7902A & C/9895K
Flexible Disc Drive
Service Documentation

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Introduction

This service manual contains service information for the 7902A, 9895K and the 7902C flexible disc drives and the controller boards used on the HP 250, 300, 1000, and 3000 series 30 and 33 systems. The following brief history describes the changes that have taken place on the disc drives and controller boards and the reasons for the changes.

The first production model 7902A flexible disc drives were installed in the HP 250, 300 and 3000 systems. The 7902A drives (P/N 07902-68811) designed for use in the HP 250 and the 7902A drives (P/N 07902-60038/07902-60023) for use in the 300/3000 were non-interchangeable. For this reason a common drive (P/N 07902-67914) was developed as a replacement. Refer to service notes HP 250-01 and 7902A-01 for instructions if one of the old drives is discovered in the field. In the past, the drive mechanisms for the 7902A had been manufactured by Shugart and utilized a tri-compliant head design. As of September, 1980, this drive was replaced with one using a bi-compliant head design used on the 7902C.

The drive used on the 9895K is built by CDC and utilizes a tri-compliant head design. These drives are not interchangeable between systems because of differences in drive boards used on the various systems. The drive boards used on the HP 300/3000 systems are designed and built by HP and utilize control signals which are non-industry standard. The drive boards used on the HP 250 systems are designed and built by both Shugart and CDC and utilize industry standard control signals.

The controller board (P/N 45000-66510) used on the old HP 250 systems, and the controller board (P/N 07902-60024) used on the old HP 300/1000/3000 systems, were also non-interchangeable and they both utilized in MC² micro CPU. A new controller board (P/N 07902-66520) was designed as a replacement for the 45000-66510 board. If one should fail in the field, refer to service note 07902A-5A for instructions. The controller board used on the old HP 300/1000/3000 systems (P/N 07902-60024) is interchangeable with the new controller board (P/N 07902-66501) designed for use with the 7902C. The new HP 3000 systems no longer use the 7902 disc drives. The 9895A flexible disc drives will be used in place of the 7902.

Repair Philosophy

The 7902A/C/9895K Flexible Disc Drives are comprised of two serviceable areas: the disc drive assembly (mechanical drive assembly with drive electronics assembly) and the controller assembly. These assemblies are serviced on the exchange program with the exception of some parts on the mechanical assembly. The field replaceable parts and field adjustments are outlined in the maintenance section.

Although detailed information is provided in this service manual, it is not recommended that component level repair be performed in the field

Repair of the 9895K/7902C is restricted to board/drive exchange

Manual Structure

Introduction

This section describes the structure of this manual and the 7902A, 9895K and the 7902C flexible disc drives. This section may prove useful when troubleshooting the 7902 flexible disc drives due to the many changes which have taken place on disc drives and controller boards. Its intent is to help direct you through the manual to the section that you desire.

DRIVES

	Systems			Refer to
45000-67914	Old HP-250, 300,3000 1000			Chap 2 Page 2-19
09895-67914		New HP 250		Chap 2 Page 2-50
07902-67902			New HP-300/ 1000	Chap 2 Page 2-56

CONTROLLERS

	Systems			Refer to
45000-66510	7902A Old HP-250	9895K	7902C	Chap 3 Page 3-24
45000-60024	Old HP-300/ 1000/ 3000			Chap 3 Page 3-45
07902-66510		New HP-250		Chap 3 Page 3-68
07902-66520	Old HP 250 (Repair Only)			Chap 3 Page 3-88
07902-66501			New HP-300/ 1000	Chap 3 Page 3-107

Chapter 1
General Description

Introduction

This section contains a general description of the HP 7902/9895K Disc Drive, and specifications.

General Description

The HP 7902/9895K Flexible Disc Drive is a random-access data storage system employing a flexible medium. The HP 7902/9895K consists of a controller printed-circuit assembly (PCA), a disc drive assembly, and a drive PCA. All necessary operating voltages must be provided by the host system. The controller PCA accepts and interprets commands over the Hewlett-Packard Interface Bus (HP-IB), controls the interface to the disc drive assembly, stores and retrieves data from the disc drive assembly, and returns disc drive and disc operation status information. The drive PCA is mounted in the disc drive assembly and contains read and write circuits, interlocks, and head positioning and head load circuits. The remainder of the drive electronics circuitry is located on the separately-mounted controller PCA.

The flexible medium used in the HP 7902/9895K is a flexible disc. The flexible disc is 20 centimeters (7.9 inches) in diameter and has a 3.8-centimeter (1.5 inch) hole for alignment on the spindle of the disc drive. The disc is enclosed in a protective polyvinylchloride (PVC) jacket with a slot for head access to the recording surface. Both sides of the flexible disc are used for data storage.

The recording head in the disc drive assembly is positioned by a mechanism that includes a stepper motor, capstan, and taut metal band. The mechanism operates in an open loop configuration — there is no positive feedback to determine the actual position of the head. The recording head has two read/write heads, one for each side of the flexible disc. When the heads are loaded, both contact the media. The heads remain loaded for approximately one second after no further commands are received.

The controller PCA contains a micro CPU chip (MC^2 or Z80), a processor-to-HP-IB interface (PHI) chip, read-only memory (ROM), random access memory (RAM), and the associated logic circuits necessary to provide an interface between up to four disc drive assemblies and the HP-IB interface channel. The MC^2 or Z80 handles data and commands directly at the byte level, eliminating the need for direct-memory access (DMA) hardware.

The controller PCA also contains an extensive self-test capability, including options for reading from an already formatted flexible disc and reading and writing on a previously unformatted disc. All self-test functions except reading from a previously formatted disc may be initiated via HP-IB command or by manual switching. The preformatted read self-

test is switch initiated. The controller PCA performs a subset of self-test each time power is applied to the HP 7902/9895K. This subset does not include reading or writing on the flexible disc. Self-test results are available as a four-bit binary word displayed on an LED array mounted on the controller PCA or two bytes of status information which can be read by the host system.

The HP 7902/9895K will read and write the HP standard flexible disc format used on the HP 9885 Flexible Disc Drive on either single-sided or double-sided flexible discs. The HP 7902/9895K will also read and write the IBM 128 byte/sector standard data interchange format (IBM 3740) on single-sided flexible discs only. When a new (previously formatted) flexible disc is loaded into the disc drive, the controller PCA will determine which format is being used and whether the disc is single or double-sided. Format and disc type are both reported as status information. When a disc is reformatted, the controller PCA performs defective track sparing and track reformatting.

Data transfers can be buffered on a sector-to-sector basis. This allows devices connected to the HP 7902/9895K to access data at any rate up to the maximum burst rate. Unbuffered data transfers may also be done, but this requires that the devices accept data at the rate that the HP 7902/9895K sends it.

A modular replacement philosophy has been implemented in the HP 7902/9895K to minimize on-site repair time. Troubleshooting the HP 7902/9895K is simplified by its self-test diagnostics. In addition, more extensive diagnostic testing using automatic test equipment connected to the controller PCA is possible. These diagnostics are not described in this manual since they are a function of the host system.

Specifications

Recording Specifications

HP Double Density Format

Encoding:		Modified modified frequency modulated (M^2 FM)
Rotatinal Speed:	CDC—	360 RPM, ±2.0 (±7.2 RPM)
	Shugart—	360 RPM, ±3.5 (±12.6 RPM)

Bit Density @ 360 RPM:

Track No.	Head 0 Single/Double-Sided	Head 1 Double-Sided Only
0	3651 BPI*	3736 BPI
38	4702	4845
76	6536	6816

* BPI — Bits Per Inch

Track Density:	48 tracks per inch
Tracks per Surface:	77
Surfaces Per Disc:	2

IBM Single Density Format

Encoding:	Modified frequency modulated (MFM)
Rotational Speed:	360 RPM, ±1 (±3.6 RPM)
Bit Density @ 360 RPM: CDC	3268 BPI, track 76, head 0
Shugart	3200 BPI, track 76, head 0
Track Density:	48 tracks per inch (approx. 19 tracks per cm)
Tracks Per Surface:	77
Surfaces Per Disc:	2

Capacity

HP Double Density Format

Bytes/Sector:	256
Sectors/Track:	30
Tracks:	154 on two surfaces
Bytes/Disc (Formatted):	1.18 megabytes (154 tracks)

IBM Single Density Format

Bytes/Sector:	128
Sectors/Track:	26
Tracks:	77 (head 0 only)
Bytes/Disc (Formatted):	256 kilobytes

Access Time

	CDC	Shugart
Track-to-Track Seek:	3ms/track, plus 20ms settling	3ms/track, plus 15ms settling
Maximum Track-to-Track Seek (76 Tracks):	248ms	246ms
Average Track-to-Track Seek:	96ms	91ms
Maximum Rotational Latency:	167ms	167ms
Average Rotational Latency:	83ms	88ms
Maximum Data Access Time (Seek Plus Latency):	415ms	413ms
Average Data Access Time:	179ms	174ms
Head Load Time:	40ms	174ms

Data Transfer Rate

	CDC	Shugart
Read Burst Transfer Rate:	190 kilobytes/second	135 kilobytes/second
Write Burst Transfer Rate:	190 kilobytes/second	110 kilobytes/second
HP Format Average Transfer Rate:	25.6 kilobytes/second[1]	23 kilobytes/second
IBM Format Average Transfer Rate:	11.1 kilobytes/second[2]	10 kilobytes/second

Environmental Specifications

Operating Limits

Temperature:	10°C to 40°C (50°F to 104°F)
Relative Humidity:	20 to 80 non-condensing with maximum wet bulb temperature not to exceed 25.5°C (77.9°F)
Altitude:	0 to 4572 M (0 to 15,000 feet)

Non-Operating Limits (Storage and Transit)

Temperature:	−40°C to 60°C (−40°F to 140°F)
Altitude:	−304.8 to 15240M (−1,000 to 50,000 feet)

Alignment Limits

Radial Alignment:	±0.0001 inch (.025 mm) of track center at track 38 for both head 0 and head 1

1 Interleave parameter dependent — best case every other sector

2 Interleave parameter dependent — best case every other sector. If sectors are not staggered, then only one sector per revolution can be transferred in buffered mode — 768 bytes/second.

Power Requirements

Controller Boards

+5V:	2.5A typical, 2.7A maximum (Note 4)
+12V:	0.25A typical, 0.30A maximum (Note 5)
−12V:	0.08A typical, 0.1A maximum (Note 5)

Drive Board (Shugart)

+5V:	0.6A typical, 0.7A maximum (Note 4)
+12V:	0.8A typical, 1.0A maximum (Note 5)
−12V:	0.8A typical, 1.0A maximum (Note 5)

Drive Board (CDC)

+5V ±5%

1A maximum

+24V ±10%

1.2A maximum

Disc Drive Assembly

86 to 127 Vac at 0.3A typical, 0.44A maximum

50/60 Hz ± 3.5% HP format

50/60 Hz ± 1% IBM format

Note 4: Voltage tolerance for +5V is +5%, −3%.

Note 5: Voltage tolerance for +12V and −12V is ±5%

Safety Considerations

General

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation.

Safety Symbols

Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the product against damage.

Indicates hazardous voltages.

Indicates earth (ground) terminal (sometimes used in manual to indicate circuit common connected to grounded chassis).

WARNING

The WARNING sign denotes a hazard. it calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

Safety Earth Ground

This is a safety class I product and is provided with a protective earthing terminal. An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and be secured against any unintended operation.

Before Applying Power

Verify that the product is configured to match the available main power source per the input power configuration instructions provided in this manual.

If this product is to be energized via an auto-transformer (for voltage reduction), make sure the common terminal is connected to the earth terminal of the main power source.

Servicing

Any servicing, adjustment, maintenance or repair of this product must be performed only by service-trained personnel.

Adjustments described in this manual may be performed with power supplied to the product while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.
Capacitors inside this product may still be charged even when disconnected from its power source.
To avoid a fire hazard, only fuses with the required current rating and of the specified type (normal blow, time delay, etc.) are to be used for replacement.

Drive Select and System Select Switch (HP Drive Board 07902/67914)

The drives connected to a controller board are differentiated by their drive number. The drive number is set between 0 and 2 by the drive select switch.

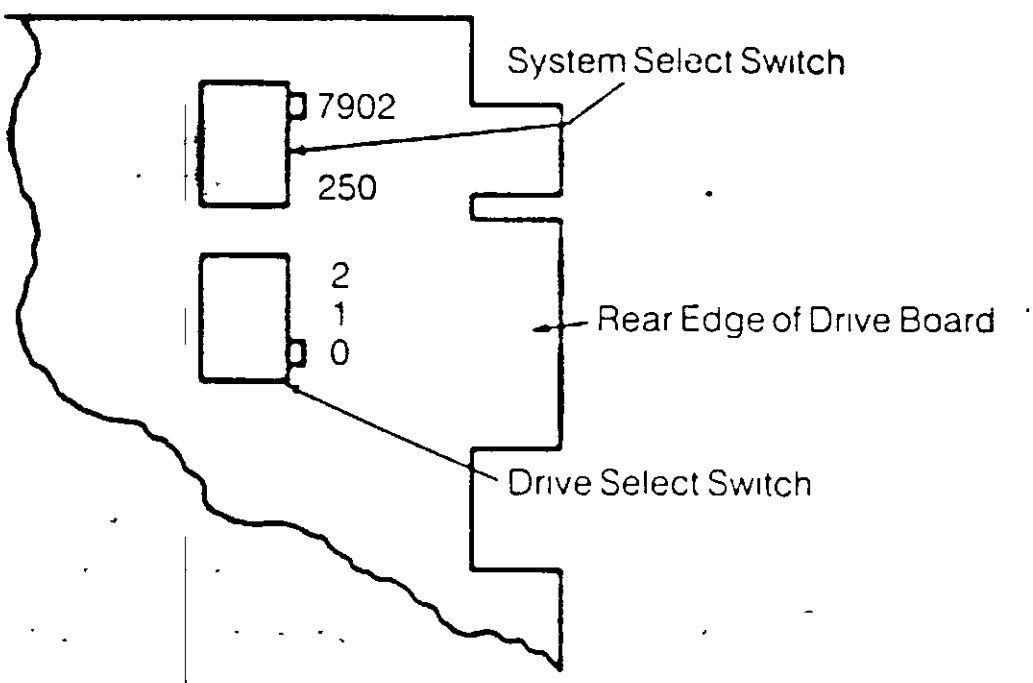


Figure 1-1. Drive and System Select Switches

The system select switch is used to tailor the drive to the system it is to be installed in. When the drive is installed in an HP-250 system, the slide switch must be positioned to "250". When the drive is installed in systems other than the HP-250 the switch must be set to "7902".

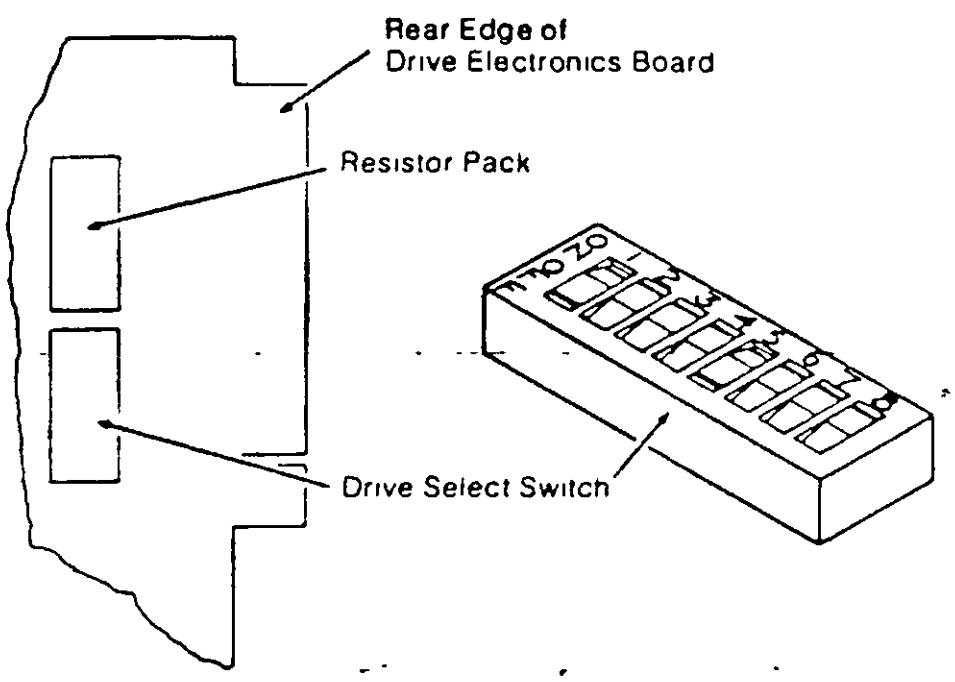
NOTE

When replacing a drive assembly in an HP-250 system, be sure to remove the jumper from J2 on the failed assembly and install it on the replacement assembly.

Drive or Unit Number (CDC Drive Boards)

The drives connected to a controller board are differentiated by their drive number. The drive number must be between 0 and 2. The factory sets drives to 0 and 1.

Set the switch segments according to the following diagram.



Select Code	Segments 1	2	3	4	5	6	7	8
3	ON	OFF	OFF	OFF	ON	OFF	OFF	OFF
2	OFF	ON	OFF	OFF	OFF	ON	OFF	OFF
1	OFF	OFF	ON	OFF	OFF	OFF	ON	OFF
0	OFF	OFF	OFF	ON	OFF	OFF	OFF	ON

Figure 1-2. Setting the Drive Number

Flexible Disc Media

The storage medium used in the 7902/9895K is a flexible disc. The flexible disc is 200mm (7.9 inches) in diameter and has a 38mm (1.5 inch) hole for alignment on the disc drive spindle. The disc is enclosed in a protective plastic jacket with a slot for head access to the recording surface. Both sides of the flexible disc are used for data storage.

By using flexible discs identified as "double-sided", up to 1.2 megabytes of data can be stored on each disc. Double-sided, double-density discs (HP part number 92195A, package of ten) are available from HP's computer supplies catalog. Phone orders may be placed by calling the toll free order number 800-538-8787. The disc memory can also handle single-sided flexible discs, allowing slightly over ¼ megabytes of storage using single density recording ½ megabytes using double-density recording. Since some storage is used in

subsystem overhead, the exact amount available for user storage depends upon the controller subsystem. Refer to the appropriate mainframe programming or reference manual for details.

Each flexible disc must be initialized before it can be used for data storage. The initialization procedure marks each disc track, checks for defective tracks, and may establish file directories. Refer to the mainframe programming or reference manual for the correct procedure.

CAUTION

USE ONLY HP MEDIA P/N 92195A. THE USE OF NON-HP MEDIA CAN RESULT IN PREMATURE DISC FAILURE OR DAMAGE TO THE 7902/9895K.

USING NON-HP MEDIA FOR ONE TIME ONLY APPLICATIONS SUCH AS DATA INTERCHANGE WILL NOT DAMAGE THE DRIVE OR DESTROY THE MEDIA, BUT IF REPEATED USAGE IS ANTICIPATED, THE DATA SHOULD BE TRANSFERRED TO HP MEDIA P/N 92195A.

For your convenience, HP offers a package of 10 discs for the 7902/9895K (HP part number 92195A).

Operating Cleanliness

To prevent potential damage or data loss, it's extremely important to maintain the cleanliness of the disc and air within the disc drive. The disc drive should not be operated in an environment in which dust, smoke, moisture, oil or chemical vapor, or other foreign matter are present. Also, be sure to strictly follow the disc handling guidelines.

The critical elements involved in the read/write process are shown below. The read/write heads must maintain contact with the disc during read and write operations. Also shown are various types of contaminants and their size relationships. A contaminant particle hard enough and of the right size may scratch either the oxide coating or the head surface. Even if not hard enough to scratch, it may be large enough to lift the head from the surface, causing data errors.

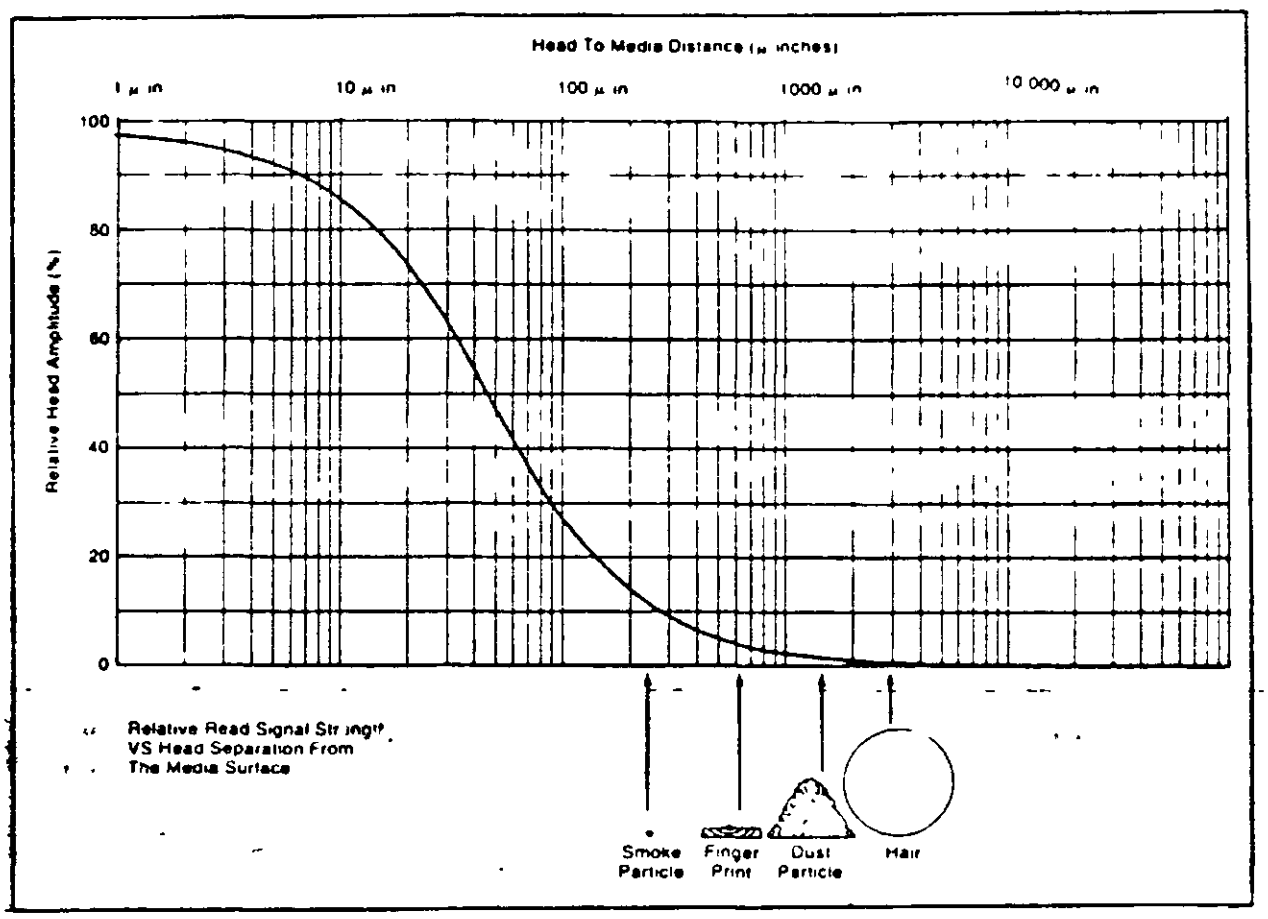


Figure 1-3. Head/Media Critical Requirements

Handling Discs

The flexible disc is basically maintenance free, but it is delicate and MUST BE HANDLED CAREFULLY. Remember, the disc contains your valuable data and programs and should be treated accordingly. A good rule of thumb is to treat your disc as you would a valuable record album. Here are some specific Do's and Don'ts to avoid loss of data or damage to your discs.

EVEN A LITTLE CARELESSNESS IN DISC HANDLING CAN DRAMATICALY REDUCE THE LIFE OF THE DISC.

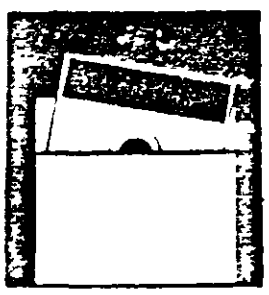
DO

Backup Discs Frequently

There is always a chance of losing data when mass storage devices are accessed. There are many causes in any computer system — a programming bug, operator error, power failure, or hardware failure. In the case of flexible discs, another mode is possible — media failure from contamination or wearout. YOUR ONLY PROTECTION AGAINST DATA LOSS IS FREQUENT BACKUP OF YOUR FILES.

DO

Return Disc to Storage Envelope When Not In Use

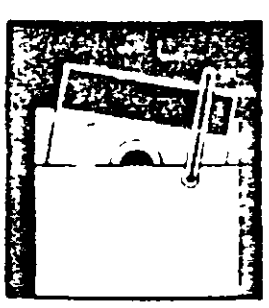


This is the single most important thing to remember about handling your disc because it prolongs disc life by protecting it from dust and scratches. Between uses discs should be stored upright in a dust free container. The box the discs are shipped in, or a similar container, is a good choice.

Operate Your System In a Clean Environment

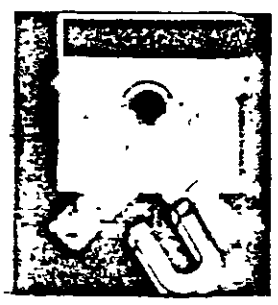
Airborne contaminates and particles accidently dropped onto the disc will cause your disc to wear out prematurely and may cause unreliable data storage and retrieval operations. Some of the most common contaminates are DUST, SMOKE, ASHES, ERASER CRUMBS, and BREADCRUMBS. Chemical vapors may also cause premature wearout.

Maintain Proper Temperature and Humidity



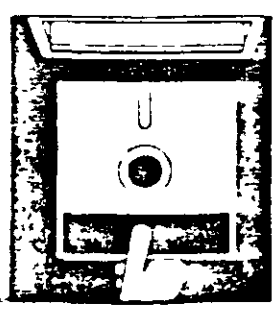
The proper operating range is 10 C (50 F) to 40 C (104 F) and 20% to 80% relative humidity. While temperature is usually easy to control, it may be necessary to make special provisions to keep the humidity in the proper range. Although the disc will continue to operate outside the normal humidity range, it will wear out more quickly and will have a higher error rate.

Avoid Magnetic Fields



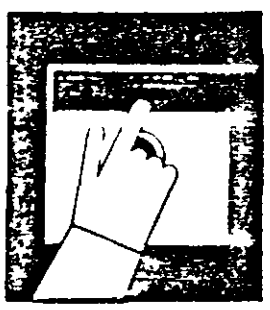
Since the data is stored as a pattern of magnetic fields on the disc, it can be erased by an external magnetic field. Avoid placing a disc near power transformers, magnets or large disc memories. Additionaly, while HP goes to great lengths to confine the magnetic fields produced by it's CRT deflection shields (so well that some our discs drives are mounted in the same cabinet as the display) CRT's with magnetic deflection systems have been known to wipe out discs, and it is a good idea to avoid placing discs on top of CRT's.

Remove Disc From Drive When Not In Use



Remove the disc completely from the drive when access is not needed for an extended period of time. The disc continues to rotate as long as it is in a drive which is turned on, even if it is not accessed. This rotation will eventually wear the disc out.

Use a Felt Tip Pen tp Label Your Disc



Use a soft felt tip pen to label your disc, and be careful to write only in the label area. Avoid the exposed media while labeling the disc. If possible, write on the large labels provided BEFORE applying them to the disc.

Replace Discs Frequently

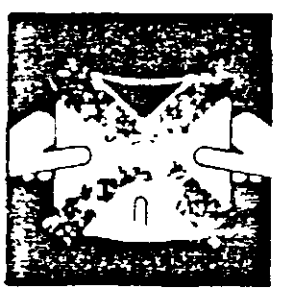
Although discs are designed to provide several million revolutions of useful life, they will eventually wear out. The life of a disc is VERY dependent on how carefully it is handled and how much it is used. A disc used sparingly (less then 20 minutes a day) should last over a year. A disc that is used heavily (more than 2 hours a day) should not be expected to last more than 3 months. To be safe, you should copy your data to a new disc and discard the old disc every 3 months for a heavily used disc or at least once a year, even for lightly used discs. If you ever see visible signs of abrasion on the disc, do an immediate backup and discard the worn disc.

DON'T

Do Not Touch the Surface of the Disc

The thickness of a fingerprint is enough to lift the head off the disc and cause errors. The oils in a fingerprint will also collect dust which can cause a disc to wear out sooner than it normally would.

Do Not Bend or Fold the Disc



The disc is flexible but will not operate if it is creased. Using ball point pens, rubber bands, paper clips, etc. can crease the disc.

Do Not Try to Clean a Disc

The inside surface of the disc jacket is covered with a special material that cleans the disc as it rotates. Any other method of cleaning may cause solvent damage to the media or scratch the disc, causing loss of data. If a disc becomes dirty or scratched, immediately transfer the data to a new disc and dispose of the old disc.

CAUTION

IF YOU EVER DESTROY MEDIA (IF IT LOOKS ANYTHING LIKE THE PHOTO BELOW) IN YOUR 7902/9895K STOP USING THE DRIVE UNTIL IT CAN BE SERVICED. THIS IS EXCEPTIONALY IMPORTANT, AS CONTINUED USE OF THE DRIVE WILL DESTROY MORE MEDIA. IMMEDIATELY CALL YOUR NEAREST HP SALES AND SERVICE OFFICE (SEE THE LIST IN THE BACK OF THIS MANUAL FOR THE NEAREST OFFICE.)

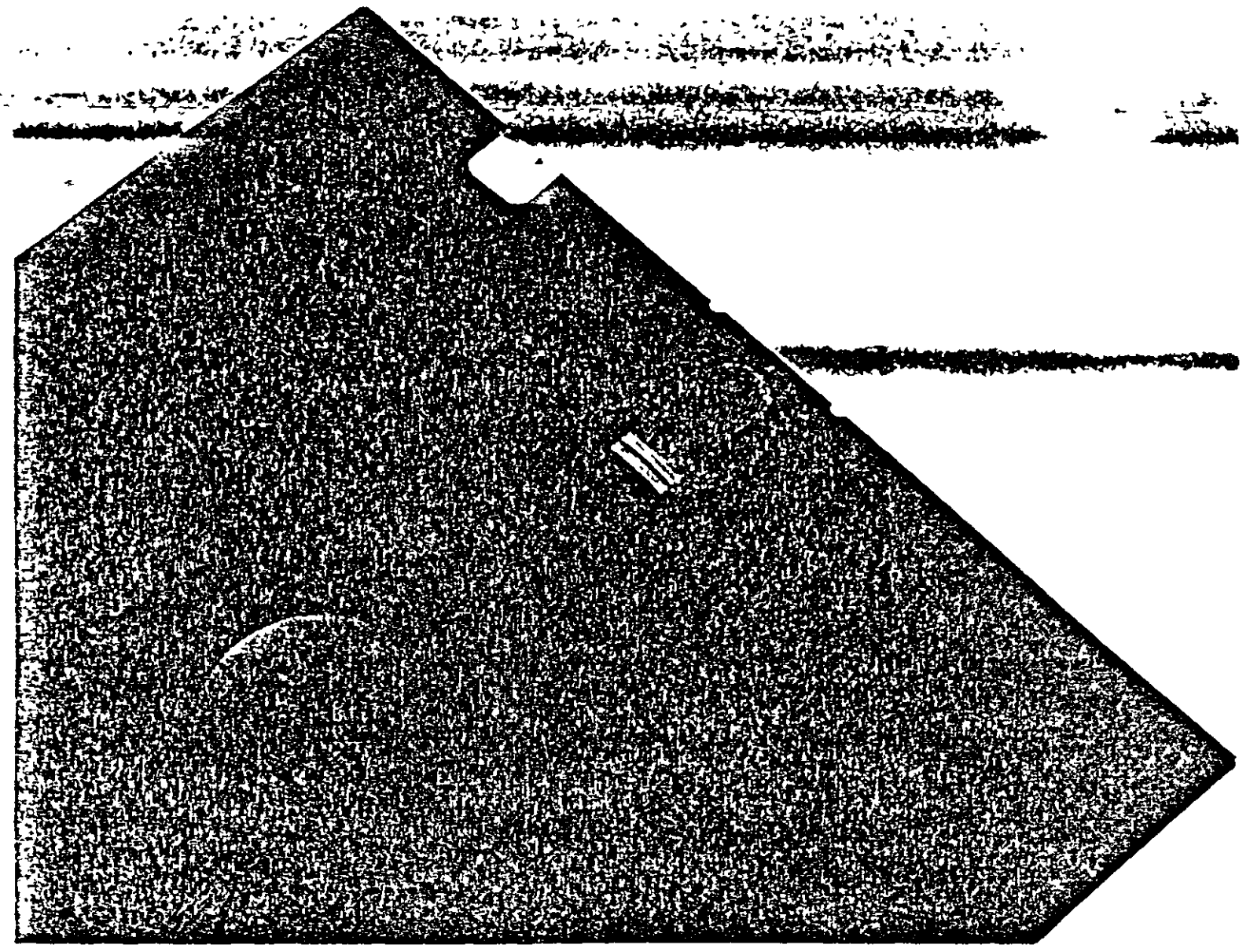


Figure 1-4. Damaged Media

Chapter 2
Flexible Disc Drives

Introduction

This section provides information on operation, theory of operation, interfacing and maintenance of the 7902A, 9895K and 7902C flexible disc drives.

Operation

Refer to Figure 2-1 for proper loading of the flexible disc medium into the disc drive. To load a disc properly, perform the following steps:

NOTE

Disk loading or unloading must be done while the drive power is applied and the drive spindle is rotating.

1. Open the door on the front of the drive by depressing the release button.
2. Insert the disc into the drive, with the lable toward the operator.
3. Press the door handle down until it locks into place.

There are no operator controls on the 7902A/7902C/9895K disc drives.

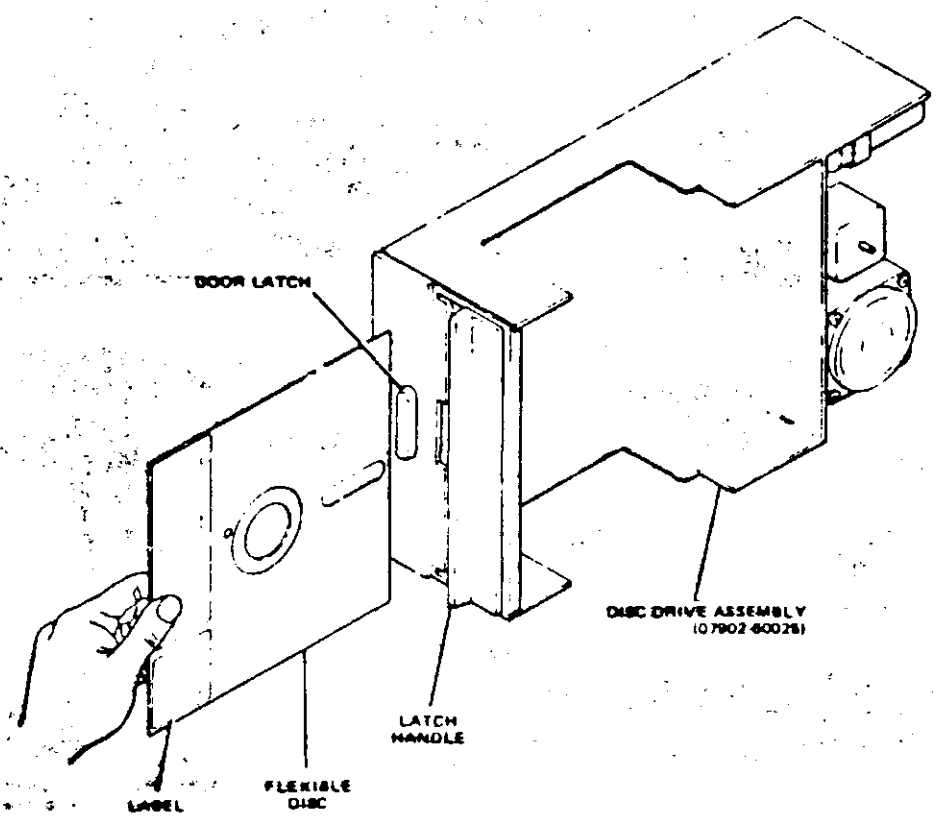
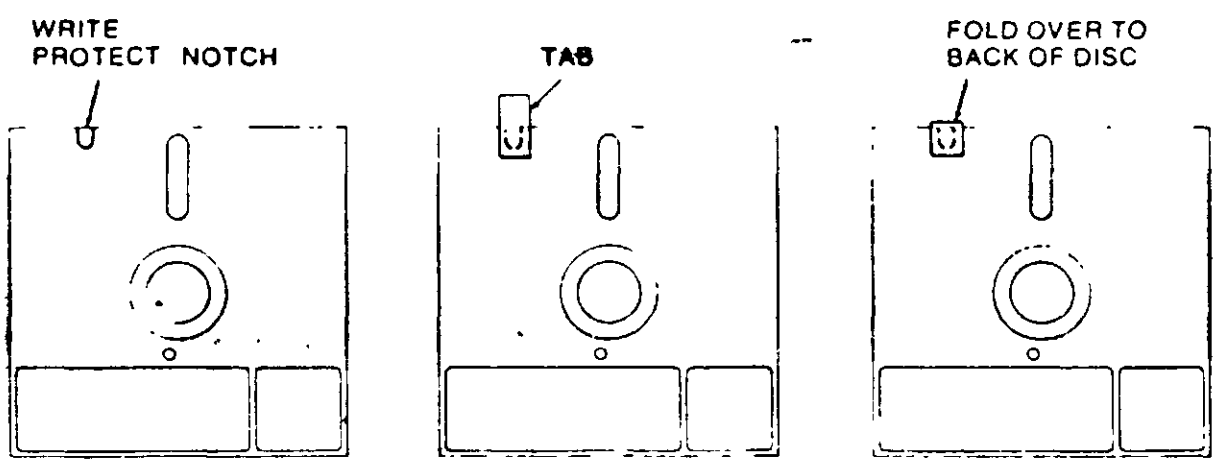


Figure 2-1. Flexible Disc Loading Details

Write Protection

Data and programs stored on a flexible disc can be protected from being written over. The disc is "write-protected" by uncovering a notch in the sealed protective jacket. When the notch is covered, as shown below, writing is allowed. HP discs are supplied with the notch covered, enabling you to write on the disc. Any opaque tape, can also be used. **Remember, fingerprints can be disastrous to your data, so be careful not to touch the surface of the disc.**



General Description

The disc drive assembly consists of a drive mechanism, read/write heads, a head positioning mechanism, and control interlocks. Drive Board A2 includes read and write circuits, control circuits for head positioning and loading, and read, write, and erase enabling.

Drive Mechanism

The drive mechanism is composed of a drive motor, spindle hub, and drive belt. The drive motor rotates the spindle at 360 rpm through the drive belt. Constant rotational speed is achieved for 60 Hz or 50 Hz primary power by changing the drive motor pulley and belt. A registration hub, centered on the spindle hub, positions the flexible disc. A hub clamp that moves in conjunction with the cartridge guide fixes the flexible disc to the registration hub.

Read/Write Heads

The read/write heads are single-element ceramic devices with straddle head erase elements to provide erase areas between tracks. The heads, one for each side of the disc, are mounted on a carriage assembly that is positioned by a stepper motor. The flexible disc is inserted through a disc access door on the front of the disc drive and is held in place perpendicular to the read/write heads by a plate located on the drive frame. During a read/write operation, the heads are in direct contact with the disc.

Head Positioning Mechanism

A mechanism that includes a stepper motor, capstan, and taut metal band positions the read/write carriage assembly on the flexible disc. The stepper motor, driven by signals from drive board A2, rotates in 3.6-degree increments moving the heads one track per increment. The HP-IB channel supplies controller board A1 with head positioning commands which in turn supplies positioning data to A2.

Drive Electronics

The drive electronics circuitry is contained on drive board A2 which is attached to the bottom of the disc drive frame. A2 is connected between the controller board A1 and the various electromechanical components of the disc drive thereby providing the necessary interface for disc drive operation. A2 recognizes when the disc drive is selected and initiates the proper head positioning and loading actions. For write operations, A2 turns on write and erase current generators and provides the correct write current transitions. During read operations, data obtained from the flexible disc is amplified and conditioned, and sent to controller board A1. A2 also contains interlock circuits that prevent drive operations when the disc access door is not closed and latched, the heads are not loaded, or the flexible disc is write protected. In adition, A2 makes available status information.

Functional Description

The following paragraphs provide a functional description of the circuits on drive board A2 and the operation of the associated disc drive electromechanical components. Refer to Figure 2-2 for a detailed functional block diagram of A2.

The circuits on A2 are divided into four principle systems: a control system, a head positioning system, a read/write system, and a power supply filtering system. The control system provides the interface between controller board A1 and the disc drive, the head actuating system moves and loads the read/write heads in response to signals from A1, the read/write system reads information from or writes information onto the surface of the flexible disc, and the power supply filtering system filters and distributes the dc voltages from the host system.

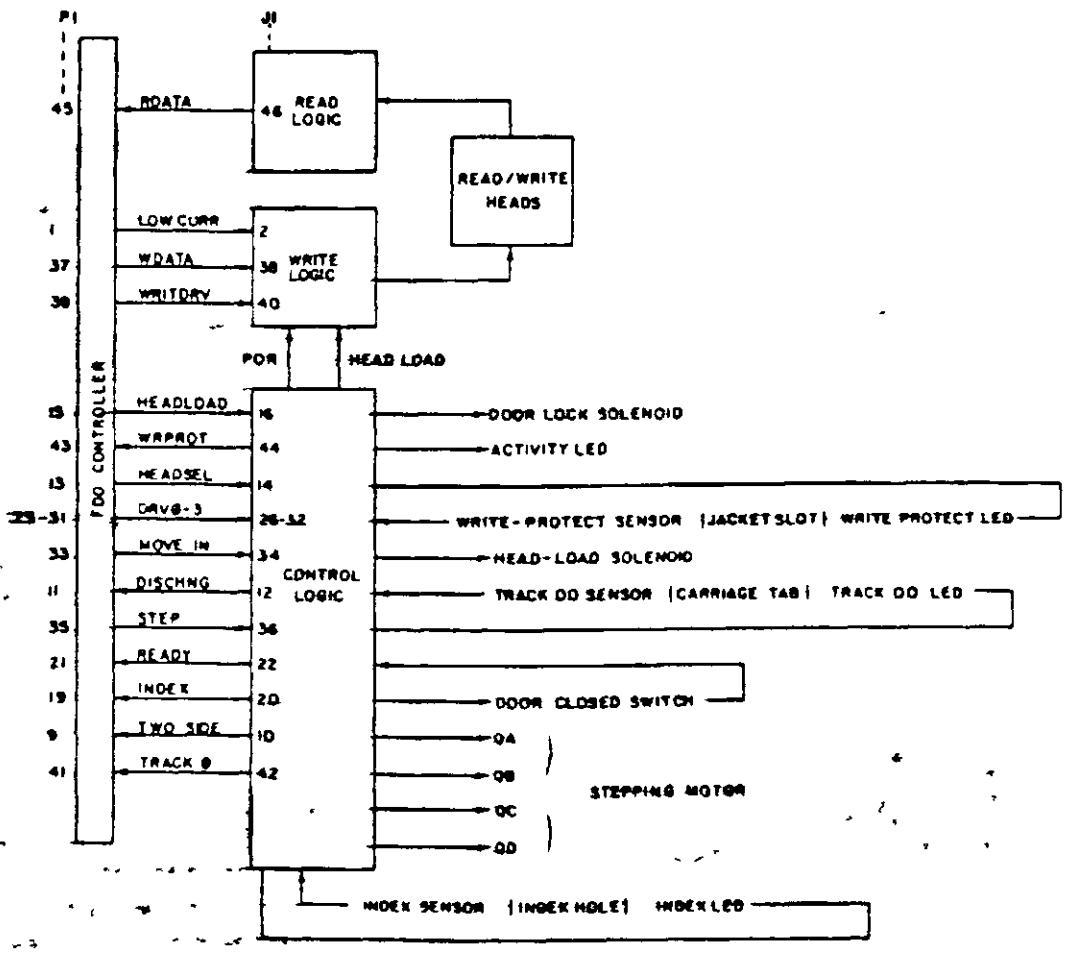


Figure 2-2. Drive Functional Block Diagram

Input/Output Signals

There are 14 signals input to drive board A2 from controller board A1, five signals output from A2 to A1, and two input/output (bidirectional) signals between A2 and A1. These signals, together with identifying mnemonics, are described in the table 2-1.

Logic Signal Notation

In the disc drive logic circuits, a signal is applied to its destination at all times in one of two states: active or inactive. A signal is active when the voltage level (high or low) is such as to make the action occur for which the signal was intended. This action is usually identified by the signal mnemonic. To indicate the active voltage level of the signals, the mnemonics for all active high signals have an "H" suffix and the mnemonics for all active low signals have an "L" suffix. Table 2-2 uses an active high signal (REDYH) and an active low signal (TRKOL) to summarize the details of the signal notation system.

Table 2-1. Drive Board A2 Input/Output Signals

Mnemonic	Signal	Function
	Output to Controller PCA	
INDXL	Index	Active when index hole in flexible disc passes index photodetector. Signal is active once per revolution of disc (6 times/second).
REDYH	Ready	Active when disc drive is in a ready state, i.e., a disc is in drive and spinning, drive is select, heads are loaded, and head 1 is not selected with single-sided disc.
SPINL	Spinning	Becomes active after a Reset Spinning (RSPNH) if the disc drive is nominally up to speed. Also alerts controller PCA to removal and insertion of a new flexible disc.
TRK0L	Track Zero	Active when read/write heads are positioned at track zero (outermost track used on disc).
WPRTL	Write Protect	Active when flexible disc in disc drive is write protected (allows reading only).
	Input from Controller Board	
DLCKL	Door Lock	When active and held by control latch, locks disc access door (without regard to heads being loaded).
DSLVL	Drive Select Valid	When active, validates Drive Select signals DSLOH, DSL 1H, and DSL2H.
DSLOH, DSL1H, DSL2H	Drive Select	Binary-coded decimal signals used to identify disc drive with which controller desires to communicate.
HDACTL	Head Load	When active and held by the control latch, signal enables stepper, loads heads, and locks door.

Table 2-1. Drive Board A2 Input/Output Signals (Continued)

Mnemonic	Signal	Function
	Input from Controller PCA (Continued)	
HED1H	Head One	When active and held by the control latch, it selects head 1. When inactive, head 0 is selected.
LDCTL	Load Control	When active, with drive selected and not in a write mode, clocks the control latch which latches input signals HDACTL, PHIBH, DLCKL, and HED1H on the drive PCA.
PHIBH PHIAH	Phase B Phase A	When held by control latch, generates signals which drive stepper motor in head actuator assembly.
PONH	Power On	When active, enables the control gates that activate the write circuits. Write is allowed if drive is selected and ready, write mode is selected, and disc drive does not contain a write-protected flexible disc.
PORH	Power On Reset	When active, resets control latch index counter and spinning flip-flop. This reset action disables stepper, unloads heads, unlocks door, selects head 0, and makes SPINL inactive.
RSPNH	Reset Spinning	When active, clocks output of the Index Counter into the spinning (SPINH) flip-flop.
WRIT	Write	When active, places disc drive in write mode.
	Output To/Input from Controller PCA	
DATAH DATAL	Data	Bidirectional differential lines carrying read and write information to and from the controller PCA.

Table 2-2. Logic Signal Notation

Signal Mnemonic	Volage Level	State	Message Transmitted
REDYH	high	active	Drive ready
REDYH	low	inactive	Drive not ready
TRKOL	low	active	Read/write heads at track 0
TRKOL	high	inactive	Read/write heads not at track 0

Control System

The control system responds to inputs from controller board A1 and places the disc drive in a write mode or a read mode. In addition, the system provides A1 with drive status information. To ensure that the drive mechanism is in the correct condition for reading and writing, the control system also monitors the state of four photodetector sensors and a door-closed switch in the drive mechanism. The actions of the various circuits comprising the control system are discussed in the following paragraphs.

Drive Select

To permit the controller board A1 to communicate with one disc drive at a time, each disc drive is assigned an identity number between 0 and 7. A1 uses this number to select the disc drive with which it desires to communicate. Drive board A2 employs a comparator to decode the identity number. The comparator compares the state of binary-coded decimal Drive Select inputs DSL0H, DSL1H, and DSL2H from A1 with BCD inputs from the front panel Drive Select switch. If the coding of the two sets of inputs coincide, and Drive Select Valid signal DSLVL is active, the drive select circuit outputs Drive Select signal DSLH. If a Drive Select switch is not connected to A2, the circuit defaults to 0.

Door Closed Detector

The disc drive assembly contains a door-closed switch which is activated by the disc guide assembly. The switch has two output lines: Door Open and Door Closed, both of which are active low. The Door Closed line is active when the disc access the door closed detector on drive board A2 to output an active high Door Closed signal. When the disc access door is open, the active Door Open signal resets the detector, causing the output to become inactive.

Write Protect Detector

The write protect detector is a phototransistor assembly mounted on the disc guide assembly. The purpose of the detector is to sense if the write protect slot in the cover of a flexible disc inserted into the drive is open or covered by a tab. The output of the photodetector is coupled to an interface circuit on drive board A2. The output of the interface is active when the write protect slot is open. The output signal from the interface inhibits the write operation by gating off the write interlock which in turn prevents operation of the write current and erase current sources. The output of the write protect photodetector can be observed at a test point labeled WPRTH.

Track Zero Detector

The track detector is a phototransistor assembly mounted on the main casting of the disc drive. The purpose of the detector is to sense when the read/write carriage assembly reaches track 00. The phototransistor output is active for tracks −01, 00, and 01, and inactive for tracks 02 and above. The phototransistor output is connected to an interface circuit on drive board A2. The interface output is AND'ed with the head actuator stepper motor phase A and B drive lines to develop a unique track 0 signal. The signal, identified as TRK0L, is coupled via a line driver to controller PCA-A1. The output of the interface circuit, before it is AND'ed with phases A and B, can be observed at a test point labeled TK0H.

Single/Double-Sided Disc Index Detector

The index detector assembly consists of two phototransistors mounted on the disc guide

assembly. The purpose of the index detector is to sense the presence of the index hole in the flexible disc. One phototransistor senses the index hole of a single-sided disc and the other phototransistor senses the index hole of a double-sided disc. The two outputs from the phototransistors are coupled to an interface circuit on drive board A2. The two interface outputs are OR'ed together to give one output which can be observed at a test point labeled INDEXH. When either a single-sided or double-sided disc is rotating in the disc drive, signal INDEXH is a pulse which occurs once per revolution of the disc. Signal INDEXH is a (connected to an index counter, and b) coupled via an inverting line driver to controller board A1 as signal INDXL. The separate outputs from the interface, before they are OR'ed, can be observed at test points labeled INDEX0L (one-sided disc index pulse) and INDEX1L (double-sided disc index pulse).

Single-Sided Disc Detector

The purpose of the single-sided disc detector is to inform controller board A1 when a single-sided disc is inserted into the disc drive. The detector monitors the state of single-sided disc index signal INDEX0L from the index detector. When INDEX0L is active, the single-sided disc detector output SSDH is active. The detector is reset at power-on and when the disc access door is opened.

Index Counter

The index counter provides Disc Spinning signal SPINH which is active when certain disc drive operating conditions are valid. These conditions are: disc loaded, disc access door closed and latched, and the occurrence of two successive index pulses (an indication that the disc is rotating). The index counter also returns disc drive status information to controller board A1.

The index counter consists of three D-type flip-flops connected in cascade. The clear input to all three flip-flops is derived from the output of the door closed detector and an inverted Power On Reset (PORH) input. As long as the disc access door is open, the clear line is held low and no circuit action can occur. The Q output of the third flip-flop, connected via an inverting line driver to A1, is status signal SPINL. Signal SPINL is inactive at this time since the clear input to the flip-flop holds its Q output low.

As soon as a disc is loaded into the disc drive and the disc access door is closed and latched, the clear line goes high and allows the first two flip-flop to start counting. When a second index pulse occurs, the second flip-flop a) lights an LED labeled B (disc ready) on drive board A2 and the DISC READY LED on the optional front panel indicator display, and b) pulls the D-input of the third flip-flop high. When PCA-A1 checks the status of the disc drive, it pulses the Reset Spinning (RSPNH) line. This action clocks the third flip-flop, causing its Q output to go high. Status signal SPINH is now active. Signal SPINH is also used internally in the A2 circuitry that determines if the disc drive is ready.

Drive Ready

Several signals in the drive PCA-A2 circuitry are gated together to produce status signal Drive Ready (REDYH). The following conditions must be true for REDYH to become active:

- SPINH active, i.e., a flexible disc has been inserted into the disc drive, the disc access door is closed and latched, and the disc is spinning.
- Drive selected with signal DSLH active.

- Heads loaded.
- Head 1 not selected if a single-sided flexible disc is in the disc drive.

Read Enable

The read mode of operation is enabled when Drive Ready signal REDYH is active and the Write (WRITL) input is inactive. These conditions enable a) the output of the read circuit, and b) the driver section of the data transceiver.

Write Enable

The write mode of operation is enabled when Drive Ready signal REDYH is active, the Write (WRITL) input is active, and the Write Protect (WPRTH) line is inactive. These conditions enable the write interlock circuit.

Write Interlock

The write interlock supplies drive to the current switches in the write current and erase current sources when the write enable signal is active. However, operation of the write interlock is inhibited if the Power On (PONH) line is inactive. Both PONH and write enable must be active in order to enable the write interlock. Signal PONH, generated in the host system power supply, is inactive when the ac line voltage input to the supply falls below its low limit specification.

Front Panel Display Drivers

The front panel display drivers provide drive for three LED's on an optional front panel indicator display that can be connected to A2 via connector A2J6. The LED's are labeled DRIVE SELECTED, DISC READY, and WRITE PROTECTED. The DRIVE SELECTED LED is driven by signal HDACTH from the control latch; the DISC READY LED is driven by the Q output of the second flip-flop in the index counter; and the WRITE PROTECTED LED is driven by a signal from the write protect interface. Two LED's on A2 are also activated by the front panel display drivers. These LED's are labeled A (drive selected) and B (disc ready).

Head Actuating System

The function of the head actuating system is load the read/write heads on any one of the 77 tracks on the flexible disc, select either of the two read/write heads for a read/write operation, and lock the disc access door to prevent removal of the flexible disc while the heads are loaded. The system circuits on drive board A2 include a control latch, a head unload delay circuit, a head load driver, a stepper driver, and a door lock driver. Associated electromechanical components on the disc drive assembly include a head load solenoid, a head actuator assembly with stepper motor, and a door lock solenoid.

Control Latch

The control latch retains inverted Head Actuate (HDACTL), Stepper Phase (PHIAH, PHIBH), Door Lock (DLCKL) and Head Select (HED1H) information received from controller A1. The latch is clocked by the Load Control (LDCTL) signal from A1, AND'ed and Drive Select (DSLH) and an inverted Write (WRITL). These signals prevent a) the latch from clocking in new information when the drive is not select or if it is in a write mode, and b) accidental stepping to other tracks when the disc drive is writing on a particular track.

The control latch is reset by the Power On Reset (PORH) input from A1. When reset, the latch is in a state whereby the heads are unloaded, the stepper motor is disabled, the disc access door is unlocked, and head 0 is selected.

Head Unload Delay

The head unload delay circuit delays unloading of the heads for approximately 1.5 seconds after the Head Actuator (HDACTL) signal becomes inactive. This allows the disc drive to respond without any settling delay to another head load command occuring less than 1.5 seconds after the previous one ended. The HDACTL signal from the conrol latch is input to a 1.5-second delay circuit, the output of which is OR'ed with HDACTL. When HDACTL is active, it loads the heads via the OR gate output. When HDACTL becomes inactive, the output of the delay circuit remains active for a further 1.5 seconds, continuing to load the heads for this period. The output of the OR gate also enables the stepper motor driver circuit.

Head Load Driver

The head load driver provides drive to the head load solenoid which, when activated, allows the heads to contact the surface of the flexible disc. The head load driver is energized when the HDACTH signal from the head load delay circuit is active and the output of the second flip-flop in the index counter is active. This gating ensures that the heads cannot be loaded without having a flexible disc in the disc drive. The input to the head load driver can be monitored at a test point labeled HDLDL.

Stepper Driver

The stepper driver provides drive for the 4-phase 3.6-degree per step permanent magnet stepper motor driving the head actuator assembly. The rotary motion of the stepper motor is transformed into linear motion by an actuator mechanism that employs a capstan and taut metal band. Each 3.6-degree step of the motor increments the head position one track.

The 4-phase coils of the stepper motor are connected to form two pairs of 2-phase coils in parallel. Current is driven into the pairs in either direction according to the stepping sequences desired. To switch the direction of current through the coils, the stepper drivers must be able to source current or sink current. Each driver pair is enabled such that one is the inverse of the other. Controller board A1 supplies two phase inputs to drive board A2. These are labeled Phase A (PHIAH) and Phase B (PHIBH). The control latch outputs non-inverted and inverted phase signals QA, QA, QB, and QB to the stepper driver. The stepping sequence for the actuator stepper motor is shown in Figure 2-3. The stepper motor driver is enabled by the output of the head unload delay circuit previously described.

Door Lock Driver

The door lock driver, when energized, energizes a door lock solenoid that holds the disc access door locked by disengaging the latch of the door opening button. The solenoid is energized by either a Door Lock (DLCKL) signal or a Head Load (HDLDL) signal. An LED on A2 labeled D (door lock) monitors the input signal to the door lock driver.

Head Switch

The head switch circuit selects read/write head 0 or head 1 by grounding the center tap of the selected head. This grounding action forward biases diodes in the input circuit of the

read preamplifier allowing it to pick up the output of the selected head. When in the write mode the grounding forward biases diodes in the write current source and the erase current source, allowing the sources to supply current to the selected head. The two outputs from the head switch circuit can be monitored at test points H0CTL (head 0) and H1CTL (head 1).

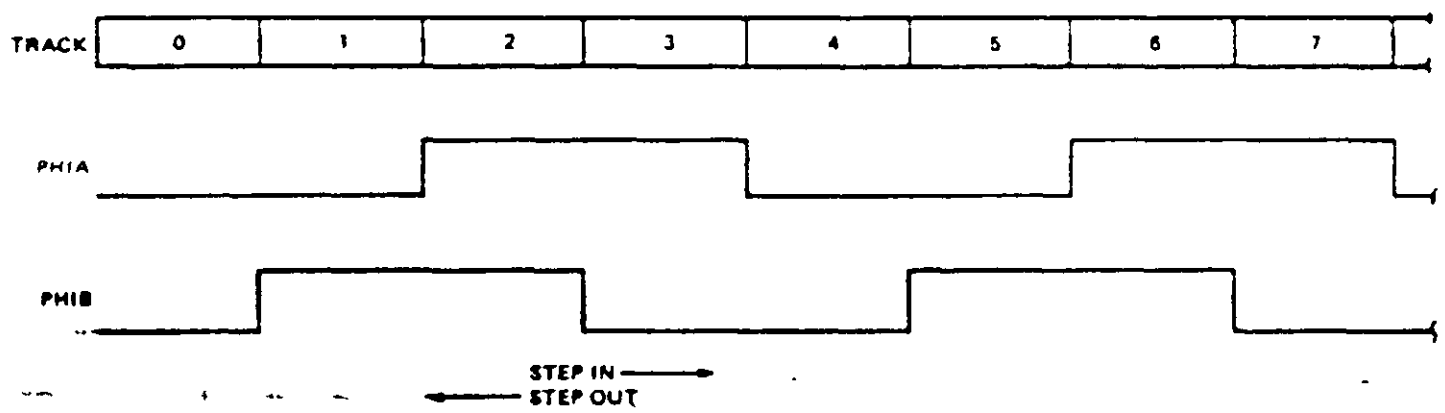


Figure 2-3. Stepper Motor Switching Sequence

Read/Write System

The function of the read/write system is to provide the means to read information from or write information onto the surface of the flexible disc. Included in the following paragraphs are functional descriptions of the read/write heads, the read mode of operation, and the write mode of operation.

Read/Write Heads

Each read/write head is a gapped ferrite core housed in a ceramic shoe (or slider). The head rides in direct contact with the surface of the disc. Two read/write windings are wound around the core. The windings are connected to a common point and phase such that the common point acts as a center tap. The windings are used for both reading and writing by detecting or providing a magnetic flux change at the gap in the ferrit core. An erase coil, wound on a yoke spanning the track being written by the read/write head, provides a constant megnetic field perpendicular to the read/write head. The erase coil is energized during the write operation and results in the outer edges of the track being trim erased. The erase head ensures that the track being recorded does not exceed the 0.012-inch track width. It also allows for minor deviations in read/write head current so that as one track is recorded it will not "splash over" to adjacent tracks.

Each data bit/clockpulse written is directed to alernate read/write coils, thus causing a change in the direction of current flow through the read/write head. The alternate switching will cause a change in the flux field of the core for each bit. The current through either of the read/write coils will cause the previously recorded information on the disc to be erased as new information is recorded.

On a read operation, as the flux field direction changes on the disc surface as it passes under the core gap, current will be induced into the windings of the read/write head. This current will result in voltage output of differing polarity. When the next bit passes under the gap, another flux reversal in the recordng surface takes place. This flux change reverses the induced head current, causing a polarity reversal of the voltage output pulses.

Read Mode Operation

As the surface of the flexible disc moves under the data head, the magnetically stored flux field intersect the gap in the ferrite core of the head. The motion of the flux reversals passing the head gap causes a current to be induced into the read/write windings wound around the core. The resulting voltage are converted to pulses and coupled to controller board A1 where they are analyzed to define the data recorded on the surface of the disc. Each flux field reversal, caused by a write current polarity change, generates a readback voltage pulse.

Read Circuit

The read circuitry on drive board A2 is enabled in the read mode. A differential signal from the selected read/write head is coupled via a cable to the input of a read preamplifier stage. The input of the read circuit is isolated from the write current source by isolating diodes. The output of the preamplifier is coupled through a balanced lowpass filter to a differentiator stage. The preamplifier signals at the output of the filter can be observed at test points labeled PREAMP + and PREAMP −. The differentiator stage transforms the read waveforms such that the data points are represented by zero crossing rather than the peaks produced at the head. The output of the differentiator can be viewed at test points labeled DIFF + DIFF −.

The output of the differentiator stage is connected to the input of a zero-crossing detector. The detector is a TTL bipolar one shot that produces pulses for positive or negative-going zero crossings. The output of the zero-crossing detector is connected to a droop detector. This circuit detects false zero crossing caused by droop in the differential output. The droop detector allows only valid output pulses from the zero crossing one-shot to pass through. The output of the detector can be viewed at a test point labeled READ DATA. An LED labeled C (read), also connected to the output of the droop detector, is dimly lit when the disc drive is in the read mode and there is data on the flexible disc.

The output of the droop detector is connected to the driver section of a data transceiver for transmission via differential lines to controller board A1.

Write Mode Operation

Information is written on the disc by passing a current through the windings of the read/write head. The current generates a flux field across the gap in the ferrite core, causing the iron oxide particles coated on the recording surface of the disc to be magnetized. The writing process orients the poles of each magnetized particle to permanently store the direction of the flux field as the oxide passes under the head. The direction of the flux is a function of the polarity of the write current. A data bit/clock pulse is written by reversing the write current through the head windings. This change in write current polarity switches the direction of the flux field across the gap. Erasing old data is accomplished by writing over any data which may have been previously written on the disc.

Write Current

The write circuit consists of a complementary write current source and an erase current source, both of which are enabled when the write mode is selected.

Data bits/clock pulses are input to drive PCA-A2 from controller PCA-A1. (Encoding is performed by circuits on A1.) The information is applied via the receiver section of the data transceiver to the clock input of a toggle flip-flop in the write current source. The flip-flop produces two complementary signals (Q and Q) that activate the write current source. The source consists of two transistor current amplifiers, one for each winding on the selected read/write head. The complementary outputs of the flip-flop alternately turn on each source. The switching action selects the head winding through which current will pass. A transistor switch in the write current source, controlled by the write interlock, supplies +12 Vdc to the source when conditions for the write mode of operation are valid.

A light-emitting diode labeled E (write), connected to the Q output of the toggle flip-flop, is dimly illuminated when the write mode is selected and the flip-flop is being toggled by signals from the receiver section of the data transceiver.

The erase current source consists of a single transistor that supplies dc current to the erase winding on the selected read/write head. Operation of the erase current source is controlled by the write interlock.

Power Supply Filtering

Drive board A2 is powered by dc voltages supplied by the host system via connector A2J5. The input voltages are +12 Vdc, +5 Vdc, and −12 Vdc. A −5 Vdc three-terminal negative regulator located on drive PCA-A2 and powered by the −12 Vdc input supplies a −5 Vdc regulated potential. The four voltages are filtered and then distributed throughout drive board A2. The disc drive spindle motor is powered by ac voltage obtained by cable directly from the host system.

Disc Structure

The flexible disc is a circle of plastic 200 mm (7.9 inches) in diameter, enclosed in a sealed black plastic jacket. Bonded onto the surface of the disc is a ferromagnetic iron oxide with characteristics similar to magnetic tape. Data is stored in the form of binary digits represented by magnetized spots on the disc. Information is stored and retrieved by read/write heads that come in contact with the disc's upper and lower surfaces.

Data is stored in concentric tracks on each side of the disc. Each disc has 77 circular tracks, numbered 0 thru 76. Each track is subdivided into either 30 sectors using HP format or 26 sectors using IBM format. Each sector contains either 256 bytes of data using HP format or 128 bytes using IBM format. The data contained in one sector is the smallest amount of information that can be written at a time. The disc is soft sectored, that is, there is no hardware indication of where each sector starts. Instead, the beginning of each sector is indicated by information recorded on the disc.

Drive Theory of Operation

Introduction

This section provides a general description of the drive module and will only cover those areas common to all versions.

General Description

The basic function of the drive is to indicate to the controller when it is ready to operate, and respond to the commands of the controller to:

- Receive and generate control signals,
- Position the read/write heads to selected tracks,
- Read or write data on the disc when selected.

Signals received and transmitted by the drive are shown in Table 2-3. Some signals received by the drive are gated with drive select so that no stepping, reading or writing can be performed on an unselected drive. Also, some signals generated within the drive are gated with drive select so that they can't be transmitted from an unselected drive.

Table 2-3. Control, Status and Data Lines Between the Controller and Drive Electronics

Signal	Mnemonic	Function
		Control Signals
Drive Select	DRV0-3	Identifies disc drive with which controller desires to communicate.
Head Load	HEADLOAD	Loads the heads and locks the door on the unit identified by Drive Select.
Head Select	HEADSEL	Selects head 1 when active, head 0 otherwise.
Low Current	LOWCURR	Reduces write current on inner tracks to decrease bit shift.
Move In	MOVEIN	Causes heads to move toward center of disc when active during a Step command. Heads move away from center when active during a Step command.
Step	STEP	Causes heads to move in direction specified by MOVEIN.
Write Enable	WRITDRV	Places disc drive in write mode when active.
		Status Signals
Disc Change	DISCHNG	Asserted when the elected drive is either not ready (due to no disc) or has a new disc inserted.
Disc Two-Sided	TWO-SIDE	Asserted when disc is found to be two-sided.
Index	INDEX	Asserted when index hole in disc passes photodetector.
Ready	READY	Asserted when a disc in the selected drive has rotated for at last two revolutions.

Track Zero	TRACK0	Asserted when heads are positioned at track zero.
Write Protect	WRPROT	Asserted when disc in selected drive is write protected.
	Data Lines	
Read Data	RDATA	Carries read data to the controller from the drive.
Write Data	WDATA	Carries write data to the drive from the controller.

During the write operation, the selected drive must have head-load, head select, write enable and write data signals. During the read operation, the selected drive will perform a head load. The write enable line remaining high implies a read operation. Under these conditions the drive will transfer read data to the controller. Controller step and direction commands are received initiating a track-seek operation on a selected drive. The selected drive transmits a track 00 signal to the controller whenever the read/write heads are at track 00.

Positioning the carriage-mounted read/write heads is accomplished by a band-driven stepper motor. Each step command from the user system increments the stepper motor which, in turn, moves the band. The band increments the read/write heads one track for each step command.

A read or write operation begins by placing the read/write heads in contact with the disc with a Head-Load command at the desired track. To write on the disc, write enable is sent by the controller to condition the write logic. The write current then in the head reverses polarity synchronous with the high-to-low transitions of the write-data pulses from the controller. The current reversals cause magnetic flux reversals on the desired disc track. Erasure of previously recorded data is simultaneously accomplished during the writing operation in addition to a delayed tunnel erase which ensures disc interchangeability.

To read from the disc, magnetized bits in the format of the pre-recorded data are sensed by the read/write heads. This signal is amplified, digitized and transmitted to the controller.

Functional Characteristics and Communication Protocol

Introduction

This section describes the recording formats used in HP disc memory.

Recording Formats

The HP disc drive supports both the HP Standard Disc Format (hereafter referred to as the HP Format) and the IBM (IBM 3740) Standard Data Interchange Format (hereafter referred to as the IBM Format). Format similarities and differences are described in the following paragraphs.

Format Similarities

The following features are common to both the IBM Format and the HP Format.

Media. A double-sided disc is used as the recording medium. The disc is composed of recording material and is enclosed in a square plastic jacket. An index hole in the disc is used to provide a rotational position reference. The disc drive will also accept a single-sided disc. Single-sided discs must be used for the IBM Format mode of operation.

Tracks. There are 77 physical tracks on each side of the disc, with a spacing of 0.0208 inch between track centers (48 tracks per inch). The outermost track is Track 0 and the innermost track is Track 76.

Recording. Information is stored on the disc as a series of magnetic flux reversals. Since a single head is used to read from and write on each side of the disc, a self-clocking code must be used to store the information.

The portion of the disc or the duration of the time used to store a single bit is referred to as a bit cell. The first part of the bit cell is called the clock window and the remainder of the bit cell is called the data window. A flux reversal in the clock window is called a clock transition and a flux reversal in the data window is called a data transition. A bit cell that contains a data transition stores a 1 and a bit cell with no data transition stores a 0.

Track Format. Each track is divided into sectors, as shown in Figure 2-3. The data contained in one sector is the smallest amount of information that can be written at a time. The disc is soft-sectored, that is, there is no hardware indication of where each sector starts. Instead, the beginning of each sector is indicated by information recorded on the disc.

In order to allow soft-sectoring, each sector is divided into two fields. First, there is an ID field which contains information to identify the sector. Next, there is a data field which contains the actual data. The ID field is written only when the disc is formatted, never during actual operation. Thus, an ID field serves as a fixed marker for the beginning of each sector. The entire data field is re-written each time a write operation occurs to the sector.

The makeup of the ID and data fields is similar. Both fields start with a series of sync-up bytes. These bytes end with a long string of identical bits. During a read, the bit string allows the controller's decoder circuitry time to synchronize itself with the data on the disc. Next comes an address mark byte, which indicates that the beginning of an ID or data field has been found. The data stored in this byte indicates which type of field it is part of. In order that no other byte can be mistaken for an address mark, the address mark byte contains an abnormal pattern of clock transitions. The first bit of an address mark is opposite type from the last bit of a sync-up field. This feature simplifies detection of address marks.

Following the address marks is a series of information bytes. In an ID field, these bytes indicate the logical track, head and sector address. In a data field, these bytes are the data being stored in the sector.

At the end of each field are two Cyclic Redundancy Check (CRC) bytes. These bytes allow the detection of most errors that occur in the storage and recovery of information from the disc.

There are gaps between each field on the track. The gaps allow for variations in disc rotational speed. The sectors are logically numbered consecutively. However, the sectors may occur in any physical order around the track. This allows the sectors to be staggered to optimize system performance.

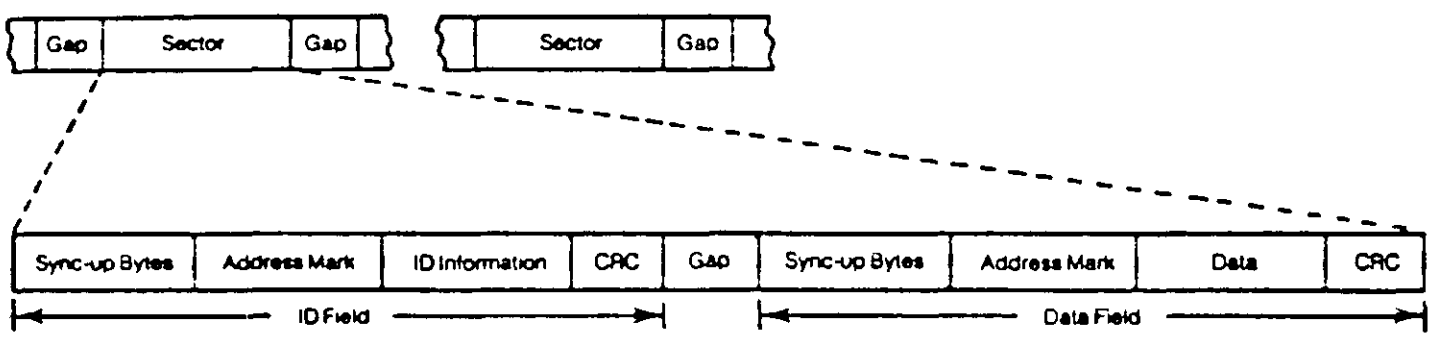


Figure 2-4. Track Format

Track Numbering. Each track has a physical address as previously described. There is also a logical track address associated with each good track. The logical track address is written in the ID field of each sector on the track. If a disc has no bad tracks, the logical address of a track is the same as the physical address.

A disc with N bad tracks can be made to look like a 77 — N track disc with no bad tracks. To do this, the logical track address stored in the ID field of each sector of every bad track is set to !FF. Tracks of this type are known as invisible tracks. All visible tracks are then sequentially assigned logic track numbers. Logical Track 0 is the outermost good track, not necessarily physical Track 0.

Format Differences

Table 2-4 summarizes the principal differences between the IBM Format and the HP Format. Details of these differences are provided in the following paragraphs.

Coding. The IBM Format uses a single-density encoding scheme known as frequency modulation (FM). The rules for FM coding are as follows:

- A 0 bit cell has no data transition.
- A 1 bit cell has a data transition.
- Every bit cell has a clock transition.

The minimum, distance between transitions is one-half bit cell, that is, the distance from a clock transition to a data transition.

Table 2-4. Format Differences

Feature	HP Format	IBM Format
Usable Physical Tracks	0 — 76	0 — 76
Sectors Per Track	30	26
Sector Numbering	0 — 29	1 — 26
Bytes Per Sector	256	128
Data Order	LS Byte First LS Bit First	MS Byte First MS Bit First
Coding	MMFM	FM
Precompensation Required	Yes	No
Sync-UP Bytes	Four Bytes of !00 And Four Bytes of !FF	Six Bytes of !00
Address Marks	Extra Clock Transitions	Missing Clock Transitions
CRC Includes Address Mark	No	Yes

The HP Format uses a double-density encoding scheme known as Modified Modified Frequency Modulation (MMFM). The rules for MMFM coding are as follows:

- A 0 bit cell has no data transition.
- A 1 bit cell has a data transition.
- A 0 bit cell has a clock transition if there is no transition in the preceding bit cell.
- A 1 bit cell never has a clock transition.

For the same recording density (flux transitions per inch), there are twice as many data transitions in MMFM coding as in FM coding.

Precompensation. Transitions which are written close together tend to appear shifted apart when they are read back. This effect is known as bit shift. Due to its large bit cell, the IBM Format is not affected by bit shift. However, because of the smaller bit cell used in the HP Format, bit shift is noticeable. To compensate for bit shift, certain MMFM transitions are written closer together. This action is called precompensation. The actual precompensation used on a transition is dependent upon the pattern being recorded.

Address Marks. There are four types of HP address marks. All are unique in that they include a bit cell with an extra clock transition. The HP address mark byte is not included in CRC generation. Address mark is abbreviated AM.

Name	Data Pattern	Clock Pattern	Where Found
ID AM	!70	!0E	ID Field
Defective Track AM	!F0	!0E	ID Field
Data AM	!50	!0E	Data Field
ECC Data AM	!D0	!0E	Data Field

At the command set level, a clear d bit indicates an ID AM in the ID field, and a set D bit indicates a defective track AM in the ID field.

There are four types of IBM Format address marks. All are unique in that they include bit cells which contain no clock transition. The IBM address mark byte is included in CRC generation.

Name	Data Pattern	Clock Pattern	Where Found
Index AM	!FC	!D7	At Index Hole
ID AM	!FE	!C7	ID Field
Data AM	!FB	!C7	Data Field
Deleted Data AM	!F8	!C7	Data Field

At the command set level, a clear D bit indicates a data AM in data field and a set D bit indicates a deleted data AM in the data field.

Presently, all data fields contain a data AM. If error correcting code (ECC) bytes added to the data field in the future, an ECC data AM will be used, allowing interchange between ECC and non-ECC systems.

Track Format. Detailed track formats for the HP format and IBM Format are shown in Figures 2-5 and 2-6, respectively.

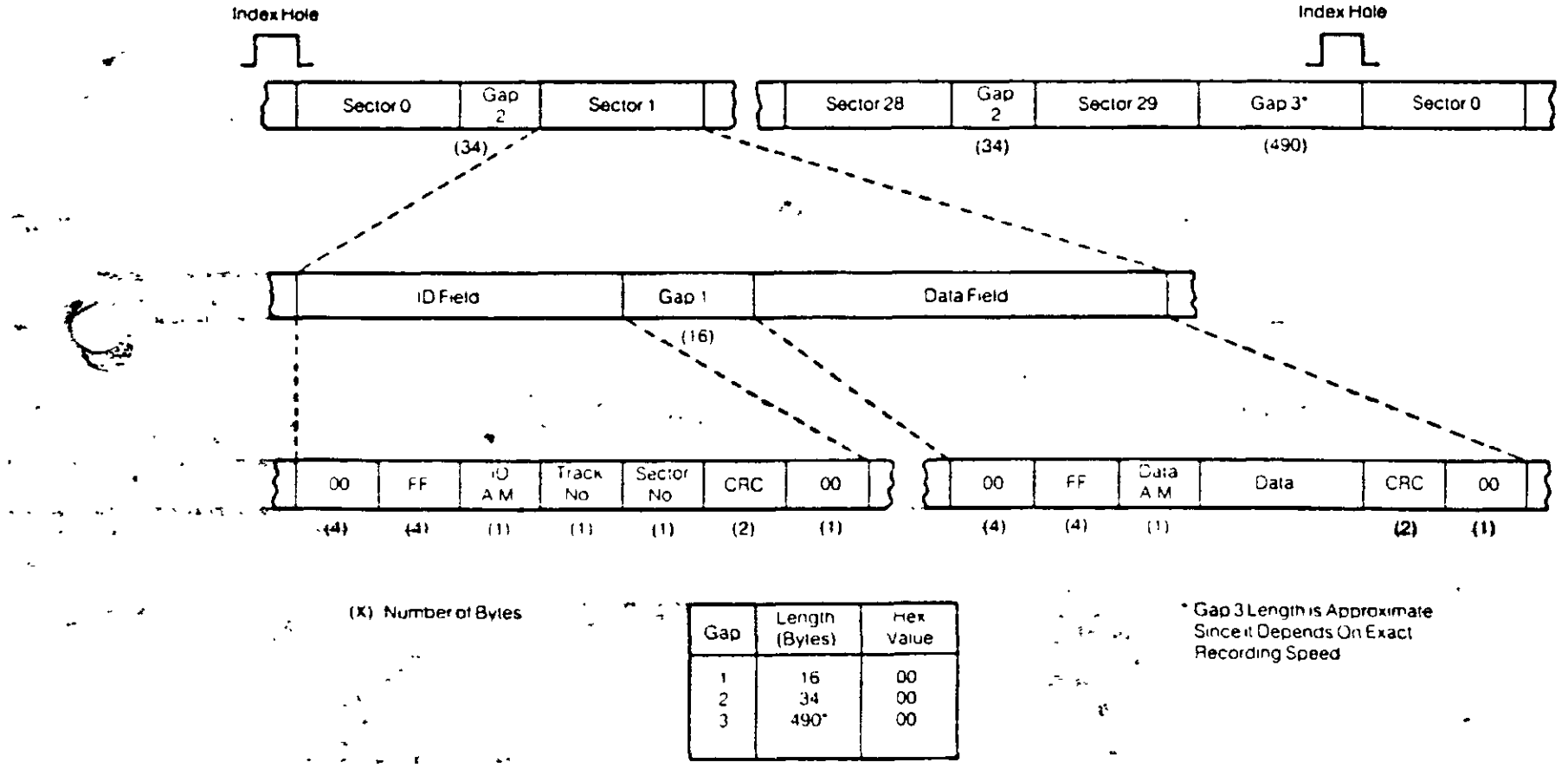


Figure 2-5. Hewlett-Packard Standard Sector Recording Format

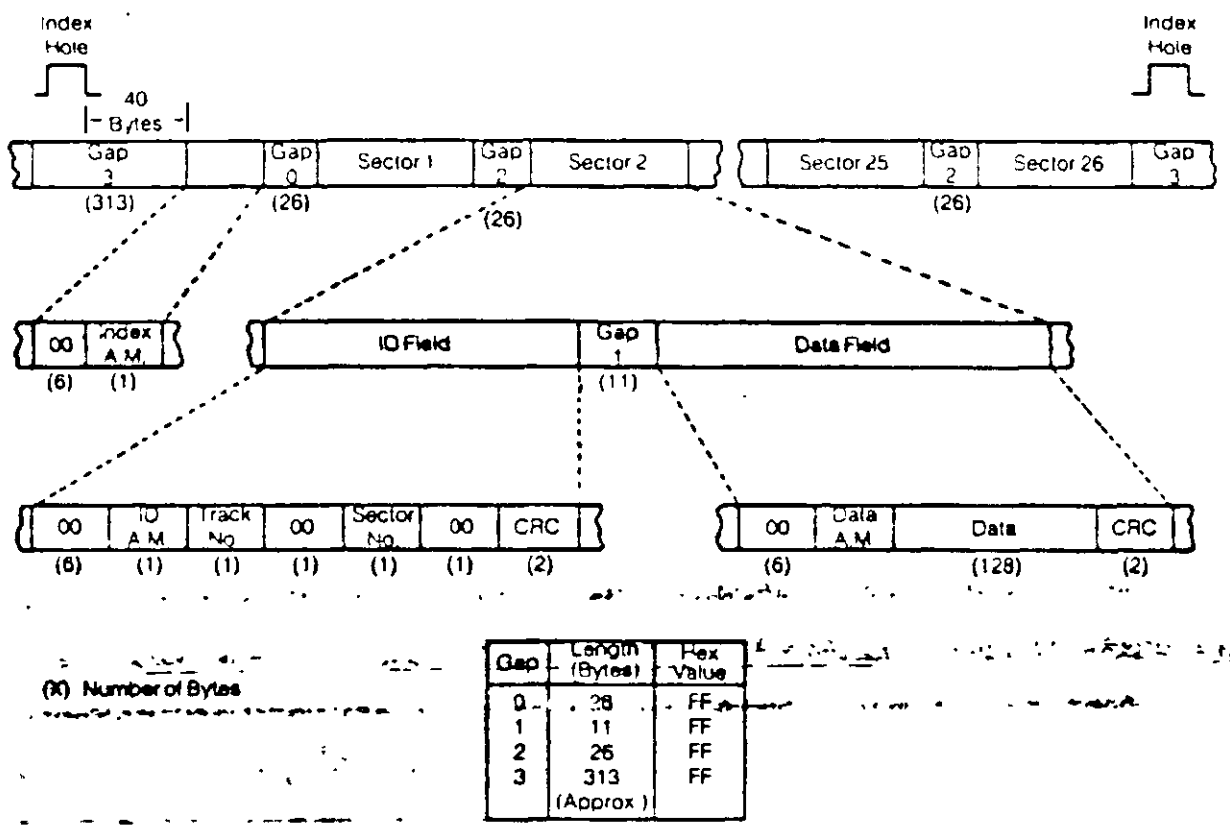


Figure 2-6. IBM Standard Sector Recording Format

Interface Information

7902A Flexible Disc Drive (P/N 45000-67914)

Introduction

This section provides information required to interface the HP 7902A Disc Drive with a host system. Included are power requirements, cabling data, switch settings, environmental limitations, and design details for a front panel display.

Power Requirements

Drive Board-A2

+5V 0.6A typical, 0.7A max, voltage tolerance: +5%, −3%
+12V 0.8A typical, 1.0A max, voltage tolerance: ±5%
−12V 0.8A typical, 1.0A max, voltage tolerance: ±5%

Disc Drive Assembly

86 — 127 Vac at 0.3A typical, 0.44A max
50/60 Hz ±3.5% HP Format
50/60 Hz ±1% IBM Format

Power Sequencing

Power On signal PON should stay low until well after all dc supply voltages have stabilized (greater than 100 milliseconds). Signal PON should go low immediately if ac power is not within specifications, or if dc power is about to fail.

System Reset (SYSRST) is a logic level, active low, signal which performs the same function as PON for the controller. It forces the system to First Status state.

AC power must be within specification for at least two seconds before reading and/or writing. This is to allow the spindle rotational speed to stabilize.

Cooling Requirements

The operating limits of the disc drive assembly and medium are specified as 10°C to 40°C, 20 to 80 percent relative humidity (RH) with maximum wet-bulb temperature of 25.5°C. these limits allow for a rise in the disc drive of 10°C. The actual operating limits are set by the medium. IBM sets the limits at 10°C to 52.6°C, 8 to 80 percent RH, maximum wet-bulb temperature of 29.4°C.

Shieldng Requirements

No shielding is required under normal operating conditions. If the disc drive assembly is subjected to medium — to high-intensity electromagnetic fields such as those from the yoke of a cathode-ray tube, an aluminum or steel shield should be placed between the source of the field and the disc drive. The head load solenoid has a small dc external field that may cause CRT deflection. A shield wrapped around the disc drive assembly will eliminate this source of interference.

Hardware Interface

The following information describes the drive board connector pin outs and signal lines. This information is the same for drive boards designed and manufactured by HP.

Figure 2-7 shows the location of the connectors on the HP drive circuit boards A2. Connection to the controller is through the 50 pin connector A2J7. DC power is supplied via A2J4. Table 2-5 lists the pin assignments for connectors A2J7, A2J8, A2J4 and A2J3. Connections for a drive display panel are provided by connector A2J2. A2J8 is used for daisy chainging drives.

AC power for the disc drive assembly is connected directly to a 3-pin connector, located on the drive, between the actuator and the spindle motor capacitor. See Figure 2-8. Pin assignments for the connector are as follows:

Pin	Signal
1	ac line
2	frame ground
3	ac neutral

Mating parts for the connector are:

Body, part no. 1251-3913 (Amp 1-480700-0)

Pin, part no. 1251-3915 (Amp 350547-1)

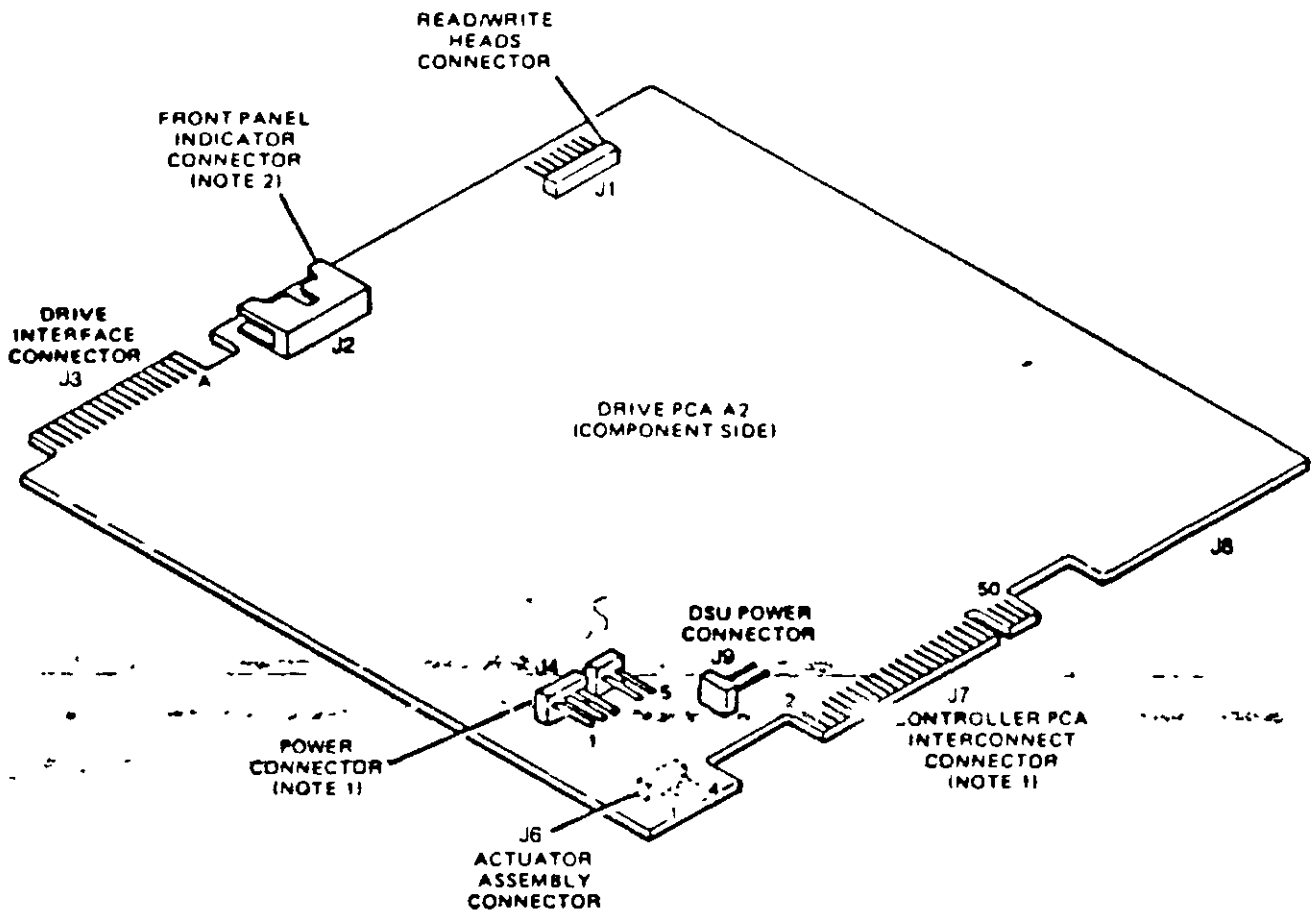


Figure 2-7. HP Drive Board A2 Connectors

Table 2-5. 7902A Drive Board A2 Connector Pin Assignments

A2J7/A2J8 (See Notes 1 and 3)

Pin	Signal	Pin	Signal
1	GND	2	DSL0H
3	GND	4	DSL1H
5	GND	6	DSL2H
7	GND	8	DSLVL
9	GND	10	LDCTL
11	GND	12	STENL
13	GND	14	DRSPNH
15	GND	16	WRITL
17	GND	18	PHIBH
19	GND	20	PHIAH
21	GND	22	DLCKL
23	GND	24	HED1H
25	GND	26	PORH
27	GND	28	INDXL
29	GND	30	SPINL
31	GND	32	TRK0L
33	GND	34	WPRTL
35	GND	36	REDYH
37	GND	38	DATAH
39	GND	40	DATAL

41	KEY	44	KEY
45	GND	46	NC
47	GND	48	PONH
49	GND	50	−5V TP

A2J4 (See Note 2)

Pin	Signal
1	GND
2	GND
3	+12V
4	KEY
5	−12V
6	+5V

A2J3

Pin	Signal
1	Enabled
2	Disc Spinning
3	Ready
4	Write Protected
5	Sel 2
6	In Use
7	Sel 0
8	Sel 1
9	GND
10	+5V

Notes:

1. Odd-numbered pins are on circuit side of the board, even-numbered pins are on component side.
2. A2J4 mating connector: part no 1251-3275 (Molex 09-50-7061)
   A2J4 connector contacts: part no. 1251-0670 (Molex 08-50-0105)
   A2J4 connector key: part no. 1251-0627 (Molex 15-04-0219)
3. Refer to table for definitions of the signal mnemonics.

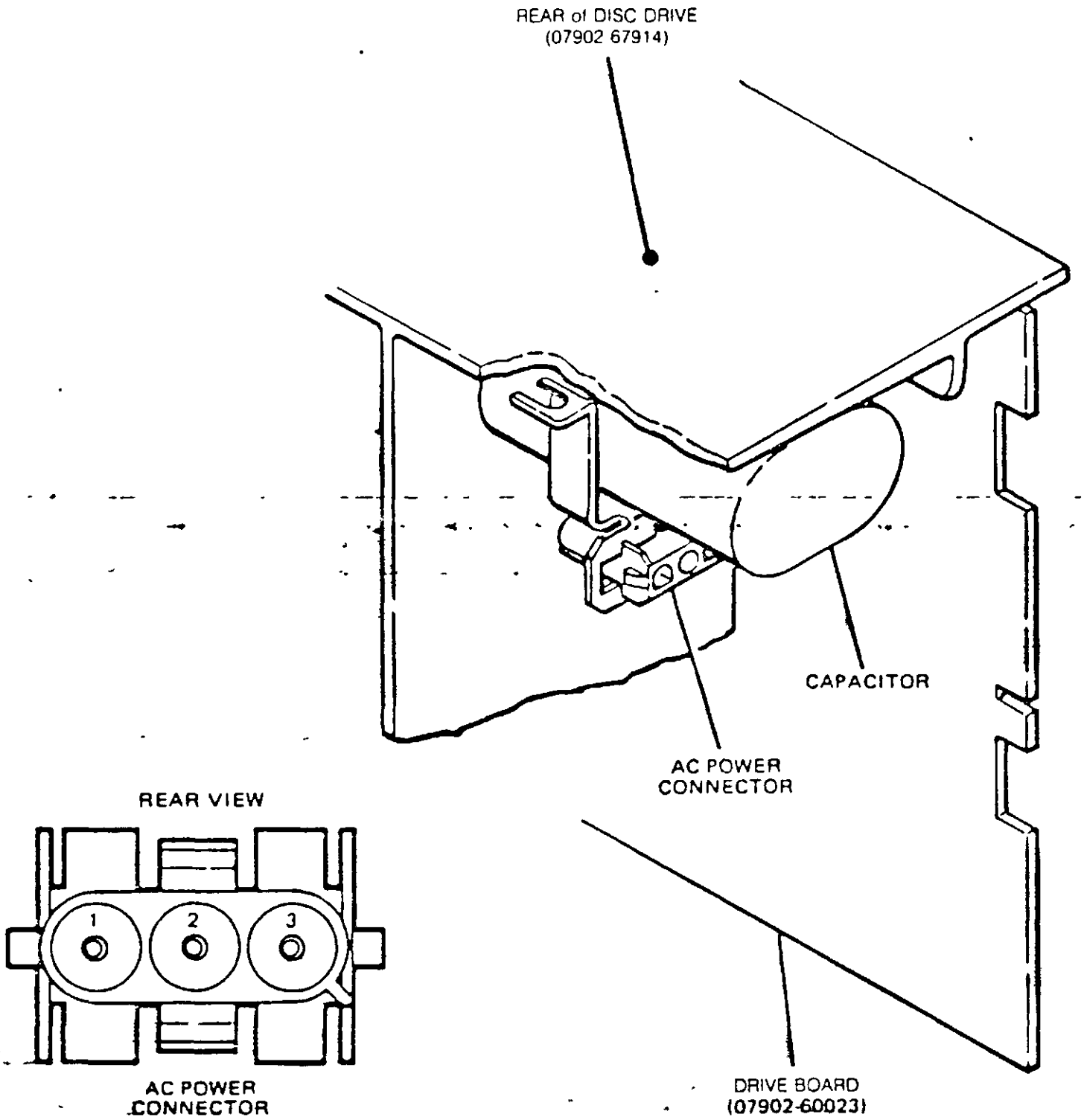
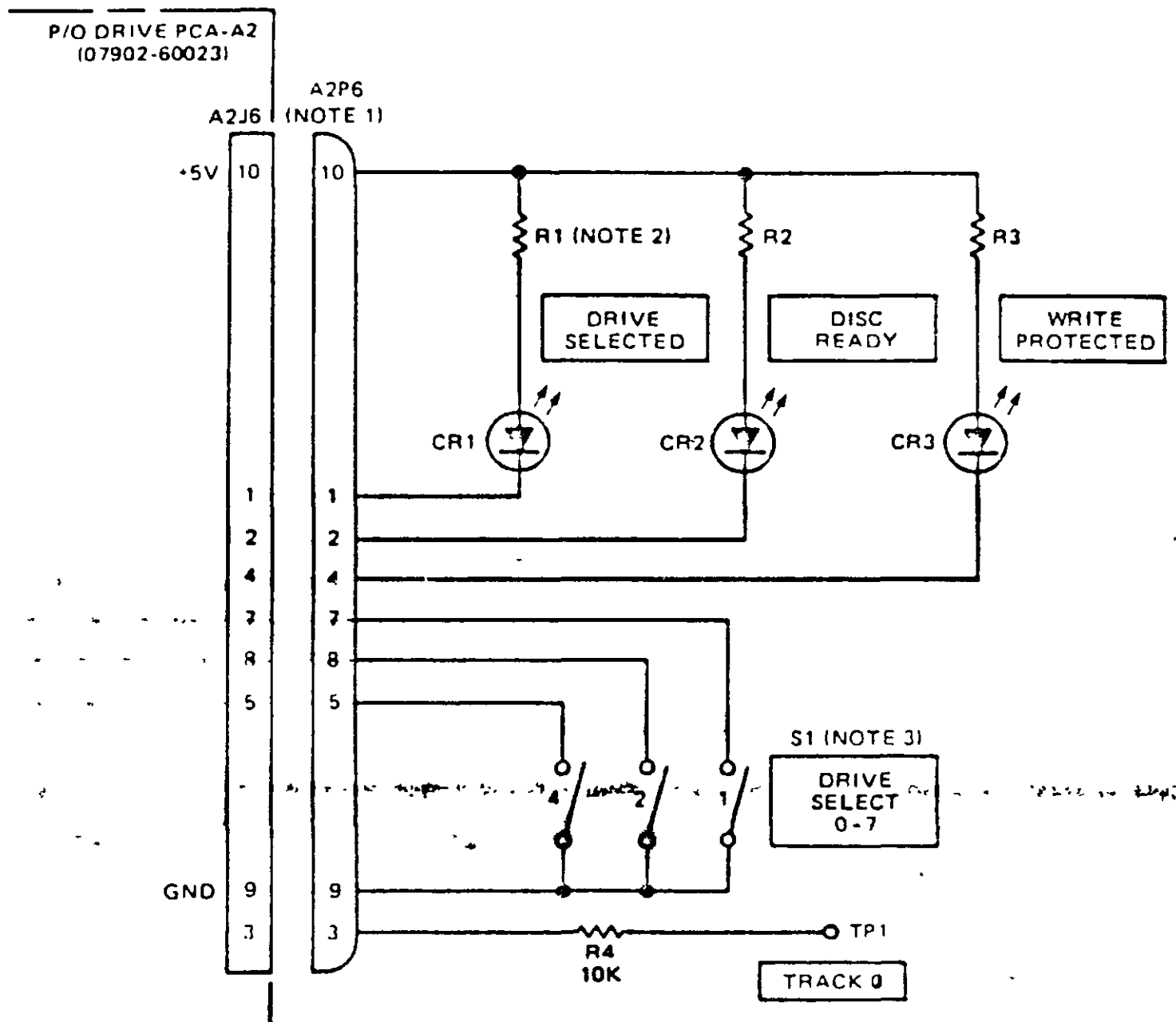


Figure 2-8. AC Power Connectors

Front Panel Indicator Display

Connector A2J2 on drive board (see Figure 2-7) is available for displaying disc drive status and for disc drive number selection. A typical design for a front panel indicator display employing the data available at A2J2 is shown in Figure 2-9. If no DRIVE SELECT switch is connected to A2J2, drive select will default to number 0. The LED status indicators shown in the design are driven by low-power Schottky buffers (active low). The LED current should be limited to 20 milliamperes or less.



NOTES
1. A2P6 IS A 10-PIN RIBBON CONNECTOR, HP PART NO 1251-4006 (3M PART NO 3473 0000)
2. LED S CR1 THROUGH CR3 ARE DRIVEN BY LOW POWER SCHOTTKY BUFFERS (ACTIVE LOW) LIMIT LED CURRENT TO 20 mA OR LESS
3. S1 IS A BINARY ENCODED 1 OF 8 SWITCH LOW TRUE A TYPICAL PC MOUNT THUMBWHEEL SWITCH IS HP PART NO 3100-3395 (EECO, PART NO 1A-21 50-61G)

Figure 2-9. Typical Front Panel Indicator Display

Maintenance

Introduction

This section contains a listing of the standard and special tools and test equipment required to service the 07902-67914 disc drive, the preventive maintenance schedule, and all required preventive maintenance inspection and cleaning procedures.

WARNING

- TO AVOID PERSONNEL INJURY AND/OR DAMAGE TO EQUIPMENT, OBSERVE ALL WARNINGS AND CAUTIONS STATED IN THIS PUBLICATION AND AS DETAILED BELOW.
- USE EXTREME CAUTION WHEN WORKING ON THE DISC DRIVE WITH POWER APPLIED. HAZARDOUS VOLTAGES ARE PRESENT INSIDE THE DISC DRIVE WHENEVER IT IS CONNECTED TO AN ACTIVE AC POWER SOURCE.
- DO NOT ATTEMPT TO REMOVE OR CHANGE PRINTED CIRCUIT ASSEMBLIES (PAC'S) OR INTERCONNECTING CABLES WITHOUT FIRST REMOVING POWER FROM THE DISC DRIVE.

CAUTION

- NEVER ATTEMPT TO SWING OPEN THE CARTRIDGE GUIDE ASSEMBLY WITHOUT FIRST UNLOADING THE HEADS FROM THE HEAD LOAD BAIL.
- NEVER ALLOW THE HEADS TO TOUCH EACH OTHER. WHENEVER THE HEADS ARE UNLOADED FROM THE HEAD LOAD BAIL, PLACE A PIECE OF CLEAN LENS TISSUE BETWEEN THE HEADS TO PREVENT THEM FROM TOUCHING.
- ENSURE THAT THE HEAD LOAD ACTUATOR UP STOP ADJUSTMENT IS PROPERLY SET. THIS ENSURES THAT THE FLEXIBLE DISC WILL CLEAR THE HEADS WHEN IT IS LOADED INTO THE DISC DRIVE.
- ENSURE THAT THE DOOR LOCK ASSEMBLY IS FUNCTIONING PROPERLY. THIS ENSURES THAT THE FLEXIBLE DISC CANNOT BE REMOVED FROM THE DISC DRIVE WHILE THE HEADS ARE LOADED.
- THE READ/WRITE HEADS ARE FACTORY ALIGNED WITH A FOUR-TRACK OFFSET BETWEEN THE HEADS. LOOSENING THE HEAD-MOUNTING SCREW WILL DESTROY THIS OFFSET AND NECESSITATE THE RETURN OF THE DISC DRIVE FOR REALIGNMENT.
- DO NOT LUBRICATE THE DISC DRIVE — OIL WILL CAUSE DUST AND DIRT TO ACCUMULATE.
- DO NOT TOUCH THE HEADS OR ATTEMPT TO CLEAN THEM.

Service Tools and Test Equipment

The following paragraphs list those standard and special tools and test equipment required to service the disc drive.

Standard Tools

Table 2-6 lists the standard tools required to service the disc drive. Equivalent tools may be used, when necessary.

Table 2-6. List of Standard Service Tools

Tool	HP Part No.
Extractor, Pin (or paper clip)	—
Nutdriver, ¼-inch socket	8720-0002
Nutdriver, 11/32-inch socket	8720-0004
Pliers, Diagonal Cutting	8710-0006
Pliers, Long Nose	8710-0016
Screwdriver, slot drive, 4 x ¼-inch	8720-0001
Screwdriver, slot drive, 3 x 3/16-inch	8730-0019
Screwdriver, Pozidriv, 4-inch	8710-0900
Screwdriver, Pozidriv, 3-inch	8710-0899
Soldering Iron	8690-0011
Soldering Iron Tip	8690-0021
Wrench Set, Hex Key	8720-0019

Standard Test Equipment

An oscilloscope (HP 1707B Oscilloscope or equivalent) is the only piece of standard test equipment required to service the disc drive. The oscilloscope is used primarily to check the alignment of various components in the disc drive and for troubleshooting.

NOTE

All oscilloscope sensitivity settings specified in the procedures given in this section assume the use of 10:1 oscilloscope probes. If 1:1 probes are ued, the sensitivity settings should be scaled accordingly.

Special Tools.

Table 2-7 lists the special tools required to service the disc drive. Substitutions must not be made.

Table 2-7. List of Special Service Tools

Tool	HP Part No.
Alignment Flexible Disc	9164-0111
Cartridge Guide Adjustment Tool	1150-1310
Bail Adjustment Tool	1535-3875
Disc Service Unit	12748-60008

Special Test Equipment

Disc Service Unit. the Disc Service Unit (DSU), part no. 12748-60008 is the only item of special test equipment required to service the disc drive. It is used for on-site preventive maintenance, alignment, adjustment, and troubleshooting of the disc drive.

The DSU provides the means to simulate drive board. A1 signals to the disc drive and process disc drive responses. Simulated signals are produced either manually or automatically to operate the disc drive. Modes of operation include seek to track, alternate seek, single step, and writes. A numerical keypad and 3-digit numerical display permits selection of test parameters including drive number, alternate seek minimum and maximum track addresses, seek to track address, and track-to-track seek time. Self-test circuitry contained in the DSU is activated at power turn-on and provides a visual indication of the DSU serviceability.

DSU Installation. To install the DSU, proceed as follows:

1. Remove power from the disc drive.
2. Disconnect the cable from connector J7 on drive board A2.
3. Connect the ribbon cable connector on the DSU cable to J7 on drive board A2.
4. Connect the 3-pin connector on the DSU cable to J9 of the drive board A2. Ensure that the connector is correctly oriented. The slots in the connector should be facing upward, away from the component side of the drive board A2.

CAUTION

ENSURE THAT THE DISC DRIVE DOES NOT CONTAIN A FLEXIBLE DISC AT POWER TURN-ON. FAILURE TO OBSERVE THIS PRECAUTION MAY RESULT IN ACCIDENTAL ERASURE OF DATA FROM A NONWRITE-PROTECTED DISC.

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5. Restore power to the disc drive.

DSU Operating Instructions

Figure 2-10 identifies the DSU front panel controls and indicators and Table 2-8 defines the functions of these components. An abbreviated instruction set for the DSU is given in Table 2-9 and additional operating instructions are provided in the following paragraphs.

Power Turn-on. At DSU power turn-on, the DSU performs a self-test. If the self-test passes, all DSU LED's, with the exception of those controlled by the disc drive (INDEX, RD/WR DATA, DRIVE READY, TRACK 0, and WRITE PROTECTED), are lit for 5 seconds. The disc drive is now recalibrated and initialized and the DSU is reset. Reset conditions for DSU include SELECT HD 1, LOCK DOOR, and HEAD LOAD pushbuttons is a non-asserting state; no WRITE condition selected, STOP LED lit; DRIVE NUMBER — 7; MAX TRACK — 76; MIN TRACK — 0; STEP RATE — 3; and keypad display — 0.

NOTE

Self-test may not occur at power turn-on if application of dc voltage is slow. In this event press the SYSTEM RESET pushbutton to initiate self-test.

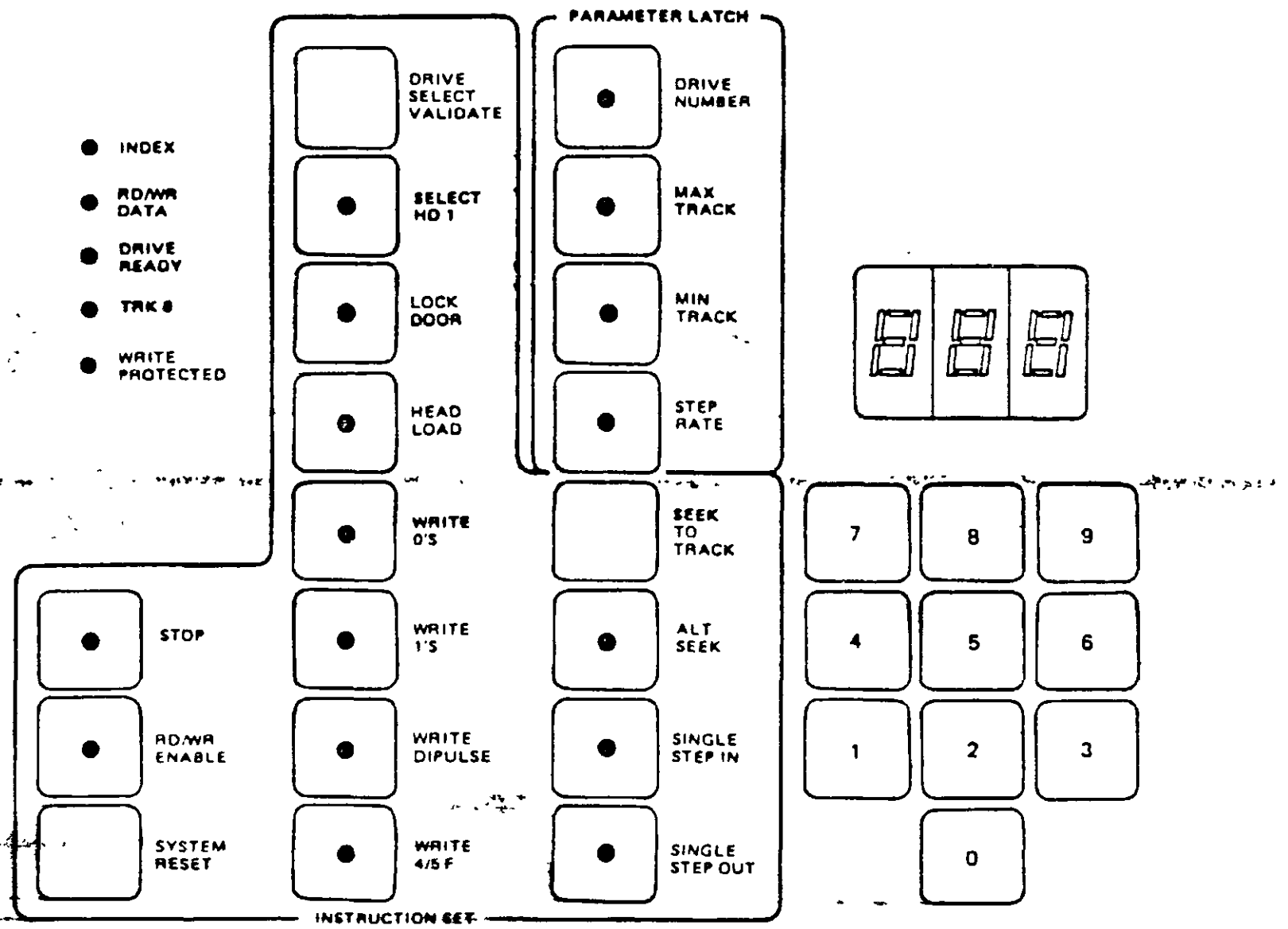


Figure 2-10. Disc Service Unit Front Panel Controls and Indicators

Table 2-8. Disc Service Unit Controls and Indicators

DECIMAL KEYPAD	Programs value for drive number, maximum and minimum tracks (alternate seek), step rate, and seek to track parameters. Each time a key is pressed, that number is entered into least significant digit of 3-digit decimal display and other numbers shift up. The programmed number is entered when appropriate parameter pushbutton is pressed. At power turn-on and reset, 3-digit readout is reset to 0.
	Parameter Latch Pushbuttons
DRIVE NUMBER	Enters keypad number selected for drive number. Pushbutton indicator flashes if number is greater than 7. Selection of a new number automatically recalibrates drive.
MAX TRACK	Enters keyboard number selected for alternate seek maximum track number. Pushbutton indicator flashes if number is less than current alternate seek minimum track number. At power turn-on and reset, number is automatically set to 76.
MIN TRACK	Enters keypad number selected for alternate seek minimum track number. Pushbutton indicator flashes if number is more than current alternate seek maximum track number. At power turn-on and reset, number is automatically set to 0.
STEP RATE	Enters keypad number in milliseconds selected for track-to-track seek time. Pushbutton indicator flashes if number is less than 3. At power turn-on and at reset, number is automatically set to 3.
	Instruction Set Pushbuttons
SEEK to TRACK	Disc drive seeks to track number selected by keypad. If number selected is greater than 76, disc drive seeks to track 76. At power turn-on and reset, track 0 is automatically selected (Keypad is reset to 0.)
ALT SEEK	Disc drive seeks between keypad selected minimum and maximum track numbers. Pushbutton indicator is lit during seek operation. At power turn-on and reset, alternate seek is automatically set to occur between tracks 0 and 76.
SINGLE STEP IN	Head assembly steps inward one track. Pushbutton indicator flashes if heads are at outermost track (0).
STOP	Stops DSU continuous operations (alternate seek, continuous write) and error signals. Pushbutton indicator lights when DSU is waiting for a command.
RD/WR ENABLE	Resets disc drive status signal (Spinning). Pushbutton must be pressed at power turn-on or when a disc is removed during a test before DSU operation can continue. Pushbutton indicator lights when Spinning signal is in asserted state.

SYSTEM RESET	Reset entire system and disc drive. DSU self-test is initiated and disc drive is recalibrated and initialized.
WRITE 0's	Writes 0's (250 kHz) on disc. Pushbutton indicator lights when write 0's is selected.
WRITE 1's	Writes 1's (500 kHz) on disc. DSU pushbutton indicator lights when Write 1's is selected.
WRITE DIPULSE	Writes dipulses on disc. Pushbutton indicator lights when write dipulses is selected.
WRITE 4/5 F	Writes at 200 kHz on disc. Pushbutton indicator lights when write 4/5 F is selected.

NOTE

If a WRITE pushbutton is pressed and released in less than 1.5 seconds, write lasts for one revolution of the disc; longer than 1.5 seconds produces a continuous write.

DRIVE SELECT VALIDATE	Validates drive number. Pushbutton indicator is lit when drive number is validated.
SELECT HD1	**Selects head. When pushbutton indicator is lit, head 1 is** selected; when indicator is off, head 0 is selected. At DSU power turn-on and reset, head 0 is selected.
HEAD LOAD	Loads the heads. Heads are loaded when pushbutton indicator is lit. At DSU power turn-on and reset, heads are unloaded. Pushbutton must be pressed before a seek to track, alternate seek, or single step in/out operation can be initiated, assuming drive is selected.
	LED's
INDEX	Lights each time index hole in disc passes disc drive index sensor. LED operation is gated by disc drive selected (SELECT DRIVE number entered and DRIVE SELECT VALIDATE pressed).
RD/WR DATA	Lights when DSU is writing or reading from a disc.
DRIVE READY	Lights when disc drive is ready to be exercised. It also lights when disc drive is not selected.
TRK 0	Lights when heads are at outermost track. LED operation is gated by disc drive selected.
WRITE PROTECTED	Lights when a write protected disc is in disc drive. Write operations are inhibited. LED operation is gated by disc drive selected.
	Test Points
INDEX	Output of disc drive index sensor. Signal is active high.
RD/WR DATA	Disc drive data signal.

HEAD LOAD	Disc drive head load signal. Signal is low when heads are loaded.
+5V	+5 Vdc supplied to DSU.
GND	+5 Vdc ground.

Drive Select. To select a drive, enter the desired drive number on the keypad display and then press the following pushbuttons: DRIVE NUMBER, DRIVE SELECT VALIDATE, RD/WR ENABLE, and HEAD LOAD.

Exercising Drive. The heads must loaded before a seek to track, alternate seek, single step in/out, or write operation can be performed. The heads are loaded when the HEAD LOAD pushbutton indicator is lit.

Alternate Seek. AT DSU power turn-on, the DSU is automatically set to perform alternate seeks between tracks 0 and 76 when the ALT SEEK pushbutton is pressed. To change the track limits requires the use of the MAX TRACK and MIN TRACK pushbuttons as described in Table 2-8. Alternate seek is halted with the STOP pushbutton.

Table 2-9. Disc Service Unit Instruction Set

DSU INSTRUCTION SET

Connect DSU to disc drive and apply power. Insert flexible disc, close door, select drive number, press DRIVE NUMBER, DRIVE SELECT VALIDATE, RD/WR ENABLE, and HEAD LOAD.

I. OPERATING MODES

MODE	DESCRIPTION
System Reset	First a DSU self-test is performed If self-test passes, DSU is reset and disc drive is recalibrated and initialized DSU reset includes HEAD LOAD, LOCK DOOR and SELECT HD 1 inactive, MIN TRACK = 7, and Keypad = 0 If self-test fails, 3-digit readout indicates "Bad", and Keypad is disabled.
Seek to Track	Carriage steps to selected track address and stops
Single Step In/Out	Operator may single step carriage inward one track or outward one track
Alternate Seek	Carriage steps from one selected extreme track address to other selected extreme track address
Write	0's or 1's (250 kHz or 500 kHz) can be written on a scratch flexible disc to check write circuits. Dipulse and 4/5 F (200 kHz) writing is also possible

II. OPERATING FEATURES

FEATURES	DESCRIPTION
Decimal Keypad	Programs values for drive number, seek to track, min and max tracks (alternate seek) and step rate parameters. At DSU power turn-on and system reset, readout is reset to 0.
Drive Select	Selects drive number (0 — 7)
INDEX LED	Lights each time index hole in disc passes disc drive index sensor
INDEX TP	Monitors output of disc drive index sensor Signal is active high
RD/WR DATA LED	Lights when DSU is writing on or reading from a disc
RD/WR DATA TP	Monitors disc drive read/write signal
TRK 0 LED	Lights when heads are at outermost track
WRITE PROTECTED LED	Lights when a write protected disc is in disc drive
DRIVE READY LED	Lights when disc drive is ready to be exercised
HEAD LOAD TP	Active low when heads are loaded

PROCEDURE

a. Press SYSTEM RESET Note System reset also occurs at DSU power-on

a Select desired track-to-track step rate on Keypad and press STEP RATE
b Select desired track number on Keypad
c. Press SEEK TO TRACK

a. Press SINGLE STEP OUT or SINGLE STEP IN, as desired.

a. Select desired minimum track number on Keypad and press MIN TRACK.
b. Select desired maximum track number on Keypad and press MAX TRACK.
c. Select desired track-to-track step rate on Keypad and press STEP RATE.
d. Press ALT SEEK.
e. Press STOP to stop alternate seek.

a Seek to desired track.
b Select desired head with SELECT HD 1 bushbutton
c. Press desired WRITE pushbutton Note If a WRITE pushbutton is pressed and released in less than 1 5 seconds produces a continuous write.
d. Press STOP to stop continuous write.

PROCEDURE

a. Set desired number on 3-digit display.
b. Press appropriate PARAMETER pushbutton to enter number into DSU.

a Select desired drive number on Keypad
b Press DRIVE NUMBER
c. Press DRIVE SELECT VALIDATE

None

None

None

None

None

None

None

None

Preventive Maintenance Schedule

The disc drive is designed for a minimum of preventive maintenance. A schedule for periodic inspection of the disc drive is provided in Table 2-10. It is recommended that the procedures listed in the schedule be performed at 12-month intervals. Also, the head radial alignment check must be performed when the disc drive is integrated into the host system and at installation of the host system. The general operation of the disc drive should be verified before regular scheduled maintenance is performed and again after it has been completed. Run the appropriate diagnostic tests in accordance with the instructions provided in the host system diagnostic manual.

Table 2-10. Preventive Maintenance Schedule

ITEM	ROUTINE
Actuator Assembly	Remove all oil, dust, and dirt. Do not clean unless absolutely necessary.
Belt	Check for frayed or weakened areas. Replace if necessary.
Base	Remove all dust and dirt. Check for loose screws, connectors, and switches.
Read/Write Heads	Check for proper azimuth and radial alignment.
	CAUTION
	Do not touch or attempt to clean the heads.

Head Azimuth and Alignment Checks

The following paragraphs contain instructions for testing head azimuth and radial alignment. Since the heads are not field replaceable, failure to meet any one or more of the specifications listed for these tests will necessitate replacement of the disc drive assembly.

Head Azimuth Test

An aximuth test on the heads of the 7902A is now available with the use of the new alignment disc, 9164-0111. This test checks the offset of each head from the perpendicular to the tangent of the track. It should be performed any time read errors occur or when there is incompatibility between discs and drives.

To perform this test requires alignment disc P/N 9164-0111. There is a unique pattern on track 76 to measure the amount of angular offset of the head gap to the track. An offset deviation of + or − 18 minutes allowable. The following procedures check that the drive is within these limits.

a. Set the oscilloscope controls as follows:

   Sweep: .5 msec/div
   Sensitivity: .1 volts/div
   Input: DC
   Display: A + B, B inverted
   Trigger: Normal, external, +

b. connect the A-channel probe to TP Diff + B-Channel probe to TP Diff − and the EXT TRIG probe to TP INDEX.

c. Insert the Alignment Disc into the drive to be aligned, and close the drive door.

d. With the DSU, select the drive to be aligned, seek to track 76, and select head 0 and do a continuous read.

NOTE

The disc drive unit under test must be in its normal operating position, i.e., horizontal or vertical. Failure to properly position the drive will result in errors in the azimuth measurement.

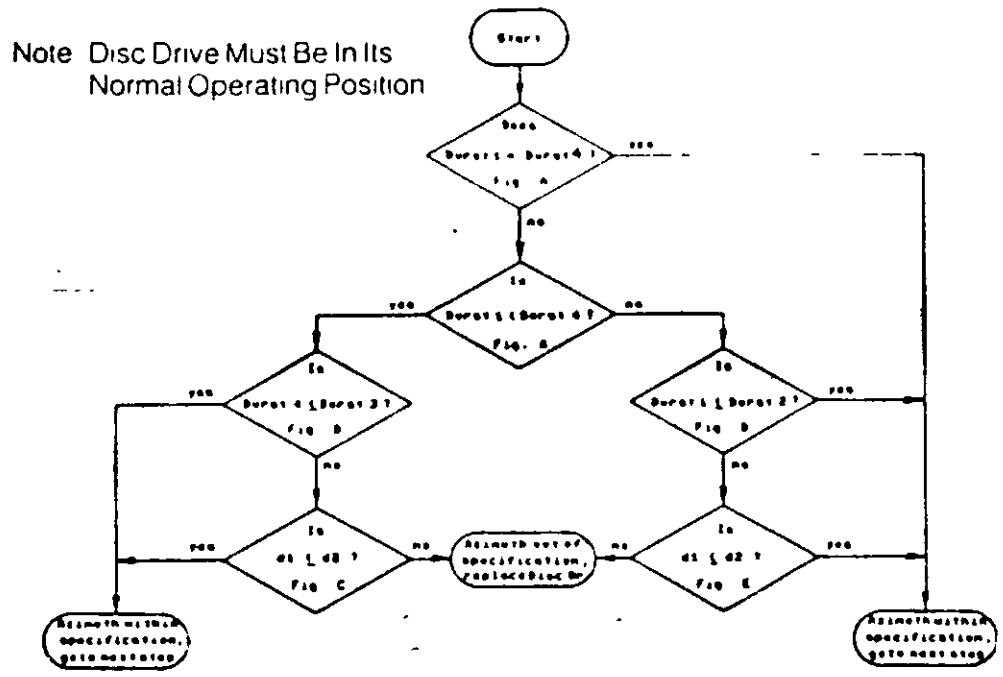
e. Follow the flowchart below. Reject the disc drive or continue to step f as directed by the flowchart.

f. Repeat steps d and e for HEAD 1.

Head Radial Alignment Check

The head radial alignment is factory set and adjustment is not normally required. To check head radial alignment, proceed as follows:

Note Disc Drive Must Be In Its Normal Operating Position



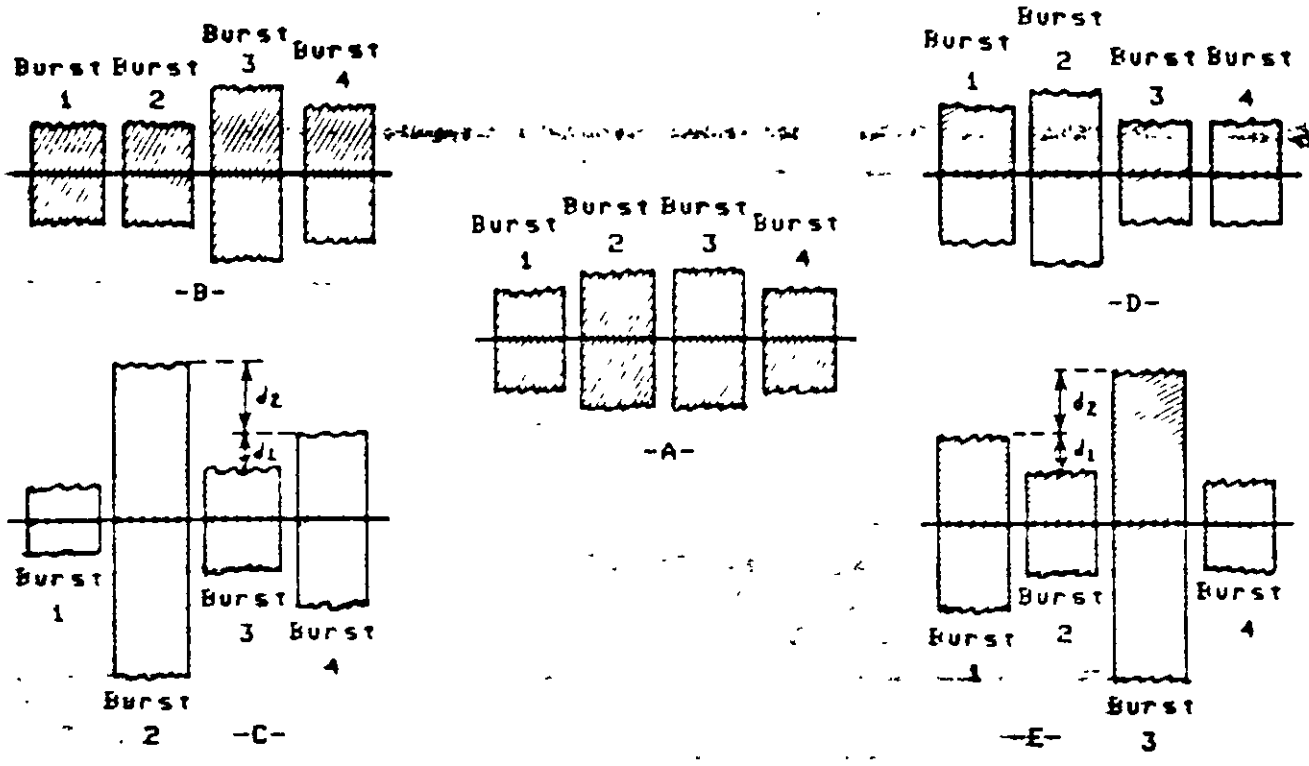


Figure 2-11. Azimuth Test Waveforms

NOTE

Due to variations in disc size with temperature and humidity, approximately 20 minutes should be allowed for the Alignment Disc to stablize at the ambient room conditions. For best results, the disc should be removed from the PSP as soon as you arrive at the test site. This lets the disc acclimate as fast as possible. The longer you can wait, the more accurate the test results.

a. Insert alignment disc, part no. 9164-0111 into the disc drive.

b. Step to track 38, select head 0 and do a continuous read.

c. Using 10:1 probes, connect an oscilloscope to the following test points on drive PCA-A2:

   Channel A — PREAMP +
   Channel B — PREAMP −

   Use drive PCA-A2 INDEX H test point for oscilloscope sync and GND 3 point for signal ground.

d. Set the oscilloscope controls as follows:

   Sweep — 20 msec/div
   Sensitivity — 0.01 volt/div
   Input — DC
   Trigger — EXT, DC, +, NORM
   Display — A + B, INV B

e. Make an estimate of the relative humidity in the room where the drive is operating, i.e. is it low (8% to 39%), medium (40% to 59%), or high (60% to 80%).

f. Compare the waveform with that shown in Figure 2-12. Head Radial Alignment Waveforms. Use the following limits when checking the waveforms.

   LOW HUMIDITY (8% to 39%): The left lobe amplitude must be between 65% and 105% of the right lobe amplitude.

   MEDIMUM HUMIDITY (40% to 59%): The smaller lobe amplitude, either left or right, must be at least 80% of the larger lobe amplitude.

   HIGH HUMIDITY (60% to 80%): The right lobe amplitude must be between 65% and 105% of the left lobe amplitude.

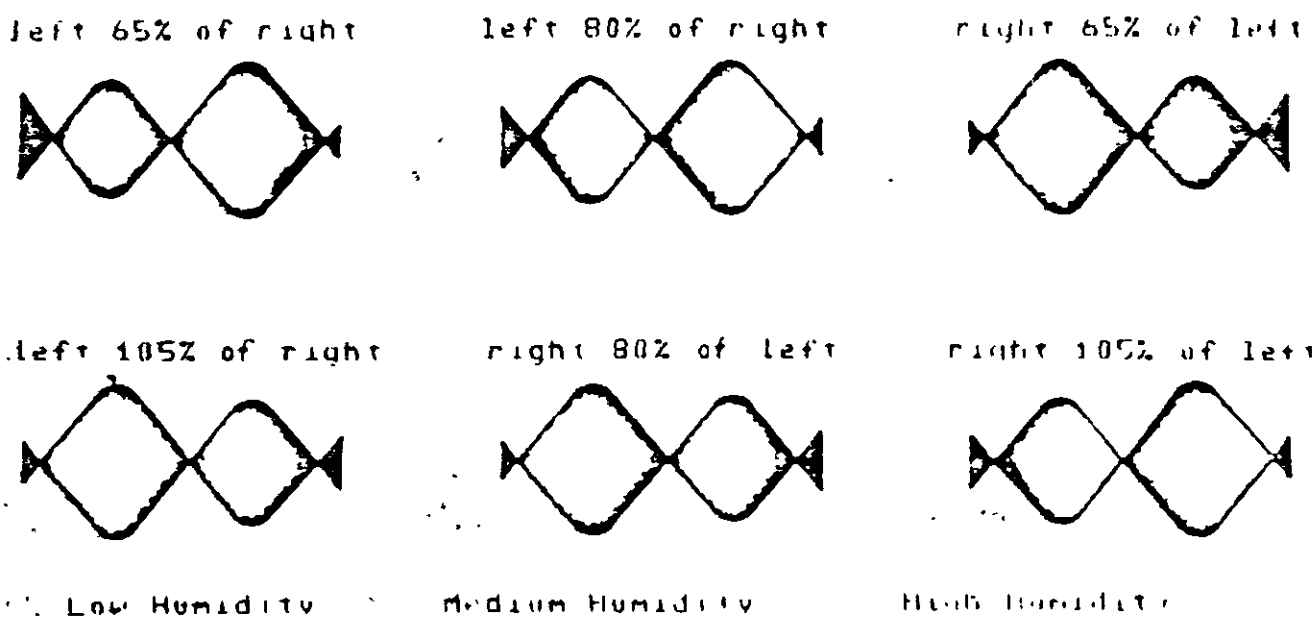


Figure 2-12. Head Radial Alignment Waveforms

g. Loosen the two mounting screws securing the motor plate to the support bracket.

h. Move the plate by rotating the eccentric adjustment nut.

i. When the lobes are within specification, tighten the motor screws.

j. Check the adjustment by stepping off track 38 and returning to it. Check in both directions.

k. Select head 1 and check that the amplitude of the two lobes is within specs. If the lobes are out of specification, repeat steps g through j. It will now be necessary to select head 0 and recheck the lobes. Continue the adjustment until the lobe amplitudes for both head 0 and head 1 are within specification.

l. If the specified waveforms cannot be obtained, replace the disc drive.

m. Following satisfactory adjustment of the head radial alignment, perform the track 0 detector adjustment procedure.

Removal and Replacement

Introduction

This section provides detailed removal and replacement procedures for those disc drive assemblies that are field replaceable. The order of presentation is based on which assemblies are most often removed or replaced before another assembly can be removed.

A procedure is presented early in this section for removing power from the disc drive since power must be removed before any of the assemblies can be removed.

Adjustments and/or checks must be performed following the replacement or movement of certain items in the disc drive. These items, and the required adjustments and checks, are detailed in Table 2-11.

WARNING

THE INFORMATION GIVEN IN THIS SECTION IS FOR SERVICE-TRAINED PERSONNEL ONLY. TO AVOID POTENTIALLY SERIOUS ELECTRICAL SHOCK, DO NOT PROCEED FURTHER IN THIS SECTION UNLESS QUALIFIED TO DO SO.

Table 2-11. Adjustments/Checks Required Following Component Replacement

Component	Adjustment/Check
Write Protect Detector	Write protect detector adjustment procedure.
Head Load Actuator	Head load actuator adjustment procedure.
	Head load actuator timing check.
Sector/Indes Phototransistor	Sector/Index phototransistor adjustment procedure.
Sector/Index LED	Sector/Index phototransistor adjustment procedure.
Track 0 Detector	Track 0 detector adjustment procedure.

Power Removal and Restoration

Most of the removal and replacement procedues given in this section require that the disc drive power be removed before they are performed. To remove power from the disc drive, proceed s follows:

a. Set the power switch on the host system of OFF.
b. Disconnect J5 and the ac power connector from the disc drive.

Power is restored to the disc drive by reversing this procedure.

Connector P2 Pin Extraction

Certain of the removal and replacement procedures require that pins (and attached wires) be extracted from connector P3. To remove a pin from connector P2, proceed as follows:

a. At the front of connector P3, insert the end of a pin extractor tool (or the end of a paper clip) between the desired pin and the wall of the connector.
b. Push down on the pin extractor to release the locking spring on the pin.
c. Remove the pin by pulling on attached wire from the rear of the connector.

To replace a pin in connector P3, push the pin into the appropriate opening at the rear of the connector until it locks in place.

NOTE

Repeated extractions of a pin will flatten the locking spring and prevent the pin from locking into the connector. When this occurs, carefully bend the spring forward until its locking action is restored.

Drive Board

The drive board is removed from the disc drive as follows:

a. Remove power from the drive.
b. Disconnect the cables from the following connectors on the drive board.

J7, J1, J2,J6

NOTE

The drive boards are matched to the drive mechanics at the factory. For this reason, when a drive board is removed it must be reinstalled on the same drive.

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c. Remove four screws securing the drive board to the disc drive frame.
d. Disconnect the cable from connector J3 on the drive board and remove the board from the disc drive.

The drive board is installed by reversing this procedure. Ensure that all of the connectors removed in steps b and d are firmly connected to the drive board.

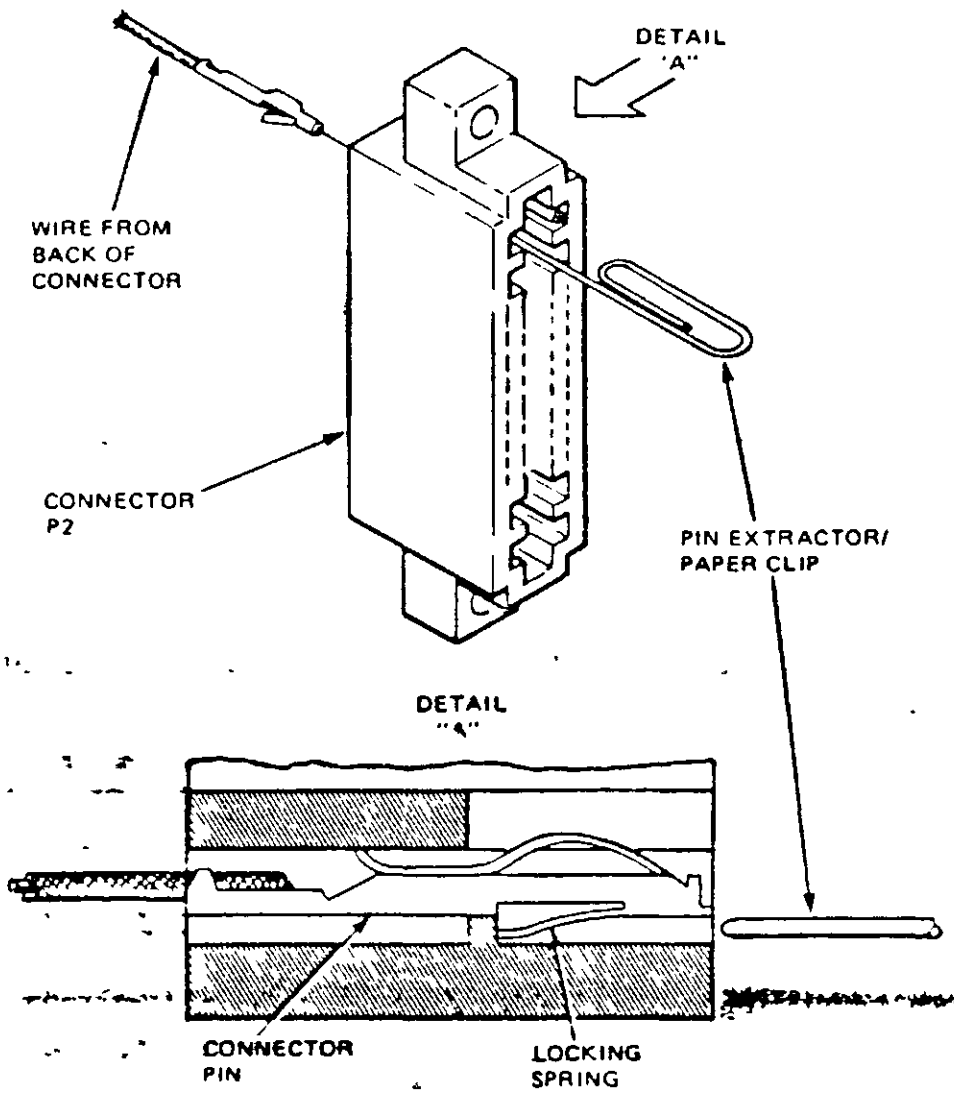


Figure 2-13. Connector P2 Pin Extraction

Head Cover Shield

The head cover shield is removed from the disc drive as follows:

a. Remove power from the disc drive.

b. Loosen the two screws securing the head cover shield to the guide opening assembly.

c. Move the head cover shield towards the head assembly until the shield is free of the two retaining screws.

d. Remove the head cover assembly from the disc drive.

The head cover shield is installed by reversing this procedure.

Cartridge Guide

Cartridge Guide Access

The cartridge guide assembly swings open to provide access to certain components mounted on the cartridge guide and the frame of the drive. To swing open the cartridge guide, proceed as follows:

a. Remove power from the disc drive.

b. Remove the head cover shield.

c. Position the read/write heads to approximately track 0 by turning the stepper actuator shaft fully counterclockwise.

d. Unlatch the cartridge guide assembly by pressing the push bar on the front of the drive.

CAUTION

THE HEADS SHOULD NEVER TOUCH EACH OTHER. ALWAYS INSERT A PIECE OF CLEAN LENS TISSUE BETWEEN THE HEADS WHEN THE HEAD LOAD BAIL IS DISENGAGED FROM THE HEAD LOAD ARM.

e. Refer to Figure 2-13. Carefully hold the moveable arm of head 1 with one finger while pushing the load bail up and back until the tab on the movable arm clears the head load bail. Be sure that the bail clears the head load arm before releasing the bail.

f. Insert a clean piece of lens tissue between the lower and upper heads to prevent them from touching and then gently release (lower) the moveable arm of head 1.

g. Loosen the two screws securing the door latch plate to the cartridge guide assembly.

h. Refer to Figure 2-13. Release the safety catch on the guide opening assembly by pressing the catch towards the rear of the drive. When the catch is released, swing the cartridge guide assembly up and away from the frame of the disc drive, as illustrated in Figure 2-13.

The cartridge guide assembly is restored to its normal operating position by reversing this procedure. Following restoration to normal operation, perform the cartridge guide assembly adjustment procedure.

Cartridge Guide Adjustment

To check the adjustment of the cartridge guide assembly, proceed as follows:

a. Insert end no. 2 of cartridge guide adjustment tool, part no. 1150-1310, through the cartridge guide tool hole and screw it completely into the disc drive frame. Hand tighten the tool.

b. Move the door handle into the latched position and hold it tightly against the latch.

c. Tighten the two screws securing the cartridge guide to the latch plate.

d. Remove the tool and check to determine if the flange on the clamp hub clears the cartridge guide when the spindle is rotating. If the clamp hub rubs on the cartridge guide, repeat steps a through c.

e. Adjust the cartridge guide stop so that it is within 0.005 inch of the disc drive frame.

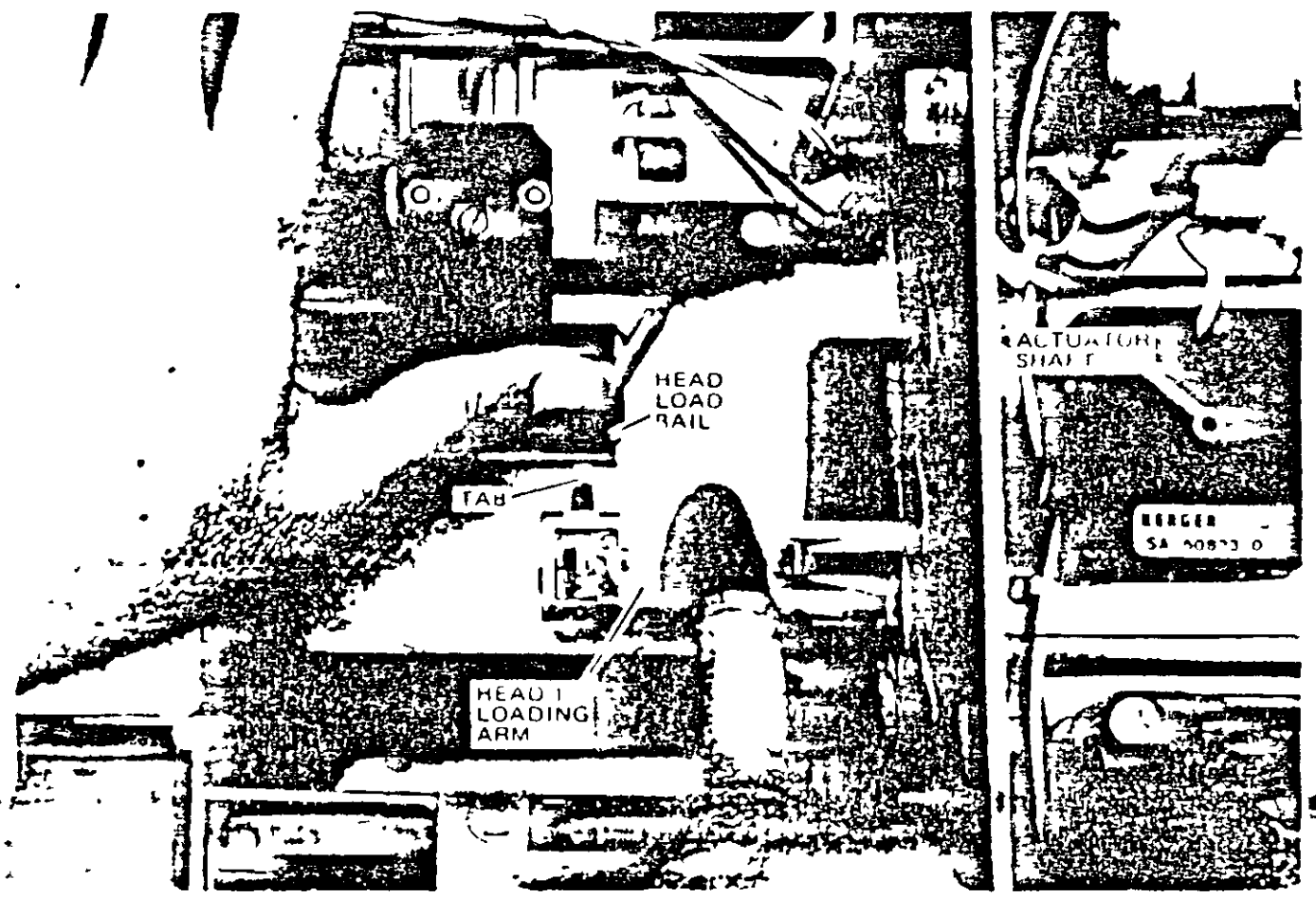
f. Insert a flexible disc into the drive, close and open the door, and check for proper operation.

g. Following the completion of this adjustment procedure, perform the following procedures:

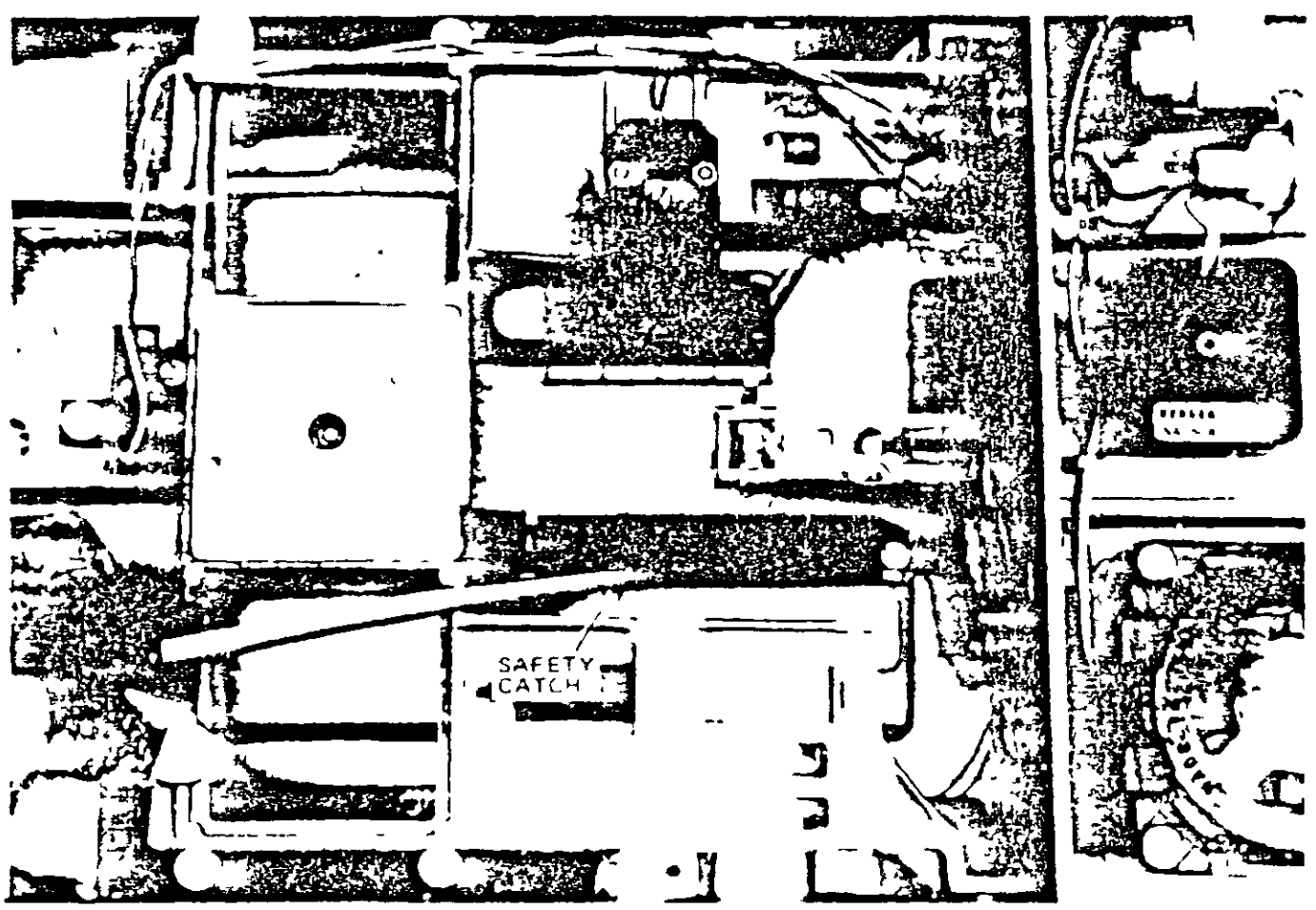
1. Sector/Index Phototransistor Adjustment Procedure

2 Write Protect Detector Adjustment Procedure.

3 Head Load Actuator Adjustment Procedure



A HEAD UNLOADING



B SAFETY CATCH RELEASE

Figure 2-14. Cartridge Guide Access Details

Sector/Index LED

The sector/index LED assembly is removed from the disc drive as follows

a Remove power from the disc drive

b Note the color coding of the two wires attached to the sector/index LED assembly and then unsolder the wires.

c. Remove the screw securing the sector/index LED assembly to the cartridge guide assembly and remove the LED assembly.

The sector/index LED assembly is replaced by reversing this procedure Following installation, perform the sector/index phototransistor adjustment procedure

Write Protect Detector

Write Protect Detector Removal

The write protect detector assembly is removed from the disc drive as follows:

a. Remove power from the disc drive.

b. Remove the drive board.

c. Extract the following pins from connector P2

Pin	Wire
4	red
D	black
11	white
M	gray

d. Remove the screw securing cable clamp to the disc drive frame

e Remove the screw securing the write protect detector assembly bracket to the disc drive frame and remove the detector assembly.

The write protect detector assembly is installed by reversing this procedure Following installation, perform the write protect detector adjustment procedure.

Write Protect Detector Adjustment

To check the adjustment of the write protect detector assembly, proceed as follows·

a Restore power to the disc drive

b. Insert a flexible disc having an open write protect notch (or hole) into the disc drive

c Using a 10 1 probe, connect an oscilloscope to the WPRTH test point on the drive board Use drive board GND 1 test point for signal ground.

NOTE

All oscilloscope sensitivity settings given in this section assume the use of 10 1 oscilloscope probes If 1 1 probes are used, the sensitivity settings should be scaled accordingly

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d. Set the oscilloscope controls as follows:

   Sweep — 2 msec/div
   Sensitivity — 0.1 volt/div
   Input — DC
   Trigger — INT, DC
   Display — A

e. Slightly loosen the screw securing the write protect detector assembly bracket to the disc drive.

f. Adjust the position of the write protect detector assembly until the waveform observed on the oscilloscope is at maximum amplitude. Tighten the screw loosened in step e.

g. Check that the position of the write protect detector does not restrict insertion of a flexible disc into the disc drive. If necessary repeat steps e and f above.

Head Load Actuator

Head Load Actuator Removal

The head load actuator assembly is removed from the disc drive as follows:

a. Remove power from the disc drive.

b. Remove the head cover shield.

c. Extract the following pins from connector P2.

Pin	Wire
17	black
U	black

d. Swing open the cartridge guide assembly.

e. Remove the screw securing the head load actuator to the cartridge guide assembly.

The head load actuator is installed by reversing this procedure. Hold the actuator in the position shown in Figure 2-14 when tightening its mounting screw. Do not install the head load shield at this time. Following installation of the actuator, perform the head load actuator adjustment procedure and the timing check.

Head Load Actuator Adjustment

To check the adjustment of the head load actuator assembly, proceed as follows:

a. Restore power to the disc drive.

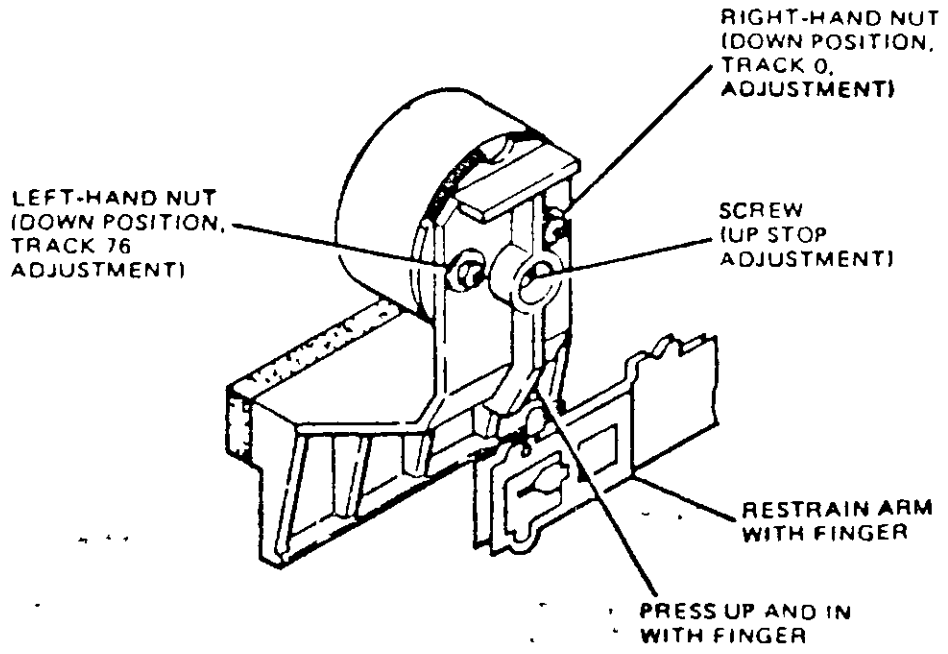
b. Position the heads to approximately track 0.

c. Insert a flexible disc into the disc drive and energize the head load actuator coil by selecting the drive.

d. The down position of the head load actuator bail is adjusted with two self-locking nuts that secure the bail to the actuator.

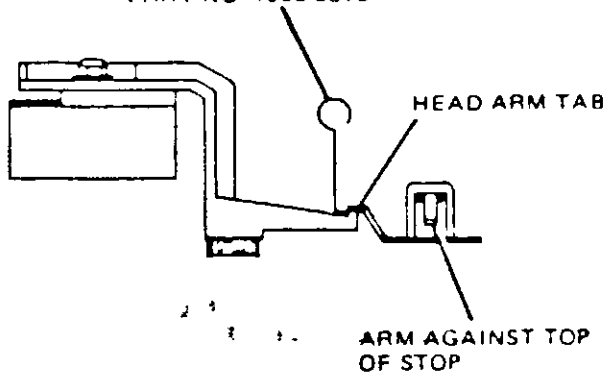
e. With the read/write heads at track 0, adjust the right-hand nut until the tip of bail

adjustment gauge, part no 1535-3875, just fits between the bail and the tab on the head 1 moveable arm

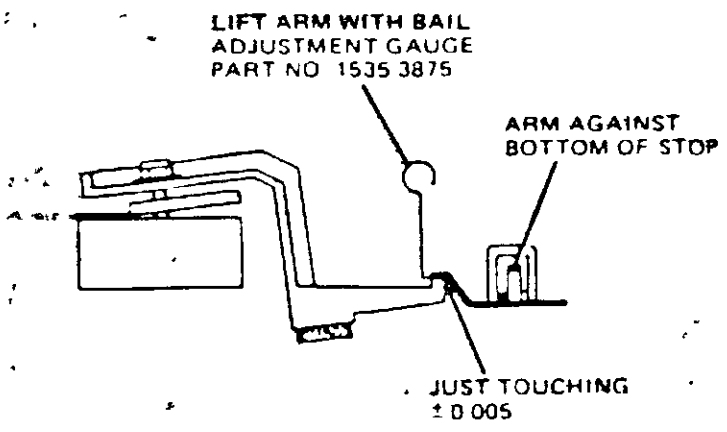


A ADJUSTMENT CONTROLS AND UNLOADING DETAILS

BAIL ADJUSTMENT GAUGE
PART NO 1535 3875



B. DOWN POSITION ADJUSTMENT



C. UP POSITION ADJUSTMENT

Figure 2-15. Head Load Actuator Unloading and Adjustment Details

f. Position the heads at track 76 and repeat step e, this time adjusting the left-hand nut.

g. Return to track 0 and recheck the clearance. If necessary, readjust the setting of the right-hand nut.

h Continue to check the clearance at track 0 and track 76 until both are correct.

i. Deselect the drive and open the cartridge guide assembly by pressing the push bar on the front panel of the drive.

j. With the loop of the bail adjustment tool hooked over the tip of the load arm tab, carefully pull the arm out to its maximum travel (do not flex the arm).

k. Adjust the up stop adjustment screw until the bail just contacts the tab of the head load arm. It may be necessary to first adjust the screw too far in and back if off, as required.

l. Following the adjustment, ensure that there is clearance between the disc and the outside head when a flexible disc is inserted into the drive.

Head Load Actuator Timing Check

To check the timing of the head actuator, proceed as follows:

a. Restore power to the disc drive.

b. Insert a flexible disc into the disc drive. Select head 0 and step to track 0. Write a series of 0's on the disc.

c. Using 10:1 probes, connect an oscilloscope to the following test points on the drive board:

Channel A — PREAMP +

Channel B — –

Use test point HDLDL on the drive board for oscilloscope sync and test point GND 3 for signal ground.

d. Set the oscilloscope controls as follows:

Sweep — 10 msec div
Sensitivity — 0.01 volt/div
Input — DC
Trigger — EXT, –, DC, NORM, SINGLE
Display — A + B, B INV

e. Observe the read signal on the oscilloscope. The signal should reach 50% of full amplitude in 35 milliseconds or less. See Figure 2-15. If this is not the case, proceed with the remainder of this procedure.

f. Repeat the head load actuator adjustment procedure.

CAUTION

DO NOT ADJUST THE HEAD LOAD ACTUATOR UP STOP ADJUSTMENT SCREW MORE THAN ¼-TURN CLOCKWISE.

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g Repeat step e If the timing is still not correct, adjust the head load actuator up stop adjustment screw clockwise until the timing is correct.

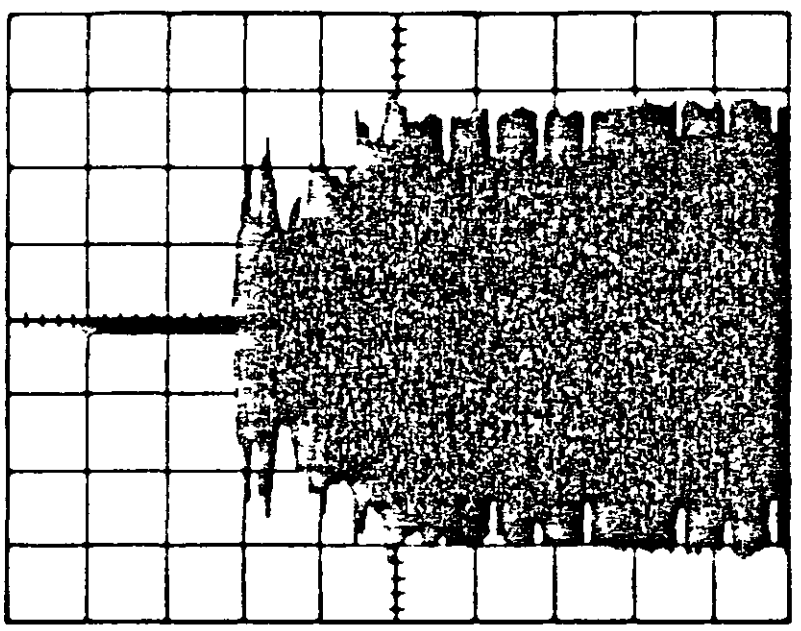


Figure 2-16. Head load Actuator Timing Check Waveform

Sector/Index Phototransistor

Sector/Index Phototransistor Removal

The sector/index phototransistor assembly is removed from the disc drive as follows:

a. Remove power from the disc drive.

b. Disconnect connector P2 from the drive board.

c. Detach the following wires from the door closed switch.

Switch	Wire
Common	orange
N/C	gray
N/O	red

d. Extract the following wires from connector P2.

Pin	Wire
12	black
N	green
P	brown
6	orange
F	gray
H	red

e Remove the screw securing cable clamp to the frame of the drive.

f Remove the sector/index phototransistor assembly from the disc drive

The sector/index phototransistor assembly is installed by reversing this procedure. Following installation, perform the sector/index phototransistor adjustment.

Sector/Index Phototransistor Adjustment

To check the adjustment of the sector/index phototransistor assembly, proceed as follows.

a Restore power to the disc drive

b Insert double-sided alignment disc, part no 9164-0111, into the disc drive and close the door.

c. Using 10:1 probes, connect an oscilloscope to test point INDEX H on the drive board.

d. Set the oscilloscope controls as follows:

Sweet — 2 msec/div
Sensitivity — 0 2 volt/div
Input — DC
Trigger — INT, +, DC, NORM
Display — A

e. Check that two pulses are present as shown in the Figure 2-16. The amplitude of the pulses should be approximately 4.0 volts. If the two pulses are not correct, proceed to step f and attempt to obtain the correct signal. If it is correct, the procedure is complete

f. Loosen the screw securing the sector/index phototransistor assembly until the assembly can just be moved.

g. Adjust the position of the sector/index phototransistor assembly until the oscilloscope waveform agrees with step e.

h Tighten the sector/index transistor assembly retaining screw and check that the waveform is still acceptable

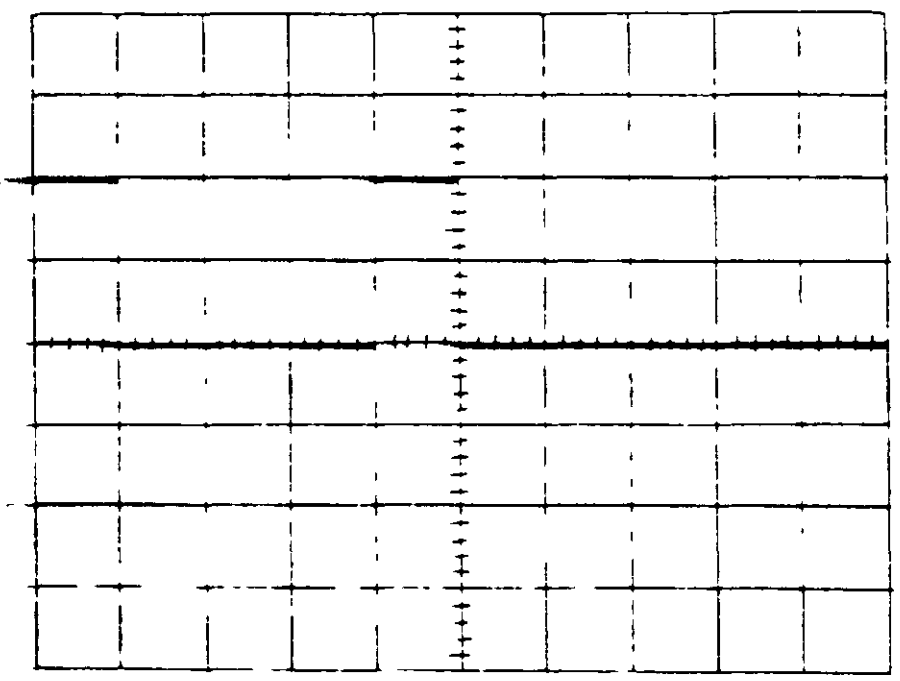


Figure 2-17. Index Pulse Waveform

Track 0 Detector

Track 0 Detector Removal

The track 0 detector is removed from the disc drive as follows:

a. Remove power from the disc drive.

b. Manually rotate the stepper actuator shaft fully clockwise to track 77.

c. Remove the screw securing the track 0 detector bracket to the frame of the disc drive and remove the track 0 detector assembly.

d. Remove the drive PCA from the disc drive.

e. Extract the following pins from connector P2.

Pin	Wire
3	brown
C	black
O	orange
L	red

f. Remove the screw securing the cable clamp to the disc drive.

g. Remove the track 0 detector from the disc drive.

The track 0 detector is installed by reversing this procedure. Following installation, perform the track 0 detector adjustment procedure.

Track 0/76 Stop Adjustment

This adjustment is not field adjustable.

Track 0 Detector Adjustment

To check that the track 0 detector is correctly adjusted, proceed as follows:

a. Before performing this procedure, check the head radial alignment and adjust if necessary.

b Insert the alignment disc into the disc drive.

c. Loosen the screw securing the track 0 detector and move the detector back as far as possible toward the actuator assembly. Tighten the securing screw.

d. Recalibrate the disc drive by pressing the RESET pushbutton on the DSU.

e. Using 10:1 probes, connect an oscilloscope to the following points on the drive board:

Channel A — PREAMP +
Channel B — PREAMP −

f Use test point INDEX H on the drive board for oscilloscope sync and test point GND 3 for signal ground.

g Set the oscilloscope controls as follows.

Sweep — 20 msec/div
Sensitivity — 0.01 volt/div
Input — DC
Trigger — EXT, −, DC, NORM
Display — A + B, B INV

h Using the DSU, step the carriage assembly in until the data burst recorded on track 0 is visible

i Loosen the screw securing the track 0 detector and move the detector forward until the TRACK 0 LED on the DSU lights Tighten the securing screw

j. Using a 10:1 probe, connect the oscilloscope to drive PCA test point TK0H. use drive PCA GND 1 test point for signal ground. Set oscilloscope for a vertical deflection of 0.1 volt/div, continuous sweep.

k. Check that voltage level at TK0H test point is high (+5 volts).

l. If the voltage is not high, loosen the screw securing the track 0 detector. Move the detector forward towards the spindle until the TK0H test point goes high.

m. Step the carriage to track 02. Check that the TK0H test point goes low. If this is not the case, move the track 0 detector back towards the actuator assembly.

n. Recheck the adjustment by stepping the heads between tracks 01 and 02. Check that TK0H test point is low at track 02 and high at track 01. A perfect adjustment presents a squarewave on the oscilloscope.

Front Plate

The front plate assembly is removed from the disc drive as follows:

a. Remove power from the disc drive.

b. Insert the cartridge guide adjustment tool through the cartridge guide tool hole in the cartridge guide assembly and screw it into the disc drive frame. Hand tighten the tool.

c. Remove the following pins from the connector P2:

Pin	Wire
2	black
B	brown
9	blue
K	purple

d Remove the screw securing cable clamp and remove the clamp.

e. Remove the two Allen-head screws securing the handle to the front plate and remove the handle

f Remove the two screws securing the lock plate assembly to the front plate

The front plate is installed by reversing this procedure Following replacement, perform the sector index phototransistor adjustment procedure.

Lock Plate Assembly

The lock plate assembly is removed from the disc drive as follows:

a Perform the front plate removal procedure.

b Remove the lock plate assembly from the disc drive.

The lock plate assembly is replaced by reversing this procedure. Following installation, adjustment of the door lock solenoid (10) should not be necessary. If adjustment is required, the gap between the armature tab and the latch should be 0.15 ± 0.010 inch. The adjustment can by made by loosening the two screws on the armature.

Line Frequency Conversion Procedure

The following procedure is given to convert the 7902A drive from 60 Hz operation to 50 Hz operation or vice versa.

The parts required to perform the conversion are as follows:

For 60 Hz operation
- 1 — Drive pulley HP part no. 1500-0499
- 1 — Drive belt HP part no. 1535-3651

For 50 Hz operation
- 1 — Drive pulley HP part no. 1535-3650
- 1 — Drive belt HP part no. 1535-3649

Follow these steps to perform the conversion:

1. Remove the drive board from the drive assembly.
2. Remove and retain the old drive belt and pulley. The pulley is held in place with a small setscrew.
3. Install the new drive pulley by sliding it onto the drive motor shaft until it touches the motor fan. Tighten the setscrew and install the new drive belt.
4. Reinstall the drive board.

Replaceable Parts

Introduction

This section provides the HP 7902A flexible disc drive parts list. The total quantity of a part is shown only the first time it is used on a particular assembly.

The number shown in the "CD" column is the part number's check digit. Include the check digit number with the part number when ordering a part from HP.

Table 2-12. HP 7902A Replaceable Parts

HP Part No.	CD	Description	Units Per Assembly
		Disc Drive Assembly	1
1535-3652	0	Door Closed Switch	1
1535-3847	5	Lock Plate Assembly	1
1535-3872	6	Sector/Index Phototransistor Assembly	1
1535-3651	9	Drive Belt 60 Hz	1
1500-0499	4	Drive Pulley 60 Hz	1
1535-3649	5	Drive Belt 60 Hz	1

1535-3650	8	Drive Pulley 50 Hz	1
1535-3870	0	Head Load Actuator	1
1535-3871	5	Sector/Index LED Assembly	1
1150-1309	4	Write Protect Detector Assembly	1
1535 3873	7	Track 0 Detector Assembly	1
9164-0096	1	Flexible Disc, Double-Sided, Unformatted	

9895K Flexible Disc Drive (HP Part No. 09895-67914)

Introduction

This section provides interface and maintenance information for the 9895K flexible disc drive.

Power Requirements

Table 2-13: HP 9895K Disc Drive Power Requirements

Drive Board (A2)
+5V 0.6A typical, 0.7A max, voltage tolerance: ±5%,
+24VDC 1.4A Nominal, voltage tolerance ±10%.

Disc Drive Assembly
86 — 127 Vac at 0.3A typical, 0.44A max
50/60 Hz ±3.5% HP Format
50/60 Hz ±1% IBM Format

Cooling Requirements

The operating limits of the disc drive assembly and medium are specified as 10°C to 40°C, 20 to 80 percent relative humidity (RH) with maxium wet-bulb temperature of 25.5°C. These limits allow for a rise in the disc drive of 10°C. The actual operating limits are set by the medium. IBM sets the limits at 10°C to 52.6°C, 8 to 80 percent RH, maximum wet-bulb temperature of 29 4°C.

Shielding Requirements

No shielding is required under normal operating conditions. If the disc drive assembly is subjected to medium to high-intensity electromagnetic fields such as those from the yoke of a cathode-ray tube, an aluminum or steel shield should be placed between the source of the field and the disc drive The head load solenoid has a small dc external field that may cause CRT deflection A steel shield wrapped around the disc drive assembly will eliminate this source of interference.

Interface Information

Figure 2 17 shows the location of the connectors on the CDC industry standard drive board A2 Connection to the controller is through the 50 pin connector A2J1. DC power is supplied via connector A2J4. Refer to Table 2-14 for the connector pin assignments.

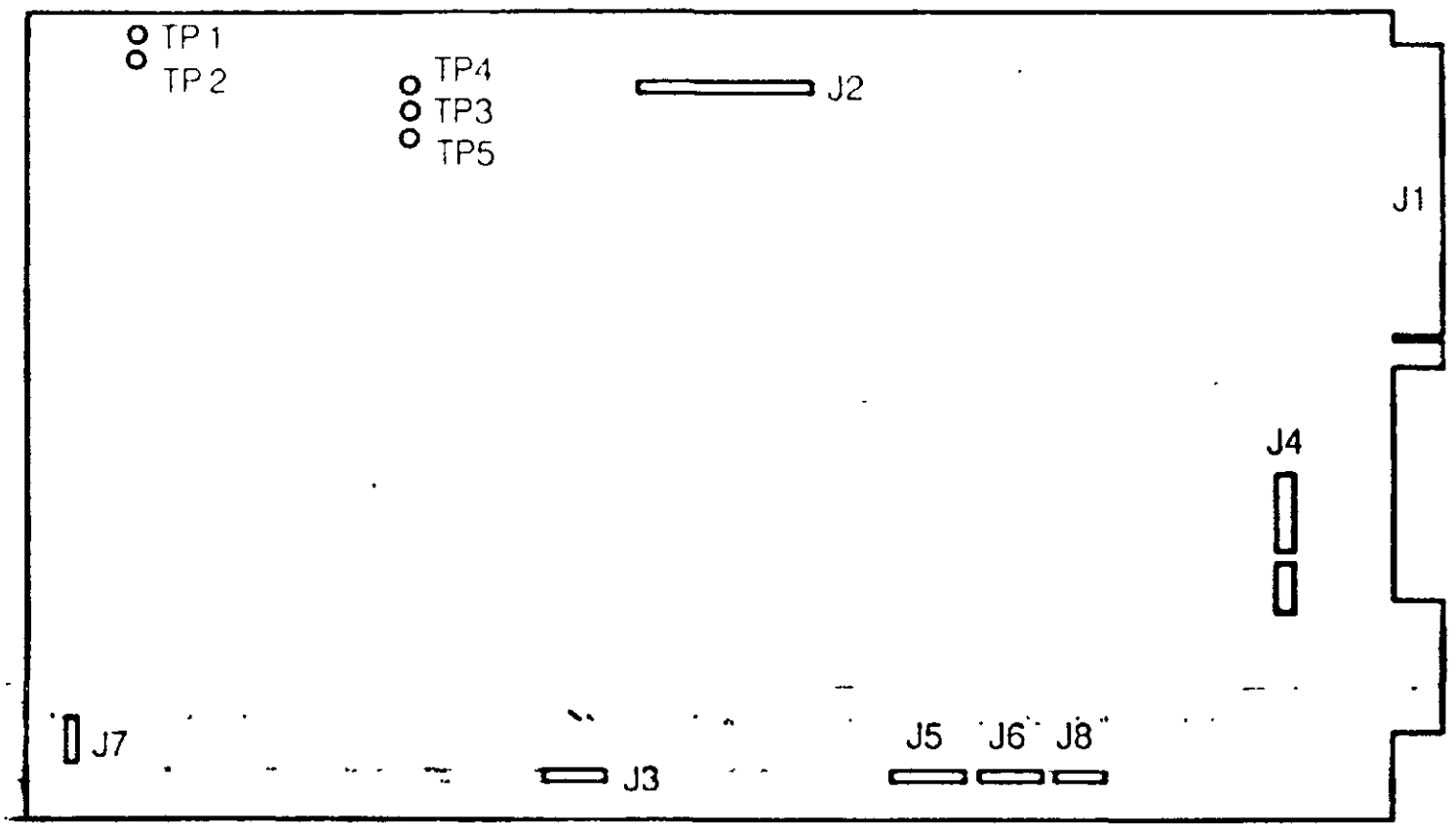


Figure 2-18. CDC Industry Standard Drive Board

Table 2-14. Connector Pin Assignments

J4

Pin	Description
1	Not Used
2	+5VDC
3	GND
4	+24VDC
5	Key
6	+24VDC Return
7	Not Used

A2J1

2	Low Current
4	Opt.
6	Opt.
8	Opt.
10	Two Sided
12	Disc Change
14	Head Select (Opt.)
16	In Use
18	Head Load
20	Index
22	Drive Ready
24	Sector

26	Drive Select 1
28	Drive Select 2
30	Drive Select 3
32	Drive Select 4
34	Direction
36	Step
38	Write Data
40	Write Enable
42	Track 00
44	Write Protect
46	Read Data
48	Sep Data
50	Sep Clock

Alignment and Adjustments

Introduction

This section provides information for the alignment and adjustments which may be performed on the 9895K flexible disc drive. This drive assembly is identical to the one used in the 9895A. Additional adjustments may be performed by inserting the 9895K drive assembly into a 9895A and following the procedures as outlined in the 9895A service manual.

DC Voltage and SignalCheck of Drive Module

1. Input dc power should be +5 Vdc ±5% at pin 5 of dc connector (pin 6 is +5V return), and +24V ±10% at pin 1 (pin 2 is +24V return).
2. Various detector functions can be checked by observing the dc level at the board connector. Table 2-15 contains a list of these functions and the point to check for the signal

Table 2-15. Detector Functions

Function	Connector, Pin 2 Wire Color
Write Protect	J5-12 Red
Track 0	J6-3 Red
Index (Single-Sided)	J6-5 Black
Index (Double-Sided)	J6-6 Purple
Door Closed	J5-2 Yellow

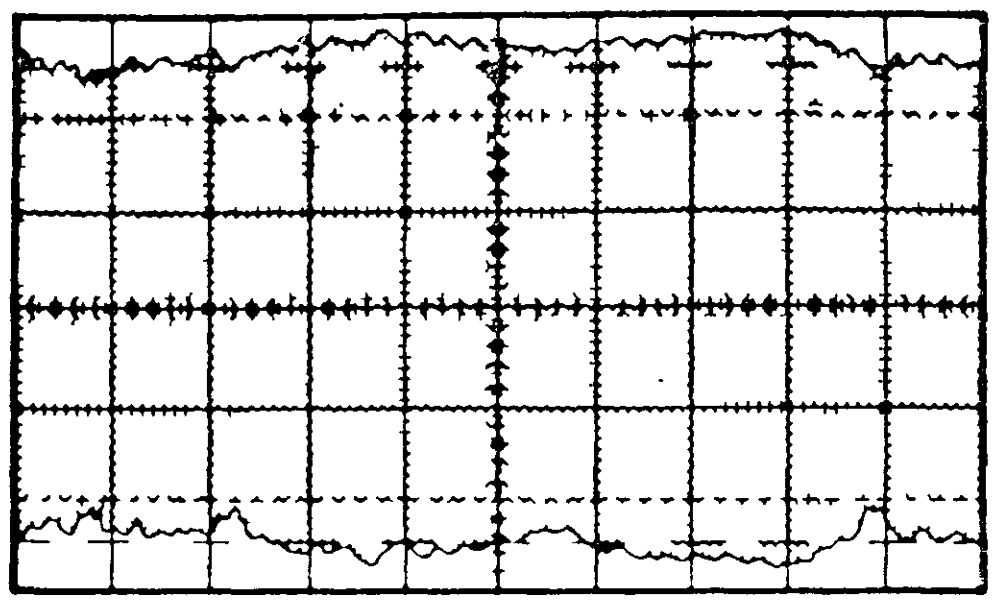
3. Certain functions used in the adjustment procedures have built-in test points. These functions are listed in Table 2-16.

Table 2-16. Adjustment Test Points

Function	Test Point
Differentiated Analog	1
Read Data (Differential)	2
Analog Read Data	3
Differential	4
Ground	15

SCOPE
SETTINGS:

200mv/cm
20ms/cm



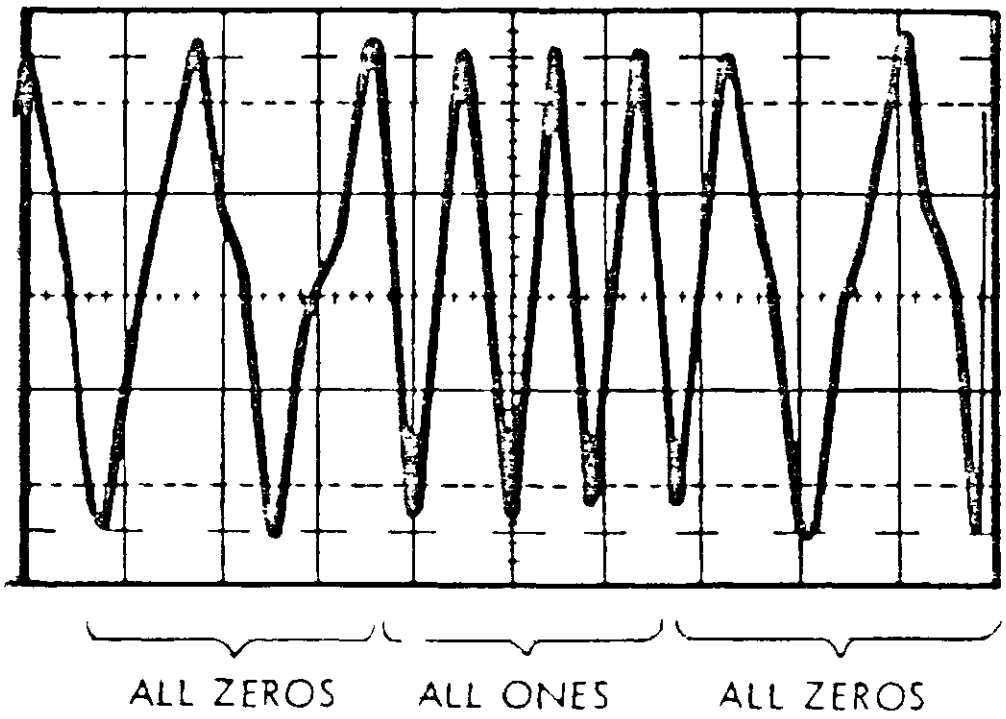
TP3 AND TP4

APPROX. AMPLITUDE RANGE,
INNER TO OUTER TRACKS:
100mv - 1100mv ALL ONES
300mv - 1200mv ALL ZEROS

Figure 2-19. Differential Read Signal for Entire Track

SCOPE
SETTING:

200mv/cm
10us/cm



TP3 AND TP4

Figure 2-20. Differential Read Signal for Portion of Outer Track

Corrective Maintenance Procedures

There are no corrective maintenance procedures for the power module or the controller, except replacement. There are a number of corrective adjustments for the drive module. This section contains these adjustments. They are as follows:

Disc Ejector Adjustment
Disc Load-Pad Adjustment
Head-Unload Clearance Adjustment

Disc Ejector

Insert a disc fully and note a clicking noise as the ejector engages a pin on the door.

While observing the ejector latch and latch block close the door. Note that closing the door moved the ejector further to the rear, allowing the latch to rotate counterclockwise until the tip drops over the step in the latch block.

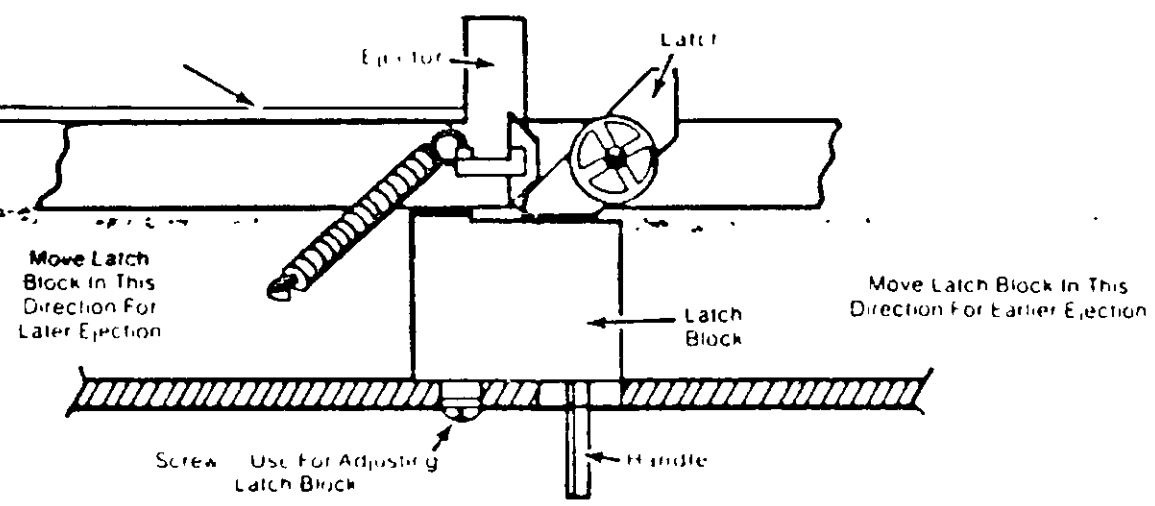


Figure 2-21. Ejector, Latch and Latch Block

With the door closed, adjust the latch block (Figure 2-20) so the tip of the latch directly below the rear edge of the ejector

Check by opening the door slowly and observing the door position when the disc is ejected. To avoid damage, it is to be ejected when the door is ¼ inch maximum from the fully opened position. If further adjustment is required, move the latch block as indicated by the arrows and instruction in Figure 2-20.

Cycle the door several times and observe the the disc ejection is within the ¼ inch maximum described above

Disc-Load-Pad Adjustment

1. Install a disc.
2. Close the door and load the heads by seeking to a track.
3. Loosen solenoid mounting screws
4. Move solenoid down on bracket to obtain a clearance of 0.010 to 0.015 inch between

the load plate and the lift extension of the upper-head arm at the location of minimum clearance. Move the carriage through its full travel manually to determine the location of minimum clearance.

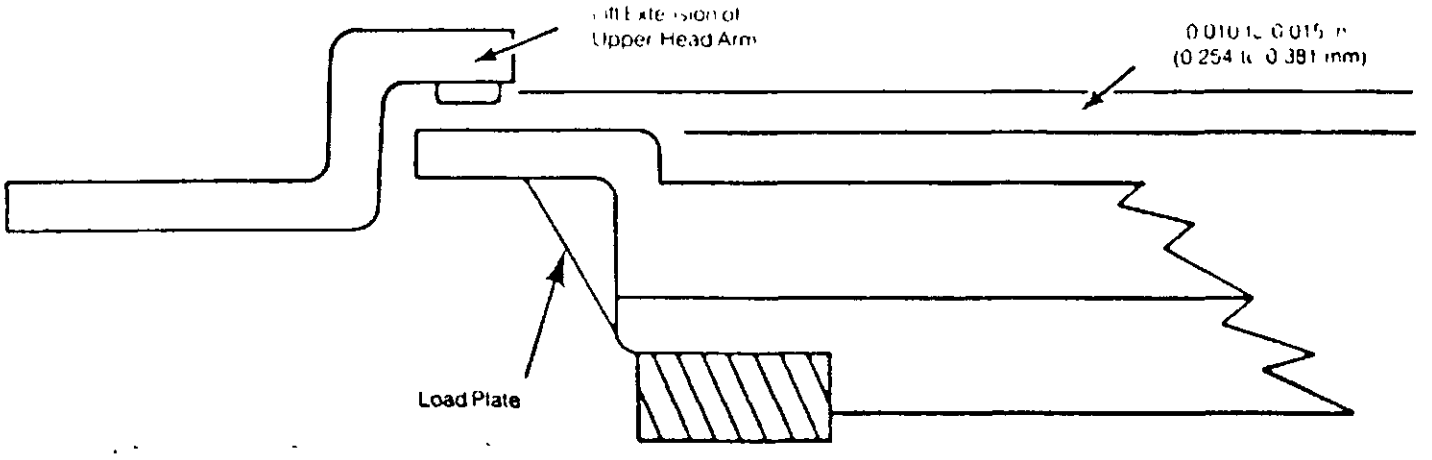


Figure 2-22. Load-Pad Adjustment

Head-Unload Clearance

Adjust setscrew on door for 0.100 inch to 0.125 inch clearance (Figure 2-22) between flyer pads with head-load solenoid de-energized and door closed.

CAUTION

MEASURE THIS DISTANCE BY EYE ONLY. DO NOT USE A GAUGE.

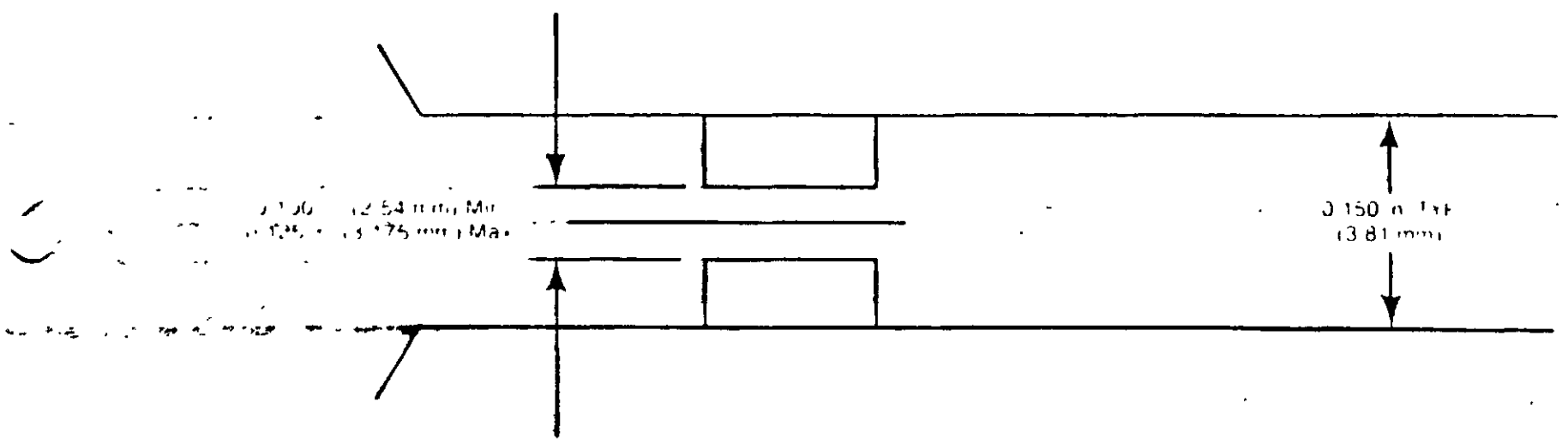


Figure 2-23. Head Unload Clearance

Line Frequency Conversion Procedure

This procedure is to be used to convert the unit from 60 Hz operation to 50 Hz operation and vice versa. This is accomplished by reversing the dual-diameter reversible pulley on the spindle-motor shaft using the following steps:

1. Remove ac power.

2. Remove printed circuit board assembly.
3. Remove the belt from the spindle-motor pulley (accessible from the underside of unit).
4. Loosen setscrew and remove pulley.
5. Reverse pulley and replace on motor shaft.
6. Position pulley allowing clearance of 0.039 inch, ±0.010 inch between shoulder of motor mounting screws and pulley (Figure 2-23).
7. Tighten down setscrew.
8. Replace belt and printed circuit board.

CAUTION
IT IS IMPORTANT THAT THE NEW OPERATING FREQUENCY BE MARKED ON THE UNIT'S RATING NAMEPLATE.

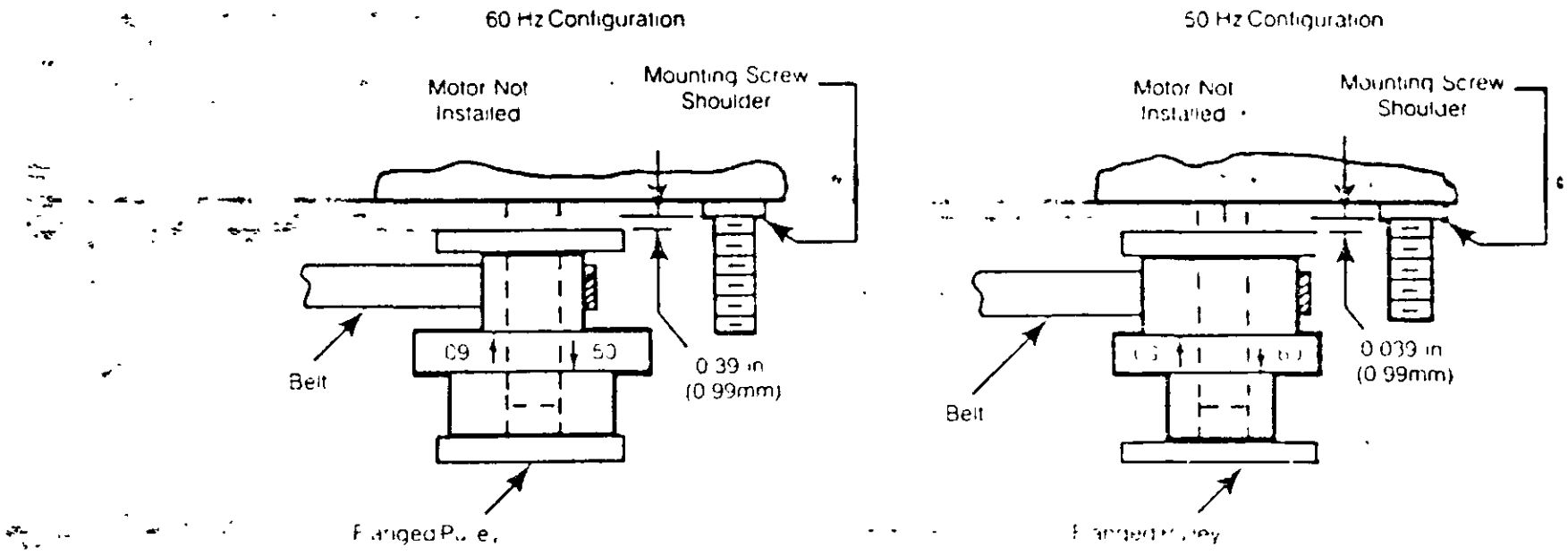


Figure 2-24. Drive Pulley Reversal

7902C Flexible Disc Drive (Part No. 07902-67902)

Introduction

This section contains interface and maintenance information for the 7902C flexible disc drive.

Power Requirements

Table 2-17. HP 7902C Disc Drive Power Requirements

Drive Board (A2)
+5V 0.6A typical, 0.7A max, voltage tolerance: +5%, −3%
+12V 0.8A typical, 1.0A max, voltage tolerance: ±5%
−12V 0.8A typical, 1.0A max, voltage tolerance: ±5%

Disc Drive Assembly
86 — 127 Vac at 0.3A typical, 0.44A max
50/60 Hz ± 3.5% HP Format
50/60 Hz ± 1% IBM Format

Cooling Requirements

The operating limits of the disc drive assembly and medium are specified as 10°C to 40°C, 20 to 80 percent relative humidity (RH) with maximum wet-bulb temperature of 25.5°C. These limits allow for a rise in the disc drive of 10°C. The actual operating limits are set by the medium. IBM sets the limits at 10°C to 52.6°C, 8 to 80 percent RH, maximum wet-bulb temperature of 29.4°C.

Shielding Requirements

No shielding is required under normal operating conditions. If the disc drive assembly is subjected to medium to high-intensity electromagnetic fields such as those from the yoke of a cathode-ray tube, an aluminum or steel shield should be placed between the source of the field and the disc drive. The head load solenoid has a small dc external field that may cause CRT deflection. A steel shield wrapped around the disc drive assembly will eliminate this source of interference.

Interface Information

Figure 2-24 shows the location of the connectors on drive board A2. Connection to the controller is through a 50-pin connector A2J7. DC power is connected via A2J4. Table 2-5 lists the pin assignments for connectors A2J3, J4 and J7. Power for the DSU is supplied by connector A2J9. Connections for a disc drive display panel are provided by connector A2J2.

AC power for the disc drive assembly is connected directly to a 3-pin connector, located on the drive, between the actuator and the spindle motor capacitor. See Figure 2-25. Pin assignments for the connector are as follows:

Pin	Signal
1	ac line
2	frame ground
3	ac neutral

Mating parts for the connector are:

Body, part no. 1251-3913 (Amp 1-480700-0)
Pin, part no. 1251-3915 (Amp 350547-1)

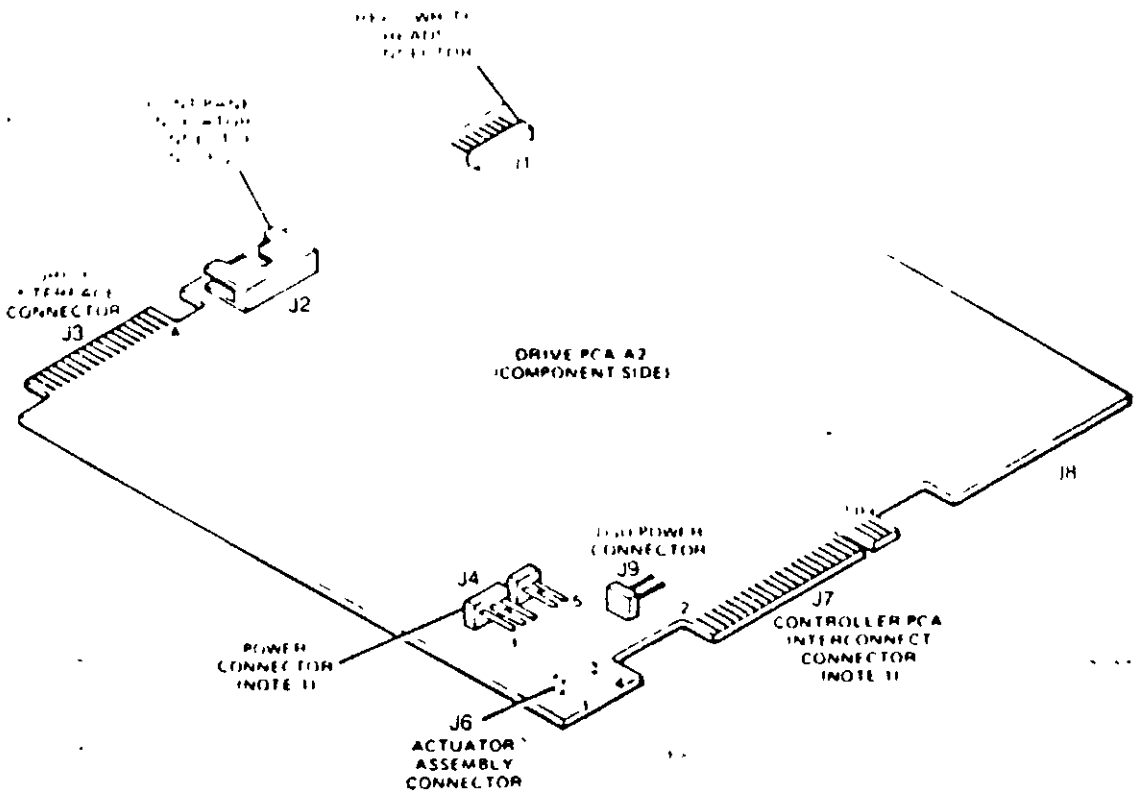


Figure 2-25. HP Drive Board A2 Connectors

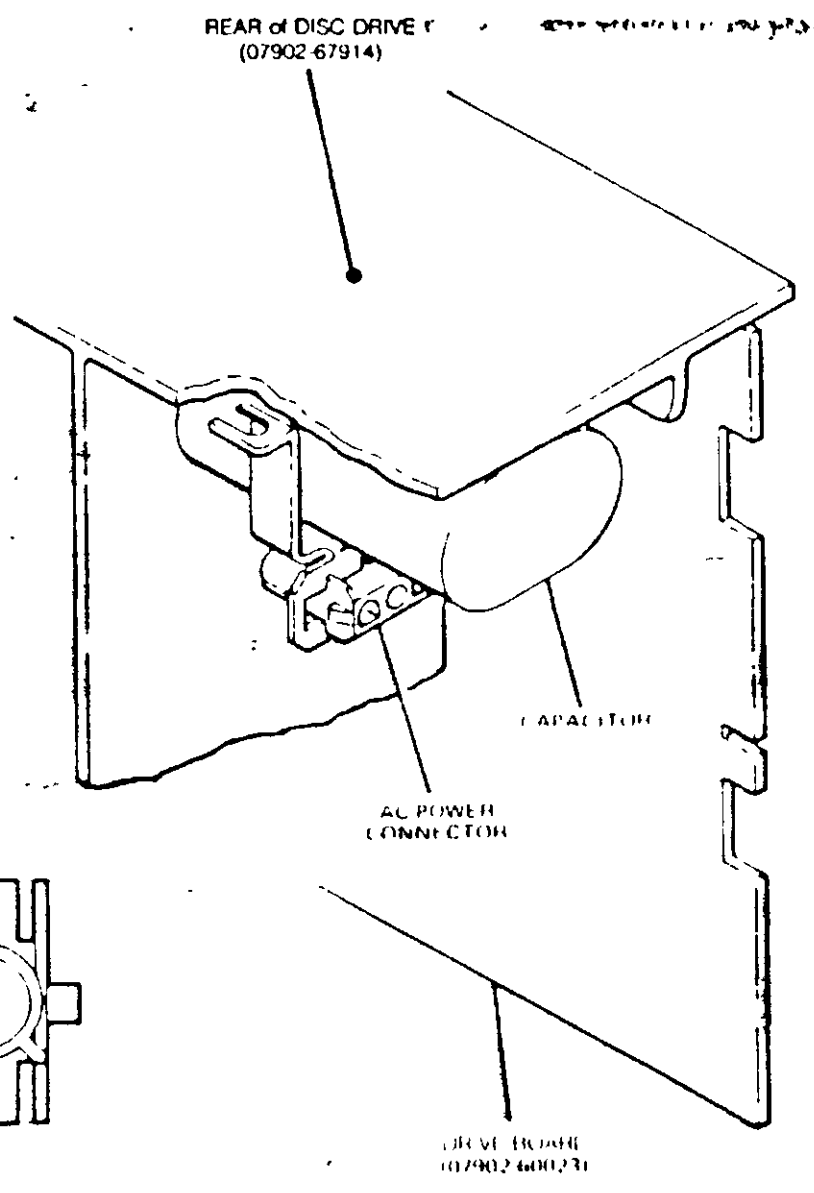


Figure 2-26. AC Power Connector

7902C Alignment and Adjustments

The 7902C disc drive assembly is an exchange assembly that is non-repairable. With the exception of the drive belt and pulley for line frequency conversion, component part replacement on this assembly can not be done.

Line Frequency Conversion Procedure

The following procedure is given to convert the 7902C drive from 60 Hz operation to 50 Hz operation or vice versa.

The parts required to perform the conversion are as follows:

For 60 Hz operation
- 1 — Drive pulley HP part no. 1500-0499
- 1 — Drive belt HP part no. 1535-3651

For 50 Hz operation
- 1 — Drive pulley HP part no. 1535-3650
- 1 — Drive belt HP part no. 1535-3649

Follow these steps to perform the conversion:

1. Remove the drive board from the drive assembly.
2. Remove and retain the old drive belt and pulley. The pulley is held in place with a small setscrew.
3. Install the new drive pulley by sliding it onto the drive motor shaft until it touches the motor fan. Tighten the setscrew and install the new drive belt.
4. Reinstall the drive board.