TEXAS INSTRUMENTS

Improving Man's Effectiveness Through Electronics

CalComp Trident Series Disk Drives Models T25, T50, and T80 Maintenance

TI INTERNAL USE ONLY
NOT FOR RESALE

VENDOR P/N 10194-901-002-1

Digital Systems Division

76205-302

TRIDENT SERIES DISK DRIVES
MAINTENANCE MANUAL
FOR MODELS T25, T50, AND T80

November 1978

CALCOMP
California Computer Products, Inc.

PUBLICATIONS RECORD MM T25, T50, T80	
REVISION	**NOTES**
1	Update to correct typographical errors and add new information.
2	Completely revised to incorporate new engineering data and procedures. Change manual Part No. 76205-302, formerly Part No. 10194-901-002-1.

CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

ILLUSTRATIONS

ILLUSTRATIONS (Continued)

TABLES

SECTION 1
GENERAL INFORMATION

This manual contains preventive maintenance, operational checks, adjustments, and removal and replacement procedures and other related maintenance information for Trident Model T25, T50, and T80 Disk Drives. The information in the manual is divided into four basic sections, with each subsection related to task oriented objectives.

- General Information
  - Equipment Specifications
  - Major Assemblies
  - Basic Operating Procedures
- Preventive Maintenance
  - Head Inspection and Cleaning
  - Pack Area Maintenance
  - Periodic Maintenance Schedules
- Corrective Maintenance
  - Head Replacement and Adjustment
  - Assembly Removal and Replacement
  - Alignment Procedures
- Troubleshooting Aids

Before performing preventive or corrective maintenance on these disk drives, maintenance personnel must become familiar with the electrical characteristics and principles of operation of the drives.

DESCRIPTION

The Trident Disk Drives (Figure 1-1) are high-speed, random-access memory devices that are used for mass data

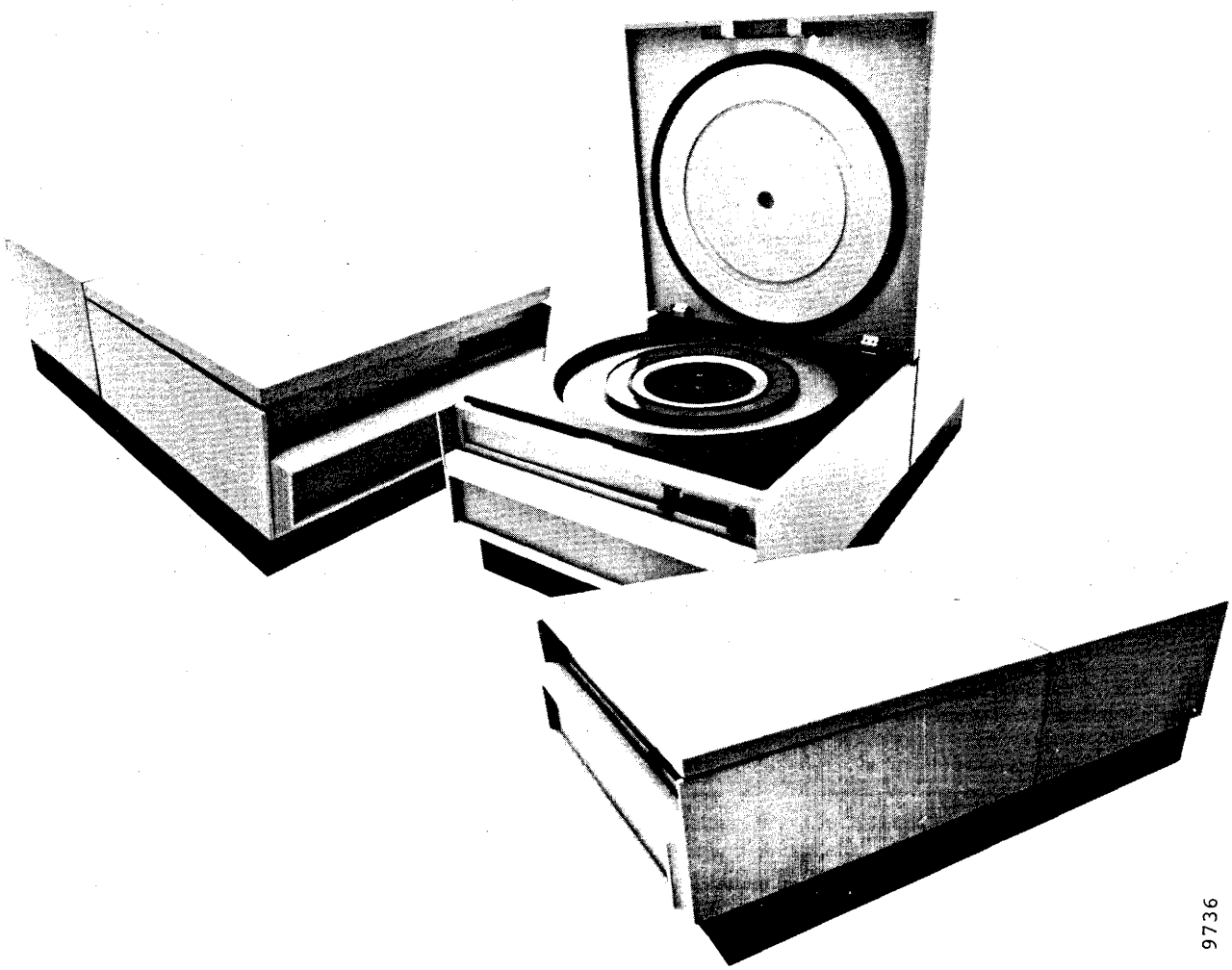


Figure 1-1. Trident Disk Drives

storage in data processing systems. The disk drives are compact and self-contained, and can be rack mounted, used in a lowboy cabinet, or used as a tabletop unit.

The disk drives use a removable disk pack (five-disk Trident Special) that is installed or removed by means of an access door at the top front of the unit. Removal of front and rear covers allow access to the interior of the unit for maintenance purposes.

Specifications

Table 1-1 lists the general electrical physical characteristics common to T25, T50, and T80 Disk Drives.

TABLE 1-1. OPERATING SPECIFICATIONS

Tracks per Cylinder	5 (plus servo track)
Cylinders per Pack	
• T25	408 (000 thru 407)
• T50 and T80	815 (000 thru 814)
Bytes per Track	
• T25 and T50	13,440 (107,520 bits)
• T80	20,160 (161,280 bits)
Bytes per Cylinder	
• T25 and T50	67,200 (537,600 bits)
• T80	100,800 (806,400 bits)
Bytes per Pack	
• T25	27.4 million (219.2 million bits)
• T50	54.7 million (437.6 million bits)
• T80	82.15 million (657.2 million bits)
Track Density	
• T25	185 tracks per inch
• T50 and T80	370 tracks per inch
Recording Density	
• T25 and T50	4040 bits per inch, nominal
• T80	6060 bits per inch, nominal
Minimum Access Time	6 milliseconds (single-track head repositioning)
Maximum Access Time	55 milliseconds (end cylinder-to-end cylinder)
Average Access Time	30 milliseconds
Pack Rotational Speed	3600 rpm, ±5%
Maximum Latency Time	17.6 milliseconds
Average Latency Time	8.3 milliseconds
Recording Method	Bit serial Triple Frequency Modulation (TFM)

TABLE 1-1. OPERATING SPECIFICATIONS (Continued)

Data Transfer Rate	
• T25 and T50	806,000 bytes (6.45 million bits)/sec
• T80	1,209,000 bytes (9.67 million bits)/sec
Bit Cell Time	
• T25 and T50	155 nanoseconds
• T80	103.3 nanoseconds
Drive Start Time	20 seconds nominal (START to drive ready)
Drive Stop Time	20 seconds nominal (STOP to disk stopped)
Ac Input Voltages	50 or 60 Hertz (±0.5 Hz), single phase (measured line-to-line or line-to-neutral)
• 200-volt Models	190v rms, +10 to −15% 200v rms, +10 to −15% 208v rms, +10 to −15% 220v rms, +10 to −15% 230v rms, +10 to −15% 240v rms, +10 to −15%
• 100-volt Models	100v rms, +10 to −15% 115v rms, +10 to −15% 127v rms, +10 to −15%
Starting Current	13 amperes for 9 seconds (200-volt models) 26 amperes for 9 seconds (100-volt models)
Running Current	4.25 amperes @ 50 Hz or 4 amperes @ 60 Hz (200-volt models) 8.5 amperes @ 50 Hz or 8 amperes @ 60 Hz (100-volt models)
Physical Dimensions	
Height	10.5 inches
Width	17.75 inches
Depth	32 inches
Weight	220 pounds
Ambient Limits	
Temperature	60°F to 100°F (16°C to 38°C) with maximum gradient of 20°F (11°C) per hour
Humidity	10 to 80 percent, relative, without condensation
Storage Limits	
Temperature	−40°F to 150°F (−40°C to 65°C)
Humidity	5 to 80 percent, relative, without condensation

METRIC CONVERSION TABLE

Table 1-2 is provided as an aid in converting drive dimensions given in this manual into metric units.

TABLE 1-2. METRIC CONVERSION TABLE

From	To	Multiply By
Inches	Centimeters	2.540
Inches	Millimeters	25.40
Feet	Meters	0.3048
Feet	Centimeters	30.48
Feet	Millimeters	304.8
Pounds	Kilograms	0.4536

SPECIAL TOOLS AND TEST EQUIPMENT

Special tools and test equipment required for performing Trident Disk Drive maintenance procedures given in this manual are listed in Table 1-3.

MAJOR COMPONENT LOCATIONS

Figure 1-2 shows the location of major components of the disk drive for the benefit of maintenance technicians unfamiliar with this unit. A brief description of each component shown in the figure follows.

- Control Panel — location of all switches and indicators normally used by the operator.
- Pack Area Lid — covers disk pack and seals pack area for positive air pressure. Lid is raised for unloading and loading of pack.
- Front and Rear Covers — dress covers that are removable for maintenance.
- Spindle — rotating assembly on which disk pack is mounted. The spindle is turned by the SPINDLE DRIVE MOTOR through a 1:1 belt drive system.
- Air Shroud — surrounds disk pack to contain and direct air flow to the pack from a BLOWER. Also mounts pack area lid.
- Head Carriage — mounts one servo head and five read/write data heads in precise alignment with the disk pack. Carriage can move the heads in and out under control of the head positioning LINEAR MOTOR.

TABLE 1-3. SPECIAL TOOLS AND TEST EQUIPMENT

Special Tools

Tool Kit 1, Part No. 13306-001 (Site Tool Kit) consisting of:

Name	Part No.	Common Name
Head Holding Fixture	96803-001	Head Camming Tool
Tool Head Positioning Initial	97769-001	Head Prepositioning Tool
Head Adjustment Tool	17209-001	Head Alignment Pliers
Head Mounting Torque Wrench	11521-001	Head Alignment Torque Wrench
Head Weight Set (3 required)	13378-001	Head Weights
Safety Pin	97722-001	————
Tach Rod Insertion Tool	13445-001	Tach Rod Tool
PWB Extender	12427-001	Card Extender
Head Support Assembly	20110-001	Head Support Tool

Tool Kit 2, Part No. 13307-001 (Regional Tool Kit) consisting of:

Name	Part No.	Common Name
Way Torque Driver	91516-001	————
Way Screw Wrench	99129-001	————
Carr & Way Alignment Tool	13483-001	————
Way Roll Adjustment Tool	13484-001	————

Model T2000B Exerciser (18327-001)

Model T2001A Head Alignment Meter (17335-001)

Dual Trace Oscilloscope (Tektronix Model 465, or better)

Digital Multimeter (accuracy of 0.5 percent, or better)

Miscellaneous

Trident Disk (Scratch) Pack (12540-801)

Trident (Head) Alignment Pack (12541-001)

Cable Terminator Assembly (19318-001)

- Logic Card Cage — contains disk drive control logic, read/write logic, and servo circuits mounted on six plug-in circuit boards. System I/O cables also plug into this assembly.
- Relay Assembly — Mounts relay and solid-state switches that perform power-up and power-down sequencing.

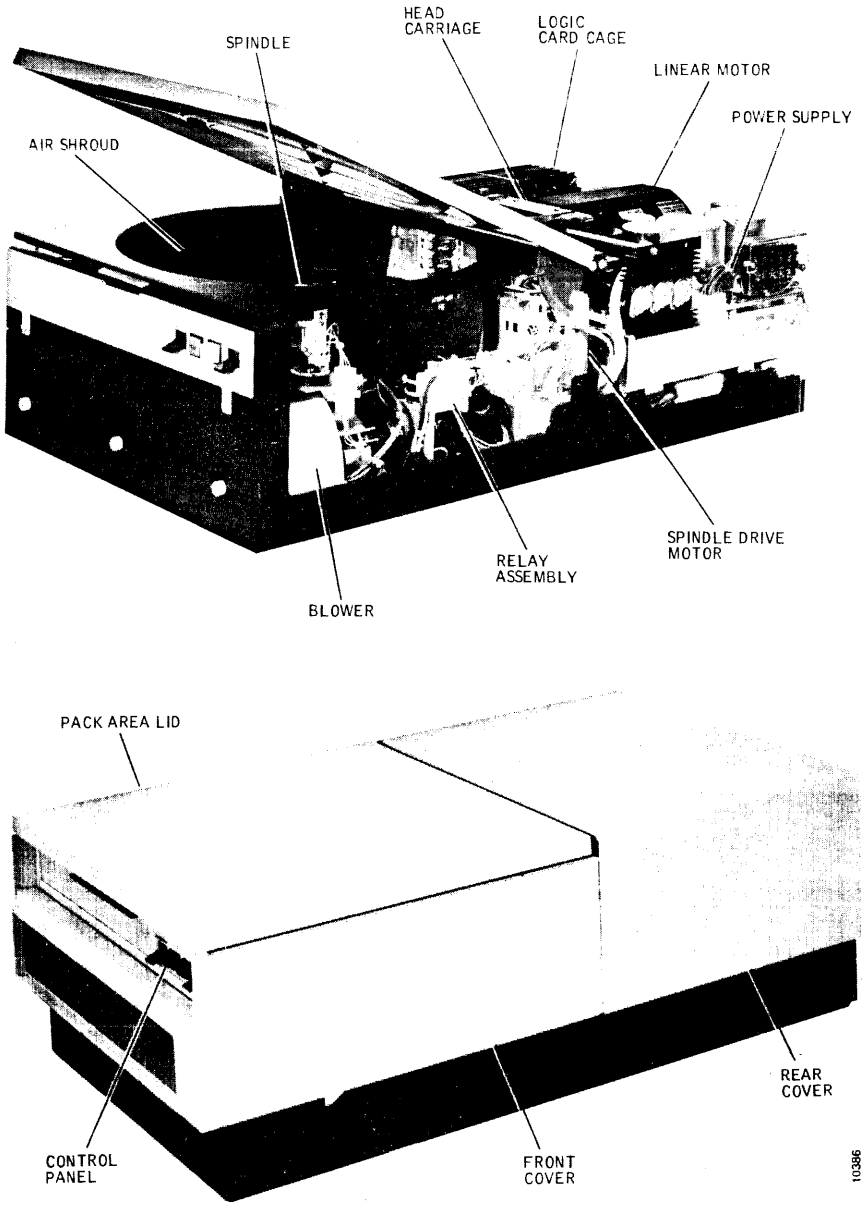


Figure 1-2. Location of Major Components

- Power Supply — Provides all necessary dc power to operate the disk drive. Also mounts the Emergency Retract relay.

CONTROLS AND INDICATORS

Trident Disk Drives are designed to be sequenced on and off by the system disk drive controller. However, operating controls are provided to power up and power down the disk drive manually for disk pack changes and for offline maintenance operation. Indicators are provided to show File Ready and Device Check status. Except for two maintenance switches, the controls and indicators are located on the operator control panel at the front of each disk drive.

Operator Control Panel

Figure 1-3 shows the four controls and indicators on the operator control panel. Their functions are described in Table 1-4.

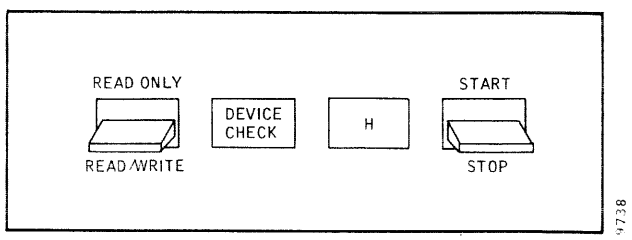


Figure 1-3. Operator Control Panel

TABLE 1-4. OPERATING CONTROLS AND INDICATORS

Name	Description and Function
READ ONLY – READ/WRITE Switch	Two-position toggle switch that provides disk pack file protection. READ ONLY position inhibits write commands from writing on the pack (an operational Device Check). READ/WRITE position enables both data read and data write operations to be performed.
DEVICE CHECK Indicator	Lights when a Device Check error has been detected by the unit and remains lit until the controller resets the Device Check error detector or until the unit is powered down.
File Ready Indicator	Flashes during power-up and power-down sequencing. The drive is in the Ready condition (powered up and heads loaded) when the indicator stays lit.
START/STOP Switch	Two-position toggle switch that permits manual power-up and power-down sequencing. START position turns on the spindle drive motor, and loads the heads. (Heads will not load if a disk pack is not installed or an unsafe condition exists.) The STOP position retracts the heads, turns off the spindle drive motor, and activates a dynamic brake to stop the disk pack.
Maintenance Switches (See Figure 1-4)	
PWR ON/OFF Switch **Note** *European models are equipped with a double-pole circuit breaker for power ON/OFF control. Also, the ac power cable is plug detachable on these models.*	Two-position toggle switch that controls ac power to the dc power supply of the disk drive. This switch should be set to OFF before any circuit board is removed or when disk drive assemblies or components are replaced. **CAUTION** *Ac power is still present at Ac Input Control Assembly when this switch is OFF and poses a shock hazard if the terminal board cover is removed. Heed all WARNING labels on the cover.*
INTERFACE/DEGATE Switch	Two-position toggle switch located on top edge of Logic I card. (Switch is accessible only when rear cover is off.) The INTERFACE position enables normal online operation, permitting the disk drive to be selected by the controller. The DEGATE position disconnects the disk drive from the controller and enables T2000B Exerciser inputs for offline maintenance operation of the drive.

Maintenance Switches

Figure 1-4 shows the locations of the two maintenance switches not normally used by operators. A functional description of each is contained in Table 1-4.

MAINTENANCE OPERATING PROCEDURES

Normal online operating procedures for operators are given in the Trident Disk Drive Installation and Operation Manual. Offline operating procedures, also included in that manual, are recapped below for the benefit of maintenance technicians.

1. To place the disk drive offline to the system for maintenance, first power down by setting the START/STOP switch to STOP. The heads should retract, the spindle should slow to a stop in 20 seconds, and the green File Ready indicator should flash on and off until the spindle and pack have stopped.

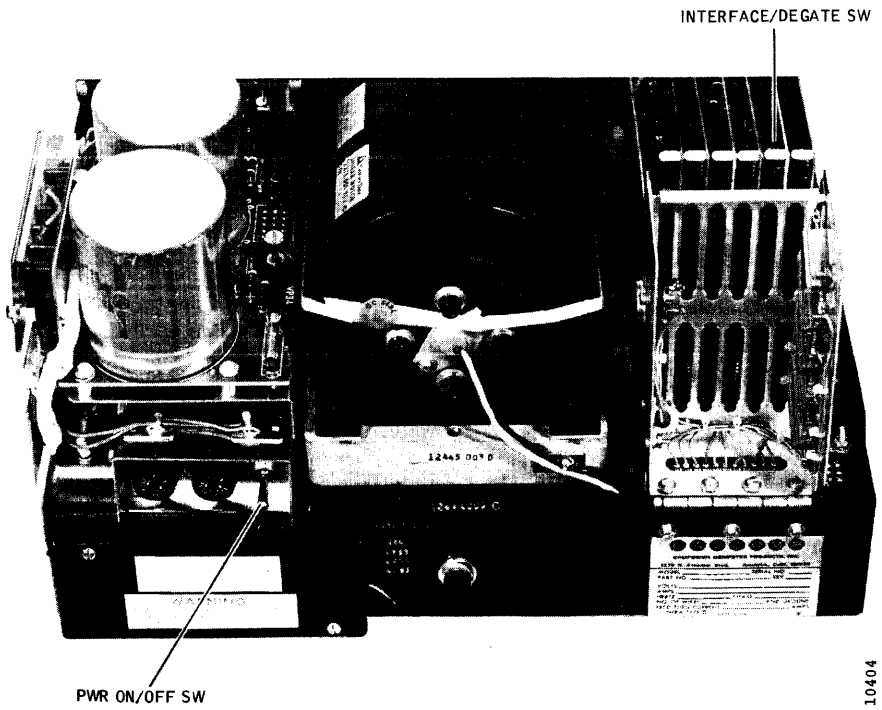


Figure 1-4. Location of Maintenance Switching

Note

Steps 2 and 3 can be performed while the disk drive is powered up. However, a pack change is usually necessary to protect the pack during maintenance, requiring power-down sequencing before or after the drive is taken offline.

2. If a T2000B Exerciser is to be used, remove the rear cover and connect the exerciser cable between the exerciser and card cage connector J01 on the disk drive. All exerciser toggle switches should be turned off (down) first.

3. Remove the rear cover from the disk drive, and set the INTERFACE/DEGATE switch to DEGATE. The disk drive is now offline to the system.

4. Power back up by setting the START/STOP switch to START. The spindle and pack should start turning and build to full speed in 20 seconds. The heads should load after speed is attained, and the flashing green File Ready indicator should light steadily after 20 seconds.

   The unit is now in the Drive Ready condition and offline. Disk drive checkout can now proceed by using the exerciser for control. Device check errors can be cleared through the exerciser or by power-down/power-up sequencing. To power down while offline, set the START/STOP switch to STOP.

CAUTION

Printed circuit boards and all other electrical components should be removed and replaced only when the PWR ON/OFF switch is OFF. Further, this switch should be turned ON or OFF only while the disk drive is offline to an operating system (DEGATE active). This prevents power transients from reaching the drive interface lines.

5. Make sure that the PWR ON/OFF switch is ON.

Note

Steps 6 and 7 need not be performed with the disk drive powered down. However, a pack change is usually normal after maintenance and before returning the disk drive to the system.

6. Set the INTERFACE/DEGATE switch to INTERFACE. The disk drive is now online to the system.

7. Disconnect the exerciser cable from the disk drive connector, if applicable.

8. Set the START/STOP switch to START. If the controller has selected the drive for sequencing, the disk drive will go through a normal power-up sequence.

FRONT AND REAR COVER REMOVAL

Access to interior assemblies of the disk drive for maintenance require the removal of the rear cover, the front cover, or both. When extensive checkout or repair is anticipated, it is easier to remove both covers before proceeding.

1. The front cover of the unit is removed by unscrewing the three thumbwheel nuts underneath the front-end bezel (Figure 1-5) and then pulling the cover straight forward until clear of the unit.

2. The rear cover of the unit is removed by unscrewing the two screws at the rear of the cover (Figure 1-6) and then pulling the cover rearward and lifting it up.

3. Front and rear cover replacement is just the reverse of the removal procedure. The covers should go back on without forcing them.

STANDALONE GROUNDING PRECAUTIONS

WARNING

A potentially hazardous voltage difference as high as 60 volts may develop between the unit ac ground (chassis frame) and the dc ground (base casting and card cage) when this unit is operated with system cabling disconnected. Read and observe the following precautions.

For normal system operation, the ac and dc grounds are isolated from one another at the disk drive, and the dc grounds of all drives are strapped together radially back at the controller. When operating a disk drive as a standalone unit, physically disconnect it from the operating system; make sure that the small green jumper lead on the dc power supply board is connected to the spade terminal marked AC/DC GND SHORT (See Figure 1-7). This shorts the ac and dc grounds together and prevents the buildup of the hazardous potential mentioned in the Warning above.

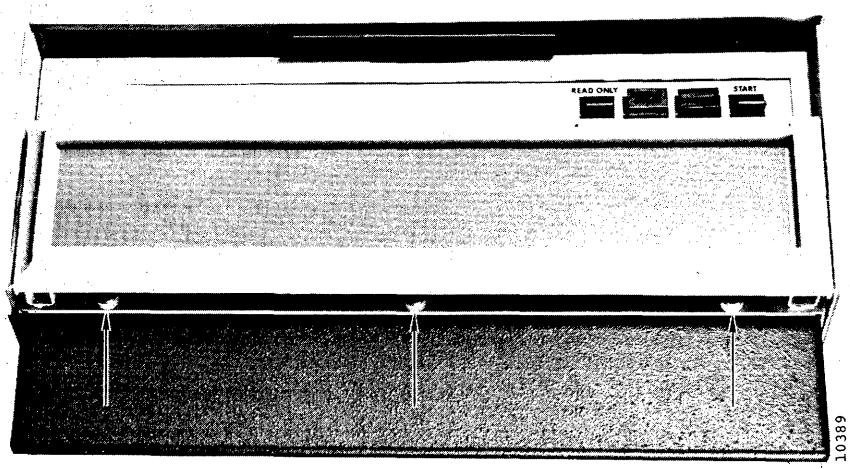


Figure 1-5. Front Cover Thumbwheel Nut Locations

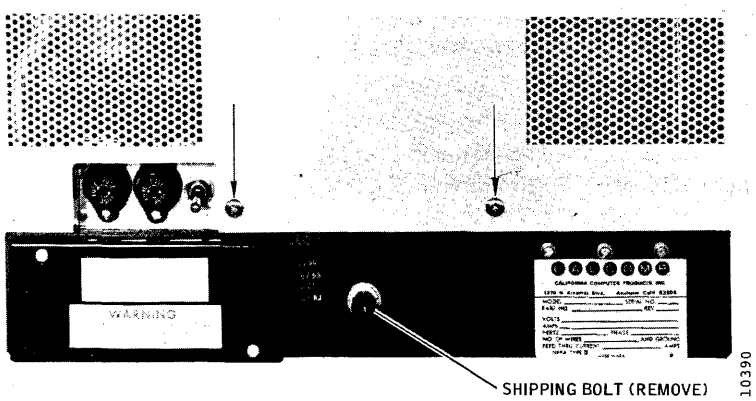
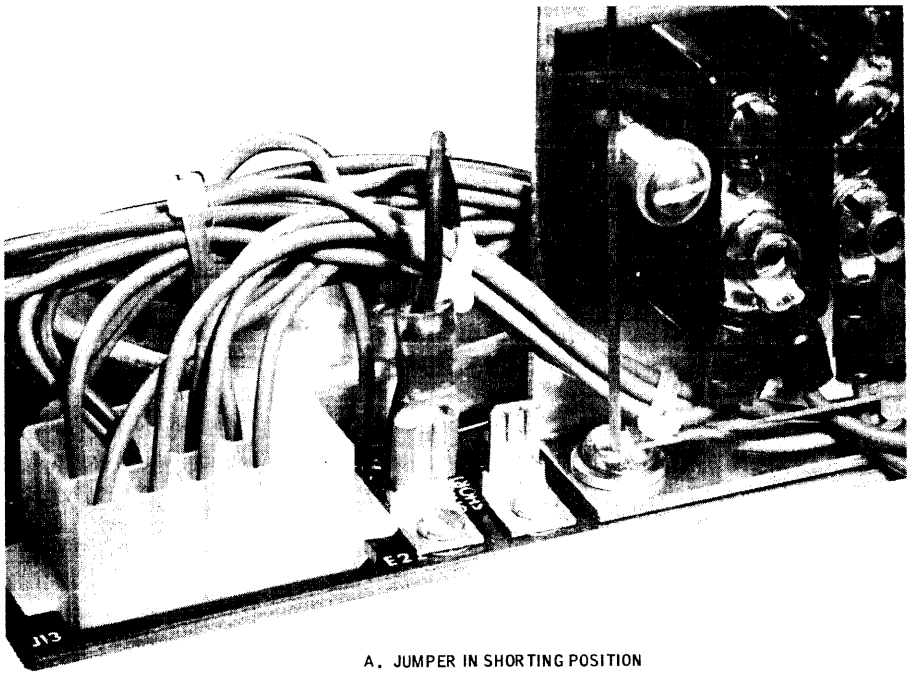
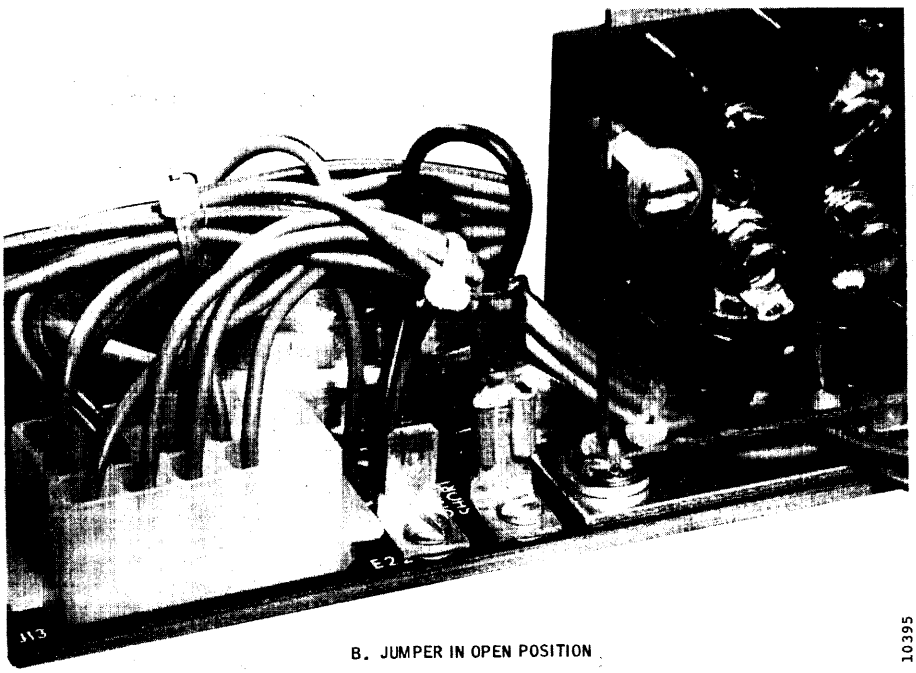


Figure 1-6. Rear Cover Screw Locations



A. JUMPER IN SHORTING POSITION



B. JUMPER IN OPEN POSITION

10395

Figure 1-7. Ground Shorting Jumper Location

When reinstalling a disk drive in the operating system after standalone operation, make sure that the dc power supply ground jumper on the drive is moved to the spade terminal marked OPEN (See Figure 1-7). Also make sure that the dc grounding strap is reconnected from the controller to dc ground terminal E11 on the drive card cage assembly.

Note

Many system noise problems occur because ac and dc ground isolation is not maintained or because of excessive resistance in the dc ground system.

If noise is experienced, make POWER OFF resistance measurements between the chassis frame (ac ground) and the base casting or card cage terminal E11 GND (dc ground). Resistance should be at least 1 megohm. If shorted, check the position of the power supply ground jumper wire first. Another possibility is that the shipping bolt that locks the base casting to the frame during shipment (Figure 1-6) is still in place. This should have been removed and discarded prior to initial installation.

SECTION 2
PREVENTIVE MAINTENANCE

The purpose of preventive maintenance is to reduce equipment downtime to the lowest possible figure. Every maintenance operation should be performed with this single objective in mind.

The most important part of any preventive maintenance program is periodic inspection. Many potential problems can be discovered visually and corrected before they become serious. Cleanliness is of particular importance in maintaining a disk drive.

Visual inspections should be made for the following conditions:

- Dirt – Because of the small air gap between a flying head and a disk surface, dust and dirt can be particularly destructive. The disk drive and disk pack filters prevent serious damage if they are changed regularly and if the disk drive is operated in a computer environment (or its equivalent).

- Wear – A certain amount of wear is inevitable where mechanical elements are involved. Metal particles and excessive clearances between adjacent moving mechanical parts are indicative of excessive wear.

- Corrosion – Corrosion may occur if the disk drive is subjected to temperature and humidity conditions that produce condensation. If corrosion takes place, it generally occurs at the junction of dissimilar metals.

- Defective wiring – Wiring insulation may become cracked or frayed, or the wires themselves may become kinked because of improper wire dress or carelessness during maintenance. Wiring attached to swingout doors or cables that run through access holes should be inspected closely.

- Loose electrical connections – Loose electrical connections can cause intermittent troubles, usually the most difficult type to remedy. Loose wirewrap connections are unusual; push-on and screw-lug type connections are more likely to be troublesome in this respect.

- Dirty, burned, or pitted contacts – Particular attention should be given to contacts that carry high currents. Dirty contacts can be cleaned with a business card dampened with alcohol; components that have burned or pitted contacts should be replaced.

- Loose mechanical connections – Because of disk drive vibration, mechanical and electrical parts should be inspected periodically to ensure that they are mounted securely.

CLEANING

Cleanliness is probably the single most important element in the maintenance program for the disk drive. With the exception of the read/write heads, cleaning operations are normally limited to the use of lint-free cloths dampened with a solution of 91 percent isopropyl alcohol. The air shroud interior and the mechanical assemblies are cleaned with this solution and then wiped dry with the lint-free cloth. The exterior panels of the drive and the disk access cover may be cleaned with a soft detergent, wiped with a damp cloth, and then wiped dry.

CAUTION

Do not use abrasive cleaners and chemical cleaning agents that contain acetone, toluene, xylene, or benzene. These cleaners may cause equipment damage that requires major repair.

PREVENTIVE MAINTENANCE ROUTINES

Preventive maintenance operations and schedules are listed in Tables 2-1 thru 2-3. The schedules are based on a normal computer room environment. In less-clean environments, more frequent attention should be given to the machine.

READ/WRITE HEAD CONFIGURATION

Each disk drive contains five read/write heads and one servo head configured as shown in Figure 2-1. These heads differ physically from one another depending upon whether they face up or face down and whether they are mounted on the right- or left-hand side of the head mounting block. Figure 2-2 shows the four types of heads used and their locations by head position.

Heads are partially identified by color coding of their connectors. Viewed from the rear of the drive, heads with green connectors are installed on the left, and heads with

TABLE 2-1. BIMONTHLY PREVENTIVE MAINTENANCE SCHEDULE

Component	Procedure	Remarks
External cabinet surfaces	Clean	Use soft cloth and commercial (soft) detergent.
Disk packs	Inspect	Inspect packs; return to factory for cleaning or repair if visible contamination is present or if read errors have been observed.
Read/write heads	Inspect	Refer to text for details.
Air Shroud	Clean	Refer to text for details.
Spindle surface	Inspect, clean, and lubricate	Refer to text for details.
Spindle drive belt	Inspect	Refer to text for details.
Intake air filter	Clean	Refer to text for details.

TABLE 2-2. SEMIANNUAL PREVENTIVE MAINTENANCE SCHEDULE

Component	Procedure	Remarks
Perform all Bimonthly Preventive Maintenance Procedures		
Internal cabinet surfaces	Clean	Use a soft brush or vacuum cleaner or both.
Spindle grounding brush	Check resistance	Refer to text for details.
Absolute air filter	Replace	Refer to text for details.
Positioning system	Check adjustment	Refer to procedures given in Section 3 or 4.
Read/write system	Check alignment	Refer to procedures given in Section 3 or 4.
Spindle drive system	Check operation	Refer to procedures given in Section 3.

TABLE 2-3. ANNUAL PREVENTIVE MAINTENANCE SCHEDULE

Component	Procedure	Remarks
Perform all Bimonthly Preventive Maintenance Procedures		
Perform all Semiannual Preventive Maintenance Procedures		
Absolute air filter	Replace	Refer to text for details.

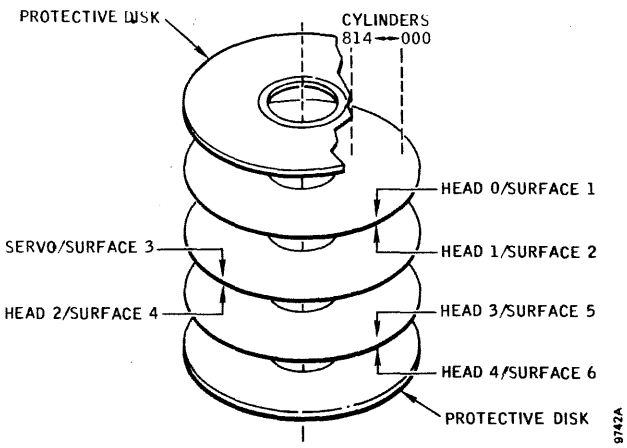


Figure 2-1. Head Configuration

red connectors are installed on the right of the head mounting block. Color coding of the connectors only simplifies identification; the heads cannot be interchanged from left to right because of physical mounting differences.

READ/WRITE HEAD PROBLEMS

The read/write heads *fly* on a small cushion of air about 30 millionths of an inch from the surface of the disk pack. An exception is during the head loading, while the air bearing that the head is to fly on is being established. As long as this minute separation between the disk surface and the head surface is maintained, the heads will operate properly and cause no damage to the disk or to themselves. However, if the heads contact the disk for any reason, damage to the disk or heads usually occurs.

During normal read/write operations the disk surfaces may become slightly scratched. This type of scratch looks similar to a polishing scratch and is insignificant as long as data can be properly recovered. However, there are types of head-to-disk interference that can cause significant damage to the disk surfaces and heads. Dirt, dust, oxide, or residue buildups on either the disk surfaces or heads are some of the most common types of head-to-disk interference.

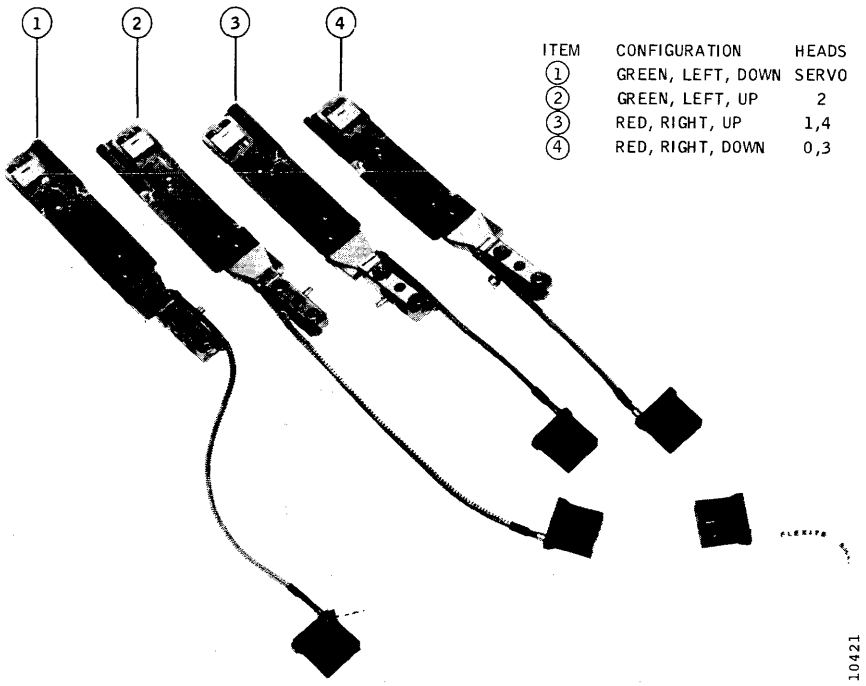


Figure 2-2. Read/Write Heads

Dirt or dust particle damage occurs when a foreign particle becomes wedged between the flying head and the spinning disk. The particle may become embedded in the surface of the disk or in the opoxy of the head and is likely to leave a deep groove at the point of entry. If the particle remains embedded in the surface of the disk, it will damage the head and render it useless. If the particle remains embedded in the head, it will damage the entire disk surface. If the particle is not detected during preventive maintenance procedures, the particle may eventually become dislodged and become wedged between another head and disk surface.

Residue may also build up on the disk surfaces or on the heads. Residue buildup is usually the result of contamination introduced into the disk pack or head area. The contamination is usually alcohol residue left after cleaning either the disk pack or the heads, fingerprints that contain oil and salt, or a contaminated environmental atmosphere such as smoke. The results of residue buildup, if not detected, are the same as particle and oxide buildup — a useless head or heads and a damaged disk pack.

An early indication of head-to-disk interference is an excessive number of intermittent read errors. Therefore, the importance of preventive maintenance cannot be overemphasized.

Figure 2-3 shows typical examples of contamination experienced with the heads and the corrective action to be taken.

ROUTINE HEAD MAINTENANCE

Only in-place inspection and cleaning of the servo and read/write heads are considered routine head maintenance and treated in this section. Head removal, bench type cleaning, installation, and alignment are corrective maintenance procedures and will be found in Section 3.

Inspecting Installed Heads

To inspect the read/write heads while they are in place for contamination, proceed as follows:

1. Make sure that the disk drive is powered down. Open the disk drive lid and remove the disk pack.

2. Remove the rear cover from the unit and remove the four screws that hold the transparent air shroud. Remove the shroud for access to the heads.

3. Move the carriage outward by hand no more than 3/8-inch to separate the heads for easier inspection. *Hold the carriage in this position.*

CAUTION

The head spring arms against the cam surfaces tend to pull the carriage further outward if not restrained and cause the heads to crash together. In step 4, do not touch the head surfaces with the inspecting tools.

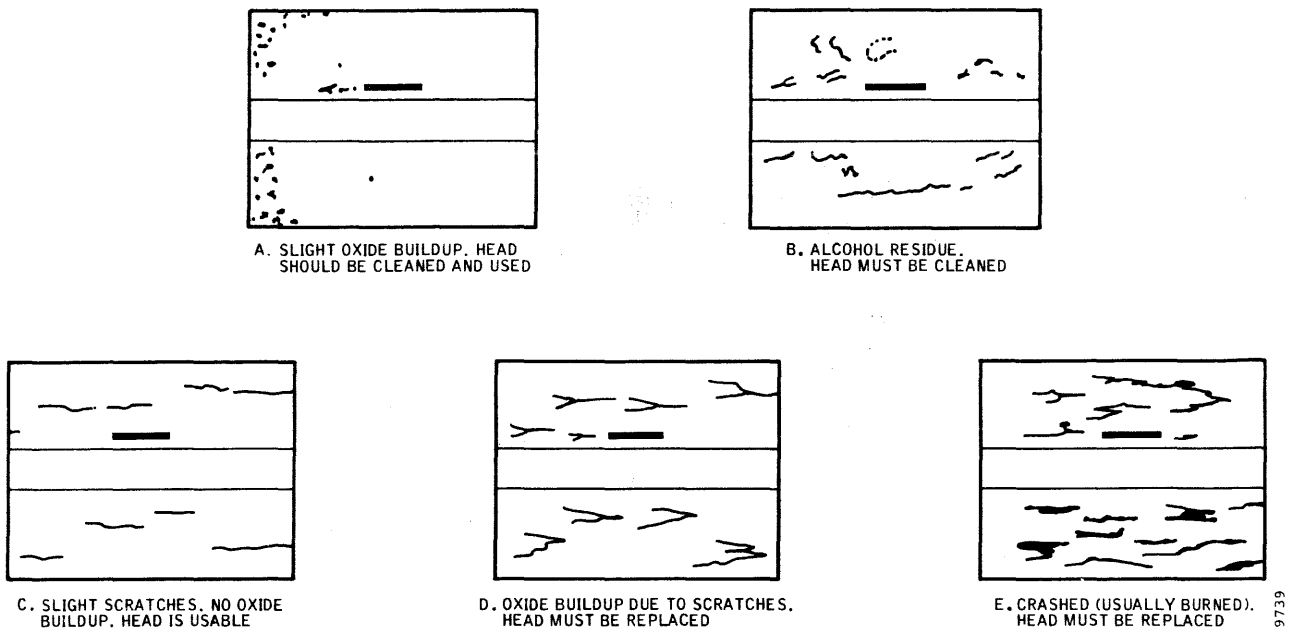


Figure 2-3. Examples of Head Contamination

4. Using a pen flashlight or other light source and a dental mirror, inspect each head for possible damage and contamination.

5. If a head has been damaged, it must be replaced. Refer to Section 3 for the head removal procedure. Dirty heads can usually be cleaned in place by following the head cleaning procedure given in this section.

6. After inspection is complete, return the heads to the fully retracted position and reinstall the transparent air shroud.

Head Cleaning Materials

The only solvents factory approved for cleaning head surfaces are uncontaminated isopropyl alcohol (at least 90 percent) and DuPont Freon TF. Under no circumstances should other solutions be used. This applies particularly to acetone, carbon tetrachloride, MEK, trichlorethylene, or even distilled water.

Head cleaning alcohol and Freon TF solutions should be stored in clean, tightly capped containers of some inert material (glass or polyethylene) to prevent evaporation and contamination of the solutions. Plastic squeeze bottles are handy containers for these solutions, provided the bottles have not been used for any other purpose. The containers should be clearly labeled.

Before each use of the solutions, test them for contamination by allowing a small amount of solution to evaporate on a clean glass. Discard the solution if any residue or dust particles are present on the glass.

Cleaning Installed Heads

CAUTION

Do not clean the heads unnecessarily. Clean only those heads that routine inspection shows to be dirty. Also, never blow on the heads. Moisture in your breath may cause the heads to pick up more contaminants than are dislodged.

1. Dampen a lint-free cloth with Freon TF and clean the contaminated head pad surface.

2. Dry the head pad with a lint-free cloth.

3. Reinspect the head pad to make sure that the head is clean and free of residue. Also check adjacent heads to be sure they have not been contaminated by the cleaning operation.

4. If oxide cannot be removed in this way, the head will have to be removed for more thorough cleaning or for replacement. Refer to Section 3 for these procedures.

HEAD CRASH RECOVERY

If a head crash is recognized and corrected immediately, propagation to the other heads can be prevented. Oxide can sometimes be removed from a head that has crashed simply by cleaning it in place. If all oxide is removed by the in-place cleaning procedure, the head can be put back into service. The crashed pack, however, must be taken out of service.

With another disk pack installed and up to speed, listen for unusual noises while the heads are flying. If noises are heard that suggest head/disk interference, power down immediately. The affected head or heads will have to be replaced. If no noises are heard, exercise the unit for at least an hour and then reexamine the heads to make sure they are not picking up more oxide.

DRY LOAD RECOVERY

A dry load occurs when the heads are extended without a pack on the spindle or when the pack is not turning. In either case, the heads usually slam together or slam into the pack with such force that they are damaged beyond repair and must be replaced, since they will not fly properly.

Note

Certain procedures in this book call for manually extending the heads without a pack. When this is done, folded strips of lint-free tissue (Kim-wipes) should be placed between the facing heads, and the heads should be moved slowly outward so that they contact one another as gently as possible.

CLEANING THE DISK PACK AREA

1. Open the pack area lid and remove the disk pack.
2. Wipe the inside of the air shroud (Figure 2-4) with a lint-free cloth dampened with alcohol. Wipe it dry and remove all residue.
3. Clean the underside of the pack area lid with the alcohol-dampened cloth. Wipe it dry and remove all residue.

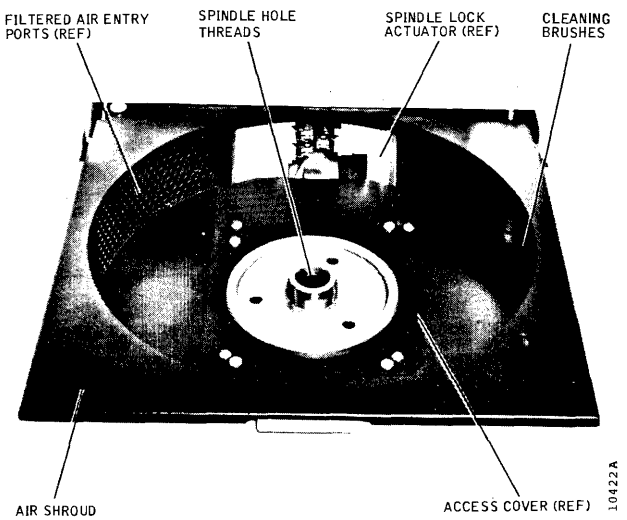


Figure 2-4. Disk Pack Area Components

4. Inspect the lid gasket for evidence of deterioration and wipe the gasket clean, if necessary.

PACK CLEANING BRUSHES

Early Trident drives were equipped with pack cleaning brushes. These were later found to be unnecessary. If your drive is still so equipped, it is recommended that the brushes be removed from the brush holder and discarded.

CLEANING AND LUBRICATING THE SPINDLE

CAUTION

Spray lubricants must not be used anywhere on or near the drive. Such lubricants can migrate into the disk pack area or onto the drive belt, causing serious contamination problems.

1. Open the pack area lid and remove the pack.
2. Inspect the spindle surface (Figure 2-4) for dirt or other contamination and for wear.

CAUTION

Do not saturate the spindle surface with alcohol. Alcohol runoff into the spindle bearing will cause damage.

3. Clean the spindle surface with alcohol and a lint-free cloth, and wipe the surface dry.
4. Use an alcohol-moistened Q-tip swab to remove contamination and grease from the threads of the spindle hole. Use a dry swab to soak up any remaining alcohol.
5. Apply a light coat of Sta-Lube Molybium Grease, Part No. 3141 to a Q-tip swab, and lubricate the threads of the spindle hole. *Do not allow lubricant to get on the surface of the spindle.*
6. Place a disk pack on the spindle to make sure that it can be installed and removed easily.
7. Operate the spindle lock by hand to verify that it engages and disengages freely.

SPINDLE GROUNDING BRUSH CHECK

1. Tilt the disk drive and support it so that the bottom access cover can be removed.
2. Remove the bottom access cover.

3. Check the resistance between the spindle contact arm (Figure 2-5) and the spindle. Resistance must be less than one-half ohm. If the resistance is too high, the brush must be serviced and readjusted. Refer to Section 3.

4. Proceed to the Spindle Drive Belt Check.

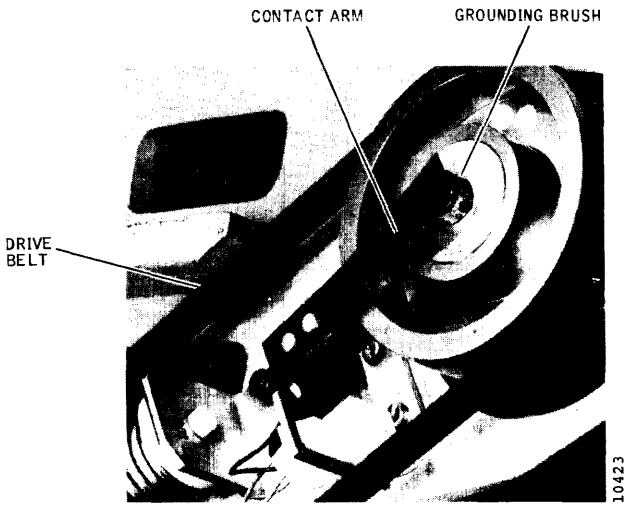


Figure 2-5. Spindle Drive Component Checks

SPINDLE DRIVE BELT CHECK

1. Inspect the spindle drive belt (Figure 2-5) for fraying or other damage. If damage or belt stretching is apparent, replace the drive belt.

2. Replace the bottom access cover, and lower the unit to its normal resting position.

CLEANING THE INTAKE AIR FILTER

The intake air filter is a foam filter element located behind the dress bezel of the front cover. It prefilters all air going to the blower and should be cleaned monthly, as follows:

1. Remove the front cover to gain access to the intake filter.

2. Pull out the foam filter element from its recess in the front of the unit; wipe the inside of the recess with a damp, lint-free cloth, and dry the recess well.

CAUTION

Do not operate the machine with the intake air filter removed, as this will cause the absolute air filter inside the unit to load up prematurely.

3. Wash the foam filter element in a weak solution of detergent in warm water, rinse the element throughly in cold water, and blow the element absolutely dry with air before reinstalling it.

4. Reinstall the clean, dry filter element (or a new filter element if deterioration had occurred) in the filter recess, and replace the front cover.

REPLACING THE ABSOLUTE AIR FILTER

The absolute air filter inside the disk drive should be replaced every 12 months of normal use or more often in extremely dirty environments. To replace this filter, proceed as follows:

1. Set the PWR ON/OFF switch to OFF, and remove the front and rear covers from the unit.

2. Open the pack area lid, remove the disk pack, and make sure that the heads are fully retracted.

3. Remove the air shroud assembly with its absolute air filter attached by following the Air Shroud Removal procedure in Section 3.

4. Remove the three screws (one upper and two lower) that attach the rectangular air filter end cap to the air shroud, and lift out the air filter element.

5. Install a new filter element; make sure that the air flow is correct (arrow on the filter element should point to the rear of the assembly), and reinstall the end cap with the three screws. Marking the filter with the date of replacement will be helpful.

6. Reinstall the air shroud assembly, intake air filter, rear cover, and front cover.

POWER SUPPLY CHECKOUT

Using a digital voltmeter, check the power supply voltages at power supply printed-circuit board connector J10 as indicated in Table 2-4. The PWR ON/OFF switch must be turned ON. See Figure 2-6 for test point locations.

TABLE 2-4. POWER SUPPLY VOLTAGE CHECK

Connector J10		
From Pin	**To Pin**	**Output**
02	01 (+)	+30 to +35v
02	03 (–)	–30 to –35v
09	04 (+)	+9 to +11v

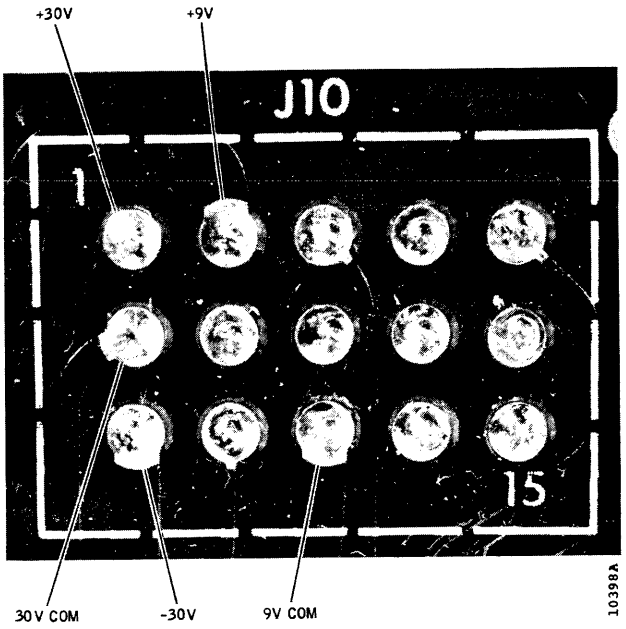


Figure 2-6. Dc Voltage Check Points

Alternatively, these voltages may be checked at the fuse block located on the frame base beneath the card cage assembly. Check voltages at these fuses with reference to dc ground (card cage terminal E11).

There are no power supply adjustments for these voltages. If any one is out of tolerance, the power supply should be repaired or replaced. See Section 3 for Power Supply Replacement procedure.

INDICATOR LAMP REPLACEMENT

To change an indicator lamp on the operator control panel, grasp the indicator tile and pull it straight out. The lamp can then be removed from the back side of the tile. After a new lamp has been installed in the tile, press the tile firmly back into the socket.

SECTION 3
CORRECTIVE MAINTENANCE

This section contains instructions for checking, adjusting, aligning, and replacing components in current production models of the Trident disk drives. Procedures for earlier production configurations differ from those given in this section in the following three areas:

- Head Alignment Checkout and Adjustment (due to updated specs and new alignment tools)
- Read/Write System Alignment (due to circuit redesign and more recent restrictions on making some on-site adjustments)
- Brush Drive Assembly Adjustment and Replacement (due to the elimination of this assembly in current models)

Instructions applicable to the earlier Trident machines, in the areas of difference noted above, will be found in Section 4, Superseded Procedures. In both Sections 3 and 4, except where specifically noted, the procedures are general and appropriate to all three (T25, T50, and T80) machine models.

Note

It is recommended that maintenance personnel read through an entire procedure before attempting to perform it to avoid confusion and thereby avoid errors.

READ/WRITE HEAD REMOVAL

To remove a read/write head or the servo head for thorough bench cleaning or replacement, proceed as follows:

1. Power down the disk drive and remove the disk pack.
2. Remove the rear cover, set the INTERFACE/DEGATE switch to DEGATE and the PWR ON/OFF switch to OFF.
3. Take out the four screws that secure the transparent air shroud covering the carriage assembly and cam tower, and pull the shroud straight up and off.
4. Remove the head cable plug retainer from the Read/Write Matrix board, disconnect the cable plug of the head being removed, and free the cable from any restraining clamps.

CAUTION

Do not overflex the head arm when installing the head camming tool during the next step, or permanent damage to the head will result.

5. Install the head camming tool on the head assembly to be replaced, as shown in Figure 3-1.

12706

Figure 3-1. Head Camming Tool Installation

6. Using an Allen wrench of the proper size, unscrew the mounting screw that attaches the head assembly to the carriage T-block, and carefully remove the head.

HEAD HANDLING, CLEANING, AND INSPECTION

Always handle head assemblies with care. The heads are very fragile. Never hold a head assembly by the head pad; don't even touch the gimbal spring that holds the head pad

in place. If the gimbal is touched near the welds, the pitch and roll attitudes of the head may be changed, causing the head to fly improperly. If a head assembly is dropped or mishandled, replace the assembly and mark the box.

Always lay the head assembly pad side up with the back side resting on a clean surface. If the head is laid pad side down or the pad is touched with your fingers, the head must be cleaned with Freon TF.

Recommended head cleaning materials and descriptions of the types of head contamination that are experienced can be found in Section 2. If a head has been flown and has brownish oxide streaks from the disk, the head must be cleaned before being reinstalled. A head cleaning brush can be used to scrub the head pad, although generally a cotton-tipped swab will be adequate. Saturate the brush or swab with alcohol solution, shake off the surplus, and lightly scrub the face of the pad with a circular motion.

After cleaning the head pad with alcohol solution, wipe the face of the pad dry with a lint-free, nontreated tissue. Silicon-treated tissue leaves an oily film and must never be used. Finish the cleaning process by polishing the head pad with a cotton swab moistened with Freon TF followed by using a dry swab. This removes any solid or moisture contaminants left by the alcohol solution.

If the oxide present on the head is black or has tinges of black, the head has rubbed the disk hard enough to generate heat and burn the oxide. High temperatures usually change the core characteristics of the head, making it unreliable. Burned heads should be replaced.

Visually, inspect all heads, whether new or just cleaned, prior to installation by reflecting light off the polished surface of the head pad. The pad must be scrupulously clean and free of all dust particles.

CAUTION

Do not blow dust off the heads with your breath. Use a lint-free tissue or soft camel hair brush to remove dust.

READ/WRITE HEAD INSTALLATION

To install a read/write head after bench cleaning and inspection (or to replace a head), proceed as follows:

CAUTION

Do not overflex the head arm when installing the head camming tool during the first step, or permanent damage to the head will result.

1. Install the head camming tool on the head assembly to be replaced, as shown in Figure 3-1.

2. Insert the head assembly with the camming tool installed in the correct position by setting the arm on the proper cam and then sliding the head to the rear so that both front and rear tangs on the head mount mate with the proper T-block slots on the carriage assembly. See Figure 3-2.

CAUTION

If the arm is allowed to slide forward toward the spindle during any of the following steps, the rear tang may disengage from the T-block slot. If this occurs, the head can rotate and slam into the opposing head, resulting in damage to both heads.

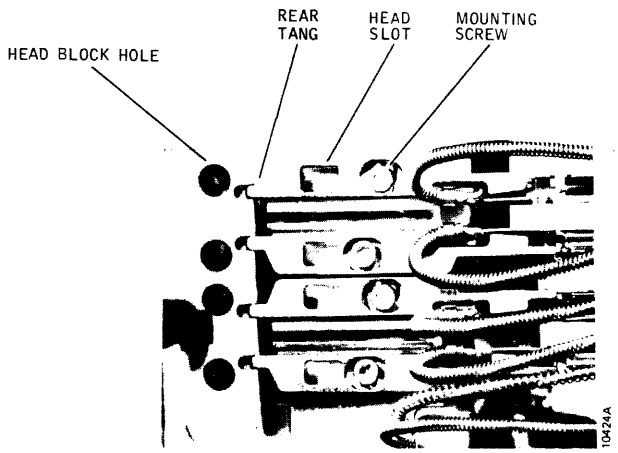


Figure 3-2. Head Positioning and Mounting Components

3. While holding the head firmly against the T-block, remove the head camming tool.

4. Install the two-prong prepositioning tool in the hole in the T-block and the slot in the head mount (See Figure 3-2), tighten the head mounting screw with the head torque wrench to 88 inch-ounces, and remove the tool.

5. Connect the head cable plug to the appropriate head receptacle on the Read/Write Matrix board, and secure it with the cable plug retainer after all heads have been installed. Dress left-side head cables back into their restraining clamps, and make sure screws are tight.

6. After all heads to be installed have been prepositioned according to steps 1 thru 5, perform the Head Alignment Checkout and Adjustment procedure given later in this section.

SERVO HEAD INSTALLATION

The servo head is installed with the head camming tool in a manner similar to the other read/write heads. However, the T-block has a positioning pin in the servo head location that makes the use of the prepositioning tool unnecessary. When installing the servo head, locate the head mount over the positioning pin, press the head rearward (into the T-block) against the pin, and tighten the securing screw with the head torque wrench to 88 inch-ounces.

When the servo head position has been disturbed by removal and replacement of the head, all other read/write heads must be realigned to the new servo head position by performing the Head Alignment Checkout and Adjustment procedure given below.

HEAD ALIGNMENT CHECKOUT AND ADJUSTMENT

Read/write head alignment must be checked and corrected to certain tolerances whenever any read/write head or the servo head has been moved (or if head misalignment is suspected as the source of read data errors). Always check and adjust the servo Track Offset Adjustment prior to checking head alignment, as later changes in this adjustment may throw marginal heads out of tolerance.

Note

Whenever possible, always use the same CE pack used to perform the last head alignment on the machine, in which case acceptable alignment tolerances are:

T25: ±150 microinches of cylinder 248 center

T50, T80: ±75 microinches of cylinder 496 center

If a different CE pack must be used, the acceptable alignment tolerances are:

T25: ±250 microinches of cylinder 248 center

T50, T80: ±125 microinches of cylinder 496 center

All heads found to be out of tolerance must be realigned to within ±50 microinches (T25) or ±25 microinches (T50, T80) of track center.

1. Connect the T2000B Exerciser to card cage connector J01 on the disk drive. Set all exerciser toggle switches off (down).

2. Make sure that the disk drive is offline to the system (DEGATE/INTERFACE switch set to DEGATE). This switch setting also enables exerciser inputs.

3. Connect the T2001A Head Alignment Meter to disk drive Read/Write Matrix card connector J4 (right-hand side of card on T25 and T50; bottom of card on T80). Set the meter scale switch to OFF.

4. Set the control panel READ-WRITE/READ ONLY switch to READ ONLY, and install the CE alignment pack on the disk drive.

5. Set the drive PWR ON/OFF switch to ON. Power up the disk drive by setting the START/STOP switch to START, and wait 20 seconds for the heads to load.

6. Enter the head alignment cylinder address with the exerciser as follows:
   - For Model T25 Disk Drives, enter cylinder 248 address by setting exerciser BUS/BIT switches to hex F8 (Bit switches 128, 64, 32, 16, and 8 up).
   - For Models T50 and T80 Disk Drives, enter cylinder address 496 by setting exerciser BUS/BIT switches to hex 1F0 (Bit switches 256, 128, 64, 32, and 16 up).

7. Perform a seek to the cylinder by setting the exerciser FUNCTION SELECT switch to SKALT and pressing the SINGLE switch down several times until the drive heads move to the alignment cylinder. Verify the seek cylinder address by setting the exerciser DISPLAY SELECT switch to CAR. Display indicators should light in a hex F8 (T25) or 1F0 (T50, T80) pattern, as applicable.

Note

Wait for at least 30 minutes before proceeding with step 8 to allow the rotating CE pack to become thermally stable. If the CE pack was brought into the computer room environment less than 2 hours before use, wait for 1 hour before proceeding.

8. Set the exerciser DISPLAY SELECT switch to SEQUENCE and the FUNCTION SELECT switch to READ. The three low-order bits of the SEQUENCE display show the head selected and should be out (Head 0 address). If any other head address is displayed, press the exerciser RSTHD switch down once to reset the head address count back to zero.

9. Set the meter scale switch on the head alignment meter to 1250 MICRO IN. and the DIBIT POLARITY switch to R2. Then activate the drive read gate by turning on the exerciser CONT switch.

10. Check the meter reading, and switch the meter scale switch to the most sensitive position possible without pinning the meter.

Note

For T25 drives, multiply all meter readings by 2. If the meter reading at switch position R2 is within the prescribed tolerance, set the DIBIT POLARITY switch to R1, take a second reading, and calculate the algebraic average of the two readings (R1 plus R2, divided by 2).

Record the meter reading or algebraic average of the R1 and R2 readings in plus or minus microinches for the head selected (Head 0 for the first record). Turn off the exerciser CONT switch.

11. Press the exerciser ADVHD switch once to step to the next head. The binary address of the active head shown by the SEQUENCE display should advance by one. (Pressing the RSTHD switch will reset the head address count back to zero.)

12. Repeat steps 9 thru 11 for each head until the off-center values of all five heads (0 thru 4) have been recorded. Any head that is outside the tolerances stated at the beginning of this procedure must be realigned to within ±50 microinches (T25) or ±25 microinches (T50, T80), as prescribed.

13. Begin realignment of out-of-tolerance heads by setting up a scope to observe the head alignment dibit signal. The drive card cage assembly will have to be raised for access to test points located on the Read/Write Matrix card.

SYNC:	Int	Pos	0.5 μsec/div	CHAN 1 only
CHAN:	1	AC	100 mv/div	TP10 (Matrix card, T25 and T50) TP6 (Matrix card, T80)
CHAN:	2	AC	100 mv/div	TP11 (Matrix card, T25 and T50) TP7 (Matrix card, T80)

MODE: ADD; INVERT CHAN 2

14. Remove the transparent air shroud covering the carriage and heads, and insert the safety pin down through the hole in the top plate of the cam tower and into the carriage T-block assembly. See Figure 3-3.

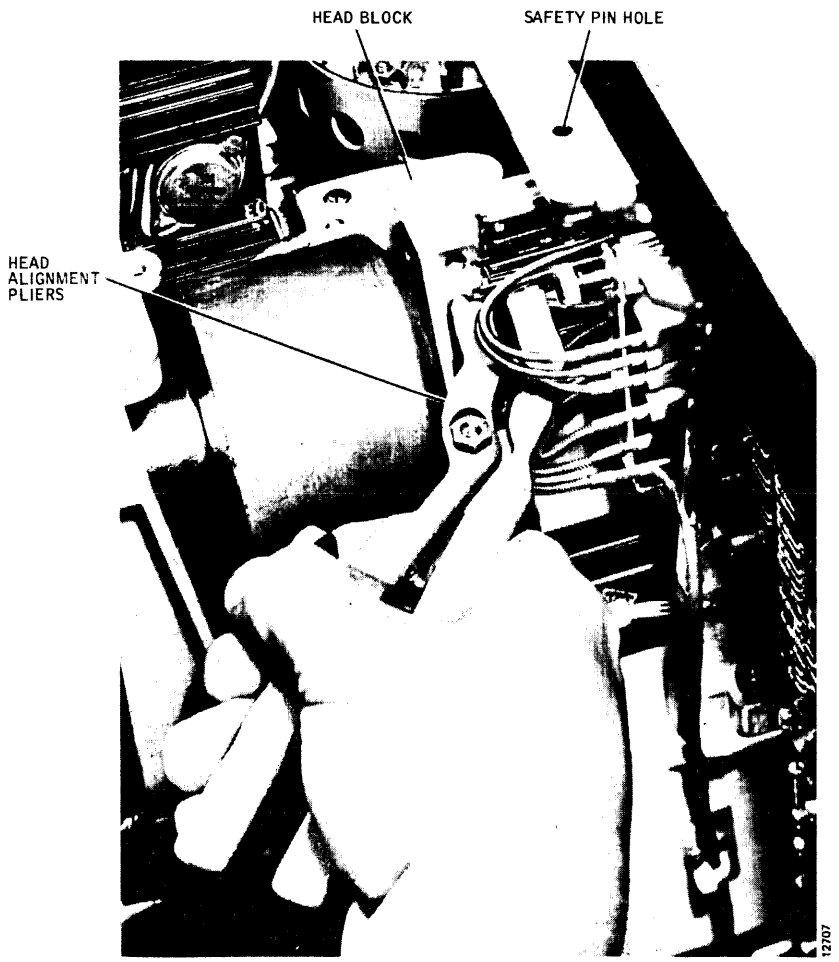


Figure 3-3. Head Alignment Pliers in Use

CAUTION

Never place your hands or tools in the head carriage area without having the safety pin in place. If the carriage attempts to retract, remove all tools and the safety pin as quickly as possible to prevent a head crash. Also, never power down the disk drive or leave the drive unattended while the safety pin is installed.

15. Torque the mounting screw for the head to be aligned to 88 inch-ounces (i.e., click felt in the torque wrench handle); and then using an allen wrench, back off the mounting screw one-eighth turn.

16. Set the scale switch on the meter box to OFF, address the head being aligned using the RSTHD and ADVHD switches on the exerciser; and turn on the exerciser CONT switch. A display resembling the aligned dibit signal shown in Figure 3-4 may or may not be seen on the scope.

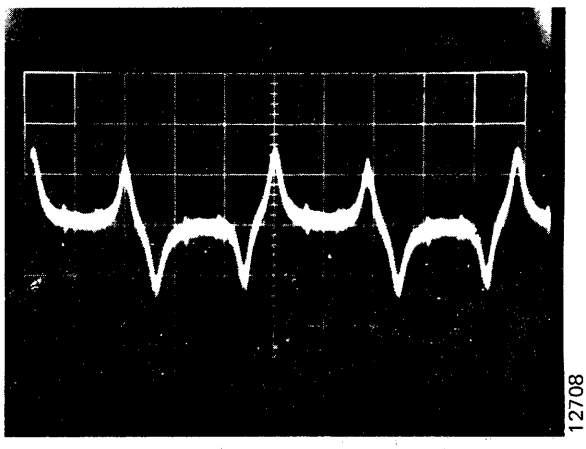


Figure 3-4. Head Alignment Dibit Waveforms

17. Run the thumbscrew on the head alignment pliers out several turns, and carefully insert the round and rectangular pins of the pliers into the T-block hole and head slot of the head to be adjusted. See Figure 3-3. Then run the thumbscrew in until it just contacts the other plier handle to act as a calibration stop.

Note

A separate setscrew on the head alignment pliers acts as a maximum limit stop to prevent the pliers from disengaging the head rear tang from its T-block slot. This setscrew is factory set and locked in place and should not be changed in the field.

18. While observing the scope, use the head alignment pliers to adjust the head position in or out for a balanced dibit signal, as shown in Figure 3-4. Head movement is controlled by adjusting the thumbscrew and the amount of pressure on the plier handles.

19. Set the head alignment meter scale switch to 100 MICRO IN., and adjust the head again with the pliers until the meter shows it to be within the realignment tolerances prescribed. This should be determined by taking the arithmetic average of readings at both the R1 and R2 positions of the DIBIT POLARITY switch. Tighten the head mounting screw to full torque with the head torque wrench, taking care not to move the head, and recheck the meter readings afterwards.

20. Repeat steps 17, 18, and 19 to realign each head requiring adjustment until all are within the prescribed realignment tolerances.

21. After all head adjustments have been made, remove the safety pin, turn off the exerciser CONT switch, and replace the transparent air shroud.

CAUTION

Never perform seek exercises with the drive without the transparent air shroud in place, during this or any other procedure. Overheating and failure of the linear motor may result.

22. Set the exerciser FUNCTION SELECT switch to SKRDM, and start random-seek exercising by turning on the CONT switch. Set the POSITION RATE control midrange for a moderate seek rate.

23. After a minimum of 2 minutes of random seek exercising (2000 seek operations, minimum), turn off the CONT switch, and press the REZERO switch on the exerciser.

24. Set the exerciser FUNCTION SELECT switch to READ, and then turn on the CONT switch. A dibit signal should appear on the scope.

Note

The air shroud must be in place for the final determination of head alignment.

25. Address each head, in turn, using the exerciser ADVHD and RSTHD switches, and verify with the head alignment meter that all heads that were realigned have not moved outside of acceptable tolerances of ±150 microinches (T25) or ±75 microinches (T50, T80) from track center. If not, loosen and realign all out-of-tolerance heads by repeating this procedure, starting at step 17. Be sure to install the safety pin.

POWER SUPPLY

The power supply assembly provides all dc voltages used by the logic card cage, sequence relay assembly, and linear motor servo amplifier as well as the drive current to the linear motor. If power supply voltage checks given in Section 2 indicate that outputs are out of tolerance, the power must be removed for replacement or repair, as no adjustments are provided. To remove the power supply, proceed as follows:

1. Disconnect the disk drive ac power cable from the power source, and remove both front and rear covers.

2. Locate the two grey wires coming from the Ac Input Control Assembly to terminals 1 and 2 at the bottom of power supply terminal board TB2. Tag and disconnect these two wires from the terminal board. Trace the wires back toward the Ac Input Control Assembly, clipping only those plastic tie wraps necessary to free the two wires from the power supply assembly. This will require unlatching and swinging the assembly to its open position.

3. Disconnect plug P21 from the Sequence Relay Assembly, and tracing the P21 cable back toward the power supply, clip the tie wraps, as necessary, to free it for removal with the power supply.

4. With the power supply swung open, disconnect plugs P10 and P13 from the bottom side of the chassis. Trace back along the P10 cable, and clip those tie wraps attaching it to the power supply until it is free of that assembly.

5. Remove the transparent air shroud that covers the head carriage assembly, and disconnect the two thin grey leads connected to the bobbin conductor band terminals of the linear motor. Spade-type connectors are used here that can be disconnected without removing the shrink tubing that insulates them. Trace the two disconnected wires back to make sure they are free to be removed with the power supply assembly.

6. Locate the ground stud underneath the power supply chassis near the front hinge, and disconnect the top wire of the two green grounding wires. The bottom wire can be left in place.

7. After checking that all power supply cables and wires are free of the disk drive, slide the power supply off its two hinge pins and remove it.

8. To reinstall the power supply assembly, reverse this procedure. Dress all cable and wire leads as close to their original positions as possible (See Figure 3-5), and replace all plastic tie wraps clipped during removal. Also make sure that the connection from the chassis ground to logic ground is reinstalled properly and that the voltages select jumper on top of terminal board TB2 matches the assembly removed and the available voltage.

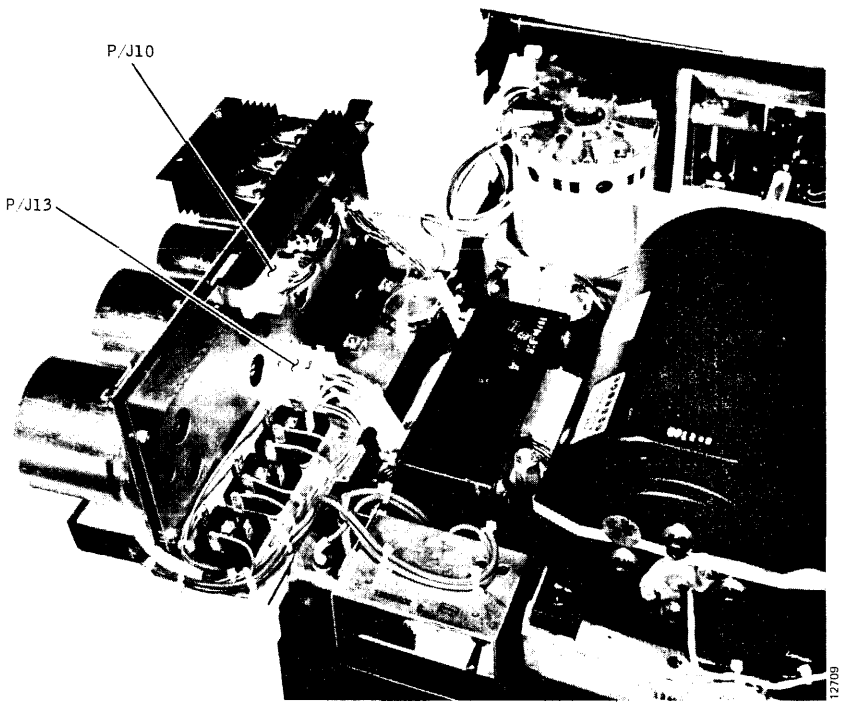


Figure 3-5. Power Supply Cable Dressing

LOGIC CARD CAGE ASSEMBLY

The logic card cage assembly, located next to the linear motor, is hinged to the disk drive frame so that it can be raised for access to card connector test points and components mounted on the chassis below. The card cage houses all the electronics on six plug-in circuit cards with the exception of circuits on the Power Supply Assembly, the Read/Write Matrix card, and the Servo Preamp card.

Plug-In Card Locations

Figure 3-6 shows the correct locations for the plug-in circuit cards, as viewed from the top of the card cage. These circuit cards are not keyed to their connectors, and it is possible to install them improperly. Card locations are identified by slot numbers 1 thru 6. Check your documentation package or the latest Field Parts Catalog for proper card usage by part number. Cards are not the same in all models.

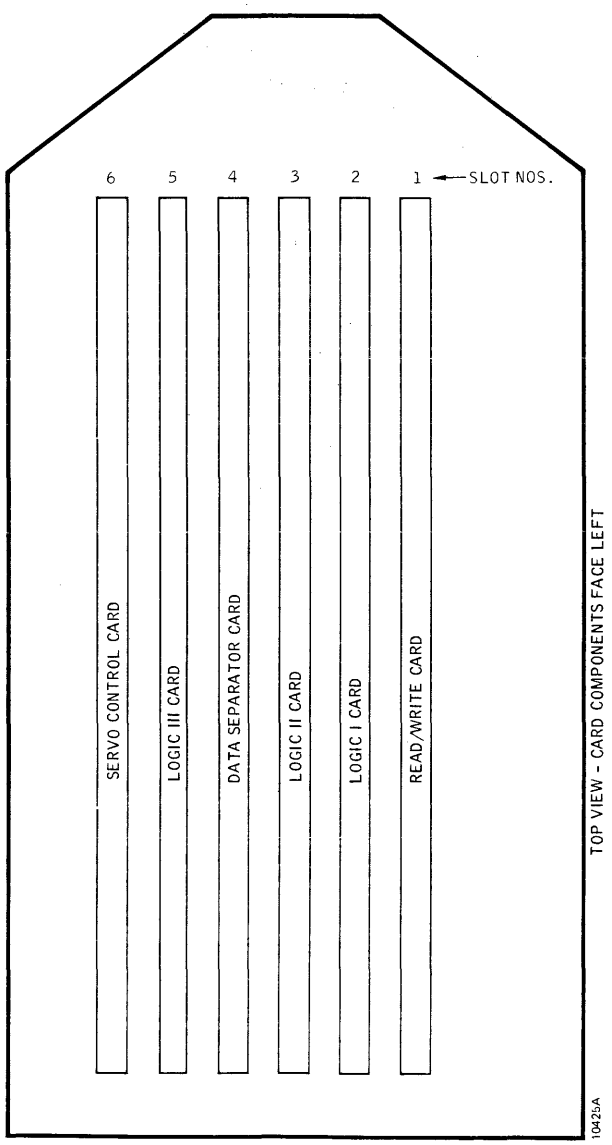


Figure 3-6. Plug-In Card Locations

Access to Logic Test Points

To gain access to card connector test points (see Figure 3-7), unlatch the card cage by turning the knurled knob located between the air-directing wings of the card cage one-quarter turn counterclockwise, and raise the card cage assembly on its hinges so that it rests against its restraining cable in the open position. The disk drive may be operated in this open position for test purposes. However, if extended, vigorous seek exercising is to be performed, the card cage assembly should be closed to restore forced-air cooling for the circuit cards. The Servo Control card is particularly prone to overheating in the open position.

Test points are identified by card slot, card connector (there are two per slot), and pin number. For example, test point 6B35 is pin 35 of connector B for card slot 6. Card slot, connectors, and connector pin numbers are fully identified by silkscreen callouts on the bottom of the connector board assembly.

Some test points are located on the circuit cards themselves, in which case the card must be removed, placed on a card extender, and reinstalled. All test point signals are referenced to dc ground, available at GND terminal E11 on the card cage assembly connector board.

Card Removal and Replacement

CAUTION

The power supply must be turned off before a circuit card is removed or replaced. Also, some cards can be damaged if they are incorrectly installed in the wrong slot.

Always remove or replace plug-in circuit cards with the card cage assembly closed and latched — never in the open position. Circuit cards can be removed by hand. Grasp the card at each top corner with both hands and pull straight up with a slight rocking motion. When reinstalling a circuit card, make sure that it is placed in the correct slot with the component side facing the power supply. Guide the card down evenly until it meets the two connectors, then press it home with thumb pressure at both top corners.

Card Cage Removal and Replacement

1. Set the drive PWR ON/OFF switch to OFF, and disconnect the ac power cable.
2. Remove the rear cover.
3. Remove all circuit cards from the card cage, keeping them in order for proper reinstallation.

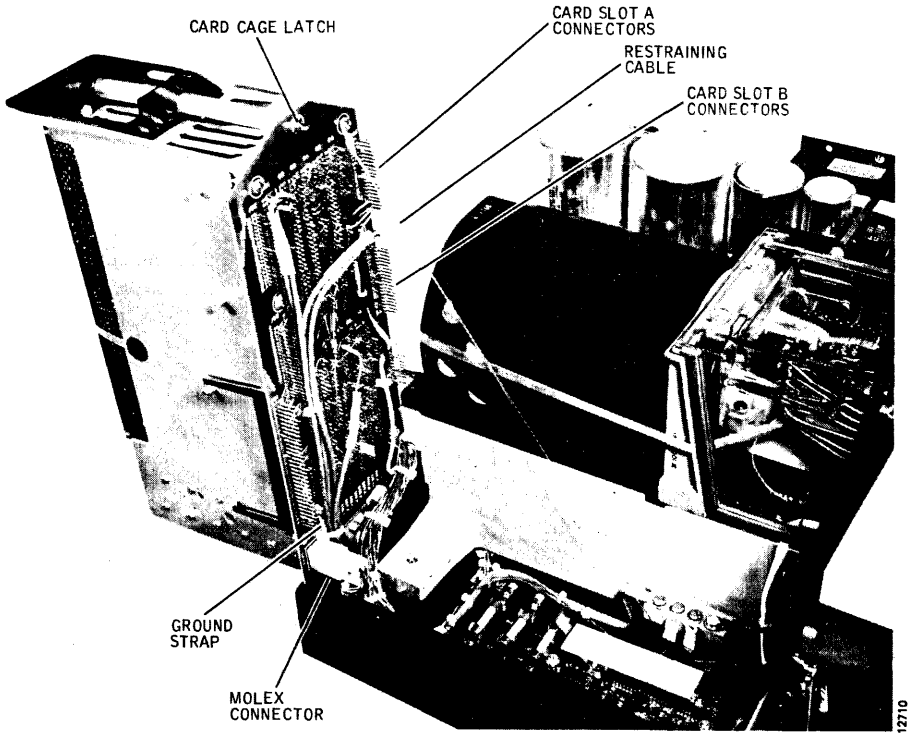


Figure 3-7. Card Cage in Raised Position

4. If present, disconnect all interfacing cables and terminator from card cage connectors J02 thru J04. Also disconnect the ground strap from GND lug E11.

5. Unlatch the card cage assembly, and swing it up to its open position. Disconnect P5 thru P7 on the side of the card cage facing the linear motor, and clip the plastic tie wraps holding the P5 thru P7 cables to the assembly.

6. See Figure 3-7. Notice several multi-wire cables and separate wires are connected directly to circuit card connector pins using pushon-type connectors. Disconnect and tag each of these wires with the connector pin number from which they were removed. Clip all tie wraps and loosen any cable clamps that hold the disconnected cables and wiring to the card cage assembly.

7. Disconnect the Molex connector P8, located at the bottom of open card cage. Also disconnect the ground strap adjacent to this connector.

8. Disconnect the restraining cable from the top end of the card cage assembly, and swing the assembly to its closed position.

9. Remove the four screws attaching the card cage assembly to its bottom hinge, and lift the assembly free and clear.

Note

When reinstalling the card cage, maintain the logic ground/chassis ground isolation. Be sure to install insulating washers on the four attaching screws. After installation, perform an ohmmeter check to verify that the card cage is not shorted to the chassis.

10. To install the repaired assembly or a replacement, reverse this procedure. When tightening the four hinge screws that mount the card cage assembly, it is helpful to have the assembly closed and latched. This will ensure proper latch alignment. Refer to Figure 3-7 when reconnecting the back plane cables for proper cable dress, and replace all securing tie wraps and cable clamps.

SERVOSYSTEM ALIGNMENT (ALL MODELS)

All adjustment points for servo system alignment are located on the Servo Control card located in card slot 6. Some adjustment points are internal to the card, requiring the card to be extended to perform complete alignment. If the entire servosystem is to be aligned, perform the procedures inthe order given. See Figure 3-8 for adjustment point locations.

PLO Frequency Adjustment

1. Turn off ac power, open the card cage assembly, and ground pin 3B09. Close the assembly, place the

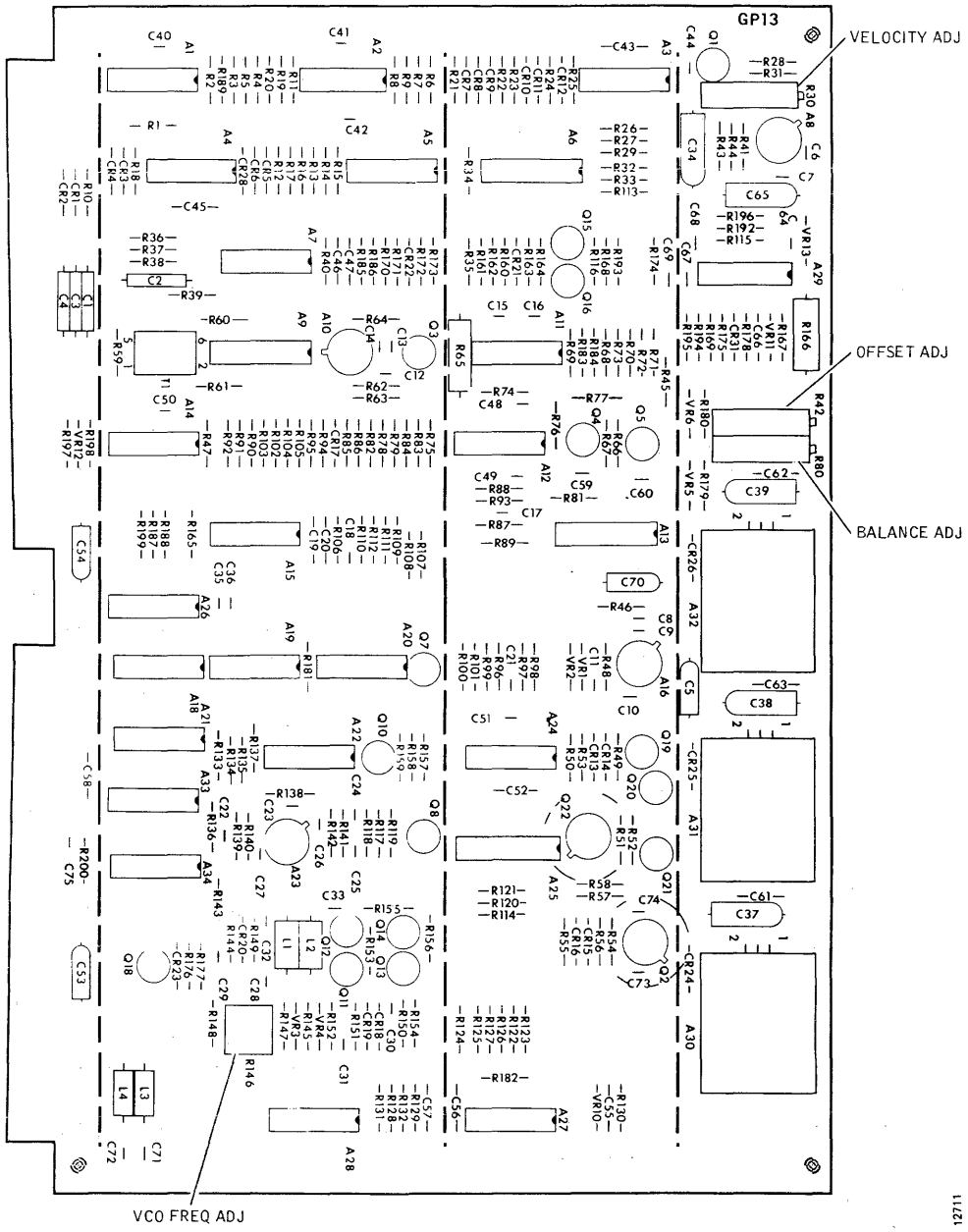


Figure 3-8. Servo Control Card Adjustment Point Locations

Servo Control card in slot 6 on an extender, and turn ac power back on.

2. Install a scratch pack, and set the START/STOP switch to START. The disk drive should power up normally, but the heads should not load.

3. Open the card cage assembly, and connect and adjust a scope to observe the 806 kHz output on pin 6B12.

   SYNC: Int Pos 1 μsec/div CHAN 1 only

   CHAN: 1 Dc 1 v/div 6B12 (806 kHz)

   MODE: CH1

4. With the heads unloaded, adjust Servo Control card potentiometer R146 for a full cycle time of approximately 1.24 microseconds.

CAUTION

When manually loading or unloading the heads, do so in a positive and deliberate manner, without hesitation. If the heads are moved into the pack too slowly, they could crash.

5. Manually load the heads and move them back and forth between the head load zone and the outer guard band of the pack. Notice that this type of back

and forth movement causes a phase shift in the scope display as the oscillator alternates between its locked and free-run states. Readjust R146 to eliminate this phase shift when the heads are moved back and forth between the head load zone and outer guard band.

6. Manually retract the heads, and set the START/STOP switch to STOP. Turn off ac power, disconnect the ground and test leads, and return the Servo Control card to its slot.

7. Remove the jumper from 3B09 to ground.

Seek Velocity Adjustment

1. Turn on ac power, connect the T2000B Exerciser to card cage connector J01, and set the INTERFACE/DEGATE switch to DEGATE. The DEGATE position of the switch enables exerciser inputs.

2. Install a scratch pack, set the START/STOP switch to START, and wait for drive ready. The heads should load.

3. Open the card cage, and connect and adjust a scope to observe the Ready signal at pin 3A48.

   SYNC: Int Neg 10 ms/div CHAN 1 only
   CHAN: 1 Dc 2 v/div 3A48 (READY)
   MODE: CH1

4. Turn off all exerciser BUS/BIT switches and press LDNAR.

5. Set the exerciser FUNCTION SELECT switch to SKALT, the POSITION RATE control to midrange, and the BUS/BIT switches as follows:
   - For Model T25 Disk Drives, set the BUS/BIT switches to a 407 address (hex 197).
   - For Model T50 and T80 Disk Drives, set the BUS/BIT switches to an 814 address (hex 32E)

6. Turn on the exerciser CONT switch. The disk drive should begin full-stroke, alternate-seek operations. Reduce the POSITION RATE control to a point where the waveforms produced by forward and reverse seeks are easily distinguished from one another.

7. Adjust the velocity potentiometer R30 on the edge of the Servo Control card for a maximum negative-level duration of 51 ±1 milliseconds on the scope display for forward or reverse seeks, whichever is longer. The shorter seek time, however, should be within 3 milliseconds of the longer.

8. Turn off the exerciser CONT switch, and press REZERO. If performing a complete alignment, proceed to the Track Offset Adjustment, step 2. Otherwise, set the START/STOP switch to STOP, and set the INTERFACE/DEGATE switch to INTERFACE.

Track Offset Adjustment

1. Install a scratch pack, set the START/STOP switch to START, and wait for drive ready.

2. Open the card cage assembly, and connect and adjust a scope to observe the dc level of the Position signal at pin 6B01.

   CHAN: 1 Dc 10 mv/div 6B01 (POSITION)

   Note

   This adjustment will affect head positioning. Any change in this adjustment may move marginally aligned heads out of tolerance. Therefore, adjust only if necessary; and if an adjustment is made, recheck read/write head alignment.

3. The scope signal mean level should be within 10 millivolts of dc ground. If it is, proceed to step 4. If not, adjust offset potentiometer R42 on the edge of the Servo Control card to center the mean level at dc ground.

4. If performing a complete alignment, proceed to Position Balance Adjustment, step 3. Otherwise, set the START/STOP switch to STOP.

Position Balance Adjustment (T50 and T80 only)

Note

The following adjustment is not applicable and should be ignored for Trident T25 drives.

1. Set the INTERFACE/DEGATE switch to DEGATE, and connect the T2000B Exerciser to card cage connector J01.

2. Install a scratch pack, set the START/STOP switch to START, and wait for drive ready.

3. Open the card cage, and connect and adjust a scope to observe the Position signal on pin 6B01; sync on SRVOFWD/ at pin 6A13.

   SYNC: Ext Neg 0.5 ms/div 6A13 (SRVOFWD/)
   CHAN: 1 Dc 1.0v/div 6B01 (POSITION)
   MODE: CH1

4. Set all exerciser BUS/BIT switches off, and press LDNAR.

5. Set the exerciser FUNCTION SELECT switch to SKALT, the POSITION RATE control to midrange, and BUS/BIT switches to a 003 address (BIT switches 1 and 2 on).

6. Turn on the exerciser CONT switch. The disk drive should begin three-cylinder, alternate-seek operation; and a scope display similar to Figure 3-9 should be observed. Readjust the exerciser POSITION RATE control to slow down the drive seek rate to a point where display jitter is emphasized but not so slow that the flicker rate is objectionable.

7. Ground the scope Channel 1 input, zero the dc level, and switch back to DC. Notice that the plateau just preceding the swings in the trace may be slightly above or below the 0 volt level. Adjust balance potentiometer R80 on the edge of the Servo Control card to bring this plateau to 0 volt. See Figure 3-9.

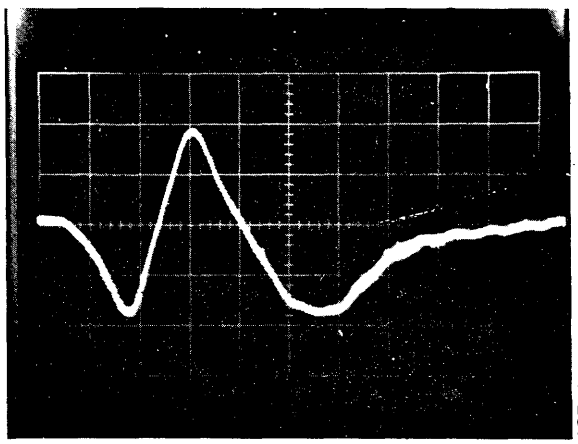


Figure 3-9. Balance Adjust Waveform

8. Turn off the exerciser CONT switch and press REZERO.

9. This completes servosystem alignment. Set the START/STOP switch to STOP, set the INTERFACE/DEGATE switch to INTERFACE, and disconnect the exerciser.

READ/WRITE SYSTEM ALIGNMENT (T25 AND T50)

This procedure is applicable only to the GR13 type Data Separator card used in most Model T25 and T50 Disk Drives. All adjustment points are located on this card, which occupies slot 4 in the card cage. Some of the adjustments are interactive, making it necessary to perform all steps in the alignment procedure. These should be done in the order given. See Figure 3-10 for adjustment point locations.

CAUTION

Do not change Data Separator card adjustments indiscriminately. Most adjustments are critical, interactive, and are set at the factory under dynamic conditions by "bucket" testing to optimize error-free operation. Consequently, some cards may run optimally and yet not meet all of the static test specifications given in this procedure. Indiscriminate readjustment of such cards could cause them to perform marginally. Also, never change the adjustment of the potentiometer on the Read/Write Matrix card that controls write current. It is not field adjustable.

1. With power off, remove the Data Separator from card slot 4, and reinstall it on a card extender.

2. Turn on power, install a scratch pack, and set the START/STOP switch to START. Allow at least 15 minutes warmup before proceeding with alignment.

3. Measure the voltage at the emitter of transistor Q9 on the extended card, preferably with a digital voltmeter. It should be between +3.50 and +4.50 volts. Make a note of the exact reading.

4. Measure the voltage at the base of transistor Q9, and adjust clamp potentiometer R60 to set the base voltage exactly 200 millivolts below the emitter voltage noted in step 3.

5. Power down the drive (START/STOP switch to STOP), and turn off ac power after the pack has braked to a stop. With power off, open the card cage assembly and ground pin 3B09 to disable the servo system. Connect and adjust a scope to observe the 1F/ clock signal on channel 1 (pin 4B26) and the Reference One-Shot signal on channel 2 (pin 4A45).

SYNC:	Int	Pos	100 ns/div	CHAN 1 only
CHAN:	1	Dc	2v/div	4B26 (1F/)
CHAN:	2	Dc	2v/div	4A45 (Ref O.S.)
MODE:	ALT			

6. Turn on ac power, and set the START/STOP switch to START. The drive should power up, but the heads should not load.

CAUTION

When manually loading or unloading the heads, do so in a positive and deliberate manner, without hesitation. If the heads are moved into the pack too slowly, they could crash.

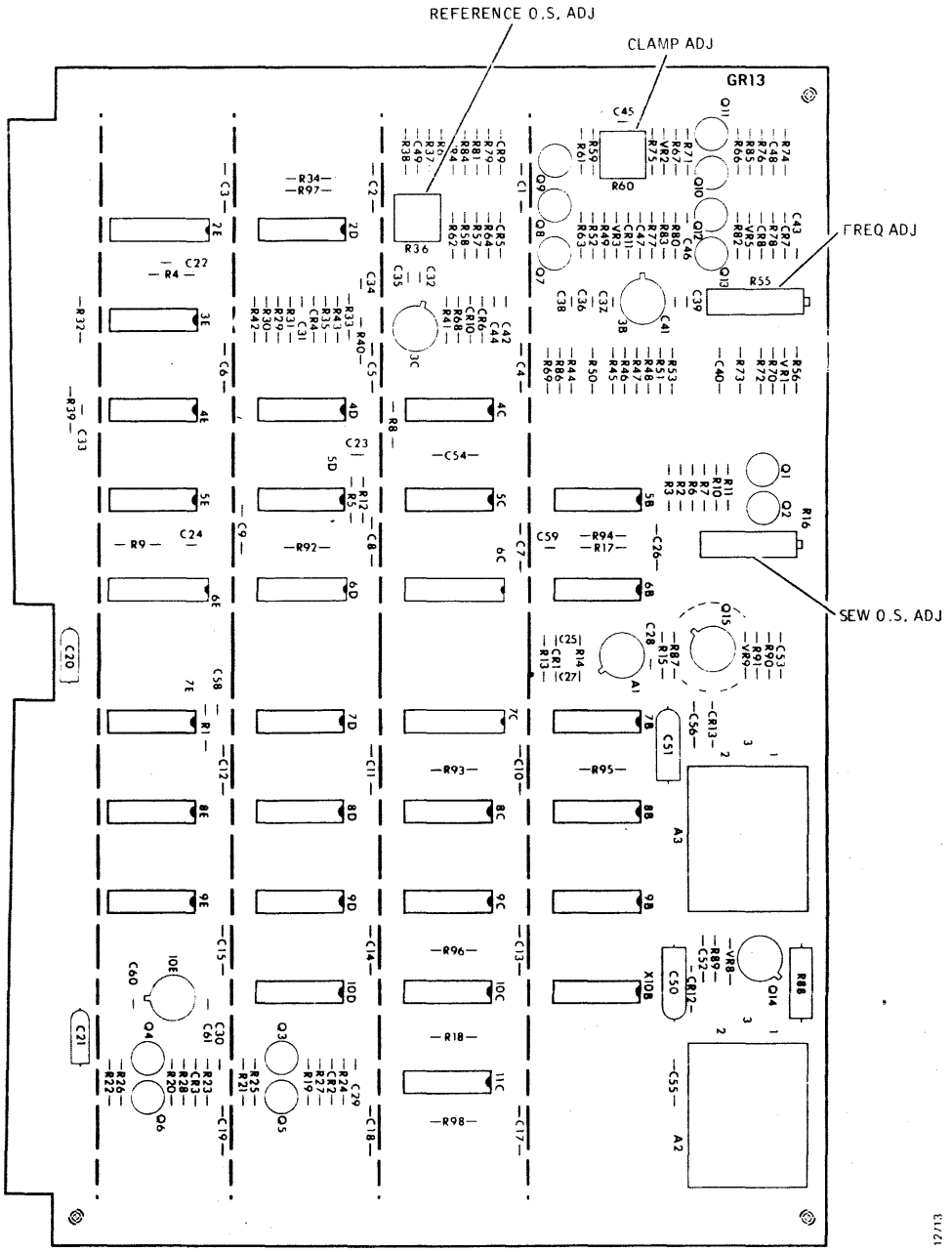


Figure 3-10. Data Separator Adjustment Point Locations (T25, T50)

7. Remove the transparent air shroud covering the head carriage, and manually load the heads. Move the heads back behind the outer guard band into the head load zone, and check the cycle time of the Channel 1 waveform. It should be 155 ±7 nanoseconds at the 50-percent amplitude points. If not, adjust potentiometer R55 on the edge of the extended card to obtain a 155-nanosecond cycle time.

8. Move the heads back and forth by hand between the head load zone and the outer guard band. Notice that this back and forth movement of the heads causes a phase shift in the Channel 1 waveform as the oscillator alternates between its locked and free-run states. While still moving the heads, readjust potentiometer R55 to eliminate this phase shift.

9. Reset the scope sweep rate to 0.5 μsec/div and turn on the 10X multiplier. A display like the one in Figure 3-11 should be obtained (50 ns/div). Roll the display to the right, and count off four cycles of the Channel 1 waveform. Rolling the display to the left, center the positive-going leading edge of the fourth cycle on the graticule center line.

10. Move the heads forward into the outer guard band. The Channel 1 waveform, locked to PLO, should not

shift and should be locked to 155 nanoseconds. The Channel 2 waveform should also be locked and stable, although it may be off one-half cycle in phase from the position shown in Figure 3-11.

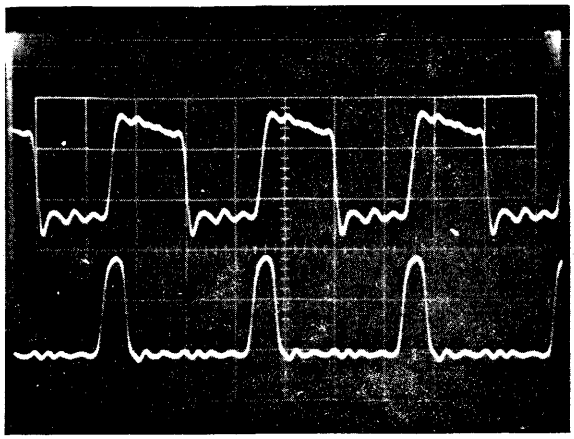


Figure 3-11. Reference One-Shot Adjustment Waveform

11. Move the heads back behind the outer guard band into the head load zone, and then readjust potentiometer R55 on the extended card to move the Channel 1 fourth cycle leading edge 75 nanoseconds early (1½ divisions to the left of the center line).

12. Move the heads back into the outer guard band, and note if the Channel 2 waveform is stable and still locked to occur every 155 nanoseconds.

Note

If the Reference One-Shot is misadjusted, the Channel 2 waveform can lock to some harmonic and change in pulse repetition time; for example, to 165 nanoseconds.

If the Channel 2 waveform is unstable or no longer locked in step with Channel 1, readjust potentiometer R36 until it becomes so.

13. Move the heads back behind the outer guard band again, and then readjust potentiometer R55 to move the Channel 1 fourth cycle leading edge 75 nanoseconds later (1½ divisions to the right of the center line).

14. Move the heads forward again into the outer guard band, and check the Channel 2 waveform for a shift into an unstable or harmonic condition, and adjust potentiometer R36, as in step 12, if necessary.

15. Repeat steps 11 thru 14, if necessary, until the Reference One-Shot adjustment controlled by potentiometer R36 is stable and does not lock to a harmonic over the 150-nanosecond range of Channel 1 adjustment.

16. After Reference One-Shot adjustment has been achieved, readjust potentiometer R55 to center the leading edge of the fourth cycle on Channel 1 again, and reverify that the Channel 1 cycle time is 155 ±7 nanoseconds.

17. Manually unload the heads, making sure that the carriage is fully retracted, and set the START/STOP switch to STOP.

18. After the disk pack has come to a stop, remove the ground from pin 3B09, and connect and adjust the scope for adjustment of the Skew One-Shot, as follows:

SYNC:	Int	Pos	500 ns/div	TRIG
CHAN:	1	Dc	2v/div	4B26 (1F/)
CHAN:	2	Dc	2v/div	4A54 (DLYDATA)
MODE:	ALT			

19. Set the START/STOP switch to START. The heads should load normally, and a display such as Figure 3-12 should be seen on the scope.

Note

Pulses on Channel 2 must occur in every cycle of the Channel 1 signal and normally occur approximately in the center of every positive half cycle on Channel 1.

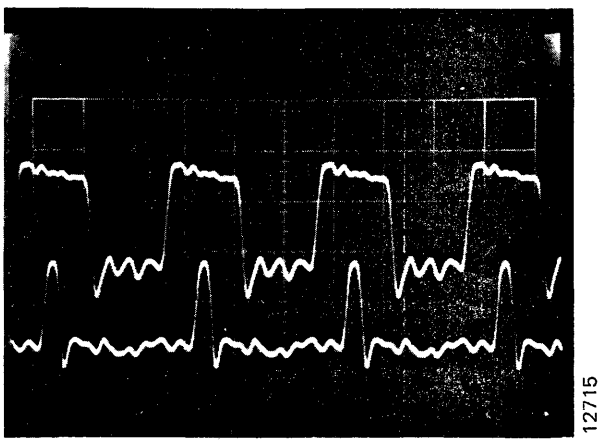


Figure 3-12. Skew One-Shot Display Waveform

20. If the pulse repetition rate of the Channel 2 signal is only half normal (pulses occurring every second cycle rather than every cycle of the Channel 1 squarewave), turn potentiometer R16 on the edge of the Data Separator card fully clockwise, and then adjust back counterclockwise until a point is reached where the Channel 2 pulses are centered in every positive half cycle on Channel 1.

21. Increase the scope sweep rate to 20 nanoseconds per division, and center the Channel 1 positive half cycle at the 50-percent amplitude points. See Figure 3-13. Fine adjust potentiometer R16 to position the leading edge of the Channel 2 pulse exactly center of the Channel 1 half cycle at its 50-percent amplitude point.

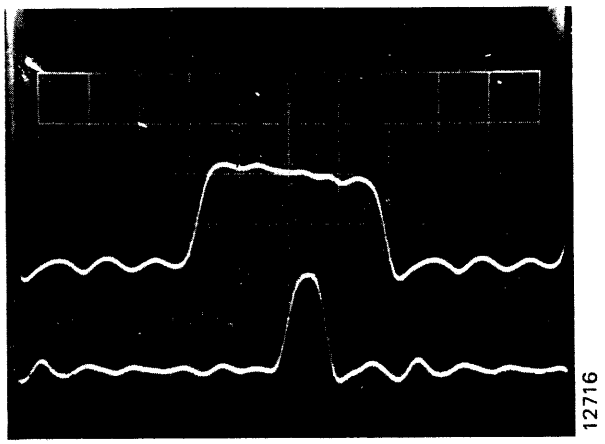


Figure 3-13. Skew One-Shot Adjustment Waveform

22. Read/write system alignment is now complete. Power down the disk drive, turn off ac power after the pack has braked to a stop, and return the Data Separator card to its normal position.

READ/WRITE SYSTEM ALIGNMENT (T80)

This procedure is the one appropriate to the type GR33 Data Separator cards used in most recent Model T80 Disk Drives. All adjustment points are located on this card, which occupies slot 4 in the card cage. Adjustments are interactive, making it necessary to perform all steps in the alignment procedure in the order given. See Figure 3-14 for adjustment point locations.

CAUTION

Do not change adjustments on Data Separator cards indiscriminately. Most are critical, interactive, and are set at the factory under dynamic, "bucket test" conditions for error-free operation. Indiscriminate readjustment of these cards could cause them to perform only marginally. Potentiometer R3 on the Data Separator is not field adjustable. Do not disturb the adjustment of this control.

1. With ac power off, disable the servo system by removing the emergency retract relay K1, located on the Power Supply Assembly circuit board (only relay on that assembly).

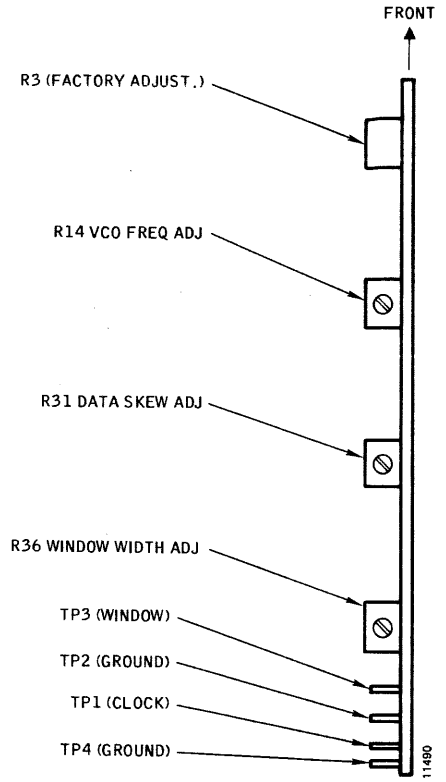


Figure 3-14. Data Separator Test and Adjustment Points (T80)

CAUTION

Whenever the servo system is disabled, be careful that the heads are fully retracted before powering down the drive. Also, never leave the drive unattended with the heads on the pack.

2. Install a scratch pack and remove the transparent air shroud covering the head carriage assembly. Power up the drive, and wait at least 20 seconds for the drive to come up to speed. The heads will not load, since the servo is disabled.

3. Check the free-running frequency of the phase lock oscillator and its ability to lock normally to the servo signal by performing the PLO Frequency Adjustment procedure. Adjust only if necessary, as adjustment will require powering down and placing the Servo Control card in slot 6 on an extender.

4. After the phase lock oscillator has been checked and verified or adjusted for normal operation, manually retract the heads and connect a scope to test points TP1 and TP3 on the Data Separator card, as follows:

SYNC:	Int	Neg	0.1 μsec/div	CHAN 1
CHAN:	1	Dc	1v/div	TP3 (DATA WINDOW)
CHAN:	2	Dc	1v/div	TP1 (CLOCK)
MODE:	ALT			

Note

Connect ground leads from both scope probes to test point TP2 on edge of card, and turn on the scope 10X magnifier to increase sweep rate to 10 nsec/division.

5. With the disk pack up to speed, manually load the heads and position them in the vicinity of cylinder 000.

6. Adjust the scope controls to display the last pulse of the Channel 2 waveform, placing the trailing edge of the pulse on the center vertical line of the graticule, as shown in Figure 3-15 (Original Setting).

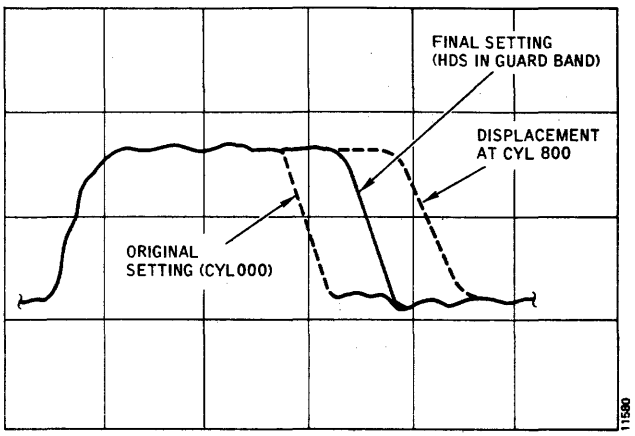


Figure 3-15. Clock Frequency Adjustment Waveform (T80)

7. Manually move the head carriage outward to the vicinity of Cylinder 800, and notice the displacement of the pulse trailing edge on the scope.

8. Calculate the amount of displacement in the trailing edge between the Cylinder 000 and 800 head positions, as shown in Figure 3-15.

9. Move the head carriage back past Cylinder 000 into the outer guard band area. Leave the heads in this position (heads loaded and picking up guard-band Servo signals) while all read/write adjustments are being made.

10. Adjust potentiometer R14 on the Data Separator card to position the trailing edge of the Channel 2 pulse exactly centered between the locations noted for Cylinders 000 and 800.

11. Adjust the scope controls to display the second negative-going pulse in the Channel 1 waveform. See Figure 3-16. Center Channel 1 vertically so that a horizontal graticule line crosses through the pulse at its 50-percent amplitude points.

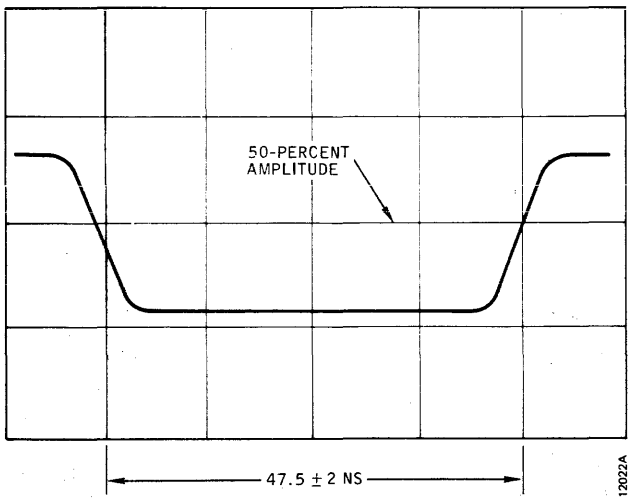


Figure 3-16. Window Width Adjustment Waveform (T80)

12. Adjust potentiometer R36 on the Data Separator card to obtain a pulse width of 47.5 nanoseconds through the center of the Channel 1 negative pulse.

13. Adjust the scope controls to center the second negative-going pulse in the Channel 1 waveform both horizontally and vertically on the graticule.

14. Adjust potentiometer R31 on the Data Separator card to move the trailing edge of the Clock pulse on Channel 2 to the exact center (±1 nanosecond) of the Data Window on Channel 1. See Figure 3-17.

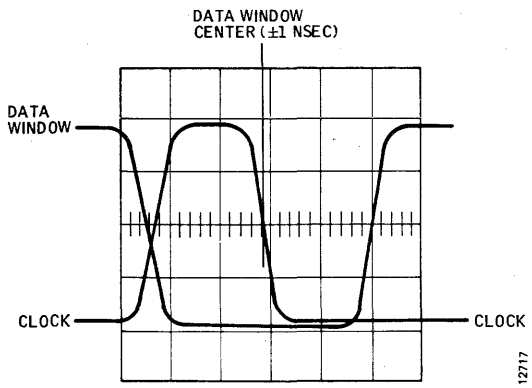


Figure 3-17. Clock Pulse Adjustment Waveform (T80)

15. Manually retract the head carriage, power down the drive, and restore the drive to operational status. Then power up, and check its read/write capability.

CARRIAGE-ACTUATED MICROSWITCHES

Two microswitches are actuated by the head carriage assembly over the full extent of its travel into the disk pack area. To gain access to these switches for checkout, adjustment, or replacement, raise the pack cover lid, remove the

disk pack, and remove the access plate on the bottom of the air shroud, secured in place by four slotted screws. See Figure 3-18.

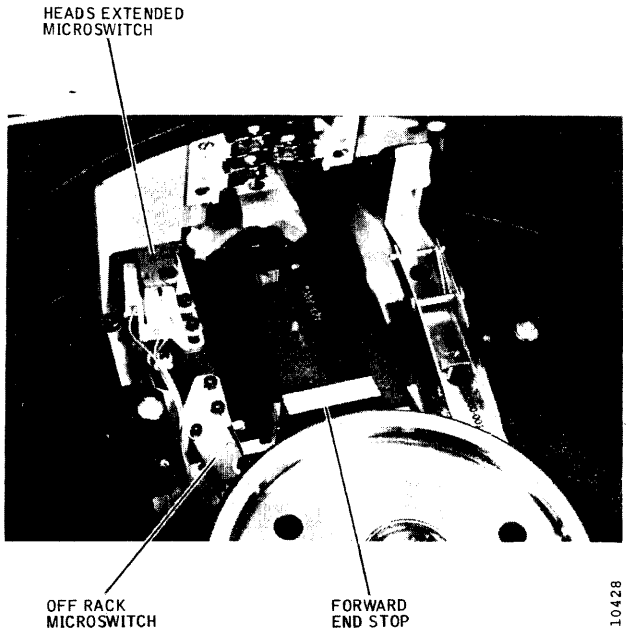


Figure 3-18. Carriage Microswitch Locations

The heads-extended microswitch is actuated each time the carriage moves the heads into the disk pack area and provides the servo control system with heads extended or heads retracted status. The off-rack microswitch is actuated only if the servosystem drives the carriage into the outer end stop.

Heads-Extended Microswitch Checkout and Adjustment

1. Set the PWR ON/OFF switch to OFF, remove the disk pack, and make sure the heads are fully retracted.

2. Remove the maintenance access panel inside the air shroud (four slotted screws).

3. Disconnect plug P50 from the microswitch and measure contact resistances of the microswitch with an ohmmeter.
   - Between NO and C lugs (should be shorted)
   - Between NC and C lugs (should be open)

4. Actuate the microswitch manually by moving the carriage out slightly, and remeasure contact resistances to see if transfer occurs.
   - Between NO and C lugs (should be open)
   - Between NC and C lugs (should be shorted)

5. If a faulty microswitch was detected in steps 3 and 4, replace the microswitch. Otherwise, reconnect plug P50.

CAUTION

Do not extend the heads past the cam tower or they will slam together, resulting in head damage.

6. Manually move the head carriage slightly forward. The microswitch should transfer (click heard) within 0.059 and 0.061 inch of travel from the fully retracted position. This can be measured with a dial indicator or with an inside caliper and feeler gauges.

7. With the head carriage fully retracted, check the operating clearance between carriage camming surface and the roller on the switch arm by slipping feeler gauges between them. There must be a minimum of 0.010 inch of clearance to prevent binding. See Figure 3-19.

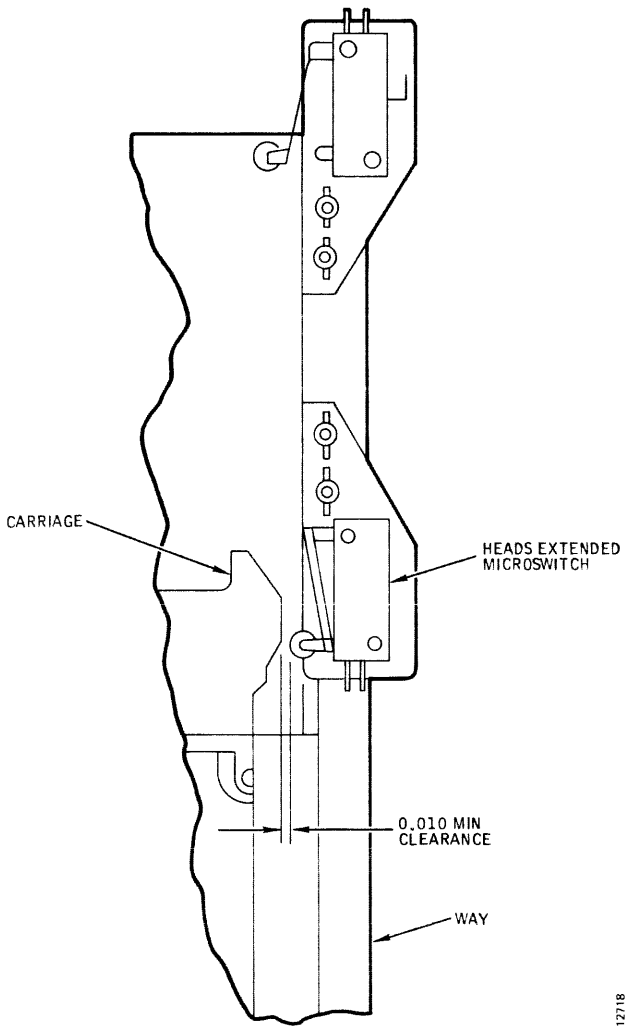


Figure 3-19. Microswitch Adjustment Clearance

8. If the step 6 and 7 checks indicate the microswitch is out of adjustment, loosen the two screws that hold the switch mounting bracket to the way assembly, position the head carriage 0.060 inch from the linear motor soft stop, adjust the microswitch until the contacts just transfer, and tighten the screws. Then repeat steps 6 and 7 to check microswitch adjustment and clearance.

9. Reinstall the maintenance access cover. In later operation, the carriage should stop on retract within 0.010 inch of the linear motor soft stop when the switch is correctly adjusted.

Heads-Extended Microswitch Replacement

If the Heads-Extended Checkout procedure indicates that the microswitch is faulty, replace the switch as follows:

1. Disconnect plug P50 from the microswitch.

2. Remove the two screws that fasten the switch mounting bracket to the way assembly, and remove the microswitch and bracket as a unit.

3. Install the new microswitch on the mounting bracket by using the original switch mounting hardware.

4. Reinstall the microswitch and bracket on the way assembly; leave the two bracket screws slightly loose. Reconnect plug P50.

5. Position the head carriage 0.060 inch from the fully retracted position, adjust the microswitch until the contacts just transfer, and tighten the bracket screws.

6. With the head carriage fully retracted, check the operating clearance between carriage camming surface and the roller on the switch arm by slipping feeler gauges between them. There must be a minimum of 0.010 inch of clearance to prevent binding. See Figure 3-19. Adjust the switch sideways, if necessary, to obtain this minimum clearance.

7. Move the head carriage manually between the fully retracted position and the microswitch transfer point. The microswitch should transfer within 0.059 and 0.061 inch of travel. If not, repeat steps 5 and 6.

8. Reinstall the maintenance access cover. In later operation, the carriage should stop on retract within 0.010 inch of the linear motor soft stop, if the switch is correctly adjusted.

Off-Rack Microswitch Checkout and Adjustment

1. Set the PWR ON/OFF switch to OFF, remove the disk pack, and make sure the heads are fully retracted.

2. Remove the maintenance access panel inside the air shroud (four slotted screws).

3. Disconnect plug P51 from the microswitch and measure contact resistances of the microswitch with an ohmmeter.
   - Between NO and C lugs (should be open)
   - Between NC and C lugs (should be shorted)

4. Actuate the microswitch manually and remeasure contact resistances to see if transfer occurs.
   - Between NO and C lugs (should be shorted)
   - Between NC and C lugs (should be open)

5. If a faulty microswitch was detected in steps 3 and 4, replace the microswitch. Otherwise, reconnect plug P51.

CAUTION

When the heads are extended past the cam tower, the head pads must be protected from making physical contact with each other. This is done by placing folded Kimwipes (at least four thicknesses) between opposing heads and moving them out slowly so that they come together gently.

6. Protect the heads and move them off the cam tower slowly until they are resting on each other. Then move the carriage until contact is made with the forward end stop. The microswitch should transfer (click heard) within 0.000 and 0.005 inch before the carriage contacts the end stop. This measurement can be checked with feeler gauges.

7. If the step 6 check shows the microswitch to be out of adjustment, loosen the two screws that hold the switch mounting bracket to the way assembly, position the head carriage 0.0025 inch from the end stop, adjust the microswitch until the contacts just transfer, and tighten the screws. Check microswitch adjustment by repeating step 6.

8. Retract the heads manually and remove the tissue pads as the heads are cammed apart. Inspect the heads for contamination, and reinstall the maintenance access cover.

Off-Rack Microswitch Replacement

If the Off-Rack Microswitch Checkout procedure indicates that the microswitch is faulty, replace the switch as follows:

1. Disconnect plug P51 from the microswitch.
2. Remove the two screws that fasten the switch mounting bracket to the way assembly, and remove the switch and bracket as a unit.
3. Install the new microswitch on the mounting bracket by using the original switch mounting hardware.
4. Reinstall the microswitch and bracket on the way assembly; leave the two bracket screws slightly loose. Reconnect plug P51.

CAUTION

When the heads are extended past the cam tower, the pads must be protected from making physical contact with each other. This is done by placing folded Kimwipes (at least four thicknesses) between opposing heads and moving them out slowly so that they come together gently.

5. Protect the heads and move them off the cam tower slowly until they are resting on each other. Then move the carriage until contact is made with the forward end stop.
6. Position the head carriage 0.0025 inch away from the end stop, adjust the microswitch until the contacts just transfer, and tighten the bracket screws.
7. Move the head carriage manually between the end stop and the microswitch transfer point. The microswitch should transfer witnin 0.000 and 0.005 inch of the end stop.
8. Retract the heads manually, and remove the tissue pads as the heads are cammed apart. Inspect the heads for contamination, and reinstall the maintenance access cover.

AIR SHROUD ASSEMBLY

The air shroud surrounds the disk pack and forms a chamber of pressurized air during operation. This assembly also houses the absolute air filter cartridge. See Figure 2-4.

Air Shroud Assembly Removal

Access to certain parts and assemblies of the disk drive, such as the blower, spindle, and the absolute air filter, require the removal of the air shroud assembly with its attached lid. To remove and reinstall the air shroud assembly, proceed as follows:

1. Remove the disk pack, if applicable, and make sure that the heads are fully retracted.
2. Set the PWR ON/OFF switch to OFF, and remove the front panel and rear cover from the disk drive.
3. Remove the front air intake (foam) filter element for access to the two screws, on the left-hand side of the filter recess, that fasten the air shroud to the blower plenum. Loosen these two captive screws.
4. Disconnect P/J30 on the machine chassis and P/J32 on the Sequence Relay assembly. This frees the electrical wiring to the shroud assembly.
5. Raise the lid and remove the four slotted screws from the bottom of the air shroud access cover. Remove the four phillips screws from the bottom of the air shroud to the standoffs on the deck plate.
6. Lift the air shroud carefully straight up and off.
7. Reinstall the air shroud assembly by following the removal procedures in reverse order. Check that the heads are fully retracted before starting the reinstallation. Also make sure that the gasket along the baseplate and head cam tower is not damaged or deformed during installation.

Absolute Air Filter Replacement

See the replacement procedure given in Section 2.

Cover Lid Spring Adjustment

The cover lid is held in the raised position by a torsion spring at the bottom of the lid. This spring, when adjusted properly, will maintain the lid in any position from half open to fully open. To adjust spring tension, proceed as follows:

1. Remove the air shroud assembly.
2. Put the lid in its half-open position, and tighten or loosen the self-locking nut on the underside of the right-hand spring keeper.
3. Lower the lid then raise it to the half-open position. The lid should remain in this position. If not, repeat step 2.

Cover Lid Removal

Replacement of the cover gasket is most easily accomplished by removing the cover first. Proceed as follows:

1. Remove the air shroud assembly.
2. Remove the gasket retainer (two slotted screws) on the hinged edge of the lid at the center.
3. Remove the six screws that secure the right and left hinge brackets to the lid and lift off the lid.
4. Reinstall the cover lid by following the removal procedure in reverse order. Make sure that the right and left hinge brackets engage their respective pivot pins and the positioning lugs on the lid.
5. Check lid-opening spring tension by performing the Cover Lid Spring Adjustment procedure.

Cover Gasket Replacement

1. Remove the air shroud assembly from the drive and the cover lid from the air shroud assembly.
2. Note that the cover gasket is not multipositional but has a slight locating protrusion at the bottom of the cover. The new gasket must be installed in the same position.
3. Reactivate the adhesive that holds the old gasket in place by soaking the edges of the gasket with an activator solution of 92 percent 1.1.1 Trichloroethane and 8 percent isopropyl alcohol by volume.
4. Continue to pry and soak the gasket with activator solution until the gasket is free of the cover.
5. Clean the lid surface free of adhesive with more activator solution, and dry the cleaned surface.
6. New cover gaskets do not require activator solution to activate their adhesive. Merely peel off the protective film from the gasket and press in place. Make sure the gasket is not deformed while installing.
7. Reinstall the cover lid and air shroud assembly. Keep the lid closed for several hours to ensure a good adhesive bond.

Lid-Closed Microswitch Checkout and Adjustment

The lid-closed microswitch is located beneath the air shroud (see Figure 3-20) and is actuated by a pin on the underside of the cover lid when the lid is closed. If the switch is suspected of faulty operation or misadjustment, proceed as follows:

1. Unplug connector P/J30.
2. Measure contact resistances of the microswitch at connector J30 by using an ohmmeter. See Figure 3-21 for connector pin locations.

   With cover open:

   - Between pins 4 and 5 (should be shorted)
   - Between pins 5 and 8 (should be open)

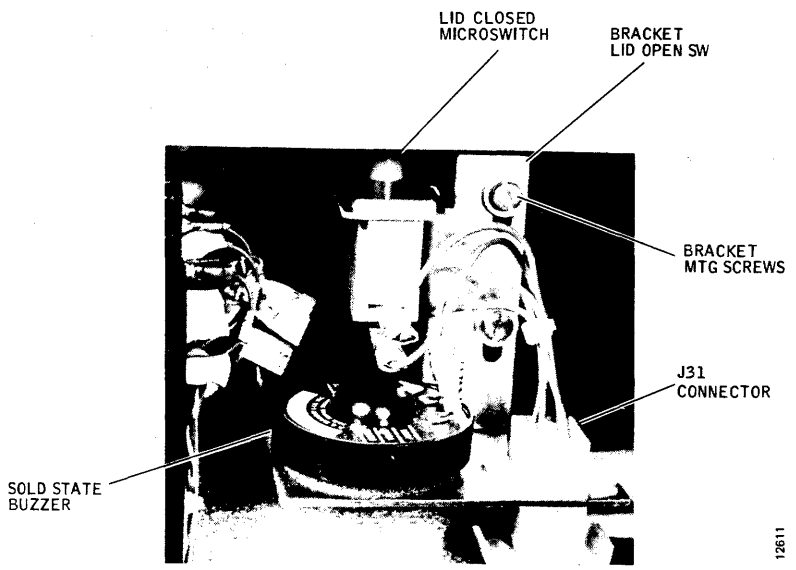


Figure 3-20. Lid Closed Switch and Solid State Buzzer Component Locations

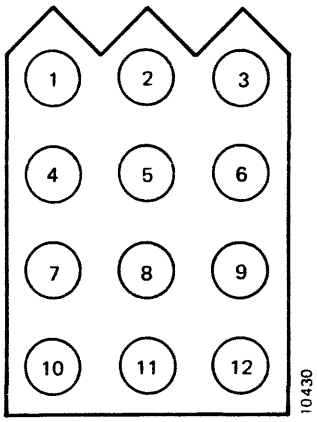


Figure 3-21. Connector J30 Pin Locations

With cover closed and latched:

- Between pins 4 and 5 (should be open)
- Between pins 5 and 8 (should be shorted)

3. If faulty contacts were detected in step 2, replace the microswitch.

4. Unlatch the lid and measure the distance that the lid has to be moved before the switch transfers. This distance should be between 0.010 and 0.060 inch.

5. If step 4 indicates that the microswitch is not positioned properly, loosen the two bracket mounting screws above the buzzer, and slide the bracket down as far as it will go.

6. With the lid closed and latched, slide the bracket upward until switch transfer occurs. Slide it up another 0.030 inch or so (not critical), and tighten the two bracket screws.

7. Repeat step 4 to check switch adjustment.

Lid-Closed Microswitch Replacement

1. Remove the air shroud assembly.

2. Remove the two bracket mounting screws immediately above the buzzer, and remove the bracket, buzzer, and microswitch as a unit.

3. Disconnect all leads from the old microswitch; tag them if necessary.

4. Press out the old switch and install its replacement. Transfer the plunger cap to the replacement switch, and reconnect all leads.

5. Reinstall the bracket assembly in the air shroud; leave the two mounting screws slightly loose.

6. Perform the Lid-Closed Switch Adjustment procedure, and reinstall the air shroud assembly.

READ/WRITE MATRIX BOARD REPLACEMENT

The Read/Write Matrix board is located adjacent to the head cam tower and immediately in front of the logic card cage assembly. Replace it as follows:

1. Set the PWR ON/OFF switch to OFF and disconnect the power cable.

2. Remove the rear cover.

3. Swing out the logic card cage assembly.

4. Tag and disconnect pushon wires from J2 and J3 pins on the matrix board.

5. Disconnect P50 from the bottom connector on the board.

6. Remove the transparent air shroud from the linear motor.

7. Disconnect the read/write head connectors.

8. Disconnect the ground wire coming from the baseplate ground connector.

9. Pull two quick-snap fasteners from the bottom of the matrix board. Carefully, remove the matrix board.

10. Remove the transparent part from the matrix board and install it on the replacement board.

11. To install the replacement board, reverse the procedure.

SERVO PREAMP BOARD REPLACEMENT

Servo Preamp board VR61 is located in the bottom of the chassis immediately below the logic card cage assembly. Replace it as follows:

1. Set the PWR ON/OFF switch to OFF and disconnect the power cable.

2. Remove the rear cover.

3. Swing the logic card cage assembly out, and remove the preamp cover.

4. Disconnect the servo head cable connector.

5. Disconnect the cable from card connector J1 and the grounding strap from the screw terminal lug on the board.

6. Remove the four screws that hold the board in place and remove the board.

7. To install the replacement board, reverse the procedure. Check servosystem alignment after replacing the board.

RELAY ASSEMBLY REPLACEMENT

The Sequence Relay Assembly is located between the blower and the spindle drive motor. It is hinged to the frame assembly so that it can be swung out for service. See Figure 3-22 for locations of major component parts. To remove and reinstall the relay assembly as a unit, proceed as follows:

1. Set the PWR ON/OFF switch to OFF, and disconnect the ac power cable from the source.

2. Remove the front cover.

3. Swing the relay assembly out to its service position, and disconnect connectors P20, P21, P22, P23, and J32. Clip any ties that attach the cables to the relay assembly.

4. Swing the relay assembly in, but not fully. Using a flathead screwdriver, spring the left-hand hinge from its pivot pin and remove the relay assembly.

5. To install the replacement relay assembly, reverse this procedure.

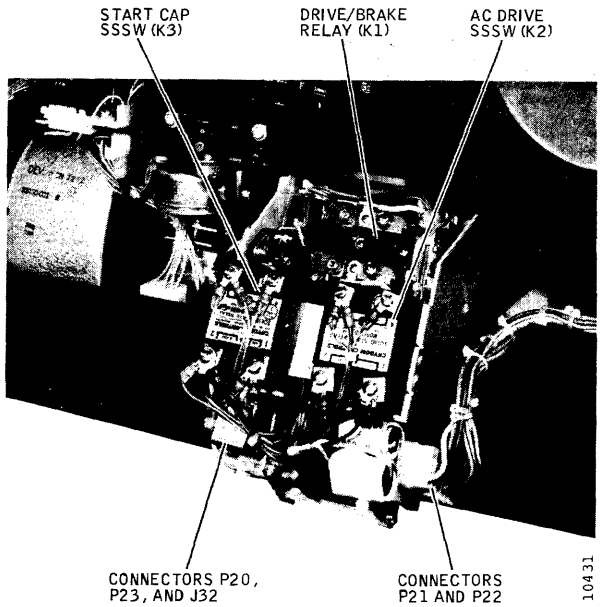


Figure 3-22. Sequence Relay Assembly Component Locations

BLOWER ASSEMBLY REPLACEMENT

The blower motor and blower are an integral unit located just behind the intake air filter and are replaced as an assembly. To replace the blower assembly, proceed as follows:

1. Set the PWR ON/OFF switch to OFF, and disconnect the ac power cable from the source.

2. Remove the front cover and the air shroud assembly.

3. Disconnect plug P23 from the relay assembly.

4. From the bottom side of the disk drive, remove the four screws that secure the blower assembly, mounting bracket to the frame assembly.

5. Lift out the blower assembly and the air duct assembly as a unit.

6. Remove the neoprene boot that connects the blower and air duct assemblies. Secure the boot with plastic ties on each end during reassembly.

7. To install the replacement blower assembly, reverse this procedure.

TRANSFORMER ASSEMBLY REPLACEMENT

The Transformer Assembly is located directly below the power supply assembly and contains the ac power transformer and tuning capacitor on one mounting plate. The assembly is replaced by performing the following steps.

1. Set the PWR ON/OFF switch to OFF, and disconnect the ac power cable from the source.

2. Loosen the screw that holds the power supply assembly in the closed position, and swing the power supply out.

3. Disconnect plug P13 from the bottom side of the power supply assembly.

4. Remove the three screws and the standoff that attach the transformer assembly to the frame, and remove the transformer assembly.

5. To install the replacement, reverse this procedure.

AC INPUT CONTROL ASSEMBLY REPLACEMENT

The Ac Input Control Assembly is located at the rear of the disk drive and contains the ac power switch, line filter, and ac fuses. See Figure 3-23. Replace it as follows:

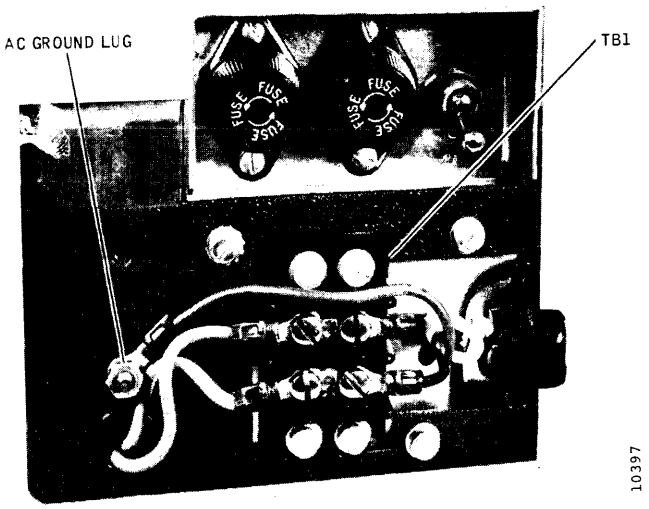


Figure 3-23. Ac Input Control Replacement Component Locations

1. Set the PWR ON/OFF switch to OFF, disconnect the ac power cable from the source, and remove the rear cover.

2. Remove the cover from terminal board TB1.

3. Disconnect and tag all wires to the terminal board, and remove the terminal board.

4. Disconnect the ground wire leading to the frame assembly from the top front of the ac input control assembly.

5. Remove the plastic cover from power supply terminal board TB2; disconnect and tag the two wires from the terminal board that lead to the ac input control assembly.

6. Cut cable ties as necessary to separate the ac input control assembly wires.

7. Unlatch the power supply assembly, and swing it out.

8. Remove the three screws that hold the ac input control assembly to the frame, note wire routing, and remove the assembly.

9. To install the replacement, reverse this procedure.

SPINDLE DRIVE SYSTEM

The Spindle Drive System consists of the spindle drive motor, spindle assembly, drive belt, spindle speed transducer, spindle grounding brush, and a spindle lock assembly. See Figure 3-24. Checkout, adjustment, and replacement procedures for these components follow.

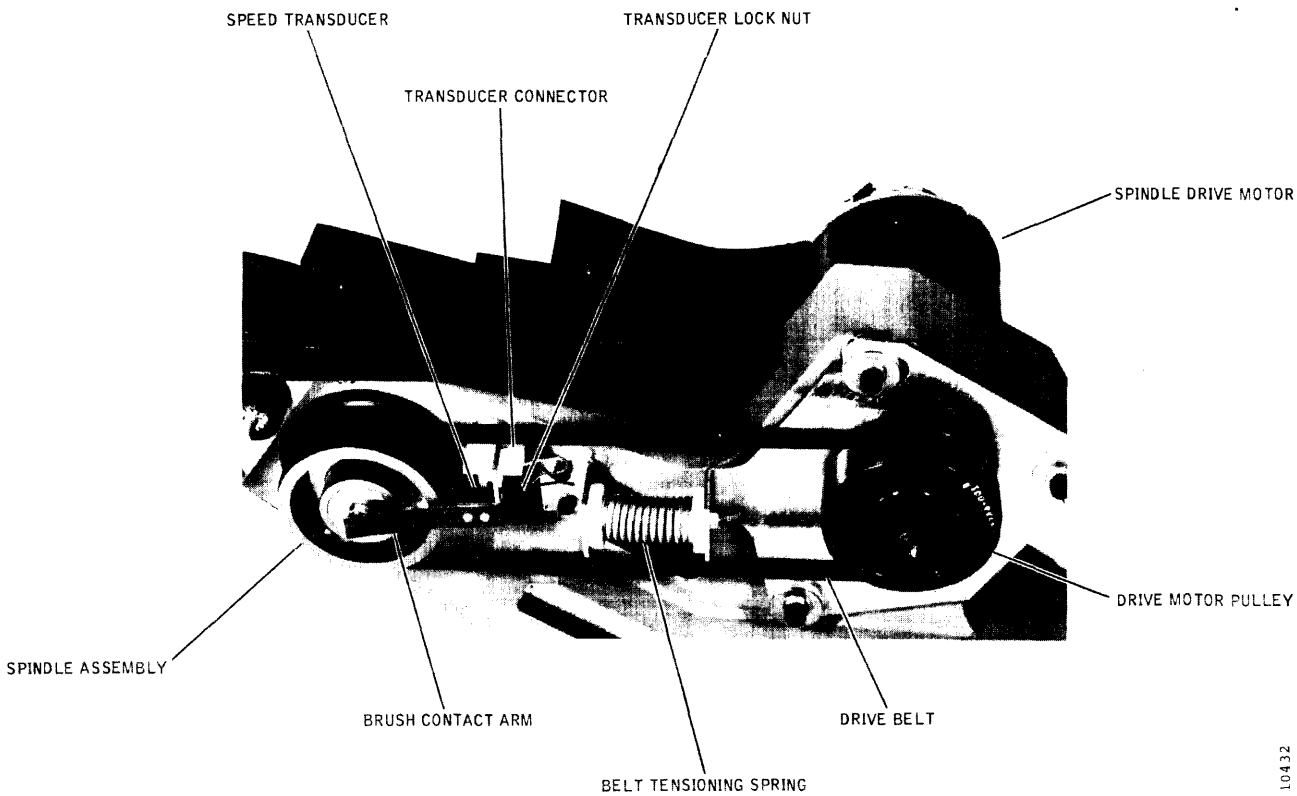


Figure 3-24. Spindle Drive Component Locations

Drive Belt Replacement

The spindle drive belt is made accessible by removing the bottom maintenance access cover. Replacement is required if there is any evidence of belt deterioration, such as fraying or stretching. Proceed as follows to replace the belt:

1. Set the PWR ON/OFF switch to OFF.

CAUTION

Most of the weight of the disk drive is toward the rear of the unit. Exercise caution when performing steps 2 thru 7 to ensure that the drive is supported properly.

2. Tip the disk drive unit up and support it. Remove the bottom access cover.

3. Pull the spindle drive motor toward the spindle and against the tensioning spring to slacken the belt, and slip the belt off the motor pulley.

4. Install a new belt in the same manner as the old belt was removed in step 3.

5. Spin the drive motor, belt, and spindle by hand to make sure that the belt rides in the center of both pulleys.

6. If the belt is not centered on both pulleys, slacken the belt, center it on the spindle pulley, and adjust the motor pulley height as necessary. There are two setscrews on the motor pulley — one on the key and one on the flat part of the shaft.

7. Repeat step 5. When the belt rides correctly, replace the bottom access plate and lower the unit.

Grounding Brush Replacement

The spindle grounding brush provides a static discharge path for the disk pack and spindle. If the static (spindle not turning) resistance between the spindle and the grounding brush should be replaced. Proceed as follows:

1. Set the PWR ON/OFF switch to OFF.

2. Remove the bottom maintenance access plate.

3. Disconnect the transducer lead connector.

4. Loosen the magnetic pickup transducer bracket.

5. Loosen the brush setscrew, and remove the grounding button from the spindle.

6. Install a new grounding brush by using the existing setscrew.

7. Center the contact arm under the grounding brush, and tighten the transducer bracket screws.

8. The contact arm pressure on the grounding brush should be 150 ±50 grams.

9. Check the static resistance between the spindle and the contact arm. It should be less than 0.5 ohm.

10. Perform applicable steps of the Speed Transducer Adjustment procedure to adjust the spindle-transducer gap.

11. Replace the bottom access plate.

Speed Transducer Checkout and Adjustment

The Speed Transducer is a magnetic pickup coil located adjacent to the spindle pulley (Figure 3-25) that generates one speed pulse per revolution of the spindle. The pickup is from a carbon steel pin embedded in the spindle pulley over which the transducer is aligned. Transducer adjustment is usually necessary only if there has been shipping damage or if the transducer has been replaced.

1. Set the PWR ON/OFF switch to OFF.

CAUTION

Most of the weight of the disk drive is toward the rear of the unit. Exercise caution when performing steps 2 thru 6 to ensure that the drive is supported properly.

2. Tip the disk drive up and support it. Remove the bottom maintenance access cover.

3. Rotate the spindle pulley manually and check for noises that would indicate that the transducer is rubbing against the spindle pulley. If the transducer is rubbing, go directly to step 5.

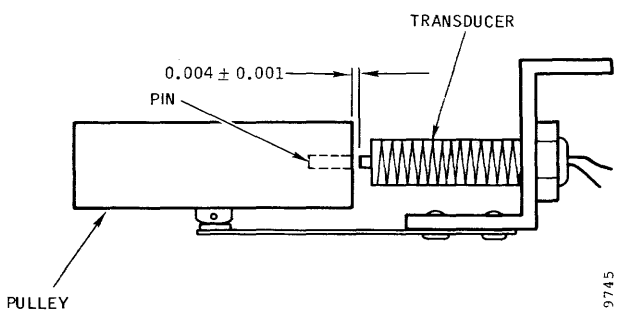


Figure 3-25. Speed Transducer Gap Limits

4. Using nonmagnetic shim material as a feeler gauge, check the gap between the transducer and the carbon steel pin in the spindle pulley. It should be 0.004 ±0.001 inch, as indicated in Figure 3-25. Also check that the end of the transducer coil is aligned with the pin.

5. To adjust the gap between the transducer and the spindle, loosen the locknut on the bracket end of the transducer, turn the threaded transducer to move the transducer toward or away from the spindle until it lightly contacts a feeler gauge of 0.004-inch-thick nonmagnetic shim stock, and tighten the locknut.

6. Replace the bottom access cover and lower the unit.

Speed Transducer Replacement

To replace the speed transducer, the transducer bracket with the spindle brush contact arm, or both, proceed as follows:

1. Set the PWR ON/OFF switch to OFF.

CAUTION

Most of the weight of the disk drive is toward the rear of the unit. Exercise caution when performing steps 2 thru 10 to ensure that the drive is supported properly.

2. Tip the disk drive up and support it. Remove the bottom maintenance access cover.

3. Disconnect the connector for the transducer leads.

4. Remove the transducer and bracket as a unit.

5. Remove the transducer from the bracket by loosening the locknut on the bracket end of the transducer and unscrewing the transducer.

6. Reinstall the replacement transducer or bracket by performing step 5 in reverse. The initial position of the transducer should be set up with the end of the transducer flush with the locknut. Leave the locknut loose.

7. Reinstall the transducer and bracket on the deck plate.

8. Perform step 5 of the Speed Transducer Checkout and Adjustment procedure to adjust the transducer-spindle gap.

9. Reconnect the transducer lead plug.

10. Replace the bottom access cover, and lower the drive.

Spindle Lock Assembly Adjustment

The Spindle Lock Assembly (Figure 3-26) is the mechanism actuated by the disk pack cover to keep the spindle from turning while the pack is being loaded or unloaded. If trouble is experienced with the spindle turning during these operations, the spindle lock may be misadjusted. Proceed as follows:

1. Set the PWR ON/OFF switch to OFF.

2. Remove the maintenance access plate inside the air shroud (four slooted screws).

3. Loosen both screws that secure the spindle lock to the base plate.

4. Adjust the spindle lock lever mounting bracket for 7.100 ±0.010 inches from the centerline of the spindle to the tip of the actuating button closest to spindle center. Tighten both screws to 100 inch-ounces.

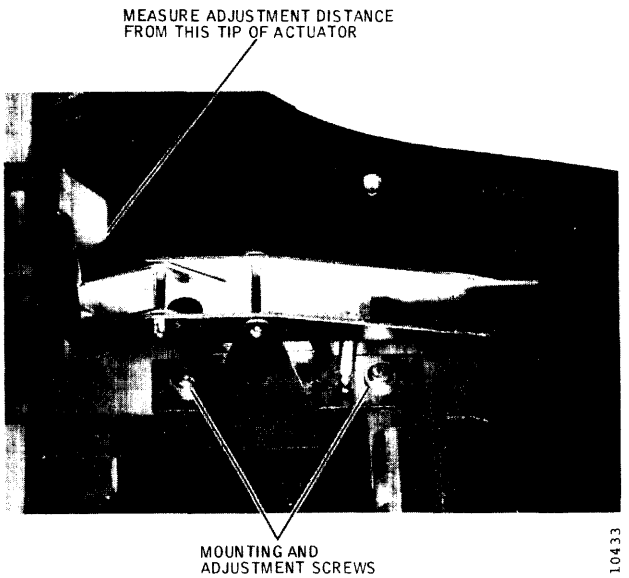


Figure 3-26. Spindle Lock Assembly

5. Install a disk pack and cover on the spindle, and observe that the spindle locks with a pack cover on.

6. Remove the pack cover and observe that the spindle is free to rotate.

7. Remove the disk pack and install the maintenance plate.

Spindle Lock Assembly Replacement

If the spindle lock assembly (Figure 3-26) does not operate properly after adjustment, or if it fails to disengage, replacement is indicated. Proceed as follows:

1. Set the PWR ON/OFF switch to OFF.
2. Remove the maintenance access plate inside the air shroud (four slotted screws).
3. Remove the spindle lock assembly.
4. Install the replacement spindle lock assembly with hardware removed in step 3. Make sure that the assembly is parallel to the base plate.
5. Perform the Spindle Lock Assembly Adjustment procedure.

Spindle Drive Motor Replacement

The spindle drive motor is a single-phase, capacitor-start motor that provides high starting torque at low speed. A thermal cutout switch is incorporated in this motor to protect it against overheating. Repeated starting and stopping during troubleshooting may trip the thermal switch and is not an indication that the motor is defective. The motor will usually start after an adequate cool-down period.

Other components associated with the drive motor, such as starting capacitor C1, sequence relay and solid state switches K1, K2, and K3, can also prevent the drive motor from operating and should be checked out before drive motor replacement is considered. If the drive motor is defective, replace it as follows:

1. Set the PWR ON/OFF switch to OFF, and disconnect the ac power cable from the source.
2. Remove the front and rear cover.
3. Remove the bottom maintenance access plate.
4. Disconnect P22 from the relay assembly.
5. Pull the drive motor toward the spindle and slip the drive belt from the motor pulley.
6. Remove the motor pulley from the end of the drive shaft.
7. Remove the four bolts that secure the drive motor to its mounting plate, swing out the power supply assembly, and remove the motor from the top.
8. To install the replacement motor, reverse the procedure.
9. Spin the pulley by hand to ensure that the drive belt runs straight and true. If necessary, adjust the vertical position of the pulley.

Spindle Assembly Replacement

The spindle assembly (Figure 3-27) is a precision unit with sealed bearings that requires no maintenance other than an occasional cleaning and relubrication of the pack mounting threads. It should never be removed from the deck plate unless replacement is necessary. Replacement of the spindle assembly is usually necessary only if pack mounting or unmounting difficulties are experienced (thread wear) or when bearing wear becomes excessive. To replace the spindle assembly, proceed as follows:

1. Set the PWR ON/OFF switch to OFF, and disconnect the ac power cable from the source.
2. Remove the maintenance access plate from the air shroud assembly (four slotted screws).

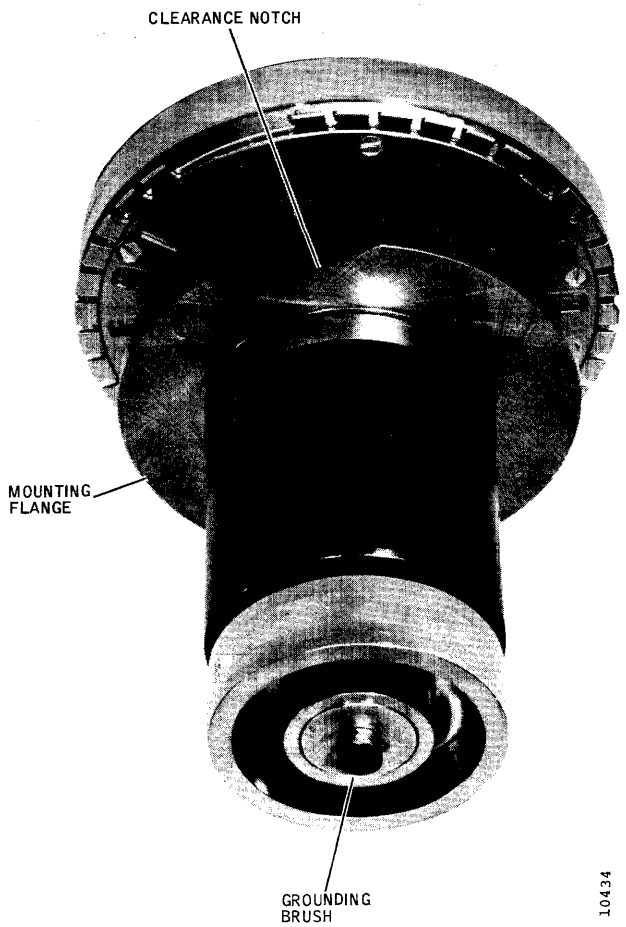


Figure 3-27. Spindle Assembly

3. Remove the bottom maintenance access plate.

4. Remove the drive belt.

5. Remove the three bolts that secure the spindle to the deck plate. Clean old Loctite from the bolts.

6. Remove the spindle assembly from the deck plate by pulling the spindle assembly straight up and out.

CAUTION

The spindle and deck plate are machined to extremely close tolerances. Cocking the spindle will result in binding against the deck plate and may damage the machined surfaces.

7. Remove the grounding button and install it on the replacement spindle shaft, or use a new button as required.

8. Clean the deck plate and spindle mating surfaces with Freon TF to remove all foreign matter.

9. Install the replacement spindle. A notch on the spindle mounting flange provides clearance for the spindle locking mechanism during removal and installation. Do not force it!

10. Apply one drop of Locktite, grade C to the threads at the ends of the mounting bolts and install the bolts. Torque the bolts to 80 inch-pounds.

11. Install the drive belt.

12. Perform step 5 of the Speed Transducer Checkout and Adjustment procedure.

13. Perform the Spindle Lock Assembly Adjustment procedure.

14. Perform the Head Alignment Checkout and Adjustment procedure.

15. Reinstall all maintenance access covers.

HEAD POSITIONING SYSTEM

The Head Positioning System consists of the linear motor with its bobbin coil and velocity tachometer components, the T-block, and the carriage and way assembly. Checkout, adjustment, and replacement procedures for these assemblies and components follow.

Linear Motor Checkout

The linear motor assembly can be checked for proper operating characteristics by performing the following steps:

CAUTION

The linear motor housing will magnetize all ferrous objects (watches, tools) placed close to it.

1. Set the PWR ON/OFF switch to OFF, and disconnect the ac power cable from the source.

2. Remove the rear cover.

3. Remove the emergency retract relay located on the power supply assembly.

4. Remove the transparent air shroud.

5. Swing out the power supply to the maintenance position.

6. Disconnect and tag the two wires connected to the linear motor conductor band lugs. See Figure 3-28.

CAUTION

In checking the bobbin resistance, current from the meter will run the bottin forward or in reverse depending upon the meter connections. Connect the meter so that, when reading bobbin resistance, the bobbin is driven in the retracted direction.

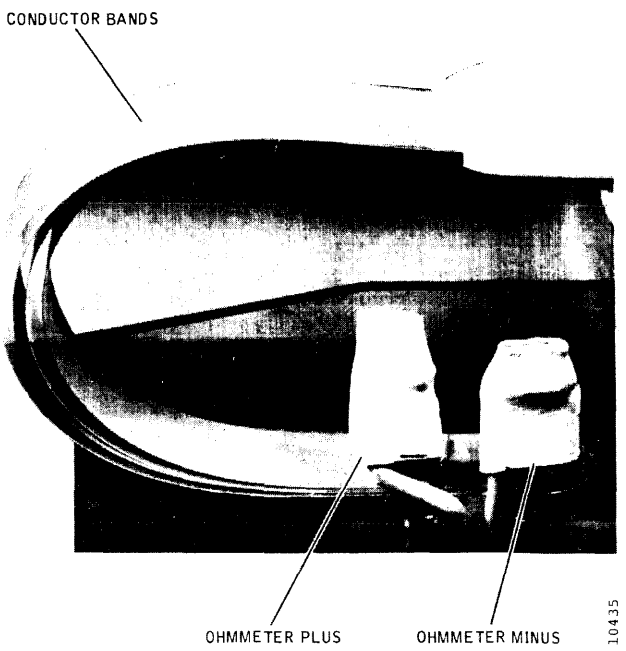


Figure 3-28. Bobbin Resistance Check Points

7. Measure the resistance of the bobbin across the conductor band lugs. Resistance should be 1.4 ±0.3 ohms. If bobbin resistance is out of tolerance, perform the Linear Motor Replacement procedure.

8. Reconnect the two wires to the conductor band lugs.

9. Place folded Kimwipe tissue pads (at least four thicknesses) between opposing heads to cushion the head pads, and move the heads out slowly so that they come together gently and clear the camming tower.

10. Move the carriage back and forth over its travel limits while checking for free movement of the carriage, particularly that the conductor bands are not being distorted and that the bobbin is not dragging. If the bobbin drags, perform the Motor Bobbin Alignment procedure.

11. Retract the heads, remove the tissue pads, and inspect the heads for lint. Clean them in place if they are dirty.

12. Reinstall the transparent air shroud, close and latch the power supply assembly, and replace the emergency retract relay.

Velocity Transducer Replacement

The velocity transducer consists of two components: the tachometer rod (tach rod) and the tachometer rod housing (pickup coil). See Figure 3-29. Both these components are installed and removed through the rear of the linear motor housing.

The tach rod is fastened internally to the T-block, while the pickup coil is held stationary inside the linear motor. A spring holds the pickup coil in position. Velocity transducer components are replaced as follows:

CAUTION

The tach rod is very brittle and will break if not handled carefully. Do not use a tach rod that has been dropped; even if it doesn't break, its magnetic characteristics may have been altered.

1. Set the PWR ON/OFF switch to OFF, and disconnect the ac power cable from the source.

2. Remove the rear cover.

3. Swing out the logic card cage assembly.

4. Velocity transducer wires from the rear of the linear motor are connected to the card cage backplane. Tag and disconnect these wires.

5. Make sure that the heads are fully retracted.

6. Remove the velocity transducer retaining plate from the rear of the linear motor (two slotted screws).

7. Remove the pickup coil and coil-retaining spring from the motor.

8. Note two pins on one end of the tach rod insertion tool, part no. 13445-001. Insert this end of the tool as far as it will go into the linear motor location vacated by the pickup coil.

9. Turn the tool counterclockwise until the two pins engage holes in the tach rod flange. Continue turning it until the tach rod is free of the T-block, and remove the tool and rod together.

10. To install velocity transducer components, reverse this procedure. Place the tach rod inside the tool over the pins to install it. Make sure that the tach rod and tool are fully inserted into the linear motor (to the mark on the tool), and torque the tach rod to 80 inch-ounces with the head torque wrench.

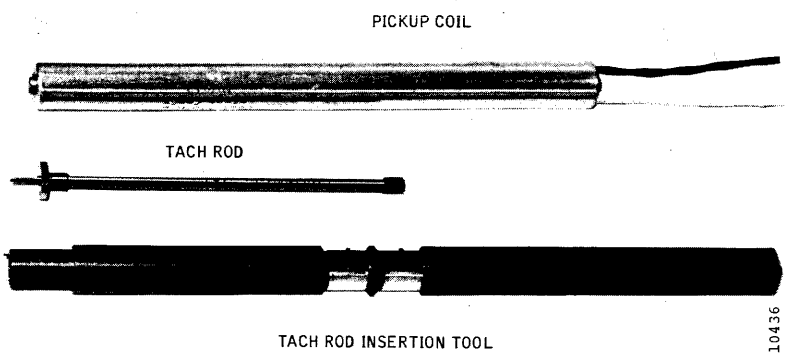


Figure 3-29. Velocity Transducer Components and Tool

11. When reinstalling the pickup coil, make sure that it is inserted into the linear motor as far as it will go. Place the retainer spring over the wire leads, and use care in reinstalling the retainer plate to avoid cutting the leads.

Motor Bobbin Alignment

The motor bobbin inside the linear motor is attached to the T-block and held in alignment by four screws. See Figure 3-29. Bobbin alignment should not be necessary unless there has been shipping damage or the linear motor has been replaced. To align the bobbin, proceed as follows:

1. Set the PWR ON/OFF switch to OFF, and disconnect the ac power cable from the source.

2. Remove the rear cover and the transparent air shroud.

3. Swing out the logic card cage and power supply assemblies.

4. Make sure the carriage is fully retracted, and loosen the four bobbin-retaining screws (just enough so that the bobbin can be moved with the fingers).

5. Cut four ¾-inch-wide shims from filing card or punch card stock. These should be at least four inches long.

6. Place folded Kimwipe tissue pads (at least four thicknesses) between opposing heads to cushion the head pads, and move the heads out slowly so that they come together gently and just clear the camming tower.

7. Place the four paper shims between the bobbin and the linear motor housing lengthwise; space them evenly around the bobbin.

CAUTION

Make sure that the shims protrude far enough beyond the T-block end of the bobbin that they can be pulled out after alignment is complete. Otherwise, removal of the entire linear motor may be necessary to retrieve them.

8. Move the heads back to the retracted position; make sure that the shims are clearly in sight.

9. Tighten and torque the four bobbin-retaining screws to 100 inch-ounces.

10. Remove the four paper shims.

11. Replace the Kimwipe tissue pads between the heads, let them come together gently, and check for any indication of bobbin drag over the full distance of carriage travel.

12. Move the heads back to the retracted position; remove the pads as the heads cam apart. Inspect the heads for lint, and clean them in place if necessary.

13. Close and secure the logic card cage and power supply assemblies; reinstall the transparent air shroud and rear cover.

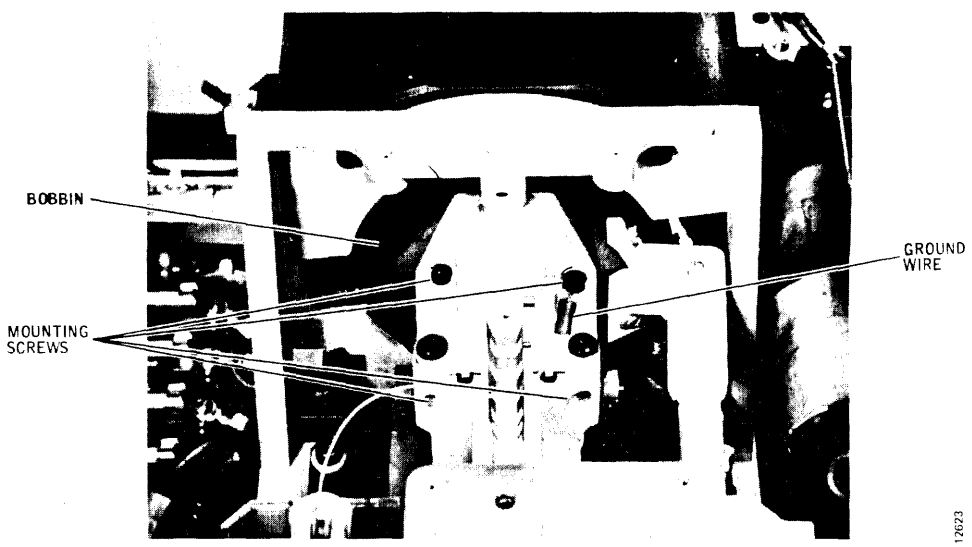


Figure 3-30. Bobbin Mounting Screw Locations

Linear Motor Replacement

Linear motor replacement is necessary, usually, only if the bobbin is defective. The linear motor is supplied as a tested assembly that includes the motor housing, bobbin, front bracket, and conductor bands, but without velocity tachometer components. To replace the linear motor, proceed as follows:

1. Set the PWR ON/OFF switch to OFF, and disconnect the ac power cable from the source.
2. Remove the rear cover and the transparent air shroud. Make sure the heads are fully retracted.
3. Unlatch the power supply assembly and swing it out.
4. Disconnect and tag the two wires to the linear motor conductor band lugs.
5. Remove the tach rod and pickup coil from the linear motor. Refer to the Velocity Transducer Replacement procedure.
6. Note the location of the ground wire, and remove the four screws that hold the bobbin to the T-block. See Figure 3-30. When reinstalling the bobbin, make sure the ground wire is reconnected, and perform the Motor Bobbin Alignment procedure.

CAUTION

Do not remove the T-block from the carriage. The T-block is factory aligned to the carriage and way assembly.

7. Place folded Kimwipe tissue pads (at least four thicknesses) between opposing heads to cushion the head pads, and move the head out slowly so that they come together gently. Move the carriage forward to get out of the way.
8. Remove the four screws that hold the linear motor to the deck plate. Torque the screws to 80 inch-pounds when reinstalling them.
9. Lift the linear motor carefully straight up and out (a two-man job). Watch your fingers during replacement.
10. To install the replacement linear motor, reverse the procedure. Make sure that the mating surfaces of the linear motor and deck plate are clean and that the linear motor is positioned squarely over the deck plate locating pins. The motor bobbin must also be aligned as per step 6.

Carriage and Way Alignment Check

The alignment accuracy of the carriage and way assembly to the axis of the spindle assembly not only determines the accuracy of head positioning within a given unit, but also affects disk pack and drive interchangeability. For this reason, carriage and way alignment is always checked dynamically at the factory against a calibrated reference CE Alignment Pack. In the field, any certified CE Alignment Pack may be used.

Carriage and way alignment is checked by first making sure that all heads are aligned to within ±50 microinches of track center at head alignment cylinder 248 for Model T25 or within ±25 microinches of track center at head alignment cylinder 496 for Models T50 and T80. Then head alignment is again checked at cylinders 4 and 400 (T25) or 8 and 800 (T50 and T80). Carriage and way alignment can be considered to be within tolerance if all heads are within ±255 microinches of track center at these two outer and inner alignment check cylinders.

To check carriage and way alignment, proceed as follows:

1. Check and realign the heads to tolerance as necessary by performing the Head Alignment and Checkout Procedure at the front of this section.

Note

In the following steps, it is presumed that the exerciser, meter box, and CE pack are still installed from step 1.

2. Load the carriage and way alignment check cylinder as follows:
   - For Model T25, load cylinder 004 address by setting the exerciser BUS/BIT switches to hex 004 (bit 4 up).
   - For Models T50 and T80, load cylinder 008 address by setting the exerciser BUS/BIT switches to hex 008 (bit 8 up).
3. Perform a seek to the cylinder by setting the exerciser FUNCTION SELECT switch to SKALT and pressing the SINGLE switch until the drive seeks to the inner alignment check cylinder. Verify the cylinder address by setting the exerciser DISPLAY SELECT switch to CAR and observing the indicator display.
4. Set the exerciser DISPLAY SELECT switch to SEQUENCE and the FUNCTION SELECT switch to READ.
5. Set the alignment meter box scale switch to 1250 MICRO IN. and the DIBIT POLARITY switch to R1.

Press the RSTHD switch to address Head 0, and activate the read gate by turning on the exerciser CONT switch. A dibit pattern should appear on the scope.

6. Check the meter reading, and switch the meter scale switch to the most sensitive position possible without pinning the meter. If the meter reading is 225 microinches or less from track center, set the DIBIT POLARITY switch to R2. If either reading exceeds 225 microinches from track center, the carriage and way assembly must be realigned.

7. Turn off the exerciser CONT switch and set the alignment meter scale switch to 1250 MICRO IN. Press the ADVHD switch four times to address Head 4, as shown on the exerciser HAR indicators.

8. Activate the read gate by turning on the exerciser CONT switch. A dibit pattern should appear on the scope. Check the meter reading, and switch the meter scale switch to the most sensitive scale position possible without pinning the meter. If the meter reading is 225 microinches or less from track center, set the DIBIT POLARITY switch to R1. If either the R1 or R2 reading exceeds 225 microinches from track center, the carriage and way assembly must be realigned.

9. Turn off the CONT switch and load the carriage and way alignment check cylinder as follows:
   - For Model T25, load cylinder 400 address by setting the exerciser BUS/BIT switches to hex 190 (bit switches 128, 32, 16, 8, 4, and 2 up).
   - For Models T50 and T80, load cylinder 800 address by setting the exerciser BUS/BIT switches to hex 320 (bit switches 512, 256, and 32 up).

10. Perform a seek to the cylinder by setting the exerciser FUNCTION SELECT switch to SKALT and pressing the SINGLE switch until the drive seeks to the outer alignment check cylinder. Verify the cylinder address by setting the exerciser DISPLAY SELECT switch to CAR and observing the indicator display.

11. Set the exerciser DISPLAY SELECT switch to SEQUENCE and the FUNCTION SELECT switch to READ.

12. Repeat steps 5 thru 8; take off-track readings for Heads 0 and 4 at the alignment check cylinders. If any reading is greater than 225 microinches, the carriage and way assembly must be realigned.

Carriage and Way Alignment Procedure

Alignment of the carriage and way assembly to the rotating axis of the spindle is necessary whenever the carriage and way assembly is replaced, or when the alignment check shows the alignment to be out of tolerance. Special tools and a fair degree of skill and experience are required. For these reasons, alignment by anyone other than factory trained personnel is discouraged.

CAUTION

The head mounting T-block is factory aligned to the carriage. No attempt should be made to adjust or replace it separately if it is damaged. Replace the entire assembly. Also, exercise care not to scratch the bearing surfaces of the way through careless tool handling.

Detailed procedures for carriage and way alignment are constantly being revised as field experience is gained. For this reason, it is recommended that the instructions packed with the special tool kit be followed. If latest instructions are not available, the procedure given in Section 4, Superceded Procedures, can be used.

Carriage and Way Assembly Replacement

The carriage, carriage way, and head mounting T-block are precisely adjusted and aligned at the factory and must be replaced as an assembly whenever any component wears, becomes misaligned, or is damaged. Replacement because of wear is indicated when the assembly cannot be brought into Carriage and Way Alignment Check tolerances by performing the alignment procedure.

CAUTION

This is a precision assembly and is easily damaged and rendered useless if the way bearing surfaces are scratched or if disassembly is attempted. Replacement and alignment require a high level of technical skill. It is recommended that only factory trained personnel attempt replacement. Special tools are also necessary.

1. Set the PWR ON/OFF switch to OFF, and disconnect the ac power cable from the source.

2. Unload the disk pack, if installed, and remove the front and rear covers from the disk drive.

3. Remove the transparent air shroud, disconnect and remove all heads from the T-block, and store the heads safely.

4. Remove the air shroud assembly.

5. Remove the Read/Write Matrix board.

6. Remove the four screws, lockwashers, and flat washers that hold the head cam tower to the deck plate, and remove the cam tower.

7. Disconnect plugs P50 and P51 from the carriage-actuated microswitches, and remove the two microswitches with their mounting brackets attached. Remount the microswitches on the replacement assembly; torque the mounting screws to 100 inch-ounces.

8. Remove the four screws (Figure 3-30) that attach the carriage to the linear motor bobbin. Note the position of the grounding wire for later reassembly.

9. Remove the three bolts and lockwashers that hold the carriage and way assembly to the deck plate, and carefully remove the assembly; tilt it to clear the conductor band support bracket.

CAUTION

Exercise great care in handling the replacement carriage and way assembly. Particularly, the coating on the bearing surfaces which is easily damaged by careless tool handling.

10. Clean the mating surfaces of the deck plate and the replacement carriage and way assembly with alcohol and wipe them dry.

11. Position the replacement carriage and way assembly on the base plate, and reinstall the three mounting bolts; leave them loose.

12. Perform the Carriage and Way Alignment procedure.

13. Reconnect the carriage to the linear motor bobbin with the four screws removed in step 8, and perform the Motor Bobbin Alignment procedure.

14. Perform the Heads-Extended Switch Checkout and Adjustment and the Off-Rack Switch Checkout and Adjustment procedures. Make sure that plugs P50 and P51 are reconnected to the microswitches after adjustment.

15. Reinstall the head cam tower by using the hardware removed in step 6. Torque the mounting screws to 45 inch-pounds.

16. Reinstall and reconnect the Read/Write Matrix board.

17. Reinstall the air shroud assembly.

18. Clean and reinstall the heads in their correct locations. Use the prepositioning tool for initial alignment, and torque the heads to the full 80 inch-ounces.

19. Reconnect the ac power cable, set the PWR ON/OFF switch to ON, and perform the appropriate steps of the Head Alignment Checkout and Adjustment procedure to align the heads.

20. Perform the Carriage and Way Alignment Check procedure. If carriage and way alignment is out of tolerance, the alignment procedure will have to be repeated. The heads will have to be removed, but note that further disassembly is unnecessary, as the alignment procedure can be carried out through the access cutout in the air shroud.

21. When carriage and way alignment and head alignment check out, replace the transparent air shroud and the two covers.

SECTION 4
SUPERCEDED PROCEDURES

This section contains maintenance instructions that do not conform to current practices but which are still applicable to some earlier production Trident disk drives. Since many of these units are still in use, these superceded procedures are still of value and have been retained.

It is not possible to give specific, serial number effectivity as to when each procedure given in this section was superceded; but the information given in the introductory paragraph for each procedure should be of help in identifying where the procedure should be used. Unless otherwise noted in the introductory paragraph, the procedure is general and appropriate to all three (T25, T50, and T80) machine models. If a procedure for an earlier production machine is not found in this section, it can be assumed that the procedure given in Section 3 applies.

Note

It is recommended that maintenance personnel read through an entire procedure before attempting to perform it to avoid confusion and preventable errors.

INDICATOR TESTING

The two control panel indicators on earlier production models incorporated a press-to-test feature for testing the condition of the indicator lamps. It was found that the indiscriminate use of this feature by operators during system operation was introducing data errors due to switching noise. If your unit is equipped with press-to-test indicators, it is recommended that they be tested only when the unit is on standby power (heads unloaded) and offline to the system (INTERFACE/DEGATE switch set to DEGATE).

USE OF OLDER EXERCISERS AND HEAD ALIGNMENT METERS

All Section 3 and 4 procedures requiring an exerciser or head alignment meter specify the use of the current Model T2000B Exerciser and the Model T2001A Head Alignment Meter. Although the use of these latest pieces of special test equipment is still recommended, earlier T2000 and T2000A Exercisers and the T2001 Meter may be substituted, when available, within the following limits. Generally, the procedures for their use remain the same.

- T2000 Exerciser – use with T25 or T50 units only
- T2000A Exerciser – use with T25, T50, or T80 units only
- T2000B Exerciser – use with any Trident models (except T82 and T302)
- T2001 Meter – use with T25, T50, or T80 units only
- T2001A Meter – use with any Trident model

HEAD ALIGNMENT USING MICROMETER-TYPE HEAD ALIGNMENT TOOL

Some technicians only have, or actually prefer to use, the older micrometer-style head alignment tool (part no. 99511-001) instead of the newer, recommended head alignment pliers. For the benefit of such technicians, the complete head alignment checkout and adjustment procedure is repeated here, using the older tool. The procedure, as given, conforms to all of the latest head alignment specifications and may be used without having to refer to the Section 3 procedure.

Read/write head alignment must be checked and corrected to certain tolerances whenever any read/write head or the servo head has been moved (or if head misalignment is suspected as the source of read data errors). Always check and adjust the servo Track Offset Adjustment prior to checking head alignment, as later changes in this adjustment may throw marginal heads out of tolerance.

Note

Whenever possible, always use the same CE pack used to perform the last head alignment on the machine, in which case acceptable alignment tolerances are:

T25: ±150 microinches of cylinder 248 center

T50, T80: ±75 microinches of cylinder 496 center

If a different CE pack must be used, the acceptable alignment tolerances are:

T25: ±250 microinches of cylinder 248 center

T50, T80: ±125 microinches of cylinder 496 center

All heads found to be out of tolerance must be realigned to within ±50 microinches (T25) or ±25 microinches (T50, T80) of track center.

1. Connect the T2000B Exerciser to card cage connector J01 on the disk drive. Set all exerciser toggle switches off (down).

2. Make sure that the disk drive is offline to the system (INTERFACE/DEGATE) switch set to DEGATE). This switch setting also enables exerciser inputs.

3. Connect the T2001A Head Alignment Meter to disk drive Read/Write Matrix card connector J4 (right-hand side of card on T25 and T50; bottom of card on T80). Set the meter scale switch to OFF.

4. Set the control panel READ-WRITE/READ ONLY switch to READ ONLY, and install the CE alignment pack on the disk drive.

5. Set the drive PWR ON/OFF switch to ON. Power up the disk drive by setting the START/STOP switch to START, and wait 20 seconds for the heads to load.

6. Enter the head alignment cylinder address with the exerciser as follows:
   - For Model T25 Disk Drives, enter cylinder 248 address by setting exerciser BUS/BIT switches to hex F8 (Bit switches 128, 64, 32, 16, and 8 up).
   - For Model T50 and T80 Disk Drives, enter cylinder address 496 by setting exerciser BUS/BIT switches to hex 1F0 (Bit switches 256, 128, 64, 32, and 16 up).

7. Perform a seek to the cylinder by setting the exerciser FUNCTION SELECT switch to SKALT and pressing the SINGLE switch down several times until the drive heads move to the alignment cylinder. Verify the seek cylinder address by setting the exerciser DISPLAY SELECT switch to CAR. Display indicators should light in a hex F8 (T25) or 1F0 (T50, T80) pattern, as applicable.

Note

Wait for at least 30 minutes before proceeding with step 8 to allow the rotating CE pack to become thermally stable. If the CE pack was brought into the computer room environment less than 2 hours before use, wait for 1 hour before proceeding.

8. Set the exerciser DISPLAY SELECT switch to SEQUENCE and the FUNCTION SELECT switch to READ. The three low-order bits of the SEQUENCE display show the head selected and should be out (Head 0 address). If any other head address is displayed, press the exerciser RSTHD switch down once to reset the head address count back to zero.

9. Set the meter scale switch on the head alignment meter to 1250 MICRO IN. and the DIBIT POLARITY switch to R2. Then activate the drive read gate by turning on the exerciser CONT switch.

10. Check the meter reading, and switch the meter scale switch to the most sensitive position possible without pinning the meter.

Note

For T25 drives, multiply all meter readings by 2. If the meter reading at switch position R2 is within the prescribed tolerance, set the DIBIT POLARITY switch to R1, take a second reading, and calculate the algebraic average of the two readings (R1 plus R2, divided by 2).

Record the meter reading or algebraic average of the R1 and R2 readings in plus or minus microinches for the head selected (Head 0 for the first record). Turn off the exerciser CONT switch.

11. Press the exerciser ADVHD switch once to step to the next head. The binary address of the active head shown by the SEQUENCE display should advance by one. (Pressing the RSTHD switch will reset the head address count back to zero.)

12. Repeat steps 9 thru 11 for each head until the off-center values of all five heads (0 thru 4) have been recorded. Any head that is outside the tolerances stated at the beginning of this procedure must be realigned to within ±50 microinches (T25) or ±25 microinches (T50, T80), as prescribed.

13. Begin realignment of out-of-tolerance heads by setting up a scope to observe the head alignment dibit signal. The drive card cage assembly will have to be raised for access to test points located on the Read/Write Matrix card.

SYNC:	Int	Pos	0.5 μsec/div	CHAN 1 only
CHAN:	1	Ac	20 mv/div	TP10 (Matrix card, T25 and T50) TP6 (Matrix card, T80)
CHAN:	2	Ac	20 mv/div	TP11 (Matrix card, T25 and T50) TP7 (Matrix card, T80)

MODE: Add; Invert Chan 2

14. Remove the transparent air shroud covering the carriage and heads, and insert the safety pin down through the hole in the top plate of the cam tower and into the carriage T-block assembly. See Figure 4-1.

CAUTION

Never place your hands or tools in the head carriage area without having the safety pin in place. If the carriage attempts to retract, remove all tools and the safety pin as quickly as possible to prevent a head crash. Also, never power down the disk drive or leave the drive unattended while the safety pin is installed.

15. Torque the mounting screw for the head to be aligned to 88 inch-ounces (i.e., click felt in the torque wrench handle); and then using an allen wrench, back off the mounting screw one-quarter turn.

16. Set the scale switch on the meter box to OFF, address the head being aligned, using the RSTHD and ADVHD switches on the exerciser, and turn on the exerciser CONT switch. A display resembling the aligned dibit signal shown in Figure 4-2 may or may not be seen on the scope.

Figure 4-2. Head Alignment Dibit Waveforms

17. Adjust the lead screw of the head alignment tool so that the round lug will fit into the T-block and the square lug will fit into the mount for the head being adjusted. Use the tool to adjust the head position for a balanced dibit pattern on the scope, as shown in Figure 4-2.

18. Set the meter scale switch to 500 MICRO IN., and adjust the head again until the meter shows less than ±100 microinches off center. Tighten the head mounting screw approximately 1/16 turn with the torque wrench.

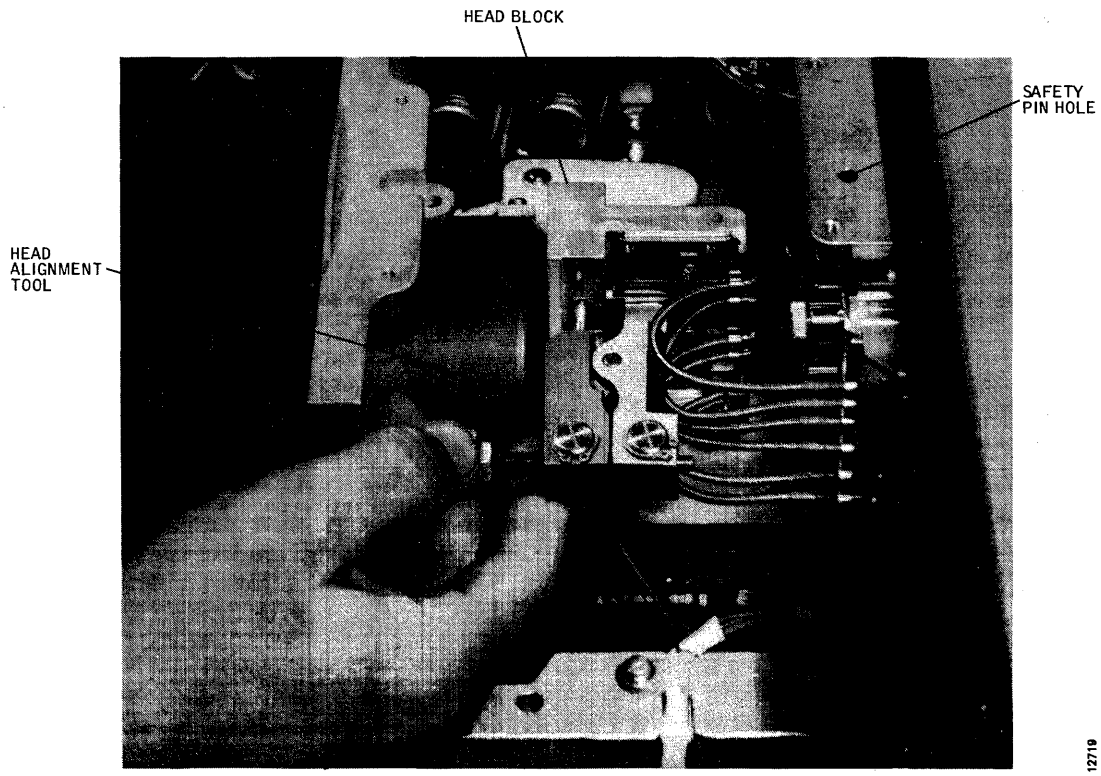


Figure 4-1. Head Alignment Tool in Use

CAUTION

Continue to observe the scope to make sure that the head remains over the dibit signal. If the dibit pattern is lost, exercise care that while attempting to regain it the head is not moved so far forward that the rear tang comes out of the T-block.

19. Set the meter scale switch to 100 MICRO IN., and adjust the head with the head alignment tool until the meter shows that the head is within alignment tolerance, as prescribed, and tighten the head mounting screw another 1/16 turn with the torque wrench.

20. Repeat step 19 two more times while checking the meter reading at both the R1 and R2 positions of the DIBIT POLARITY switch and averaging the two readings. The head mounting screw should now be torqued to 88 inch-ounces, and the meter should indicate that the head is 0 ±50 microinches (T25) or 0 ±25 microinches. If not, back off the head mounting screw 1/8 turn with an Allen wrench, and repeat this step.

CAUTION

Never attempt to position the head while the mounting screw is torqued to the full 88 inch-ounces. Damage to the mounting screw or to the head alignment tool may result.

21. Repeat steps 15 thru 20 for each head needing adjustment.

22. After all head adjustments have been made, remove the safety pin, turn off the exerciser CONT switch, and replace the transparent air shroud.

CAUTION

Never perform seek exercises with the drive without the transparent air shroud in place, during this or any other procedure. Overheating and failure of the linear motor may result.

23. Set the exerciser FUNCTION SELECT switch to SKRDM, and start random-seek exercising by turning on the CONT switch. Set the POSITION RATE control midrange for a moderate seek rate.

24. After a minimum of 2 minutes of random seek exercising (2000 seek operations, minimum), turn off the CONT switch, and press the REZERO switch on the exerciser.

25. Reposition the heads to the prescribed head alignment cylinder, as per steps 6 and 7. Allow 5 minutes for the pack to return to thermal stability before proceeding.

26. Set the exerciser FUNCTION SELECT switch to READ, and then turn on the CONT switch. A dibit signal should appear on the scope.

27. Address each head, in turn, using the exerciser ADVHD and RSTHD switches, and verify with the head alignment meter that all heads that were realigned have not moved outside of acceptable tolerances of ±150 microinches (T25) or ±75 microinches (T50, T80) from track center. If not, loosen and realign all out-of-tolerance heads by repeating this procedure, starting at step 17. Be sure to install the safety pin.

READ/WRITE SYSTEM ALIGNMENT (EARLY T80)

This procedure is applicable only to the GR21 type Data Separator card used in early Model T80 Disk Drives. All adjustment points are located on this card, which occupies slot 4 in the card cage. Some of the adjustments are interactive, making it necessary to perform all steps in the alignment procedure. These should be done in the order given. See Figure 4-3 for adjustment point locations.

CAUTION

Do not change Data Separator card adjustments indiscriminately. Most adjustments are critical, interactive, and were set at the factory under dynamic conditions to optimize error-free operation. Indiscriminate readjustment of such cards could cause them to perform marginally.

1. With power off, remove the Data Separator from card slot 4, and reinstall it on a card extender.

2. Turn on power, install a scratch pack, and set the START/STOP switch to START. Allow at least 15 minutes warmup before proceeding with alignment.

3. Measure the voltage at the emitter of transistor Q9 on the extended card, preferably with a digital voltmeter. It should be between +3.50 and +4.50 volts. Make a note of the exact reading.

4. Measure the voltage at the base of transistor Q9, and adjust clamp potentiometer R60 to set the base voltage exactly 200 millivolts below the emitter voltage noted in step 3.

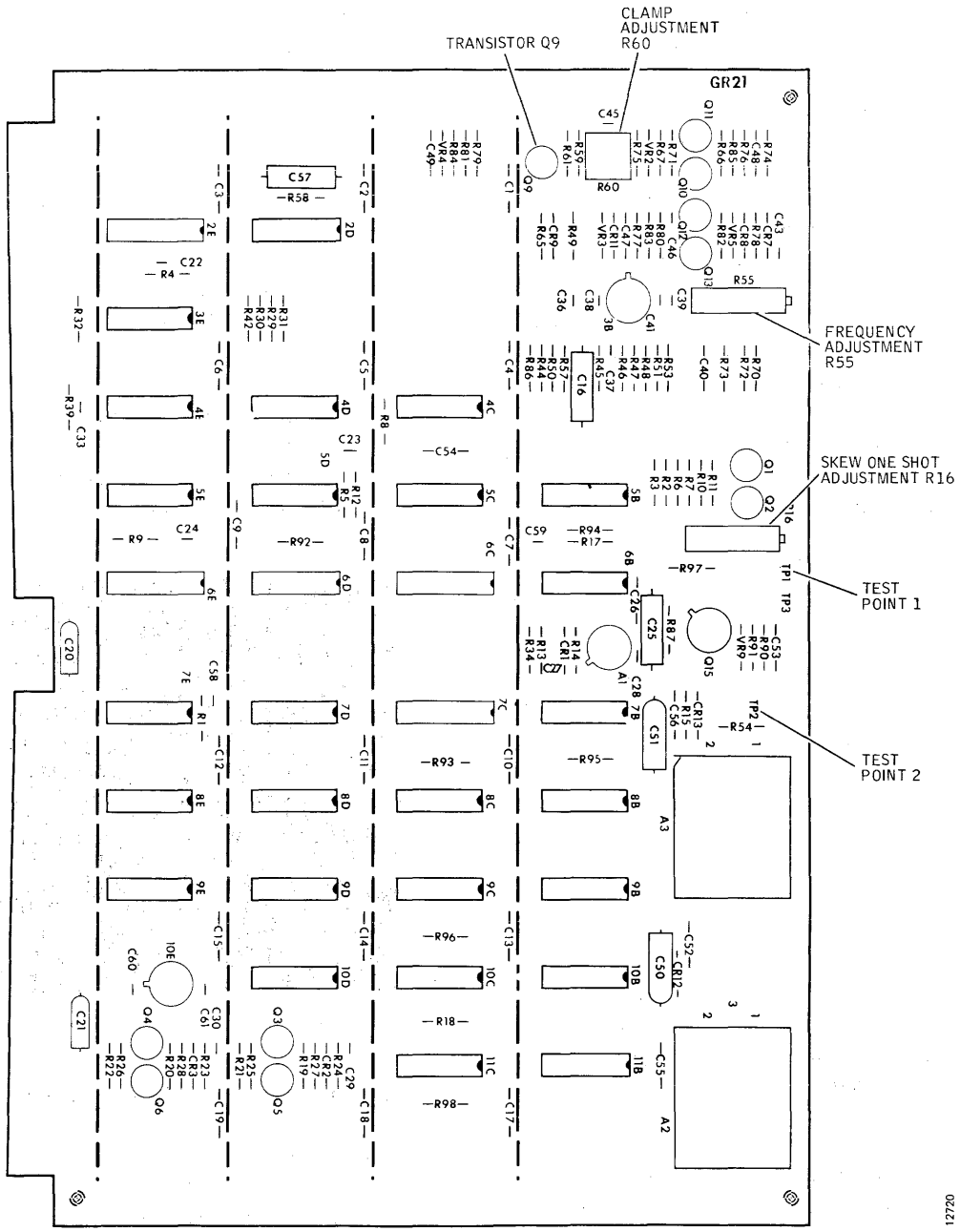


Figure 4-3. Data Separator Test and Adjustment Points (Early T80)

5. Power down the drive (START/STOP switch to STOP), and after the heads have retracted, open the card cage assembly and ground pin 3B09 to disable the servo system. Connect and adjust a scope to observe the 1F/ clock signal on channel 1 (card test point TP2).

SYNC:	Int	Pos	100 nsec/div	CHAN 1 only
CHAN:	1	Dc	2v/div	GR21 card TP2 (1F/)

MODE: CH1

6. Set the START/STOP switch to START. The drive should power up, but the heads should not load.

CAUTION

When manually loading or unloading the heads, do so in a positive and deliberate manner, without hesitation. If the heads are moved onto the pack too slowly, they could crash.

7. Remove the transparent air shroud covering the head carriage, and manually load the heads. Move the heads back behind the outer guard band into the head load zone, and check the cycle time of the Channel 1 waveform. It should be 103 ±4 nanoseconds at the 50-percent amplitude points. If not, adjust potentiometer R55 on the extended card to obtain a 103-nanosecond cycle time.

8. Turn on the 10X multiplier, if available on the scope, and roll the trace somewhere in the center. Move the heads back and forth by hand between the head load zone and the outer guard band. Notice that this back and forth movement of the heads causes a phase shift in the Channel 1 waveform as the oscillator alternates between its locked and free-run states. While still moving the heads, readjust potentiometer R55 to reduce this phase shift to a minimum.

9. After the step 8 adjustment has been completed, manually retract the heads, set the START/STOP switch to STOP, and replace the transparent air shroud. After the disk pack has come to a stop, remove the ground jumper from pin 3B09, and reconnect and adjust the scope as follows for Skew One-Shot adjustment:

SYNC:	Int	Pos	100 nsec/div	TRIG
CHAN:	1	Dc	2v/div	GR21 card TP2 (1F/)
CHAN:	2	Dc	2v/div	GR21 card TP1 (DLYDATA)

MODE: Alternate

10. Set the START/STOP switch to START. The heads should load normally, and a display like Figure 4-4 should be seen on the scope.

Note

Pulses on Channel 2 must occur in every cycle of the Channel 1 signal and normally occur approximately in the center of every positive half cycle on Channel 1.

11. If the pulse repetition rate of the Channel 2 signal is only half normal (pulses occurring every second cycle rather than every cycle of the Channel 1 squarewave), turn potentiometer R16 on the edge of the extended card fully clockwise, and then adjust back counter-clockwise until a point is reached where the Channel 2 pulses are centered in every positive half cycle on Channel 1.

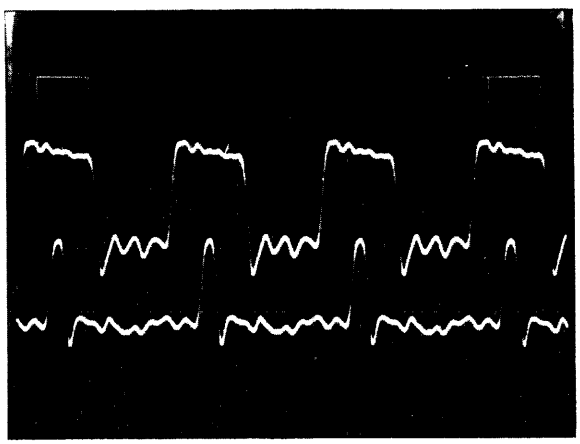


Figure 4-4. Skew One-Shot Display Waveform

12. Increase the scope sweep rate to 20 nanoseconds per division, and center the Channel 1 positive half cycle at the 50-percent amplitude points. See Figure 4-5. Fine adjust potentiometer R16 to position the leading edge of the Channel 2 pulse exactly center of the Channel 1 half cycle at its 50-percent amplitude point.

13. Read/write system alignment is now complete. Power down the disk drive, turn off ac power after the pack has braked to a stop, and return the Data Separator card to its normal position.

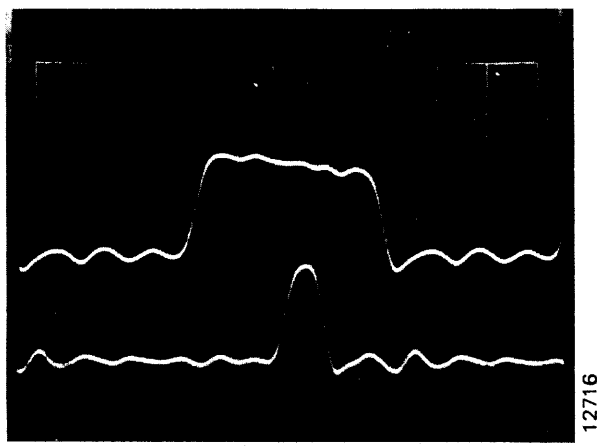


Figure 4-5. Skew One-Shot Adjustment Waveform

BRUSHES AND BRUSH DRIVE ASSEMBLY

Earlier production T25, T50, and T80 Disk Drives were provided with pack cleaning brushes that swept over the recording surfaces of the pack to dislodge dust and oxide during the power-up cycle prior to loading the heads. This feature has since been found to be unnecessary and is no longer included on current production machines. In fact, the factory now recommends that the brush tips be removed from all units equipped with brush drive assemblies to effectively defeat their function. However, maintenance procedures for servicing this assembly are provided here for those users who insist upon the brushes remaining operational.

The brush drive assembly is mounted directly on the air shroud assembly. However, access to all parts for checkout, adjustment, and replacement does not require removal of the air shroud. Simply remove the unit front cover. The brush drive assembly is located on the right-hand side of the unit, just in front of the sequence relay assembly. See Figure 4-6 for brush drive component locations.

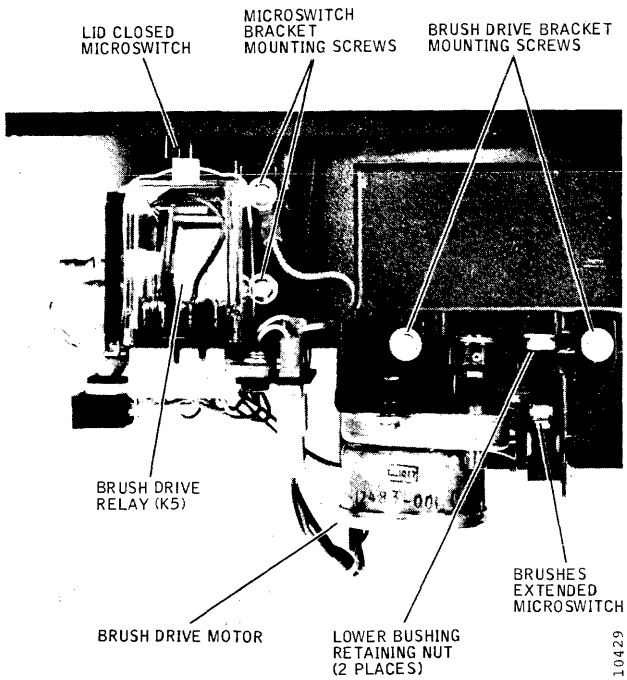


Figure 4-6. Brush Drive Component Locations

Inspecting Disk Cleaning Brushes

1. Carefully move the cleaning brushes (Figure 4-7) out of their recess by pulling the brush arm out slowly by hand.

2. Inspect the individual brushes for wear and dirt. If any brush shows indication of wear, contamination, or burning, replace the brush.

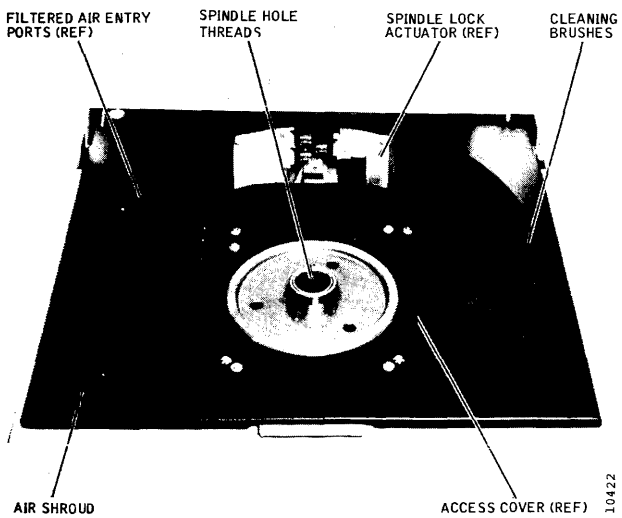


Figure 4-7. Disk Pack Area Components

Note

Before installing a replacement brush, check it for burrs or flashing, which might affect its proper seating. See Figure 4-8.

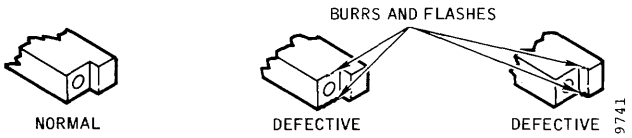


Figure 4-8. Brush Holder Defects

3. Inspect each set of brushes for evidence of incorrect brush-to-pack contact. See Figure 4-9. Incorrect contact is most often caused by a warped brush arm or one that has been aligned improperly.

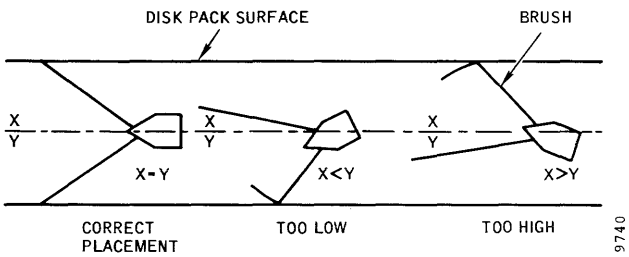


Figure 4-9. Brush Alignment Check

Brush Replacement

The pack cleaning brushes are replaced by simply pulling out the brush arm slowly so that the brush can be pulled off the end of the arm (press fit). However, before installing the replacement brush, check it for molding burrs and flashing. Push the arm back into the retracted position, again slowly, after replacement is completed.

Brush Arm Replacement

Usually the brush arm will need replacing only if it is warped or cracked. It too is replaced simply by removing the two screws that mount it to the shaft from inside the air shroud recess. Transfer or replace the brushes on the new arm, and reinstall the arm on the shaft. Make sure that the arm is pressed downward against the nylon spacers for correct vertical positioning.

Brush Drive Microswitch Adjustment

1. Set the PWR ON/OFF switch to OFF.

2. Remove the front cover.

3. Loosen the brush drive microswitch screws, and ensure that the brush arms are in the retracted position.

4. Move the microswitch toward the brush arms until switch contact transfers, and continue to move the microswitch approximately 1/16-inch. Tighten the screws.

5. Initiate a manual brush drive cycle by pushing the brushes slowly toward the spindle and then back until the brush drive microswitch transfers.

6. Ensure that the brush arms are completely out of the shroud area and are concentric with the shroud when the brush cycle is complete. Check that the microswitch trips just before the brush arms hit the mechanical stop.

7. Install the front cover.

Brush Motor Assembly Replacement

1. Set the PWR ON/OFF switch to OFF.

2. Remove the front cover.

3. Disconnect the brush drive motor and microswitch connectors.

4. Remove the two screws that attach the motor assembly bracket to the air shroud, and remove the motor and microswitch as a unit.

5. Remove the motor from the bracket.

6. To install the replacement brush motor and microswitch, reverse the procedure. The brush arm may have to be rotated to engage the groove and dog coupling between the motor shaft and the brush arm shaft before the mounting bracket screw holes line up.

7. Move the brush arm slowly to the fully retracted position, and perform the Brush Drive Microswitch Adjustment procedure.

Brush-to-Pack Alignment

Note

This procedure is to be performed only when there is evidence that the brush arm shaft is not parallel with the spindle centerline or when the entire air shroud assembly is replaced. It requires a special tool.

1. Set the PWR ON/OFF switch to OFF.

2. Remove the front cover.

3. From inside the disk pack area, remove the two screws that attach the brush arm to the shaft, and remove the brush arm.

4. Remove the brush motor assembly. Refer to the Brush Motor and Microswitch Replacement procedure. The brush arm shaft will drop out.

5. Remove any shim washers inside the brush arm recess and install a brush alignment tool over the spindle; extend the arm of the alignment tool inside the brush arm recess.

6. Loosen the two nuts that hold the lower bushing piece of the brush arm shaft.

7. Reinsert the brush arm shaft up through the lower bushing, through the hole in the alignment tool arm, and into the upper bushing.

8. With the shaft in place and aligned by tool, tighten the lower bushing nuts. Check the shaft for binding, and readjust it as necessary.

9. Measure the clearance between the lower surface of the alignment tool arm and the lower bushing by using feeler gauges. This determines the thickness of shim washers to be installed in step 11.

10. Remove the brush arm shaft and the alignment tool.

11. Place the necessary thickness of shim washers over the lower bushing hole, and reinsert the brush arm shaft up through the lower bushing and the shim pack and into the upper bushing.

12. Reinstall the brush arm and the two attaching screws to hold the brush arm shaft in place. All shim washers must be between the brush arm and the lower bushing for proper brush alignment.

CARRIAGE AND WAY ALIGNMENT

This procedure for carriage and way alignment is given here in lieu of a more recent procedure (drawing no. 18800-001) normally provided with the special alignment tool set. The later procedure is more definitive and should be used, if available.

Alignment of the carriage and way assembly to the rotating axis of the spindle is necessary whenever the carriage and way assembly is replaced, or when the alignment check shows the alignment to be out of tolerance. Special tools and a fair degree of skill and experience are required. For

these reasons, alignment by anyone other than factory trained personnel is discouraged.

CAUTION

The head-mounting T-block is factory aligned to the carriage. No attempt should be made to adjust the bearing surfaces of the way through careless tool handling.

Three mounting bolts hold the carriage and way assembly to the deck plate and secure the alignment in pitch, roll, and yaw aspects. A toothed leveling jack is located below the right-hand bolt. To alter carriage and way alignment, proceed as follows:

1. Set the PWR ON/OFF switch to OFF, and disconnect the ac power cable from the source.

2. Unload the disk pack, if installed, and remove the rear cover from the disk drive.

3. Remove the transparent air shroud, disconnect and remove all heads from the T-block, and store the heads safely.

4. Remove the maintenance access cover inside the air shroud (four slotted screws).

5. Remove the Carriage and Way Alignment Tool, part no. 13483-001, from its case and clean all mating and measuring surfaces with alcohol and Kimwipes. Wipe them dry.

6. Calibrate the four dial indicators on the tool by using the reference gauge block supplied with the tool as follows. See Figure 4-10.
   - Turn the cutout surface of the gauge block up, and position it to contact the bottom surface of the tool near its mounting point and the plunger of dial indicator A, making sure that the nylon stop is not touching the tool. With the gauge block held firmly to the tool, zero the indicator with one revolution of preload by moving the knurled bezel.
   - Calibrate dial indicator B in an identical manner to zero with one revolution of preload.
   - Next, press the cutout surface of the gauge block flat against the vertical surface of the tool to which indicators C and D are mounted. Applying pressure between the gauge block and the tool as shown in the figure, calibrate the two indicators to the numbers marked on the tool.

7. Clean the mating surfaces of the T-block and the measuring surfaces of the spindle with alcohol and Kimwipes. Wipe them dry.

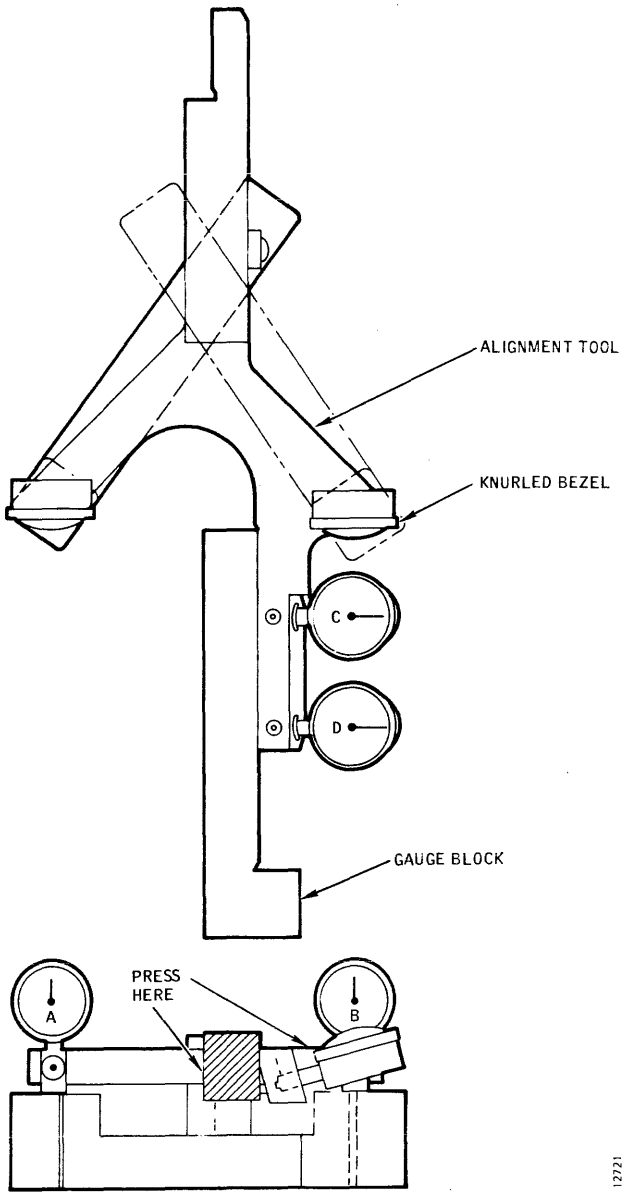


Figure 4-10. Calibration of Alignment Tool Indicators

8. Loosen the three bolts that attach the carriage and way assembly to the deck plate assembly, and tighten them just fingertight.

CAUTION

Great care must be taken when installing the alignment tool not to scratch the spindle or the carriage and way assembly and not to jamb the dial indicators.

9. Move the carriage and T-block assembly to mid-position on the way, and install the alignment tool on the carriage. Make sure that the alignment tool is well seated on the T-block and carriage, and tighten the securing screws to 80 inch-ounces with the head torque wrench.

10. Move the carriage forward carefully until the leveling dial indicators A and B make positive contact with the machined top surface of the spindle.

11. Using the T-handle Way Roll Adjustment tool, part no. 13484-001, fitted to the leveling jack gear, adjust the leveling jack until both leveling indicators both read the same (not necessarily zero).

12. Torque the three carriage and way mounting bolts equally in small increments with the Way Torque Driver, part no. 91516-001, to a full setting of 45 inch-pounds. Check that the leveling dial indicator readings are still within 0.0002 inch of each other. If not, loosen the bolts and repeat steps 11 and 12.

13. Loosen the three carriage and way mounting bolts again, but do not disturb the leveling jack setting. Position the carriage and tool so that dial indicator C or D is contacting the spindle hub at its widest point (highest indicator reading).

14. Gently move the way sideways, towards or away from the dial indicator to obtain a zero reading. Beware of false zero feadings due to double revolutions.

15. Carefully reposition the carriage so that the other dial indicator contacts the spindle hub at the same point, and repeat step 14. Continue making small adjustments in the position of the way until the average reading between the two indicators (higher reading minus lower reading, divided by two) is within 0.0002 inch of zero.

16. Begin tightening the three mounting bolts in turn by small increments until all three are torqued to 45 inch-pounds. Do not overtorque, or the deck plate will be damaged.

17. After the mounting bolts have been tighted, recheck all dial indicator readings to make sure alignment tolerances are within limits. If roll adjustment has been thrown out of tolerance, small corrections can cometimes be made by loosening the jack screw mounting bolt only, adjusting the jack screw slightly, and retorquing the bolt to 45 inch-pounds. Otherwise, loosen the bolts and repeat the alignment process.

18. When alignment is completed, move the carriage to mid-position, and remove the alignment tool.

19. Move the carriage back and forth over its full length of travel to check for bobbin or tach rod drag. No resistance or roughness should be felt. If bobbin drag is evident, perform the Motor Bobbin Alignment procedure.

20. Move the carriage to the retract position, and reinstall the access cover in the air shroud. Clean the air shroud of all dust or lint, and close the cover lid.

21. Clean and remount the heads on the T-block in their proper positions; use the head prepositioning tool for initial setting. Torque each head mounting screw to the full 80 inch-ounces. Reconnect all cable leads to the Read/Write Matrix and Servo Preamp boards, and clamp the cable connectors in place.

22. Perform the Head Alignment Checkout and Adjustment procedure.

23. Perform the Carriage and Way Alignment Check procedure. If carriage and way alignment is out of tolerance, this procedure must be repeated.

24. After carriage and way alignment and head alignment are completed, replace the transparent air shroud and the rear cover.

SECTION 5
MAINTENANCE AIDS

The information contained in this section is intended as a troubleshooting guide for maintenance personnel involved in maintaining the disk drives.

Disk drives have a set of problems unique to themselves. This section is subdivided into five basic subsections that describe the majority of disk drive malfunctions.

- Power-Sequencing Malfunctions
- Read/Write Malfunctions
- Spindle Malfunctions
- Interface Malfunctions
- Positioning Malfunctions

POWER-SEQUENCING MALFUNCTIONS

When the power and sequencing subsystems fail to function properly, the malfunction can be identified quickly by systematic symptom analysis. Listed below are typical symptoms and probable causes for each:

Symptom	Probable Cause
No dc power, blower motor off, and ac power switch on	• No ac input power • Ac fuses F1 and/or F2 open • Defective ac switch • Defective ac input filter
Blower motor off and dc power on	• Connector J23 • Blower motor
No dc power and blower motor on	• Connector J13 • Power transformer • Dc power supply
Drive motor off, blower motor on, and dc power on	• Dc unsafe or defective Logic III board • Defective relay K1, K2, or K3 • Drive Motor • Heads-extended microswitch • Lid-closed microswitch • Connector J22 • START/STOP switch
Brush motor will not cycle, blower motor on, and dc power on	• Defective Logic III board • Brush-extended switch • Defective relay K5 • Brush motor • Connector J31 or J32
Pack speed too slow	• Defective Logic III board • Drive belt • Spindle • Low ac input power
Unable to initiate power-up	• All circuit boards not in • Heads not retracted • Pack lid not closed • Defective START/STOP switch • Defective spindle drive motor
Brush assembly continues to cycle	• Brush drive microswitch not properly adjusted

READ/WRITE MALFUNCTIONS

This subsection is intended to provide maintenance personnel with information concerning the disk drive read/write system.

Symptom	Probable Cause
Read errors, all heads on drive	• Spindle grounding brush not making contact • Dc voltage at incorrect levels • Defective line receiver • Heads positioned at wrong cylinder. Run diagnostic to test the drive servo and positioning circuitry • Loose connectors on matrix card • Matrix card

Symptom	Probable Cause
	• Defective read differential amplifier • Defective read crossover detector • Defective delay line • Defective data receiver/ transmitter • Floating ground on base plate • Carriage not grounded • Ac and dc grounds not isolated
Unable to read on a particular head or heads	• Defective head • Head not being selected. Defective head-select circuitry • Head plug not making good electrical contact in preamp connector • Incorrect dc voltage levels • Incorrect head alignment • Dirty head
Intermittent read errors on a particular head or heads	• Head plug not making good electrical contact • Floating ground on base plate • Damaged head cable • Faulty head alignment • Incorrect or noisy dc voltages • Defective head-select circuitry • Dirty or defective head • Stretched or worn belt

SPINDLE MALFUNCTIONS

When the spindle system fails to function properly, the malfunction can be identified quickly by systematic symptom analysis. Listed below are some typical symptoms, and probable causes for each.

Symptom	Probable Cause
Ac fuse blows, or drive motor hums until thermal overload trips	• Spindle lock will not release
Cannot mount pack	• Binding spindle shaft, usually caused by dirty spindle shaft • Spindle locking assembly defective
Pack does not turn, no speed	• Belt off or slipping on pulley. Replace or adjust belt. • Dc unsafe condition
Audible noise	• Defective spindle bearing • Defective drive motor • Belt damaged • Belt inside out • Drive motor start winding not dropping out
Unable to remove pack from spindle	• Spindle-locking assembly

INTERFACE MALFUNCTIONS

In most cases, diagnostic programs will aid in isolating the failure and determining where the problem lies. Careful inspection of the interconnecting cables, receiver and driver modules, and logic modules necessary to perform specific interface functions will usually result in finding the cause of the problem.

When the interface fails to function properly, the malfunction can be identified quickly by systematic symptom analysis. Listed below are some typical symptoms, and probable causes for each.

Symptom	Probable Cause
Unable to respond to any address	• Defective signal • Logic II card • Defective radial interface cable
Drive unable to transfer control data	• Logic II card • Logic I card • Defective signal interface

POSITIONING MALFUNCTIONS

If the head positioning system fails to function properly, the malfunction can be quickly identified by systematic system analysis. Listed below are some possible symptoms and the probable cause of each.

Symptom	Probable Cause
No first seek on power up	• No pack on spindle • Circuit board loose or removed

Symptom	Probable Cause
	• Dc voltage unsafe • Spindle speed too slow • Speed transducer misadjusted or defective • Defective Logic III board • Defective heads-extended or brush-extended microswitch • Defective Logic II board • Emergency Retract relay missing or defective
First seek starts but retracts immediately	• Defective heads-extended microswitch • Defective Logic II board • Defective Servo Control board • Defective Servo Preamp board • Defective servo head
Seek to cylinder inoperative	• Drive not selected or Device Check • Present position or illegal cylinder addressed • Defective Logic I board • Defective Logic II board
Chronic seek incomplete condition	• Mechanical interference in positioning system • Defective heads extended microswitch • Defective Logic II board
Seek to cylinder unreliable	• Bad cylinder address bit • Defective Logic I board • Defective Servo Control board • Velocity control or PLO frequency control misadjusted (Servo Control board)
	• Defective disk pack
Track-following inoperative or unreliable	• Servo head defective or dirty • Defective Logic II board • Position or offset control misadjusted • Defective Servo Control board • Defective Servo Preamp board • Defective disk pack
Offset inoperative or faulty	• Defective Logic I board • Defective Logic II board • Defective Servo Control board
Head retract inoperative or faulty	• Defective Logic III board • Defective Logic II board • Defective Servo Control board
Emergency Retract	• Heads driven off rack • Dc voltage unsafe • Controller +5v not up • Circuit board loose or removed • Defective off-rack microswitch • Defective Servo Control board • Defective Logic III board • Defective Power Supply VP34 board
Crash seek into end stop	• Loose or broken tach rod • Defective Servo Control board

EXERCISE 1

1. INSTALL EXERCISER AS INDICATED IN T2000B EXERCISE TECHNICAL MANUAL. (PAGE 2-1)

2. PERFORM THE FOLLOWING OPERATIONS USING THE EXERCISER.

ALTERNATE SEEKS STEPPED	PAGE 2-4	EXERCISER
SEEKS FORWARD	PAGE 2-5	TECHNICAL
RANDOM SEEKS	PAGE 2-5	MANUAL

3. PERFORM THE FOLLOWING MANUAL OPERATIONS USING THE T2000B.

SINGLE SEEKS	PAGE 2-6	"
SET HEAD, ADDRESS REGISTER	PAGE 2-7	"

****
* INSTRUCTIONS FOR PERFORMING THE ADJUSTMENT PROCEDURES. (READ *
* THESE IN THEIR ENTIRETY BEFORE PROCEEDING TO EXERCISES.) *
****

4. REMOVE FRONT PANEL AND REAR COVER AS SHOWN ON PAGE 1-8 OF TRIDENT MAINTENANCE MANUAL.

5. UTILIZE THE MAINTENANCE MANUAL PROCEDURES WHILE DOING THE ADJUSTMENTS AND NOTING ANY SPECIAL INSTRUCTIONS IN THE TRIDENT LAB GUIDE. THESE WILL BE DONE IN THE ORDER SPECIFIED IN THIS LAB GUIDE.

6. IF YOU HAVE ANY QUESTIONS ON THIS LAB GUIDE, INDICATE SO TO THE INSTRUCTOR AND HE WILL PROVIDE HELP.

****
* REMEMBER TO USE CAUTION SO AS NOT TO SHORT ANY TEST POINTS. *
* SHORTING THESE POINTS MAY RESULT IN LOST LAB TIME FOR YOUR- *
* SELF AND OTHERS. *
****

7. IF THERE ARE ANY QUESTIONS THAT YOU ARE UNABLE TO ANSWER BECAUSE THE CIRCUITS HAVE NOT YET BEEN COVERED IN CLASS, PLEASE NOTIFY THE INSTRUCTOR, AND RETURN TO THEM ON A SUBSEQUENT DAY.

EXERCISE 2

DISASSEMBLE THE FOLLOWING ASSEMBLIES AND THAN REASSEMBLE THEM.

EXERCISE 7

SET UP SCOPE AS FOLLOWS:

SYNC	EXT	POS	3A19	EFWD
CHAN 1	DC	2V/DIV	3A05	TRKFL
CHAN 2	DC	2V/DIV	6B01	POSITION

SEEK BETWEEN CYLINDERS 000 AND 003.

WHAT IS THE AMPLITUDE OF POSITION WHEN TRKFL GOES HIGH?

_____V

WHAT CAUSES THE TRACK FOLLOW SIGNAL TO GO ACTIVE?

_____

_____

WHERE DOES THE POSITION SIGNAL ORIGINATE?

_____

WHAT DOES THE 0V LEVEL OF THE POSITION SIGNAL INDICATE?

_____

WHAT DOES THE PEAK AMPLITUDE OF THE POSITION SIGNAL INDICATE?

_____

EXERCISE 8

** READ/WRITE SYSTEM ALIGNMENT **

1. ALL ADJUSTMENTS FOR THE READ/WRITE SYSTEM ARE LOCATED ON THE 4A/B CARD AND WILL REQUIRE EXTENSION OF THE CARD FOR ACCESS. TURN AC OFF AND INSTALL 4AB CARD ON AN EXTENDER. THE READ/ WRITE ADJUSTMENTS START ON PAGE 3-10 OF THE MAINTENANCE MAN-UAL. THEY ARE IN THE PROPER SEQUENCE IN THE MANUAL. IF YOU HAVE ANY QUESTIONS PLEASE ASK YOUR INSTRUCTOR.

2. THE FIRST ADJUSTMENT IS CALLED THE CLAMP ADJUSTMENT (STEPS 1 THROUGH 4). YOU ARE HERE LIMITTING THE VOLTAGE APPLIED TO THE VCO FROM THE ERROR ANPLIFIER.

3. THE SECOND ADJUSTMENT YOU'LL BE MAKING IS THE VCO FREQUENCY ADJUSTMENT. THIS IS ADJUSTING THE FREE RUNNING FREQUENCY OF THE VCO TO MATCH THAT OF THE PLO WHEN THE HEADS ARE LOADED. THE REASON FOR THIS IS THAT MOST OF THE READ OPERATIONS ARE DONE ON THE SAME DRIVE THEY ARE WRITTEN ON.

4. THE THIRD ADJUSTMENT YOU WILL BE MAKING IS THE REFERENCE ONE-SHOT. THIS ADJUSTMENT IS NOT IN THE MANUAL AS A SEPARATE AD-JUSTMENT. INSERT THE FOLLOWING PROCEDURE BETWEEN STEPS 8 AND 9 ON PAGE 3-12.

   A. SYNC INTERNAL, POSITIVE, AND AT 20NS/DIV ON CHANN 2.
   B. WITH THE HEADS LOADED THE REFERENCE ONE-SHOT PULSE SHOULD BE 25NS +/-2NS.
   C. IF THIS REQUIREMENT IS NOT MET ADJUST R36 TO OBTAIN THE CORRECT TIMING.
   D. RESET YOUR SCOPE PER THE SETTINGS FOUND IN STEP 5.

5. STEPS 9 THROUGH 15 ARE CHECKING THE FINE TUNING OF THE REFER-ENCE ONE-SHOT. THIS IS DONE BY MALADJUSTING THE BIT CELL CLOCK AND SEEING IF THE REFERENCE ONE-SHOT CAN LOCK ONTO THE SELECT-ED FREQUENCY.

6. STEP 16 RESETS THE BIT CELL CLOCK TO IT'S CORRECT FREQUENCY.

7. STEPS 17 THROUGH 22 ARE THE SKEW ONE-SHOT ADJUSTMENT. HERE YOU ARE SETTING THE DATA AND WINDOW TIMING RELATIONSHIPS.

EXERCISE 3

1. POWER SUPPLY CHECKOUT PAGE 2-6. MEASURE THE VOLTAGES USING A DVM.

2. MEASURE THE +5DVC AT PIN 59 OR 60 ON ANY PCB CONNECTOR IN THE CARD CASE. THE VOLTAGE SHALL BE +4.75 TO +5.25 VOLTS.

** SERVO ALIGNMENT **

1. SERVO ALIGNMENT REQUIRES THAT THE 6AB CARD BE EXTENDED. THIS CARD WILL BECOME WARM IF EXTENDED AND THE DRIVE IS SEEKING FOR A LONG TIME PERIOD. DO NOT ALLOW THE DRIVE TO DO CONTINUOUS SEEKS WHILE YOU ARE NOT ACTUALLY SCOPING THE SIGNALS.
2. PLO FREQUENCY ADJUSTMENT
   A. FOLLOW THE SEQUENCE FOR THIS ADJUSTMENT FOUND ON PAGE 3-8.

****
* USE CAUTION IN LOADING THE HEADS. *
****

   B. ON WHAT LOGIC DIAGRAM IS THIS ADJUSTMENT SHOWN?

      LD _____

3. TRACK OFFSET ADJUSTMENT
   A. THIS ADJUSTMENT IS FOUND ON PAGE 3-10.
   B. INCREASE SCOPE GAIN TO .2V/DIV AND ADJUST SO THE ZERO VOLT LINE IS IN EXACT CENTER OF WAVEFORM.
   C. RECHECK AGAIN AFTER SEEKING TO AN ODD AND EVEN CYLINDER.

4. POSITION BALANCE ADJUSTMENT
   A. WHEN ADJUSTING THIS ON A DS25 THE POSITION SIGNAL IN A THREE CYLINDER SEEK MUST BE + AND - 2VP-P. OR BOTH THE PLUS AND MINUS EXCURSIONS ON THE SCOPE MUST BE EQUAL. BY MALADJUSTING THE POT R80 YOU CAN HAVE A +1V AND A -3V POSITION SIGNAL.
   A. INCREASING THE SEEK RATE ON THE EXERCISER WILL GIVE A BETTER PRESENTATION ON THE SCOPE.
   B. THIS PROCEDURE IS FOUND ON PAGE 3-10.
   C. SINCE THIS SIGNAL IS SOMEWHAT DIFFICULT TO SEE, AN ALTERNATE METHOD OF SEEING THIS IS TO USE DELAYED SWEEP AND LOOK AT THE START OF THE SECOND SEEK. IF YOU HAVE ANY TROUBLE WITH SETTING UP DELAYED SWEEP CALL YOUR INSTRUCTOR OVER.

5. SEEK VELOCITY ADJUSTMENT
   A. THIS PROCEDURE IS FOUND ON PAGE 3-9.
   B. ON WHAT LOGIC DIAGRAM IS THIS SIGNAL FOUND?

      LD _____

EXERCISE 4

```
*********************************************
* STOP THE EXERCISER FROM SEEKING WHEN      *
* NOT ACTUALLY VIEWING WAVEFORMS.  SERVO    *
* CARD SETS VERY WARM WHEN EXTENDED.        *
*********************************************
```

CONNECT SCOPE AS FOLLOWS:

SYNC	INT	POS	CHAN 1	
CHAN 1	DC	2V/DIV	03A50	SKENA
CHAN 2	DC	2V/DIV	03A05	TRKFL
MODE	CHOPPED			

INSTALL DISK PACK AND POWER UP DRIVE. SET UP EXERCISER TO SEE ALTERNATELY BETWEEN CYLINDERS 000 AND 128. ADJUST THE POSITION ON THE EXERCISER FOR ONE SEEK EVERY 100 MS.

HOW WIDE IS SKENA?

_____ SEC.

HOW WIDE IS TRKFL?

_____ SEC.

VARY THE POSITION RATE.

DOES WIDTH ON SKENA CHANGE?

_____

MOVE CHAN 2 PROBE TO 03A29 SKSTGT/ AND TRIGGER NEGATIVE ON CHAN 2 ONLY.

HOW WIDE IS THE NEGATIVE PORTION OF THIS CHAN 2 SIGNAL?

_____SEC. (A VERY SHORT PULSE)

NOW MOVE CHAN 1 TO 3A06 SETCYL. SYNC INTERNAL POS ON CHAN 1.

HOW WIDE IS SETCYL?

_____SEC.

EXERCISE 5

SET UP SCOPE AS FOLLOWS:

SYNC	EXT	POS	03A19	FWD
CHAN 1	DC	2V/DIV	6B01	POSITION
CHAN 2	DC	2V/DIV	3B22	UTH
MODE	CHOPPED			

SET UP EXERCISER FOR ALTERNATE SEEKS BETWEEN CYCLINDERS 000 AND 005.

HOW MANY POSITIVE PULSES ARE ON CHAN 2?

_____

SET UP THE EXERCISER TO DO ALTERNATE SEEKS BETWEEN CYLINDERS 000 AND 001.

CHAN 2 GOES POSITIVE WHEN CHAN 1 IS AT _____VOLTS.

CHAN 2 GOES NEGATIVE WHEN CHAN 1 IS AT ----------VOLTS.

SET UP SCOPE AS FOLLOWS:

SYNC	INT	POS	CHAN 1	
CHAN 1	DC	2V/DIV	03A19	EFWD
CHAN 2	DC	2V/DIV	06B01	POSITION

WITH THE EXERCISER SEEK BETWEEN CYLINDERS 000 AND 003. ADJUST THE RATE TO SEE BOTH FORWARD AND REVERSE SEEKS.

WHILE GOING FORWARD BETWEEN CYLINDERS 000 AND 001 THE POSITION SIGNAL ENDS (POSITIVE) OR (NEGATIVE)?

NOW WHILE GOING REVERSE BETWEEN CYLINDERS 001 AND 000 IS THE POSITION SIGNAL ENDS (POSITIVE) OR (NEGATIVE)?

WHY THE DIFFERENCE, IF ANY?

_____

EXERCISE 6

SET UP SCOPE AS FOLLOWS:

SYNC	INT	POS	CHAN 1	
CHAN 1	DC	2V/DIV	05B14	IDX
CHAN 2	DC	2V/DIV	06A55	GAPCLK

WHAT IS THE CYCLE TIME OF SIGNAL ON CHAN 2?

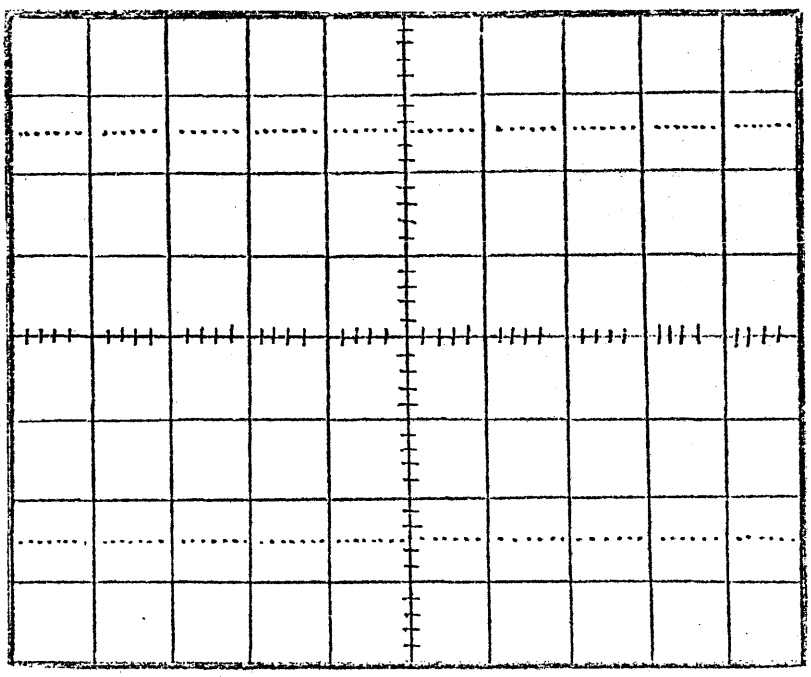
_____SEC

SET MODE TO ALTERNATE AND CHANGE SWEEP TIME TO 2MS/DIV. USING DELAYED SWEEP, LOOK AT CHAN 2 JUST BEFORE SECOND PULSE ON CHAN 1.

HOW MANY MISSING POSITIVE PULSES ARE THERE ON CHAN 2?

_____

DRAW BOTH CHAN 1 AND CHAN 2 BELOW.



EXERCISE 9

1. PERFORM A STORE REGESTER COMMAND ON THE DRIVE ASSIGNED TO YOU BY THE LAB INSTRUCTOR. ENTER THE COMMAND WORDS YOU USED IN COLUMN A BELOW. IN COLLUMN B ENTER THE STATUS RECEIVED AFTER THE COMMAND WAS EXACUTED.

A		B	
WORD 0	_____	WORD 0	_____
WORD 1	_____	WORD 7	_____
WORD 2	_____	STORED WORD 1	_____
WORD 3	_____	STORED WORD 2	_____
WORD 4	_____	STORED WORD 3	_____
WORD 5	_____		
WORD 6	_____		
WORD 7	_____		

2. PERFORM A WRITE FORMAT COMMAND TO THE DRIVE. RECORD THE COMMAND WORDS YOU USED IN COLUMN A AND THE STATUS RECEIVED BACK IN COLUMN B AFTER TO OPERATION WAS COMPLETED.

A		B	
WORD 0	_____	WORD 0	_____
WORD 1	_____	WORD 7	_____
WORD 2	_____		
WORD 3	_____		
WORD 4	_____		
WORD 5	_____		
WORD 6	_____		
WORD 7	_____		

EXERCISE 10

1. PERFORM A SEEK COMMAND USING THE SYSTEM DESIGNATED BY YOUR LAB INSTRUCTOR. RECORD THE COMMAND WORDS USE TO DO THIS OPERATION IN COLUMN A AND WHEN THE OPERATION IS COMPLETED, RECORD THE STATUS WORDS 0 AND 7 IN CLOUMN B. FINALLY EXPLAIN THE MEANING OF THESE TWO STATUS WORDS RECORDED IN COLUMN B.

A	B
WORD 0 _____	WORD 0 _____
WORD 1 _____	WORD 7 _____
WORD 2 _____	
WORD 3 _____	
WORD 4 _____	
WORD 5 _____	
WORD 6 _____	
WORD 7 _____	

EXPLAINATION: _____

_____

2. PERFORM A REZERO OPERATION TO THE DISK AND RECORD THE COMMANDS USED. MAKE SURE TO WATCH THE DRIVE TO INSURE THAT IT REALLY DOES A REZERO.

WORD 0 _____	WORD 4 _____
WORD 1 _____	WORD 5 _____
WORD 2 _____	WORD 6 _____
WORD 3 _____	WORD 7 _____

DEFINE THE STATUS FOUND IN THE DRIVE AND CONTROLLER STATUS WORDS.

_____

_____

REQUIRED TOOLS FOR TRIDENT MAINTENANCE AND INSTALLATION

TI PART NO.	VENDOR P/N	DESCRIPTION
943849-1001	18327-001	T-2000B EXERCISER
" -1002	17335-001	T-2001A ALIGNMENT METER
" -1007	14975-002	DS200 CE ALIGNMENT PACK
" -1008	16988-201	DS200 SCRATCH PACK
" -1009	13306-001	TOOL KIT #1 (NOTE 1)
" -1010	17209-001	HEAD ALIGNMENT PLIERS
" -1011	97769-001	HEAD PRE-POSITIONING TOOL
" -1012	96803-001	HEAD CAMMING TOOL
" -1013	11521-001	TORQUE WRENCH
" -1014	97722-001	SAFETY PIN
" -1015	99496-001	RAIL CLEANING TOOL
" -1016	13445-001	TACH ROD INSERTION TOOL
" -1018	12427-001	CARD EXTENDER
" -1019	10076-001	HEAD SUPPORT TOOL
" -1020	79213306	TRIDENT TOOL KIT CASE (NOTE 2)
943850-1005	12541-001	DS25/50 CE ALIGNMENT PACK
" -1006	12540-001	DS25/50 SCRATCH PACK

NOTE 1: TOOL KIT #1 INCLUDES PART NOS. 943849-1009 THROUGH 943849-1019.

NOTE 2: THE TRIDENT TOOL CASE CONTAINS THE FOLLOWING: PART NOS. 943849-1001,-1002, AND -1010 THRU -1019.

DS25/50 SIGNATURE LIST

+18VDC	THIS IS THE UNREGULATED OUTPUT OF DROPPING RESISTORS FED FROM THE +30VDC.	LD9.1
+30VDC	THIS IS THE UNREGULAGED +30VDCV FROM THE POWER SUPPLY'S RECTIFIER.	LD9.0
+5V	THE +5VDC PROVIDED FOR ALL BOARDS AS VCC AND IS REGULATED ON THE 4A/B CARD.	LD9.1
+5VDC	THIS IS THE VCC REGULATED ON THE 5A/B CARD.	LD9.1
+9VDC	THE +9VDC UNREGULATED FROM THE POWER SUPPLY	LD9.0
-18VDC	THIS IS THE UNREGULATED OUTPUT OF DROPPING RESISTORS FED FROM THE -30VDC.	LD9.1
-30VDC	THIS IS THE -30DC OUTPUT FROM THE RECTIFIER OF THE POWER SUPPLY AND UNREGULATED.	LD9.0
1.6MHZ	A SERVO CONTROL CLOCK SIGNAL.	LD4.1
14VAC	THE OUTPUT OF THE LINE TRANSFORMER ON THE 115V MODELS ONLY.	LD9.0
2FE	2F EARLY IS TWICE THE FREQUENCY OF F AND IS STROBED 11NS EARLY.	LD6.2
2FL	2F LATE IS TWICE THE F FREQUENCY AND IS DELAYED BY 11NS FOR PRE-STRESSING AND STROBING DATA.	LD6.2
2FOT	2F ON TIME IS THE NOMINAL 2F STROBE SIGNAL.	LD6.2
30VAC	THE OUTPUT OF THE LINE TRANSFORMER.	LD9.0
403KHZ	A SERVO CONTROL CLOCK SIGNAL.	LD4.1
806KHZ	A SERVO CONTROL CLOCK SIGNSL.	LD4.1
ADMDET	ADDRESS MARK DETECTED IS A 17US PULSE SENT TO THE CONTROLLER WHEN AN ADDRESS MARK HAS BEEN READ.	LD6.4
ADMK	THE COMMAND USED TO READ OR WRITE AN ADDRESS MARK. CONTROL TAG AND BUS 4.	LD1.3
AGC	AUTOMATIC GAIN CONTROL IS USED TO CONTROL THE GAIN OF THE SERVO PREAMPLIFIER FOR A STEADY OUTPUT.	LD4.2

AMCT	ADDRESS MARK COUNT IS ACTIVE WHEN A READ OR WRITE ADRESS MARK IS IN PROGRESS AND STAYS ACTIVE FOR 3.7US.	LD6.4
AMDRIVEP	AMPLIFIER DRIVE PLUS IS THE OUTPUT OF THE SERVO AMPLIFIER CONTROL CIRCUITS AND WILL DRIVE THE BOBBIN IN THE FORWARD DIRECTION.	LD3.7
AMPDRIVEM	AMPLIFIER DRIVE MINUS IS THE OUTPUT OF THE SERVO AMPLIFIER CONTROL CIRCUITS AND WILL DRIVE THE BOBBIN IN THE REVERSE DIRECTION.	LD3.7
AMPDIBP-M	AMPLIFIED DIBITS PLUS/MINUS IS THE AMPLIFIED SERVO HEAD SIGNAL.	LD4.0
ATTEN	ATTENTION IS AN INTERRUPT TO THE CONTROLLER.	LD8.0
BRAKE	THIS IS USED TO OPERATE THE DC BRAKE OF THE SPINDLE DRIVE MOTOR.	LD2.2
BRAKEPICK	THE SIGNAL WHICH TURNS ON THE BRAKE TRANSISTOR Q1.	LD2.3
BRSHEXTSW	THIS COMES FROM THE BRUSHES EXTENDED SWITCH IN THE EARLIER MODELS AND IS NOT USED NOW.	LD2.0
BUS0-9	THE BUS LINE FROM EITHER THE EXERCISER OR THE CONTROLLER USED TO OPERATE THE DRIVE.	LD1.2

BUS LINE	SETCYLTAG	SETHDTAG	CONTROLTAG
BUS 0	CAR 512	----	STROBE LATE
BUS 1	CAR 256	----	STROBE EARLY
BUS 2	CAR 128	OFFSET	WRITE
BUS 3	CAR 064	OSFWD	READ
BUS 4	CAR 032	----	ADDRESS MARK
BUS 5	CAR 016	----	RESET HD ADR REG
BUS 6	CAR 008	----	DEVICE CHECK RESET
BUS 7	CAR 004	HAR 4	HEAD SELECT
BUS 8	CAR 002	HAR 2	REZERO
BUS 9	CAR 001	HAR 1	HEAD ADVANCE

CAR*S	CYLINDER ADDRESS REGISTER SET LOCKS THE NEW ADDRESS INTO THE CAR AT THE FALL OF THE SET CYLINDER TAG LINE.	LD3.4
CAR001-512	THESE ARE THE CYLINDER ADDRESS REGISTER OUTPUTS.	LD3.5
CARWIZ1,2,4	CYLINDER ADDRESS REGISTER WRITE CURRENT ZONES ARE THE CONTROLING SIGNALS FOR THE WRITE CURRENT ZONING.	LD3.5
CNTENA	THIS IS THE OUTPUT OF THE SEQUENCE COUNTER USED DURING POWERING UP OR DOWN.	LD2.2

CNTLRPS	THE +5VDC PROVIDED BY THE CONTROLLER FOR PULL-UP CURRENT IN THE TERMINATOR.	LD1.1
CONTROLTAG	THE CONTROL TAG FROM EITHER THE EXERCISER OR CONTROLLER.	LD1.2
DATA+PLO	DATA OR PLO IS THE OR'ED DATA OR PLO GATED BY READ.	LD6.2
DATAE	DATA EARLY IS THE PRESTRESSED DATA EARLY BY 11NS.	LD6.5
DATAL	DATA LATE IS THE OUTPUT OF THE PRESTRESS CIRCUITS WHICH IS SHIFTED 11NS LATE.	LD6.5
DATA/SYNC	DATA PHASE SYNC IS A 4.65US PULSE PRODUCED BY READ COMMAND AND IS USED TO IDENTIFY 1'S AND 0'S.	LD6.4
DATAOT	DATA ON TIME IS THE DATA OUT OF THE PRESTRESS CIRCUITS WHICH HAS NOT BEEN SHIFTED.	LD6.5
DCUSF	DC UNSAFE IS AN ERROR SIGNAL REAULTING FROM A LOSS OR DEVIATION OF ONE OF THE FOLLOWING VOLTAGES. +5VDC, +12VDC, -12VDC, OR CONTROLLER'S +5VDC.	LD7.1
DEGATE	THE SIGNAL IN THE DRIVE WHICH CONNECTS THE EXERCISER TO THE DRIVE INSTEAD OF THE CONTROLLER.	LD1.1
DEVCK	DEVICE CHECK IS AN ERROR CONDITION CAUSED BY VARIOUS FAILURES AND REQUIRES OPERATOR INTERVENTION.	LD7.0
DEVCK*R	THE RESET FOR DEVICE CHECK FROM CONTROL TAG AND BUS BIT 6.	LD1.3
DEVCK*S	DEVICE CKECK SET IS PRODUCED IF A SEEK IS ATTEMPTED WHILE INHIBIT SEEK START IS ACTIVE.	LD7.0
DEVCKIND	DEVICE CHECK INDICATOR IS THE RED LAMP ON THE OPERATOR PANEL WHICH WILL LIGHT ON DEVICE CKECK.	LD7.0
DIF*C	DIFFERENCE CLOCK IS GENERATED ONCE FOR EACH CYLINDER CROSSED AND IS USED TO DECREMENT THE DIFFERENCE COUNTER.	LD3.3
DIF*S	DIFFERENCE SET IS A 350NS PULSE GENERATED AT THE RISE OF SET CYLINDER TAG AND USED TO LOAD THE DIFFERENCE COUNTER WITH THE SUBTRACTOR'S OUTPUT.	LD3.4
DIF001*S-512*S	THESE ARE THE SUBTRACTOR'S OUTPUTS TO THE DIFFERENCE COUNTER.	LD3.5

DIF001-512	THESE ARE THE OUTPUTS OF THE DIFFERENCE COUNTER TO THE D/A CONVERTER.	LD3.6
DRVMTR	THE SIGNAL WHICH OPERATES THE K1 DRIVER TRANSISTOR.	LD2.3
DZERO	DIFFERENCE EQUALS ZERO SAYS THE DIFFERENCE COUNTER IS EMPTY.	LD3.6
DZSKGT	DIFFERENCE ZERO SEEK START GATE TELLS THE MEANS THE DRIVE WAS GIVEN A SEEK COMMAND TO THE CYLINDER AT WHICH HE WAS ALREADY SETTING.	LD3.0
EBRAKE	THE STATUS LINE TO THE EXERCISER SAYING THE BRAKE IS ON.	LD2.2
EBRUSHEXT	STATUS TO THE EXERCISER SAYING THE BRUSHES ARE EXTENDED.	LD2.4
EBUS0-9	THE BUS LINES FROM THE EXERCISER WHICH WITH THE TAG LINES CONTROLS THE OPERATION OF THE DRIVE.	LD1
ECONTROLTAG	THE TAG LINE FROM THE EXERCISER USED WITH THE BUS LINES TO OPERATE THE DRIVE IN VARIOUS COMMAND MODES.	LD1
EDCUSF	THE DC UNSAFE STATUS SENT TO THE EXERCISER.	LD7.1
EDEVCKRW	A DEVICE CHECK READ/WRITE ERROR TO THE EXERCISER.	LD7.0
EDRVMTR	THE STATUS SIGNAL TO THE EXERCISER WHICH SAYS THE SPINDLE DRIVE MOTOR IS ON.	LD2.3
EEMRET	THE EMERGENCY RETRACT STATUS ISSUED TO THE EXERCISER.	LD7.1
EFWD	THE SIGNAL FORWARD SENT TO THE EXERCISER AS STATUS.	LD3.0
EHAR1,2,4	THE HEAD ADDRESS LINES RETURNED TO THE EXERCISER SHOWING THE HEAD BEING USED.	LD1.3
EHDEXT	STATUS TELLING THE EXERCISER THE HEADS ARE EXTENDED.	LD2.0
EHDLD	THE STATUS TO THE EXERCISER WHICH SAYS THE HEADS ARE LOADED ON THE PACK.	LD3.3
EIDX	THE INDEX LINE FROM THE DRIVE TO THE EXERCISER.	LD5.1
ELDSP	THE LINE FROM THE DRIVE TO THE EXERCSIER SAYING LOAD SPEED OPERATION IS ACTIVE.	LD3.0

ELIDCLSD	THE STATUS SIGNAL TO THE EXERCISER SAYING THE LID IS CLOSED.	LD2.0
EMERT	EMERGENCY RETRACT IS AN ERROR CONDITION RESULTING IN THE REMOVAL OF THE HEADS FROM THE PACK AND THE LOSS OF READY.	LD7.1
EMRLYM	THIS IS THE LINE DRIVER OUTPUT FOR THE EMERGENCY RETRACT RELAY.	LD7.1
EOC	END OF CYLINDER IS A STATUS SIGNAL TO THE CONTROLLER WHICH SAYS THE HEAD SELECTED DOES NOT EXIST.	LD8.0
EOFFSET	THE OFFSET STATUS SET BACK TO THE EXERCISER.	LD3.2
EOSERR	THE ERROR STATUS OF NOT READY AND SETTING HEAD TAG.	LD7.0
ERDY	THE STATUS LINE FROM THE DRIVE TELLING THE EXERCISER HE'S READY.	LD3.2
EREAD	THE STATUS FROM THE DRIVE TELLING THE EXERCISER HE IS IN A READ OPERATION.	LD1.3
ERETHD	THE SIGNAL TELLING THE EXERCISER THE RETRACT HEADS SIGNAL IS ACTIVE.	LD3.1
ESCILLOS	THE ERROR SIGNAL FROM THE DRIVE INDICATING TO THE EXERCISER A SEEK OPERATION DURING OFFSET OR A SEEK TO AN ILLEGLE CYLINDER WAS TRIED.	LD7.0
ESCRDY	AN ERROR LINE INDICATING TO THE EXERCISER THE DRIVE WAS NOT READY WHEN A SEEK OPERATION WAS ATTEMPTED.	LD7.0
ESETCYLTAG	THE TAG LINE FROM THE EXERCISER USED TO PERFORM A SEEK OPERATION.	LD1
ESETHDTAG	THE TAG LINE FROM THE EXERCISER WHICH SETS IN A HEAD ADDRESS OR OFFSET COMMAND.	LD1
ESKENA	THE SEEK ENABLE STATUS SENT TO THE EXERCISER.	LD3.0
ESKINC	THE ERROR SIGNAL TO THE EXERCISER WHICH SAYS SEEK INCOMPLETE IS ACTIVE.	LD7.2
ESKINCENA	THE ENABLING LINE FROM THE EXERCISER WHICH ALLOWS THE SEEK INCOMPLETE COUNTER TO RUN.	LD1.0
ESPEED	THE STATUS LINE INDICATING THE DRIVE IS HAS AT LEAST 85% OF THE SPINDLE SPEED.	LD2.5

ET25	TELLS TE EXERCISER THAT THE DRIVE IS A T25.	LD1.0
ET80	THE LINE TO THE EXERCISER TELLING IT HE'S CONNECTED TO A T80 DISK DRIVE.	LD6.0
ETRKFL	THE SIGNAL TO THE EXERCISER INDICATING THE DRIVE IS IN TRACK FOLLOW MODE.	LD3.0
EWRDONLY	AN ERROR SIGNAL FROM THE DRIVE SAYING THE EXERCISER IS TRYING TO WRITE WHEN THE DRIVE IS IN READ ONLY MODE.	LD7.0
EWRT	STATUS TO THE EXERCISER SAYING THE DRIVE IS IN A WRITE OPERATION.	LD1.3
EWRT*C	THE WRITE DATA LINE FROM THE EXERCISER TO THE DRIVE.	LD1
EWRTOS	AN ERROR SIGNAL TO THE EXERCISER SAYING OFF-IS ACTIVE AND A WRITE OPERATION WAS ATTEMPTED.	LD7.0
EWRTRDY	ERROR STATUS TO THE EXERCISER SAYING THE DRIVE IS NOT READY AND YOU ARE TRYING TO WRITE.	LD7.0
EWRTUTH	THE ERROR STATUS TO THE EXERCISER TELLING THAT THE UPPERTHRESHOLD SIGNAL IS ACTIVE DURING A WRITE COMMAND.	LD7.0
EXERIN	THE SIGNAL FROM THE EXERCISER INDICATING TO THE DRIVE THAT THE EXERCISER IS PLUGGED INTO IT.	LD1
F	F IS THE 155NS BIT CELL OR THE DATA CLOCK.	LD6.2
FASTLOCK	FAST LOCK IS USED TO LOCK UP THE VCO FASTER DURING A READ OPERATION. IT IS ACTIVE FOR 4.65US.	LD6.4
FS	FIRST SEEK INDICATES THAT THIS IS A FIRST SEEK.	LD3.1
FSEL	F SELECT IS THE SELECTED PHASE OF THE F CLOCK USED FOR STROBING IN DATA FROM THE CONTROLLER DURING A WRITE OPERATION.	LD6.2
FSYNC	F SYNC IS THE PULSE PRODUCED TO INVERT THE F CLOCK IF 1'S AND 0'S ARE TURNED OVER.	LD6.3
FULLSPEED	FULLSPEED SAYS THE SEQUENCE COUNTER HAS REACHED A FULL COUNT OF 15.	LD2.2
FWD	FORWARD IS SET FROM THE CARRY OUT OF THE SUB-TRACTOR AND PRODUCES SERVO FORWARD SIGNAL.	LD3.0

FWD*S	FORWARD SET IS THE TERM USED TO SET THE FORWARD FF AND IS GENERATED FROM THE CARRY OUT.	LD3.4
GAPCLK	GAP CLOCK IS PRODUCED FORM THE DIBITS AND IS USED TO DETECT INDEX.	LD4.2
HAR*S	THE TERM DEVELOPED FROM SET HEAD TAG.	LD1.2
HAR1,2,4	THIS IS THE HEAD ADDRESS REGISTER OUTPUT AND USED TO SELECT ONE OF THE FIVE HEADS.	LD1.3
HDDLY*C	THIS IS THE CLOCK USED TO COUNT UP THE HEAD LOAD DELAY COUNTER AND HAS A FREQUENCY OF 3.14KHZ.	LD2.1
HDEXT	HEADS EXTENDED TELLS THE LOGIC THE HEADS ARE NOT IN THE HOLE OR RETRACTED.	LD2.0
HDEXTSW	THIS IS THE OUTPUT FROM THE HEADS EXTENDED SWITCH.	LD2.0
HDLD	HEAD LOAD IS A LOGIC SIGNAL WHICH INDICATES THE SERVO HEAD IS READING DIBIT INFORMATION.	LD4.2
HDLDDLY	HEAD LOAD DELAY OCCURS 4.8MS AFTER HEAD LOAD AND IS USED TO MAKE SURE THE SERVO HEAD IS WELL WITHIN THE OUTTER GUARD BAND.	LD3.3
HDSEL	THE COMMAND TO SELECT A HEAD. THIS IS CONTROL TAG AND BUS 7.	LD1.3
HDUSF	HEADS UNSAFE IS AN ERROR IF MORE THAN ONE HEAD IS SELECTED OR IF NO HEAD IS SELECTED AND SHOULD BE.	LD6.1
HLREV	HIGH-LOW REVERSE IS AN ERROR CONDITION WHICH MEANS THE DRIVE HAS GONE TOO FAR REVERSE AND IS NOT ON THE DATA TRACKS.	LD3.0
IADDMKDET	THE ADDRESS MARK SIGNAL TO THE CONTROLLER.	LD8.1
IATTEN	THE OUTPUT ATTENTION TO THE CONTROLLER.	LD8.1
ICOMPSECT-IDX	THIS IS THE OR'ED INDEX AND SECTOR OUTPUT TO THE CONTROLLER.	LD8.1
IDEVCK	DEVICE CHECK OUTPUT TO THE CONTROLLER.	LD8.1
IDX	INDEX IS A 4US PULSE PRODUCED FROM GAP CLOCK AND FLAGS THE START OF A TRACK.	LD5.1
IEOC	THIS IS THE END OF CYLINDER INTERFACE SIGNAL TO THE CONTROLLER.	LD8.1

IIDX	THE OUTPUT OF INDEX TO THE CONTROLLER.	LD8.1
ILLCYL	ILLEGAL CYLINDER IS AN ERROR SIGNAL PRODUCED WHEN THE NEW CYLINDER ADDRESS ON A DS25 EXCEEDS 407 OR 815 IN A DS50.	LD3.4
INHSKST	INHIBIT SEEK START RESULTS FROM OFFSET OR ILLEGAL CYLINDER.	LD7.0
IOFFSET	OUTPUT INTERFACE OFFSET STATUS LINE.	LD8.1
IONLINE	ONLINE OUTPUT STATUS TO THE CONTROLLER.	LD8.1
IR/WCLOCK M-P	THIS IS THE OUTPUT FROM THE LINE DRIVERS OF F CLOCK.	LD6.3
IR/WDATA M-P	THIS IS THE OUTPUT FROM THE LINE DRIVERS OF READ DATA.	LD6.0
IRDONLY	READ ONLY STATUS TO THE CONTROLLER.	LD8.1
IRDY	READY SIGNAL SENT TO THE CONTROLLER.	LD8.1
ISECTOR	INTERFACE SECTOR LINE TO THE CONTROLLER.	LD8.1
ISELECTED	THE HANDSHAKE TO THE CONTROLLER SAYING THE DRIVE IS SELECTED.	LD8.1
ISELECT	THE LINE FROM THE CONTROLLER WHICH SELECTS THE DRIVE TO BE USED.	LD1.1
ISEQUENCE	THE LINE FROM THE CONTROLLER REQUIRED TO SEQUENCE UP THE DRIVE TO A READY STATE.	LD1.1
ISKINC	SEEK INCOMPLETE OUTPUT STATUS TO THE CONTROLLER.	LD8.1
ITERIN	A GROUND LINE INDICATING THAT A TERMINATOR IS PLUGGED INTO THE DRIVE ON LINE.	LD1.1
IWRUSF	WRITE CURRENT UNSAFE IS AN ERROR IF THE WRITE CURRENT IS NOT WITHIN ACCEPTABLE LIMITS.	LD6.1
IWSAMP	WRITE CURRENT SAMPLE LINE FEEDS A MONITOR TO CHECK THE LEVEL OF THE CURRENT.	LD6.0
K1PICK	THIS SIGNAL OPERATES THE MECHANICAL RELAY TO ALLOW AC TO THE SPINDLE MOTOR.	LD2.3
K2PICK	THIS SIGNAL OPERATES THE TRIAC WHICH FEEDS AC TO THE SPINDLE MOTOR RUN WINDINGS.	LD2.3
K3PICK	THE SIGNAL WHICH OPERATES THE START RELAY.	LD2.3

K5PICK	THIS SIGNAL ON THE EARLIER MODELS OPERATED THE BRUSH MOTOR RELAY. THE CIRCUIT IS NOT USED NOW.	LD2.3
LDSP	LOAD SPEED IS USED DURING A FIRST SEEK AND A REZERO OPERATION AND IS ABOUT 8 IN/SEC.	LD3.0
LIDCLSDSW	THIS IS THE OUTPUT FROM THE LID CLOSED SWITCH.	LD2.0
LINMTRDRV	LINEAR MOTOR DRIVE IS THE +/- 35VDC INPUT TO THE BOBBIN OF THE LINEAR MOTOR USED TO MOVE THE HEADS FORWARD OR REVERSE.	LD3.7
MODULSIN	MODULES IN IS ACTIVE IF ALL THE LOGIC CARDS ARE PLUGGED INTO THEIR CORRECT LOCATIONS.	LD7.1
MULTIHDBUS	MULTI-HEAD BUS IS A MONITOR FOR THE HEADS UN-SAFE CIRCUITRY.	LD6.0
NRZDATA	NRZ DATA IS THE WRITE DATA AT THE OUTPUT OF THE LINE RECEIVERS.	LD6.3
OFFRACK	OFF RACK TELLS THE LOGIC THE HEADS HAVE GONE TOO FAR FORWARD AND HAVE OPERATED THE OFF RACK SWITCH.	LD2.0
OFFSET	THIS IS THE OUTPUT OF THE OFFSET FF.	LD3.2
ONTIME	THIS IS THE DATA WHICH FEEDS THE DATA ON TIME FF.	LD6.5
OSFWD	THIS IS THE OFFSET DIRECTION. FORWARD WHEN ACTIVE.	LD3.2
OSGT	OFFSET GATE TELLS THE ERROR CIRCUITS THAT THERE IS AN OFFSET ACTIVE.	LD3.1
OSST	OFFSET SET INDICATES AN OFFSET IS ACTIVE.	LD3.1
P5REGB	THE CONTROL VOLTAGE FOR THE BASE OF Q1 THE +5VDC DRIVER.	LD9.1
P5REGE	THE CONTROL VOLTAGE FOR THE EMITTER OF Q1 THE +5VDC DRIVER.	LD9.1
PACKOFF	THE PACK OFF SIGNAL IS ACTIVE WHEN THE DRIVE IS SEQUENCING UP AND THERE IS NO PACK INSTALLED IN THE DRIVE.	LD2.2
PICKSTART	PICK START OPERATES THE START WINDINGS OF THE SPINDLE MOTOR DURING A POWER UP SEQUENCE.	LD2.2

PLO	PHASE LOCKED OSCILLATOR IS THE CIRCUIT WHICH PRODUCES THE CONTROL CLOCKS FOR THE SERVO CONTROL SYSTEM. IT ALSO FEEDS THE VCO DURING A WRITE OPERATION.	LD4.1
POSITION	POSITION IS A +/-2V SIGNAL WHICH IS PRODUCED FROM THE DIBITS AND IS USED TO LOCATE CYLINDERS REQUESTED BY THE CONTROLLER.	LD4.2
POWERON	POWER ON IS A MASTER PRE-CONDITIONING SIGNAL.	LD4.0
PWRGND	THE GROUND PATH WHICH FEEDS ALL THE DRIVERS ON THE LOGIC III CARD.	LD2.3
RDATA	READ DATA IS THE NRZ READ DATA BEFORE IT IS GATED THROUGH THE LINE DRIVERS.	LD6.3
RDDATAM-P	THIS IS THE DIFFERENTIAL READ DATA LINE FROM THE MATRIX CARD.	LD6.0
RDONLY	READ ONLY IS THE STATUS CONDITION WHICH PREVENTS THE CONTROLLER FORM WRITING ON THE DISK PACK.	LD5.0
RDONLYSW	READ ONLY SWITCH OUTPUT SETS THE READ ONLY LATCH.	LD5.0
RDY	READY FLAGS THE CONTROLLER AND THE INTERNAL CIRCUITS OF THE DRIVE THAT IT IS READY FOR A COMMAND.	LD3.2
RDYIND	READY INDICATOR DRIVES THE GREEN READY LIGHT ON THE FRONT PANEL.	LD5.0
READ	THE COMMAND TO PERFORM A READ OPERATION. THIS IS CONTROL TAG AND BUS 3.	LD1.3
RECDATA	RECORDED DATA IS THE DATA RECEIVED DURING A READ OPERATION AND IS USED TO SYNCHRONIZE THE READ VCO DURING A READ OPERATION.	LD6.2
RECPLO	RECORDED PLO IS THE PHASE LOCKED OSCILLATOR'S OUTPUT USED TO SYNCHRONIZE THE READ VCO DURING A WRITE OPERATION.	LD6.2
RELXDUCER	THIS IS THE SIGNAL WHICH INDICATES ONE REV-OLUTION PER PULSE AND IS PICKED UP OFF THE BOTTOM OF THE SPINDLE. (RELUCTANCE TRANSDUCER)	LD2.5
RESET	THIS SIGNAL RESETS THE EMERGENCY RETRACT LATCH.	LD7.1
RETHD	RETRACT HEADS IS THE SIGNAL WHICH TELLS THE SERVO CONTROL LOGIC TO KEEP THE HEADS RETRACTED.	LD2.2

RETHD*S	RETRACT HEADS SET INDICATES CERTAIN CONDITIONS HAVE BEEN MET TO EITHER LOAD OR UNLOAD THE HEADS.	LD2.0
REZERO	THE COMMAND WHICH MOVES THE HEADS BACK TO CYLIONDER ZERO. CONTROL TAG AND BUS 8.	LD1.3
SECTOR	SECTOR IS A 1.24US PULSE WHICH IS PRODUCED AT THE BEGINNING OF EACH SECTOR.	LD5.1
SEEKFF	SEEK FF IS SET FLAGGING THE START OF A SEEK.	LD3.1
SELECT	THE SIGNAL FROM ISELECT WHICH GATES VARIOUS OPERATIONS IN THE DRIVE.	LD1.1
SEQOSC	SQUARED OSCILLATOR IS A 1.24 SECOND CLOCK USED FOR TIMING THE SEQUENCING OF THE DRIVE.	LD2.1
SEQUENCE	THE SIGNAL DEVELPOED FROM ISEQUENCE.	LD1.1
SETCYLTAG	THE SET CYLINDER TAG FROM EITHER THE EXERCISER OR CONTROLLER.	LD1.2
SKENA	SEEK ENABLE IS USED DURING A PROGRAMED SEEK AND INDICATES THE DRIVE IS IN THE VELOCITY MODE.	LD3.0
SKENA*R	SEEK ENABLE RESET RESETS THE SEEK FF WHEN TRACK FOLLOW IS GENERATED.	LD3.0
SKINC	SEEK INCOMPLETE IS AN ERROR WHICH SAYS THE SEEK WAS STARTED BUT NOT COMPLETED WITHIN 615MS.	LD7.2
SKINC*C	THIS CLOCK COUNTS UP THE SEEK INCOMPLETE COUNTER AND HAS A FREQUENCY OF 23.5 HZ.	LD2.1
SKSTGT	SEEK START GATE IS A SHORT PULSE WHICH IS PRODUCED AT THE DROP OF SET CYLINDER TAG LINE.	LD3.1
SKWDATA	SKEWED DATA IS THE DATA SKEWED OR MOVED BACK INTO THE PROPER BIT CELL.	LD6.3
SPEED	SPEED IS AN ACTIVE LEVEL WHEN THE SPINDLE IS AT LEAST 85% OF 3600RPM DURING A POWER UP AND 95% DURING NORMAL OPERATION.	LD2.5
SPEEDCLK	THIS IS THE CLOCK SIGNAL USED TO DETECT PROPER OPERATING SPEED OF 3600RPM. IT'S FREQUENCY IS 12.59KHZ.	LD2.1
SPEEDIN	THIS IS A SQUARED UP RELXDUCER PULSE.	LD2.5
SPINDL-ALERT	THE SIGNAL WHICH OPERATES THE SAFTY ALARM IN THE DRIVE.	LD2.3

SQUARED DIBITS	THIS IS THE SIGNAL USED TO SYNCHRONIZE THE PLO.	LD4.2
SRVOENA	SERVO ENABLE ALLOWS THE HEAD POSITIONING SYSTEM TO OPERATE.	LD3.1
SRVOFWD	SERVO FORWARD TELLS THE AMPLIFIER DRIVE CIRCUIT TO MOVE THE HEADS IN THE FORWARD DIRECTION.	LD3.2
START	THE SIGNAL PRODUCED FROM THE START SWITCH.	LD2.0
STARTSW	THIS IS THE OUTPUT FROM THE START SWITCH.	LD2.0
STBELY	STROBE EARLY MOVES THE DATA IN THE BIT CELL BY 11NS EARLY FOR SOFT ERROR RECOVERY. THIS IS PRODUCED BY CONTROL TAG AND BUS 1.	LD1.3
STBLT	STROBE LATE MOVES THE DATA IN THE BIT CELL BY 11NS LATE FOR SOFT ERROR RECOVERY. THIS IS CONTROL TAG AND BUS 0.	LD1.3
STROBP-M	STROBE PLUS/MINUS IS PRODUCED FROM THE 403KHZ AND IS USED TO SAMPLE THE PLUS AND MINUS PEAKS OF THE DIBIT SIGNAL.	LD4.1
TERM VOLT	THE VOLTAGE (+5VDC) TO THE TERMINATOR.	LD1.1
TRKFL	TRACK FOLLOW SAYS THE DRIVE IS AT THE DESIRED CYLINDER AND IS HOLDING THERE.	LD3.0
UTH	UPPER THRESHOLD IS A SQUARED POSITION SIGNAL. IT IS TURNED ON AT .75V AND OFF AT .2V OF THE POSITION SIGNAL.	LD3.3
UTH*P-M	UPPER THRESHOLD PLUS/MINUS IS PRODUCED FOR EACH PLUS/MINUS OF THE POSITION SIGNAL.	LD4.2
VBRAKE	THE +14VDC USED IN THE 115V MODELS FOR SPINDLE MOTOR BRAKE.	LD9.0
VELENA	VELOCITY ENABLE ALLOWS THE POSITIONING SYSTEM TO MOVE THE HEADS IN THE VELOCITY MODE.	LD3.2
VELOCITY-TACH	VELOCITY TACHOMETER IS THE NEGITIVE FEEDBACK USED TO CONTROL THE VELOCITY OF THE HEAD POSITIONING SYSTEM.	LD3.8
WRT	THE COMMMAND TO DO A WRITE OPERATION. THIS IS CONTROL TAG AND BUS 2.	LD1.3
WRT*AM	THIS IS THE COMMAND TO WRITE AN ADDRESS MARK.	LD6.4

WRTDATA	WRITE DATA IS THE PRESTRESSED DATA GATED WITH DERGATE/ OR DEGATE WITH THE EXERCISER WRITE CLOCK (EWRI*C).	LD6.5
WRTDISABLE	WRITE DISABLE INHIBITS ANY WRITE OPERATION.	LD5.0
WRTRANS	WRITE TRANSISTIONS FEEDS THE ERROR LOGIC TO MONITOR ANY LOSS OF WRITE DATA TRANSISTIONS.	LD6.0

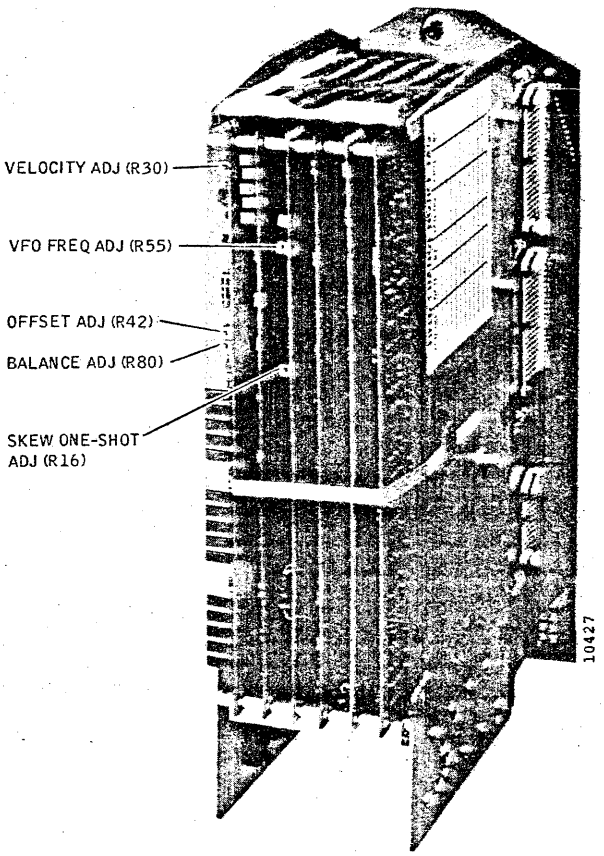


Figure 3-6. Read/Write and Servo Alignment Adjustment Points

Note

If potentiometer R16 is turned too far the channel 2 pulse will occur only in every other cycle of the channel 1 train. Pulses on channel 2 must occur in every cycle.

4. Increase the scope sweep rate to 20 ns/cm, center the channel 1 half cycle in which the leading edge of the data pulse occurs in the scope display, and adjust potentiometer R16 so that the +1.5-volt point in the leading edge of the channel 2 pulse occurs 2 nanoseconds before the center of the channel 1 half cycle.

5. Set the START/STOP switch to STOP.

Write Clock Phase Selection

This procedure is normally performed only during installation to compensate for delays in write data timing due to variations in data cable lengths. However, it should be repeated whenever the disk drive system is recabled.

1. Install a scratch pack, and set the START/STOP switch to START.

2. With the heads loaded, initiate a continuous write operation via the controller.

3. Connect and adjust a scope to observe the relationship between NRZDATA at 4B35 and the write clock at 4B26 (T25 and T50) or TP2 (T80).

SYNC: Int Pos 100 ns/cm TRIG

CHAN: 1 DC 2v/cm 4B26 (T25, T50) WRITE CLOCK (IF/)
TP2 (T80) WRITE CLOCK (IF/)

CHAN: 2 DC 2v/cm 4B35 NRZDATA

MODE: Alternate, Sync on Chan 1 only

4. Determine from the scope display whether NRZDATA transitions on channel 2 are occurring during period A or period B, as shown in Figure 3-7, and so note.

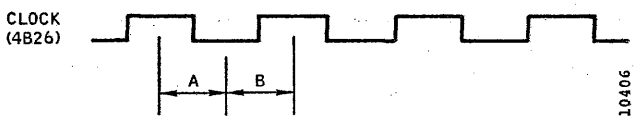


Figure 3-7. Write Clock Phase Check

5. Set the START/STOP switch to STOP, wait for the disk to stop, and turn the PWR ON/OFF switch to OFF.

6. Remove the 4AB circuit card and locate jumper IC socket 10B.

7. Install two jumpers between opposite pins of socket 10B as follows:

   - If NRZDATA transitions occur during period A, place jumpers between pins 6 and 9 and between pins 7 and 8.
   - If NRZDATA transitions occur during period B, place jumpers between pins 1 and 14 and between pins 2 and 13.

8. Reinstall the card in location 4AB.

SERVOSYSTEM ALIGNMENT

All adjustment points for servosystem alignment are located on the Servo Control card in card slot 6AB. Some adjustment points are internal to the card, requiring the card to be extended to perform complete alignment. If the entire servosystem is to be aligned, perform the procedures in the order given. See Figure 3-6 for adjustment point locations.