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**CDC® FIXED STORAGE DRIVE**

**PA5G1/PA5G2**

**PA5J1/PA5J2**

**PA5N1/PA5N2**

**PA5Z1/PA5Z2**

**GENERAL DESCRIPTION**

**OPERATION**

**INSTALLATION AND CHECKOUT**

**PARTS DATA**

---

**Volume 1**

**HARDWARE MAINTENANCE MANUAL**

## WARNING

Always observe the following when installing, operating, and maintaining this unit.

- This drive must be connected to a power distribution system that has a direct connection to earth ground (TT network).
- When the drive is mounted in an equipment rack or cabinet, be certain that the internal temperature of the rack or cabinet does not exceed the limits defined in this manual. Where units are stacked vertically, pay special attention to the top, where temperatures are usually highest.
- To ensure the integrity of safety features built into the drive, installation and maintenance must be performed only by qualified service personnel using designated CDC/MPI parts.
- In case of fire or other emergency, isolate the drives from main power by disconnecting the drive power plugs from their site power receptacles. In situations where pulling the plugs is not possible or practical, use the system main power disconnect to isolate the drives from main power.

## ACHTUNG

Folgendes ist bei Installation, Bedienung und Wartung des Geraetes unbedingt zu beachten:

- Dieses Laufwerk muss an ein Spannungsversorgungssystem angeschlossen werden, welches direkt nach Erde verbunden ist (TT Spannungsversorgungssystem).
- Wenn das Laufwerk in einem Geraeteinschub oder Gehaeuse montiert ist, versichern Sie sich, dass die Temperatur im Einschub oder Gehaeuse die in diesem Handbuch festgelegten Werte nicht ueberschreitet. Sind Geraete uebereinander angeordnet, achten Sie besonders auf das obere Geraet, da dort die Temperatur gewoehnlich am hoechsten ist.
- Um die Zuverlaessigkeit der im Laufwerk eingebauten Sicherheitseinrichtungen zu gewaehrleisten, darf die Installation und Wartung des Geraetes nur von qualifiziertem Wartungspersonal unter Verwendung von Original-CDC/MPI-Ersatzteilen durchgefuehrt werden.
- Bei Ausbrechen von Feuer oder in anderen Notfaellen ist die Verbindung zum Hauptstromnetz durch das Ziehen des Netzsteckers aus der Steckdose zu unterbrechen. Sollte dies nicht moeglich oder unpraktisch sein, so ist der Hauptstromunterbrecher des Systems zu bedienen, um die Laufwerke vom Hauptstromnetz zu trennen.

## WARNING

This equipment generates, uses and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of the FCC Rules which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference.



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**Volume 1**

**HARDWARE MAINTENANCE MANUAL**

## REVISION RECORD

REVISION	DESCRIPTION
01 (08-10-83)	Preliminary release.
02 (09-30-83)	Preliminary manual updated with technical and editorial changes. This edition obsoletes all previous editions.
A (11-01-83)	Original release.
B (01-31-84)	Manual revised to incorporate the following series code 01/02 changes: ECOs DJ05611, DJ05655, DJ05642, technical changes, and editorial changes.
C (05-04-84)	Manual revised to incorporate the following series code 03/04 changes: ECOs DJ05681, DJ05684, DJ05751, DJ05752, technical changes, and editorial changes. This edition obsoletes all previous editions.
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E (02-22-85)	Manual revised to incorporate the following series code 07/08/09 changes: Class 1 ECOs DJ05851, DJ05879, DJ05905, DJ05989, DJ30000, DJ30014, FCO DJ05989, Class 2 ECOs DJ03715, DJ05899, DJ05961, DJ08190, DJ30010, DJ30018, DJ30031, DJ30040, technical changes, and editorial changes.

REVISION LETTERS I, O, Q  
AND X ARE NOT USED.

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manual to:

Control Data Corporation  
Technical Publications Dept.  
5950 Clearwater Drive  
Minnetonka, MN 55343  
or use Comment Sheet in the back  
of this manual.

## REVISION RECORD (Contd)

REVISION	DESCRIPTION
<p style="text-align: center;">F (10-25-85)</p>	<p>Incorporated the following series code 10/11/12/13 changes: Class 1 ECOs DJ30016, DJ30028, DJ30046, DJ30056, DJ30112, DJ30154, DJ30170, DJ30196, DJ30210, Class 2 ECOs DJ03833, DJ08262, DJ28036, DJ28053, DJ30021, DJ30030, DJ30061, DJ30099, DJ30100, DJ30111, DJ30115, DJ30123, DJ30131, DJ30161, DJ30166, DJ30175, DJ30180, DJ30205, DJ30207, technical changes, and editorial changes. Added SMD-E interface information. This edition obsoletes all previous editions.</p>
<p style="text-align: center;">G (01-10-86)</p>	<p>Incorporated the following series code 12 and 13 changes: class 1 ECO DJ30240, class 2 ECOs DJ30236, DJ30249, DJ30257, DJ30265, DJ30266, DJ30276, DJ30279, DJ30282, technical changes and editorial changes. Added 300 MB drive information. This edition obsoletes all previous editions.</p>
<p style="text-align: center;">H (07-18-86)</p>	<p>Incorporated the following series code 14 and 15 changes: class 1 ECOs DJ30296, DJ30297, DJ30308, DJ30337, DJ30350, DJ30365, DJ30378, FCOs DJ30014, DJ30102, class 2 ECOs DJ30283, DJ30334, DJ30338, DJ30348, DJ30412, DJ30416, technical changes, and editorial changes. This edition obsoletes all previous editions.</p>
<p style="text-align: center;">J (10-31-86)</p>	<p>Incorporated the following series code 16 and 17 changes: class 1 ECOs DJ30420, DJ30435, DJ30462, DJ30463, class 2 ECOs DJ30437, DJ30441, DJ30450, DJ30466, DJ30473, DJ30484, technical changes, and editorial changes.</p>
<p style="text-align: center;">K (03-09-87)</p>	<p>Incorporated the following series code 17, 18, and 19 changes: Class 1 ECOs DJ30336, DJ30476, DJ30477, DJ30493, DJ30506, DJ30507, Class 2 ECOs DJ30488, DJ30492, DJ30520, DJ30521, DJ30554, DJ30563, technical changes, and editorial changes. This edition obsoletes all previous editions.</p>
<p style="text-align: center;">L (07-02-87)</p>	<p>Incorporated the following series 18 and 19 changes: Class 1 ECOs DJ30588, DJ30603, DJ30643, DJ30646, Class 2 ECO DJ30670, technical changes, and editorial changes.</p>

## MANUAL TO EQUIPMENT LEVEL CORRELATION

This manual reflects the equipment configurations listed below.

EXPLANATION: Locate the equipment type and series code number, as shown on the Equipment Configuration Log, in the list below. Immediately to the right of the series code number is an FCO number. If that number and all of the numbers underneath it match all of the numbers on the Equipment Configuration Log, then this manual accurately reflects the equipment.

This correlation sheet also applies to the following related manuals:

Pub. No. 83324770 Rev. D

Pub. No. 83325480 Rev. B

Pub. No. 83325530 Rev. B

Pub. No. 83324780 Rev. H

Pub. No. 83325540 Rev. C

EQUIPMENT TYPE	SERIES CODE	WITH FCOs	COMMENTS	
PA5G1/2, PA5J1/2, PA5N1/2, PA5Z1/2	01	None		
	02	05751		
	03	None		
	04	None		
	05	None		
	06	None		
	07	None		
	08	05989		
	09	30014	Applies to PA5G1A/B/C/D/ G/K, PA5G2A/B/D/E/G/K, PA5N1A/B/C/E/F/G, PA5N2A/ B/C/F/G only.	
			30102	Applies to PA5N1D, PA5N2D/E/H only.
		10	None	
	11	30197	Applies to all drives (except PA5N1D, PA5N2D/E) series code 08-11 only.	
		30199	Applies to PA5N1D, PA5N2D/E, series code 08-11 only.	
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## MANUAL TO EQUIPMENT LEVEL CORRELATION (Contd)

EQUIPMENT TYPE	SERIES CODE	WITH FCOs	COMMENTS
PA5G1/2.	12	None	
PA5J1/2.	13	None	
PA5N1/2.	14	None	
PA5Z1/2	15	None	
	16	None	
	17	None	
	18	None	
	19	None	
	20	None	

# LIST OF EFFECTIVE PAGES

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## PREFACE

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This manual contains maintenance information for the CONTROL DATA® PA5G1/PA5G2, PA5J1/PA5J2, PA5N1/PA5N2, and PA5Z1/PA5Z2 Fixed Storage Drives (FSDs). It provides instructions to all personnel who operate the FSD and to customer engineers who install and check out the FSD. Customer engineers who troubleshoot and repair FSDs should obtain copies of the Hardware Maintenance Manual, Volumes 2 and 3 (listed below) that pertain to the drives they are maintaining.

The information in this manual is presented as follows:

- Section 1 - General Description. Describes equipment functions and specifications.
- Section 2 - Operation. Describes and illustrates the location and use of all controls and indicators, and provides operating procedures.
- Section 3 - Installation and Checkout. Describes site requirements, unpackaging and inspection, installation and checkout.
- Section 4 - Parts Data. Contains illustrated parts breakdown and spare parts list.
- Appendix A - Diagnostic Testing and Status Code Summary. Contains simplified troubleshooting information.

The following manuals apply to the FSD and are available from Control Data Corporation, Literature Distribution Services, 308 North Dale Street, St. Paul, MN 55103:

<u>Publication No.</u>	<u>Title</u>
83324760	PA5G1/PA5G2, PA5J1/PA5J2, PA5N1/PA5N2, and PA5Z1/PA5Z2 Hardware Maintenance Manual, Volume 1
83324770	PA5G1/PA5G2 and PA5N1/PA5N2 Hardware Maintenance Manual, Volume 2 (contains SMD-0 theory of operation and maintenance)

<u>Publication No.</u>	<u>Title</u>
83325480	PA5G2G, PA5N2C, PA5N2D, and PA5Z1/PA5Z2 Hardware Maintenance Manual, Volume 2 (contains SMD-E theory of operation and maintenance)
83325530	PA5J1/PA5J2 Hardware Maintenance Manual, Volume 2 (contains theory of operation and maintenance)
83324780	PA5G1/PA5G2, PA5N1/PA5N2, and PA5Z1/PA5Z2 Hardware Maintenance Manual, Volume 3 (contains diagrams)
83325540	PA5J1/PA5J2 Hardware Maintenance Manual, Volume 3 (contains diagrams)
83325440	RSD/FSD Power Supply Diagrams Manual (contains power supply diagrams, which are intended for reference use only)
83325450	Special Supplement (applies to PA5Z2C)
83325320	A Guide for the Disk Drive Operator
83325360	Reference Card (provides status code and diagnostics information)
83322440	CDC Microcircuits, Volume 1 (provides functional descriptions for integrated circuits)
83324440	CDC Microcircuits, Volume 2 (provides functional descriptions for integrated circuits)

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## IMPORTANT SAFETY INFORMATION AND PRECAUTIONS

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Proper safety and repair is important to the safe, reliable operation of this unit. Service should be done by qualified personnel only. This maintenance manual describes procedures recommended by the manufacturer as effective methods of servicing the unit. Some of these procedures require the use of specially designed tools. For proper maintenance and safety, these specially designed tools should be used as recommended.

The procedures in this maintenance manual and labels on the unit contain warnings and cautions which must be carefully read and observed in order to minimize or eliminate the risk of personal injury. The warnings point out conditions or practices that are potentially hazardous to maintenance personnel. The cautions point out practices which, if disregarded, could damage the unit and make it unsafe for use.

For the safety of maintenance and operating personnel, the following precautions must be observed:

- Perform all maintenance by following the procedures given in this manual and using only CDC/MPI replacement parts.
- Read and observe all cautions and warnings provided in the procedures and labeled on the unit.
- Use the special tools called out in the maintenance procedures.
- Observe sound safety practices when performing maintenance.
- Use caution when troubleshooting a unit that has voltages present. Remove power from unit before servicing or replacing components.
- Wear safety glasses when servicing units.
- Wear safety shoes when removing or replacing heavy components.

It is also important to understand that these warnings and cautions are not exhaustive. The manufacturer could not possibly know, evaluate and advise maintenance personnel of all conceivable ways in which maintenance might be performed or the possible risk of each maintenance technique. Consequently, the manufacturer has not completed any such broad evaluation. Thus, any persons who use any non-approved maintenance procedure or tool must first satisfy themselves that neither their safety nor the unit performance will be jeopardized by the maintenance techniques they select.

## CONFIGURATION CHART

EQUIPMENT NUMBER*	INTERFACE	DATA CAPACITY (MB)	POWER SUPPLY
PA5G1A	SMD-0 -- Single Channel	340	Remote
PA5G1B	SMD-0 -- Single Channel	340	Remote
PA5G1C	SMD-0 -- Single Channel	340	Remote
PA5G1D	SMD-0 -- Single Channel	340	Integral
PA5G1G	SMD-0 -- Single Channel	340	Integral
PA5G1K	SMD-0 -- Single Channel	340	Remote
PA5G1L	SMD-0 -- Single Channel	340	Integral
PA5G1M	SMD-0 -- Single Channel	340	Integral
PA5G1N	SMD-0 -- Single Channel	340	Integral
PA5G1R	SMD-0 -- Single Channel	340	Integral
PA5G1S	SMD-0 -- Single Channel	340	Integral
PA5G1T	SMD-0 -- Single Channel	340	Integral
PA5G2A	SMD-0 -- Dual Channel	340	Remote
PA5G2B	SMD-0 -- Dual Channel	340	Remote
PA5G2D	SMD-0 -- Dual Channel	340	Integral
PA5G2E	SMD-0 -- Dual Channel	340	Integral
PA5G2G	SMD-E -- Dual Channel	340	Integral
PA5G2J	SMD-0 -- Single Channel	340	Integral
PA5G2K	SMD-0 -- Dual Channel	340	Remote
PA5G2M	SMD-0 -- Dual Channel	340	Integral
PA5J1A	SMD-0 -- Single Channel	300	Remote
PA5J1B	SMD-0 -- Single Channel	300	Integral
PA5J1C	SMD-0 -- Single Channel	300	Integral
PA5J1D	SMD-0 -- Single Channel	300	Integral
PA5J2A	SMD-0 -- Dual Channel	300	Remote
PA5J2B	SMD-0 -- Dual Channel	300	Integral
PA5N1A	SMD-0 -- Single Channel	515	Remote
PA5N1B	SMD-0 -- Single Channel	515	Integral
PA5N1C	SMD-0 -- Single Channel	515	Integral
PA5N1D	SMD-0 -- Single Channel	515	Integral
PA5N1E	SMD-0 -- Single Channel	515	Integral
PA5N1F	SMD-0 -- Single Channel	515	Remote
PA5N1G	SMD-0 -- Single Channel	515	Integral
PA5N1H	SMD-0 -- Single Channel	515	Integral
PA5N2A	SMD-0 -- Dual Channel	515	Remote
PA5N2B	SMD-0 -- Dual Channel	515	Integral
PA5N2C	SMD-E -- Dual Channel	515	Integral
PA5N2D	SMD-E -- Dual Channel	515	Integral
PA5N2E	SMD-0 -- Dual Channel	515	Integral

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## CONFIGURATION CHART (Contd)

EQUIPMENT NUMBER*	INTERFACE	DATA CAPACITY (MB)	POWER SUPPLY
PA5N2F	SMD-0 -- Dual Channel	515	Remote
PA5N2G	SMD-0 -- Dual Channel	515	Integral
PA5N2K	SMD-0 -- Dual Channel	515	Integral
PA5Z1A	SMD-E -- Single Channel	515	Remote
PA5Z1B	SMD-E -- Dual Channel	515	Integral
PA5Z1C	SMD-E -- Single Channel	515	Integral
PA5Z2A	SMD-E -- Dual Channel	515	Remote
PA5Z2B	SMD-E -- Dual Channel	515	Integral
PA5Z2C	SMD-E -- Dual Channel	515	Integral
PA5Z2D	SMD-E -- Dual Channel	515	Integral

\* Refer to Section 4 for equipment package listings that include painted parts and other supplied options.

## ABBREVIATIONS

---

A	Ampere	CLK	Clock
ABV	Above	CLR	Clear
ac	Alternating Current	cm	Centimetre
ADD	Address	CNTR	Counter
ADDR	Address	COMP	Comparator
ADJ	Adjust	CONT	Control
ADRS	Address	CONTD	Continued
AGC	Automatic Gain Control	CT	Center Tap
ALT	Alternate	CYL	Cylinder
AM	Address Mark	D/A	Digital to Analog
AME	Address Mark Enable	dc	Direct Current
AMP	Amplifier, Ampere	DET	Detect
ASSY	Assembly	DIFF	Differential
BLW	Below	DIV	Division
C	Celsius	DLY	Delay
CB	Circuit Breaker	DRVR	Driver
CDA	Complete Drive Assembly	ECL	Emitter Coupled Logic
CDC	Control Data Corporation	ECO	Engineering Change Order
CH	Channel	EN	Enable
CHK	Check	ENBL	Enable

## ABBREVIATIONS (Contd)

---

EXT	External	IND	Index
F	Fahrenheit, Fuse	INTRPT	Interrupt
FCO	Field Change Order	I/O	Input/Output
FDBK	Feedback	IPB	Illustrated Parts Breakdown
FIG	Figure	IPS	Inches per Second
FLT	Fault	kg	Kilogram
FRU	Field Replaceable Unit	kPa	Kilopascal
FSD	Fixed Storage Drive	kW	Kilowatt
ft	Foot	lb	Pound
FTU	Field Test Unit	lbf	Pounds-Force
FWD	Forward	LED	Light Emitting Diode
GND	Ground	LSI	Large Scale Integration
HD	Head	LTD	Lock to Data
HEX	Hexagon	m	Metre
Hg	Mercury	MAX	Maximum
HR	High Resolution	MB	Megabyte
HYST	Hysteresis	MEM	Memory
Hz	Hertz	MHz	Megahertz
IC	Integrated Circuit	mm	Millimetre
IDENT	Identification	MPI	Magnetic Peripherals, Inc.
in	Inch		

## ABBREVIATIONS (Contd)

---

MPU	Microprocessor Unit	PS	Power Supply
MRK	Mark	PWR	Power Supply
ms	Millisecond	RCVR	Receiver
MTR	Motor	RD	Read
mV	Millivolt	RDY	Ready
N	Newton	REF	Reference
NC	No Connection	REQ	Request
NORM	Normal	RES	Resolution
NRZ	Non Return to Zero	REV	Reverse, Revision
ns	Nanosecond	RGTR	Register
OC	On Cylinder	r/min	Revolutions Per Minute
OS	One-Shot	RTZ	Return to Zero
OSC	Oscillator	R/W	Read/Write
P	Plug	s	Second
PD	Peak Detect	S/C	Series Code
pF	Picofarad	SEC	Second
PG	Page	SEL	Select
PHH	Phillips Head	SEQ	Sequence
PLO	Phase Lock Oscillator	SPD	Speed
PROC	Procedure	SS	Sector Switch
PROG	Programmable	T	Tracks to go

## ABBREVIATIONS (Contd)

---

TF	Thread Forming	W/	With
TIM	Timer	W/O	Without
TP	Test Point	W PROT	Write Protect
TSP	Troubleshooting Procedure	W+R	Write or Read
TTL	Transistor-Transistor Logic	W·R	Write and Read
		WRT	Write
V	Volts, Voltage	XFR	Transfer
Vbb	Bias Voltage	Ω	Ohms
VCC	Bias Voltage	\$	Hexadecimal Address
VCO	Voltage Controlled Oscillator	uF	Microfarad
		us	Microsecond
W	Watts		



## **SECTION 1**

### **GENERAL DESCRIPTION**

---

## INTRODUCTION

The Control Data PA5G1/PA5G2, PA5J1/PA5J2, PA5N1/PA5N2, and PA5Z1/PA5Z2 Fixed Storage Drives (FSDs) are high speed, random access digital data storage devices that connect to a central processor through a controller. All the equipment specifications for the drives are listed in table 1-1.

The remainder of this section provides a general description of the drives and is divided into the following areas:

- Equipment Interface Description -- Describes available drive interfaces.
- Equipment Functional Description -- Explains the basic function of the drive.
- Equipment Physical Description -- Provides a basic description of the drive's physical characteristics.
- Equipment Configuration -- Describes the various drive configurations and how to identify them.

## EQUIPMENT INTERFACE DESCRIPTION

The drive can be configured to operate with either a standard (SMD-0) or an enhanced (SMD-E) interface. Refer to section 3 of this manual for definitions of signals on the interface cables (under Interface Requirements). Section 3 also contains instructions on selecting the various interface options available (under Setting Circuit Board Switches). Refer to volume 2 of the hardware maintenance manual for a complete description of interface functions.

## EQUIPMENT FUNCTIONAL DESCRIPTION

The drive contains all the circuits and mechanical devices necessary to record data on and recover it from its disks. The necessary power for this is provided by the power supply, which receives its input power from the site main power source.

TABLE 1-1. DRIVE SPECIFICATIONS

Characteristics	Conditions	Specifications
<b>PHYSICAL</b>		
<b>Size</b>	<b>Dimensions</b>	See Space Requirements in section 3
	Weight (Drive only)	31.7 kg (70.0 lb)
	Weight (Power Supply only)	5.4 kg (12.0 lb)
<b>Interface</b>		See configuration chart in front of manual
<b>Recording</b>	<b>Total Capacity (Unformatted)</b>	
	PA5G1/PA5G2	340 megabytes
	PA5J1/PA5J2	300 megabytes
	PA5N1/PA5N2, PA5Z1/PA5Z2	515 megabytes
	<b>Bytes per track</b>	
	300/340 MB Drives	20 160 bytes
	515 MB Drives	30 240 bytes
	<b>Number of disks</b>	7
	<b>Movable data heads</b>	
	300 MB Drives	19
	340/515 MB Drives	24
	<b>Servo Heads</b>	1
	<b>Tracks per inch</b>	
	300 MB Drives	1040
	340/515 MB Drives	960
	<b>Physical heads per surface</b>	2
	<b>Logical cylinders per head/disk assy</b>	
	300 MB Drives	823 (0-822)
	340/515 MB Drives	711 (0-710)
	<b>Modulation</b>	
	300/340 MB Drives	<b>MFM</b>
	515 MB Drives	2-7 code
Table Continued on Next Page		

TABLE 1-1. DRIVE SPECIFICATIONS (Contd)

Characteristics	Conditions	Specifications
PHYSICAL (Contd)		
Recording (Contd)	Density (inner track) 300 MB Drives 340 MB Drives 515 MB Drives	10 430 bits per inch 9492 bits per inch 15 040 bits per inch
PERFORMANCE		
Transfer rate	Disk speed at 3600 r/min 300/340 MB Drives  515 MB Drives	9.677 MHz (1.2 megabytes/sec)  14.52 MHz (1.8 megabytes/sec)
Latency	Average  Maximum	Latency is time to reach a particular track address after positioning is complete.  8.33 milliseconds (disk rotation speed at 3600 r/min)  16.83 milliseconds (disk rotation speed at 3564 r/min)
Seek Time	Full 300 MB Drives  340/515 MB Drives  Average 300 MB Drives 340/515 MB Drives  Single Track	45 milliseconds maximum  40 milliseconds maximum  21 milliseconds 19 milliseconds  5 milliseconds maximum
Start Time		35 seconds typical 45 seconds maximum
Stop Time		35 seconds typical 45 seconds maximum

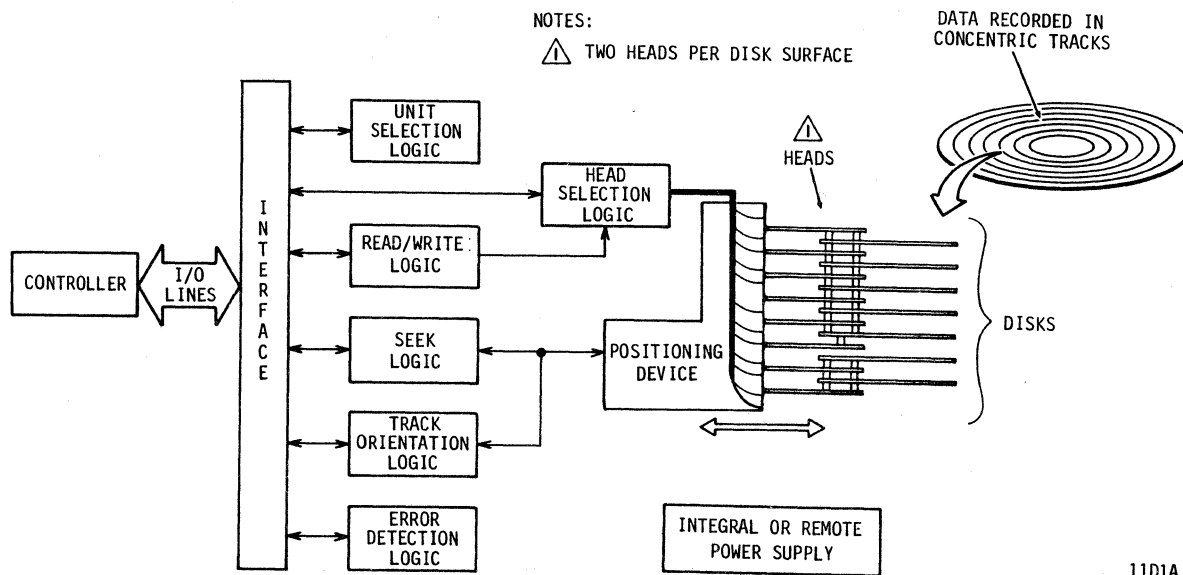
All functions performed by the drive are done under direction of the controller. The controller communicates with the drive via the interface which consists of a number of I/O lines carrying the necessary signals to and from the drive.

Some interface lines, including those that carry commands to the drive, are not enabled unless the drive is selected by the controller. Unit selection allows the controller, which can be connected to more than one drive, to initiate and direct an operation on a specific drive.

All operations performed by the drive are related to data storage and recovery (normally referred to as writing and reading). The actual reading and writing is performed by electromagnetic devices called heads that are positioned over the recording surfaces of the rotating disks. There are two heads for each disk surface, and the heads are positioned in such a way that data is written in concentric tracks around the disk surfaces (see figure 1-1).

Before any read or write operation can be performed, the controller must instruct the drive to position the heads over the desired track (called seeking) and also to use the head located over the surface (head selection) where the operation is to be performed.

After selecting a head and arriving at the data track, the controller still must locate that portion of the track on which the data is to be written or read. This is called track orientation.



11D1A

Figure 1-1. Drive Functional Block Diagram

tation and is done by using the Index and Sector signals generated by the drive. The Index signal indicates the logical beginning of each track, and the Sector signals are used by the controller to determine the position of the head on the track with respect to Index.

When the desired location is reached, the controller commands the drive to actually read or write the data. During a read operation, the drive recovers data from the disks and transmits it to the controller. During a write operation, the drive receives data from the controller, processes it and writes it on the disks.

The drive is also capable of recognizing certain errors that may occur during its operation. When an error is detected, it is indicated either by a signal to the controller or by a maintenance indicator on the drive itself.

## **EQUIPMENT PHYSICAL DESCRIPTION**

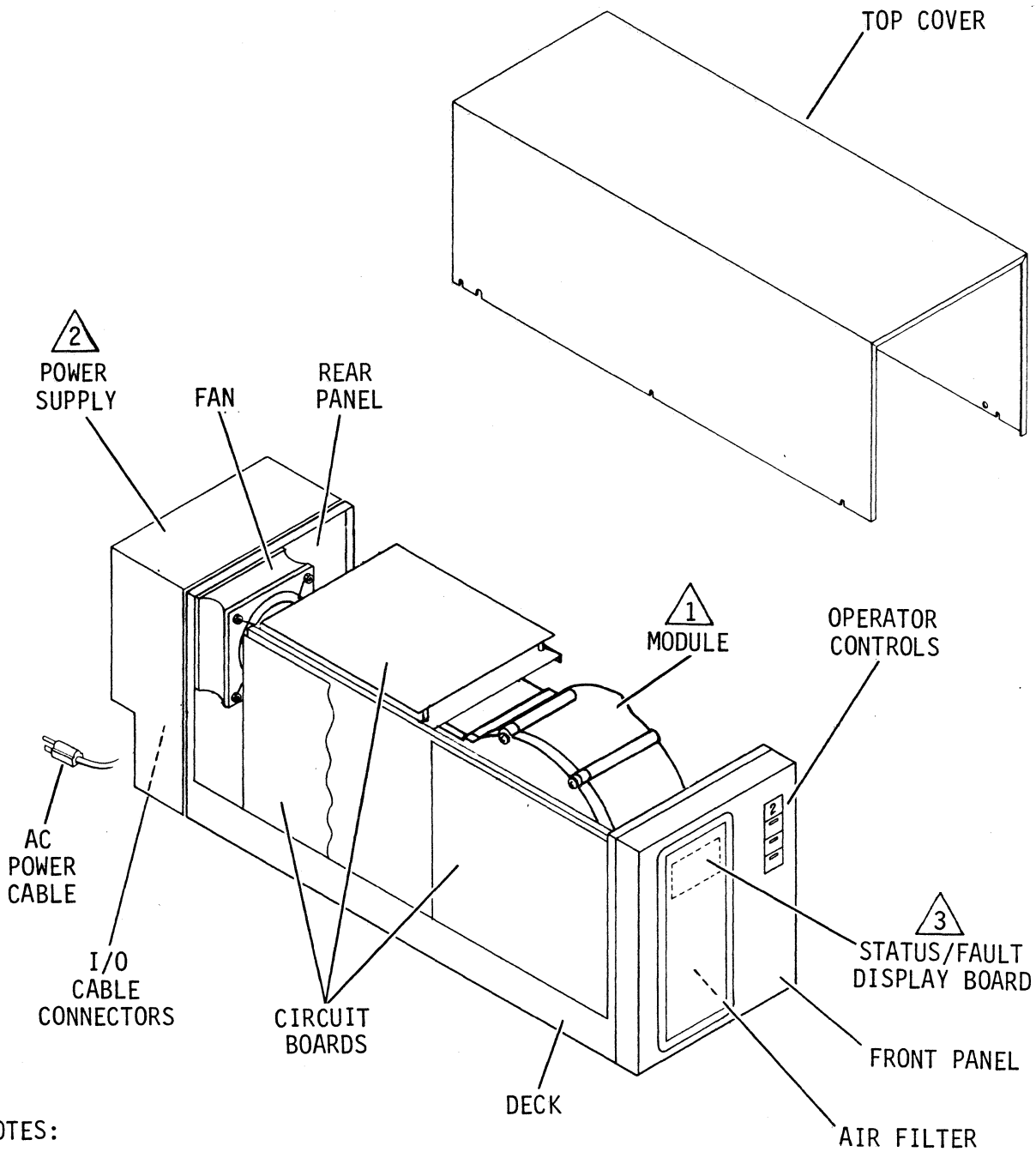
The following paragraphs provide a physical description of the drive. The components mentioned in this discussion are identified in figure 1-2.

A drive installation requires a drive, interconnecting cabling, and a power supply. Site power enters the power supply via the ac power cable. The power supply develops the dc voltages required by the drive. These voltages are supplied to the drive by the dc power cable.

The drive package includes a deck, front and rear panels, and a top cover. Air flow is provided by a fan, mounted on the rear panel, to circulate cooling air around the electronic assemblies. This air enters a port in the front panel, passes through an air filter, and exhausts through the rear panel opening.

The drive front panel contains the operator controls and a Fault Display board (located behind front panel insert and filter). The operator controls consist of the logic plug and all switches and indicators used by the operator to control normal operation of the drive.

The drive's internal components include a set of circuit boards and a module. The circuit boards are interconnected through a mother board, and they contain the electronics required for drive operation. The module is a sealed unit containing the electromechanical components used for data storage and retrieval. These components include the disks, spindle, drive motor, actuator, and heads.



NOTES:

- ① MODULE CONTAINS THE DISKS, SPINDLE, DRIVE MOTOR, ACTUATOR, AND HEADS.
- ② SHOWN WITH INTEGRAL POWER SUPPLY. A REMOTE POWER SUPPLY IS ALSO AVAILABLE.
- ③ LOCATED BEHIND FRONT PANEL INSERT.

11D5B

Figure 1-2. Drive Major Assemblies

The seven disks provide the recording medium for the drive. These disks are center-mounted on a spindle, and the spindle is coupled directly to the drive motor. When activated, the drive motor rotates the disks at 3600 r/min and also produces a circulation of air within the sealed module.

The actuator is the assembly that holds the heads and moves the heads over the rotating disks. There are 25 (20 on 300 MB drives) heads; a servo head to control actuator positioning, and 24 (19 on 300 MB drives) data heads used for data transfers to and from the disks. The actuator has a voice coil which moves in and out of a permanent magnetic field in response to signals from the servo positioning circuitry. The voice coil forces the actuator carriage to roll on parallel rails to move the heads accurately across the disk surfaces. When the drive is not in use, the heads rest on the disk surface in the pre-assigned landing zone (beyond the data zone in the outer area of the disk surface). The actuator is automatically latched in this position, at shutdown, for moving or shipping protection. When the drive is activated to bring the disks up to speed, the heads fly on a cushion of air close to the disk surface.

A complete listing of field-replaceable parts is given in the parts data section of this manual. Refer to volume 2 of the hardware maintenance manual for theory of operation of the drive components.

## **EQUIPMENT CONFIGURATION**

### **GENERAL**

The equipment configuration is identified by the equipment identification label and by the Equipment Configuration Log. It is necessary to identify the equipment configuration to determine if the manuals being used are applicable to the equipment. The following describes the equipment identification label, Equipment Configuration Log, and Manual To Equipment Level Correlation Sheet.

### **EQUIPMENT IDENTIFICATION**

#### **General**

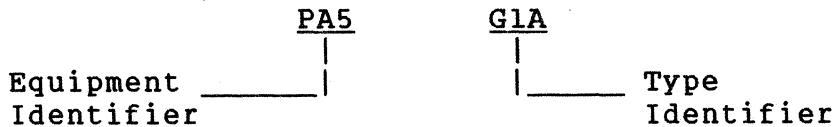
The equipment is identified by labels attached to the drive and to the power supply. The label on the drive identifies the basic mechanical and logical configuration of the drive at the time it leaves the factory. The label on the power supply references the components making up the drive installation and lists the site power requirements for the power supply. The information contained on these labels is defined in the following paragraphs.



## Equipment Identification Number

The equipment identification number is divided into the two parts shown in the example:

EXAMPLE:



The equipment identifier indicates the basic functional capabilities of the drive.

The type identifier indicates differences between drives that have the same equipment identifier. These differences are necessary to adapt a drive to specific system requirements. However, they do not change the overall capabilities of the drive as defined in table 1-1.

The standard drive has single channel access. An option is available that gives the drive dual channel access. Single channel drives can connect to and communicate with one controller. Dual channel drives can connect to and communicate with two controllers.

## Series Code

The series code represents a time period within which a unit is built. All units are interchangeable at the system level, regardless of series code; however, parts differences may exist within units built in different series codes. When a parts difference exists, that difference is noted in the parts data section of this manual.

## Part Number

The equipment identification label on the power supply lists three numbers: the equipment package part number, the CDA number, and the power supply number. The equipment package part number is the number assigned to the complete unit including drive, power supply (if applicable), painted panels, installation hardware, etc. If the drive has an integral power supply, the CDA part number is the number assigned to the drive and power supply as one unit. On units with a remote power supply or no power supply, the CDA part number is the number assigned to the drive only. The power supply number is the part number for the power supply only.

## **Serial Number**

Each drive has a unique serial number assigned to it. Serial numbers are assigned sequentially within a family of drives. Therefore, no two equipments will have the same serial number.

## **EQUIPMENT CONFIGURATION LOG**

Engineering Change Orders (ECOs) are electrical or mechanical changes that are performed at the factory and may cause a series code change. When the factory installs an ECO early (prior to a series code change), it is logged on the units configuration log.

Field Change Orders (FCOs) are electrical or mechanical changes that may be performed either at the factory or in the field. FCO changes do not affect the series code but are indicated by an entry on the Equipment Configuration Log that accompanies each machine. The components of a machine with an FCO installed may not be interchangeable with those of a machine without the FCO; therefore, it is important that the Equipment Configuration Log be kept current by the person installing the FCO.

## **MANUAL TO EQUIPMENT LEVEL CORRELATION**

Throughout the life cycle of a machine, changes are made, either in the factory build (a series code change) or by FCOs installed in the field. All of these changes are also reflected in changes to the manual package. In order to assure that the manual correlates with the machine, refer to the manual to equipment level correlation sheet located in the front matter of this manual. This sheet records all the FCOs which are reflected in the manual. It should correlate with the machine Equipment Configuration Log if all the FCOs have also been installed in the machine.

## **SECTION 2**

## **OPERATION**

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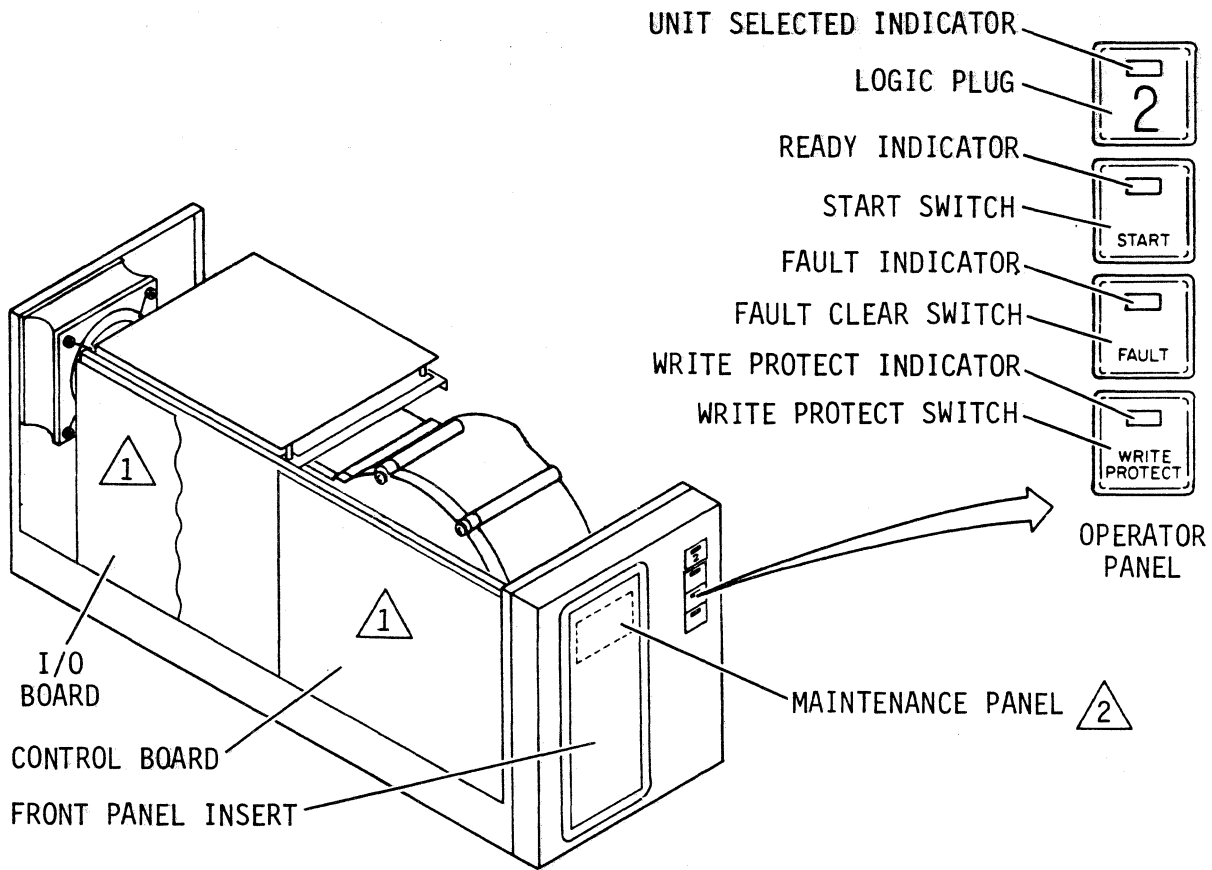
## INTRODUCTION

This section provides the information and instructions to operate the drive. It is arranged as follows:

- Switches and Indicators -- locates and describes the switches and indicators used for normal drive operation.
- Power On Procedure -- describes how to turn on the drive.
- Power Off Procedure -- describes how to turn off the drive.
- Filter Replacement and Cleaning -- describes filter maintenance for the drive operator.

## SWITCHES AND INDICATORS

Switches and indicators used by the operator are on the power supply and on the drive operator panel. Figure 2-1 shows these switches and indicators, and they are described in table 2-1. Refer to section 3 and to appendix A for information on switches that are not normally used by the drive operator.

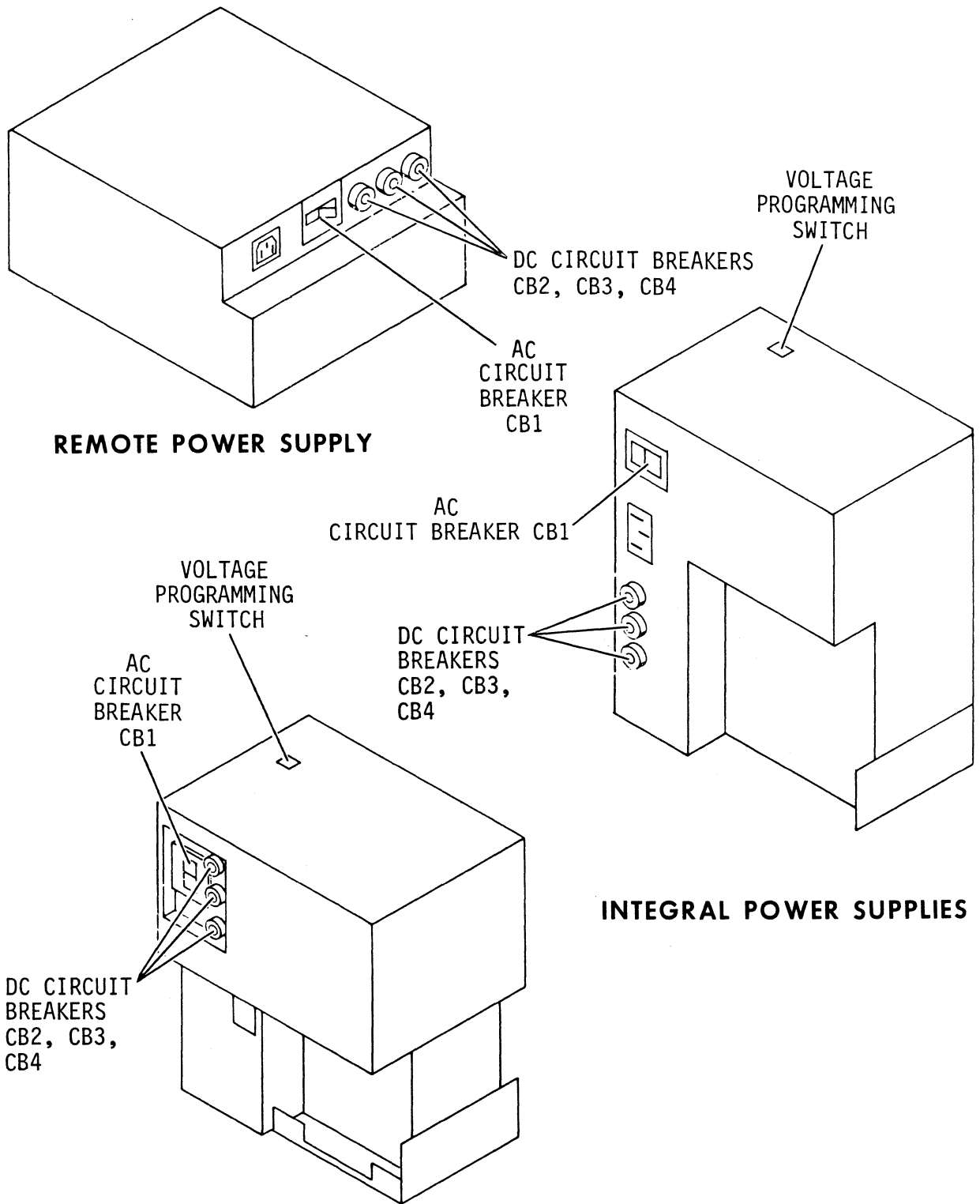


NOTES:

- △ 1 SWITCHES LOCATED ON CIRCUIT BOARDS ARE EXPLAINED IN SECTION 3.
- △ 2 MAINTENANCE PANEL IS LOCATED BEHIND FRONT PANEL INSERT AND FILTER. REFER TO APPENDIX A FOR OPERATING PROCEDURE.

11D2D

Figure 2-1. Switches and Indicators (Sheet 1 of 2)



11D7 C

Figure 2-1. Switches and Indicators (Sheet 2)

TABLE 2-1. DRIVE SWITCHES AND INDICATORS

Switch or Indicator	Function
POWER SUPPLY	
<p>ON/OFF Circuit Breaker</p> <p>-24 V</p> <p>+24 V</p> <p>-5 V</p>	<p>Applies site ac power to power supply which, in turn, supplies the dc operating voltages to the drive electronics and fan.</p> <p>Protects the -24 V supply. To reset circuit breaker, press in pop-out element.</p> <p>Protects the +24 V supply. To reset circuit breaker, press in pop-out element.</p> <p>Protects the -5 V supply. To reset circuit breaker, press in pop-out element.</p> <p>The +5 and +40 V supplies are protected by current-limiting circuitry in the power supply.</p>
OPERATOR PANEL	
<p>Logic Plug/Unit Selected Indicator</p>	<p>The logic plug activates switches that establish the logical address of the device. Logic plugs are available with numbers 0 through 15 (refer to table 4-3 for part numbers). The Unit Selected indicator is lit if drive is selected.</p>
Table Continued on Next Page	

TABLE 2-1. DRIVE SWITCHES AND INDICATORS (Contd)

Switch or Indicator	Function
OPERATOR PANEL (Contd)	
<p>START Switch/ Ready Indicator</p>	<p>The START switch has alternate action, in for Start and out for Stop, and it contains the Ready indicator. Pressing the START switch to the Start position enables the power on sequence. The Ready indicator flashes until the disks are up to speed, the heads are loaded, and there are no fault conditions. The Ready indicator is on steady with power on complete.</p> <p>Pressing the START switch to release it from the Start position causes the Ready indicator to flash until disk rotation has stopped.</p>
<p>FAULT Indicator/ Fault Clear Switch</p>	<p>The FAULT indicator is inside the Fault Clear switch and lights if certain faults exist within the drive. It is turned off by any of the following (provided that the fault condition(s) no longer exist):</p> <ul style="list-style-type: none"> <li>• Pressing the Fault Clear switch</li> <li>• Fault Clear command from the controller</li> <li>• A drive power on operation</li> </ul>
<p>WRITE PROTECT Switch/Indicator</p>	<p>Places the drive in the WRITE PROTECT mode (preventing write operations) and lights the WRITE PROTECT indicator. The WRITE PROTECT indicator must be off to allow write operations.</p>



## POWER ON PROCEDURE

This procedure describes how to turn on the drive. It is assumed that dc power is available to the drive because power supply circuit breaker CBl is normally left in the ON position.

1. Press START switch to engage it in Start position.
  - If the Local/Remote switch on the I/O board was set in the Local position, the power on sequence begins immediately.
  - If the Local/Remote switch was set in the Remote position, the power on sequence begins when power sequence ground is available from the controller.
2. When the power on sequence begins, the Ready indicator (located in START switch) flashes, indicating that power on is in progress.
3. Observe that Ready indicator lights steadily within 30 seconds, indicating that disks are up to speed and heads are loaded.
4. Ensure that FAULT indicator is off.

The power on sequence is now complete, and the drive is ready to receive commands from the controller.

## POWER OFF PROCEDURE

This procedure describes how to turn off the drive.

1. Press START switch to release it from Start position.
2. Observe that Ready indicator (located in START switch) flashes, indicating that power off is in progress.
3. Observe that Ready indicator goes off within 45 seconds, indicating that power off is complete.

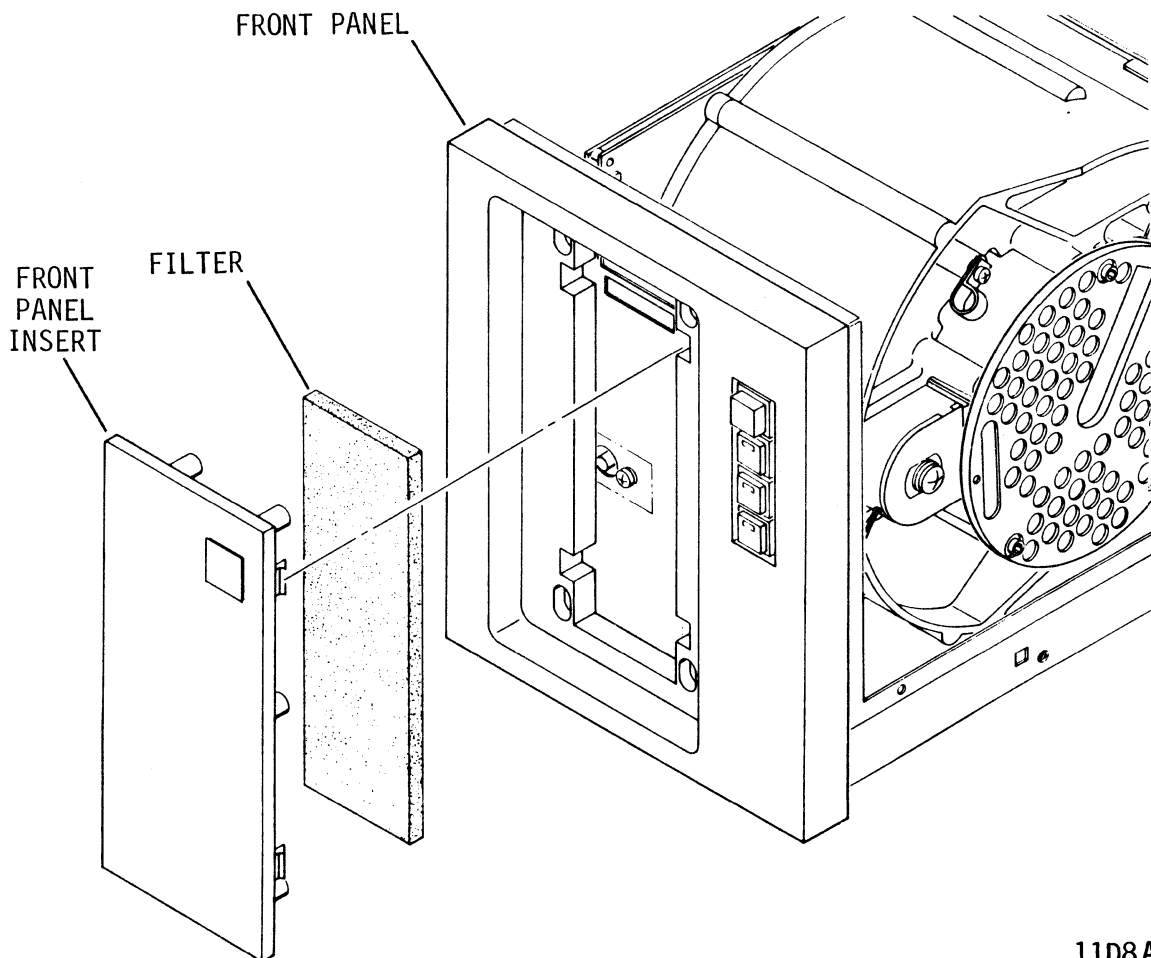
With power off complete, the heads are positioned and locked in the landing zone and the disks are not rotating. Normally, power supply circuit breaker CBl is left ON to continue supplying dc power to the drive.

## FILTER REPLACEMENT AND CLEANING

The air filter is located behind the front panel insert (see figure 2-2). To gain access to the filter, you must remove the front panel insert by pulling it forward.

Check the air filter periodically to ensure that it is clean. It should be replaced about every six months in a computer room environment; replace it more often in dirtier locations.

Replace the filter if a new one is available. If it is not available, clean it by washing in a solution of water and mild detergent. Rinse thoroughly and install when the filter is dry.



11D8A

Figure 2-2. Air Filter Replacement

## **SECTION 3**

### **INSTALLATION AND CHECKOUT**

---

## INTRODUCTION

The information contained in this section describes installation and initial checkout of the drive.

## SITE REQUIREMENTS

### GENERAL

The site requirements considered are electrostatic discharge protection, environment, space, power, grounding, and interface.

### ELECTROSTATIC DISCHARGE PROTECTION

All drive electronic assemblies are sensitive to static electricity, due to the electrostatically sensitive devices used within the drive circuitry. Although some of these devices such as metal-oxide semiconductors are extremely sensitive, all semiconductors as well as some resistors and capacitors may be damaged or degraded by exposure to static electricity.

Electrostatic damage to electronic devices may be caused by a direct discharge of a charged conductor, or by exposure to the static fields which surround charged objects. To avoid damage to drive electronic assemblies, service personnel must observe the following precautions when servicing the drive:

- Ground yourself to the drive whenever the drive electronics are or will be exposed. Connect yourself to ground with a wrist strap (refer to Accessories in section 4 for part numbers). Connection may be made to any metal assembly or to the ground lug at the rear of the drive. As a general rule, remember that you, the drive, and the circuit boards must all be at ground potential to avoid potentially damaging static discharges.
- Keep boards in conductive bags - when circuit boards are not installed in the drive, keep them in conductive static shielding bags (refer to Accessories in Section 4 for part numbers). These bags provide absolute protection from direct static discharge and from static fields surrounding charged objects. Remember that these bags are conductive and should not be placed where they might cause an electrical short circuit.

- Remove boards from bags only when you are grounded - all boards received from the factory are in static shielding bags, and should not be removed unless you are grounded.
- Turn off power to drive before removing or installing any circuit boards.
- Never use an ohmmeter on any circuit boards.

## ENVIRONMENTAL REQUIREMENTS

All environmental requirements for the drive are listed in table 3-1.

TABLE 3-1. ENVIRONMENTAL REQUIREMENTS

Conditions	Characteristics	Specifications
<b>TEMPERATURE</b>		
Non-Operating (Unpackaged)	Range	-10 to 50°C (14 to 122°F)
	Maximum change per hour	15°C (27°F)
Storage/Transit (Packaged)	Range	-40 to 60°C (-40 to 140°F)
	Maximum change per hour	20°C (36°F)
Operating	Range 300/340 MB Drives	15 to 45°C (59 to 104°F)
	515 MB Drives	10 to 40°C (50 to 104°F)
	Maximum change per hour	10°C (18°F)
Table Continued on Next Page		

TABLE 3-1. ENVIRONMENTAL REQUIREMENTS (Contd)

Conditions	Characteristics	Specifications
<b>RELATIVE HUMIDITY</b>		
Non-Operating (Unpackaged)	Range	10% to 90% (no condensation allowed)
Storage/Transit (Packaged)	Range	5% to 95% (no condensation allowed)
Operating	Range	20% to 80% 10% per hour maximum change (no condensation allowed)
<b>BAROMETRIC PRESSURE (STANDARD DAY)</b>		
Non-Operating (Unpackaged)	Range	-300 m to 3000 m (-983 ft to 10 000 ft) 105 kPa to 69 kPa (31 in Hg to 20 in Hg)
Storage/Transit (Packaged)	Range	-300 m to 3000 m (-983 ft to 10 000 ft) 105 kPa to 69 kPa (31 in Hg to 20 in Hg)
Operating	Range	-300 m to 3000 m (-983 ft to 10 000 ft) 105 kPa to 69 kPa (31 in Hg to 20 in Hg)

### SPACE REQUIREMENTS

The drive slide mounts side-by-side with another drive into a 483 mm (19 in) standard rack. The slide action allows a complete outward extension of either unit for ease of maintenance. The space requirements are shown in figure 3-1.

The combined mass of the drive and power supply is 37.1 kg (82 lb). With both units mounted inline and extended on the slides, the center of gravity is approximately 36 cm (14 in) from the rack front.

## POWER REQUIREMENTS



This unit has a single-phase power supply with a capacitor input filter (sometimes called a switching type supply). If power to the unit originates from a 3-phase, 4-wire, wye branch or feeder circuit, ensure the circuit meets the latest requirements of the United States National Electrical Code. Failure to meet these requirements may result in hazardous conditions due to high currents (and heating) in the neutral conductors and transformers supplying the system.

Drive ac power requirements are listed in table 3-2. Conversion to the different line voltages is explained in the installation procedures. If an ac cord is not supplied with the unit, either order one from CDC (see figure 3-10 and the parts data section) or obtain one commercially per the specifications in table 3-3. Typical drive current versus start-up time is shown in figure 3-2 for 120 and 220/240 volt connections.

TABLE 3-2. POWER REQUIREMENTS

Specifications	VALUES	
	100/120 V ac	208/240 V ac
Voltage Range	87 to 128 V	179 to 256 V
Nominal Line Frequency	50/60 Hz	50/60 Hz
Frequency Range	48.0 to 62.0 Hz	48.0 to 62.0 Hz
Phase Requirements	Single Phase	Single Phase
Power Consumed*		
Integral Pwr Sup	0.225 kW	0.230 kW
Remote Pwr Sup	0.260 kW	0.252 kW
Line Current*		
Integral Pwr Sup	3.95 A	2.25 A
Remote Pwr Sup	3.40 A	2.10 A
Power Factor*		
Integral Pwr Sup	0.570	0.490
Remote Pwr Sup	0.712	0.659
Start Up Current	See figure 3-2.	See figure 3-2.

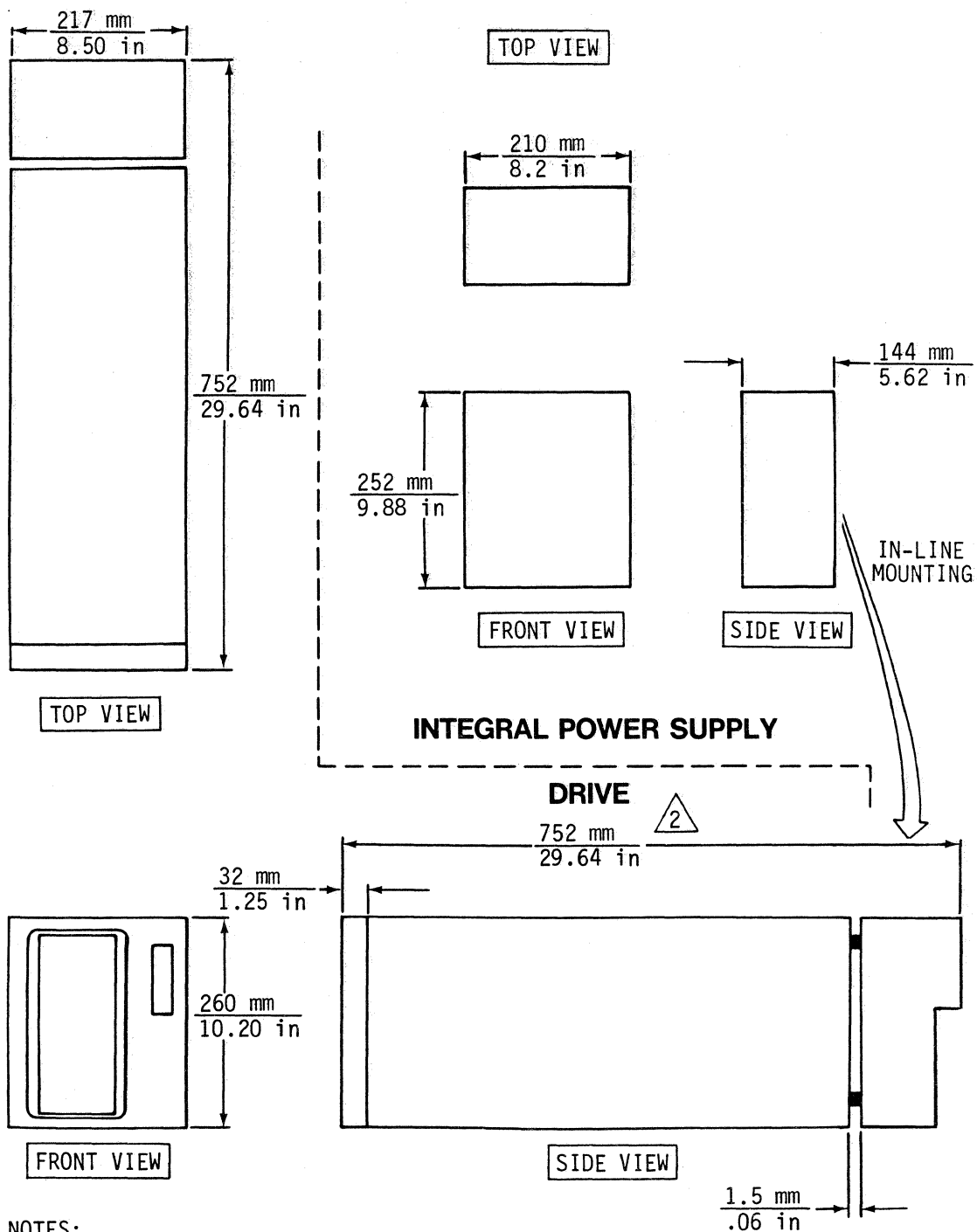
\*Measured when disks are rotating and carriage is moving.

TABLE 3-3. AC CORD SET MINIMUM RATINGS

Used On	Current	Voltage	Conductor Size	Number of Conductors
100 to 120 V 50/60 Hz	13 A	125 V	16 AWG	3
208 to 240 V 50/60 Hz	6 A	250 V	16 AWG	3

Note: Cord set must be U.L. Listed, C.S.A. Certified, and one of the following basic cord types: SV, SP-2, SP-3, S, or SJ. A cord set is defined as a cord with its connectors attached.





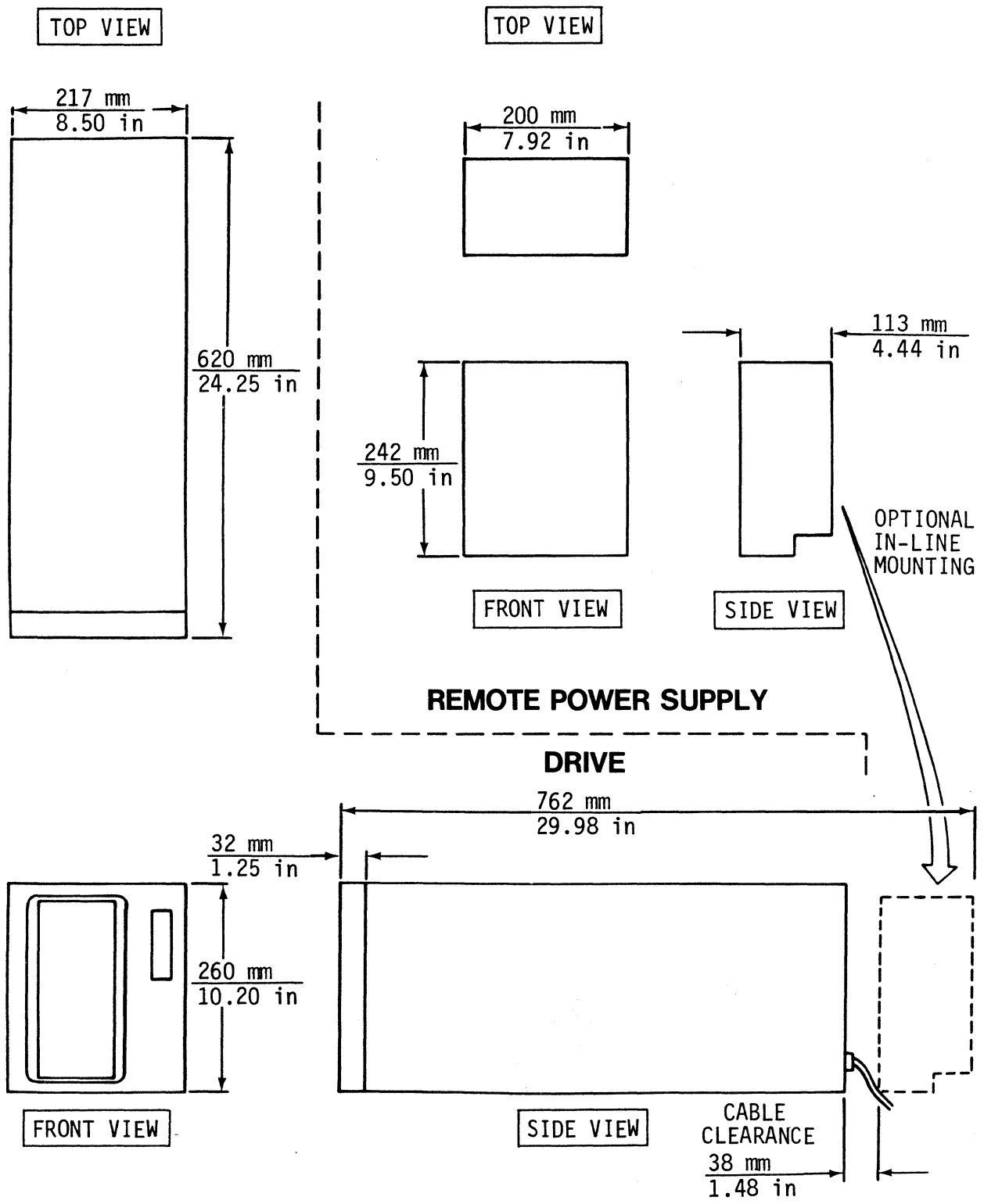
NOTES:

1. DIMENSIONS SHOWN ARE NOMINAL.

2. ADD 25 mm (1 INCH) FOR AC POWER CORD IN OLDER POWER SUPPLIES.

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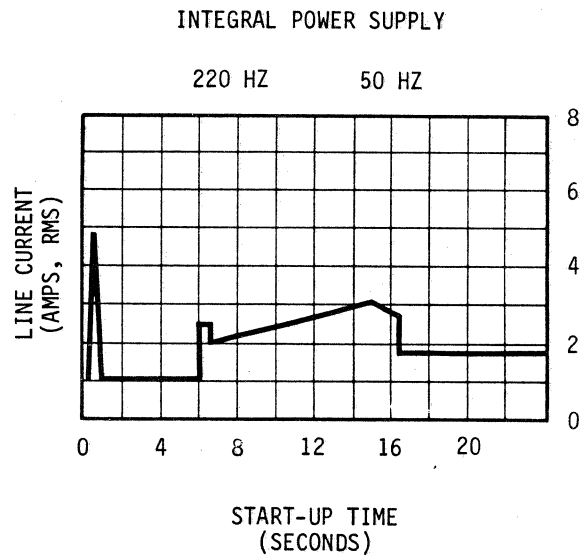
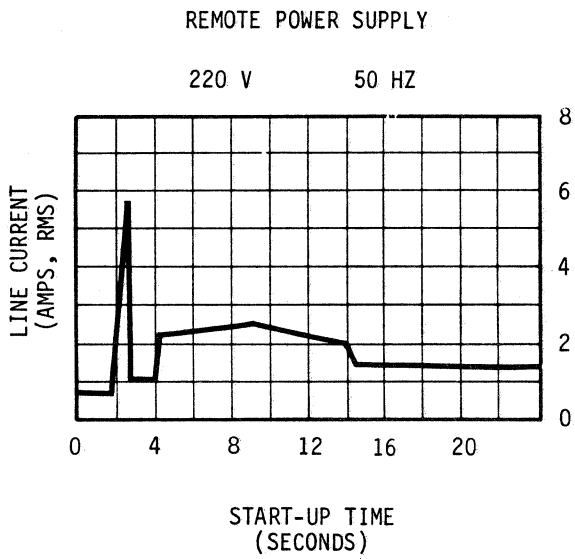
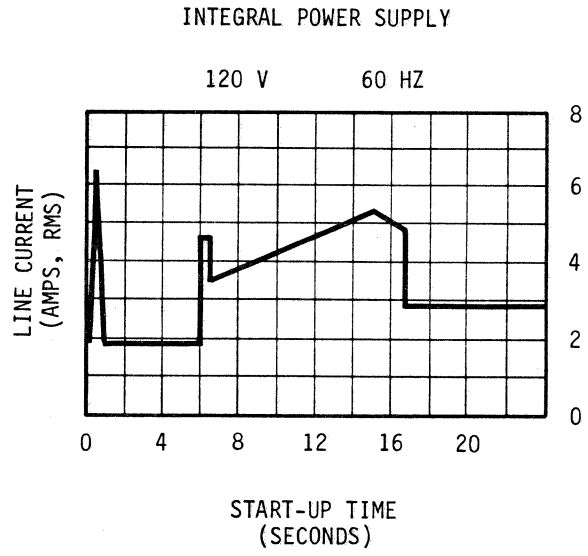
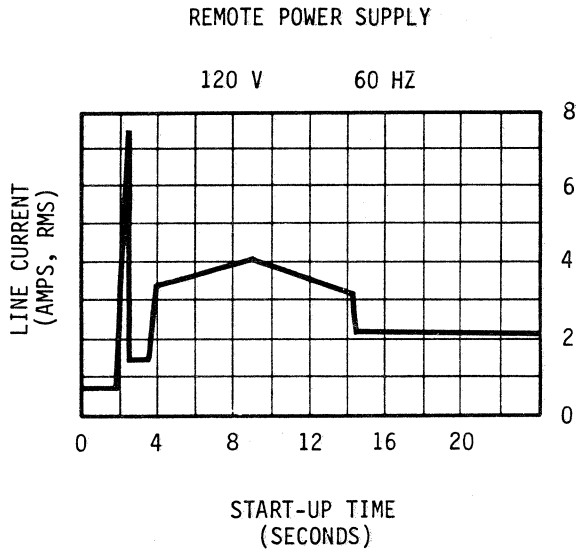
Figure 3-1. Drive Space Requirements (Sheet 1 of 2)



NOTE: DIMENSIONS SHOWN ARE NOMINAL.

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Figure 3-1. Drive Space Requirements (Sheet 2)



11D493

Figure 3-2. Typical Line Current Versus Start-up Time

## **GROUNDING REQUIREMENTS**

### **General**

Safety grounding (connecting the drive power cord to a grounded outlet) and system grounding (establishing a common ground between the drives, the power supplies, and the controller) are discussed in the following paragraphs.

### **Safety Grounding**

A safety ground must be provided by the site ac power system. The green (or green and yellow striped) wire in the drive's power cord provides the safety ground connection between the power supply and the site power system. In turn, the site ac power system must tie this connection (safety ground) to earth ground. All site ac power connection points, including convenience outlets for test equipment, must be maintained at the same safety ground potential.

### **System Grounding**

In addition to safety grounding, system ground connections are also required. System ground is established by a set of ground straps connected in a star or daisy chain configuration. The ground straps connect ground on the controller to earth ground and to each power supply in the system. The interconnect cabling between each drive and its power supply connects case ground on the power supply to case ground on the drive. The installation procedures in this section provide detailed grounding instructions and a schematic diagram of the star and daisy chain configurations.

## INTERFACE REQUIREMENTS

An important part of site preparation is planning the layout and routing of I/O cables. The I/O cables are designated as A and B cables. The I/O A cables may be connected in either a star or daisy chain configuration as shown in figure 3-3. Each configuration calls for the use of terminators; these too are shown in figure 3-3.

The following discussion of the I/O configurations applies to single channel installations where a set of drives are interfaced to one controller. Extending the discussion to dual channel installations (involving two controllers) requires doubling the quantities of cables and terminators because the two channels have independent cabling.

The star configuration has individual A and B cables going from the controller to each drive, and each drive has a terminator installed on it. Use this configuration if the controller has a separate I/O connector for each drive.

The daisy chain configuration has individual B cables going from the controller to each drive. However, a single A cable connects the controller to the first drive. Other A cables go from drive to drive, and the last drive in the string has a terminator installed on it. Use this configuration if the controller has only one I/O connector to serve the entire drive string.

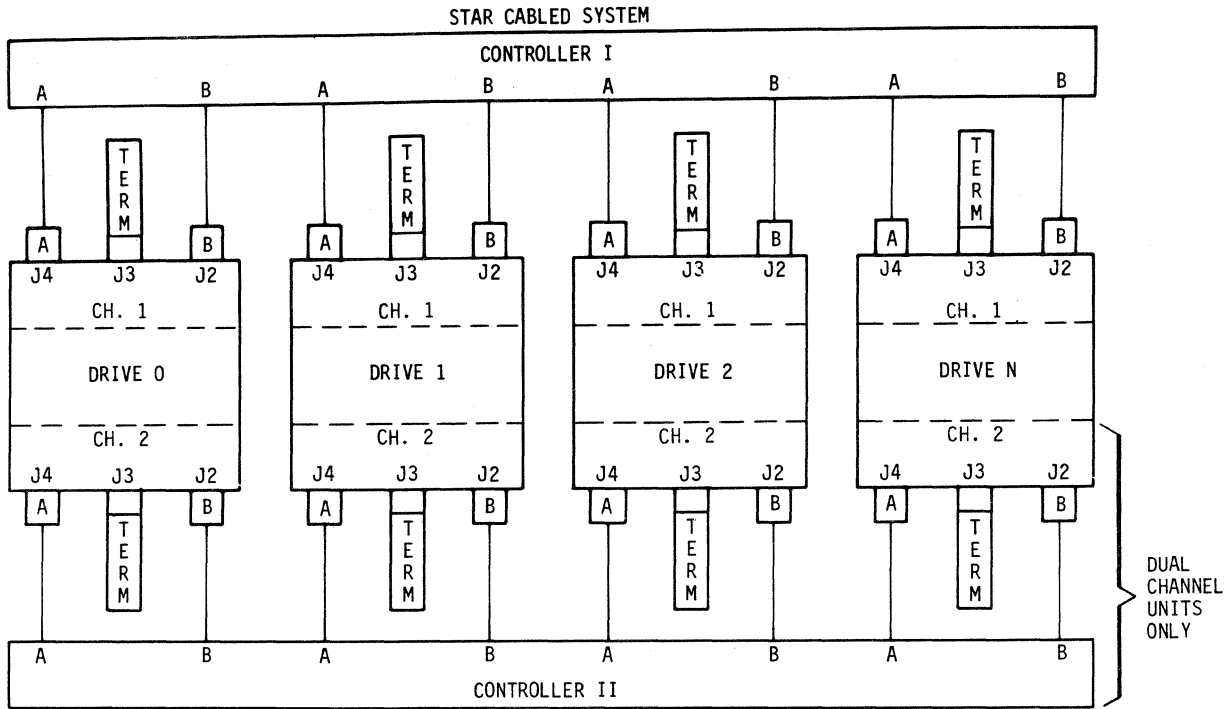
In estimating the I/O cables needed for an installation, decide which configuration will be used and allow sufficient length to permit extension of rack-mounted drives. Limitations on I/O cable lengths may influence system layout. The maximum length for each B cable is 15.3 m (50 ft). Each star system A cable or the cumulative A cabling in a daisy chain system cannot exceed 30.6 m (100 ft) in length. Refer to Accessories in section 4 for terminator and I/O cable part numbers.

Figures 3-4 and 3-5 show the pin assignments and signal names for the A cable. Figure 3-6 shows the pin assignments and signal names for the B cable. Detailed information about interface lines is given in section 1 of hardware maintenance manual, volume 2.

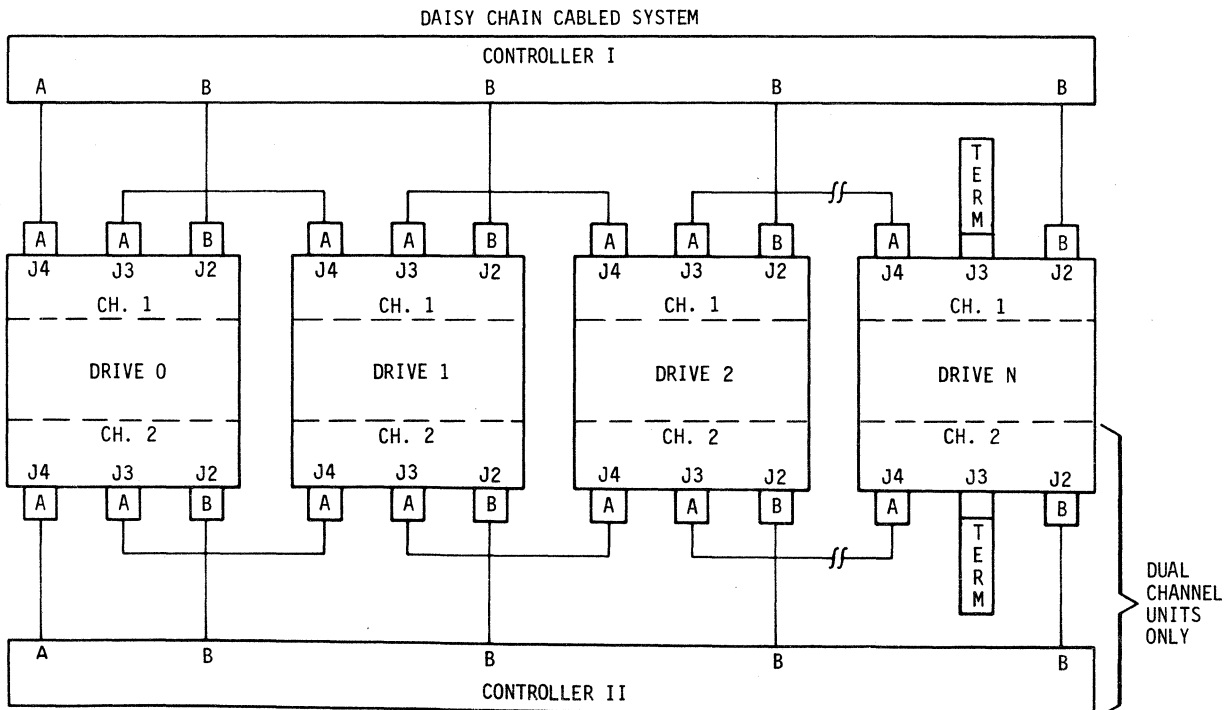
## FINAL UNPACKAGING AND INSPECTION

### GENERAL

After removing packaging material according to the unpackaging instructions provided with the drive, inspection for shipping damage should be carried out and several final unpackaging pro-

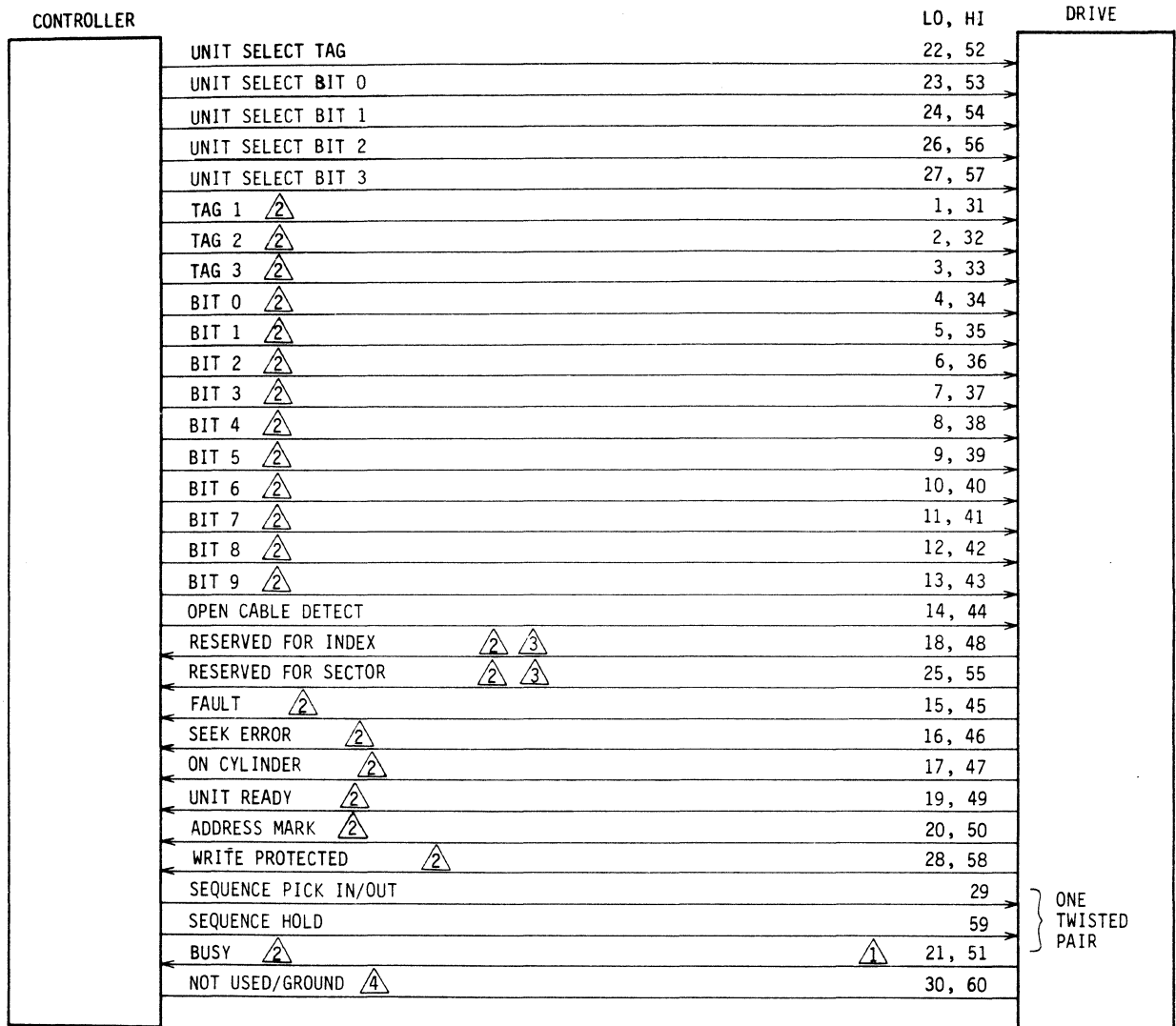


- NOTES:
1. MAXIMUM INDIVIDUAL A CABLE LENGTHS = 100 FEET (STAR)
  2. MAXIMUM CUMULATIVE A CABLE LENGTHS = 100 FEET (DAISY CHAIN)
  3. MAXIMUM INDIVIDUAL B CABLE LENGTHS = 50 FEET
  4. A SYSTEM MAY INCLUDE UP TO 8 DRIVES







10R50B

**Figure 3-3. System Cabling**

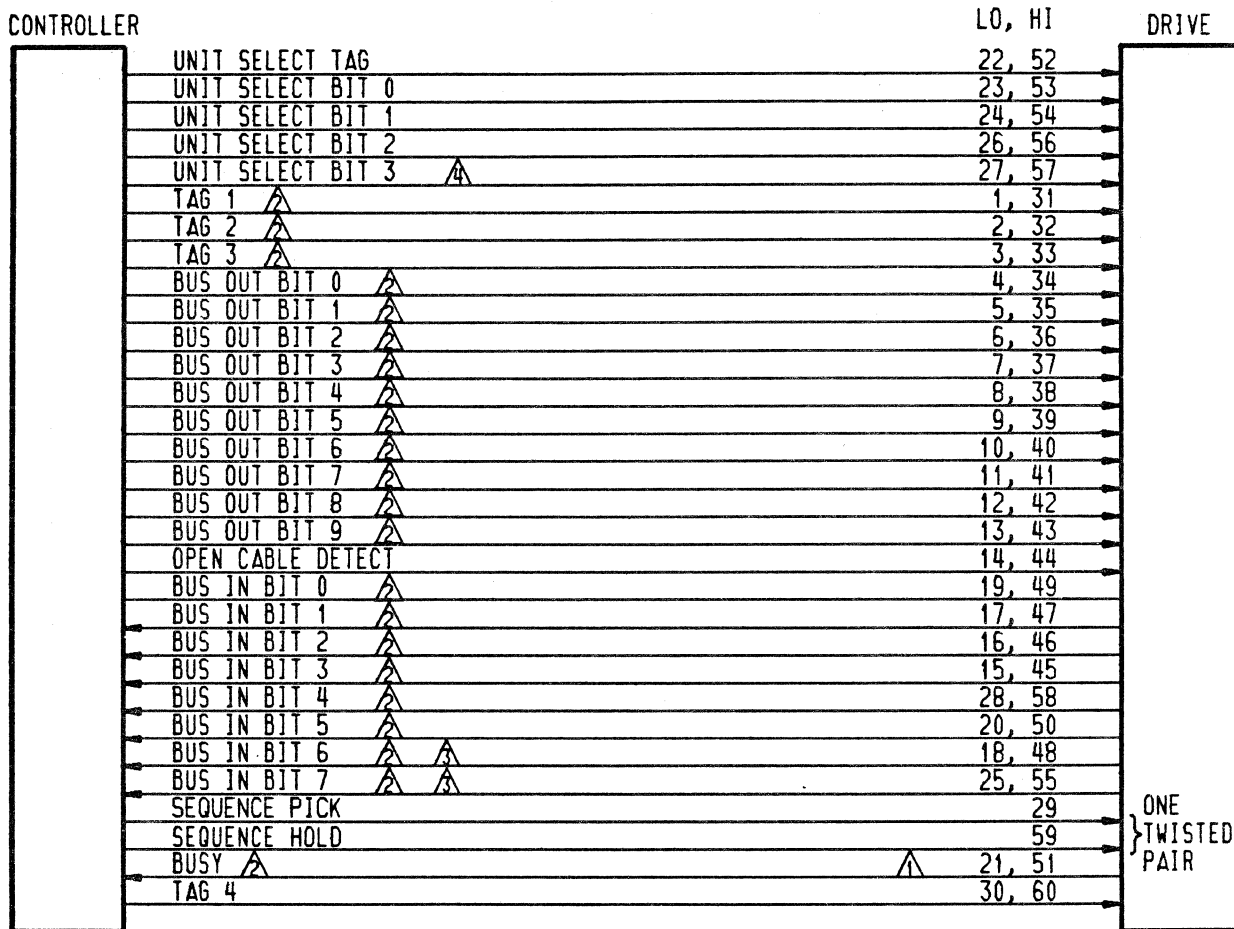


NOTES:

-  DUAL CHANNEL UNITS ONLY
-  GATED BY UNIT SELECT
-  INDEX AND SECTOR MAY BE IN "A" CABLE, "B" CABLE, OR "A" AND "B" CABLES.
-  CUSTOMER OPTION.

10R339B

Figure 3-4. A Cable, with \_SYX/\_TQX I/O Board



NOTES:

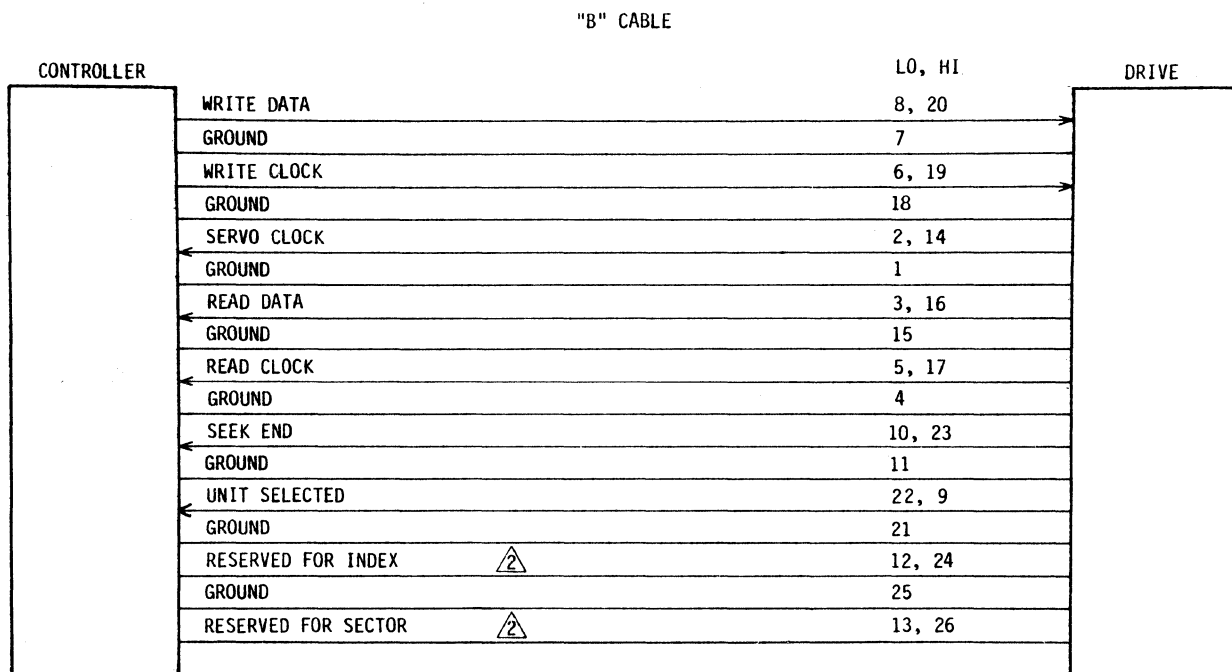
- <sup>1</sup> DUAL CHANNEL UNITS ONLY
- <sup>2</sup> GATED BY UNIT SELECT
- <sup>3</sup> INDEX AND SECTOR MAY BE IN "A" CABLE, "B" CABLE, OR BOTH.
- <sup>4</sup> FUNCTIONS AS TAG 5 LINE FOLLOWING UNIT SELECTION.

SMD-E SIGNAL DEFINITIONS

1163-1

Figure 3-5. A Cable, with \_VJX I/O Board





NOTES:

1 NO SIGNALS GATED BY UNIT SELECTED.

△ INDEX AND SECTOR MAY BE IN "A" CABLE, "B" CABLE, OR "A" AND "B" CABLES.

10R340

Figure 3-6. B Cable

cedures performed. Most packaging materials can be reused if it is necessary to ship the drive at some future date. To obtain packaging instructions, contact:

Packaging Engineer, Material Services Dept.  
 Normandale Division, MPI  
 7801 Computer Ave  
 Minneapolis, MN 55435

When ordering packaging instructions, specify the exact equipment number and series code of the drive as shown on the equipment identification label.

**UNPACKAGING**

1. Open package (save all packaging materials).
2. If drive has a slide mount option, remove packages containing two slide mounts and slide mount hardware kit.

3. Remove package containing ac power cable (and dc power cable for drives with remote power supply).
4. Remove plastic dust cover from around drive and power supply.
5. Check all items against shipping bill for required equipment and hardware to complete installation. Discrepancies, missing items, damaged equipment, etc., should be reported to the CDC account sales representative responsible for the equipment.

## INSPECTION

Inspect the drive, power supply, and accessory items for possible shipping damage. All claims for shipping damage should be filed with the carrier involved.

## INSTALLATION PROCEDURES

### GENERAL

The following text provides the procedures necessary to install the drive and power supply. It is assumed that the requirements for site preparation have been completed prior to performing the installation procedures.

The following procedures should be considered in the order presented, but the order may be altered for a specific installation:

- Mounting Drive in Rack
- Remote Power Supply Bracket Installation
- Power Supply Voltage Conversion
- System I/O Cabling
- System Grounding and Interconnect Cabling
- Mounting Remote Power Supply in Rack
- Setting Circuit Board Switches.

## MOUNTING DRIVE IN RACK

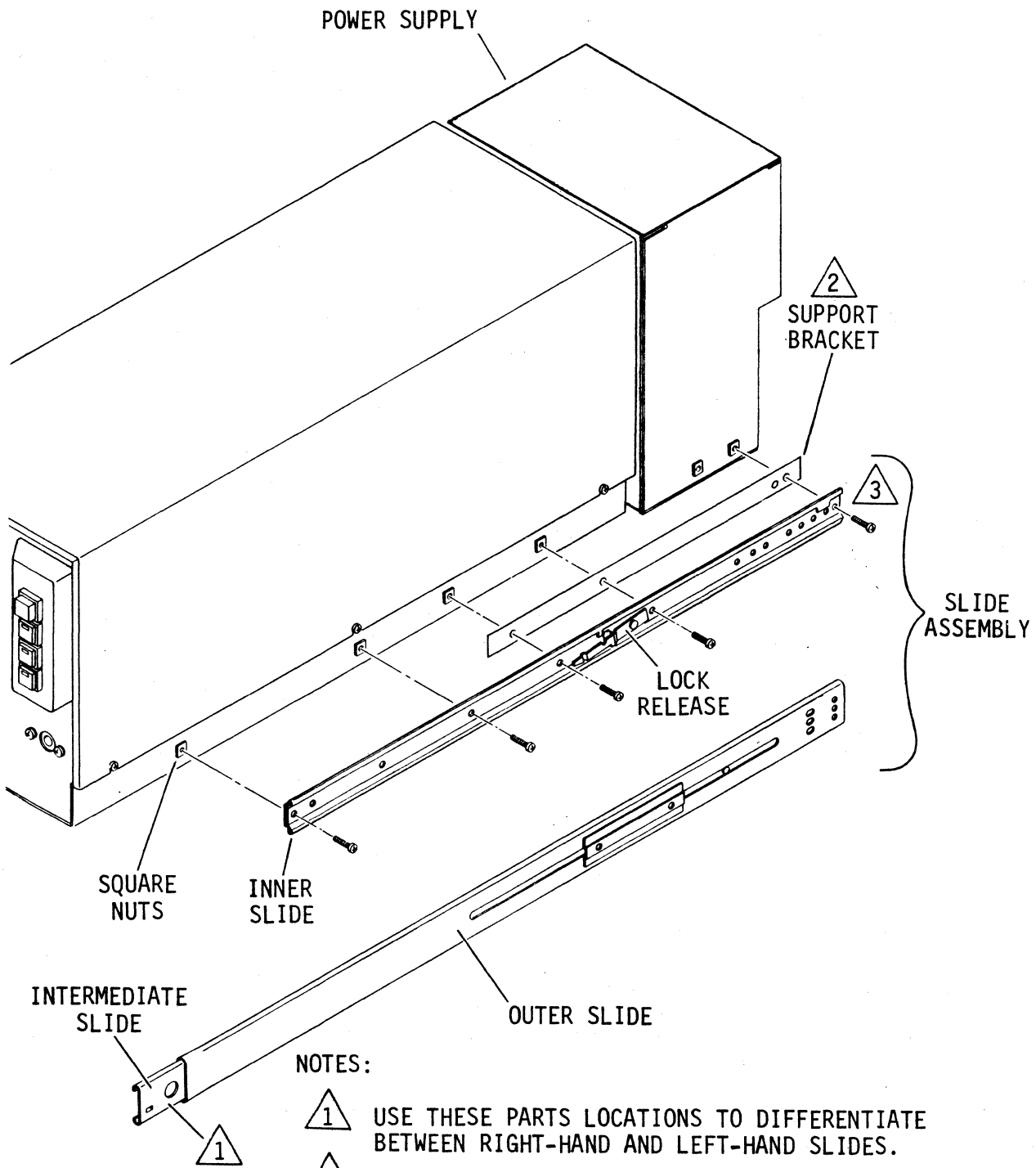
A drive mounting kit for mounting the drive in a standard rack is available as an accessory (refer to Accessories in section 4 for part number). For drives with the integral power supply, the support bracket must be removed prior to slide installation (see figure 3-7). For drives with the remote power supply, the slide assemblies permit inline mounting of the drive and remote power supply. With the slides fully extended, both units are positioned beyond the front surface of the rack for ease of maintenance. The following procedures provide instructions for attaching the drive and power supply to the slides.

### NOTE

The procedure describing how to mount the remote power supply on the slide assemblies follows System Grounding and Interconnect Cabling.

### Drive Installation (Integral Power Supply)

1. Remove support bracket (one on each side) from drive. Discard brackets and retain screws for inner slide installation on drive (see figure 3-7).
2. Remove screws (4 each) from slide hardware kit.
3. Disengage inner slide from intermediate and outer slides of each slide assembly by pressing lock release and pulling out inner slide.
4. Mount right-hand and left-hand inner slides on drive by installing screws through holes in inner slide into square nuts in drive. Figure 3-7 defines which slide component is used on the right-hand side of the drive.
5. Mount right-hand and left-hand outer slides of slide assemblies in rack in accordance with user requirements. Figure 3-7 defines which slide component mounts on the right side of the rack.
6. Push each intermediate slide to fully retracted position inside outer slide.
7. Lift drive and guide inner slides into intermediate slides of slide assemblies. Continue pushing slides together until their lock releases engage.
8. Connect ac power cable to AC INPUT connector J1 and to site ac power source.



NOTES:

- ① USE THESE PARTS LOCATIONS TO DIFFERENTIATE BETWEEN RIGHT-HAND AND LEFT-HAND SLIDES.
- ② BRACKET IS USED TO SUPPORT INTEGRAL POWER SUPPLY WHEN SLIDES ARE NOT USED.
- ③ USE END HOLE FOR RSD.  
USE SECOND HOLE FOR FSD.

11D12E

Figure 3-7. Drive Installation (Integral Power Supply)

### **Drive Installation (Remote Power Supply)**

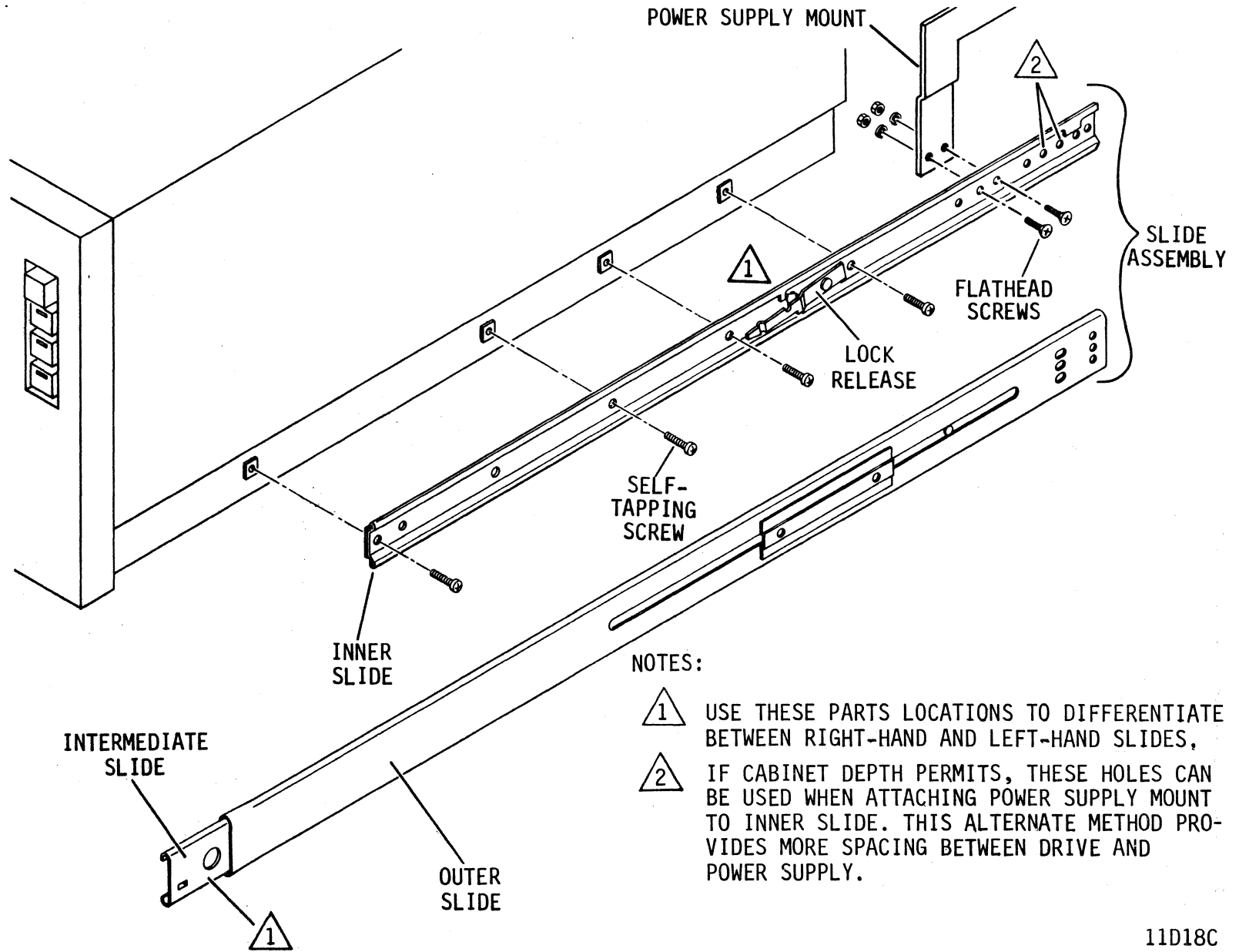
1. Remove screws (8 each) from slide hardware kit. Set aside the remaining screws in kit for remote power supply installation.
2. Disengage inner slide from intermediate and outer slides of each slide assembly by pressing lock release and pulling out inner slide (see figure 3-8).
3. Install remote power supply mounts on inner slides using mounting hardware.
4. Mount right-hand and left-hand inner slides on drive by installing screws through holes in inner slide into square nuts in drive. Figure 3-8 defines which slide component is used on the right-hand side of the drive.
5. Mount right-hand and left-hand outer slides of slide assemblies in rack in accordance with user requirements. Figure 3-8 defines which slide component mounts on the right side of the rack.
6. Push each intermediate slide to fully retracted position inside outer slide.
7. Lift drive and guide inner slides into intermediate slides of slide assemblies. Continue pushing slides together until their lock releases engage.

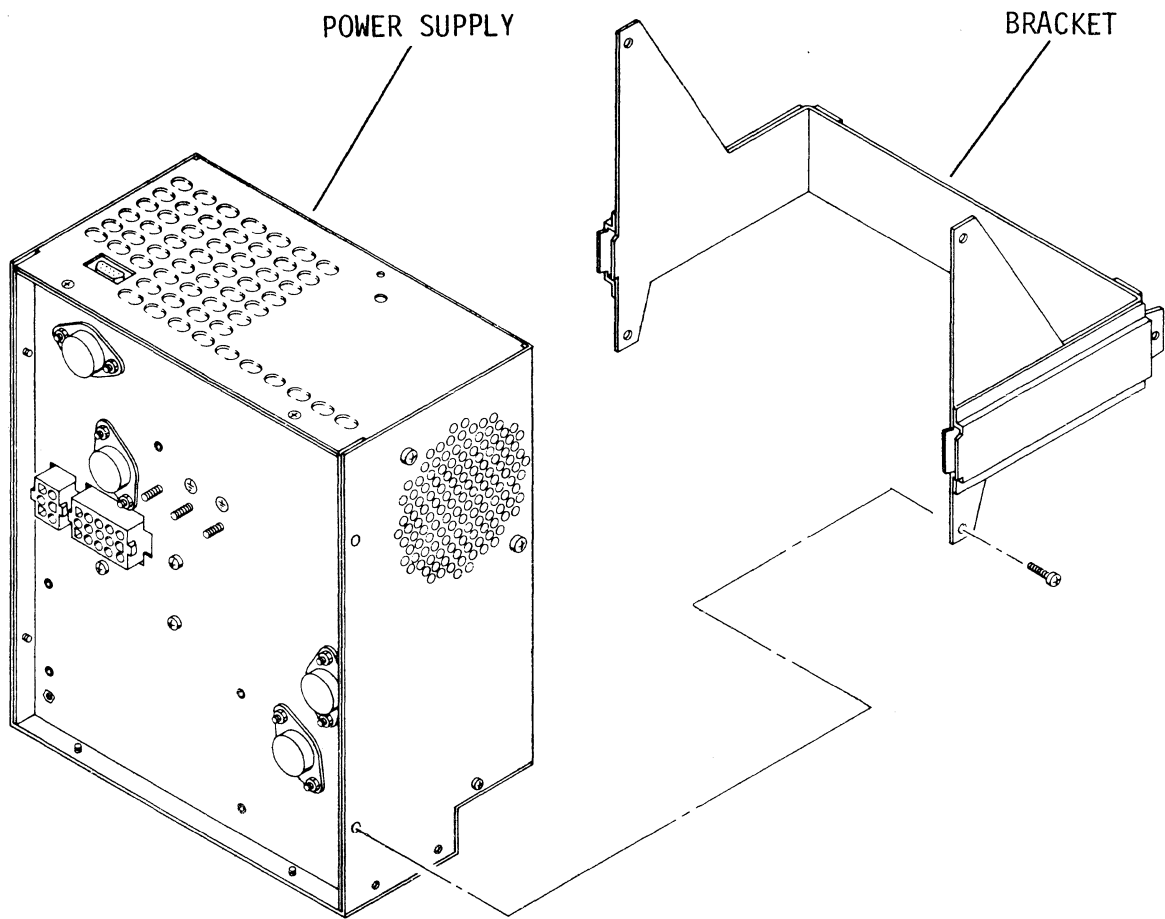
### **REMOTE POWER SUPPLY BRACKET INSTALLATION**

If the power supply is to be installed on the slide assemblies, a mounting bracket must first be attached to the power supply. Newer drives have the bracket already attached. On older drives, attach bracket as follows:

1. Remove and discard the 4 screws from power supply, where bracket attaches (see figure 3-9).
2. Align the bracket holes with the vacated holes in power supply and secure into place using the four 6-32 x 3/8 screws supplied with hardware kit.

Figure 3-8. Drive Installation (Remote Power Supply)



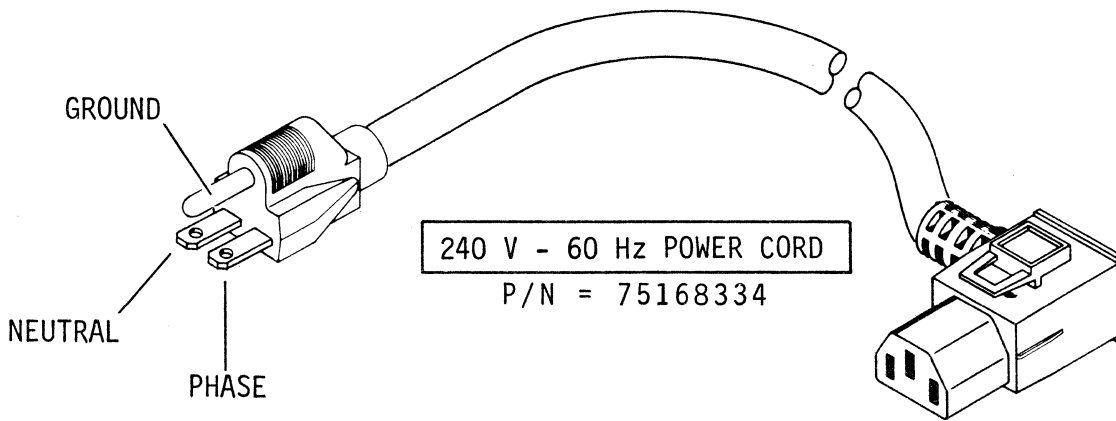
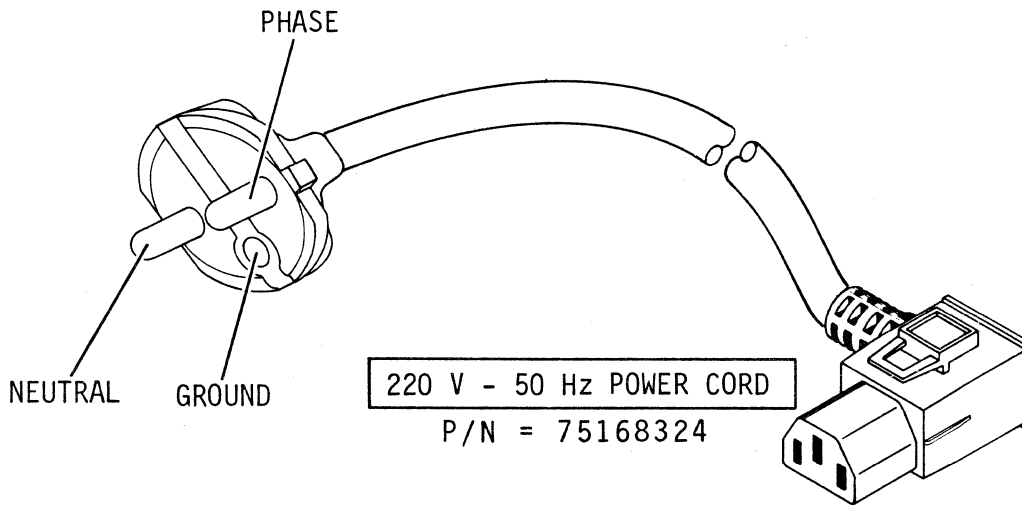
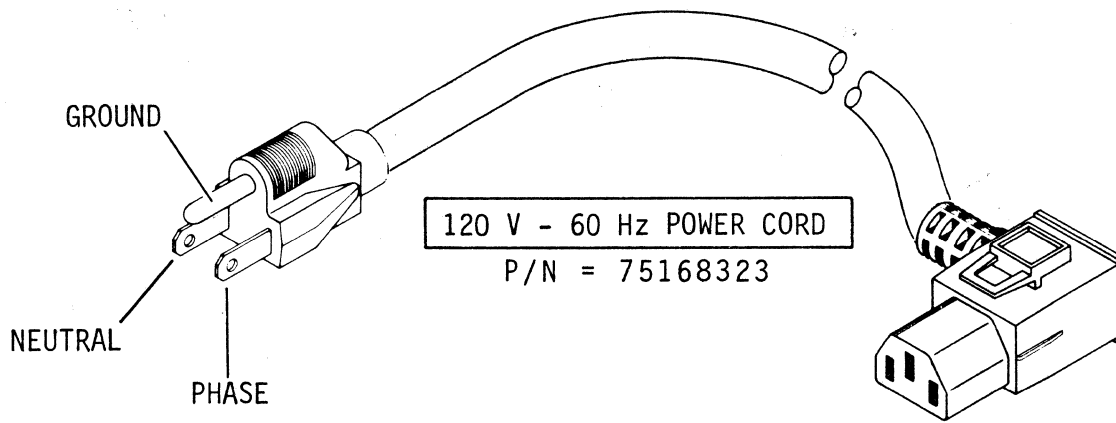


10R319

Figure 3-9. Remote Power Supply Bracket Installation

### POWER SUPPLY VOLTAGE CONVERSION

The power supply is configured before shipment to operate in one of two ranges of ac input voltages. The equipment label on the power supply indicates the voltage range selected prior to shipment. The voltage range for drives with the integral power supply is determined by setting the voltage programming switch (located on top of power supply) to the desired range. The voltage range for drives with the remote power supply is determined by: 1) on older supplies, which voltage programming plug is installed inside the power supply, or 2) on newer supplies, setting the voltage programming switch (located on bottom of power supply) to the desired range. The ac power cord must be replaced if the voltage range is changed. Either order a CDC cord (see figure 3-10 and the parts data section) or select a commercially available cord per the specifications in table 3-3.



10R56F

Figure 3-10. AC Power Cables



1. Ensure that ac power cable is disconnected from power supply.

#### NOTE

Perform step 2 on integral supplies, and on newer remote supplies which have a voltage programming switch. Perform step 3 on older remote supplies, which do not have a voltage programming switch.

2. Change voltage programming switch to desired setting (switch is located on top of integral power supply, and on bottom of remote power supply).
3. On older remote power supplies, perform the following:
  - a. Remove attaching hardware (designated "A" in figure 3-11) from power supply.
  - b. Place power supply on work surface with bottom cover facing up.

#### CAUTION

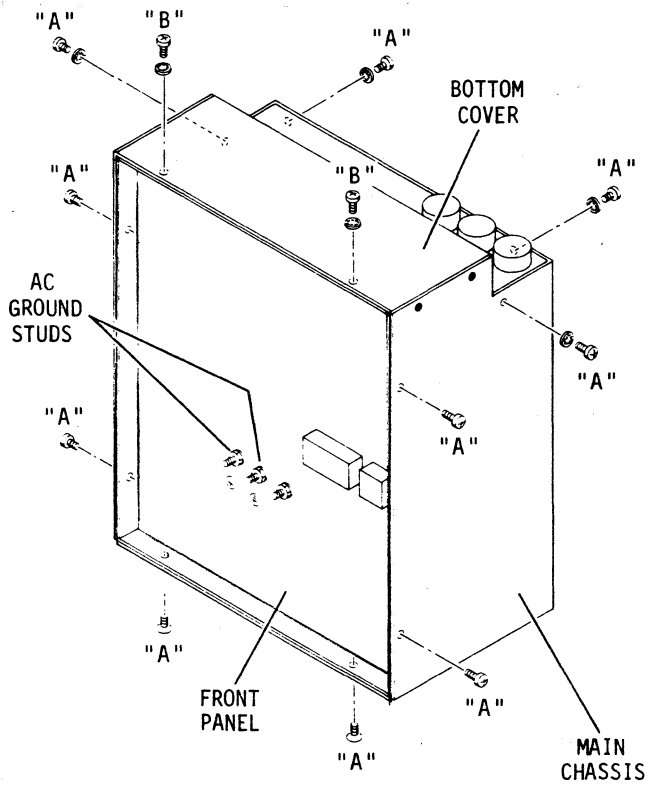
Use caution during the following steps to avoid damaging internal components and wiring.

- c. Slide bottom cover and front panel away from main chassis without straining internal wiring.
- d. Remove attaching hardware (designated "B") and tilt bottom cover away from front panel to expose voltage programming plug.

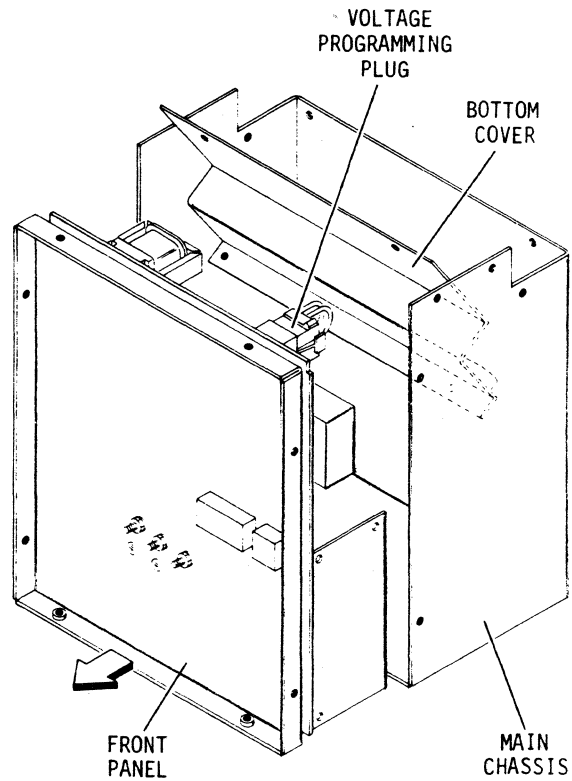
#### NOTE

The voltage programming plugs are stamped to indicate their voltage ranges. The plug for 120 V ac has blue jumper wires, and the plug for 220/240 V ac has red jumper wires.

- e. Squeeze retaining tabs and remove voltage programming plug from its socket. Install replacement voltage programming plug in socket.
- f. Align bottom cover with front panel and replace attaching hardware (designated "B").



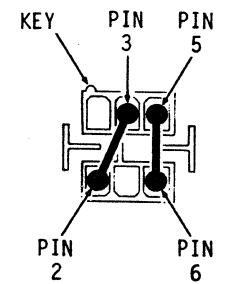
HARDWARE REMOVAL



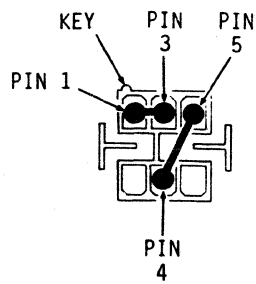
VOLTAGE PROGRAMMING PLUG REMOVAL

NOTES:

1. REMOVE HARDWARE DESIGNATED "A" PRIOR TO REMOVING HARDWARE DESIGNATED "B"



—120 V—  
(BLUE JUMPER WIRES)



—220 V—  
(RED JUMPER WIRES)

IDENTIFYING VOLTAGE PROGRAMMING PLUGS

10R84B

Figure 3-11. Voltage Conversion (Older Remote Power Supplies)

- g. Slide bottom cover and front panel back into alignment with main chassis.
  - h. Install hardware (designated "A") to attach bottom cover and front panel to main chassis.
4. Modify equipment label to reflect new ac operating voltage range for power supply.
  5. Replace existing ac power cable with the ac power cable specified for new operating voltage.

## SYSTEM I/O CABLING

This procedure describes how to connect the I/O cables and terminators. The recommended connections are A cable to J4 and terminator to J3. These connections may be reversed without affecting drive operation. Figure 3-12 shows typical I/O cable connections at the drive I/O plate.

The site preparation information, provided earlier in this section, describes both star and daisy chain cable routing. With the correct number of terminators and lengths of I/O cables available, you are ready to begin connecting the system I/O cabling. Unless otherwise noted, each step in the following procedure applies to all drives in the system.

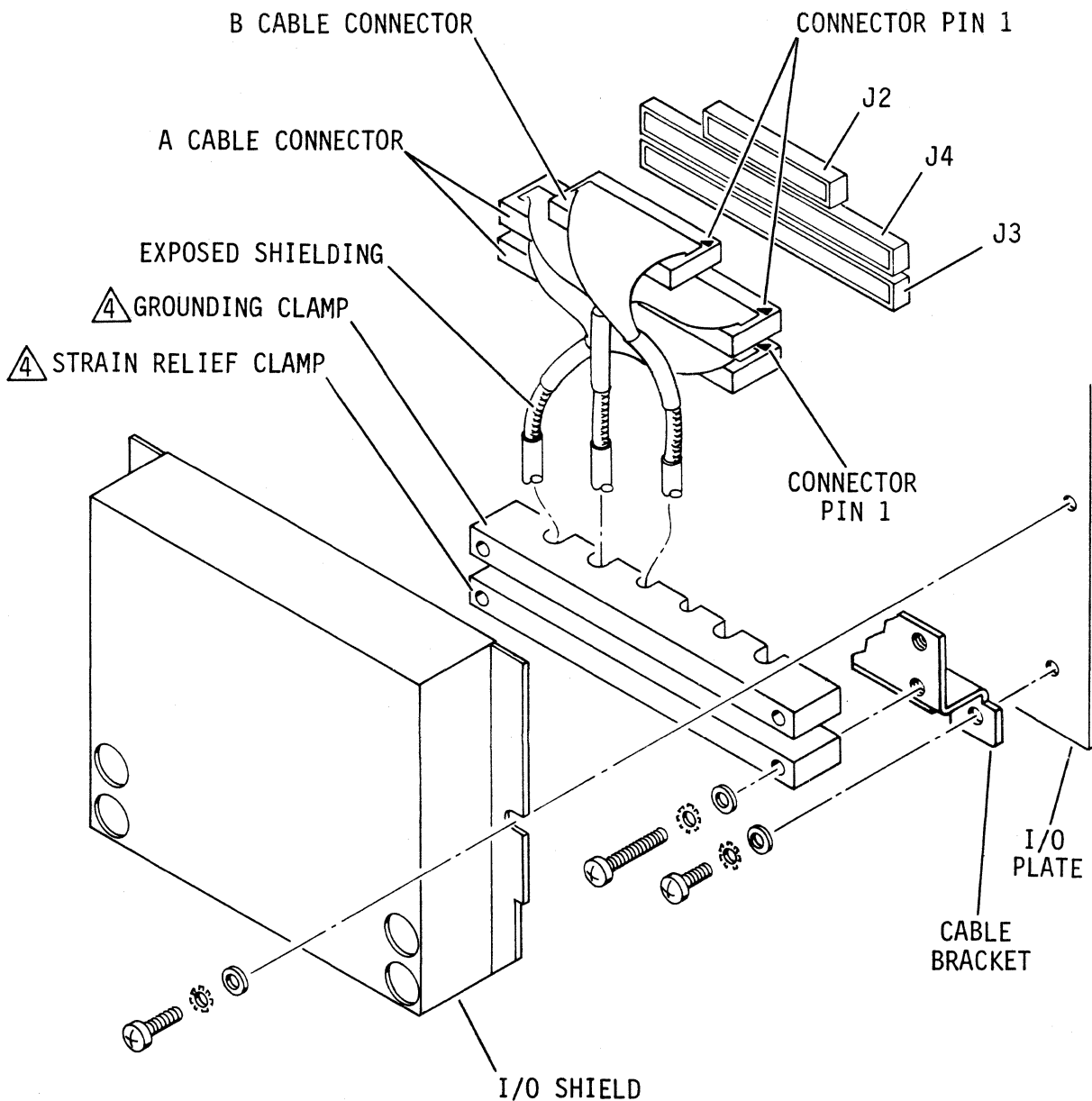
In installations where the remote power supply is slide mounted directly behind the drive, it is necessary to remove the power supply from the slides to connect or disconnect the I/O cables.

1. Remove I/O shield from I/O plate (see figure 3-12).
2. Install cable bracket on panel below I/O plate with attaching hardware.

### NOTE

Steps 3 through 6 apply to single channel drives and must be repeated for dual channel drives. The I/O plate on dual channel drives has two sets of connectors: 1J2, 1J3, and 1J4 for channel 1, and 2J2, 2J3, and 2J4 for channel 2.

3. Connect B cables from controller to connector J2 on each drive.



NOTES:

1. CABLE BRACKET IS ATTACHED TO EITHER REAR PANEL OR I/O PLATE, DEPENDING ON DRIVE CONFIGURATION.
2. EXACT PLACEMENT OF CONNECTORS J2, J3, AND J4 ON I/O PLATE VARIES.
3. I/O SHIELD IS USED ON INTEGRAL POWER SUPPLY ONLY.

- △ 4 CABLE OPENINGS ARE LARGER ON STRAIN RELIEF CLAMP THAN ON GROUNDING CLAMP.

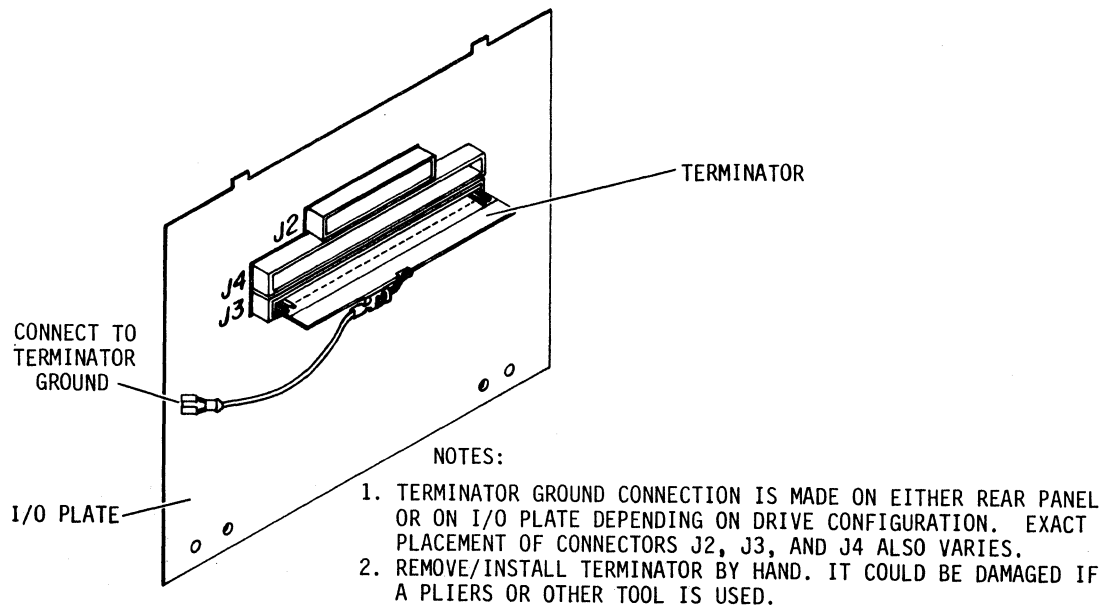
11D13F

Figure 3-12. I/O Cable Attachment (Typical)

## NOTE

Figure 3-3 defines star and daisy chain systems. In star systems, repeat step 4 for each drive, and skip to step 6. In daisy chain systems, perform step 4 for first drive in daisy chain and repeat step 5 for remaining drives.

4. Connect A cable from controller to drive connector J4.
5. Connect A cable from connector J3 on each drive to connector J4 on next drive in daisy chain.
6. Install terminator on drive connector J3 and make terminator ground connection (see figure 3-13). Terminators are required on:
  - all drives in a star system.
  - last drive in a daisy chain system.



10R331A

Figure 3-13. Terminator Installation (Typical)

## NOTE

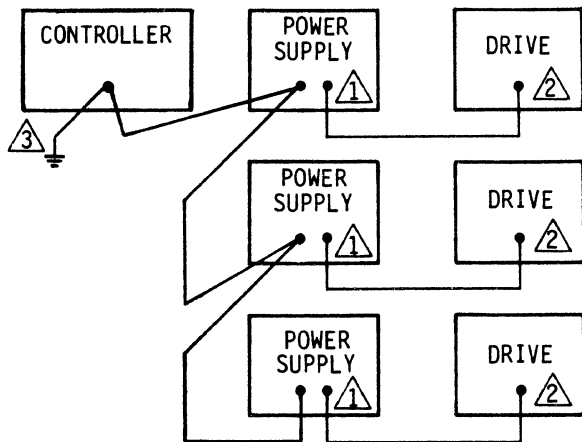
On each I/O cable, there are several locations where heat shrink tubing can be removed to expose the ground shield. By selecting the proper section of heat shrink for removal in the following step, the ground shield will be exposed only where it is contacted by the grounding clamp.

7. Strip heat shrink tubing from all cables so that bare shielding will be in contact with grounding clamp.
8. Loosely install grounding clamp (grounding clamp has smaller diameter openings than strain relief clamp) onto cable bracket with cables positioned as shown in figure 3-12. Ensure that bare shielding on each cable is in contact with grounding clamp.
9. Position cabling so that outer insulation begins just below grounding clamp; then secure grounding clamp into place. This will ensure that the strain relief clamp (installed in the following step) is in contact with outer insulation of cabling.
10. Install strain relief clamp onto cable bracket with cables positioned as shown in figure 3-12.
11. Install I/O shield on I/O plate with attaching hardware.

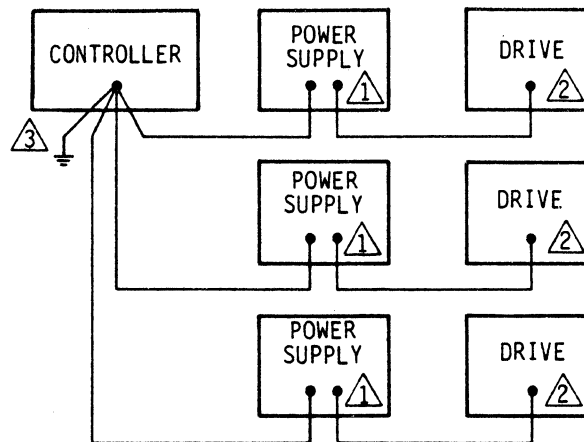
## SYSTEM GROUNDING AND INTERCONNECT CABLING

This section contains instructions on grounding the system and interconnecting the remote power supply and drive. It is assumed that the site has been prepared in accordance with the site requirements information provided earlier in this section. The following procedures describe how to ground the system in a star or daisy chain configuration as shown in figure 3-14.

For drives with the integral power supply, interconnect ground cabling between drive and power supply has already been installed during manufacturing. For drives with remote power supply, interconnect cabling is supplied with each drive and installed on site, between case ground on each drive and case ground on its power supply. Refer to Accessories in section 4 for grounding accessories part numbers.



DAISY CHAIN CONFIGURATION



STAR CONFIGURATION

NOTES:

- ① GROUND CONNECTIONS TO POWER SUPPLY USE STUDS MARKED  $\text{⏏}$ . THERE MUST BE NO CONNECTION TO STUD MARKED "+ 5V RET."
- ② DRIVE IS GROUNDED AT "DC GND" SCREW ON DRIVE REAR PANEL.

IF DRIVE HAS INTEGRAL POWER SUPPLY:  
DC GROUND CABLE BETWEEN DRIVE AND POWER SUPPLY  
HAS ALREADY BEEN INSTALLED DURING MANUFACTURING.

IF DRIVE HAS REMOTE POWER SUPPLY:  
DRIVES SUPPLIED WITH ONE-FOOT DC POWER CABLE HAVE A  
SEPARATE GROUND STRAP THAT CONNECTS BETWEEN POWER SUPPLY  
AND DRIVE. DRIVES SUPPLIED WITH A LONGER DC POWER CABLE  
USE THE CABLE SHIELD FOR A GROUND CONNECTION BETWEEN  
POWER SUPPLY AND DRIVE. EACH END OF THESE CABLES HAS A  
SEPARATE GROUND STRAP CONNECTED TO GROUND SHIELD.

- ③ EARTH GROUND CONNECTION

11D15A

Figure 3-14. System Grounding Diagram

## Star Grounding Procedure

This procedure describes how to ground the system in a star configuration. In this configuration, ground straps connect the controller ground to each power supply in the system as shown in figure 3-14.

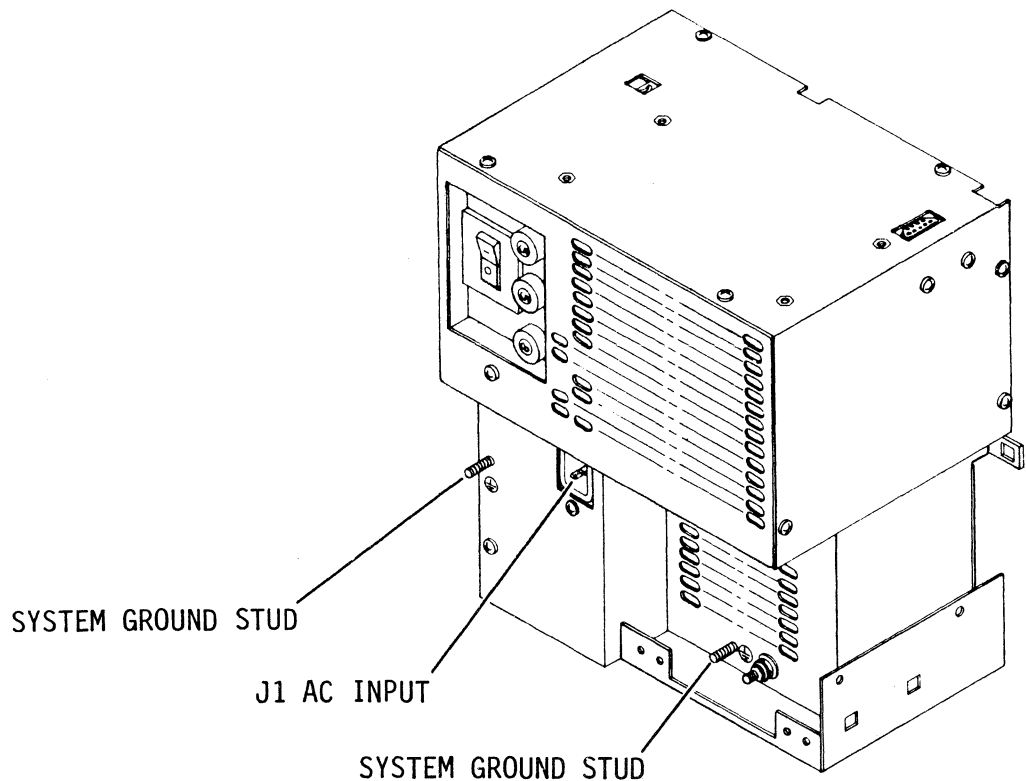
1. Prepare ground straps as follows:
  - a. Allowing sufficient length for drive extension, cut ground straps to length needed for the following connections:
    - Controller to earth ground
    - Controller to each power supply
  - b. Crimp and solder terminal lugs to both ends of each ground strap.
2. Referring to figure 3-14, connect ground straps to controller as follows:
  - a. Connect one end of each of the ground straps to controller ground terminal.
  - b. Connect one of the ground straps to earth ground.
  - c. Route the remaining ground straps to the power supplies.

### NOTE

For drives with integral power supply, perform step 3 only. For drives with remote power supply, skip to step 4.

3. Connect a ground strap from controller to each power supply as follows:
  - a. Remove nut and lockwasher from one of the system ground studs on each power supply. These studs are identified by ground symbols. The stud marked "+5V RET" is not used. See figure 3-15.
  - b. Place lockwasher on ground stud. Then place terminal lug on stud and secure with nut.





NOTE:

1. PLACEMENT OF SYSTEM GROUND STUD AND AC INPUT CONNECTOR IS NOT THE SAME ON ALL INTEGRAL POWER SUPPLIES.

11D387

Figure 3-15. System Grounding (Integral Power Supply)

NOTE

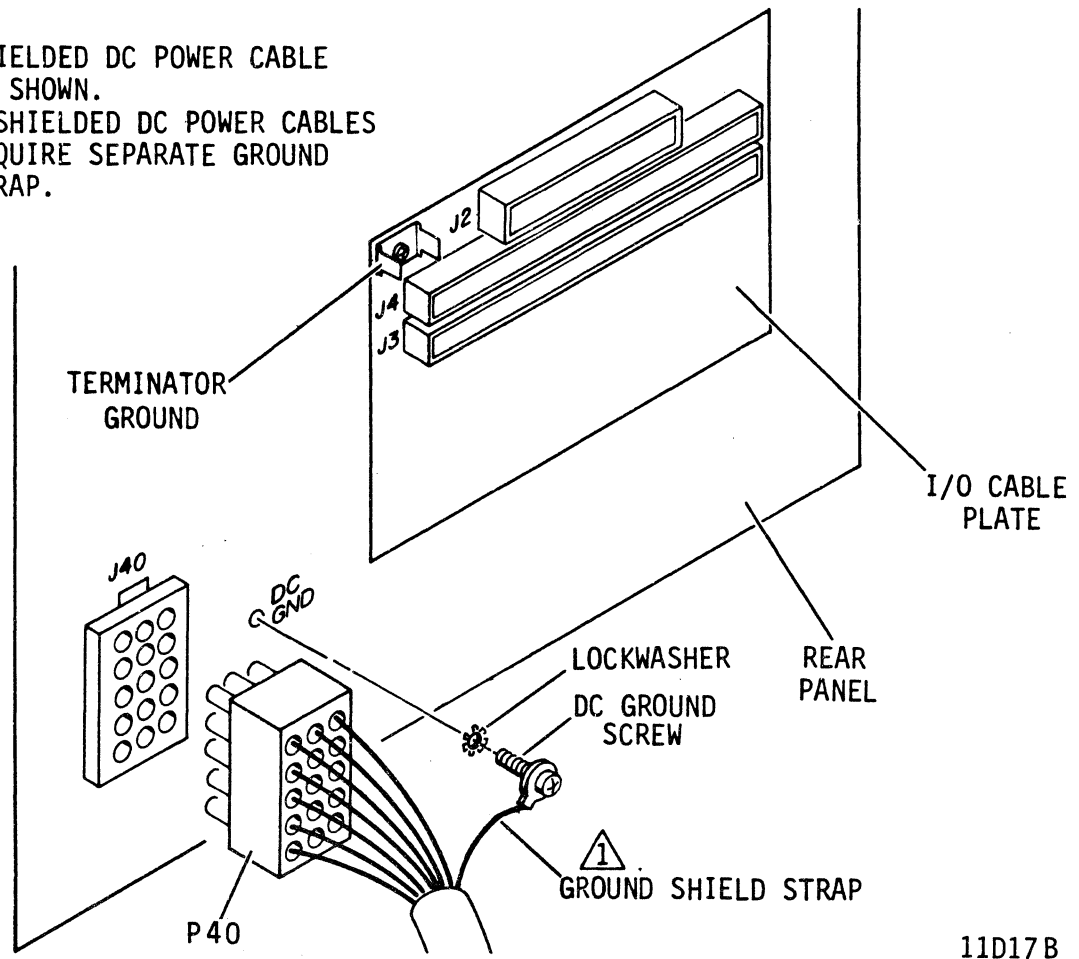
Ground connections to remote power supply precede installation of power supply in cabinet.

4. Referring to figure 3-11, attach a ground strap from controller to each power supply as follows:
  - a. Locate power supply close to where it will be installed.
  - b. Remove nuts and lockwashers from two ground studs on front panel of power supply. These studs are identified by ground symbols. The stud marked "+5V RET" is not used.

- c. Place lockwasher on ground stud farthest from connector J15.
  - d. Place terminal lug of ground strap on stud and secure with nut.
5. Identify whether dc power cable has a ground shield strap attached at each end. If it does, proceed with step 6. Otherwise, skip to step 7.
6. Referring to figures 3-14 and 3-16, connect shielded dc power cable between power supply and drive as follows:
  - a. Connect shielded dc power cable between connector J15 on front panel of power supply and connector J40 on rear panel of drive.
  - b. Place lockwasher on remaining ground stud on power supply.
  - c. Place terminal lug of ground shield strap over lockwasher on stud and secure with nut.
  - d. Remove DC GND screw and lockwasher from rear panel of drive.
  - e. Insert screw through terminal lug of ground shield strap and then through lockwasher.
  - f. Reinstall screw in rear panel of drive.
7. Referring to figures 3-14 and 3-16, connect the unshielded dc power cable and the ground strap between power supply and drive as follows:
  - a. Connect unshielded dc power cable between connector J15 on front panel of power supply and connector J40 on rear panel of drive.
  - b. Place lockwasher on remaining ground stud on power supply.
  - c. Place terminal lug of ground strap over lockwasher on stud and secure with nut.
  - d. Remove DC GND screw and lockwasher from rear panel of drive.
  - e. Insert screw through terminal lug of ground strap and then through lockwasher.
  - f. Reinstall screw in rear panel of drive.

NOTES:

- ⚠ SHIELDED DC POWER CABLE IS SHOWN. UNSHIELDED DC POWER CABLES REQUIRE SEPARATE GROUND STRAP.



11D17B

Figure 3-16. Drive Grounding (Remote Power Supply)

### Daisy Chain Grounding Procedure

This procedure describes how to ground the system in a daisy chain configuration. In this configuration, a ground strap connects the controller ground to the first power supply in the system. The remainder of the power supplies are connected by grounding straps going from the first power supply to the second, the second to the third, and so on. See figure 3-14.

1. Prepare ground straps as follows:
  - a. Allowing sufficient length for drive extension, cut ground straps to length needed for the following connections:

- Controller to earth ground
  - Controller to nearest drive
  - Each drive to next drive in daisy chain
- b. Crimp and solder terminal lugs to both ends of each ground strap.
2. Referring to figure 3-14, connect ground straps to controller as follows:
- a. Connect two ground straps to controller ground terminal.
  - b. Connect one of the ground straps to earth ground.
  - c. Route the other ground strap to the first power supply in the daisy chain. Route the remaining ground straps (prepared in step 1) from power supply to power supply.

NOTE

For drives with integral power supply, perform step 3 only. For drives with remote power supply, skip to step 4.

3. Make the daisy chain ground connections at each power supply as follows:
- a. Remove nut and lockwasher from one of the system ground studs on each power supply. These studs are identified by ground symbols. The stud marked "+5V RET" is not used. See figure 3-15.
  - b. Place lockwasher on ground stud. Then place terminal lug(s) on stud and secure with nut.

NOTE

Ground connections to remote power supply precede installation of power supply in cabinet.

4. Referring to figure 3-11, make daisy chain connections at each power supply as follows:
- a. Locate power supply close to where it will be installed.

- b. Remove nuts and lockwashers from two ground studs on front panel of power supply. These studs are identified by ground symbols. The stud marked "+5V RET" is not used.
    - c. Place lockwasher on ground stud farthest from connector J15.
    - d. Place terminal lug of ground strap(s) on stud and secure with nut.
  5. Identify whether dc power cable has a ground shield strap attached at each end. If it does, proceed with step 6. Otherwise, skip to step 7.
  6. Referring to figures 3-14 and 3-16, connect shielded dc power cable between power supply and drive as follows:
    - a. Connect shielded dc power cable between connector J15 on front panel of power supply and connector J40 on rear panel of drive.
    - b. Place lockwasher on remaining ground stud on power supply.
    - c. Place terminal lug of ground shield strap over lockwasher on stud and secure with nut.
    - d. Remove DC GND screw and lockwasher from rear panel of drive.
    - e. Insert screw through terminal lug of ground shield strap and then through lockwasher.
    - f. Reinstall screw in rear panel of drive.
  7. Referring to figures 3-14 and 3-16, connect the unshielded dc power cable and the ground strap between power supply and drive as follows:
    - a. Connect unshielded dc power cable between connector J15 on front panel of power supply and connector J40 on rear panel of drive.
    - b. Place lockwasher on remaining ground stud on power supply.
    - c. Place terminal lug of ground strap over lockwasher on stud and secure with nut.
    - d. Remove DC GND screw and lockwasher from rear panel of drive.

- e. Insert screw through terminal lug of ground strap and then through lockwasher.
- f. Reinstall screw in rear panel of drive.

## MOUNTING REMOTE POWER SUPPLY IN RACK

### NOTE

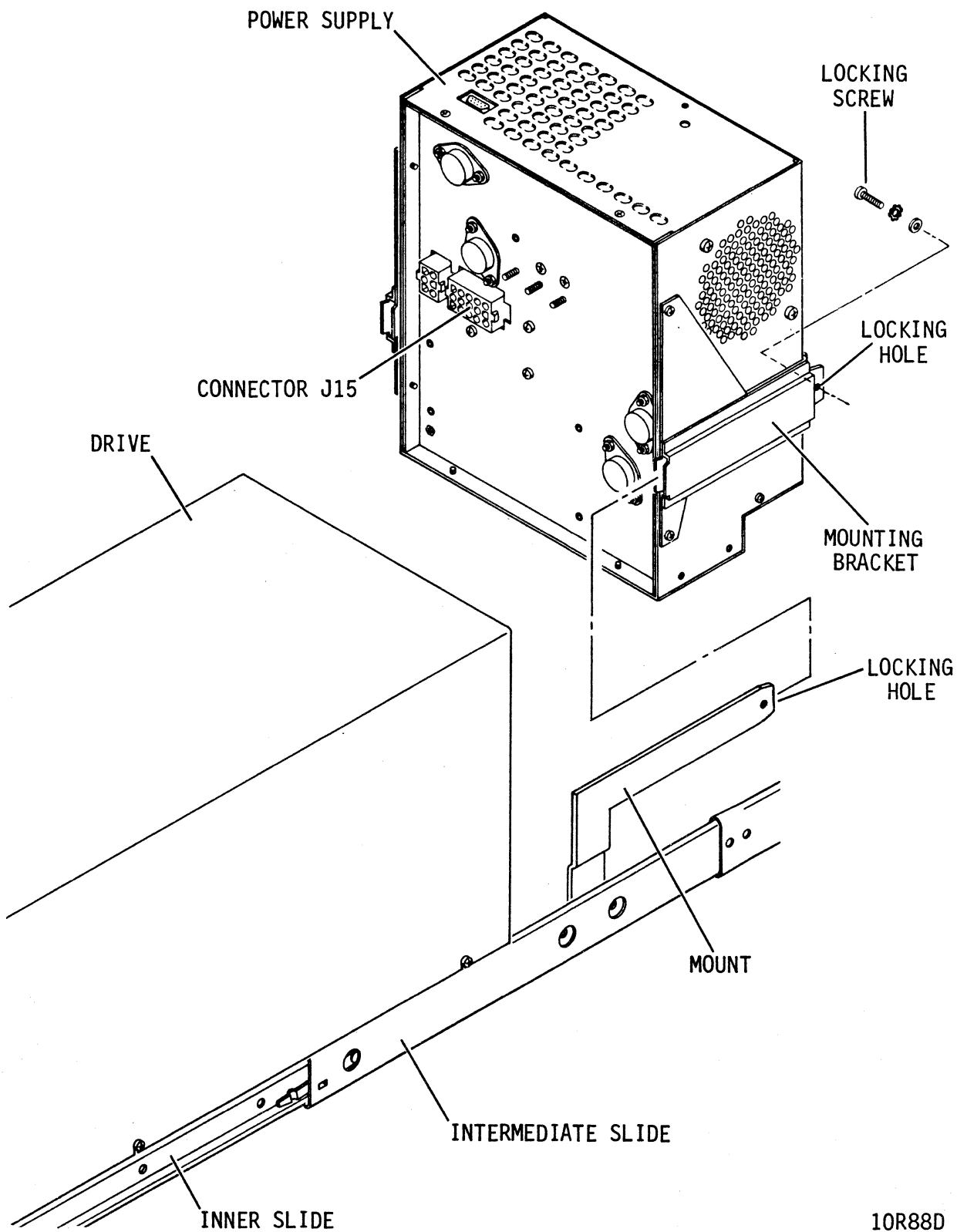
If the power supply is not installed behind the drive, ensure that the location provides adequate clearance for good airflow, and connect ac power cable to AC INPUT connector J1 and site ac power source.

The following procedure provides instructions for mounting the remote power supply behind the drive on the slide assemblies and connecting ac power cable to the supply. Figure 3-10 shows the ac power cable provided with the power supply.

1. Ensure that power supply mounts have been installed on the slides as directed in Mounting Drive in Rack procedure.
2. Position power supply so that mounts and matching slots in bracket are aligned as shown in figure 3-17.
3. Slide power supply toward drive, until locking holes in bracket align with locking holes in mounts.
4. Secure power supply bracket to mounts with 8-32 x 5/16 screws, washers and lockwashers.
5. Connect ac power cable to AC INPUT connector J1 and to site ac power source.

## SETTING CIRCUIT BOARD SWITCHES

The circuit boards inside the drive contain a number of switches that must be set correctly for normal operation of the drive. Figures 3-18 through 3-20 identify these switches for single and dual channel drives and give their locations on the circuit boards. Figures 3-18 through 3-20 give, for each I/O board type, the correct settings for normal drive operation for all switches except the sector select switches. Setting the sector select switches is discussed in the following paragraphs.



10R88D

Figure 3-17. Installing Remote Power Supply on Slides

Figure 3-21 shows the location of the Sector Select switch assembly. The Sector Select switch assembly has twelve independent switches used for selecting sectors. The number of sectors per revolution generated by the drive logic must be matched to that required by the controller. Therefore, sector select switches are provided in the drive logic to allow selection of different sector counts.

Two methods are provided for determining sector switch settings. One is a recommended method, and the other is an alternate method. The two methods are identical when the number of sector clocks per revolution of the disk is evenly divisible by the number of sectors. However, if the division has a remainder, the two methods treat the remainder differently. With the recommended method, the remainder results in an extra sector pulse just before index. Some controllers, however, cannot accommodate the extra sector pulse. With the alternate method, there is no extra sector pulse. Descriptions of both methods follow.

#### Recommended Method for Sector Switch Settings

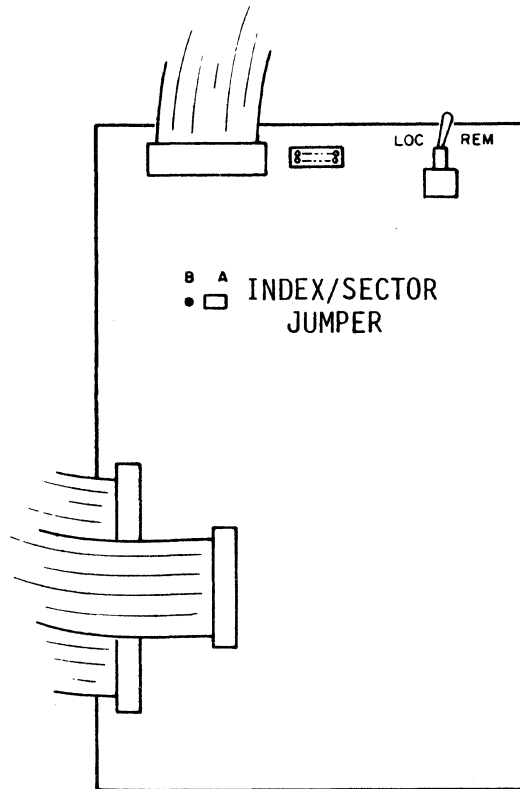
Refer to the subsystem reference manual to determine the number of sectors required by the controller; then locate that number in table 3-6. Across from the number of sectors listed in the table is a row of Cs and Os. C represents the Closed or On position of the sector switch. O represents the Open or Off position of the sector switch. Set the switches to the positions designated in the table while referring to figure 3-21 for an illustration of the switch positions.

The switch settings listed in table 3-6 have been determined from a formula. Use of this formula is demonstrated below to provide the user with an additional tool for determining sector switch settings. Also, there are examples showing how to calculate the number of bytes in a sector for 300, 340, and 515 MB drives.

Each sector will contain a certain number of clock pulses (received from the servo tracks). The number of clock pulses in each sector is the result of the number of sectors required by the controller. Thus:

$$\text{Selected Clock Pulses} = \frac{13\ 440}{\text{Number of Sectors}} - 1$$

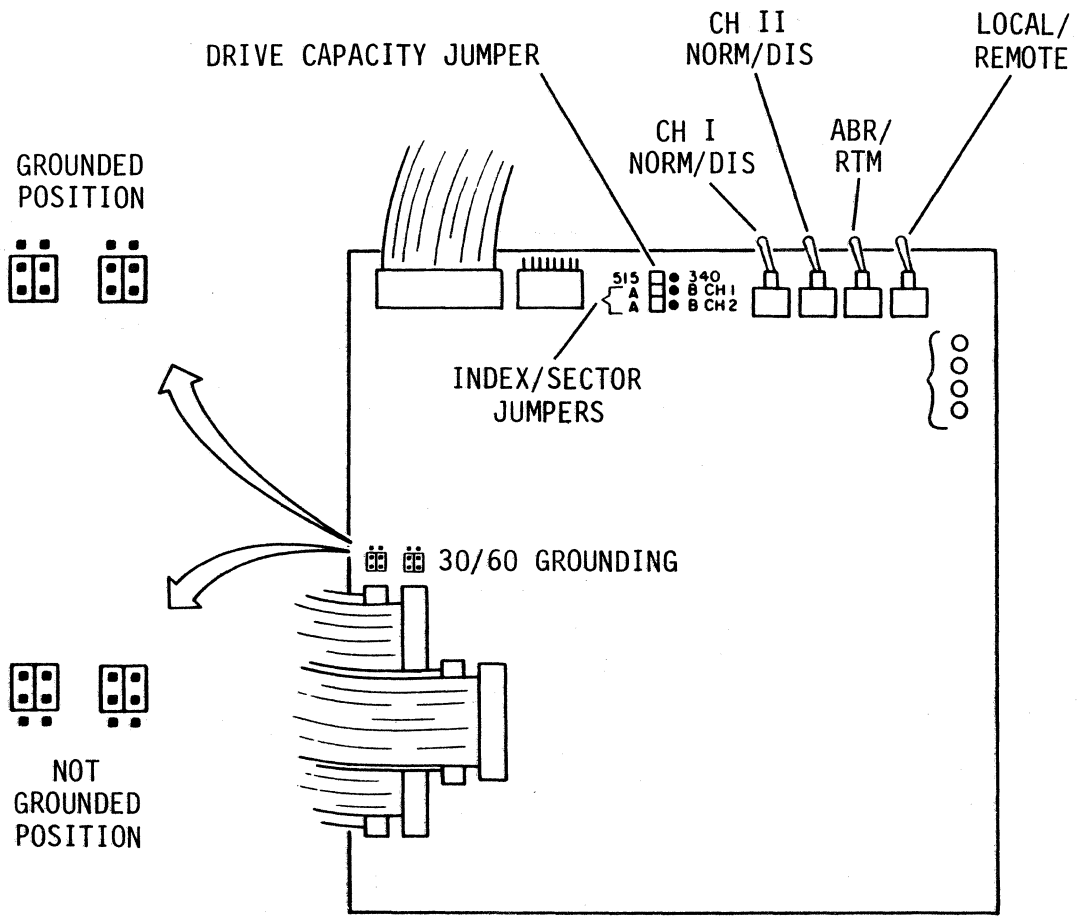




11D609

SWITCH	SETTING	DESCRIPTION
LOC/REM	LOC	Drive powerup independent of controller.
	REM	Drive powerup dependent on controller.
Index/Sector jumper	A	Index and sector signals are in A cable.
	B	Index and sector signals are in B cable.
	Jumper removed	Index and sector signals are in A and B cables.

Figure 3-18. Switch Settings on \_SYX I/O Board

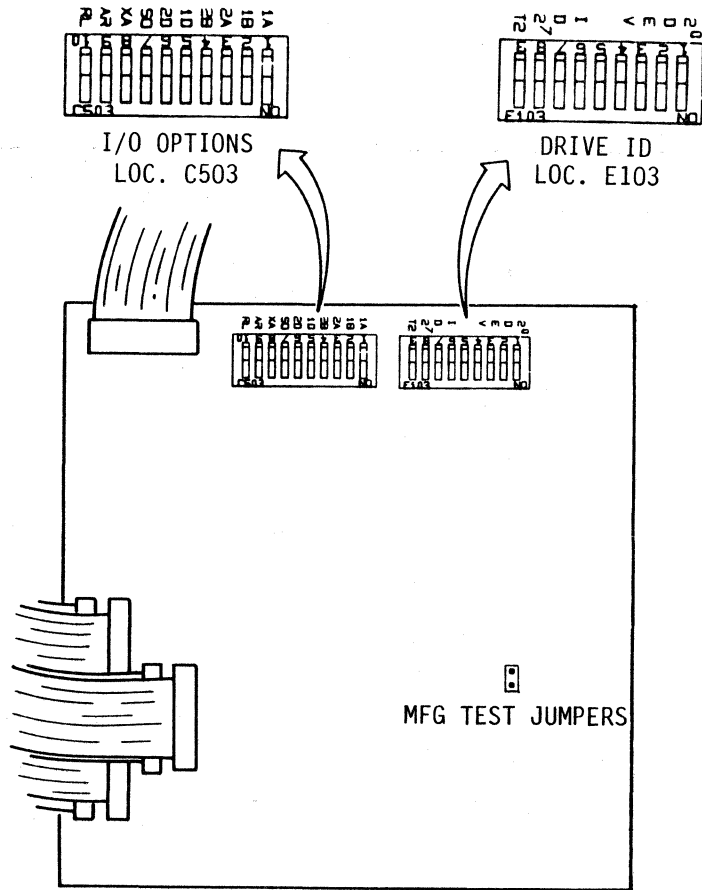


11D610

Figure 3-19. Switch Settings on TQX I/O Board (Sheet 1 of 2)

SWITCH	SETTING	DESCRIPTION
LOCAL/REMOTE	LOCAL	Drive powerup independent of controller.
	REMOTE	Drive powerup dependent on controller.
ABR/RTM	ABR	Drive remains reserved until it receives release or priority select command.
	RTM	Drive is released from reserved condition approximately 500 ms after being selected.
CH II NORM/DIS	NORM	Setting for normal operation.
	DIS	Disables channel II.
CH I NORM/DIS	NORM	Setting for normal operation.
	DIS	Disables channel I.
Drive Capacity jumper	340	340 MB drives.
	515	515 MB drives.
Index/Sector jumper	A	Index and sector signals are in A cable.
	B	Index and sector signals are in B cable.
	Jumper removed	Index and sector signals are in A and B cables.
30/60 Grounding jumpers	Grounded	Pins 30 and 60 are grounded.
	Not Grounded	Pins 30 and 60 are not grounded.

Figure 3-19. Switch Settings on \_TOX I/O Board (Sheet 2)



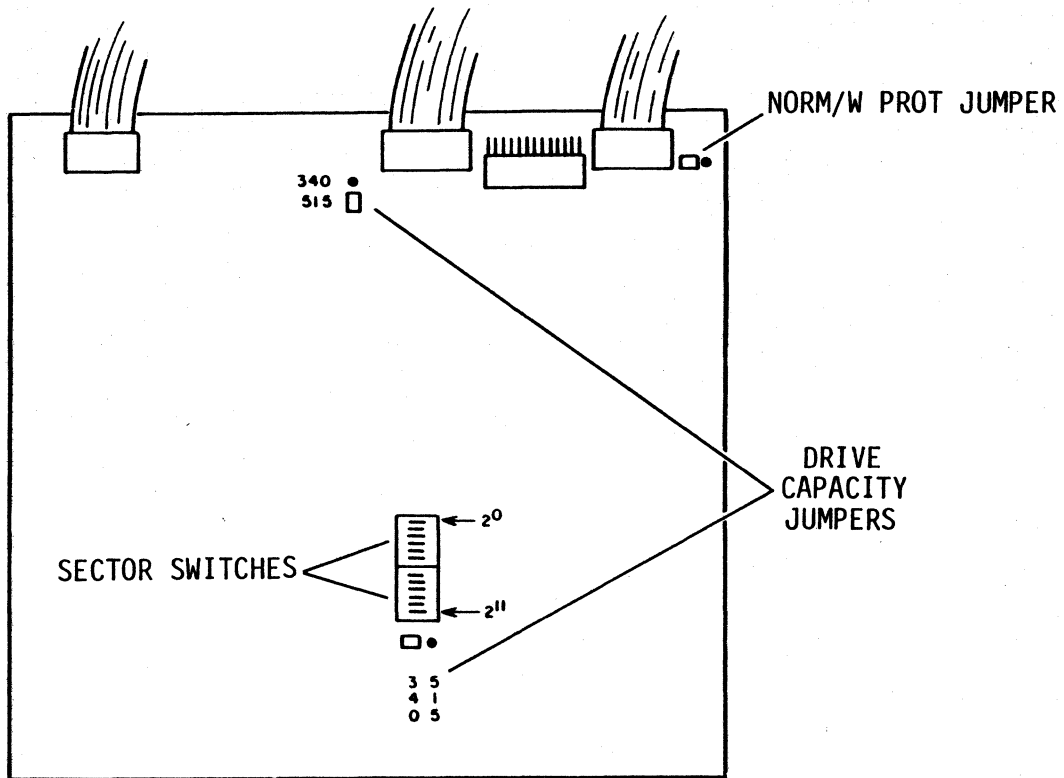
11D611

SWITCH	SETTING	DESCRIPTION
1A	Open (off)	Index and Sector signals are in Ch I A cable.
	Closed(on)	Index and Sector signals are not in Ch 1 A cable.
1B	Open (off)	Index and Sector signals are in Ch I B cable.
	Closed(on)	Index and Sector signals are not in Ch 1 B cable.
2A	Open (off)	Index and Sector signals are in Ch II A cable.
	Closed(on)	Index and Sector signals are not in Ch II A cable.

Figure 3-20. Switch Settings on \_VJX I/O Board (Sheet 1 of 2)

SWITCH	SETTING	DESCRIPTION
2B	Open (off)	Index and Sector signals are in Ch II B cable.
	Closed(on)	Index and Sector signals are not in Ch II B cable.
1D	Open (off)	Ch I enabled.
	Closed(on)	Ch I disabled.
2D	Open (off)	Ch II enabled.
	Closed(on)	Ch II disabled.
SO	Open (off)	SMD-E mode.
	Closed(on)	SMD-0 mode.
XA		Extended cylinder address switch not used in this drive. Set in open (off) position.
AR	Open (off)	Absolute Reserve mode.
	Closed(on)	Reserve Timeout mode.
RL	Open (off)	Drive powerup dependent on controller.
	Closed(on)	Drive powerup independent of controller.
$2^0 \rightarrow 2^7$		Set according to customer requirements.
T2		On newer _VJX boards only. For extended cylinder addressing, which is not used in this drive. Set in closed (on) position.
Mfg test jumpers		Jumpers preset during manufacturing. Drive will not operate with jumpers removed.

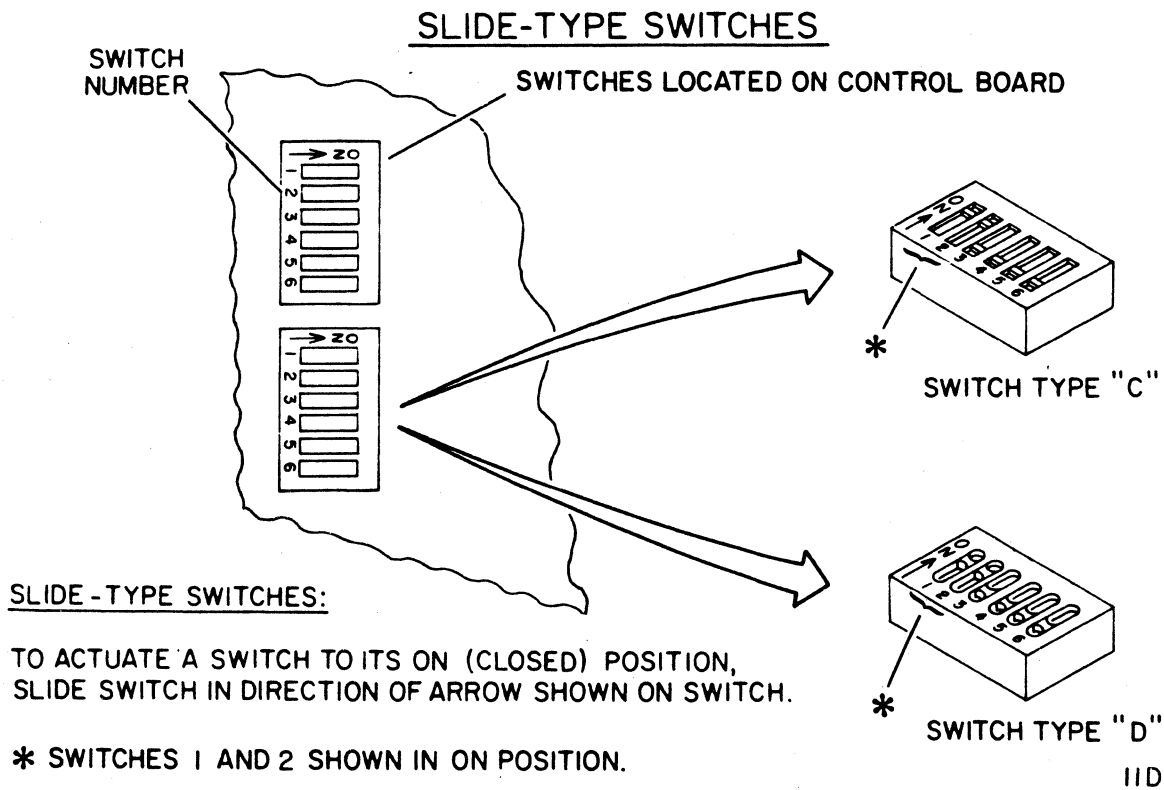
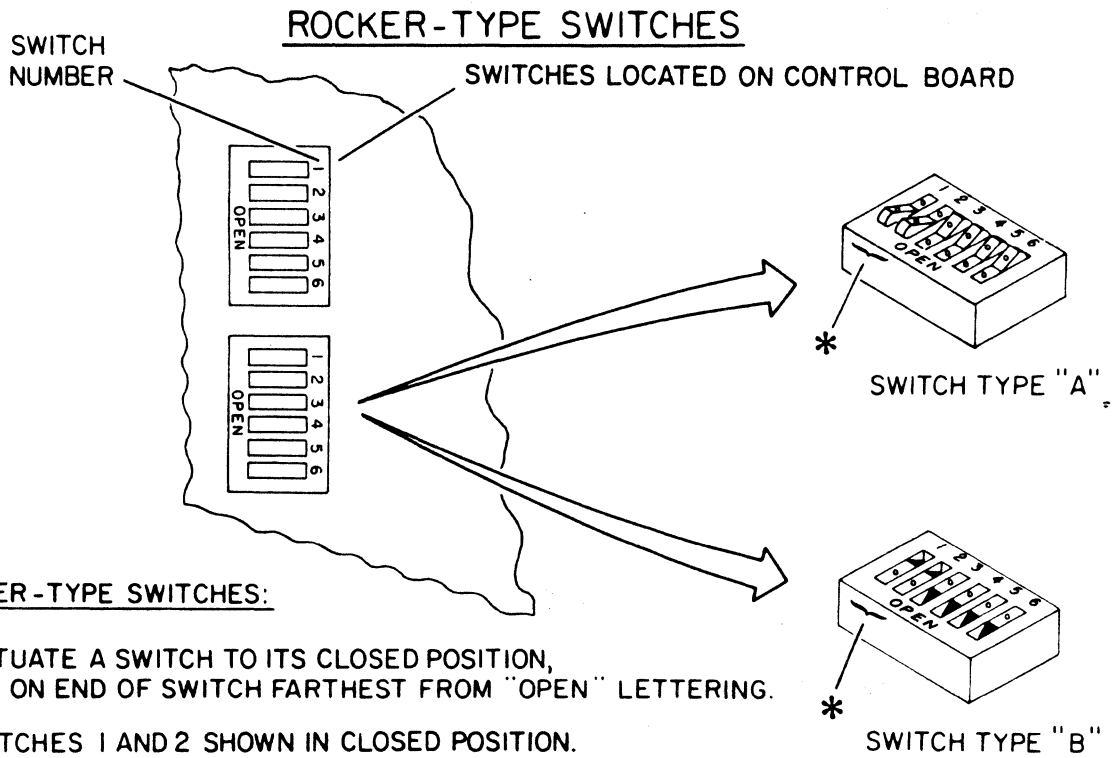
Figure 3-20. Switch Settings on \_VJX I/O Board (Sheet 2)



11D612

SWITCH	SETTING	DESCRIPTION
Drive Capacity jumpers	340	340 MB drives.
	515	515 MB drives.
Sector switches		See discussion on setting circuit board switches.
NORM/W PROT jumper	NORM	Normal.
	W PROT	Write Protect.

Figure 3-21. Switch Settings on \_VCX Control Board



11D23B

Figure 3-22. Miniature Switches

TABLE 3-6. SECTOR SELECT SWITCH SETTINGS

Number of Sectors	Switch Number											
	0	1	2	3	4	5	6	7	8	9	10	11
4	C	C	C	C	C	O	O	O	C	O	C	C
5	C	C	C	C	C	C	C	O	O	C	O	C
6	C	C	C	C	C	C	O	C	O	O	O	C
7	C	C	C	C	C	C	C	O	C	C	C	O
8	C	C	C	C	O	O	O	C	O	C	C	O
9	O	O	C	O	C	O	C	C	C	O	C	O
10	C	C	C	C	C	C	O	O	C	O	C	O
11	O	O	C	O	O	O	C	C	O	O	C	O
12	C	C	C	C	C	O	C	O	O	O	C	O
13	O	O	O	C	O	O	O	O	O	O	C	O
14	C	C	C	C	C	C	O	C	C	C	O	O
15	C	C	C	C	C	C	C	O	C	C	O	O
16	C	C	C	O	O	O	C	O	C	C	O	O
17	C	O	C	O	C	O	O	O	C	C	O	O
18	C	O	O	C	O	C	C	C	O	C	O	O
19	O	C	O	O	O	O	C	C	O	C	O	O
20	C	C	C	C	C	O	O	C	O	C	O	O
21	C	C	C	C	C	C	C	O	O	C	O	O
22	C	O	O	O	O	C	C	O	O	C	O	O
23	C	C	C	O	O	O	C	O	O	C	O	O
24	C	C	C	C	O	C	O	O	O	C	O	O
25	O	O	O	C	C	O	O	O	O	C	O	O
26	C	C	O	O	O	O	O	O	O	C	O	O
27	O	O	O	O	C	C	C	C	C	O	O	O
28	C	C	C	C	C	O	C	C	C	O	O	O

Table Continued on Next Page



TABLE 3-6. SECTOR SELECT SWITCH SETTINGS (Contd)

Number of Sectors	Switch Number											
	0	1	2	3	4	5	6	7	8	9	10	11
29	O	C	C	C	O	O	C	C	C	O	O	O
30	C	C	C	C	C	C	O	C	C	O	O	O
31	O	O	O	O	C	C	O	C	C	O	O	O
32	C	C	O	O	O	C	O	C	C	O	O	O
33	O	C	C	O	C	O	O	C	C	O	O	O
34	O	C	O	C	O	O	O	C	C	O	O	O
35	C	C	C	C	C	C	C	O	C	O	O	O
36	O	O	C	O	C	C	C	O	C	O	O	O
37	O	C	O	C	O	C	C	O	C	O	O	O
38	O	O	O	O	O	C	C	O	C	O	O	O
39	C	C	C	O	C	O	C	O	C	O	O	O
40	C	C	C	C	O	O	C	O	C	O	O	O
41	O	C	C	O	O	O	C	O	C	O	O	O
42	C	C	C	C	C	C	O	O	C	O	O	O
43	C	C	C	O	C	C	O	O	C	O	O	O
44	O	O	O	O	C	C	O	O	C	O	O	O
45	C	O	O	C	O	C	O	O	C	O	O	O
46	C	C	O	O	O	C	O	O	C	O	O	O
47	O	O	C	C	C	O	O	O	C	O	O	O
48	C	C	C	O	C	O	O	O	C	O	O	O
49	C	O	O	O	C	O	O	O	C	O	O	O
50	C	C	O	C	O	O	O	O	C	O	O	O
51	O	C	C	O	O	O	O	O	C	O	O	O
52	C	O	O	O	O	O	O	O	C	O	O	O
53	O	O	C	C	C	C	C	C	O	O	O	O

Table Continued on Next Page

TABLE 3-6. SECTOR SELECT SWITCH SETTINGS (Contd)

Number of Sectors	Switch Number											
	0	1	2	3	4	5	6	7	8	9	10	11
54	C	C	C	O	C	C	C	C	O	O	O	O
55	C	C	O	O	C	C	C	C	O	O	O	O
56	C	C	C	C	O	C	C	C	O	O	O	O
57	O	C	O	C	O	C	C	C	O	O	O	O
58	O	C	C	O	O	C	C	C	O	O	O	O
59	O	C	O	O	O	C	C	C	O	O	O	O
60	C	C	C	C	C	O	C	C	O	O	O	O
61	C	C	O	C	C	O	C	C	O	O	O	O
62	C	C	C	O	C	O	C	C	O	O	O	O
63	O	O	C	O	C	O	C	C	O	O	O	O
64	C	O	O	O	C	O	C	C	O	O	O	O
65	C	O	C	C	O	O	C	C	O	O	O	O
66	O	C	O	C	O	O	C	C	O	O	O	O
67	C	C	C	O	O	O	C	C	O	O	O	O
68	O	O	C	O	O	O	C	C	O	O	O	O
69	C	O	O	O	O	O	C	C	O	O	O	O
70	C	C	C	C	C	C	O	C	O	O	O	O
71	O	O	C	C	C	C	O	C	O	O	O	O
72	C	O	O	C	C	C	O	C	O	O	O	O
73	C	C	C	O	C	C	O	C	O	O	O	O
74	O	O	C	O	C	C	O	C	O	O	O	O
75	O	C	O	O	C	C	O	C	O	O	O	O
76	C	C	C	C	O	C	O	C	O	O	O	O
77	C	O	C	C	O	C	O	C	O	O	O	O
78	C	C	O	C	O	C	O	C	O	O	O	O

Table Continued on Next Page

TABLE 3-6. SECTOR SELECT SWITCH SETTINGS (Contd)

Number of Sectors	Switch Number											
	0	1	2	3	4	5	6	7	8	9	10	11
79	C	O	O	C	O	C	O	C	O	O	O	O
80	C	C	C	O	O	C	O	C	O	O	O	O
81	O	O	C	O	O	C	O	C	O	O	O	O
82	O	C	O	O	O	C	O	C	O	O	O	O
83	O	O	O	O	O	C	O	C	O	O	O	O
84	C	C	C	C	C	O	O	C	O	O	O	O
85	C	O	C	C	C	O	O	C	O	O	O	O
86	C	C	O	C	C	O	O	C	O	O	O	O
87	C	O	O	C	C	O	O	C	O	O	O	O
88	C	C	C	O	C	O	O	C	O	O	O	O
89	O	C	C	O	C	O	O	C	O	O	O	O
90	O	O	C	O	C	O	O	C	O	O	O	O
91	O	C	O	O	C	O	O	C	O	O	O	O
92	C	O	O	O	C	O	O	C	O	O	O	O
93	C	C	C	C	O	O	O	C	O	O	O	O
94	C	O	C	C	O	O	O	C	O	O	O	O
95	O	O	C	C	O	O	O	C	O	O	O	O
96	C	C	O	C	O	O	O	C	O	O	O	O
97	C	O	O	C	O	O	O	C	O	O	O	O
98	O	O	O	C	O	O	O	C	O	O	O	O
99	O	C	C	O	O	O	O	C	O	O	O	O
100	C	O	C	O	O	O	O	C	O	O	O	O
101	O	O	C	O	O	O	O	C	O	O	O	O
102	O	C	O	O	O	O	O	C	O	O	O	O
103	C	O	O	O	O	O	O	C	O	O	O	O

Table Continued on Next Page

TABLE 3-6. SECTOR SELECT SWITCH SETTINGS (Contd)

Number of Sectors	Switch Number											
	0	1	2	3	4	5	6	7	8	9	10	11
104	O	O	O	O	O	O	O	C	O	O	O	O
105	C	C	C	C	C	C	C	O	O	O	O	O
106	C	O	C	C	C	C	C	O	O	O	O	O
107	O	O	C	C	C	C	C	O	O	O	O	O
108	C	C	O	C	C	C	C	O	O	O	O	O
109	O	C	O	C	C	C	C	O	O	O	O	O
110	C	O	O	C	C	C	C	O	O	O	O	O
111	O	O	O	C	C	C	C	O	O	O	O	O
112	C	C	C	O	C	C	C	O	O	O	O	O
113	C	O	C	O	C	C	C	O	O	O	O	O
114	O	O	C	O	C	C	C	O	O	O	O	O
115	C	C	O	O	C	C	C	O	O	O	O	O
116	O	C	O	O	C	C	C	O	O	O	O	O
117	C	O	O	O	C	C	C	O	O	O	O	O
118	O	O	O	O	C	C	C	O	O	O	O	O
119	C	C	C	C	O	C	C	O	O	O	O	O
120	C	C	C	C	O	C	C	O	O	O	O	O
121	O	C	C	C	O	C	C	O	O	O	O	O
122	C	O	C	C	O	C	C	O	O	O	O	O
123	O	O	C	C	O	C	C	O	O	O	O	O
124	C	C	O	C	O	C	C	O	O	O	O	O
125	O	C	O	C	O	C	C	O	O	O	O	O
126	C	O	O	C	O	C	C	O	O	O	O	O
127	O	O	O	C	O	C	C	O	O	O	O	O
128	O	O	O	C	O	C	C	O	O	O	O	O

Note: C = Closed or On position; O = Open or Off position.

NOTE

Ignore any remainder in the calculation. The existence of a remainder adds a "short" sector before index.

Each sector switch represents a binary and decimal value of clock pulses (as counted in the logic). The values related to each switch are as follows:

<u>Switch No.</u>	<u>Binary Value</u>	<u>Decimal Value</u>
0	$2^0$	1
1	$2^1$	2
2	$2^2$	4
3	$2^3$	8
4	$2^4$	16
5	$2^5$	32
6	$2^6$	64
7	$2^7$	128
8	$2^8$	256
9	$2^9$	512
10	$2^{10}$	1024
11	$2^{11}$	2048

Here is an example of determining the switch settings for selecting 63 sectors:

$$\text{Selected Clock Pulses} = \left( \frac{13\ 440}{63} - 1 \right) = (213.33 - 1) = 212.33$$

If there is a remainder, it should be ignored. In this case, the number of selected clock pulses becomes 212.

Determine which switches to place in the Closed or On position as follows:

Selected clock pulses	212
Clock pulses selected by switch 7	128
(Difference)	84
Clock pulses selected by switch 6	64
(Difference)	20
Clock pulses selected by switch 4	16
(Difference)	4
Clock pulses selected by switch 2	4
(Difference)	0

Thus, placing switches 2, 4, 6, and 7 in the Closed or On position selects 63 sectors. Since a remainder existed in the calculation formula, an additional "short" sector will be present just before index.

To calculate the number of bytes in one sector, based on the above switch settings, proceed as follows:

- Add 1 to the selected clock pulses:  $212 + 1 = 213$ .
- For 300 and 340 MB drives, multiply this number by the number of bytes per clock pulse (1.5) to find the number of bytes per sector:  $213 \times 1.5 = 319.5$
- For 515 MB drives, multiply the same number by the number of bytes per clock pulse (2.25) to find the number of bytes per sector:  $213 \times 2.25 = 479.25$

### Alternate Method for Sector Switch Settings

Use the following formula to determine sector switch settings if the subsystem cannot accept an extra sector pulse before index.

Here is an example of determining the switch settings for selecting 63 sectors:

$$\text{Selected Clock Pulses} = \left( \frac{13\ 440}{63} - 1 \right) = (213.33 - 1) = 212.33$$

If there is a remainder, it is necessary to round up to the next whole number. In this case, the number of selected clock pulses becomes 213.

Determine which switches to place in the Closed or On position as follows:

Selected clock pulses	213
Clock pulses selected by switch 7	128
(Difference)	85
Clock pulses selected by switch 6	64
(Difference)	21
Clock pulses selected by switch 4	16
(Difference)	5
Clock pulses selected by switch 2	4
(Difference)	1
Clock pulses selected by switch 0	1
(Difference)	0

Thus, placing switches 0, 2, 4, 6, and 7 in the Closed or On position selects 63 sectors. Since a remainder existed in the calculation formula, the last (63rd) sector will be shorter than those preceding it.

To calculate the number of bytes in each of the first 62 sectors, based on the above switch settings, proceed as follows:

- Add 1 to the selected clock pulses:  $213 + 1 = 214$
- For 300 and 340 MB drives, multiply this number by the number of bytes per clock pulse (1.5) to find the number of bytes per sector:  $214 \times 1.5 = 321.0$
- For 515 MB drives, multiply the same number by the number of bytes per clock pulse (2.25) to find the number of bytes per sector:  $214 \times 2.25 = 481.5$

To calculate the number of bytes in the 63rd sector for 300 and 340 MB drives, proceed as follows:

- Multiply the number of bytes per sector (calculated above) by 62 (the number of full-length sectors):  
 $321 \times 62 = 19\ 902$
- Subtract this number from the number of bytes per track (20 160) to find the number of bytes in the 63rd sector:  
 $20\ 160 - 19\ 902 = 258$

To calculate the number of bytes in the 63rd sector for 515 MB drives, proceed as follows:

- Multiply the number of bytes per sector (calculated above) by 62 (the number of full-length sectors):  
 $481.5 \times 62 = 29\ 853$
- Subtract this number from the number of bytes per track (30 240) to find the number of bytes in the 63rd sector:  
 $30\ 240 - 29\ 853 = 387$

## CHECKOUT

After completing installation of the drive, follow the sequence outlined below for initial startup. Refer to section 2 of this manual for information about operation of the drive.

1. Install logic plug in operator panel. Logic plug for each drive in a system must have a unique number.
2. Remove drive top cover and set LOCAL/REMOTE switch to LOCAL position.

3. Set circuit breaker CBl at rear of power supply in ON position, and observe that the drive cooling fan operates.
4. Press START switch on drive operator panel, and observe that the following events occur:

- The drive motor starts.
- The Ready indicator (inside the START switch) lights steadily within 45 seconds of startup. This indicates that the drive motor is up to speed and that the heads are at track 0.

If any of these events do not occur, a problem exists in the drive. Then refer to troubleshooting information either in appendix A of this manual or in volume 2 of the hardware maintenance manual.

5. Power down drive.
6. Set LOCAL/REMOTE switch to REMOTE position if remote operation is desired and install top cover.
7. Return drive to normal operating position in equipment rack.
8. Drive is now ready for online operation.



**SECTION 4**

**PARTS DATA**

---

## INTRODUCTION

This section contains listings of field replaceable parts (including FRUs), manufacturer's recommended spare parts, and accessories. Use only MPI replacement parts. Using non-CDC/MPI parts can adversely affect safety. Using other manufacturers' parts could also degrade reliability, increase maintenance downtime, and void warranty coverage.

## FIELD REPLACEABLE PARTS LIST

This listing is divided into four columns:

- INDEX NO - The numbers in this column correspond to the numbers shown within the facing page illustration.
- PART NUMBER - Contains one of the following:
  1. Eight digit part number - use this number to order a replacement part. Within the continental U.S., parts may be ordered from Control Data Corporation, World Distribution Center, 304 North Dale St., St. Paul, MN, 55103, Telephone 612-292-2200.
  2. Optional - parts which are not used in all applications. To determine usage in a particular equipment, you must first know the Equipment Package part number (refer to Equipment Configuration in section 1 of this manual for definition and location of this number) and then refer to table 4-1. Table 4-1 contains the Equipment Package part number (the first 6 digits are on line 1, and the last 2 digits are on line 2) and a list of optional parts. If an optional part is used in a particular Equipment Package, "XX" will appear in that column.
  3. Spare - indicates that the item is a manufacturer's recommended spare part. Refer to table 4-2 for replacement part number information.
- PART DESCRIPTION - Contains part nomenclature/description. If an item is indented more than the previous item, it indicates it is part of the previous item (assembly).

- NOTE - Usually contains entries to define differences between machine configurations (i.e., model differences, older units vs newer units, etc.).

## **MANUFACTURER'S RECOMMENDED SPARE PARTS**

This listing (table 4-2) is divided into three columns:

- DESCRIPTION/NOTES - Contains the part nomenclature/description and other pertinent information.
- PART NUMBER - Contains the part number of the part when the unit was manufactured or as a result of the latest FCO. This part can be used as a replacement on the series code and types of units indicated in the Description/Notes column. However, always use Replacement Part Number when ordering new parts or spares.
- REPLACEMENT PART NUMBER - Contains the interchangeable replacement part number. Use this number for ordering replacement or spare parts.

## **ACCESSORIES**

This listing (table 4-3) contains the following:

- PART NUMBER - Use this number to order this part. See Field Replaceable Parts List for ordering information.
- DESCRIPTION - Contains the part nomenclature/description.

# LOCATOR

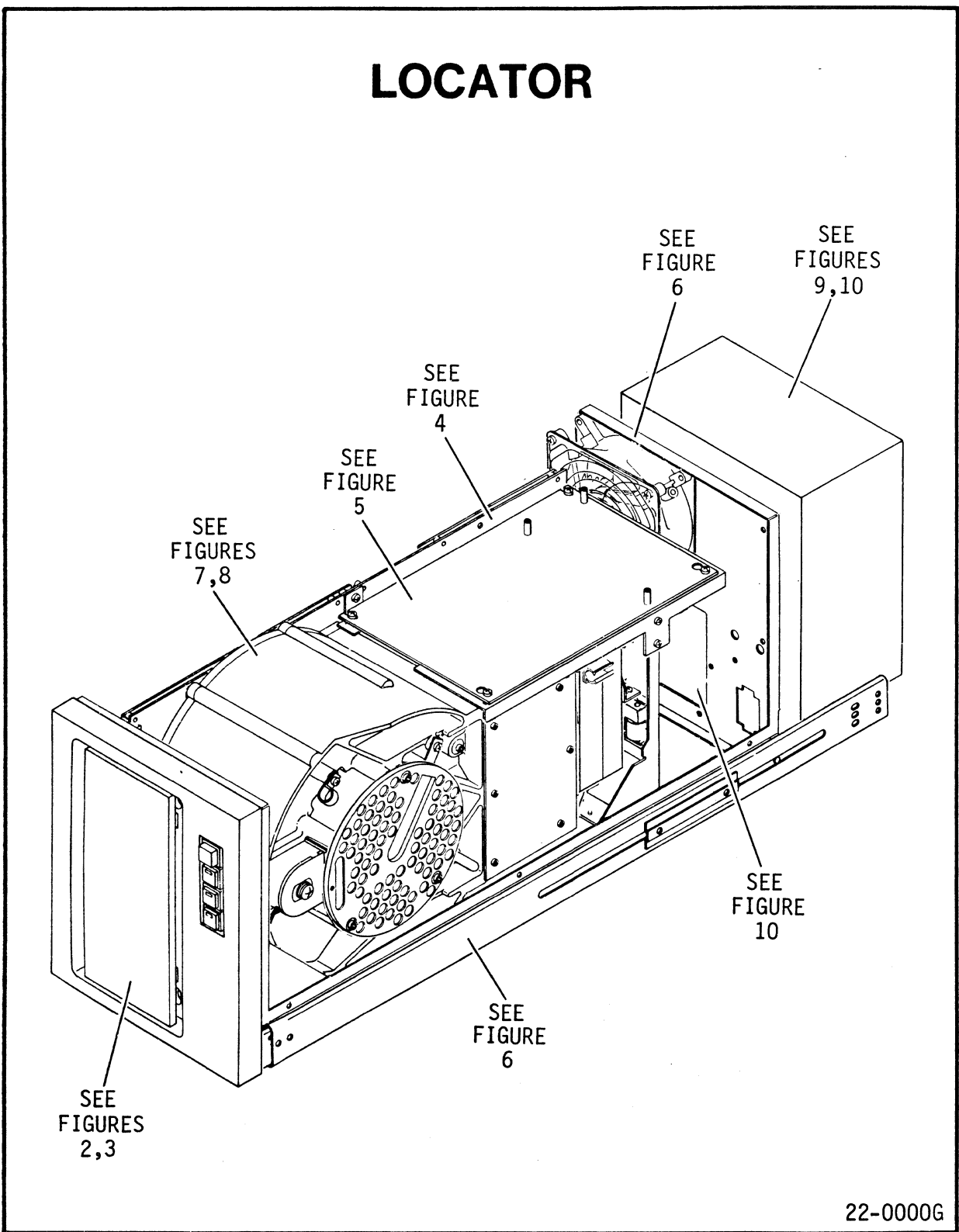
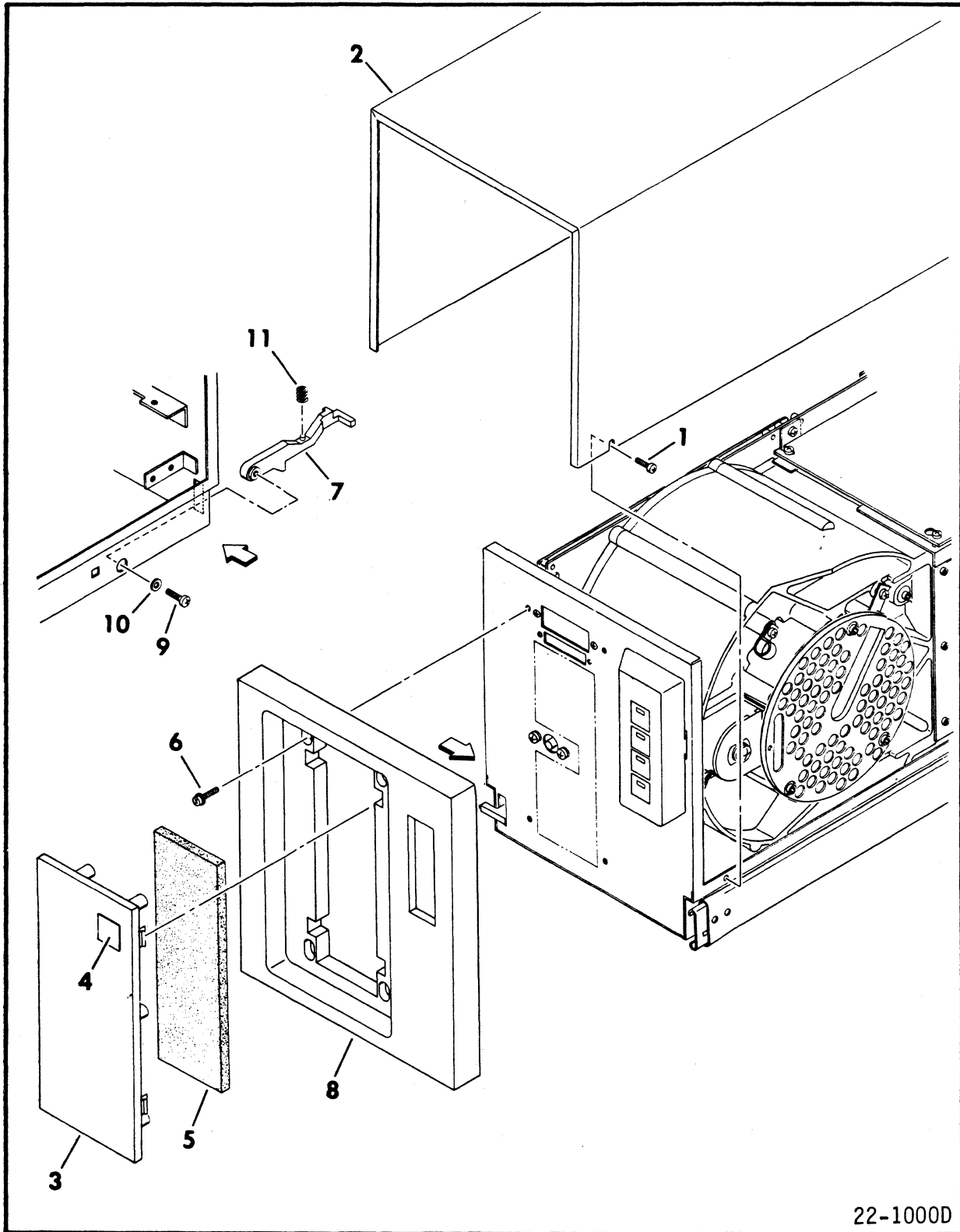


Figure 4-1



22-1000D

Figure 4-2

INDEX NO	PART NO	PART DESCRIPTION	NOTE
1	92743156	SCREW, PHH, 6-32 x 3/16	
2	72852546	COVER	
3	Optional	INSERT, Front Panel	
4	Optional	EMBLEM, Product Ident	
5	Spare	FILTER, Primary	Except PA5N1C
5	45070750	FILTER ASSEMBLY	PA5N1C only
6	53879414	SCREW, W/WASHER, 6-32 x 1/2	
7	Optional	LATCH, Cabinet	
8	Optional	PANEL, Front	
9	Optional	SCREW, PHH, 8-32 x 1/4	
10	Optional	WASHER, #8	
11	Optional	SPRING	

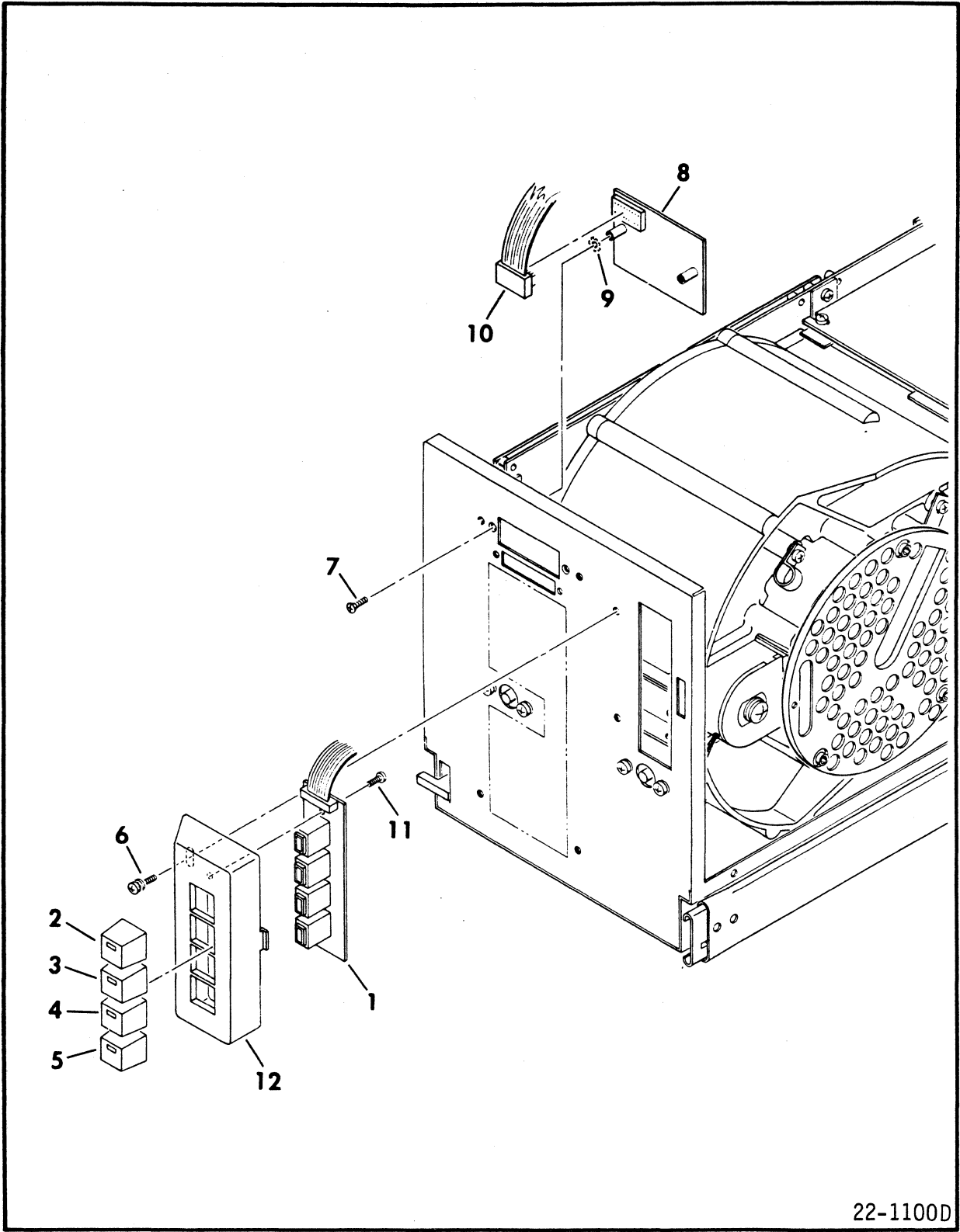


Figure 4-3

INDEX NO	PART NO	PART DESCRIPTION	NOTE
1	Spare	OPERATOR PANEL	
2		LOGIC PLUG	See Note 4
	Spare	LOGIC PLUG KIT (PA5N1C only)	See Note 2
3	94394255	LENS, "START"	See Note 1
3	15181644	LENS, "START"	See Note 2
3	15181647	LENS, "MARCHE"	See Note 3
4	94394256	LENS, "FAULT"	See Note 1
4	15181643	LENS, "FAULT"	See Note 2
4	15181646	LENS, "FAUTE"	See Note 3
5	94394257	LENS, "WRITE PROTECT"	See Note 1
5	15181645	LENS, "WRITE PROTECT"	See Note 2
5	15181648	LENS, "PROT. ECRIT"	See Note 3
6	92001710	SCREW W/WASHER, 6-32 x 5/16	
7	10125711	SCREW, PHH, 6-32 x 3/16	
8	Spare	FAULT DISPLAY BOARD	
9	10126401	LOCKWASHER, #6	
10	Spare	FAULT STATUS CABLE	
11	10127102	SCREW, PHH, 4-40 x 1/4	See Note 2
12	81903870	BRACKET, Switch	See Note 2

Note 1: Used on older operator panels, which have logic plugs without indicator lights.

Note 2: Used on newer operator panels, which have logic plugs with indicator lights.

Note 3: Used on PA5N1E, PA5N2D drives only.

Note 4: Refer to table 4-3 (Accessories) for listing of available logic plugs.



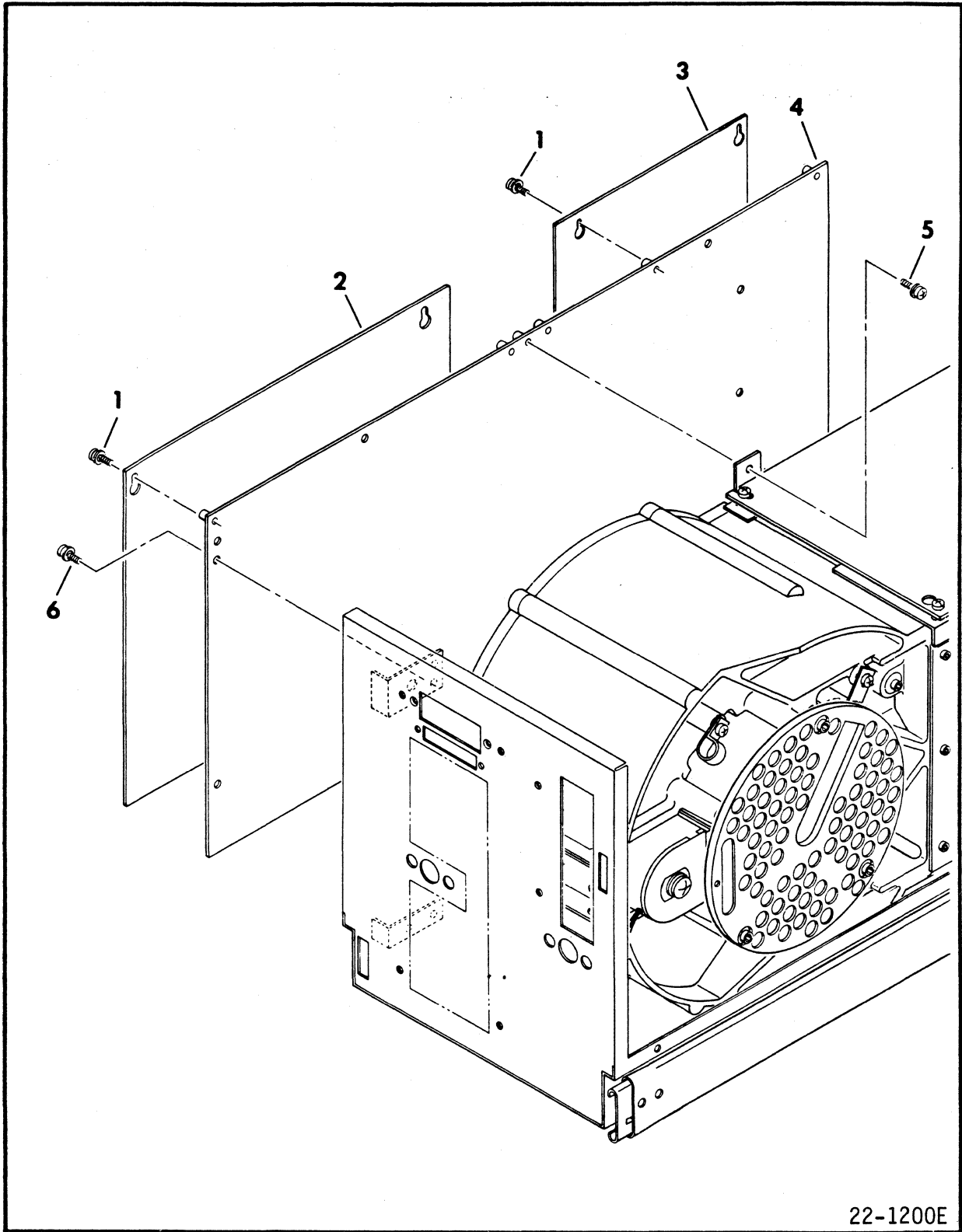


Figure 4-4

INDEX NO	PART NO	PART DESCRIPTION	NOTE
1	92001710	SCREW W/WASHER, 6-32 x 5/16	
2	Spare	CONTROL BOARD	
3	Spare	I/O BOARD	
4	Spare	MOTHER BOARD	
5	92001704	SCREW W/WASHER, 6-32 x 3/8	
6	10127111	SCREW, PHH, 6-32 x 1/4	

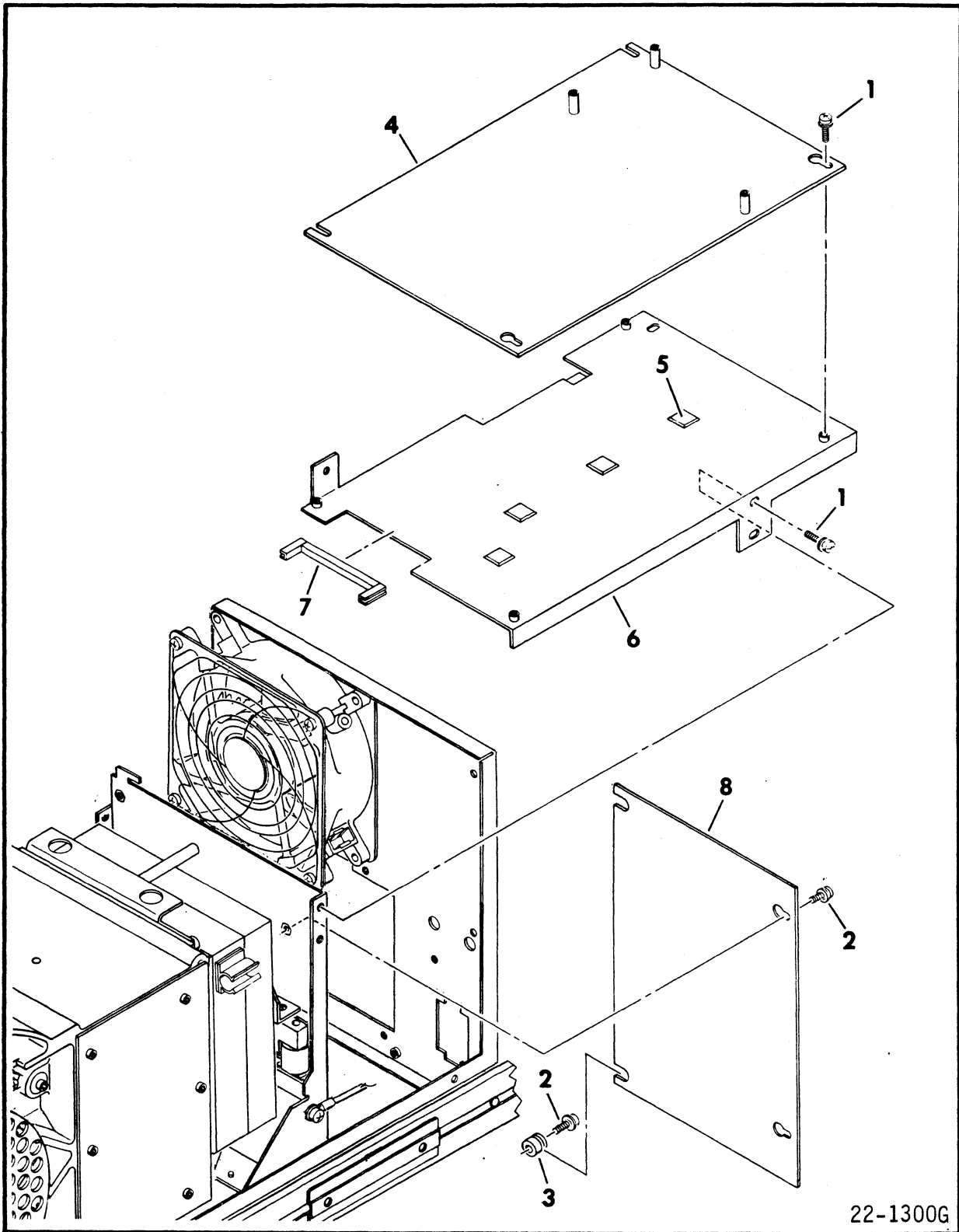


Figure 4-5

INDEX NO	PART NO	PART DESCRIPTION	NOTE
1	92001710	SCREW W/WASHER, 6-32 x 5/16	
2	92001705	SCREW W/WASHER, 6-32 x 1/2	
3	92723601	SPACER	
4	Spare	READ/WRITE BOARD	
5	51805802	BUMPER	
6	72857460	BRACKET, R/W Board	See Note 1
6	72857462	BRACKET, R/W Board	See Note 2
6	72857463	BRACKET, R/W Board	See Note 3
7	94385500	CHANNEL, Rubber	
8	Spare	MOT SPD & PWR AMP BOARD	

Note 1: Used on S/C 06 & Blw drives.

Note 2: Used on S/C 07 thru 12 drives without  
ECO DJ30240 installed.

Note 3: Used on S/C 13 & Abv drives, and on drives  
with ECO DJ30240 installed.

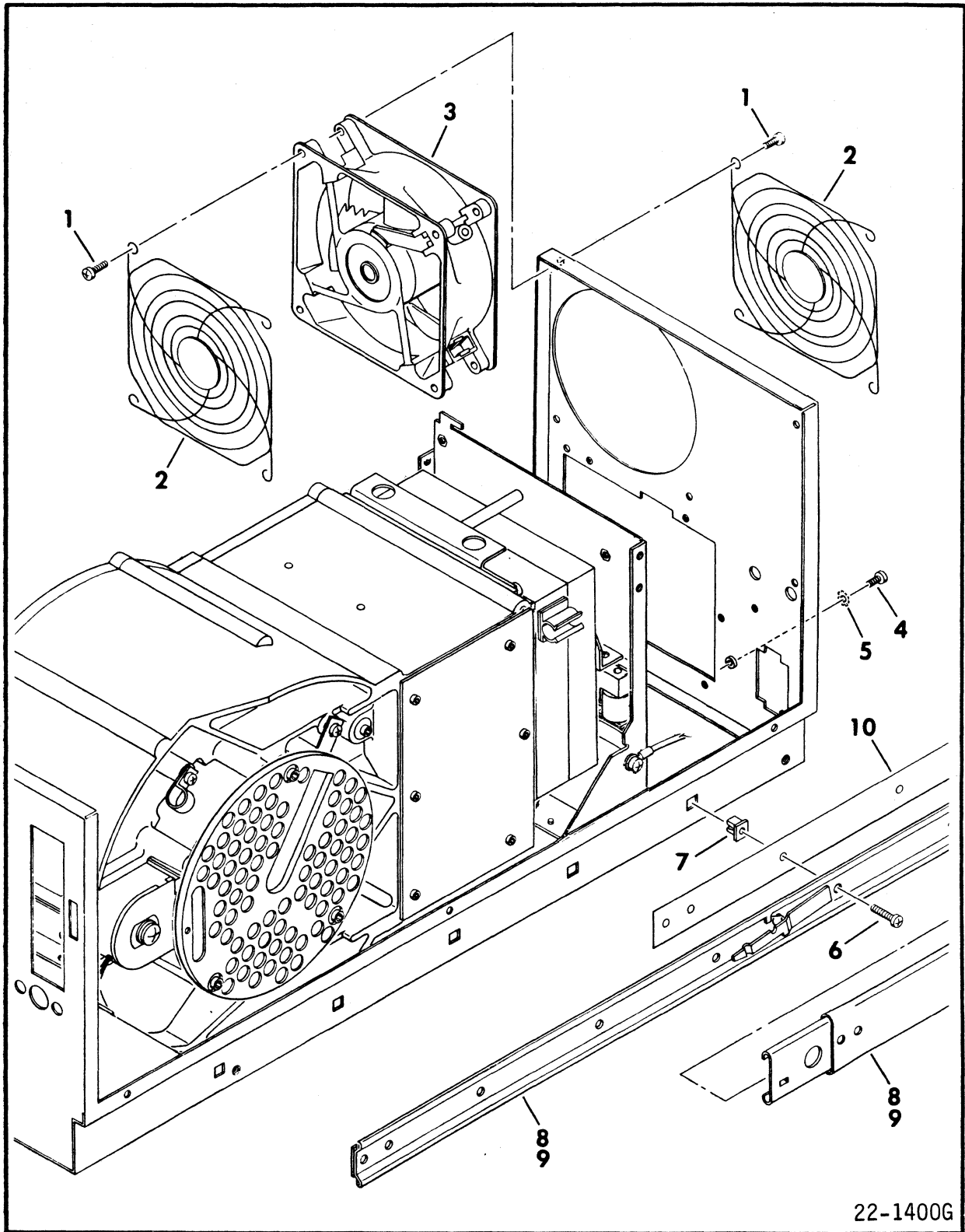


Figure 4-6

INDEX NO	PART NO	PART DESCRIPTION	NOTE
1	10127124	SCREW, PHH, 8-32 x 5/8	See Note 1
2	94375408	GUARD, Finger	
3	Spare	FAN ASSEMBLY	
4	10127141	SCREW, PHH, 10-32 x 5/16	
5	10126403	LOCKWASHER, #10	
6	94375825	SCREW, PHH, 8-16 x 1/2	
7	72854290	NUT, Square	
8	Optional	SLIDE ASSEMBLY, LH	
9	Optional	SLIDE ASSEMBLY, RH	
10	93265870	BRACKET, Support	See Note 2

Note 1: Older fans with untapped holes use self-tapping screws, p/n 17901518.

Note 2: Used on integral power supply drives only.

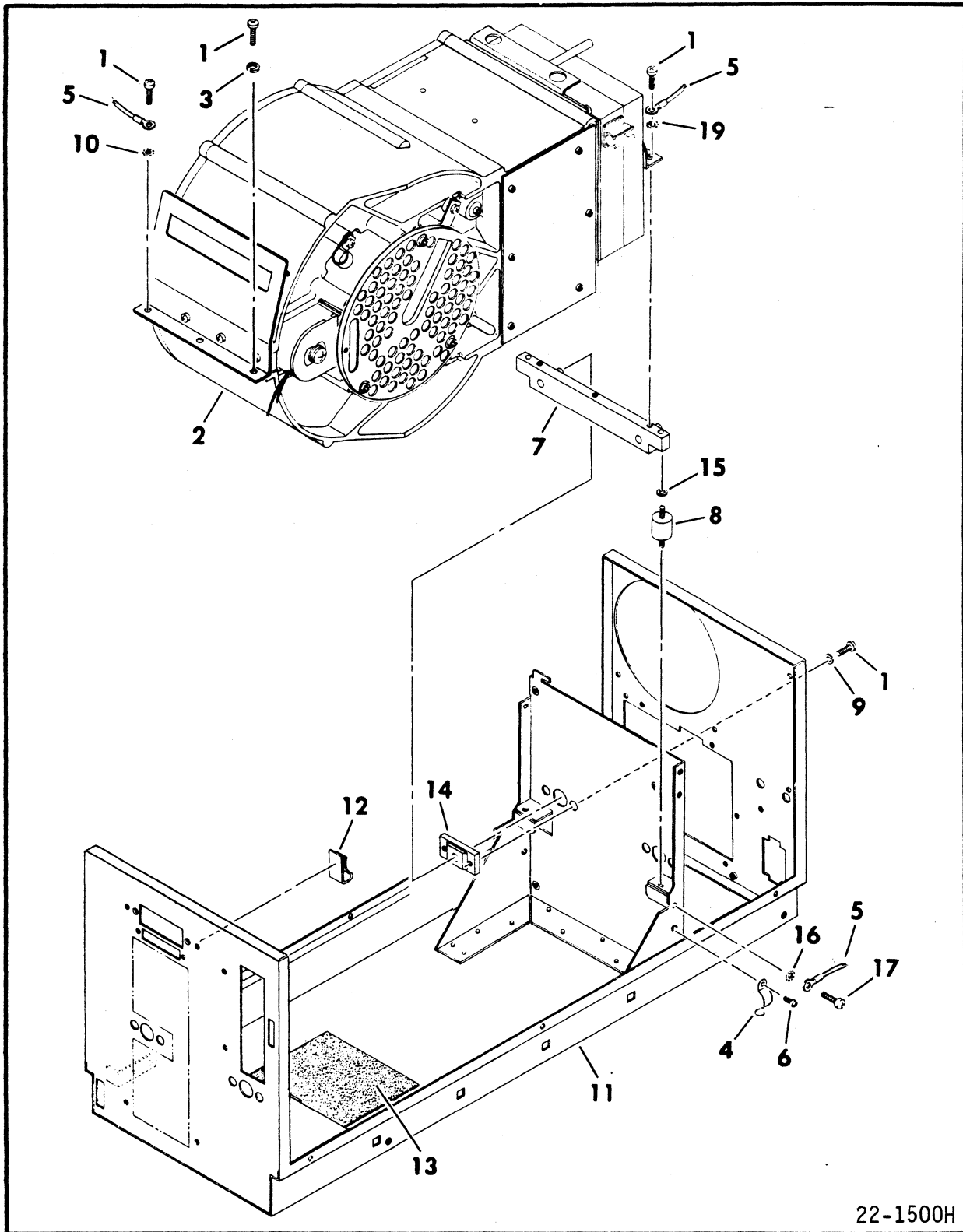


Figure 4-7

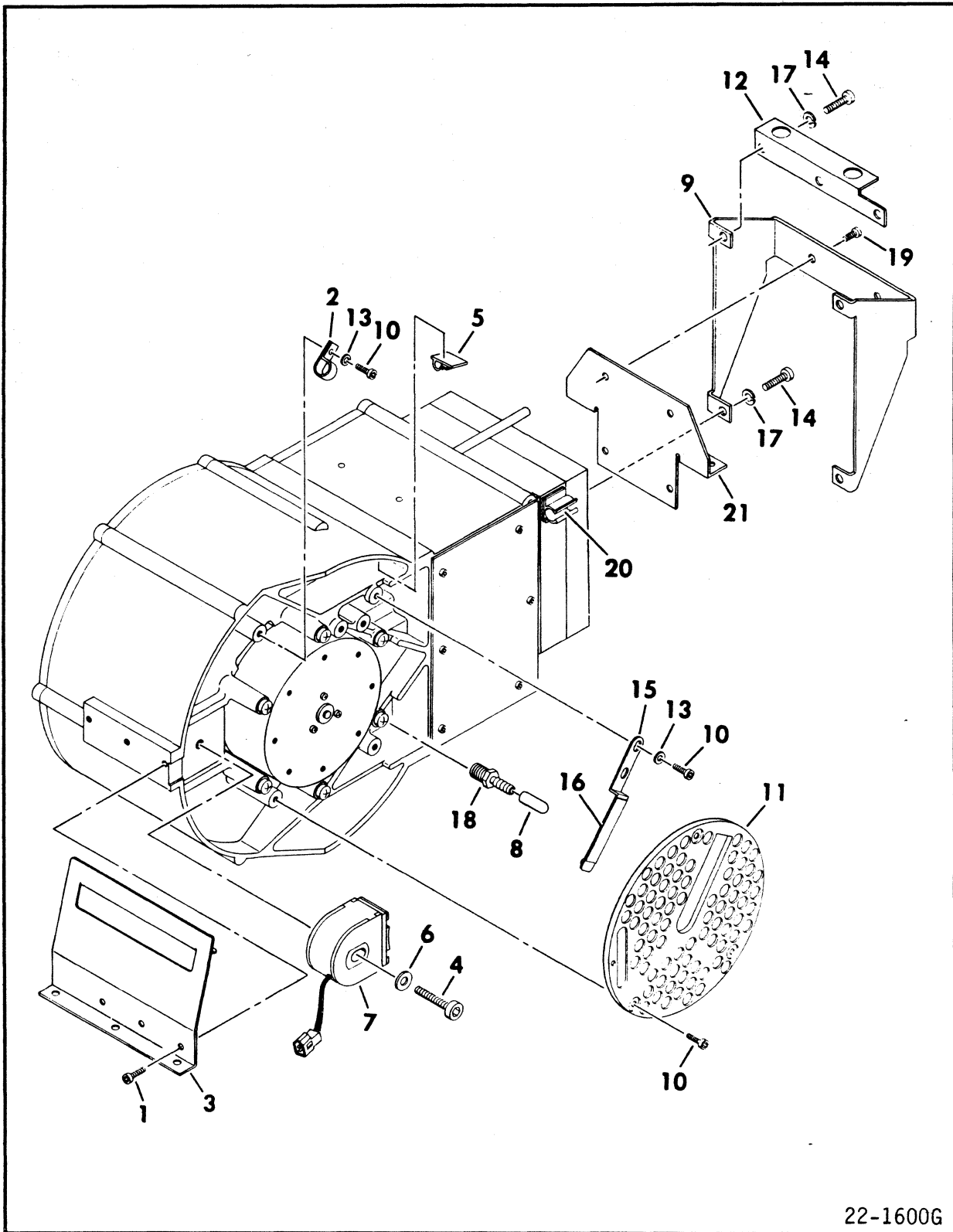
INDEX NO	PART NO	PART DESCRIPTION	NOTE
1	10127141	SCREW, PHH, 10-32 x 5/16	
2	Spare	MODULE ASSEMBLY	
3	10125805	LOCKWASHER, #10	
4	93148609	CLIP, Tension	
5	94281477	GROUND CABLE	
6	92001710	SCREW, PHH, 6-32 x 5/16	
7	72859942	BAR, Retaining	
8	93568017	SHOCK MOUNT	
9	10125607	WASHER, #10	
10	10126403	LOCKWASHER, #10	
11	72857451	BASE	See Note 1
11	72857453	BASE	See Note 2
11	72857454	BASE	See Note 3
12	94241019	CLIP, Cable	
13	41286580	PAD, Rubber	
14	41286510	DAMPER, Vibration	
15	94047052	WASHER, Special	
16	10126402	LOCKWASHER, #8	
17	10127120	SCREW, PHH, 8-32 x 1/4	

Note 1: Used on S/C 06 & Blw drives.

Note 2: Used on S/C 07 thru 12 drives without  
ECO DJ30240 installed.

Note 3: Used on S/C 13 & Abv drives, and on drives  
with ECO DJ30240 installed.





22-1600G

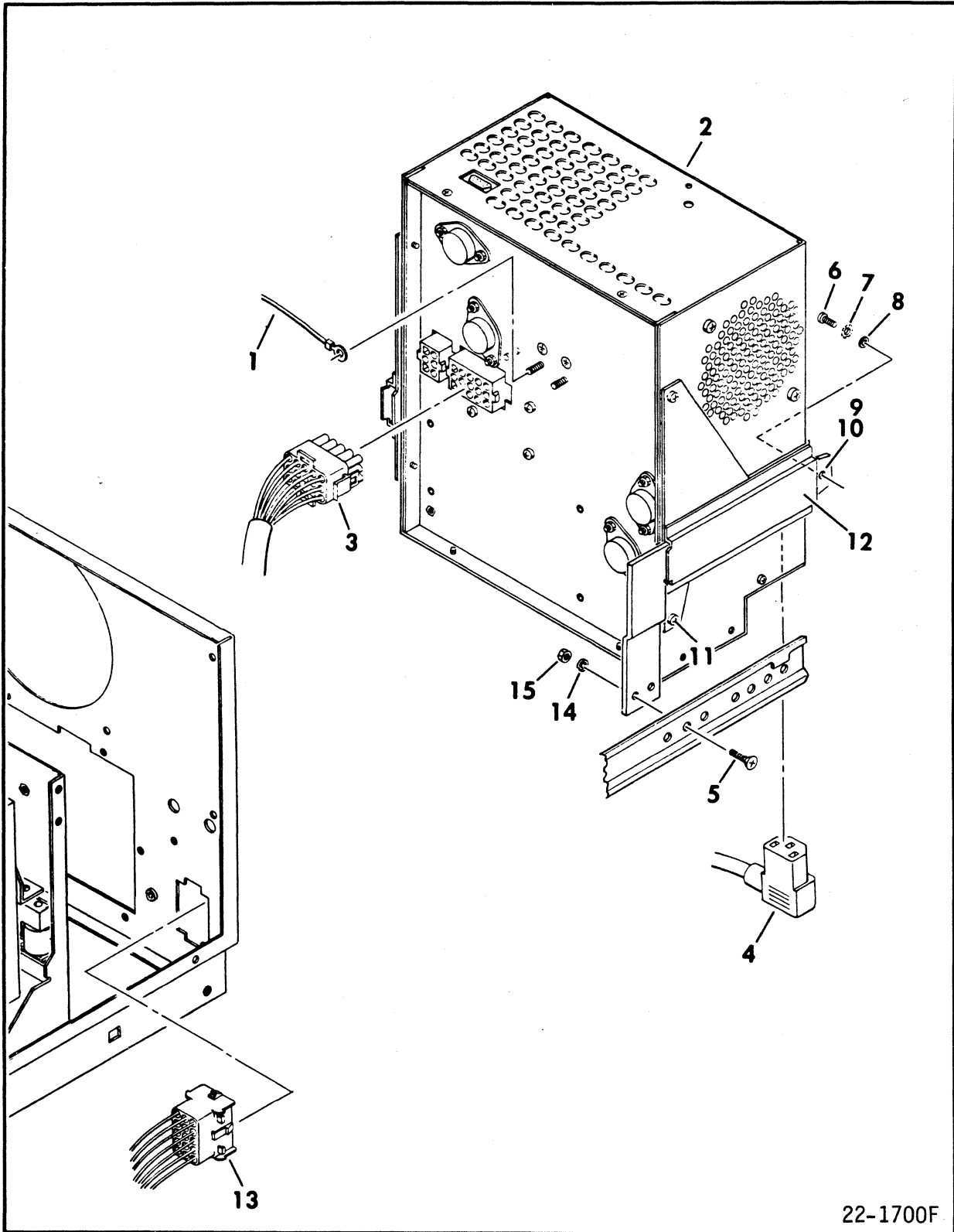
Figure 4-8

INDEX NO	PART NO	PART DESCRIPTION	NOTE
1	10126233	SCREW, Socket Hd, 10-24 x 3/8	
2	92602004	CLAMP, Cable	
3	72855730	SUPPORT	
4	10126260	SCREW, Socket Hd, 1/4-20 x 1 1/2	
5	94241019	CLIP	
6	92039213	WASHER, Special	
7	Spare	BRAKE ASSEMBLY	
8	95796513	CLOSURE, Vinyl	On newer modules
9	95138481	SUPPORT, Cover	On older modules
10	10126218	SCREW, Socket Hd, 6-32 x 3/8	
11	72856001	SHIELD, Motor	
12	46618990	HANDLE, Module	See Note 3
13	10125605	WASHER #6	
14	10126256	SCREW, Socket Hd, 1/4-20 x 3/4	
15	Spare	GROUND SPRING ASSEMBLY	
16	73157960	TAPE	
17	10125806	LOCKWASHER, 1/4	
18	94915601	FITTING, Miniature	On newer modules
19	92727238	SCREW, Socket Hd, 8-32 x 3/8	See Note 1
19	10127131	SCREW, PHH, 10-24 x 3/8	See Note 2
20	94241002	CLIP	
21	72855770	SUPPORT, Cover	See Note 1
21	95259411	SUPPORT, Cover	See Note 2

Note 1: Used only on S/C 03 & Blw drives without ECO 05752 installed.

Note 2: Used only on S/C 04 & Abv drives, and on drives with ECO 05752 installed.

Note 3: Not used on early model drives.



22-1700F

Figure 4-9 (Drives With Remote Power Supply)

INDEX NO	PART NO	PART DESCRIPTION	NOTE
1	94369549	GROUND CABLE	See Note 1
2	Spare	POWER SUPPLY, Remote	
3	Spare	DC POWER CABLE (P15/P40)	
4	Optional	AC POWER CABLE (P01)	
5	92905077	SCREW, PHH, 8-32 x 1/2	See Note 2
6	10127121	SCREW, PHH, 8-32 x 5/16	See Note 2
7	10126402	LOCKWASHER, #8	See Note 2
8	10125606	WASHER, #8	See Note 2
9	92723680	MOUNT, LH	See Note 2
10	92723681	MOUNT, RH	See Note 2
11	17901509	SCREW, PHH, 6-32 x 3/8	See Note 2
12	93402700	BRACKET, Mounting	See Note 2
13	80547300	DC POWER CABLE (P35/J40)	
14	10125804	LOCKWASHER, #8	See Note 2
15	10125106	NUT, 8-32	See Note 2

Note 1: Supplied with PA5G1C/K, PA5G2K, PA5N1F, PA5N2F drives only.

Note 2: Not supplied with PA5G1K, PA5G2K, PA5N1F, PA5N2F drives.

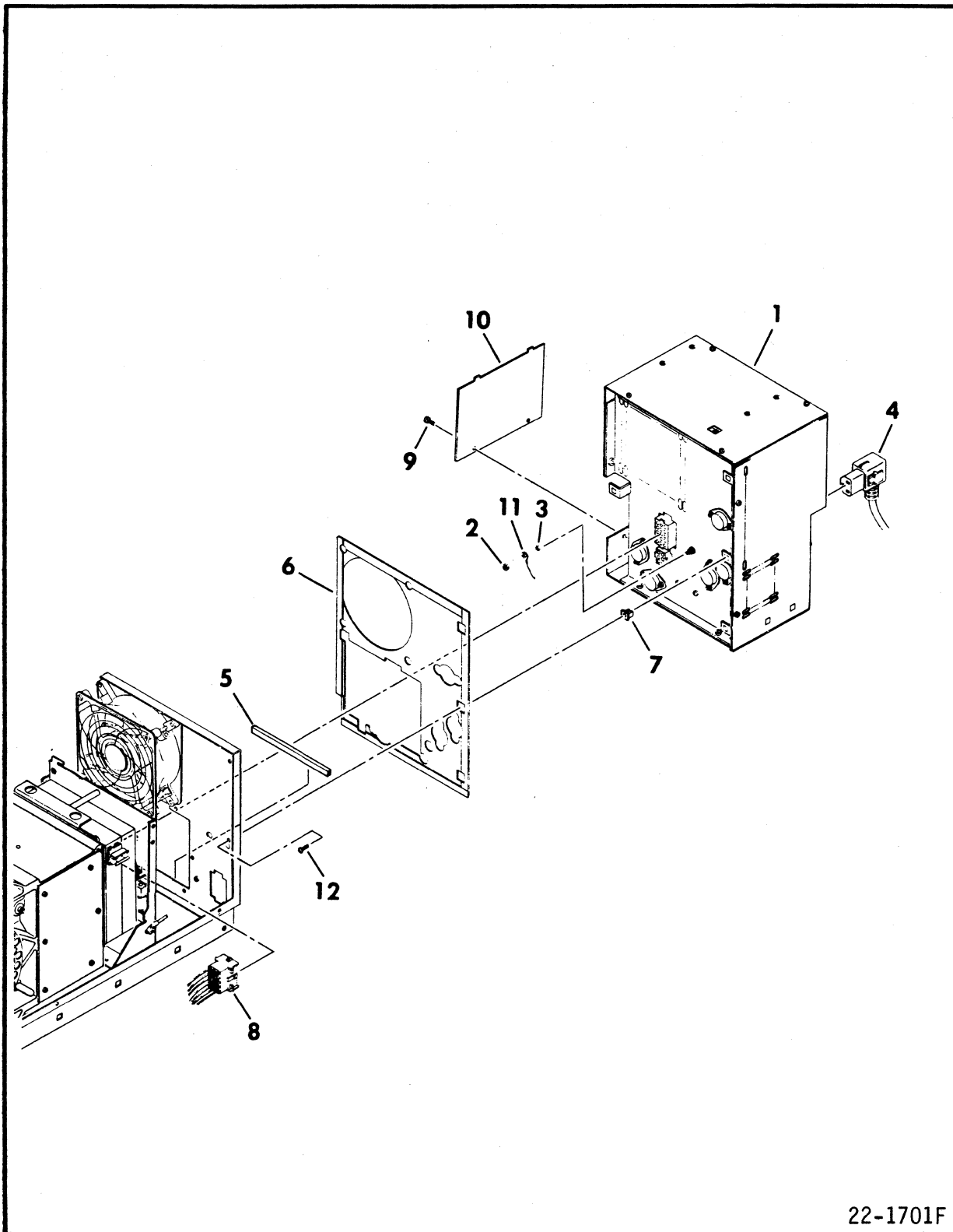
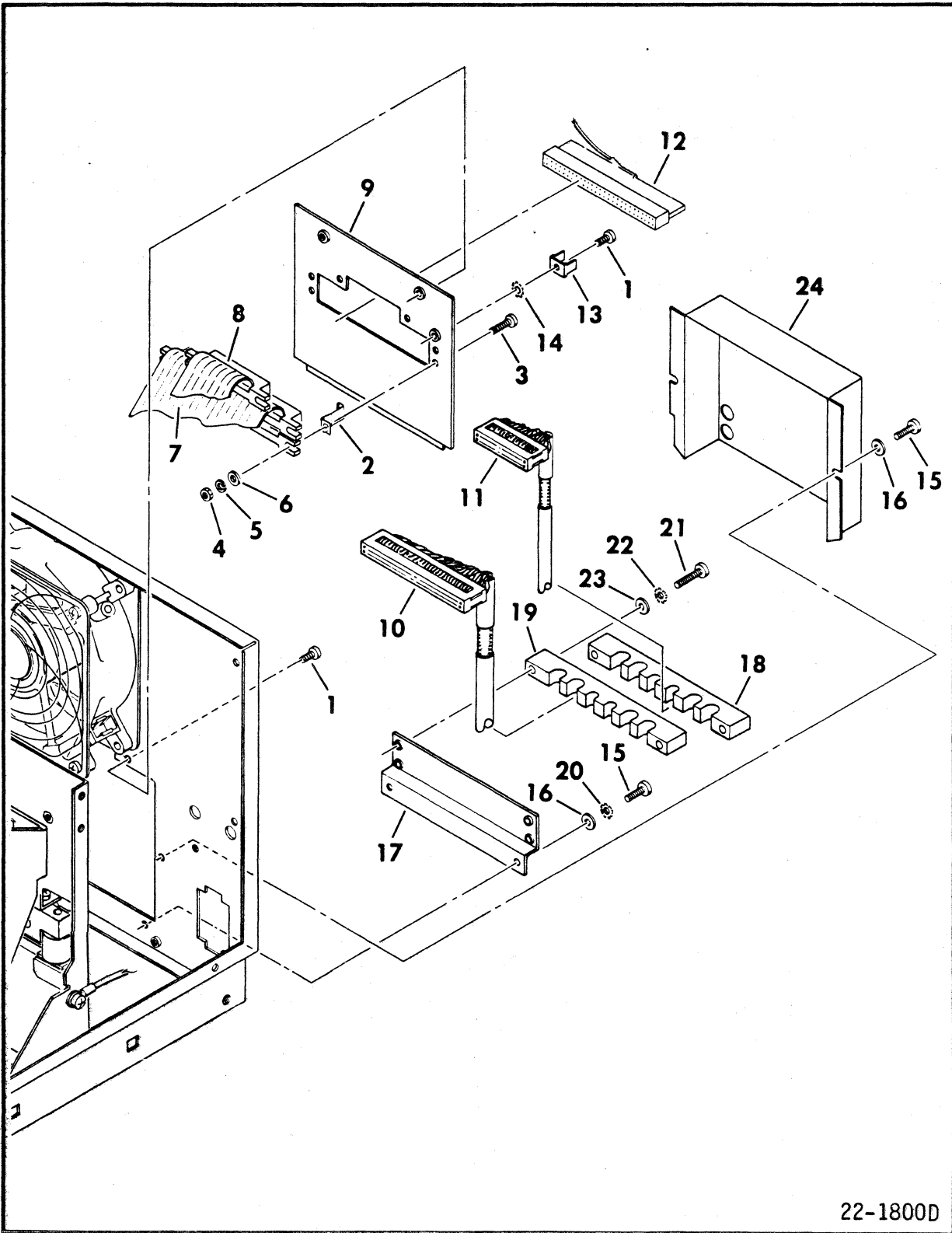


Figure 4-9 (Drives with Integral Power Supply)

INDEX NO	PART NO	PART DESCRIPTION	NOTE
1	Spare	POWER SUPPLY, Integral	
2	10125108	NUT, Hex, 10-32	
3	10126403	LOCKWASHER, #10	
4	Optional	AC POWER CABLE (P01)	
5	94385500	CHANNEL, Rubber	
6	92475850	GASKET, RF	
7	72854290	NUT, Square	
8	Spare	DC POWER CABLE (P15/P35)	
9	10127111	SCREW, PHH, 6-32 x 1/4	
10	76376370	PLATE, Cover	See Note 1
10	76376371	PLATE, Cover	See Note 2
11	94281437	GROUND CABLE	
12	94375825	SCREW, PHH, 8-16 x 1/2	

Note 1: Used on longer type (p/n 81542300) power supplies.

Note 2: Used on shorter type power supplies.



22-1800D

Figure 4-10 (Drives with Remote Power Supply)

INDEX NO	PART NO	PART DESCRIPTION	NOTE
1	10127111	SCREW, PHH, 6-32 x 1/4	
2	92010915	CLIP, Connector	
3	10127105	SCREW, PHH, 4-40 x 1/2	
4	10125103	NUT, Hex, 4-40	
5	10125801	LOCKWASHER, #4	
6	10125603	WASHER, #4	
7	Spare	"A" CABLE, Internal	
8	Spare	"B" CABLE, Internal	
9	72856550	PLATE, I/O (Single Ch)	
9	72856551	PLATE, I/O (Dual Ch)	
10		NOT SUPPLIED	
11		NOT SUPPLIED	
12	Optional	TERMINATOR	
13	94274116	TERMINAL	
14	10126401	LOCKWASHER, #6	
15	10127113	SCREW, PHH, 6-32 x 3/8	
16	10125605	WASHER, #6	
17	72851240	BRACKET, Cable	
18	72851231	CLAMP, Strain Relief	
19	72851230	CLAMP, Grounding	
20	10126401	LOCKWASHER, #6	
21	10127146	SCREW, PHH, 10-32 x 7/8	
22	10126403	LOCKWASHER, #10	
23	10125607	WASHER, #10	
24	92070380	SHIELD, I/O	
	93920481	CLAMP (for flat cables)	



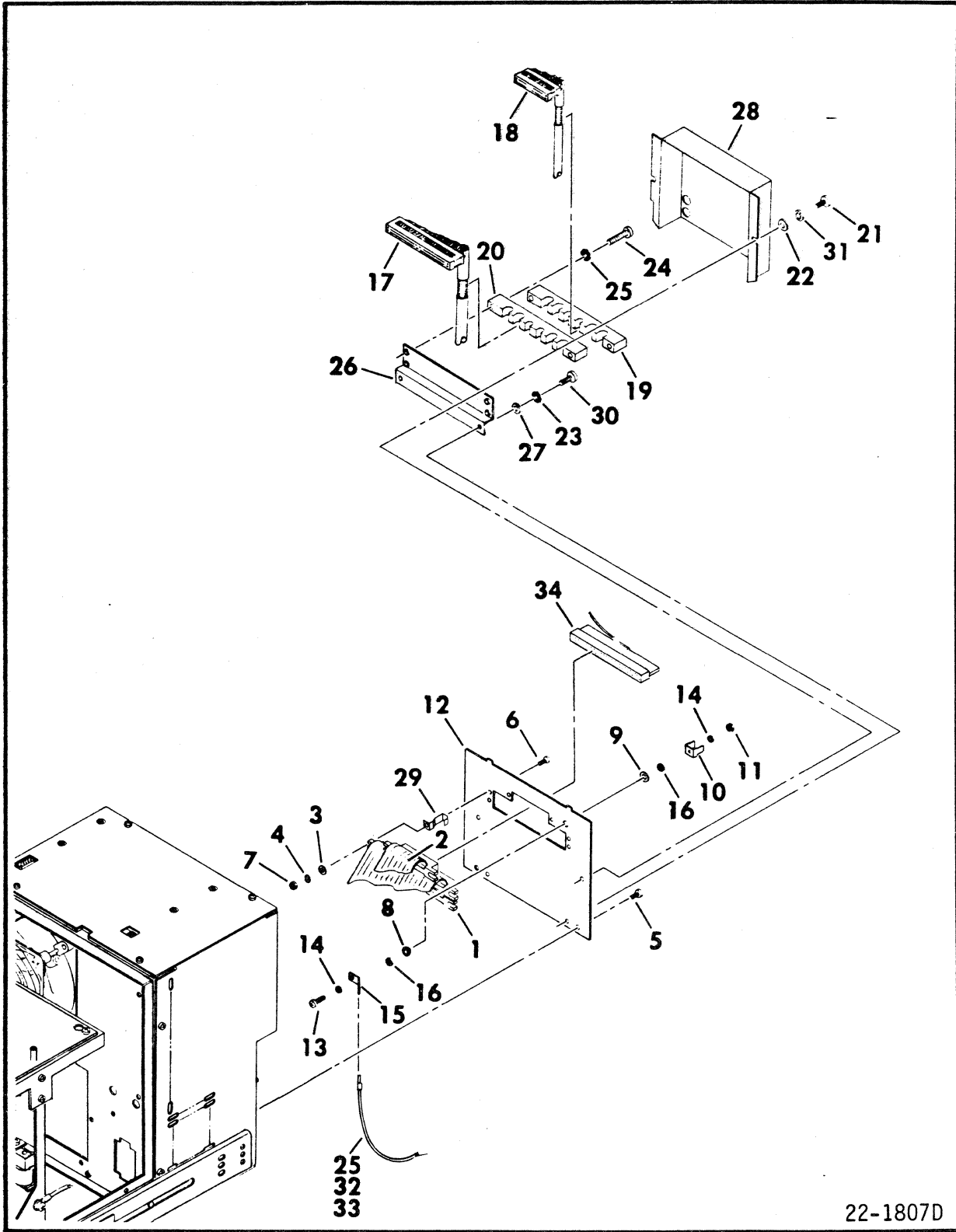


Figure 4-10 (Drives with Longer Integral Power Supply--P/N 81542300--Except PA5N1C)

INDEX NO	PART NO	PART DESCRIPTION	NOTE
1	Spare	"A" CABLE, Internal	
2	Spare	"B" CABLE, Internal	
3	10125603	WASHER, #4	
4	10125801	LOCKWASHER, #4	
5	17901508	SCREW, PHH, 6-32 x 1/4	
6	10127105	SCREW, PHH, 4-40 x 1/2	
7	10125103	NUT, Hex, 4-40	
8	95643808	WASHER, Insulated	
9	95797301	WASHER, Phenolic	
10	94274116	TERMINAL	
11	95510030	NUT, Hex, 6-32	
12	72855611	PLATE, I/O (Single Ch)	
12	72855613	PLATE, I/O (Dual Ch)	
13	92751168	SCREW, PHH, 6-32 x 3/4	
14	95524401	LOCKWASHER, #6	
15	94274104	TERMINAL	
16	94047078	WASHER, Special	
17	Optional	"A" CABLE, External	
18	Optional	"B" CABLE, External	
19	72851231	CLAMP, Strain Relief	See Note 1
19	45419021	CLAMP, Strain Relief	See Note 2
20	72851230	CLAMP, Grounding	See Note 1
20	45419020	CLAMP, Grounding	See Note 2
21	10127113	SCREW, PHH, 6-32 x 3/8	
22	10125605	WASHER, #6	
23	10126401	LOCKWASHER, #6	
24	10127146	SCREW, PHH, 10-32 x 7/8	
25	10126403	LOCKWASHER, #10	
26	72851240	BRACKET, Cable	
27	10125605	WASHER, #6	
28	92070380	SHIELD, I/O	
29	92010915	CLIP, Connector	
30	10127113	SCREW, PHH, 6-32 x 3/8	
31	10126103	LOCKWASHER, #6	
32	76376380	GROUND CABLE	
33	10125108	NUT, Hex, 10-32	
34	Optional	TERMINATOR	
	93920481	CLAMP (for flat cables)	See Note 1

Note 1: Not used on PA5N1D/PA5N2E drives.

Note 2: Used on PA5N1D/PA5N2E drives only.

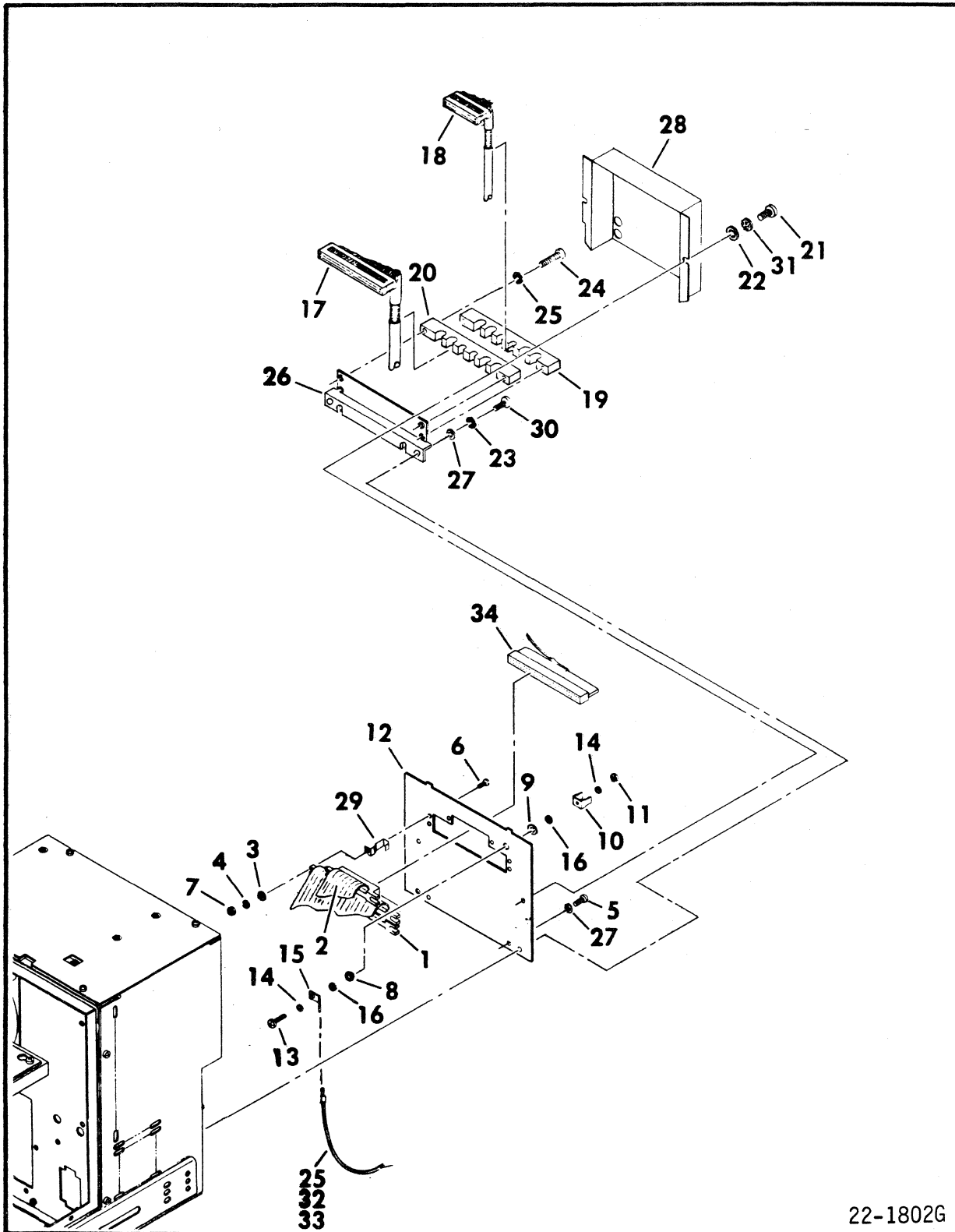
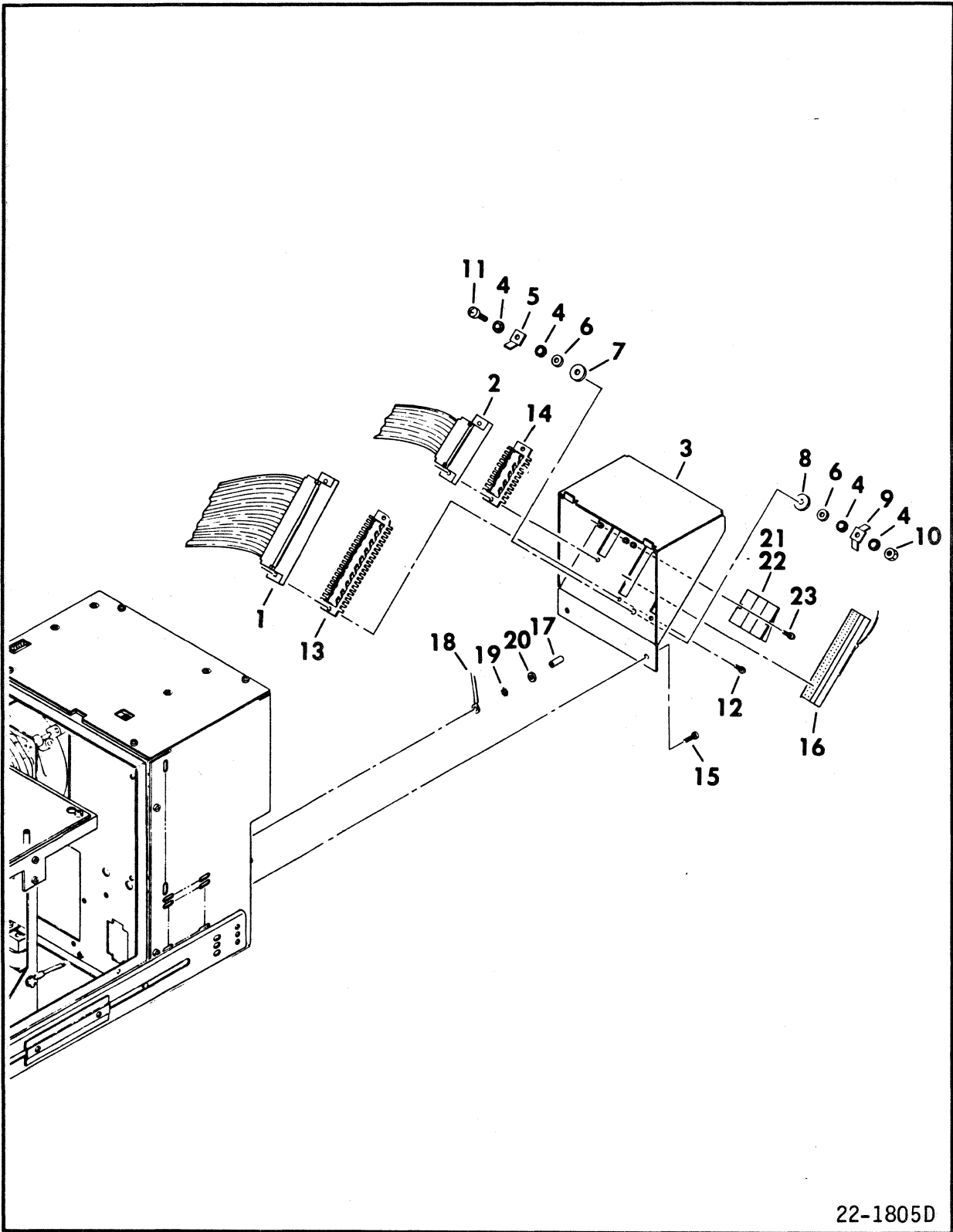


Figure 4-10 (Drives with Shorter Integral Power Supply, Except PA5N1C)

INDEX NO	PART NO	PART DESCRIPTION	NOTE
1	Spare	"A" CABLE, Internal	
2	Spare	"B" CABLE, Internal	
3	10125603	WASHER, #4	
4	10125801	LOCKWASHER, #4	
5	10127121	SCREW, PHH, 8-32 x 5/16	
6	10127105	SCREW, PHH, 4-40 x 1/2	
7	10125103	NUT, Hex, 4-40	
8	95643808	WASHER, Insulated	
9	95797301	WASHER, Phenolic	
10	94274116	TERMINAL	
11	95510030	NUT, Hex, 6-32	
12	95131791	PLATE, I/O (Single Ch)	
12	95131795	PLATE, I/O (Dual Ch)	
13	92751168	SCREW, PHH, 6-32 x 3/4	
14	95524401	LOCKWASHER, #6	
15	94274104	TERMINAL	
16	94047078	WASHER, Special	
17	Optional	"A" CABLE, External	
18	Optional	"B" CABLE, External	
19	72851232	CLAMP, Strain Relief	See Note 1
19	45419023	CLAMP, Strain Relief	See Note 2
20	72851233	CLAMP, Grounding	See Note 1
20	45419022	CLAMP, Grounding	See Note 2
21	10127113	SCREW, PHH, 6-32 x 3/8	
22	10125605	WASHER, #6	
23	10126402	LOCKWASHER, #8	
24	10127146	SCREW, PHH, 10-32 x 7/8	
25	10126403	LOCKWASHER, #10	
26	72851241	BRACKET, Cable	
27	10125606	WASHER, #8	
28	92070381	SHIELD, I/O	
29	92010915	CLIP, Connector	
30	10127122	SCREW, PHH, 8-32 x 3/8	
31	10126103	LOCKWASHER, #6	
32	76376381	GROUND CABLE	
33	10125108	NUT, Hex, 10-32	
34	Optional	TERMINATOR	
	93920483	CLAMP (for flat cables)	

Note 1: Not used on PA5N1D/E, PA5N2E drives.

Note 2: Used on PA5N1D/E, PA5N2D/E drives only.



22-1805D

Figure 4-10 (PA5N1C)

INDEX NO	PART NO	PART DESCRIPTION	NOTE
1	Spare	"A" CABLE, Internal	
2	Spare	"B" CABLE, Internal	
3	95752260	PLATE, I/O	See Note 1
3	95752261	PLATE, I/O	See Note 2
4	95524401	LOCKWASHER, #6	
5	94274104	TERMINAL	
6	94047078	WASHER, Special	
7	95643808	WASHER, Insulated	
8	95797301	WASHER, Phenolic	
9	94274116	TERMINAL	
10	95510030	NUT, Hex, 6-32	
11	92751164	SCREW, PHH, 6-32 x 1/2	
12	10127104	SCREW, PHH, 4-40 x 3/8	
13	15183357	GROUND PLANE	
14	15183358	GROUND PLANE	
15	17901508	SCREW, PHH, 6-32 x 1/4	See Note 1
15	10127121	SCREW, PHH, 8-32 x 5/16	See Note 2
16	Optional	TERMINATOR	
17	45071901	BOOT, Ground Lug	
18	76376381	GROUND CABLE	See Note 2
19	10126403	LOCKWASHER, #6	See Note 2
20	10125108	NUT, 10-32	See Note 2
	81308300	CLAMP ASSEMBLY	See Note 2
21	45070640	RESTRAINT, A Cable	See Note 2
22	45070641	RESTRAINT, B Cable	See Note 2
23	17901509	SCREW, PHH, 6-32 x 3/8	See Note 2

Note 1: Used on longer type (p/n 81542300) power supplies.

Note 2: Used on shorter type power supplies.















TABLE 4-1. OPTIONAL PARTS (Contd)

PART NO.	PART DESCRIPTION	515 MB* EQUIPMENT PACKAGE 730888xx													
		00	01	03	04	06	07	08	09	10	11	12	13	14	
73089401	PA5N1A DRIVE	XX		XX		XX					XX			XX	
73089402	PA5N2A DRIVE		XX		XX										
73089405	PA5N1F DRIVE						XX	XX							
73089406	PA5N2F DRIVE								XX	XX					
73089407	PA5Z2A DRIVE											XX			
73089418	PA5Z1A DRIVE												XX		
72858101	INSERT, Fr Pan	XX	XX	XX	XX						XX	XX	XX		
72858103	INSERT, Fr Pan					XX								XX	
72858107	INSERT, Fr Pan							XX		XX					
94397022	EMBLEM, Pr Id	XX	XX	XX	XX						XX	XX	XX		
72854001	PANEL, Front	XX	XX	XX	XX						XX	XX	XX		
72854002	PANEL, Front					XX								XX	
72854007	PANEL, Front							XX		XX					
72854222	PANEL, Front						XX		XX						
10127120	SCREW, 8-32x1/4	XX	XX	XX	XX	XX					XX	XX		XX	
10125606	WASHER, #8	XX	XX	XX	XX	XX					XX	XX		XX	
94205567	SPRING	XX	XX	XX	XX	XX					XX	XX		XX	
72857411	LATCH, Cabinet	XX	XX	XX	XX	XX					XX	XX		XX	
73157938	SLIDE ASSY, LH	XX	XX	XX	XX	XX							XX	XX	
73157939	SLIDE ASSY, RH	XX	XX	XX	XX	XX							XX	XX	
75168323	AC CABLE (P01)	XX	XX									XX	XX		
75168324	AC CABLE (P01)													XX	
75168347	AC CABLE (P01)			XX	XX	XX					XX				
93270700	TERMINATOR					XX									

\*Remote Power Supply Drives

Table Continued on Next Page





TABLE 4-1. OPTIONAL PARTS (Contd)

PART NO.	PART DESCRIPTION	515 MB* EQUIPMENT PACKAGE 805088xx												
		16	17	18	20	21	22	25	26	27	28	30	37	39
80371001	PA5N1B DRIVE								XX				XX	
80371002	PA5N2B DRIVE		XX					XX						
80371007	PA5N2D DRIVE			XX										
80371011	PA5N2G DRIVE	XX												
80371015	PA5Z2B DRIVE				XX									
80371016	PA521B DRIVE					XX								
80371017	PA5N1H DRIVE						XX							
80371020	PA5Z2C DRIVE									XX	XX			
80371022	PA5N2K DRIVE											XX		
80371030	PA5Z1C DRIVE													XX
72858101	INSERT, Fr Pan				XX	XX						XX	XX	
72858103	INSERT, Fr Pan			XX										XX
72858114	INSERT, Fr Pan		XX											
72858115	INSERT, Fr Pan	XX												
72858117	INSERT, Fr Pan							XX	XX					
72858118	INSERT, Fr Pan			XX										
72858121	INSERT, Fr Pan									XX	XX			
94397022	EMBLEM				XX	XX						XX	XX	
72854001	PANEL, Front				XX	XX		XX	XX			XX	XX	
72854002	PANEL, Front			XX										XX
72854016	PANEL, Front		XX											
72854017	PANEL, Front	XX												
72854019	PANEL, Front			XX										
72854023	PANEL, Front									XX	XX			
72854222	PANEL, Front						XX							
10127120	SCREW, 8-32x1/4		XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
10125606	WASHER, #8		XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
94205567	SPRING		XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
72857411	LATCH, Cabinet		XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
73157938	SLIDE ASSY, LH		XX		XX	XX	XX		XX	XX	XX	XX		XX
73157939	SLIDE ASSY, RH		XX		XX	XX	XX		XX	XX	XX	XX		XX
75168323	AC CABLE (P01)	XX			XX	XX				XX		XX	XX	
75168324	AC CABLE (P01)		XX								XX			
75168334	AC CABLE (P01)						XX	XX	XX					
81537400	"A" CABLE, Ext												XX	
81537401	"A" CABLE, Ext						XX							
92708900	"B" CABLE, Ext												XX	
92708902	"B" CABLE, Ext						XX							
93270700	TERMINATOR	XX	XX	XX			XX			XX	XX		XX	
92678808	FILLER PANEL									XX	XX			
81244504	BAR KIT												XX	
81244510	BAR KIT									XX	XX			
81244512	BAR KIT									XX	XX			

\*Integral Power Supply Drives

Table Continued on Next Page





TABLE 4-2. MANUFACTURER'S RECOMMENDED SPARE PARTS

DESCRIPTION/NOTES	PART NUMBER	REPLACE- MENT PART NUMBER
FILTER, Primary (except PA5N1C)	72852571	72852571
OPERATOR PANEL		
FPBX replacement kit (includes HPBX operator panel assembly, logic plugs, lenses, and bracket)		
All except PA5Z1C, PA5Z2D	54330905	17190500
PA5Z1C, PA5Z2D	54330905	17190501
HPBX--S/C 08 & Abv	54330907	54330907
LOGIC PLUG KIT (PA5N1C only)	81397702	81397702
FAULT DISPLAY BOARD		
SMD-0 Interface Drives		
BUQX--S/C 05 & Blw	54384501	47040251*
DUQX--S/C 06-16	54384503	47040251*
FUQX--S/C 17 & Abv	54384505	54384505
SMD-E Interface Drives		
FUQX	54384505	54384505
FAULT STATUS CABLE		
SMD-0 Interface Drives (P13/P19)	47002001	47002001
SMD-E Interface Drives (P13/P17/P19)	47002002	47002002
CONTROL BOARD		
300 MB		
YVCX--S/C 12-19	54389323	54389337
ANVCX--S/C 19 & Abv	54389337	54389337
340/515 MB (Except PA5Z2C)		
EVCX--S/C 06 & Blw (FCOs 30014, 30102)	54389305	54389334
WVCX--S/C 07-09 (FCOs 30014, 30102)	54389321	54389334
KVCX--S/C 10-11	54389310	54389334
RVCX--S/C 12 (SMD-0 interface)	54389316	54389334
TVCX--S/C 12 (SMD-E interface)	54389318	54389334
UVCX--S/C 13-14	54389319	54389334
AAVCX--S/C 15-19	54389325	54389334
AKVCX--S/C 19 & Abv	54389334	54389334
340/515 MB (PA5Z2C only)		
ZVCX--S/C 14-19	54389324	54389336
AMVCX--S/C 19 & Abv	54389336	54389336
I/O BOARD (Single Channel)		
SMD-0 Interface		
BSYX--S/C 05 & Blw	54368101	54368106
DSYX--S/C 06-08	54368103	54368106
ESYX--S/C 09-11	54368104	54368106
GSYX--S/C 12 & Abv	54368106	54368106
*Includes new _UQX board and P13/P19 cable.		
Table Continued on Next Page		

TABLE 4-2. MANUFACTURER'S RECOMMENDED SPARE PARTS (Contd)

DESCRIPTION/NOTES	PART NUMBER	REPLACE- MENT PART NUMBER
SMD-E Interface		
CVJX	54391702	54391702
I/O BOARD (Dual Channel)		
300 MB SMD-0 Interface		
BVJX--S/C 12-13	54391701	54391705
FVJX--S/C 14 & Abv	54391705	54391705
340/515 MB SMD-0 Interface		
BTQX--S/C 04 & Blw	54374901	54374904
DTQX--S/C 05 & 18	54374903	54374904
ETQX--S/C 19 & Abv	54374904	54374904
340/515 MB SMD-E Interface		
BVJX--S/C 13 & Blw	54391701	54391707
FVJX--S/C 14-19 (All except PA5N2D)	54391705	54391707
FVJX--S/C 14-17 (PA5N2D only)	54391705	54391707
EVJX--S/C 18-19 (PA5N2D only)	54391704	54391707
HVJX--S/C 19 & Abv	54391707	54391707
MOTHER BOARD		
BSVX--S/C 03 & Blw	54366901	54366902
CSVX--S/C 04 & Abv	54366902	54366902
READ/WRITE BOARD (300 MB Drives)		
GUGX--S/C 12-14	54381307	54381308
HUGX--S/C 15 & Abv	54381308	54381308
READ/WRITE BOARD (340 MB Drives)		
BUGX--S/C 04 & Blw	54381301	54381305
CUGX--S/C 05-08	54381302	54381305
EUGX--S/C 09 & Abv	54381305	54381305
READ/WRITE BOARD (515 MB Drives)		
CSUX--S/C 04 & Blw	54366502	54391300
AVHX--S/C 05 & Abv	54391300	54391300
MOTOR SPD & PWR AMP BOARD		
BSWX--S/C 01	54367301	54367304
CSWX--S/C 02-07	54367302	54367304
ESWX--S/C 08 & Abv	54367304	54367304
FAN ASSEMBLY	81235102	81235102
MODULE ASSEMBLY (300 MB Drives)		
PA5J1A/B, PA5J2A/B	92104301	92104301
PA5J1C	92104302	92104302
PA5J1D	92104303	92104303
MODULE ASSEMBLY (340 MB Drives)		
S/C 17 & Blw		
PA5G1A/D/L/R, PA5G2A/D/G	73090400	73090411
PA5G1B/G, PA5G2B/E	73090401	73090412
PA5G1C	73090402	73090413

Table Continued on Next Page

TABLE 4-2. MANUFACTURER'S RECOMMENDED SPARE PARTS (Contd)

DESCRIPTION/NOTES	PART NUMBER	REPLACE- MENT PART NUMBER
MODULE ASSEMBLY (340 MB Drives)(Contd)		
S/C 17 & Blw		
PA5G1K, PA5G2K	73090406	73090417
PA5G1M, PA5G2M	73090408	73090419
PA5G1N	73090407	73090418
PA5G1S	73090409	73090420
PA5G1T	73090410	73090421
S/C 18 & Abv		
PA5G1A/D/L/R, PA5G2A/D/G	73090411	73090411
PA5G1B/G, PA5G2B/E	73090412	73090412
PA5G1C	73090413	73090413
PA5G1K, PA5G2K	73090417	73090417
PA5G1M, PA5G2M	73090419	73090419
PA5G1N	73090418	73090418
PA5G1S, PA5G2J	73090420	73090420
PA5G1T	73090421	73090421
MODULE ASSEMBLY (515 MB Drives)		
S/C 17 & Blw		
PA5N1A/B/H, PA5N2A/B/C, PA5Z1A/B, PA5Z2A/B	73089100	73089118
PA5N1C	73089116	73089133
PA5N1D, PA5N2E, PA5Z1C, PA5Z2D	73089102	73089119
PA5N1E, PA5N2D	73089106	73089123
PA5N1F, PA5N2F	73089103	73089120
PA5N1G, PA5N2G	73089107	73089124
PA5N2K	73089109	73089126
PA5Z2C	73089108	73089125
S/C 18 & Abv		
PA5N1A/B/H, PA5N2A/B/C, PA5Z1A/B, PA5Z2A/B	73089118	73089118
PA5N1C	73089133	73089133
PA5N1D, PA5N2E, PA5Z1C, PA5Z2D	73089119	73089119
PA5N1E, PA5N2D	73089123	73089123
PA5N1F, PA5N2F	73089120	73089120
PA5N1G, PA5N2G	73089124	73089124
PA5N2K	73089126	73089126
PA5Z2C	73089125	73089125
BRAKE ASSEMBLY		
Older type (has 30-inch cable that connects directly to Motor Speed/Power Amp board).	72856100	72856100
Newer type (has 3-inch cable that connects to Motor Wiring harness).	72856101	72856101
Table Continued on Next Page		

TABLE 4-2. MANUFACTURER'S RECOMMENDED SPARE PARTS (Contd)

DESCRIPTION/NOTES	PART NUMBER	REPLACE- MENT PART NUMBER
POWER SUPPLY, Remote+		
S/C 03 & Blw	72896502	72896504
S/C 04-06	72896503	72896504
S/C 07-12 (All except PA5G1K/PA5G2K/ PA5J1A/PA5J2A/PA5N1F/PA5N2F)	72896503	72896504
S/C 07-12 (PA5G1K/PA5G2K/PA5J1A/PA5J2A PA5N1F/PA5N2F)	72896504	72896504
S/C 13 & Abv	72896504	72896504
POWER SUPPLY, Integral		
Longer Type	81542300	81542301*
Shorter Type	81542301	81542301
DC POWER CABLE (P15/P40)(Remote P/S Drives)		
1 foot (0.3 metre) long	93991802	93991802
5 foot (1.5 metre) long	92081500	92081500
5 foot (1.5 metre) long with right-angle connectors	92081510	92081510
DC POWER CABLE(P15/35)(Integral P/S Drives)	80547301	80547301
"A" CABLE, Internal (Channel 1)		
PA5G1A/B/C/K, PA5G2B, PA5J1A/C, PA5N1A/F, PA5Z1A	92439600	92439600
PA5G1D/L/M/N/R/S/T, PA5J1B/D PA5N1B/E/G/H, PA5Z1B/C	92439606	92439606
PA5G2A/K, PA5J2A, PA5N2A/F, PA5Z2A	92439601	92439601
PA5G2D/J/M, PA5J2B, PA5N2B/D/G/K, PA5Z2B/C/D	92439607	92439607
PA5N1C	92439609	92439609
"A" CABLE, Internal (Channel 2)		
PA5G2A/K, PA5J2A, PA5N2A/F, PA5Z2A	92439602	92439602
PA5G2D/J/M, PA5J2B, PA5N2B/D/G/K, PA5Z2B/C/D	92439608	92439608
"B" CABLE, Internal (Channel 1)		
PA5G1A/B/C/K, PA5G2B, PA5J1A, PA5N1A/F, PA5Z1A	92246300	92246300
PA5G1D/L/M/N/R/S/T, PA5J1B/C/D PA5N1B/E/G/H, PA5Z1B/C	92246306	92246306
PA5G2A/K, PA5J2A, PA5N2A/F, PA5Z2A	92246301	92246301
PA5G2D/J/M, PA5J2B, PA5N2B/D/G/K, PA5Z2B/C/D	92246307	92246307
PA5N1C	92246309	92246309
"B" CABLE, Internal (Channel 2)		
PA5G2A/K, PA5J2A, PA5N2A/F, PA5Z2A	92246302	92246302
PA5G2D/J/M, PA5J2B, PA5N2B/D/G/K, PA5Z2B/C/D	92246308	92246308
+Power Supply is not supplied with equipment packages 73089917/21.		
*Power Supply Conversion Kit, P/N 45776800 (45776802 is required for PA5N1C), is also required.		

TABLE 4-3. ACCESSORIES

PART NUMBER	DESCRIPTION
12263496	STATIC GROUND WRIST STRAP, 6 1/2 to 8 inch wrist
12263623	STATIC GROUND WRIST STRAP, up to 6 1/2 inch wrist
12263624	STATIC SHIELDING BAG, 5 x 8 inch
12263625	STATIC SHIELDING BAG, 8 x 12 inch
12263626	STATIC SHIELDING BAG, 10 x 12 inch
12263499	STATIC SHIELDING BAG, 14 x 18 inch
12263627	STATIC SHIELDING BAG, 16 x 24 inch
81537400	I/O A CABLE, 5 foot (1.5 metre) long
81537401	I/O A CABLE, 10 foot (3.0 metre) long
81537402	I/O A CABLE, 15 foot (4.5 metre) long
81537403	I/O A CABLE, 20 foot (6.1 metre) long
81537404	I/O A CABLE, 25 foot (7.6 metre) long
81537405	I/O A CABLE, 30 foot (9.1 metre) long
81537406	I/O A CABLE, 40 foot (12.2 metre) long
81537407	I/O A CABLE, 50 foot (15.3 metre) long
81537408	I/O A CABLE, 100 foot (30.6 metre) long
92708900	I/O B CABLE, 5 foot (1.5 metre) long
92708901	I/O B CABLE, 10 foot (3.0 metre) long
92708902	I/O B CABLE, 15 foot (4.5 metre) long
92708903	I/O B CABLE, 20 foot (6.1 metre) long
92708904	I/O B CABLE, 25 foot (7.6 metre) long
92708905	I/O B CABLE, 30 foot (9.1 metre) long
92708906	I/O B CABLE, 40 foot (12.2 metre) long
92708907	I/O B CABLE, 50 foot (15.3 metre) long
93270700	I/O TERMINATOR
81244502	DRIVE MOUNTING KIT (for mounting drive in a standard rack)
24534808	GROUND STRAP, 9/16 inch wide (specify length desired)
40125601	GROUND LUG
10126403	LOCKWASHER, #10 (for grounding)
93991802	DC POWER CABLE, 1 foot (0.3 metre) long
92081500	DC POWER CABLE, 5 foot (1.5 metre) long
92081510	DC POWER CABLE, 5 foot (1.5 metre) long with right-angle connectors
92081501	DC POWER CABLE, 8 foot (3.0 metre) long
94398817	LOGIC PLUG "0" (See Note 1)
94398818	LOGIC PLUG "1" (See Note 1)
94398819	LOGIC PLUG "2" (See Note 1)
94398820	LOGIC PLUG "3" (See Note 1)
94398821	LOGIC PLUG "4" (See Note 1)
94398822	LOGIC PLUG "5" (See Note 1)
94398823	LOGIC PLUG "6" (See Note 1)
94398824	LOGIC PLUG "7" (See Note 1)

Table Continued on Next Page

TABLE 4-3. ACCESSORIES (Contd)

PART NUMBER	DESCRIPTION
15181751	LOGIC PLUG "0" (See Note 2)
15181752	LOGIC PLUG "1" (See Note 2)
15181753	LOGIC PLUG "2" (See Note 2)
15181754	LOGIC PLUG "3" (See Note 2)
15181755	LOGIC PLUG "4" (See Note 2)
15181756	LOGIC PLUG "5" (See Note 2)
15181757	LOGIC PLUG "6" (See Note 2)
15181758	LOGIC PLUG "7" (See Note 2)
15181663	LOGIC PLUG "8" (See Note 3)
15181664	LOGIC PLUG "9" (See Note 3)
15181665	LOGIC PLUG "10" (See Note 3)
15181666	LOGIC PLUG "11" (See Note 3)
15181667	LOGIC PLUG "12" (See Note 3)
15181668	LOGIC PLUG "13" (See Note 3)
15181669	LOGIC PLUG "14" (See Note 3)
15181670	LOGIC PLUG "15" (See Note 3)
<p>Note 1: Used on older operator panels, which have logic plugs without indicator lights.</p> <p>Note 2: Used on newer operator panels, which have logic plugs with indicator lights.</p> <p>Note 3: Cannot be used with BSYX, DSYX, ESYX, BTQX, or DTQX I/O boards.</p>	

## **APPENDIX A**

### **DIAGNOSTIC TESTING AND STATUS CODE SUMMARY**



# DIAGNOSTIC TESTING AND STATUS CODE SUMMARY A

---

## INTRODUCTION

This appendix is a summary of diagnostic information and servo status codes. The summary briefly explains:

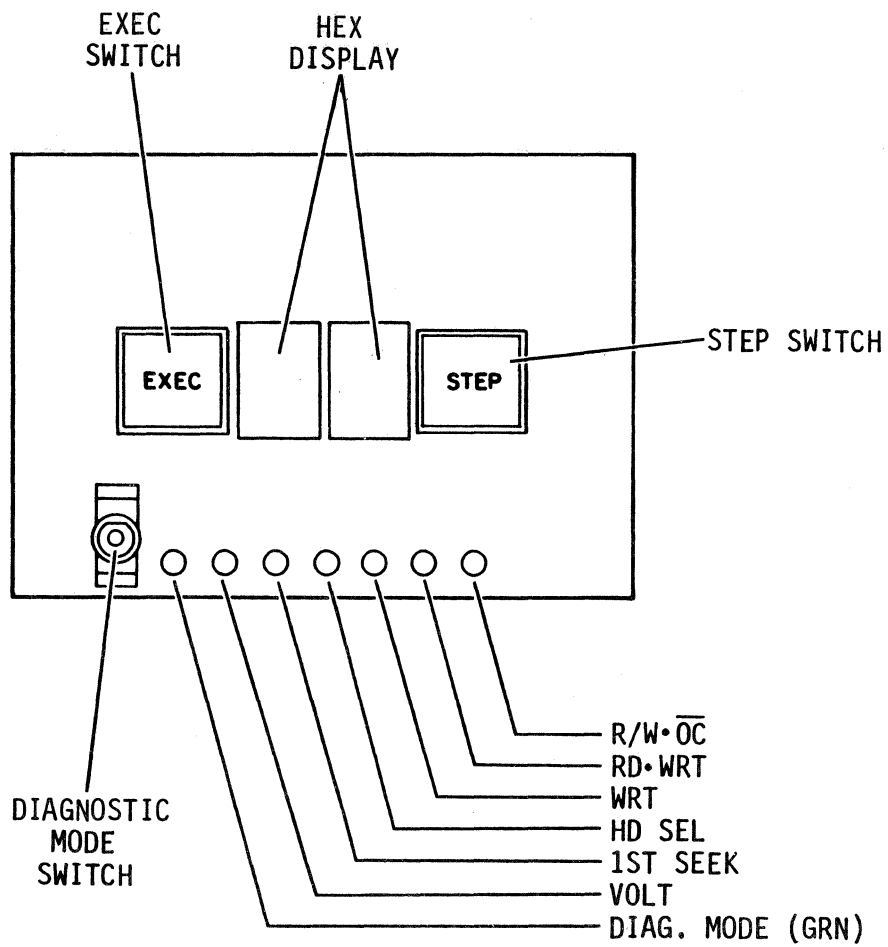
- Switches and Indicators
- Test Selection
- Test Descriptions
- Status Code Summary

To use this summary you must understand the detailed test descriptions found in volume 2 of the hardware maintenance manual.

Before doing any troubleshooting you should be familiar with the troubleshooting information contained in volume 2 of the hardware maintenance manual.

## SWITCHES AND INDICATORS

The offline diagnostics are initiated and monitored via switches and indicators on the maintenance panel (see figure A-1). This panel is located behind the front panel insert and filter. Table A-1 describes the function of the switches and indicators.



11D314A

Figure A-1. Maintenance Panel

TABLE A-1. MAINTENANCE PANEL SWITCHES AND INDICATORS

Description	Function
Diagnostic Mode Switch	<p>Setting the switch to the up position places the unit in diagnostic mode and disables the interface. The diagnostic mode indicator lights when the switch is set to diagnostic mode.</p> <p>Setting the switch to the down position permits normal controller selection on the interface. This also causes the drive to do an RTZ.</p>
STEP Switch	<p>Used to step the hex display pattern from 0 to F. Holding the switch down causes the numbers to increment continuously and wrap around from F to 0. Refer to EXEC switch. Note: Switch must be pressed for a minimum of 400 milliseconds to activate.</p>
EXEC Switch (Execute)	<p>Used to enter values in memory. The entries permit test selection, entry of test parameters, and test deselection. Note: Switch must be pressed for a minimum of 400 milliseconds to activate.</p>
Hex Display	<p>Used to display current status when unit is operating in normal mode, or diagnostic information when operating in diagnostic mode.</p>
Diagnostic Mode Indicator	<p>Indicates that drive is in diagnostic mode.</p>
First Seek Indicator <sup>1</sup>	<p>Indicates drive failed first seek/load attempt.</p>
Read or Write and Not On Cylinder Indicator <sup>1</sup>	<p>Indicates read or write conditions existed during a seek operation (an off cylinder condition).</p>
<p>Table Continued on Next Page</p>	

TABLE A-1. MAINTENANCE PANEL SWITCHES AND INDICATORS (Contd)

Description	Function
Write Indicator <sup>1</sup>	Indicates that a write fault has occurred.
Read and Write Indicator <sup>1</sup>	Indicates that a write and read command were active simultaneously.
Voltage Indicator <sup>1</sup>	Indicates a below normal voltage condition has occurred.
Head Select Indicator <sup>1</sup>	Indicates a multiple head selection condition has occurred.
<sup>1</sup> When cylinder logging is enabled via Test 10, the fault indicators do not display meaningful information. Disregard fault indicators until cylinder logging has been disabled.	

## TEST SELECTION

Placing the Diagnostic Mode switch to the on (up) position causes "00" to be displayed in the hex display. Pressing the STEP switch after mode selection increments the least significant (rightmost) display character. Once the desired character is displayed, press the EXEC switch to enter the character into memory.

This procedure must be repeated for the most significant character. Pressing the EXEC switch after entering the test number in memory initiates test execution. After test completion, test 00 is enabled ("00" in display). To determine if an error occurred, place the Diagnostic Mode switch in the off (down) position and observe the display, or execute Diagnostic Test 00.

## TEST DESCRIPTIONS

### TEST 00 -- DISPLAY STATUS/ERROR CODE LOG

This test displays the sixteen most recently generated status/error codes stored in memory locations 20 through 2F. Pressing the STEP switch displays memory starting at location 20. At the completion of a successful powerup, the contents are: 00 (most recent code), 6D, 08, 07, 2E, 03, 02, 71, 70 (oldest code), with 00 in all remaining locations.

### TEST 01 -- DISPLAY FAULT LOG OR CYLINDER LOG

This test displays eight bytes stored in memory at locations 31 through 38. Pressing the STEP switch displays the contents of these locations starting at location 31. Following Test 10, the last four cylinder addresses are displayed (two bytes per address). Otherwise, the eight most recent fault conditions are displayed. The definition of each bit within the fault byte is provided below:

<u>Bit</u>	<u>Definition</u>
0 (LSB)	Not Used (01)
1	Voltage Fault (02)
2	Write Fault (04)
3	Read-Write Fault (08)
4	(Read+Write)-Off Cylinder Fault (10)
5	Head Select Fault (20)
6	First Seek Fault (40)
7 (MSB)	Not Used (80)

### TEST 02 -- PERFORM MPU INITIALIZATION

This test reexecutes the MPU initialization routine. If the spindle motor is operating, the test also reexecutes the first seek operation (spindle motor is not recycled). The expected contents for drive initialization with the spindle stopped are: 03 (latest status), 02, 71, 70, with 00 in all remaining locations. The expected contents for drive initialization with the spindle operating are: 51 (latest status), D1, 18, 70, with 00 in all remaining locations.

### TEST 03 -- SWITCH DISPLAY TEST

This test exercises the switches and indicators on the maintenance panel and is divided into three parts. Part 1 tests the hex display and fault indicators. Part 2 tests the switches (except STEP and EXEC switches). Part 3 tests the STEP and EXEC switches.

### TEST 04 -- CALCULATE FOUR MOST LIKELY FAILED FIELD-REPLACEABLE UNITS

This test uses the fault and status history as displayed by Tests 00 and 01 to predict the most likely cause of drive failure. The field-replaceable unit corresponding to each display is provided below.

<u>Hex Display</u>	<u>Field-Replaceable Unit</u>
1	Power Supply
2	Control Board
3	Power Amplifier
4	Module
5	Read/Write Board
6	Module
7	Cooling Fan
8	I/O Board
9	Operator Panel
A	Mother Board
B	Module
C	Module
D	Maintenance Panel
F	Air Filter

### TEST 05 -- SERVO TEST

This test automatically performs a series of RTZ, one-track, velocity recalibrate, and maximum-length seek operations.

### TEST 06 -- CLEAR STATUS/ERROR LOG

This test clears the status/error log.

#### **TEST 07 -- CLEAR FAULT LOG**

This test clears the fault log.

#### **TEST 08 -- DIRECT SEEK**

This test performs continuous seeks between cylinder zero and the cylinder address loaded by Test 0D.

#### **TEST 09 -- RANDOM SEEK**

This test performs random seeks within the limits of cylinder zero and the maximum cylinder address.

#### **TEST 0A -- DISPLAY/ALTER LOAD DELAY**

This test stores and displays a count corresponding to the amount of delay between seeks during the scan cycle portion of the load operation. A load delay count of 00 represents default.

#### **TEST 0B -- NOT USED**

#### **TEST 0C -- DISPLAY EPROM PART NUMBER**

This test displays the eight-digit decimal part number of the EPROM located on the control board.

#### **TEST 0D -- LOAD CYLINDER ADDRESS**

This test allows the operator to load a number to be used as the upper cylinder address in Test 08 (Direct Seek).

#### **TEST 0E -- RETURN TO ZERO**

This test executes a return to zero (RTZ) seek.

#### **TEST 0F -- DISABLE CYLINDER LOG**

This test disables cylinder address logging and enables fault logging.

## **TEST 10 -- ENABLE CYLINDER LOG**

This test causes cylinder addresses, rather than fault conditions, to be loaded into the fault log. Test 01 is used to display the last four cylinder addresses that were accessed.

## **TEST 11 -- DISABLE FAN FAULT**

This test causes the servo MPU to disable the Fan Fault.

## **TEST 12 -- ENABLE FAN FAULT**

This test causes the servo MPU to enable the Fan Fault.

## **STATUS CODE SUMMARY**

Table A-2 provides a summary of the status codes. Refer to volume 2 of the hardware maintenance manual for descriptions, probable causes, and maintenance actions applicable to each status code.



TABLE A-2. STATUS CODE SUMMARY

Status Code	Description
00	<u>Normal On Cylinder</u> Normal On Cylinder
01	<u>Normal Motor Stop</u> Retracting Heads To Landing Zone
02	Stopping Motor
03	Motor Stopped OK
07	<u>Normal Motor Start</u> Motor Start In Progress (No Jog)
08	Motor Start In Progress (Including Jog)
09	Speed OK Too Soon
0A	Too Long To Get Up To Speed (Retry)
0B	Too Long To Get Up To Speed (Sensor Fault)
0C	Too Many Startup Failures (No Retry)
0D	Too Many Startup Failures (Sensor Fault)
0E	Motor Speed Too High
0F	Motor Speed Too Low
10	Speed Loss Recovery With Seek Error
11	<u>Motor Stop During Recovery From Speed Drop</u> Retracting Heads to Landing Zone
12	Stopping Motor

Table Continued on Next Page

TABLE A-2. STATUS CODE SUMMARY (Contd)

Status Code	Description
	<u>Motor Start During Recovery From Speed Drop</u>
18	Motor Start In Progress (Including Jog)
19	Speed OK Too Soon
1A	Too Long To Get Up To Speed (Retry)
1B	Too Long To Get Up To Speed (Sensor Fault)
1C	Too Many Startup Failures (No Retry)
1D	Too Many Startup Failures (Sensor Fault)
1E	Motor Speed Too High
1F	Motor Speed Too Low
	<u>Normal Load</u>
21	Heads Loaded Before Load Begins
22	Fault After Power Amplifier Driver Enabled
25	Demodulator Active Timeout
26	Cylinder Pulse Timeout
27	Fault After Load Complete
28	Code 22 And Too Many Retries
2B	Code 25 And Too Many Retries
2C	Code 26 And Too Many Retries
2D	Code 27 And Too Many Retries
	<u>Power Sequence</u>
2E	Sequence Power Delay
Table Continued on Next Page	

TABLE A-2. STATUS CODE SUMMARY (Contd)

Status Code	Description
	<u>Normal RTZ</u>
30	Can't Move In From Outer Guard Band
31	Lost Demodulator Active Before Turnaround
33	Timeout During RTZ
34	Backup Into Outer Guard Band
35	Turnaround
36	Out Of Guard Band Too Soon
37	Can't Find Cylinder Pulse At Track -1
38	Can't Find Fine Enable
39	Settle In On Track 0
	<u>Normal Guard Bands</u>
40	Inner Guard Band Detected During Normal Seek
41	Inner Guard Band Detected During On Cylinder Routine
42	Inner Guard Band Detected While On Cylinder
43	Outer Guard Band Detected During Normal Seek
44	Outer Guard Band Detected During On Cylinder Routine
45	Outer Guard Band Detected While On Cylinder
	<u>Normal Seek Timeout</u>
46	Seek Timeout
	<u>(Normal) Can't Stop On Track During On Cylinder Routine</u>
47	Too Long To Get On Cylinder Sense
48	Demodulator Active Lost During On Cylinder Routine
49	Too Many Cylinder Pulses During Settle In
4A	Too Many On Cylinder Dropouts
Table Continued on Next Page	

TABLE A-2. STATUS CODE SUMMARY (Contd)

Status Code	Description
	<u>Normal On Track</u>
4B	Off Cylinder
4C	Lost Demodulator Active While On Cylinder
4E	Voltage Fault While On Cylinder
	<u>(Normal) Illegal Cylinder Address Greater Than 710</u>
4D	Illegal Cylinder Address
	<u>Reset Dummy RTZ Mode Canceled</u>
50	Recovery From Low Vcc Reset
51	Recovery From MPU Hang Reset
52	Recovered From Low Vcc Reset And Subsequent Speed Loss
53	Recovered From MPU Hang And Subsequent Speed Loss
58	Non-Maskable Interrupt
59	Software Interrupt
5A	PTM Test Failure
5B	Too Many Fan Faults (Greater Than 10)
5C	Fan Fault
5F	PIA Test Failure
	<u>Servo Test Diagnostics</u>
60	Servo Test Failure During RTZ
61	Servo Test Failure During Recalibrate
62	Servo Test Failure During 1 Track Seek
63	Servo Test Failure During Maximum Length Seek
Table Continued on Next Page	

TABLE A-2. STATUS CODE SUMMARY (Contd)

Status Code	Description
<u>Servo Test Diagnostics (Contd)</u>	
64	Failed Recalibrate Test
65	1 Track Seek Too Fast
66	1 Track Seek Too Slow
67	Maximum Length Seek Too Slow
68	Maximum Length Seek Too Fast
69	Bad Preseek Status
6A	Not Up To Speed During Seek Test
6D	Scan Cycle Or Sweep Cycle Active
70	Self Test Complete
71	Fan On
72	Execute Switch Does Not Release
7C	On Cylinder Missing In I/O
80	Fault Before Seek Begins
90	Recovered From Speed Loss
<u>Load And Fault Detected Before Seek Error Was Set</u>	
A1	Heads Loaded Before Load Begins
A2	Fault After Power Amplifier Driver Enabled
A5	Demodulator Active Too Late
A6	Cylinder Pulse Timeout
A7	Fault After Load Complete
A8	Code 22 And Too Many Retries
AB	Code 25 And Too Many Retries
AC	Code 26 And Too Many Retries
AD	Code 27 And Too Many Retries
Table Continued on Next Page	

TABLE A-2. STATUS CODE SUMMARY (Contd)

Status Code	Description
	<u>RTZ And Fault Detected Before Seek Error Was Set</u>
B0	Can't Move In From Outer Guard Band
B1	Lost Demodulator Active Before Turnaround
B3	Timeout During RTZ
B4	Backup Into Outer Guard Band
B5	Turnaround
B6	Out Of Guard Band Too Soon
B7	Can't Find Cylinder Pulse At Track -1
B8	Can't Find Fine Enable
B9	Settle In On Track 0
	<u>Guard Bands And Fault Detected Before Seek Error Was Set</u>
C0	Inner Guard Band Detected During Normal Seek
C1	Inner Guard Band Detected During On Cylinder Routine
C2	Inner Guard Band Detected While On Cylinder
C3	Outer Guard Band Detected During Normal Seek
C4	Outer Guard Band Detected During On Cylinder Routine
C5	Outer Guard Band Detected While On Cylinder
	<u>Seek Timeout And Fault Detected Before Seek Error Was Set</u>
C6	Seek Timeout
Table Continued on Next Page	

TABLE A-2. STATUS CODE SUMMARY (Contd)

Status Code	Description
	<u>Can't Stop On Track During On Cylinder Routine And Fault Detected Before Seek Error Was Set</u>
C7	Too Long To Get On Cylinder Sense
C8	Demodulator Active Lost During On Cylinder Routine
C9	Too Many Cylinder Pulses During Settle In
CA	Too Many On Cylinder Dropouts
	<u>On Track And Fault Detected Before Seek Error Was Set</u>
CB	Off Cylinder
CC	Lost Demodulator Active While On Cylinder
CE	Voltage Fault While On Cylinder
	<u>Illegal Cylinder Address Greater Than 710 And Fault Detected Before Seek Error Was Set</u>
CD	Illegal Cylinder Address
	<u>Reset Dummy RTZ Mode Active</u>
D0	Recovery From Low Vcc Reset
D1	Recovery From MPU Hang Reset
	<u>MPU Power On Test</u>
FF	MPU Failed Power On Test

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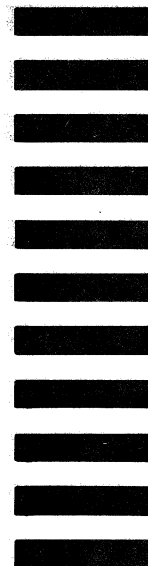
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