

IOU 54
DISC DRIVE
CONTROLLER
MAINTENANCE FIELD MANUAL

PRELIMINARY EDITION

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EQUIPMENT CHARACTERISTICS**1.1 GENERAL**

The IOU 54 controller is a disk controller that is used with the 10.5" Fujitsu Eagle (470 MB).

The IOU 32/42/52 controllers ensure data integrity by verifying each sector immediately after each write operation. The IOU 54 controller offers an alternative approach: each sector may be written without verification with the expectation that infrequent read/write errors will be recovered when the sector is read using the error correction process. This option has not yet been implemented, however it may be available in the near future.

As the error correction process is capable of recovering a small error (a single "burst" of up to 11 consecutive bits), and not a large error, all sectors with media defects must be alternated prior to using the disk. If this procedure is not followed data will be lost immediately on uncorrectable sectors and somewhat later on sectors that become uncorrectable through time. The disk must also be periodically analyzed in order to detect and alternate marginal sectors.

There will be a magnetic tape with each Fujitsu Eagle Disk that will have a complete list of defects on that particular unit. The ATP MISC54 will have a formatter that will read in the tape, and will automatically generate an alternate sector for each defective sector.

1.2 SPECIFICATIONS**Power Requirements:**

+5 VDC 4.9 Amps, Max. Noise/Ripple - 50mv pp.
+12 VDC 200 mAmps
-12 VDC 200 mAmps

Regulation:

Only the +5 VDC power must be regulated; voltage tolerance is specified at +10%.

INSTALLATION

2.1 SWITCH SETTINGS

The controller is usually set to address "D", but can be set to any address that is not being used by another device.

The setting of the configuration switches depends upon the disk drive being used and whether the verify-after-write check is enabled. Use the following table to set the configuration switches:

Fujitsu 10.5" Eagle 470 MB \$96 or \$16

The \$80 switch is set to "1" if the verify-after-write check is enabled.

IMPORTANT - Until further notice, all IOU 54's will be configured for verify-after-write (ie. 96).

2.2 CABLING

The IOU 54 is connected to the disk drive by two ribbon cables. The radial cable, which is connected to P3 on the IOU 54 has 26 conductors. The buss cable, which is connected to P4 on the IOU 54 has 60 conductors.

The red stripe must face up whenever a cable is connected to the IOU 54. The red stripe must also correspond to pin 1 on the disk drives' interface connector (pin 1 is often marked by an arrowhead on the interface connector, or a pin number near the connector).

2.3 WRITE CONTROL INSTRUCTIONS

Device controls are issued to the IOU 54 in the following format:

ldyy9D (d = controller address & yy = control byte)

CODE	DEFINITION
\$01	Allow access to FE and reserved sectors
\$02	Bypass verify-after-write check (next write only)
\$03	Start memory I/O mode
\$04	Reset memory I/O mode
\$05	Start user mode (Jump to location \$8000)
\$08	Seek using a physical sector address
\$09	Verify instead of write
\$10	Disable completion interrupts
\$14	Enable completion interrupts
\$20	Reset error counters
\$21	Read error counters
\$30	Disable read retries
\$31	Enable read retries
\$41	Clear tick on each read/write sector operation
\$42	Set tick on each write sector operation and enter disk I/O mode
\$44	Start tick-scan mode
\$60	Disable alternate sectoring
\$70	Enable alternate sectoring
\$71	Alternate next sector
\$72	Start read map mode
\$73	Reset read map mode
\$75	Start format disk mode
\$76	Start diagnostic mode
\$7F	Read identification string
\$99	Read next sequential logical sector
\$9A	Initiate automatic read of next sector
\$9B	Disable verify-after-write check
\$9C	Enable verify-after-write check
\$A0	Move ROM version # to status byte 0
\$A1	Read controller parameters
\$A2	Start set drive characteristics mode
\$A3	Read status buffer
\$A4	Read trace buffer
\$B0	Set status byte 0 to \$04
\$xD	Set logical sector address extension

2.4 TRACE CODES

The trace buffer contains information about the last disk operation and is of the following form:

byte 0	Number of subsequent bytes that contain trace buffer entries
bytes 1-150	Trace buffer entries

Each trace buffer entry consists of a 1-byte trace code and a 3-byte binary sector address, or a 3-byte drive status in the case of trace code \$60. If the high order bit of the trace code is set (e.g. \$81 instead of \$01), the sector address referred to by the trace code is the same as for the previous trace buffer entry. For decoding purposes, the \$80 bit must be subtracted from each code.

TRACE CODE	DEFINITION
\$01	On-cylinder status immediately after seek initiation
\$02	Fault, seek error, or power fail status immediately after seek initiation
\$04	Timeout waiting for on-cylinder
\$05	Fault, seek error, or power fail status after on-cylinder status
\$06	Fault after sequence command
\$07	CRC error after "normal" read
\$08	Header ECC error
\$09	Timeout waiting for disk state machine
\$0A	User requested invalid sector address
\$0C	Data does not compare on verify
\$0D	Unable to assign new alternate
\$0E	Valid header after "indexed" read, but wrong cylinder
\$11	ISA not in alternate sector map
\$12	Fault after head select
\$13	Unable to read alternate map
\$14	Error using alternate sector
\$16	Cannot match header
\$17	Valid header after "indexed" read, but wrong head
\$18	(Reserved)
\$19	Fault or power fail condition
\$1A	Unable to clear fault
\$1B	Drive not ready
\$1C	Unable to restore drive
\$1E	Invalid request
\$1F	Error in microcode
\$20	Invalid interlace parameter
\$21	Insufficient RAM for drive tables
\$22	Unable to write sequence tables
\$23	Spurious entry into format logic
\$24	Write instruction expected from user
\$25	Unable to read any header on requested track

TRACE CODE	DEFINITION
\$27	Two consecutive control errors
\$28	Unable to write reserved sectors
\$29	Controller is inoperative
\$30	Retry error, "out" read
\$31	Retry error, "in" read
\$32	Retry error, "normal" read
\$33	Retry error, "early-normal" read
\$34	Retry error, "early-in" read
\$35	Retry error, "early-out" read
\$36	Retry error, "late-in" read
\$37	Retry error, "late-out" read
\$38	Retry error, "late-normal" read
\$41	Retry operation
\$42	Read from index
\$43	Alternate map search
\$44	Assigning new alternate
\$47	Rewriting header and data
\$48	Sector is marked
\$49	Retry after header match, but compare error
\$4A	Attempting BEP error correction
\$4B	BEP reports error is uncorrectable
\$50	Clearing tick
\$51	Verifying head position
\$60	Drive status (consists of unit status, read/write check status and access status bytes; if the drive does not support extended status, the last two bytes will be zero).
\$FF	Trace buffer full

2.4.1 STATUS IN

The format for Status In (Read Status 0) is:

4dyy9D (d = controller address & yy = test byte)

STATUS BYTE	STATUS CODE
\$01	Read busy
\$02	Write busy
\$04	End
\$08	Service Request
\$10	Flag 1, seek or write completed (successfully)

The following completion codes are designated by the three highest status bits as shown below:

000 - Successful completion

001	-	Unrecoverable error (read, write or verify)
010	-	Marked sector
011	-	Invalid sector number
100	-	Write attempt while drive is write-protected or not ready
101	-	Alternated sector not found in the map
110	-	Drive not formatted
111	-	Serious drive problem: invalid request of hardware problem, see trace and status buffers

2.4.2 STATUS 2

Status 2 contains a controller-identifier value of \$FD

2.4.3 STATUS BUFFER

The Status Buffer contains more detail than what is normally shown by the Status In instruction. The Status Buffer is read by using the ldA39D Write Control instruction. There are 18 bytes in the Status Buffer, designated as shown below:

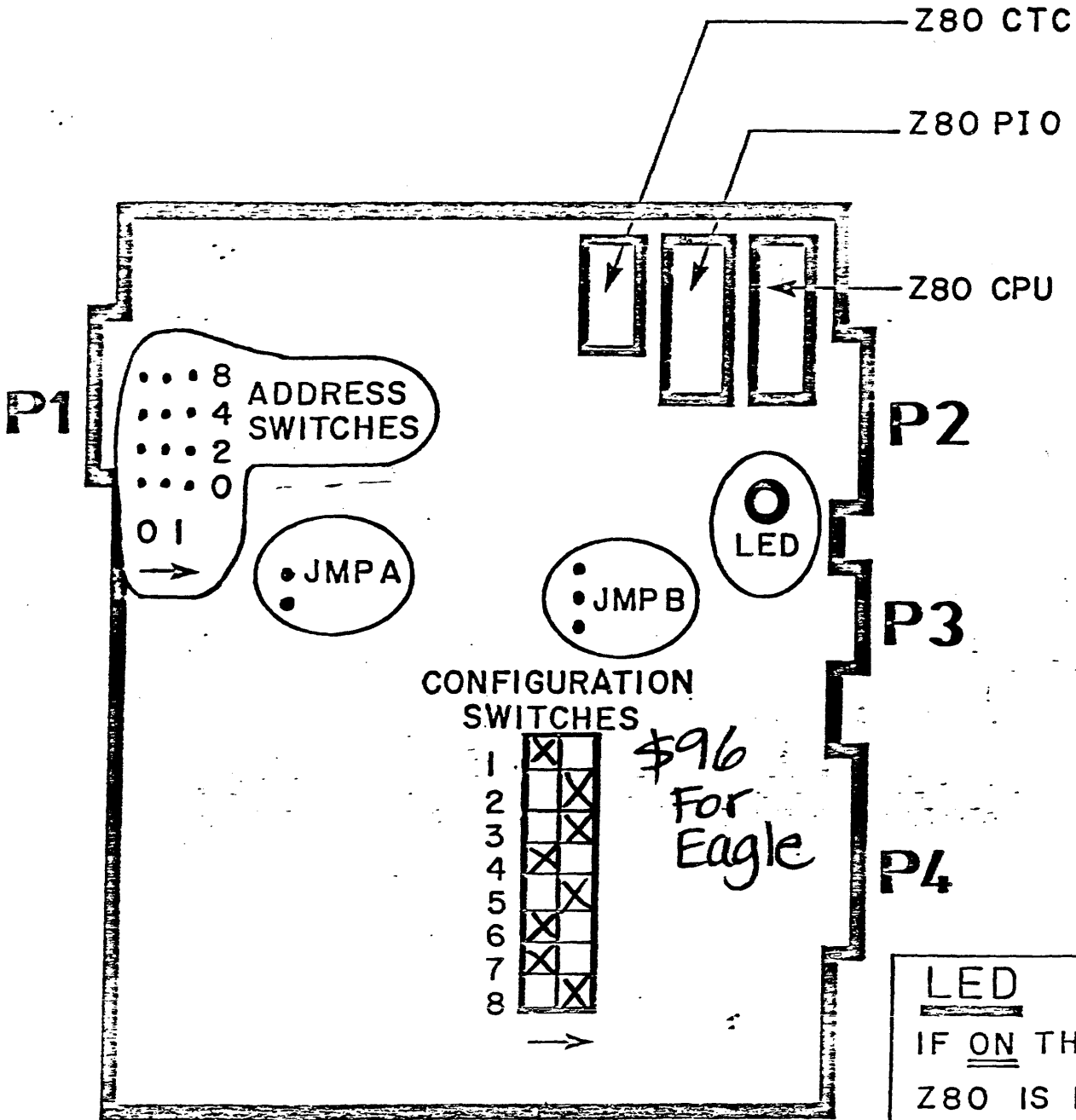
Byte 0:	Controller Mode (in hex)
	1 - disk I/O mode
	2 - tick scan mode
	3 - memory I/O mode
	4 - user mode
	5 - format drive mode
	6 - read map mode
	7 - set drive characteristics mode
	8 - diagnostic mode
Byte 1:	User selected options
	\$80 - generate completion interrupt
	\$40 - clear tick on read and write
	\$20 - verify instead of write
	\$10 - initiate automatic read of next sector
	(remaining bits are reserved)
Byte 2:	More user selected options
	\$80 - assign alternate on write error
	\$40 - assign alternate on next write
	\$20 - search alternate map if sector is marked or read error
	\$10 - bypass verify after write
	\$08 - allow access to reserved sectors
	\$04 - retry on error
	(remaining bits are reserved)
Byte 3:	Completion status byte (upper 3 bits only)
	(see status byte 0 description)
Bytes 4-5:	Binary read error counter (total)

Bytes 6-7: Binary write error counter (total)
Bytes 8-10: Binary sector address of last operation
Bytes 11-14: Physical sector address of last operation

Byte 15: Status byte A (additional status)
\$80 - (reserved)
\$40 - CRC error of compare error
\$20 - Sector marked
\$10 - Sector found in alternate map
\$08 - New alternate entry made
\$04 - Invalid sector number
\$02 - Control error
\$01 - Header mismatch

Bytes 16-17: Interlace parameter

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\$96 For Eagle

LED
 IF ON THE
 Z80 IS HALTED
 IPL will attempt
 to reset this
 error condition -
 IF light remains
 on - then replace
 the board

JMP B ↑ EAGLE
 •
 •
 • ↓ OTHER

JMP A
 ALWAYS ON
 INTERNAL CLOCK

EAGLE UPGRADE PROCEDURE

1. Removal Of Current Drive From System 64 Cabinet.
 - A. Lock the heads and motor clamp. Refer to the Black Book Section on Fujitsu.
 - B. Remove the Buss, Radial, and Disc Ready Cables.
 - C. Disconnect the power cables.
 - D. Remove the existing cable retractors. (All new hardware is required for the Eagle.)
 - E. Fully extend the drive on its rails until the slide locks engage. To remove the drive from the rails, depress the two buttons on each side of the drive that are located about half-way down the length of the slide. Continue pulling the drive, while supporting it, until it is free from the slides.
 - F. Turn the drive on its side and lock the spindle.
 - G. Remove the associated power supply. If no other disk power supplies remain, also remove the power supply mounting hardware.
 - H. Remove the rail slides.
 - I. All removed hardware must be packaged for return. Do not put the power supply or loose hardware in the same box with the disk drive as damage may result to the drive.

2. Installing The New Hardware

- A. The rails and slides should have been shipped on the Eagle. Remove the slides from the drive.
- B. See Figure I-1. Systems shipped with Eagles have had the order in which they are mounted in the cabinet reversed. The first disk is now directly below the tape drive and the second disk is at the base of the system.

Use Holes 21-24 For The 1st Drive
Use Holes 3-7 For The 2nd Drive

- C. Using Figure I-2 mount the rail slides as shown.

Note: The front of the slides mount differently then the assembly that was just removed. The slide now mounts in front of the rack instead of behind it.

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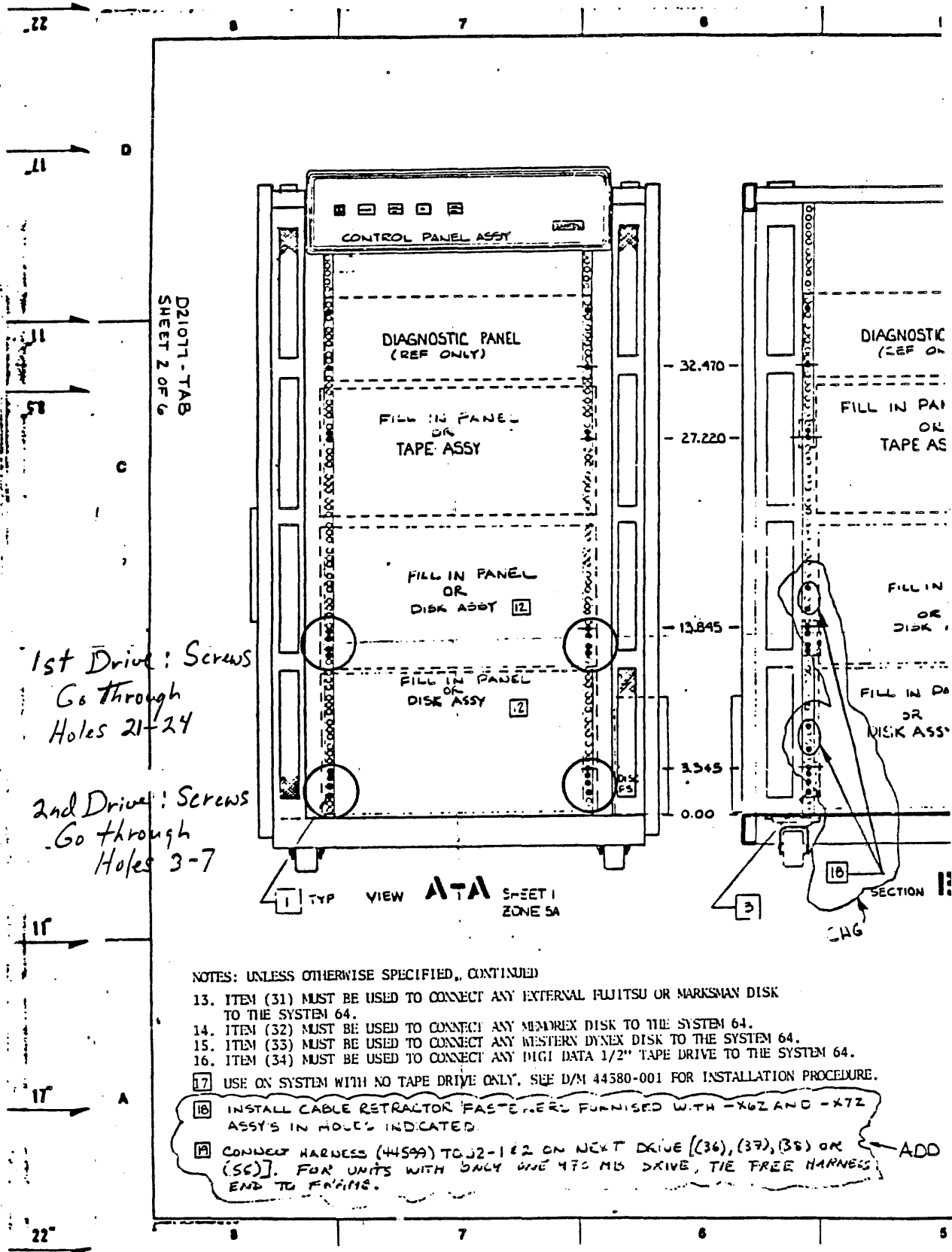
-
- D. Refer to Figure I-3. Attach brackets A and X to the plastic cable retractor as shown. Attach bracket X to system frame one or two holes above the rail slide.
- E. Slide the Eagle onto the rails.
- CAUTION: This is a three or four person job. The Eagle weighs 140 lbs.
- F. Attach Bracket A to rear of drive as shown.
- G. Details for routing cables appear in the Eagle Installation Section (attached).
- H. If this system is one of the first 20 shipped, you will need to replace the System Control Panel. The reason for this is the difference in connectors for the DISC READY Lamps. New systems are shipped with two sets of DISC READY connectors. The small connectors are for the 168 MB and 84 MB Fujitsu. The large connectors are for the Eagles.
- I. To replace the control panel remove the four (4) phillips head screws as shown in Figure I-4. If only a harness was sent use wiring diagram below for proper installation.

Proceed to the following section:

INSTALLATION PROCEDURES FOR THE EAGLE DISK DRIVE

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Rail Placement



1st Drive: Screws
Go through
Holes 21-24

2nd Drive: Screws
Go through
Holes 3-7

NOTES: UNLESS OTHERWISE SPECIFIED, CONTINUED

- 13. ITEM (31) MUST BE USED TO CONNECT ANY EXTERNAL FUJITSU OR MARKSMAN DISK TO THE SYSTEM 64.
- 14. ITEM (32) MUST BE USED TO CONNECT ANY MEMOREX DISK TO THE SYSTEM 64.
- 15. ITEM (33) MUST BE USED TO CONNECT ANY WESTERN DYNEX DISK TO THE SYSTEM 64.
- 16. ITEM (34) MUST BE USED TO CONNECT ANY DIGI DATA 1/2" TAPE DRIVE TO THE SYSTEM 64.
- 17. USE ON SYSTEM WITH NO TAPE DRIVE ONLY. SEE D/M 44580-001 FOR INSTALLATION PROCEDURE.

18. INSTALL CABLE RETRACTOR FASTENERS FURNISHED WITH -X6Z AND -X7Z ASSYS IN HOLES INDICATED.

19. CONDUIT HARNESS (44599) TO J2-1 & 2 ON NEXT DRIVE ((36), (37), (38) OR (56)). FOR UNITS WITH ONLY ONE 470 MB DRIVE, TIE FREE HARNESS END TO FRAME. ADD

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Fig I-1

Rack Mount Installation

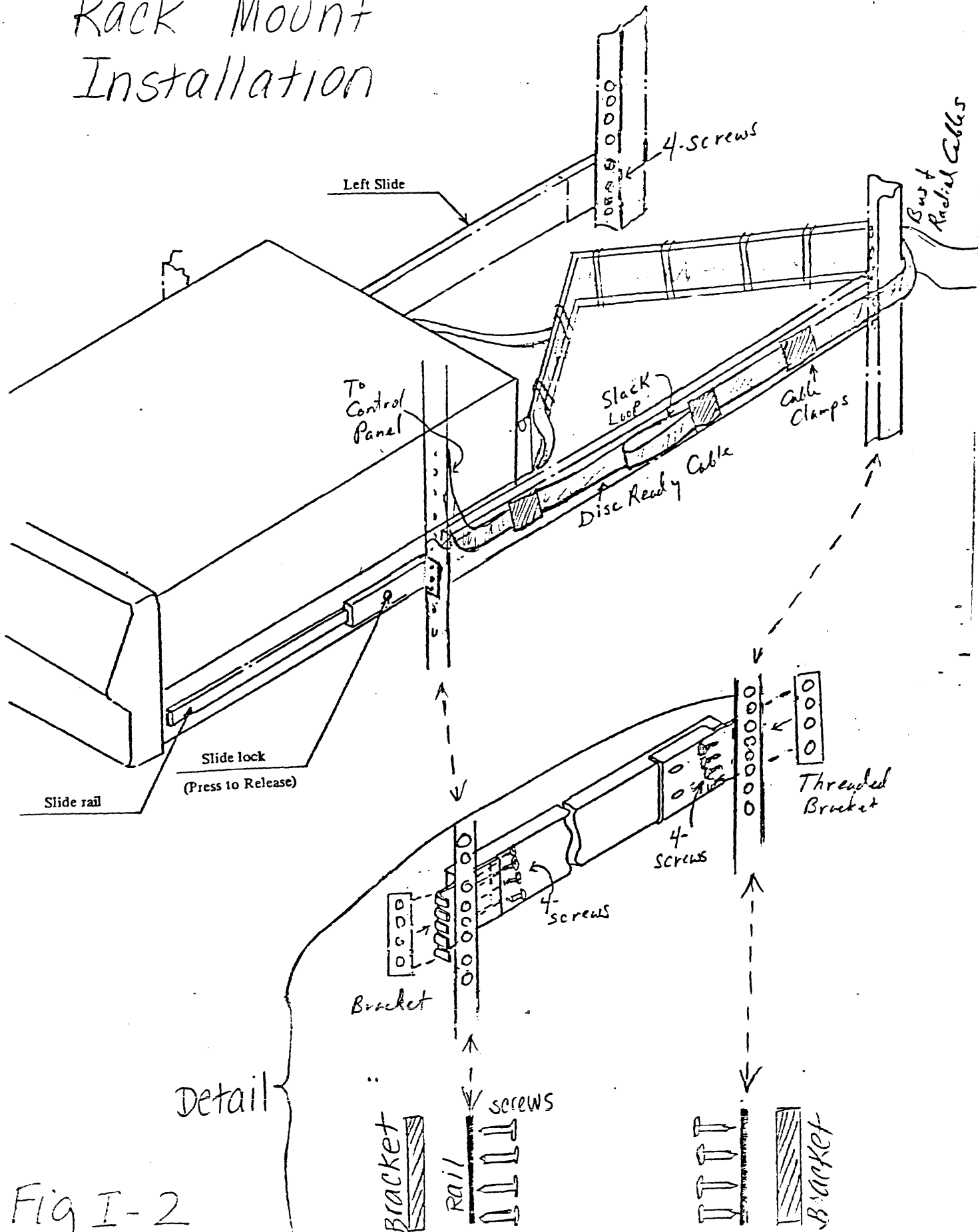


Fig I-2

PRELIMINARY

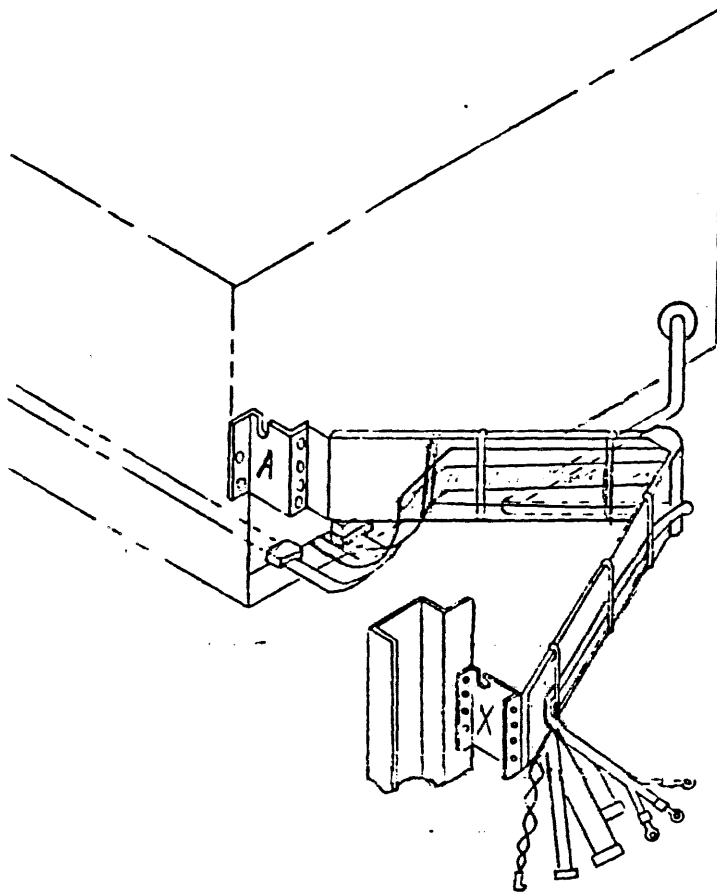


Fig I-3

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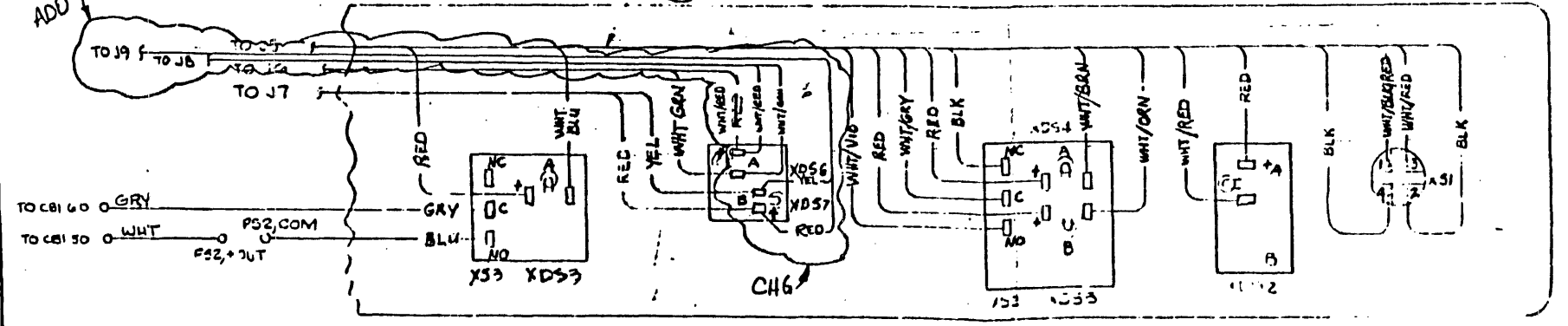
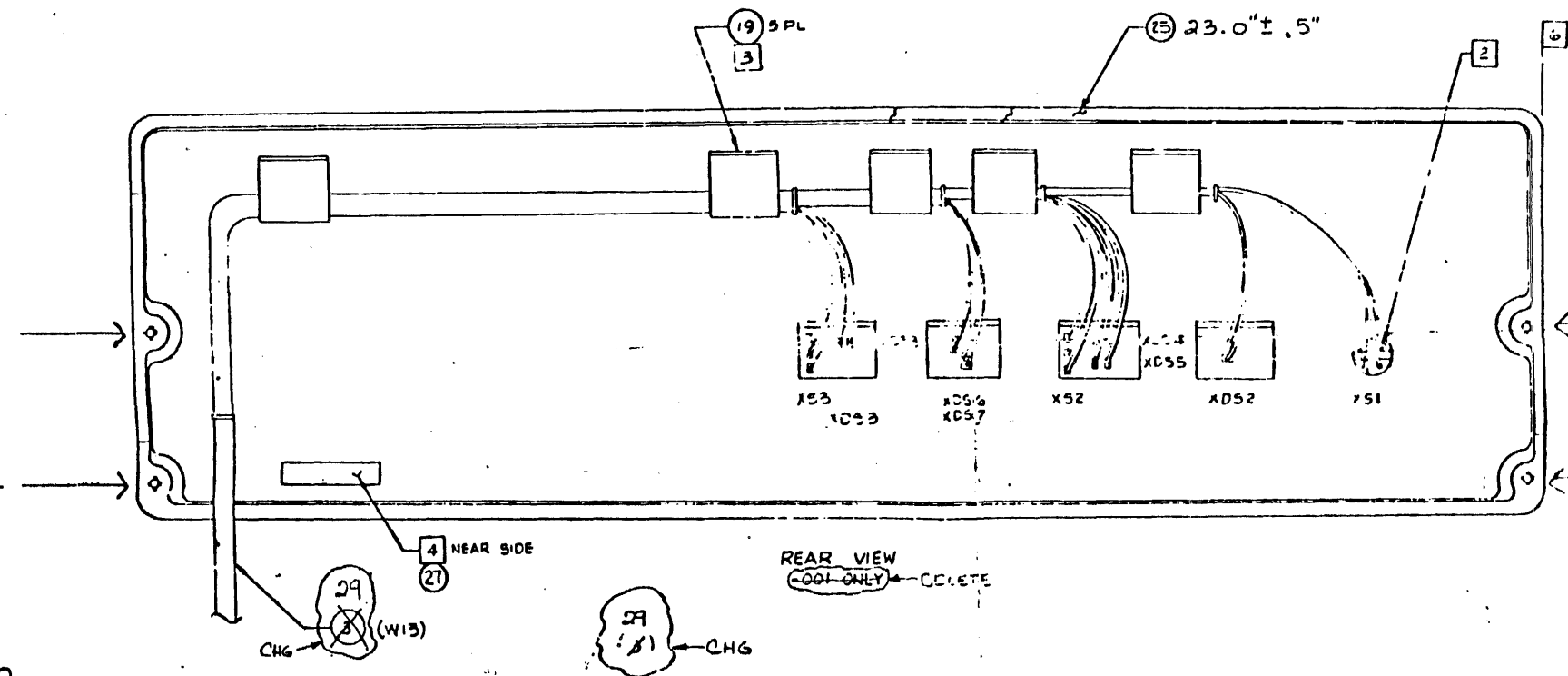


Fig I-4

WIRING DIAGRAM (5)
(WHT/RED)

INSTALLATION PROCEDURES FOR THE EAGLE DISK DRIVE

SHIPPING RESTRAINTS

1. Remove the system side panels.
2. The drive is held in place on its rails by a single nut and bolt (See Figure 0-1). Remove this assembly.
3. Fully extend the drive on its rails.
4. Remove the top cover by removing the four screws located on each corner of the cover. (See Figure 0-2.)
5. a) To remove the Vibration Damping Block, the card cage must be laid on its side. Remove the two screws at the base of the card cage (located just above the rail). (See Figure 0-3.) Pull up on the card cage and lay it over on its side.

b) The foam block should now be visible. It is removed by lifting the Disk Enclosure slightly and pulling the block out towards the card cage. The drive should now be resting on its shock mounts.
6. The final restraint is the head lock. See detail "C" of Figure 0-4.

CABLING (Refer to Figures 0-5 and 0-6 for all of the following steps.)

1. Radial Cable to CNP43.
2. Buss Cable to J1 of the Power Sequencing Card.
3. Power Sequencing Card to CNP41 of the Interface Board. Ground Strap to TB1.
4. Power Sequencing Harness Assembly to CNP42. Brown and White twisted pair extends from the left end of CNP42. Figure 0-1 shows how to route cables on retractor assembly.
5. Run the Disc Ready Cable from the Eagle Front Panel along the bottom of the chassis and out from underneath the Interface Board with the red strip facing the rail. (See Figure 0-7.) The Disk Ready Cable should be routed as shown in Figure I-2. Note the slack loop midway across the rail. The first drive plugs into the Wht/Grn and Wht/Red twisted pair. The 2nd drive plugs into the red/yellow twisted pair. The two smaller connectors are used for the 168 MB or 84 MB drive.
6. A/C. See Figure 0-8 (AC Wiring Diagram). Example: DISK1 goes to TB2-6B

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and TB3-6B and GND to lug E6. The A/C cable provided is much too long. See Figure 0-8.1 and note that cable is looped and tied to the system frame.

SWITCH SETTINGS

1. Interface Board: Set drive address switches to OFF. Drive address is always 0. (See Figure 0-6.)
2. Figure 0-9 shows the location of the Logic PCB. Using Extractor Tool (see Figure 0-9.1), remove the Logic PCB. Card Extractor is to remain with the drive at all times. DO NOT REMOVE.
3. Using Figure 0-10 verify or set mini-jumps to match drawing. BC7-BF7 set the Bytes Per Sector and Sectors Per Track. AE7 sets the interface control options.
4. Power Sequencing/Terminator board has two pin patches. Refer to Figure 0-11.

J2 Configurations:

- a. Only one Eagle in system- Jump 1-3 and 2-4.
- b. If 2nd Eagle in system- Remove pin patches and plug Brn/Wht twisted pair from first drive onto J2, pins 1 and 2. Connector is offset so that it can't be put on backwards.
- c. If using Auxiliary Cabinet, continue this sequence for any additional Eagles.
- d. The twisted pair coming from the last drive in the string should be coiled and tie wrapped to the system frame.

POWER SUPPLY (Refer To Figure 0-12 for the following steps.)

1. Set the Local/Remote switch to the Local position.
2. Set the Main Line switch to the ON position.

DRIVE FRONT PANEL (Refer To Figure 0-12.1.)

1. Set START to ON. All Eagles are to be left in the ON position. The power sequencing boards will cycle the drives up when the system is powered on.
2. Set Protect to OFF.

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ADJUSTMENTS/CHECKS

1. VOLATAGES

- A. Measurements are made at the backplane of the card cage. (See Figure 0-13.)
- B. Voltages are adjusted on the power supply to within the tolerances shown on Table 13.1.

2. SERVO ADJUSTMENTS

- A. The drive was shipped properly aligned. The exact policy and procedures are currently being reviewed. Until further notice **DO NOT ATTEMPT** to align the servos on the Eagle drive.

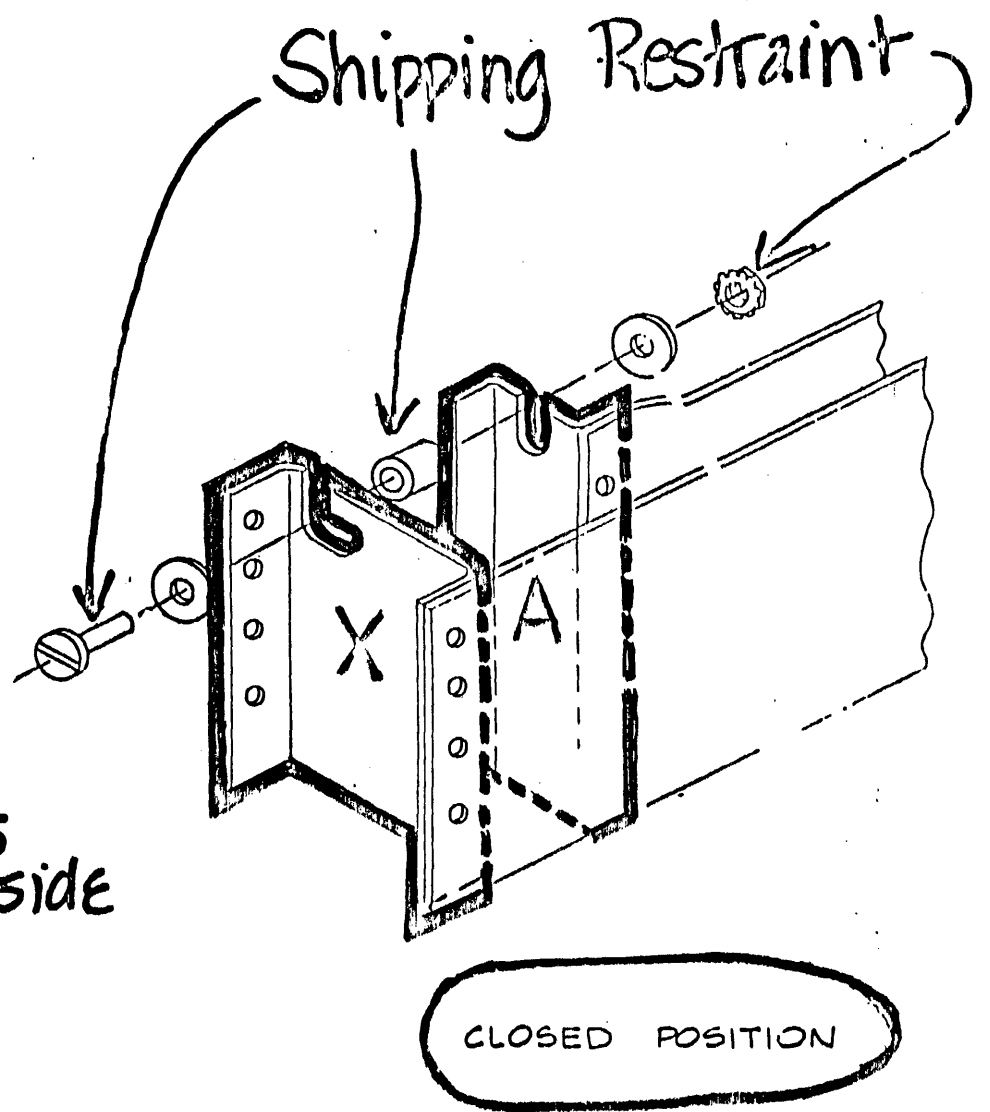
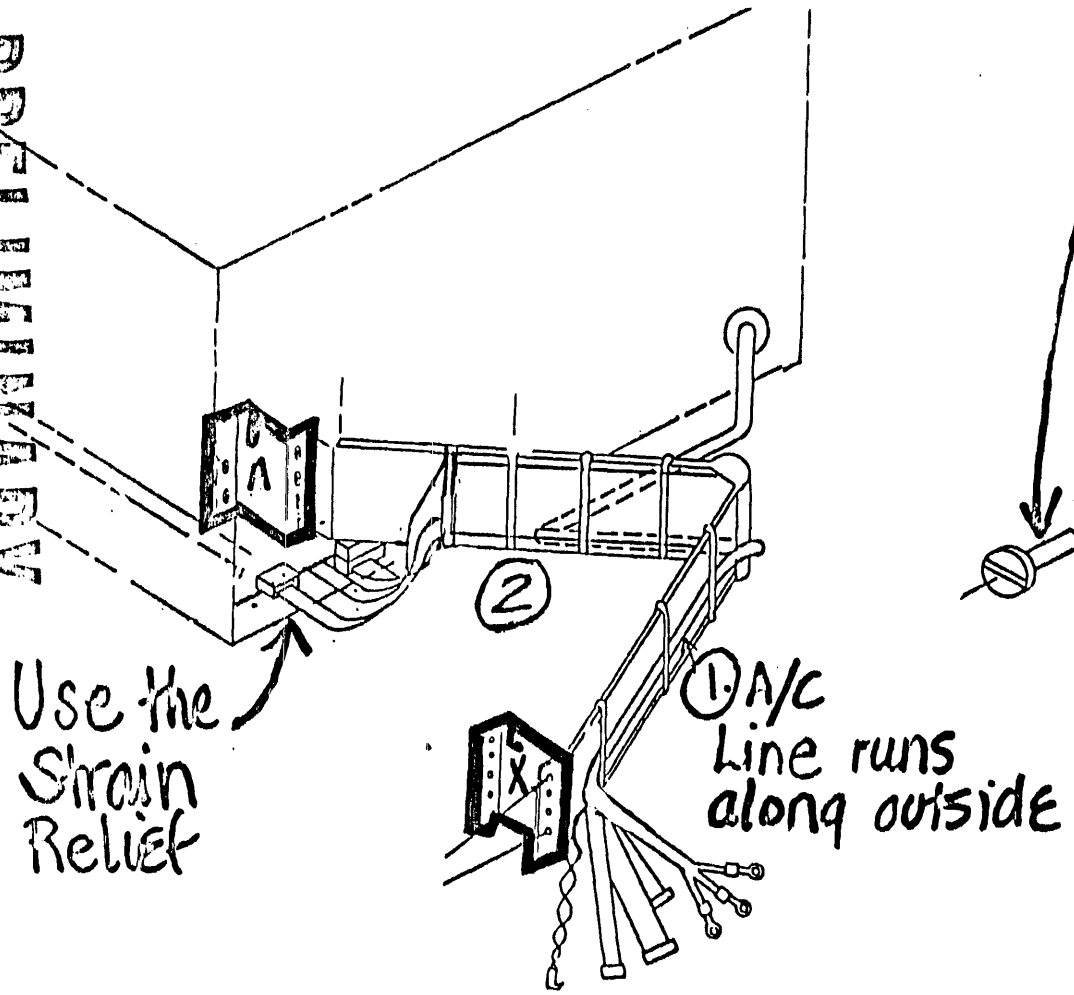
Note: The above statement against aligning the servos applies to all, including those who may have been trained.

DRIVE CHECK-OUT

- 1. ATP's have been shipped to the field on the drive.
- 2. Run DISC54 to verify that the drive is operational.
- 3. **DO NOT FORMAT** the drive. The alternate sector map will be destroyed. Attached to each Eagle drive is a tape containing a copy of the alternate sector map. There can be as many as 500 alternate sectors from the factory. The ATP used to read this tape onto the disk is not currently working, however it will be soon. Leave the tape with the drive at all times.
- 4. Do not bump the disc while it is running. Errors have been observed from the slight shock to the drive. This should not be encountered unless the disc is extended for installation or maintenance.

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DEFINITION



② All other cables run inside

Figure 0-1

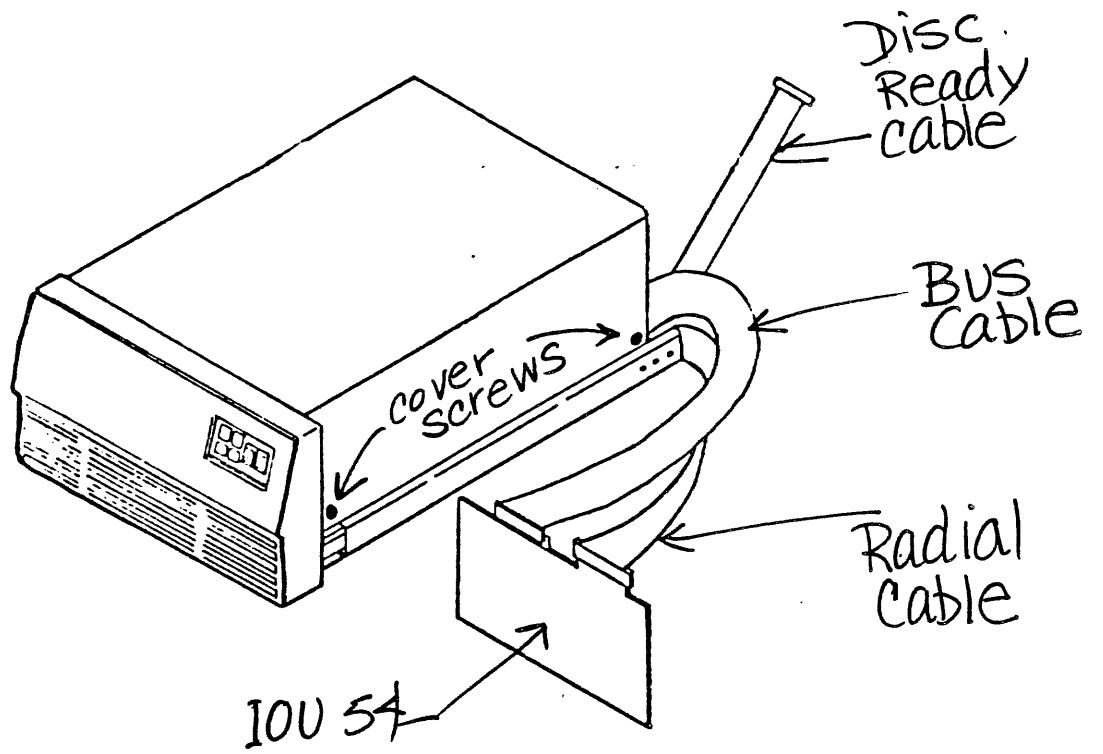


Fig 0-2

PRELIMINARY

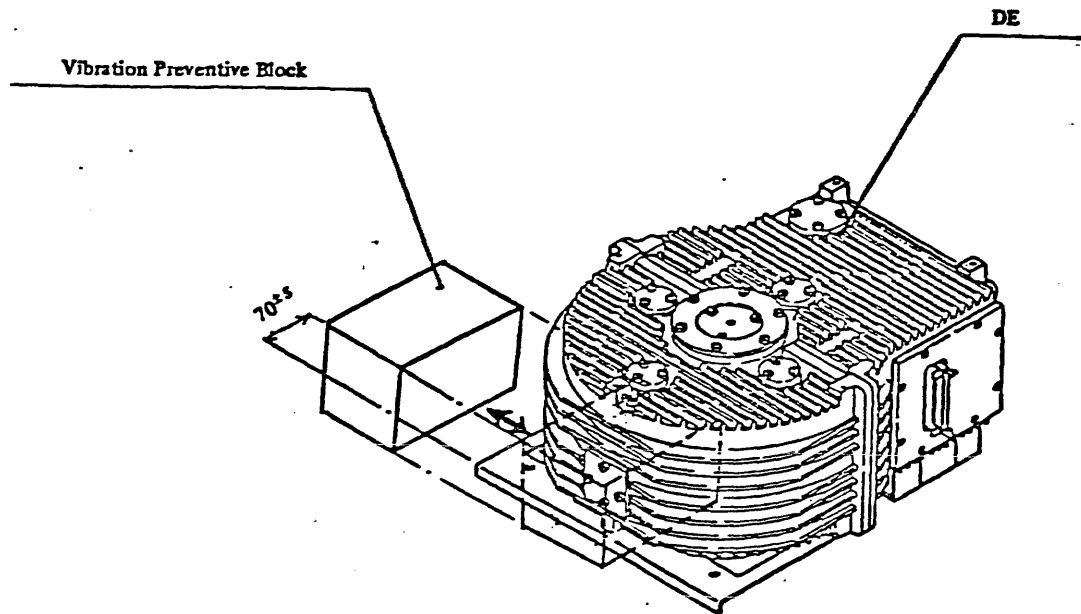
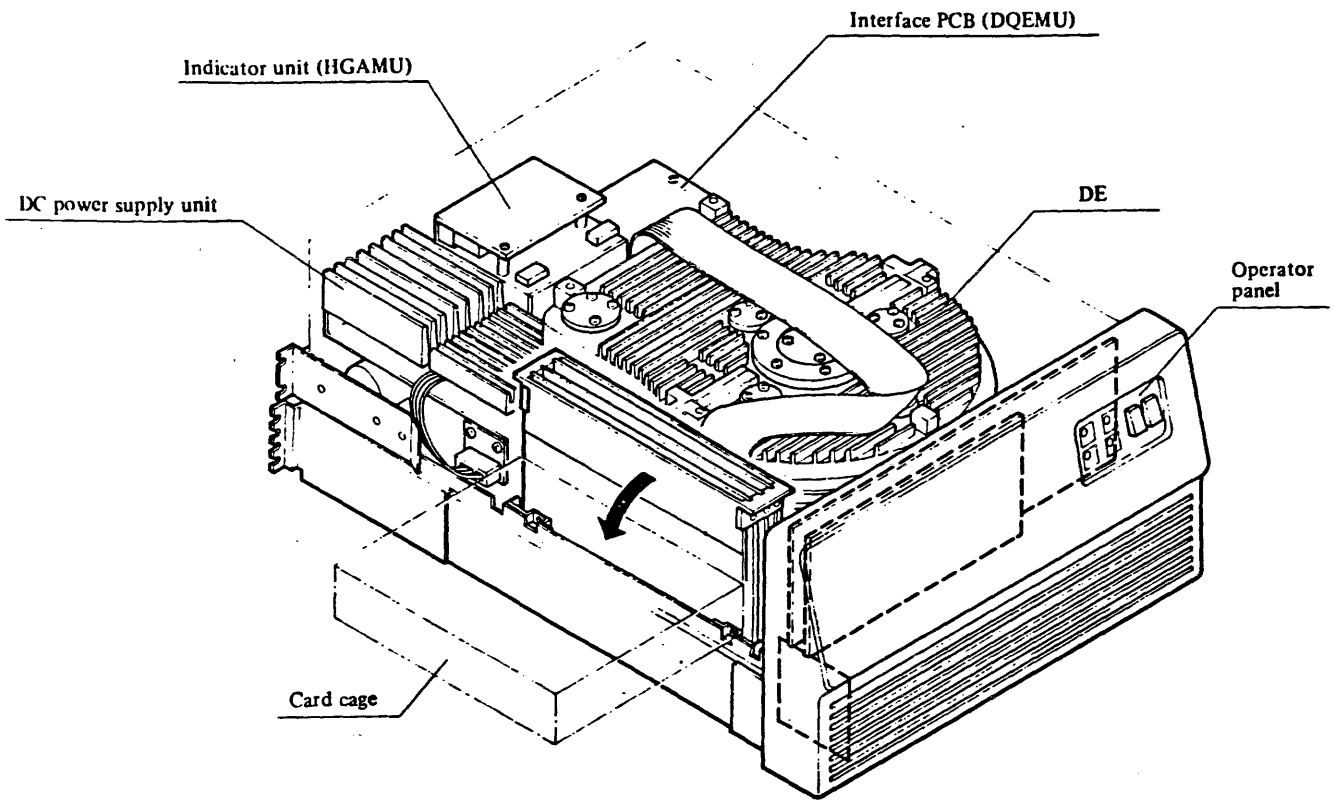
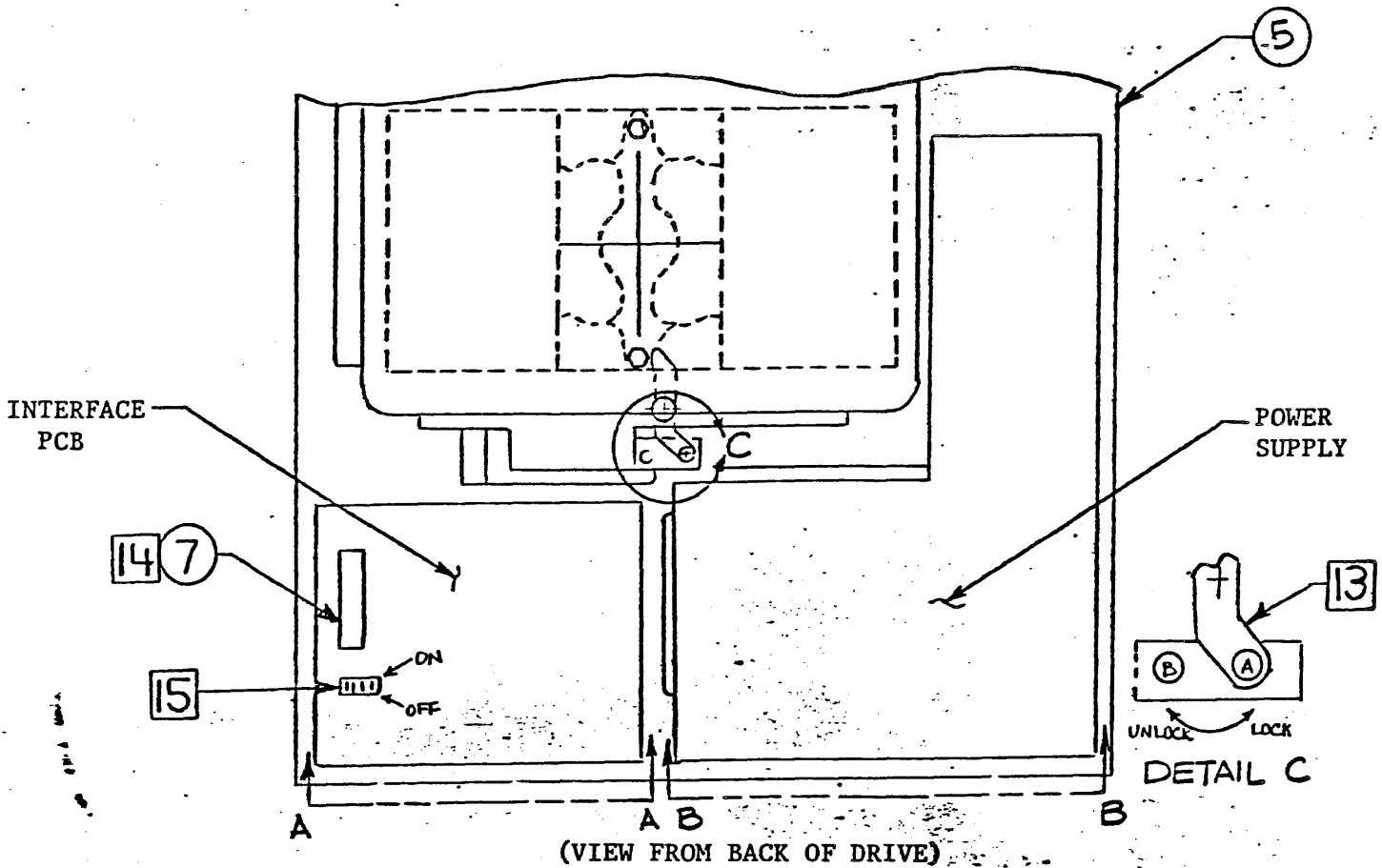


Fig. 0-3

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13 UNLOCK THE ROTARY ACTUATOR BY THE FOLLOWING INSTRUCTIONS: 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" 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'.

14 ON INTERFACE PCB (VENDOR # DQEMU), LOCATED NEXT TO THE POWER SUPPLY, APPLY REVISION LABEL (7), AND MARK AT REV. "A".

15 SET THE DRIVE LOGICAL ADDRESS ON THE INTERFACE PCB TO ZERO BY TURNING ALL FOUR DIP SWITCHES TO 'OFF'.

Fig 0-4

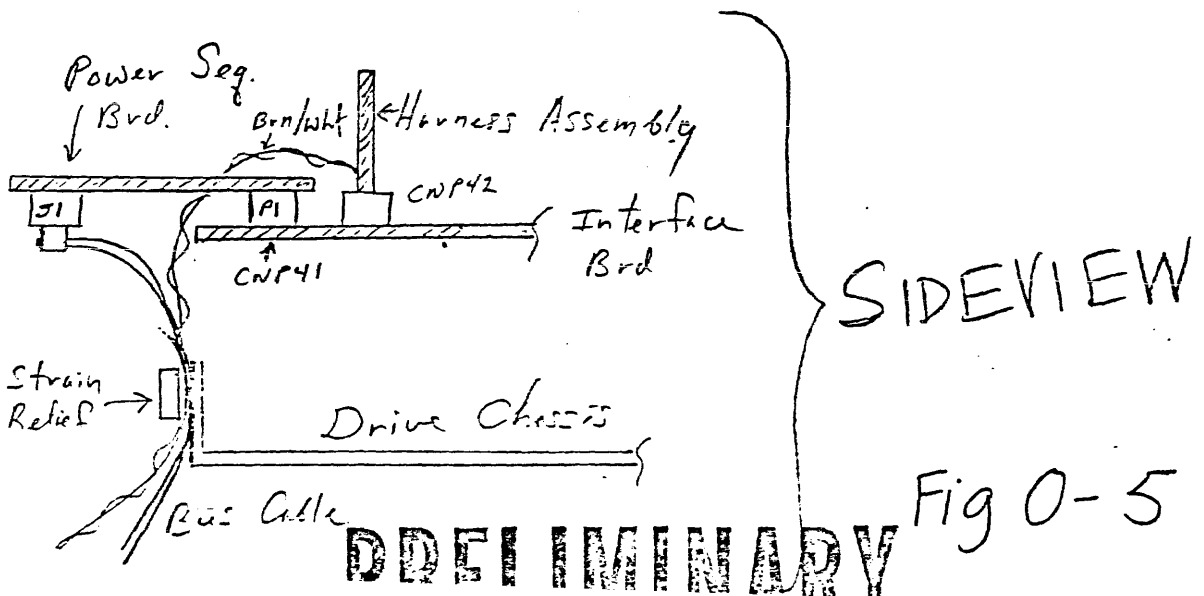
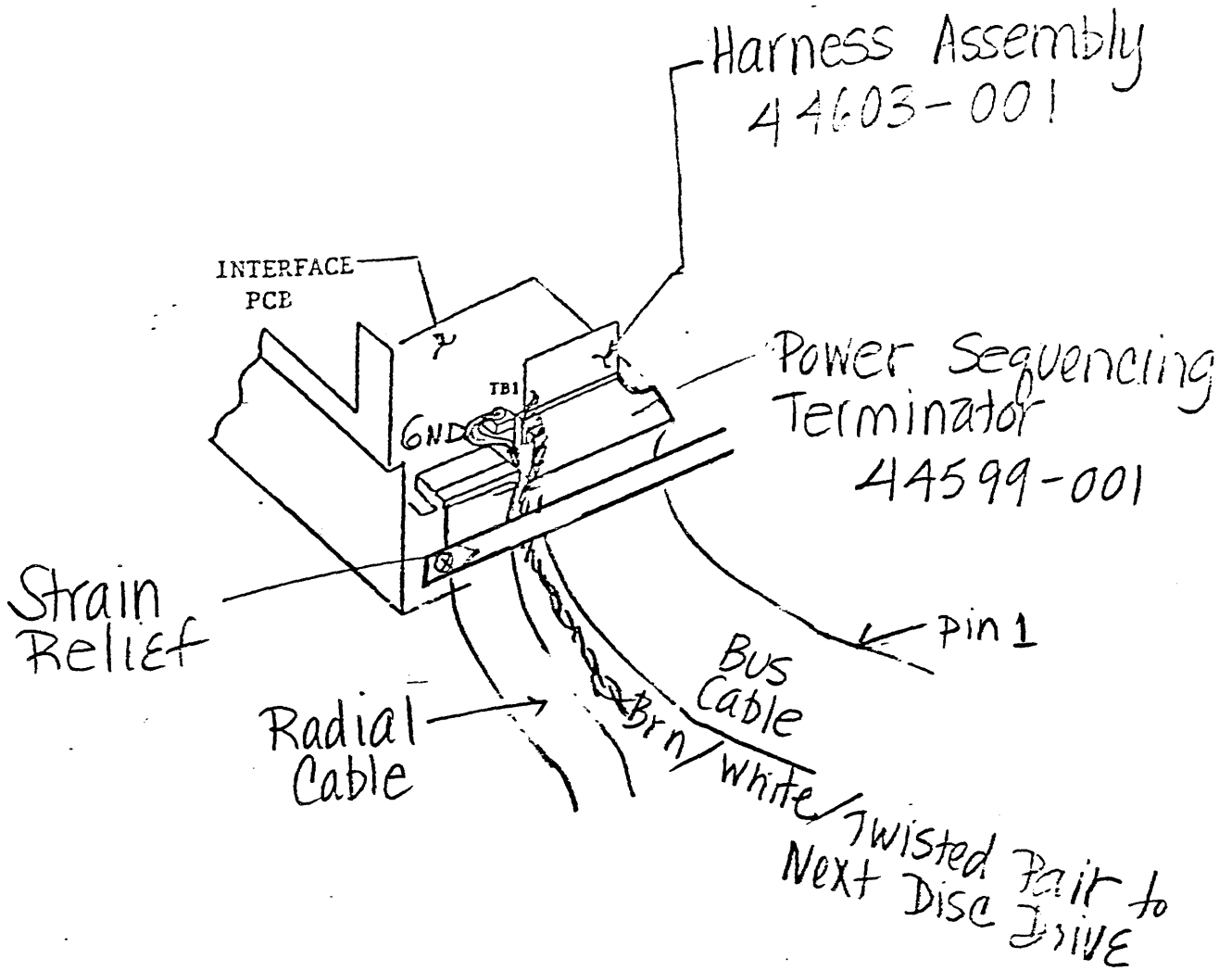


Fig 0-5

DEVELOPMENT

Drive Address	Switch Position			
	1	2	3	4
0	OFF	OFF	OFF	Not Used
1	ON	OFF	OFF	
2	OFF	ON	OFF	
3	ON	ON	OFF	
4	OFF	OFF	ON	
5	ON	OFF	ON	
6	OFF	ON	ON	
7	ON	ON	ON	

(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.

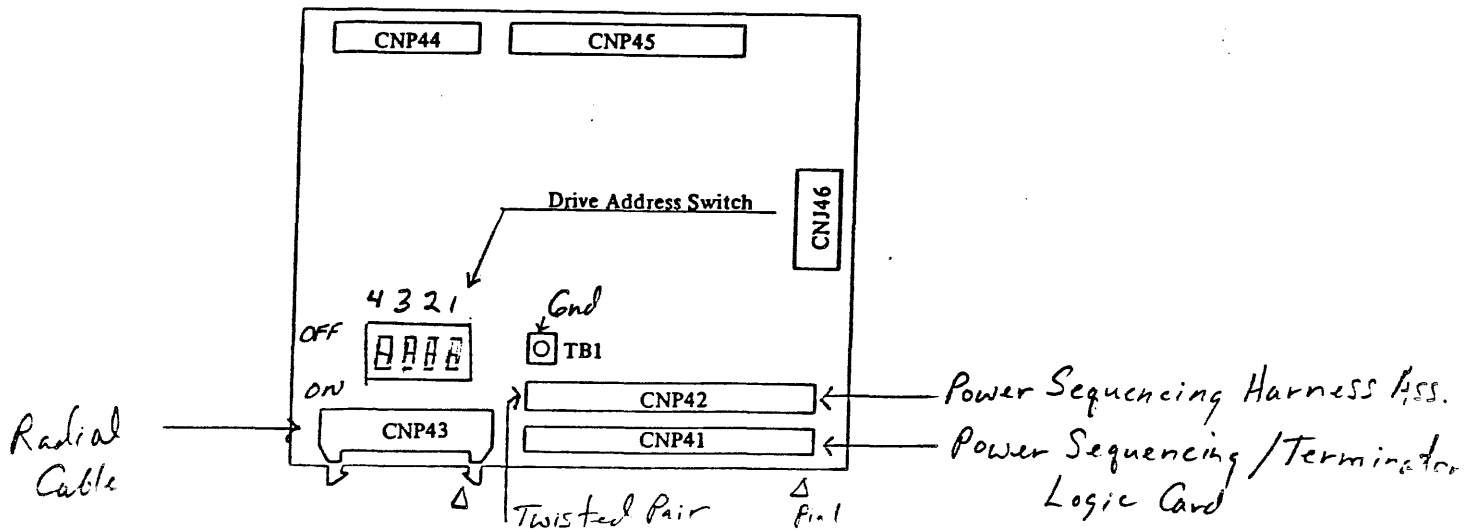


Fig. O-6

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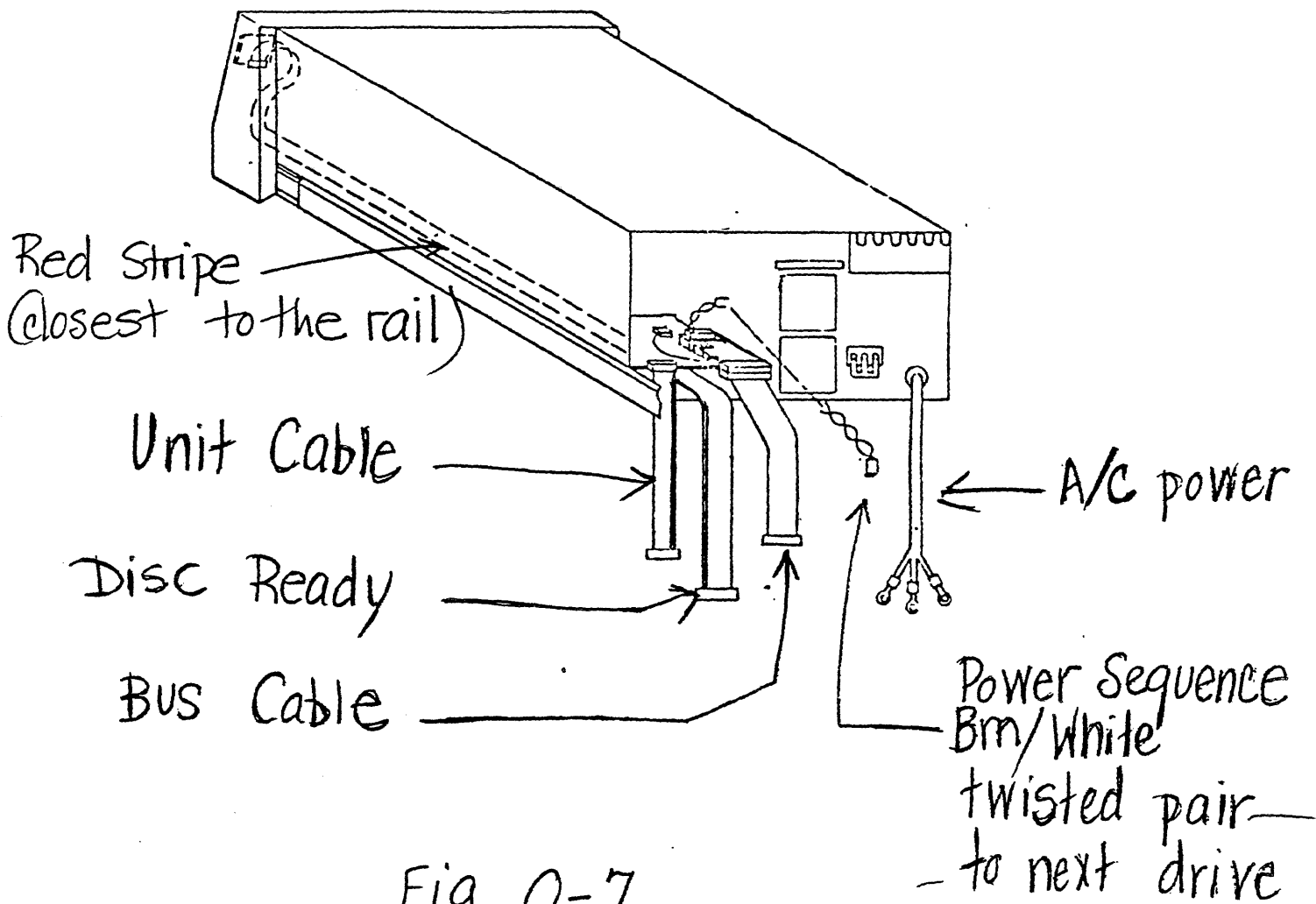
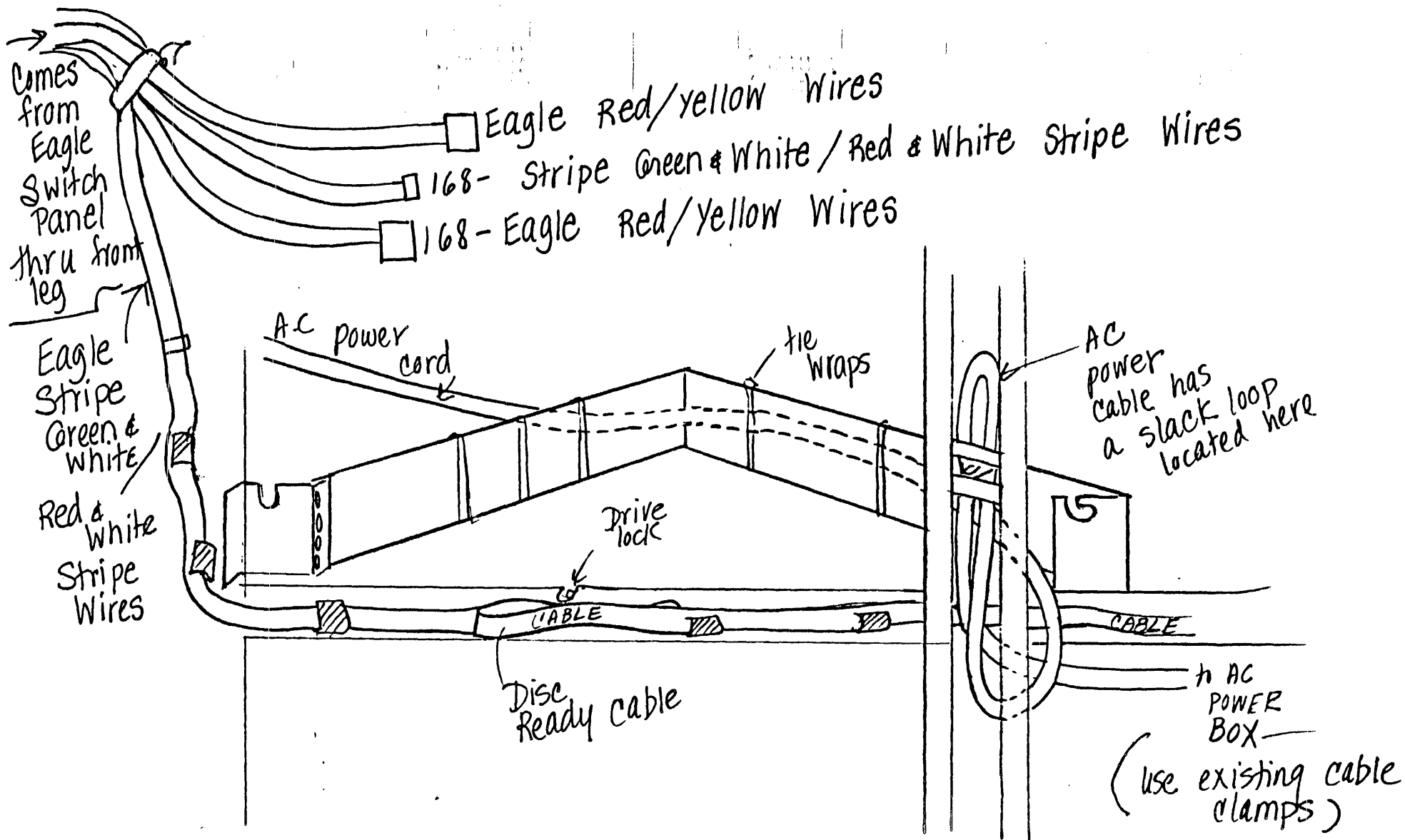


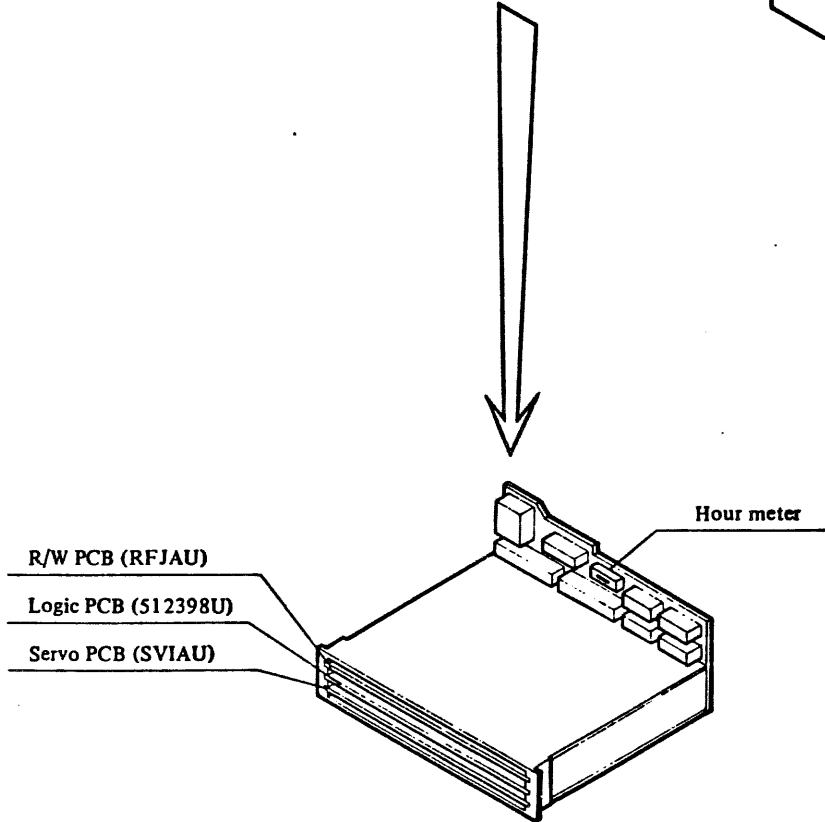
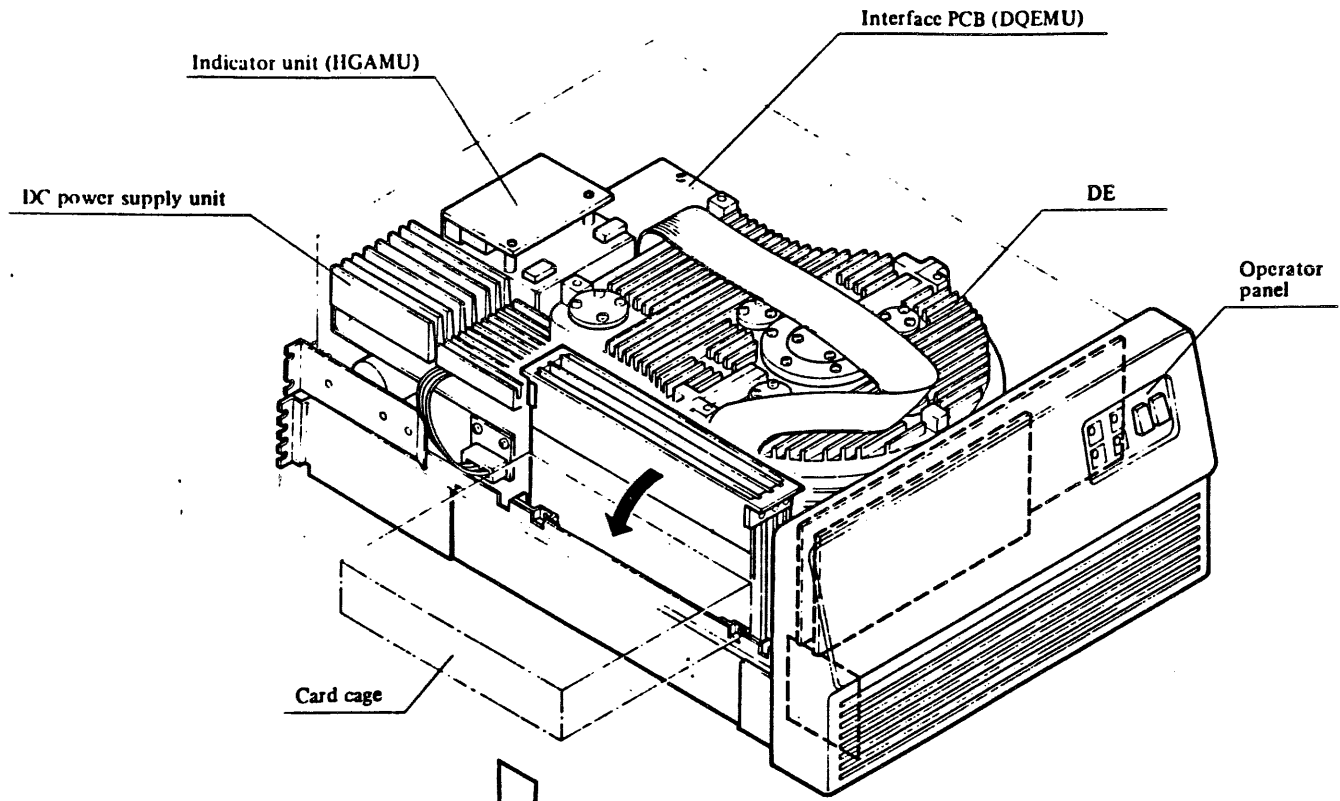
Fig 0-7

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Fig 0-8.1





(b) New version

Fig 0-9

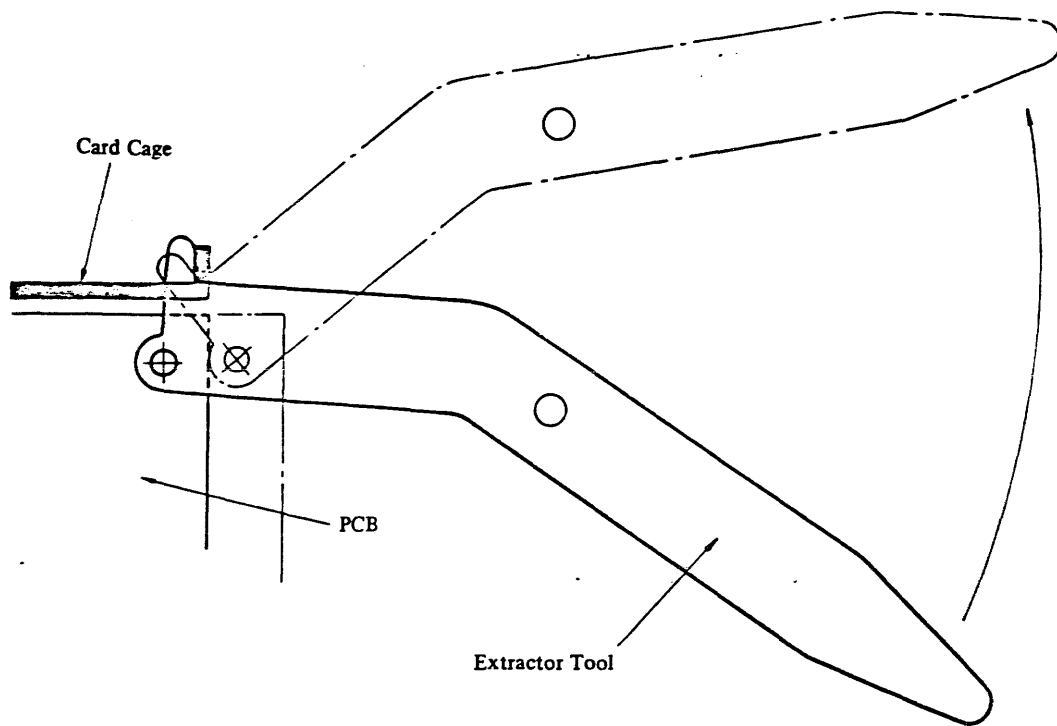


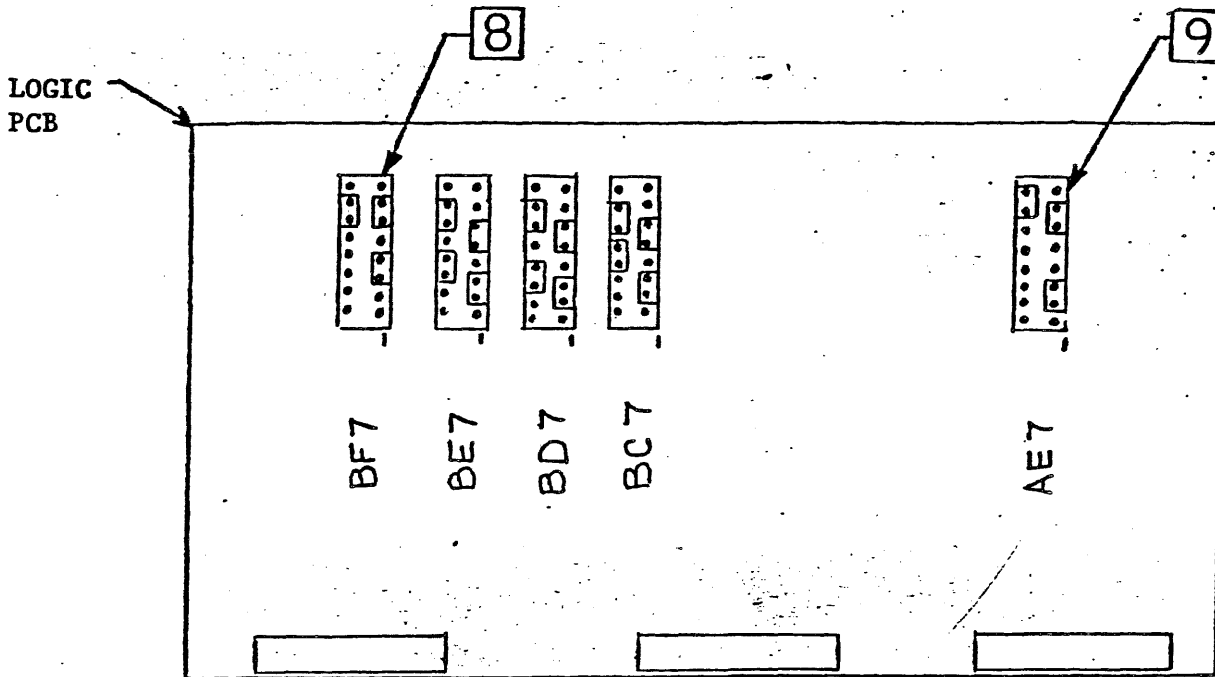
Figure PCB Removal

(1) Interface Changing

The interface can be changed by shorting the appropriate pins with jumper plugs, as shown below.

Table 3.3-1 Interface Selection

Item	Pin number to be shortened	Default mode	Function
Incorporate TAG4, 5 Status Capability	03 - 02	o	Enable
	03 - 04		Disable
Operation of Seek End status	06 - 05		Seek End is not issued after Offset Command is reset.
	06 - 07	o	Seek End is issued after Offset Command is reset.
Response of Unit Ready	10 - 09	o	Unit Ready is issued even if the drive is in a fault condition.
	10 - 11		Unit Ready is not issued when the drive is in a fault condition.



7. REMOVE THE LOGIC PCB FROM THE CARD CAGE.

8 INSTALL SECTOR COUNT JUMPERS IN THE FOLLOWING LOCATIONS:

LOC. BF7	JUMP: 3-4, 6-7, 10-11
BE7	2-3, 5-6, 10-11, 13-14
BD7	2-3, 5-6, 10-11, 13-14
BC7	2-3, 5-6, 10-11, 12-13

9 INSTALL INTERFACE MODIFICATION JUMPERS IN THE FOLLOWING LOCATIONS:

LOC. AE7	JUMP: 2-3, 6-7, 9-10
----------	----------------------

10. REPLACE THE LOGIC PCB IN THE CARD CAGE.

~~X~~ ON DRIVER PCB (VENDOR # TVKMU) LOCATED BEHIND THE FRONT PANEL, PLACE REVISION LABEL (7) ON THE RIGHT OF THE COMPONENT SIDE, AND MARK AT REV. "A".

~~X~~ ON DRIVER PCB (VENDOR # TVLMU) LOCATED BEHIND THE FRONT PANEL, PLACE REVISION LABEL (7) ON THE END NEAREST THE OPERATOR PANEL, AND MARK AT REV. "A".

Fig 0-10

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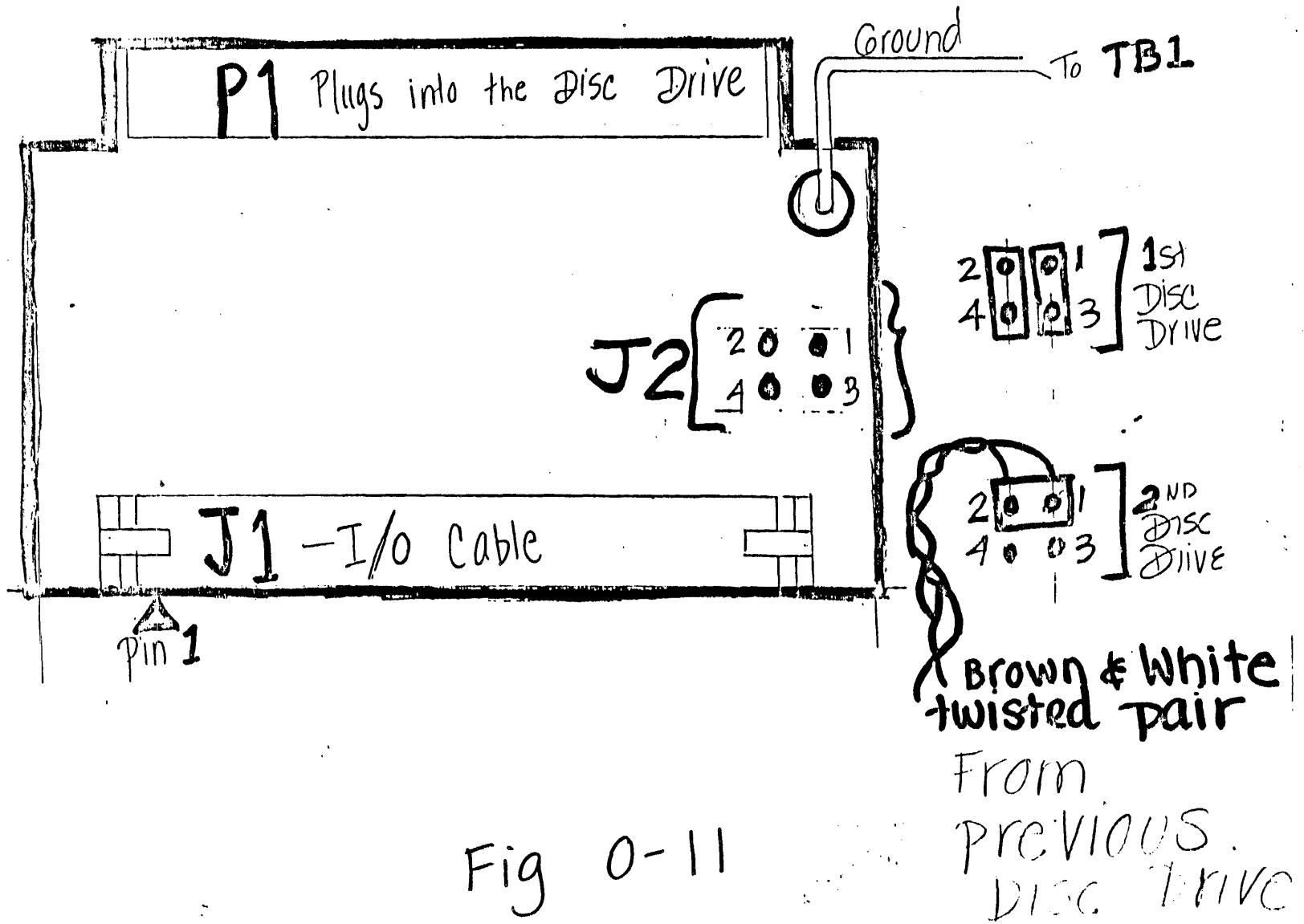


Fig 0-11

DC POWER SUPPLY UNIT

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

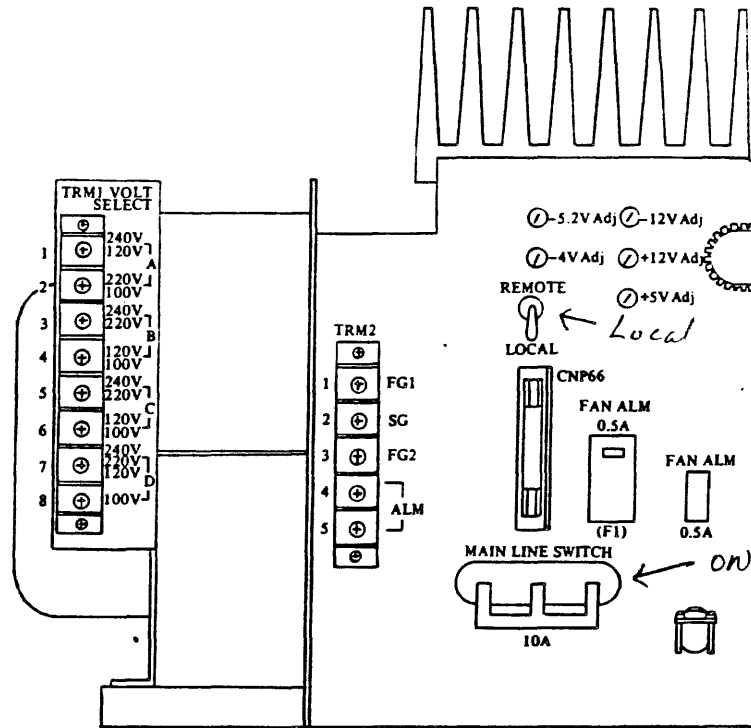


Figure 3.1-1 Control Panel of DC Power Supply Unit

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

Supplies AC power to the unit. If one of following failures occurs, 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 to the drive's front panel.

PRELIMINARY

Fig. 0-12

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.

PRELIMINARY

OPERATOR PANEL

Switches and indicators on the operator panel are shown in Figure 3.5-1.

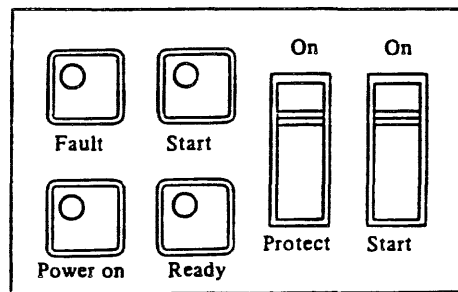


Figure C-12.1 Operator Panel

(1) Start-On (Switch)

When the Remote/Local switch on the control panel of DC power supply unit is set to Local, this switch enables rotation of the spindle motor. The heads start Initial Seek operation and stop on the cylinder zero, approximately 40 seconds later, lighting the Ready lamp. The spindle motor stops rotating approximately 15 seconds after the switch is set to off position.

When the Remote/Local switch is set to Remote, the spindle motor starts and stops rotating in accordance with the Power Sequence Pick/Hold commands issued from the controller if the Start switch is On.

(2) Protect-On (Switch)

Inhibits Write operation. If a write command is issued from the controller while the switch is On, the Fault and Control Check conditions will be returned to the controller.

(3) Start (LED)

Indicates that the spindle is rotating.

(4) Ready (LED)

Indicates that the spindle has reached the rated speed and no fault condition exists in the drive. It goes off when the heads are seeking to the desired cylinder.

PRELIMINARY

Figure C-12.1

(5) Fault (LED and Switch)

Indicates a Fault condition (i.e., R/W check status) or a Seek Error.
Depressing the indicator switch clears this condition.

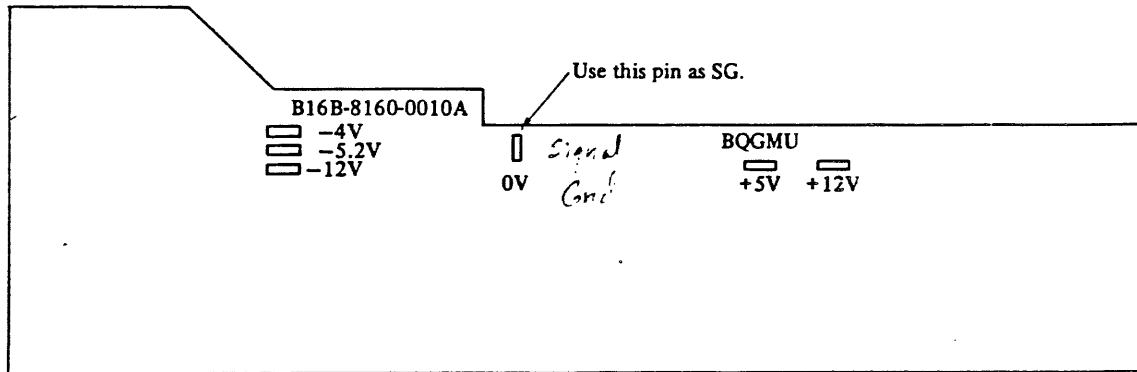
(6) Power On

Indicates that the DC power supply unit is on.

PRELIMINARY

Adjustment of DC Voltages

Check the DC voltages at the check pins of Back Panel (BQGMU) using digital multimeter. The check pins' configuration is shown in Figure 13.9-2. If a DC voltage is out of the acceptable range of Table 13.9-1, readjust the corresponding RV shown in Figure 13.9-1.



Card Cage Backplane

Figure *0-13* Top View of Back Panel

Table *13.1* Acceptable Range of DC Voltages

DC Voltage	Acceptable Range
+12 V	11.4 ~ 12.6 V
+5 V	4.75 ~ 5.25 V
-4 V	-3.8 ~ -4.2 V
-5.2 V	-4.94 ~ -5.46 V
-12 V	-11.4 ~ -12.6 V

Fig 0-13

PRELIMINARY