HEWLETT PACKARD

OPERATING AND SERVICE MANUAL

7920A
DISC DRIVE

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OPTIONS COVERED

This manual covers option 015 as well as the standard HP 7920A Disc Drive.

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LIST OF EFFECTIVE PAGES

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Change 0 (Original) ..... DEC 1980

All pages in this edition are original.

PREFACE

This manual provides field service information for the Hewlett-Packard 7920A Disc Drive and is intended for use by service-trained personnel. The HP 7920A Disc Drive is a state-of-the-art, mass-memory (50 Mbyte) product and, because of its product design, a modular replacement philosophy has been implemented to minimize on-site repair time. On-site troubleshooting and repair is assured through the use of the information provided in this manual and the maintenance aids contained in the service kit. For disc drive operating instructions, refer to the *HP 7920 Disc Drive Operator's Manual,* part no. 07920-90030.

WARNING

The HP 7920A Disc Drive contains magnetic material (spindle assembly and actuator assembly), a potential hazard to personnel during shipping. Special packaging and markings are required by the United States Government for shipping. If reshipment of the disc drive becomes necessary, refer to section II of this manual for repackaging instructions. If reshipment of the spindle assembly and/or the actuator assembly becomes necessary, refer to section VIII of this manual for repackaging information.

The contents of this manual are organized in nine sections as follows:

- Section I provides a general description of the disc drive, storage media, option and accessories, specifications and related manuals.
- Section II provides information relative to site preparation, unpacking, inspection, power requirements, mounting, interconnection, checkout, and repackaging for shipment.
- Section III provides descriptions of the operator controls, indicators, and fuses. Also, general operating instructions are included.
- Section IV provides the theory of operation in which each major circuit group is described in detail.
- Section V provides preventive maintenance information, maintenance precautions, lists of all standard and special tools and test equipment required to service the disc drive, the preventive maintenance schedule, and required preventive maintenance inspection and cleaning procedures.
- Section VI provides step-by-step alignment and adjustment procedures for the disc drive.
- Section VII provides troubleshooting information which includes functional diagrams of the disc drive and troubleshooting flowcharts.
- Section VIII provides step-by-step removal and replacement procedures for each field-replaceable electrical and electro-mechanical assembly used in the disc drive.
- Section IX provides listings of all field-replaceable parts and an illustrated parts breakdown for the disc drive, as well as replacement part ordering information.

SAFETY CONSIDERATIONS

KEEP WITH MANUAL

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

SAFETY SYMBOLS

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

Indicates hazardous voltages.

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

WARNING

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

CAUTION

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

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

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

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

SERVICING

WARNING

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

Adjustments described in this manual may be performed with power supplied to the product while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Capacitors inside this product may still be charged even when disconnected from its power source.

To avoid a fire hazard, only fuses with the required current rating and of the specified type (normal blow, time delay, etc.) are to be used for replacement.

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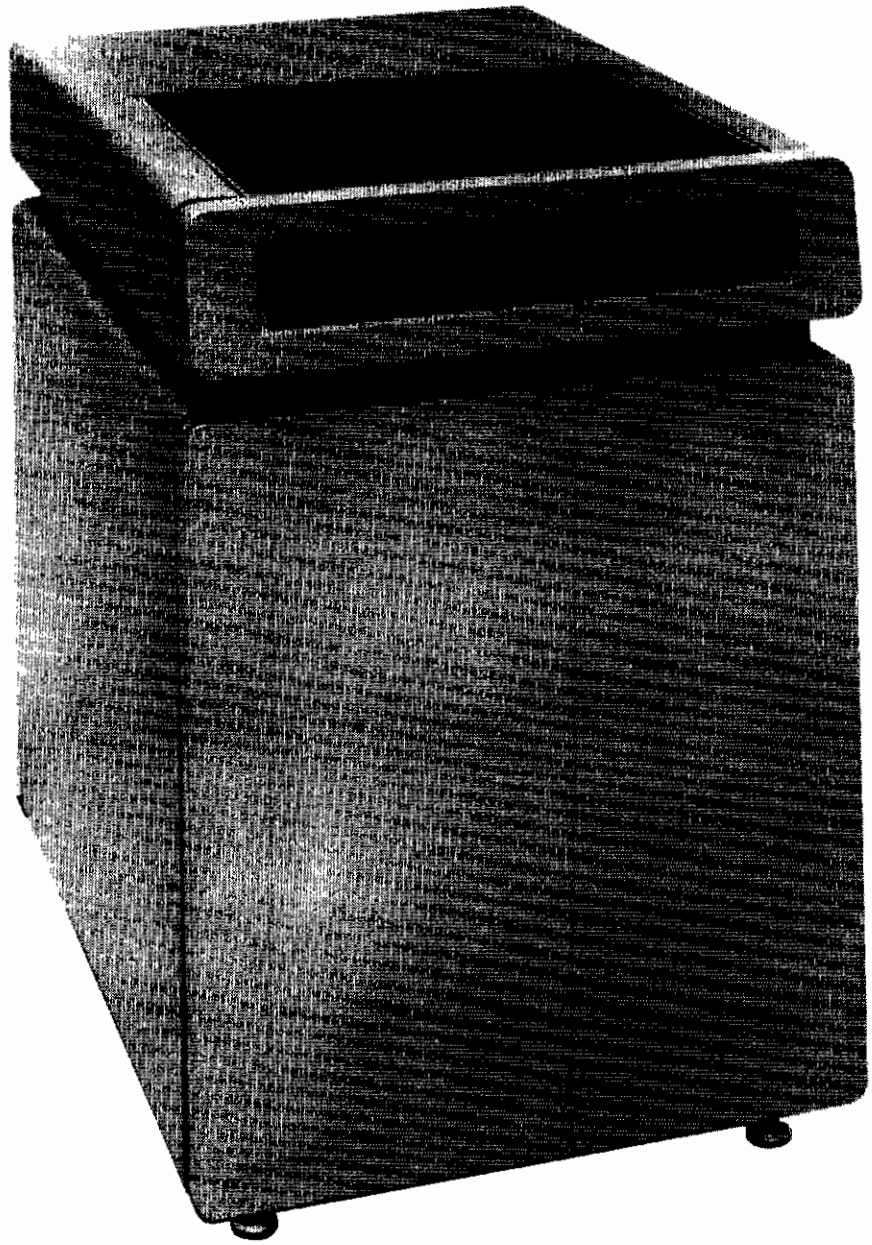

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Figure 1-1. HP 7920 Disc Drive

GENERAL INFORMATION

SECTION I

1-1. INTRODUCTION

This section contains a general description of the HP 7920A Disc Drive (figure 1-1) and its major assemblies, a list of equipment supplied, options, accessories, specifications, and related documents.

The HP 7920A Disc Drive is a high-performance, random-access, storage device designed for use as a peripheral unit in small and medium size systems. Data is stored on three discs contained in an easily removable pack. The disc pack contains five surfaces on which data is stored and one surface reserved for head positioning and sector timing.

Through the use of the five data surfaces, the disc drive provides the using system with access to 50 million bytes of formatted information in a single package. Separate heads are used for each data surface to retrieve existing data or to record new data. Head positioning at any one of the 823 cylinder positions is controlled by a closed-loop, track-following, servo system that derives cylinder position information from the top surface of the center disc.

The disc drive is contained in a floor-mounted, free-standing enclosure that also provides space for housing the HP 13037 Disc Controller. The disc drive consists of a rigid-cast mainframe, an electromagnetic head-positioning mechanism, disc rotation assemblies, air circulation and filtration assemblies, pack chamber, electronic assemblies, and enclosure.

1-2. GENERAL INFORMATION

The following paragraphs provide brief descriptions of each of the disc drive assemblies.

1-3. AIR CIRCULATION AND FILTRATION ASSEMBLY

The air circulation and filtration assembly provides cooling air to electronic components and the disc pack. Air is drawn into the enclosure by a centrifugal blower through a prefilter mounted between the blower inlet and the front door. Part of the airflow is directed along the length of the heatsink on power and motor regulator PCA-A9. The remainder of the air is forced through the absolute filter, then into the pack chamber. Air is exhausted through vents at the rear of the enclosure.

1-4. DISC ROTATION ASSEMBLIES

The disc rotation assemblies consist of the pack chamber, the pack detector assembly, and spindle assembly. The spindle assembly consists of a spindle motor and hub on which the disc pack is secured. Speed of the motor is maintained at 3,600 rpm by the spindle logic, motor control circuits, and a phase encoder.

The pack detector assembly consists of a phototransistor assembly which emits an infrared beam that is reflected off the surface of the bottom disc and returned to the photosensitive portion of the assembly. When a disc pack is in place, the pack detector generates an enabling signal for use in the rotation control circuits.

The disc pack is placed into the pack chamber and seated on the spindle hub. It is secured by threading the disc pack lockscrew into the pack lock assembly on the spindle.

1-5. ACTUATOR ASSEMBLY

A coil and carriage assembly, magnet and rail assembly, carriage latch and detector assembly, and velocity transducer and shaft comprise the actuator assembly. Head positioning is determined by the coil and magnet which form a linear motor. Current applied to the coil causes the coil and carriage assembly to move across the disc surfaces. The amount of current applied determines the force for carriage travel and the polarity of the current determines the direction of travel. The carriage mounts the read/write and servo heads, and is attached to the coil. This assembly rides on the rails, which are positioned longitudinally at the top and bottom of the magnet, permitting travel of the coil and carriage inward towards or outward from the center of the disc pack. The carriage contains three bearings that enable free travel along the rails.

A carriage latch and detector assembly, consisting of a solenoid and photocoupler, are mounted on the side of the magnet. At the time the heads load, the solenoid is momentarily energized and the latch is held away from the carriage as it moves away from the home position. When the carriage is returned to the retracted position, the latch locks the carriage in place and prevents it from extending outward during fault conditions. The photocoupler detects the carriage in its latched (or home) position.

The velocity transducer measures the linear velocity of the coil and carriage assembly. A cylindrical coil and permanent magnet comprise the transducer. The coil is

mounted in the center of the linear motor and the magnet is attached to the carriage. Motion of the magnet through the coil generates a voltage, the magnitude of which is proportional to the linear velocity and the polarity indicates direction of motion. This voltage is used in the servo loop to control head acceleration/deceleration during carriage motions between tracks.

1-6. DATA AND SERVO HEADS

Each disc pack contains five data surfaces and one surface for servo information. Correspondingly, the disc drive uses five data heads and one servo head. The data heads are read/write heads which read data from or write data onto the data surfaces. The servo head is a read-only head that reads head position information from the prerecorded servo surface.

1-7. PRINTED CIRCUIT ASSEMBLIES

The printed circuit assemblies (PCA's) include eleven cards, four of which are mounted inside a card cage. The other PCA's are mounted in various locations throughout the disc drive. The PCA's are as follows:

a. I/O Sector A2
b. Servo A3
c. Drive Control A4
d. Track Follower A5
e. Read/Write Preamplifier A6
f. Motherboard A7
g. Spindle Logic A8
h. Power and Motor Regulator A9
i. Encoder A10
j. Indicator A11
k. Fault Indicator A12

1-8. I/O SECTOR PCA-A2. I/O sector PCA-A2 provides interface capability between the controller and the disc drive. The interface includes the four-line tag bus that specifies which function is to be performed, the 16-line control bus (of which 11 are used) that contains additional command or status information and the command strobe that validates all tag bus functions. The I/O sector PCA contains logic circuitry which decode the incoming command information to provide read or write commands, sector address, head address, cylinder address, seek operations and also the drive sector timing circuits. In addition, status, unit identity, and drive type information is generated and returned to the controller from the I/O sector PCA. The I/O sector PCA is mounted inside the card cage chassis and interfaces with other functions in the disc drive through connector pins and mating receptacles at the bottom of the PCA. Controller interface is provided by a ribbon cable that connects to the I/O sector PCA at the connector pin array on the top side of the PCA.

1-9. TRACK FOLLOWER PCA-A5. The track follower PCA-A5 decodes servo information that is magnetically recorded on the servo surface. The servo code provides information which includes radial and circumferential signals. The radial position signal is used to locate the head over the addressed track and the circumferential timing signals are used for sector sensing. Three signals are generated from the code to accomplish these functions. Two signals, the sector clock and index pulse, are applied to the I/O sector PCA-A2 for use in sector sensing. The radial position signal is applied to the servo PCA-A3 for use in track location. In addition, an AGC signal is developed to detect the presence or absence of servo signals. This PCA is located in the card cage chassis.

1-10. SERVO PCA-A3. The servo PCA-A3 contains the circuitry that controls the motion of the actuator. Signals are developed to determine direction of carriage travel and the velocity at which it moves. In addition to forward and reverse seek operations, signals are developed to cause the heads to be loaded at cylinder zero and to fully retract (seek home) the heads. Recalibrate and offset functions are also controlled by signals developed on this PCA. This PCA is located in the card cage chassis.

1-11. DRIVE CONTROL PCA-A4. Drive control PCA-A4 contains read/write and seek control logic and fault logic. The read/write logic routes read and write data to and from the controller, and monitors write faults. The fault logic circuits monitor write faults, head selection and location faults, and power supply and interlock faults. Also, outputs from the fault logic are applied to indicators on the fault indicator PCA-A12. In addition to the read/write and fault logic circuits, drive control PCA-A4 contains the spindle run control circuit, carriage solenoid control, and a timer for seek operations. This PCA is mounted in the card cage chassis.

1-12. READ/WRITE PREAMPLIFIER PCA-A6. Read/Write preamplifier PCA-A6 decodes the data head select word received from drive control PCA-A4 and makes the actual head selection for read or write operations. Also, when write commands are applied to read/write preamplifier PCA-A6, write current circuits switch write data to the data heads. In the read mode, sensed data is amplified and routed to the controller. The read/write preamplifier PCA is physically located near the head assembly and is mounted in a receptacle on the motherboard PCA.

1-13. MOTHERBOARD PCA-A7. Motherboard PCA-A7 provides the main base for electrical interconnections within the disc drive. PCA's A2 through A6 connect to the motherboard PCA through receptacles attached to the motherboard. An additional receptacle provides interconnections with the remainder of the PCA's through a wiring harness, and a receptacle provides interconnection to a velocity transducer. The motherboard PCA also contains circuitry to detect faults in the power supplies. This PCA is mounted horizontally at the right-rear corner of the disc drive.

1-14. SPINDLE LOGIC PCA-A8. The spindle logic PCA-A8 contains the circuits that establish and regulate spindle speed lockup at 3,600 rpm and decode signals from phase encoder PCA-A10 into proper phase timing for a phase-lock loop. Also, the circuitry controls and detects spindle stopping, and detects and prevents excessive spindle motor current during normal and failure modes. The spindle logic PCA is mounted horizontally in a card cage located directly above the operator panel. Three LED's are edge mounted on the PCA, and provide the operator with indications of spindle logic and motor status. The functions of the indicators are described in section III.

1-15. POWER AND MOTOR REGULATOR PCA-A9. Power and motor regulator PCA-A9 provides the regulation for dc voltages developed in the power supply assembly, except for the unregulated +36 and −36-volt supplies. In addition, spindle motor control circuits operate with those on the spindle logic PCA to provide drive and control for the spindle motor. The linear motor power amplifier and emergency retract control circuits are also contained on this board. Power and motor regulator PCA-A9 contains heat sinks on which the regulator pass transistors and power amplifier transistors are mounted. Cooling air from the air circulation and filtration system is directed along the length of the heat sinks to remove the heat generated by the power circuits. This PCA is mounted on the underside of the disc drive and is accessible through the enclosure front door, and the side panels when removed.

1-16. ENCODER PCA-A10. Encoder PCA-A10 consists of two identical circuits. Each circuit contains an LED phototransistor assembly, and an amplifier. Light passing through the encoder disc slots causes two phase signals to be generated and applied to the spindle logic circuits which complete the spindle motor control phase-lock loop. The encoder PCA is mounted on the spindle motor housing.

1-17. INDICATOR PCA-A11. Indicator PCA-A11 is mounted on the operator panel and contains the operator indicators and the RUN/STOP switch. Descriptions of these indicators and the switch are given in section III.

1-18. FAULT INDICATOR PCA-A12. Fault indicator PCA-A12 is mounted on the operator panel and contains eight LED fault indicators that light when a monitored circuit malfunctions. Descriptions of these indicators are given in section III. The panel is accessible through the front door.

1-19. SWITCHES AND SOLENOID

The switches and solenoids include the operator control switches, the door unlock solenoid, carriage latch solenoid, the door closed switch, and the door unlocked switch. (The carriage latch solenoid is described in paragraph 1-5.)

1-20. OPERATOR CONTROL SWITCHES. The operator control switches control power to the disc drive, select unit identification, and control the operating mode. Descriptions of these switches are given in section III.

1-21. DOOR UNLOCK SOLENOID. The door unlock solenoid de-energizes during normal operation and locks the pack chamber door.

1-22. DOOR LOCKED SWITCH. The door locked switch is mechanically linked to the door unlock solenoid. When the solenoid is energized, the switch arm is depressed. This action causes the DOOR UNLOCKED indicator to turn on.

1-23. DOOR CLOSED SWITCH. The door closed switch is actuated by a plunger that is depressed downward when the pack chamber door is closed. The switch is closed which provides a signal that is ANDed with the pack-in-place signal to enable the run spindle logic on PCA-A4.

1-24. POWER SUPPLY ASSEMBLY

The power supply assembly consists of the power transformer, rectifiers, fuses, and a terminal board that allows strapping the primary windings of the power transformer to match local ac power sources. (Refer to section II for strapping information.) The power supply assembly is mounted at the left rear of the disc drive with the fuseholders accessible through the rear cabinet door. Unregulated dc output voltages of +20V and −20V, +10V, +36V and −36V, and 25 Vac are applied to power and motor control PCA-A9.

1-25. POWER PANEL ASSEMBLY

The power panel assembly consists of a circuit breaker with terminal strips, an associated power outlet strip, and a blower. The power outlet strip has four receptacles that may be used as a source of ac power. Power panels and disc drives connected for the standard 120-Vac input power include a power cord. (Refer to section II for power cord wiring and installation.)

1-26. EQUIPMENT SUPPLIED

The following equipment is supplied with each disc drive:

a. One HP 7920 Disc Drive

b. One *HP 7920 Disc Drive Operator's Manual,* part no. 07920-90030

c. One HP 07905-80010 Terminator PCA

1-27. OPTIONS

Options are factory modifications of a standard disc drive that are requested by the customer. Option 015 is available for 220 Vac and 240 Vac, 47.5 to 66 Hz operation of the disc drive.

1-28. ACCESSORIES

The accessories described in the following paragraphs may be ordered with the disc drive or separately from your local Hewlett-Packard Sales and Service Office. Sales and Service Offices are listed at the back of this manual.

1-29. HP 13394A FORMATTED DISC PACK

The HP 13394A Formatted Disc Pack is the storage media used on this disc drive. The disc pack (with covers attached) measures 11.68 cm (4.6 in.) high and 37.85 cm (14.9 in.) in diameter and contains five discs each measuring 35.56 cm (14 in.) in diameter with three of the discs 0.19 cm (0.075 in.) thick and two discs 0.13 cm (0.050 in.) thick. The three discs provide five data surfaces and one magnetically encoded servo positioning and index information surface. The top and bottom discs are protect discs which provide physical protection for the three center discs. There are 823 concentric recording tracks on each disc surface (8 are allocated as replacements for defective tracks). Each set of five vertically aligned data tracks form a data cylinder. When formatted, each data track is subdivided into 48 data sectors. Each data sector is capable of storing up to 128 words of data. A data word consists of two bytes or 16 bits of information. The HP 13394A Formatted Disc Pack (figure 1-2) is formatted in this fashion and must be used as the removable storage media for this disc drive.

1-30. MULTI-UNIT CABLES

The following listed cables are available for interconnection of up to eight disc drives and a single controller. The cables are available in four lengths as follows:

a. HP 13013B Multi-Unit Cable, part no. 13013-60013, 3.66 m (12 ft)

b. HP 13013B-001 Multi-Unit Cable, part no. 13013-60011, 1.83 m (6 ft)

c. HP 13013B-002 Multi-Unit Cable, part no. 13013-60014, 5.49 m (18 ft)

d. HP 13013B-003 Multi-Unit Cable, part no. 13013-60012, 2.44 m (8 ft)

1-31. DATA CABLES

Five data cables are available for interconnection of up to eight disc drives and a single controller. The cables and lengths are as follows:

a. HP 13213B Data Cable, part no. 13213-60007, 3.05 m (10 ft)

b. HP 13213B-001 Data Cable, part no. 13213-60008, 7.62 m (25 ft)

c. HP 13213B-002 Data Cable, part no. 13213-60009, 15.24 m (50 ft)

d. HP 13213B-003 Data Cable, part no. 13213-60010, 22.86 m (75 ft)

e. HP 13213B-004 Data Cable, part no. 13213-60006, 1.82 m (6 ft)

1-32. SPECIFICATIONS

Specifications for the HP 7920 Disc Drive are listed in table 1-1.

1-33. RELATED MANUALS

The following related manual may be ordered from a Hewlett-Packard Sales and Service Office. Sales and Service Offices are listed at the back of this manual.

- *HP 13037 Disc Controller Installation and Service Manual,* part no. 13037-90006.

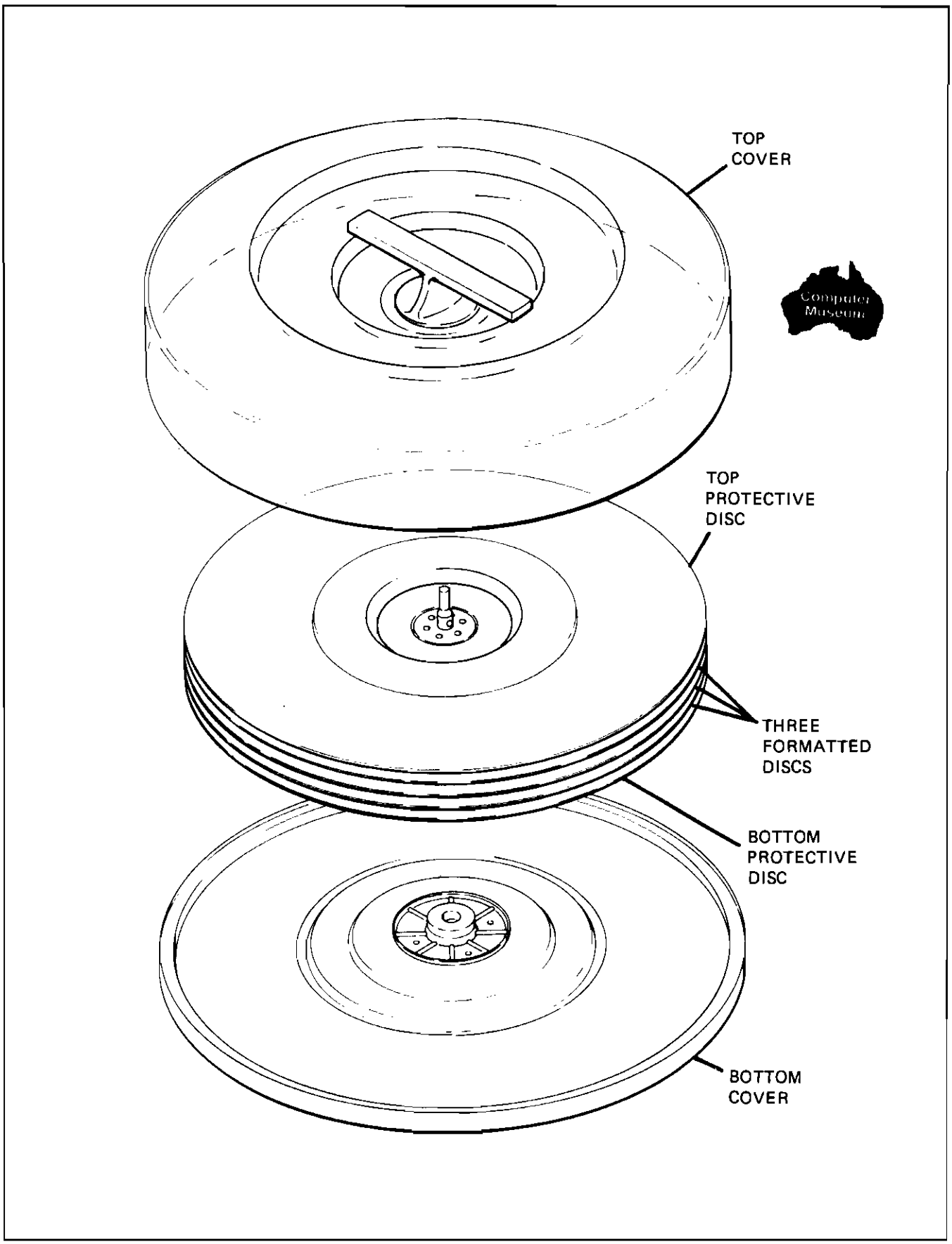

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Figure 1-2. HP 13394A Formatted Disc Pack

Table 1-1. HP 7920 Disc Drive Specifications

Functional specifications

Seek time

Track-to-track ..... 5 ms
Average random ..... 25 ms
Maximum stroke (823 tracks) ..... 45 ms

Rotation

Speed ..... 3600 rpm
Average rotational delay ..... 8.3 ms

Data transfer rate

Bits/second 7,500,000
Kilobytes/second 937.5

Data capacity

	48 Sectors/Track — 815 Tracks*			
	Data Bits Per	Data Bytes per	sectors per	Tracks Per
Byte	8			
Sector	2,048	256		
Track	98,304	12,288	48	
Surface	80,117,760	10,014,720	39,120	815
Drive	400,588,800	50,073,600	195,600	4,075

*Total number of tracks per surface is 823, 8 of which are utilized as spares or for defective track allocation. 815 tracks per surface (minimum) are guaranteed to be good.

Environmental specifications

Temperature

Operating ..... +10° to +40°C (50° to 104°F), rate of change not to exceed 20°C (36°F)/hr. Above 3 038 m (10,000 ft) altitude maximum ambient temperature is reduced from 40° to 30°C (104° to 86°F).

Non-Operating ..... −40° to +75°C (−40° to +167°F), rate of change not to exceed 20°C (36°F)/hr.

Relative humidity

Operating ..... 8% to 80% non-condensing at wet bulb temperature to 29.4°C (85°F)

Non-Operating ..... 5% to 95%

Heat dissipation

7920M Master Drive ..... 782 Watts (2670 Btu/hr), maximum
7920S Add-On Drive ..... 530 Watts (1810 Btu/hr), maximum

Altitude

Operating ..... Sea level to 4 572 m (15,000 ft)
Non-Operating ..... 304.8 m (1,000 ft) below sea level to 15 240 m (50,000 ft)

Table 1-1. HP 7920 Disc Drive Specifications (Continued)

Power requirements

VOLTAGE AC VOLTS, RMS	7920S				7920M			
	OPERATING		MAXIMUM		OPERATING		MAXIMUM	
	CURRENT AMPERES, RMS	POWER (WATTS)	CURRENT AMPERES, RMS	POWER (WATTS)	CURRENT AMPERES, RMS	POWER (WATTS)	CURRENT AMPERES, RMS	POWER (WATTS)
100	6.0	460	7.2	590	8.6	680	7.2	800
120	5.2	475	6.2	590	7.5	700	6.0	810
220	2.9	460	3.5	580	4.3	700	4.6	820
240	2.8	470	3.2	580	4.0	710	4.4	820

Notes: 1. The operating readings were measured under the following operating conditions:
a. Line frequency: 60 Hz for 100 Vac and 120 Vac, 50 Hz for 220 Vac and 240 Vac.
b. Disc Drive operation – alternate seeks between widely separated tracks with 25 ms delay between seeks.

2. The maximum readings were measured under the following operating conditions:
a. Line frequency: 60 Hz for 100 Vac and 120 Vac, 50 Hz for 220 Vac and 240 Vac.
b. Disc Drive operation – spindle startup, excluding 60A, 5 ms inrush transient turn-on current.

Physical characteristics

Dimensions

Height ..... 82.6 cm (32.5 in.)
Width ..... 49.9 cm (19.65 in.)
Depth ..... 81.3 cm (32 in.)

Weight

7920M Master Drive (includes 13037 controller)

Net ..... 159 kg (350 lb)
Shipping ..... 202 kg (445 lb)

7920S Add-On Drive

Net ..... 143 kg (315 lb)
Shipping ..... 188 kg (415 lb)

INSTALLATION

SECTION II

2-1. INTRODUCTION

WARNING

This disc drive does not contain operator-serviceable parts. To prevent electrical shock, refer all installation and maintenance activities to service-trained personnel.

This section contains the necessary information to unpack, inspect, install, check out, or otherwise prepare the disc drive for use. Included are site preparation data, unpacking, inspection, installation information, and recommended packing and shipping methods.

2-2. UNPACKING AND INSPECTION INSTRUCTIONS

The disc drive is shipped in a reusable container. When the shipment arrives, ensure that the container has been received as specified by the carrier's bill of lading. Inspect the shipping container immediately upon receipt for evidence of mishandling during transit. If the container is damaged or water-stained, request that the carrier's agent be present when the container is unpacked.

If the container appears to be received in satisfactory condition, proceed with the unpacking instructions. The disc drive is unpacked as follows:

a. Using a large screwdriver, remove the clinp fasteners that secure the top of the container to the base. Set the top aside and retain the fasteners. (See figure 2-1.)

b. Locate the packing list and compare this list against the purchase order to verify that the shipment is correct.

c. Cut the polystrap and the strap that secures the ramp to the disc drive and then lift out the ramp. Save the ramp for later use. Remove the foam collars (if used) and the plastic bag from the disc drive.

d. Inspect the disc drive for damage such as dented corners, surface scratches, and loose components. Also, check the rigid foam-plastic cushioning (if used) for any signs of deformation which could indicate rough handling during transit.

e. At each corner of the container base, loosen the bolts that secure the leveling feet retainers. At the rear container base (rear of disc drive) ensure that bolts are free from the threaded sleeves mounted in the container base.

f. On the container base, as viewed from the rear of the disc drive, remove the two screws that secure the rear retaining member to the base and slide out member.

g. Position the ramp at the rear of the container base and ensure that ramp is firmly seated on base.

h. On the disc drive, ensure that leveling feet are fully threaded into the enclosure to prevent possible dragging or bending when the disc drive is rolled down the ramp and onto the floor.

WARNING

To avoid personal injury when moving the disc drive off the container base, do not position any part of the body in the path of the disc drive movement.

CAUTION

To avoid damage to the disc drive from a "runaway" condition when moving the disc drive off the container base, position a handler on each side of the disc drive.

i. Move the disc drive off the container base and onto the floor using the ramp.

j. Open the front and rear doors and further inspect the unit for damage, such as broken controls, fuseholders, or loose components.

k. If visual examination reveals any damage to the disc drive, follow the claims procedures described in paragraph 2-5. Retain the shipping container and packing material for future use.

2-3. MANUALS

Check to ensure that all manuals that are specified on the packing list have been received.

2-4. EQUIPMENT

The disc drive model number and full serial number are stamped on an identification label affixed to the rear panel. Be sure to include the model number and serial

number in any correspondence with Hewlett-Packard about this product.

2-5. CLAIMS PROCEDURE

WARNING

To avoid dangerous electrical shock, do not apply power to the disc drive when there are signs of physical damage to any portion of the outer enclosure.

2-6. SITE PREPARATION

Site preparation information for the disc drive includes environmental, power, cooling, and mounting requirements. Each of these requirements is discussed in the following paragraphs.

2-7. ENVIRONMENTAL REQUIREMENTS

The disc drive has been designed to operate with an air inlet temperature range of 10°C to 40°C (50°F to 104°F) with the rate of temperature change not to exceed 10

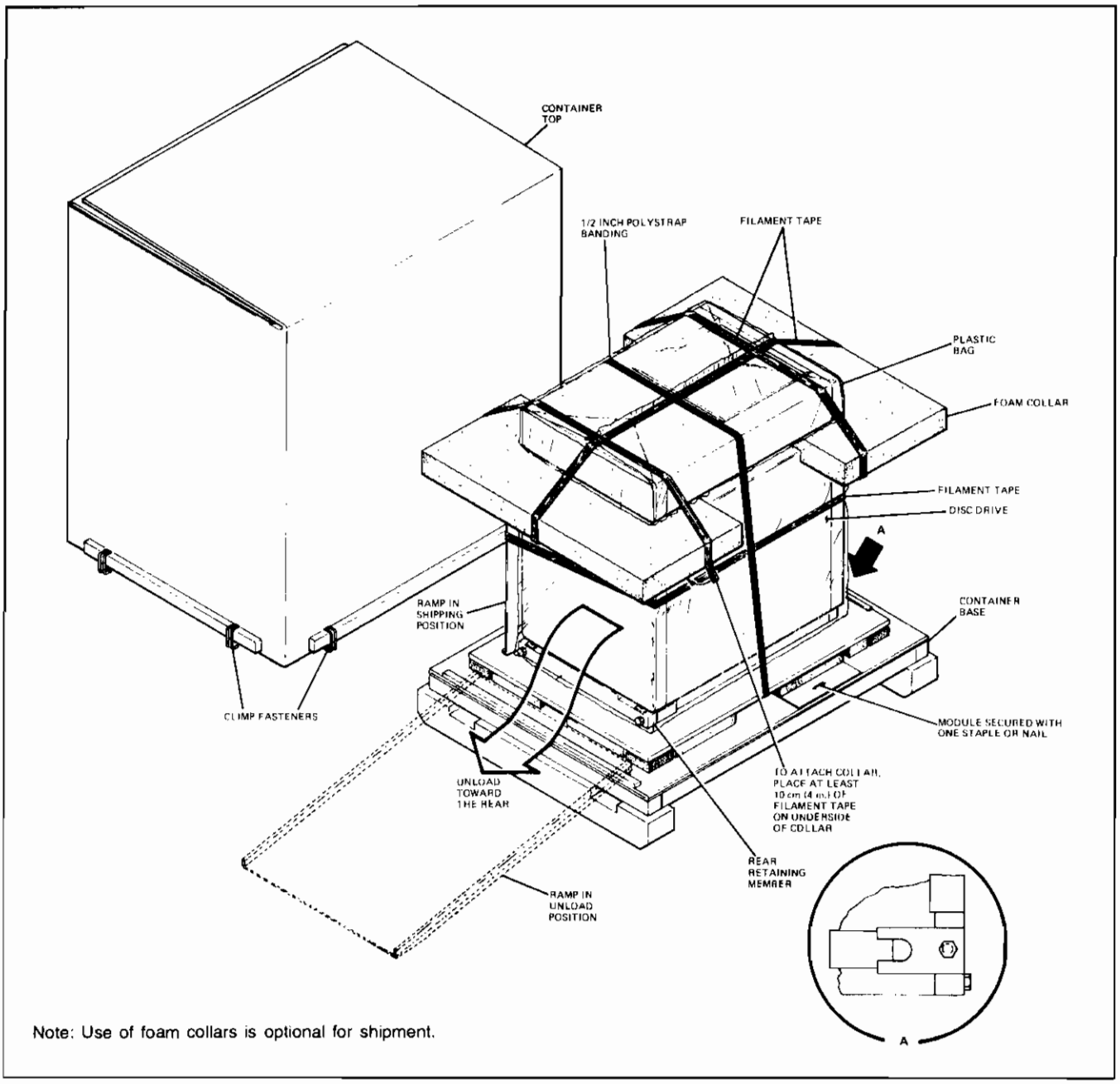

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Figure 2-1. Unpacking the Disc Drive

Celsius degrees (18 Fahrenheit degrees) per hour. It is expected that the disc packs to be used will be stored at the same room temperature at which the disc drive is operating.

2-8. COOLING REQUIREMENTS

A blower provides adequate ventilation to the power board when the disc drive is operated within the environmental limitations specified in table 1-1. Cooling air is drawn into the enclosure through the front door plenum and is exhausted through vents on the rear door. Air entering the enclosure is directed through a plenum and prefilter to the heatsink on the power and motor regulator PCA-A9, and additionally filtered air to the discs. The air filtration system purges the cooling air to the discs of 99 percent of contaminants 0.3 micron or larger. An exhaust blower, mounted on the power panel assembly, provides additional cooling for the enclosure.

Note: To obtain maximum cooling efficiency, ensure that the back of the disc drive is at least 50 cm (20 in.) from any object or barrier.

2-9. MOUNTING REQUIREMENTS

The disc drive is mounted in a free-standing enclosure which requires only that the entire unit be moved to the desired location. The unit should be located to provide adequate air circulation at the front and rear doors. Also, allow adequate clearance to open the doors fully. (See figure 2-4.)

When positioned, adjust the four feet on the bottom of the unit to relax the "dead-weight" strain from the casters and to provide a more stable foundation than casters normally provide. Place a level on the top of the disc drive and adjust the feet to ensure the top of the unit is level. Place the level along both the depth and width of the disc drive.

2-10. INSTALLATION INFORMATION

The following paragraphs provide the necessary information to install the disc drive. The information includes manual updating information, a list of tools and test equipment required for installation, ac outlet and external ground requirements, a fuse rating check, power cord information, and interconnection instructions.

2-11. MANUAL UPDATING

Before installing the disc drive, read all updating instructions for the disc drive manual and any related manuals (see section I of this manual). Updating instructions (if any) are provided with the appropriate manual.

2-12. TOOLS AND TEST EQUIPMENT REQUIRED

The following paragraphs describe the tools and test equipment required to install the disc drive.

2-13. TOOLS. No installation tools other than ordinary handtools are required.

2-14. TEST EQUIPMENT. A suitable ac voltmeter (HP 970A Digital Voltmeter, or equivalent battery-operated device suitable for measuring primary ac line voltage), the CE Alignment Pack (product number 13398A) or the Product Support Package (part no. 07920-67801), are the only test equipment required for installation. The ac voltmeter is used to verify the adequacy of the ac power outlet to be used and the DSU (Disc Service Unit) is used to verify the alignment of certain adjustable parameters.

2-15. POWER REQUIREMENTS

The disc drive may be operated continuously from a single-phase, primary power source of 100, 120, 220, or 240 Vac (+5, −10%) at a line frequency of 47.5 to 66 Hz with a power consumption of 475 watts.

Note: If a controller is installed in the enclosure, power consumption for both units is 710 watts.

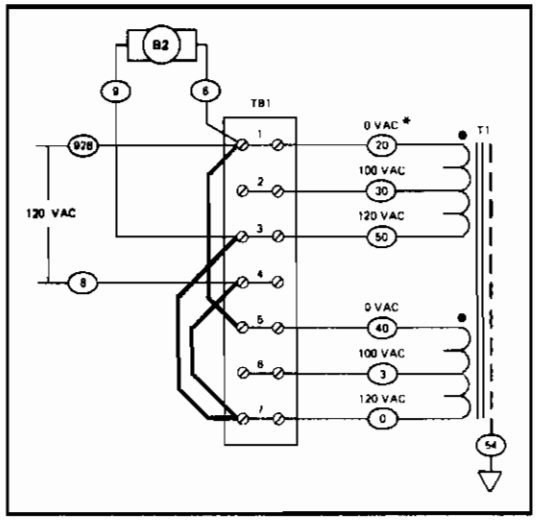
IMPORTANT NOTICE

The disc drive power panel assembly and power supply are wired at the factory for either 120 Vac or 240 Vac (Option 015) input voltage. The label on the back lower left-hand side of the enclosure denotes the wiring configuration. The 120 Vac configuration can be changed to 100 Vac operation and the 240 Vac configuration can be changed to 220 Vac operation by changing the strapping on power supply terminal board TB1. The 240 Vac power panel assembly may require a power cord change to adapt it to the different power outlet. *No other wiring configurations are permissible.*

IF YOUR DISC DRIVE IS CONFIGURED FOR 120 VAC, THE REVERSIBLE POWER IDENTIFICATION LABEL WILL READ AS FOLLOWS, DEPENDING ON THE TYPE OF DISC DRIVE:

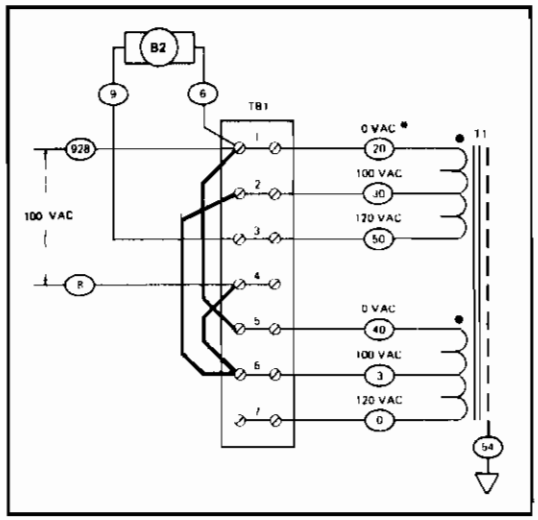
7920S ~ LINE	7920M ~ LINE
120V + 5 - 10%	120V + 5 - 10%
590 WATTS MAX.	850 WATTS MAX.
6.5A MAX.	8.6A MAX.
47.5-66Hz	47.5-66Hz

AND TERMINAL BOARD TB1 IS STRAPPED LIKE THIS.



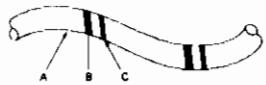
TO CHANGE OPERATING VOLTAGES FROM 120 VAC TO 100 VAC, FIRST REMOVE THE POWER IDENTIFICATION LABEL. THEN STRAP TERMINAL BOARD TB1 AS SHOWN.

THEN REVERSE AND REPLACE THE LABEL, ENSURING THAT IT READS LIKE ONE OF THESE, DEPENDING ON THE TYPE OF DISC DRIVE.



7920S ~ LINE	7920M ~ LINE
100V + 5 - 10%	100V + 5 - 10%
600 WATTS MAX.	840 WATTS MAX.
7.3A MAX.	10A MAX.
47.5-66Hz	47.5-66Hz

NOTE: ENCIRCLED NUMBERS INDICATE WIRING COLOR CODE AS FOLLOWS



COLOR	1ST DIGIT A	2ND DIGIT B	3RD DIGIT C
BLACK	0	0	0
BROWN	1	1	1
RED	2	2	2
ORANGE	3	3	3
YELLOW	4	4	4
GREEN	5	5	5
BLUE	6	6	6
VIOLET	7	7	7
GREY	8	8	8
WHITE	9	9	9

* THIS POINT IS NOT AT ZERO POTENTIAL WITH RESPECT TO THE CABINET. THIS POINT IS AT ZERO POTENTIAL WITH RESPECT TO POINT 928.

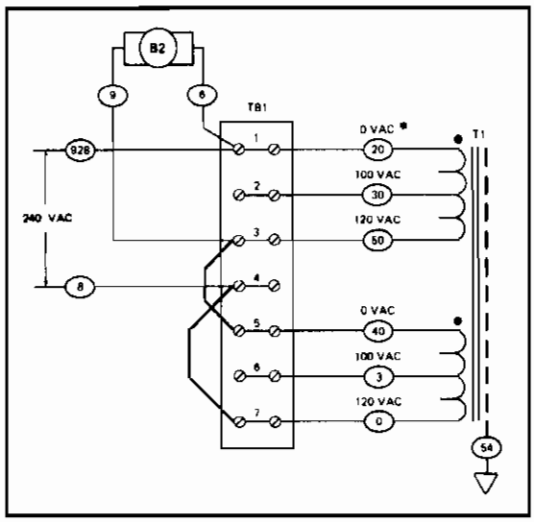
7301-4A

Figure 2-2. Strapping Configurations for 120 Vac and 100 Vac

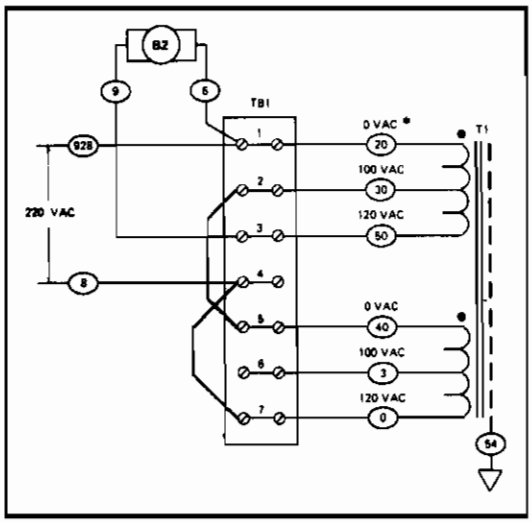
IF YOUR DISC DRIVE IS CONFIGURED FOR 240 VAC, THE REVERSIBLE POWER IDENTIFICATION LABEL WILL READ AS FOLLOWS, DEPENDING ON THE TYPE OF DISC DRIVE:

~LINE	~LINE
7920S 240V~ 50Hz	7920M 240V~ 50Hz
580 WATTS MAX. 3.4A MAX.	800 WATTS MAX. 3.8A MAX.
OPERATING RANGE	OPERATING RANGE
216V~ -252V~ 47.5-66Hz	216V~ -252V~ 47.5-66Hz

AND TERMINAL BOARD TB1 IS STRAPPED LIKE THIS.



TO CHANGE OPERATING VOLTAGES FROM 240 VAC TO 220 VAC, FIRST REMOVE THE POWER IDENTIFICATION LABEL. THEN STRAP TERMINAL BOARD TB1 AS SHOWN.



THEN

REVERSE AND REPLACE THE LABEL, ENSURING THAT IT READS LIKE ONE OF THESE, DEPENDING ON THE TYPE OF DISC DRIVE.

~LINE	~LINE
7920S 220V~ 50Hz	7920M 220V~ 50Hz
580 WATTS MAX. 3.6A MAX.	715 WATTS MAX. 3.9A MAX.
OPERATING RANGE	OPERATING RANGE
198V~ -231V~ 47.5-66Hz	198V~ -231V~ 47.5-66Hz

NOTE ENCIRCLED NUMBERS INDICATE WIRING COLOR CODE AS FOLLOWS

COLOR	1ST DIGIT A	2ND DIGIT B	3RD DIGIT C
BLACK	0	0	0
BROWN	1	1	1
RED	2	2	2
ORANGE	3	3	3
YELLOW	4	4	4
GREEN	5	5	5
BLUE	6	6	6
VIOLET	7	7	7
GREY	8	8	8
WHITE	9	9	9

* THIS POINT IS NOT AT ZERO POTENTIAL WITH RESPECT TO THE CABINET. THIS POINT IS AT ZERO POTENTIAL WITH RESPECT TO POINT 928.

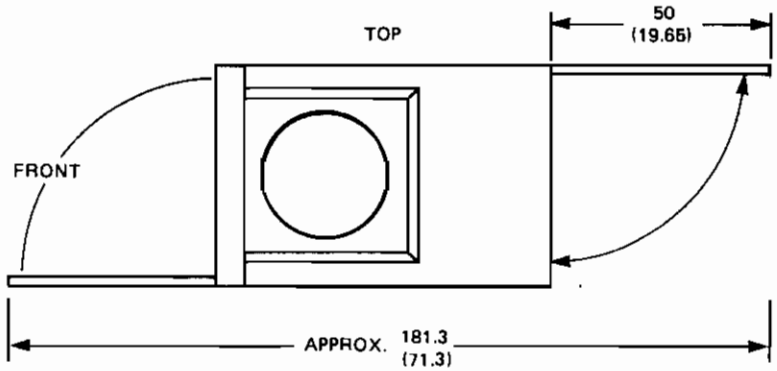
7301-6A

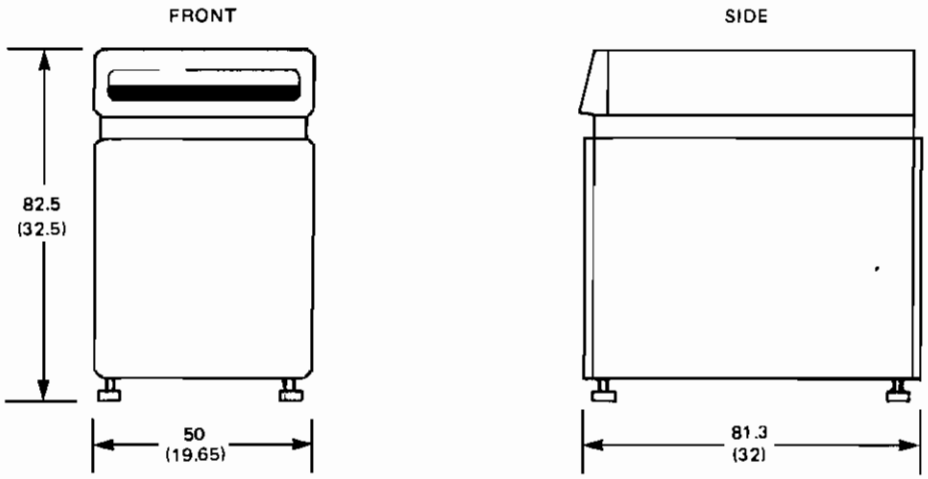
Figure 2-3. Strapping Configurations for 240 Vac and 220 Vac

WARNING

Disconnect the power cord from power source before changing a strapping configuration.

If the primary power source is other than that noted on the power identification label, remove the shroud on the enclosure and change the strapping configuration of terminal board TB1 on the power supply assembly to correspond with your requirements. Figures 2-2 and 2-3 depict and provide instructions for changing the strapping on terminal board TB1.





NOTES:

1. ALL DIMENSIONS ARE IN CENTIMETERS AND (INCHES).
2. WHEN THE DISC DRIVE IS INSTALLED, ALLOW 46 CENTIMETERS (18 INCHES) OF CLEARANCE ON EACH SIDE OF THE DISC DRIVE SO THE DISC DRIVE CAN BE SERVICED.

7301-5A

Figure 2-4. HP 7920 Disc Drive Dimensions

2-16. AC POWER OUTLET AND EXTERNAL GROUND

The female power outlet, which will be used to supply ac power to the power panel assembly in the disc drive enclosure, must be checked by a qualified electrician to ensure that the proper voltage is available to the disc drive. The outlet and its associated wiring and circuit breakers must be capable of carrying the current specified in table 1-1.

Have a qualified electrician check the power outlet with an ac voltmeter to ensure that the required single-phase voltage is present. Also check the earth (safety) ground, in the power outlet, to ensure a good earth ground (properly earthed). Ensure that input voltage ranges are those specified below for each disc drive operating ac voltage configuration:

Disc Drive Operating Voltage (VAC, +5, −10%)	Input AC Voltage Range (VAC, RMS)
100	90 to 105
120	108 to 126
220	198 to 231
240	216 to 252

Bear in mind that the electrical load imposed by the disc drive may reduce the voltage below the non-load value. If the line voltage is not within the correct range, have the electrician check the power outlet to ensure that it is wired correctly with respect to ac high potential (L), ac neutral (N), and earth ground (E). If the outlet is wired improperly, corrections must be made by a qualified electrician. Local electrical codes must be observed if the installation is inside a building.

2-17. FUSE RATING CHECK

The disc drive is equipped with one primary power fuse (F1) and seven secondary fuses (F2 through F6, A9F1 and A9F2).

WARNING

Observe the warning label affixed to the operator panel when replacing the primary power fuse. Be sure to disconnect the power cord from power source before changing any fuse.

The primary power fuse is located on the operator panel. Open the front door to gain access to the fuseholder, then check that the rating of the primary power fuse conforms to that specified in table 2-1.

Table 2-1. Primary Power Fuse Ratings

SOURCE VOLTAGE	REQUIRED RATING	HP PART NO.
100 Vac	8AT*, 250V	2110-0383
120 Vac	8AT*, 250V	2110-0383
220 Vac	4AT*, 250V	2110-0365
240 Vac	4AT*, 250V	2110-0365

*The T indicates that a time delay or slo-blo fuse must be used.

Five of the secondary fuses are located at the rear of the power supply assembly and the sixth and seventh are located on the power and motor regulator PCA-A9. Ensure that each fuse rating is that specified in table 2-2.

Table 2-2. Secondary Power Fuse Ratings

SECONDARY FUSE	SUPPLY VOLTAGE		REQUIRED RATING	HP PART NO.
	UNREGULATED	REGULATED		
F2	−36 Vdc	—	8AT*, 250V	2110-0383
F3	+36 Vdc	—	8AT*, 250V	2110-0383
F4	+10 Vdc	+ 5 Vdc	8A, 250V	2110-0342
F5	+20 Vdc	+12 Vdc	1.5A, 250V	2110-0043
F6	−20 Vdc	−12 Vdc	1.5A, 250V	2110-0043
A9F1	25 Vac	—	1A, 125V	2110-0516
A9F2	−36 Vdc	−24 Vdc	1A, 125V	2110-0516

*The T indicates that a time delay fuse must be used.

2-18. POWER CORD INSTALLATION

WARNING

The following must be performed by a qualified electrician. Use extreme caution when connecting the disc drive to the mains power source. Connect the power cable to the disc drive first then connect it to the power source. Heed all "WARNING" signs on equipment.

Check the input ac voltage and the fuse ratings before proceeding with the power cord installation. The disc drive may be equipped with one of two types of power panel assembly. To install a power cord on a disc drive with serial number prefix prior to 1740, proceed to step a. To attach a power cord on a disc drive with serial number prefix 1740 or greater, proceed to step b.

a. The power panel assembly, part no. 02940-60157, is supplied with a standard 120 Vac hardwired power cord. For the Option 015 power panel, part no. 02940-60156, the power cord must be installed locally. To install a power cord, proceed as follows:

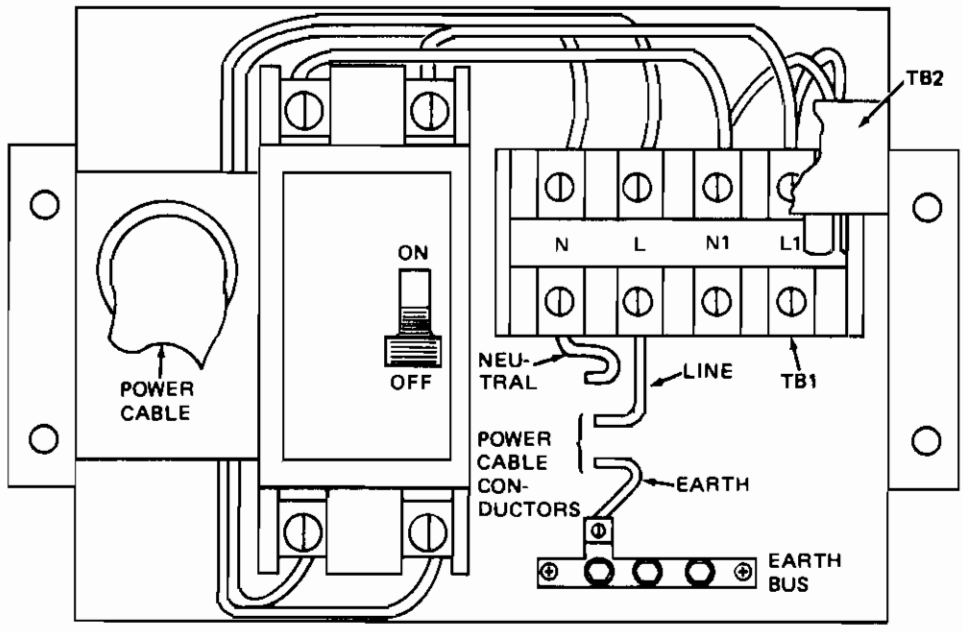
(1) Set circuit breaker (8, figure 9-11) on power distribution unit (7, figure 9-10) to OFF.

(2) Using a Pozidriv screwdriver, remove four screws (22, figure 9-10) securing "WARNING" cover (21, figure 9-10) to power panel assembly and remove cover.

(3) Prepare three-conductor power cable (minimum conductor size no. 14 AWG/1.5 mm²) by first stripping off 230 millimeters (9 inches) of outer insulation from end of cable and then removing 13 millimeters (1/2 inch) of insulation from end of each conductor.

(4) Pass prepared end of power cable through cable clamp (5, figure 9-10) into power distribution unit. Do not tighten clamp at this time.

(5) Using a blade-type screwdriver, attach earth



MAINS SUPPLY	EARTH GROUND	NEUTRAL	LINE
120 Vac 60 Hz*	Green	White	Black
240 Vac 50 Hz*	Wire in accordance with local electrical codes.		

*Typical Operating Values

7301-7A

Figure 2-5. Power Distribution Unit

ground conductor of power cable to box lug (6, figure 9-11) on earth bus (7, figure 9-11).

(6) Using a blade-type screwdriver, attach line (L) conductor of power cable to mating terminals on barrier block TB1 (1, figure 9-11) as shown in figure 2-5.

(7) Dress power cable conductors within power distribution unit and tighten cable clamp on cable jacket.

(8) Replace "WARNING" cover on power panel assembly.

(9) Connect power cable to a suitable mains power source.

(10) Set circuit breaker on power panel assembly to ON.

b. The power panel assembly, part no. 29425-60003, is supplied with a standard 120 Vac power cord. For the Option 015 power panel, part no. 29425-60004, an appropriate power cord is supplied with the disc drive. The various Option 015 power cords available are shown in figure 2-8. To attach a power cord, proceed as follows:

CAUTION

Do not attempt to operate a disc drive configured for 120 Vac on 240 Vac or a disc drive configured for 240 Vac on 120 Vac. Damage to the disc drive may result.

(1) Set circuit breaker of the disc drive to the OFF position.

(2) Plug the female end of the power cord into the ac power inlet in the rear of the disc drive.

(3) Connect power cable to a suitable mains power source.

(4) Set circuit breaker of the disc drive to the ON position.

2-19. INTERCONNECTION INSTRUCTIONS

Interconnecting the disc drive depends upon the system configuration, that is, whether a single disc drive is to be installed, or whether multiple disc drives are to be connected in series, or whether an add-on disc drive is to be installed in an existing system.

Before connecting the disc drive, ensure that the internally connected data and interconnecting cables are properly installed. Remove the shroud and check that the data cable is connected between drive control PCA-A4 and the termination assembly, and the interconnecting cable is connected between I/O sector PCA-A2 and the termination assembly. (See figure 2-6 for termination assembly details.)

Interconnecting the disc drive may be performed in two steps: first, make the necessary connections to the disc drive and then make the connections to the controller. If this is a multi-unit installation, connect all disc drives before connecting the controller. See figure 2-6 for disc drive interconnection information and figure 2-7 for controller interconnection information.

2-20. SINGLE-UNIT INSTALLATION. A single unit installation involves only one disc drive. Connect the multi-unit cable, HP 13013B, directly to the controller. Ensure that the terminator PCA, part no. 07905-60039, is installed. Then, connect the data cable to the termination assembly.

2-21. MULTIPLE-UNIT INSTALLATION. For multiple-unit installations, position each disc drive in the desired locations and proceed with the termination assembly connections at the back of each disc drive. Ensure that the terminator PCA is installed in the last disc drive in the series, and that the cable-to-cable adapter, part no. 07905-80010, is installed in all others.

2-22. ADD-ON INSTALLATION. For an add-on installation, remove the terminator PCA from the last disc drive in the existing system and replace it with the cable-to-cable adapter. Ensure that the terminator PCA is installed in add-on drive. Proceed with the termination assembly connections.

2-23. CONTROLLER INTERCONNECTIONS. After connecting the cables to the disc drive(s), proceed with the controller interconnections as follows:

a. Remove the top and front covers from the controller.

b. Pass the free end of the multi-unit cable from the first disc drive through the opening provided at the rear of the controller. (See figure 2-7.) Connect the cable to the device controller PCA at connector DRVJ3. The cable should be positioned in the channel provided and should lie to the right side of the fan.

c. For HP 13037A/B Disc Controllers, remove the data cable retainer from the device controller PCA. (See figure 2-7, view A.)

d. Pass the free end of each data cable through the opening provided at the rear of the controller. Connect each data cable to the device controller PCA at connectors J4 through J11. The cables should be positioned in the channel provided and should lie to the right side of the fan.

Note: Any data cable may be connected to any of the PCA connectors on the controller.

e. For HP 13037A/B Disc Controllers, replace the data cable retainer. (See figure 2-7, view A.) For HP 13037C Disc Controllers, secure each cable to the data cable retainer assembly on the PCA with the attached spring-loaded captive screws. (See figure 2-7, view B.)

f. On the controller, ensure that the jumper cable, part no. 13037-60021, is connected between connector J2 on the error correct PCA and connector J2 on the microprocessor PCA.

g. Ensure that the cable from the computer interface is connected to the device controller PCA at connector IFJ1.

h. Replace the controller top cover and front panel.

i. Replace and secure the controller.

j. Connect the ac power cord from the disc drive to a receptacle on the power panel assembly. Then, connect the ac power cord from each disc drive installed to an appropriate ac power source.

k. Close the rear door of the disc drive enclosure.

When one or more disc drives are installed, the logical unit address of each must be specified to the controller. The position of the UNIT SELECT switch determines the logical unit address of the disc drive. Ensure that no two logical unit addresses are alike.

2-24. INSTALLATION CHECKOUT

After the disc drive(s) has been installed and interconnected, visually inspect the installation. Ensure that the interconnecting and data cables are properly routed and anchored, the last disc drive in the series is properly terminated, and the correct logical unit addresses are specified. If there is any evidence of condensation in or on the disc drive, clean the heads as outlined in section V. Refer to section III for a full description of each operation control and indicator, and for the basic operating procedures.

Note: Before operating the disc drive, ensure that the heads are properly aligned. Then verify that velocity command gain is properly adjusted. (Refer to Section VI for adjustment procedures.) Then check the air pressure as described in Section V, paragraph 5-13.

If the disc drive is installed in an HP system, run the appropriate subsystem diagnostic tests in accordance with the instructions provided in the Diagnostic Reference Manual. If the disc drive is installed in some other system, perform the diagnostic tests in accordance with the instructions provided for that system.

2-25. REPACKAGING FOR SHIPMENT

WARNING

This disc drive contains magnetic material (spindle assembly and actuator assembly), a potential hazard to personnel during shipping. The disc drive (with the covers removed) does not exceed aircraft limitations, 5.25 milligauss at 4.6 m (15 ft), and can be shipped into or within the United States provided that all applicable regulations of the U.S. Department of Transportation (DOT) are followed before release to the initial carrier in the U.S. Refer to DOT Regulations, Title 49, parts 171-177 (Hazardous Materials).

Note: If all the covers are *undamaged and in place*, the HP 7920 Disc Drive measures less than 5.25 milligauss at 0.9 m (2.95 ft) and does not require handling as a restricted article as mentioned in the above warning.

When the disc drive requires repackaging for shipment, use the original container and packing material. If the container is not available, consult your local Hewlett-Packard Sales and Service Office to obtain a container or instructions for fabricating an acceptable alternate. Before shipment, the container (or equipment) should have a tag identifying the owner and the service or repair to be performed. Include the equipment model number and full serial number. The approximate shipping weight for the disc drive is contained in table 1-1.

If the disc drive is to be shipped, follow the procedure outlined in DOT Regulations, Title 49, parts 171-177 (Hazardous Materials). To package the disc drive, proceed as follows:

a. Place the ramp on the rear of the container base. (See figure 2-1.)

b. Thread the leveling feet fully into the enclosure to allow freedom of movement of the disc drive.

c. Position the disc drive at the ramp with the front of the enclosure facing the container base.

d. On the front of the container base, thread the two leveling feet retainer bolts into the threaded sleeves until the retainers are firmly secured but not tight.

e. Align the retainer slots approximately parallel with the side member of the container to receive the disc drive leveling feet.

CAUTION

Ensure that the retainer slots are wrapped with a protective tape to avoid damage to the leveling feet threads.

f. Roll the disc drive onto the container base via the ramp and seat the leveling feet in the retainer slots.

g. Install the rear retaining member, seating the retainers on the leveling feet.

h. Tighten the retainer bolts and the rear retaining member screws.

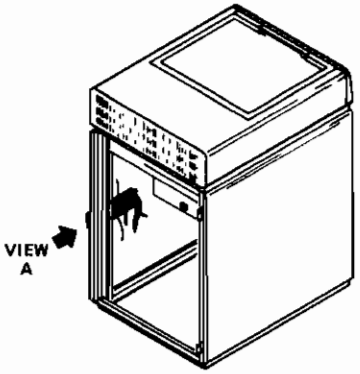
i. Place the plastic packing bag over the disc drive. Install the foam collars (if used) on the disc drive as shown in figure 2-1 using 2 cm (0.75 in.) filament tape.

j. Replace and secure the ramp with 2 cm (0.75 in.) filament tape. Attach a 1 cm (0.5 in.) polystrap band around the disc drive and under the floater base. (Refer to figure 2-1.)

k. Replace the top cover and secure with climp fasteners.

INTERCONNECTION INFORMATION

VIEW A	SINGLE-UNIT INSTALLATION	MULTI-UNIT INSTALLATION		ADD-ON INSTALLATION
		UNITS 2 THRU 7	LAST IN SERIES	
I	USE TERMINATOR PCA, P/N 07905-60039	USE CABLE-TO-CABLE ADAPTER, P/N 07905-80010	USE TERMINATOR PCA, P/N 07905-60039	USE TERMINATOR PCA, P/N 07905-60039
II	CONNECT MULTI-UNIT CABLE, HP 13013B, TO CONTROLLER	CONNECT MULTI-UNIT CABLE, HP 13013B, TO PREVIOUSLY CONNECTED DISC DRIVE IN SERIES	CONNECT MULTI-UNIT CABLE, HP 13013B, TO NEXT TO LAST DISC ORIVE IN SERIES	CONNECT MULTI-UNIT CABLE, HP 13013B, TO LAST DISC DRIVE IN SERIES
III	NOT USED	CONNECT MULTI-UNIT CABLE, HP 13013B, TO NEXT DISC ORIVE TO BE CONNECTED	NOT USED	NOT USED



NOTES:

1. THE HP 13013B MULTI-UNIT CABLE IS AVAILABLE IN FOUR LENGTHS AS FOLLOWS:

CABLE	PART NO.	LENGTH
HP 13013B	13013-60013	3.68 m (12 ft)
HP 13013B-001	13013-80011	1.83 m (6 ft)
HP 13013B-002	13013-80014	5.48 m (18 ft)
HP 13013B-003	13013-60012	2.44 m (8 ft)

2. THE HP 13213B DATA CABLE IS AVAILABLE IN FIVE LENGTHS AS FOLLOWS:

CABLE	PART NO.	LENGTH
HP 13213B	13213-60007	3.05 m (10 ft)
HP 13213B-001	13213-60008	7.62 m (25 ft)
HP 13213B-002	13213-60009	15.25 m (50 ft)
HP 13213B-003	13213-60010	22.88 m (75 ft)
HP 13213B-004	13213-60006	1.83 m (6 ft)

3. THE TERMINATOR PCA, PART NO. 07905-60039, IS ONLY USED ON THE LAST DISC DRIVE IN THE SERIES.

   FOR SINGLE UNIT INSTALLATIONS, THE TERMINATOR PCA IS USED.

   FOR MULTIPLE UNIT INSTALLATIONS, THE TERMINATOR PCA IS USED ON THE LAST DISC DRIVE IN THE SERIES AND THE CABLE-TO-CABLE ADAPTERS, PART NO. 07905-80010, ARE USED FOR EACH OF THE REMAINING DISC DRIVES.

   FOR ADD-ON INSTALLATIONS, THE TERMINATOR PCA MUST BE REMOVED FROM THE LAST DISC DRIVE IN THE EXISTING SERIES AND BE REPLACED WITH A CABLE-TO-CABLE ADAPTER. THE TERMINATOR PCA IS USED ON THE LAST DISC DRIVE IN THE SERIES.

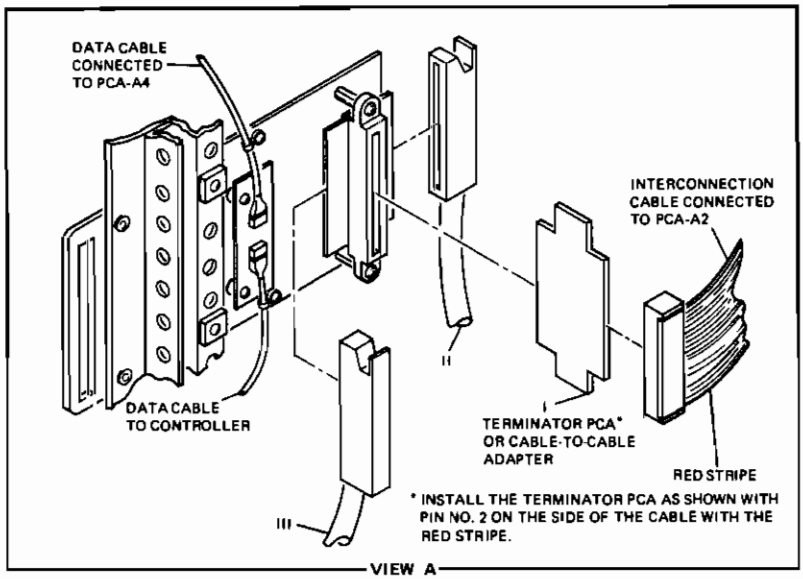


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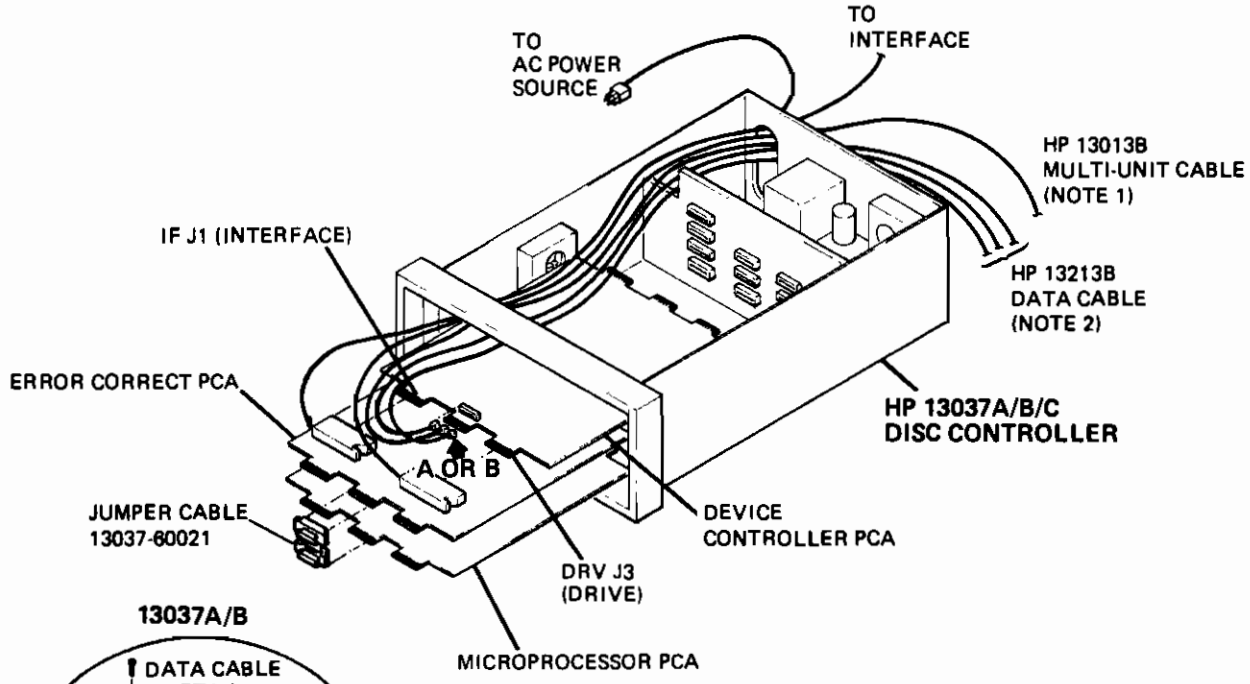
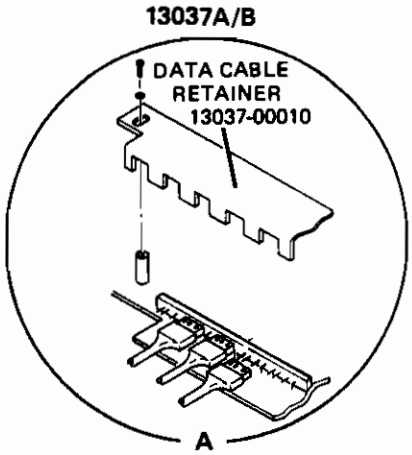
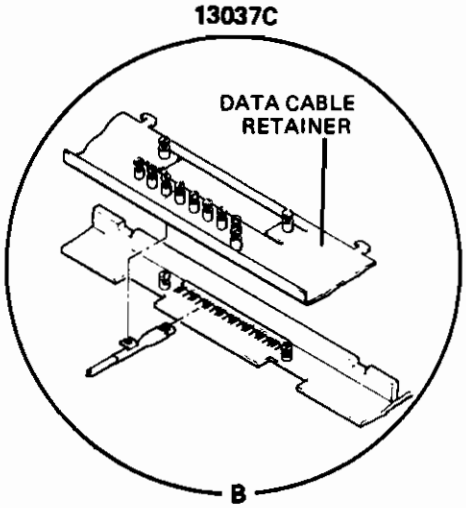
Figure 2-6. Disc Drive Interconnection Diagram







NOTES:

1. THE HP 13013B MULTI-UNIT CABLE IS AVAILABLE IN FOUR LENGTHS AS FOLLOWS. MAXIMUM CUMULATIVE CABLE LENGTH, CONTROLLER TO LAST DISC DRIVE, IS 25.5 METRES (74 FEET).

CABLE	PART NO.	LENGTH
HP 13013B	13013-60013	3.66 m (12 ft)
HP 13013B-001	13013-60011	1.83 m (6 ft)
HP 13013B-002	13013-60014	5.49 m (18 ft)
HP 13013B-003	13013-60012	2.44 m (8 ft)

2. THE HP 13213B DATA CABLE IS AVAILABLE IN FIVE LENGTHS AS FOLLOWS:

CABLE	PART NO.	LENGTH
HP 13213B	13213-60007	3.05 m (10 ft)
HP 13213B-001	13213-60008	7.62 m (25 ft)
HP 13213B-002	13213-60009	15.24 m (50 ft)
HP 13213B-003	13213-60010	22.86 m (75 ft)
HP 13213B-004	13213-60006	1.83 m (8 ft)

7301-76C

Figure 2-7. Disc Drive to Controller Interconnection Diagram

STANDARD

B120-2371 (2.3m)

OPTION 015

B120-1860 (1.5m)

NOTE: OTHER COUNTRIES SUCH AS CANADA, JAPAN (100 OR 200 VOLTS), MEXICO, PHILIPPINES, AND TAIWAN MAY USE SOME OF THE ABOVE SETS. CONSULT YOUR NEAREST HP SALES OFFICE.

SWITZERLAND

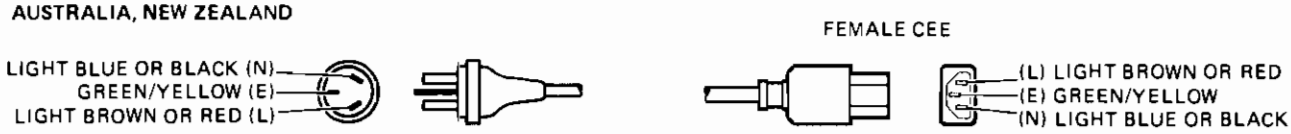
B120-2104 (2m)

EAST AND WEST EUROPE, SAUDI ARABIA, UNITED REPUBLIC OF EGYPT

NOTE: THE LIGHT BLUE (N) AND BROWN (L) WIRES TO THE MALE SCHUKO CONNECTOR MAY BE CONNECTED OPPOSITE TO THAT SHOWN.

B120-1689 (2.0m)

AUSTRALIA, NEW ZEALAND



B120-1369 (2.2m)

GREAT BRITAIN, CYPRUS, NIGERIA, RHODESIA, SINGAPORE

B120-1351 (2.2m)

NOTE: OTHER COUNTRIES USE MORE THAN ONE OF THE ABOVE POWER CORD CONFIGURATIONS. FOR CORRECT POWER CORD SET IN YOUR AREA, CONSULT YOUR NEAREST HP SALES OFFICE.

E EARTH OR SAFETY GROUND
N NEUTRAL OR IDENTIFIED CONDUCTOR
L LINE OR ACTIVE CONDUCTOR

Figure 2-8. AC Power Cord Sets

OPERATION

SECTION III

3-1. INTRODUCTION

This section contains operator information for the HP 7920 Disc Drive. The information includes a description of operating precautions, operator controls and indicators, and the basic operating procedures.

3-2. OPERATING PRECAUTIONS

The operator should observe the following precautions when operating the disc drive:

a. With the shroud removed, the disc drive has a strong magnetic field; do not wear a wrist watch when working near the top of the disc drive.

b. The prefilter should not be left out while the disc drive is operating. The longer it is out, the greater the chance of contaminants entering the drive.

c. Heed all warning and caution labels affixed to the disc drive.

d. In normal operation the heads "fly" over the discs surfaces on a thin cushion of air. A small particle of dust or other contaminants between the head and the disc can cause the head to contact the disc and possible damage to the disc and/or the head. Operate the disc drive in a clean area to minimize this malfunction.

e. Cooling air is drawn into the disc drive through the front panel and is exhausted through ports located on the rear panel. Ensure that at least a one-foot clearance is available at the front and rear of the enclosure to permit adequate airflow.

f. Ensure that routine maintenance procedures are regularly performed.

3-3. OPERATOR CONTROLS, INDICATORS, AND FUSE

Figure 3-1 illustrates the location of each operator panel control, indicator, and fuse, and the following paragraphs describe their functions.

(1) DRIVE FAULT indicator — lights in the event a malfunction occurs in the read/write circuitry, a seek operation is not completed within 90 milliseconds, a recalibrate operation is not completed within 1250 milliseconds, the correct signal level is not detected on the servo surface, a power supply malfunction occurs, or the carriage back detector is not clear, or a PCA is unplugged.

(2) READ ONLY indicator — lights when the READ ONLY switch is activated. When lighted, it indicates that all data surfaces are protected from any write operation.

(3) DOOR UNLOCKED indicator — lights whenever the RUN/STOP switch is set to stop, the spindle has stopped, the door unlock solenoid is energized, and it is safe to open the pack chamber door.

(4) DRIVE READY indicator — lights to indicate that the startup sequence is complete, the spindle has reached operational speed, and the heads have been loaded.

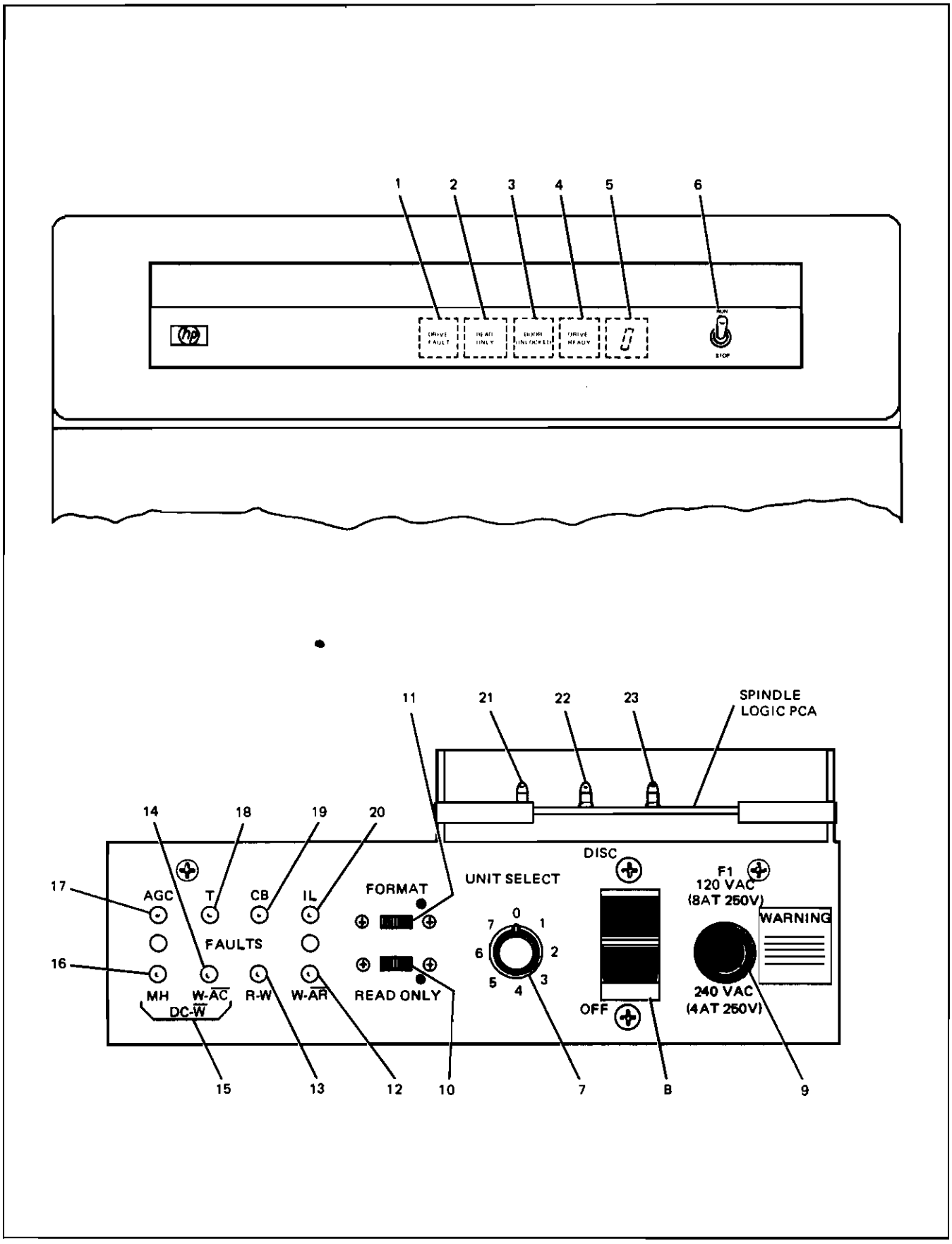
(5) Unit Select Identification numerical indicator — displays the selected logical unit address of the disc drive. It also indicates that ac power has been applied to the disc drive power supplies. An eight appears if a fault occurs in the pack detector circuit. When the system selects the disc drive, a light-emitting diode (LED) is lighted in the upper left-hand corner of this indicator.

(6) RUN/STOP toggle switch — initiates the startup sequence, controls the application of power to the spindle motor and door unlock solenoid, clears any disc drive faults, and initiates the shutdown sequence.

When set to RUN, the startup sequence is initiated, power is applied to the spindle motor, the door unlock solenoid is de-energized, and any disc drive faults are cleared. After the startup sequence is complete, the heads will be loaded at cylinder zero and the DRIVE READY indicator will light.

When set to STOP, the shutdown sequence is initiated, the heads are retracted, the spindle is braked to a stop, and the door unlock solenoid is energized to permit safe access to the disc pack.

(7) UNIT SELECT rotary switch — selects the logical unit address of the disc drive. The Unit Select Identification indicator (5) will correspond to the switch position.



7301-9A

Figure 3-1. Operator Controls, Indicators, and Fuse

(8) DISC rocker switch — controls the application of ac power to the disc drive power supplies and blower motor. The Unit Select Identification indicator will light to indicate that power has been applied.

(9) F1 primary power fuse — provides protection from an ac power overload. The current and voltage ratings with HP part numbers of the required fuse are listed in table 2-1.

(10) READ ONLY slide switch — inhibits write operations and lights the READ ONLY indicator.

When set to the protected position (•), the data recorded on the data surfaces is protected from any write operations. The READ ONLY indicator will light to indicate that the data protection feature is activated.

When set to the unprotected position, the data recorded on any data surface is not protected from write operations and is therefore subject to change. (Specific sectors may be protected in software through the recorded preamble, refer to paragraph 4-6).

(11) FORMAT slide switch — allows the program to alter or protect the contents of the sector address field. When set to the format position (•), the program can change the contents of the sector address field. This position is used to initialize an unrecorded disc or to selectively set protected track or defective track status bits in the sector address field.

When set to the protected position, the program is prevented from altering the contents of the sector address field.

FAULTS — a group of eight LED indicators that light when the internal fault detection circuitry of the disc drive detects a non-destructive read/write fault ($W \bullet \overline{AR}$ or $R \bullet W$), a destructive read/write fault ($W \bullet \overline{AC}$, $DC \bullet \overline{W}$, or MH), a servo fault (AGC, CB, or T), or an interlock fault (IL).

(12) $W \bullet \overline{AR}$ (Write • $\overline{\text{Access Ready}}$) indicator — lights when the heads are not positioned over a valid track while in the write mode.

(13) $R \bullet W$ (Read • Write) indicator — lights when both read and write modes are active simultaneously.

(14) $W \bullet \overline{AC}$ (Write • $\overline{\text{AC Current}}$) indicator — lights when the unit is in the write mode and data is not being written onto the discs, or when the data cable is missing or open.

(15) $DC \bullet \overline{W}$ (DC Write Current • $\overline{\text{Write}}$) — When both the MH (16) and $W \bullet \overline{AC}$ (14) indicators light simultaneously, the heads are receiving write (drive) current while the disc drive is not in the write mode.

(16) MH (Multiple Head) indicator — Lights when two or more heads have been selected for a read or write operation.

(17) AGC (Automatic Gain Control) indicator — lights when the AGC signal is lost while the heads are supposed to be on the servo surface. When this indicator is lighted, the heads will be retracted.

(18) T (Timeout) indicator — lights whenever a timeout period has exceeded the maximum time limit. When the indicator lights, the heads will be retracted and the spindle will be braked to a stop.

(19) CB (Carriage Back) indicator — lights when the heads have not been successfully loaded, or moved off the rest position, or the carriage back detector has failed.

(20) IL (Interlock) indicator — lights when a failure occurs in a dc voltage supply, a dc voltage is out of tolerance, a PCA is improperly seated, when the line voltage is 15 percent below nominal, or current limit has occurred in the spindle power amplifier.

SPINDLE LOGIC PCA INDICATORS — Three LED's are edge-mounted on the spindle logic PCA-A8. These indicators provide the operator with indications of conditions that occur in the spindle rotation system. The indicators are described below and are depicted in figure 3-1.

(21) SPU (Speed Up) indicator — lights (green) when the spindle motor is at operational speed.

(22) OFF (Off) indicator — lights (yellow) when power to the spindle motor is removed.

(23) SPFLT (Spindle Fault) indicator — lights (red) when an overcurrent is sensed. This fault also forces an interlock fault and retracts the heads.

3-4. REAR PANEL

Figure 3-2 illustrates the locations of each rear panel fuse and connector and the following paragraphs describe the functions.

(1) F6 — a 1.5-ampere, 250-volt secondary fuse (part no. 2110-0043) that provides overload protection for the −20 Vdc unregulated (−12 Vdc regulated) power supply.

(2) F5 — a 1.5-ampere, 250-volt secondary fuse (part no. 2110-0043) that provides overload protection

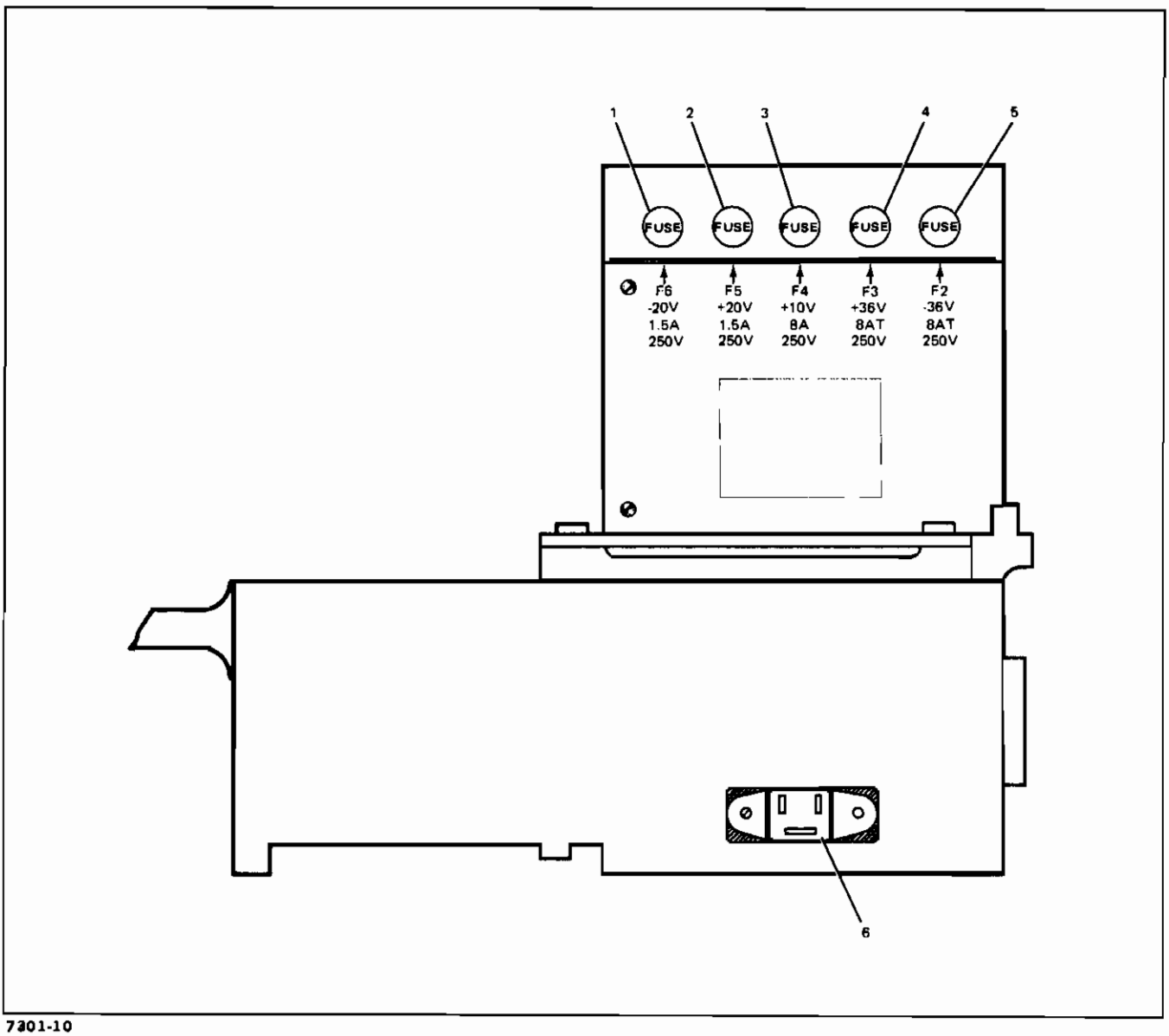


Figure 3-2. Rear Panel Fuses and Connector

for the + 20 Vdc unregulated (+ 12 Vdc regulated) power supply.

(3) F4 — an 8-ampere, 250-volt secondary fuse (part no. 2110-0342) that provides overload protection for the + 10 Vdc unregulated (+ 5 Vdc regulated) power supply.

(4) F3 — an 8-ampere, 250-volt, slo-blo secondary fuse (part no. 2110-0383) that provides overload protection for the + 36 Vdc power supply.

(5) F2 — an 8-ampere, 250-volt, slo-blo secondary fuse (part no. 2110-0383) that provides overload protection for the − 36 Vdc power supply.

(6) AC Line Connector — a three input power line connector that provides the means to connect the disc drive to the power panel assembly ac outlet strip.

3-5. OPERATING PROCEDURES

The following paragraphs provide the basic operating procedures for the disc drive. Procedures are included for startup, disc pack changing, logical unit identification changing, shutdown, and disc drive fault responses. The disc drive cannot be started without a disc pack installed.

3-6. STARTUP PROCEDURE

To operate the disc drive, proceed as follows:

a. Set RUN/STOP switch to STOP.

b. Open front door to gain access to operator controls.

c. Set READ ONLY switch as desired.

d. Set FORMAT switch as desired.

e Set UNIT SELECT switch to correspond to the disc drive logical unit address which will permit proper operation with the system.

f. Set DISC switch to on position and observe that the Unit Select Identification and DOOR UNLOCKED indicators light. The Unit Select Identification indicator should display the same number selected with the UNIT SELECT switch.

g. Close front door.

CAUTION

Never attempt to open the pack chamber door unless the DOOR UNLOCKED indicator is lit.

h. If a disc pack is to be installed, open the pack chamber door. Otherwise, proceed to step 1.

CAUTION

If head and disc contact should occur, as described in paragraph 3-2d, do not attempt to retrieve data by placing the potentially damaged disc pack in another drive or place another disc pack in this drive until the drive and disc pack have been checked by qualified personnel.

i. On the disc pack to be installed, remove the bottom cover of the disc pack storage case by grasping the top cover handle with one hand and positioning the disc pack on edge. Then with the other hand, turn the knob on the bottom cover counterclockwise until the bottom cover releases.

CAUTION

Press the handle down continuously while installing or removing the disc pack.

j. Carefully seat the disc pack on the spindle and secure by applying downward pressure on the top cover handle and rotating the handle fully clockwise until it stops turning. Remove the top cover.

k. Close pack chamber door.

l. Set RUN/STOP switch to RUN. The DOOR UNLOCKED indicator will extinguish and after a 35-second startup sequence is complete, the DRIVE READY indicator will light indicating that the spindle has reached operational speed, and the heads have been loaded at cylinder zero. The DRIVE FAULT indicator will light only if a malfunction in the read/write circuitry occurs, or a seek operation is not completed within 90 milliseconds, or a recalibrate operation is not complete within 1,250 milliseconds, or AGC, carriage-back (CB), or interlock (IL) faults exist.

3-7. CHANGING A DISC PACK

To change a disc pack, proceed as follows:

a. If the disc drive is operating, set the RUN/STOP switch to STOP. The DRIVE READY indicator will extinguish immediately. (If the disc drive is not operating, check that the RUN/STOP switch is at STOP and set the DISC switch to on.)

CAUTION

Never attempt to open the pack chamber door unless the DOOR UNLOCKED indicator is lit.

b. Allow the spindle to stop rotating (approximately 30 seconds). The DOOR UNLOCKED indicator will light indicating that the spindle has stopped, the door unlock solenoid is energized, and it is safe to open the pack chamber door.

c. Lift open the pack chamber door.

CAUTION

Press the handle down continuously while installing or removing the disc pack.

d. Place the top cover on the disc pack and secure pack to cover by applying downward pressure on the top cover handle and rotating the handle counterclockwise at least 3 turns. When the cover is secured to the disc pack, the pack will release from the spindle. Remove the disc pack and close the pack chamber door.

e. Turn the disc pack on edge and carefully secure the bottom cover by turning the knob on the bottom cover fully clockwise.

f On the replacement disc pack, remove the bottom cover of the disc pack storage case by grasping the top cover handle with one hand and positioning the disc

pack on edge. Then with the other hand, turn the knob on the bottom cover counterclockwise until the bottom cover releases.

g Open pack chamber door. Carefully seat the disc pack on the spindle and secure by applying downward pressure on the top cover handle and rotating the handle fully clockwise until it stops turning. Remove the top cover

h. Close pack chamber door.

3-8. CHANGING LOGICAL UNIT IDENTIFICATION

To change the logical unit identification of the disc drive, proceed as follows:

a. If the disc drive is operating, set the RUN/STOP switch to STOP. The DRIVE READY indicator will extinguish immediately.

b. Open the front door to gain access to the operator controls.

c. Set the UNIT SELECT switch to correspond to the disc drive logical unit address which will permit proper operation with the system.

Note: Make sure that no two drives in the system have the same logical unit number.

d. Close front door.

e. Set the RUN/STOP switch to RUN to resume operation.

3-9. SHUTDOWN PROCEDURE

To shut down the disc drive, proceed as follows:

a. Set the RUN/STOP switch to STOP The DRIVE READY indicator will extinguish immediately.

CAUTION

Never attempt to open the pack chamber door unless the DOOR UNLOCKED indicator is lit.

b. Allow the spindle to stop rotating (approximately 30 seconds). The DOOR UNLOCKED indicator will light indicating that the spindle has stopped, the door unlock solenoid is energized, and it is safe to open the pack chamber door and front door. If desired, the disc pack may be left in the disc drive.

c. Open the front door.

d. Set the DISC switch to OFF.

THEORY OF OPERATION

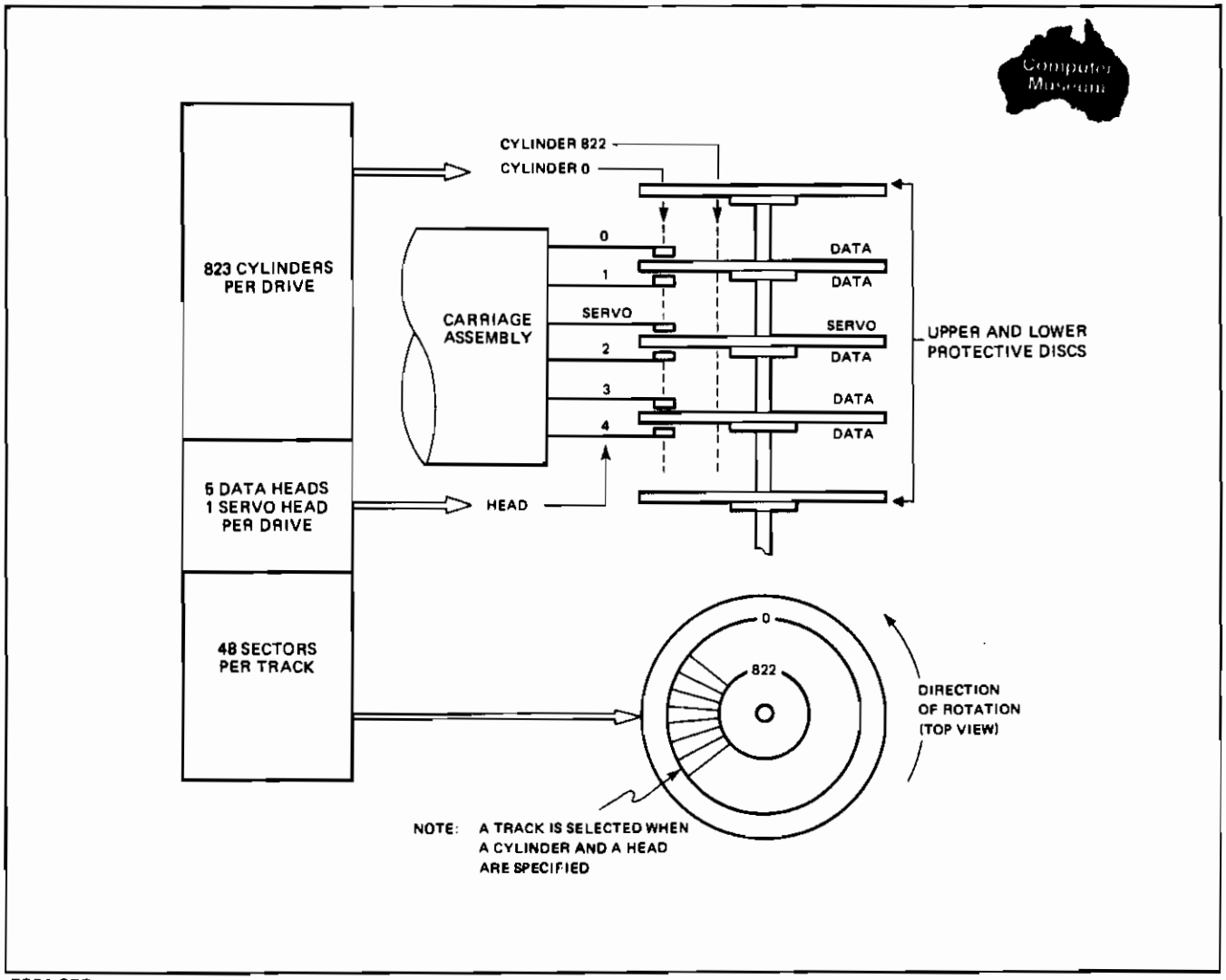
SECTION IV

4-1. INTRODUCTION

This section contains the theory of operation for the disc drive. Included are a description of its addressing structure and modes, its sector format, and a detailed discussion of each of its functional systems.

4-2. ADDRESSING STRUCTURE

The disc pack used with this disc drive is comprised of five discs. The top and bottom discs provide physical protection for the three center discs. These three center discs provide five data surfaces and one servo surface. As shown in figure 4-1, the disc drive accesses data on the five data surfaces with five read/write or data heads. Head positioning information and sector clocking are derived from the sixth (servo) surface through a read only or servo head. There are 815 ensured cylinder positions available for data storage. Cylinder addresses range from zero to 822. Each data cylinder consists of five data tracks, one on each data surface. Tracks are addressed when both cylinder and head addresses are specified. Each data track is divided into 48 physical data sectors. Sectors are addressed when both head and sector addresses are specified for a given cylinder. Head addresses range from zero to 4 and sector addresses range from zero to 47.



7301-358

Figure 4-1. Addressing Structure of an HP 7920 Disc Drive

The physical location of each data sector is determined by counting clock transitions which are derived from the servo code written on the servo surface (see figure 4-2). There are 53,760 clock transitions produced per revolution (3.22 MHz at 3600 rpm). A unique index pattern is encoded on the servo track between physical sectors 0 and 47. It is used to sense the start of physical sector 0. The sector counting electronics counts these clock transitions to keep track of the physical sectors as they pass beneath the heads, and when the index pattern is detected at the end of each revolution, it resets its counter to zero and begins counting for the next revolution.

The disc drive keeps track of physical sectors as they pass beneath the heads. The controller, on the other hand, deals only with logical sectors in order to minimize intervention during automatic head and/or track switching. This feature of the controller enables multiple sector operations to continue beyond the end of a track without waiting for another revolution of the disc to take place.

Logical sectors are staggered as the tracks progress downward through the cylinder, so that sector 47 on the next track will follow sector 47 on the current track (see figure 4-3). This logical structuring of sectors permits the controller to verify the address fields and track status of sector 47 on the new track and then immediately continue with the data transfer to sector 0 of the new track. The mapping from logical sector to physical sector is performed by the controller microcode before the sector address is transferred to the disc drive. An inverse mapping operation occurs in the case where the disc drive returns its present sector address in response to a controller command.

4-3. ADDRESSING MODES

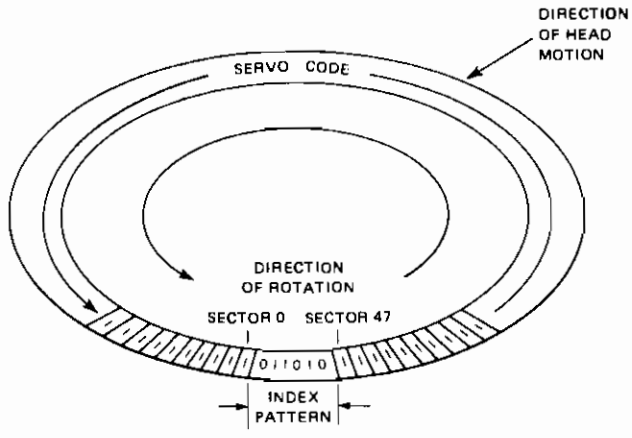
The controller operates in two modes, the surface mode and the cylinder mode, to access the data storage areas of the disc drive. The following paragraphs discuss controller/disc drive operations in the two modes.

4-4. SURFACE MODE

In the surface mode of operation, only one head is selected. A cylinder of information therefore consists of all sectors in a given track (see figure 4-4). An end-of-cylinder will occur after the data in sector 47 of that track has been transferred. Cylinder switching (a seek operation) may take place at this time, but head switching (an address record operation) occurs only after the selected surface is scanned. Data transfers will continue with sector 0 of the next cylinder after the address fields and track status indicators of sector 47 of that cylinder have been verified by the controller.

4-5. CYLINDER MODE

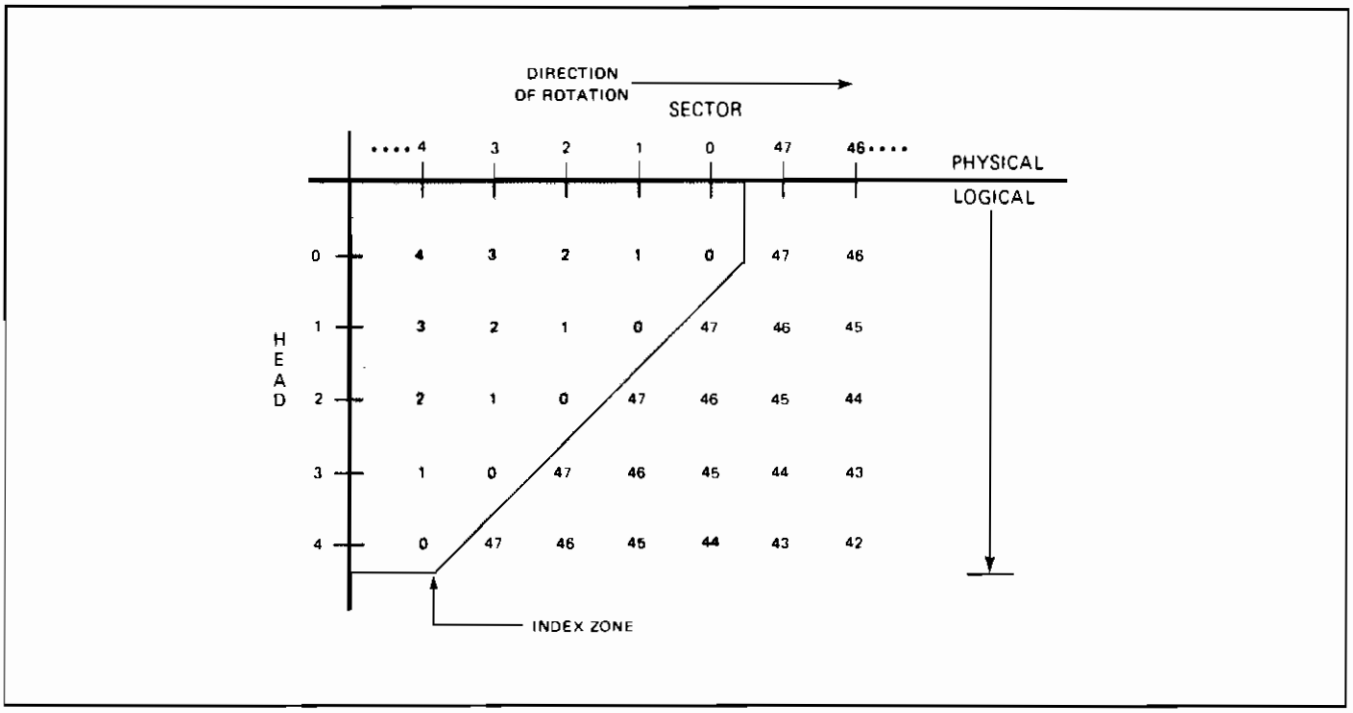
In the cylinder mode of operation, the heads are positioned over a particular cylinder and then data is written or read starting with the lowest numbered head and continuing to the highest numbered head. A cylinder of information therefore consists of all sectors on all tracks at a given cylinder address. Head switching occurs after the data in sector 47 of the current track has been transferred. Head switching is sequential, that is, head 1 will be selected after head 0, and so forth. Data transfers will continue with sector 0 of the next track after the address fields and



NOTES: 1. SERVO CODE = 6720 (MINUS 3) DI-BITS PER REVOLUTION.
2. SECTOR CLOCK = 53,760 CYCLES PER REVOLUTION (3.22 MHz at 3600 RPM).
3. ONE INDEX PULSE IS GENERATED PER REVOLUTION.

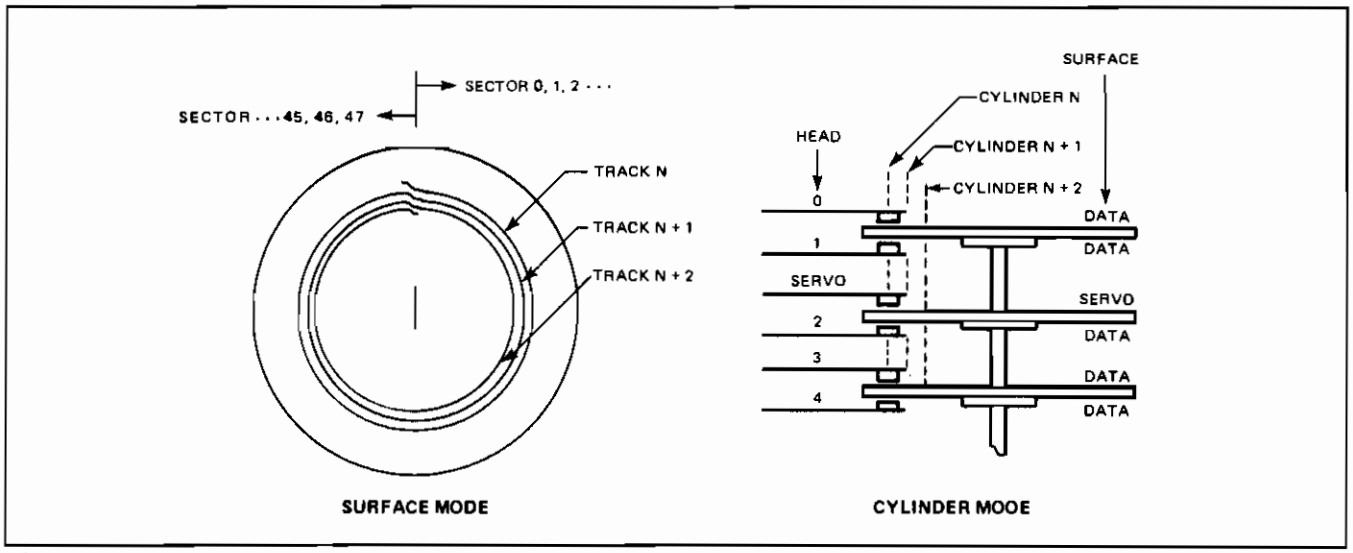
7301-36

Figure 4-2. Sector Clock and Index Generation



7301-37

Figure 4-3. Logical vs. Physical Sectors



7301-38

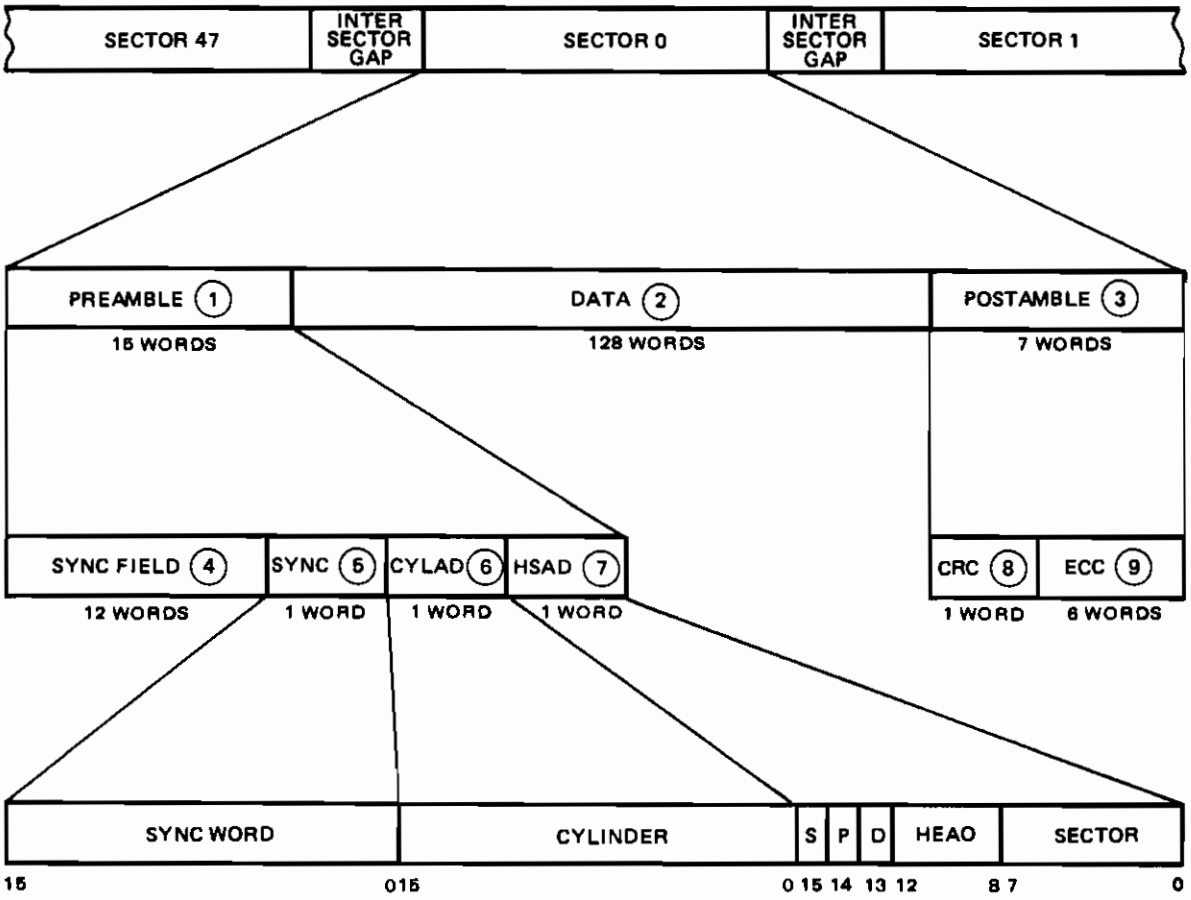
Figure 4-4. Surface Mode vs. Cylinder Mode

track status indicators of sector 47 of that track have been verified by the controller. An end-of-cylinder will occur after the data in sector 47 of the last track has been transferred. Cylinder switching (a seek operation) may take place at this time and the process repeated.

4-6. SECTOR FORMAT

The smallest addressable data storage area on a data surface is a data sector (see figure 4-5). Accessing a data sector is accomplished when the controller specifies the address of the cylinder, head, and sector. Each data sector contains a 15-word preamble, a 128-word data field, and a 7-word postamble.

The 15-word preamble is used for synchronization and addressing purposes. It is comprised of a 12-word sync field; a sync word; a cylinder address word; and a word which specifies the head and sector addresses and provides the spare, protected, and defective track status indicators.



(1) PREAMBLE – 16 WORDS FOR SYNCHRONIZATION AND ADDRESSING

(2) DATA – 128 WORDS OF DATA

(3) POSTAMBLE – DATA CHECKING AND ERROR CORRECTION INFORMATION

(4) SYNC FIELD – 12 WORDS (192 BITS) OF 0's

(5) SYNC – SYNC WORD – 100376_8 IF ECC FIELD IS VALID (BITS 15-0)
100377_8 OTHERWISE

(6) CYLAD – CYLINDER – CYLINDER ADDRESS (BITS 15-0)

(7) HSAD – S – IF "1", SPARE TRACK IN ACTIVE USE (BIT 15)
P – IF "1", PROTECTED TRACK (BIT 14)
D – IF "1", DEFECTIVE TRACK (BIT 13)
HEAD – HEAD ADDRESS (BITS 12-8)
SECTOR – SECTOR ADDRESS (BITS 7-0)

(8) CRC – CYCLIC REDUNDANCY CHECK – 1 WORD OF CHECK INFORMATION

(9) ECC – ERROR CORRECTION CODE – 6 WORDS OF CHECK AND CORRECTION INFORMATION

7300-37A

Figure 4-5. Sector Format

The data field is used to store 128 words of data. Each word is defined as being 16 bits. Only the data field is transferred to and from the system during most data operations. The preamble and postamble are normally generated and checked by the controller.

The 7-word postamble consists of a cyclic redundancy check word and six words of error correction code. The controller generates this check information during a write operation and appends it to the other information written in the sector. The check information itself depends on the value of every bit from the first bit in the sync word to the last bit in the data field. During a read operation, this check information is regenerated and compared in such a way that the presence of errors is detected, and by using the error correction hardware in the controller, the error(s) may be corrected.

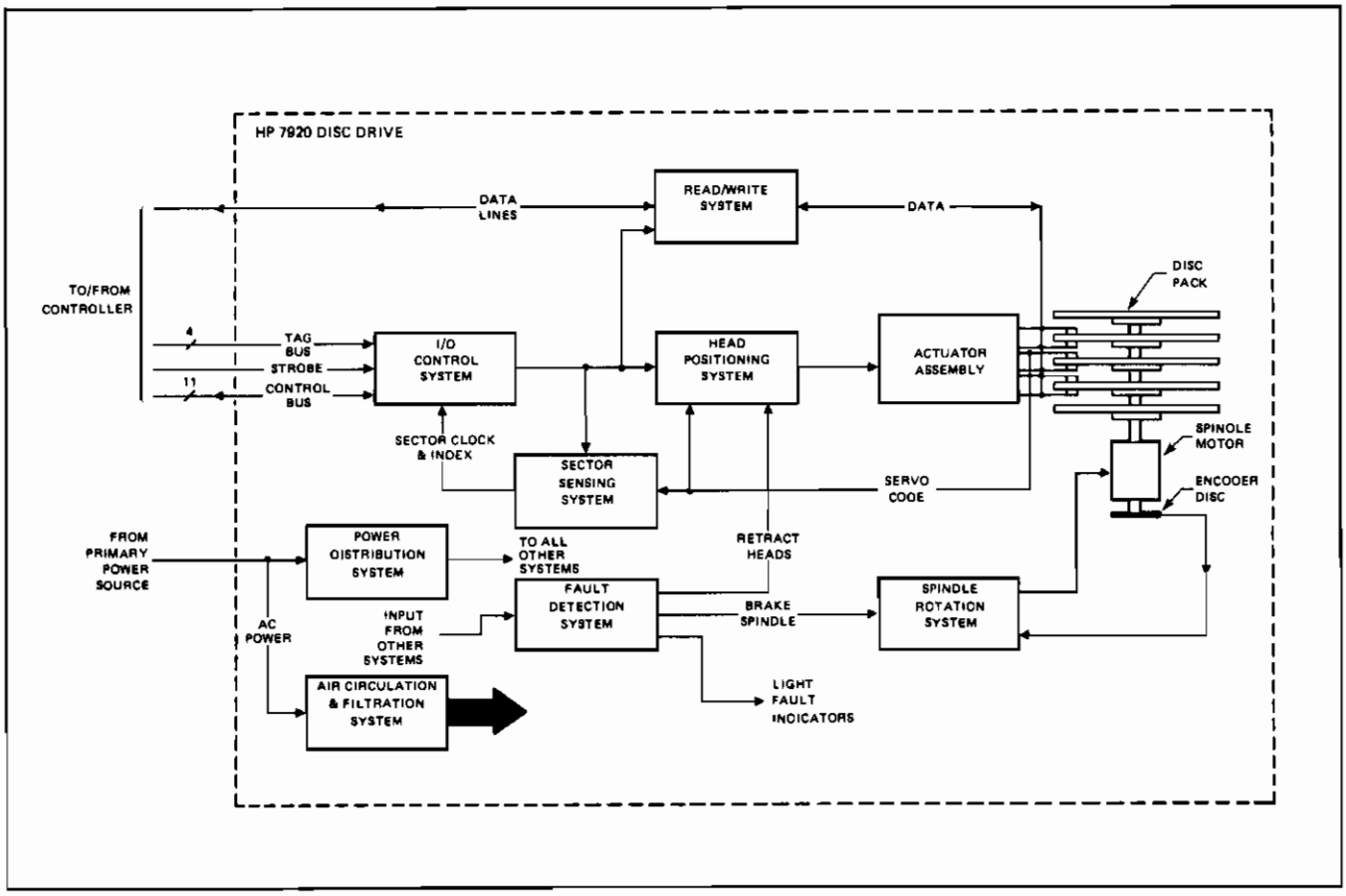
The HP 13394A Formatted Disc Pack is formatted in this fashion and it must be used as the removable storage media for this disc drive.

4-7. FUNCTIONAL DESCRIPTION

The disc drive is organized into eight functional systems. (See figure 4-6.) These are the input/output (I/O) control system, spindle rotation system, head positioning system, sector sensing system, read/write system, fault detection system, air circulation and filtration system, and power distribution system.

Each of these functional systems is discussed in detail in the following paragraphs. In addition, a functional block diagram is provided for each system in Section VII, Troubleshooting. An alphabetic listing of each signal mnemonic, a source and destination signal list, and a mainframe wiring diagram are also provided in Section VII, Troubleshooting.

The I/O control system provides the communication link between the controller and the disc drive via its tag and control buses. The spindle rotation system provides power to the spindle motor and maintains spindle speed at 3600 revolutions per minute. It also operates the pack loading assembly door lock mechanism. The head positioning system controls the loading and unloading of heads under both normal and abnormal (fault) circumstances. The sector sensing system continually monitors the physical sector presently passing beneath the heads. The controller is notified when the present sector equals the addressed sector. This information is also used to enable the read/write system for a data transfer operation. The read/write system provides the means to read information from a data



7301-40

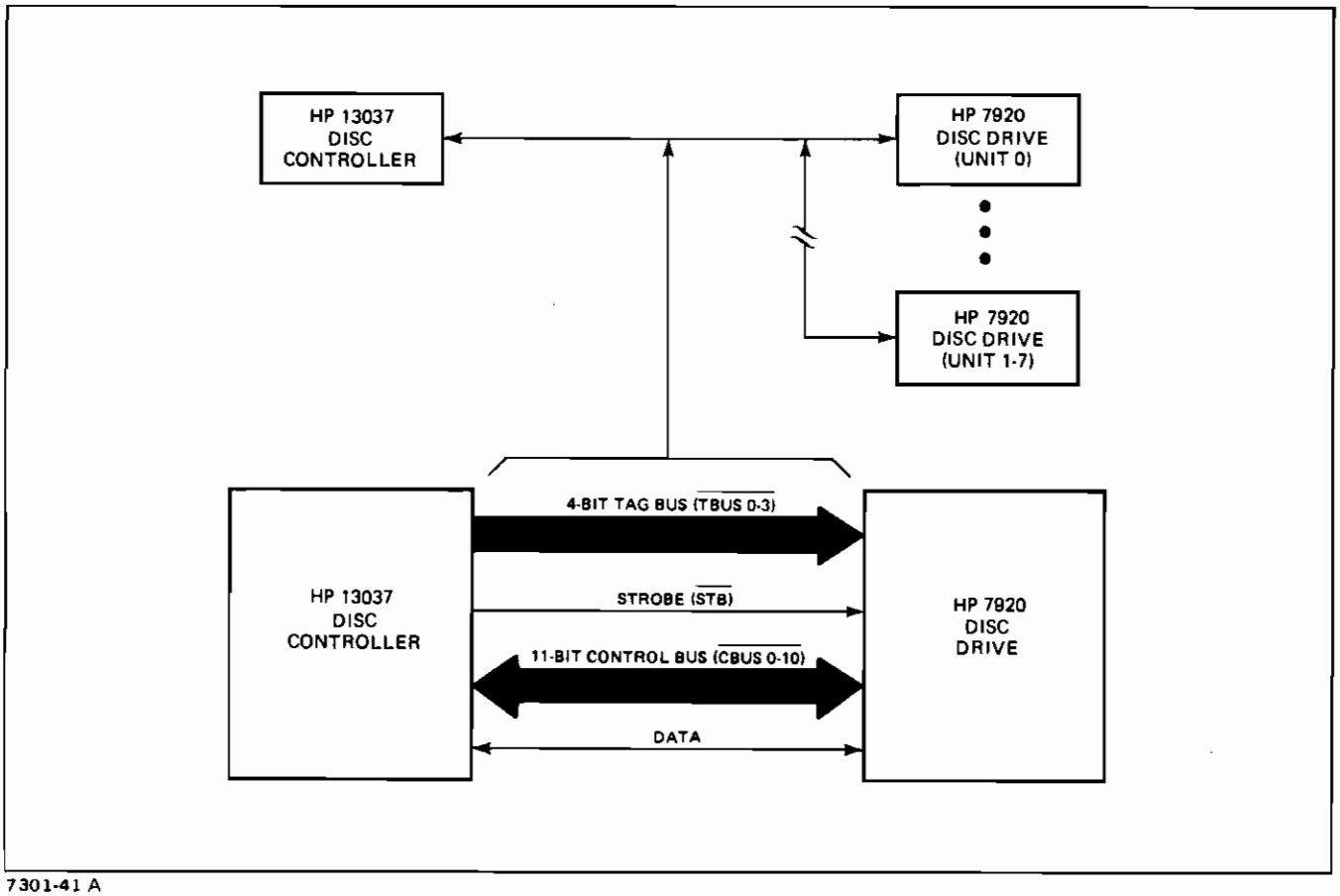
Figure 4-6. HP 7920 Disc Drive, Simplified Block Diagram

surface or write information onto a data surface. The fault detection system continually monitors various conditions within the disc drive, and lights fault indicators, retracts the heads, and brakes spindle rotation when a fault is detected. The air circulation and filtration system provides cooling air to the heat generating components of the disc drive and cool filtered air to the pack chamber. The power distribution system supplies all operating voltages to the seven other disc drive systems.

4-8. I/O CONTROL SYSTEM

The I/O control system (see figure 7-24) consists of circuits on the I/O sector PCA-A2 and the drive control PCA-A4, although all communication between these two PCA's occurs via the motherboard PCA-A7. Included are the tag bus, control bus, select, unit identity, status, and attention logic. The purpose of the I/O control system is to provide the communication link between the controller and the disc drive. As can be seen in figure 4-7, communication between the controller and all connected disc drives takes place via a 4-bit unidirectional tag bus and an 11-bit bidirectional control bus. A command is placed on the tag bus by the controller to specify what function the disc drive should perform. The command is validated by an active strobe signal from the controller. Upon receipt of certain commands, the disc drive will transfer information to the controller via the control bus. Other tag bus commands require that the controller place supplemental information on the control bus in order for the disc drive to execute the commanded function. Data is transferred between the controller and the selected disc drive via bidirectional data lines unique to that disc drive.

4-9. TAG BUS LOGIC. Each disc drive connected to the controller can respond to fourteen individual tag bus commands. Table 4-1 provides a summary of the tag bus commands. Included are the 4-bit codes that must be placed on the tag bus by the controller, the function that will be decoded, an indication of which functions require previous selection of the disc drive, the type of information that will be placed on the control bus, its direction of flow, and the action that will take place. As can be seen, tag bus bit 3 determines whether the disc drive or the controller will transfer information on the control bus. If bit 3 is active (bit 3 = 0), the disc drive will send information to the controller. If bit 3 is inactive (bit 3 = 1), the controller will send information to the disc drive. All commands placed on the tag bus by the controller are ground-true. They will remain valid as long as the strobe signal from the controller remains active (see figure 4-8). All validations occur on the leading edge of the strobe signal and terminate on its trailing edge.



7301-41 A

Figure 4-7. Disc Drive Interface

Table 4-1. Tag Bus Command Summary

TAG BUS BIT 3	2	1	0	DECODED FUNCTION	DISC DRIVE SELECTED	CONTROL BUS (REFER TO TABLE 4-2) INFORMATION	DIRECTION	ACTION
0	0	0	0	READ	YES	CURRENT STATUS	FROM DISC DRIVE	The selected disc drive will gate its current status onto the control bus and keep it updated throughout the entire read operation. It will then wait for the leading edge of its internal sector compare signal before transferring sector compare (status bit 8 = 1) in its status word on the control bus and the bit-encoded data from the addressed sector to the controller on its data lines. The transfer of data will continue until the end of the addressed sector is reached or the read command is dropped.
0	0	0	1	WRITE	YES	CURRENT STATUS	FROM DISC DRIVE	The selected disc drive will gate its current status onto the control bus and keep it updated throughout the entire write operation. It will then wait for the leading edge of its internal sector compare signal before transferring sector compare (status bit 8 = 1) in its status word on the control bus and the bit-encoded data from the controller to the addressed sector on its data lines. The transfer of data will continue until the end of the addressed sector is reached or the write command is dropped.
0	0	1	0	REQUEST STATUS (RQS)	YES	CURRENT STATUS	FROM DISC DRIVE	The selected disc drive will gate its current status onto the control bus and keep it updated as long as the strobe signal remains active.
0	0	1	1	REQUEST IDENTITY (RQI)	NO	IDENTITY	FROM DISC DRIVE	Every disc drive connected to the controller that has its attention bit set (status bit 7 = 1) will gate its identity onto a line on the control bus that corresponds to the unit number of that disc drive. The identity will remain active until the attention bit is cleared or the request identity command is dropped. The internal rotational position sensing feature of each disc drive permits the transfer of its identity up to 15 sectors before an actual sector compare occurs. This feature and the amount of look-ahead is jumper-selectable in each disc drive.
0	1	0	0	DISCONNECT (DCN)	NO	— — —	— — —	Every disc drive connected to the controller will be reset to its unselected state and the light-emitting diode (LED) in the upper left-hand corner of each unit select display will go out. In this state, each disc drive can only respond to four tag bus commands (ADU, CPS, DCN, or RQI).
0	1	0	1	CONTROLLER PRESET (CPS)	NO	— — —	— — —	Same as DISCONNECT. In addition, each disc drive connected to the controller will clear any nondestructive read/write faults (W • $\overline{AR}$ and R • W); an AGC fault; its head and sector address registers; its illegal head and sector address flip-flops; and the seek check, first status, drive fault, and attention status bits.
0	1	1	0	REQUEST SECTOR (RQP)	YES	HEAD-SECTOR ADDRESS	FROM DISC DRIVE	The selected disc drive will gate the contents of its head address register and its present sector address counter onto the control bus. This information will remain on the control bus as long as the strobe signal remains active and the present sector address will be continually updated by the sector counter.
0	1	1	1	NOT USED				

Table 4-1. Tag Bus Command Summary (Continued)

TAG BUS BIT 3	2	1	0	DECODED FUNCTION	DISC DRIVE SELECTED	CONTROL BUS (REFER TO TABLE 4-2) INFORMATION	DIRECTION	ACTION
1	0	0	0	SEEK	YES	CYLINDER ADDRESS	FROM CONTROLLER	The selected disc drive will check for a legal cylinder address on the control bus, then clock this address into its new cylinder address register (legal cylinder addresses are 0 thru 822). A seek operation to that address will then be initiated. When the heads are correctly positioned and settled over the specified cylinder, the disc drive will make attention (status 7 = 1) available in its status word. If the cylinder address is illegal, the disc drive will make seek check (status bit 2 = 1) and attention (status bit 7 = 1) available in its status word and it will not clock the illegal address into its new cylinder address register.
1	0	0	1	ADDRESS RECORD (ADR)	YES	HEAD-SECTOR ADDRESS	FROM CONTROLLER	The selected disc drive will check for a legal head and sector address on the control bus, then clock these addresses into its head address register and sector address register, respectively (legal head addresses are 0 thru 4 and legal sector addresses are 0 thru 47). If either address is illegal, the disc drive will make seek check (status bit 2 = 1) available in its status word and it will not clock the illegal address into the respective register.
1	0	1	0	ADDRESS UNIT (ADU)	NO	UNIT ADDRESS	FROM CONTROLLER	Every disc drive connected to the controller will compare the unit address on the control bus with the unit address set on its UNIT SELECT switch. If they compare, only that disc drive will be set to its selected state and the light-emitting diode (LED) in the upper left-hand corner of the unit select display will light. In this state, the selected disc drive can respond to all fourteen tag bus commands.
1	0	1	1	RECALIBRATE (RCL)	YES	— — —	— — —	The selected disc drive will clear its new cylinder address register and present cylinder address counter, then initiate a recalibrate (seek home) operation to cylinder 0. When the heads are correctly positioned and settled over cylinder 0, the disc drive will make attention (status bit 7 = 1) available in its status word.
1	1	0	0	TRANSMIT SECTOR (XMS)	YES	HEAD-SECTOR ADDRESS	FROM CONTROLLER	The selected disc drive will check for a legal sector address on the control bus, then clock this address into its sector address register (legal sector addresses are 0 thru 47). If the address is illegal, the disc drive will make seek check (status bit 2 = 1) available in its status word and it will not clock the illegal address into its sector address register. The head address on the control bus is ignored and the contents of the head address register will remain unchanged. Note: This function is designed to permit flexibility in defective and spare track operations by allowing only the sector address to be changed.
1	1	0	1	SET OFFSET (SOF)	YES	OFFSET MAGNITUDE AND SIGN	FROM CONTROLLER	The selected disc drive will clock the contents on the control bus into its offset magnitude and sign registers and reposition the heads accordingly (valid offset magnitudes are 0 thru 63 increments of 12.5 microinches each in either a positive or negative direction from track center). Note: This function is designed to permit marginal data recovery.
1	1	1	0	CLEAR STATUS (CLS)	YES	SELECT CLEAR	FROM CONTROLLER	The selected disc drive will selectively clear either first status (status bit 3 = 0) or attention (status bit 7 = 0) or both status bits depending upon the state of bits 0 and 1 on the control bus.
1	1	1	1	NOT USED				

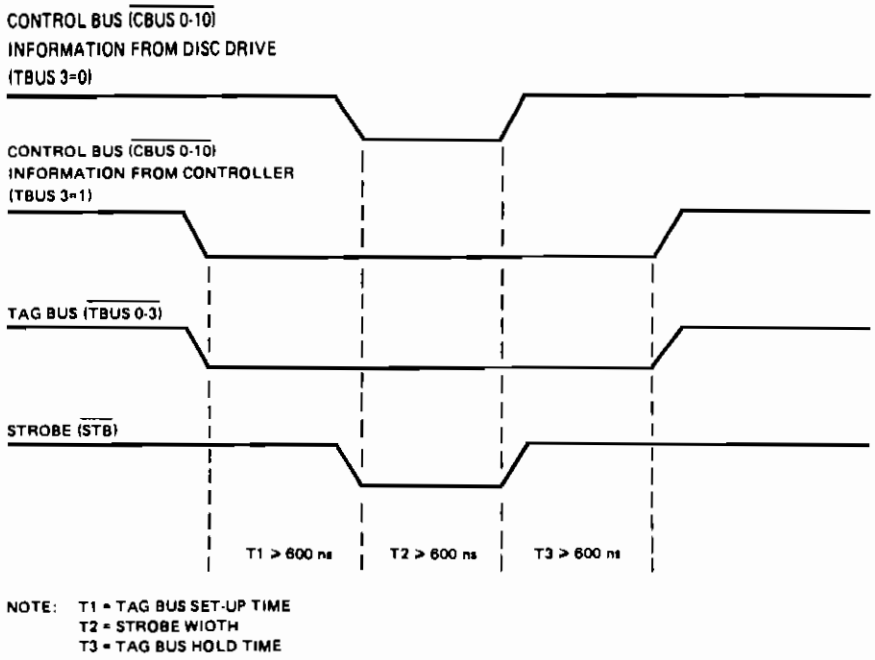


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Figure 4-8. Tag Bus Timing

4-10. CONTROL BUS LOGIC. Each disc drive connected to the controller can transmit information to the controller or receive information from the controller via the 11-bit bidirectional control bus (see figure 4-7). Upon receipt of certain tag bus commands, the disc drive will transmit its current status (READ, WRITE, or RQS), its identity (RQI), or its stored head address and present sector address (RQP) to the controller via the control bus. Other tag bus commands require that the controller place supplemental information on the control bus in order for the disc drive to execute the commanded function. This information includes the cylinder address (SEEK), head and sector addresses (ADR or XMS), unit address (ADU), offset magnitude and sign (SOF), or the information to selectively clear the attention and/or first status, status bits (CLS). Table 4-2 provides a summary of the control bus bit assignments for each decoded tag bus function.

The control bus receivers within each disc drive are always enabled to receive the supplemental information from the controller. The ground-true signals from the controller are converted to positive-true signals by the control bus receivers for use throughout the disc drive circuitry.

The control bus drivers are only enabled by four tag bus commands, i.e., READ, WRITE, RQS, or RQP. These commands require that the particular disc drive be selected. Once enabled, the control bus drivers convert the positive-true signals from the disc drive into ground-true signals for transfer to the controller. The identity of each disc drive connected to the controller that has its attention bit set (status bit 7 = 1) will be placed directly onto the control bus in response to a decoded RQI command. This information will bypass the control bus drivers, but it will still be transferred as a ground-true signal.

4-11. SELECT LOGIC. A disc drive must be selected by the controller in order for it to respond to ten of the fourteen tag bus commands. If not selected, it can only respond to four commands, i.e., ADU, CPS, DCN, or RQI. The controller selects a disc drive by placing the unit address of the desired disc drive on the control bus and an ADU command on the tag bus. Each disc drive connected to the controller will compare its unit address, established by the setting of its UNIT SELECT switch, with the unit address on the control bus. If they compare, only that disc drive will set its select flip-flop once the RQI command is decoded. When set, the SEL signal will become active (SEL = 1) to enable the remaining ten tag bus commands to be decoded by that disc drive. It will also enable the read/write logic in that disc drive. The $\overline{\text{SELL}}$ signal will become active ($\overline{\text{SELL}}$ = 0) to light the light-emitting diode (LED), located in the upper left-hand corner of the unit select display. The disc drive will be reset to its unselected state whenever the controller issues either a CPS or DCN command on the tag bus, or the RUN/STOP switch is set to RUN, or the power-on sequence is initiated.

Table 4-2. Control Bus Bit Assignments

CONTROL BUS BIT	DECODED TAG BUS FUNCTION						
	CLEAR STATUS	SET OFFSET	SEEK	REQUEST SECTOR / ADDRESS RECORD / TRANSMIT SECTOR	ADDRESS UNIT	READ/WRITE REQUEST STATUS	REQUEST IDENTITY
0	ATTENTION	MAGNITUDE 1	CYLINDER 1	SECTOR 1	UNIT 1	STATUS DRIVE BUSY	UNIT 0
1	FIRST STATUS	2	2	2	2	DRIVE READY	1
2		4	4	4	4	SEEK CHECK	2
3		8	8	8		FIRST STATUS	3
4		16	16	16		DRIVE FAULT	4
5		32	32	32		FORMAT	5
6			64			READ ONLY	6
7		SIGN —	128			ATTENTION	7
8			256	HEAD 1		SECTOR COMPARE	
9			512	2		DRIVE TYPE { 1	
10				4		DRIVE TYPE { 0	

4-12. UNIT IDENTITY LOGIC. The unit identity logic on the I/O sector PCA - A2 does not require a disc drive to be selected in order for it to transfer the identity of the disc drive to the controller. During a polling operation, the controller will issue an RQI command on the tag bus. Every disc drive connected to the controller that has its attention bit set (status bit 7 = 1) will gate its identity onto a specific line on the control bus that corresponds to the unit number of that disc drive. This information will bypass the control bus drivers, but it will still be transferred to the controller as a ground-true signal.

A jumper-selectable feature can be enabled to cause the disc drive to wait for the leading edge of its internal sector compare signal before transferring its identity. This internal rotation position sensing (RPS) feature can also establish up to 15 sectors worth of look-ahead. The amount of look-ahead is jumper-selectable on the I/O sector PCA-A2. A look-ahead of zero sectors is typical when a disc drive is connected to an HP 13037 Disc Controller.

Table 4-3. Status Word Bit Assignments

CONTROL BUS	STATUS
0	Drive Busy
1	Drive Ready
2	Seek Check
3	First Status
4	Drive Fault
5	Format
6	Read Only
7	Attention
8	Sector Compare
9	Drive Type { Always 1
10	Drive Type { Always 0

4-13. STATUS LOGIC. An 11-bit status word is transferred to the controller in response to one of three decoded tag bus commands, i.e., READ, WRITE, or RQS. Table 4-3 lists the status word bit assignments and each bit is discussed in the following paragraphs.

4-14. Drive Busy. The drive busy status bit will be active (status bit 0 = 1) whenever the heads are not correctly positioned and settled over a legal cylinder.

4-15. Drive Ready. The drive ready status bit will be active (status bit 1 = 1) and the DRIVE READY lamp will light whenever the heads are positioned over the data area of the disc pack (cylinders 0 thru 822).

4-16. Seek Check. The seek check status bit will be active (status bit 2 = 1) whenever one or more of the following conditions exists:

a. The controller has placed an illegal cylinder address (cylinder address > 822) on the control bus with a SEEK command on the tag bus. This condition will also cause the attention bit to be active (status bit 7 = 1).

b. The controller has placed an illegal head address (head address > 4) on the control bus with an ADR command on the tag bus.

c. The controller has placed an illegal sector address (sector address > 47) on the control bus with either an ADR or XMS command on the tag bus.

d. The controller has attempted to command a seek operation while the disc drive was in the process of executing a previous SEEK command.

This bit can be cleared if a legal operation (SEEK, ADR, or XMS) is performed to correct the error. The attention bit can be selectively cleared by the controller if it issues a CLS command on the tag bus with bit 0 active on the control bus.

4-17. First Status. The first status, status bit will be active (status bit 3 = 1) whenever the disc drive initially loads the heads. This bit can be selectively cleared by the controller if it issues a CLS command on the tag bus with bit 1 active on the control bus.

4-18. Drive Fault. The drive fault status bit will be active (status bit 4 = 1) and the DRIVE FAULT lamp will light whenever the disc drive fault circuits detect either a read/write, servo, or interlock fault condition. Non-destructive read/write faults ($W \bullet \overline{AR}$ or $R \bullet W$) can be cleared by the controller if it issues a CPS command on the tag bus. Destructive read/write faults ($W \bullet \overline{AC}$, or $DC \bullet \overline{W}$, or MH), servo faults (T, AGC, or CRB), or an interlock fault (IL) cause the heads to unload.Operator intervention will therefore be required.

4-19. Format. The format status bit will be active (status bit 5 = 1) whenever the FORMAT switch on the operator control panel is set to the format position (•).

4-20. Read Only. The read only status bit will be active (status bit 6 = 1) and the READ ONLY lamp will light whenever the READ ONLY switch on the operator control panel is set to the protected position (•) thereby inhibiting any write operations.

4-21. Attention. The attention status bit will be active (status bit 7 = 1) whenever the disc drive:

a. Correctly positions the heads over cylinder 0 (initial head load or RCL operation).

b. Retracts the heads under either normal or abnormal (fault) circumstances.

c. Completes a seek operation to a legal cylinder address (cylinder address ≤ 822).

d. Is commanded to perform a seek operation to an illegal cylinder address (cylinder address > 822). This condition will also cause the seek check status bit to be active (status bit 2 = 1).

This bit can be selectively cleared by the controller if it issues a CLS command on the tag bus with bit 0 active on the control bus. Refer to paragraph 4-24 for more detailed information regarding attention logic operation.

4-22. Sector Compare. The sector compare status bit will be active (status bit 8 = 1) only during a read or write operation for as long as the present sector equals the addressed sector. This bit will be cleared whenever the end of the addressed sector is reached or the READ or WRITE command is dropped.

4-23. Drive Type. Status bits 9 and 10 enable the controller to determine the type of disc drive, total number of heads, and the number of sectors per track. The drive type code for an HP 7920 Disc Drive is 01, therefore,bit 9 will always be active and bit 10 will always be inactive for this type of disc drive.

4-24. ATTENTION LOGIC. There are three attention flip-flops in each disc drive which are used to control the state of the attention bit (status bit 7). This status bit, in conjunction with other status bits, is used to notify the controller when the disc drive has performed certain operations. The ACRY and retract attention flip-flops are located on the drive control PCA-A4, and the SEEK • ICA flip-flop is located on the I/O sector PCA-A2. All three flip-flops are initially reset by $\overline{CLA}$ (via NDPS) when power is first applied or the RUN/STOP switch is set to RUN. When reset, these flip-flops cause the attention bit to be inactive (status bit 7 = 0).

Every time the RUN/STOP switch is set to RUN and the disc pack has come up to speed, a seek home operation will be initiated. When the heads are correctly positioned over cylinder 0, the ACRY attention flip-flop will be set by the leading edge of ACRY (status bit 0 = 0 and status bit 7 = 1). This will notify the controller that the seek home operation has been completed.

During normal seek operations, the ACRY and retract attention flip-flops are reset once the heads leave the cylinder over which they were settled (status bit 0 = 1 and status bit 7 = 0). Once the heads are correctly positioned

and settled over any legal cylinder, the ACRY attention flip-flop will be set by the leading edge of ACRY. If a seek operation to the same cylinder address is attempted, ACRY will remain active because the heads will not have moved, but CYL will momentarily go inactive (CYL = 0) as the first seek command is dropped and then it will return active (CYL = 1) as the second seek command is decoded. When this occurs, the ACRY attention flip-flop will be direct-set by the leading edge of CYL. In both cases (either a seek operation to a different cylinder address or to the same cylinder address) when the ACRY attention flip-flop is set, the controller is notified that a legal seek operation has been completed (status bit 0 = 0 and status bit 7 = 1).

If a seek operation to an illegal cylinder is attempted, the ACRY attention flip-flop will be inhibited from being set because CYL will be held inactive (CYL = 0), and instead the SEEK • ICA flip-flop will be set as soon as the strobe signal goes inactive (status bit 2 = 1 and status bit 7 = 1). This will notify the controller of the illegal seek request.

If the RET signal becomes active (RET = 1) for any reason, the heads will be retracted and the drive ready flip-flop, on the drive control PCA-A4, will be reset. This will cause the retract attention flip-flop to be set by the leading edge of $\overline{DRDY}$ (status bit 1 = 0 and status bit 7 = 1). This will notify the controller of the retracted condition of the heads.

4-25. SPINDLE ROTATION SYSTEM

The spindle rotation system (see figure 7-25) consist of circuits on the drive control PCA-A4, spindle logic PCA-A8, power and motor regulator (PMR) PCA-A9, and the encoder PCA-A10. Further, it includes such mechanical assemblies as the spindle motor, pack detector, and pack loading assembly door lock mechanism. Communication between the drive control PCA-A4 and the rest of the circuitry occurs via the motherboard PCA-A7, while the remainder of the communication occurs via the main harness. The primary purpose of the spindle rotation system is to provide power to the spindle motor and to maintain its operational speed at 3600 revolutions per minute. In addition, it operates the pack chamber door lock mechanism. Included in the following are discussions relative to spindle logic initiatization; the pack chamber door control, run spindle command, and spindle motor phase encoding and decoding, speed control and speed up detection, current regulation, dynamic braking, speed down detection, overcurrent protection, and overvoltage protection.

4-26. SPINDLE LOGIC INITIALIZATION. During the power-up sequence, $\overline{PSF}$ will momentarily become active ($\overline{PSF}$ = 0) because the power supplies have not yet reached their full operating level. This will momentarily hold the door unlocked solenoid de-energized which prevents access to the pack chamber. In addition, it will cause $\overline{SPS}$ to become active ($\overline{SPS}$ = 0) which will reset both current limit latches, direct-set the reverse direction detector, and clock the speed down latch clear.

Once the power supplies reach their proper operating level ($\overline{PSF}$ = 1), SPEN will become active (SPEN = 1) if the encoder PCA-A10 interlock is not open. The speed down detector will then detect that the spindle motor is stopped and it will direct-set the speed down latch. Setting the speed down latch causes $\overline{SPD}$ to become active ($\overline{SPD}$ = 0).

4-27. DOOR CONTROL LOGIC. The door unlock solenoid will be energized when the speed-down latch is set, the carriage is retracted, the RUN/STOP switch is set to STOP, and the power supplies are operating. When the solenoid is energized, the pack chamber door will be unlatched permitting access to the pack chamber and the DOOR UNLOCKED lamp will light. A disc pack can now be installed.

With a pack installed and the pack chamber door closed, the RUN/STOP switch can be set to RUN. Setting this switch to RUN, sets the run/stop flip-flop. This will generate both a destructive and a non-destructive preset to initialize the rest of the disc drive circuitry (refer to paragraph 4-49). With STOP inactive (STOP = 0), the door unlock solenoid will be de-energized to again latch the pack chamber door and the DOOR UNLOCKED lamp will extinguish.

4-28. RUN SPINDLE COMMAND LOGIC. Once a pack is in place (PIP = 1), the pack chamber door is locked (DL = 1), the carriage is fully retracted from the pack chamber (CRB = 1), no interlock fault (ILF = 0) or time-out fault (TOF = 0) exists, the run/stop flip-flop is set (RUN = 1), and the run spindle flip-flop will be set to generate the run spindle command ($\overline{RS}$ = 0).

This command will reset the speed down latch and the reverse direction detector, and cause an encoder pulse to be generated. The encoder pulse will clock the initial phasing information from the phase encoder into the phase A and phase B flip-flops.

4-29. PHASE ENCODING AND DECODING. The spindle motor is a brushless dc motor with two sets of phase windings. Power is applied to each winding in a prescribed sequence from the + and -36 volt supplies through four current switches. Two switches are provided for each phase winding because current is required to flow through the winding in both a positive and negative direction. Each switch is activated three times during any given revolution of the motor. It is the relative position of the rotor with respect to the windings that determines which switch to activate. Rotor position and motor speed are derived by the phase encoder, from the encoder PCA.

The phase encoder circuitry consists of an encoder disc, which is fastened to the bottom of the spindle motor shaft, and the encoder PCA-A10. The encoder disc is a thin metal disc with three 60-degree slots spaced 60 degrees apart. The encoder PCA-A10 consists of two identical circuits, one for phase A and the other for phase B. Each circuit is comprised of a light-emitting diode (LED), a phototransistor, and an amplifier/inverter stage. The PCA is attached

to the spindle motor housing so that the light from each LED passes through the slotted area of the encoder disc and strikes the associated phototransistor. When light strikes the phototransistor, it conducts and the resultant output is amplified and inverted. The LED/phototransistor pairs are physically mounted on the PCA 30 degrees apart with phase A arranged to conduct before phase B, therefore, the output from phase A will lead that from phase B by 30 degrees.

The two signals from the encoder PCA-A10 are routed to the spindle logic PCA-A8 where they are conditioned and inverted. They can be observed at the test points labeled "ENCA" and "ENCB". They are then coupled to the input of the encoder pulse generator and two "exclusive-OR" gates which act as programmable inverters. The encoder pulse generator produces a pulse for each edge of both spindle encoder sensors. Twelve encoder pulses are produced per revolution. The frequency of the encoder pulses at 3600 revolutions per minute is 720 Hz. The output from the encoder pulse generator can be observed at the test point labeled "ENCP". The "exclusive-OR's" invert the encoder signals when the stop spindle command is active (RS = 1) to dynamically brake the motor.

When the run spindle command is active ($\overline{RS} = 0$), no inversion takes place and the encoder signals are clocked into the phase A and phase B flip-flops by the output from the encoder pulse generator. The latched encoder signals are then routed to the phase decoder network where they are decoded to select the proper current switch. These phase selection outputs can be observed at test points labeled "PH1+", "PH1−", "PH2+", and "PH2−". Figure 4-9 illustrates the timing relationship of the two input phase signals, the output from the encoder pulse generator, and the four resultant phase selection output signals.

If an overcurrent condition is detected in a given phase, that phase will be inhibited. Similarly, if an overvoltage condition is sensed, power to that phase will momentarily be interrupted. Both motor phases will be inhibited when the stop spindle command is active ($\overline{RS} = 1$) and the speed is detected to be down or at the moment the reverse direction detector first detects that motor has begun to rotate clockwise (reverse).

The latched encoder signals are also applied to the reverse direction detector which is used to detect a clockwise rotation of the motor during speed down detection. In addition, a 180 Hz signal is derived from the latched encoder signals. This signal is used to clock the timeout counter during a seek, seek home, or normal head load or unload operation.

4-30. SPEED CONTROL. As previously mentioned, motor speed is derived from the phase encoder information. The two signals from the encoder PCA-A10 are conditioned, inverted, and applied to the input of the encoder pulse generator. The encoder pulse generator produces a pulse for every edge of the encoder signals. Twelve encoder pulses are produced per revolution. The frequency of the encoder pulses at 3600 revolutions per minute is 720 Hz. The output from the encoder pulse generator can be observed at the test point labled "ENCP". This output is routed to the phase and speed down detectors.

The phase detector is a 3-stage shift register. The output from the encoder pulse generator is used to shift "0's" to the right and the output from a 720 Hz reference clock is used to shift "1's" to the left. The 720 Hz reference clock is derived from a 3 MHz crystal-controlled oscillator and a divide-by-4168 counter. The output from the 3 MHz oscillator can be observed at the test point labeled "3 MHz" and the output from the 720 Hz reference clock can be observed at the test point labeled "720 Hz". Phase detection is achieved by monitoring the center bit of the shift register. This bit can be observed at the test point labeled "PHASE".

When the disc pack is rotating slower than 3600 rpm, "1's" will be shifted through the shift register because reference clock pulses will occur more frequently than encoder pulses. This will cause a "1" to remain in the center bit of the shift register and maximum spindle current to be commanded. As a result, the motor will begin to accelerate. As the motor comes up to speed, encoder pulses will begin to shift "0's" into the left-most bit. Eventually, this will force the "1" out of the center bit. When this occurs, a decrease in the center bit duty cycle will result which in turn will decrease the spindle current command causing less current to be delivered to the motor. At speed, the center bit will toggle and the duty cycle will be nearly symmetrical.

The left- and right-most bits of the shift register are monitored by the speed up detector. When these bits remain unchanged for approximately one-half a second, the motor is declared to be at speed. The green SPD LED at the output of the speed up detector will remain off until the spindle is declared to be at speed.

If the spindle begins to loose speed slightly, the encoder pulse that was suppose to shift the "1" out of the center bit will be late. This will cause an increase in the center bit duty cycle, an increase in the spindle current command, and more current to be delivered to the motor until it returns to speed.

The output from the center bit of the shift register is buffered and filtered to produce a smooth dc voltage which represents the spindle current command.

The current command limiter reduces the spindle current command during the braking operation. The spindle current command is applied to the input of the current regulation circuit. It can be observed at the test point labeled "SCC".

4-31. MOTOR CURRENT REGULATION. The motor current regulation circuitry compares the smooth dc voltage representing the spindle current command with

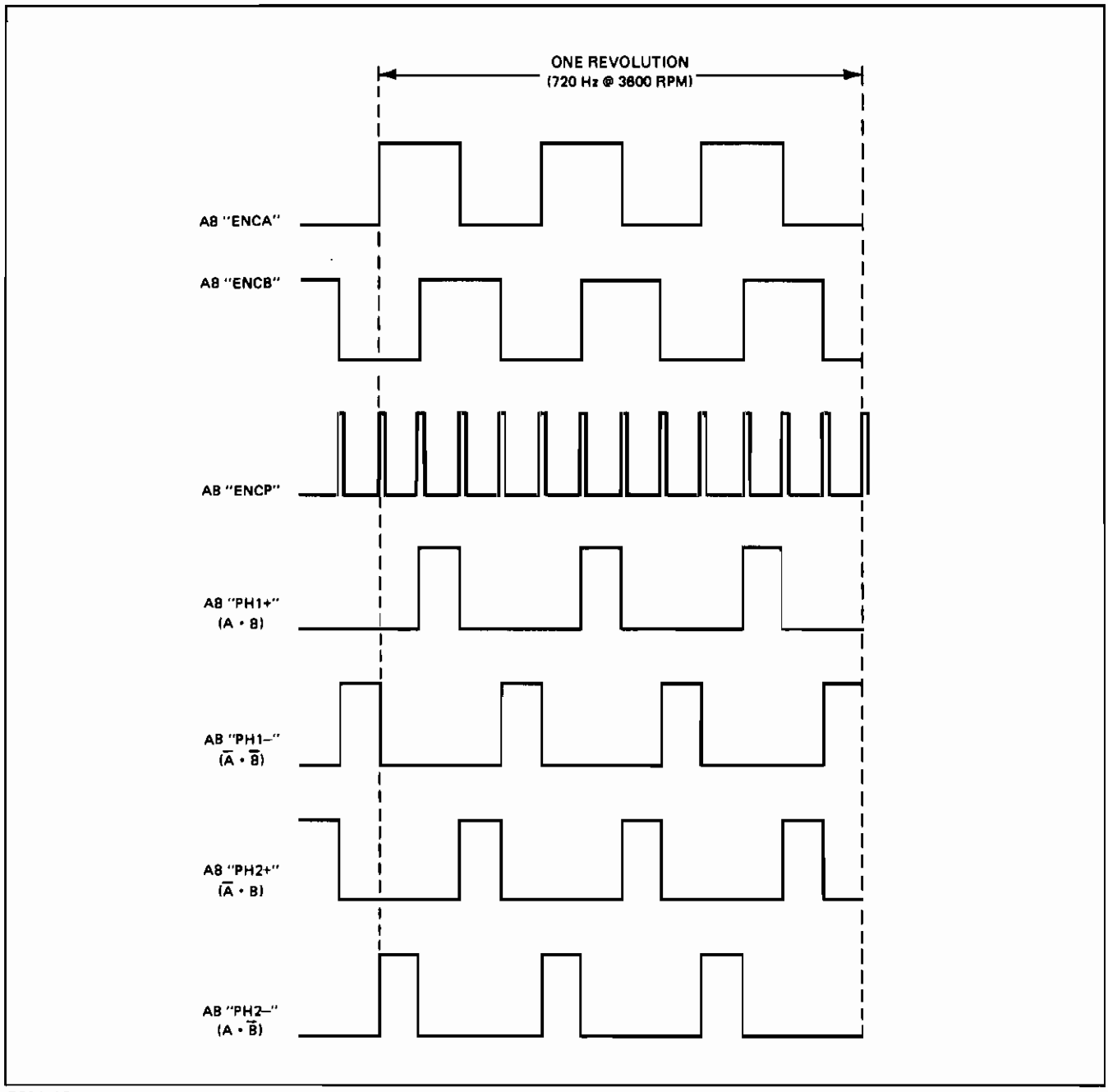

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Figure 4-9. Phase Selection Timing

the average spindle motor current derived from the spindle motor current sampling resistor and regulates the motor current accordingly. This is achieved by applying the desired spindle current command to the positive inputs of two differential amplifiers and the derived average spindle motor current to the negative inputs. The unity-gain inverting amplifier inverts negative current samples, so that they may be processed as positive current samples. The actual measured current sample can be observed at the test point labeled "SMC".

The difference between the desired current and the actual measured current is applied to the negative inputs of two comparators. The output from a 22 kHz triangle wave generator is applied to the positive inputs. This signal can be observed at the test point labeled "22 kHz". A pulse train is produced with a duty cycle determined by the points at which the smooth dc voltage intersects the slopes of the triangular wave. If there is a small difference between the desired current and the actual current, a low duty cycle will be output from the comparators. Similarly, a larger difference produces a higher duty cycle output. It is the duty cycle that controls the pulse selection outputs which in turn control the application of current to the spindle motor windings. The output that regulates the positive phases can be observed at the test point labeled "$\overline{P+}$", while the output that regulates the negative phases can be observed at the test point labeled "$\overline{P-}$".

4-32. DYNAMIC BRAKING. When the RUN/STOP switch is set to STOP, the spindle motor is dynamically braked to a stop. Dynamic braking is achieved by attempting to drive the motor in a clockwise (reverse) direction while it is rotating in a counterclockwise (forward) direction. This is accomplished by inverting the information from the phase encoder circuitry. The "exclusive-OR's" at the input to the phase A and phase B flip-flops act as programmable inverters. When the stop spindle command is active ($\overline{RS}$ = 1), the phase encoder information is inverted. This will cause the opposite phase to be driven which will brake the motor to a stop.

4-33. SPEED DOWN DETECTION. The speed down detector monitors the encoder pulses, and when the interval of time between transitions exceed 0.7 of a second, it direct-sets the speed down latch to declare the motor stopped. With the stop spindle command active ($\overline{RS}$ = 1) and the speed down ($\overline{SPD}$ = 0), the spindle current command to both motor phases will be inhibited. If the speed down detector should fail to detect the proper time interval between encoder pulses, the reverse direction detector will be clocked set at the moment the motor first begins to rotate clockwise (phase B leads phase A). When set, the reverse direction detector will inhibit the spindle current command to both motor phases. In either case, the yellow OFF LED will light when the spindle current command to both motor phases has been inhibited and the motor will remain stopped until another run spindle command is issued ($\overline{RS}$ = 0).

4-34. OVERCURRENT PROTECTION. The four current switches, located on the PMR PCA-A9, have overcurrent sense networks associated with them. These networks sense the level of the current being applied to the associated motor phase and if this current exceeds the established upper limit, the appropriate current limit signal will become active ($\overline{CL1}$ or $\overline{CL2}$ = 0). This will set the associated current limit latch on the spindle logic PCA-A8. The state of the latch can be observed at the test point labeled "CL1" or "CL2". When set, the latch will disable the spindle current command to that motor phase. The other phase, however, will remain operative to keep the spindle motor rotating until the heads have been unloaded. In addition, the set output will cause the SPFLT LED to light indicating that a spindle fault exists. It will also signal the fault detection circuity through the interlock chain to cause an emergency retract operation. The current limit latches are reset by setting the POWER switch to OFF, then to ON which causes $\overline{SPS}$ to momentarily become active ($\overline{SPS}$ = 0).

4-35. OVERVOLTAGE PROTECTION. During spindle braking, the current switch circuits attempt to drive the + and – 36 volt supply lines to about 60 volts. To protect against this condition, a pair of shunt regulator circuits are employed to monitor the + and – 36 volt supply lines. If an overvoltage condition is sensed (voltage greater than 42 volts), the active phase is turned off and a bleeder resistor is switched in to lower the excessive voltage. The state of the disabling command can be observed at the test point labeled "VL+" or "VL–". When the lower threshold is reached (voltage less than 40 volts), the system resumes normal operation.

If the spindle motor is jammed when the run spindle command is issued ($\overline{RS}$ = 0), a stall condition will occur. The dissipation that would result in the bleeder resistor would exceed its 10 watt rating, therefore, two regulator protection circuits are employed to sample excessive on-time of each bleeder resistor and inhibit the bleeding action as a result, however, the active phase is inhibited.

4-36. HEAD POSITIONING SYSTEM

The head positioning system (see figure 7-26) consists of circuits on the I/O sector PCA-A2, servo PCA-A3, drive control PCA-A4, track follower PCA-A5, and power and motor regulator (PMR) PCA-A9. Further, it includes such mechanical assemblies as the actuator assembly, carriage latch solenoid, carriage back detector, and velocity transducer and shaft. With the exception of the PMR PCA-A9, all communication between PCA's occurs via the motherboard PCA-A7. The PMR PCA-A9 communicates with the other PCA's through the main harness. The purpose of the head positioning system is to control the application of power to the coil in the actuator assembly. This causes the heads to be accurately positioned over a specified cylinder during an initial head load, forward or reverse seek, offset, or recalibrate operation. In addition, it provides the means to retract the heads under both normal and abnormal (fault) conditions. Included in the following are discussions relative to an initial head load, normal head unload, forward or reverse seek, offset, recalibrate, and emergency retract operation.

4-37. INITIAL HEAD LOAD OPERATION. Once the disc pack reaches its operational speed of 3600 revolutions per minute, the heads will automatically be loaded. The heads will fly above the surface of the discs supported by a thin cushion of air. This cushion of air acts as an air bearing to the heads. The air bearing functions as a very stiff spring which is opposed by the leaf spring on each head arm. These two opposing forces tend to cancel one another at a flying height of 42 microinches (1.08 microns) at cylinder 0 to 35 microinches (0.89 microns) at cylinder 822. In order for the heads to fly properly several conditions have to be satisfied. Among these are the cleanliness of the air that surrounds the disc surfaces, the axial runout and flatness of the disc surfaces, and the flatness of the head surface near the read/write gap.

With a disc pack installed ($\overline{PIP}$ = 0); the pack access door locked ($\overline{DL}$ = 0); the run/stop flip-flop set (STOP = 0); no existing AGC fault (AGF = 0), carriage back fault (CBF = 0), interlock fault (ILF = 0), destructive write fault (DWF = 0), or timeout fault (TOF = 0), the head positioning system circuitry waits for the spindle to reach operational speed ($\overline{SPU}$ = 0). When this occurs, the RET signal will become inactive (RET = 0). This will cause the $\overline{SKH}$ signal to become active ($\overline{SKH}$ = 0) which will

initiate a 1250 millisecond timeout cycle, set the servo enable flip-flop, and direct set the seek home flip-flop. The state of the $\overline{SKH}$ signal can be observed at the test point on the drive control PCA-A4 labeled "$\overline{SKH}$".

The $\overline{SKH}$ signal will also cause the CYL signal to become active (CYL = 1) to clear the seek check flip-flop on the I/O sector PCA-A2. The state of the CYL signal can be observed at the test point on the servo PCA-A3 labeled "CYL". Clearing the seek check flip-flop clears the seek check status bit (status bit 2 = 0).

In addition, the $\overline{COF}$ signal will become active ($\overline{COF}$ = 0) to clear the offset magnitude and sign registers on the track follower PCA-A5. This will ensure that any offset information stored during a previous offset operation will be cleared out so that it will not affect the positioning of the heads.

With the servo enable flip-flop set ($\overline{SEN}$ = 1 and $\overline{SEN}$ = 0) and the $\overline{DRDY}$ and $\overline{RET}$ signals active ($\overline{DRDY}$ and $\overline{RET}$ = 1), the ECS signal will become active (ECS = 1). This causes the $\overline{CSOL}$ signal to become active ($\overline{CSOL}$ = 0) to energize the carriage latch solenoid permitting carriage movement. Also with the head positioning servo loop enabled ($\overline{SEN}$ = 0) and no existing power supply fault ($\overline{PSF}$ = 1), the linear motor relay on the PMR PCA-A9 will be energized to permit current to be applied to the linear motor coil. These conditions can be observed at the test points on the PMR PCA-A9 labeled "$\overline{SEN}$" and "$\overline{PSF}$". The $\overline{SEN}$ signal also enables the linear motor power amplifier (LMAE = 1) after a 60 millisecond delay to ensure closure of the linear motor relay contacts.

With the seek home flip-flop set (SKH = 1 and $\overline{SKH}$ = 0), the new cylinder address register and present cylinder address counter will be initiated by $\overline{SKH}$. Since the new cylinder address and the present cylinder address count both match, the MATCH signal will become active (MATCH = 1). The state of the MATCH signal can be observed at the test point on the servo PCA-A3 labeled "M".

Since the heads are not yet positioned over the servo zone, the AGC signal from the track follower PCA-A5 will be inactive (AGC = 0). The set output from the seek home flip-flop and the absence of the AGC signal (AGC = 0) will activate the +slew FET switch on the servo PCA. With this switch closed, a constant velocity will be developed and an appropriate current will be applied to the linear motor coil. This current command can be observed at the test point on the servo PCA-A3 labeled "CC". The coil will be repelled from the linear motor magnet to push the carriage assembly supporting the heads along the rails at approximately 3.5 inches per second.

A voltage which is proportional to the linear velocity of the carriage is fed back through the tachometer buffer and FET switch to the summing junction of the summing amplifier. The tachometer buffer is a unity-gain amplifier used to eliminate the effects of temperature on the velocity transducer signal. The voltage developed is used to precisely control the head positioning servo loop during the initial head load operation. This voltage can be observed at the test point on the servo PCA-A3 labeled "TAC".

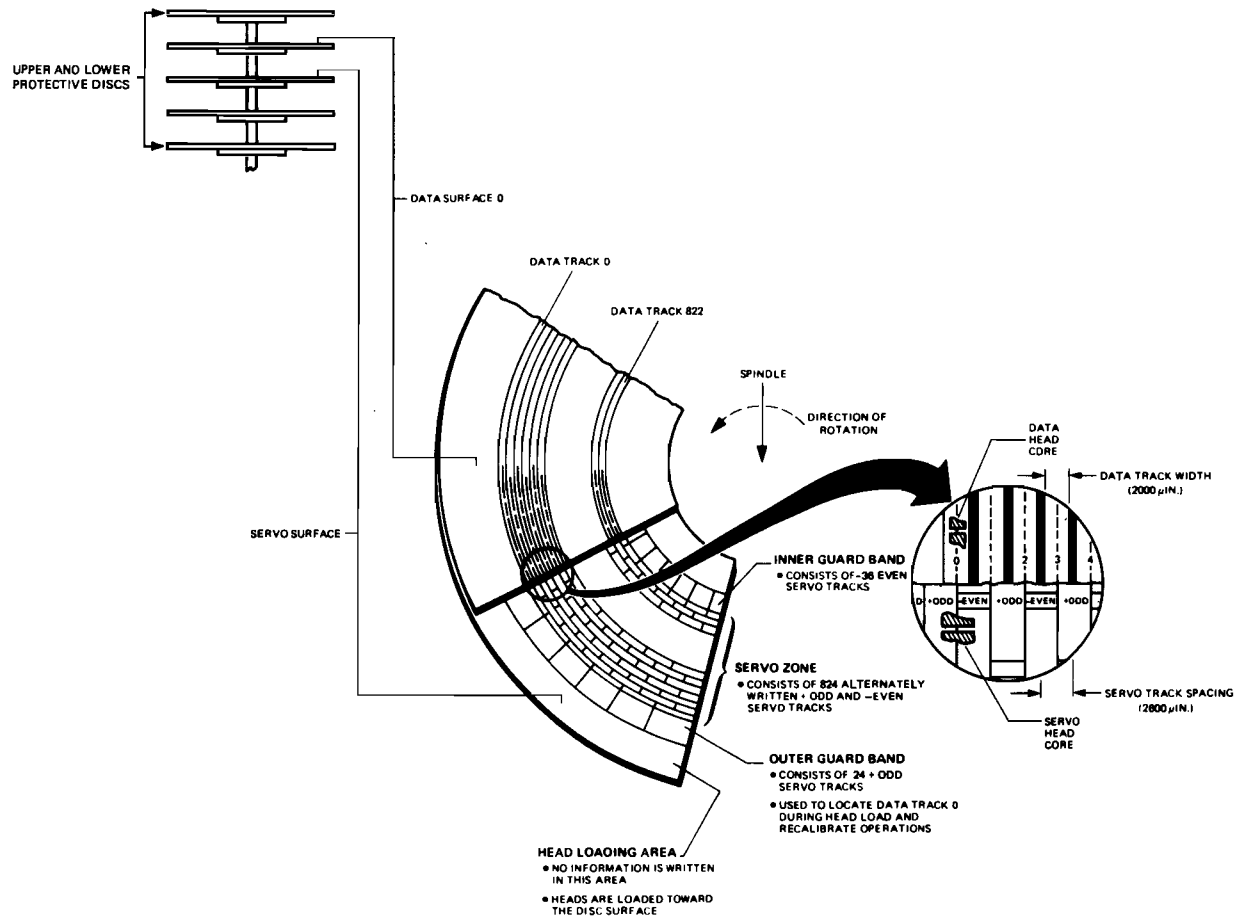
The velocity transducer and shaft are used to develop this linear velocity voltage. The velocity transducer is a cylindrical coil assembly mounted in the center of the linear motor magnet assembly. A magnet is attached to the carriage assembly by a supporting shaft. The motion of this magnet as it passes through the coil generates the linear velocity voltage. The magnitude of the voltage is proportional to the linear velocity and the polarity indicates the direction of motion.

As the heads approach the head loading area of the disc pack, they are forced away from the disc surfaces by the air pressure developed by the rotating disc pack and the air distribution system. The heads will actually fly above the surfaces of the discs supported by a thin cushion of air.

When the outside edge of the outer guard band is first detected by the servo head, the AGC signal will become active (AGC = 1) to disable the forward slew operation. The state of the AGC signal can be observed at the test point on the track follower PCA-A5 labeled "AGC". The seek home flip-flop will be clocked clear by the leading edge of the AGC signal. The set output from the seek home flip-flop (SKH = 0) together with the absence of the RET signal (RET = 0) and the active MATCH + SKI signal (MATCH + SKI = 1), activates the fine position FET switch. With this switch closed, the current applied to the linear motor coil will be determined by the POS signal.

The POS signal is used to provide radial (cylinder) position information to the head positioning servo loop. This signal is derived from the servo code which is magnetically recorded on the servo surface (see figure 4-10). The servo code consists of 6720 di-bits per revolution, although three of these di-bits are not recorded in the index zone. As the servo surface passes beneath the servo head, a voltage is magnetically induced. The output from the servo head is directly coupled to the input of the differential preamplifier stage on the track follower PCA-A5. This stage consists of two differential amplifiers coupled together by a filter network. The gain of the first differential amplifier is controlled by the output from the servo AGC circuit. The differential output is filtered and coupled to a second fixed-gain differential amplifier. The output from the differential preamplifier stage can be observed at the test point on the track follower PCA-A5 labeled "PRE". It will be approximately 1.5 volts peak-to-peak. This output is then coupled to the input of the phase switchable amplifier stage. Figure 4-10 illustrates the servo and data track assignments, as well as the waveforms produced at the "PRE" test point as the servo head moves across +odd and −even servo tracks.

The phase switchable amplifier stage provides a low source impedance servo code output which is either in phase or 180-degrees out of phase with the output of the



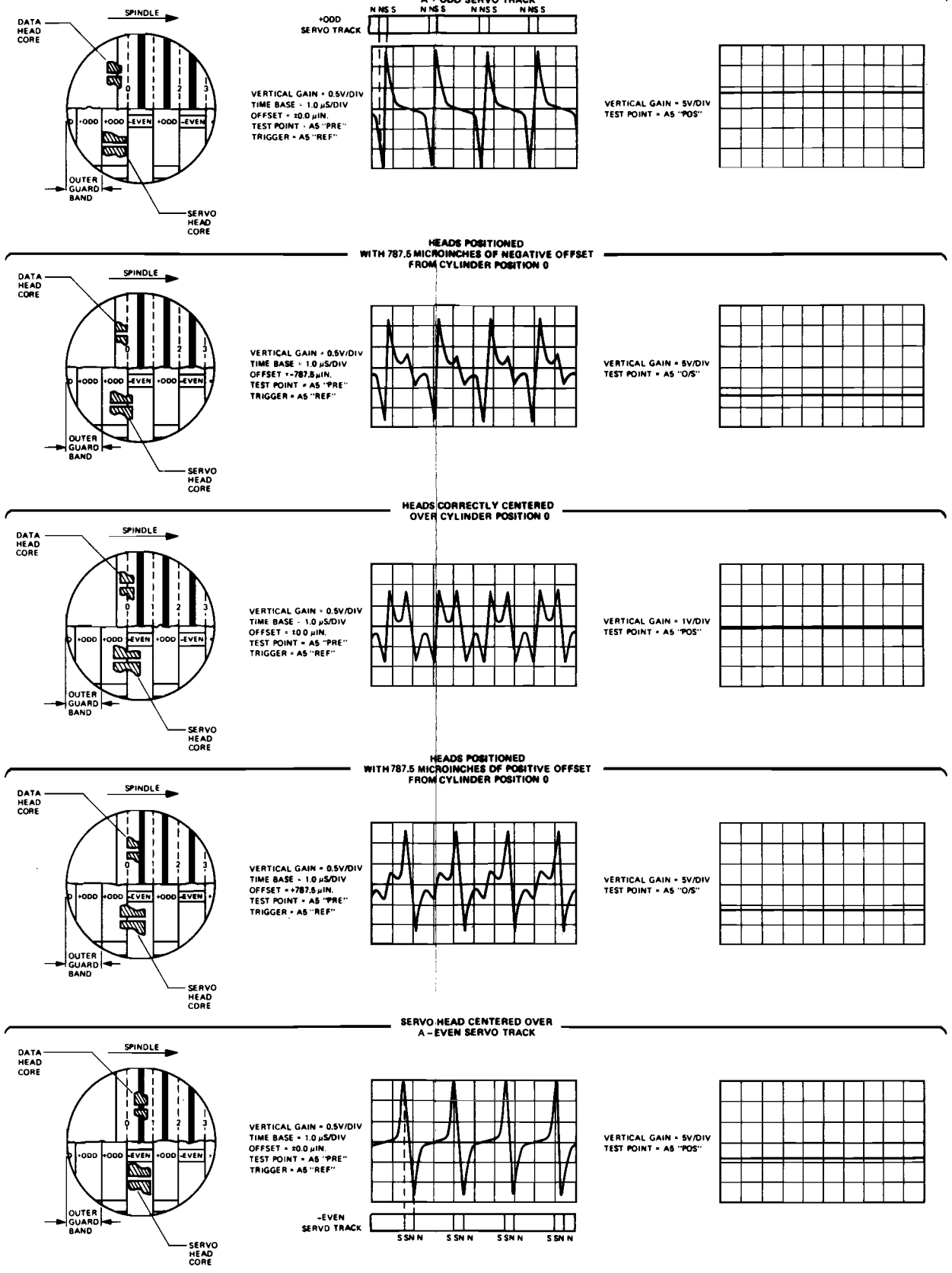


Figure 4-10. Servo and Data Track Assignments

differential preamplifier stage. The phase is determined by the least significant bit of the addressed cylinder (LSB). The LSB signal will be active (LSB = 1) for odd cylinders and inactive (LSB = 0) for even cylinders. In the case of an initial head load, the LSB signal will be inactive (LSB = 0).

The output from the phase switchable amplifier is coupled to the positive and negative peak detectors where the peaks in the servo code are detected and stored. The peak detectors are gated by either the REF or $\overline{\text{REF}}$ signal. This is determined by the state of the LSB signal and an exclusive-OR acting as a programmable inverter. When LSB is active (LSB = 1), the $\overline{\text{REF}}$ signal will gate the peak detectors and when LSB is inactive (LSB = 0), the REF signal will gate the peak detectors. In the case of an initial head load, the REF signal will gate the peak detectors. The state of the REF signal can be observed at the test point on the track follower PCA-A5 labeled "REF".

The output from each peak detector is buffered by a unity-gain, non-inverting amplifier and then coupled to the summing junction of the output summing amplifier. Also summed into this junction is the output of the offset circuit. The output summing amplifier exhibits a gain of 4 to the peak detectors and 0.5 to the offset circuit. The resultant output from the output summing amplifier is the POS signal which can be observed at the test point on the track follower PCA-A5 labeled "POS".

The derived POS signal is centered about a ground reference and it has a scaling factor of 4 volts per 0.001 inch at track center. The signal will be positive once the servo head detects the edge of the outer guard band and it will remain positive until the first track of the servo zone is detected. It will then appear as a triangular waveform as the servo head moves across the servo surface from track 0 to 822. Each zero crossing represents a data track centerline.

Once the track center of cylinder 0 is detected (TCD and FINE POSITION = 1), the $\overline{\text{SB}}$ signal will become active ($\overline{\text{SB}}$ = 0). This signal will inhibit tachometer feedback to the head positioning servo loop. The state of the TCD signal can be observed at the test point on the servo PCA-A3 labeled "TCD". After a 1.3 millisecond delay to allow time for the heads to settle, the drive ready flip-flop will be set. The set output from the drive ready flip-flop causes the DRIVE READY lamp to light, the drive ready status bit to be active (status bit 1 = 1), the first status flip-flop to be clocked set, the AGC and carriage back fault detection circuits to be enabled, and the $\overline{\text{ACRY}}$ signal to become active ($\overline{\text{ACRY}}$ = 0). The state of the DRDY signal can be observed at the test point on the drive control PCA-A4 labeled "DRDY".

The set output from the first status flip-flop causes the first status status bit to be active (status bit 3 = 1). This will notify the controller that the disc drive has completed an initial head load operation. This status bit can be selectively cleared by the controller if it issues a CLS command on the tag bus with bit 1 active on the control bus.

When the $\overline{\text{ACRY}}$ signal becomes active ($\overline{\text{ACRY}}$ = 0), it cancels the 1250 millisecond timeout cycle; causes the drive busy status bit to be inactive (status bit 0 = 0); clocks the ACRY attention flip-flop set; and enables future seek, recalibrate, or write operations. The state of the $\overline{\text{ACRY}}$ signal can be observed at the test point on the drive control PCA-A4 labeled "$\overline{\text{ACRY}}$".

The set output from the ACRY attention flip-flop causes the attention status bit to be active (status bit 7 = 1). This will notify the controller that the disc drive has correctly positioned the heads over cylinder 0. This status bit can be selectively cleared by the controller if it issues a CLS command on the tag bus with bit 0 active on the control bus.

The heads will remain settled over cylinder 0 until a seek, recalibrate, or set offset command is decoded, or until they are unloaded when the RUN/STOP switch is set to STOP or a fault condition is detected.

4-38. NORMAL HEAD UNLOAD OPERATION. The heads are automatically unloaded whenever the RUN/STOP switch is set to STOP (STOP = 1); an AGC fault (AGF = 1), carriage back fault (CBF = 1), interlock fault (1LF = 1), destructive write fault (DWF = 1), or timeout fault (TOF = 1) exists; or the spindle begins to loose speed ($\overline{\text{SPU}}$ = 1). When any one of these conditions exists, the RET signal will become active (RET = 1). This will clear the drive ready and seek home flip-flops, de-energize the carriage latch solenoid, activate the −slew FET switch, and initiate a 1250 millisecond timeout cycle.

With the drive ready flip-flop cleared (DRDY = 0 and $\overline{\text{DRDY}}$ = 1), the DRIVE READY lamp will be extinguished, the drive ready status bit will become inactive (status bit 1 = 0), the AGC and carriage back fault detection circuits will be disabled, the $\overline{\text{ACRY}}$ signal will become inactive ($\overline{\text{ACRY}}$ = 1), and the retract attention flip-flop will be clocked set (status bit 7 = 1). The state of the DRDY signal can be observed at the test point on the drive control PCA-A4 labeled "DRDY".

The set output from the retract attention flip-flop causes the attention status bit to be active (status bit 7 = 1). This will notify the controller that the disc drive has initiated a normal head unload operation. This status bit can be selectively cleared by the controller if it issues a CLS command on the tag bus with bit 0 active on the control bus.

When the $\overline{\text{ACRY}}$ signal becomes inactive ($\overline{\text{ACRY}}$ = 1), the drive busy status bit will become active (status bit 0 = 1); future seek, recalibrate, or write operations will be inhibited; and the attention reset flip-flop will be clocked set to prevent the ACRY and retract attention flip-flops from being reset. The state of the $\overline{\text{ACRY}}$ signal can be observed at the test point on the drive control PCA-A4 labeled "$\overline{\text{ACRY}}$".

With the −slew FET switch closed, a constant velocity will be commanded and an appropriate current applied to the

linear motor coil. This current command can be observed at the test point on the servo PCA-A3 labeled "CC". This current will cause the carriage assembly to slew in reverse at 3.5 inches per second until it reaches its fully retracted position (CRB = 1). When this occurs, the RET and CRB signals will both be active (RET and CRB = 1). Together these signals cancel the 1250 millisecond timeout cycle and clear the servo enable flip-flop to disable the head positioning servo loop.

In addition, the CRB and STOP signals will clear the run spindle flip-flop to issue a stop spindle command ($\overline{RS}$ = 1). The door unlock solenoid will be energized to permit pack access as soon as the spindle has been braked to a stop. The heads will remain in their fully retracted position until another head load operation is initiated.

4-39. SEEK OPERATION. A seek operation is used to move the heads from their present cylinder position to some other cylinder position. The disc drive can execute a seek command whenever the heads are positioned and settled over any legal cylinder ($\overline{ACRY}$ and $\overline{SB}$ = 0). The controller issues a seek command on the tag bus with a cylinder address on the control bus. When the command is decoded, the SK signal will become active (SK = 1). This will initiate a 90 millisecond timeout cycle, direct set the first clock inhibit flip-flop, and clock the cylinder address (D0 thru D9) into the new cylinder address register provided it is legal (ICA = 0).

The SK signal will also cause the CYL signal to become active (CYL = 1) to clear the seek check flip-flop on the I/O sector PCA-A2. The state of the CYL signal can be observed at the test point on the servo PCA-A3 labeled "CYL". Clearing the seek check flip-flop clears the seek check status bit (status bit 8 = 0).

In addition, the $\overline{COF}$ signal will become active ($\overline{COF}$ = 0) to clear the offset magnitude and sign registers on the track follower PCA-A5. This will ensure that any offset information stored during a previous offset operation will be cleared out so that it will not affect the positioning of the heads.

As previously mentioned, the legal cylinder address supplied by the controller was stored in the new cylinder address register when the seek command was decoded. This address provides destination information to the head positioning servo loop. In addition, the least significant bit of the new cylinder address (LSB) is routed to the track follower PCA-A5 where it controls the phase switchable amplifier and the programmable inverter at the input to the peak detector circuitry. This bit will be active (LSB = 1) for odd cylinders and inactive (LSB = 0) for even cylinders. The use of this bit is discussed in detail in paragraph 4-38. Further, the three most significant bits of the new cylinder address are inverted and routed to the R/W preamplifier PCA-A6 as the $\overline{DWA}$, $\overline{DWB}$, and $\overline{DWC}$ signals. These signals are used to control the programmable write current sink.

The cylinder address comparator compares the cylinder address stored in the new cylinder address register with the count stored in the present cylinder address counter. It produces a 10-bit digital difference from these two addresses. It also produces a signal which indicates whether a forward or reverse seek operation is required. If the present cylinder address is less than the new cylinder address, the forward FET switch will be activated and the present cylinder address counter will count up (POSITIVE = 1). If the present cylinder address is greater than the new cylinder address, the reverse FET switch will be activated and the present cylinder address counter will count down (POSITIVE = 0). Both commands (forward or reverse) assume that the addresses do not match ($\overline{MATCH}$ = 1), the seek operation is not inhibited ($\overline{SKI}$ = 1), a seek home operation is not commanded (SKH = 0), and a retract operation is not commanded (RET = 0). If the present cylinder address is equal to the new cylinder address, the fine position FET switch will be activated and the current applied to the linear motor coil will be determined by the POS signal.

In the case of a forward or reverse seek operation, the digital to analog converter converts the digital difference from the cylinder address comparator into an analog current which is applied to the input of the velocity curve generator. The velocity curve generator produces a current equal to a constant multiplied by the square root of the analog current from the digital to analog converter. The VC GAIN potentiometer on the servo PCA-A3 provides the means to adjust the seek time by varying the gain of the velocity command. The velocity command can be observed at the test point on the servo PCA-A3 labeled "VC". If the reverse FET switch is activated, the velocity command will be routed to the summing junction of the summing amplifier. If the forward FET switch is activated, the velocity command will be inverted by a unity-gain, inverting amplifier before it is applied to the summing junction. The summing junction also receives a voltage which is proportional to the linear velocity of the carriage. This voltage is developed by the velocity transducer and shaft and is fed back through the tachometer buffer and FET switch.

The summing amplifier compares the buffered output from the tachometer (measured velocity) with the output from the velocity curve generator (commanded velocity) and produces a current command which drives the difference to zero. This current command can be observed at the test point on the servo PCA-A3 labeled "CC". The amount of current available may be limited by the current command limiter. This circuit is activated by the seek inhibit signal (SKI = 1).

The current command is coupled through the voltage gain amplifier to the linear motor power amplifier via a closed FET switch. Both of these amplifiers are located on the PMR PCA-A9. The FET switch and linear motor relay were both activated when the head positioning servo loop

was enabled (SEN = 1) during the initial head load operation. Power is applied to the linear coil through the energized linear motor relay. The linear motor voltage developed can be observed at the test point labeled "LMV" and a sample of linear motor current can be observed at the test point labeled "LMC". Both of these test points are located on the PMR PCA-A9.

As the heads begin to move across the disc surfaces, the $\overline{\text{ACRY}}$ signal will become inactive ($\overline{\text{ACRY}}$ = 1). This will cause the drive busy status bit to become active (status bit 0 = 1); future seek, recalibrate, or write operations to be inhibited; and the attention reset flip-flop to be clocked clear to reset the ACRY attention and retract attention flip-flops (status bit 7 = 0).

In addition, the POS signal will be developed from the servo code written on the servo surface. This signal can be observed at the test point on the track follower PCA-A5 (source) or servo PCA-A3 (destination) labeled "POS". Every time the POS signal passes through zero volts, a clock pulse is generated by the cylinder pulse generator on the servo PCA-A3. The first clock pulse is inhibited because the first clock inhibit flip-flop was set when the seek command was decoded. This flip-flop will be clocked clear on the leading edge of the TCD signal to enable subsequent clock pulses to clock the present cylinder address counter. The track center detector will produce the TCD signal when the heads are within 1/4 track width of track center. The state of the TCD signal can be observed at the test point on the servo PCA-A3 labeled "TCD".

The match logic monitors the digital difference applied to the digital to analog converter. When the heads are positioned within one cylinder from the addressed cylinder, the $\overline{\text{MATCH-1}}$ signal will become active ($\overline{\text{MATCH-1}}$ = 0). This signal notifies the track center detector that the present cylinder address count is one less than the address stored in the new cylinder address register. The last clock pulse is produced by the track center detector rather than by the cylinder pulse generator. This pulse is produced when the last 1/4 track of travel is detected. When the present cylinder address count equals the address stored in the new cylinder address register, the MATCH signal will become active (MATCH = 1). The state of the $\overline{\text{MATCH-1}}$ and MATCH signals can be observed at the test points on the servo PCA-A3 labeled "MI" and "M", respectively. When the MATCH signal becomes active (MATCH = 1), it disables the forward or reverse velocity command to the summing junction of the summing amplifier, activates the fine position FET switch, and increases the sensitivity of the track center detector. With the fine position FET switch closed, the current applied to the linear motor coil will be determined by the POS signal.

Once the track center of the addressed cylinder is detected (TCD and FINE POSITION = 1), the $\overline{\text{SB}}$ signal will become active ($\overline{\text{SB}}$ = 0). This will inhibit tachometer feedback to the head positioning servo loop. After a 1.3 millisecond delay to allow time for the heads to settle, the $\overline{\text{ACRY}}$ signal will become active ($\overline{\text{ACRY}}$ = 0). The drive ready flip-flop is not affected. It remains set from the initial head load operation.

When the $\overline{\text{ACRY}}$ signal becomes active ($\overline{\text{ACRY}}$ = 0), it cancels the 90 millisecond timeout cycle; causes the drive busy status bit to be inactive (status bit 0 = 0); clocks the ACRY attention flip-flop set; and enables future seek, recalibrate, or write operations. The state of the $\overline{\text{ACRY}}$ signal can be observed at the test point on the drive control PCA-A4 labeled "$\overline{\text{ACRY}}$".

The set output from the ACRY attention flip-flop causes the attention status bit to be active (status bit 7 = 1). This will notify the controller that the disc drive has completed a seek operation to a legal cylinder. This status bit can be selectively cleared by the controller if it issues a CLS command on the tag bus with bit 0 active on the control bus.

The heads will remain settled over the addressed cylinder until a set offset, recalibrate, or another seek command is decoded, or until they are unloaded when the RUN/STOP switch is set to STOP or a fault condition is detected.

4-40. OFFSET OPERATION. An offset operation is used to move the heads in small increments to either side of track center. This function is designed to permit marginal data recovery. The controller issues a set offset command on the tag bus with the offset magnitude and sign on the control bus. The internal control bus bits D0 through D5 specify the offset magnitude in 63 increments of 12.5 microinches each, while bit D7 specifies the direction (+ or −) from track center. The disc drive decodes the tag bus command and the SOF signal becomes active (SOF = 1) to clock the offset magnitude and sign into the offset magnitude and sign registers, respectively. Both of these registers are located on the track follower PCA-A5. They are both cleared by the $\overline{\text{COF}}$ signal when the heads are initially loaded or when a seek or recalibrate command is decoded. Therefore if offset is desired, the offset magnitude and sign must be re-specified after either of these operations is performed.

In addition, the SOF signal disables the $\overline{\text{ACRY}}$ signal for 1.3 milliseconds to allow the heads time to settle. With $\overline{\text{ACRY}}$ disabled ($\overline{\text{ACRY}}$ = 1), the drive busy status bit will momentarily become active (status bit 0 = 1); future seek, recalibrate, or write operations will momentarily be inhibited; and the attention reset flip-flop will be clocked clear to reset the ACRY attention and retract attention flip-flops (status bit 7 = 0). When the $\overline{\text{ACRY}}$ signal becomes active again ($\overline{\text{ACRY}}$ = 0), the drive busy status bit will become inactive (status bit 0 = 0); the ACRY attention flip-flop will be clocked set; and future seek, recalibrate, or write operations will be enabled. The state of the $\overline{\text{ACRY}}$ signal can be observed at the test point on the drive control PCA-A4 labeled "$\overline{\text{ACRY}}$".

The set output from the ACRY attention flip-flop causes the attention status bit to be active (status bit 7= 1). This will notify the controller that the disc drive has completed the offset operation. This status bit can be selectively

cleared by the controller if it issues a CLS command on the tag bus with bit 0 active on the control bus.

The stored offset magnitude is converted into an analog voltage by the digital to analog converter. The amount of voltage developed can be observed at the test point on the track follower PCA-A5 labeled "O/S". This voltage is applied through a FET switch to the summing junction of the output summing amplifier for a negative offset operation. In the case of a positive offset operation, this voltage is inverted by a unity-gain inverting amplifier before it is applied to the summing junction. The output summing amplifier exhibits a gain of 0.5 to the offset circuit. The amount of offset is summed into the POS signal to cause the heads to be repositioned. Figure 4-10 illustrates the heads centered over cylinder 0, positioned over cylinder 0 with maximum negative offset, and positioned over cylinder 0 with maximum positive offset.

The heads will remain settled over their present cylinder position until a seek, recalibrate, or another set offset command is decoded, or until they are unloaded when the RUN/STOP switch is set to STOP or a fault condition is detected.

4-41. RECALIBRATE OPERATION. A recalibrate operation is used to move the heads from their present cylinder position to a home position over cylinder 0. The controller issues a recalibrate command to establish a reference head position. The disc drive can execute a recalibrate command whenever the heads are positioned and settled over any legal cylinder ($\overline{ACRY}$ and $\overline{SB}$ = 0). When the command is decoded, the $\overline{RH}$ signal will become active ($\overline{RH}$ = 0). This will cause the $\overline{SKH}$ signal to become active ($\overline{SKH}$ = 0) which will initiate a 1250 millisecond timeout cycle and direct set the seek home flip-flop. The servo enable flip-flop is not affected. It remains set from the initial head load operation. The state of the $\overline{SKH}$ signal can be observed at the test point on the drive control PCA-A4 labeled "$\overline{SKH}$".

This signal will also cause the CYL signal to become active (CYL = 1) to clear the seek check flip-flop on the I/O sector PCA-A2. The state of the CYL signal can be observed at the test point on the servo PCA-A3 labeled "CYL". Clearing the seek check flip-flop clears the seek check status bit (status bit 8 = 0).

In addition, the $\overline{COF}$ signal will become active ($\overline{COF}$ = 0) to clear the offset magnitude and sign registers on the track follower PCA-A5. This will ensure that any offset information stored during a previous offset operation will be cleared out so that it will not affect the positioning of the heads.

With the seek home flip-flop set (SKH = 1 and $\overline{SKH}$ = 0), the new cylinder address register and present cylinder address counter will be cleared by $\overline{SKH}$. Since the new cylinder address and present cylinder address count both match (both are zero), the MATCH signal will become active (MATCH = 1). The state of the MATCH signal can be observed at the test point on the servo PCA-A3 labeled "M".

With the heads currently positioned over the servo zone, the AGC signal from the track follower PCA-A5 will be active (AGC = 1). The reset output from the seek home flip-flop ($\overline{SKH}$ = 0) and the presence of the AGC signal (AGC = 1) will activate the – slew FET switch. With this switch closed, a constant velocity will be commanded and an appropriate current applied to the linear motor coil. This current command can be observed at the test point on the servo PCA-A3 labeled "CC".

The carriage assembly will slew in reverse at 3.5 inches per second. When the edge of the outer guard band is first detected by the servo head, the AGC signal will become inactive (AGC = 0) to disable the reverse slew operation. The set output from the seek home flip-flop (SKH = 1) and the absence of the AGC signal (AGC = 0) will activate the + slew FET switch. With this switch closed, a forward slew operation will be initiated to reverse the movement of the heads.

When the outside edge of the outer guard band is again detected by the servo head, the AGC signal will become active (AGC = 1) to disable the forward slew operation. The seek home flip-flop will be clocked clear by the leading edge of the AGC signal. The set output from the seek home flip-flop (SKH = 0) together with the absence of the RET signal (RET = 0) and the active MATCH + SKI signal (MATCH + SKI = 1), activates the fine position FET switch. With this switch closed, the current applied to the linear motor coil will be determined by the POS signal. This signal can be observed at the test point on the track follower PCA-A5 (source) or servo PCA-A3 (destination) labeled "POS".

During head movement, the $\overline{ACRY}$ signal will become inactive ($\overline{ACRY}$ = 1). This will cause the drive busy status bit to become active (status bit 0 = 1); future seek, recalibrate, or write operations to be inhibited; and the attention reset flip-flop to be clocked clear to reset the ACRY attention and retract attention flip-flops (status bit 7 = 0).

Once the track center of cylinder 0 is detected (TCD and FINE POSITION = 1), the $\overline{SB}$ signal will become active ($\overline{SB}$ = 0). This signal will inhibit tachometer feedback to the head positioning servo loop. The state of the TCD signal can be observed at the test point on the servo PCA-A3 labeled "TCD". After a 1.3 millisecond delay to allow time for the heads to settle, the $\overline{ACRY}$ signal will become active ($\overline{ACRY}$ = 0). The drive ready flip-flop is not affected. It remains set from the initial head load operation.

When the $\overline{ACRY}$ signal becomes active ($\overline{ACRY}$ = 0), it cancels the 1250 millisecond timeout cycle; causes the drive busy status bit to be inactive (status bit 0 = 0); clocks the ACRY attention flip-flop set; and enables future seek, recalibrate, or write operations. The state of the $\overline{ACRY}$ signal can be observed at the test point on the drive control PCA-A4 labeled "$\overline{ACRY}$".

The set output from the ACRY attention flip-flop causes the attention status bit to be active (status bit 7 = 1). This will notify the controller that the disc drive has correctly positioned the heads over the home position (cylinder 0). This status bit can be selectively cleared by the controller if it issues a CLS command on the tag bus with bit 0 active on the control bus.

The heads will remain settled over the home position (cylinder 0) until a seek, set offset, or another recalibrate command is decoded, or until they are unloaded when the RUN/STOP switch is set to STOP or a fault condition is detected.

4-42. EMERGENCY RETRACT OPERATION.

The circuitry used to retract the heads during an emergency condition is located on the PMR PCA-A9. It consists of the retract timer, programmable voltage regulator, and linear motor relay. An emergency retract operation is initiated whenever the head positioning servo loop is disabled ($\overline{SEN}$ = 1) or a power supply failure is detected ($\overline{PSF}$ = 0). These conditions can be observed at the test points on the PMR PCA-A9 labeled "$\overline{SEN}$" and "$\overline{PSF}$". Whenever either of these conditions exists, the linear motor relay will be de-energized to permit a retract voltage to be applied to the linear motor coil. Initially a retract voltage of approximately 7 volts is applied to the coil for about 500 milliseconds. The retract voltage is then reduced to approximately 4 volts until the carriage is fully retracted (CRB = 1) at which time the retract voltage is removed. During an emergency retract operation, the carriage will normally reach its fully retracted position before the retract voltage is reduced. Sustaining the higher retract voltage for an excessive period of time can damage the programmable voltage regulator, therefore, the retract voltage is reduced in the event that the carriage fails to reach its fully retracted position before the retract timer times out. The retract timer is designed to accept power from either the +10 or +36 Vdc supply, thus, if either supply should fail, the circuit will still function. Further, if both supplies should fail (as in the loss of mains power), the rotating spindle will act as a generator to provide enough power to retract the heads. The emergency retract voltage can be observed at the test point on the PMR PCA-A9 labeled "ERV"

If a timeout or interlock fault should occur during normal operations (TOF or ILF = 1), the servo enable flip-flop will be cleared to disable the head positioning servo loop. This will de-energize the carriage unlatched solenoid (ECS = 0 and $\overline{CSOL}$ = 1) and linear motor relay (SEN = 0), disable the linear motor power amplifier (LMAE = 0), and initiate an emergency retract operation ($\overline{ER}$ = 0) after a 60 millisecond delay to ensure closure of the linear motor relay contacts. The state of the $\overline{ER}$ signal can be observed at the test point on the PMR PCA - A9 labeled "$\overline{ER}$".

If a power supply fault ($\overline{PSF}$ = 0) should occur, write data phase A and write data phase B are disabled (WDA = 0 and WDB = 0). This action prevents the heads from writing on the disc during an emergency retract operation.

If a failure is detected in one or more of the power supplies ($\overline{PSF}$ = 0), a greater emergency is said to exist because it cannot be assumed that supply voltages are available to power the disc drive circuitry. In this case, the linear motor relay is immediately de-energized ($\overline{PSF}$ = 0) and a FET switch grounds the $\overline{ER}$ signal line ($\overline{ER}$ = 0) to force an emergency retract operation. In addition, the $\overline{PSF}$ signal disables power to the spindle permitting it to coast to a stop and holds the door unlock solenoid de-energized to prevent access to the pack chamber until the carriage has been fully retracted (CRB = 1), spindle has come to a stop (SPD = 1), and the RUN/STOP switch has been set to STOP (STOP = 1).

4-43. SECTOR SENSING SYSTEM

The sector sensing system (see figure 7-27) consists of circuits on the track follower PCA-A5 and the I/O sector PCA-A2, although all communication between these two PCA's occurs via the motherboard PCA-A7. The purpose of the sector sensing system is to monitor circumferential head position by continually monitoring the physical location of each data sector as it passes beneath the heads. It notifies the controller when the present sector count equals the addressed sector. In addition, it enables the read/write system for a data transfer operation and gates the unit identity of the disc drive to the controller upon request, provided the RPS feature is enabled.

To accomplish this, a sector clock and index pulse are derived from the servo code which is magnetically recorded on the servo surface (see figures 4-2 and 4-10). The servo code consists of 6720 di-bits per revolution, although three of these di-bits are not recorded in the index zone. As the servo head flies over the servo surface, a voltage is magnetically induced. The output from the servo head is directly coupled to the input of the differential preamplifier stage. This stage consists of two differential amplifiers coupled together by a filter network. The gain of the first differential amplifier is controlled by the output from the AGC circuit on the track follower PCA-A5. The differential output is filtered and coupled to a second, fixed-gain differential amplifier. The output from the differential preamplifier stage can be observed at the test point labeled "PRE". It will be approximately 1.4 volts peak-to-peak.

For PCA-A5 with series code 1704 and prior codes, this differential output is then coupled to the zero crossing detector where an edge is produced for every zero crossing detected. The output from the zero crossing detector can be observed at the test point labeled "ZCR". This output is then coupled to the input of an integrated phase locked loop which has an internal voltage controlled oscillator. The sector clock developed by the phase locked loop is eight times the frequency of the zero crossing detector. This output is coupled to a divide-by-eight counter and it is fed back to provide a reference signal to the phase locked loop and a clocking signal to the index detector. This reference signal can be observed at the test point labeled "REF".

For PCA-A5 with series code 1713 and subsequent codes, this differential output is coupled to the input of an inte-

grated phase-locked loop through the servo head signal filter (pi low-pass filter). The sector clock developed by the phase-locked loop is coupled to a divide-by-eight counter and is fed back to provide a reference signal to the phase-locked loop and a clocking signal to the index detector. The reference signal can be observed at the test point labeled "REF".

The developed sector clock is a square-wave with exactly 53,760 transitions per revolution or 3.2256 MHz at a spindle speed of 3600 revolutions per minute. It is this output that is used to clock the sector counting electronics on the I/O sector PCA-A2. Also, since the sector clock is phase locked to the servo code, it tracks any variations in spindle speed. The sector clock can be observed at the test point labeled "SCL".

The differential output from the differential preamplifier stage is also coupled to the input of the dual level detectors. The dual level detectors detect the presence of peaks in the servo code that exceed 0.33 volts in amplitude. The output from the negative level detector can be observed at the test point labeled "$\overline{\text{NLD}}$" and the output from the positive level detector can be observed at the test point labeled "$\overline{\text{PLD}}$". The output from the positive level detector is not used in this disc drive.

The output from the negative level detector is coupled to the index detector where it clocks a 2 microsecond monostable multivibrator. The output from the multivibrator is coupled to a 7-bit shift register. As the discs rotate counterclockwise from the beginning of sector 0 through the end of sector 47, positive-true bits are shifted into the shift register on the trailing edge of the reference signal. A unique 6-bit index pattern is magnetically recorded between physical sectors 0 and 47. When the entire 6-bits of the index pattern have been shifted into the shift register, an index pulse is generated on the trailing edge of the next reference signal transition. This index pulse can be observed at the test point labeled "$\overline{\text{IP}}$". It will remain active for 2.48 microseconds.

The derived sector clock is coupled to a divide-by-1120 counter. At each count of 1120, the sector counter is clocked to store the present sector count. This count corresponds to the physical sector presently passing beneath the heads. One revolution results in 53,760 clock transitions which when divided by 1120 equals 48 physical sectors. The present sector count along with the head address are returned to the controller whenever it issues an RQP command. Each time the disc pack completes a revolution, the index pattern is detected and the index pulse is generated to clear both the divide-by-1120 and sector counters. This will initiate the counting cycle for the next revolution.

The sector address register is initially cleared when $\overline{\text{NDPS}}$ becomes active ($\overline{\text{NDPS}} = 0$). This occurs when power is first applied or when the RUN/STOP switch is set to RUN. This will establish a sector address of zero which will remain in effect until the contents of the sector address register are changed by either an ADR or XMS command. Whenever an ADR or XMS command is issued by the controller, a 6-bit sector address is also supplied. Bits D4 and D5 are both checked to ensure that the address is legal before it is stored in the sector address register (legal sector addresses are 0 thru 47). If both bits are active, the supplied address is greater than 47 and is therefore illegal. An llegal address is not stored in the sector address register, but instead a seek check will result (status bit 2 = 1).

The legal address stored in the sector address register is continually compared with the present sector count by the sector comparator. Once the sector presently passing beneath the heads matches the addressed sector, the sector compare flip-flop will be clocked. When clocked during a read or write operation, the sector compare flip-flop will be clocked set (status bit 8 = 1) and the sector compare signal will become active (SC = 1) to enable the read/write system for a data transfer operation. Sector compare can be observed at the test point labeled "SC". It will remain active until the end of the addressed sector is forced (count 1088) or the READ or WRITE command is dropped.

The legal address stored in the sector address register is also continually compared with the present sector count by the look-ahead comparator. This comparator forms part of the rotational position sensing feature in each disc drive. This feature (if enabled) permits a disc drive to transfer its identity to the controller up to 15 sectors (5.2 milliseconds) before an actual sector compare occurs (status bit 8 = 1). Four jumpers provide the means to add a 4-bit binary number to the present sector count. If all four jumpers are installed, a zero will be added to the present sector count and the look-ahead feature will have no effect. If all four jumpers are removed, 15 will be added to the present sector count. Any combination of jumpers may be used, however, a look-ahead of zero sectors is recommended when the disc drive is connected to an HP 13037 Disc Controller.

When sector compare minus look-ahead occurs, the disc drive will gate its identity onto a specific line on the control bus that corresponds to the unit number of that disc drive. This assumes, of course, that the disc drive has its attention bit set (status bit 7 = 1) and an RQI command is active.

4-44. READ/WRITE SYSTEM

The read/write system (see figure 7-28) consists of circuits on the I/O sector PCA-A2, servo PCA-A3, drive control PCA-A4, and R/W preamplifier PCA-A6. All communication between these PCA's occurs via the motherboard PCA-A7. The data heads connect directly to the R/W preamplifier PCA-A6. The purpose of the read/write system is to provide the means to read information from or write information onto a data surface of the disc pack. Included in the following are discussions relative to head selection, read mode operation, write mode operation, and read/write fault detection.

4-45. HEAD SELECTION. Information is read from or written onto a data surface of the disc pack by means of five data heads. There is one data head for each data surface. Each data head consists of a gapped ferrite core mounted in a ceramic shoe. Data heads are gimbaled

and contoured to fly over the surface of the disc supported by a thin cushion of air. Two windings are wound around the ferrite core. They are connected at a common point and phased such that the common point acts as a center tap. These windings are used for both reading and writing by detecting or producing a magnetic field at the gap in the ferrite core.

The appropriate head must be selected before a read or write operation can be performed. The address of the desired head is stored in the head address register on the I/O sector PCA-A2. The head address register is initially cleared when $\overline{\text{NDPS}}$ becomes active ($\overline{\text{NDPS}}$ = 0). This occurs when power is first applied or when the RUN/STOP switch is set to RUN. This will establish a head address of zero which will remain in effect until the contents of the head address register is changed by an ADR command. Whenever an ADR command is issued by the controller, a 3-bit head address is also supplied. Bits D8, D9, and D10 are checked to ensure that the address is legal before it is stored in the head address register (legal head addresses are 0 thru 4). If D10 and either D8 or D9 are active, the supplied address is greater than 4 and is therefore illegal. An illegal head address is not stored in the head address register, but instead a seek check will result (status bit 2 = 1).

The stored head address is buffered and level shifted by circuits on the drive control PCA-A4. The buffered head select bits (BHS0 thru BHS2) are coupled to the input of the data head decoder on the R/W preamplifier PCA-A6. If no write faults exist (WFLT = 0), the center tap winding of the addressed head will be switched to a +12 Vdc power source. The multiple heads selected detector continuously monitors the center tap windings, and if more than one head is selected, a destructive MH fault will be declared.

4-46. READ MODE OPERATION. As the data surfaces pass beneath the data heads, the magnetically stored flux fields intersect the gap in the ferrite core. Gap motion through the flux field causes a voltage to be induced into the read/write winding wound around the core. This induced voltage is analyzed by the read circuitry to define the data recorded on the data surface. Each flux reversal (caused by a write current polarity change) generates a readback voltage pulse.

The read circuitry on the R/W preamplifier PCA-A6 and drive control PCA-A4 is always enabled in the read mode. A differential signal is coupled from the selected head windings to the input of the preamplifier stage via the head select diodes and the two conducting read/write mode FET switches. The other heads and the write current paths are isolated by back-biased diodes. The gain of the preamplifier stage is set by the data AGC circuit on the drive control PCA-A4. The output of the preamplifier stage is coupled through a balanced low-pass filter to the differentiator stage. The differentiator stage transforms the read data waveform such that the data points are represented by zero crossings rather than the peaks produced at the data head.

The differential data from the R/W preamplifier PCA-A6 is coupled through a second balanced low-pass filter on the drive control PCA-A4 to the input of the fixed-gain read amplifier. The output from this amplifier is coupled to the zero crossing detector and data AGC circuit. The data AGC circuit maintains a constant peak-to-peak level at the input of the zero crossing detector by controlling the gain of the preamplifier stage on the R/W preamplifier PCA-A6. The data AGC circuit is disabled during write mode operations.

Once the sector presently passing beneath the heads matches the addressed sector, the sector compare flip-flop on the I/O sector PCA-A2 will be clocked. When clocked during a read mode operation, the sector compare flip-flop will be clocked set (status bit 8 = 1) and the sector compare signal will become active (SC = 1) to enable the read/write system for a data transfer. Sector compare will remain active until the end of the addressed sector is forced (count 1088) or the READ command is dropped.

With the disc drive selected (SEL = 1) and the read system enabled (URG = 1), the zero crossing detector and line driver are both enabled. The zero crossing detector will produce a pulse for positive- or negative-going zero crossings. These pulses are transferred to the controller via the bidirectional data lines unique to that disc drive. Data separation is performed by circuits in the controller.

4-47. WRITE MODE OPERATION. Data is written by passing a current through the read/write winding in the selected head. This generates a flux field across the gap. The flux field magnetizes the iron oxide particles bound to the surface of the disc. The writing process orients the poles of each magnetized particle to permanently store the direction of the flux field as the oxide passes beneath the head. The direction of the flux field is a function of the write current polarity. Data is written by reversing the write current through the head windings. This change in write current polarity switches the direction of the flux field across the gap. Erasing old data is accomplished by writing over any data which may have been previously written on the disc.

As in a read operation, the sector compare flip-flop must be clocked set (status bit 8 = 1) and the sector compare signal must be active (SC = 1) to enable the read/write system for a data transfer. Sector compare will remain active until the end of the addressed sector is forced (count 1088) or the WRITE command is dropped.

With the disc drive selected (SEL = 1) and the write system enabled (UWG = 1), the line receiver on the R/W preamplifier PCA-A6 is enabled to accept data from the controller via the bidirectional data lines unique to that disc drive. Data formatting is performed by circuits in the controller. The data pulses produced by the line receiver toggle the write toggle logic to supply two complimentary write data signals (WDA and WDB) once the write mode of operation has been enabled. The write mode is enabled when the disc drive is selected (SEL = 1), the write system is enabled (UWG = 1), no write faults exist (WFLT = 0), and the read only mode is disabled (RO2 = 0).

The read only mode inhibits a write operation and thus prevents data from being written onto any data surface of the disc pack. The read only mode is selected when the READ ONLY switch is set to READ ONLY. The READ ONLY lamp will light and the read only status bit will become active (status bit 6 = 1) to signify that the read only mode has been selected.

When the write signal is active (WRITE = 1) and the URG and $\overline{ACRY}$ signals are both inactive (URG and $\overline{ACRY}$ = 0) which signifies that the read mode is disabled and the heads are settled over a legal cylinder, the WEN signal will become active (WEN = 1) to enable the write mode. Once enabled, the the read/write mode FET switches will disconnect the head select diodes from the preamplifier stage. In addition, it will enable the switchable write current source to produce write current to the head windings. The amount of write current produced is controlled by the programmable write current sink.

The three most significant bits of the cylinder address are coupled from the servo PCA-A3 to the input of the programmable write current sink on the R/W preamplifier PCA-A6. This information is used to modify the write current via the programmable write current sink. Seven write current zones ensure proper saturation for best head resolution. Write current is reduced by 3.50 milliamperes for each 128 cylinder increment from cylinder zero. Maximum write current is available at the outer cylinders and it is progresively reduced as the heads are moved toward the inner cylinders. This will optimize the write current for the changing relative velocity between the heads and media as cylinder radius decreases. Table 4-4 lists the reduction in write current as a function of the cylinder address.

Table 4-4. Write Current Reduction vs. Cylinder Address

CYLINDER	DWA	DWB	DWC	REDUCTION IN WRITE CURRENT (mA peak)
0 → 127	0	0	0	0
128 → 255	0	0	1	3.50
256 → 383	0	1	0	7.0
384 → 511	0	1	1	10.5
512 → 639	1	0	0	14.0
640 → 767	1	0	1	17.5
768 → 822	1	1	0	21.0

The programmable write current sink draws current from the selected head through the write current switches. Each write current switch is in series with one of the head windings. The complementary write data lines (WDA and WDB) alternately control these write current switches. This selects the head winding through which the write current will pass. Changing the write current from one winding to the other reverses the flux field at the gap in the ferrite core. This changes the direction of the magnetization of the oxide particles bound to the surface of the disc, thereby writing a data bit.

4-48. READ/WRITE FAULT DETECTION. As previously mentioned, the multiple heads selected detector continuously monitors the center taps of each head winding, and if more than one head is selected, a destructive MH fault is declared. In addition, the ac write current detector continuously monitors the write current paths, and if the absence of alternating write current is sensed, a destructive W • $\overline{AC}$ fault is declared. The dc write current detector continuously monitors the output of the switchable write current source, and if dc write current is being applied to the head windings and the disc drive is not in the write mode, a destructive DC • $\overline{W}$ fault is declared. The state of the $\overline{ACRY}$ signal is continuously monitored, and if head movement is detected during the write mode, a non-destructive W • $\overline{AR}$ fault is declared. The state of the URG signal is continuously monitored, and if the read and write modes are simultaneously enabled, a non-destructive R • W fault is declared. Whenever one of these read/write fault conditions is detected, a latch on the drive control PCA-A4 will be set, an LED will light, subsequent read/write faults will be inhibited, the write mode will be terminated, and all heads will be disabled.

4-49. FAULT DETECTION SYSTEM

The fault detection system (see figure 7-29) consists of circuits on the I/O sector PCA-A2, servo PCA-A3, drive control PCA-A4, spindle logic PCA-A8, power and motor regulator (PMR) PCA-A9, and fault indicator PCA-A12. All communication between card cage PCA's occurs via the motherboard PCA-A7. The spindle logic PCA-A8 and PMR PCA-A9 communicate with the other PCA's through the main harness. The fault indicator PCA-A12 communicates with the drive control PCA-A4 through a separate interconnecting cable. The purpose of the fault detection system is to continually monitor various conditions within the disc drive, and light fault indicators, retract the heads, and brake spindle rotation when a fault is detected. Included in the following are discussions relative to illegal address, timeout, AGC, carriage back, interlock, and read/write fault detection.

4-50. ILLEGAL ADDRESS DETECTION. Circuits on the I/O sector PCA-A2 and servo PCA-A3 continually monitor the internal control bus in the disc drive for illegal cylinder, head, and sector addresses. In addition, multiple SEEK commands are detected by circuitry on the I/O sector PCA-A2. Whenever one or more of these conditions exists, the disc drive will make seek check (status bit 2 = 1) available in its status word and it will not clock the illegal address into the appropriate register. Each of these detection circuits is discussed in detail in the following paragraphs.

4-51. Illegal Cylinder Address Detection. The internal control bus bits D0 through D9 are continually monitored by the illegal cylinder address detector on the servo PCA-A3. If a cylinder address greater than 822 is detected, the ICA signal will become active (ICA = 1). This will inhibit the illegal cylinder address from being clocked into the new cylinder address register (see figure 7-29). The seek check flip-flop will be clocked set on the leading edge of the decoded SEEK command. The seek check flip-flop is reset by $\overline{NDPS}$ whenever the power-on sequence is initiated (ILF = 1), the RUN/STOP switch is set to RUN (RUN = 1), or a CPS command is decoded (CPS = 1). In addition, the seek check flip-flop is reset by CYL whenever the seek home command is active ($\overline{SKH}$ = 0) or a seek to a legal cylinder address command is decoded. Further, if the heads are in motion ($\overline{ACRY}$ = 1) when the SEEK command is decoded, the seek check flip-flop will be clocked set on the leading edge of the decoded SEEK command. This will notify the controller that the disc drive is in the process of executing a previous SEEK command.

4-52. Illegal Head Address Detection. The internal control bus bits D8, D9, and D10 are continually monitored by the illegal head address detection circuitry on the I/O sector PCA-A2. If a head address greater than 4 is detected, the illegal head address flip-flop will be clocked set on the leading edge of the decoded ADR command. In addition, the illegal head address will not be clocked into the head address register (see figure 7-28). The illegal head address flip-flop is reset by $\overline{NDPS}$ whenever the power-on sequence is initiated (ILF = 1), the RUN/STOP switch is set to RUN (RUN = 1), or a CPS command is decoded (CPS = 1).

4-53. Illegal Sector Address Detection. The internal control bus bits D4 and D5 are continually monitored by the illegal sector address detection circuitry on the I/O sector PCA-A2. If a sector address greater than 47 is detected, the illegal sector address flip-flop will be clocked set on the leading edge of the decoded ADR or XMS command. In addition, the illegal sector address will not be clocked into the sector address register (see figure 7-27). The illegal sector address flip-flop is reset by $\overline{NDPS}$ whenever the power-on sequence is initiated (ILF = 1), the RUN/STOP switch is set to RUN (RUN = 1), or a CPS command is decoded (CPS = 1).

4-54. TIMEOUT FAULT DETECTION. Each time a forward or reverse seek operation is commanded, circuits on the drive control PCA-A4 initiate a 90 millisecond timeout cycle. When the SEEK command is decoded (SK = 1), the timeout cycle flip-flop is set to initiate the 90 millisecond timeout cycle. A 180 Hz signal (STP) derived from the spindle speed (see figure 7-29) is used to clock the timeout counter. Similarly, a 1250 millisecond timeout cycle is initiated each time an initial head load, normal head unload, or recalibrate operation is commanded. Table 4-5 provides a summary of those conditions that initiate and those conditions that cancel a timeout cycle. If the event being timed is not cancelled before the timeout counter times out, a timeout fault will be declared. When a timeout fault is detected, the following events will occur:

- $\overline{TOFL}$ signal becomes active ($\overline{TOFL}$ = 0).
- T fault LED lights ($\overline{TOFL}$ = 0).
- Timeout counter reset is inhibited ($\overline{TOFL}$ = 0).
- Heads are unloaded, spindle is braked to a stop, and the pack chamber door is unlatched. Refer to table 4-6 for the specific events.

The timeout counter is reset by DPS whenever the power-on sequence is initiated (ILF = 1) or the RUN/STOP switch is set to RUN (RUN = 1).

Table 4-5. Summary of Timeout Conditions

TIMEOUT CYCLE	INITIATING CONDITION	CANCELLING CONDITION
90 ms	Seek command (SK = 1)	Heads settled on specified cylinder within 90 milliseconds ($\overline{TOFL}$ • ACRY = 1).
1250 ms	Initial Head load ($\overline{SKH}$ = 0)	Heads settled on cylinder 0 within 1250 milliseconds ($\overline{TOFL}$ • ACRY = 1).
1250 ms	Normal head unload (RET • $\overline{TOFL}$ + $\overline{ILFL}$ = 1)	Heads reach fully retracted position within 1250 milliseconds ($\overline{TOFL}$ • RET • CRB = 1).
1250 ms	Recalibrate command (RH = 1)	Heads are settled on cylinder 0 within 1250 milliseconds ($\overline{TOFL}$ • 2 ACRY = 1).

Table 4-6. Fault Events

STEP	EVENT
1	DRIVE FAULT lamp lights ($\overline{FLTL}$ = 0).
2	Drive fault status bit is active (status bit 4 = 1).
3	Normal head unload operation is initiated (RET = 1).
4	Drive ready flip-flop is reset (RET = 1).
5	DRIVE READY lamp goes out ($\overline{DRDYL}$ = 1).
6	Servo enable flip-flop is reset (TOF = 1).
7	Head positioning servo is disabled ($\overline{SEN}$ = 1).
8	Heads are fully retracted (CRB = 1).
9	Run spindle flip-flop is reset (TOF • CRB = 1).
10	Stop spindle command becomes active ($\overline{RS}$ = 0).
11	Spindle is braked to a stop ($\overline{SPD}$ = 0).
12	Door unlock solenoid is energized ($\overline{SPD}$ = 0).
13	DOOR UNLOCKED lamp lights ($\overline{DU}$ = 0).

4-55. AGC FAULT DETECTION. The state of the $\overline{AGC}$ signal is continually monitored by a circuit on the servo PCA-A3. If the servo $\overline{AGC}$ signal is lost while the heads are located on or between cylinders 0 and 822, an AGC fault will be declared. When an AGC fault is detected, the following events will occur:

- AGC fault flip-flop is set (AGCF • DRDY = 1).
- $\overline{AGFL}$ signal becomes active ($\overline{AGFL}$ = 0).
- AGC fault LED lights ($\overline{AGFL}$ = 0).
- Heads are unloaded. Refer to table 4-6, steps 1 through 8, for the specific events.

The AGC fault flip-flop is reset by NDPS whenever the power-on sequence is initiated (ILF = 1), the RUN/STOP switch is set to RUN (RUN = 1), or a CPS command is decoded (CPS = 1).

4-56. CARRIAGE BACK FAULT DETECTION. The state of the CRB signal is continually monitored by a circuit on the drive control PCA-A4. If the CRB signal becomes active (CRB = 1) indicating that the heads have been fully retracted, but the drive ready flip-flop has not been reset by the RET signal (CRB and DRDY simultaneously active), a carriage back fault will be declared. When a carriage back fault is detected, the following events will occur:

- Carriage back fault flip-flop is set (CRB • DRDY = 1).
- $\overline{CBFL}$ signal becomes active ($\overline{CBFL}$ = 0).
- CB fault LED lights ($\overline{CBFL}$ = 0).
- Heads are unloaded. Refer to table 4-6, steps 1 through 8, for the specific events.

The carriage back fault flip-flop is reset by DPS whenever the power-on sequence is initiated (ILF = 1) or the RUN/STOP switch is set to RUN (RUN = 1).

4-57. INTERLOCK FAULT DETECTION. The interlock fault detection circuitry on the drive control PCA-A4 continually monitors the interlock chain, the −36, −24, −12, +5, +12, and +36 Vdc and 25 Vac power supply voltages, the temperature of the heat sink on the PMR PCA-A9, and the spindle fault logic on the spindle logic PCA-A8. If any one of the PCA's (with the exception of the indicator PCA-A11 and the fault indicator PCA-A12) is not firmly in place, the pack chamber is disconnected, any one of the monitored power supplies falls below a specified value, the temperature of the heat sink on the PMR PCA-A9 rises above a specified value, or a spindle fault is detected, an interlock fault will be declared. When an interlock fault is detected, the following events will occur:

- $\overline{ILFL}$ signal becomes active ($\overline{ILFL}$ = 0).
- IL fault LED lights ($\overline{ILFL}$ = 0).
- Heads are unloaded, spindle is braked to a stop, and the pack chamber door is unlatched. Refer to table 4-6 for the specific events.

If an interlock is indicated because the +5, +12, −12 Vdc, or 25 Vac is missing, or the spindle logic PCA-A8 is unplugged, the spindle will not be braked to a stop and the pack chamber door will not be unlocked. Under these conditions, the following events will occur:

- ILFL signal becomes active (ILFL = 0)
- IL fault LED lights (ILFL = 0)
- Heads are unloaded and steps 1 through 8 of table 4-6 apply.

Note: If the drive control PCA-A4 is unplugged, then the DRIVE FAULT and IL indicators will not light.

4-58. READ/WRITE FAULT DETECTION. The read/write fault detection circuitry on the drive control PCA-A4 continually monitors internal disc drive signals to detect five fault conditions. These fault conditions are classified as either non-destructive or destructive write faults. There are two non-destructive and three destructive write faults. Each is discussed in detail in the following paragraphs.

4-59. Non-destructive Write Faults. The two fault conditions classified as non-destructive are:

- Write without Access Ready (W • $\overline{AR}$).
- Simultaneous read or write (R • W).

In the first condition, the state of the $\overline{ACRY}$ signal is continually monitored. If the heads are not settled over the specified cylinder ($\overline{ACRY}$ = 1) during the write mode (WRITE = 1) and no other write faults exist ($\overline{WFLT}$ = 1), a W • $\overline{AR}$ fault is declared. When a W • $\overline{AR}$ fault is detected, the following events will occur:

- W • $\overline{AR}$ fault flip-flop is set (W • $\overline{AR}$ • $\overline{WFLT}$ = 1).
- $\overline{WRFL}$ signal becomes active ($\overline{WRFL}$ = 0).
- W • $\overline{AR}$ fault LED lights ($\overline{WRFL}$ = 0).
- $\overline{NDWF}$ signal becomes active ($\overline{NDWF}$ = 0).
- $\overline{WFLT}$ signal becomes active ($\overline{WFLT}$ = 0).
- Subsequent read/write faults are inhibited ($\overline{WFLT}$ = 0).
- DRIVE FAULT lamp lights ($\overline{FLTL}$ = 0).
- Drive fault status bit becomes active (status bit 4 = 1).

The W • $\overline{AR}$ fault flip-flop is reset by NDPS whenever the power-on sequence is initiated (ILF = 1), the RUN/STOP switch is set to RUN (RUN = 1), or a CPS command is decoded (CPS = 1).

In the second condition, the state of the URG signal is continually monitored. If the URG signal becomes active (URG = 1) during the write mode (WRITE = 1) and no other write faults exist ($\overline{WFLT}$ = 1), a R • W fault is declared. When a R • W fault is detected, the following events will occur:

- R • W fault flip-flop is set (R • W • $\overline{WFLT}$ = 1).
- $\overline{RWFL}$ signal becomes active ($\overline{RWFL}$ = 0).
- R • W fault LED lights ($\overline{RWFL}$ = 0).
- $\overline{NDWF}$ signal becomes active ($\overline{NDWF}$ = 0).
- $\overline{WFLT}$ signal becomes active ($\overline{WFLT}$ = 0).
- Subsequent read/write faults are inhibited ($\overline{WFLT}$ = 0).
- DRIVE FAULT lamp lights ($\overline{FLTL}$ = 0).
- Drive fault status bit becomes active (status bit 4 = 1).

The R • W fault flip-flop is reset by NDPS whenever the power-on sequence is initiated (ILF = 1), the RUN/STOP switch is set to RUN (RUN = 1), or a CPS command is decoded (CPS = 1).

4-60. Destructive Write Faults. The three fault conditions classified as destructive are:

- A write gate without any alternating write current (W • $\overline{AC}$).
- More than one head selected (MH).
- DC write current without a write gate (DC • $\overline{W}$).

In the first condition, the state of the ACW signal is continually monitored. If the ACW signal remains inactive (ACW = 0) during the write mode (WRITE = 1) and no write faults exist ($\overline{WFLT}$ = 1), a W • $\overline{AC}$ fault is declared. When a W • $\overline{AC}$ fault is detected, the following events will occur:

- W • $\overline{AC}$ fault flip-flop is set (W • $\overline{AC}$ • $\overline{WFLT}$ = 1).
- $\overline{WAFL}$ signal becomes active ($\overline{WAFL}$ = 0).
- W • $\overline{AC}$ fault LED lights ($\overline{WAFL}$ = 0).
- $\overline{DWF}$ signal becomes active ($\overline{DWF}$ = 0).
- $\overline{WFLT}$ signal becomes active ($\overline{WFLT}$ = 0).
- Subsequent read/write faults are inhibited ($\overline{WFLT}$ = 0).
- Heads are unloaded. Refer to table 4-6, steps 1 through 8, for the specific events.

The W • $\overline{AC}$ fault flip-flop is reset by DPS whenever the power-on sequence is initiated (ILF = 1) or the RUN/STOP is set to RUN (RUN = 1).

In the second condition, the state of the $\overline{MHS}$ signal is continually monitored. If the $\overline{MHS}$ signal becomes active ($\overline{MHS}$ = 0) and no other write faults exist ($\overline{WFLT}$ = 1), a MH fault is declared. When a MH fault is detected, the following events will occur:

- MH fault flip-flop is set ($\overline{MHS}$ • $\overline{WFLT}$ = 1).
- $\overline{MHFL}$ signal becomes active ($\overline{MHFL}$ = 0).
- MH fault LED lights ($\overline{MHFL}$ = 0).
- $\overline{DWF}$ signal becomes active ($\overline{DWF}$ = 0).
- $\overline{WFLT}$ signal becomes active ($\overline{WFLT}$ = 0).
- Subsequent read/write faults are inhibited ($\overline{WFLT}$ = 0).
- Heads are unloaded. Refer to table 4-6, steps 1 through 8, for the specific events.

The MH fault flip-flop is reset by DPS whenever the power-on sequence is initiated (ILF = 1) or the RUN/STOP switch is set to RUN (RUN = 1).

In the third condition, the state of the DCW signal is continually monitored. If write current is being applied to the heads (DCW = 1), the disc drive is not in the write mode (WRITE = 0), and no other write faults exist ($\overline{WFLT}$ = 1), a DC • $\overline{W}$ fault is declared. When a DC • $\overline{W}$ fault is detected, the following events will occur:

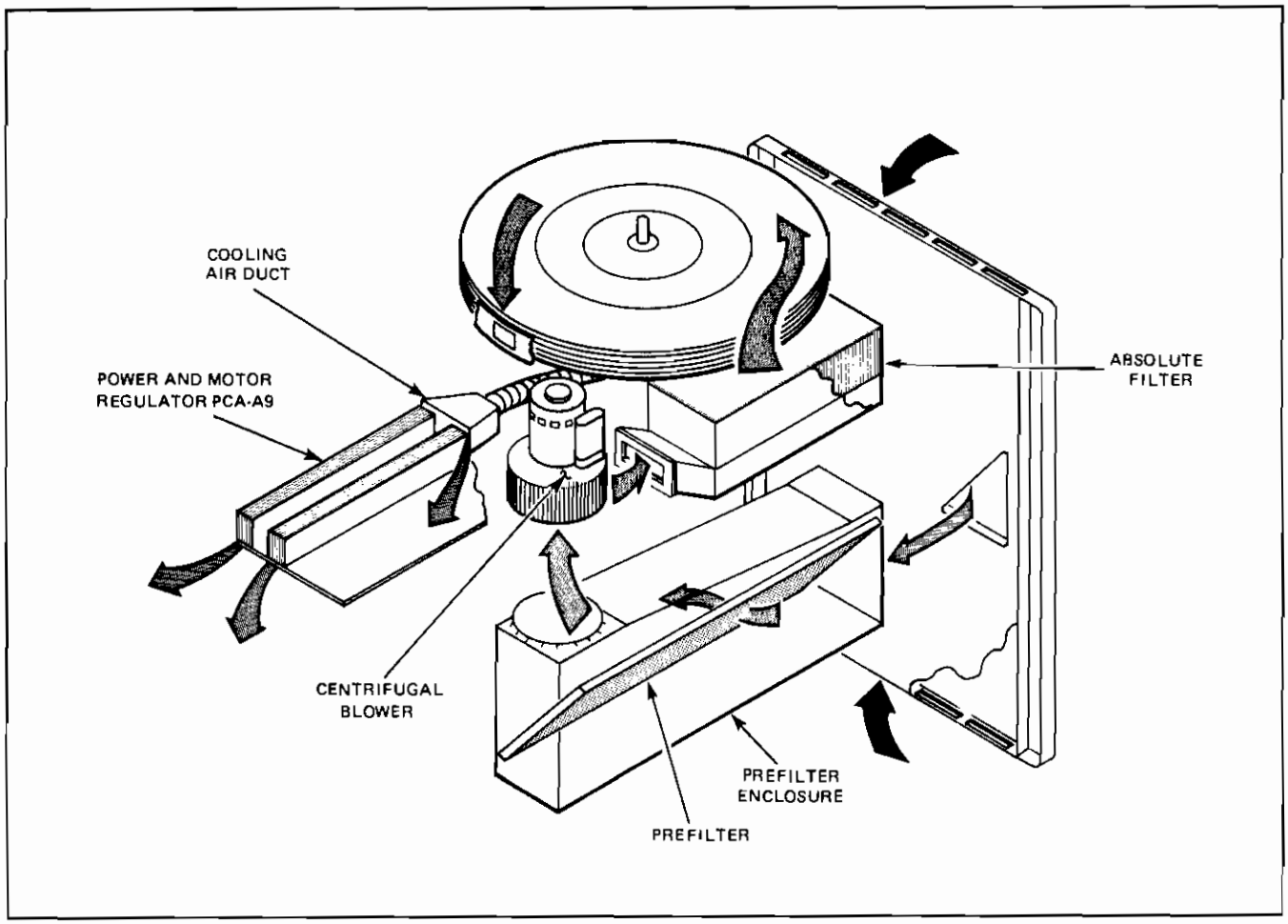
- Both the W • $\overline{AC}$ and MH fault flip-flops are set (DC • $\overline{W}$ • $\overline{WFLT}$ = 1).
- Both the $\overline{WAFL}$ and $\overline{MHFL}$ signals become active ($\overline{WAFL}$ and $\overline{MHFL}$ = 0).
- Both the W • $\overline{AC}$ and MH fault LED's light ($\overline{WAFL}$ and $\overline{MHFL}$ = 0).
- $\overline{DWF}$ signal becomes active ($\overline{DWF}$ = 0).
- $\overline{WFLT}$ signal becomes active ($\overline{WFLT}$ = 0).
- Subsequent read/write faults are inhibited ($\overline{WFLT}$ = 0).
- Heads are unloaded Refer to table 4-6, steps 1 through 8, for the specific events.

The W • $\overline{AC}$ and MH fault flip-flops are reset by DPS whenever the power-on sequence is initiated (ILF = 1) or the RUN/STOP switch is set to RUN (RUN = 1).

4-61. AIR CIRULATION AND FILTRATION SYSTEM

The air circulation and filtration system (see figure 4-11) consists of a rotating impeller located on the disc drive mainframe and an exhaust fan located on the power panel assembly. In addition, a prefilter and absolute filter are used to trap contaminants in the developed air supply.

As can be seen in figure 4-11, a centrifugal blower draws cooling air into the prefilter enclosure through the vent openings in the front door of the enclosure. The larger airborne contaminants are trapped as the air is drawn through the prefilter. Approximately one-half of the developed air flow bypasses the absolute filter element, passing directly through the lower half of the absolute filter box. From there, the air is directed through a flexible hose to the cooling air duct where it is diverted into three separate paths. Two of these paths flow along the fins of



7301-45

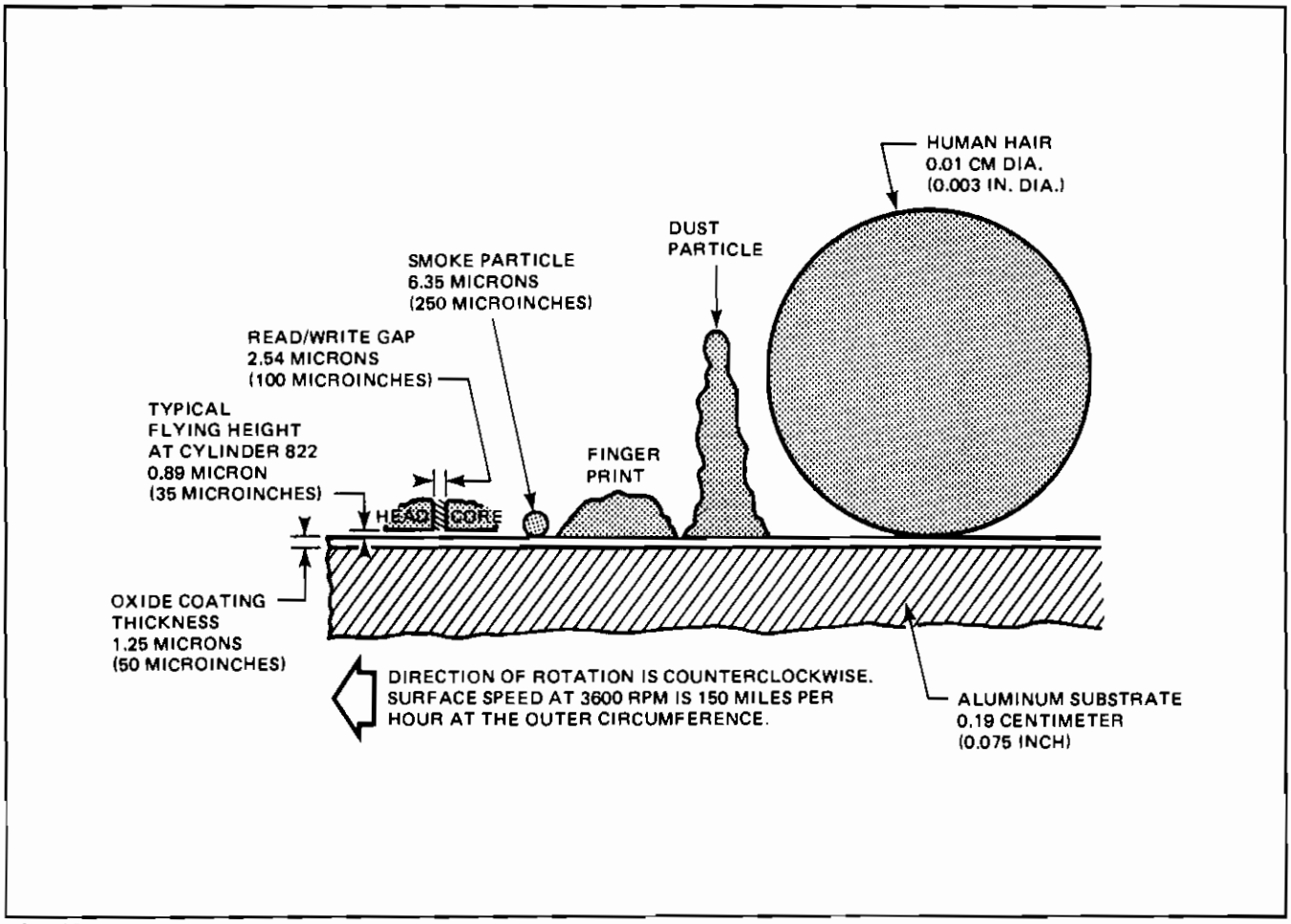
Figure 4-11. Air Circulation and Filtration System

the heat sink on the power and motor regulator PCA-A9 and the remaining path is distributed over the components mounted on the PCA. The flow of air from the heat sink exits through the ducting and vent openings provided at the rear of the enclosure.

The remaining half of the developed air flow passes through the filtration element in the absolute filter where 99 percent of all contaminants 0.3 microns or larger are trapped. After the air is thoroughly filtered, it is ducted into the pack chamber. When a disc pack is installed, all critical areas will be purged of any foreign matter. Also, the high positive pressure developed within the pack chamber tends to reject any foreign matter that may be airborne.

Figure 4-12 shows the critical elements involved in the read/write process, i.e., the read/write gap, the flying height of the heads, and the thickness of the oxide coating on the disc surfaces. The flying height of the heads is an average value due to the surface irregularities of both the heads and discs. Figure 4-12 also shows various types of contaminants and their size relationships. If a particle was hard enough and of the right size, it could scratch either the oxide coating or the head surface. Even if it was not hard enough to scratch, it may be large enough to increase the head-to-disc spacing, thereby causing data errors.

Therefore, to prevent potential damage due to head-to-disc contact and possible data losses, it becomes extremely important to maintain the cleanliness of the air supply within the disc drive. To ensure that clean air will be present, the disc drive must be operated in the specified environment and the cleanliness of the prefilter and efficiency of the absolute filter must be checked on a regular basis. Refer to Section V, Maintenance for the absolute filter output air pressure measurement procedure. Further, the absolute filter must be changed whenever the air flow through it becomes restricted and the output air pressure drops below the value specified in paragraph 5-13. Refer to Section VIII, Removal and Replacement for the prefilter and absolute filter replacement procedures.



7301-46

Figure 4-12. Types of Contaminants and Critical Elements

4-62. POWER DISTRIBUTION SYSTEM

The power distribution system primarily consists of the power panel assembly, power supply assembly, voltage regulator and protection circuits, and the associated switches, fuses, lamps, and wiring. The purpose of the power distribution system is to develop the various operating voltages from the primary power source and distribute these voltages throughout the disc drive circuitry. Figures 7-22 or 7-22A and 7-23 provide the wiring diagrams for the power panel assembly and disc drive mainframe assembly, respectively. Tables 7-3 and 7-4 provide the signal distribution list for the motherboard PCA-A7 and the power distribution list for the disc drive mainframe assembly, respectively. Together these diagrams and listings provide all of the wiring information for the disc drive.

4-63. POWER PANEL ASSEMBLY. The power panel assembly (21, figure 9-1) is located in the lower rear section of the disc drive cabinet. This assembly consists of a circuit breaker, a convenience outlet strip, and an air exhaust fan. The circuit breaker and outlet strip equip the cabinet with a complete electrical package to control, protect, and distribute single-phase mains power. The exhaust fan is used to help maintain the internal cabinet temperature at the proper operating level.

Disc drives with serial numbers prefixed 1783 and prior ordered for use with 120 Vac include a hardwired power cord; those ordered for 240 Vac do not include a power cord. Disc drives with serial numbers prefixed beginning with 1740 include an appropriate power cord.

4-64. POWER SUPPLY ASSEMBLY. The power supply assembly consists of a power transformer (T1), three bridge rectifiers (CR1 thru CR3), five filter networks (R1 thru R5 and C1 thru C5), and five fuses (F2 thru F6). This assembly develops five unregulated dc voltages (+20V, −20V, +10V, +36V, and −36V) and one ac voltage (25 Vac) from the primary power source. The terminal strip (TB1) on the primary side of the power transformer (T1) permits strapping of the primary windings to match the available primary power source. Refer to Section II, Installation for the various strapping configurations of TB1. Fuses provide overload protection for the five unregulated secondary voltages. All power supply assembly grounds are brought to a common ground block (TB2). It is important that these connections be made as shown because each has a specific assignment, i.e., ground 1 serves as logic ground, ground 2 serves linear motor ground, and grounds 3 and 4 serve as spindle motor grounds.

4-65. VOLTAGE REGULATOR CIRCUITS. The unregulated dc voltages developed by the power supply assembly are routed to the four voltage regulator circuits on the power and motor regulator PCA-A9 via the power supply harness. The unregulated output from the +10 volt supply is routed to the input of the +5 volt voltage regulator. The +5 volt regulated supply is sampled at the motherboard PCA-A7 so that the proper voltage level will be maintained at that point. The unregulated output from the +20 and −20 volt supplies are routed to the inputs of the +12 and −12 volt voltage regulators. The unregulated output from the −36 volt supply is routed to the −24 volt voltage regulator. Test points are provided on the power and motor regulator PCA-A9 to monitor the outputs from the +5, +12, −12, and −24 volt regulated supplies.

4-66. VOLTAGE PROTECTION CIRCUITS. Circuits are provided in the disc drive to detect over and under voltage conditions in the +5, +12, −12, +36 and −36 volt supplies and the 25 Vac supply. Reverse polarity protection is also incorporated into each disc drive supply. Diodes on the power and motor regulator PCA-A9 provide reverse polarity protection at the input of the +5, +12, −12, and −24 volt regulated supplies and +36 and −36 volt unregulated supplies. Diodes on the motherboard PCA-A7 provide additional reverse polarity protection for the +12 and −12 volt regulated supplies. In addition, a crowbar circuit on the motherboard PCA-A7 guards the +5 volt regulated supply from a possible overvoltage condition and guards the −12 volt regulated supply from a possible connection to a positive supply. A fuse (A9F1) provides overload protection for the 25 Vac supply. The −24 volt regulated supply is also protected from overload by a fuse (A9F2).

4-67. SUPPLY VOLTAGE DISTRIBUTION. The outputs from each of the four regulated supplies, the +10 volt unregulated supply, the 25 Vac supply, and ground 1 are routed throughout the disc drive via the main harness and motherboard PCA-A7. The regulated supplies are used to provide the operating voltages for the disc drive circuitry. The unregulated +10 volt supply is used to provide the operating voltage for the carriage unlatched solenoid and pack chamber door unlocked solenoid. In addition, it provides the input to the +5 volt voltage regulator. Ground 1 is used as logic ground throughout the disc drive circuitry. A power distribution list is provided in table 7-4. The outputs from the +20, −20, +36, −36 volt unregulated supplies and grounds 2, 3, and 4 are not included in this listing because they are used exclusively on the power and motor regulator PCA-A9. As previously mentioned, the unregulated outputs from the + and −20 and −36 volt supplies are used to develop regulated voltages, ground 2 is used as linear motor ground, and grounds 3 and 4 are used as spindle motor grounds. The unregulated + and −36 volt supplies are used to provide the operating voltages for the linear motor power amplifier and the four spindle motor current switches which are located on the power and motor regulator PCA-A9.

MAINTENANCE

SECTION V

5-1. INTRODUCTION

This section contains maintenance precautions, listings of special tools and test equipment, preventive maintenance routines, and preventive maintenance inspection and cleaning procedures. Maintenance of the disc drive must be performed by service-trained personnel only.

5-2. MAINTENANCE PRECAUTIONS

To avoid injury to personnel and to prevent damage to equipment, observe the following safety precautions:

WARNING

- **Observe all warnings and cautions provided in this manual and that are placed on the equipment.**
- **Use extreme caution when working on the disc drive with shroud removed or doors opened. Hazardous voltages are present inside the mainframe when the power distribution assembly is connected to an active ac power source.**
- **Do not attempt to remove or change printed-circuit assemblies, interconnecting cables, or extender cards while power is applied.**

CAUTION

- Do not run the disc drive without an absolute filter. Severe contamination in the head/disc area will result which could damage the head and/or disc surface.
- Use only the specified brand of cleaning tissue. Some other brands contain contaminating oils and/or lint which may leave a harmful residue.
- Use only the specified type of alcohol. Some other brands contain impurities that could cause damage.
- Avoid applying excessive pressure to the gimbal area of the head while cleaning. Excessive pressure may alter or damage the head attitude which is precision set at the factory.
- Never place an inspection mirror between the heads or allow it to touch the heads. The flying attitude of the heads may be altered or damaged.
- Do not use oil or other similar lubricants anywhere in the disc drive.
- Do not attempt to manually extend the carriage assembly unless the head spacer tool (part no. 13354-60021) is clamped to the carriage assembly and there is no disc pack in the disc drive; otherwise, head damage will result.

5-3. SERVICE TOOLS AND TEST EQUIPMENT

The following paragraphs list and describe the tools and test equipment required to service the disc drive.

5-4. STANDARD TOOLS

Recommended standard tools and materials required for service are listed in table 5-1. Except where noted, equivalent tools may be substituted.

Table 5-1. Standard Tools

TOOL	HP PART NO.
Molykote*	6040-0084
Alcohol, isopropyl*	8500-0559
Bit, 1/4-inch drive, hex key	8710-0664
Bit, 1/4-inch drive, Pozidriv #2	8710-0903
Bit, 1/4-inch drive, slotted	8710-0669
Bit, 1/4-inch drive (used with part no. 1535-2653)	1535-2652
Extension bar (used with part no. 8710-1139)	8710-1132
Gauge set, 0.0015 - 0.025 inch	8750-0053
Hex head driver (used with part no. 8710-1139)	8710-1145
Inspection mirror	8830-0005
Kimwipe tissues*	9300-0001
Pin extractor	8710-0688
Pliers, diagonal cutting	8710-0006
Pliers, long nose	8710-0016
Q-tips	8520-0023
Screwdriver, 4 x 1/4-inch	8730-0001
Screwdriver, 3 x 3/16-inch	8730-0019
Screwdriver, Pozidriv	8710-0900
Screwdriver, Pozidriv	8710-0899
Screwdriver, Pozidriv, stubby	- - -
Screwdriver, offset	- - -
Socket set, 1/4-inch drive	- - -
Soldering iron	8690-0011
Soldering iron tip	8690-0021
Steel rule, 6-inch	8750-0001
Tape, masking	0460-0030
Wire strippers	8710-0058
Wrench, 7/16-inch box	8720-0017
Wrench, torque, 0 - 12 inch-pounds	1535-2853
Wrench, torque, 30 - 200 inch-pounds	8710-1139

*Do not substitute.

WARNING

Isopropyl alcohol is a restricted article (flammable liquid). Transport in accordance with Department of Transportation Regulations, Title 49, parts 171 - 177 Hazardous Materials).

5-5. STANDARD TEST EQUIPMENT

The standard test equipment required for maintenance are as follows:

a. Digital Voltmeter, HP 970A or equivalent battery-operated digital voltmeter.
b. Oscilloscope, HP 180A, or equivalent

5-6. SPECIAL TOOLS

Table 5-2 lists the special tools required for maintenance. Figure 5-1 depicts the special tools.

Table 5-2. Special Tools

NAME	HP PART NO. OR HP PRODUCT NO.
Air Pressure Measuring Gauge	0101-0374
Cam Alignment Assembly	13354-60001
CE Pack Assembly	13398A
Extender Board	13354-60003
Head Alignment Tool	13354-20007
Head Cleaning Tool	07900-00091
Head Installation Tool	13354-20009
Head Initial Position Tool	13354-20008
Spindle Logic Extender	13354-60002
Head Extender Cable	12995-60038
Head Spacer Tool	13354-60021
Fault Indicator Assembly	13354-60014
Pack Lock Lubrication Tool	07920-20086
Socket	8710-1239
Torque Wrench	8710-1240
Standoff	2510-0115
Wrench-Retainer	07920-20088
Hub Locking Bushing	07920-60091

5-7. SPECIAL TEST EQUIPMENT

The only special test equipment required for maintenance is the Disc Service Unit (part no. 13354-60011). The Disc Service Unit (DSU) and its components are depicted in figure 5-2. The following equipment is supplied with each DSU:

a. DSU Test Module, part no. 13354-60005
b. Head Alignment PCA, part no. 13354-60010
c. 20-Pin Jumper Cable, part no. 13354-60013
d. 50-Pin Jumper Cable, part no. 13354-60012

The DSU test module simulates controller signals which are applied to the disc drive and processes disc drive responses for display. Simulated signals are produced either manually or automatically to operate the disc drive under both static and dynamic conditions. All operations, including read and write, are limited to addressing and accessing. The actual writing of data is not performed and during a read operation, the DSU test module does not decode any data. Disc drive faults that occur during any operation are displayed by the light-emitting diodes which are located on the operator panel.

In the automatic mode (functions 1, 2, and 3), the DSU test module provides the means to automatically perform alternate, incremental, or random seek operations. These capabilities are used to exercise the disc drive to relax any mechanical stresses, and to permit an adjustment of the seek time.

The index sequences (functions 4, 5, and 6) are not used on the HP 7920 Disc Drive.

In the alignment mode (function 7), the DSU test module provides the means to automatically seek a specific cylinder while displaying a dimensional offset. These capabilities are used to align the data heads.

In the manual mode (function 8), the DSU test module provides the means to manually program cylinder addresses, head and sector addresses, unit addresses, and offset information onto the control bus lines and the disc drive functions onto the tag bus lines. These capabilities are typically used for off-line checkout of the disc drive.

A three-digit numerical display is provided on the DSU test module for measuring seek time, delay between seeks, and head alignment. In addition, a meter is provided for measuring radial head alignment. In the manual mode, the state of each of the control bus lines and tag bus lines is displayed on LED's.

Instructions for using the DSU for alignment and adjustment are provided in Section VI of this manual and an off-line checkout procedure in which the DSU is used is provided in Section VII.

5-8. DSU CONTROLS AND INDICATORS. The following paragraphs describe the controls and indicators for the DSU (figure 5-3).

Toggle switches — Twenty toggle switches that are used for seek, alignment, and manual functions of the DSU. For alternate and incremental seek operations, the switches are divided into two groups of 10 switches each. Each group is used to select a cylinder address in binary form for alternate seek operations. For the incremental seek operations, only the bottom 10 switches are used for selecting cylinder addresses.

The center column of placarded information relating to the switches includes VFY, H4, H2, and H1, and S32, S16, S8, S4, S2, and S1. The VFY function is not used for the HP 7920A. The labels H4, H2, and H1 are used with the head alignment and manual functions. The toggle switches select the desired data head in binary form.

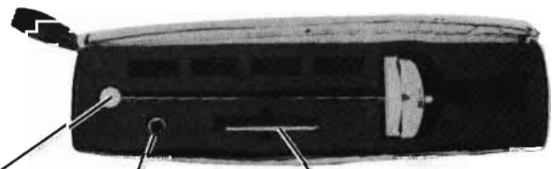
The labels S32, S16, S8, S4, S2, and S1 are used with the manual function. The toggle switches select the desired sector for operation.

CE DISC PACK
IN CARRYING CASE
HP 13398A

DATA DISC PACK
IN CARRYING CASE
HP 13394A (DISC PACK ONLY)

HEAD INITIAL
POSITION TOOL
P/N 13354-20008

HEAD ALIGNMENT TOOL
P/N 13354-20007



TORQUE WRENCH
8710-1240

SOCKET
8710-1239

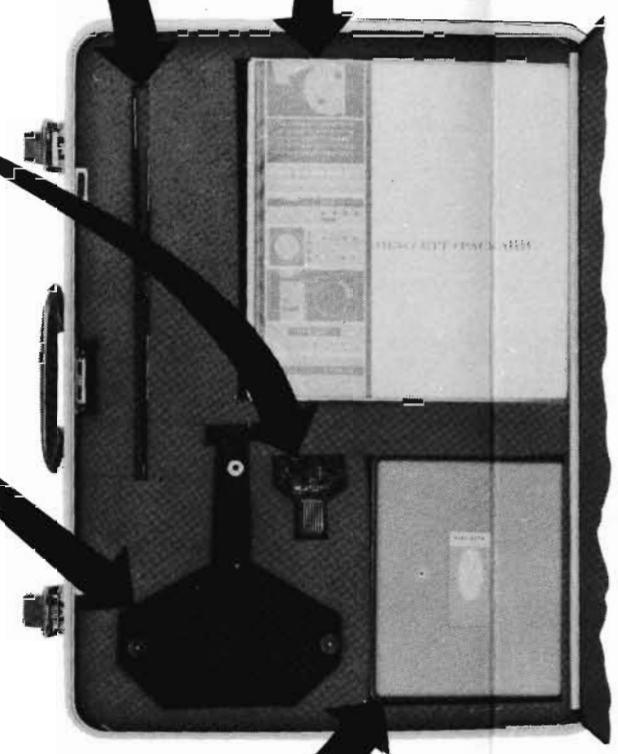
STANDOFF 2510-0115
WRENCH-RETAINER 07920-20088
HUB LOCKING BUSHING 07920-60091

OPERATING AND
SERVICE MANUAL
P/N 07920-90001

EXTENDER BOARD
P/N 13354-60003
(INTERFACE CABLE
NOT SHOWN)

FAULT INDICATOR
SERVICE ADAPTER
P/N 13354-60014

CAM ALIGNMENT
TOOL P/N 13354-60001



DISC SERVICE KIT,
IN CARRYING CASE

AIR PRESSURE
MEASURING GAUGE
P/N 0101-0374

AIR PRESSURE
PROBE ASSEMBLY
P/N 12995-60013

DISC SERVICE UNIT
P/N 13354-60005
P/N 13354-60010
P/N 13354-60012
P/N 13354-60013

TORQUE WRENCH
P/N 8710-1139

SPINDLE LOGIC
EXTENDER
P/N 13354-60002

TORQUE WRENCH
P/N 1535-2653

POZIDRIV BIT
P/N 8710-0915

EXTENSION BAR
P/N 8710-1132

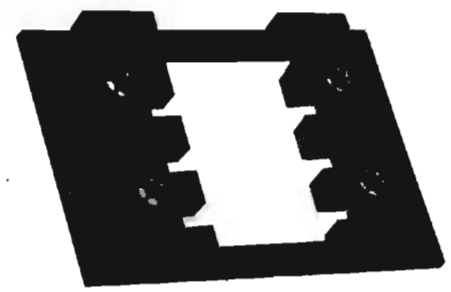
1/4-INCH BIT
P/N 1535-2652

HEX HEAD DRIVER
P/N 8710-1145

HEAD INSTALLATION TOOL
P/N 13354-20009

HEAD CLEANING TOOL
P/N 07900-00091

HEAD EXTENDER CABLE
P/N 12995-60038

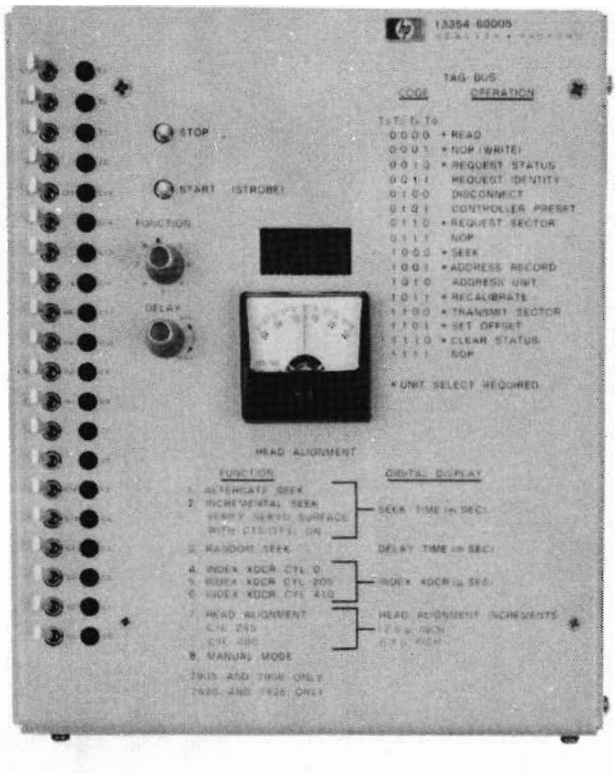


HEAD SPACER TOOL
P/N 13354-60021

PACK LOCK
LUBRICATION TOOL
07920-20086

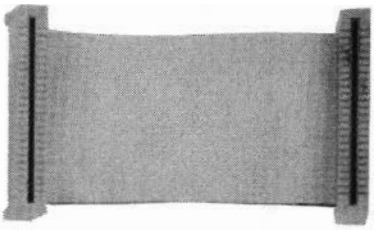
Figure 5-1. Special Service Tools

DSU TEST MODULE
P/N 13354-60005

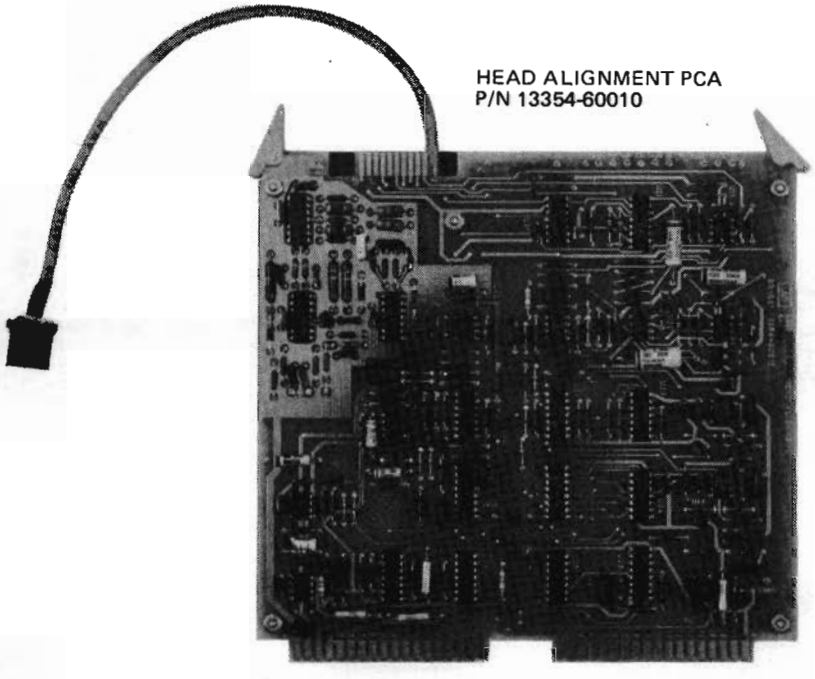


20-PIN JUMPER CABLE
P/N 13354-60013

50-PIN JUMPER CABLE
P/N 13354-60012

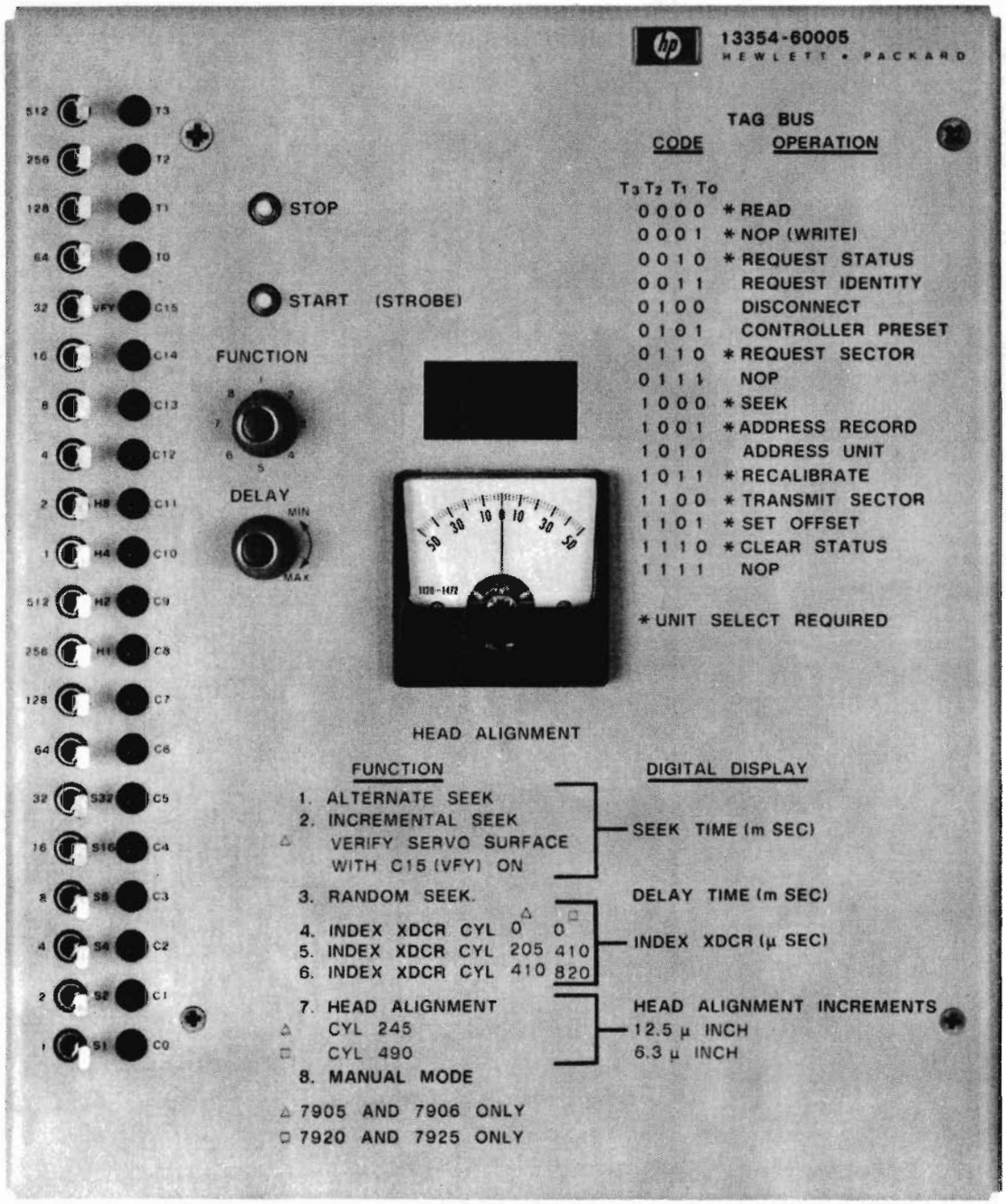


HEAD ALIGNMENT PCA
P/N 13354-60010



7301-12A

Figure 5-2. Disc Service Unit



7300-11B

Figure 5-3. DSU Test Module, Controls and Indicators

The right-hand column of labels is used in the manual mode. Switches T1 through T3 set the tag bus commands and switches C0 through C15 set the control bus commands.

LED Indicators — Twenty indicators used in conjunction with the toggle switches. When a switch is set to the right, the corresponding LED lights indicating that the switch line is active. The indicators also display the states of the tag bus and control bus.

STOP Pushbutton — Momentary contact switch that stops an operation in progress.

START Pushbutton — Momentary contact switch that starts an operation, or in the manual mode, provides the strobe (STB) as long as actuated.

DELAY Control — Varies time between seek operations from one millisecond (MIN) and 1.2 seconds (MAX).

Digital Display — Three-digit display that indicates head offset in microinches. If head offset is out of range, two decimal points on the left and center digits light. For seek operations, the display reads out time in milliseconds.

HEAD ALIGNMENT Meter — Analog meter is used during head alignment. The meter displays head offset in 6.3-microinch increments. Each minor division represents 12.5 microinches. (See figure 5-4.)

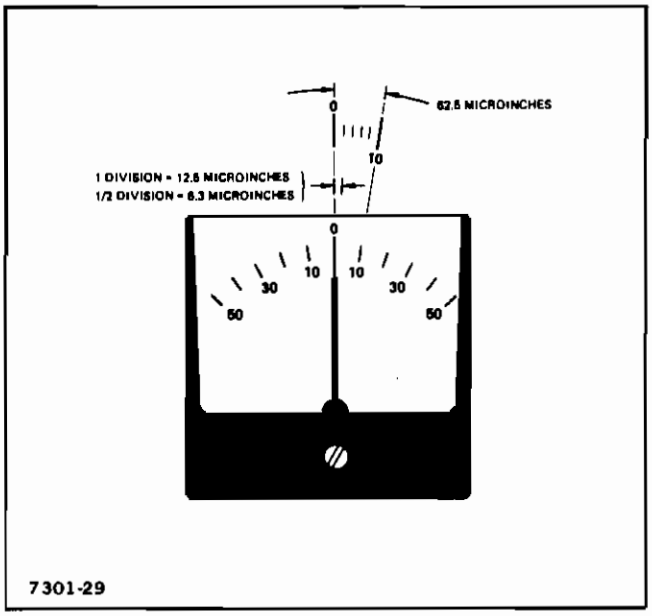


Figure 5-4. Head Alignment Meter Calibrations

5-9. DSU OPERATION. The operating functions of the DSU using the controls and indicators are described in the following paragraphs.

FUNCTION 1 — ALTERNATE SEEK. This function is used to exercise the disc drive. The toggle switches are used to select the cylinder addresses for the seek operation. The top 10 switches are used to select the first cylinder address and the bottom 10 switches are used to select the second cylinder address. When the START pushbutton is pressed, the heads seek home (cylinder 0) then go to the first cylinder address. When the heads reach the first address, a seek to the second address is performed. This operation continues until the STOP pushbutton is pressed or the function is changed. If either address is greater than 822, the heads will remain at the address within range. If both addresses are out of range, only the seek home operation will be performed. Seek delay time is adjusted by the DELAY control.

Note: All operations are terminated when the FUNCTION switch is set to any other position.

FUNCTION 2 — INCREMENTAL SEEK. The bottom 10 switches are used to set the address increment the drive will seek. When the START pushbutton is pressed, the heads seek home and then will proceed to the next address. The next address is determined by the present address plus the address number set on the toggle switches. The incremental seek begins at cylinder zero and progresses to the next higher address until the highest cylinder number selected is an out-of-range address. When the out-of-range address is reached, the next seek will be the present address less the number set on the toggle switches. Seek delay time is adjusted by the DELAY control.

FUNCTION 3 — RANDOM SEEK. Cylinder addresses are generated with a pseudo random sequence provided by the DSU. When the START pushbutton is pressed, the heads seek home then progress through the random sequence. The sequence continues until the STOP pushbutton is pressed or the function is changed. The seek time delay is adjusted by the DELAY control.

FUNCTIONS 4, 5, and 6 — INDEX SEQUENCES. These functions are not used for the HP 7920 Disc Drive.

FUNCTION 7 — HEAD ALIGNMENT. This function is used to align the data heads. The data head offset to be displayed on the meter and digital display are selected by the three toggle switches denoted by H4, H2, and H1. When the START pushbutton is pressed, the heads seek home then seek to track 490. The head offset is displayed in 6.3-microinch units on the meter and digital display.

FUNCTION 8 — MANUAL. This function is used to operate the disc drive manually. Tag bus commands are entered by toggle switches T0 through T3. Head selection is accomplished with switches H4, H2, and H1, and sector is selected using switches labeled S32, S16, S8, S4, S2, and S1. When the START pushbutton is pressed the operation begins. Indicator LED's C0 through C15 display the state of the control bus. The tag bus commands are listed on the front panel of the DSU and described in Section IV, Theory of Operation. Also, the control bus functions are described in Section IV.

5-10. PREVENTIVE MAINTENANCE

Table 5-3 provides preventive maintenance routines for the disc drive. These routines are to be performed every six months. However, if the disc drive is installed in an environment that contains abnormal amounts of dust, smoke, oil vapor, or other foreign matter, the routines should be performed more frequently.

Preliminary steps are included to provide guidelines for preparing the disc drive for service. References are made to Section VIII, Removal and Replacement for any disassembly that is required. In addition to the routines contained in table 5-3, detailed preventive maintenance procedures are also included.

When the preventive maintenance has been completed and the disc drive has been restored to an operating condition, perform an operational checkout using the appropriate diagnostic tests or the off-line checkout given in Section VII, Troubleshooting.

5-11. GENERAL CLEANING INFORMATION

To ensure trouble-free operation, the disc drive should be kept free of unusual amounts of contaminants. When the results of an inspection indicate that excessive amounts of smoke, dust, oil vapor, or other foreign matter is present, a general cleaning is required. Refer to table 5-1 for the appropriate cleaning materials, ensuring that only the specified brands and types are used.

5-12. PRELIMINARY STEPS

Before performing any or all of the preventive maintenance routines given in table 5-3 and in the preventive maintenance procedures, perform the following preliminary steps:

a. Disconnect the ac power cord from the main power source.

b. If necessary, move the disc drive to a convenient working location within the same area.

c. Remove front and rear doors.

d. Remove the side panels and shroud. (Refer to Section VIII, Removal and Replacement.)

Table 5-3. Preventive Maintenance Routines

ITEM	ROUTINE
Absolute Filter and Prefilter	Measure absolute filter output air pressure. Refer to paragraph 5-13. Replace as necessary. (Refer to Section VIII, Removal and Replacement.)
Data and Servo Heads	Inspect for contamination. (Refer to figure 5-7.) Clean as necessary. (Refer to paragraph 5-14.)
Head Cables and Connectors	Inspect for looseness and/or damage. Replace as necessary.
Carriage Rails and Bearings	Clean as required. (Refer to paragraph 5-15.) Inspect bearings for excessive wear and ease of operation.
Spindle and Pack Chamber	Remove all foreign particles and clean as necessary. (Refer to paragraph 5-16.)
Spindle Ground Contact and Spring	Inspect spindle ground contact and spring for excessive wear and/or looseness. Replace as necessary.
Power Supplies	Check all power supply voltage values. (Refer to paragraph 7-3.)
Mainframe Switches and Solenoids	Inspect for proper operation. (Refer to Section VI, Alignment and Adjustment.)
Alignment of all adjustable parameters	Check alignment of all adjustable parameters. If necessary, adjust. (Refer to Section VI, Alignment and Adjustment.)
Indicators	Inspect for proper operation. Replace as necessary. (Refer to Section VIII, Removal and Replacement.)
Pack Lock Lubrication	Perform the pack lock lubrication procedure. (Refer to paragraph 5-14.)

Note: Remove components only to the extent necessary to gain adequate access for servicing.

e. Remove and store disc pack. Ensure that the disc pack is stored in the proper storage container.

f. Proceed with the preventive maintenance procedures.

5-13. SERVICING THE AIR CIRCULATION SYSTEM

Servicing the air circulation system consists of measuring the air pressure at the outlet on the pack loading assembly, and periodic replacement of the prefilter and/or the absolute filter. To measure the absolute filter air pressure proceed as follows:

a. Disconnect the ac power cord from the ac mains power and then remove the shroud. (Refer to Section VIII, Removal and Replacement.)

b. Connect the power panel assembly power cord to a source of ac power.

c. Set the power distribution unit circuit breaker to ON and the disc drive DISC switch to the on position.

d. Install a scratch pack and close the pack chamber door.

e. On the disc drive, set the RUN/STOP switch to RUN and wait until the heads load.

f. Using the air pressure measuring gauge with the air pressure probe assembly, place the probe over the air pressure outlet. (See figure 5-5).

g. Observe the air pressure. Check that the air pressure is equal to or greater than the minimum acceptable limits given in substeps (1) or (2). Substep (1) applies to an absolute air filter with part number 3150-0340 and substep (2) applies to an absolute filter with part number 3150-0276. he part number is on a label on the front of the absolute filter.

(1) For absolute filters with part number 3150-0340, the minimum acceptable limits are:

LINE FREQUENCY (Hz)	NORMAL OPERATION (Inches of water)	MINIMUM ACCEPTABLE LIMITS (Inches of water)
50	> 0.45	0.45
60	> 0.45	0.45

(2) For absolute filters with part number 3150-0276, the minimum acceptable limits are:

LINE FREQUENCY (Hz)	NORMAL OPERATION (Inches of water)	MINIMUM ACCEPTABLE LIMITS (Inches of water)
50	> 0.60	0.60
60	> 0.60	0.60

Note: Meter may peg with filter is new.

h. Set RUN/STOP switch to STOP, DISC switch and circuit breaker to OFF, and disconnect power cord from source of ac power.

i. If observed air pressure is less than minimum acceptable limits, remove and inspect the prefilter.

j. If the prefilter is dirty, replace the prefilter. (Ensure that the prefilter airflow direction arrow is facing in the proper direction.)

k. After replacing the prefilter, remeasure the air pressure.

l. If the air pressure remains below acceptable limits after the prefilter has been replaced, replace the absolute filter. (Refer to Section VIII, Removal and Replacement.)

m. Replace the shroud.

5-14. PACK LOCK LUBRICATION

Pack lock (2, figure 9-5) lubrication is performed at every preventive maintenance interval. The pack lock lubrication tool (part no. 07920-20086) and the lubricant (part no. 6040-0084) are required to perform this procedure.

WARNING

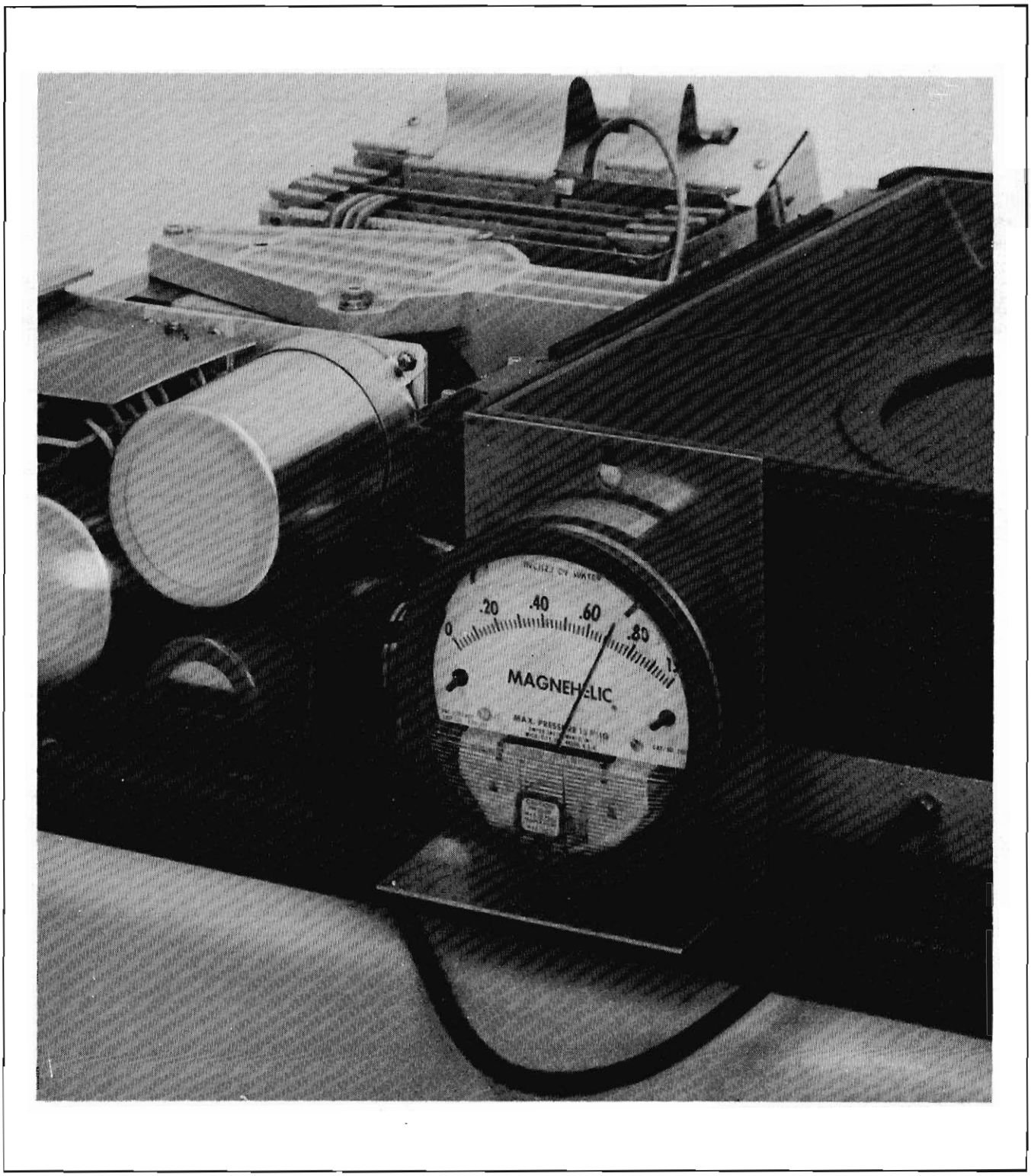
The lubricant (part no. 6040-0084) used in this procedure can cause painful eye irritation upon contact and for some people skin inflammation (dermatitis). When using this lubricant, hand protection (latex gloves) should be worn and care should be taken to keep the lubricant away from eye tissue.

Note: If the lubricant (part no. 6040-0084) gets on the skin, a waterless hand cleaner is recommended to remove the lubricant.

a. If the disc drive is operating, set the RUN/STOP switch to STOP.

b. Allow the spindle to halt (approximately 30 seconds). The DOOR UNLOCKED indicator will light, which means that the spindle has stopped rotating, the door unlock solenoid is energized, and it is safe to open the pack chamber door.

c. Remove and store the disc pack. Be sure to leave the pack chamber door open.



7301-14A Figure 5-5. Measuring Absolute Filter Air Pressure

d. Disconnect the ac power cord from the ac mains power.

e. Use a Q-tip to remove any old lubricant in the pack lock that is not on the threads.

f. Apply the lubricant (part no. 6040-0084) to the pack lock lubrication tool. The lubricant should be applied to fill all the threads flush to the top of the thread. (Refer to figure 5-5A). Use a Kimwipe tissue to remove all excess lubricant from the threads. Use a Q-tip to remove any lubricant from the clearance hole in the pack lock lubrication tool.

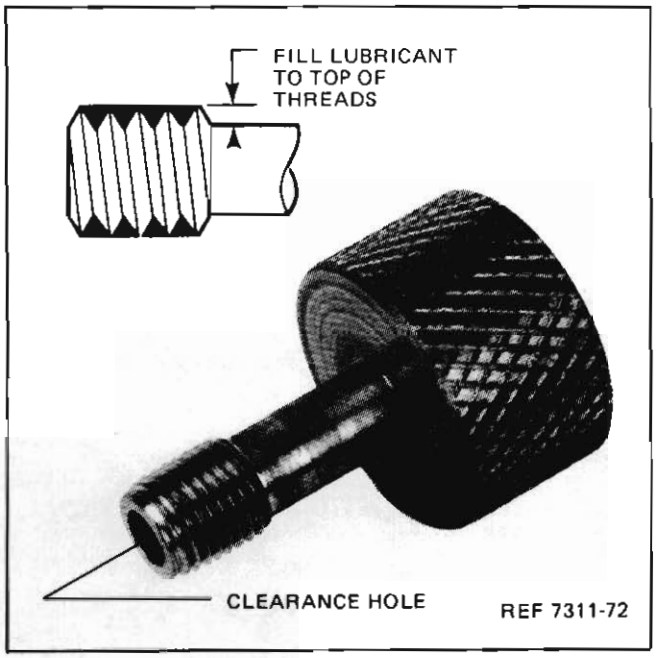


Figure 5-5A. Pack Lock Lubrication Tool

g. While applying a slight upward pull on the tool, screw the pack lock lubrication tool into and out of the pack lock three times. Applying a slight upward pull insures the lubricant is applied where it is needed.

h. Clean the lubricant from the pack lock lubrication tool with a Kimwipe tissue.

i. Use a Q-tip to remove any lubricant in the pack lock that is not on the threads.

j. Use a Q-tip to apply a light coat of lubricant on the top of the release pin in the pack lock.

k. Clean the pack chamber and the top of the spindle as outlined in paragraph 5-17.

l. Reconnect the ac power cord to the ac mains power and close the pack chamber door.

5-15. CLEANING DATA AND SERVO HEADS

When inspection reveals contamination on the data and servo heads (see figure 5-7), clean as follows:

a. Fold Kimwipe tissue into a rectangle (approximately 1 by 5 inches) and wrap it over the edge of the head cleaning tool. (See figure 5-6.) Use an elastic band to secure the tissue to the tool.

b. Dampen the tissue with filtered 91-percent isopropyl alcohol.

CAUTION

Avoid applying excessive pressure to the gimbal area of the head while cleaning. Excessive pressure may alter the flying attitude of the head which was precision set at the factory.

c. Clean each head by placing the tissue covered tool between the surfaces, then gently wipe the head face. Use only sufficient pressure to thoroughly wet the head and remove contamination.

d. Replace the Kimwipe tissue on the head cleaning tool with a clean dry Kimwipe tissue. Fold and attach the tissue to the head cleaning tool as described in step a.

e. Carefully remove any remaining contamination from the head surfaces.

CAUTION

Never place an inspection mirror between the heads or allow the mirror to touch the heads. The head flying attitude may be altered or damaged.

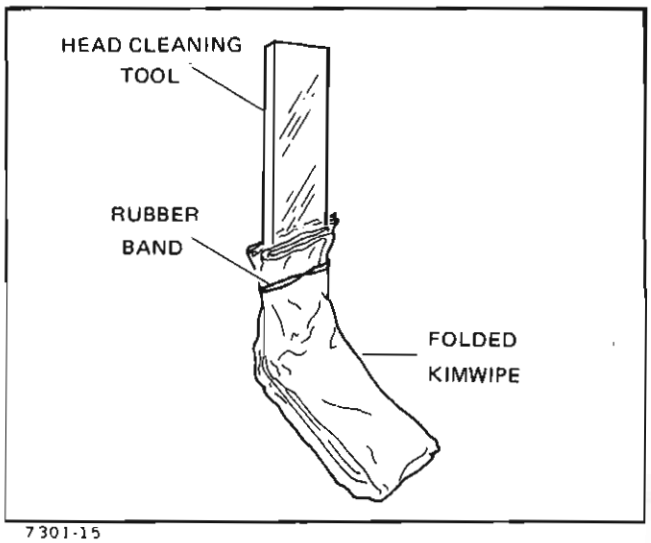


Figure 5-6. Prepared Head Cleaning Tool

f. Using an inspection mirror, verify that all signs of contamination have been removed. If the contamination cannot be removed, replace the head. (Refer to Section VIII, Removal and Replacement.)

5-16. CLEANING CARRIAGE RAILS AND BEARINGS

To clean the carriage rails and bearings, use Q-tips slightly dampened with filtered 91-percent isopropyl alcohol. Wipe the rails and bearing surfaces clean, ensuring that alcohol is not applied to the bearing lubrication pack.

5-17. CLEANING THE SPINDLE ASSEMBLY AND THE PACK CHAMBER

To clean the spindle assembly and pack chamber, proceed as follows:

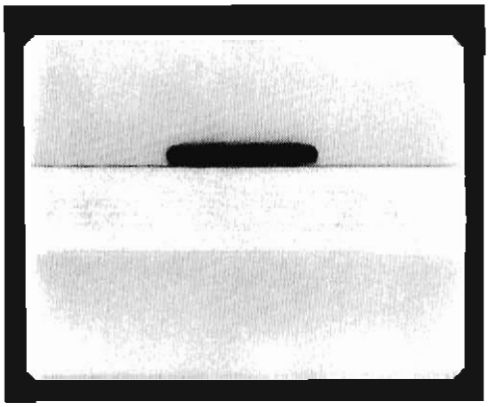
CAUTION

Exercise care to ensure that masking tape adhesive is not left on any surfaces. Residue adhesive will allow contamination to accumulate.

a. Using masking tape, lightly apply adhesive side of tape to all exposed surfaces of the spindle to remove foreign matter.

b. Using a Kimwipe dampened with 91-percent isopropyl alcohol, wipe clean the spindle assembly.

c. Using masking tape, lightly press adhesive side of tape to all exposed surfaces of pack chamber and door. Then wipe clean with a Kimwipe tissue slightly dampened with filtered 91-percent isopropyl alcohol.



TYPE OF CONTAMINATION:

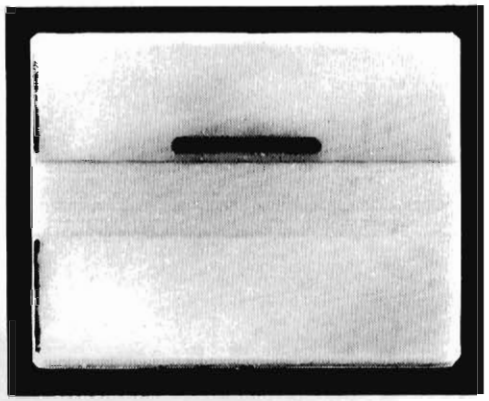
NONE, IDEAL HEAD CONDITION.

CAUSE:

NEW HEAD OR MINIMAL OPERATION IN A CLEAN ENVIRONMENT.

REMEDY:

NONE.



TYPE OF CONTAMINATION:

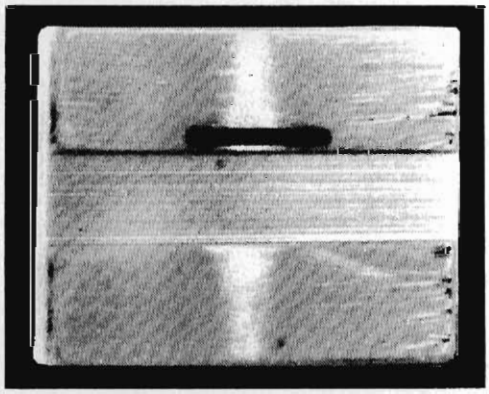
OXIDE BUILDUP ON TRAILING EDGE (DOWN HEAD SHOWN). TYPICAL OPERATING CONDITION.

CAUSE:

NEW MEDIA OR MANY HOURS OF OPERATION.

REMEDY:

CLEAN AS OUTLINED IN PARAGRAPH 5-15.



TYPE OF CONTAMINATION:

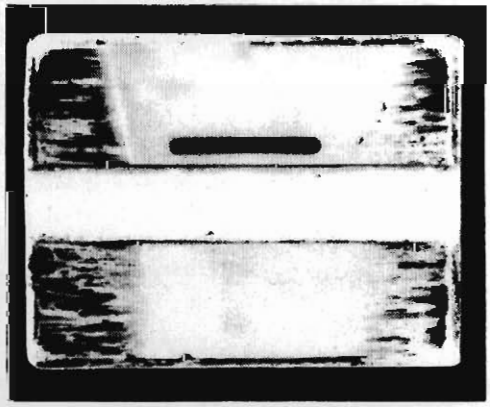
ABRASION AND PARTICULATE.

CAUSE:

MEDIA IS ABRASIVE OR EXCESSIVE MECHANICAL RUNOUT EXISTS.

REMEDY:

REPLACE DEFECTIVE HEAD AS OUTLINED IN PARAGRAPH 8-18. A DELAY IS PERMISSIBLE, IF WIDTH OF ABRASION IS LESS THAN 0.13-cm (0.05-in.)



TYPE OF CONTAMINATION:

ABRASION AND PARTICULATE.

CAUSE :

EXCESSIVE OPERATION ON ABRASIVE MEDIA. AIR FLOW RESTRICTED AND/OR CONTAMINANTS PRESENT IN AIR CIRCULATION

REMEDY:

REPLACE DEFECTIVE HEAD AS OUTLINED IN PARAGRAPH 8-18. REPLACE MEDIA. CHECK ABSOLUTE FILTER SEAL AND MEASURE ABSOLUTE FILTER OUTPUT AIR PRESSURE AS OUTLINED IN PARAGRAPH 5-13.

7300-12(1) THRU (4) A

Figure 5-7. Examples of Head Contamination

ALIGNMENT AND ADJUSTMENT

SECTION VI

6-1. INTRODUCTION

WARNING

This disc drive does not contain operator-serviceable parts. To prevent electrical shock, refer all installation and maintenance activities to service-trained personnel.

This section contains step-by-step alignment procedures for the disc drive. The procedures are divided into two categories; the first category is devoted to the alignment and adjustment procedures that do not require the use of the disc service unit (DSU) and the second category covers the procedures that require the use of the DSU. Alignment and adjustment procedures are to be performed only after a repair has been made, or when specified parameters are out of tolerance. Do not perform any adjustment unless necessary.

6-2. SERVICE ADJUSTMENTS NOT REQUIRING THE DSU

The switches, solenoids, and carriage latch and detector assembly are the only components and assemblies that do not require the use of the DSU for adjustment.

6-3. DOOR LOCK ASSEMBLY

WARNING

To avoid dangerous electrical shock, do not perform the following procedure until the mains power is removed from the disc drive.

The door lock assembly consists of the door unlock solenoid, the door closed switch, and the door locked switch, all of which are mounted on a single frame. If a component on this assembly fails, the entire assembly is replaced from the service kit and the defective assembly is repaired after the disc drive has been restored to operation. Normally, the switches and solenoid are not adjustable, however, it is possible to position the switches and solenoid slightly after replacement. Paragraphs 6-4 and 6-5 describe the methods for adjusting the switches and solenoid.

6-4. DOOR UNLOCK SOLENOID. Be sure to remove the ac power from the disc drive when performing this procedure.The door unlock solenoid electromechanically latches or unlatches the pack chamber door. When the solenoid is replaced, ensure that the latch lever, which is connected to the solenoid, operates freely. Manually operate the solenoid to determine if any physical binding is present. If the lever is binding, loosen the two screws that secure the solenoid and position the solenoid to gain free operation of the latch lever. Then tighten the solenoid screws.

6-5. DOOR CLOSED AND DOOR LOCKED SWITCHES. The function of the door closed switch (19, figure 9-4 or figure 9-4A) is to detect a door closed condition. To check or adjust the door closed switch after replacement, proceed as follows:

a. Disconnect the ac power cord from the ac mains power.

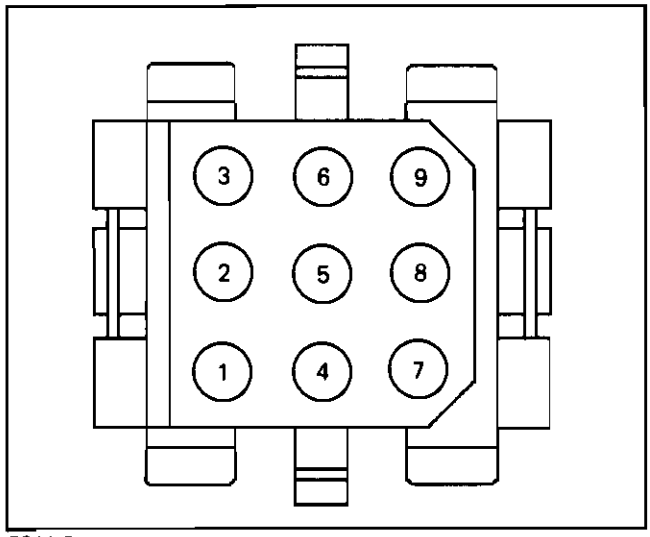
b. Remove the shroud. (Refer to paragraph 8-3.)

c. Disconnect the cable attached to the connector assembly (30).

d. Using an ohmmeter, measure the resistance between pins 5 and 6 on the connector assembly (refer to figure 6-1).

e. Close the pack chamber door. An open circuit condition (infinite resistance) should be detected by the ohmmeter.

f. Open the pack chamber door by pushing down on the latch lever (11). A short circuit condition (zero resistance) should be detected by the ohmmeter.



7311-2

Figure 6-1. Connector Assembly

g. If the above checks are not correct, the switch must be adjusted as described in step h. If the above checks are correct, the switch is properly adjusted. Proceed to step i.

h. Loosen the two screws (20) which secure the switch and reposition the switch. Repeat steps d through g.

i. Attach the cable to the connector assembly, replace the shroud, and restore the ac power.

The door locked switch (14, figure 9-4 or figure 9-4A) detects whether the door unlock solenoid (13) has locked or unlocked the pack chamber door. When the solenoid is energized, the door should be unlocked and the switch closed. To check or adjust the door locked switch after replacement, proceed as follows:

a. Disconnect the ac power cord from the ac mains power.

b. Remove the shroud. (Refer to paragraph 8-3.)

c. Disconnect the cable attached to the connector assembly (30).

d. Using an ohmmeter, measure the resistance between pins 1 and 2 on the connector assembly (refer to figure 6-1).

e. Close the pack chamber door. An open circuit condition (infinite resistance) should be detected by the ohmmeter.

f. Push down on the latch lever (11). A short circuit condition (zero resistance) should be detected by the ohmmeter.

g. If the above checks are not correct, the switch must be adjusted as described in step h. If the above checks are correct, the switch is properly adjusted. Proceed to step i.

h. Loosen the two screws (15) which secure the switch and reposition the switch. Repeat steps d through g.

i. Attach the cable to the connector assembly, replace the shroud, and restore the ac power.

6-6. CARRIAGE LATCH AND DETECTOR ASSEMBLY

The carriage latch and detector assembly requires adjustment only if the assembly has been replaced. To adjust the carriage latch and detector assembly, proceed as follows:

a. Remove the power cord from the ac mains power.

b. Loosen the two retaining screws securing the assembly to the face of the actuator assembly.

c. Position the assembly so that the carriage-back flag on the coil and carriage assembly travels through the approximate center of the photoswitch light path, ensuring that there is no contact between components.

d. Tighten the retaining screws.

CAUTION

To avoid damage to the disc drive, do not move the carriage out more than 1.3 cm (0.5 in.).

e. Check the latching action by pressing in the solenoid plunger and slightly pulling out the carriage. Then press in the carriage and latch the assembly. Ensure that the latching action is smooth. Connect the power cord to the ac mains power.

6-6A. HEAD CAM ALIGNMENT

The head cam alignment procedure is performed whenever a head cam or head cam support is replaced. To adjust the head cams, proceed as follows:

a. Remove the power cord from the ac mains power.

b. Install the head cam alignment tool, part no. 13354-60001, on the spindle hub. (See figure 6-1A.) Ensure that the head cams mate with the head cam alignment tool.

c. If the head cams require adjustment, perform substeps (1) through (3), otherwise proceed to step d.

(1) Loosen the two screws (12, figure 9-7) on the two head cams (11).

(2) Adjust the head cams to position with the head cam alignment tool. (See figure 6-1B.)

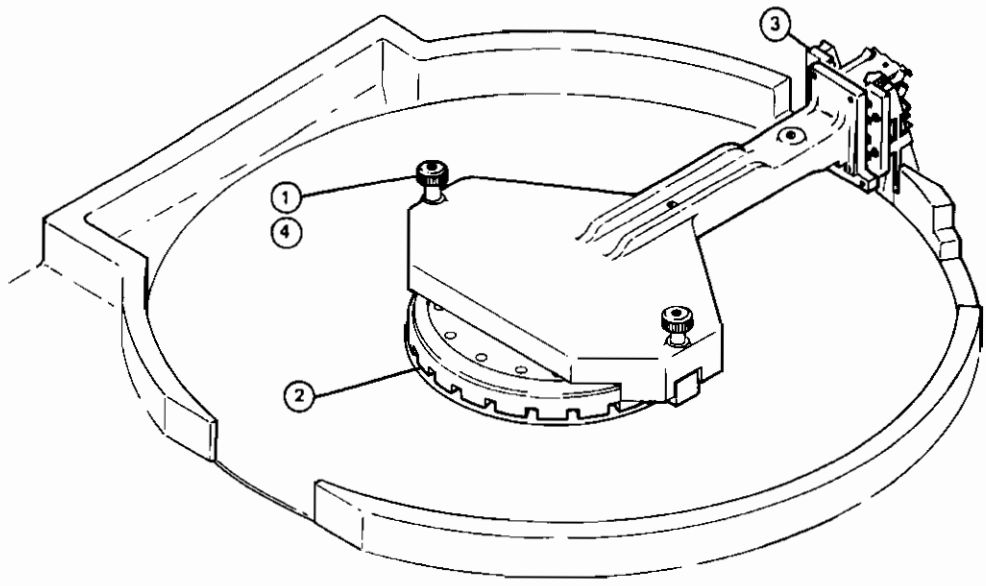
(3) Torque the head cam securing screws (12) to 7 inch-pounds.

d. Remove the head cam alignment tool.

e. Restore ac power to the disc drive.

6-7. SERVICE ADJUSTMENTS REQUIRING THE DSU

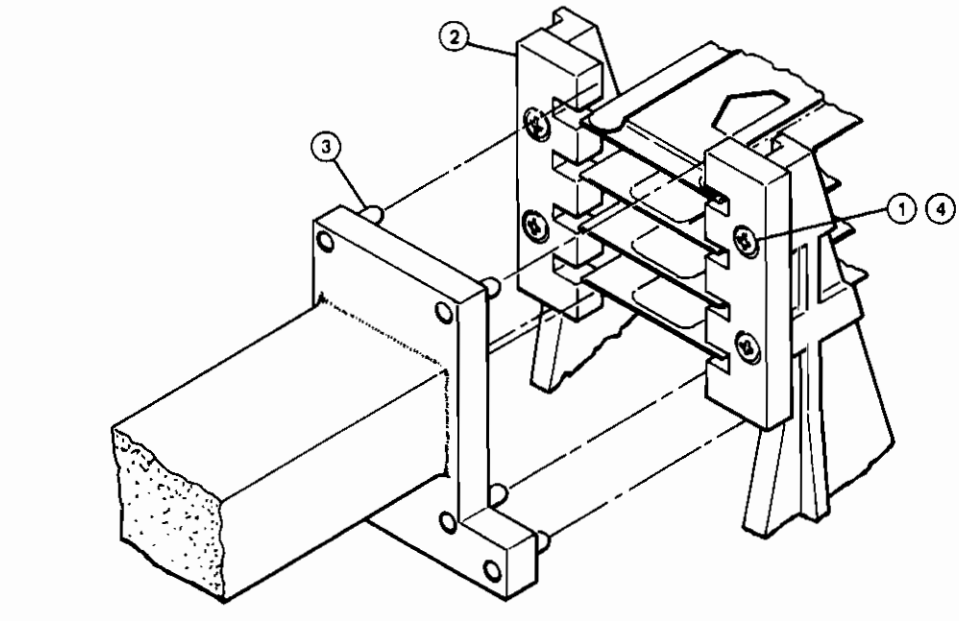
The DSU is required to perform the velocity command gain adjustment and data head alignment. An installation procedure for the DSU, an exercising procedure for the disc drive, and all alignment and adjustment procedures which require the use of the DSU are provided in the following paragraphs.



INSTRUCTIONS

1. LOOSEN KNURLED SCREWS
2. SLIDE ALIGNMENT TOOL ONTO SPINDLE HUB
3. ENSURE THAT ALIGNMENT TOOL BUTTS UP AGAINST CAMS
4. SECURE ALIGNMENT TOOL ON SPINDLE HUB, USING KNURLED SCREW

Figure 6-1A. Use of Head Cam Alignment Tool



INSTRUCTIONS

1. LOOSEN FOUR HEAD CAM SCREWS
2. SEAT HEAD CAMS AGAINST SIX ALIGNMENT TOOL PINS 3
3. TIGHTEN HEAD CAM SCREWS

Figure 6-1B. Head Cam Tool Alignment

6-8. INSTALLING THE DSU

WARNING

Adjustments requiring the DSU are performed with power supplied to the disc drive, and protective covers removed. Such maintenance should be performed only by service-trained personnel who are aware of the hazards involved (for example, fire and electrical shock).

To install the DSU, proceed as follows:

a. Disconnect the ac power cord from the ac mains power.

b. Remove the shroud from the disc drive enclosure.

c. Loosen the screw that secures the PCA retainer to the card cage and remove the retainer.

d. Disconnect the interconnect cable from J1 on I/O sector PCA-A2.

e. Insert head alignment PCA, part no. 13354-60010, into card slot A1. (See figure 6-2.) Ensure that the PCA is correctly oriented, then firmly seat the PCA in the receptacle. The component side of the PCA must face toward the right side of the card cage as viewed from the front.

f. Hang the DSU Test Module, part no. 13354-60005, on the top outer edge of the card cage.

g. Connect the 50-pin jumper cable, part no. 13354-60012, between the 50-pin connector on the DSU and J1 on I/O sector PCA-A2.

h. Connect the 20-pin jumper cable, part no. 13354-60013, between the 20-pin connector on the DSU and the 20-pin connector on the head alignment PCA.

CAUTION

Do not plug or unplug any cables from the data heads to read/write preamplifier PCA-A6 or from the servo head to track follower PCA-A5 or from the head alignment PCA to read/write preamplifier PCA-A6 while the heads are loaded. Incorrect information can be written on the disc.

i. Connect the head cable connector from the head alignment PCA to the head connector located at the top of read/write preamplifier PCA-A6.

j. Connect the primary power cord to the ac mains power.

6-9. EXERCISING THE DISC DRIVE

After the DSU has been installed, the disc drive should be exercised to relax any mechanical stresses. This is particularly important when one of the mechanical assemblies has been replaced. To exercise the disc drive, proceed as follows:

a. Install the DSU as outlined in paragraph 6-8.

b. Set the RUN/STOP switch to STOP and the DISC switch to the on position.

c. Install a scratch pack in the pack chamber.

d. On the disc drive, set the RUN/STOP switch to RUN. Set the unit select switch to 0 (zero).

e. On the DSU, set the FUNCTION switch to position 3 (RANDOM SEEK).

f. On the DSU, rotate the DELAY potentiometer fully clockwise to MAX.

Note: With the DELAY potentiometer set to MAX, a maximum delay between seek operations is introduced.

g. On the DSU, press the START pushbutton and allow the disc drive to perform a series of random seek operations.

h. After several seek operations have been performed, rotate the DELAY potentiometer fully counterclockwise to MIN.

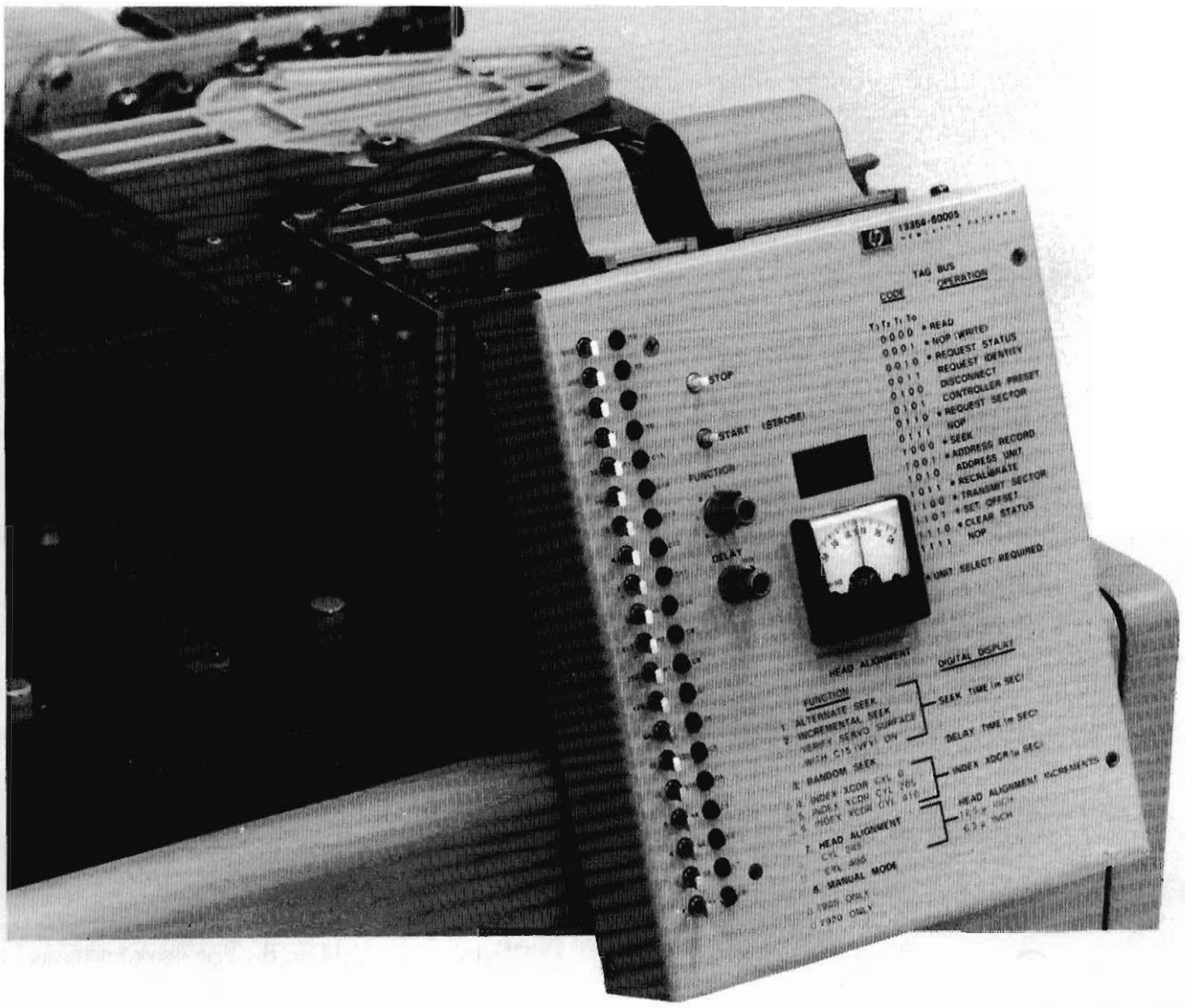
Note: With the DELAY potentiometer set to MIN, a minimum delay between seek operations is introduced.

i. If one of the assemblies has been replaced, allow the disc drive to run for at least one minute, otherwise allow the drive to run for at least 5 seconds.

j. On the DSU, press the STOP pushbutton.

6-10. VELOCITY COMMAND GAIN ADJUSTMENT

The only electrical adjustment requiring the use of the DSU is the velocity command gain adjustment. To perform this adjustment, proceed as follows:



7301-16

Figure 6-2. DSU Installed

WARNING

The following adjustments are performed with power supplied to the disc drive, and protective covers removed. Such maintenance should be performed only by service-trained personnel who are aware of the hazards involved (for example, fire and electrical shock).

a. Remove the terminal block cover on the power supply.

b. Using an HP 970 Digital Voltmeter (or equivalent battery-operated voltmeter, for isolation from AC ground paths), measure the voltage across terminals 1 and 4 on TB1 of the power supply (refer to figures 2-2 and 2-3). Also note the power supply strapping by comparing the strapping on TB1 with the strapping shown in figures 2-2 and 2-3. These measurements will be used to determine the seek time adjustment range.

c. Exercise the disc drive as outlined in paragraph 6-9.

d. On the DSU, set the FUNCTION switch to position 1 (ALTERNATE SEEK).

e. On the DSU, select cylinder address 0 on the top ten switches (all 10 switches set to the left).

f. With the lower bank of switches, select cylinder address 822 (switches 512, 256, 32, 16, 4, and 2 set to the right).

g. On the DSU, press the START pushbutton and allow the disc drive to alternately seek between cylinders 0 and 822.

h. On the DSU, rotate the DELAY potentiometer until the seek time from cylinder 0 to cylinder 822 (forward seek operation) can be differentiated from the seek time from cylinder 822 to cylinder 0 (reverse seek operation).

Note: The two seek times will probably be different.

i. For both forward and reverse seek operations, observe the digital displays to ensure that the seek time is in the range specified in the following table and that the deviation between forward and reverse seek times is 1.5 milliseconds or less. Use the values measured in step b to determine the proper seek time range.

STRAPPING OF THE POWER SUPPLY (Vac)	LINE VOLTAGE (Vac, as measured in step b)	SEEK TIME RANGE (milliseconds)
100	90 to 95	44.0 to 47.0
	96 to 100	43.5 to 46.5
	101 to 105	43.0 to 46.0
120	108 to 110	44.0 to 47.0
	111 to 115	43.0 to 46.0
	116 to 120	42.5 to 45.5
	121 to 126	42.0 to 45.0
220	198 to 200	44.5 to 47.5
	201 to 210	43.5 to 46.5
	211 to 220	43.0 to 46.0
	221 to 230	42.2 to 45.5
240	216 to 220	44.0 to 47.0
	221 to 230	43.0 to 46.0
	231 to 240	42.5 to 45.5
	241 to 252	42.0 to 45.0

Note: The seek time adjustment is set for the best overall operation of the disc drive and this time setting will vary for each disc drive. The best operation of the disc drive does not necessarily mean the shortest seek time. If necessary, adjust VC GAIN potentiometer A3R33 on servo PCA-A3 until the values are within the specified range.

j. On the DSU, press the STOP pushbutton.

k. On the disc drive, set the RUN/STOP switch to STOP.

l. Replace the terminal block cover on the power supply.

m. Remove the DSU and the head alignment PCA from the disc drive and then replace all cables removed during the DSU installation.

n. Replace the shroud on the disc drive enclosure.

6-11. HEAD ALIGNMENT PROCEDURES

The head alignment procedures include the servo head alignment, data head alignment, and data head alignment check. Also, a warmup procedure is included which must be performed before the alignment procedures or the alignment check can be performed. (See figure 6-3 for head alignment locations.)

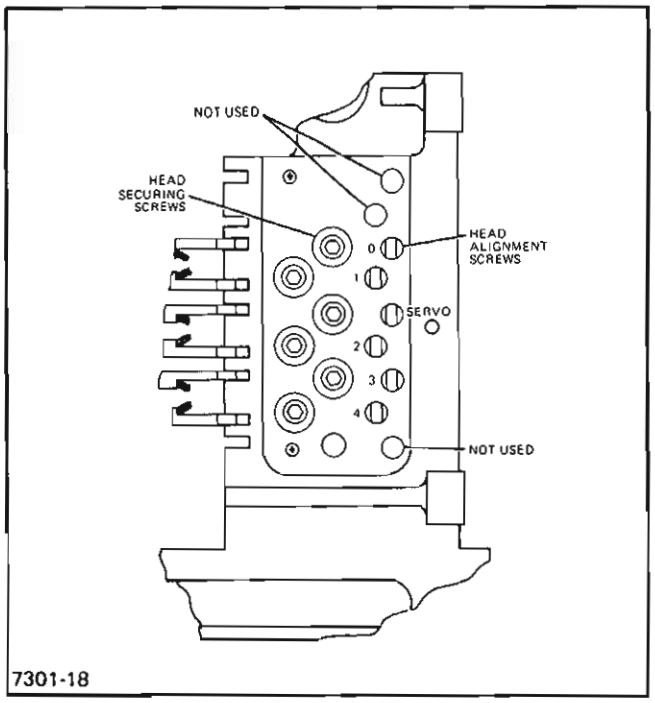


Figure 6-3. Data Head Alignment Locations (Original Equipment actuators for disc drives with serial prefix 1844 and prior)

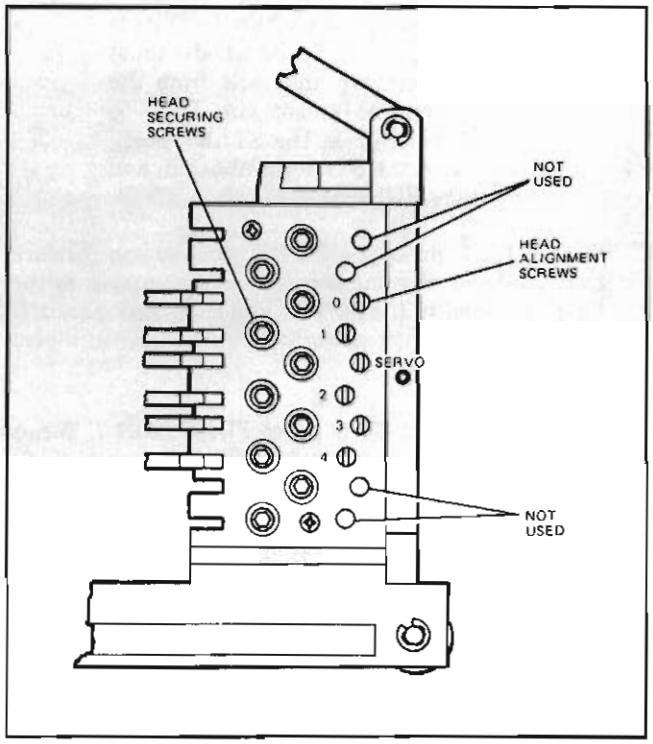


Figure 6-3A. Data Head Alignment Locations (For Actuator P/N 07920-60097)

The servo head alignment procedure should be performed only when necessary. After the servo head has been aligned, the data heads must be checked for alignment, and aligned as necessary. Do not attempt to align the data heads unless the servo head has been replaced, one or more data heads have been replaced, or the data head alignment check reveals that a head is out of the allowable tolerance.

6-12. WARMUP. The warmup is performed to allow for temperature stablization before proceeding with head alignment or head alignment check. To perform the warmup, proceed as follows:

a. Install the DSU as outlined in paragraph 6-8.

b. Install the HP 7920 CE Disc Pack in the disc drive.

c. On the disc drive, set the READ ONLY switch to the protected position (•), the unit select switch to 0 (zero), and the RUN/STOP switch to RUN.

d. Set the DSU to function 3 and rotate the DELAY control to a position near MIN. Press the START pushbutton and allow the disc drive to perform random seek operations for 5 minutes.

e. Set the DSU to function 7 and press the START pushbutton. Allow the disc drive heads to remain positioned at cylinder 490 for 15 minutes before proceeding.

Note: Do not stop the spindle while the DSU is set to FUNCTION 7. If the spindle must be stopped, remove any tools from the actuator assembly; set the DSU to FUNCTION 1; press the START pushbutton, then the STOP pushbutton; and then set the RUN/STOP switch to STOP.

Note: When the DSU is set to function 7 and the START pushbutton is pressed, ensure the meter pointer moves to the far right, then to the far left, and then back again. If the meter does not act as described, perform the servo head alignment. The time required for this cycle is 5 seconds. This operation is referred to as the 5-second cycle throughout the alignment procedures.

6-13. SERVO HEAD ALIGNMENT. The servo head normally requires alignment only after replacement. To align the servo head, proceed as follows:

WARNING

Do not use any tools on the carriage assembly while the heads are loaded unless the DSU has just performed a function 7 operation and the 5-second DSU head alignment cycle time is completed. This precaution is necessary to prevent the carriage from emergency retracting and damaging tools, or possibly causing injury to personnel.

a. Perform the warmup procedure outlined in paragraph 6-12.

b. On the DSU, set the FUNCTION switch to position 7.

Note: Do not stop the spindle while the DSU is set to FUNCTION 7. If the spindle must be stopped, remove any tools from the actuator assembly; set the DSU to FUNCTION 1; press the START pushbutton, then the STOP pushbutton; and then set the RUN/STOP switch to STOP.

c. Torque the servo head to 5 inch-pounds.

d. On the DSU, set the FUNCTION switch to position 1 (ALTERNATE SEEK).

e. On the DSU, select cylinder address 822 on the upper bank of ten switches (switches 512, 256, 32, 16, 4, and 2 set to the right).

f. On the DSU, select cylinder address 896 (illegal address) on the lower bank of switches (switches 512, 256, and 128 set to the right).

g. Press the START pushbutton on the DSU. The heads will go to cylinder 822 and remain at 822.

h. Check the clearance, shown in figure 6-4, between the upper crash stop and the upper part of the carriage assembly to ensure it is approximately 0.051 cm (0.020 in.). If the clearance is not correct, perform step i, otherwise proceed to step k.

i. On the DSU, set the FUNCTION switch to position 7.

Note: Do not stop the spindle while the DSU is set to FUNCTION 7. If the spindle must be stopped, remove any tools from the actuator assembly; set the DSU to FUNCTION 1; press the START pushbutton, then the STOP pushbutton; and then set the RUN/STOP switch to STOP.

j. Insert the head alignment tool into the servo head alignment hole (see figure 6-3) with the "L-shaped" handle end pointing upward. Adjust the head position to obtain the clearance shown in figure 6-4. Rotate the tool counterclockwise for more clearance, and clockwise for less clearance. Repeat steps d through h.

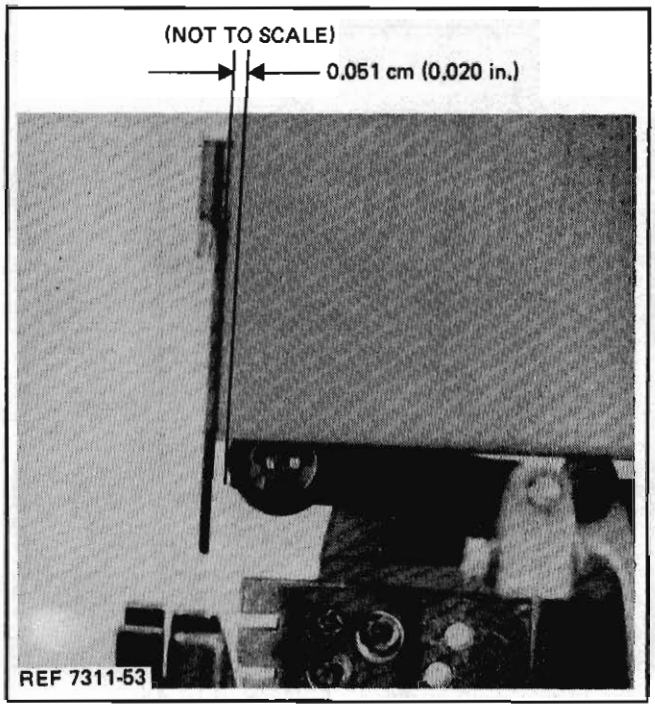


Figure 6-4. Actuator Crash Stop Clearance

k. On the DSU, set the FUNCTION switch to position 7.

Note: Do not stop the spindle while the DSU is set to FUNCTION 7. If the spindle must be stopped, remove any tools from the actuator assembly; set the DSU to FUNCTION 1; press the START pushbutton, then the STOP pushbutton; and then set the RUN/STOP switch to STOP.

l. On the DSU, press the START pushbutton. Ensure that the head alignment meter pointer moves to the far right, then to the far left, and then back again. If the pointer does not perform as stated above, repeat steps d through l.

m. Ensure that the DSU is set to FUNCTION 7. Torque the servo head to 7.5 inch-pounds and repeat steps d through l and then proceed to step n.

n. Perform the data head alignment check.

6-14. DATA HEAD ALIGNMENT CHECK. The data head alignment check may be performed independent of the alignment procedures to verify whether any or all data heads are within tolerance. If any data head is out of tolerance, perform the data head alignment procedure. To check data head alignment, proceed as follows:

a. Perform the warmup procedure outlined in paragraph 6-12.

b. On the DSU, select the data head to be checked using the binary combination of toggle switches H4, H2, and H1.

c. Set the FUNCTION switch to position 7, press the START pushbutton, and wait for the completion of the 5-second cycle.

Note: Do not stop the spindle while the DSU is set to FUNCTION 7. If the spindle must be stopped, remove any tools from the actuator assembly; set the DSU to FUNCTION 1; press the START pushbutton, then the STOP pushbutton; and then set the RUN/STOP switch to STOP.

d. Verify that the head alignment is within a reading of ±5 on the HEAD ALIGNMENT meter.

e. Repeat steps b through d for each data head to be checked.

f. Perform the data head alignment procedure for each data head that is out of tolerance.

g. After this procedure is completed and all tools have been removed from the actuator assembly, set the DSU to FUNCTION 1.

h. On the DSU, press the START pushbutton and then press the STOP pushbutton. Set the RUN/STOP switch to STOP.

6-15. DATA HEAD ALIGNMENT. The data head alignment procedure should be performed when a servo head has been replaced, a data head has been replaced, or when the data head alignment check reveals that a data head is out of tolerance. To align a data head, proceed as follows:

CAUTION

Do not insert the head alignment tool into the servo head adjustment hole, which is the third from the top (see figure 6-3), otherwise all data heads will require realignment.

a. Perform the warmup procedure outlined in paragraph 6-12.

b. On the DSU, set the FUNCTION switch to position 7 and press the START pushbutton. After the 5-second cycle is complete, torque all data heads to be aligned to 5 inch-pounds.

Note: Do not stop the spindle while the DSU is set to FUNCTION 7. If the spindle must be stopped, remove any tools from the actuator assembly; set the DSU to FUNCTION 1; press the START pushbutton, then the STOP pushbutton; and then set the RUN/STOP switch to STOP.

c. Select the data head to be aligned using the binary combination of toggle switches H4, H2, and H1. Press the START pushbutton and wait for the completion of the 5-second cycle.

d. Insert the head alignment tool, with the "L-shaped" handle end pointing upward, into the data head alignment hole and adjust the head until the meter deflection is between a reading of −10 and +10 units. Remove the alignment tool. (Note that the tool pointer and meter pointer move in the same direction.)

e. Torque the data head to 7.5 inch-pounds.

f. Insert the alignment tool and carefully adjust the data head for a reading of 0.0 ±1 on the HEAD ALIGNMENT meter. Remove the alignment tool.

g. Press the START pushbutton and wait for the 5-second cycle to complete. The display and meter should read the same as that given in step f.

h. Repeat steps c through g for each data head to be aligned, using the binary combination of toggle switches H4, H2, and H1.

i. Set the FUNCTION switch to position 3, rotate the DELAY control to a position near MIN, and press the START pushbutton. Allow the disc drive to random seek for 2 minutes.

j. Verify that head alignment is within ±2 increments of zero on the digital display (a reading of ±2 on the HEAD ALIGNMENT meter).

k. If a head is out of tolerance, repeat steps e through j.

l. Repeat steps i and j for each data head.

6-16. ON-LINE CHECKOUT

When all adjustments have been completed, remove the CE disc pack. Disconnect the ac power cord from the ac mains power. Remove the DSU, head alignment PCA, and related cabling. Reconnect the cabling disconnected prior to alignment, replace the shroud, and apply ac power. Perform an on-line checkout in accordance with diagnostic tests supplied with the system.

TROUBLESHOOTING

WARNING

This disc drive does not contain operator-serviceable parts. To prevent electrical shock, refer all installaiton and maintenance activities to service-trained personnel.

This section contains information useful for troubleshooting the HP 7920 Disc Drive. Included are functional diagrams, troubleshooting flowcharts, wiring diagrams, and test waveforms. The information provided is for the isolation of malfunctions within the drive and not for equipment external to the drive.

7-1. DIAGNOSTIC TEST PROGRAMS

Diagnostic test programs, for use with Hewlett-Packard systems containing disc drives, are available from Hewlett-Packard. It is recommended that the user of an HP 7920 Disc Drive installed in a non-HP system have available a diagnostic test program with capabilities similar to those offered by Hewlett-Packard.

An HP-generated diagnostic tests the system devices which are associated with disc drive operation. In addition to this testing capability, the diagnostic can also be used to isolate a group of circuits within the drive as the possible cause of a malfunction. These include the read/write circuits, the head positioning circuits, and the head and sector storage circuits. It should be noted that the diagnostic is the only readily available means by which the user can check the ability of the read/write circuits to write data on the disc surfaces, read it back from the disc surfaces, and store and retain the data. The disc service unit (DSU) will not issue a write command and does not check data generated by the drive in response to a read command.

The diagnostic is also able to determine the status of the drive (drive busy, not ready, seek check, first status, and attention). It also monitors the on/off status of the DRIVE FAULT indicator (fault).

The diagnostic can also be employed to detect patterns exhibited by intermittent errors. This may be done by running the diagnostic continuously over a period of time and checking for the conditions present at each occurrence of the error.

Detailed operating instructions for HP-supplied diagnostic test programs are contained in the documentation delivered with the software.

7-2. TROUBLESHOOTING FLOWCHARTS

If a malfunction can be associated with a certain circuit through knowledge of the drive, the service-trained user can go directly to the appropriate troubleshooting flowchart (figures 7-2 through 7-21) and following the instructions given, attempt to remedy the fault. Visual indication of the drive status, as described in table 7-1 is intended to aid in isolating the malfunction to a particular area of the drive. If the malfunction cannot be located in this manner, carry out the procedure described in the power-up flowchart (figure 7-1). Failing this, the diagnostic test program should be used to isolate the fault. It should be noted that the power-up flowchart checks, in general, operation of the blower, power sources, door lock circuits, spindle rotating circuits, and head positioning circuits. The diagnostic test program, on the other hand, checks operation of the I/O control circuits, read/write circuits, sector sensing circuits, and the portions of the head positioning circuits that seek to a cylinder addressed by the disc controller.

7-3. POWER SOURCES

The troubleshooting procedures in this section assume that all power sources in the drive are within tolerance. If they are not, the cause of the trouble will be apparent (IL LED indicator lit). If the +5 Vdc power source exceeds approximately +5.6 Vdc, a crowbar circuit on PCA-A7 disables the 5-volt supply, causing all indicators to be extinguished. The mainframe assembly wiring diagram (figure 7-23) can be used to trace power source malfunctions. To check the voltages, proceed as follows:

WARNING

The followlng procedure is performed with power supplied to the disc drive, and protective covers removed. This troubleshooting should be performed only by service-trained personnel who are aware of the hazards involved (for example, fire and electrical shock).

a. If applicable, remove the disc pack from the disc drive.

b. Remove ac power from the disc drive.

c. Remove the shroud as outlined in paragraph 8-3.

d. Remove track follower PCA-A5 and replace with extender board, part no. 13354-60003.

e. Apply ac power to the disc drive and check the voltages shown below.

+5.0 ±0.1 Vdc at A5J1-5, E
+12.0 ±0.6 Vdc at A5J1-3, C
−12.0 ±0.6 Vdc at A5J1-2, B
−24.0 ±1.2 Vdc at A5J1-14
25 Vac at A5J2-6

f. If the voltages are not within specification, refer to mainframe assembly wiring diagram, figure 7-23, for further troubleshooting.

7-4. VISUAL INDICATION OF DRIVE STATUS

Table 7-1 lists the response of the drive to certain conditions as evidenced by the appearance of the light-emitting diodes (LED's) on fault indicator PCA-A12 and spindle logic PCA-A8, the indicators on the operator control panel, and the drive mechanism. Also provided is a description of the circuit that implements the response, including its logic equation and location on the system functional diagram.

7-5. DISC SERVICE UNIT

The disc service unit (DSU) simulates disc controller signals and processes the response of the drive for display. A detailed description of the DSU is given in paragraphs 5-7 through 5-9 and installation instructions are provided in paragraph 6-8. The four DSU modes of operation are described in table 7-2.

Note: All operations of the DSU, including read, are limited to addressing and accessing. During a read operation, the DSU test module does not decode data. Performance testing of the read and write functions must be performed by a diagnostic test program.

7-6. SYSTEM FUNCTIONAL DIAGRAMS

Figures 7-24 through 7-29 provide functional diagrams for the disc drive. These include the I/O control system, spindle rotation system, head positioning system, sector sensing system, read/write system, and fault detection system. Each of the systems is discussed in detail in Section IV, Theory of Operation. A grid-coordinate system is used on the functional diagrams to aid in following signal flow. In addition, cross-references are provided for each signal where it leaves one diagram to appear on another. In order to simplify the diagrams as much as possible, all interconnections that occur through the mainframe wiring harness and motherboard PCA-A7 have been omitted. Refer to the mainframe assembly wiring diagram (figure 7-23) and the motherboard PCA-A7 signal distribution list (table 7-3) for this information.

7-7. WIRING CONNECTIONS

Wiring connections for the drive (except that on motherboard PCA-A7) is shown in the mainframe assembly wiring diagram (figure 7-23). Motherboard wiring connections are contained in the motherboard PCA-A7 signal distribution list (table 7-3). Two cables connect the drive to the disc controller — an HP 13013B multi-unit cable which contains the control bus, tag bus, and strobe signal wiring; and an HP 13213B data cable which carries the read/write and SL (Drive Select) signals.

7-8. POWER DISTRIBUTION

Distribution of the ac power input to the drive enclosure is shown in the power panel assembly wiring diagram (figure 7-22 or 7-22A). The drive converts the ac power to 25 Vac, +5 Vdc, +12 Vdc, +36 Vdc, −12 Vdc, −24 Vdc, and −36 Vdc for distribution to the components of the drive. This distribution is detailed in the power distribution list (table 7-4).

Table 7-1. Visual Indication of Drive Status

INDICATOR/ INDICATION	ACTIVE STATE		FUNCTIONAL DIAGRAM
	LOGIC EQUATION	CIRCUIT DESCRIPTION	
Unit Select Identification Indicator	SEL	Indicator is lit when the following conditions are met: a. Control bus bits D0 thru D2 match signals US0 thru US2 from UNIT SELECT switch S3. b. Select flip-flop is set. [ADU (Address Unit) signal selected on tag bus while $\overline{\text{STROBE}}$ signal is active sets flip-flop.]	I/O Control System, figure 7-24.
READ ONLY Indicator	$\overline{\text{R01}}$	Indicator is lit when READ ONLY switch S5 is set to READ ONLY.	Read/Write System, figure 7-28.
DOOR UNLOCKED Indicator	$\overline{\text{PSF}}$ • (STOP • CRB • SPD)	Indicator is lit when the following conditions are met (door unlock solenoid energized): a. RUN/STOP switch S2 set to STOP. b. Carriage fully retracted. c. Spindle stopped.	Spindle Rotation System, figure 7-25.
DRIVE READY Indicator	Set = AGC • CB Reset = FLT + $\overline{\text{DL • PIP}}$ + $\overline{\text{SPU}}$ + STOP	Indicator is lit when the following conditions are met: a. AGC (Automatic Gain Control) signal active. b. SB (Servo Balanced) signal active.	Head Positioning System, figure 7-28.
DRIVE FAULT Indicator	FLTL = AGCF + CBF + TOF + ILF + W • $\overline{\text{AC}}$ + W • $\overline{\text{AR}}$ + R • W + MH + DCW	Indicator is lit when one of the following conditions is met: a. AGC (Automatic Gain Control) signal active, caused by loss of servo information any time after drive becomes active. (Loss of servo information can occur when new servo heads are installed and the disc drive contains a track follower PCA-A5 with series code prior to 1713.) b. CB (Carriage Back) signal active, caused by defective carriage back detector (phototransistor). This occurs when drive is ready but the phototransistor or CB signals say that heads are retracted. c. TO (Time Out) caused by one of the following: 1. Any head loading sequence or recalibration taking more than 1.25 seconds. 2. Track-to-track seek taking more than 90 milliseconds. 3. New servo heads are installed without replacing track follower PCA-A5 with one having series code 1713 or subsequent code. d. ILF (Interlock) signal active, due to one of the following: 1. Out of tolerance or missing power supply voltage. 2. Excessive temperature condition, as sensed by switch A9A1. 3. PCA improperly seated or missing. 4. Line voltage 15 percent below nominal value. 5. Current limit in spindle power amplifier. e. Destructive write fault, caused by any one of the following: 1. Drive in write mode with no data signal applied (W • $\overline{\text{AC}}$ LED indicator is lit.) 2. More than one head selected for reading or writing. (MH LED indicator is lit.) 3. DC write current is supplied to the head driver while drive is not in write mode. (Both MH and W • $\overline{\text{AC}}$ LED's are lit.)	Head Positioning System, figure 7-26.

Table 7-1. Visual Indication of Drive Status (Continued)

INDICATOR/ INDICATION	ACTIVE STATE		FUNCTIONAL DIAGRAM
	LOGIC EQUATION	CIRCUIT DESCRIPTION	
DRIVE FAULT Indicator (Continued)		f. Non-destructive write fault, caused by one of the following: 1. Heads not settled on a cylinder [ACRY (Access Ready) signal inactive] while in write mode. (W • AR LED indicator is lit.) 2. Drive in both read and write mode at the same time. (R • W LED indicator is lit.)	
IL LED Indicator	— — —	Indicator is lit when any one of the following conditions is met: a. Any PCA (with the exception of PCA-A11 and PCA-A12) not firmly seated or correctly positioned in the drive. b. Pack loading assembly disconnected. c. 25 Vac, +36 Vdc, +12 Vdc, +5 Vdc, −12 Vdc, −24 Vdc, or −36 Vdc power source out of tolerance or missing. d. Temperature of heat sink on PCA-A9 rises above a specified limit. e. A spindle fault is detected.	Fault Detection System, figure 7-29.
AGC LED Indicator	AGCF • DRDY = AGC • SKH • DRDY	Indicator is lit when both of the following conditions are met: a. Heads are out of cylinder area between inner and outer guard bands. [DRDY (Drive Ready) signal active.] b. AGC (Automatic Gain Control) and DRDY (Drive Ready) signals active.	Fault Detection System, figure 7-29.
CB LED Indicator	CRB • DRDY	Indicator is lit when both of the following conditions are met: a. CRB (Carriage Back) signal active. b. DRDY (Drive Ready) signal active.	Fault Detection System, figure 7-29.
MH LED Indicator	MHS + WRITE • DCW	Indicator is lit when more than one head is selected for reading or writing.	fault Detection System, figure 7-29.
W • AC and MH LED Indicators	WRITE • DCW	Both indicators are lit when the following conditions are met: a. DC current supplied to head drivers. b. Drive not in write mode.	Fault Detection System, figure 7-29.
T LED Indicator	TOFL	Indicator is lit when any one of the following conditions is met: a. Heads not settled on specified cylinder within 90 milliseconds after SK (Seek) signal is activated. b. Heads not settled on cylinder 0 within 1250 milliseconds after SKH (Seek Home) signal becomes activa. c. Heads do not reach fully retracted position within 1250 milliseconds after RET (Retrack) signal becomes active. d. Heads not settled on cylinder 0 within 1250 milliseconds after RH (Restore Home) signal becomes active.	Fault Detection System, figure 7-29.

Table 7-1. Visual Indication of Drive Status (Continued)

INDICATOR/ INDICATION	ACTIVE STATE		FUNCTIONAL DIAGRAM
	LOGIC EQUATION	CIRCUIT DESCRIPTION	
W • $\overline{AR}$ LED Indicator	WRITE • ACRY	Indicator is lit when both of the following conditions are met: a. Drive in write mode. b. ACRY (Access Ready) signal inactive.	Fault Detection System, figure 7-29.
R • W LED Indicator	URG • WRITE	Indicator is lit when both of the following conditions are met: a. URG (Unselected Read Gate) signal active. b. WRITE (Write) signal active.	Fault Detection System, figure 7-29.
W • $\overline{AC}$ LED Indicator	WRITE • $\overline{ACW}$	Indicator is lit when the following conditions are met: a. Drive in write mode. b. No data signal present.	Fault Detection System, figure 7-29.
SPU LED Indicator	— — —	Indicator is lit when spindle motor is operating at correct speed.	Spindle Rotation System, figure 7-25.
OFF LED Indicator	— — —	Indicator is lit when power is removed from spindle motor.	Spindle Rotation System, figure 7-25.
SPFLT LED Indicator	— — —	Indicator is lit when an overcurrent condition is sensed in spindle rotation system.	Spindle Rotation System, figure 7-25.
Spindle starts to rotate from a stationary state.	PIP • DL • $\overline{ILF}$ • RUN • CRB • $\overline{TOF}$	Spindle rotation occurs when the following conditions are met: a. Disc pack in place. b. Disc pack access door locked. c. No IL drive fault. d. RUN/STOP switch set to RUN. e. Carriage fully retracted. f. No time-out fault.	Spindle Rotation System, figure 7-25.
Spindle continues to rotate.	CRB • ILF	Once started, the spindle motor continues to rotate as long as both of the following conditions are met: a. Carriage not fully retracted. [CRB (Carriage Back) signal inactive.] b. ILF (Interlock Fault) signal inactive.	Spindle Rotation System, figure 7-25.
Heads seek to cylinder 0 (home) from the retracted position.	RET • SPU	During a power-up operation, the heads seek home when the RET (Retract) signal becomes inactive. This occurs when the spindle reaches operational speed (SPU signal active).	Head Positioning System, figure 7-26.
Heads seek from one cylinder to another.	ACRY • SK • $\overline{ICA}$	The heads seek from one cylinder to another provided all of the following conditions are met: a. Heads settled on any legal cylinder. [ACRY (Access Ready) signal active.] b. The SK (Seek) signal from controller is present. c. The address to which the heads are to seek is not an illegal one (823).	Head Positioning System, figure 7-26.

Table 7-2. Disc Service Unit (DSU) Functions 1, 2, 3, and 8

CONTROL/ INDICATOR	FUNCTION
	Function No. 1 — Alternate Seek
FUNCTION switch	Selects automatic Alternate Seek function (position 1).
START (STROBE) pushbutton	Starts operation of Alternate Seek function. Heads first seek to cylinder 0, then to the cylinder address selected on the upper bank of ten toggle switches, and then alternately between this address and the cylinder address selected on the lower bank of ten toggle switches. If either selected address is an illegal one (greater than 822), the heads seek to the legal address and remain there. If both addresses are illegal, no seek is performed.
STOP pushbutton	Stops operation of Alternate Seek function.
Upper bank of 10 toggle switches (1 thru 512)	Select cylinder address to which heads seek after leaving cylinder 0.
Lower bank of 10 toggle switches (1 thru 512)	Select cylinder address to which heads seek after leaving cylinder address selected by upper bank of 10 toggle switches.
DELAY control	Selects time interval between seeks.
3-digit display	Indicates time interval for seek. Readout is in milliseconds.
	Function No. 2 — Incremental Seek
FUNCTION switch	Selects automatic Incremental Seek function (position 2).
START (STROBE) pushbutton	Starts operation of Incremental Seek function. Heads first seek to cylinder 0 and then to next address. Next address is determined by adding the numbers selected by the lowest nine (1 thru 256) switches on the lower bank of ten toggle switches. Incremental seeking of the heads to the next address continues until a next address greater than 822 is reached. When this occurs, the programmed next address number is subtracted from the preceding valid next address (822 or less), causing decremental seeking to the next address until cylinder 0 is reached. The heads continue this incremental and decremental seek action until the STOP pushbutton is pressed.
STOP pushbutton	Stops operation of Incremental Seek function.
Lower bank of 9 toggle switches (1 thru 256)	Select amount by which current cylinder address is incremented (or decremented) for next seek.
DELAY control	Selects time interval between seeks.
3-digit display	Indicates time for seek. Readout is in milliseconds.
	Function No. 3 — Random Seek
FUNCTION switch	Selects automatic Random Seek function (position 3).
START (STROBE) pushbutton	Starts operation of Random Seek function. Heads first seek to cylinder 0 and then to cylinder addresses generated by the DSU in a pseudo-random sequence.

Table 7-2. Disc Service Unit (DSU) Functions 1, 2, 3, and 8 (Continued)

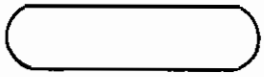
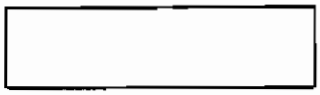
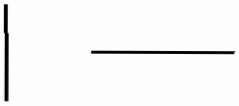
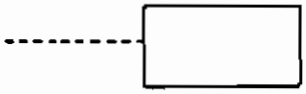
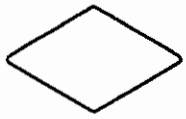
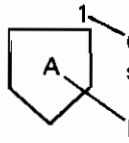
CONTROL/ INDICATOR	FUNCTION
	Function No. 3 — Random Seek (Continued)
STOP pushbutton	Stops operation of Random Seek function.
DELAY control	Selects time interval between seeks.
3-digit display	Indicates time interval between seeks. Readout is in milliseconds.
	Function No. 8 — Manual Mode
FUNCTION switch	Selects Manual mode of operation (position 8).
START (STROBE) pushbutton	When pressed, activates STROBE signal applied to the tag bus decoder in I/O Sector PCA-A2. This executes the command selected by tag bus switches 64 through 512 on the upper bank of 10 toggle switches. The STROBE signal is active as long as the START (STROBE) pushbutton is held down.
Upper 4 toggle switches (64 thru 512)	Select input command to be supplied on tag bus to drive. The toggle switch settings and the associated input commands are listed on the upper right-hand corner of the DSU front panel. The DSU does not issue a Write command.
T0 thru T3 LED indicators	Indicate the state of the tag bus bits (input command) selected by the upper 4 toggle switches (64 through 512).
Lower bank of 16 toggle switches (1 thru 512 and 1 thru 32)	Select state of control bus bits C0 through C15 for the following tag bus commands. Bits are strobed into the drive when the START (STROBE) pushbutton is pressed.

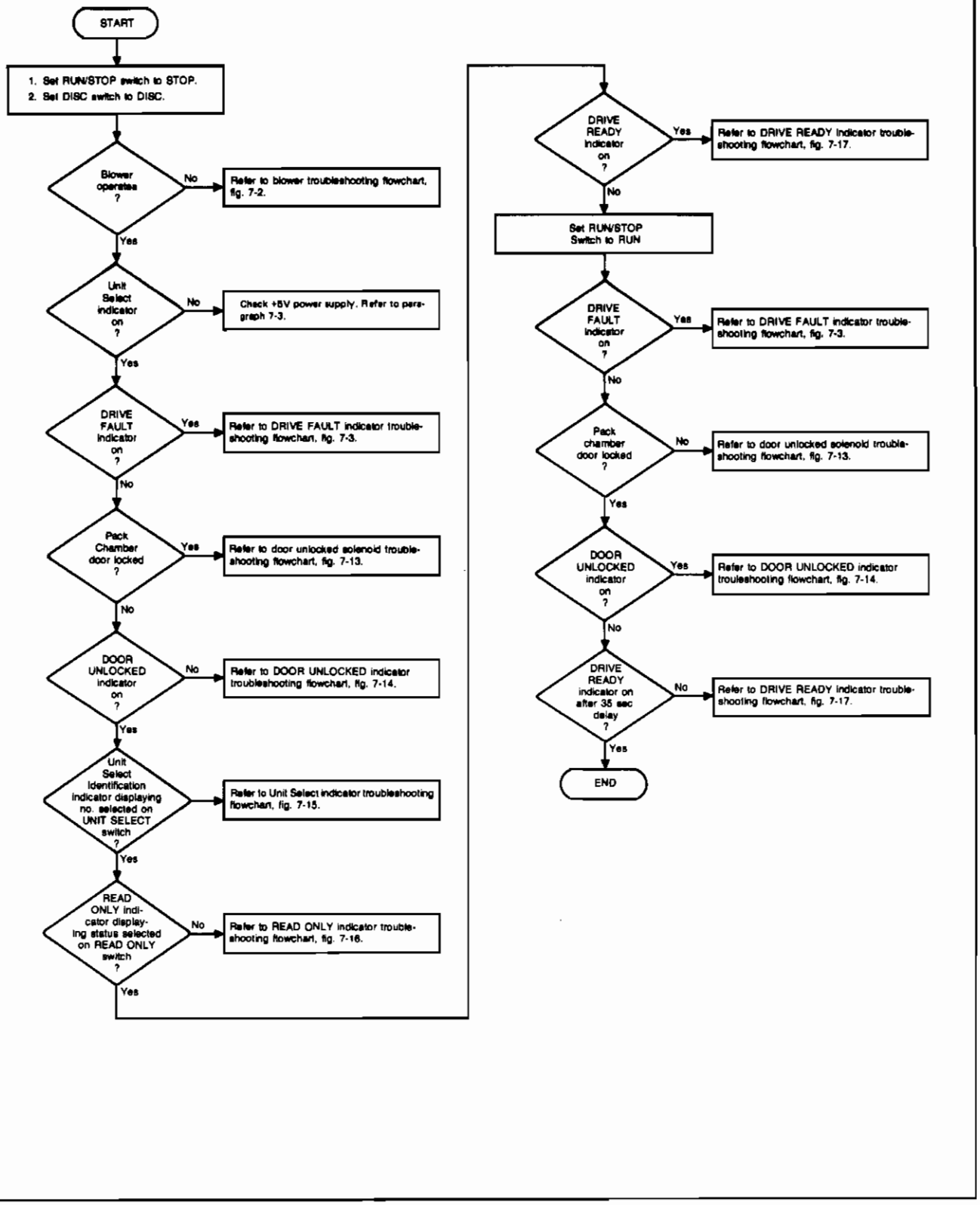
Command	Control Bits	
Address Record (ADR) — 1001	C0 thru C5	Select sector address to be stored in drive Sector Address register.
	C8, C9 and C10	Select head identity to be stored in drive Head register.
Address Unit (ADU) — 1010	C0 thru C2	Select identity of drive to be enabled for communication with DSU. (The identity of the drive is the number selected on the UNIT SELECT switch on the drive operator panel.)
Clear Status (CLS) — 1110	C0	Clears three Attention flip-flops in drive. This deactivates First Status signal. Note: If C0 and C1 are both selected, the Attention flip-flops and the Frist Status flip-flop are cleared.
Seek (SK) — 1000	C0 thru C9	Select cylinder address to which heads are to seek.
Set Offset (SOF) — 1101	C0 thru C5	Select offset magnitude in 53 increments of 25 microinches each.
	C7	Selects direction (+ or −) of offset.
Transmit Sector (XMS) — 1100	C0 thru C5	Select sector address to be stored in drive Sector Address register.

Table 7-2. Disc Service Unit (DSU) Functions 1, 2, 3, and 8 (Continued)

CONTROL/ INDICATOR	FUNCTION
C0 thru C15 LED indicators	**Function No. 8 — Manual Mode (Continued)** a. Indicate the state of the control bus bits selected by the lower band of 16 toggle switches when any one of the preceding six commands is selected. b. Indicate the status of the drive when any one of the following commands is selected: Read (READ) — 0000 Write (WRITE) — 0001 Request Status (RQS) — 0010 Coding for the LED's is as follows. With the exception of C0 (ACRY), a lighted LED indicates that the corresponding signal is active. C0, when lighted, indicates that signal ACRY is inactive. C0 — ACRY (Access Ready) C1 — DRDY (Drive Ready) C2 — Illegal head selected, illegal sector selected, or seek check C3 — First Status C4 — FLT (Fault) C5 — Format C6 — READ Only C7 — ATT (Attention) C8 — SC (Sector Compare) C9 — Ground C10 — Drive Type } C9 on and C10 off, drive = 7920A C11 through C15 — Not used c. Indicate position information when Request Position (RQP) command is selected. Coding for the LED's is as follows: C0 thru C5 — Present sector from servo code. C6 — 0 C7 — 0 C8, C9, and C10 — Identity of selected head (0 thru 4) C11 thru C15 — Not used

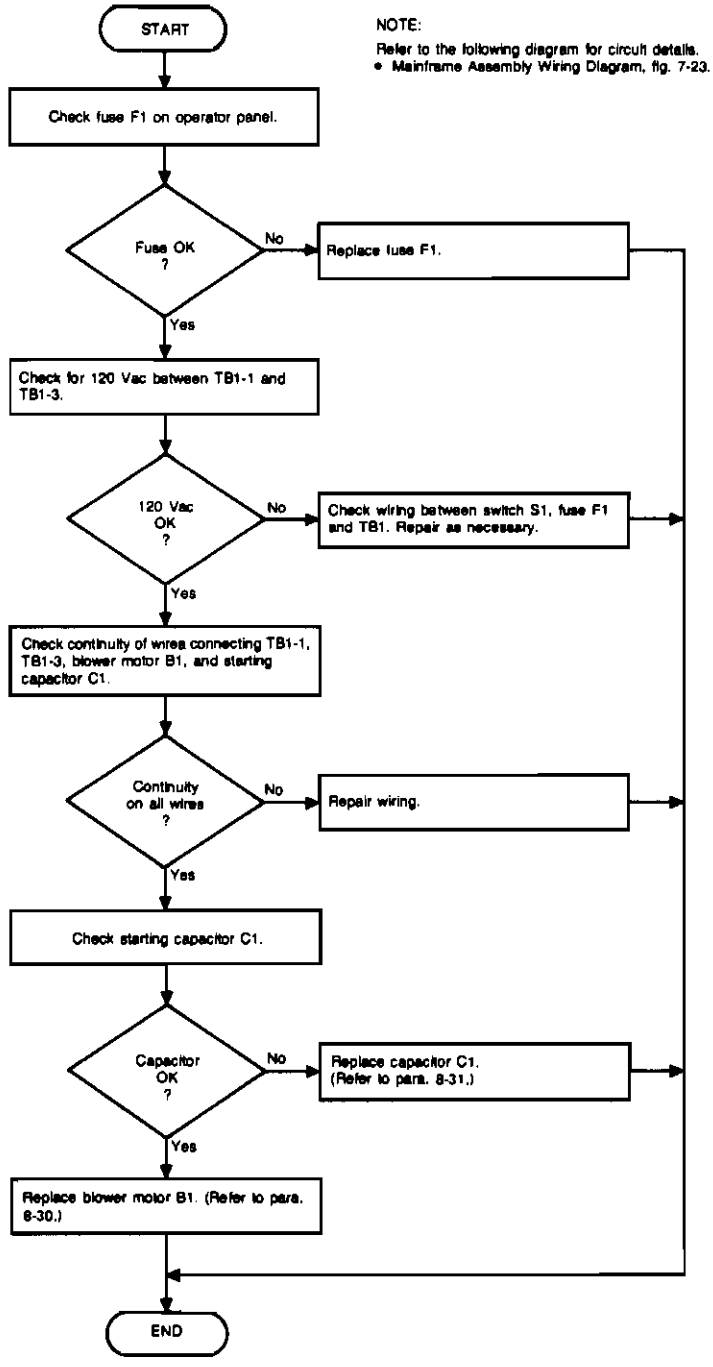
Table 7-3. Flowchart Symbols

SYMBOL	DESCRIPTION
	TERMINATION SYMBOL. This symbol indicates an entry to the flowchart or an exit from the flowchart.
	PROCESS SYMBOL. This symbol indicates the execution of a defined operation.
	FLOWLINE SYMBOL. This symbol indicates the logical path to follow in the flowchart.
	ANNOTATION SYMBOL. This symbol is used for descriptive comment in the flowchart.
	DECISION SYMBOL. This symbol requires a choice of logical paths. This choice of paths depends on the answer to the question contained in the symbol.
	OFFPAGE CONNECTOR. This symbol designates entry or exit from a page.
EXIT from a page  Go to sheet 2, block A.	ENTRY from a page 



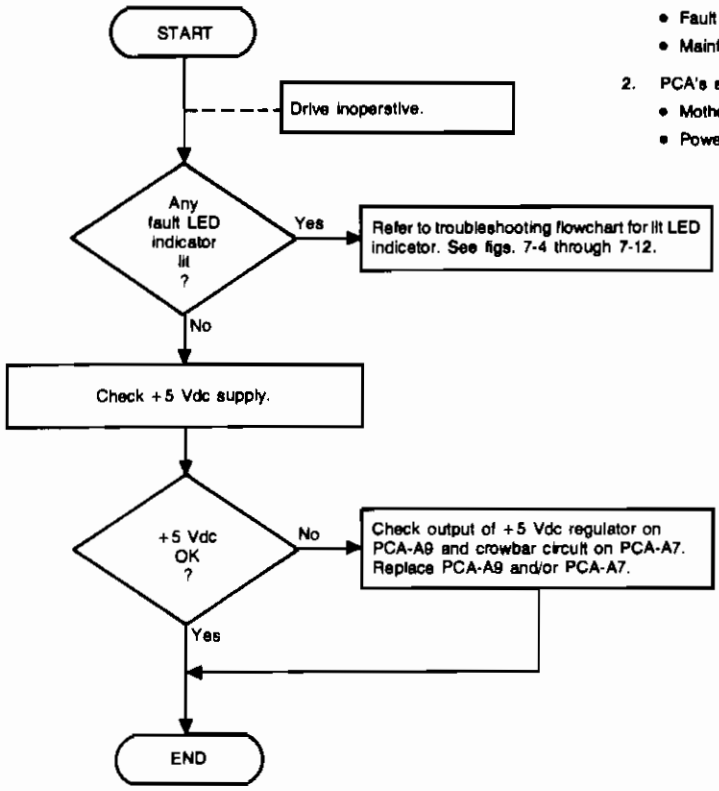
7301-55A

Figure 7-1. Power-Up Troubleshooting Flowchart



7301-56A

Figure 7-2. Blower Troubleshooting Flowchart

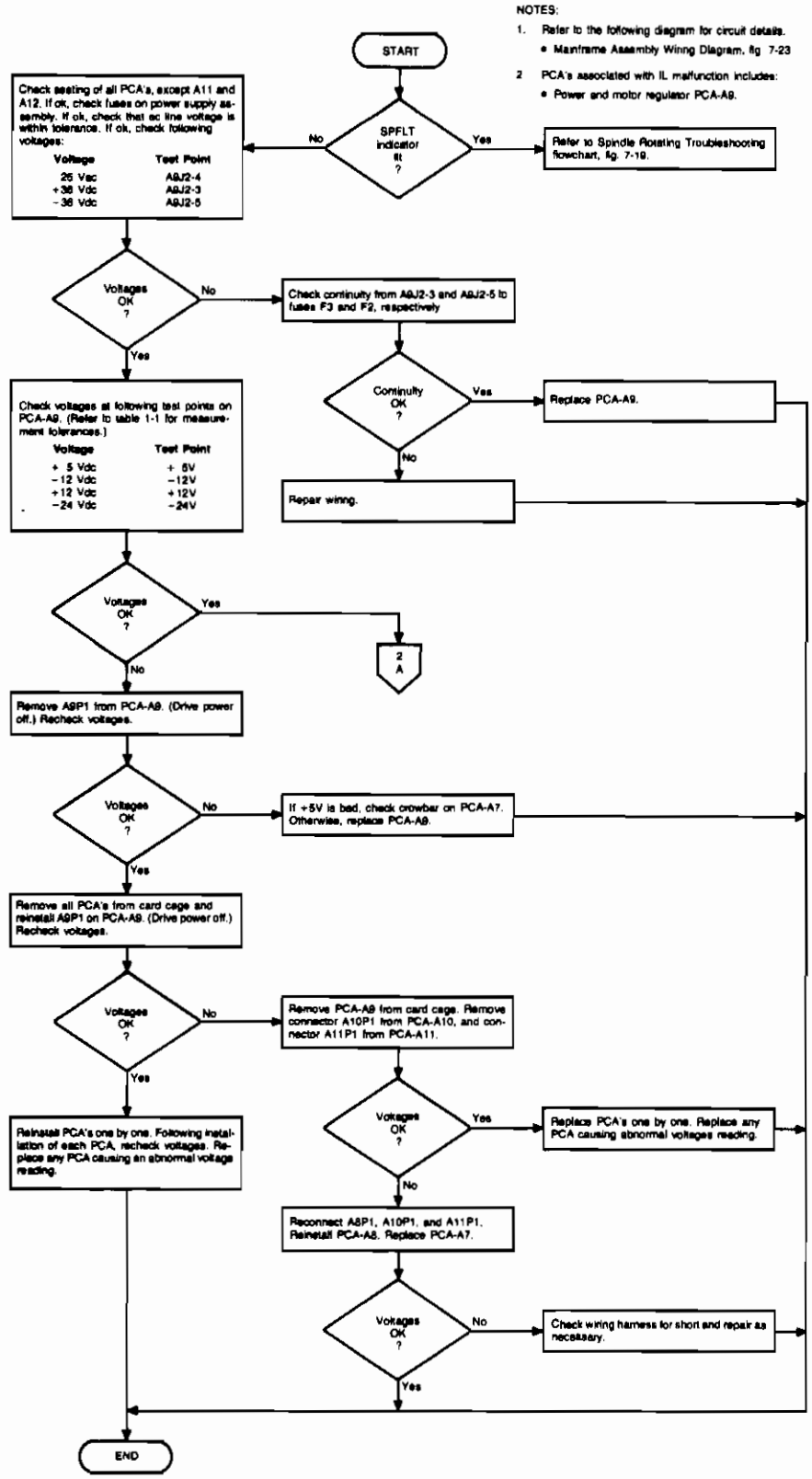


NOTES:

1. Refer to the following diagrams for circuit details.
   - Fault Detection System Functional Diagram, fig. 7-29.
   - Mainframe Assembly Wiring Diagram, fig. 7-23.
2. PCA's associated with DRIVE FAULT malfunctions include:
   - Motherboard PCA-A7.
   - Power and motor regulator PCA-A9.

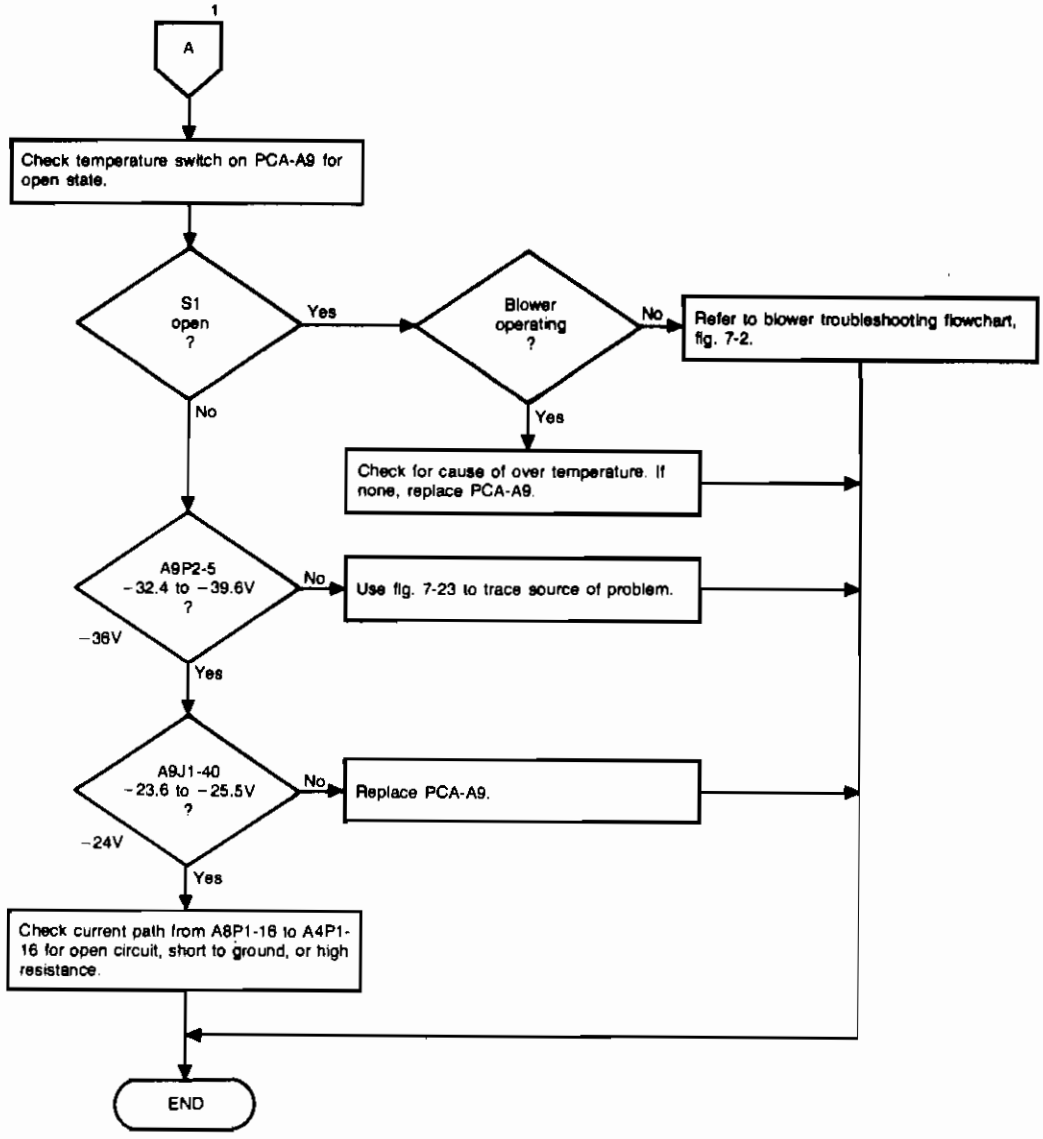
7301-57

Figure 7-3. DRIVE FAULT Indicator Troubleshooting Flowchart



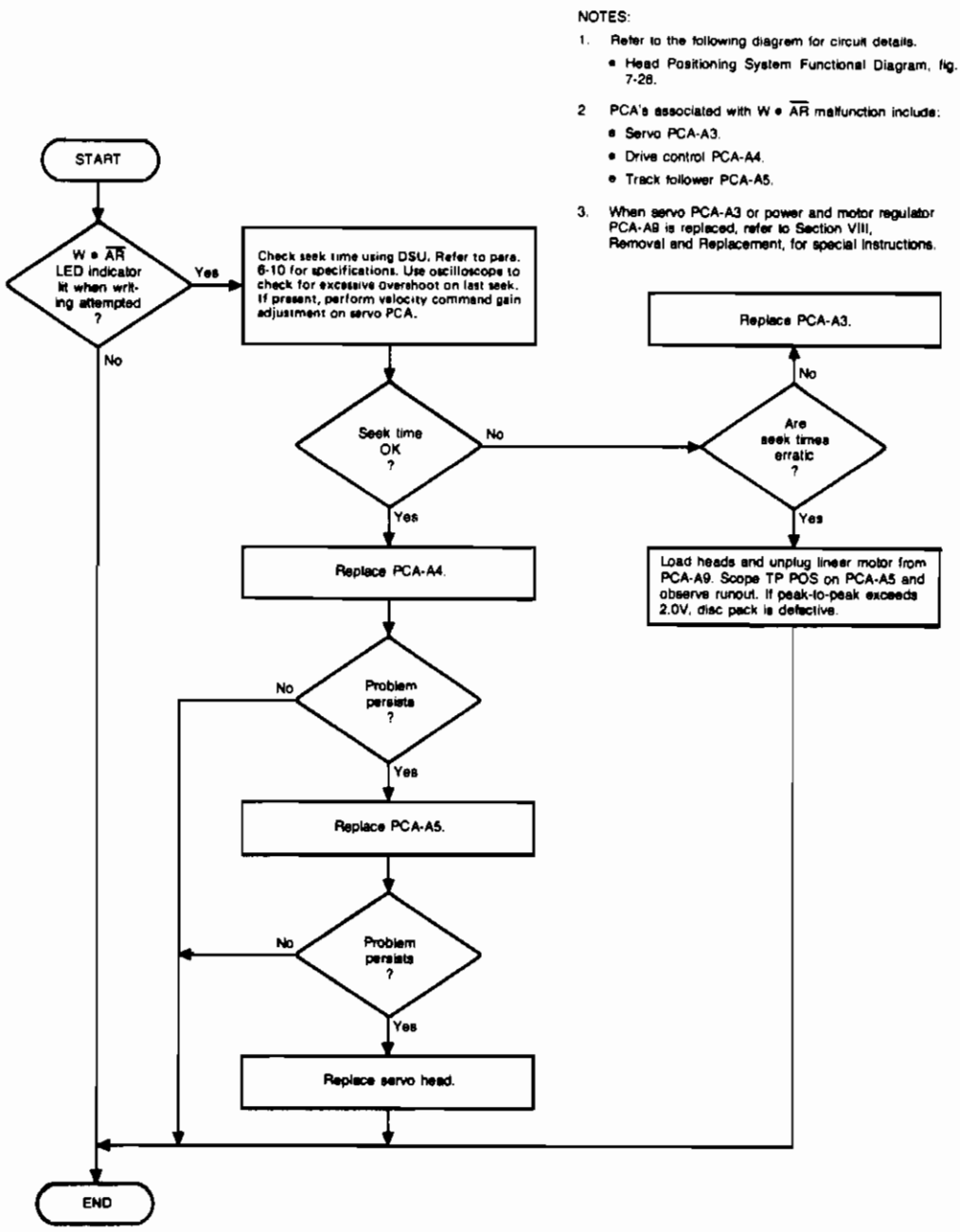
7301-58(1)

Figure 7-4. IL LED Indicator Troubleshooting Flowchart (Sheet 1 of 2)



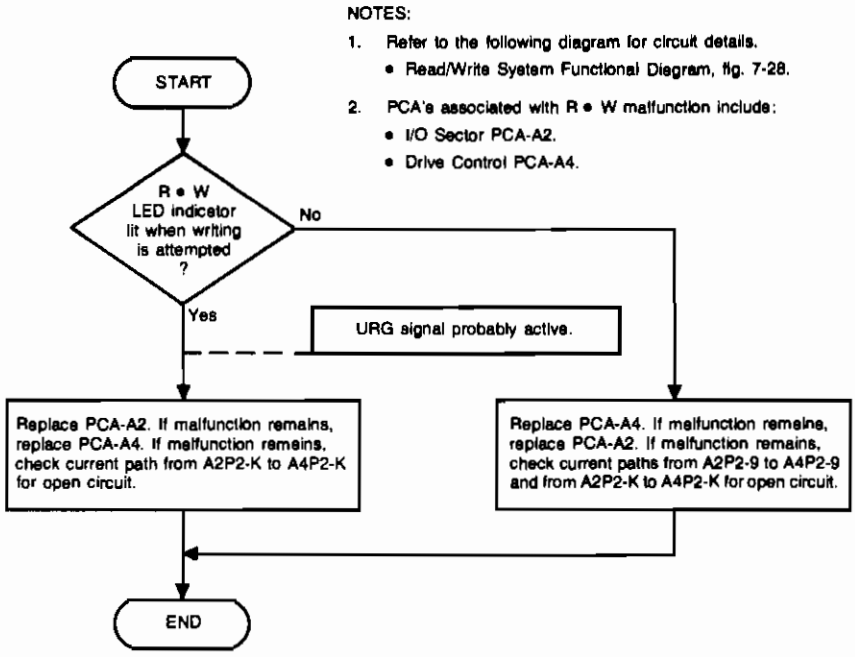
7301-58(2)

Figure 7-4. IL LED Indicator Troubleshooting Flowchart (Sheet 2 of 2)



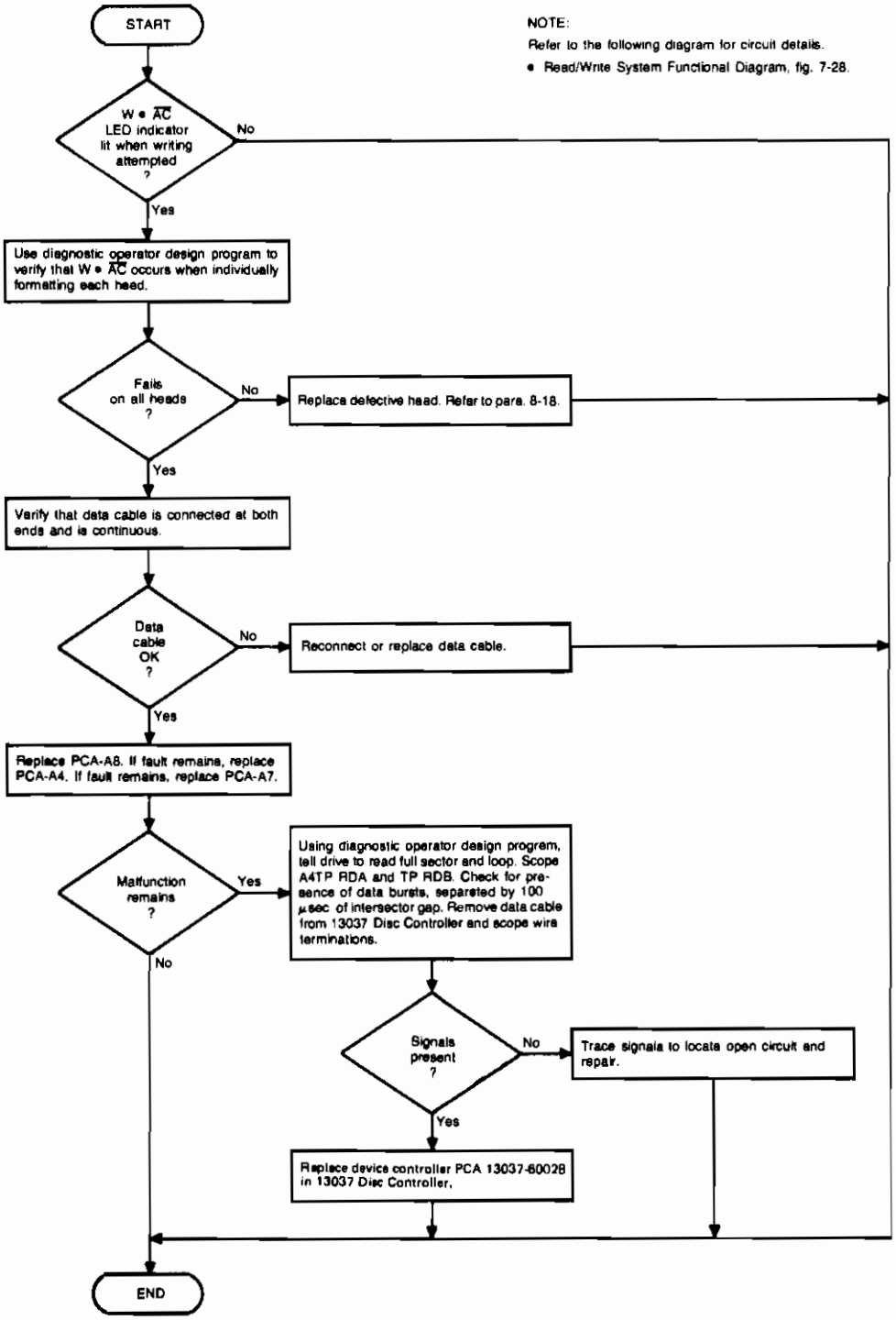
7301-59A

Figure 7-5. W•$\overline{AR}$ LED Indicator Troubleshooting Flowchart



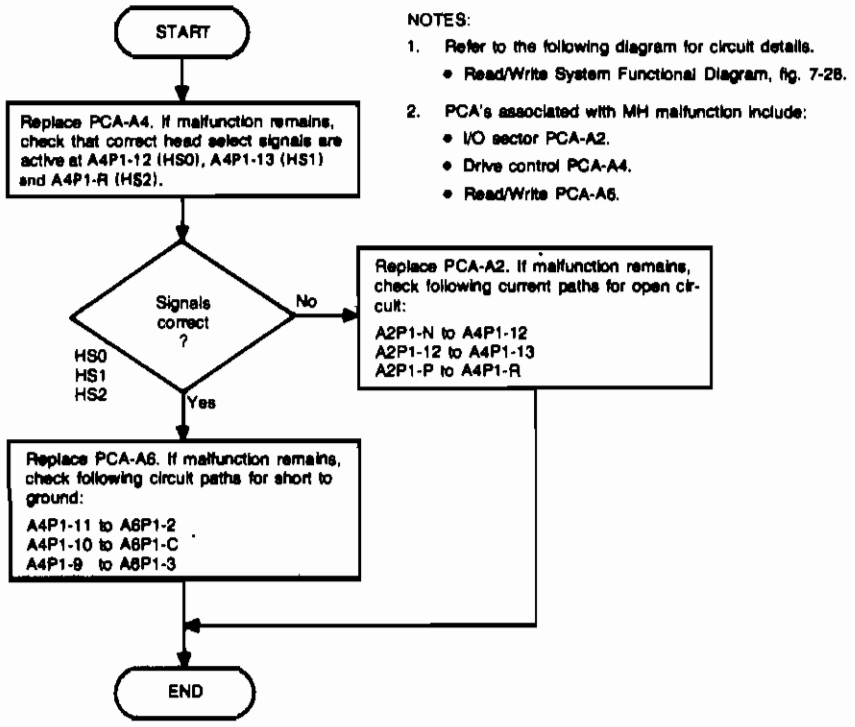
7301-60

Figure 7-6. R•W LED Indicator Troubleshooting Flowchart



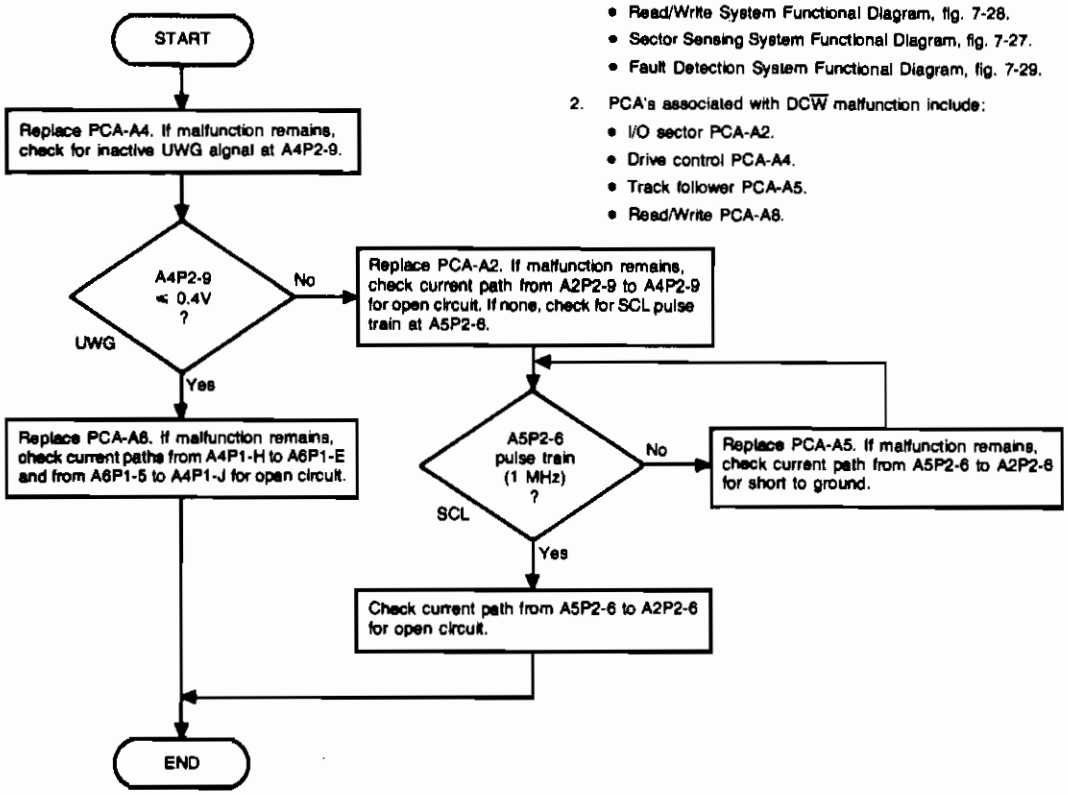
7301-61A

Figure 7-7. W•$\overline{AC}$ LED Indicator Troubleshooting Flowchart



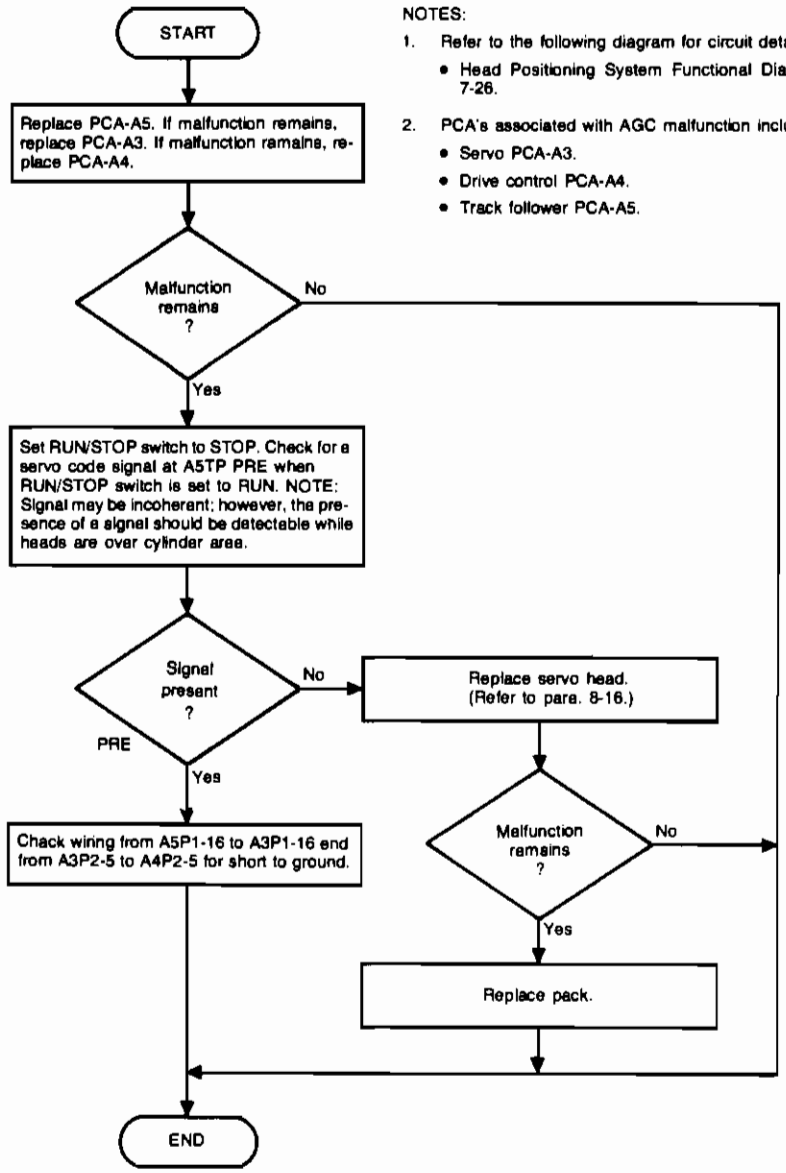
7301-62A

Figure 7-8. MH LED Indicator Troubleshooting Flowchart



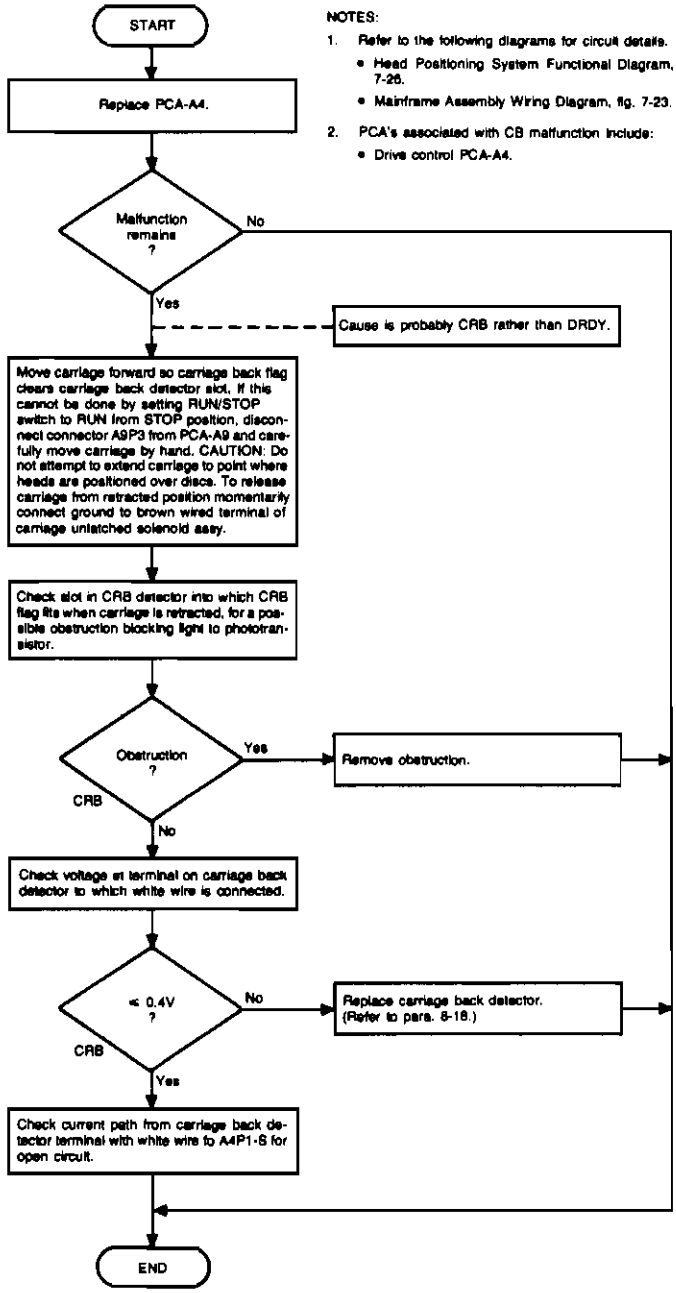
7301-63A

Figure 7-9. DC•W̄ LED Indicator Troubleshooting Flowchart



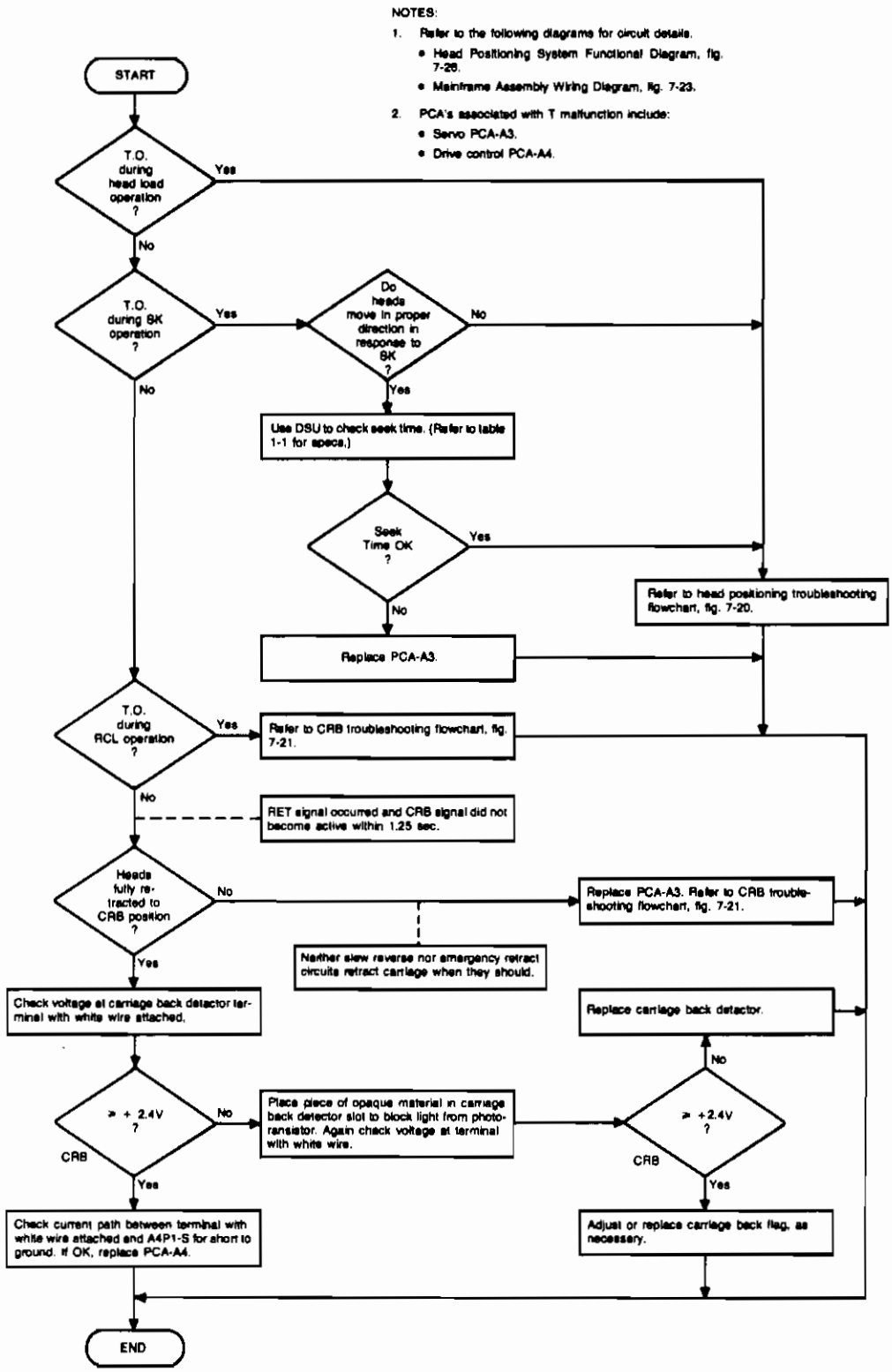
7301-64

Figure 7-10. AGC LED Indicator Troubleshooting Flowchart



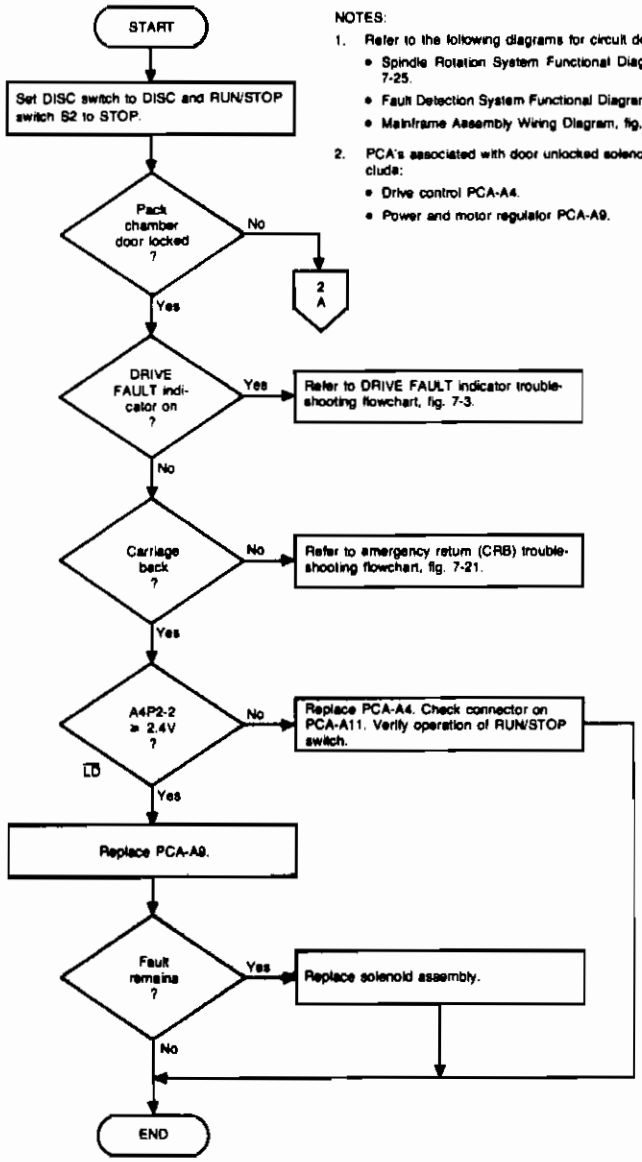
7301-65

Figure 7-11. CB LED Indicator Troubleshooting Flowchart



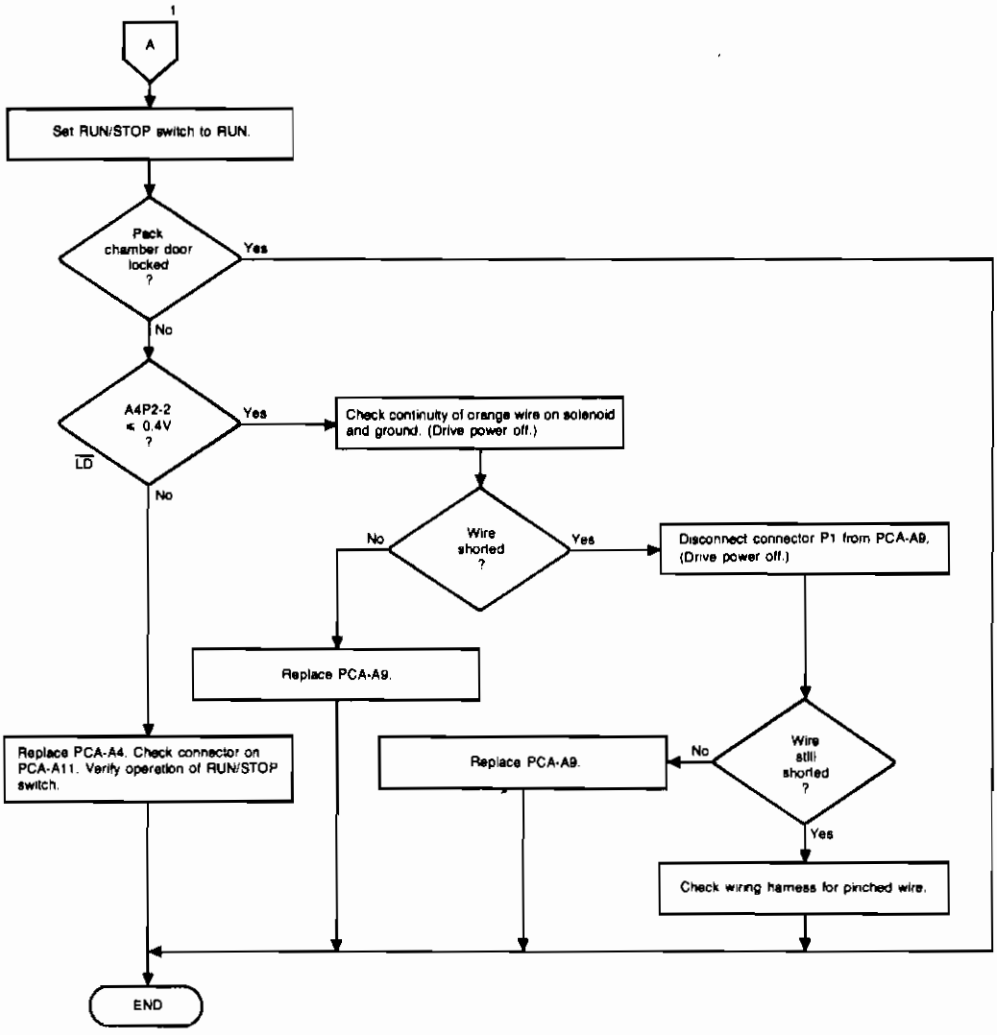
7301-66

Figure 7-12. T LED Indicator Troubleshooting Flowchart



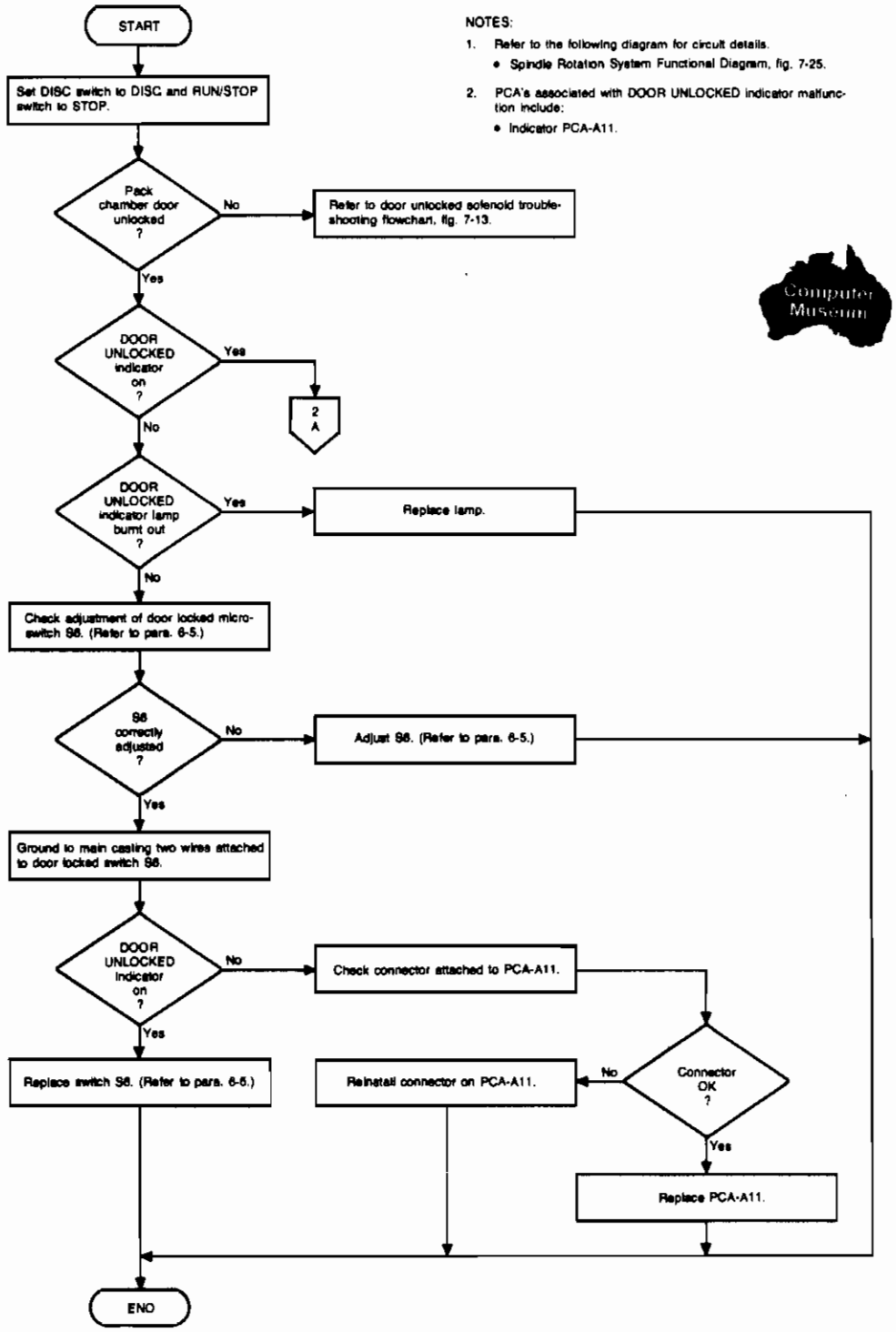
7301-67(1)

Figure 7-13. Door Unlock Solenoid Troubleshooting Flowchart (Sheet 1 of 2)



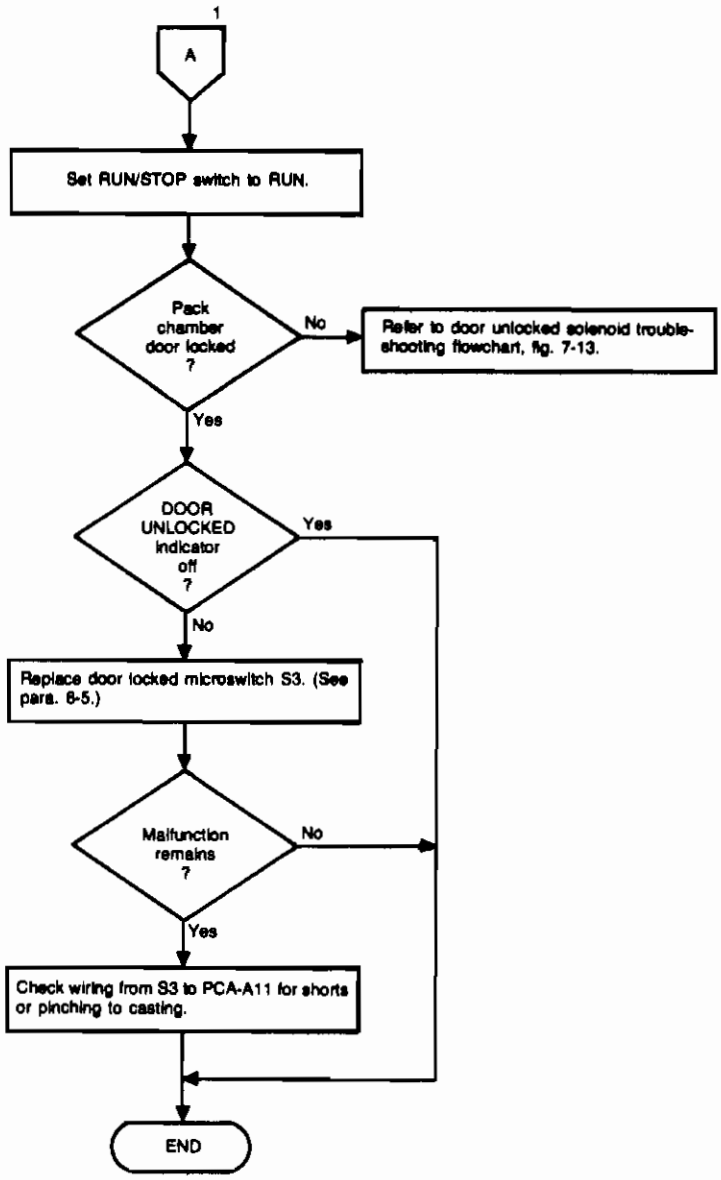
7301-67(2)

Figure 7-13. Door Unlock Solenoid Troubleshooting Flowchart (Sheet 2 of 2)



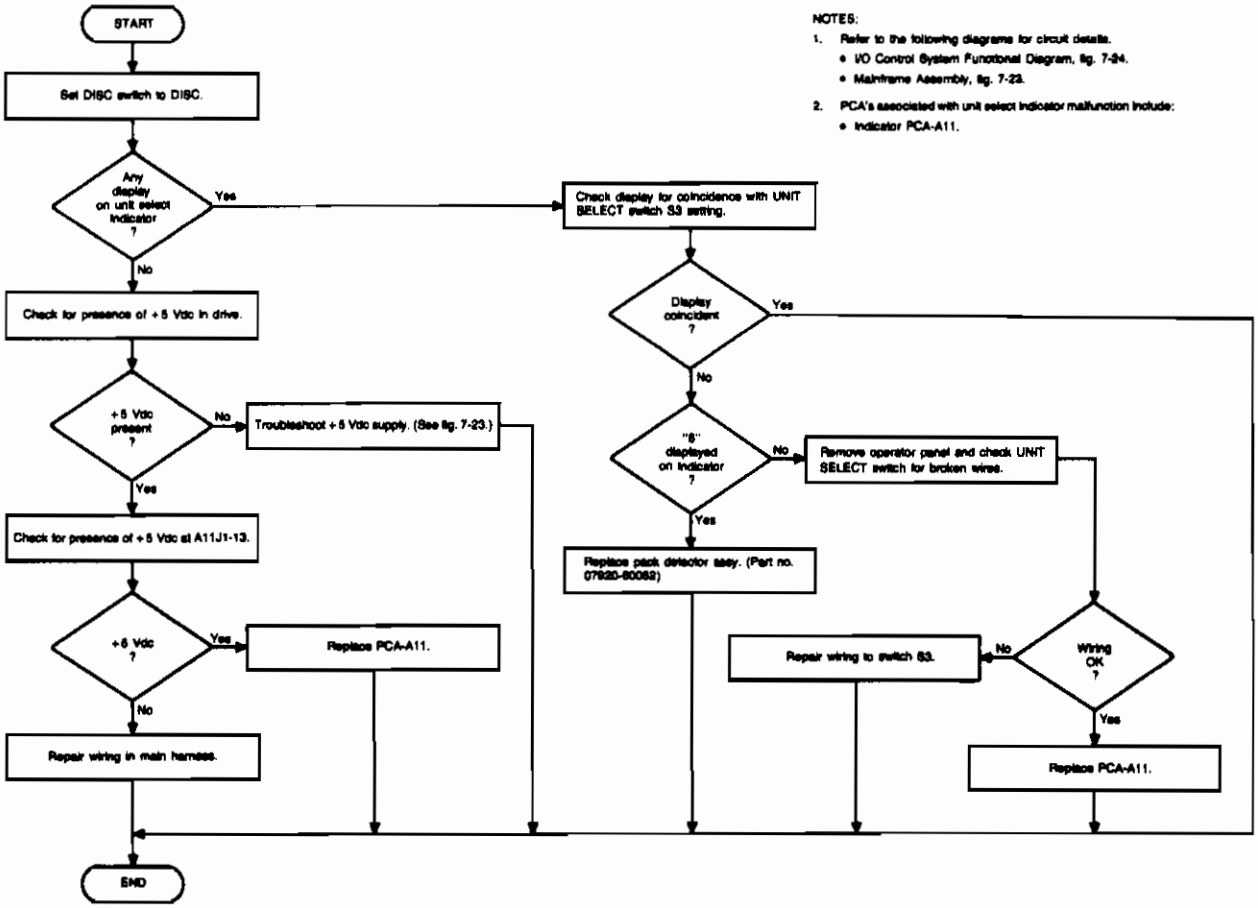
7301-68(1)

Figure 7-14. DOOR UNLOCKED Indicator Troubleshooting Flowchart (Sheet 1 of 2)



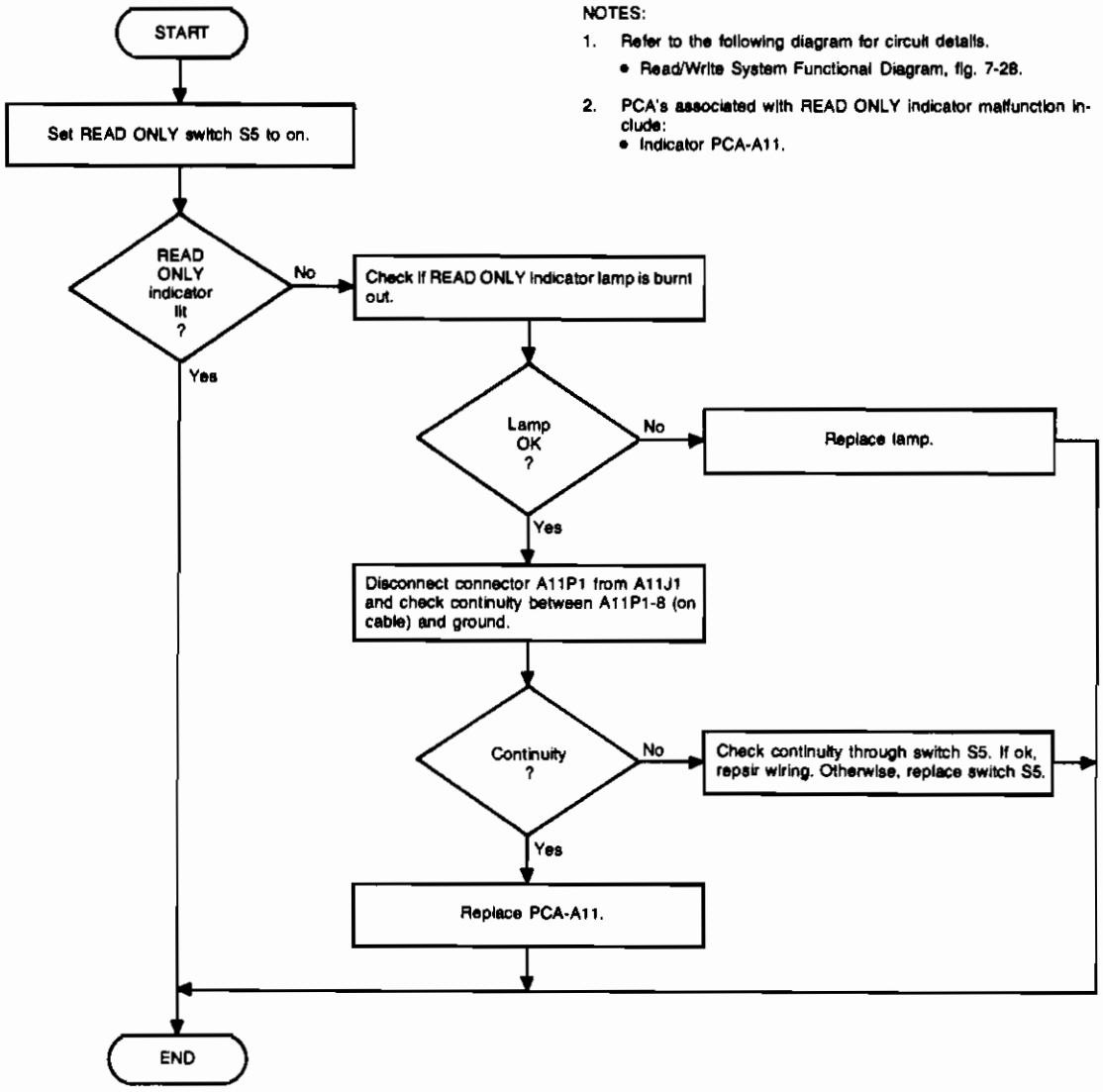
7301-68(2)

Figure 7-14. DOOR UNLOCKED Indicator Troubleshooting Flowchart (Sheet 2 of 2)



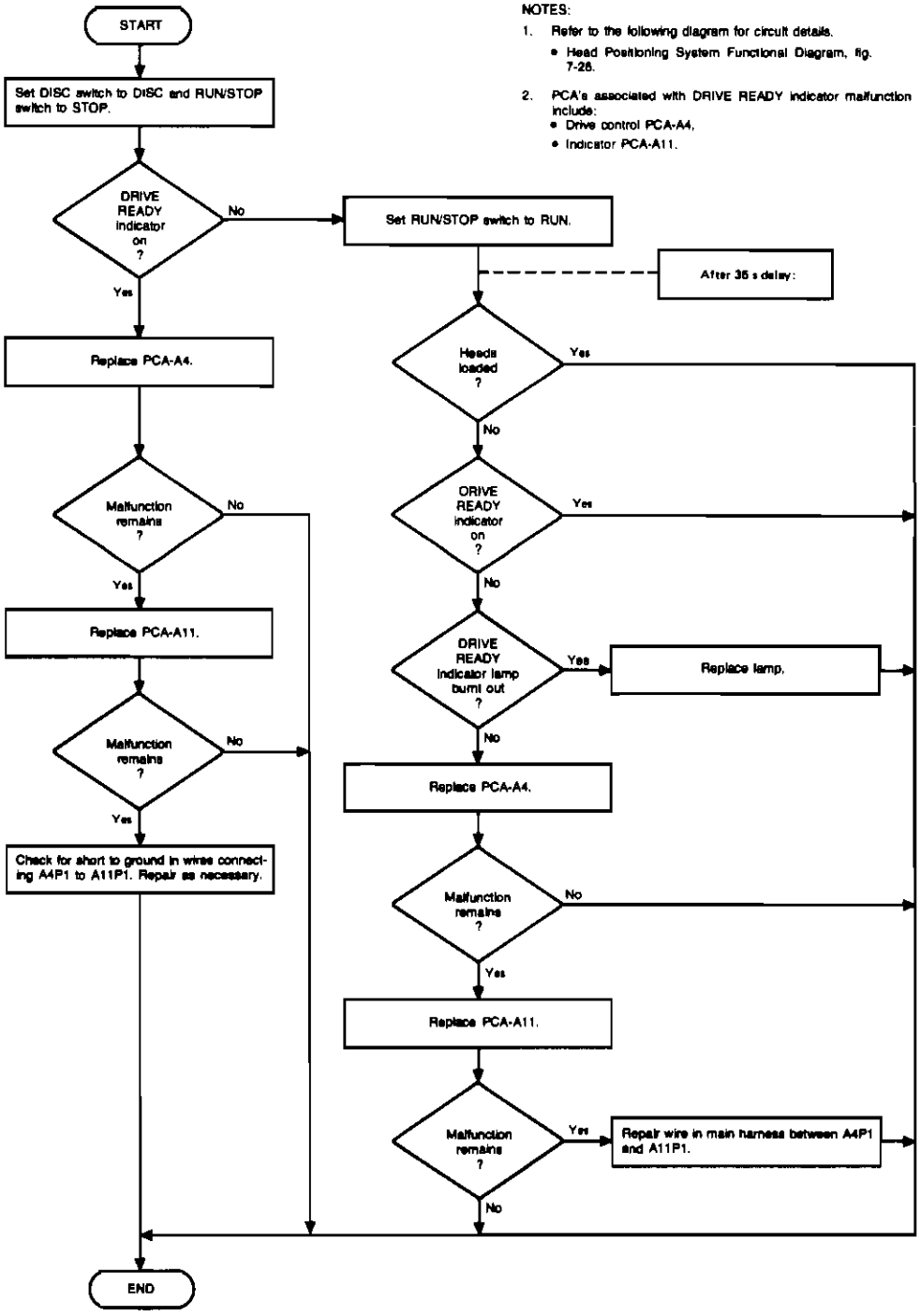
7301-69

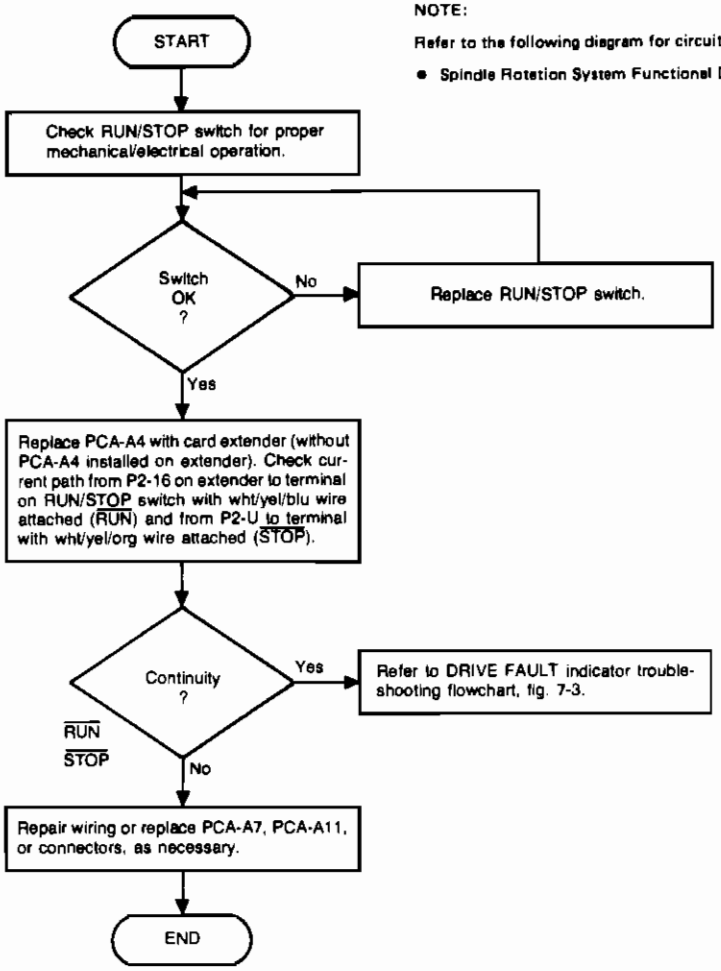
Figure 7-15. Unit Select Indicator Troubleshooting Flowchart



7301-70

Figure 7-16. READ ONLY Indicator Troubleshooting Flowchart

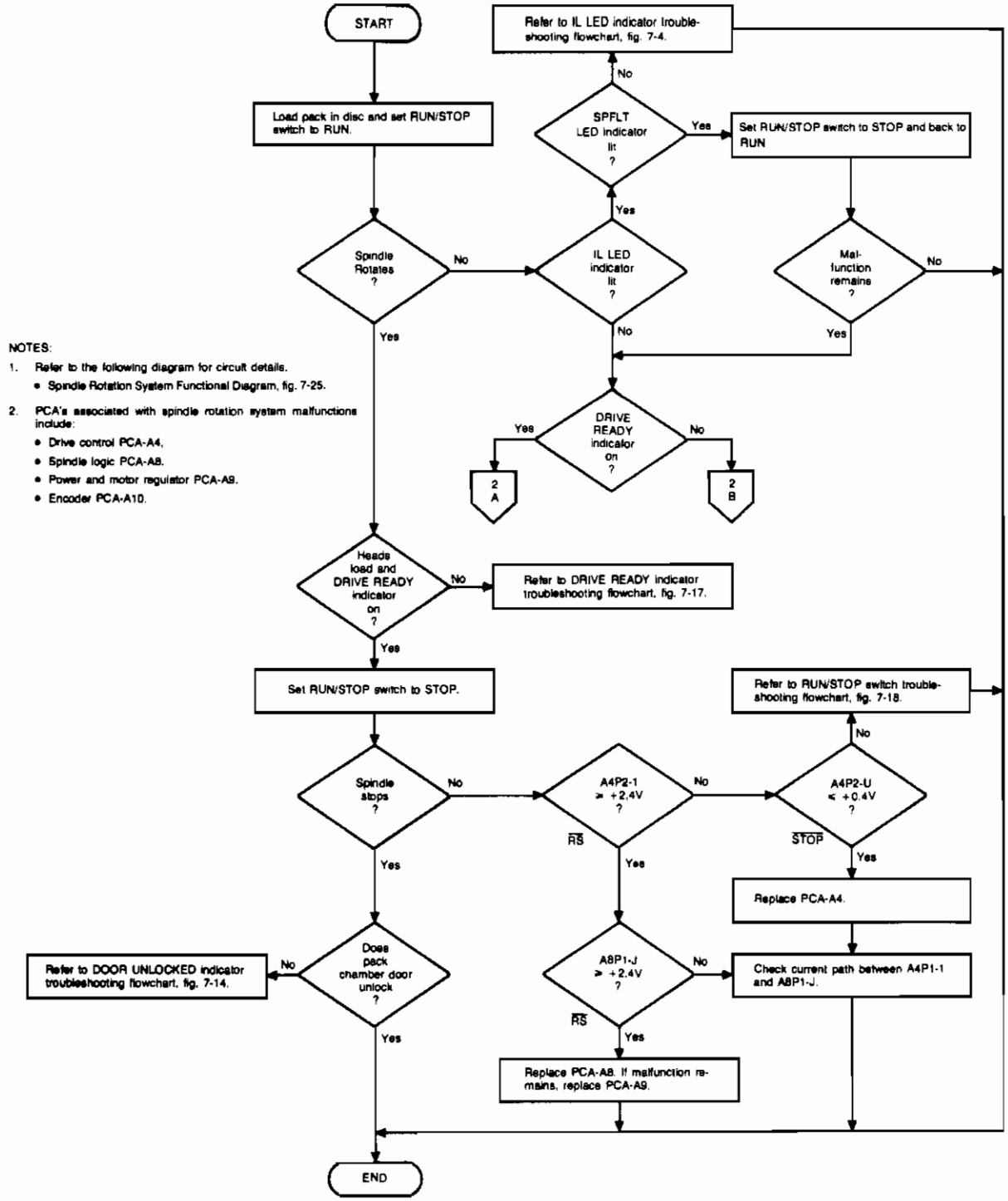

START
Set DISC switch to DISC and RUN/STOP switch to STOP.
DRIVE READY indicator on ?
No
Yes
Set RUN/STOP switch to RUN.
After 35 s delay:
Replace PCA-A4.
Heads loaded ?
Yes
No
Malfunction remains ?
No
Yes
ORIVE READY indicator on ?
Yes
No
Replace PCA-A11.
DRIVE READY indicator lamp burnt out ?
Yes
Replace lamp.
No
Malfunction remains ?
No
Yes
Replace PCA-A4.
Check for short to ground in wires connecting A4P1 to A11P1. Repair as necessary.
Malfunction remains ?
No
Yes
Replace PCA-A11.
Malfunction remains ?
Yes
Repair wire in main harness between A4P1 and A11P1.
No
END
NOTES:
1. Refer to the following diagram for circuit details.
• Head Positioning System Functional Diagram, fig. 7-28.
2. PCA's associated with DRIVE READY indicator malfunction include:
• Drive control PCA-A4,
• Indicator PCA-A11.



NOTE:

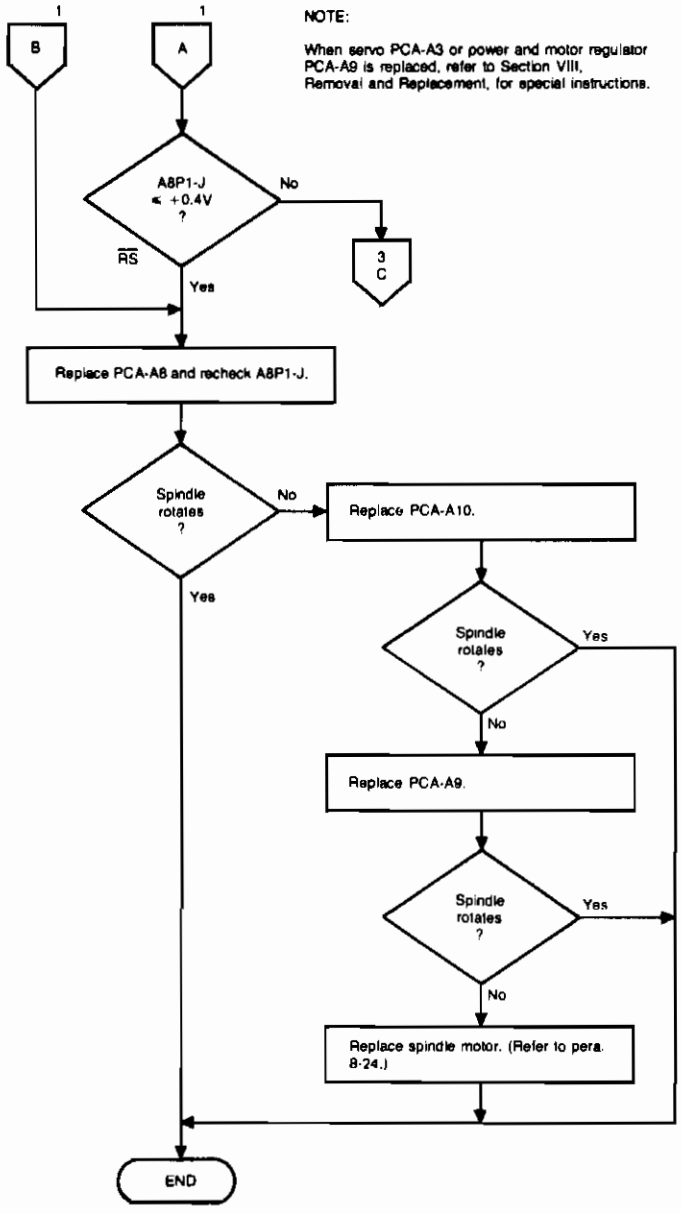
Refer to the following diagram for circuit details.

- Spindle Rotation System Functional Diagram, fig. 7-25.



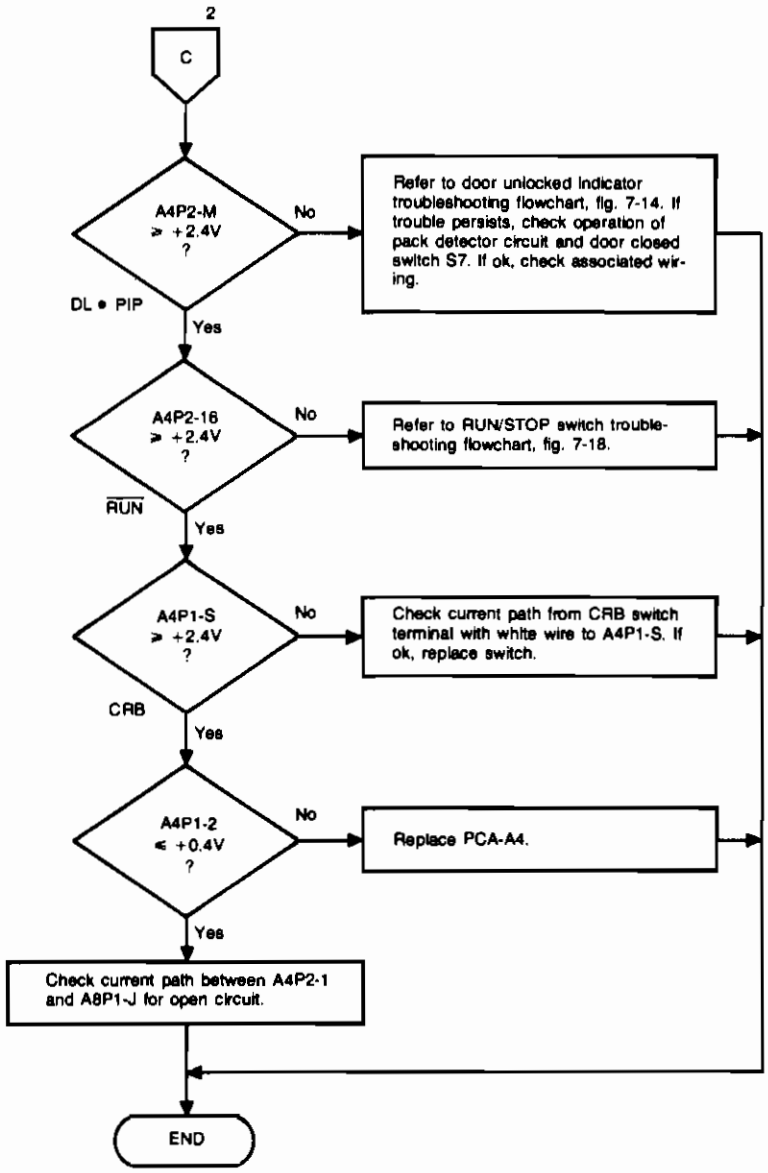
7301-73(1)

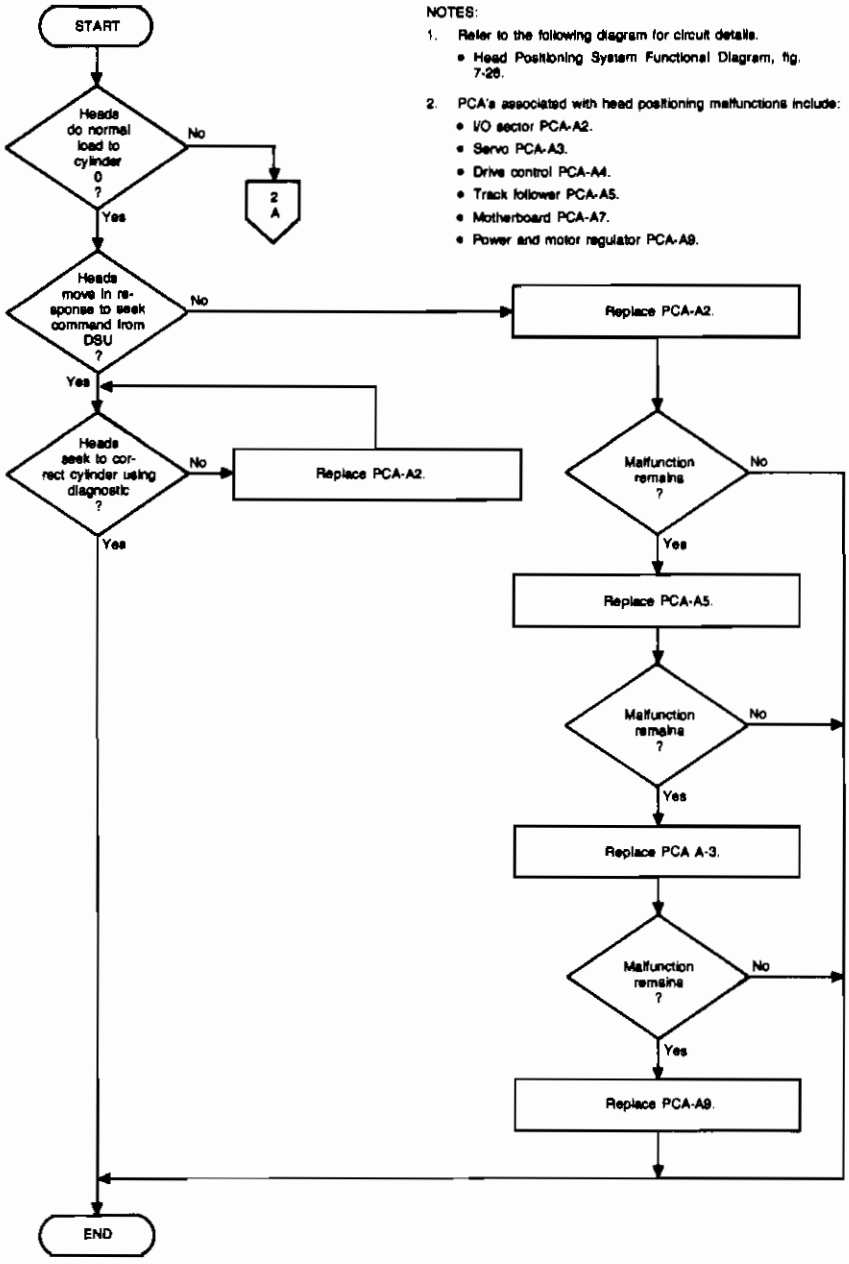
Figure 7-19. Spindle Rotation Troubleshooting Flowchart (Sheet 1 of 3)

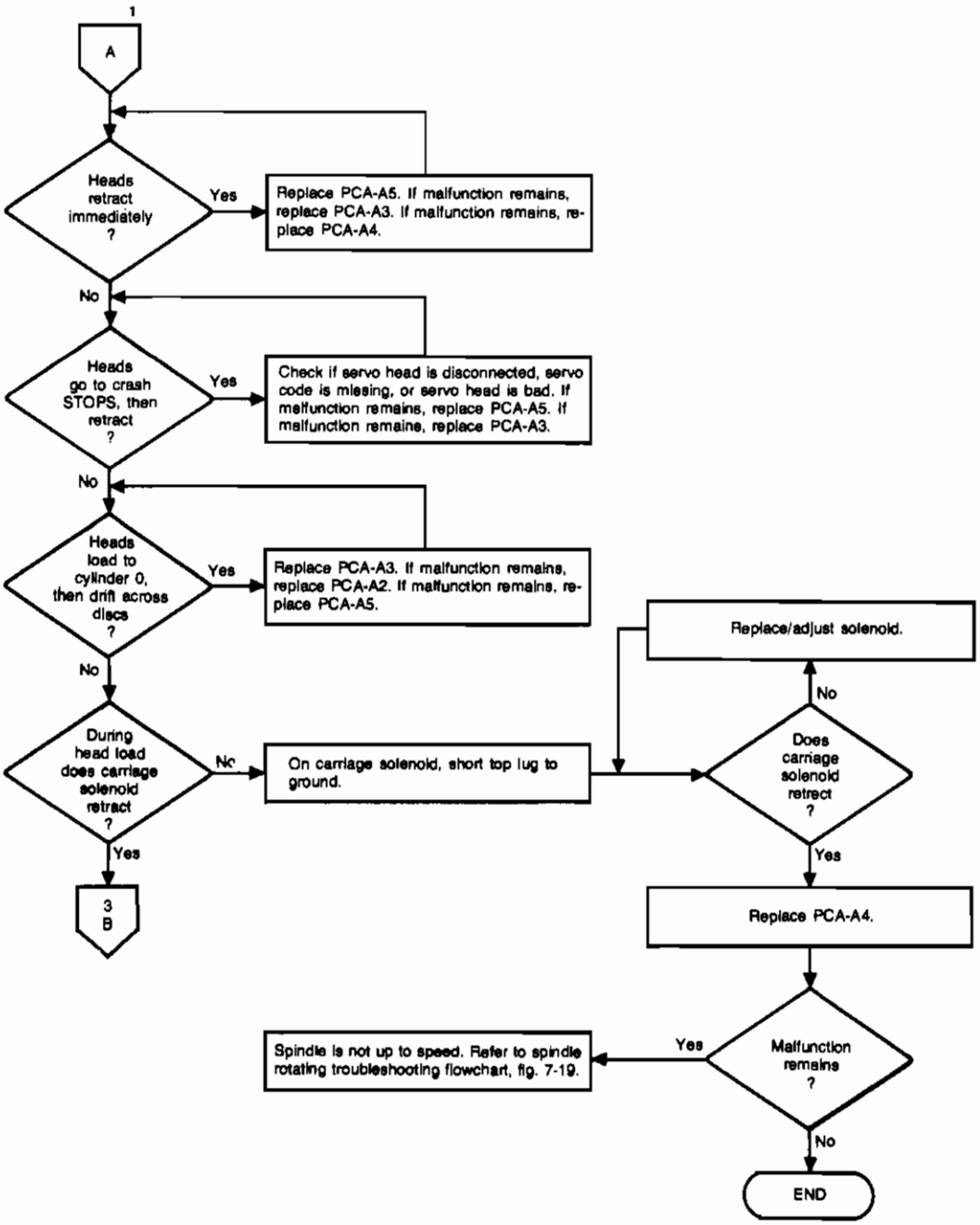


7301-73(2)A

Figure 7-19. Spindle Rotation Troubleshooting Flowchart (Sheet 2 of 3)

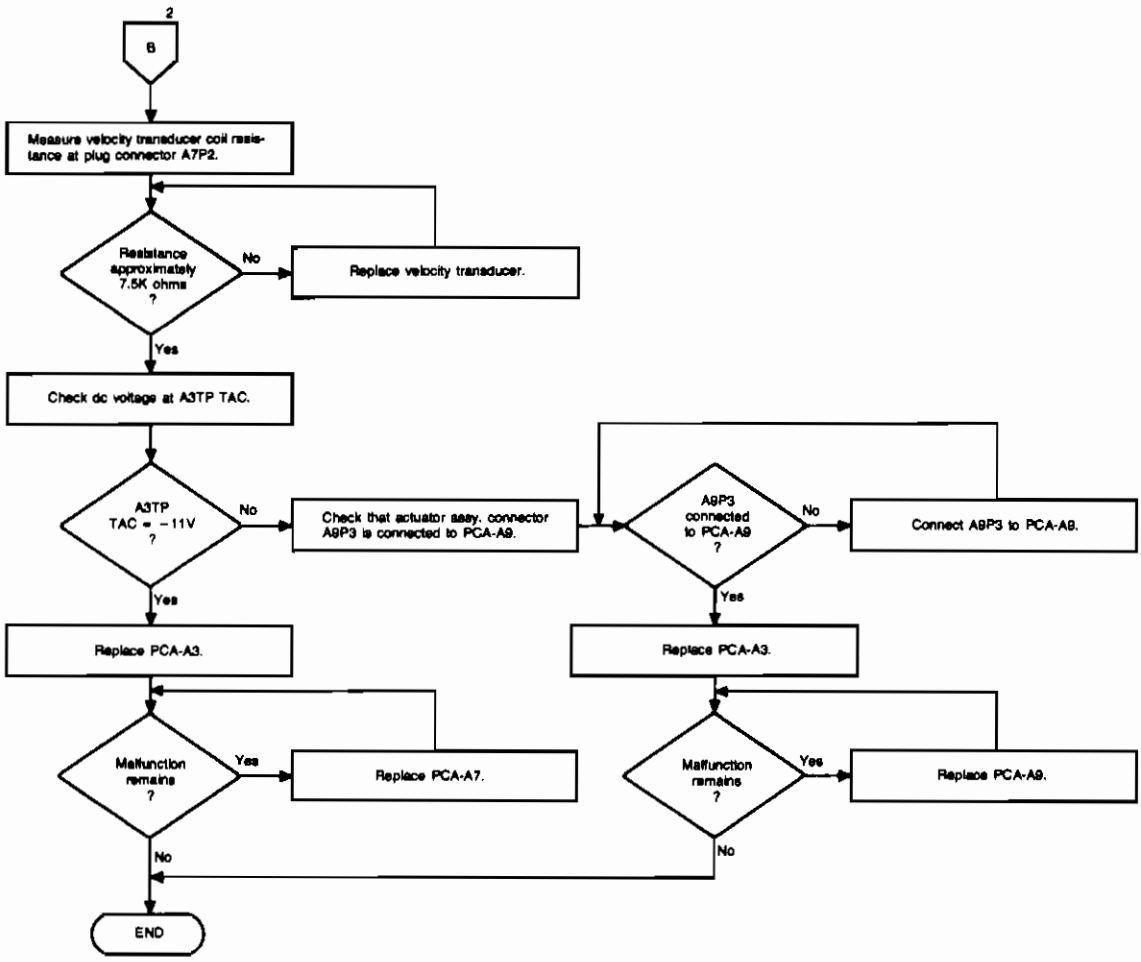

2
C
A4P2-M
≥ +2.4V
?
No
Refer to door unlocked indicator troubleshooting flowchart, fig. 7-14. If trouble persists, check operation of pack detector circuit and door closed switch S7. If ok, check associated wiring.
DL • PIP
Yes
A4P2-16
≥ +2.4V
?
No
Refer to RUN/STOP switch troubleshooting flowchart, fig. 7-18.
RUN
Yes
A4P1-S
≥ +2.4V
?
No
Check current path from CRB switch terminal with white wire to A4P1-S. If ok, replace switch.
CRB
Yes
A4P1-2
≤ +0.4V
?
No
Replace PCA-A4.
Yes
Check current path between A4P2-1 and A8P1-J for open circuit.
END


START
Heads do normal load to cylinder 0 ?
No
2 A
Yes
Heads move in response to seek command from DSU ?
No
Replace PCA-A2.
Yes
Heads seek to correct cylinder using diagnostic ?
No
Replace PCA-A2.
Yes
Malfunction remains ?
No
Yes
Replace PCA-A5.
Malfunction remains ?
No
Yes
Replace PCA A-3.
Malfunction remains ?
No
Yes
Replace PCA-A9.
END
NOTES:
1. Refer to the following diagram for circuit details.
• Head Positioning System Functional Diagram, fig. 7-26.
2. PCA's associated with head positioning malfunctions include:
• I/O sector PCA-A2.
• Servo PCA-A3.
• Drive control PCA-A4.
• Track follower PCA-A5.
• Motherboard PCA-A7.
• Power and motor regulator PCA-A9.



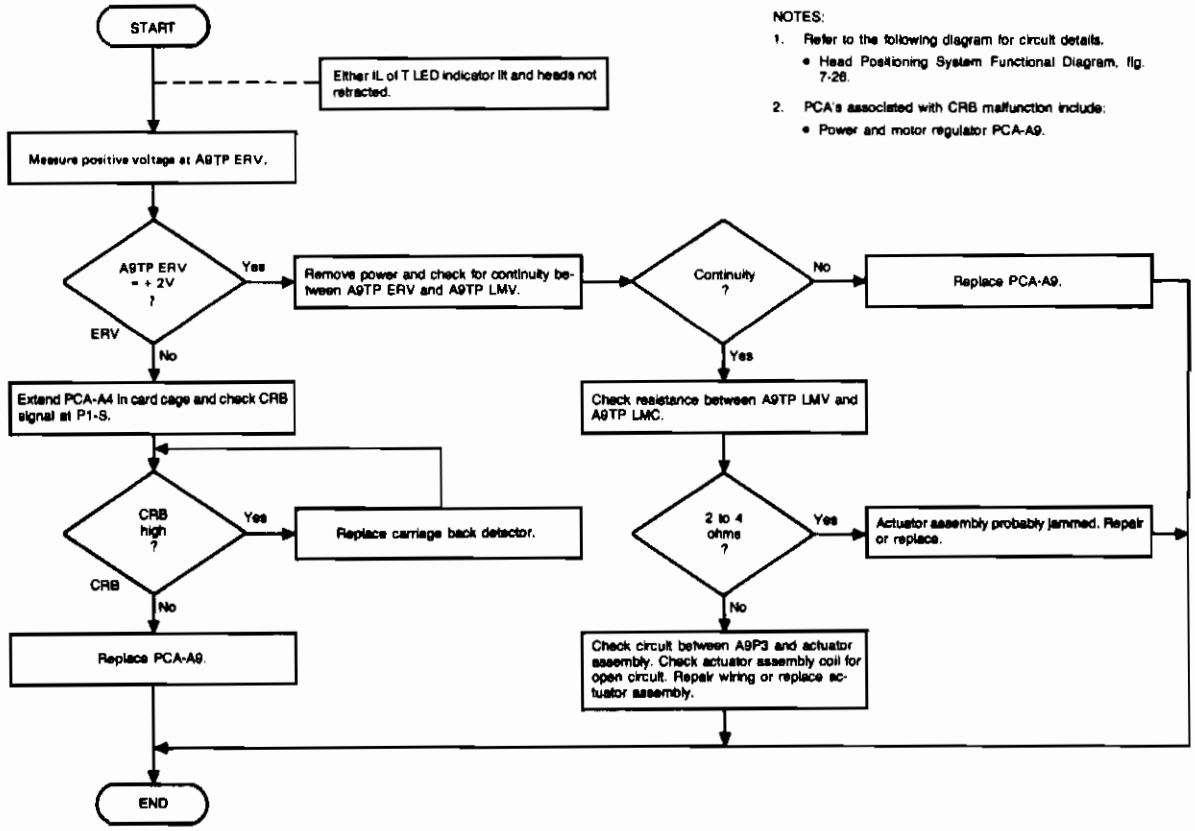
7301-74(2)A

Figure 7-20. Head Positioning Troubleshooting Flowchart (Sheet 2 of 3)



7301-74(3)A

Figure 7-20. Head Positioning Troubleshooting Flowchart (Sheet 3 of 3)



7301-75A

Figure 7-21. Emergency Return (CRB) Troubleshooting Flowchart

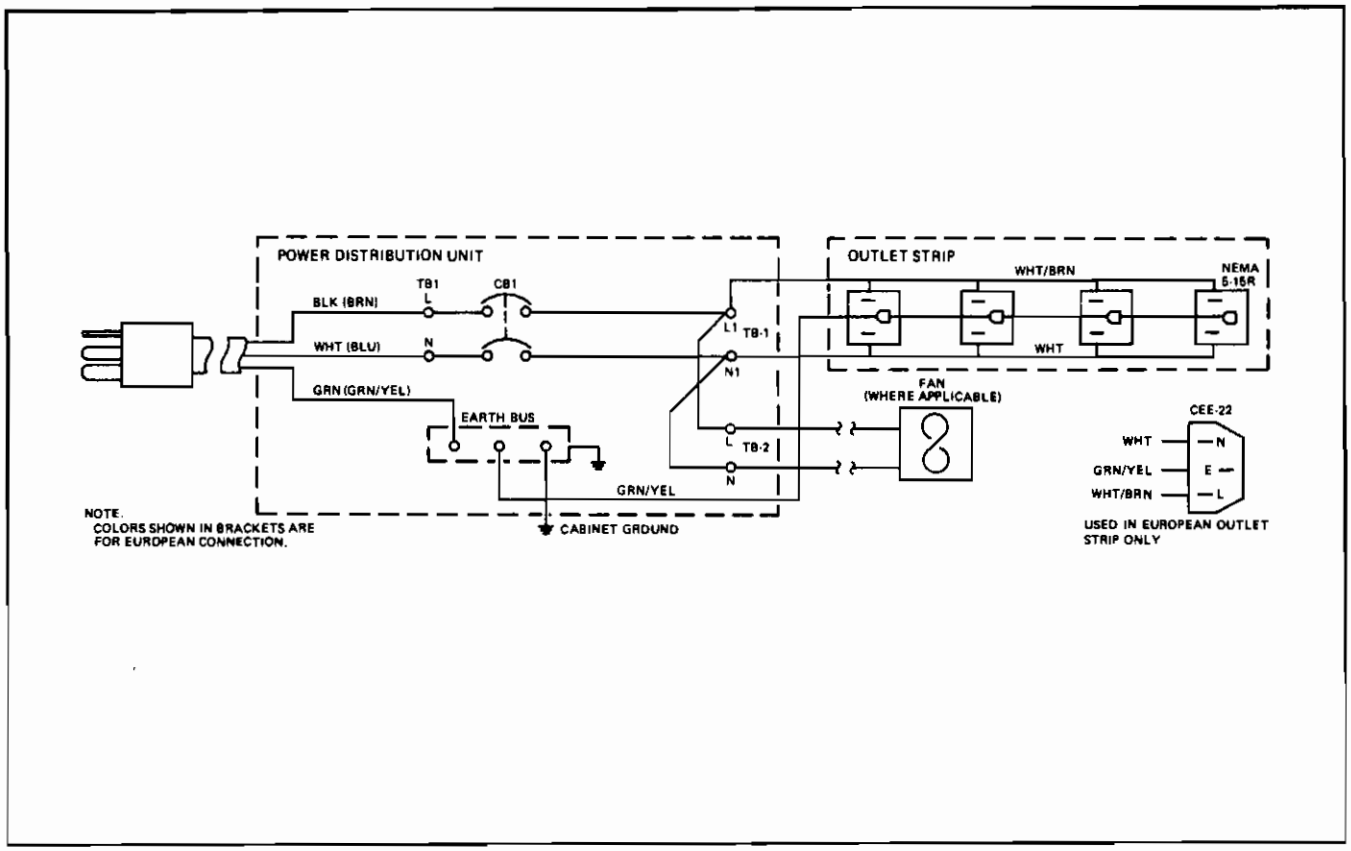


Figure 7-22 Power Panel Assembly (Part No. 02940-60156 and 02940-60157), Schematic Diagram

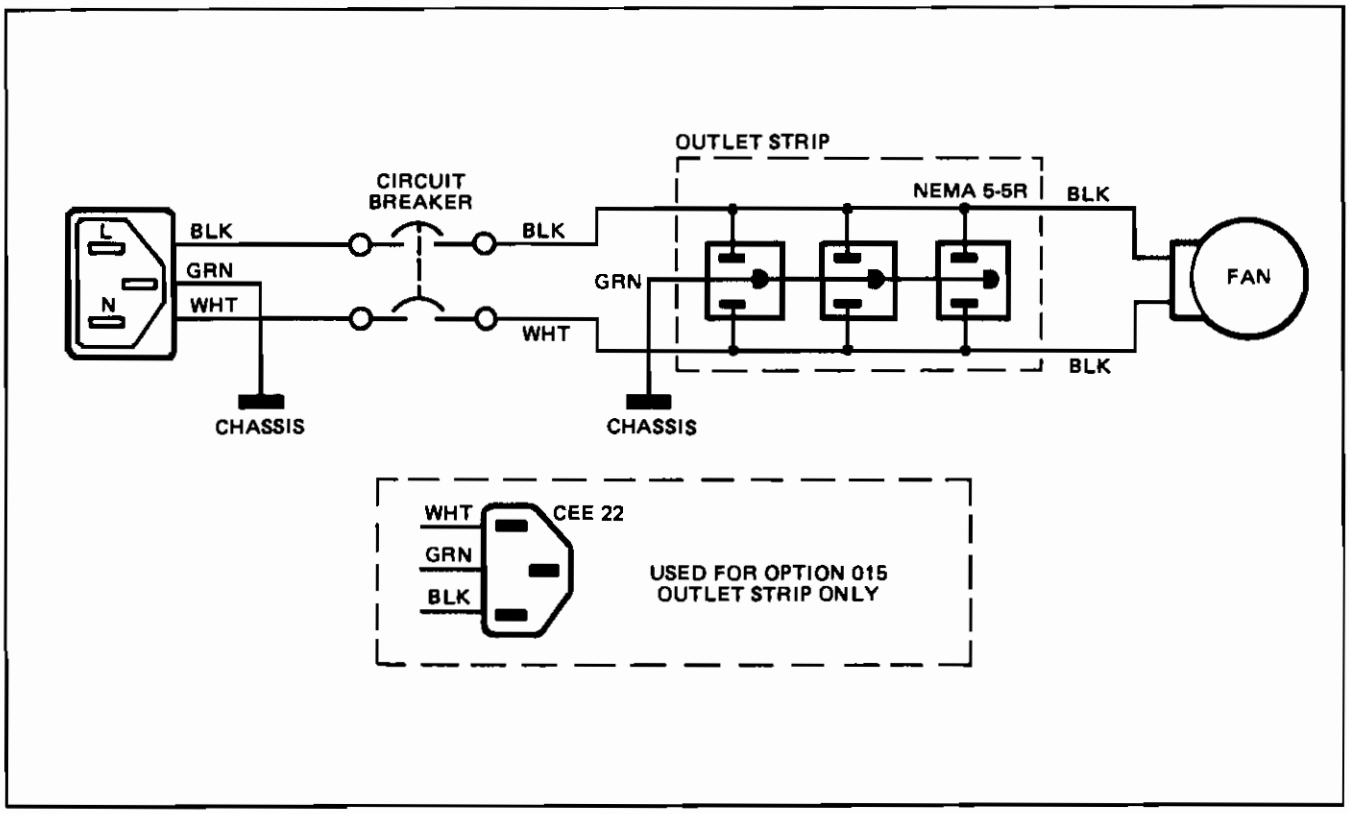


Figure 7-22A. Power Panel Assembly (Part No. 29425-60003 and 29425-60004), Schematic Diagram

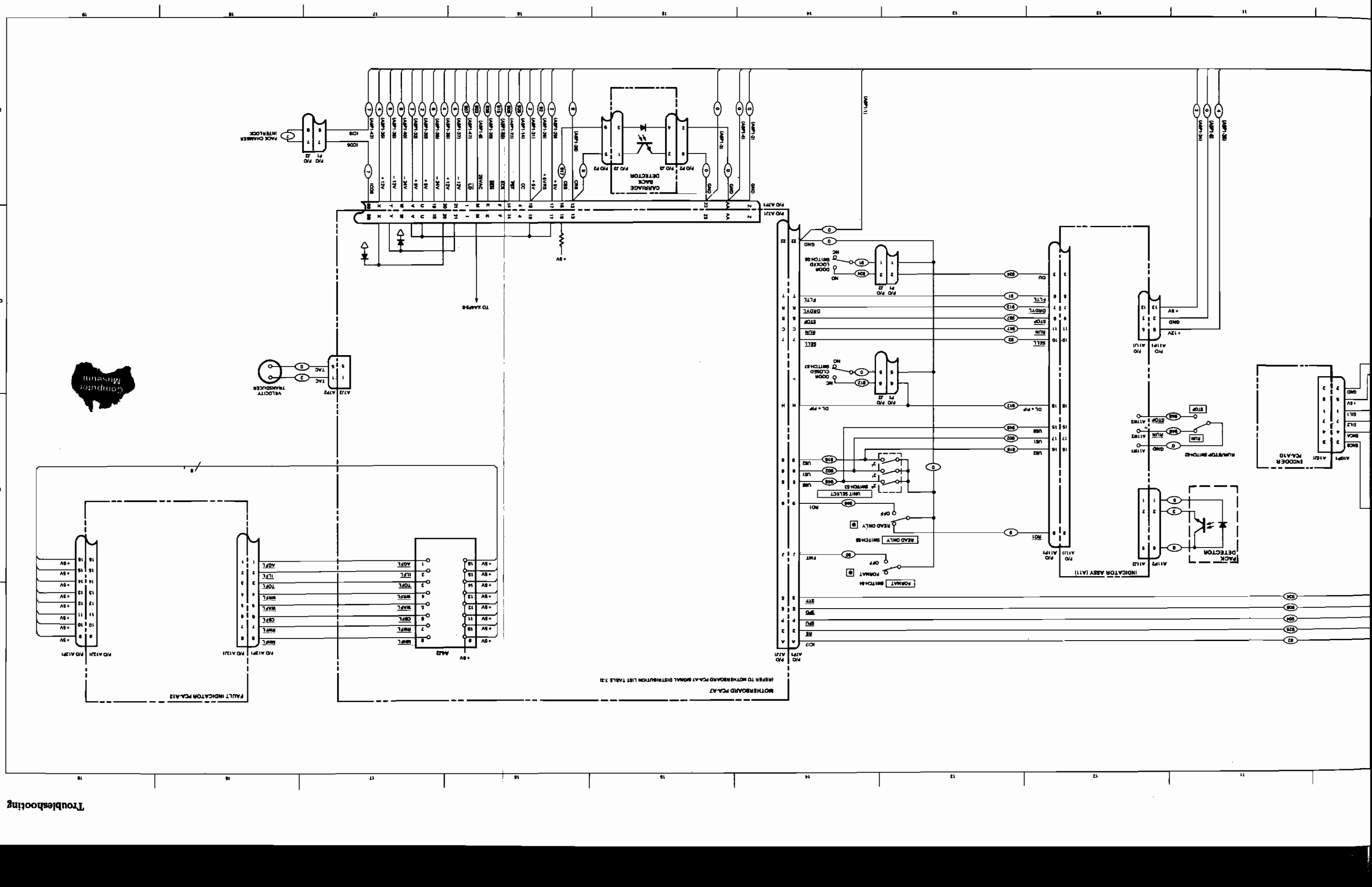
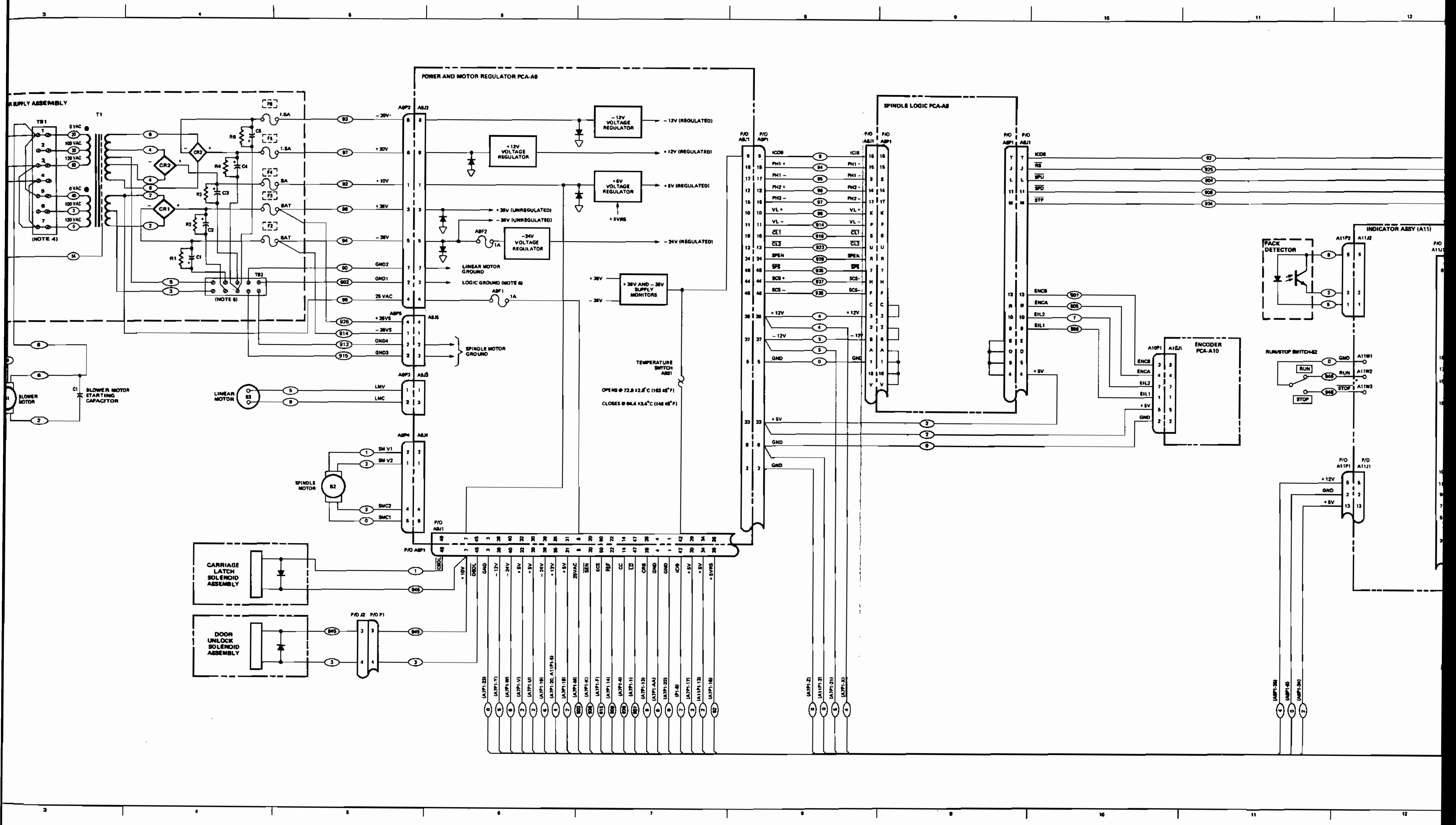
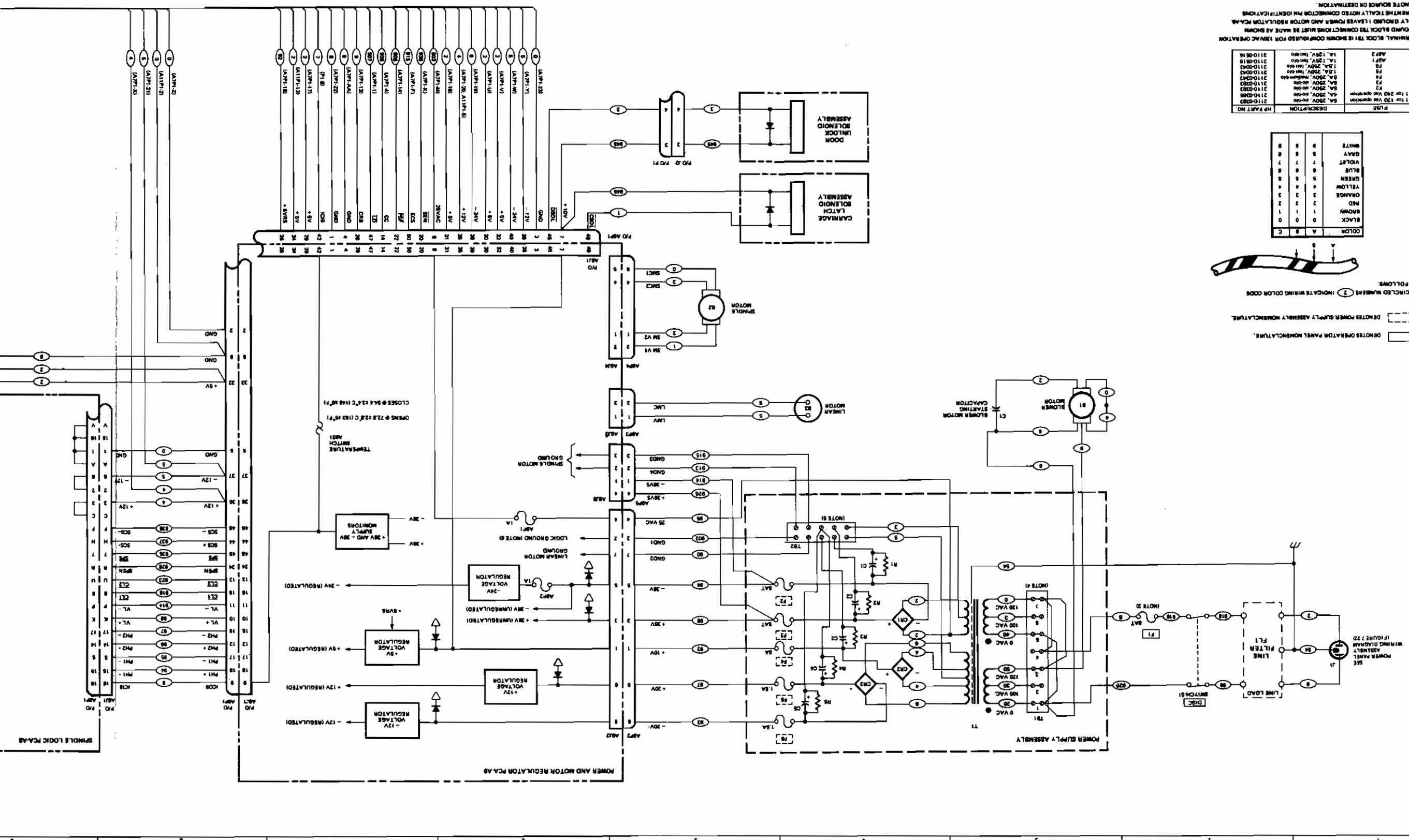


Figure 7-23. Mainframe Assembly, Wiring Diagram


POWER SUPPLY ASSEMBLY
TB1
T1
(NOTE 4)
(NOTE 5)
TB2
POWER AND MOTOR REGULATOR PCA-A9
-12V VOLTAGE REGULATOR
+12V VOLTAGE REGULATOR
+5V VOLTAGE REGULATOR
-24V VOLTAGE REGULATOR
+36V AND -36V SUPPLY MONITORS
-12V (REGULATED)
+12V (REGULATED)
+5V (REGULATED)
-24V (REGULATED)
+36V (UNREGULATED)
-36V (UNREGULATED)
LINEAR MOTOR GROUND
LOGIC GROUND (NOTE 6)
SPINDLE MOTOR GROUND
TEMPERATURE SWITCH A9S1
OPENS @ 72.8 ±2.8°C (163 ±5°F)
CLOSES @ 64.4 ±3.4°C (148 ±5°F)
BLOWER MOTOR
BLOWER MOTOR STARTING CAPACITOR
LINEAR MOTOR
SPINDLE MOTOR
CARRIAGE LATCH SOLENOID ASSEMBLY
DOOR UNLOCK SOLENOID ASSEMBLY
SPINDLE LOGIC PCA-A8
ENCODER PCA-A10
PACK DETECTOR
RUN/STOP SWITCH-S2
INDICATOR ASSY (A11)


NOTES
1. DENOTES OPERATOR PANEL NOMENCLATURE.
DENOTES POWER SUPPLY ASSEMBLY NOMENCLATURE.
2. ENCIRCLED NUMBERS (2) INDICATE WIRING COLOR CODE AS FOLLOWS:
COLOR A B C
BLACK 0 0 0
BROWN 1 1 1
RED 2 2 2
ORANGE 3 3 3
YELLOW 4 4 4
GREEN 5 5 5
BLUE 6 6 6
VIOLET 7 7 7
GRAY 8 8 8
WHITE 9 9 9
3.
FUSE DESCRIPTION HP PART NO.
F1 for 120 Vac operation 8A, 250V, slo-blo 2110-0383
F1 for 240 Vac operation 4A, 250V, slo-blo 2110-0586
F2 2A, 250V, fast-blo 2110-0043
F3 8A, 250V, fast-blo 2110-0383
F4 1.5A, 250V, fast-blo 2110-0043
F5 8A, 250V, fast-blo 2110-0383
F6 1.5A, 250V, fast-blo 2110-0043
F7 1A, 125V, fast-blo 2110-0118
F8 1A, 125V, fast-blo 2110-0043
ASP 2 1A, 125V, fast-blo 2110-06 16
4. TERMINAL BLOCK TB1 IS SHOWN CONFIGURED FOR 120VAC OPERATION
5. GROUND BLOCK TB2 CONNECTIONS MUST BE MADE AS SHOWN
6. ONLY GROUND 1 LEAVES POWER AND MOTOR ISOLATION PCA-A6
7. PARENTHETICALLY NOTED CONNECTOR PIN IDENTIFICATIONS DENOTE SOCKET ON DESTINATION.
DOOR UNLOCK SOLENOID ASSEMBLY
CARRIAGE LATCH SOLENOID ASSEMBLY
SPINDLE MOTOR
LINEAR MOTOR
BLOWER MOTOR
BLOWER MOTOR STARTING CAPACITOR
TEMPERATURE SWITCH A6S1
SPINDLE MOTOR GROUND
LINEAR MOTOR GROUND
LOGIC GROUND NOTE 6
+ 24V REGULATOR
+ 5V REGULATOR
+ 12V REGULATOR
– 12V REGULATOR
+ 5V VOLTAGE REGULATOR
+ 12V VOLTAGE REGULATOR
– 12V VOLTAGE REGULATOR
+ 24V AND – 24V SUPPLY MONITORS
POWER AND MOTOR REGULATOR PCA-A9
POWER SUPPLY ASSEMBLY
LINE FILTER FL1
LINE LOAD
SEE POWER PANEL ASSEMBLY WIRING DIAGRAM (FIGURE 7-22)
SPINDLE LOGIC PCA-A8

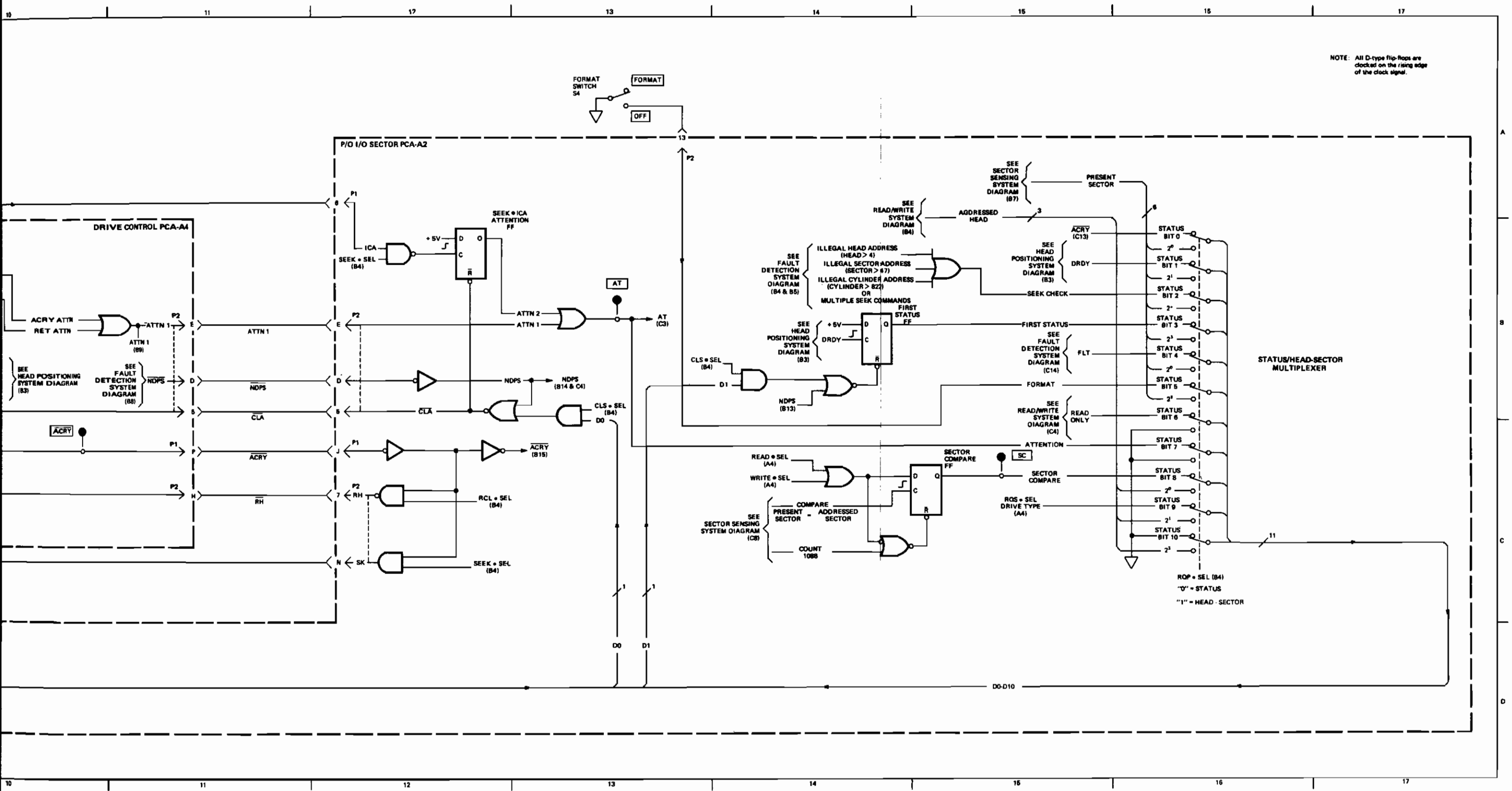
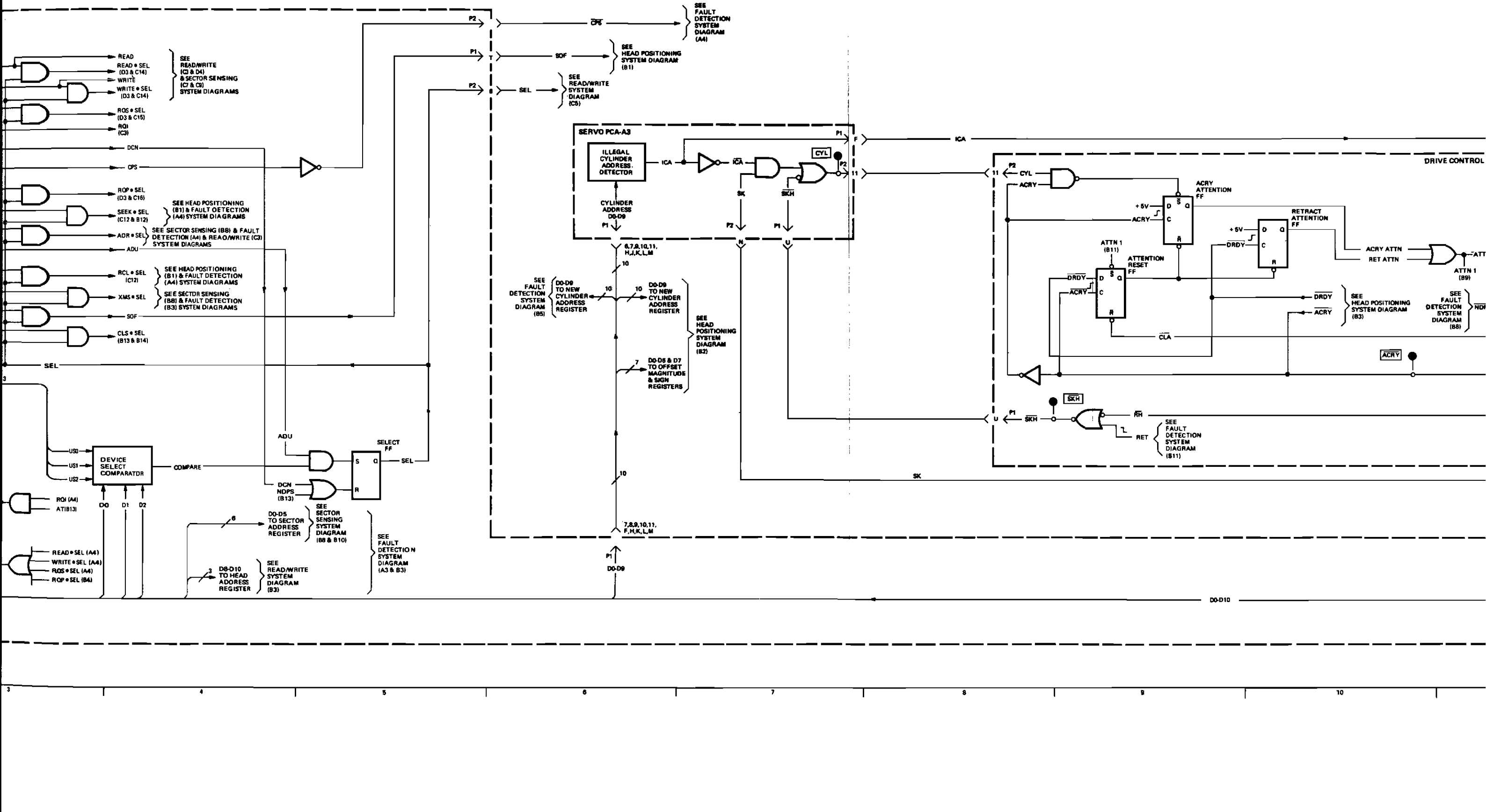
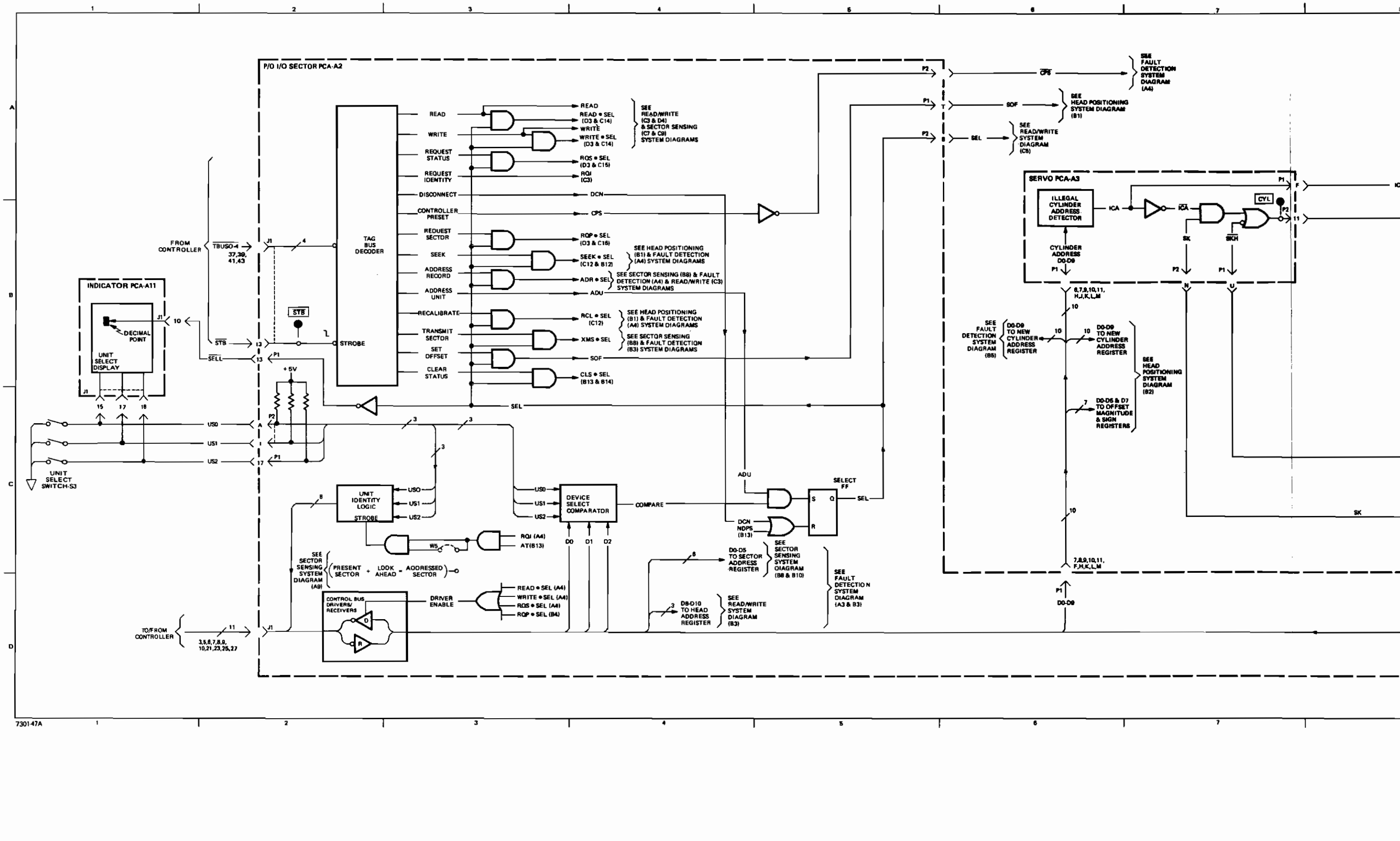


Figure 7-24. I/O Control System, Functional Diagram


READ
READ • SEL (D3 & C14)
WRITE
WRITE • SEL (D3 & C14)
SEE READ/WRITE (C3 & D4) & SECTOR SENSING (C7 & C9) SYSTEM DIAGRAMS
ROS • SEL (D3 & C15)
RQI (C3)
DCN
CPS
RQP • SEL (D3 & C16)
SEEK • SEL (C12 & B12)
SEE HEAD POSITIONING (B1) & FAULT DETECTION (A4) SYSTEM DIAGRAMS
ADR • SEL
SEE SECTOR SENSING (B8) & FAULT DETECTION (A4) & READ/WRITE (C3) SYSTEM DIAGRAMS
ADU
RCL • SEL (C12)
SEE HEAD POSITIONING (B1) & FAULT DETECTION (A4) SYSTEM DIAGRAMS
XMS • SEL
SEE SECTOR SENSING (B8) & FAULT DETECTION (B3) SYSTEM DIAGRAMS
SOF
CLS • SEL (B13 & B14)
SEL
P2
P1
CPS
SEE FAULT DETECTION SYSTEM DIAGRAM (A4)
SOF
SEE HEAD POSITIONING SYSTEM DIAGRAM (B1)
SEL
SEE READ/WRITE SYSTEM DIAGRAM (C5)
SERVO PCA-A3
ILLEGAL CYLINDER ADDRESS DETECTOR
ICA
CYL
CYLINDER ADDRESS D0-D9
SK
SKH
6,7,8,10,11, H,J,K,L,M
SEE FAULT DETECTION SYSTEM DIAGRAM (B5)
D0-D9 TO NEW CYLINDER ADDRESS REGISTER
SEE HEAD POSITIONING SYSTEM DIAGRAM (B2)
D0-D5 & D7 TO OFFSET MAGNITUDE & SIGN REGISTERS
7,8,9,10,11, F,H,K,L,M
D0-D9
DRIVE CONTROL
ACRY ATTENTION FF
RETRACT ATTENTION FF
ATTENTION RESET FF
ATTN 1 (B11)
+5V
ACRY
DRDY
CLA
ACRY ATTN
RET ATTN
ATTN 1 (B9)
SEE HEAD POSITIONING SYSTEM DIAGRAM (B3)
SEE FAULT DETECTION SYSTEM DIAGRAM (B8)
RH
RET
SEE FAULT DETECTION SYSTEM DIAGRAM (B11)
US0
US1
US2
DEVICE SELECT COMPARATOR
COMPARE
ADU
SELECT FF
DCN
NDPS (B13)
ROI (A4)
ATI (B13)
D0
D1
D2
D0-D5 TO SECTOR ADDRESS REGISTER
SEE SECTOR SENSING SYSTEM DIAGRAM (B8 & B10)
SEE FAULT DETECTION SYSTEM DIAGRAM (A3 & B3)
READ • SEL (A4)
WRITE • SEL (A4)
ROS • SEL (A4)
RQP • SEL (B4)
D8-D10 TO HEAD ADDRESS REGISTER
SEE READ/WRITE SYSTEM DIAGRAM (B3)
D0-D10


P/O I/O SECTOR PCA-A2
FROM CONTROLLER
TBUS0-4
37,39, 41,43
TAG BUS DECODER
READ
WRITE
REQUEST STATUS
REQUEST IDENTITY
DISCONNECT
CONTROLLER PRESET
REQUEST SECTOR
SEEK
ADDRESS RECORD
ADDRESS UNIT
RECALIBRATE
TRANSMIT SECTOR
SET OFFSET
CLEAR STATUS
READ • SEL (D3 & C14)
WRITE • SEL (D3 & C14)
ROS • SEL (D3 & C15)
RQI (C3)
DCN
CPS
RQP • SEL (D3 & C16)
SEEK • SEL (C12 & B12)
ADR • SEL
ADU
RCL • SEL (C12)
XMS • SEL
SOF
CLS • SEL (B13 & B14)
SEL
SEE READ/WRITE (C3 & D4) & SECTOR SENSING (C7 & C9) SYSTEM DIAGRAMS
SEE HEAD POSITIONING (B1) & FAULT DETECTION (A4) SYSTEM DIAGRAMS
SEE SECTOR SENSING (B8) & FAULT DETECTION (A4) & READ/WRITE (C3) SYSTEM DIAGRAMS
SEE HEAD POSITIONING (B1) & FAULT DETECTION (A4) SYSTEM DIAGRAMS
SEE SECTOR SENSING (B8) & FAULT DETECTION (B3) SYSTEM DIAGRAMS
INDICATOR PCA-A11
DECIMAL POINT
UNIT SELECT DISPLAY
STB
STROBE
SELL
+5V
US0
US1
US2
UNIT SELECT SWITCH-S3
UNIT IDENTITY LOGIC
STROBE
DEVICE SELECT COMPARATOR
COMPARE
WS
RQI (A4)
AT(B13)
D0
D1
D2
SEE SECTOR SENSING SYSTEM DIAGRAM (A9)
PRESENT SECTOR + LOOK AHEAD - ADDRESSED SECTOR
CONTROL BUS DRIVERS/ RECEIVERS
D
R
DRIVER ENABLE
READ • SEL (A4)
WRITE • SEL (A4)
ROS • SEL (A4)
RQP • SEL (B4)
TO/FROM CONTROLLER
3,5,6,7,8,9, 10,21,23,25,27
ADU
SELECT FF
S
Q
R
SEL
DCN
NDPS (B13)
D0-D5 TO SECTOR ADDRESS REGISTER
SEE SECTOR SENSING SYSTEM DIAGRAM (B8 & B10)
D8-D10 TO HEAD ADDRESS REGISTER
SEE READ/WRITE SYSTEM DIAGRAM (B3)
SEE FAULT DETECTION SYSTEM DIAGRAM (A3 & B3)
CPS
SOF
SEL
SEE FAULT DETECTION SYSTEM DIAGRAM (A4)
SEE HEAD POSITIONING SYSTEM DIAGRAM (B1)
SEE READ/WRITE SYSTEM DIAGRAM (C5)
SERVO PCA-A3
ILLEGAL CYLINDER ADDRESS DETECTOR
ICA
CYL
SK
SKH
CYLINDER ADDRESS D0-D9
6,7,9,10,11, H,J,K,L,M
SEE FAULT DETECTION SYSTEM DIAGRAM (B5)
D0-D9 TO NEW CYLINDER ADDRESS REGISTER
D0-D9 TO NEW CYLINDER ADDRESS REGISTER
SEE HEAD POSITIONING SYSTEM DIAGRAM (B2)
D0-D6 & D7 TO OFFSET MAGNITUDE & SIGN REGISTERS
7,8,9,10,11, F,H,K,L,M
D0-D9
7301-47A

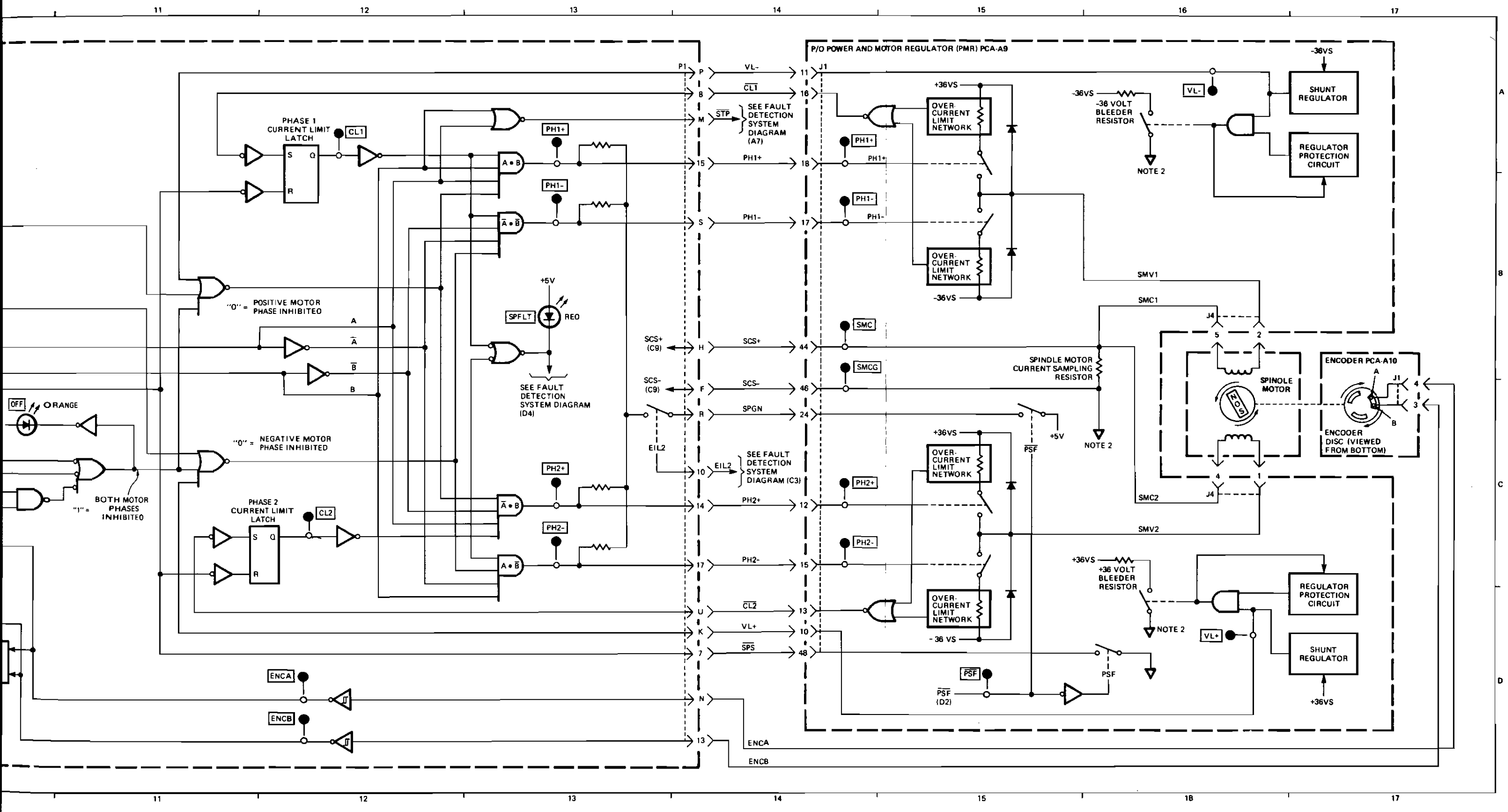
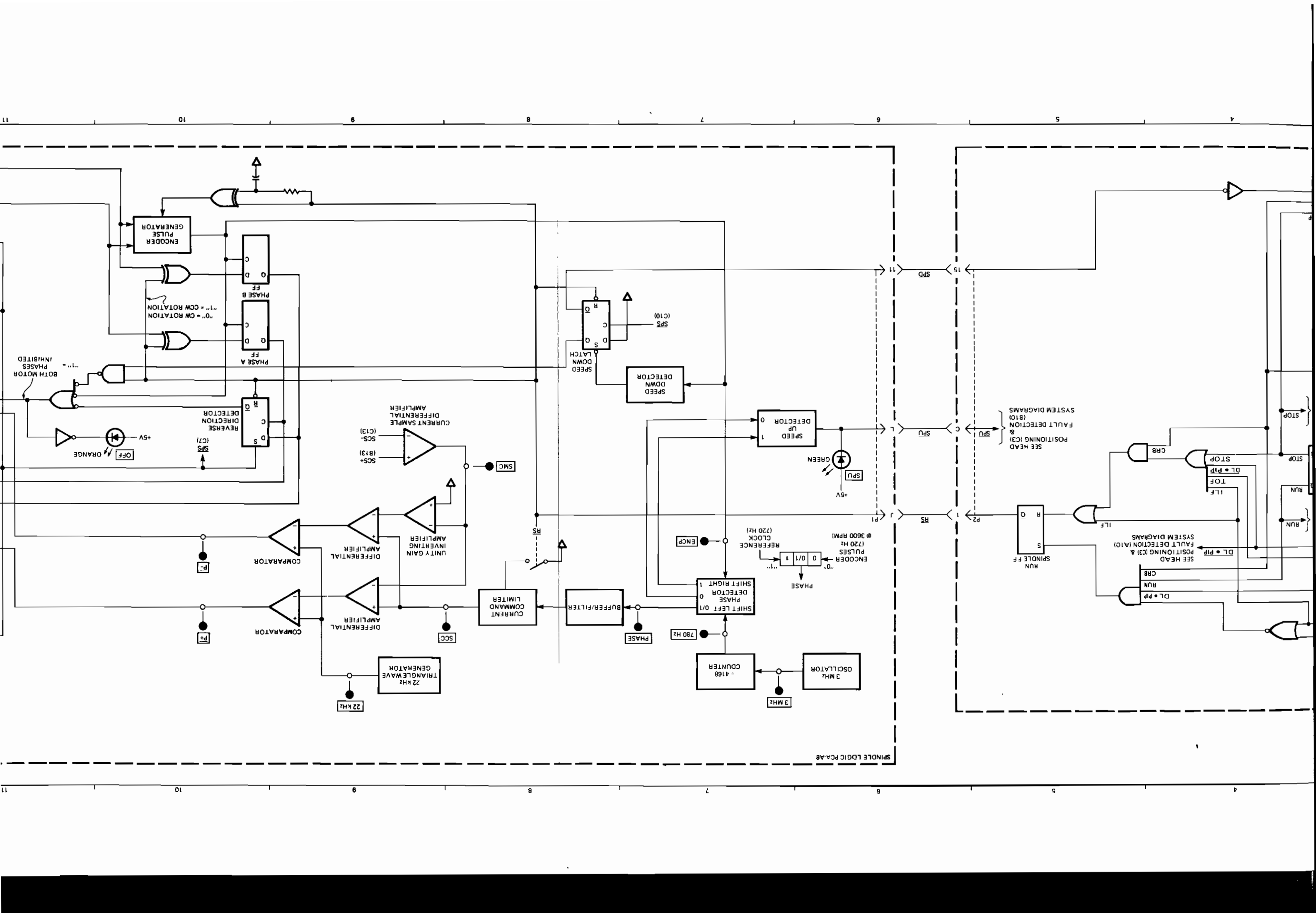


Figure 7-25. Spindle Rotation System, Functional Diagram


SPINDLE LOGIC PCA-A8
3 MHz
OSCILLATOR
÷ 4168
COUNTER
780 Hz
SHIFT LEFT 0/1
PHASE DETECTOR
SHIFT RIGHT
BUFFER/FILTER
CURRENT COMMAND LIMITER
PHASE
SCC
REFERENCE CLOCK (720 Hz)
ENCODER PULSES (720 Hz @ 3600 RPM)
ENCP
"0" = CW ROTATION
"1" = CCW ROTATION
SPEED UP DETECTOR
SPEED DOWN DETECTOR
SPEED DOWN LATCH
SPD
SPU
SPS
(C10)
(C7)
GREEN
ORANGE
OFF
+5V
BOTH MOTOR PHASES INHIBITED
PHASE A FF
PHASE B FF
ENCODER PULSE GENERATOR
REVERSE DIRECTION DETECTOR
SEE HEAD POSITIONING (C3) & FAULT DETECTION (B10) SYSTEM DIAGRAMS
SPINDLE FF
RUN
STOP
CRB
DL • PIP
ILF
TOF
CURRENT SAMPLE DIFFERENTIAL AMPLIFIER
SCS+ (B13)
SCS- (C13)
SMC
UNITY GAIN INVERTING AMPLIFIER
DIFFERENTIAL AMPLIFIER
COMPARATOR
P+
P-
TRIANGLE WAVE GENERATOR
22 kHz

NOTES: 1. ALL D-TYPE FLIP FLOPS ARE CLOCKED ON THE RISING EDGE OF THE CLOCK SIGNAL
2. SPINDLE MOTOR GROUND (GROUNDS 3 AND 4).

INDICATOR PCA-A11
DOOR LOCKED SWITCH S6
NO
NC
C
DU
3
J1
DOOR UNLOCKED
+12V
PACK DETECTOR
+5V
J2
5
2
1
PIP
PACK DETECT CIRCUIT
J1
18
DL • PIP
M
P2
DOOR CLOSED SWITCH S7
NO
NC
C
RUN/STOP SWITCH S2
RUN
W2
W1
STOP
W3
11
RUN
16
9
STOP
U
CARRIAGE BACK DETECTOR
J3
1
CBS
+5V
4
3
2
CRB
S
P1
DOOR UNLOCK SOLENOID
J2
4
DSOL
3
+10V
P/O PMR PCA-A9
J1
45
7
+10V
J1
22
47
PSF
(D15)
PSF
N
LD
2
P2
DRIVE CONTROL PCA-A4
SEE FAULT DETECTION SYSTEM DIAGRAM (B9)
TOF
ILF
DL • PIP
RUN
CRB
DL • PIP
SEE HEAD POSITIONING (C3) & FAULT DETECTION (A10) SYSTEM DIAGRAMS
SEE FAULT DETECTION SYSTEM DIAGRAM (D7)
RUN
RUN/STOP FF
S
Q
R
Q
RUN
STOP
SEE HEAD POSITIONING (C3) & FAULT DETECTION (B10) SYSTEM DIAGRAMS
STOP
RUN SPINDLE FF
S
R
Q
P2
1
RS
ILF
TOF
DL • PIP
STOP
CRB
SEE HEAD POSITIONING (C3) & FAULT DETECTION (B10) SYSTEM DIAGRAMS
SPU
C
SPU
L
PSF
SEE FAULT DETECTION SYSTEM DIAGRAM (D5)
15
SPD
11
STOP
CRB
SPD
SPINDLE LOGIC PCA-A8
3 MHz
3 MHz OSCILLATOR
÷ 4168 COUNTER
780 Hz
PHASE
SHIFT LEFT 0/1
PHASE DETECTOR 0
SHIFT RIGHT 1
BUFFER/FILTER
CURRENT COMMAND LIMITER
PHASE
"0"
"1"
ENCODER PULSES (720 Hz @ 3600 RPM)
0
0/1
1
REFERENCE CLOCK (720 Hz)
ENCP
RS
J
P1
+5V
SPU
GREEN
SPEED UP DETECTOR
1
0
SMC
SPEED DOWN DETECTOR
SPEED DOWN LATCH
S
D
Q
C
R
Q
SPS
(C10)

7301-48A

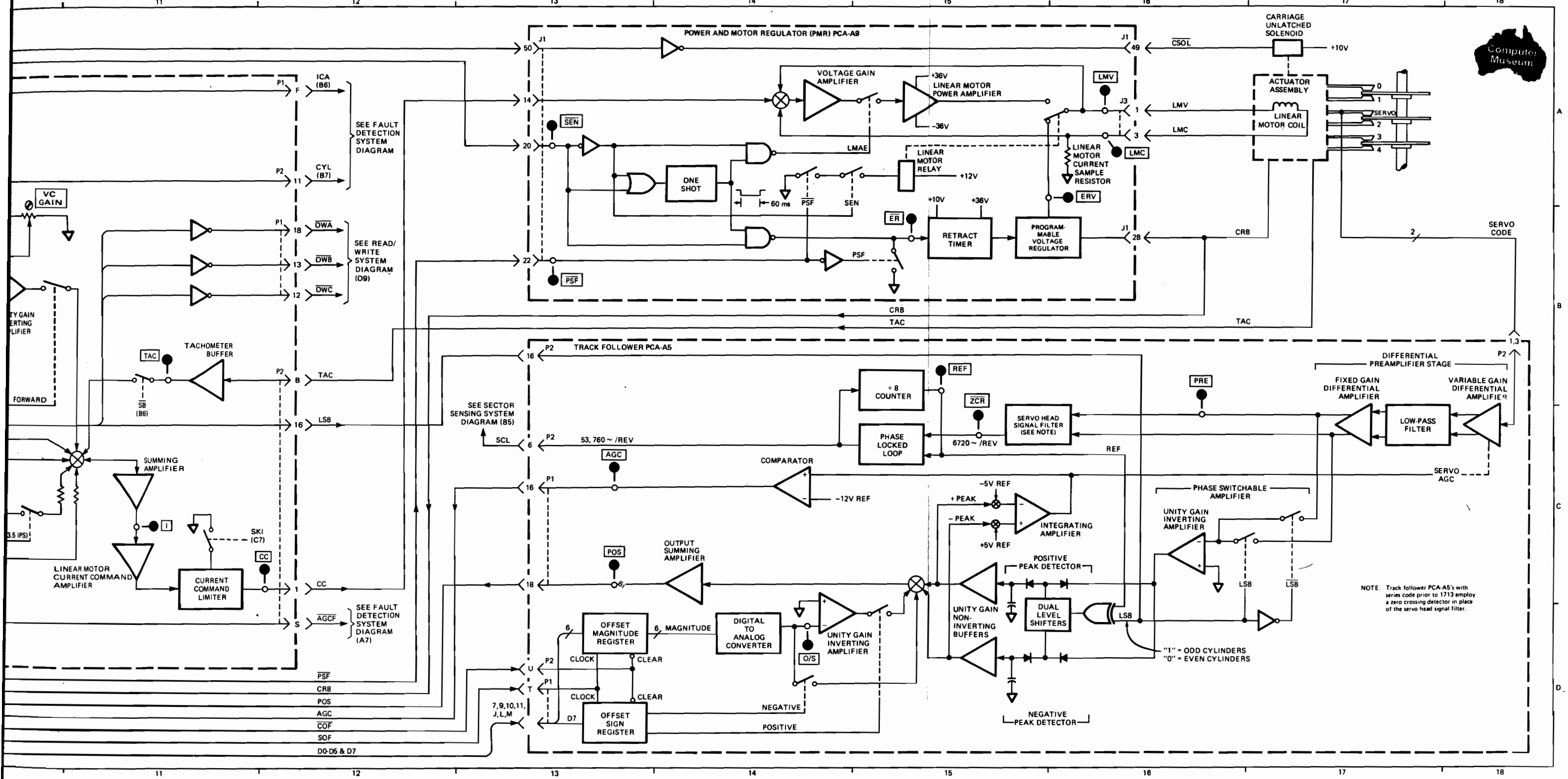
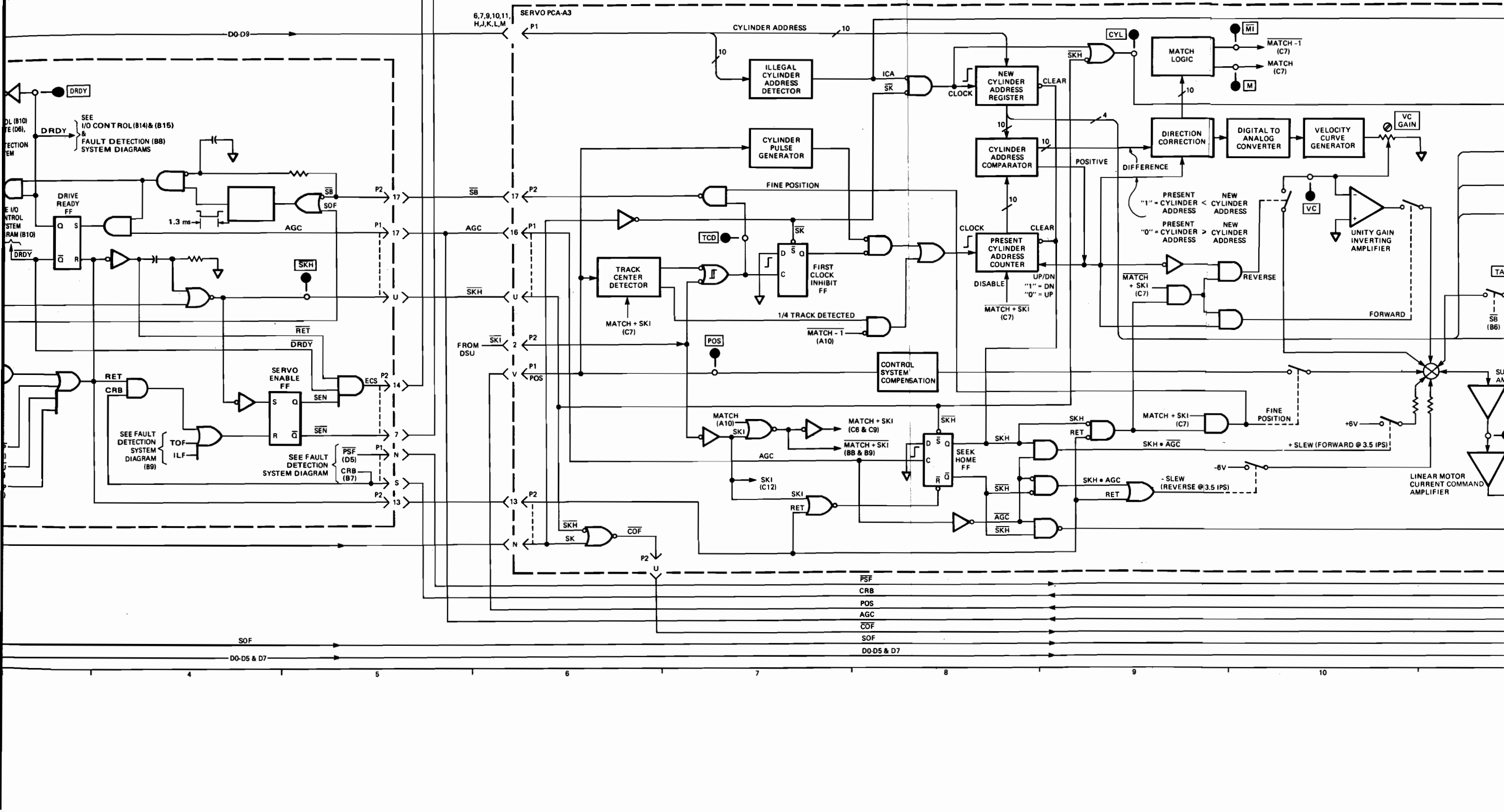
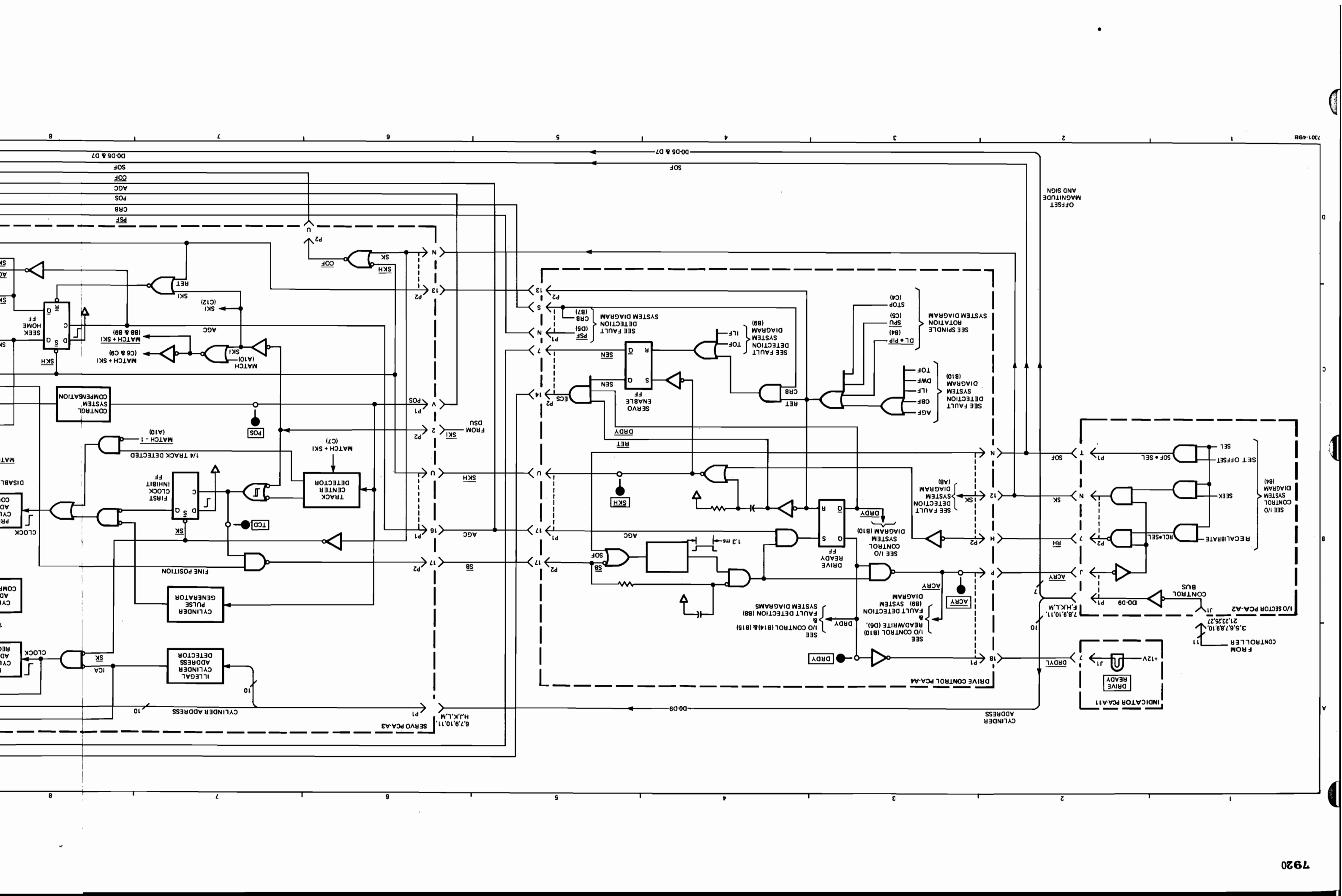
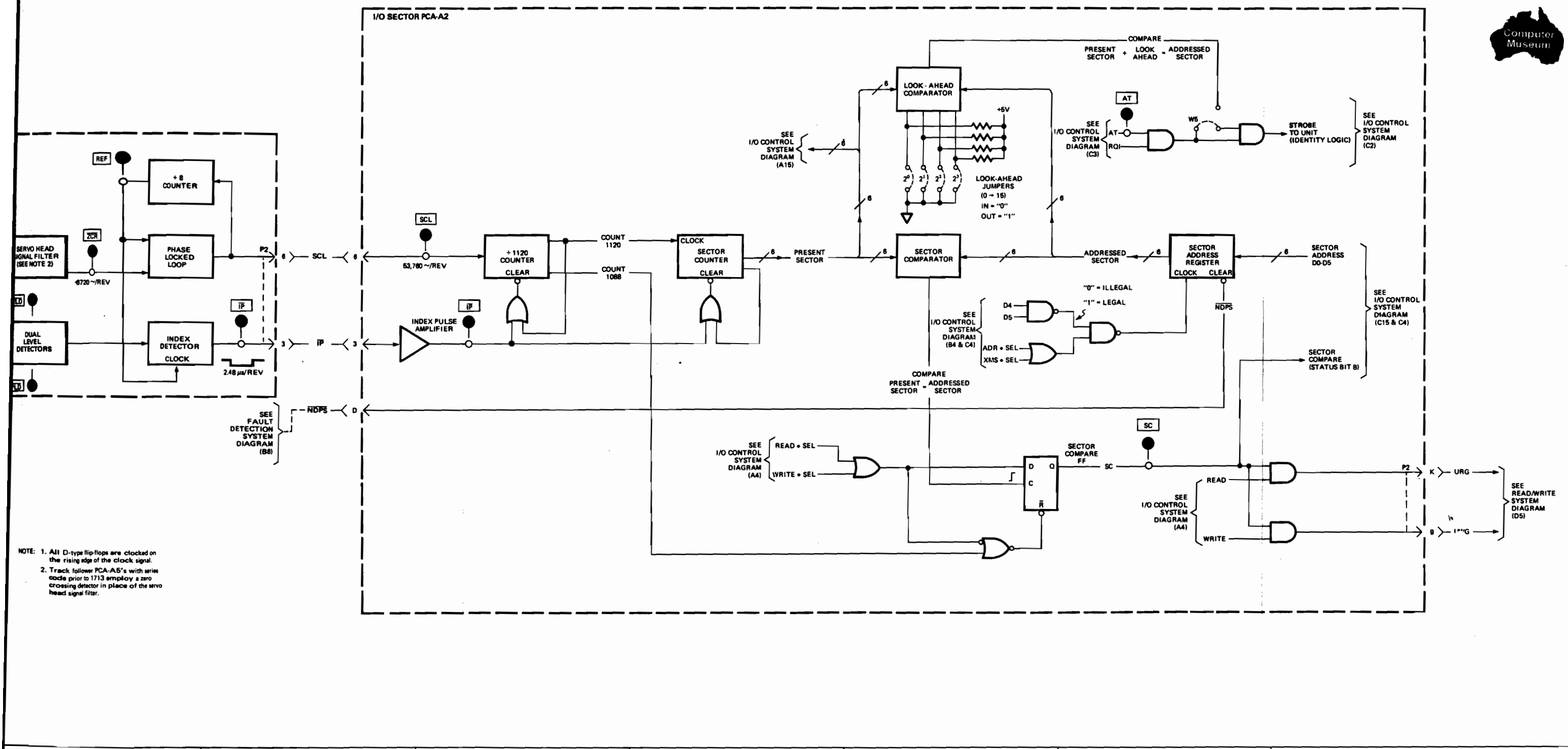


Figure 7-26. Head Positioning System, Functional Diagram

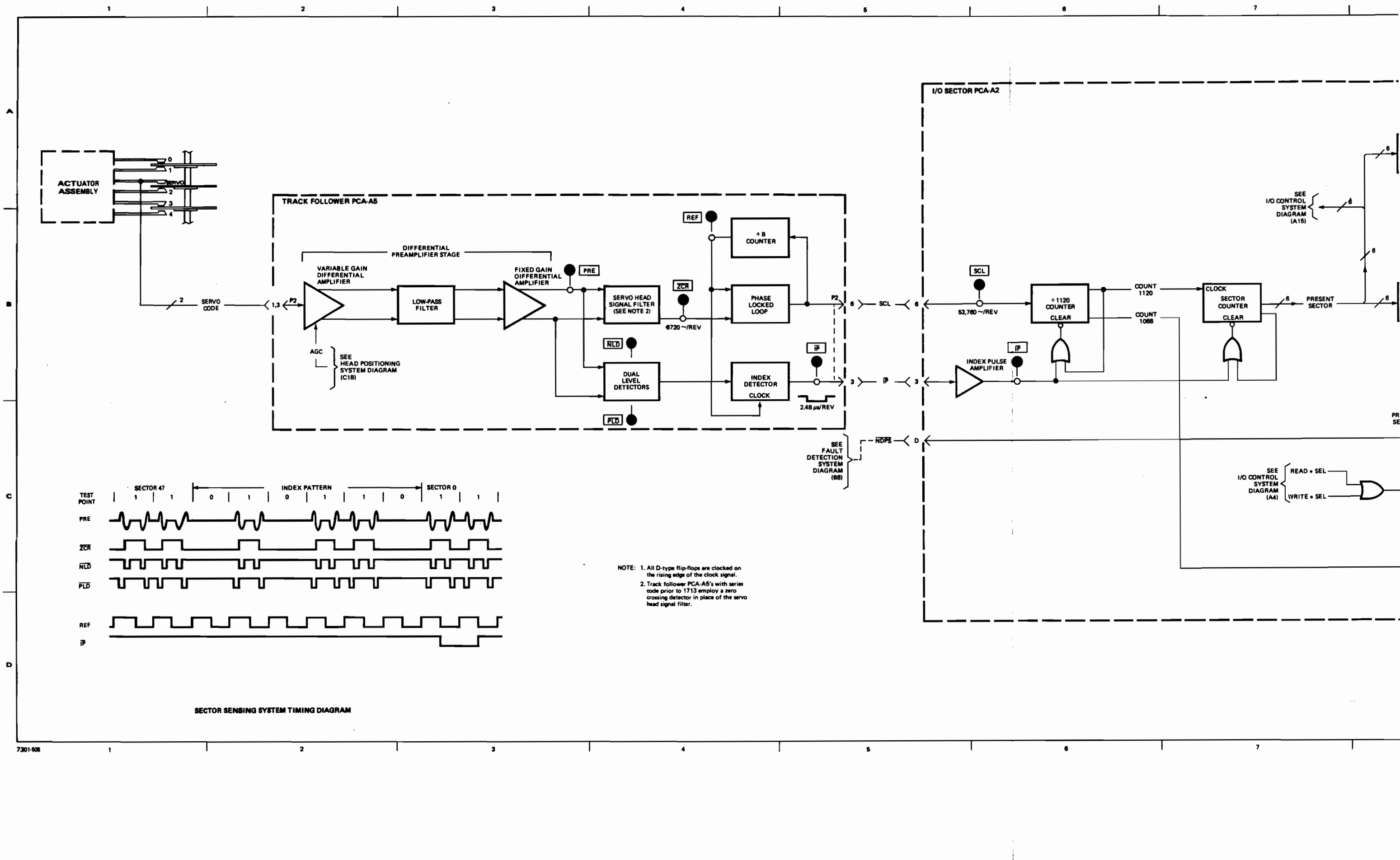

SERVO PCA-A3
6,7,9,10,11, H,J,K,L,M
D0-D9
CYLINDER ADDRESS
ILLEGAL CYLINDER ADDRESS DETECTOR
ICA
CLOCK
NEW CYLINDER ADDRESS REGISTER
CLEAR
CYL
MATCH LOGIC
MI
M
MATCH -1 (C7)
MATCH (C7)
DRDY
SEE I/O CONTROL (B14) & (B15) & FAULT DETECTION (B8) SYSTEM DIAGRAMS
DRIVE READY FF
1.3 ms
AGC
SB
SOF
SKH
RET
DRDY
RET
CRB
SERVO ENABLE FF
SEN
ECS
SEE FAULT DETECTION SYSTEM DIAGRAM (B9)
TOF
ILF
PSF (D5)
CRB (B7)
SEE FAULT DETECTION SYSTEM DIAGRAM
CYLINDER PULSE GENERATOR
FINE POSITION
TRACK CENTER DETECTOR
MATCH + SKI (C7)
TCD
SK
FIRST CLOCK INHIBIT FF
1/4 TRACK DETECTED
MATCH - 1 (A10)
POS
FROM DSU
SKI
CONTROL SYSTEM COMPENSATION
CYLINDER ADDRESS COMPARATOR
POSITIVE
DIFFERENCE
DIRECTION CORRECTION
DIGITAL TO ANALOG CONVERTER
VELOCITY CURVE GENERATOR
VC GAIN
PRESENT "1" = CYLINDER ADDRESS < NEW CYLINDER ADDRESS
PRESENT "0" = CYLINDER ADDRESS ≥ NEW CYLINDER ADDRESS
VC
UNITY GAIN INVERTING AMPLIFIER
PRESENT CYLINDER ADDRESS COUNTER
DISABLE
UP/DN "1" = DN "0" = UP
MATCH + SKI (C7)
MATCH + SKI (C7)
REVERSE
FORWARD
MATCH (A10)
SKI (C12)
MATCH + SKI (C8 & C9)
MATCH + SKI (B8 & B9)
SEEK HOME FF
SKH • AGC
+SLEW (FORWARD @ 3.5 IPS)
-SLEW (REVERSE @ 3.5 IPS)
+6V
-6V
FINE POSITION
LINEAR MOTOR CURRENT COMMAND AMPLIFIER
PSF
CRB
POS
AGC
COF
SOF
D0-D5 & D7


7301-49B
DD-D5 & D7
SOF
OFFSET MAGNITUDE AND SIGN
DRIVE CONTROL PCA-A4
INDICATOR PCA-A11
DRIVE READY
+12V
J1
DRDYL
CYLINDER ADDRESS
DD-D9
I/O SECTOR PCA-A2
FROM CONTROLLER
3,5,6,7,8,9,10, 21,22,25,27
J11
CONTROL BUS
DD-D9
7,8,9,10,11, F,H,K,L,M
ACRY
RH
RCL•SEL
RECALIBRATE
SEEK
SOF • SEL
SET OFFSET
SEL
SEE I/O CONTROL SYSTEM DIAGRAM (84)
SERVO PCA-A3
6,7,9,10,11, H,J,K,L,M
CYLINDER ADDRESS
ILLEGAL CYLINDER ADDRESS DETECTOR
ICA
CLOCK
SK
CYLINDER PULSE GENERATOR
FINE POSITION
TRACK CENTER DETECTOR
1/4 TRACK DETECTED
MATCH - 1 (A10)
MATCH + SKI (C7)
FIRST CLOCK INHIBIT FF
TCD
POS
CONTROL SYSTEM COMPENSATION
FROM DSU
SKI
DRDY
SERVO ENABLE FF
SEN
ECS
SEE FAULT DETECTION SYSTEM DIAGRAM (B9)
TOF
ILF
SEE FAULT DETECTION SYSTEM DIAGRAM (B10)
AGF
CBF
DWF
SEE SPINDLE ROTATION SYSTEM DIAGRAM
DL • PIP (B4)
SPU (C5)
STOP (C4)
SEE FAULT DETECTION SYSTEM DIAGRAM (B7)
CRB
PSF
SEE FAULT DETECTION SYSTEM DIAGRAM (A8)
SEE I/O CONTROL SYSTEM DIAGRAM (B10)
DRIVE READY FF
1.3 ms
SOF
SB
AGC
SKH
SK
COF
RET
ACRY
SEE I/O CONTROL (B14)& (B15) & FAULT DETECTION (B8) & SYSTEM DIAGRAMS
SEE I/O CONTROL (B10) & READ/WRITE (D6), & FAULT DETECTION (B9) SYSTEM DIAGRAM
MATCH (A10)
MATCH + SKI (C6 & C9)
MATCH + SKI (B8 & B9)
SEEK HOME FF
SKI (C12)
PSF
CRB
POS
AGC
COF
SOF
DD-D5 & D7



NOTE: 1. All D-type flip-flops are clocked on the rising edge of the clock signal.
2. Track follower PCA-A5's with series code prior to 1713 employ a zero crossing detector in place of the servo head signal filter.

Figure 7-27. Sector Sensing System, Functional Diagram



NOTE: 1. All D-type flip-flops are clocked on the rising edge of the clock signal.
2. Track follower PCA-A5's with series code prior to 1713 employ a zero crossing detector in place of the servo head signal filter.

SECTOR SENSING SYSTEM TIMING DIAGRAM

7301-508

READ DATA

R/W PREAMPLIFIER PCA-A6

+12V

HEAD

DATA HEAD 0

DATA HEAD 1

DATA HEAD 2

DATA HEAD 3

DATA HEAD 4

INHIBIT

DATA HEAD DECODER

SERVO

WDPB

WDPA

READ

WRITE

WEN

PREAMPLIFIER STAGE

DGC

LOW-PASS FILTER

DIFFERENTIATOR STAGE

P1 13 RDA F

P1 14 RDB B

H DGC M

LINE DRIVER

SEL (C6)

URG (D7)

RDA

RDB

READ AMPLIFIER

LOW-PASS FILTER

ZERO CROSSING DETECTOR

DGC

DATA AGC CIRCUIT

WRITE (D7)

P/O DRIVE CONTROL PCA-A4

CYLINDER	$\overline{DWA}$ 2^2	$\overline{DWB}$ 2^1	$\overline{DWC}$ 2^0	DECREASE IN WRITE CURRENT (mA PEAK)
0 → 127	0	0	0	0
128 → 255	0	0	1	3.25
256 → 383	0	1	0	6.50
384 → 511	0	1	1	9.75
512 → 639	1	0	0	13.00
640 → 767	1	0	1	16.25
768 → 822	1	1	0	19.50

P1 11 BHS0 2 C

P1 10 BHS1 C

9 BHS2 3

+12V

SEE FAULT DETECTION SYSTEM DIAGRAM (D5)

T WFLT R

B WDA D

7 WDB 4

SEE FAULT DETECTION SYSTEM DIAGRAM (C9)

+12V

P1 H WEN E

SEE FAULT DETECTION SYSTEM DIAGRAM (C8)

WRITE DATA PHASE A

WRITE DATA PHASE B

WDA

WDB

AC WRITE CURRENT DETECTOR

MULTIPLE HEADS SELECTED DETECTOR

DC WRITE CURRENT DETECTOR

F ACW

6 $\overline{MHS}$

5 DCW

SEE FAULT DETECTION SYSTEM DIAGRAM (C8)

SERVO PCA-A3

SEE HEAD POSITIONING SYSTEM DIAGRAM (B12)

D9 P1 18 $\overline{DWA}$ A

D8 13 $\overline{DWB}$ B

D7 12 $\overline{DWC}$ 1

$\overline{DWA}$ (13.00 mA) $\overline{DWB}$ (6.50 mA) $\overline{DWC}$ (3.25 mA)

PROGRAMMABLE WRITE CURRENT SINK

SWITCHABLE WRITE CURRENT SOURCE

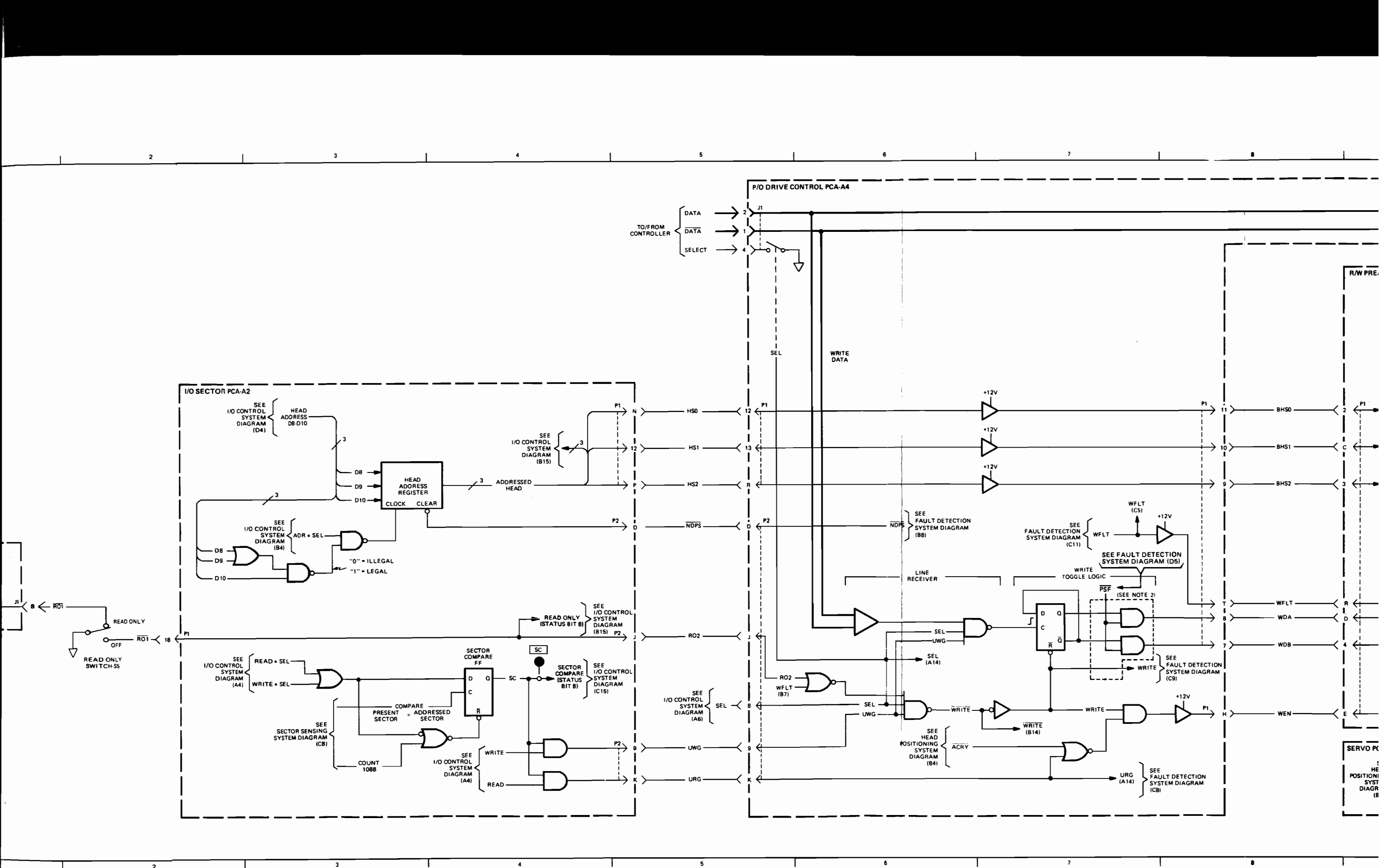
NOTES:

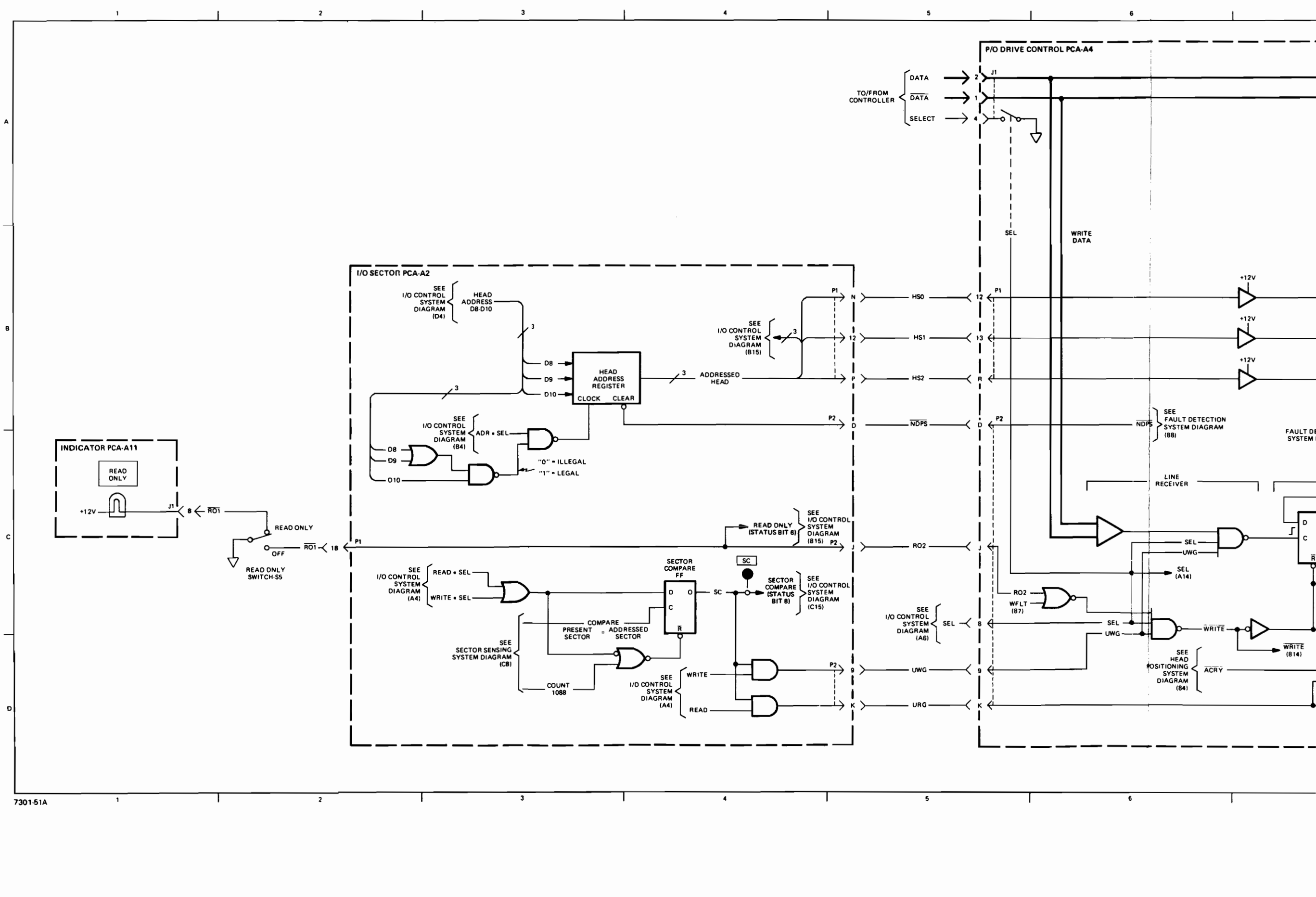
1. All D-Type flip-flops are clocked on the rising edge of the clock signal.
2. First used on disc drives with serial prefix 1B25.

THE CONFIGURATION SHOWN BELOW USED PRIOR TO 1740

WRITE

Figure 7-28. Read/Write System, Functional Diagram


P/O DRIVE CONTROL PCA-A4
I/O SECTOR PCA-A2
TO/FROM CONTROLLER
DATA
DATA
SELECT
J1
SEL
WRITE DATA
SEE I/O CONTROL SYSTEM DIAGRAM (D4)
HEAD ADDRESS D8-D10
HEAD ADDRESS REGISTER
CLOCK
CLEAR
ADDRESSED HEAD
SEE I/O CONTROL SYSTEM DIAGRAM (B15)
SEE I/O CONTROL SYSTEM DIAGRAM (B4)
ADR • SEL
"0" = ILLEGAL
"1" = LEGAL
HS0
HS1
HS2
NDPS
RO2
SEL
UWG
URG
READ ONLY
READ ONLY SWITCH-S5
READ ONLY (STATUS BIT 8)
SEE I/O CONTROL SYSTEM DIAGRAM (B15)
SEE I/O CONTROL SYSTEM DIAGRAM (A4)
READ • SEL
WRITE • SEL
SECTOR COMPARE FF
SC
SECTOR COMPARE (STATUS BIT 8)
SEE I/O CONTROL SYSTEM DIAGRAM (C15)
COMPARE PRESENT SECTOR = ADDRESSED SECTOR
SEE SECTOR SENSING SYSTEM DIAGRAM (C8)
COUNT 1088
SEE I/O CONTROL SYSTEM DIAGRAM (A6)
SEE FAULT DETECTION SYSTEM DIAGRAM (B8)
SEE FAULT DETECTION SYSTEM DIAGRAM (C11)
WFLT (C5)
+12V
SEE FAULT DETECTION SYSTEM DIAGRAM (D5)
LINE RECEIVER
WRITE TOGGLE LOGIC
PSF
(SEE NOTE 2)
WFLT (B7)
SEL (A14)
WRITE (B14)
SEE HEAD POSITIONING SYSTEM DIAGRAM (B4)
ACRY
URG (A14)
SEE FAULT DETECTION SYSTEM DIAGRAM (C8)
WRITE
SEE FAULT DETECTION SYSTEM DIAGRAM (C9)
BHS0
BHS1
BHS2
WFLT
WDA
WDB
WEN
R/W PRE
SERVO PC


P/O DRIVE CONTROL PCA-A4
TO/FROM CONTROLLER
DATA
DATA
SELECT
J1
SEL
WRITE DATA
I/O SECTOR PCA-A2
SEE I/O CONTROL SYSTEM DIAGRAM (D4)
HEAD ADDRESS D8-D10
HEAD ADDRESS REGISTER
CLOCK
CLEAR
ADDRESSED HEAD
SEE I/O CONTROL SYSTEM DIAGRAM (B15)
ADR • SEL
"0" = ILLEGAL
"1" = LEGAL
HS0
HS1
HS2
NDPS
SEE FAULT DETECTION SYSTEM DIAGRAM (88)
INDICATOR PCA-A11
READ ONLY
+12V
RO1
READ ONLY SWITCH-S5
OFF
READ ONLY (STATUS BIT 8)
RO2
SEE I/O CONTROL SYSTEM DIAGRAM (A4)
READ • SEL
WRITE • SEL
SECTOR COMPARE FF
SC
SECTOR COMPARE (STATUS BIT 8)
SEE I/O CONTROL SYSTEM DIAGRAM (C15)
COMPARE
PRESENT SECTOR = ADDRESSED SECTOR
SEE SECTOR SENSING SYSTEM DIAGRAM (C8)
COUNT 1088
WRITE
READ
UWG
URG
SEL (A14)
WFLT (87)
WRITE (B14)
ACRY
SEE HEAD POSITIONING SYSTEM DIAGRAM (84)
LINE RECEIVER
+12V

7301-51A

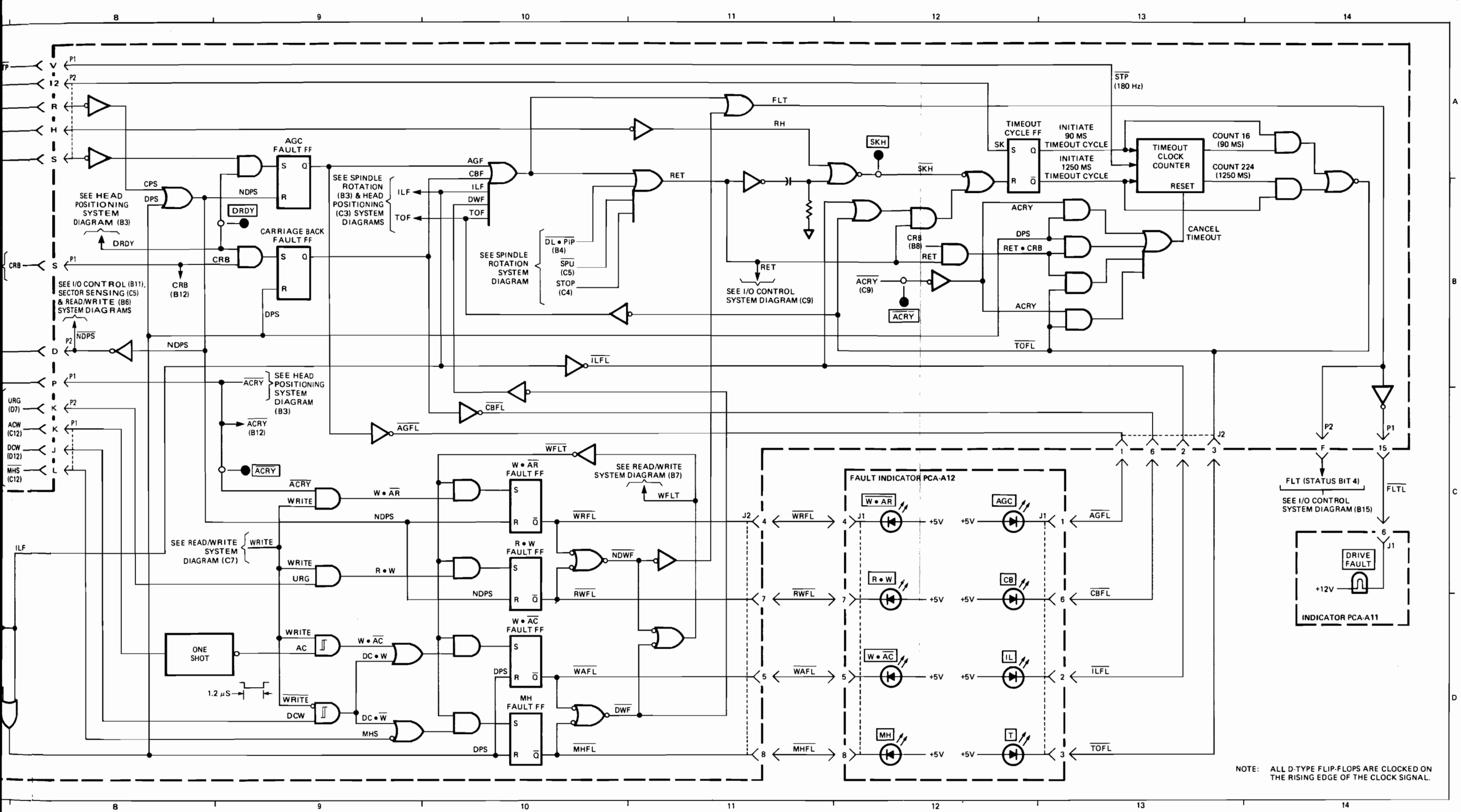
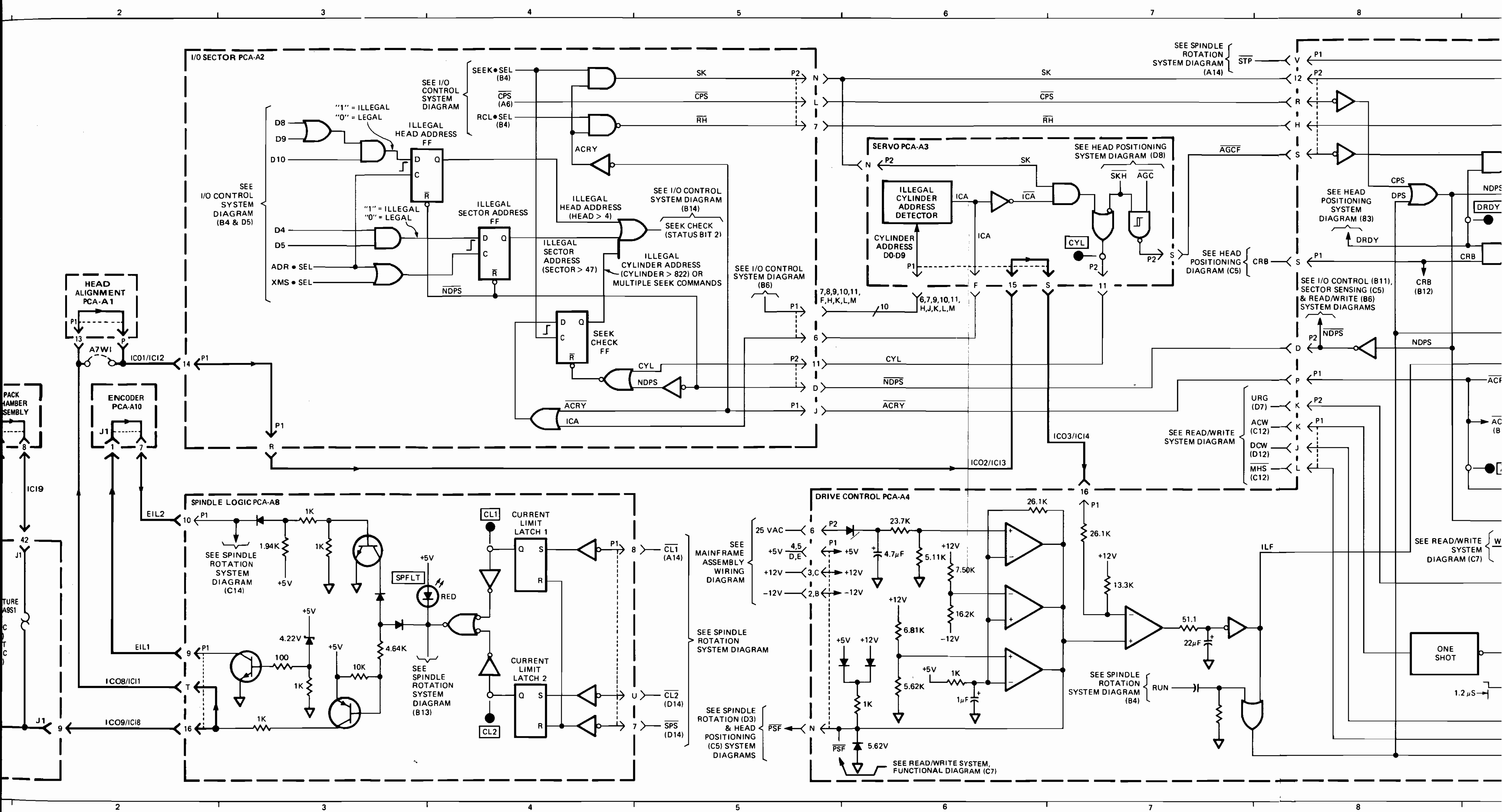
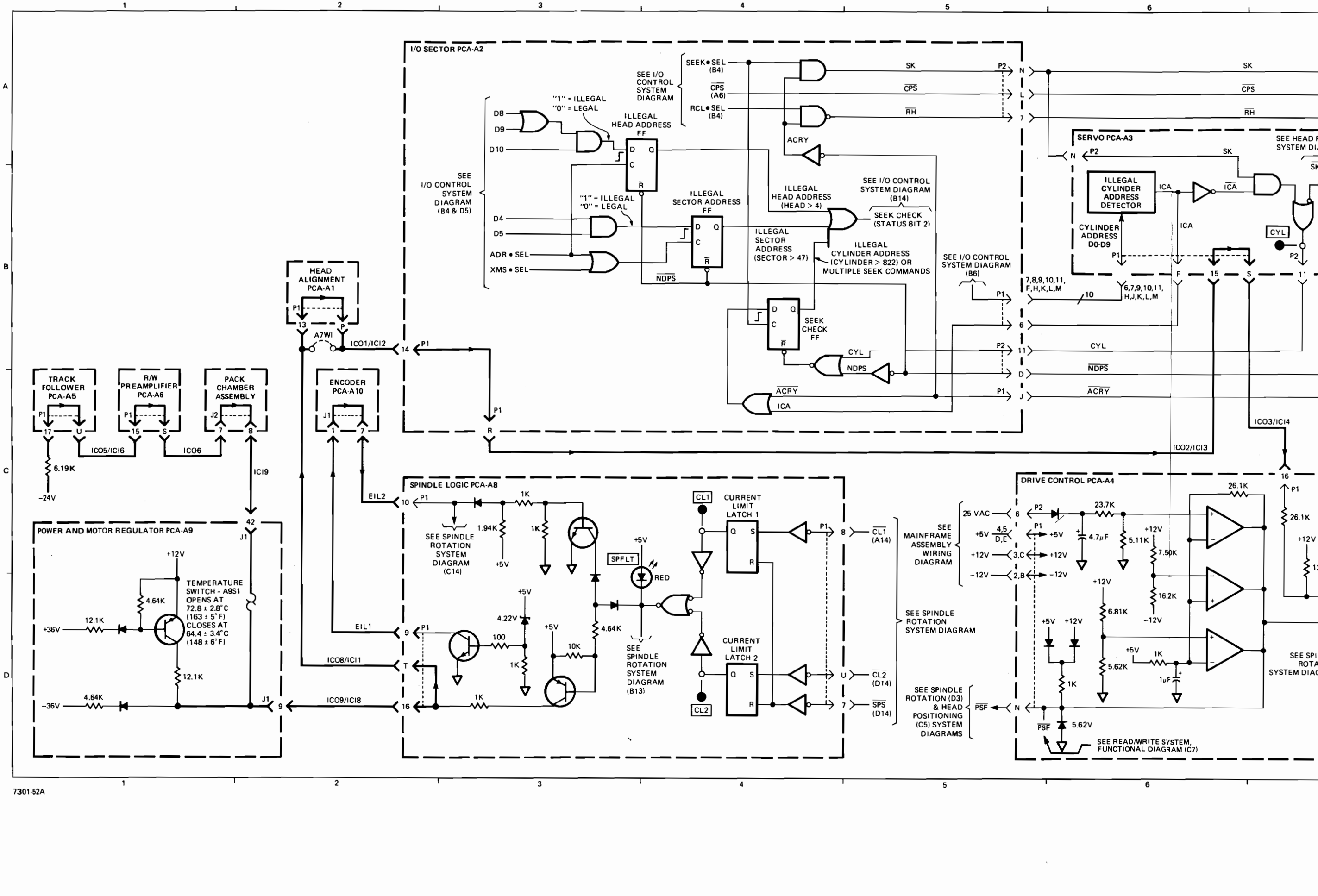


Figure 7-29. Fault Detection System, Functional Diagram


I/O SECTOR PCA-A2
SPINDLE LOGIC PCA-A8
SERVO PCA-A3
DRIVE CONTROL PCA-A4
HEAD ALIGNMENT PCA-A1
ENCODER PCA-A10
ILLEGAL HEAD ADDRESS FF
ILLEGAL SECTOR ADDRESS FF
SEEK CHECK FF
ILLEGAL CYLINDER ADDRESS DETECTOR
CURRENT LIMIT LATCH 1
CURRENT LIMIT LATCH 2
ONE SHOT
SEE I/O CONTROL SYSTEM DIAGRAM (B4 & D5)
SEE I/O CONTROL SYSTEM DIAGRAM (B14)
SEE I/O CONTROL SYSTEM DIAGRAM (B6)
SEE SPINDLE ROTATION SYSTEM DIAGRAM
SEE MAINFRAME ASSEMBLY WIRING DIAGRAM
SEE HEAD POSITIONING SYSTEM DIAGRAM (D8)
SEE HEAD POSITIONING DIAGRAM (C5)
SEE READ/WRITE SYSTEM DIAGRAM
SEE READ/WRITE SYSTEM, FUNCTIONAL DIAGRAM (C7)
SEE I/O CONTROL (B11), SECTOR SENSING (C5) & READ/WRITE (B6) SYSTEM DIAGRAMS


I/O SECTOR PCA-A2
SEEK • SEL (B4)
CPS (A6)
RCL • SEL (B4)
SEE I/O CONTROL SYSTEM DIAGRAM
SK
CPS
RH
ACRY
"1" = ILLEGAL
"0" = LEGAL
D8
D9
D10
ILLEGAL HEAD ADDRESS FF
SEE I/O CONTROL SYSTEM DIAGRAM (B4 & D5)
D4
D5
ADR • SEL
XMS • SEL
ILLEGAL SECTOR ADDRESS FF
NDPS
ILLEGAL HEAD ADDRESS (HEAD > 4)
SEE I/O CONTROL SYSTEM DIAGRAM (B14)
SEEK CHECK (STATUS BIT 2)
ILLEGAL SECTOR ADDRESS (SECTOR > 47)
ILLEGAL CYLINDER ADDRESS (CYLINDER > 822) OR MULTIPLE SEEK COMMANDS
SEEK CHECK FF
CYL
ICA
SEE I/O CONTROL SYSTEM DIAGRAM (B6)
7,8,9,10,11, F,H,K,L,M
6,7,9,10,11, H,J,K,L,M
SERVO PCA-A3
ILLEGAL CYLINDER ADDRESS DETECTOR
CYLINDER ADDRESS D0-D9
SEE HEAD P SYSTEM DI
HEAD ALIGNMENT PCA-A1
A7WI
ICO1/ICI2
TRACK FOLLOWER PCA-A5
R/W PREAMPLIFIER PCA-A6
PACK CHAMBER ASSEMBLY
ENCODER PCA-A10
ICO5/ICI6
ICO6
ICI9
6.19K
-24V
ICO3/ICI4
ICO2/ICI3
SPINDLE LOGIC PCA-A8
EIL2
EIL1
ICO8/ICI1
ICO9/ICI8
SEE SPINDLE ROTATION SYSTEM DIAGRAM (C14)
1.94K
SPFLT
RED
SEE SPINDLE ROTATION SYSTEM DIAGRAM (B13)
4.22V
4.64K
100
10K
CL1
CL2
CURRENT LIMIT LATCH 1
CURRENT LIMIT LATCH 2
CL1 (A14)
CL2 (D14)
SPS (D14)
SEE SPINDLE ROTATION SYSTEM DIAGRAM
SEE MAINFRAME ASSEMBLY WIRING DIAGRAM
SEE SPINDLE ROTATION (D3) & HEAD POSITIONING (C5) SYSTEM DIAGRAMS
DRIVE CONTROL PCA-A4
25 VAC
+5V
+12V
-12V
4.7μF
23.7K
5.11K
7.50K
16.2K
6.81K
5.62K
26.1K
PSF
SEE READ/WRITE SYSTEM, FUNCTIONAL DIAGRAM (C7)
POWER AND MOTOR REGULATOR PCA-A9
TEMPERATURE SWITCH - A9S1 OPENS AT 72.8 ± 2.8°C (163 ± 5°F) CLOSES AT 64.4 ± 3.4°C (148 ± 6°F)
12.1K
+36V
-36V

7301-52A

Table 7-3. Motherboard PCA-A7 Signal Distribution List

SIGNAL MNEMONIC	DEFINITION	A1 HEAD ALIGNMENT PCA		A2 I/O SECTOR PCA			A3 SERVO PCA		A4 DRIVE CONTROL PCA				A5 TRACK FOLLOWER PCA		A6 R/W PREAMPLIFIER PCA	A7 MOTHERBOARD PCA			COMMENTS
		XA1P1	XA1P2	XA2P1	XA2P2	J1	XA3P1	XA3P2	XA4P1	XA4P2	J1	J2	XA5P1	XA5P2	XA6P1	J1	J2	J3	
$\overline{ACRY}$	"Not" Access Ready	N		J		24			P										Exits A4P1-N to DSU and A2J1-24 to controller.
ACW	AC Write (Current Sense)								K						F				
AGC	Automatic Gain Control						16		17				16						
$\overline{AGCF}$	"Not" AGC Fault							S		S									
$\overline{AGFL}$	"Not" AGC Fault LED											1							To Fault Indicator PCA pin A12J1-1.
ATT	Attention				E					E									
--	Spare									T								5	
BHS0	Buffered Head Select Bit 0								11						2				
BHS1	Buffered Head Select Bit 1								10						C				
BHS2	Buffered Head Select Bit 2								9						3				
--	Spare																	1	
$\overline{CBFL}$	"Not" Carriage Back Fault LED											6							To Fault Indicator PCA pin A12J1-6.
CBS	Carriage Back Supply															16			To Carriage Back Detector.
$\overline{CBUS0}$	"Not" Control Bus Bit 0					3													Two-way control bus to and from controller.
$\overline{CBUS1}$	"Not" Control Bus Bit 1					5													Two-way control bus to and from controller.
$\overline{CBUS2}$	"Not" Control Bus Bit 2					7													Two-way control bus to and from controller.

■ DENOTES SIGNAL SOURCE ◪ DENOTES BIDIRECTIONAL SIGNAL

Table 7-3. Motherboard PCA-A7 Signal Distribution List (Continued)

SIGNAL MNEMONIC	DEFINITION	A1 HEAD ALIGNMENT PCA		A2 I/O SECTOR PCA			A3 SERVO PCA		A4 DRIVE CONTROL PCA				A5 TRACK FOLLOWER PCA		A6 R/W PREAMPLIFIER PCA	A7 MOTHERBOARD PCA			COMMENTS
		XA1P1	XA1P2	XA2P1	XA2P2	J1	XA3P1	XA3P2	XA4P1	XA4P2	J1	J2	XA5P1	XA5P2	XA6P1	J1	J2	J3	
$\overline{CBUS3}$	"Not" Control Bus Bit 3					9													Two-way control bus to and from controller.
$\overline{CBUS4}$	"Not" Control Bus Bit 4					21													Two-way control bus to and from controller.
$\overline{CBUS5}$	"Not" Control Bus Bit 5					23													Two-way control bus to and from controller.
$\overline{CBUS6}$	"Not" Control Bus Bit 6					25													Two-way control bus to and from controller.
$\overline{CBUS7}$	"Not" Control Bus Bit 7					27													Two-way control bus to and from controller.
$\overline{CBUS8}$	"Not" Control Bus Bit 8					10													Two-way control bus to and from controller.
$\overline{CBUS9}$	"Not" Control Bus Bit 9					8													Two-way control bus to and from controller.
$\overline{CBUS10}$	"Not" Control Bus Bit 10					6													Two-way control bus to and from controller.
CC	Current Command							1								4			To Power and Motor Regulator PCA pin A9J1-14.
$\overline{CLA}$	"Not" Clear Attention				5					5									
$\overline{COF}$	"Not" Clear Offset							U						U					
$\overline{CPS}$	"Not" Controller Preset				L					R									
CRB	Carriage Back								S							13			From Carriage Back Detector. Also, to Power and Motor Regulator PCA pin A9J1-28.
CYL	Set Cylinder				11			11		11									
D0	Internal Control Bus Bit 0			M			11						11						
D1	Internal Control Bus Bit 1			10			L						L						

DENOTES SIGNAL SOURCE DENOTES BIDIRECTIONAL SIGNAL

Table 7-3. Motherboard PCA-A7 Signal Distribution List (Continued)

SIGNAL MNEMONIC	DEFINITION	A1 HEAD ALIGNMENT PCA		A2 I/O SECTOR PCA			A3 SERVO PCA		A4 DRIVE CONTROL PCA				A5 TRACK FOLLOWER PCA		A6 R/W PREAMPLIFIER PCA	A7 MOTHERBOARD PCA			COMMENTS
		XA1P1	XA1P2	XA2P1	XA2P2	J1	XA3P1	XA3P2	XA4P1	XA4P2	J1	J2	XA5P1	XA5P2	XA6P1	J1	J2	J3	
D2	Internal Control Bus Bit 2			11			M						M						
D3	Internal Control Bus Bit 3			L			10						10						
D4	Internal Control Bus Bit 4			K			9						9						
D5	Internal Control Bus Bit 5			H			7						7						
D6	Internal Control Bus Bit 6			9			K						K*						*Not Used.
D7	Internal Control Bus Bit 7			8			J						J						
D8	Internal Control Bus Bit 8			7			H						H*						*Not Used.
D9	Internal Control Bus Bit 9			F			6						6*						*Not Used.
D10	Internal Control Bus Bit 10			15*			8*						8*						*Not Used.
DATA	Data										2								Two-way data bus to and from controller.
$\overline{DATA}$	"Not" Data										1								Two-way data bus to and from controller.
DCW	DC Write (Current Sense)								J						5				
DGC	Data AGC								M						H				
DGCD	Data AGC Defeat		A							A									
DL•PIP	Door Locked and Pack In Place									M						H			From Indicator PCA pin A11J1-18.
$\overline{DPS}$	"Not" Destructive Preset									P						N*			*Not Used.

DENOTES SIGNAL SOURCE DENOTES BIDIRECTIONAL SIGNAL

Table 7-3. Motherboard PCA-A7 Signal Distribution List (Continued)

SIGNAL MNEMONIC	DEFINITION	A1 HEAD ALIGNMENT PCA		A2 I/O SECTOR PCA			A3 SERVO PCA		A4 DRIVE CONTROL PCA				A5 TRACK FOLLOWER PCA		A6 R/W PREAMPLIFIER PCA	A7 MOTHERBOARD PCA			COMMENTS
		XA1P1	XA1P2	XA2P1	XA2P2	J1	XA3P1	XA3P2	XA4P1	XA4P2	J1	J2	XA5P1	XA5P2	XA6P1	J1	J2	J3	
DRDY	Drive Ready				4					4									
$\overline{\text{DRDYL}}$	"Not" Drive Ready Lamp								18							R			To DRIVE READY lamp via Indicator PCA pin A11J1-7.
$\overline{\text{DSUT}}$	"Not" DSU Drive Type					18													Identifies 7920 to DSU.
$\overline{\text{DWA}}$	"Not" Decrease Write Current A (13mA)						18								A				
$\overline{\text{DWB}}$	"Not" Decrease Write Current B (6.5mA)						13								B				
$\overline{\text{DWC}}$	"Not" Decrease Write Current C (3.25mA)						12								1				
ECS	Energize Carriage Solenoid									14						F			To Power and Motor Regulator PCA pin A9J1-50.
FLT	Drive Fault				F					F									
$\overline{\text{FLTL}}$	"Not" Drive Fault Lamp								15							T			To DRIVE FAULT lamp via Indicator PCA pin A11J1-6.
FMT	Format Pack				13											J			From FORMAT switch — S4.
HS0	Head Select Bit 0			N					12										
HS1	Head Select Bit 1			12					13										
HS2	Head Select Bit 2			P					R										
ICA	Illegal Cylinder Address			6			F												
ICI5	Interlock Chain In A5												17						Interlock chain source from −24V supply.
ICO5/ICI6	Interlock Chain Out A5/In A6												U		15				

DENOTES SIGNAL SOURCE DENOTES BIDIRECTIONAL SIGNAL

Table 7-3. Motherboard PCA-A7 Signal Distribution List (Continued)

SIGNAL MNEMONIC	DEFINITION	A1 HEAD ALIGNMENT PCA		A2 I/O SECTOR PCA			A3 SERVO PCA		A4 DRIVE CONTROL PCA				A5 TRACK FOLLOWER PCA		A6 R/W PREAMPLIFIER PCA	A7 MOTHERBOARD PCA			COMMENTS
		XA1P1	XA1P2	XA2P1	XA2P2	J1	XA3P1	XA3P2	XA4P1	XA4P2	J1	J2	XA5P1	XA5P2	XA6P1	J1	J2	J3	
ICO6	Interlock Chain Out A6														S	BB			To pack chamber interlock pin J2-7.
ICI1	Interlock Chain In A1	13														A			From interlock chain.
ICO1/ICI2	Interlock Chain Out A1/In A2	P		14															
ICO2/ICI3	Interlock Chain Out A2/In A3			R			15												
ICO3/ICI4	Interlock Chain Out A3/In A4						S		16										To interlock logic on Drive Control PCA — A4.
$\overline{ILFL}$	"Not" Interlock Fault LED											2							To Fault Indicator PCA pin A12J1-2.
$\overline{IP}$	"Not" Index Pulse		B		3									3					
$\overline{LD}$	"Not" Lock Door (Pack Access)									2						1			To Power and Motor Regulator PCA pin A9J1-47.
LSB	Least Significant Bit (of Cylinder Address)							16						16					
$\overline{MHFL}$	"Not" Multiple Head Fault LED											8							To Fault Indicator PCA pin A12J1-8.
$\overline{MHS}$	"Not" Multiple Head Sense								L						6				
$\overline{NDPS}$	"Not" Non-Destructive Preset		D		D					D									
POS	Position						V						18						
$\overline{PSF}$	"Not" Power Supply Failed								N							14			To Power and Motor Regulator PCA pin A9J1-22.
--	Spare									B									
RDA	Read Data A								F						13				

DENOTES SIGNAL SOURCE DENOTES BIDIRECTIONAL SIGNAL

Table 7-3. Motherboard PCA-A7 Signal Distribution List (Continued)

SIGNAL MNEMONIC	DEFINITION	A1 HEAD ALIGNMENT PCA		A2 I/O SECTOR PCA			A3 SERVO PCA		A4 DRIVE CONTROL PCA				A5 TRACK FOLLOWER PCA		A6 R/W PREAMPLIFIER PCA	A7 MOTHERBOARD PCA			COMMENTS
		XA1P1	XA1P2	XA2P1	XA2P2	J1	XA3P1	XA3P2	XA4P1	XA4P2	J1	J2	XA5P1	XA5P2	XA6P1	J1	J2	J3	
RDB	Read Data B								6						14				
RET	Retract Heads							13		13									
$\overline{RH}$	"Not" Restore Home				7					H									
RO1	Read Only 1			18												9			From READ ONLY switch — S5.
RO2	Read Only 2				J					J									
$\overline{RS}$	"Not" Run Spindle									1						3			To Spindle Logic PCA pin A8P1-J.
$\overline{RUN}$	"Not" Run									16						C			From Indicator PCA pin A11J1-11.
$\overline{RWFL}$	"Not" Read with Write Fault LED											7							To Fault Indicator PCA pin A12J1-7.
$\overline{SB}$	"Not" Servo Balanced							17		17									
SCL	Sector Clock				6									6					
SEL	Drive Selected				8					8									
$\overline{SELL}$	"Not" Drive Selected LED			13												7			To Indicator PCA pin A11J1-10.
$\overline{SEN}$	"Not" Servo Enable									7						K			To Power and Motor Regulator PCA pin A9J1-20.
SK	Seek				N			N		12									
$\overline{SKH}$	"Not" Seek Home						U		U										
$\overline{SKI}$	"Not" Seek Inhibit		2					2											

DENOTES SIGNAL SOURCE DENOTES BIDIRECTIONAL SIGNAL

Table 7-3. Motherboard PCA-A7 Signal Distribution List (Continued)

SIGNAL MNEMONIC	DEFINITION	A1 HEAD ALIGNMENT PCA		A2 I/O SECTOR PCA			A3 SERVO PCA		A4 DRIVE CONTROL PCA				A5 TRACK FOLLOWER PCA		A6 R/W PREAMPLIFIER PCA	A7 MOTHERBOARD PCA			COMMENTS
		XA1P1	XA1P2	XA2P1	XA2P2	J1	XA3P1	XA3P2	XA4P1	XA4P2	J1	J2	XA5P1	XA5P2	XA6P1	J1	J2	J3	
SOF	Set Offset			T						N			T						
$\overline{SPD}$	"Not" Speed Down									15						E			From Spindle Logic PCA pin A8P1-11.
$\overline{SPU}$	"Not" Speed Up									C						P			From Spindle Logic PCA pin A8P1-L.
$\overline{STB}$	"Not" Strobe					13													From Controller.
$\overline{STOP}$	"Not" Stop									U						B			From Indicator PCA pin A11J1-9.
$\overline{STP}$	"Not" Set Timeout Period								V							S			From Spindle Logic PCA pin A8P1-M.
TAC	Tachometer							B									1		From Velocity Transducer.
$\overline{TAC}$	"Not" Tachometer							C									5		From Velocity Transducer.
$\overline{TBUS0}$	"Not" Tag Bus Bit 0					37													One-way tag bus from controller.
$\overline{TBUS1}$	"Not" Tag Bus Bit 1					39													One-way tag bus from controller.
$\overline{TBUS2}$	"Not" Tag Bus Bit 2					41													One-way tag bus from controller.
$\overline{TBUS3}$	"Not" Tag Bus Bit 3					43													One-way tag bus from controller.
$\overline{TOFL}$	"Not" Timeout Fault LED											3							To Fault Indicator PCA pin A12J1-3.
URG	Unselected Read Gate		K		K					K									
US0	Unit Select Bit 0				A											5			From UNIT SELECT switch — S3. Also, to Unit Select Display via Indicator PCA pin A11J1-15.
US1	Unit Select Bit 1				1											6			From UNIT SELECT switch — S3. Also, to Unit Select Display via Indicator PCA pin A11J1-17.

DENOTES SIGNAL SOURCE DENOTES BIDIRECTIONAL SIGNAL

Table 7-3. Motherboard PCA-A7 Signal Distribution List (Continued)

SIGNAL MNEMONIC	DEFINITION	A1 HEAD ALIGNMENT PCA		A2 I/O SECTOR PCA			A3 SERVO PCA		A4 DRIVE CONTROL PCA				A5 TRACK FOLLOWER PCA		A6 R/W PREAMPLIFIER PCA	A7 MOTHERBOARD PCA			COMMENTS
		XA1P1	XA1P2	XA2P1	XA2P2	J1	XA3P1	XA3P2	XA4P1	XA4P2	J1	J2	XA5P1	XA5P2	XA6P1	J1	J2	J3	
US2	Unit Select Bit 2			17												8			From UNIT SELECT switch — S3. Also, to Unit Select Display via Indicator PCA pin A11J1-16.
UWG	Unselected Write Gate		9		9					9									
$\overline{\text{WAFL}}$	"Not" Write with No AC Fault LED											5							To Fault Indicator PCA pin A12J1-5.
WDA	Write Data A								8						D				
WDB	Write Data B								7						4				
WEN	Write Enable	H							H						E				
WFLT	Write Fault								T						R				
$\overline{\text{WRFL}}$	"Not" Write with Access Not Ready Fault LED											4							To Fault Indicator PCA pin A12J1-4.
+5VRS	+5V Remote Sense															18			To Power and Motor Regulator PCA pin A9J1-26. Source from +5V supply.

DENOTES SIGNAL SOURCE DENOTES BIDIRECTIONAL SIGNAL

Table 7-4. Power Distribution List

SUPPLY VOLTAGE		CONNECTIONS VIA MOTHERBOARD PCA — A7													CONNECTIONS VIA MAIN HARNESS							
		HEAD ALIGNMENT PCA A1		I/O SECTOR PCA A2			SERVO PCA A3		DRIVE CONTROL PCA A4			TRACK FOLLOWER PCA A5		R/W PREAMPLIFIER PCA A6	MOTHERBOARD PCA A7		SPINDLE LOGIC PCA A8	PMR PCA A9	ENCODER PCA A10	INDICATOR PCA A11		FAULT INDICATOR PCA A12
		XA1P1	XA1P2	XA2P1	XA2P2	J1	XA3P1	XA3P2	XA4P1	XA4P2	J2	XA5P1	XA5P2	XA6P1	J1	J3	P1	J1	J1	J1	J2	J1
REGULATED DC	+5V	4, 5, D, E		4, 5, D, E		26, 30, 32, 35	4, 5, D, E		4, 5, D, E		9, 10, 11, 12, 13, 14, 15, 16	4, 5, D, E			17, 18, U, V		4, 5, D, E	29, 30, 31, 32, 33, 34	5	13	5	9, 10, 11, 12, 13, 14, 15, 16
	+12V	3, C		3, C			3, C		3, C			3, C		9, K	20, X		3, C	35, 36		5		
	−12V	2, B		2, B			2, B		2, B			2, B		10, L	21, Y		2,B	37, 38				
	−24V													11, M	19, W			39, 40				
UNREGULATED DC	+10V																	7				
AC	25V									6					M	2		8				
GROUND		1, A	18, V	1, A	18, V	11, 12, 14, 15, 16, 19, 20, 29, 31, 33, 34, 45, 46, 47, 48, 49, 50	1, A	18, V	1, A	18, V		1, A	18, V	7, 8, 12, N, P	22, 23, Z, AA	4	1, 18, A, V	1, 2, 3, 4, 5, 6	2	2		

■ DENOTES SOURCE

REMOVAL AND REPLACEMENT

SECTION VIII

8-1. INTRODUCTION

This section provides removal and replacement procedures for the field-replaceable disc drive assemblies. The procedures are given in the order in which disassembly normally occurs. Each assembly or component that must be removed before access can be gained to another assembly is presented first, followed by the next assembly that can be removed. References are made to illustrations and listings contained in Section IX, Replaceable Parts, to aid in identifying and locating parts.

8-2. PREPARATION FOR SERVICE

WARNING

This disc drive does not contain operator-serviceable parts. To prevent electrical shock, refer all installation and maintenance activities to service-trained personnel.

Before starting any removal and replacement procedure, perform the following steps:

a. If the disc drive is in an operating mode, set the RUN/STOP switch to STOP. The DRIVE READY indicator will extinguish immediately.

b. Allow the spindle to halt (approximately 30 seconds). The DOOR UNLOCKED indicator will light, at which time the spindle has stopped rotating, the door unlock solenoid is energized, and it is safe to open the pack chamber door.

c. Remove and store the disc pack.

d. Open the front and rear doors.

e. On the operator panel, set the DISC switch to OFF. Disconnect the ac power cord from the ac mains power.

8-3. SHROUD REMOVAL AND REPLACEMENT

To remove the shroud, proceed as follows:

a. Perform the preparation for service outlined in paragraph 8-2.

b. Disconnect the ac power cord from the ac mains power.

c. Open the rear door.

d. At the lower rear of the shroud, two latches mounted to the enclosure frame secure the shroud to the enclosure. Disconnect these latches.

e. Lift the rear of the shroud up to gain approximately 3 cm (1 in.) clearance and pull the shroud straight back.

To replace the shroud, place it on the side rails of the enclosure and push straight in. When fully seated, the fixed runners on the shroud will drop into mating holes. Secure the shroud with the latches.

8-4. DOOR AND SIDE COVER REMOVAL AND REPLACEMENT

To remove either door, proceed to step a. The side covers are secured to the frame with four screws, two screws on each end. The cover is also secured by a flange and bracket arrangement located at the bottom center of the cover, and with latching brackets at the top. To remove either side cover, proceed to step b.

a. To remove the front or rear door, proceed as follows:

(1) Perform the preparation for service outlined in paragraph 8-2.

(2) Disconnect the ac power cord from the ac mains power.

(3) Open the door that is to be removed.

(4) Pull down on the spring-loaded lever on the upper door hinge and lift the door off.

(5) To replace the door, perform the above steps in reverse order.

b. To remove a side cover, proceed as follows:

(1) Remove the four screws (9, figure 9-1) securing the cover to the frame.

(2) Pull the bottom of the cover away from the frame to disengage the flange from the frame bracket.

(3) To remove the cover, lift it out and up.

To replace a side cover, proceed as follows:

(1) Insert the top edge of the cover into the enclosure frame and pull downward to secure the cover onto the mating frame shoulders.

(2) Push in the bottom of the cover, ensuring that the bottom flange is inserted into the mating slot on the bottom of the enclosure frame.

(3) Replace and tighten the four screws (9, figure 9-1) which secure the cover to the frame.

8-5. PREFILTER REMOVAL AND REPLACEMENT

To remove the prefilter, open the front door and slide the filter out of the prefilter chamber. Insert a new filter, ensuring airflow arrow points in the correct direction (refer to figure 9-1), and close the front door.

8-6. ABSOLUTE FILTER REMOVAL AND REPLACEMENT

Note: For disc drives with a serial prefix prior to 1843, use the absolute filter with part number 3150-0276 or if a contamination shield (27, figure 9-2) is installed, use the absolute filter with part number 3150-0340.

To remove the absolute filter, (1, figure 9-8) proceed as follows:

a. Perform the preparation for service outlined in paragraph 8-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the shield panels (10 and 14, figure 9-1).

d. On the prefilter chamber (21, figure 9-1), disengage the two quick-release fasteners at the top of the assembly.

e. Pull prefilter chamber down, then out of the enclosure.

f. Loosen the air hose clamp (3, figure 9-8) and separate it from the absolute filter.

g. Remove the two knurled screws (2) from the front of the absolute filter.

h. Pull the absolute filter down and out of the enclosure.

To replace the absolute filter, proceed as follows:

a. Inspect the new filter for holes or damage to the paper element.

b. Insert the absolute filter, ensuring that the bottom of the filter box rests on the tab on the impeller cover assembly.

c. Press the filter up and seat the guide pin into the corresponding hole, then secure the filter with the two knurled screws.

d. Reinstall the air hose on the absolute filter.

e. Replace the prefilter chamber, ensuring that the rear mounting bracket seats onto the mating bracket in the disc drive.

f. Push the prefilter chamber up and latch in place. The neck on the prefilter chamber acts as a guide into the impeller cover assembly to ensure proper mounting.

g. Reinstall the shield panels (10 and 14, figure 9-1).

h. Restore the ac power to the disc drive.

i. Measure the air pressure of the absolute filter as outlined in paragraph 5-13.

8-7. FRONT FRAME ASSEMBLY

To remove the front frame assembly (39, figure 9-2), proceed as follows:

a. Perform the preparation for service outlined in paragraph 8-2.

b. Disconnect the ac power from the ac mains power.

c. Remove the shroud. (Refer to paragraph 8-3.)

d. Disconnect the door lock assembly wiring connector. Remove the cable clamp from the right mounting bracket of the front frame assembly.

CAUTION

Do not extend the front frame more than 10 cm (4 in.). Damage to wiring and associated connectors can occur.

e. On the front frame mounting brackets, remove the two screws (40, figure 9-2) on each bracket and lift the frame out far enough to gain access to PCA-A11.

f. On the indicator PCA, disconnect the 18-pin connector and the pack detector cable and remove the front frame assembly.

To replace the front frame assembly, perform the above steps in the reverse order.

8-8. INDICATOR ASSEMBLY PCA-A11 AND INCANDESCENT LAMP REMOVAL AND REPLACEMENT

To remove indicator assembly PCA-A11 or replace an incandescent lamp, proceed as follows:

a. Perform the preparation for service outlined in paragraph 8-2.

b. Disconnect the ac power from the ac mains power.

c. Remove the shroud. (Refer to paragraph 8-3.)

d. Remove the front frame assembly. (Refer to paragraph 8-7.)

e. If an incandescent lamp requires replacement, follow substeps (1) through (3); otherwise, proceed to step f.

(1) Being careful not to bend the lamp contact, rotate the lamp contact on the indicator PCA counterclockwise. Remove the defective lamp.

(2) Insert the replacement lamp and rotate the lamp contact clockwise to hold the new lamp in place.

(3) Proceed to step g.

f. Remove indicator assembly PCA-A11 and replace with the new indicator assembly.

Note: When replacing indicator assembly PCA-A11, ensure that the LED on the indicator assembly is centered in the hole in the front panel frame.

g. Replace the front frame. (Refer to paragraph 8-7.) Replace the shroud. (Refer to paragraph 8-3.) Restore the ac power to the disc drive.

8-9. PACK CHAMBER ASSEMBLY REMOVAL AND REPLACEMENT

To remove the pack chamber assembly (2, figure 9-1), proceed as follows:

a. Remove the disc pack.

b. Perform the preparation for service outlined in paragraph 8-2.

c. Disconnect the ac power cord from the ac mains power.

d. Remove the shroud. (Refer to paragraph 8-3.)

e. Remove the front frame assembly. (Refer to paragraph 8-7.)

f. At the bottom of the pack chamber assembly, release the four quick-release fasteners (43, figure 9-4 or 39, figure 9-4A).

g. Disconnect connector J2 from plug P1 (cable harness leading to the door lock assembly).

h. Lift the pack chamber assembly out of the disc drive.

To replace the pack chamber assembly, proceed as follows:

Note: If a new pack chamber, part number 07920-60094, is to be installed in a disc drive with a serial prefix prior to 1841, the read/write preamplifier bracket (10, figure 9-2) must be removed.

a. This step applies only to disc drives with serial prefix 1841 or greater. Loosen (do not remove) the two screws which hold the preamplifier retainer (43, figure 9-4A) and push the retainer upward (toward the door of the pack chamber).

b. Align the four quick-release fasteners over the four posts on the mainframe and place the pack chamber assembly on the mainframe.

c. Secure the pack chamber assembly by attaching the quick-release fasteners to the mainframe and reconnect connector J2.

d. Ensure (by visual inspection) that the heads can enter the pack chamber without interference through the hole in the side of the pack chamber assembly.

e. This step applies only to disc drives with serial prefix 1841 or greater. Lower the preamplifier retainer (43, figure 9-4A) and push the retainer down on the read/write preamplifier PCA-A6. Tighten the knurled screws (44, figure 9-4A).

f. Replace the front frame assembly. (Refer to paragraph 8-7.) Replace the shroud. (Refer to paragraph 8-3.) Restore the ac power to the disc drive.

8-10. PRINTED CIRCUIT CARD REMOVAL AND REPLACEMENT

Four of the PCA's are mounted in the card cage chassis and a fifth is mounted in a separate card chassis. The remainder of the PCA's are mounted in other locations throughout the disc drive.

8-11. CARD CAGE PCA'S

To remove any of the four card cage PCA's, A2 through A5, proceed as follows:

a. Perform the preparation for service outlined in paragraph 8-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the shroud. (Refer to paragraph 8-3.)

d. On the PCA retainer (1, figure 9-2), remove securing screw and remove retainer.

e. Disconnect the interconnecting cable from jack J1 on I/O Sector PCA-A2 (4).

f. On drive control PCA-A4 (6), simultaneously lift up on the two PCA extractor levers and slide the PCA up 5 cm (2 in.). Disconnect the data cable and fault indicator cable from the PCA. If desired, remove the drive control PCA-A4 from the card cage chassis.

g. To remove track follower PCA-A5 (7), disconnect the servo head connector, then simultaneously lift up on the two PCA extractor levers and slide the PCA up and out of the card cage chassis.

Note: Whenever track follower PCA-A5 is replaced, the data head alignment check must be performed. (Refer to Section VI, Alignment and Adjustment.)

CAUTION

Ensure that the correct replacement PCA is inserted into its corresponding card slot, otherwise damage to the PCA may result.

h. Insert the replacement PCA into the card slot ensuring that the component side of the PCA faces toward the outer side of the disc drive. Reconnect any cables disconnected during removal and then press the PCA firmly into the receptacle until seated.

i. Replace PCA retainer and secure with the screw.

j. Replace the shroud. (Refer to paragraph 8-3.) Restore the ac power to the disc drive.

8-12. SPINDLE LOGIC PCA-A8

Spindle logic PCA-A8 (43, figure 9-2) is mounted in a card cage located directly above the operator panel. To remove this PCA, proceed as follows:

a. Perform the preparation for service outlined in paragraph 8-2.

b. Disconnect the ac power cord from the ac mains power.

c. Open the front door.

d. Insert a blade-type screwdriver between the card cage side and the spindle logic PCA retainer (42, figure 9-2).

e. Lightly pry inward the retainer arm to extract the screw head from its seating hole and lift out retainer.

f. Lift the PCA extractors outward and slide out the spindle logic PCA.

To replace spindle logic PCA-A8, insert the PCA into the card slot and firmly seat into the mating receptacle. Then replace the retainer, ensuring that the screw heads are secured in the seating holes.

8-13. READ/WRITE PREAMPLIFIER PCA-A6

To remove read/write preamplifier PCA-A6 (13, figure 9-2) from a disc drive with a serial number prefix prior to 1841, proceed to step a. To remove PCA-A6 from a disc drive with a serial number prefix 1841 or greater, proceed to step b.

a. This procedure for the removal and replacement of read/write preamplifier PCA-A6 applies to disc drives with a serial number prefix prior to 1841.

CAUTION

The read/write preamplifier PCA-A6 contains a CMOS component. To avoid damage to the CMOS component, do not touch the components or the circuit traces on the PCA.

(1) Perform the preparation for service outlined in paragraph 8-2.

(2) Disconnect the ac power cord from the ac mains power.

(3) Remove the shroud. (Refer to paragraph 8-3.)

(4) Disconnect all head connectors from PCA-A6.

(5) Lift up on the two spring clips of the read/write preamplifier PCA retainer and gently tilt the PCA toward the card cage chassis (8, figure 9-2).

(6) Lift the PCA out of the receptacle.

To replace the read/write preamplifier, proceed as follows:

(1) Insert and firmly seat the PCA in the receptacle. Seat the retainer spring clips over the top of the PCA.

(2) Connect read/write head connectors to PCA-A6.

(3) Replace the shroud. (Refer to paragraph 8-3.) Restore the ac power to the disc drive.

b. This procedure for removal and replacement of read/write preamplifier PCA-A6 applies to disc drives with serial prefix 1841 or greater.

CAUTION

The read/write preamplifier PCA-A6 contains a CMOS component. To avoid damage to the CMOS component, do not touch the components or the circuit traces on the PCA.

(1) Perform the preparation for service outlined in paragraph 8-2.

(2) Disconnect the ac power cord from the ac mains power.

(3) Remove the shroud. (Refer to paragraph 8-3.)

(4) Disconnect all head connectors from PCA-A6.

(5) Loosen (do not remove) the two screws which hold the preamplifier retainer (43, figure 9-4A) and push the retainer upward. Pull the PCA out of the connector and remove it from the disc drive.

To replace the read/write preamplifier, proceed as follows:

(1) Insert and firmly seat the PCA in the connector. Loosen (do not remove) the two screws which hold the preamplifier retainer (43, figure 9-4A) and push the retainer down. Tighten the two screws which hold the preamplifier. Ensure that the preamplifier retainer securely holds the read/write preamplifier.

(2) Connect the head connectors to the read/write preamplifier.

(3) Replace the shroud. (Refer to paragraph 8-3.) Restore the ac power to the disc drive.

8-14. CARD CAGE CHASSIS AND MOTHERBOARD PCA-A7

To remove the card cage chassis (8, figure 9-2) and motherboard PCA-A7 (14), proceed as follows:

a. Perform the preparation for service outlined in paragraph 8-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the shroud. (Refer to paragraph 8-3).

d. Remove card cage PCA's. (Refer to paragraph 8-11.)

Note: Before removing the card cage chassis, release the data cable from the cable retainer at the rear of the card cage chassis and release the fault indicator cable from the cable retainer on the side of the card cage chassis.

e. At the bottom of the card cage, release the four quick-release fasteners and lift out card cage chassis.

f. Remove read/write preamplifier PCA-A6. (Refer to paragraph 8-13.)

g. On the motherboard, disconnect cabling, and remove velocity transducer connector.

h. Loosen the five screws (15) and lift out the motherboard.

To replace the motherboard and card cage chassis, perform the above steps in the reverse order.

8-15. POWER AND MOTOR REGULATOR PCA-A9

To remove power and motor regulator PCA-A9 (46, figure 9-2), proceed as follows:

a. Perform the preparation for service outlined in paragraph 8-2.

b. Disconnect the ac power cord from the ac mains power.

c. Open the front and rear doors and remove the shield panels (10 and 14, figure 9-1).

d. Rotate the three 1/4-turn fasteners that secure the PCA to the bottom of the mainframe.

e. Lower the PCA into its service position.

f. Loosen the air hose clamp (54, figure 9-2) screw and disconnect air hose (55).

g. Disconnect the four cables and the wiring harness.

h. Lift PCA straight up and out to disengage three catches on edge of PCA from mating hinge hooks.

To replace power and motor regulator PCA-A9, perform the above steps in the reverse order.

Note: Ensure the cables attached to PCA-A9 are pushed up into the groove (near the hinges) in the mainframe before the 1/4-turn fasteners are secured to the bottom of the mainframe.

8-16. FAULT INDICATOR PCA-A12

Fault indicator PCA-A12 is mounted on the back side of the operator panel assembly. To remove fault indicator PCA-A12, proceed as follows:

a. Perform the preparation for service outlined in paragraph 8-2.

b. Disconnect the ac power cord from the ac mains power.

c. Open the front door on the disc drive enclosure.

CAUTION

To prevent connector damage, remove the fault indicator ribbon cable from the plastic clip located at the bottom of the spindle logic card cage.

d. Remove the two screws at the top of the panel and the two screws on the underside of the operator panel.

e. Pull the panel out far enough to gain access to the PCA.

f. Disconnect the plug from jack A12J1 on the fault indicator PCA.

g. From the rear side of the PCA, remove two nuts (6, figure 9-9) on mounting posts and lift off PCA.

To replace fault indicator PCA-A12, perform the above steps in the reverse order.

Note: When fault indicator PCA-A12 (5, figure 9-9) is replaced, ensure that the letters "hp" on the back of PCA-A12 are oriented so they are on the top side of the PCA when it is installed in the operator panel (25, figure 9-9).

8-17. PACK DETECTOR ASSEMBLY REMOVAL AND REPLACEMENT

To remove the pack detector assembly, proceed as follows:

a. Perform the preparation for service outlined in paragraph 8-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the shroud. (Refer to paragraph 8-3.)

d. Open the front door.

e. Remove the front frame assembly. (Refer to paragraph 8-7.) Remove pack chamber assembly. (Refer to paragraph 8-9.)

f. Remove the two screws that secure pack detector assembly to the mainframe, and remove the assembly.

To replace the pack detector assembly, perform the above steps in the reverse order. When the pack chamber is back in place, measure the air pressure as outlined in paragraph 5-13.

8-18. DATA AND SERVO HEAD REMOVAL AND REPLACEMENT

The data and servo heads are removed and replaced in the same manner. When any head is replaced, head alignment must be performed as part of the replacement. To remove a data or servo head, proceed as follows:

a. Perform the preparation for service outlined in paragraph 8-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the shroud. (Refer to paragraph 8-3.)

d. Remove the front frame assembly (refer to paragraph 8-7) and then remove the pack chamber assembly (refer to paragraph 8-9).

e. Remove card cage PCA's. (Refer to paragraph 8-11.)

f. Remove card cage chassis. (Refer to paragraph 8-14.)

CAUTION

The read/write preamplifier PCA-A6 contains a CMOS component. To avoid damage to the CMOS component, do not touch the components or the circuit traces on the PCA.

g. Disconnect head cable connector to be removed from read/write preamplifier PCA-A6.

CAUTION

To avoid damage to the head, be sure to install the head installation tool on the head as shown in figure 8-1.

h. Install the head installation tool as shown in figure 8-1. The UP side of the installation tool is used for heads 1, 2, and 4. The DN side of the installation tool is used for heads 0, 3, and the servo.

i. Hold the head in place by applying a slight pressure to the head installation tool, then loosen the head securing screw.

j. Remove the head with the head installation tool attached. Care must be exercised to avoid damaging critical alignments of the head assembly.

To replace a data or servo head, proceed as follows:

CAUTION

To avoid damage to the head, do not touch or clean the surface of the head that attaches to the actuator.

CAUTION

To avoid damage to the head, be sure to install the head installation tool on the head as shown in figure 8-1.

a. Install the head installation tool as shown in figure 8-1. The UP side of the installation tool is used for heads 1, 2, and 4. The DN side of the installation tool is used for heads 0, 3, and the servo.

b. Clean the head surface as outlined in paragraph 5-15.

c. Before seating the head in place, pull head cable through slot into which the head positions.

d. Replace head and thread in head securing screw.

e. Using fingers, thread in screw until it is just snug and the head remains in place.

CAUTION

Do not torque head securing screw with head installation tool attached to head, as the heads will not seat properly in the carriage. Damage to the head and disc surface is likely to occur if the head is tightened with the tool in place.

f. Remove the head installation tool.

g. Insert the head initial position tool to ensure the head alignment screw can be adjusted through the head alignment hole in the coil/carriage assembly.

h. Torque the head securing screw to 5 inch-pounds, and remove the head initial position tool.

i. Replace the card cage, card cage PCA's, pack chamber assembly, and the front frame assembly.

j. Reconnect all cabling disconnected prior to head removal. If applicable, replace the contamination shield (27, figure 9-2).

k. Perform the head alignment procedures given in Section VI, Alignment and Adjustment. Measure the air pressure of the absolute filter as outlined in paragraph 5-13.

8-19. CARRIAGE LATCH AND DETECTOR ASSEMBLY REMOVAL AND REPLACEMENT

To remove and replace the carriage latch and detector assembly (5 and 7, figure 9-7), proceed as follows:

a. Perform the preparation for service outlined in paragraph 8-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the shroud. (Refer to paragraph 8-3.)

d. Remove the card cage PCA's and card cage chassis. (Refer to paragraphs 8-11 and 8-14.)

e. Disconnect the connector from the detector (5) and the two connectors from the carriage latch (7).

f. Remove the two retaining screws (8 and 9) that secure the carriage latch and detector assembly to the actuator assembly.

g. Install replacement assembly and hold in place with retaining screws. Do not tighten retaining screws.

h. Connect the wiring connectors.

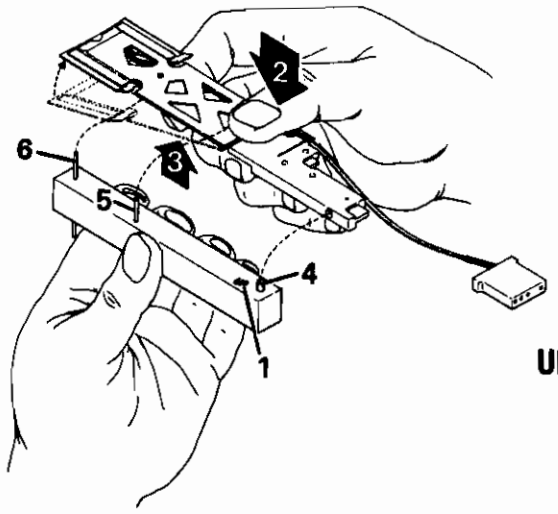
i. Adjust the carriage latch and detector assembly position so that the carriage back flag on the coil/carriage assembly travels through the approximate center of the photoswitch, ensuring that there is no contact between components.

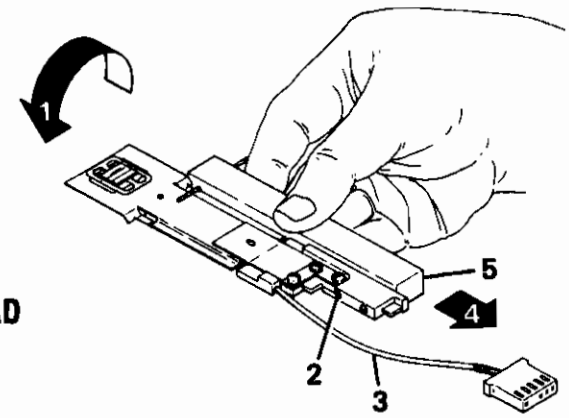
j. Tighten the retaining screws.

CAUTION

To avoid damage to the disc drive, do not move the carriage out more than 1.3 cm (0.5 in.).

k. Check the latching action by pressing in the solenoid plunger and pulling out the carriage. Then press in the carriage and latch the assembly. Ensure that the latching action is smooth.

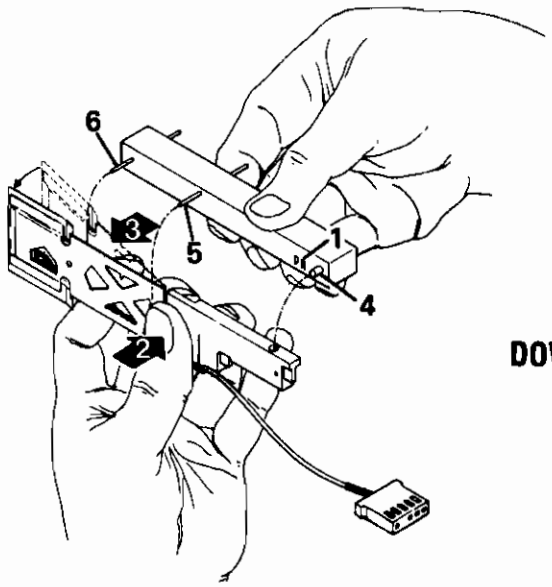


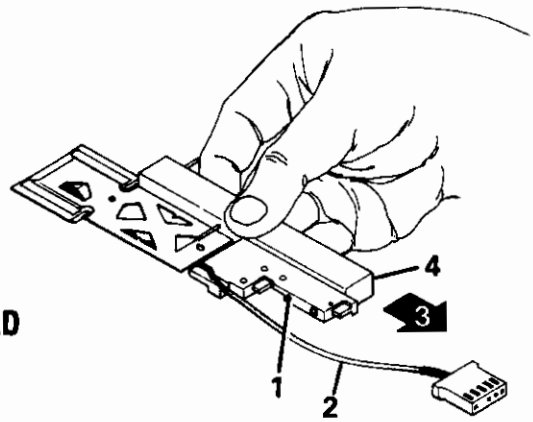


UP HEAD

1. Position the head installation tool with the marking:
   - UP for heads 1, 2, and 4
   - DN for heads 0, 3, and the servo
2. Firmly hold thumb at spring joint.
3. Lift head arm up until assembly is straight.
4. Post inserts into hole on head assembly.
5. Center pin slides over back of head assembly.
6. Front pin slides under head assembly.

HEAD		
UP	DOWN	
1	—	Rotate head into installation position.
2,3	1,2	Ensure that mounting hole (2) and cable (3) are facing head preamplifier side of drive.
4	3	Install head and secure.
5	4	Remove head installation tool before tightening head securing screw.





DOWN HEAD

Figure 8-1. Using the Head Installation Tool

8-20. ACTUATOR ASSEMBLY REMOVAL AND REPLACEMENT

WARNING

When shipping magnetic assemblies (spindle assembly and actuator assembly) which have been removed from the disc drive, each magnetic assembly must be packaged individually. Transporting more than one removed magnetic assembly in a single container could exceed aircraft limitations, 5.25 milligauss at 4.6 m (15 ft), which would create a potential hazard to personnel during shipping. If the magnetic material is being shipped into or within the United States, all applicable regulations of the U.S. Department of Transportation (DOT) must be followed before release to the initial carrier in the U.S. Refer to DOT Regulations, Title 49, parts 171-177 (Hazardous Materials).

To remove the actuator assembly, proceed as follows:

a. Perform the preparation for service outlined in paragraph 8-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the shroud. (Refer to paragraph 8-3.)

d. Remove card cage PCA's and card cage chassis. (Refer to paragraphs 8-11 and 8-14.)

e. Remove side covers. (Refer to paragraph 8-4.)

f. On power and motor regulator PCA-A9, release the 1/4-turn fasteners and lower the PCA into its service position.

CAUTION

Exercise care when handling the actuator assembly if the carriage latch and detector assembly is removed. Carriage movement is no longer restrained and damage to the heads may result.

g. Disconnect the carriage latch and detector assembly wiring connectors.

h. Disconnect the head cable connectors and remove the heads as outlined in paragraph 8-18.

i. Disconnect the velocity transducer cable from motherboard PCA-A7.

j. Disconnect two leads on terminal board tabs that connect to coil ribbon cable.

k. Remove the front frame assembly (refer to paragraph 8-7) and then remove the pack chamber assembly (refer to paragraph 8-9). Remove the bottom plate (22, figure 9-2).

l. Remove the cable shield on the underside of the casting.

m. From the bottom of the mainframe, remove four bolts and lockwashers (30 and 31, figure 9-2) that secure the actuator assembly to the mainframe.

n. Grasp the top of the actuator assembly and lift it straight up to release the guide pins from the holes in the mainframe, then lift the assembly to the rear to remove it from the disc drive.

To replace the actuator assembly, proceed as follows:

a. Position the actuator assembly over its mounting space and seat the guide pins into the mating holes on the mainframe. Attach the two capacitors to the coil band shield barrier block and to ground. (Refer to figure 9-7.)

b. Replace four bolts and lockwashers and secure actuator assembly to the mainframe. Torque the bolts to 80 inch-pounds.

c. Replace the bottom plate (22, figure 9-2). Replace pack chamber assembly and connect door lock assembly cable. (Refer to paragraph 8-9.) Replace the front frame assembly. (Refer to paragraph 8-7.)

d. Replace the cable shield on the underside of the casting.

e. Connect coil ribbon cable to terminal board.

f. Reconnect the velocity transducer cable to motherboard PCA-A7, install the heads as outlined in paragraph 8-18, and reconnect the carriage latch and detector assembly connectors.

g. Return power and motor regulator PCA-A9 to its operating position and secure with the three 1/4-turn fasteners.

h. Replace card cage chassis and card cage PCA's.

i. Restore ac power to the disc drive. Measure the absolute filter air pressure as outlined in paragraph 5-13.

j. Replace shroud and side covers.

8-21. VELOCITY TRANSDUCER AND VELOCITY TRANSDUCER SHAFT

The velocity transducer (3, figure 9-7) and the velocity transducer shaft (1) are removed from the disc drive as follows:

a. Perform the preparation for service outlined in paragraph 8-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the shroud. (Refer to paragraph 8-3.)

d. Remove the card cage chassis. (Refer to paragraph 8-14.)

e. Disconnect the velocity transducer cable from connector A7P2 on motherboard PCA-A7.

f. Loosen the setscrew (4) that secures the velocity transducer shaft to the carriage assembly.

g. Using a slender tool (such as a 1/32-inch allen wrench), push the velocity transducer shaft free from the carriage assembly.

h. Remove the two screws (2) that secure the velocity transducer (1) to the actuator assembly.

i. Carefully slide the velocity transducer, with the velocity transducer shaft inside it, out from the rear of the actuator assembly.

CAUTION

The velocity transducer shaft contains a calibrated magnet. To avoid damage to the velocity transducer shaft, avoid contact by the magnet end of the shaft with ferrous or magnetic materials.

j. Carefully slide the velocity transducer shaft out from the rear of the velocity transducer.

To install a new velocity transducer and/or velocity transducer shaft, proceed as follows:

CAUTION

Exercise extreme care when replacing the velocity transducer. A slight torque on the back section will break the wires inside the assembly.

a. If the velocity transducer requires replacement, replace it with a new one.

b. Gently push the velocity transducer into the back of the actuator assembly and secure it in place with the two screws previously removed.

CAUTION

The velocity transducer shaft contains a calibrated magnet. To avoid damage to the velocity transducer shaft, avoid contact by the magnet end of the shaft with ferrous or magnetic materials.

c. If the velocity transducer shaft requires replacement, replace it with a new one.

d. Insert the rod end of the velocity transducer shaft into the opening at the end of the velocity transducer.

e. Using a slender tool of nonmagnetic material (such as the eraser end of a pencil), push on the magnet end of the velocity transducer shaft until the rod end extends through the hole in the carriage assembly.

f. Tighten the setscrew (4) on the carriage assembly to secure the velocity transducer shaft.

g. Replace the card cage chassis. (Refer to paragraph 8-14.)

h. Replace the shroud. (Refer to paragraph 8-3.) Restore the ac mains power to the disc drive.

8-22. HEAD CAM

To replace a head cam (11, figure 9-7), proceed as follows:

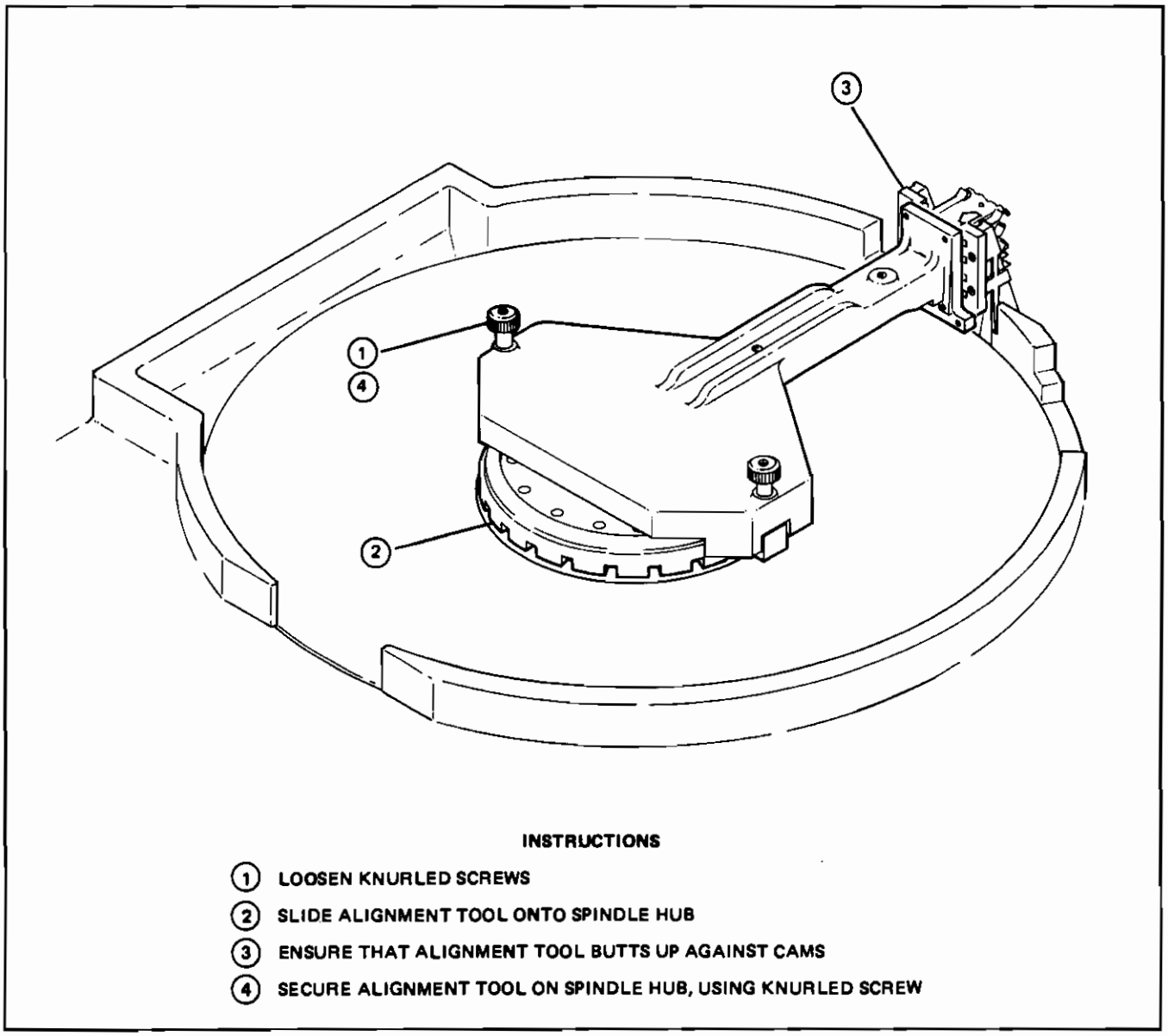
a. Perform the preparation for service outlined in paragraph 8-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the shroud. (Refer to paragraph 8-3.)

d. Remove the front frame assembly (refer to paragraph 8-7) and then remove the pack chamber assembly (refer to paragraph 8-9). Remove the data heads and the servo head. (Refer to paragraph 8-18.)

e. Remove the two screws (12) which secure the head cam to the head cam support.



7301-20A

Figure 8-2. Use of Head Cam Alignment Tool

f. Install the new head cam on the head cam support by loosely tightening the two head cam screws (12).

g. Loosen the two screws (12) on the other head cam (11).

h. Install the head cam alignment tool, part no. 13354-60001, on the spindle hub. (See figure 8-2.) Ensure that the head cams mate with the head cam alignment tool.

i. Adjust the cams to position with the head cam alignment tool. (See figure 8-3.)

j. Torque the cam securing screws (12) to 7 inch-pounds.

k. Remove the head cam alignment tool. Replace the data heads and the servo head. (Refer to paragraph 8-18.)

l. Replace the pack chamber assembly (refer to paragraph 8-9) and then replace the front frame assembly (refer to paragraph 8-7).

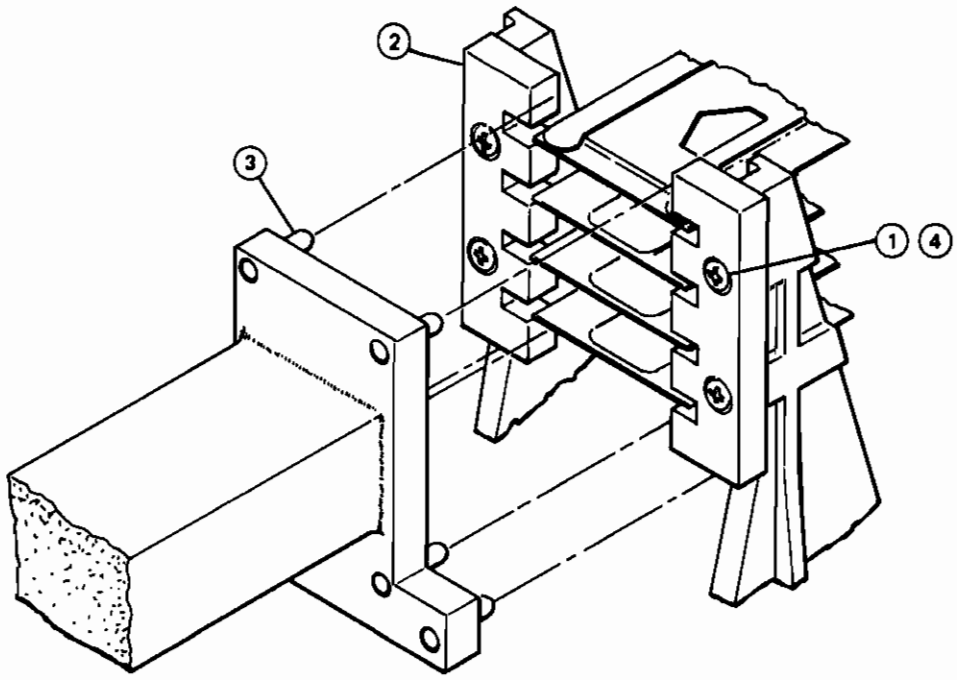
m. Measure the absolute filter air pressure as outlined in paragraph 5-13.

n. Replace the shroud. (Refer to paragraph 8-3.) Restore ac power to the disc drive.

8-23. HEAD CAM SUPPORT

To replace a head cam support (14, figure 9-7), proceed as follows:

a. Perform the preparation for service outlined in paragraph 8-2.



INSTRUCTIONS

1. LOOSEN FOUR HEAD CAM SCREWS
2. SEAT HEAD CAMS AGAINST SIX ALIGNMENT TOOL PINS (3)
3. TIGHTEN HEAD CAM SCREWS

7301-21

Figure 8-3. Head Cam Tool Alignment

b. Disconnect the ac power cord from the ac mains power.

c. Remove the shroud. (Refer to paragraph 8-3.)

d. Remove the front frame assembly. (Refer to paragraph 8-7.) Remove the pack chamber assembly. (Refer to paragraph 8-9.) Remove the bottom plate (22, figure 9-2.) Remove the data heads and the servo head. (Refer to paragraph 8-18.)

e. Remove the two screws (12, figure 9-7) which secure the head cam to the head cam support.

f. Remove the two screws (15) which secure the head cam support (14) to the magnet and rail assembly (34, figure 9-7).

g. Install the new head cam support (14) using the two screws (15) and the lockwashers, ensuring that the support is pushed forward firmly against the stop on the lower beam (toward the crash stops).

h. Install the head cam (11) on the head cam support by loosely tightening the two head cam screws (12) and washers (13).

i. Loosen the two screws (12) on the other head cam (11).

j. Install the head cam alignment tool, part no. 13354-60001, on the spindle hub. (See figure 8-2.) Ensure that the head cams mate with the head cam alignment tool.

k. Adjust the cams to position with the head cam alignment tool. (See figure 8-3.)

l. Torque the cam securing screws (12) to 7 inch-pounds.

m. Remove the head cam alignment tool. Replace the data heads and the servo head. (Refer to paragraph 8-18.)

n. Replace the bottom plate (22, figure 9-2). Replace the pack chamber assembly (refer to paragraph 8-9) and then replace the front frame assembly (refer to paragraph 8-7).

o. Measure the absolute filter air pressure as outlined in paragraph 5-13.

p. Replace the shroud. (Refer to paragraph 8-3.)

8-24. SPINDLE ASSEMBLY REMOVAL AND REPLACEMENT

WARNING

When shipping magnetic assemblies (spindle assembly and actuator assembly) which have been removed from the disc drive, each magnetic assembly must be packaged individually. Transporting more than one removed magnetic assembly in a single container could exceed aircraft limitations, 5.25 milligauss at 4.6 m (15 ft), which would create a potential hazard to personnel during shipping. If the magnetic material is being shipped into or within the United States, all applicable regulations of the U.S. Department of Transportation (DOT) must be followed before release to the initial carrier in the U.S. Refer to DOT Regulations, Title 49, parts 171-177 (Hazardous Materials).

To remove the spindle assembly (34, figure 9-2), proceed as follows:

a. Perform the preparation for service outlined in paragraph 8-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the shroud. (Refer to paragraph 8-3.)

d. Remove the side panels. (Refer to paragraph 8-4.)

e. Remove the front frame assembly (refer to paragraph 8-7) and then remove the pack chamber assembly (refer to paragraph 8-9).

f. On power and motor regulator PCA-A9, release the two 1/4-turn fasteners and lower the PCA into its service position.

CAUTION

When removing the spindle assembly, do not attempt to remove the spindle hub. Damage to the disc drive will occur if removal of this component is attempted.

g. From the bottom side of the mainframe, remove the four bolts with lockwashers (35 and 36, figure 9-2) that secure the spindle assembly to the mainframe.

h. Disconnect the spindle motor wiring connector from the PMR PCA.

i. Disconnect encoder PCA-A10 cable connector.

j. Lift the spindle assembly straight out from the mainframe.

CAUTION

The inner perimeter of the spindle hub may contain a series of tapped holes, some of which may contain items which appear to be setscrews. These items are balance weights and must not be touched. If any weight is moved, the spindle balance will be disturbed and damage to the disc drive will occur.

To replace the spindle assembly, perform the above steps in the reverse order. Torque the mounting bolts to 80 inch-pounds. Before replacing the pack chamber assembly, verify the head cam alignment. (Refer to paragraph 8-22.) Measure the absolute filter air pressure as outlined in paragraph 5-13. Verify data head alignment. (Refer to Section VI, Alignment and Adjustment.)

8-25. ENCODER PCA-A10 REMOVAL AND REPLACEMENT

To remove encoder PCA-A10 (4, figure 9-5), proceed as follows:

a. Perform the preparation for service outlined in paragraph 8-2.

b. Disconnect the ac power cord from the ac mains power.

c. Open the front door and remove the shield panel (10, figure 9-1).

d. On encoder PCA-A10, disconnect the cable connector.

e. On encoder PCA-A10, remove two screws (5, figure 9-5) and lift off the PCA.

To replace encoder PCA-A10, perform the above steps in the reverse order.

8-26. SPINDLE GROUND SPRING

To replace the spindle ground spring (9, figure 9-5), proceed as follows:

a. Perform the preparation for service outlined in paragraph 8-2.

b. Disconnect the ac power cord from the ac mains power.

c. Open the front door of the disc drive and remove the shield panel (10, figure 9-1).

d. Remove the bottom cover (7, figure 9-5) of the spindle.

e. Remove the spindle ground spring (9) from the bottom cover (7).

The spindle ground spring is installed by reversing this procedure. Ensure that the insulated side of the replacement spindle ground spring faces toward the spindle assembly bottom cover (7).

8-27. SPINDLE GROUND CONTACT AND ENCODER DISC

To replace the spindle ground contact (12, figure 9-5) or an encoder disc (13), proceed as follows:

a. Perform the preparation for service outlined in paragraph 8-2.

b. Disconnect the ac power cord from the ac mains power.

c. Open the front door of the disc drive and remove the shield panel (10, figure 9-1).

d. Remove the bottom cover (7, figure 9-5) of the spindle.

e. Remove encoder PCA-A10. (Refer to paragraph 8-25.)

f. While holding the spindle motor hub, use a wrench to remove the spindle ground contact.

g. If the encoder disc requires replacement, replace it with a new encoder disc.

h. Place the encoder disc in position in the spindle.

Note: For proper operation of the disc drive the part number on the encoder disc must face toward the bottom cover (7) of the spindle.

i. If the spindle ground contact requires replacement, replace it with a new spindle ground contact.

j. Attach the spindle ground contact to the spindle shaft.

k. Replace encoder PCA-A10. (Refer to paragraph 8-25.)

l. Replace the bottom cover (7) of the spindle.

m. Replace the shield panel (10, figure 9-1).

n. Restore ac power to the disc drive.

8-28. PACK LOCK

To perform the pack lock replacement procedure requires the special tool package for the service kit, part number 07920-67802. To change a pack lock, proceed as follows:

a. If the disc drive is in an operating mode, set the RUN/STOP switch to STOP.

b. Allow the spindle to halt (approximately 30 seconds). The DOOR UNLOCKED indicator will light, which means that the spindle has stopped rotating, the door unlock solenoid is energized, and it is safe to open the pack chamber door.

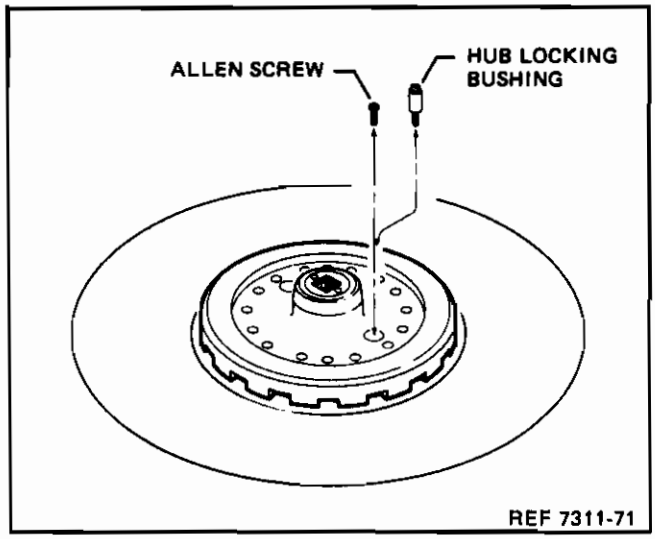


Figure 8-3A. Spindle Screw Locations

c. Remove and store the disc pack. Be sure to leave the pack chamber door open.

d. Disconnect the ac power cord from the ac mains power.

e. Rotate the spindle hub (see figure 8-3A) until one of the allen screws is visible through one of the large holes in the spindle hub. Remove the allen screw and replace it with the hub locking bushing.

f. Remove the pack lock retainer (1, figure 9-5) using the pack lock retainer tool which fits on the 100 foot-pound torque wrench. Throw out the old retainer.

g. Remove the pack lock assembly (2). Be sure to leave the compression spring (3) in the spindle assembly. Throw out the old pack lock assembly.

h. Insert the new pack lock assembly (2) into the spindle. Ensure that the bottom of the pack lock is centered in the compression spring (3).

i. Insert the new pack lock retainer (1) and hand tighten the retainer into the spindle. Ensure that the pack lock moves freely up and down inside the retainer.

j. Screw the pack lock retainer (1) down until it is flush with the top of the spindle. Torque the pack lock retainer to 30 foot-pounds.

k. Remove the hub locking bushing and replace with the allen head screw removed in step e. Torque the allen head screw to 10 inch-pounds. (Refer to figure 8-3A.)

CAUTION

To prevent damage to the disc drive from a possible head crash, ensure that the pack chamber area is clean.

l. Clean the pack chamber and the top of the spindle as outlined in paragraph 5-17.

m. Reconnect the ac power cord to the ac mains power and close the pack chamber door.

8-29. BLOWER MOTOR REMOVAL AND REPLACEMENT

To remove the blower motor, proceed as follows:

a. Perform the preparation for service outlined in paragraph 8-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the shroud. (Refer to paragraph 8-3.)

d. Open the front door and remove the shield panel (10, figure 9-1).

e. Remove the prefilter assembly. (Refer to paragraph 8-5.)

f. On the blower motor starting capacitor (13, figure 9-8), remove blower motor leads.

g. On the power supply assembly (19, figure 9-2), remove the safety cover (16).

h. Disconnect lead 3 on power supply terminal block (27, figure 9-6).

i. On power and motor control PCA-A9, release two 1/4-turn fasteners and lower the PCA into its service position. Disconnect the connectors on power and motor control PCA-A9 and remove the PCA.

j. Remove four screws (6, figure 9-8) that secure the impeller cover assembly (5) to the mainframe and remove the impeller cover assembly.

k. Loosen the setscrew that attaches the impeller (7) to the blower motor shaft.

l. Remove the four screws (9) that secure the blower motor (8) to the mainframe.

m. Remove the blower motor.

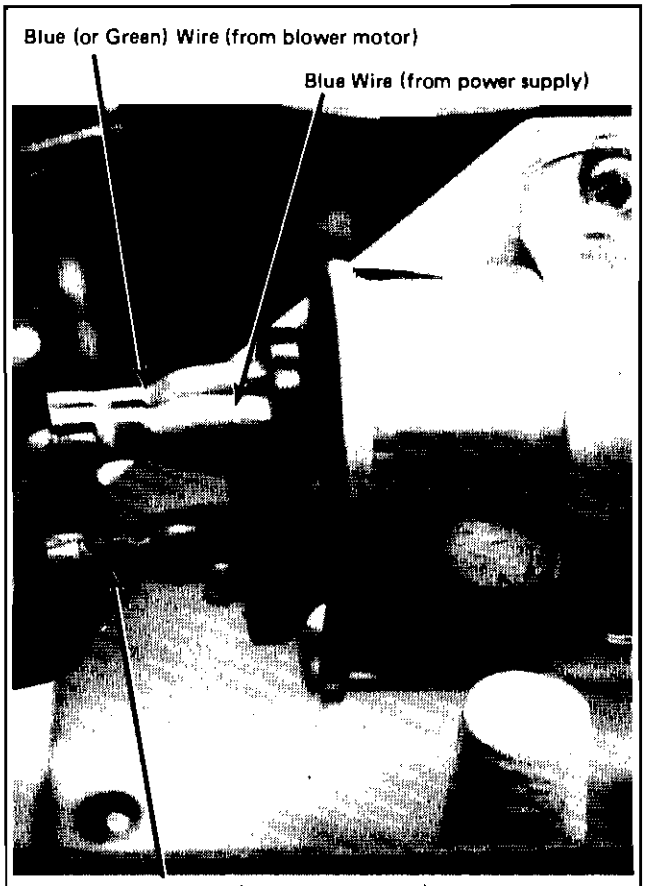
To replace the blower motor, perform the above steps in the reverse order. When the blower motor is replaced, ensure the safety cover is replaced on the power supply assembly.

8-30. BLOWER MOTOR STARTING CAPACITOR REMOVAL AND REPLACEMENT

To remove the blower motor starting capacitor, proceed as follows:

a. Perform the preparation for service outlined in paragraph 8-2.

b. Disconnect the ac power cord from the ac mains power.



Note: Negative symbol stamped on the capacitor, below the terminals, should be on the down side (toward the casting) of the capacitor.

REF 7311-58

Figure 8-4. Blower Motor Starting Capacitor

c. Remove the shroud. (Refer to paragraph 8-3.)

d. Remove the insulator cover and the wires from the blower motor starting capacitor. (Refer to figure 8-4.)

e. Remove the top screw (12, figure 9-8) that secures the capacitor clamp (11) to the capacitor mounting bracket and remove the capacitor from the disc drive.

To replace the blower motor starting capacitor, perform the above steps in the reverse order.

8-31. POWER SUPPLY ASSEMBLY REMOVAL AND REPLACEMENT

To remove the power supply assembly, proceed as follows:

a. Perform the preparation for service outlined in paragraph 8-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the shroud. (Refer to paragraph 8-3.)

d. Remove the side panels. (Refer to paragraph 8-4.)

e. On power and motor regulator PCA-A9, release the three 1/4-turn fasteners and lower the PCA into its service position.

f. Disconnect the power cable connectors from power and motor regulator PCA-A9.

g. Remove the safety cover (16, figure 9-2) from the power supply (19). On the input power terminal block (27, figure 9-6), remove the leads from terminals 1 and 3.

h. Remove harness cable retainer that is attached to the bottom of the mainframe.

i. Remove the four bolts with washers (20 and 21, figure 9-2) that secure the power supply assembly to the mainframe.

j. Disconnect the ground lead from the mainframe.

k. Lift the power supply assembly off the mainframe.

To replace the power supply assembly, perform the above steps in the reverse order.

8-32. DOOR LOCK ASSEMBLY REMOVAL AND REPLACEMENT

To remove the door lock assembly, proceed as follows:

a. Perform the preparation for service outlined in paragraph 8-2.

b. Disconnect the ac power cord from the ac mains power.

c. Remove the shroud. (Refer to paragraph 8-3.)

d. Remove the front frame assembly (refer to paragraph 8-7) and then remove the pack chamber assembly (refer to paragraph 8-7).

e. Remove the five screws (1, figure 9-4) that secure the door lock assembly to the pack chamber assembly and remove the assembly.

To replace the door lock assembly, perform the above steps in the reverse order. When the pack chamber is replaced, measure the absolute filter air pressure as outlined in paragraph 5-13.

8-33. POWER PANEL ASSEMBLY REMOVAL AND REPLACEMENT

To remove the power panel assembly (25, figure 9-1), proceed as follows:

a. Perform the preparation for service outlined in paragraph 8-2.

b. Disconnect the ac power cord from the ac mains power.

c. Disconnect all cables passing through the opening in the power panel assembly to disc drive. Loosen the cable strain relief clamps at the bottom of the enclosure and withdraw the cables from the enclosure.

d. Disconnect any power cords attached to the outlets on the power panel assembly.

e. Disconnect the power panel assembly grounding wire from the grounding stud at the bottom rear of the enclosure.

f. Remove the four screws attaching the power panel assembly to the enclosure and remove the assembly.

To replace the power panel assembly, perform the above steps in the reverse order. When the power panel assembly is replaced, ensure the grounding wire is connected to the enclosure.

REPLACEABLE PARTS

SECTION IX

9-1. INTRODUCTION

This section provides listings of all field-replaceable parts and an illustrated parts breakdown for the disc drive, as well as replaceable part ordering information.

Replaceable parts for the disc drive are listed in disassembly order in tables 9-1 through 9-12 and illustrated in figures 9-1 through 9-12. In each listing, attaching parts are listed immediately after the item they attach. Items in the DESCRIPTION column are indented to indicate relationship to the next higher assembly. In addition, the symbol "— — — x — — —" follows the last attaching part for that item. Indentation is as follows:

MAJOR ASSEMBLY
*Replaceable Assembly
*Attaching Parts for Replaceable Assembly
**Subassembly or Component Part
**Attaching Parts for Subassembly or Component Part

The replaceable parts listings provide the following information for each part:

a. FIG. & INDEX NO. The figure and index number which indicates where the replaceable part is illustrated.

b. HP PART NO. The Hewlett-Packard part number for each replaceable part.

c. DESCRIPTION. The description of each replaceable part. Refer to table 9-13 for an explanation of abbreviations used in the DESCRIPTION column.

d. MFR CODE. The five-digit code that denotes typical manufacturer of a part. Refer to table 9-14 for a listing of manufacturers that correspond to the codes.

e. MFR PART NO. The manufacturer's part number of each replaceable part.

f. UNITS PER ASSEMBLY. The total quantity of each part used in the major assembly.

The MFR CODE and MFR PART NO. for common hardware items are listed as 00000 and OBD (order by description), respectively, because these items can usually be purchased locally.

9-2. ORDERING INFORMATION

To order replaceable parts for the disc drive, address the order to your local Hewlett-Packard Sales and Service Office. Sales and Service Offices are listed at the back of this manual. Specify the following information for each part ordered:

a. Model and full serial number

b. Hewlett-Packard part number.

c. Complete description for each part as provided in the replaceable parts listings.

Table 9-1. HP 7920 Disc Drive, Replaceable Parts

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
9-1-	7920	DISC DRIVE	28480	7920	
1	07920-60065	*SHROUD ASSEMBLY	28480	07920-60065	1
2	07920-60094	*PACK CHAMBER ASSEMBLY (See figure 9-4A)	28480	07920-60094	1
3	No Number	*MAINFRAME ASSEMBLY (See figure 9-2)	28480	NSR	1
		(Attaching Parts)			
4	2940-0055	*SCREW, cap, hex hd, 1/4-20, 0.625 in. long	00000	OBD	6
		— — — x — — —			
5	7120-0695	*LABEL, P.M.	28480	7120-0695	1
6	07920-60085	*DOOR, front	28480	07920-60085	1
7	07920-60086	*DOOR, rear	28480	07920-60086	1
8	07920-60087	*PANEL, side	28480	07920-60087	2
		(Attaching parts)			
9	2680-0244	*SCREW, machine, ph, pozi, 10-32, 0.375 in. long	00000	OBD	8
		— — — x — — —			
10	07920-00061	*PANEL, shield	28480	07920-00061	1
		(Attaching Parts)			
11	2680-0106	*SCREW, machine, ph, pozi, 10-32, 0.625 in. long	00000	OBD	5
12	3050-0007	*WASHER, cup	28480	3050-0007	5
13	3050-0248	*WASHER, shoulder, 0.145 in. ID	28480	3050-0248	5
		— — — x — — —			
14	07920-00064	*PANEL, shield	28480	07920-00064	1
		(Attaching Parts)			
15	2510-0045	*SCREW, machine, ph, pozi, 8-32, 0.375 in. long	00000	OBD	2
		— — — x — — —			
16	07920-60088	*PANEL, filler	28480	07920-60088	1
		(Attaching Parts)			
17	2680-0106	*SCREW, machine, ph, pozi, 10-32, 0.625 in. long	28480	OBD	4
18	3050-0007	*WASHER, cup	28480	3050-0007	4
19	3050-0248	*WASHER, shoulder, 0.145 in. ID	28480	3050-0248	4
		— — — x — — —			
20	3150-0316	*PREFILTER	28480	3150-0316	1
21	07920-60079	*PREFILTER CHAMBER	28480	07920-60079	1
		(Attaching Parts)			
22	1390-0386	*FASTENER, snap-in-grommet (for use with item 23)	28480	1390-0388	2
23	1390-0389	*FASTENER, snap-in-grommet (for use with item 22)	28480	1390-0389	2
		— — — x — — —			
24	8120-1860	*POWER CORD, 240 Vac (Option 015)	28480	8120-1860	1
	8120-1689	*POWER CORD, 240 Vac (Option 015)	28480	8120-1689	REF
	8120-1369	*POWER CORD, 240 Vac (Option 015)	28480	8120-1369	REF
	8120-1351	*POWER CORD, 240 Vac (Option 015)	28480	8120-1351	REF
	8120-2104	*POWER CORD, 240 Vac (Option 015)	28480	8120-2104	REF
25	02940-60157●	*POWER PANEL ASSEMBLY (See figure 9-10)	28480	02940-60157	1
	29425-60003■	*POWER PANEL ASSEMBLY (See figure 9-12)	28480	29425-60003	1
	02940-60156●	*POWER PANEL ASSEMBLY (Option 015) (See figure 9-10)	28480	02940-60156	REF
	29425-60004■	*POWER PANEL ASSEMBLY (Option 015) (See figure 9-12)	28480	29425-60004	REF
		(Attaching Parts)			
26	2680-0106	*SCREW, machine, ph, pozi, 10-32, 0.625 in. long	00000	OBD	4
27	3050-0007	*WASHER, cup	28480	3050-0007	4
28	3050-0248	*WASHER, shoulder, 0.145 in. ID	28480	3050-0248	4
29	0590-0804	*NUT, w/retainer, 10-32	28480	0590-0804	4
		— — — x — — —			
30	07920-60069	*PANEL, filler, rear	28480	07920-60089	1
		(Attaching Parts)			
31	2360-0115	*SCREW, machine, ph, pozi, 6-32, 0.312 in. long	00000	OBD	4
32	3050-0226	*WASHER, int-tooth, no. 6	00000	OBD	4
		— — — x — — —			
33	07920-60056	*TERMINATION ASSEMBLY	28480	07920-60056	1

NOTES: ● Used on disc drives with serial numbers prefixed 1736 and prior.
■ First used on disc drives with serial numbers prefixed 1740.

Table 9-1. HP 7920 Disc Drive, Replaceable Parts (Continued)

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
9-1-					
		(Attaching Parts)			
34	2510-0045	*SCREW, machine, ph, pozi, 6-32, 0.375 in. long	00000	OBD	2
35	2580-0003	*NUT, hex, 8-32, w/lock	00000	OBD	2
		— — — x — — —			
36	No Number	*FRAME, enclosure	28480	NSR	1
37	0590-0804	*NUT, sheet metal, 10-32	28480	0590-0804	8
38	1492-0081	*CASTER	28480	1492-0081	4
		(Attaching Parts)			
39	2940-0214	*SCREW, cap, hex hd, w/washer, 5/16-18, 0.625 in. long	00000	OBD	4
		— — — x — — —			
40	0403-0246	*LEVELER	28480	0403-0246	4
41	1460-1570	*SPRING LATCH	28480	1460-1570	2
		(Attaching Parts)			
42	2510-0254	*SCREW, machine, hex indented flange lock, 8-32, 0.375 in. long	00000	OBD	1
43	8120-1405	*POWER INTERCONNECT CABLE	28480	8120-1405	1
	8120-1575	*POWER INTERCONNECT CABLE (Option 015)	28480	8120-1575	1

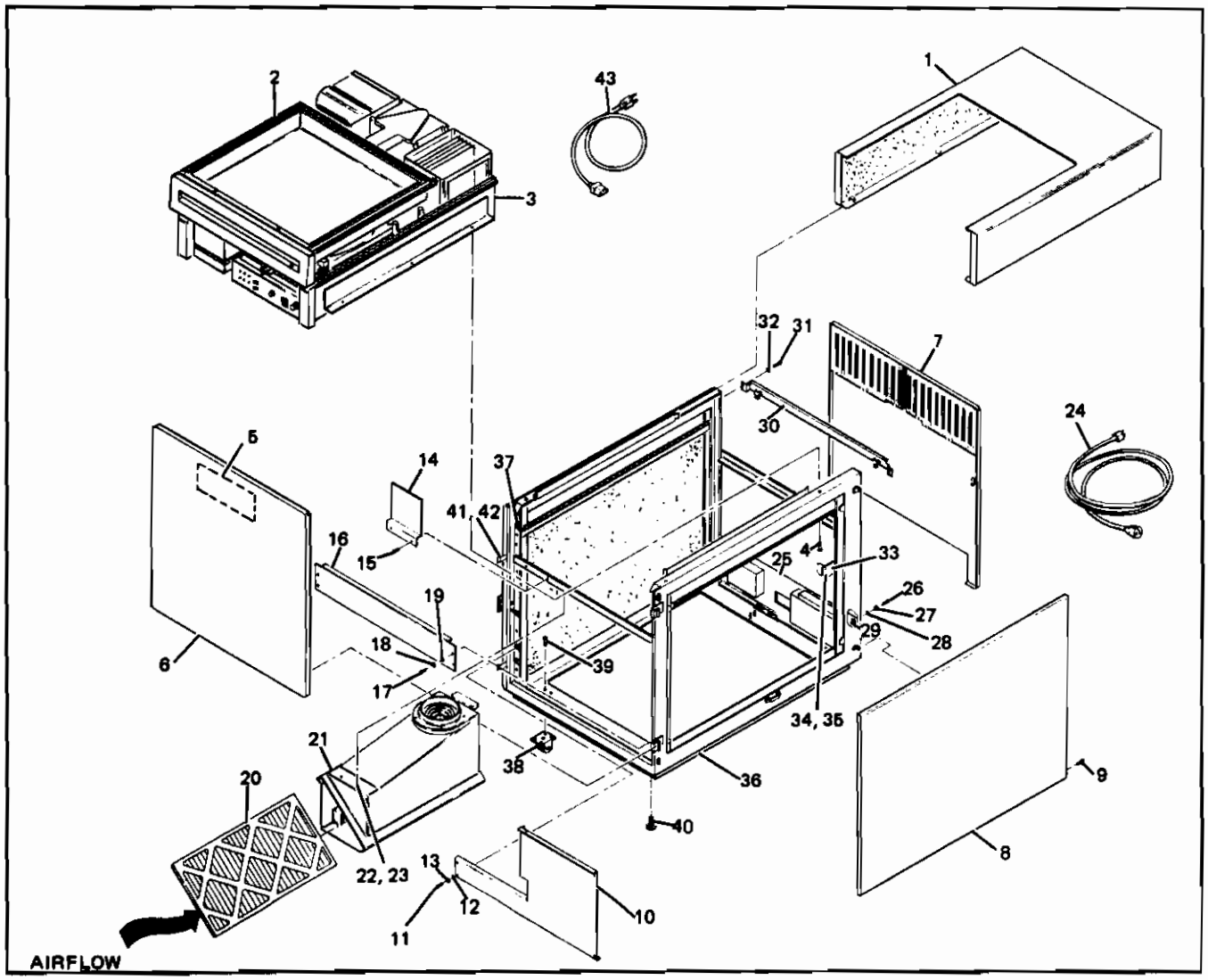


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Figure 9-1. HP 7920 Disc Drive, Exploded View

Table 9-2. Mainframe Assembly, Replaceable Parts

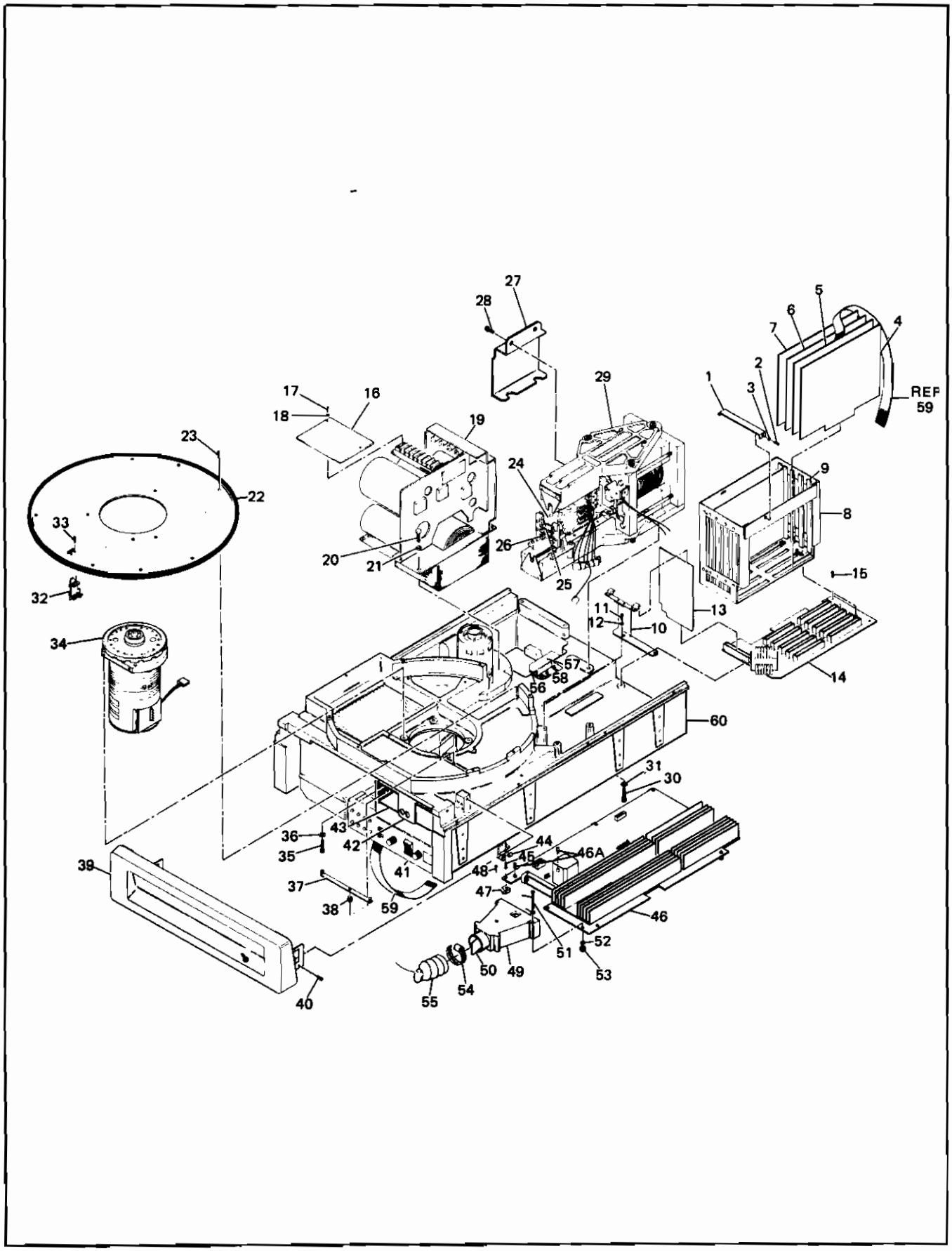
FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
9-2-	No Number	MAINFRAME ASSEMBLY (3, figure 9-1)	28480	NSR	REF
1	07905-00003	*RETAINER, PCA	28480	07905-00003	1
		(Attaching Parts)			
2	2360-0117	*SCREW, machine, ph, pozi, 6-32, 0.375 in. long, w/ext-tooth	00000	OBD	1
3	3050-0001	*WASHER, flat, no. 8	00000	OBD	1
		— — — x — — —			
4	07920-60001	*I/O SECTOR PCA (A2)	28480	07920-60001	1
5	07920-60003 ★	*SERVO PCA (A3)	28480	07920-60003	1
		(Only for use with PMR PCA, part no. 07920-60010)			
	07920-60083 ●	*SERVO PCA (A3)	28480	07920-60083	1
		(Only for use with PMR PCA, part no. 07920-60080)			
6	07920-60002	*DRIVE CONTROL PCA (A4)	28480	07920-60002	1
7	07920-60004	*TRACK FOLLOWER PCA (A5)	28480	07920-60004	1
8	07920-60023	*CARD CAGE CHASSIS	28480	07920-60023	1
9	0403-0102	**GUIDE, PCA, nylon, 6.5 in. long, 0.312 in. wide	23880	1650F	10
10	07920-60061 ♦	*BRACKET ASSEMBLY, read/write preamplifier PCA	28480	07920-60061	1
		(Attaching Parts)			
11	2510-0045 ♦	*SCREW, machine, ph, pozi, 8-32, 0.375 in. long, w/ext-tooth	00000	OBD	2
12	3050-0001 ♦	*WASHER, flat, no. 8	00000	OBD	2
		— — — x — — —			
13	07920-60006	*READ/WRITE PREAMPLIFIER PCA (A6)	28480	07920-60006	1
14	07920-60008	*MOTHERBOARD PCA (A7)	28480	07920-60008	1
		(Attaching Parts)			
15	2510-0045	*SCREW, machine, ph, pozi, 8-32, 0.375 in. long, w/ext-tooth	00000	OBD	5
		— — — x — — —			
16	07905-00063	*COVER, terminal block	28480	07905-00063	1
		(Attaching Parts)			
17	2360-0127	*SCREW, machine, ph, pozi, 6-32, 0.875 in. long	00000	OBD	2
18	2190-0851	*WASHER, lock, split, no. 6	00000	OBD	2
		— — — x — — —			
19	07920-60022	*POWER SUPPLY ASSEMBLY (See figure 9-6)	28480	07920-60022	1
		(Attaching Parts)			
20	2940-0055	*SCREW, cap, hex hd, 1/4-20, 0.625 in. long	00000	OBD	4
21	2190-0032	*WASHER, lock, split, 1/4 in.	00000	OBD	4
		— — — x — — —			
22	07920-60101	*PLATE, bottom	28480	07920-60101	1
		(Attaching Parts)			
23	2510-0045	*SCREW, machine, ph, pozi, 8-32, 0.375 in. long, w/ext-tooth	00000	OBD	10
		— — — x — — —			
24	07920-60033	*HEAD ASSEMBLY, read/write (down)	28480	07920-60033	4
25	07920-60034	*HEAD ASSEMBLY, servo	28480	07920-60034	1
26	07920-60032	*HEAD ASSEMBLY, read/write (up)	28480	07920-60032	5
27	07920-00084 ■	*SHIELD, contamination	28480	07920-00084	1
		(Attaching Parts)			
28	2510-0045 ■	*SCREW, machine, ph, pozi, 8-32, 0.375 in. long, w/ext tooth	00000	OBD	2
		— — — x — — —			
29	07920-60097	*ACTUATOR ASSEMBLY (See figure 9-7)	28480	07920-60097	1
		(Attaching Parts)			
30	3020-0006	*SCREW, cap, socket hd, 1/4-20, 1.25 in. long	00000	OBD	4
31	2190-0032	*WASHER, lock, split, 1/4 in.	00000	OBD	4
		— — — x — — —			
32	07920-60052	*PACK DETECTOR ASSEMBLY	28480	07920-60052	1
		(Attaching Parts)			
33	2200-0105	*SCREW, machine, ph, pozi, 4-40, 0.312 in. long, w/ext-tooth	00000	OBD	2
		— — — x — — —			
34	07920-60012	*SPINDLE ASSEMBLY (See figure 9-5)	28480	07920-60012	1

NOTES:
★ Used on disc drives with serial numbers 1740 and prior.
● First used on disc drives with serial numbers prefixed 1752.
♦ Used on disc drives with serial numbers 1842 and prior.
■ First used on disc drives with serial numbers prefixed 1843.

Table 9-2. Mainframe Assembly, Replaceable Parts (Continued)

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
9-2-					
		(Attaching Parts)			
35	3020-0006	*SCREW, cap, socket hd, 1/4-20, 1.25 in. long	00000	OBD	4
36	2190-0032	*WASHER, lock, split, 1/4 in.	00000	OBD	4
		— — — x — — —			
37	07920-60026	*HUB LOCK	28480	07920-60026	1
		(Attaching Parts)			
38	1460-0629	*SPRING, hub lock	28480	1460-0629	1
		— — — x — — —			
39	07920-60075	*FRONT FRAME ASSEMBLY (See figure 9-3)	28480	07920-60075	1
		(Attaching Parts)			
40	2510-0045	*SCREW, machine, ph, pozi, 8-32, 0.375 in. long, w/ext-tooth	00000	OBD	4
		— — — x — — —			
41	No Number	*OPERATOR PANEL AND LOWER CARD CAGE ASSEMBLY (See figure 9-9)	28480	NSR	1
42	07920-00075	*RETAINER, spindle logic PCA	28480	07920-00075	1
43	07920-60031	*SPINDLE LOGIC PCA (A8)	28480	07920-60031	1
44	07920-40007	*HINGE, female	28480	07920-40007	3
45	2510-0105	*SCREW, machine, ph, pozi, 8-32, 0.438 in. long	00000	OBD	3
46	07920-60010★	*POWER AND MOTOR REGULATOR (A9) (Only for use with SERVO PCA, part no. 07920-60003)	28480	07920-60010	1
	07920-60080●	*POWER AND MOTOR REGULATOR (A9) (Only for use with SERVO PCA, part no. 07920-60083)	28480	07920-60080	1
46A	2110-0516	**FUSE, 1A, 125V, fast-blo	75915	78-154	2
47	07920-40008	*HINGE, male	28480	07920-40008	3
		(Attaching Parts)			
48	0824-0397	*SCREW, self-tapping, pozi, 8-16, 0.438 in. long	00000	OBD	3
		— — — x — — —			
49	07920-20063	*DUCT, air	28480	07920-20063	1
50	07920-00056	*FIN, air duct	28480	07920-00056	1
51	2360-0137	*SCREW, machine, ph, pozi, no. 6-32, 1.75 in. long	00000	OBD	2
52	3050-0228	*WASHER. flat, no. 6	00000	OBD	4
53	2420-0001	*NUT, 6-32, hex, w/lock washer	00000	OBD	2
54	1400-0851	*CLAMP, hose	81646	6206	1
55	0890-1147	*HOSE, air	28480	0890-1147	1
56	9135-0031	*FILTER, line	28480	9135-0031	1
57	07905-00093	*BRACKET, filter	28480	07905-00093	1
		(Attaching Parts)			
58	2510-0045	*SCREW, machine, ph, pozi, 8-32, 0.375 in. long, w/ext-tooth	00000	OBD	2
		— — — x — — —			
59	07920-60048	*FAULT INDICATOR CABLE ASSEMBLY	28480	07920-60048	1
60	No Number	*AIR DISTRIBUTION ASSEMBLY (See figure 9-8)	28480	NSR	1

NOTES: ★ Used on disc drives with serial numbers 1740 and prior.
● First used on disc drives with serial numbers prefixed 1752.

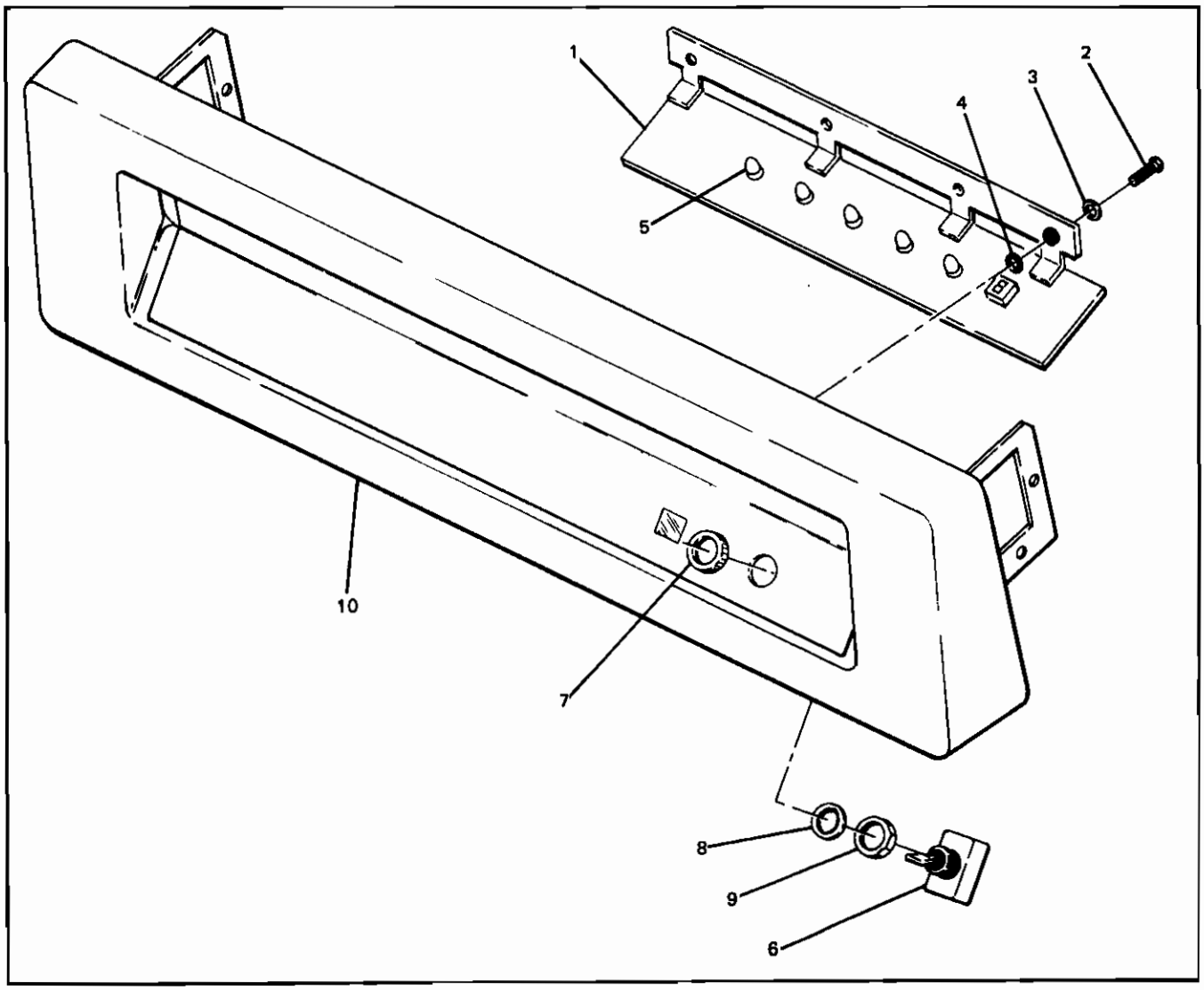


7301-23C

Figure 9-2. Mainframe Assembly, Exploded View

Table 9-3. Front Frame Assembly, Replaceable Parts

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
9-3-	07920-60075	FRONT FRAME ASSEMBLY (39, figure 9-2) (Direct replacement for all HP 7920 Disc Drives)	28480	07920-60075	REF
1	07920-60011	*INDICATOR ASSEMBLY (A11) (Attaching Parts)	28480	07920-60011	1
2	2200-0107	*SCREW, machine, ph, pozi, 4-40, 0.375 in. long, w/ext-tooth	00000	OBD	4
3	3050-0105	*WASHER, flat, no. 4	00000	OBD	4
4	0380-0019	*SPACER, no. 4, 0.188 in. thick — — — x — — —	78854	10918-412	4
5	2140-0343	*LAMP, incandescent, 14V	05464	330	4
6	3101-1051	*SWITCH, toggle, DPDT (Attaching Parts)	27191	8908K507	1
7	3130-0103	*NUT, face	28460	3130-0103	1
8	2190-0102	*WASHER, lock, int-tooth, 7/16 in.	00000	OBD	1
9	2950-0035	*NUT, hex, 15/32-32 — — — x — — —	00000	OBD	1
10	07920-60076	*FRONT PANEL ASSEMBLY	28480	07920-60076	1



7301-24C

Figure 9-3. Front Frame Assembly, Exploded View

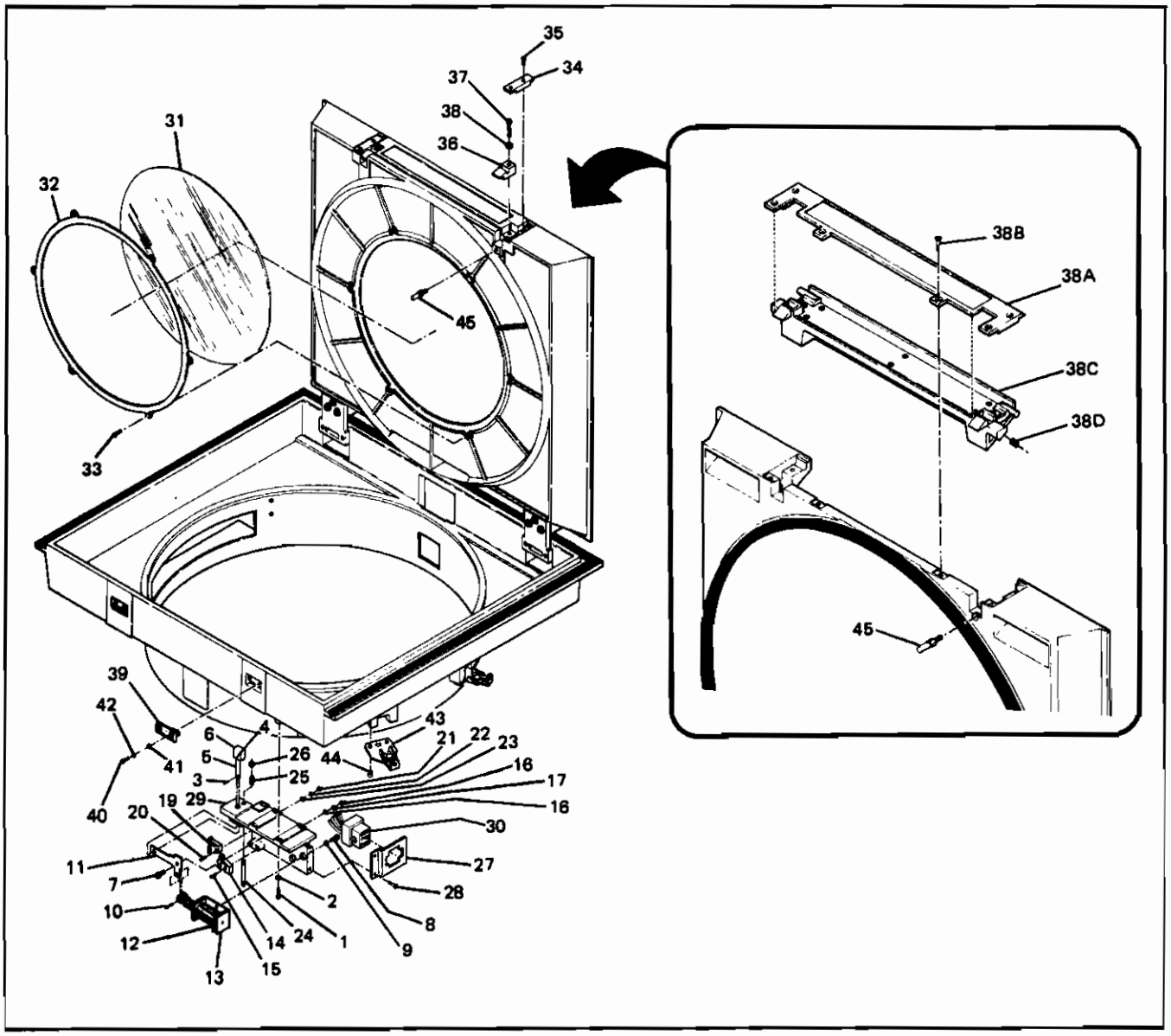
Table 9-4. Pack Chamber Assembly (Serial no. prefix 1828 and prior), Replaceable Parts

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
9-4-	No Number	PACK CHAMBER ASSEMBLY (2, figure 9-1)	28480	No Number	REF
	07920-60054	*DOOR LOCK ASSEMBLY	28480	07920-60054	1
		(Attaching Parts)			
1	2360-0121	*SCREW, machine, ph, pozi, 6-32, 0.375 in. long, w/ext-tooth	00000	OBD	5
2	3050-0228	*WASHER, flat, no. 8	00000	OBD	5
		— — — x — — —			
3	1480-0073	**PIN, roll	28480	1480-0073	1
4	1480-0073	**PIN, roll	28480	1480-0073	1
5	1530-1933	**SHAFT, lock	28480	1530-1933	1
6	07920-40010	**TIP, lock shaft	28480	07920-40010	1
7	0570-1153	**SCREW, shoulder, 6-32	28480	0570-1153	1
8	2200-0141	**SCREW, machine, ph, pozi, 4-40, 0.312 in. long, w/ext-tooth	00000	OBD	2
9	3050-0229	**WASHER, flat, no. 4	00000	OBD	2
10	1480-0072	**PIN, roll	28480	1480-0072	2
11	07920-00009	**LEVER, latch	28480	07920-00009	1
12	1901-0028	**SEMICONDUCTOR DEVICE, diode	04713	SR1358-9	1
13	0491-0079	**SOLENOID, door unlock	02289	SDA1512D1	1
14	3102-0009	**SWITCH, door locked	28480	3102-0009	1
		(Attaching Parts)			
15	0520-0141	**SCREW, machine, ph, pozi, 2-56, 1.0 in. long	00000	OBD	2
16	0610-0001	**NUT, hex, 2-56	00000	OBD	2
17	2190-0045	**WASHER, lock, split, no. 2	00000	OBD	2
18	2190-0479	**WASHER, flat, no. 2	00000	OBD	4
		— — — x — — —			
19	3102-0009	**SWITCH, door closed	28480	3102-0009	1
		(Attaching Parts)			
20	0520-0136	**SCREW, machine, ph, pozi, 2-56, 0.625 in. long	00000	OBD	2
21	0610-0001	**NUT, hex, 2-56	00000	OBD	2
22	2190-0045	**WASHER, lock, split, no. 2	00000	OBD	2
23	2190-0479	**WASHER, flat, no. 2	00000	OBD	4
		— — — x — — —			
24	1530-1935	**SHAFT, door detect	28480	1530-1935	1
25	1460-1533	**SPRING	28480	1460-1533	1
26	0380-0627	**STANDOFF, round, 4-40, 0.188 in. long	28480	0380-0627	1
27	07920-00039	**BRACKET, connector mounting	28480	07920-00039	1
		(Attaching Parts)			
28	2360-0113	**SCREW, machine, ph, pozi, 6-32, 0.250 in. long, w/ext-tooth	00000	OBD	2
		— — — x — — —			
29	07920-20052	**MOUNT, latch	28480	07920-20052	1
30	No Number	**CONNECTOR ASSEMBLY	28480	NSR	1
31	07920-20007■	*WINDOW, door	28480	07920-20007	1
32	07920-00046■	*RETAINER RING, window	28480	07920-00046	1
		(Attaching Parts)			
33	2200-0185 ■	*SCREW, machine, fh, pozi, 82-deg, 4-40, 0.250 in. long	28460	2200-0165	6
		— — — x — — —			
34	07920-40011■	*RETAINER, handle	28480	07920-40011	2
		(Attaching Parts)			
35	2200-0166 ■	*SCREW, machine, fh, pozi, 82-deg, 4-40, 0.312 in. long	00000	OBD	4
		— — — x — — —			
36	07920-40012■	*LATCH, handle	28480	07920-40012	2
37	2360-0121 ■	*SCREW, machine, ph, pozi, 6-32, 0.500 in. long	00000	OBD	2
38	3050-0228 ■	*WASHER, flat, no. 6	00000	OBD	2
		— — — x — — —			
38A	07920-40022★	*HANDLE, spanner	28480	07920-40022	1
		(Attaching Parts)			
38B	2200-0167 ★	*SCREW, machine, fh, pozi, 82-deg, 4-40, 0.375 in. long	00000	OBD	6
		— — — x — — —			

Notes: ■ Used only on pack chamber assemblies *with* a window in the door.
★ Used only on pack chamber assemblies *without* a window in the door.

Table 9-4. Pack Chamber Assembly (Serial no. prefix 1828 and prior), Replaceable Parts (Continued)

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
38C	07920-60099★	*ACCESS DOOR HANDLE ASSEMBLY	28480	07920-60099	1
38D	1460-0565 ★	*SPRING	28480	1460-0565	2
39	07920-40013	*LATCH, door	28480	07920-40013	2
		(Attaching Parts)			
40	2200-0105	*SCREW, machine, pozi, 4-40, 0.312 in. long	00000	OBD	4
41	3050-0229	*WASHER, flat, no. 4	00000	OBD	4
42	2190-0003	*WASHER, lock, split, no. 4	00000	OBD	4
		— — — x — — —			
43	07920-00071	*PLATE, snapslide	28480	07920-00071	4
		(Attaching Parts)			
44	2360-0184	*SCREW, machine, fh, pozi, 82-deg, 0.312 in. long	00000	OBD	8
		— — — x — — —			
45	07920-20051	*STUD, door detect	28480	07920-20051	1



7301-25C Figure 9-4. Pack Chamber Assembly (Serial no. prefix 1828 and prior), Exploded View

Table 9-4A. Pack Chamber Assembly (Beginning with serial no. prefix 1841), Replaceable Parts

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
9-4A-	07920-60094 ★	PACK CHAMBER ASSEMBLY (2, figure 9-1) (Direct replacement for all HP 7920 Disc Drives)	28480	07920-60094	REF
	07920-60054	*DOOR LOCK ASSEMBLY (Attaching Parts)	28480	07920-60054	1
1	2360-0119	*SCREW, machine, ph, pozi, 6-32, 0.437 in. long, w/ext-tooth	00000	OBD	5
2	3050-0228	*WASHER, flat, no. 6 — — — x — — —	00000	OBD	5
3	1480-0073	**PIN, roll	28480	1480-0073	1
4	1480-0073	**PIN, roll	28480	1480-0073	1
5	1530-1933	**SHAFT, lock	28480	1530-1933	1
6	07920-40010	**TIP, lock shaft	28480	07920-40010	1
7	0570-1153	**SCREW, shoulder, 8-32	28480	0570-1153	1
8	2200-0141	**SCREW, machine, ph, pozi, 4-40, 0.312 in. long, w/ext-tooth	00000	OBD	2
9	3050-0229	**WASHER, flat, no. 4	00000	OBD	2
10	1480-0072	**PIN, roll	28480	1480-0072	2
11	07920-00009	**LEVER, latch	28480	07920-00009	1
12	1901-0028	**SEMICONDUCTOR DEVICE, diode	04713	SR1358-9	1
13	0491-0079	**SOLENOID, door unlock	02289	SDA1512D1	1
14	3102-0009	**SWITCH, door locked (Attaching Parts)	28480	3102-0009	1
15	0520-0141	**SCREW, machine, ph, pozi, 2-56, 1.0 in. long	00000	OBD	2
16	0610-0001	**NUT, hex, 2-56	00000	OBD	2
17	2190-0045	**WASHER, lock, split, no. 2	00000	OBD	2
18	2190-0479	**WASHER, flat, no. 2 — — — x — — —	00000	OBD	4
19	3102-0009	**SWITCH, door closed (Attaching Parts)	28480	3102-0009	1
20	0520-0136	**SCREW, machine, ph, pozi, 2-56, 0.625 in. long	00000	OBD	2
21	0610-0001	**NUT, hex, 2-56	00000	OBD	2
22	2190-0045	**WASHER, lock, split, no. 2	00000	OBD	2
23	2190-0479	**WASHER, flat, no. 2 — — — x — — —	00000	OBD	4
24	1530-1935	**SHAFT, door detect	28480	1530-1935	1
25	1460-1533	**SPRING	28480	1460-1533	1
26	0380-0627	**STANDOFF, round, 4-40, 0.188 in. long	28480	0380-0627	1
27	07920-00039	**BRACKET, connector mounting (Attaching Parts)	28480	07920-00039	1
28	2360-0113	**SCREW, machine, ph, pozi, 6-32, 0.250 in. long, w/ext-tooth — — — x — — —	00000	OBD	2
29	07920-20052	**MOUNT, latch	28480	07920-20052	1
30	No Number	**CONNECTOR ASSEMBLY	28480	NSR	1
31	1390-0455	*LATCH, door (Attaching Parts)	28480	1390-0455	2
32	2360-0195 ■	*SCREW, machine, ph, pozi, 6-32, 0.312 in. long	00000	OBD	4
32A	2360-0117 ♦	*SCREW, machine, ph, pozi, 6-32, 0.375 in. long	00000	OBD	4
33	3050-0228 ■	*WASHER, flat, no. 6	00000	OBD	4
34	No Number ■	*LATCH CLAMP	28480	No Number	4
34A	07920-00109♦	*LATCH RETAINER — — — x — — —	28480	07920-00109	2
35	07920-40022	*HANDLE, spanner (Attaching Parts)	28480	07920-40022	1
36	2200-0167	*SCREW, machine, fh, pozi, 82-deg, 4-40, 0.375 in. long — — — x — — —	00000	OBD	6
37	07920-60099	*ACCESS DOOR HANDLE ASSEMBLY	28480	07920-60099	1
38	1460-0565	*SPRING	28480	1460-0565	2
39	07920-00071	*PLATE, snapslide	28480	07920-00071	4

NOTES: ★ First used on disc drives with serial numbers prefixed 1841.
■ Used only on disc drives with serial numbers 1905 and prior. When replacing these items, use items 32A and 34A.
♦ First used on disc drives with serial numbers prefixed 1906.

Table 9-4A. Pack Chamber Assembly (Beginning with serial no. prefix 1841), Replaceable Parts (Continued)

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
9-4A-					
		(Attaching Parts)			
40	2360-0184	*SCREW, machine, fh, pozi, 82-deg, 0.312 in. long — — — x — — —	00000	OBD	8
41	07920-20051	*STUD, door detect	28480	07920-20051	1
42	0403-0101	*GUIDE, PCA, nylon, 2.5 in. long, 0.312 in. wide	23880	1250F	1
43	07920-00091	*BRACKET, preamplifier retainer (When replacing this part, order item 42 also.) (Attaching Parts)	28480	07920-00091	1
44	0570-0901	*SCREW, knurled, 6-32, 0.25 in. long	00000	OBD	2
45	2190-0008	*WASHER, lock, ext-tooth, no. 6 — — — x — — —	00000	OBD	2

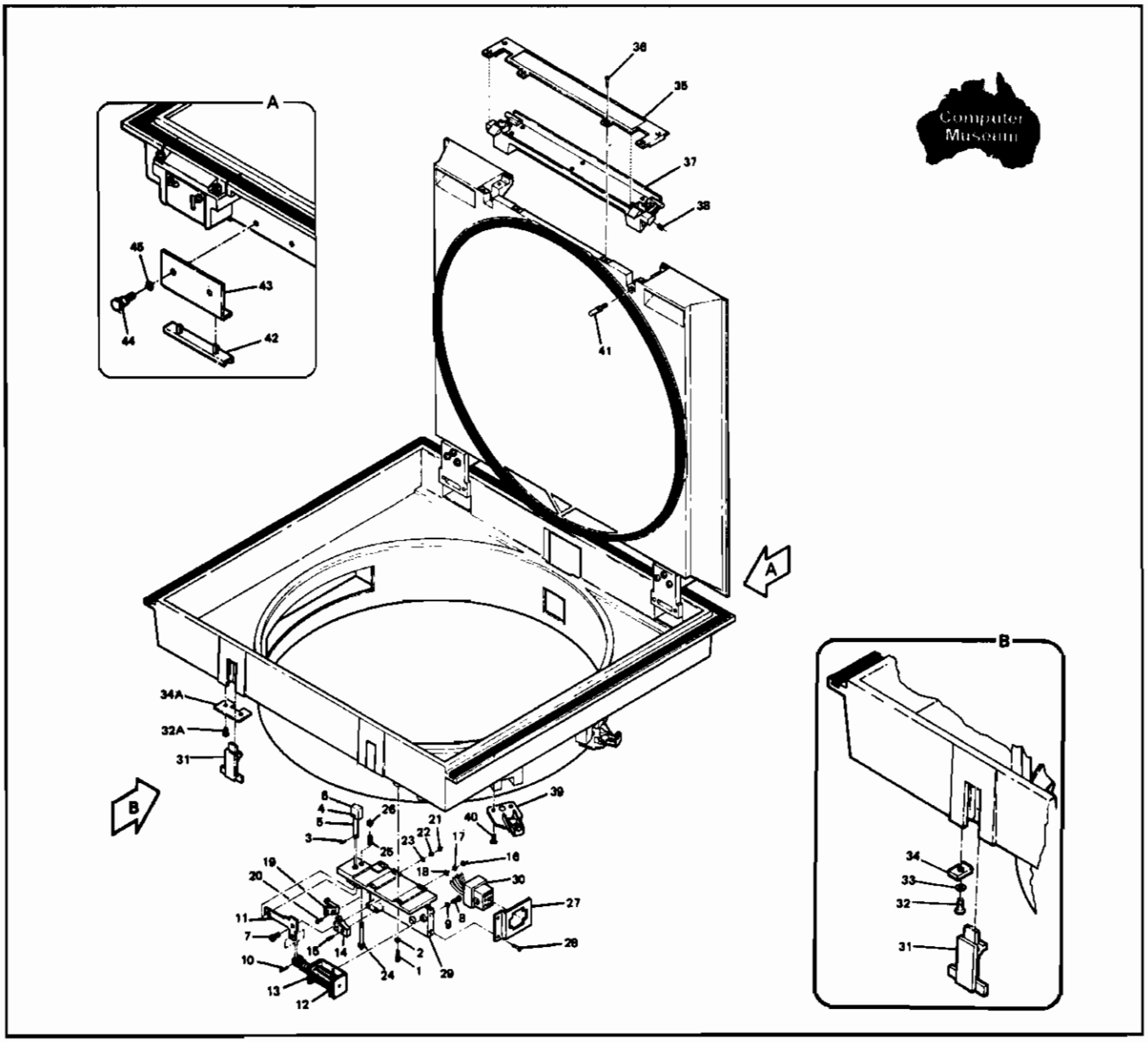
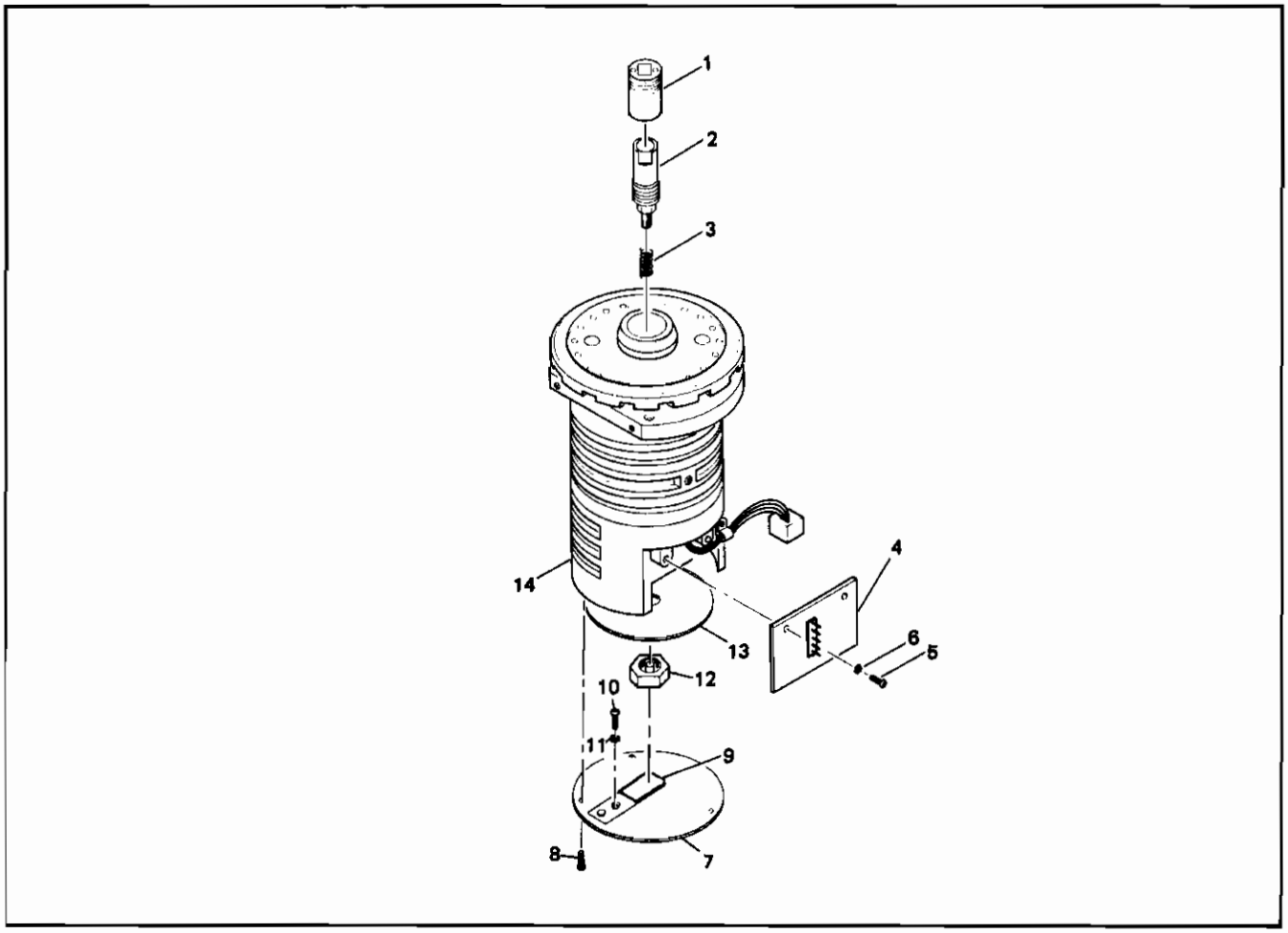


Figure 9-4A. Pack Chamber Assembly (Beginning with serial no. prefix 1841), Exploded View

Table 9-5. Spindle Assembly, Replaceable Parts

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
9-5-	07920-60012	SPINDLE ASSEMBLY (34, figure 9-2)	28480	07920-60012	REF
1	07920-20038	*RETAINER, packlock	28480	07920-20038	1
2	07920-60024	*PACKLOCK ASSEMBLY	28480	07920-60024	1
3	1460-0813	*SPRING, compression	28480	1460-0813	1
4	07920-60009	*ENCODER PCA (A10)	28480	07920-60009	1
		(Attaching Parts)			
5	2510-0100	*SCREW, machine, ph, pozi, 8-32, 0.375 in. long	00000	OBD	2
6	2190-0073	*WASHER, lock, split, no. 6	00000	OBD	2
		— — — x — — —			
7	07905-00031	*COVER, bottom	28480	07905-00031	1
		(Attaching Parts)			
6	2510-0103	*SCREW, machine, ph, pozi, 8-32, 0.375 in. long, w/ext-tooth	00000	OBD	3
		— — — x — — —			
9	07905-00032	*SPRING, ground	28480	07905-00032	1
		(Attaching Parts)			
10	2360-0191	*SCREW, machine, ph, pozi, no. 6-32, 0.188 in. long	00000	OBD	2
11	2190-0008	*WASHER, lock, ext-tooth, no. 8	00000	OBD	2
		— — — x — — —			
12	07905-60031	*SPINDLE GROUND CONTACT	28480	07905-60031	1
13	07920-00018	*DISC, encoder	28480	07920-00016	1
14	No Number	*MOTOR, spindle	28480	NSR	1



7301-28A

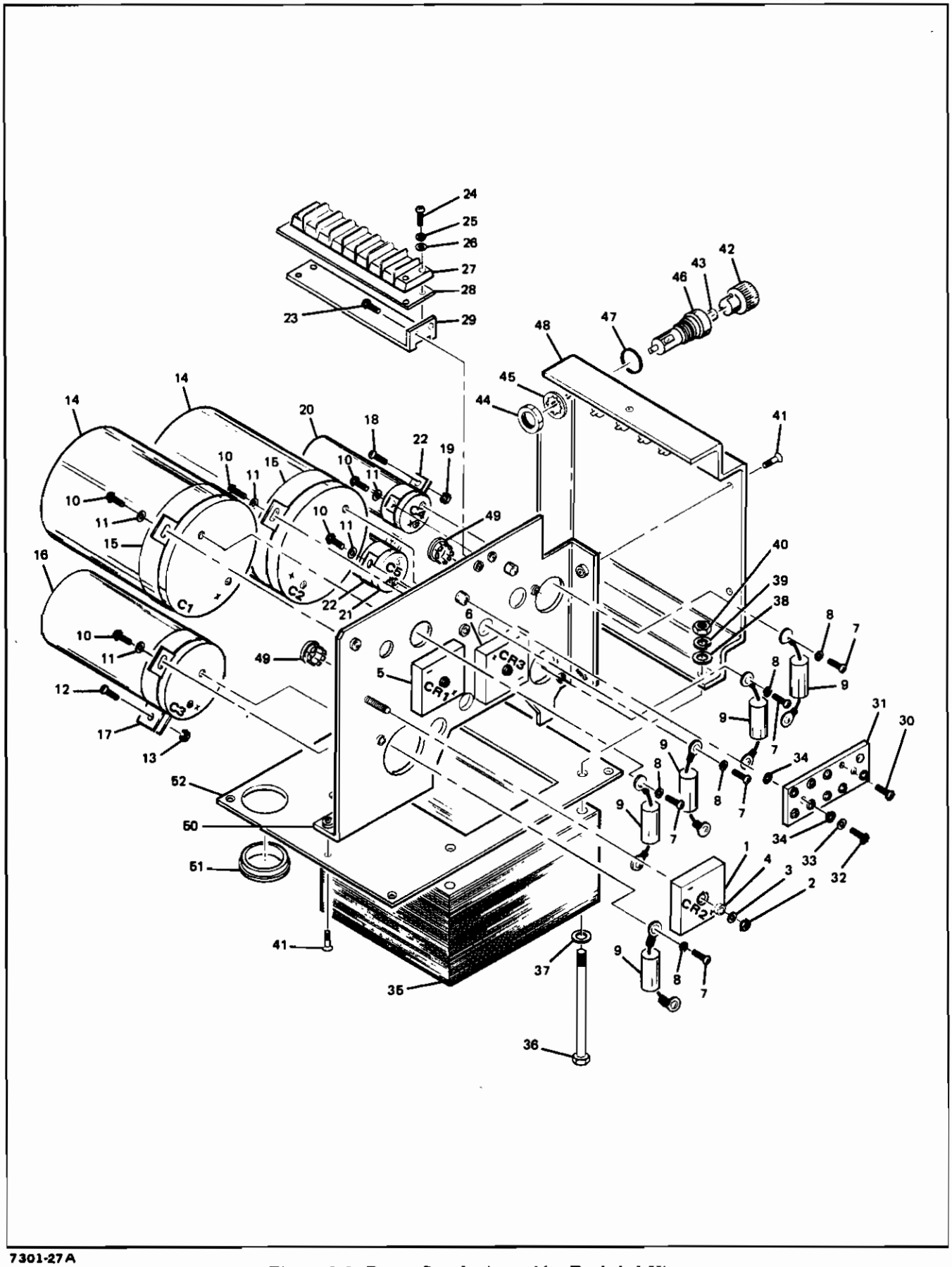
Figure 9-5. Spindle Assembly, Exploded View

Table 9-6. Power Supply Assembly, Replaceable Parts

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
9-6-	07920-60022	POWER SUPPLY ASSEMBLY (19, figure 9-2)	28480	07920-60022	REF
1	1906-0205	*DIODE ASSY (CR2)	28480	1906-0205	1
		(Attaching Parts)			
2	2420-0001	*NUT, hex, 8-32, w/ext-tooth	00000	OBD	1
3	3050-0010	*WASHER, flat, no. 6	00000	OBD	1
4	0380-0549	*SPACER, 0.194 in. ID, 0.312 in. OD, 0.125 in. long	00000	OBD	1
		— — — x — — —			
5	1906-0205	*DIODE ASSY (CR1)	28480	1906-0205	1
		(Attaching Parts)			
	2420-0001	*NUT, hex, 6-32, w/ext-tooth	00000	OBD	1
	3050-0010	*WASHER, flat, no. 6	00000	OBD	1
	0380-0549	*SPACER, 0.194 in. ID, 0.312 in. OD, 0.125 in. long	00000	OBD	1
		— — — x — — —			
6	1906-0205	*DIODE ASSY (CR3)	28480	1906-0205	1
		(Attaching Parts)			
	2420-0001	*NUT, hex, 6-32, w/ext-tooth	00000	OBD	1
	3050-0010	*WASHER, flat, no. 6	00000	OBD	1
	0380-0549	*SPACER, 0.194 in. ID, 0.312 in. OD, 0.125 in. long	00000	OBD	1
		— — — x — — —			
7	2680-0099	*SCREW, machine, ph, pozi, 10-32, 0.375 in. long	00000	OBD	10
8	2190-0034	*WASHER, lock, split, no. 10	00000	OBD	10
9	0698-3640	*RESISTOR, fxd, film 1.8k, 5%, 2W (R1 thru R5)	28480	0698-3640	5
10	2360-0115	*SCREW, machine, ph, pozi, w/ext-tooth, 6-32, 0.312 in. long	00000	OBD	13
11	3050-0226	*WASHER, flat, no. 6	00000	OBD	13
12	2510-0107	*SCREW, machine, ph, pozi, 8-32, 0.5 in. long	00000	OBD	3
		(used on C1, C2, C3)			
13	2580-0003	*NUT, hex, 8-32, w/ext-tooth (used on C1, C2, C3)	00000	OBD	3
14	0180-0539	*CAPACITOR, elctlt, 41000 UF, +75 −10%, 50Vdc (C1 and C2)	56289	360X413G050DC2B	2
15	0180-1958	*CLAMP, capacitor (used on C1 and C2)	28480	0180-1958	2
16	0180-0541	*CAPACITOR, elctlt, 55000 UF, +75 −10%, 15 Vdc (C3)	53021	500842U030AB-2B	1
17	0180-1969	*CLAMP, capacitor (used on C3)	56289	1782-02	1
18	2360-0229	*SCREW, machine, ph, pozi, 6-32, 0.562 in. long	00000	OBD	2
		(used on C4 and C5)			
19	2420-0001	*NUT, hex, 6-32, w/ext-tooth (used on C4 and C5)	00000	OBD	2
20	0180-0540	*CAPACITOR, elctlt, 8400 UF, +75 −10%, 30 Vdc (C4)	53021	500553U015-BC2B	1
21	0180-0542	*CAPACITOR, elctlt, 4400 UF, +75 −10%, 30 Vdc (C5)	53021	500442U030-BC1B	1
22	1210-0013	*CLAMP, capacitor (used on C4 and C5)	28480	1210-0013	2
23	2360-0115	*SCREW, machine, ph, pozi, w/ext-tooth, 6-32, 0.312 in. long	00000	OBD	2
24	2360-0203	*SCREW, machine, ph, pozi, 6-32, 0.625 in. long	00000	OBD	2
25	2190-0851	*WASHER, lock, split, no. 6	00000	OBD	2
26	3050-0228	*WASHER, flat, no. 6	00000	OBD	2
27	0360-0622	*BLOCK, barrier, 7-terminal	28480	0360-0622	1
28	0360-0625	*STRIP, marker	28480	0360-0625	1
29	07905-00072	*BRACKET, terminal block	28480	07905-00072	1
30	2360-0115	*SCREW, machine, ph, pozi, w/ext-tooth, 6-32, 0.312 in. long	00000	OBD	9
31	07920-20062	*BLOCK, ground	28480	07920-20062	1
		(Attaching Parts)			
32	2360-0203	*SCREW, machine, ph, pozi, 6-32, 0.625 in. long	00000	OBD	2
33	2190-0851	*WASHER, lock, split, no. 6	00000	OBD	2
34	1200-0092	*WASHER, insulator	28480	1200-0092	4
		— — — x — — —			
35	9100-2968	*TRANSFORMER, power (T1)	28480	9100-2968	1
		(Attaching Parts)			
36	0570-0070	*SCREW, cap, 1/4-20, 3.5 in. long	00000	OBD	4
37	2190-0784	*WASHER, fiber	28480	2190-0784	4
38	3050-0225	*WASHER, flat, 1/4 in.	00000	OBD	4
39	2190-0740	*WASHER, lock, split, 1/4 in.	00000	OBD	4
40	2950-0004	*NUT, hex, 1/4-20	00000	OBD	4
		— — — x — — —			

Table 9-6. Power Supply Assembly, Replaceable Parts (Continued)

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
9-6-					
41	2510-0100	*SCREW, machine, 100-deg fh, 8-32, 0.312 in. long	00000	OBD	4
42	2110-0465	*CAP, fuseholder	75915	2110-0465	5
43	2110-0383	*FUSE, 8A, 250V, slo-blo (F2 and F3)	71400	MDA-8	2
	2110-0342	*FUSE, 8A, 250V, slo-blo (F4)	75915	314-008	1
	2110-0043	*FUSE, 1.5A, 250V (F5 and F6)	71400	AGC 1-1/2	2
44	2950-0054	*NUT, hex, 1/2-28	00000	OBD	5
45	2190-0068	*WASHER, lock, int-tooth, 0.505 in. ID	78189	1924-02	5
46	2110-0470	*FUSEHOLDER	75915	2110-0470	5
47	1400-0090	*WASHER, rubber, 0.625 in. OD, 0.5 in. ID	75915	901-129	5
48	07920-00015	*BRACKET, AC power	28480	07920-00015	1
49	0400-0056	*BUSHING, snap-in for 0.500 in. hole	51249	SB-500-6	2
50	07920-00014	*CHASSIS, power supply	28480	07920-00014	1
51	0400-0085	*BUSHING, snap-in for 1.093 in. hole	28480	0400-0085	1
52	07920-00012	*BRACKET, transformer	51249	SB-1093-14	1



7301-27A

Figure 9-6. Power Supply Assembly, Exploded View

Table 9-7. Actuator Assembly, Replaceable Parts

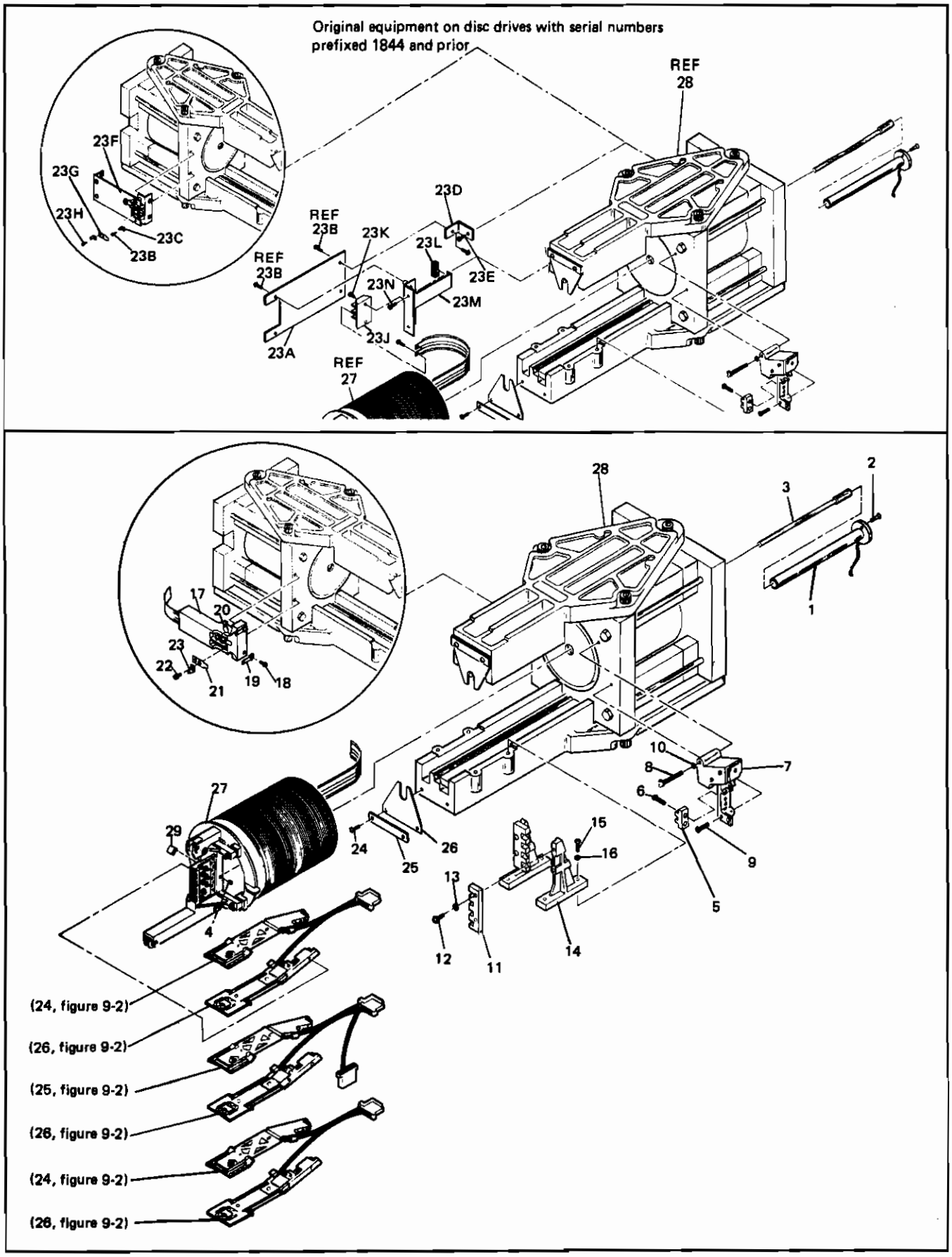
FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
9-7-	07920-60097	ACTUATOR ASSEMBLY (29, figure 9-2) (Direct replacement for all HP 7920/7925 Disc Drives.)	28480	07920-60097	REF
1	07905-60046	*VELOCITY TRANSDUCER (Attaching Parts)	28480	07905-60046	1
2	2200-0166	*SCREW, machine, pozi, 82-deg fh, 4-40, 0.312 in. long — — — x — — —	00000	OBD	2
3	07905-60049	*SHAFT, velocity transducer (Attaching Parts)	28480	07905-60049	1
4	0520-0127	*SETSCREW, hex drive, 2-56, 0.187 in. long — — — x — — —	00000	OBD	1
5	1990-0615	*PHOTOSWITCH, carriage-back detector (Attaching Parts)	28480	1990-0615	1
6	0624-0314	*SCREW, self-tapping, 4-20, 0.375 in. long — — — x — — —	00000	OBD	2
7	07920-60017	*SOLENOID, carriage latch assembly (Attaching Parts)	28480	07920-60017	1
8	2200-0121	*SCREW, machine, ph, pozi, 4-40, 1.125 in. long	00000	OBD	1
9	2200-0145	*SCREW, machine, ph, pozi, 4-40, 0.438 in. long	00000	OBD	1
10	3050-0229	*WASHER, flat, no. 4 — — — x — — —	00000	OBD	2
11	4040-1102	*CAM, head (Attaching Parts)	28480	4040-1102	2
12	2200-0105	*SCREW, machine, ph, pozi, 4-40, 0.312 in. long, w/ext-tooth	00000	OBD	2
13	3050-0229	*WASHER, flat, no. 4 — — — x — — —	00000	OBD	2
14	0050-1986	*SUPPORT, head cam (Attaching Parts)	28480	0050-1986	2
15	2360-0121	*SCREW, machine, ph, pozi, 8-32, 0.500 in. long	00000	OBD	2
16	2190-0851	*WASHER, lock, split, no. 6 — — — x — — —	00000	OBD	2
17	07920-40023	*SHIELD, coil band (Attaching Parts)	28480	07920-40023	1
18	2360-0123	*SCREW, machine, ph, pozi, 6-32, 0.625 in. long, w/ext-tooth	28480	OBD	1
19	0360-0043	*LUG, solder — — — x — — —	28480	0360-0043	2
20	0150-0093	*CAPACITOR, 0.01 UF, 100 Vdc, +80% −20%, cer	06062	108-K80011	2
21	0360-0628	*TERMINAL (Attaching Parts)	28480	0360-0626	2
22	2360-0113	*SCREW, machine, ph, pozi, 6-32, 0.250 in. long, w/ext-tooth	00000	OBD	4
23	0360-0036	*LUG, ground — — — x — — —	28480	0360-0036	2
23A●	07905-00087	*SHIELD, coil band (Attaching Parts)	28480	07905-00087	1
23B●	2360-0115	*SCREW, machine, ph, pozi, 6-32, 0.312 in. long, w/ext-tooth	00000	OBD	4
23C●	0360-0036	*LUG, ground — — — x — — —	28480	0360-0036	2
23D●	07905-00086	*BRACKET, shield (Attaching Parts)	28480	07905-00086	2
23E●	2360-0115	*SCREW, machine, ph, pozi, 6-32, 0.312 in. long, w/ext-tooth — — — x — — —	00000	OBD	1
23F●	0150-0093	*CAPACITOR, 0.01 UF, 100 Vdc, +80% −20%, cer	06062	108-K80011	2
23G●	0360-0628	*TERMINAL, 0.167 in. tab (Attaching Parts)	28480	0360-0628	2
23H●	2360-0115	*SCREW, machine, ph, pozi, 6-32, 0.312 in. long, w/ext-tooth — — — x — — —	00000	OBD	4
23J●	0360-0525	*BLOCK, barrier, 2 terminal (Attaching Parts)	28480	0360-0525	1
23K●	2360-0121	*SCREW, machine, ph, pozi, 6-32, 0.500 in. long, w/ext-tooth — — — x — — —	00000	OBD	2

NOTE: ● Used only on actuator assembly part no. 07920-60015, which is original equipment on serial numbers prefixed 1844 and prior. For assembly replacement, order part no. 07920-60097.

Table 9-7. Actuator Assembly, Replaceable Parts (Continued)

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
9-7-					
23L ●	4320-0340	*EXTRUSION, rubber	28480	4320-0340	1
23M ●	07905-00088	*BRACKET, barrier block	28480	07905-00088	1
		(Attaching Parts)			
23N ●	2360-0193	*SCREW, machine, ph, pozi, 8-32, 0.250 in. long, w/ext-tooth — — — x — — —	00000	OBD	2
24	No Numbar	*SCREW, machine, pozi, 82-deg fh, 4-40, 0.438 in. long	00000	NSR	4
25	No Number	*CLAMP, crash stop	28480	NSR	2
28	No Number	*CRASH STOP	28480	NSR	2
27	No Number	*COIL/CARRIAGE ASSEMBLY	28480	NSR	1
28	No Number	*MAGNET/RAIL ASSEMBLY	28480	NSR	1
29	07920-40028	*HEAD SCREW FASTENER BLOCK	28480	07920-40026	2

NOTE: ● Used only on actuator assembly part no. 07920-60015, which is original equipment on serial numbers prefixed 1644 and prior. For assembly replacement, order part no. 07920-60097.



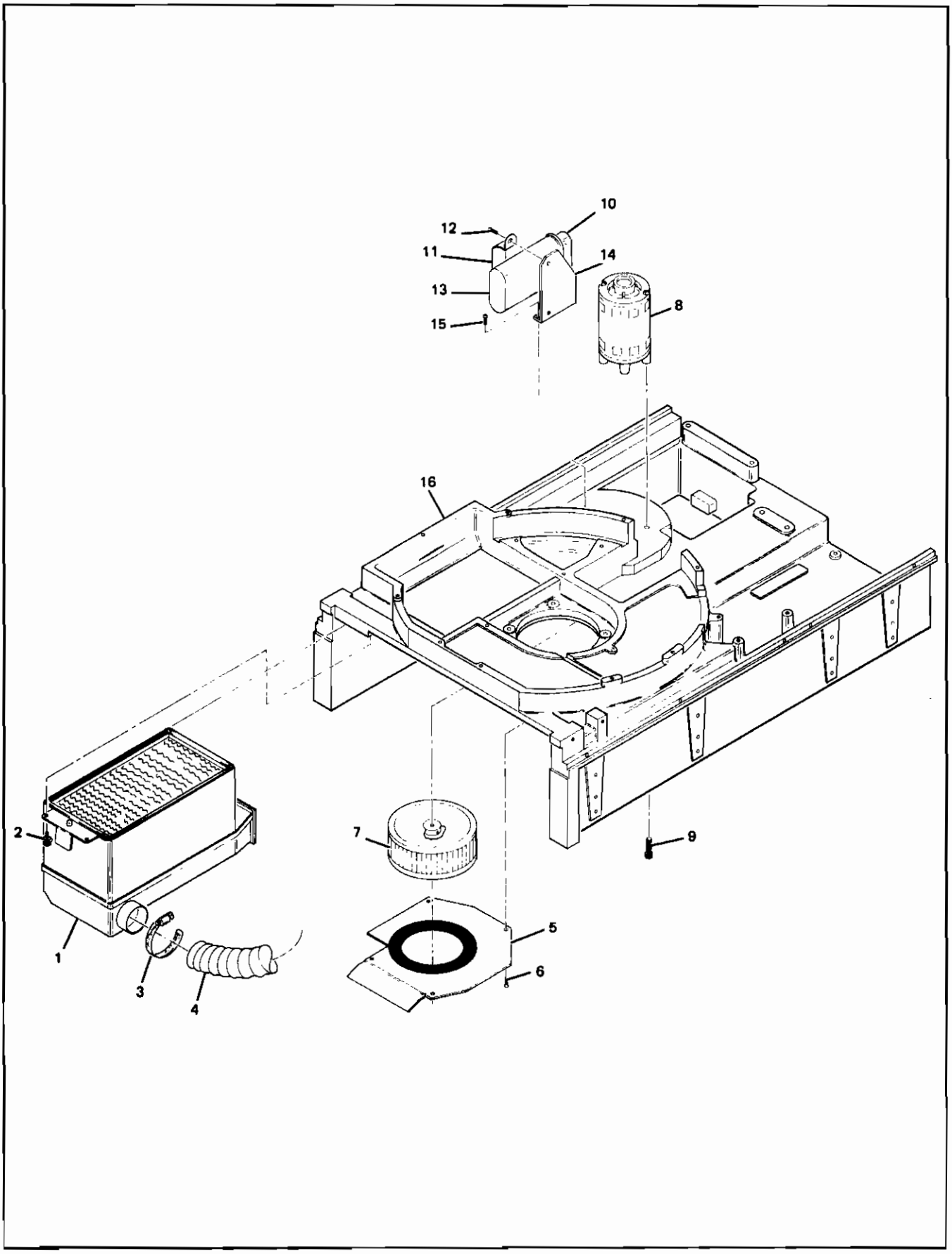
7301-288

Figure 9-7. Actuator Assembly, Exploded View

Table 9-8. Air Distribution Assembly, Replaceable Parts

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
9-8-	No Number	AIR DISTRIBUTION ASSEMBLY (60, figure 9-2)	28480	No Number	REF
1	3150-0278 ★	*FILTER, absolute	28480	3150-0276	1
	3150-0340 ■	*FILTER, absolute [Must be used in conjunction with a contamination shield (27, figure 9-2).]	28480	3150-0340	REF
		(Attaching Parts)			
2	0570-0003	*SCREW, knurled, 8-32, 0.375 in. long — — — x — — —	73734	33021	2
3	1400-0851	*CLAMP, hose	81646	6206	1
4	0890-1147	*HOSE, air (55, figure 9-2)	28480	0890-1147	REF
5	07920-60068	*IMPELLER COVER ASSEMBLY	28480	07920-60068	1
		(Attaching Parts)			
6	2510-0045	*SCREW, machine, ph, pozi, 8-32, 0.375 in. long, w/ext-tooth — — — x — — —	00000	OBD	4
7	3160-0292	*IMPELLER	28480	3160-0292	1
8	3140-0532	*MOTOR, blower, 115 Vac, 3300 rpm	28480	3140-0532	1
		(Attaching Parts)			
9	2510-0052	*SCREW, machine, 82-deg fh, pozi, 8-32, 0.625 in. long — — — x — — —	00000	OBD	4
10	0340-0761	*INSULATOR COVER, terminal	90201	OC-1	1
11	1400-0513	*CLAMP, capacitor	26480	1400-0513	1
		(Attaching Parts)			
12	2360-0195	*SCREW, machine, ph, pozi, 6-32, 0.312 in. long, w/ext-tooth — — — x — — —	00000	OBD	2
13	0160-0585	*CAPACITOR, fxd, paper, 5 μf, 10%, 370 VACW	56289	500P9032	1
14	07920-00059	*BRACKET, capacitor mounting	28480	07920-00059	1
		(Attaching Parts)			
15	2510-0045	*SCREW, machine, ph, pozi, 8-32, 0.375 in. long, w/ext-tooth — — — x — — —	00000	OBD	2
16	No Number	*CASTING, mainframe	26480	NSR	1

Notes: ★ Used on disc drives with serial numbers 1842 and prior.
■ First used on disc drives with serial numbers prefixed 1843.

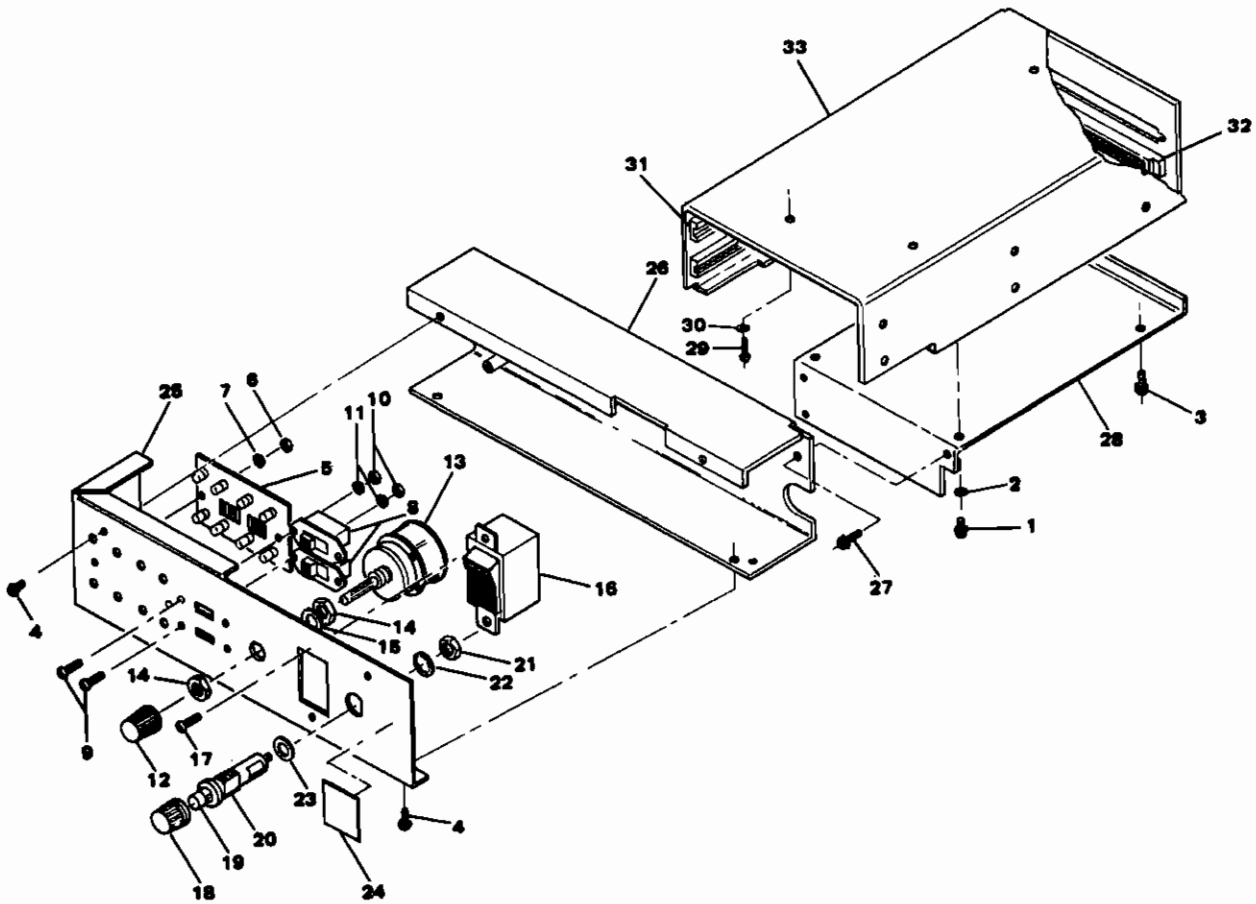


7301-31B

Figure 9-8. Air Distribution Assembly, Exploded View

Table 9-9. Operator Panel and Lower Card Cage Assembly, Replaceable Parts

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
9-9-	No Number	OPERATOR PANEL AND LOWER CARD CAGE ASSEMBLY (41, figure 9-2)	28480	No Number	REF
1	2360-0121	*SCREW, machine, ph, pozi, 4-40, 0.250 in. long, w/ext-tooth	00000	OBD	2
2	3050-0228	*WASHER, flat, no. 6	00000	OBD	2
3	2380-0113	*SCREW, machine, ph, pozi, 8-32, 0.250 in. long, w/ext-tooth	00000	OBD	2
4	0380-0174	*SCREW, machine, ph, pozi, 4-40, 0.250 in. long, w/ext-tooth	00000	OBD	4
5	07920-60030	*FAULT INDICATOR PCA (A12)	28480	07920-60030	1
		(Attaching Parts)			
6	2260-0002	*NUT, hex, 4-40	00000	OBD	2
7	2190-0061	*WASHER, lock, split no. 4	00000	OBD	2
		— — — x — — —			
8	3101-0070	*SWITCH, slide, DPDT	79727	GF-126-0000	2
		(Attaching Parts)			
9	0520-0131	*SCREW, machine, ph, pozi, 2-56, 0.438 in. long	00000	OBD	2
10	0810-0013	*NUT, hex, 2-56	00000	OBD	2
11	2190-0045	*WASHER, lock, split, no. 2	00000	OBD	2
		— — — x — — —			
12	0370-1099	*KNOB	28480	0370-1099	1
13	3100-3287	*SWITCH, rotary, eight-position	76854	AK	1
		(Attaching Parts)			
14	2950-0001	*NUT, hex, 3/8-32	00000	OBD	2
15	2190-0022	*WASHER, lock, int-tooth, 3/8	00000	OBD	1
		— — — x — — —			
16	3101-2122	*SWITCH, rocker	27191	8931K-483	1
		(Attaching Parts)			
17	2360-0113	*SCREW, machine, ph, pozi, 6-32, 0.250 in long, w/ext-tooth	00000	OBD	2
		— — — x — — —			
18	2110-0485	*CAP, fuseholder	75915	345002-020	1
19	2110-0383	*FUSE, 8A, 250V, slo-blo (F1) (used on 120 Vac models)	71400	MDA8	1
	2110-0365	*FUSE, 4A, 250V, slo-blo (F1) (Used on 240 Vac models)	28480	2110-0385	REF
20	2110-0464	*FUSEHOLDER	75915	345002-010	1
		(Attaching Parts)			
21	2950-0054	*NUT, hex, 1/2-28	00000	OBD	1
22	2190-0068	*WASHER, lock, int-tooth, 0.50 in. I.D.	00000	OBD	1
23	0900-0016	*SPACER, 0.50 in. ID	00000	OBD	1
		— — — x — — —			
24	7120-4368	*LABEL, warning	26480	7120-4366	1
25	07920-00040	*PANEL	28480	07920-00040	1
26	07920-00042	*ENCLOSURE, operator panel	28480	07920-00042	1
		(Attaching Perts)			
27	2360-0115	*SCREW, machine, ph, pozi, 6-32, 0.312 in. long, w/ext-tooth	00000	OBD	3
		— — — x — — —			
28	07920-00043	*PLATE, bottom, card cage	28480	07920-00043	1
29	2510-0045	*SCREW, machine, ph, 8-32, 0.375 in. long	00000	OBD	4
30	3050-0001	*WASHER, flat, no. 8	00000	OBD	4
31	0403-0302	*GUIDE, PCA, nylon, 8.0 in. long, 0.312 in. wide	28480	0403-0302	2
32	1251-0334	*CONNECTOR, edge, 36-pin	71785	251-18-30-261	1
		(Attaching Parts)			
	2260-0009	*NUT, hex, 4-40, w/ext-tooth	00000	OBD	2
	3050-0229	*WASHER, flat, no. 4	00000	OBD	4
	2200-0147	*SCREW, machine, ph, pozi, 4-40, 0.5 in. long	00000	OBD	2
		— — — x — — —			
33	07920-00041	*CARD CAGE, lower	28480	07920-00041	1

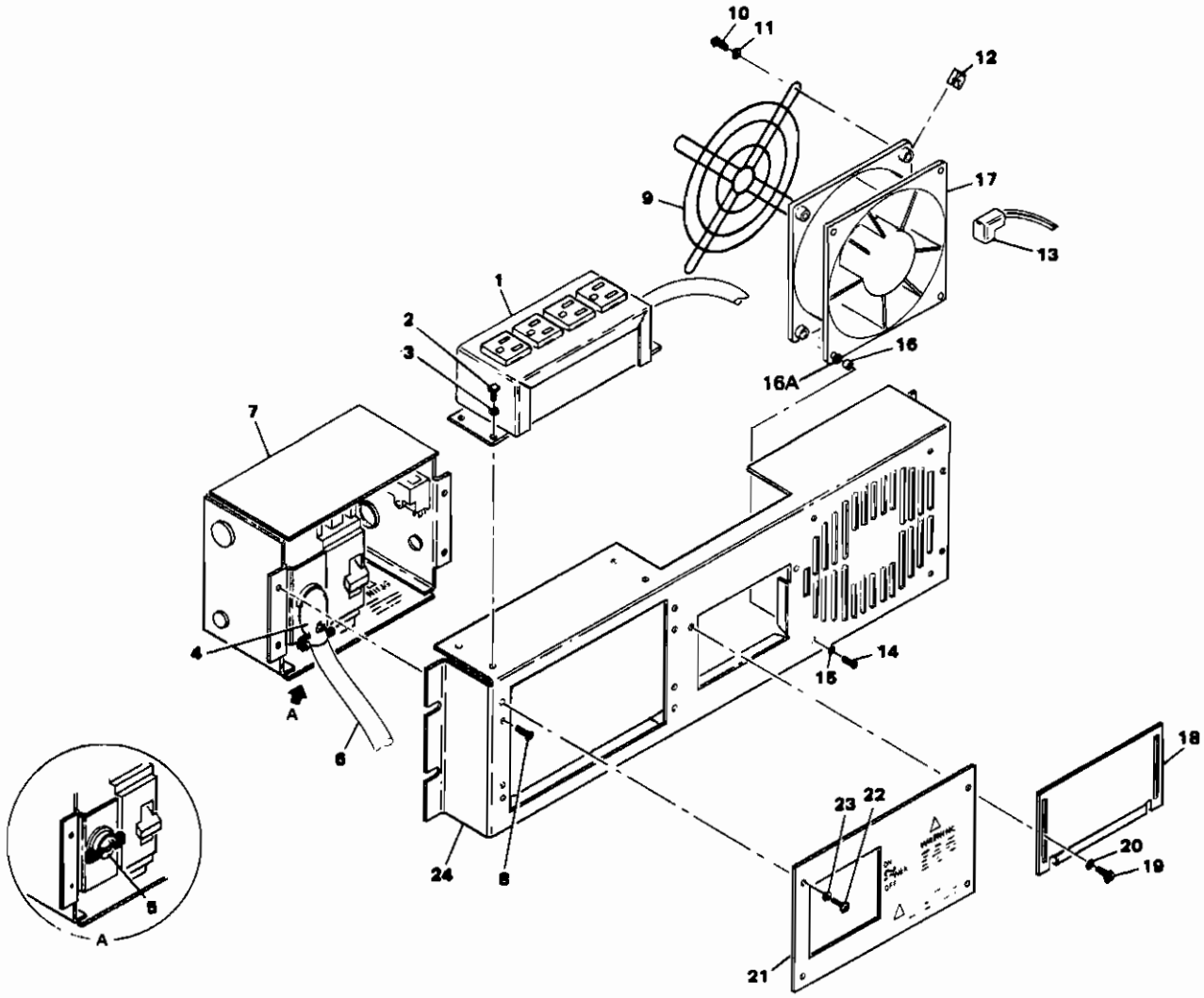


7301-32A

Figure 9-9. Operator Panel and Lower Card Cage Assembly, Exploded View

Table 9-10. Power Panel Assembly (Part no. 02940-60156 and 02940-60157), Replaceable Parts

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
9-10-	02940-60157	POWER PANEL ASSEMBLY (25, figure 9-1)	28480	02940-60157	REF
	02940-60156	POWER PANEL ASSEMBLY (Option 015) (25, figure 9-1)	28480	02940-60156	REF
1	02940-60138	*CONNECTOR ASSY, four-receptacle, 120 Vac	28480	02940-60138	1
	02940-60139	*CONNECTOR ASSY, four-receptacle, 240 Vac (Option 015)	28480	02940-60139	REF
		(Attaching Parts)			
2	2360-0115	*SCREW, ph, pozi, 6-32, 0.312 in. long, w/ext-tooth	00000	OBD	4
3	3050-0228	*WASHER, flat, no. 6	00000	OBD	4
		— — — x — — —			
4	0100-0935	*CLAMP, cable (Standard only)	83833	266	1
5	0100-0168	*CLAMP, cable (Option 015)	83833	3302	1
6	02940-60145	*CABLE, AC power (Standard only)	28480	02940-60145	1
7	02940-60130	*POWER DISTRIBUTION UNIT (See figure 9-11)	28480	02940-60130	1
		(Attaching Parts)			
8	2360-0192	*SCREW, machine, pozi, 100-deg fh, 8-32, 0.25 in. long	00000	OBD	4
		— — — x — — —			
9	3160-0099	*GRILL, fan	28480	3160-0099	1
		(Attaching Parts)			
10	2360-0125	*SCREW, machine, ph, pozi, 6-32, 0.75 in. long, w/ext-tooth	00000	OBD	4
11	3050-0100	*WASHER, flat, no. 6	00000	OBD	4
12	0590-0653	*NUT, clip, 6-32	28480	0590-0653	4
		— — — x — — —			
13	02940-60176	*CABLE, electrical, thrae-wire, blower	28480	02940-60176	1
14	0624-0217	*SCREW, self-tapping, ph, pozi, 8-20, 0.50 in. long	00000	OBD	4
15	3050-0228	*WASHER, flat, no. 6	00000	OBD	4
16	0380-0105	*SPACER, no. 8, 0.250 in. long	00000	OBD	4
16A	3050-0880	*WASHER, fiber, no. 8	28480	3050-0860	4
17	3160-0341	*BLOWER, 120 Vac	28875	BS2107F-510H	1
	3160-0342	*BLOWER, 240 Vac (Option 015)	28875	BS2107F-531H	REF
18	1600-0555	*SHUTTER, cable entry	28480	1600-0555	1
		(Attaching Parts)			
19	2360-0115	*SCREW, machine, ph, pozi, 6-32, 0.312 in. long, w/ext-tooth	00000	OBD	2
20	3050-0066	*WASHER, flat, no. 6	00000	OBD	2
		— — — x — — —			
21	1600-0554	*COVER, access	28480	1600-0554	1
		(Attaching Parts)			
22	2360-0115	*SCREW, machine, ph, pozi, 6-32, 0.312 in. long, w/ext-tooth	00000	OBD	4
23	3050-0228	*WASHER, flat, no. 6	00000	OBD	4
		— — — x — — —			
24	7101-0398	*CHASSIS, main, rear	28480	7101-0398	1

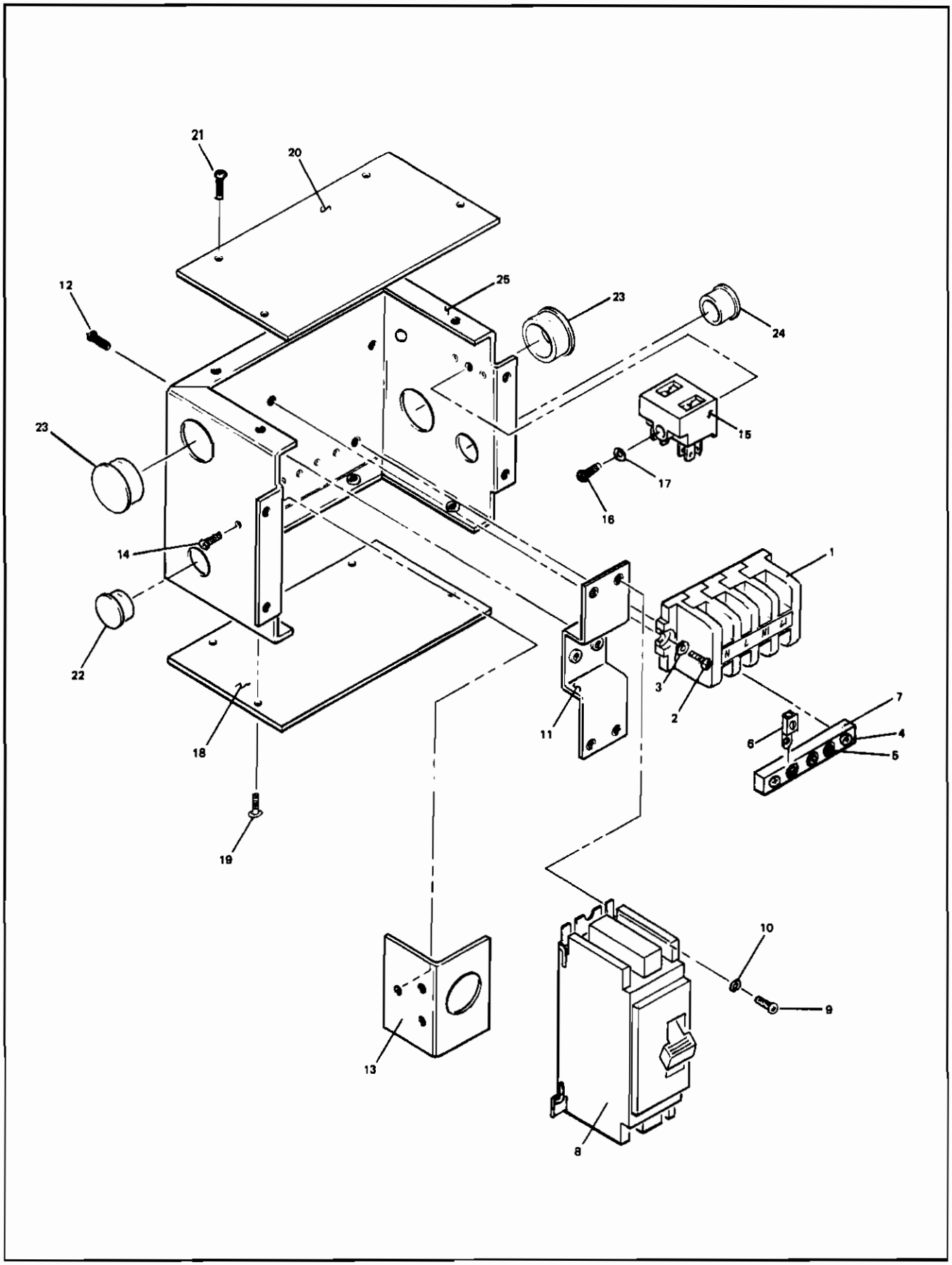


7301-338

Figure 9-10. Power Panel Assembly (Part no. 02940-60156 and 02940-60157), Exploded View

Table 9-11. Power Distribution Unit (For Power Panel Assembly, Part no. 02940-60156 and 02940-60157), Replaceable Parts

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
9-11-	02940-60130	POWER DISTRIBUTION UNIT (7, figure 9-10)	28480	02940-80130	REF
1	0360-1094	*BLOCK, barrier, end	28480	0360-1094	1
		(Attaching Parts)			
2	2510-0045	*SCREW, machine, ph, pozi, 8-32, 0.375 in. long	00000	OBD	2
3	3050-0139	*WASHER, flat, no. 8	00000	OBD	2
		— — — x — — —			
4	2510-0049	*SCREW, machine, ph, pozi, 8-32, 0.50 in. long, w/ext-tooth	00000	OBD	2
5	2660-0224	*SCREW, machine, hex hd, 10-32, 0.375 in. long	00000	OBD	3
6	0362-0511	*LUG, box	28480	0362-0511	1
7	02940-21122	*BAR, terminal	28480	02940-21122	1
8	3105-0069	*CIRCUIT BREAKER	56365	QOU215	1
		(Attaching Parts)			
9	2380-0113	*SCREW, machine, ph, pozi, 6-32, 0.25 in. long, w/ext-tooth	00000	OBD	4
10	3050-0100	*WASHER, flat, no. 8	00000	OBD	4
		— — — x — — —			
11	02940-01281	*BRACKET, mounting, circuit breaker	28480	02940-01281	1
		(Attaching Parts)			
12	2360-0113	*SCREW, machine, ph, pozi, 6-32, 0.25 in. long, w/ext-tooth	00000	OBD	2
		— — — x — — —			
13	02940-00307	*PLATE, inlet	28480	02940-00307	1
		(Attaching Parts)			
14	2360-0113	*SCREW, machine, ph, pozi, 6-32, 0.25 in. long, w/ext-tooth	00000	OBD	3
		— — — x — — —			
15	0360-0698	*BLOCK, terminal	28480	0380-0698	1
		(Attaching Parts)			
16	2360-0127	*SCREW, machine, ph, pozi, 6-32, 0.875 in. long	00000	OBD	1
17	3050-0226	*WASHER, flat, no. 6	00000	OBD	1
		— — — x — — —			
18	02940-01288	*COVER, bottom	28480	02940-01288	1
		(Attaching Parts)			
19	2360-0113	*SCREW, machine, ph, pozi, 6-32, 0.25 in. long, w/ext-tooth	00000	OBD	4
		— — — x — — —			
20	02940-01279	*COVER, top	28480	02940-01279	1
		(Attaching Parts)			
21	2360-0113	*SCREW, machine, ph, pozi, 6-32, 0.25 in. long, w/ext-tooth	00000	OBD	4
		— — — x — — —			
22	6960-0027	*PLUG, 0.625 in. dia.	26480	6960-0027	1
23	6960-0085	*PLUG, 0.875 in. dia.	26480	6960-0085	2
24	0400-0096	*BUSHING, 0.5 in. dia. ID	28480	0400-0096	1
25	02940-01280	*CHASSIS, power distribution unit	28480	02940-01280	1



7301-39A

Figure 9-11. Power Distribution Unit (For Power Panel Assembly, Part no. 02940-60156 and 02940-60157), Exploded View

Table 9-12. Power Panel Assembly (Part No. 29425-60003 and 29425-60004), Replaceable Parts

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
9-12-	29425-60003	POWER PANEL ASSEMBLY (25, figure 9-1)	28480	29425-60003	REF
	29425-60004	POWER PANEL ASSEMBLY (Option 015) (25, figure 9-1)	28480	29425-60004	REF
1	8120-2371	*POWER CORD, 120 Vac (only with 29425-60003)	28480	8120-2371	1
2	29425-00004	*ACCESS PLATE	28480	29425-00004	1
		(Attaching Parts)			
3	2360-0115	*SCREW, machine, ph, pozi, w/ext-tooth, 6-32, 0.312 in. long	00000	OBD	4
4	3050-0228	*WASHER, flat, no. 6	00000	OBD	4
		— — — x — — —			
5	2360-0192	*SCREW, machine, 100-deg fh, pozi, 6-32, 0.250 in. long	00000	OBD	4
6	2360-0115	*SCREW, machine, ph, pozi, w/ext-tooth, 6-32, 0.312 in. long	00000	OBD	4
7	2380-0117	*SCREW, machine, ph, pozi, w/ext-tooth, 8-32, 0.375 in. long	00000	OBD	2
8	1251-4945	*OUTLET, 120 Vac	28480	1251-4945	1
9	29425-00005	*PLATE, top	28480	29425-00005	1
10	29425-00001	*PLATE, top (with outlets), (Option 015)	28480	29425-00001	1
		(Attaching Parts)			
11	2360-0115	*SCREW, machine, ph, pozi, w/ext-tooth, 6-32, 0.312 in. long	00000	OBD	4
		— — — x — — —			
12	29425-00006	*PLATE, bottom	28480	29425-00006	1
		(Attaching Parts)			
13	2360-0115	*SCREW, machine, ph, pozi, w/ext-tooth, 8-32, 0.312 in.long	00000	OBD	4
		— — — x — — —			
14	3105-0069	*CIRCUIT BREAKER	28480	3105-0089	1
		(Attaching Parts)			
15	2360-0115	*SCREW, machine, ph, pozi, w/ext-tooth, 8-32, 0.312 in. long	00000	OBD	4
16	3050-0066	*WASHER, flat, no. 6	00000	OBD	4
		— — — x — — —			
17	29425-00003	*INLET CONNECTOR PLATE (with connector)	28460	29425-00003	1
		(Attaching Parts)			
18	2360-0115	*SCREW, machine, ph, pozi, w/ext-tooth, 6-32, 0.312 in. long	00000	OBD	2
		— — — x — — —			
19	29425-00007	*CHASSIS, main	28480	29425-00007	1
20	1600-0555	*SHUTTER	28480	1600-0555	1
		(Attaching Parts)			
21	2360-0115	*SCREW, machine, ph, pozi, w/ext-tooth, 8-32, 0.312 in. long	00000	OBD	2
22	3050-0066	*WASHER, flat, no. 6	00000	OBD	2
		— — — x — — —			
23	3160-0099	*FAN GUARD	28480	3160-0099	1
		(Attaching Parts)			
24	2360-0125	*SCREW, machine, ph, pozi, 6-32, 0.750 in. long	00000	OBD	4
25	0590-0653	*NUT, sheetmetal-U, 8-32	00000	OBD	4
26	3050-0066	*WASHER, flat, no. 8	00000	OBD	4
		— — — x — — —			
27	3160-0341	*FAN, 120 Vac	28875	BS2107F-510H	1
	3180-0342	*FAN, 240 Vac (Option 015)	28875	BS2107F-531H	REF
		(Attaching Parts)			
28	0824-0248	*SCREW, tapping, hex head, 8-32, 0.750 in. long	00000	OBD	4
29	3050-0139	*WASHER, flat, no. 8	00000	OBD	4
30	0380-0105	*SPACER, metallic, rnd, 0.250 in. long	00000	OBD	4
31	3050-0660	*WASHER, fiber, no. 8	00000	OBD	4
		— — — x — — —			
32	29421-00006	*PANEL	28480	29421-00006	1

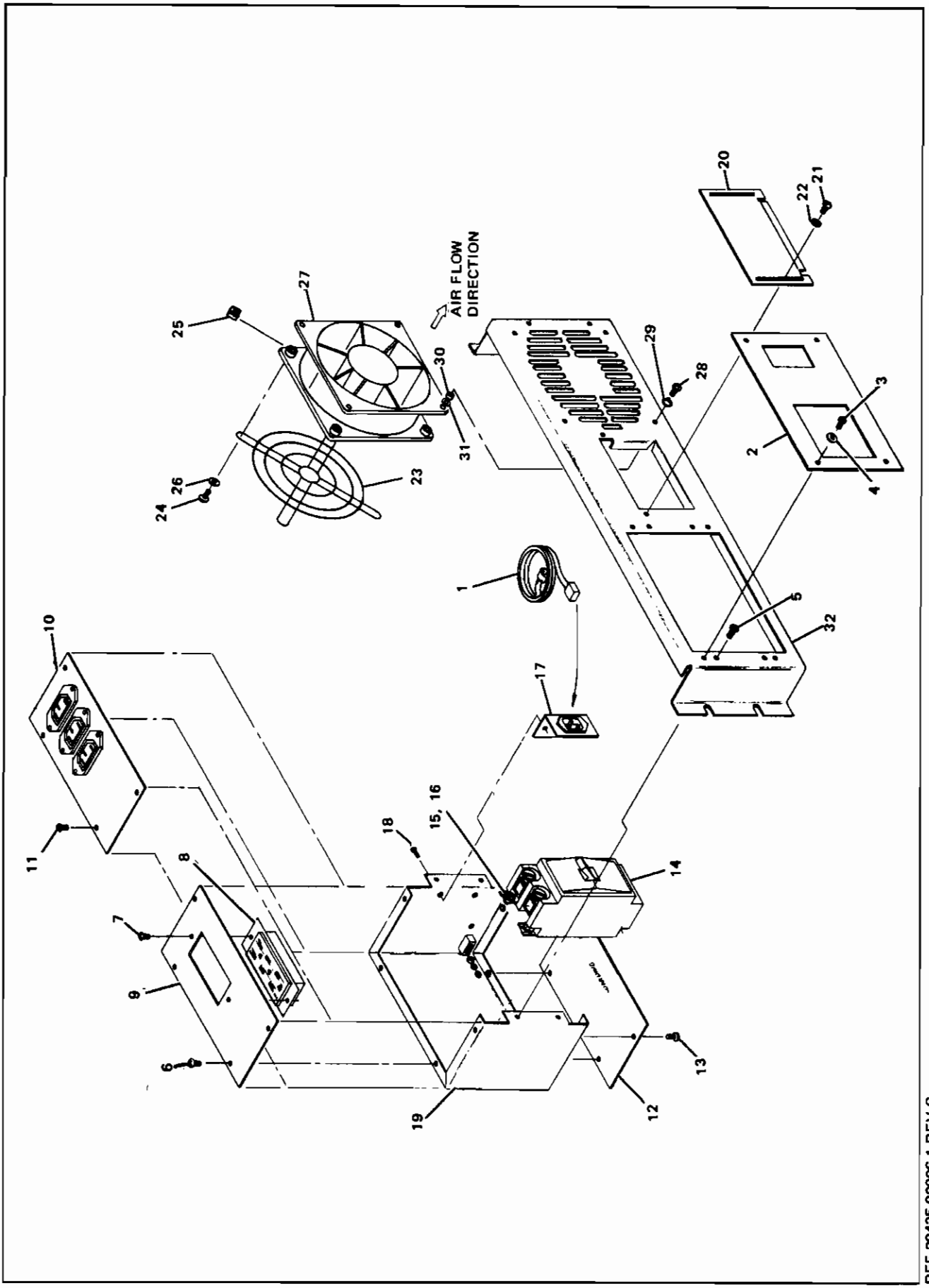


Figure 9-12. Power Panel Assembly (Part no. 29425-60003 and 29425-60004), Exploded View

REF 29425-90006-1 REV C

Table 9-13. Reference Designations and Abbreviations

REFERENCE DESIGNATIONS

A = assembly	H = hardware	T = transformer
B = blower, fan, motor, synchro	J = jack, receptacle connector	TB = terminal board
BT = battery	K = relay	TP = test point
C = capacitor	L = inductor	U = integrated circuit, non-repairable assembly
CB = circuit breaker	M = meter	V = electron tube
CR = diode	MP = mechanical part	VR = voltage regulator
DL = delay line	P = plug connector	W = cable assembly (with connectors), wire
DS = indicator lamp	Q = semiconductor device other than diode or integrated circuit	X = socket
E = contact, miscellaneous electrical part	R = resistor	Y = crystal unit
F = fuse	RT = thermistor	Z = network, tuned circuit
FL = filter	S = switch	

ABBREVIATIONS

A = ampere(s)	Hg = mercury	PCA = printed-circuit assembly
ac = alternating current	Hz = Hertz	ph = pan head
Al = aluminum		phh = phillips head
AR = as required	ID = inside diameter	PNP = positive-negetive-positive (transistor)
assy = assembly	impreg = impregnated	P/O = part of
	in. = inch, inches	porc = porcelain
Be Cu = beryllium copper	incand = incandescent	posn = position
brs = brass	incl = include(s)	pot = potentiometer
	insul = insulation, insuleted	pozi = pozidrive
c = centi (10^{-2})	int = internal	
C = Celsius, centigrade	I/O = input/output	qty = quantity
Cd pl = cadmium plate		
cer = ceramic	k = kilo (10^{3}), kilohm	rdh = round head
CMOS = complamentery metal-oxide transistors	kg = kilogram	rect = rectifier
comp = composition		ref = reference
conn = connector	lb = pound	rf = radio frequency
CRT = cathode-ray tube	LED = light-emitting diode	rh = right hand
CTL = complementary transistor logic	lh = left hand	rms = root-mean-square
	lin = linear	rpm = revolutions per minute
d = decl (10^{-1})		RTL = resistor-transistor logic
dc = direct current	M = mega (10^{6}), megohm	rwv = reverse working voltage
deg = degree(s)	m = milli (10^{-3})	
depc = deposited carbon	met oxd = metal oxide	sb = slow blow
dia = diameter	mfr = manufacturer	SCR = semiconductor-controlled rectifier
dpdt = double-pole, double-throw	mintr = miniature	
dpst = double-pole, single-throw	misc = miscellaneous	Se = selenium
DTL = diode transistor logic	mom. = momentary	Si = silicon
	mtg = mounting	spcl = special
ECL = emitter-coupled logic	My = Mylar	spdt = single-pole, double throw
elctlt = electrolytic		spst = single-pole, single throw
encap = encapsulated	n = nano (10^{-9})	sst = stainless steel
ext = external	n.c. = normally closed	stl = steel
	Ne = neon	
F = Fahrenheit, farad	no. = number	Ta = tantalum
FET = field-effect transistor	n.o. = normally open	Ti = titanium
FF = flip-flop	np = nickel plated	tgl = toggle
fig. = figure	NPN = negative-positive-negative (transistor)	thd = thread
filh = fillister head		tol = tolerance
fh = flat head	NPO = negative-positive zero (zero temperature coefficient)	TTL = transistor-transistor logic
film = film		
fxd = fixed	NRFR = not recommended for field replacement	U (μ) = micro (10^{-6})
G = giga (10^{9})	NSR = not separately replaceable	V = volt(s)
GE = germanium		var = variable
gl = glass	OBD = order by description	Vdcw = direct current working volts
	OD = outside diameter	
H = henry, henries	ovh = ovel head	W = watt(s)
hd = head	oxd = oxide	w/ = with
hdw = hardware		WIV = inverse working volts
hex = hexagon, hexagonal	p = pico (10^{-12})	ww = wire-wound
	PC = printed-circuit	

Table 9-14. Code List of Manufacturers

The following code numbers are extracted from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1, and H4-2, and their supplements.

CODE NO.	MANUFACTURER	ADDRESS
02289	Hi-C Inc.	Windsor Locks, Ct
04713	Motorola, Inc. Semiconductor Products Div.	Phoenix, Az
05464	Industrial Electronics Engineers, Inc.	Van Nuys, Ca
23880	Stanford Applied Engineering Inc.	Santa Clara, Ca
27191	Cutler-Hammer, Inc., Power Distribution and Control Div.	Milwaukee, Wi
28480	Hewlett-Packard Co.	Palo Alto, Ca
28875	IMC Magnetics Corp, NH Div.	Rochester, NH
46384	Penn Engineering	Doylestown, Pa
50522	Monsanto, Electronic Special Products	Cupertino, Ca
51249	Heyman Mfg. Co.	Cleveland, Oh
53021	Sangamo Electric	Springfield, Il
56289	Sprague Electric Co.	North Adams, Ma
56365	Square D Co.	Park Ridge, Il
71400	McGraw Edison Co., Bussman Mfg. Div.	St. Louis, Mo
71785	TRW Electronic Components, Cinch Div.	Elk Grove Village, Il
73734	Federal Screw Products Co.	Chicago, Il
75915	Littelfuse, Inc.	Des Plaines, Il
76854	Oak Industries, Inc., Switch Div.	Crystal Lake, Il
78189	Illinois Tool Works, Inc., Shakeproof Div.	Elgin, Il
79727	Continental-Wirt Electronics Div.	Warminster, Pa
81646	Ideal Corp.	New York, NY
83833	Thomas & Betts Co.	Indianapolis, In
90201	Mallory Capacitor Co.	Indianapolis, In
97464	Industrial Retaining Ring Co.	Irvington, NJ

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Telex: 62650
Cable: HEWPARD Canberra

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Cable: GECDAC Dacca

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