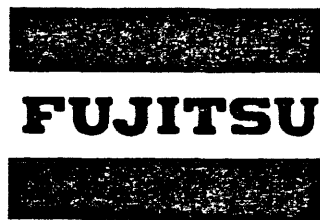# M2351A/AF MINI-DISK DRIVE ENGINEERING SPECIFICATION

FUJITSU

0.0 INTRODUCTION

THIS SPECIFICATION DESCRIBES THE TECHNICAL DETAILS OF A 470 MEGABYTE
DISK DRIVE WITH A MODIFIED STORAGE MODULE DEVICE (SMD) INTERFACE.

1.0 CAPACITY

1.1 NO. OF SPINDLE(S) PER UNIT: 1

1.2 DISK SIZE/TYPE: 10.5" NON-REMOVABLE

1.3 NO. OF DISK(S) PER SPINDLE: 6

1.4 NO. OF MOVING R/W HEADS: 20
(TRACKS(S) PER CYL.)

Head 1 is is Servo head

1.5 NO. OF FIXED R/W HEADS: 0

1.6 NO. OF CYLINDERS: 842

1.7 TOTAL NO. OF TRACKS: 16,840

1.8 NO. OF BYTES PER TRACK: 28,160
NO. OF BITS PER TRACK: 225,280

1.9 UNFORMATTED (GROSS) CAPACITY PER UNIT: 474.2 M BYTES

1.10 FORMATTED CAPACITIES:

1.10.1 BYTES/SECTOR: 768

1.10.2 NO. OF SECTOR/TRACK: ~~32~~ 33

1.10.3 NO. OF SECTORS/DRIVE: 572,560

1.10.4 NO. OF BYTES/TRACK: 26,112

1.10.5 NO. OF BYTES/DRIVE: 439.7 M BYTES

1.11 FORMATTED VS. UNFORMATTED

1.11.1 CAPACITY RATIO: 92.7%

PM 402

2.0 SPEED

2.01 ROTATIONAL SPEED: 3961 RPM +-0.5%

2.02 AVERAGE LATENCY: 7.57 M SEC

2.03 HEAD POSITIONING TIMES

   2.03.1 TRACK TO TRACK: 5.0 MILLISECONDS

   2.03.2 AVERAGE: 18 MILLISECONDS

   2.03.3 MAXIMUM: 35 MILLISECONDS

2.04 MAX REZERO TIME: 325 MILLISECONDS (WORST CASE)

2.05 HEAD SWITCHING TIME: 14 MICROSECONDS

2.06 BIT CELL TIME : 67.24 NANOSECONDS

2.07 DATA TRANSFER RATE: 1.859 MBYTES/SEC
                         =14.872 MBITS/SEC

2.08 START TIME: 40 SECONDS MAXIMUM

2.09 STOP TIME: 15 SECONDS MAXIMUM

2.10 HEAD LOADING TIME: N/A

2.11 WRITE TO READ DELAY: 12 MICROSECONDS

3.0 TECHNOLOGY

3.01 NON-REMOVABLE WINCHESTER TYPE HEADS AND PLATTERS

3.03 RECORDING HEAD: MANGANESE/ZINC

3.04 RECORDING MEDIUM: FERROUS OXIDE COATED ALUMINUM

3.05 HEAD POSITIONING: DIRECT DRIVE ROTARY ACTUATOR

3.06 SPINDLE MOTOR: DC BRUSHLESS

3.07 ENCODING TECHNIQUE: M.F.M.

3.08 VFO DATA SEPARATOR: INCLUDED

3.09 MAX RECORDING DENSITY: 12,800 FCI (FLUX TRANSITIONS PER INCH)

3.10 TRACK DENSITY: 880 TPI

EU 402

4.0 POWER REQUIREMENTS AND SPECIFICATIONS

4.1 AC POWER

4.1.1 100 VAC +-10%, 50/60 HZ +-2 HZ, 6 AMPS, 50 AMP STARTING SURGE

4.1.2 120 VAC +-10%, 60 HZ +-2 HZ, 5 AMPS, 40 AMP STARTING SURGE

4.1.3 220 VAC +-10%, 50 HZ +-2 HZ, 3 AMPS, 25 AMP STARTING SURGE

4.1.4 240 VAC +-10%, 50 HZ +-2 HZ, 3 AMPS, 20 AMP STARTING SURGE

4.2 DC POWER   NO EXTERNAL DC POWER REQUIRED

4.3 GROUNDING REQUIREMENTS

4.3.1 LOGIC GROUND: IS SEPARATED FROM CHASSIS GROUND
                     (1 MEGOHM MIN)

4.3.2 AC OR CHASSIS GROUND: (THE SAME) SHALL BE CONNECTED
                     TO AC 'GREEN' WIRE WHEN MEASURING
                     ELECTRICAL/ELECTROSTATIC NOISE
                     SUSCEPTIBILITY.

4.4 POWER CABLES AND CONNECTORS

4.4.1 AC CABLE: PROVIDED WITH STANDARD PLUG

4.5 PROTECTION AGAINST DAMAGE CAUSED BY POWER LOSS

4.5.1 RECORD INTEGRITY (R/W SAFETY) PROVISIONS: STORED DATA IS
      PROTECTED EXCEPT THAT WHICH IS BEING WRITTEN AT THE TIME
      OF A POWER FAILURE.

4.5.2 HEAD/MEDIA DAMAGE PROTECTION: NO DAMAGE WILL OCCUR.

RM 402

5.0 PHYSICAL DIMENSIONS

   5.1 HEIGHT: 10.4 INCHES

   5.2 WIDTH: STANDARD EIA 19" RACK MOUNT

   5.3 DEPTH: 25.0 INCHES BEHIND FRONT MOUNTING SURFACE

   5.4 WEIGHT: 137 POUNDS MAX.

   5.5 HEAT DISSIPATION: 2000 BTU MAX

   5.6 MOUNTING: RACK MOUNTING ONLY

   5.7 DRAWING NO. REFERENCED DEFINING MOUNTING HOLES, CONNECTOR
       POSITIONS, OPERATOR PANEL ETC.: TBD

   5.8 OPERATOR CONTROLS (SWITCHES, LAMPS, PUSHBUTTONS, ETC.):

       ROTARY ACTUATOR LOCK
       MAIN AC CIRCUIT-BREAKER
       LOCAL/REMOTE SPINDLE MOTOR ENABLE SWITCH
       SPINDLE MOTOR START SWITCH
       WRITE PROTECT SWITCH
       POWER ON INDICATOR LED
       START INDICATOR LED
       READY INDICATOR LED
       FAULT CLEAR SWITCH AND INDICATOR LED
       UNIT STATUS INDICATOR LED'S AND REZERO SWITCH
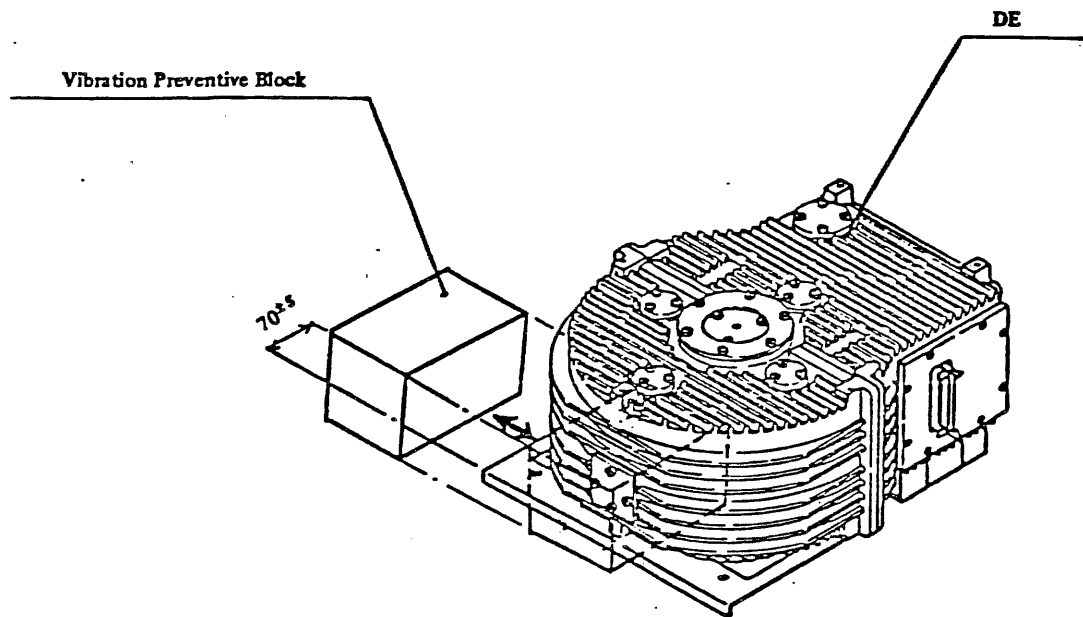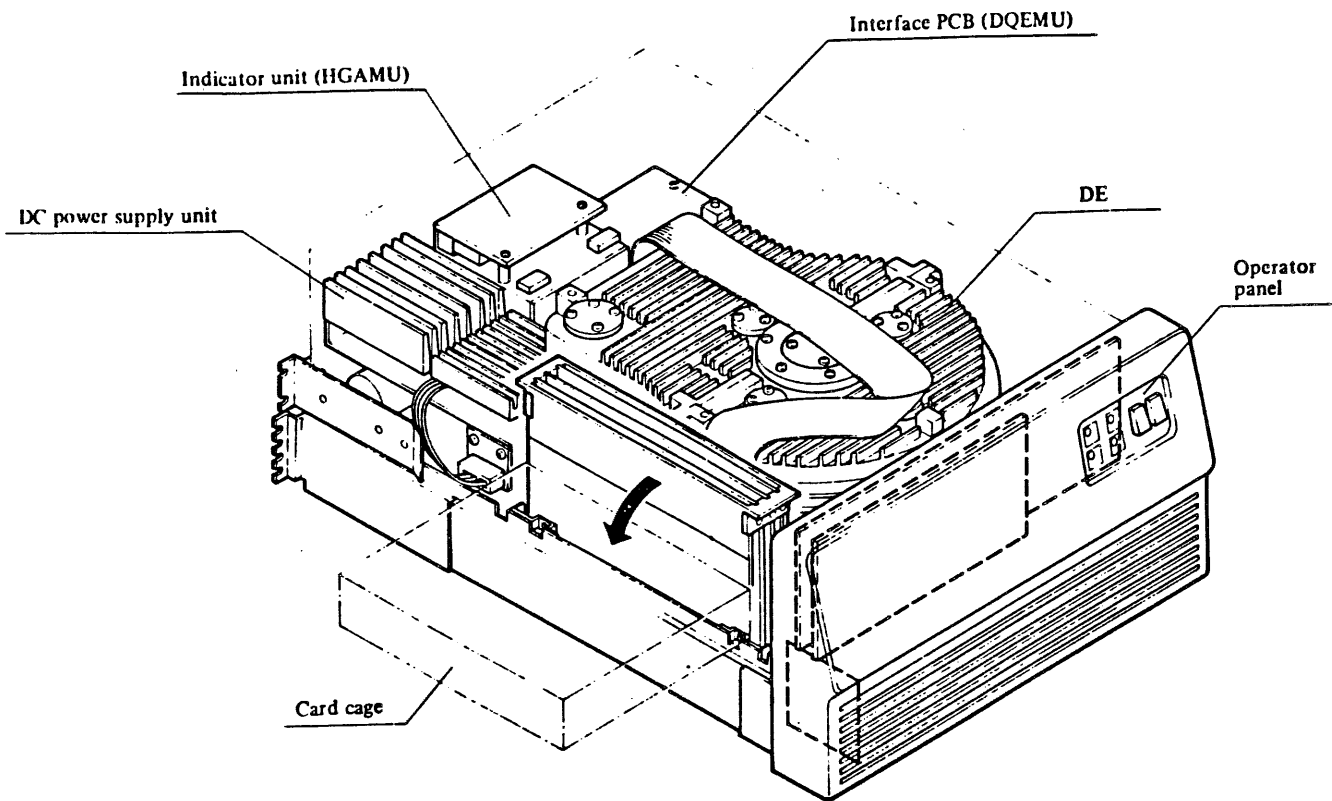
6.0 RELIABILITY SPECIFICATIONS

   6.1 MTBF: 10,000 PWR ON HRS AFTER AN INITIAL PERIOD OF 200 HOURS.

   6.2 MTTR: 30 MIN OR LESS

   6.3 USEFUL LIFE: 5 YEARS

   6.4 SOFT READ ERRORS: 1 IN 10 GIGA BITS READ (10 BILLION BITS)

   6.5 HARD READ ERRORS: 1 IN 10 TERA BITS READ (10 TRILLION BITS)

   6.6 SEEK ERRORS: 1 IN 10 MILLION SEEKS

A T T E N T I O N

THIS DRIVE HAS TWO SHIPPING RESTRAINTS:

1. THE STANDARD CARRIAGE RESTRAINT
   (VCM LOCK/UNLOCK) AS SHOWN ON
   PAGE 2-4 OF THE CE MANUAL.

2. A FOAM BLOCK (VIBRATION DAMPNER)
   HAS BEEN PLACED UNDER THE DE
   (HDA). TO REMOVE:
   (1) REMOVE 2 SCREWS SECURING
       THE CARD CAGE
   (2) LIFT THE CARD CAGE UP
       AND ROTATE OUT
   (3) THE FOAM BLOCK SHOULD BE
       READILY VISIBLE AND EASILY
       REMOVED BY HAND
   (4) LIFT, ROTATE, AND SLIDE THE
       CARD CAGE BACK DOWN – CHECK
       THAT CABLES ARE NOT UNDER
       THE CARD CAGE
   (5) SECURE CAGE WITH 2 SCREWS

Interface PCB (DQEMU)

Indicator unit (HGAMU)

DC power supply unit

DE

Operator panel

Card cage

DE

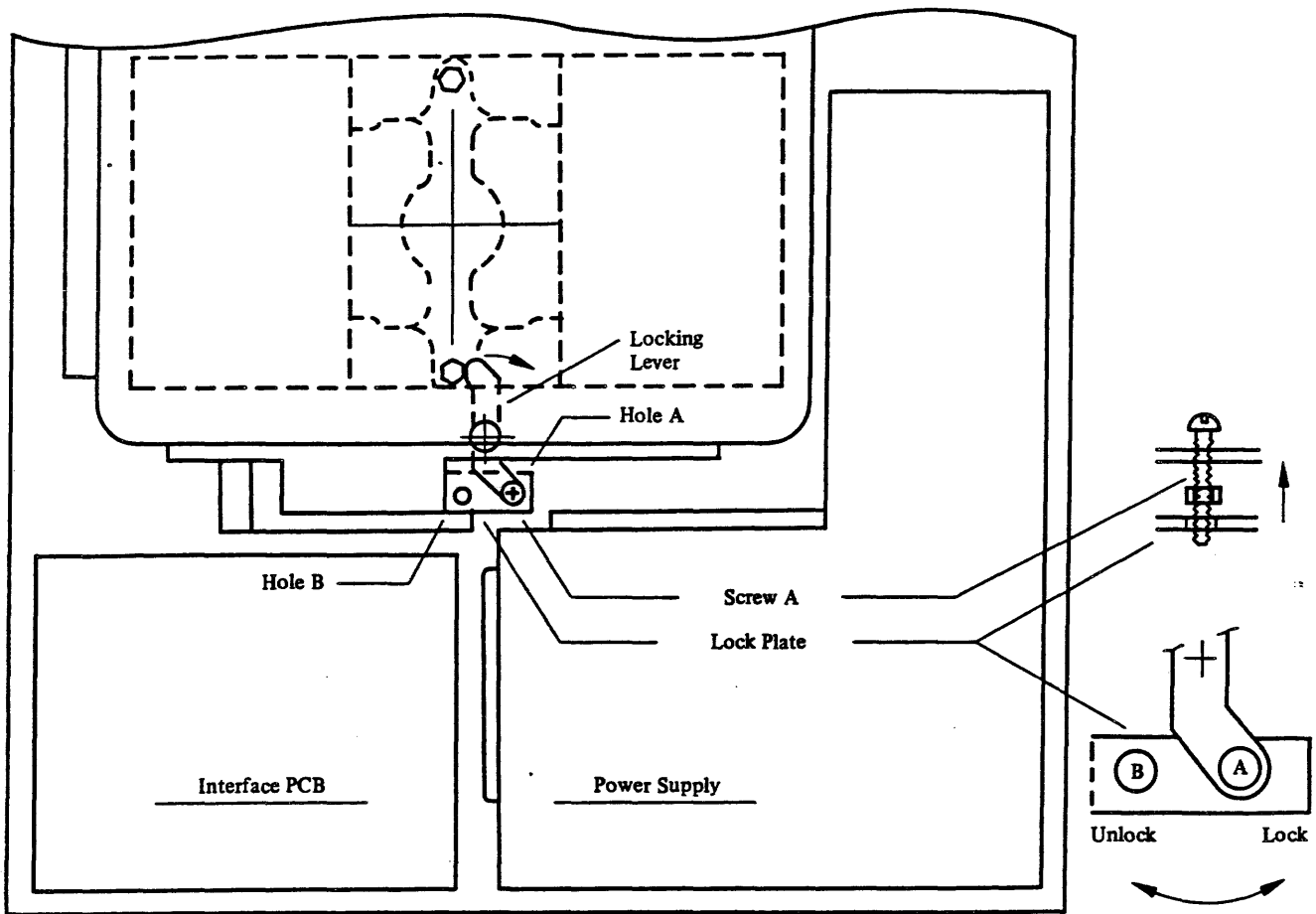Vibration Preventive Block

$70^{\pm 5}$

PRELIMINARY

Figure 2.3-1   Rotary Actuator Unlocking/Locking
(Top View)

(1)   Unlocking

This mechanism can be readily viewed from the rear of the drive by looking over the Interface PCB.

Loosen Screw A (by means of a phillips screwdriver, 8 inches or longer), sufficiently to free the screw tip from the hole in the Lock Plate. With the screwdriver, rotate the Locking Lever to the Unlocked position (Hole B), and secure in that position by gently tightening Screw A. (Refer to Figure 2.3-1)

3.1 DC POWER SUPPLY UNIT

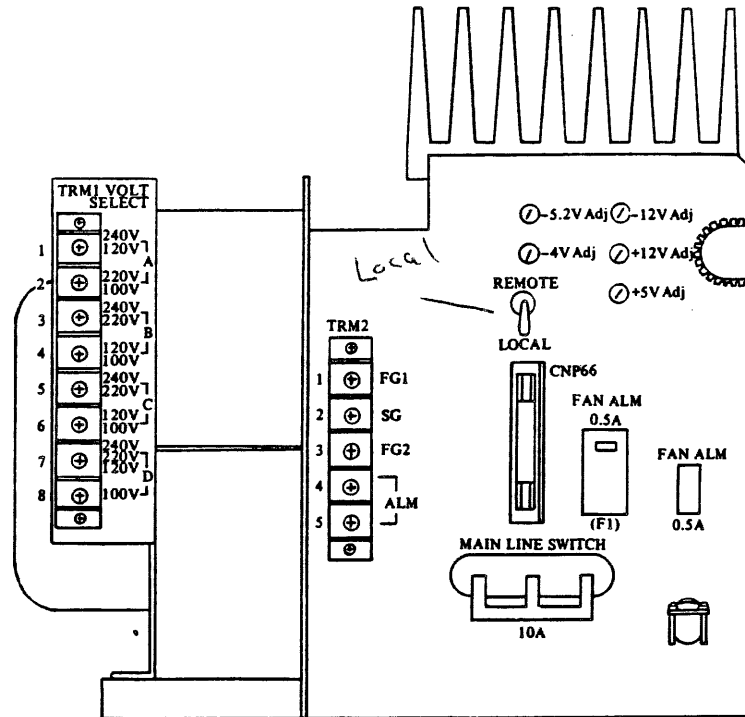Control panel of the DC power supply unit is shown in Figure 3.1-1.

Figure 3.1-1 Control Panel of DC Power Supply Unit

(1) Main Line Switch (Non-Fuse Breaker)

Supplies AC power to the unit. If one of following failures occures, it goes off.
- Over current in the AC input
- Over current or voltage in the DC output
- Fan (Line-Blower) Alarm
- Over Temperature of the heat sink or of the transformer in the DC power
  supply unit.

(2) Fan ALM (Fuse)

Indicates fan alarm of the line-blower.

(3) Remote/Local (Switch)

When this is set to Remote, the spindle motor starts/stops rotating in accordance

At the time of shipment, SG and FG2 are connected with a shorting plate.

Refer to Chapter 4.3 on the operation.

(6) Volt ADJ (Variable Resistors)

Although adjustment should not be required, variable resistors are provided to adjust the -5.2, -4, ±12, -5 Vdc output voltages within the tolerance specified, if necessary.

3.2 INTERFACE PCBs

(1) INTERFACE PCB ------ DQEMU (B16B-8140-0010A#U)

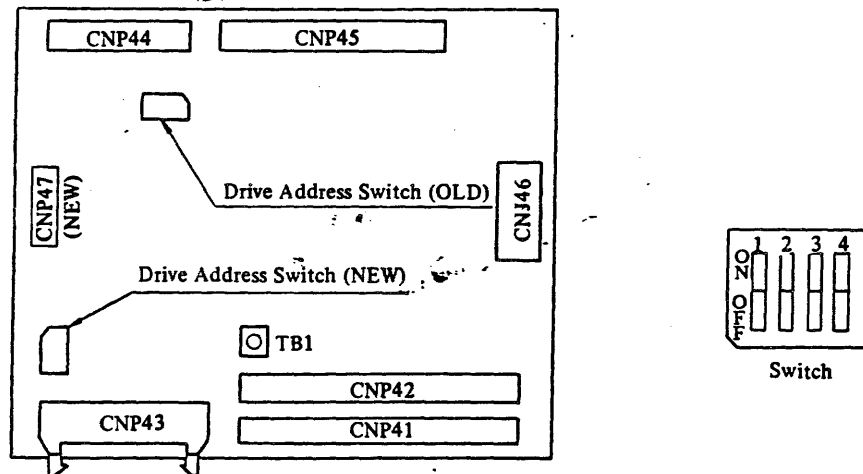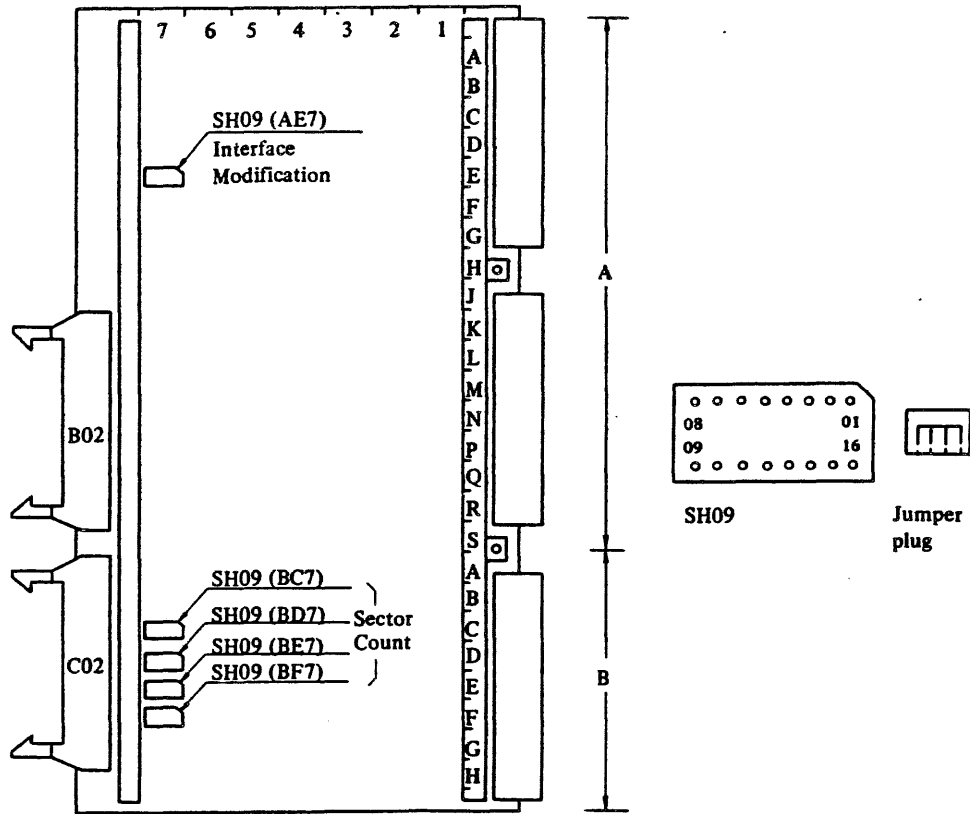Drive logical address 0 to 7 can be set with three positions of the switch in binary code as shown in Table 3.2-1.

Figure 3.2-1 Drive Address Switch

Short circuits (SH09) and jumper plugs for setting sector count and changing interface requirements are provided.

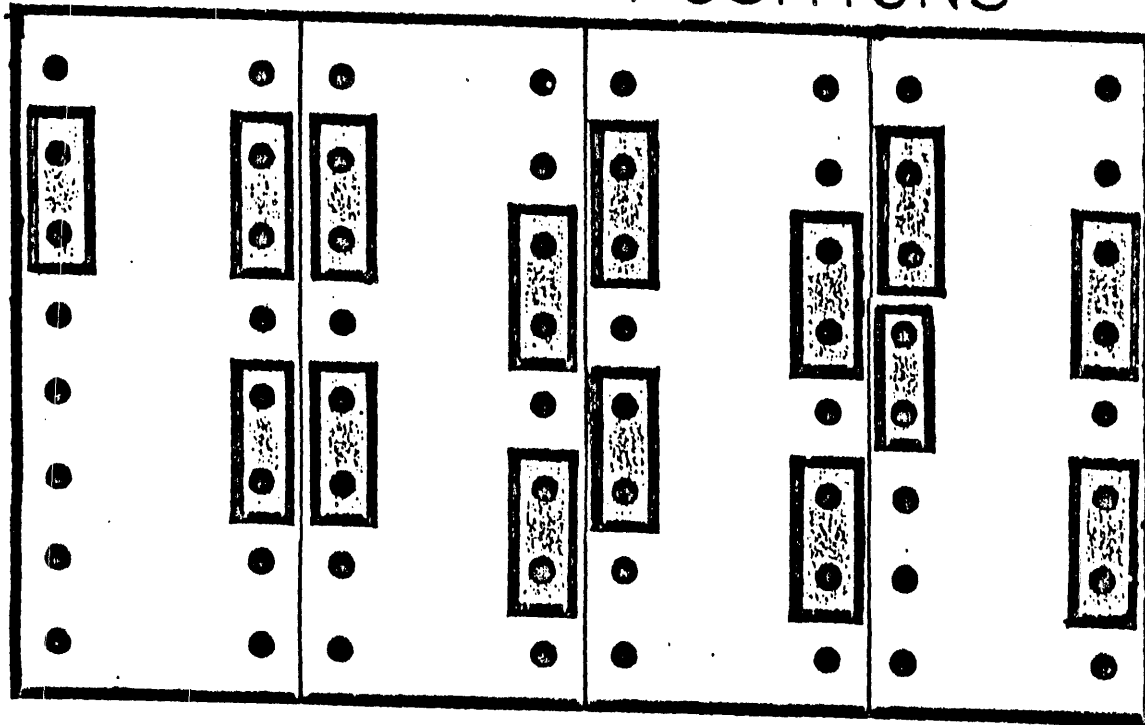( ) indicates location of short circuit on the PCB.

Figure 3.3-1 Sector Count and Interface Selection

Removal of the Logic PCB is required to set the sector count or change the interface options. This is accomplished with the extractor tools provided with the drive (refer to Table 1.9-1, item 4) as shown below.

B03P-4655-0001A...B

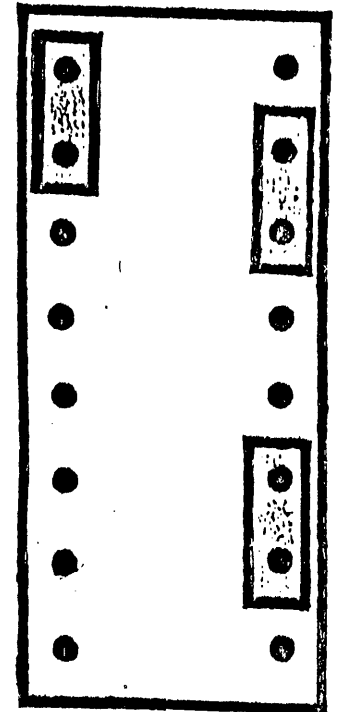# FUJI SECTOR JUMPER POSITIONS

BF7   BE7   BD7   BC7   AE7

Table 1.9-1   Maintenance Tools and Equipment

No.	Tools and Equipment	Specification	Remark
1	Extension Cable	B660-1060-T072A#L510R0	20 pins
2	Extension Cable	B660-1060-T074A#L510R0	50 pins
3	Extension Unit	C960-0030-T029	
4	Extractor	C960-0300-T001	One required
5	Oscilloscope	TEKTRONIX 475, or equivalent	
6	Oscilloscope Probe (X10)	TEKTRONIX P6053B or equivalent	
7	Digital Multimeter		
8	Screwdriver	#2 Phillips /8" shank min.	
9	Hexagonal Wrenches	6mm /8" shank min.	Metric system
10	Scope Probe tip.	flexible - mini	
11			
12			
13			

Slip-on Probe Tips and Adapters

The following tips and adapters are designed for use with Tektronix Miniature Probes and accept a slip-on tip.

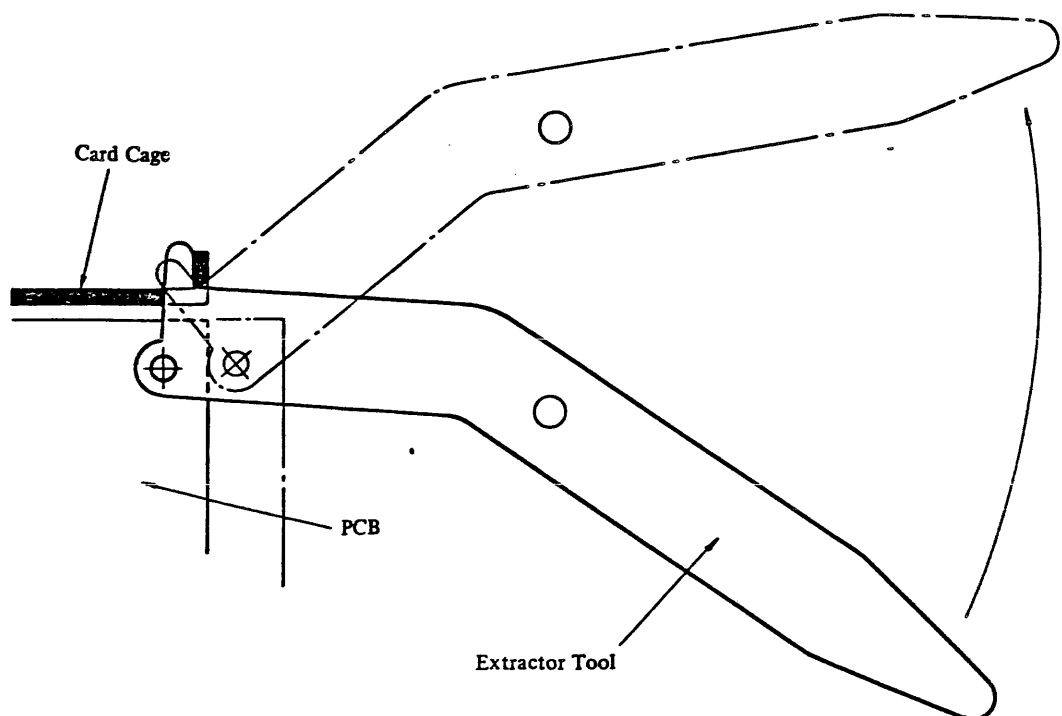CZ   CY   BM   BN   BO   BP   BQ   BR   BS   BT   BU   BV
BZ   CA   CB   CC   CG   CH   CF   CI   CJ   CP
DA   BW   BX   BY   CK   CL   CS   BI   CN   CD   CE   CU
CM   CR   CT   CO

Card Cage

PCB

Extractor Tool

Figure 3.3-2   PCB Removal

Interface PCB (DQFMU)

Plastic Cover

Interface PCB (DQEMU)

Power Amplifier (TVHMU)

Indicator Unit (HGAMU)

Disk Enclosure (DE)

Operator Panel

DC Power
Supply Unit

Card Cage

Front Panel

Line Blower

Servo PCB (SVIAU)

Logic PCB (512398)

R/W PCB (RFJAU)
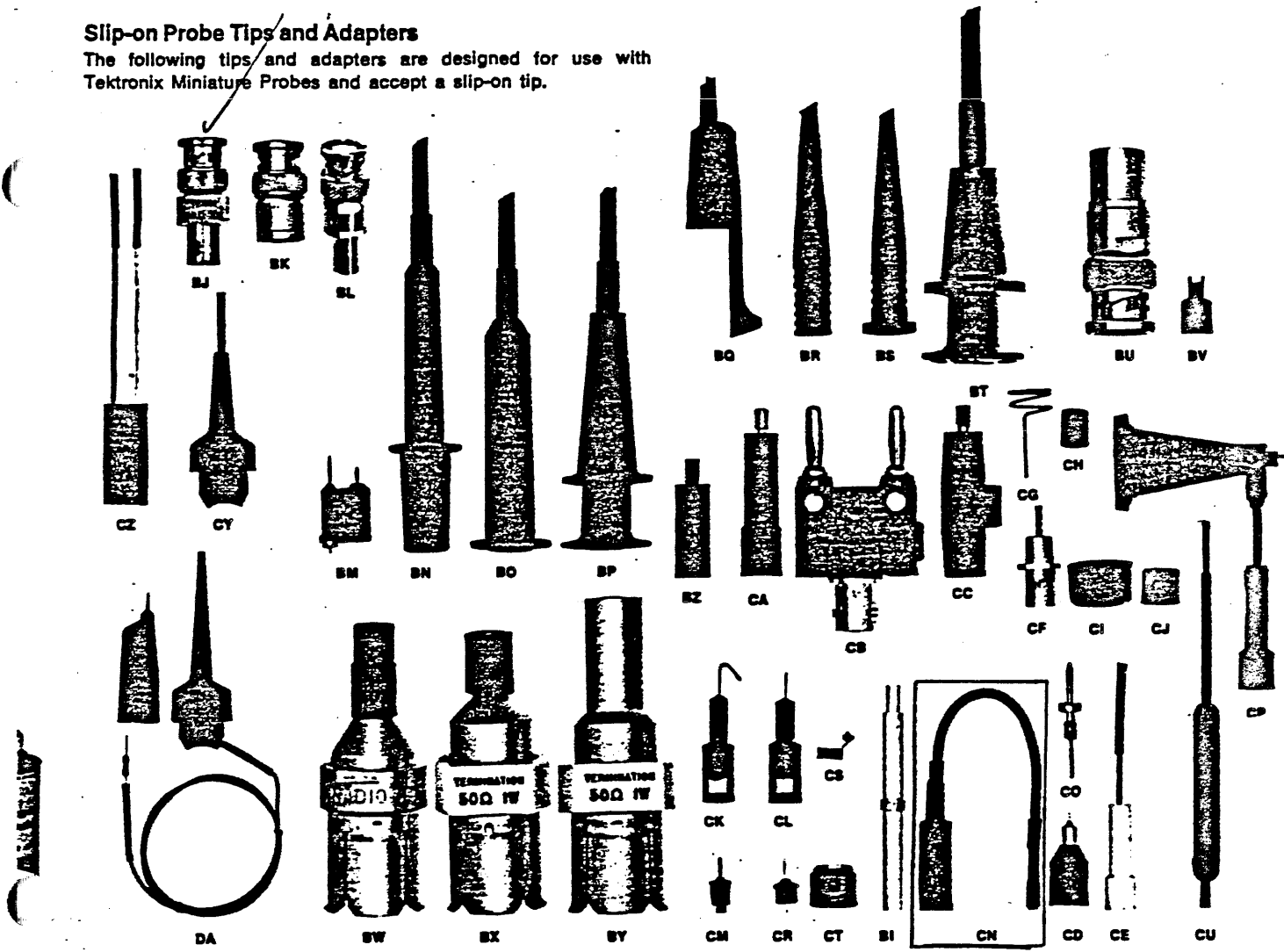
Hour Meter   *optional*
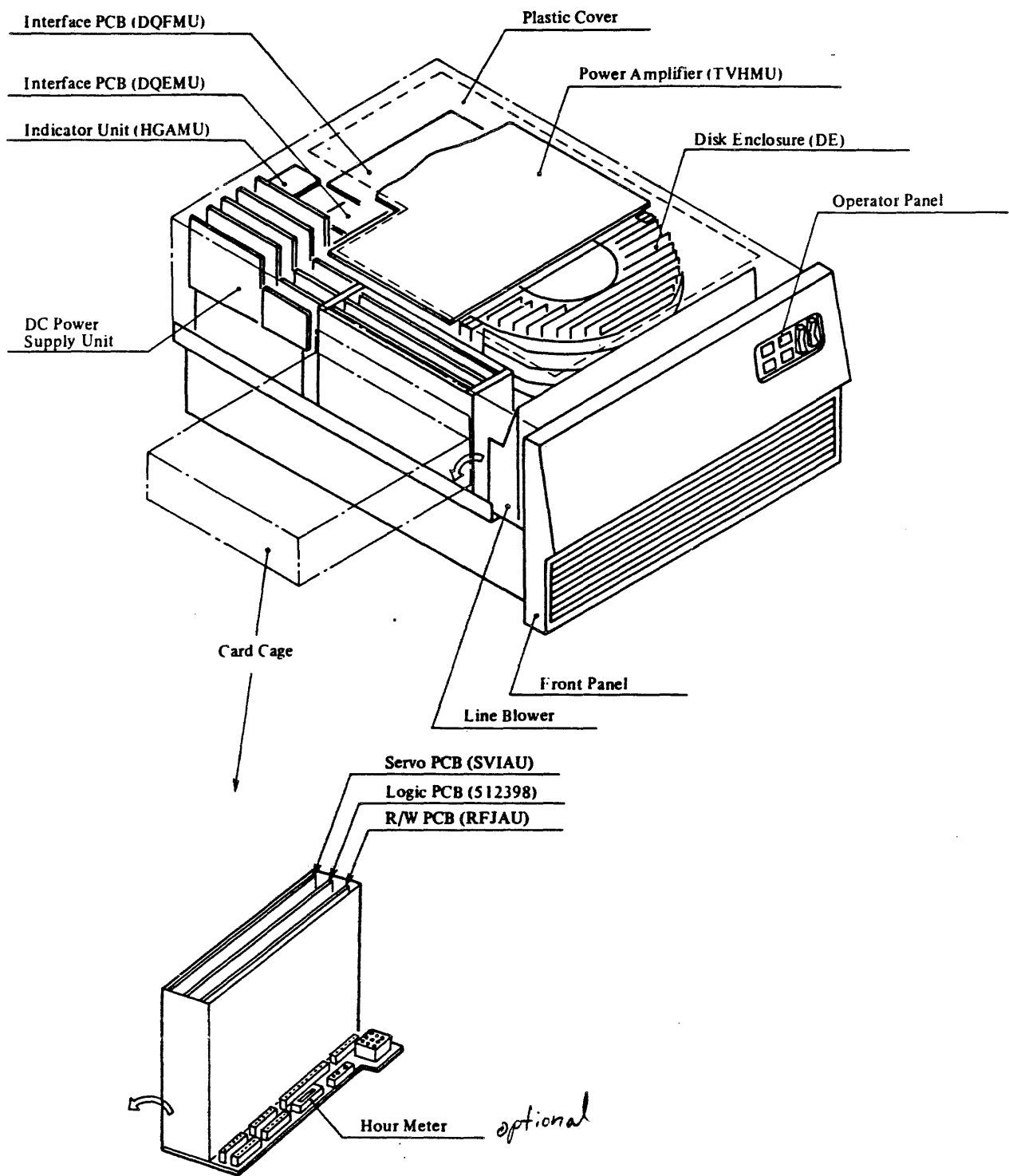
Figure 5.1-1 Construction of the Drive

B03P-4655-0001A...B

D.C. VOLTAGE CHECK

The regulated power supply voltage can be checked at connector
CNP65, or at the test points provided (both on the card cage
backpanel), as shown below.

Molex Connector

CNP65

7 +5	4 Grnd	1 +12
8 -4	5 Grnd	2 Grnd
9 Grnd	6 -5.2	3 -12

(Bottom View)

CNP65

[:]-4
[:]-5.2
[:]-12

Grnd   +5   +12

(Top View)

Ferrofluidic Seal

Housing

Spindle Assembly

Cover

Disk

Head Arm Assembly

Ferrofluidic Seal

Rotation

Spindle Motor

Ferrofluidic Seal

Rotary Actuator
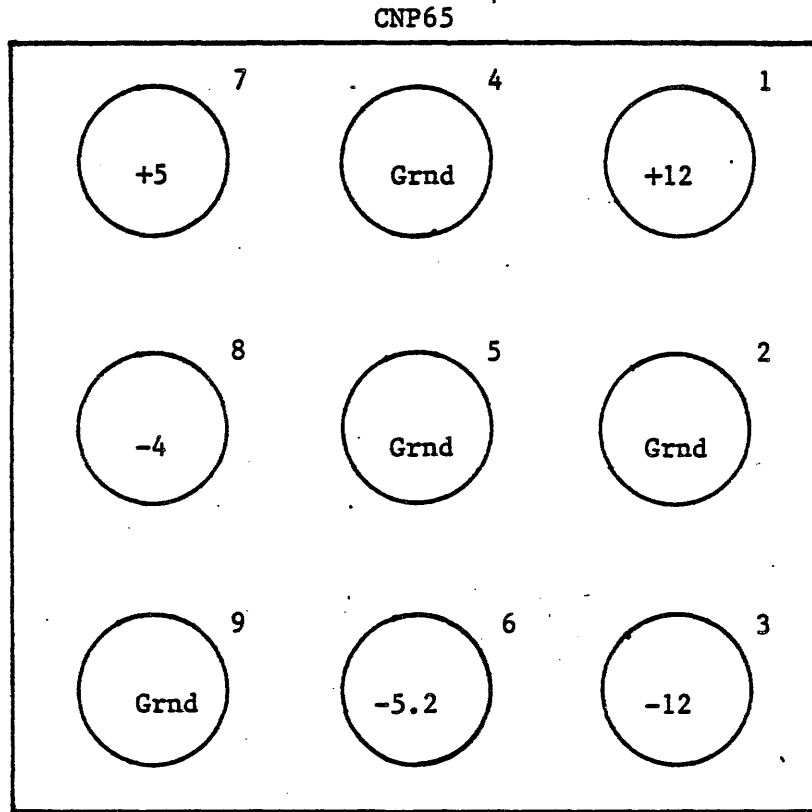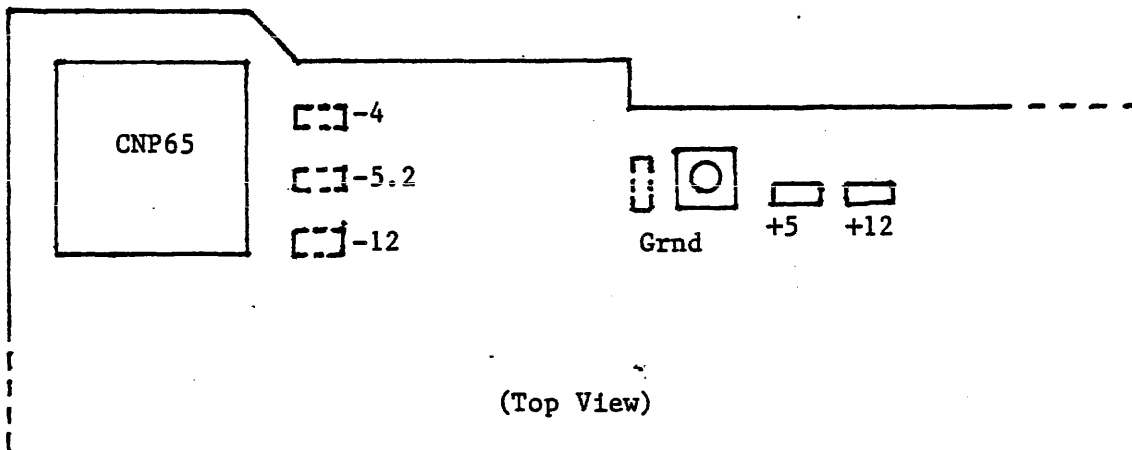
Figure 5.2-2   Cross Sectional View of the DE
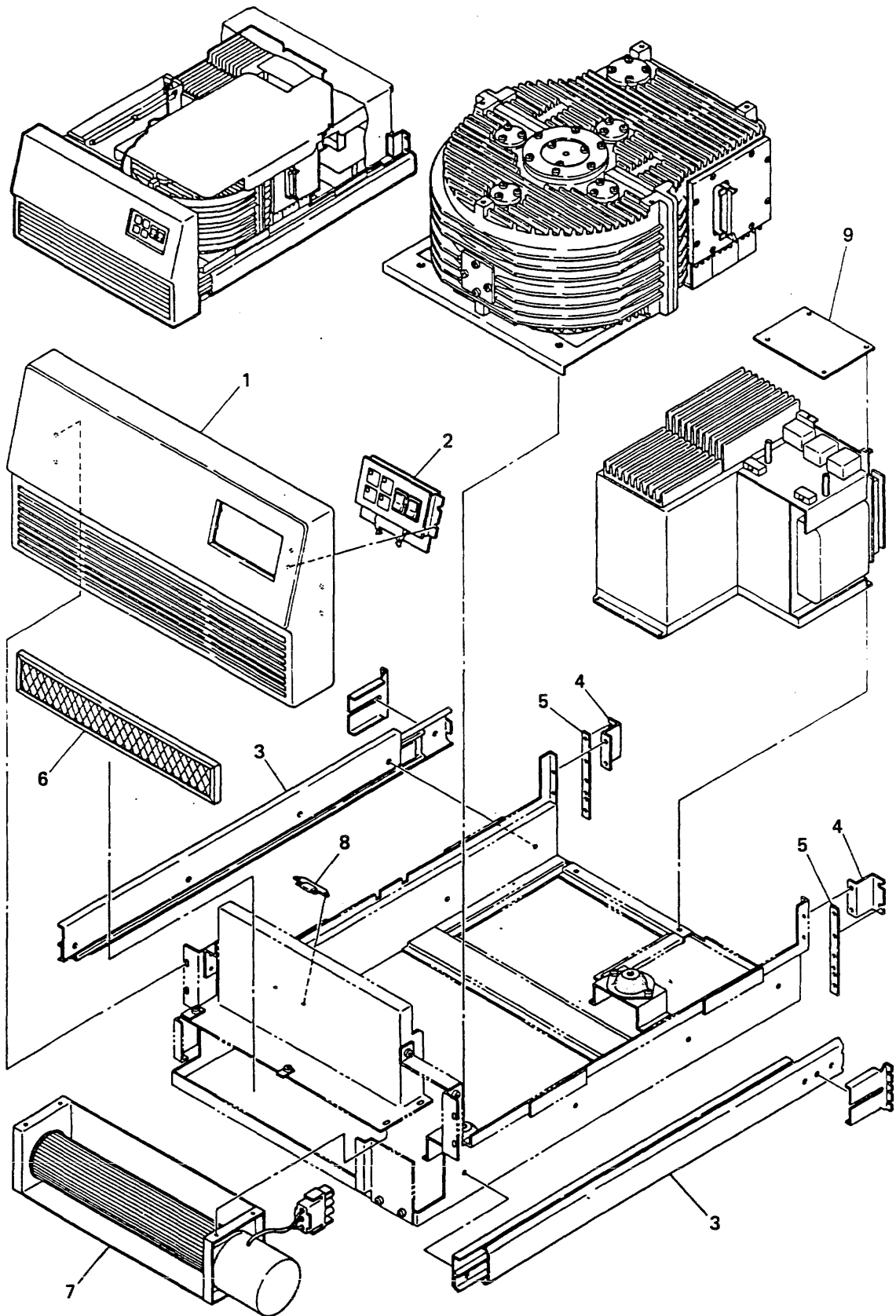
Figure 5.7-3 Optional Assemblies and Component Parts
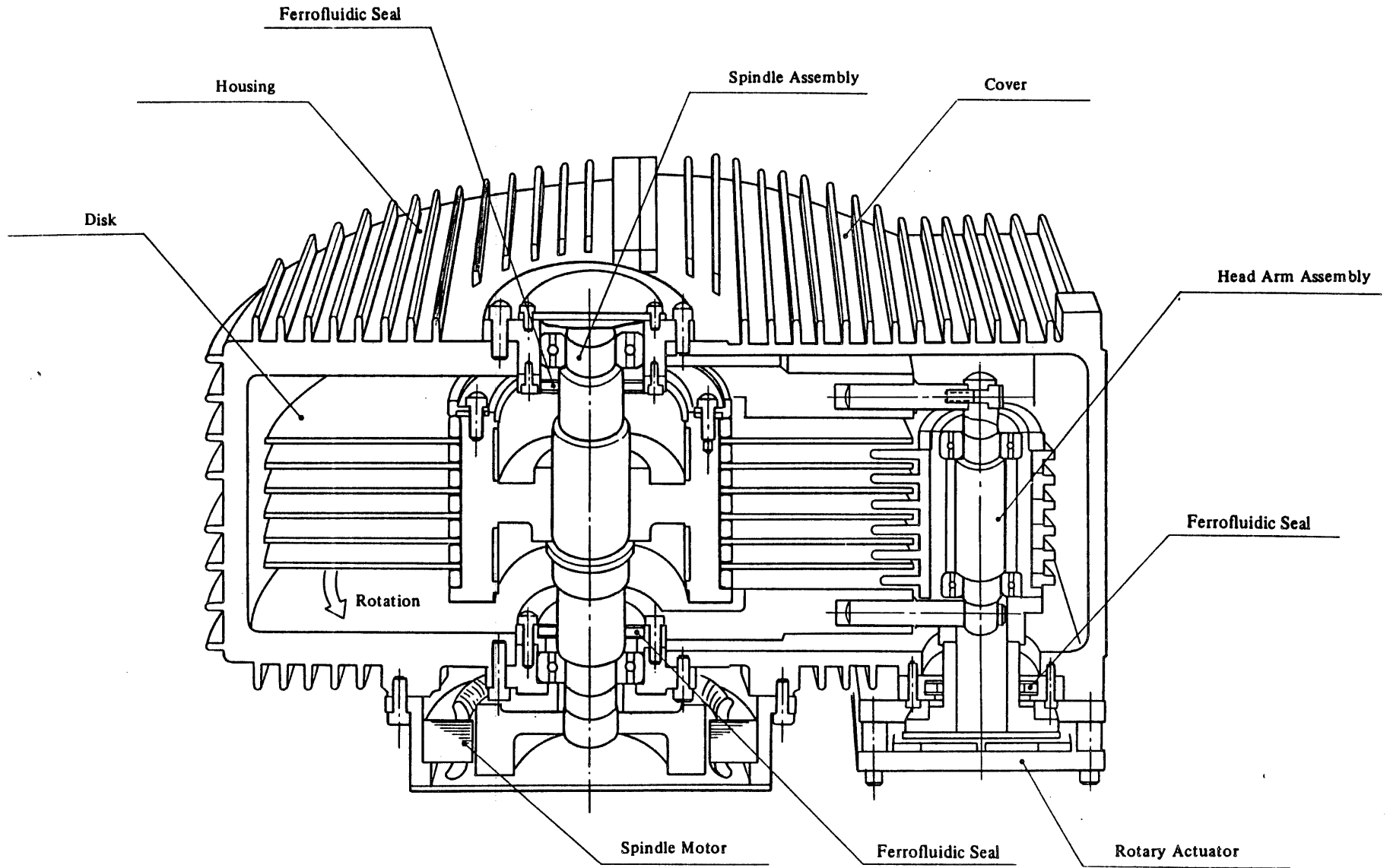
Note that AI and AO are skipped
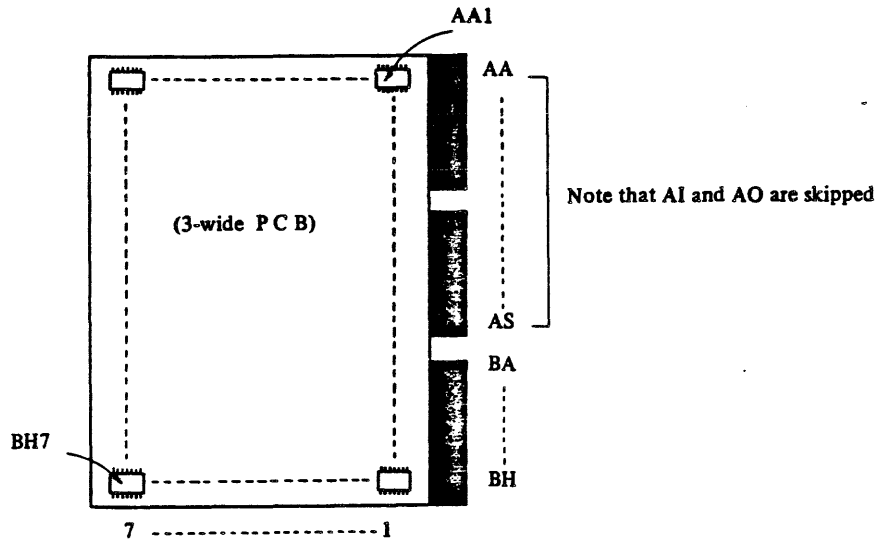
Figure 14.1-2   IC Location

Soldering surface

Figure 14.1-3   PCB Pin Numbering

B03P-4655-0001A...B

3 (RFJAU)   2 (512398)   1 (SVIAU)

```
AA1 ○      ─ ○ AB1        ○          ○            ○          ○
  2 ○          ○
  3 ○          ○
  4 ○          ○
  5 ○          ○
  6 ○          ○
  7 ○          ○
  8 ○          ○
  9 ○          ○
  U ○          ○
  V ○          ○
  W ○          ○ ─
  X ○          ○
  Y ○          ○
AAZ ○        ○ ABZ
AD1 ○        ○ AE1
  2 ○          ○

ADZ ○        ○ AEZ        ○          ○            ○          ○

AG1 ○        ○ AH1        ○          ○            ○          ○

AGZ ○        ○ AHZ
AK1 ○        ○ AL1

AKZ ○        ○ ALZ        ○          ○            ○          ○

BA1 ○        ○ BB1        ○          ○            ○          ○

BAZ ○        ○ BBZ
BD1 ○        ○ BE1

BDZ ○        ○ BEZ        ○          ○            ○          ○
```
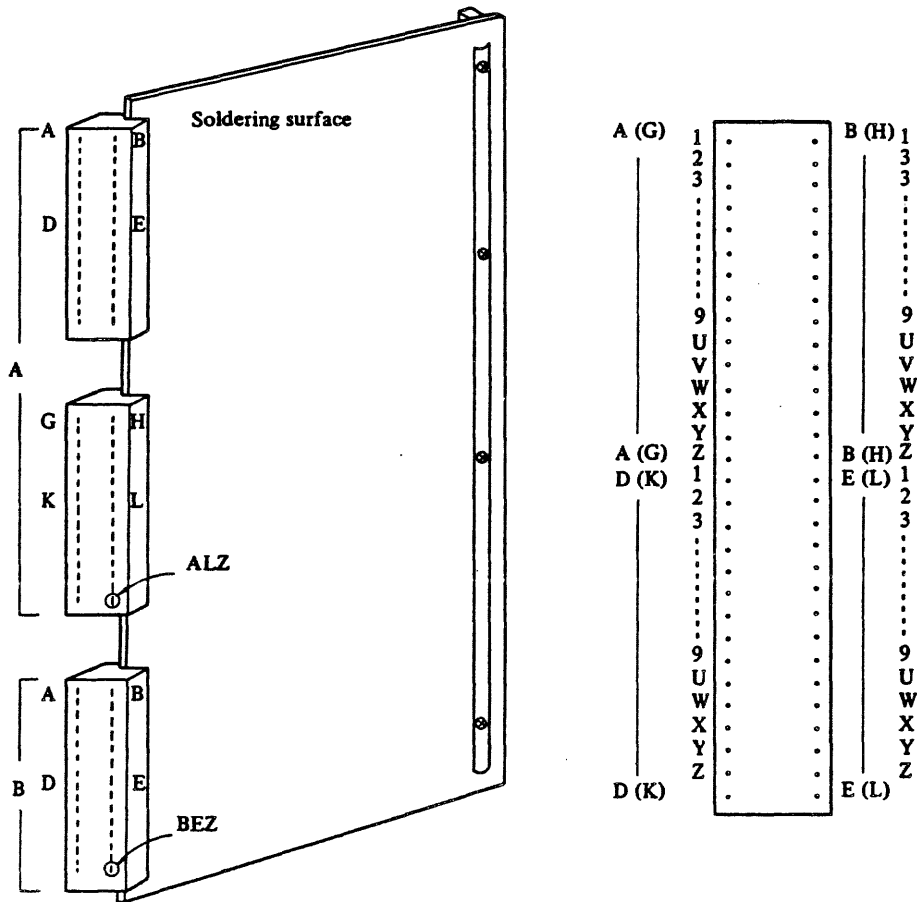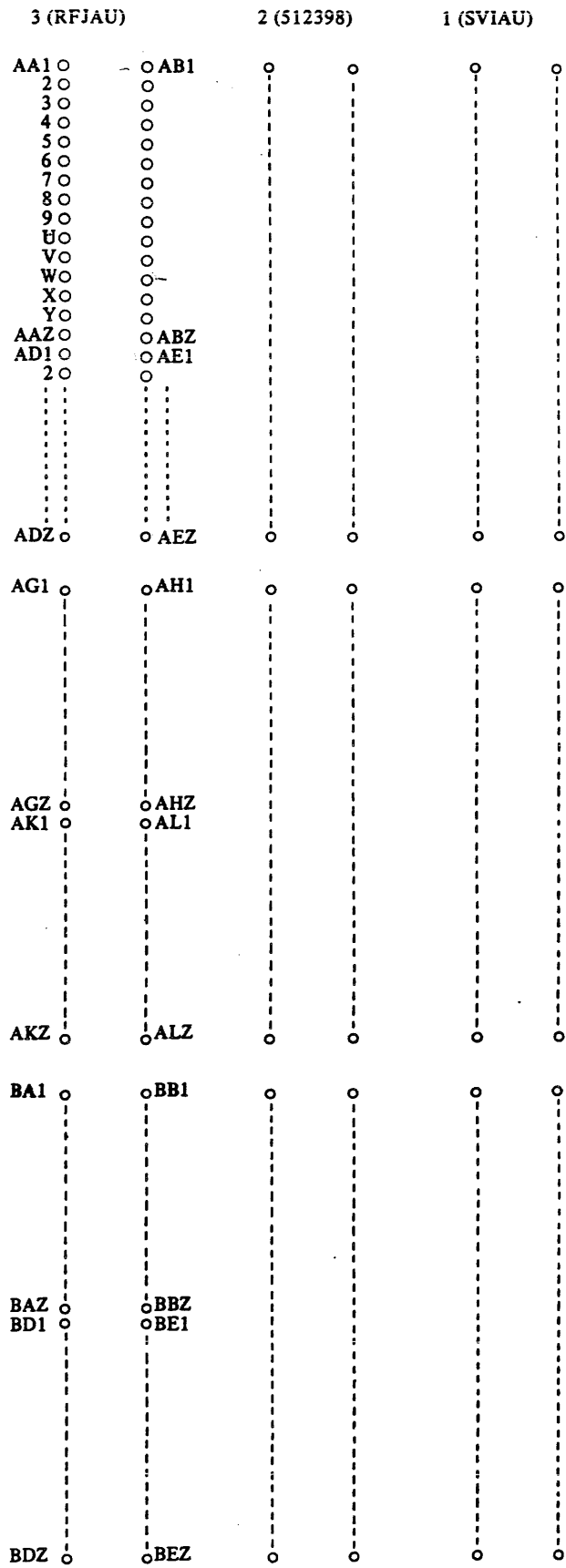
Figure 14.1-4   Back Panel Pin Numbering (Bottom View)

10.11 INTERCOMMUNICATION PROTOCOL: SMD

10.11.1 A CABLE CONNECTOR PIN ASSIGNMENTS

HIGH SIGNAL PIN	LOW SIGNAL PIN	SIGNAL NAME
31	1	TAG 1
32	2	TAG 2
33	3	TAG 3
34	4	BUS 0
35	5	BUS 1
36	6	BUS 2
37	7	BUS 3
38	8	BUS 4
39	9	BUS 5
40	10	BUS 6
41	11	BUS 7
42	12	BUS 8
43	13	BUS 9
44	14	OPEN CABLE DETECT
45	15	STATUS 3
46	16	STATUS 2
47	17	STATUS 1
48	18	STATUS 6
49	19	STATUS 0
50	20	STATUS 5
51	21	BUSY (NOT USED)
52	22	UNIT SELECT TAG
53	23	UNIT SELECT 1
54	24	UNIT SELECT 2
55	25	STATUS 7
56	26	UNIT SELECT 4
57	27	TAG 5
58	28	STATUS 4
60	30	TAG 4
29		POWER SEQUENCE PICK
59		POWER SEQUENCE HOLD

10.11.2 B CABLE CONNECTOR PIN ASSIGNMENTS

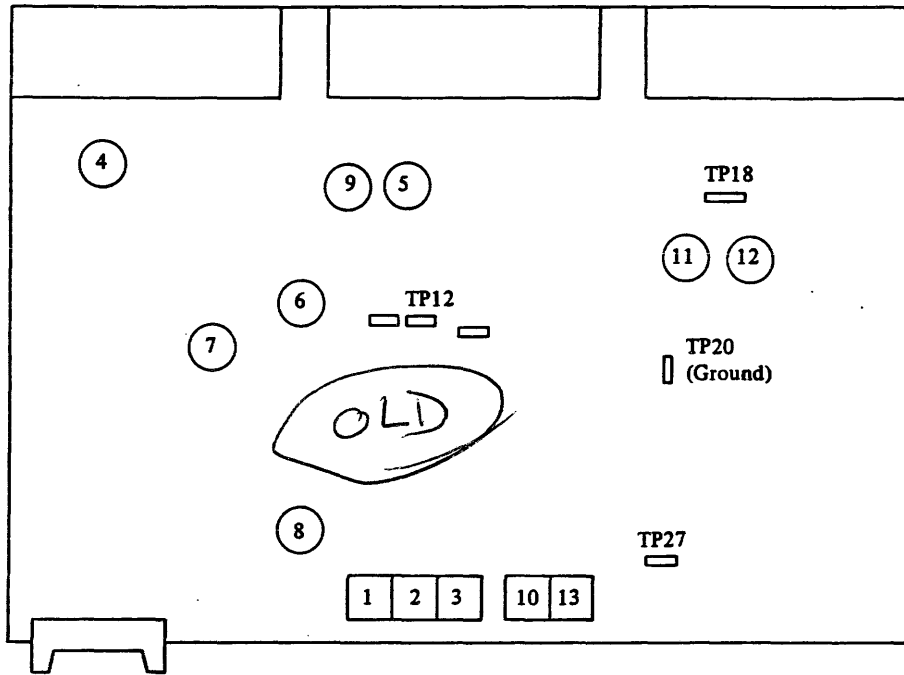| LOW SIGNAL PIN	HIGH SIGNAL PIN	SIGNAL NAME
2	14	1F WRITE CLOCK
3	16	READ DATA
5	17	READ CLOCK
6	19	WRITE CLOCK
8	20	WRITE DATA
10	23	SEEK END
12	24	INDEX
13	26	SECTOR
22	9	UNIT SELECTED

PINS 1, 4, 7, 11, 15, 18, 21, AND 25 ARE GROUND.

Figure 14.2-1   RVs and TPs on PCB SVIAU/01
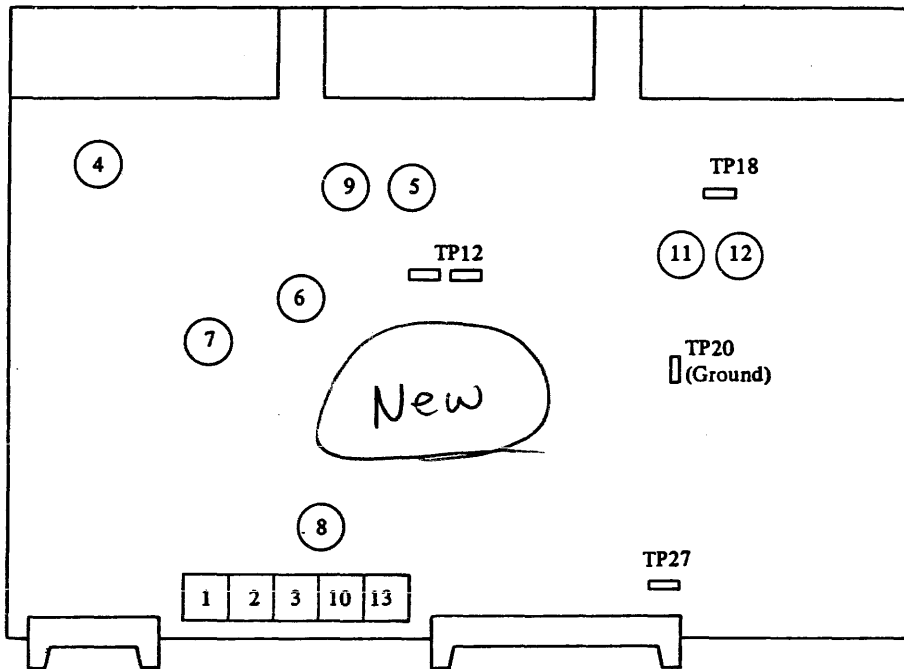
Figure 14.2-2   RVs and TPs on PCB SVIAU/02

(3) DYNAMIC ADJUSTMENT

START

Push the MRTZ switch on
the PCB HGAMU

No ← READY ?

Yes

No ← Adjust RV1

Yes

E
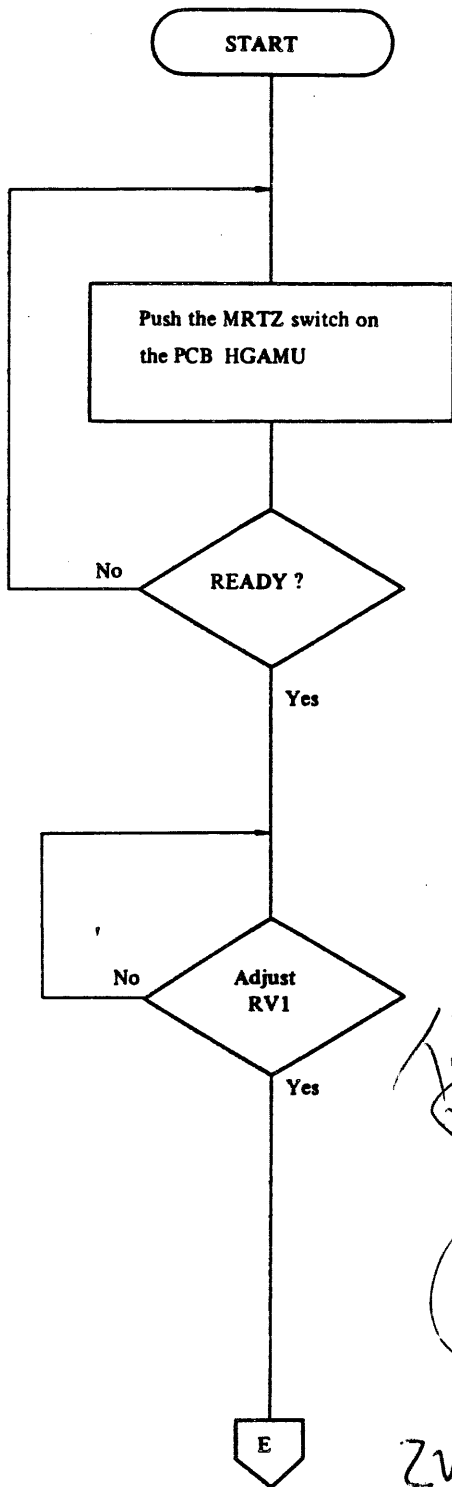
Adjust RV3 by trial and error
until the READY lamp on the
operator panel light after
RTZ operation.

Performing RTZ operation from
cylinder 841 repetitively, adjust
RV1 as follows.

Position Signal (handwritten)

Test Point (handwritten)

CP. ABW
(POSN)

+2V

0V

−2V

T_1

T_2

$$\frac{T_1}{T_2} = \frac{1}{5.8} \pm 2\%$$

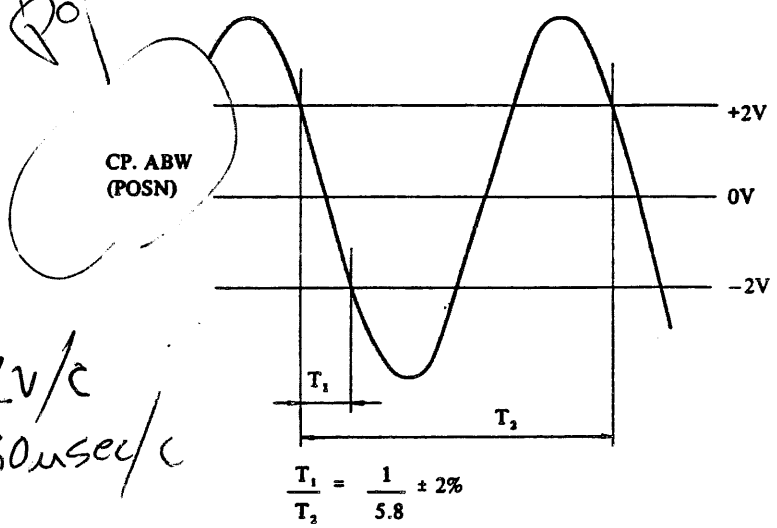*2v/c* (handwritten)
50 μsec/c (handwritten)

Figure 14.2-4 Dynamic Adjustment of Servo Circuit (Sheet 1 of 3)

*uncal 0 crossing between I C.
2v peak to peak* (handwritten)

B03P-4655-0001A...B

E

Repetitive seek operation
with difference 6

No — Adjust RV10 — Yes

No — Adjust RV13 — Yes

G   from Sheet 3

Repetitive seek operation
between cylinders 384 and
640 (difference 256)

No — Adjust RV2 and RV3 — Yes

F

CP. ABW (POSN)

RV10

overshoot

RV13

Good

seek speed
adj

2 ms/div
sync. pos on ch2

RV3

CP. BEU
(*ACMDZ)

15ms ± 0.2 ms

CP. ABW
(POSN)

RV.2

overshoot

NG   NG   Good
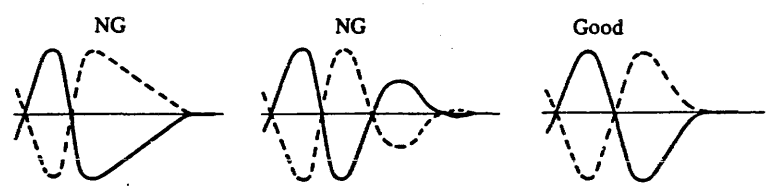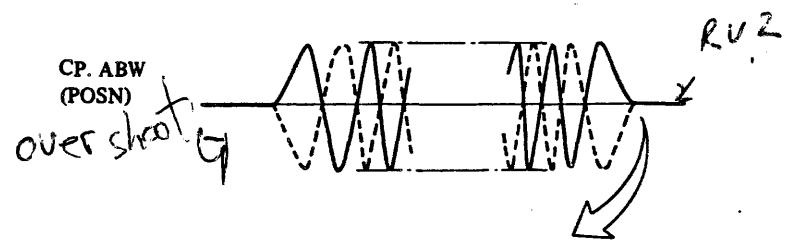
Figure 14.2-4   Dynamic Adjustment of Servo Circuit (Sheet 2 of 3)
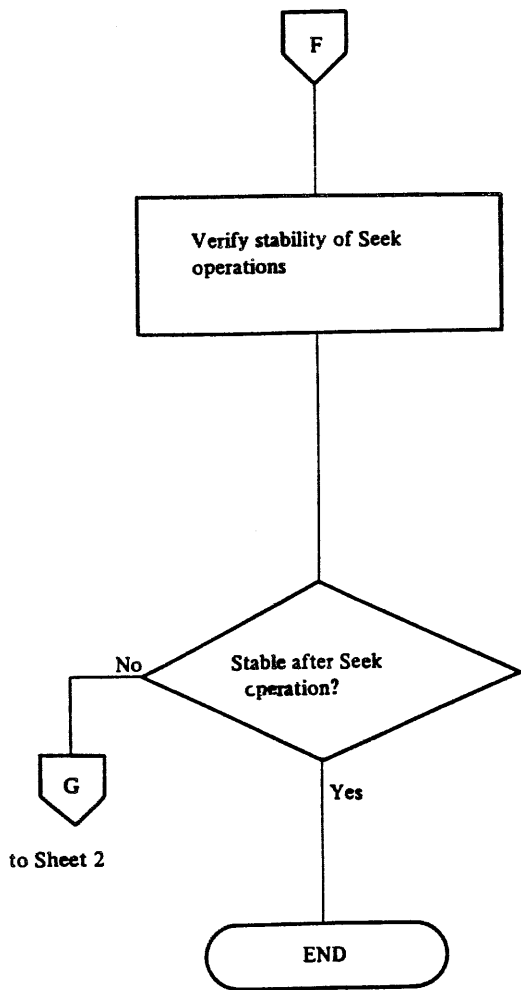
Verify stability and vibration
while performing seek operations
by varying seek distance and
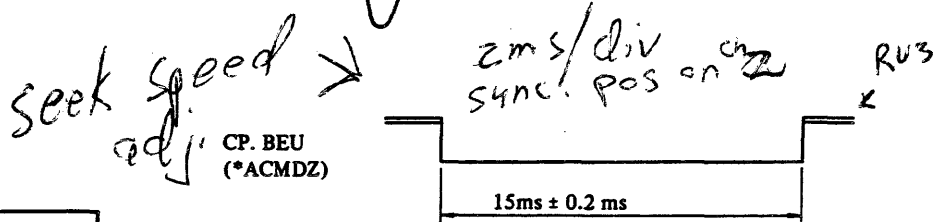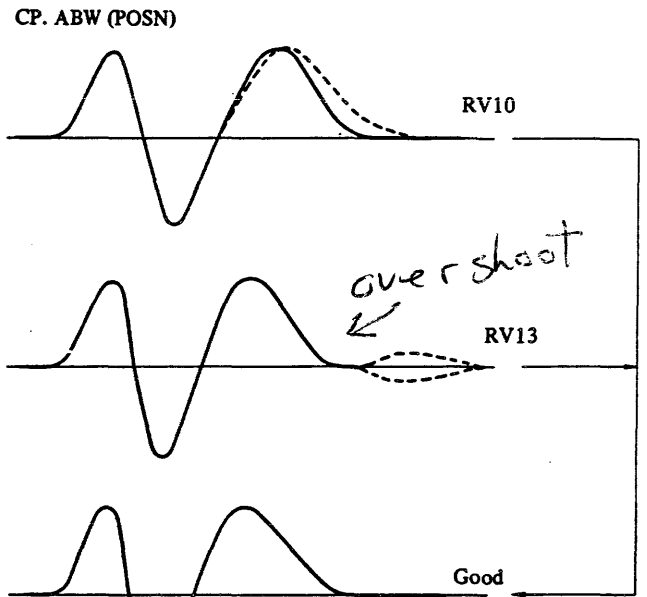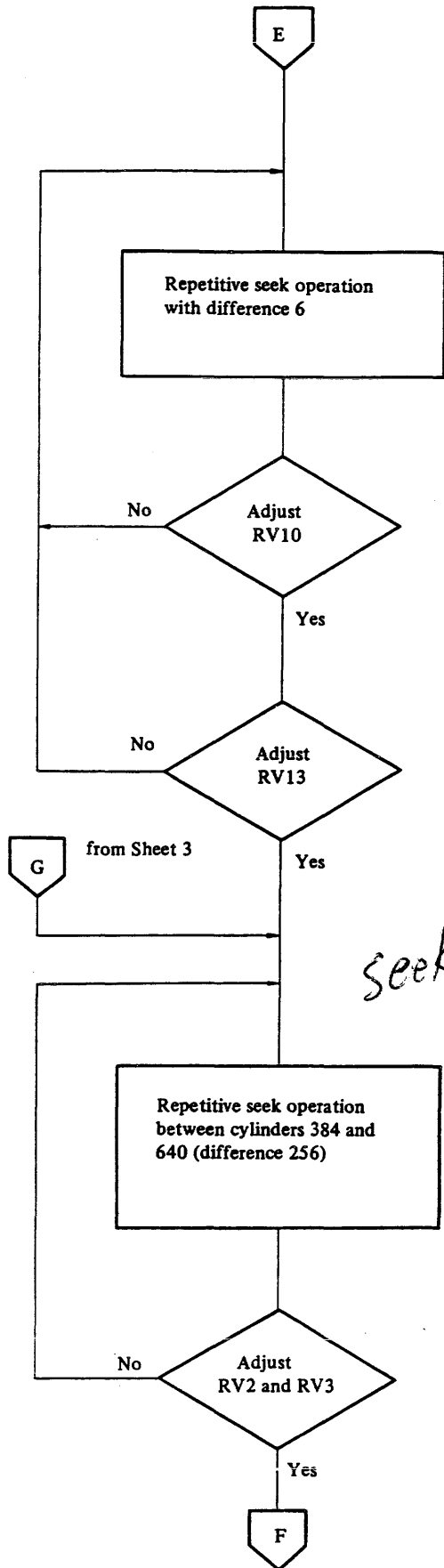time interval.

CP.AL3 (FNPOS)
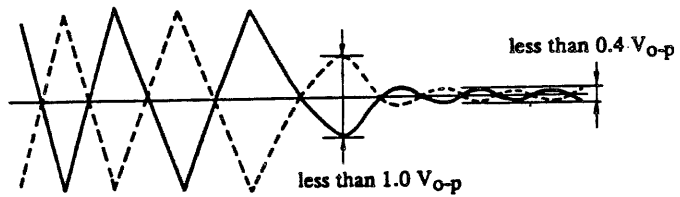
Figure 14.2-4 Dynamic Adjustment of Servo Circuit (Sheet 3 of 3)

9.2 SERVO FORMAT

The two-phase composite servo signal is pre-recorded on the bottom servo surface. This signal is read by the servo head, and the index signal, sector count clock signal, read/write PLO signal, and two types of position signals, 90 degrees out of phase with each other, are generated. The two-phase servo signal makes the effective track width of the servo signal (29μm), one-half of the actual track width (58μm).
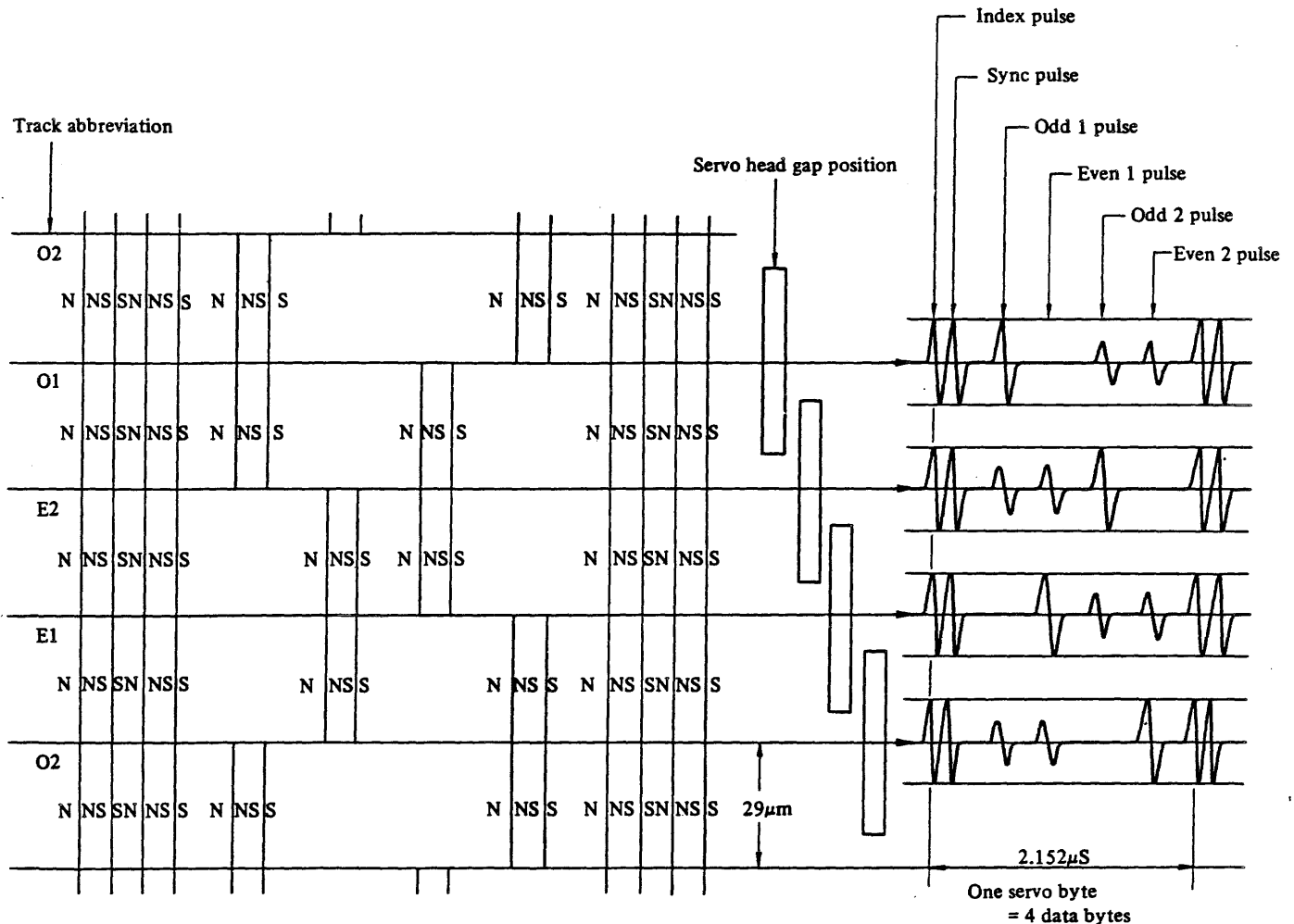
Figure 9.2-1 Magnetized Pattern of Two-phase
Servo Signal and Read Signal

Quadriture Tracking

Each area is identified by the index pulse (0:present, 1: sbsent) preceding the sync pulse. The valid index pattern, detedted once per rotation, indicates the physical starting point. Inner Guard Band 1 and 2 and the Outer Guard Band are written every 64 servo bytes;. this means that there are 110 locations at which these patterns are written. However, if any of the 110 locations coincides with the location at which the valid index pattern is written, the valid index pattern is effective.

0   1   0   1   1

Valid index pattern

0   1   1   1   0
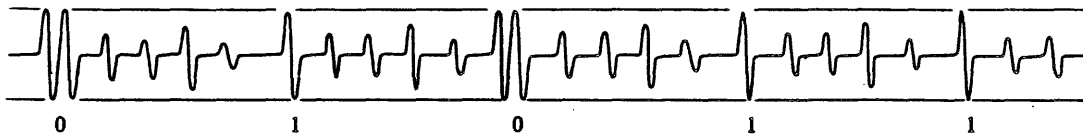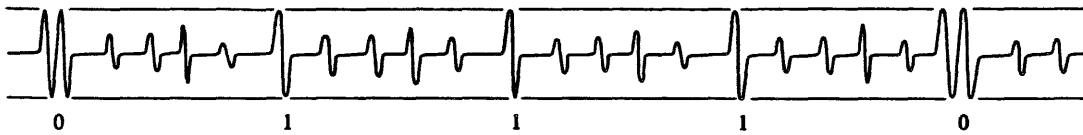
Inner Guard Band 2 pattern

0   1   0   1   0
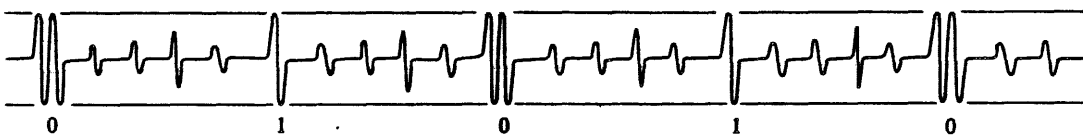
Inner Guard Band 1 pattern

1   0   0   1   1
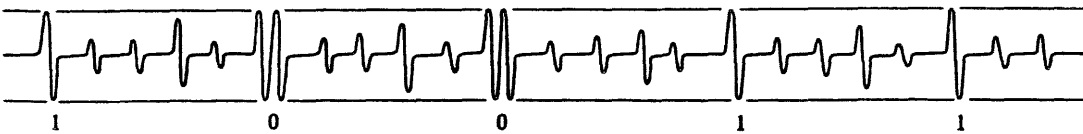
Outer Guard Band pattern

Figure 9.2-4 Index Pulse Pattern

These switches and indicators are provided for aiding maintenance, and are shown in Figure 2.4-1.
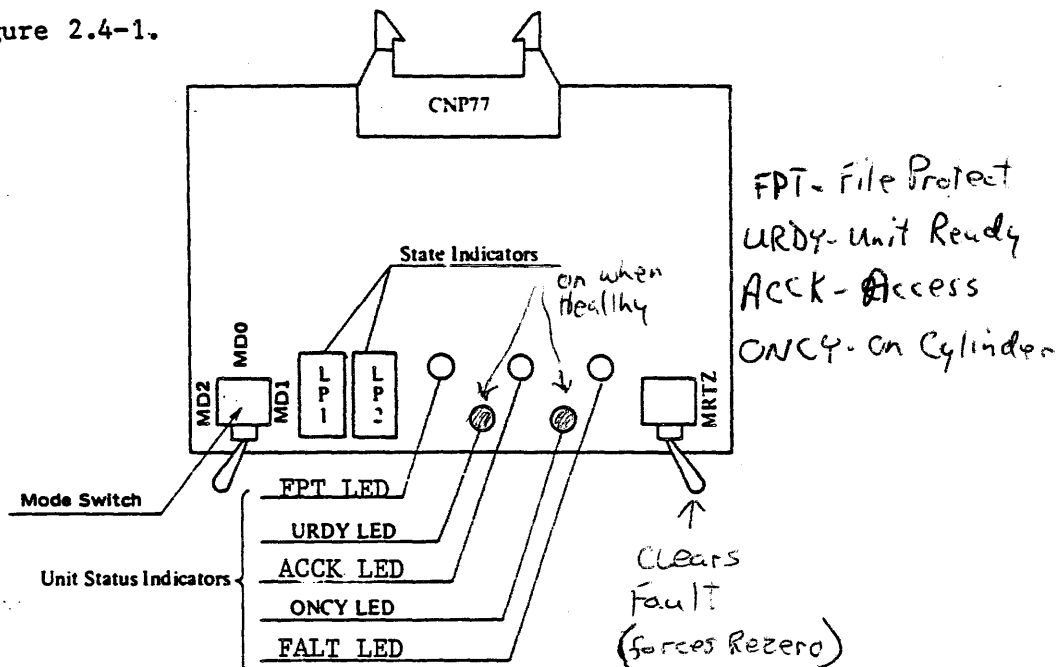
Figure 2.4-1 Switches and Indicators

(1) Unit Status Indicators (LEDs)

Indicate Unit Status as shown in Table 2.4-1. These statuses are also issued to the controller as States 0 to 4 when both Tag 4 and 5 are false if this feature is utilized.

Refer to item (2-1) ∿ (2-5) in Chapter 6.4 for detailed descriptions of each state.

Table 2.4-1 Unit Status Indicators

Name of LED	Color of LED	Content
URDY	Green	Unit Ready
ONCY	Green	On Cylinder
ACCK	Red	Seek Error (Access Check)
FALT	Red	Fault
FPT	Yellow	Write Protected (File Protect)

B03P-4655-0002A...D1

The disk unit and the control unit will issue the following statuses.

Table 15.2-1 Error Status

NOT READY	Not Ready status indicates disk drive is not ready
FAULT	Fault status indicates a fault condition has occurred in the unit
SEEK ERROR	Seek Error status indicates a seek error has occurred in seek operation
READ ERROR	Read Error status indicates a data error has occurred in read operation
AM MISSING	AM Missing status indicates that AM (Address Mark) has not found in read operation

Maintenance Personnel can see the unit status and error state on the Indicator Unit (HGAMU) and the Operator Panel. Refer to Section 3.7 for detailed unit status and error state, and how to know the error state by unit state indicators (colored LEDs), state indicators (7-segment LEDs) and state switch (Toggle Switch) mounted on the Indicator PCB.

The trouble shooting guide is provided with the Error State which is defined by indicators on the PCB and the Operator Panel.

The Error State is shown in Table 15.2-2.

Table 15.2-2 Error State

Error Status	Indicator Unit (HGAMU)						Indicators on the Operator Panel			Error State	Figure
	Unit State Indicator (LEDs)			State mode Switch	State Indicator Lamp						
					Lamp 1	Lamp 2					
	URDY	ACCK	FALT		Bit 1 2 4 8	Bit 1 2 4 8	Fault	Power on	Ready		
Not Ready	Off	–	–	–	– – – –	– – – –	–	Off	Off	Power Alarm	
	Off	–	–	0	– – – 1	– – – –	–	–	Off	Hall Alarm	15.4-1
	Off	–	–	2	– – – –	1 – – –	–	–	Off	DE Sequence Check	
Fault	–	–	On	1	1 – – –	– – – –	On	–	–	Index Check	15.4-2
	–	–	On	1	– 1 – –	– – – –	On	–	–	Control Check	
	–	–	On	1	– – 1 –	– – – –	On	–	–	Multi Head Check	
	–	–	On	1	– – – 1	– – – –	On	–	–	Head Short Check	
	–	–	On	1	– – – –	1 – – –	On	–	–	Write Current On Read Check	
	–	–	On	1	– – – –	– 1 – –	On	–	–	Write Transition Check	
	–	–	On	1	– – – –	– – 1 –	On	–	–	Delta I Write Check	
	–	–	On	1	– – – –	– – – 1	On	–	–	Servo Off-Track	
Seek error	–	On	–	2	– 1 – –	– – – –	–	–	–	Access Timeout Check	15.4-3
	–	On	–	2	– – 1 –	– – – –	–	–	–	Over Shoot Check	
Read error	–	–	–	–	– – – –	– – – –	–	–	–	Read Error	15.4-4
AM Missing	–	–	–	–	– – – –	– – – –	–	–	–	AM Missing	15.4-5

(handwritten note near header: Not up to speed — pointing to Hall Alarm)
(handwritten note: Not Ready bracket — Hall Alarm, DE Sequence Check)

POWER SEQUENCE IS REQUIRED WHEN THE REMOTE/LOCAL SWITCH
ON THE POWER SUPPLY UNIT IS SET TO REMOTE. IN THIS MODE,
WHEN THE CONTROLLER SETS THE PICK AND HOLD LINES TO
GROUND THE FIRST DRIVE'S SPINDLE STARTS ROTATING IF THE
START SWITCH HAS BEEN PRESSED. APPROXIMATELY FIVE SECONDS
LATER THE PICK SIGNAL IS TRANSFERRED TO THE NEXT DRIVE,
AND THIS IS REPEATED UNTIL ALL DRIVES ARE SEQUENCED UP.
WHEN BOTH SIGNALS GO FALSE, THE SPINDLE STOPS ROTATING.
IF THE MODE SWITCH ON THE POWER SUPPLY UNIT IS SET TO
LOCAL, EACH START SWITCH MUST BE PRESSED MANUALLY TO
START THE SPINDLE ROTATING. REFER TO FIGURE 10.12-14.

10.11.4 A - CABLE OUTPUT SIGNALS (GATED BY UNIT SELECTED LINE IN
THE DRIVE)

10.11.4.1 STATUS 0 TO 7

THE STATUS 0 TO 7 LINES INDICATE STATUS INFORMATION DETER-
MINED BY COMBINATIONS OF TAG 4 AND TAG 5 SIGNALS. INFORMA-
TION AVAILABLE IS SPECIFIED IN TABLE 10.11-2.

TABLE 10.11-2 STATUS

TAG 4	FALSE	TRUE	FALSE	TRUE
TAG 5	FALSE	FALSE	TRUE	TRUE
STATUS	UNIT STATUS	SECTOR STATUS	WRITE/READ CHECK STATUS	ACCESS STATUS
0	UNIT READY	SECTOR 1	INDEX CHECK	DE SEQUENCE CHECK
1	ON CYLINDER	SECTOR 2	CONTROL CHECK	ACCESS TIME-OUT CHECK
2	SEEK ERROR	SECTOR 4	MULTI HEAD CHECK	OVER SHOOT CHECK
3	FAULT	SECTOR 8	HEAD SHORT CHECK	REZERO MODE LATCH
4	WRITE PROTECTED	SECTOR 16	WRITE CURRENT ON READ CHECK	SERVO LATCH
5	ADDRESS MARK FOUND	SECTOR 32	WRITE TRANSI-TION CHECK	LINEAR MODE LATCH
6	INDEX	SECTOR 64	DELTA I WRITE CHECK	CONTROL LATCH
7	SECTOR	SECTOR 128	SERVO OFF-TRACK	WAIT LATCH

4M 402

10.11.4.2 UNIT STATUS

WHEN BOTH TAG 4 AND 5 ARE FALSE, STATUS 0 ~ 7 INDICATE THE BASIC INFORMATION REQUIRED FOR THE SEEK, READ AND WRITE OPERATIONS.

10.11.4.2.1 UNIT READY (STATUS 0)

WHEN THIS SIGNAL IS TRUE AND THE DRIVE IS SELECTED, THIS SIGNAL INDICATES THAT THE DRIVE HAS REACHED THE RATED SPEED.

10.11.4.2.2 ON CYLINDER (STATUS 1)

INDICATES THAT THE HEADS ARE LOCATED ON THE SPECIFIED TRACK. THIS SIGNAL GOES FALSE FOR APPROXIMATELY 3 MS AT THE BEGINNING AND AT THE END OF THE OFFSET OPERATION. FOR A ZERO TRACK SEEK, ON CYLINDER WILL GO FALSE FOR MAX. 10 uS.

REFER TO FIGURES 10.12-3 AND -7.

10.11.4.2.3 SEEK ERROR (STATUS 2)

INDICATES THAT A SEEK ERROR HAS OCCURRED. IN THIS CASE, ON CYLINDER DOES NOT GO TRUE. THE SEEK ERROR IS CLEARED WHEN AN RTZ (TAG 3 AND BUS 6) IS RECEIVED OR BY PUSHING THE FAULT CLEAR SWITCH ON THE OPERATOR PANEL OR MAINTE-NANCE-AID MRTZ SWITCH ON THE STATUS DISPLAY PCB. THE SEEK ERROR STATUS IS DEFINED AS FOLLOWS:

1. SEEK OR RTZ OPERATION IS NOT COMPLETE WITHIN THE SPECIFIED TIME.
2. HEADS TRAVEL TO A POSITION OUTSIDE THE RECORDING AREA.
3. AN ILLEGAL CYLINDER ADDRESS IS ISSUED TO THE DRIVE.
4. HEAD OVERSHOOTS TO AN UNSPECIFIED CYLINDER ADDRESS.
5. SEEK COMMAND IS RECEIVED BY THE DRIVE DURING THE NOT ON CYLINDER STATUS, WHEN THE HEADS ARE IN MOTION, OR DURING A WRITE/READ OPERATION.

10.11.4.2.4 FAULT (STATUS 3)

INDICATES THAT A FAULT CONDITION FOR WRITE/READ OPERATION EXISTS IN THE DRIVE. FAULT CONDITIONS ARE DESCRIBED IN THE WRITE/READ CHECK STATUS IN DETAIL.

IF ONE OF THE FAULT CONDITIONS OCCURS, WRITING IS IMME-DIATELY INHIBITED AND THE FAULT SIGNAL IS ISSUED TO THE CONTROLLER.

THE FAULT STATUS CAN BE CLEARED BY ONE OF THE FOLLOWING
OPERATIONS:

1. FAULT CLEAR ON TAG 3 AND BUS 4
2. FAULT CLEAR SWITCH ON THE OPERATOR PANEL
3. PUSHING ON THE MAINTENANCE-AID MRTZ SWITCH ON THE
   STATUS DISPLAY PCB
4. SWITCHING OFF THE POWER TO THE DRIVE
5. STOPPING ROTATION OF THE SPINDLE MOTOR

FAULT STATUS TURNS ON THE CHECK LAMP ON THE OPERATOR
PANEL AS WELL AS MAINTENANCE AID LED ON THE PCB.

10.11.4.2.5 WRITE PROTECTED (STATUS 4)

INDICATES THAT THE DRIVE IS IN THE WRITE-PROTECTED MODE.
THE WRITE-PROTECT FUNCTION IS ENABLED BY THE FILE PRO-
TECT SWITCH ON THE OPERATOR PANEL, AND BECOMES ACTIVE
WHILE THE DRIVE IS NOT SELECTED. IF THE DRIVE IS SE-
LECTED AND THE WRITE-PROTECT-FUNCTION IS DESIRED, THE
DRIVE MUST BE MOMENTARILY DESELECTED.

10.11.4.2.6 ADDRESS MARK FOUND (STATUS 5)

ADDRESS MARK FOUND IS AN 8-BYTE PULSE WHICH IS SENT TO
THE CONTROLLER AT LEAST 2 BYTES AFTER THE RECOGNITION
OF A 3-BYTE DC-ERASED AREA.

10.11.4.2.7 INDEX (STATUS 6)

INDEX MARK IS DERIVED FROM THE SERVO INFORMATION. IT
OCCURS ONCE PER REVOLUTION AND IS USED FOR REFERENCE
IN WRITE/READ OPERATION.

REFER TO FIGURE 10.12-15 FOR THE TIMING OF INDEX AND
SECTOR. -

10.11.4.2.8 SECTOR (STATUS 7)

THE SECTOR MARK IS ALSO DERIVED FROM THE SERVO INFORM-
ATION. THE NUMBER OF SECTORS PER REVOLUTION IS SELECT-
ABLE BY 15 JUMPER PLUGS AND IS DETERMINED BY COUNTING
BYTE CLOCK. THE SHORT CIRCUITS ARE LOCATED ON THE
LOGIC PCB. EACH PIN OF THE SHORT CIRCUIT REPRESENTS A
BINARY NUMBER MINUS 1 OF BYTE CLOCK TO BE COUNTED IN
EACH SECTOR.

10.11.4.3 SECTOR STATUS (STATUS 0 TO 7)

INDICATES THE CURRENT SECTOR ADDRESS FROM 1 TO 255 IN
THE DRIVE. REFER TO FIGURE 10.12-15 FOR TIMING OF SECTOR
ADDRESS.

10.11.4.4 WRITE/READ CHECK STATUS

INDICATES THE FAULT STATUS WHILE IN THE WRITE OR READ
OPERATION. WHEN ONE OF THESE CONDITIONS OCCURS IN THE
DRIVE, THE FAULT SIGNAL IN THE UNIT STATUS IS ISSUED AS
A SUMMARY TO THE CONTROLLER. IT CAN BE CLEARED BY A FAULT
CLEAR SIGNAL FROM THE CONTROLLER.

10.11.4.4.1 INDEX CHECK (STATUS 0)

INDICATES THAT THE INDEX SIGNAL IS NOT DETECTED WHERE IT
SHOULD BE OR WAS DETECTED WHERE IT SHOULD NOT HAVE BEEN
WHILE PERFORMING WRITE/READ OPERATIONS.

10.11.4.4.2 CONTROL CHECK (STATUS 1)

THE FOLLOWING FAULT CONDITIONS CAUSE CONTROL CHECK.

1. WRITE AND READ GATE ARE ISSUED AT THE SAME TIME.
2. WRITE OPERATION DURING OFFSET MODE.
3. WRITE GATE IS ISSUED IN THE WRITE PROTECT MODE.

10.11.4.4.3 MULTI-HEAD CHECK (STATUS 2)

INDICATES THAT TWO OR MORE HEAD IC'S ARE SELECTED SIMUL-
TANEOUSLY. (ONE DE HAS FIVE HEAD IC'S AND FOUR HEADS
ARE CONNECTED TO ONE HEAD IC.)

10.11.4.4.4 HEAD SHORT CHECK (STATUS 3)

INDICATES THAT ABNORMAL CURRENT WAS SENSED IN THE WRITE
SELECT LINE DURING WRITE OPERATION.

10.11.4.4.5 WRITE CURRENT ON READ CHECK (STATUS 4)

INDICATES THAT WRITE CURRENT WAS SENSED DURING A READ
OPERATION.

10.11.4.4.6 WRITE TRANSITION CHECK (STATUS 5)

INDICATES THAT WRITE CURRENT HAS NOT BEEN SWITCHED FOR
WRITING DATA. THE DETECTION IS CONTINUED FROM BYTE-8
AFTER WRITE GATE IS TRUE UNTIL THE END OF THE WRITE
OPERATION.

10.11.4.4.7 DELTA I WRITE CHECK (STATUS 6)

INDICATES THAT AN ABNORMAL WRITE CURRENT WAS SENSED IN
THE INNER HEAD OR OUTER HEAD.

10.11.4.4.8 SERVO OFF-TRACK (STATUS 7)

        INDICATES THE FOLLOWING FAULT CONDITIONS.

        1. THE HEAD IS +-100 MICRO INCHES OFF THE DESIRED
            TRACK DURING THE WRITE/READ OPERATION.
        2. WRITE/READ GATE IS RECEIVED BY THE DRIVE DURING
            NOT ON CYLINDER STATUS, HEADS IN MOTION OR SEEK
            ERROR.

10.11.4.5 ACCESS STATUS

        INDICATES ACCESS STATUS OF THE HEAD IN SEEK AND RTZ OPERA-
        TION. IT ALSO INDICATES START AND STOP SEQUENCE OF THE
        SPINDLE MOTOR.

10.11.4.5.1 DE SEQUENCE CHECK (STATUS 0)

        INDICATES THAT AN ABNORMAL START/STOP SEQUENCE OF THE
        DE OCCURRED IN THE DRIVE.

        IT CANNOT BE CLEARED BY THE FAULT CLEAR SWITCH ON THE
        OPERATOR PANEL OR FAULT CLEAR SIGNAL ON THE INERFACE
        BUT ONLY BY STOPPING ROTATION OF THE SPINDLE.

10.11.4.5.2 ACCESS TIME-OUT CHECK (STATUS 1)

        DURING AN RTZ OR SEEK OPERATION, ON CYLINDER FAILED TO
        APPEAR WITHIN 250 MS +-30% AFTER ACCESS START. IT CAN
        BE CLEARED BY RTZ OPERATION.

10.11.4.5.3 OVER-SHOOT CHECK (STATUS 2)

        INDICATES THE HEADS GO PAST THE DESIRED TRACK DURING
        SEEK OR RTZ OPERATION OR GO INTO THE GUARD BAND DURING
        A SEEK OPERATION.

        IT ALSO INDICATES THAT THE HEADS ARE MOVING AT ABNORMAL
        SPEED DURING RTZ OPERATION.

        OVER-SHOOT CHECK CAN BE CLEARED BY RTZ OPERATION.

10.11.4.5.4 REZERO MODE LATCH (STATUS 3)
           SERVO LATCH (STATUS 4)
           LINEAR MODE LATCH (STATUS 5)
           CONTROL LATCH (STATUS 6)
           WAIT LATCH (STATUS 7)

        THESE FIVE LATCHES OBSERVE THE SEQUENCE OF SEEK AND RTZ
        OPERATIONS. WHENEVER AN ERROR OCCURS DURING SEEK OR
        RTZ, THE CONTENT OF THESE LATCHES ARE FROZEN AT THAT
        TIME, SO THAT THEY ARE BENEFICIAL FOR ERROR ANALYSIS.
        THEY CAN BE CLEARED BY RTZ OPERATION. THE RELATIONSHIP
        BETWEEN ACCESS STATE AND THE CONTENTS OF LATCHES IS
        SHOWN IN TABLE 10.11-3.

TABLE 10.11-3   ACCESS STATES

REZERO MODE LATCH	SERVO LATCH	LINEAR MODE LATCH	CONTROL LATCH	WAIT LATCH	STATE	MODE
0	0	0	0	1	WAIT STATE	RESET
0	0	0	0	0	START RTZ	
1	0	0	0	0	MOVE IN	
1	0	0	1	0	TURN AROUND	
1	0	1	1	0	MOVE OUT	RTZ
0	0	1	1	0	RTZ LINEAR MODE	
0	1	1	1	0	ON TRACK	
0	1	0	1	0	ACCELERATE	
0	1	0	0	0	DECELERATE	
0	1	1	0	0	SEEK LINEAR MODE	SEEK
0	1	1	1	0	ON TRACK	

10.11.5 B - CABLE INPUT SIGNALS

10.11.5.1 WRITE DATA

CARRIES NRZ DATA WHICH IS TO BE WRITTEN ON THE DISK
SURFACE AND MUST BE SYNCHRONIZED WITH WRITE CLOCK. REFER
TO FIGURE 10.12-16.

10.11.5.2 WRITE CLOCK

WRITE CLOCK IS A RETURN SIGNAL OF THE 1F WRITE CLOCK
ISSUED FROM THE DRIVE AND MUST BE SYNCHRONIZED WITH THE
NRZ WRITE DATA. REFER TO FIGURE 10.12-16.

10.11.6 B - CABLE OUTPUT SIGNALS (ON CONTINUOUSLY EVEN THOUGH THE
DRIVE IS NOT SELECTED)

10.11.6.1 1F WRITE CLOCK

USED BY THE CONTROLLER TO SYNCHRONIZE WRITE DATA AND WRITE
CLOCK. IT IS SYNCHRONIZED TO THE SERVO PULSE WHILE IN THE
WRITE OPERATION AND TO THE RAW DATA IN A READ OPERATION.
REFER TO 10.11.5.2 AND FIGURE 10.12-16.