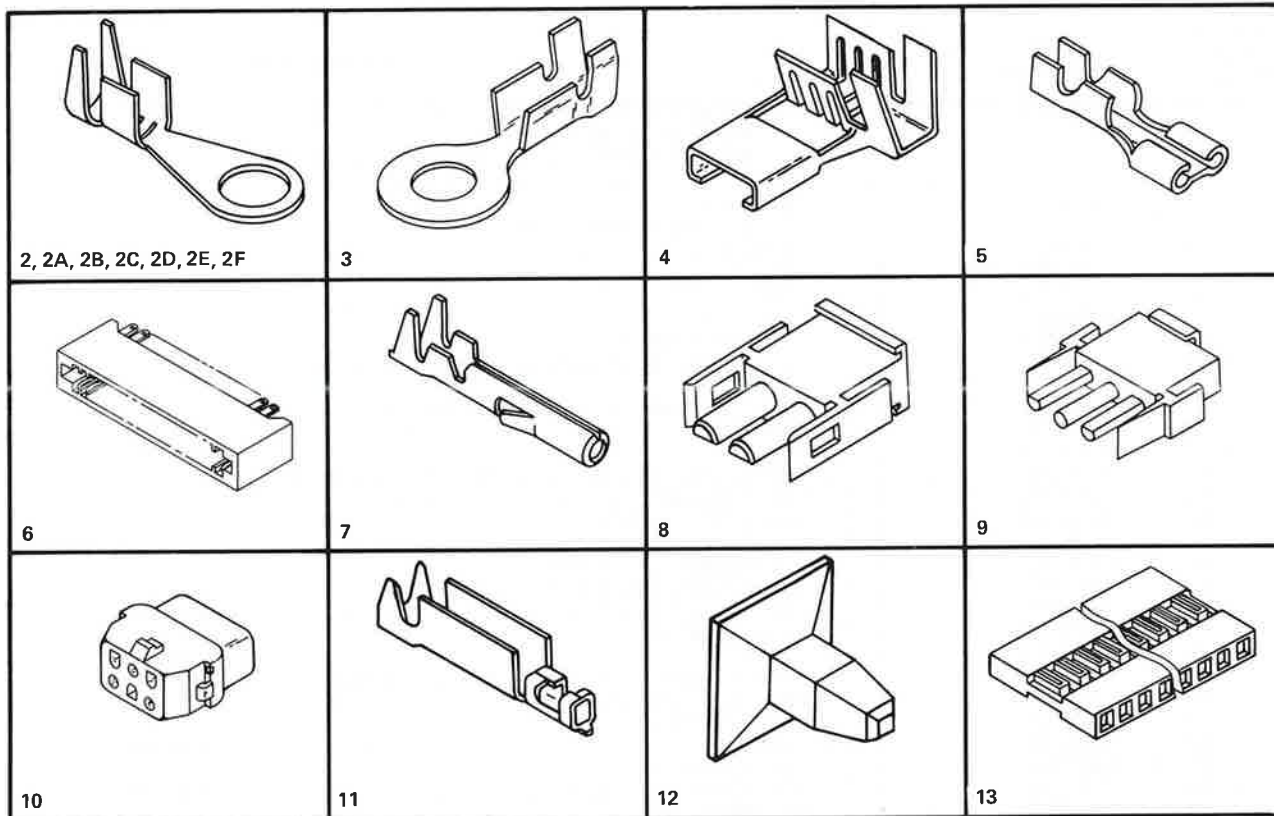


FIGURE 13. CABLE ASSEMBLIES WITH COMPONENT PARTS. SEE LIST 13.

FIGURE- INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION			
			1	2	3	4
13 - 2	186961	AR	.	TERMINAL, RING- 20-18 AWG NO. 6 HOLE		
- 2A	334921	AR	.	TERMINAL, LUG INS- 18-22 AWG		
- 2B	483677	AR	.	TERMINAL, RING-NO. 6 STUD 18-20 AWG		
- 2C	483678	AR	.	TERMINAL, RING-NO. 6 STUD 14-16 AWG		
- 2D	483681	AR	.	TERMINAL, RING		
- 2E	360370	AR	.	TERMINAL, RING TONGUE- 14-16 AWG		
- 2 ^F	483683	AR	.	TERMINAL, RING		
- 3	236915	AR	.	TERMINAL, CONTACT FEMALE- 18-20 AWG		
- 4	517913	AR	.	CLIP, TERMINAL		
- 5	523267	AR	.	TERMINAL, SLIP-CN		
- 6	1608573	AR	.	CONNECTOR, HCUSING DISPLAY		
- 7	1847523	AR	.	PIN, TERMINAL		
- 8	1847524	AR	.	PLUG, 2 CIRCUIT		
- 9	1847526	AR	.	PLUG, 3 CIRCUIT		
- 10	1847531	AR	.	HCUSING, 6 CIRCUIT		
- 11	2637682	AR	.	PIN, CONTACT- 22-26 AWG		
- 12	2637689	AR	.	INSERT, PLASTIC		
- 13	2731395	AR	.	HOUSING, 1 X 14		

FIGURE- INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION			
			1	2	3	4
13 -	NO NO.	REF	CABLE ASSEMBLIES WITH COMPONENT PARTS FOR ILLUSTRATION SEE FIGURE 13			
- 1	5759502		JUMPER FOR COMPONENT PARTS SEE INDEX NO. 2E			
- 1	5759615		JUMPER ASM FOR COMPONENT PARTS SEE INDEX NO. 2			
- 1	5921712		JUMPER ASM FOR COMPONENT PARTS SEE INDEX NO. 2A			
- 1	6837737		CABLE ASM, KEYBOARD FOR COMPONENT PARTS SEE INDEX NOS. 11, 13, 14			
- 1	6837742		CABLE ASM, DISKETTE SIGNAL AND POWER FOR COMPONENT PARTS SEE INDEX NOS. 11, 12, 14B, 18			
- 1	6837744		CABLE ASM, DISPLAY FOR COMPONENT PARTS SEE INDEX NOS. 6, 11, 14A			
- 1	6838234		POWER CORD, 1.8 M (6 FT) U.S.			
- 1	6838245		CABLE ASM, DC DISTRIBUTION FOR COMPONENT PARTS SEE INDEX NOS. 4, 7, 15, 16, 17			
- 1	6838246		CABLE ASM, AC DISTRIBUTION FOR COMPONENT PARTS SEE INDEX NOS. 2B, 2C, 2D, 7, 8, 9, 10, 18			
- 1	6838247		CABLE ASM, PRIME POWER FOR COMPONENT PARTS SEE INDEX NOS. 3, 2B			
- 1	6841461		POWER CORD, 2.4 M (8 FT) U.S.			
- 1	6841720		POWER CORD, AUSTRIA, FINLAND, GERMANY, NETHERLAND, NORWAY, SPAIN, SWEDEN			
- 1	6841722		POWER CORD, SWITZERLAND			
- 1	6841724		POWER CORD, BELGIUM, FRANCE			
- 1	6841726		POWER CORD, UK			
- 1	6841728		POWER CORD, AUSTRALIA			
- 1	6841730		POWER CORD, ITALY			
- 1	6841732		POWER CORD, DENMARK			
- 1	6841965		JUMPER ASM FOR COMPONENT PARTS SEE INDEX NOS. 2B, 5			
- 1	6841966		JUMPER ASM FOR COMPONENT PARTS SEE INDEX NO. 2B			
- 1	6842371		POWER CORD, GEG/I			
- 1	6846470		JUMPER ASM FOR COMPONENT PARTS SEE INDEX NO. 2F			

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Figure 13. Cable assemblies with component parts (continued)

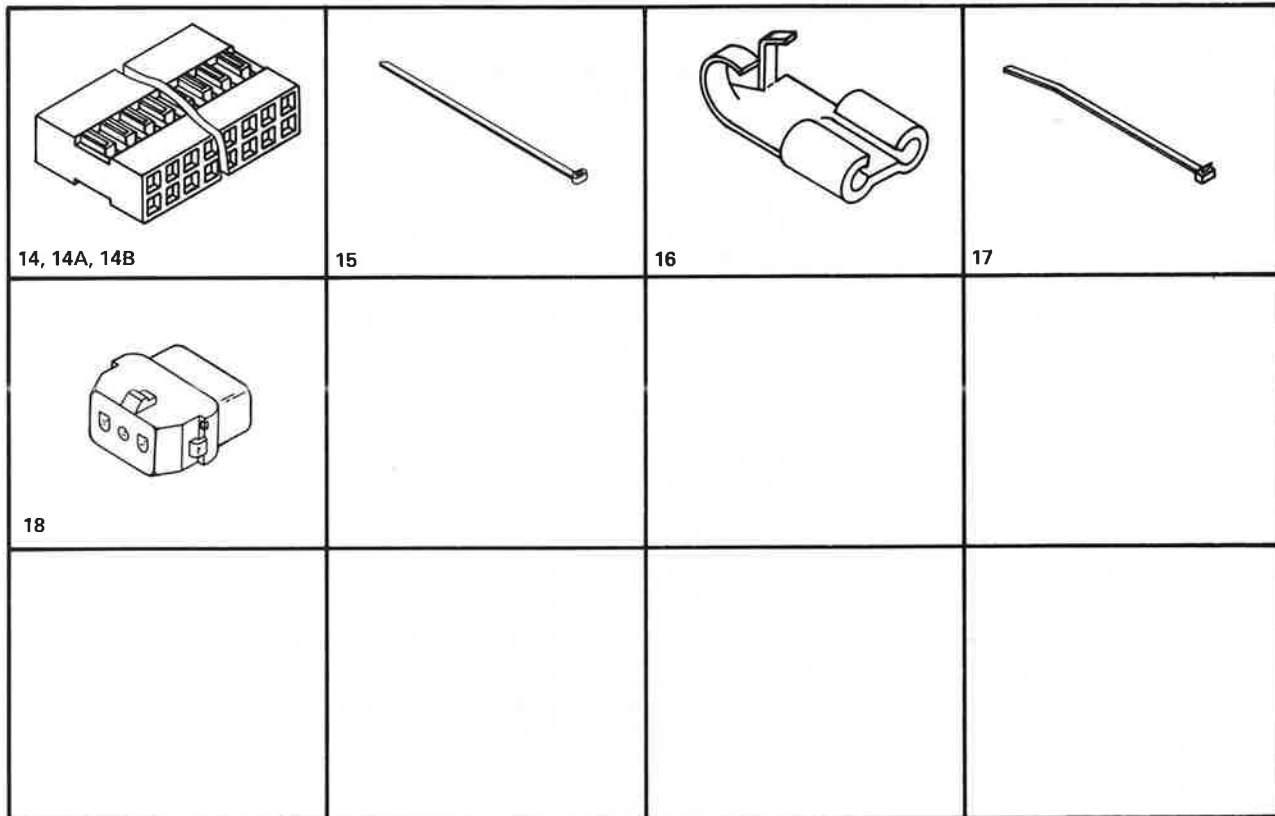


FIGURE 13. CABLE ASSEMBLIES WITH COMPONENT PARTS. SEE LIST 13.

FIGURE- INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION			
			1	2	3	4
13 - 14	2731844	AR	.	HOUSING, LEFT POLARIZED- 2 X 8		
- 14A	2731845	AR	.	HOUSING ASM, POLARIZED		
- 14B	8324648	AR	.	HOUSING		
- 15	5420242	AR	.	TIE, CABLE		
- 16	5761553	AR	.	TERMINAL, SIE-CN- 12-14 AWG		
- 17	6846793	AR	.	TIE, CABLE		
- 18	1847527	AR	.	CONNECTOR, 3 PCS		



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35229	6 - 22		11 - 21	4240512	4 - 4		13 - 1
	7 - 18		12 - 21		4A- 4	5759615	13 - 1
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111256	10 - 3	1622316	3 - 3	4240574	6 - 18		11 - 22
	11 - 3		3 - 9	4240576	6 - 18		12 - 22
	12 - 3		3 - 17	4240580	6 - 10	6837718	1 - 13
111264	1 - 31	1622346	1 - 30	4240582	6 - 13	6837729	10 - 23
186961	13 - 2		8 - 5	4240583	6 - 13		11 - 23
236915	13 - 3	1622401	3 - 4	4240584	7 - 5		12 - 23
334921	13 - 2A		3 - 10	4240585	4A- 12	6837731	1 - 20
360370	13 - 2B		3 - 18	4240586	4A- 11	6837732	1 - 20
473442	2 - 36	1622402	4 - 8	4240589	6 - 8	6837737	13 - 1
483677	13 - 2B		4A- 8	4240592	6 - 3	6837742	4 - 5
483678	13 - 2C		6 - 5	4240593	5 - 1		4A- 5
483681	13 - 2D	1622403	8 - 9	4240594	5 - 13		13 - 1
483683	13 - 2F	1622541	10 - 12	4240596	5 - 10	6837744	13 - 1
511063	10 - 2		11 - 11	4240599	5 - 12	6838213	1 - 26
	11 - 2		12 - 11	4240600	5 - 7		8 - REF
	12 - 2	1643374	9 - 1	4240601	5 - 9	6838217	8 - 1
512137	10 - 6	1643377	9 - 1	4240604	7 - 7	6838218	2 - 19
517913	13 - 4	1643380	9 - 1	4240605	7 - 7	6838219	2 - 12
523267	13 - 5	1643383	9 - 1	4240610	7 - 8	6838220	1 - 25
526378	7 - 19	1643386	9 - 1	4240614	6 - 7	6838221	1 - 1
749062	10 - 27	1643389	9 - 1	4240615	5 - 3	6838224	2 - 6A
	11 - 27	1643392	9 - 1	4240620	5 - 3	6838225	2 - 5
	12 - 27		5 - 1	4240631	6 - 9	6838229	4A- 6
848865	2 - 16	1643395	9 - 1	4240632	6 - 15	6838234	2 - 11A
1176668	10 - 5	1821987	11 - 6	4240638	7 - 3		13 - 1
	11 - 5		12 - 6	4240642	5 - 16	6838235	1 - 8
	12 - 5	1847523	13 - 7	4240644	6 - 6	6838236	1 - 16
1608441	2 - 20	1847524	13 - 8	4240661	6 - 1	6838237	10 - 8
1608573	13 - 6	1847526	13 - 9	4240662	6 - 1	6838245	13 - 1
1621170	5 - 4	1847527	13 - 18	4240663	6 - 16	6838246	13 - 1
	5 - 8	1847531	13 - 10	4240666	7 - 1	6838247	13 - 1
	5 - 11	1860765	9 - 1	4240667	7 - 1	6838249	10 - 19
1621172	3 - 5	1860768	9 - 1	4240671	7 - 9		11 - 19
	3 - 11	1860771	9 - 1	4240673	7 - 11		12 - 19
1621176	10 - 26	1860774	9 - 1	4240675	7 - 11	6838279	2 - 10
	11 - 26	1860777	9 - 1	4240677	7 - 13		10 - REF
	12 - 26	1860783	9 - 1	4240679	7 - 13	6838280	2 - 10
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1621187	10 - 20	2426474	1 - 13	4412938	10 - 7	6838282	10 - 25
	11 - 20	2451197	1 - 10	4468640	10 - 15		11 - 25
	12 - 20		2 - 9		11 - 14		12 - 25
1621190	1 - 14	2451224	2 - 3		12 - 14	6838288	2 - 8
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1621192	7 - 14		2 - 22	4499218	1 - 26A		11 - 10
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	12 - 17		7 - 2	4499222	10 - 10	6840706	2 - 23
1621310	4 - 3		7 - 17		11 - 9	6840707	2 - 30
	4A- 3	2462686	6 - 19		12 - 9	6840710	2 - 27
1621509	1 - 5		7 - 4	4499223	1 - 18	6841070	10 - 24
1621510	1 - 24	2596291	7 - 20	4499224	1 - 19		11 - 24
	2 - 7	2632773	1 - 22	5130277	10 - 9		12 - 24
	2 - 11	2637682	13 - 11	5130688	8 - 7	6841071	2 - 14
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684172^	2 - 11A						
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6841722	2 - 11A						
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6841724	2 - 11A						
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6842373	1 - 6						
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6843260	4 - 2						
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6843262	1 - 4						
6844682	4A - 9						
6844699	2 - 4						
6844700	8 - 2						
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Appendix B. Tools and test equipment

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Tools and test equipment

Shipping group tools

Retaining clip (part 4240632)

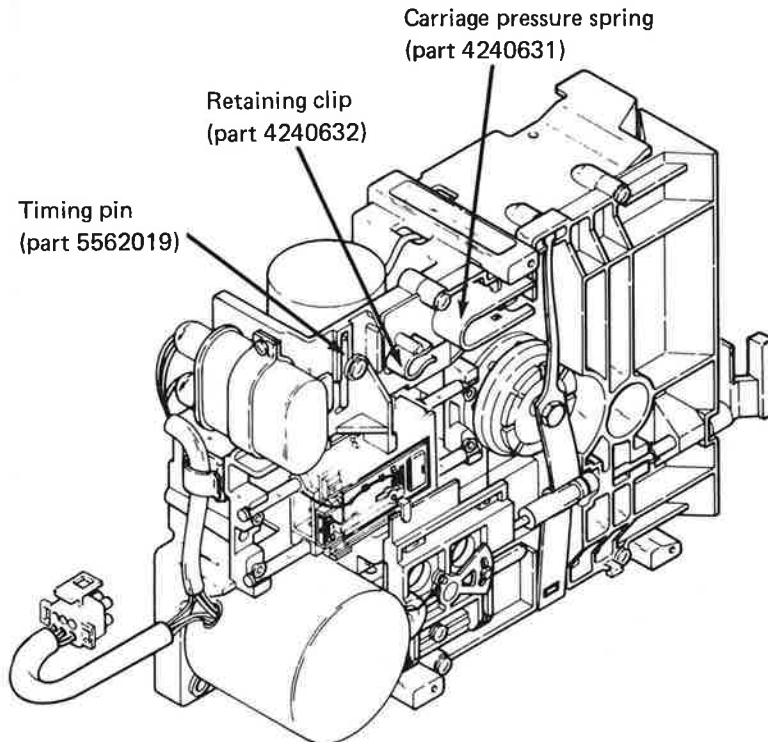
The retaining clip is shipped with the diskette unit and is located on the diskette guide. The clip is used to hold the thickness gauge during head alignment adjustments.

Timing pin (part 5562019)

The timing pin is shipped with the diskette unit and is located on the diskette unit casting. The timing pin is used during head alignment adjustments.

Carriage pressure spring (part 4240631)

The carriage pressure spring is shipped with the diskette unit and is located on the diskette guide. The pressure spring is used during head alignment adjustments.



CE tool kit tools

Display unit adjustment tool (part 460811)

The display unit adjustment tool is a non-metallic fiber screwdriver. It is used to make the display unit adjustments.

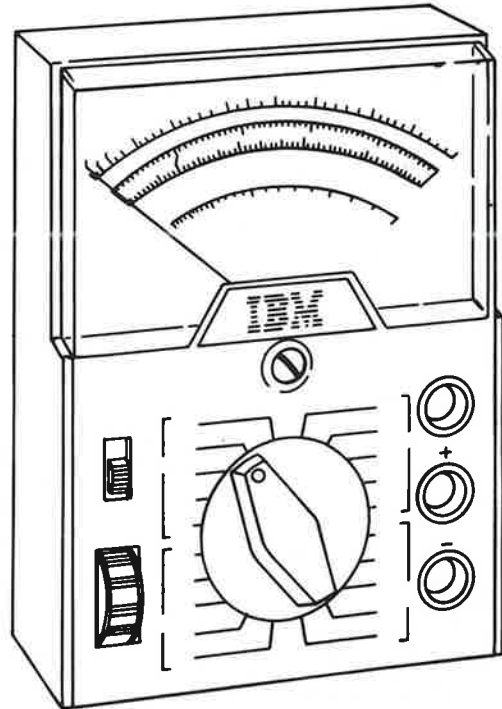


Metric tool supplement (BM 1749235)

The metric tool supplement (not shown) contains the metric tools needed to repair the 5322 computer.

CE meter (part 1749231)

The CE meter is used to measure the ac and dc voltages and to perform continuity checks.



Tools and test equipment

CE tool kit tools (continued)

General logic probe (part 453212)

The general logic probe provides a visual indication of a line level. The probe can also be used to detect pulses and to serve as a babysitter. (Refer to the handbook that comes with the probe.)

The probe UP and DOWN lights will momentarily flash on during power-on if the probe is connected to its machine power source. Ignore these indications.

Indicator lights

UP indicates an up level (+).

DOWN indicates a down level (-).

A pulsing line is indicated by both lights being on.

Both lights are off if the line level is from +1.0 Vdc to +2.0 Vdc for the MULTI logic setting.

Safe operating ranges:

Logic Selector	}	MULTI	+60.0V
		MST 2/4	+14.0V
		MST 1	+14.0V

Voltages greater than the above ranges will damage the probe.

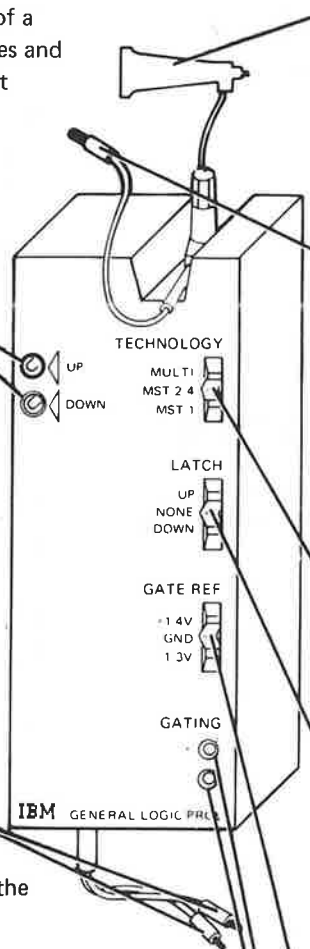
Power leads

CAUTION

Improper connection of the power lead might cause the probe to malfunction.

Connect the probe power leads as follows:

- When probing on the CPU planar board, use the logic probe power pins on the CPU planar board (1230).
- When probing on the diskette drive control card, use the logic probe power pins on the drive control card (1502, 1503).



Test terminal

The line being probed is connected to this terminal. (Various probes may be attached, other than the one shown, to aid in probing.) Do not use a tip longer than 76.2 mm (3 in)

Ground lead

Connect this lead to any signal ground near the probe point. Do not use frame ground.

CAUTION

Improper indications result if this lead is not connected to signal ground. A maximum length of 101.6 mm (4 in) can be used.

Logic selector (TECHNOLOGY)

- MULTI

Selects the type of logic to be probed. Circuits probed in the 5322 require the MULTI setting.

LATCH switch

- NONE

Allows the probe to be used as a babysitter. The up position allows latching the UP light on a positive pulse. The down position allows latching the DOWN light on a negative pulse. The NONE position resets the lights and prevents any latching action.

GATE REF volts switch

- GND

This switch affects only the gating terminals and is not needed to probe the 5322.

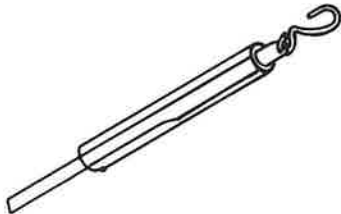
GATING terminals

These terminals are not needed to probe the 5322.

Branch office tools

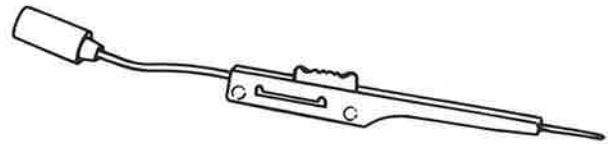
Force gauge (part 460870)

The force gauge is used to make the drive band adjustments in the diskette units.



Miniprobe (part 453718)

The miniprobe is a probe tip that attaches to the test leads of the CE meter and is used to probe connectors.



Glossary

Definitions of abbreviations, acronyms, and words

This glossary defines the abbreviations, acronyms, and words that are used in this service manual and not defined in the *IBM Limited Vocabulary*, ZC28-2510.

Sources of the definitions

The primary source for the definitions is the *IBM Data Processing Glossary*, GC20-1699, which includes definitions from the American National Standards Institute (ANSI) and the International Organization for Standardization (ISO). ANSI definitions are preceded by an asterisk (*) to indicate that the entry is reprinted from the *American National Dictionary for Information Processing*. The symbol "(ISO)" at the beginning of a definition indicates that the definition has been discussed and agreed upon at meetings of the International Organization for Standardization, and has been approved by ANSI for inclusion in the *American National Dictionary for Information Processing*.

If you do not find the term you are looking for, refer to the Index of this service manual or to the *IBM Data Processing Glossary*.

Acknowledgment

This glossary includes definitions developed by the American National Standards Institute (ANSI) and the International Organization for Standardization (ISO). This material is reproduced from the *American National Dictionary for Information Processing*, copyright 1977 by the Computer and Business Equipment Manufacturers Association, copies of which may be purchased from the American National Standards Institute, 1430 Broadway, New York, New York 10018.

Glossary

Definitions of abbreviations, acronyms, and words (continued)

A

A. The logic block symbol for the AND function.

access lines. These lines cause the stepper motor in the diskette drive to turn.

***accumulator.** (ISO) A register in which the result of an operation is formed.

alcohol pad. A pad soaked with isopropyl alcohol.

***alphameric.** Pertaining to a character set that contains letters, digits, and usually other characters, such as punctuation marks.

alternate cylinder. A cylinder on a diskette that can be assigned in place of a primary cylinder that has failed.

alternate track. A track on a diskette that can be assigned in place of a primary track that has failed.

amplifier (AR). An electronic device that produces an increased level of voltage, current, or power.

anode. The electron collecting element of an electron tube or cathode-ray tube.

ANSI. American National Standards Institute.

AR. See *amplifier*.

AR-DIFF. See *differentiator-amplifier*.

ascender. The part of a character or letter that rises above the main body of the character or letter.

Attn. The abbreviation used on the attention key on the 5322 keyboard.

***attribute.** A characteristic of a unit of data such as length, value, or method of presentation.

B

bail assembly. A mechanical arm that operates under control of the head load solenoid to load or release the read/write head load arm.

band. See *drive band*.

BASIC. The acronym for Beginner's All-purpose Symbolic Instruction Code, a standardized language for programming.

baud. See *baud-rate*.

baud-rate. The rate of data transmission speed on a communications circuit (usually equal to one bit-per-second).

bezel. The plastic enclosure around the face of the cathode-ray tube of the display unit.

buffer. A storage unit for storing data during an input/output operation.

***byte.** A sequence of eight adjacent binary digits that are operated upon as a unit and that constitute the smallest addressable unit in the system.

C

carriage. The part that carries the read/write head and is controlled by the stepper motor drive.

cathode. The electron emitting element of an electron tube or cathode-ray tube.

cathode-ray tube (CRT). An electronic vacuum tube, such as a television picture tube, that can be used to display graphic images.

***central processing unit (CPU).** (ISO) A unit of a computer that includes circuits controlling the interpretation and execution of instructions.

channel. A data path that connects the processing unit, storage, and input/output

devices.

characteristics. Statements about the electrical, physical, or functional features of a machine that are not specifications.

clamp. A part used to lock another part.

clamped. Held tightly.

Cmd. The abbreviation used on the command key on the 5322 keyboard.

collet. The part of the diskette drive that centers and holds the diskette to the drive hub.

***computer.** (ISO) A data processor that can perform substantial computation, including numerous arithmetic or logic operations, without intervention by a human operator during the run.

CPU. See *central processing unit*.

CRC. See *cyclic redundancy check*.

crosstalk. Data bits sensed from one diskette track while the read/write head is reading from another track.

CRT. See *cathode-ray tube*.

cyclic redundancy check (CRC). In the 5322 computer, a method of checking for errors in read-only storage (ROS) by accumulating a check character as the ROS module is read and then comparing that check character to a CRC count character that is contained in the ROS module.

D

data bus in (DBI). The data path used to move information from storage and input/output devices to the processing unit.

data bus out (DBO). The data path used to move information from the processing unit to storage and input/output devices.

DBI. See *data bus in*.

DBO. See *data bus out*.

DCP. See *diagnostic control program*.

decoder. In the 5322, the circuit (instruction decoder) that translates the programmed instruction into the function to be performed by the processing unit.

descender. The part of a character or letter that is below the main body of the character or letter.

DET. See *detector*.

detector (DET). An electronic device that is used to recognize valid data in an electronic circuit.

diagnostic control program (DCP). In the 5322, the control program that permits program selection and loading, message displays, keyboard input, and interrupt processing for the CE diskette-resident diagnostics.

differentiator-amplifier (AR-DIFF). An electronic device whose output signal is a function of the time rate of change of the input signal.

direct memory access (DMA). In the 5322, a method of moving blocks of data, under control of the DMA controller and without processing unit intervention, between storage and the CRT display and diskette drive attachments.

diskette 1. A diskette used for storing data on only one surface.

diskette 2. A diskette used for storing data on both surfaces.

diskette 2D. A diskette used for storing data on both surfaces with twice the bit density used on a diskette 2.

DMA. See *direct memory access*.

DR. See *driver*.

Glossary

Definitions of abbreviations, acronyms, and words (continued)

drive band. A metal band connected to the stepper motor pulley and the head/carriage assembly.

drive hub. A continuously running part that turns the diskette at 360 rpm.

driver (DR). An electronic circuit that converts a low level logic voltage to the level needed to operate a stepper motor or a solenoid.

E

EC. See *engineering change*.

engineering change (EC). An IBM supplied alteration in the design or operation of a device or a program.

eyelet. A small diameter ring at the end of a cable that makes it possible for the cable to be connected to a fixed bolt.

F

fan enclosure. The safety cover that is installed on the diskette drive ac motor cooling fan.

fault locating test (FLT). In the System/23, a diagnostic program used to determine system failure conditions. FLT's are used with the MAPs and service manual procedures to determine, isolate, and solve system problems.

ferroresonant. Pertaining to a type or power supply used in the 5322 computer. The ferroresonant power supply contains an input transformer with a resonant primary winding that aids in voltage/current regulation.

field replaceable unit (FRU). An assembly that is replaced in its entirety when any one of its components fails.

FLT. See *fault locating test*.

FM. The abbreviation for frequency modulation. See *modulation*.

FRU. See *field replaceable unit*.

G

gain. In an amplifier, pertains to the ratio of increase of output over input.

GBG/I. See *General Business Group/International*.

General Business Group/International (GBG/I). A division of IBM's General Business Group that has responsibility for marketing, servicing, manufacturing, and overall performance responsibility for General Systems and Office Product operations in Europe, the Americas, and the Far East. In this service manual, GBG/I indicates machines built for sale and use outside of Canada and the U.S.A..

general logic probe (GLP). A CE tool used during maintenance activity to verify the presence or absence of logic signals in the System/23.

GLP. See *general logic probe*.

H

head/carriage. The unit that contains the read/write head.

hex. See *hexadecimal*.

hexadecimal. Pertaining to a number system with a base of 16.

highlight. To increase the brightness of a displayed image on the CRT display screen.

hub. See *drive hub*.

I

ID. See *identifier*.

***identifier (ID).** (ISO) A character or group of characters used to identify or name an item of data and possibly used to indicate certain properties of that data.

implode. To burst inward.

in. The abbreviation for inch. One inch equals 25.4 mm.

***input/output (I/O).** (ISO) Pertaining to a device or to a channel that may be involved in an input process, and at a different time, in an output process.

INTA. Used as the abbreviation for the interrupt acknowledge signal in the 5322 computer.

interpreter. In the 5322, a microprogram stored in read-only storage that controls the operation of the BASIC instructions.

***interrupt.** To stop a process in such a way that it can be resumed.

inverter (N). An electronic circuit that inverts a signal (+ to -, or - to +).

I/O. See *input/output*.

isopropyl alcohol. A fluid that can be used to clean some machine parts.

J

jacket. The permanently attached cover that protects the diskette surface.

K

K-bytes. 1,024 bytes; used in referring to storage capacity.

L

LED. See *light emitting diode*.

light emitting diode (LED). A device that emits light for detection purposes.

linearity. In the 5322 display unit adjustment procedures, refers to the equal spacing and size of the characters and images displayed on the CRT display screen.

loop. Within a program, a group or set of instructions that are executed repeatedly.

M

MAPs. The abbreviation for maintenance analysis procedures.

mask. A binary bit pattern that is used to control the selection or exclusion of specific data bits.

Mb. See *megabyte*.

megabyte (Mb). 1,048,576 bytes; used in referring to storage capacity.

memory. Used to indicate storage, as in direct memory access.

MFM. The abbreviation for modified frequency modulation. See *modulation*.

microinstruction. An instruction within a microprogram. See *microprogram*.

microprocessor (MPU). A processing unit, with microcode, contained on an integrated circuit chip.

microprogram. In the 5322, refers to the programs used to control the operation of the central processing unit.

miniprobe. A probe tip that attaches to a test lead of the CE meter and is used to probe connectors.

mm. The abbreviation for millimeter.

modulation. In the diskette drive, the process of changing the amplitude and frequency of the read and write signals.

Glossary

Definitions of abbreviations, acronyms, and words (continued)

millivolt (mV). Equal to 0.001 volt.

MPU. See *microprocessor*.

mV. See *millivolt*.

N

N. See *inverter*.

O

option. A selection choice, such as to select an option in a diagnostic program.

oscillator. An electronic circuit that generates alternating current.

overcurrent. A flow of electrical current that exceeds the normal rated flow for a device.

overvoltage. A level of voltage that exceeds the normal rated level for a device.

P

page register. In the 5322, a register used to extend the addressing capacity of the computer.

phototransistor (PTX). An electronic device used to sense the light from a light-emitting diode (LED).

PID. See *program identification*.

planar board. In the 5322, the primary printed-circuit board that contains the logic for the processing unit, the display attachment, and the keyboard attachment. Also contains the ROS control programs for the above devices and the diskette attachment.

PN. The abbreviation for part number.

port. An access point (for example, printer port) for data entry and exit to which an

input/output device can be attached.

preamp. The abbreviation for preamplifier. See *preamplifier*.

preamplifier (preamp). An electronic circuit that, by enabling a received signal to control a source of power, can supply a larger copy of the necessary characteristics of the signal. Usually, a preamp is followed in the circuit by an amplifier.

processor. The processing unit of the 5322.

program identification (PID). The identifying number or name assigned to a program.

program temporary fix (PTF). A temporary solution or by-pass of a problem diagnosed by IBM field engineering as a result of a defect in a current, unaltered release of the program.

PTF. See *program temporary fix*.

PTX. See *phototransistor*.

R

raster. The rectangular pattern on the screen of a cathode-ray tube caused by the scanning of the video beam. On the display screen of the 5322, the raster is normally visible only when the operator's brightness control is in the full clockwise position.

read-only storage (ROS). Storage from which data can only be read, but not written.

read/write. In the diskette drive, pertains to reading data from and writing data to a diskette.

read/write storage. Storage where data can be written to and read from.

recess. In the diskette drive, the groove in the fan enclosure that permits the ac motor drive belt to turn without rubbing against the fan enclosure.

register. (ISO) A storage device, having a specified storage capacity such as a bit, a byte, or a computer word, and usually intended for a special purpose.

replace. In this service manual, pertains to removing a failing part and installing a new part.

ROS. See *read-only storage*.

R/W. The abbreviation for read/write.

R/W storage. See *read/write storage*.

S

scan code. In the 5322, the scan code is the 7-bit character that encodes the characters from the keyboard.

SM. The abbreviation used for service manual in the System/23 service library.

solenoid plunger. In the diskette drive, the moving part of the solenoid that operates the bail assembly to load or release the read/write head load arm.

spindle. The shaft in the diskette drive that engages the diskette and causes it to rotate.

T

stepper motor. In the diskette drive, the incremental motor that moves the head/carriage assembly from track to track.

translator. In the 5322, the program that translates the BASIC language instructions into machine operations.

TSR. The abbreviation used for transistor-switching-regulator power supply.

tunnel erase. The process used to erase the data along the edge of a diskette track during a write operation. This erasing prevents crosstalk between tracks during later read operations.

typamatic. A type of key on the 5322 keyboard that causes its input character to be input repeatedly as long as the key is pressed.

V

Vac. The abbreviation for volts of alternating current.

variable frequency oscillator (VFO). An electronic circuit used to synchronize the diskette drive reading circuits when the diskette drive is performing a read operation.

Vdc. The abbreviation for volts of direct current.

VFO. See *variable frequency oscillator*.

video. Pertaining to the visual images on the screen of the cathode-ray tube.

volume table of contents (VTOC). A table of contents that is written on a diskette to describe each data set stored on the diskette.

VTOC. See *volume table of contents*.

W

welded. Connected together using heat (as in metal parts).

write/erase. Pertains to the writing of data to a diskette and erasing data from a diskette.

Y

yoke. Pertains to the assembly on a cathode-ray tube (CRT) that contains the horizontal and vertical deflection coils. The position of the yoke affects the size and alignment of the image on the screen of the CRT.

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