PERKIN-ELMER

INTELLIGENT DISK CONTROLLER (IDC)

Programming Manual

50-007 R02

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

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Printed in the United States of America

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PREFACE

This manual contains operating procedures, programming instructions and programming sequences for the Perkin-Elmer Intelligent Disk Controller (IDC).

Chapter 1 provides a discussion of the dual port option. Chapter 2 discusses controller modes and data format. Chapter 3 details programming instructions. Chapter 4 describes the selector channel (SELCH), controller, and disk drive interrupts. Chapter 5 provides a guide to performing stand-alone disk input/output (I/O).

Appendix A provides the IDC sector and track format. Appendixes B and D provide the programming specifications for the medium capacity cartridge disk drive (MCCDD) and the mass storage module (MSM) disk systems, respectively. Appendixes C and E provide the disk installation and system operation procedures for the MCCDD and MSM disk systems, respectively. Appendixes F and G provide the programming specifications and system operation procedures for the 330Mb fixed media disk drive (MSM300F). Appendix H outlines programming specifications and system operation procedures for the 50Mb cartridge disk drive (CDD50) system.

The IDC is designed to operate with the Perkin-Elmer Series 3200 processors only. For additional information, see the specific processor user's manual.

For information on the contents of all Perkin-Elmer 32-bit manuals, see the 32-Bit Systems User Documentation Summary.

CHAPTER 1
INTELLIGENT DISK CONTROLLER (IDC) DESCRIPTION

1.1 INTRODUCTION

This document provides programming information for the Perkin-Elmer Intelligent Disk Controller (IDC) family of disk subsystems. It is assumed that the reader is familiar with the input/output (I/O) programming structure of Perkin-Elmer processors.

The Perkin-Elmer IDC subsystem provides a random access, rotating memory storage facility for the Perkin-Elmer family of computers. An IDC subsystem contains a single controller capable of handling up to four disk drives.

Memory access is through a selector channel (SELCH) or channel manager, which is assigned a high priority on the memory bus to ensure that the 1209 kb/second transfer rate is maintained. Data is recorded in a fixed-sector format, with each sector containing 256 data bytes. A single transfer can range from two bytes to a whole cylinder, depending on available memory, because the IDC permits data transfers across sector and head boundaries. Simultaneous seek and overlapping seek/data transfers are permitted in subsystems with multiple disk drives.

The appendixes summarize specifications pertinent to programming the IDC disk drives.

1.2 DUAL PORT OPTION

Dual port operation is provided as an optional feature for some of the Perkin-Elmer IDC family of disk drives. A drive with this feature may be attached to two different controllers. This allows the disk to be used as a message storage facility in processor-to-processor communications, or permits minimum down-time for system reconfiguration in the event of a processor failure in a real-time, dual-processor system.

The drive may be manually assigned to either channel by operation of the channel switch on the drive's I/O board. If this switch is in its central position, both channels compete for the use of the drive on a cable-selected priority basis.

The dead-man timer, which is a reserved timer feature, allows the drive to be released automatically to the alternate channel after a delay following the selection of the drive by the active channel. The first I/O instruction to the drive triggers the timer. I/O instructions restart the timer.

CHAPTER 2
CONTROLLER MODES AND DATA FORMAT

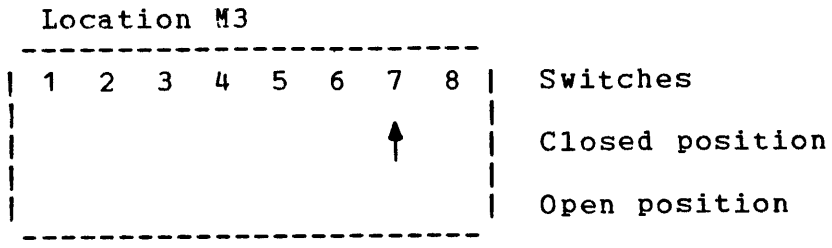
2.1 INTRODUCTION

The controller can be put into either the data mode or the format mode and can be run using either the normal protocol or the high speed protocol, depending on the setting of toggles 8 and 7 of the file 0 address switch at location M3 on the IDC controller board.

- Data Mode (toggle 8 closed)
- Format Mode (toggle 8 open)
- Normal Protocol (toggle 7 closed)
- High Speed Protocol (toggle 7 open)

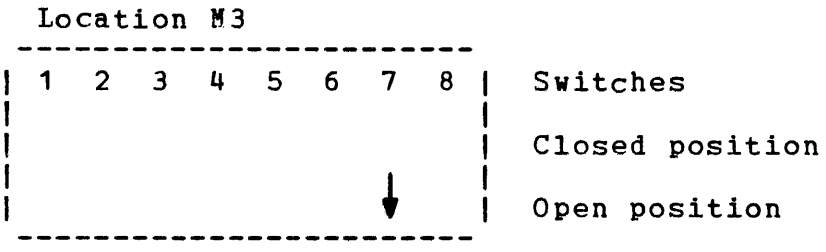
The high speed protocol must be used whenever the IDC is attached to an I/O switch in a multiprocessor configuration. Otherwise, the normal protocol must be used.

To use normal protocol, the file 0 address switch must be set as follows:



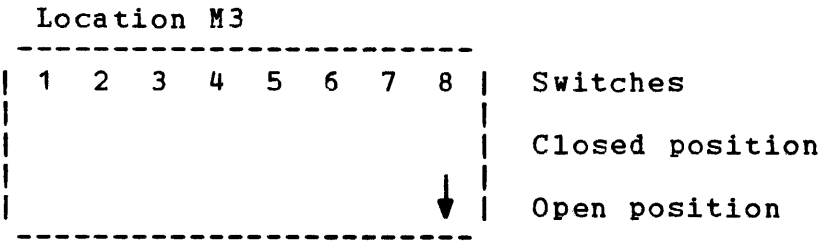
1 through 6 = NA
7 = Closed
8 = NA

In high speed protocol, the file 0 address switch is set as follows:



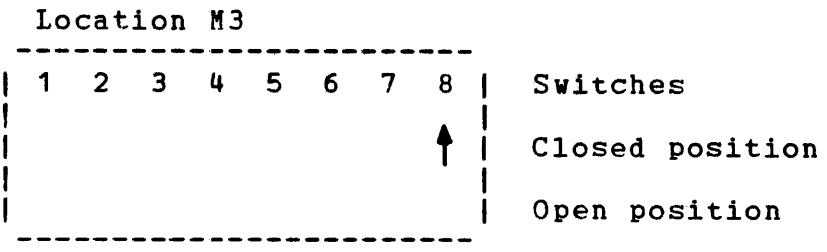
1 through 6 = NA
7 = Open
8 = NA

If format mode is enabled, the file 0 address switch must be set in the open position.



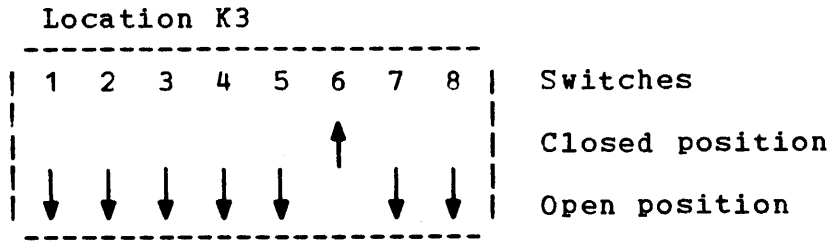
1 through 7 = NA
8 = Open

If format mode is disabled, the file 0 address switch must be set in the closed position.



1 through 7 = NA
8 = Closed

For the controller device address, the following controller address switch toggle settings are used and are the default setting (the controller address switch is at location K3 on the IDC board).



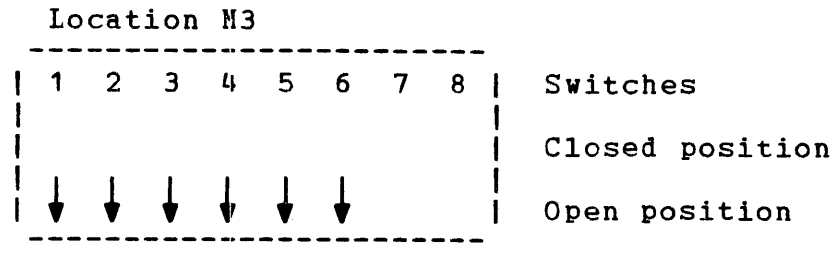
1 through 5 = Open
6 = Closed X'FB'
7 and 8 = Open

See Table 2-1 for the controller address that corresponds to each open toggle.

TABLE 2-1 CONTROLLER DEVICE ADDRESS

SWITCH TOGGLE	CONTROLLER ADDRESS
1	X'80'
2	X'40'
3	X'20'
4	X'10'
5	X'08'
6	X'04'
7	X'02'
8	X'01'

For the file 0 drive device address, the following file 0 address switch toggle settings are used and are the default settings:



1 through 6 = Open
7 and 8 = NA X'FC'

See Table 2-2 for the file 0 drive address that corresponds to each open toggle.

TABLE 2-2 FILE 0
DEVICE ADDRESSES

FUNCTION SWITCH	FILE 0 ADDRESS
1	X'80'
2	X'40'
3	X'20'
4	X'10'
5	X'08'
6	X'04'
7	0
8	0

2.2 DISK DATA FORMAT

The disk is segmented into 33 physical sectors per track. Each sector contains two data records. Of the 33 sectors per track, only 32 are used for data storage. Therefore, each track contains 64 records for data storage. Each record contains 256 bytes for a total of 16,384 bytes of data storage per track.

Each physical sector has an identification address that contains the cylinder, head, and sector numbers. This address is recorded in the identification field at the physical location of the sector on the disk. Each track has 33 identification fields.

Each of the 33 sectors is 610 bytes long and contains three main fields:

- Identification field
- Two data fields

Each data field contains two data records, and both records can be read or written to after a header match. The records are numbered so that they can be operated on consecutively. Therefore, physical sector 0 on head 0 contains records 0 and 1; physical sector 1 on head 0 contains records 2 and 3; and so on. All 64 records on a track can be read or written to in one revolution of the disk. See Appendix A through E.

The number of bytes in a data transfer is not limited by sector or track boundaries; therefore, as few as two bytes or as much as a full cylinder, if sufficient memory is available, can be transferred in one operation. The controller continues the write or read operation until the last sector specified is complete, even if less than one sector is specified. For a write operation, the remaining portion of the sector data field is filled with the last halfword specified. The SELCH interrupts when the specified number of halfwords has been transferred, but the controller continues to transfer the last halfword until the sector boundary is reached; it then becomes idle. At this time, the user may interrogate the controller status to determine if the transfer was error free. The user cannot write or read the sector header field, shown in Figure 2-1, when in data mode.

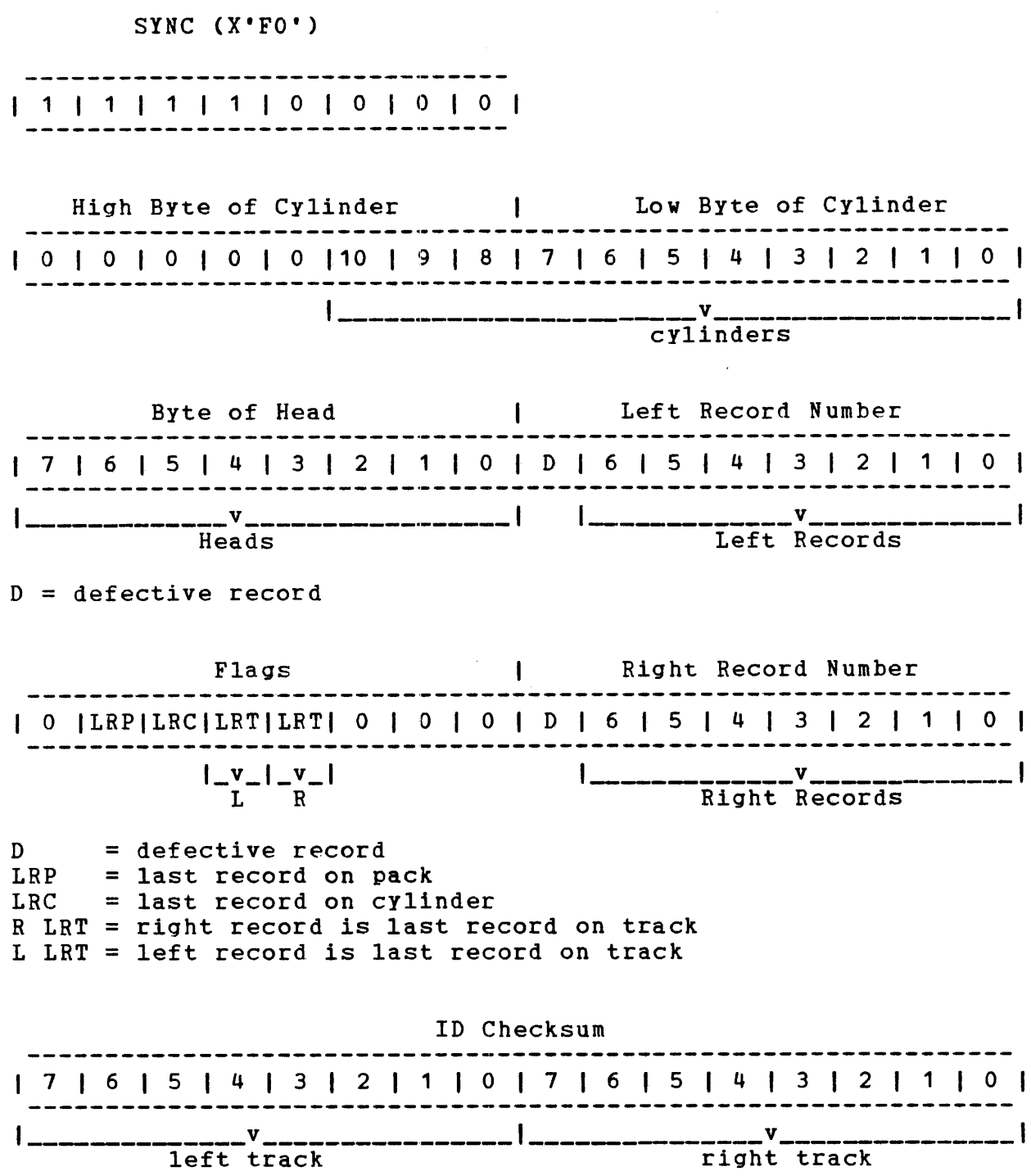


Figure 2-1 Sector Header Field

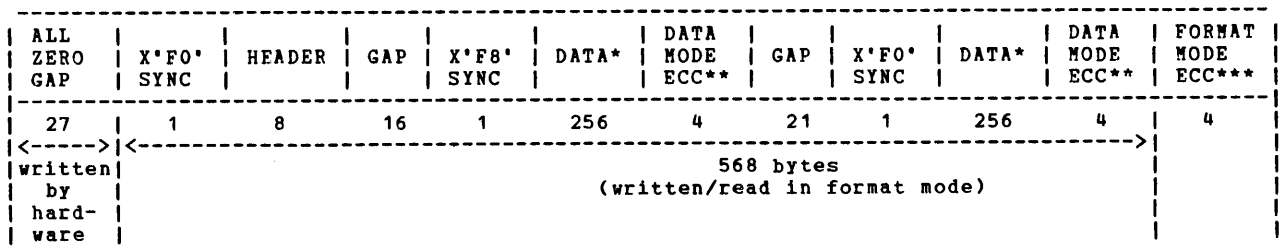
2.3 FORMAT MODE

To write or read the sector header field, the IDC must be placed in the format mode and controller format mode commands must be used. See Section 2.1.

The hardware uses the header field to inhibit data transfers on sectors that are flagged as defective and to guard against attempted transfers if the heads are not properly positioned.

2.4 DISK TESTING AND FORMATTING

Each disk pack supplied by Perkin-Elmer is tested to ensure the integrity of the disk surface. The IDC Test Program and IDC Formatter Program perform this function. Figure 2-2 shows sector format in format mode (consecutive sectors).



* Written/read in data mode (nonformat)

** Written/read by hardware in data mode, by software in format mode

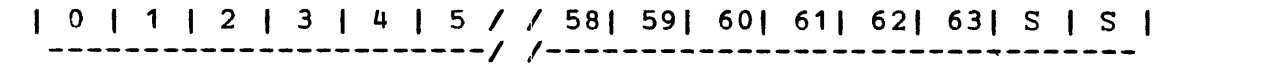
*** Written/read by hardware in format mode, not used in data mode

Figure 2-2 Sector Format (Format Mode Only)

In format mode, the formatter program writes and reads 568 bytes per sector, in the sequence shown. Note that the data field in this case is 256 bytes. This permits testing the error correction code (ECC) field used in the data mode. For this reason, the sequences: format track/write/followed by read or write, generally produce ECC errors.

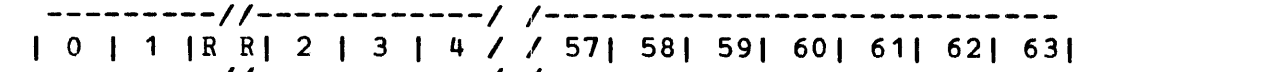
The formatter program writes a prescribed pattern, reads it back a specified number of times, and verifies that the data has no ECC errors. If no errors occur for any of the read operations, the program writes the sector header field with the defective sector bit reset. If a data or ECC error is detected for any of the read operations, the physical sector header field is written with the defective sector bits set for both sectors.

The defective sectors are reassigned as a spare sector. The sector numbers then sequence over the reassigned sectors and include trailing spare sectors into the numbered sector sequence. To illustrate this sequence of events, note first a representation of perfect media:



S = spare sector

Note the difference after one sector is flagged as defective and reassigned.



R = reassigned due to media defect

CHAPTER 3
PROGRAMMING INSTRUCTIONS

3.1 PROCESSOR INSTRUCTIONS

Processor input/output (I/O) instructions are used to communicate with the disk drive, controller, and selector channel (SELCH) or channel manager on a byte or halfword I/O basis. The following is a brief description of these instructions.

- Sense Status (SS or SSR) - interrogates the drive and controller to ensure that data transfers or commands are completed and correct. Also determines whether the SELCH is busy.

- Output Command (OC or OCR) - controls disk operations and initializes and sets up the SELCH.

- Write Data (WD or WDR)/Write Data Halfword (WH or WHR) - loads the cylinder address in the controller, the head and cylinder address in the drive, and loads the SELCH address registers.

- Read Data (RD or RDR)/Read Halfword (RH or RHR) - determines the current rotational position of the addressed drive and interrogates the SELCH address register to ensure a data transfer is completed when the SELCH terminates.

3.2 CONTROLLER COMMAND, STATUS, AND DATA INFORMATION

Table 3-1 shows the controller command, status, and data bytes.

TABLE 3-1
CONTROLLER COMMAND, STATUS, AND DATA BYTES

BIT	0 DIS	1 EN	2 MAINT	3 NU	4 RESET	5 FMT	6 WRITE	7 READ	COMMAND BITS
OC	X	X	0	0	0	0	0	1	READ
	X	X	0	0	0	0	1	0	WRITE
	X	X	0	0	0	0	1	1	READ CHECK
	X	X	0	0	0	1	0	0	CHECK FORMAT TRACK
	X	X	0	0	0	1	0	1	READ FORMAT
	X	X	0	0	0	1	1	0	WRITE FORMAT
	X	X	0	0	0	1	1	1	WRITE FORMAT TRACK
	X	X	0	0	1	0	0	0	RESET
	X	X	0	1	0	0	0	1	READ RAM
	X	X	0	1	0	0	1	0	WRITE RAM
	X	X	0	1	0	0	1	1	EXAM PAGE 0
	X	X	1	0	0	0	0	1	READ UNCORR
	X	X	1	1	0	0	0	0	SELF-TEST
	X	X	1	1	0	0	1	0	WRITE LONG
	X	X	1	1	0	1	1	1	LAMP TEST

WD	0	0	SECT 32	SECT 16	SECT 8	SECT 4	SECT 2	SECT 1	WD0
	Not used by IDC								WD1
									WD2

SS	WRITE PRTCT	HDR FAIL	DEF SEC	CYL OV	BSY	EX	CTLR IDLE	DATA ERROR	STATUS BYTE

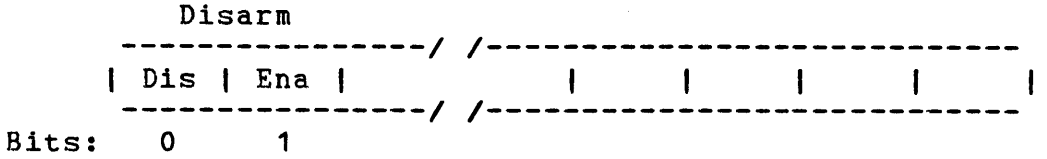
Controller Command Exceptions:

WD1 and WD2--Data unused due to redundancy and inadequate range. The controller will ignore these writes.

Controller OC bits 2 and 3--(unused by IDC) used for ECC and diagnostic control.

3.2.1 Controller Command Byte Definitions

The controller command byte is defined as follows:



- Disable - when this bit is set and the enable bit is reset, the interrupt is queued and not passed to the processor.

- Enable - when this bit is set and the disable bit is reset, all interrupts occurring for the device are passed to the processor.

- Disarm - when both the enable and disable bits are set, no interrupts are queued or generated by the device. All pending interrupts are cleared.

3.2.1.1 Read Command

This command (OC X'01') enables the controller to perform a data mode read from a disk. Before this command is issued, the heads must be positioned, the buffer start and end addresses written to the SELCH, the head address written to the drive, the sector header written to the controller, and the head address again written to the drive. The SELCH must be started immediately following the controller read command.

Data transfer from the controller is delayed at least 25 microseconds following a sector match; the SELCH must be started before the end of this delay. Normally, 256 bytes/sector are read in the data mode. If the last sector read is not a complete sector, the SELCH terminates (and interrupts) after the last data halfword is transferred. The controller continues reading until the data mode error correction code (ECC) is verified.

If an error is indicated, the controller will automatically retry the read on the next revolution. If an ECC error is not indicated, the data will be transferred and the transfer will continue as normal. However, if the error persists, internal (to the IDC) automatic error correction (auto-correction) occurs. The corrected data is then transferred as normal (no errors are reported to the host CPU). The remaining sectors are transferred as normal. At the end of the transfer, the controller idle is set.

3.2.1.2 Write Command

This command (OC X'02') enables the controller to perform a data mode write to the disk. Before this command is issued, the heads must be positioned, the buffer start and end addresses written to the SELCH, the head address written to the drive, the sector header written to the controller, and the head address again written to the drive. The SELCH must be started immediately following the controller write command. Data transfer to the controller is delayed at least 25 microseconds following a sector match; the SELCH must be started before the end of this delay. Normally, 256 bytes/sector are written in the data mode.

If the last sector written is not a complete sector, the SELCH terminates (and interrupts) after the last data halfword is transferred. The controller continues writing and fills the remainder of the sector with the last data halfword, writes the data mode error correction code (ECC) word, and then sets the controller idle bit.

3.2.1.3 Read Check Command

This command (OC X'03') enables the controller to perform an offline read of a single sector (no data is passed to the SELCH). The heads must be positioned, the head address written to the drive, the sector header loaded into the controller, and the head address again written to the drive prior to the command. The SELCH must not be started. The controller cannot be used until the controller idle status bit sets when the read check operation is complete. The controller status bits have the same meaning as for the data mode read. A controller interrupt is generated when the controller idle bit sets.

3.2.1.4 Check Format Track Command

This command (OC X'04') enables the controller to perform a read format of the entire track provided the controller format switch is on. Before this command is issued, the heads must be positioned, the head and cylinder address written to the controller, and the buffer start and end address written to the SELCH. This command is used after the command write format track for media verification.

3.2.1.5 Read Format Command

This command (OC X'05') enables the controller to perform a format mode read from the disk, when the file 0 address switch is in the format (0) position. Before this command is issued, the heads must be positioned, the buffer start and end addresses written to the SELCH, the head address written to the drive, the sector header written to the controller, and the head address again written to the drive. The SELCH must be started immediately following the controller read format command.

Normally, 568 bytes/sector are read in the format mode. If the last sector read is not a complete sector, the SELCH terminates (and interrupts) after the last data byte is transferred. The controller continues reading until the format mode ECC word is verified; it then sets the controller idle bit.

3.2.1.6 Write Format Command

This command (OC X'06') enables the controller to perform a format mode write to the disk when the controller function switch is on. Before this command is issued, the heads must be positioned, the buffer start and end addresses written to the SELCH, the head address written to the drive, the sector header written to the drive, the sector header written to the controller, and the head address again written to the drive. The SELCH must be started immediately following the controller write format command. Normally, 566 bytes/sector are written in the format mode. If the last sector written is not a complete sector, the SELCH terminates (and interrupts) after the last halfword is transferred; the controller continues writing and fills the remainder of the sector with the last data halfword, writes the format mode ECC word, and then sets the controller idle bit. See Section 2.1 for a discussion of the format mode.

3.2.1.7 Write Format Track Command

This command (OC X'07') enables the controller to perform a format mode write to the disk when the file 0 address switch is in the format position. Before this command is issued, the heads must be positioned, and the head address written to the drive. The command can now be issued, followed by a single write halfword to the drive. The all zero's gap and sync of sector zero are skipped. The halfword is written continuously on the entire track. This command is used for media certification.

3.2.1.8 Reset Command

This command (OC X'08') performs the same function as system clear and should not be used in normal programming sequences. The reset command disarms interrupts for all drives, deselects all drives, resets the seek complete flip-flop, mode flip-flop, head select register, data input register, and resets the write protect, header fail, defective sector, and examine status bits. The busy and controller idle status bits are set and the cylinder overflow status bit is not affected. In addition, any data transfer in progress is terminated and writing is inhibited. The reset command does not affect a seek in progress. Further commands should not be initiated until the controller idle status bit is set.

3.2.1.9 Read Random Access Memory (RAM) Command

This command (OC X'11') enables the controller to perform only data transfers from the controller to the SELCH. The command does not require that a disk file be connected or online. The buffering in the IDC is arranged as three sectors. More than three sectors can be read, but after three sectors, the same data is repeated until the SELCH word count is satisfied. The command is used for a reliability test of the internal buffers.

3.2.1.10 Write Random Access Memory (RAM) Command

This command (OC X'12') enables the controller to perform only data transfers from the SELCH to the controller. The command is used in conjunction with read RAM command. As with the read RAM command, more than three sectors can be transferred, but only the last three sectors will be in RAM and the previous sectors will be overwritten.

3.2.1.11 Examine Page 0 Command

This command (OC X'13') enables the controller to perform a read out of internal constant and variable storage. The command requires that an address be written to the controller in the form of a sector number. The command is then issued. The command is executed without idle turning off, and no interrupt occurs. To get the data the command has read, an RD instruction should be directed to the controller. Any subsequent RDs to the controller return a byte of zero. Typically, this command is only used during diagnostics.

3.2.1.12 Read Uncorrected Data Command

This command (OC X'21') is the same as the read command, with the only difference being the handling of soft ECC errors. Data is transferred as normal until an ECC error is encountered. The sector with the ECC error is the last sector transferred into memory. Then, the idle bit and data error bit will be set. There is no way to identify whether the ECC error is correctable or uncorrectable. If no ECC errors are encountered, the command will terminate normally with only the idle bit set.

3.2.1.13 Self-test Command

This command (OC X'30') invokes the controller self-test function. When the command is issued, the idle bit is reset and the controller self-test begins. If the self-test has completed without errors, the idle bit is set and an interrupt is generated, if enabled. If the self-test has completed with errors, the idle bit is set, the data error bit is set, and an interrupt is generated, if enabled.

3.2.1.14 Write Long Command

This command (OC X'32') enables the controller to write any specified ECC code to a specified sector. The command is typically used under the control of a diagnostic program. The parameters are identical to the write command, except that only a single sector can be transferred. A data buffer is prepared in memory and transferred to the controller. The controller forces the first four bytes of data in the desired sector to be zeros followed by the 256 bytes of data from memory. Because the extra four bytes are used as an ECC code, the controller will not append a hardware ECC. Thus, the host has control over the ECC written. The ECC code can be correct or can indicate a correctable error or even an uncorrectable error.

3.2.1.15 Lamp Test Command

This command (OC X'37') turns on for five seconds the diagnostic indicator (DIAG) located on the front edge of the board. During execution of the command, the idle bit is reset. At the end of five seconds, the idle bit is set and an interrupt is generated, if enabled.

3.2.2 Controller Status Byte Definitions

When system power is first applied, the controller does not select any device. Before sensing the controller status bits for the first time following a power failure, a command should be issued to an existing drive, causing it to be selected; for example, a disarm command (X'C0'). The controller status byte is defined as follows:

	Wrt Prt	Hdr Flr	Def Sec	Cyl Ovf	Bsy	Exa	Ctl Idl	Dta Err
Bits:	0	1	2	3	4	5	6	7

- Write Protect (Wrt Prt) - sets when a data mode write is attempted on a sector that has the write protect bit set in its header, or after an attempt to write to the disk if the drive is in write protect mode. Write protect is also set if the file 0 address format switch is not in the format position when a read format or write format operation is attempted. Write protect sets the examine status bit, terminating the SELCH before any data is transferred and the controller idle status bit is set when the end of the sector is reached.

- Header Failure (Hdr Flr) - sets in the data read, data write, or read check modes if the sector header from the processor does not agree with that read from the disk. The header is checked before transfer of any data to or from each sector. The header fail status bit is also set if the controller cannot match the sector number from the processor with the sector number from the disk when the sector counter has determined a match should exist after two revolutions of the disk. The header fail status bit sets the examine bit causing the SELCH to terminate and the controller idle status bit is set when the end of the sector is reached.

- Defective Sector (Def Sec) - sets in the data read, data write, or read check operations if the header field of the sector read by the IDC is defective.

- Cylinder Overflow (Cyl Ovf) - is set when a data transfer is attempted across a cylinder boundary. Cylinder overflow immediately sets the examine and controller idle status bits causing the SELCH to terminate when the cylinder boundary is reached. The cylinder overflow status bit is reset by writing the desired head address and issuing a set head number drive command to the selected drive. The cylinder overflow status bit is reset while the controller idle status bit is being set. The cylinder overflow status bit can be reset only by a set head number drive command to the selected disk drive. See Section 3.4.

- Busy (Bsy) - is used by the SELCH to control data transfers and is reset by a controller reset command. See the appropriate SELCH or channel manager programming manual.

- Examine (Exa) - is immediately set when any of the write protect, header fail, defective sector, or cylinder overflow controller status bits are set. When the examine status bit is set, it causes the SELCH to terminate. The examine status bit is set when any of the write protect, header fail, defective sector, or cylinder overflow status bits are set. This causes the SELCH to terminate any transfer in progress.

- Controller Idle (Ctl Idl) - is set when the controller is free to begin another operation. The states of the disk drive status bits are valid only when the controller idle status is set. A controller interrupt is generated when the controller idle bit is set at the completion of a controller operation. Also, the controller idle bit is reset when a command is directed to a disk drive, and the drive control sequence (not necessarily the operation) is complete. As a result, no interrupt is generated. The controller idle status bit is set by a controller reset command after a delay of approximately one millisecond.

- Data Error (Dta Err) - Causes the SELCH to terminate and is set if any of the three following conditions are encountered:

  1. ECC Error

  Read - automatically retries the read. If an error persists, auto-correction occurs, corrected data is transferred as normal, and no errors are reported to the CPU. At the end of the transfer, the controller idle bit is set.

  Read Uncorrected - reads the specified sectors into memory until an ECC error is encountered. The transfer ends after the sector with the ECC error is transferred into memory.

  Read Format - reads the desired sector into memory and reports any ECC errors. No correction is attempted.

  Read Check - reads the desired sector and reports an ECC error status by setting the data error status bit and the controller idle status bit. If no error was encountered, only the controller idle status bit is set. An interrupt is generated if enabled.

  ECC errors or uncorrectable ECC errors are reported to the CPU by setting the data error status bit.

  2. Data Overflow

  If the SELCH does not initiate data transfers at the required rate, a data overflow condition occurs. The data error status bit is set to indicate that data was loaded from the disk before transfer of the previous data to the SELCH, or that the same data was transferred twice to the disk before the next data was received from the SELCH. When data overflow occurs, the SELCH is terminated, aborting the operation. The attempted operation should be repeated after setting up the SELCH and the controller, to recover from the data overflow condition.

  3. Drive Status

  If the write protect bit is set in the status byte of the selected disk drive before a write operation or becomes set during the transfer, the data error status bit is set. In this case, the data error status bit can be reset by a controller command. If the selected disk's drive unsafe, drive ready, seek incomplete, or offline status bits are set before or during any operation, the data error status bit is set. In this case, the data error status bit cannot be reset by a command to the controller. See Section 3.5.

3.3 DRIVE WRITE DATA INSTRUCTIONS

Two write data instructions or a write halfword instruction is used to transfer cylinder address information to the drive. A write data or write halfword instruction is used to transfer head address information to the drive. This is to be followed by a set cylinder number command or a set head number command.

	0	0	0	0	0	0	CYL 512	CYL 256
WRITE DATA	CYL 128	CYL 64	CYL 32	CYL 16	CYL 8	CYL 4	CYL 2	CYL 1
	0	0	0	HEAD 16	HEAD 8	HEAD 4	HEAD 2	HEAD 1
Bits:	0	1	2	3	4	5	6	7

3.4 DRIVE COMMAND BYTE

The drive command bytes have the following meanings:

	Disarm							
	Dis	En	Set Head#	Set Cyl#	0	0	Seek	Re-store
	Rel	Clr Flt	1	1	Srv Off +	Srv Off -	Dta Stb E	Dta Stb L
Bits:	0	1	2	3	4	5	6	7

If a command is directed to a nonexistent drive, the hardware responds as if the drive existed; i.e., false SYNC does not result. A drive interrupt results, if enabled, with status X'09'; the controller will be idle.

- Disable (Dis) - disables passing all interrupts that are generated by the drive to the processor and queues them. The enable command bit must be reset.

1	0	X	X	0	0	X	X

X="DON'T-CARE"

- Enable (En) - enables passing all interrupts generated by the drive to the processor. The disable command bit must be reset.

0	1	X	X	0	0	X	X

X="DON'T-CARE"

- Disarm - no interrupts are queued or generated by the drive. All queued interrupts are cleared. The disable and enable command bits must both be set.

1	1	X	X	0	0	X	X

X="DON'T-CARE"

- Set Head Number (Set Head #) - causes a set head control tag to be generated. The desired head address must be written to the drive before the set head number command is issued.

X	X	1	0	0	0	0	0

X="DON'T-CARE"

- Set Cylinder Number (Set Cyl #) - causes a set cylinder control tag to be generated. The desired cylinder address must be written to the drive before the set cylinder number command is issued. If an invalid cylinder address is written to the drive, the seek incomplete status bit is set. If a seek command is issued, no seek takes place.

X	X	0	1	0	0	0	0

X="DON'T-CARE"

- Seek - positions the heads to the desired cylinder. The user must write the cylinder address to the drive and issue a set cylinder number command before issuing a seek command. The alternate channel busy, drive unsafe, drive not ready, seek incomplete, and offline drive status bits must be reset before issuing a seek command. The drive not ready status bit is set during the seek, and resets when the heads are in position. If the seek operation cannot be completed, the seek incomplete status bit is set, and the drive not ready status bit remains set. A restore command must be issued to recover from the seek incomplete condition. When attempting consecutive seek operations to more than one drive, the user must wait for the controller idle status bit to set before issuing the next seek command. No controller interrupt is generated in this case. The controller idle bit sets approximately six microseconds following the seek command to any drive. A drive interrupt is generated when the seek operation is complete.

X	X	0	0	0	0	1	0

X="DON'T-CARE"

- Restore - causes the heads to move to cylinder 000. The restore command is required to reset the seek incomplete status bit. The drive not ready status bit need not be reset before issuing the restore command. The drive not ready bit is set at the start of the restore operation and remains set until its completion. Maximum restoration time is 1.75 seconds. A drive interrupt is generated when the restore operation is completed.

X	X	0	0	0	0	0	1

X="DON'T-CARE"

When the set head number and set cylinder number command bits (bits 2 and 3) are both set, the drive command bits have the following definitions.

3.4.1 Release Command

In dual port operation, this command releases the drive allowing alternate channel access independently of the dead-man timer feature. Drive release occurs within six microseconds. The program must wait for controller idle status before using the controller or addressing any drive. The program must also issue a sense status command to the drive just released to ensure that the drive was properly released and to reset the release mechanism. Status returned should be X'09'.

The release command can be used to release the drive to the alternate channel, regardless of the state of the dead-man timer. When the drive is released and the other channel has a request pending, the alternate channel busy status bit is reset for the other channel, causing a drive interrupt on the other channel.

If the dead-man timer is disabled and the drive has been selected by one channel, only a release command, initialization, or a power failure/restore sequence can release the drive and make alternate channel access possible. If one controller reserves the drive and does not release it, the other controller cannot access the drive. If the channel switch on the drive's I/O board is not in its central position, the drive remains reserved to the selected channel. Standard Perkin-Elmer support requires the dead-man timer to be enabled.

The requirement for the sense status operation after the release command will be satisfied under microcode control when interrupt driven (drive interrupts enabled).

1	X	1	1	X	X	X	X

X="DON'T-CARE"

3.4.2 Clear Fault Command

This command resets the drive unsafe status bit and turns the fault lamp off, providing the fault no longer exists. If a head select fault exists, a valid head number must be written to the drive and a set head number command issued before the clear fault command is issued. The program must wait for controller idle status to be returned before using the controller or addressing any drive.

X	1	1	1	X	X	X	X

X="DON'T-CARE"

3.4.3 Servo Offset Plus Command

This command causes the heads to be offset from the normal on-cylinder position towards the spindle. This command must not be issued in conjunction with the servo offset minus or clear fault commands or while writing to the disk.

X	0	1	1	1	0	X	X

X="DON'T-CARE"

3.4.4 Servo Offset Minus Command

This command causes the heads to be offset from the normal on-cylinder position away from the spindle. This command must not be issued in conjunction with the servo offset plus or clear fault commands or while writing to the disk.

X	0	1	1	0	X	X	X

X="DON'T-CARE"

3.4.5 Data Strobe Early Command

This command causes data to be read from the cylinder at an earlier time than the normal optimum time. The data strobe early command must not be issued in conjunction with the data strobe late or clear fault commands.

X	0	1	1	X	X	1	0

X="DON'T-CARE"

3.4.6 Data Strobe Late Command

This command causes data to be read from the cylinder at a later time than the normal optimum time. The data strobe late command must not be issued in conjunction with the data strobe early or clear fault commands.

The data strobe and servo offset commands are intended to be an aid in recovering marginal data. The head position and data strobe timing revert to nominal when the respective command bits are reset or the drive is released. Maximum time for the servo to move from the offset minus to offset plus position, or vice versa, is seven milliseconds. A drive interrupt is generated when a servo offset is complete.

X	0	1	1	X	X	0	1

X="DON'T-CARE"

Writing data to the disk in servo offset mode is possible, but care should be taken not to do so. Writing to the disk in strobe offset mode is meaningless; the attempted strobe offset has no effect while writing to the disk.

Table 3-2 shows the recommended sequence for the recovery of marginal data when the controller data error status bit is set following an attempted normal read operation. The read attempts should be performed in steps 1 to 9 as shown.

TABLE 3-2 RECOMMENDED SEQUENCE FOR MARGINAL DATA RECOVERY

DATA STROBE \ HEAD POSITION	OFFSET MINUS	NOMINAL ON-CYLINDER	OFFSET PLUS
EARLY STROBE	8	2	9
NOMINAL STROBE	6	1	7
LATE STROBE	4	3	5

This ensures that optimum use is made of the servo offset feature. For steps 2 and 3, the proper output command is all that is required before attempting the reread. At the end of the retry sequence (to return to step 1), issue an offset nominal/strobe nominal command (X'30') and immediately reseek the current cylinder. If desired, the entire sequence may then be repeated. In addition, it is necessary to issue an OC X'30' before a transition is to be made from track offset plus to track offset minus or vice versa (i.e., steps 4 to 5, 5 to 6, 6 to 7, 7 to 8, and 8 to 9 above). Under no circumstances should a set head command be issued after a track offset (plus or minus) command is issued or before it is reset. Failure to follow this rule could create a fault condition in the disk drive.

3.5 DISK WRITE/READ DATA DEFINITIONS

The disk write/read data are defined in the following sections.

3.5.1 Disk Write Data Definition Command

The controller must be idle before a write data or write halfword instruction to the drive. If the drive is offline, an interrupt with status X'09' results from the operation, if enabled. Two write data instructions or a write halfword instruction are used to load the cylinder address prior to a seek command.

Two write data instructions or a write halfword instruction are used to load the head address prior to a set head command. The head address must be right-justified in the written halfword. If a write operation to the disk is attempted, an invalid head address causes the drive unsafe status bit to be set following a set head number command.

3.5.2 Disk Read Data Definition Command

This command is used to determine the location of a failing sector during media verification. If an error is found, after a format track read, the IDC returns the failing sector plus one. If no error was found, zero is returned. Subsequent reads will return a value of 'FE'. The normal response of the IDC is to return the value 'FE' in all but the above instances.

3.6 DISK DRIVE STATUS BYTE DEFINITIONS

When the controller idle status bit is set, the disk drive status byte has the following meanings:

Bits:	0	1	2	3	4	5	6	7
	Wrt Prt	0	Alt Chn Bsy	Drv Uns	Drv Not Rdy	Exa	Sek Inc	Off

- Write Protect (Wrt Prt) is set when the protect switch on the disk drive is on. Write protect should be tested before attempting a write or write format operation.

- Alternate Channel Busy (Alt Chn Bsy) - is set in dual port operation only if the disk drive is already reserved and/or selected by the opposite channel. Alternate channel busy is returned to the channel attempting to select the drive within 400 nanoseconds following the selection attempt. When the alternate channel busy status bit is set, the controller can perform no operation other than sense status to the drive.

  Either channel may select the drive following initialization or a power fail/restore sequence by issuing an I/O instruction (preferably a Disarm command) to the drive. If both channels issue I/O instructions simultaneously, the channel with higher priority selects the drive and reserves it for the controller on that channel. Once the drive is reserved for one controller, the alternate channel busy status bit is set for the controller on the second channel. When the drive is released, the alternate channel busy status bit resets for the controller on the second channel, causing a drive interrupt.

- Drive Unsafe (Drv Uns) - is set when the drive is in an unsafe condition or cannot be selected. The drive unsafe status bit is set if an invalid head address is used while writing to the drive or a fault occurs.

  The drive unsafe status bit can be reset by a clear fault command, operation of the fault clear switch on the drive operator panel, operation of the master fault clear switch on the fault card, initialization, or removal of drive power, provided the fault no longer exists. In the case of a head select fault, a valid head address must be written to the drive, followed by a set head number command, before the clear fault command is issued.

- Drive Not Ready (Drv Not Rdy) - is set when the drive is not ready to start a seek, read, or write, and during the time the heads are being positioned as the result of a seek, restore, servo offset plus, or servo offset minus command. When the drive not ready status bit resets, a seek, read, or write operation may be performed. When a seek is attempted to the current cylinder address, or if a head offset is attempted to the current offset, drive not ready is set, and an interrupt is generated when the seek or offset is complete. For details of the offset sequence, see Table 3-1.

- Examine (Exa) - is set whenever the write protect or drive unsafe status bits are set.

- Seek Incomplete (Sek Inc) - is set when the drive is unable to complete a servo offset, a seek to a valid cylinder address, or a restore operation in a set time. The seek incomplete status bit is also set if an invalid cylinder address is written to the drive. In the case of a seek or restore, this status bit can be reset only by a restore command. The drive ready status bit is set during the time seek incomplete is set. Both reset when the offset or restore operation is complete.

- Offline (Off) - is set when the drive unsafe status bit is set for the currently selected drive, or when the currently selected drive is offline. The drive ready status and offline statuses are returned (X'09') when a sense status is directed to a nonexisting drive. In this case, an interrupt is generated, if enabled, with status X'09'. See Section 4.3 for more information.

If a sense status command is directed to a nonexistent drive, the returned status byte is X'09'. A drive interrupt results from the nonexistent drive, if enabled.

If a sense status command is directed to a drive that has been released, the returned status is X'09', indicating proper operation of the drive release command. Subsequent sense status operations will either select the drive or return a status indicating alternate channel busy.

CHAPTER 4
INTERRUPTS

4.1 SELECTOR CHANNEL (SELCH) INTERRUPTS

When data transmission between the SELCH and the disk controller is terminated, the processor is interrupted by the SELCH (SELCH interrupts are always enabled) for these reasons:

- The SELCH starting (incrementing) address matches the final address, denoting normal termination.
- The SELCH starting address increments from all ones to all zeros. This is considered an abnormal termination because an address match did not occur.
- Any of the examine, seek incomplete, or offline status bits for the selected disk drive are set, denoting an abnormal termination.
- Any of the write protect, header fail, defective sector, cylinder overflow, or data error controller status bits are set during a SELCH data transfer. In this case, the controller terminates the SELCH; this is an abnormal termination.

4.2 CONTROLLER INTERRUPTS

The controller interrupts the processor, if enabled, when the controller idle status bit sets at the completion of any controller operation. No interrupt is generated when controller idle resets following a command to a drive (e.g., seek).

4.3 DISK DRIVE INTERRUPTS

Interrupts to the controller from all drives are disabled when the controller idle status bit is reset and all the drive interrupts are queued. When the controller is idle, the interrupts are passed to the processor. A disk drive interrupt is generated, if enabled, under the following conditions:

- The offline status bit for the currently selected drive is set, or the bit is already set when an attempt is made to select the drive. An interrupt is not generated when the offline status bit sets for an unselected drive.

- The drive unsafe status bit is set when an attempt is made to select an unselected drive. In this case, the drive cannot be selected.

- A seek, restore, or servo offset in progress either completes or times-out.

- A seek end interrupt from the drive occurs. If a port requests the drive when the other port has it selected, a seek end interrupt occurs at both ports when the port that originally has the drive releases it.

- A release command is given to a selected port.

When a disk drive interrupt is acknowledged, the drive is automatically selected as part of the interrupt acknowledge sequence in the hardware:

1. The interrupting drive device address is returned to the processor.

2. The status byte for the selected drive is returned to the processor.

4.4 INTERRUPT PRIORITY

The interrupt priority for the SELCH, controller, and drives is as follows:

PRIORITY	DEVICE	PREFERRED ADDRESS
HIGHEST	SELCH	X'F0
	CONTROLLER	X'FB
TO	DRIVE 0	X'FC
	DRIVE 1	X'FD
	DRIVE 2	X'FE
LOWEST	DRIVE 3	X'FF

CHAPTER 5
STAND-ALONE DISK INPUT/OUTPUT (I/O)

5.1 DISK OPERATIONS

To initiate disk operations, certain mandatory instruction sequences must be followed if controller and/or drive status is unknown. The following sections provide a guide to performing stand-alone disk input/output (I/O).

5.2 SENSE STATUS SEEK OPERATION

The required sequence is:

1. Write the cylinder address halfword to the drive.
2. Issue a set cylinder number command to the drive, and wait for controller idle, (controller status = X'02').
3. Issue a seek command to the drive and wait for controller idle, (controller status = X'02').
4. Wait for drive ready (status bit = 0).

The following points should be noted:

- If the alternate channel busy status bit for the desired drive is set, the drive is selected by the alternate channel. (This applies to dual port operation only.) In this case, all other status bits are blocked by the drive. No operation other than sense status may be performed until alternate channel busy resets.
- If the drive offline status bit is set, the drive is unavailable for any operation.
- If the seek incomplete status bit is set, the drive ready status bit is forced set. A restore command (mandatory) causes both bits to reset when the restore operation is complete.
- If drive ready is set, and the seek incomplete status bit is reset, then a seek or restore is in progress if previously commanded.

5.3 SENSE STATUS READ/WRITE OPERATIONS

The required sequence to perform either operation is:

1. Stop the selector channel (SELCH), and write the buffer start and end addresses to the SELCH.

2. Write the head address halfword to the drive.

3. Issue a set head number command to the drive, and wait for controller idle (controller status = X'02').

4. Write the sector header to the controller; then write the head address to the drive. Issue a set head number command to the drive, and wait for controller idle.

5. Issue the controller read/write command.

6. Issue the read/write command to the SELCH.

7. Wait for SELCH busy; then stop the SELCH.

8. Wait for controller idle. Check controller status for normal completion.

9. The SELCH final address may be read to verify that the transfer was completed.

The following points should be noted:

- If any of the controller write protect, header fail, defective sector, cylinder overflow, or data error status bits are set, the controller becomes idle, and the SELCH is terminated.

- If the data error status bit is set, the data transfer was in error, or the drive status is not acceptable.

- As a result of sensing drive status following a data error status from the controller, and if a write operation was attempted and the write protect status bit is set, the program should not attempt recovery for the operation. For all operations, the program should not attempt recovery if the drive unsafe or offline status bits remain set, following a clear fault command to the drive.

5.4 INTERRUPT READ/WRITE OPERATIONS

The required sequence to perform either operation is:

1. Disable processor interrupts, and set up low memory for processing interrupts from the SELCH, controller, and disk drive.

2. Stop the SELCH, and write the buffer start and end addresses to the SELCH.

3. Write the head address halfword to the drive.

4. Issue a set head number command to the drive, and wait for controller idle = 1 (controller status = X'02').

5. Write the sector header to the controller; then write the head address to the drive. Issue a set head number command to the drive, and wait for controller idle = 1.

6. Issue the controller read/write command, enabling controller interrupts.

7. Issue the read/write command to the SELCH.

8. Enable processor I/O interrupts (the processor may be halted, if desired).

9. When the SELCH interrupts, issue a stop command; then check the status and final address for normal termination.

10. When the controller interrupts, check the status for normal termination.

Status errors are the same as for sense status read/write operation.

5.5 MULTIDISK OPERATION

Simultaneous seek and overlapping seek/data transfer operations are permitted in multidisk systems. Sequences previously detailed are applicable to individual drive operations. Special attention should be given to the following:

- Prior to initiating simultaneous seek operations, ensure that the controller idle status bit is set and all other controller status bits are reset. The alternate channel busy drive status bit must be reset for any addressed drive, in dual port operation.

- The normal sequence of interrupts in a single disk system (for seek followed by data transfer) is: (1) drive interrupt, (2) SELCH interrupt, and (3) controller interrupt. In a multidisk environment, interrupts can occur in the sequence: (1) SELCH interrupt, (2) drive interrupt, and (3) controller interrupt, since simultaneous seek operations and overlapped seek/data transfer operations are allowed. The status interrupting device is returned to the interrupt handler by a high speed microcoded sequence.

- If the cylinder overflow status bit is set when the controller interrupts, this indicates that the data transfer is incomplete, and the program should begin reading/writing the next cylinder.

  The following points should be noted:

  1. Issue a stop command to the SELCH; then read the address of the last halfword transferred from the SELCH address register. Due to the timing of the SELCH/memory cycle with respect to the cylinder overflow error during a write operation, this address is not correct; therefore, subtract two from the address. This yields the new starting address.

  2. If the new starting address is less than the ending address, issue a stop command, seek the new cylinder desired, and write the new starting address to the SELCH.

  3. Write the new cylinder, head and sector address information to the disk controller and drive, issue the desired command to the controller, and issue a SELCH GO command.

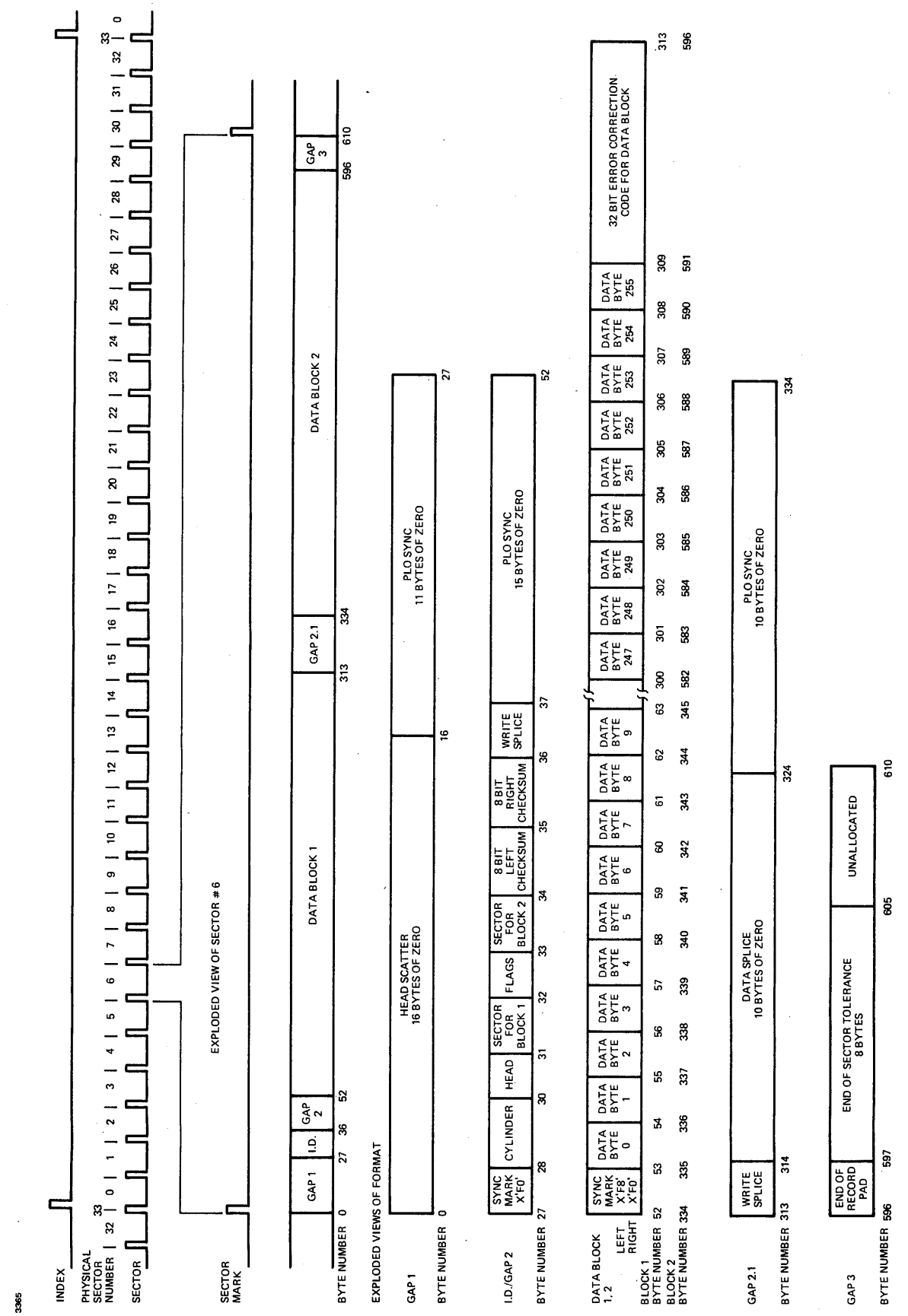
- The controller reset command clears queued interrupts and should not be used while multidisk operations are in progress.

- If the SELCH busy status bit is set, controller and drive status are not available to the processor. A sense status to the controller or the drive, in this case, returns a status byte of X'04' (False Sync).

- The head address must be written to the selected drive immediately before initiating any data transfer operation (including read check).

- If one drive is seeking and a second drive is transferring data, the seek complete interrupt from the first drive is queued until the data transfer is complete for the second drive.

APPENDIX A
IDC SECTOR AND TRACK FORMAT



APPENDIX B
MEDIUM CAPACITY CARTRIDGE DISK DRIVE (MCCDD) INTELLIGENT DISK SYSTEMS (32, 64, AND 96MB) SPECIFICATIONS

3366-1

SPECIFICATIONS	VOLUME (1) REMOVABLE 16 MB UNFORMATTED 13.5 MB FORMATTED	VOLUME (2) PLUS VOLUME 1 FIXED 16 MB UNFORMATTED 13.5 MB FORMATTED	VOLUME (2) PLUS VOLUME 1 FIXED 48 MB UNFORMATTED 40.5 MB FORMATTED	VOLUME (2) PLUS VOLUME 1 FIXED 80 MB UNFORMATTED 67.5 MB FORMATTED
TRANSFER RATE (BYTES/SEC)	1,209 K			
START-UP TIME (SECONDS)	30 (MAX)			
STOP TIME (SECONDS)	45 (MAX)			
ACCESS TIME*: (MILLISECONDS) AVERAGE ROTATIONAL LATENCY	8.33			
MAXIMUM ROTATIONAL LATENCY	17.33			
AVERAGE HEAD POSITIONING	30			
MAXIMUM HEAD POSITIONING	55			
MINIMUM BETWEEN ADJACENT CYLINDERS	6			
FORMATTED CAPACITY: (DATA BYTES) SECTOR	256			
TRACK	16,384			
CYLINDER(S)	(1 TRACK) = 16,384	(1 TRACK) = 16,384	(3 TRACKS) = 49,152	(5 TRACKS) = 81,920
TOTAL**	13,484,032	13,484,032	40,452,096	67,420,160
FORMAT: (LOGICAL) SECTORS PER TRACK	64 NO SPARE			
TRACKS PER CYLINDER	1		3	5
SECTORS PER CYLINDER	64		192	320
CYLINDERS PER CARTRIDGE	823	821 + 2 MAINTENANCE		
TRACKS PER CARTRIDGE	823		2469	4115
SECTORS PER CARTRIDGE	52,672		158,016	263,360
PARITY	HALFWORD EVEN LONGITUDINAL			
WRITE PROTECT	HARDWARE - ENTIRE PACK SOFTWARE - BY SECTOR			

* INCLUDES HEAD-SETTLING TIME
** ASSUMES NO DEFECTIVE TRACKS

APPENDIX C
OPERATING AND DISK CARTRIDGE INSTALLATION PROCEDURES FOR THE MCCDD INTELLIGENT DISK SYSTEMS

C.1 OPERATING PROCEDURES

Figure C-1 shows the controls and indicators of the operating front panel of the MCCDD intelligent disk system.

C.1.1 Switches and Indicators

- OPERATOR CONTROL PANEL

  STOP/START Switch- is a two position rocker-type that is used to start and stop the disk drive. The removable cartridge should not be inserted unless the switch is in the STOP position, the TRANS indicator is off and the AC breaker is on. When the switch is in the START position, the disk drive comes up to normal operating speed in approximately 15 seconds. When the switch is in the STOP position, the disk stops in approximately 45 seconds. When the disk is stopped, (the TRANS indicator is off) the disk cartridge can be removed.

  Transition Indicator (TRANS) - is a red indicator and is lit when the drive is in a transitional stage. The indicator is lit when the STOP/START switch is in the START position and extinguishes when one or two READY indicators are lit. The TRANS indicator goes on again when the STOP/START switch is set in the STOP position and extinguishes when the spindle has stopped.

  Read Indicators (READY) - are two green lights designated UPPER and LOWER. These indicators are lit when the spindle is up to speed, heads are in positions over track zero and no other conditions exist that would prevent a seek, read, or write command from being executed. These lights remain on during a seek, read, or write operation and go off when the STOP/START switch is in the STOP position.

  Write Protect - is activated for the removable cartridge (UPPER) or the fixed disk (LOWER) by independent write protect switches. When these switches are operated, the media write driver is disabled.

  Cartridge Missing Indicator (CART) - is a red indicator that goes on when the cartridge is not installed in the disk or if the disk is not set properly on the spindle.

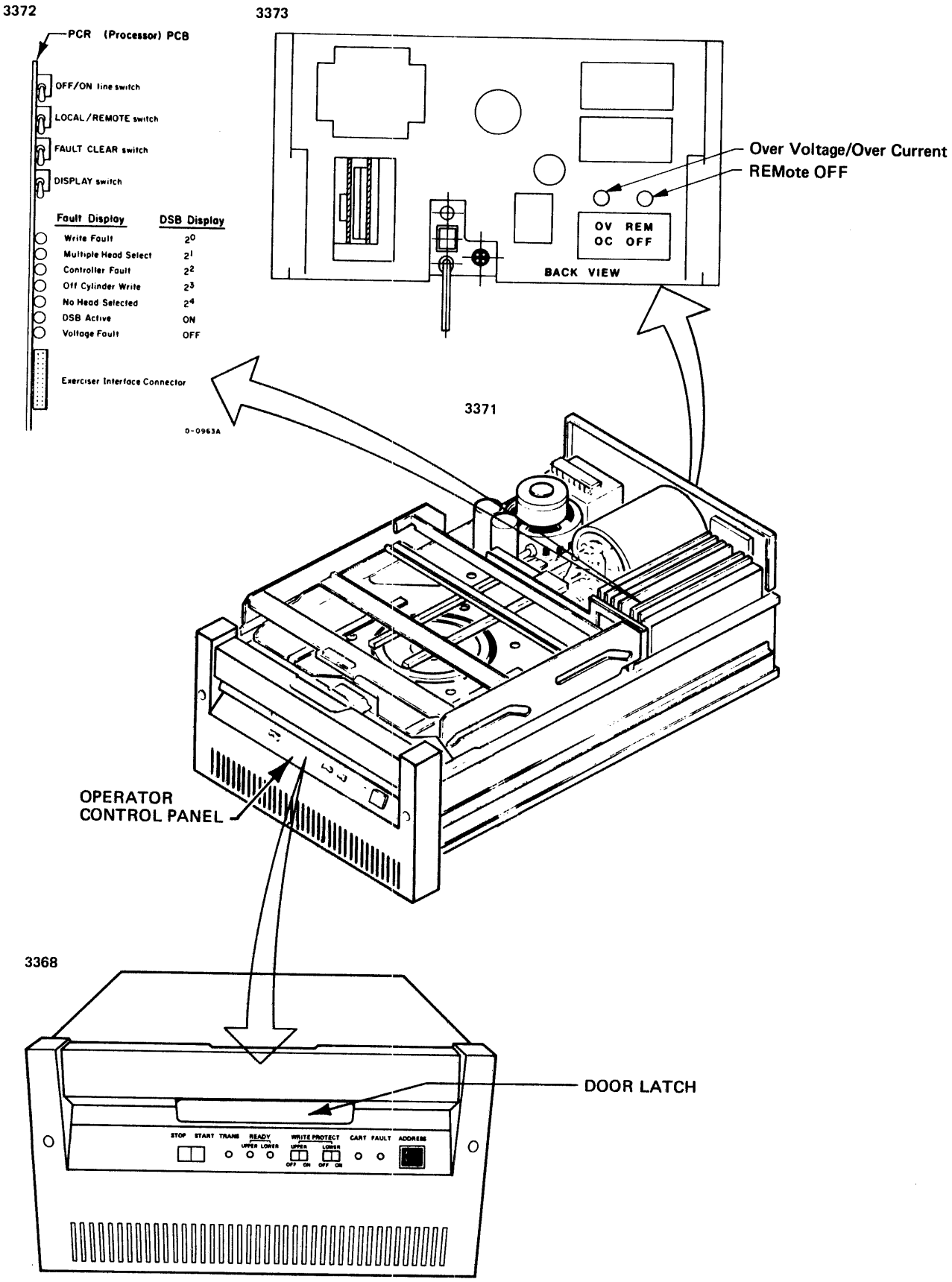


Figure C-1 Switches and Indicators

Fault Indicator (FAULT) - is a red indicator that goes on when a read or write fault condition exists in the disk drive. When a fault condition occurs which offsets one of the two positions (fixed or removable), the FAULT indicator goes on and the other positioner continues to operate normally.

NOTE

When the front panel indicators flash continuously, an internal fault (other than a read/write fault) is indicated.

Address ID Plug (ADDRESS) - is used to select one particular drive, where multiple drives are used, as determined by the address ID plug. The number of the drive is changed by changing the ID plug. A maximum of eight drives can be daisy-chained together.

Disk Cartridge Access Door Latch - when actuated opens the disk cartridge access door. This latch will not release the door until the spindle motor has stopped rotating (the interlock solenoid then releases the latch).

WARNING

IN THE EVENT OF AN AC POWER LOSS, THE INTERLOCK SOLENOID PREVENTS THE DOOR FROM BEING OPENED (TO PREVENT DAMAGE TO THE CARTRIDGE). THE SPINDLE WILL STOP ROTATING APPROXIMATELY 15 SECONDS AFTER THE POWER LOSS.

- REAR PANEL

AC POWER Circuit Breaker	Controls application of AC power.
POWER SUPPLY Circuit Breakers	Controls application of AC source voltage to the drive power internal supplies.
AC MOTOR THERMAL BREAKER	Breaker trip due to excessive heat; can be caused by excessive power cycling.

- MAINTENANCE SWITCHES AND INDICATORS

The maintenance switches and indicators are provided for maintenance personnel as an aide in fault isolation. They are located on the PRC PCB (microprocessor board) in the logic chassis and are accessible by removing the top cover. See Figure C-1.

The indicator LEDs display two types of information:

1. Faults which occur in the drives.
2. The DSB (detached status bits) code.

C.2 POWER APPLICATION

To apply power to the MCCDD disk system, perform the following steps:

1. Verify that all power and I/O cables are connected correctly.
2. Verify that the proper address ID plug is installed in the control panel.
3. Verify that the STOP/START switch is in the STOP position.
4. Actuate the AC circuit breaker and verify operation of the cooling fans.

C.2.1 Starting Procedure

The following five steps describe the procedure for starting the MCCDD drive system:

1. Install the disk cartridge in accordance with Section C.3.2
2. Set the STOP/START switch in the START position and verify that the AC motor is operating.

NOTE

If the AC motor is not operating, verify that the front door is completely closed, or the disk cartridge may not be properly installed on the spindle.

3. Verify that the TRANS indicator is off. The READY indicator will be lit when the disk is at operating speed and the heads are loaded.

4. Verify that the FAULT indicator remains off.

5. The disk is ready to receive commands from the controller.

C.2.2 Write Protect

The WRITE PROTECT switch is set for UPPER or LOWER in the ON position for the unit to be protected against a controller Write Command.

C.2.3 Power Down

The disk drive can be stopped whether or not the unit is in the process of performing its functions. If the STOP/START switch is in the STOP position when the heads are loaded, the carriage will perform a retract.

- With the STOP/START in the STOP position verify that the READY indicator is off and the TRANS indicator is on until the spindle stops rotating. When the spindle has stopped, the TRANS indicator goes off.

C.3 HANDLING AND INSTALLATION

The following sections outline handling and installation procedures.

C.3.1 Disk Pack Handling

To ensure maximum disk pack life and reliability, observe the following six precautions:

1. Store disk packs in machine-room atmosphere (16° C to 32° C, 60° F to 90° F, 10% to 80% relative humidity).

2. If the disk pack must be stored in an environment other than the computer environment, allow two hours for adjustment to the computer environment before using the disk pack.

3. Never store the disk packs in sunlight or in an unclean environment.

4. Store disk packs flat, not on edge. They may be stacked with similar packs when stored.

5. Be sure that the plastic cover is on the disk pack whenever it is not installed in a drive.

6. When marking packs, use pen or felt tip marker rather than a lead pencil to minimize loose residue. Mark labels before placing them on disk packs. Never place labels on oxide-coated surfaces of the disk packs.

CAUTION

ALWAYS AVOID ABUSIVE CONTACT BETWEEN THE DISK PACK AND THE SPINDLE. BECAUSE THE READ/WRITE HEADS ARE SOMETIMES MANUALLY POSITIONED DURING MAINTENANCE PROCEDURES, MAKE CERTAIN THAT THE HEADS ARE FULLY RETRACTFD BEFORE INSTALLING OR REMOVING THE DISK PACK.

C.3.2 Disk Cartridge Installation

To install the disk (see Figure C-2) perform the following steps:

1. Release the latch under the center lip of the front door and pull down the door.

NOTE

To release the latch on the front door, the AC circuit breaker must be ON, the START/STOP switch must be in the STOP position and the TRANS indicator must be extinguished.

2. To separate dust cover from the disk cartridge, push cover release button toward the center of the cartridge and disengage the cover from the cartridge.

3. Set cover aside, upside down, to prevent dust from collecting inside the cover.

WARNING

VERIFY THAT THE DISK CARTRIDGE HEADS ARE FULLY RETRACTED.

4. Verify that disk cartridge head opening is towards the heads. Slide disk cartridge into receiver quide and push the cartridge to the rear until it stops.

C.3.3 Disk Cartridge Removal

For disk cartridge removal see Figure C-2 and proceed with the following steps:

1. STOP/START set in the STOP position.
2. Pull down front door when the TRANS indicator goes off.
3. Pull cartridge from receiver with sufficient force to overcome the detent action.
4. Place the dust cover on the cartridge.

WARNING

THE HANDLE SWINGS OUT TO CARRY THE CARTRIDGE. DO NOT PUSH COVER RELEASE BUTTON WHILE CARRYING.

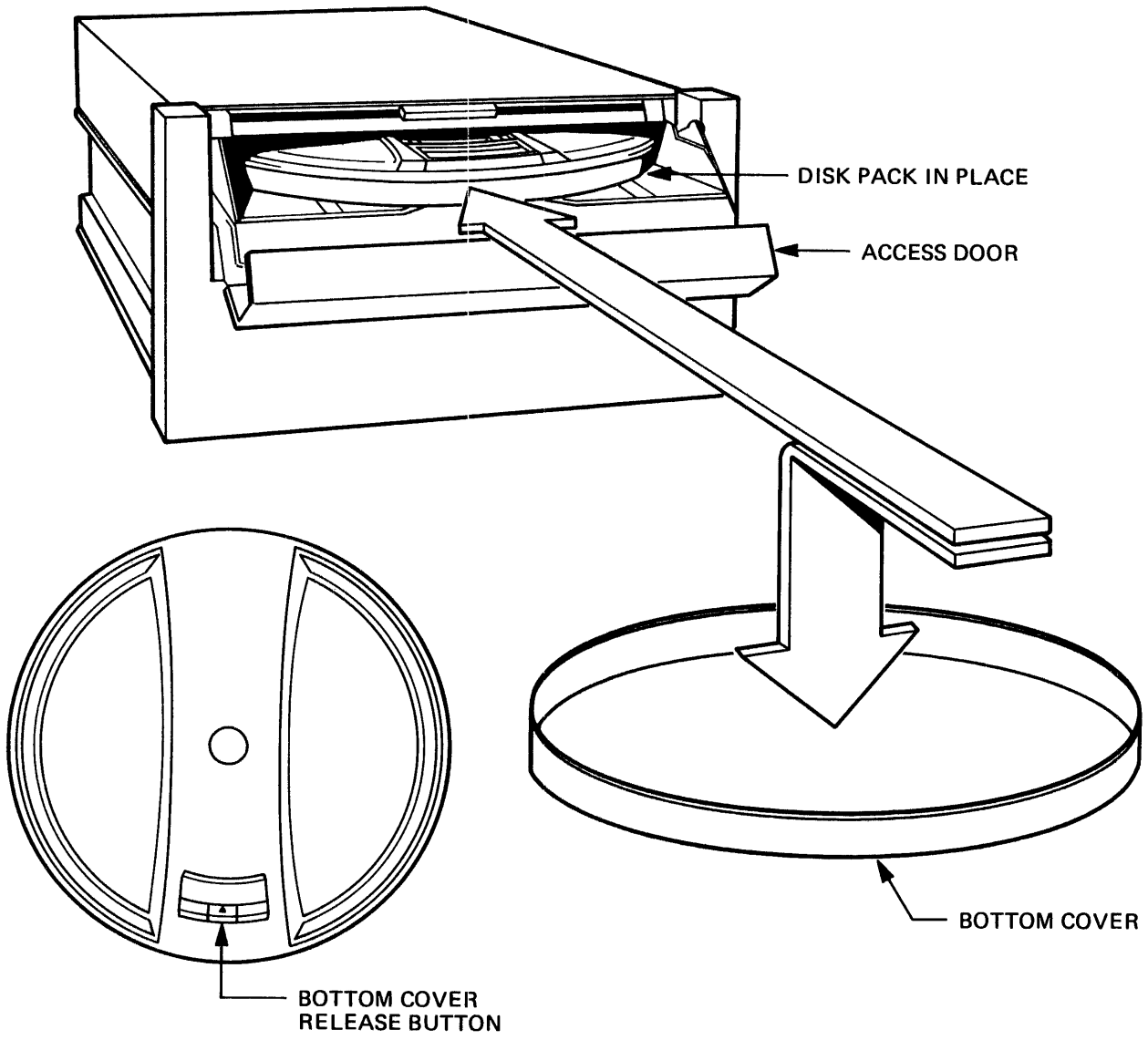


Figure C-2 Disk Cartridge Installation and Removal

APPENDIX D
MASS STORAGE MODULE (MSM) INTELLIGENT DISK SYSTEMS (80, 80-F, 80-F/HPT, 300MB) SPECIFICATIONS

SPECIFICATIONS	MSM80	MSM80-F AND MSM80-F/HPT	MSM300
TRANSFER RATE (BYTES/SEC)	1,209 k (nominal)	1,209 k	1,209 k
START-UP TIME (SECONDS)	15	15	15
STOP TIME (SECONDS)	30	15	50
ACCESS TIME*: (MILLISECONDS)			
Average Rotational Latency	8.33	8.33	8.33
Maximum Rotational Latency	17.2	17.3	17.2
Average Head Positioning	30	24	30
Maximum Head Positioning	55	24	55
Minimum Between Adjacent Cylinders	7	24	7
FORMATTED CAPACITY: (DATA BYTES)			
Sector	256	256	256
Track	16,384	16,384	16,384
Cylinder	81,920	81,920	81,920
Pack**	67,420,160	+1,572,864	256,196,608
FORMAT:			
Sectors Per Track	64	64	64
Tracks Per Cylinder	5	5	5
Sectors Per Cylinder	320	320	1,216
Cylinders Per Pack	823	+19.2	823
Tracks Per Pack	4,115	+96	15,637
Sectors Per Pack	263,360	+6,144	1,000,768
PARITY	Halfword Even Longitudinal		
WRITE PROTECT	Hardware - Entire Pack Software - By Sector		

* Includes Head-Settling Time
** Assumes no defective tracks

APPENDIX E
OPERATING AND DISK INSTALLATION PROCEDURES FOR THE MSM INTELLIGENT DISK SYSTEMS

E.1 OPERATING PROCEDURES

Figures E-1, E-2, and E-3 show the controls and indicators of the MSM intelligent disk systems.

E.1.1 Switches and Indicators for MSM80 and MSM300 Systems (See Figures E-1 and E-2)

- OPERATOR CONTROL PANEL

START Pushbutton Switch	Energizes (when depressed to turn the START indicator lamp on) spindle drive motor and positions the heads to cylinder 0, provided the following conditions are met: 1. Disk pack is in place and pack cover is closed. 2. Circuit breakers are on (AC and DC power is applied). Causes a power-off sequence (when depressed to turn off the START indicator lamp).
START Indicator	Turns on when the START pushbutton is depressed to put the drive online. Turns off when the START pushbutton is depressed to put the drive offline.
FAULT Pushbutton Switch	Clears the fault circuits and turns off the FAULT indicator lamp, provided the fault is no longer present (does not clear the maintenance fault register).

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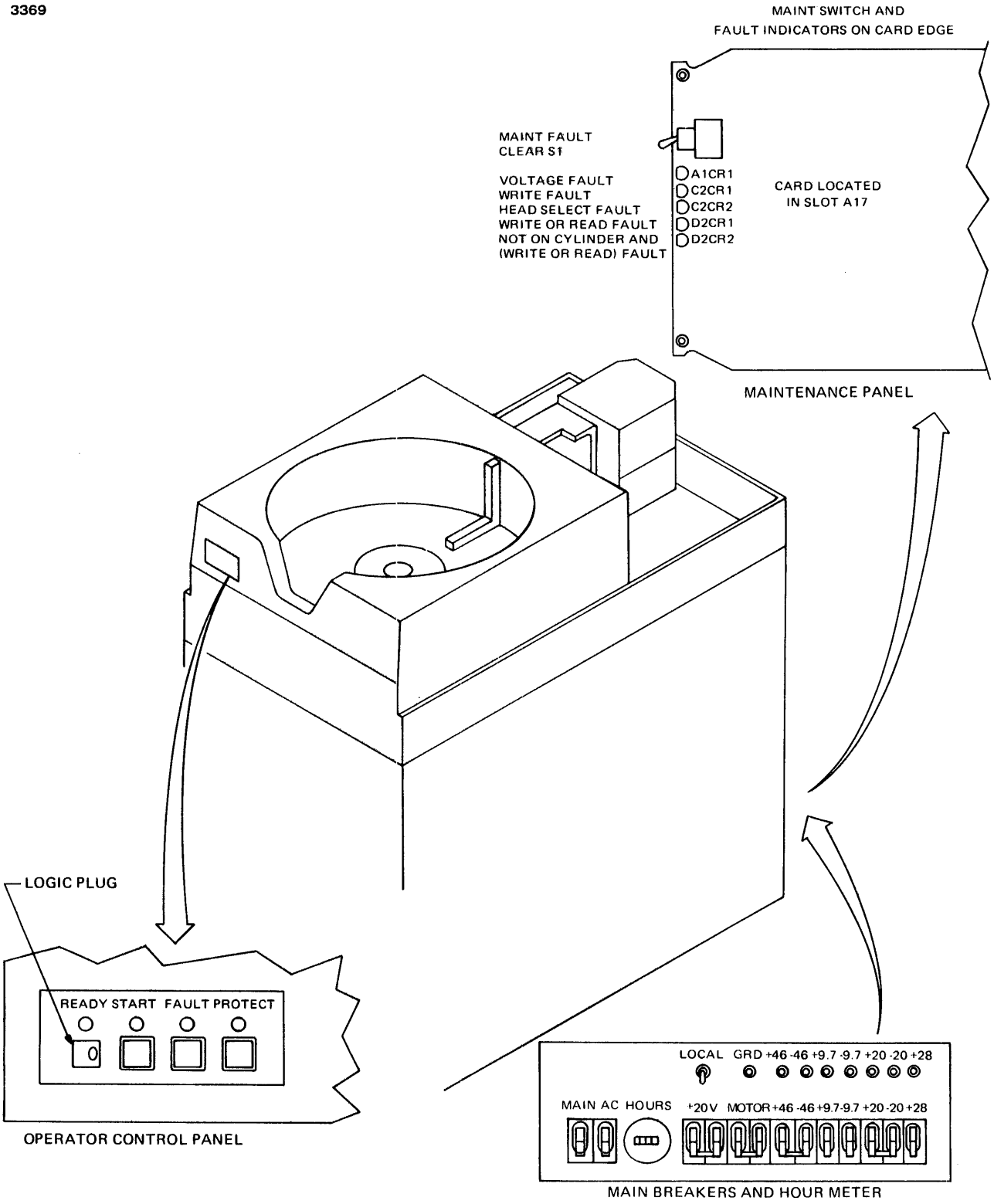


Figure E-2 Drive Assembly Switches and Indicators (MSM300)

FAULT Indicator	FAULT Indicator turns on in response to one or more of the following conditions: 1. Simultaneous selection of read and write 2. No write current when write gate is present (drive related problem) 3. No more than one head selected 4. Selection of read or write while off cylinder 5. Low DC voltage condition sensed for drive internal power supplies (drive related problem) 6. Loss of servo track clock signal for 350 ms with heads loaded (drive or pack related problem)
READY Indicator	Lights when the unit is up to speed, the heads are loaded, and no fault condition exists.
PROTECT Pushbutton Switch	Inhibits writing to the mounted disk pack when depressed to turn on the PROTECT indicator lamp. Allows writing to the disk when depressed to turn off the PROTECT indicator lamp.
PROTECT Indicator	Lights when writing to the mounted disk pack is inhibited.
LOGIC Plug	Completes circuits to permit selection of the drive through a binary code. Each drive on the controller has a unique logic assignment from 0-3.

CAUTION

UNIT SELECT LOGIC PLUG SHOULD NOT BE CHANGED OR REMOVED UNLESS UNIT IS SHUT OFF WITH HEADS UNLOADED.

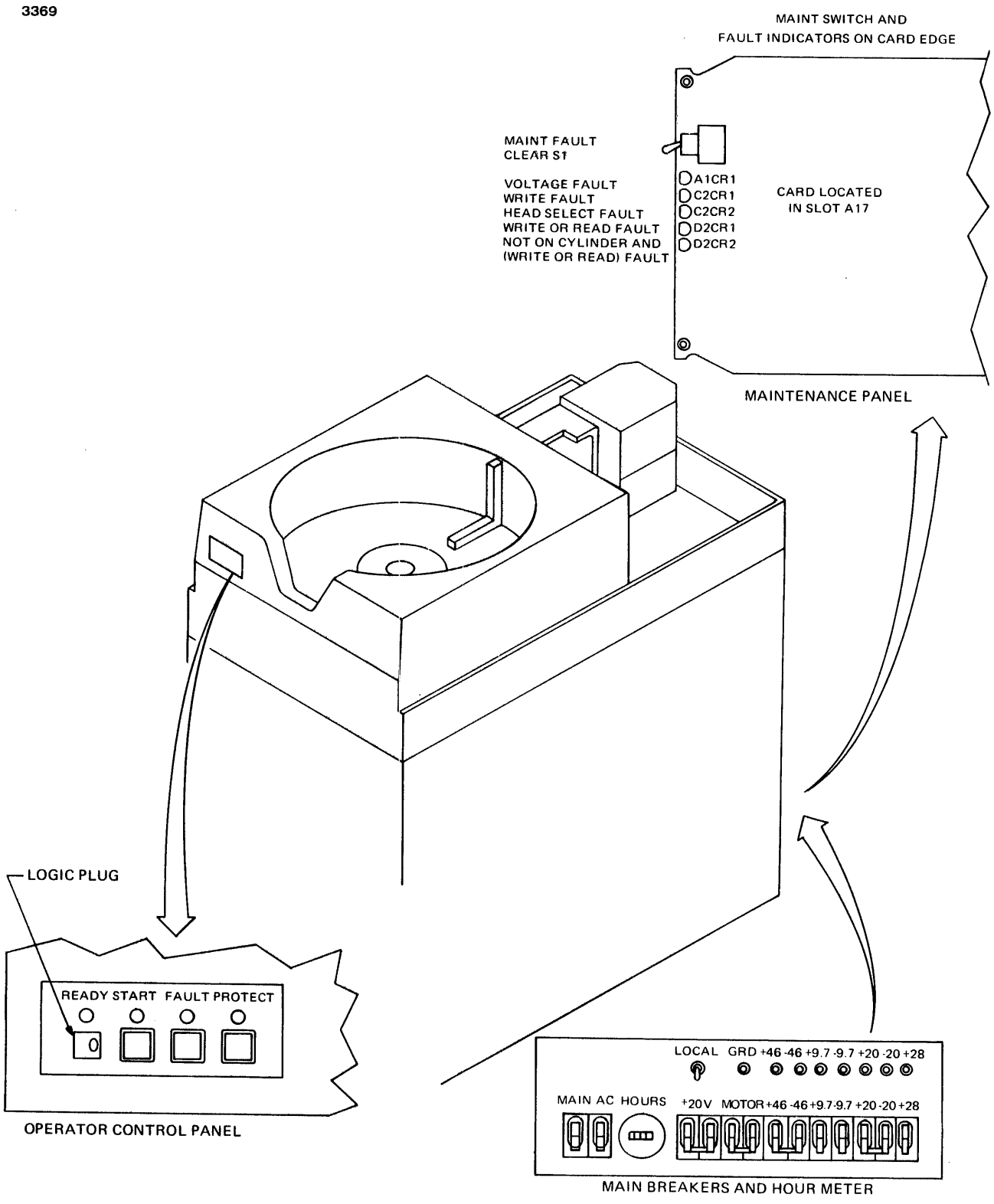


Figure E-2 Drive Assembly Switches and Indicators (MSM300)

- REAR PANEL

AC POWER (Removable Pack only) Circuit Breaker	Controls application of AC power.
POWER SUPPLY Circuit Breakers	Controls application of AC source voltage to the drive power internal supplies.
AC MOTOR THERMAL BREAKER	Breaker trip due to excessive heat; can be caused by excessive power cycling.
Elapsed Time Meter	Active when AC power is applied by circuit breakers. Records accumulated AC power-on time.

- MAINTENANCE PANEI

WRITE Indicator	Indicates that a Write was attempted and no AC write current and/or DC current was sensed.
HEAD SELECT Indicator	Indicates that more than one head is selected.
W.R. Indicator	Indicates simultaneous selection of Read and Write.
ON CYLINDER Indicator	Indicates selection of Read or Write while off cylinder.
VOLTAGE Indicator	Indicated that a low voltage condition existed for drive internal power supplies.

E.1.2 Switches and Indicators for MSM80-F Systems (See Figure E-3)

- OPERATOR CONTROL PANEL

READY Indicator	Indicates Unit Ready status, i.e., pack is up to speed, the heads are loaded, and no fault condition exists within the unit.
FAULT Indicator/Switch	Indicates any fault condition. The switch clears the fault flip-flop.
WRITE PROTECT Indicator/Switch	Indicates that the drive's write circuits are disabled.

- REAR PANEL

  CBI POWER ON/OFF Switch Controls application of AC power.

- MAINTENANCE Switches and Indicators

  The fault confitions listed in Table E-1 are stored within the microprocessor card. These faults are displayed, along with the number of occurrences, behind the front panel (see Figure E-3). The use of the fault status request button allows the operator to sequence through all of the existing faults.

  All past faults remain stored until the drive is powered down or cleared by the CLEAR switch on the display card. The FAULT CLEAR switch on the front panel clears faults 1 through 5, listed in Table E-1, if the fault no longer exists.

- CHANNEL SELECT and RESERVE Switches and Indicators (Located on Logic circuit board)

NRM/DI Switch	Switch disables Channel I or allows Channel I to be selected.
NRM/DII Switch	Switch disables Channel II or allows Channel II to be selected.
RTM/ABR Switch	In ABR position, once drive is selected it must be released in order for reserve to drop. In RTM position, once drive is deselected, reserve drops after 500 msec.
CH. I SEL Indicator	Indicates Channel I is selected.
CH. I RES Indicator	Indicates Channel I is reserved.
CH. II SEL Indicator	Indicates Channel II is selected.
CH. II RES Indicator	Indicates Channel II is reserved.

- Miscellaneous Switches and Indicators (Located on logic circuit board)

WRITE PROTECT Indicator/Switch	Inhibits writer.

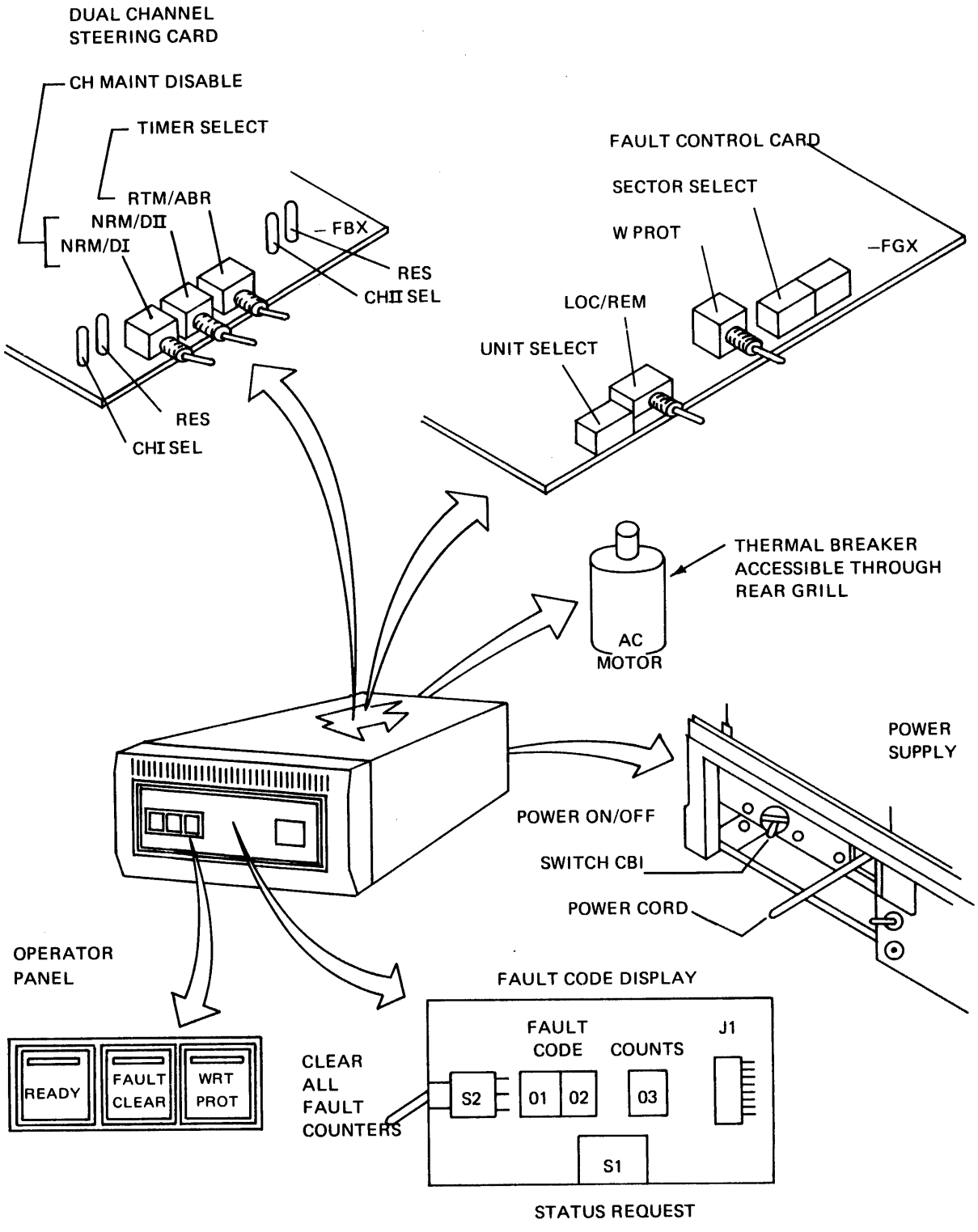


Figure E-3 Switches and Indicators (MSM80-F)

TABLE E-1 FAULT CONDITIONS

FAULT NO.	ERROR INDICATION	FUNCTION
1	Voltage fault	Indicates a below normal voltage has existed
2	Not on cylinder and read or write	Indicates write or read condition while off cylinder
3	Write fault	Indicates that a write fault has occurred
4	Head select fault	Indicates that a multiple head select has occurred
5	Read and write fault	Indicates a simultaneous write and read condition
6	Microprocessor fault	Failed self-test after power on
7	I/O test	Failed self-test after power on
8	Settle out problem	Detected three or more off-cylinder conditions at completion of a seek
9	Drift off cylinder	Lost on cylinder
10	Marginal motor start	Not up to speed
11	Brake failure	Monitors brake current
12	End of travel indicated during seek	Detected inner or outer guardbands
13	No lock in 250 ms	Did not complete seek within this time
14	First seek failure	Did not complete first seek
15	RTZ took too long	On cylinder not detected after time-out
16	Maximum address fault	Illegal seek
17	Failed to complete RTZ	On cylinder not detected after RTZ
18	Lost spindle RPM	Spindle speed below 3,000 RPM
19	No cylinder pulse detected	During first seek (status indication only)
20	No pick command	Status indication only
21	No start command detected	Status indication only
22	No seek command detected	Status indication only

E.2 POWER APPLICATION

Power will be applied to the MSM disk system as outlined in the following sections.

E.2.1 MSM80 and MSM300

To apply power to the MSM80 and MSM300 systems, perform the following steps:

1. Set AC POWER circuit breaker to the ON position.
2. Set POWER SUPPLY circuit breakers to ON.
3. Install a disk pack (see Section E.3.2).
4. Depress the START switch to turn the START indicator lamp on. The spindle motor then energizes. Head loading sequence begins when the spindle is up to speed. The sequence is complete when the heads are positioned to cylinder 0. The disk drive is now ready to receive a Read, Write, or Seek command, and the READY indicator lamp is on.

E.2.2 MSM80-F

To apply power to the MSM80-F system, perform the following steps:

1. Place LOC/RPM switch in desired position.
2. Place CBI breaker in ON position.
3. When disk is up to speed, check FAULT indicator.
4. Check to see if drive READY indicator is lit.

E.3 DISK PACK HANDLING AND INSTALLATION

Handle, install, and remove disk packs in the MSM disk system as outlined in the following sections.

E.3.1 Disk Pack Handling for the MSM80 and MSM300 Systems

To ensure maximum disk pack life and reliability, observe the following precautions:

1. Store disk packs in machine-room atmosphere (16° C to 32° C, 60° F to 90° F, 10% to 80% relative humidity).

2. If the disk pack must be stored in an environment other than the computer environment, allow two hours for adjustment to the computer environment before using the disk pack.

3. Never store the disk packs in sunlight or in an unclean environment.

4. Store disk packs flat, not on edge. They may be stacked with similar packs when stored.

5. Be sure that both top and bottom plastic covers are on the disk pack whenever it is not installed in a drive.

6. When marking packs, use pen or felt tip marker rather than a lead pencil to minimize loose residue. Mark labels before placing them on disk packs. Never place labels on oxide-coated surfaces of the disk packs.

CAUTION

ALWAYS AVOID ABUSIVE CONTACT BETWEEN THE DISK PACK AND THE SPINDLE. BECAUSE THE READ/WRITE HEADS ARE SOMETIMES MANUALLY POSITIONED DURING MAINTENANCE PROCEDURES, MAKE CERTAIN THAT THE HEADS ARE FULLY RETRACTED BEFORE INSTALLING OR REMOVING THE DISK PACK.

E.3.2 Disk Pack Installation for the MSM80 and MSM300 Systems

To install the disk pack, perform the following seven procedures:

1. Verify that READY and START indicators are off. Raise the pack access cover when disk pack rotation has stopped and the cover latch is disengaged. (The AC POWER circuit breaker must be set to the ON position.)

2. Lift the disk pack by the plastic canister handle.

3. Disengage the bottom dust cover from the disk pack by using the knob in the center of the cover. Set the cover aside in an uncontaminated area.

4. Place the disk pack onto the spindle. A spindle lock mechanism is actuated when the disk pack canister cover is on the spindle. The mechanism holds the spindle stationary while loading or unloading a disk pack.

5. Twist the canister handle clockwise to lock the disk pack in place. A click may be heard as the spindle lock mechanism engages.

6. Lift the canister clear of the disk pack, place the bottom dust cover on the canister, and set it aside in an uncontaminated area.

7. Close the front cover immediately to prevent entry of dust and contamination of disk surfaces.

E.3.3 Disk Pack Removal for the MSM80 and MSM300 Systems

To remove the disk pack, perform the following procedure:

1. At the operator control panel, depress the START switch to turn off the START indicator.

2. Ensure disk pack rotation has stopped: stopping time is approximately 18 seconds. Drives equipped with "Pack Interlock" prohibit removal of the pack before rotation has stopped, i.e., pack access cover will not open.

3. Raise the front cover.

4. Place the plastic canister over the mounted disk pack so that the post protruding from the center of the disk pack is received into the canister handle.

5. Twist the canister handle counterclockwise until the disk pack is free of the spindle.

6. Lift the canister and disk pack clear of the spindle.

7. Close the front cover.

8. Place the bottom dust cover in position on the disk pack and lock it; (screw into dust cover for MSM80; snap into dust cover for MSM300).

E.4 LOGICAL ADDRESSING

With the fixed head feature incorporated in the MSM80-F, the 96 physical fixed heads are addressed by the controller as logical cylinders. This addressing scheme allows maximum interface commonality with the moving head storage of the MSM80-F. The logical/physical addressing relationship for the drives is summarized in Table E-2. The remaining fixed heads are addressed in the highest fixed head cylinder.

TABLE E-2 LOGICAL/PHYSICAL ADDRESSING

MEDIA DATA	MSM80-F	MSM80	MSM300
Data surfaces/device	5	5	19
Movable heads/surface	2	1	1
Fixed heads/device	48/96	0	0
Movable cylinders/device	823	823	823
Fixed cylinders/device	10/20	0	0
Movable heads/logical cylinder	5	5	19
Fixed heads/logical cylinder	5*	0	0
Movable cylinder addresses	0-822	0-822	0-822
Fixed cylinder addresses	896-915	-	-

*1.6 Mb Fixed Head Option has 1 Addressable Head in Cylinder 915.

APPENDIX F
330MB FIXED MEDIA DISK DRIVE SPECIFICATIONS (MSM300F)

SPECIFICATIONS	330MB DISK DRIVE
Transfer Rate (Bytes Per Sec)	1,209 k
Start-up Time (Seconds)	30 sec
Stop Time (Seconds)	30 sec
Average Latency (Milliseconds)	8.33 ms
Maximum Latency	17.33 ms
Average Head Positioning Time	30 ms
Maximum Head Positioning Time	55 ms
One Cylinder Seek	10 ms
Bytes Per Sector	256
Bytes Per Track	16,384
Bytes Per Cylinder	262,144
Bytes Per Spindle	268,435,456
Sectors Per Track (Logical)	64
Sectors Per Cylinder	1,024
Sectors Per Spindle	1,048,576
Tracks Per Cylinder	16
Tracks Per Spindle	16,384
Cylinders Per Spindle	1,024

APPENDIX G
OPERATING PROCEDURES FOR THE 330MB DISK DRIVE (MSM300F)

G.1 OPERATING PROCEDURES

Figure G-1 shows the switches and indicators of the operating and maintenance panel of the 330Mb disk drive.

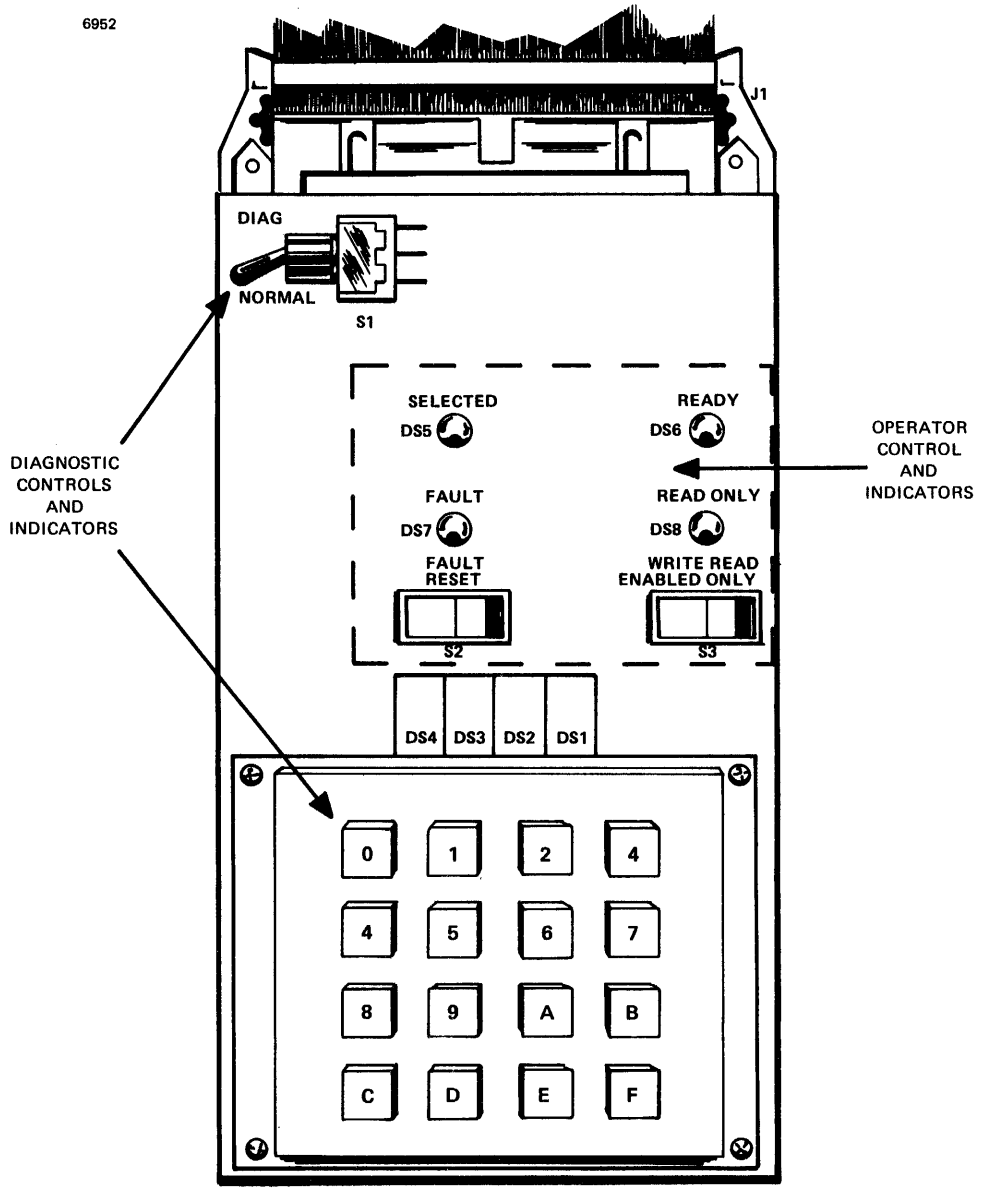


Figure G-1 Switches and Indicators (MSM300F)

G.1.1 Switches and Indicators for the 330Mb Disk Drive

The operation and diagnostic control panel consists of switches and indicators that are externally visible and accessible to the operator, and of the switches and indicators that are visible and accessible only after the front panel has been opened for diagnostic purposes. See Figure G-1. Operator switch and indicator functions are listed in Table G-1. Diagnostic control and indicator functions are listed in Table G-2.

TABLE G-1 OPERATOR SWITCHES AND INDICATORS

SWITCH OR INDICATOR	TYPE	FUNCTION
FAULT RESET Switch	Momentary pushbutton	Resets fault latch and extinguishes unsafe LED indicator if unsafe condition no longer exists.
READ ONLY Switch	Toggle	Disables drive from performing a write operation. NOTE Read operations are not affected by the position of this switch.
READ ONLY Indicator	Yellow LED	Indicates position of READ ONLY switch.
READY Indicator	Green LED	Indicates drive is online. Spindle is operating at full rotating speed, and heads are positioned over data area.
SELECTED Indicator	Green LED	Indicates drive is currently selected by control unit.
FAULT Indicator	Red LED	Indicates unsafe condition within drive. NOTE The error code display indicators display the error code that caused the unsafe condition.

TABLE G-2 DIAGNOSTIC CONTROLS AND INDICATORS

CONTROL OR INDICATOR	TYPE	FUNCTION
DIAG/NORMAL Switch	Toggle	Sets drive offline and into diagnostic mode.
Diagnostic Key Pad	Keys 0--F (hexadecimal)	Key configuration selects diagnostic test to be executed.
Error Code Display Indicators		Display error caused by drive malfunctions. NOTE When not in the diagnostic mode, depressing any key on the key pad resets the error display indicators.

G.2 OPERATING INSTRUCTIONS

During the initial power-up sequence, the type of drive (Table G-3) is displayed for a few seconds in the error code display indicators. During the power-up sequence, a number of automatic diagnostic routine sequences are performed before the drive becomes ready for system usage. A number of built-in self-tests are also performed during normal system use. See Table G-5. When a fault is detected by these self-tests, an appropriate error code is displayed in the error code display. Error codes are listed in Table G-4.

TABLE G-3 DISPLAY OF DRIVE TYPE

DISPLAY DATA	MODEL TYPE	APPLICABLE MODEL SPECIFICATIONS			
		CAPACITY (MB)	CYLINDER QUANTITY	HEAD QUANTITY	NOTES
C 3 3 0	330	330	1024	16	

TABLE G-4 ERROR CODES

ERROR CODE	DEFECT
EC 11	ROM Failure
EC 12	RAM Failure
EC 13	Nonexisting Module
EC 14	Difference Counter Fail
EC 15	Seek-In Failure
EC 16	Seek-Out Failure
EC 17	Offset-In Failure
EC 18	Offset-Out Failure
EC 21	Upspeed Failure
EC 22	Power Failure
EC 31	Drifted Into Guardband
EC 32	Rezero Timeout
EC 33	Seek Incomplete
EC 34	Maximum Cylinder Address Exceeded
EC 42	Read Error
EC 43	Address Mark Read Error
EC 45	Sync Error
EC 46	Index Error
EC 52	PLO Error
EC 53	Write With Write-Protect Active
EC 54	Write With Read Gate Active
EC 55	Write With Offset Active
EC 56	Write Without Fine Track
EC 58	Multiple Head Selected
EC 59	Read/Write Unsafe
EC 61	Bad Entry

TABLE G-5 POWER-UP ERROR CODE DESCRIPTION

ERROR CODE	DESCRIPTION
EC 11	ROM CHECK Reads each byte of data from ROM and adds to the next byte of data until the second last byte. The sum is then compared to the last byte of data. If the ROM is good, the sum should be equal to the last byte.
EC 12	RAM CHECK Writes a data pattern of 10101010 to RAM, performs a shift function, then reads the data pattern back. Result should be 01010101; if not, the RAM is bad. If good, then a pattern of all zeros is written to RAM.
EC 13	IDENTITY HDA A 4-bit binary code is read from the HDA to determine the module type.
EC 14	DIFFERENCE COUNTER CHECK A count equivalent to difference = 0 is loaded into the counter and the signal line difference = 0 is monitored for correct operation.
EC 15	SEEK FORWARD CHECK A cylinder difference count is sent to the servo board through the D/A converter. The analog signal is propagated through the remainder of the seek circuit to the last stage, which is the output drivers. At this point, the signal is sent back to the I/O board for examination. A comparator is used for determining whether the signal is good or bad.
EC 16	SEEK REVERSE CHECK Similar to seek forward check (EC 15) except the polarity is opposite.
EC 17	OFFSET FORWARD CHECK Similar to seek forward check (EC 15) except the signal goes through the offset circuit instead of the seek circuit.
EC 18	OFFSET REVERSE CHECK Similar to seek forward check (EC 15) except the polarity is opposite.

G.3 OPERATIONAL ERROR CHECKING

During normal system usage and/or diagnostic self-testing a number of built-in self-tests are performed. If any error conditions are detected by the microprocessor, a fault condition is indicated together with the appropriate error code display by the fault indicators. Table G-6 lists the applicable error codes and Table G-8 lists the tests. All error codes remain displayed until any key on the keyboard is depressed. The FAULT RESET momentary switch allows clearing of the fault condition, but does not clear the display.

TABLE G-6 OPERATIONAL ERROR CODE DESCRIPTIONS

ERROR CODE	DESCRIPTION
EC 21	UPSPEED DETECTION When the drive fails to come up to 3000 RPM in 15 seconds.
EC 22	POWER-FAILURE DETECTION When there is a loss of any voltage (dc).
EC 31	DRIFTED INTO GUARDBAND When the heads moved into the inner or outer guardbands other than during a rezero operation.
EC 32	REZERO TIMEOUT When it takes longer than 700 ms to do a rezero operation.
EC 33	SEEK TIMEOUT When it takes longer than 100 ms to do a seek operation.
EC 34	MAX CYLINDER EXCEEDED Received a cylinder number higher than the maximum legal cylinder number.
EC 42	READ ERROR A four-block bit pattern generated by the random number generator is written on all tracks. Then during a read operation, a bit-by-bit comparison of the recorded data against the pattern generated is made by the random number generator. If all four blocks contained no less than one error bit, a read error is displayed.
EC 43	ADDRESS MARK READ ERROR The address mark read error code is displayed when the address mark is not detected.

TABLE G-6 OPERATIONAL ERROR CODE DESCRIPTIONS (Continued)

ERROR CODE	DESCRIPTION
EC 45	SYNC ERROR The sync error code is displayed when the logic 1 bit that initiates the data block is not detected.
EC 46	INDEX ERROR The index error code is displayed when the index error is not detected.
EC 52	PLO ERROR When PLO error signal is low (active).
EC 53	WRITE WITH WRITE PROTECT ACTIVE Write while read-only switch activated.
EC 54	WRITE WITH READ GATE ACTIVE Write gate and read gate both active.
EC 55	WRITE WITH OFFSET ACTIVE Write gate while offset active.
EC 56	WRITE WITHOUT FINE TRACK Write gate with no fine track.
EC 58	MULTI-CHIP SELECTED More than one head select chip is active.
EC 59	READ/WRITE UNSAFE A failure in the head-arm integrated circuit.
EC 61	BAD ENTRY The bad entry code is displayed when the keyboard selection is in a non-functional code (e.g., too many keys activated or some other type of erroneous keyboard activation).

G.4 INTERNAL DIAGNOSTICS

The disk drive has the capability of operating internal diagnostics without an external tester and without disconnecting cables from the controller. Table G-8 lists and describes these tests.

Seek operations are performed over all cylinders. Read/write operations are only performed on the CE cylinders and cannot access customer data tracks. These tests can be run by the controls on the diagnostic keyboard located behind the front panel. Refer to Table G-2 for a description of the controls and indicators.

The DIAG/NORMAL switch sets the drive offline from the controller and into the diagnostic self-test mode of operation. The keyboard functions are listed in Table G-7. Function code descriptions are listed in Table G-8.

TABLE G-7 KEYBOARD FUNCTIONS

KEY	FUNCTION
A	SINGLE CYCLE REZERO Each time the button is depressed, a rezero operation is performed.
B	BREAK Depressing the button causes interruption of the test routine running.
C	CONTINUE Depressing the button allows starting a set default series of tests or allows starting a test after selecting the test with the function key.
D	DELETE Clears display of error codes or parameter entries.
E	EXAMINE Allows displaying/changing parameters from the parameter table.
F	FUNCTION Allows selection of test to run.

TABLE G-8 FUNCTION CODE DESCRIPTIONS AND TESTS

FUNCTION CODE	DESCRIPTION
None	SINGLE REZERO Each time the button (key A) is depressed, a rezero operation is performed.
F 11	RANDOM SEEK Seeking randomly across the data area.
F 12	SEQUENTIAL FORWARD AND REVERSE SEEKS Seeking sequentially with programmable steps (increments).
F 13	ALTERNATE Seeking back and forth between two given cylinders.
F 14	WRITE ONLY Performs the write operation only.
F 15	READ ONLY Performs the read operation only.
F 16	READ/WRITE Performs read after write.
F 17	COMBINATION A combination of read/write and seek.
F 18	ERROR LOGGING Displays up to 31 stored error codes.

The parameter table is displayed/changed by the use of the "E" examine key. All numbers displayed or entered into the table are decimal values. Examine function descriptions are listed in Table G-9.

TABLE G-9 EXAMINE FUNCTION DESCRIPTIONS

EXAMINE	DISPLAY/ALTER
E 01	Examine run condition flagword Default Value : 0000 Digit 0: 1= Stop on error Digit 1: 1= Suppress display of error codes Digit 2: 1= Display cylinder number Digit 3: 1= Display seek time
E 02	Examine lower cylinder limit (seek)
E 03	Examine upper cylinder limit (seek)
E 04	Examine lower cylinder limit (CE tracks)
E 05	Examine upper cylinder limit (CE tracks)
E 06	Examine cylinder increments (used for sequential seek test F 12)
E 07	Examine upper and lower head limit Digits 0-1 display lower head limit Digits 2-3 display upper head limit
E 08	Examine seek interval time (time displayed in ms)

APPENDIX H
OPERATING AND DISK INSTALLATION PROCEDURES FOR THE 50MB CARTRIDGE DISK DRIVE (CDD50) INTELLIGENT DISK SYSTEMS

H.1 INSTALLATION AND CHECKOUT

This section provides the information and procedures necessary to install the CDD50.

H.1.1 Unpacking

Inspection should be made for possible shipping damage. All claims for this type of damage should be filed promptly with the transporter involved. Retain the shipping container and packing material if a claim is to be filed for damage, or if the unit is to be shipped to a service center.

Be sure to avoid damaging the unit while it is being unpacked. Unpack the unit as follows:

1. Open the container and remove the CDD50 assemblies and cables.

WARNING

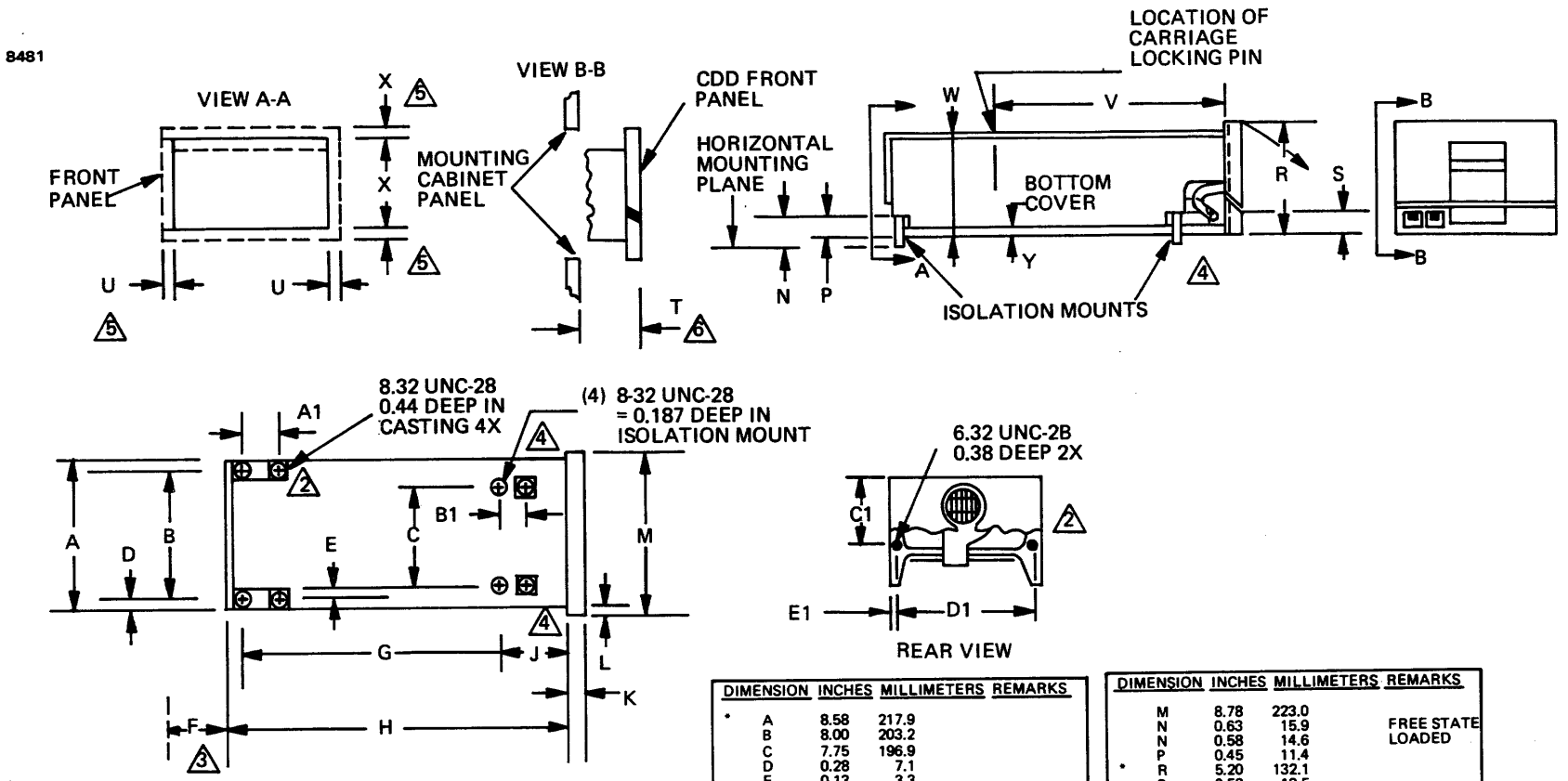
DO NOT RELEASE THE CARRIAGE LOCK UNTIL THE CDD50 IS INSTALLED IN ITS DESIGNATED LOCATION. DAMAGE CAN OCCUR AS A RESULT OF ACCIDENTAL LOADING OF THE HEADS. THE CARRIAGE IS TO BE LOCKED IN THE RETRACTED POSITION ANY TIME THE CDD50 IS TO BE MOVED. SEE SECTION H.4.

2. Do not connect the input power cable until all other installation steps have been completed and the CDD50 is ready for initial checkout.

3. Remove the isolation mounts from the accessory pack in the shipping container. The location of the isolation mounts for a horizontally mounted CDD50 is shown in Figure H-1. Figure H-2 shows the location of isolation mounts for the vertically mounted CDD50. Screw the four isolation mounts into the four 8-32 tapped holes in the base deck.

CAUTION

IN HANDLING THE CDD50, BE VERY CAREFUL NOT TO DAMAGE THE EXPOSED BASE PRINTED WIRE ASSEMBLY (PWA) IN THE BOTTOM OF THE CDD50.



DIMENSION	INCHES	MILLIMETERS	REMARKS
* A	8.58	217.9	
B	8.00	203.2	
C	7.75	196.9	
D	0.28	7.1	
E	0.13	3.3	
F	2.00	50.8	3
G	17.55	445.8	
* H	20.38	530.4	REF
J	2.94	74.7	REF
K	0.63	15.9	
L	0.10	2.5	

DIMENSION	INCHES	MILLIMETERS	REMARKS
M	8.78	223.0	
N	0.63	15.9	FREE STATE
N	0.58	14.6	LOADED
P	0.45	11.4	
* R	5.20	132.1	
S	0.53	13.5	
T	0.03	0.8	5 6
U	0.03	0.8	
V	12.55	318.8	
* W	5.04	128.0	MAXIMUM
X	0.13	3.2	
Y	0.06	1.5	

DIMENSION	INCHES	MILLIMETERS	REMARKS
A1	0.95	24.1	
B1	0.35	8.9	
C1	3.84	97.5	
D1	8.0	203.2	
E1	0.28	7.1	

NOTES:

1. ALL DIMENSIONS SHOWN ARE NOMINAL UNLESS *, THEN MAX.
2. PROVISIONS FOR SHIPPING TIE DOWN
3. AIR ENTRY AND CABLE CLEARANCE
4. CLEARANCE OF 0.75 INCHES (19.1mm) MUST BE PROVIDED AT AIR EXITS.
5. MAINTAIN CLEARANCE BETWEEN CDD AND SURROUNDING STRUCTURE FOR RELATIVE MOTION.
6. MAINTAIN CLEARANCE BETWEEN CDD FRONT PANEL AND FRONT SURFACE OF MOUNTING CABINET PANEL FOR RELATIVE MOTION.

Figure H-1 CDD50 Horizontal Mounting

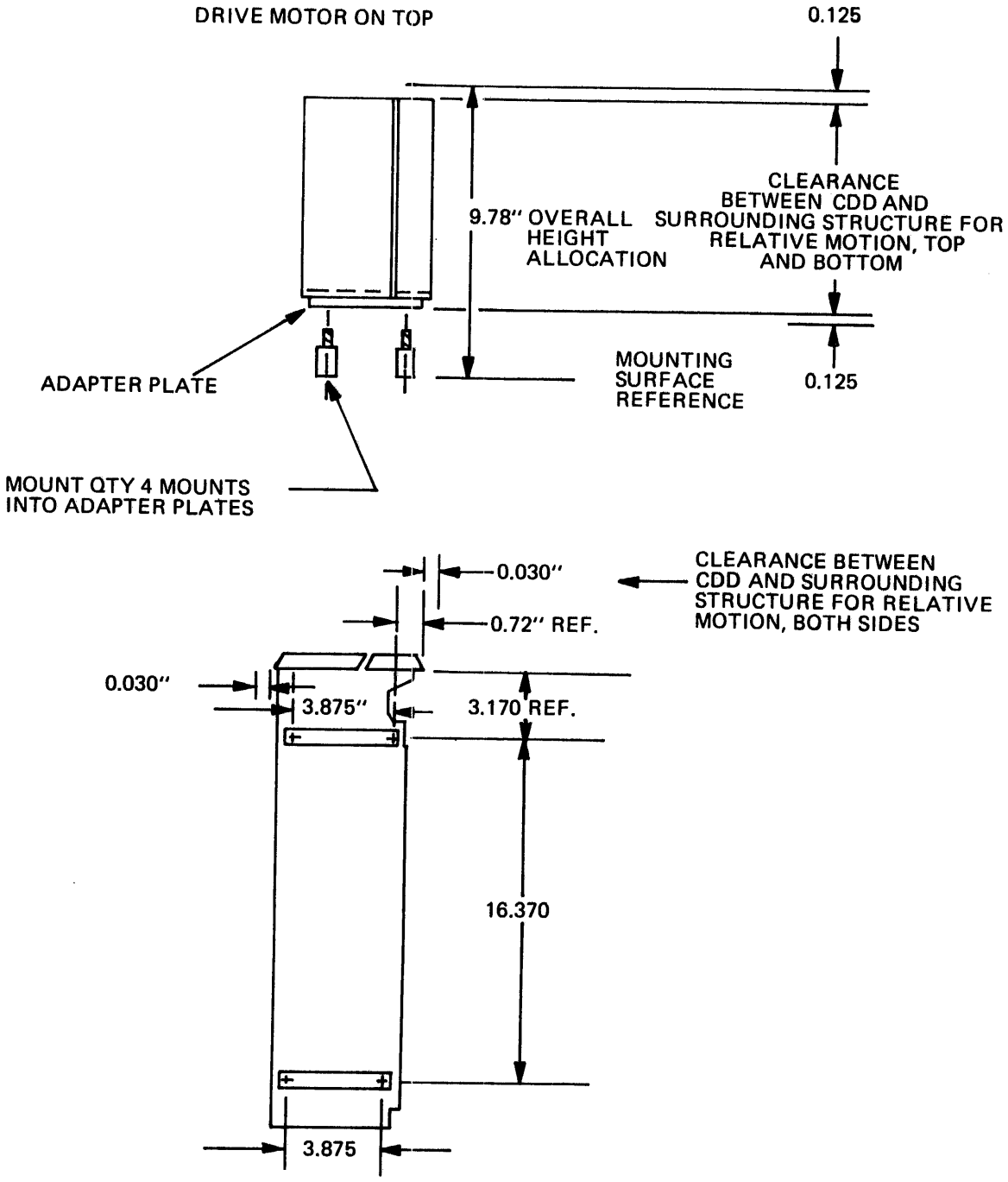
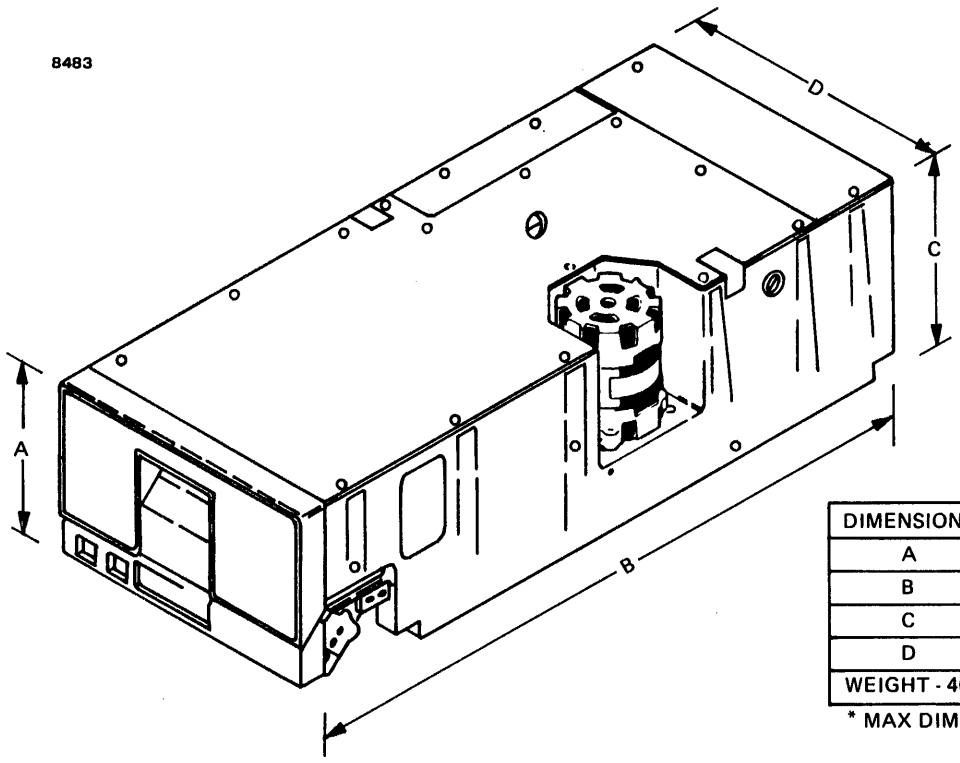


Figure H-2 CDD50 Vertical Mounting

H.1.2 Space Allocation

Figure H-3 shows the CDD50 overall dimensions for determining space allocation. Example configurations are shown in Figure H-4.



DIMENSION*	in	mm
A	5.20	132.1
B	20.88	530.4
C	5.04	128.0
D	8.58	217.9
WEIGHT - 40 LBS (18 kg)		

* MAX DIMENSIONS

Figure H-3 CDD50 Overall Dimensions

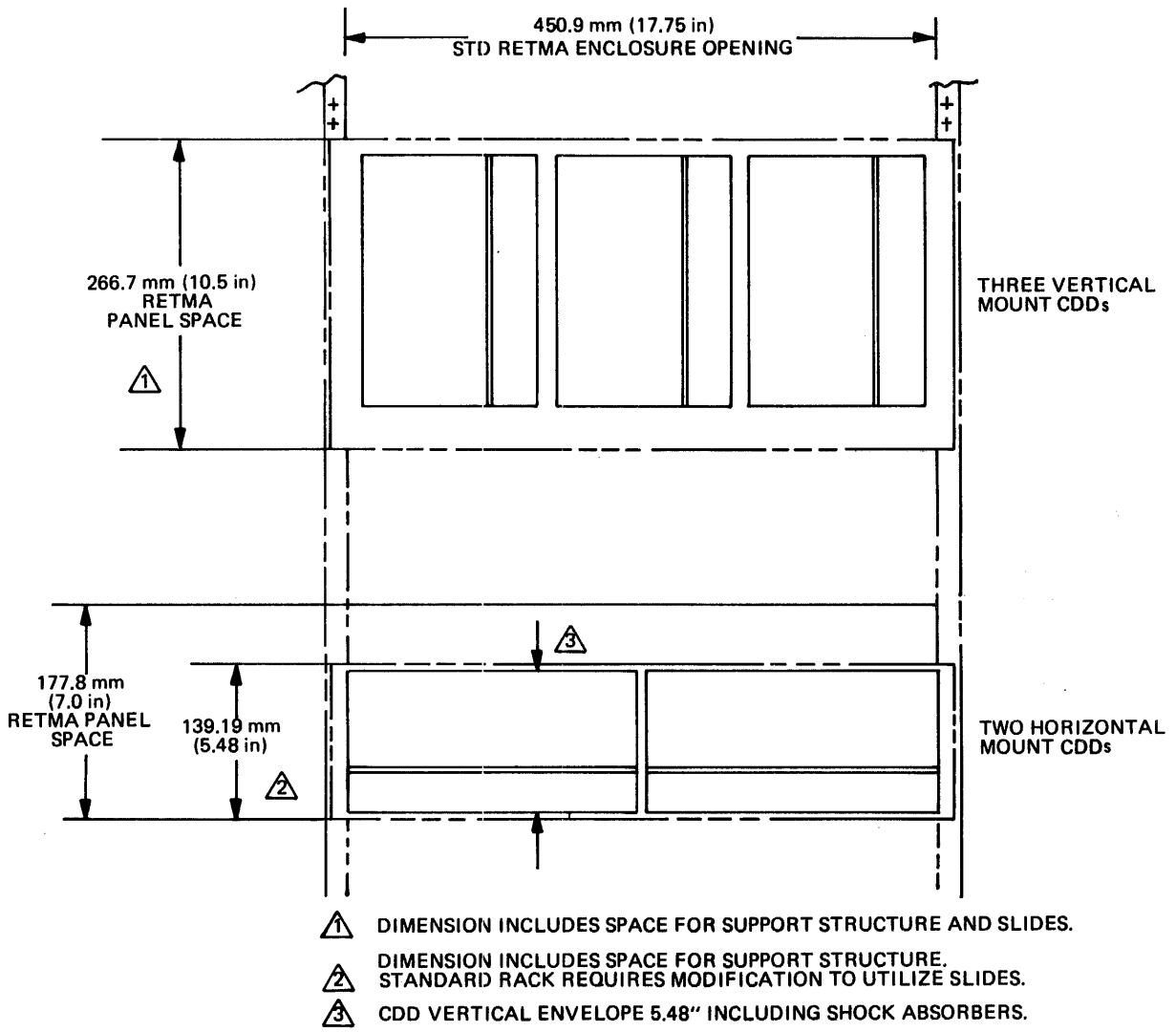


Figure H-4 CDD50 Example Configurations

H.2 OPERATING PRECAUTIONS

The following precautions and practices should be observed while operating the CDD50 to obtain the best performance and reliability of equipment.

1. Keep a cartridge in the unit at all times with the access door closed to prevent unnecessary entry of atmospheric contaminants.

2. To prevent damage and/or data loss, follow the disk cartridge installation procedure outlined in Section H.6.

3. The operator should not attempt to override any interlocks in the system.

WARNING

REMOVING THE SEAL OR TOP COVER ON SEALED AREA VOIDS WARRANTY.

4. If a pinging or scratching sound (caused by head-to-disk contact) is heard, stop the unit by using the stop and power down procedures in Sections H.2.3 and H.2.4.

5. If, while the drive is operating, the cartridge receiver door latch is inadvertently released (Figure H-6) causing the spindle to begin slowing down (READY indicator blinks), place the START/STOP switch in the STOP position and allow the spindle to come to a complete stop. Remove the cartridge and inspect the door mechanism for any damage. In the absence of damage, reinsert the cartridge and restart the drive in a normal manner.

H.2.1 Power Up for On-Line Operation

The following procedure is to be performed after the installation procedure has been completed, including initial checkout.

1. Install the disk cartridge as described in Section H.6. Ensure that the correct cartridge is selected (correct number of sectors, etc.).

2. Place the START/STOP switch to the START (in) position. The front panel door will lock, READY will blink, and the spindle will start if the door is fully closed with a cartridge installed. When the spindle reaches the proper speed, the heads will load, servo adjustments will be made, and READY will blink rapidly during cartridge protect data quality tests (see Section H.10). READY should then stop blinking and remain illuminated (indicating that the drive is ready for commands from the controller). Any seek, read or write activity requested over the interface will again cause the READY indicator to blink rapidly.

If the FAULT indicator starts blinking after a start sequence, the speed at which it is blinking indicates what type of fault has occurred. If FAULT blinks at a normal rate, the problem is probably drive-related and attempts should be made to clear the fault using the FIXED PROT switch (see Section H.9). READY should be active after the fault is cleared. If the FAULT indicator blinks rapidly after a start sequence, a cartridge protect data quality fault has occurred, indicating that the cartridge should be replaced after the fault is cleared (see Section H.10). READY will be active after the fault is cleared.

H.2.2 Write Protect Operation

1. Prepare the disk cartridge by sliding the write protect tab to the UP position in the slot (see Figure H-5).

2. Perform power-up for on-line operation procedure.

3. Place the drive in write protect mode by pushing in the FIXED PROT switch. The FIXED PROT indicator will light.

H.2.3 Stop Operation

1. Depress the START/STOP switch to the STOP (out) position. The READY indicator will blink until the spindle has stopped rotating and then extinguish when the spindle has stopped. Note that a protect data quality test will occur during rapid blinking.

2. Remove the disk cartridge (if desired) in accordance with the normal disk cartridge removal procedure (see Section H.7). The CDD50 front door panel does not unlock until the READY indicator stops blinking and extinguishes.

H.2.4 Power Down

Position the AC power source to OFF (an ON/OFF switch is not on the CDD50). This is done only after the CDD50 has been stopped in accordance with the normal stop operation procedures.

NOTE

Operation of the AC power ON/OFF switch is normally performed by maintenance personnel.

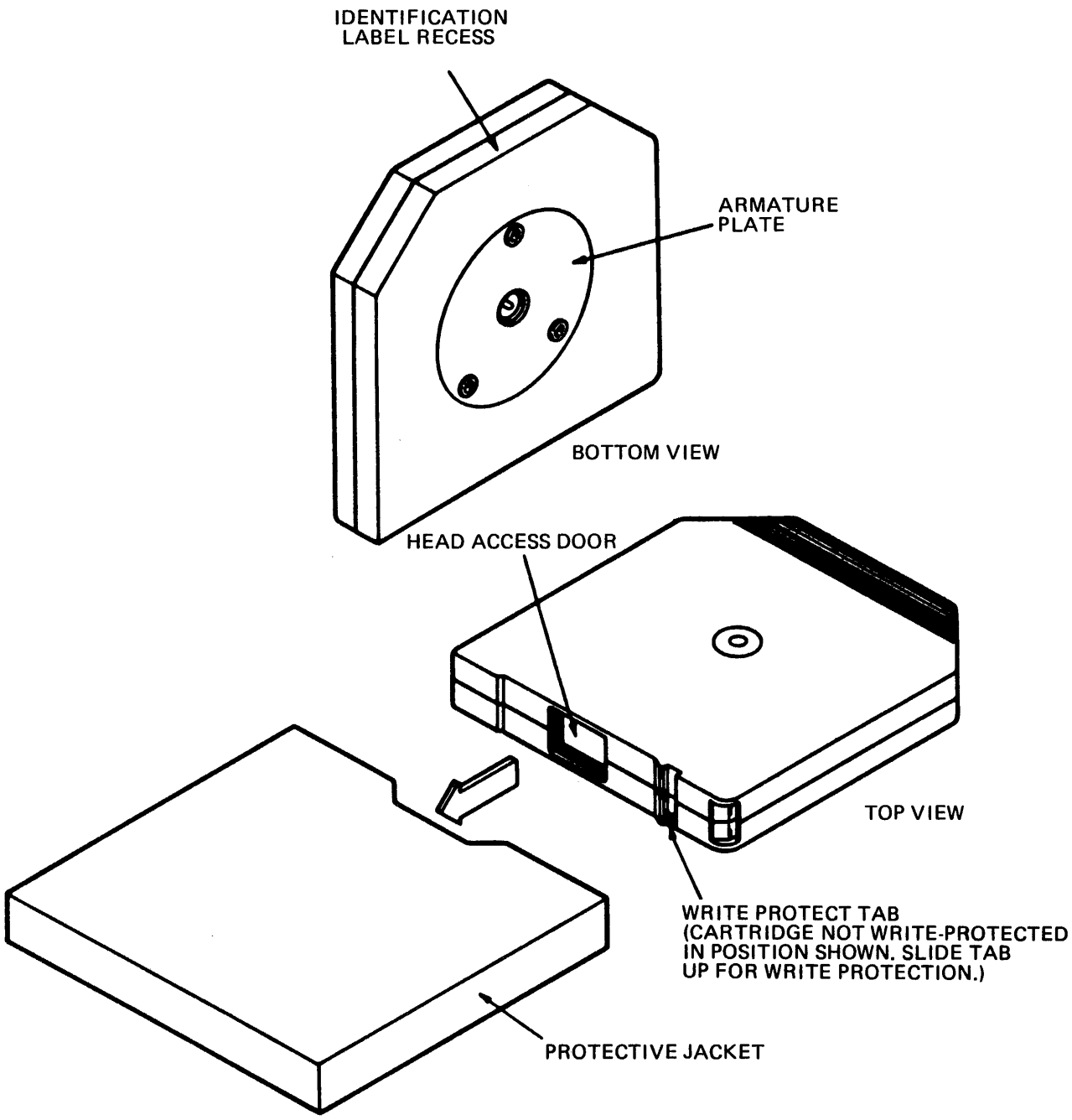


Figure H-5 Disk Cartridge Showing Protective Jacket and Write Protect Tabs

H.3 OPERATING PROCEDURES

Figure H-6 shows the controls and indicators of the CDD50.

H.3.1 Switches and Indicators for the 50Mb Cartridge Disk Drive (CDD50)

All operator controls and indicators are on the front panel. A functional description of these controls and indicators is given in Section H.3.1.1.

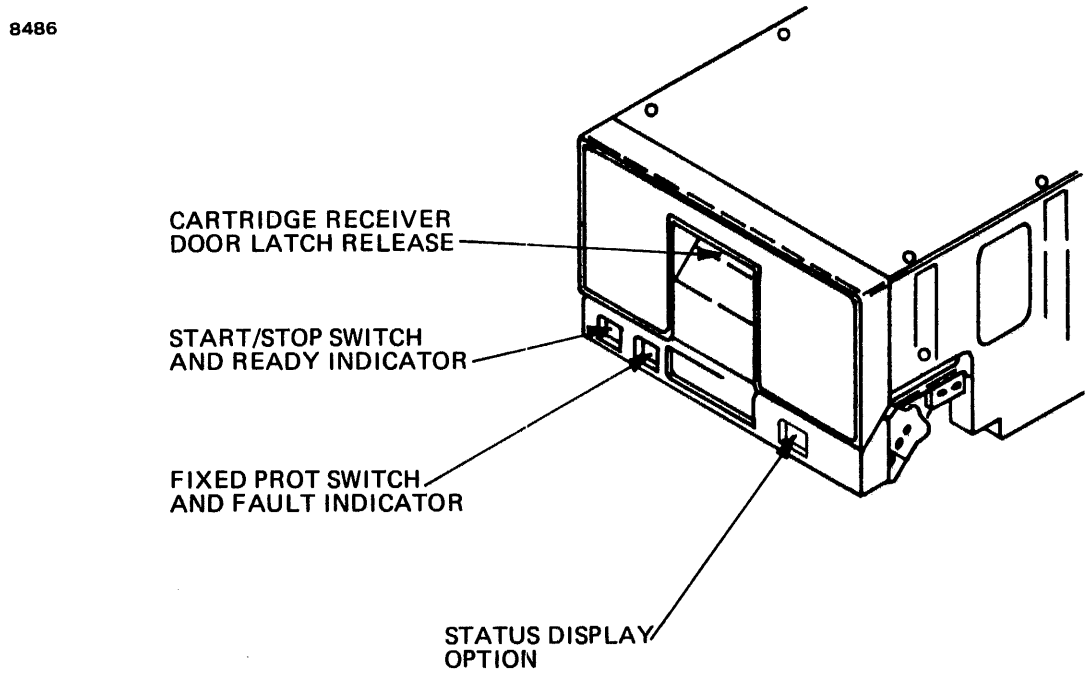


Figure H-6 Operator Controls and Indicators

H.3.1.1 Controls and Indicators

Control or indicator function:

START/STOP switch indicator	Energizes spindle motor and initiates the first seek mode, provided the following conditions are met.

- AC power is present (ON) at the CDD50.
- The disk cartridge loading door is closed and latched with the cartridge in place.
- The WRITE PROT indicator is not blinking, indicating a no fault condition.

READY indicator	Located within the START/STOP switch, READY indicates unit ready status. The READY indicator lights whenever a unit has completed the purge cycle and the heads are loaded. The READY light will blink throughout the spindle start and stop procedures. As long as the heads are on cylinder, the READY indicator will be illuminated, even though the WRITE/PROT indicator may blink to show a fault. The CDD50 indicator will blink rapidly during activity to indicate that the drive is seeking, reading, writing or doing a self-test.
FIXED PROT switch/FAULT indicator	When operated to the inward position, this alternate action switch disables the write driver to the fixed media. The indicator, when lit steadily, indicates that the fixed disk is write protected. When the indicator blinks, it indicates a fault condition has occurred or exists. Rapid blinking (with READY inactive) indicates a cartridge protect data quality fault (see Section H.10).
Disk cartridge access door latch	The disk cartridge access door is unlatched by lifting the latch located under the lip of the recess in the access door. The latch will not release the door catch until the spindle motor has stopped rotating and the interlock solenoid releases the catch. The START/STOP switch must be released (out) before the solenoid will release the catch. In the event of loss of AC power, the interlock solenoid does not release the catch in order to prevent damage to the cartridge.

H.4 INITIAL CHECKOUT AND START-UP PROCEDURE

This procedure should be used to make the first power application to the unit. It is assumed that the procedures previously outlined in this section have been performed.

1. Ensure that the system AC power circuit breaker is off.
2. Ensure that the subsystem power supply power switch is positioned to OFF.
3. Verify that the START/STOP switch is in the STOP (out) position.

4. Unscrew the carriage locking pin (counterclockwise direction) until the head of the screw is flush with the top of the cover (see Figure H-7). Resistance to turning will be felt as the locking pin nears the correct position.

CAUTIONS

1. DO NOT REMOVE THE CARRIAGE LOCKING PIN AT ANY TIME. THE AIR SYSTEM SEAL INTEGRITY REQUIRES THAT THIS SCREW REMAIN IN THE TOP COVER AT ALL TIMES.

2. THE CARRIAGE IS TO BE LOCKED DURING SHIPPING USING THE CARRIAGE LOCKING PIN (FIGURE H-7). THIS PREVENTS DAMAGE TO THE DRIVE AS A RESULT OF THE HEADS LOADING.

5. Install the power input/output (PIO) cabling between the power source and drive (see H.11.3).

6. Turn on the subsystem AC power circuit breaker.

7. Turn the subsystem power switch to ON (if applicable to the subsystem). The CDD50 cooling fan should operate and the front panel door should unlock when the START/STOP switch is in the STOP position.

8. Verify that the proper disk cartridge is available and insert it into the CDD50.

9. Push the START/STOP switch to START. The spindle motor should rotate. Head loading sequence is initiated, and the START/STOP indicator blinks until the heads are loaded, then remains illuminated. The front panel door locks when spindle rotation begins.

10. Perform diagnostics as applicable.

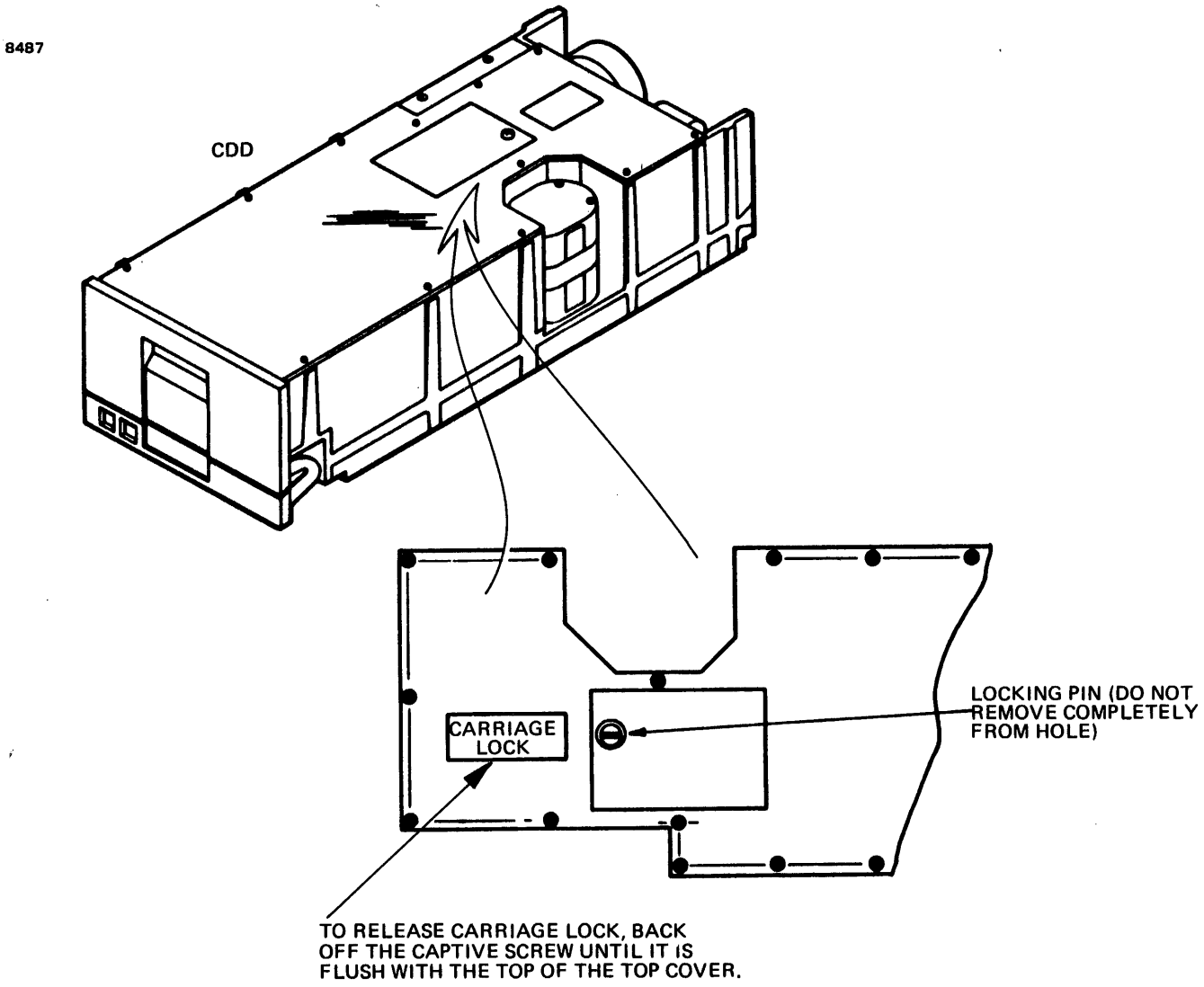


Figure H-7 Cartridge Lock Assembly

H.5 DISK CARTRIDGE HANDLING AND STORAGE

The following practices should be observed when handling or storing disk cartridges.

NOTE

The cartridge should not be shipped in the disk drive.

1. The cartridge should be stored in its protective jacket when not in the drive system (see Figure H-5).

2. Cartridges can be stored flat or on edge. Avoid stacking disk cartridges on top of one another.

H.6 DISK CARTRIDGE INSTALLATION

The removable disk cartridge must be stored in the same environment as the CDD50 for 60 minutes immediately preceding its use. In the event that it becomes necessary to use a cartridge that has not been allowed to stabilize at the ambient CDD environment temperature or a cartridge that was exposed to temperatures below 60 F (16 C) immediately prior to the stabilization period, the cartridge must be visually inspected to ensure that condensation is not present on any part of the cartridge.

Install the disk cartridge using the following procedure (see Figure H-8).

1. Release the latch under the lip of the front panel door recess and pull down the cartridge area access door.

NOTE

Power must be applied to the CDD50 with the START/STOP indicator in the STOP position. To release the latch on the front door panel, the READY indicator must be off and the FIXED PROT indicator must not be blinking.

2. Remove the cartridge from its protective jacket. Store the jacket in such a way as to prevent dust from collecting inside the jacket.

3. Slide the disk cartridge into the receiver track, ensuring that the head opening is toward the rear of the drive and the top surface of the cartridge is up. (The top is marked TOP.)

4. Push the disk cartridge in until it stops.

5. Close the disk cartridge access door until it is latched. The disk cartridge fits into place on the spindle automatically as the access door is closed.

6. Operate the START/STOP switch to apply power to the spindle motor.

7. If the spindle motor will not rotate, the disk cartridge access door may not be completely closed, the disk cartridge may not be properly seated on the spindle chuck, or the cartridge receiver/base may not be properly placed on the lower chassis. If this occurs, remove the cartridge and reinstall it as outlined in the previous steps.

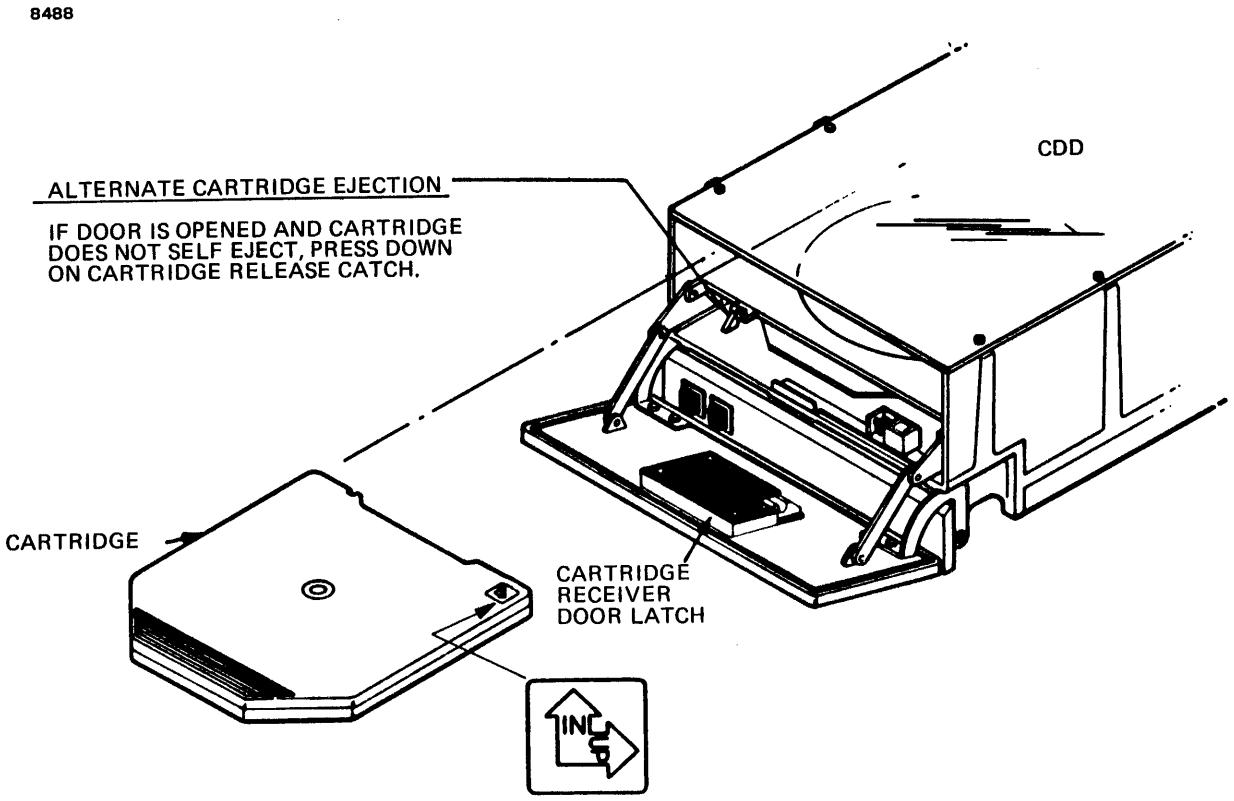


Figure H-8 Disk Cartridge Installation and Removal

H.7 DISK CARTRIDGE REMOVAL

The following sections detail disk cartridge removal procedures.

H.7.1 Normal Removal

See Figure H-8 for the following procedure.

1. Push the START/STOP switch to STOP.

2. Pull down the cartridge access door after the READY indicator ceases blinking and is extinguished entirely. When the access door is completely open, the disk cartridge will partially eject out of the receiver.

3. Pull the cartridge out of the receiver.

4. As the drive will not operate without a disk cartridge installed, a dummy cartridge should be in the drive at all times. This also prevents the entry of atmospheric contaminants into the sealed area of the drive.

NOTE

It is important that the door on the CDD50 remain closed when the drive is not in use.

H.7.2 Power Failure or Emergency Stop Removal

In case of an emergency need to remove the cartridge during operation, perform the following procedure (see Figure H-9).

CAUTION

THE PROCEDURE BELOW SHOULD BE PERFORMED ONLY BY QUALIFIED MAINTENANCE PERSONNEL.

1. If the heads are loaded (they are still flying over the disks), they must be retracted manually before stopping the spinning of the disks (if they are still spinning). To manually retract the heads, carefully lift the front of the unit until the heads slide back into the unloaded position. When the carriage is fully retracted, screw the locking pin into place to prevent the heads from rolling out of the fully unloaded position. There is a carriage locking solenoid, but it does not lock the carriage back until AC power is removed, and the cartridge door cannot be opened in the normal manner if power is removed from the CDD50.

2. Stop the unit and wait approximately three minutes for the disk cartridge to stop spinning.

CAUTION

VERIFY THAT SPINDLE ROTATION DOES NOT EXIST PRIOR TO DEFEATING THE DOOR INTERLOCK. SEE THE DISK CARTRIDGE REMOVAL PROCEDURE IN SECTION H.7.1. THE CARTRIDGE REMOVAL PROCEDURE MUST BE PERFORMED ONLY BY QUALIFIED MAINTENANCE PERSONNEL AND SHOULD BE FOR DRIVE FAILURE ONLY. THE CARTRIDGE ACCESS DOOR SHOULD ALWAYS BE CLOSED AFTER THE CARTRIDGE IS REPLACED WITH A DUMMY CARTRIDGE.

3. Open the disk cartridge access door. This automatically removes the disk cartridge from the spindle chuck. The door will not open if a fault exists. Power must be ON and the START/STOP switch out to retract the door latch solenoid.

   Pull the disk cartridge out and store it in the protective jacket. Install a scratch disk cartridge having no valuable data; this prevents the entry of atmospheric contaminants into the sealed area of the drive.

If in an emergency (EMERGENCY ONLY), the disk cartridge access door will not open, proceed as follows:

1. Make sure the spindle motor has stopped completely. Either observe the motor or wait a full three minutes after initiating a stop. Make sure the heads are fully retracted.

2. See Figure H-9. Insert a plastic credit card or similar object into the space between the access door and the lower front panel. Push the small release tab behind the panel (about 3 inches from the right edge) toward the right with the card and hold while pushing up with the fingers on the door latch release. Pull the door open and remove the cartridge. Close the front access door.

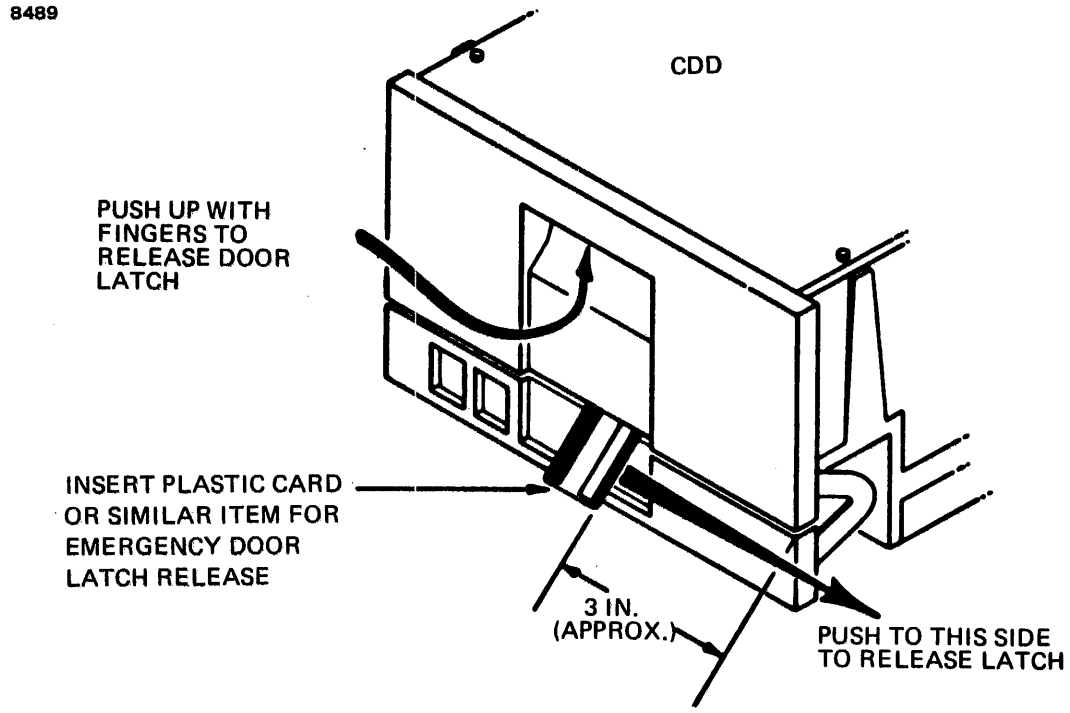


Figure H-9 Emergency/Drive Failure Cartridge Door Opening Procedure

H.8 OPERATION

This section provides the instructions and information required to operate the CDD50 module drive power supply input/output (PIO) adapter.

H.8.1 Controls

The only control on the PIO is the AC power ON/OFF switch shown in Figure H-10. This switch operates the AC power circuit breaker CB-1. This switch is not available to the equipment operator. Only maintenance personnel should operate the ON/OFF switch.

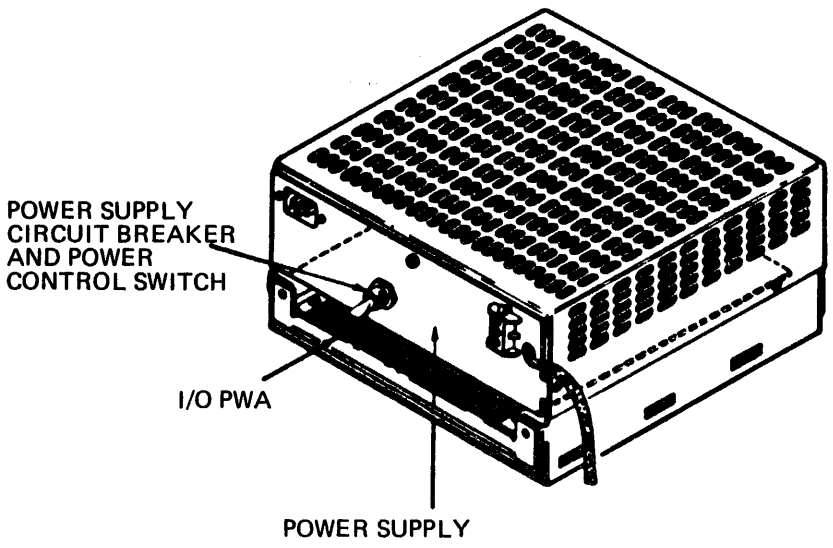


Figure H-10 Operator Controls

H.8.2 Power Cable and Mating Connector

The AC power cable supplied with the PIO is 2.29 meters (7.5 feet) long. The cable connector plug requiring a mating receptacle is described as follows:

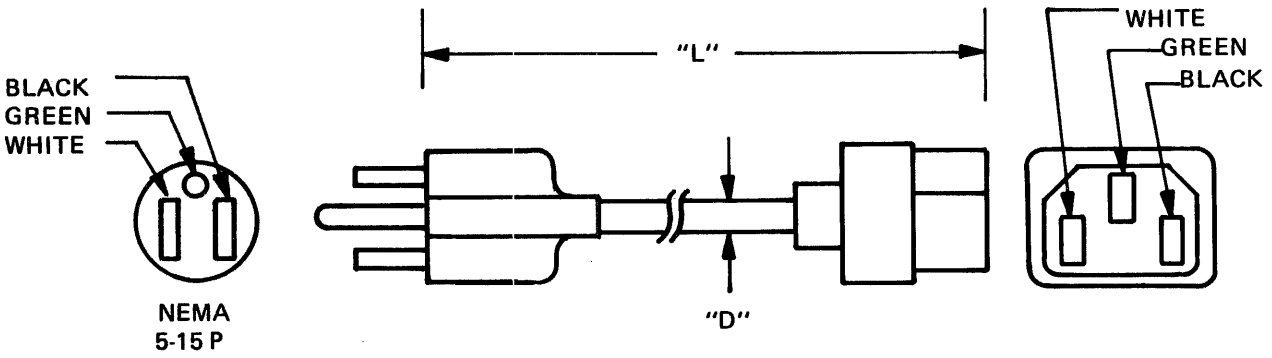
DESCRIPTION	CDC P/N	NEMA CONFIGURATION
120 V, 15 A, 60 Hz, 2-pole, 3-wire receptacle connector at PIO end; 2-pole, 3-wire plug connector at power source end (see Figure H-11).	75778702	5-15 P 5-15 R

A color coded power cable is supplied with the 50 Hz drive, but the 50 Hz power source end connector must be furnished by the user. The cable color code and unit power requirements are as follows:

COLOR-CODE		DESCRIPTION	
220-240 V 50 Hz	Brown	Phase one	#18 AWG
	Blue	Neutral	WIRE
	Green and yellow	AC equipment ground	

Do not connect the AC power cable between power source and PIO until all other installation steps have been completed, and the drive is ready for initial checkout.

AC POWER CABLE (INPUT)



AC POWER CABLE (60 Hz)

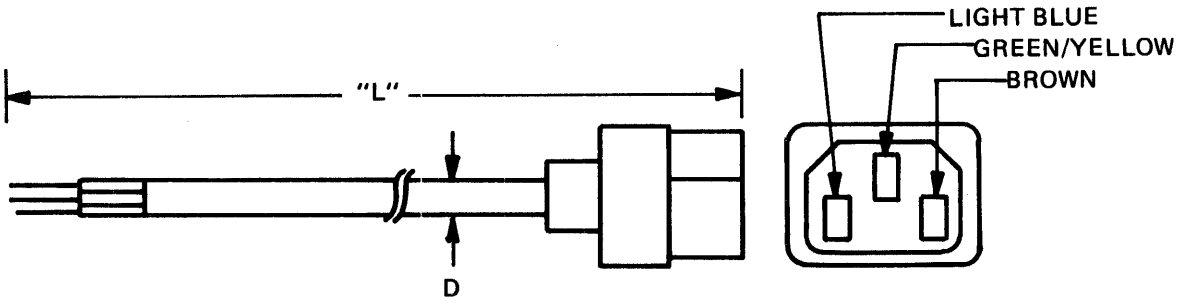


Figure H-11 AC Cable Receptacle

H.9 FAULT OPERATING INSTRUCTIONS

A blinking FIXED PROT indicator indicates a fault exists in the drive. If this condition occurs, proceed as follows:

1. Actuate the FIXED PROT switch twice to initiate a fault reset, then return the switch to the original position. If FIXED PROT has ceased blinking, normal operation can be resumed. If the indicator still blinks, proceed to Step 2.

2. Perform the stop operation and power down procedures (see Sections H.2.3 and H.2.4), then power up and start the unit again. If the FIXED PROT indicator still blinks, contact qualified maintenance personnel.

NOTE

See Section H.10 if FAULT is blinking rapidly.

H.10 AUTOMATIC SELF-TEST CAPABILITY

Upon initial power application, a microprocessor within the CDD50 performs a self-test function. This test is limited to the microprocessor, its memory and I/O ports. A fault during this test sequence will be indicated by the FIXED WRITE PROTECT/FAULT LED's failure to be reset within six seconds.

The next level of testing will occur after initial head loading. The microprocessor will issue a series of seek commands while automatically adjusting velocity feedback to optimize access time. If the CDD50 retracts its heads during normal operation due to a fault condition, this test will be reinitiated via a FAULT CLEAR command that results in a successful head load attempt.

The final phase of automatic testing, performed on the removable media and heads after each head load and prior to each head unload, is named the CDD protect data quality (PDQ) feature. It consists of a head/media performance test that will allow early detection of impending head/media failure before serious damage can occur. Three significant benefits are available to the user from this technological advancement: data is almost always recoverable; drive damage requiring depot level refurbishment is significantly reduced if not eliminated; and the undesirable effects of propagation to other components are eliminated.

When the velocity calibration test is complete, the CDD50 will automatically perform a sequential forward/reverse seek on each removable media surface while monitoring relative embedded servo amplitudes. If the amplitude delta exceeds a defined limit, the user is notified of a potential problem via the interface fault line (shared memory data (SMD) interface) or fault bit (LDI interface) and a rapidly blinking FAULT indicator on the front operator panel with the READY indicator off.

If the PDQ fault is indicated, the user can, if desired, reinitiate the test by issuing a FAULT CLEAR command either over the interface or by manual intervention using the operator panel FIXED WRITE PROTECT/FAULT CLEAR switch. The retest can be commanded a maximum of five times, at which time the fault cannot be cleared. It is recommended that if the drive passes any subsequent retest, copy data from the removable media immediately and remove the failing cartridge. Due to the characteristics of CDD technology and early detection of failure, the drive will usually remain serviceable by installing a new cartridge.

In those cases where subsequent retries are unsuccessful, the user has still another option. However, it will require the assistance of a field engineer. The field engineer can disable the PDQ protective feature, which effectively lowers the read threshold circuit. This provides another opportunity to recover the data and still keep the drive serviceable.

If there is no critical data on the cartridge, follow the flowchart in Figure H-12 to avoid possible head crashes.

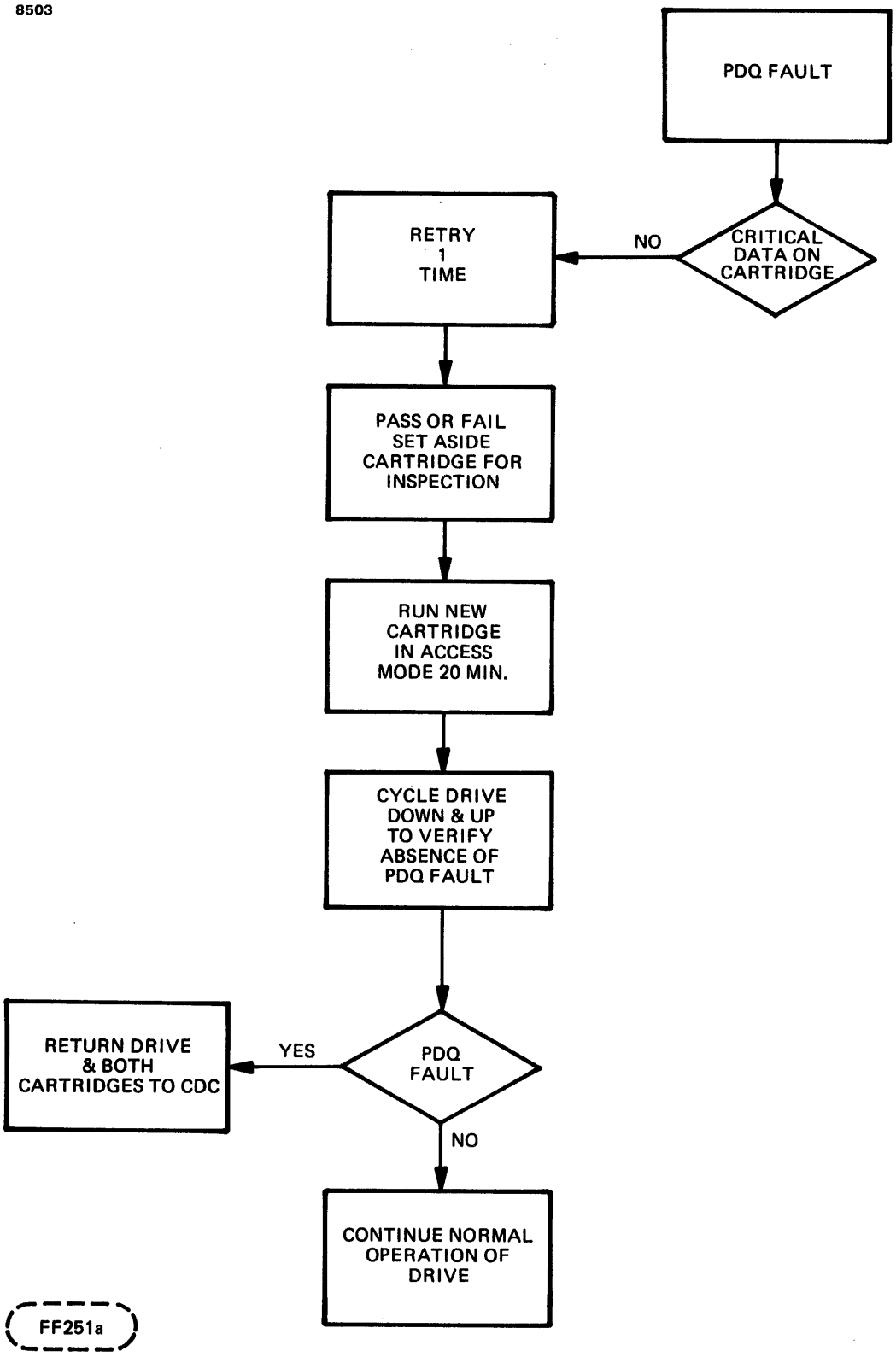


Figure H-12 PDQ Fault Flowchart

H.11 CABLING AND FEATURE SELECTION

The connectors for interfacing the PIO to the controller and the CDD50 to the PIO, as well as the drive address selection switch, are located on the I/O board. Remove the I/O board as follows:

1. Remove the two screws holding the I/O board in the PIO base pan (see Figure H-13).

2. Slide out the I/O board until the I/O connectors and drive address selection switch are accessible.

The I/O board is now ready to accomplish drive address selection, terminator board installation and cabling.

H.11.1 Feature Selection

The PIO is provided with a dip switch module that allows a binary address to be selected to operate in a multiple drive system. The drive can be selected only as units 0 through 3. The dip switch module is located in the I/O board in the PIO (see Figure H-13).

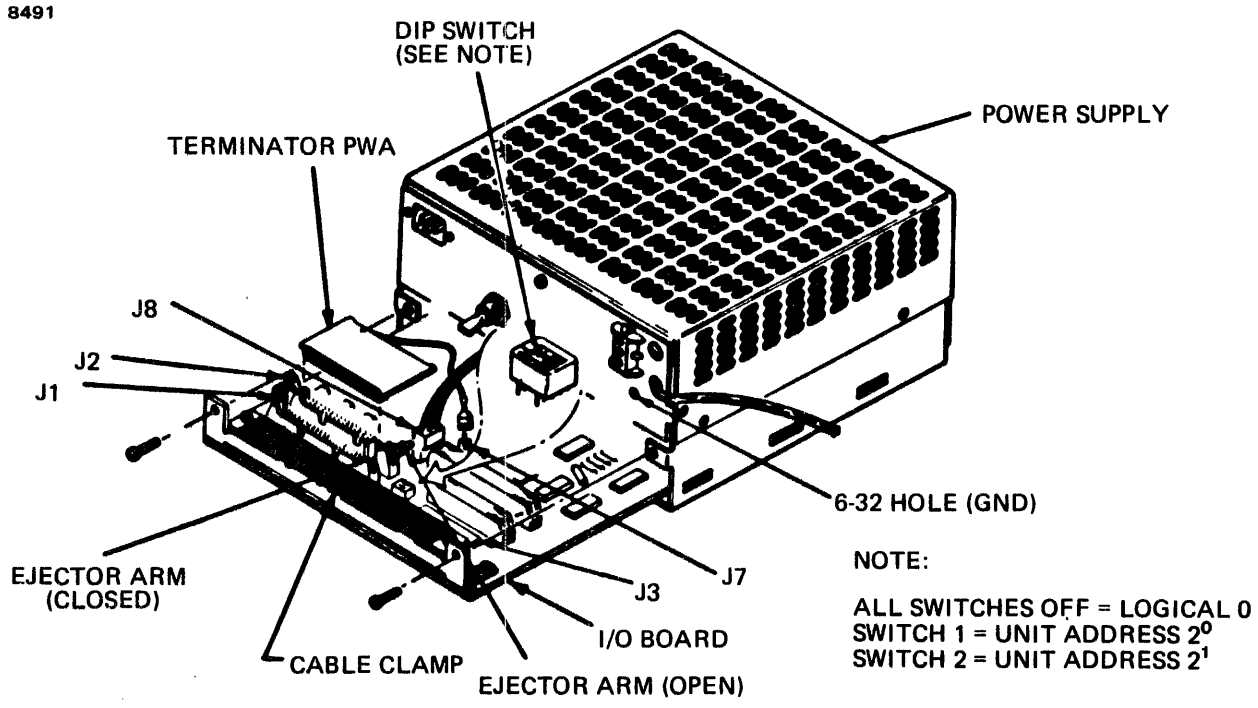


Figure H-13 Power Supply and I/O Board

H.11.2 Radial or Daisy-Chain Selection

Figure H-14 shows the intercabling and terminator placement for various drive arrangements. Shown are the radial and daisy-chained systems configurations. A single drive is connected as shown for the radial configuration.

Ensure that the terminator PWA is plugged into the PIO Board (J2) and the connector ejector arms are closed (see Figure H-13).

H.11.3 50Mb Cartridge Disk Drive (CDD50) to Power Input/Output (PIO) Intercabling

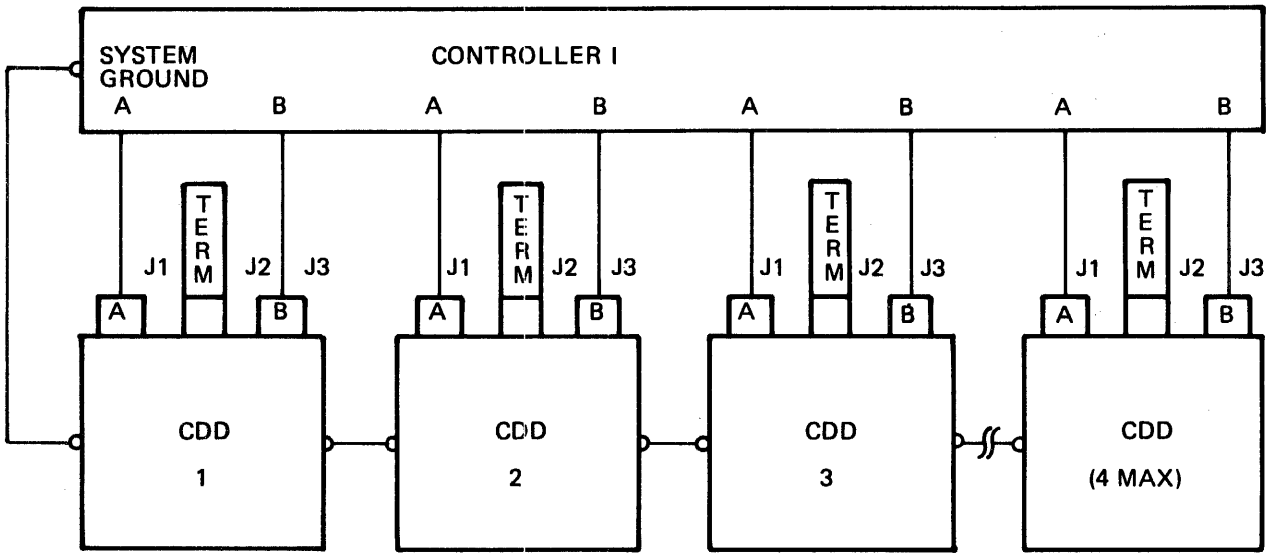
Four cables are used to connect the CDD50 to the PIO. Unshielded cables can be used for lengths of four feet or less. Shielded cables must be used for lengths between 4 feet and 10 feet (maximum length). The four cables are as follows:

- One 40 conductor flat ribbon cable (C cable)
- One 26 conductor flat ribbon cable (D cable)
- One AC power cable (3-wire)
- One DC power cable (6-wire, part of PIO)

Connect these cables as follows (see Figure H-15):

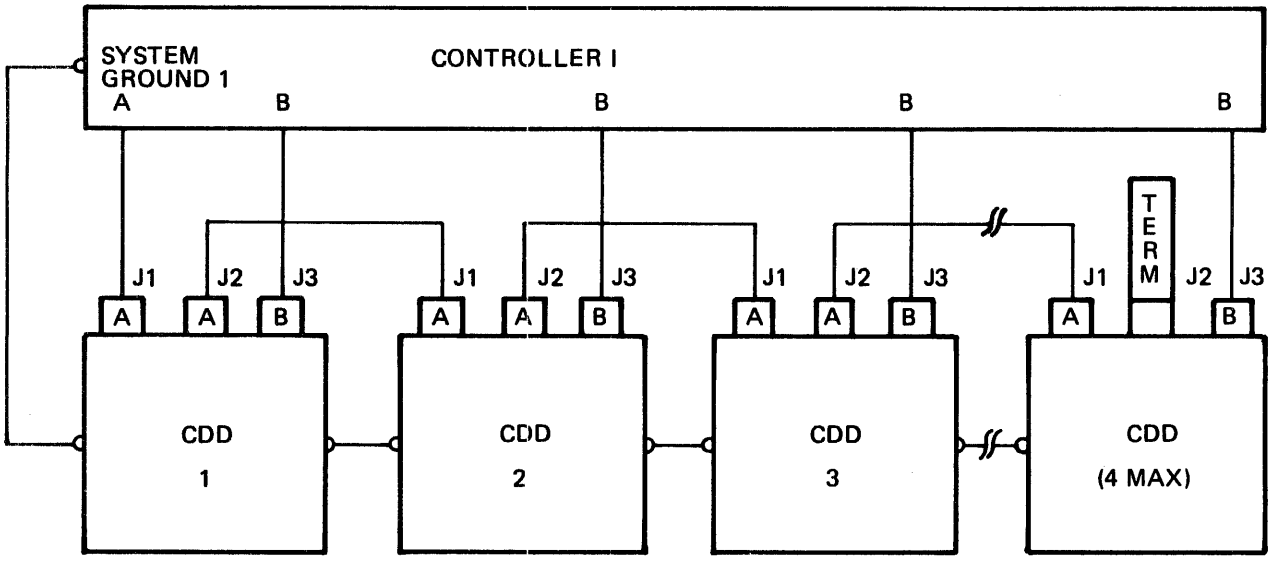
1. Remove two screws holding the AC Distribution PWA cover in place and remove the cover.
2. Connect the 40 conductor flat ribbon (C) cable between the CDD50 Base PWA (J1 on Base PWA) and the PIO PWA (J4).
3. Connect the 26 conductor flat ribbon (D) cable between the CDD50 Base PWA (J2) and the PIO PWA (J5).
4. Connect the DC power cable for the PIO to the CDD50 Base PWA (J3).
5. Connect the AC power cable between the CDD50 AC Distribution PWA (J1) and the PIO power supply.
6. Reinstall the AC Distribution PWA Cover.

RADIAL SYSTEM CONFIGURATION



NOTES:
1. MAXIMUM TOTAL "A" CABLE LENGTHS = 100 FEET (30.48 METERS)
2. MAXIMUM INDIVIDUAL "B" CABLE LENGTHS = 50 FEET (15.24 METERS)

DAISY-CHAINED SYSTEM CONFIGURATION



NOTES:
1. TERMINATION OF "A" CABLE LINES ARE REQUIRED AT THE CONTROLLER AND THE LAST UNIT OF THE DAISY CHAIN OR EACH UNIT IN A RADIAL CONFIGURATION.
2. TERMINATION OF "B" CABLE RECEIVER LINES ARE REQUIRED AT THE CONTROLLER AND ARE ON THE UNIT'S RECEIVER CARDS.
3. MAXIMUM CUMULATIVE "A" CABLE LENGTH PER CONTROLLER = 100 FEET (30.48 METERS) MAXIMUM INDIVIDUAL "B" CABLE LENGTH = 50 FEET (15.24 METERS)

Figure H-14 CDD50 Module Drive System Cabling

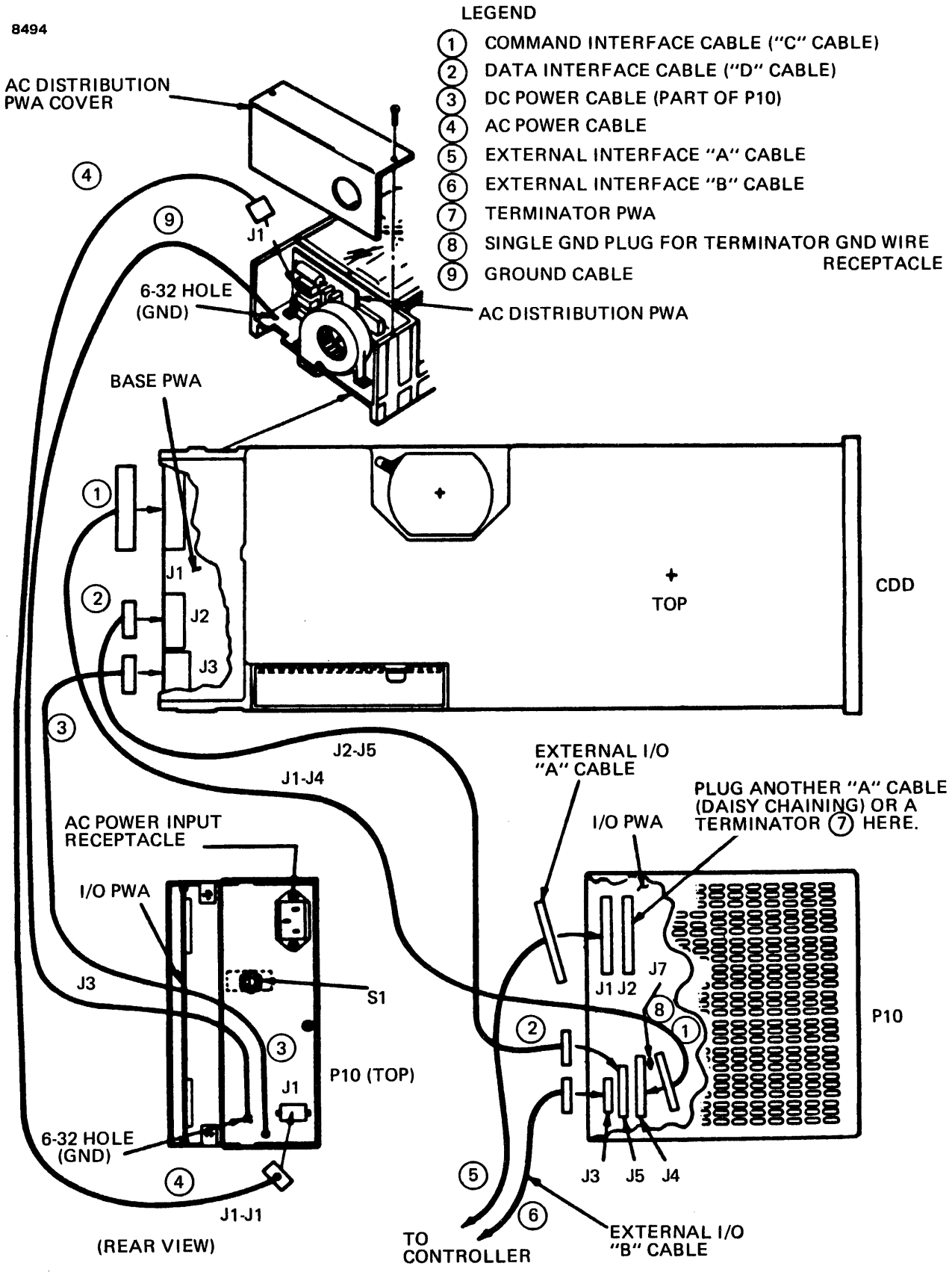


Figure H-15 CDD50 Module Drive Cable Connections

H.11.4 Power Input/Output (PIO) Controller Cabling

Standard SMD/CMD flat A and B cables can be used to interface the PIO to the controller. See Section H.15. The connector pin and signal name assignments are shown in Figures H-16 and H-17. Figure H-18 is a table that shows the decoding of the Tag bus lines.

Install the cables as follows (see Figure H-15):

1. Connect the A cable to the PIO PWA (J1) and close the connector ejector arms.

2. Connect the B cable to the PIO PWA (J3). Ensure that the connectors are oriented correctly on the I/O PWA (i.e., Pin 1 to Pin 1).

3. Connect the other end of the cables (Steps 1 and 2) to the controller.

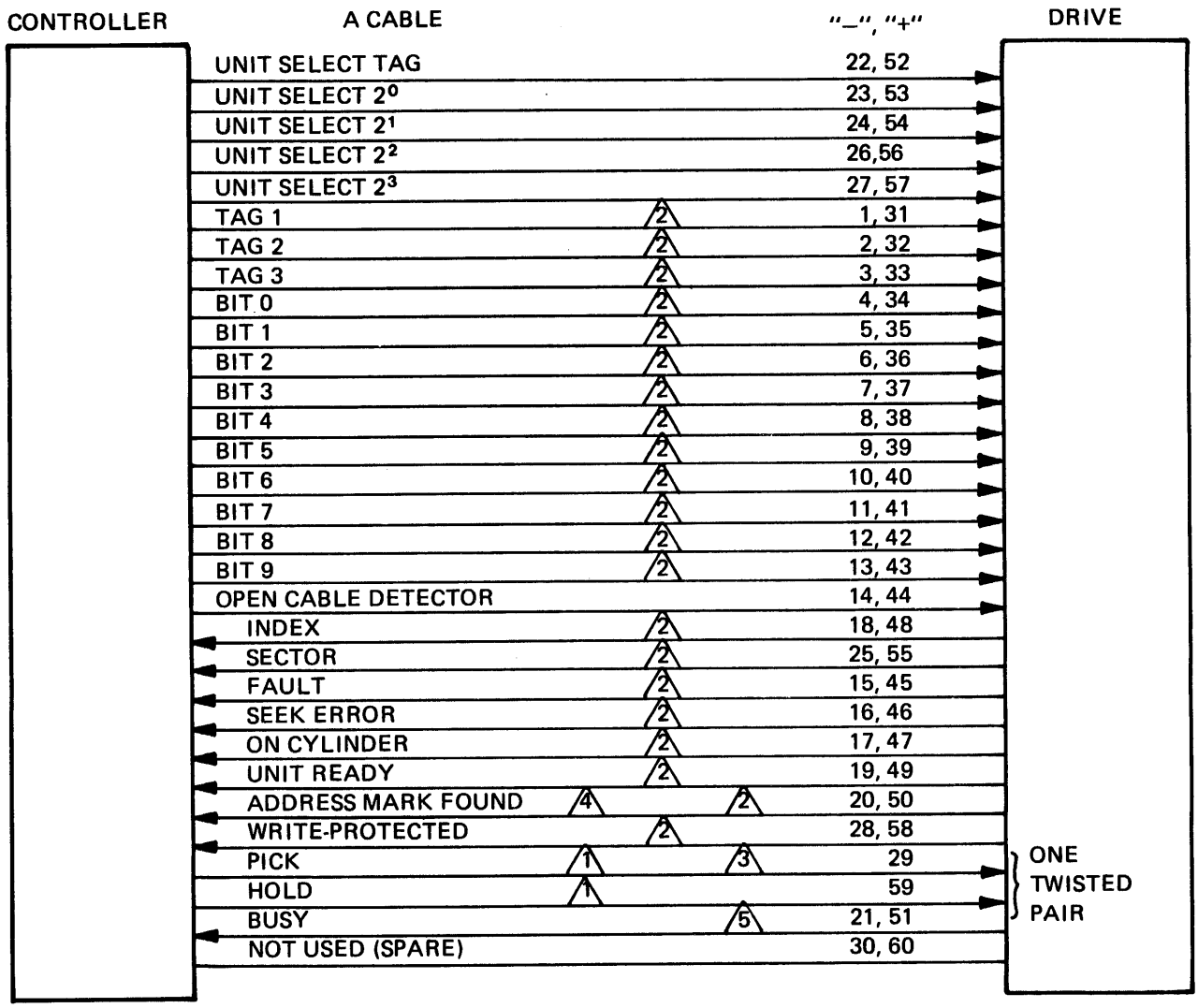
4. Route all cables through the cable clamp on the I/O PWA.

5. Install the terminator on J2 of the I/O PWA. If the disk drives are daisy-chained, the terminator should be installed on J2 of the last drive system.

CAUTION

ENSURE J1 AND J2 CONNECTOR EJECTOR ARMS ARE FULLY CLOSED BEFORE REINSTALLING I/O PWA.

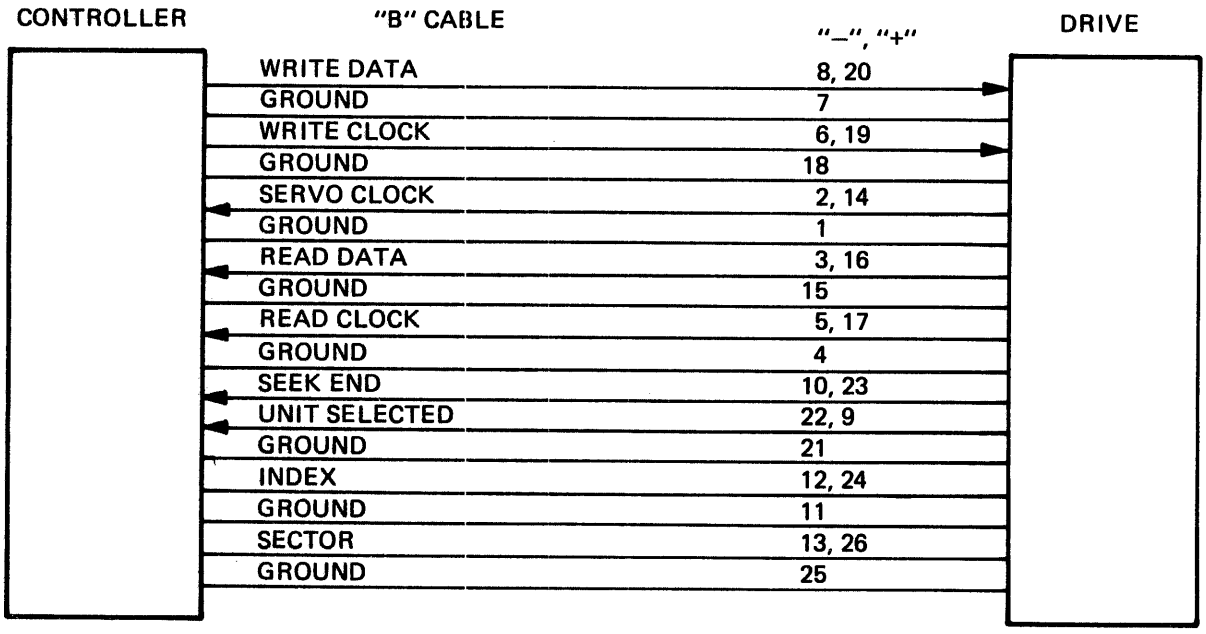
6. Reinstall the I/O PWA in the base pan of the power supply.



NOTE: 60 POSITION
30 TWISTED PAIR - STRAIGHT FLAT CABLE
MAXIMUM LENGTH - 100 FT (30.48 METERS) (CUMULATIVE)

1. SPECIAL SIGNAL, NOT A BALANCED TRANSMISSION SIGNAL
2. GATED BY UNIT SELECTED
3. NOT INTERPRETED, IS DAISY-CHAINED, NO DRIVER CONNECTION WITHIN THE CDD
4. NOT ACTIVATED, IS DAISY-CHAINED, ALWAYS A LOGIC ZERO OUTPUT IF UNIT IS SELECTED
5. NOT GENERATED, IS DAISY-CHAINED, NO DRIVER CONNECTION WITHIN THE CDD

Figure H-16 Tag Bus I/O Interface (A Cable)



NOTES: 1. 26 CONDUCTOR FLAT CABLE
MAXIMUM LENGTH - 50 FT. (15.24 METERS)

2. NO SIGNALS GATED BY "A" CABLE UNIT SELECT.

Figure H-17 B Cable Interface

8504

	TAG 1	TAG 2	TAG 3
BUS	CYLINDER ADDRESS	HEAD/VOLUME SELECT	CONTROL SELECT
BIT 0	2^0	2^0 (1)	WRITE GATE
BIT 1	2^1	2^1 (1)	READ GATE
BIT 2	2^2	(2)	SERVO OFFSET PLUS
BIT 3	2^3	(2)	SERVO OFFSET MINUS
BIT 4	2^4	(2)	FAULT CLEAR
BIT 5	2^5	(2)	(2)
BIT 6	2^6	(2)	RTZ
BIT 7	2^7	(2)	DATA STROBE EARLY
BIT 8	2^8	(2)	DATA STROBE LATE
BIT 9	2^9	(2)	(2)

(1) HEAD CHANGES ARE NOT INITIATED UNTIL A VALID SEEK IS RECEIVED FOLLOWING A HEAD CHANGE COMMAND IF THE SEEK-ON-HEAD-CHANGE OPTION IS NOT SELECTED. IF THE SEEK-ON-HEAD-CHANGE OPTION IS SELECTED, THE HEAD CHANGES AND A ZERO DISTANCE SEEK WILL BE INITIATED AS A RESULT OF THE HEAD CHANGE.

Z179b

(2) NOT INTERPRETED BY THE CDD.

Figure H-18 Tag Bus Decode

H.12 CABLING AND MATING CONNECTORS

The connectors for interfacing CDD50 command/data signals to the host adapter and the DC power are located on the Base PWA at the rear of the unit (see Figure H-19). The connector for the AC power is located on the AC Distribution PWA (see Figure H-20).

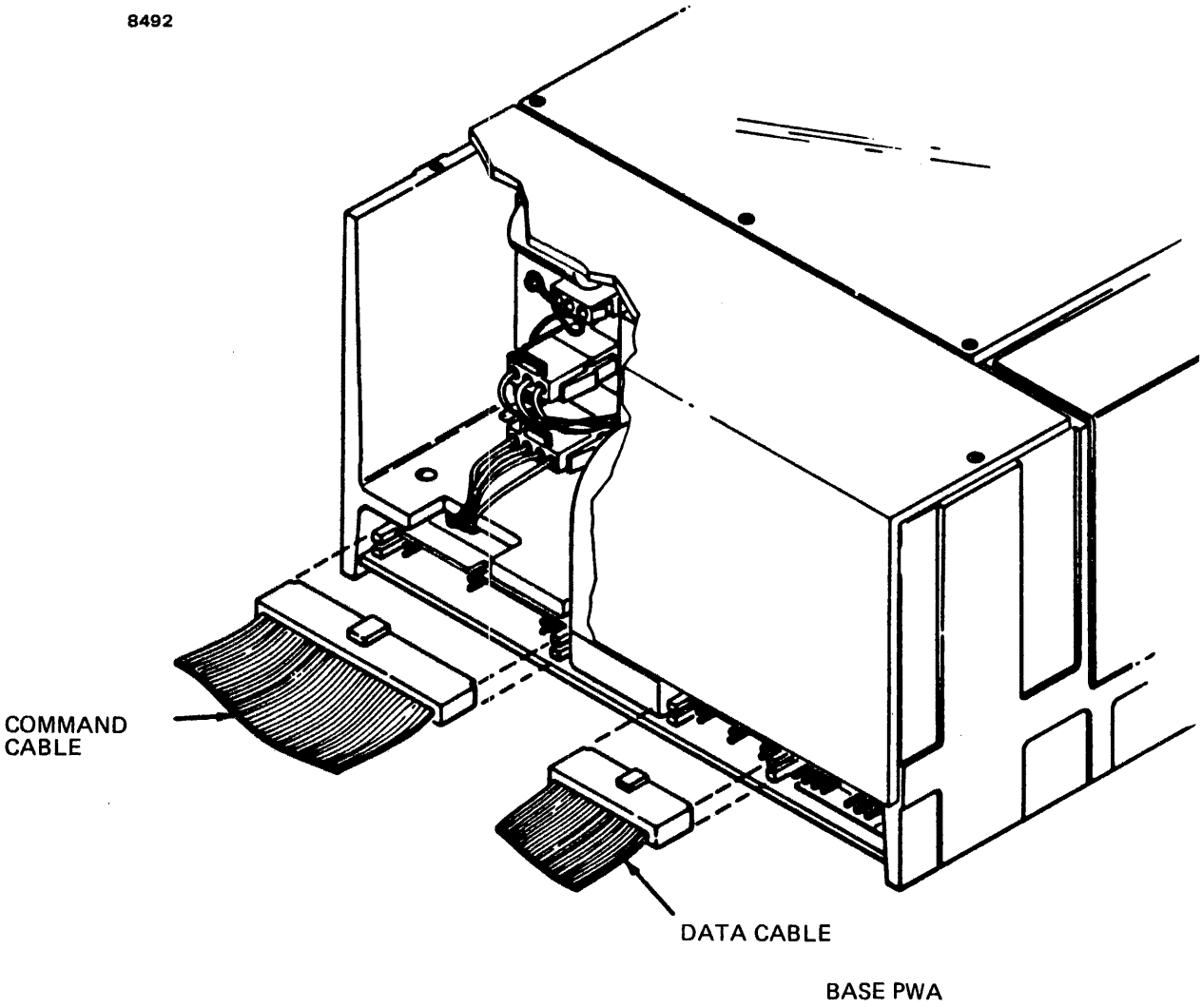


Figure H-19 Command/Data Cable Connections

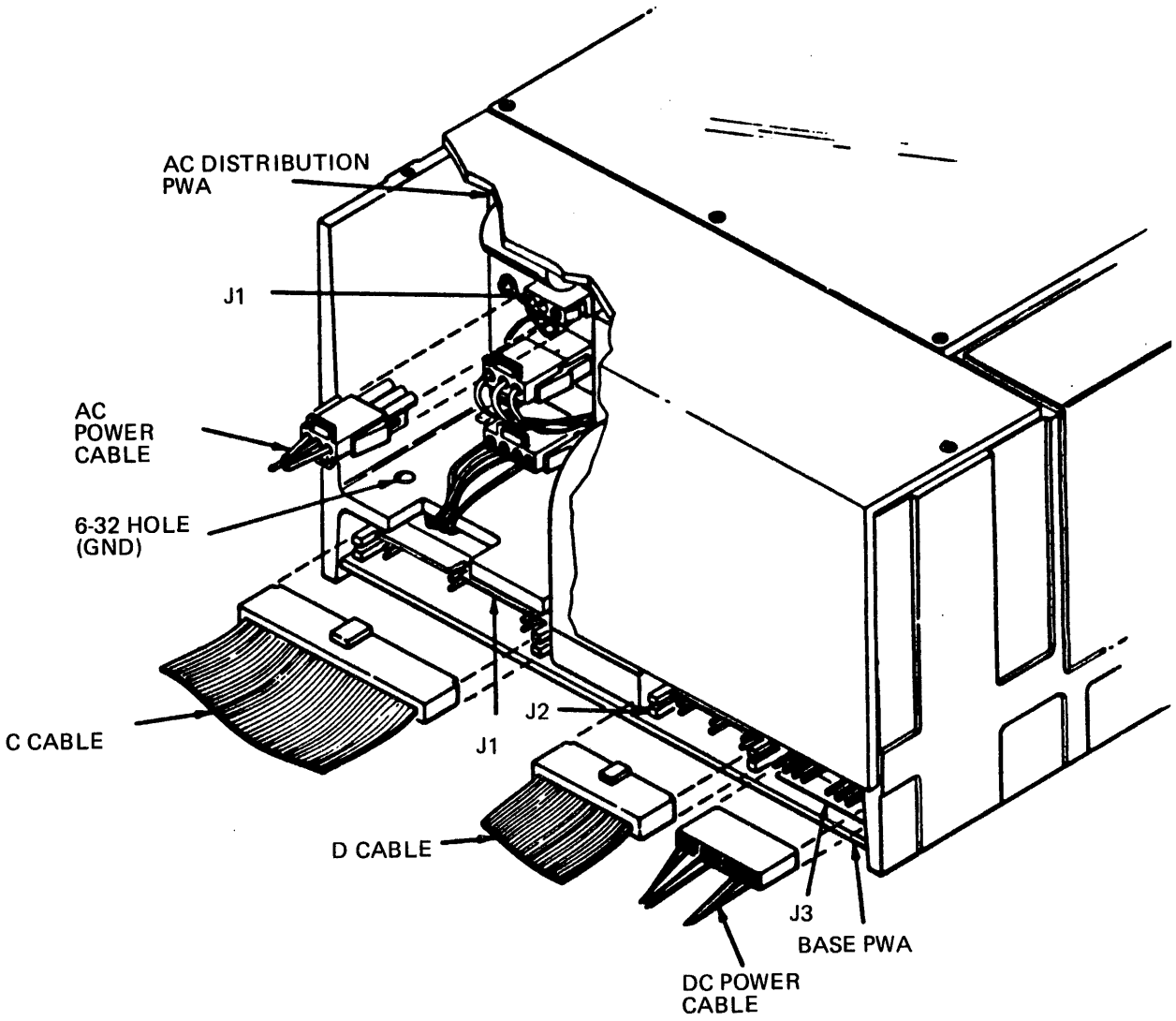


Figure H-20 AC and DC Cabling

H.12.1 Command/Data Interface Cabling and Connectors

The command/data physical interface consists of a 40-pin command (C) cable and a 26-pin data (D) cable. The command cable can be daisy-chained. However, since there is only one command I/O connector provided on the CDD50 Base PWA, the user must provide the daisy-chain facilities. A maximum of four CDD50s can be daisy-chained. The data cable must be radially connected. The maximum cumulative daisy-chained cable length is 10 feet. The maximum radial cable length is 10 feet. See Figure H-21.

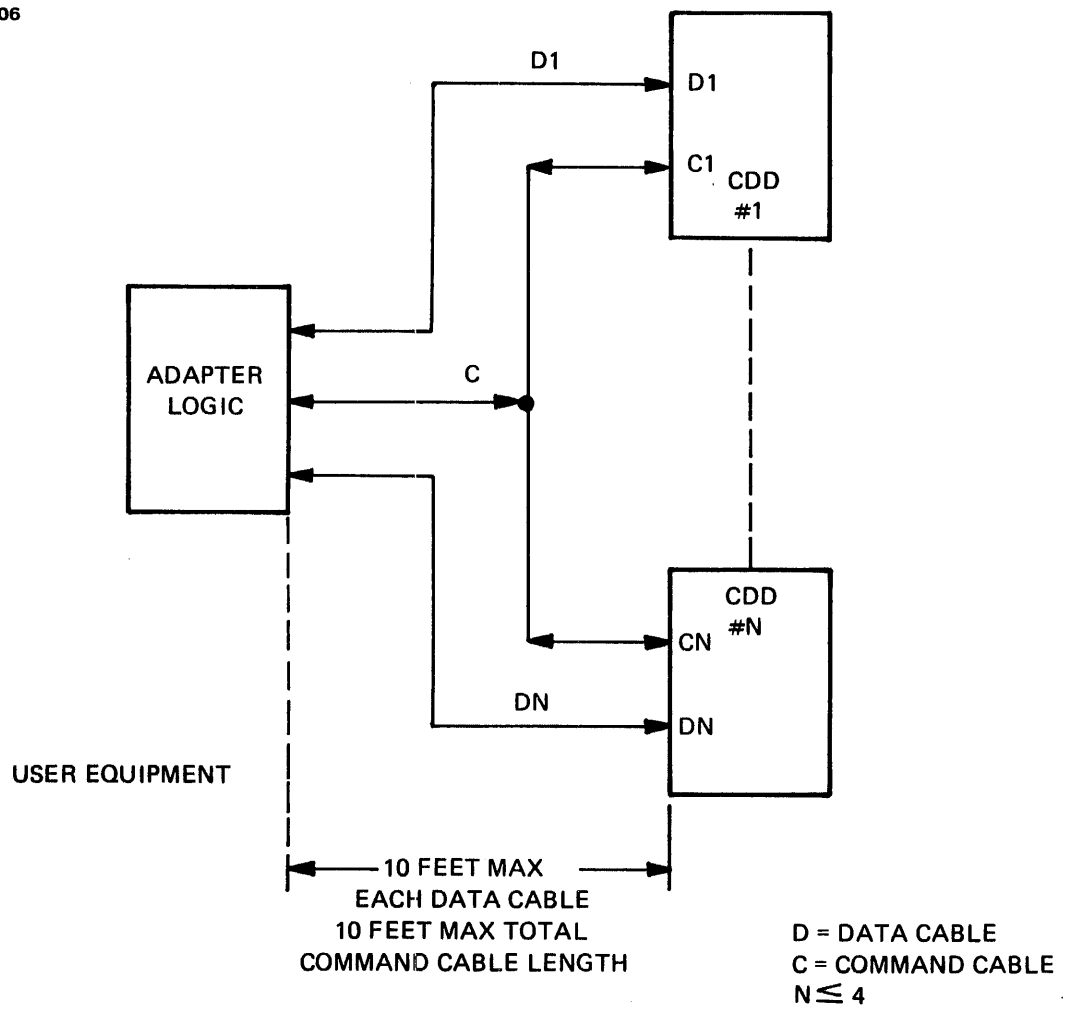


Figure H-21 CDD50 Interface Cable

Figure H-22 illustrates the type of connector used on the Base PWA and the cable connector required to mate with it. Section H.15 lists the recommended components that can be used to interconnect the drive(s) to the user adapter. Connector pin and signal name assignments are shown in Figures H-23 and H-24.

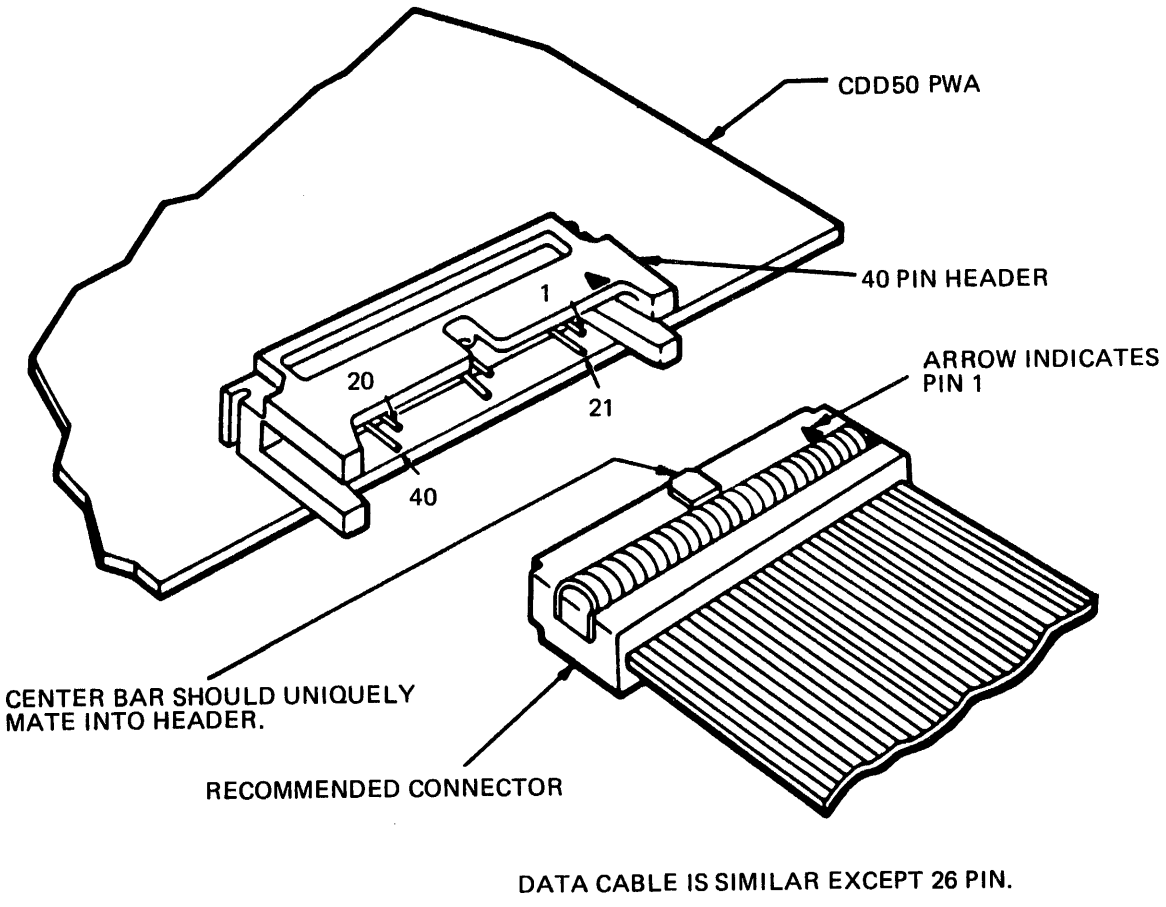


Figure H-22 Pictorial Representation of Command Cable and Connector

8501

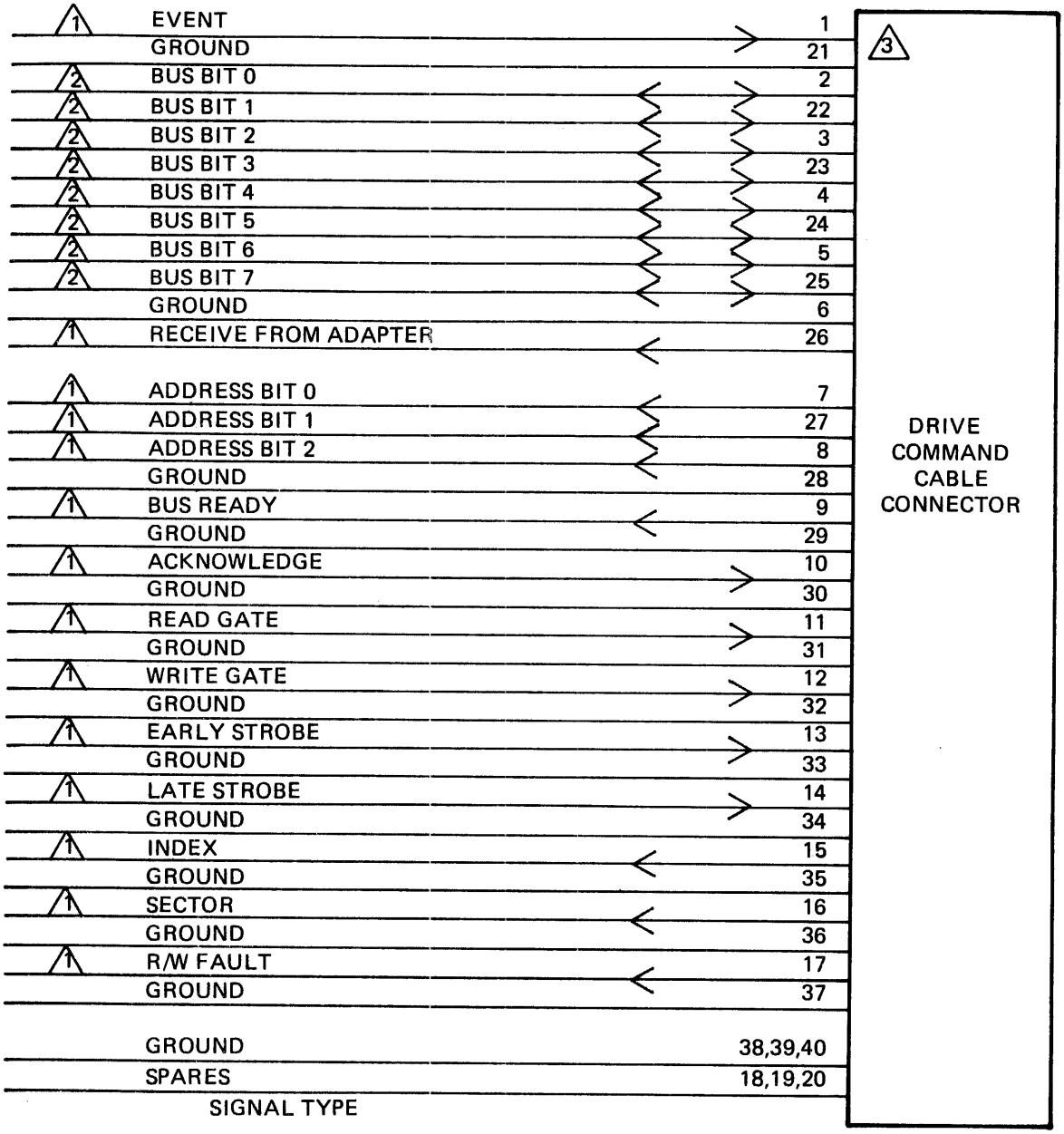
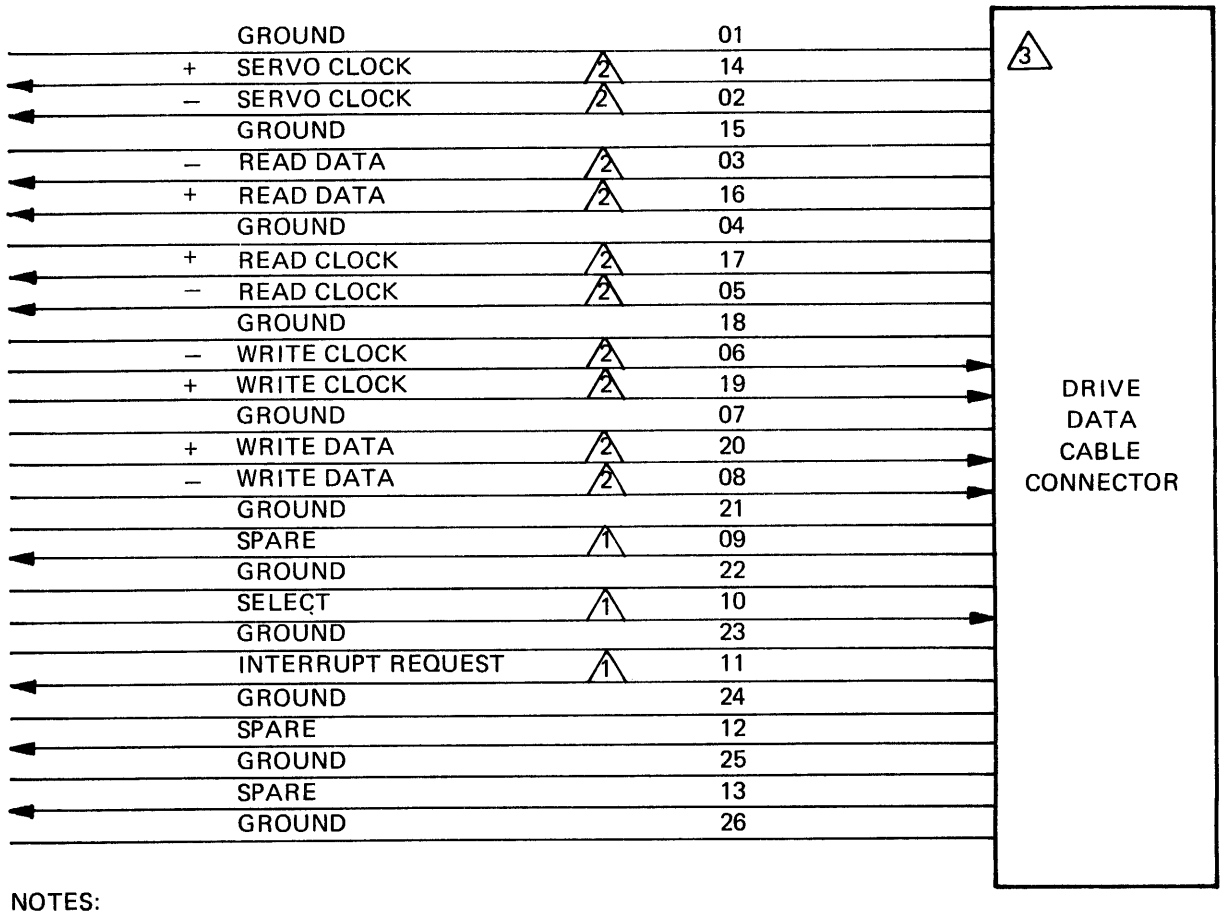


Figure H-23 Command Cable Pin Assignments



NOTES:

1. ACTIVE LOW, SINGLE ENDED LINES
2. DIFFERENTIAL PAIR LINES
3. LINES ARE SHOWN IN THE ACTUAL SEQUENCE THEY APPEAR IN THE FLAT CABLE.

Figure H-24 Data Cable Connector Assignments

H.12.2 AC and DC Power Cabling and Connectors

The AC power input connector is mounted on the AC Distribution PWA. It is a 3-circuit position Mate-N-lock type female housing with male contacts. The DC power connector is an 8-circuit position male header mounted on the Base PWA. Locations of the above connectors are shown in Figure H-20. Recommended mating connectors for the AC and DC power input cables are given in Section H.15.

H.12.3 Input/Output (I/O) and Power Cable Routing

For sliding rack-mounted drives, it is recommended that a cable retract mechanism be incorporated in the rack design. Retract mechanisms can be purchased from a number of available manufacturers.

H.13 MAINTENANCE FEATURES

The FAULT indicator blinks when a fault is detected in the drive.

The AC ON/OFF power switch (not on the CDD50) applies AC power to the CDD50 when operated. Once the CDD50 fan motor starts, the front door panel will unlock. This control is not available to the operator.

The CDD50 requires no electrical/mechanical adjustments or preventative maintenance procedures.

H.14 GROUNDING

Connect a low impedance ground strap, 19 mm (0.75 in) braid, from controller system ground to PIO GND (on front plate) to CDD50 casting. In order to ensure reliable interface operation and prevent damage to drivers or receivers, a DC ground should exist between the drive and the adapter. This ground should be carefully incorporated into the overall grounding system to prevent circulating ground currents. Figure H-20 shows the location of the CDD50 system ground tie point.

H.15 ACCESSORIES

Power I/O-to-controller accessory items that are required but not furnished with the device unless specifically ordered are shown in Table H-1.

TABLE H-1 INTERFACE ACCESSORIES

DESCRIPTION	CDC P/N	VENDOR P/N
Connector (40 conductor)	92014152-0/54-6	Berg 65948-440/640
Connector (40 conductor daisy-chain)	92014153-8/55-3	Ansley 609-4030 or Berg 65948-540/740
Connector (26 conductor)	92014136-3/38-9	Berg 65948-426/626
Right angle header (40 conductor)	51847515	Berg 65496-025
Right angle header (26 conductor)	51847513	Berg 65496-013

TABLE H-1 INTERFACE ACCESSORIES (Continued)

DESCRIPTION	CDC P/N	VENDOR P/N
Vertical header (40 conductor)	9543303	AMP 102154-9
Vertical header (26 conductor)	95433301	AMP 102154-6
Cable (40 conductor)	65832230	3M 3365-40
Cable (26 conductor)	75884912-9	3M 3476-26
Shielded cable (40 conductor)		Spectra-Strip 151-2830-040
Shielded cable (26 conductor)		Spectra-Strip 151-2830-026

H.16 PERFORMANCE CHARACTERISTICS

The performance characteristics of the CDD50 are shown in Table H-2.

TABLE H-2 PERFORMANCE CHARACTERISTICS

CHARACTERISTIC	SPECIFICATION
Data capacity (unformatted)*	
per track	20,672 bytes
per removable cartridge	25Mb
per fixed disk	25Mb
total	50Mb
Number of data heads	4
per removable cartridge	2
per fixed disk	2
Recording mode	RLL 2,9
Data interface	NRZ DATA + CLOCK
Flux reversal density	6774 fri/10,161 bpi
Track density	715 tpi
Number of tracks per surface	624
Data transfer rate (nominal)	9.677 MHz
Maximum latency	17.95 ms
Average latency	8.55 ms
Positioning times	
average	35 ms
maximum	80 ms
single Track	10 ms
Spindle speed	3510 +3.0% rpm -4.8% rpm

* Formatted capacity realized in a specific system application is generally less than the unformatted capacity. However, all CDD50 systems will be the same.

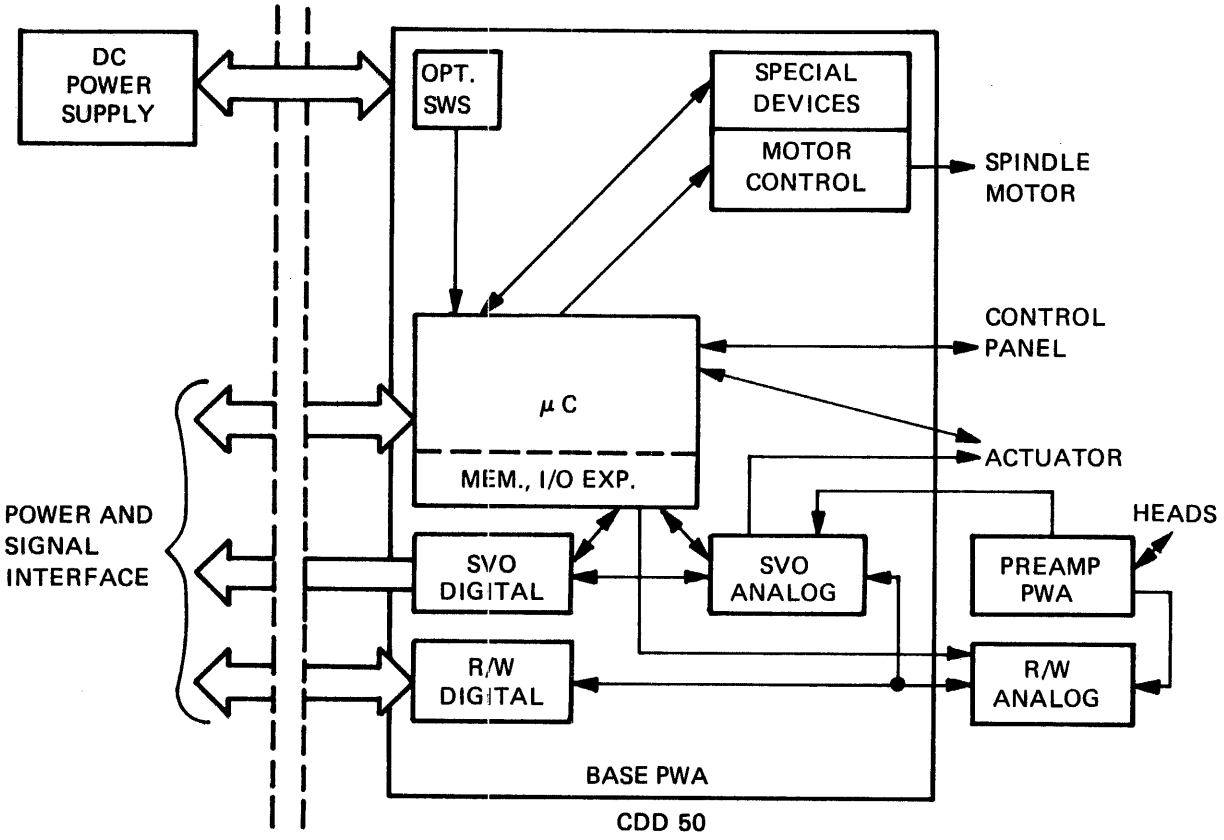


Figure H-25 CDD50 Functional Block Diagram

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