SY34-0243-0

IBM

IBM 5247 Disk Unit Service Manual

IBM System/23 Service Library

Volume 6

SY34-0243-0

IBM

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Chapter 1. Using the IBM System/23 Service Library

IBM System/23 Service Library

Volume 6

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Preface

This service manual, which is Volume 6 of the *IBM System/23 Service Library*, is intended to be used for servicing the IBM 5247 Disk Unit. Service personnel using this manual are assumed to have completed the 5247 Disk Unit training course.

This manual contains the maintenance procedures, theory of operation, and parts catalog for the 5247 Disk Unit.

First Edition (April 1982)

Contents

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

Chapter 1. Using the IBM System/23 Service Library

Instructions

For instructions on how to use the complete service library, see "Chapter 1. Using the IBM System/23 Service Library," in Volume 1.

Using this service manual

When a step in a procedure is fully explained by another procedure, that procedure is referenced using the procedure number within parentheses. For example:

2. Remove the front cover (6100).

In this example, the front cover removal is fully explained in the procedure "6100 Front cover."

Chapter 2. Maintenance procedures

Contents

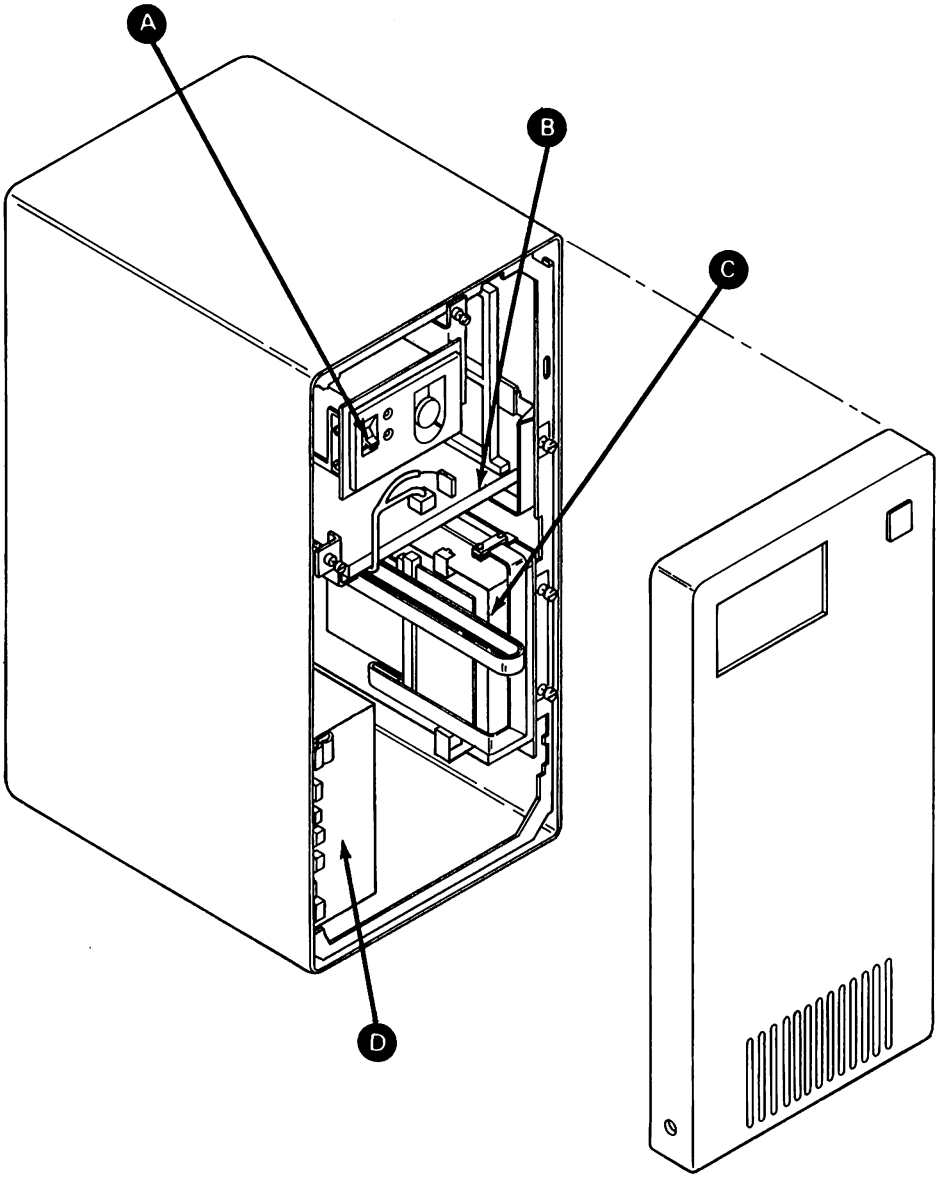
Maintenance procedures

Contents (continued)

6001 Locations

Front view

(A) Switch box
(B) Logic tray
(C) Direct access storage device (DASD)
(D) Power supply

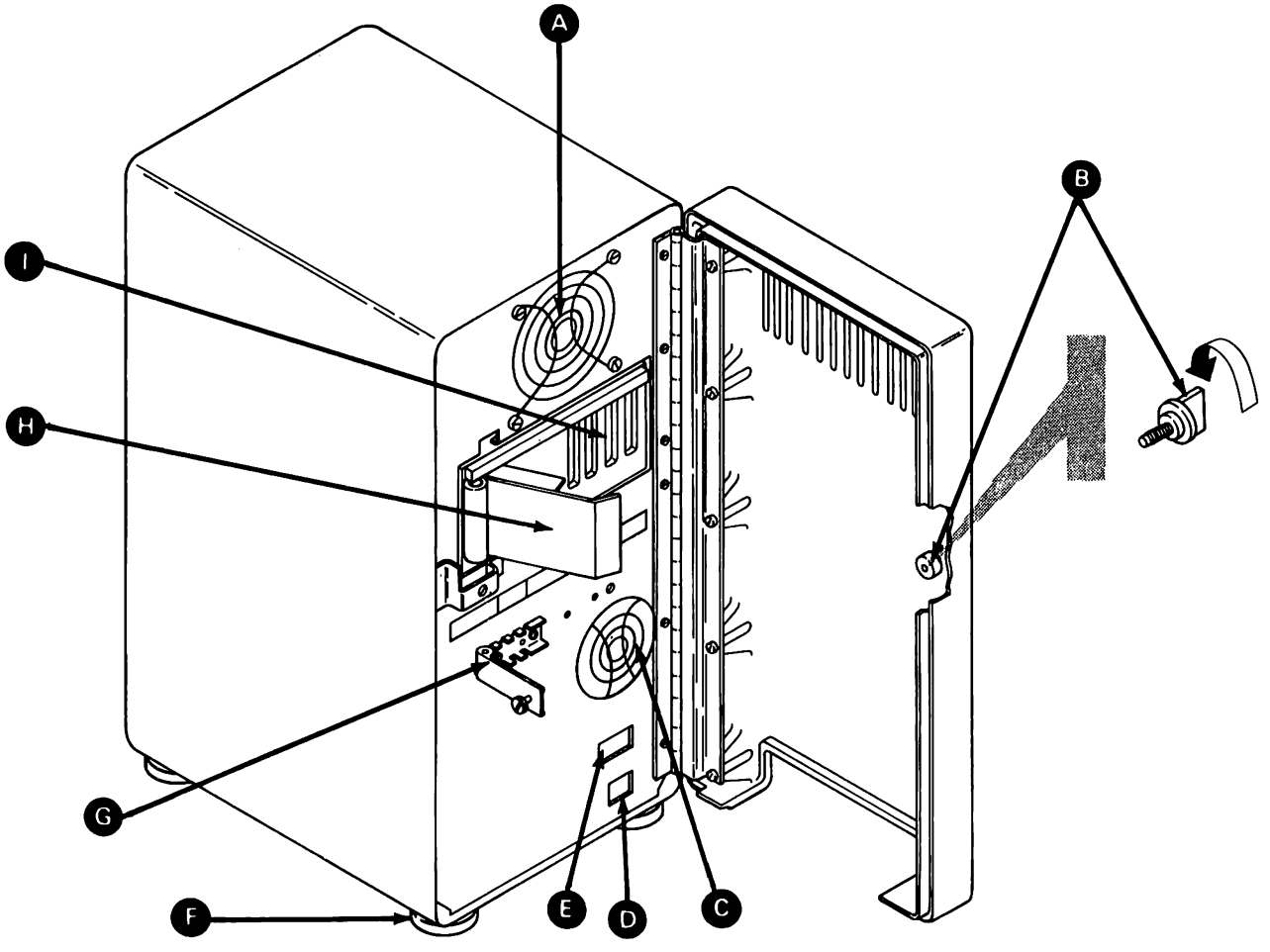


Maintenance procedures

6001 Locations

Rear view

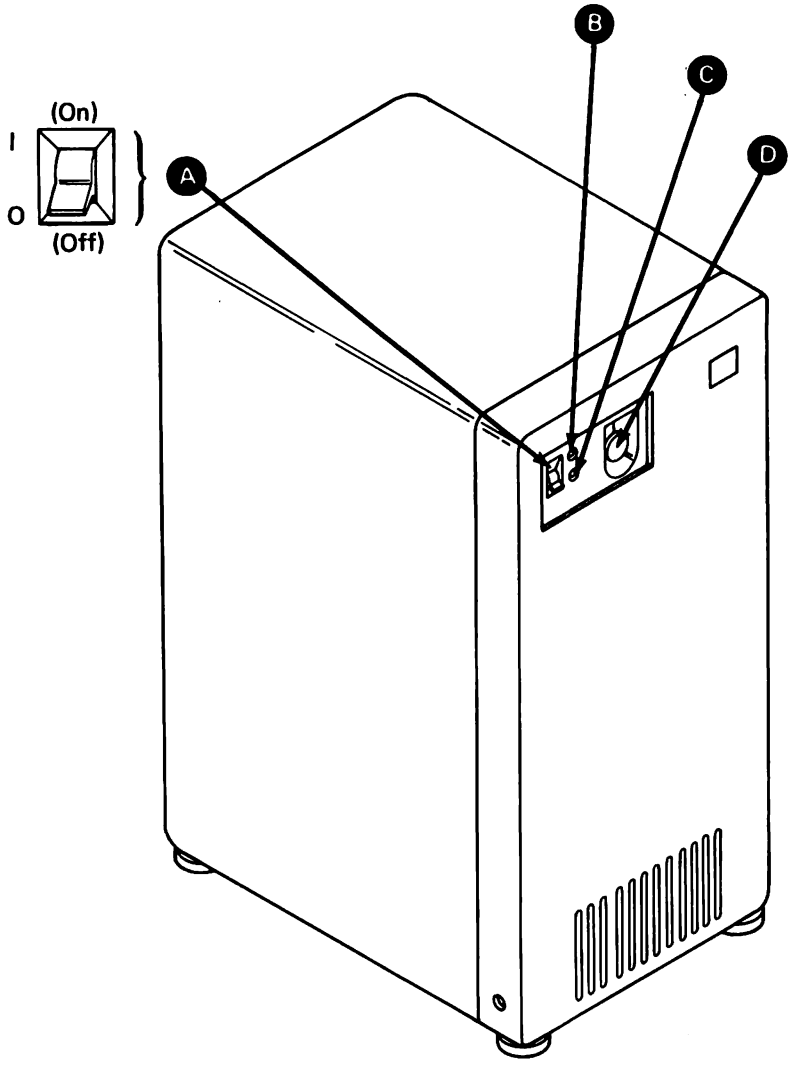
- A Logic fan
- B Back cover knob
- C Power supply fan
- D AC line cable receptacle
- E AC line circuit breaker
- F Enclosure leveler (1 of 4)
- G Cable ground clamp
- H Cable retainer
- I Customer access panel



6002 Locations

Operator switches and indicators

- A Power switch
- B Ready indicator
- C Power indicator
- D Emergency Pull switch (emergency power off, EPO)

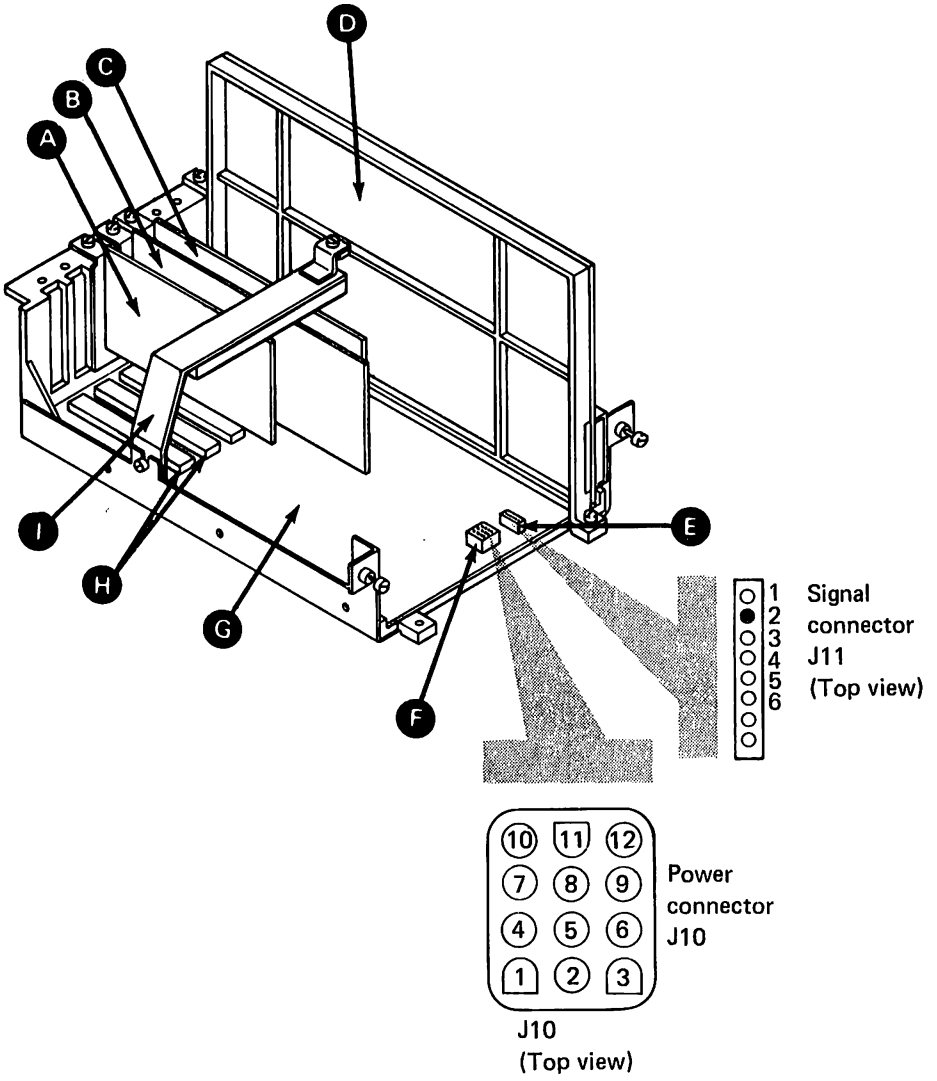


Maintenance procedures

6003 Locations

Logic tray

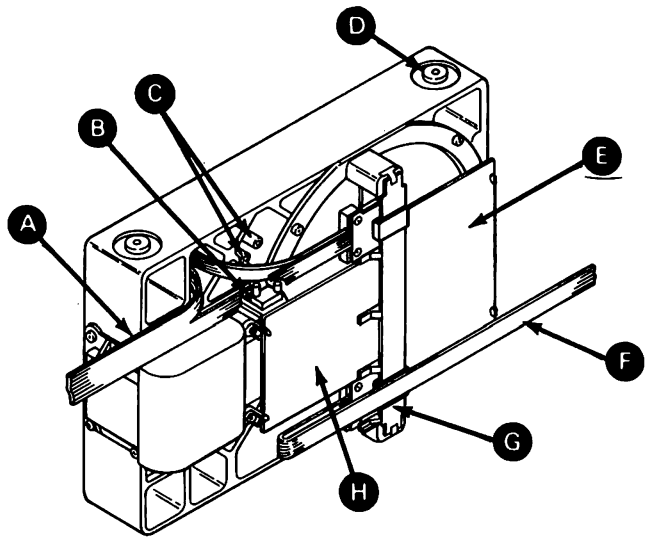
- A Serial interface adapter (SIA) expander card (01A A1 A5)
- B Serial interface adapter (SIA) base card (01A A1 A4)
- C Read/write storage card (01A A1 A3)
- D Disk attachment card (01A A1 A9)
- E Signal connector J11
- F Power connector J10
- G Base planar board (01A A1 A8)
- H I/O expansion connectors
- I Card retainer bracket



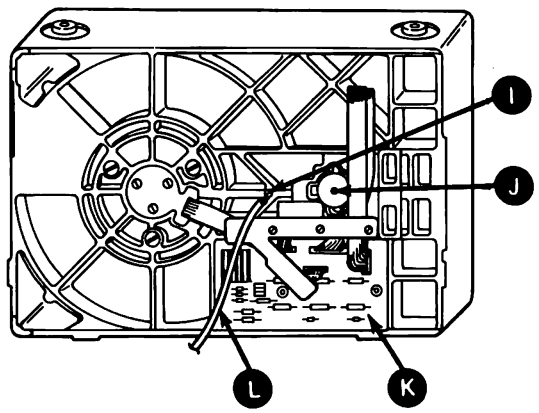
6004 Locations

Direct access storage device (DASD) (Version A1 and Version A2)

- A DASD dc power cable
- B Head flex cable
- C Head flex cable stowing holes
- D Shock mounts (1 of 4)
- E Digital card (01B A1 A2)
- F DASD signal cable
- G Maple connector block
- H Analog card (01B B1 A3)
- I Ground point
- J Head-lock solenoid
- K Motor/actuator card (01B C1 A1)
- L Ground cable



Front view

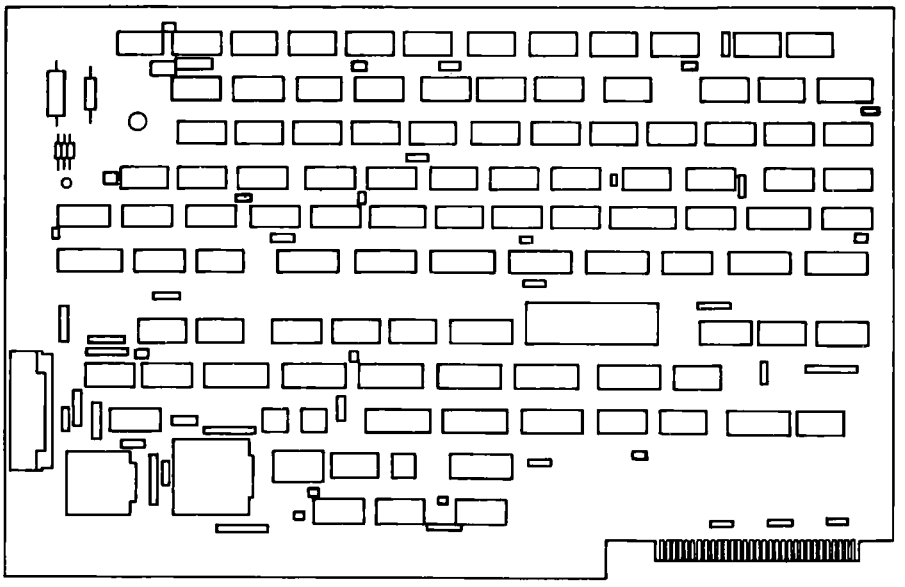


Rear view

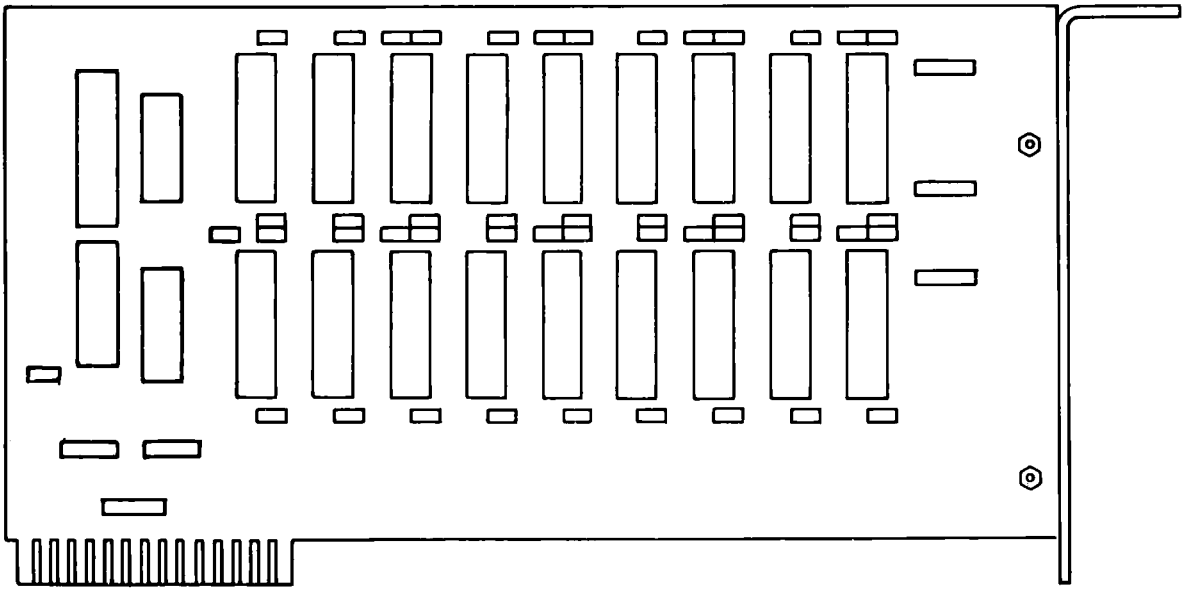
Maintenance procedures

6005 Locations--card diagrams

Disk attachment card (01A A1 A9)

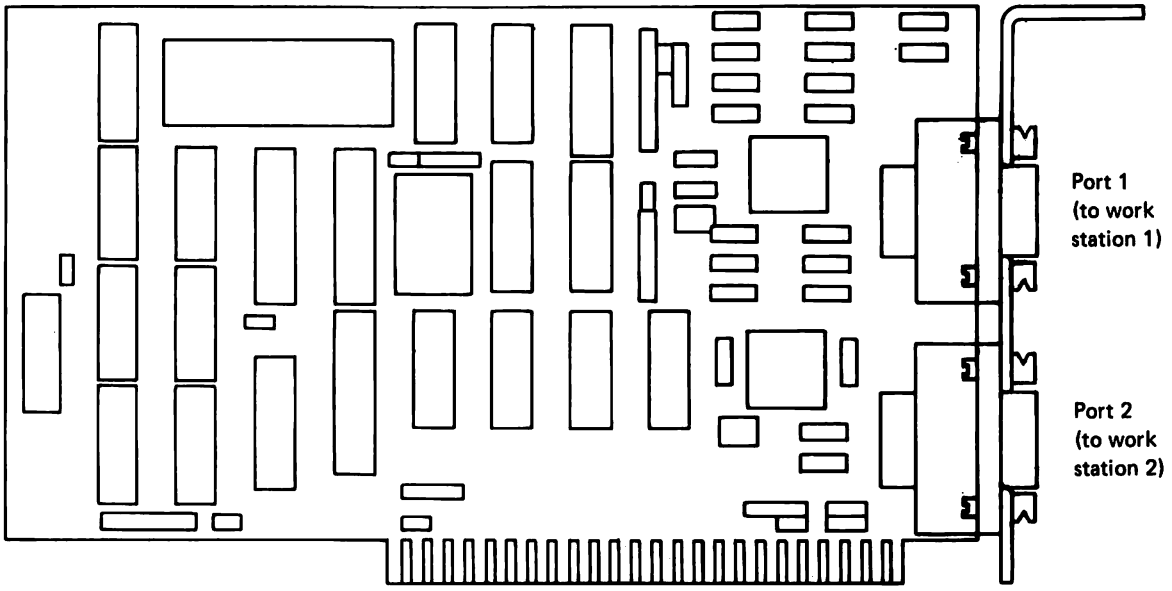


Read/write storage card (01A A1 A3)

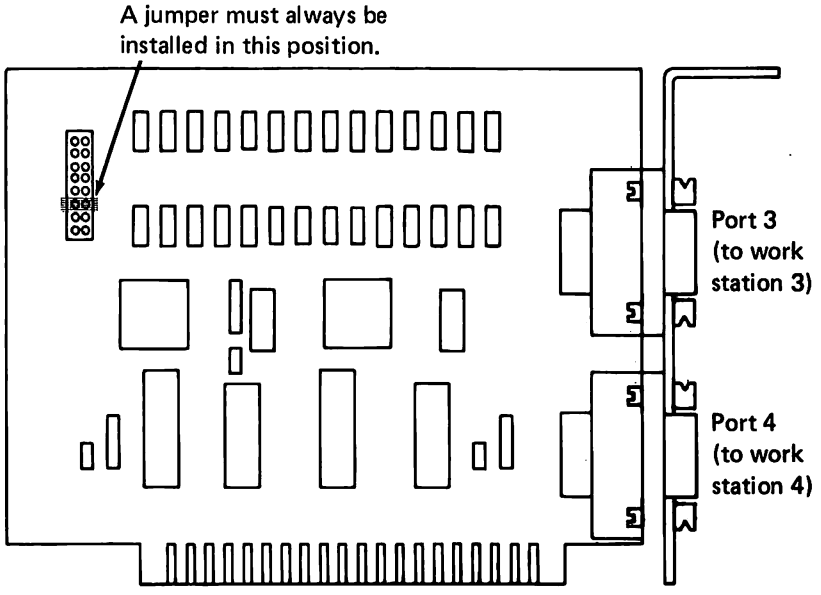


Note: The outline shapes of the card diagrams identify each card in the 5247. The exact location of the components and the number of components shown on each card may differ for your system.

SIA base card (01A A1 A4)

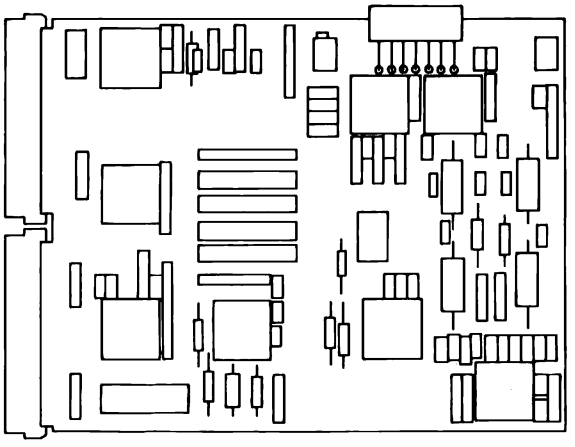


SIA expander card (01A A1 A5)

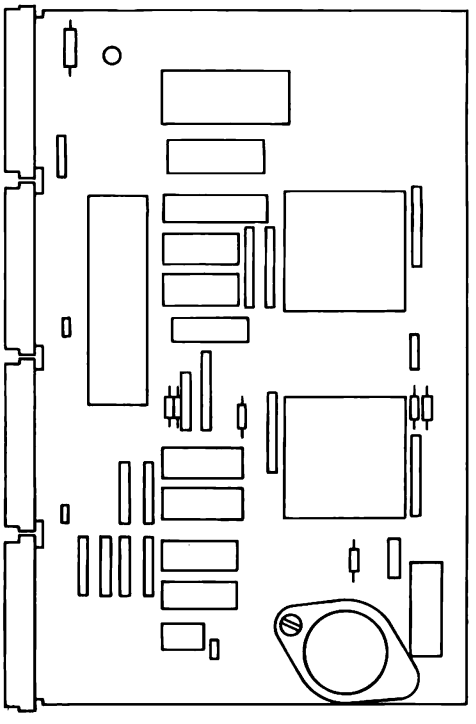


6005 Locations--card diagrams (continued)

Analog card (01B B1 A3)

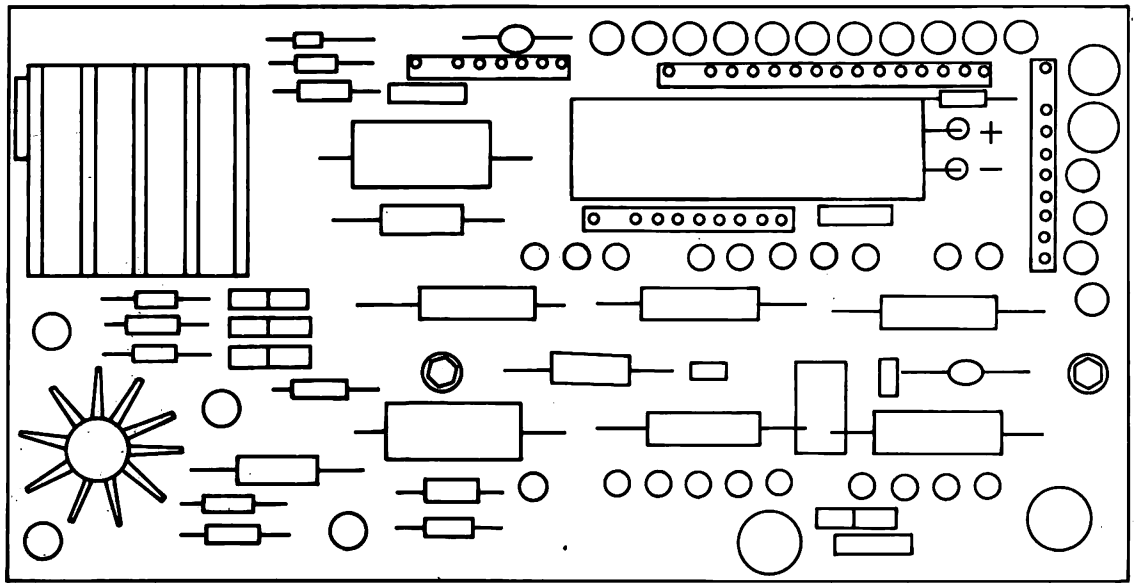


Digital card (01B A1 A2)



Note: The outline shapes of the card diagrams identify each card in the 5247. The exact location of the components and the number of components shown on each card may differ for your system.

Motor/actuator card (01B C1 A1)

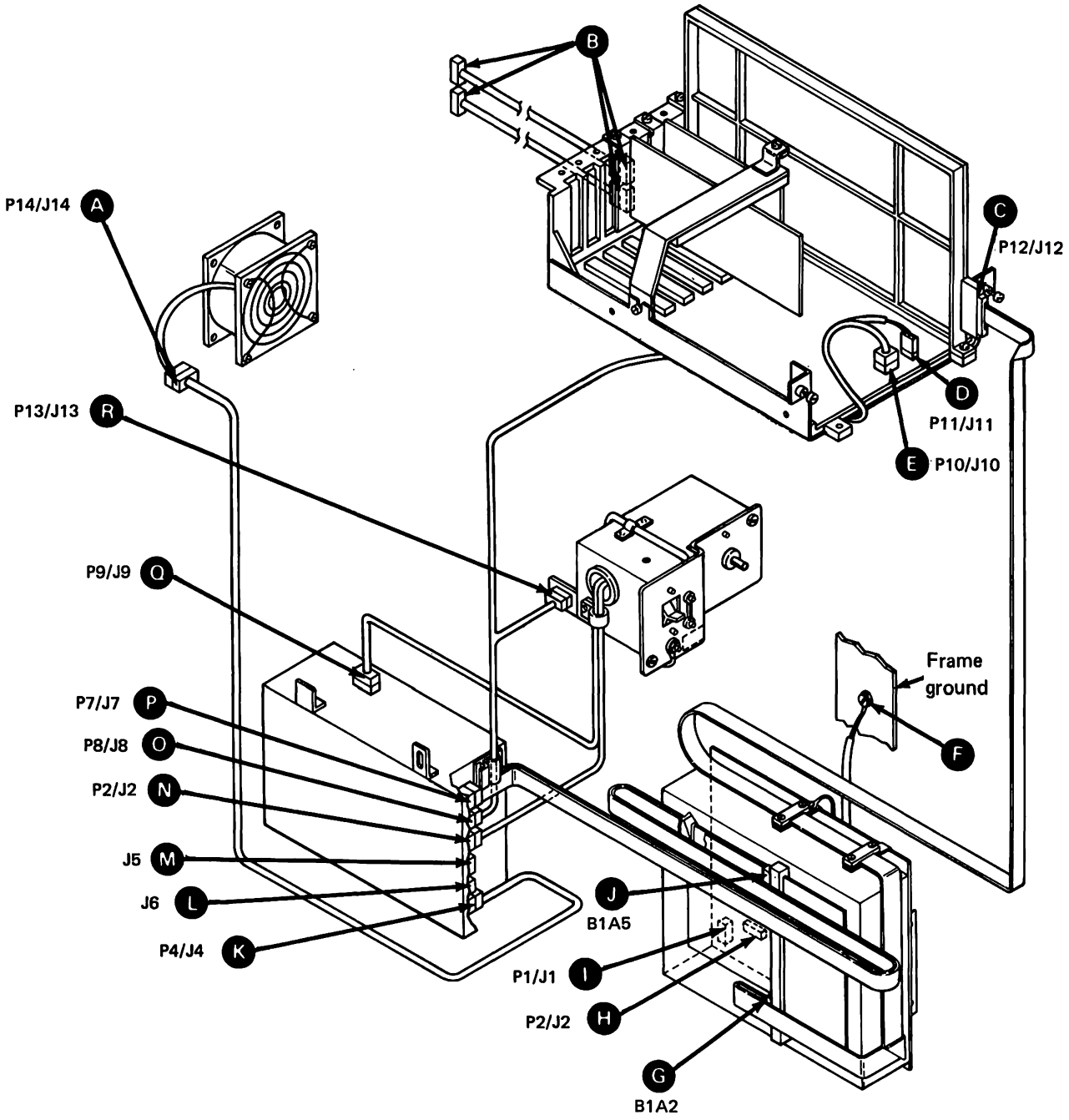


Maintenance procedures

6006 Locations

Cables and connectors

- (A) Fan cable connector P14/J14
- (B) Work station cable connectors
- (C) DASD cable connector P12/J12
- (D) Switch box and planar board dc power cable connectors P11/J11
- (E) Switch box and planar board dc power cable connector P10/J10
- (F) DASD grounding point
- (G) DASD signal cable connector B1A2
- (H) DASD dc power cable connector P2/J2
- (I) DASD dc power cable connector P1/J1
- (J) DASD dc power cable connector B1A5
- (K) Fan cable connector P4/J4
- (L) AC line voltage selection (200 - 240 Vac) connector J6
- (M) AC line voltage selection (100 - 137 Vac) connector J5
- (N) Switch box ac power cable connector P2/J2
- (O) Switch box and planar board dc power cable P8/J8
- (P) DASD dc power cable connector P7/J7
- (Q) EPO switch ac power cable P9/J9
- (R) Switch box and planar board dc power cable connector P13/J13

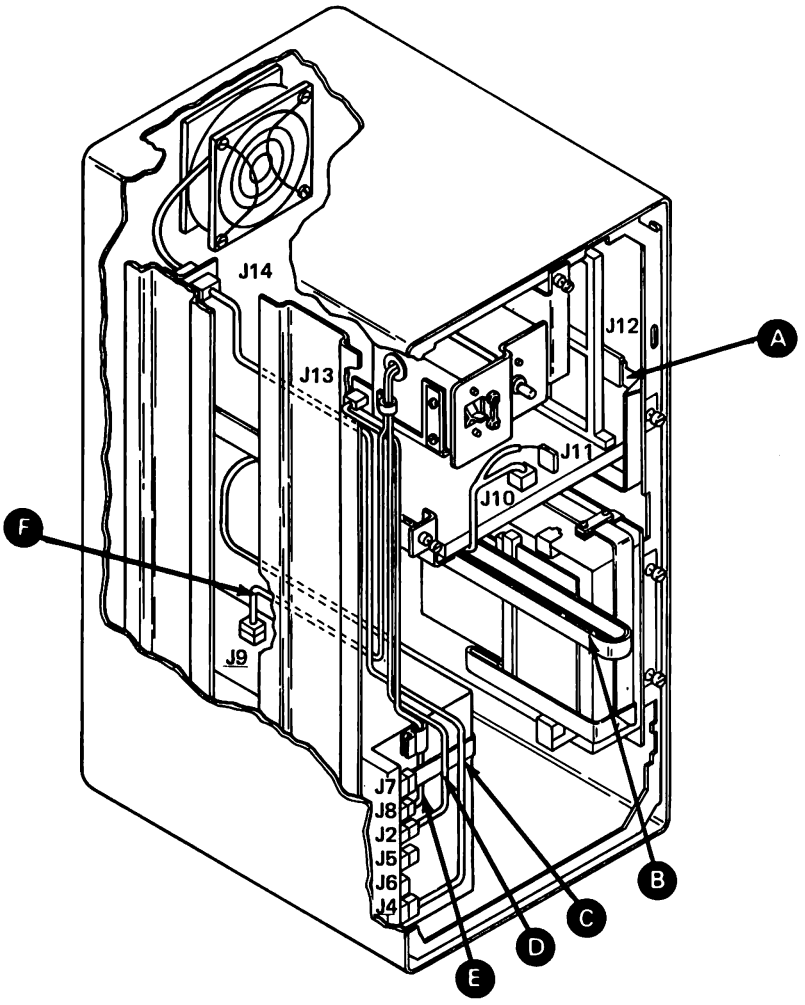

B
P14/J14
A
C
P12/J12
P13/J13
R
D
P11/J11
E
P10/J10
P9/J9
Q
Frame ground
P7/J7
P
F
P8/J8
O
P2/J2
N
J5
M
J6
L
J
B1A5
P4/J4
K
P1/J1
I
P2/J2
H
G
B1A2

Maintenance procedures

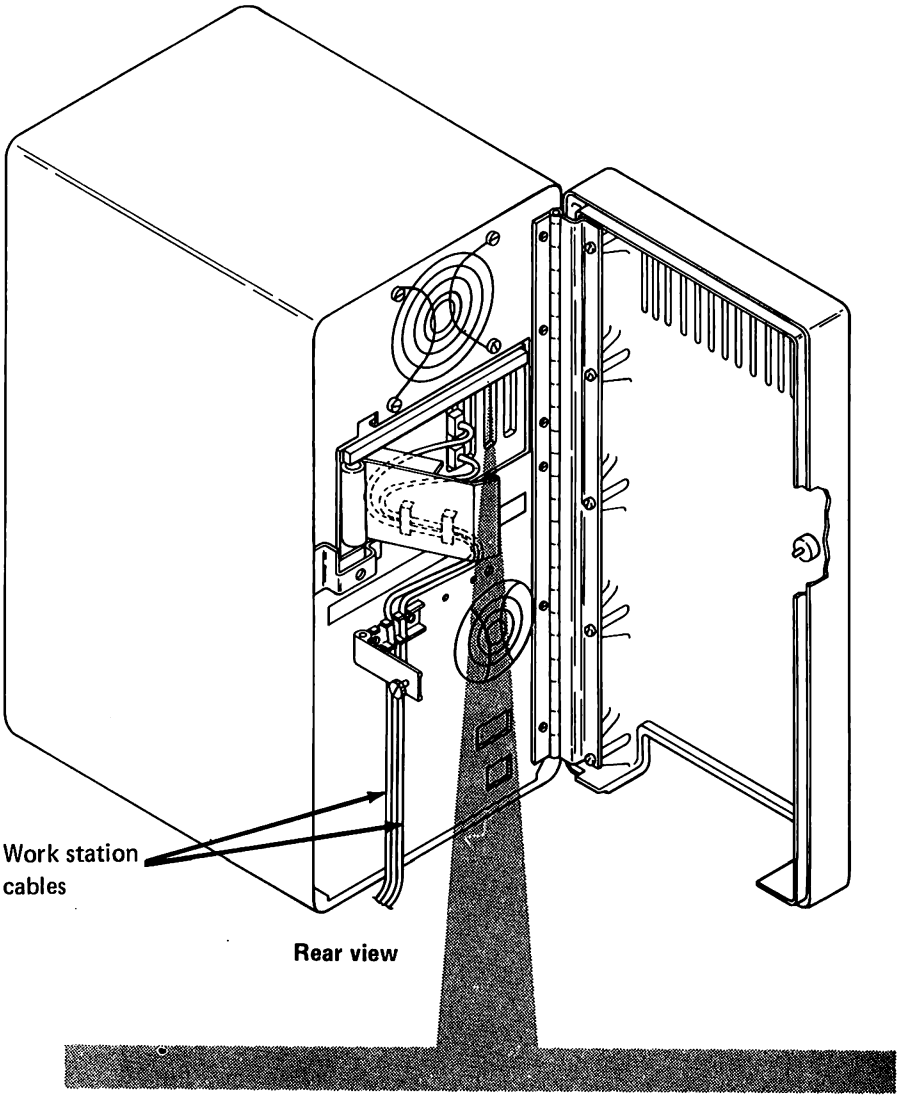
6007 Locations

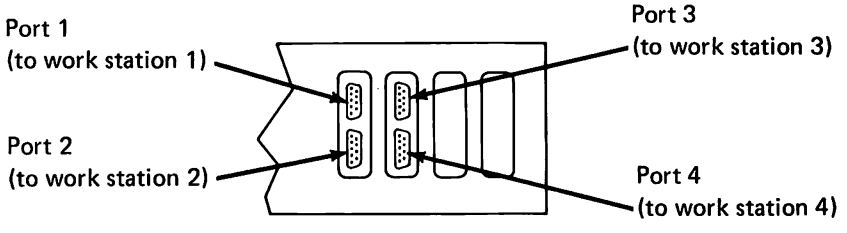
Cable routing

- A DASD signal cable
- B DASD dc power cable
- C Fan cable
- D Switch box ac power cable
- E Switch box and planar board dc power cable
- F EPO switch ac power cable



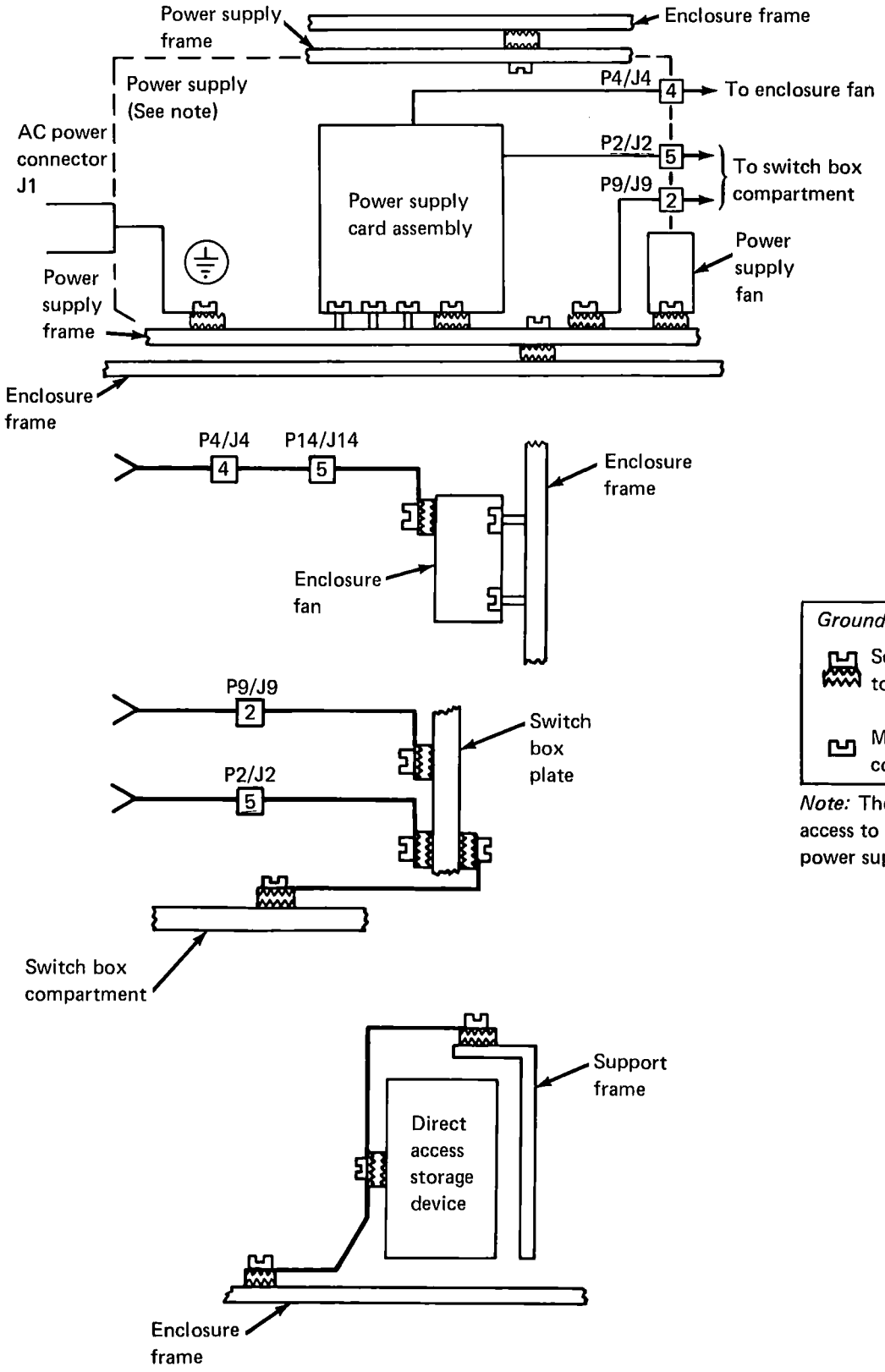
Front view


Work station cables
Rear view


Port 1
(to work station 1)
Port 2
(to work station 2)
Port 3
(to work station 3)
Port 4
(to work station 4)

Maintenance procedures

6010 AC safety ground locations



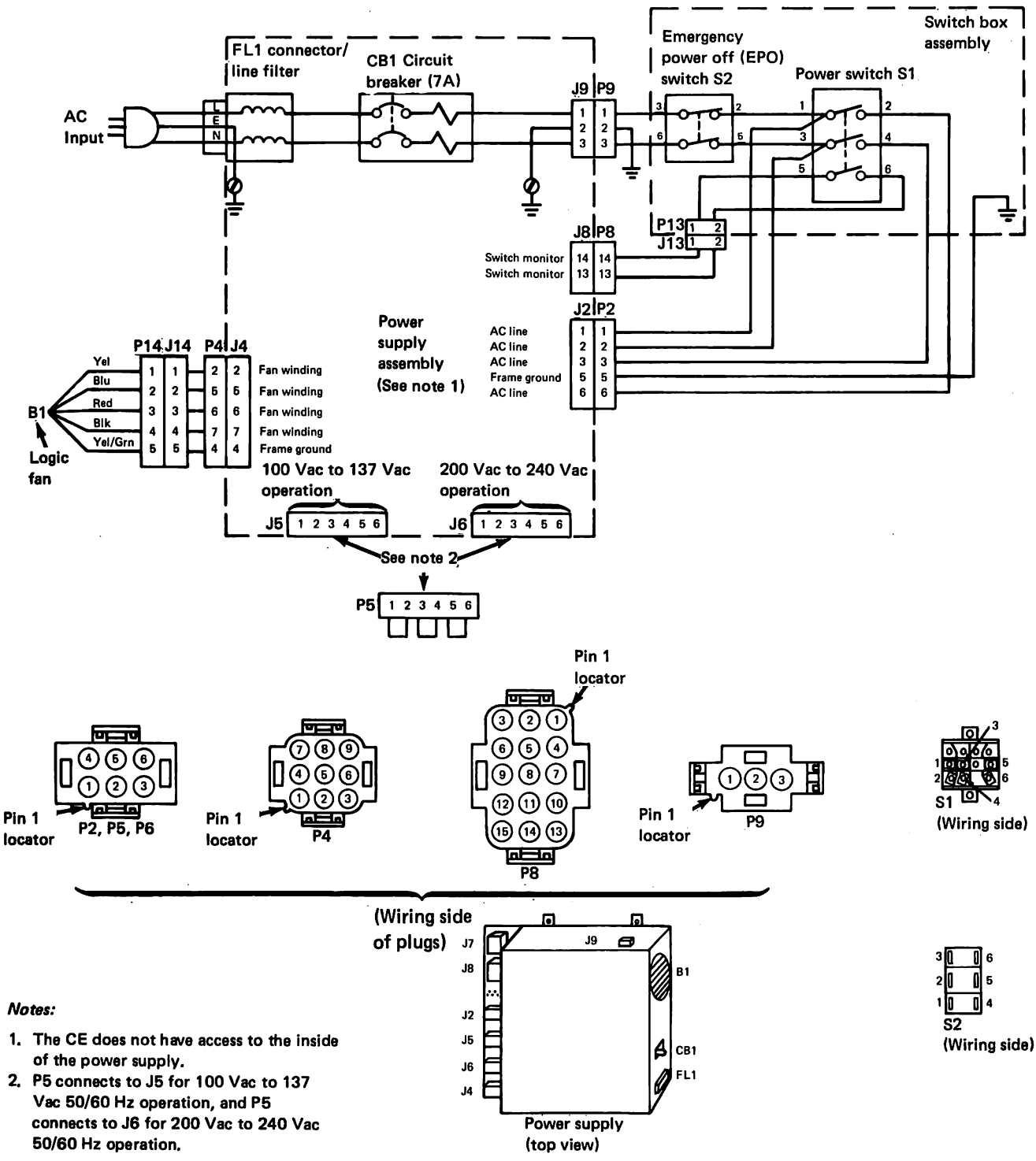
Grounding symbols

Screw and external-tooth starwasher

Metal-to-metal contact via screw

Note: The CE does not have access to the inside of the power supply.

6020 AC voltage distribution diagram

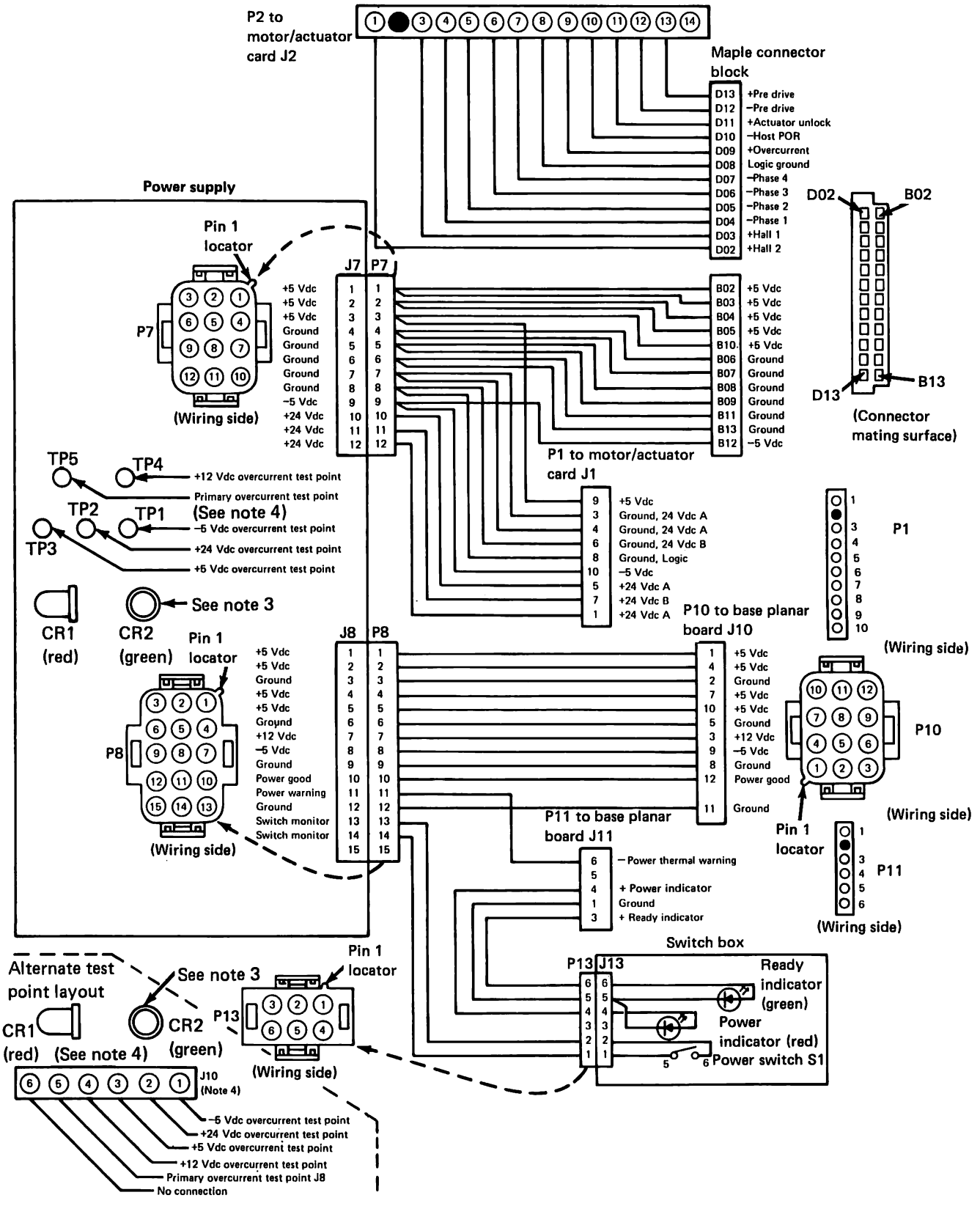


Notes:

1. The CE does not have access to the inside of the power supply.
2. P5 connects to J5 for 100 Vac to 137 Vac 50/60 Hz operation, and P5 connects to J6 for 200 Vac to 240 Vac 50/60 Hz operation.

Maintenance procedures

6025 DC voltage distribution diagram



DC voltage tolerances (See note 1)

Voltage	Tolerance (Vdc)	Ripple voltage PP (See note 2)
+5 Vdc	+4.6 to +5.5	0.12
−5 Vdc	−4.6 to −5.5	.05
+12 Vdc	+11 to +13.2	0.12
+24 Vdc	+22 to +26.4	0.325
Power good	+2.4 to +5.5	—
Power thermal warning	+2.4 to +5.5	—

Notes:

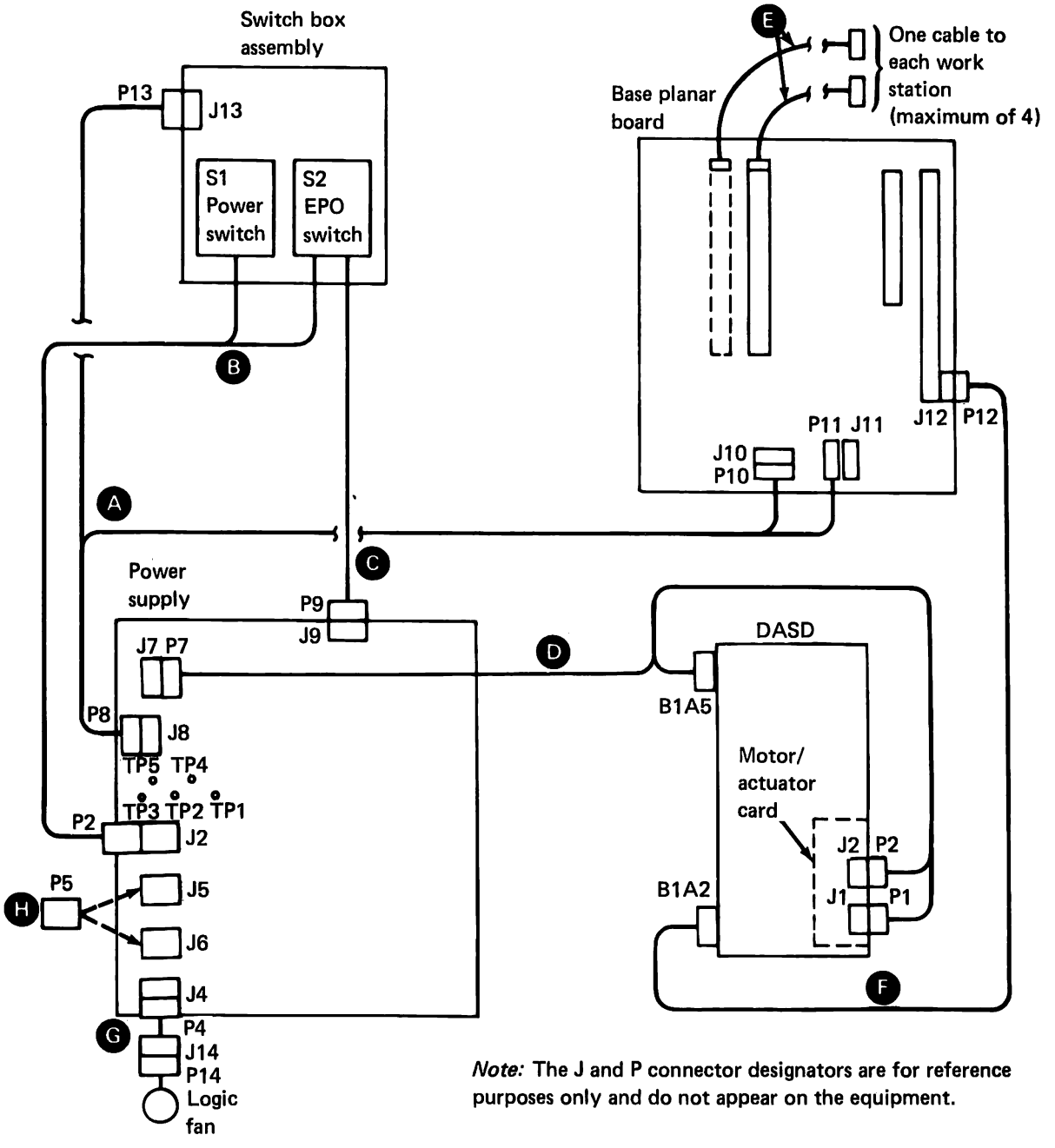
1. The voltage tolerances in the above chart are for voltages measured at power supply connectors J7 and J8 only.
2. Ripple voltage can be measured most accurately with an oscilloscope. However, an alternate way to get an indication of ripple voltage is with a CE meter (PN 1749231).
   a. Connect a capacitor (0.22 uF or larger, 50 Vdc or higher) in series with one of the meter leads. (Capacitor not supplied.)
   b. Set the meter range to 2.5 Vac.
   c. Connect one meter lead to the dc voltage in question, the other lead to frame ground. (Remember, a capacitor is in series with one of the leads.)
   d. If the meter pointer leaves zero on the meter scale, too much ripple voltage may be present.
3. The red LED indicator (CR1) lights when an overvoltage or a thermal overload has occurred. The green LED indicator (CR2) lights when the power supply output voltages are good.
4. The test point voltages are latched following an overcurrent (OC) shutdown condition; they will remain latched until system power is switched off. These voltages are measured with respect to frame ground. The test point associated with the output that caused the shutdown will be at a TTL-low level (0 to +0.4 Vdc); the other test point voltages will be at a TTL-high level (+2.4 to +5.5 Vdc). If a severe overcurrent condition is present when system power is switched on, the primary overcurrent test point (TP5) will be latched at a TTL-low level (0 to +0.4 Vdc). Depending upon the amount of the overcurrent, the output voltage test points may or may not identify the shorted output.

Maintenance procedures

6030 System cabling diagram

- (A) Switch box and planar board dc power cable
- (B) Switch box ac power cable
- (C) EPO switch ac power cable
- (D) DASD dc power cable
- (E) Work station signal cable
- (F) DASD signal cable
- (G) Fan cable
- (H) AC line selection plug

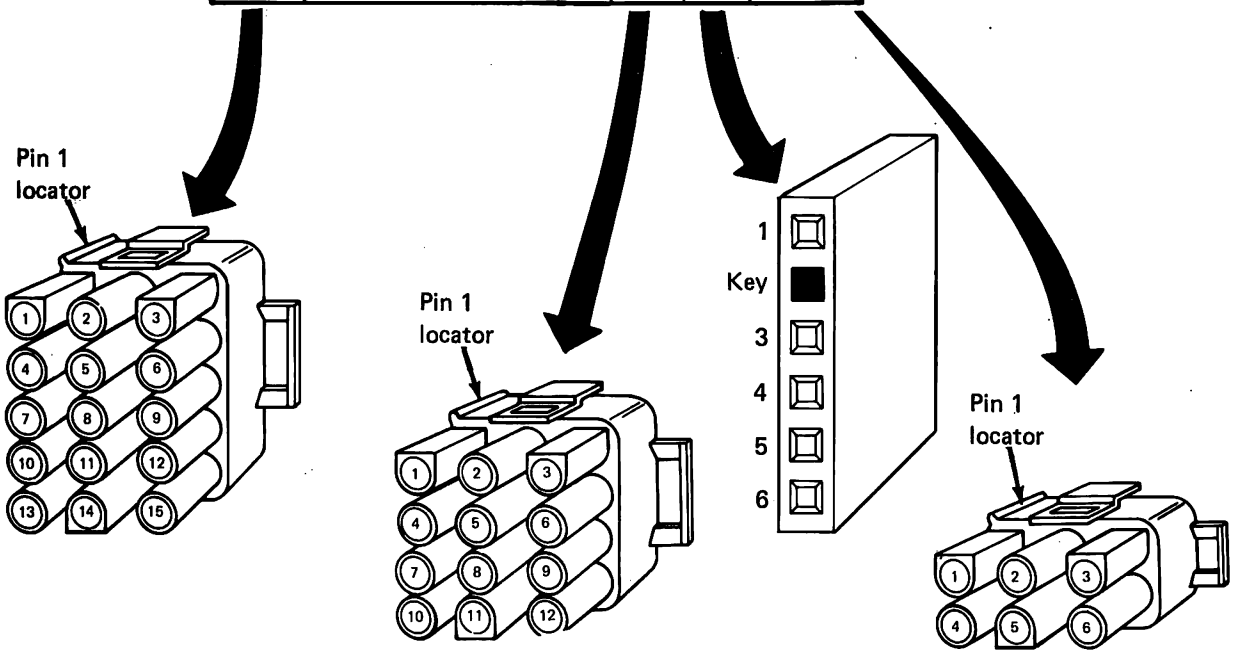
Wiring details for the system cables are on the following pages.



Note: The J and P connector designators are for reference purposes only and do not appear on the equipment.

Ⓐ Switch box and planar board dc power cable

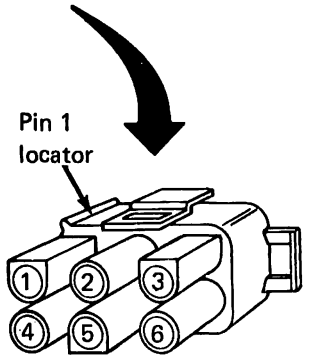
Power supply		Base planar board		Switch box
P8 Pin	Line name	P10 Pin	P11 Pin	P13 Pin
1	+5 Vdc	1	–	–
2	+5 Vdc	4	–	–
3	Ground	2	–	–
4	+5 Vdc	7	–	–
5	+5 Vdc	10	–	–
6	Ground	5	–	–
7	+12 Vdc	3	–	–
8	–5 Vdc	9	–	–
9	Ground	8	–	–
10	+Power good	12	–	–
11	–Power thermal warning	–	6	–
12	Ground	11	–	–
13	Switch monitor	–	–	2
14	Switch monitor	–	–	1
15	Not used	–	–	–
–	Ground	–	1	5
–	+ Ready indicator	–	3	6
–	+ Power on indicator	–	4	4
–	Shield	–	–	3



6030 System cabling diagram (continued)

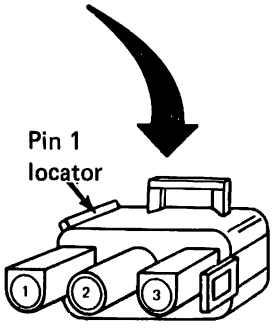
(B) Switch box ac power cable

Power supply		Power switch	EPO switch
P2 Pin	Line name	S1 Terminal	S2 Terminal
1	AC line	1	5
2	AC line	3	2
3	AC line	4	–
5	Safety ground	–	–
6	AC line	2	–



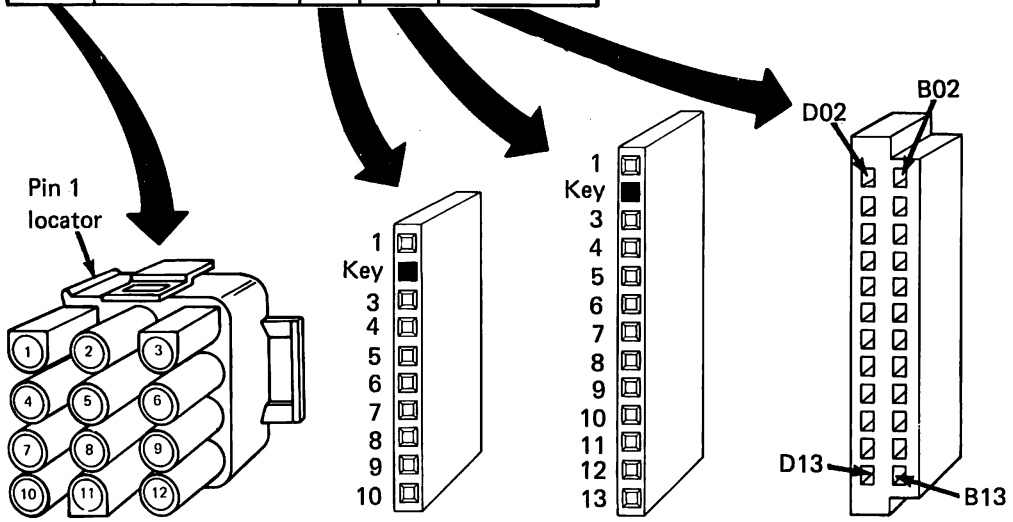
(C) EPO switch ac power cable

Power supply		EPO switch
P9 Pin	Line name	S2 Terminal
1	AC line	6
2	Safety ground	–
3	AC line	3



Ⓓ DASD dc power cable

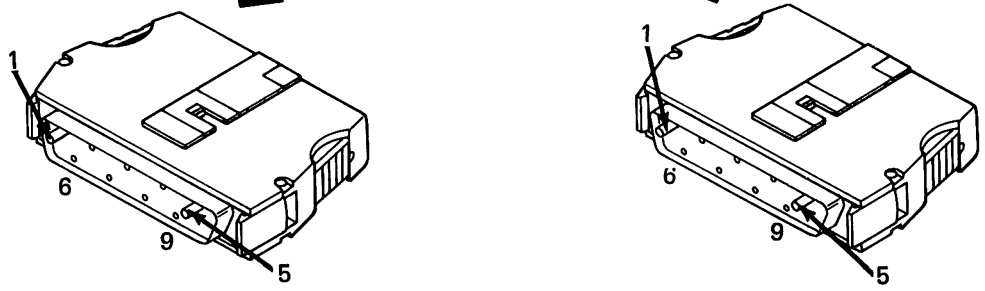
Power supply		Motor/ actuator card		Maple connector block
P7 Pin	Line name	P1 Pin	P2 Pin	B1A5 Pin
1	+5 Vdc	–	–	B02
1	+5 Vdc	–	–	B03
2	+5 Vdc	–	–	B04
2	+5 Vdc	–	–	B05
3	+5 Vdc	9	–	B10
4	Ground	–	–	B06
4	Ground	–	–	B07
5	Ground	–	–	B08
5	Ground	–	–	B09
6	Ground	–	–	B11
6	Ground	–	–	B13
7	Ground	3	–	–
7	Ground	4	–	–
8	Ground	6	–	–
8	Ground	8	–	–
9	–5 Vdc	10	–	B12
10	+24 Vdc	5	–	–
11	+24 Vdc	7	–	–
12	+24 Vdc	1	–	–
–	+ Hall 2	–	1	D02
–	+ Hall 1	–	3	D03
–	– Phase 1	–	4	D04
–	– Phase 2	–	5	D05
–	– Phase 3	–	6	D06
–	– Phase 4	–	7	D07
–	Logic ground	–	8	D08
–	+ Overcurrent	–	9	D09
–	– Host POR	–	10	D10
–	+ Actuator unlock	–	11	D11
–	– Pre drive	–	12	D12
–	+ Pre drive	–	13	D13



6030 System cabling diagram (continued)

Ⓔ Work station signal cable

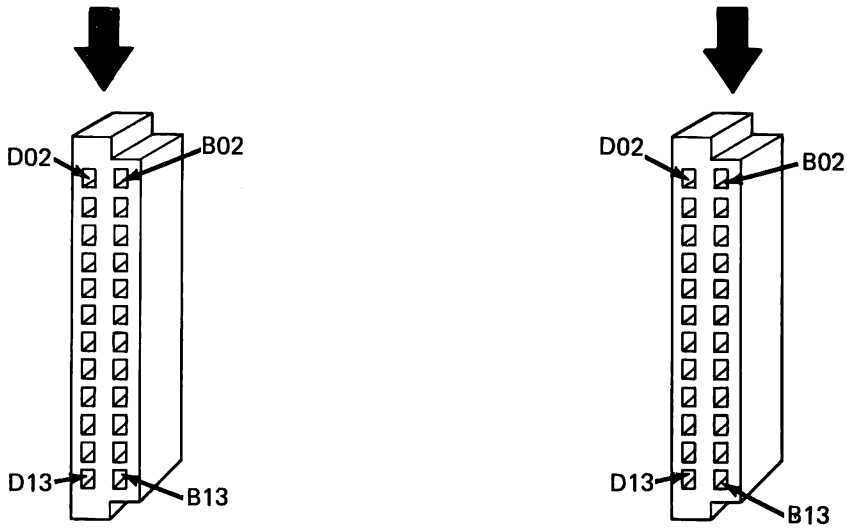
SIA card on base planar board (5247)		Work station SIA card
Pin	Line name	Pin
1	Twisted pair	1
5	Twisted pair	5



Note: The same type of connectors are used on both ends of this cable. The end of the cable that connects to the 5247 is labeled.

(F) DASD signal cable

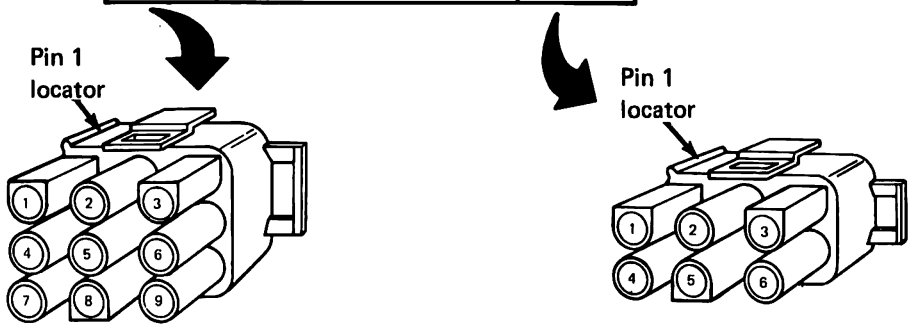
Disk attachment card			Maple connector block
J12 Pin	**Line name**	**Signal direction**	**B1A2 Pin**
B02	– Command mode	→	D02
B03	Data bus 0	↔	D03
B04	Data bus 1	↔	D04
B05	Data bus 2	↔	D05
B06	Data bus 3	↔	D06
B07	Data bus 4	↔	D07
B08	Data bus 5	↔	D08
B09	Data bus 6	↔	D09
B10	Data bus 7	↔	D10
B11	– Register select 0	→	D11
B12	– Register select 1	→	D12
B13	– Cable interlock (to DASD)	→	D13
D02	– Cable interlock (from DASD)	←	B02
D03	+5 Vdc sense	←	B03
D04	– Command valid	→	B04
D05	– Command received	←	B05
D06	– Disk ready	←	B06
D07	20 MHz to disk	→	B07
D08	Ground	—	B08
D09	– Write select to disk	→	B09
D10	– Read/write data	↔	B10
D11	+ Read/write data	↔	B11
D12	– Attachment reset to disk	→	B12
D13	– Odd parity	→	B13



6030 System cabling diagram (continued)

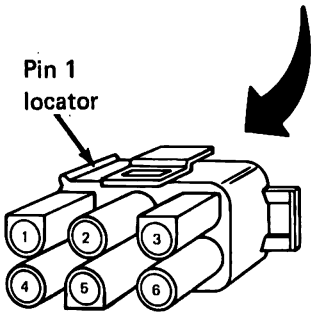
G Fan cable

Power supply P4 Pin	Line name	Fan assembly J14 Pin
2	Fan winding	1
4	Frame ground	5
5	Fan winding	2
6	Fan winding	3
7	Fan winding	4



H AC line selection plug

P5 Pin	Line name
1	} Jumper
2	
3	} Jumper
4	
5	} Jumper
6	



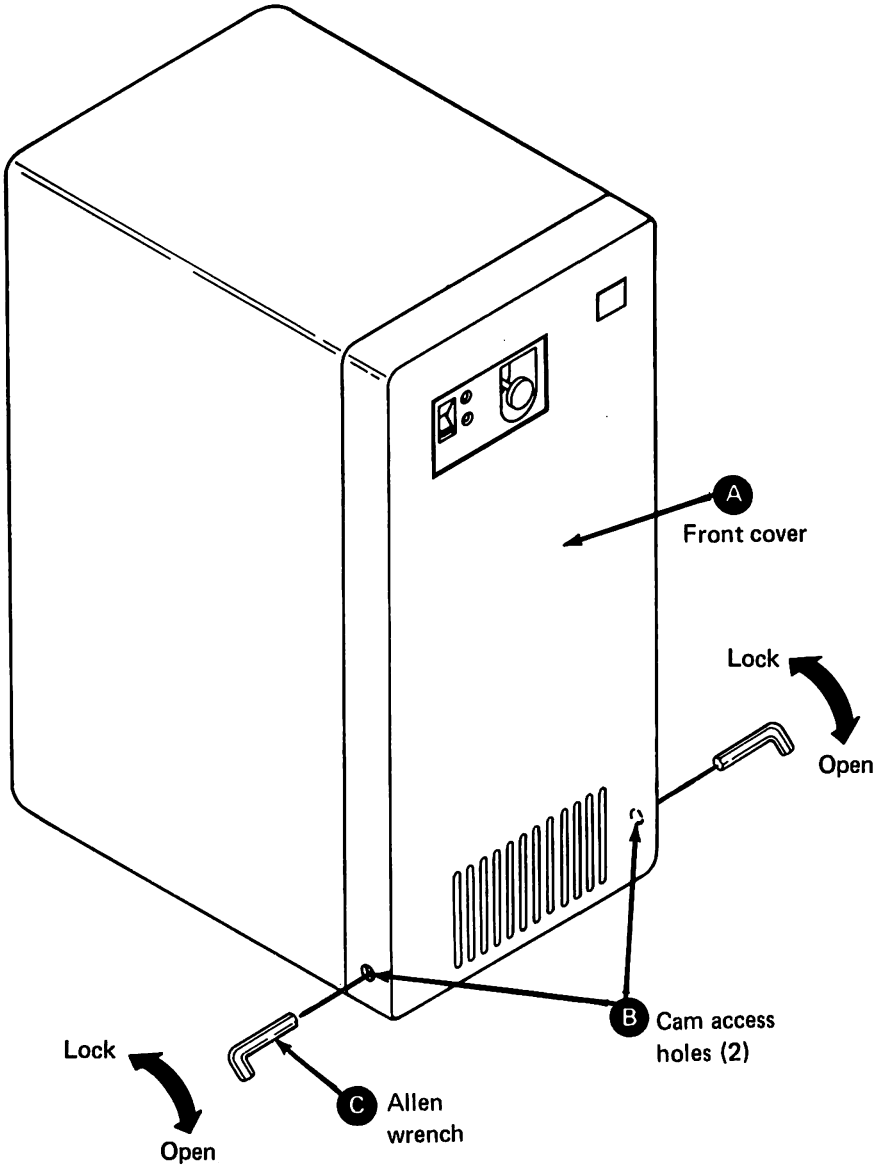
6100 Front cover

Removal

1. Switch off the 5247 power and wait until the Power indicator goes off.
2. Insert the 3-mm Allen wrench Ⓒ into one of the cam access holes Ⓑ on each side of the front cover Ⓐ.
3. Turn the cam as shown approximately one-quarter turn to open the front cover latch.
4. Hold the front cover and repeat steps 2 and 3 for the other cam; remove the front cover.

Replacement

1. Install the front cover Ⓐ on the 5247. Align the front cover latches in the slots of the enclosure.
2. Turn the cams as shown approximately one-quarter turn to lock the front cover latches.



Maintenance procedures

6110 Front cover latch mechanism

Removal

To remove the front cover latches:

1. Switch off the 5247 power and wait until the Power indicator goes off.
2. Remove the front cover (6100).
3. Remove the two screws (I) and the two springs (H).
4. Remove the four screws (G) and the washers (F) from the latches (D) and (E).
5. Remove the latches from the cover.
6. Remove the screw (A) and the washer (C) to disconnect the EMC strap (B) from the left front latch (E).

If it is necessary to remove the cams:

1. Remove the two screws (L), and the two brackets (K).

   Note: Observe the position of each cam before removal.
2. Remove the two cams (J).

Replacement

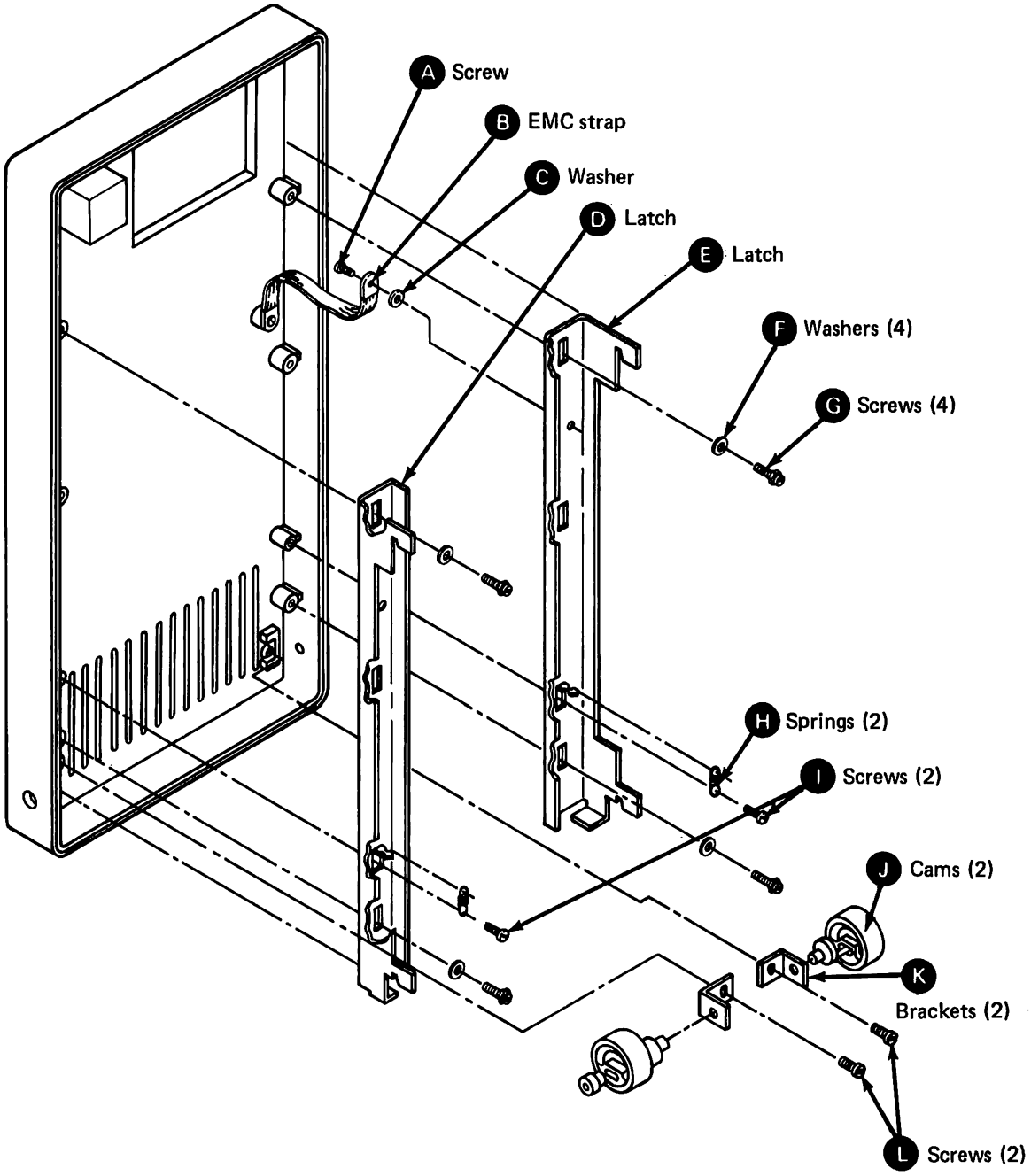
To replace the front cover latches:

1. Install the screw (A) and the washer (C) to connect the EMC strap (B) to the left front latch (E).
2. Install the latches (D) and (E), then install the screws (G) and the washers (F).
3. Install the two springs (H) and the two screws (I).
4. Install the front cover (6100).

If it is necessary to replace the cams:

Note: Place each cam in the same position as it was removed.

1. Install the cams (J) in the front cover.
2. Install the brackets (K) and the screws (L).
3. Install the front cover (6100).


A Screw
B EMC strap
C Washer
D Latch
E Latch
F Washers (4)
G Screws (4)
H Springs (2)
I Screws (2)
J Cams (2)
K Brackets (2)
L Screws (2)

Maintenance procedures

6120 Rear cover latch mechanism

Removal

1. Switch off the 5247 power and wait until the Power indicator goes off.
2. Open the rear cover by pushing in the knob assembly (A) and turning it counterclockwise.

   Note: Hold the knob assembly (A) while removing the C-clip (C).
3. Remove the C-clip (C).
4. Remove the spring (B) and the knob assembly.

Replacement

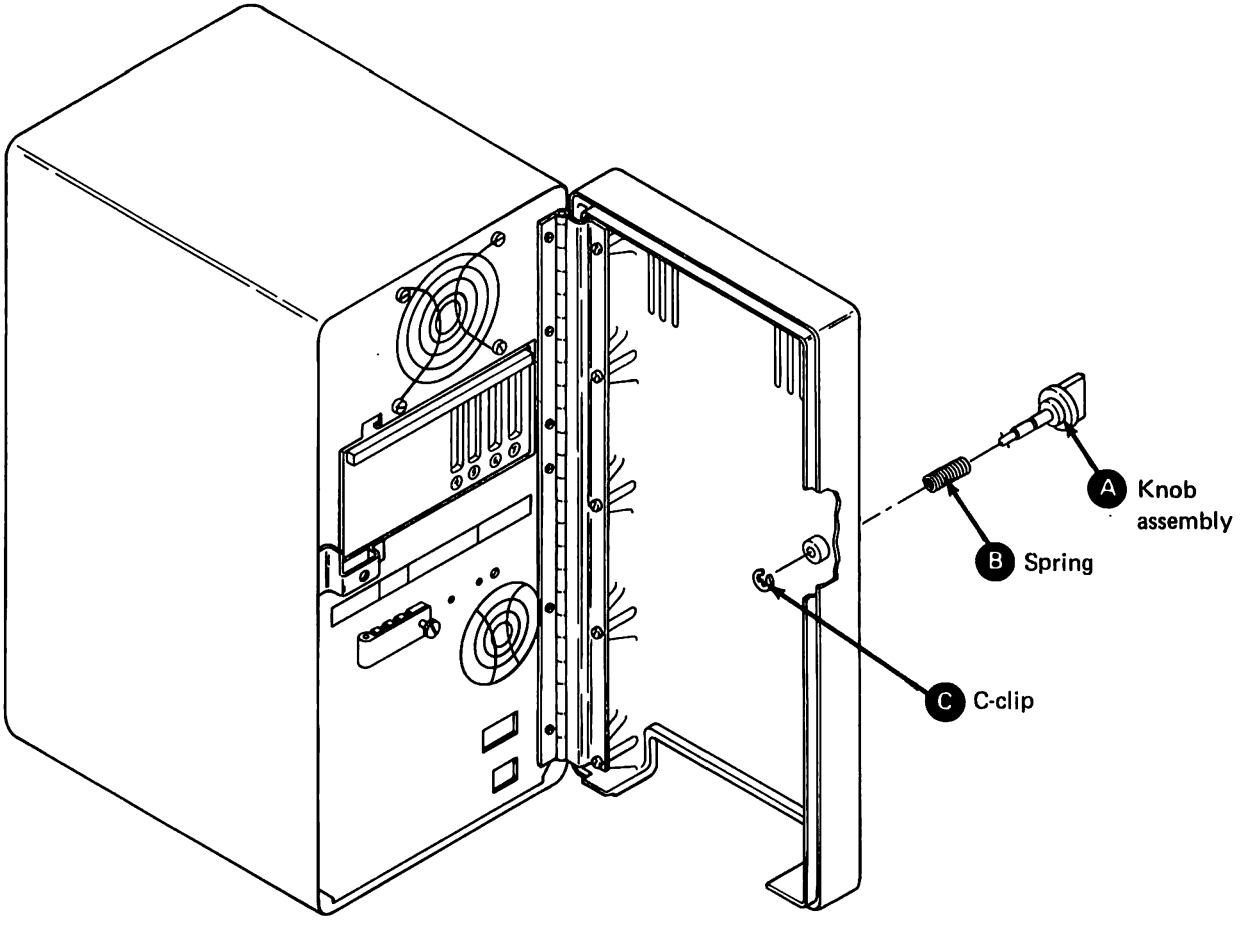
1. Install the knob assembly (A) and the spring (B) in the rear cover.
2. Install the C-clip (C).
3. Close the rear cover. Push in the knob assembly and turn it clockwise.

To open rear cover

Open the rear cover by pushing in the knob assembly (A) and turning it counterclockwise.

To close rear cover

Close the rear cover, then push in the knob assembly (A) and turn it clockwise.



6130 Base planar board

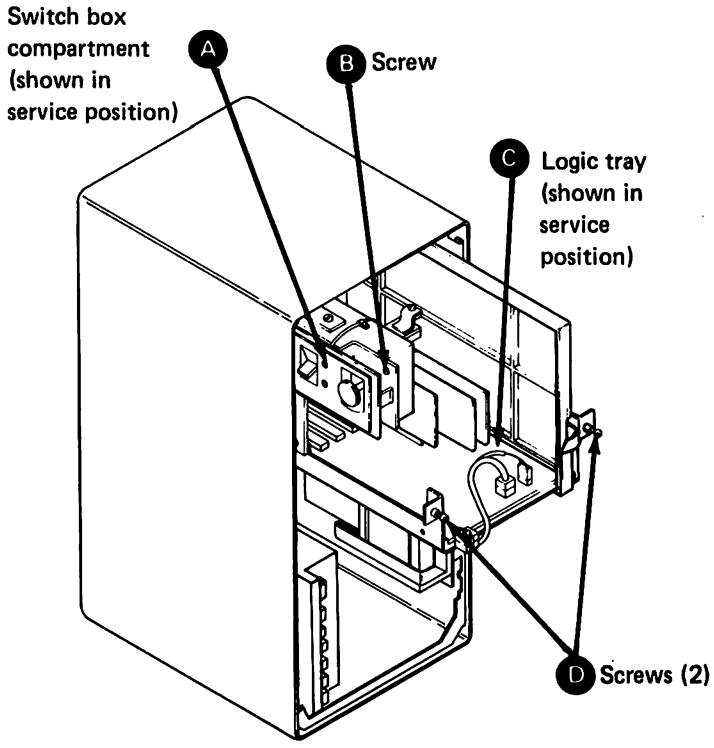
Service position

1. Switch off the 5247 power and wait until the Power indicator goes off.
2. Remove the front cover (6100).
3. Loosen the screw (B) on the switch box compartment (A) until the screw turns freely, then swing the compartment outward from the enclosure to its fully-open position.
4. Loosen the two screws (D) on the sides of the logic tray (C) until the screws turn freely, then slide the logic tray out to the service position.

   Note: When the logic tray is in the service position, the plug-in cards, cables, CE test pins, and diagnostic switches (or jumpers) associated with this assembly are accessible.

Operating position

1. Slide the logic tray (C) into the 5247 enclosure and tighten the two screws (D).
2. Close the switch box compartment (A) and tighten the screw (B).
3. Install the front cover (6100).



Front view

Maintenance procedures

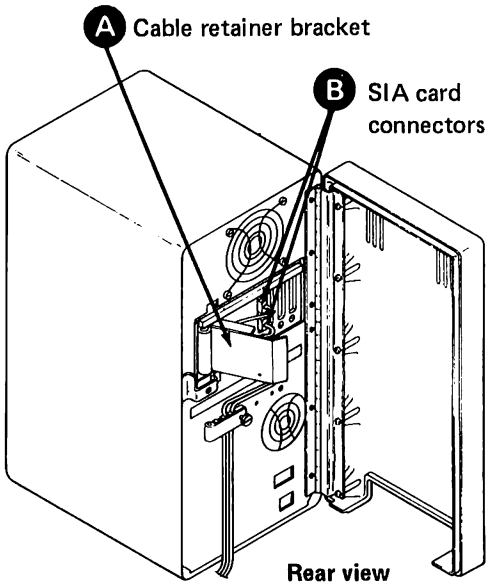
6130 Base planar board (continued)

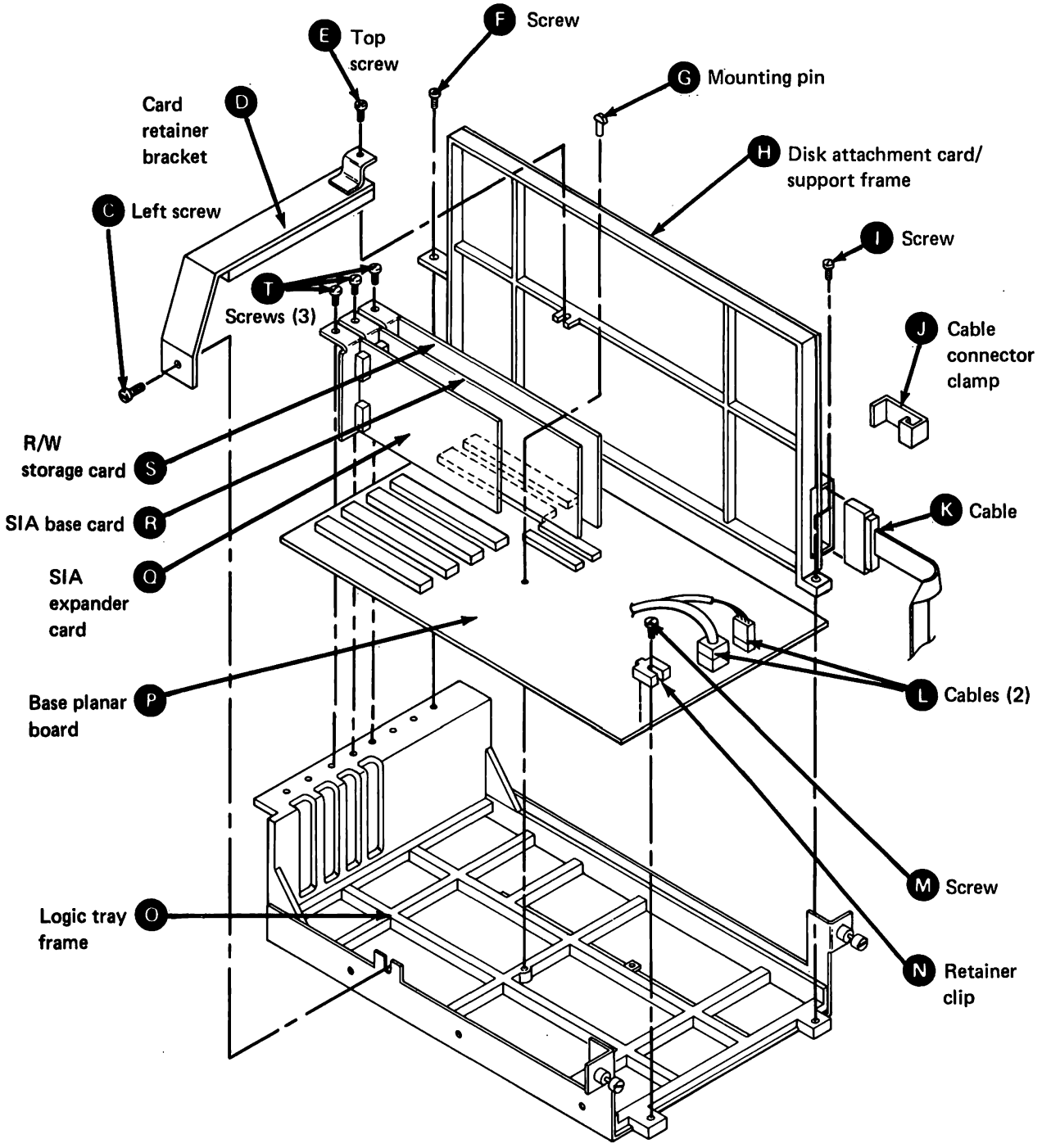
Removal

1. Place the logic tray in the Service position.
2. Open the rear cover (6120).
3. Mark and disconnect all work station cables from the SIA card connectors (B) (6007).
4. Remove the cable connector clamp (J). Mark and disconnect the cable (K) from the disk attachment card/support frame (H). Then, mark and disconnect the two cables (L) from the base planar board (P).
5. Loosen the left screw (C) and the top screw (E) of the card retainer bracket (D); remove the card retainer bracket.
6. Remove the two screws (F) and (I) from the disk attachment card/support frame and unplug the disk attachment card/support frame from the base planar board.
7. Remove the screws (T) from the brackets that hold the R/W storage card (S) and the SIA card(s) (Q) and (R) to the logic tray frame (O). Mark and unplug these cards from the base planar board (P).
8. Remove the screw (M) and the retainer clip (N) from the base planar board.
9. To remove the mounting pin (G), insert the handle of a 3-mm Allen wrench into the mounting hole for this pin on the underside of the base planar board. Push up on the wrench to remove the mounting pin. Then, lift out the base planar board.

Replacement

1. Place the new base planar board (P) onto the logic tray frame (O) and install the mounting pin (G).
2. Install the retainer clip (N) and the screw (M) to the base planar board.
3. Install the R/W storage card (S), the SIA card(s) (Q) and (R), and the disk attachment card/support frame (H) removed from the old board. Hold the cards and the frame in place with screws (F), (I), and (T).
4. Install the card retainer bracket (D), and tighten screws (C) and (E).
5. Connect the two cables (L) to the base planar board. Then, connect the cable (K) to the disk attachment card/support frame and install the cable connector clamp (J).
6. Return the logic tray to the Operating position.
7. Install the front cover (6100).
8. Hold the cable retainer bracket (A) in the open position, and connect the marked work station cables to the respective SIA card connectors (B).
9. Close the rear cover (6120).

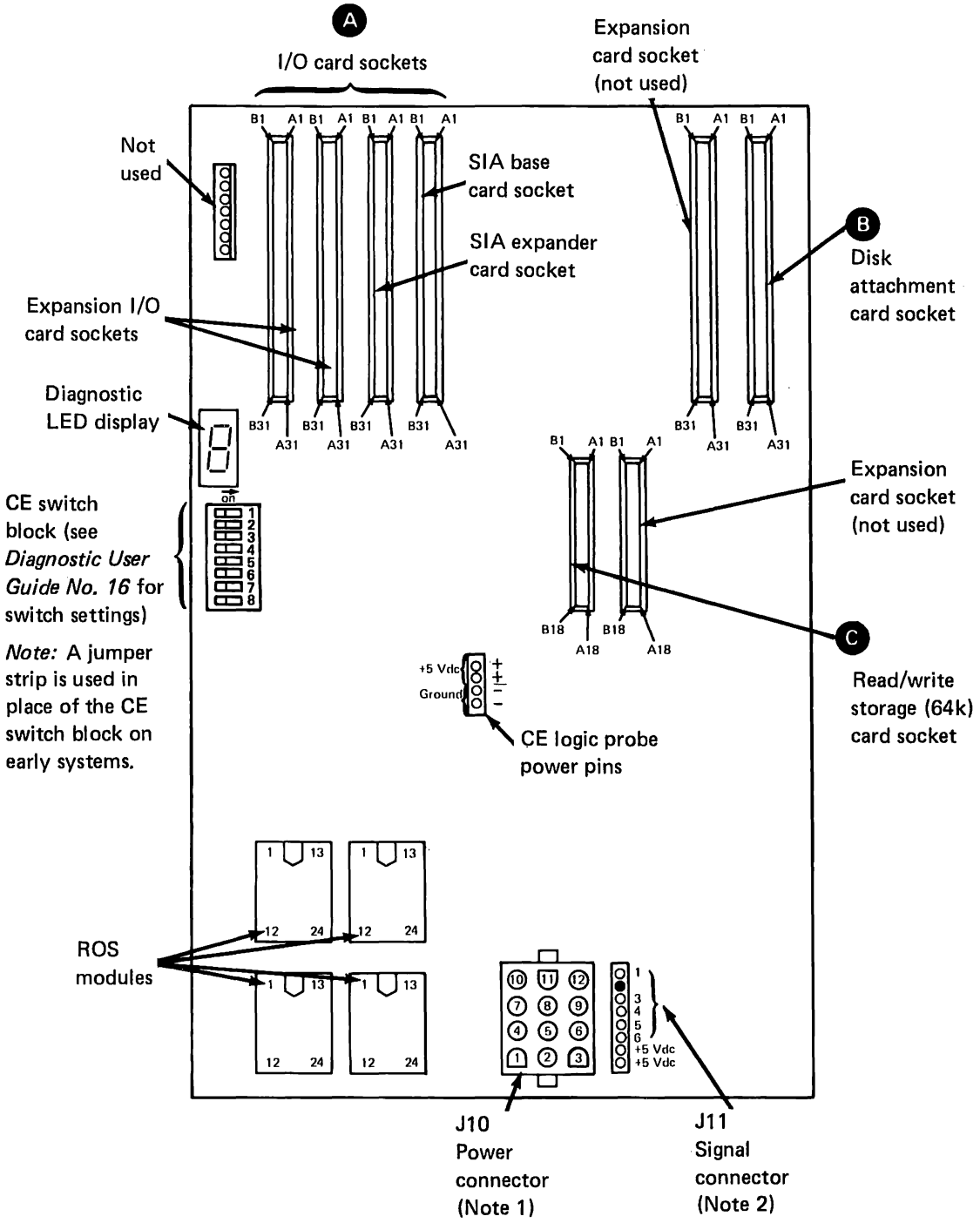



E Top screw
F Screw
G Mounting pin
Card retainer bracket
D
H Disk attachment card/ support frame
C Left screw
I Screw
T Screws (3)
J Cable connector clamp
R/W storage card S
SIA base card R
SIA expander card Q
K Cable
Base planar board P
L Cables (2)
M Screw
Logic tray frame O
N Retainer clip

Maintenance procedures

6130 Base planar board (continued)

Board diagram and connector pin assignments



Notes:

1. See "6025 DC voltage distribution diagram" for connector pin assignments.
2. See "6030 System cabling diagram" for connector pin assignments.

Ⓐ I/O card sockets

Pin	Line name	Signal direction	Pin	Line name	Signal direction
A01	+ I/O trap	←	B01	Ground	— —
A02	+ I/O data bit 7	↔	B02	+ Reset	→
A03	+ I/O data bit 6	↔	B03	+5 Vdc	→
A04	+ I/O data bit 5	↔	B04	+ Interrupt request 2	←
A05	+ I/O data bit 4	↔	B05	−5 Vdc	— —
A06	+ I/O data bit 3	↔	B06	+ DMA request 2	←
A07	+ I/O data bit 2	↔	B07	Reserved	— —
A08	+ I/O data bit 1	↔	B08	− DMA acknowledge 2	→
A09	+ I/O data bit 0	↔	B09	+12 Vdc	— —
A10	+ I/O ready	←	B10	+ IO/not memory	→
A11	+ I/O address enable	→	B11	Reserved	— —
A12	Reserved	— —	B12	Reserved	— —
A13	SIA clock	→	B13	− I/O write	→
A14	SIA transmitted data	→	B14	− I/O read	→
A15	SIA received data	←	B15	+ DMA acknowledge 3	→
A16	+ I/O address bit 15	→	B16	+ DMA request 3	←
A17	+ I/O address bit 14	→	B17	− DMA acknowledge 1	→
A18	+ I/O address bit 13	→	B18	+ DMA request 1	←
A19	+ I/O address bit 12	→	B19	− DMA acknowledge 0	→
A20	+ I/O address bit 11	→	B20	+ DMA request 0	←
A21	+ I/O address bit 10	→	B21	+ Interrupt request 7	←
A22	+ I/O address bit 9	→	B22	+ Interrupt request 6	←
A23	+ I/O address bit 8	→	B23	+ Interrupt request 5	←
A24	+ I/O address bit 7	→	B24	+ Interrupt request 4	←
A25	+ I/O address bit 6	→	B25	+ Interrupt request 3	←
A26	+ I/O address bit 5	→	B26	+ Interrupt request 0	←
A27	+ I/O address bit 4	→	B27	+ Terminal count	→
A28	+ I/O address bit 3	→	B28	+ I/O address latch enable	→
A29	+ I/O address bit 2	→	B29	+5 Vdc	— —
A30	+ I/O address bit 1	→	B30	Reserved	— —
A31	+ I/O address bit 0	→	B31	Ground	— —

Legend:

→ Signal flow is from the base planar.

← Signal flow is to the base planar.

↔ Signal flow is bidirectional.

+ or − The active polarity of the signal line.

Maintenance procedures

6130 Base planar board (continued)

Ⓑ Disk attachment card socket

Pin	Line name	Signal direction	Pin	Line name	Signal direction
A01	+5 Vdc	— —	B01	Ground	— —
A02	+5 Vdc	— —	B02	+ Power good	→
A03	+5 Vdc	— —	B03	+5 Vdc	— —
A04	– I/O read	→	B04	+5 Vdc	— —
A05	– Device select 1	→	B05	+5 Vdc	— —
A06	– I/O write	→	A06	Ground	— —
A07	Not used	— —	B07	–5 Vdc	— —
A08	– File storage acknowledge	→	B08	–5 Vdc	— —
A09	Not used	— —	B09	Ground	— —
A10	– File storage ready	→	B10	Not used	— —
A11	Not used	— —	B11	– File storage write	←
A12	Not used	— —	B12	+ I/O address/data bit 7	↔
A13	Not used	— —	B13	+I/O address/data bit 6	↔
A14	+ Parity high	↔	B14	+ I/O address/data bit 5	↔
A15	+ File storage address bit 16/ parity low	↔	B15	+ I/O address/data bit 4	↔
A16	+ File storage address/data bit 15	↔	B16	+ I/O address/data bit 3	↔
A17	+ File storage address/data bit 14	↔	B17	+ I/O address/data bit 2	↔
A18	+ File storage address/data bit 13	↔	B18	+ I/O address/data bit 1	↔
A19	+ File storage address/data bit 12	↔	B19	+ I/O address/data bit 0	↔
A20	+ File storage address/data bit 11	↔	B20	Not used	— —
A21	+ File storage address/data bit 10	↔	B21	Not used	— —
A22	+ File storage address/data bit 9	↔	B22	Not used	— —
A23	+ File storage address/data bit 8	↔	B23	Not used	— —
A24	+ File storage address/data bit 7	↔	B24	Not used	— —
A25	+ File storage address/data bit 6	↔	B25	Not used	— —
A26	+ File storage address/data bit 5	↔	B26	+ Interrupt 1	←
A27	+ File storage address/data bit 4	↔	B27	Ground	— —
A28	+ File storage address/data bit 3	↔	B28	– File storage request	←
A29	+ File storage address/data bit 2	↔	B29	Ground	— —
A30	+ File storage address/data bit 1	↔	B30	Ground	— —
A31	+ File storage address/data bit 0	↔	B31	Ground	— —

Legend:

→ Signal flow is from the base planar.
← Signal flow is to the base planar.
↔ Signal flow is bidirectional.
+ or – The active polarity of the signal line.

C Read/write storage card socket

Pin	Line name	Signal direction	Pin	Line name	Signal direction
A01	+ Memory data parity low	⟷	B01	+ Memory data parity high	⟷
A02	+ Memory data bit 7	⟷	B02	+ Memory data bit 15	⟷
A03	+ Memory data bit 6	⟷	B03	+ Memory data bit 14	⟷
A04	+ Memory data bit 5	⟷	B04	+ Memory data bit 13	⟷
A05	+ Memory data bit 4	⟷	B05	+ Memory data bit 12	⟷
A06	+ Memory data bit 3	⟷	B06	+ Memory data bit 11	⟷
A07	+ Memory data bit 2	⟷	B07	+ Memory data bit 10	⟷
A08	+ Memory data bit 1	⟷	B08	+ Memory data bit 9	⟷
A09	+ Memory data bit 0	⟷	B09	+ Memory data bit 8	⟷
A10	−5 Vdc	— —	B10	− Column address strobe (0 for Base) (2 for Expansion)	⟶
A11	+12 Vdc	— —	B11	− Column address strobe (1 for Base) (3 for Expansion)	⟶
A12	+ Memory address bit 7	⟶	B12	− Write enable high	⟶
A13	+ Memory address bit 6	⟶	B13	− Write enable low	⟶
A14	+ Memory address bit 5	⟶	B14	− Memory 64K	⟵
A15	+ Memory address bit 4	⟶	B15	− Memory card installed	⟵
A16	+ Memory address bit 3	⟶	B16	+5 Vdc	— —
A17	+ Memory address bit 2	⟶	B17	− Row address strobe	⟶
A18	+ Memory address bit 1	⟶	B18	Ground	— —

Legend:

⟶ Signal flow is from the base planar.
⟵ Signal flow is to the base planar.
⟷ Signal flow is bidirectional.
+ or − The active polarity of the signal line.

Maintenance procedures

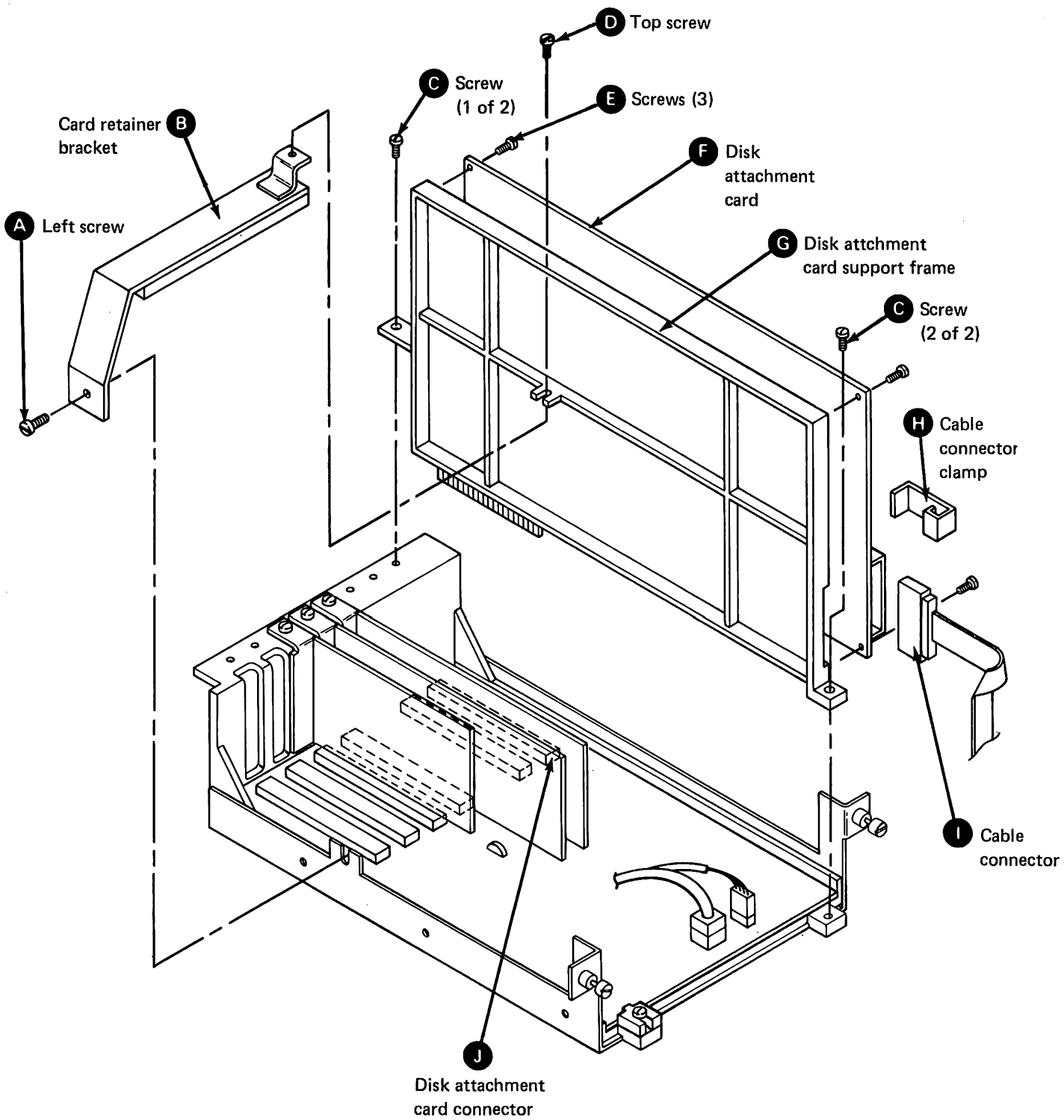
6140 Disk attachment card

Removal

1. Switch off the 5247 power and wait until the Power indicator goes off.
2. Place the switch box and the logic tray in the Service position (6130).
3. Remove the cable connector clamp (H). Unplug the cable connector (I) from the disk attachment card (F).
4. Loosen the left screw (A) and the top screw (D) of the card retainer bracket (B); remove the card retainer bracket.
5. Remove the two screws (C) from the disk attachment card support frame (G); unplug and remove the disk attachment card support frame.
6. Separate the disk attachment card (F) from the disk attachment card support frame (G) by removing the three screws (E).

Replacement

1. Place the disk attachment card (F) on the disk attachment card support frame (G) and install the three screws (E).
2. Plug the disk attachment card support frame into the connector (J) on the base planar board.
3. Fasten the disk attachment card support frame to the logic tray assembly with the two screws (C).
4. Install the card retainer bracket (B). Hold the bracket in place by tightening screws (A) and (D).
5. Insert the cable connector (I) into the disk attachment card, then install the cable connector clamp (H).
6. Return the switch box and the logic tray to the Operating position (6130).


D Top screw
C Screw (1 of 2)
E Screws (3)
Card retainer bracket
B
F Disk attachment card
A Left screw
G Disk attchment card support frame
C Screw (2 of 2)
H Cable connector clamp
I Cable connector
J Disk attachment card connector

Maintenance procedures

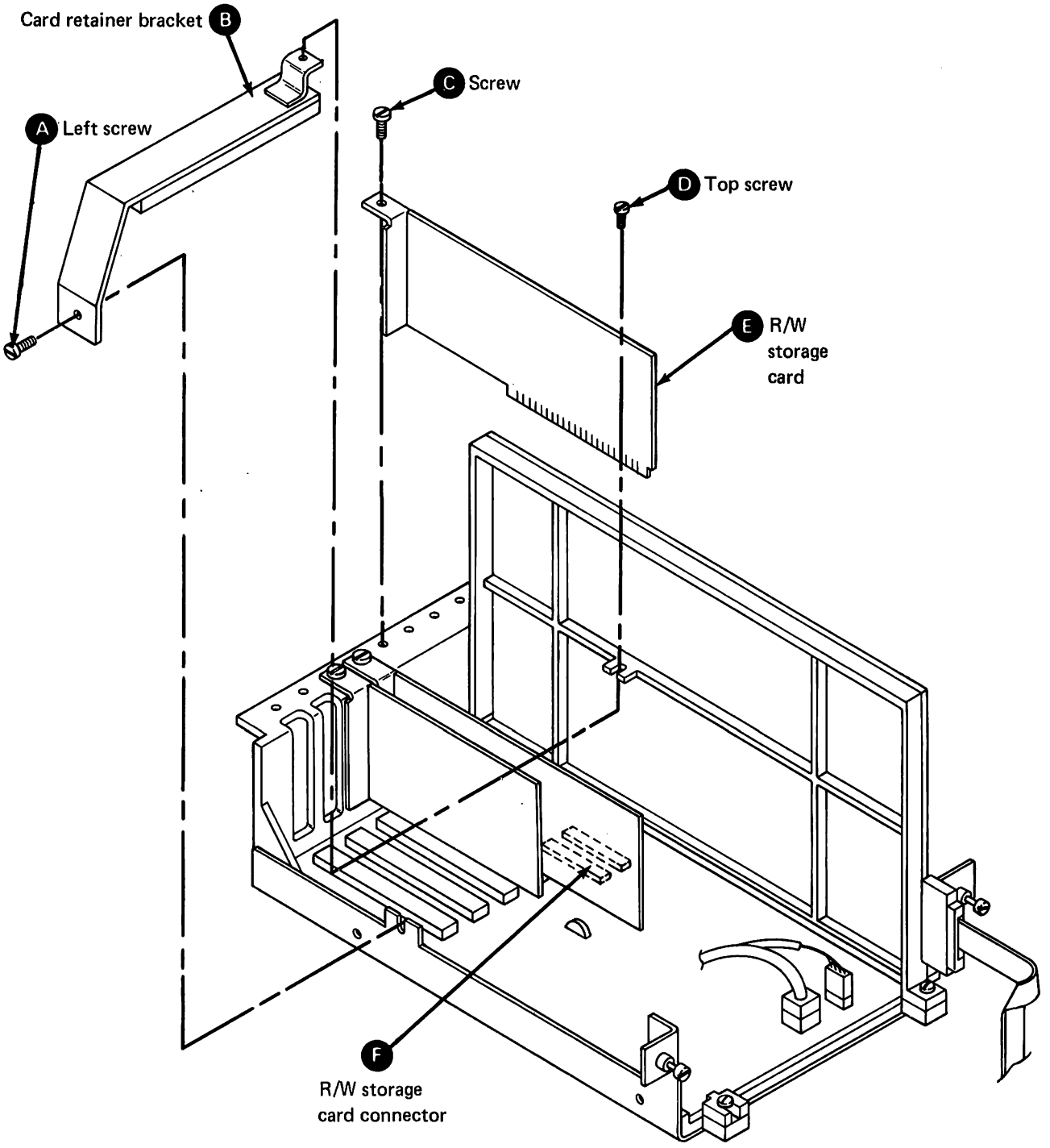
6150 Read/write (R/W) storage card

Removal

1. Switch off the 5247 power and wait until the Power indicator goes off.
2. Place the switch box and the logic tray in the Service position (6130).
3. Loosen the left screw Ⓐ and the top screw Ⓓ of the card retainer bracket Ⓑ; remove the card retainer bracket.
4. Remove the screw Ⓒ, then unplug and remove the R/W storage card Ⓔ from the base planar board.

Replacement

1. Plug the R/W storage card Ⓔ into the connector Ⓕ on the base planar board and install the screw Ⓒ.
2. Install the card retainer bracket Ⓑ. Hold the bracket in place by tightening screws Ⓐ and Ⓓ.
3. Return the switch box and the logic tray to the Operating position (6130).


Card retainer bracket B
A Left screw
C Screw
D Top screw
E R/W storage card
F R/W storage card connector

Maintenance procedures

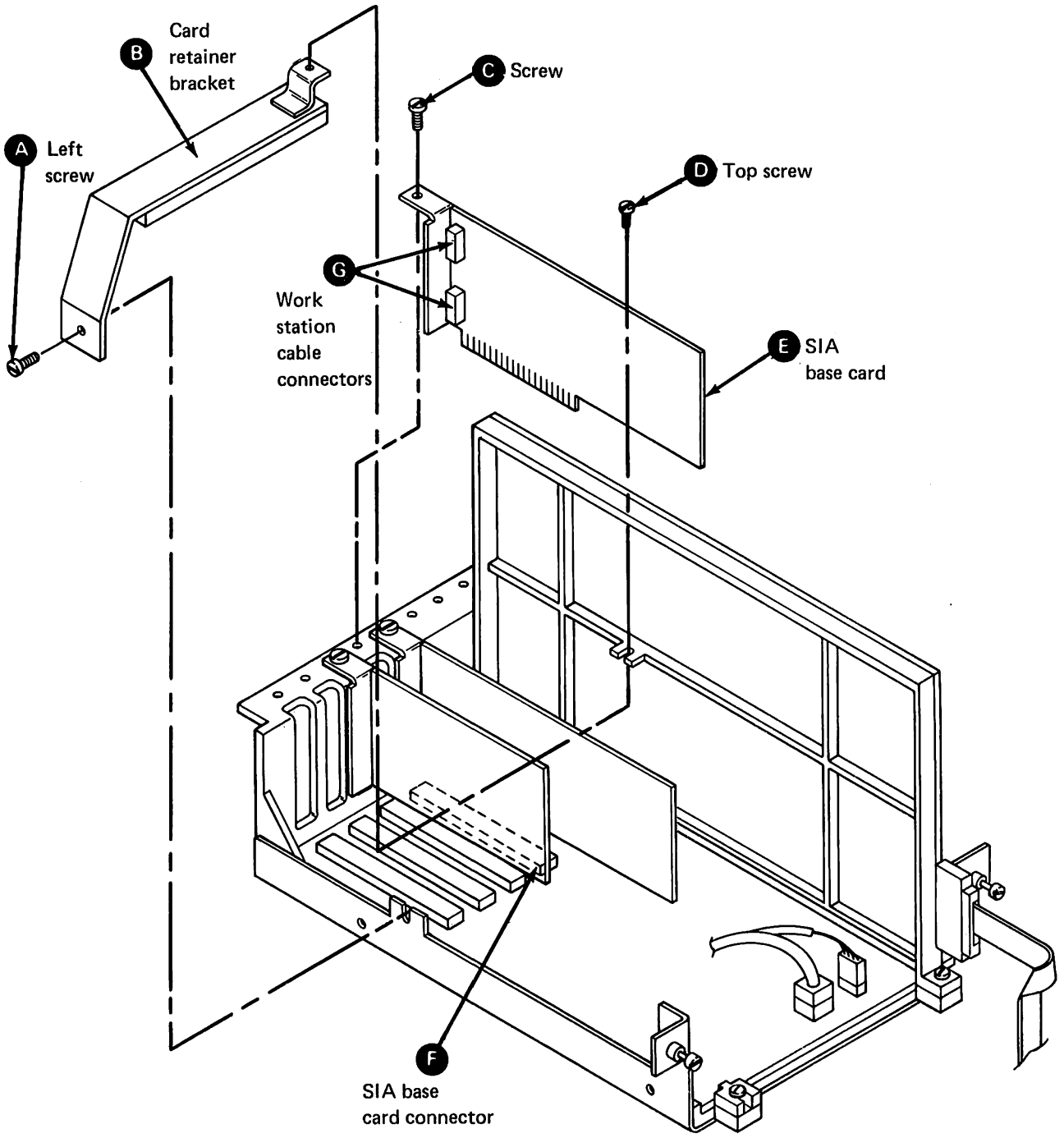
6160 Serial interface adapter (SIA) base card

Removal

1. Switch off the 5247 power and wait until the Power indicator goes off.
2. Open the rear cover (6120).
3. Mark and disconnect the work station cables from the connectors (G) on the rear of the SIA base card (E) (6007).
4. Place the switch box and the logic tray in the Service position (6130).
5. Loosen the left screw (A) and the top screw (D) of the card retainer bracket (B); remove the card retainer bracket.
6. Remove the screw (C), then unplug the SIA base card (E) from the base planar board.

Replacement

1. Plug the SIA base card (E) into the connector (F) on the base planar board and install the screw (C).
2. Install the card retainer bracket (B). Hold the bracket in place by tightening screws (A) and (D).
3. Return the switch box and the logic tray to the Operating position (6130).
4. Observe the cable marking and connect the work station cables to the SIA base card.
5. Close the rear cover (6120).


A Left screw
B Card retainer bracket
C Screw
D Top screw
E SIA base card
F SIA base card connector
G Work station cable connectors

Maintenance procedures

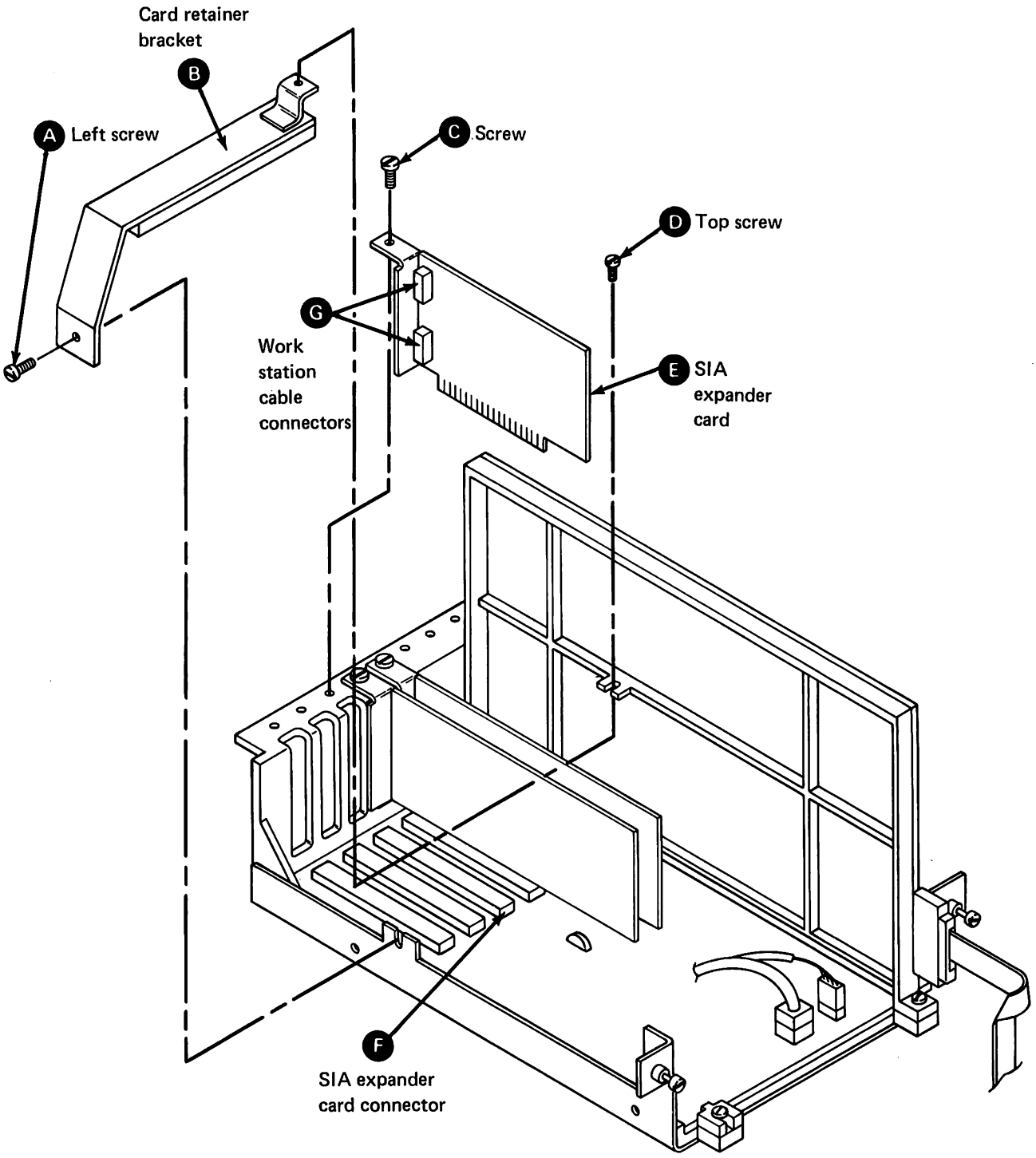
6170 Serial interface adapter (SIA) expander card

Removal

1. Switch off the 5247 power and wait until the Power indicator goes off.
2. Open the rear cover (6120).
3. Mark and disconnect the work station cables attached to the connectors (G) on the rear of the SIA expander card (E) (6007).
4. Place the switch box and the logic tray in the Service position (6130).
5. Loosen the left screw (A) and the top screw (D) of the card retainer bracket (B); remove the card retainer bracket.
6. Remove the screw (C), then unplug the SIA expander card from the base planar board.

Replacement

1. Plug the SIA expander card (E) into the connector (F) on the base planar board and install the screw (C).
2. Install the card retainer bracket (B). Hold the bracket in place by tightening screws (A) and (D).
3. Return the switch box and the logic tray to the Operating position (6130).
4. Observe the cable marking and connect the work station cables to the SIA expander card.
5. Close the rear cover (6120).


Card retainer bracket
B
A Left screw
C Screw
D Top screw
G
Work station cable connectors
E SIA expander card
F
SIA expander card connector

Maintenance procedures

6180 Direct access storage device (DASD)

Service position

1. Switch off the 5247 power and wait until the Power indicator goes off.
2. Remove the front cover (6100).
3. Loosen the two screws (B), then slide the DASD (A) out to the service position.

Removal

Warning: Customer data will be lost if the DASD is replaced.

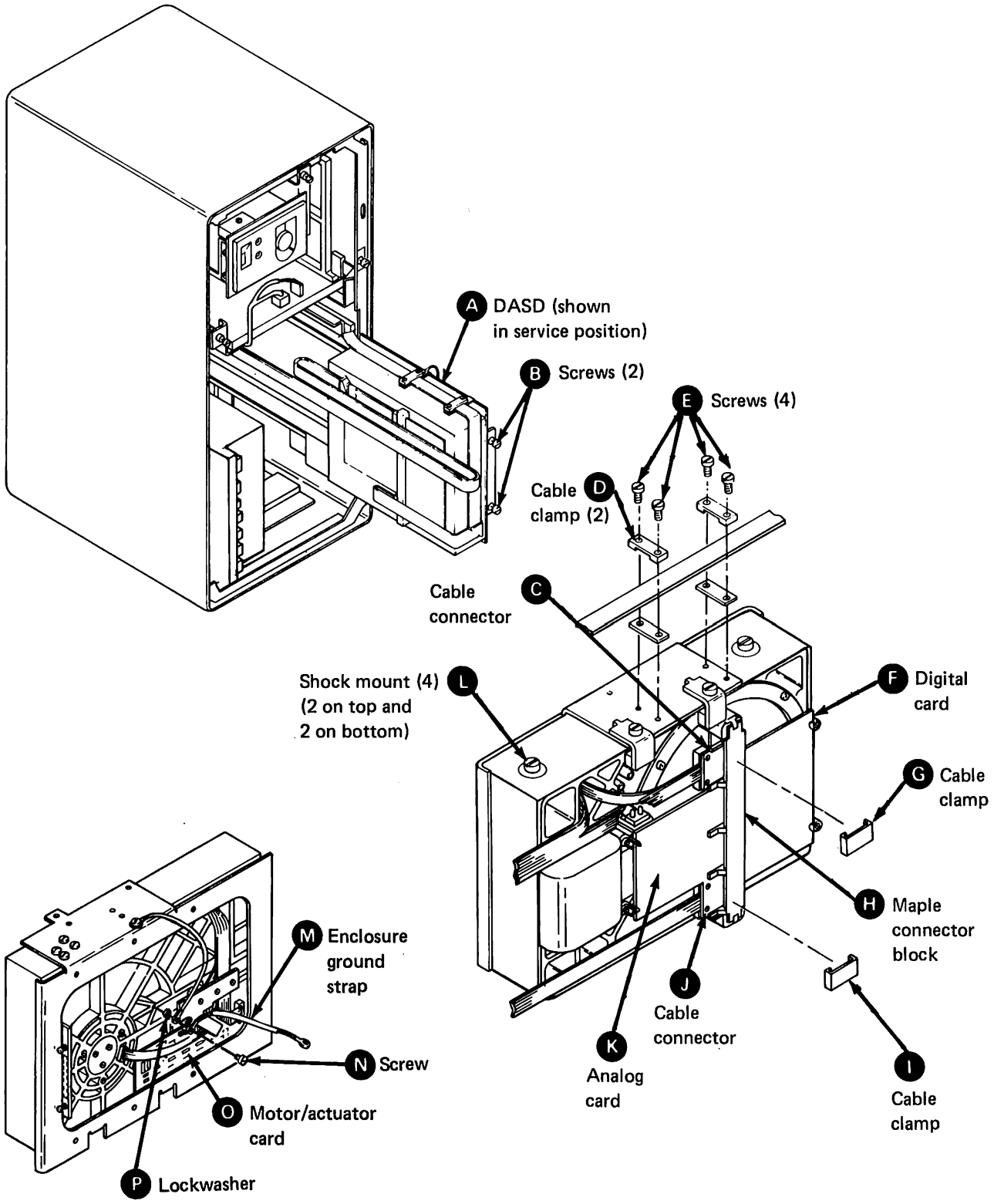
1. Place the DASD in the Service position.
2. Remove the four screws (E) and both halves of the two cable clamps (D) from the top surface of the DASD.
3. Remove the two cable clamps (G) and (I), then mark and disconnect the two cable connectors (C) and (J) from the maple connector block (H).
4. Disconnect the enclosure ground strap (M) by removing the screw (N) and lockwasher (P).
5. Remove the analog card (K) (6190), but do not unsnap the card guide and do not remove the CE test point label.
6. Remove the digital card (F) (6200), but do not unsnap the card guide.
7. Remove the motor/actuator card (O) (6210).
8. Remove all the external ribbon cables from the DASD.
9. Remove the shock mounts (L) (6240), starting with step 6 of the 6240 removal procedure.
10. Fill out the DASD return label and attach the label to the DASD.

Replacement

1. Install the shock mounts (L) (6240) on the new DASD (A) by performing steps 1 through 9 of the 6240 replacement procedure.
2. Install the analog card (K) (6190).
3. Install the digital card (F) (6200).
4. Run the enclosure ground strap (M) between the DASD and the enclosure frame, then attach the strap to the DASD with the screw (N) and the lockwasher (P).
5. Install the external ribbon cables to the DASD and place the cables near their point of connection.
6. Remove the cable clamp near the top of the motor/actuator card (O). Install the motor/actuator card in the DASD casting, connect the correct cables to the card, then attach the cable clamp to the casting at the top of this card (6210).
7. Connect the two cable connectors (C) and (J) to the maple connector block (H) and install the two cable clamps (G) and (I).
8. Insert the ribbon cable between the halves of the two cable clamps (D) and install the clamps on the DASD with the four screws (E).
9. Slide the DASD into the 5247 enclosure and tighten the two screws (B).
10. Format the new DASD as follows:
    a. Switch on the 5247 power, then wait at least 90 seconds.

       Note: The Ready indicator will not come on at this time because the new DASD is received without an initial microprogram load (IMPL).

    b. Execute the format diagnostic PID 0600. See *Diagnostic user guide 0006* for details.
11. Have the customer install the IMPL at the nearest work station by inserting CSF diskette VOL005 and entering LINK PREPARE.DISK from the keyboard.
    a. Switch off the 5247 power and wait until the Power indicator goes off.
    b. Switch on the 5247 power and observe that the Ready indicator comes on within 90 seconds.
    c. If the Ready indicator comes on, go to step 12; if it does not, go to the System/23 Start MAP 1000.
12. Install the front cover (6100).


A DASD (shown in service position)
B Screws (2)
E Screws (4)
Cable clamp (2)
D
Cable connector
C
Shock mount (4) (2 on top and 2 on bottom)
L
F Digital card
G Cable clamp
H Maple connector block
J Cable connector
K Analog card
I Cable clamp
M Enclosure ground strap
N Screw
O Motor/actuator card
P Lockwasher

Maintenance procedures

6190 Analog card

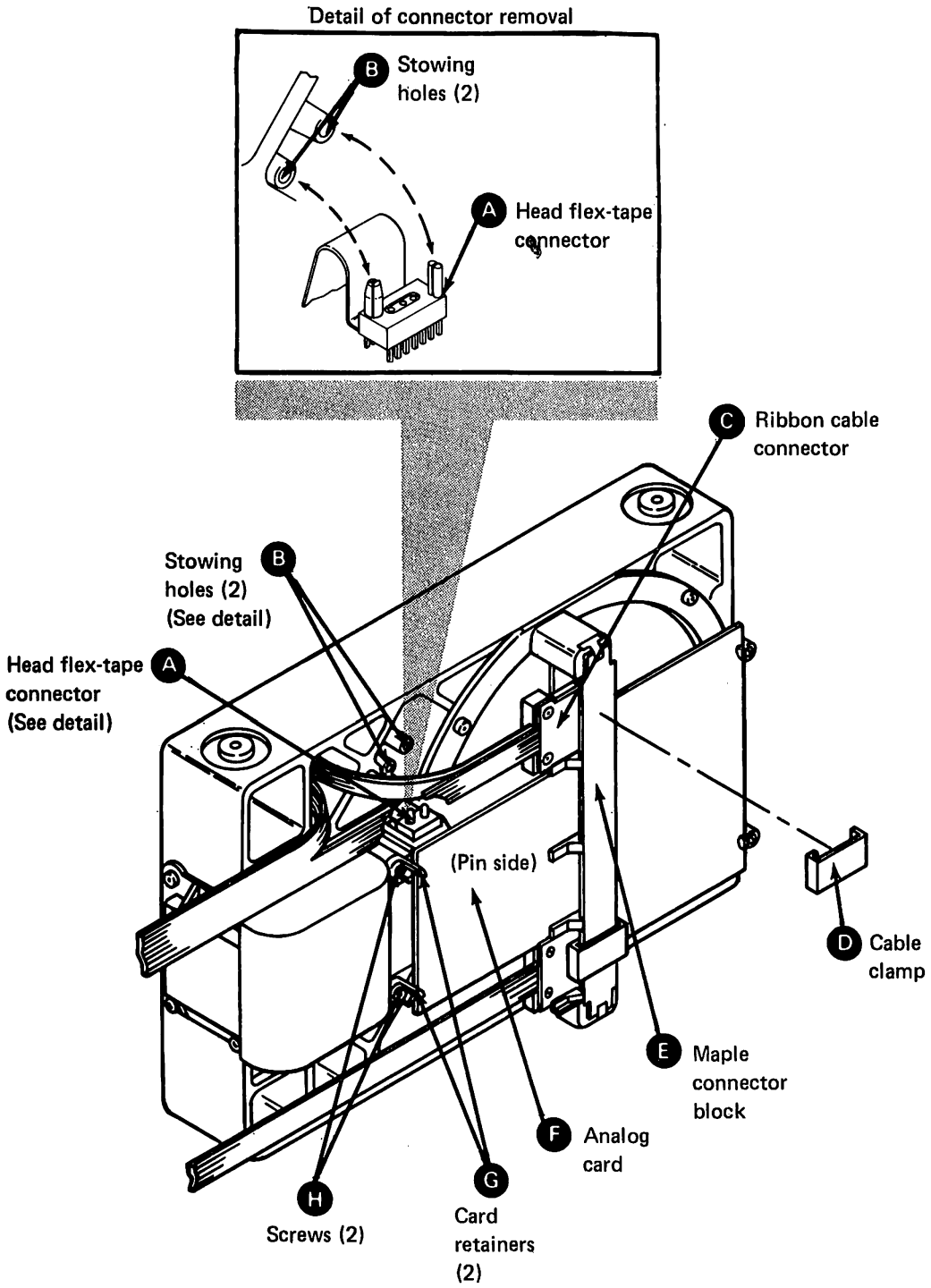
Removal

1. Switch off the 5247 power and wait until the Power indicator goes off.
2. Place the DASD in the Service position (6180).
3. To obtain access to the head flex-tape connector (A), remove the cable clamp (D) and unplug the ribbon cable connector (C), located directly above the analog card (F).

   Warning: The head flex cable is easily damaged and it cannot be replaced in the field.
4. Carefully disconnect the head flex-tape connector (A) and insert the two posts on the top of this connector in the stowing holes (B).
5. Loosen the two screws (H) and turn the two card retainers (G) counterclockwise approximately 180 degrees. Slightly tighten the two screws (H) to hold the retainers away from the card.
6. Disconnect the analog card from the maple connector block (E). Unsnap the card guide from the analog card, then slide the label from the CE test points off the analog card. Keep both of these items for use on the replacement analog card.

Replacement

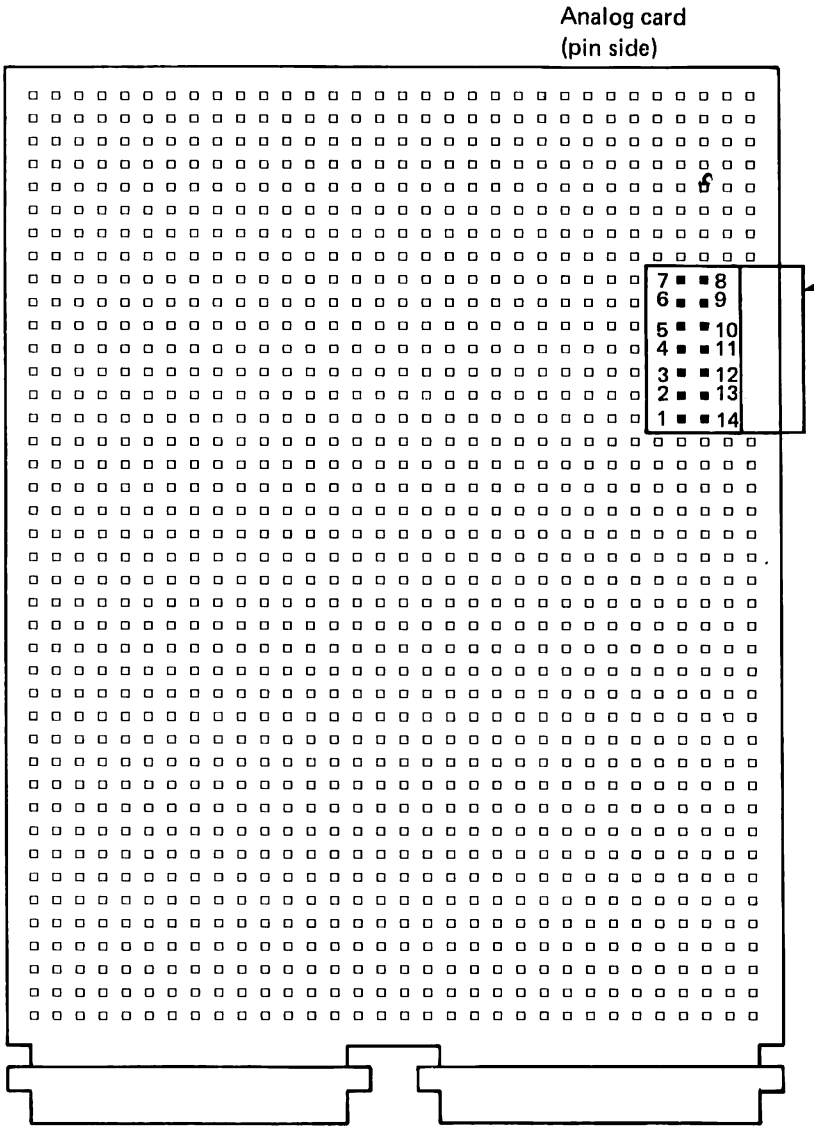
1. Snap the card guide onto the pin side of the analog card. Next, slide the label for the CE test points on the analog card. Then, install the analog card (F) into the maple connector block (E) with the parts side of the card facing toward the DASD casting.
2. Loosen the two screws (H), then turn the two card retainers (G) fully clockwise. Ensure that the analog card is in each retainer notch, then tighten the two screws (H).
3. Remove the head flex-tape connector (A) from the stowing holes and connect it to the connector on the top of the analog card.
4. Connect the ribbon cable connector (C) (directly above the analog card) to the maple connector block; install the cable clamp (D).
5. Install the DASD in the 5247 enclosure (6180).


Detail of connector removal
B Stowing holes (2)
A Head flex-tape connector
C Ribbon cable connector
Stowing holes (2) (See detail)
B
Head flex-tape connector (See detail)
A
(Pin side)
D Cable clamp
E Maple connector block
F Analog card
G Card retainers (2)
H Screws (2)

Maintenance procedures

6190 Analog card (continued)

CE test points



1 – Head select A
2 + Arm electronics R/W data
3 – 5 volts
4 – Arm electronics module error
5 + 5 volts
6 – Arm electronics module enable
7 Ground
8 – Card interlock
9 Ground
10 – Head select B
11 Ground
12 – Version A2
13 – Arm electronics R/W data
14 – Write gate

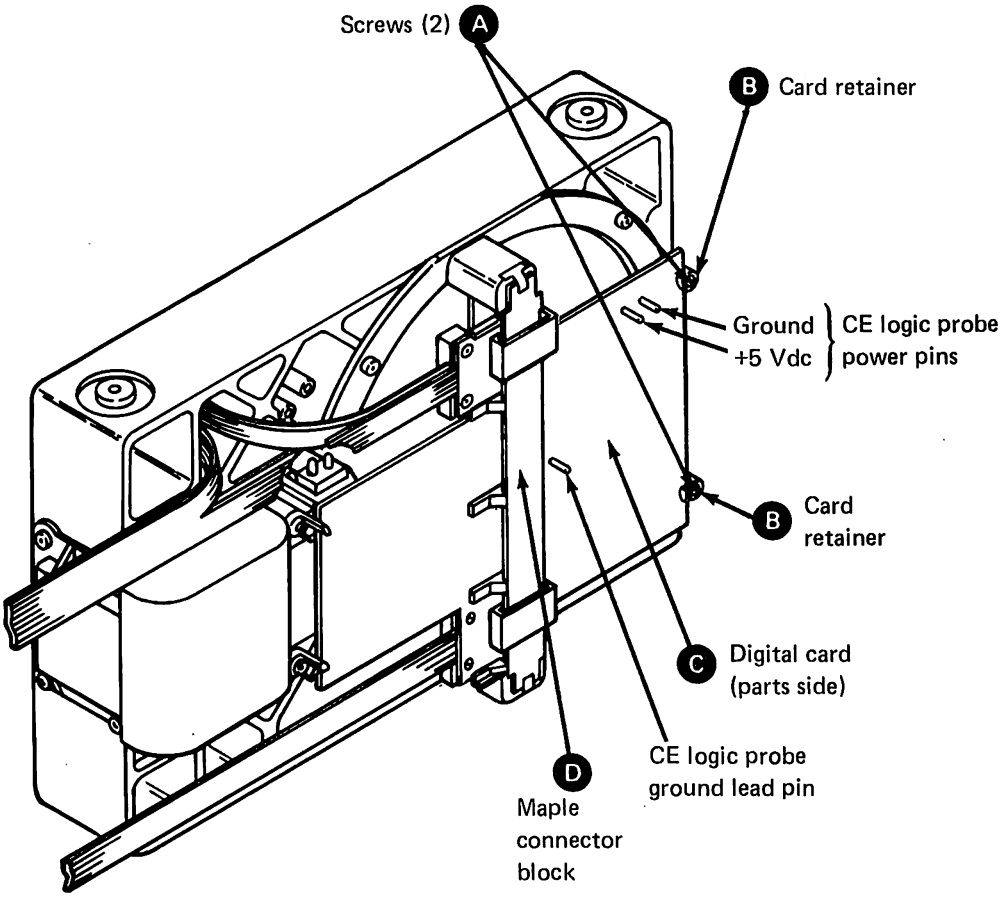
6200 Digital card

Removal

1. Switch off the 5247 power and wait until the Power indicator goes off.
2. Place the DASD in the Service position (6180).
3. Loosen the two screws (A) and turn the two card retainers (B) counterclockwise approximately 180 degrees. Slightly tighten the two screws (A) to hold the retainers away from the card.
4. Disconnect the digital card (C) from the maple connector block (D). Unsnap the card guide from the digital card and keep it for use on the replacement digital card.

Replacement

1. Snap the card guide onto the pin side of the digital card. Then, install the digital card (C) into the maple connector block (D) with the parts side of the card facing away from the DASD casting.
2. Loosen the two screws (A), then turn the two card retainers fully clockwise. Ensure that the digital card is in each retainer notch, then tighten the two screws (A).
3. Install the DASD in the 5247 enclosure (6180).



Maintenance procedures

6210 Motor/actuator card

Service check

1. Switch off the 5247 power and wait until the Power indicator goes off.
2. Place the DASD in the Service position (6180).

To check the head-lock solenoid, perform the following two steps:

a. Mark and disconnect the two-position connector (P3-B) from the motor/actuator card (A).

b. Set the CE meter to the ohms RX1 position. Connect the meter test leads across the contacts (7 and 8) of the connector (P3-B). The CE meter should indicate 24 (±5) ohms.

To check the actuator (voice) coil, perform the following two steps:

a. Mark and disconnect the five-position connector (P3-A) from the motor/actuator card (A).

b. Set the CE meter to the ohms RX1 position. Connect one meter test lead to P3-A, pin 1, and connect the other meter test lead to P3-A, pin 3. The CE meter should indicate approximately 20 ohms.

Note: This measurement is very sensitive to movement of the DASD.

To check the motor windings, perform the following five steps:

a. Mark and disconnect the 10-position connector (P4) from the motor/actuator card (A).

b. Set the CE meter to the ohms RX1 position. Connect one meter test lead to P4, pin 1, and connect the other meter test lead to P4, pin 6. The CE meter should indicate 1.6 (+0.2, -0.1) ohms for the phase 2 motor winding resistance.

c. Remove the meter test lead from P4, pin 6, and connect it to P4, pin 5. The CE meter should indicate 1.6 (+0.2, -0.1) ohms for the phase 4 motor winding resistance.

d. Remove the meter test lead from P4, pin 5, and connect it to P4, pin 4. The CE meter should indicate 1.6 (+0.2, -0.1) ohms for the phase 1 motor winding resistance.

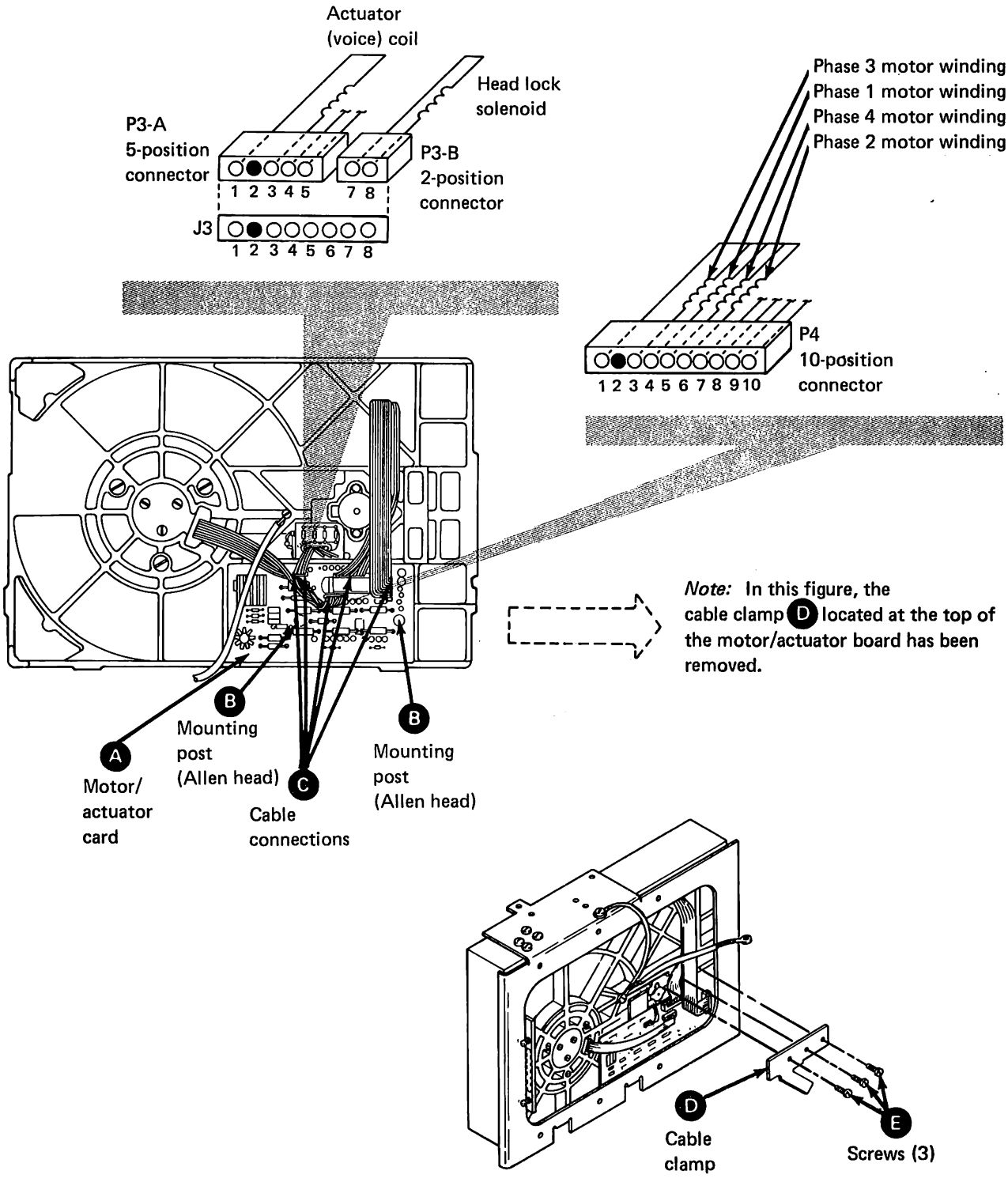
e. Remove the meter test lead from P4, pin 4, and connect it to P4, pin 3. The CE meter should indicate 1.6 (+0.2, -0.1) ohms for the phase 3 motor winding resistance.

Removal

1. Switch off the 5247 power and wait until the Power indicator goes off.
2. Place the DASD in the Service position (6180).
3. Remove the three screws (E) and the cable clamp (D).
4. Mark and disconnect all cable connections (C) from the motor/actuator card (A).
5. Use a 3-mm Allen wrench to loosen the two mounting posts (B), then remove the motor/actuator card.

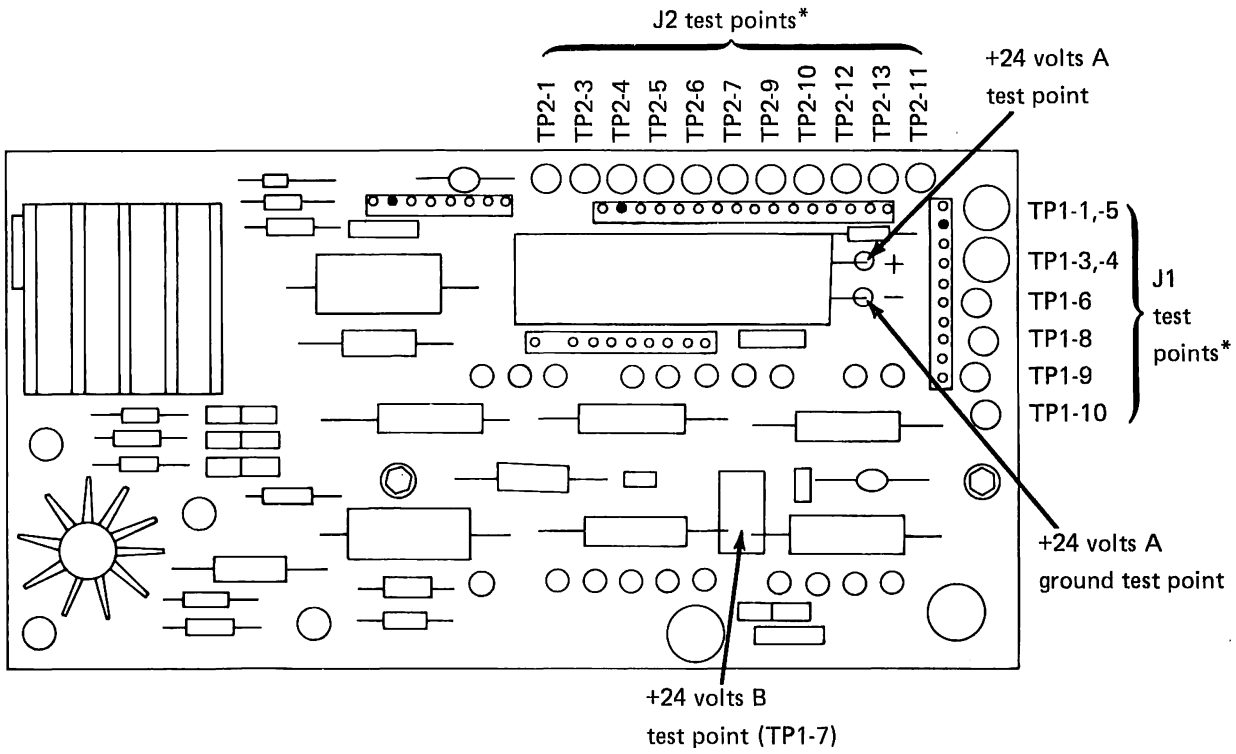
Replacement

1. Insert the motor/actuator card into the casting with the parts side of the card facing away from the DASD casting.
2. Use a 3-mm Allen wrench to tighten the two mounting posts (B).
3. Connect all the cable connections (C) to the motor/actuator card (A).
4. Install the cable clamp (D); hold the clamp in place with the screws (E).
5. Install the DASD in the 5247 enclosure (6180).


Actuator
(voice) coil
Head lock
solenoid
P3-A
5-position
connector
1 2 3 4 5
7 8
P3-B
2-position
connector
J3
1 2 3 4 5 6 7 8
Phase 3 motor winding
Phase 1 motor winding
Phase 4 motor winding
Phase 2 motor winding
P4
10-position
connector
1 2 3 4 5 6 7 8 9 10
Note: In this figure, the cable clamp D located at the top of the motor/actuator board has been removed.
A
Motor/
actuator
card
B
Mounting
post
(Allen head)
C
Cable
connections
B
Mounting
post
(Allen head)
D
Cable
clamp
E
Screws (3)

6210 Motor/actuator card (continued)

CE test points



J1 Connector (System power)

Pin	Function	*TP
10	–5 volts	TP1-10
9	+5 volts	TP1-9
8	Logic ground (power supply ground)	TP1-8
7	24 volts B	TP1-7
6	24 volts B ground	TP1-6
5	24 volts A	TP1-5
4	+24 volts A ground	TP1-4
3	+24 volts A ground	TP1-3
2	Key	–
1	+24 volts A	TP1-1

J2 Connector (Drive cable)

Pin	Function	*TP
16	Logic gnd for CE use	–
15	Not used	–
14	Not used	–
13	+ Actuator predrive	TP2-13
12	– Actuator predrive	TP2-12
11	+ Actuator unlock	TP2-11
10	– Power on reset (POR)	TP2-10
9	+ Overcurrent	TP2-9
8	Logic ground	–
7	– Phase 4	TP2-7
6	– Phase 3	TP2-6
5	– Phase 2	TP2-5
4	– Phase 1	TP2-4
3	+ Hall sensor 1	TP2-3
2	Key	–
1	+ Hall sensor 2	TP2-1

J3 Connector (Actuator and head lock solenoid)

Pin	Function
1	Actuator drive
2	Polarized plug
3	Actuator drive
4	Gain adjustment
5	Logic ground
**6	Not used
7	– Pick/hold head lock
**8	+ Pick/hold head lock

J4 Connector (Motor)

Pin	Function
10	+ 5 volts
9	+ Hall sensor 2
8	+ Hall sensor 1
7	Logic ground
6	– Phase 2 drive
5	– Phase 4 drive
4	– Phase 1 drive
3	– Phase 3 drive
2	Key
1	+ 24 volts A

*TP is a test point
**J3-6 and J3-8 are common.

Maintenance procedures

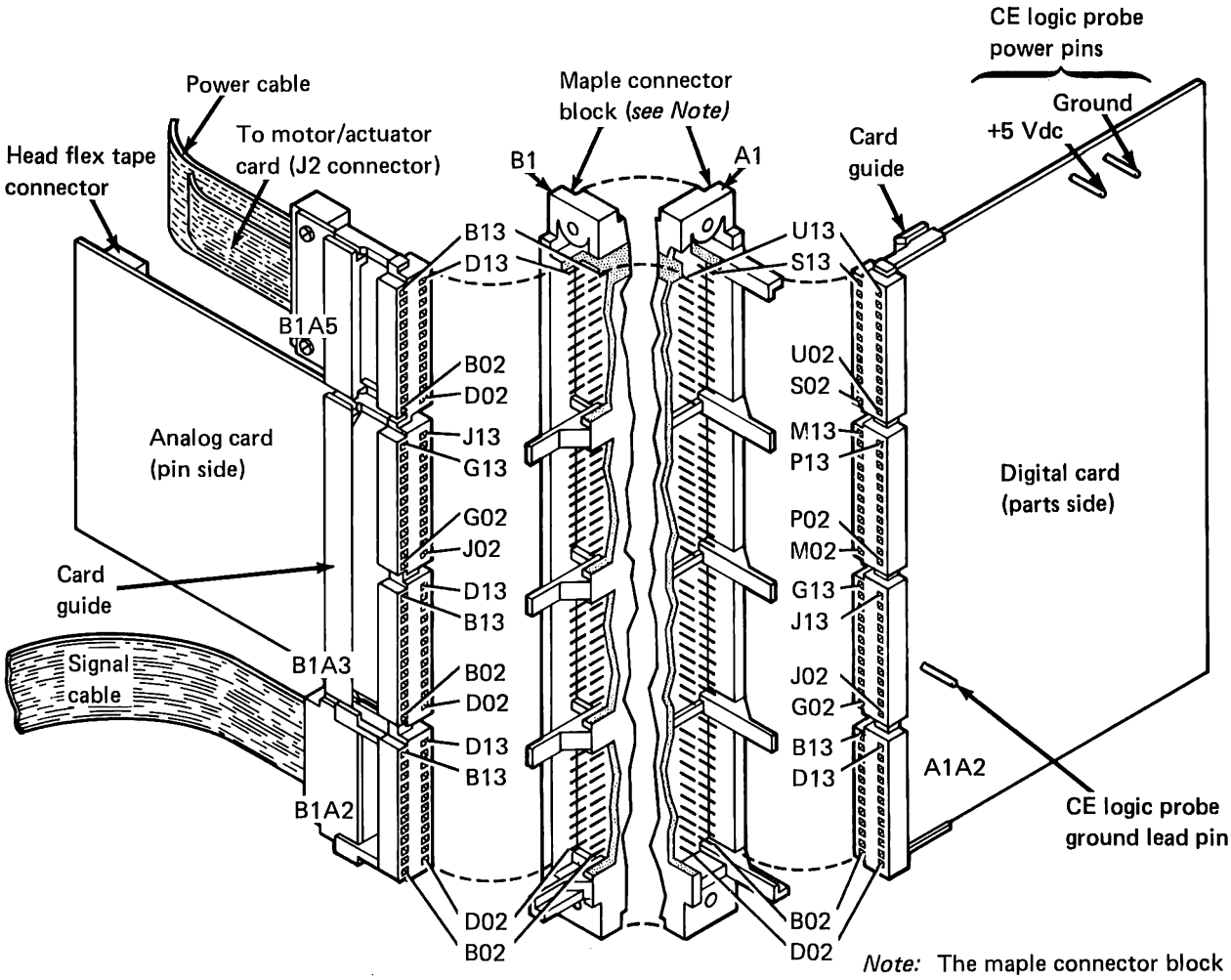
6220 Maple connector block

Removal

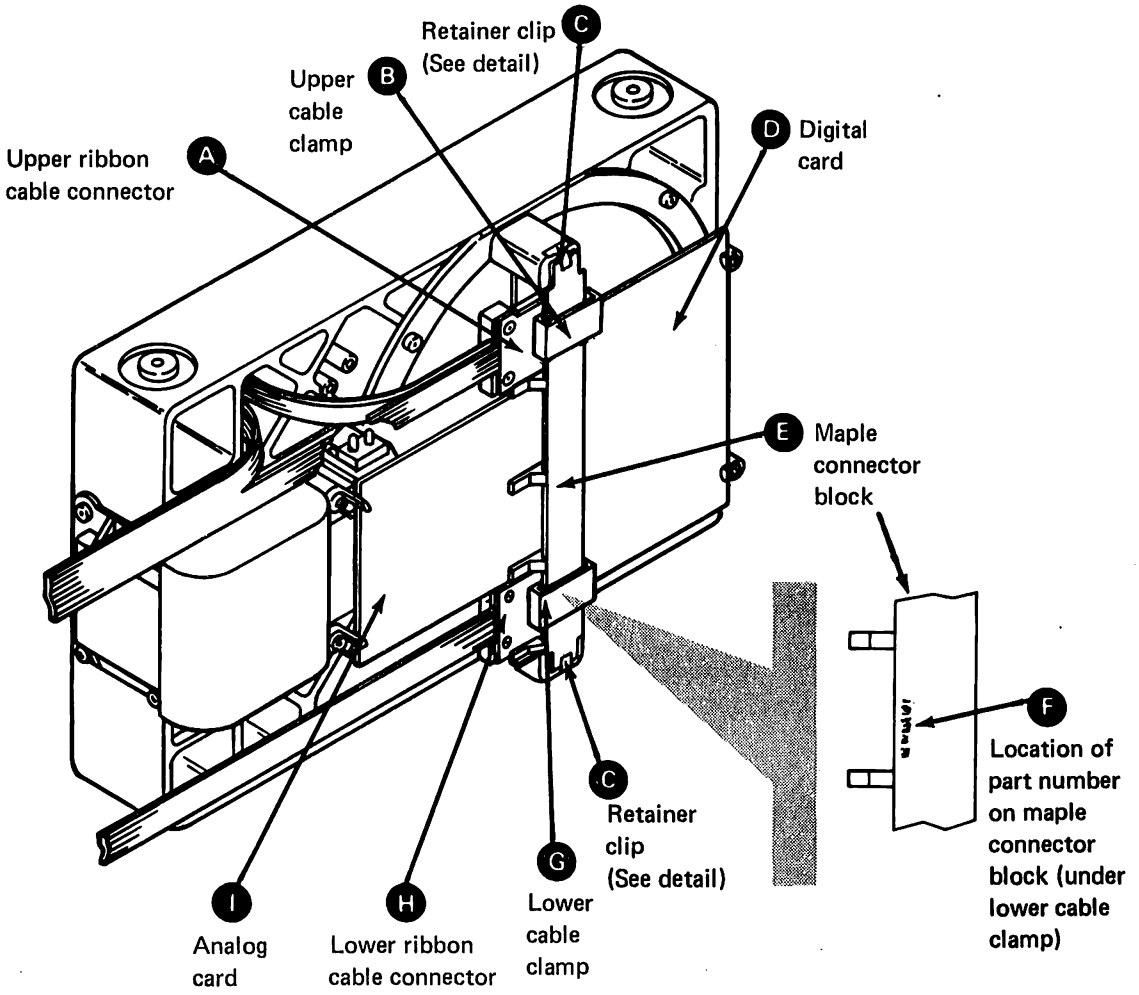
1. Switch off the 5247 power and wait until the Power indicator goes off.
2. Place the DASD in the Service position (6180).
3. Remove the upper cable clamp Ⓑ and disconnect the upper ribbon cable connector Ⓐ.
4. Remove the lower cable clamp Ⓖ and disconnect the lower ribbon cable connector Ⓗ.
5. Remove the analog card Ⓘ (6190).
6. Remove the digital card Ⓓ (6200).
7. Pry off the two retainer clips Ⓒ with a small flat-blade screwdriver, then remove the maple connector block Ⓔ.

Replacement

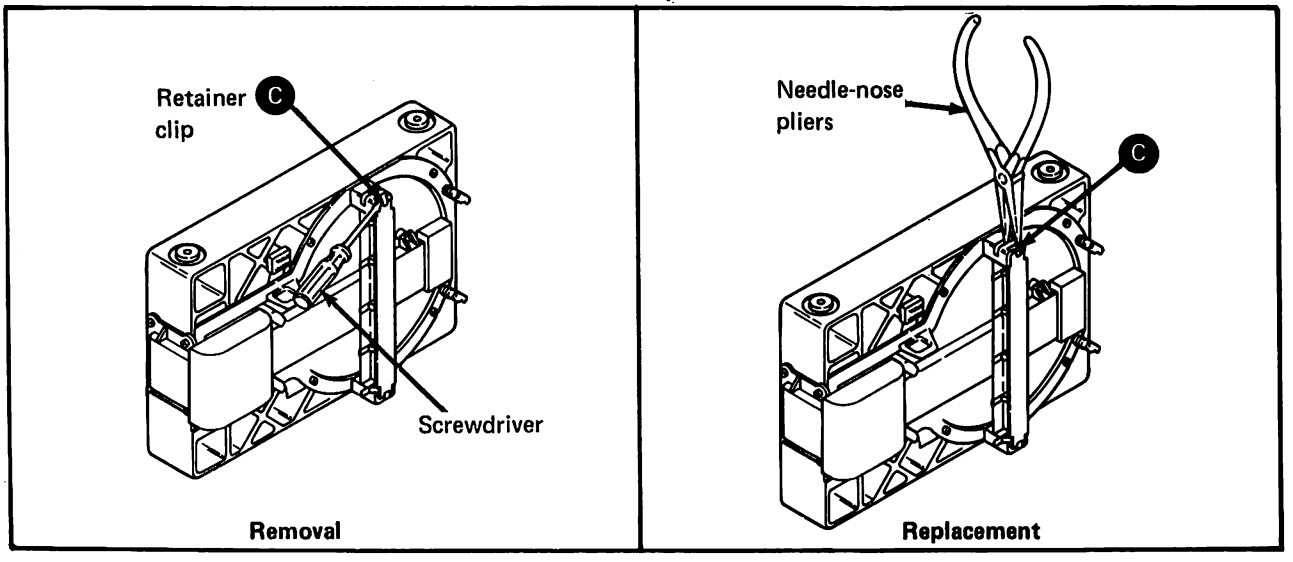
1. Locate the part number Ⓕ on the maple connector block Ⓔ. Insert the block into the casting with the part number facing out and toward the analog card Ⓘ as shown in the figure.
2. Hold the maple connector block in place with the two retainer clips Ⓒ. Use needle-nose pliers to fasten the clips in place.
3. Install the digital card Ⓓ (6200).
4. Install the analog card Ⓘ (6190).
5. Connect the lower ribbon cable connector Ⓗ and install the lower cable clamp Ⓖ.
6. Connect the upper ribbon cable connector Ⓐ and install the upper cable clamp Ⓑ.
7. Install the DASD in the 5247 enclosure (6180).



Note: The maple connector block is one piece; it is shown separated into two pieces for illustrative purposes only.



Retainer clip detail



Maintenance procedures

6240 Shock mounts

Removal

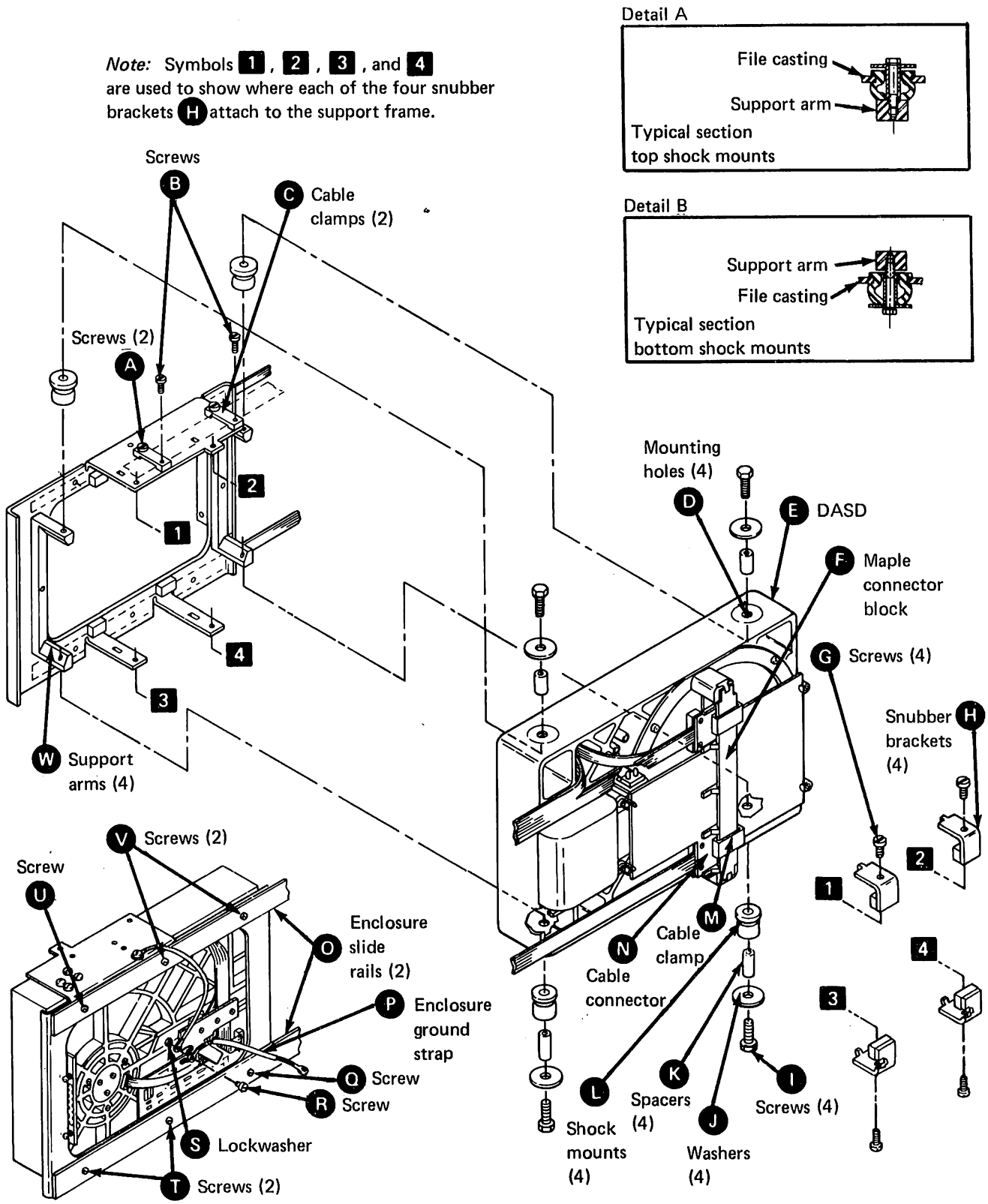
1. Switch off the 5247 power and wait until the Power indicator goes off.
2. Place the DASD (E) in the Service position (6180).
3. Disconnect the enclosure ground strap (P) by removing the screw (R) and the lockwasher (S).
4. On the top surface of the DASD, loosen the two screws (A) and remove the other two screws (B); then, slide the ribbon cable out of the two cable clamps (C).
5. Remove the cable clamp (M) and disconnect the cable connector (N). Move the ribbon cable out of the work area.

   Warning: Care must be taken to prevent damage to the DASD when it is not installed in the normal shock mounts.

   Note: The DASD weighs 7.3 kg (16.1 lb) and can be lifted by one person.
6. Remove the four screws (V) and (T).
7. Give support to the DASD and remove the screw (Q); let the rear edge of the DASD gently rest on the enclosure. Note this position of the DASD for replacement.
8. While still supporting the DASD, remove the last screw (U) that holds the DASD to the enclosure slide rails (O). Carefully place the DASD on a flat surface.
9. Remove the four screws (G) and remove the four snubber brackets (H).
10. Remove the four screws (I) and the four washers (J) from the shock mounts (L); separate the DASD from the four support arms (W).
11. Grasp the round end of each shock mount (L) and pull the shock mount out of its mounting hole (D).
12. Remove the spacer (K) from the center of each shock mount.

Replacement

1. With the DASD (E) on a flat surface and the maple connector block (F) facing up, insert the shock mount (L) into the mounting hole (D) with the round end of the shock mount facing down as shown. The flat portion of the shock mount should extend through the mounting hole as shown in Details A and B.
2. Repeat step 1 for the remaining three shock mounts.
3. Place the DASD onto the four support arms (W) so that the holes through the center of the shock mounts are aligned with the holes through the support arms.
4. Insert spacer (K) into the center of one of the shock mounts. Then install the washer (J), and insert the screw (I) through the hole in the shock mount; finger-tighten the screw (I).
5. Repeat step 4 for the remaining three shock mounts. Then, tighten the four screws (I).
6. Install the four snubber brackets (H) and the four screws (G).
7. While resting the rear edge of the DASD on the enclosure, lift the front of the DASD to align its top-front mounting hole with the hole in the top enclosure slide rail. Insert and finger-tighten the screw (U).
8. Lift up the rear of the DASD and install the screw (Q).
9. Install the four screws (V) and (T); tighten the six screws (Q), (T), (U), and (V).
10. Connect the cable connector (N) and install the cable clamp (M).
11. Insert the ribbon cable under the two cable clamps on the top surface of the DASD. Install the two screws (B) and tighten the four screws (A) and (B).
12. Run the enclosure ground strap (P) between the DASD and the enclosure frame, then attach the enclosure ground strap to the DASD with the screw (R) and the lockwasher (S).
13. Install the DASD in the 5247 enclosure (6180).


Detail A
File casting
Support arm
Typical section
top shock mounts
Detail B
Support arm
File casting
Typical section
bottom shock mounts
Note: Symbols 1 , 2 , 3 , and 4 are used to show where each of the four snubber brackets H attach to the support frame.
Screws
B
C Cable clamps (2)
Screws (2)
A
2
1
4
3
W Support arms (4)
Mounting holes (4)
D
E DASD
F Maple connector block
G Screws (4)
Snubber brackets (4)
H
1
2
4
3
V Screws (2)
Screw
U
O Enclosure slide rails (2)
P Enclosure ground strap
Q Screw
R Screw
S Lockwasher
T Screws (2)
M
N Cable clamp
Cable connector
L
K
J
I Screws (4)
Spacers (4)
Shock mounts (4)
Washers (4)

Maintenance procedures

6250 Power supply

Removal

> ***DANGER***
> ***Hazardous voltages are generated in the power supply. Before removing the power supply, switch off the 5247 power and disconnect the power cable from the ac service outlet.***

1. Switch off the 5247 power and wait until the Power indicator goes off. Then, disconnect the power cable from the ac service outlet.
2. Open the rear cover (6120) and disconnect the power cable from the rear of the power supply.
3. Remove the front cover (6100).
4. Mark and disconnect all cable connectors (A) from the power supply (K), including the cable connector on the top surface of the supply. Do not disconnect the jumper plug P5 from the power supply (6020).

   Note: Lockwashers (B) and (I) are located between the power supply mounting brackets and the enclosure. You must remove the power supply from the enclosure to locate the lockwashers.
5. Remove the two screws (F) and (H) that hold the top-front mounting bracket and the bottom-front mounting flange to the enclosure.

   Note: Remove the P7 and P8 power supply cables from the cable clamps on the power supply.
6. Pull the power supply slightly away from the side of the enclosure, then slide the power supply out of the front of the 5247 enclosure.
7. Locate and remove the two lockwashers that were behind the power supply mounting brackets.

Replacement

Note: If you are installing a new power supply, check that the correct selection has been made for the ac line voltage. See "AC line voltage selection."

1. Place the power supply (K) in the enclosure so that the top-rear mounting bracket (D) and the bottom-rear mounting flange (G) slide under the enclosure mounting clips (E).

   Note: To maintain electromagnetic compatibility (EMC) integrity, the power supply lockwashers (B) and (I) must be installed when you are replacing the power supply.
2. Lift the front edge of the power supply slightly, and slide the lockwasher (I) between the bottom-front mounting flange (J) and the enclosure.
3. Insert the screw (H) through the hole in the flange and the lockwasher, and finger-tighten the screw.
4. Pull the top of the power supply slightly away from the side of the enclosure. While holding the power supply in this position, use needle-nose pliers to slide the lockwasher (B) between the top-front mounting bracket and the enclosure. Next, insert the screw (F) through the hole in the bracket and the lockwasher, and tighten the screw (F). Then tighten screw (H).
5. Reconnect all the cable connectors to the power supply. Verify that the correct ac line voltage selection has been made for the new power supply. See "AC line voltage selection."

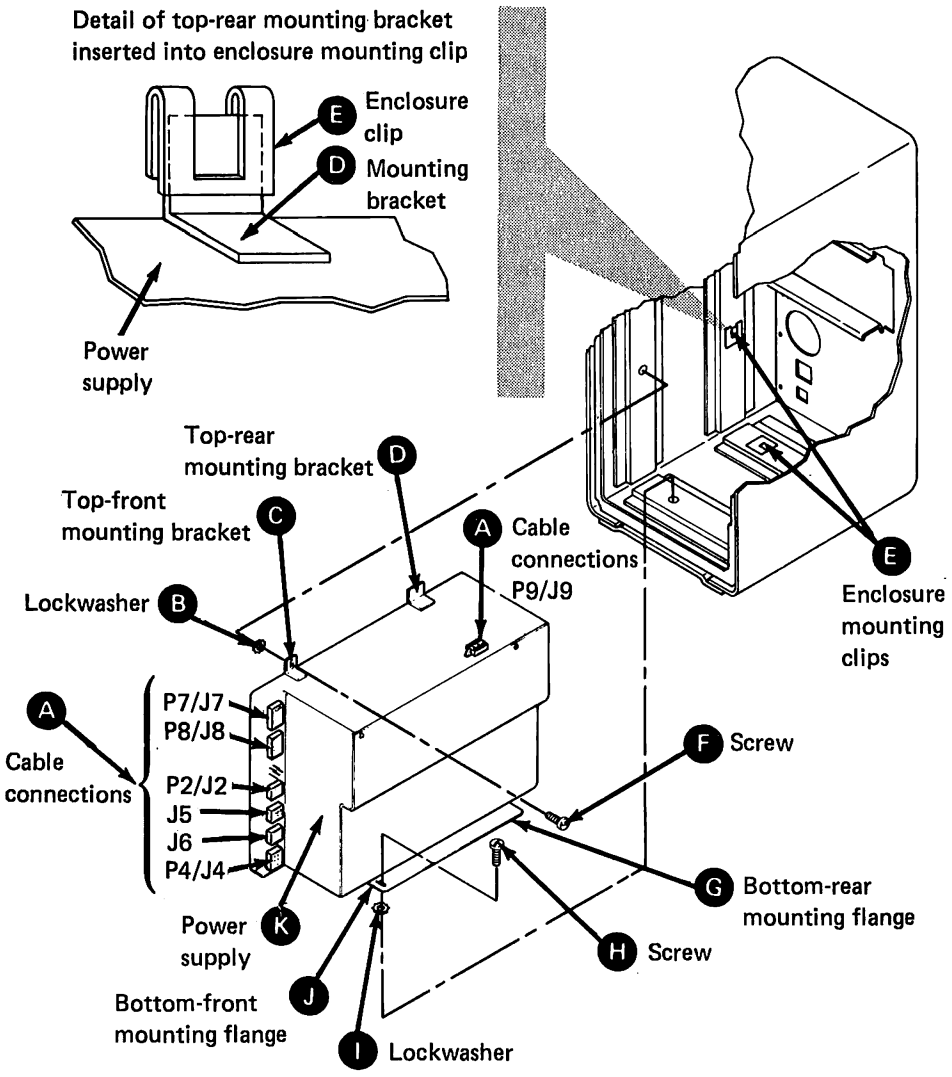
   Note: Insert the P7 and P8 power supply cables into the cable clamps on the power supply.
6. Install the front cover (6100).
7. Connect the power cable to the rear of the power supply, then close the rear cover (6120).

AC line voltage selection

DANGER
Hazardous voltages are generated in the power supply. Before making the ac line voltage selection, switch off the 5247 power and disconnect the power cable from the ac service outlet.

1. Switch off the 5247 power and wait until the Power indicator goes off. Then, disconnect the power cable from the ac service outlet.
2. Remove the front cover (6100).
3. Measure the ac input voltage at the customer's ac service outlet.
4. See the "Note" on the ac voltage distribution diagram (6020), and insert plug P5 into the correct power supply connector (J5 or J6) for the ac voltage measured in step 3.

   Note: If the ac line voltage selection plug is inserted into the wrong connector, no damage will result to the power supply. However, the power supply will not supply the needed output voltages for correct operation of the 5247.
5. Install the front cover (6100).



Maintenance procedures

6260 Power switch

Service check

> ***DANGER***
> ***AC line voltage is present at the power switch terminals even when the switch is in the off position. Before removing the power switch, disconnect the power cable from the service outlet.***

1. Switch off the 5247 power and wait until the Power indicator goes off. Then, disconnect the power cable from the ac service outlet.
2. Remove the front cover (6100).
3. Unscrew (counterclockwise) and remove the Emergency Pull knob (H).
4. Squeeze the sides of the operating panel (A) and then remove the panel by pulling it off.
5. Unsnap and fold down the front half of the indicator holder (I).
6. Remove the green and the red indicators from the indicator holder; do not disconnect the wires going to the indicators. Place the indicators and the attached cable assembly on top of the switch cover (G) so that they are out of the work area.

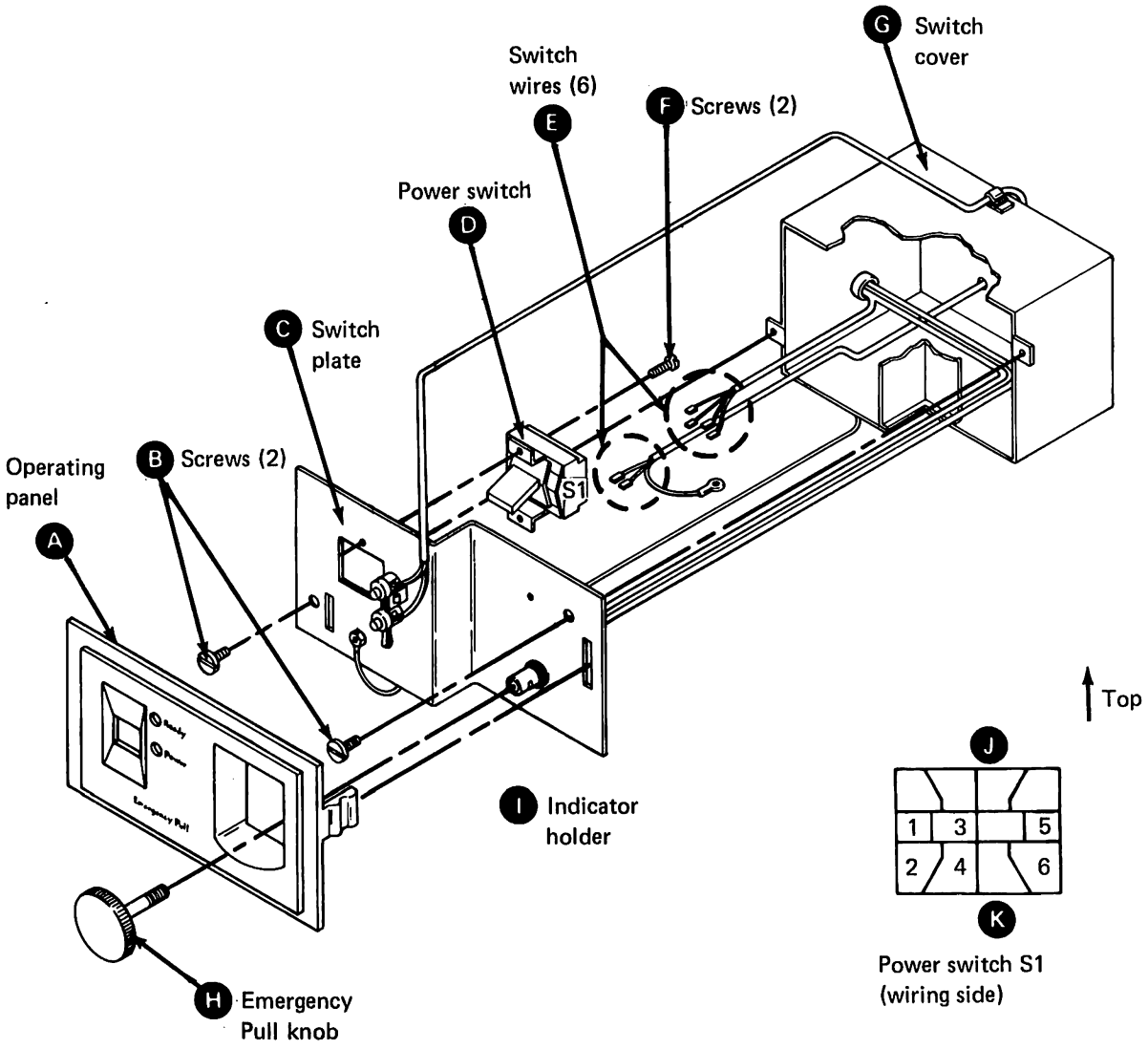
   Note: If the indicator leads become disconnected, the longest lead of each pair of wires connects to the white dot terminal of the indicator.
7. Remove the two screws (B) to separate the switch plate (C) from the switch cover (G).
8. Mark and disconnect the six wires (E) from the rear of the power switch (D).
9. Set the CE meter switch to the ohms RX1 position. Connect one meter test lead to power switch terminal 1 (J), and connect the other meter test lead to power switch terminal 2 (K). 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.
10. Use the same procedure as in step 9 and check between power switch terminals 3 (J) and 4 (K).
11. Use the same procedure as in step 9 and check between power switch terminals 5 (J) and 6 (K).

Removal

1. Perform steps 1 through 8 of the Service check.
2. Remove the two screws (F), then remove the power switch (D).

Replacement

1. Place the power switch (D) on the switch plate (C) and install the two screws (F).
2. Connect the six wires (E) to the rear of the power switch.
3. Place the switch plate and the switch cover together, then install and tighten the two screws (B).
4. Insert the green indicator into the upper portion of the indicator holder (I) and insert the red indicator into the lower portion of the holder.
5. Snap the two halves of the indicator holder together.
6. Install the operating panel (A).
7. Install the Emergency Pull knob (H).
8. Install the front cover (6100).
9. Connect the power cable to the ac service outlet.


G Switch cover
Switch wires (6)
E
F Screws (2)
Power switch
D
C Switch plate
B Screws (2)
Operating panel
A
S1
I Indicator holder
H Emergency Pull knob
Top
J
1
3
5
2
4
6
K
Power switch S1 (wiring side)

Maintenance procedures

6270 Emergency power off (EPO) switch

Service check

> ***DANGER***
> ***AC line voltage is present at the emergency power off switch terminals even when the switch is in the off position. Before removing the emergency power off switch, disconnect the power cable from the service outlet.***

1. Switch off the 5247 power and wait until the Power indicator goes off. Then, disconnect the power cable from the ac service outlet.
2. Remove the front cover (6100).
3. Unscrew and remove the Emergency Pull knob (K).
4. Squeeze the sides of the operating panel (A) and then remove the panel by pulling it off.
5. Unsnap and fold down the front half of the indicator holder (D).
6. Remove the green and the red indicators from the indicator holder; do not disconnect the wires going to the indicators. Place the indicators and the attached cable assembly on top of the switch cover (E) so that they are out of the work area.

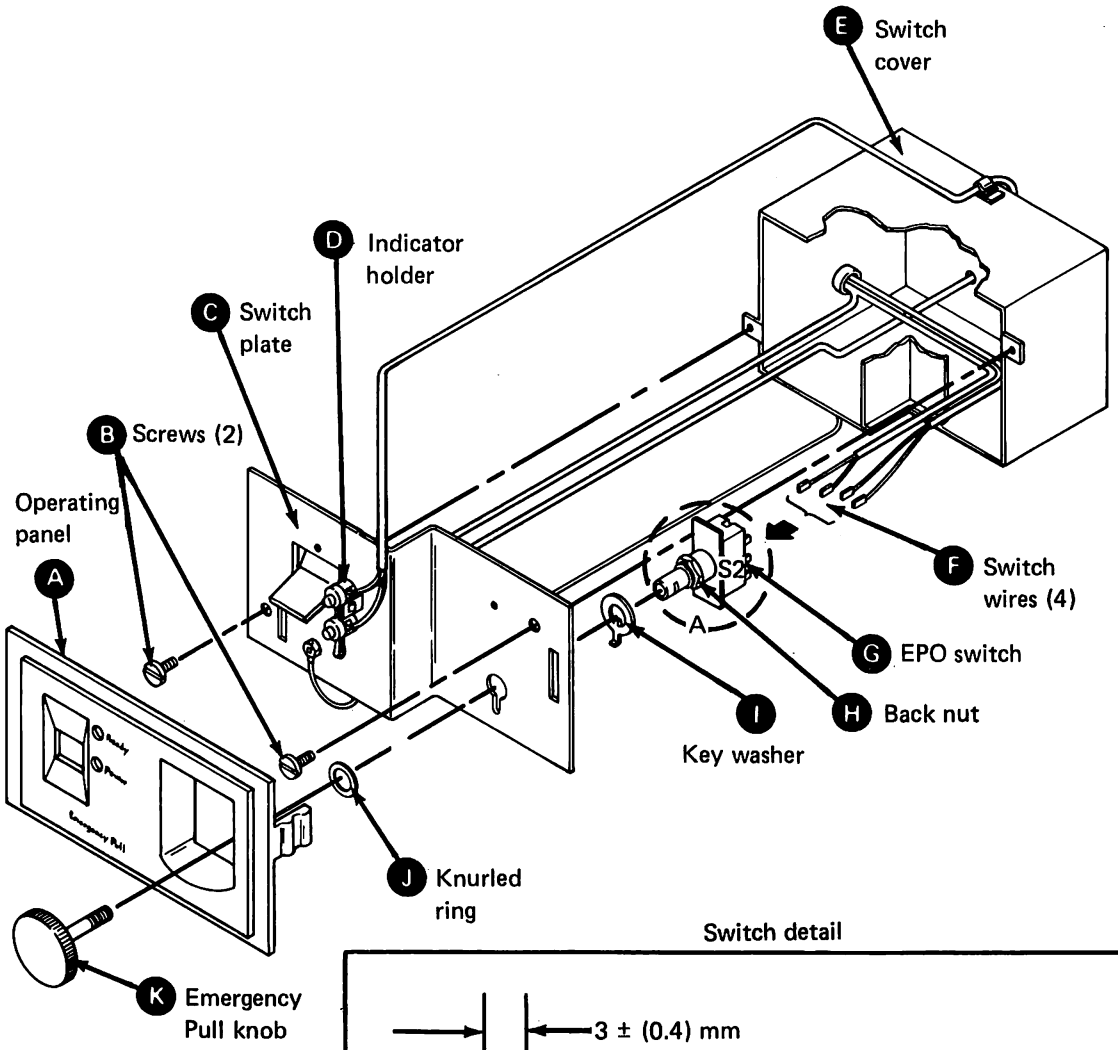
   Note: If the indicator leads become disconnected, the longest lead of each pair of wires connects to the white dot terminal of the indicator.
7. Remove the two screws (B) to separate the switch plate (C) from the switch cover (E).
8. Mark and disconnect the four wires (F) from the rear of the EPO switch (G).
9. Set the CE meter switch to the ohms RX1 position. Connect one meter test lead to EPO switch terminal 2 (L), and connect the other meter test lead to EPO switch terminal 3 (M). With the EPO switch in the reset (pushed-in) position, the CE meter should indicate a short circuit. With the EPO switch in the activated (pulled-out) position, the CE meter should indicate an open circuit.
10. Use the same procedure as in step 9 and check between EPO switch terminals 5 (L) and 6 (M).

Removal

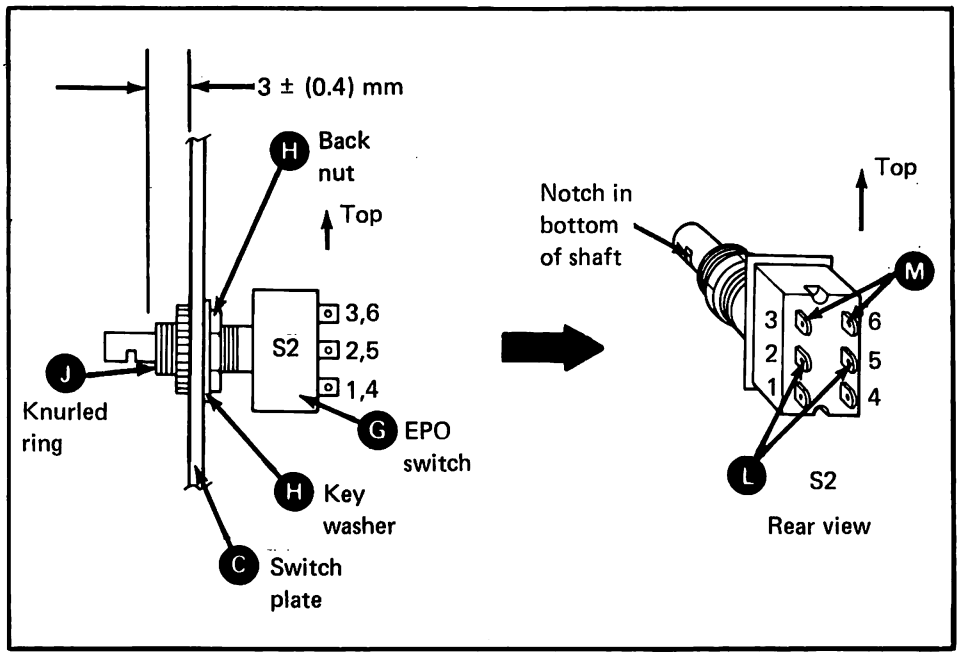
1. Perform steps 1 through 8 of the Service check.
2. Remove the knurled ring (J), key washer (I), and EPO switch (G).

Replacement

1. Check that the shaft of the EPO switch (G) is pushed in fully. Then, place the key washer (I) on the shaft of the EPO switch. Insert the shaft through the opening in the switch plate (C). Install and finger-tighten the knurled ring (J) on the end of the shaft. Turn the back nut (H) to tighten these items together and to obtain the shaft protrusion shown in the switch detail.
2. Connect the four wires (F) to the rear of the EPO switch.
3. Place the switch plate and the switch cover together, then install and tighten the two screws (B).
4. Insert the green indicator into the upper portion of the indicator holder (D) and insert the red indicator into the lower portion of the holder.
5. Snap the two halves of the indicator holder together.
6. Install the operating panel (A).
7. Install the Emergency Pull knob (K).
8. Install the front cover (6100).
9. Connect the power cable to the ac service outlet.



Switch detail



Maintenance procedures

6280 Power indicator

Service check

1. Switch off the 5247 power and wait approximately 20 seconds.
2. Remove the front cover (6100).
3. Unscrew and remove the Emergency Pull knob (F).
4. Squeeze the sides of the operating panel (A) and then remove the panel by pulling it off.
5. Unsnap and fold down the front half of the indicator holder (E).
6. Mark the wire connected to the terminal of the lower (red) indicator (C) that is next to a white dot. (This is the cathode terminal.)
7. Disconnect both wires (D) from the red indicator.

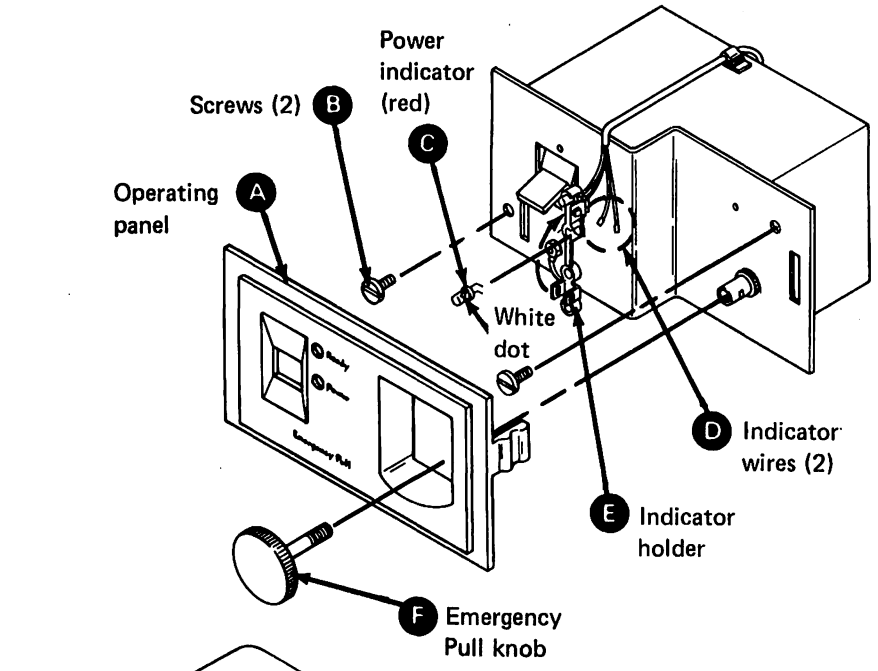
   Note: The wire that has been marked should be slightly longer than the other wire.
8. Disconnect P11 (I) from the base planar board (J).
9. Set the CE meter switch to the ohms RX1 position. Connect one meter test lead to P11, pin 1 (G), and connect the other meter test lead to the indicator cable wire that was marked in step 6. The CE meter should indicate a short circuit.
10. Use the same procedure as in step 9 and check between P11, pin 4 (H), and the indicator cable wire that is not marked. The CE meter should indicate a short circuit.

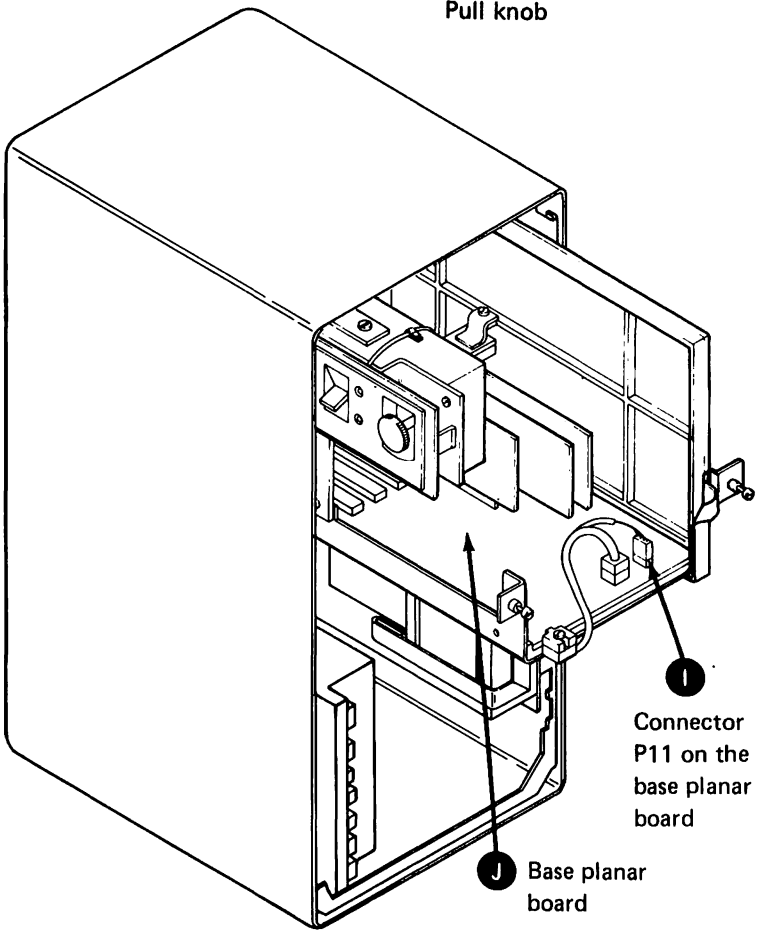
Removal

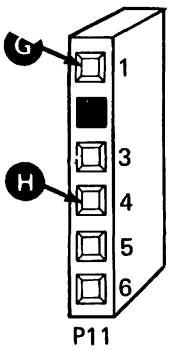
1. Perform steps 1 through 6 of the Service check.
2. Disconnect both wires (D) from the red indicator (C) and remove the red indicator.

Replacement

1. Connect the two wires (D) to the new red indicator (C). Connect the marked wire to the indicator terminal that is next to the white dot.
2. Insert the red indicator (C) into the lower portion of the indicator holder (E), then snap the indicator holder together.
3. Install the operating panel (A).
4. Install the Emergency Pull knob (F).
5. Install the front cover (6100).


Power indicator (red)
Screws (2)
B
C
Operating panel
A
White dot
D
Indicator wires (2)
E
Indicator holder
F
Emergency Pull knob


I
Connector P11 on the base planar board
J
Base planar board


G
1
H
3
4
5
6
P11

Maintenance procedures

6290 Ready indicator

Service check

1. Switch off the 5247 power and wait until the Power indicator goes off.
2. Remove the front cover (6100).
3. Unscrew and remove the Emergency Pull knob (F).
4. Squeeze the sides of the operating panel (A) and then remove the panel by pulling it off.
5. Unsnap and fold down the front half of the indicator holder (E).
6. Mark the wire connected to the terminal of the upper green indicator (C) that is next to a white dot. (This is the cathode terminal.)
7. Disconnect both wires (D) from the green indicator.

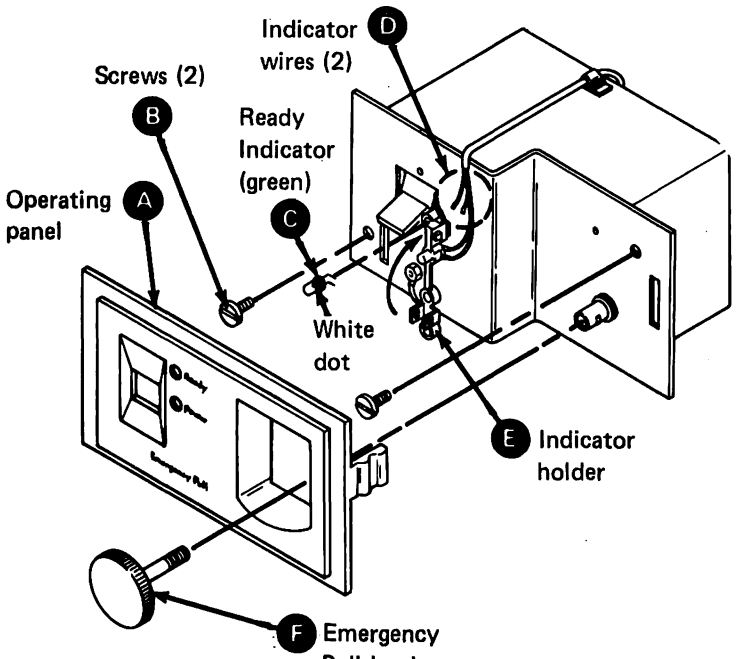
   Note: The wire that has been marked should be slightly longer than the other wire.
8. Disconnect P11 (I) from the base planar board (J).
9. Set the CE meter switch to the ohms RX1 position. Connect one meter test lead to P11, pin 1 (G), and connect the other meter test lead to the LED cable wire that was marked in step 6. The CE meter should indicate a short circuit.
10. Use the same procedure as in step 9 and check between P11, pin 3 (H), and the indicator cable wire that is not marked. The CE meter should indicate a short circuit.

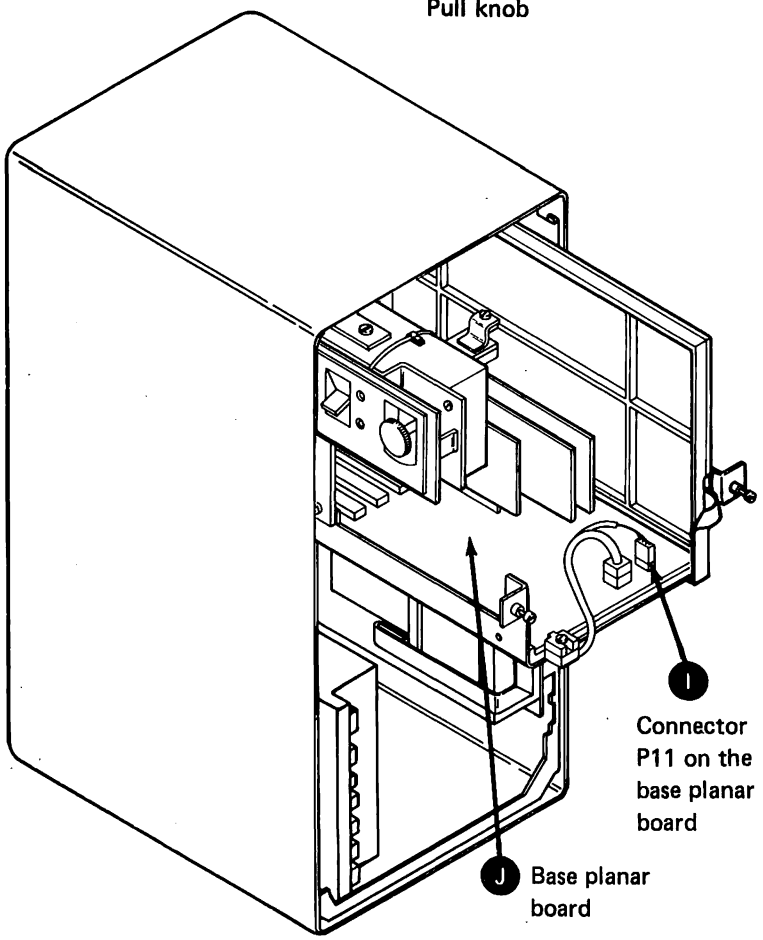
Removal

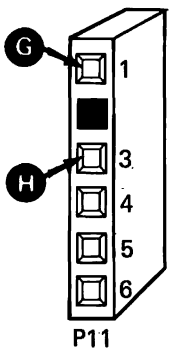
1. Perform steps 1 through 6 of the Service check.
2. Disconnect both wires (D) from the green indicator (C) and remove the green indicator.

Replacement

1. Connect the two wires (D) to the new green indicator (C). Connect the marked wire to the terminal that is next to the white dot.
2. Insert the green indicator (C) into the upper portion of the indicator holder (E), then snap the indicator holder together.
3. Install the operating panel (A).
4. Install the Emergency Pull knob (F).
5. Install the front cover (6100).


Indicator wires (2)
D
Screws (2)
B
Ready Indicator (green)
Operating panel
A
C
White dot
E
Indicator holder
F
Emergency Pull knob


I
Connector P11 on the base planar board
J
Base planar board


G
H
1
3
4
5
6
P11

Maintenance procedures

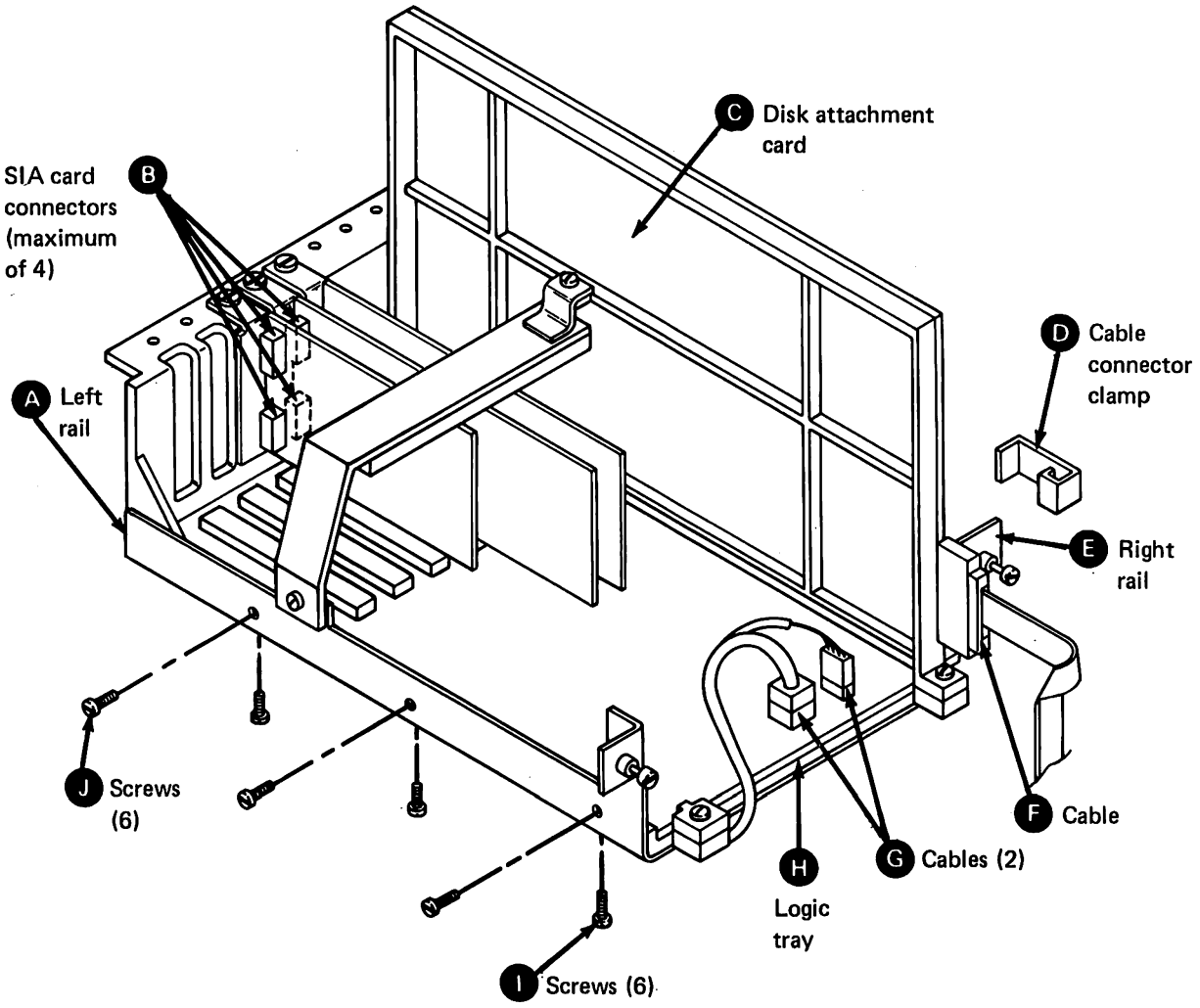
6300 Logic tray rail assemblies

Removal

1. Switch off the 5247 power and wait until the Power indicator goes off.
2. Open the rear cover (6120).
3. Mark and disconnect all work station cables attached to the SIA card connectors (B).
4. Place the switch box and the logic tray in the Service position (6130).
5. Remove the cable connector clamp (D). Mark and disconnect the two cables (G) from the logic tray (H) and the one cable (F) from the disk attachment card (C). Disconnect the cables from any cable clamps or retainers on the underside of the logic tray.
6. Remove the six screws (J) that hold the logic tray, and the rails (A) and (E), to the slides.
7. Give support to the logic tray board. Remove the six screws (I) from the rails and remove the rails.

Replacement

1. Install the rails on the logic tray (H) with the six screws (I).
2. Install the logic tray and rails on the slides with the screws (J).
3. Connect the two cables (G) to the logic tray. Connect the one cable (F) to the disk attachment card (C), then install the cable connector clamp (D). Insert the cables into any cable clamps or retainers on the underside of the logic tray.
4. Return the switch box and the logic tray to the Operating position (6130).
5. Attach the work station cables to the respective SIA card connectors (B).
6. Close the rear cover (6120).


C Disk attachment card
SIA card connectors (maximum of 4)
B
A Left rail
D Cable connector clamp
E Right rail
J Screws (6)
F Cable
G Cables (2)
H Logic tray
I Screws (6)

Maintenance procedures

6310 Logic fan assembly

Removal

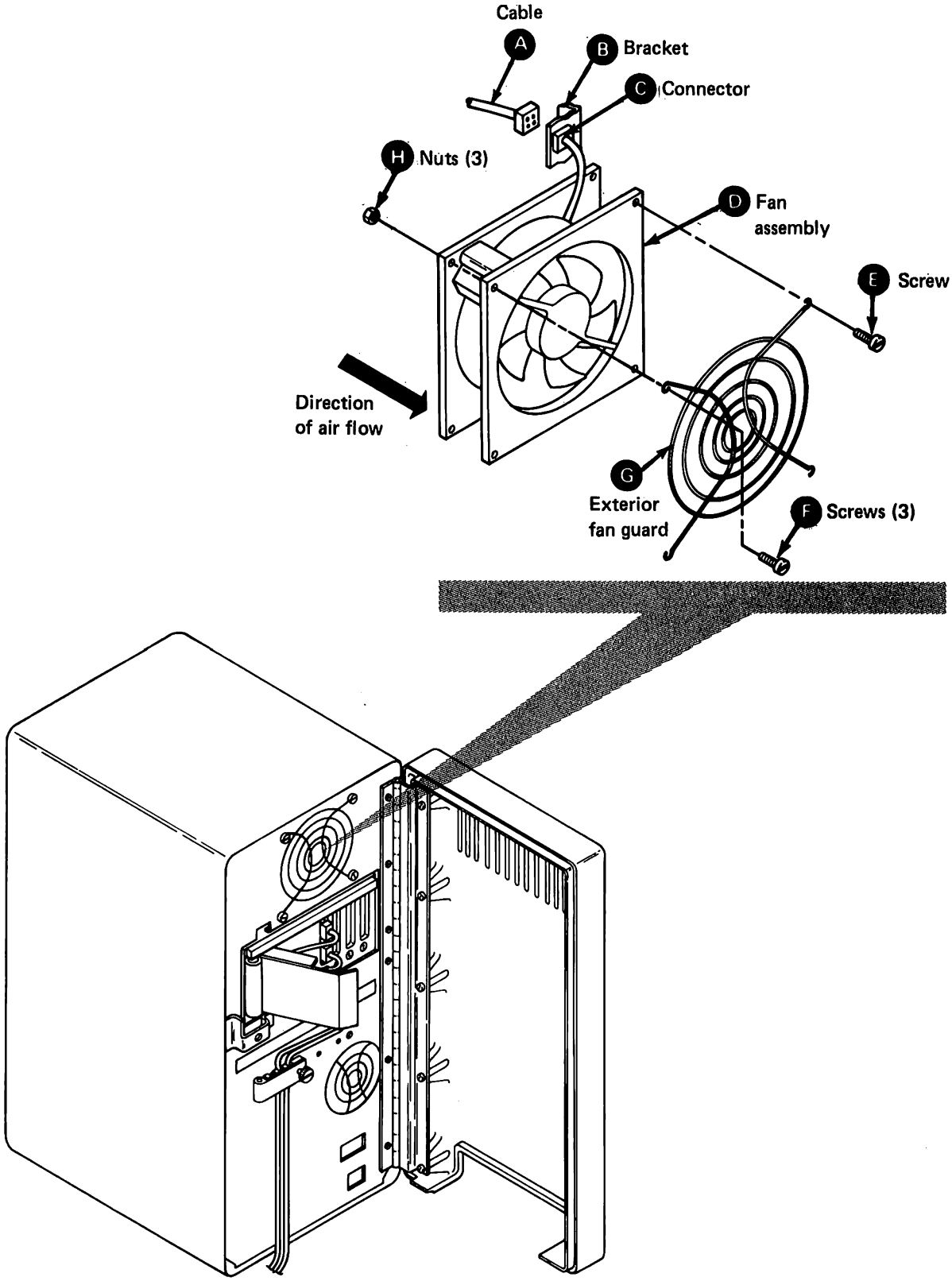
> ***DANGER***
> ***AC line voltage is located on the logic fan assembly connector. Before removing the logic fan assembly, disconnect the power cable from the service outlet.***

1. Switch off the 5247 power and wait until the Power indicator goes off. Then, disconnect the power cable from the ac service outlet.
2. Remove the front cover (6100).
3. Slide the logic tray out to the Service position (6130) to obtain rear access to the logic fan assembly.
4. Open the rear cover by pushing in the knob assembly and turning it counterclockwise.
5. Disconnect the cable (A) from the fan connector (C).
6. Remove the connector (C) from the bracket (B).
7. Remove the four screws (E) and (F), and the three nuts (H).
8. Remove the exterior fan guard (G) and the fan assembly (D).

Replacement

Note: The new fan assembly is supplied with an attached inside fan guard. The direction of air flow from the fan is marked on the fan assembly, and is toward the outside of the 5247.

1. Install the fan assembly (D) and the exterior fan guard (G) with the four screws (E) and (F), and the three nuts (H). Note that the short screw (E) threads into the upper right corner of the fan assembly. The other three screws (F) thread into nuts (H).
2. Install the fan connector (C) in the bracket (B).
3. Connect the cable (A) to the fan connector (C).
4. Close the rear cover by pushing in the knob assembly and turning it clockwise.
5. Return the logic tray to the Operating position (6130).
6. Install the front cover (6100).


Cable
A
B Bracket
C Connector
H Nuts (3)
D Fan assembly
E Screw
Direction of air flow
G Exterior fan guard
F Screws (3)

Maintenance procedures

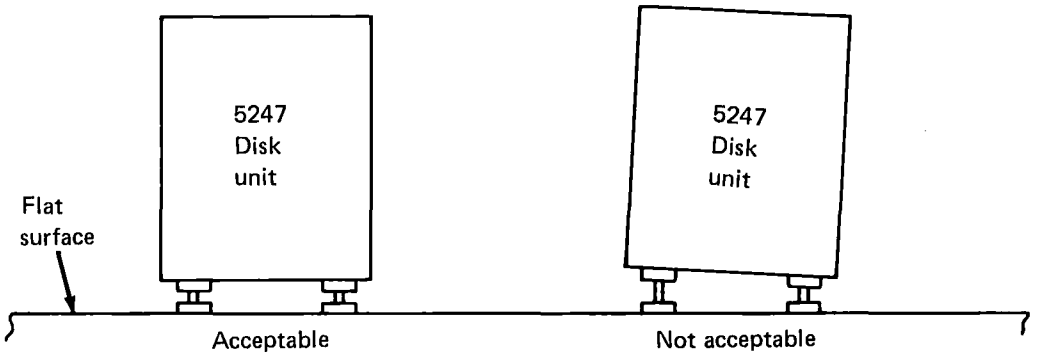
6320 Enclosure levelers

Service check

Make a visual check of the enclosure. The enclosure should be level and the glides (B) should all be on the same flat surface.

Adjustment

1. Switch off the 5247 power and wait until the Power indicator goes off.
2. Place a tool or another object under the bottom corner of the enclosure (A) to lift the glide (C) off the flat surface.
3. Loosen the nut (B).
4. Screw the glide in or out (as needed) to level the enclosure.
5. Tighten the nut.

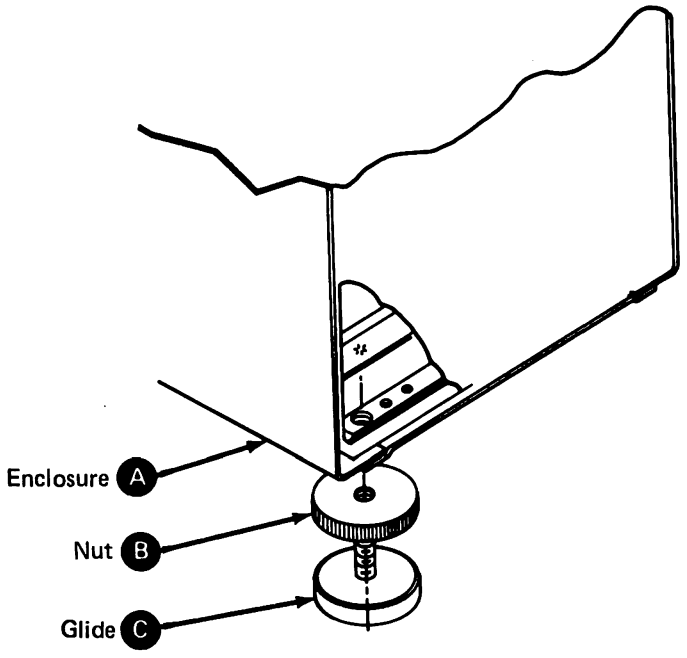


Removal

1. Switch off the 5247 power and wait until the Power indicator goes off.
2. Place a tool or another object under the bottom corner of the enclosure (A) to lift the glide (C) off the flat surface.
3. Loosen the nut (B).
4. Remove the glide and the nut.

Replacement

1. With the bottom corner of the enclosure (A) lifted off the flat surface, install the glide (C) and the nut (B).
2. Adjust the glide to level the enclosure.
3. Tighten the nut and lower the enclosure.

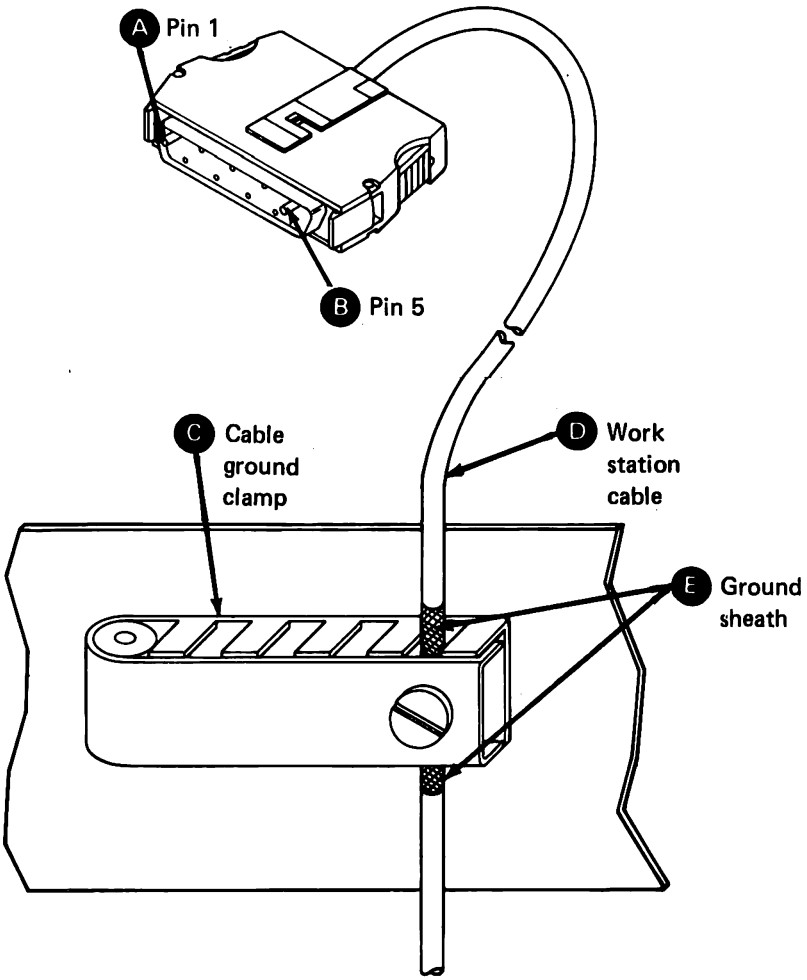


Maintenance procedures

6330 Work station signal cable check

Service check

1. Check that the ground sheath (E) at each end of the work station signal cable (D) is fastened securely in the cable ground clamp (C).
2. Disconnect the suspect work station signal cable from the 5247. **Do not disconnect the cable from the work station at this time..**
3. Set the CE meter switch to the ohms RX10 position. Connect one meter test lead to connector pin 1 (A), and connect the other meter test lead to connector pin 5 (B). The CE meter should indicate greater than 70 ohms, but less than 150 ohms.
4. Use the same procedure as in step 3 and check between pin 1 and the ground sheath (E) of the cable. The CE meter should indicate greater than 30 ohms, but less than 100 ohms.
5. Use the same procedure as in step 3 and check between connector pin 5 and the ground sheath (E) of the cable. The CE meter should indicate greater than 30 ohms, but less than 100 ohms.
6. If the preceding checks were all good, now disconnect the suspect work station signal cable from the work station.
7. Set the CE meter switch to the ohms RX1K position. Connect the meter leads between connector pin 1 and pin 5 at either end of the suspect work station signal cable. The CE meter should indicate an open circuit.



6340 System cables

Removal and replacement

No special instructions are needed for the removal and the replacement of the system cables. See 6030 for system cabling connection information. See 6006 and 6007 for cable routing information.

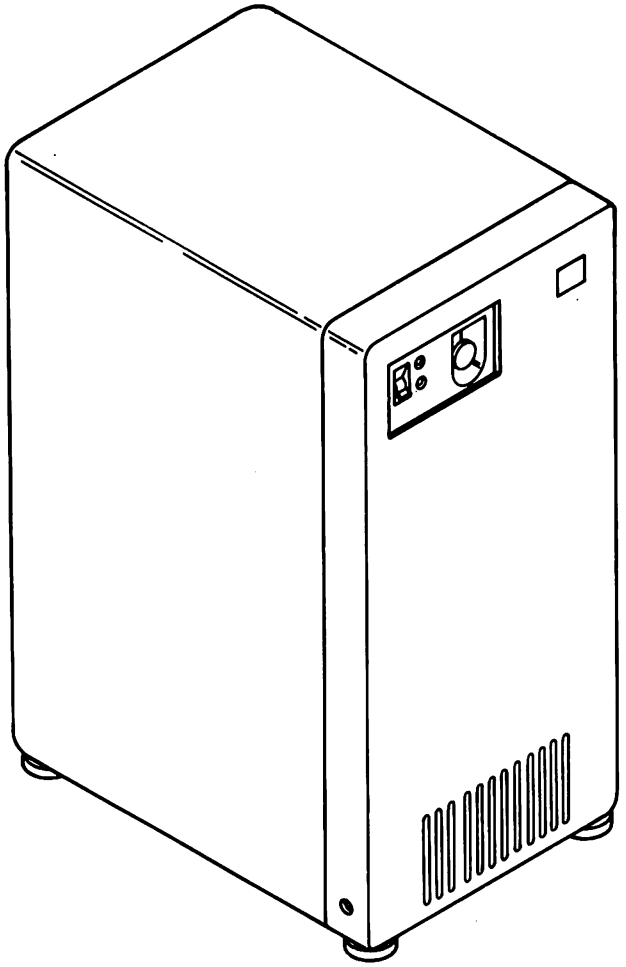
Chapter 3. Theory of operation

Contents

Theory of operation

Introduction

The IBM 5247 Disk Unit is a fixed-disk, shared storage device which operates under the direction of one or more System/23 computers (commonly referred to as work stations.) Each work station executes BASIC programs and Customer Support Functions (CSFs) in its own read/write storage, and views the 5247 Disk Unit as an extension of its I/O storage. File sharing is permitted between work stations, with the sharing being controlled by file OPEN and CLOSE statements. Where desired, file qualifier statements can be used to restrict the sharing of stored data.



Models

There are two models of the 5247—the Model 11 and the Model 12. Physically, the two models look the same, however, their storage capacities are different. The Model 11 has a storage capacity of 15.4 megabytes, and the Model 12 has a storage capacity of 30.8 megabytes. Conversion from one model to the other model can be performed in the field.

Typical system configurations

The standard 5247 configuration can attach to a maximum of two work stations. An optional expander card, which plugs into the 5247, permits attachment of the 5247 to two more work stations, increasing the system total to four work stations.

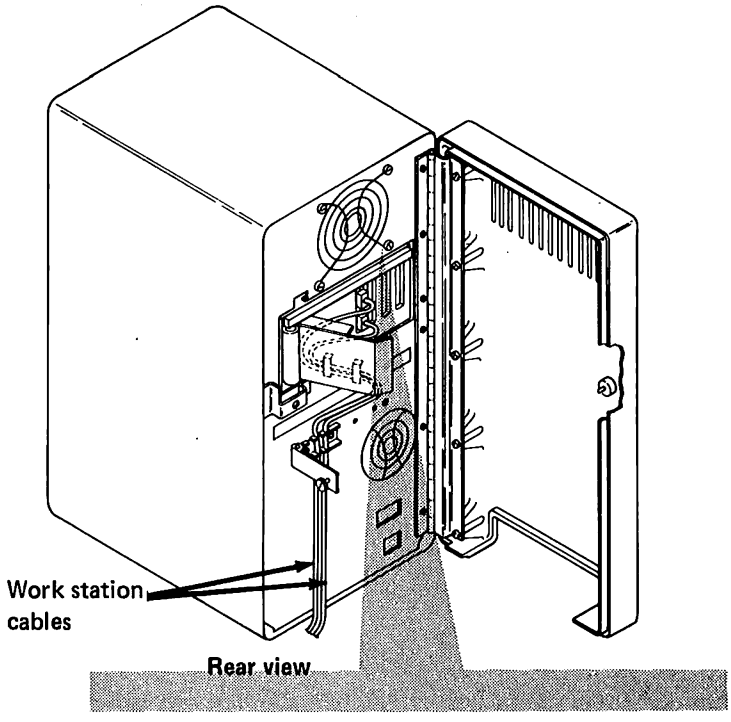
Each work station is attached individually to the 5247 by a pair of shielded, twisted wires. Precut cable assemblies are available in the following lengths to connect the 5247 to the work stations:

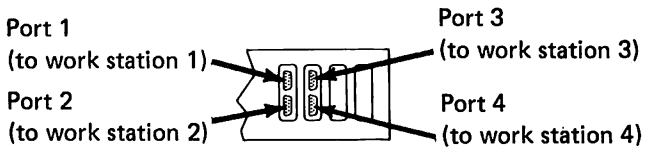
- 1.8 meters (5.9 feet)
- 4 meters (13.1 feet)
- 15 meters (49.2 feet)
- 30 meters (98.4 feet)
- 150 meters (492 feet)
- 300 meters (984 feet)

The work station cable assemblies must be connected to the port connectors on the customer access panel at the rear of the 5247 as follows:

Work station	5247 connector
No. 1	Port 1
No. 2	Port 2
No. 3	Port 3
No. 4	Port 4

If printers are desired, they may attach to each individual work station. Also, each work station may have an IBM System/23 diskette unit attached to it. Four typical system configurations are described in the following paragraphs.





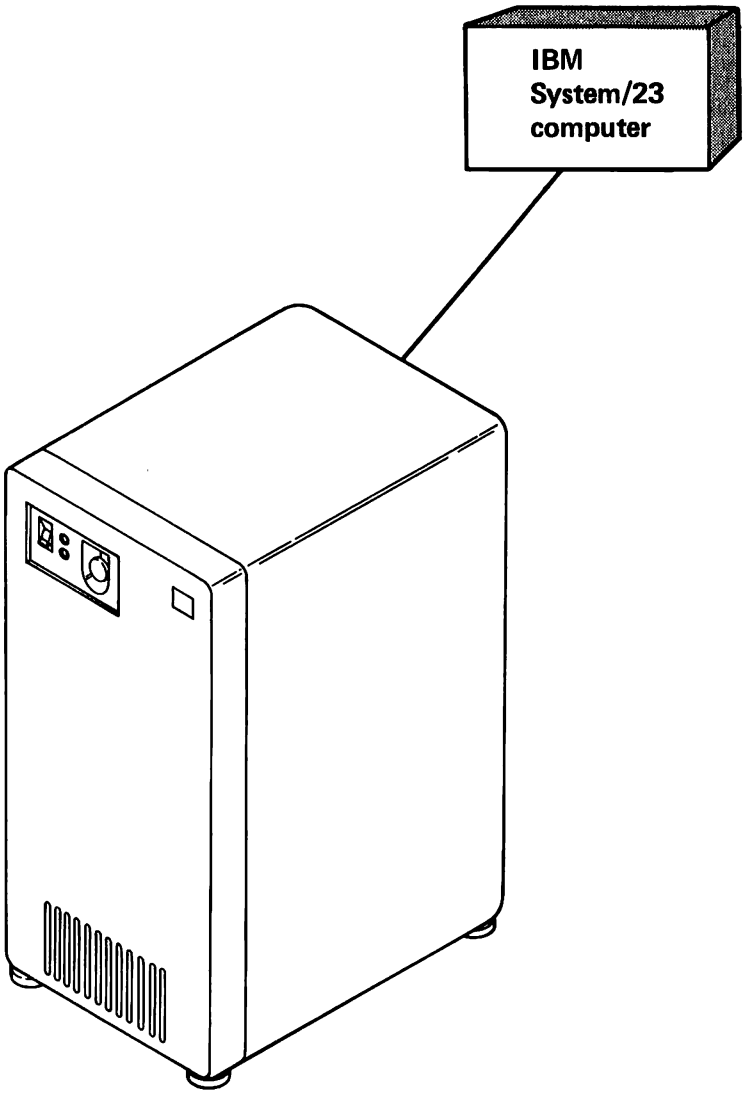
Theory of operation

Introduction (continued)

One work station. The minimum system configuration consists of:

- One System/23 computer with one diskette drive
- One 5247 Disk Unit

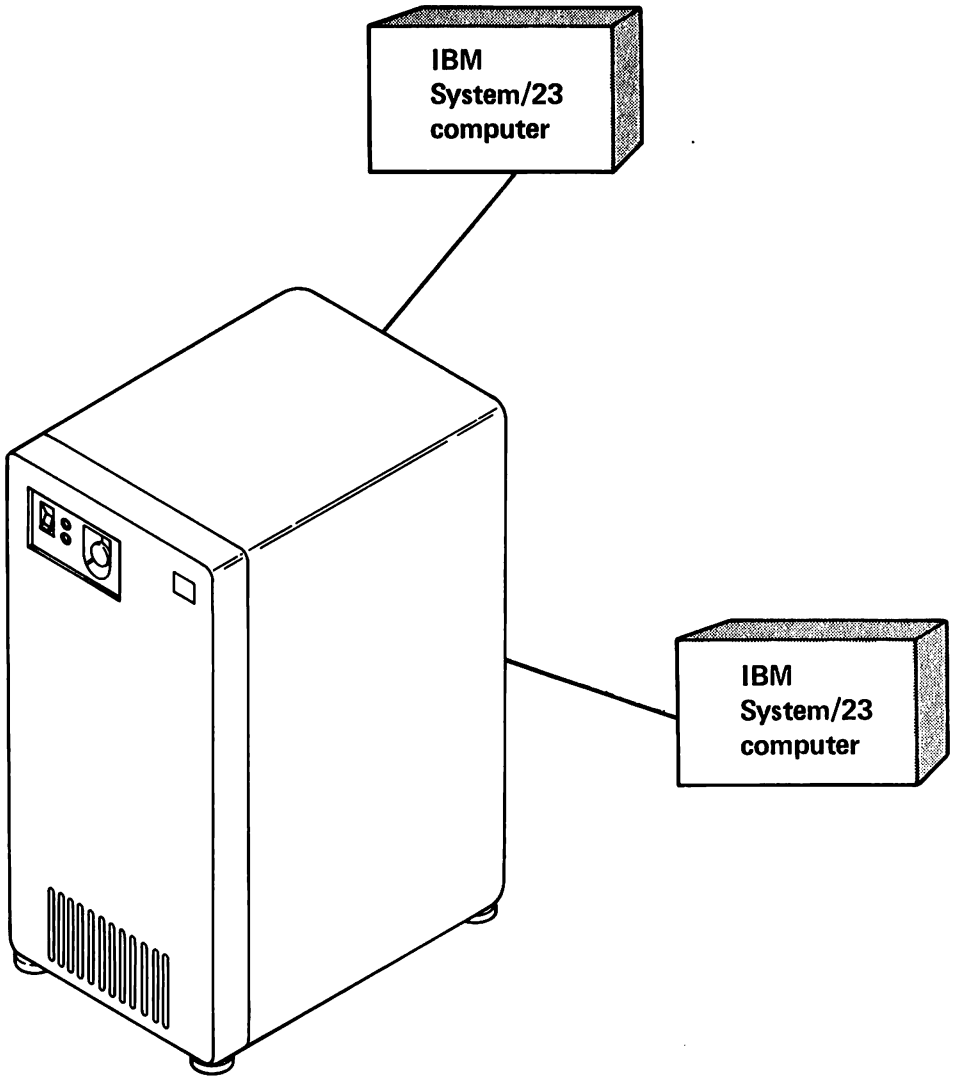
The System/23 computer must be connected to port 1 of the 5247 and contain, or have access to, at least one diskette drive. Also, this work station has to be within 4 meters (13.1 feet) and must be located in the same room as the 5247.



Two work stations. A system with two work stations consists of:

- Two System/23 computers
- One 5247 Disk Unit

The work station connected to port 1 of the 5247 must contain, or have access to, at least one diskette drive; this work station has to be within 4 meters (13.1 feet) and must be located in the same room as the 5247. The second work station (connected to port 2 of the 5247) may have access to 0, 1, 2, 3, or 4 diskette drives.



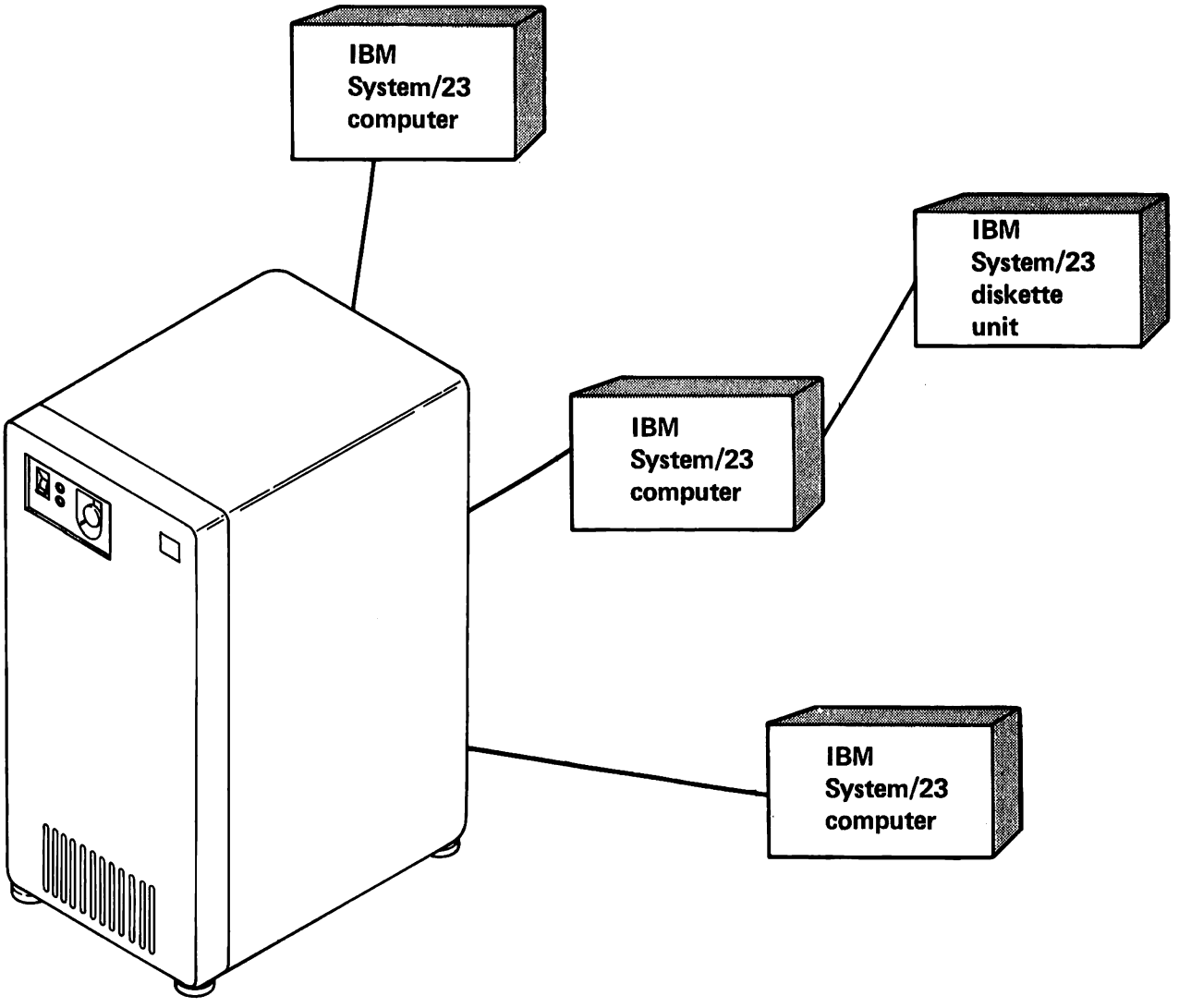
Theory of operation

Introduction (continued)

Three work stations. A system with three work stations consists of:

1. Three System/23 computers
2. One 5247 Disk Unit, containing an optional plug-in expander card

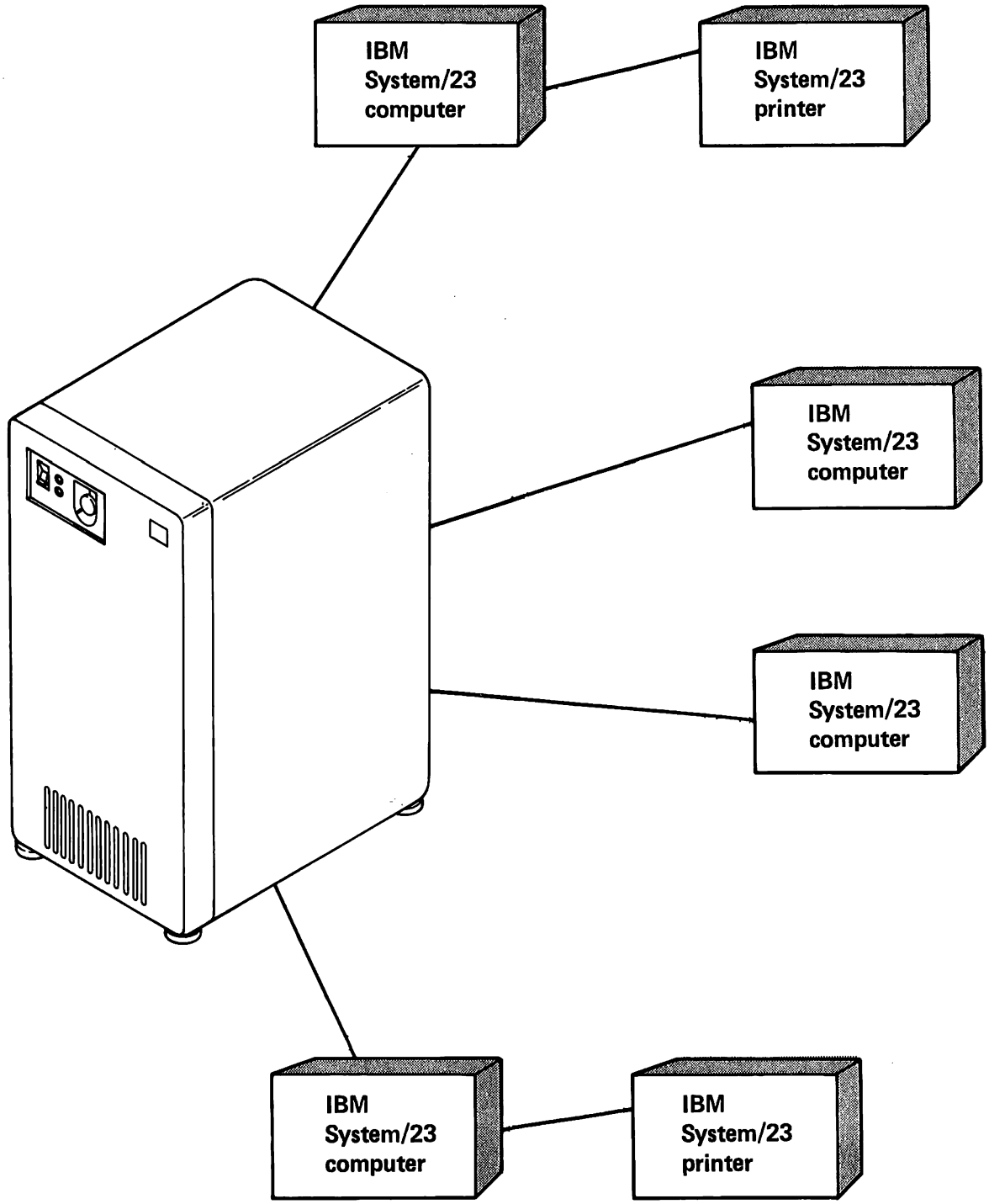
The work station connected to port 1 of the 5247 must contain, or have access to, at least one diskette drive; this work station has to be within 4 meters (13.1 feet) and be located in the same room as the 5247. The other two work stations (connected to ports 2 and 3 of the 5247) may each have access to 0, 1, 2, 3, or 4 diskette drives.



Four work stations. A system with four work stations consists of:

- Four System/23 computers
- One 5247 Disk Unit, containing an optional plug-in expander card

The work station connected to port 1 of the 5247 must contain, or have access to, at least one diskette drive; this work station has to be within 4 meters (13.1 feet) and be located in the same room as the 5247. The other three work stations (connected to ports 2, 3, and 4 of the 5247) may each have access to 0, 1, 2, 3, or 4 diskette drives.



Theory of operation

Introduction (continued)

Specifications

Functional

Storage capacity	
Model 11	15.4 Mbytes
Model 12	30.8 Mbytes
No. of read/write heads	
Model 11	2
Model 12	4
Cylinders, total	445
Data cylinders	443
Customer engineer (CE) cylinder	1
Spare cylinder with defect map	1
Tracks per cylinder	
Model 11	2
Model 12	4
Sectors per track	
Usable sectors	68
Spare sectors	2
Bytes per sector	
Total bytes	340
Data bytes	256
Data bytes per track (maximum)	17,408
Data bytes per cylinder (maximum)	
Model 11	34,816
Model 12	69,632
Rotational speed	3151 (±6.9) rpm
Time of rotation	19 (±0.04) ms
Average rotational delay (or latency)	9.52 ms
Average access time (without latency)	40 ms
Average single track access (without latency)	7 ms
Data transfer rate	
To or from link	1 Mbit, max.
On and off disk (instantaneous)	1.25 Mbytes

Environmental

Operating

Temperature	15.6° to 32.2°C (60° to 90°F)
Relative humidity	8 to 80%
Maximum wet bulb	22.8°C (73°F)
Heat output	1093 btu/hr

Nonoperating

Temperature	10° to 43°C (50° to 100° F)
Relative humidity	8 to 80%
Maximum wet bulb	26.7°C (80°F)

Storage

Temperature	0.6° to 60°C (33° to 140°F)
Relative humidity	5 to 80%
Wet bulb	0.6° to 29.4°C (33° to 85°F)

Shipping

Temperature	−40° to 60°C (−48° to 140°F)
Relative humidity	5 to 100% (including condensation, excluding rain)
Wet bulb	0.6° to 29.4°C (33° to 85°F)

Physical

Width	310 mm (12.2 in.)
Depth	493 mm (19.4 in.)
Height	660 mm (25.9 in.)
Weight	47 kg (103.5 lb.)

Power requirements

	U.S./ Canada	World trade countries 50 Hz		World trade countries 60 Hz	
Voltage (Vac)	104-127	90-119	180-259	90-137	180-254
Current (A, max.)	3.1	3.6	1.8	3.6	1.8
Frequency (Hz)	60 (±0.5)	50 (±0.5)	50 (±0.5)	60 (±0.5)	60 (±0.5)

Theory of operation

Major units

The 5247 is a self-contained device that has within it the following major units:

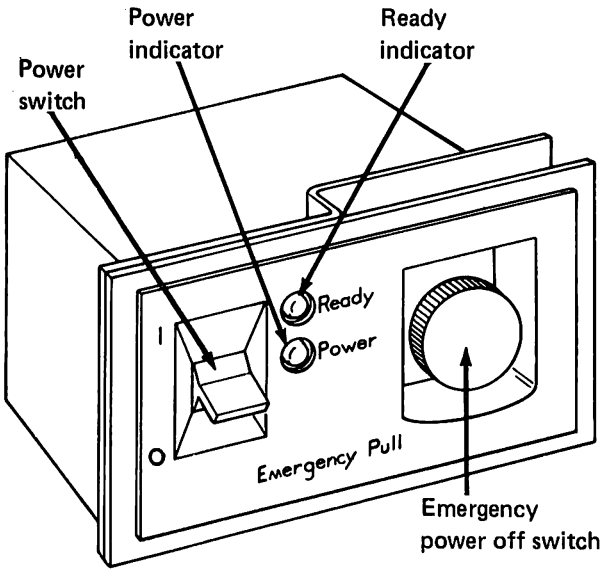
- Control panel (part of the switch box)
- Logic tray
- Direct access storage device (DASD)
- Power supply

Control panel

The control panel (which is the front surface of the switch box) is the central location for the following operator controls:

- Power switch
- Power indicator
- Ready indicator
- Emergency power off (EPO) switch

All of the operator controls are field replaceable units (FRUs).



Control panel

Power switch. When the power is switched on, ac and dc voltages become active in the 5247. Each time the 5247 is powered-on, the self-contained, power-on diagnostics are run automatically.

Power indicator. When the power to the 5247 is switched on, the Power indicator comes on, giving an immediate indication that the power-on sequence is in process. When power is switched off, there is a delay of approximately 20 seconds before the Power indicator goes off. This period of time is required by the direct access storage device (DASD) to safely sequence to a controlled stop. *(There is no delay if the emergency power off switch is used to switch off the power to the 5247. However, this switch should only be used in an emergency condition as permanent damage to the DASD may result.)*

Ready indicator. This indicator comes on approximately 60 seconds after the power is switched on. When the indicator is on, it means:

1. The power-up diagnostics have been completed satisfactorily.
2. The 5247 contains the initial microprogram load (IMPL).
3. The 5247 is ready for use by the work stations.

The Ready indicator goes off at the same time the power to the 5247 is switched off.

Emergency power off (EPO) switch. This switch is labeled Emergency Pull and it should only be used if a hazardous operating condition exists, or you cannot switch off the power to the 5247 by using the power switch.

When the EPO switch is activated (that is, pulled out), ac input power to the 5247 is removed immediately. Also, the Power and the Ready indicators will go off with no delay. To reset the EPO switch, the switch must be pushed in.

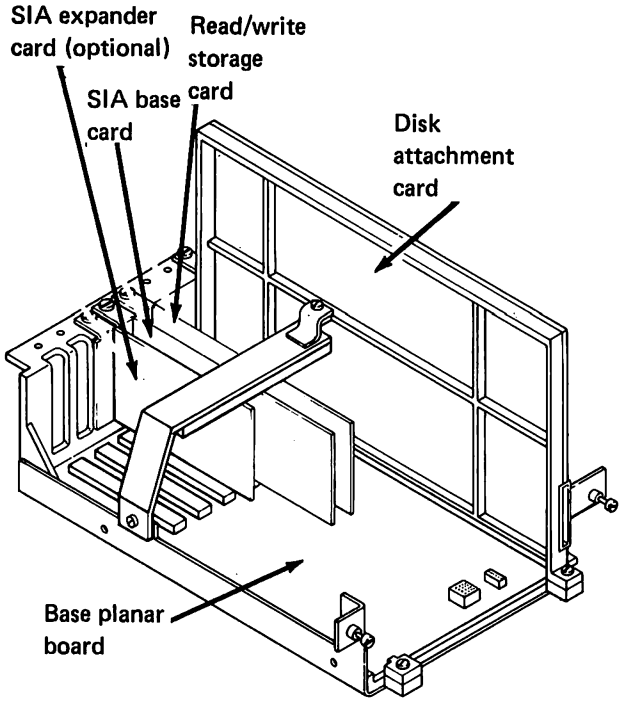
Warning: If the EPO switch is used to power-down the 5247, the DASD read/write heads are not locked in position. Use extreme care when moving the 5247 as any abrupt movement could cause damage to the disk surface.

Note: If a write cycle was in process at the time the EPO switch was activated, a block of data may be lost by the work station that was in operation with the 5247.

Logic tray

The logic tray contains the electronic circuits that are used to control the flow of data between the work stations and the DASD. The logic tray includes the following FRUs:

- Base planar board
- Read/write (R/W) storage card
- Serial interface adapter (SIA) base card
- Serial interface adapter (SIA) expander card (optional)
- Disk attachment card

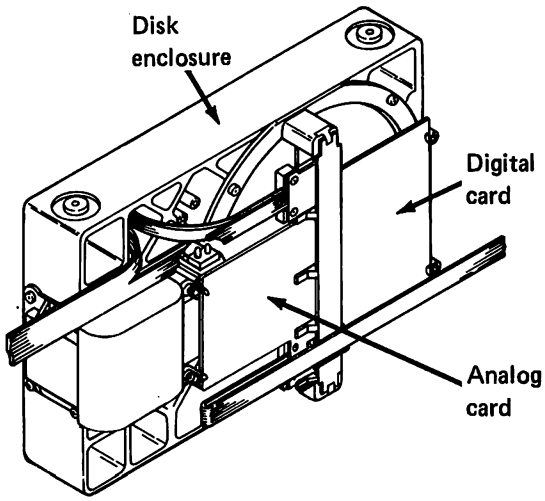


Logic tray

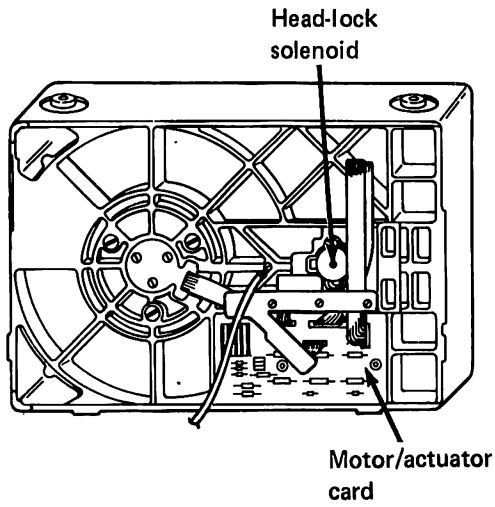
Direct access storage device (DASD)

The DASD is a fixed disk unit. Depending upon the model number of the 5247, the DASD can have a storage capacity of either 15.4 megabytes (Model 11) or 30.8 megabytes (Model 12).

Basically, the DASD consists of a disk enclosure and three electronic cards (analog, digital, and motor/actuator). All of these items are field replaceable units. The disk enclosure (DE) consists of a casting that contains the disks, the spindle assembly, the actuator, the head-lock solenoid, the disk drive motor, and limited electronics. The disks and the access mechanism are sealed in an enclosure.



Front view



Rear view

Direct access storage device

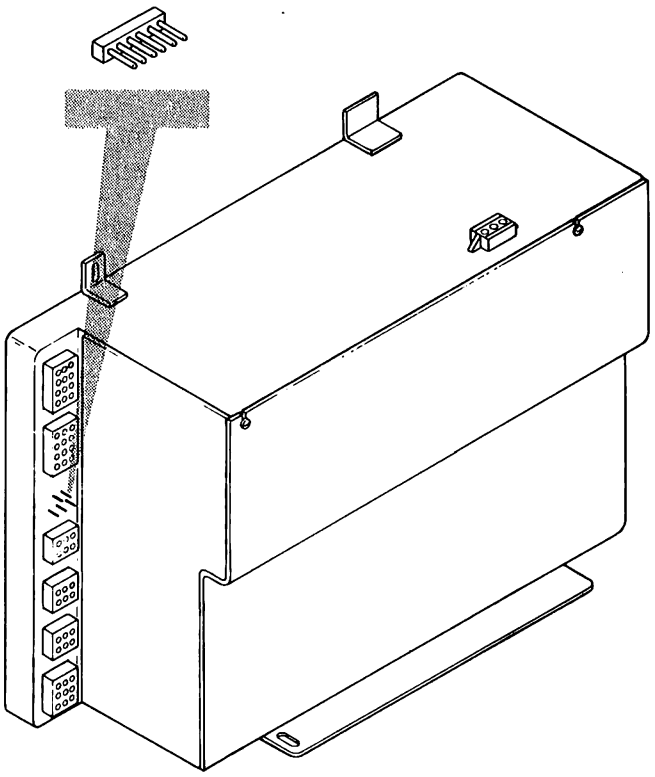
Theory of operation

Major units (continued)

Power supply

The customer engineer (CE) does not have access to the parts inside the power supply. The complete power supply is a field replaceable unit. It has an ac input voltage operating range of from 100 Vac to 240 Vac, at either 50 or 60 Hz. AC input voltage selection is made by changing the position of a jumper plug on the power supply. (For details, see "Maintenance procedure 6250" in Chapter 2.)

Alternate test point configuration



Power supply

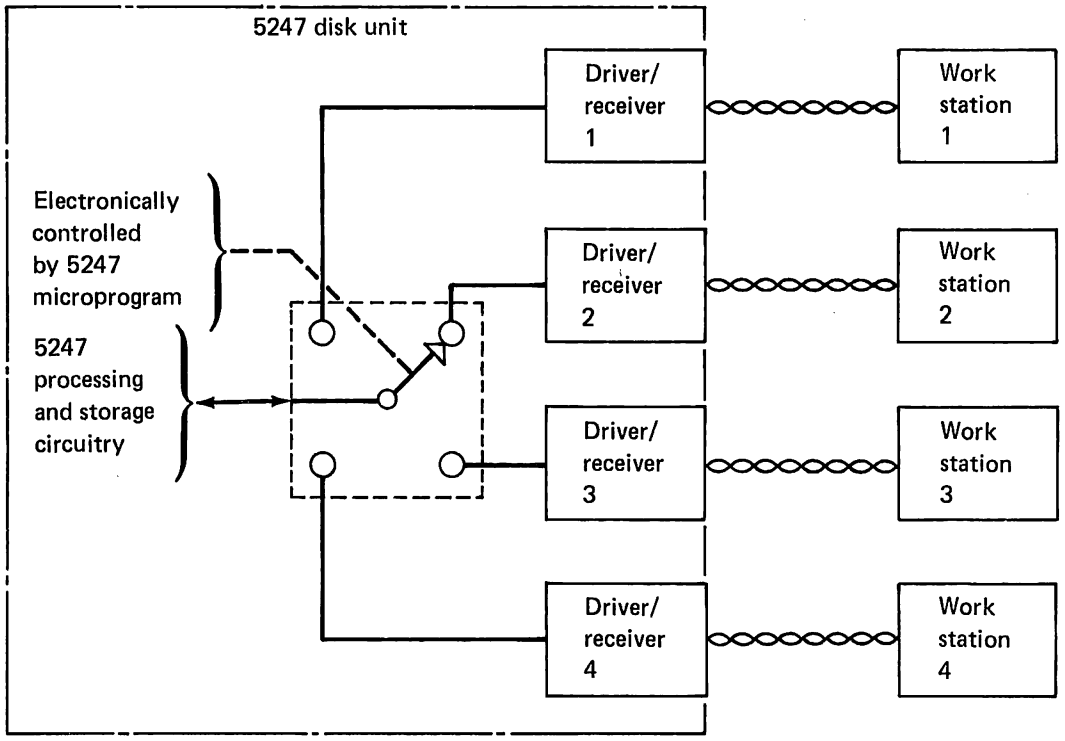
Serial link communications

Each work station is connected to the 5247 by a separate pair of shielded twisted wires. These wires are arranged to form a half-duplex, point-to-point, communications link. The purpose of the link is to permit the exchange of information between the 5247 and each work station in a controlled manner. The information is transferred over the link in a serial bit-by-bit format at a one megabit-per-second data rate.

The work stations are sequentially polled, on an individual basis, by the 5247 to determine if they have a request for service. The polling is continuous, from work station to work station, unless a particular work station is disabled because of:

- Power not being on
- A link failure
- A request for a disconnect

For any of the above conditions, the 5247 will omit the disabled work station from the normal polling sequence. This work station will be polled on a less frequent basis, until the work station is again enabled.



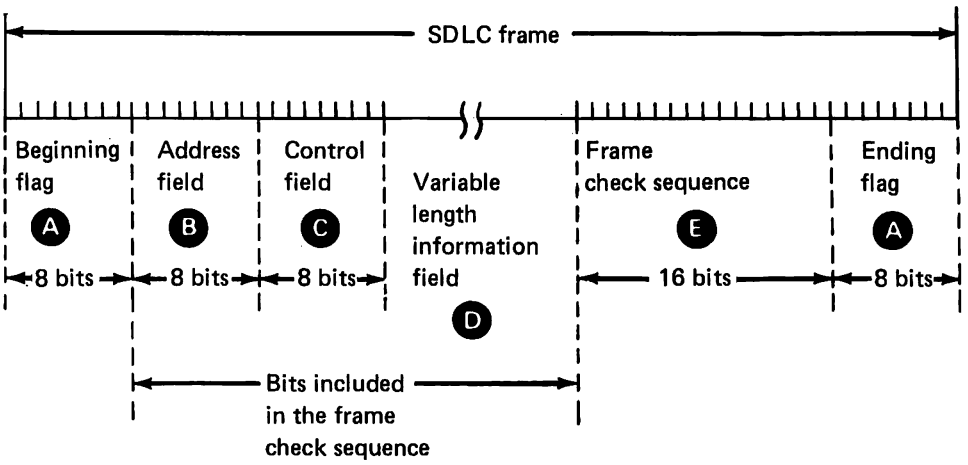
Work station polling

Link protocol

The method of communications control used on the link is named synchronous data link control (SDLC). With this method of control, there is a primary station, which is the 5247, and one or more secondary stations, which are the work stations. The primary station is the controlling station and the secondary stations are the responding stations. The primary station controls the communications link by sending commands to the secondary stations, and the secondary stations respond to the commands.

All information, including commands and responses, is transmitted in groups of bits named a frame. The frame format enables the receiving station to determine:

- Where the transmission starts and stops
- If the transmission is for that station
- What action is to be performed with the transmission
- Specific information for that station
- Data transmission integrity (error checking)



Flags. The beginning flag (A) and the ending flag (A) contain the same fixed 8-bit pattern. These two flags enclose the SDLC frame. The beginning flag is a reference for the position of the address field (B) and the control field (C), and starts transmission error checking. The ending flag indicates the end of the frame.

Address field. The address field (B) follows immediately after the beginning flag. It identifies the work station that is receiving or sending the frame.

Control field. The control field (C) comes after the address field. The control field contains commands or responses to control the link. In addition to containing the poll bit, this field supports the SDLC commands and responses that are listed below:

Information field. Following the control field, there may or may not be an information field (D). Data to be transferred on the link is contained in the information field of a frame. The information field does not have a set length, but it must be in multiples of eight bits.

Frame check sequence (FCS). The frame check sequence field (FCS) (E) is after the information field (or the control field if the frame does not contain an information field). The purpose of the FCS field is to check the received frame for errors that may have been introduced by the link. This field contains a 16-bit check sequence that is the result of a computation on the contents of the address, the control, and the information fields that are transmitted. The computation method used is named cyclic redundancy checking (CRC). The receiving station performs a similar computation and compares its results with the transmitted FCS field. The receiving station accepts no frame that is found to be in error.

Abbreviation	Meaning	Function
I	Information frame	Command or response
RR	Ready to receive - - originating station	Command or response
RNR	Not ready to receive - - temporary busy condition	Command or response
TEST	Test pattern is contained in the information field	Command or response
DISC	Disconnect - - do not transmit to or receive information from this station	Command
SNRM	Set normal response mode - - transmit on command only	Command
UA	Unnumbered acknowledge for SNRM and DISC commands	Response
DM	Disconnect mode - - this station is in the disconnected mode	Response
FRMR	Frame reject - - invalid frame received; must receive SNRM or DISC	Response
RD	Request disconnect - - this station wants to be disconnected	Response

Theory of operation

Serial link communications (continued)

Normal disconnect mode

At power on or following a disconnect sequence, each work station enters the normal disconnect mode (NDM). In this mode, the work station responds with DM (disconnect mode) to all commands until it can accept a set normal response mode (SNRM) command. When an acceptable SNRM command is received, the work station responds with UA (unnumbered acknowledge) and enters the poll response mode.

Poll response mode

Following the acceptance of an SNRM command by the work station, the 5247 begins polling the work stations for service requests, using the command RR. If the work station has no request pending, a negative response to the poll is sent.

A negative response to the poll is indicated by the work station sending either an RR or an RNR response. If the work station has a request for service pending, the data exchange mode is entered.

Data exchange mode

When the work station has a request for service pending and a poll command is received, the work station sends the service request to the 5247 by a request control block (RCB). The RCB is contained in the information field of the SDLC frame. Following the acceptance of the RCB by the 5247, the 5247 may either request additional data with a poll command, or send an RCB response to the work station in an SDLC frame. After the 5247 sends the RCB to the work station, data may be sent by a later SDLC frame.

Request control block exchanges

All data exchanges between the 5247 and the work stations are performed by request control blocks (RCBs). An RCB is 32 bytes long, and contains the following information;

- Commands for the 5247
  - — Control
  - — Disk
  - — Diagnostic
  - — Data management
- Fixed block address (FBA) of the start of a file.
- Location of a block on the disk where the desired command is to take place.
- Number of disk blocks to be read, written, or scanned.
- Work station identifier.
- Relative disk block position and quantity of block(s) to be locked (if any).
- Status reply to the work station for a specified command.

An RCB sent from the work station to the 5247, requesting service, is referred to as a request RCB. An RCB sent back from the 5247 to the work station in response to the request RCB is referred to as a status RCB. There are four types of RCB exchanges:

- Ⓐ type 1
- Ⓑ type 2
- Ⓒ type 3
- Ⓓ type 4

Each type of exchange is shown pictorially, and is described in detail on the following page.

Theory of operation

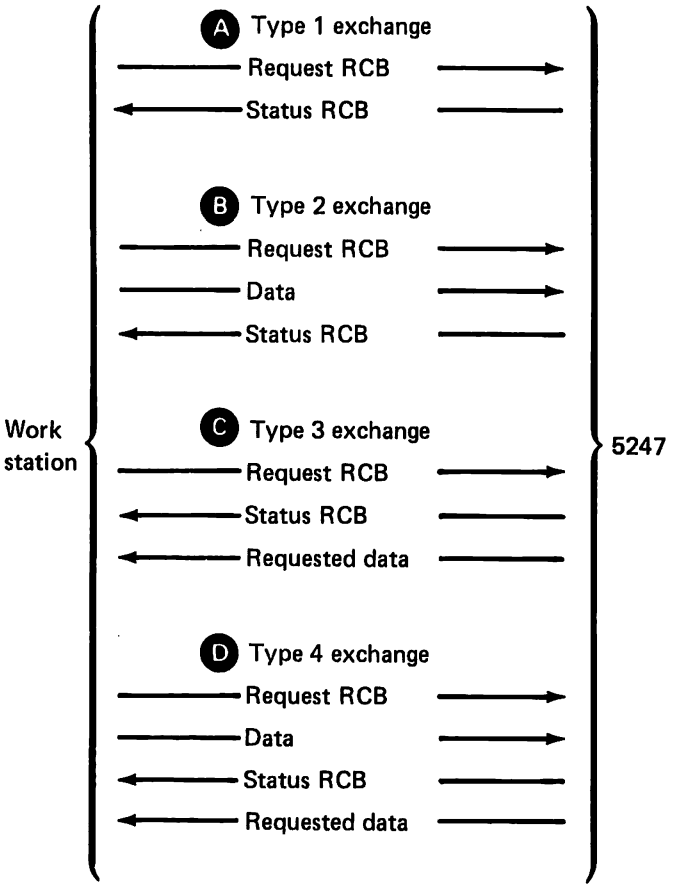
Request control block exchanges (continued)

Ⓐ Type 1 RCB exchange. This exchange is an RCB-only exchange. A request RCB is sent to the 5247, and a status RCB is returned to the work station. No data is exchanged. This exchange is used for simple requests such as "lock the 5247" or "read the work station identifier." It would also be used if the requesting RCB was in error.

Ⓑ Type 2 RCB exchange. This exchange is used for the transfer of data from the work station to the 5247. A request RCB is sent to the 5247. If acknowledged, data is then sent to the 5247. When the requested function is completed in the 5247, a status RCB is returned to the work station. This exchange is used for requests such as "write to the disk."

Ⓒ Type 3 RCB exchange. This exchange is used for the transfer of data from the 5247 to the work station. A request RCB is sent to the 5247. When the requested function is completed in the 5247, a status RCB is returned to the work station. When the status RCB is acknowledged, the requested data is then returned to the work station. This exchange is used for requests such as "read the disk."

Ⓓ Type 4 RCB exchange. This exchange is used for the transfer of data between both the 5247 and the work station. A request RCB is sent to the 5247 and, when acknowledged, data is sent to the 5247. When the requested function is completed, a status RCB is returned to the work station. When the status RCB is acknowledged, the requested data is then transmitted to the work station. This exchange is used for requests such as "scan the disk."

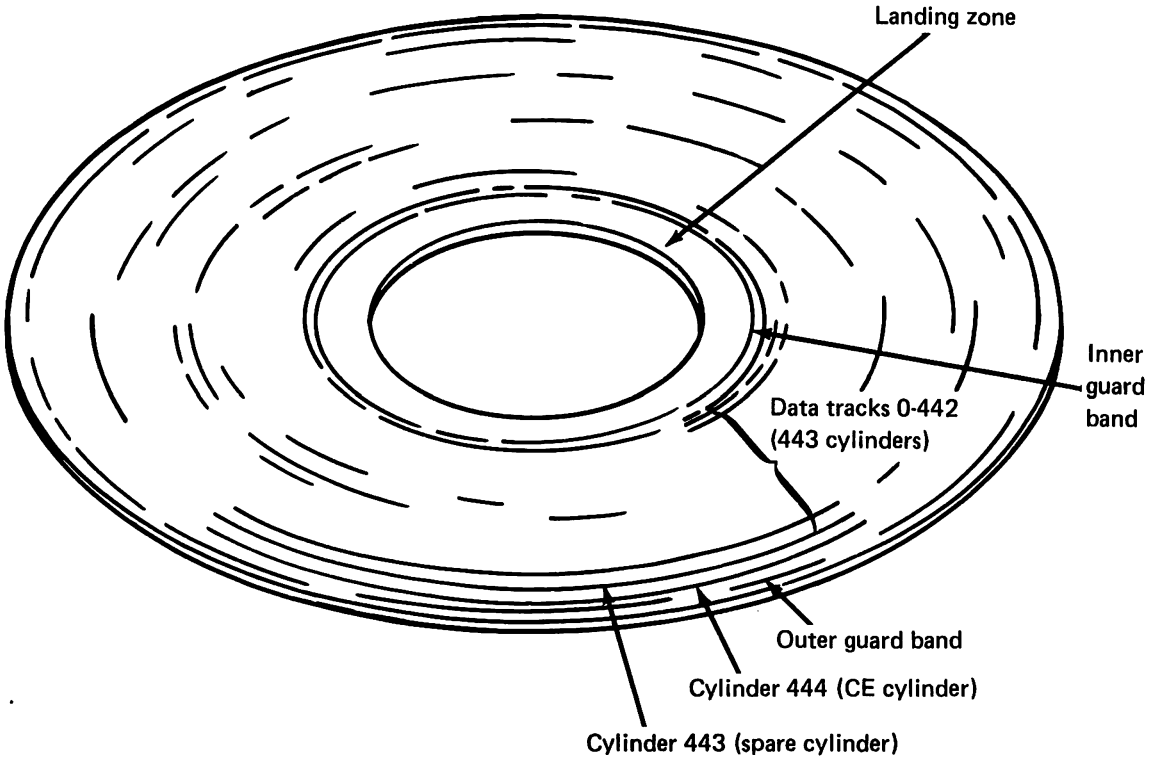


RCB exchanges

Disk surface format

Note: The Model 11 disk unit contains a Version A1 direct access storage device (DASD) and the Model 12 disk unit contains a Version A2 DASD. The Version A1 DASD has one operational disk, two read/write heads, and a storage capacity of 15.4 megabytes. The Version A2 DASD has two operational disks, four read/write heads, and a storage capacity of 30.8 megabytes.

Each side of a disk surface has a landing zone, an inner guard band, an outer guard band, and a data area. The landing zone provides an area for the read/write heads to rest during a start-up or a power-down cycle. The inner guard band is a buffer area between the data area and the landing zone. The outer guard band is a buffer area between the data area and the outer stop of the actuator. The data area is the portion of the disk on which information is written; it is divided into cylinders, tracks, and sectors.



Theory of operation

Disk surface format (continued)

Tracks

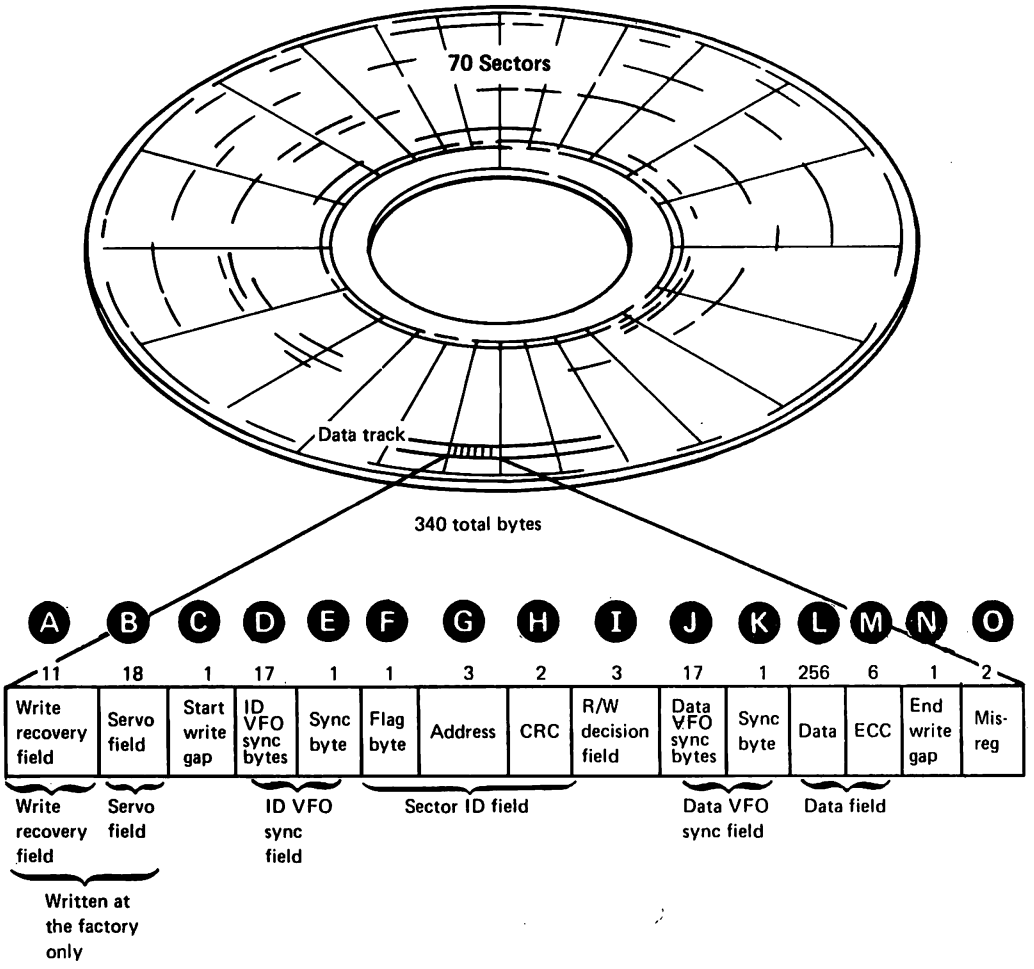
A track is a circular path on a disk that passes under a single data head in one revolution of the disk. The tracks form a series of concentric circles. Each side of a disk contains 445 tracks in the data area. The Version A1 direct access storage device (DASD) has two tracks per cylinder, and the Version A2 has four tracks per cylinder.

Cylinders

A cylinder consists of either two or four tracks (one on each side of each disk) that can be read or written without moving the position of the read/write heads. There are 445 cylinders in the data area; 443 of these cylinders are for reading and writing data; one cylinder is reserved for customer engineering use, and one cylinder includes the surface defect map and off-track alternate sector assignments. The cylinders are numbered 0 through 444, with cylinder 0 located nearest to the center of the disk.

Sectors

Each track on the disk is divided into 70 equally spaced parts, which are named sectors. Each sector is individually addressable, and provides storage for one 256-byte data field. Additional bytes provide for disk address identification, write recovery, synchronization, and error correction coding. Data storage uses 68 of the available 70 physical sectors on each track. The remaining two sectors are reserved, and are used as replacements for sectors that become defective. These two sectors are not used for storing data until they are assigned as alternate sectors during the defect mapping or in response to a user defect.

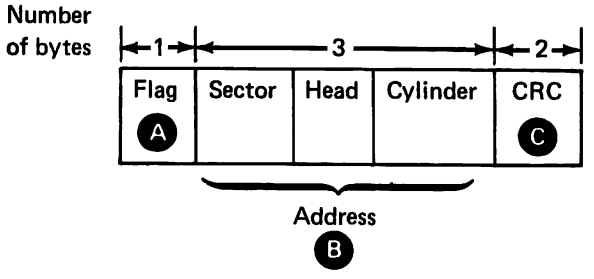


- (A) Write recovery field—allows the read circuits to recover after a write operation in the preceding sector.
- (B) Servo field—provides sector timing and actuator position information.
- (C) Start write gap—allows for write turn-on.
- (D) ID VFO sync bytes—permits the VFO to synchronize with the sector ID data read from the disk.
- (E) Sync byte—completes the VFO synchronization field and identifies the next character as the first sector ID character.
- (F) Flag byte—indicates the surface condition of the disk for the sector.
- (G) Address—indicates the logical address of the sector and identifies the head and the cylinder.
- (H) CRC—ensures valid sector ID information.
- (I) R/W decision field—allows time for read-to-write turnaround.
- (J) Data VFO sync bytes—permits the VFO to synchronize with the data read from the disk.
- (K) Sync byte—completes the VFO synchronization field and identifies the next character as the first data character.
- (L) Data—contains 256 bytes of data.
- (M) ECC—verifies the data (L) is correct.
- (N) End write gap—allows for write turn off.
- (O) Misregistration—permits the data area (L) to increase in size because of motor speed and clock frequency tolerances.

Sector format

A sector is the addressable unit on the disk surface. Each sector contains a sector identification (ID) field and a 256-byte data field. Before the data field can be accessed, the sector ID field must be read to verify that the correct sector has been found.

Sector ID field format. The sector ID field is six bytes long. Each sector on the disk has a unique ID field, which has the following format:



Ⓐ Flag. The flag byte indicates the surface condition of the sector on the disk. The following listing gives the description of each bit when it is at an up level:

Bit No.	*Description*
0 (MSB)	Not used; this bit should always be at a down level.
1	Not used; this bit should always be at a down level.
2	Indicates that this sector has a user defect.
3	Indicates that the logical sector normally in this physical location is displaced, pushed down, two sectors.
4	Indicates that the logical sector normally in this physical location is displaced, pushed down, one sector.
5	Indicates that this sector has been moved off-track.
6	Indicates that this sector has a defect. The first two (primary) defects will have the address of sectors 68 and 69, with 68 being used first. Secondary defects have the address of the alternative sector.
7 (LSB)	Indicates that this sector is a secondary alternative sector. This sector is a replacement for another sector that has more than two defects on another track.

Ⓑ Address. The three address bytes indicate the logical address of the sector. Encoded within these bytes are the sector number, the head address, the cylinder number, and the relocation assignment of the sector ID field as a result of a surface defect. The relocation assignment of the sector ID field to a usable portion of the same sector is named an extension. One extension relocates the sector ID field 64 bytes later in the sector. Two extensions relocate the sector ID field 128 bytes later in the sector.

Byte	Bit No.	Level	Value	Function
1	0 (MSB)	Down	–	Not used
	1	Up	64	Sector number
	2	Up	32	
	3	Up	16	
	4	Up	8	
	5	Up	4	
	6	Up	2	
	7	Up	1	
2	0 (MSB)	Up	–	128 bytes (2 extensions)
	1	Up	–	64 bytes (1 extension)
	2, 3	Down	–	Spare
	4	Up	2	Head address
	5	Up	1	
	6	Down	–	Spare
	7	Up	256	Cylinder number
3	0 (MSB)	Up	128	
	1	Up	64	
	2	Up	32	
	3	Up	16	
	4	Up	8	
	5	Up	4	
	6	Up	2	
	7	Up	1	

On a sector marked defective (by bit 6 of the flag byte being at an up level), the first two bits (0 and 1) of byte 2 indicate which area of the sector is defective. With both of these bits at a down level, the data area is defective and the sector ID field is written in the normal position. With bit 1 at an up level and bit 0 at a down level, the normal sector ID field area is defective, and this information is written 64 bytes later (1 extension). When bit 0 is at an up level and bit 1 is at a down level, part of the normal sector ID field area and part of the data area are defective, and the sector ID field is written 128 bytes later (2 extensions).

Ⓒ Cyclic redundancy check (CRC). The two CRC bytes are used to ensure valid sector ID address information. During a write operation, the four bytes of the flag and the address fields are used to generate two CRC bytes. The generated CRC bytes are then written on the disk. During a read operation, the four bytes of the flag and the address fields are once again used to generate a second group of CRC bytes. The second group of CRC bytes is then compared with the CRC bytes read from the disk. If the bytes are not the same, an error is indicated, and normal read/write operations are not permitted for that sector.

Data field. The data field consists of a 256-byte data area, followed by a 6-byte error correction code (ECC).

Data area. Work station records are stored in the data areas of the sectors. These records are arranged in a block size of 512 bytes, which is twice as large as the 256-byte sector size of the disk. A microprogram within the 5247 masks the 256-byte sector size from the work station, and lets data be read or written in two contiguous logical sectors, providing a storage capacity of 512 bytes.

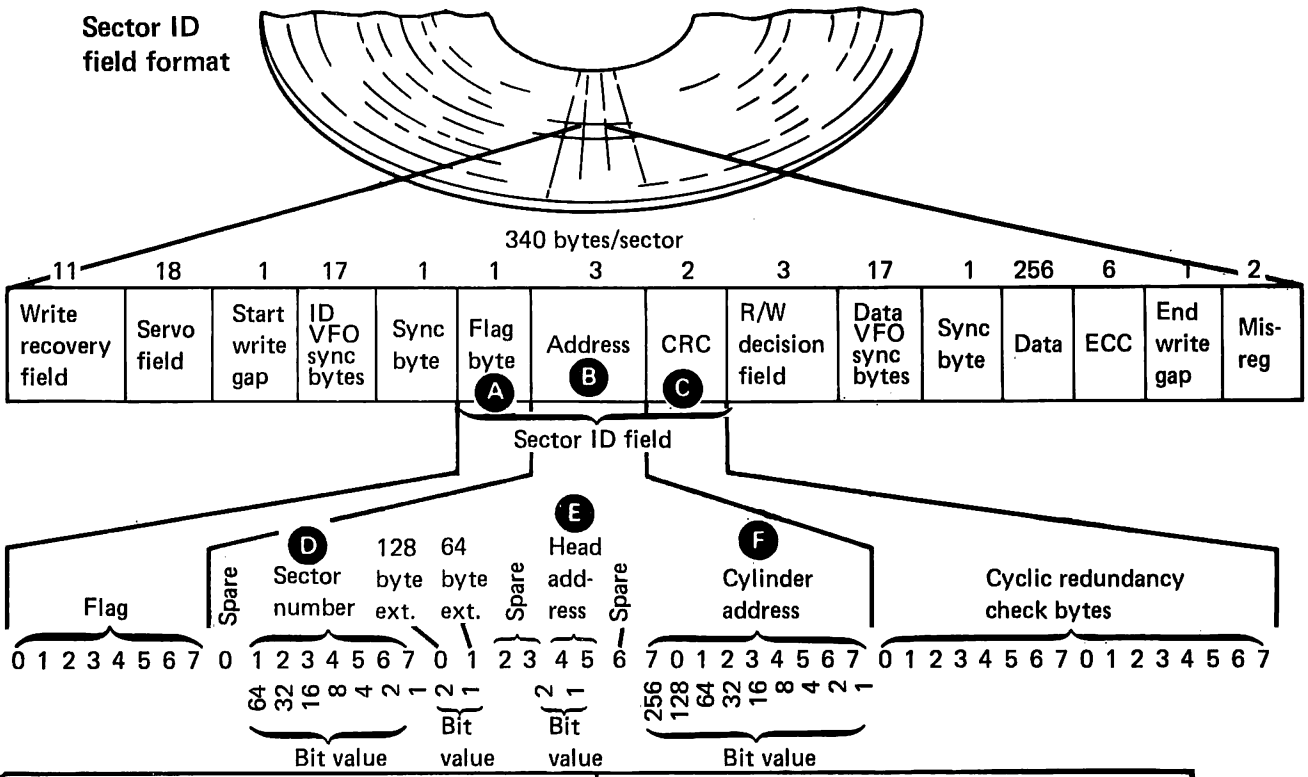
If a record is less than 512 bytes, the remainder of the data field is padded with zeros before the error correction code bytes are written. If a record is longer than 512 bytes, it is written over as many blocks as are required to store the complete record.

Error correction code (ECC). The ECC is 6 bytes long. It verifies that the data read in the 256-byte data area that immediately precedes the ECC is correct. After reading a data field and its ECC, a 6-byte syndrome remains which contains information necessary to locate and correct an error in the data area. This syndrome permits correction of:

- Any one error burst that is less than 9 bits
- Up to a 16-bit error burst that is within a 2-byte boundary.

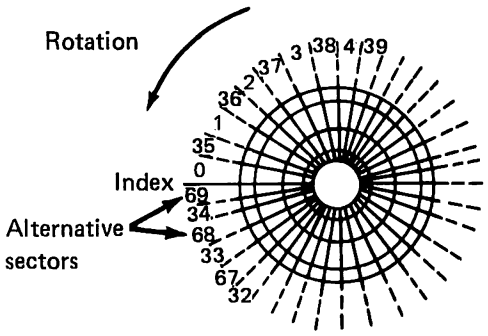
Theory of operation

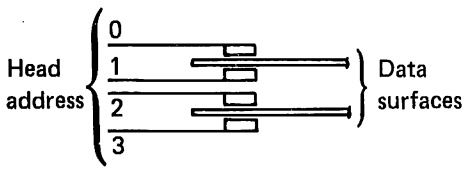
Disk surface format (continued)

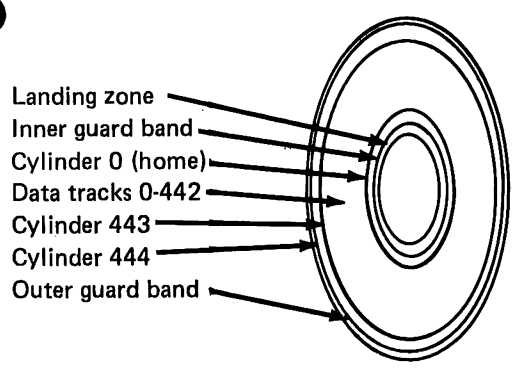


A Flag byte

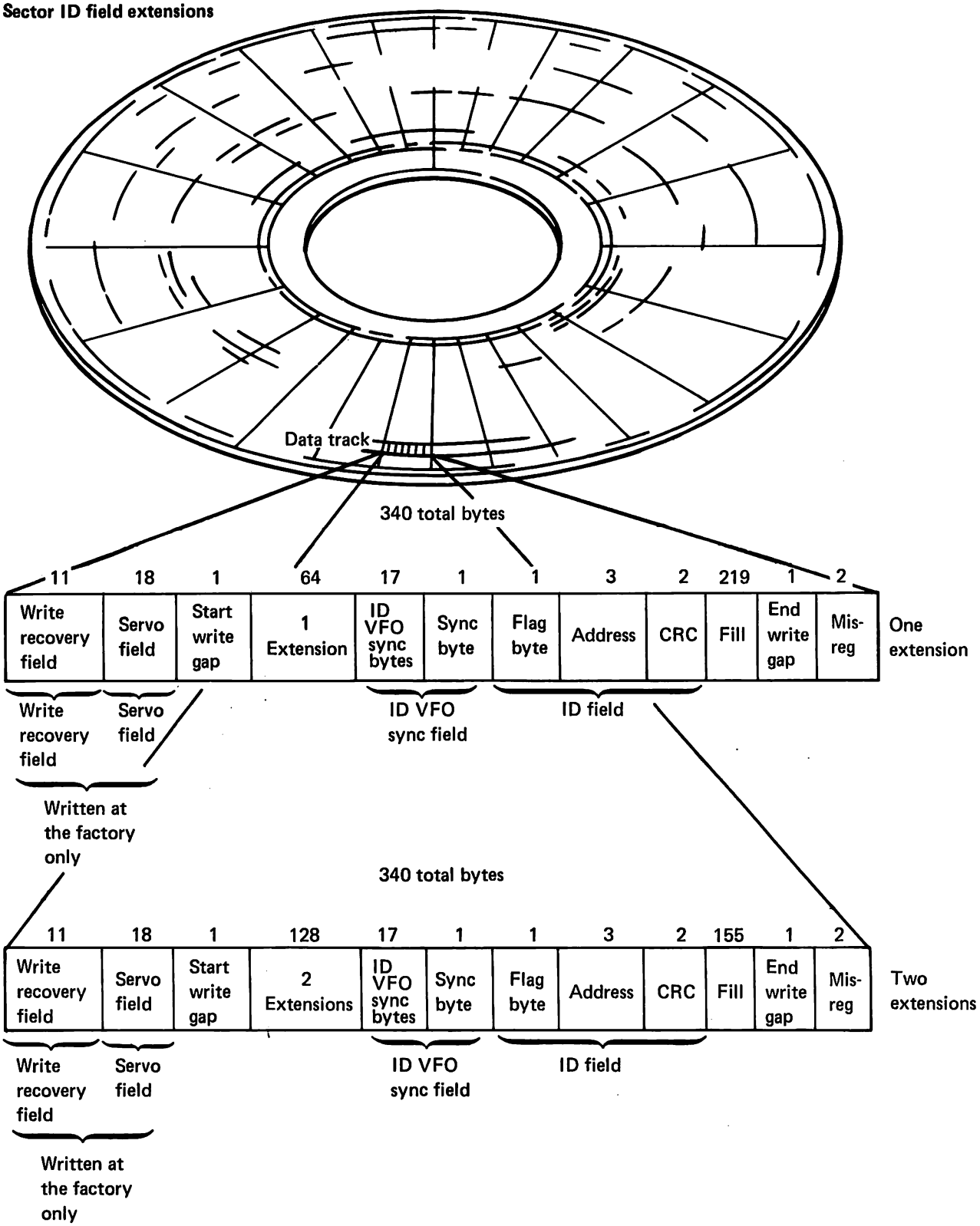
Bit	Description
0 (MSB)	Not used
1	Not used
2	Sector has a user defect.
3	Logical sector normally here is 2 sectors later.
4	Logical sector normally here is 1 sector later.
5	Sector moved off track.
6	Sector has defect.
7	Secondary alternative sector







Sector ID field extensions



Theory of operation

Disk surface format (continued)

Physical sectors and logical sectors

An index code, written on each track in the dedicated servo field, identifies the beginning of all tracks for a specific cylinder. When the index code is read, the DASD generates an index pulse. After each revolution of the disk, the index pulse occurs instead of a sector pulse for the first physical sector (sector 0). All index codes on the disk surfaces are aligned vertically.

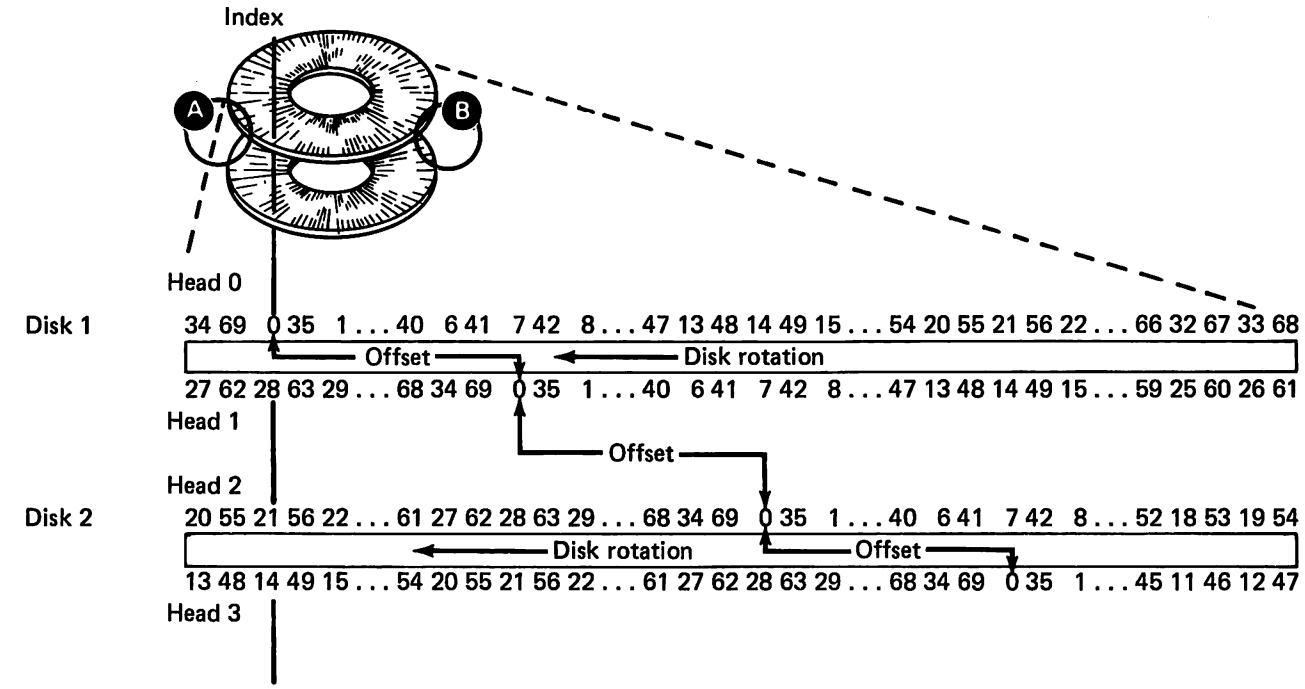
Because of sector number interleaving and head-switch timing, the logical sector number assignments are not necessarily the same as their physical location assignments.

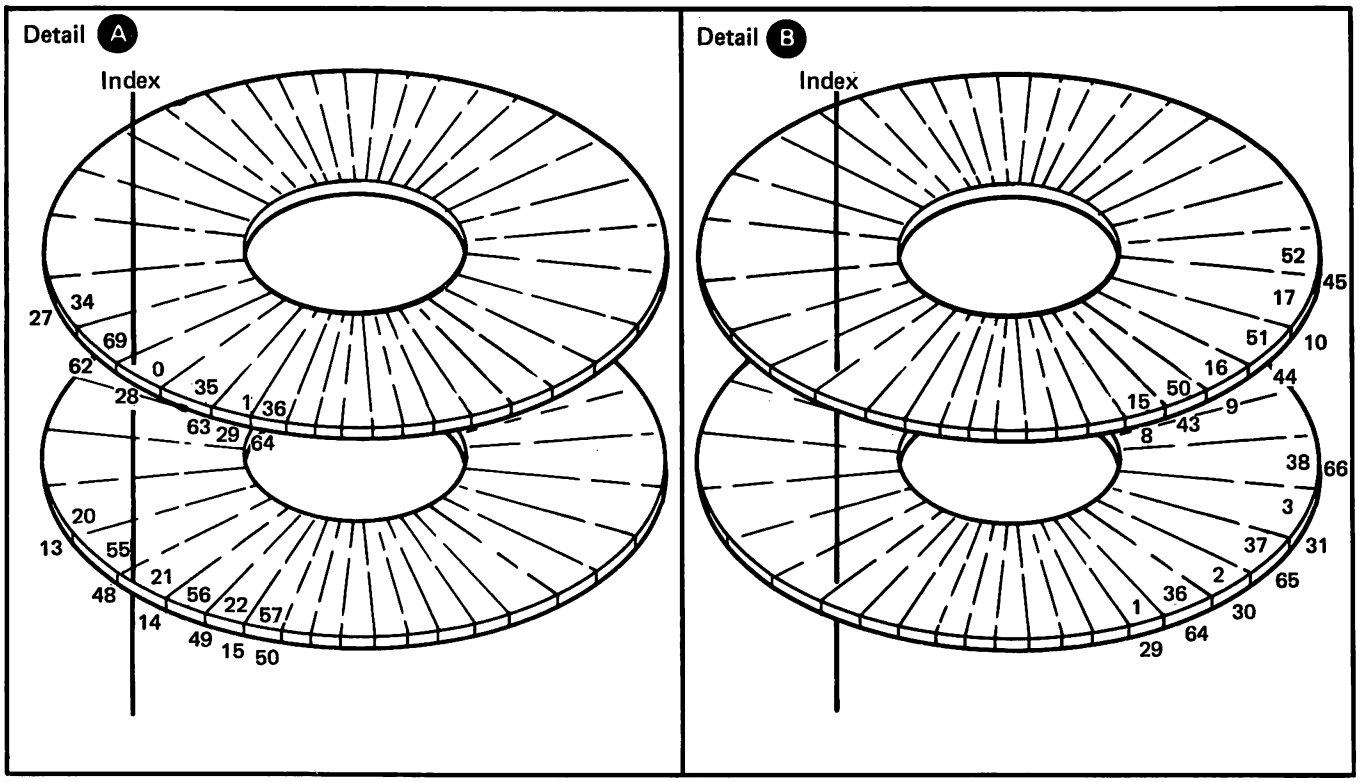
With sector number interleaving, the 70 sectors are logically numbered consecutively 0, 35, 1, 36, 2, 37,.....33, 68, 34, 69. To minimize the operational delay resulting from head switching, the logical sector numbering is offset 14 sectors (with respect to the physical position) for each head switch (0 to 1, 1 to 2, 2 to 3, and 3 to 4). The sector interleaving and the sector shifting are shown (for a cylinder without any defects) in the following table and in the figure on the next page.

	Logical location			
Physical location	Head 0	Head 1	Head 2	Head 3
0	0 (Index)	28 (Index)	21 (Index)	14 (Index)
1	35	63	56	49
2	1	29	22	15
3	36	64	57	50
4	2	30	23	16
5	37	65	58	51
6	3	31	24	17
7	38	66	59	52
8	4	32	25	18
9	39	67	60	53
10	5	33	26	19
11	40	68	61	54
12	6	34	27	20
13	41	69	62	55
14	7	0	28	21
15	42	35	63	56
16	8	1	29	22
17	43	36	64	57
18	9	2	30	23
19	44	37	65	58
20	10	3	31	24
21	45	38	66	59
22	11	4	32	25
23	46	39	67	60
24	12	5	33	26
25	47	40	68	61
26	13	6	34	27
27	48	41	69	62
28	14	7	0	28
29	49	42	35	63
30	15	8	1	29
31	50	43	36	64
32	16	9	2	30
33	51	44	37	65
34	17	10	3	31

	Logical location			
Physical location	Head 0	Head 1	Head 2	Head 3
35	52	45	38	66
36	18	11	4	32
37	53	46	39	67
38	19	12	5	33
39	54	47	40	68
40	20	13	6	34
41	55	48	41	69
42	21	14	7	0
43	56	49	42	35
44	22	15	8	1
45	57	50	43	36
46	23	16	9	2
47	58	51	44	37
48	24	17	10	3
49	59	52	45	38
50	25	18	11	4
51	60	53	46	39
52	26	19	12	5
53	61	54	47	40
54	27	20	13	6
55	62	55	48	41
56	28	21	14	7
57	63	56	49	42
58	29	22	15	8
59	64	57	50	43
60	30	23	16	9
61	65	58	51	44
62	31	24	17	10
63	66	59	52	45
64	32	25	18	11
65	67	60	53	46
66	33	26	19	12
67	68	61	54	47
68	34	27	20	13
69	69	62	55	48

Logical sector numbering





Alternate sector assignment

When a sector is found to be defective, it is assigned to an alternate sector on the same track. These are named primary track defects. For tracks that contain more than two defective sectors, the additional defective sectors are assigned to an alternate sector on another track. These sectors, named secondary defective sectors, are then reassigned with the penalty of an access operation to the reassigned track, and another access back to the original track.

The status of each sector with respect to defects is identified by bits within the flag byte of the sector ID field.

The list of defects found by the factory and written on the defect map track cannot be changed.

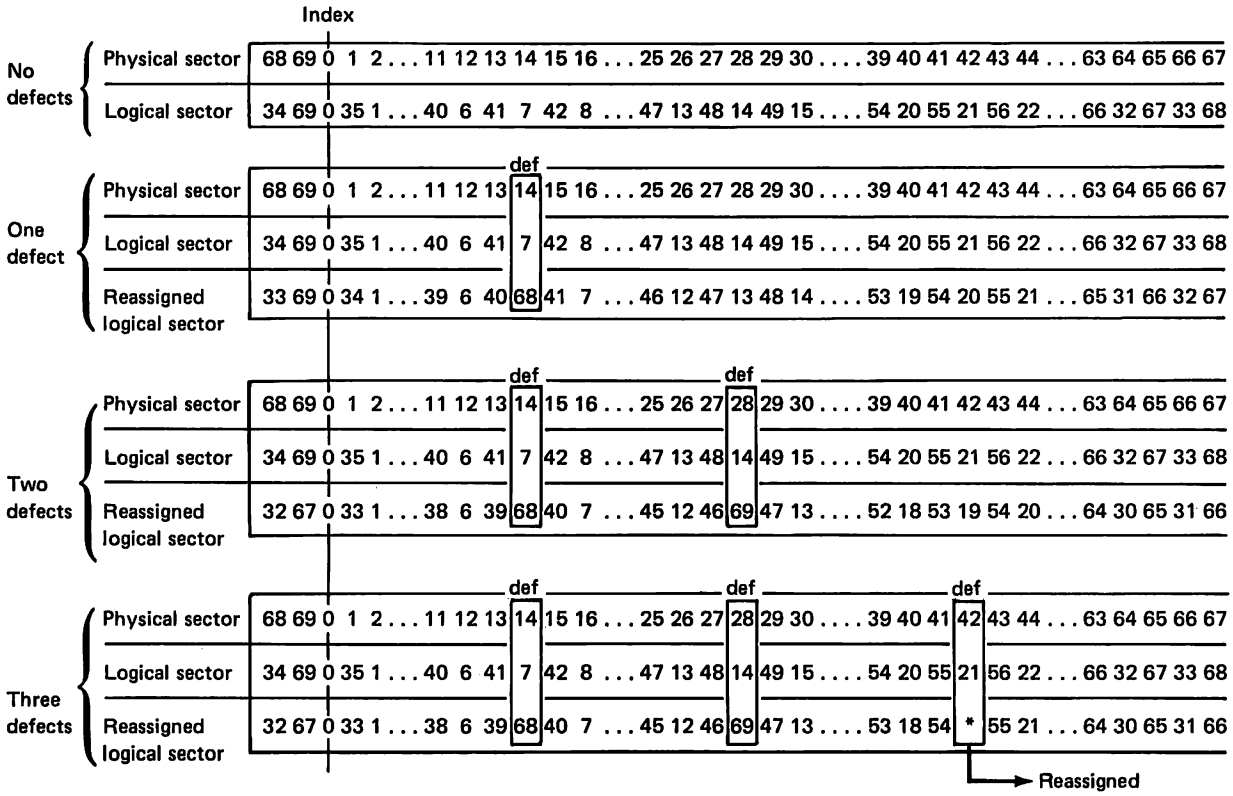
Primary track defects. The first defective sector (counting logically from logical sector 0) detected on any track will have its address changed to sector 68; also flag bit 6 (defective sector) and flag bit 4 (displaced 1 sector) will be at an up level. This sector and the remaining sectors on this track will be displaced one sector. The sectors will be rearranged as if the defective sector was not physically present. See the example given for head 0, physical location 14 on the next page. In the special case where sectors 68 and 69 are both defective, they are flagged as defective, but are not displaced.

The second defective sector has its address changed to sector 69; also flag bit 6 (defective sector) and flag bit 3 will be at an up level. Bit 3 (displaced 2 sectors) is written in this sector and the following displaced sectors to indicate how many sectors the logical sector normally in that physical position has been displaced. See the example given for head 0, physical position 28 on the next page.

Secondary track defects. The third or subsequent defective sector on any track will be flagged as defective and reassigned off-track to spare cylinder 443. Flag bit 6 (defective sector) and flag bit 5 (reassigned defect) will be at an up level, except where the defective sector falls within the band of displaced sectors following the primary defect. In this case, the defective sector will be flagged defective, reassigned, and displaced. The alternate sector address will have the address of the sector it replaces, and it will have flag bit 7 (secondary assigned alternative) at an up level. See the example given for head 0, physical position 42 on the next page.

Sector ID defects. Defective sectors on any track where the normal track sector ID is not recoverable will be formatted and reassigned as described in the preceding paragraphs, but with the ID field extended 64 bytes later in the sector. If the extended ID field is not recoverable, the ID field will be extended an additional 64 bytes, making a total extension of 128 bytes.

Alternate sector assignment (head 0)



Theory of operation

Disk surface format (continued)

Fixed block addressing

Fixed block addressing (FBA) is used to mask the physical characteristics of the DASD from the microprogram. Storage requests from the work station, or replies from the 5247, are coded in an FBA numbering system. The FBA is part of the operating system program that is written onto the disk during the initial microprogram load (IMPL). The FBA is transferred from the disk to read/write storage following the power-up routine. A lower-level of microcode in the 5247 converts the FBA into cylinder, head, and sector information. This information is then used to access a specific location on the disk.

The FBA microcode used in the 5247 maps the DASD storage area into 512-byte blocks. For the Version A1 DASD (15.4 megabytes), the FBA numbers range from 0 to 30,123 (75AB hex); for the Version A2 DASD (30.8 megabytes), the upper FBA limit is increased to 60,247 (EB57 hex). A hexadecimal and decimal conversion chart is given below.

Hexadecimal-to-decimal conversion

To find the decimal number, locate the hex number and its decimal equivalent for each position. Add these to obtain the decimal number.

Decimal-to-hexadecimal conversion

To find the hex number, locate the next lower decimal number and its hex equivalent. Each difference is used to obtain the next hex number until the entire number is developed.

Hexadecimal columns							
4		3		2		1	
Hex = Dec		Hex = Dec		Hex = Dec		Hex = Dec	
0	0	0	0	0	0	0	0
1	4,096	1	256	1	16	1	1
2	8,192	2	512	2	32	2	2
3	12,288	3	768	3	48	3	3
4	16,384	4	1,024	4	64	4	4
5	20,480	5	1,280	5	80	5	5
6	24,576	6	1,536	6	96	6	6
7	28,672	7	1,792	7	112	7	7
8	32,768	8	2,048	8	128	8	8
9	36,864	9	2,304	9	144	9	9
A	40,960	A	2,560	A	160	A	10
B	45,056	B	2,816	B	176	B	11
C	49,152	C	3,072	C	192	C	12
D	53,248	D	3,328	D	208	D	13
E	57,344	E	3,584	E	224	E	14
F	61,440	F	3,840	F	240	F	15
0 1 2 3		4 5 6 7		0 1 2 3		4 5 6 7	
Byte				Byte			

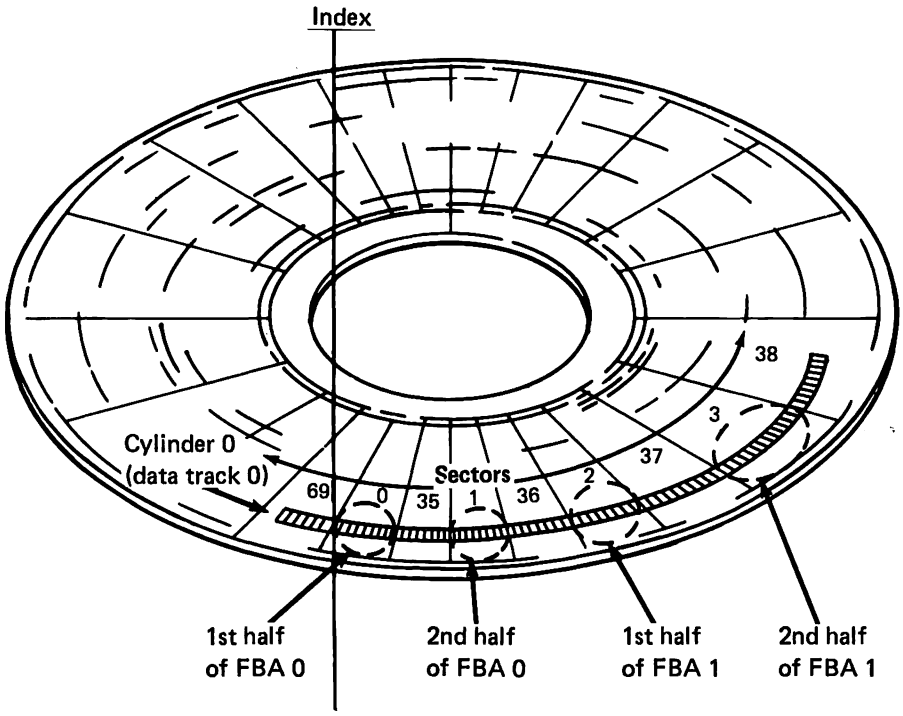
To determine the fixed block address from the cylinder, head, and logical sector number for a given version of the DASD, solve the following equation:

```
FBA = (cylinder number x maximum number
      of heads + head number) X (34)
      + (logical sector number/2)
```

For example, if the cylinder number is 0, the head number is 0, the logical sector number is 2, and the DASD version has 2 read/write heads, the FBA calculates to be 1.

```
FBA = (0 X 2 + 0) X (34) + (2/2) = 1
```

The FBA numbering assignment appears as one large, continuous loop. Every logical, even-numbered sector is the beginning of the first 256-byte FBA block, and the following logical odd-numbered sector is the second 256-byte block of the FBA. For the example given, the first half of FBA 1 would be in logical sector 2, and the second half of FBA 1 would be in logical sector 3. (A second level of microcode converts the logical sector number to a physical sector location on the disk.)



Theory of operation

System operation

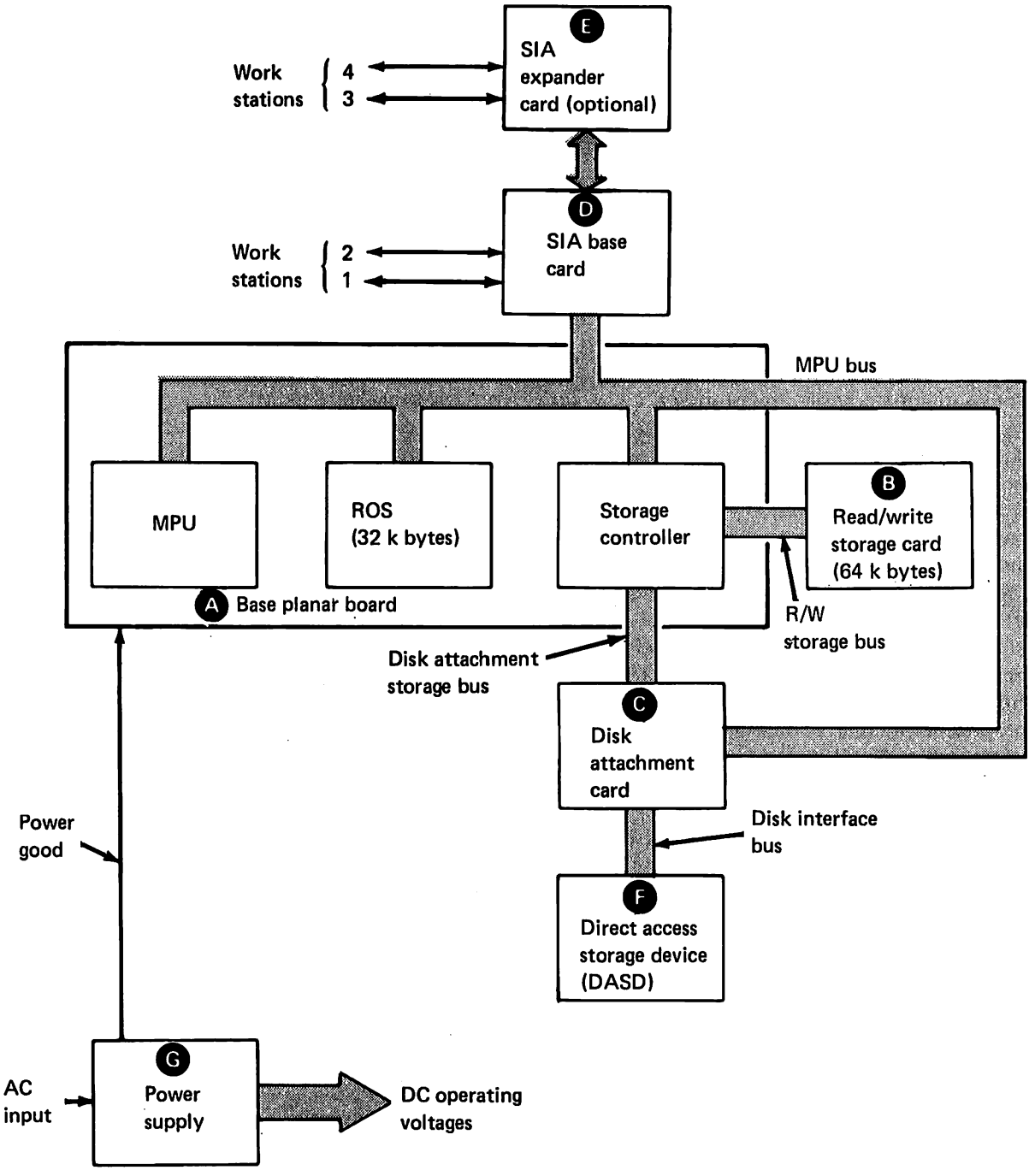
The 5247 is a shared disk file controller for up to four work stations. This function is performed by the following major units:

- Ⓐ Base planar board
- Ⓑ Read/write storage card
- Ⓒ Disk attachment card
- Ⓓ SIA base card
- Ⓔ SIA expander card (optional)
- Ⓕ Direct access storage device
- Ⓖ Power supply

The base planar board Ⓐ contains a microprocessor unit (MPU) that controls the exchange of information between the work stations and the 5247 as instructed by a microprogram contained in the read/write storage card Ⓑ. Data communications to and from the individual work stations is sent through the associated SIA card (Ⓓ or Ⓔ). This information is transferred between the direct access storage device (DASD) Ⓕ and the base planar MPU by the disk attachment card Ⓒ. (The disk attachment card accepts commands from the MPU and provides the status to the MPU for all DASD operations.) A self-contained power supply Ⓖ provides operating voltages for the 5247 circuits.

System operation of the 5247 consists of three major areas:

- Power-on sequencing
- Work station communications
- Disk operations


E
SIA
expander
card (optional)
Work
stations
4
3
D
SIA base
card
Work
stations
2
1
MPU bus
MPU
ROS
(32 k bytes)
Storage
controller
B
Read/write
storage card
(64 k bytes)
A Base planar board
R/W
storage bus
Disk attachment
storage bus
C
Disk
attachment
card
Power
good
Disk interface
bus
F
Direct access
storage device
(DASD)
G
AC
input
Power
supply
DC operating
voltages

Power-on sequencing

When the ac power to the 5247 is switched on, a *power-good* signal is sent to the base planar board to indicate that all of the dc voltages are within tolerance. This is followed by the microprocessor (MPU) executing the power-on diagnostic microprogram contained in read-only storage (ROS). The ROS-resident diagnostic microprogram first checks itself for errors, and then performs various pattern checks of the R/W storage card. Next, the SIA cards are checked by electronically wrapping the driver outputs to the respective receiver inputs. When these checks are completed satisfactorily, the program proceeds to the disk diagnostics, where tests are performed using both the MPU bus and the file storage bus to electronically wrap the registers on this card (without operating the DASD). After these tests, the DASD is commanded to start, and a number of seek, read, and write operations are performed. At the end of the DASD tests, the ROS program is used to read the initial microprogram load (IMPL) off the disk, and transfer the IMPL into R/W storage. Once the IMPL has been transferred from the disk, the microprogram branches, and begins executing instructions out of R/W storage. At this time, the front panel Ready indicator will come on.

If after branching to R/W storage a catastrophic error (such as a trap condition or an unexpected interrupt) occurs, the microprogram will branch to ROS. Then a stop command is sent to the disk and the Ready indicator will go off. The microprogram will begin executing instructions to maintain communications with the work stations. For most errors, the link to the work stations can be kept operational. If no errors are detected, control is given to the initial microprogram load (IMPL), which proceeds with polling of the work stations.

Work station communications

The work stations are polled, one at a time, in a rotary pattern to determine if they have a request for service. Typically, the disk is in a ready condition, and one of the work stations responds with a service request, such as a *write-to-disk).* The service request is contained in a request control block (RCB) that is sent over the communications link. The RCB is received serially by the SIA card port that is attached to the requesting work station. On the SIA card, the RCB is removed from the serial transmission, converted to a byte format, and then transferred to R/W storage. The MPU recognizes the request for service, and proceeds to set up the circuits on the respective SIA card and the base planar board to receive data. Next, the MPU sends an acknowledgement to the work station, requesting it to send the data. The work station responds by sending the serial burst of data to the SIA card. The data is byte-formatted on the SIA card, and transferred by direct memory access (DMA) into the assigned area on the R/W storage card. At this point, the RCB and the associated data are both in R/W storage. Before transmission, the RCB was encoded by the work station with the:

- Disk operation to be performed
- Number of blocks to be transferred

The FBA is converted by the 5247 microprogram to a logical sector, head number, and cylinder number on the disk. This converted information is used during the disk operations.

Disk operations

Assuming the RCB contained a command to *write-to-disk*, the MPU (on the base planar board) sends a series of internal commands to the disk attachment card. These commands are passed over the MPU bus to registers on the disk attachment card. The internal commands consist of several write and read cycles that specify the cylinder number and the head address for a seek (access) command by the DASD. When these commands are received, the DASD signals the disk attachment card that it is busy as the actuator positions the selected read/write head over the target cylinder. (Together, the cylinder number and the head selection identify a specific track on one side of the disk.) No data is transferred at this time, since the desired sector has not been found. Next, the disk attachment card registers are initialized for a *write-to-disk*. The DMA controller on the disk attachment card is also initialized by the MPU with the starting address of the data location in R/W storage to be written to the disk, and the total number of bytes to be transferred. When this is completed, the MPU sends a command over the MPU bus to the disk attachment card to *write sector*. (The bytes of data are to be written in a sector on the disk that was specified by the FBA.) At this point, the MPU releases control of the buses, and the disk attachment card is in complete control. As the disk continues to rotate, each of its sectors is checked for the sector ID field that agrees with the sector ID mask contained in R/W storage. (This mask is encoded in the received RCB.) When the sector ID fields are the same, the correct sector has been found. Signals are then sent to R/W storage to cause high-speed DMA transfers of the stored data over the disk attachment storage bus and onto the desired sector of the disk. This completes the *write-to-disk* operation.

Theory of operation

Functional unit descriptions

Base planar board

The base planar board contains the processor. This board is the primary control unit for the 5247; it provides plug-in interface connections for the following 5247 cards:

- R/W storage card
- SIA base card
- SIA expander card (optional)
- Disk attachment card

Processor subsystem. The processor subsystem includes a microprocessor (MPU) Ⓐ, read-only storage (ROS) modules Ⓑ, MPU support logic Ⓒ, and a storage controller Ⓓ.

Ⓐ Microprocessor (MPU). A single microprocessor (MPU) is used for overall control of the 5247, including the management of work station communications. The MPU is a 16-bit, parallel, central processor. It provides a local bus (address, data, and control) for direct memory access (DMA) and direct processor control (DPC) operations. DMA is used for high-speed data transfers, and DPC is used to send commands and to sense status conditions. In addition to the local bus, the MPU provides a disk attachment storage bus interface (address, data, and control lines) for high-speed data transfers between the disk attachment card and R/W storage.

Ⓑ Read-only storage (ROS). The processor contains 32 kilobytes of read-only storage (ROS). . The ROS-resident microprograms are used to:

- Perform power-on diagnostics
- Transfer the initial microprogram load (IMPL) to R/W storage
- Provide a minimum SIA support for work station communications

Ⓒ MPU support logic. The MPU support logic contains the circuits associated with:

- Direct memory access (DMA) control
- Interrupt control
- Timer control
- Customer engineer (CE) service control

Direct memory access (DMA) control. High-speed data transfers between the serial interface adapter (SIA) card(s) and R/W storage are completed by a direct memory access (DMA) controller. This device, upon receipt of an SIA request, provides a sequential memory address and byte count, which lets the SIA card write (or read) data directly to (or from) R/W storage, without the aid of the MPU. The DMA controller can execute data transfers at a one-megabyte-per-second rate.

Interrupt control. There are two types of interrupts used in the 5247: nonmaskable and maskable. The nonmaskable interrupts have the highest priority of interrupt, and can originate from:

- Hardware errors (trap conditions)
- Thermal warning
- Power-off request

The maskable interrupts can be enabled, disabled, or selectively masked by the 5247 microprogram. The maskable interrupt assignments, starting with the highest priority interrupt, are as follows:

- Serial interface adapter (SIA) card
- Direct access storage device (DASD)
- System timer

Timer control. Several internal timing functions are required by the 5247. These timing functions are provided by a programmable module. The module can be addressed and loaded by the microprograms to provide timing signals that control the:

- Log interval counters
- System time-out conditions
- Error code display intervals
- Operational monitors

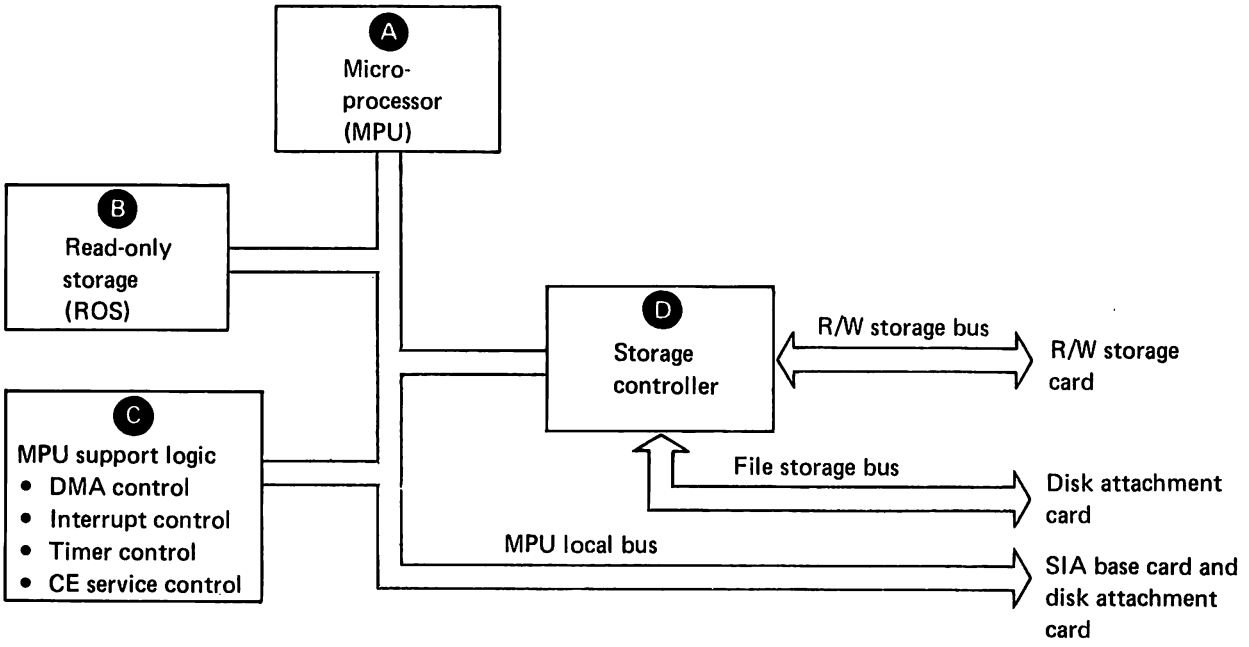
Customer engineer (CE) service control. The processor subsystem provides the following CE service control functions:

- *CE display.* A single-digit hexadecimal display is provided on the base planar board to aid the CE in isolating problems. The display shows the letter "F" following power turn-on, and sequences through various numbers and letters as the power-on tests progress. After the end of the power-on diagnostics, the display is turned off, and remains off until an error occurs. Some error conditions are displayed using a series of consecutive characters, separated by a blanking interval.
- *CE diagnostic switches.* A block of eight switches are provided on the base planar board to permit the CE to select various test options during the power-on diagnostics. (On early models, jumper pins are used in place of these switches.) See *Diagnostic user guide 0016* for a detailed description of this switch block (and jumper pins).

Ⓓ Storage controller. A storage controller, located between the MPU bus, the disk attachment storage bus, and R/W storage, transfers storage requests in the following priority:

1. Disk attachment card
2. Storage refresh
3. Microprocessor (MPU)

The disk attachment card request has the highest priority. This is followed in priority by a refresh timer request for a storage cycle. The lowest priority request occurs when the MPU makes a storage request.



Base planar board block diagram

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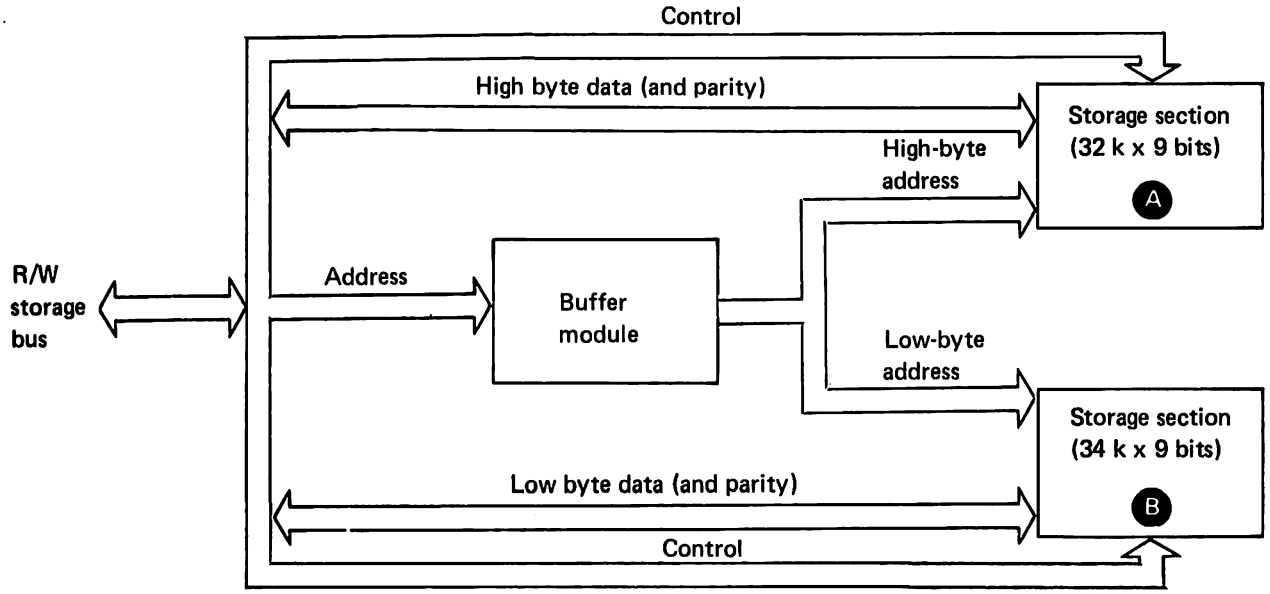
Read/write (R/W) storage card

The read/write (R/W) storage card plugs into the base planar board. Two 32K X 9-bit storage sections (A) and (B) are used to obtain a total storage capacity of 64 kilobytes for this card. Eight of the nine bit positions in each section are used to store data; the ninth bit is a parity bit.

Parity checking, storage refreshing, and storage address decoding are all performed by the storage controller, located on the base planar board.



R/W storage card block diagram

Serial interface adapter (SIA) cards

There are two types of serial interface adapter (SIA) cards — the SIA base card and the SIA expander card. Both of these cards plug into the base planar board. The SIA base card is supplied with the basic 5247, and provides for attachment of two work stations to the 5247. The SIA expander card is optional, and increases the 5247 attachment capacity to a total of four work stations.

SIA base card. The SIA base card serializes and deserializes, on a bit-by-bit basis, two high-speed SDLC data links between the 5247 and the work stations. The data is transferred to, and from, R/W storage (on the base planar board) by direct memory access (DMA). The SIA base card contains the following circuits:

Ⓐ **Channel interface**—converts the SDLC module interface to an MPU-compatible interface; it also permits the running of interrupted DMA transfers.

Ⓑ **SDLC module**—performs SDLC framing, zero- bit insertion/deletion, frame check sequence (FCS) generation/verification, and NRZI encoding/decoding.

Ⓒ **Timing oscillator**—provides an accurate timing reference for the receive clock recovery circuits and the SDLC module.

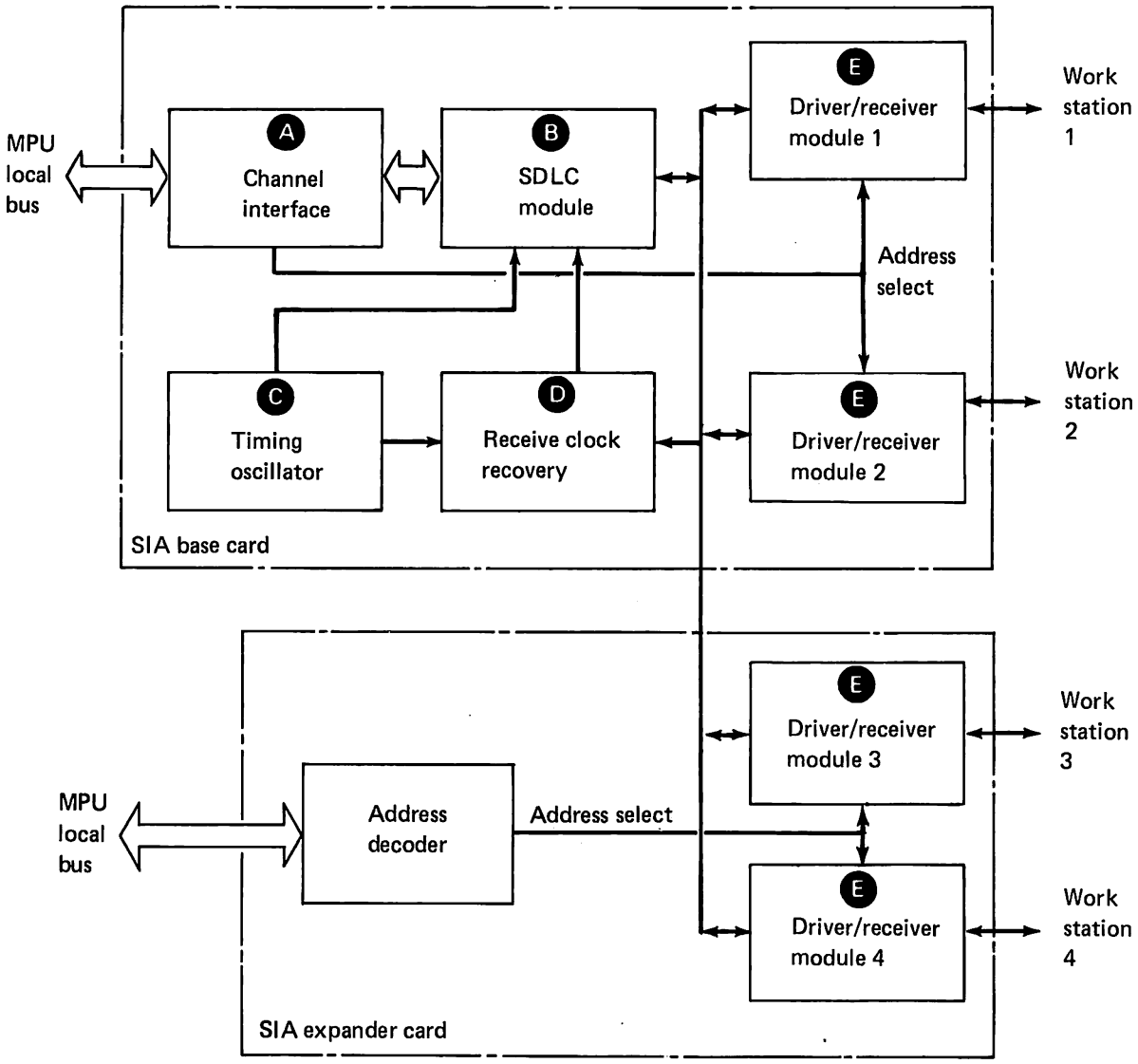
Ⓓ **Receive clock recovery**—reconstructs the clock signal to permit samples to be taken of the received data at the correct points.

Ⓔ **Driver/receiver module**—provides the proper source and termination characteristics to permit attaching the 5247 to long lengths of shielded cable. Each module can be addressed separately by the MPU on the base planar board.

Transmit operation. Following transmit initialization, the SIA base card requests a DMA transfer. If the request is given, the SIA card serializes the beginning of the SDLC frame. (The DMA controller on the base planar board is set up by the MPU for a specific data block and starting address before transmission begins.) The SIA base card then transmits the first and subsequent data bytes under DMA control, requesting transfers every 8 to 10 microseconds, until the complete block of data is sent. On the last DMA transfer, the SIA base card ends the transmission by attaching to the SDLC frame a frame check sequence, followed by the ending flag. The SIA base card automatically performs NRZI encoding and zero-bit insertion of the transmitted data. The end of a satisfactory transmit operation is indicated by an interrupt being sent to the MPU.

Receive operation. After initialization, the SIA base card begins searching the data link for a beginning flag. Once the beginning flag is received, the SIA base card deserializes the data and interrupts the MPU, indicating that the first address byte has been received. A DMA request is also generated by the SIA base card at this time. The first data byte is then transferred to R/W storage, if the DMA controller on the base planar board has been initialized. Subsequent data is received and transferred to R/W storage at an 8-to-10 microsecond per byte data rate, until the ending flag is detected. Next, the SIA base card checks the two bytes received just before the ending flag for a valid frame check sequence. Then it interrupts the MPU with the status of the received data. Flag bytes and frame check sequence bytes are not transferred to R/W storage; they are removed by the SIA base card.

SIA expander card. The SIA expander card contains two driver/receiver modules (E) for work stations 3 and 4. Each of these modules is individually addressable by the MPU. The SDLC formating and processing circuits on the SIA base card are time-shared with the SIA expander card. All data transferred between the 5247 and work stations 3 and 4 must pass through the SIA base card.



SIA block diagram

Disk attachment card

The disk attachment card plugs into the base planar board. This card performs the following major functions:

- Interprets and transfers MPU commands to the DASD.
- Supplies DASD status to the MPU.
- Does a parallel-to-serial conversion of the data sent to the DASD, and a serial-to-parallel conversion of the data sent to R/W storage.
- Checks the integrity of the transferred data.
- Does a sector ID comparison of the ID field written on the disk with the ID field mask in R/W storage.
- Controls direct memory access transfers.
- Encodes and decodes the data transferred to, and from, the DASD.

The types of ID or data operations that the disk attachment card performs include:

- Read ID—transfers only the ID from a physical sector to R/W storage.
- Write ID—writes the ID and the data field to a physical sector from R/W storage.
- Read recovery—transfers the data from a physical sector to R/W storage, but ignores the ID of that sector.
- Read data—locates a specific sector using the logical sector ID, then transfers its data field to R/W storage.
- Write data—locates a specific sector using the logical sector ID, then writes its data field from R/W storage.
- Scan sector—locates a specific sector using the logical sector ID, then compares its data field with a data field mask in R/W storage.

The disk attachment card consists of the following major stages:

Ⓐ **DASD interface registers.** These registers are used during the transfer of commands to, and the receipt of status from, the DASD.

Ⓑ **DASD drivers/receivers.** These circuits provide the proper source and termination characteristics for the DASD interface lines.

Ⓒ **Attachment command/status registers.** These registers send commands to the attachment's R/W channel, and read the status of the R/W channel back to the MPU.

Ⓓ **Timing and control.** This logic provides the signals required to synchronize the operation of the disk attachment card's circuits.

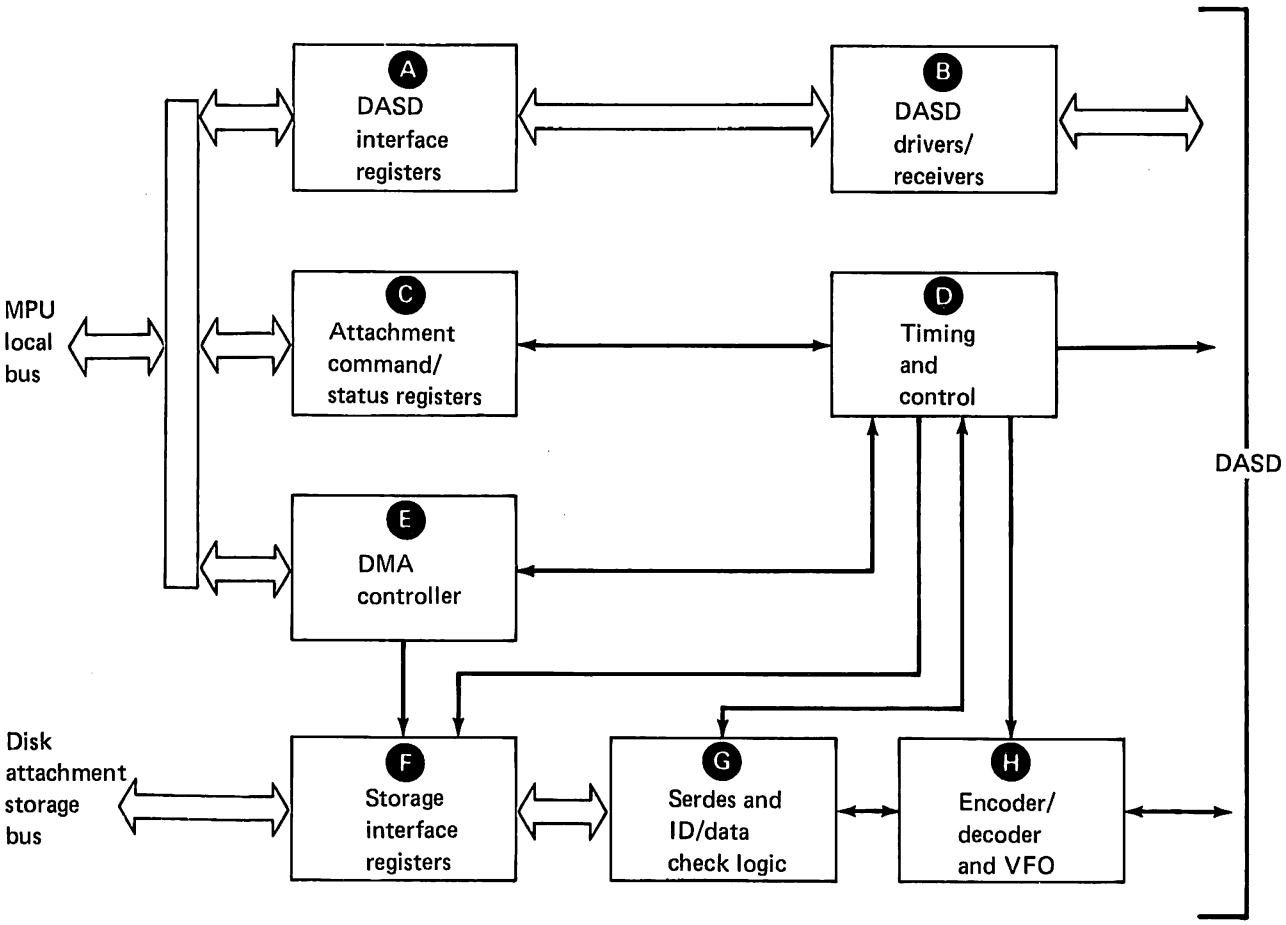
Ⓔ **DMA controller.** This stage holds the 16-bit addresses for data to be read from, or written to, R/W storage. The count in the controller is increased after each word transfer. There are three DMA channels. One channel is used for data, one channel for sector ID, and one channel for ECC codes generated during *write-to-disk* operations.

Ⓕ **Storage interface registers.** These registers hold the 16-bit address or data word to be transferred to, or from, R/W storage.

G Serdes and ID/data check logic. This logic performs several major functions:

- Does a parallel-to-serial conversion of the data sent to the DASD, and a serial-to-parallel conversion of the data sent to the MPU.
- Generates error correction codes (ECCs) for all data written to the disk, and checks the ECCs of all data read from the disk.
- Identifies to the MPU if data that is not valid can be corrected using the ECC syndrome.
- Generates cyclic redundancy codes (CRCs) for all sector IDs written to the disk, and checks the CRCs of all sector IDs read from the disk.
- Performs a comparison check to locate a specific sector on the disk or to locate a specific data pattern in a data field.

H Encoder/decoder and VFO. During a write operation, these circuits encode the data into a DASD-compatible digital format, and convert the data to a differential signal. During a read operation, they remove the clock and data from the differential signal, and convert the DASD-formatted data to a standard binary format.



Disk attachment card block diagram

Disk attachment-to-DASD interface lines. The following is a description of the interface lines between the disk attachment card and the direct access storage device (DASD). Where needed, the active polarity of the line is indicated. A minus (–) sign before the signal name means the line is active at a down level; a plus (+) sign means the line is active at an up level.

Command/status bus. This group of eight bidirectional lines transfer the commands to, and the status from, the DASD.

– **Odd parity.** This line maintains odd parity across the command/data bus and the two register select lines (RS0 and RS1) during transfers to the DASD.

– **Attachment reset to disk.** When this line is active, it initializes the DASD circuitry.

– **Command valid.** This line indicates to the DASD that the command/status bus contains a valid command.

– **Command mode.** This line identifies to the DASD the direction of information flow on the command/status bus. When the command mode line is active, command data is sent to the DASD. When the command mode line is inactive, status information is obtained from the DASD.

– **Register select 0 (RS0) and –register select 1 (RS1).**These two lines select the desired DASD command or status register.

– **Cable interlock (to DASD).** This line provides a continuity-check input level to the DASD.

– **Cable interlock (from DASD).** This line completes the continuity return path from the DASD to the disk attachment card. It is at a down level when there is continuity to, and from, the DASD; it is at an up level when there is an open-circuit condition.

– **Disk ready.** This line signals the disk attachment card that the DASD is ready to perform seek, read, and write commands. It indicates that:

- The disk motor is up to speed
- No data unsafe conditions exist

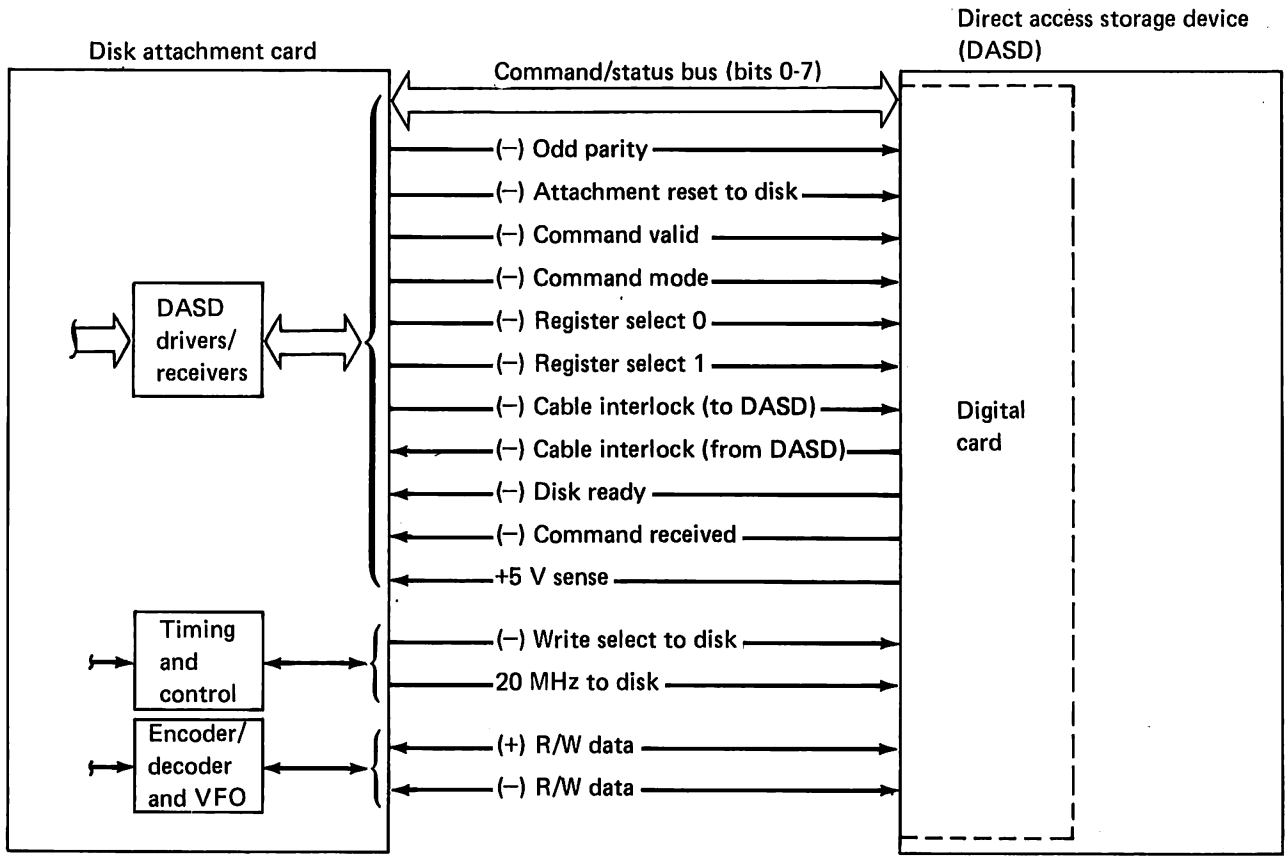
– **Command received.** This line indicates the DASD received the command from the disk attachment card.

+5V sense. The disk attachment card senses this line to determine that +5V power is sent to the DASD.

– **Write select to disk.** This line causes the data on the R/W data lines to be written on the disk.

20 MHz to disk. This line provides a 20 MHz clock signal to the DASD.

+ R/W data and –R/W data. These two bidirectional lines transfer encoded data between the DASD and the disk attachment card.



DASD interface lines

Theory of operation

Functional unit descriptions (continued)

Direct access storage device (DASD)

The direct access storage device (DASD) is available in two storage capacities:

- Version A1 contains two usable read/write heads, and has a storage capacity of 15.4 megabytes.
- Version A2 contains four usable read/write heads, and has a storage capacity of 30.8 megabytes.

Both versions, A1 and A2, contain two disks. However, only one of the disks in Version A1 is operational; the other disk is used to maintain mechanical integrity and to provide air movement. The DASD consists of the following major units:

Ⓐ Disk enclosure
Ⓑ Analog card
Ⓒ Digital card
Ⓓ Motor/actuator card

Ⓐ Disk enclosure

The disk enclosure is a field replaceable unit. It consists of a casting that contains the disks, the spindle assembly, the actuator, the disk drive motor, the head-lock solenoid, and limited electronics. The disk enclosure is a sealed unit, and no customer engineer access is permitted inside the enclosure. Built-in filters maintain clean air and the correct pressure in the disk enclosure.

Data heads attached to the actuator are positioned over the correct track to write data to, or read data from, either side of the disk. The actuator is driven by a voice coil motor (VCM) that moves a carriage assembly. The carriage assembly contains the read/write heads and the arm electronics module. The arm electronics selects the correct head, has a preamplifier for the read data, and contains the necessary write drive circuits.

Ⓑ Analog card

The analog card is a field replaceable unit that plugs into the maple connector block. The analog card contains two channels:

- Data channel
- Servo channel

The data channel performs the following functions:

- Interfaces with the arm electronics module.
- Provides automatic gain control for the data.
- Supplies analog servo information for the servo channel.
- Supplies data pulses for the variable frequency oscillator (VFO).

The servo channel performs the following functions:

- Stabilizes the control of the read/write heads.
- Permits the digital card to control the actuator during multiple-track seek operations.
- Supplies on-track indications and position-error signals to the digital card.

Ⓒ Digital card

The digital card is a field replaceable unit that plugs into the maple connector block. The digital card:

- Supplies timing for the analog card.
- Contains write-protect safety circuits for the servo field.
- Ensures that the read/write heads do not write off track.
- Checks the arm electronics module for loss-of-data conditions.
- Interfaces with the disk attachment card.
- Controls the actuator during multiple-track seek operations.
- Checks and controls the speed of the disks.

Ⓓ Motor/actuator card

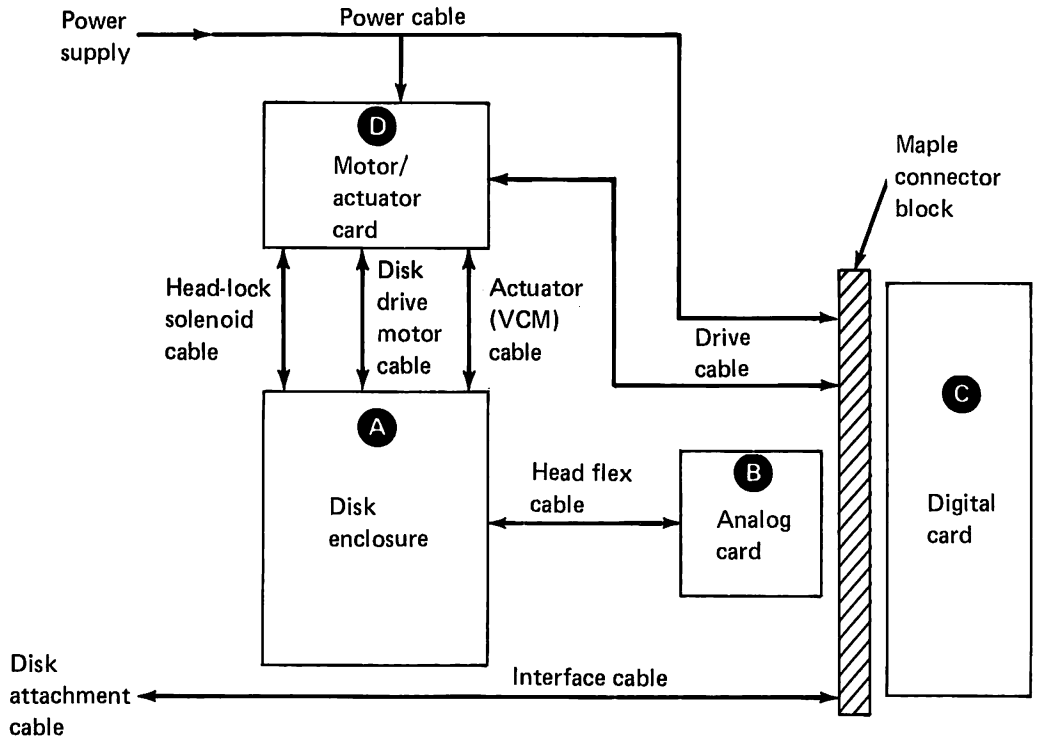
The motor/actuator card is a field replaceable unit that is mounted to the disk enclosure casting. The motor/actuator card contains drive circuits for the following items:

- Disk drive motor
- Actuator voice coil motor
- Head-lock solenoid

Disk operations

The DASD performs the following disk operations:

- Start motor—starts the disk drive motor.
- Stop motor—positions the read/write heads to the landing zone and stops the disk drive motor.
- Read—reads ID or data from the disk.
- Write—writes ID or data to the disk.
- Recalibrate—moves the read/write heads to the home position. Under some error conditions, the read/write heads may move to the inner guard band or to the landing zone.
- Head select—selects one of the read/write heads.
- Cylinder seek—moves the read/write heads toward the seek address location.
- Settle sequence—moves the read/write heads over the correct track.
- Track follow—keeps the read/write heads aligned correctly over the selected track.



DASD block diagram

Theory of operation

Diagnostics

Power-on diagnostic

The power-on diagnostic is in the ROS modules on the base planar board. This diagnostic tests and verifies the operation of selected circuits contained on the :

- Base planar board
- R/W storage card
- SIA base card
- SIA expander card
- Disk attachment card
- Direct access storage device (DASD)

A complete description of the power-on diagnostic is in Diagnostic user guide 0016.

Media-resident diagnostics

A media-resident diagnostic control program (DCP) and device tests are used by the CE to perform fault locating tests (FLTs) and CE utility programs. These diagnostics are on the CE diagnostic diskette, and are loaded to the 5247 disk from the diskette drive of the work station attached to port 1 of the 5247. Once the diagnostic diskette has been loaded to the disk, the diagnostic control program can then be used to test a work station that does not contain, or have access to, a diskette drive.

The instructions for using these diagnostics and the utility programs are contained in the following Diagnostic user guides:

Diagnostic user guide	Application
0001	Work station with a diskette drive
0002	Work station without a diskette drive
0006	5247 FLT programs

Work station diagnostic

The work station diagnostic is in ROS modules on the 5247 disk unit adapter card of each work station. (This card is also named the work station SIA card.) This diagnostic is executed by the work station at power-on to check selected portions of the 5247 disk unit adapter card, and to verify the status of the 5247 and the serial data link.

A complete description of the work station diagnostic is in Diagnostic user guides 0001 (for a work station with a diskette drive) and 0002 (for a work station without a diskette drive).

Appendix A. Parts catalog

Contents

Parts catalog

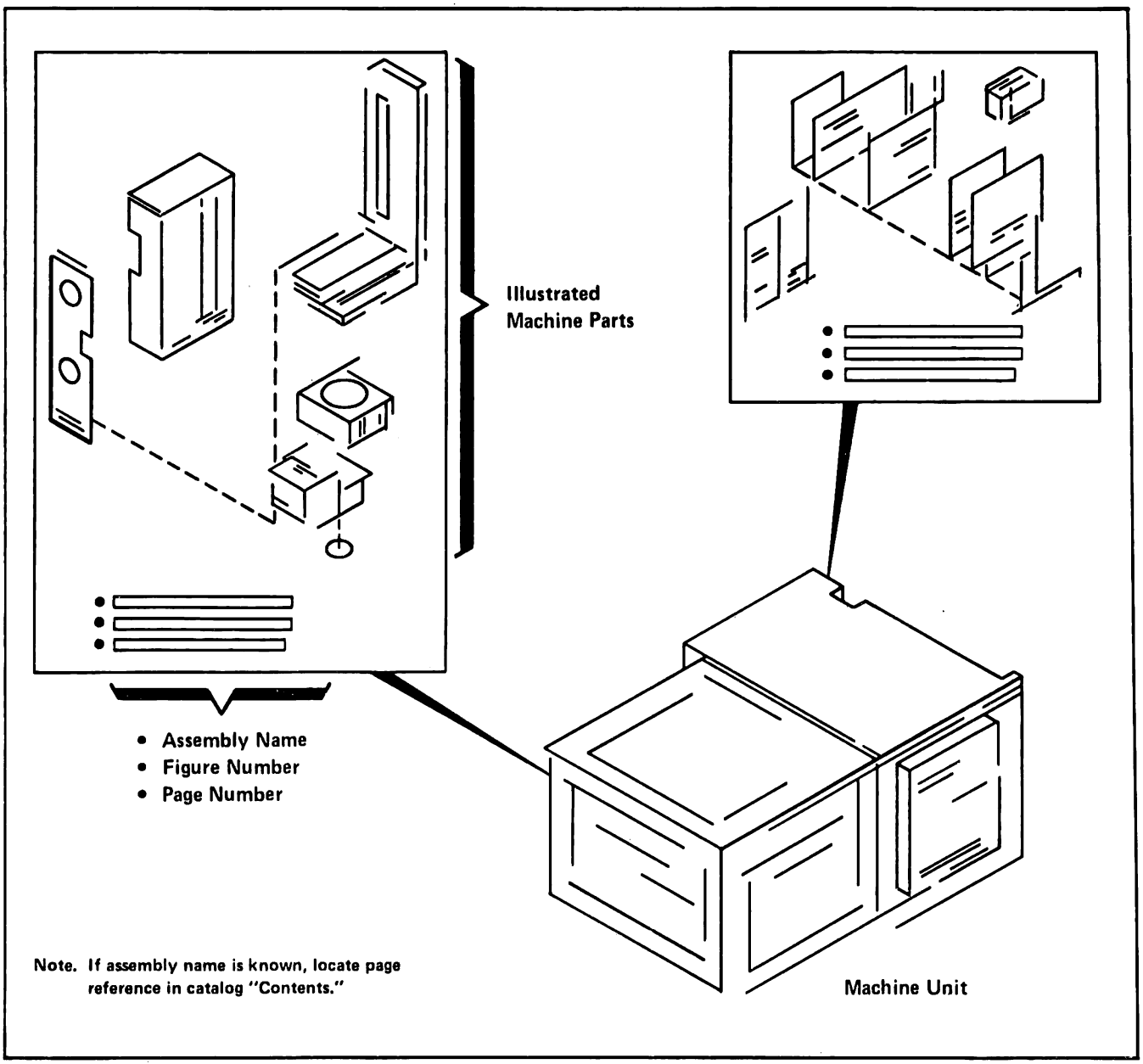
How to use a parts catalog

PARTS CATALOG STRUCTURE

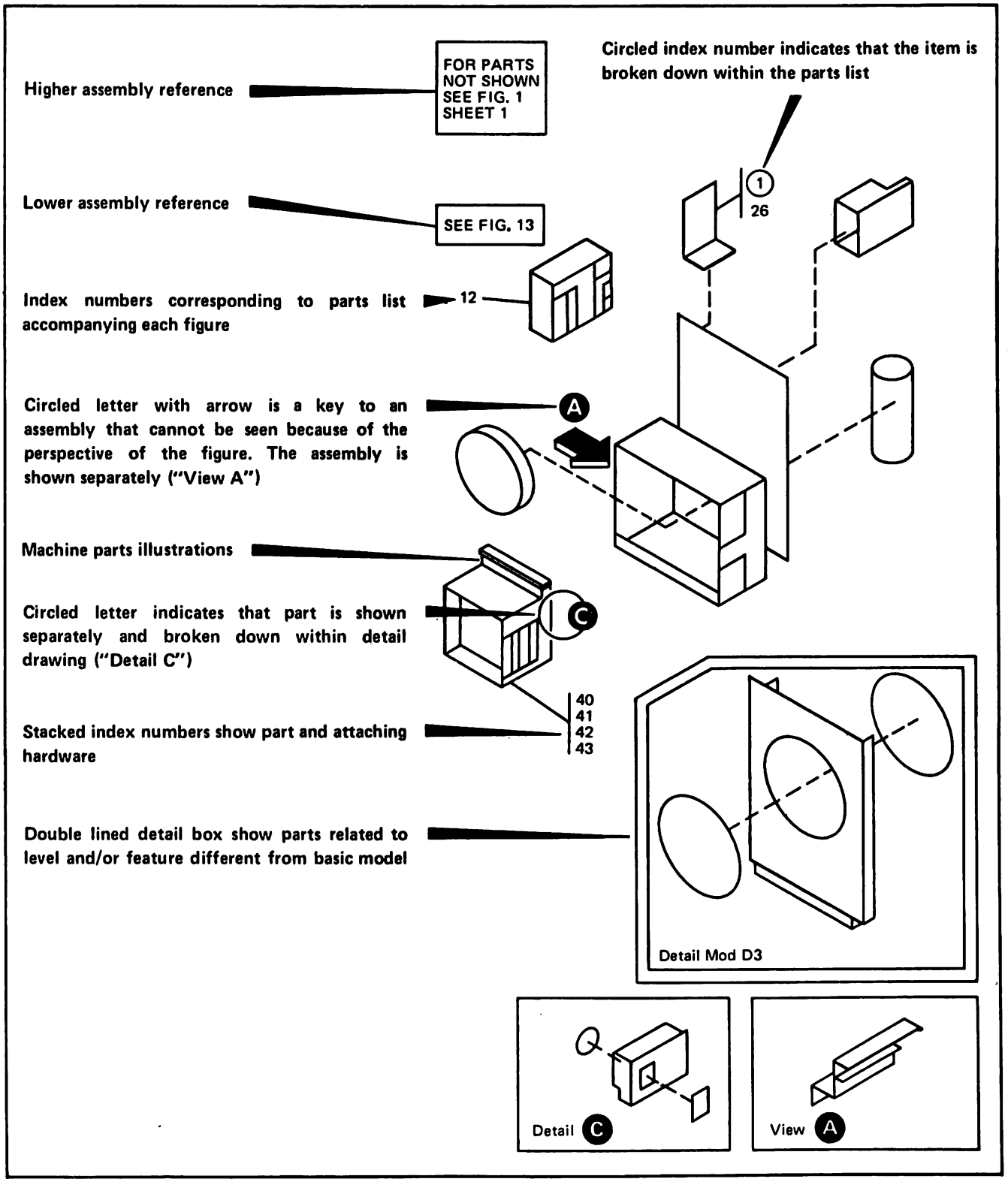
To find parts quickly, you should have a general understanding of the three major sections of this catalog:

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



2 CATALOG SECTION (illustrated parts breakdown)



Parts catalog

How to use a parts catalog (continued)

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
-	5892859	REF	POWER SUPPLY ASM,NO.1- 208V 50 AND 60 HZ
-	1553193 7	REF	POWER SUPPLY ASM,NO.1 AND 3- 60 HZ LV
-	1553194	REF	POWER SUPPLY ASM,NO.1 AND 3- 60 HZ HV
-	1553195 NP 2	REF	POWER SUPPLY ASM,NO.1 AND 3- 50 HZ LV
-	1553196 NP	REF	POWER SUPPLY ASM,NO.1 AND 3- 50 HZ HV
-	1631389	REF	PWR SPLY ASM,NO.1 AND 3-50 HZ LV-UK ONLY
-	1631390 3	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. 4	1	. LABEL
- 2	845762	1	. LABEL
- 3	5891299	1	. COVER
- 4	"COMM" 5	4	. SCREW,MACH BIND HD 8-32 NC-2A X .250 LG
- 5	1632336	1	. FUSE,7A-USED ON 208V POWER SUPPLY NO. 1
			NO FUSE REQUIRED ON 110V POWER SUPPLY
- 6	512137	1	. FUSE,5A-USED ON 110V POWER SUPPLY NO. 1
- 6	1632336	1	. FUSE,7A-USED ON 208V POWER SUPPLY NO. 1
- 7	5130278 NR 6	1	. LABEL-USED ON 208V POWER SUPPLY NO. 1
- 8	5130277	1	. LABEL-USED ON 110V POWER SUPPLY NO. 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 8
- 11	5130276	1	. BRACKET
- 12	58207 9	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: *Indenture* 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 assemblies.
9	AR	As required – use quantity as required.

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	0935-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 - 89		15 - 81		11 - 2		24 - 8
2032	7 - 8		15 - 85		11 - 9	25891	2 - 49
3550	1 - 28		15A- 66		13 - 11		2 -101
	1 - 55		15A- 70		14 - 18	26380	14 -110

Parts catalog

ORDERING PARTS

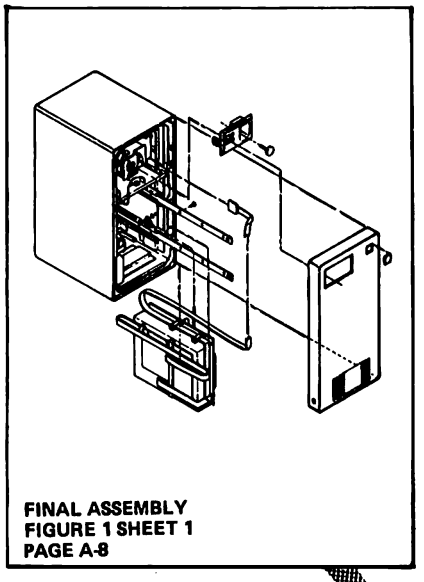
Refer to the Catalog Section when ordering parts. The example shown here should help guide you through a typical situation.

FIGURE INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION 1 2 3 4	
5 -	5891860 A	REF	POWER SUPPLY,NO. 3,60 HZ	
-	5892846	REF	POWER SUPPLY,NO. 3,50 HZ	
-	1631386	REF	POWER SUPPLY NO. 3,50 HZ-UK ONLY	
			FOR NEXT HIGHER ASM SEE LIST 3-25	
			AND FOR ILLUSTRATION FIG. 5	
- 1	475124	1	. CLAMP, CAPACITOR	
- 2	58207	2	. SCREW,MACH BIND HD 8-32 NC-2A X .250 LG	ATT PT
- 3	5252807	1	. CAPACITOR,C3	
- 4	526378	2	. CAP	
- 5	2701001	1	. TRANSFORMER,60HZ	
- 5	2701011	1	. TRANSFORMER,50HZ	
- 5	5130347 B	1	. TRANSFORMER,50 HZ-UK ONLY	
- 6	236849	4	. SCREW, MACH BIND HD 10-32 X .250LG	ATT PT
- 7	56079	1	. WASHER,LOCK EXT T .204ID .410OD	ATT PT
- 8	351237	1	. . SHIELD	
- 9	10170	2	. . SCREW,MACH-BIND HD 6-32 X 1/4 LG	ATT PT
- 10	322766	1	. . TERMINAL BOARD- 8 DBL SCREW TERMINAL	

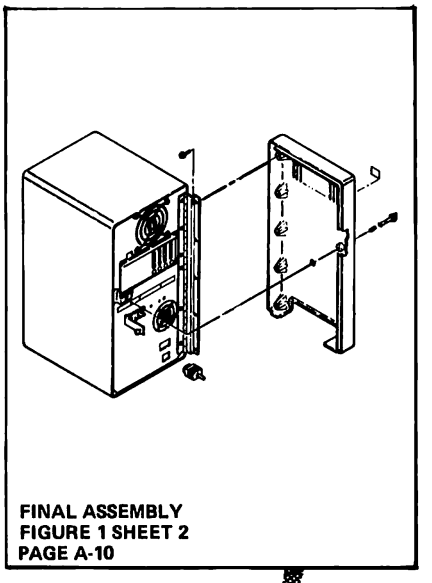
If, for example, you need the *power supply, no. 3, 60 HZ,* order part number 5891860 A (all one-dot items will also be received). See the explanation of the Catalog Section for information on how the leading dots are used in the parts listings. If you need the *transformer, 50 HZ-UK only,* order part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

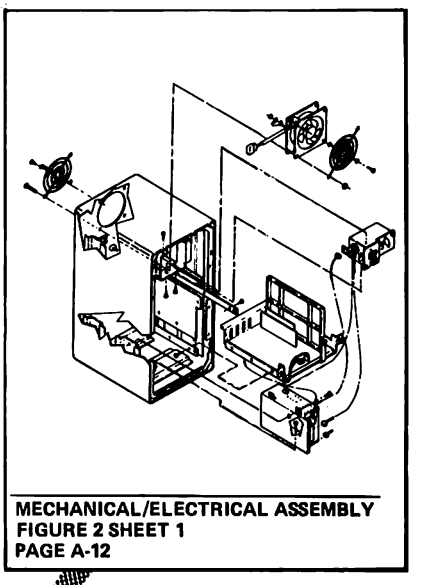
In either case, order the assembly rather than the detail parts.



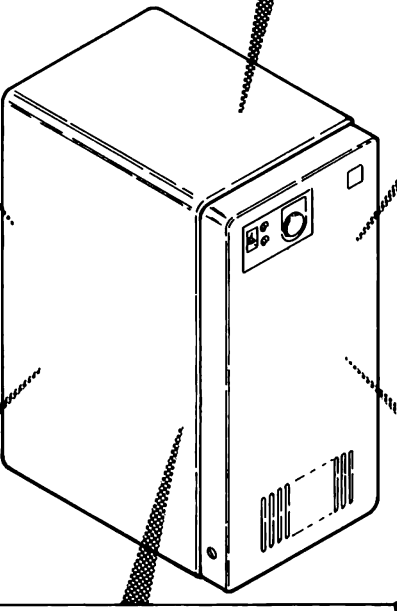
FINAL ASSEMBLY
FIGURE 1 SHEET 1
PAGE A-8

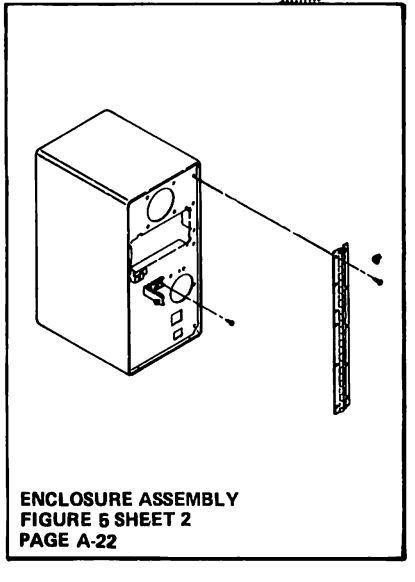


FINAL ASSEMBLY
FIGURE 1 SHEET 2
PAGE A-10

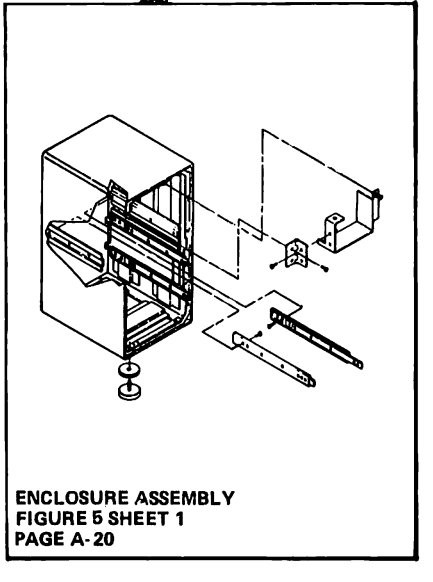


MECHANICAL/ELECTRICAL ASSEMBLY
FIGURE 2 SHEET 1
PAGE A-12

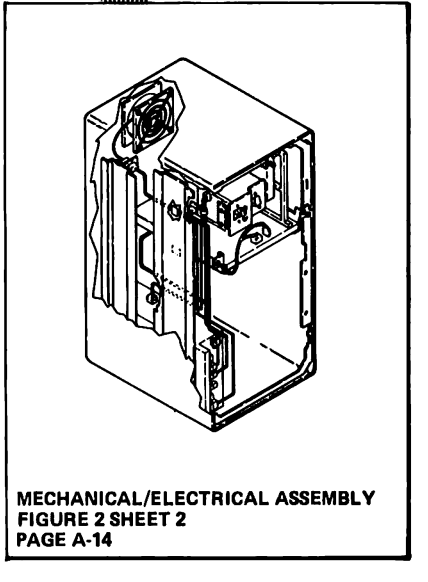




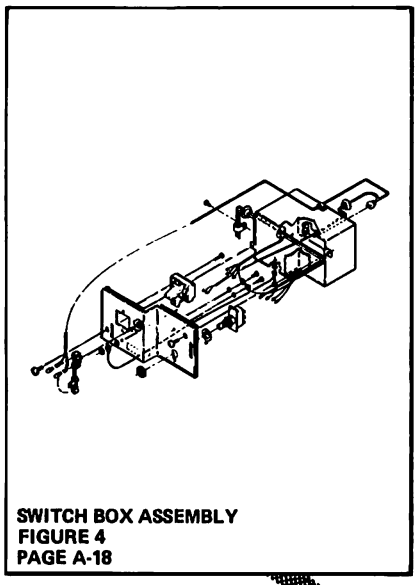
ENCLOSURE ASSEMBLY
FIGURE 5 SHEET 2
PAGE A-22



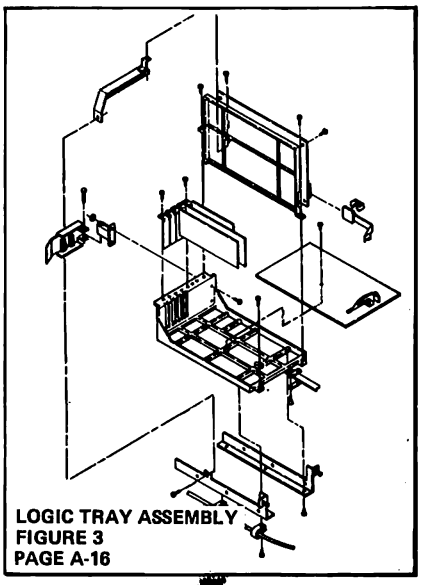
ENCLOSURE ASSEMBLY
FIGURE 5 SHEET 1
PAGE A-20



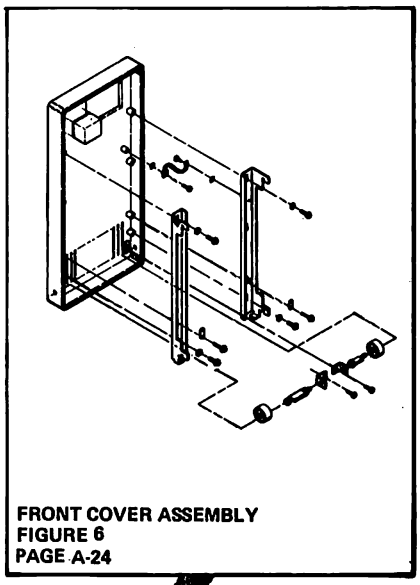
MECHANICAL/ELECTRICAL ASSEMBLY
FIGURE 2 SHEET 2
PAGE A-14



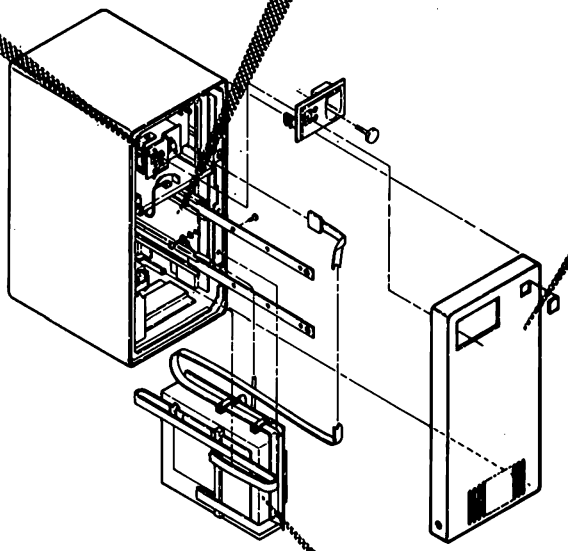
SWITCH BOX ASSEMBLY
FIGURE 4
PAGE A-18

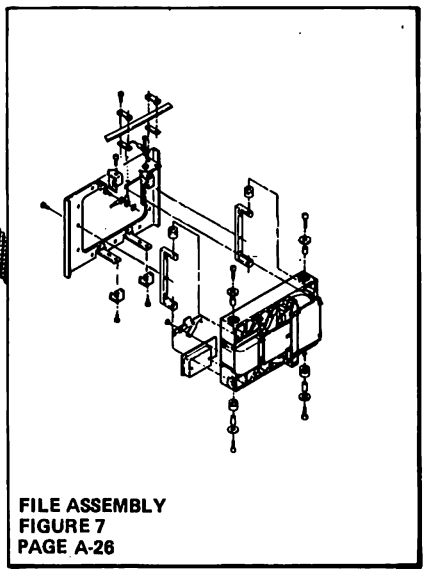


LOGIC TRAY ASSEMBLY
FIGURE 3
PAGE A-16



FRONT COVER ASSEMBLY
FIGURE 6
PAGE A-24





FILE ASSEMBLY
FIGURE 7
PAGE A-26

Figure 1. Final assembly

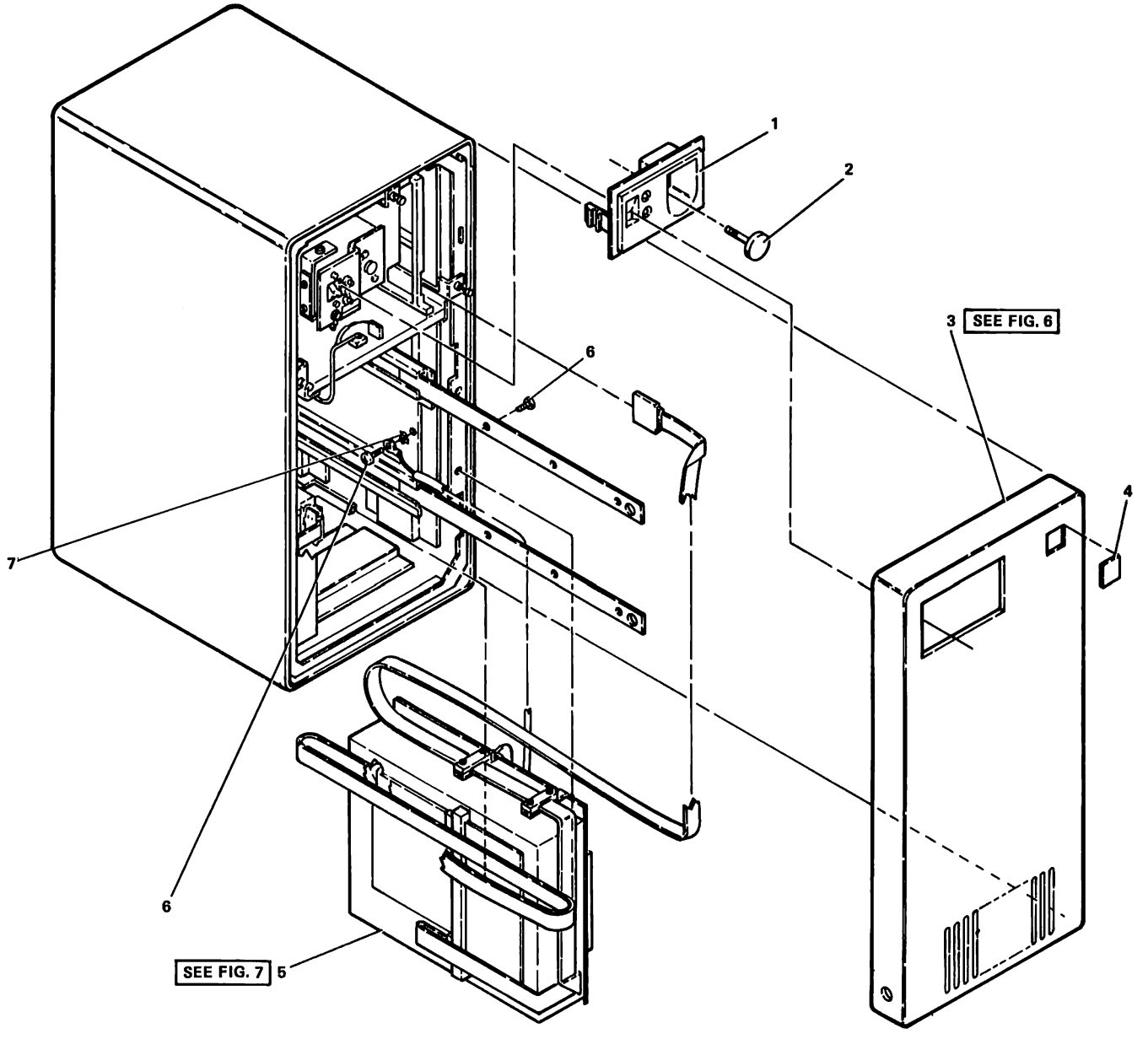


FIGURE 1. FINAL ASSEMBLY. SHEET 1 OF 2. INDEX NOS. 1-7. SEE LIST 1.

FIGURE-INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION 1 2 3 4
1 -	8257595	1	FINAL.ASM
			FOR ILLUSTRATION SEE FIGURE 1
- 1	8257657	1	. PANEL ASM,OPERATOR
- 2	8257674	1	. KNOB
- 3	8257703	1	. COVER ASM,FRONT
			FOR DETAIL BREAKDOWN SEE FIGURE 6
- 4	8257691	1	. NAME PLATE LOGO
- 5	8257643 NP	1	. FILE ASM
- 5	8257644 NP	1	. FILE ASM
			FOR DETAIL BREAKDOWN SEE FIGURE 7
- 6	1621190	7	. BOLT,PAN HD- M4 X 8 LG ATT PT
- 7	1622346	1	. WSHR,LK EXT TH- GROUNDING ATT PT

Figure 1. Final assembly

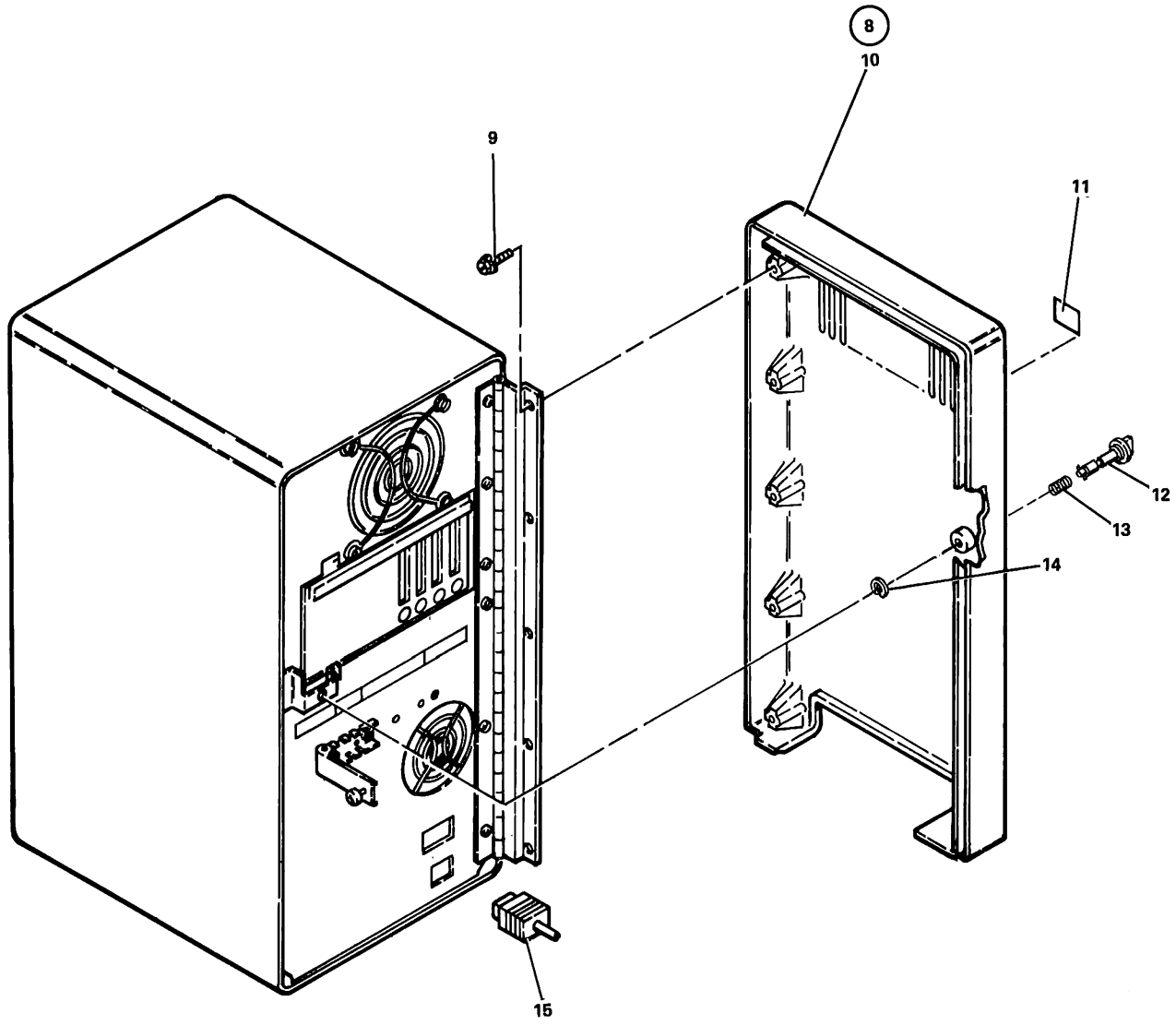


FIGURE 1. FINAL ASSEMBLY. SHEET 2 OF 2. INDEX NOS. 8-15. SEE LIST 1.

FIGURE-INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION 1 2 3 4
1 - 8	8257868	1	. COVER ASM,BACK
- 9	2549526	5	. SCREW ATT PT
- 10	8257877	1	. . COVER
- 11	8257691	1	. . NAME PLATE LOGO
- 12	8257880	1	. . KNOB ASM
- 13	6195578	1	. . SPRING,COMPRESSION
- 14	1126831	1	. . RING,RETAINING
- 15	5642989	1	. CORD,POWER-120 V U.S.
- 15	5642992	1	. CORD,POWER-200 V JAPAN
- 15	6838234	1	. CORD,POWER-250 V CSA 1.83M OR 6 FT
- 15	6841461	1	. CORD,POWER-250 V CSA 2.44M OR 8 FT
- 15	6841720	1	. CORD,POWER-250 V AUSTRIA,FINLAND,SWEDEN, NORWAY,GERMANY,SPAIN,NETHERLANDS
- 15	6841722	1	. CORD,POWER-250 V SWITZERLAND
- 15	6841724	1	. CORD,POWER-250 V BELGIUM,FRANCE
- 15	6841726	1	. CORD,POWER-250 V U.K.
- 15	6841728	1	. CORD,POWER-250 V AUSTRALIA
- 15	6841730	1	. CORD,POWER-ITALY
- 15	6841732	1	. CORD,POWER-DENMARK
- 15	6842371	1	. CORD,POWER-WTC

Figure 2. Mechanical/electrical assembly

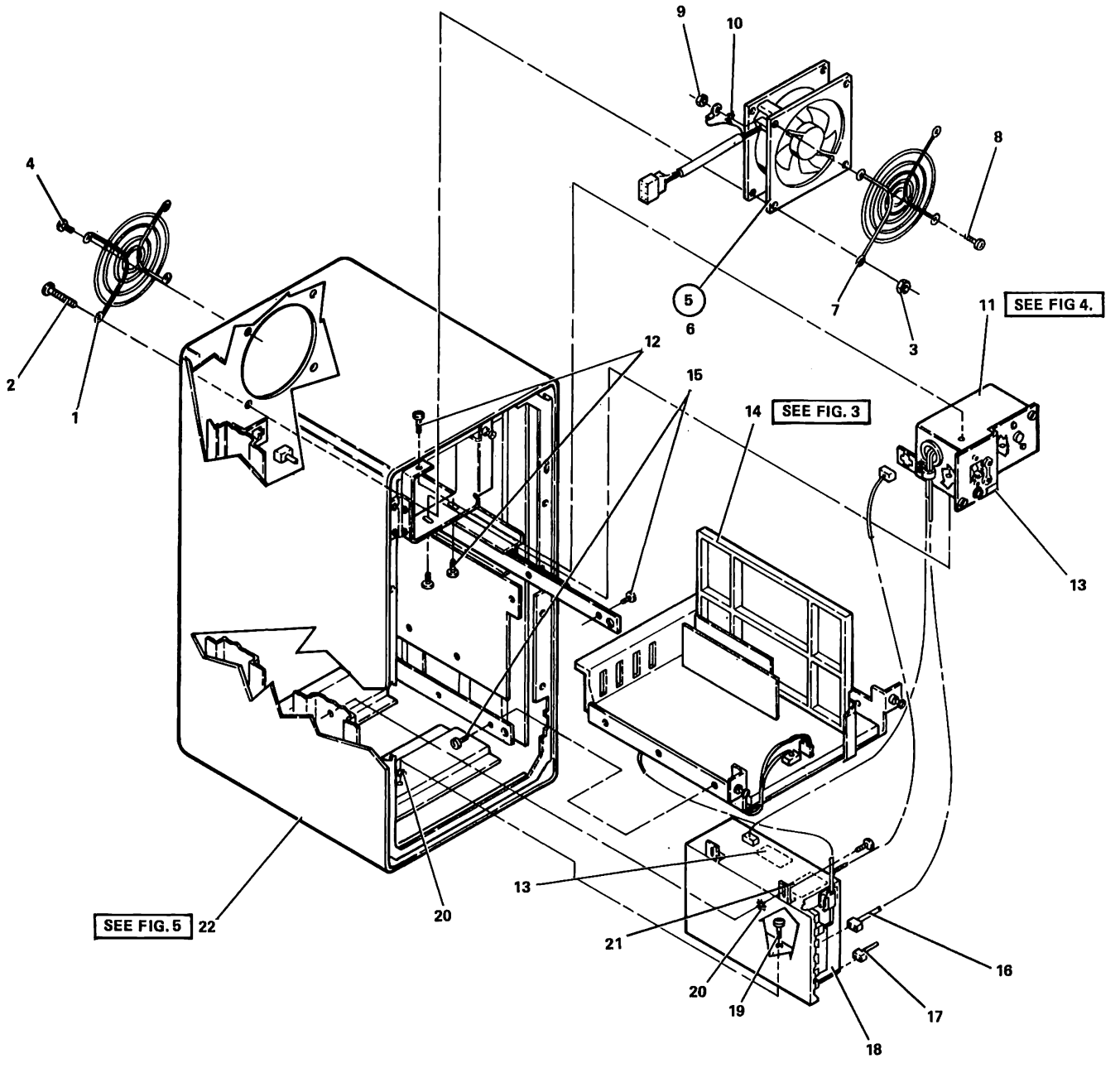


FIGURE 2. MECHANICAL/ELECTRICAL ASSEMBLY. SHEET 1 OF 2. INDEX NOS. 1-22. SEE LIST 2.

FIGURE-INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION 1 2 3 4	
2 -	NO NO.	REF	MECHANICAL ELECTRICAL ASM FOR ILLUSTRATION SEE FIGURE 2	
- 1	6195581	1	. GUARD,FAN	
- 2	1621157	3	. SCREW	ATT PT
- 3	1622441	3	. NUT	ATT PT
- 4	1621181	1	. SCREW,MACH PAN HD- M3.5 X 6 LG	ATT PT
- 5	8257659	1	. FAN ASM	
- 6	1637783	1	. . FAN,DUAL VOLT- 115/220 VAC	
- 7	6195581	1	. . GUARD,FAN	
- 8	1621186	1	. . SCREW,MACH PAN HD- M3.5 X 20 LG	ATT PT
- 9	1622402	1	. . NUT,HEX- M3.5 X 6	ATT PT
- 10	1622345	1	. . WASHER,LOCK EXT T- 3.7 ID X 7 OD	ATT PT
- 11	NO NO.	REF	. BOX ASM,SWITCH FOR DETAIL BREAKDOWN SEE FIGURES 4	
- 12	1621197	3	. SCREW,MACH PAN HD- M4 X 6 LG	ATT PT
- 13	138754	1	. LABEL,VOLTAGE-ENGLISH	
- 13	6843634	1	. LABEL,DUTCH	
- 13	6825818	1	. LABEL,VOLTAGE-FINNISH	
- 13	6825840	1	. LABEL,LINE VOLT PRESENT,JAPAN	
- 13	6825819	1	. LABEL,VOLTAGE-GERMAN	
- 13	6825828	1	. LABEL,VOLTAGE-FRENCH	
- 13	4420467	1	. LABEL,FRENCH	
- 13	6825820	1	. LABEL,VOLTAGE-ITALIAN	
- 13	6825821	1	. LABEL,VOLTAGE-SPANISH	
- 13	984123	1	. LABEL,WARNING-CANADIAN	
- 13	8551903	1	. LABEL,WARNING-SWEDISH	
- 13	6843726	1	. LABEL,NORWEGIAN	
- 14	NO NO.	REF	. LOGIC TRAY ASM FOR DETAIL BREAKDOWN SEE FIGURE 3	
- 15	1621190	6	. BOLT,PAN HD- M4 X 8 LG	ATT PT
- 16	8257688	1	. CABLE ASM	
- 17	8257695	1	. CABLE ASM,FAN	
- 18	6023328	1	. POWER SUPPLY ASM	
- 19	1621190	2	. BOLT,PAN HD- M4 X 8 LG	ATT PT
- 20	1622346	2	. WSHR,LK EXT TH- 4.15 ID X 9.0 OD X .4 T	ATT PT
- 21	845762	1	. LABEL,INFORMATION-ENGLISH	
- 21	6843636	1	. LABEL,DUTCH	
- 21	6825864	1	. LABEL,INFORMATION-FINNISH	
- 21	6825867	1	. LABEL,MACHINE WIRED FOR,JAPAN	
- 21	6812826	1	. LABEL,INFORMATION-GERMAN	
- 21	4174469	1	. LABEL,FRANCE	
- 21	6812824	1	. LABEL,INFORMATION-ITALIAN	
- 21	6812823	1	. LABEL,INFORMATION-SPANISH	
- 21	845762	1	. LABEL,INFORMATION-ENGLISH	
- 21	6812825	1	. LABEL,INFORMATION-CANADIAN	
- 21	8551907	1	. LABEL,INFORMATION-SWEDISH	
- 21	6843640	1	. LABEL,NORWEGIAN	
- 22	8257669		. ENCLOSURE ASM FOR DETAIL BREAKDOWN SEE FIGURE 5	

Figure 2. Mechanical/electrical assembly

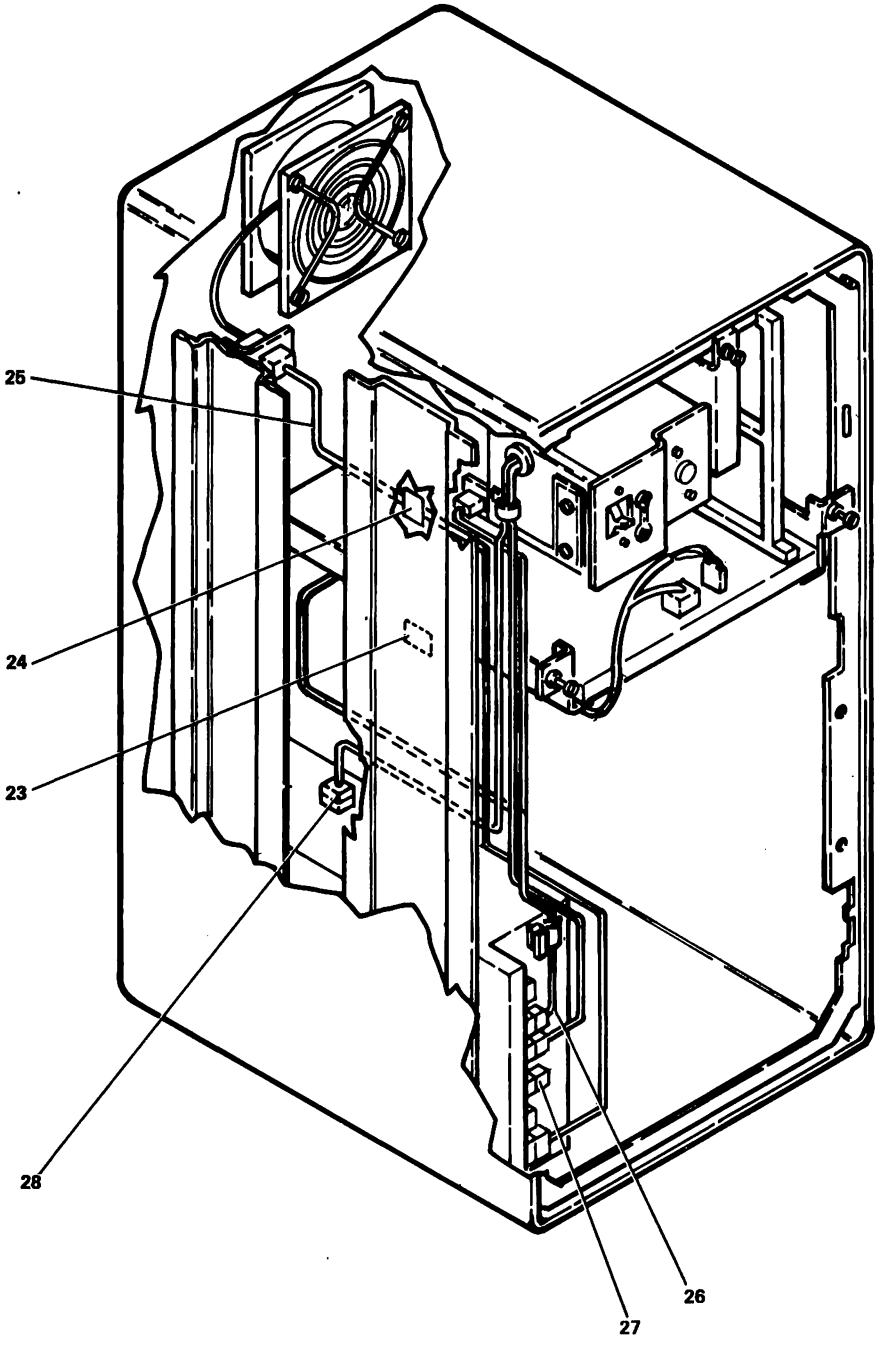


FIGURE 2. MECHANICAL/ELECTRICAL ASSEMBLY. SHEET 2 OF 2. INDEX NOS. 23-28. SEE LIST 2.

FIGURE-INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION 1 2 3 4
2 - 23	124943	1	. LABEL,HAZARDOUS AREA-ENGLISH
- 23	6843633	1	. LABEL,DUTCH
- 23	8326801	1	. LABEL,HAZARDOUS AREA-FINNISH
- 23	8326797	1	. LABEL,HAZARDOUS AREA,JAPAN
- 23	6815193	1	. LABEL,HAZARDOUS AREA-GERMAN
- 23	6815182	1	. LABEL,HAZARDOUS AREA-FRENCH
- 23	6843745	1	. LABEL,FRENCH
- 23	6815181	1	. LABEL,HAZARDOUS AREA-ITALIAN
- 23	6815180	1	. LABEL,HAZARDOUS AREA-SPANISH
- 23	984122	1	. LABEL,HAZARDOUS AREA-CANADIAN
- 23	8551904	1	. LABEL,HAZARDOUS AREA-SWEDISH
- 23	6843637	1	. LABEL,NORWEGIAN
- 24	2596275	2	. CLIP,CABLE
- 25	8257695	1	. CABLE ASM,FAN
- 26	8257697	1	. CABLE ASM,SWITCH BOX TO LOGIC TRAY
- 27	6023387	1	. CONNECTOR,P5
- 28	8257694	1	. CABLE ASM,SWITCH BOX

Figure 3. Logic tray assembly

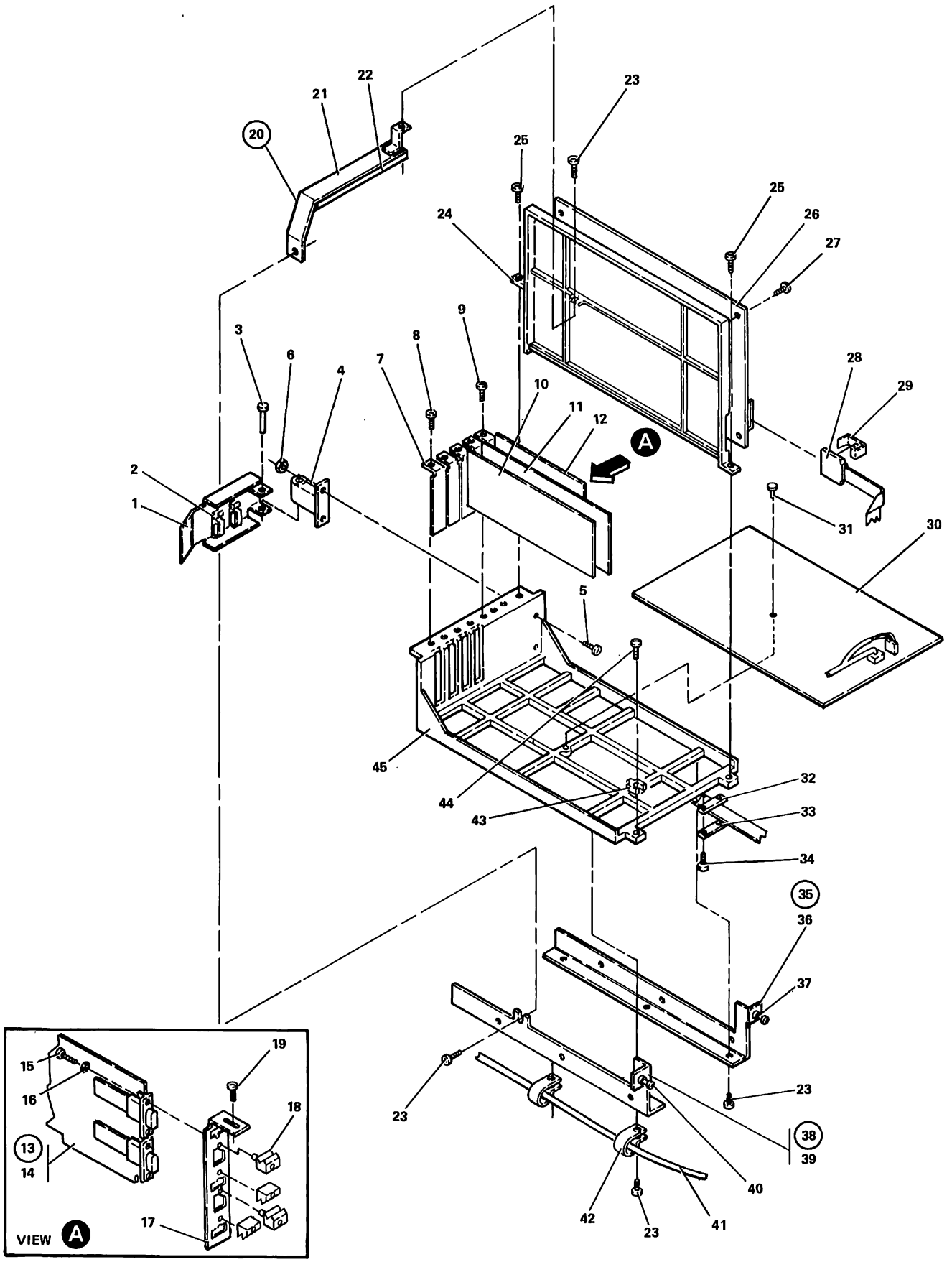


FIGURE 3. LOGIC TRAY ASSEMBLY. SEE LIST 3.

FIGURE-INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION 1 2 3 4
3 -	NO NO.	REF	LOGIC TRAY ASM FOR NEXT HIGHER ASM SEE LIST 2-14 AND FOR ILLUSTRATION SEE FIGURE 3
- 1	8257667	1	. RETAINER,CABLE
- 2	4412993	2	. CLIP
- 3	8257666	1	. PIN ATT PT
- 4	8257668	1	. BLOCK
- 5	1621194	2	. SCREW,MACH PAN HD- M4 X 20 LG ATT PT
- 6	1622403	2	. NUT,HEX- M4 X 7 ATT PT NOTF INDEX NUMBERS 1-6 APPLY TO EARLY LEVEL MACHINES ONLY
- 7	8257678	AR	. BLANK
- 8	1621197	4	. SCREW,MACH PAN HD- M4 X 6 LG ATT PT
- 9	1621197	1	. SCREW,MACH PAN HD- M4 X 6 LG ATT PT USED ON
- 10	NO NO.	1	. CARD ASM,SIA EXPANDER FOR PART NUMBER SEE CARD
- 11	NO NO.	1	. CARD ASM,SIA BASE FOR PART NUMBER SEE CARD
- 12	NO NO.	1	. CARD ASM,MEMORY FOR PART NUMBER SEE CARD
- 13	6069665	1	. CARD ASM
- 14	4498616	1	. . STATION,CARD ATTACH
- 15	1621172	4	. . SCREW,MACH PAN HD- M3 X 10 LG ATT PT
- 16	1622316	4	. . WASHER,LOCK SPRING- 3.1 ID X 6.2 OD ATT PT
- 17	8257687	1	. . BRACKET STANDOFF ASM
- 18	6031052	4	. . BLOCK,LATCHING
- 19	6846445	1	. . SCREW ATT PT
- 20	8257681	1	. RETAINER ASM
- 21	8257684	1	. . RETAINER
- 22	8257679	1	. . PAD
- 23	1621191	8	. SCREW,MACH PAN HD- M4 X 10 LG ATT PT
- 24	8257693	1	. FRAME,CARD ASM
- 25	1621193	2	. SCREW,MACH PAN HD- M4 X 16 LG ATT PT
- 26	NO NO.		. CARD ASM,DISK ATTACH FOR PART NUMBER SEE CARD
- 27	1608428	3	. SCREW ATT PT
- 28	8257706	1	. CABLE ASM
- 29	2469297	1	. CLAMP,CABLE
- 30	NO NO.		. PLANAR BOARD ASM FOR PART NUMBER SEE BOARD
- 31	2632773	1	. CLIP ATT PT
- 32	652683	2	. RETAINER,CABLE
- 33	652650	2	. STRAIN RELIEF
- 34	8257682	4	. SCREW ATT PT
- 35	6060885	1	. RAIL ASM,RIGHT
- 36	8257676	1	. . RAIL,RIGHT
- 37	8257646	1	. . LATCH,PANEL FASTNER
- 38	6060886	1	. RAIL ASM,LEFT
- 39	8257677	1	. . RAIL,LEFT
- 40	8257646	1	. . LATCH,PANEL FASTNER
- 41	8257697	1	. CABLE ASM,SWITCH BOX TO LOGIC TRAY
- 42	327921	2	. CLAMP,CABLE
- 43	8257683	1	. CLIP
- 44	1621192	1	. SCREW,MACH PAN HD- M4 X .7 X 12 LG ATT PT
- 45	8257692	1	. STIFFENER ASM

Figure 4. Switch box assembly

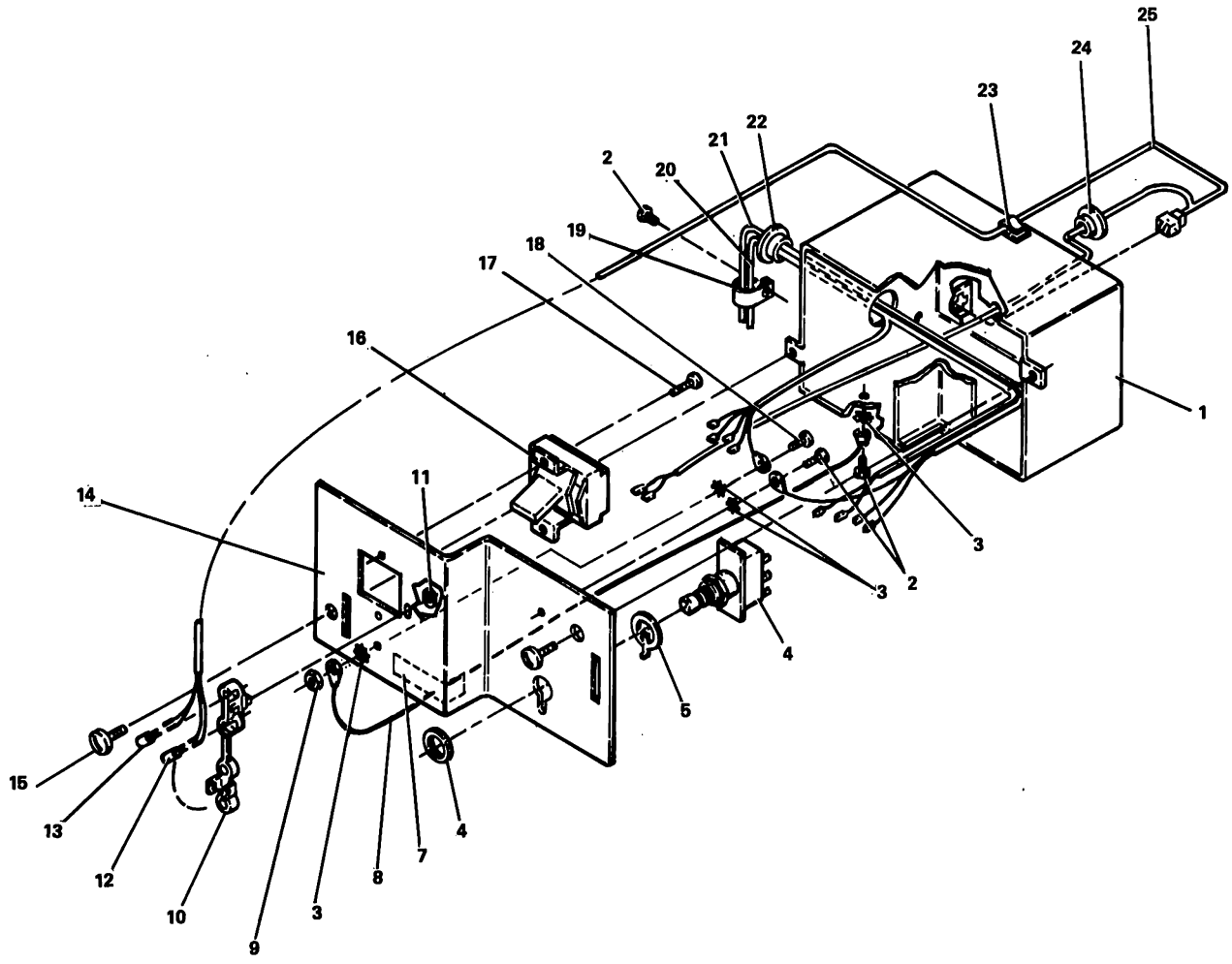


FIGURE 4. SWITCH BOX ASSEMBLY. SEE LIST 4.

FIGURE-INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION 1 2 3 4
4 -	NO NO.	REF	BOX ASM,SWITCH FOR NEXT HIGHER ASM SEE LIST 2-11 AND FOR ILLUSTRATION SEE FIGURE 4
- 1	8257653	1	. BOX,SWITCH
- 2	1621197	3	. SCREW,MACH PAN HD- M4 X 6 LG ATT PT
- 3	1622346	4	. WSHR,LK EXT TH- 4.15 ID X 9.0 OD X .4 T ATT PT
- 4	6060898	1	. SWITCH,EPC
- 5	6060899	1	. WASHER,KEY LOCKING
- 7	138754	1	. LABEL,VOLTAGE
- 8	8257648	1	. JUMPER ASM
- 9	1622403	1	. NUT,HEX- M4 X 7 ATT PT
- 10	8257689	1	. RETAINER,LED
- 11	1072821	1	. NUT ATT PT
- 12	2396867	1	. LED,POWER
- 13	8519094	1	. LED,READY
- 14	8257655	1	. PLATE,FLOATING
- 15	6845240	2	. SCREW ATT PT
- 16	8257650	1	. SWITCH,POWER
- 17	1621181	2	. SCREW,MACH PAN HD- M3.5 X 6 LG ATT PT
- 18	1621191	1	. SCREW,MACH PAN HD- M4 X 10 LG ATT PT
- 19	327921	1	. CLAMP,CABLE
- 20	8257688	1	. CABLE ASM,SWITCH BOX AC POWER
- 21	8257694	1	. CABLE ASM,EPO SWITCH AC POWER
- 22	5761936	1	. GROMMET
- 23	2596275	1	. CLIP,CABLE
- 24	6060891	1	. GROMMET
- 25	8257665	1	. CABLE ASM,SWITCH BOX AND PLANOR BOARD DC POWER

Figure 5. Enclosure assembly

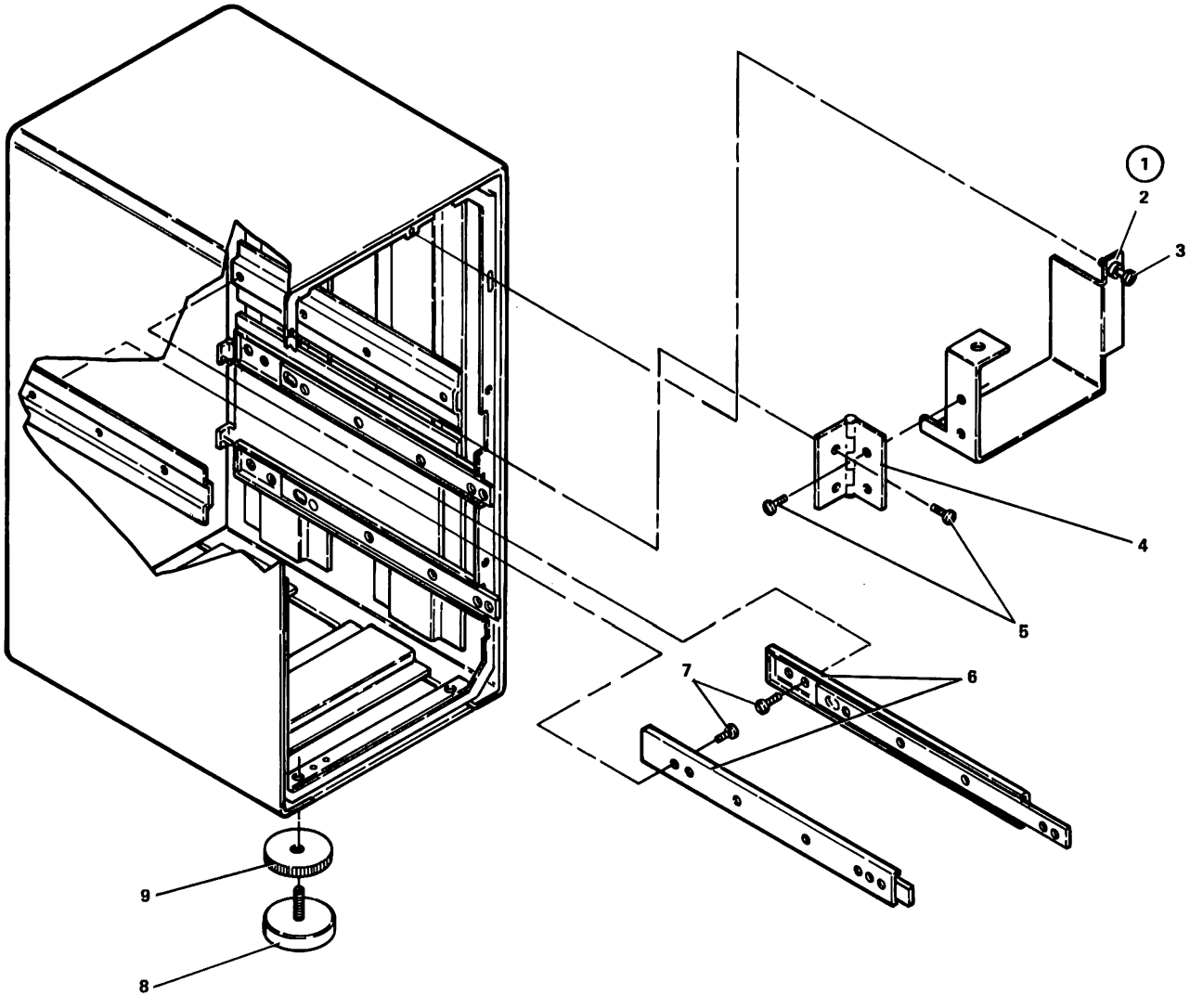


FIGURE 5. ENCLOSURE ASSEMBLY. SHEET 1 OF 2. INDEX NOS. 1-9 . SEE LIST 5.

FIGURE-INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION 1 2 3 4
5 -	8257669		ENCLOSURE ASM FOR NEXT HIGHER ASM SEE LIST 2-22 AND FOR ILLUSTRATION FIGURE 5.
- 1	8257647	1	. BRACKET ASM,SWITCH
- 2	8257654	1	. . BRACKET,SWITCH BOX
- 3	8257646	1	. . LATCH,PANEL FASTNER
- 4	8257656	1	. HINGE,SWITCH BOX
- 5	1621197	4	. SCREW,MACH PAN HD- M4 X 6 LG ATT PT
- 6	8257670	4	. SLIDE
- 7	1621190	14	. BOLT,PAN HD- M4 X 8 LG ATT PT
- 8	6081612	4	. GLIDE ASM,ADJUSTABLE
- 9	6081613	4	. NUT,ADJUSTABLE GLIDE

Figure 5. Enclosure assembly

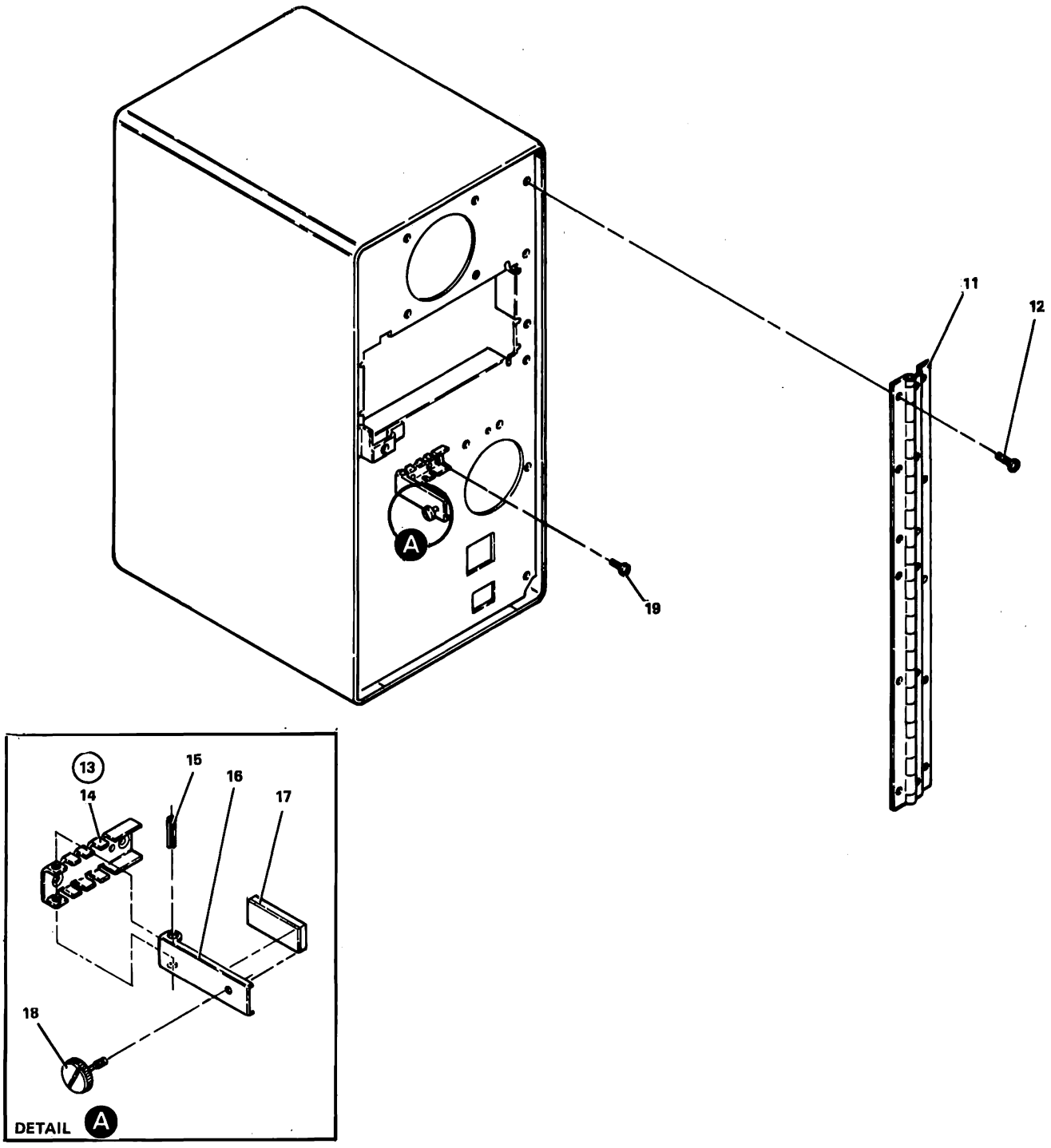


FIGURE 5. ENCLOSURE ASSEMBLY. SHEET 2 OF 2. INDEX NOS. 11-19. SEE LIST 5.

FIGURE-INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION 1 2 3 4	
5 - 11	8257675	1	. HINGE	
- 12	1621197	6	. SCREW,MACH PAN HD- M4 X 6 LG	ATT PT
- 13	6060890	1	. BRACKET ASM,EMC GROUNDING	
- 14	6060889	1	. . BRACKET,GROUNDING	
- 15	1693675	1	. . PIN,SPRING	
- 16	6060888	1	. . COVER	
- 17	6060887	1	. . PAD	
- 18	6846463	1	. . SCREW	
- 19	1621307	2	. SCREW	ATT PT

Figure 6. Front cover assembly

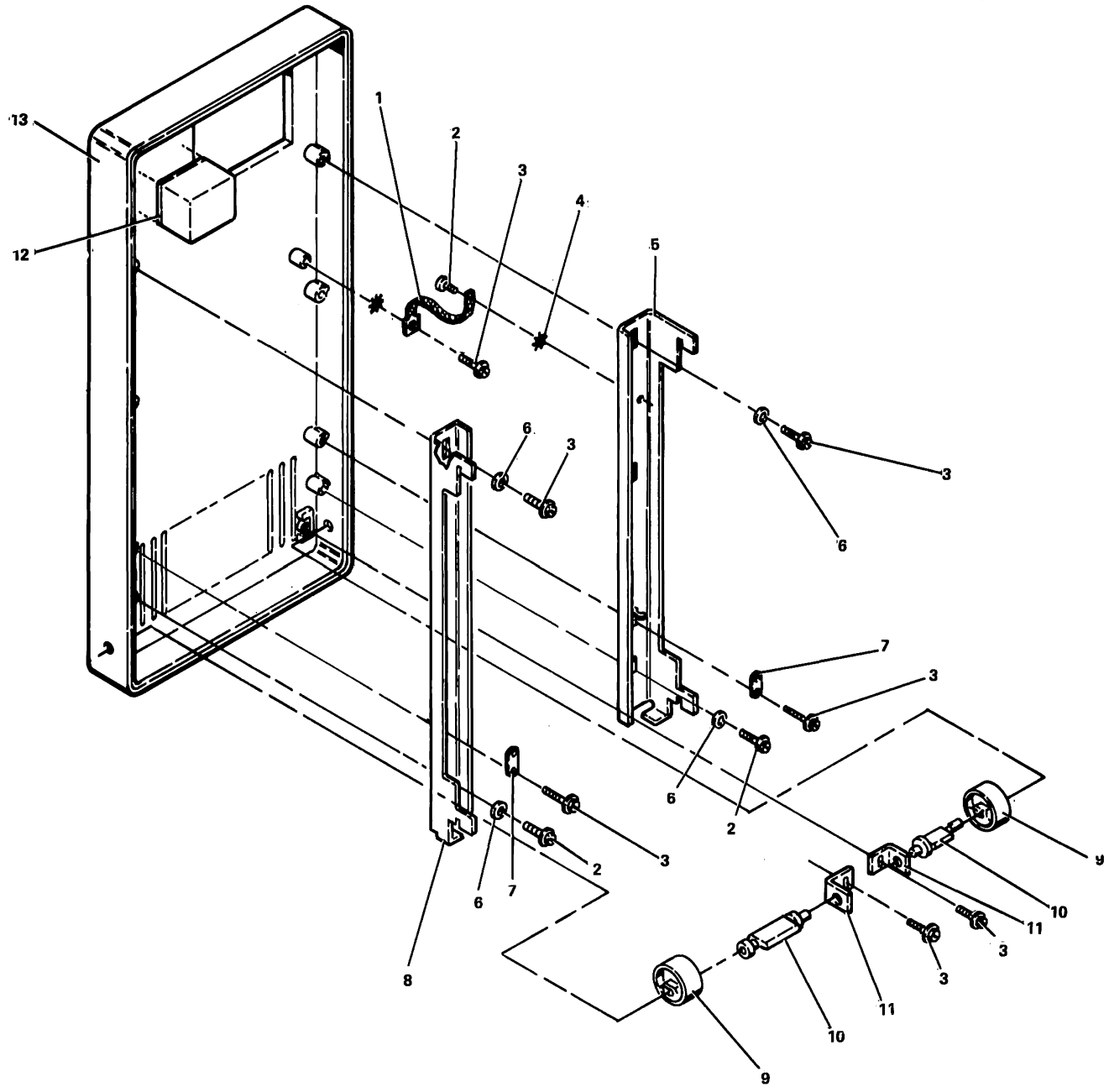


FIGURE 6. FRONT COVER ASSEMBLY. SEE LIST 6.

FIGURE-INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION 1 2 3 4
6 -	8257703	1	COVER ASM,FRONT FOR NEXT HIGHER ASM SEE LIST 1-3 AND FOR ILLUSTRATION FIGURE 6.
- 1	523022	1	. JUMPER ASM,GROUND
- 2	7362385	1	. SCREW,THD FORM HEX WSHR HD- M4 X 8 LG ATT PT
- 3	1608277	9	. SCREW,THD FORM HEX WSHR HD- 6-19 X 3/8 L ATT PT
- 4	1622346	2	. WSHR,LK EXT TH- 4.15 ID X 9.0 OD X .4 T ATT PT
- 5	8257874	1	. LATCH,LEFT FRONT
- 6	1622305	4	. WASHER,FLAT- M10 OD X 5.5 ID ATT PT
- 7	8257871	2	. SPRING,EXTENSION
- 8	8257873	1	. LATCH,RIGHT FRONT
- 9	6081623	2	. CAM,COVER LATCH
- 10	6195579	2	. SHAFT,CAM
- 11	6081622	2	. BRACKET,CAM MOUNTING
- 12	6060900	1	. PAD,FOAM
- 13	8257704	1	. COVER ASM,FRONT

Figure 7. File assembly

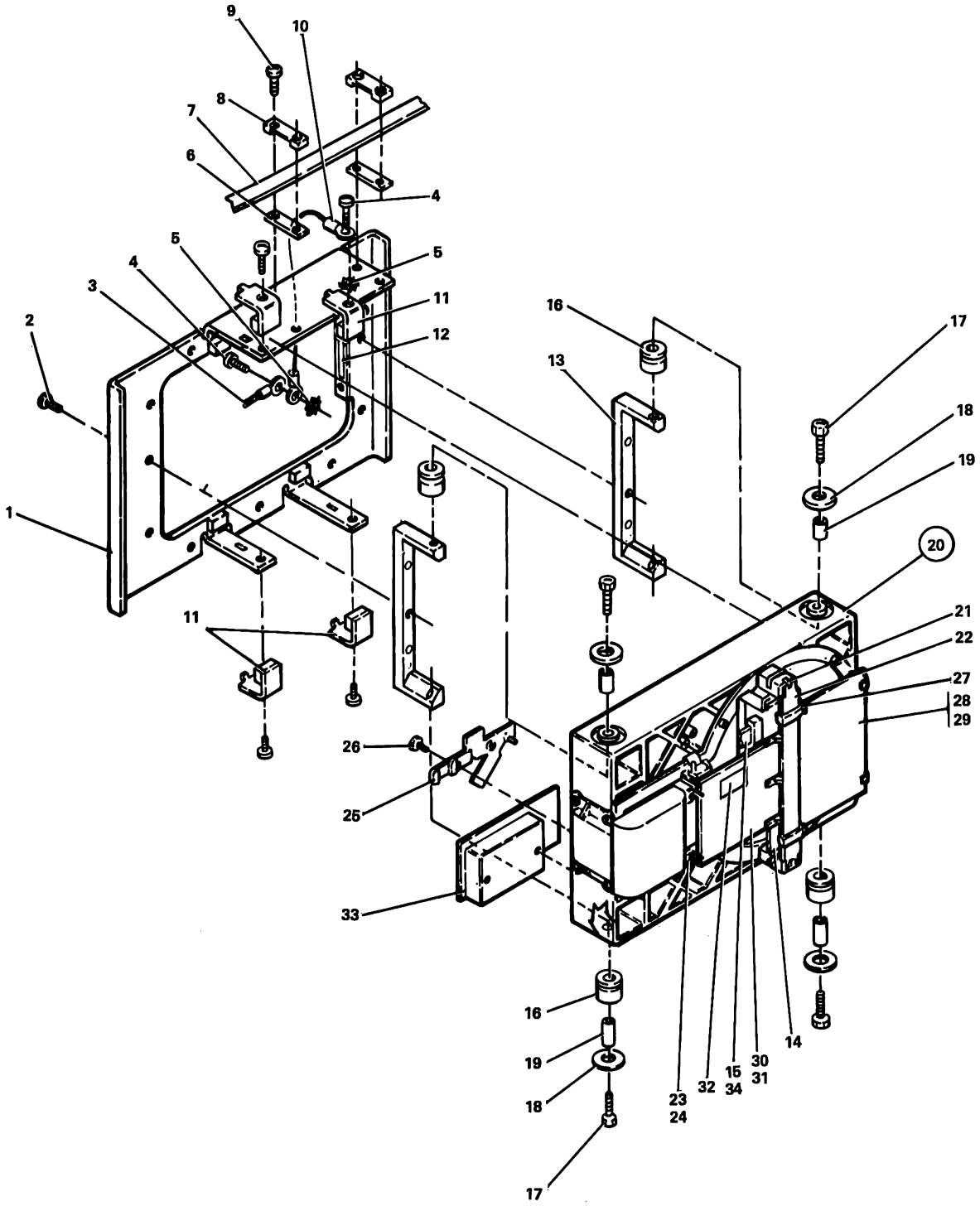


FIGURE 7. FILE ASSEMBLY. SEE LIST 7.1

FIGURE-INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION 1 2 3 4	
7 -	NO NO.	REF	FILE ASM FOR NEXT HIGHER ASM SEE LIST 1-5 AND FOR ILLUSTRATION FIGURE 7	
- 1	6060884	1	. FRAME,SUPPORT	
- 2	1621192	6	. SCREW,MACH PAN HD- M4 X 12 LG	ATT PT
- 3	6060893	1	. JUMPER ASM	
- 4	1621190	2	. BOLT,PAN HD- M4 X 8 LG	ATT PT
- 5	1622346	2	. WSHR,LK EXT TH- 4.15 ID X 9.0 OD X .4 T	ATT PT
- 6	652683	2	. FILLER	
- 7	8257706	1	. CABLE ASM	
- 8	652650	2	. STRAIN RELIEF	
- 9	1621170	4	. SCREW,MACH PAN HD- M3 X 6 LG	ATT PT
- 10	1249650	1	. JUMPER	
- 11	6060905	4	. SNUBBER,BRACKET ASM	
- 12	6060897	1	. LABEL,ATTENTION	
- 13	8257664	2	. ARM,SUPPORT	
- 14	8257706	1	. CABLE ASM,SIGNAL TO FILE	
- 15	8257696	1	. CABLE ASM,POWER TO FILE	
- 16	1616580	4	. SHOCKMOUNT	
- 17	1621599	4	. SCREW,HEX CAP HD- M6 X 1 X 3 LG	ATT PT
- 18	1616732	4	. WASHER	ATT PT
- 19	1616733	4	. SPACER	
- 20	1616698	1	. DISK ENCLOSURE,A01	
- 20	1616699	1	. DISK ENCLOSURE,A02	
- 21	1616617	2	. . CLIP	
- 22	818039	1	. . CONNECTOR,MAPLE BLOCK	
- 23	1616752	4	. . RETAINER,CARD	
- 24	1621182	4	. . SCREW,MACH PAN HD- M3 X .5 X 8 LG	ATT PT
- 25	1616784	1	. . RETAINER,CARD	
- 26	1621285	3	. . SCREW,FL HD- M3 X .5 X 6 LG	ATT PT
- 27	4233751	2	. CLAMP	
- 28	NO NO.	1	. CARD ASM,DIGITAL FOR PART NUMBER SEE CARD	
- 29	813590	1	. GUIDE,CARD	
- 30	NO NO.	1	. CARD ASM,ANALOG FOR PART NUMBER SEE CARD	
- 31	811804	1	. GUIDE,CARD	
- 32	1616634	1	. LABEL	
- 33	NO NO.	1	. CARD ASM,DRIVE FOR PART NUMBER SEE CARD	
- 34	811802	1	. GUIDE,CARD	

Figure 8. Cable assemblies with component parts

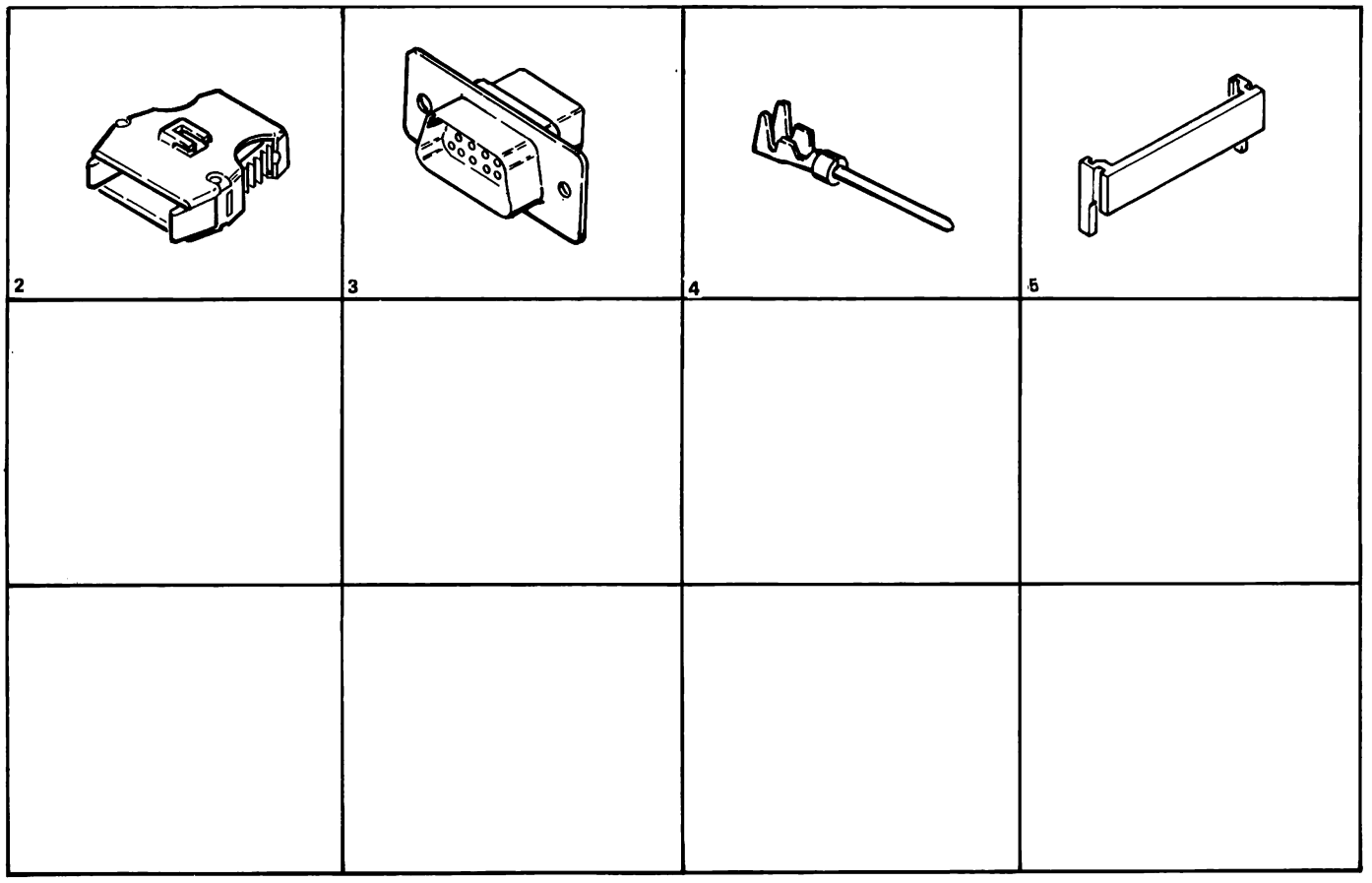


FIGURE 8. CABLE ASSEMBLIES WITH COMPONENT PARTS. SEE LIST 8.

FIGURE-INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION 1 2 3 4
8 - 2	6060896	AR	. HOUSING,SNAP ON
- 3	6837614	AR	. CONNECTOR,9-POSITION PLUG
- 4	1655339	AR	. PIN,TERMINAL
- 5	811802	AR	. GUIDE,CARD

FIGURE-INDEX NUMBER	PART NUMBER	UNITS PER ASM.	DESCRIPTION 1 2 3 4
8 -	NO NO.		CABLE ASSEMBLIES WITH COMPONENT PARTS
- 1	5642989		. CORD,POWER-120 V U.S.
- 1	5642992		. CORD,POWER-200 V JAPAN
- 1	6023356		. CABLE ASM
- 1	6023388		. JUMPER ASM
- 1	6060893		. JUMPER ASM
- 1	6838234		. CORD,POWER-250 V CSA 1.83M OR 6 FT
- 1	6841461		. CORD,POWER-250 V CSA 2.44M OR 8 FT
- 1	6841720		. CORD,POWER-250 V AUSTRIA,FINLAND,SWEDEN, NORWAY,GERMANY,SPAIN,NETHERLANDS
- 1	6841722		. CORD,POWER-250 V SWITZERLAND
- 1	6841726		. CORD,POWER-250 V U.K.
- 1	6841728		. CORD,POWER-250 V AUSTRALIA
- 1	6841730		. CORD,POWER-ITALY
- 1	6841732		. CORD,POWER-DENMARK
- 1	6842371		. CORD,POWER-WTC
- 1	8257658		. CABLE ASM,1.8M EXTERNAL SIGNAL
- 1	8257665		. CABLE ASM,SWITCH BOX AND PLANOR BOARD DC POWER
- 1	8257688		. CABLE ASM,SWITCH BOX AC POWER
- 1	8257694		. CABLE ASM,EPO SWITCH AC POWER
- 1	8257695		. CABLE ASM,FAN
- 1	8257696		. CABLE ASM,POWER TO FILE
- 1	8257697		. CABLE ASM,SWITCH BOX TO LOGIC TRAY
- 1	8257698		. CABLE ASM,4M EXTERNAL SIGNAL
- 1	8257699		. CABLE ASM,15M EXTERNAL SIGNAL
- 1	8257700		. CABLE ASM,30M EXTERNAL SIGNAL
- 1	8257701		. CABLE ASM,150M EXTERNAL SIGNAL
- 1	8257702		. CABLE ASM,300M EXTERNAL SIGNAL
- 1	8257706		. CABLE ASM,SIGNAL TO FILE

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Appendix B. Tools and test equipment

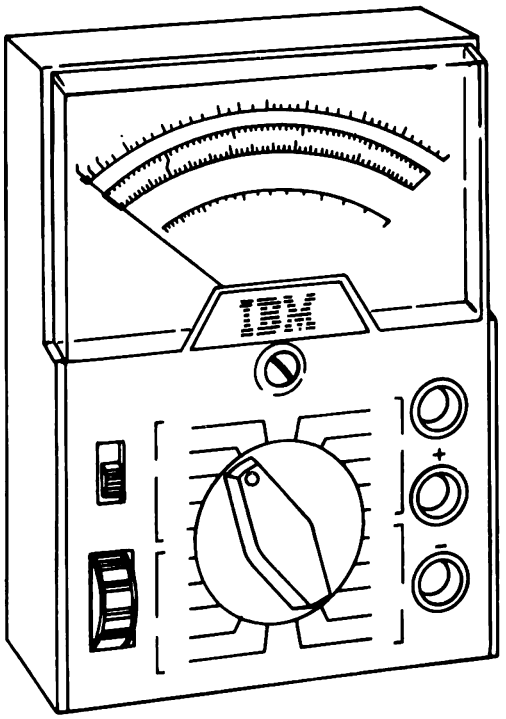
Contents

Tools and test equipment

CE tool kit tools

CE meter (part 1749231)

The CE meter is used for measuring the ac and dc voltage and for performing continuity checks.

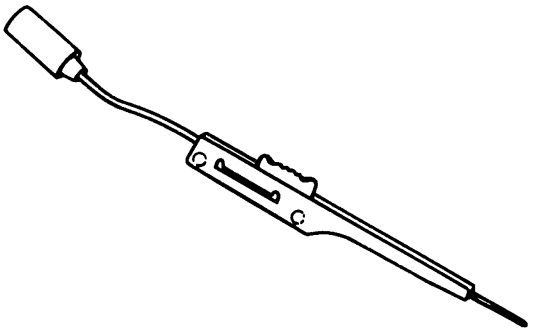


Metric tool supplement (BM 1749235)

The metric tool supplement (not shown) contains the metric tools needed to do the removal and replacement procedures.

Miniprobe (part 453718)

The miniprobe attaches to the test leads of the CE meter and is used to probe connectors.



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 handbook that comes with probe.)

Probe UP and DOWN lights will momentarily flash on during power up if the probe is connected to its machine power source. Please ignore.

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:

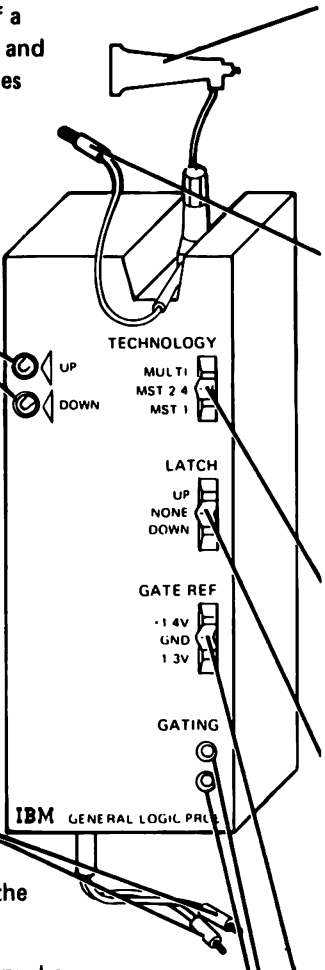
	MULTI	+60.0V
Logic	MST 2/4	+14.0V
Selector	MST 1	+14.0V

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.

When probing on the base planar board, connect the probe power leads to the power pins provided for this purpose on the base planar board (6130).



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 3 inches (76.2 mm).

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 4 inches (101.6 mm) can be used.

Logic Selector (TECHNOLOGY)

- MULTI

Selects the type of logic to be probed. Circuits probed in the 5247 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. 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 5247.

GATING Terminals

These terminals are not needed to probe the 5247.

Tools and test equipment

Branch office tools

Module extractor (part 1715889)

The extractor (not shown) clips over a plug-in ROS module, and allows the module to be easily removed from its mating socket.

Pin straightener (part 453473)

This tool (not shown) staightens bent module pins without causing additional pin damage.

Appendix C. 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*.

Acknowlegement

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Glossary

Definitions of abbreviations, acronyms, and words (continued)

A

A: A unit of current; ampere.

ac: Alternating current.

accept: To take or receive.

access: The process of moving the actuator and/or selecting a different read/write head in order to reach another storage location on the disk. Also used to describe the manner in which information is obtained from read-only storage or read/write storage by the microprocessor (MPU).

acknowledge: To respond to a poll, address, or message.

actuator: A device used to move the read/write heads over a turning disk.

adjacent: Next to; near to.

AGC: See *automatic gain control*.

alternate sector: A spare sector on the disk that is used in place of a defective sector.

amplifier: An electronic device that produces an increased level of voltage, current, or power.

analog card: An electronic card used in the direct access storage device.

ANSI: American National Standards Institute.

arm electronics module: This module is on the actuator arm inside the disk enclosure. It contains head selection circuitry, a preamplifier for the read data, and write drive circuits.

automatic gain control (AGC): A process used to maintain the output signal level at a constant level, regardless of variations in the level of the input signal.

avoid: To prevent, not permit to happen.

B

BASIC: The acronym for Beginner's All-purpose Symbolic Instruction Code, a standardized language for programming.

band: An area on the disk, such as the inner guard band and the outer guard band.

basis: Anything upon which something is based; fundamental.

begin: Start, commence, or initiate.

bidirectional line: A line that lets data, address, or control signals to flow either to, or from, a device, a module, or a circuit.

bit-by-bit: One bit at a time.

buffer area: A circular section on the disk surface that is used to separate the data area from the:

- Landing zone
- Outer stop of the actuator

built-in: Contained inside of; an integral part.

burst: A continuous transmission of information; not interrupted.

byte-formatted: Arranged in groups of bytes.

C

capacity: The ability to receive or contain.

catastrophic error: The occurrence of an unexpected interrupt during the running of the 5247 microprograms.

cathode terminal: In the 5247, the cathode terminal of the Power indicator and the Ready indicator is identified with a white dot.

characteristics: Statements about the electrical, physical, or functional features of a device or circuit.

computation: The act or method of computing; a calculation.

***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.

concentric circles: A group of circles with a common center.

consist: Is made up from; contains: includes.

contiguous sectors: One sector is next to the other sector.

CRC: See *Cyclic redundancy check.*

CSF: See *customer support functions.*

customer support functions (CSF): The customer support functions are contained on diskettes. The diskettes contain programs that perform specific jobs to permit the customer to use the System/23 more efficiently.

cyclic redundancy check (CRC): A method of checking for errors in storage (or data transmission) by accumulating a check character and then comparing the check character to a CRC count character that is part of the original data.

D

DASD: See *direct access storage device.*

dc: Direct current.

DCP: See *diagnostic control program.*

DE: See *disk enclosure.*

defective: Not usable; bad; failed.

deserialize: To convert a binary bit stream from a serial format to a parallel format.

detect: Sense.

detector: An electronic device that is used to recognize valid data.

diagnostic control program (DCP): The control program that permits program selection and loading, message displays, keyboard input, and interrupt processing for the diskette-resident diagnostics.

differential signal: A signal that is balanced around ground and, in this case, has positive and negative peak levels that are the same.

direct access storage device (DASD): This device is a fixed disk unit. It consists of a disk enclosure and three electronic cards (analog, digital, and motor/actuator).

direct memory access (DMA): A method of moving blocks of data, under control of the DMA controller and without the aid of the MPU.

direct processor control (DPC): Processor operations that are used to send commands and to sense status conditions.

disk enclosure (DE): The disk enclosure consists of a casting that contains the disks, the spindle assembly, the actuator, the disk drive motor, the head-lock solenoid, and limited electronics.

diskette: A magnetic medium used for the storage of data or microprograms.

displace: To move from one position to another.

DMA: See *direct memory access.*

DPC: See *direct program control.*

driver: In the 5247, an electronic circuit that is used to provide the proper characteristics to permit sending a signal over a length of wire.

E

EC: See *engineering change.*

ECC: See *error correction code.*

Glossary

Definitions of abbreviations, acronyms, and words (continued)

eliminates: Gets rid of; does away with.

emergency power off (EPO) switch: This switch is labeled Emergency Pull and it should only be used to switch off power to the 5247 if a hazardous operating condition exists.

EMC: Electromagnetic compatibility.

enclosure: A housing for an electrical or an electronic device, such as the disk enclosure.

engineering change (EC): An IBM-supplied alteration in the design or operation of a device or a program.

EPO: See *emergency power off switch.*

equation: A group of terms which, when solved, are equal to another term.

Error correction code (ECC): A method of error checking using a 6-byte field, following each data field that is written to, or read from, the disk. The syndrome that remains after reading a data field and its ECC contains information necessary to locate and correct an error in the data area.

expander: The optional SIA card in the 5247 that permits attachment of the 5247 to two more work stations.

extreme: All the way in one direction.

F

fault locating test (FLT): A diagnostic program used to determine system failure conditions. FLTs are used with the MAPs and service manual procedures to determine, isolate, and solve system problems.

FBA: See *fixed block addressing.*

FCS: See *frame check sequence.*

field replaceable unit (FRU): An assembly that is replaced in its entirety when any one of its components fails.

fixed block addressing (FBA): The FBA is part of the operating system program that is written onto the disk during the initial microprogram load. The FBA codes the storage requests from the work station into a numbering system, where each 512-byte block of data is assigned a number.

FLT: See *fault locating test.*

Frame check sequence (FCS): A method of error checking using a 16-bit pattern that is the result of a computation on the contents of the address, the control, and the information fields of the serial data link control (SDLC) frame. The computation method used is called cyclic redundancy checking (CRC).

FRU: See *field replaceable unit.*

G

gain: In an amplifier, pertains to the ratio of an increase of output over input.

general logic probe (GLP): A CE tool used during maintenance activity to verify the presence or absence of logic signals.

glide: The four leveling devices on the bottom of the 5247 enclosure.

GLP: See *general logic probe.*

guard bands: Inner and outer areas on the disk surface. The inner guard band is a buffer area between the data area and the landing zone. The outer guard band is a buffer area between the data area and the outer stop of the actuator.

H

half-duplex: Data transmission in both directions on the channel, but not at the same time.

handshake: An exchange of signals that is required in order for information to pass between two data devices.

Hertz: A measure of frequency; one cycle per second.

hex: See *hexadecimal*.

hexadecimal: Pertaining to a number system with a base of 16.

holder: In the 5247, a device that is used to hold the Power and the Ready indicators.

Hz: See *Hertz*.

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.

IMPL: See *initial microprogram load*.

in: The abbreviation for inch. One inch equals 25.4 mm.

individual: One; single; by itself.

initial microprogram load (IMPL): The loading of the data management system onto the disk.

***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.

***interrupt:** To stop a process in such a way that it can be resumed.

inverter: An electronic circuit that inverts a signal (+ to – or – to +).

I/O: See *input/output*.

K

knurled: Having small ridges on the edge of a surface.

L

landing zone: An area on the disk surface where it is intended for the read/write heads to contact the surface as the disk slows its rotation.

levelers: The four glides on the bottom of the 5247 enclosure.

logic tray: A flat metal frame with rolled edges that contains the base planar board and the plug-in cards.

logical sector address: A logical address given to a physical sector location.

logical sector number: The number given to each sector as it occurs in sequence of use around a specific track.

loop: Within a program, a group or set of instructions that are executed repeatedly.

LSB: Least significant bit.

M

MAPs: The abbreviation for maintenance analysis procedures.

maple connector block: This block provides a means of making electrical connections to the direct access storage device; it also is a plug-in connector for the analog card, the digital card, and the motor/actuator card.

mask.: A binary bit pattern contained in R/W storage that is used for comparison of sector or data fields present on the disk. Also used in referring to a pattern of bits that is used to retain or eliminate another pattern of bits.

Mb: See *megabyte*.

Mbit: See *megabit*.

Mbyte: See *megabyte*.

megabit: Used in referring to a data rate; one million bits.

Glossary

Definitions of abbreviations, acronyms, and words (continued)

megabyte (Mb): When used in referring to the storage capacity of the 5247 disk, it represents one million bytes.

memory: Used to indicate storage, as in direct memory access.

microinstructions: An instruction within a microprogram. See *microprogram.*

microprocessor (MPU): A processing unit, with microcode, contained on an integrated circuit chip.

microprogram: Refers to the programs used to control the operation of the microprocessor.

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.

millivolt (mV): Equal to 0.001 volt.

motor/actuator card: An electronic card used in the direct access storage device.

MPU: See *microprocessor.*

MSB: Most significant bit.

multiple-track seek: A seek operation in which the read/write heads move two tracks or more.

mV: See *millivolt.*

N

nonmaskable interrupts: These interrupts are caused by hardware conditions or errors. They cannot be enabled, disabled, or selectively masked by the micropgrogram.

non-return-to-zero inverted (NRZI): A method of data transmission encoding where each binary zero causes a transition in the data stream.

NRZI: See *non-return-to-zero inverted.*

O

occurrence: Something that happens; an event.

odd: Pertains to a number that cannot be divided by two to give a whole number.

off-track: Not on the same track as the defect.

onto: To place or position upon.

originate: To initiate; to begin.

oscillator: A device that generates a signal that changes between two levels at a certain frequency.

overall: From one extreme limit of a thing to the other; includes everything.

P

pair: Two of something.

physical sector address: An area on the disk surface that never changes in location.

physical sector number: The number assigned to the physical sector address starting from cylinder 0, head 0, sector 0 through cylinder 444, last head (1 or 3), and last sector 69.

PID: See *program identification.*

planar board: The primary printed-circuit board that contains the logic for the processor. Also, contains connectors for the plug-in cards.

PN: The abbreviation for part number.

polling: An orderly procedure of inviting each work station to request servicing by the 5247.

port: An access point (for example, port 1) for data entry and exit to which a work station can be attached.

portion: A part of an item or thing.

position-error signal: A signal that indicates how far the data heads are from the center of the selected track or if the data heads are on the center of the correct track.

positioned: Having been placed or put.

preamplifier: An amplifier that primarily raises the output of a low-level signal.

processor: The processing unit of the 5247.

program identification (PID): The identifying number or name assigned to a program.

protocol: The standards or procedures dealing with serial data link control. They describe how data is to be formatted, what the control signals do, error checking, and so forth.

provide: To give or supply.

pry: To detach or remove by using leverage with a tool such as a screwdriver.

Q

qualifier: A term that modifies or restricts the meaning of a statement or another term.

R

RCB: See *request control block.*

read-only storage (ROS): Storage from which data can only be read, but not written.

read/write storage (R/W): Storage where data can be written to and read from.

reassemble: To assemble after repair; to put back together.

recalibrate: An action in which the actuator returns the read/write heads to home. If an unsafe condition is present, the actuator may return the read/write heads either to the guard band or to the landing zone.

reconstruct: To recreate or make over.

recoverable: To get back or regain.

redundancy: Added information used to reduce error.

refresh: To restore information that would otherwise be lost.

register: A group of latches or polarity-hold circuits that store one or more bits of information.

replace: In this service manual, pertains to removing a failing part and installing a new part.

request control block: A request control block is 32 bytes long. It is used for all data exchanges between the 5247 and the work stations.

resides: Contained in.

restrict: To confine or keep within limits.

ROS: See *read-only storage.*

ROS-resident: A read-only program that is contained in ROS.

rpm: Revolutions per minute.

R/W storage: See *read/write storage.*

S

SDLC: Serial data link control.

sector: One of 70 equal parts of a data track.

sector number interleaving: The 70 sectors are logically numbered consecutively 0, 35, 1, 36.....33, 68, 34, 69.

self-contained: Contained within.

serdes: Circuits which perform both a serial conversion of parallel data and a parallel formating of serial data.

Glossary

Definitions of abbreviations, acronyms, and words (continued)

servo signal: The part of the signal read from the disk that indicates the position of the read/write heads.

settle: The time or mode necessary after a seek operation for the actuator to remain close to the center of the selected track to read or write.

shifting: Movement from one location to another.

SIA: Serial interface adapter.

SM: The abbreviation used for service manual in this service library.

snap: To install or put together by using a quick motion.

SNRM: Set normal response mode. A serial data link control command.

spindle assembly: A part of the disk enclosure that holds the disk(s) and rotates.

squeeze: To force together.

stabilize: To hold constant or firm.

stage: A term applied to an electronic circuit, such as an amplifier stage.

subsequent: Occurs after, or later in time; usually follows in order.

syndrome: The 6-byte remainder from the ECC check that contains information necessary to locate and correct an error in the preceding 256-byte data field.

T

target cylinder: The cylinder on which it is desired to read or write data.

time-shared: To use the same device at different times for two or more purposes.

transfer: To transmit, or copy, information from one device to another.

transition: A quick change in signal polarity.

U

UA: Unnumbered response. A serial data link control command.

unexpected: Not planned or anticipated.

unique: One of a kind; has no like or equal.

unsnap: To remove or separate by using a quick motion.

utility: Something useful.

V

Vac: The abbreviation for volts of alternating current.

variable frequency oscillator: In the 5247, an electronic circuit that is used as a reference for data and clock synchronization.

VCM: Voice coil motor.

version: The storage capacity designation used for the 15.4 Mbyte DASD is Version A1, and the designation for the 30.8 Mbyte DASD is Version A2.

W

within: Inside of; between

wrap test: A test that electronically wraps the output of a device back to its input.

Z

zone: An area on the disk assigned to a certain function, such as a landing zone.

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