

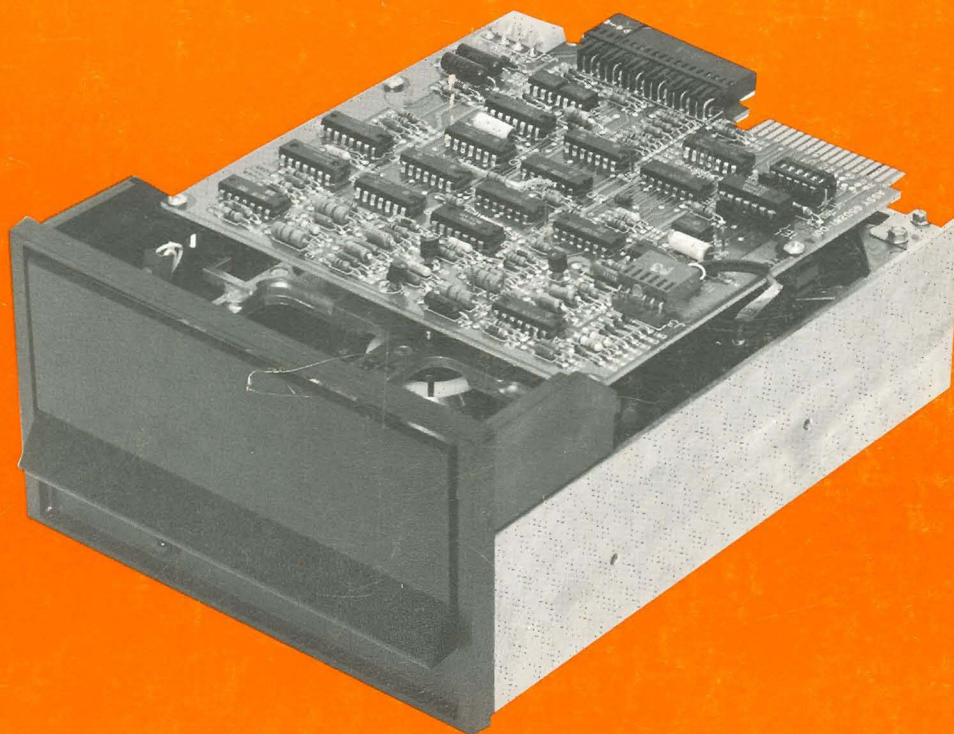
**SIEMENS**

**OEM**

**Floppy Disk Drive FDD100-5**

VOLUME 3

OPERATION  
MAINTENANCE





**MODEL FDD100-5  
MICROFLOPPY<sup>(TM)</sup>  
FLEXIBLE  
DISK DRIVE**

**OPERATION AND  
MAINTENANCE MANUAL**

**A22742-A1005-X001-\* -7630**



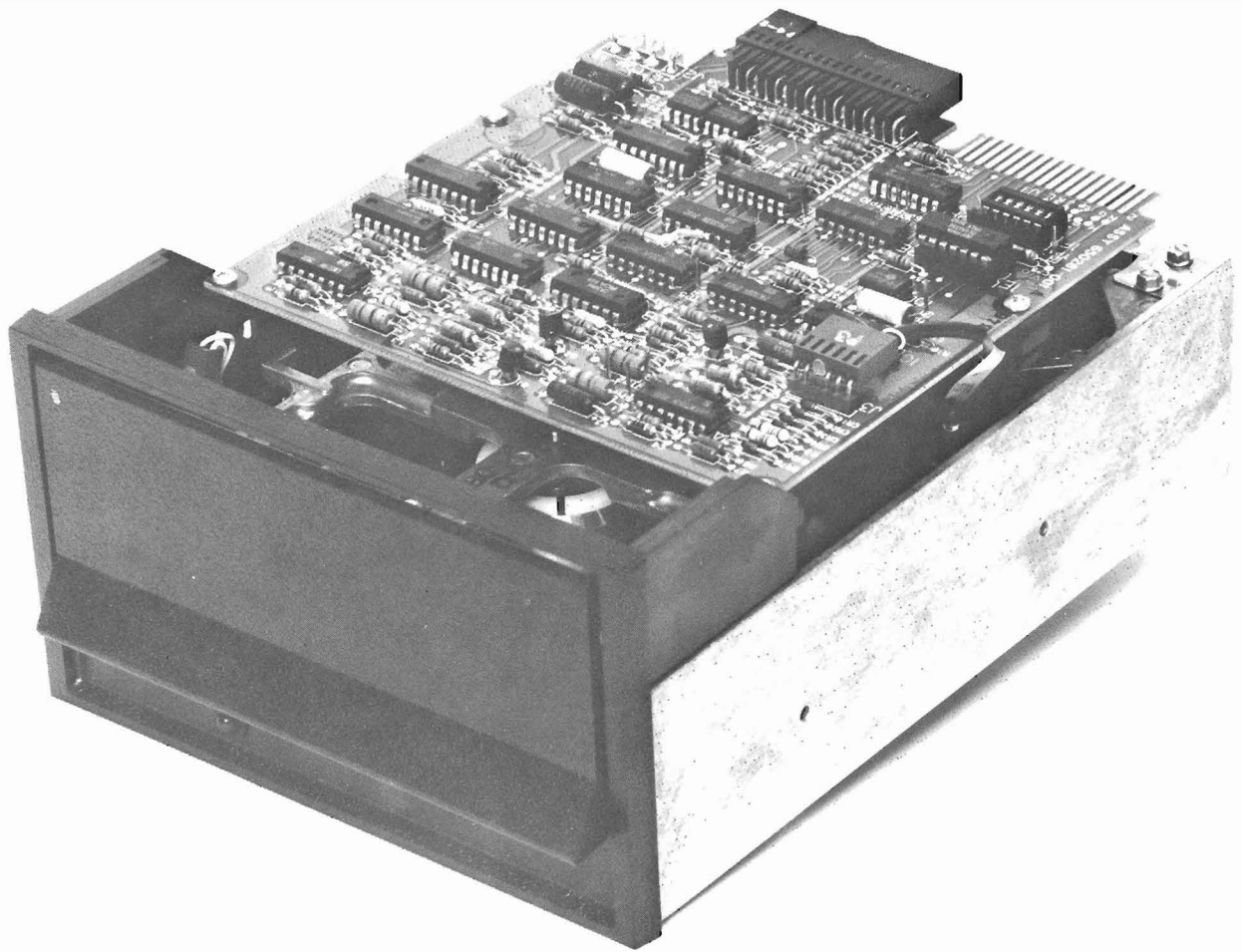
MODEL FDD100-5

FLEXIBLE DISK DRIVE  
OPERATION AND MAINTENANCE  
A22742-A1005-X001-\* -7630

REVISION LEVEL

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A	Original Publication	3/79





Model FDD100-5 Flexible Disk Drive





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## SECTION 1

### GENERAL DESCRIPTION

#### 1.1 SCOPE

This manual describes interfacing, operation, and maintenance of the Model FDD100-5 Flexible Disk Drive, and is divided into the following five sections:

- Section 1 — General Description
- Section 2 — Installation and Interfacing
- Section 3 — Operation Procedures
- Section 4 — Theory of Operation
- Section 5 — Maintenance

In this manual, it is assumed the user has a practical understanding of floppy disk controllers; e.g., the Model FDC100-5 Controller, and of TTL and MOS LSI logic.

#### NOTE

The Company also offers a line of intelligent microfloppy controllers. Model FDC100-5 is a single-density, single-head controller for use with the Model FDD100-5 Disk Drive, or its equivalent. Model FDC200-5 is a double-density, dual-head controller for use with the Model FDD200-5 Disk Drive or its equivalent.

#### 1.2 INTRODUCTION

The Model FDD100-5 Disk Drive is a high-speed, random access device which stores data on and retrieves data from an oxide-coated, single-sided mylar diskette that is 5.125 inches (13.0175 cm) in diameter. It provides a highly reliable and compact solution to problems of low-cost data storage. The Model FDD100-5 Disk Drive contains electronics for Read, Write, Control, Step, and Direction functions, and for Status indications. The signal interface is a printed wiring board (PWB) edge connector with a pin arrangement that is compatible with the standard ANSI X3T9.2 configuration; the

PWB also has a standard DC power connector. The Model FDD100-5 Disk Drive has an unformatted data storage capacity of 125K bytes on 40 tracks per diskette side. To obtain compatibility with other disk drives that have less capacity, only the first 35 tracks are normally used. The first 35 tracks provide an unformatted data storage capacity of 109.4K bytes. Formatting the disk drive is a function of the host system.

### 1.2.1 DOUBLE DENSITY

By using MFM, M<sup>2</sup>FM or GCR double-density encoding techniques, unformatted data storage capacity on the single-sided diskette can be increased to 250K bytes (40 tracks) or 218.8K bytes (35 tracks). An optional system that uses dual index and file protect sensors permits data storage on both sides of a dual-sided diskette. This option, coupled with double-density encoding techniques and extended track capability, makes it possible to store up to 500K bytes of data on a single diskette.

### 1.2.2 DAISY CHAIN CAPABILITY

Up to four Model FDD100-5 Disk Drives can be daisy chained on a single bus. When all expanded capacity features of the disk drives are employed, a total unformatted system capacity of two megabytes is attainable.

### 1.2.3 APPLICATIONS

Options that can be selected and installed by the customer are available to broaden applications. The Model FDD100-5 Disk Drive can be used in the following applications:

- A. Microcomputer program/load storage.
- B. Power typing systems.
- C. Microprocessor systems.
- D. Word processing systems.
- E. Desk-top calculators and portable computers.
- F. Text editing systems.
- G. Smart terminals.

The Model FDD100-5 Disk Drive is also equipped with an interface that allows upward expansion of the units within the system and future system enhancements with the larger floppy disk drives. AC power requirements have been eliminated through the use of a DC servo-controlled spindle-driven motor.

#### 1.2.4 HEAD CHARACTERISTICS

The read/write head is of the single-gap type with trailing tunnel-erase structure to ensure interchange capability by enhancing off-track reading capability. The written track is 0.013 inch (0.03302 cm) wide, and the 40 tracks are centered at 1/48-inch (0.053-cm) intervals. The head carriage is positioned by a precision four-start lead screw that is driven by a low-power, permanent-magnet stepper motor.

### 1.3 FEATURES

The Model FDD100-5 Disk Drive includes the following features:

- A. Small Size – compactness and light weight.
- B. High Data Integrity – soft error rate not greater than one in  $10^9$  bits.
- C. Low Cost – competitive with cassette drives.
- D. Compatible Media – industry-standard media and format ensures interchangeability.
- E. Gentle Media Handling – field proven patented positive operator interlock extends media life, and does not allow clutch to engage diskette unless package is correctly positioned in disk drive.
- F. Ceramic/Ferrite Heads – high reliability and long life.
- G. Daisy-Chain Capability – up to four disk drives may be interconnected on a single bus.
- H. Simplified Power Requirements – uses only +5 and +12 volts DC power.
- I. Molded Construction – for rugged consistency and quality.
- J. Write Protection – optical write inhibit protects data file.
- K. High-Speed Head Positioner – provides track-to-track access time of 25 milliseconds.
- L. Industry Standard Tracks – allows use of up to 40 tracks and matches industry standards for the first 35 tracks.
- M. Double-Density Recording – disk drive electronics and head are designed for use with MFM, M<sup>2</sup>FM or GCR double-density encoding techniques which enable up to 250 K bytes of unformatted data to be stored on each side of a diskette.

## 1.4 SPECIFICATIONS

Specifications for the Model FDD100-5 Disk Drive are listed in Table 1-1. Unformatted data capacity specifications are listed in Table 1-2.

Table 1-1. Model FDD100-5 Disk Drive Specifications

GENERAL		
Parameter	Characteristics	
	35 Tracks	40 Tracks
Track Density:	48 TPI	48 TPI
Rotational Speed:	300 ± 3 rpm	300 ± 3 rpm
Data Transfer Rate:	125K bits/sec	125K bits/sec
Access Time –		
Track-to-Track:	25 msec	25 msec
Average Random Access Time:	298 msec	340 msec
Settle Time:	15 msec	15 msec
Average Latency:	100 msec	100 msec
Recording Density (FM):	2581 BPI (inner track)	2768 BPI (inner track)
Data Flux Density:	5162 fci (inner track)	5536 fci (inner track)
Head Load Time:	50 msec	50 msec
Power-Up Delay:	1 sec	1 sec
PHYSICAL		
Parameter	Characteristics	
Height:	3.25 ± 0.02 inches (in.) (8.255 ± 0.0508 cm) 3.38 ± 0.02 in. (8.582 ± 0.0508 cm) over front bezel	
Width:	5.75 ± 0.02 in. (14.605 ± 0.0508 cm)	
Length:	8.00 in. (20.32 cm) max.	
Net Weight:	3.5 pounds (1.5876 kg)	
Shipping Weight:	4.5 pounds (2.0412 kg)	
Media Requirements –		
Type 820 (or equivalent):	Soft-Sector Format	
Type 821 (or equivalent):	10 Physical Sectors	
Type 822 (or equivalent):	16 Physical Sectors	
Power:	+12VDC ± 5%, 1.8A max., 0.80A typ., 100 mV p-p max. ripple +5VDC ± 5%, 0.7A max., 0.4A typ., 50mV p-p max. ripple	
Typical Power Dissipation:	12W operating 7W standby	



Table 1-1. Model FDD100-5 Disk Drive Specifications (continued)

ENVIRONMENTAL	
Parameter	Characteristics
Temperature Range –	
Operating:	4 to 46°C (40 to 115°F)
Shipping or Storage:	-40 to 60°C (-40 to 140°F)
Wet Bulb (maximum):	36.3°C (78°F)
Relative Humidity Range –	
Operating:	20 to 80%, noncondensing
Shipping or Storage:	5 to 95%, noncondensing
RELIABILITY	
Parameter	Characteristics
Mean Time Between Failure (MTBF):	8500 hours (assume 25% power-on cycle for spindle-drive motor)
Mean Time To Repair (MTTR):	0.5-hour
Media Life (with approved media):	Not less than 3 x 10 <sup>6</sup> passes per track
Design Life:	5 years

Table 1-2. Unformatted Data Capacity Specifications

Capacity	Single Density (FM)		Double Density (MFM, M <sup>2</sup> FM)	
	Single Side	Double Side	Single Side	Double Side
Track:	3.13K bytes	3.13K bytes	6.26K bytes	6.26K bytes
Diskette (35 Tracks):	109.4K bytes	218.8K bytes	218.8K bytes	437.6K bytes
(40 Tracks):	125.0K bytes	250.0K bytes	250.0K bytes	500.0K bytes



## SECTION 2

### INSTALLATION AND INTERFACE

#### 2.1 UNPACKING AND INSPECTION

During unpacking and inspection, use the following procedure:

- A. Remove contents of shipping container and inspect for in-transit damage. If damage is evident, notify carrier and manufacturer. Specify nature and extent of damage.
- B. Verify that contents of shipping container agree with shipping list. Notify a Company representative if anything is missing.
- C. Verify that model designation and serial number agree with those on shipping invoice.
- D. Inspect assemblies for loose hardware and connectors; if necessary, tighten hardware.

#### 2.2 INSTALLATION

The Model FDD100-5 Disk Drive may be mounted in one of the following positions:

- A. Horizontally, with PWB facing up as shown in Figure 2-1.
- B. Vertically, on either the right or left side, with the door opening to one side or the other side.
- C. Vertically, with the door opening upward.
- D. Any combination of A, B, and/or C.

Figure 2-2 shows outline and mounting dimensions.

#### 2.3 INTERFACE

Communication between the Model FDD100-5 Disk Drive and the controller is established through an I/O cable. Power to the Model FDD100-5 Disk Drive is applied through a separate cable. Input interface signal lines are terminated by a resistor network that offers an impedance of 132 Ohms. For ideal signal transmission, the input/output (I/O) cable should have a characteristic impedance of 132 Ohms. Maximum cable length between the controller and the last disk drive should be not greater than 10 feet (3.048 m).

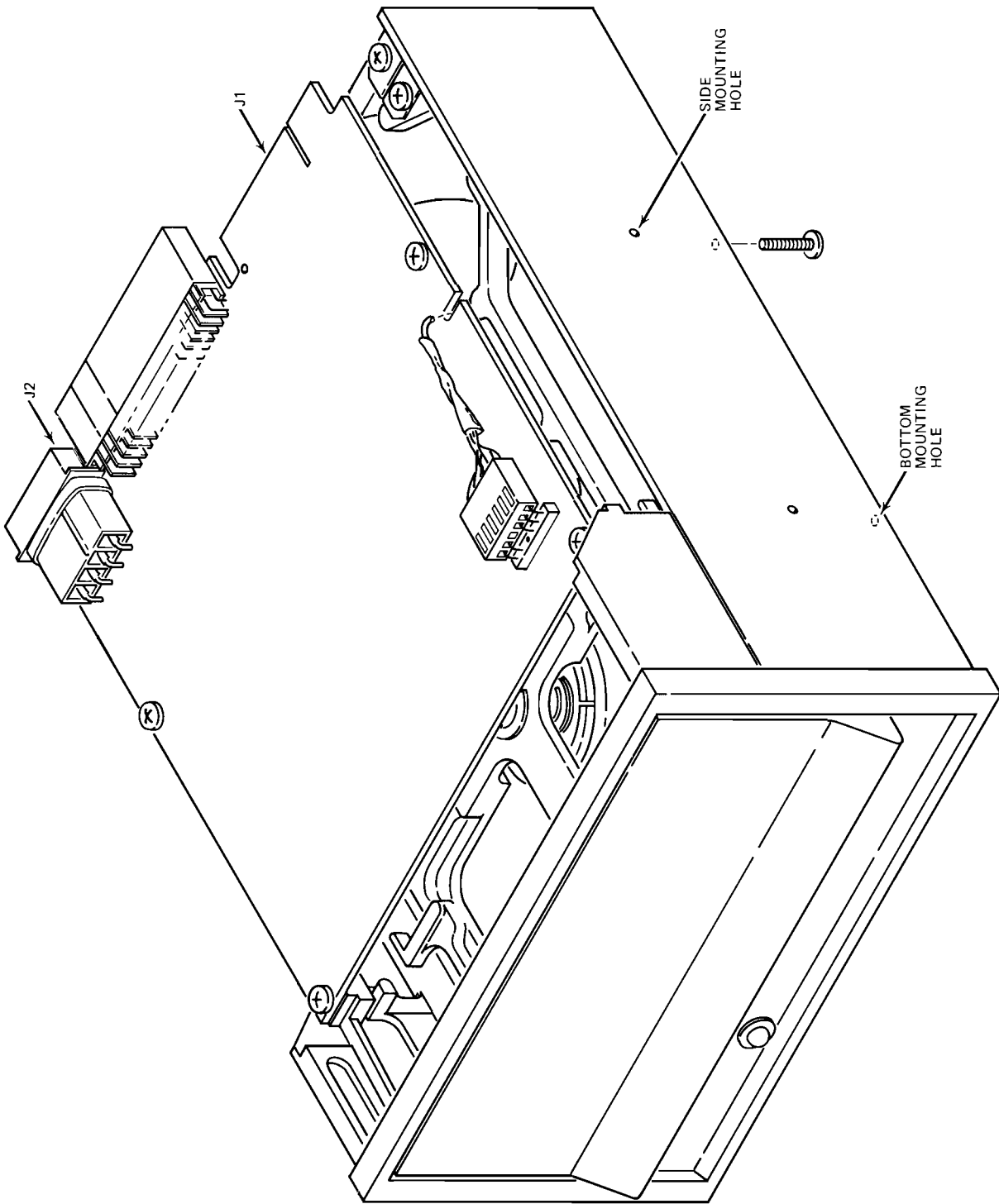


Figure 2-1. Model FDD100-5 Disk Drive, Isometric View

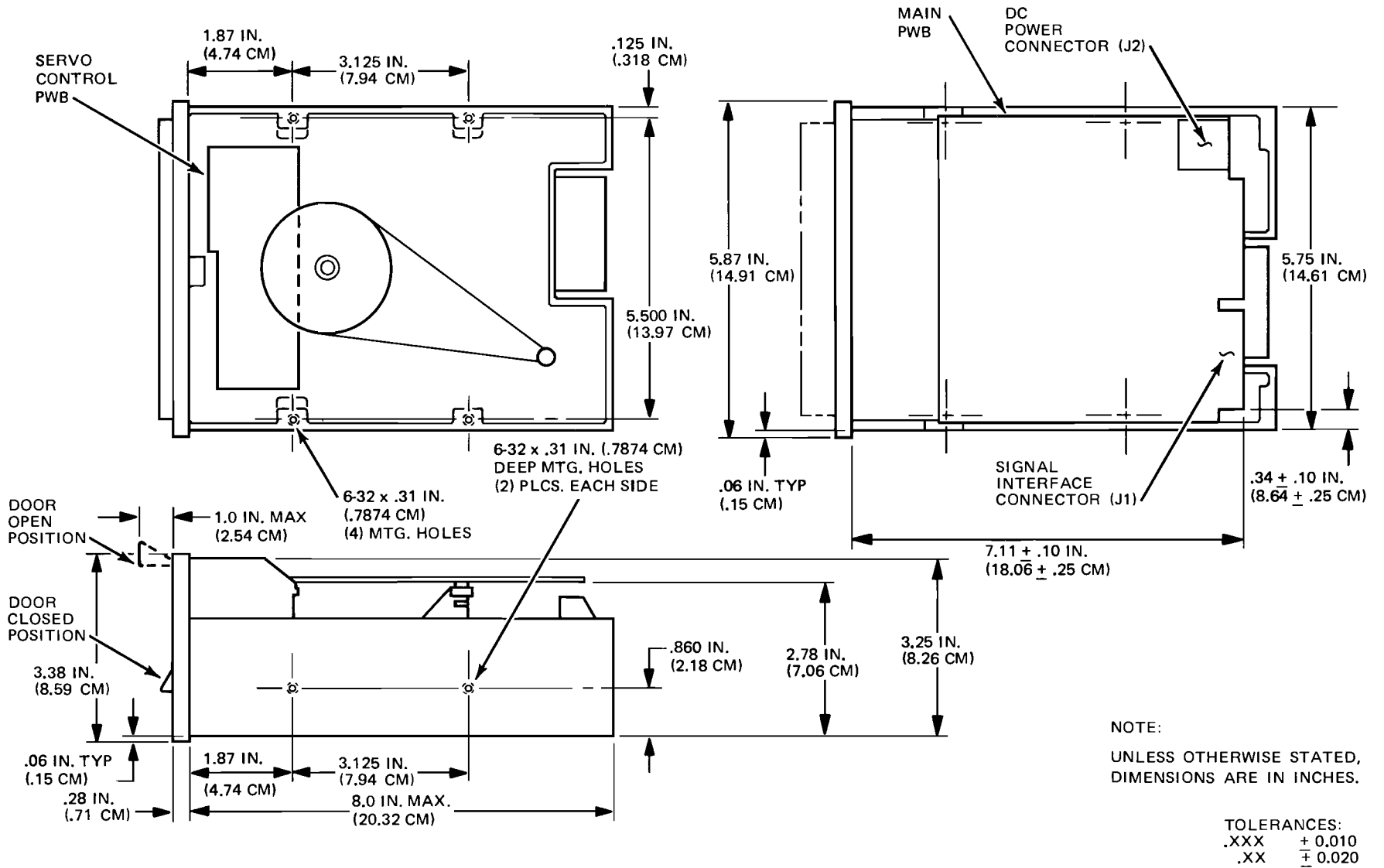


Figure 2-2. Outline and Mounting Dimensions

### 2.3.1 SYSTEM CONFIGURATION

The Model FDD100-5 Disk Drive can be connected in either a star or daisy-chain configuration as shown in Figure 2-3.

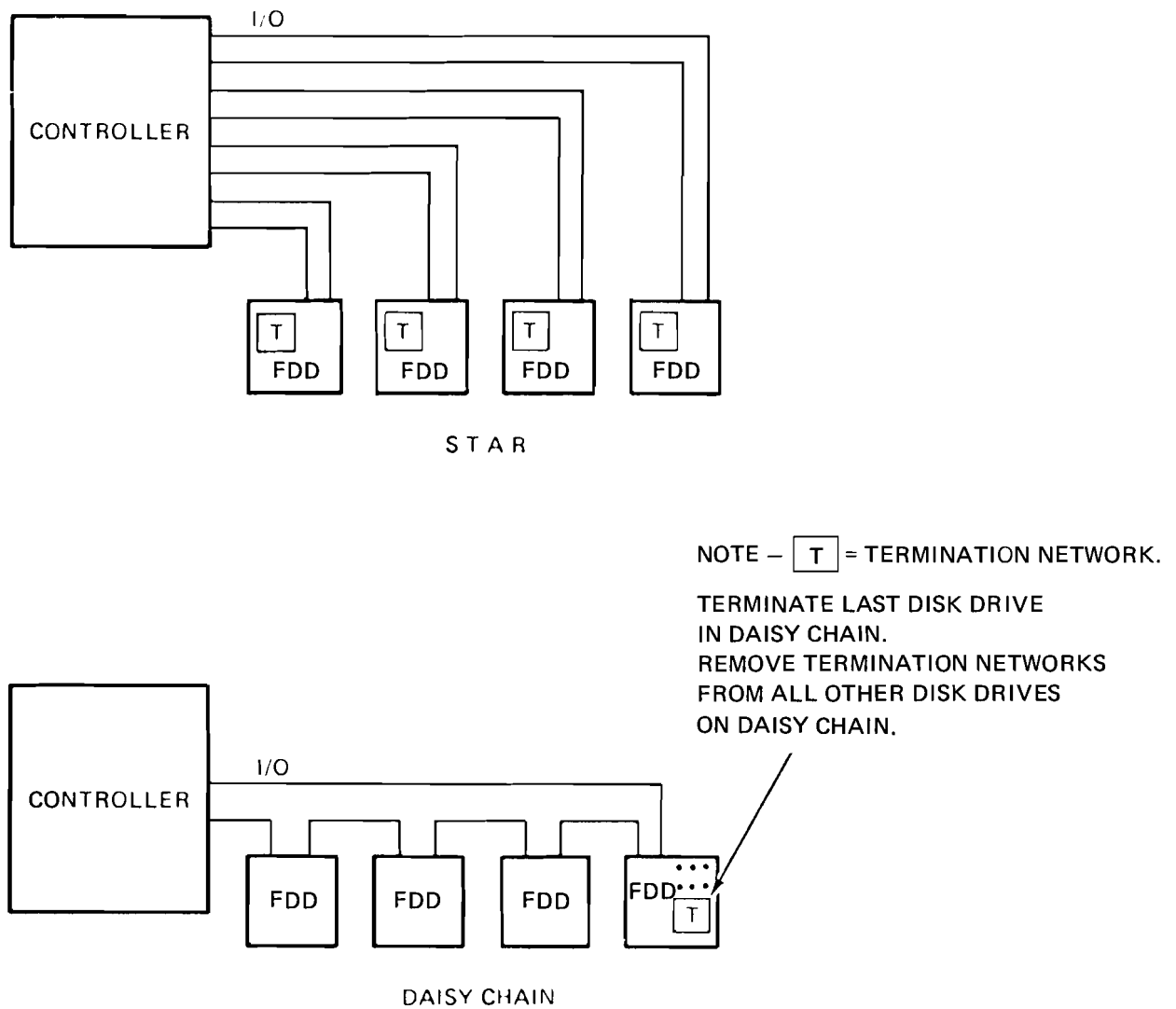


Figure 2-3. Model FDD100-5 Disk Drive System Configurations.

In the star configuration, each disk drive requires a termination network; in the daisy-chain configuration, only the last disk drive in the daisy chain requires a termination network. Either system configuration can interface with up to four Model FDD100-5 Disk Drives.

### 2.3.2 ELECTRICAL CONNECTORS

The interface between the Model FDD100-5 Disk Drive and the controller consists of two connectors: J1 and J2. J1 provides the signal interface and J2 provides DC power. There is also a frame ground "Fast-On" terminal.

**2.3.2.1 Signal Interface Connector.** The signal interface (J1) is a 34-pin PWB edge connector with dimensions as shown in Figure 2-4. Even-numbered pins are located on the component side of the PWB, and odd-numbered pins are located on the solder side. Pin 2 is located closest to the corner of the PWB. A slot is provided between pins 4 and 6 for connector keying. The recommended connectors for P1 are listed in Table 2-1.

Table 2-1. Recommended Connectors – P1

Type of Cable	Manufacturer	Connector P/N	Contact P/N
Twisted Pair, 26	AMP	583717-5	1-583616-1
Flat Cable	3M "Scotchflex"	3463-0001	N.A.

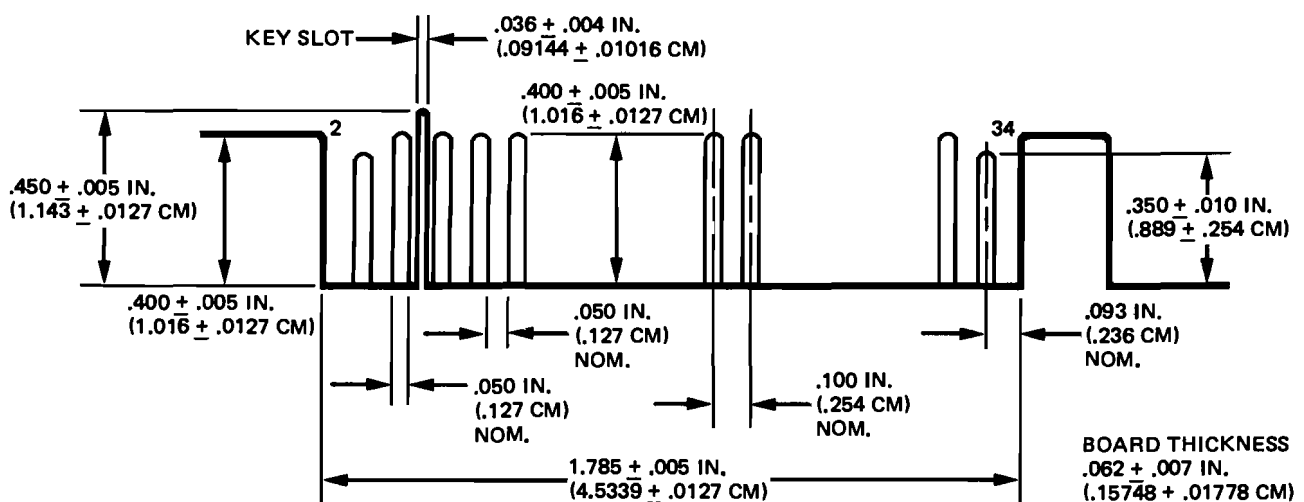


Figure 2-4. J1 Connector Dimensions

2.3.2.2 Power Connector. The DC power connector (J2) is mounted opposite to J1 on the component side of the PWB. Power connector J2 is a 4-pin AMP P/N 1-480426-0. The recommended mating connector for P2 is AMP P/N 1-480424-0 that uses AMP pins P/N 60619-1. The recommended wire size is No. 18 AWG. Figure 2-5 shows the pin-numbering sequence of J2. The +5V and +12V power returns are tied together and connected to the chassis at the disk drive.

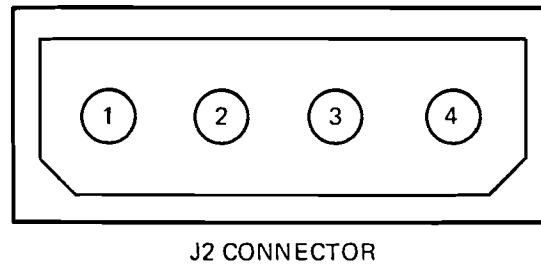


Figure 2-5. J2 Connector Outline

2.3.2.3 Frame Ground. The Model FDD100-5 Disk Drive must be grounded to the controller to ensure proper operation and low noise susceptibility. The AC ground or neutral wire should be connected to the disk drive frame. A Fast-On tab is provided on the disk drive. This tab is an E.T.C. P/N 3431, and the mating connector is AMP P/N 60972-1. Means for AC coupling only between frame and logic ground are provided on the main disk drive PWB; however, use of this feature may increase noise susceptibility in the disk drive. Modification is made by removing R53 (1M) from main disk drive PWB.

### 2.3.3 TRANSMITTER CHARACTERISTICS

The Model FDD100-5 Disk Drive uses an SN7438 IC or equivalent to transmit all control and data signals. This IC can sink 48 milliamperes at a low level of 0.4-volt. Output signals are to be terminated by a 132-Ohm resistor network at the controller interface.

### 2.3.4 RECEIVER CHARACTERISTICS

The Model FDD100-5 Disk Drive uses an SN7414 IC or equivalent to receive all transmitted signals from the controller. The input of each receiver is terminated by a resistor network.



### 2.3.5 TERMINATOR

The resistor network that is used to terminate all input signals is inserted in or removed from a socket on the PWB. Network impedance is 132 Ohms provided by a 220-Ohm resistor to +5V together with a 330-Ohm resistor to DC ground as shown in Figure 2-6. Each Model FDD100-5 Disk Drive is shipped with a terminator installed.

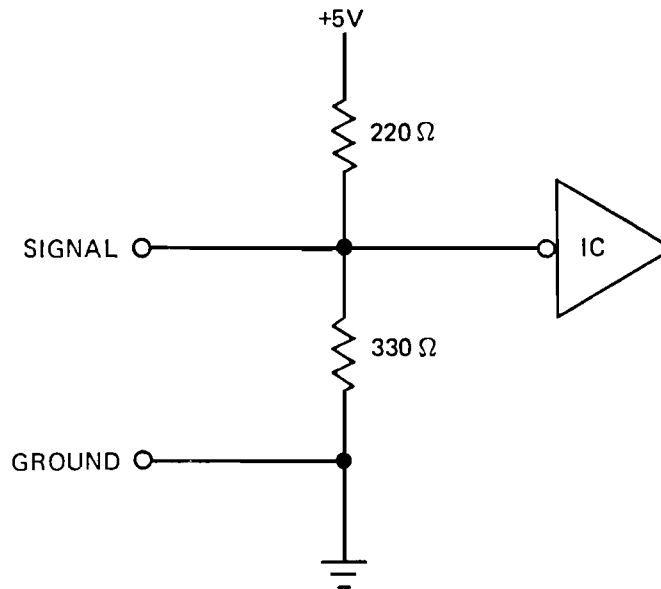


Figure 2-6. Termination Configuration

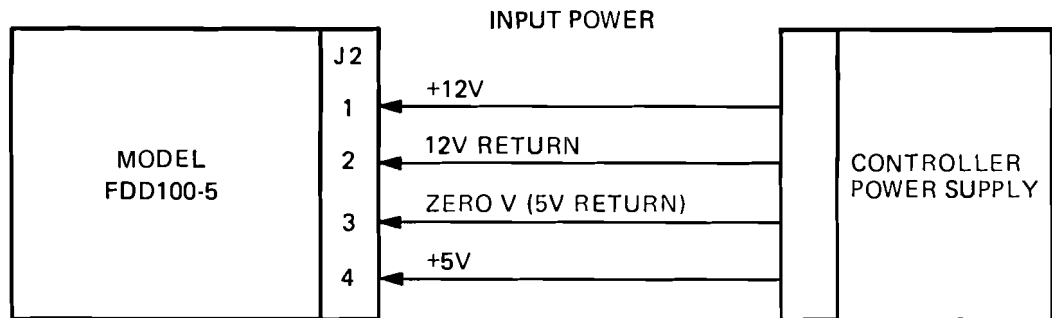
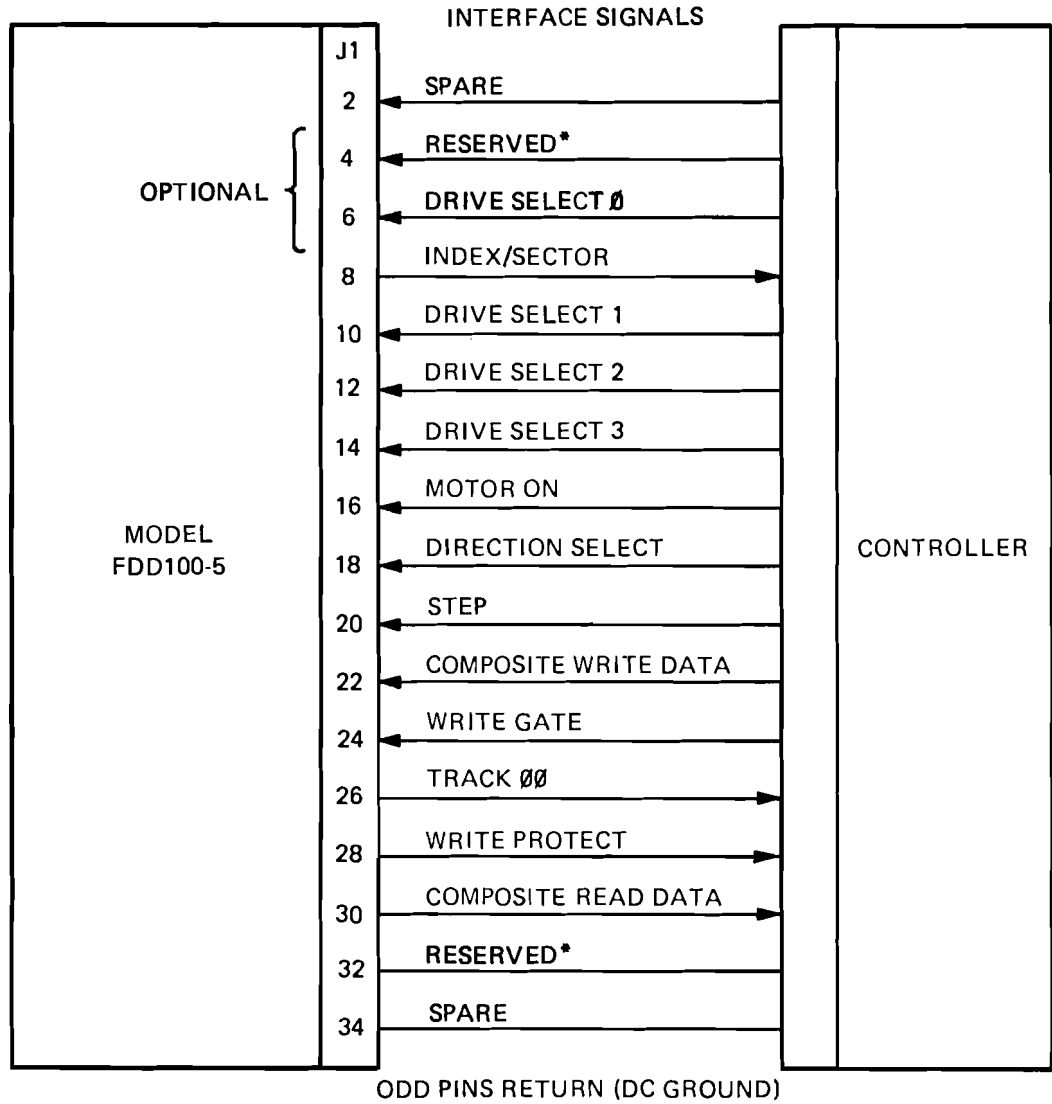
## 2.4 INTERFACE SIGNALS

A diagram of the Model FDD100-5 Disk Drive interface signals is shown in Figure 2-7, and the interface signal timing requirements are shown in Figure 2-8.

### 2.4.1 INPUT CONTROL LINES

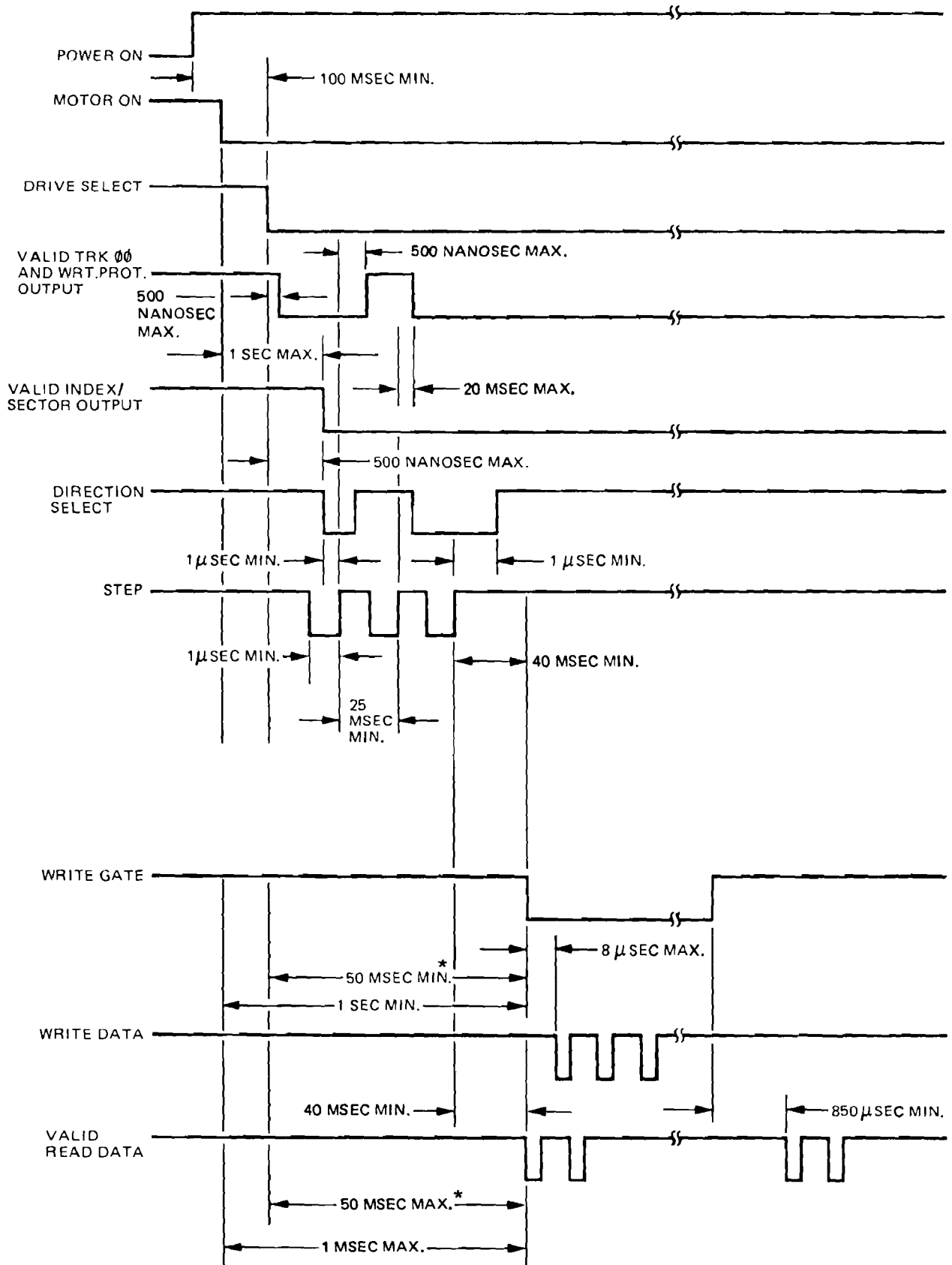
Input control signals are carried by eight lines; one of which is optional.

**2.4.1.1 Drive Select Lines.** There are four Drive Select lines: DS1 (J1-10), DS2 (J1-12), and DS3 (J1-14) are standard, and DS0 (J1-6) is optional. A low (true) level on any one of these lines allows the controller to communicate with the disk drive assigned to that line. During all communication with the disk drive, the line must remain true because all transmitters and receivers are gated



\*THESE PINS HAVE BEEN RESERVED FOR USE BY THE MODEL FDD200-5 DISK DRIVE.

Figure 2-7. Interface Signals and Input Power



\*IF HEAD LOAD WITH SELECT. IF HEAD IS ALREADY LOADED 500 NANOSECONDS.

Figure 2-8. Interface Timing Diagram

with a corresponding Drive Select line; therefore, they can be activated only by the corresponding Drive Select command from the controller. In a multiple-drive system, the user must alter the program shunt module to allow the multiplexing of the I/O lines. An optional interface line may be assigned to the DS0 (J1-6) line.

2.4.1.2 Motor On (J1-16). This feature is provided for the user to directly control (via the interface) the DC spindle motor. A low level at the interface turns the spindle motor on. The spindle takes one second after this line is activated to come up to speed. A one second delay should occur after motor on and before any reading or writing is attempted. If such a feature is not desirable, the spindle motor can be kept on by permanently grounding the Motor On line; however, use of this feature is recommended to reduce average power consumption and increase overall life of the disk drive. If the Motor On signal is used, the program shunt module may require changing if the Head Load with Motor On option is selected.

2.4.1.3 Direction Select (J1-18). This line controls the direction of travel of the read/write head. A low level on this line causes the head to move toward the center of the spindle only when a Step pulse occurs. The Direction Select signal should be stable from 1.0 microsec. before to 1.0 microsec. after the trailing edge of Step.

2.4.1.4 Step (J1-20). A low pulse on this line, together with Direction Select, initiates a single-track move of the head. Head movement begins on the trailing edge of this pulse. Minimum pulse width should be not less than 1.0 microsecond and the maximum pulse repetition rate should be one pulse every 25 milliseconds.

2.4.1.5 Write Gate (J1-24). A low level on this line enables Composite Write Data to be written on the diskette. A high (false) level on this line enables the stepper motor logic and Composite Read Data line so that Read data may be read from the diskette.

## 2.4.2 OUTPUT LINES

Output signals from disk drive to controller are carried by three lines; Track 00, Index/Sector, and Write Protect.

2.4.2.1 Track 00 (J1-26). A low level on this line informs the controller that the position of the read/write head is at track 00. Subsequent step-out pulses are ignored by the disk drive.

2.4.2.2 Index/Sector (J1-8). For soft sector operation that uses single-hole media, this line transmits a reference Index pulse once every diskette rotation to indicate the beginning of a track. For hard sector operation that uses multi-hole media, this line transmits the Index pulse and all Sector pulses, where Sector pulses indicate the beginning of a sector. Pulse width for both Index and Sector is  $4 \pm 1.5$  milliseconds. An optional set of photosensors are installed on some configurations of the Model FDD100-5 Disk Drive to enable either side of the diskette to be recorded. Index/Sector timing is shown in Figure 2-9.

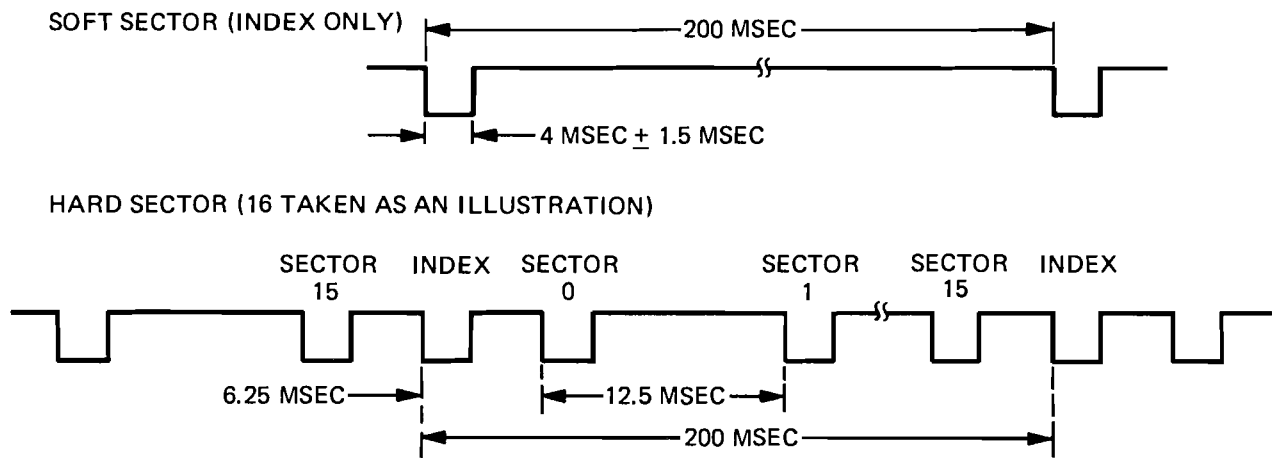


Figure 2-9. Index/Sector Timing

2.4.2.3 Write Protect (J1-28). A photosensor assembly senses the presence or absence of a notch in the diskette. If a notch is not detected, a low-level signal is transmitted to the controller to indicate that a Read-only diskette has been inserted into the Model FDD100-5 Disk Drive. This condition also inhibits writing data on the diskette.

### 2.4.3 DATA LINES

Data lines are used to write data on or to read data from the diskette.

2.4.3.1 Composite Write Data (J1-22). The controller uses this line to transmit information to be encoded on the diskette of the selected disk drive. Pulse widths of clock and data bits should

be a minimum of 250 nanoseconds and a maximum of 2.1 microseconds. At 125 kHz, the clock interval is 8 microseconds, while the clock-to-data or data-to-clock interval is 4 microseconds. The write clock frequency should be held within  $\pm 0.5$  percent. Write timing is shown in Figure 2-10.

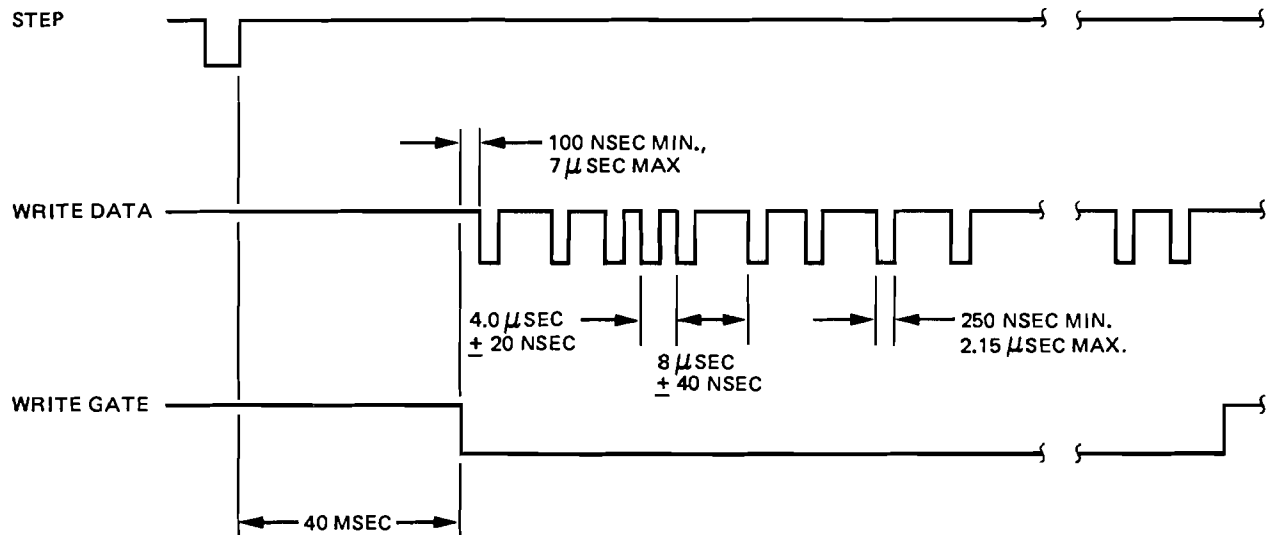
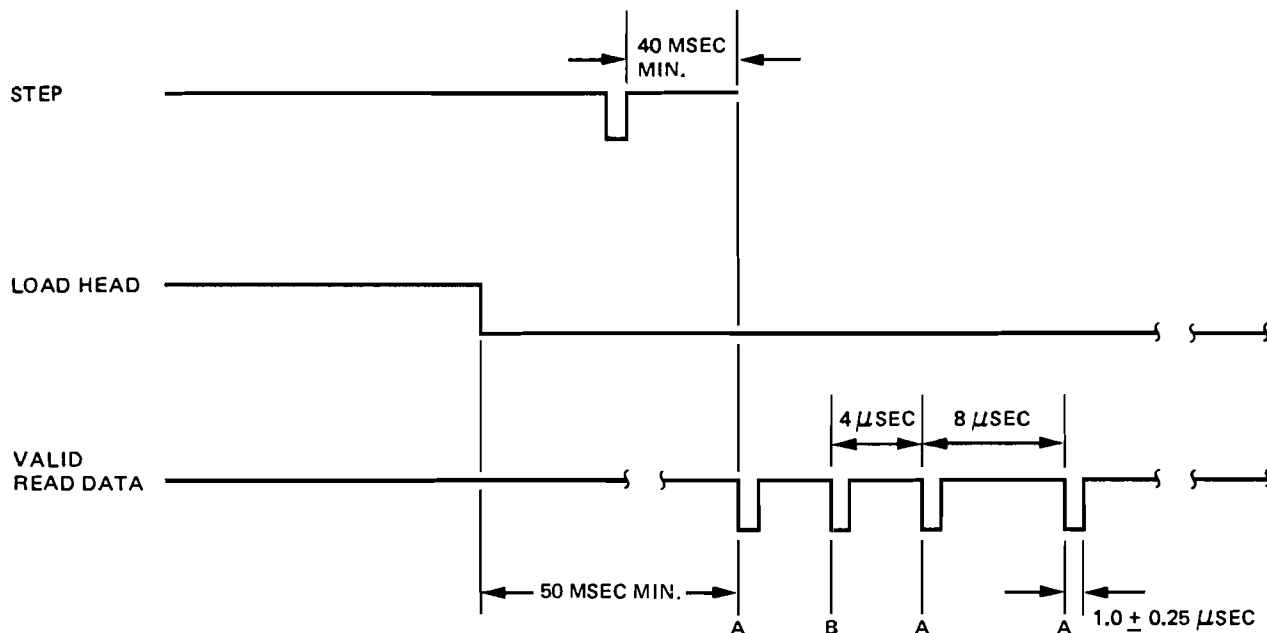


Figure 2-10. Write Timing

2.4.3.2 Composite Read Data (J1-30). This line furnishes previously recorded information to the controller. Information is transmitted in the encoding scheme used without discriminating between clock and data bits. Decoding of data is accomplished by the controller. Data and clock pulse widths are 1 microsecond  $\pm 250$  nanoseconds at the encoded frequency. Read timing is shown in Figure 2-11.

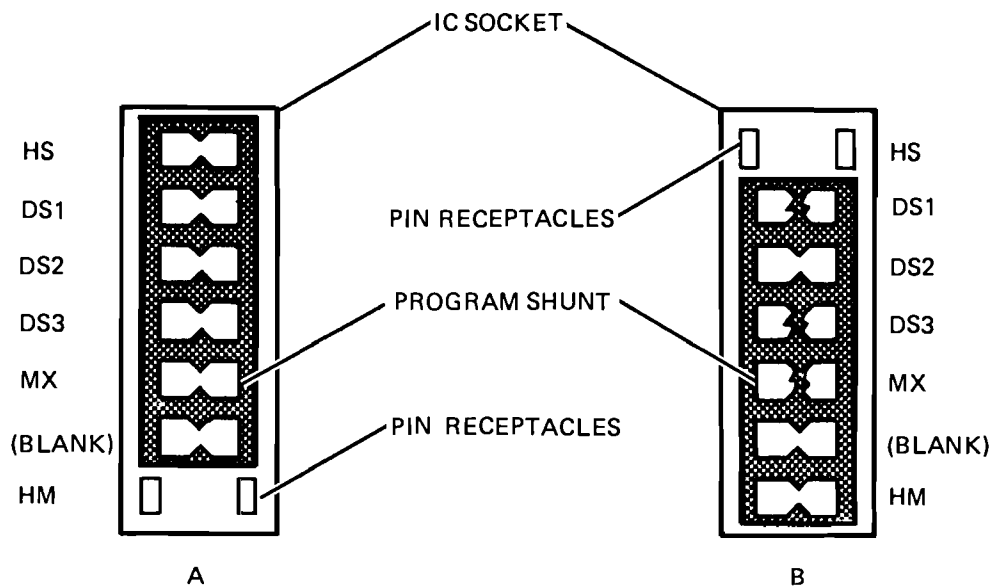
## 2.5 PROGRAM SHUNT MODULE

Figure 2-12 shows the program shunt module with the program shunt installed. The module is an IC socket located on the PWB near J1. The IC socket has seven sets of pin receptacles, while the program shunt has six sets of pins. One set of pin receptacles at either end of the IC socket is always unused.



A – LEADING EDGE OF BIT MAY BE  $\pm 800$  NSEC FROM ITS NOMINAL POSITION  
 B – LEADING EDGE OF BIT MAY BE  $\pm 400$  NSEC FROM ITS NOMINAL POSITION

Figure 2-11. Read Timing



- SINGLE DRIVE CONFIGURATION
- HEAD LOAD WITH DRIVE SELECT

- MULTIPLE DRIVE CONFIGURATION
- HEAD LOAD WITH MOTOR ON
- DRIVE NUMBER 2 PROGRAMMED

HS – HEAD SELECT – HEAD IS LOADED BY DRIVE SELECT SIGNAL  
 DS1 – DRIVE SELECT 1 – SELECT SIGNAL FOR DRIVE ONE.  
 DS2 – DRIVE SELECT 2 – SELECT SIGNAL FOR DRIVE TWO.  
 DS3 – DRIVE SELECT 3 – SELECT SIGNAL FOR DRIVE THREE.  
 MX – MULTIPLEX – MUST BE CUT FOR MULTIPLE DRIVE CONFIGURATION.  
 HM – HEAD MOTOR – HEAD IS LOADED BY MOTOR ON SIGNAL.

Figure 2-12. Program Shunt Module

### 2.5.1 HS – HEAD SELECT OPTION

The Head Select option causes the head of the disk drive to load when the Drive Select signal is received. The program shunt is installed so that the HS position is short circuited (see Figure 2-12A). The HS position can be used in either single-drive or multiple-drive configuration.

### 2.5.2 HM – HEAD MOTOR OPTION

The Head Motor option causes the head of the disk drive to load when the Motor On signal is received. The program shunt is installed so that the HM position is short circuited (see Figure 2-12B). The HM position can be used in either single-drive or multiple-drive configuration.

### 2.5.3 SINGLE-DRIVE CONFIGURATION

With a single-drive configuration, the program shunt need not be altered in any way except to select either the HS or HM positions. Any Drive Select signal will activate the Select Light and load the head if HS is programmed.

### 2.5.4 MULTIPLE-DRIVE CONFIGURATION

With a multiple-drive configuration, the MX (Multiplex) position and two of the three DS (Drive Select) positions must be cut (see Figure 2-12B). The shunt positions can be cut by using AMP special tool, P/N 435705, or by bending the leg of the program shunt away from the socket before installation to provide the necessary open-circuit condition.

## 2.6 OPTIONS

The Model FDD100-5 Disk Drive can be modified by the customer to operate by other than the standard methods described in subsection 2.5. The modifications can be made by connecting option pads or cutting jumpers, or by using the optional interface lines at J1 connector pins 2, 4, 6, 32, and 34, or by altering the program shunt module. Available options are listed and described in Table 2-2.



Table 2-2. Options

Option	Modification
Drive Select $\emptyset$ (DS0)	Adds DS0 input line to spare interface line so that system can accommodate four disk drives. If J1-6 is designated as DS0, cut etch between pads E and F, then add jumper between pads E and G.
Write Protect to Interface Only	This option indicates to the interface that a Write Protected or Non-Write Protected diskette is installed in the disk drive; <u>it does not inhibit writing.</u> Cut etch between pads C and D.
Write Inhibit Controlled by Interface Line	Cut etch between pads C and D, then add jumper from pad C to pad associated with spare interface line.
Independent Head Load (Pin J1-6)	Add jumper between pads E and R. Modify program shunt module to select <u>neither</u> HM nor HS.
Motor On with Select	Cut etch between pads M and N; then add jumper between pads G and P.
Indicator Lamp with Motor On	Cut etch between pads G and H; then add jumper between pads H and P.
Indicator Lamp with Interface Only	Cut etch between pads G and H; then add jumper from pad H to pad associated with selected spare interface line.
Select Disk Drive without Loading Head	Place program shunt module in HM position. (Load head only with Motor On signal.)
<p>Note</p> <p>Upon implementing any optional modification, verify that associated interface line is properly terminated.</p>	



## SECTION 3

### OPERATION PROCEDURES

#### 3.1 GENERAL

There are no front panel controls on the Model FDD100-5 Disk Drive. A single front panel indicator lamp lights when the disk drive is selected. All power and control functions are handled through the interface. Operating procedures consist primarily of loading and unloading the diskette. Adjustments and corrective maintenance procedures are covered in Section 5, Maintenance.

#### 3.2 DISKETTE

The diskette recording medium is contained in a sealed envelope that measures 5.25 inches (13.335 cm) square. The diskette recording medium is 5.125 inches (13.0175 cm) in diameter and is made of mylar coated with magnetic oxide on both sides. The diskette has 40 circular tracks that are spaced 0.02083-inch (0.529082 mm) apart.

#### 3.3 DISKETTE HANDLING

Protection of the diskette requires the same careful handling specified for computer magnetic tapes. Use the following procedure:

- A. Return the diskette to its storage envelope whenever it is removed from the disk drive.
- B. Keep diskettes away from magnetic fields and ferromagnetic materials.
- C. Replace storage envelopes when they become worn, cracked, or distorted.
- D. Do not write on the plastic jacket with a lead pencil or ball-point pen; use a felt-tip pen.
- E. Do not touch or try to clean the diskette surface. Abrasions may cause loss of data.
- F. Do not expose diskette to heat or sunlight. Exposure to temperatures in excess of 51.6°C (125°F) may cause irreversible damage to the diskette.

### 3.4 LOADING THE DISKETTE

To load the diskette, open the door on the front panel of the Model FDD100-5 Disk Drive, insert the diskette, and close the door. A door interlock mechanism prevents the door from closing if the diskette is not properly loaded. The door may be closed without a diskette being loaded.

### 3.5 WRITE PROTECT FEATURE

The diskette is protected from being written on when a Write Protect tab is used. Figure 3-1 shows an unprotected (Read and Write), and a Write-protected (Read-only) diskette. A photoelectric sensor detects the presence or absence of a notch in the side of the diskette. When the open notch is sensed, writing is allowed. When the notch is not sensed (covered with a tab), writing is inhibited, and a status signal informs the controller that a Write Protect condition exists. Optional modification to the disk drive electronics may cause the Write Protect signal to go only to the disk drive/controller interface which will not inhibit writing on the diskette.

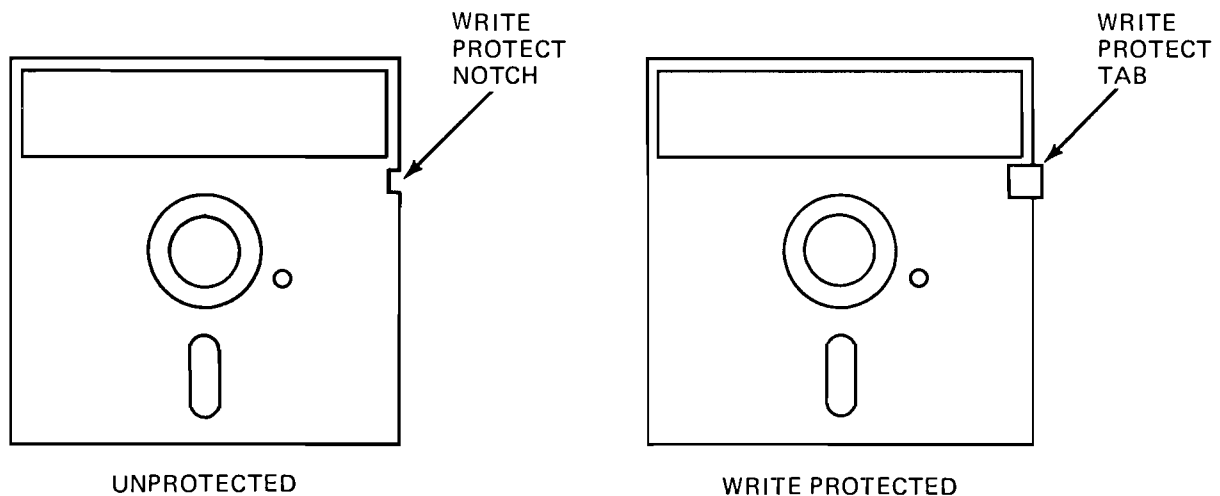


Figure 3-1. Write Protect Feature

## SECTION 4

### THEORY OF OPERATION

#### 4.1 FUNCTIONAL DESCRIPTION

Figure 4-1 is a functional block diagram that shows overall operation of the Model FDD100-5 Disk Drive. The disk drive has one main PWB which contains Read, Write, and Control logic, and a small servo control PWB which contains the speed-control circuit for the spindle drive motor.

##### 4.1.1 DRIVE SELECT

Disk drive selection occurs when the Drive Select line that corresponds to a particular disk drive is active. Only the disk drive in which this line is active will respond to input lines. Under normal operation, the Drive Select line will load the read/write (R/W) head, enable the input lines, and activate the output lines. Optional modes of operation are available to the user.

##### 4.1.2 POWER-UP MODE

The two DC power sources can be applied to the disk drive in any sequence; however, once power has been applied, a 1-second delay must be allowed before any Read or Write operation is attempted. This delay is for stabilization of the diskette rotational speed and must be allowed any-time the Motor On line is activated. When DC power is applied, a Power On Reset (POR) pulse automatically resets the electronics and inhibits inadvertent writing or erasing on the diskette. Therefore, the disk drive is ready for operation after application of DC power and one second after activation of Motor On; also, the initial position of the R/W head with respect to data tracks is indeterminate immediately after application of DC power. To ensure proper positioning of the R/W heads before any Read or Write operation, a Step Out operation for each disk drive should be performed until the Track  $\emptyset\emptyset$  status signal becomes active.

##### 4.1.3 HEAD LOAD SIGNAL LINE (OPTION)

The Head Load signal is applied through control logic to the Head Load solenoid. The solenoid allows the diskette envelope with its rotating media to be pushed against the R/W head so that contact is made through the slot in the envelope. The Head Load signal line is optional. Without the use of this option, the head is loaded when either the Drive Select or Motor On signals are activated.

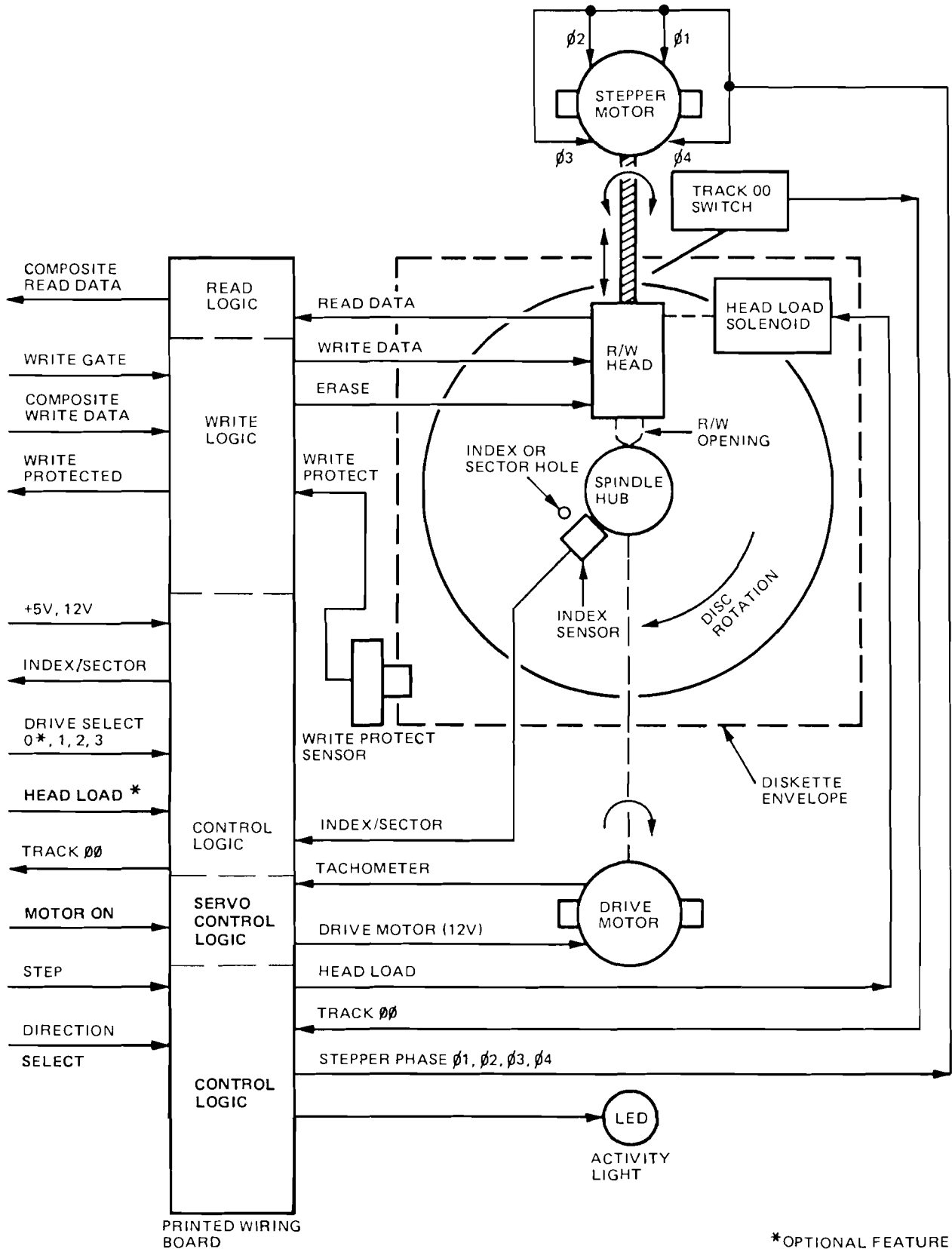


Figure 4-1. Model FDD100-5 Disk Drive, Block Diagram

#### 4.1.4 SEEK MODE

The read/write head carriage is mounted on a threaded shaft connected to the stepper motor. As the stepper motor turns in one direction, the head is stepped outward toward the edge of the diskette. When the motor turns in the other direction, the head is stepped inward toward the spindle hub. This allows access to any track on the diskette. Direction Select from the interface or controller determines the direction of rotation of the stepper motor, while the number of Step pulses determines the amount of stepper-motor rotation. The control logic translates these input pulses into a sequential pattern of phase currents to the stepper motor. Each pulse on the Step line causes the R/W head to move one track in or out, depending on the state of the Direction Select line. Multiple-track accessing is accomplished by repeated pulsing of the Step line until the desired track has been reached. Seeking cannot occur while a Write operation is in progress.

#### 4.1.5 READ/WRITE HEAD

The Model FDD100-5 Disk Drive uses a unique single-sided read/write head assembly that is mounted on the head carriage. The head is fixed with respect to the carriage and diskette surface. The head is basically a ferrite core that is mounted in a ceramic button assembly, the face of which has a spherical profile. The head also uses a trailing tunnel-erase structure.

#### 4.1.6 SENSORS AND SWITCHES

The index sensor is a light-sensitive device which is activated whenever an index or sector hole passes it in rotation. The sensor output is a pulse which is fed back to the interface as the Index/Sector signal. The Track 00 signal is generated when the R/W head carriage trips a microswitch as it reaches track 00 on the diskette. The Track 00 signal is then transmitted back to the interface. The Write Protect sensor detects the presence or absence of a notch in the diskette envelope. If a tab is covering the notch (to indicate a Read-only diskette), a Write Protect signal is sent back to the interface. The Write Protect signal also disables the Write logic so that writing on the diskette is not possible.

#### 4.1.7 WRITE MODE

A Write operation records data on the diskette in the form of flux reversals. To write data on the diskette, certain timing relationships must be ensured. These relationships are required to avoid erasure of data due to hardware failure, unstabilized head position, or head in transit conditions (see Figure 2-8). The Write circuitry is enabled by activating the Write Gate interface line.

#### 4.1.8 ERASE MODE

The Erase circuitry is also enabled by activating the Write Gate interface line and the erase currents are applied to the R/W head erase coils when writing data. The erase poles erase an area just to each side of a track. This ensures off-track reading ability and provides capability to read during worst-case conditions.

#### 4.1.9 READ MODE

A Read operation retrieves previously recorded data from the selected diskette. This is accomplished by the winding in the read head sensing flux reversals on the diskette. The Read mode is entered on a selected disk drive by deactivating the Write Gate line. Certain timing relationships are required to ensure stabilization of the R/W head position (see Figure 2-8).

#### 4.1.10 POWER-DOWN MODE

When the +5V supply drops to an unsafe level during DC power-down, all Write and Erase circuitry is deactivated to prevent inadvertent writing or erasing on the diskette.

#### 4.1.11 SPINDLE DRIVE MOTOR

The spindle drive motor is a DC motor with an integral tachometer. It is activated by a separate Motor On interface line. This motor requires approximately one second to attain stabilized speed. The Motor On signal turns on a current driver that applies current to the motor windings. The phase of the tachometer output voltage is compared with the phase of a reference oscillator. Any phase error is converted to a voltage that is added to a constant voltage. The sum is applied to the motor drive circuit which increases or decreases the motor speed, as required, to keep the tachometer phase-locked with the reference oscillator (see paragraphs 5.8.1 – 5.8.2).



## 4.2 POSITIONING CHARACTERISTICS

Head positioning is governed by five timing characteristics:

- A. Time for a single-track move is 25 milliseconds. This is the time required to move the R/W head between any two adjacent tracks.
- B. Head settling time is 15 milliseconds. This is the time required for the head assembly to cease oscillating after the head has achieved nominal track location following a move.
- C. Random average access time (T) is 298 milliseconds (35 tracks) or 340 milliseconds (40 tracks). This time is determined from the following equation:

$$T = \frac{(\text{No. of tracks} - 1) (\text{Step time})}{3} + \text{Settle Time}$$

- D. The time to move the R/W head 39 tracks is 975 milliseconds. It is defined as the time to move the head from track 00 to track 39, or from track 39 to track 00.
- E. Head load time is 50 milliseconds. This is the time required for the head load arm to contact the diskette and settle down before a Read or Write operation begins.

## 4.3 DATA FORMAT

To perform data transfer, the operating system must be able to locate specific data areas on the diskette. Two such format schemes exist; both involve detecting and establishing a reference point on the diskette to organize data on a track and further divide this track into smaller segments called sectors. Such a subdivision can be achieved by either hard or soft sector formats. All disk drive tolerances have been taken into account in developing the formats.

### 4.3.1 HARD SECTOR FORMAT

The controller will typically record 10 or 16 sectors (records) per track due to the availability of hard-sectored diskettes in these configurations. Each track is started by an Index pulse, and each sector is started by a Sector pulse which is present on connector pin J1-8. Figure 4-2 shows a hard-sectored format. The number of sectors is determined by the number of sector holes in the diskette.

### 4.3.2 SOFT SECTOR FORMAT

The controller may record one long record or several small records in this type of format. The Index pulse starts each track, and a unique record identifier precedes each record. Figure 4-3 shows a soft-sectored format.

SECTOR SEPARATION DONE BY THE USING SYSTEM  
FM RECOMMENDED FORMAT (SINGLE DENSITY)

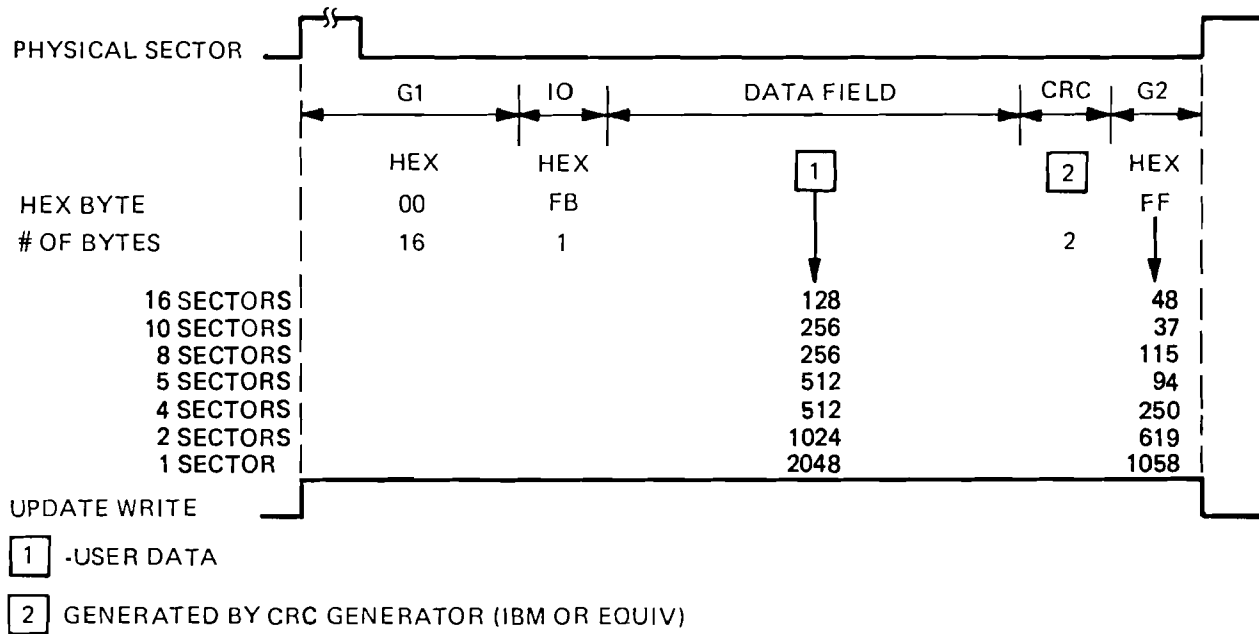
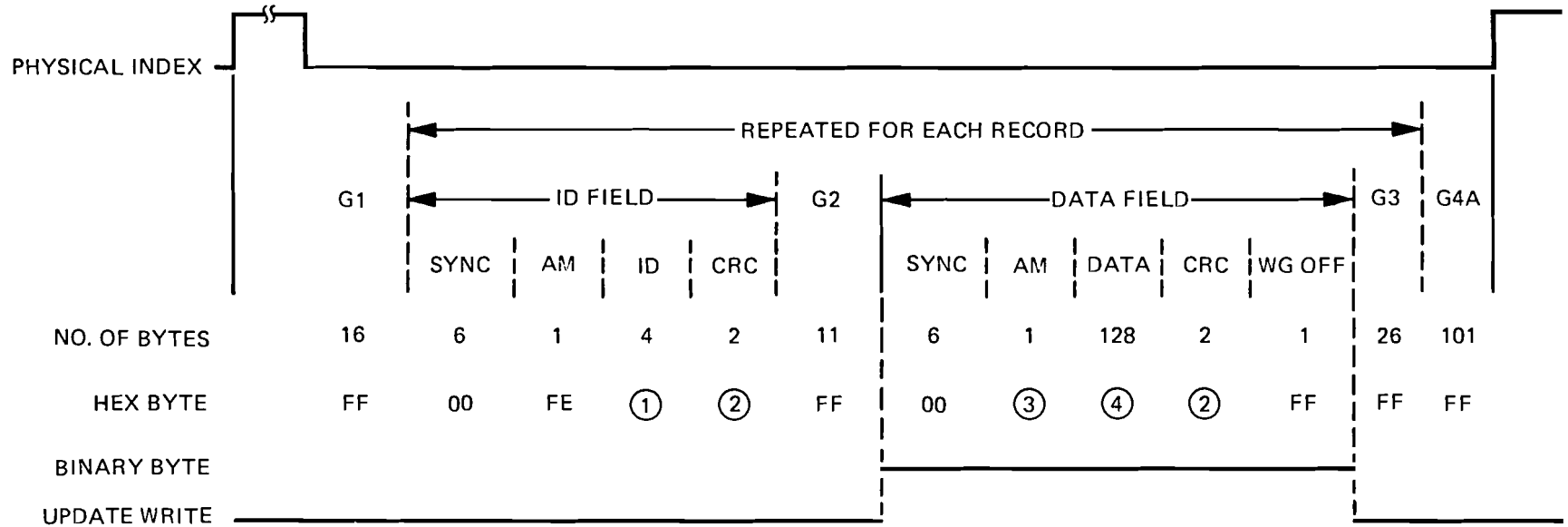


Figure 4-2. Hard-Sectored Format for Single Density



- ① - TRACK ADDRESS, ZEROES; SECTOR ADDRESS, ZEROES.
- ② - GENERATED BY CRC GENERATOR (IBM OR EQUIVALENT).
- ③ - FB FOR DATA FIELD, OR F8 FOR DELETED DATA FIELD.
- ④ - USER DATA.

Figure 4-3. Soft-Sectored Format (128 Bytes/Sector, 16 Sectors)



## SECTION 5

### MAINTENANCE

#### 5.1 RELIABILITY

To establish mean time between failures, mean time to repair, and service life, operation time must be greater than 10,000 hours, and field performance data from all field sites must be used in the calculation.

##### 5.1.1 MEAN TIME BETWEEN FAILURES (MTBF)

MTBF is derived from the following expression:

$$\text{MTBF} = \frac{\text{Operating Hours}}{\text{Number of Failures}}$$

Operating hours means power-on hours minus any maintenance times. The MTBF design goal for the Model FDD100-5 Disk Drive is 8500 hours.

##### 5.1.2 MEAN TIME TO REPAIR (MTTR)

This is defined as the average time for an adequately trained service engineer to diagnose and correct problems on-site. MTTR for the Model FDD100-5 Disk Drive is 30 minutes and does not include travel time or time when the disk drive is not released to the service engineer.

##### 5.1.3 SERVICE LIFE

The Model FDD100-5 Disk Drive is designed and constructed for a minimum useful life of five years.

#### 5.2 DIAGNOSTIC TECHNIQUES

Incorrect operating procedures, faulty programming, damaged diskettes, and soft errors created by airborne contaminants, random electrical noise, and other external causes, can produce errors

that may be falsely attributed to disk drive failure or maladjustment. Unless visual inspection of the disk driver discloses an obvious misalignment or broken part, attempt to repeat the fault with the original diskette; then attempt to duplicate the fault on a second diskette.

### 5.3 ERROR RATES

Errors may occur in Write, Read, or Seek operations. The error rate for each of these operations is defined in the following paragraphs.

#### 5.3.1 WRITE ERROR RATE

For successful writing of a record, the Write operation should always be followed by a Write Check or Read operation during the next diskette rotation. Not more than five such Write and verification attempts is recommended. If a record cannot be successfully written within five attempts, that sector or track must be labeled defective and an alternate sector or track must be assigned. If more than two defective tracks are encountered, the diskette should be replaced.

#### 5.3.2 READ ERROR RATE

If a Read error occurs, up to ten attempts should be made to recover data. Repositioning the head on the desired track is recommended if the error persists. The Read recoverable error rate is not greater than 1 in  $10^9$  bits transferred. The Read unrecoverable error rate is not greater than 1 in  $10^{12}$  bits transferred.

#### 5.3.3 SEEK ERROR RATE

Unless the stepping rate is exceeded, seek errors will rarely occur. Recalibration of track location can be achieved by initiating Step commands until track  $\emptyset\emptyset$  is sensed. The seek error rate is not greater than 1 in  $10^6$  seeks.

### 5.4 ERROR DETECTION AND CORRECTION

Detection and correction of write and read errors is described in the following paragraphs.

#### 5.4.1 WRITE ERRORS

If an error occurs during a Write operation, it will be detected on the next diskette rotation by doing a Read operation commonly called a "Write Check." To correct the error, another Write and Write Check operation must be done. If the Write operation is not successful after five attempts, error correction should be attempted on another track. If the error persists, the diskette should be considered defective and be discarded or re-initialized.

#### 5.4.2 READ ERRORS

Most errors that occur will be "soft" errors; that is, by performing an error recovery procedure, the data will be recovered.

Soft errors are usually caused by any of three conditions:

- A. Airborne contaminants that pass between the R/W head and the diskette surface. These contaminants will generally be removed by the cartridge self-cleaning wiper.
- B. Random electrical noise which usually lasts for a few microseconds.
- C. Small defects in the written data and/or track, not detected during the Write operation and which may cause a soft error during a Read operation.

5.4.2.1 Soft Error Recovery Procedure. To recover soft errors, the following procedure is recommended:

- A. Reread the track five times or until such time as the data are recovered.
- B. If data are not recovered after performing step A, access the head to the adjacent track in the same direction previously moved, then return to the desired track and repeat step A.
- C. If data are not recovered, the error is not recoverable.

#### 5.5 ALIGNMENT DISKETTE

The Alignment Disk, (Dysan P/N 282 or 224/2) is available from Dysan Corp., Santa Clara, California. This special tool is used to perform the following alignments and adjustments:

- A. R/W head radial adjustment using track 16.
- B. Index photo detector alignment using track 01 and track 35.
- C. Identification of track zero. Read track 00 with a 125 KHz signal (2F). This test is used to determine if the head is positioned over track 00 when the track 00 output in the interface is at a low (true) level.

USE CARE TO PRESERVE PRERECORDED ALIGNMENT TRACKS. THE WRITE PROTECT TAB SHOULD ALWAYS BE INSTALLED ON THE ALIGNMENT DISKETTE TO PREVENT ACCIDENTAL WRITING ON ITS SURFACE.

## 5.6 REMOVAL AND REINSTALLATION PROCEDURES

For assembly and component locations, refer to the illustrated Parts Breakdown in Appendix D. All item numbers refer to the Illustrated Parts Breakdown, Figure D-1 (overall view).

### 5.6.1. FRONT BEZEL

To remove and reinstall the front bezel, use the following procedure:

- A. Close door
- B. Using a screwdriver, carefully bend the two tabs located on the top sides of the bezel (item 26) inward and push forward off the tabs on the diskette guides. (items 9 and 10)
- C. Open door
- D. Carefully push two plastic studs on lower portion of front bezel forward through two retainers (item 75) from bottom of disk drive.
- E. To reinstall, open door and push the two plastic studs into the two retainers. Close door and push upper portion of bezel onto the tabs on the diskette guides. The ends of the diskette guides must be fully seated in the bezel for the tabs to lock into the notch on the bezel tabs.



## 5.6.2 DRIVE MOTOR ASSEMBLY

To remove and reinstall the drive motor assembly, use the following procedure:

- A. Remove drive belt (item 25) (remove from large pulley first).
- B. Disconnect connector P6-2 from servo control PWB (item 3).  
Cut wire ties to free drive motor wires.
- C. Remove head cable connector, four screws (item 84) which attach PWB and fold back main PWB (about 120°).
- D. Remove drive motor mounting screws and washers (items 68, 69, & 70).
- E. Remove drive motor and carefully route wires through hole in disk drive main frame.
- F. Reinstall by reversing steps A-E and replace wire ties.
- G. Adjust motor speed (see paragraphs 5.8.1 & 5.8.2).

## 5.6.3 STEPPER MOTOR AND LEAD SCREW

To remove and reinstall the stepper motor and lead screw, use the following procedure:

- A. Remove head cable connector and main harness connectors.
- B. Remove four screws (item 84) which attach PWB and remove PWB.
- C. Remove two screws, washers and motor clamps (items 64, 65 and 66) that attach stepper motor.
- D. Remove E-ring (item 61) and washer (item 62) from front end of lead screw.
- E. Remove stepper motor through back by gently turning lead screw in a counterclockwise (CCW) direction, as viewed from back of motor, to disengage head/carriage assembly.
- F. Reinstall by reversing steps A-E. When replacing antibacklash nut and spring (item 51) it must be positioned with 0.010-0.030 inch (0.0254-0,0762 cm) clearance between antibackwash nut and carriage. (figure 5-2).
- G. Adjust head radial alignment (see paragraph 5.8.6).

#### 5.6.4 HEAD AND CARRIAGE ASSEMBLY

To remove and reinstall the head and carriage assembly, use the following procedure:

- A. Close door and remove motor cover plate (item 54) by carefully peeling it off from the motor body.
- B. Remove stepper motor lead screw per paragraph 5.6.3. For replacement of head and carriage assembly it is not necessary to remove motor body.
- C. Loosen screws (item 79). Move guideshaft towards the front of the drive to free head cable from underneath the guide shaft. Cut tie end to free cable from frame.
- D. Move carriage up and away from the guide rod and gently remove the head assembly.
- E. To reinstall, reverse above procedure. Be careful to ensure that there is enough slack in the head cable to allow carriage to go to track 00 and the cable is routed properly.
- F. Align head to correct track position by using alignment disk. Head assembly will be approximately in alignment if stepper motor body is not removed.
- G. Readjust track 00/39 stop if necessary (see paragraph 5.8.5).
- H. Replace motor cover plate (item 54), if damaged, use new part.

#### 5.6.5 READ/WRITE HEAD LOAD PAD

This assembly could be easily replaced by merely compressing the slot while pushing it out. To install merely push the assembly, and it will snap into place. Using alignment disk, display the signal at track 00 on the oscilloscope, turn the pad assembly using screw driver in the slot until maximum signal is achieved. If unit exhibits head flying phenomenon, check head load force ( $14 \pm 2$  grams). If head load force is not proper change spring, Arm Return (P/N 630276).

#### 5.6.6 SPINDLE HUB AND PULLEY ASSEMBLY.

This assembly requires dial indicators and surface plate, so they are not recommended for field replacement.

### 5.6.7 CARRIER FRAME ASSEMBLY

Removal of this assembly is normally not required or recommended. The only time removal would be required in the field is when the entire assembly must be replaced. To remove and reinstall or replace the carrier frame assembly, use the following procedure:

- A. Remove head cable connector and main harness connectors.
- B. Remove four screws (item 84) which attach PWB and remove PWB.
- C. Remove harness connector P11 from LED. Cut wire ties on carrier frame and fold wires back off carrier frame.
- D. Remove two screws (item 79) that attach leaf hinges (item 45) to main frame.
- E. Open door and carefully slide the carrier assembly out of the grooves in the disk guides towards the rear end of the unit. To reinstall, reverse the procedure and slide the assembly into the grooves. Lightly tighten leaf hinge mounting screws.
- F. Close door and position clutch assembly on carrier frame in center of drive hub (item 16). Tighten leaf hinge mounting screws. Check that door does not bind in bezel by opening and closing door. If binding occurs, loosen leaf hinge mounting screws and reposition carrier frame until it operates freely.
- G. Reverse steps A-C and replace wire ties.
- H. Check and readjust index timing (see paragraph 5.8.5).

### 5.6.8 WRITE PROTECT SENSORS AND DISKETTE GUIDE ASSEMBLIES

The Write Protect sensors are integral to the diskette guide assemblies. They are electro-optical devices and normally do not require replacement. To remove and reinstall or replace either diskette guide assembly, use the following procedure:

- A. Remove head cable connector and main harness connectors.

- B. Remove four screws (item 84) which attach PWB and remove PWB.
- C. Note orientation of optical device connectors, top and bottom, and remove them.
- D. Remove front bezel (see paragraph 5.6.1).
- E. Remove carrier frame assembly (see paragraph 5.6.7).
- F. Remove two screws (item 74) which attach diskette guide (item 9 or 14) and remove diskette guide.
- G. Reinstall by reversing steps A-E. Use alignment tool, P/N 650160-T115 to position diskette guide when attaching it to main frame.

#### 5.6.9 INDEX SENSOR ASSEMBLY

To remove and reinstall index sensor assembly, use the following procedure:

- A. Remove head cable connector, four screws (item 84) which attach PWB and fold back main PWB (about 120°).
- B. Note orientation of connector on index sensor assembly and remove it.
- C. From bottom of disk drive, remove screw and washer (items 34 & 78) that attach sensor block (item 37) to main frame. Remove sensor block from top of disk drive.
- D. To remove photo transistor (item 43) from sensor block, carefully remove bonding agent from around photo transistor using an X-acto knife or similar tool.
- E. To replace photo transistor, insert into sensor block with flat on photo transistor flange seated into "D" hole and bond in place using a high strength, flexible adhesive. Carefully bend leads over (about 90°).
- F. Reinstall index sensor assembly by reversing steps A-C. Ensure that mounting surface is smooth and sensor block is seated into main frame.
- G. Adjust and set index timing (see paragraph 5.8.5).

#### 5.6.10 INDEX LED

To remove and reinstall the index LED, use the following procedure:

- A. Remove head cable connector, four screws (item 84) which attach PWB and fold back main PWB (about 120°).

- B. Remove connector from LED on carrier frame (item 15).
- C. Carefully remove bonding agent from around LED using an x-acto knife or similar tool. Use caution not to bend or distort carrier frame or leaf springs that attach carrier to the main frame.
- D. Insert new LED into carrier frame with flat on LED flange seated into "D" hole and bond in place using a high strength, flexible adhesive. Carefully bend lead over 90° toward outside of disk drive.
- E. Adjust and set index timing (see paragraph 5.8.5).

#### 5.6.11 TRACK $\emptyset\emptyset$ SWITCH

To remove and reinstall the track  $\emptyset\emptyset$  switch, use the following procedure:

- A. Remove connector from micro switch (item 32).
- B. Remove two screws and washers (items 76, 72 & 77) and remove switch.
- C. Reinstall by reversing steps A & B. Adjust per paragraph 5.8.3.

#### 5.6.12 SERVO CONTROL PWB

To remove and reinstall the servo control PWB, use the following procedure:

- A. Remove connectors P6-1 and P6-2.
- B. Remove two screws (item 82) that attach PWB to main frame and lift out PWB.
- C. Reinstall by reversing steps A & B.
- D. Check motor speed and adjust if necessary (see paragraphs 5.8.1 & 5.8.2).

### 5.6.13 SOLENOID ASSEMBLY

TO remove and reinstall the solenoid assembly, use the following procedure:

- A. Remove head cable connector and main harness connectors.
- B. Remove four screws (item 84) which attach PWB and remove PWB.
- C. Remove head and carriage assembly (see paragraph 5.6.4).
- D. Remove carrier assembly (see paragraph 5.6.7).
- E. Note color coding of wires and unsolder from terminals on solenoid body (item 36).
- F. Remove screw and washers (items 80, 70 & 69) that attach solenoid assembly from bottom of disk drive and lift out entire assembly from top of disk drive.
- G. Reinstall by reversing steps A-F. Ensure that tab on solenoid frame is seated in hole in main frame.
- H. Check and adjust head load bail (see paragraph 5.8.7).

### 5.6.14 CLUTCH ASSEMBLY

All item numbers refer to the Illustrated Parts Breakdown, Figure D-2 (clutch assembly).

To remove and reinstall the clutch assembly, use the following procedure:

- A. Remove head cable connector.
- B. Remove four screws (item 84) which attach PWB and carefully fold back PWB (about 120°).

- C. With door closed, remove E-ring (item 8) from clutch shaft (item 2) on carrier (item 1).
- D. Open door and carefully remove entire clutch assembly, with clutch spring (item 9) from disk drive.
- E. Carefully place new clutch assembly, with clutch spring onto the spindle hub on disk drive.
- F. Slowly close door to compress clutch spring and allow clutch shaft to protrude through hole in carrier.
- G. Reinstall E-ring onto clutch shaft. No adjustment required.

## 5.7 HEAD AMPLITUDE CHECK

The head amplitude check is valid only when reading previously written data. The diskette used for this check should show no evidence of wear or damage on either side. Use the following procedure:

- A. Install known good diskette.
- B. Start motor.
- C. Select disk drive and step to track 34.
- D. Sync oscilloscope external on TP5 (+Index). Set oscilloscope to measure differential signal between TP1 and TP2. Ground probes.
- E. Set volts-per-division to 50 millivolts and timebase to 20 milliseconds per division.
- F. Write entire track with all one's.
- G. Measure read-back head amplitude. Average minimum read-back head amplitude should be 200 millivolts peak-to-peak.
- H. Check motor speed (see paragraphs 5.8.1–5.8.2).
- I. If output from disk drive PWB looks inappropriate, change main disk drive PWB and recheck.
- J. Check head load pad for wear which would cause soft failure mode, i.e., slight gap between head and pad. This can be checked by very lightly touching the top of the head load arm and checking to see if the signal as observed on the scope increases. (See paragraph 5.8.3 for adjustment.
- K. If steps H–J check out but average minimum read-back head amplitude remains low, the head and carriage assembly must be replaced.

## 5.8 ADJUSTMENT PROCEDURES

This subsection provides eight adjustment procedures that may be necessary after replacement of an assembly or component in the disk drive. Test point locations are shown in Figure 5-1.

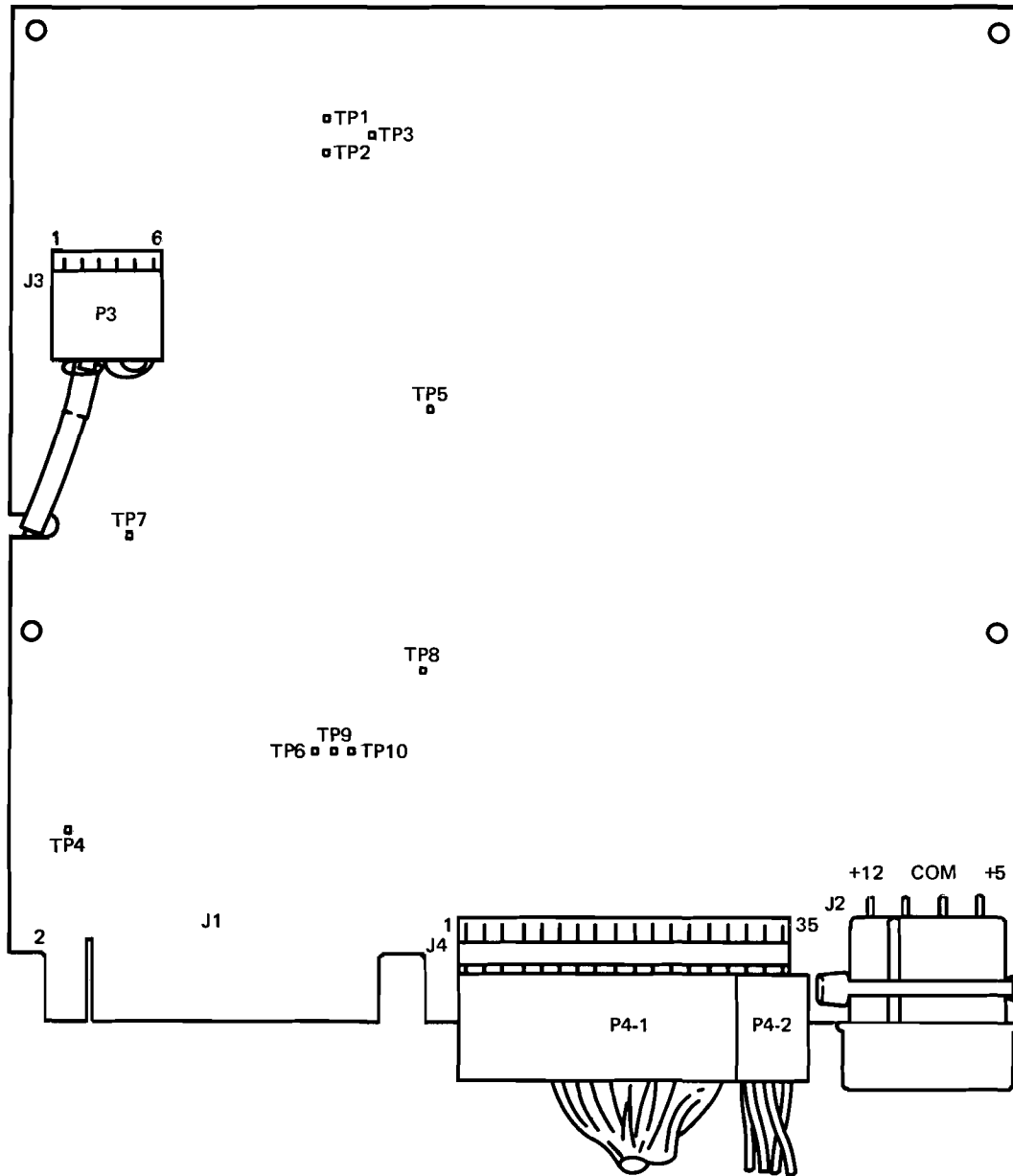


Figure 5-1. Test Point Locations



### 5.8.1 MOTOR SPEED ADJUSTMENT WITHOUT FREQUENCY COUNTER

This adjustment procedure can be used only where there is fluorescent lighting:

- A. Insert a diskette, energize disk drive, and start motor. Step head to track 16 and keep head loaded.
- B. Adjust potentiometer R7, on servo control PWB until lines on spindle pulley appear motionless. For 60 Hertz power, use outside ring of lines. For 50 Hertz power, use inside ring.
- C. A one percent speed variation is exhibited by the strobe lines rotating 90° in five seconds.

### 5.8.2 MOTOR SPEED ADJUSTMENT WITH FREQUENCY COUNTER

This adjustment procedure can be used anywhere a frequency counter is available.

- A. Install a soft-sector scratch diskette.
- B. Start motor, load head, and step to track 16.
- C. Connect frequency counter to TP5 (+Index) on main disk drive PWB.
- D. Adjust potentiometer R7, on servo control PWB, for  $200 \pm 1$  milliseconds.

### 5.8.3 READ/WRITE HEAD-LOAD PAD ADJUSTMENT

To adjust the read/write head-load pad, see Figure 5-2 and use the following procedure:

- A. Insert an Alignment Diskette or any diskette with data on track 34.
- B. Connect oscilloscope to TP1 and TP2 and sync external positive on TP5 (+Index).
- C. Select disk drive and step head carriage to track 34.
- D. Observe Read signal on oscilloscope while rotating read/write head-load pad CCW in small increments (10 degrees) until maximum read-back head amplitude is obtained. The amplitude should be not less than 200 millivolts peak-to-peak.

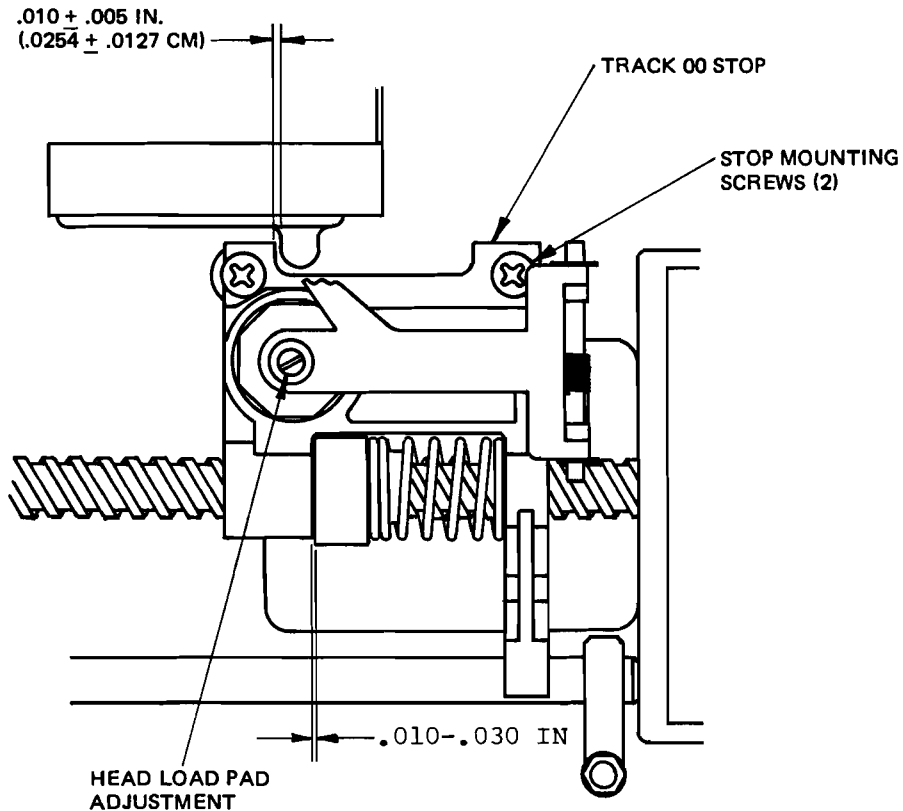


Figure 5-2. Track 00/39 Stop and Head-Load Pad Adjustment

#### 5.8.4 TRACK 00 SWITCH ADJUSTMENT

To adjust the track 00 switch position, see Figure 5-3 and use the following procedure:

- A. Power up disk drive and insert an Alignment Diskette.
- B. Step to track 00. This should energize Phase A on stepper motor. Loosen track 00 switch mounting bracket.
- C. Adjust track 00 switch position, by moving its mounting bracket, in direction as shown by arrow, until switch is just activated.
- D. Observe a high signal at TP8 with oscilloscope. Step to track 01. Signal level at TP8 should switch from high to low. If transition from high to low does not occur, readjust track 00 switch position.
- E. Step to track 00. Signal level at TP8 should switch from low to high.
- F. Readjust track 00 switch position to transfer both open and closed states between track 00 and track 01, then secure mounting bracket of track 00 switch.

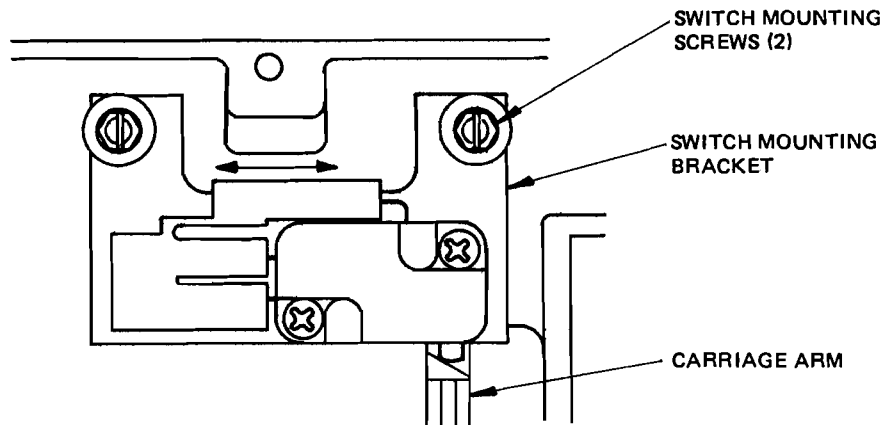


Figure 5-3. Track 00 Switch Adjustment

#### 5.8.5 TRACK 00/39 STOP ADJUSTMENT

To adjust track 00/39 stop (see Figure 5-2), use the following procedure:

- A. Unplug head cables and remove PWB from disk drive. Leave interface and PWB connectors installed.
- B. Step selected disk drive to track 00.
- C. Adjust track 00 stop until distance between track 00 stop and post on main frame is  $0.010 \pm 0.005$  inch ( $0.0254 \pm 0.0127$  cm). This task can be simplified by using a .010" thick mylar or other plastic strip between the stop and post and pushing the stop against the plastic strip. Remove plastic strip after tightening screws.
- D. Step to track 39 and verify clearance exists between track 00/39 stop and post on main frame.
- E. Reinstall disk drive PWB and plug in head cables.

## 5.8.6 INDEX/SECTOR TIMING ADJUSTMENT

To adjust index/sector timing, see Figure 5-4 and use the following procedure:

- A. Insert an Alignment Diskette.
- B. Start motor and select disk drive.
- C. Sync oscilloscope with external positive probe on TP5 to monitor +Index signal, then set time base on oscilloscope to 50 microseconds/division.
- D. Connect probe to TP1 and TP2 and ground probes.  
On oscilloscope, set inputs to AC and set vertical deflection to 500 millivolts/division.
- E. Step to track  $\phi 1$ .
- F. Observe timing between start of sweep and first data pulse. This should be  $200 \pm 100$  microseconds. If timing is not within tolerance, continue with adjustment.
- G. Loosen mounting screw in appropriate Index Sensor block until assembly is just able to be moved. This is located on bottom of disk drive.
- H. Observe timing and adjust Index Sensor position until timing is  $200 \pm 50$  microseconds. Verify that detector assembly is against registration surface.
- I. Open and close door; then, recheck timing. Repeat several times.
- J. Tighten mounting screw slowly. Do not overtighten.
- K. Recheck timing to ensure Index Sensor did not move when mounting screw was tightened.

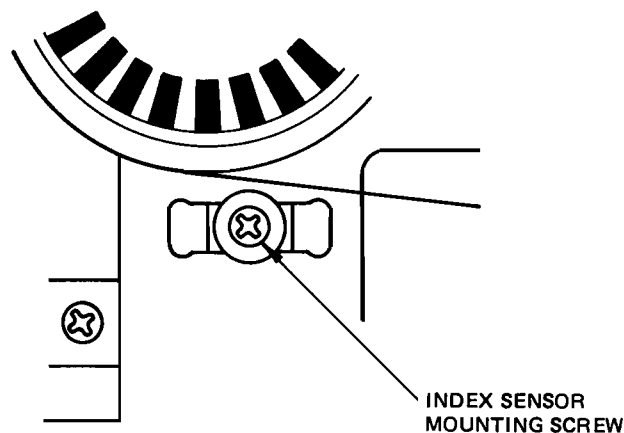


Figure 5-4. Index/Sector Timing Adjustment

### 5.8.7 RADIAL ALIGNMENT OF HEAD

To radially align the head, use the following procedure:

- A. Start motor and select disk drive.
- B. Insert an Alignment Disk. Alignment Disk should be at the same environmental room conditions as drive for at least one hour before alignment.
- C. Sync oscilloscope external positive with probe on TP5 and set time base on oscilloscope to 20 milliseconds/division. This provides a display of one diskette rotation.
- D. Set oscilloscope to measure differential signal between TP1 and TP2. Ground probes, set inputs to AC, and set vertical deflection to 100 millivolts/division.
- E. Step to track 00. Insure that the following conditions both exist:
  1. Phase A of stepper driver logic is active,
  2. TP1 & 2 indicate a 2F data pattern on the diskette. This will insure that the proper stepper motor phase is active with the correct track number.
- F. Step disk drive to track 16.
- G. Loosen two mounting screws that hold stepper motor to main frame.
- H. Rotate stepper motor to move head radially in and out and observe cat eye pattern on oscilloscope until the lobes are within 80% of each other, then carefully lock down two previously loosened stepper motor mounting screws.
- I. Check adjustment by stepping off several tracks in both directions from track 16 and return to track 16. If necessary, readjust by repeating steps G and H, until cat eye pattern is within 80% of each other.
- J. After radial alignment of head is completed, track 00 switch and track 00/39 stop position must be checked and adjusted as required (see paragraph 5.8.4 & 5.8.5).

### 5.8.8 HEAD-LOAD BAIL ADJUSTMENT

To adjust the head-load bail, see Figure 5-5 and use the following procedure:

- A. Select disk drive and load head to energize head-load solenoid.
- B. Adjust two screws that hold diskette load arm and arm adjustment bracket to head-load solenoid until  $0.19 \pm 0.01$ -inch ( $0.4826 \pm 0.0254$  cm) clearance is obtained between lower side of head-load bail

and platen on main frame casting. Verify that head-load arm on carriage clears top side of bail by at least 0.015 inch (0.0381 cm) from tracks 00 through 39.

- C. If bail cannot be adjusted, head-load solenoid must be readjusted (see paragraph 5.8.9).

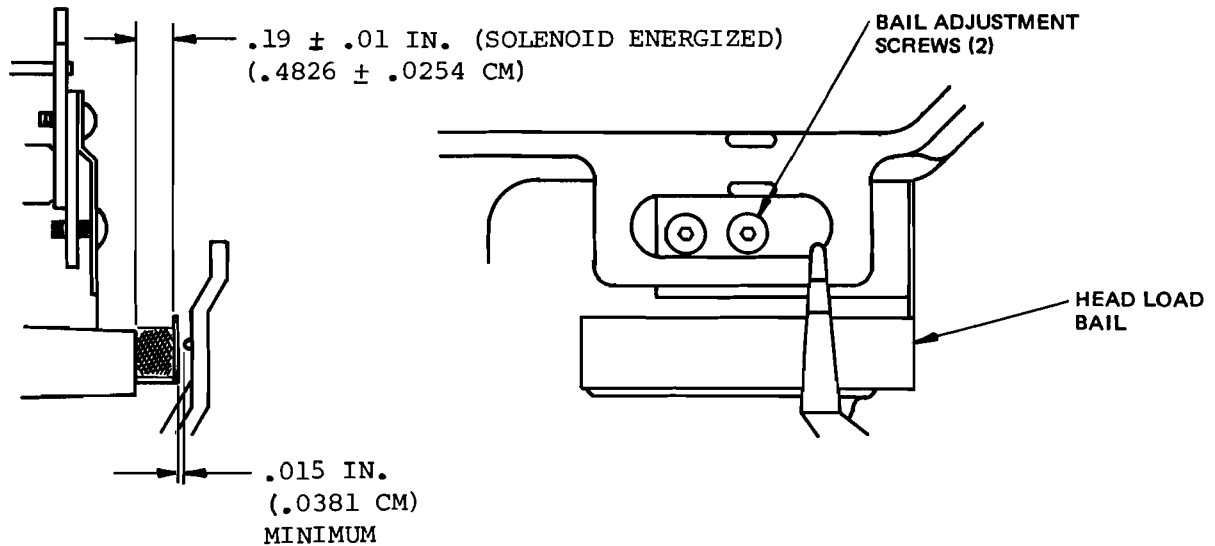


Figure 5-5. Head-Load Bail Adjustment

## 5.8.9 HEAD-LOAD SOLENOID ADJUSTMENT

To adjust the head-load solenoid, see Figure 5 - 6 and use the following procedure:

- A. Unload head-load solenoid and open door to lift head/carriage assembly arm off head-load bail.
- B. Using a small screwdriver or similar tool, reach through access hole on bottom of disk drive and bend tab on solenoid frame in to increase travel or out to decrease travel. Adjust to  $0.090 \pm .01$  inch travel measured at center of head-load bail (0.95 inch from solenoid center).
- C. Adjust head-load bail (see paragraph 5.8.8).

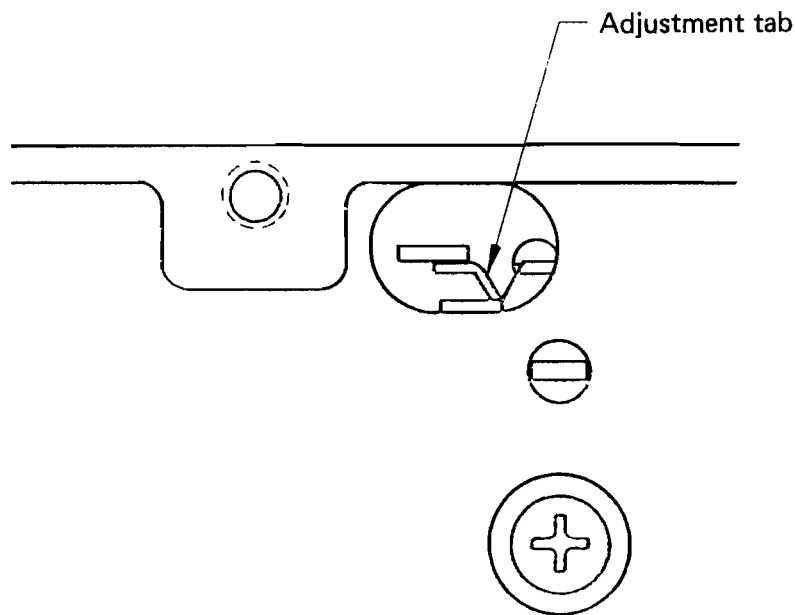


Figure 5 - 6 Head-Load Solenoid Adjustment





## APPENDIX A

### SPARE PARTS LIST – MODEL FDD 100-5 DISC DRIVE

Part Number	Description
650281-001	Assembly, PWB, Main
640204-001	Assembly, PWB, Servo Control
630321-001	Assembly, Spindle Drive Motor
630300-001	Assembly, Stepper Motor
650168-001	Assembly, Head Carriage
650166-001/002	Assembly, Carrier (Single/Double LED)
640181-001/002	Assembly, Diskette Guide, Right Spare (with/without LED & sensor)
640181-003/004	Assembly, Diskette Guide, Left Spare (with/without LED & sensor)
640162-001	Assembly, Index Sensor
640155-001	Assembly, Head-Load Solenoid
630258-001	Assembly, Head-Load Pad
630289-001	Belt, Spindle Drive
617500-001	LED, Status Indicator
650199-001	Bezel Front
640186-001	Door
618808-001	Switch, (Track 00)
618550-006	Shunt, Programmable
650190-001	Assembly Clutch
618417-001	Termination Network
630396-001	Motor Cover Plate



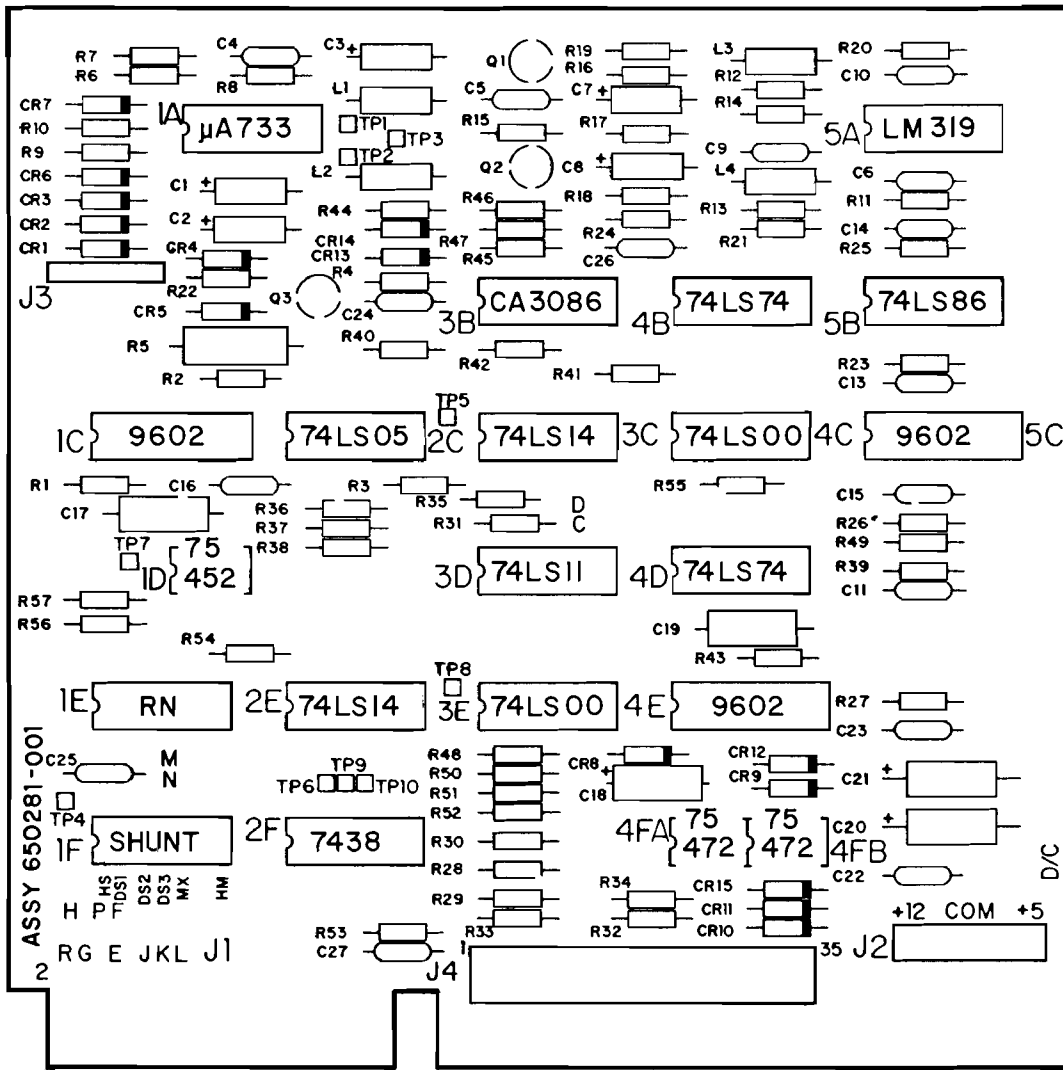
APPENDIX B

MODEL FDD100-5 DISK DRIVE

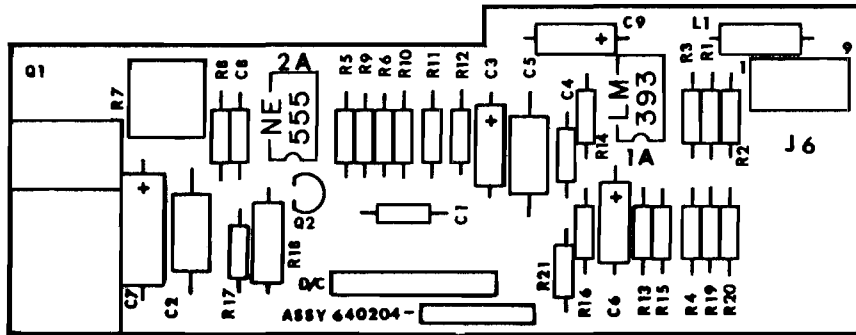
ASSEMBLY DRAWINGS AND MATERIAL LISTS INDEX

Title	Dwg. No.	Page
Assembly, PWB, Main	650281-100	B-3
Assembly, PWB, Servo Control	640204-100	B-4





Assembly, PWB, Main



Assembly, PWB, Servo Control

## APPENDIX C

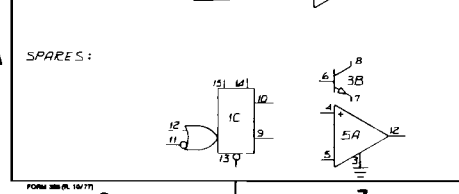
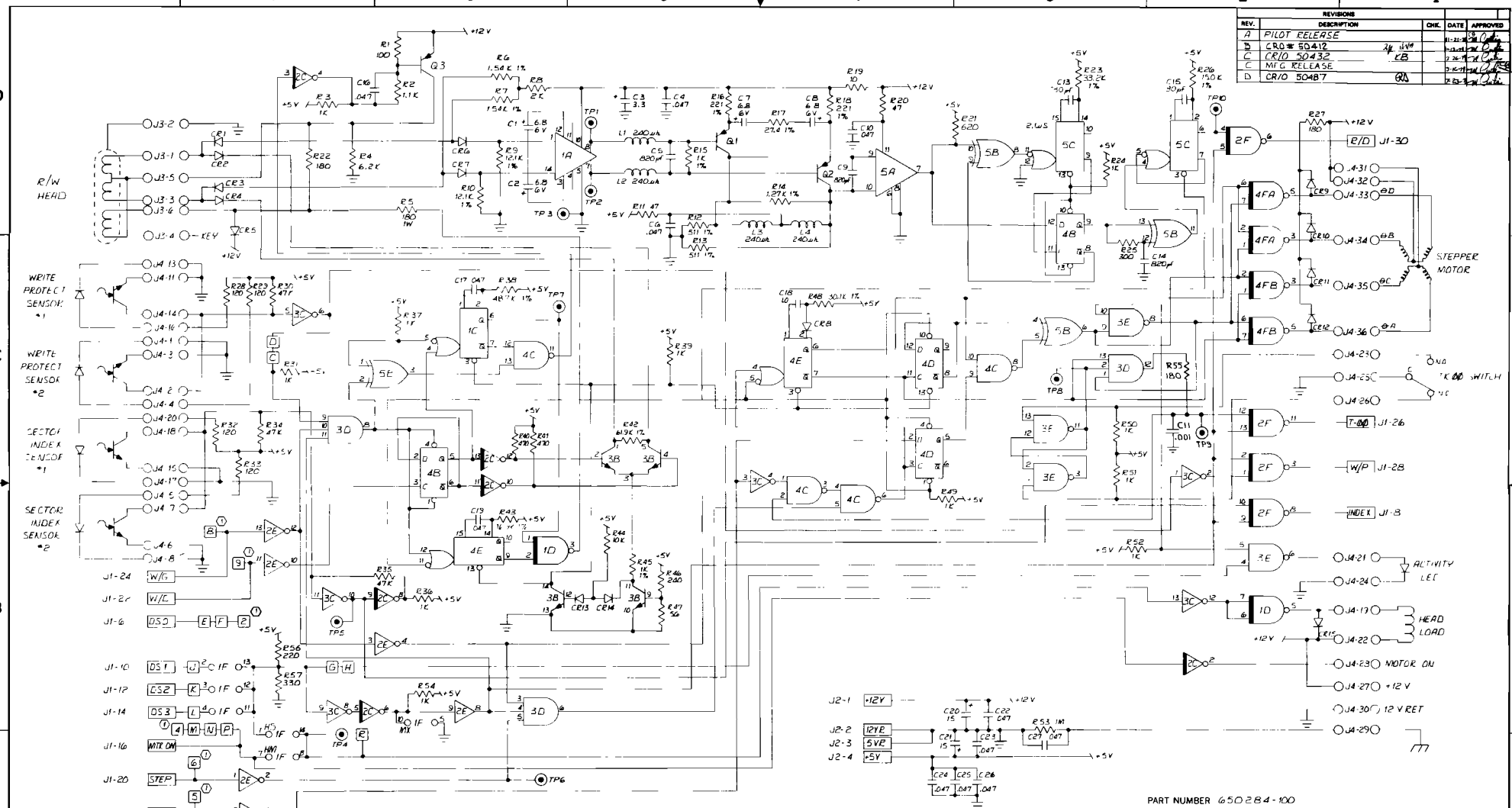
### LOGIC SCHEMATICS

Title	Dwg No.	Page
Schematic Diagram, Model FDD100-5 Disk Drive	650284-100	C-3
Schematic Diagram, Motor Control	630322-100	C-5





REVISIONS				
REV.	DESCRIPTION	CHK.	DATE	APPROVED
A	PILOT RELEASE			
B	CR/O 50412	AK	11/4/67	
C	CR/O 50432	CB	7/31/67	
D	CR/O 50487	QA	7/25/67	



- NOTES: UNLESS OTHERWISE SPECIFIED
- 9. INDICATES OPEN COLLECTOR
  - 8. INDICATES POWER INTERCONNECTION
  - 7. INDICATES ANGULAR CONNECTOR
  - 6. INDICATES INTERFACE CONNECTOR
  - 5. INDICATES JUMPER OPTION PADS
  - 4. ALL CAPACITORS ARE IN MICROFARADS
  - 3. ALL RESISTORS ARE IN OHMS, 1/4W, 5%
  - 2. TIMING VALUES INDICATED ARE NOMINAL
  - 1. TYPICAL TERMINATION IN WHEN PART W/P 618417-001 IS INSTALLED IN LOCATION 1E

LOCATION		IC DESIGNATIONS		REFERENCE DESIGNATIONS	
TYPE	LOCATION	TYPE	TYPE	LAST USED	NOT USED
1A	4A733	4C, 3E	74LS00		
5A	LM319	1D	75452	R57	
3B	CA3086	3C, 2E	74LS14	C27	C12
4B, 4D	74LS74	3D	74LS11	L4	
5B	74LS86	2F	743B	CE15	
1C, 5C, 4E	9602	4F, 4B	75472	Q3	
2C	74LS05			TP10	

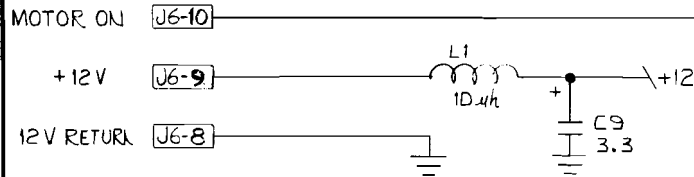
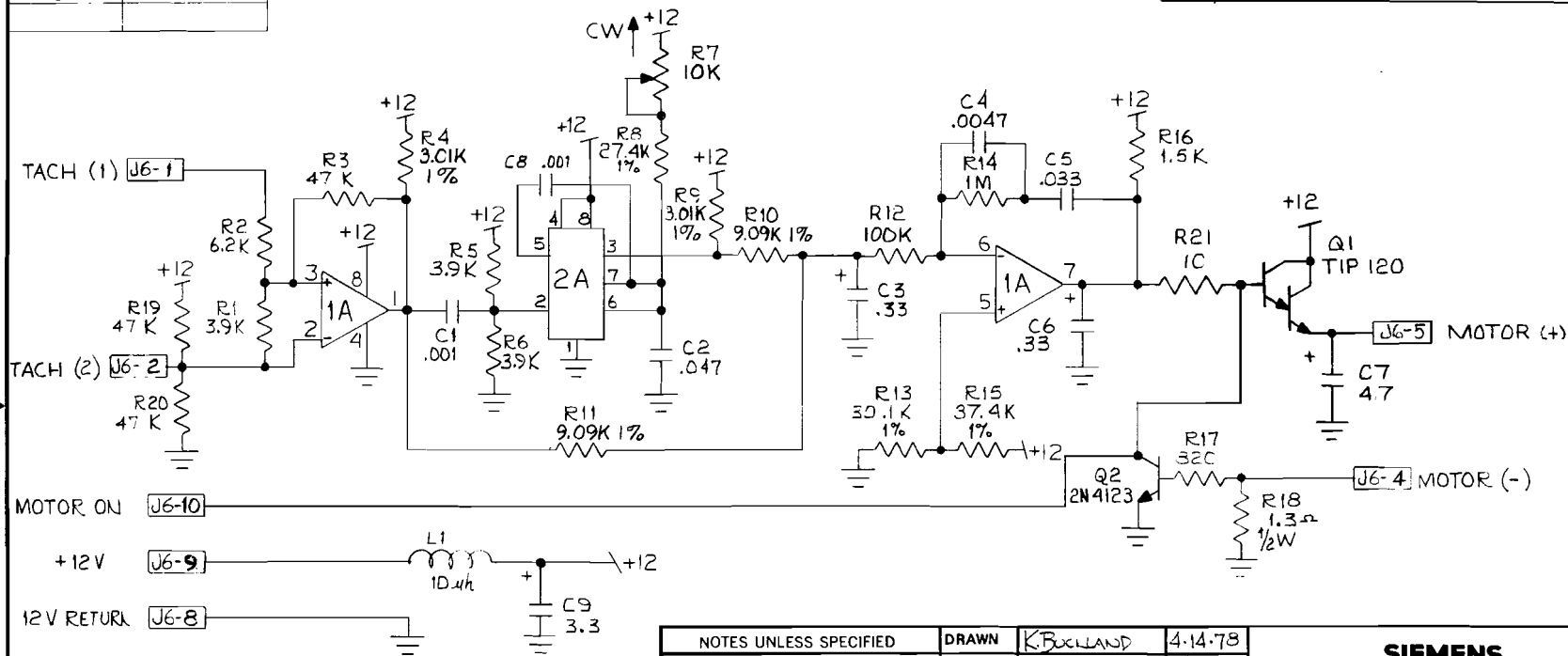
PART NUMBER 650284-100

NOTES UNLESS SPECIFIED	DRAWN <i>L. P. K. CLAMP</i>	DATE <i>10-16-70</i>	
1. TOLERANCES XX — ANGULAR XXX —	CHECK		
2. BREAK ALL SHARP EDGES APPROX .010	APPR.		
3. MACH. SURFACES	MATERIAL		
4. ALL DIMS IN INCHES	FINISH		<b>SCHMATIC DIAGRAM</b> <b>MODEL 100-5B</b>
5. DIMENSIONS APPLY AFTER FINISH AND HEAT TREAT	MODEL No.	FDD 100-5B	
	SCALE		
	NO NEXT ASSY THIS DRAWING	CODE	<b>650284-100</b>
		REV.	D
		DATE	52465
		SHEET	1 OF 1



REF. DESIGNATIONS		I C DESIGNATIONS	
LAST USED	NOT USED	LOCATION	TYPE
R21		1A	LM393
C9		2A	NE555
L1			
Q2			

REVISIONS				
REV.	DESCRIPTION	CHK.	DATE	APPROVED
A	PILOT RELEASE		11-16-78	<i>[Signature]</i>
A	MFG. RELEASE		3-16-79	<i>[Signature]</i>
B	CR/O 50462		8/13/79	<i>[Signature]</i>
C	CR/O 50474		7/5/79	<i>[Signature]</i>



3. R21 IS NOT REQUIRED WITH PCB'S, REVS A AND B.  
 2. ALL CAPACITORS IN MICROFARADS  
 1. ALL RESISTORS IN OHMS, 1/4W, 5%  
 NOTES: UNLESS OTHERWISE SPECIFIED

NOTES UNLESS SPECIFIED		DRAWN	K. BUCKLAND	4-14-78	SIEMENS CORPORATION			
1. TOLERANCES .XX± ANGULAR ± .XXX±		CHECK			SCHEMATIC DIAGRAM MOTOR DRIVE PWB			
2. BREAK ALL SHARP EDGES APPROX. .010		APPR.						CODE FD 108
3. MACH. SURFACES		MATERIAL						QTY REQ'D.
4. ALL DIMS IN INCHES.		FINISH			SCALE	SIZE	630322-100	
5. DIMENSIONS APPLY AFTER FINISH AND HEAT TREAT		MODEL No. FDD 100-5B/200 5N			DO NOT SCALE THIS DRAWING	WEIGHT		
		NEXT ASSY					SHEET 1 OF 1	



## APPENDIX D

### IPB ILLUSTRATION INDEX

Figure	Title	Page
D-1	Model FDD100-5 Disk Drive – Overall View	D-3
D-2	Model FDD100-5 Disk Drive – Clutch Assembly	D-7
D-3	Model FDD100-5 Disk Drive – Carriage Assembly	D-9



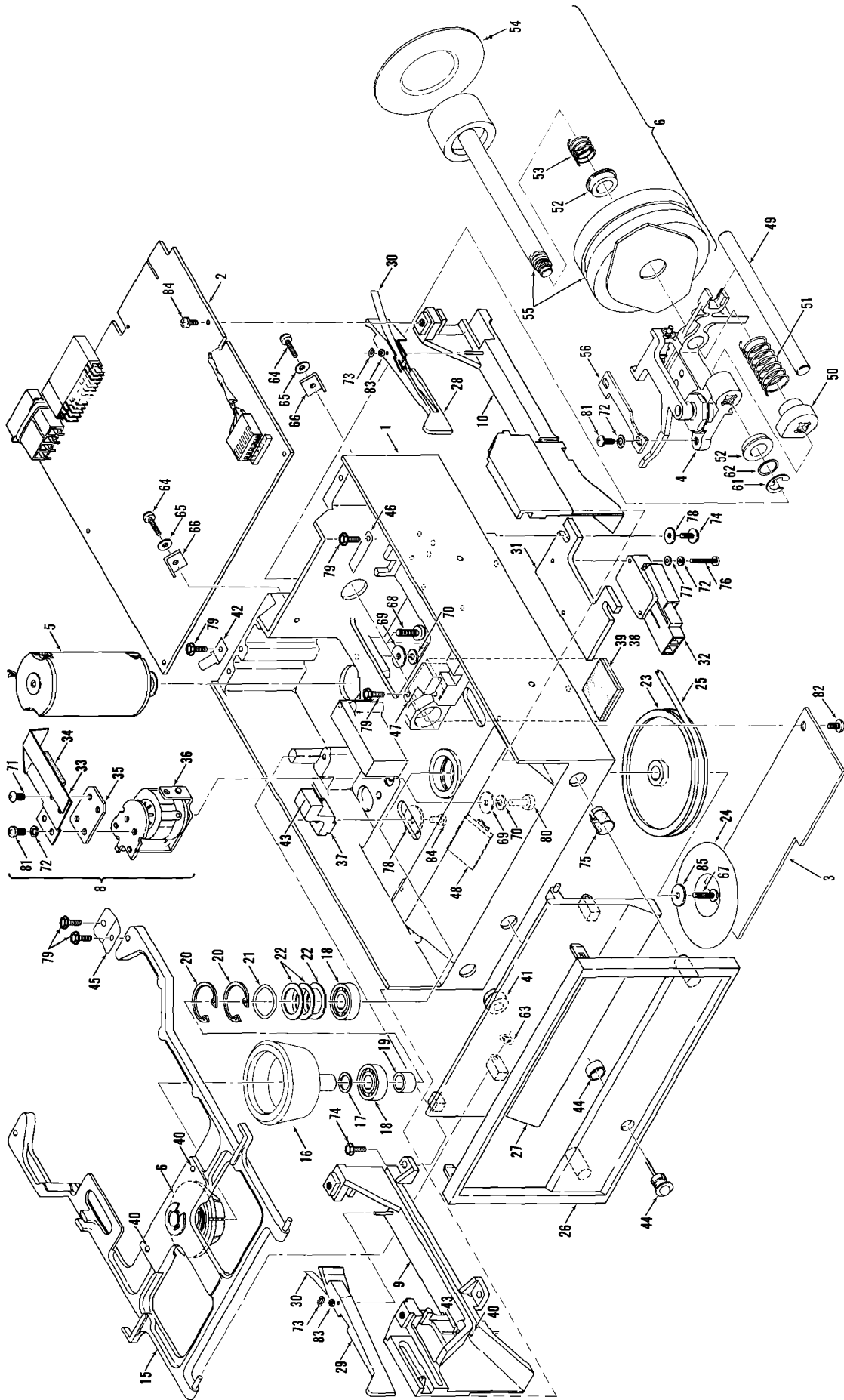


Figure D-1. Model FDD100-5B Disk Drive — Overall View





IPB LIST - MODEL FDD100-5 - OVERALL VIEW

SHEET 1 OF 2

ITEM NO.	PART NO.										DESCRIPTION	FIGURE NO.	QUANTITY		
	TOP ASSY	SUB ASSY	COMPONENT												
1	6	5	0	1	8	9	-	0	0	1	Main Frame, Machined	D-1 ↑	1		
2	6	5	0	2	8	1	-	0	0	1	Assembly, PWB (Main)		1		
3	6	4	0	2	0	4	-	0	0	1	Assembly, PWB (Servo)		1		
4	6	5	0	1	6	8	-	0	0	1	Assembly, Carriage		1		
5	6	3	0	3	2	1	-	0	0	1	Assembly, Drive Motor \$18.50 2/2/84		1		
6	6	3	0	3	0	0	-	0	0	1	Assembly, Stepper Motor		1		
7	6	5	0	1	6	6	-	0	0	1	Assembly, Carrier		1		
8	6	4	0	1	5	5	-	0	0	1	Assembly, Solenoid		1		
9	6	4	0	1	6	6	-	0	0	1	Assembly, Guide-Disk (Right)		1		
10	6	4	0	1	6	6	-	0	0	2	Assembly, Guide-Disk (Left)		1		
-11	6	5	0	2	8	5	-	0	0	4	Assembly, Harness		1		
12															
13							*	*	*	*	COMPONENT PARTS	*	*	*	*
14															
15	6	5	0	1	8	0	-	0	0	1	Carrier, Machined		1		
16	6	3	0	3	0	1	-	0	0	1	Hub, Drive		1		
17	6	4	0	1	4	8	-	0	0	1	Shim, Small Dia. .001		A/R		
	6	4	0	1	4	8	-	0	0	2	Shim, Small Dia. .003		A/R		
	6	4	0	1	4	8	-	0	0	3	Shim, Small Dia. .005		A/R		
18	6	1	0	2	0	2	-	0	0	2	Bearing		2		
19	6	4	0	1	4	3	-	0	0	1	Spacer, Bearing		1		
20	1	0	0	0	0	1	-	0	0	4	Ring, Retaining		2		
21	1	0	0	1	3	4	-	0	0	3	Washer, Wave		1		
22	6	4	0	1	4	8	-	0	0	4	Shim, Large Dia.		3		
23	6	4	0	1	7	9	-	0	0	1	Pulley, Hub-Machined		1		
24	6	3	0	2	7	3	-	0	0	1	Label, Strobe		1		
25	6	3	0	2	8	9	-	0	0	1	Belt, Drive		1		
26	6	5	0	1	9	9	-	0	0	1	Bezel, Front		1		
27	6	4	0	1	8	6	-	0	0	1	Door		1		
28	6	4	0	1	5	6	-	0	0	1	Arm, Disk Protect (Right)		1		
29	6	4	0	1	5	6	-	0	0	2	Arm, Disk Protect (Left)		1		
30	6	3	0	2	6	4	-	0	0	1	Spring, Disk Protect		2		
31	6	4	0	1	6	1	-	0	0	1	Plate, Switch Mount		1		
32	6	1	8	8	0	8	-	0	0	1	Micro-Switch, SPDT		1		
33	6	4	0	1	4	2	-	0	0	1	Arm, Diskette Load		1		
34	6	3	0	2	7	8	-	0	0	1	Pad, Diskette Load		1		
35	6	3	0	2	6	1	-	0	0	1	Bracket, Arm Adjustment		1		
36	6	1	8	3	0	2	-	0	0	1	Solenoid		1		
37	6	4	0	1	8	5	-	0	0	1	Index Block		2		
-38	6	1	3	6	0	0	-	0	0	3	Tie, Restraint		3		
39	6	1	3	5	5	0	-	0	0	4	Tie Base, Cable		1		
40	6	1	7	5	0	2	-	0	0	1	LED, Emitter		4		
41	6	1	0	7	0	0	-	0	0	1	Bumper		1		
42	6	1	7	8	1	1	-	0	0	1	Ground Lug		1		
43	6	1	9	4	1	1	-	0	0	1	Photo Transistor	D-1 ↓	4		

-Not Shown

ITEM NO.	PART NO.										DESCRIPTION	FIGURE NO.	QUANTITY						
	TOP ASSY	SUB ASSY	COMPONENT																
44			6 1 7 5 0 0 - 0 0 1	Indicator, LED - Red										D-1	1				
45			6 3 0 2 6 3 - 0 0 1	Hinge, Leaf											↑	2			
46			6 3 0 2 7 7 - 0 0 1	Clamp, Guide Shaft										↑		1			
47			6 3 0 2 9 8 - 0 0 1	Clamp, Guide Shaft - Stop											↑	1			
48			6 1 0 9 5 8 - 0 0 1	Clamp, Cable										↑		1			
49			6 1 3 1 1 1 - 0 0 2	Shaft, Carriage Guide											↑	1			
50			6 4 0 1 6 0 - 0 0 1	Nut, Carriage										↑		1			
51			6 3 0 3 2 5 - 0 0 1	Spring, Nut - Carriage											↑	1			
52			6 1 0 2 0 5 - 0 0 2	Bearing, Flanged										↑		2			
53			6 3 0 2 9 9 - 0 0 1	Spring, Stator											↑	1			
54			6 3 0 3 9 6 - 0 0 1	Plate, Cover										↑		1			
55			6 5 0 2 1 3 - 0 0 1	Motor, Stepper											↑	1			
56			6 4 0 1 6 5 - 0 0 1	Stop, Track <del>Ø</del> 39										↑		1			
57															↑				
58														↑					
59															↑				
60				*	*	*	*	*	ATTACHING PARTS							*	*	*	*
61			6 1 2 7 5 0 - 0 0 4	Ring, Retaining										↑	1				
62			6 1 3 8 0 4 - 0 0 8	Washer, Flat											↑	1			
63			6 1 2 7 5 3 - 0 0 1	Ring, Retaining										↑		1			
64			1 0 0 0 4 1 - 2 0 5	Screw, Soc Hd Gap (4-40x5/16)											↑	2			
65			6 1 3 8 0 0 - 0 0 3	Washer, Flat (#4)										↑		2			
66			6 1 0 9 5 2 - 0 0 2	Clamp, Motor											↑	2			
67			6 1 3 0 0 5 - 3 0 4	Screw, Button Hd (8-32x1/4)										↑		1			
68			6 1 3 0 0 0 - 3 0 6	Screw, Phillips Rec. (6-32x3/8)											↑	2			
69			6 1 3 8 0 0 - 0 0 4	Washer, Flat (#6)										↑		3			
70			6 1 3 8 0 3 - 0 0 4	Washer, Split Lock (#6)											↑	3			
71			6 1 3 0 0 5 - 2 0 4	Screw, Button Hd (6-32x1/4)										↑		2			
72			1 0 0 0 4 2 - 2 0 0	Washer, Split Lock (#4)											↑	6			
73			6 1 2 7 5 1 - 0 0 1	Ring, Grip										↑		2			
74			6 1 3 0 1 1 - 2 0 6	Screw, Hex Hd, Thread, Forming (4-40)											↑	6			
75			6 1 1 3 0 1 - 0 0 1	Fastener, Tubular Type										↑		2			
76			1 0 0 0 3 6 - 2 0 9	Screw, Phillips Rec. (4-40x9/16)											↑	2			
77			1 0 0 2 5 1 - 2 0 0	Washer, Flat (#4)										↑		2			
78			6 1 3 8 0 6 - 0 0 2	Washer, Flat (#4)											↑	4			
79			6 1 3 0 1 1 - 2 0 4	Screw, Hex Hd, Thread Forming (4-40)										↑		7			
80			6 1 3 0 0 0 - 3 0 8	Screw, Phillips Rec. (6-32x1/2)											↑	1			
81			1 0 0 0 3 6 - 2 0 4	Screw, Phillips Rec. (4-40x1/4)										↑		4			
82			1 0 0 0 3 6 - 3 0 4	Screw, Phillips Rec. (6-32x1/4)											↑	2			
83			6 1 3 8 0 7 - 0 0 1	Washer, Teflon										↑		2			
84			1 0 0 0 3 6 - 2 0 6	Screw, Phillips Rec. (4-40x3/8)											↓	6			
85			6 1 3 8 0 4 - 0 0 6	Washer, Flat (#6)										D-1		1			

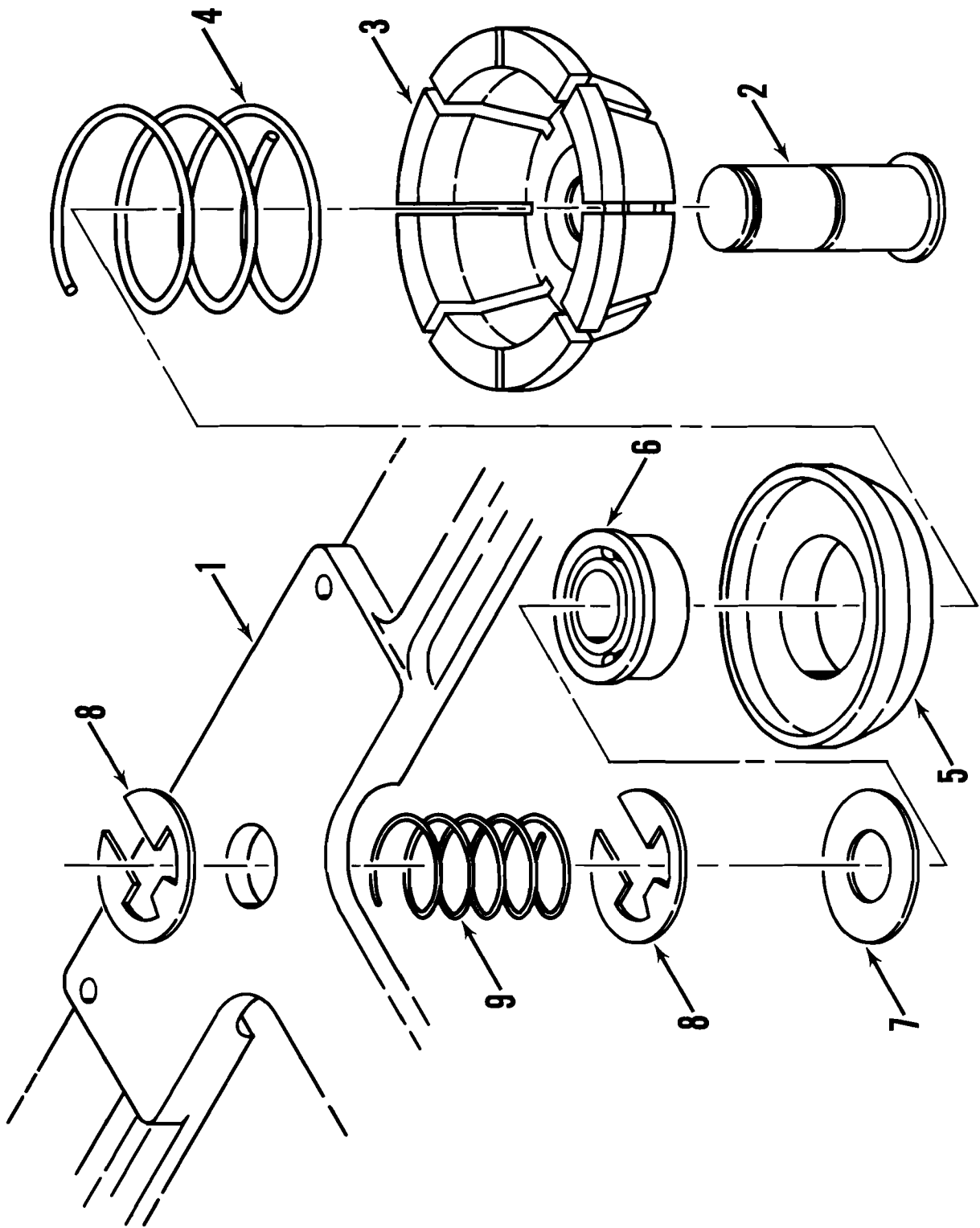



Figure D-2. Model FDD100-5 — Clutch Assembly

IPB LIST – MODEL FDD100-5 – CLUTCH ASSEMBLY

SHEET 1 OF 1

ITEM NO.	PART NO.								DESCRIPTION	FIGURE NO.	QUANTITY		
	TOP ASSY	SUB ASSY	COMPONENT										
1		6	5	0	1	8	0	-	0	0	1	D-2  D-2	1
2		6	3	0	2	6	2	-	0	0	1		1
3		6	4	0	1	8	2	-	0	0	1		1
4		6	3	0	2	7	1	-	0	0	1		1
5		6	4	0	1	8	4	-	0	0	1		1
6		6	1	0	2	0	5	-	0	0	1		1
7		6	4	0	1	4	8	-	0	0	3		1
8		6	1	2	7	5	0	-	0	0	2		2
9		6	1	3	2	5	0	-	0	0	8		1

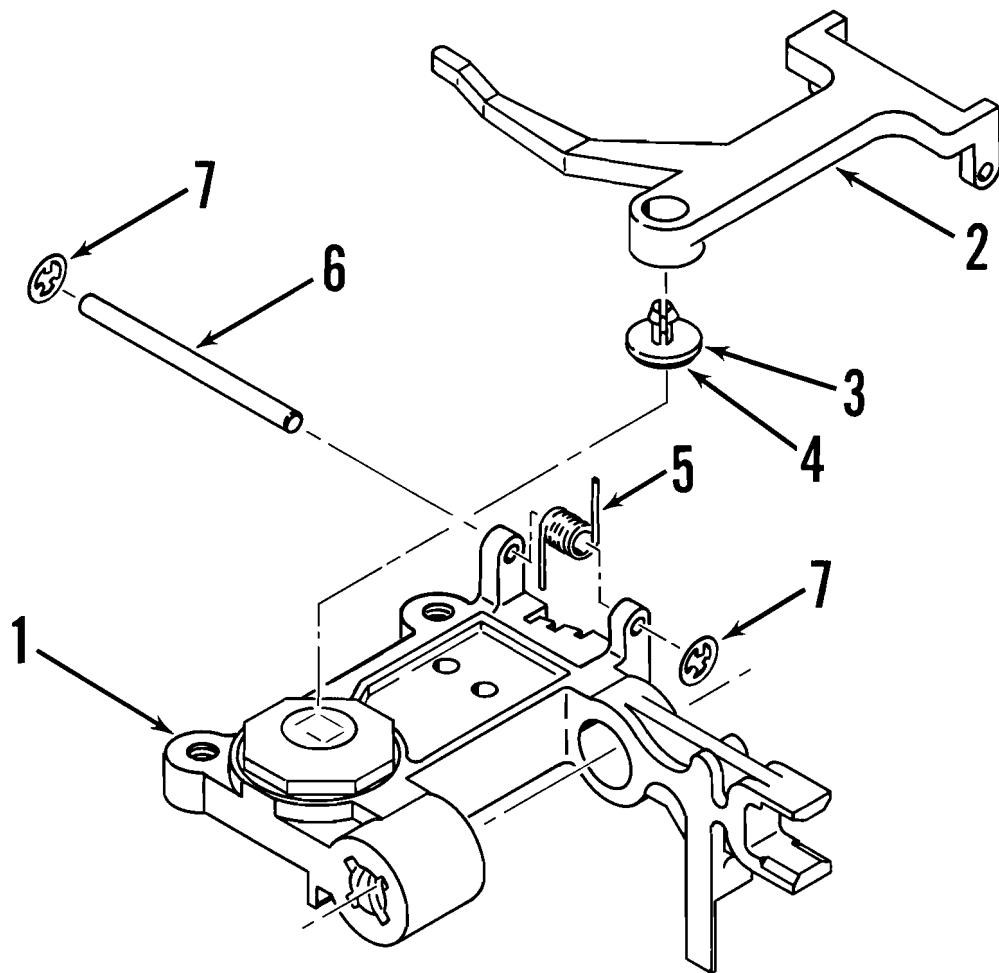


Figure D-3. Model FDD100-5 – Carriage Assembly

IPB LIST – MODEL FDD100-5 – CARRIAGE ASSEMBLY

SHEET 1 OF 1

ITEM NO.	PART NO.										DESCRIPTION	FIGURE NO.	QUANTITY		
	TOP ASSY	SUB ASSY	COMPONENT												
1	6	5	0	1	6	9	-	0	0	1	Assy., Carriage and Read/Write Head	D-3	1		
2		6	5	0	1	9	8	-	0	0	1	Arm, Head Load		1	
3		6	4	0	1	5	8	-	0	0	1	Button		1	
4		6	3	0	0	7	5	-	0	0	2	Pad		1	
5		6	3	0	2	7	6	-	0	0	1	Spring, Arm Return		1	
6		1	0	0	0	4	5	-	2	2	6	Pin, Dowel		1	
7		6	1	2	7	5	3	-	0	0	1	Ring, Retaining, Push-on		D-3	2



**OEM DIVISION**

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