83325710

CONTROL DATA

CDC® EMD/SABRE EIGHT-INCH MODULE DRIVE

PA8G1/PA8G2 (736 MB)

PA8K1/PA8K2 (850 MB)

PA8W2 (1120 MB)

PA8N1/PA8N2 (1230 MB)

GENERAL DESCRIPTION

OPERATION

INSTALLATION AND CHECKOUT

USER'S MANUAL

LIST OF EFFECTIVE PAGES

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f-18	B	3-14	B	3-56	C	3-98	C	B-4	C
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1-10	C	3-26	B	3-68	C	3-110	C	B-16	C
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Blank	-	3-28	C	3-70	C	3-112	C	Blank	-
S-2 Div	-	3-29	B	3-71	C	3-113	C	C-1	C
Blank	-	3-30	B	3-72	C	3-114	C	C-2	C
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2-2	B	3-32	B	3-74	C	Blank	-	C-4	C
2-3	B	3-33	B	3-75	C	App A Div	-	C-5	C
Blank	-	3-34	B	3-76	C	Blank	-	C-6	B
2-5	B	3-35	C	3-77	C	A-1	B	C-7	B
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PAGE	REV
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PREFACE

This manual contains maintenance information for the CONTROL DATA® PA8G1, PA8G2, PA8K1, PA8K2, PA8N1, PA8N2, and PA8W2 Eight-Inch Module Drives (EMDs). It provides instructions to all personnel who operate the EMD and to customer engineers who install and check out the EMD. Customer engineers who troubleshoot and repair EMDs should obtain copies of the manuals listed below.

As you use these manuals, you will find information specific to either the PA8G1/PA8G2 drives, the PA8K1/PA8K2 drives, the PA8N1/PA8N2 drives, or the PA8W2 drives. Specific references to one type of drive or the other are keyed to the nominal drive capacity as follows:

- PA8G1/PA8G2 EMDs are referred to as 736 MB drives.
- PA8K1/PA8K2 EMDs are referred to as 850 MB drives.
- PA8W2 EMDs are referred to as 1120 MB drives.
- PA8N1/PA8N2 EMDs are referred to as 1230 MB drives.

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.

Appendix A - Diagnostic Testing and Status Code Summary. Provides simplified troubleshooting information.

Appendix B - Reference Material for Sector Selection. Provides additional information on setting sector switches.

Appendix C - Installation and Operating Requirements (German). Contains basic installation and operation information in the German language.

Appendix D - Installation and Operating Requirements (French). Contains basic installation and operation information in the French language.

Appendix E - Installation and Operating Requirements (Spanish). Contains basic installation and operation information in the French language.

New features, technical changes, additions, and deletions in this manual are indicated as follows:

- A vertical bar in the outer margin of a page marks the changed area.
- A dot by the page number indicates the entire page contains new or changed information.
- A vertical bar by the page number indicates the information was moved from another page, but there were no technical or editorial changes.

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

Publication No.	Title
83325690	PA8XX Theory Manual
83325700	PA8XX Parts Data Manual (contains listings of field replaceable parts, manufacturer's recommended spare parts, and accessories)
83325710	PA8G1/PA8G2/PA8K1/PA8K2/PA8N1/PA8N2 User's Manual (contains general description, operation, installation & checkout information)
83325720	PA8XX Maintenance Manual (contains general maintenance information, trouble analysis, and repair & replacement)
83325730	PA8XX Diagrams Manual
83325660	Reference Card (summarizes status codes and diagnostic operation for drives with the SMD-E interface)

CONTENTS

FIGURES

TABLES

IMPORTANT SAFETY INFORMATION AND PRECAUTIONS

Use of proper safety and repair techniques is important for safe, reliable operation of this unit. Service should be done only by qualified persons. We recommend the procedures in this manual as effective ways of servicing the unit. Some procedures require the use of special tools. For proper maintenance and safety, you must use these tools as recommended.

The procedures in this manual and labels on the unit contain warnings and cautions that must be carefully read and followed to minimize or eliminate the risk of personal injury. The warnings point out conditions or practices that may endanger you or others. The cautions point out conditions or practices that may damage the unit, possibly making it unsafe for use.

You must also understand that these warnings and cautions are not exhaustive. We cannot possibly know, evaluate, and advise you of all the ways in which maintenance might be performed or the possible risk of each technique. Consequently, we have not completed any such broad evaluation. If you use a non-approved procedure or tool, first ensure that the method you choose will not risk either your safety or unit performance.

For the safety of yourself and others, observe the following warnings and precautions.

- Perform all maintenance by following the procedures in this manual.
- Follow all cautions and warnings in the procedures and on unit labels.
- Use the special tools called out in the procedures.
- Use sound safety practices when operating or repairing the unit.
- Use caution when troubleshooting a unit that has voltages present. Remove power from unit before servicing or replacing parts.
- Wear safety glasses when servicing units.
- Wear safety shoes when removing or replacing heavy parts.
- Use only designated CDC/MPI replacement parts. Non-CDC/MPI replacement parts can adversely affect safety in addition to degrading reliability, increasing maintenance downtime, and voiding warranty coverage.

- Use care while working with the power supply because line voltages are always present when the ac power cord is connected to a power source. Setting the power supply switch to position "0" disables dc power to the drive but has no effect on ac power within the supply. For complete safety, remove the ac power plug from the site power outlet.

- In case of fire or other emergency, isolate the drive from main power by removing the drive power plug from the ac outlet. In situations where pulling the plug is not possible or practical, use the system main power disconnect to isolate the drives from main power.

- When the drive is mounted in an equipment rack or cabinet, ensure that the internal temperature of the rack or cabinet will not exceed the limits defined for the drive. Where units are stacked vertically, pay special attention to the top where temperatures are usually highest.

- This drive is designed to be installed and operated in accordance with IEC380, IEC435, VDE805, VDE806.

- Follow the precautions listed under Electrostatic Discharge Protection in section 3 of this manual.

- If the power supply is placed on a bench for testing, position the supply so all ventilation holes are open, to allow proper air flow to internal components.

- Do not attempt to disassemble the module. It is not field repairable. Replace the entire module assembly if it is defective.

- Do not operate the drive over an extended period of time without the top cover installed.

- If the power supply is connected to an IT network, ensure that the input voltage is limited to 230 volts.

- Do not attempt to disassemble the power supply. It is not field repairable. Replace the entire supply if it is defective.

- Always deenergize drive before removing or installing circuit boards, cables, or any other electrical components.

- If you do not use a recommended CDC power supply, ensure that the supply meets the specifications in this manual and is designed to be used in accordance with IEC380, IEC435, VDE805, VDE806.

ABBREVIATIONS

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

ABBREVIATIONS (Contd)

ENBL	Enable
EXT	External
F	Fahrenheit, Fuse
FCO	Field Change Order
FDBK	Feedback
FIG	Figure
FLT	Fault
FRU	Field Replaceable Unit
ft	Foot
FTU	Field Test Unit
FWD	Forward
GND	Ground
HD	Head
HEX	Hexagon, Hexadecimal
Hg	Mercury
HR	High Resolution
HYST	Hysteresis
Hz	Hertz
IC	Integrated Circuit
IDENT	Identification
in	Inch
IND	Index
INTRPT	Interrupt
I/O	Input/Output
IPB	Illustrated Parts Breakdown
kg	Kilogram
kPa	Kilopascal
kW	Kilowatt
lb	Pound
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LSI	Large Scale Integration
LTD	Lock to Data
m	Metre
MAX	Maximum
MB	Megabyte
MEM	Memory
MHz	Megahertz
mm	Millimetre

ABBREVIATIONS (Contd)

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

ABBREVIATIONS (Contd)

SEQ	Sequence
SPD	Speed
SS	Sector Switch
T	Tracks to go
TF	Thread Forming
TIM	Timer
TP	Test Point
TSP	Troubleshooting Procedure
TTL	Transistor-Transistor Logic
V	Volts, Voltage
Vbb	Bias Voltage
VCC	Bias Voltage
VCO	Voltage Controlled Oscillator
W	Watts
W/	With
W/O	Without
W P	Write Protect
W+R	Write or Read
W·R	Write and Read
WRT	Write
XFR	Transfer
Ω	Ohms
$	Hexadecimal Address
µF	Microfarad
µs	Microsecond

SECTION 1

GENERAL DESCRIPTION

[illegible]

INTRODUCTION

The Control Data PA8G1/PA8G2, PA8K1/PA8K2, PA8N1/PA8N2, and PA8W2 Eight-Inch Module Drives (EMDs) are high speed, random access digital data storage devices that connect to a central processor through a controller. Equipment specifications for the drive are listed in table 1-1.

The remainder of this section provides a general description of the drive 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-O) 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 the theory 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
Size	Dimensions	See Space Requirements in section 3
	Weight (Drive only)	14.8 kg (32.8 lb)
	Weight (Power Supply only)	3.6 kg (8.0 lb)
Interface	SMD-0/SMD-E	
Recording	Total Capacity PA8G1/PA8G2 PA8K1/PA8K2 PA8W2 PA8N1/PA8N2	(Unformatted) 741.63 MB (736 nominal) 851.14 MB (850 nominal) 1123.05 MB (1120 nominal) 1236.06 MB (1230 nominal)
	Bytes per track 736 MB drives 850 MB drives 1120 MB drives 1230 MB drives	(Unformatted) 30 240 bytes 41 088 bytes 45 792 bytes 50 400 bytes
	Number of disks	9
	Movable data heads	15
	Servo Heads	1
	Physical heads per surface	1
	Logical cylinders per head/disk assy 736 MB drives 850 MB drives 1120 MB drives 1230 MB drives	 1635 (0-1634) 1381 (0-1380) 1635 (0-1634) 1635 (0-1634)
	Modulation	2-7 code

Table Continued on Next Page

TABLE 1-1. DRIVE SPECIFICATIONS (Contd)

Characteristics	Conditions	Specifications
Transfer rate	Disk speed at 3600 r/min	
	736 MB drives	14.52 MHz (1.814 MB/s)
	850 MB drives	19.72 MHz (2.465 MB/s)
	1120 MB drives	21.98 MHz (2.750 MB/s)
	1230 MB drives	24.19 MHz (3.024 MB/s)
Latency		Latency is time to reach a particular track address after positioning is complete.
	Average	8.33 milliseconds (disk rotation speed at 3600 r/min)
	Maximum	16.83 milliseconds (disk rotation speed at 3564 r/min)
Seek Time	Full	35 milliseconds maximum
	Average	16 milliseconds
	Single Track	5 milliseconds maximum
Start Time		90 seconds maximum
Stop Time		60 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 is one head for each disk surface. 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 cylinder (called seeking) and 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 must locate that portion of the track where the data is to be written or read. This is called track orientation and is done by using the Index and Sector signals generated by the drive. The Index signal indicates the logical beginning of each track. 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.

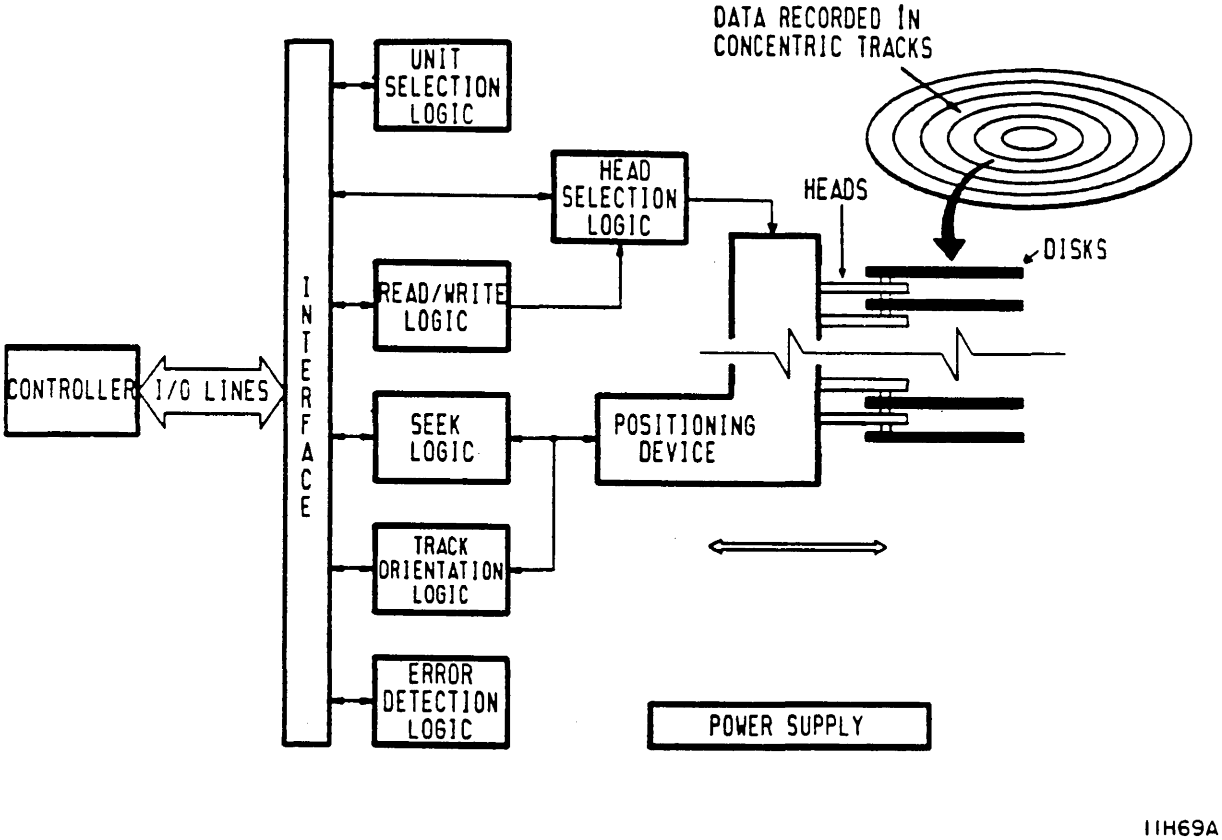


Figure 1-1. Drive Functional Block Diagram

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.

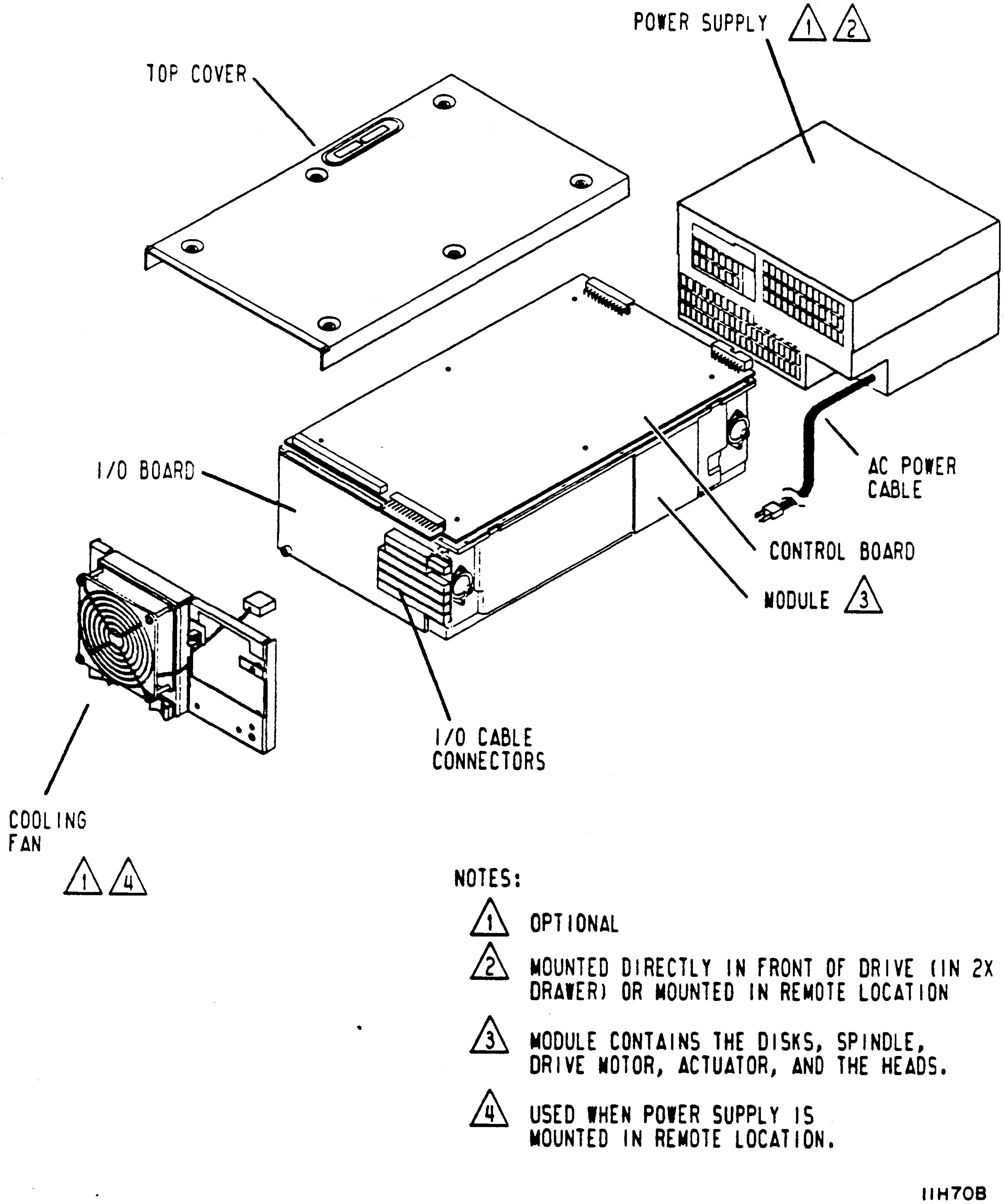


Figure 1-2. Drive Major Assemblies (Sheet 1 of 2)

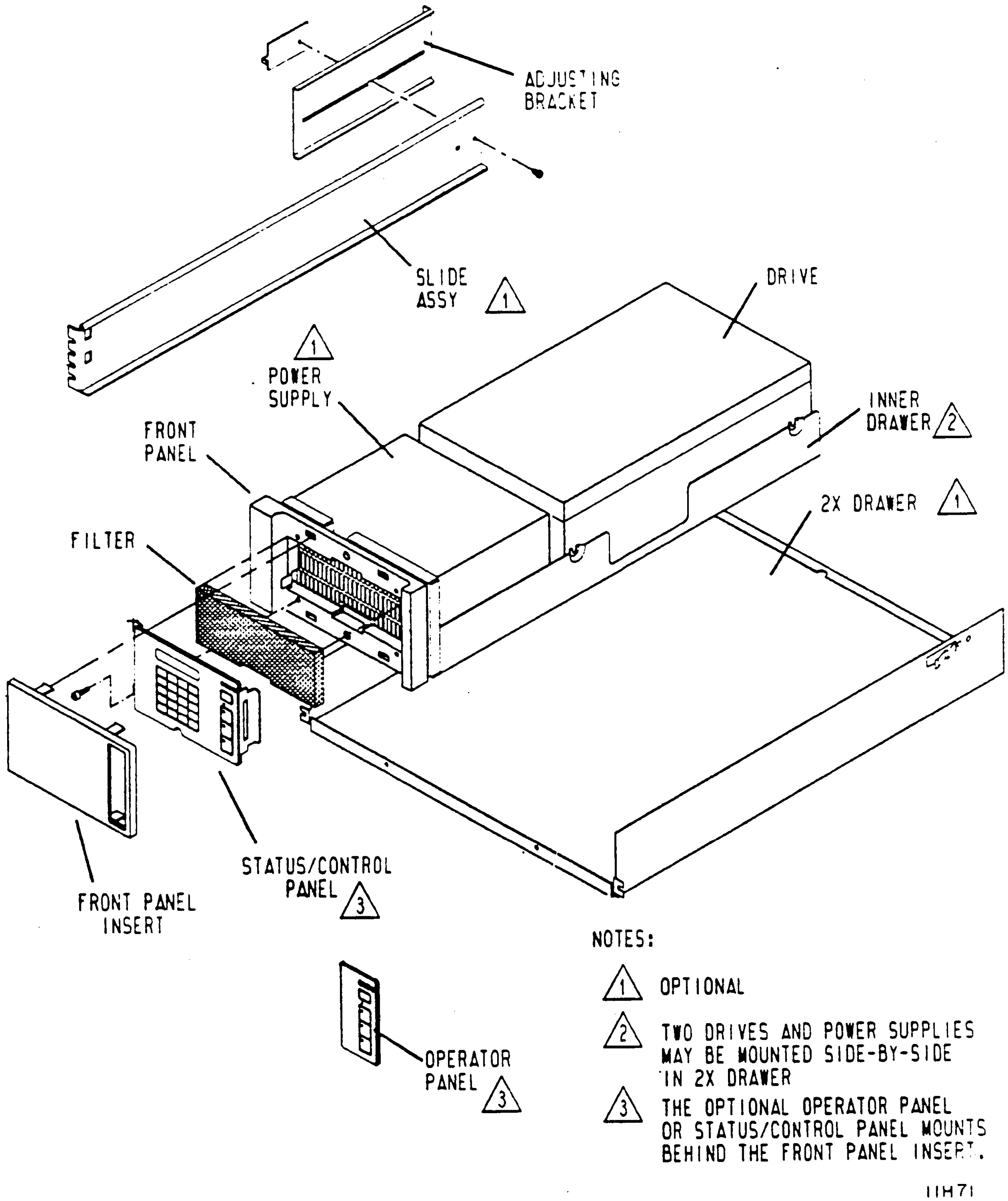


Figure 1-2. Drive Major Assemblies (Sheet 2)

The drive package includes a top cover, rear panel, module, and two circuit boards. Air flow is provided by a cooling fan. The cooling fan is an integral part of the optional power supply, and provides cooling air to the drive when the power supply is mounted directly in front of the drive. When the power supply is mounted in a remote location, drive cooling is provided by an optional fan and rear panel assembly.

Two optional panels provide external control of the drive. The operator panel contains basic switches and indicators for the operator. The status/control panel contains these same switches and indicators and, for troubleshooting, a diagnostic keyboard and display. These panels can be mounted either inline with the drive and power supply or in a remote location.

The drive's internal components include two circuit boards and a module. The circuit boards are mounted on the module, 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.

The nine disks provide the recording medium for the drive. These disks are 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 16 heads; a servo head to sense actuator positioning, and 15 data heads used for data transfers to and from the disks. The actuator has a voice coil that rotates in and out of a permanent magnetic field in response to signals from the servo positioning circuitry. The voice coil moves the heads in an arc across the rotating disks. When the drive is not in use, the heads rest on the disk surface in the preassigned landing zone (beyond the data zone). 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.

The drive may be mounted either in a cabinet or rack. An optional 2X drawer with a front panel for each drive is available for mounting two drives and power supplies side-by-side.

A complete listing of field-replaceable parts is given in the parts data manual. Refer to the theory manual for theory of operation of drive components.

EQUIPMENT CONFIGURATION

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

The equipment is identified by labels attached to the drive top cover and to the power supply. The label on the drive top cover identifies the basic mechanical and logical configuration of the drive at the time it leaves the factory. To maintain drive configuration whenever the top cover is removed, always identify which drive the top cover was removed from. 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:

```
                     PA8        G1A
                      |          |
      Equipment ______|          |_____ Type
      Identifier                        Identifier
```

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.

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 manual.

Part Number

The equipment identification label on the power supply lists three numbers: the equipment package part number, the Complete Drive Assembly (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. 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. When the factory installs an ECO early (prior to a series code change), it is logged on the unit's 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 you enter the FCO on the Equipment Configuration Log when you install 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 the parts data manual. This sheet records all the FCOs that are reflected in the manuals. It should agree with the machine Equipment Configuration Log if all the FCOs have been installed in the machine.

SECTION 2

OPERATION

OPERATION 2

INTRODUCTION

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

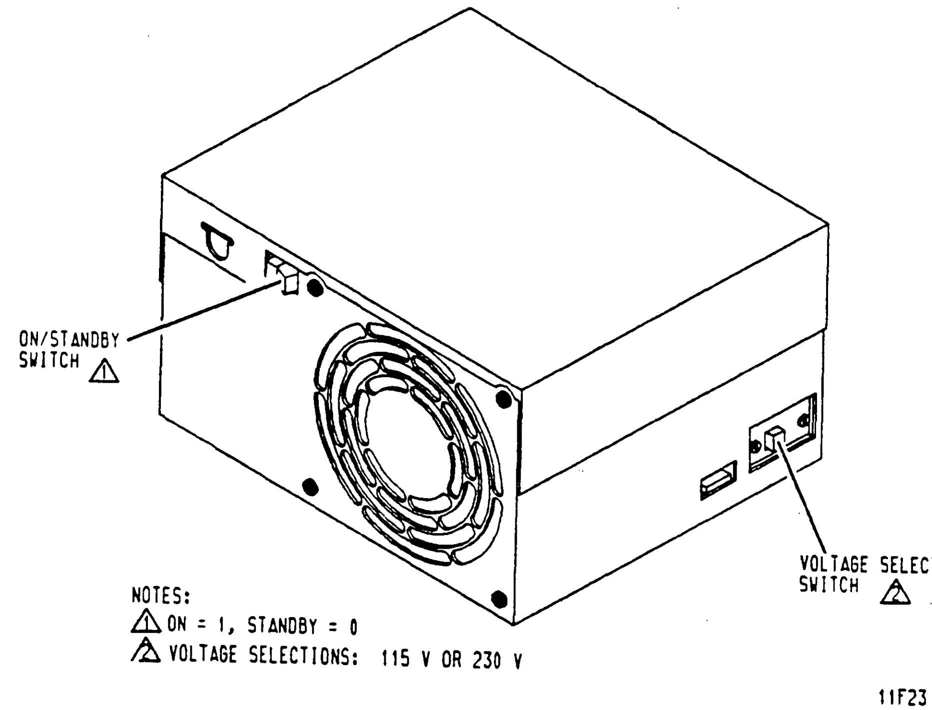
- Switches and Indicators -- Locates and describes the switches and indicators used for normal drive operation.
- Air Filter -- Describes filter maintenance for the drive operator.
- Operating Instructions -- Describes procedures for operating the drive.

SWITCHES AND INDICATORS

Switches and indicators used by the operator are on the power supply and the optional operator panel or status/control panel. Figure 2-1 shows these switches and indicators. They are explained in table 2-1.

As shown in figure 2-1, both the status/control panel and the operator panel provide identical sets of switches and indicators for the operator. In addition, the status/control panel has a diagnostic keyboard and liquid crystal display, intended for maintenance use. Refer to appendix A for a description of the maintenance features of the status/control panel.

Operation of a drive that does not have either type of panel is controlled by setting the appropriate switches on the control and I/O boards. LED indicators on the control board provide status on several drive conditions. Refer to section 3 for information on these switches and indicators. Normally the drive operator does not use them.



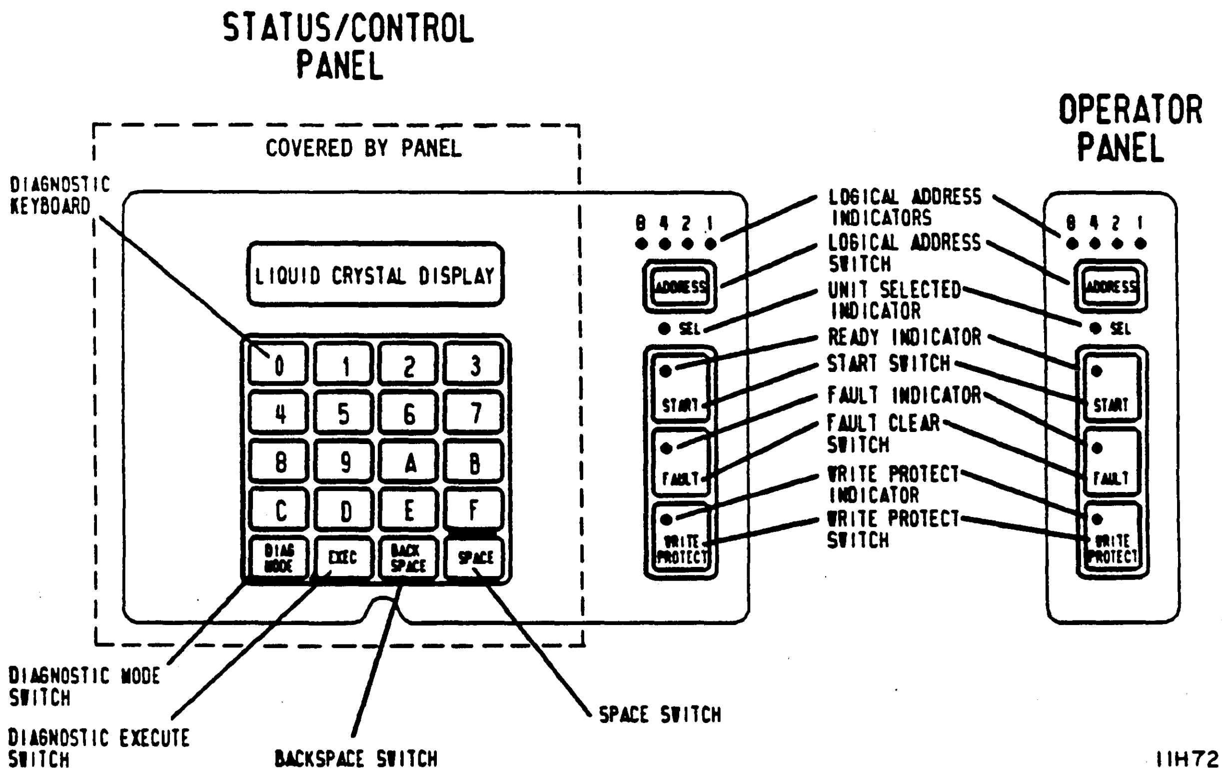


Figure 2-1. Switches and Indicators

TABLE 2-1. DRIVE SWITCHES AND INDICATORS

Switch or Indicator	Function
POWER SUPPLY	
On/Standby Switch (1/0)	Applies dc operating voltages to the drive electronics and fan when placed in the On (1) position.
OPERATOR PANEL OR STATUS/CONTROL PANEL	
Logical Address Switch (ADDRESS)/ Indicators (8/4/2/1)	The Logical Address switch establishes the logical address of the drive. The switch must be pressed for 2 to 3 seconds to advance the logical address. Pressing it longer causes the address to increment continuously. The Logical Address Indicators display the logical address in binary. The logical address is stored in memory when dc power is removed.
Unit Selected Indicator	Indicates that the drive is selected by a controller.
START Switch/ Ready Indicator	The START switch has momentary action for Start and Stop, and it contains the Ready indicator. Pressing the START switch enables the power on sequence, and Ready indicator flashes (rapidly) 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. Pressing the START switch to release it from the Start position causes the Ready indicator to flash (slowly) until disk rotation has stopped. The current condition of the START switch (Start/ Stop) is stored in memory when dc power is removed.

Table Continued on Page 2-5

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

Switch or Indicator	Function
OPERATOR PANEL OR STATUS/CONTROL PANEL (Contd)	
FAULT Indicator/ Fault Clear Switch	The FAULT indicator is inside the Fault Clear switch, and it lights if a fault exists within the drive. It is turned off by any of the following (provided that the error condition or conditions no longer exist): • Pressing the Fault Clear switch • Fault Clear command from the controller • A drive power on operation
WRITE PROTECT Switch/Indicator	The operation of the WRITE PROTECT switch or the WRITE PROTECT maintenance switch on the control board places the drive in the write protected mode (preventing write operations) and lights the WRITE PROTECT indicator. The current position of the WRITE PROTECT switch is stored in memory when dc power is removed.

AIR FILTER

The air filter is located behind the operator panel or status/control panel, as shown in figure 2-2. The air filter should be periodically inspected and either replaced or cleaned. Clean the filter only if a replacement filter is not available. The filter should be replaced about every six months in a computer room environment; replace it more often in a dirtier location.

CAUTION

Be careful not to damage system cabling when sliding drive in the drawer and drawer in and out of rack.

1. Remove front panel insert from each drive (see figure 2-2).

NOTE

Release latch on left-hand drive locks 2X drawer in rack. Release latch on right-hand drive has no function.

2. Push 2X drawer release latch to the right and extend 2X drawer to gain access to power supply.

3. Remove power from drive as follows:

   For drives with operator panel or status/control panel:

   a. Press START switch to stop drive.

   b. Wait for Ready indicator (in START switch) to stop flashing; then, set On/Standby switch on power supply to Standby (O) position.

   For drives without either panel, set On/Standby switch on power supply to Standby (O) position.

NOTE

If an operator panel is used, ignore steps 4 and 7. Filter may be replaced with operator panel in place.

4. Remove screws securing status/control panel to front panel and move status/control panel away from front panel to gain access to filter.

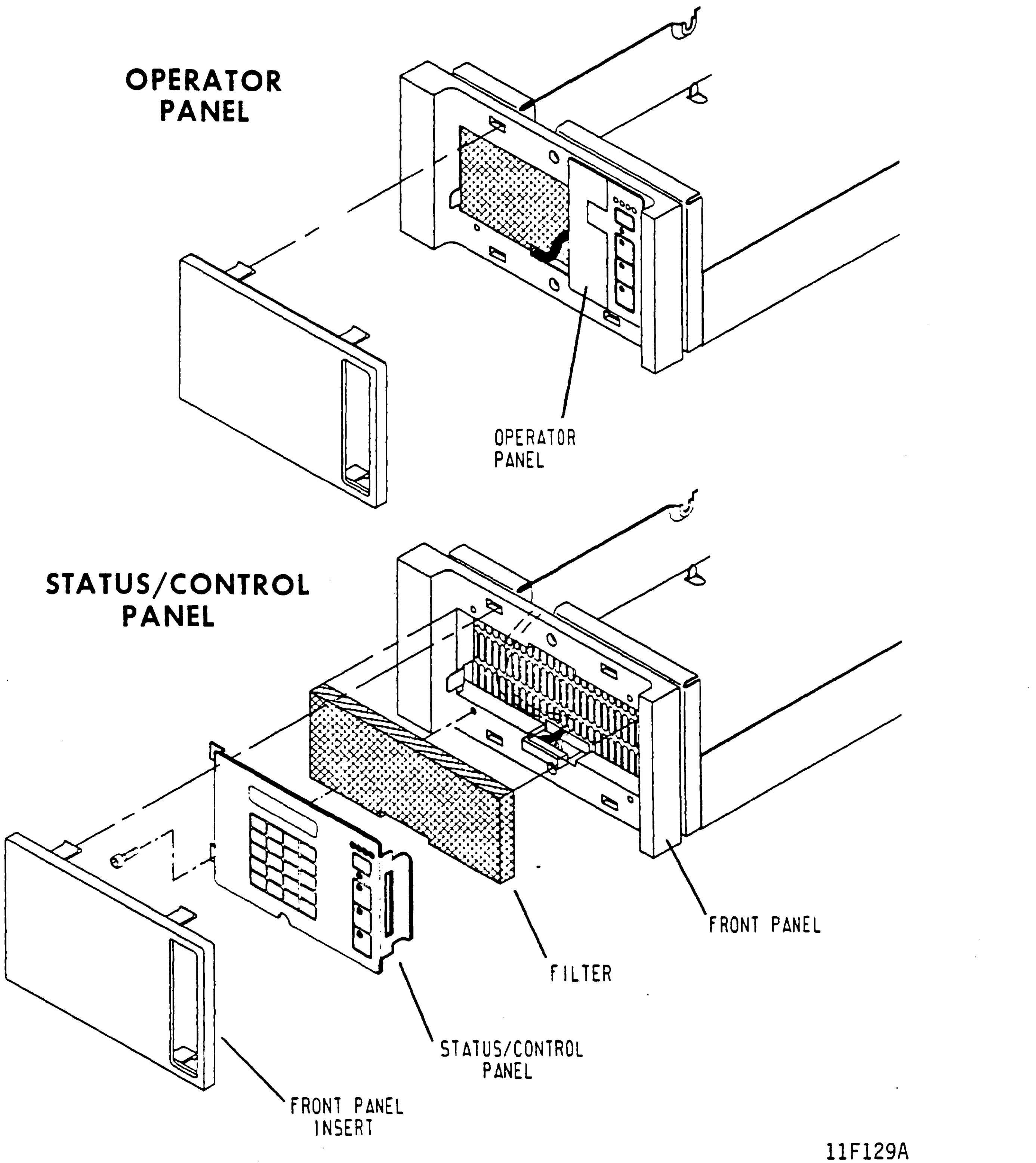


Figure 2-2. Air Filter Replacement

5. Remove dirty filter. If replacement filter is unavailable, clean dirty filter in solution of water and mild detergent. Rinse filter and allow it to dry.

6. Install clean filter.

7. Align status/control panel to front panel and secure with screws.

8. Set On/Standby switch on power supply to On (1) position.

9. Push 2X drawer back to closed position in rack.

10. Replace front panel insert.

OPERATING INSTRUCTIONS

For drives with no operator or status/control panel, there are no operating procedures. On these drives, when the R/L (Remote/Local) switch is placed in the Remote position, spindle power on/power off is handled by the controller. In Remote operation, the power on sequence is delayed. The length of delay is determined by the logical address number used, in increments of 5 seconds.

POWER ON PROCEDURE (DRIVES WITH OPERATOR PANEL OR STATUS/CONTROL PANEL)

This procedure describes how to turn on the drive. It is assumed that dc power is available to the drive because the power supply On/Standby switch is normally left in the On (1) position.

1. Press START switch to engage it in Start position.

   - If R/L (Remote/Local) switch on I/O board was set in Local position, power on sequence begins immediately.

   - If R/L (Remote/Local) switch on I/O board was set in Remote position, power on sequence continues when power sequence Pick or Hold (ground) signal is available from controller. With R/L (Remote/ Local) switch in Remote position, power on sequence to each drive is delayed. Length of delay is determined by logical address number used, in increments of 5 seconds.

     For example:
     Logical Address 0 = 0 second delay
     Logical Address 7 = 35 second delay

2. After delay is completed, observe that Ready indicator (located in START switch) flashes rapidly, indicating that power on is in progress.

3. Observe that Ready indicator lights steadily within 90 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 (DRIVES WITH OPERATOR PANEL OR STATUS/CONTROL PANEL)

This procedure describes how to turn off the drive.

1. Press START switch to release it from Start position to start power off sequence. If R/L (Remote/Local) switch is in Remote position, power down starts when sequence pick or hold is dropped by controller.

2. Observe that Ready indicator (located in START switch) flashes slowly, indicating that power off is in progress.

3. Observe that Ready indicator goes off within 60 seconds, indicating that power off is complete.

With power off complete, the heads are positioned in the landing zone and the disks are not rotating. Normally, the power supply On/Standby switch is left On (1) to continue supplying dc power to the drive.

INSTALLATION AND CHECKOUT 3

INTRODUCTION

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

SITE REQUIREMENTS

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 surrounding 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 parts data manual for part numbers). Connection may be made to any metal assembly. 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 parts data manual 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.
- Do not touch pins on power supply connector J15. Power supply circuitry is sensitive to electrostatic discharge.
- 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
TEMPERATURE		
Storage (Packaged)	Range	-10 to 50°C (14 to 122°F)
	Maximum change per hour	15°C (27°F)
Transit (Packaged)	Range	-40 to 60°C (-40 to 140°F)
	Maximum change per hour	20°C (36°F)

Table Continued on Next Page

TABLE 3-1. ENVIRONMENTAL REQUIREMENTS (Contd)

Conditions	Characteristics	Specifications
TEMPERATURE (Contd)		
Operating	Range	10 to 45°C (50 to 113°F)
	Maximum change per hour	15°C (27°F)
RELATIVE HUMIDITY		
Storage (Packaged)	Range	5% to 95%
Transit (Packaged)	Range	5% to 95%
Operating	Range	20% to 80% (no condensation allowed).
Table Continued on Next Page		

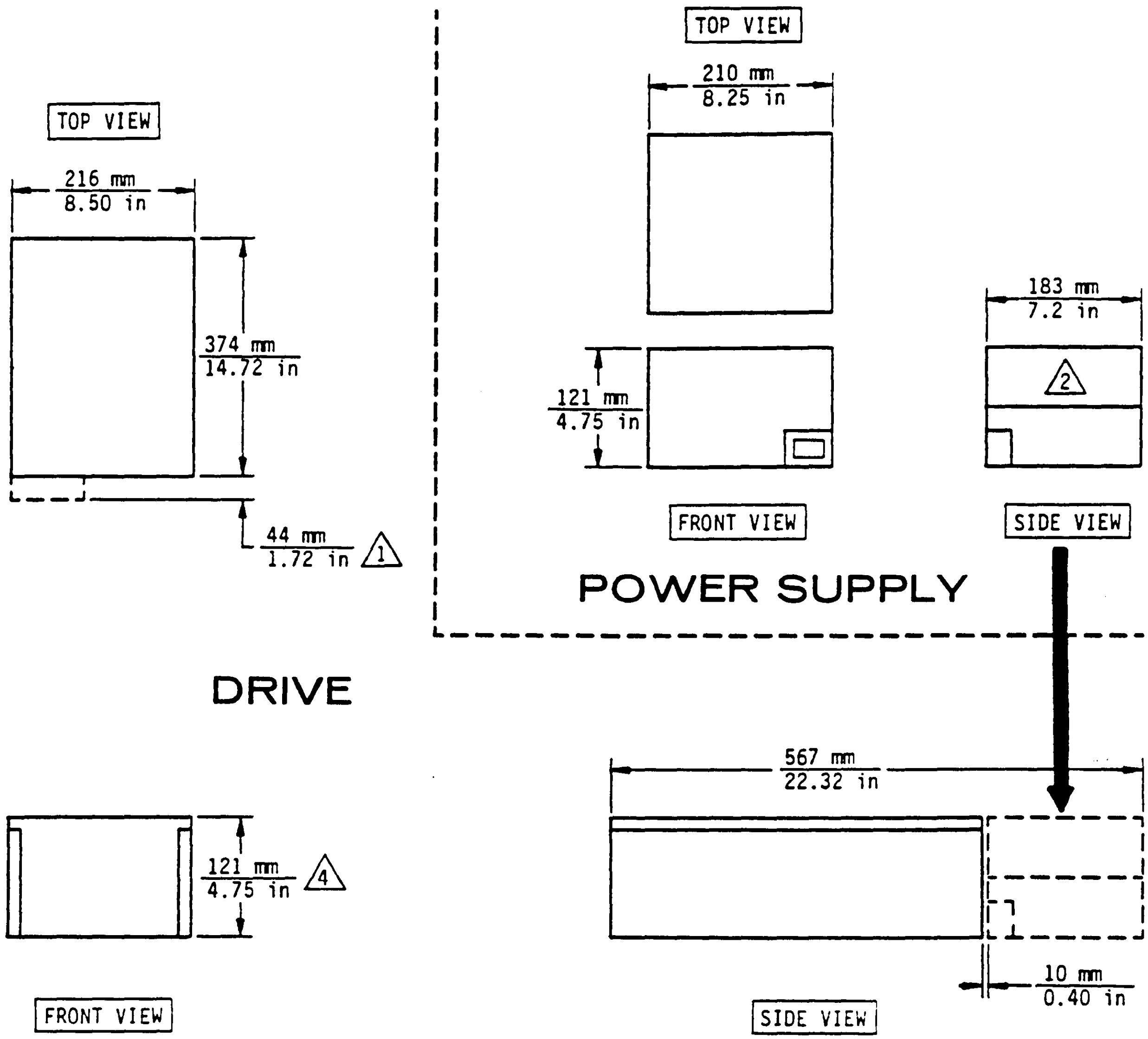
TABLE 3-1. ENVIRONMENTAL REQUIREMENTS (Contd)

Conditions	Characteristics	Specifications
BAROMETRIC PRESSURE (STANDARD DAY)		
Storage (Packaged)	Range	-305 m to 3000 m (-1000 ft to 10 000 ft) 104 kPa to 69 kPa (30 in to 20 in Hg)
Transit (Packaged)	Range	-305 m to 12 192 m (-1000 ft to 40 000 ft) 104 kPa to 19 kPa (30 in Hg to 6 in Hg)
Operating	Range	-305 m to 3000 m (-1000 ft to 10 000 ft) 104 kPa to 69 kPa (30 in Hg to 20 in Hg)

SPACE REQUIREMENTS

The drive and power supply mount side-by-side with another drive and power supply into a 2X drawer, and the 2X drawer slide mounts into a 483 mm (19 in) standard rack. The slide action allows outward extension of the drawer for ease of maintenance. The space requirements are shown in figure 3-1.

The combined mass of the drive and power supply is 18.4 kg (40.8 lb).



NOTES:

1. COOLING FAN MOUNTS ON REAR PANEL WHEN POWER SUPPLY IS NOT MOUNTED IN LINE WITH DRIVE.
2. COOLING FAN IS INSIDE POWER SUPPLY.
3. DIMENSIONS ARE NOMINAL.
4. HEIGHT IS 136 mm (5.35 in) ON DRIVES WITH VOLTAGE CONVERTER MOUNTED UNDER TOP COVER.

11H95

Figure 3-1. Drive Space Requirements

POWER REQUIREMENTS

WARNING

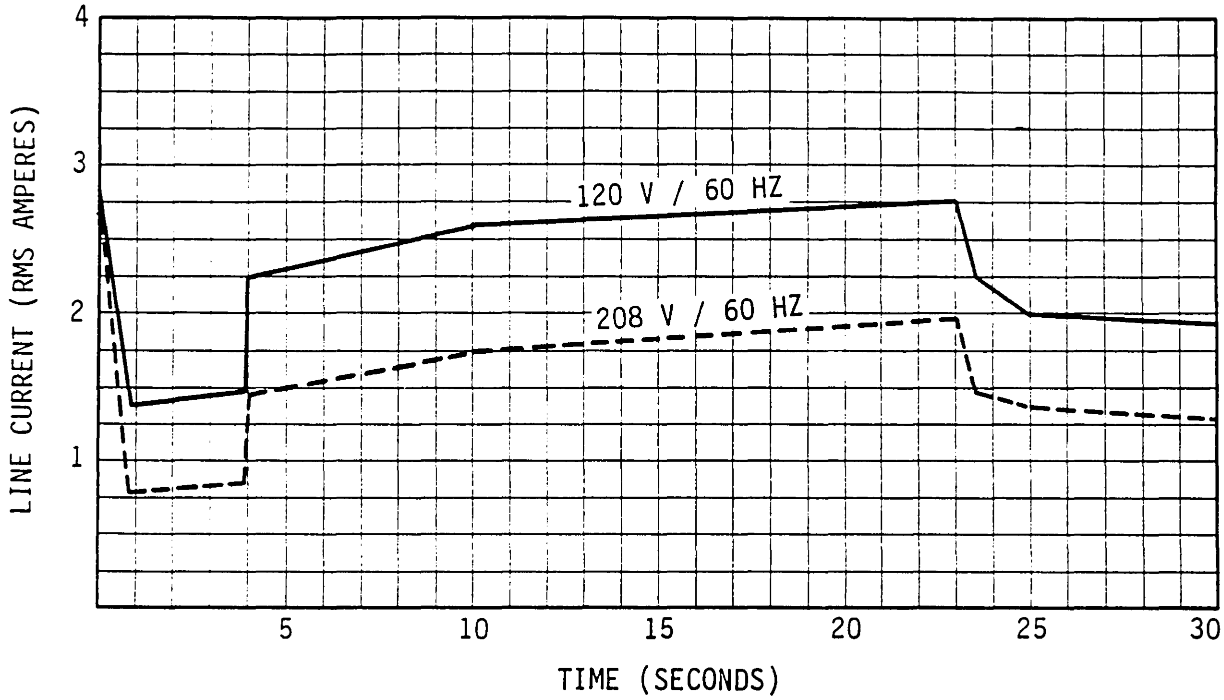
This unit has a single phase power supply with a capacitor input filter (sometimes called a switching type supply). If power comes from a 3-phase, 4-wire, wye branch or feeder circuit, ensure the circuit meets the latest requirements of the United States National Electrical Code. Failure to meet these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

Drive ac power requirements are listed in table 3-2. Conversion to the different line voltages is explained in the installation procedures. Typical drive current versus start-up time is shown in figure 3-2 for 100-120 and 208-240 volt connections.

TABLE 3-2. POWER REQUIREMENTS

Specifications	Nominal Values	
	100 - 120 V ac	208 - 240 V ac
Voltage Range	85 to 132 V	177 to 264 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*	0.140 - 0.145 kW	0.143 - 0.147 kW
Line Current*	2.5 - 2.2 A	1.5 - 1.4 A
Power Factor*	0.57 - 0.55	0.46 - 0.44
Start Up Current	See figure 3-2.	See figure 3-2.

*Measured at nominal values when disks are rotating and carriage is moving.



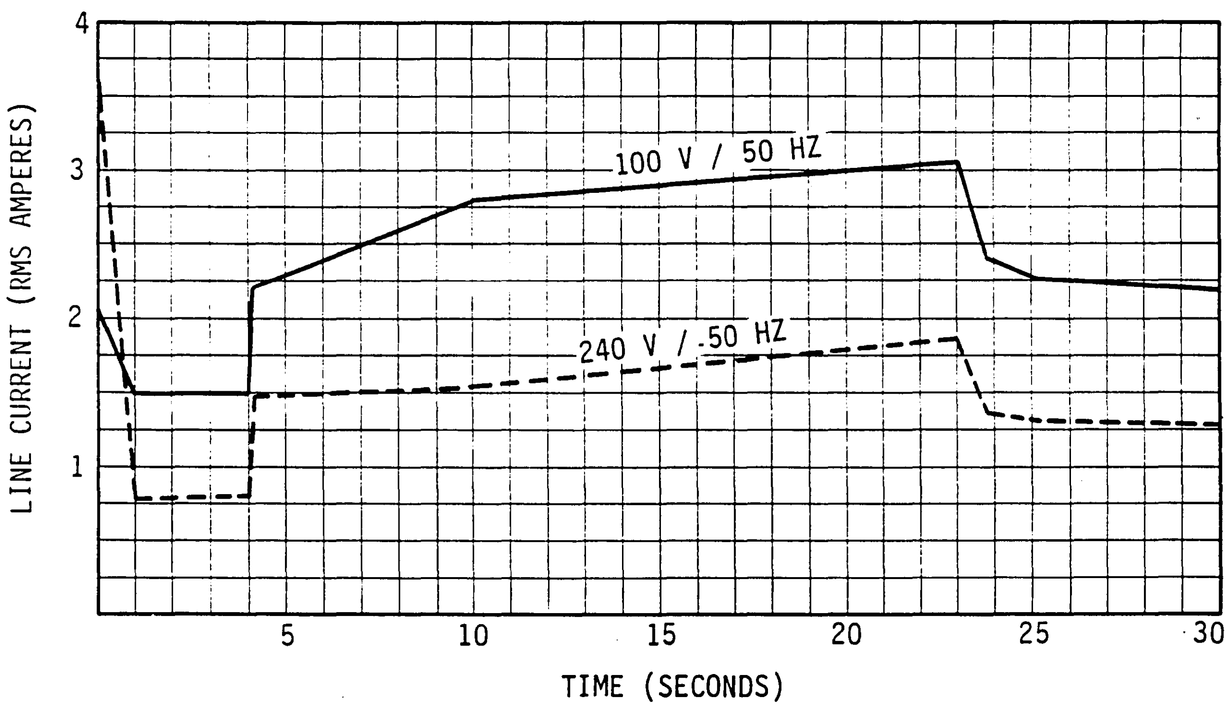


Figure 3-2. Typical Line Current Versus Start-up Time

GROUNDING REQUIREMENTS

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 drive in the system. 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 A cables may be connected in either a daisy chain (figure 3-3) or star (figure 3-4) configuration. Each configuration calls for the use of terminators.

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.

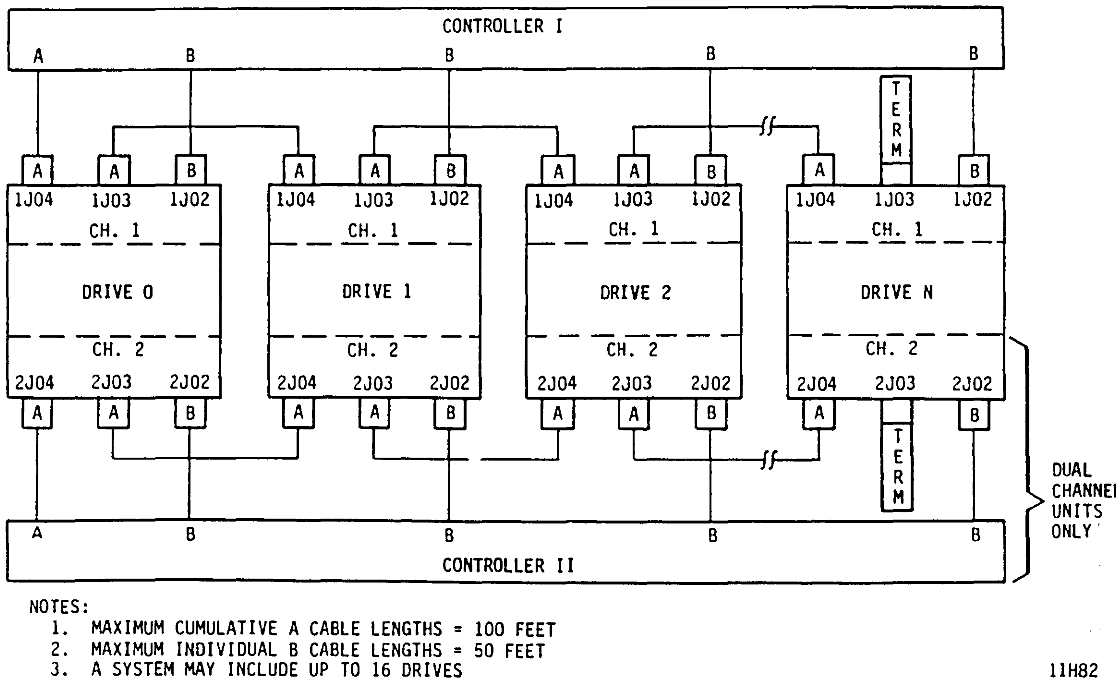
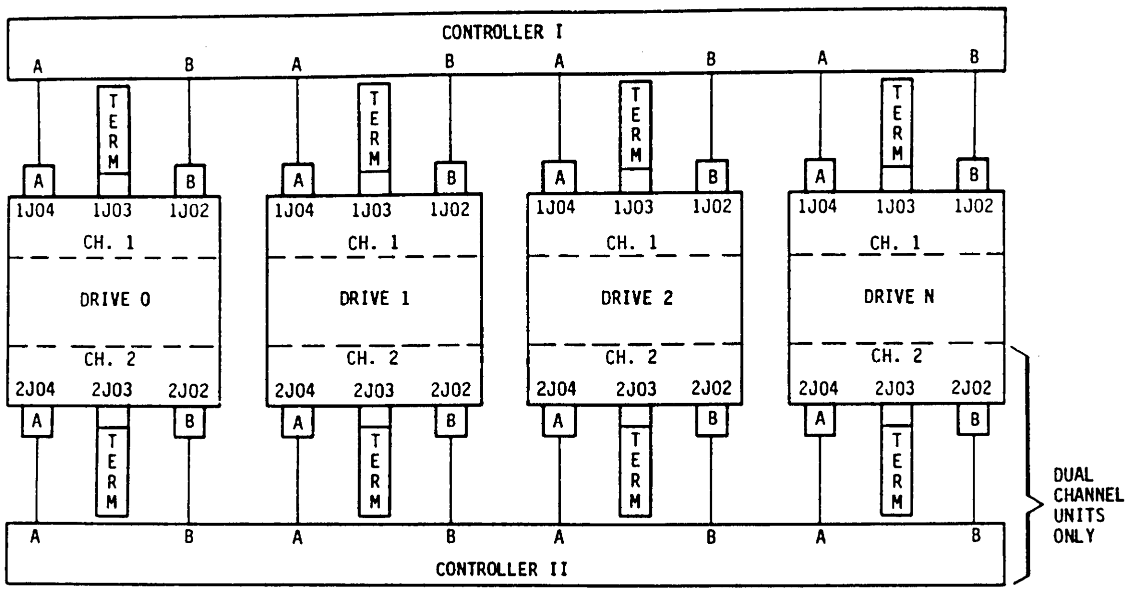


Figure 3-3. Daisy Chain Configuration

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. The last drive in the string has a terminator installed on it. Use this configuration if the controller has only one A cable connector to serve the entire drive string.



NOTES:
1. MAXIMUM INDIVIDUAL A CABLE LENGTHS = 100 FEET
2. MAXIMUM INDIVIDUAL B CABLE LENGTHS = 50 FEET
3. A SYSTEM MAY INCLUDE UP TO 16 DRIVES

11H83

Figure 3-4. Star Configuration

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

In estimating the I/O cables needed for an installation, decide on the configuration that 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 parts data manual for terminator and I/O cable part numbers.

Figure 3-5 shows 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 the theory manual.

UNPACKAGING, INSPECTION AND REPACKAGING

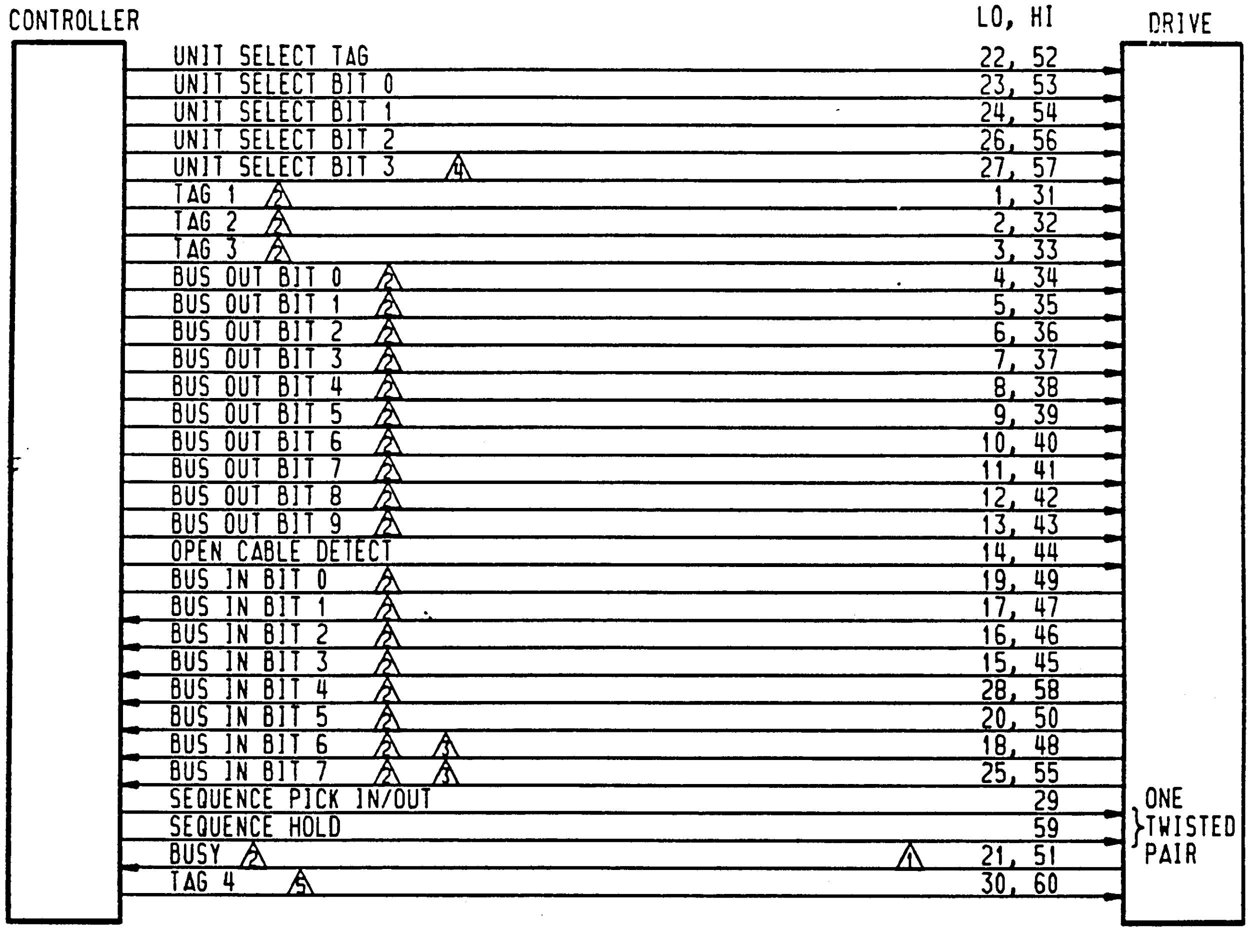
After removing packaging material according to the unpackaging instructions provided with the drive, inspection for shipping damage should be carried out and several final unpackaging procedures performed. Save all packaging materials for future use.

UNPACKAGING

1. Open package (save all packaging materials).
2. If drive has a 2X drawer with slide mount option, remove packages containing drawer, two slide mounts and slide mount hardware kit.
3. Remove package containing ac power cable and dc power cable.
4. Open sealed vapor barrier bag and remove 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.



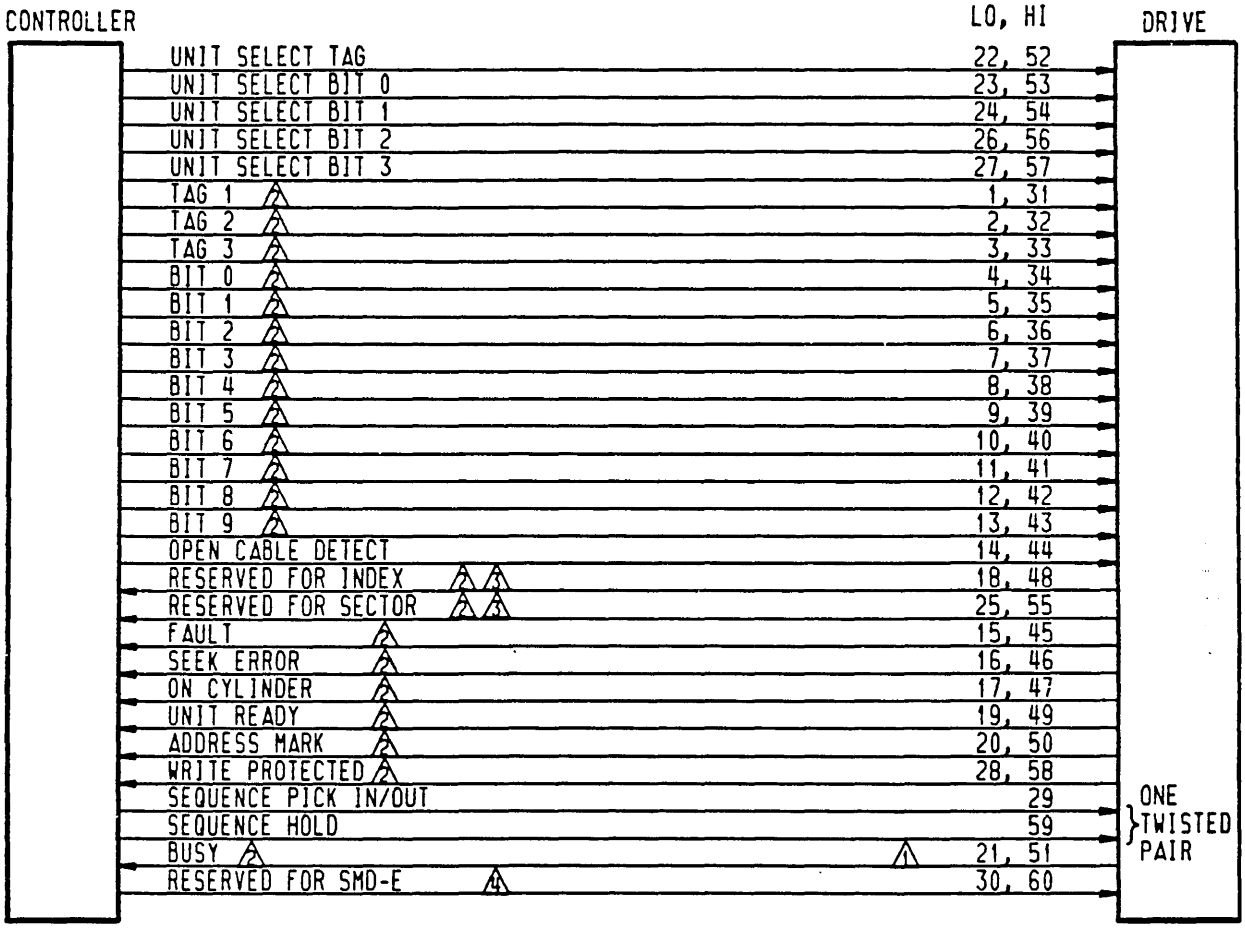
NOTES:

1. DUAL CHANNEL UNITS ONLY
2. GATED BY UNIT SELECT
3. INDEX AND SECTOR MAY BE IN "A" CABLE, "B" CABLE, OR BOTH.
4. FUNCTIONS AS TAG 5 LINE FOLLOWING UNIT SELECTION.
5. FUNCTIONS AS CYLINDER ADDRESS BIT 2^{10} LINE, WHEN OPERATING WITH TAG 1 EXTENDED ADDRESSING FEATURE.

SMD-E SIGNAL DEFINITIONS

11F43

Figure 3-5. A Cable (Sheet 1 of 2)



NOTES:

1. DUAL CHANNEL UNITS ONLY
2. GATED BY UNIT SELECT
3. INDEX AND SECTOR MAY BE IN "A" CABLE, "B" CABLE, OR BOTH.
4. FUNCTIONS AS CYLINDER ADDRESS BIT 2^{10} LINE WHEN OPERATING WITH TAG 1 EXTENDED ADDRESSING FEATURE.

SMD-O SIGNAL DEFINITIONS

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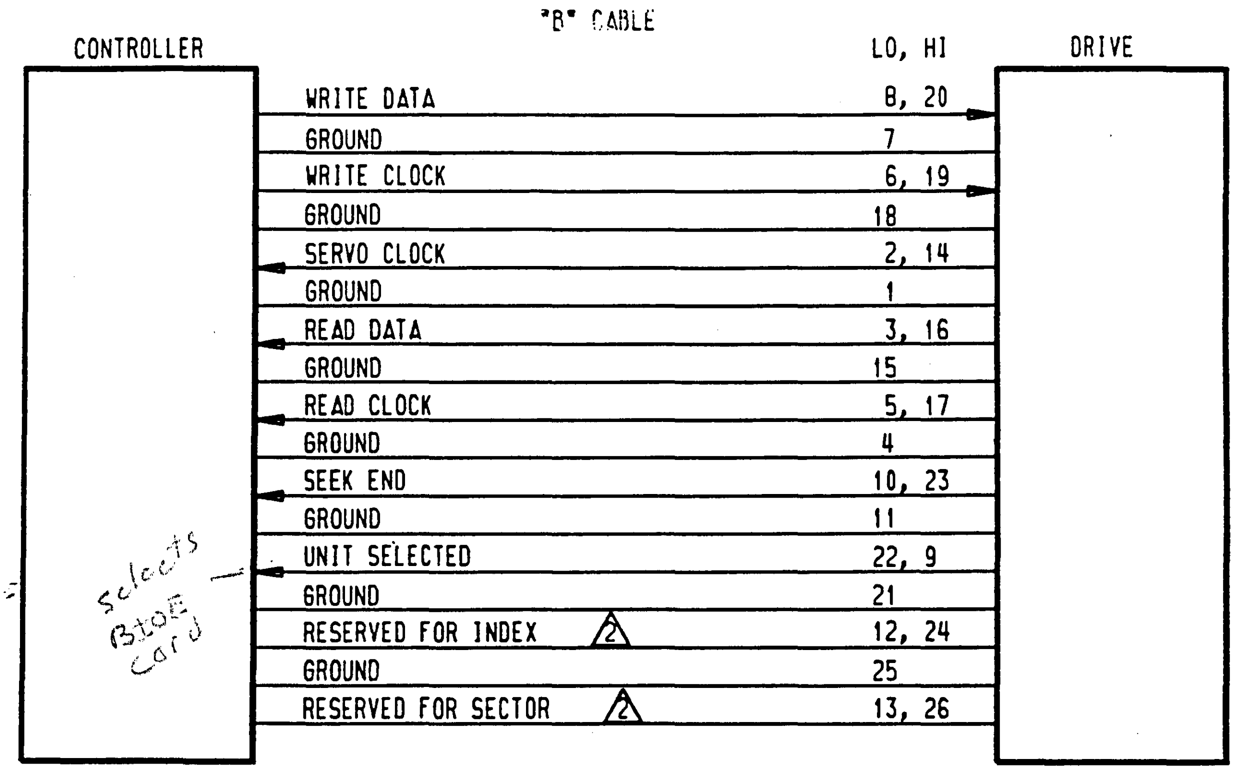
Figure 3-5. A Cable (Sheet 2)



NOTES:

1 NO SIGNALS GATED BY UNIT SELECTED

2 INDEX AND SECTOR MAY BE IN "A" CABLE, "B" CABLE, OR BOTH

11F44

Figure 3-6. B Cable

REPACKAGING

If it is necessary to ship the drive, repackage the drive with the original packaging materials (saved during installation). Comply with the manufacturer's packaging instructions to ensure that the drive will be undamaged in shipment. 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.

INSTALLATION PROCEDURES

GENERAL

With the site requirements completed and the drive unpackaged, you are ready to begin the installation. Certain parts of the installation may vary -- how the drive and power supply are mounted, how dc power is supplied to the drive, and whether an operator panel or status/control panel is used. For those installations where the drive and power supply are mounted in a 2X drawer, the following procedures apply:

- Mounting 2X Drawer in Rack
- Mounting Front Panel
- Installing Operator Panel or Status/Control Panel Jumper Cable
- Mounting the Status/Control Panel
- Mounting the Operator Panel
- Mounting Drive and Power Supply in 2X Drawer

For some customers, the drive, power supply, and operator panel (if used) are mounted in an inner drawer prior to shipment. In this case, the following procedures apply:

- Mounting 2X Drawer in Rack
- Mounting Drive and Power Supply in 2X Drawer

For those installations where a 2X drawer is not used, the topic Alternate Methods for Installing the Drive provides some basic information. However, specific details of alternate mounting are beyond the scope of this manual.

There is another group of procedures that apply to all installations. They are:

- Power Supply Voltage Conversion
- System I/O Cabling
- System Grounding
- Circuit Board Switches and Indicators

In most cases, you will find it convenient to perform the procedures in the order they are presented in the manual. However, you might find it convenient to make switch settings on both the drive and the power supply before mounting them.

POWER SUPPLY VOLTAGE CONVERSION

The power supply is configured before shipment to operate in one of two ac input voltage ranges. The voltage select plate on the power supply (see figure 3-7) indicates the voltage range selected prior to shipment. The voltage range is determined by setting the voltage select switch to the desired range.

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

CAUTION

> Power supply will fail if voltage select is set for low range and a voltage in the high range is applied.

2. Remove screw securing voltage select plate to power supply and remove plate from power supply. Retain plate and hardware.

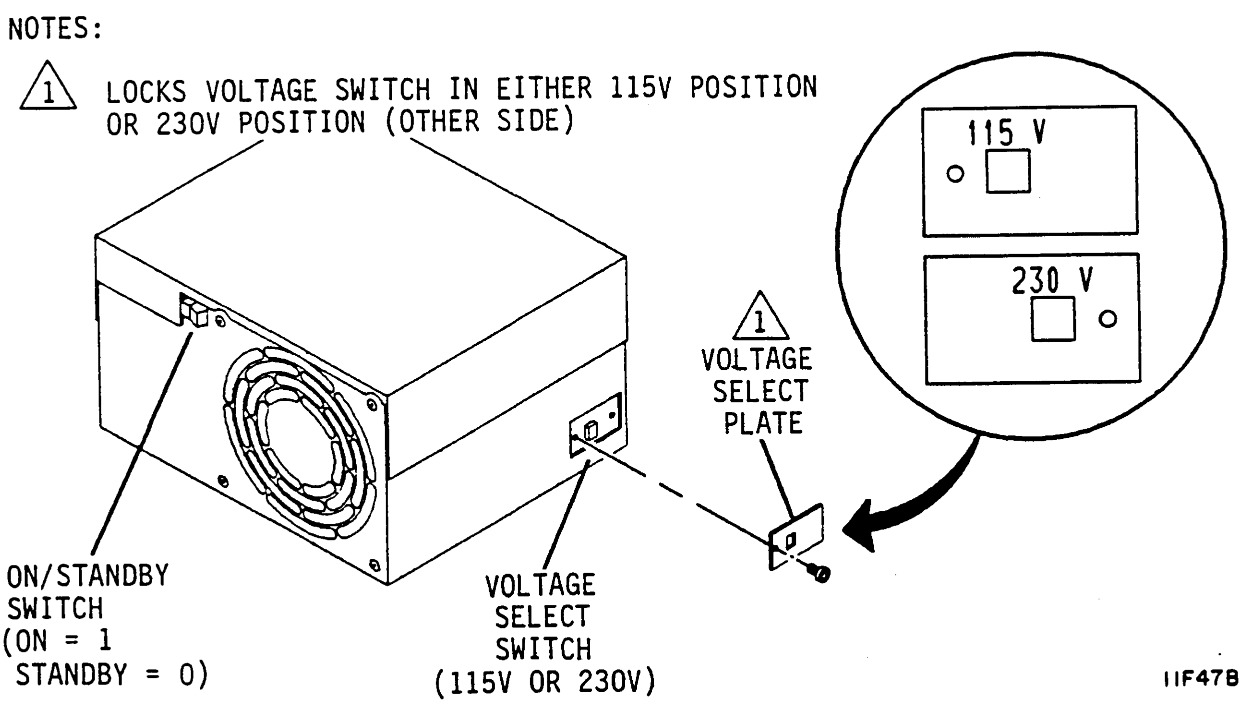


Figure 3-7. Power Supply Voltage Conversion

3. Set voltage select switch to desired range.

4. Reverse voltage select plate and install plate on power supply to lock switch in desired range.

5. Replace existing ac power cable with ac power cable specified for new operating voltage.

The ac power cord must be replaced if the voltage range is changed. Refer to figure 3-8 and to the parts data manual for information about ordering the replacement ac power cable.

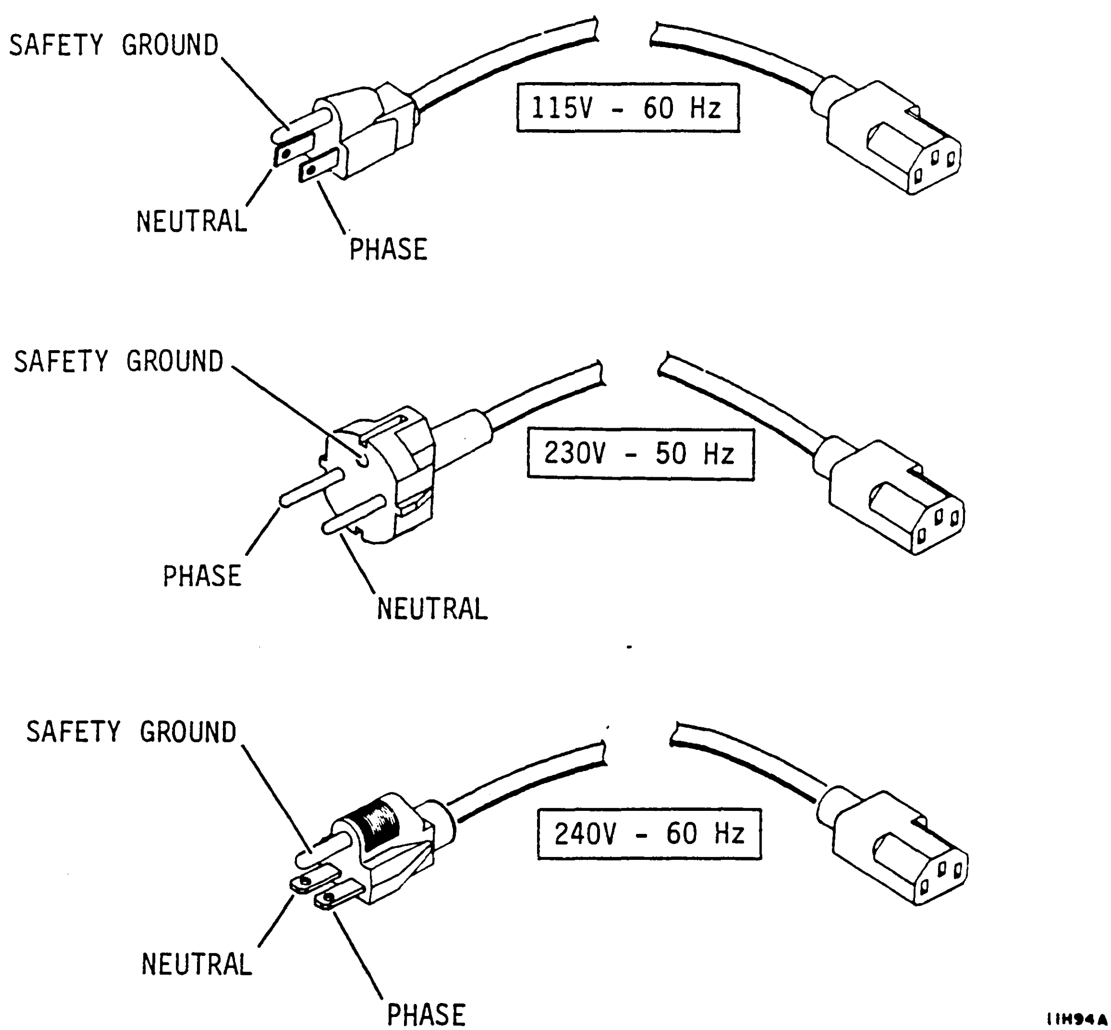


Figure 3-8. AC Power Cables

MOUNTING 2X DRAWER IN RACK

The slide assemblies permit inline mounting of the 2X drawer in a rack. The drawer may be extended out the front surface of the rack for maintenance. The following procedure provides instructions for attaching the 2X drawer to the rack.

1. Remove screws from rack mounting kit. There are four smaller screws in kit. Two screws attach slide adjusting brackets to slides (step 2). Two others attach inner drawers to 2X drawer (see Mounting Drive and Power Supply in 2X Drawer).

2. Loosely attach a slide adjusting bracket to each slide with a bracket clamp and screw (see figure 3-9).

3. Loosely attach screws and nut plates (for each slide) to rack as follows (see figure 3-9):

   - For rack front, screws go in top and third holes.
   - For rack rear, screws go in top and bottom holes.

4. Set slide adjusting brackets as required for proper rack depth. Mount right-hand and left-hand slides in rack in accordance with user requirements. Orient slides so that 2X drawer rests on flat edge of slides as shown in figure 3-9.

5. Secure adjusting brackets to slides and slides to rack.

6. Lift drawer and guide it into slide assemblies. Continue pushing until drawer is in rack. Ensure that there is no binding when sliding 2X drawer in and out of rack.

If it is necessary to remove drawer from rack, slide drawer out to full extension. Press drawer locking springs and remove drawer from rack.

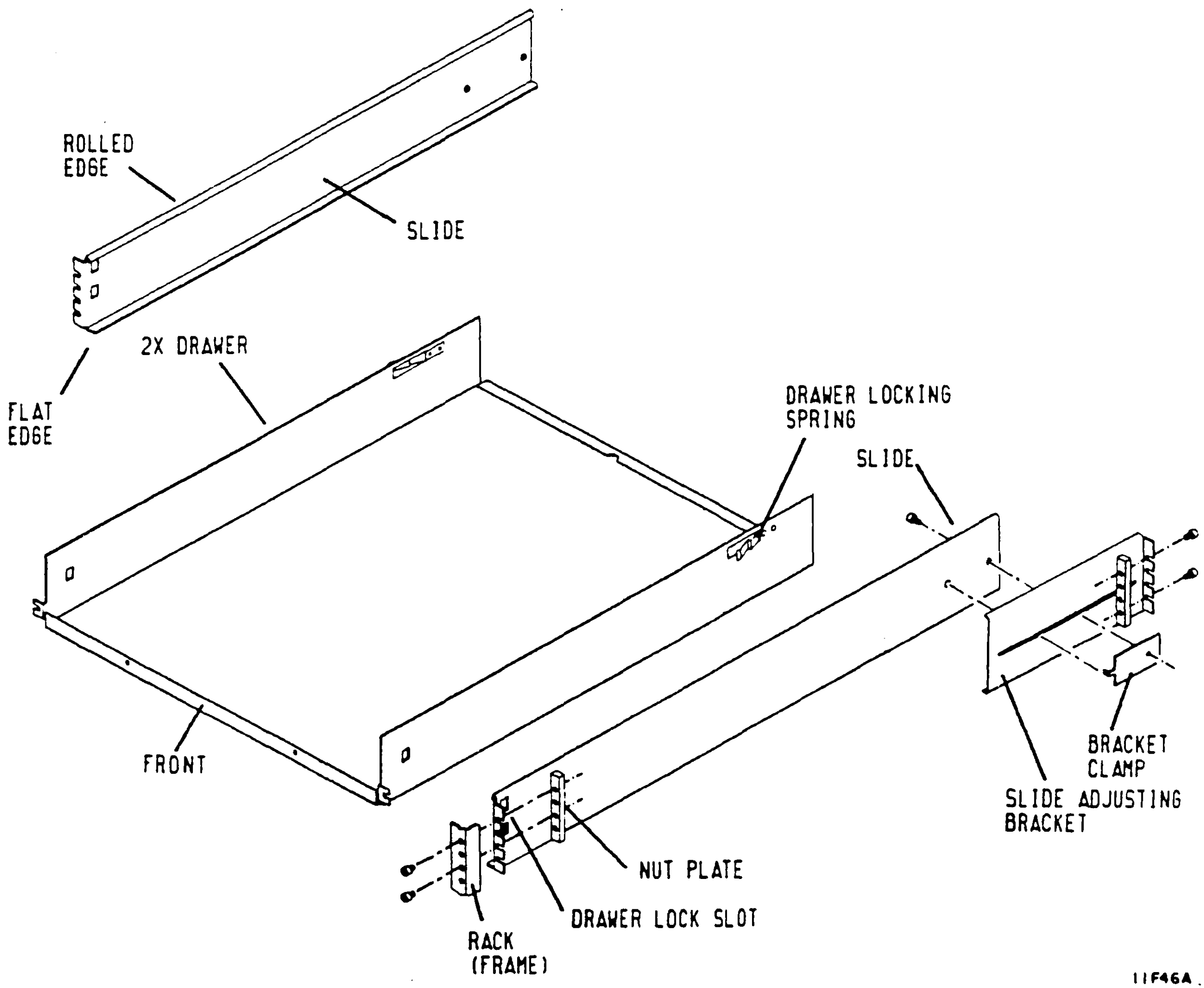


Figure 3-9. 2X Drawer Installation

MOUNTING FRONT PANEL

If an operator panel or status/control panel will be installed, skip this procedure and go on to the next procedures, which include front panel mounting instructions.

NOTE

When installing front panel, ensure that overhang (wide edge) covers rack frame (vertical support).

1. Align top edge of front panel to top edge of inner drawer (see figure 3-10).
2. Secure front panel into place with four screws.
3. Install filter.
4. Remove adhesive backing and attach filler plate to front panel insert.
5. Install front panel insert.

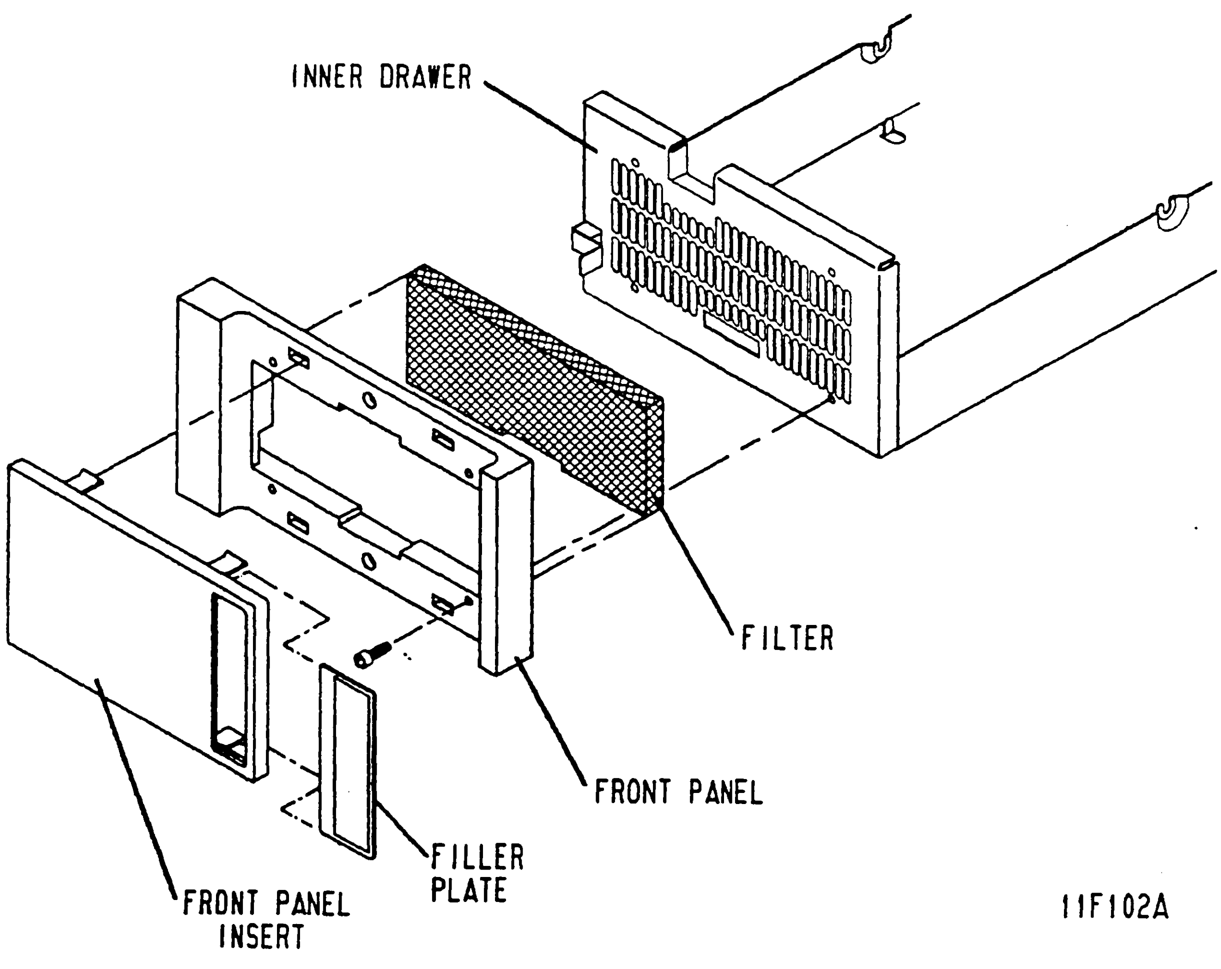


Figure 3-10. Mounting Front Panel

INSTALLING OPERATOR PANEL OR STATUS/CONTROL PANEL JUMPER CABLE

During a new installation, installing the jumper cable is quite simple as nothing has been mounted in the inner tray. However, to install the jumper cable in an existing installation, the drive and power supply must be removed from the inner drawer. This requires you to remove the inner drawer from the 2X drawer.

New Installation

1. Attach two metal cable clamps (found in operator panel kit or status/control panel kit) to exposed shielding on jumper cable. One cable clamp is longer than the other. Attach longer cable clamp to J13 end of jumper cable and shorter cable clamp to P13 end of jumper cable.

2. Attach cable clamp at P13 end of jumper cable to inner drawer using a screw and lockwasher. See figure 3-11.

3. Route jumper cable around left side of inner drawer.

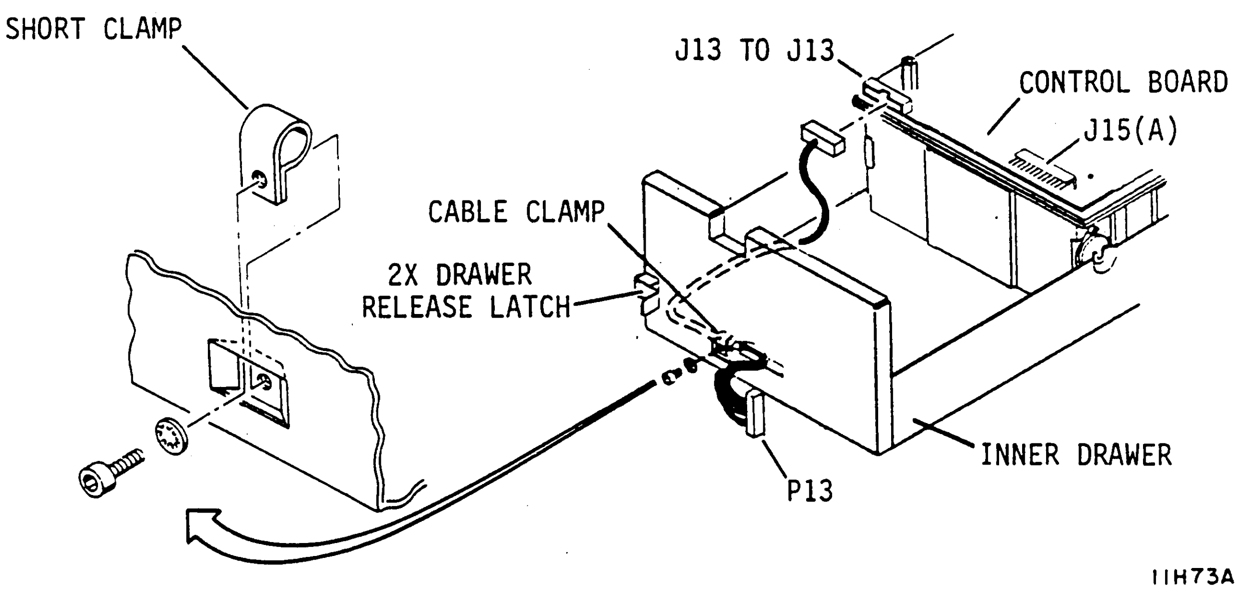


Figure 3-11. Installing Jumper Cable

Existing 2X Drawer Installation

1. Remove front panel insert from each drive.

2. Remove filter.

NOTE

The release latch on left-hand drive locks 2X drawer in rack. The release latch on right-hand drive has no function.

3. Push 2X drawer latch to the right and extend 2X drawer to fully extended position. See figure 3-11.

4. Set On/Standby switch on power supply to Standby (O) position.

5. Push 2X drawer back to closed position in rack.

NOTE

Do not remove strain relief clamp from cable bracket.

6. Remove I/O cover and grounding clamp from I/O cable bracket.

CAUTION

Remove terminators by hand. They could be damaged if a pliers or other tool is used.

7. Disconnect I/O cables, terminators, and system ground strap from drive.

8. Remove I/O cable bracket from drive rear panel.

9. Disconnect ac power cable from site power.

10. Push 2X drawer release latch to the right and extend 2X drawer to fully extended position.

11. Remove inner drawer locking screw.

12. Push 2X drawer release latch to the right, lift inner drawer up and remove it from 2X drawer. Place inner drawer on work table.

13. Loosen shock mount screws securing module to inner drawer.

14. Lift front end of drive up enough to disconnect dc power cable from J15(A) on control board.

15. Disconnect dc ground strap from module.

16. Carefully lift drive out of drawer and move to desired location.

17. Remove screws securing power supply to inner drawer.

18. Disconnect ac power cable from ac input connector J1 while removing power supply from inner drawer.

19. Remove front panel from inner drawer.

20. Attach two metal cable clamps (found in operator panel kit or status/control panel kit) to exposed shielding on jumper cable. One cable clamp is longer than the other. Attach longer cable clamp to J13 end of jumper cable and shorter cable clamp to P13 end of jumper cable.

21. Attach cable clamp at P13 end of jumper cable to inner drawer using a screw and lockwasher. See figure 3-11.

22. Route jumper cable around left side of inner drawer.

23. Perform procedure to mount either status/control panel or operator panel on front surface of inner drawer.

NOTE

Because this is not a new installation, some of the steps in the following procedure are already done.

24. Perform procedure for mounting drive and power supply in 2X drawer.

25. Attach I/O cable bracket to drive rear panel.

26. Connect I/O cables, terminators, and system ground strap to drive.

27. Attach grounding clamp and I/O cover to I/O cable bracket.

28. Push 2X drawer latch to the right and extend 2X drawer far enough to set On/Standby switch on power supply to On (1) position.

29. Push 2X drawer back to closed position in rack.

Mounting The Status/Control Panel

Refer to figure 3-12 and perform the following steps to install an operator panel:

NOTE

When installing front panel, ensure that overhang (wide edge) covers rack frame (vertical support).

1. Align front panel to inner drawer so that holes in front panel are centered on holes in inner drawer.
2. Secure front panel into place with two screws on right side of front panel.
3. Install filter.
4. Connect jumper cable to P13 on status/control panel.
5. Align status/control panel to front panel and secure with screws.
6. Remove protective film from front surface of status/control panel.

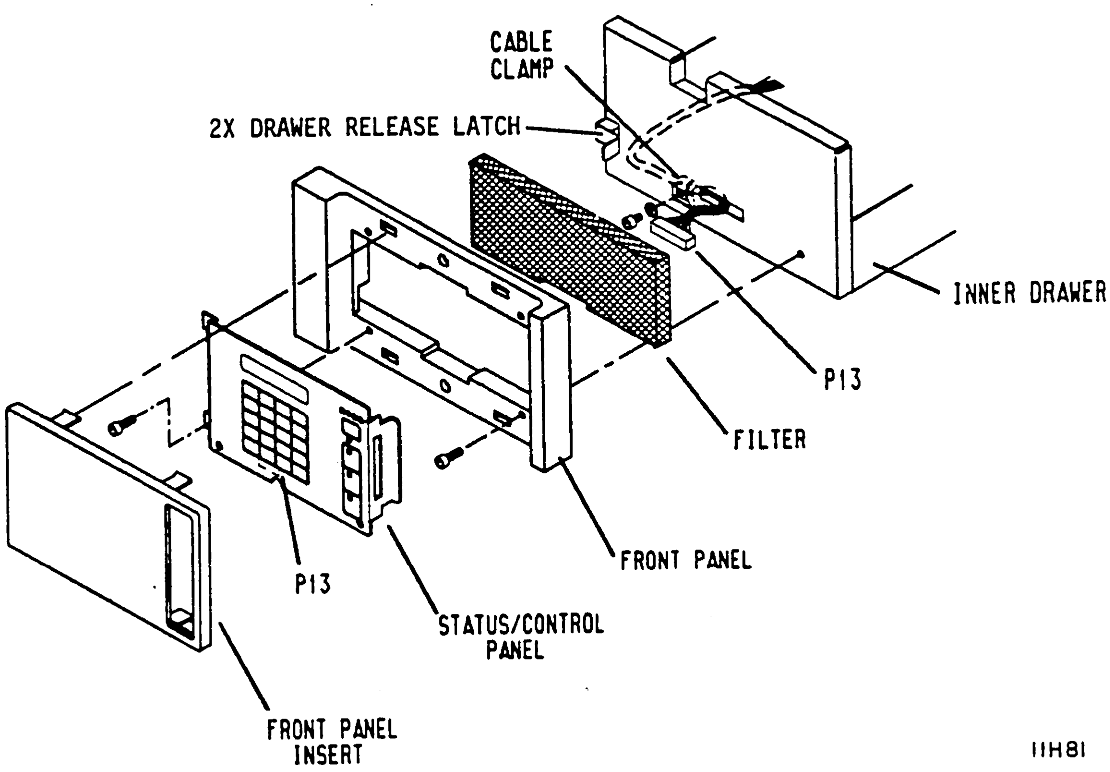


Figure 3-12. Mounting the Status/Control Panel

Mounting The Operator Panel

Refer to figure 3-12 and perform the following steps to install an operator panel:

NOTE

> When installing front panel, ensure that overhang (wide edge) covers rack frame (vertical support).

1. Align front panel to inner drawer so that holes in front panel are centered on holes in inner drawer.
2. Secure front panel into place with two screws on left side of front panel.
3. Install filter.
4. Remove screws attaching operator panel to shield.
5. Align shield to front panel and secure with screws.
6. Connect jumper cable to P13 on operator panel.
7. Align operator panel to shield and secure with screws.

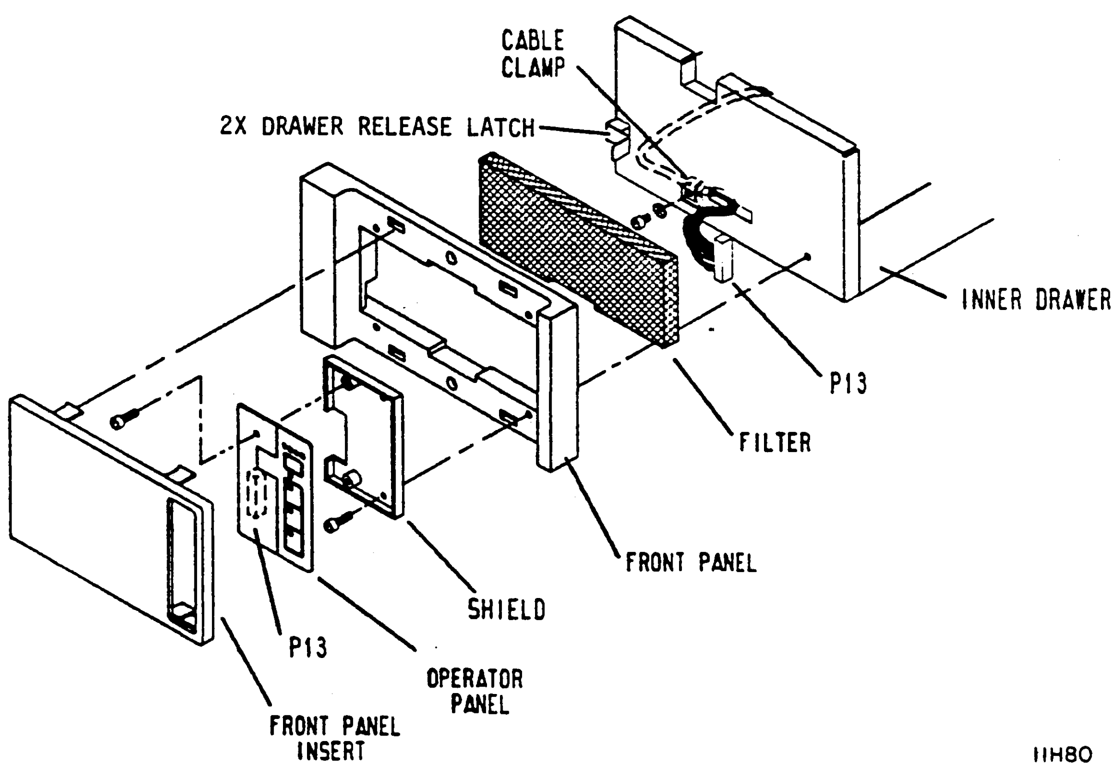


Figure 3-13. Mounting the Operator Panel

MOUNTING DRIVE AND POWER SUPPLY IN 2X DRAWER

You may find it convenient to make normal switch settings on the drive and power supply (described later in this section) before mounting them in the 2X drawer. See figure 3-14.

If your drive and power supply were mounted in the inner drawer prior to shipment, skip to step 11 of this procedure.

NOTE

> For drives with an operator panel or status/control panel, ensure that P13 jumper cable does not interfere with power supply mounting. Cable is routed around left side of power supply (see figure 3-11).

1. Place power supply into position in inner drawer and secure with screws.

2. Connect dc power cable to J15 on power supply.

3. Orient ground strap as shown in figure 3-14, and connect ground strap to ac ground terminal on power supply. Ensure that lock washer is placed between ground strap and power supply case.

4. Connect ac power cable to ac input connector J1 on power supply. Route cable inside inner drawer as shown in figure 3-14.

5. Loosely attach shock mount screws to drive shock mounts.

6. Mount drive to inner drawer so that drive is supported on shock mount screws.

7. Lift front end of drive up enough to connect dc power cable to J15(A) on control board.

8. To complete installation of status/control panel or operator panel jumper cable, perform the following steps:

   a. Attach cable clamp at J13 end of jumper cable with screw in hole just above left front shock mount. See figure 3-14. Ensure that lock washer is placed between clamp and module.

   b. Lift front end of drive up enough to connect jumper cable end marked J13 to J13 on control board.

9. Attach ground strap to drive module. See figure 3-14.

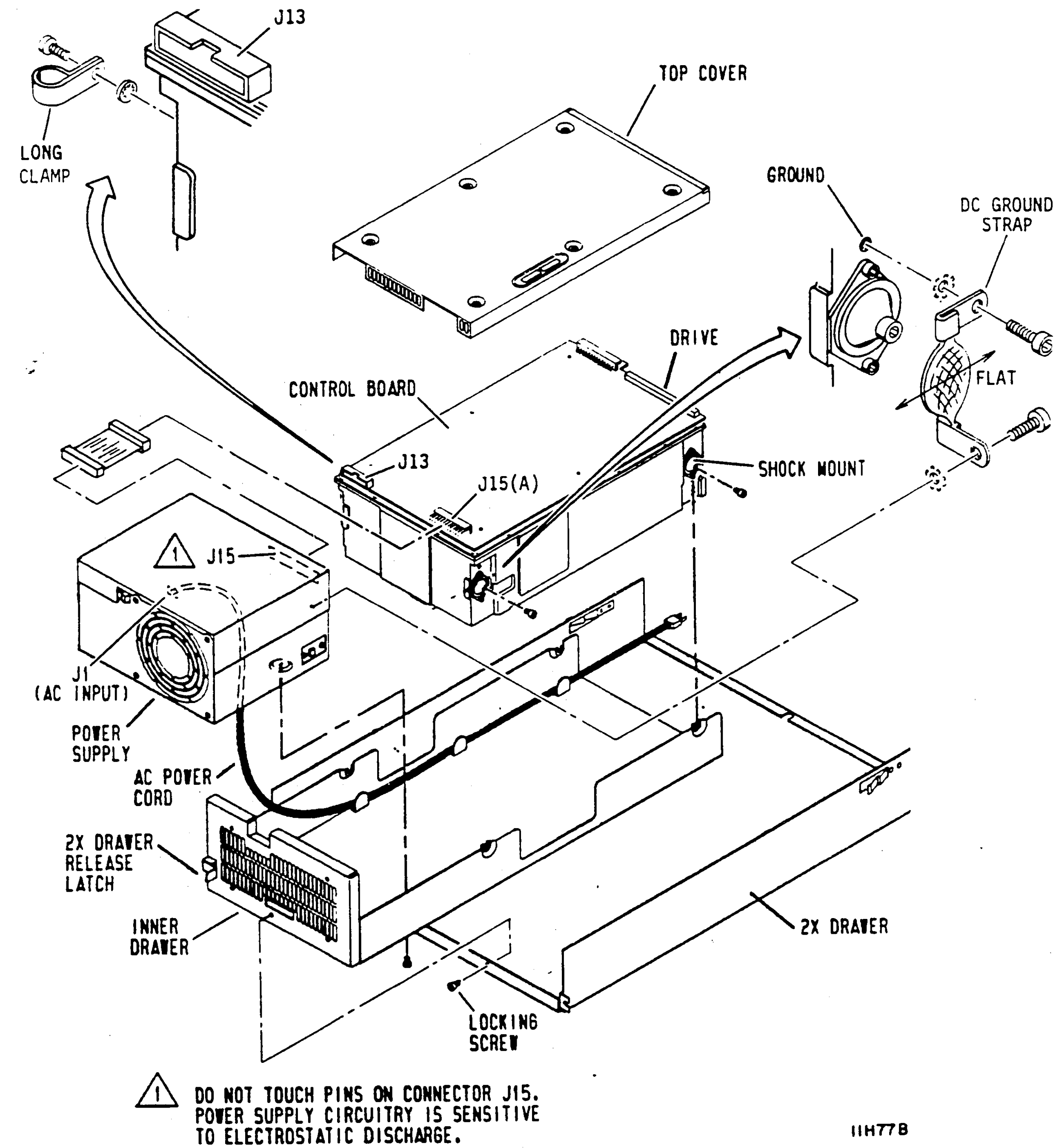


Figure 3-14. Mounting Drive and Power Supply in 2X Drawer

10. Tighten shock mount screws to secure drive in place.

11. Slide inner drawer into position in 2X drawer and secure with locking screw.

12. Push 2X drawer back to closed position in rack.

13. Replace front panel insert.

14. Connect ac power cable to site power.

ALTERNATE METHODS FOR INSTALLING THE DRIVE

Any alternate method of mounting the drive in an enclosure must satisfy certain requirements regarding mechanical isolation and air flow. The mounting design must support the drive by its shock mounts, either horizontally or vertically. It must allow adequate clearance between the drive and any surfaces near the drive. The mounting design must also ensure adequate ventilation of the drive and power supply. Detailed mounting requirements are given in the drive's product specification. Before actually mounting the drive and power supply in the enclosure, you may find it convenient to set their switches for normal operation.

When the power supply mounting is remote from the drive, a shielded dc power cable is recommended. Figure 3-15 shows how the cable connects to the power supply and the drive. One end of the cable connects to J15 on the power supply, and the trailing ground lead on that end connects to the ac ground terminal on the power supply. The other end of the cable goes to J15(B) on the drive. The trailing ground lead on that end connects to the ground screw below the I/O connectors.

When the power supply is mounted remotely, an optional auxiliary fan and rear panel may be installed to provide air circulation for the drive. See figure 3-15. The fan kit has the fan mounted so the airflow arrow (on the body of the fan) will point toward the drive. This blows cooling air through the drive and is the preferred method. If, however, the installation requires it, the fan may be reversed so that the airflow arrow points away from the drive. This draws warm air out of the drive.

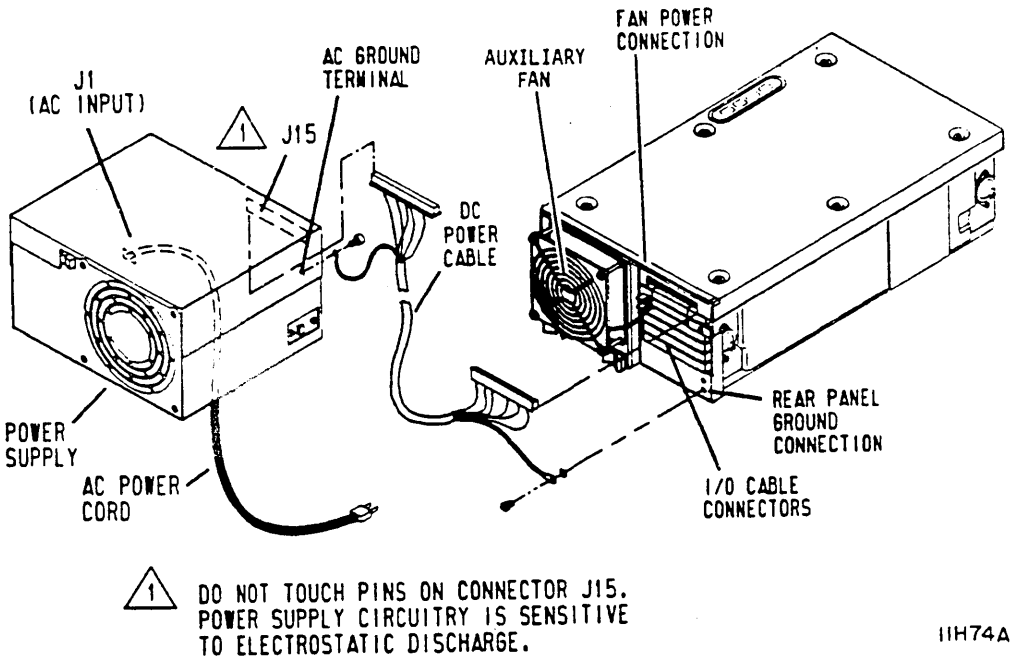


Figure 3-15. Cabling for a Remote Power Supply

Some drives operate from a power source supplying -12 V, +5 V, and +24 V. They contain a voltage converter that develops an additional supply voltage of -5 V from the -12 V input. As shown in figure 3-16, these drives have two dc power connectors, CN9 and CN10, located side-by-side above the I/O connectors. Following the directions provided with the power supply, connect the two dc power cables from the supply to CN9 and CN10. The following list provides pin assignments for these connectors:

Connector	Pin Number	Signal
CN9	1	+5 V
	2	+5 V
	3	+24 V return
	4	+24 V return
	5	+24 V
	6	Key
	7	+24 V
CN10	1	-12 V return
	2	Key
	3	-12 V return
	4	-12 V
	5	-12 V
	6	+5 V return
	7	+5 V return

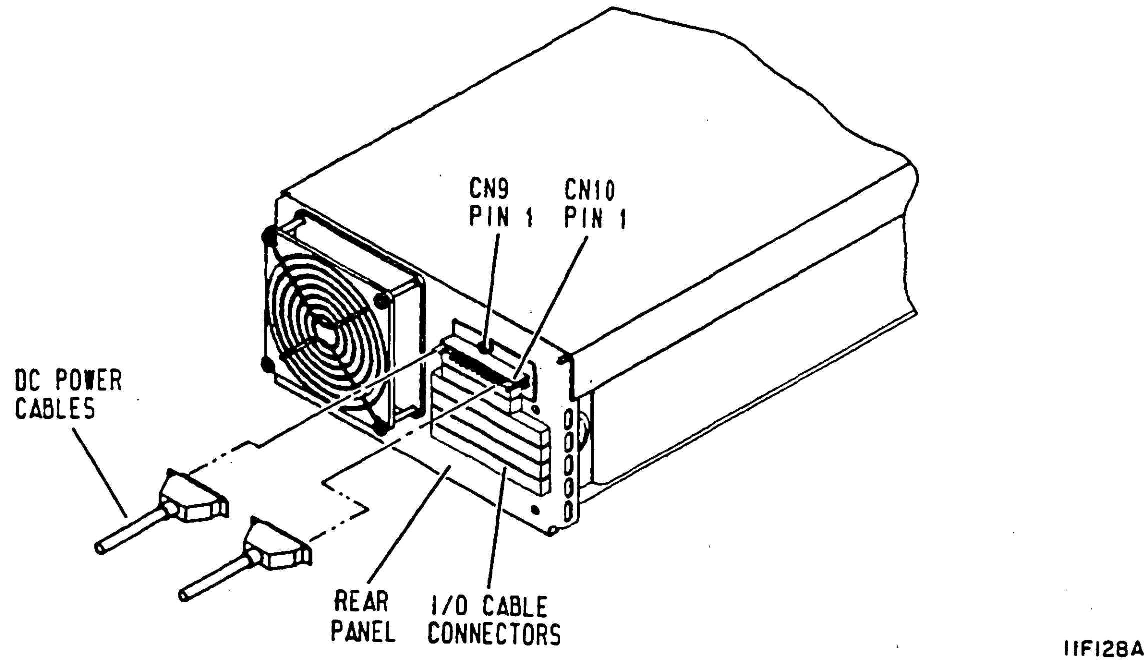


Figure 3-14. Cabling for a Drive with a Voltage Converter

SYSTEM I/O CABLING

It 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 cable the system in either a daisy chain or star configuration. These configurations were discussed earlier in this section under Interface Requirements.

The following procedures make the connections for one I/O channel. For dual channel installations, part of the procedure must be repeated. On dual channel drives there are two sets of I/O connectors: 1J02, 1J03, and 1J04 for channel 1, and 2J02, 2J03, and 2J04 for channel 2. The recommended connections are A cable to J04 and terminator to J03. These connections may be reversed without affecting drive operation. Figure 3-16 shows typical I/O cable connections.

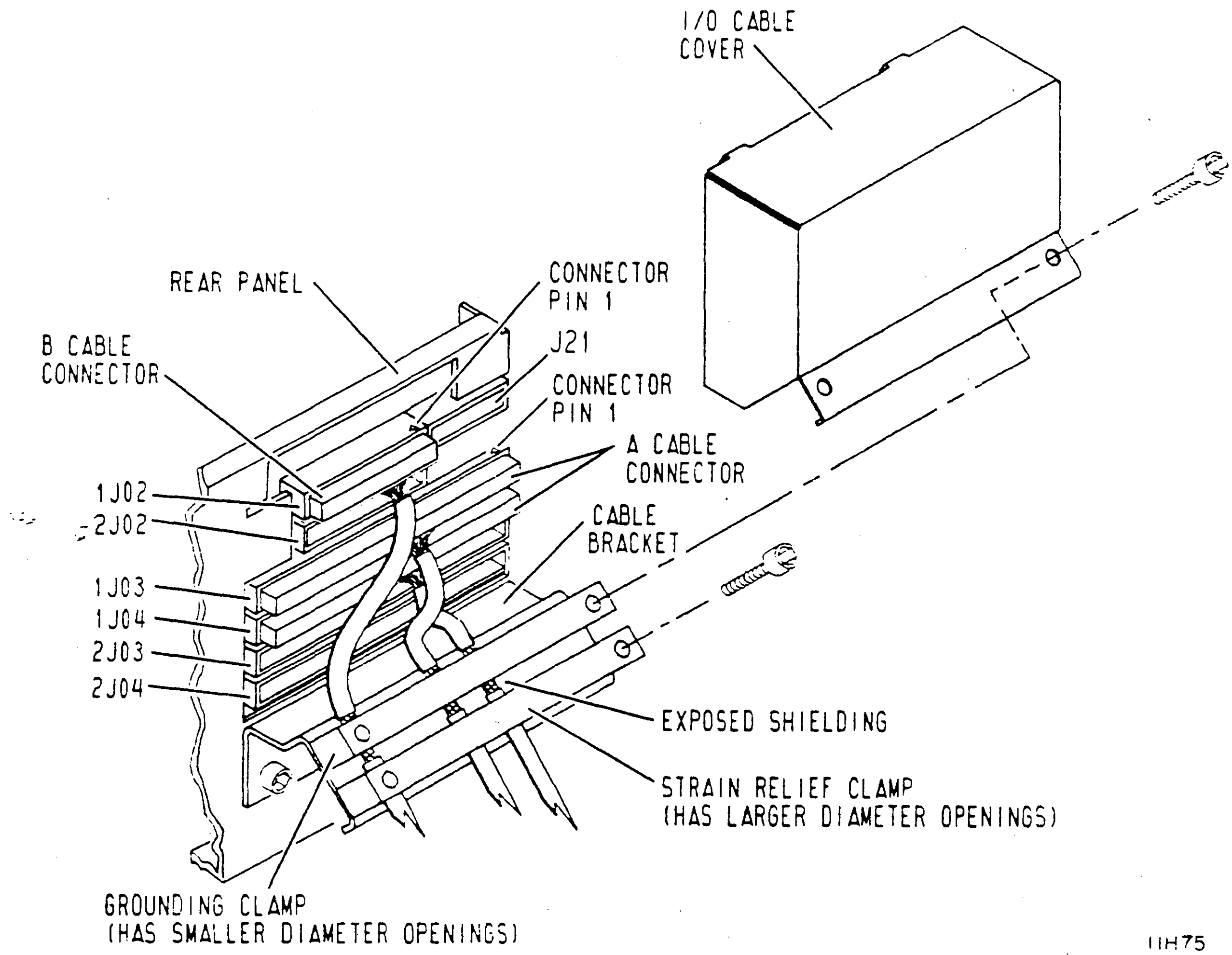


Figure 3-16. I/O Cable Attachment

Daisy Chain I/O Cabling Procedure

1. Attach cable bracket to rear panel, using two shorter screws found in hardware kit.

NOTE

> Steps 2 through 5 apply to single channel drives and must be repeated for dual channel drives.

2. Connect B cables from controller to connector J02 on each drive.

3. Connect A cable from controller to connector J04 on first drive in daisy chain.

NOTE

If drive is not last drive in daisy chain, repeat step 4 until last drive is connected. When last drive is connected in daisy chain, perform step 5.

4. Connect another A cable from connector J03 to connector J04 on next drive in daisy chain.

5. Install terminator on drive connector J03 and make terminator ground connection (see figure 3-17). A terminator is required on last drive in a daisy chain system.

NOTE

In the next step it is important that heat shrink be removed to expose ground shield only where it contacts the grounding clamp.

6. Strip heat shrink tubing from all cables so that bare shielding will be in contact with grounding clamp. See figure 3-16.

7. Loosely install strain relief clamp (strain relief clamp has larger diameter openings than grounding clamp) onto cable bracket with cables positioned as shown in figure 3-16.

8. Position cabling so that bare shielding begins just above strain relief clamp; then secure strain relief clamp into place with screws. This will ensure that grounding clamp (installed in following step) is in contact with bare shielding of cabling.

9. Install grounding clamp and I/O cable cover onto cable bracket with cables positioned as shown in figure 3-16 and secure with screws. Ensure that bare shielding on each cable is in contact with grounding clamp.

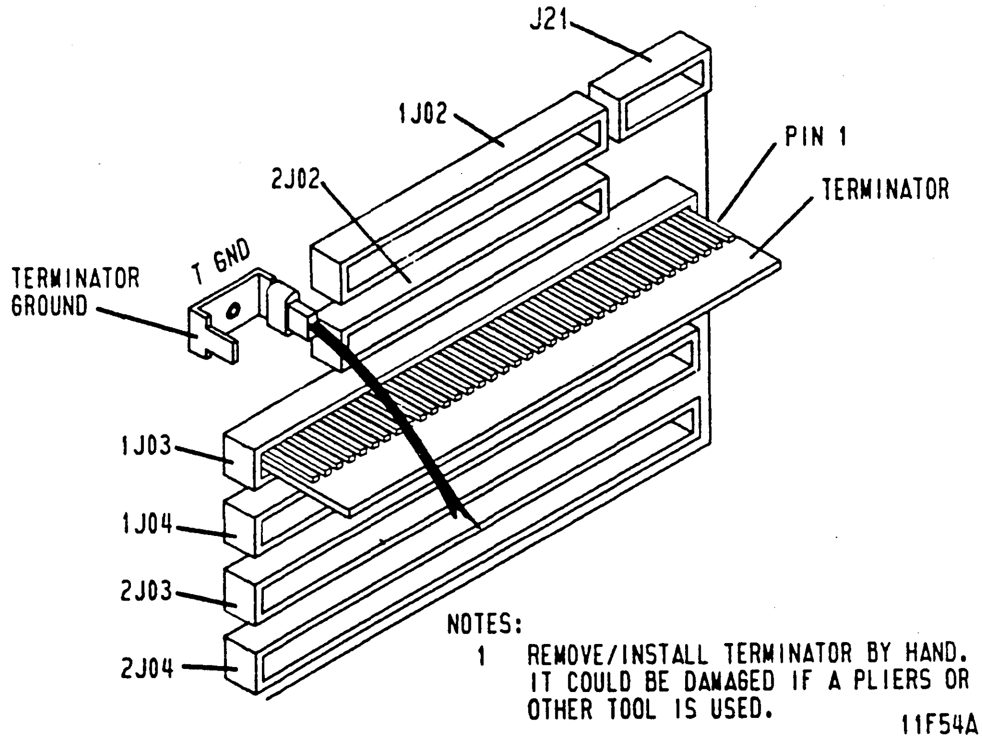


Figure 3-17. Terminator Installation (Typical)

Star I/O Cabling Procedure

1. Attach cable bracket to rear panel, using two shorter screws found in hardware kit.

NOTE

Steps 2 through 4 apply to single channel drives and must be repeated for dual channel drives.

2. Connect B cables from controller to connector J02 on each drive.

NOTE

Repeat steps 3 and 4 for each drive in star system.

3. Connect an A cable from controller to drive connector J04.

4. Install terminator on drive connector J03 and make terminator ground connection (see figure 3-17). Terminators are required on all drives in a star system.

NOTE

In the next step it is important that heat shrink be removed to expose ground shield only where it contacts the grounding clamp.

5. Strip heat shrink tubing from all cables so that bare shielding will be in contact with grounding clamp. See figure 3-16.

6. Loosely install strain relief clamp (strain relief clamp has larger diameter openings than grounding clamp) onto cable bracket with cables positioned as shown in figure 3-16.

7. Position cabling so that bare shielding begins just above strain relief clamp; then secure strain relief clamp into place with screws. This will ensure that grounding clamp (installed in following step) is in contact with bare shielding of cabling.

8. Install grounding clamp and I/O cable cover onto cable bracket with cables positioned as shown in figure 3-16 and secure with screws. Ensure that bare shielding on each cable is in contact with grounding clamp.

SYSTEM GROUNDING

This section contains instructions on grounding the system to the 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 3-18. Refer to accessories in parts data manual for part numbers of grounding accessories.

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 mounting drive and power supply procedure in this section for instructions on attaching ground cable between drive and power supply.

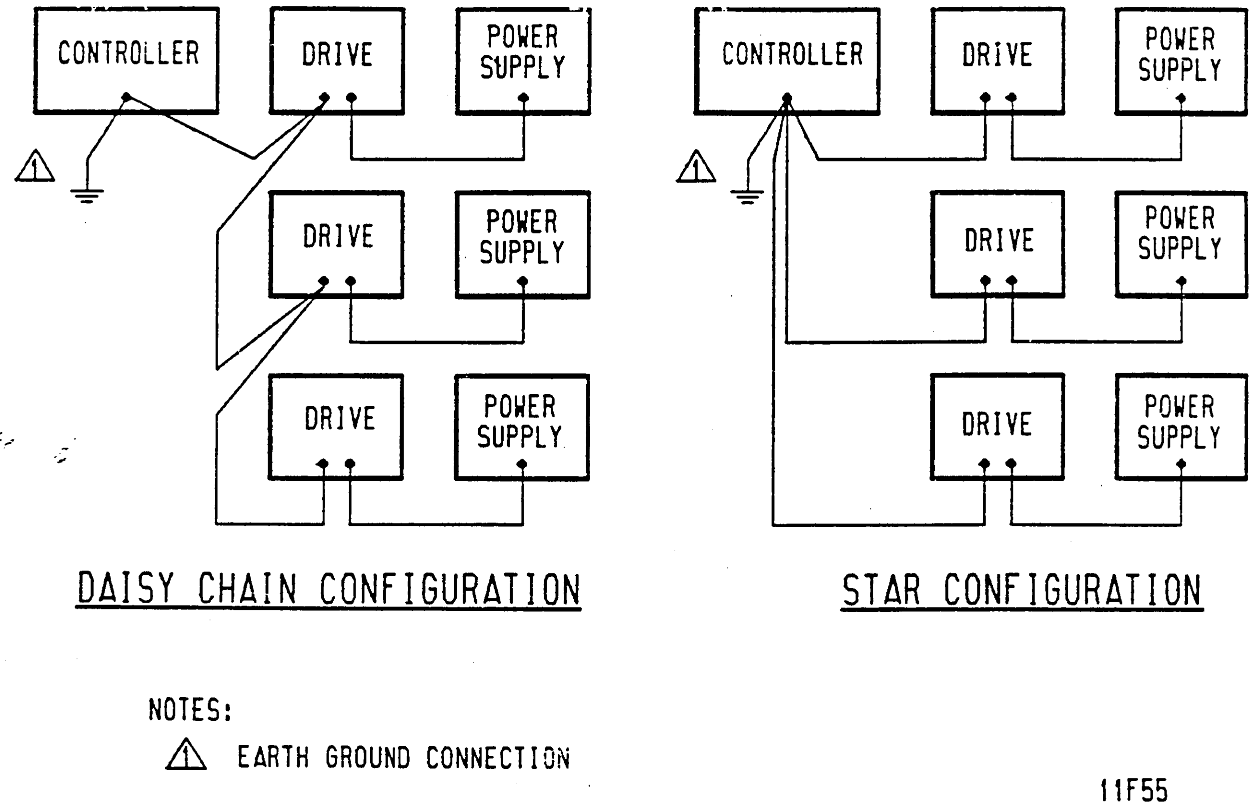


Figure 3-18. System Grounding Diagram

Star Grounding Procedure

In this configuration, ground straps connect the controller ground to each drive in the system as shown in figure 3-18.

1. Prepare ground straps as follows:

   a. Allowing sufficient length for drive extension, cut ground straps to length needed for following connections:

      - Controller to earth ground
      - Controller to each drive

   b. Crimp and solder terminal lugs to both ends of each ground strap.

2. Referring to figure 3-18, connect ground straps to controller as follows:

   a. Connect one end of each ground strap to controller ground terminal.

   b. Connect one of the ground straps to earth ground.

   c. Route remaining ground straps to drives.

3. Connect a ground strap from controller to each drive as follows:

   a. Remove screw and lockwasher from system ground terminal (DC GND) on each drive. See figure 3-19.

   b. Attach system ground strap to drive ground terminal. Ensure that lockwasher is between ground strap and ground terminal.

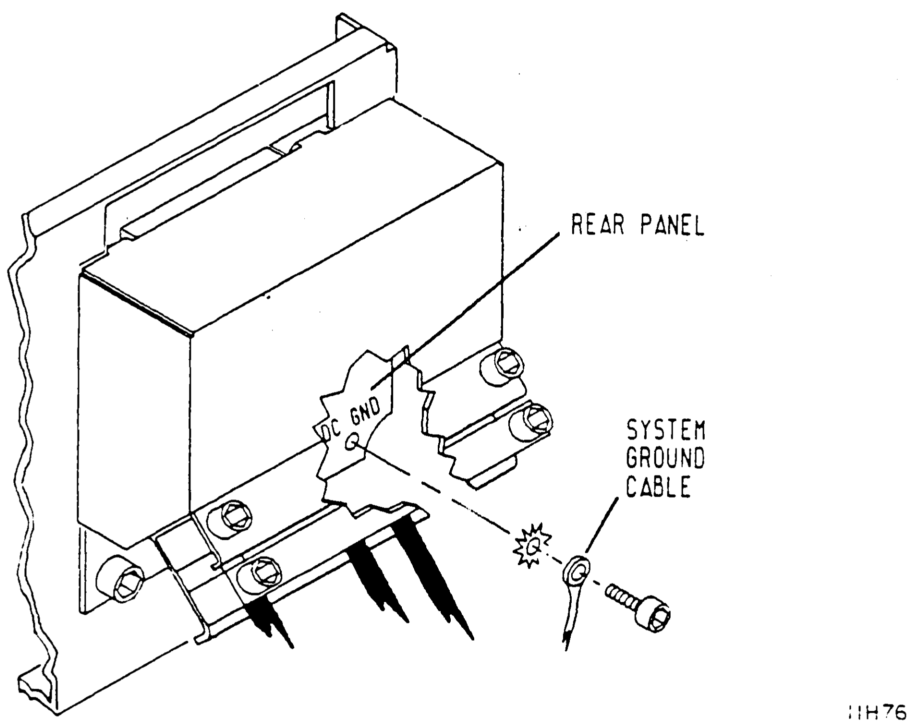


Figure 3-19. System Grounding

Daisy Chain Grounding Procedure

In this configuration, a ground strap connects the controller ground to the first drive in the system. The remainder of the drives are connected by grounding straps going from the first drive to the second, the second to the third, and so on. See figure 3-18.

1. Prepare ground straps as follows:

   a. Allowing sufficient length for drive extension, cut ground straps to length needed for 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 3-18, connect ground straps to controller as follows:

   a. Connect two ground straps to controller ground terminal.

   b. Connect one ground strap to earth ground.

   c. Route other ground strap to first drive in daisy chain. Route remaining ground straps (prepared in step 1) from drive to drive.

3. Make daisy chain ground connections at each drive as follows:

   a. Remove screw and lockwasher from system ground terminal (DC GND) on each drive. See figure 3-19.

   b. Attach system ground strap to drive ground terminal. Ensure that lockwasher is between ground strap and ground terminal.

CIRCUIT BOARD SWITCHES AND INDICATORS

The circuit boards inside the drive contain a number of switches that must be set correctly for normal operation of the drive. The following pictures and tables contain information about switch settings:

- Figure 3-20 -- shows pictures of actual DIP switches with instructions on setting them to either the open (off) or the closed (on) position.
- Figure 3-21 -- identifies switches and gives their locations on the I/O board.
- Table 3-3 -- lists the possible settings for normal drive operation for all switches on the I/O board.
- Figure 3-22 -- identifies various types of control boards.
- Figure 3-23 -- identifies switches and indicators on the control board.
- Table 3-4 -- lists the possible settings for normal drive operation for switches on the control board. However, setting the sector switches and logical address is covered later in this section.
- Table 3-5 -- describes the maintenance indicators.
- Figure 3-24 -- identifies jumpers on the control board.
- Table 3-6 -- lists the possible settings for normal drive operation for jumpers on the control board.

You may encounter two types of switches. Rocker switches are actuated by pressing one end of the actuator or the other (rocking it) to turn the switch on (closed) or off (open). Slide switches are actuated by sliding the actuator one way or the other to turn the switch on or off. Use a slender ball point pen, a straightened paper clip, or any similar object to change switch settings. Do not use a lead pencil point as it may break off and lodge in the switch, or cause the switch to malfunction.

To determine the type of control board in your drive, examine the arrangement of DIP switches on the board. By uncovering slots in the drive top cover, you can see the DIP switches. Figure 3-22 shows Type 1, Type 2, and Type 3 control boards.

Type 1 control boards have 3 groups of switches with 6 switches in each group. Type 2 and Type 3 control boards have 2 groups of switches, with 10 switches in each group. The main difference between Type 2 and Type 3 boards is the location and function of jumpers that select certain features.

Setting the circuit board switches or seeing the maintenance indicators does not require removing the top cover. Both the top cover and the rear panel have openings to allow access to the DIP switches. On Type 3 control boards, the top cover opening also allows access to the jumpers. However, for Type 2 control boards, it is necessary to remove the top cover to examine or change the jumpers.

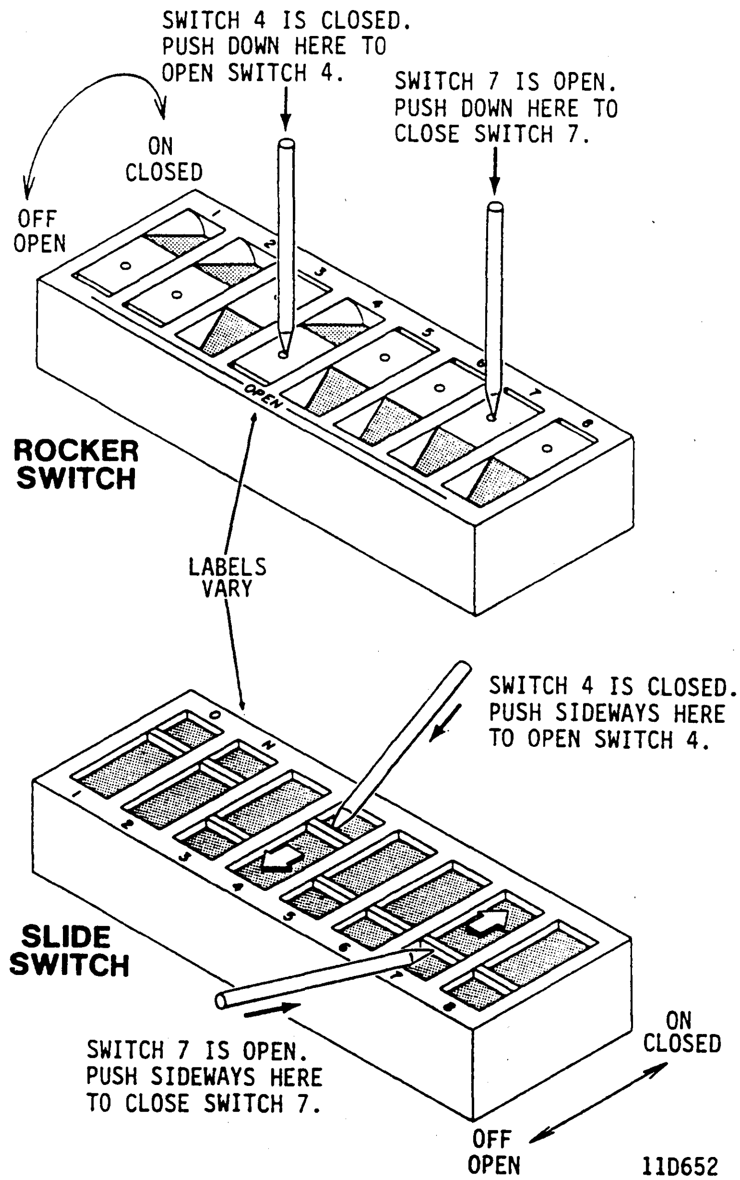


Figure 3-20. How to Set DIP Switches

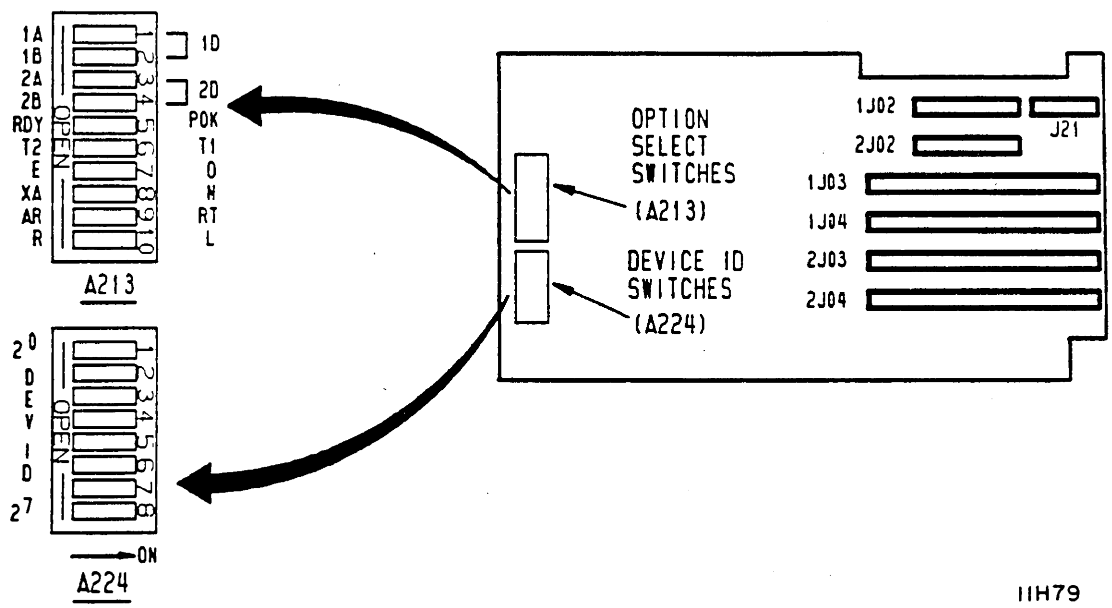


Figure 3-21. I/O Board Switches

TABLE 3-3. I/O BOARD SWITCHES

Switch	Setting	Description
1A/1D, 1B/1D		Enable/Disable CH 1 and select an option for sending Index & Sector to CH 1 controller. The four combinations of switch settings are as follows:
1A/1D 1B/1D	1A 1D	This pair of switch settings enables CH 1 & sends I & S on A cable only
1A/1D 1B/1D	1D 1B	This pair of switch settings enables CH 1 & sends I & S on B cable only
1A/1D 1B/1D	1A 1B	This pair of switch settings enables CH 1 & sends I & S on A and B cables
1A/1D 1B/1D	1D 1D	This pair of switch settings disables CH 1
2A/2D, 2B/2D		Enable/Disable CH 2 and select an option for sending Index & Sector to CH 2 controller (see description of CH 1 switches)
RDY/POK	RDY	Normal I/O Ready status (Up to speed, heads loaded, and no fault exists)
	POK	Ready status with Power OK. In addition to above conditions (when switch is in RDY), Ready status also indicates that the optional power supply we provide has an acceptable ac input voltage. If the ac input voltage drops, Ready status goes inactive at least 5 milliseconds before a voltage fault is registered.

Table Continued on Next Page

TABLE 3-3. I/O BOARD SWITCHES (Contd)

Switch	Setting	Description
T2/T1		Selects type of extended cylinder addressing, provided that XA/N switch is set in XA position.
	T2	Enables Extended Cylinder Address Bits 2^{10} and 2^{11}, via Tag 2 (Head Select). Can be selected in either SMD-0 or SMD-E mode.
	T1	Enables Extended Cylinder Address Bit 2^{10}, via Tag 1 (Cylinder Select). Can be selected in either SMD-0 or SMD-E mode, but Tags 4 and 6 are unusable with this selection.
E/O	E	SMD-E mode (Tags 1 - 6)
	O	SMD-O mode (Tags 1 - 3)
XA/N	XA	Extended Cylinder Address (cylinders 0-1634 on 736 MB, 1120 MB, and 1230 MB drives; 0-1380 on 850 MB drives); method set by T2/T1 switch
	N	Normal Cylinder Address (cylinders 0-1023): T2/T1 switch has no effect
AR/RT	AR	Absolute Reserve (Dual Channel)
	RT	Reserve Timer (Dual Channel)
R/L	R	Remote power on
	L	Local power on
DEV ID 2^0-2^7	(Closed)	Set according to customer requirements.

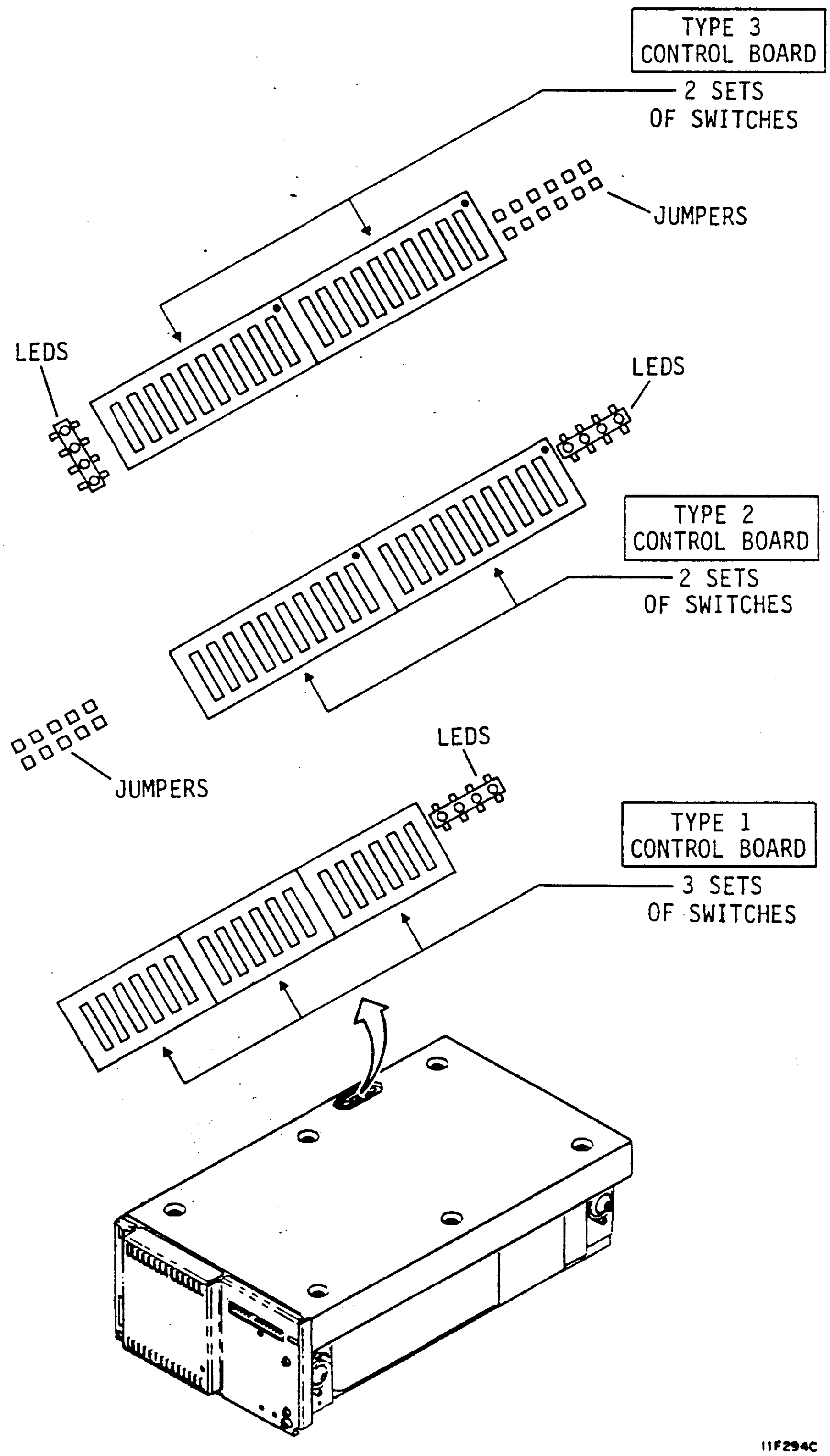


Figure 3-22. Control Board Types

TABLE 3-4. CONTROL BOARD INDICATORS

Indicator	Function
Maintenance LEDs	Provide indications of drive status when no operator panel or status/control panel is available.
+5 V	Indicates presence of +5 V.
SEL	Indicates that drive is selected by a controller.
RDY	Indicates that the drive is ready (spindle power on is complete, heads are loaded, and no fault exists).
FLT	Indicates that a fault exists within the drive.

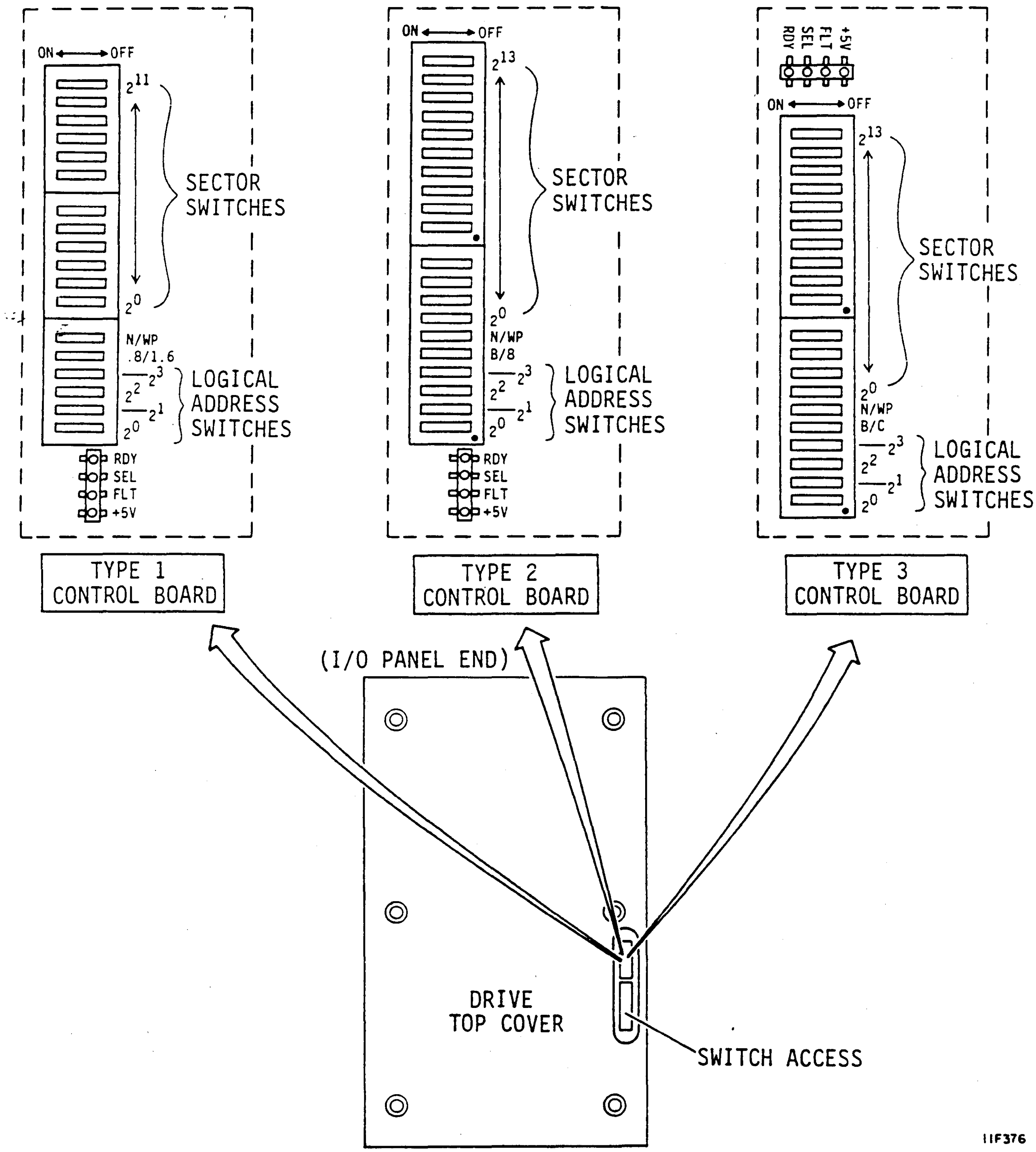


Figure 3-23. Control Board Switches and Indicators

TABLE 3-5. CONTROL BOARD SWITCHES

Switch	Setting*	Description
Logical Address Switches 2^0-2^3		Switches 2^0 through 2^3 are used to set the logical address for drives without the operator panel or status/control panel. See discussion on Setting Logical Address Switches.
Sector Switches		Allow the dividing of the disk into specific segments or sectors. The switch settings determine the number of sectors per track. See discussion on Setting Sector Switches (Types 2 and 3) or appendix B (Type 1).
.8/1.6 (Type 1) (Sector Clock) Switch	.8	Sector clock frequency = .8 MHz
	1.6	Sector clock frequency = 1.6 MHz
B/8 (Type 2) B/C (Type 3) (Sector Clock) Switch	8 or C (Off)	<u>Clock frequency</u> -- <u>Drive capacity</u> 1.6 MHz — 736 MB drives 1.6 MHz — 850 MB drives 1.83 MHz — 1120 MB drives 2.016 MHz — 1230 MB drives
	B (On)	Byte frequency sector clock.
WP/N (Write Protect/ Normal) Switch	WP (Off)	Write Protect
	N (On)	Normal Placing the switch in the WP position prevents the drive from performing write operations. The switch must be in the N position to enable write operations.
*On = Closed; Off = Open		

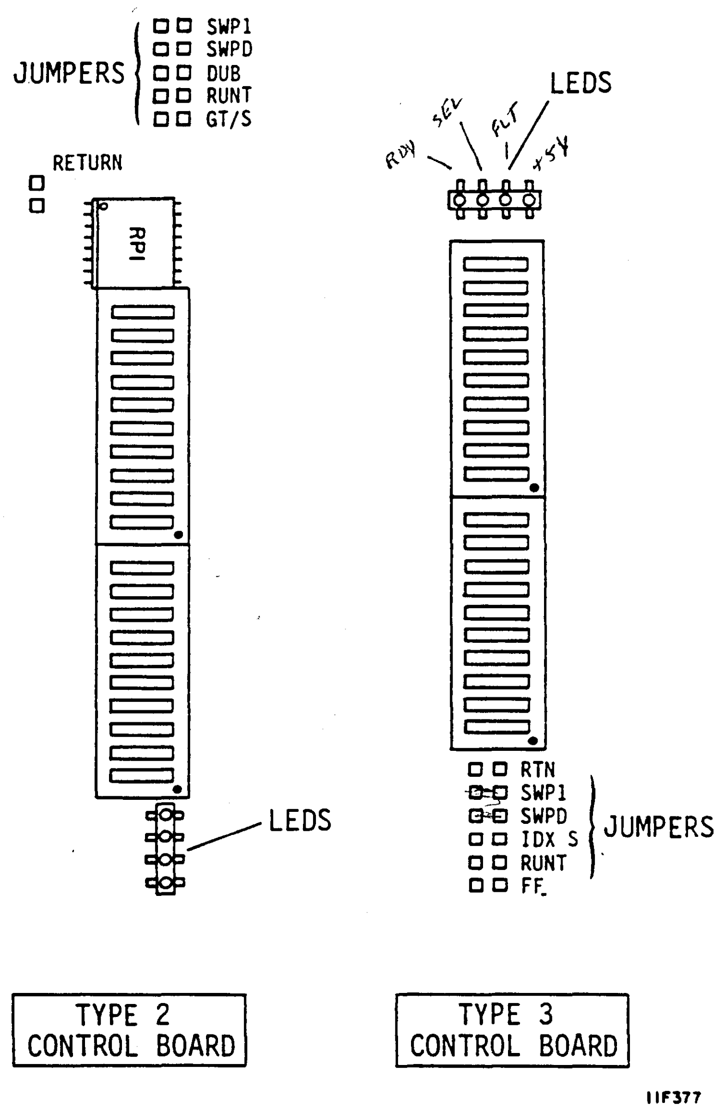


Figure 3-24. Control Board Jumpers

TABLE 3-6. CONTROL BOARD JUMPERS

Jumper [Board Types]	Setting	Description
RUNT Jumper* [2 & 3]	Connected	Runt sector pulses are suppressed.
	Discon- nected	Runt sector pulses may appear.
SWP1 Jumper** [2 & 3]	Connected	Disables the option for sweep only on seeks.
	Discon- nected	Enables the option for sweep only on seeks.
SWPD Jumper** [2 & 3]	Connected	Disables sweep cycles.
	Discon- nected	Enables sweep cycles.
DUB Jumper [2 only]	Connected	Jumper is properly set at the factory and must not be changed.
GT/S Jumper [2 only]	Discon- nected	Jumper is properly set at the factory and must not be changed.
RTN (Return) Jumper** (Not labeled on Type 2 boards) [2 & 3]	Connected	Enables the option to return the heads to their original position following a sweep segment.
	Discon- nected	Disables that option.
IDX S Jumper [3 only]	Discon- nected	Jumper is properly set at the factory and must not be changed.
FF [3 only]	N/A	Reserved for future use.

* For explanation, see Setting Sector Switches.

** Read Programming the Sweep Cycle Function before selecting sweep cycle options. Some controllers will not function with sweep cycle enabled.

Setting Logical Address Switches

The control board logical address switch settings are shown in table 3-7. For drives with an operator panel or status/control panel, the Logical Address switch settings on the control board are ignored. Set the logical address on either panel by pressing the Logical Address switch and observing the indicators, displayed in binary (see figure 2-1).

TABLE 3-7. LOGICAL ADDRESS SWITCHES ON CONTROL BOARD

Logical Address	Switch (Binary)*				Logical Address	Switch (Binary)*			
	2^0	2^1	2^2	2^3		2^0	2^1	2^2	2^3
0	C	C	C	C	8	C	C	C	O
1	O	C	C	C	9	O	C	C	O
2	C	O	C	C	10	C	O	C	O
3	O	O	C	C	11	O	O	C	O
4	C	C	O	C	12	C	C	O	O
5	O	C	O	C	13	O	C	O	O
6	C	O	O	C	14	C	O	O	O
7	O	O	O	C	15	O	O	O	O

* O = Open (Off), C = Closed (On)

Programming the Sweep Cycle Function

The sweep cycle is a feature that periodically moves the heads to different locations on the disks during intervals when the drive is idle. The following are highlights of the sweep cycle function:

- Using the sweep cycle enhances drive reliability. We encourage you either to enable the drive sweep cycle or to use a sweep cycle driven at the system or subsystem level. Consult with an analyst in making this choice.

- There are several sweep cycle options available at the drive level. Make sure that the selected option is compatible with system operation.

- Our testing has verified that sweep activity results in lower particle count in the module.

- The sweep routine consumes approximately 11 seconds of a 13-hour period. Thus, the drive is available to the system more than 99% of the time.

- You can disable the sweep cycle (described below) without affecting the specified Mean Time Between Failures (MTBF) or warranty agreements.

Status codes associated with the sweep cycle are discussed at the end of this supplemental packet.

The drive is preset during manufacturing with a set of sweep cycle options selected. Three jumpers on the control board control the selection, as shown in figure 3-24.

The three sweep cycle jumpers are identified as SWPD, SWP1, and RTN. The following paragraphs discuss the functions controlled by each jumper and tell different ways to position the jumpers:

SWPD -- enables or disables the sweep cycle function. The jumper can be positioned as follows:

- Connecting the two pins -- disables the sweep cycle function. The other jumpers then have no effect.

- Mounted on one pin (two pins not connected) -- enables the sweep cycle function.

SWP1 -- enables or disables the option to sweep only on seeks. When enabled, sweep movements can occur only in conjunction with seeks required by the controller. Each time the drive performs a sweep cycle, it starts a 12-minute timeout. When the timeout has elapsed, the drive performs another sweep cycle only when it receives a Seek command (Tag 1). When combining a sweep cycle with a seek, the drive performs the sweep cycle first and then executes the Seek command. The jumper can be positioned as follows:

- Connecting the two pins -- disables the option to sweep only on seeks (sweep cycles can be initiated within the drive).

- Mounted on one pin (two pins not connected) -- enables the option to sweep only on seeks.

RTN (not labeled on Type 2 control boards) -- enables or disables the option to return the heads to their original cylinder following a sweep segment. The jumper can be positioned as follows:

- Connecting the two pins -- enables the option. The drive performs the sweep and, when selected, returns to the original cylinder (where it was before the sweep occurred) with the following exceptions:

  - If the sweep was initiated by a Seek command, the drive performs the sweep function and then moves the heads to the cylinder requested by the controller.

  - If the drive had not been selected during the 12 minutes prior to a sweep, the heads stay on a cylinder accessed during the sweep segment.

- Mounted on one pin (two pins not connected) -- disables the option. The heads always stay on a cylinder accessed during the sweep segment with the following exception: If the sweep was initiated by a Seek command, the drive performs the sweep function and then moves the heads to the cylinder requested by the controller.

Setting Sector Switches

Setting the sector select switches is discussed in the following paragraphs. Refer to the subsystem or controller reference manual to determine the number of sectors (or the bytes/sector) required by the controller. To achieve that requirement, the following settings are required:

- Sector switches -- See figure 3-23.
- Sector Clock switch (B/C or B/8) -- See figure 3-23.
- RUNT jumper -- See figure 3-24.

The information in this topic applies to drives with Type 2 and Type 3 control boards (see figure 3-23). If your drive has a Type 1 control board, refer to appendix B for instructions on setting its sector switches.

Your task of setting the sector switches on the drive is relatively easy if you already understand the various choices available. There are a number of selection methods, each described by a separate table of selections. If you know how many sectors are needed or the number of bytes in each sector, refer to the switch selection tables, make the suggested settings, and proceed with the drive installation. However, if you need more information about the different methods before you choose one of them, read on. The following material will step you through the selection process.

Additional background information about sector selection appears in appendix B. For most installations it will not be necessary to refer to appendix B. However, some systems designers, when matching a disk drive to a specific controller, choose a sector length different from any given here in the tables. In cases like this, the material in the appendix relates arbitrary sector lengths to switch settings.

Sixteen tables are needed to cover all the possibilities for sector selection on the drives described in this manual. The following variables make it necessary to use multiple tables:

- Drive Capacity -- the 736 MB drive, the 850 MB drive, the 1120 MB drive, and the 1230 MB drive have different numbers of bytes per track.

- Sector Clock Frequency -- selecting a different sector clock frequency (via the B/C switch on Type 3 control boards [B/8 switch on Type 2]) affects the switch settings and in some cases the number of bytes per sector.

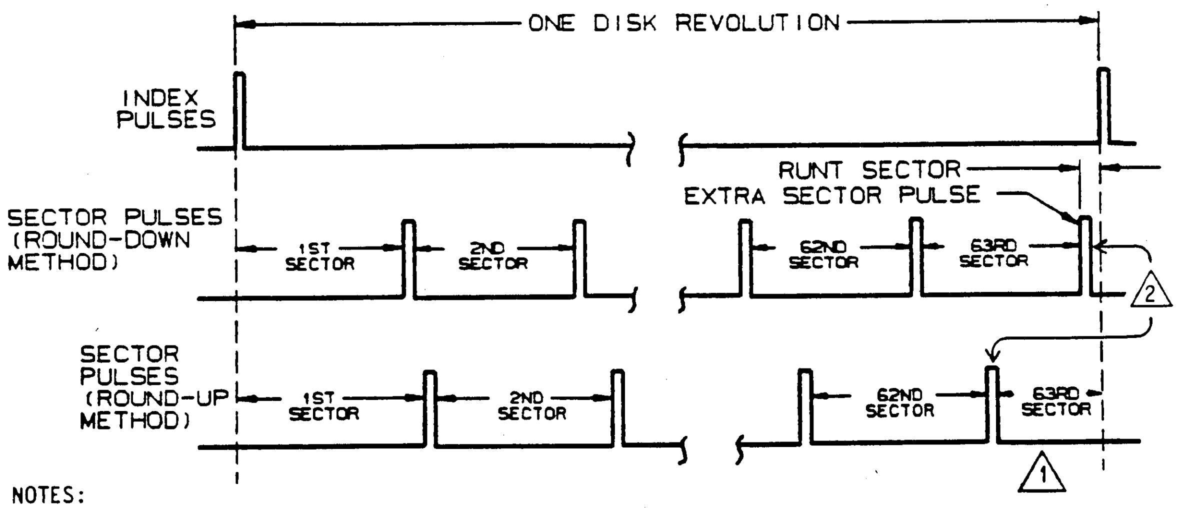
- Round-up and Round-down Methods -- produce differing results when the number of sector clock pulses per revolution is not evenly divisible by the number of sectors. The problem of an uneven division can be solved by methods of either rounding up or rounding down the result.

Round-down and Round-up Methods

Figure 3-25 uses an example of 63 sectors to show how the two methods differ both in terms of sector lengths and in the presence or absence of an extra sector pulse. This illustration also lists and describes the various tables.

For the round-down method, the sector tables list the bytes in usable sectors and the bytes in the runt sector. A runt sector is a short interval following the last usable sector. When a runt sector occurs, it is preceded by an extra sector pulse. The topic Runt Suppression describes when this extra sector pulse can be eliminated.

For the round-up method, the sector tables list the bytes in early sectors and the bytes in the last sector. The last sector can be somewhat shorter than the other sectors. There is no runt sector (or extra sector pulse), however.



NOTES:

1. WITH ROUND-UP METHOD, LAST SECTOR MAY BE SHORTER THAN EARLY SECTORS.
2. CONNECTING "RUNT" JUMPER SUPPRESSES SECTOR PULSE PRECEDING SHORT LAST SECTOR.

11H130

SELECTING A TABLE FOR 736 MB DRIVES:

	B/C [B/8] Switch	Round-down Method	Round-up Method
1.6 MHz Clock	C [8] (Off or Open)	Table 3-9	Table 3-10
Byte Clock	B [B] (On or Closed)	Table 3-11	Table 3-12

SELECTING A TABLE FOR 850 MB DRIVES:

	B/C [B/8] Switch	Round-down Method	Round-up Method
1.6 MHz Clock	C [8] (Off or Open)	Table 3-13	Table 3-14
Byte Clock	B [B] (On or Closed)	Table 3-15	Table 3-16

SELECTING A TABLE FOR 1120 MB DRIVES:

	B/C [B/8] Switch	Round-down Method	Round-up Method
1.83 MHz Clock	C [8] (Off or Open)	Table 3-17	Table 3-18
Byte Clock	B [B] (On or Closed)	Table 3-19	Table 3-20

SELECTING A TABLE FOR 1230 MB DRIVES:

	B/C [B/8] Switch	Round-down Method	Round-up Method
2.016 MHz Clock	C [8] (Off or Open)	Table 3-21	Table 3-22
Byte Clock	B [B] (On or Closed)	Table 3-23	Table 3-24

Figure 3-25. Choosing a Sector Selection Method

The round-up and round-down methods yield the same results for many sector counts. In these cases, the two methods call for identical switch settings.

The choice of sector clock frequencies (via the B/C switch [B/8 switch on Type 2 boards]) can affect the lengths of the usable sectors (round-down and round-up methods), the runt sector (round-down method), or the last sector (round-up method).

Exact Sector Lengths

The sector selection tables provide idealized values for sector lengths. Deriving exact values from these idealized values requires an adjustment. This adjustment must be considered if the chosen sector length allows minimal overhead or if runt sector suppression is planned.

The adjustment must be made to calculate the actual lengths of the first sector (logical sector 0) and the last sector. For each drive type and sector clock combination, table 3-8 lists the number of bytes of adjustment that must be added to the first sector and subtracted from the last sector.

TABLE 3-8. SECTOR LENGTH ADJUSTMENT

Drive Type	Sector Clock	Adjustment (Bytes)
736 MB	1.6 MHz	4.50
736 MB	Byte Clock	5.00
850 MB	1.6 MHz	6.00
850 MB	Byte Clock	6.00
1120 MB	1.83 MHz	6.00
1120 MB	Byte Clock	7.00
1230 MB	2.016 MHz	7.50
1230 MB	Byte Clock	8.00

The following examples show how to calculate exact sector lengths for the round-down method and then the round-up method. These examples are based on selecting 63 sectors on a 736 MB drive with the 1.6 MHz sector clock. Table 3-8 indicates for this case that the adjustment is 4.50 bytes.

Example 1: Round-down method (see table 3-9)

Values from table	Adjusted values
Sectors 0 thru 62 = 479.25 bytes	Sector 0 = 479.25 + 4.50 = 483.75 bytes Sectors 1 thru 62 = 479.25 bytes
Runt Sector = 47.25 bytes	Runt Sector = 47.25 - 4.50 = 42.75 bytes

Example 2: Round-up method (see table 3-10)

Values from table	Adjusted values
Sectors 1 thru 61 = 480.37 bytes	Sector 0 = 480.37 + 4.50 = 484.87 bytes Sectors 1 thru 61 = 480.37 bytes
Sector 62 = 456.75 bytes	Sector 62 = 456.75 - 4.50 = 452.25 bytes

If a round-down sector table indicates either no runt or a very short runt, in actuality the last usable sector is shortened. Example 3 is based on selecting 89 sectors on a 736 MB drive with the 1.6 MHz sector clock:

Example 3: Round-down method (see table 3-9)

Values from table	Adjusted values
Sectors 0 thru 88 = 339.75 bytes	Sector 0 = 339.75 + 4.50 = 344.25 bytes Sectors 1 thru 88 = 339.75 bytes
Runt Sector = 2.25 bytes	Runt Sector = 2.25 - 4.50 = -2.25 bytes

A negative runt sector length doesn't make sense, however. The numbers indicate that there really is no runt and that sector 88 is shortened by 2.25 bytes. Expressing these results more sensibly:

Sector 0 = 339.75 + 4.50 = 344.25 bytes
Sectors 1 thru 87 = 339.75 bytes
Sector 88 = 339.75 - 2.25 = 337.50 bytes

Runt Suppression

Runt suppression may or may not be desirable. Runt sector pulses are suppressed when the RUNT jumper is connected (see figure 3-24 and table 3-6). Consider the three examples given above in the discussion of exact sector lengths.

Selecting runt suppression defeats the purpose of using the round-up method. Referring to example 2, the 452.25-byte (shorter) last sector would no longer be preceded by a sector pulse and would not be available for use.

Depending on the controller requirements, runt suppression may improve operation with the round-down method. If runt suppression had been selected in example 1, the runt sector would no longer exist. With no extra sector pulse, sector 62 would be extended by 42.75 bytes.

If runt suppression had been selected in example 3, the sector pulse preceding sector 88 would be suppressed. This illustrates an important point about runt suppression:

> If the length of the runt shown in the sector table is shorter than the length of the adjustment shown in table 3-8, DO NOT use runt sector suppression.

Making the Selection

You must decide now which sector selection table you will use for switch setting information. If you don't know which table is best, compare the sector lengths listed in each of the tables to the requirements of the controller. The choice of tables may be arbitrary, or one of the tables may offer a real advantage over the others.

The Sector Select switch assembly has 14 independent switches used for selecting sectors. These switches and the B/C [or B/8] switch are located on the control board as shown in figure 3-23. Across from the number of sectors listed in each table is a row of Cs and Os. C represents the Closed (On) position of the sector switch. O represents the Open (Off) position of the sector switch. Set the switches to the positions designated in the table while referring to figure 3-20 for an illustration of the switch positions. Verify also that the B/C [or B/8] switch is set correctly.

For future reference, you may want to record the switch settings you made. Use the following worksheet:

Table Used: ________________

Number of Sectors: __________

Switch Settings:

2^0 __ 2^1 __ 2^2 __ 2^3 __ 2^4 __

2^5 __ 2^6 __ 2^7 __ 2^8 __ 2^9 __

2^{10} __ 2^{11} __ 2^{12} __ 2^{13} __

B/C [or B/8] Switch: On _____ Off _____

RUNT jumper: Connected __ Disconnected __

TABLE 3-9. SECTOR SELECT SWITCH SETTINGS -- 736 MB DRIVES USING 1.6 MHz CLOCK AND ROUND-DOWN METHOD

Number of Sectors	Sector Switches* 2^0	2^1	2^2	2^3	2^4	2^5	2^6	2^7	2^8	2^9	2^{10}	2^{11}	2^{12}	2^{13}	Bytes in Usable Sectors	Bytes in Runt Sector
4	O	O	O	O	O	O	C	C	C	O	C	O	O	C	7560	0
5	O	O	O	O	O	O	O	O	C	C	O	C	O	C	6048	0
6	O	O	O	O	O	O	O	C	O	C	C	C	O	C	5040	0
7	O	O	O	O	O	O	O	O	C	O	O	O	C	C	4320	0
8	O	O	O	O	O	C	C	C	O	C	O	O	C	C	3780	0
9	O	C	C	O	C	O	C	O	O	O	C	O	C	C	3359.25	6.75
10	O	O	O	O	O	O	O	C	C	O	C	O	C	C	3024	0
11	C	O	C	O	C	C	C	O	O	C	C	O	C	C	2748.37	7.87
12	O	O	O	O	O	O	C	O	C	C	C	O	C	C	2520	0
13	C	O	C	C	O	C	C	C	C	C	C	O	C	C	2325.37	10.12
14	O	O	O	O	O	O	O	C	O	O	O	C	C	C	2160	0
15	O	O	O	O	O	O	O	O	C	O	O	C	C	C	2016	0
16	O	O	O	O	C	C	C	O	C	O	O	C	C	C	1890	0
17	C	C	O	O	C	O	C	C	C	O	O	C	C	C	1778.62	3.37
18	C	C	O	C	O	C	O	O	O	C	O	C	C	C	1679.62	6.75
19	O	C	O	C	C	C	C	O	O	C	O	C	C	C	1590.75	15.75
20	O	O	O	O	O	O	C	C	O	C	O	C	C	C	1512	0
21	O	O	O	O	O	O	O	O	C	C	O	C	C	C	1440	0
22	C	C	O	C	C	C	O	O	C	C	O	C	C	C	1373.62	20.25
23	O	O	O	O	C	C	C	O	C	C	O	C	C	C	1314	18
24	O	O	O	O	O	C	O	C	C	C	O	C	C	C	1260	0
25	C	O	C	C	O	O	C	C	C	C	O	C	C	C	1209.37	5.62
26	C	C	C	O	C	C	C	C	C	C	O	C	C	C	1162.12	24.75
27	C	O	C	C	C	O	O	O	O	O	C	C	C	C	1119.37	16.87
28	O	O	O	O	O	O	C	O	O	O	C	C	C	C	1080	0
29	O	C	O	O	O	C	C	O	O	O	C	C	C	C	1041.75	29.25
30	O	O	O	O	O	O	O	C	O	O	C	C	C	C	1008	0
31	C	O	C	C	C	O	O	C	O	O	C	C	C	C	975.37	3.37
32	O	O	O	C	C	C	O	C	O	O	C	C	C	C	945	0
33	O	C	O	O	C	O	C	C	O	O	C	C	C	C	915.75	20.25
34	O	C	O	C	O	C	C	C	O	O	C	C	C	C	888.75	22.50
35	O	O	O	O	O	O	O	O	C	O	C	C	C	C	864	0
36	O	C	C	O	C	O	O	O	C	O	C	C	C	C	839.25	27
37	O	C	O	C	O	C	O	O	C	O	C	C	C	C	816.75	20.25
38	C	O	C	C	C	C	O	O	C	O	C	C	C	C	795.37	15.75
39	C	C	C	C	O	O	C	O	C	O	C	C	C	C	775.12	10.12
40	O	O	O	O	O	C	C	O	C	O	C	C	C	C	756	0
41	C	O	O	O	C	C	C	O	C	O	C	C	C	C	736.87	28.12
42	O	O	O	O	O	O	O	C	C	O	C	C	C	C	720	0
43	C	C	C	C	O	O	O	C	C	O	C	C	C	C	703.12	5.62
44	O	C	C	C	C	O	O	C	C	O	C	C	C	C	686.25	45
45	C	C	O	C	O	C	O	C	C	O	C	C	C	C	671.62	16.87

* C = Closed or On; O = Open or Off

Continued

DIAGNOSTIC TESTING AND STATUS CODE SUMMARY A

CAUTION

When servicing the drive, observe all precautions listed under Electrostatic Discharge Protection in section 3 of this manual. Failure to observe these precautions can result in serious damage to electronic assemblies.

INTRODUCTION

This appendix presents information on interpreting the information displayed on the status/control panel and running offline diagnostic tests. More complete troubleshooting information can be found in the maintenance manual. You should be familiar with the contents of that manual before doing any troubleshooting.

For trouble analysis, a status/control panel is needed. If the drive installation does not include a status/control panel, we advise that you connect one to the drive during troubleshooting. Refer in the parts data manual for part numbers of the status/control panel and its interconnect cable. Refer to section 3 of this manual for instructions on connecting the panel to the drive.

The following types of troubleshooting information are presented in this appendix:

- Power On Test -- Describes drive self tests that occur when dc power is applied to the drive
- Diagnostic Testing -- Describes how to use diagnostic testing to isolate drive malfunctions
- Drive Status Codes -- Provides information on correcting problems associated with drive power on/power off and with servo operation

POWER ON TEST

When dc power is applied to the drive, the Control MPU performs a series of self-tests. During these tests the Address, Ready, FAULT, and WRITE PROTECT lights on the operator panel or status/control panel will be lit. After approximately four seconds, the FAULT light will go off, indicating successful completion of the self-tests. If the Ready and FAULT lights remain on constantly, it indicates the drive failed the power on self-test. The Address lights will then indicate which self-test routine the drive failed to complete. Refer to table A-1 to determine the test that failed and what action to take.

In addition to the individual tests listed in table A-1, the Control MPU attempts to communicate with the status/control panel. If this communication is unsuccessful, the Control MPU displays the message PANEL FAILURE on the LCD of the panel.

TABLE A-1. POWER ON TEST FAILURE

Address Lights* 8 4 2 1	Hex Code	Test Failed** & Actions
● ● ● ●	F	RAM Test Action: 1. Replace control board.
● ● ● o	E	ROM Test Action: 1. Replace control board.
● ● o ●	D	I/O Chip Test Actions: 1. Replace I/O board. 2. Replace control board.
● ● o o	C	Peripheral Chip (Test 1) Action: 1. Replace control board.
● o ● ●	B	Peripheral Chip (Test 2) Action: 1. Replace control board.
● o ● o	A	Motor MPU Test Action: 1. Replace control board.

* Darkened circles indicate light is On.

**Ready and FAULT lights remain on constantly, indicating drive failed four second power on self test.

DIAGNOSTIC TESTING

The drive's offline diagnostics are initiated and monitored via the keyboard and LCD of the status/control panel. Figure A-1 shows the placement of switches and indicators on both the status/control panel and the operator panel. Table A-2 describes the maintenance features of the status/control panel.

TEST SELECTION PROCEDURE

To run offline diagnostic tests on the drive, place the drive in diagnostic mode and select the tests desired. To do this:

- Press the DIAG MODE switch to enter diagnostic mode and observe that the LCD reads DIAG TEST XX.
- Enter two hexadecimal characters on the keyboard and press EXEC switch to select the first test.

Directions for running the individual diagnostic tests appear later in this section. When the EXEC switch is pressed one more time, the test ends and the LCD again reads DIAG TEST XX. At this point you have two choices:

- Enter two hexadecimal characters on the keyboard and press EXEC switch to select another test, or
- Press the DIAG MODE switch to leave diagnostic mode and observe that the LCD displays drive operating status.

TABLE A-2. MAINTENANCE SWITCHES AND INDICATORS

Switch or Indicator	Function
STATUS/CONTROL PANEL ONLY	
Diagnostic Keyboard	Used to enter diagnostic tests and parameters.
Liquid Crystal Display	Displays drive status, faults, and current cylinder address.
DIAG MODE (Diagnostic Mode) Switch	Places drive in diagnostic mode and disables the I/O.
SPACE and BACK SPACE Switches	Used to enter the desired diagnostic tests.
EXEC (Execute) Switch	Starts and stops diagnostic tests.

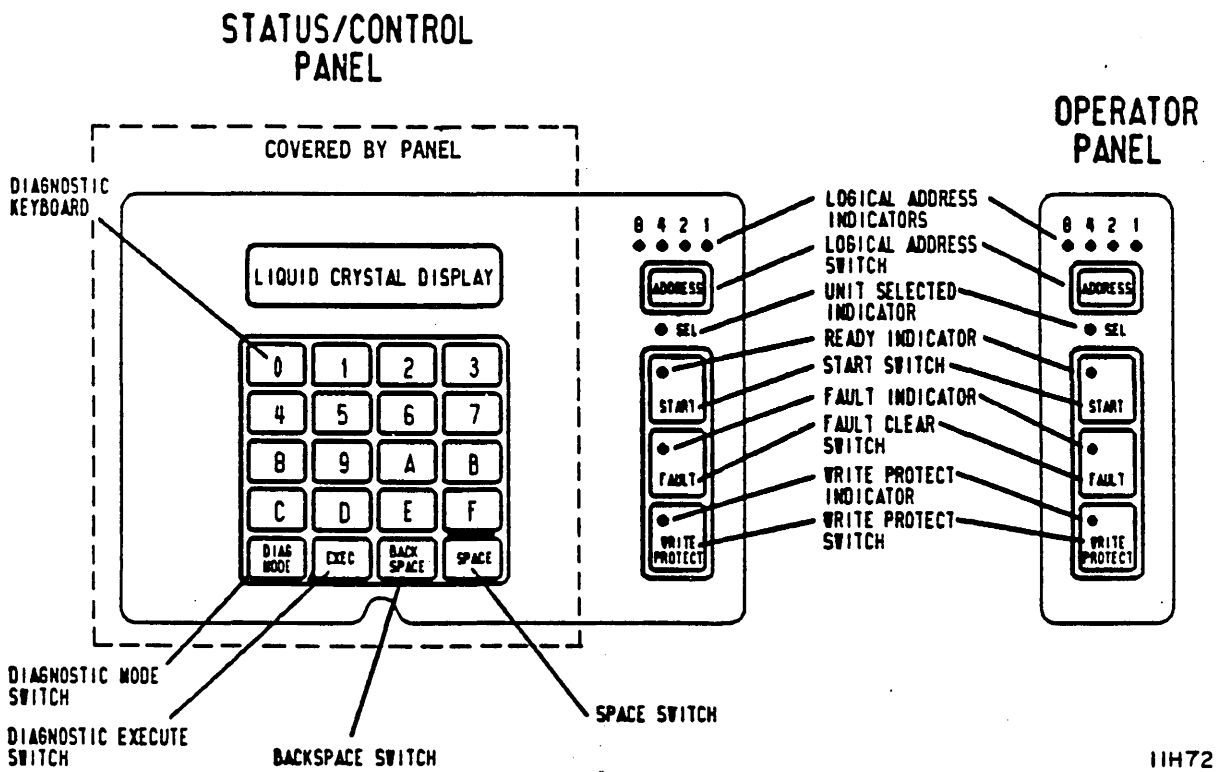


Figure A-1. Status/Control and Operator Panels

TEST DESCRIPTIONS

Test 00 -- Display Drive Operating Status Log

This test displays the 8 most recently generated drive status codes. After test selection, the display provides a hexadecimal status code from the internal log. This code is preceded by a character (0-7) and a colon, indicating the position of the status code in the status log. To execute test 00, perform the following steps:

1. Enter Test 00, then press EXEC switch. The LCD will display DRIVE LOG: 0:XX where the number 0 indicates the position in the log and XX represents the status code entered in that position.

2. Press SPACE switch repeatedly until you see a code preceded by an asterisk (for example, DRIVE LOG: *5:XX). The asterisk identifies that code as the most recent entry in the status log.

3. Use the SPACE switch to step through from the 8th most recent to the most recent status.

4. Press EXEC switch to end the test and return to test selection.

Test 01 -- Display Fault Log

This test displays the 8 most recently stored fault codes. After test selection, a hexadecimal fault code will be displayed. This code is preceded by a character (0-7) and a colon, indicating the position of the fault code in the fault log. To execute test 01, perform the following steps:

1. Enter Test 01, then press EXEC switch. The LCD will display FAULT LOG: 0:XX where the number 0 indicates the position in the log and XX represents the fault code entered in that position.

2. Press SPACE switch repeatedly until you see a code preceded by an asterisk (for example, FAULT LOG: *5:XX). The asterisk identifies that code as the most recent entry in the fault log.

3. Use the SPACE switch to step through from the 8th most recent to the most recent fault.

4. If more than one fault occurs simultaneously (multiple faults), more than one bit in the fault code will be set. Check the bit-mapped locations of each fault by referring to the following list:

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

5. Press EXEC switch to end the test and return to test selection.

Test 04 -- Calculate Three Most Likely Field Replaceable Units

NOTE

Do not execute Tests 05, 06, or 07 prior to running Test 04.

This test uses the fault status and the drive operating status history (Tests 00 and 01) to predict the most likely cause of drive failure. Table A-3 lists the individual codes and their corresponding replacement part. To execute Test 04, perform the following steps:

1. Enter Test 04, then press EXEC switch. The LCD will display FRUS: XX XX XX. Upon test completion, the three field replaceable units will be displayed, with the first hexadecimal code being the most likely cause of the failure.

2. Press EXEC switch to end the test and return to test selection.

TABLE A-3. CODING OF FIELD REPLACEABLE UNITS

Hex Display	Field Replaceable Unit
01	Control Board
02	Module
03	Power Supply
04	I/O Board
05	Control Board
06	Module

Test 05 -- Servo Test

This test clears both the drive status log and fault log. Because Test 04 relies on status history that would be cleared by Test 05, you might want to run Test 04 before running Test 05. Test 05 automatically performs several types of seek operations. They are as follows:

Operation	Number Of Times Executed
RTZ	1
1 Track Seek	16
RTZ	1
Partial Servo Recalibrate	1
RTZ	1
Maximum Length Seek	16
RTZ	1

Execution stops when an error is detected or the test completes. To execute Test 05, perform the following steps:

1. Enter Test 05, then press EXEC switch. Upon successful completion of the test, the LCD will display OK, CYL: 000. If an error occurs, the LCD will display SERVO ERROR: XX. Drive status codes (servo errors) are defined in table A-4 later in this section.

2. Press EXEC switch to end the test and return to test selection.

Test 06 -- Clear Drive Operating Status Log

This test clears the drive status log resident in program RAM. Because Test 04 relies on status history that would be cleared by Test 06, you might want to run Test 04 before running Test 06. To execute Test 06, perform the following steps:

1. Enter Test 06 and press EXEC switch. The LCD will display DRIVE LOG CLEAR.

2. Press EXEC switch to end the test and return to test selection.

Test 07 -- Clear Fault Log

This test clears the fault log. Because Test 04 relies on status history that would be cleared by Test 07, you might want to run Test 04 before running Test 07. To execute Test 07, perform the following steps:

1. Enter Test 07 and press EXEC switch. The LCD will display FAULT LOG CLEAR.

2. Press EXEC switch to end the test and return to test selection.

Test 08 -- Direct Or Continuous Seeks

This test performs direct or continuous seeks between cylinder 0 and the desired cylinder address. Operation stops if an error occurs or if the EXEC switch is pressed. To execute Test 08, perform the following steps:

1. Enter Test 08 and press EXEC switch.

2. The display HEX CYL XXX asks you to supply a valid destination address (between 0 and 662 inclusive on 736 MB, 1120 MB, and 1230 MB drives; between 0 and 564 on 850 MB drives). Enter <u>three</u> characters and press SPACE switch.

3. The display DIR OR CONT? D/C asks you to select either DIRect (D) or CONTinuous (C) seeks. Enter either C or D to start test.

4. If D was entered and the direct seek was successful, the LCD will display OK, CYL: XXX, where XXX is the destination address previously entered. Press EXEC switch to end the test and return to test selection.

5. If either D or C was entered and an error occurs, the LCD will display SERVO ERROR: XX. Drive status codes (servo errors) are defined in table A-4 later in this section. By running Test 05 or Test OE, you can clear the seek error.

6. If C was entered, press EXEC switch to end the test and return to test selection.

Test 09 -- Random Seek

This test performs random seeks between cylinder 0 and the maximum cylinder address (0-1634 on 736 MB, 1120 MB, and 1230 MB drives; 0-1380 on 850 MB drives). Operation stops if an error occurs or if the EXEC switch is pressed. To execute Test 09, perform the following steps:

1. Enter Test 09 and press EXEC switch.

2. The LCD will display OK, CYL: XXX if execution was successful.

3. If an error occurs during the test, the LCD will display SERVO ERROR: XX. Drive status codes (servo errors) are defined in table A-4 later in this section.

4. Press EXEC switch to end the test and return to test selection.

Test OC -- Display EPROM Part Number

This test displays the 8-digit part number of the control microprocessor EPROM. To execute Test OC, perform the following steps:

1. Enter Test OC and press EXEC switch. The LCD will display the 8-digit part number of the EPROM (for example, EPROM# = 12345678).

2. Press EXEC switch to end the test and return to test selection.

Test OE -- Return To Zero

This test initiates a return to zero command. To execute Test OE, perform the following steps:

1. Enter Test OE and press EXEC switch. The LCD will display OK, CYL: 000.

2. If an error occurs during the test, the LCD will display SERVO ERROR: XX. Drive status codes (servo errors) are defined in table A-4 later in this section.

3. Press EXEC switch to end the test and return to test selection.

DRIVE STATUS CODES

Whenever the drive is in a power on condition (dc power active), the Control MPU is periodically checking the operation of the drive and generating appropriate operating status codes.

Table A-4 lists the status codes and a definition of each code. If a drive malfunction occurs, observe the error code and perform Diagnostic Test 04 to calculate the action to be taken.

Figure A-2 shows an example of the LCD during normal operation and when a fault occurs. During normal operation, the LCD displays current drive status, current cylinder address, and which drive channel is selected and/or reserved.

If a fault occurs, the LCD displays the type of fault(s) that occurred along with the current drive status. If more than one fault occurred, use the SPACE switch to step through the fault log to determine what faults are present.

Pressing the Fault Clear switch on the status/control panel clears the LCD fault display and the FAULT indicator, provided that the fault condition is no longer present. However, a Fault Clear signal from the controller clears only the FAULT indicator.

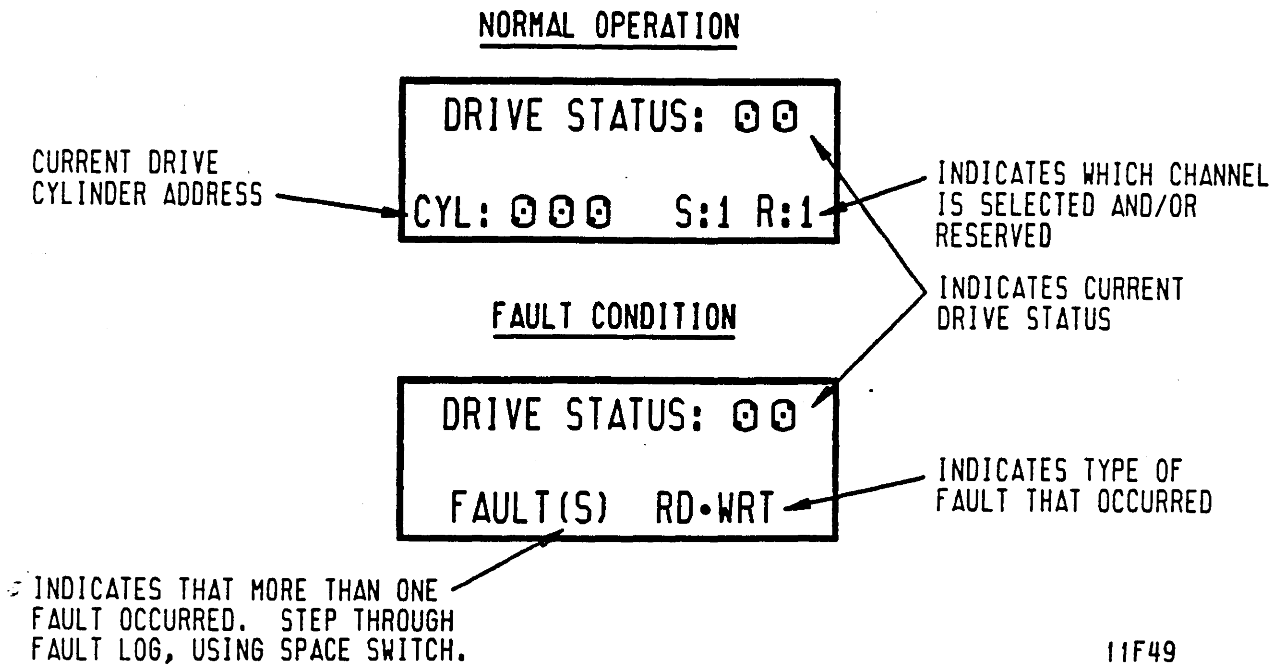


Figure A-2. Example of LCD (Liquid Crystal Display)

TABLE A-4. DRIVE STATUS CODES

Code	Title	Description
Normal Start/Stop Status		
00	Ready & On Cylinder	Indicates that the drive is on cylinder and ready to perform normal operations.
02	Motor Stopping	Indicates that the motor is coasting down or that motor braking is in progress.
03	Motor Stopped	Indicates that the motor is stopped.

Table Continued on Next Page

TABLE A-4. DRIVE STATUS CODES (Contd)

Code	Title	Description
		Normal Start/Stop Status (Contd)
04	First Load/Calibrate	Indicates that the heads are moving from the landing zone to track 0 and servo calibration is being performed.
05	Sequence Delay	Indicates, in Remote mode, that a power sequence delay is occurring. The delay depends on the drive's unit address.
06	START Switch Pressed and Waiting for Power Sequence Signals	Indicates, in Remote mode, that the START switch was pressed and that the drive is waiting for power sequence signals from the controller before starting the sequence delay.
07	Starting Motor	Indicates that start conditions are present and that the spindle motor is starting.
08	Motor Up To Speed	Indicates that the spindle motor has reached full speed.
		SWEEP CYCLE STATUS
0A	Drive in Sweep Segment	The drive is executing a series of seeks for a sweep cycle. On Cylinder and Seek End are inactive at this time.
0B	Heads Left on Last Cylinder of Sweep	Current head position determined by last sweep cycle -- not by a controller-requested seek. On Cylinder and Seek End are inactive at this time.

Table Continued on Next Page

TABLE A-4. DRIVE STATUS CODES (Contd)

Code	Title	Description
		Seek Error Status
46	Seek Timeout	Indicates that during a normal seek the drive took longer than 100 milliseconds to reach on cylinder.
4B	Off Track Seek Error	Indicates that either the drive failed to stay on cylinder or cylinder pulses were detected during track-following.
4D	Illegal Cylinder Address	Indicates that during a normal seek, the controller issued too high a cylinder address (>1634 for 736 MB, 1120 MB, and 1230 MB drives; >1380 for 850 MB drives).
4F	Seek Error On Settle In	Indicates that the drive could not settle in on the destination cylinder.
		First Seek Fault Status
54	First Seek Fault On Retract	Indicates that the drive failed to complete the retract portion of the first seek.
55	First Seek Fault On Load	Indicates that the drive failed to load the heads.
56	First Seek Fault On RTZ	Indicates that the drive failed to complete the return to zero (RTZ) portion of the first seek.
57	First Seek Fault On Calibrate	Indicates that the drive did not complete the velocity calibration operation.

Table Continued on Next Page

TABLE A-4. DRIVE STATUS CODES (Contd)

Code	Title	Description
Error Condition Status		
58	Speed Loss	Indicates that the spindle speed fell below 3564 r/min. When this happens, the drive activates the Write Protect line, drops the Ready signal, and performs a retract operation.
59	Motor Can't Start Due to Error	Indicates a problem in the motor control circuitry.
5A	Emergency Retract	Indicates that the heads moved to the landing zone due to a power loss (-Low Vcc active), or that a servo-controlled retract failed.
Motor and Servo MPU Errors		
60	Motor MPU Failure	Indicates that the Control MPU was unable to communicate with the Motor MPU.
61	Servo MPU Failure	Indicates that the Control MPU was unable to communicate with the Servo MPU.