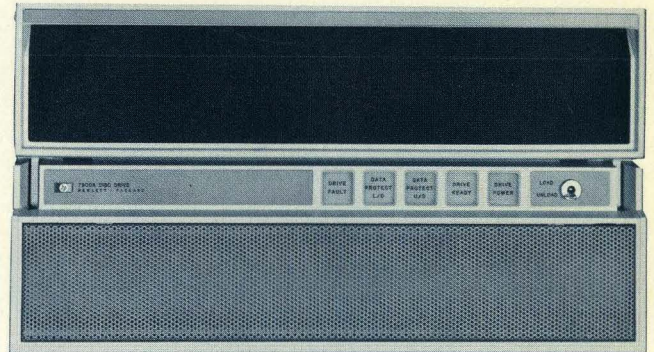


OPERATING AND SERVICE MANUAL

7900A

DISC DRIVE



HEWLETT  PACKARD

CERTIFICATION

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

UPDATING SUPPLEMENT

28 OCT 1974

MANUAL IDENTIFICATION

Manual Serial No. Prefix: 1349,1415,
 1418,1432
 Manual Printed: AUG 1974
 Manual Part No.: 07900-90002
 Microfiche Part No.: 07900-90027

SUPPLEMENT DESCRIPTION

The purpose of this supplement is to adapt the manual to equipment containing production improvements made subsequent to the printing of the manual and to correct manual errors. Enter the new information (or the Change Number, if more convenient) into the appropriate places in the manual, identified at left. For any given instrument serial number prefix, all change steps noted for prior serial number prefixes must be incorporated in addition to those for the given prefix.

INSTRUMENT CHANGES

Serial No. Prefix	Change
1434	1 thru 2

ASSEMBLY CHANGES

Ref Des	Description	HP Part No.	Series	Changes

Changes 1 and 2 dated 28 October, 1974

US-1

CHANGE

DESCRIPTION

- 1 Title page. Add 1434 after the Serial Numbers Prefixed information.
- 2 Receiver Assenbly. Page 6-2, table 6-1, item 26. Change part number of receiver assembly from 07900-60083 to 07900-60087.

OPERATING AND SERVICE MANUAL

7900A

DISC DRIVE

Serial Numbers Prefixed: 1349, 1415, 1418, 1432

Note

This manual may be backdated to cover earlier versions of the disc drive by incorporating appropriate backdating information from appendix B.

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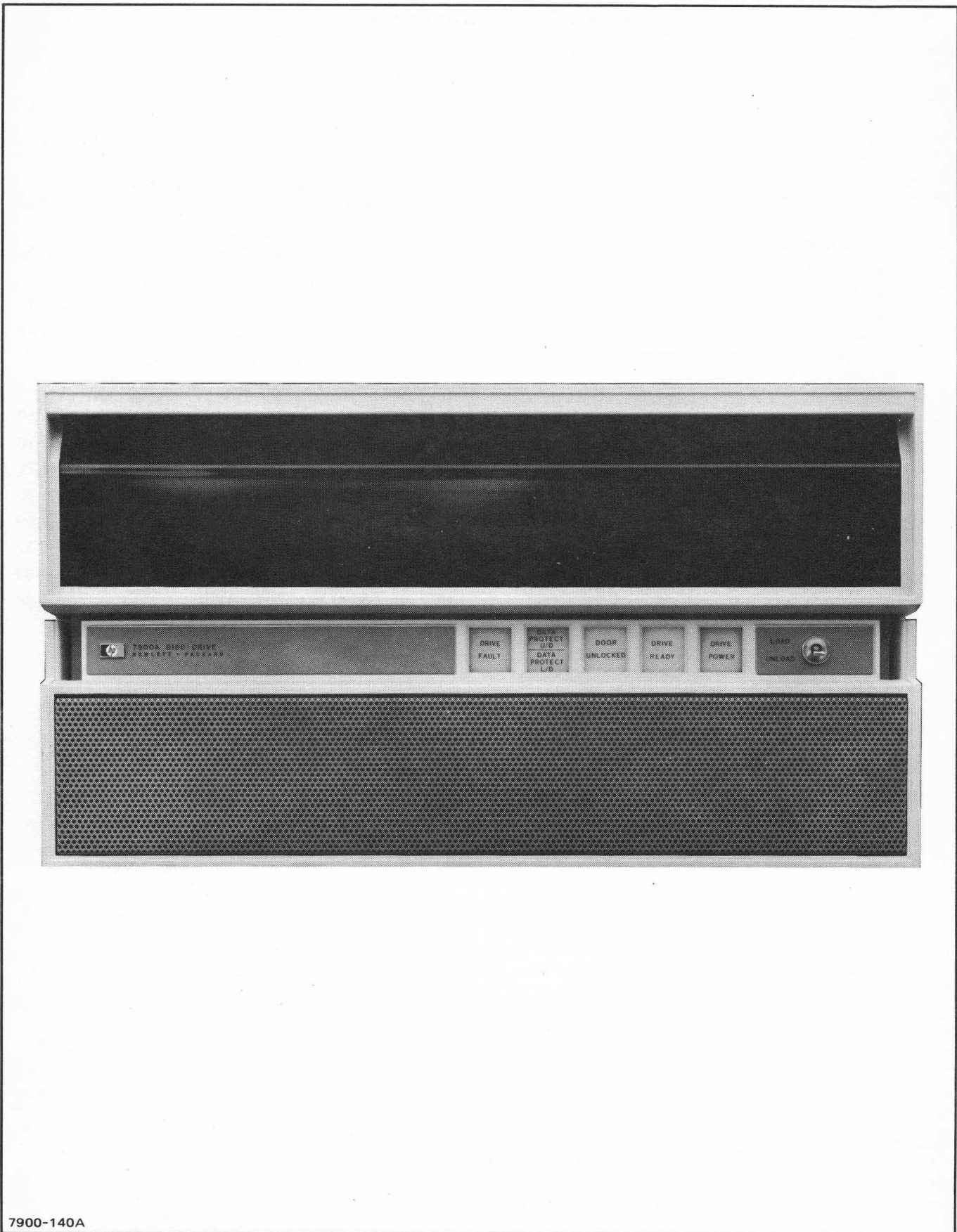
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7900-140A

Figure 1-1. Hewlett-Packard 7900A Disc Drive

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This manual contains the information required to install, operate, test, adjust, and troubleshoot the Hewlett-Packard 7900A Disc Drive. (See figure 1-1.) This section covers a general description, identification, specifications, options, accessories, related manuals, and other basic information.

1-3. The various sections in this manual provide information as follows:

a. SECTION II, INSTALLATION. Provides information relative to unpacking and inspection, power requirements, mounting, checkout, packing and shipping, etc.

b. SECTION III, OPERATION. Provides information relative to operating controls and indicators and the operating instructions for the disc drive.

c. SECTION IV, THEORY OF OPERATION. Provides an overall functional description and an overall block diagram.

d. SECTION V, MAINTENANCE. Provides preventive maintenance information, maintenance precautions, repair information, a list of required test equipment, performance tests, adjustment procedures, troubleshooting information, schematic diagrams, and printed-circuit assembly parts location diagrams.

e. SECTION VI, REPLACEABLE PARTS. Provides ordering information for all replaceable parts and assemblies and parts location drawings and parts listings.

1-4. GENERAL DESCRIPTION.

1-5. The disc drive (figure 1-1) is a random-access mass-storage dual disc memory device, compactly designed for use as a peripheral unit in small- and medium-size computing systems. The disc drive has a random average access time of 30 milliseconds and will store a total of 5 million eight-bit bytes. The disc drive head-positioning mechanism is a voice coil actuator which employs both position and velocity feedback. Position feedback comes from a precise photo optical system which can position any actuator to within 0.0003 inch of its nominal position. Other significant features of the disc drive include 2200 bits per inch of data density and 2400 r/min spindle speed as standard, and an absolute filtration system, which eliminates environmental contamination and maintains positive pressure in the drive enclosure.

1-6. IDENTIFICATION.

1-7. Hewlett-Packard identification can be made by reviewing the sticker on the rear panel (see figure 1-2). Hewlett-Packard products carry a model number, an option number listing, and a ten-digit serial number. The model number corresponds to the placarding on the front panel and the option number(s) indicates those options which the customer has specified, if any.

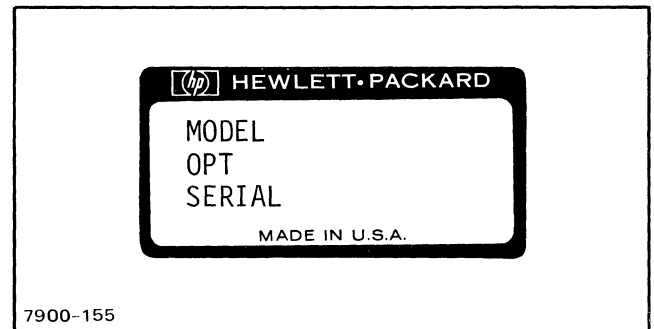


Figure 1-2. Identification Sticker

1-8. Hewlett-Packard identifies each unit with a two-section serial number (0000A-00000). The first four digits are a serial number prefix used to identify a particular unit configuration. The letter identifies the country in which the unit was manufactured. The last five digits identify each specific unit. If the serial number prefix on the unit does not agree with the prefix on the title page of this manual, there are differences between that unit and the unit described in this manual. These differences are described in manual supplements available at the nearest HP Sales and Service Office or in appendix B of this manual.

1-9. Printed-circuit assembly (PCA) revisions are identified by a letter, a series code, and a division code marked beneath the part number on the PCA. The letter identifies the revision of the etched track pattern on the unloaded PCA. The four-digit series code pertains to the electrical characteristics of the loaded PCA and the positions of the components. The two-digit division code identifies the division of Hewlett-Packard that manufactured the PCA. If the series code numbers do not correspond exactly with the code numbers on the schematic diagrams in this manual, the PCA's are different from those described in this manual. These differences are covered in manual supplements available at the nearest HP Sales and Service Office.

1-10. SPECIFICATIONS.

1-11. Specifications for the disc drive are listed in table 1-1.

1-12. OPTIONS.

1-13. Options are factory modifications of a standard disc drive that are requested by the customer. Option 001 is available for 50 Hz operation for the disc drive.

1-14. ACCESSORIES.

1-15. The following accessories may be ordered with the disc drive or separately from your local Hewlett-Packard

Sales and Service Office (refer to the list at the back of this manual for addresses).

<u>HP Model/Part Number</u>	<u>Description</u>
9164-0045	Disc Cartridge
07900-60014	Service Extender Board
13212A	Multunit Cable (W2)
13211A	Rack Mounting Kit

1-16. RELATED MANUALS.

1-17. The HP 7900A Disc Drive receives +5, ±12, and ±24 Vdc and 120 Vac power from the HP 13215A Disc Power Supply. Interconnection information for these two units can be found in the HP 13215A Disc Power Supply Operating and Service Manual, part number 13215-90003.

Table 1-1. HP 7900A Disc Drive Specifications

DEVICE TYPE				Rotational Delay (latency):				
Moving-head disc drive, two discs; 1 fixed disc, 1 removeable front-loading cartridge (mechanically similar to IBM 2315 disc cartridge).				Average (1/2 revolution) 12.5 ms				
				Maximum (1 revolution) 25 ms				
DATA ACCESS				Data Transfer:				
Head Positioning (including settling time):				Eight-Bit Bytes/Second 312k				
				Bits/Second 2.5M				
Track-to-Track (average) 7 ms				Cartridge Change at 60 Hz Power:				
Random Average 30 ms				Stop Time 25 seconds				
203 tracks (maximum) 55 ms				Start Time 30 seconds				
<hr/>								
DATA CAPACITY								
Approximately 48 million bits structured as follows when in 24-sector format:								
APPROXIMATE	TOTAL BITS PER	DATA BITS PER	DATA BYTES PER	SECTORS PER	TRACKS PER	CYLINDERS PER	RECORDING SURFACES PER	DISCS PER
Byte	8	8						
Sector	2.6k	2k	256					
Track	60k	50k	6k	24				
Cylinder	240k	200k	25k	96	4			
Surface	12M	10M	1.25M	4.8M	200 + 3	200 + 3		
Disc	24M	20M	2.5M	9.6k	400	200	2	
Drive	48M	40M	5M	19.2k	800	200	4	2

Table 1-1. HP 7900A Disc Drive Specifications (Continued)

ENVIRONMENTAL	Power Requirements:
Operating Temperature 10° to 40°C 50° to 104°F	Provided by HP 13215A Disc Power Supply
Non-operating Temperature -20° to 65°C -4° to 149°F	120 Vac ±10%, 60 Hz ±2% (50 Hz optional in disc drive), 6.5A
Humidity 8 to 80% non-condensing	+5 Vdc adjustable, regulated
Attitude (pitch and roll) ±30 degrees about either axis	+12 Vdc regulated
Absolute Filtering 0.3 micron filter	-12 Vdc regulated
Positive Pressure Maintained during cartridge change	+24 Vdc ±10% unregulated
GENERAL	Weight:
Standard Features:	Net 117 lb (53 kg)
Write protect on either disc (switch setting inside cartridge door).	Shipping 184 lb (84 kg)
Parallel connection of up to four drives per controller.	Dimensions:
	Fits standard EIA 19-inch rack
	19 inches wide (ahead of mounting flange)
	16-3/4 inches wide (behind mounting flange)
	10-1/2 inches high
	22-15/16 inches deep (from mounting flange)
	25-5/8 inches deep (overall)

SECTION II INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information on unpacking and incoming inspection, input power requirements, mounting, checkout, and packing and shipping for the disc drive.

2-3. UNPACKING AND INSPECTION.

2-4. If the carton is damaged upon receipt, request that the carrier's agent be present when the unit is unpacked. Inspect the unit for damage (scratches, dents, broken parts, etc). If the unit is damaged and fails to meet specifications, notify the carrier and the nearest HP Sales and Service Office immediately. (HP Sales and Service Offices are listed at the back of this manual.) Retain the shipping container and the packing material for the carrier's inspection. Hewlett-Packard will arrange for repair or replacement of the damaged unit without waiting for any claims against the carrier to be settled.

2-5. POWER REQUIREMENTS.

2-6. The disc drive may be run continuously from the HP 13215A Disc Power Supply. Cable interconnection information between the disc drive and disc power supply is covered in paragraph 2-13.

2-7. POWER CABLE.

2-8. To protect operating personnel, the National Electrical Manufacturer's Association (NEMA) recommends that the unit panel and chassis be grounded. This unit is equipped with a detachable three-conductor shielded power cable which, when connected to the disc power supply, grounds the unit.

2-9. MOUNTING.

2-10. Prior to rack mounting, remove the top cover and remove the shipping clamp shown in figure 2-1. The shipping clamp is used to prevent internal movement that would cause damage to the heads or disc components during packing or shipment. When removing the shipping clamp, use care not to bump or jar the heads or snag the head leads. The shipping clamp is secured in place by a pozi drive screw. After removal of the shipping clamp, replace the top cover.

Note

Retain the shipping clamp for future shipping.

2-11. The unit is air cooled. Sufficient space (a one-inch minimum) should be allotted so that a free flow of air can be exhausted from the rear and top of the unit when it is in operation. The unit should be used in an area where the

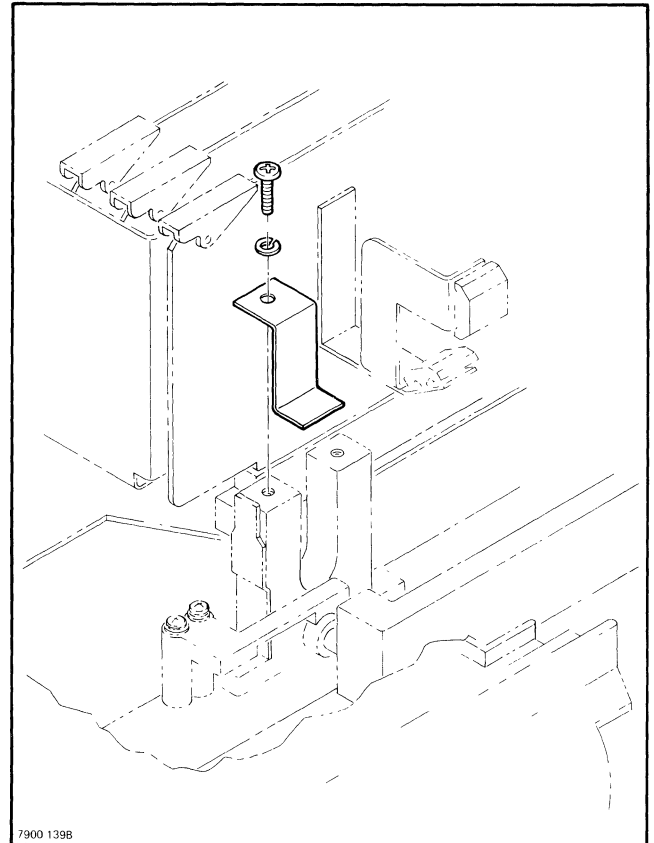


Figure 2-1. Disc Drive Shipping Clamp

ambient temperature does not exceed 40°C. The air inlet is the screen at the lower front of the disc drive; the inlet must not be covered.

2-12. Mounting the disc drive in a rack cabinet, requires that the rack mounting technique maintains isolation between the disc drive chassis and the rack cabinet. Disc drive front frame design maintains isolation between the front panel and the disc drive chassis. The HP 13211A Disc Drive Rack Mounting Kit is an available accessory for mounting the disc drive in an HP 2940A/B Cabinet with the required chassis isolation. The following procedure provides rack mounting instructions using the HP 13211A Disc Drive Rack Mounting Kit (figure 2-4 includes identification of the isolation technique). To mount the disc drive in an HP 2940 Rack Cabinet using the HP 13211A Disc Drive Rack Mounting Kit, proceed as follows:

a. Place the disc drive on a table in an environmentally clean area. Attach the right and left chassis slides to the disc drive using eight number 8-32, 0.625 flat head screws, four on each side, as shown in figure 2-3.

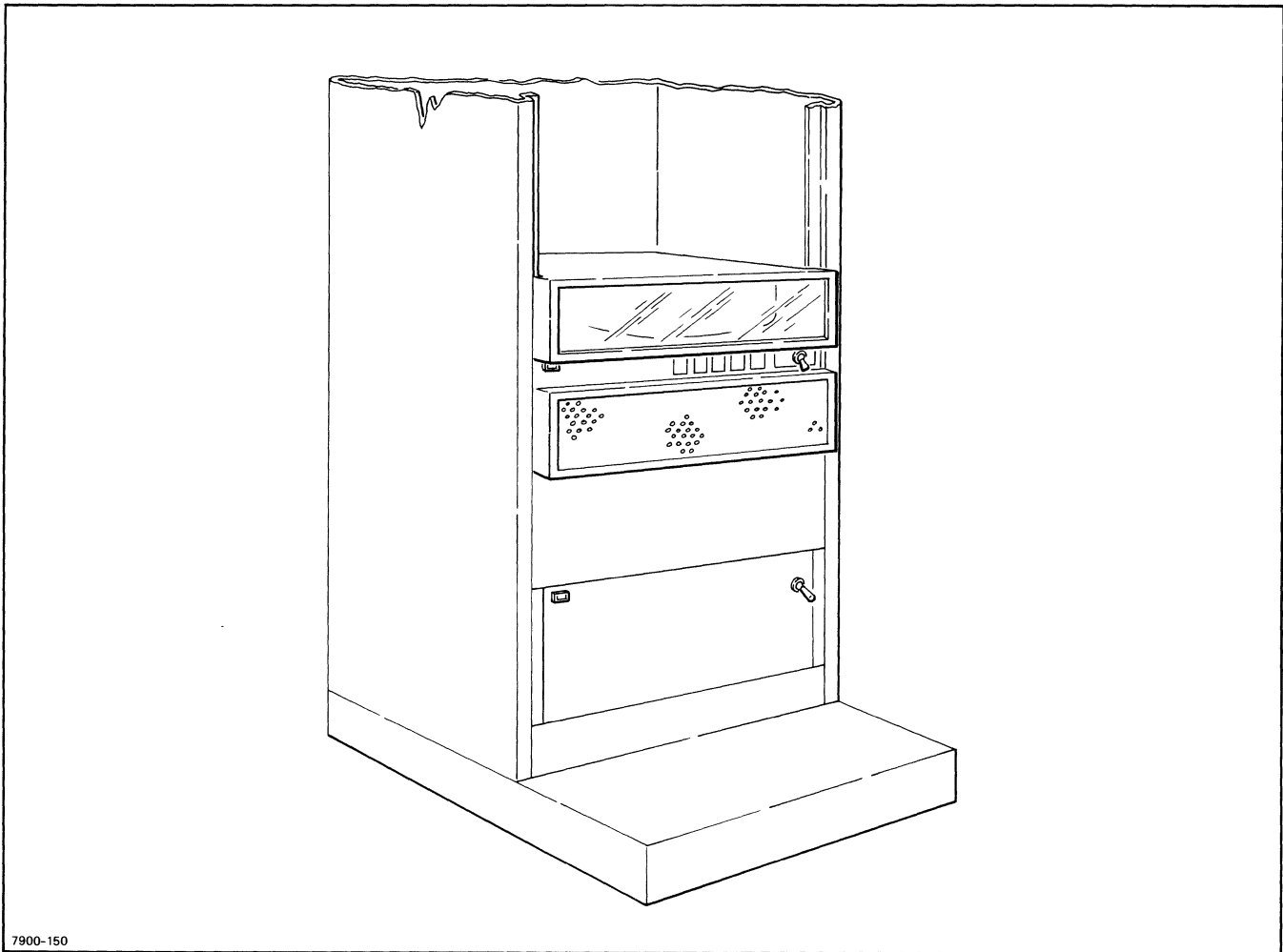


Figure 2-2. Disc Drive Cabinet Mounting

b. Attach the rack mount brackets to the rack cabinets as shown in figure 2-4 using different hardware for the front of the bracket than for the rear. Each bracket is attached on the front using two number 1/4-20, 0.5-inch hexagon head screws, two number 1/4 split lock washers, and two number 1/4-20 spring nuts; the rear is attached by using two 1/4-20, 1.0-hexagon head screws, two 1/4-20 split lock washers, two 1/4-20 flat washers, two back spacer-insulators, and two 1/4-20 spring nuts.

Note

Align the mounting screw in conjunction with RETMA mounting pattern shown in figure 2-4. Proper alignment with the RETMA pattern will assure alignment of the 7900A chassis mounting holes with the RETMA pattern holes used for securing the disc drive front panel to the cabinet.

A minimum vertical clearance of 10-1/2 inches above the bottom front of the rack mount bracket must be maintained to allow for disc drive clearance.

c. Extend the chassis slides out, as shown in figure 2-5, from the front of the rack cabinet. Lift the disc drive into place with the attached chassis slides so that the chassis slides on the disc drive slide into the extended chassis slides in front of the rack cabinet. Press in on the slide lock buttons located on the sides of the disc drive chassis slides and ensure that the buttons are in place in the holes in the extended chassis slides. While holding the slide lock buttons in, push the drive partially back into the rack cabinet.

d. With the disc drive secure in the chassis slides, open the front panel and observe the four drive chassis mounting slots shown in figure 2-6. The holes will line up with the RETMA standard mounting holes if the rack mount brackets were correctly installed. Using four number 10-32, 0.5-inch flat head screws, secure the disc drive to the front of the rack cabinet. Although the front panel is bolted to the rack cabinet, disc drive chassis grounding is isolated from the cabinet by an RF filter connected between the disc drive chassis and front panel.

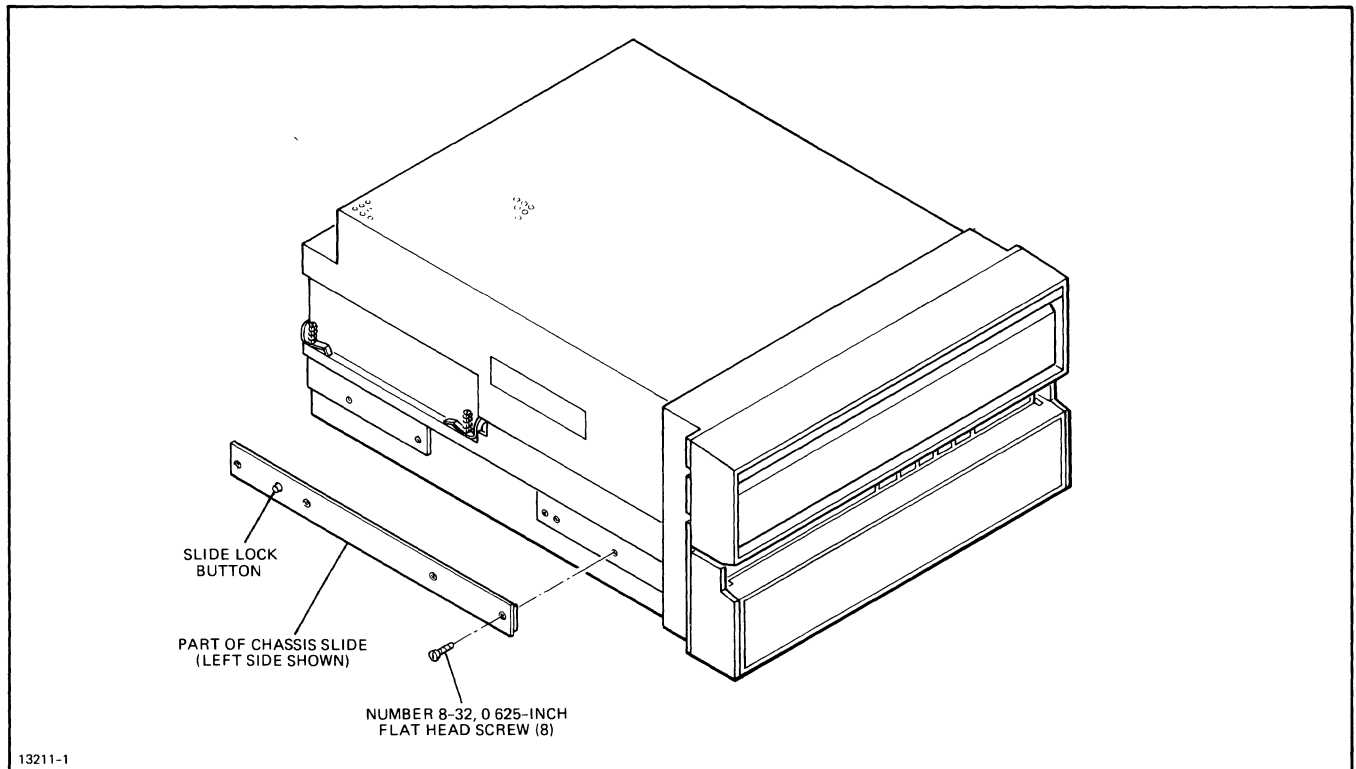


Figure 2-3. Chassis Slide Attachment

CAUTION

The rack slide mounting kit must be used in its entirety; using only the four number 10-32, 0.5-inch flat head screws to secure the disc drive could result in damage to the disc drive and rack cabinet since the screws can not support the disc drive weight.

If more than one disc drive is mounted in a rack cabinet, care should be taken to extend only one at a time for servicing or adjustments; otherwise, the rack cabinet may tip over.

2-13. INTERCONNECTION INSTRUCTIONS.

2-14. Connect the disc drive to the disc power supply as shown in figure 2-7. (Also refer to the HP 13215A Disc Power Supply Operating and Service Manual.) Plug the disc power supply into the appropriate ac source. The disc drive and disc power supply should be mounted as close to the computer as possible with the disc power supply and computer using the same ac source.

2-15. Refer to section V of this manual for an overview of the assembly connector locations. Connector XA17 is reserved for the cable from the computer/controller. Unless the disc drive is to be parallel-connected in a system, connector XA16/20 is occupied by termination assembly A20.

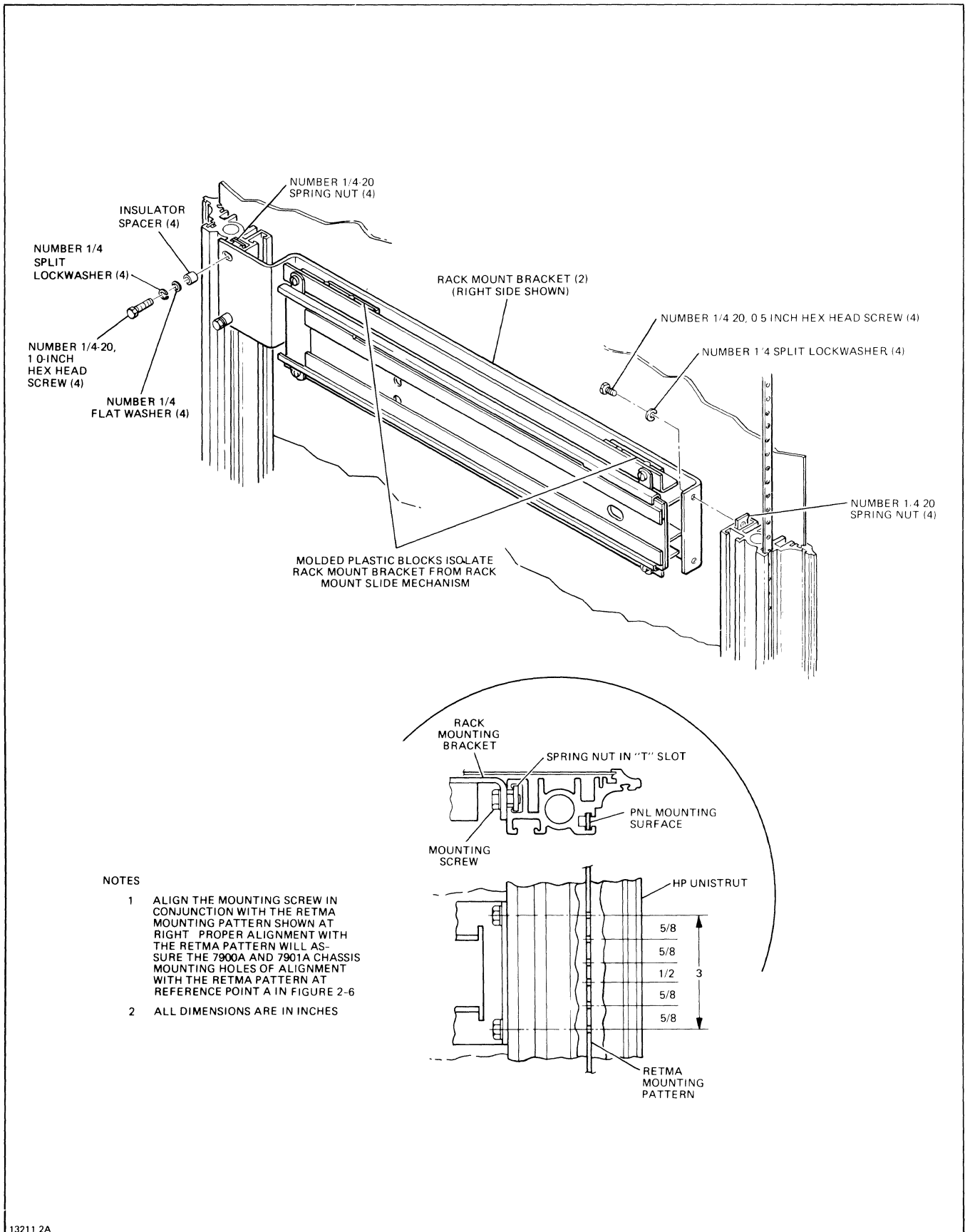
2-16. If the disc drive is to be parallel-connected in a system, an accessory extender board and an accessory multi-unit cable (HP 13212A) are required and inserted into connector XA16/20 in the first unit of the chain and inserted into connector XA17 in the second unit of the chain. This procedure is the same for the third and fourth units of a system (one controller will handle up to four disc drives per system). In the fourth and final disc drive of a system, the termination assembly must be inserted into connector XA20.

2-17. When one or more disc drives are installed, internal drive identification must be made to establish the drive response. On input/output multiplex assembly A7 located in the disc drive card cage, there are three jacks. Jumper the disc drive according to the notes on the I/O multiplex assembly A7 schematic.

2-18. SHIPPING INSTRUCTIONS.

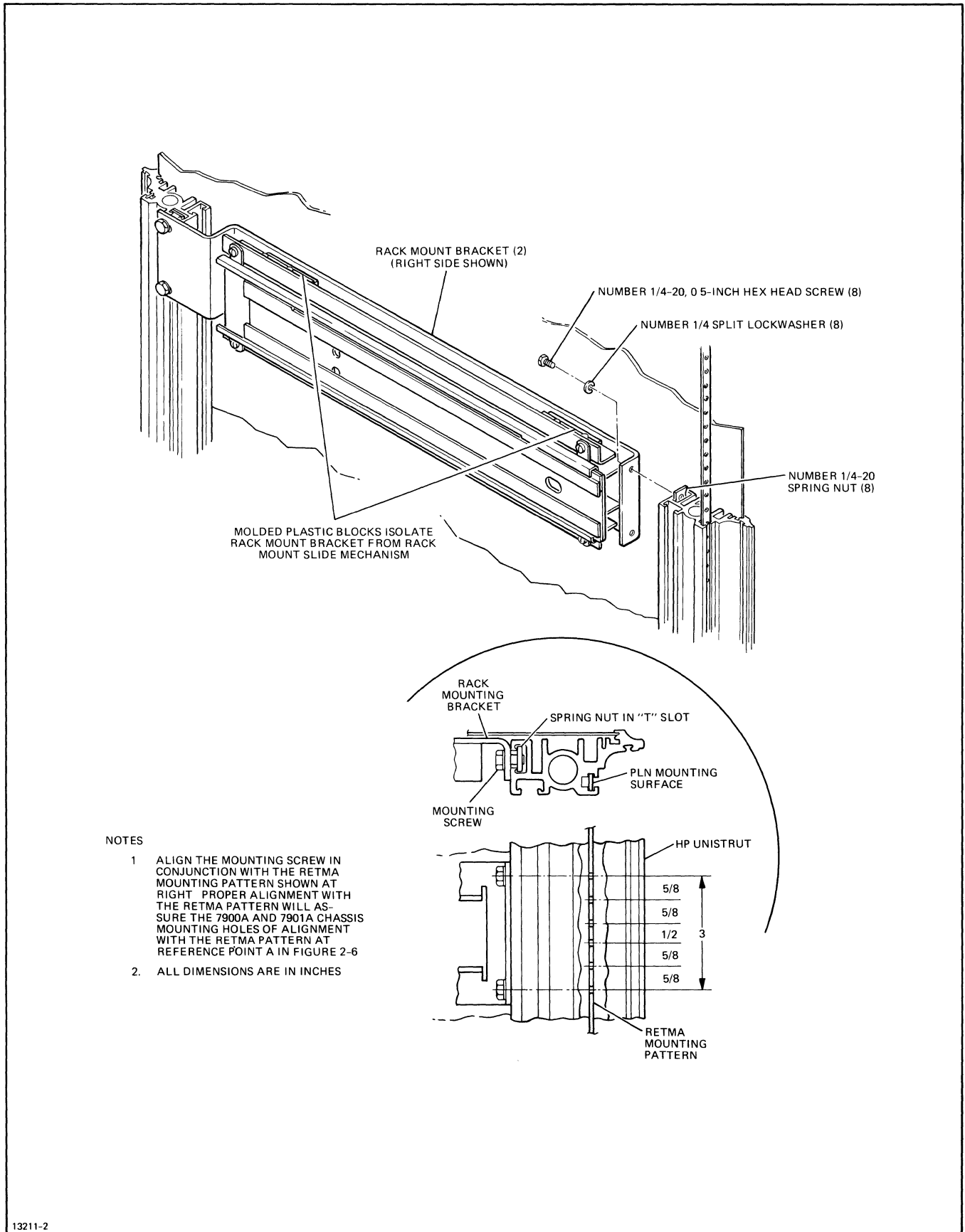
2-19. USING ORIGINAL PACKAGING.

2-20. The same containers (part no. 9211-1691) and materials (part no. 9222-0355) used in factory packaging can be obtained through Hewlett-Packard Sales and Service Offices listed at the back of this manual. If the disc drive is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service or repair required, return address, model number, and full serial number. Also, mark the container FRAGILE to assure careful handling and with a



13211 2A

Figure 2-4. Rack Mount Bracket Attachment



13211-2

Figure 2-4. Rack Mount Bracket Attachment (Series 1341 and Below Only)

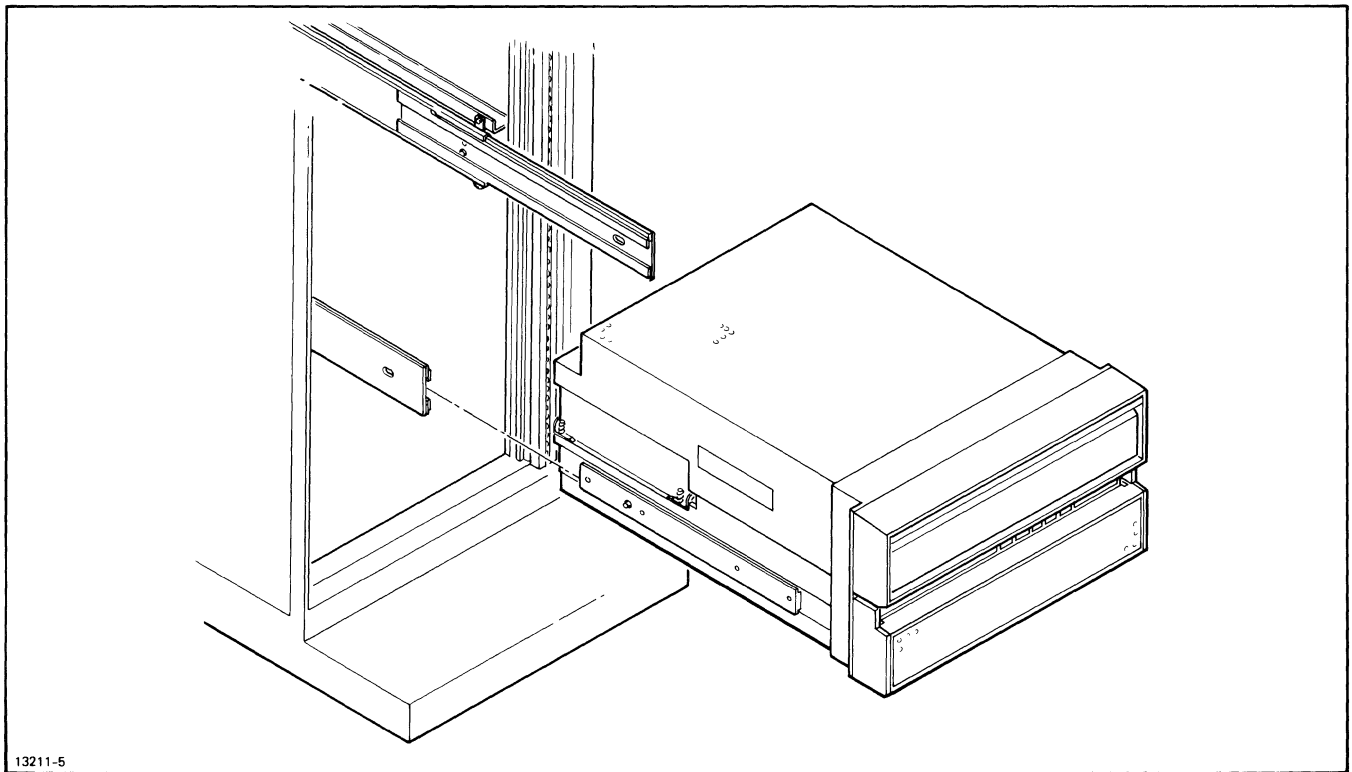


Figure 2-5. Disc Drive Slide Attachment

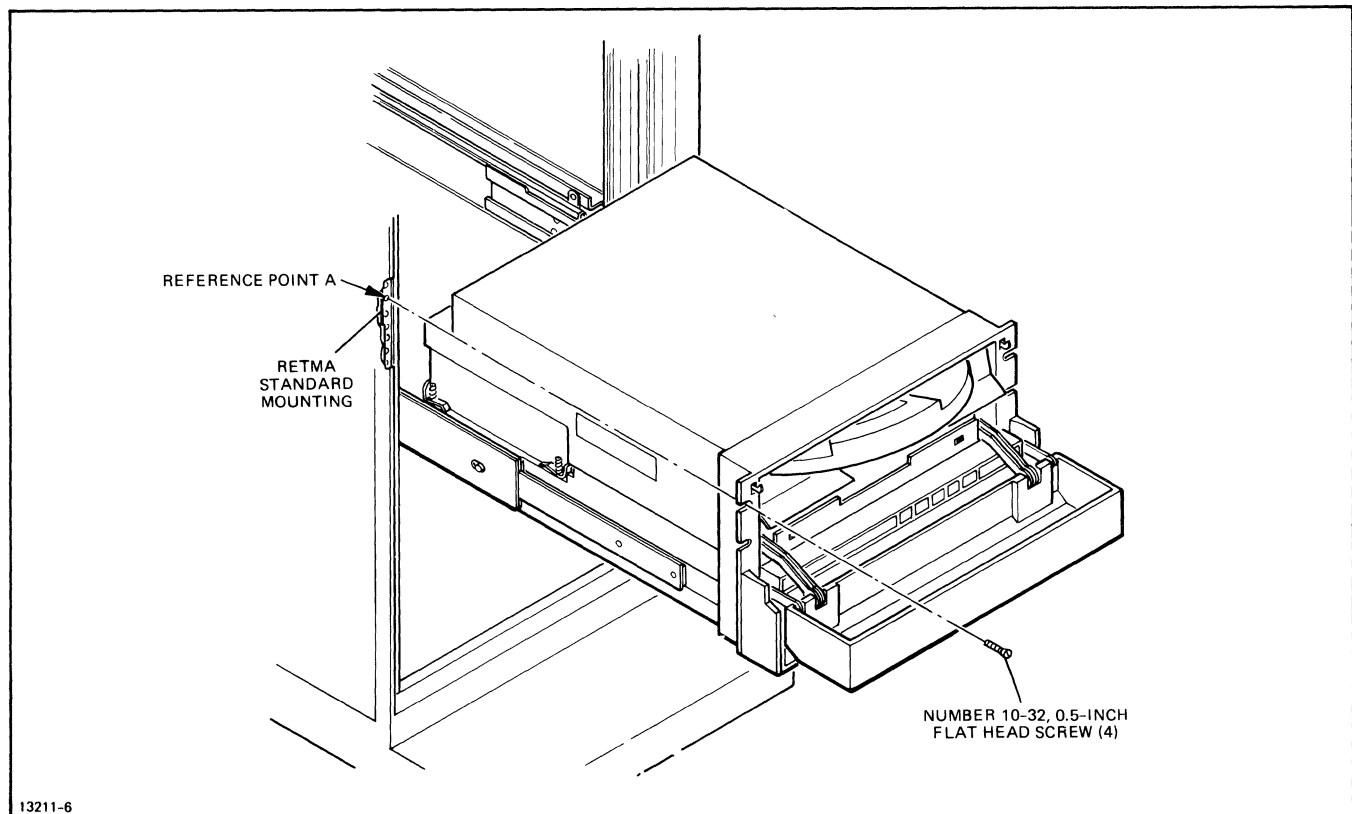


Figure 2-6. Disc Drive to RETMA Attachment

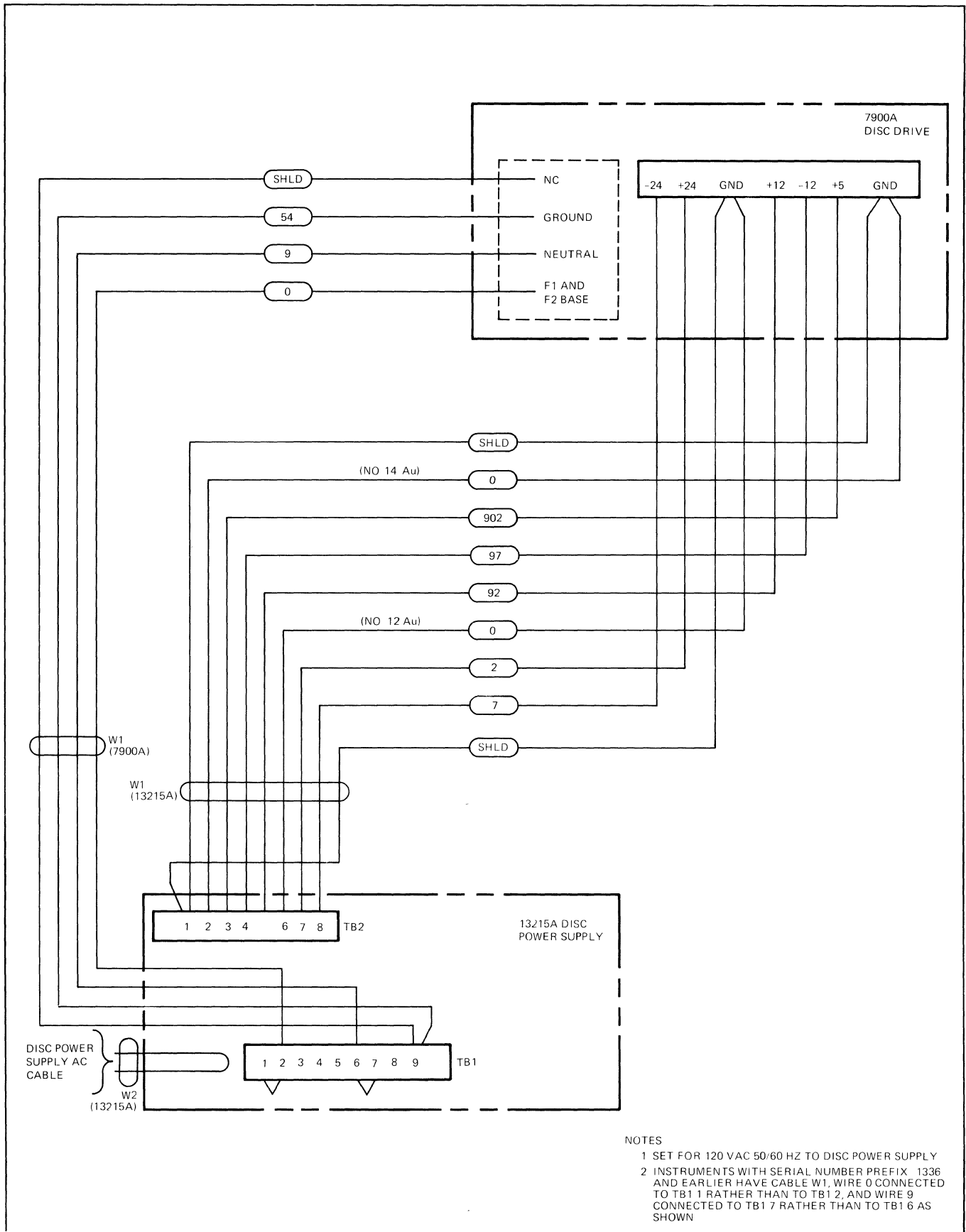


Figure 2-7. Disc Drive/Disc Power Supply Interconnecting Diagram

caution that states: "MAGNETIC EQUIPMENT SUITABLE FOR AIR SHIPMENT IF MAINTAINED AT A DISTANCE OF 25 FEET OR MORE FROM COMPASS SENSING DEVICES." In any correspondence, refer to the unit by model number and full serial number.

CAUTION

Restore shipping clamp used in original shipment to prevent internal movement of carriage and internal damage. (See figure 2-1.) If no shipping clamp is available, some means of fastening the carriage assembly to the linear motor must be used. The shipping clamp should be used whenever possible.

Note

In normal operation, there is a spring detent to hold the carriage in the most rearward position possible during cartridge change and power-off situations. The spring force of this detent is not sufficient to protect the carriage head assembly during shipment.

2-21. USING OTHER PACKAGING.

2-22. The following general instructions should be used for repackaging with commercially available materials:

CAUTION

Restore shipping clamp used in original shipment to prevent internal movement of carriage and internal damage. (See figure 2-1.) If no shipping clamp is available, some means of fastening the carriage assembly to the linear motor must be used. The shipping clamp should be used whenever possible.

Note

In normal operation, there is a spring detent to hold the carriage in the most rearward position possible during cartridge change and power-off situations. The spring force of this detent is not sufficient to protect the carriage head assembly during shipment.

a. Wrap the unit in heavy paper or plastic. (If shipping to a Hewlett-Packard Sales and Service Office, attach a tag indicating the type of service required, return address, model number and full serial number.)

b. Use a strong shipping container. A double-wall carton made of 350 pound test material is adequate.

c. Use enough shock-absorbing material (3- to 4-inch layer) around all sides of the unit to provide firm cushioning and prevent movement inside the container. Protect the control panel with cardboard.

d. Seal the shipping container securely and mark it FRAGILE to assure careful handling and with a caution that states: "MAGNETIC EQUIPMENT SUITABLE FOR AIR SHIPMENT MAINTAINED IF AT A DISTANCE OF 25 FEET OR MORE FROM COMPASS SENSING DEVICES."

e. In any correspondence, refer to the unit by model number and full serial number.

SECTION III OPERATION

3-1. INTRODUCTION.

3-2. Operating instructions for the disc drive, which must be interconnected with the HP 13215A Disc Power Supply, are covered in this section. Operating instructions and interconnection information for the HP 13215A Disc Power Supply are covered only to the extent of understanding the disc drive operation. The operator should be thoroughly familiar with the disc power supply operating procedures and have the appropriate manual on hand.

3-3. OPERATING CONTROLS AND INDICATORS.

3-4. Front and rear panel controls, indicators, and terminals of the disc drive are identified in figure 3-1.

3-5. OPERATING INSTRUCTIONS.

3-6. To operate the disc drive, proceed as follows:

a. Set the interconnected disc power supply POWER switch to ON. The DRIVE POWER lamp on the disc drive will light.

Note

In multiunit operation, the terminating disc drive must have power applied during system operation.

b. Open the disc drive front door by pulling out and down from the upper edge of the front door.

c. Install the disc cartridge (part no. 9164-0045 or equivalent).

d. Set either or both of the data protect switches on if data protection is required. The corresponding indicators will light, depending on the data protection desired.

e. Close the disc drive front door.

f. Set the disc drive LOAD/UNLOAD switch to the LOAD position. The DOOR UNLOCKED indicator will go off. After a 30-second start-up time, the DRIVE READY lamp will light, indicating that the disc drive heads are loaded. The DRIVE FAULT lamp will light only if an illegal memory operation is attempted, or if some of the read/write circuitry failed, or if a seek operation did not finish within 850 milliseconds.

CAUTION

If a head crash should occur, do not attempt to retrieve data by putting the damaged cartridge in another disc drive or a second head crash may occur.

3-7. To change a cartridge in the disc drive, proceed as follows:

a. Set the disc drive LOAD/UNLOAD switch to the UNLOAD position. The DRIVE READY light will immediately go out.

b. Allow the internal brake to bring the spindle to a halt (approximately 25 seconds), and wait for the DOOR UNLOCKED indicator to light.

c. Open the disc drive front door by pulling out and down from the upper edge of the front door.

d. Remove the disc cartridge.

e. Install the new disc cartridge.

f. Close the disc drive front door.

g. Set the disc drive LOAD/UNLOAD switch to the LOAD position. The DOOR UNLOCKED indicator will go off. After a 30-second start-up time, the DRIVE READY lamp will light, indicating that the disc drive is awaiting a command from the disc drive controller.

Note

In multiunit operation, the terminating disc drive must have power applied during system operation.

3-8. To render the disc drive in-operative, proceed as follows:

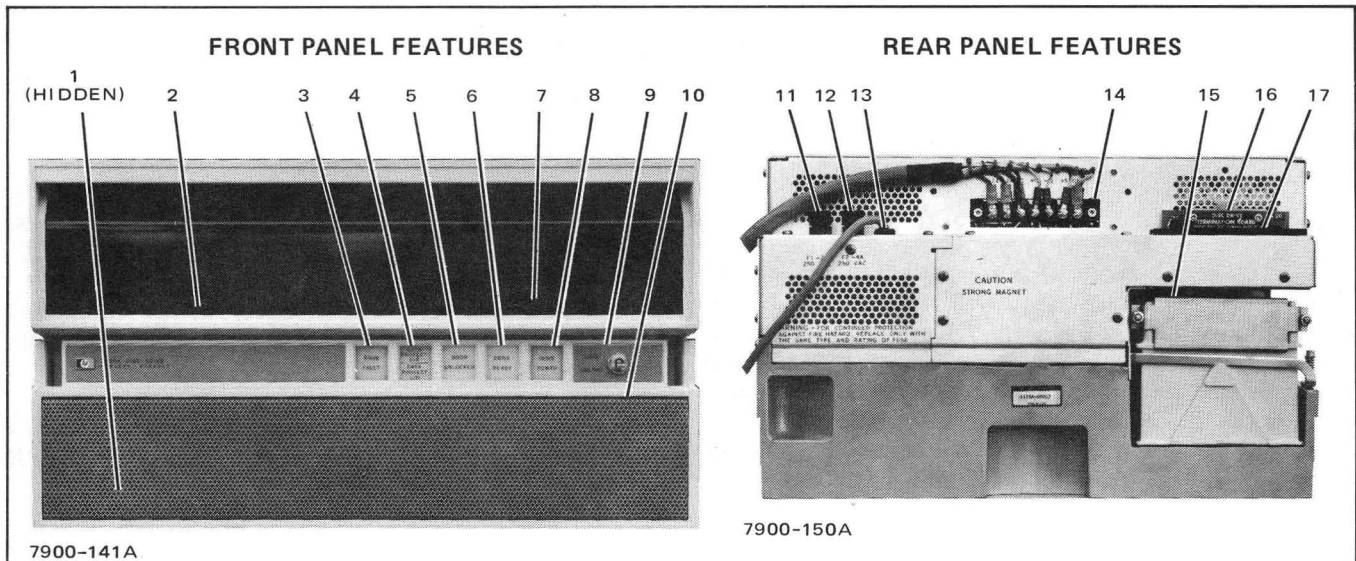
a. Set the disc drive LOAD/UNLOAD switch to the UNLOAD position.

b. Allow the internal brake to bring the spindle to a halt (approximately 25 seconds), and wait for DOOR UNLOCKED indicator to light.

c. Set the disc power supply POWER switch to the OFF position. The DRIVE POWER lamp on the disc drive will go off.

CAUTION

Power down the disc drive system using the LOAD/UNLOAD switch — not the main power switch. Proper head unloading is guaranteed only if LOAD/UNLOAD switch is operated with power on. Head and/or disc damage may occur if the internal protection feature is disabled.



1. Format PROTECT/OVERRIDE switch.

Used in conjunction with the HP 13210A Disc Drive Interface Kit. When in the PROTECT position, prevents the operator from altering the contents of a sector address field. When in the OVERRIDE position, the operator can alter the contents of a sector address field.

2. L/D PROTECT switch.

Turns lower data protection feature on or off. When activated, protects lower fixed disc from any write operations.

3. DRIVE FAULT indicator lamp.

Lights whenever an illegal memory operation is attempted, a malfunction in the read/write hardware circuitry occurs, or if a seek operation is not completed in 850 milliseconds.

4. DATA PROTECT L/D indicator lamp.

Lights whenever the L/D PROTECT switch is in the ON position. When lit, the lower fixed disc is protected against any write operations.

DATA PROTECT U/D indicator lamp.

Lights whenever the U/D PROTECT switch is in the ON position. When lit, the upper removeable disc is protected against any write operations.

5. DOOR UNLOCKED indicator lamp.

Lights whenever the LOAD/UNLOAD switch is set to UNLOAD and the drive spindle is stopped.

6. DRIVE READY indicator lamp.

Lights when the disc drive motor has reached 2400 r/min, the air filtration system has been purged of unclean air, and the heads are in a loaded position over cylinder zero. Stays lit during legal memory operations.

Figure 3-1. Disc Drive Front and Rear Panel Features (Sheet 1 of 2)

7. U/D PROTECT switch.

Turns upper data protection feature on or off. When activated, protects upper removeable cartridge disc from any write operations.

8. DRIVE POWER indicator lamp.

Lights when the disc power supply has been interconnected to the disc drive and the disc power supply POWER switch is set to ON.

9. LOAD/UNLOAD switch.

Turns disc drive spindle motor on and off (on in the LOAD position and off in the UNLOAD position). When set to LOAD (on) the front panel interlocks are energized, preventing entry to the removeable disc cartridge. In the UNLOAD (off) position the spindle motor is stopped and the front panel can be opened to load or change a disc cartridge.

10. Air filtration screen.

Coarse filtration screen for the disc drive.

11. Fuse holder.

Fuse protection for the blower motor. Fuse rating is 1 amperes.

12. Fuse holder.

Fuse protection for the spindle motor. Fuse rating is 4 amperes.

13. Power interconnect cord.

120 Vac power interconnect cable interconnecting with the disc power supply.

14. DC interconnect terminal.

Tie point for +5, ± 12 and ± 24 Vdc supply voltages to the disc drive from the disc power supply.

15. Absolute filter.

A 0.3 micron filter for the disc drive.

16. Connector.

Extender or termination printed-circuit assembly connector.

17. Connector.

Extender printed-circuit assembly connector.

Figure 3-1. Disc Drive Front and Rear Panel Features (Sheet 2 of 2)

SECTION IV

THEORY OF OPERATION

4-1. INTRODUCTION.

4-2. This section describes the overall mechanical and electrical characteristics of the disc drive. Detailed functional descriptions are also provided and are complemented by an overall block diagram.

4-3. MECHANICAL AND ELECTRICAL CHARACTERISTICS.

4-4. The Hewlett-Packard 7900A Disc Drive is a random access, mass storage device designed for use with small to medium-sized computing systems. Through the use of removeable and interchangeable single disc cartridges, the disc drive provides the using system with access to large volume data storage, as well as fast, random access storage for high-activity programs and data. The disc drive utilizes interchangeable front-loading single disc cartridges capable of storing up to 2.5 million bytes of information. Data storage areas on the disc may be addressed in direct fashion. A separate magnetic head is used for each disc surface to retrieve existing data, or to record new data.

4-5. The disc drive with a removeable disc, in combination with a non-removeable disc, stores up to five million bytes of information. Both discs are served by the same moving actuator. The removeable single disc is mounted in a protective cartridge which acts as a guide during loading. When mounted in the drive, the disc is free to rotate within the cartridge. At operating speed, the heads are placed in flying position by a mechanical head-loading mechanism. An electromagnetically actuated carriage moves the heads to any one of 203 cylinder positions. The carriage assembly is supported on ball bearings which are spring loaded against stainless steel rails. Disc addressing and head selection are under the control of the using system.

4-6. The disc drive interfaces directly with the using system controller (HP 13210A Disc Drive Interface Kit for HP 2100 Series Computers) and receives all data inputs directly from the using system processor interface. Similarly, all data and data status signals are either sent directly to the using system, or are transmitted to the using system through the controller.

4-7. There are three major functions the disc drive performs:

- a. It supplies a medium of data storage.
- b. It supplies a mechanism of data storage and retrieval.
- c. It supplies fast, accurate access to any desired storage location.

4-8. The medium through which the data is stored is in a thin layer of magnetic material on the surface of a disc platter.

4-9. The mechanism of data storage and retrieval is accomplished by using a ferromagnetic read/write head suspended over the surface of the disc.

4-10. The means of access to this data is by a head-carriage assembly (see figure 4-1) that positions the read/write heads over the addressed cylinder. The carriage assembly consists of a coil of wire, free to move within the field of two permanent magnets. In essence, the coil and the magnet form a linear motor which moves the carriage assembly, just as a voice coil moves the diaphragm in a speaker.

4-11. The head support arms are attached to the carriage assembly. Accurate positioning of a head over a track is accomplished by positioning the carriage with a signal generated from an extremely accurate optical transducer. Due to the high carriage speeds, a velocity transducer is also attached to the carriage. Carriage velocity feedback is required for proper servo control.

4-12. The heads are moved to take maximum advantage of the storage capacity. There are 203 cylinders, i.e., unique positions of the carriage assembly. That part of the carriage assembly which distinguishes one cylinder from the next is the encoder assembly. One part of the encoder detects a reference point, called the home position, which is labeled cylinder 0. The rest of the encoder generates a very accurate positioning signal. This signal is used to move the head to the center of the desired cylinder, and it is also used to update the current track address indicator whenever the head moves from one cylinder to the next.

4-13. The disc is rotated beneath a read/write head by means of a pulley, belt, and spindle motor. (See figure 4-1.) The spindle motor control circuitry controls the application of power to the spindle motor — ac power for starting the motor, dc power for stopping the motor, and no power at all when exchanging disc cartridges or when the drive is otherwise not ready for use.

4-14. Attached to each disc hub is a short, thin-walled skirt with slots cut in it. This slotted skirt, together with a photocell assembly for detecting the slots, is the means for detecting angular position. If radial lines were drawn through the slots, the disc would be divided into 24 equal pie-shaped wedges. The area of the disc which passes beneath a read/write head from one radial line to the next is called a sector. The sectors are numbered from 0 to 23. The controller sends the desired sector address to the disc drive, and the sector detect circuitry compares the desired address with the actual position of the disc. This comparison signal is part of the dynamic status sent to the controller and is used to start data transfer.

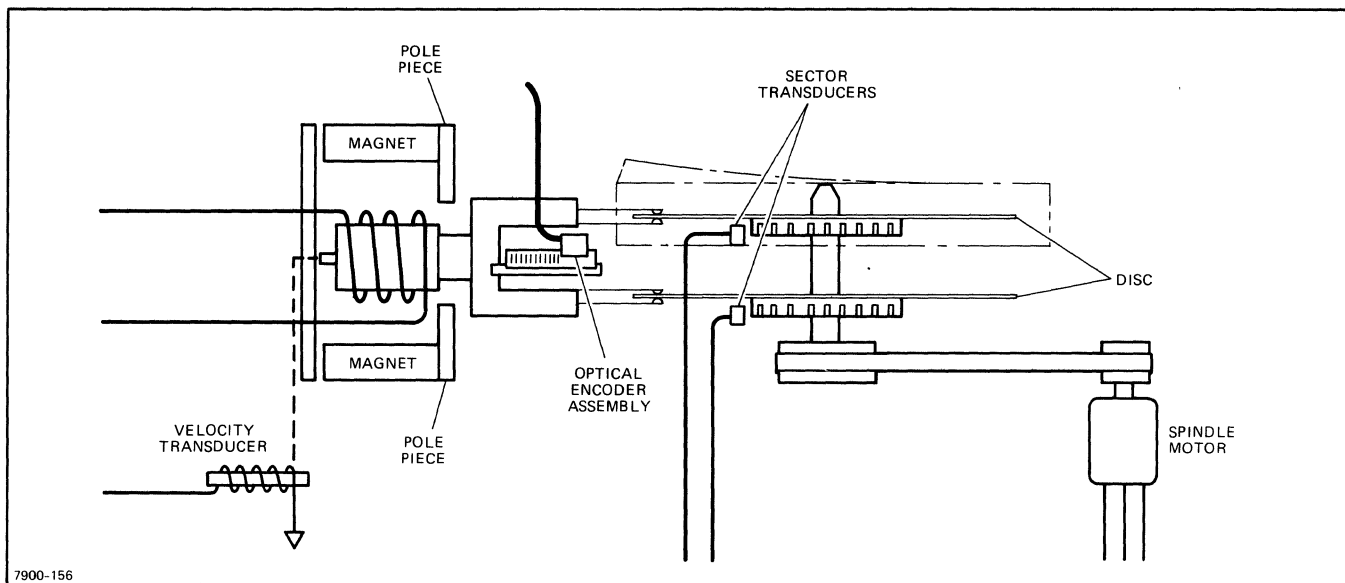


Figure 4-1. Disc Drive Overview

4-15. A complete address specifying a sector consists of an appropriate selection for each of the levels in figure 4-2. There are not enough signal lines to send the entire address to the disc drive at once, so the address is broken into three parts. First, two signal lines are dedicated to selecting the disc drive (level 1). Next, eight signal lines are used to select the cylinder (level 2). Finally, the same eight lines select the head and sector (levels 3 and 4).

4-16. The spring action of the head supporting arm forces the head toward the surface. The air pressure created by the rotating disc forces the head away from the disc. The two forces are in equilibrium when the head is suspended at the proper height for reading and writing. The controller selects one of the four heads at the same time that it selects the starting sector.

4-17. DETAILED FUNCTIONAL DESCRIPTION.

4-18. An overall block diagram of the drive functions is shown in figure 4-4 at the end of this section.

4-19. INPUT RECEIVERS AND GATING.

4-20. Each one of the input lines, the "not" Set Cylinder, "not" Outbus, "not" Select, "not" Set Head, and "not" Control lines from the controller (computer) to the disc drive, is applied to an inverter which senses the level (whether high or low) of the line. The outputs of these receivers are then fed to logic circuits throughout the disc drive. (See figure 4-4.) The receiver presents a single load to each line and, in effect, isolates the input line from the disc drive circuits.

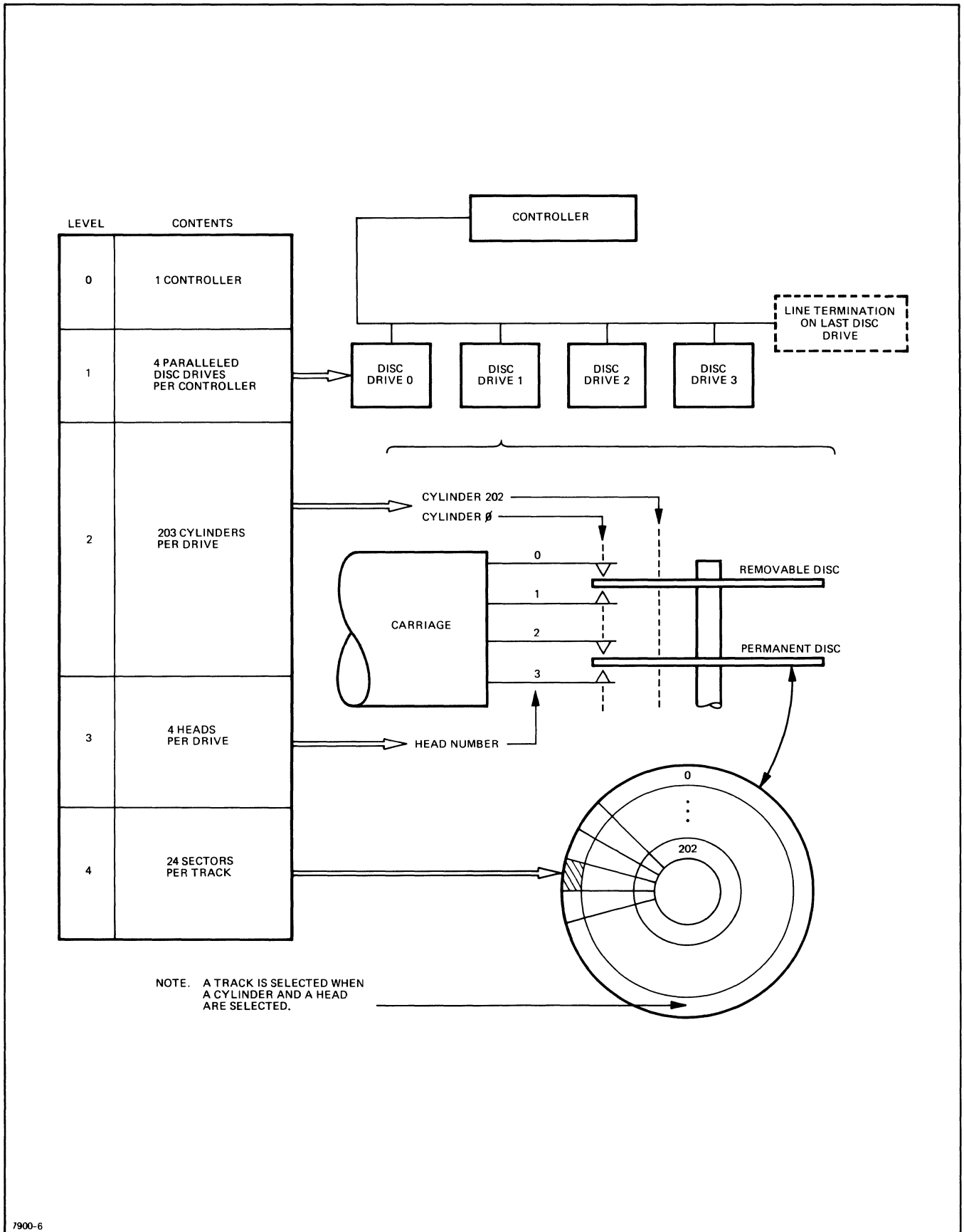
4-21. Logic operations performed by the input receivers and gating circuits include select gating and the combining of other inputs to produce seek home and gate status functions.

4-22. POSITION ENCODER.

4-23. Position detection within the disc drive is accomplished by means of the photo-optical encoder. The light source, reticle, and photovoltaic cells are mounted on the casting. The encoder plate is attached to the carriage and moves with it. Both the encoder plate and the reticle are made of glass, with plated chrome lines. The width of the lines is 0.005 inch, and the space between the lines is also 0.005 inch. The encoder plate has a continuous 2-1/2 inches of lines and spaces, giving about 250 lines. Also on the encoder plate is a solid strip used as a reference for track 0. The reticle contains four groups of lines, each group containing 15 lines. As the encoder plate lines move past the reticle lines, the lines are either in phase or out of phase with each other. When the lines are in phase, light is allowed to pass through both the grid and the reticle to the photovoltaic cells. When they are out of phase, no light can pass through.

4-24. POSITION ENCODER CIRCUITS.

4-25. The encoder assembly supplies three types of information to the position control electronics. The solid strip on the encoder plate and the associated photovoltaic cell provide reference information. The end of the strip indicates the center of cylinder zero. If an address error occurs, the controller will have the drive search for this reference point. After the home (cylinder zero) position is found, normal operations can resume. Consecutive lines from the home



7900-6

Figure 4-2. Addressing Structure of HP 7900A Disc Drive

position correspond to consecutive cylinders on the disc. The encoder plate and its associated photovoltaic cells provide the information signals that indicate that the carriage is moving from one cylinder to one of the two adjacent tracks. From these same signals is derived the direction of movement information. The reticle has two functional groups of lines. The associated photovoltaic cell outputs are called channel A and channel B. There is a 90-degree phase difference between them when compared with the encoder plate lines. The result is that carriage movement in one direction causes channel B signal to lead channel A signal by 90 degrees while movement in the other direction causes B to lag A by 90 degrees. This is the source of information on direction of movement.

4-26. Every alternate zero crossing of the channel A signal indicates the center of a cylinder. The positioning electronics uses these zero crossings during the positioning operation to update the current position of the heads. The accuracy of positioning is such that a seek is repeatable to within 100 microinches at a given temperature.

4-27. The channel C or cylinder zero photocell signal is sensed for three conditions; one, that the carriage is beyond cylinder zero and in the unloaded direction; two, that the carriage is at cylinder zero; and three, that the carriage is beyond cylinder zero in the loaded direction.

4-28. SET ADDRESS AND VELOCITY COMMAND LOGIC.

4-29. An eight-bit latch stores the desired cylinder address sent from the computer. An eight-bit up-down counter working from the encoder-derived pulses stores the instantaneous cylinder location of the carriage. The outputs from the eight-bit latch and the eight-bit up-down counter are then applied to an eight-bit adder in a way that the adder output is a binary number equal to the difference between the two inputs. For example, if the computer sets 150 into the seek register and the disc carriage is sitting on cylinder 25, the adder output will be +125. As the carriage moves closer to cylinder 150, the adder output number gets smaller and smaller until it becomes zero when the two match.

4-30. A digital-to-analog converter takes the binary output from the adder and converts it into a voltage that is proportional to the distance the carriage is away from its destination. The voltage is sent to the servo amplifier, where it commands the carriage to travel at a certain velocity; fast when it is far away and progressively slower as it approaches its destination.

4-31. SERVO AMPLIFIER.

4-32. The servo power amplifier controls the current to the linear actuator which positions the head carriage over the disc. The amplifier is connected in a current-feedback configuration to provide a high-impedance current source for the linear motor coil.

4-33. VELOCITY TRANSDUCER.

4-34. The velocity transducer measures the linear velocity of the head carriage assembly. The transducer consists of two parts, a cylindrical coil assembly and a high coercive force permanent magnet. The coil is mounted in the center of the linear motor assembly and the magnet is attached to the carriage assembly by a support rod. The motion of the magnet through the coil generates a voltage whose magnitude is proportional to the linear velocity and whose polarity indicates the direction of motion. This voltage, which is proportional to velocity, is used in the head-carriage motion control servo system to precisely control the system during a seek operation.

4-35. SECTOR TRANSDUCER.

4-36. The sector transducer supports a light and photocell on opposite sides of a slotted skirt that extends downward from the disc hub. As the hub rotates, light passes through the slots and falls on the photocell which in turn produces electrical pulses which are amplified and fed to the sector logic circuits.

4-37. SECTOR LOGIC.

4-38. Each revolution of the disc produces 24 equally spaced sector pulses and one index pulse which follows the "0" sector pulse by about a third of a sector space. Figure 4-3 is a breakdown of the sector logic.

4-39. Pulses arrive from the upper and lower sector transducers and are processed by a pair of one-shots to separate the index pulses from the sector pulses. An adjustable time delay is also used on the upper (removable) disc signal to permit alignment of the pulses with the disc data.

4-40. Sector pulses are fed to the inputs of divide-by-24 counters. The corresponding index pulse initially resets each counter to zero. The five output bits from one or the other of these counters are then fed to one side of a comparator.

4-41. The output of the head and sector address register is fed to the other side of the comparator. The desired head and sector address is entered into this register by the computer. The head address portion is used to select one of two counters. Either one of the upper or lower counters feed the comparator. The sector position is compared with the counter output and when they match, a high Sector Compare output signal is produced.

4-42. The head address also gates either the upper or lower sector pulses to a 24-microsecond one-shot which generates the Sector Pulse output.

4-43. SPEED SENSE.

4-44. Sector pulses from the lower disc are used to sense two thresholds of spindle speed. One senses when the disc is about 80 percent of nominal speed and the other senses when the disc is below about 0.2 percent of nominal speed, or virtually stopped.

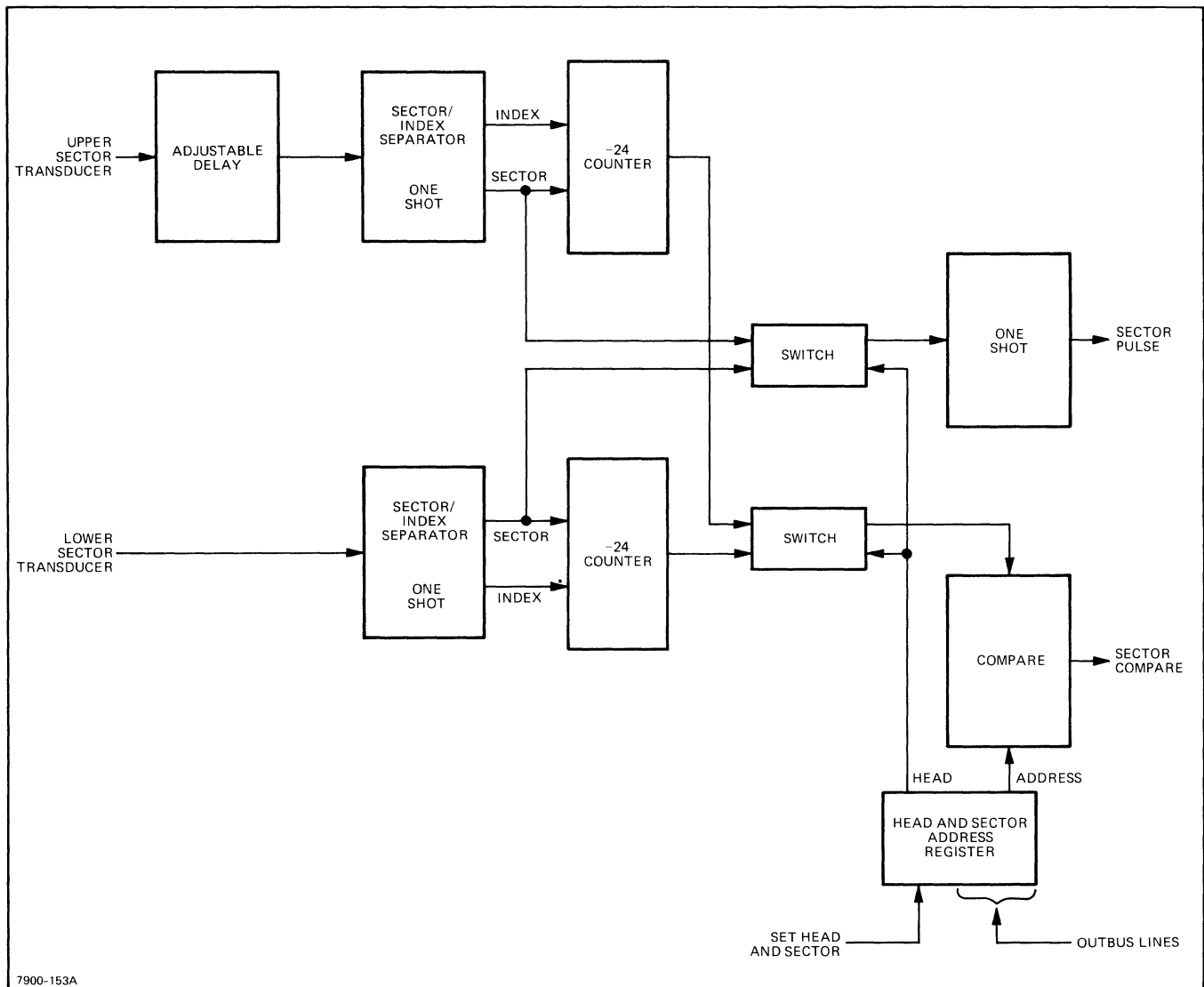


Figure 4-3. Sector Logic Breakdown

4-45. The 80 percent threshold uses a pair of flip-flops controlled by a retriggerable one-shot which is clocked by the sector pulses. It requires two consecutive pulses with spacing less than the nominal 80 percent period to establish the up-to-speed condition. The less than 0.2 percent circuit uses a single retriggerable one-shot with a period of about 0.75 second.

4-46. DISC DRIVE CONTROL LOGIC.

4-47. The disc drive control logic includes a variety of functions which coordinate operation of the carriage positioning servo with the rest of the system.

4-48. Control of the servo relay, which connects the coil to the power amplifier, is accomplished by the disc drive control logic. Closure of this relay requires that all interlocks

are clear, the disc is up to speed, a start-up time delay has elapsed, and there is not a drive fault condition. Drive fault is sensed when the carriage fails to complete a move within a certain time interval, or when the read/write electronics is unsafe.

4-49. The logic to position the carriage at cylinder zero, either by computer command or on initial load, is accomplished by the disc drive control logic, as is the status information of Drive Ready and Access Ready.

4-50. LOAD SWITCH.

4-51. The LOAD/UNLOAD switch indicates the operational status of the disc drive. In the UNLOAD position the drive motor and circuitry are not activated and in the LOAD position, the drive motor and circuitry are activated.

4-52. SPINDLE MOTOR CONTROL LOGIC.

4-53. The spindle motor control logic determines when and what power is applied to the spindle motor. This may be no power (off), ac to make the motor run, or dc to make the motor brake.

4-54. To make the motor run requires that the LOAD/UNLOAD switch be in the LOAD position, that all interlocks are clear, that the carriage is retracted, and that the brake relay is open. Once the motor has started, it will continue to run until the LOAD/UNLOAD switch is in the UNLOAD position or one of the interlocks are set, regardless of the state of the other conditions.

4-55. When the switch is in the UNLOAD position, ac power is removed from the motor. After the carriage has retracted, the logic commands the brake relay to transfer the motor to the dc circuit. After a short time delay, which allows the contacts to settle, the dc circuit is turned on. When the speed-sense circuit indicates that the spindle has stopped, the dc is slowly turned off and after another time delay, the brake relay is allowed to return the motor to the ac circuit. If the LOAD/UNLOAD switch is set to LOAD while the motor is braking, the spin down sequence will continue until the spindle has completely stopped. Then the motor will start to run again.

4-56. MOTOR AND BRAKE CONTROL.

4-57. The motor and brake control implements the spindle motor control functions commanded by the spindle motor logic section.

4-58. A brake relay switches the motor windings to either the ac drive circuit or the dc drive circuit.

4-59. The ac drive circuit uses a zero-crossing detector which minimizes RF interference. The logic section energizes a relay which in turn controls the zero-crossing trigger circuit.

4-60. The dc circuit uses an emitter-follower to drive the motor from the +24 volt supply. An RC circuit on the emitter-follower input provides for gradual rise and fall of current in the motor.

4-61. OUTPUT DRIVERS AND GATING.

4-62. The output drivers and gating circuitry contain the gating and drivers for the status output lines. "Not" Drive Ready, "not" Access Ready, Sector Pulse, and Sector Compare are gated onto their respective lines whenever the disc drive is selected.

4-63. First Status, Seek Check, Data Protect, Override and Drive Unsafe are gated onto controller lines Inbus 0 through 4, respectively, whenever the disc drive is selected and "not" Outbus 7 is low.

4-64. Attention status appears on the inbus line corresponding to the disc drive address when "not" Outbus 6 is low.

4-65. STATUS LOGIC.

4-66. The status logic contains latch circuits for producing the status bits Attention, Seek Check and First Status.

4-67. Attention is set high everytime a seek has been completed and Access Ready comes high. It is cleared whenever a gate status command is received or when "not" Set Cylinder goes low. The I/O must request Attention by making "not" Outbus 6 go low.

4-68. Seek Check comes high whenever the computer tries to command an illegal cylinder or sector address or issues a seek command while the carriage is in motion. It is cleared whenever the next valid seek command is issued.

4-69. First Status is made high whenever the machine is loaded and "not" Drive Ready goes low. It is cleared at the end of a gate status command and remains low until the next time "not" Drive Ready goes high and then goes low.

4-70. DATA PROTECT LOGIC.

4-71. The data protect logic includes the front-panel operated surface protect function and the read/write fault interlocks. The surface protect function allows the operator to inhibit writing and erasing on the upper and/or lower discs to protect data already written. Surface protect is operated by two sliding switches located below the interchangeable disc cartridge, visible and accessible only when the disc drive door is open. When surface protect is in effect, the appropriate front panel indicator will be lit.

4-72. The read/write fault interlocks consist of sensing circuitry and logic to protect against hardware failures and software mistakes that could destroy data written on the discs. Seven illegal conditions are looked for, and any one condition will set one or more flip-flops on the read/write control assembly. When any flip-flop is set, the servo relay is de-energized. When this happens, the linear motor coil is switched to the +5 volt supply and the retract batteries through the carriage retracted switch. This causes the carriage to fully retract until the carriage retracted switch is transferred. During a drive fault retract condition with the power up, battery charge is conserved by decoupling the batteries from the +5 volt supply. This is accomplished by the diodes in series with the +5 volt supply and the battery. Whenever any flip-flop is set, a drive fault indicator on the front panel will illuminate. Test points on the read/write control assembly and indicators on the disc service unit permit checking the status of the flip-flops for determination of the fault condition. The illegal combinations are given in table 4-1; referenced test points are shown in figure 5-32.

Table 4-1. Read/Write Fault Conditions

ILLEGAL CONDITION	A10TP3	A10TP2	A10TP4
Straddle erase current flowing without an erase gate.	1	0	0
A write gate without straddle erase current.	0	1	0
Simultaneous read gate and erase gate.	1	1	0
More than one head selected at once.	0	0	1
A write gate without ac write current (data).	1	0	1
DC write current without a write gate.	0	1	1
An erase gate without an Access Ready signal.	1	1	1

4-73. Sensing circuits are located on the preamplifier assembly to detect erase current and multiple head select. Outputs from the preamplifier assembly go to sensing circuits on the read/write control assembly to detect ac and dc write currents.

4-74. There are three delays incorporated in the read/write interlocks to ensure legitimate fault conditions. The three propagation delays that are compensated for are:

- a. Erase Detect with respect to the positive-going edges of Erase Gate and Write Gate.
- b. AC Write Current with respect to the positive-going edge of Write Gate.
- c. DC Write Current with respect to the positive-going edge of Write Gate.

4-75. **FORMAT SWITCH.**

4-76. The format **OVERRIDE/PROTECT** switch is located on assembly A2 behind the front filter panel. The switch is used in conjunction with the HP 13210A Disc Drive Interface Kit to allow or prevent changing the address field of a sector.

4-77. **READ/WRITE CONTROL.**

4-78. The read/write control assembly receives the Read, Write, and Erase signals on the outbus lines. These commands are gated appropriately with unit select, control, and surface protect, so as to enable read (when the unit is selected and read is requested) and to enable write and erase (only when the unit is selected, the surface addressed is not protected and write and erase is requested) and to enable erase (only when the unit is selected; the surface addressed is not protected and erase is requested).

4-79. Both Write Data and Read Data pass between the drive controller and the read/write control assembly on a single transmission line pair. This line is terminated at the drive end by resistors on assembly A20 which plugs into the unused interface connector. On the read/write control assembly, the transmission line is connected to both a line driver and line receiver. During a selected write gate, the line receiver transfers data from the transmission line to the write toggle. During a selected read gate, the line driver transfers data from the zero crossing detector to the transmission line.

4-80. **READ/WRITE HEADS.**

4-81. There is one read/write head for each disc surface. Each head consists of a gapped ferrite core, mounted in a ceramic disc or shoe. The head is gimbaled and contoured to fly, supported by a thin cushion of air, over the surface of the disc. Electrically, each head consists of three coils, each with one end connected to a common point. Two of these coils are wound on the ferrite core and polarized in a manner that the common point acts as the center tap of a single coil. These two coils are used for both writing or reading data by producing or detecting magnetic flux across the gap in the ferrite head. The third coil is wound on a strap that straddles the ferrite head and is used to straddle erase. This erase strap produces two gaps, on either side and slightly behind the data gap. The straddle erase gaps are parallel to the direction of rotation of the disc while the data gap is normal to the direction of rotation. The straddle erase gaps apply a dc magnetic field to the disc to erase the edges of the data track during write operations. This provides an erased band between data tracks and prevents the head from seeing read data from the adjacent tracks (in case of small registration errors between the head and data track). The straddle erase winding is not used during the read operation.

4-82. **SELECT LOGIC.**

4-83. Head address data is taken from the head address register on the sector assembly. The data is then encoded on the read/write control assembly and sent to the four head switches on the preamplifier assembly. The four head switches provide a positive voltage to the common point of the selected head and maintain a negative voltage on the common points of the non-selected heads. The voltages bias switching diodes that connect the selected head to the read amplifier and write drivers.

4-84. READ AMPLIFIER/WRITE DRIVER.

4-85. The following are the primary functions of the pre-amplifier assembly. With a Write Enable command from the read/write control assembly, a precise write current source is turned on and field-effect transistor (FET) switches turn off the input to the read preamplifier. The write data comes from the read/write control assembly on two complementary lines, each controlling a switching transistor which connects the current source through switching diodes to one winding of the selected head. With each clock or data bit, the write data lines toggle, turning off one head winding and turning on the other. Current is directed from the common point, through the winding, head switching diodes, write switching transistor, and write current source to the negative supply. Another switching transistor lowers the write current source by about 20 percent for cylinders greater

than 127. This optimizes the write characteristics over the disc. When write enable is low, the preamplifier is connected to the selected head by the FET switches and the head select diodes.

4-86. The write driver is isolated by back-biased diodes. The read amplifier consists of totally balanced differential circuitry. It includes a preamplifier, a fourth-order low-pass filter, a differentiator, and a buffer-amplifier. The filter attenuates noise and higher harmonic components and the differentiator converts the data from representative peaks to representative zero crossings. The output of the buffer amplifier goes to the zero crossing detector on the read/write control board. The zero crossing detector uses two comparators, phased oppositely across the input. The positive-going transitions at each comparator are gated and added, forming the output data.

SIGNAL LINE	FUNCTION
Set Cylinder	This pulse samples Outbus 0 thru 7 for a new cylinder address. The address is stored in a register within the disc drive, and movement of the carriage to the new location is started. This movement is called a seek. See figure 15 for timing diagram.
Outbus 0	This part of the cylinder address is stored in a register within the disc drive by Set Cylinder. This part of the head address is stored in a register within the disc drive by Set Head. This is part of the memory control. This signal must be maintained by the disc drive controller during the entire memory operation.
Outbus 1	This part of the cylinder address is stored in a register within the disc drive by Set Cylinder. This part of the head address is stored in a register within the disc drive by Set Head. This is part of the memory control. This signal must be maintained by the disc drive controller during the entire memory operation.
Outbus 2	This part of the cylinder address is stored in a register within the disc drive by Set Cylinder. This is part of the memory control. This signal must be maintained by the disc drive controller during the entire memory operation.
Outbus 3	This part of the cylinder address is stored in a register within the disc drive by Set Cylinder. This part of the sector address is stored in a register within the disc drive by Set Head.
Outbus 4	This part of the cylinder address is stored in a register within the disc drive by Set Cylinder. This part of the sector address is stored in a register within the disc drive by Set Head.
Outbus 5	This part of the cylinder address is stored in a register within the disc drive by Set Cylinder. This part of the sector address is stored in a register within the disc drive by Set Head. Enables the Attention status bits of all four disc drives to appear on Inbus 0 thru 3 lines.
Outbus 6	This part of the cylinder address is stored in a register within the disc drive by Set Cylinder. This part of the sector address is stored in a register within the disc drive by Set Head. Enables the First Status, Seek Check, Surface Disable, +5V, and Drive Unsafe status bits of the currently addressed disc drive to appear on Inbus 0 thru 4 lines, respectively.
Outbus 7	This part of the cylinder address is stored in a register within the disc drive by Set Cylinder. This part of the sector address is stored in a register within the disc drive by Set Head. Enables the First Status, Seek Check, Surface Disable, +5V, and Drive Unsafe status bits of the currently addressed disc drive to appear on Inbus 0 thru 4 lines, respectively.
Select 1	Most significant bit of the drive address.
Select 2	Least significant bit of the drive address.
	These two lines contain the binary-coded logical address of a disc drive. Each one of the four disc drives decodes the address. Only the addressed disc drive will respond to commands and return status. These signals are levels, not pulses, and must be maintained during the entire disc drive operation.
Set Head	This pulse samples Outbus 0 thru 7 for new head and sector addresses. The addresses are stored in a register within the disc drive, and comparison of the new (desired) sector address with the current sector position of the disc drive is started. See figure 15 for timing diagram.
Control	This line enables the memory function specified by Outbus 0, Outbus 1, and Outbus 2. The Control signal must remain false during the entire data transfer. If Outbus 7 is low when Control is low, then the Attention flip-flop (see below) on the currently addressed disc drive will be cleared.
R/W Data 1 R/W Data 2	These two lines constitute a bi-directional differential pair of signal lines (figure 16, sketch C). The signal transferred in either direction is a combination of data multiplexed with a data recovery clock.
Attention	This status signal becomes high when a seek (head movement to new position) is successfully completed. It is cleared by: CONTROL + OUTBUS 7 + DRIVE ADDRESS (Select 1 and 2 decoded). This signal appears on Inbus 0, 1, 2, or 3 when Outbus 6 is high.
First Status	This status bit only becomes high when Drive Ready changes from false to true. It becomes false when Attention is cleared (refer to Attention above). This signal appears on the Inbus 0 line of the addressed disc drive when Outbus 7 is high.
Seek Check	This status bit indicates that an illegal addressing function was attempted. The illegal functions which make it high are: 1. Cylinder address ≥ 203 . 2. Sector address ≥ 24 . 3. A seek was attempted while another seek was still in progress. The status bit is cleared by a seek home operation. This signal appears on the Inbus 1 line of the addressed disc drive when Outbus 7 is low.

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SIGNAL LINE	FUNCTION
Drive Unsafe	This status bit shows that it is not safe to use the disc. It is high if an illegal memory operation was attempted, or if some of the read/write circuitry failed, or if a seek operation did not finish within 850 milliseconds. The disc drive cannot be used until this condition is cleared. It is cleared by turning off the spindle motor (LOAD/UNLOAD switch on front panel) or by connecting the disc service unit which will analyze the error condition. This signal appears on the Inbus 4 line of the addressed disc drive when Outbus 7 is low.
Data Protect	This bit indicates the status of the write protect switches on the front panel of the disc drive. It is high if the surface selected by the head address is protected against writing; it is low if the surface is not protected. This signal appears on the Inbus 2 line of the addressed disc drive when Outbus 7 is low.
Format	When in the OVERRIDE position, this switch puts a low signal on Inbus 3. When the controller receives an Initialize Data command, it checks this line: if it is low, it executes the command; if it is high (i.e., switch in PROTECT position), the command channel flag is set and no attempt is made to execute the command.
Sector Pulse	A 24 microsecond pulse at the beginning of each sector. There are 24 pulses per revolution of the disc.
Sector Compare	This status bit shows the results of a continual comparison between the current sector position of the disc drive and the address held in the sector address register within the disc drive (refer to Set Head above). It can be interpreted in either of the following two ways: 1. It is high during the sector before the addressed sector. 2. It is high during the addressed sector. It is low during the rest of the revolution of the disc.
Drive Ready	This status bit indicates that the disc is ready for use; i.e., the heads are over the discs and read/write operations can take place. It becomes low if any one of the conditions necessary for safe operation of the disc drive becomes low.
Access Ready	This status bit indicates that the heads are positioned over the desired cylinder. The address of this cylinder was previously stored in the cylinder address register within the disc drive by the Set Cylinder line. It becomes low with the leading edge of the Set Cylinder pulse, and it becomes high 3 milliseconds (head-settling time) after the new cylinder position is reached.
Inbus 0	= OUTBUS 6 • ATTENTION + OUTBUS 7 • FIRST SEEK • DRIVE ADDRESS (for disc drive 0) (Select 1 & 2 decoded)
Inbus 1	= OUTBUS 6 • ATTENTION + OUTBUS 7 • SEEK CHECK • DRIVE ADDRESS (for disc drive 1) (Select 1 & 2 decoded)
Inbus 2	= OUTBUS 6 • ATTENTION + OUTBUS 7 • SURFACE DISABLE • DRIVE ADDRESS (for disc drive 2) (Select 1 & 2 decoded)
Inbus 3	= OUTBUS 6 • ATTENTION + OUTBUS 7 • +5V • DRIVE ADDRESS (for disc drive 3) (Select 1 & 2 decoded)
+5V	This signal appears on the Inbus 3 line of the addressed disc drive when Outbus 7 is low.
Inbus 4	= OUTBUS 7 • DRIVE UNSAFE • DRIVE ADDRESS (Select 1 & 2 decoded)
Inbus 5	This status line indicates that only this disc drive has been selected.

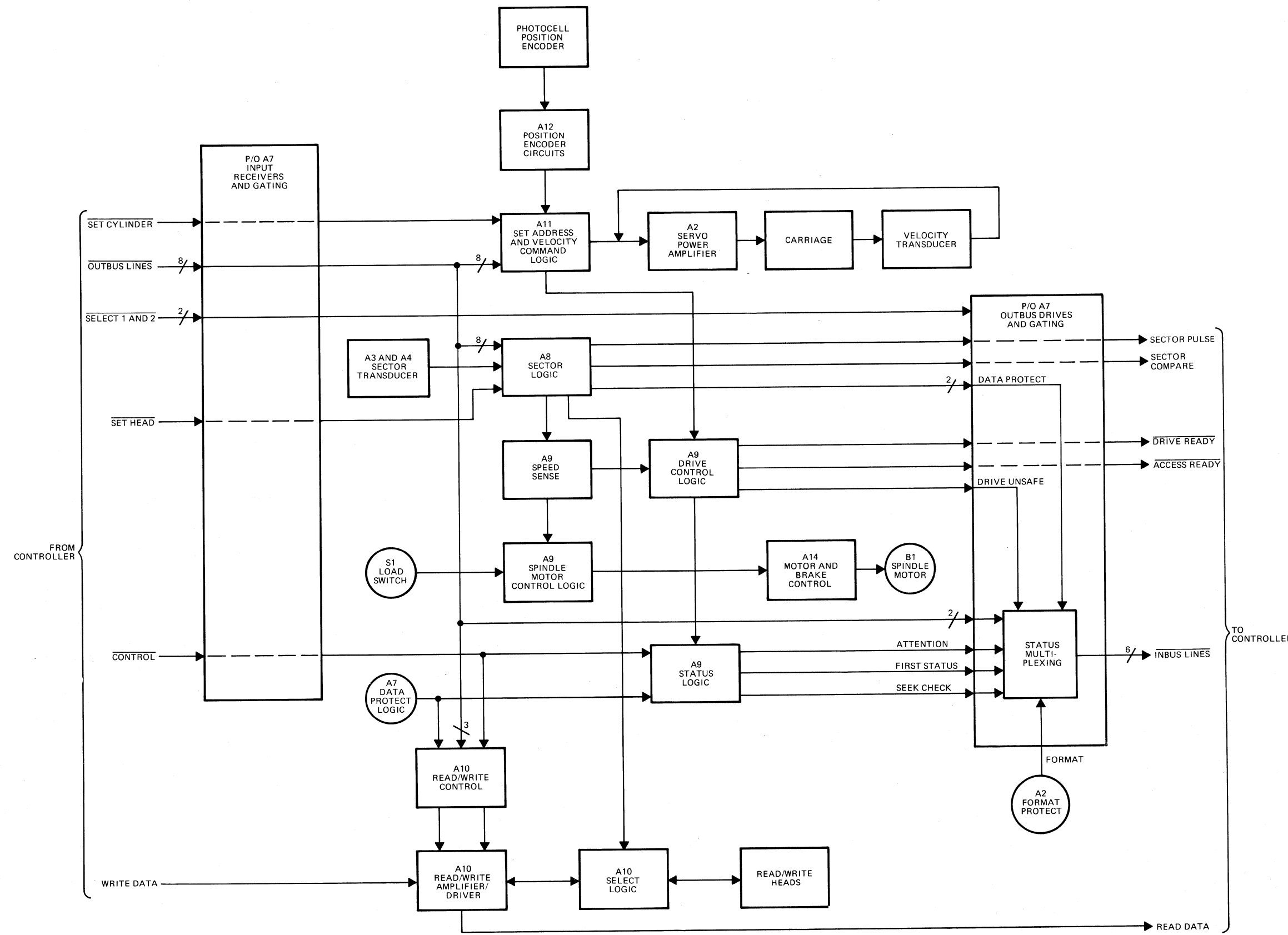


Figure 4-4. Overall Block Diagram

SECTION V

MAINTENANCE

5-1. INTRODUCTION.

5-2. This section contains disc drive preventive maintenance information, maintenance precautions, general repair information, a list of required test equipment, performance tests, adjustment procedures, troubleshooting information, parts lists, parts location diagrams, and schematic diagrams.

5-3. PREVENTIVE MAINTENANCE.

CAUTION

Disc drive cleanliness cannot be over-emphasized. The preventive maintenance schedule in table 5-1 gives the maximum time between intervals. Various user environments may require accelerated intervals to prevent catastrophic failures.

5-4. The disc drive is designed for a minimum of maintenance. Table 5-1 lists the schedules for periodic inspection and cleaning of the unit. When the disc drive is placed in a severe environment, a greater frequency of preventive maintenance may be required (an environment which has an unusual amount of dust, smoke, oil vapor, etc is considered severe). The paper in the absolute filter is normally white; it should be changed once a year in normal computer room environments; however, if it is observed to have discolored significantly (dark brown or gray), it should be changed immediately. To change the absolute filter proceed as follows:

- a. Set the LOAD/UNLOAD switch to the UNLOAD position and wait for DOOR UNLOCKED indicator to light. Remove drive power to the disc drive at the disc power supply by setting the disc power supply POWER switch to OFF.
- b. Remove the two screws on the side of the absolute filter. Remove the front and rear filter clamps.
- c. Remove the locknuts on the rear of the absolute filter. Remove the filter bracket.
- d. Remove the absolute filter.
- e. Install a new absolute filter (part no. 3150-0225).
- f. Restore the filter bracket and finger tighten the locknuts.
- g. Restore the front and rear filter clamps and moderately tighten the two side screws.
- h. Tighten all locknuts and screws.

CAUTION

Do not remove the disc drive top and bottom covers in severe environments. An environment free of dust, smoke, oil vapor, etc is necessary to protect against internal disc drive contamination when the covers are removed.

Do not run the disc drive for extended periods without the front filter as this will put an abnormal load on the absolute filter. Also, do not run the disc drive without an absolute filter as severe head-disc interference may result.

5-5. INSPECTION.

5-6. A bi-monthly inspection for contamination, wear, damage, looseness, malfunction, missing parts, and power supply voltages should be performed on the following assemblies:

- a. Inspect read/write heads for contamination and damage.
- b. Inspect carriage rails and bearings for contamination, wear, and damage.
- c. Inspect encoder plate for contamination and wear.
- d. Inspect spindle and linear motor for contamination and looseness.
- e. Inspect front door filter for contamination.
- f. Inspect front door for contamination.
- g. Inspect absolute filter for contamination and possible replacement.
- h. Inspect casting and cartridge receiver for contamination and damage.
- i. Inspect drive belt for wear and possible replacement.
- j. Inspect all hardware for looseness or missing parts.
- k. Inspect cables and connectors for damage or looseness.
- l. Inspect spindle discharge contact for looseness.
- m. Check voltages from power supply for correctness.

Table 5-1. Preventive Maintenance Schedule

ITEM	SCHEDULE		
	2 MONTHS	6 MONTHS	12 MONTHS
Read/write heads	Clean with Kimwipes and filtered 91% isopropyl alcohol. (Refer to paragraph 5-12.)		
Carriage rails	a. Clean with Q-tips and filtered 91% isopropyl alcohol. (Refer to paragraph 5-14.) b. Inspect bearings for wear and ease of rotation. (Refer to paragraph 5-14.)		
Encode plate	Clean with Q-tips and filtered 91% isopropyl alcohol. (Refer to paragraph 5-16.)		
Spindle	a. Clean with masking tape by pressing sticky side to exposed surface. (Refer to paragraph 5-22.) b. Inspect bearings for wear and ease of rotation. (Refer to paragraph 5-22.)		
Linear motor	Clean with masking tape by pressing sticky side to exposed portion of coil. (Refer to paragraph 5-22.)		
Front door filter	Clean with vacuum cleaner. (Refer to paragraph 5-18.)		
Casting and cartridge receiver	Clean with Kimwipes and filtered 91% isopropyl alcohol. (Refer to paragraph 5-24.)		
Drive belt	Inspect for wear and possible replacement.		
Power Supply	Check output voltages. Adjust if necessary.		
Alignment of all adjustable parameters	Check and adjust if necessary. (Refer to paragraph 5-35.)		
Absolute filter	Inspect for contamination. Replace if dirty. (Refer to paragraph 5-4.)	Replace.	
Lower disc assembly		Remove and clean with Kimwipes and filtered 91% isopropyl alcohol. (Refer to paragraph 5-12.)	
Static discharge contact	Inspect for looseness.		Replace.

- n. Inspect door guide rails for wear and damage.
- o. Inspect lamps and switches for proper operation.

5-7. Periodic checks should be made on the overall filter system effectiveness. To check the effectiveness, proceed as follows:

- a. Turn on disc drive power supply; the disc drive DRIVE POWER lamp should turn on.
- b. Set the disc drive LOAD/UNLOAD switch to the UNLOAD position. The DRIVE READY lamp should be off.
- c. Wait for the DOOR UNLOCKED indicator to light and open the disc drive front door.
- d. Remove the disc cartridge and check for a positive discharge of air from the front left side of the disc drive.
- e. If no air flow can be felt (especially over the duct on the left hand bottom side of the receiver), clean the front filter and replace the absolute filter.

5-8. CLEANING.

5-9. Cleaning should be performed bi-monthly or whenever an inspection procedure (paragraph 5-6) uncovers disc drive contamination.

5-10. The disc drive should be kept free of dust, moisture, grease, and foreign matter to ensure trouble-free operation.

5-11. Required cleaning materials include Kimwipe tissues and filtered 91 percent isopropyl alcohol, part no. 1535-1432.

CAUTION

Do not substitute any other brand of tissue since many contain contaminating oils and leave a residue that may cause damage. Also, do not substitute any other type of alcohol since many types contain impurities.

5-12. READ/WRITE HEADS AND LOWER DISC ASSEMBLY. Kimwipe tissues, a head cleaning tool, filtered 91 percent isopropyl alcohol, and an inspection mirror are required for cleaning the heads.

5-13. To clean the read/write heads, proceed as follows:

- a. Set the LOAD/UNLOAD switch to the UNLOAD position. Wait for the DOOR UNLOCKED indicator to light and remove the disc cartridge. Remove drive power to the disc drive at the disc power supply by setting the disc power supply POWER switch to OFF.
- b. Remove the disc drive top cover and cartridge receiver. Remove the bottom cover section nearest the back of the disc drive. Remove the lower head access cover.
- c. Fold one Kimwipe tissue (Type 900-S) into a rectangle (approximately 1 by 5 inches) and wrap it over the

rounded edge of the head cleaning tool. A paper clip can be used to secure the Kimwipe to the tool for ease of handling. (See figure 5-1.)

CAUTION

Do not substitute any other brand of tissue since many contain contaminating oils and leave a residue that may cause head damage.

d. Dampen (do not saturate) the Kimwipe with the filtered 91 percent isopropyl alcohol, part no. 1535-1432.

CAUTION

In making finger contact with the head and head assembly, note that the head shoes are mounted on fragile gimbals and that excessive force can cause damage to the heads.

Do not attempt to move the carriage assembly since the heads will mechanically load, resulting in disc and/or head damage.

e. Clean the upper pair of heads first. This is accomplished by placing the tissue-covered tool between the head pair and gently wiping the head surfaces. Use the inspection mirror to confirm that all signs of oxide contamination are removed.

f. Remove the lower disc assembly (6-month intervals only).

g. Clean the recording surfaces using Kimwipes and filtered 91 percent isopropyl alcohol. While spinning the disc assembly, wipe the surfaces from the inside to the outside edge.

h. Clean the lower pair of heads from the bottom of the disc drive. The procedure is the same as in step e. When cleaning heads with lower disc assembly installed, care must be taken when inserting the spoon between the heads due to the limited working space available.

i. Replace the lower disc assembly.

j. When the heads have been cleaned, remove all cleaning tools and replace cartridge receiver, disc drive top, bottom, and access covers. Ensure the rubber apron on bottom of receiver hangs freely.

k. Restore the disc drive to operational status.

5-14. CARRIAGE RAILS AND BEARINGS. The required carriage rails and bearings cleaning materials include Kimwipe tissues and filtered 91 percent isopropyl alcohol.

5-15. To clean the carriage rails, proceed as follows:

- a. Set the LOAD/UNLOAD switch to the UNLOAD position. Wait for DOOR UNLOCKED indicator to light and remove the disc cartridge. Remove drive power to the disc drive at the disc power supply by setting the disc power supply POWER switch to OFF.

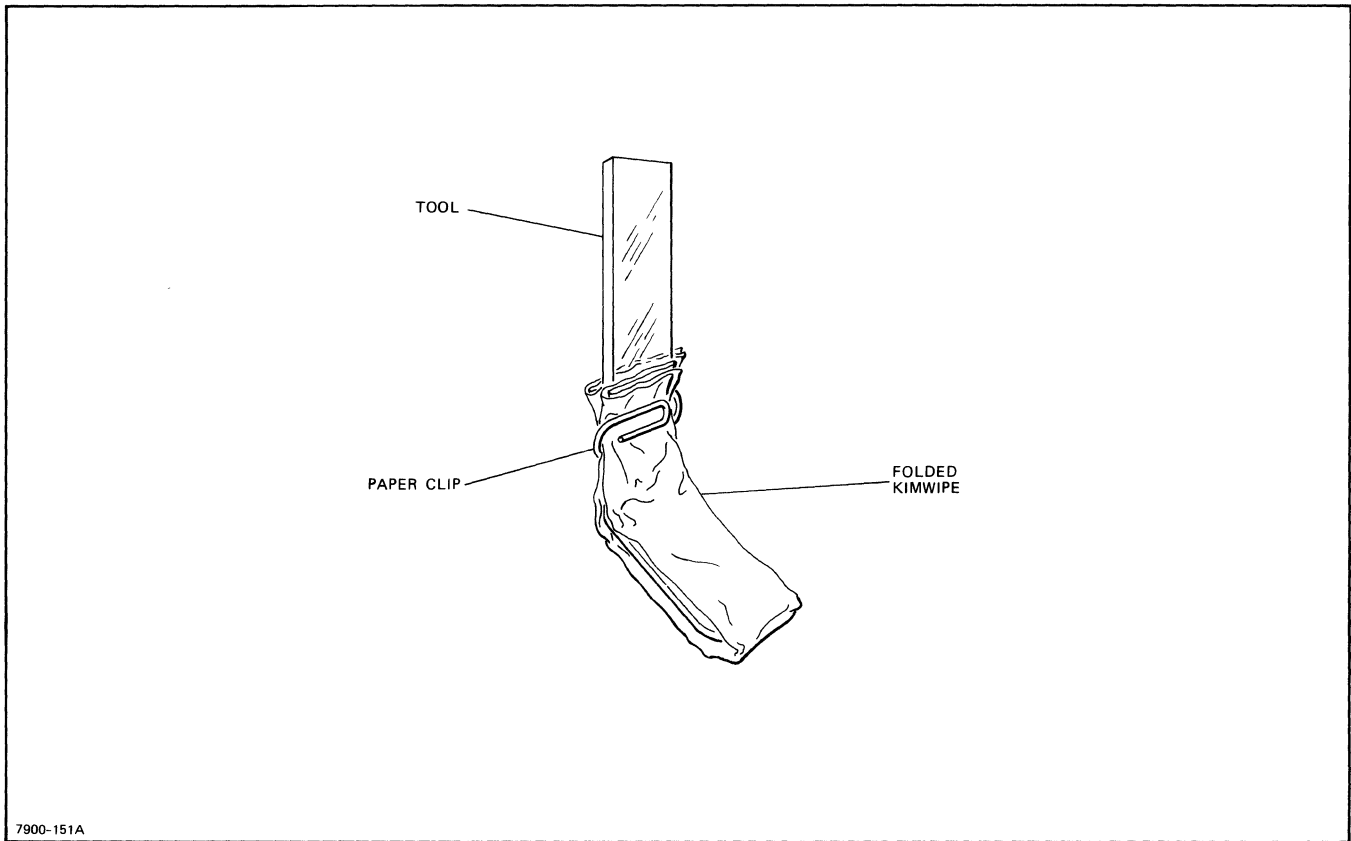


Figure 5-1. Head Cleaning Tool

b. Remove the disc drive top cover and cartridge receiver.

CAUTION

Care must be taken not to saturate bearings. Excessive alcohol may damage the lubrication pack.

c. Dampen the Kimwipe tissue with alcohol and clean carriage rails and bearings.

d. Replace the cartridge receiver and disc drive top. Ensure that rubber apron on bottom of receiver hangs freely.

e. Restore the disc drive to operational status.

5-16. **ENCODER PLATE.** The required encoder plate cleaning materials include Kimwipe tissues and filtered 91 percent isopropyl alcohol.

5-17. To clean the encoder plate proceed as follows:

a. Set the LOAD/UNLOAD switch to the UNLOAD position. Wait for DOOR UNLOCKED indicator to light and remove the disc cartridge. Remove drive power to the disc drive at the disc power supply by setting the disc power supply POWER switch to OFF.

b. Remove the disc drive top cover and cartridge receiver.

CAUTION

Exercise caution when cleaning. Excessive pressure may cause the glass to break.

c. Dampen a tissue and clean the glass encoder plate.

d. Replace the cartridge receiver and disc drive top.

e. Restore the disc drive to operational status.

5-18. **FRONT DOOR FILTER.** The only required front door filter cleaning material is a vacuum cleaner.

5-19. To clean the front door filter proceed as follows:

a. Set the LOAD/UNLOAD switch to the UNLOAD position and wait for DOOR UNLOCKED indicator to light. Remove drive power to the disc drive at the disc power supply by setting the disc power supply POWER switch to OFF.

b. Press in on the front door filter from either the upper left or right sides. The front door filter should pop out on the opposite side pressed. Remove panel.

c. Remove the front door filter from the disc drive area before further cleaning.

d. Vacuum off any exterior dust particles on the front door filter.

e. Remove the foam plastic filter from the panel and vacuum the panel to remove any dust wedges between the intake holes.

f. Vacuum the foam plastic filter material of any exterior dust particles.

g. Connect the vacuum to a blower and blow out and away from the filter any dust particles. Do not blow dust through the plastic filter.

h. Return the foam plastic filter to the panel and install the front door filter in the disc drive.

i. Restore the disc drive to operational status.

5-20. FRONT DOOR ASSEMBLY. The required disc drive front door assembly cleaning materials include Kimwipe tissues and filtered 91 percent isopropyl alcohol.

5-21. To clean the disc drive and front door assembly, proceed as follows:

a. Set the LOAD/UNLOAD switch to the UNLOAD position. Wait for DOOR UNLOCKED indicator to light and remove the disc cartridge. Remove drive power to the disc drive at the disc power supply by setting the disc power supply POWER switch to OFF.

b. Remove the disc drive top cover, cartridge receiver, and bottom front cover.

CAUTION

Do not attempt to blow dirt from the disc drive. Contamination may be forced into the lower disc chamber.

c. Clean and vacuum the entire front casting and exposed enclosures to remove all foreign material.

d. Replace cartridge receiver and disc drive top and bottom front covers. Ensure that rubber apron on bottom of receiver hangs freely.

e. Clean front door window with a tissue dampened with alcohol.

f. Restore the disc drive to operational status.

5-22. SPINDLE AND LINEAR MOTOR. The required spindle and linear motor cleaning materials include one roll of one-inch masking tape.

5-23. To clean the spindle and linear motor, proceed as follows:

a. Set the LOAD/UNLOAD switch to the UNLOAD position. Wait for DOOR UNLOCKED indicator to light and remove the disc cartridge. Remove drive power to the disc drive at the disc power supply by setting the disc power supply POWER switch to OFF.

b. Remove the disc drive top cover and cartridge receiver.

c. Remove watches and rings from your hands.

d. Wrap two or three turns of tape around one hand (sticky side exposed).

e. Press the tape against all exposed magnetic areas of the spindle and exposed part of linear motor until all foreign particles are removed.

f. Place folded Kimwipe between upper heads.

g. Remove connector A2P5 on the servo amplifier assembly to disable the linear motor.

h. Set the LOAD/UNLOAD switch to LOAD and wait for the spindle to reach full speed.

CAUTION

Do not move the carriage manually until the spindle has reached full speed or damage to the lower heads and disc may result.

i. Manually move the carriage forward to inspect and clean remaining portions of the linear motor.

j. Manually return the carriage to the fully retracted position.

CAUTION

Ensure that the carriage is fully retracted before turning off spindle motor or damage to the lower heads and disc may result.

k. Set the LOAD/UNLOAD switch to UNLOAD and wait for the spindle to stop.

l. Re-install connector A2P5 on the servo amplifier assembly and remove Kimwipe from between upper heads.

m. Replace the cartridge receiver and disc drive top. Ensure that rubber apron on bottom of receiver hangs freely.

n. Restore the disc drive to operational status.

5-24. **CASTING AND CARTRIDGE RECEIVER.** The required casting and cartridge receiver cleaning materials include Kimwipe tissues and filtered 91 percent isopropyl alcohol.

5-25. To clean the casting and cartridge receiver, proceed as follows:

a. Set the LOAD/UNLOAD switch to the UNLOAD position. Wait for DOOR UNLOCKED indicator to light and remove the disc cartridge. Remove drive power to the disc drive at the disc power supply by setting the disc power supply POWER switch to OFF.

b. Remove the disc drive top cover and cartridge receiver.

c. Clean cartridge receiver with a tissue dampened with alcohol.

d. Clean exposed areas of casting with a tissue dampened with alcohol.

e. Replace the cartridge receiver and disc drive top. Ensure that rubber apron on bottom of receiver hangs freely.

f. Restore the disc drive to operational status.

5-26. MAINTENANCE PRECAUTIONS.

WARNING

This unit has dangerous line voltages present at various points within the chassis. Use extreme caution when working on the unit with the cover removed, or serious injury or death to personnel may result.

5-27. REPAIR INFORMATION.

5-28. The etched printed-circuit assemblies (PCA's) used in Hewlett-Packard equipment are the plated-through type consisting of metal bonded to both sides of an insulating material. The metallic conductors are extended through the component holes by a plating process. Soldering can be performed on either side of the PCA with equally good results. Table 5-2 lists recommended tools and materials for use in repairing etched PCA's. Following are recommendations and precautions pertinent to PCA repair work.

a. Avoid unnecessary component substitution; it can result in damage to the PCA and/or adjacent components.

b. Do not use a high-power soldering iron on PCA's. Excessive heat may lift a conductor or damage the board.

CAUTION

Do not use a sharp metal object such as an awl or twist drill to remove solder. Sharp objects may damage the plated-through conductor.

Table 5-2. Printed-Circuit Assembly Repair Equipment

ITEM	USE	DESCRIPTION	RECOMMENDED MODEL
Soldering Tool	Soldering and unsoldering	Wattage rating: 47-1/2 to 56-1/2W Tip Temp: 850° to 900°F	Ungar #776 Handle with Ungar #4037 Heating Unit*
Soldering Tip*	Soldering and unsoldering	Shape: pointed	Ungar #PL111*
Suction Device	Removes molten solder from connection		Soldapullit by Edsyn Co., Arleta, California
Resin (Flux) Solvent	Removes excess flux from soldered area	Must not dissolve etched circuit base board material or conductor bonding agent	Freon Aceton Lacquer Thinner Isopropyl Alcohol (100% dry)
Solder	Component replacement, printed-circuit board repair, and wiring connections	Resin (flux) core, high tin content (60/40 tin/lead), 18 gauge (SWG) preferred	

*For working on etched boards; for general purpose work, use Ungar #1237 Heating Unit (37.5W, tip temp of 750° to 800°F) and Ungar #PL113 1/8-inch chisel tip.

c. Use a suction device (table 5-2) or wooden toothpick to remove solder from component mounting holes.

d. After soldering, remove excess flux from the solder areas and apply a protective coating to prevent contamination and corrosion.

5-29. The following procedures are recommended when component replacement is necessary:

a. Remove defective component from board.

b. If component was unsoldered, remove solder from mounting holes with a suction device (table 5-2) or a wooden toothpick.

c. Shape leads of replacement component to match mounting hole spacing.

d. Insert component leads into mounting holes and position component as original was positioned. Do not force leads into mounting holes; sharp lead ends may damage the plated-through conductor.

Note

Although not recommended when both sides of the PCA are accessible, axial lead components such as resistors and tubular capacitors can be replaced without unsoldering. Clip leads near body of defective component, remove component and straighten leads left in board. Wrap leads of replacement component one turn around original leads. Solder wrapped connection and clip off excess lead.

5-30. REQUIRED TOOLS AND TEST EQUIPMENT.

5-31. Table 5-3 lists tools and test equipment required to service the disc drive. Equivalent equipment may be substituted in each case.

5-32. PERFORMANCE TESTS.

5-33. After the disc drive has been installed and/or adjusted, turn the POWER switch (located on the disc power supply) to ON. The DRIVE POWER lamp will light (located on the disc drive front panel). Set the LOAD/UNLOAD switch to LOAD; the DRIVE READY lamp will light after a 30-second start-up.

5-34. Run the disc drive diagnostic software program to establish whether data read/write functions are operating properly. If the DRIVE FAULT lamp lights, or if the DRIVE POWER and DRIVE READY lamps fail to light, refer to the troubleshooting paragraph in this section.

5-35. ALIGNMENTS AND ADJUSTMENTS.

5-36. Prior to the performance of alignment and adjustment procedures, set the LOAD/UNLOAD switch to the UNLOAD position and wait for DOOR UNLOCKED indicator to light. Remove the disc cartridge. Remove drive power from the disc drive at the disc power supply by setting the disc power supply POWER switch to OFF.

5-37. Remove the disc drive top cover and cartridge receiver.

5-38. ENCODER PLATE CLEARANCE.

5-39. The encoder plate clearance adjustment is normally required if the encoder plate is replaced for maintenance purposes. To adjust the encoder plate clearance, proceed as follows:

CAUTION

Exercise caution when touching the encoder glass. Excessive pressure may cause the glass to break.

a. Loosen the encoder plate clamp screws. (See figure 5-2.)

b. Move the encoder glass away from the corner lip allowing the insertion of a 0.030-inch feeler gauge.

c. With the proper distance measured between the corner lip and the encoder plate, gently tighten the encoder plate clamp screws.

5-40. ENCODER CLEARANCE.

5-41. The encoder clearance adjustment is normally required if the encoder assembly or encoder plate is replaced or moved for maintenance purposes. To adjust the encoder clearance, proceed as follows:

a. Disable disc drive cartridge-in-place switch S5 and door closed switch S6.

b. Place a folded Kimwipe between the upper heads.

c. Disable the linear motor by removing connector A2P5 on the servo amplifier assembly.

CAUTION

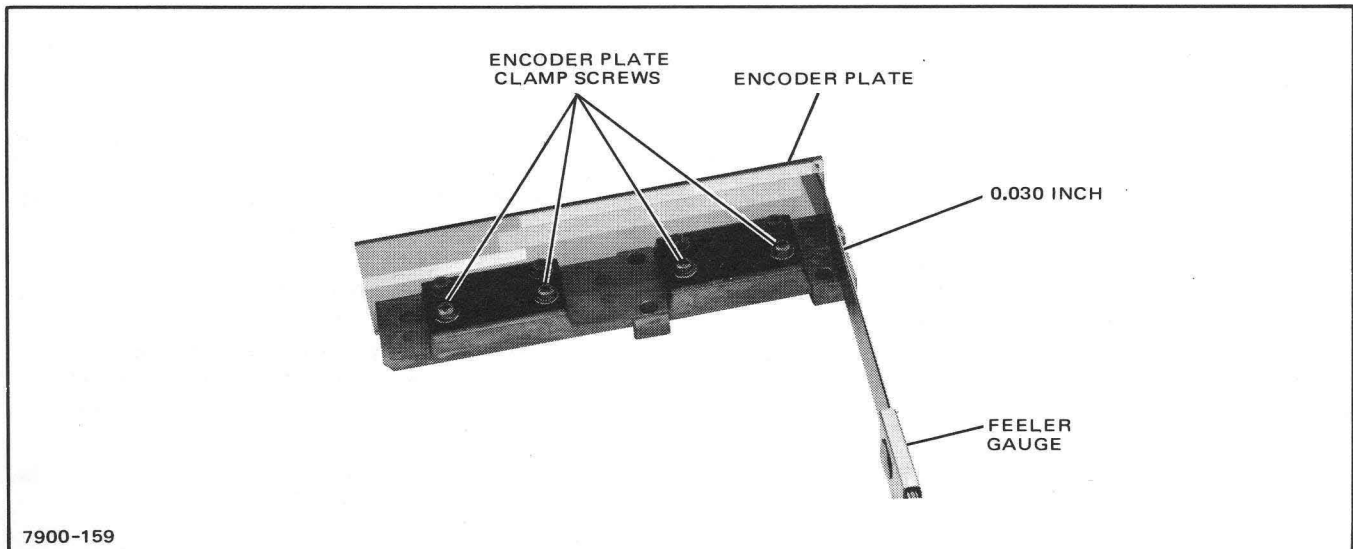
To prevent the lower heads from contacting and damaging the disc surface, the disc drive speed must always be up while the carriage is extended.

d. Turn on the disc power supply and set the disc drive LOAD/UNLOAD switch to LOAD.

e. Wait for the spindle to reach maximum speed (about 30 seconds).

Table 5-3. Required Tools and Test Equipment

TEST EQUIPMENT AND TOOLS	RECOMMENDED MODEL AND PART NUMBER
Oscilloscope	HP 180A
Dual Channel Vertical Amplifier	HP 1801A
Time Base	HP 1821A
Probe, 10:1 (Quantity 3)	HP 10006A
Probe, 1:1	HP 10008A
Current Probe Kit	HP 456A
Digital Voltmeter	HP 3439A
DC Multi-Function Plug-In	HP 3444A
Probe	HP 10025A
Disc Service Unit	HP 13219A
Diagnostic Program Tape	13041-60001
Extender Board	07900-60014
Alignment Cartridge	1535-0066 or 1535-2531
Head Adjustment Tool	07900-60044
Mylar Shim (0.005 Inch Thick)	1535-0861
Alcohol (6 oz. Bottle)	1535-1432
Head Cleaning Tool	07900-00091
Head Installation Tool (Quantity 2)	1460-1334, -1333
Kimwipe Tissues (Type 900-S)	9300-0001
STANDARD TOOL KIT	
Posidrive Screw Driver	(Stanley 2951)
Posidrive Screw Driver	(Stanley 2952)
Long Nose Pliers	(Xcelite 71CG)
Wire Cutters	(Xcelite 74CG)
Screw Driver 4 x 1/4 Inch	(Xcelite R-144)
Screw Driver 4 x 1/8 Inch	(Xcelite R-184)
Wire Stripper	(K-Miller 101-S)
6 Inch Steel Rule	(General 616)
Soldering Iron	(Ungar 6010)
Inspection Mirror	(G.C. Electric 5090-P)
IC Pin Clip	(A-P, Inc.)
Socket Keys	(Xcelite 99PS-40)



7900-159

Figure 5-2. Encoder Plate Adjustment

f. Manually extend the carriage and ensure that the clearance between the encoder plate and the reticle is between 0.005 and 0.008 inch at both ends of travel. If this is not met, the encoder mounting screws must be loosened and encoder housing moved. (See figure 5-3.)

CAUTION

When checking or adjusting the encoder clearance, use non-metallic feeler gauge to avoid scratching the encoder glass.

g. Perform the Encoder Parallelism Adjustment procedure starting with step "d."

5-42. ENCODER PARALLELISM ADJUSTMENT.

5-43. This procedure is normally required only if the encoder assembly is replaced or moved for maintenance purposes.

a. Disable cartridge-in-place interlock switch S5 and door closed switch S6.

b. Place folded Kimwipe between the upper heads.

c. Disable the linear motor by removing connector A2P5 on the servo amplifier assembly.

d. Connect the oscilloscope to the in-phase (A channel) amplifier output on the encoder assembly (A12TP5).

CAUTION

To prevent the lower heads from contacting and damaging the disc surface, speed must always be up while the carriage is extended.

e. Loosen the encoder locking screw (Allen head). (See figure 5-3.)

f. Turn on the disc power supply and set the disc drive LOAD/UNLOAD switch to LOAD.

g. Wait for disc drive to reach maximum speed (about 30 seconds).

h. Manually exercise the carriage and adjust the encoder parallelism adjusting screw for maximum peak-to-peak amplitude output. (See figure 5-3.)

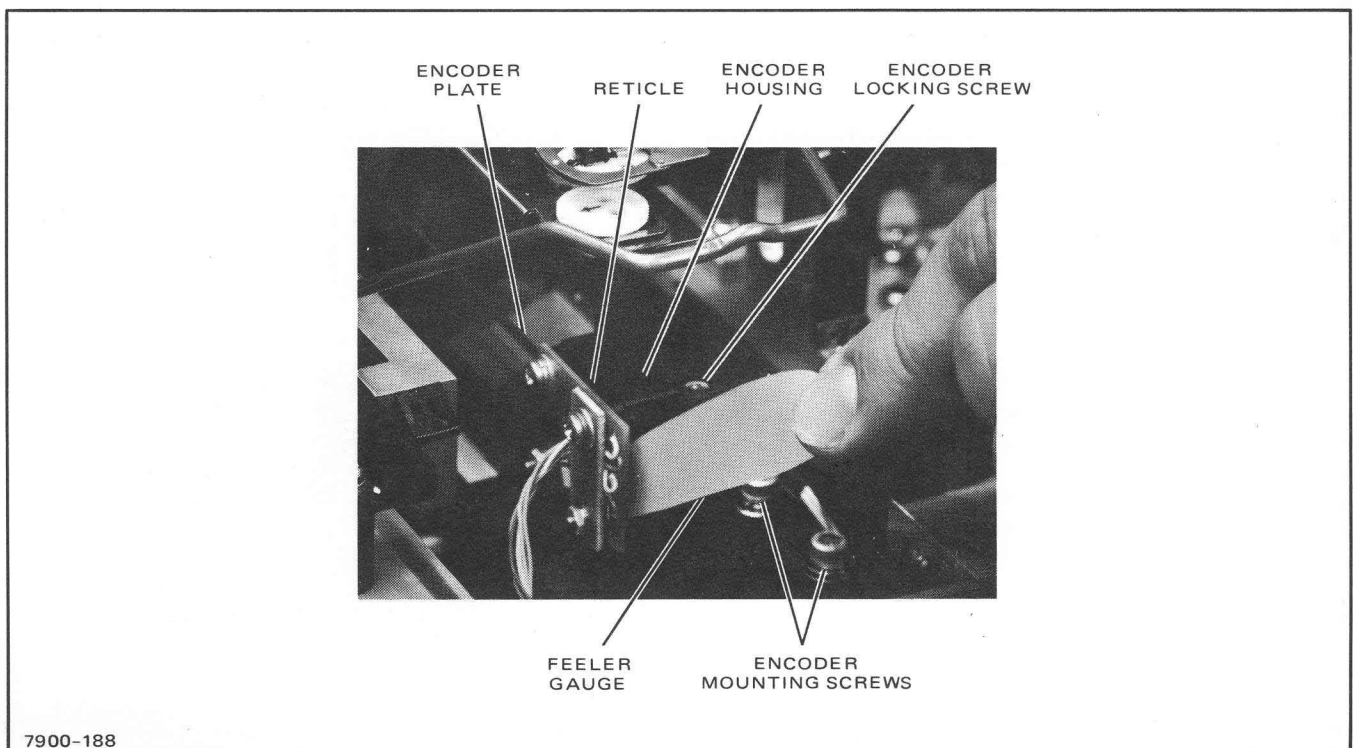
i. Observe the shape of the waveform. The waveform should be almost triangular with little rounding of the peak, as shown in figure 5-4.

Note

At this point, the reticle mask marks are parallel to the encoder cylinder marks.

j. Tighten encoder locking screw and recheck.

k. Perform the encoder alignment procedure starting with step "e."



7900-188

Figure 5-3. Encoder Clearance Adjustment

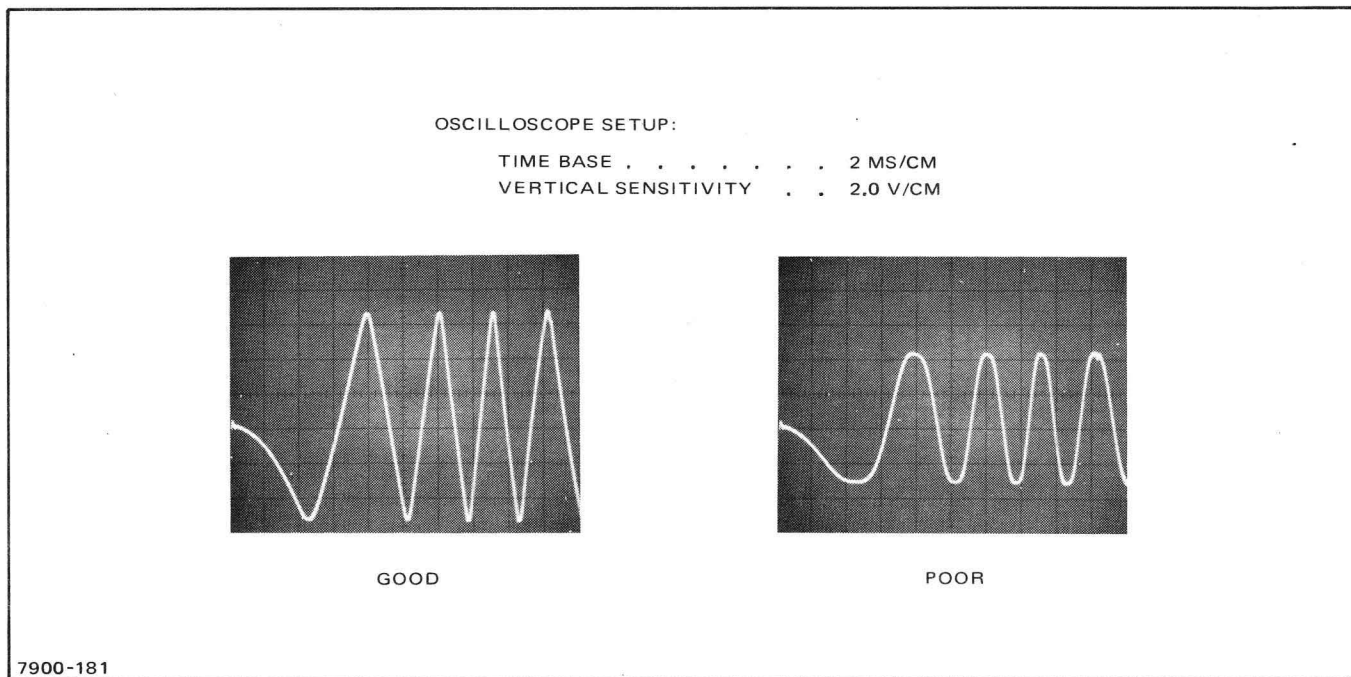


Figure 5-4. Encoder Parallelism Adjustment Waveforms

5-44. ENCODER ALIGNMENT.

5-45. To align the encoder, proceed as follows:

a. Disable the linear motor by removing connector A2P5 on the servo amplifier assembly and place folded Kimwipe between upper heads. Disable cartridge-in-place switch S5 and door closed switch S6.

CAUTION

To prevent the heads from contacting and damaging the disc surface, speed must always be up while the carriage is extended.

b. Turn on disc power supply and set the LOAD/UNLOAD switch to LOAD.

c. Wait for disc drive to reach maximum speed.

d. Connect the oscilloscope to the encoder assembly channel A amplifier output (A12TP5).

e. Manually move the carriage back and forth while making the following adjustments:

- (1) Adjust the A GAIN variable resistor on encoder assembly A12 for $12 \pm 0.5V$ peak-to-peak output. (See figure 5-5.)
- (2) Adjust the A BAL variable resistor on encoder assembly A12 for an equal swing (± 0.5 volts) above and below 0 volts. (See waveform in figure 5-5.)

f. Set the C BAL variable resistor on encoder assembly A12 at midrange.

g. Set the VEL COM variable resistor on cylinder address assembly A11 fully counterclockwise; then advance it 1/4 turn clockwise.

h. Retract the carriage, set LOAD/UNLOAD switch to UNLOAD, and remove disc drive power.

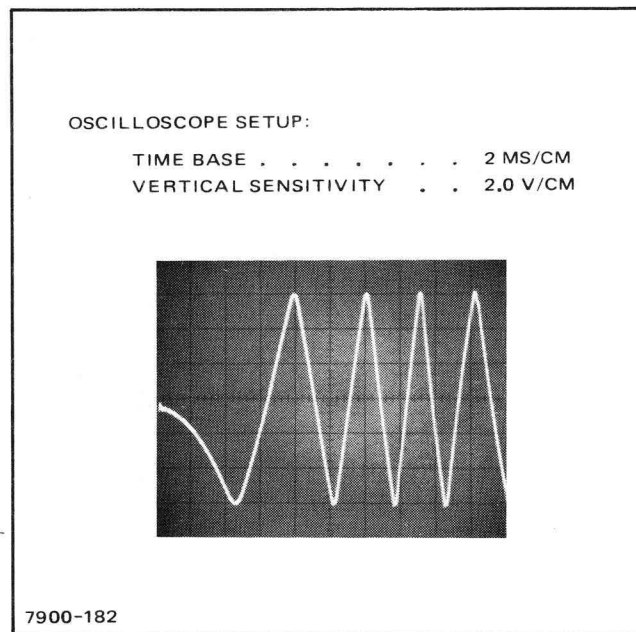


Figure 5-5. Encoder Gain Adjustment Waveform

- i. Connect the disc service unit. (Refer to Disc Service Unit Operating and Service Manual.)
- j. Reconnect COIL lead A2P5.
- k. Move servo amplifier power connector A2P6 to the TEST position (A2J7).

Note

Current is limited to the linear motor while in the TEST position, preventing possible damage to the motor during adjustments.

- l. Remove the carriage detent.
- m. Restore disc drive power.
- n. Ensure that the RESET DRIVE FAULT switch on the disc service unit is ON. Set the LOAD/UNLOAD switch to LOAD.

Note

After 30 seconds, the carriage will extend to the HOME position (cylinder 000).

- o. Connect the oscilloscope to the channel C amplifier output (A12TP3).

Oscilloscope Setup:

Time Base 10 ms/cm
Vertical Sensitivity 0.01 V/cm

- p. Adjust the C BAL variable resistor to obtain an oscilloscope deflection of 0 ± 0.1 volts.
- q. Using the disc service unit perform one-cylinder increment seeks to ensure that the cylinder addressing circuitry is functional.
- r. Set the LOAD/UNLOAD switch to UNLOAD and remove disc drive power.
- s. Reconnect A2P6 to the operate position. Remove Kimwipe from between upper head.
- t. Install the carriage detent, cartridge receiver, and a "scratch" disc cartridge.
- u. Restore disc drive power and set LOAD/UNLOAD switch to LOAD.
- v. Program the disc service unit to alternately seek between cylinder 000 and 202. (Refer to Disc Service Operating and Service Manual.)
- w. Connect the oscilloscope to the ACCESS READY test point on the disc service unit.
- x. Adjust the VEL CMND variable resistor on cylinder address assembly A11, such that the "not" Access Ready signal is low (0 volts) for 53 ± 2 milliseconds.
- y. Set the DRIVE OPERATION CONTROL on the disc service unit to ACCESS STOP.

- z. Set the LOAD/UNLOAD switch to UNLOAD and remove drive power.

5-46. HEAD ALIGNMENT.

- 5-47. To align the disc drive heads, proceed as follows:

- a. Turn on the disc power supply and set UP DISC PROTECT SWITCH S3 to PROTECT.

- b. Install the alignment disc cartridge (part number 1535-0066 or 1535-2531).

- c. Set the LOAD/UNLOAD switch to LOAD.

- d. Set the disc service unit to allow the disc drive to alternately seek between cylinders 000 and 128. The DELAY switch must be ON. (Refer to Disc Service Unit Operating and Service Manual.)

- e. Allow the disc drive to operate in this manner for approximately 25 minutes to stabilize disc drive temperature. The top cover of the disc drive must be on during this time.

- f. Using the disc service unit, position the carriage to cylinder 100 and select head 0.

- g. Connect the oscilloscope to TP2 on read/write pre-amplifier assembly A13.

- h. Connect the SYNC probe to upper disc index test point A8TP4.

- i. Set the RESET DRIVE FAULT switch on the disc service unit to ON.

- j. Loosen the locking screws holding the head in place. (See figure 5-6.)

- k. With alignment cartridge (part number 1535-0066) installed and using the head adjusting tool (figure 5-6), position the head to minimize amplitude modulation of the output signal. (See waveforms in figure 5-7.) If alignment cartridge (part number 1535-2531) is used, attach oscilloscope channel B to A8TP4. Adjust oscilloscope to obtain presentation shown in figure 5-8, channel B. Vary the time base vernier for index pulses at the beginning and end of trace. Connect the channel A probe to A13TP2. Using the head adjusting tool (figure 5-6), position the head to obtain the presentation shown in figure 5-8, channel A. The composite view shows the desired waveforms for both channels.

- l. Tighten the locking screw and ensure that the adjustment has not changed.

- m. Perform a seek to cylinder 95 and ensure that the circumferential adjustment waveform is present.

Note

If the waveform is not present, it is possible that the head was aligned to cylinder 105 instead of cylinder 100.

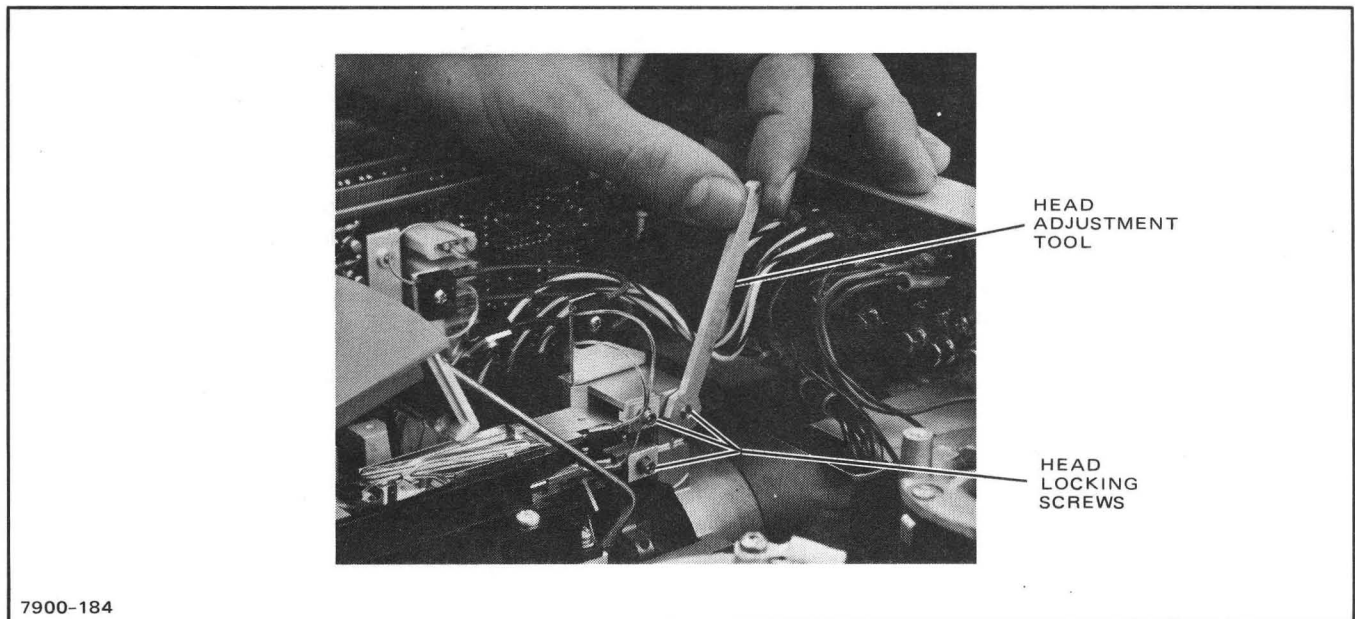


Figure 5-6. Head Alignment

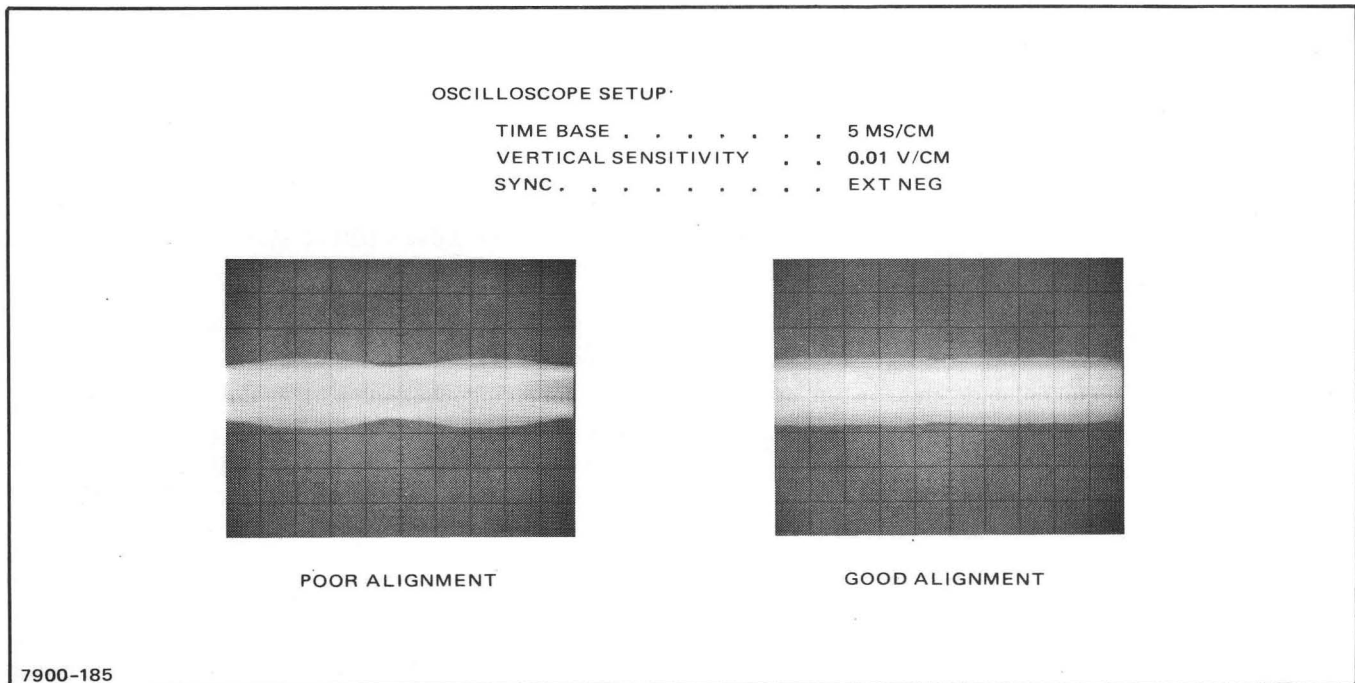


Figure 5-7. Head Alignment Waveforms (Using Alignment Cartridge, Part No. 1535-0066)

n. Using disc service unit, select head 1. (Refer to operating procedures in the Disc Service Unit Operating and Service Manual.)

o. Repeat steps "j" through "m" for head 1.

5-48. SECTOR CIRCUMFERENTIAL.

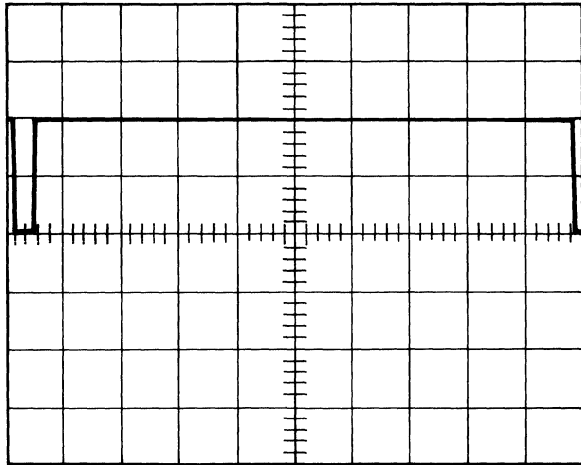
5-49. To adjust for minimum sector circumferential seek (or skew) proceed as follows:

5-12

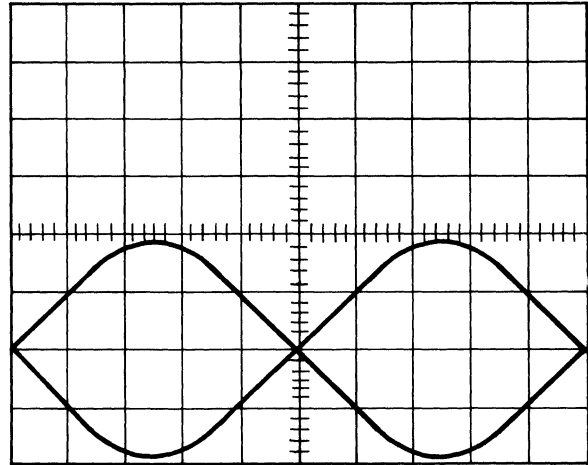
a. Using the disc service unit, position the carriage at cylinder 95 and select head 0.

b. Connect the oscilloscope to TP 2 of read/write pre-amplifier assembly A13.

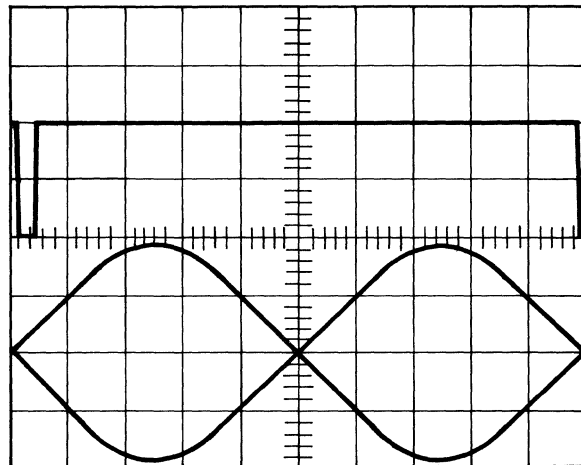
c. Connect the SYNC probe to upper disc index test point A8TP4.



INDEX PULSE
CHANNEL B



READ/WRITE PREAMPLIFIER
CHANNEL A



COMPOSITE VIEW
CHANNELS B AND A

OSCILLOSCOPE SET UP:

- TIME BASE 2 MS/CM (UNCALIBRATED)
- VERTICAL SENSITIVITY
- CHANNEL B 0.2 V/CM
- CHANNEL A 0.01 V/CM
- SYNC NEGATIVE, INTERNAL,
 CHANNEL B, CHOPPED

Figure 5-8. Head Alignment Waveforms (Using Alignment Cartridge, Part No. 1535-2531)

d. Adjust the sector position variable resistor A8R2 for a 20 μ s delay from the leading edge of index (beginning of sweep) to the first data pulse. When using alignment cartridge part number 1535-0066, observe the waveform as shown in figure 5-9. If alignment cartridge part number 1535-2531 is used, observe the waveform as shown in figure 5-10.

e. Select head 1.

f. When using alignment cartridge part number 1535-0066, observe the waveform in figure 5-9 and ensure that the first data pulse is present within $\pm 6 \mu$ s of the data pulse position in step d. If alignment cartridge part number 1535-2531 is used, observe the waveform in figure 5-10. Ensure that the first pulse of the data burst occurs within $\pm 6 \mu$ s of the data pulse position in step d.

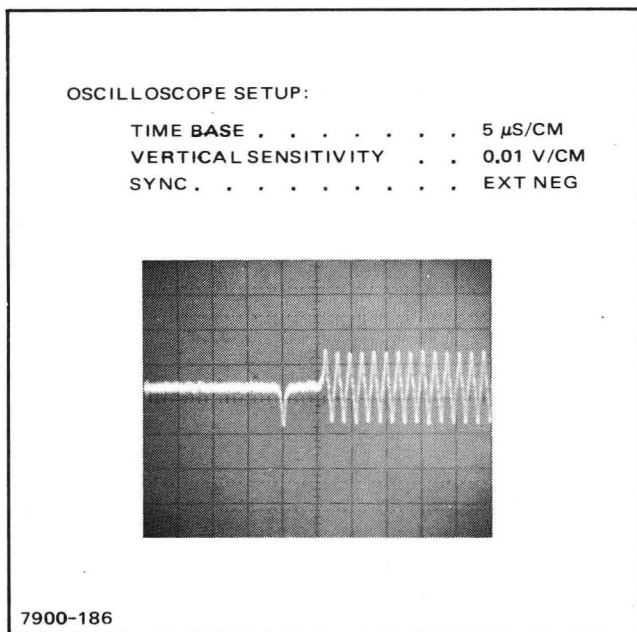


Figure 5-9. Sector Circumferential Adjustment Waveform (Using Alignment Cartridge, Part Number 1535-0066)

Note

If the above requirement is not met, care should be taken to ensure that the heads are properly seated in the carriage assembly.

g. Alternately select head 0 and 1. Adjust the sector position variable resistor A8R2 until the midpoint of the time difference between the two heads (as observed in steps d and f) occurs 20 microseconds from the beginning of the trace. For example, if head 0 is delayed 20 μ s and head 1 is 16 microseconds, then A8R2 would be adjusted until head 0 is delayed 22 μ s and head 1 is 18 μ s.

h. Remove any alignment tools and restore disc drive for operation.

5-50. CARRIAGE VERNIER ADJUSTMENT.

a. Loosen the two mounting screws for the position scale on the upper deck assembly.

b. Use the Disc Service Unit to position the carriage at cylinder 100.

c. Using a 0.005 inch thick mylar shim, adjust the gap between the carriage vernier and position scale to 0.005 +0.005 -0.001 inch.

d. Return the carriage to cylinder 000.

e. Adjust the position scale so that the line marked "0" aligns with the line marked "0" on the carriage vernier. Tighten the two mounting screws.

f. Use the Disc Service Unit to incrementally seek between 000 and 202 to verify that the position scale does not touch the vernier.

5-51. TROUBLESHOOTING.

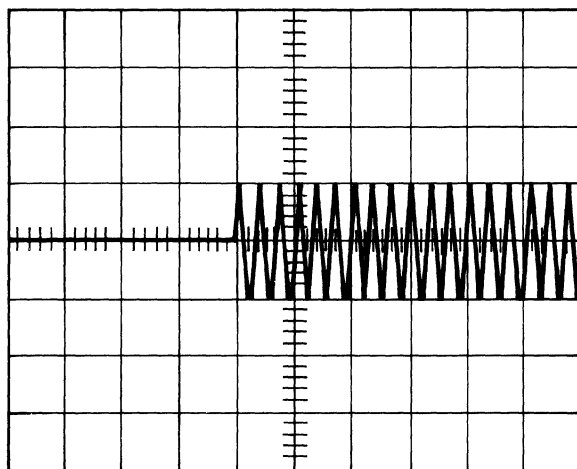
5-52. If the disc drive remains inoperative after being set in the LOAD position, check disc drive fuses F1 and F2.

5-53. The disc drive was designed with built-in read-write fault circuitry that tests the possible illegal combinations of latches and current conditions during read-write operations. These illegal combinations are given in table 4-1. Any one of these fault conditions will set the Read-Write Unsafe FF which terminates any operation in progress, retracts and unloads the heads, and illuminates the DRIVE FAULT indicator lamp on the front panel.

5-54. The other disc drive unsafe condition that can occur is if a seek operation did not finish within 850 milliseconds. If the condition occurs, the disc drive cannot be used until the condition is cleared. It is cleared by turning off the spindle motor (LOAD/UNLOAD switch on the front of the disc drive) or by utilizing the HP 13219A Disc Service Unit to further analyze the error condition.

5-55. The disc service unit is used to exercise the disc drive in an off-line mode of operation. The service unit has the following capabilities:

- Selecting any disc drive in a series of four or less.
- Displaying all status information.
- Displaying read-write fault information.
- Providing common disc drive test points.
- Performing seek operations:
 - At one cylinder increments.



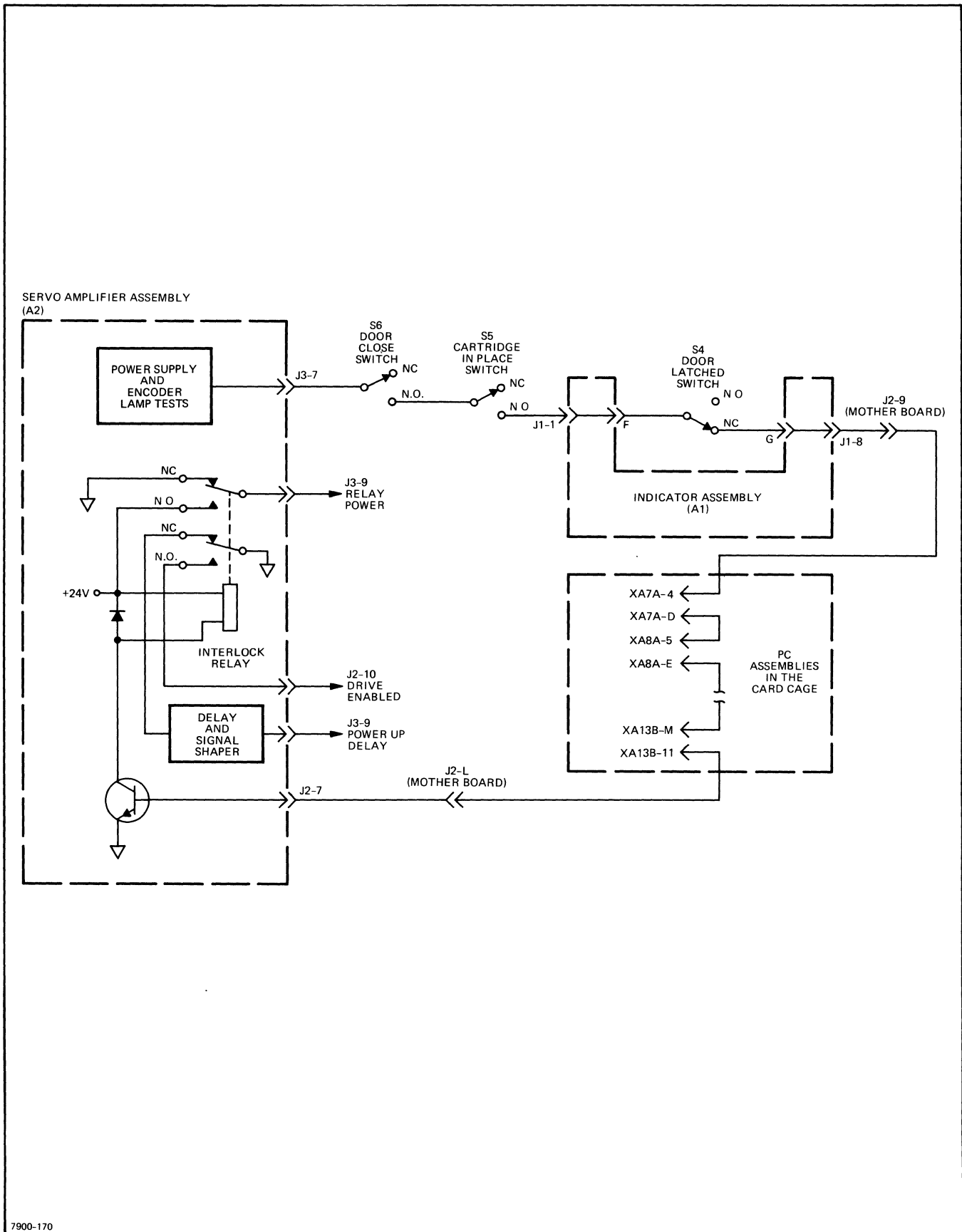
OSCILLOSCOPE SET UP:

TIME BASE 5 μ S/CM
 VERTICAL SENSITIVITY 0.01 V/CM
 SYNC EXT NEG

7900-US2

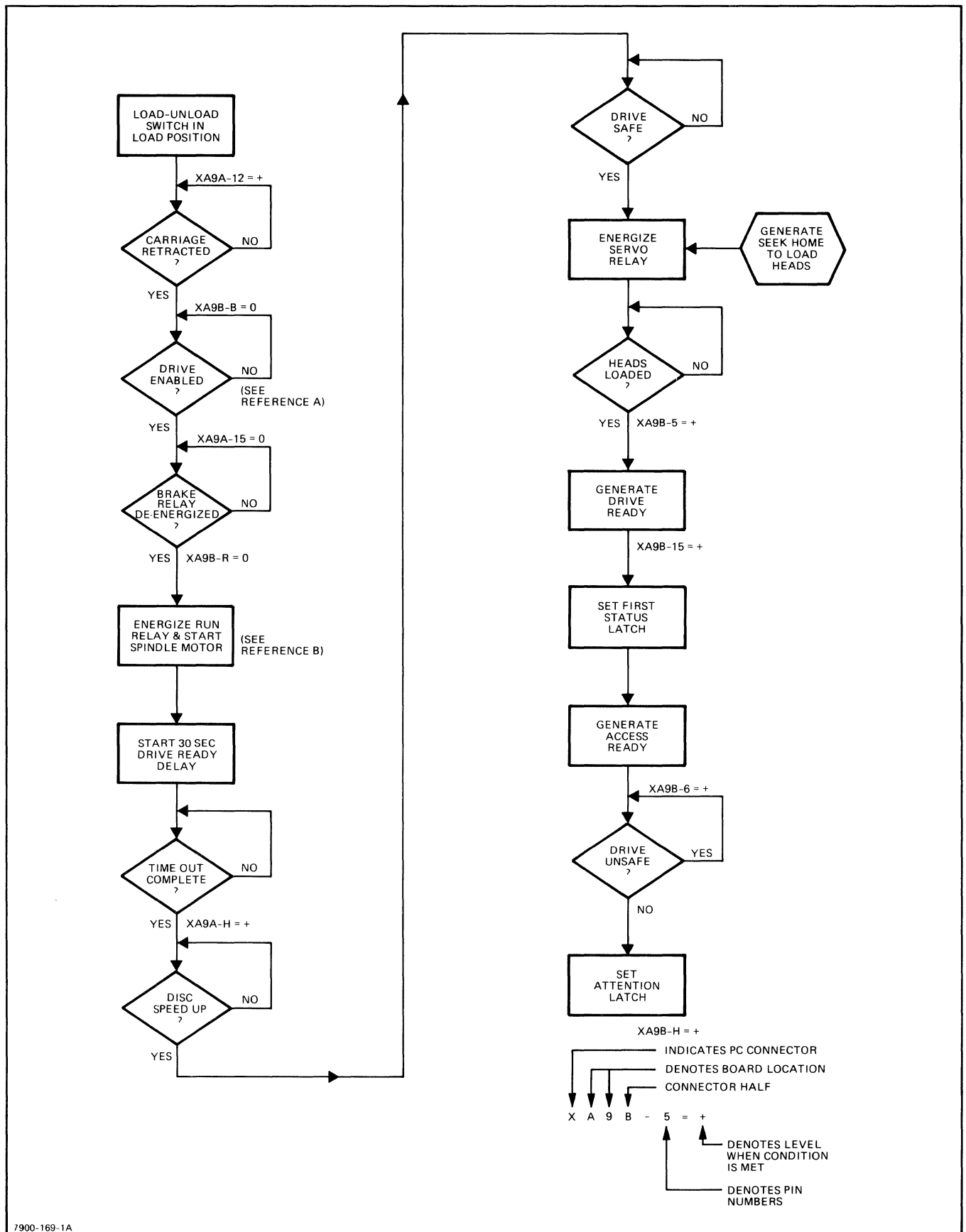
Figure 5-10. Sector Circumferential Adjustment Waveform
 (Using Alignment Cartridge, Part No. 1535-2531)

- (2) In single cycle operation.
 - (3) Alternately between any two cylinders.
 - (4) In single cycle operation with the servo inhibited.
- f. Selecting any head and sector address.
 - g. Displaying head/sector address.
 - h. Displaying the difference between desired cylinder address and actual carriage position.
 - i. Performing a restore home operation.
- 5-56. When using the disc service unit to troubleshoot the disc drive, refer to the Disc Service Unit Operating and Service Manual and the flow charts in figure 5-11. Also refer to the diagnostic waveforms in figure 5-12, the schematic and parts location diagrams in figures 5-13 through 5-49, the replaceable parts listed in tables 5-6 through 5-21, and the integrated circuit details given in table 5-22 and figure 5-50. Table 5-4 lists all chassis-mounted components and each respective schematic, parts location diagram, and parts list for the parts.



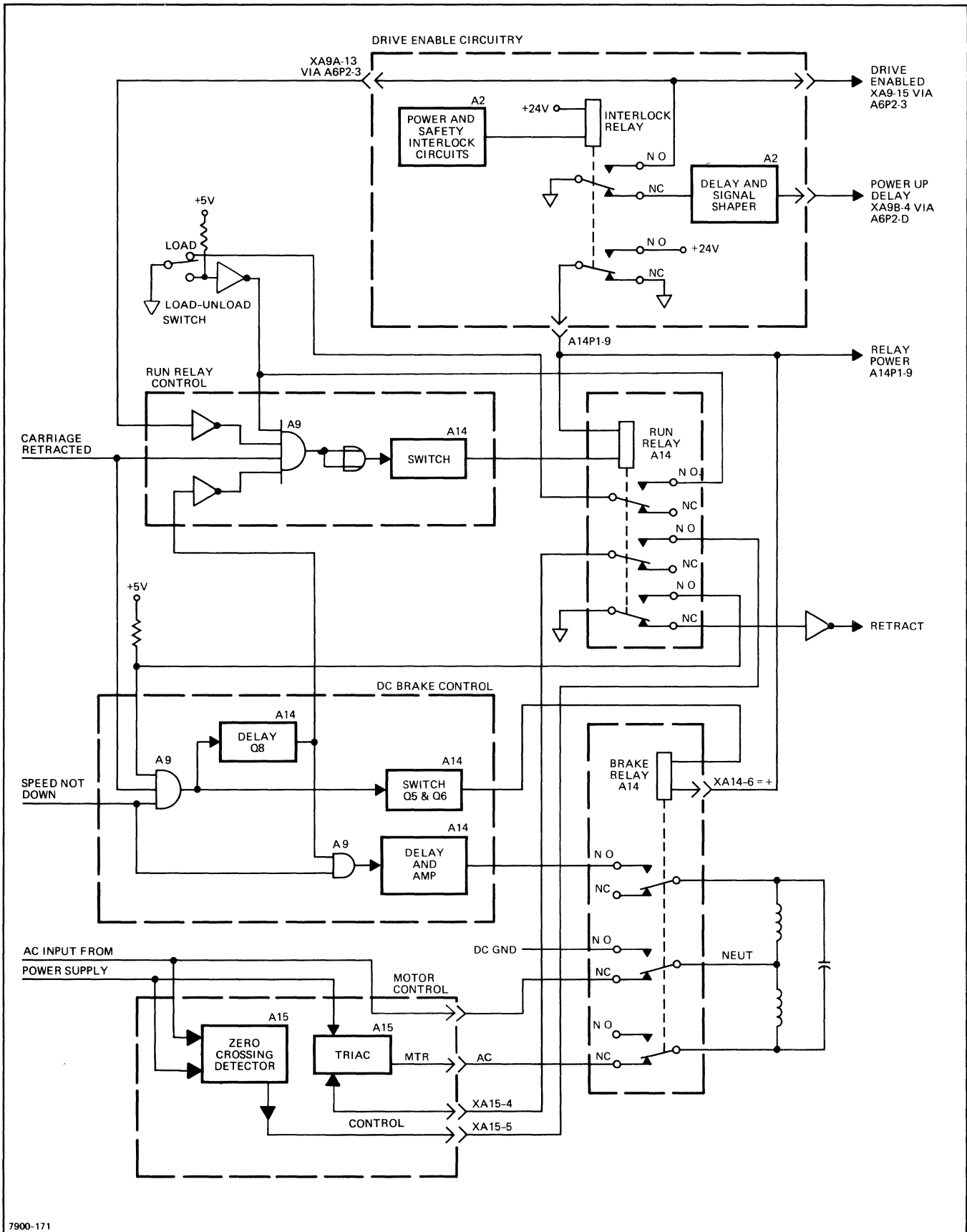
7900-170

Figure 5-11. Troubleshooting Diagrams (Sheet 1 of 4)



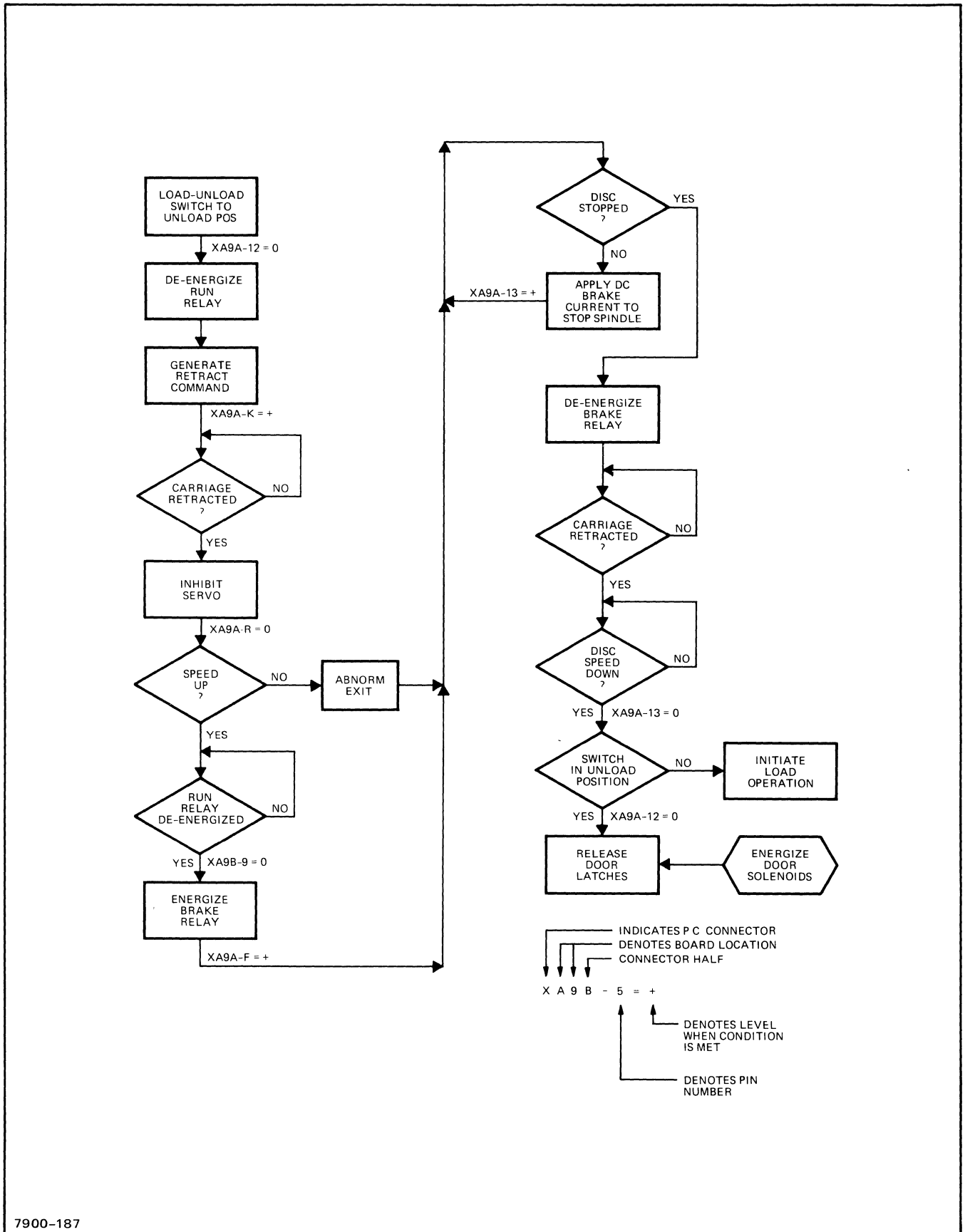
7900-169-1A

Figure 5-11. Troubleshooting Diagrams (Sheet 2 of 4)



7900-171

Figure 5-11. Troubleshooting Diagrams (Sheet 3 of 4)



7900-187

Figure 5-11. Troubleshooting Diagrams (Sheet 4 of 4)

TEST EQUIPMENT USED

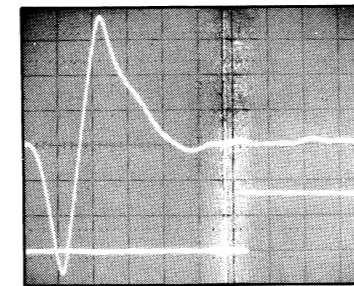
180A PLUG-IN OSCILLOSCOPE MAINFRAME
 1804A FOUR CHANNEL AMPLIFIER FOR 180 SYSTEM
 1821A TIME BASE/DELAY GENERATOR FOR 180 SYSTEM
 10:1 DIVIDER PROBES

TRACK SEEKING

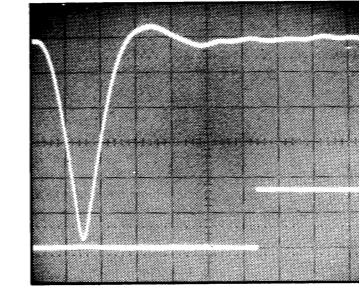
CHANNEL A TO: A12TP4 & 8 CHANNELS A & B RESPECTFULLY (1804A)
 CHANNEL B TO: A12TP3 VELOCITY TRANSDUCER A12TP5 CURRENT COMMAND A11 TP3 VELOCITY COMMAND (1804A)
 CHANNEL B TO: A9TP3 ACCESS READY (1804A)
 EXT INPUT (SYNC) TO: A11TP2 SET CYLINDER (1821A)

7900-104

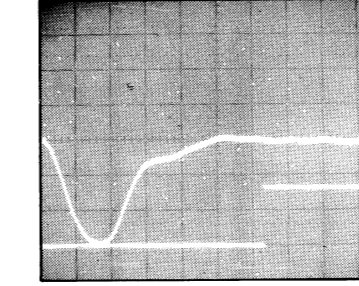
SINGLE TRACK SEEK GOING FORWARD



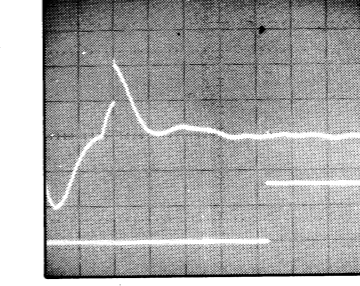
A12TP5
CHANNEL A
2V/CM, 1 MSEC/CM



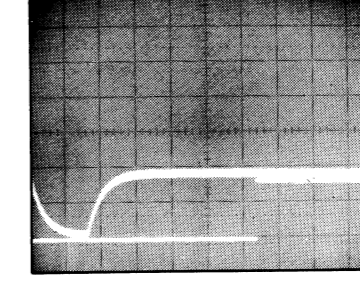
A12TP8
CHANNEL B
2V/CM, 1 MSEC/CM



A12TP2
VELOCITY TRANSDUCER
0.2V/CM, 1 MSEC/CM

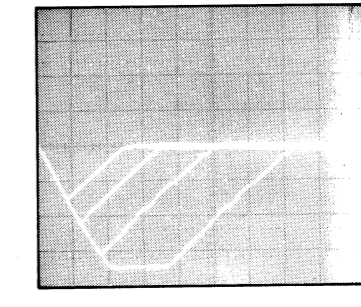


A12TP4
CURRENT COMMAND
1V/CM, 1 MSEC/CM



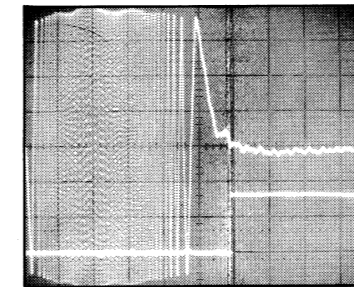
A11TP3
VELOCITY COMMAND
0.2V/CM, 1 MSEC/CM

16, 32, 64, AND 128 TRACK SEEKS GOING FORWARD

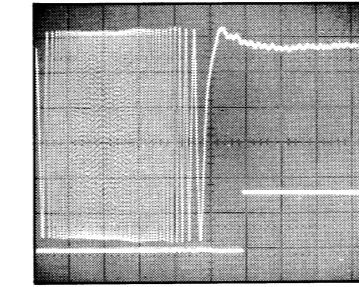


A12TP2
VELOCITY TRANSDUCER
2V/CM

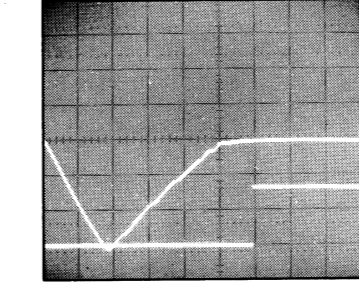
64 TRACK SEEK GOING FORWARD



A12TP5
CHANNEL A
2V/CM, 5 MSEC/CM



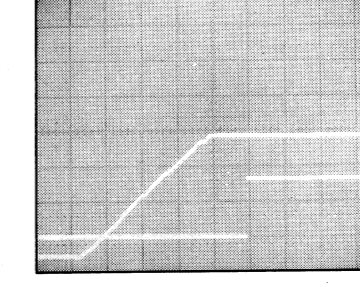
A12TP8
CHANNEL B
2V/CM, 5 MSEC/CM



A12TP2
VELOCITY TRANSDUCER
2V/CM, 5 MSEC/CM

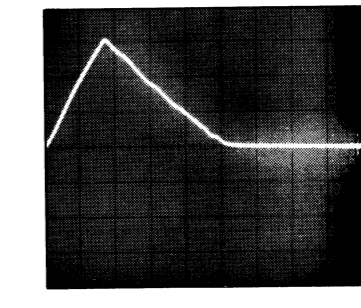


A12TP4
CURRENT COMMAND
5V/CM, 5 MSEC/CM



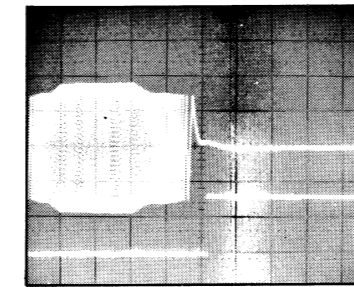
A11TP3
VELOCITY COMMAND
2V/CM, 5 MSEC/CM

64 TRACK SEEK GOING BACKWARDS

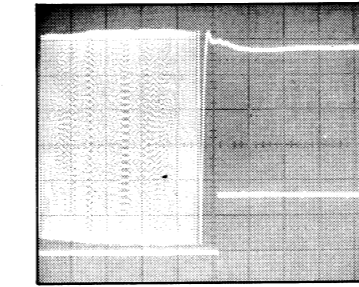


A12TP2
VELOCITY TRANSDUCER
2V/CM

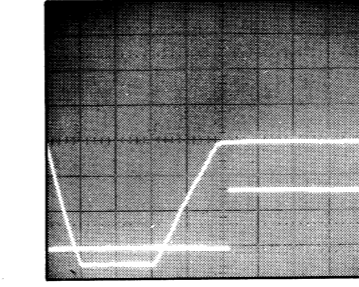
200 TRACK SEEK GOING FORWARD



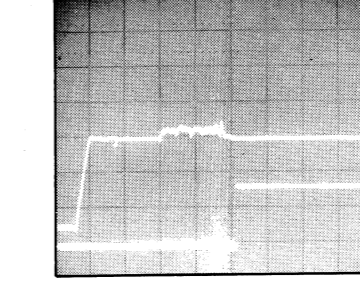
A12TP5
CHANNEL A
2V/CM, 10 MSEC/CM



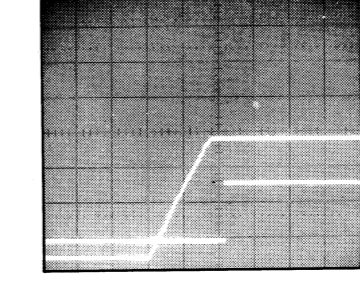
A12TP8
CHANNEL B
2V/CM, 10 MSEC/CM



A12TP2
VELOCITY TRANSDUCER
2V/CM, 10 MSEC/CM

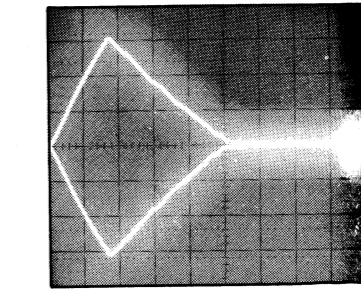


A12TP4
CURRENT COMMAND
5V/CM, 10 MSEC/CM



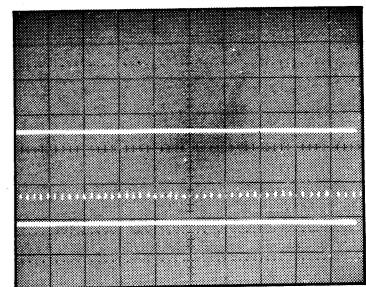
A11TP3
VELOCITY COMMAND
2V/CM, 10 MSEC/CM

64 TRACK SEEK GOING FORWARDS AND BACKWARDS



A12TP2
VELOCITY TRANSDUCER
2V/CM

SECTOR PULSES

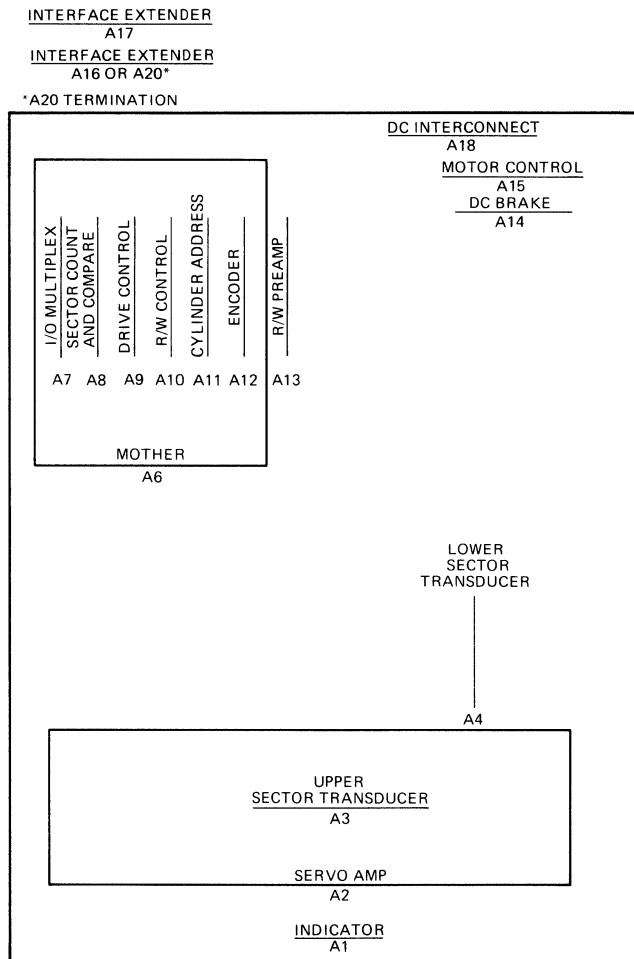


A8TP4 and 5
INDEX, INDEX

SECTOR PULSES

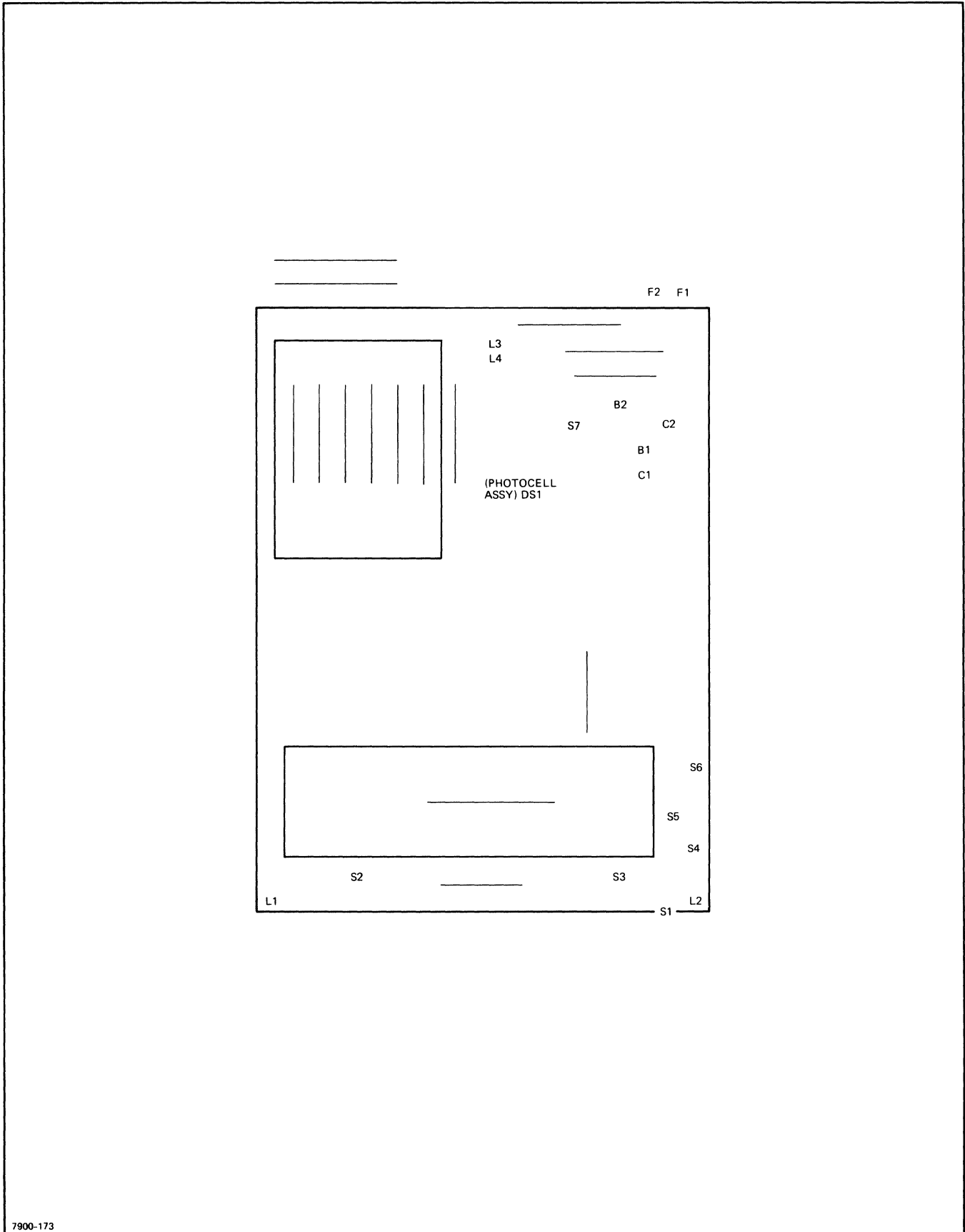
CHANNEL A TO: A8TP4 INDEX (1804A)
 CHANNEL B TO: A8TP5 SECTOR PULSE (1804A)
 EXT INPUT (SYNC) TO: A8TP4 INDEX (1821A)

Figure 5-12. Diagnostic Waveforms



7900-172

Figure 5-13. Printed-Circuit Assembly Locations



7900-173

Figure 5-14. Chassis-Mounted Electrical Component Locations

Table 5-4. Chassis-Mounted Component Cross-Reference

COMPONENT	SCHEMATIC DIAGRAM	PARTS LOCATION DIAGRAM	PARTS LIST
B1	Figure 5-42. DC Brake Assembly A14	Figure 6-3	Table 6-3
B2	Figure 5-42. DC Brake Assembly A14	Figure 6-3	Table 6-3
C1	Figure 5-42. DC Brake Assembly A14	Figure 6-3	Table 6-3
C2	Figure 5-42. DC Brake Assembly A14	Figure 6-3	Table 6-3
DS1	Figure 5-26. Motherboard Assembly A6	Figure 6-3	Table 6-3
F1	Figure 5-44. Motor Control Assembly A15	Figure 6-7	Table 6-7
F2	Figure 5-44. Motor Control Assembly A15	Figure 6-7	Table 6-7
L1	Figure 5-17. Indicator Assembly A1	Figure 6-2	Table 6-2
L2	Figure 5-17. Indicator Assembly A1	Figure 6-2	Table 6-2
L3	Figure 5-26. Motherboard Assembly A6	Figure 6-7	Table 6-7
L4	Figure 5-22. Servo Amplifier Assembly A2	Figure 6-5	Table 6-5
S1	Figure 5-17. Indicator Assembly A1	Figure 6-2	Table 6-2
S2	Figure 5-17. Indicator Assembly A1	Figure 6-2	Table 6-2
S3	Figure 5-17. Indicator Assembly A1	Figure 6-2	Table 6-2
S4	Figure 5-17. Indicator Assembly A1	Figure 6-3	Table 6-3
S5	Figure 5-17. Indicator Assembly A1	Figure 6-3	Table 6-3
S6	Figure 5-17. Indicator Assembly A1	Figure 6-3	Table 6-3
S7	Figure 5-20. Servo Amplifier Assembly A2	Figure 6-3	Table 6-3

Table 5-5. Schematic Diagram Notes

SCHEMATIC DIAGRAM NOTES

Resistance is in ohms and capacitance is in microfarads unless otherwise noted.

P/O = part of.

Reference designations within outlined (— — —) assemblies are abbreviated. Full description includes assembly number, e.g. R1 of assembly A1 is A1R1. Designations of other components are complete as shown.



Encloses wire color code. Code used (MIL-STD-681) is the same as the resistor color code. First number identifies the base color, second number the wider stripe and the third number identifies the narrower stripe. E.G. (947) denotes white base, yellow wide strip and violet narrow stripe.



Screwdriver adjustment



Test Point



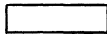
Circuit assembly outline.



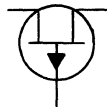
Wiper moves toward CW with clockwise rotation of control as viewed from shaft or knob.



Voltage regulator (breakdown diode).



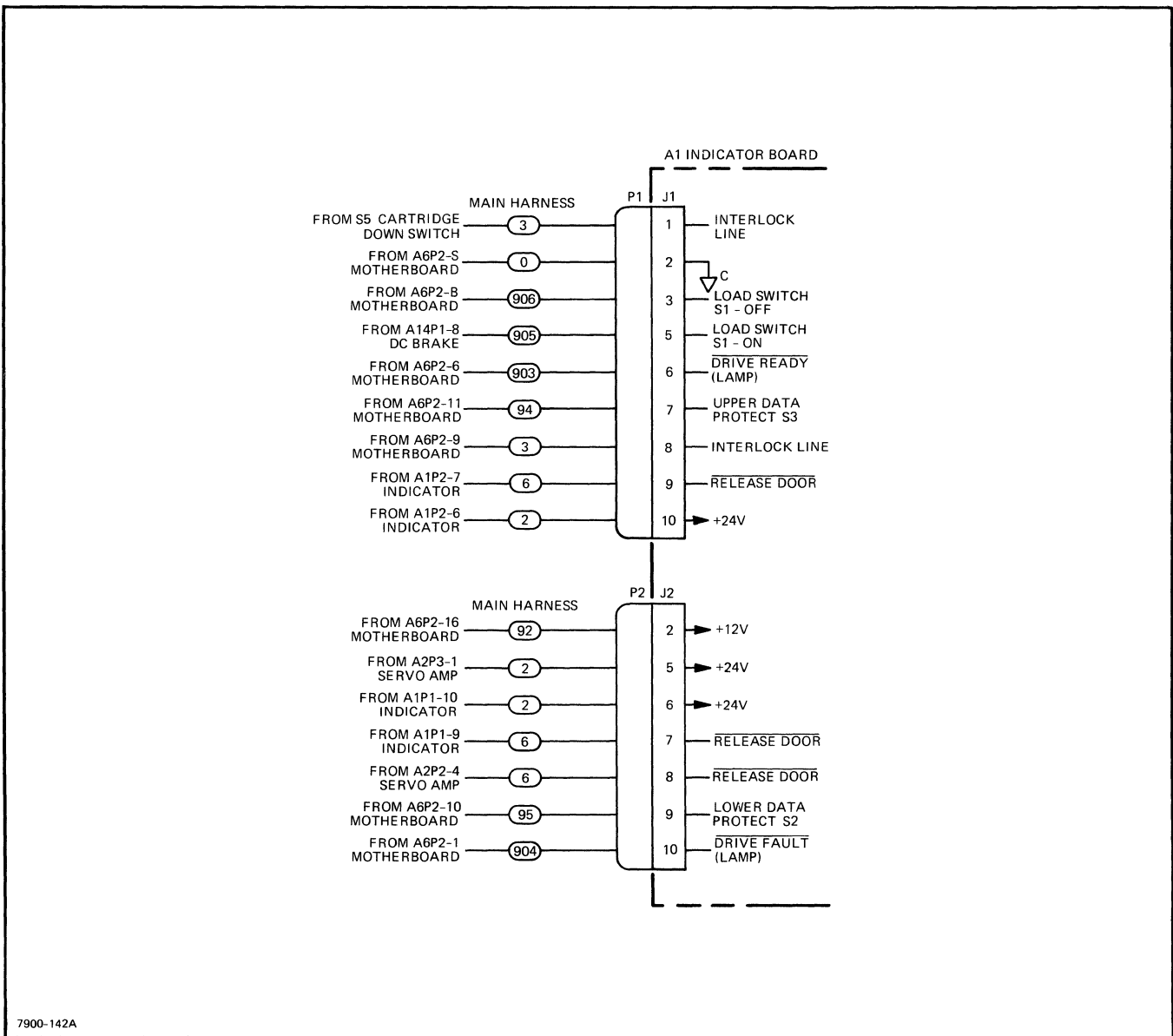
Denotes front panel designations.



Denotes FET with P-type base.

Table 5-6. Indicator Assembly A1 (07900-60063) Replaceable Parts

REFERENCE DESIGNATION	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.
CR1, 2	1901-0026	DIODE, silicon, 200 PIV, 0.75A	04713	SR 1358-8
DS1 thru 6	2140-0343	LAMP, incandescent, 14V, 0.8A	98978	330



7900-142A

Figure 5-15. Indicator Assembly A1 Harness Diagram

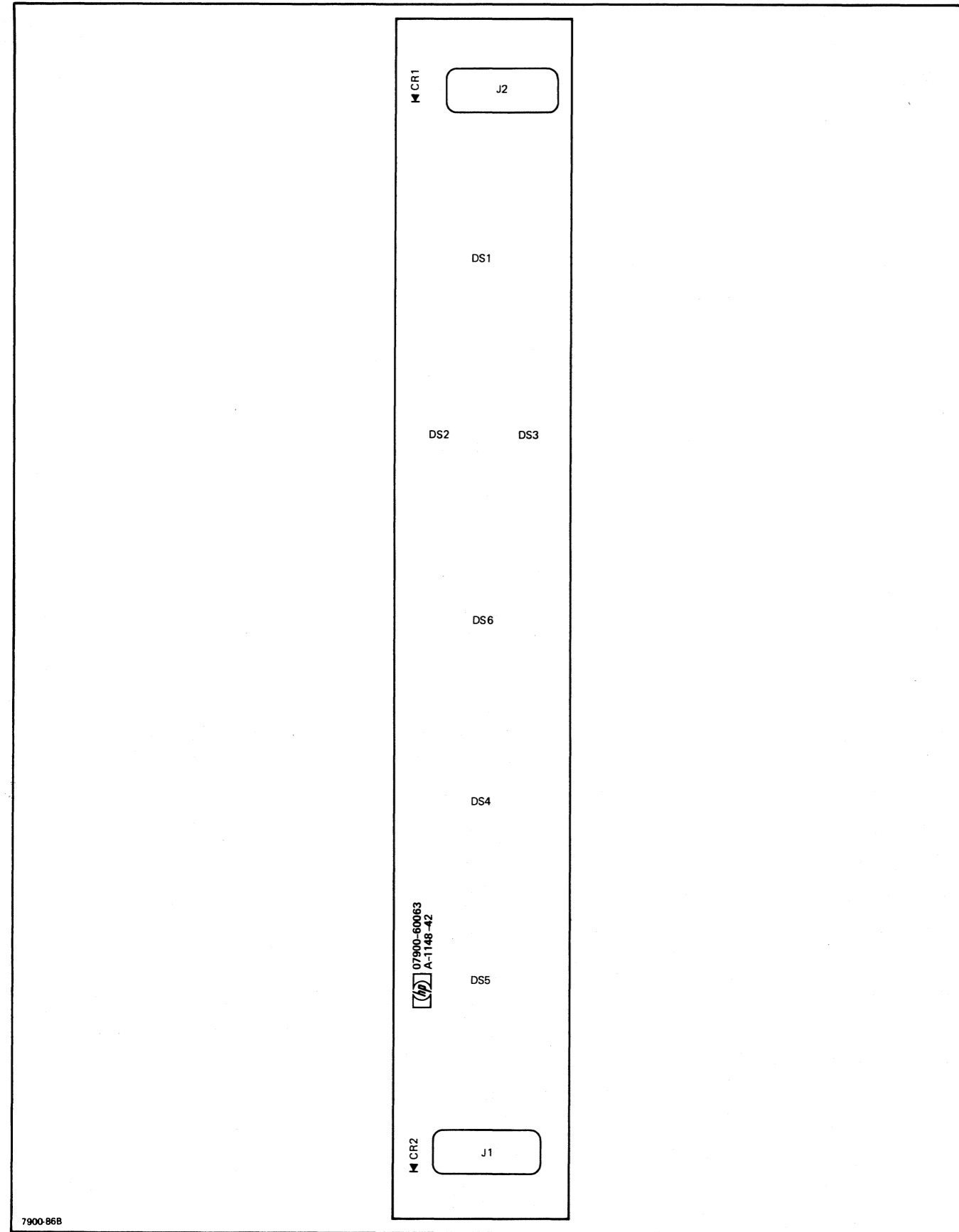


Figure 5-16. Indicator Assembly A1 Parts Location Diagram

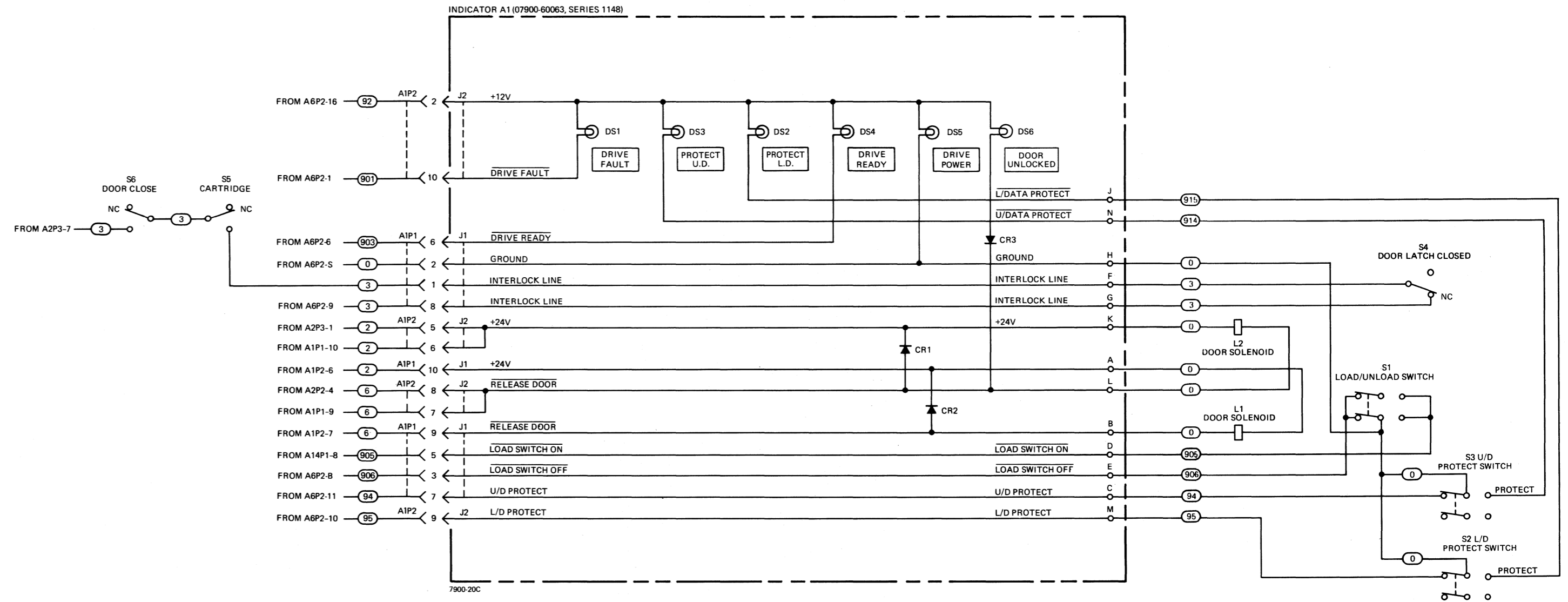


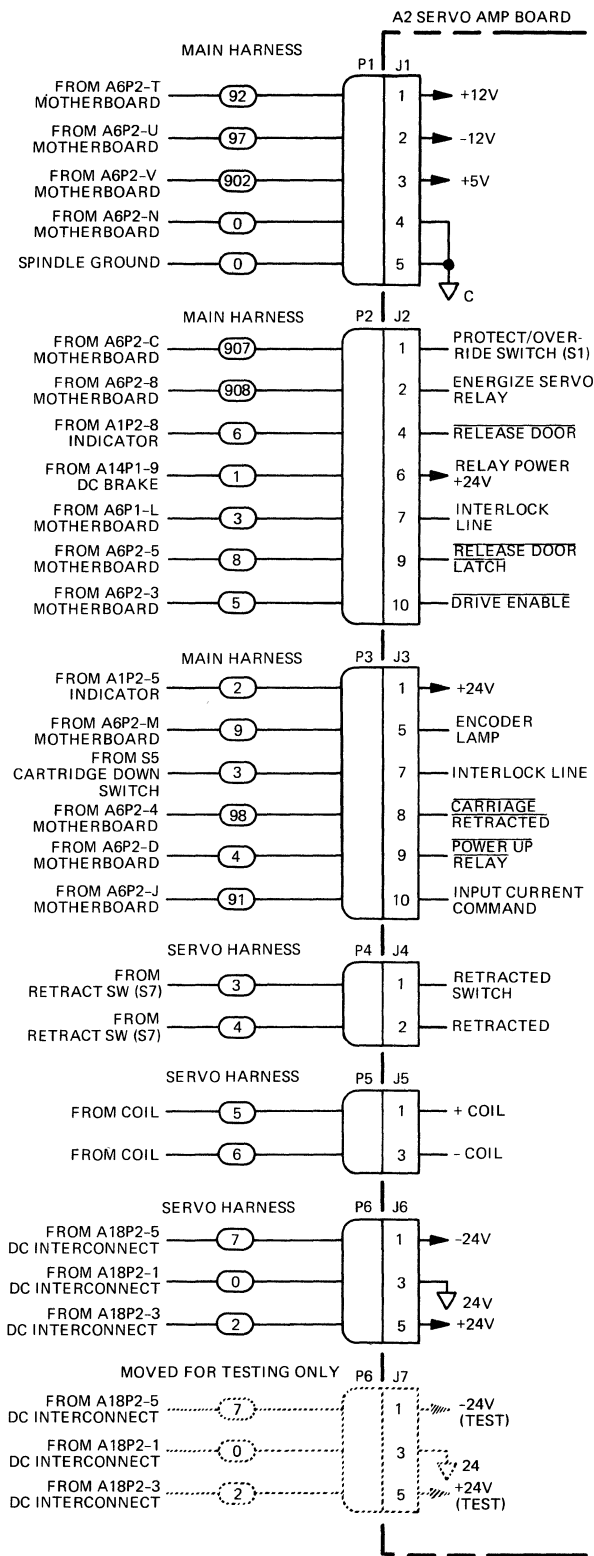
Figure 5-17. Indicator Assembly A1 Schematic Diagram

Table 5-7. Servo Amplifier Assembly A2 (07900-60048) Replaceable Parts

REFERENCE DESIGNATION	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.
BT1, 2, 3	1420-0088	BATTERY, nickel cadmium, 1.25V	05397	CH 500
C1, 3	0160-2128	CAPACITOR, fxd, My, 0.33 μ F, 20%, 200 VDCW	56289	225P33402Y-PWM
C2, 7	0180-0116	CAPACITOR, fxd, elect, 6.8 μ F, 10%, 35 VDCW	56289	150D685X9035B2-DYS
C4, 5	0160-2055	CAPACITOR, fxd, cer, 0.01 μ F, +80 -20%, 100 VDCW	56289	C023F101F103ZS22-CDH
C6, 9	0160-2199	CAPACITOR, fxd, mica, 30 pF, 5%, 300 VDCW	28480	0160-2199
C8	0160-0155	CAPACITOR, fxd, My, 0.0033 μ F, 10%, 200 VDCW	56289	192P33292-PTS
C10	0180-0113	CAPACITOR, fxd, elect, Ta, 100 μ F, +20 -15%, 30 VDCW	56289	109D107C2030T2
C11, 12	0160-0153	CAPACITOR, fxd, My, 0.001 μ F, 10%, 200 VDCW	56289	192P10292-PTS
C13	0160-0167	CAPACITOR, fxd, My, 0.082 μ F, 10%, 200 VDCW	56289	192P82392-PTS
CR1,2,3,8,9,12,13, 15 thru 18, 20, 22, 23, 26	1901-0040	DIODE, silicon, 30 mA, 30WV	07263	FDG1088
CR4, 10, 19	1902-0025	DIODE, breakdown, 10.0V, 5%, 400 mW	28480	1902-0025
CR5, 11	1902-3203	DIODE, breakdown, silicon, 14.7V, 5%	28480	1902-3203
CR6	1901-0049	DIODE, silicon, 50 PIV	28480	1901-0049
CR7, 14	1901-0460	DIODE, silicon	03508	STB 523
CR24,25,27 thru 29	1901-0416	DIODE, silicon, 200 PIV, 3A	28480	1901-0416
CR21	1902-3036	DIODE, breakdown, 3.16V, 5%	04713	SZ10939-38
K1	0490-0347	RELAY, 24 Vdc	02288	TF 154CC-CC-24VDC
K2	0490-0983	RELAY, 472 ohms, 10A, 24V coil	77342	KUP11D17-24V
Q1, 14	1854-0039	TRANSISTOR, silicon, NPN	80131	2N3053
Q2,3,4,6 thru 9, 13, 18, 19, 21	1854-0215	TRANSISTOR, silicon, NPN	80131	2N3904
Q5, 10, 15	1853-0036	TRANSISTOR, silicon, PNP	80131	2N3906
Q11	1854-0053	TRANSISTOR, silicon, NPN	80131	2N2218
Q12	1853-0012	TRANSISTOR, silicon, PNP	80131	2N2904A
Q16	1853-0305	TRANSISTOR, silicon, PNP	04713	2N5875
Q17	1854-0518	TRANSISTOR, silicon, NPN	28480	1854-0518
Q20	1854-0072	TRANSISTOR, silicon, NPN	80131	2N3054
Q22 thru 25	1854-0519	TRANSISTOR, silicon, NPN	28480	1854-0519
R1, 2	0811-1655	RESISTOR, fxd, ww, 10 ohms, 5%, 20W	28480	0811-1655
R3, 4	0757-0449	RESISTOR, fxd, flm, 20k, 1%, 1/8W	28480	0757-0449
R5	0683-1515	RESISTOR, fxd, comp, 150 ohms, 5%, 1/4W	01121	CB 1515
R6	0757-0465	RESISTOR, fxd, met flm, 100k, 1%, 1/8W	28480	0757-0465
R7	0683-2735	RESISTOR, fxd, comp, 27k, 5%, 1/4W	01121	CB 2735
R8, 11	0757-1094	RESISTOR, fxd, met flm, 1.47k, 1%, 1/8W	28480	0757-1094
R9, 10	0757-0280	RESISTOR, fxd, met flm, 1k, 1%, 1/8W	28480	0757-0280
R12, 26	0698-3451	RESISTOR, fxd, met flm, 133k, 1%, 1/8W	28480	0698-3451
R13	0693-3315	RESISTOR, fxd, comp, 330 ohms, 5%, 1/4W	01121	CB 3321
R14, 31	0683-1525	RESISTOR, fxd, comp, 1.5k, 5%, 1/4W	01121	CB 1525
R15,18,24,41,42, 59, 60	0683-1025	RESISTOR, fxd, comp, 1k, 5%, 1/4W	01121	CB 1025
R16,17,19,25,51, 65, 71	0683-2225	RESISTOR, fxd, comp, 2.2k, 5%, 1/4W	01121	CB 2225
R20, 22, 23	0698-3157	RESISTOR, fxd, met flm, 19.6k, 1%, 1/8W	28480	0698-3157

Table 5-7. Servo Amplifier Assembly A2 (07900-60048) Replaceable Parts (Continued)

REFERENCE DESIGNATION	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.
R21	0811-3039	RESISTOR, fxd, ww, 0.1 ohm, 1.0%, 10W	28480	0811-3039
R27, 45	0698-3615	RESISTOR, fxd, met ox, 47 ohms, 5%, 2W	28480	0698-3615
R28	0683-1505	RESISTOR, fxd, comp, 15 ohms, 5%, 1/4W	01121	CB 1505
R29, 34, 50, 52, 54, 58	0683-1035	RESISTOR, fxd, comp, 10k, 5%, 1/4W	01121	CB 1035
R30	0683-2715	RESISTOR, fxd, comp, 270 ohms, 5%, 1/4W	01121	CB 1525
R32, 35	0683-4715	RESISTOR, fxd, comp, 470 ohms, 5%, 1/4W	01121	CB 4715
R33	0683-6815	RESISTOR, fxd, comp, 680 ohms, 5%, 1/4W	01121	CB 6815
R36	0683-3325	RESISTOR, fxd, comp, 3.3k, 5%, 1/4W	01121	CB 3325
R37	0683-4755	RESISTOR, fxd, comp, 4.7M, 5%, 1/4W	01121	CB 4755
R38, 39	0683-4705	RESISTOR, fxd, comp, 47 ohms, 5%, 1/4W	01121	CB 4705
R40	0683-5615	RESISTOR, fxd, comp, 560 ohms, 5%, 1/4W	01121	CB 5615
R43, 44	0683-5125	RESISTOR, fxd, comp, 5.1k, 5%, 1/4W	01121	CB 5125
R46	0683-5625	RESISTOR, fxd, comp, 5.6k, 5%, 1/4W	01121	CB 5625
R47, 49	0761-0008	RESISTOR, fxd, met ox, 510 ohms, 5%, 1W	28480	0761-0008
R48	0698-3626	RESISTOR, fxd, met ox, 180 ohms, 5%, 2W	28480	0698-3626
R53	0683-2205	RESISTOR, fxd, comp, 22 ohms, 5%, 1/4W	01121	CB 2205
R55	0683-7515	RESISTOR, fxd, comp, 750 ohms, 5%, 1/4W	01121	CB 7515
R56	0683-1225	RESISTOR, fxd, comp, 1.2k, 5%, 1/4W	01121	CB 1225
R57	0686-1515	RESISTOR, fxd, comp, 150 ohms, 5%, 1/2W	01121	EB 1515
R61,62,66,68,72	0683-1015	RESISTOR, fxd, comp, 100 ohms, 5%, 1/4W	01121	CB 1015
R63	0683-1815	RESISTOR, fxd, comp, 180 ohms, 5%, 1/4W	01121	CB 1815
R64	0683-6805	RESISTOR, fxd, comp, 68 ohms, 5%, 1/4W	01121	CB 6805
R67	0683-5605	RESISTOR, fxd, comp, 56 ohms, 5%, 1/4W	01121	CB 5605
R69, 70, 74 thru 76	0811-2490	RESISTOR, fxd, ww, 0.1 ohms, 3%, 5W	28480	0811-2490
R73	0686-1015	RESISTOR, fxd, comp, 100 ohms, 5%, 1/2W	01121	EB 1015
R77	0761-0015	RESISTOR, fxd, comp, 1.5k, 5%, 1/2W	24546	FP-32-1-T00-150-J
S1	3101-1219	SWITCH, toggle, SPDT, subminiature	09353	7101 PC
U1	1820-0207	INTEGRATED CIRCUIT, TTL	28480	1820-0207
U2	1820-0054	INTEGRATED CIRCUIT, TTL	01295	SN7400N
U3, 4	1820-0477	INTEGRATED CIRCUIT	28480	1820-0477



7900-143A

Figure 5-18. Servo Amplifier Assembly A2 Harness Diagram

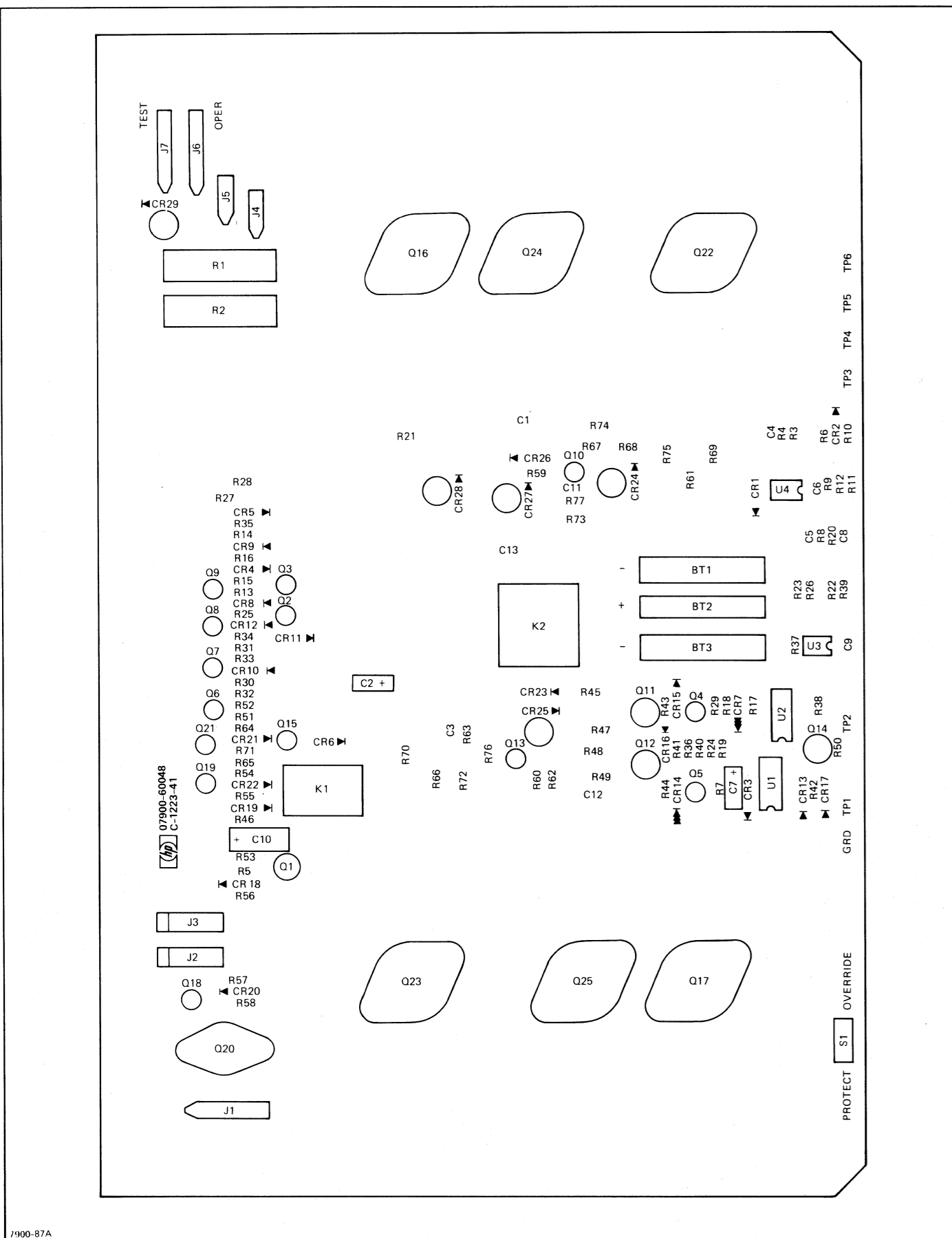


Figure 5-19. Servo Amplifier Assembly A2 Parts Location Diagram

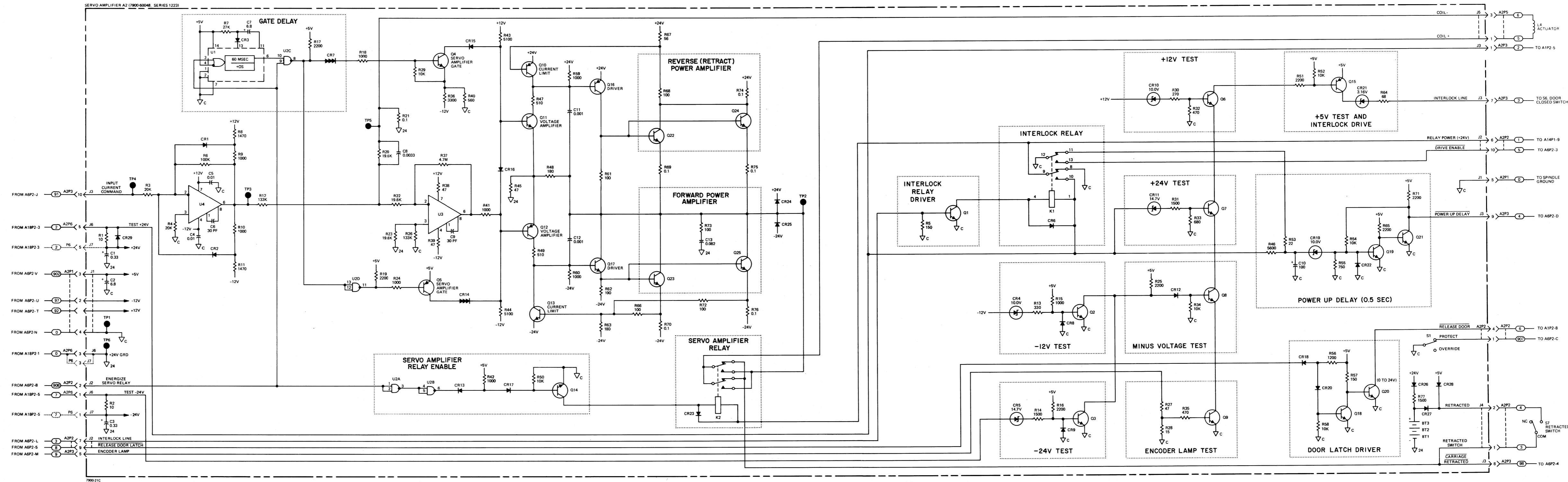
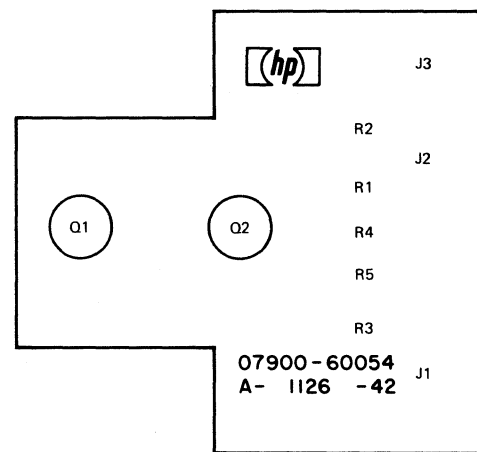


Figure 5-20. Servo Amplifier Assembly A2, Schematic Diagram

Table 5-8. Sector Transducer Assembly A3 (07900-60054) Replaceable Parts

REFERENCE DESIGNATION	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.
DS1	2140-0094	LAMP, incandescent, 5.3V	92966	7153
Q1	1990-0085	PHOTOTRANSISTOR, 30V	07263	FPT-100
Q2	1854-0071	TRANSISTOR, NPN (Selected from 2N3704)	28480	1854-0071
R1	0698-6283	RESISTOR, fxd, comp, 10 ohms, 5%, 1/8W	01121	BB 1005
R2	0698-7187	RESISTOR, fxd, comp, 2M, 5%, 1/8W	01121	BB 2055
R3	0698-6984	RESISTOR, fxd, comp, 470 ohms, 5%, 1/8W	28480	0698-6984
R4	0698-6725	RESISTOR, fxd, comp, 100k, 10%, 1/8W	01121	BB 1041
R5	0698-5178	RESISTOR, fxd, comp, 1.5k, 5%, 1/8W	28480	0698-5178



7900-89

Figure 5-21. Sector Transducer Assembly A3 Parts Location Diagram

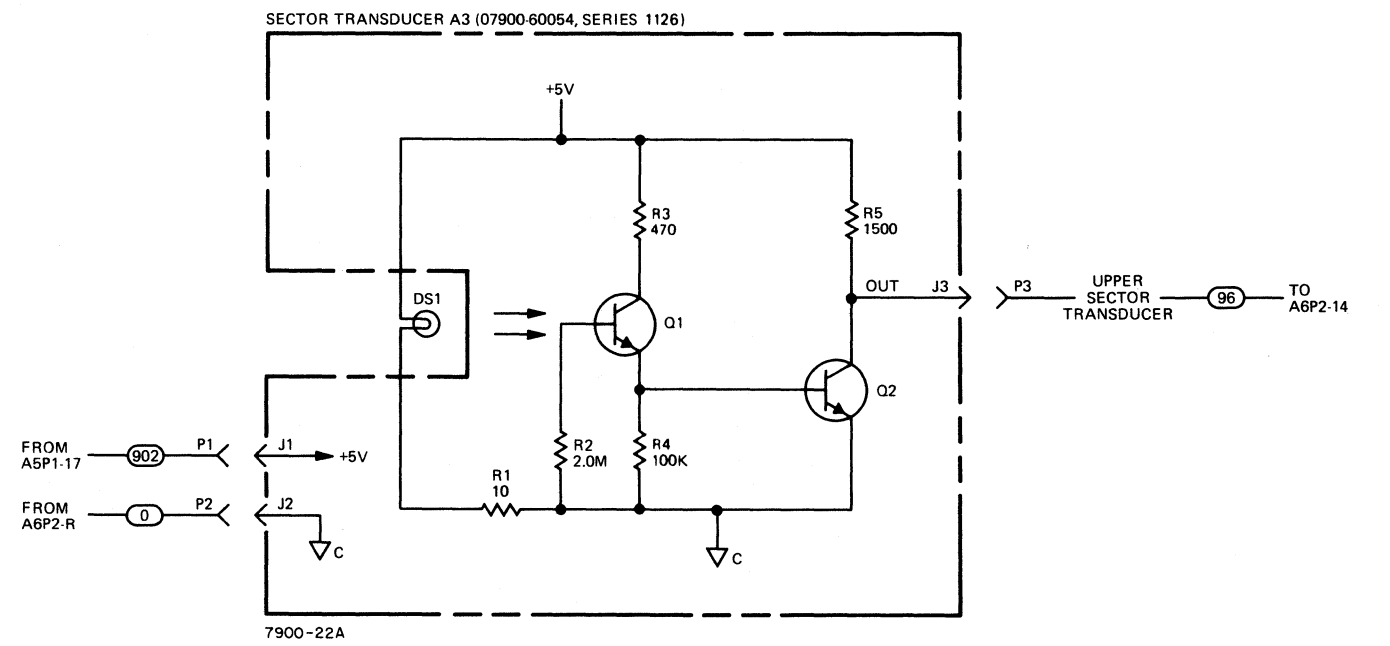
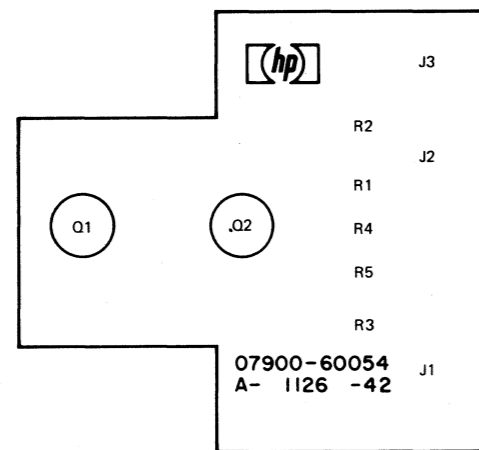


Figure 5-22. Sector Transducer Assembly A3, Schematic Diagram

Table 5-9. Sector Transducer Assembly A4 (07900-60054) Replaceable Parts

REFERENCE DESIGNATION	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.
DS1	2140-0094	LAMP, incandescent, 5.3V	92966	7153
Q1	1990-0085	PHOTOTRANSISTOR, 30V	07263	FPT-100
Q2	1854-0071	TRANSISTOR, NPN (Selected from 2N3704)	28480	1854-0071
R1	0698-6283	RESISTOR, fxd, comp, 10 ohms, 5%, 1/8W	01121	BB 1005
R2	0698-7187	RESISTOR, fxd, comp, 2M, 5%, 1/8W	01121	BB 2055
R3	0698-6984	RESISTOR, fxd, comp, 470 ohms, 5%, 1/8W	28480	0698-6984
R4	0698-6725	RESISTOR, fxd, comp, 100k, 10%, 1/8W	01121	BB 1041
R5	0698-5178	RESISTOR, fxd, comp, 1.5k, 5%, 1/8W	28480	0698-5178



7900-88

Figure 5-23. Sector Transducer Assembly A4 Parts Location Diagram

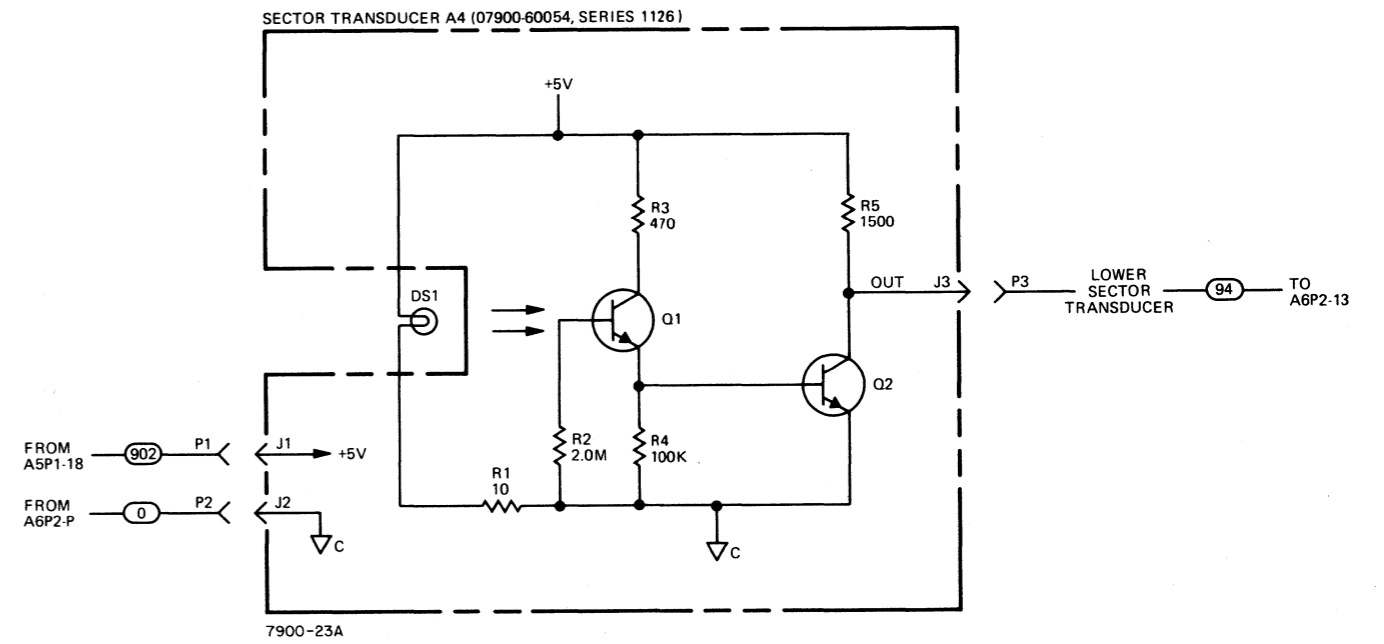


Figure 5-24. Sector Transducer Assembly A4, Schematic Diagram

Table 5-10. Motherboard Assembly A6 (07900-60055) Replaceable Parts

REFERENCE DESIGNATION	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.
XA7A/B thru XA13A/B	1251-1886	CONNECTOR, pc, 30-contact (2 x 15)	71785	252-15-30-340
XA16/20,17	1251-2025	CONNECTOR, pc, 48-contact (2 x 24)	71785	252-24-30-340

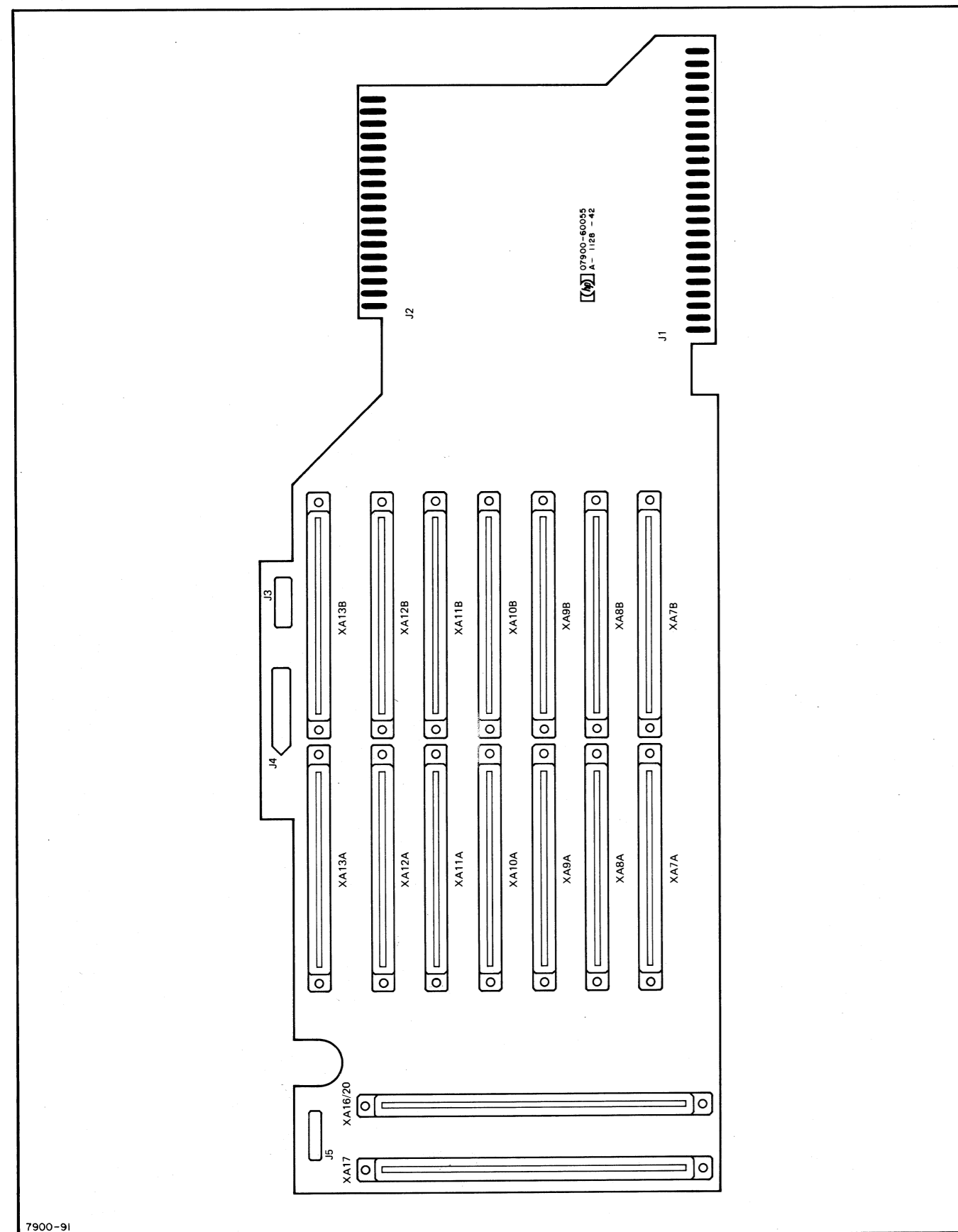
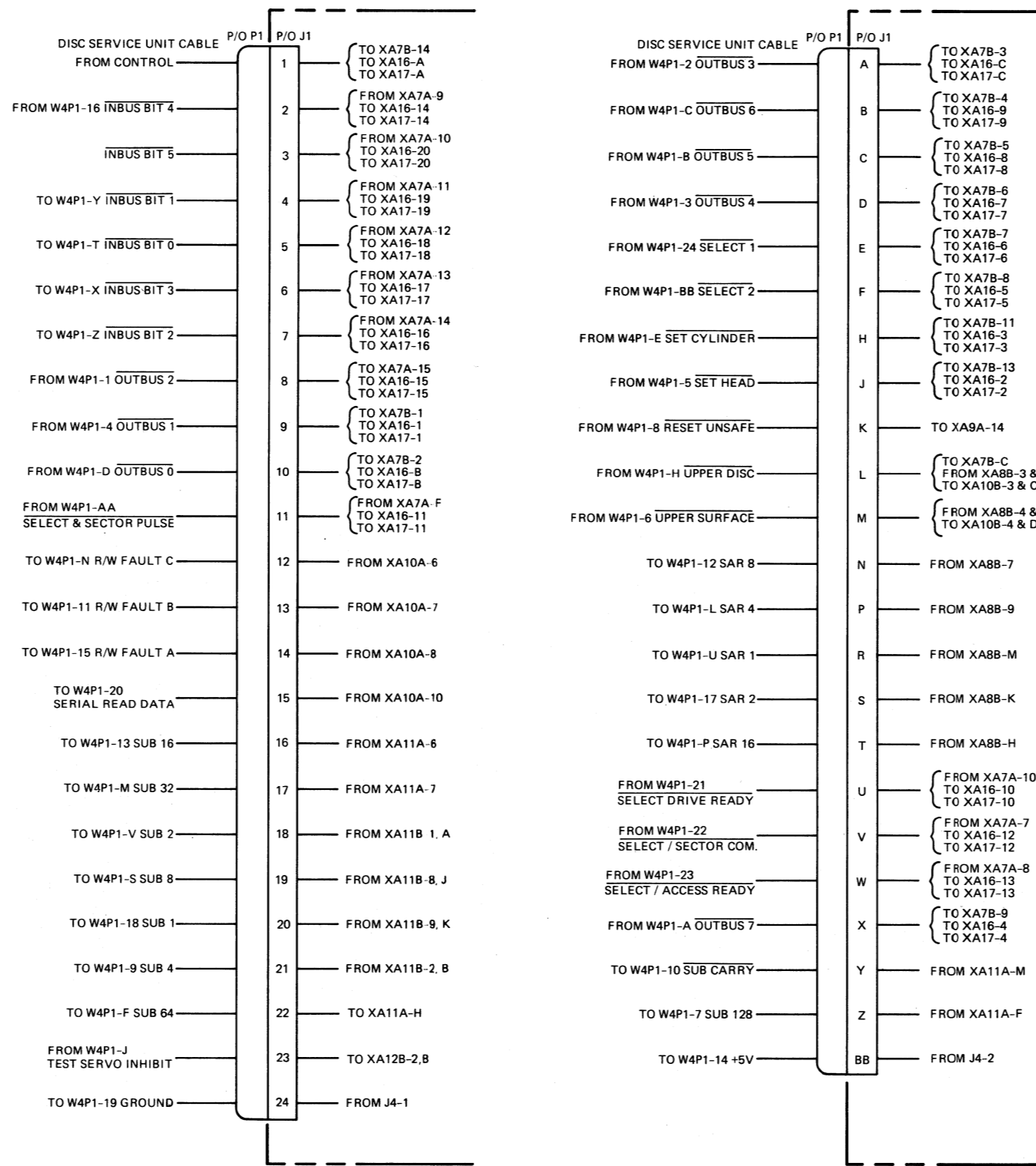


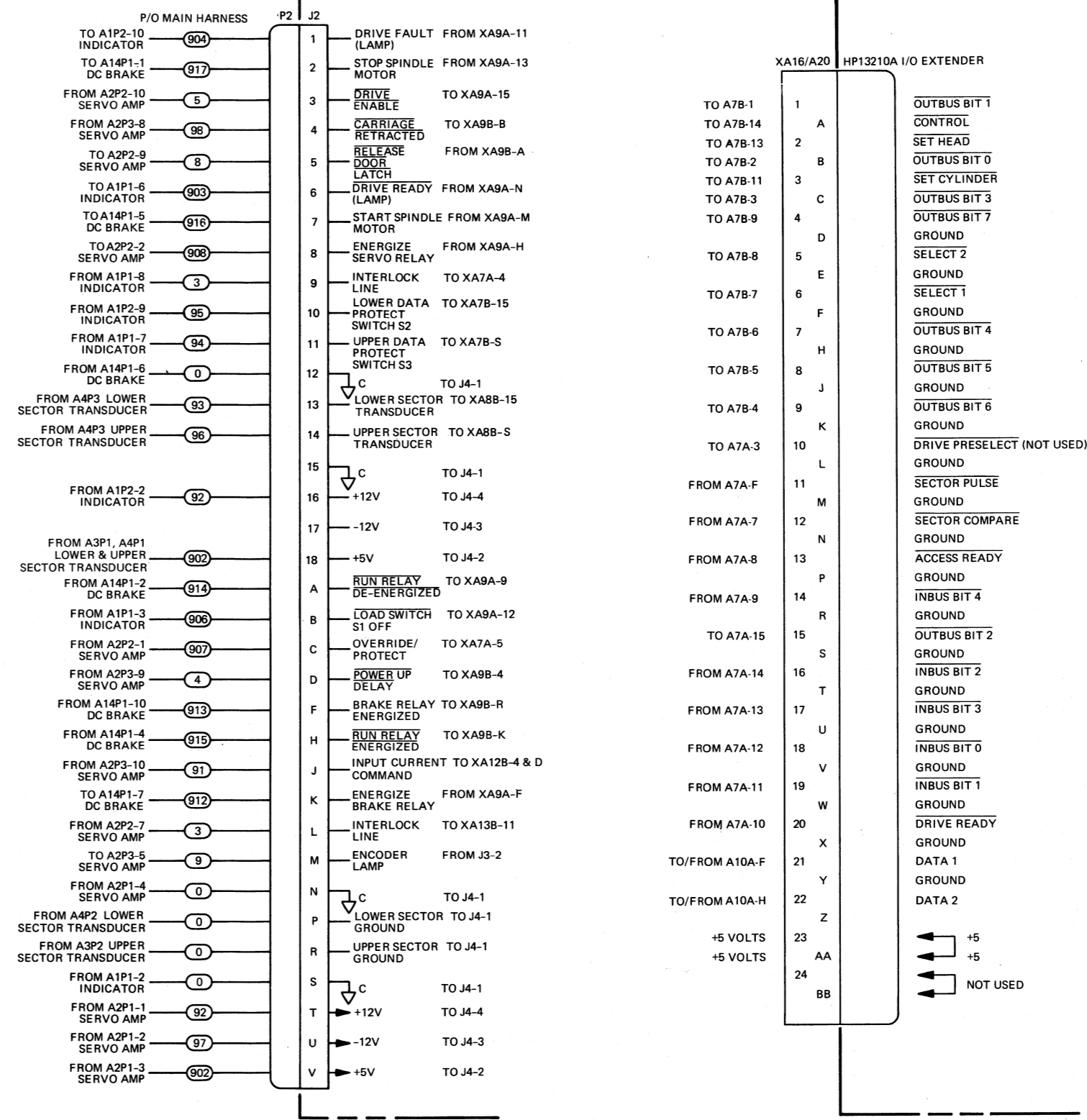
Figure 5-25. Motherboard Assembly A6 Parts Location Diagram

A6 MOTHERBOARD



7900-144A

A6 MOTHERBOARD



P/O A6 MOTHERBOARD

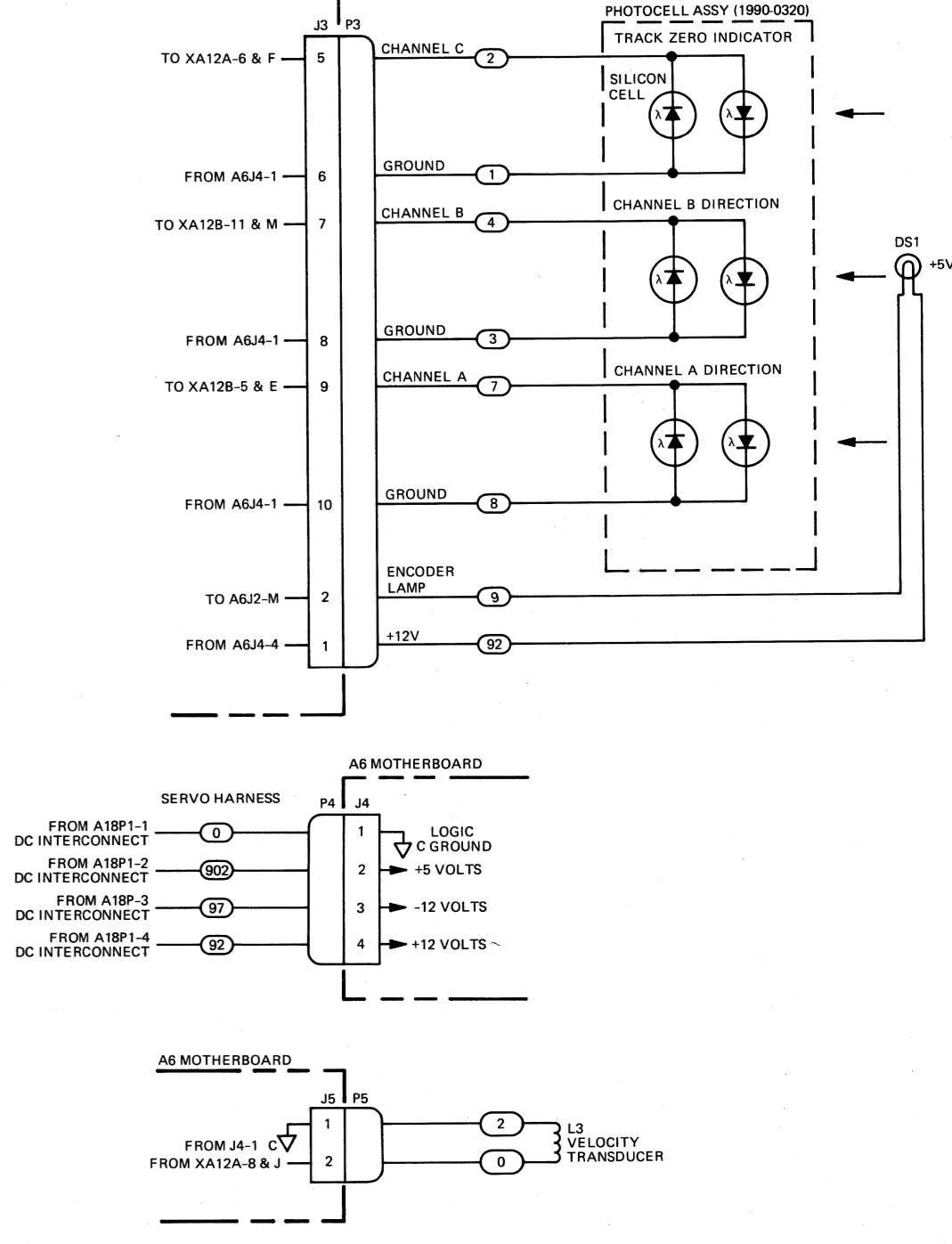


Figure 5-26. Motherboard Assembly A6, Main and Servo Harness Diagram

Table 5-11. Input/Output Multiplex Assembly A7 (07900-60058) Replaceable Parts

REFERENCE DESIGNATION	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.
C1	0180-0116	CAPACITOR, fxd, elect, 6.8 μ F, 10%, 35 VDCW	56289	150D685X9035B2-DYS
C2 thru 5	0160-2055	CAPACITOR, fxd, cer, 0.01 μ F, +80-20%, 100 VDCW	56289	C023F101F103ZS22-CDH
C6, 7	0160-3533	CAPACITOR, fxd, mica, 470 pF, 5%, 100 VDCW	00853	RDM15F471J1C
CR1	1901-0040	DIODE, silicon, 30 mA, 30 VDCW	07263	FDG 1088
P1, 2, 3	5040-1485	CONDUCTOR ASSY, plug-in jumper	28480	5040-1485
R1,3,5 thru 18	0683-1025	RESISTOR, fxd, comp, 1.0k, 5%, 1/4W	01121	CB 1025
R2, 4	0683-1015	RESISTOR, fxd, comp, 100 ohms, 5%, 1/4W	01121	CB 1015
R19	0683-4725	RESISTOR, fxd, comp, 4.7k, 5%, 1/4W	01121	CB 4725
U12,13,15,24,33	1820-0054	INTEGRATED CIRCUIT, TTL	01295	SN 7400N
U14, 21	1820-0511	INTEGRATED CIRCUIT, TTL	01295	SN 7408N
U25	1820-0239	INTEGRATED CIRCUIT, TTL	28480	1820-0239
U31, 32	1820-0577	INTEGRATED CIRCUIT, TTL	01295	SN 7416N
U34, 43, 45	1820-0174	INTEGRATED CIRCUIT, TTL	01295	SN 7404N
U35	1820-0537	INTEGRATED CIRCUIT, TTL	28480	1820-0537

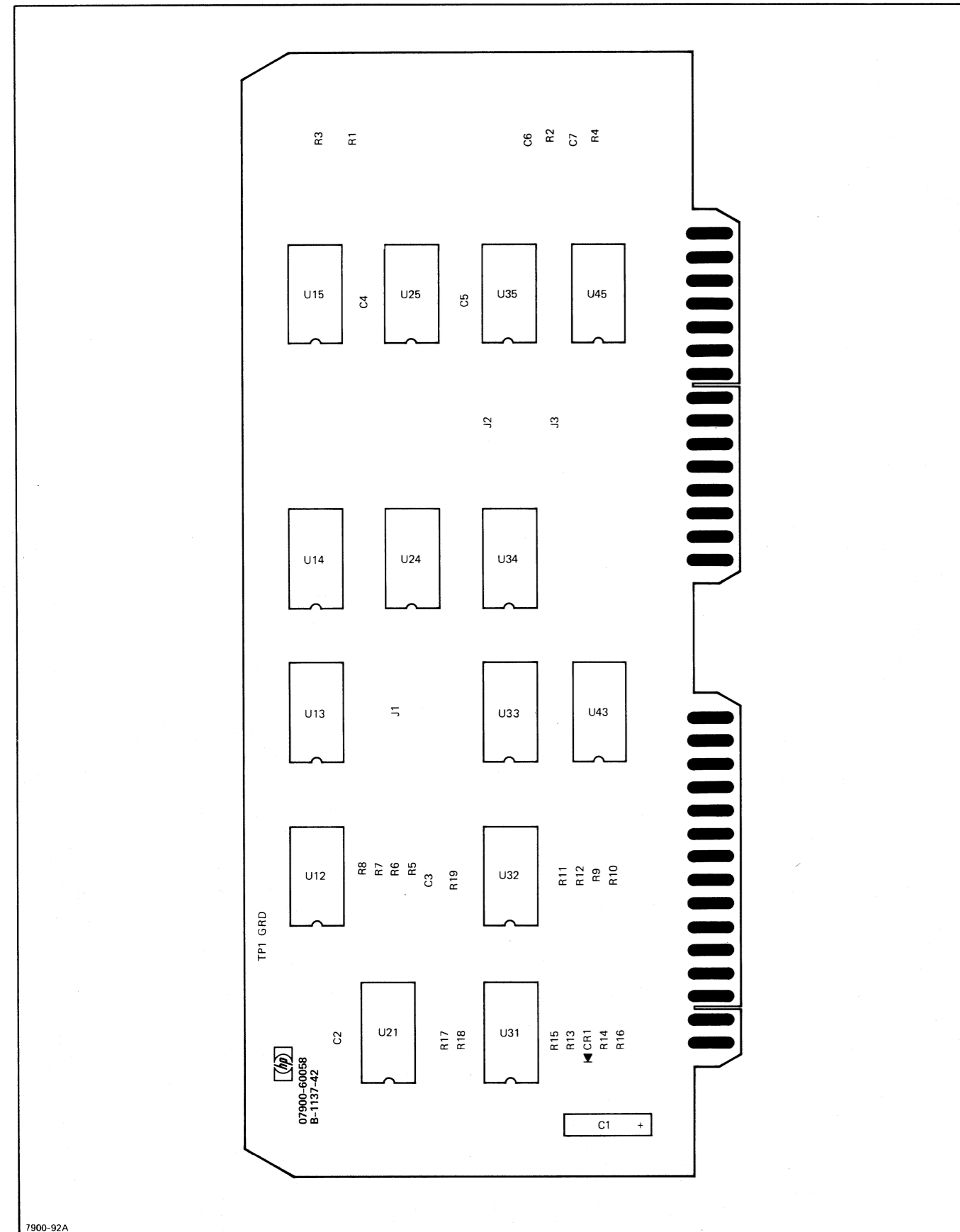
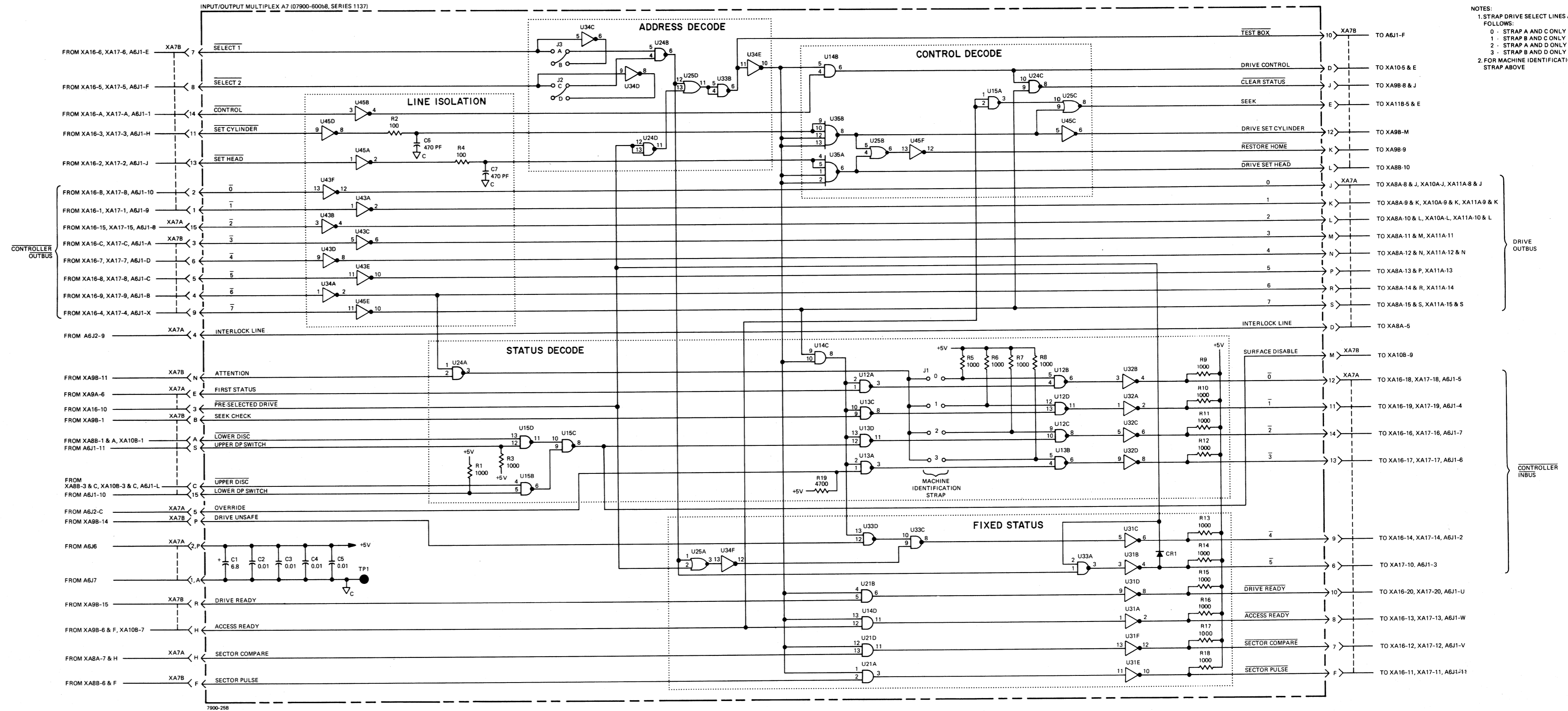


Figure 5-27. Input/Output Multiplex Assembly A7 Parts Location Diagram



NOTES:
 1. STRAP DRIVE SELECT LINES AS FOLLOWS:
 0 - STRAP A AND C ONLY
 1 - STRAP A AND D ONLY
 2 - STRAP B AND D ONLY
 3 - STRAP B AND C ONLY
 2. FOR MACHINE IDENTIFICATION STRAP ABOVE

Figure 5-28. Input/Output Multiplex Assembly A7 Schematic Diagram

Table 5-12. Sector Count and Compare Assembly A8 (07900-60008) Replaceable Parts

REFERENCE DESIGNATION	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.
C1	0180-0116	CAPACITOR, fxd, elect, 6.8 μ F, 10%, 35 VDCW	56289	150D685X9035B2-DYS
C2, 3	0160-0153	CAPACITOR, fxd, My, 0.001 μ F, 10%, 200 VDCW	56289	192P10292-PTS
C4 thru 8, 12	0160-2055	CAPACITOR, fxd, cer, 0.01 μ F, +80-20%, 100 VDCW	56289	C023F101F103ZS22-CDH
C9	0160-0161	CAPACITOR, fxd, My, 0.01 μ F, 10%, 200 VDCW	56289	192P10392-PTS
C10, 15	0160-0158	CAPACITOR, fxd, My, 0.0056 μ F, 10%, 200 VDCW	56289	192P56292-PTS
C11	0160-3238	CAPACITOR, fxd, My, 0.15 μ F, 5%, 200 VDCW	56289	192P15452-PTS
C13, 14	0160-0167	CAPACITOR, fxd, My, 0.082 μ F, 10%, 200 VDCW	56289	192P82392-PTS
C16	0160-0299	CAPACITOR, fxd, My, 1800 pF, 10%, 200 VDCW	56289	192P18292-PTS
C17	0180-2207	CAPACITOR, fxd, elect, 100 μ F, 10%, 10 VDCW	56289	150D101X9010R2-DYS
CR1	1901-0040	DIODE, silicon, 30 mA, 30 VDCW	07263	FDG 1088
R1	0698-3460	RESISTOR, fxd, met flm, 422k, 1%, 1/8W	28480	0698-3460
R2	2100-2517	RESISTOR, var, flm, 50k, 10%, lin, 1/2W	28480	2100-2517
R3	0757-0438	RESISTOR, fxd, met flm, 5.11k, 1%, 1/8W	28480	0757-0438
R4, 6	0698-4007	RESISTOR, fxd, flm, 27.8k, 1%, 1/8W	28480	0698-4007
R7	0698-3449	RESISTOR, fxd, flm, 28.7k, 1%, 1/8W	28480	0698-3449
R5, 8, 10	0698-3160	RESISTOR, fxd, met flm, 31.6k, 1%, 1/8W	28480	0698-3160
R9	0698-4207	RESISTOR, fxd, flm, 44.2, 1%, 1/8W	28480	0698-4207
U11, 12, 21, 22, 24, 34, 35	1820-0054	INTEGRATED CIRCUIT, TTL	01295	SN 7400N
U13, 23	1820-0099	INTEGRATED CIRCUIT, TTL	01295	SN 7493N
U14, 44	1820-0077	INTEGRATED CIRCUIT, TTL	01295	SN 7474N
U25	1820-0537	INTEGRATED CIRCUIT, TTL	28480	1820-0537
U26, 27, 46, 47	1820-0515	INTEGRATED CIRCUIT, TTL	07263	U7B960259X
U31, 33	1820-0174	INTEGRATED CIRCUIT, TTL	01295	SN 7404N
U32	1820-0250	INTEGRATED CIRCUIT, TTL	28480	1820-0250
U42, 43	1820-0301	INTEGRATED CIRCUIT, TTL	01295	SN 7475N
U45	1820-0239	INTEGRATED CIRCUIT, TTL	28480	1820-0239

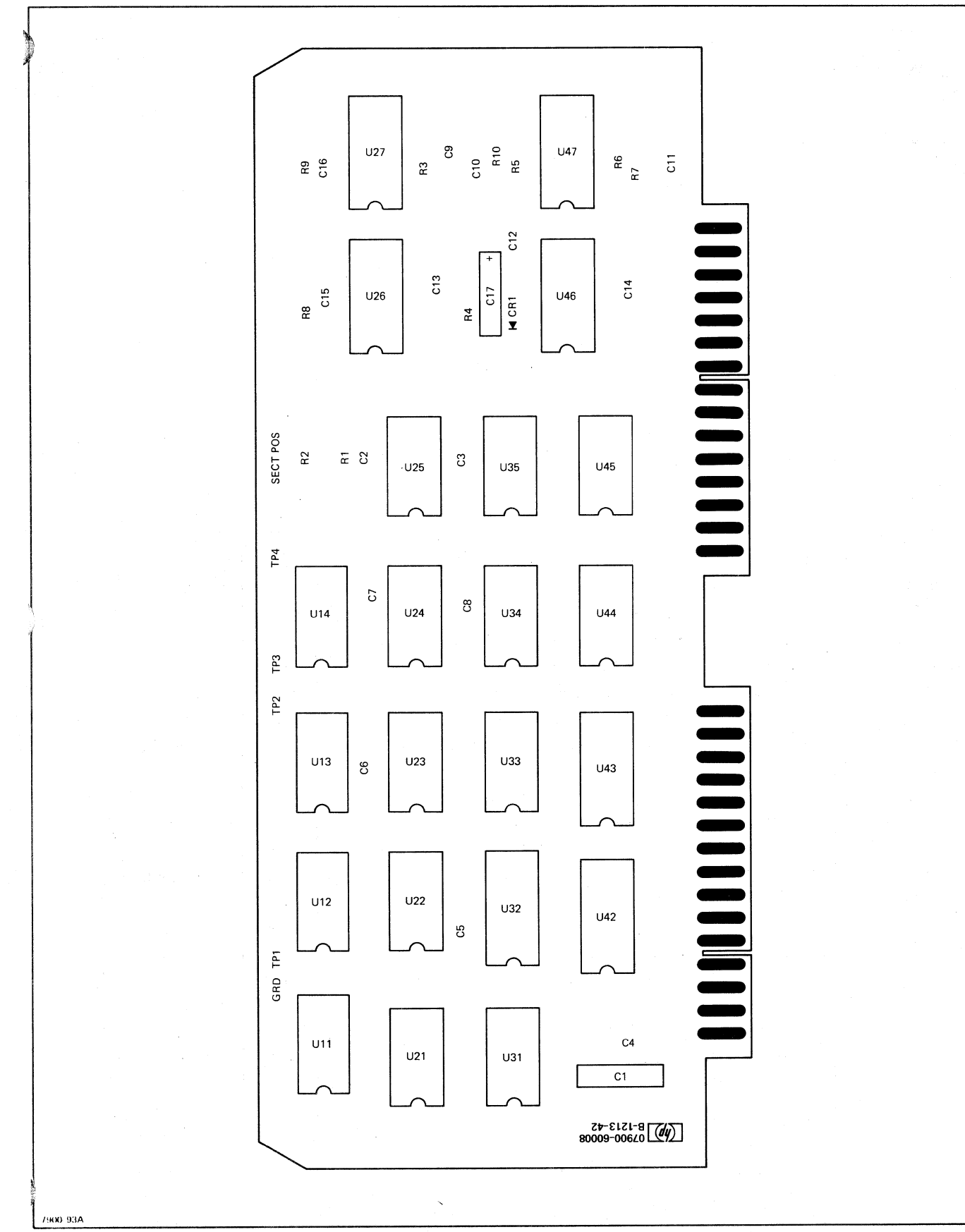


Figure 5-29. Sector Count and Compare Assembly A8 Parts Location Diagram

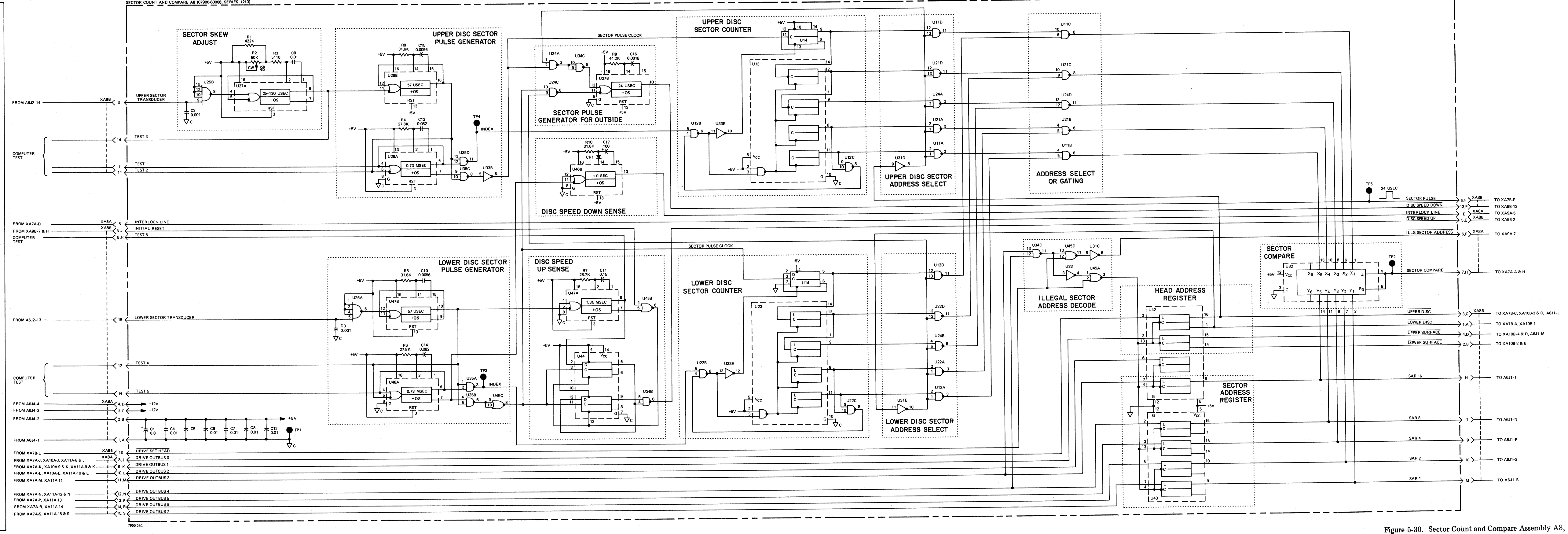


Figure 5-30. Sector Count and Compare Assembly A8, Schematic Diagram

Table 5-13. Drive Control Assembly A9 (07900-60009) Replaceable Parts

REFERENCE DESIGNATION	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.
C1	0180-0116	CAPACITOR, fxd, elect, 6.8 μ F, 10%, 35 VDCW	56289	150D685X9035B2-DYS
C2 thru 6,9,13,15, 17,20	0160-2055	CAPACITOR, fxd, cer, 0.01 μ F, +80-20%, 100 VDCW	56289	C023F101F103ZS22-CDH
C7, 8	0180-0291	CAPACITOR, fxd, elect, 1.0 μ F, 10%, 35 VDCW	56289	150D105X9035A2-DYS
C10, 11	0160-0153	CAPACITOR, fxd, My, 0.001 μ F, 10%, 200 VDCW	56289	192P10292-PTS
C12, 16	0180-2207	CAPACITOR, fxd, elect, 100 μ F, 10%, 10 VDCW	56289	150D101X9010R2-DYS
C14	0180-0106	CAPACITOR, fxd, Ta, 60 μ F, 20%, 6 VDCW	28480	0180-0106
C18	0180-1746	CAPACITOR, fxd, elect, 15 μ F, 10%, 20 VDCW	28480	0180-1746
C19	0160-2199	CAPACITOR, fxd, mica, 30 pF, 5%, 300 VDCW	28480	0160-2199
C21	0180-1701	CAPACITOR, fxd, Ta, 6.8 μ F,	56289	150D685X006A2
CR1 thru 6, 8 thru 17	1901-0040	DIODE, silicon, 30 mA, 30 VDCW	07263	FDG 1088
CR18	1901-0016	DIODE	04713	1N1566
Q1, 2	1854-0071	TRANSISTOR, silicon, NPN	28480	1854-0071
R1 thru 4, 8, 24, 28,29	0683-4725	RESISTOR, fxd, comp, 4.7k, 5%, 1/4W	01121	CB 4725
R5	0683-3335	RESISTOR, fxd, comp, 33k, 5%, 1/4W	01121	CB 3335
R6, 10	0683-1035	RESISTOR, fxd, comp, 10k, 5%, 1/4W	01121	CB 1035
R7, 21	0683-2715	RESISTOR, fxd, comp, 270 ohms, 5%, 1/4W	01121	CB 2715
R9, 13, 27	0683-1025	RESISTOR, fxd, comp, 1k, 5%, 1/4W	01121	CB 1025
R11,12	0683-3915	RESISTOR, fxd, comp, 390 ohms, 5%, 1/4W	01121	CB 3915
R14, 15, 20	0683-4715	RESISTOR, fxd, comp, 470 ohms, 5%, 1/4W	01121	CB 4715
R16	0757-0458	RESISTOR, fxd, met flm, 51.1k, 1%, 1/8W	28480	0757-0458
R17, 23	0683-2235	RESISTOR, fxd, comp, 22k, 5%, 1/4W	01121	CB 2235
R18, 19	0683-7545	RESISTOR, fxd, comp, 750k, 5%, 1/4W	01121	CB 7545
R22	0683-2225	RESISTOR, fxd, comp, 2.2k, 5%, 1/4W	01121	CB 2225
R25, 26	0683-6815	RESISTOR, fxd, comp, 680 ohms, 5%, 1/4W	01121	CB 6815
U11, 14, 25	1820-0077	INTEGRATED CIRCUIT, TTL	01295	SN 7474N
U12,21,24,31	1820-0054	INTEGRATED CIRCUIT, TTL	01295	SN 7400N
U13, 22,34	1820-0239	INTEGRATED CIRCUIT, TTL	28480	1820-0239
U15, 45	1820-0515	INTEGRATED CIRCUIT, TTL	07263	U7B960259X
U23, 42, 44	1820-0174	INTEGRATED CIRCUIT, TTL	01295	SN 7404N
U30	1820-0477	INTEGRATED CIRCUIT	28480	1820-0477
U32	1820-0069	INTEGRATED CIRCUIT, TTL	01295	SN 7420N
U33,35	1820-0537	INTEGRATED CIRCUIT, TTL	28480	1820-0537
U41	1820-0535	INTEGRATED CIRCUIT, TTL	01295	SN 75451
U43	1820-0799	INTEGRATED CIRCUIT	28480	1820-0799
W1, 2	8159-0005	JUMPER	00736	L-2007-1

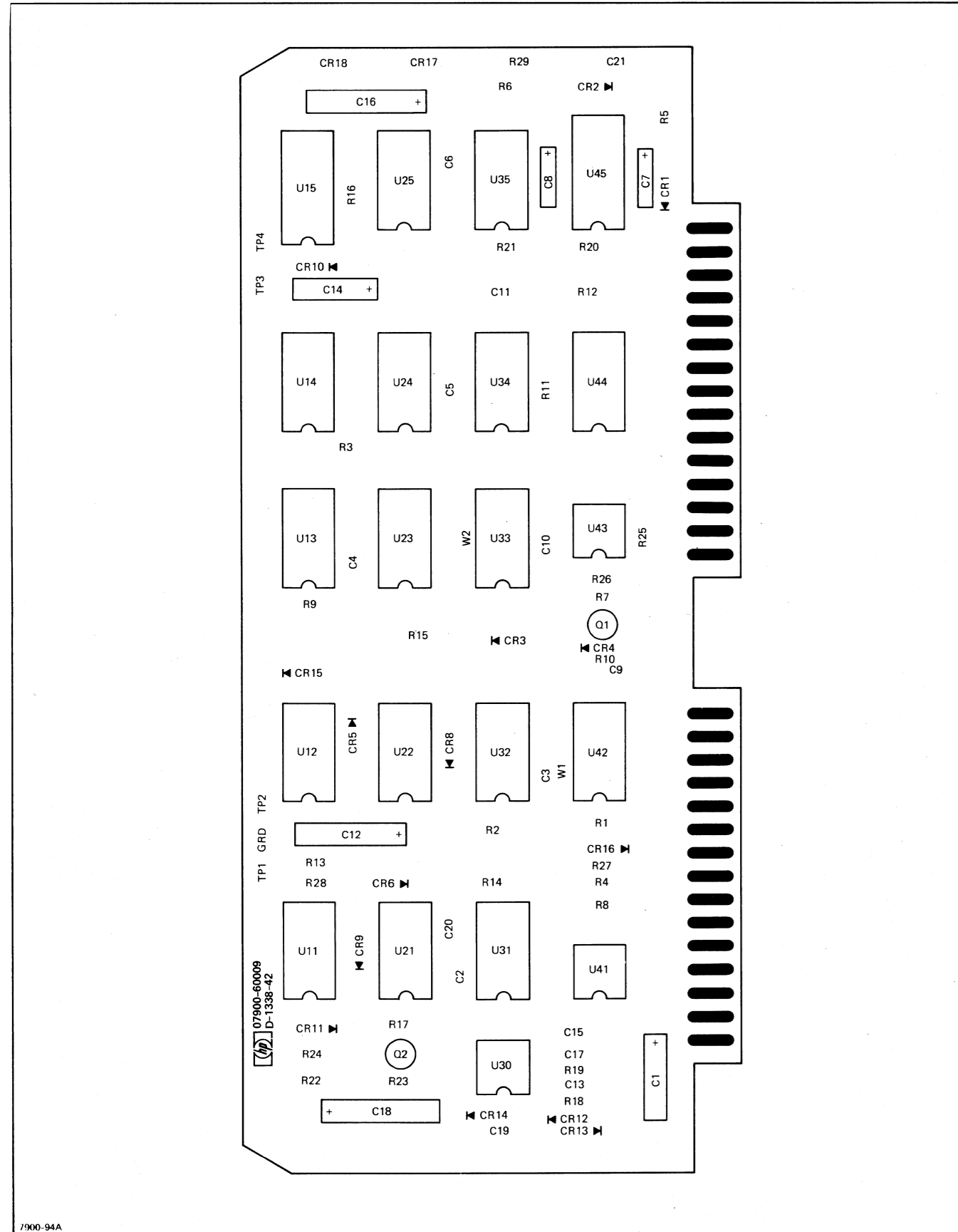


Figure 5-31. Drive Control Assembly A9 Parts Location Diagram

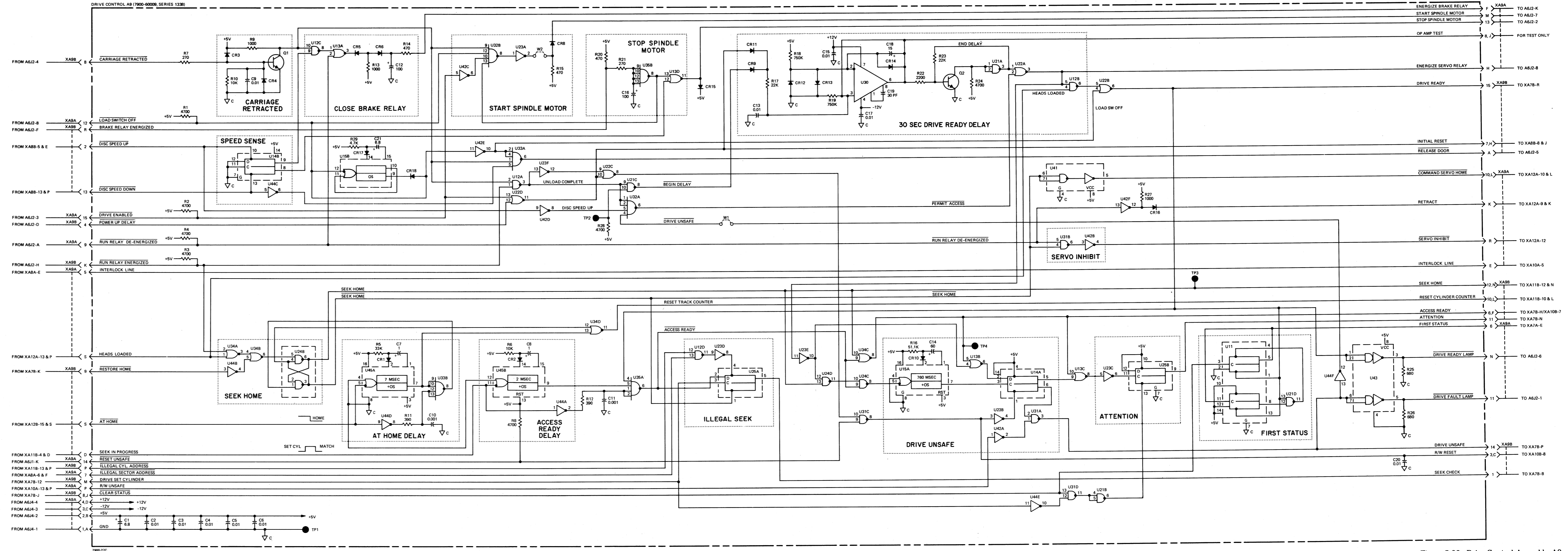


Figure 5-32. Drive Control Assembly A9, Schematic Diagram

Table 5-14. Read/Write Control and Interlock Assembly A10 (07900-60011) Replaceable Parts

REFERENCE DESIGNATION	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.
C1, 5	0180-1746	CAPACITOR, fxd, elect, 15 μ F, 10%, 20 VDCW	28480	0180-1746
C2,3,4,6,9 thru 18	0160-2055	CAPACITOR, fxd, cer, 0.01 μ F, +80-20%, 100 VDCW	56289	C023F101F103ZS22-CDH
C7	0180-0229	CAPACITOR, fxd, elect, 33 μ F, 10%, 10 VDCW	28480	0180-0229
C8	0160-3534	CAPACITOR, fxd, mica, 510 pF, 5%, 100 VDCW	00853	RDM15F511JIC
C19	0160-0297	CAPACITOR, fxd, My, 0.0012 μ F, 10%, 200 VDCW	56289	192P12292-PTS
C20	0160-0155	CAPACITOR, fxd, My, 0.0033 μ F, 10%, 200 VDCW	56289	192P33292-PTS
C21	0160-0229	CAPACITOR, fxd, My, 1800 pF, 10%, 200 VDCW	56289	192P18292-PTS
CR1	1902-0041	DIODE, breakdown, 5.11V, 5%	04713	SZ10939-98
CR2	1901-0044	DIODE, silicon, 20 mA/1V	28480	1901-0044
Q1, 3, 6	1854-0045	TRANSISTOR, silicon, NPN	04713	2N956
Q2, 4, 5	1853-0010	TRANSISTOR, silicon, PNP	28480	1853-0010
R1, 2	0698-3441	RESISTOR, fxd, met flm, 215 ohms, 1%, 1/8W	28480	0698-3441
R3	0757-0198	RESISTOR, fxd, met flm, 100 ohms, 1%, 1/2W	28480	0757-0198
R4	0698-3446	RESISTOR, fxd, met flm, 383 ohms, 1%, 1/8W	28480	0698-3446
R5,6,13,20,21,22	0757-0438	RESISTOR, fxd, met flm, 5.11k, 1%, 1/8W	28480	0757-0438
R7	0757-0416	RESISTOR, fxd, met flm, 511 ohms, 1%, 1/8W	28480	0757-0416
R8	0757-0290	RESISTOR, fxd, met flm, 6.19k, 1%, 1/8W	28480	0757-0290
R9	0698-4037	RESISTOR, fxd, met flm, 46.4 ohms, 1%, 1/8W	28480	0698-4037
R10, 12, 19	0757-0280	RESISTOR, fxd, met flm, 1k, 1%, 1/8W	28480	0757-0280
R11	0757-0442	RESISTOR, fxd, met flm, 10k, 1%, 1/8W	28480	0757-0442
R14, 18	0757-0441	RESISTOR, fxd, met flm, 8.25k, 1%, 1/8W	28480	0757-0441
R15	0698-3136	RESISTOR, fxd, met flm, 17.8k, 1%, 1/8W	28480	0698-3136
R16	0698-0084	RESISTOR, fxd, met flm, 2.15k, 1%, 1/8W	28480	0698-0084
R17	0757-0289	RESISTOR, fxd, met flm, 13.3k, 1%, 1/8W	28480	0757-0289
U11, 21, 24, 32	1820-0054	INTEGRATED CIRCUIT, TTL	01295	SN 7400N
U12, 22	1820-0069	INTEGRATED CIRCUIT, TTL	01295	SN 7420N
U13, 23	1820-0537	INTEGRATED CIRCUIT, TTL	28480	1820-0537
U14, 44	1820-0239	INTEGRATED CIRCUIT, TTL	28480	1820-0239
U15	1820-0077	INTEGRATED CIRCUIT, TTL	01295	SN 7474N
U25, 35	1820-0398	INTEGRATED CIRCUIT	12040	LM710C
U31	1820-0722	INTEGRATED CIRCUIT, TTL	01295	SN 75109N
U33	1820-0174	INTEGRATED CIRCUIT, TTL	01295	SN 7404N
U34	1820-0577	INTEGRATED CIRCUIT, TTL	01295	SN 7416N
U41	1820-0723	INTEGRATED CIRCUIT, TTL	01295	SN 75107N
U42	1820-0068	INTEGRATED CIRCUIT, TTL	12040	SN 7410N
U43	1820-0141	INTEGRATED CIRCUIT, TTL	04713	MC3001P
U45	1820-0514	INTEGRATED CIRCUIT, TTL	01295	SN 7426N

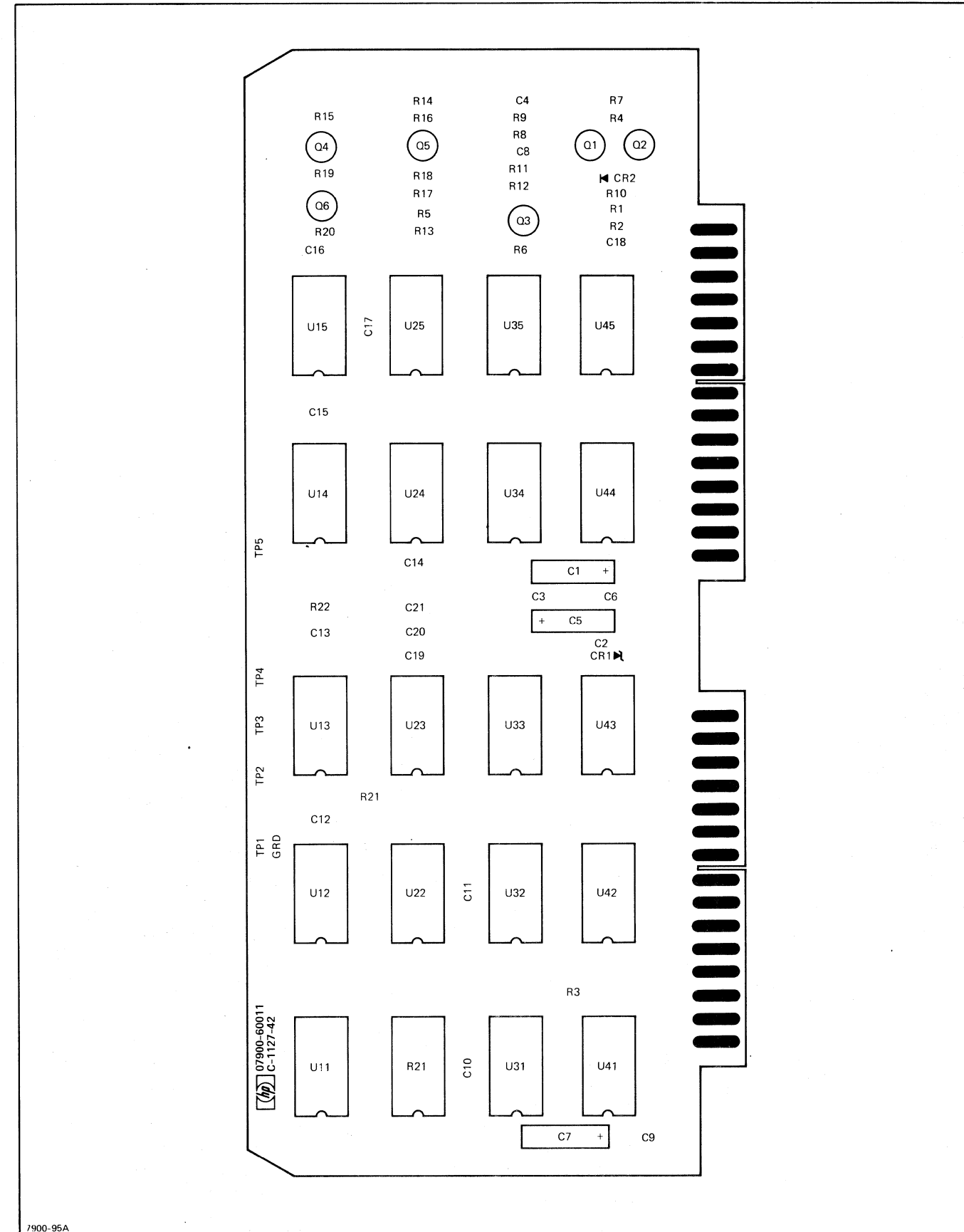


Figure 5-33. Read/Write Control and Interlock Assembly A10 Parts Location Diagram

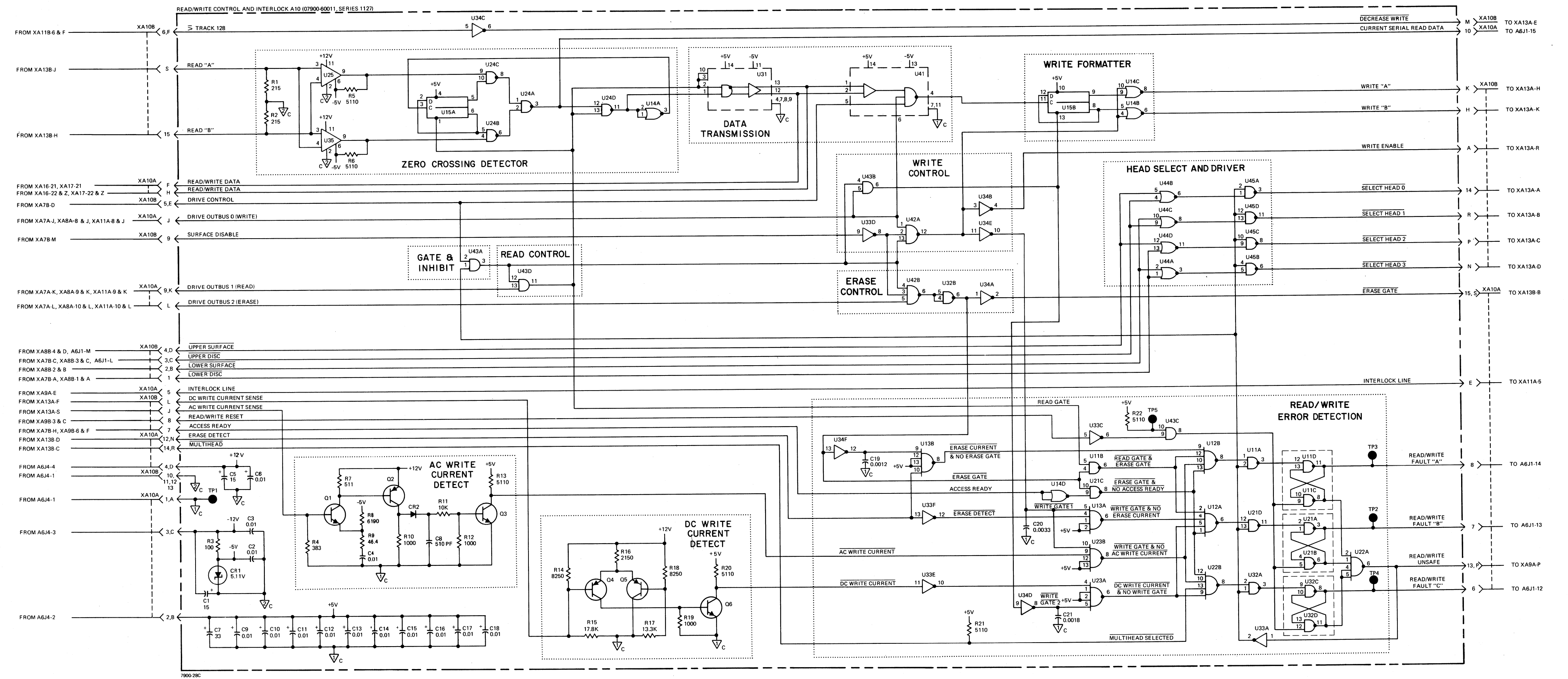


Figure 5-34. Read/Write Control and Interlock Assembly A10, Schematic Diagram

Table 5-15. Cylinder Address Assembly A11 (07900-60052) Replaceable Parts

REFERENCE DESIGNATION	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.
C1	0180-0116	CAPACITOR, fxd, elect, 6.8 μ F, 10%, 35 VDCW	56289	150D685X9035B2-DYS
C2 thru 7, 9	0160-2055	CAPACITOR, fxd, cer, 0.01 μ F, +80-20%, 100 VDCW	56289	C023F101F103ZS22-CDH
C8	0160-3456	CAPACITOR, fxd, cer, 0.001 μ F, 10%, 250 VDCW	56289	C067F251F102KE12-CDH
C10	0160-2199	CAPACITOR, fxd, mica, 30 pF, 5%, 300 VDCW	28480	0160-2199
C11	0160-0159	CAPACITOR, fxd, My, 0.0068 μ F, 10%, 200 VDCW	56289	192P68282-PTS
CR1 thru 13	1901-0040	DIODE, silicon, 30 mA, 30 VDCW	07263	FDG1088
Q1, 2	1853-0010	TRANSISTOR, silicon, PNP	28480	1853-0010
R1 thru 8	0683-4715	RESISTOR, fxd, comp, 470 ohms, 5%, 1/4W	01121	CB 4715
R9	0698-3457	RESISTOR, fxd, met flm, 316k, 1%, 1/8W	28480	0698-3457
R10	0698-5092	RESISTOR, fxd, flm, 160k, 1%, 1/8W	28480	0698-5092
R11	0698-3201	RESISTOR, fxd, flm, 80k, 1%, 1/8W	28480	0698-3201
R12	0698-4008	RESISTOR, fxd, met flm, 40k, 1%, 1/8W	28480	0698-4008
R13	0757-0449	RESISTOR, fxd, flm, 20k, 1%, 1/8W	28480	0757-0449
R14	0757-0442	RESISTOR, fxd, met flm, 10k, 1%, 1/8W	28480	0757-0442
R15, 16	0698-4002	RESISTOR, fxd, met flm, 5k, 1%, 1/8W	28480	0698-4002
R17, 23	0683-2225	RESISTOR, fxd, comp, 2.2k, 5%, 1/4W	01121	CB 2225
R18	0683-1055	RESISTOR, fxd, comp, 1M, 5%, 1/4W	01121	CB 1055
R19, 22, 27	0698-3162	RESISTOR, fxd, met flm, 46.4k, 1%, 1/8W	28480	0698-3162
R20	0683-1515	RESISTOR, fxd, comp, 150 ohms, 5%, 1/4W	01121	CB 1515
R21	0757-0447	RESISTOR, fxd, met flm, 16.2k, 1%, 1/8W	28480	0757-0447
R24	0757-0459	RESISTOR, fxd, met flm, 56.2k, 1%, 1/8W	28480	0757-0459
R25	0757-0289	RESISTOR, fxd, met flm, 13.3k, 1%, 1/8W	28480	0757-0289
R26	0757-0123	RESISTOR, fxd, met flm, 34.8k, 1%, 1/8W	28480	0757-0123
R28, 30	0757-0401	RESISTOR, fxd, met flm, 100 ohms, 1%, 1/8W	28480	0757-0401
R29	0757-0280	RESISTOR, fxd, met flm, 1k, 1%, 1/8W	28480	0757-0280
R31	0757-0403	RESISTOR, fxd, met flm, 121 ohms, 1%, 1/8W	28480	0757-0403
R32	0698-3439	RESISTOR, fxd, met flm, 178 ohms, 1%, 1/8W	28480	0698-3439
R33	0698-3440	RESISTOR, fxd, met flm, 196 ohms, 1%, 1/8W	28480	0698-3440
R34	0698-3437	RESISTOR, fxd, met flm, 133 ohms, 1%, 1/8W	28480	0698-3437
R35	0698-3441	RESISTOR, fxd, met flm, 215 ohms, 1%, 1/8W	28480	0698-3441
R36	2100-2521	RESISTOR, var, flm, 2k, 10%, lin, 1/2W	28480	2100-2521
U13	1820-0537	INTEGRATED CIRCUIT, TTL	28480	1820-0537
U22, 25	1820-0233	INTEGRATED CIRCUIT, TTL	01295	SN 74193N
U23, 36	1820-0239	INTEGRATED CIRCUIT, TTL	28480	1820-0239
U24, 47	1820-0054	INTEGRATED CIRCUIT, TTL	01295	SN 7400N
U26	1820-0174	INTEGRATED CIRCUIT, TTL	01295	SN 7404N
U31	1820-0477	INTEGRATED CIRCUIT	28480	1820-0477
U32, 35	1820-0305	INTEGRATED CIRCUIT	01295	SN 7483N
U33, 34	1820-0282	INTEGRATED CIRCUIT, TTL	01295	SN 7486N
U42, 45	1820-0301	INTEGRATED CIRCUIT, TTL	01295	SN 7475N
U43, 44	1820-0511	INTEGRATED CIRCUIT, TTL	01295	SN 7408N
U46	1820-0068	INTEGRATED CIRCUIT, TTL	12040	SN 7410N

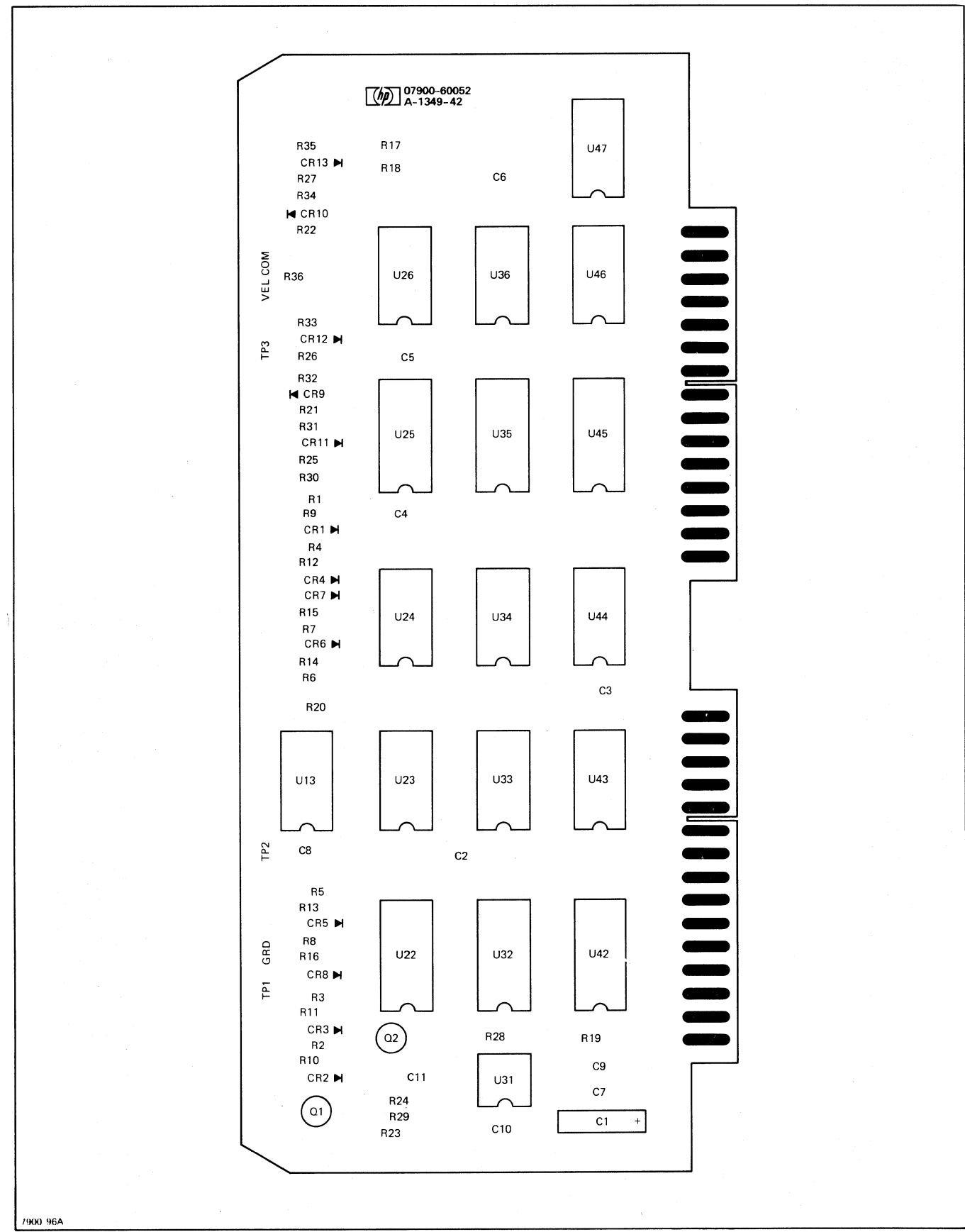


Figure 5-35. Cylinder Address Assembly A11 Parts Location Diagram

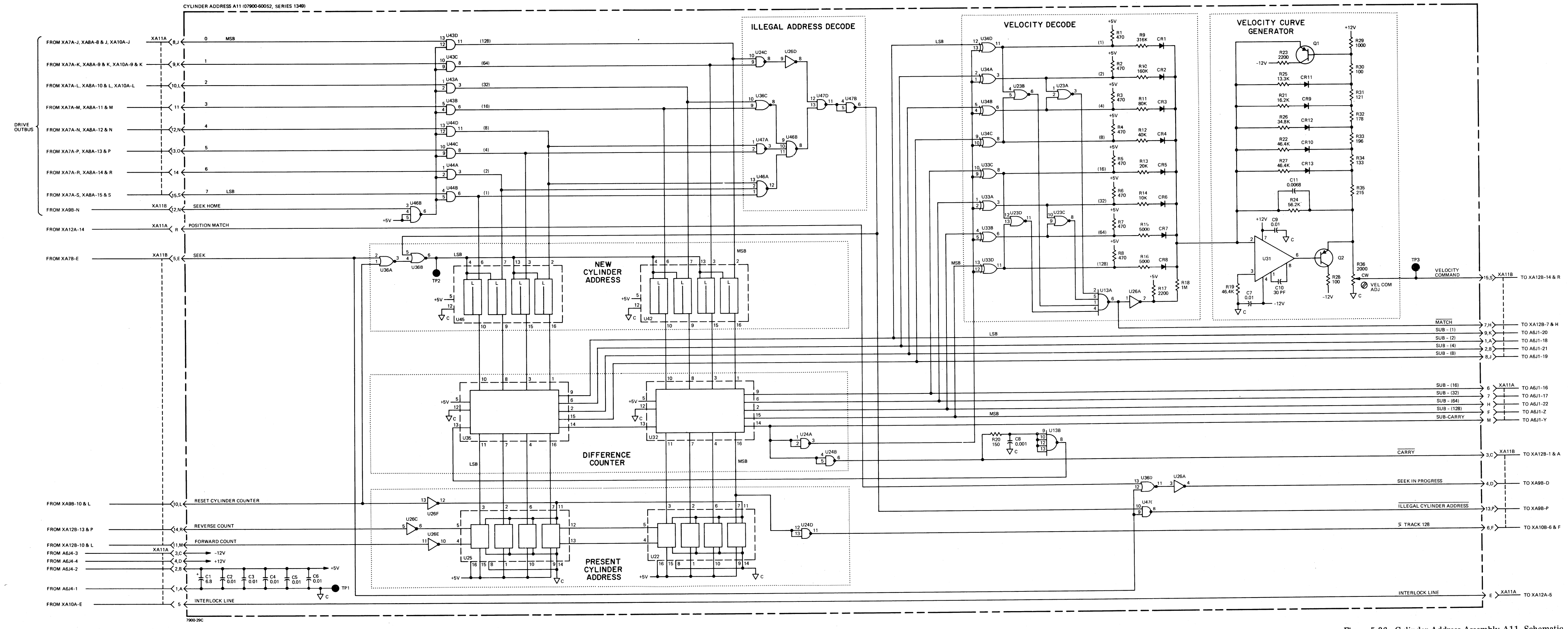


Figure 5-36. Cylinder Address Assembly A11, Schematic Diagram

Table 5-16. Encoder Assembly A12 (07900-60053) Replaceable Parts

REFERENCE DESIGNATION	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.
C1,4,5	0180-0116	CAPACITOR, fxd, elect, 6.8 μ F, 10%, 35 VDCW	56289	150D685X9035B2-DYS
C2,3,6,7,8,10,11, 13,18,19,21 thru 26	0160-2055	CAPACITOR, fxd, cer, 0.01 μ F, +80-20%, 100 VDCW	56289	C023F101F103ZS22-CDH
C9,12,14	0160-2150	CAPACITOR, fxd, mica, 33 pF, 5%	28480	0160-2150
C15	0180-0374	CAPACITOR, fxd, Ta, 10 μ F, 10%, 20 VDCW	56289	150D106X9020B2-DYS
C16,17	0160-0153	CAPACITOR, fxd, My, 0.001 μ F, 10%, 200 VDCW	56289	192P10292-PTS
C20	0160-0163	CAPACITOR, fxd, My, 0.033 μ F, 10%, 200 VDCW	56289	192P33392-PTS
CR1,2,3,6 thru 11	1901-0040	DIODE, silicon, 30 mA, 30 VDCW	07263	FDG 1088
CR4,5,12,13,15	1901-0460	DIODE, silicon	03508	STB523
CR14	1902-3059	DIODE, breakdown, silicon, 3.83V, 5%	28480	1902-3059
Q1 thru 4	1854-0071	TRANSISTOR, silicon	28480	1854-0071
Q5 thru 8	1855-0056	TRANSISTOR, silicon, FET	80131	2N4342
Q9	1854-0215	TRANSISTOR, silicon	80131	2N3904
R1, 2	2100-2514	RESISTOR, var, cermet, 20k, 10%, lin, 1/2W	28480	2100-2514
R3, 4	0683-1055	RESISTOR, fxd, comp, 1M, 5%, 1/4W	01121	CB 1055
R5, 7	0683-5645	RESISTOR, fxd, comp, 560k, 5%, 1/4W	01121	CB 5645
R6	0683-3945	RESISTOR, fxd, comp, 390k, 5%, 1/4W	01121	CB 3945
R8	2100-2489	RESISTOR, var, flm, 5k, 10%, lin, 1/2W	28480	2100-2489
R10, 51	0698-4002	RESISTOR, fxd, met flm, 5k, 1%, 1/8W	28480	0698-4002
R11	0698-3457	RESISTOR, fxd, met flm, 316k, 1%, 1/8W	28480	0698-3457
R12,14,15,18,19, 20,23,32	0683-4725	RESISTOR, comp, 4.7k, 5%, 1/4W	01121	CB 4725
R13	0686-4715	RESISTOR, fxd, comp, 470 ohms, 5%, 1/2W	01121	EB 4715
R16,17,27,64	0683-2235	RESISTOR, fxd, comp, 22k, 5%, 1/4W	01121	CB 2235
R21	0683-4735	RESISTOR, fxd, comp, 47k, 5%, 1/4W	01121	CB 4735
R22	0683-3335	RESISTOR, fxd, comp, 33k, 5%, 1/4W	01121	CB 3335
R24,33	0683-1015	RESISTOR, fxd, comp, 100 ohms, 5%, 1/4W	01121	CB 1015
R25,31	0683-6825	RESISTOR, fxd, comp, 6.8k, 5%, 1/4W	01121	CB 6825
R26,29,38,40,50, 52,55 thru 58	0683-1035	RESISTOR, fxd, comp, 10k, 5%, 1/4W	01121	CB 1035
R28	0683-3935	RESISTOR, fxd, comp, 39k, 5%, 1/4W	01121	CB 3935
R30	0757-0439	RESISTOR, fxd, met flm, 6.81k, 1%, 1/8W	28480	0757-0439
R34	0757-0434	RESISTOR, fxd, met flm, 3.65k, 1%, 1/8W	28480	0757-0434
R35,41,46,54	0757-0449	RESISTOR, fxd, flm, 20k, 1%, 1/8W	28480	0757-0449
R36,62,63	0683-4745	RESISTOR, fxd, comp, 470k, 5%, 1/4W	01121	CB 4745
R37,39,43,45	0683-1025	RESISTOR, fxd, comp, 1k, 5%, 1/4W	01121	CB 1025
R42,53	0757-0442	RESISTOR, fxd, met flm, 10k, 1%, 1/8W	28480	0757-0442
R44	0757-0458	RESISTOR, fxd, met flm, 51.1k, 1%, 1/8W	28480	0757-0458
R47	0757-0465	RESISTOR, fxd, met flm, 100k, 1%, 1/3W	28480	0757-0465
R48	0683-8235	RESISTOR, fxd, comp, 82k, 5%, 1/4W	01121	EB 8235
R49	0683-3645	RESISTOR, fxd, comp, 360k, 5%, 1/4W	28480	0683-3645
R59	0683-2745	RESISTOR, fxd, comp, 270k, 5%, 1/4W	28480	0683-2745
R60	0757-0280	RESISTOR, fxd, met flm, 1k, 1%, 1/8W	28480	0757-0280
R65	0683-6835	RESISTOR, fxd, met flm, 68k, 5%, 1/4W	01121	CB 4745
R66,67	0683-4725	RESISTOR, fxd, comp, 4.7k, 5%, 1/4W	01121	CB 4725
R68	0683-4735	RESISTOR, fxd, comp, 47k, 5%, 1/4W	01121	CB 4735
U1,2,7,11	1820-0493	INTEGRATED CIRCUIT	12040	LM307N
U3	1820-0174	INTEGRATED CIRCUIT, TTL	01295	SN 7404N
U4,5,10	1820-0239	INTEGRATED CIRCUIT, TTL	28480	1820-0239
U6,8	1820-0054	INTEGRATED CIRCUIT, TTL	01295	SN 7400N
U9,12	1826-0068	INTEGRATED CIRCUIT	28480	1826-0068
U13	1820-0577	INTEGRATED CIRCUIT, TTL	01295	SN 7416N
U14	1820-0477	INTEGRATED CIRCUIT	28480	1820-0477

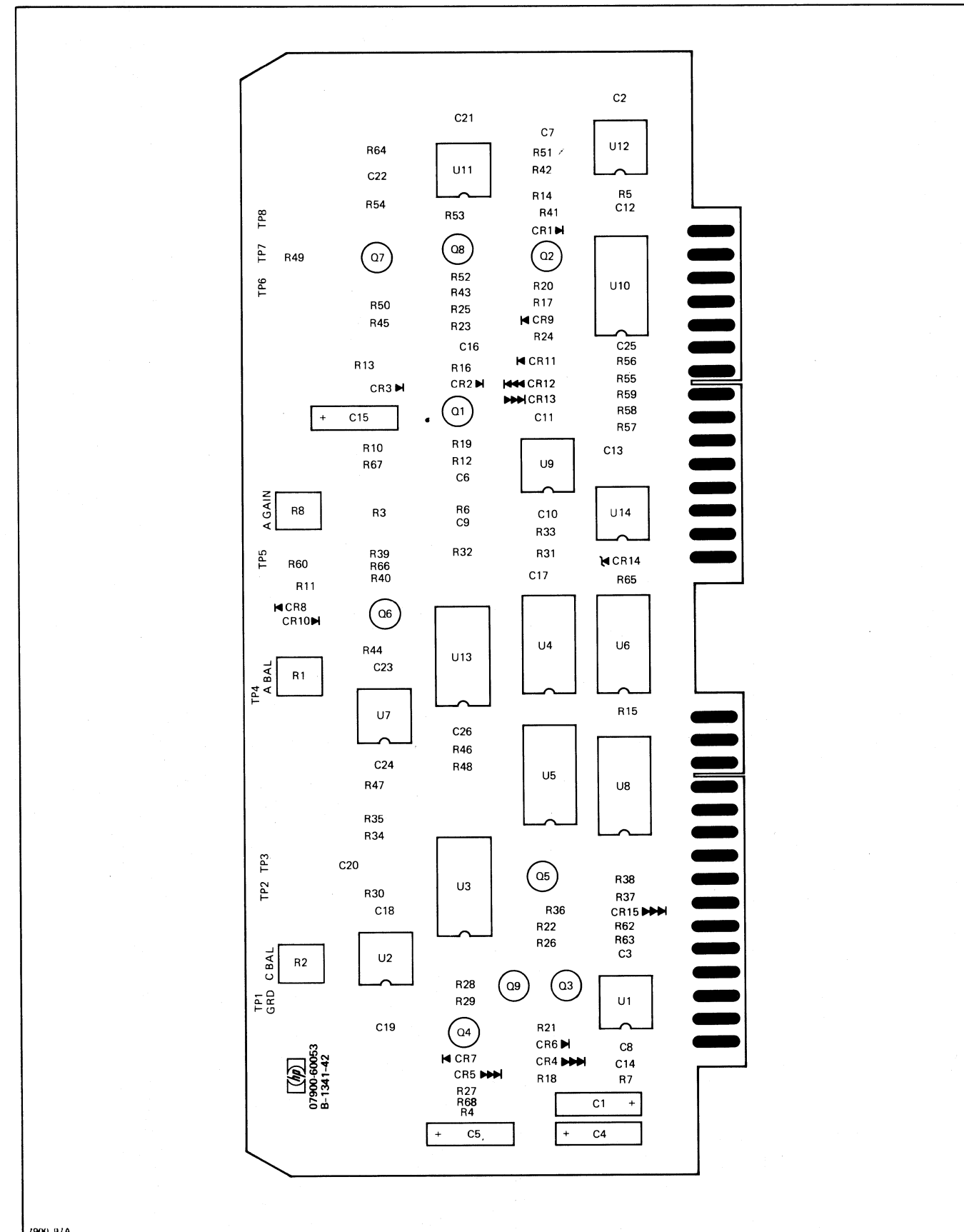


Figure 5-37. Encoder Assembly A12 Parts Location Diagram

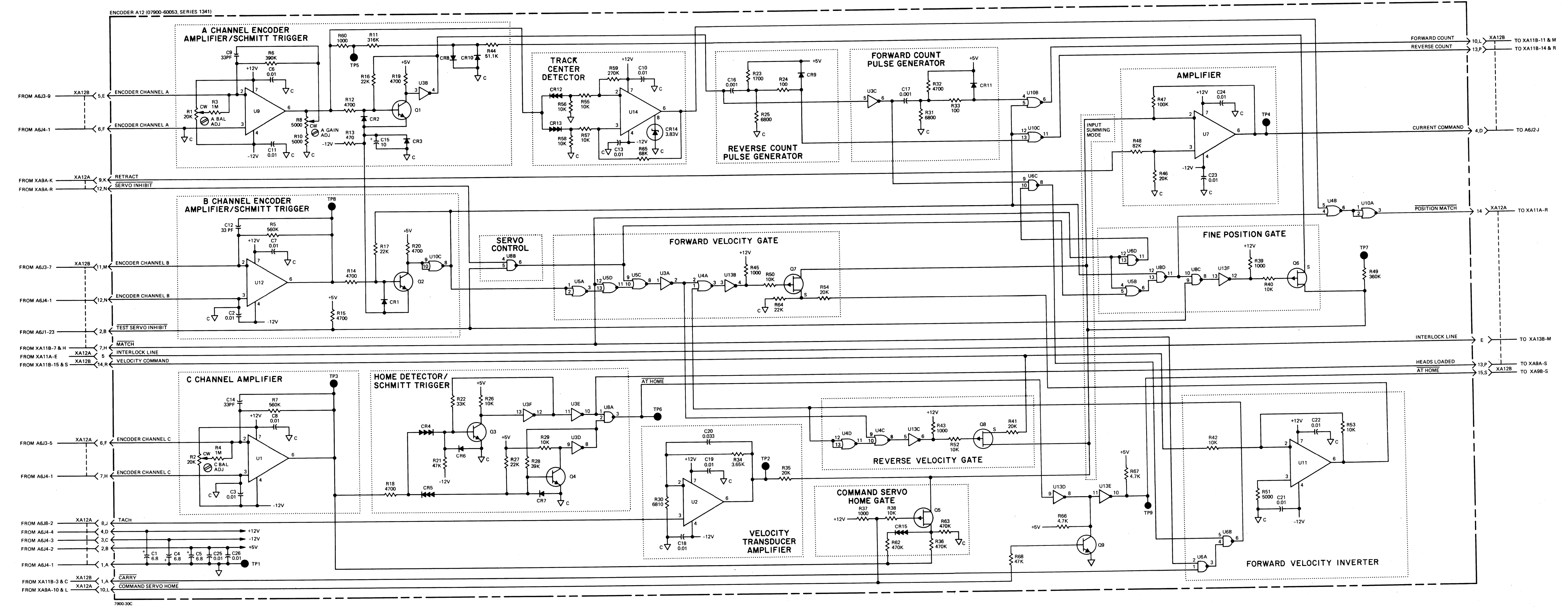


Figure 5-38. Encoder Assembly A12, Schematic Diagram

Table 5-17. Read Preamp and Write Driver Assembly A13 (07900-60006) Replaceable Parts

REFERENCE DESIGNATION	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.
C1	0160-3456	CAPACITOR, fxd, cer, 0.001 μ F, 10%, 250 VDCW	56289	C067F251F102KE12-CDH
C2, 3	0180-1746	CAPACITOR, fxd, elect, 15 μ F, 10%, 20 VDCW	28480	0180-1746
C4	0160-0298	CAPACITOR, fxd, My, 0.0015 μ F, 10%, 200 VDCW	56289	192P15292-PTS
C5, 6, 19, 20	0150-0121	CAPACITOR, fxd, cer, 0.1 μ F, +80-20%, 50 VDCW	56289	5C50BIS-CML
C7,11,12,15,16,21	0160-2055	CAPACITOR, fxd, cer, 0.01 μ F, +80-20%, 100 VDCW	56289	C023F101F103ZS22-CDH
C8	0160-2197	CAPACITOR, fxd, mica, 10 pF, 5%	72136	RDM15C100J3C
C9, 10	0160-2199	CAPACITOR, fxd, mica, 30 pF, 5%, 300 VDCW	28480	0160-2199
C13	0140-0193	CAPACITOR, fxd, mica, 82 pF, 5%	28480	0140-0193
C14	0160-2255	CAPACITOR, fxd, cer, 8.2 pF, 500 VDCW	72982	301-000-COHO-829C
C17, 18	0160-2198	CAPACITOR, fxd, mica, 20 pF, 5%	72136	RDM15C200J3C
CR1, 2	1902-0049	DIODE, breakdown, 6.19V, 5%	04713	SZ10939-122
CR3 thru 6, 9 thru 22, 24	1901-0450	DIODE, silicon, 30 mA, 30 VDCW	07263	FDG 1088
CR7, 8	1902-3149	DIODE, breakdown, 9.09V, 5%	28480	1902-3149
CR23	1902-3003	DIODE, breakdown, 2.37V, 2%	04713	SZ10939-3
L1, 2	9100-1627	COIL/CHOKE, 39 μ H, 5%	82142	15-1315-2J
L3, 4	9100-1623	COIL/CHOKE, 27 μ H, 5%	99800	1537-48
Q1 thru 5, 8, 9, 16	1853-0010	TRANSISTOR, silicon, PNP	28480	1853-0010
Q6, 7, 11, 15, 17, 18	1854-0045	TRANSISTOR, silicon, NPN	04713	2N956
Q10, 14	1854-0260	TRANSISTOR, silicon, NPN	28480	1854-0260
Q12, 13	1855-0078	TRANSISTOR, silicon, FET	28480	1855-0078
R1, 3, 5, 7, 38	0757-0274	RESISTOR, fxd, met flm, 1.21k, 1%, 1/8W	28480	0757-0274
R2,4,6,8,10,24	0757-0418	RESISTOR, fxd, met flm, 619 ohms, 1%, 1/8W	28480	0757-0418
R9, 42	0698-3150	RESISTOR, fxd, met flm, 2.37k, 1%, 1/8W	28480	0698-3150
R11	0698-3399	RESISTOR, fxd, met flm, 133 ohms, 1%, 1/2W	28480	0698-3399
R12	0757-0198	RESISTOR, fxd, met flm, 100 ohms, 1%, 1/2W	28480	0757-0198
R13 thru 16, 39, 40	0757-0465	RESISTOR, fxd, met flm, 100k, 1%, 1/8W	28480	0757-0465
R17, 18	0757-0799	RESISTOR, fxd, met flm, 121 ohms, 1%, 1/2W	28480	0757-0799
R19	0757-0199	RESISTOR, fxd, met flm, 21.5k, 1%, 1/8W	28480	0757-0199
R20, 26	0698-3151	RESISTOR, fxd, met flm, 2.87k, 1%, 1/8W	28480	0698-3151
R21, 45, 46	0757-0428	RESISTOR, fxd, met flm, 1.62k, 1%, 1/8W	28480	0757-0428
R22	0698-3441	RESISTOR, fxd, met flm, 215 ohms, 1%, 1/8W	28480	0698-3441
R23	0757-0441	RESISTOR, fxd, met flm, 8.25k, 1%, 1/8W	28480	0757-0441
R25	0761-0037	RESISTOR, fxd, met ox, 390 ohms, 5%, 1W	28480	0761-0037
R27, 33	0698-3157	RESISTOR, fxd, met flm, 19.6k, 1%, 1/8W	28480	0698-3157
R28, 32	0757-0438	RESISTOR, fxd, met flm, 5.11k, 1%, 1/8W	28480	0757-0438
R29	0757-0458	RESISTOR, fxd, met flm, 51.1k, 1%, 1/8W	28480	0757-0458
R30, 41	0698-4037	RESISTOR, fxd, met flm, 46.4 ohms, 1%, 1/8W	28480	0698-4037
R31, 34, 53, 54	0757-0280	RESISTOR, fxd, met flm, 1k, 1%, 1/8W	28480	0757-0280
R35	0757-0418	RESISTOR, fxd, met flm, 619 ohms, 1%, 1/8W	28480	0757-0418
R36	0757-0442	RESISTOR, fxd, met flm, 10k, 1%, 1/8W	28480	0757-0442
R37	0757-0401	RESISTOR, fxd, met flm, 100 ohms, 1%, 1/8W	28480	0757-0401
R43, 44	0757-0447	RESISTOR, fxd, met flm, 16.2k, 1%, 1/8W	28480	0757-0447
R47, 48	0683-1005	RESISTOR, fxd, comp, 10 ohms, 5%, 1/4W	01121	CB 1005
R49, 50	0757-0416	RESISTOR, fxd, met flm, 511 ohms, 1%, 1/8W	28480	0757-0416
R51, 52	0698-3156	RESISTOR, fxd, flm, 14.7k, 1%, 1/8W	28480	0698-3156
R55, 56	0757-0279	RESISTOR, fxd, met flm, 3.16k, 1%, 1/8W	28480	0757-0279
R57, 58	0698-3132	RESISTOR, fxd, flm, 261 ohms, 1%, 1/8W	28480	0698-3132
U1	1826-0064	INTEGRATED CIRCUIT	07263	U6A7733393
U2	1820-0192	INTEGRATED CIRCUIT	28480	1820-0192

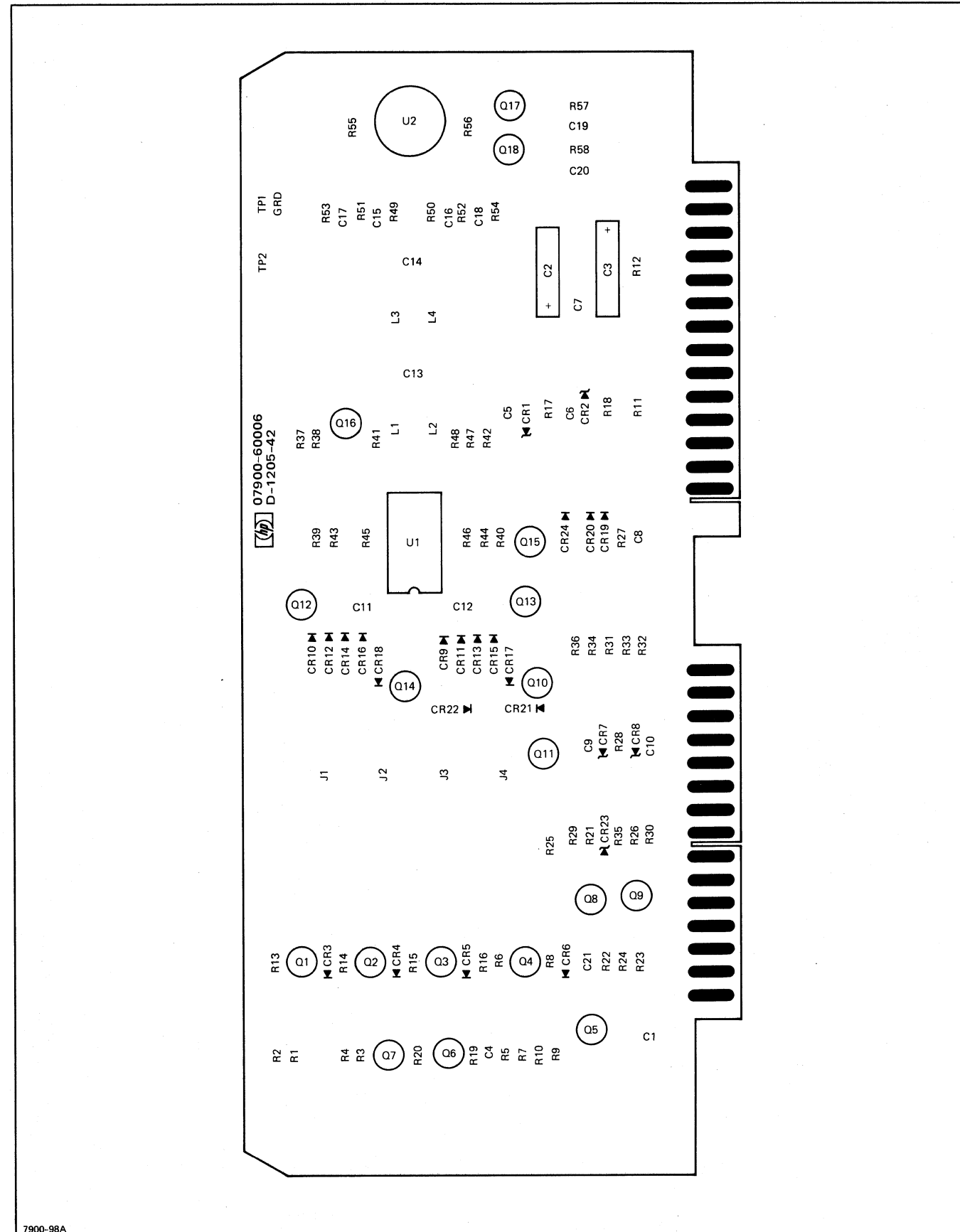


Figure 5-39. Read Preamp and Write Driver Assembly A13 Parts Location Diagram

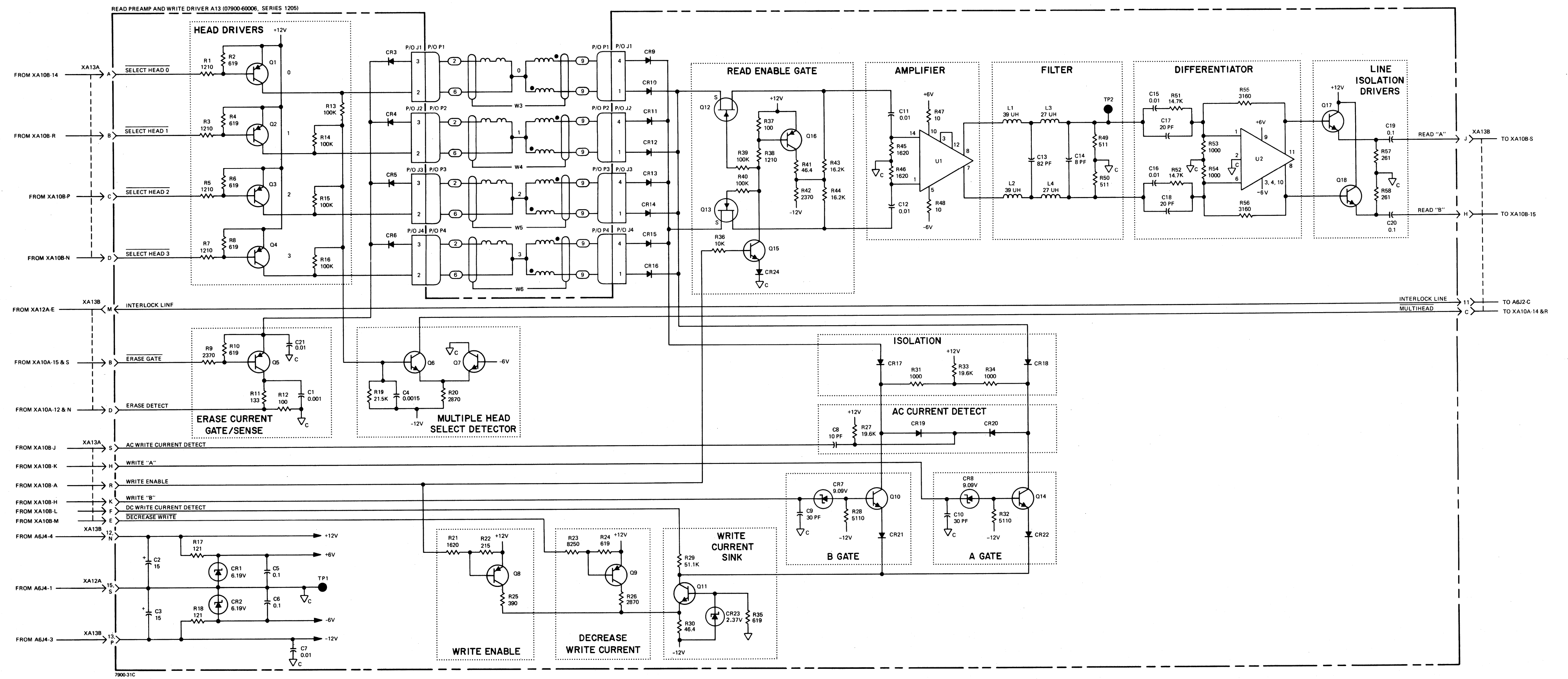


Figure 5-40. Read Preamp and Write Driver Assembly A13, Schematic Diagram

Table 5-18. DC Brake Assembly A14 (07900-60050) Replaceable Parts

REFERENCE DESIGNATION	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.
C1	0180-0136	CAPACITOR, fxd, elect, 10 μ F, -10 +100%, 50 VDCW	56289	40D106F050DC4M1
C2	0160-2055	CAPACITOR, fxd, cer, 0.01 μ F, +80 -20%, 100 VDCW	56289	C023F101F103ZS22-CDH
C3	0180-0141	CAPACITOR, fxd, elect, 50 μ F, +75 -10%, 50 VDCW	56289	30D506G050DD2-DSM
C4	0160-0269	CAPACITOR, fxd, cer, 0.1 μ F, 20%, 500 VDCW	56289	41C92A10-CDH
C5, 6	0160-0904	CAPACITOR, fxd, cer, 0.05 μ F, 20%, 1000 VDCW	56289	41C169A4-CDH
*C7	0150-0121	CAPACITOR, fxd, cer, 0.1 μ F, +80 -20%, 50 VDCW	56289	5C50B1-CML
CR1, 2	1901-0040	DIODE, silicon, 30 mA, 30 VDCW	07263	FDG 1088
CR3 thru 6,10,11	1901-0049	DIODE, silicon, 50 PIV	28480	1901-0049
CR7, 8, 9	1901-0418	DIODE, silicon, 400 PIV	04713	IN5000
K1	0490-1052	RELAY, 470 ohms, 10A, 24V coil	77342	KUP14D17
K2	0490-0984	RELAY, 470 ohms, 5A, 24V coil	77342	KUP14D13
Q1,5 thru 8	1854-0215	TRANSISTOR, silicon, NPN	80131	2N3904
Q2	1853-0020	TRANSISTOR, silicon, PNP	28480	1853-0020
Q3	1854-0039	TRANSISTOR, silicon, NPN	80131	2N3053
Q4	1854-0072	TRANSISTOR, silicon, NPN	80131	2N3054
R1, 3, 17, 18	0683-1035	RESISTOR, fxd, comp, 10k, 5%, 1/4W	01121	CB 1035
R2, 5, 15, 16	0683-2235	RESISTOR, fxd, comp, 22k, 5%, 1/4W	01121	CB 2235
R4	0683-4725	RESISTOR, fxd, comp, 4.7k, 5%, 1/4W	01121	CB 4725
R6	0683-4715	RESISTOR, fxd, comp, 470 ohms, 5%, 1/4W	01121	CB 4715
R7	0683-1015	RESISTOR, fxd, comp, 100 ohms, 5%, 1/4W	01121	CB 1015
R8 thru 11	0811-1666	RESISTOR, fxd, ww, 1.0 ohm, 5%, 2W	28480	0811-1666
R12	0683-6825	RESISTOR, fxd, comp, 6.8k, 5%, 1/4W	01121	CB 6825
R13, 14	6083-3325	RESISTOR, fxd, comp, 3.3k, 5%, 1/4W	01121	CB 3325
R19, 20	0683-0475	RESISTOR, fxd, comp, 4.7 ohms, 5%, 1/4W	01121	CB47G5

*C7 used only on series codes 1418 and higher.

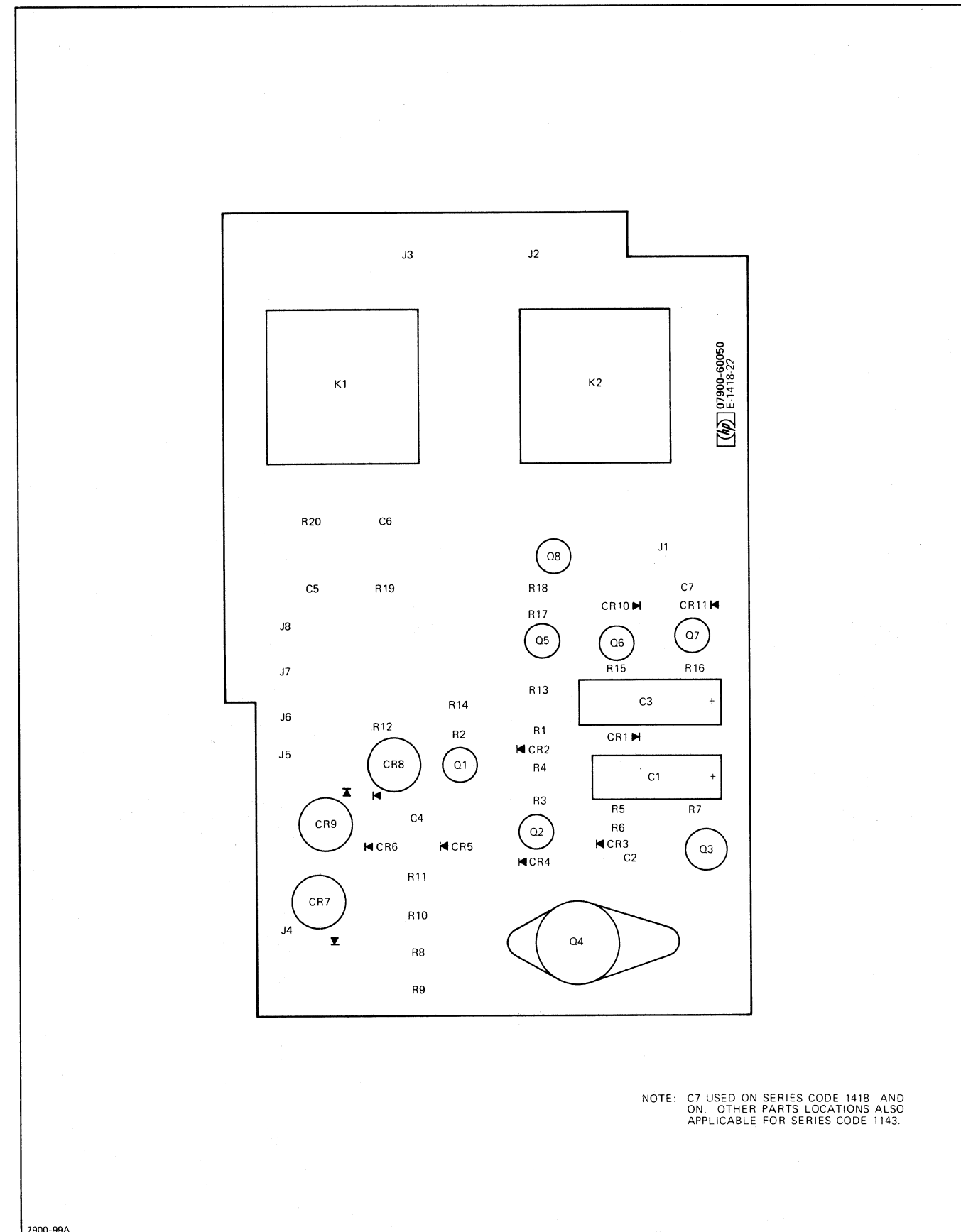


Figure 5-41. DC Brake Assembly A14 Parts Location Diagram

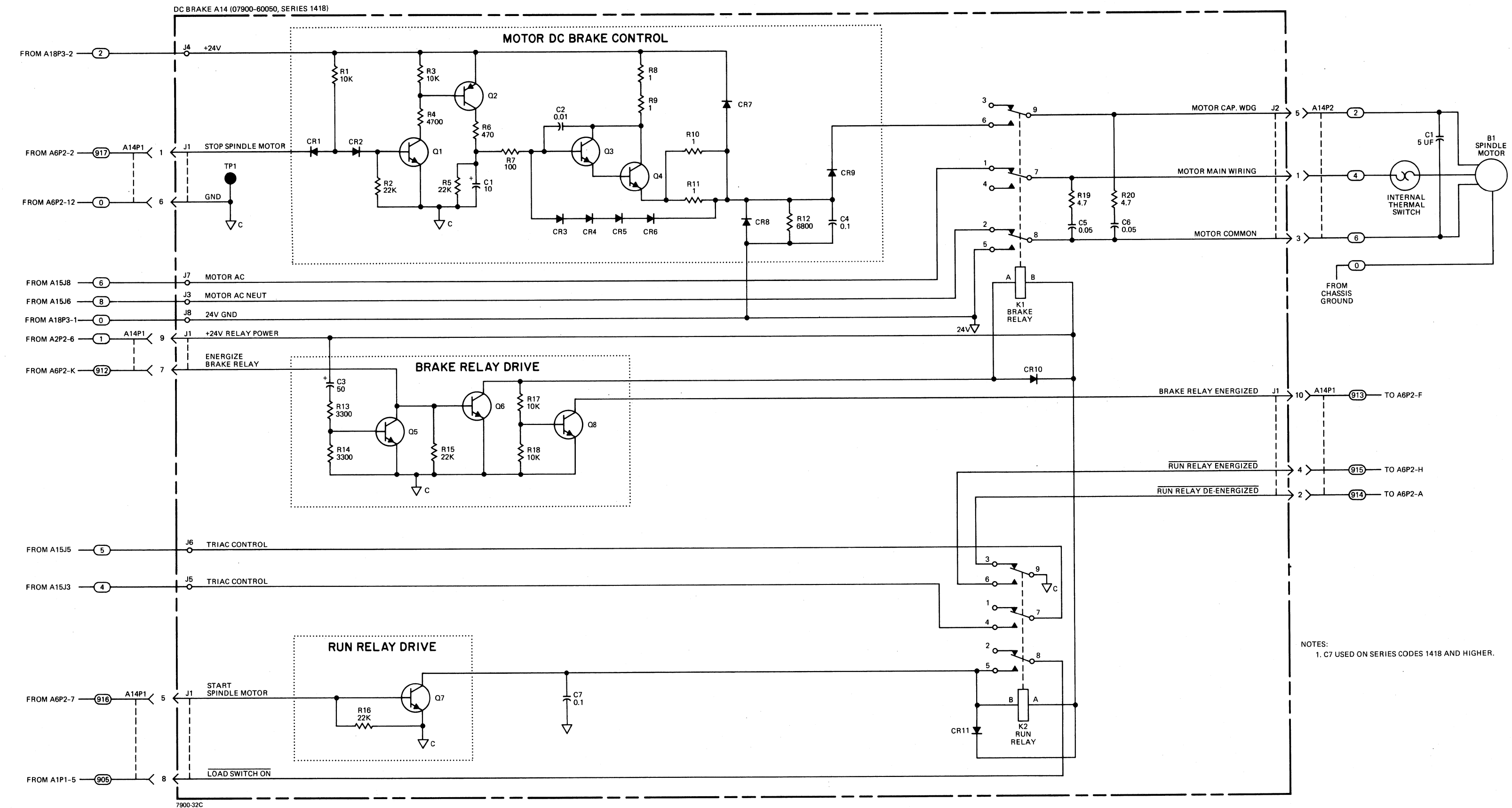


Figure 5-42. DC Brake Assembly A14, Schematic Diagram

Table 5-19. Motor Control Assembly A15 (07900-60057) Replaceable Parts

REFERENCE DESIGNATION	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.
C1, 4	0160-0269	CAPACITOR, fxd, cer, 0.1 μ F, 20%, 500 VDCW	56289	41C92A10-CDH
C3	0160-3043	CAPACITOR, fxd, cer, 2 x 0.005 μ F, 20%, 250 VAC	56289	29C147A-CDH
R2	0764-0044	RESISTOR, fxd, met ox, 8.2k, 5%, 2W	28480	0764-0044
R4	0683-1015	RESISTOR, fxd, comp, 100 ohms, 5%, 1/4W	01121	CB 1015
R5	0812-0060	RESISTOR, fxd, ww, 5k, 5%, 5W	28480	0812-0060
R6	0686-1025	RESISTOR, fxd, comp, 1k, 5%, 1/2W	01121	CB 1025
R7	0683-1025	RESISTOR, fxd, comp, 1k, 5%, 1/4W	01121	CB 1025
R8	0686-1015	RESISTOR, fxd, comp, 100 ohms, 5%, 1/2W	01121	CB 1015
R9	0686-6815	RESISTOR, fxd, comp, 680 ohms, 5%, 1/2W	01121	CB 6815
SCR1	1884-0054	THYRISTOR	02735	40526
SCR2	1884-0076	THYRISTOR, triac, 400V	86684	40430

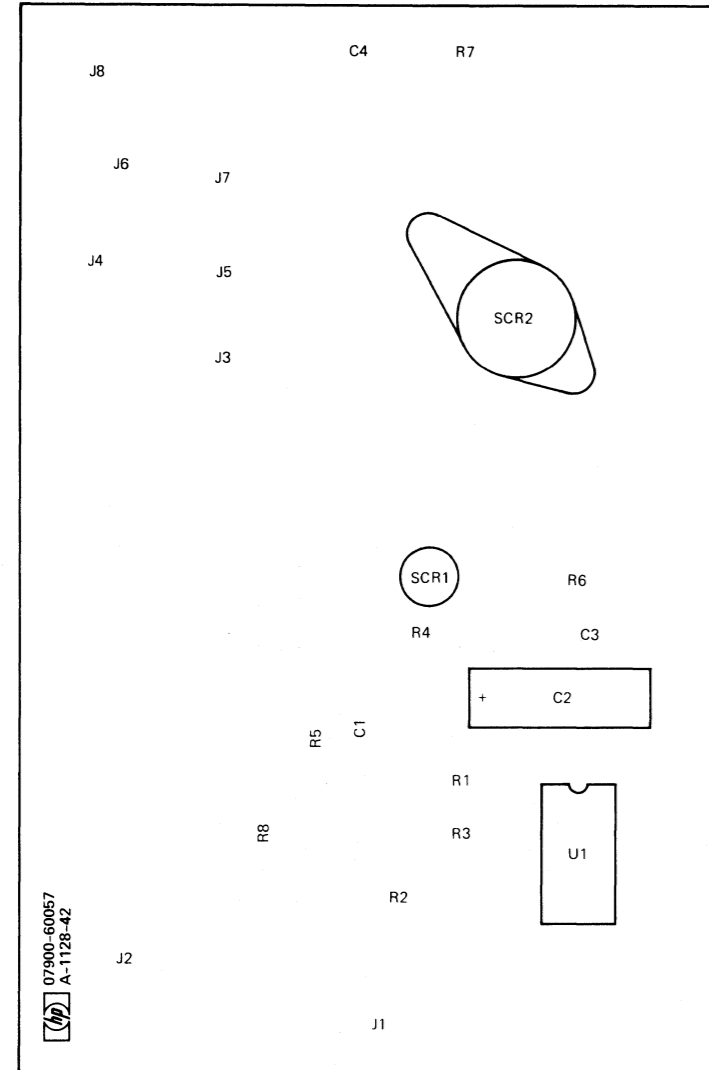


Figure 5-43. Motor Control Assembly A15 Parts Location Diagram

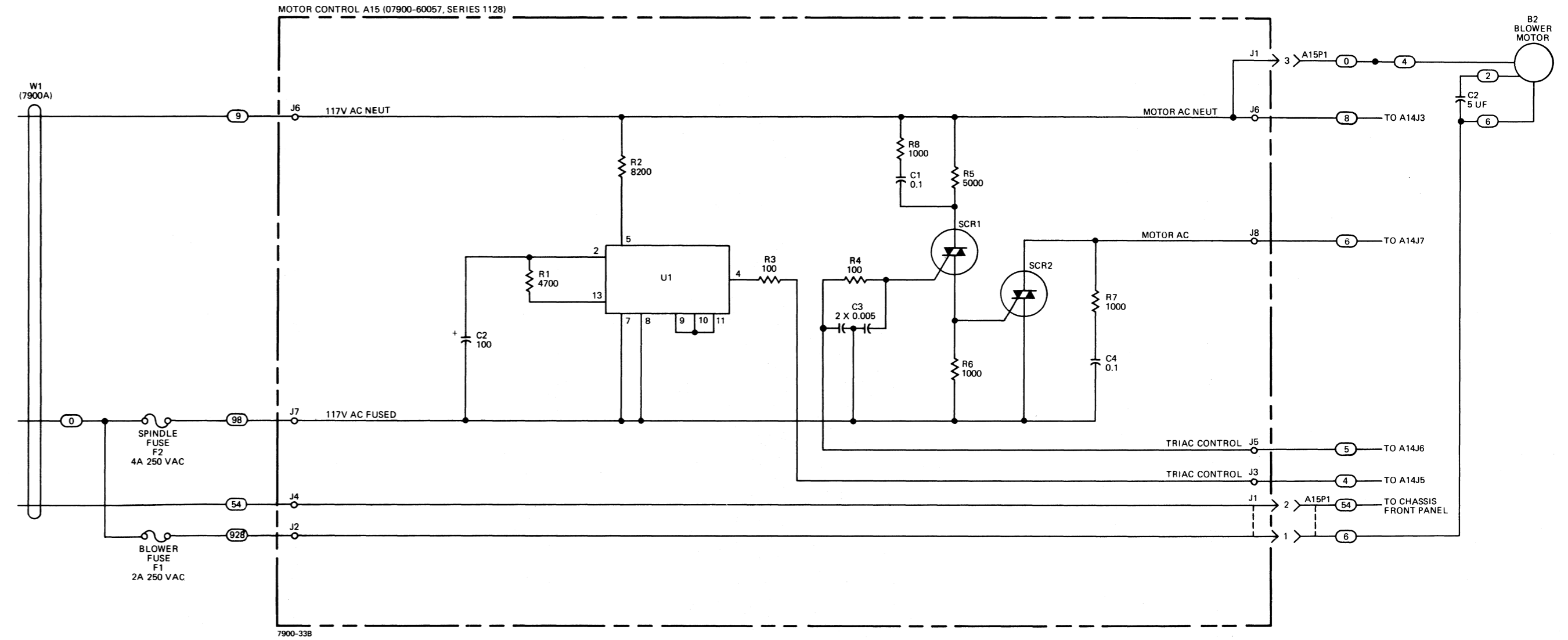
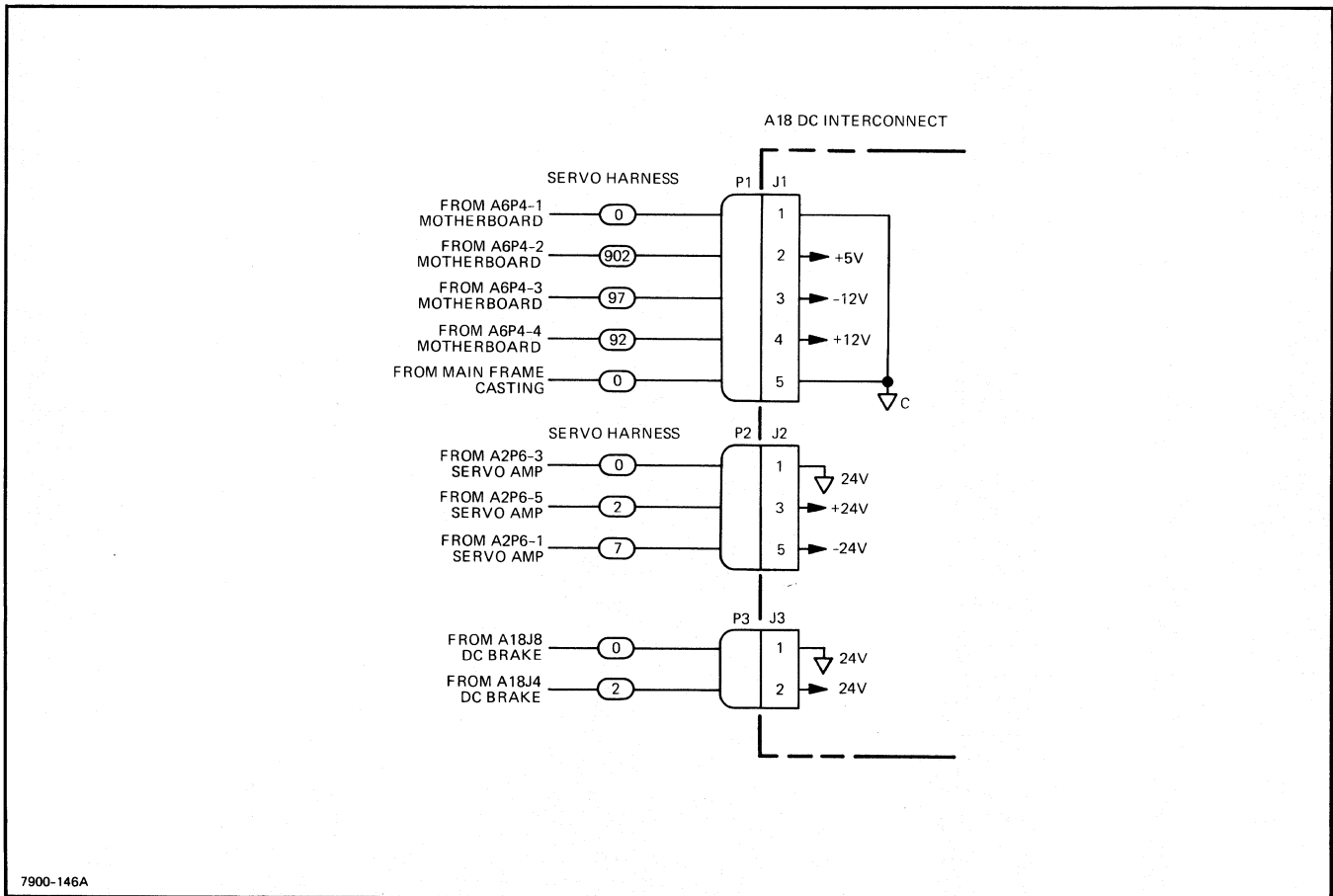


Figure 5-44. Motor Control Assembly A15, Schematic Diagram

Table 5-20. DC Interconnect Assembly A18 (07900-60056) Replaceable Parts

REFERENCE DESIGNATION	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.
C1, 2, 5	0160-0174	CAPACITOR, fxd, cer, 0.47 μ F, +80 -20%, 25 VDCW	56289	5C11B7S-CML
C3, 4, 6	0180-0100	CAPACITOR, fxd, elect, 4.7 μ F, 10%, 35 VDCW	56289	150D475X9035B2-DYS
CR1,3,7,10,11	1901-0416	DIODE, silicon, 200 PIV, 3A	28480	1901-0416
CR2, 4	1902-3205	DIODE, breakdown, 15.0V, 5%	28480	1902-3205
CR5, 6	1884-0012	RECTIFIER, silicon controlled, 2N3528	02735	2N3528
CR8	1902-3110	DIODE, breakdown, 5.9V, 2%	15818	CD35641
CR9	1884-0088	THYRISTOR, scr, 200V	86684	2N3228
R1 thru 3	0683-6815	RESISTOR, fxd, comp, 680 ohms, 5%, 1/4W	01121	CB 6815
TB1	0360-1686	BARRIER BLOCK	73631	GBP-7



7900-146A

Figure 5-45. DC Interconnect Assembly A18 Harness Diagram

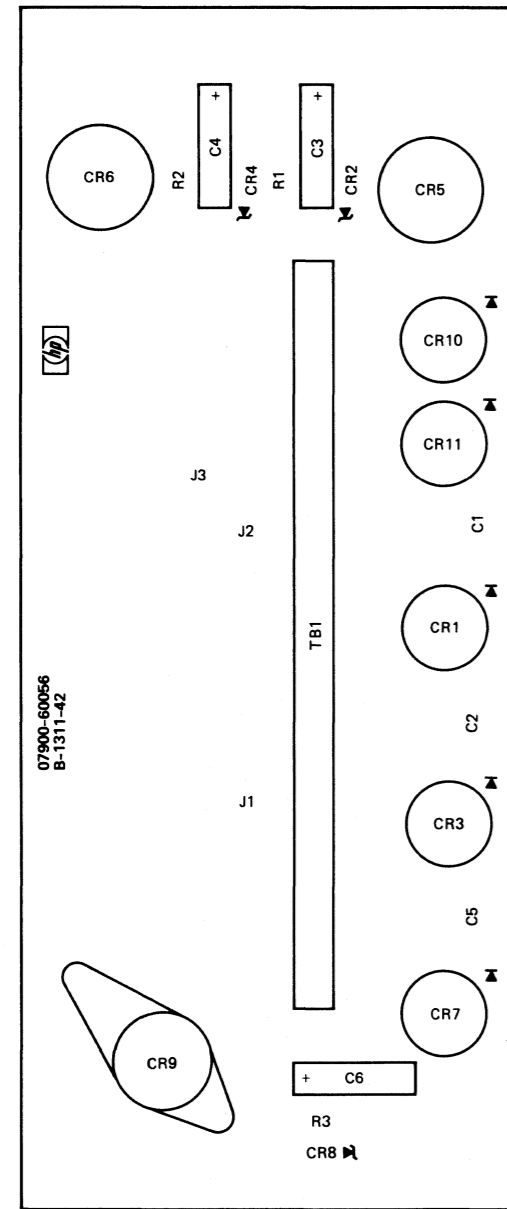


Figure 5-46. DC Interconnect Assembly A18 Parts Location Diagram

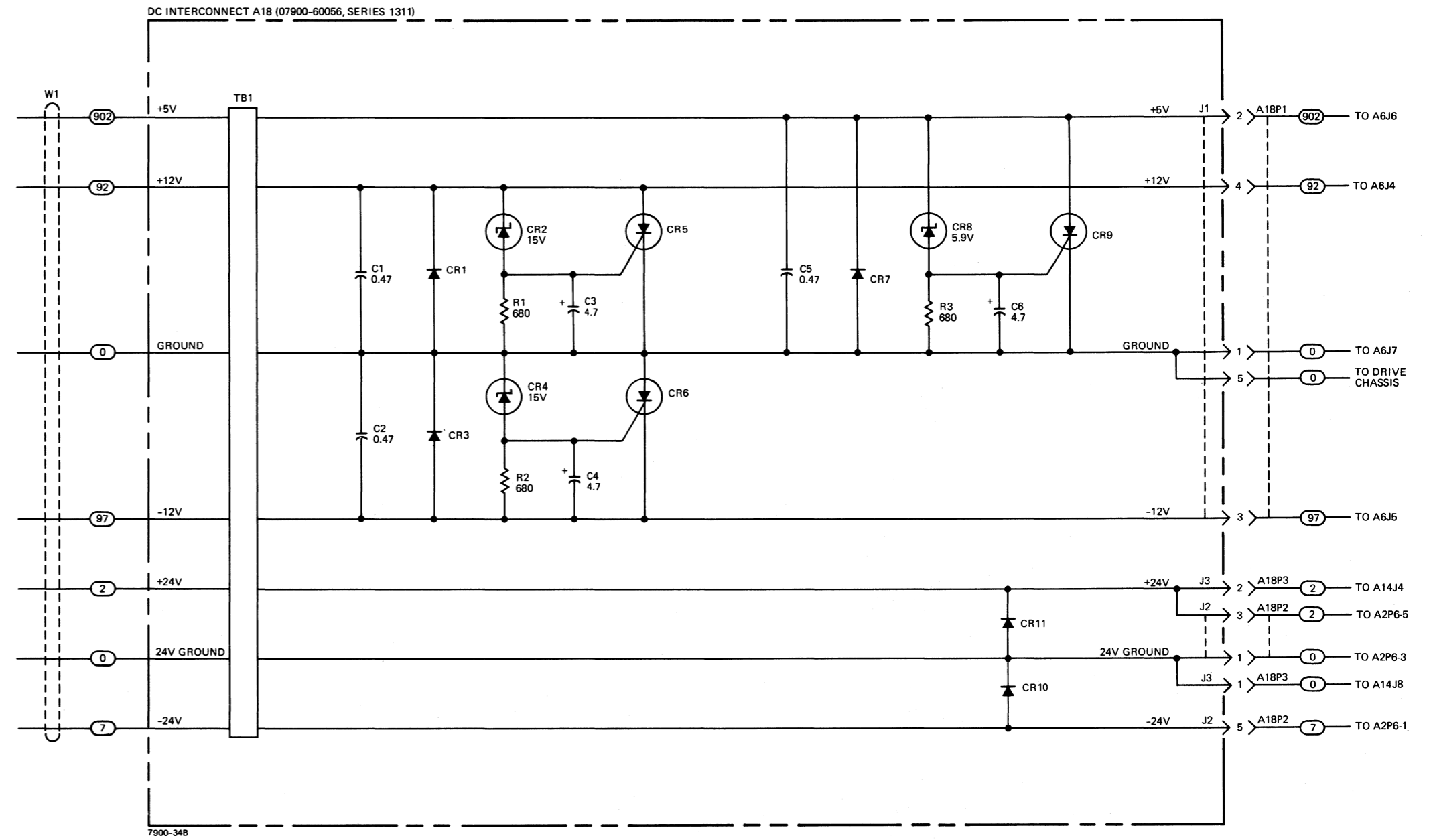


Figure 5-47. DC Interconnect Assembly A18, Schematic Diagram

Table 5-21. Termination Assembly A20 (07900-60033) Replaceable Parts

REFERENCE DESIGNATION	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.
R1 thru 13	0757-0420	RESISTOR, fxd, met flm, 750 ohms, 1%, 1/8W	28480	0757-0420
R14, 15	0757-0398	RESISTOR, fxd, met flm, 75 ohms, 1%, 1/8W	28480	0757-0398
R16 thru 28	0698-3444	RESISTOR, fxd, met flm, 316 ohms, 1%, 1/8W	28480	0698-3444
R29, 30	0757-0417	RESISTOR, fxd, met flm, 562 ohms, 1%, 1/8W	28480	0757-0417

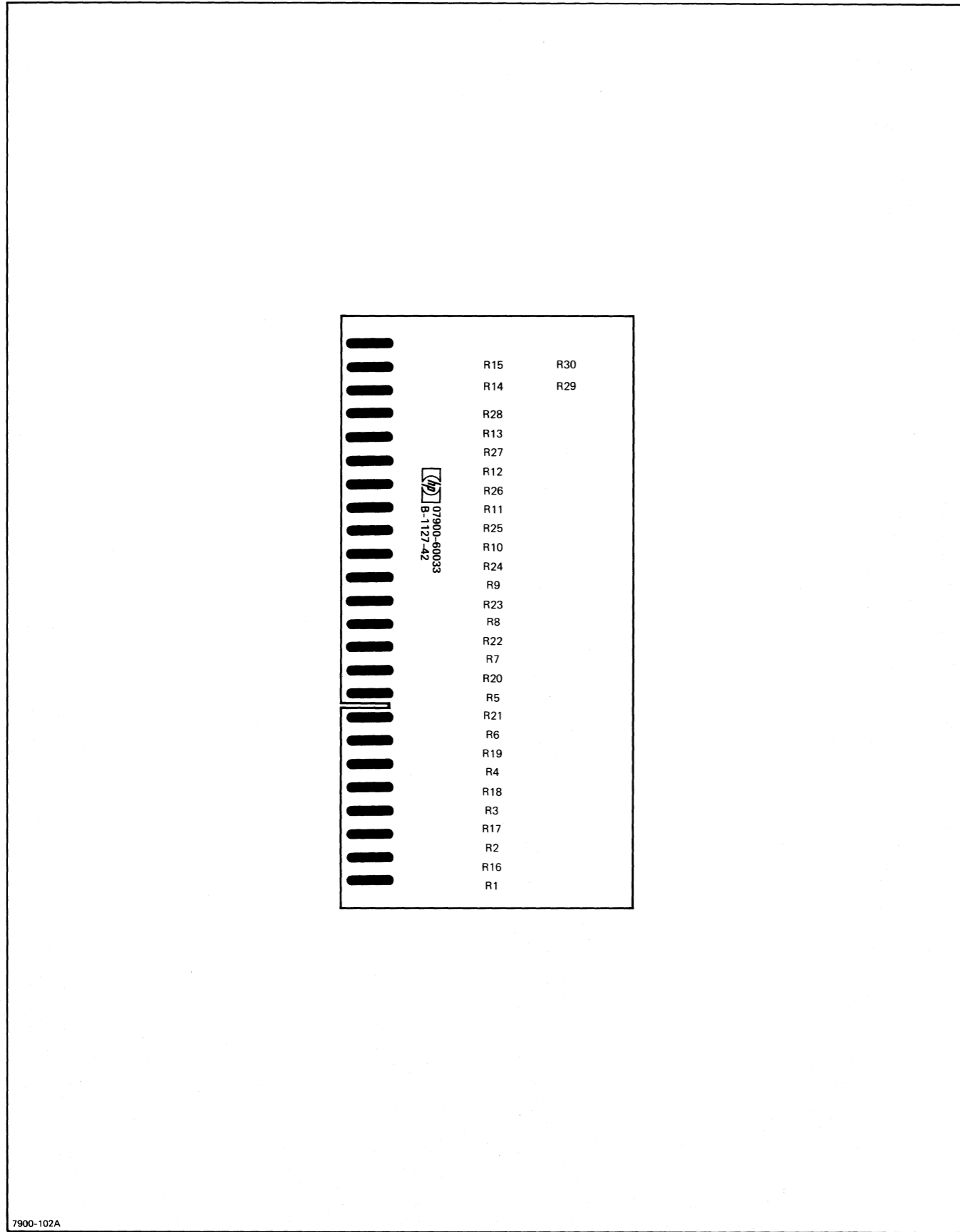


Figure 5-48. Termination Assembly A20 Parts Location Diagram

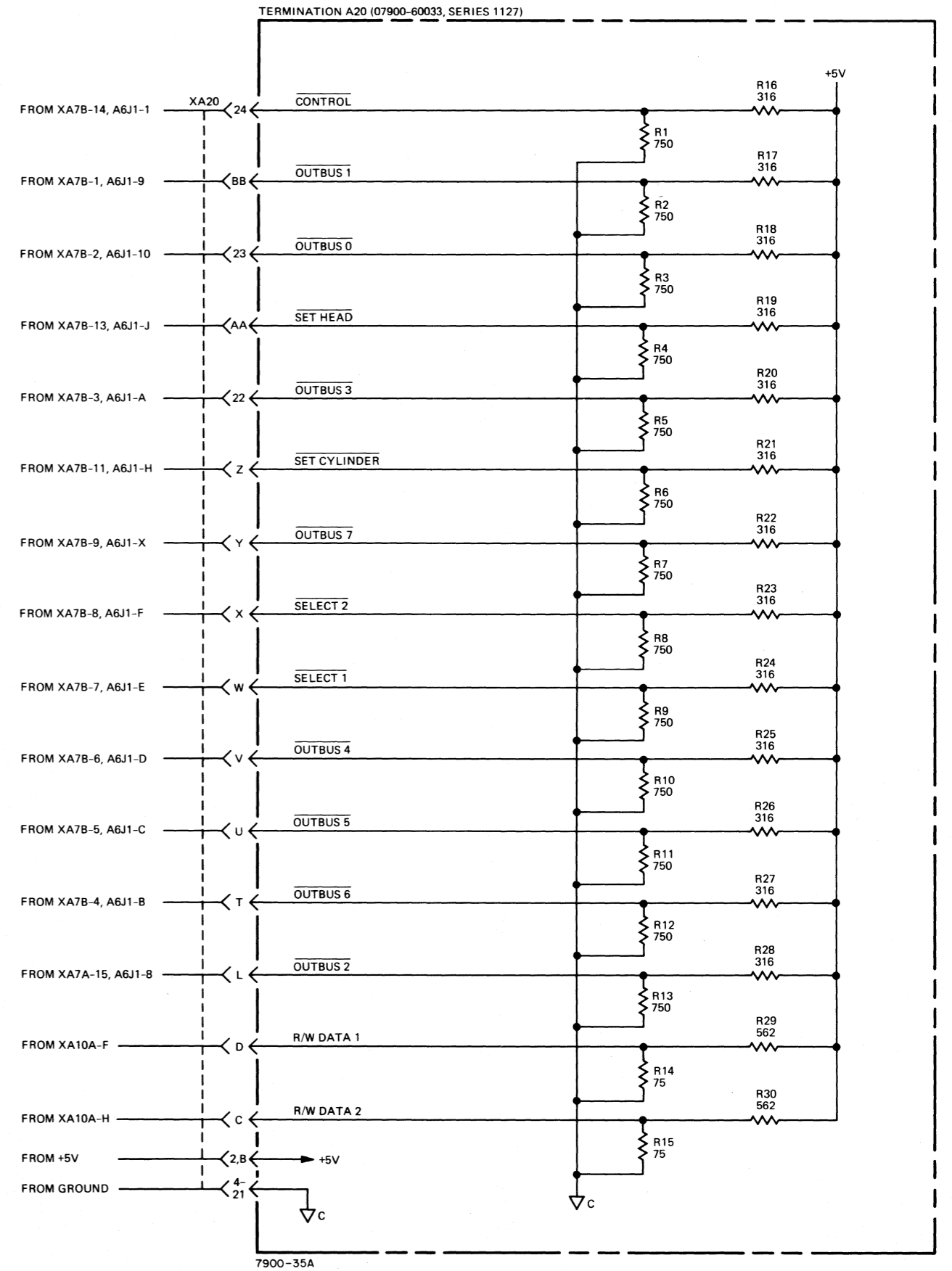


Figure 5-49. Termination Assembly A20, Schematic Diagram

Table 5-22. Integrated Circuit Characteristics

CHARACTERISTIC NUMBER	INPUT LEVEL		OUTPUT LEVEL		OPEN INPUT ACTS AS	PROPAGATION DELAY	
	LOGIC 1 (VOLTS MIN)	LOGIC 0 (VOLTS MAX)	LOGIC 1 (VOLTS MIN)	LOGIC 0 (VOLTS MAX)		TO LOGIC 1 (NS)	TO LOGIC 0 (NS)
2	2.0	0.8	2.4	0.4	Logic 1	29	15
8	2.0 ⁽¹⁾	0.8	2.4	0.4	Logic 1	35	50
9	2.0 ⁽²⁾	0.8	2.4	0.4	Logic 1	40	25
13	2.0 ⁽³⁾	0.8	2.4	0.4	Logic 1	55	60
29	2.0 ⁽⁴⁾	0.8 ⁽⁵⁾	2.4	0.4	Logic 1	135	135
35	2.0	0.8	2.4	0.4	Logic 1	(6)	(7)
36	2.0	0.8	4.7	0.5	Logic 1	---	---
44	1.8	1.1	2.5	0.45	Logic 1	40	---
49	1.8	1.1	2.5	0.4	Logic 1	10	10
61	2.0	0.8	2.4	0.4	Logic 1	22	15
62	2.0	0.9	2.5	0.4	---	12	15
63	2.0	0.8	2.4	0.4	Logic 1	23 and 30	17 and 22
64	--	6.5	2.5	4.0	---	---	---
65	2.0	0.8	2.4	0.4	Logic 1	32	24
66	1.5	1.1	2.4	0.4	Logic 1	27	22
67	2.0	0.8	--	0.4	Logic 1	15	23
68	2.0	0.8	--	--	---	15 and 25	15 and 25
69	2.0	0.8	2.4	0.4	---	25 and 15	25 and 15

NOTES:

- (1) Required pulse widths: 30 ns min.
- (2) Required pulse widths: clock 30 ns min., data 75 ns min.
- (3) Required pulse widths: 16 ns min.
- (4) +2.2V for pin 1.
- (5) +0.6V for pin 1.
- (6) Delay is 27 ns at output and 22 ns at carry/borrow.
- (7) Delay is 37 ns at output and 18 ns at carry/borrow.

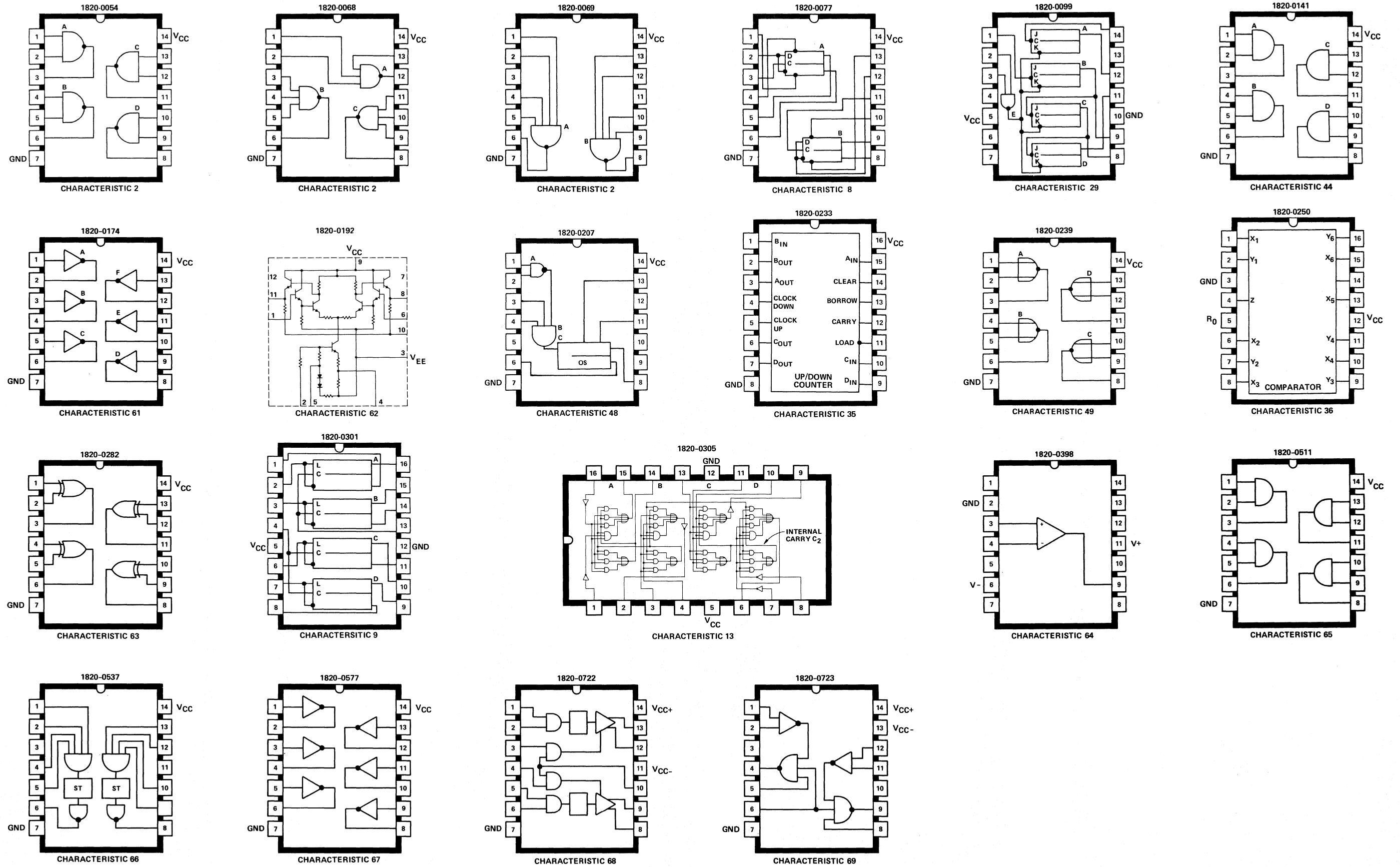


Figure 5-50. Integrated Circuit Diagrams

SECTION VI

REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts for the disc drive. Figures 6-1 through 6-7 are parts location diagrams for the unit. Tables 6-1 through 6-7 are parts lists for the parts called out in figures 6-1 through 6-7, respectively. Index numbers for the parts in the figures and tables correspond to disassembly sequence for the unit or assembly. Assembly order is the reverse of the disassembly order.

6-3. Separate parts lists and parts location diagrams are provided for each printed-circuit assembly. These are located in section V of this manual, adjacent to the respective schematic diagrams for the assemblies. Parts are listed in these tables in alphanumeric order by reference designation. Table 6-8 is a total quantity listing of the parts for the printed-circuit assemblies only.

6-4. Tables 6-1 through 6-8 list the following information for each part:

a. Hewlett-Packard part number.

b. Description of the part. (Refer to table 6-9 for an explanation of abbreviations used in the DESCRIPTION column.)

c. Typical manufacturer of the part as a five-digit code. (Refer to table 6-10 for a listing of the manufacturers that correspond to the codes.)

d. Manufacturer's part number.

Note

When OBD appears in the MFR PART NO. column for a particular part, the part is available from normal commercial sources.

e. Total quantity of each part used in the next higher assembly is listed in the UNITS PER ASSY column.

Note

When the UNITS PER ASSEMBLY column in the parts list indicates "REF" for a given part, the part has been listed elsewhere in section VI as noted in the DESCRIPTION column.

6-5. Items in the DESCRIPTION column of the replaceable parts lists are indented to indicate item relationships, as follows:

DESCRIPTION

MAJOR ASSEMBLY

- . Subassembly
- . Attaching Parts for Subassembly
- . . Subassembly Parts
- . . Attaching Parts for Subassembly Parts

6-6. ORDERING INFORMATION.

6-7. To order replacement parts, address order or inquiry to the local Hewlett-Packard Field Office. (Refer to list at the end of this manual for addresses.) Specify the following information for each part ordered:

- a. Unit model and serial number.
- b. Hewlett-Packard stock number for each part.
- c. Description of each part.
- d. Circuit reference designation (if applicable).

Table 6-1. HP 7900A Disc Drive Replaceable Parts

FIG & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-1-1	07900-00040	7900A DISC DRIVE * COVER, top (Attaching Parts)	28480	07900-00040	1
2	2510-0119	* SCREW, machine, flh, pozi, no. 8-32, 0.250 in. ---- x ----	00000	OBD	8
3	7120-0636	* LABEL, preventive maintenance record	28480	7120-0636	1
4	07900-00038	* COVER, front bottom (Attaching Parts)	28480	07900-00038	1
5	2510-0119	* SCREW, machine, flh, pozi, no. 8-32, 0.250 in. ---- x ----	00000	OBD	7
6	07900-00057	* INSULATOR, cover (Attaching Parts)	28480	07900-00057	1
	0460-0102	* TAPE, transfer, 4 in. wide ---- x ----	76381	467	3 ft
7	07900-00039	* COVER, rear bottom (Attaching Parts)	28480	07900-00039	1
8	2510-0119	* SCREW, machine, flh, pozi, no. 8-32, 0.250 in. ---- x ----	00000	OBD	13
9	07900-00037	* COVER, right side (Attaching Parts)	28480	07900-00037	1
10	2510-0041	* SCREW, machine, ph, pozi, w/ext tooth, no. 8-32, 0.250 in.	00000	OBD	4
11	2510-0045	* SCREW, machine, ph, pozi, w/ext tooth, no. 8-32, 0.375 in. ---- x ----	00000	OBD	4
12	07900-00020	* COVER, left side (Attaching Parts)	28480	07900-00020	1
13	2510-0041	* SCREW, machine, ph, pozi, w/ext tooth, no. 8-32, 0.250 in.	00000	OBD	6
14	2510-0045	* SCREW, machine, ph, pozi, w/ext tooth, no. 8-32, 0.375 in. ---- x ----	00000	OBD	3
15	07900-00073	* COVER, service connection (Attaching Parts)	28480	07900-00073	1
	2510-0043	* SCREW, machine, ph, pozi, w/ext tooth, no. 8-32, 0.312 in. ---- x ----	00000	OBD	1
16	07900-60031	* FRONT COVER ASSEMBLY (see figure 6-2) (Attaching Parts)	28480	07900-60031	1
17	2510-0127	* SCREW, machine, flh, pozi, no. 8-32, 1.000 in.	00000	OBD	4
18	07900-40022	* SPACER, insulator	28480	07900-40022	4
19	3050-0088	* WASHER, cup	00000	OBD	4
20	2190-0048	* WASHER, cup, ext tooth lock	00000	OBD	4
21	2510-0127	* SCREW, machine, flh, pozi, no. 8-32, 1.000 in.	00000	OBD	2
22	07900-20092	* SPACER, insulator	28480	07900-20092	2
23	3050-0088	* WASHER, cup	00000	OBD	2
24	2190-0048	* WASHER, cup, ext tooth lock ---- x ----	00000	OBD	2
25	1460-0571	* SPRING receiver hold-down (see figure 6-3, item 1)	28480	1460-0571	Ref
26	07900-60083	* RECEIVER ASSEMBLY	28480	07900-60083	1
27	07900-60059	* RECEIVER SHIELD ASSEMBLY (Attaching Parts)	28480	07900-60059	1
	2200-0145	* SCREW, machine, ph, pozi, no. 4-40, 0.438 in.	00000	OBD	2
	2190-0003	* WASHER, split lock, no. 4 ---- x ----	00000	OBD	2
28	07900-60058	* INPUT/OUTPUT MULTIPLEXER PCA ASSEMBLY (A7) (see figure 5-28)	28480	07900-60058	1
29	07900-60008	* SECTOR COUNTER AND COMPARE PC ASSEMBLY (A8) (see figure 5-30)	28480	07900-60008	1
30	07900-60009	* DRIVE CONTROL PC ASSEMBLY (A9) (see figure 5-32)	28480	07900-60009	1
31	07900-60011	* READ/WRITE CONTROL AND INTERLOCK PC ASSEMBLY (A10) (see figure 5-34)	28480	07900-60011	1
32	07900-60052	* CYLINDER ADDRESS PC ASSEMBLY (A11) (see figure 5-36)	28480	07900-60052	1
33	07900-60053	* ENCODER PC ASSEMBLY (A12) (see figure 5-38)	28480	07900-60053	1

Table 6-1. HP 7900A Disc Drive Replaceable Parts (Continued)

FIG & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-1-34	07900-60006	7900A DISC DRIVE (continued) * READ PREAMP AND WRITE DRIVE PC ASSEMBLY (A13) (see figure 5-40)	28480	07900-60006	1
35	No Number	* UPPER DECK ASSEMBLY (see figure 6-3)			1
36	No Number	* LOWER DECK ASSEMBLY (see figure 6-6)			1
37	No Number	* REAR DECK ASSEMBLY (see figure 6-7)			1
38	07900-60018	* MOTOR POWER MODULE (see figure 6-7, item 15)			Ref
		ACCESSORIES (not shown in figure 6-1)			
	13211A	RACK SLIDE MOUNTING KIT	28480	13211A	1
	12869A	DISC PACK			1
	07900-60014	SERVICE EXTENDER BOARD	28480	07900-60014	1
	07900-60034	MULTIUNIT CABLE (W2)			1
	7120-0134	INFORMATION LABEL	22670	7120-0134	1
	9211-1691	WOOD CONTAINER	28480	9211-1691	1
	9211-1704	CORRUGATED CARTON			1
	9222-0355	PLASTIC BAG	85474	9222-0355	1
	07900-00097	SHIPPING CLAMP	28480	07900-00097	1
	07900-90002	OPERATING AND SERVICE MANUAL	28480	07900-90002	1

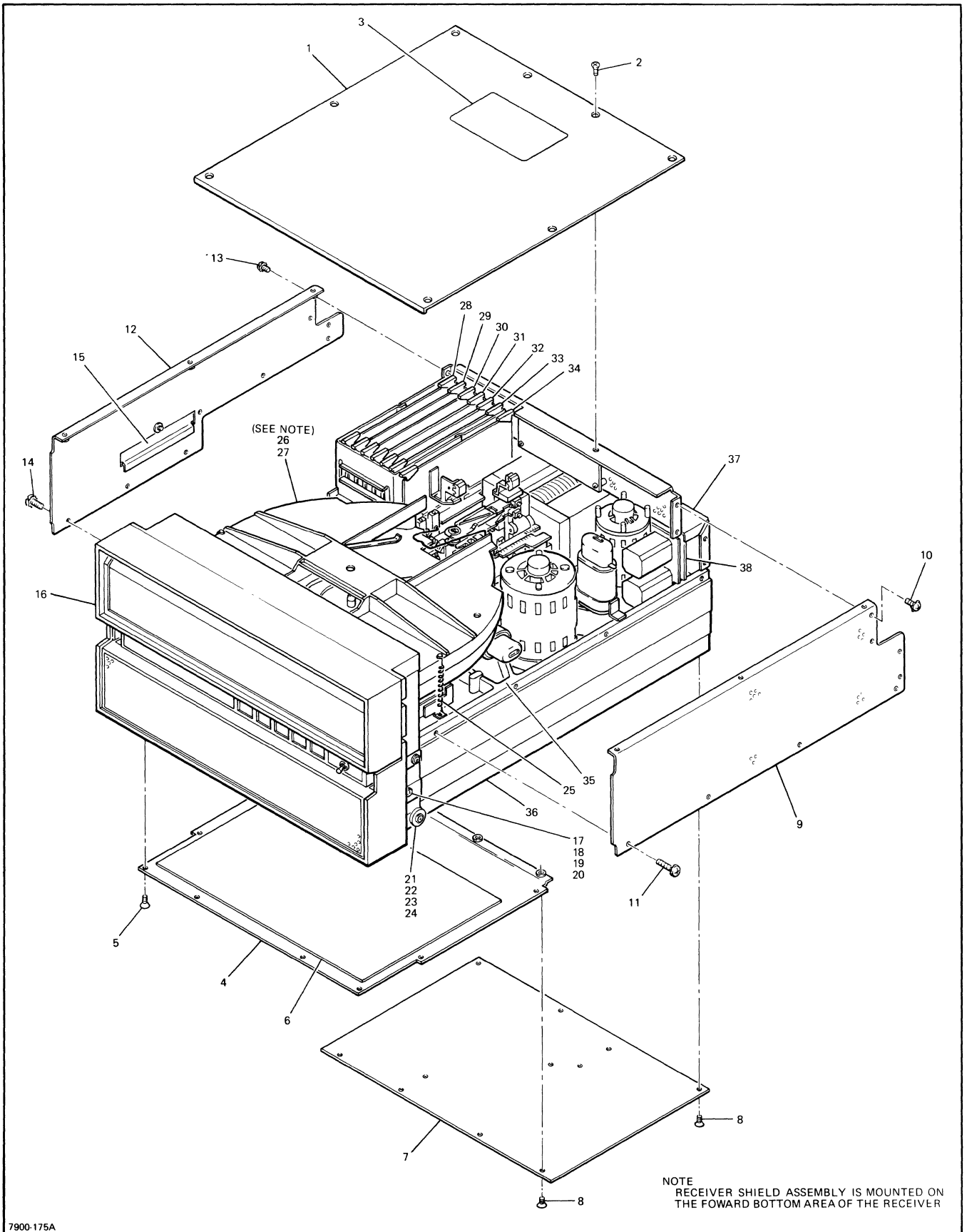


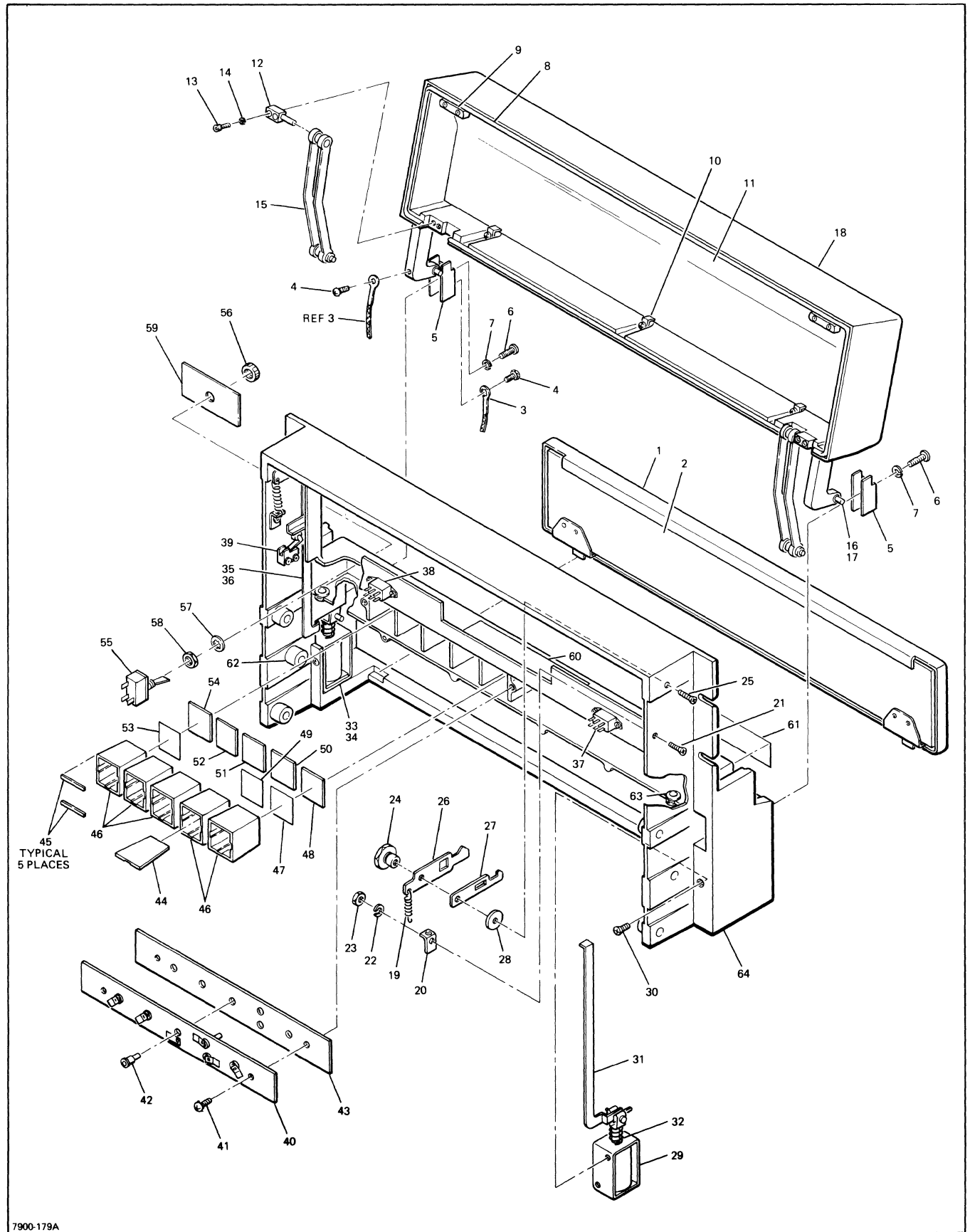
Figure 6-1. HP 7900A Disc Drive

Table 6-2. Front Cover Assembly Replaceable Parts

FIG & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-2-	07900-60031	FRONT COVER ASSEMBLY (figure 6-1, item 16)			
1	07900-00046	* SCREEN, filter	28480	07900-00046	1
2	4208-0039	* FOAM, plastic	18121	OBD	1
3	No Number	* GROUND STRAP (Attaching Parts)			1
4	2200-0105	* SCREW, machine, ph, pozi, w/ext tooth, no. 4-40, 0.312 in. --- x ---	00000	OBD	2
	0360-0016	** TERMINAL, lug, no. 4	78452	718	2
	8160-0045	** WIRE, braided, 3.250 in.	92194	1229	1
5	07900-00058	* CLAMP, door pivot (Attaching Parts)	28480	07900-00058	2
6	2360-0203	* SCREW, machine, ph, pozi, no. 6-32, 0.625 in.	00000	OBD	1
7	2190-0006	* WASHER, split lock, no. 6 --- x ---	00000	OBD	1
	No Number	* FRONT DOOR ASSEMBLY			1
8	0905-0434	** GASKET, silastic, 4 ft	28480	0905-0434	1
9	07900-40036	** CATCH, door latch (Attaching Parts)	28480	07900-40036	2
	3030-0026	** SCREW, socket head cap, no. 4-40, 0.375 in.	00000	OBD	2
	3050-0105	** WASHER, flat, no. 4 --- x ---	00000	OBD	2
10	07900-40040	** CLIP, window (Attaching Parts)	28480	07900-40040	3
	2200-0143	** SCREW, machine, ph, pozi, no. 4-40, 0.375 in.	00000	OBD	1
	2190-0003	** WASHER, split lock, no. 4	00000	OBD	1
	2190-0416	** WASHER, flat, no. 4 --- x ---	00000	OBD	1
11	07900-20029	** WINDOW, door (Attaching Parts)	28480	07900-20029	1
	2200-0143	** SCREW, machine, ph, pozi, no. 4-40, 0.375 in.	00000	OBD	3
	2190-0003	** WASHER, split lock, no. 4	00000	OBD	3
	2190-0416	** WASHER, flat, no. 4 --- x ---	00000	OBD	3
12	07900-20051	** PIVOT, drag link (Attaching Parts)	28480	07900-20051	2
13	3030-0026	** SCREW, socket head cap, no. 4-40, 0.375 in.	00000	OBD	2
14	2190-0108	** WASHER, split lock, no. 4 --- x ---	00000	OBD	2
15	07900-60038	** DRAG LINK ASSEMBLY	28480	07900-60038	2
16	1480-0022	** PIN, dowel, 0.187D	70276	1480-0022	2
17	1410-0151	** BEARING, sleeve	96881	3L4-D	2
18	07900-20028	** DOOR, front	28480	07900-20038	1
19	1460-1287	* SPRING, extension	28480	1460-1287	2
20	07900-00074	* BRACKET, spring (Attaching Parts)	28480	07900-00074	2
21	2200-0166	* SCREW, machine, flh, pozi, no. 4-40, 0.312 in.	00000	OBD	1
22	2190-0003	* WASHER, split lock, no. 4	00000	OBD	1
23	2260-0001	* NUT, hexagon, no. 4-40 --- x ---	00000	OBD	1
24	07900-20053	* PIVOT, latch (Attaching Parts)	28480	07900-20053	2
25	2200-0168	* SCREW, machine, flh, no. 4-40, 0.438 in. --- x ---	00000	OBD	1
26	07900-00088	* DETENT, door	28480	07900-00088	2
27	07900-00089	* LATCH, door	28480	07900-00089	2
28	2190-0886	* WASHER, flat, nylon, no. 1/4	78471	94070	2
29	0491-0060	* SOLENOID (L1) (Attaching Parts)	73949	11	1
30	2360-0181	* SCREW, machine, flh, pozi, no. 6-32, 0.250 in. --- x ---	00000	OBD	2

Table 6-2. Front Cover Assembly Replaceable Parts (Continued)

FIG & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-2-31	07900-00049	FRONT COVER ASSEMBLY (continued)			
32	1460-0019	* LINK, door, lefthand	28480	07900-00049	1
33	0491-0060	* SPRING, compression	4E425	1460-0019	2
34	2360-0181	* SOLENOID (L2) (Attaching Parts)	73949	11	1
35	07900-00070	* SCREW, machine, flh, pozi, no. 6-32, 0.250 in. ---- x ----	00000	OBD	2
36	1460-0019	* LINK ASSEMBLY, righthand	28480	07900-00070	1
37	3101-0070	* SPRING, compression	28480	1460-0019	1
	0520-0129	* SWITCH, data protect, lower disc (S2) (Attaching Parts)	79727	GF-126-0000	1
	2190-0045	* SCREW, machine, ph, pozi, no. 2-56, 0.312 in.	00000	OBD	2
	0610-0001	* WASHER, split lock, no. 2	00000	OBD	2
		* NUT, hexagon, no. 2-56	00000	OBD	2
		---- x ----			
38	3101-0070	* SWITCH, data protect, upper disc (S3) (Attaching Parts)	79725	GF-126-0000	1
	0520-0129	* SCREW, machine, ph, pozi, no. 2-56, 0.312 in.	00000	OBD	2
	2190-0045	* WASHER, split lock, no. 2	00000	OBD	2
	0610-0001	* NUT, hexagon, no. 2-56	00000	OBD	2
		---- x ----			
39	3101-1617	* SWITCH, sensitive, interlock (S4) (Attaching Parts)	01963	E63-24K	1
	0520-0168	* SCREW, machine, flh, pozi, no. 2-56, 0.500 in.	00000	OBD	2
	2190-0045	* WASHER, split lock, no. 2	00000	OBD	2
	2190-0479	* WASHER, flat, no. 2	00000	OBD	2
	0610-0001	* NUT, hexagon, no. 2-56	00000	OBD	2
		---- x ----			
40	07900-60063	* INDICATOR ASSEMBLY (A1) (see figure 5-17) (Attaching Parts)	28480	07900-60063	1
41	2200-0105	* SCREW, machine, ph, pozi, w/ext tooth, no. 4-40, 0.312 in. ---- x ----	00000	OBD	2
42	2140-0343	** LAMP, incandescent, 14V, 0.8A (DS1 thru DS6)	98976	330	6
43	07900-00105	* INSULATOR, pc board	28480	07900-00105	1
44	07900-40041	* PARTITION, horizontal	28480	07900-40041	1
45	07900-0101	* CLIP, retaining	28480	07900-0101	10
46	07900-40042	* FRAME, window	28480	07900-40042	5
47	07900-00102	* FILTER, red	28480	07900-00102	1
48	07900-20035	* LENS, drive fault	28480	07900-20035	1
49	07900-00103	* FILTER, yellow	28480	07900-00103	1
50	07900-20079	* LENS, data protect	28480	07900-20079	1
51	07900-20078	* LENS, door unlocked	28480	07900-20078	1
52	07900-20032	* LENS, drive ready	28480	07900-20032	1
53	07900-00104	* FILTER, green	28480	07900-00104	1
54	07900-20031	* LENS, drive power	28480	07900-20031	1
55	3101-1051	* SWITCH, load-unload (S1) (Attaching Parts)	27191	8908K507	1
56	3101-0103	* NUT, face	00000	OBD	1
57	2190-0068	* WASHER, lock, internal tooth, 0.525 in. ID	00000	OBD	1
58	2950-0035	* NUT, hexagon, no. 15/32 ---- x ----	00000	OBD	1
59	7120-3716	PLATE, ID	28480	7120-3716	1
60	7120-0695	* LABEL, information	28480	7120-0695	1
61	7120-3707	* LABEL, ID	28480	7120-3707	1
62	07900-40029	* SPACER, inner	28480	07900-40029	6
63	0400-0089	* GROMMET, std	77969	15	2
64	07900-20030	* FRAME, front	28480	07900-20030	1



7900-179A

Figure 6-2. Front Cover Assembly

Table 6-3. Upper Deck Assembly Replaceable Parts

FIG & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-3-1	No Number 1460-0571	UPPER DECK ASSEMBLY (figure 6-1, item 35) * SPRING, receiver holddown	28480	1460-0571	2
2	07900-00074	* BRACKET, spring (Attaching Parts)	28480	07900-00074	1
	2200-0139	* SCREW, machine, ph, pozi, no. 4-40, 0.250 in.	00000	OBD	1
	2190-0003	* WASHER, split lock, no. 4 ---- x ----	00000	OBD	1
3	07900-00059	* PLATE, spring mounting (Attaching Parts)	28480	07900-00059	1
	2200-0139	* SCREW, machine, ph, pozi, no. 4-40, 0.250 in.	00000	OBD	2
	2190-0003	* WASHER, split lock, no. 4	00000	OBD	2
	2190-0416	* WASHER, flat, no. 4 ---- x ----	00000	OBD	2
4	3101-1617	* SWITCH, door closed (S6) (Attaching Parts)	01963	E63-24K	1
	0520-0131	* SCREW, machine, ph, pozi, no. 2-56, 0.438 in.	00000	OBD	2
	0610-0013	* NUT, hexagon, no. 2-56	00000	OBD	2
	2190-0045	* WASHER, split lock, no. 2	00000	OBD	2
	2190-0479	* WASHER, flat, no. 2 ---- x ----	00000	OBD	2
5	07900-20075	* SWITCH, cartridge down (S5) (Attaching Parts)	28480	07900-20075	1
	2200-0091	* SCREW, machine, ph, pozi, no. 4-40, 0.562 in.	00000	OBD	2
	2190-0003	* WASHER, split lock, no. 4	00000	OBD	2
	2190-0416	* WASHER, flat, no. 4 ---- x ----	00000	OBD	2
6	07900-00060	* SUPPORT, drag link (Attaching Parts)	28480	07900-00060	2
	2510-0045	* SCREW, machine, ph, pozi, w/ext tooth, no. 8-32, 0.375 in.	00000	OBD	2
7	07900-00054	* COVER, transducer (Attaching Parts)	28480	07900-00054	1
	2510-0045	* SCREW, machine, ph, pozi, w/ext tooth, no. 8-32, 0.375 in. ---- x ----	00000	OBD	2
8	07900-60045	* SECTOR TRANSDUCER ASSEMBLY (A3, Upper, see figure 5-22) (A4, lower, see figure 5-24) (Attaching Parts)	28480	07900-60045	2
	2510-0103	* SCREW, machine, ph, pozi, no. 8-32, 0.375 in.	00000	OBD	2
	2190-0017	* WASHER, split lock, no. 8	00000	OBD	2
	3050-0001	* WASHER, flat, no. 8 ---- x ----	00000	OBD	2
9	07900-20024	* BLOCK, mounting, upper transducer (Attaching Parts)	28480	07900-20024	1
	2510-0045	* SCREW, machine, ph, pozi, w/ext tooth, no. 8-32, 0.375 in. ---- x ----	00000	OBD	2
10	9160-0211	* MAGNET, permanent, 6.000 in. long			1
11	07900-20098	* POST, cartridge positioning (Attaching Parts)	28480	07900-20098	2
	2510-0051	* SCREW, machine, ph, pozi, w/ext tooth, no. 8-32, 0.625 in. ---- x ----	00000	OBD	1
12	07900-20065	* SUPPORT, spring, crash stop (Attaching Parts)	28480	07900-20065	1
	3030-0027	* SCREW, socket head cap, no. 8-32, 1.250 in.	00000	OBD	2
	2190-0017	* WASHER, split lock, no. 8 ---- x ----	00000	OBD	2
13	07900-40023	* SPRING, crash stop (Attaching Parts)	28480	07900-40023	1
	2200-0145	* SCREW, machine, ph, pozi, no. 4-40, 0.438 in.	00000	OBD	2
	2190-0003	* WASHER, split lock, no. 4 ---- x ----	00000	OBD	2

Table 6-3. Upper Deck Assembly Replaceable Parts (Continued)

FIG & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-3-14	07900-40023	UPPER DECK ASSEMBLY (continued) * SPRING, crash stop (Attaching Parts)	28480	07900-40023	1
	2200-0151	* SCREW, machine, ph, pozi, no. 4-40, 0.750 in.	00000	OBD	2
	2190-0003	* WASHER, split lock, no. 4 ---- x ----	00000	OBD	2
15	* 1530-1689 or 07900-60075	* SPINDLE ASSEMBLY (Attaching Parts)	28480	1530-1689 or 07900-60075	1
	3030-0004	* SCREW, socket head cap, no. 1/4-20, 0.750 in.	00000	OBD	3
	2190-0032	* WASHER, split lock, 0.250 in. ID	00000	OBD	3
	3050-0099	* WASHER, flat, 0.250 in. ID ---- x ----	00000	OBD	3
16	07900-20056	* BAIL, cartridge (Attaching Parts)	28480	07900-20056	1
	0510-0052	* RETAINER, ring	97464	7100-12-CD	2
17	1460-0570	* SPRING, bail ---- x ----	28480	1460-0570	1
18	0340-0761	* INSULATOR, terminal	90201	OC-1	2
19	0160-0585	* CAPACITOR, spindle motor, 5 uF (C1) (Attaching Parts)	56289	500P9032	1
	2360-0195	* SCREW, machine, ph, pozi, w6ext tooth, no. 6-32, 0.312 in.	00000	OBD	1
	2420-0001	* NUT, hexagon, w/ext tooth, no. 6-32 ---- x ----	00000	OBD	1
20	1400-0189	* CLAMP, capacitor (Attaching Parts)	01002	128A2244G21	2
	2510-0043	* SCREW, machine, ph, pozi, w/ext tooth, no. 8-32, 0.312 in.	00000	OBD	2
	3050-0001	* WASHER, flat, no. 8 ---- x ----	00000	OBD	2
21	07900-00052	* BRACKET, clamp mounting (Attaching Parts)	28480	07900-00052	1
	2510-0045	* SCREW, machine, ph, pozi, w/ext tooth, no. 8-32, 0.375 in. ---- x ----	00000	OBD	2
22	0160-0585	* CAPACITOR, blower motor, 5 uF (C2) (Attaching Parts)	56289	500P9032	1
	2360-0195	* SCREW, machine, ph, pozi, w/ext tooth, no. 6-32, 0.312 in.	00000	OBD	1
	2420-0001	* NUT, hexagon, w/ext tooth, no. 6-32 ---- x ----	00000	OBD	1
23	1400-0293	* CLAMP, cable, 0.375D (Attaching Parts)	95987	318-6B	1
	2510-0105	* SCREW, machine, ph, pozi, no. 8-32, 0.438 in.	00000	OBD	1
	2190-0017	* WASHER, split lock, no. 8	00000	OBD	1
	2190-0453	* WASHER, D ---- x ----	00000	OBD	1
24	1400-0874	* CLAMP, cable, 0.437D (Attaching Parts)	83930	443-7-2-8	1
	2510-0105	* SCREW, machine, ph, pozi, no. 8-32, 0.438 in.	00000	OBD	1
	2190-0017	* WASHER, split lock, no. 8	00000	OBD	1
	2190-0453	* WASHER, D ---- x ----	00000	OBD	1
25	1400-0292	* CLAMP, cable, 0.250D (Attaching Parts)	95987	1/4 6-B	5
	2510-0105	* SCREW, machine, ph, pozi, no. 8-32, 0.438 in.	00000	OBD	1
	2190-0017	* WASHER, split lock, no. 8	00000	OBD	1
	2190-0453	* WASHER, D ---- x ----	00000	OBD	1
26	3140-0763	* MOTOR, spindle (B1) (Attaching Parts)	03511	3140-0763	1
	2680-0116	* SCREW, machine, flh, no. 10-32, 0.375 in. ---- x ----	00000	OBD	4

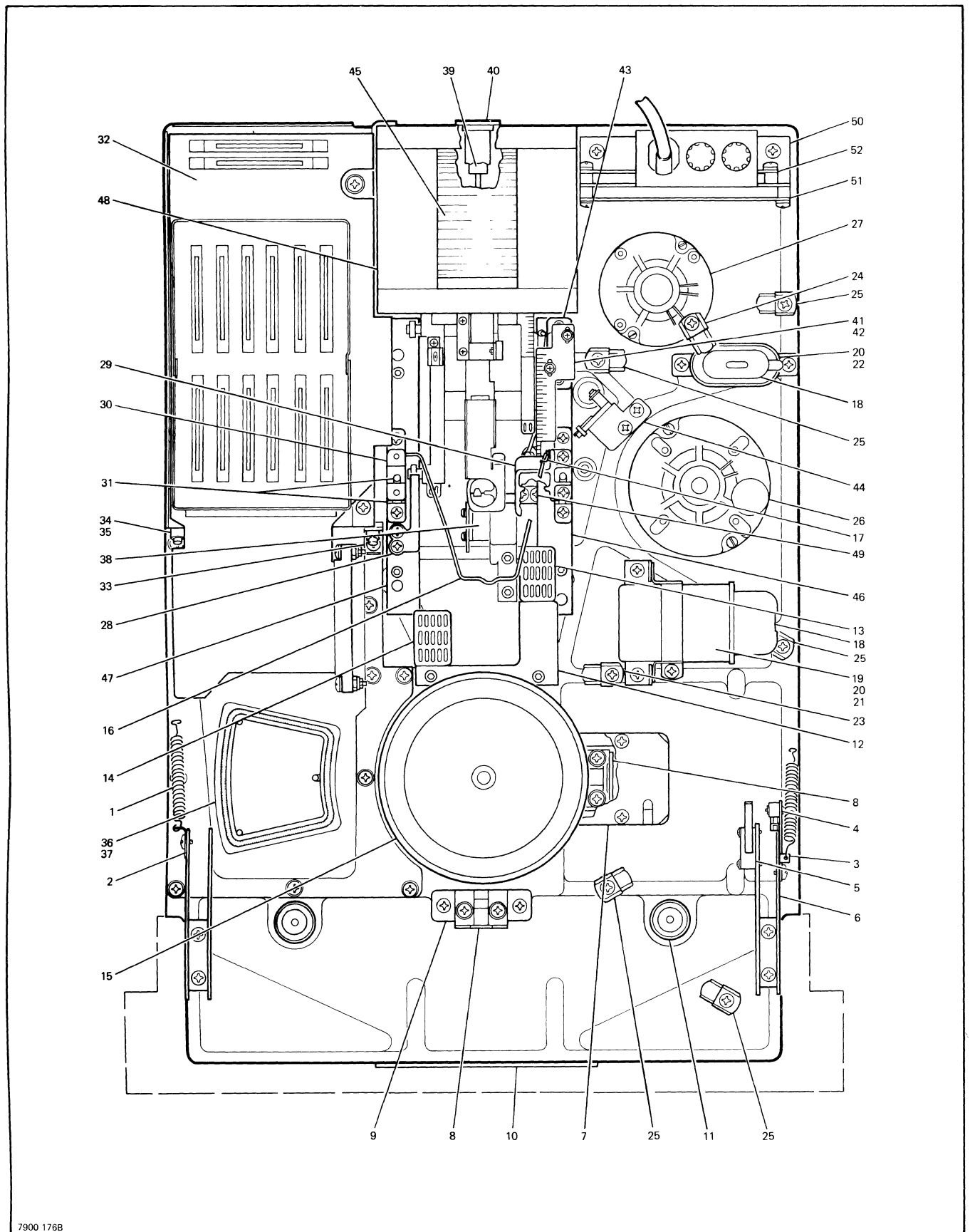
*Note: Two part numbers are listed for the spindle assembly; either may be used (they are interchangeable) (serial prefix 1432).

Table 6-3. Upper Deck Assembly Replaceable Parts (Continued)

FIG & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-3-27	3140-0762	UPPER DECK ASSEMBLY (continued) * MOTOR, blower (B2) (Attaching Parts)	03511	5KPM49FG337	1
	2510-0109	* SCREW, machine, ph, pozi, no. 8-32, 0.625 in.	00000	OBD	4
	2190-0017	* WASHER, split lock, no. 8	00000	OBD	4
	3050-0001	* WASHER, flat, no. 8 --- x ---	00000	OBD	4
28	07900-40025	* DETENT (Attaching Parts)	28480	07900-40025	1
	2360-0209	* SCREW, machine, ph, pozi, no. 6-32, 1.000 in.	00000	OBD	2
	2190-0006	* WASHER, split lock, no. 6	00000	OBD	2
	3050-0003	* WASHER, flat, no. 6 --- x ---	00000	OBD	2
29	07900-40044	* CAM, upper heads (Attaching Parts)	28480	07900-40044	1
	2360-0199	* SCREW, machine, ph, pozi, no. 6-32, 0.438 in.	00000	OBD	2
	2190-0085	* WASHER, split lock, no. 6	00000	OBD	2
	2190-0416	* WASHER, flat, no. 6 --- x ---	00000	OBD	2
30	07900-20027	* BLOCK, pivot (Attaching Parts)	28480	07900-20027	2
	2360-0115	* SCREW, machine, ph, pozi, w/ext tooth, no. 6-32, 0.312 in. --- x ---	00000	OBD	2
31	07900-40038	* LATCH, spring, receiver (Attaching Parts)	28480	07900-40038	2
	0520-0165	* SCREW, machine, flh, pozi, no. 2-56, 0.312 in. --- x ---	00000	OBD	2
32	07900-60055	* MOTHERBOARD PC ASSEMBLY (A6) (see figure 5-26) (Attaching Parts)	28480	07900-60055	1
	2510-0133	* SCREW, machine, ph, pozi, no. 8-32, 0.188 in.	00000	OBD	2
	2190-0010	* WASHER, lock, ext tooth, no. 8	00000	OBD	2
	2200-0091	* SCREW, machine, ph, pozi, no. 4-40, 0.562 in.	00000	OBD	2
	2190-0003	* WASHER, split lock, no. 4	00000	OBD	2
	2190-0416	* WASHER, flat, no. 4	00000	OBD	4
	2260-0001	* NUT, hexagon, no. 4-40 --- x ---	00000	OBD	2
	33	07900-00072	* RETAINER, filter rod (Attaching Parts)	28480	07900-00072
34	2510-0111	* SCREW, machine, ph, pozi, no. 8-32, 0.438 in.	00000	OBD	1
	2190-0017	* WASHER, split lock, no. 8 --- x ---	00000	OBD	1
35	07900-20060	* ROD, filter holddown	28480	07900-20060	2
36	0380-0018	* SPACER, 0,250 in. long	14480	0380-0018	2
36	07900-40021	* DUCT, cartridge (Attaching Parts)	28480	07900-40021	1
	2510-0105	* SCREW, machine, ph, pozi, no. 8-32, 0.438 in.	00000	OBD	8
	2510-0111	* SCREW, machine, ph, pozi, no. 8-32, 0.750 in.	00000	OBD	2
	2190-0017	* WASHER, split lock, no. 8	00000	OBD	9
	3050-0001	* WASHER, flat, no. 8 --- x ---	00000	OBD	10
	37	0460-1029	* GASKET, industrial tape, foam backed	76381	4308
38	07900-60026	* ENCODER ASSEMBLY (see figure 6-3) (Attaching Parts)	28480	07900-60026	1
	3030-0027	* SCREW, socket head cap, no. 8-32, 1.25 in.	00000	OBD	2
	2190-0017	* WASHER, split lock, no. 8	00000	OBD	2
	3050-0001	* WASHER, flat, no. 8 --- x ---	00000	OBD	2

Table 6-3. Upper Deck Assembly Replaceable Parts (Continued)

FIG & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-3-39	07900-60067	UPPER DECK ASSEMBLY (continued) * VELOCITY TRANSDUCER SHAFT ASSEMBLY (Attaching Parts)	28480	07900-60067	1
	3030-0430	* SCREW, set, no. 4-40, 0.250 in ---- x ----	00000	OBD	1
40	07900-60025	* VELOCITY TRANSDUCER ASSEMBLY (L3) (Attaching Parts)	28480	07900-60025	1
	2200-0165	* SCREW, machine, ph, pozi, no. 4-40, 0.250 in. ---- x ----	00000	OBD	2
41	07900-00100	* SCALE, position	28480	07900-00100	1
42	3101-1607	* SWITCH, carriage (S7) (Attaching Parts)	01963	E23-00K	1
	2200-0151	* SCREW, machine, ph, pozi, no. 4-40, 0.750 in.	00000	OBD	2
	2190-0003	* WASHER, split lock, no. 4	00000	OBD	2
	2190-0416	* WASHER, flat, no. 4 ---- x ----	00000	OBD	2
43	07900-20055	* SPACER, carriage switch (Attaching Parts)	28480	07900-20055	1
	2360-0117	* SCREW, machine, ph, pozi, w/ext tooth, no. 6-32, 0.375 in. ---- x ----	00000	OBD	2
44	07900-60060	* COIL LEAD ASSEMBLY (Attaching Parts)	28480	07900-60060	1
	2510-0045	* SCREW, machine, ph, pozi, w/ext tooth, no. 8-32, 0.375 in.	00000	OBD	2
	3030-0431	* SCREW, socket head cap, no. 4-40, 0.635 in. ---- x ----	00000	OBD	2
45	07900-60022	* CARRIAGE ASSEMBLY (see figure 6-5)	28480	07900-60022	1
46	07900-20016	* RAIL, master, right (Attaching Parts)	28480	07900-20016	1
	3030-0015	* SCREW, socket head cap, no. 8-32, 0.750 in.	00000	OBD	2
	2190-0429	* WASHER, split lock, no. 8 ---- x ----	00000	OBD	2
47	07900-20008	* RAIL, master, left (Attaching Parts)	28480	07900-20008	1
	3030-0015	* SCREW, socket head cap, no. 8-32, 0.750 in.	00000	OBD	2
	2190-0429	* WASHER, split lock, no. 8 ---- x ----	00000	OBD	2
48	07900-60024	* LINEAR MOTOR ASSEMBLY (L4) (Attaching Parts)	28480	07900-60024	1
	3030-0433	* SCREW, socket head shoulder, no. 10-24, 1.500 in.	00000	OBD	1
	3030-0437	* SCREW, socket head cap, no. 10-24, 2.000 in.	00000	OBD	2
	2190-0034	* WASHER, split lock, no. 10 ---- x ----	00000	OBD	2
49	07900-40014	* CAM, lower heads (Attaching Parts)	28480	07900-40014	1
	2510-0113	* SCREW, machine, ph, pozi, no. 8-32, 0.875 in.	00000	OBD	2
	2190-0017	* WASHER, split lock, no. 8	00000	OBD	2
	3050-0001	* WASHER, flat, no. 8 ---- x ----	00000	OBD	2
50	07900-60018	* MOTOR POWER MODULE (see figure 6-7, item 15)	28480	07900-60018	Ref
51	NSR	* DC BRAKE PC ASSEMBLY (A14) (see figure 5-42)			Ref
52	NSR	* MOTOR CONTROL PC ASSEMBLY (A15) (see figure 5-44)			Ref

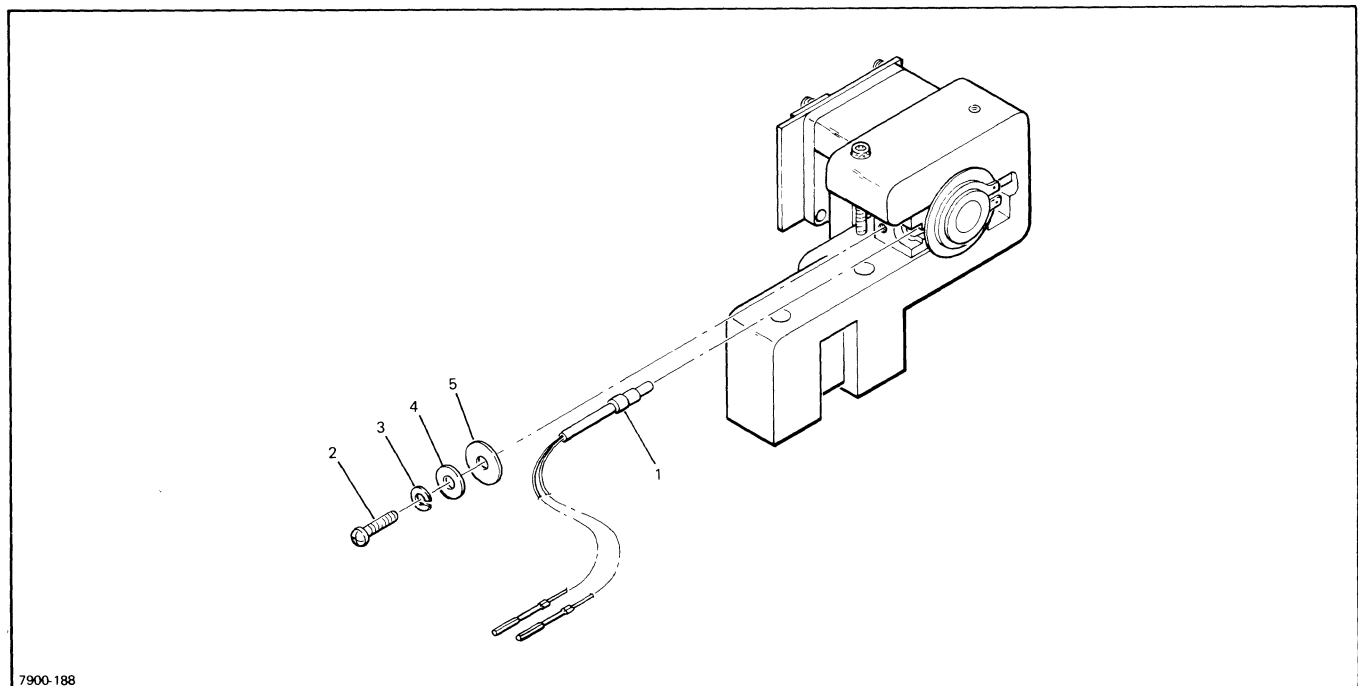


7900 176B

Figure 6-3. Upper Deck Assembly

Table 6-4. Encoder Assembly Replaceable Parts

FIG & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-4-1	07900-60026 07900-60061	ENCODER ASSEMBLY (figure 6-3, item 38) * LAMP ASSEMBLY (DS1) (Attaching Parts)	28480	07900-60061	1
2	2360-0195	* SCREW, machine, ph, pozi, no. 6-32, 0.312 in.	00000	OBD	1
3	2190-0085	* WASHER, split lock, no. 6	00000	OBD	1
4	3050-0228	* WASHER, flat, no. 6	00000	OBD	1
5	3050-0003	* WASHER, fiber, no. 6 --- x ---	00000	OBD	1

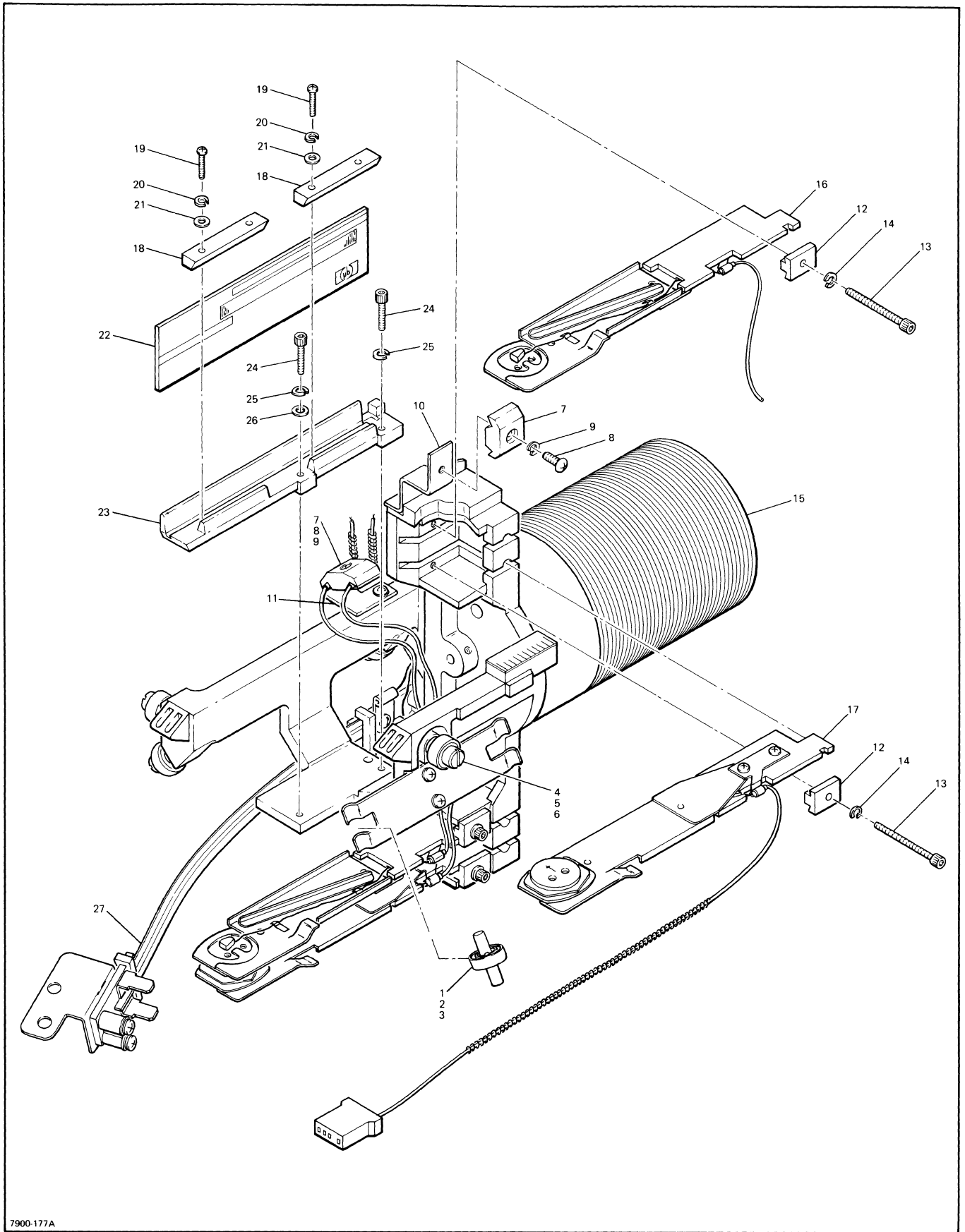


7900-188

Figure 6-4. Encoder Assembly

Table 6-5. Carriage Assembly Replaceable Parts

FIG & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-5-1	07900-60022	CARRIAGE ASSEMBLY (figure 6-3, item 45)			
2	07900-20012	* SHAFT, bearing	28480	07900-20012	2
	1410-1007	* BEARING, ball (Attaching Parts)	40920	SR3RZZ5P24LG39	2
3	0510-0045	* RETAINER, ring ---- x ----	79136	5133-18-5-MD-R	2
4	0570-1153	* SCREW, shoulder	00000	OBD	5
5	07900-20077	* SPACER, bearing	28480	07900-20077	5
6	1400-1007	* BEARING, ball ---- x ----	28480	1400-1007	5
7	07900-40043	* CLAMP, head cable (Attaching Parts)	28480	07900-40043	2
8	2200-0143	* SCREW, machine, ph, pozi, no. 4-40, 0.375 in.	00000	OBD	1
9	2190-0003	* WASHER, split lock, no. 4 ---- x ----	00000	OBD	1
10	07900-00107	* BRACKET, cable, upper head (Attaching Parts)	28480	07900-00107	1
	2200-0143	* SCREW, machine, ph, pozi, no. 4-40, 0.375 in.	00000	OBD	2
	2190-0003	* WASHER, split lock, no. 4 ---- x ----	00000	OBD	2
11	07900-0109	* BRACKET, cable, lower head (Attaching Parts)	28480	07900-0109	1
	2200-0139	* SCREW, machine, ph, pozi, no. 4-40, 0.250 in.	00000	OBD	1
	2190-0003	* WASHER, split lock, no. 4 ---- x ----	00000	OBD	1
12	07900-20083	* CLAMP, head (Attaching Parts)	28480	07900-20083	4
13	3030-0434	* SCREW, socket head cap, no. 4-40, 1.000 in.	00000	OBD	1
14	2190-0003	* WASHER, split lock, no. 4 ---- x ----	00000	OBD	1
15	NSR	* COIL, motor (L4)			
		THE FOLLOWING ITEMS ARE PART OF THE UPPER DECK ASSEMBLY. THEY ARE INCLUDED HERE TO FACILITATE IDENTIFICATION AND INSTALLATION.			
16	07900-60004	DOWN HEAD ASSEMBLY	28480	07900-60004	2
17	07900-60001	UP HEAD ASSEMBLY	28480	07900-60001	2
18	07900-40033	CLAMP, encoder plate (Attaching Parts)	28480	07900-40033	2
19	0520-0131	SCREW, machine, ph, pozi, no. 2-56, 0.438 in.	00000	OBD	2
20	2190-0045	WASHER, split lock, no. 2	00000	OBD	2
21	2190-0479	WASHER, flat, no. 2 ---- x ----	00000	OBD	2
22	1000-0276	ENCODER PLATE	91001	1000-0276	1
23	07900-20014	HOLDER, encoder plate (Attaching Parts)	28480	07900-20014	1
24	3030-0026	SCREW, socket head cap, no. 4-40, 0.375 in.	00000	OBD	2
25	2190-0003	WASHER, split lock, no. 4	00000	OBD	2
26	2190-0416	WASHER, flat, no. 4 ---- x ----	00000	OBD	1
27	07900-60060	COIL LEAD ASSEMBLY (see figure 6-3, item 44)	28480	07900-60060	Ref



7900-177A

Figure 6-5. Carriage Assembly

Table 6-6. Lower Deck Assembly Replaceable Parts

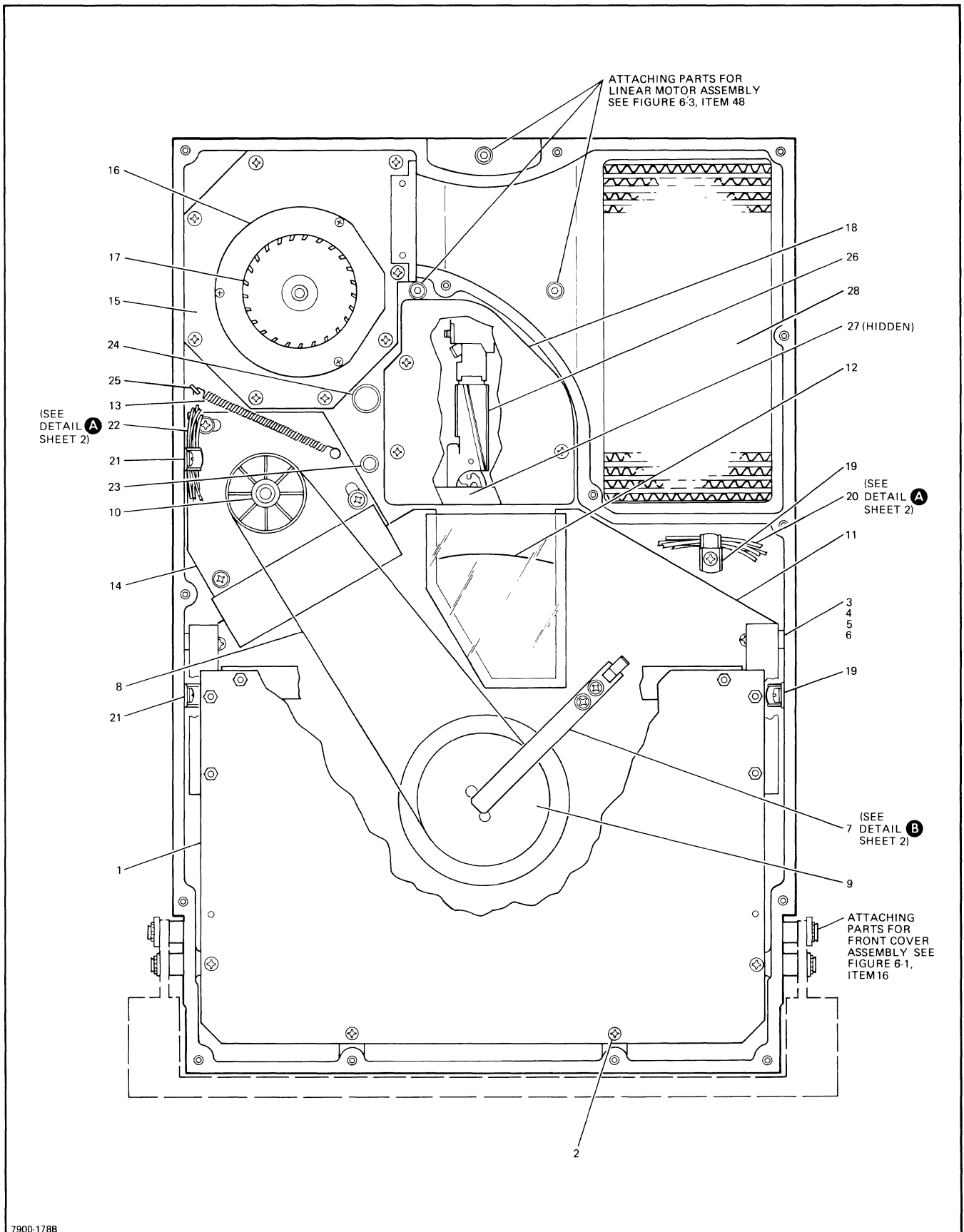
FIG & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-6-1	No Number 07900-60048	LOWER DECK ASSEMBLY (figure 6-1, item 36) * SERVO AMPLIFIER PC ASSEMBLY (A2)(see figure 5-17) (Attaching Parts)	28480	07900-60048	1
2	2510-0045	* SCREW, machine, ph, pozi, w/ext tooth, no. 8-32, 0.375 in.	00000	OBD	4
3	02510-0107	* SCREW, machine, ph, pozi, no. 8-32, 0.500 in.	00000	OBD	2
4	2190-0017	* WASHER, split lock, no. 8	00000	OBD	2
5	3050-0001	* WASHER, flat, no. 8	00000	OBD	2
6	3050-0239	* WASHER, fiber, no. 8	00000	OBD	2
*7	07900-60079	* STRAP, ground (Attaching Parts)	28480	07900-60079	1
	2360-0197	* SCREW, machine, ph, pozi, no. 6-32, 0.375 in.	00000	OBD	2
	2190-0006	* WASHER, split lock, no. 6	00000	OBD	2
	3050-0228	* WASHER, flat, 0.312 OD	00000	OBD	2
**7	07900-60080	* STRAP, ground (Attaching Parts)	28480	07900-60080	1
	2360-0197	* SCREW, machine, ph, pozi, no. 6-32, 0.375 in.	00000	OBD	2
	2190-0006	* WASHER, split lock, no. 6	00000	OBD	2
	3050-0228	* WASHER, flat, 0.312 OD	00000	OBD	2
	07900-60078	* MOUNT ASSY, ground button	28480	07970-60078	1
	1460-0649	* SPRING, compression	28480	1460-0649	1
	3030-0212	* SCREW, 8-32, 7/8 in.	00000	OBD	3
	2190-0429	* WASHER, lock, 0.168 ID, 0.280 OD, split --- x ---	00000	OBD	3
8	1500-0301	* BELT, drive	73518	B-2293-J	1
9	07900-20069	* PULLEY, spindle (60 Hz std)	28480	07900-20069	1
	or				
	07900-20071	* PULLEY, spindle (50 Hz opt 001) (Attaching Parts)	28480	07900-20071	1
	3030-0047	* SCREW, socket head cap, no. 8-32, 0.625 in.	00000	OBD	3
	2190-0429	* WASHER, split lock, no. 8 --- x ---	00000	OBD	3
10	07900-40018	* PULLEY, spindle motor (60 Hz std)	28480	07900-40018	1
	or				
	07900-20007	* PULLEY, spindle motor (50 Hz opt 001) (Attaching Parts)	28480	07900-20007	1
	3030-0079	* SCREW, set, no. 8-32, 0.25 in. --- x ---	00000	OBD	1
11	07900-00115	* COVER, lower disc (Attaching Parts)	28480	07900-00115	1
	2510-0045	* SCREW, machine, ph, pozi, w/ext tooth, no. 8-32, 0.375 in. --- x ---	00000	OBD	4
12	07900-60032	* LOWER DISC ASSEMBLY (Attaching Parts)	28480	07900-60032	1
	3030-0245	* SCREW, socket head cap, no. 1/4-28, 0.375 in. --- x ---	00000	OBD	3
13	1460-1323	* SPRING, extension	84830	LE-034-C-7-MW	1
14	07900-00110	* PLATE, mounting, spindle motor (Attaching Parts)	28480	07900-00110	1
	2510-0109	* SCREW, machine, ph, pozi, no. 8-32, 0.625 in.	00000	OBD	3
	2190-0017	* WASHER, split lock, no. 8	00000	OBD	3
	3050-0001	* WASHER, flat, no. 8	00000	OBD	3
	0380-0003	* SPACER, 0.125 long --- x ---	14480	0380-0003	1
15	07900-00017	* FAN COVER ASSEMBLY (Attaching Parts)	28480	07900-00017	1
	2510-0041	* SCREW, machine, ph, pozi, w/ext tooth, no. 8-32, 0.250 in. --- x ---	00000	OBD	8
16	3160-0244	* HOUSING, inlet (Attaching Parts)	60399	675	1
	2200-0139	* SCREW, machine, ph, pozi, no. 4-40, 0.250 in.	00000	OBD	3
	2260-0009	* NUT, hexagon, no. 4-40, w/ext tooth --- x ---	00000	OBD	3

*Used on standard production units and for field replacement when ground button need not be replaced and spindle has a long shaft (figure 6-6, sheet 2).

**These parts used for field replacement of ground button or ground strap or both. Ground strap 07900-60080 must be used on units in which ground button mount assembly 07900-60078 is installed.

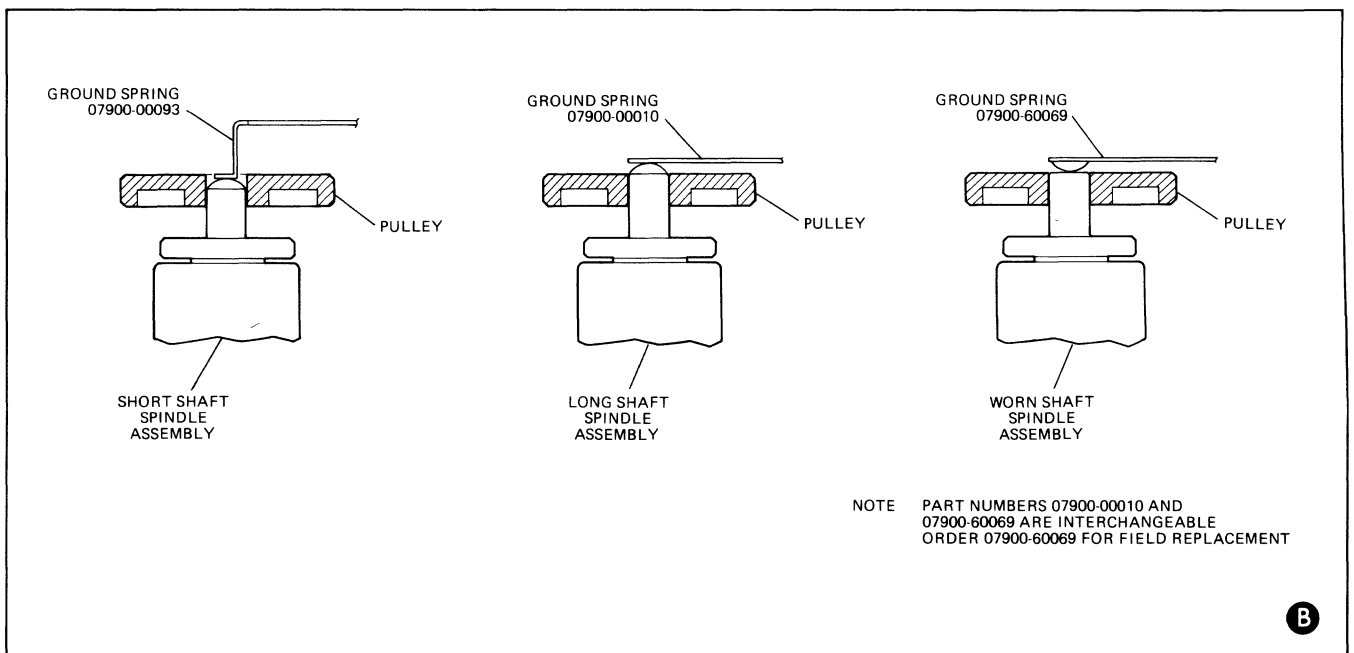
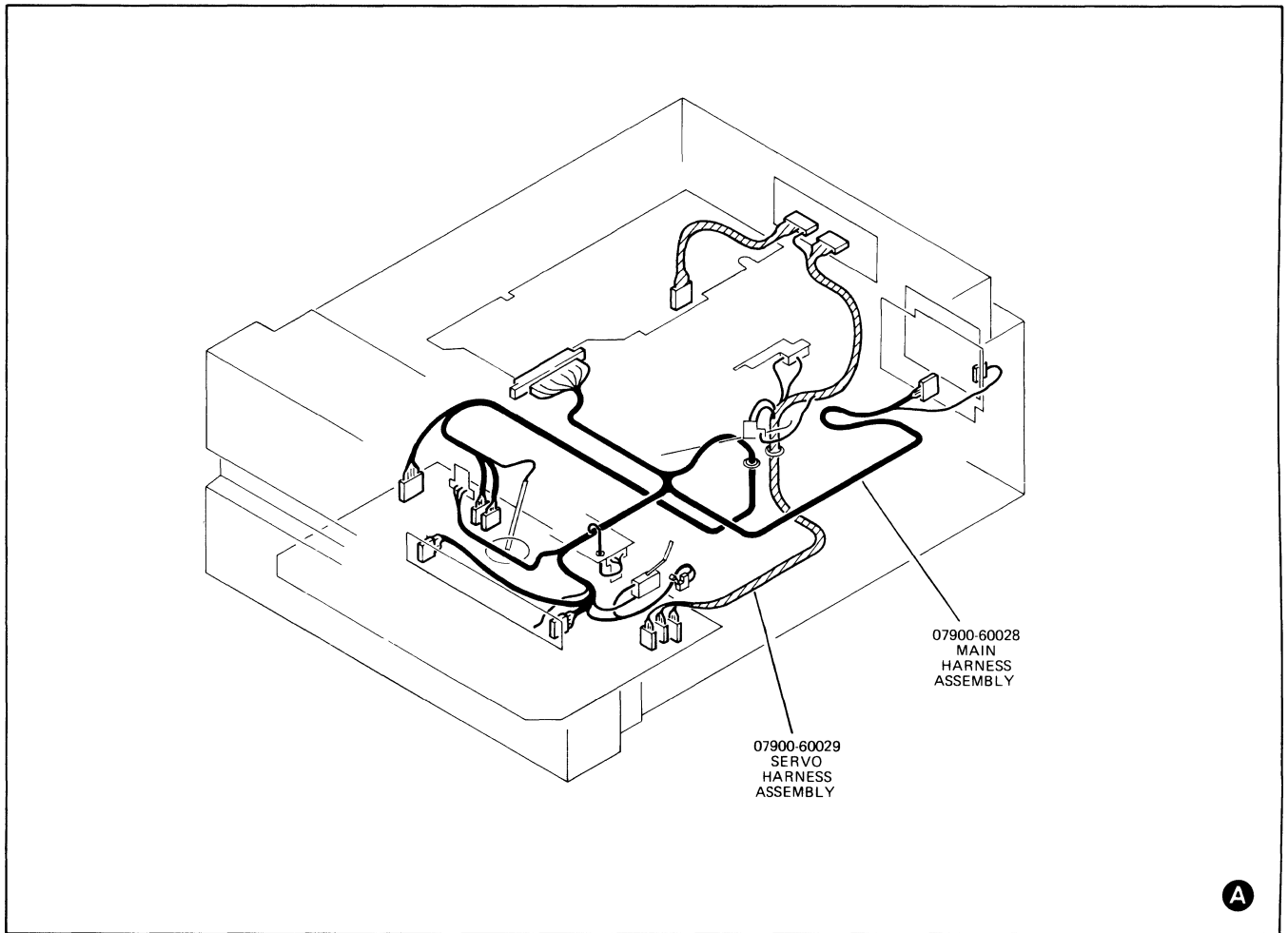
Table 6-6. Lower Deck Assembly Replaceable Parts (Continued)

FIG & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-6-17	3160-0243	LOWER DECK ASSEMBLY (continued) * FAN, blade (Attaching Parts)	60399	AA-408-201-1	1
		* SCREW, set ---- x ----	00000	OBD	1
18	07900-00053	* COVER, head well (Attaching Parts)	28480	07900-00053	1
	2510-0045	* SCREW, machine, ph, pozi, w/ext tooth, no. 8-32, 0.375 in. ---- x ----	00000	OBD	3
19	1400-0187	* CLAMP, cable, 0.312D (Attaching Parts)	95987	5/16-6B	2
	2510-0105	* SCREW, machine, ph, pozi, no. 8-32, 0.438 in.	00000	OBD	1
	2190-0017	* WASHER, split lock, no. 8	00000	OBD	1
	2190-0453	* WASHER, D ---- x ----	00000	OBD	1
20	07900-60028	* MAIN HARNESS ASSEMBLY	28480	07900-60028	1
21	1400-0293	* CLAMP, cable, 0.375D (Attaching Parts)	95987	3/8-6B	2
	2510-0105	* SCREW, machine, ph, pozi, no. 8-32, 0.438 in.	00000	OBD	1
	2190-0017	* WASHER, split lock, no. 8	00000	OBD	1
	2190-0453	* WASHER, D ---- x ----	00000	OBD	1
22	07900-60029	* SERVO HARNESS ASSEMBLY	28480	07900-60029	1
23	0400-0166	* GROMMET, std	28520	OCB-500	1
24	0400-0094	* GROMMET, std	28520	SB750-9	1
25	0580-0001	* SCREW, spade	79251	A-24F8-1323	1
26	07900-60001	UP HEAD ASSEMBLY (see figure 6-5, item 17)			Ref
27	07900-40014	CAM, lower heads (see figure 6-3, item 49)			Ref
28	3150-0225	FILTER, absolute (see figure 6-7, item 26)			Ref



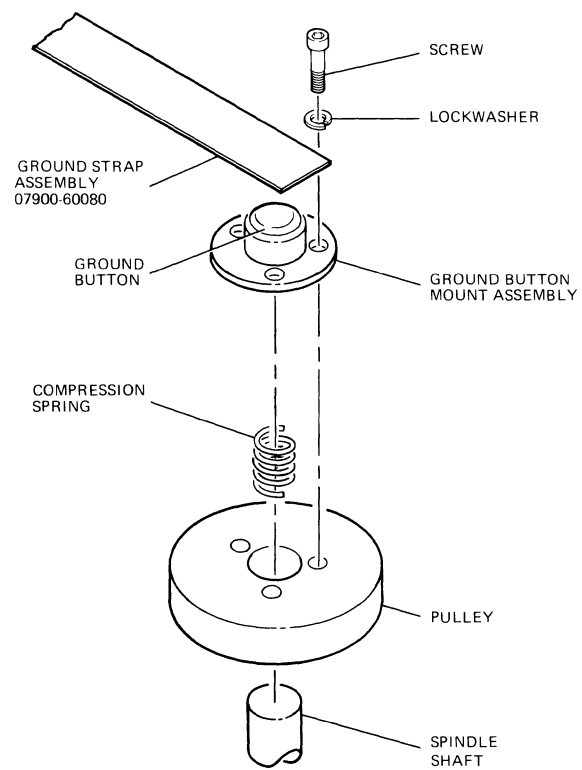
7900-178B

Figure 6-6. Lower Deck Assembly (Sheet 1 of 2)



7900-189

Figure 6-6. Lower Deck Assembly (Sheet 2 of 2)



NOTE
USE ONLY GROUND STRAP ASSEMBLY
07900-60080 ON A DISC DRIVE WITH A
GROUND BUTTON MOUNT ASSEMBLY
INSTALLED

7900 200

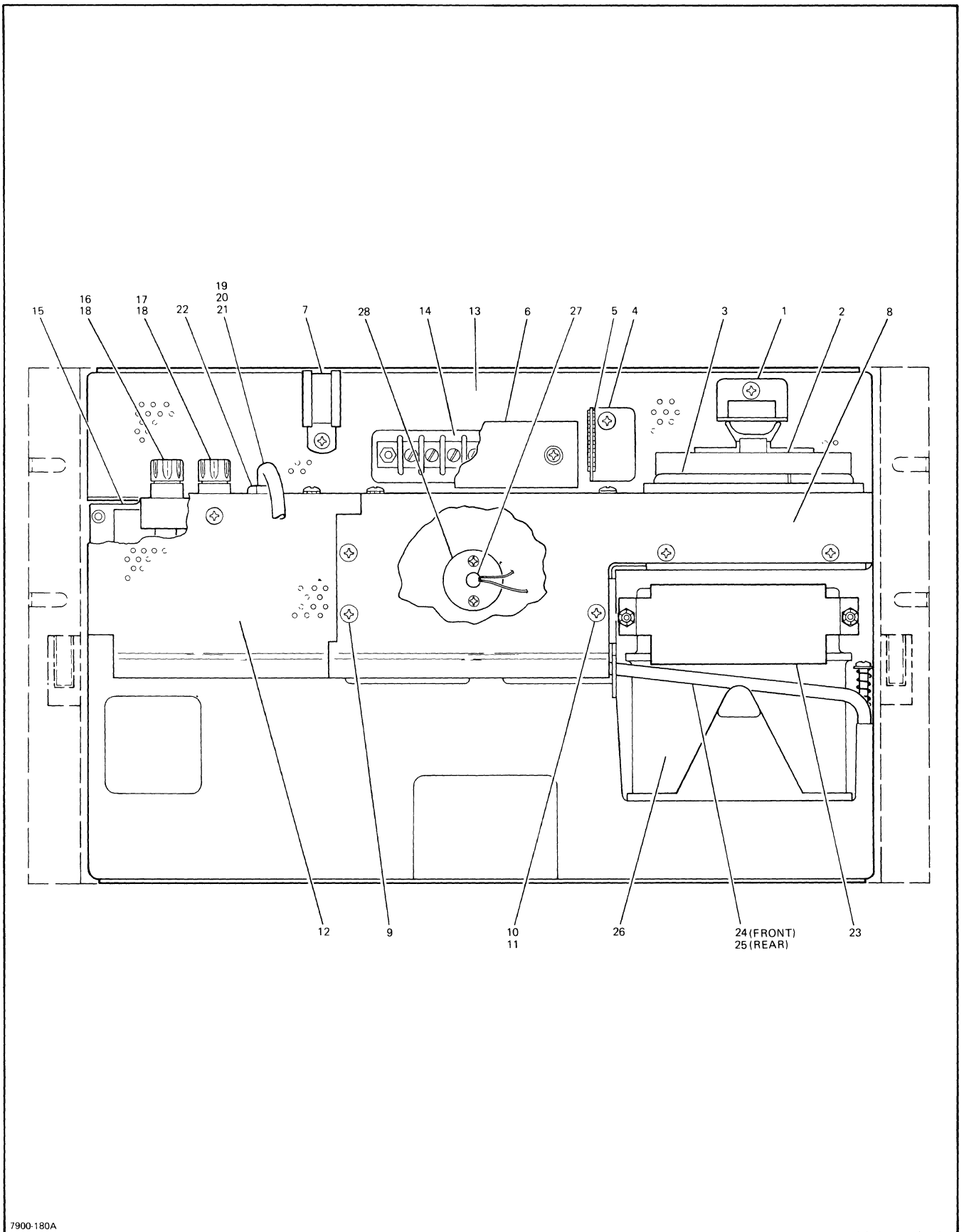
Figure 6-7. Field Replacement of Ground Button

Table 6-7. Rear Deck Assembly Replaceable Parts

FIG & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-7-1	No Number 07900-00071	REAR DECK ASSEMBLY (figure 6-1, item 37) * BRACKET, connector holddown (Attaching Parts)	28480	07900-00071	1
	2510-0043	* SCREW, machine, ph, pozi, w/ext tooth, no. 8-32, 0.312 in. ----x----	00000	OBD	1
2	07900-60033	* TERMINATION PC ASSEMBLY (A20) (see figure 5-49)	28480	07900-60033	1
3	07900-80015	* INPUT/OUTPUT EXTENDER PC BOARD	28480	07900-80015	1
4	07900-00084	* BRACKET, cable support (Attaching Parts)	28480	07900-00084	1
	2510-0043	* SCREW, machine, ph, pozi, w/ext tooth, no. 8-32, 0.312 in. ----x----	00000	OBD	1
5	0400-0082	* GROMMET, flexible	03296	G-51H-B	
6	07900-00061	* COVER, barrier strip (Attaching Parts)	28480	07900-00061	1
	2360-0115	* SCREW, machine, ph, pozi, w/ext tooth, no. 6-32, 0.312 in.	00000	OBD	2
	3050-0228	* WASHER, flat, 0.312 OD ----x----	00000	OBD	2
7	1400-0874	* CLAMP, cable (Attaching Parts)	83930	443-7-2-8	1
	2510-0043	* SCREW, machine, ph, pozi, w/ext tooth, no. 8-32, 0.312 in. ----x----	00000	OBD	1
8	07900-00026	* PANEL, lower rear (Attaching Parts)	28480	07900-00026	1
9	2510-0041	* SCREW, machine, ph, pozi, w/ext tooth, no. 8-32, 0.250 in.	00000	OBD	6
10	2510-0133	* SCREW, machine, ph, pozi, no. 8-32, 0.188 in.	00000	OBD	1
11	2190-0010	* WASHER, ext tooth lock, no. 8 ----x----	00000	OBD	1
12	07900-00066	* COVER, power module (Attaching Parts)	28480	07900-00066	1
	2510-0041	* SCREW, machine, ph, pozi, w/ext tooth, no. 8-32, 0.250 in. ----x----	00000	OBD	3
13	07900-00021	* PANEL, upper rear	28480	07900-00021	1
14	07900-60056	* DC INTERCONNECT PC ASSEMBLY (A18) (see figure 5-44) (Attaching Parts)	28480	07900-60056	1
	2360-0115	* SCREW, machine, ph, pozi, w/ext tooth, no. 6-32, 0.312 in. ----x----	00000	OBD	4
15	07900-60018	* MOTOR POWER MODULE (Attaching Parts)	28480	07900-60018	1
	2510-0045	* SCREW, machine, ph, pozi, w/ext tooth, no. 8-32, 0.375 in. ----x----	00000	OBD	2
16	2110-0007	** FUSE, blower, slo blo, 1A, 250 VAC (F1)	75915	3130015	1
17	2110-0365	** FUSE, spindle, slo blo, 4A, 250 VAC (F2)	71400	MDA-4AMP	1
18	1400-0084	** HOLDER, fuse (Attaching Parts)	75915	342014	2
	2950-0038	** NUT, no. 1/2-24	00000	OBD	1
	2190-0037	** WASHER, int tooth lock	00000	OBD	1
	0900-0016	** O-RING ----x----	83259	2-112-N219-7	1
19	8120-1734	** CABLE, AC interconnecting 8 ft (W1)	83259	2-112-N219-7	1
20	0362-0292	** TERMINAL, crimp lug	59730	RB857	1
21	0362-0294	** TERMINAL, crimp lug	59730	RA857	3
22	0400-0155	** BUSHING, strain relief	28520	SR-7P-2	1
23	07900-00078	* BRACKET, filter (Attaching Parts)	28480	07900-00078	1
	0590-0049	* NUT, hexagon, lock, no. 8-32	00000	OBD	2
	1460-1271	* SPRING, compression ----x----	84830	LC-045D-12	2

Table 6-7. Rear Deck Assembly Replaceable Parts (Continued)

FIG & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-7-24	07900-00076	REAR DECK ASSEMBLY continued) * CLAMP, filter, front (Attaching Parts)	28480	07900-00076	1
	2510-0063	* SCREW, machine, ph, pozi, no. 8-32, 1.500 in.	00000	OBD	1
	3050-0001	* WASHER, flat, no. 8	00000	OBD	1
	1460-1271	* SPRING, compression --- x ---	84830	LC-045D-12	1
25	07900-00075	* CLAMP, filter, rear (Attaching Parts)	28480	07900-00075	1
	2510-0063	* SCREW, machine, ph, pozi, no. 8-32, 1.500 in.	00000	OBD	1
	3050-0001	* WASHER, flat, no. 8	00000	OBD	1
	1460-1271	* SPRING, compression --- x ---	84830	LC-045D-12	1
26	3150-0225	* FILTER, absolute	28480	3150-0225	1
27	07900-60067	VELOCITY TRANSDUCER SHAFT ASSEMBLY (see figure 6-3, item 39)			Ref
28	07900-60025	VELOCITY TRANSDUCER ASSEMBLY (see figure 6-3, item 40)			Ref



7900-180A

Figure 6-8. Rear Deck Assembly

Table 6-8. Printed-Circuit Assembly Replaceable Parts

HP PART NO.		MFR CODE	MFR PART NO.	TQ
0140-0193	CAPACITOR, fxd, mica, 82 pF, 5%	28480	0140-0193	1
*0150-0121	CAPACITOR, fxd, cer, 0.1 μ F, +80 -20%, 50 VDCW	56289	5C50BI-CML	5
0160-0153	CAPACITOR, fxd, My, 0.001 μ F, 10%, 200 VDCW	56289	192P10292-PTS	8
0160-0155	CAPACITOR, fxd, My, 0.0033 μ F, 10%, 200 VDCW	56289	192P33292-PTS	2
0160-0158	CAPACITOR, fxd, My, 0.0056 μ F, 10%, 200 VDCW	56289	192P56292-PTS	2
0160-0159	CAPACITOR, fxd, My, 0.0068 μ F, 10%, 200 VDCW	56289	192P68282-PTS	1
0160-0161	CAPACITOR, fxd, My, 0.01 μ F, 10%, 200 VDCW	56289	192P10392-PTS	1
0160-0163	CAPACITOR, fxd, My, 0.033 μ F, 10%, 200 VDCW	56289	192P33392-PTS	1
0160-0167	CAPACITOR, fxd, My, 0.082 μ F, 10%, 200 VDCW	56289	192P82392-PTS	3
0160-0174	CAPACITOR, fxd, cer, 0.47 μ F, +80 -20%, 25 VDCW	56289	5C11B7S-CML	3
0160-0229	CAPACITOR, fxd, My, 1800 pF, 10%, 22 VDCW	56289	192P18292-PTS	1
0160-0269	CAPACITOR, fxd, cer, 0.1 μ F, 20%, 500 VDCW	56289	41C92A10-CDH	3
0160-0297	CAPACITOR, fxd, My, 0.0012 μ F, 10%, 200 VDCW	56289	192P12292-PTS	1
0160-0298	CAPACITOR, fxd, My, 0.0015 μ F, 10%, 200 VDCW	56289	192P15292-PTS	1
0160-0299	CAPACITOR, fxd, My, 1800 pF, 10%, 200 VDCW	56289	192P18292-PTS	1
0160-0904	CAPACITOR, fxd, cer, 0.05 μ F, 20%, 1000 VDCW	56289	41C169A4-CDH	2
0160-2055	CAPACITOR, fxd, cer, 0.01 μ F, +80 -20%, 100 VDCW	56289	C023F101F103ZS22-CDH	64
0160-2128	CAPACITOR, fxd, My, 0.33 μ F, 20%, 200 VDCW	56289	225P33402Y-PWM	2
0160-2150	CAPACITOR, fxd, mica, 33 pF, 5%	28480	0160-2150	3
0160-2197	CAPACITOR, fxd, mica, 10 pF, 5%	72136	RDM15C100J3C	1
0160-2198	CAPACITOR, fxd, mica, 20 pF, 5%	72136	RDM15C200J3C	2
0160-2199	CAPACITOR, fxd, mica, 30 pF, 5%, 300 VDCW	28480	0160-2199	6
0160-2255	CAPACITOR, fxd, cer, 8.2 pF, 5%, 500 VDCW	72982	301-000-COHO-829C	1
0160-3043	CAPACITOR, fxd, cer, 2 x 0.005 μ F, 20%, 250 VAC	56289	29C147A-CDH	1
0160-3238	CAPACITOR, fxd, My, 0.15 μ F, 5%, 200 VDCW	56289	192P15452-PTS	1
0160-3456	CAPACITOR, fxd, cer, 0.001 μ F, 10%, 250 VDCW	56289	C067F251F102KE12-CDH	2
0160-3533	CAPACITOR, fxd, mica, 470 pF, 5%, 100 VDCW	00853	RDM15F471JIC	2
0160-3534	CAPACITOR, fxd, mica, 510 pF, 5%, 100 VDCW	00853	RDM15F511JIC	1
0180-0098	CAPACITOR, fxd, elctlt, 100 μ F, 20%, 20 VDCW	56289	150D107X0020S2-DYS	1
0180-0100	CAPACITOR, fxd, Ta, 4.7 μ F, 10%, 35 VDCW	56289	150D475X9035B2-DYS	3
0180-0106	CAPACITOR, fxd, Ta, 60 μ F, 20%, 6 VDCW	28480	0180-0106	1
0180-0113	CAPACITOR, fxd, elctlt, Ta, 100 μ F, +20, -15%, 300 VDCW	56289	109D107C2030T2	1
0180-0116	CAPACITOR, fxd, elctlt, 6.8 μ F, 10%, 35 VDCW	56289	150D685X9035B2-DYS	9
0180-0136	CAPACITOR, fxd, elctlt, 10 μ F, -10 +100%, 50 VDCW	56289	40D106F050DC4M1	1
0180-0141	CAPACITOR, fxd, elctlt, 50 μ F, +75 -10%, 50 VDCW	56289	30D506G050DB2-DSM	1
0180-0229	CAPACITOR, fxd, elctlt, 33 μ F, 10%, 10 VDCW	28480	0180-0229	1
0180-0291	CAPACITOR, fxd, elctlt, 1.0 μ F, 10%, 35 VDCW	56289	150D105X9035A2-DYS	2
0180-0374	CAPACITOR, fxd, Ta, 10 μ F, 10%, 20 VDCW	56289	150D106X9020B2-DYS	1
0180-1701	CAPACITOR, fxd, Ta, 6.8 μ F, 10%, 6 VDCW	56289	150D685X0006A2-DYS	1
0180-1746	CAPACITOR, fxd, elctlt, 15 μ F, 10%, 20 VDCW	28480	0180-1746	5
0180-2207	CAPACITOR, fxd, elctlt, 100 μ F, 10%, 10 VDCW	56289	150D101X9010R2-DYS	3
0360-1686	BARRIER BLOCK	73631	GBP-7	1
0490-0347	RELAY, 24 Vdc	02288	TF154CC-CC-24VDC	1
0490-0983	RELAY, 470 ohms, 10A, 24V coil	77342	KUP11D17-24V	1
0490-1052	RELAY, 470 ohms, 10A, 24V coil	77342	KUP14D17	1

*Note: Total quantity for item 0150-0121 is 5 for series codes 1418 and higher. Total quantity for series code lower than 1418 is 4.

Table 6-8. Printed-Circuit Assembly Replaceable Parts (Continued)

HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	TQ
0683-0475	RESISTOR, fxd, comp, 4.7k, 5%, 1/4W	01121	CB47G5	2
0683-1005	RESISTOR, fxd, comp, 10 ohms, 5%, 1/4W	01121	CB 1005	2
0683-1015	RESISTOR, fxd, comp, 100 ohms, 5%, 1/4W	01121	CB 1015	12
0683-1025	RESISTOR, fxd, comp, 1k, 5%, 1/4W	01121	CB 1025	31
0683-1035	RESISTOR, fxd, comp, 10k, 5%, 1/4W	01121	CB 1035	22
0683-1055	RESISTOR, fxd, comp, 1M, 5%, 1/4W	01121	CB 1055	4
0683-1225	RESISTOR, fxd, comp, 1.2k, 5%, 1/4W	01121	CB 1225	1
0683-1505	RESISTOR, fxd, comp, 15 ohms, 5%, 1/4W	01121	CB 1505	1
0683-1515	RESISTOR, fxd, comp, 150 ohms, 5%, 1/4W	01121	CB 1515	3
0683-1525	RESISTOR, fxd, comp, 1.5k, 5%, 1/4W	01121	CB 1525	2
0683-1815	RESISTOR, fxd, comp, 180 ohms, 5%, 1/4W	01121	CB 1815	1
0683-2205	RESISTOR, fxd, comp, 22 ohms, 5%, 1/4W	01121	CB 2205	1
0683-2225	RESISTOR, fxd, comp, 2.2k, 5%, 1/4W	01121	CB 2225	11
0683-2235	RESISTOR, fxd, comp, 22k, 5%, 1/4W	01121	CB 2235	10
0683-2715	RESISTOR, fxd, comp, 270 ohms, 5%, 1/4W	01121	CB 2715	3
0683-2735	RESISTOR, fxd, comp, 27k, 5%, 1/4W	01121	CB 2735	1
0683-3325	RESISTOR, fxd, comp, 3.3k, 5%, 1/4W	01121	CB 3325	3
0683-3335	RESISTOR, fxd, comp, 33k, 5%, 1/4W	01121	CB 3335	2
0683-3645	RESISTOR, fxd, comp, 360k, 5%, 1/4W	01121	CB 3645	1
0683-3915	RESISTOR, fxd, comp, 390 ohms, 5%, 1/4W	01121	CB 3915	2
0683-3935	RESISTOR, fxd, comp, 39k, 5%, 1/4W	01121	CB 3935	1
0683-3945	RESISTOR, fxd, comp, 390k, 5%, 1/4W	01121	CB 3945	1
0683-4705	RESISTOR, fxd, comp, 47 ohms, 5%, 1/4W	01121	CB 4705	2
0683-4715	RESISTOR, fxd, comp, 470 ohms, 5%, 1/4W	01121	CB 4715	14
0683-4725	RESISTOR, fxd, comp, 4.7k, 5%, 1/4W	01121	CB 4725	20
0683-4735	RESISTOR, fxd, comp, 47k, 5%, 1/4W	01121	CB 4735	2
0683-4745	RESISTOR, fxd, comp, 470k, 5%, 1/4W	01121	CB 4745	3
0683-4755	RESISTOR, fxd, comp, 4.7M, 5%, 1/4W	01121	CB 4755	1
0683-5125	RESISTOR, fxd, comp, 5.1k, 5%, 1/4W	01121	CB 5125	2
0683-5605	RESISTOR, fxd, comp, 56 ohms, 5%, 1/4W	01121	CB 5605	1
0683-5615	RESISTOR, fxd, comp, 560 ohms, 5%, 1/4W	01121	CB 5615	1
0683-5625	RESISTOR, fxd, comp, 5.6k, 5%, 1/4W	01121	CB 5625	1
0683-5645	RESISTOR, fxd, comp, 560k, 5%, 1/4W	01121	CB 5645	2
0683-6805	RESISTOR, fxd, comp, 68 ohms, 5%, 1/4W	01121	CB 6805	1
0683-6815	RESISTOR, fxd, comp, 680 ohms, 5%, 1/4W	01121	CB 6815	6
0683-6825	RESISTOR, fxd, comp, 6.8k, 5%, 1/4W	01121	CB 6825	3
0683-7515	RESISTOR, fxd, comp, 750 ohms, 5%, 1/4W	01121	CB 7515	1
0683-7545	RESISTOR, fxd, comp, 750k, 5%, 1/4W	01121	CB 7545	2
0683-8235	RESISTOR, fxd, comp, 82k, 5%, 1/4W	01121	EB 8235	1
0686-1015	RESISTOR, fxd, comp, 100 ohms, 5%, 1/2W	01121	EB 1015	2
0686-1025	RESISTOR, fxd, comp, 1k, 5%, 1/2W	01121	CB 1025	1
0686-1515	RESISTOR, fxd, comp, 150 ohms, 5%, 1/2W	01121	EB 1515	1
0686-4715	RESISTOR, fxd, comp, 470 ohms, 5%, 1/2W	01121	EB 4715	1
0686-6815	RESISTOR, fxd, comp, 680 ohms, 5%, 1/2W	01121	EB 6815	1

Table 6-8. Printed-Circuit Assembly Replaceable Parts (Continued)

HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	TQ
0698-0084	RESISTOR, fxd, met flm, 2.15k, 1%, 1/8W	28480	0698-0084	1
0698-3132	RESISTOR, fxd, flm, 261 ohms, 1%, 1/8W	28480	0698-3132	2
0698-3136	RESISTOR, fxd, met flm, 17.8k, 1%, 1/8W	28480	0698-3136	1
0698-3150	RESISTOR, fxd, met flm, 2.37k, 1%, 1/8W	28480	0698-3150	2
0698-3151	RESISTOR, fxd, met flm, 2.87k, 1%, 1/8W	28480	0698-3151	2
0698-3156	RESISTOR, fxd, flm, 14.7k, 1%, 1/8W	28480	0698-3156	2
0698-3157	RESISTOR, fxd, met flm, 19.6k, 1%, 1/8W	28480	0698-3157	5
0698-3160	RESISTOR, fxd, met flm, 31.6k, 1%, 1/8W	28480	0698-3160	3
0698-3162	RESISTOR, fxd, met flm, 46.4k, 1%, 1/8W	28480	0698-3162	3
0698-3201	RESISTOR, fxd, flm, 80k, 1%, 1/8W	28480	0698-3201	1
0698-3315	RESISTOR, fxd, comp, 330 ohms, 5%, 1/4W	01121	CB 3321	1
0698-3399	RESISTOR, fxd, met flm, 133 ohms, 1%, 1/2W	28480	0698-3399	1
0698-3437	RESISTOR, fxd, met flm, 133 ohms, 1%, 1/8W	28480	0698-3437	1
0698-3439	RESISTOR, fxd, met flm, 178 ohms, 1%, 1/8W	28480	0698-3439	1
0698-3440	RESISTOR, fxd, met flm, 196 ohms, 1%, 1/8W	28480	0698-3440	1
0698-3441	RESISTOR, fxd, met flm, 215 ohms, 1%, 1/8W	28480	0698-3441	4
0698-3444	RESISTOR, fxd, met flm, 316 ohms, 1%, 1/8W	28480	0698-3444	13
0698-3446	RESISTOR, fxd, met flm, 383 ohms, 1%, 1/8W	28480	0698-3446	1
0698-3450	RESISTOR, fxd, flm, 42.2k, 1%, 1/8W	28480	0698-3450	1
0698-3451	RESISTOR, fxd, met flm, 133k, 1%, 1/8W	28480	0698-3451	2
0698-3457	RESISTOR, fxd, met flm, 316k, 1%, 1/8W	28480	0698-3457	2
0698-3460	RESISTOR, fxd, met flm, 422k, 1%, 1/8W	28480	0698-3460	1
0698-3615	RESISTOR, fxd, met ox, 47 ohms, 5%, 2W	28480	0698-3615	2
0698-3626	RESISTOR, fxd, met ox, 180 ohms, 5%, 2W	28480	0698-3626	1
0698-4002	RESISTOR, fxd, met flm, 5k, 1%, 1/8W	28480	0698-4002	5
0698-4007	RESISTOR, fxd, flm, 27.8k, 1%, 1/8W	28480	0698-4007	3
0698-4008	RESISTOR, fxd, met flm, 40k, 1%, 1/8W	28480	0698-4008	1
0698-4037	RESISTOR, fxd, met flm, 46.4 ohms, 1%, 1/8W	28480	0698-4037	3
0698-5092	RESISTOR, fxd, flm, 160k, 1%, 1/8W	28480	0698-5092	1
0698-5178	RESISTOR, fxd, comp, 1.5k, 5%, 1/8W	28480	0698-5178	2
0698-6283	RESISTOR, fxd, comp, 10 ohms, 5%, 1/8W	01121	BB 1005	2
0698-6725	RESISTOR, fxd, comp, 100k, 10%, 1/8W	01121	BB 1041	2
0698-6984	RESISTOR, fxd, comp, 470 ohms, 5%, 1/8W	28480	0698-6984	2
0698-7187	RESISTOR, fxd, comp, 2M, 5%, 1/8W	01121	BB 2055	2
0757-0123	RESISTOR, fxd, met flm, 34.8k, 1%, 1/8W	28480	0757-0123	1
0757-0198	RESISTOR, fxd, met flm, 100 ohms, 1%, 1/2W	28480	0757-0198	2
0757-0199	RESISTOR, fxd, met flm, 21.5k, 1%, 1/8W	28480	0757-0199	1
0757-0274	RESISTOR, fxd, met flm, 1.21k, 1%, 1/8W	28480	0757-0274	5
0757-0279	RESISTOR, fxd, met flm, 3.16k, 1%, 1/8W	28480	0757-0279	2
0757-0280	RESISTOR, fxd, met flm, 1k, 1%, 1/8W	28480	0757-0280	11
0757-0289	RESISTOR, fxd, met flm, 13.3k, 1%, 1/8W	28480	0757-0289	2
0757-0290	RESISTOR, fxd, met flm, 6.19k, 1%, 1/8W	28480	0757-0290	1
0757-0398	RESISTOR, fxd, met flm, 75 ohms, 1%, 1/8W	28480	0757-0390	2
0757-0401	RESISTOR, fxd, met flm, 100 ohms, 1%, 1/8W	28480	0757-0401	3
0757-0403	RESISTOR, fxd, met flm, 121 ohms, 1%, 1/8W	28480	0757-0403	1

Table 6-8. Printed-Circuit Assembly Replaceable Parts (Continued)

HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	TQ
0757-0416	RESISTOR, fxd, met flm, 511 ohms, 1%, 1/8W	28480	0757-0416	3
0757-0417	RESISTOR, fxd, met flm, 562 ohms, 1%, 1/8W	28480	0757-0417	2
0757-0418	RESISTOR, fxd, met flm, 619 ohms, 1%, 1/8W	28480	0757-0418	7
0757-0420	RESISTOR, fxd, met flm, 750 ohms, 1%, 1/8W	28480	0757-0420	13
0757-0428	RESISTOR, fxd, met flm, 1.62k, 1%, 1/8W	28480	0757-0428	3
0757-0435	RESISTOR, fxd, met flm, 3.65k, 1%, 1/8W	28480	0757-0435	1
0757-0438	RESISTOR, fxd, met flm, 5.11k, 1%, 1/8W	28480	0757-0438	9
0757-0439	RESISTOR, fxd, met flm, 6.81k, 1%, 1/8W	28480	0757-0439	1
0757-0441	RESISTOR, fxd, met flm, 8.25k, 1%, 1/8W	28480	0757-0441	3
0757-0442	RESISTOR, fxd, met flm, 10k, 1%, 1/8W	28480	0757-0442	5
0757-0447	RESISTOR, fxd, met flm, 16.2k, 1%, 1/8W	28480	0757-0447	3
0757-0449	RESISTOR, fxd, flm, 20k, 1%, 1/8W	28480	0757-0449	7
0757-0458	RESISTOR, fxd, met flm, 51.1k, 1%, 1/8W	28480	0757-0458	3
0757-0459	RESISTOR, fxd, met flm, 56.2k, 1%, 1/8W	28480	0757-0459	1
0757-0464	RESISTOR, fxd, met flm, 90.9k, 1%, 1/8W	28480	0757-0464	1
0757-0465	RESISTOR, fxd, met flm, 100k, 1%, 1/8W	28480	0757-0465	5
0757-0799	RESISTOR, fxd, met flm, 121 ohms, 1%, 1/2W	28480	0757-0799	2
0757-1094	RESISTOR, fxd, met flm, 1.47k, 1%, 1/8W	28480	0757-1094	2
0761-0008	RESISTOR, fxd, met ox, 510 ohms, 5%, 1W	28480	0761-0008	2
0761-0015	RESISTOR, fxd, met ox, 1.5k, 5%, 1W	24546	FP-32-1-T00-150-J	1
0761-0037	RESISTOR, fxd, met ox, 390 ohms, 5%, 1W	28480	0761-0037	1
0764-0044	RESISTOR, fxd, met ox, 8.2k, 5%, 2W	28480	0764-0044	1
0811-1655	RESISTOR, fxd, ww, 10 ohms, 5%, 20W	28480	0811-1655	2
0811-1666	RESISTOR, fxd, ww, 1.0 ohms, 5%, 2W	28480	0811-1666	4
0811-2490	RESISTOR, fxd, ww, 0.1 ohm, 3%, 5W	28480	0811-2490	5
0811-3039	RESISTOR, fxd, ww, 0.1 ohm, 1.0%, 10W	28480	0811-3039	1
0812-0060	RESISTOR, fxd, ww, 5k, 5%, 5W	28480	0812-0060	1
1251-1886	CONNECTOR, pc, 30 contact (2 x 15)	71785	252-15-30-340	14
1251-2025	CONNECTOR, pc, 48-contact (2 x 24)	71785	252-24-30-340	3
1420-0088	BATTERY, nickel cadmium, 1.25V	05397	CH 500	3
1820-0054	INTEGRATED CIRCUIT, TTL	01295	SN 7400N	25
1820-0068	INTEGRATED CIRCUIT, TTL	10240	SN 7410N	2
1820-0069	INTEGRATED CIRCUIT, TTL	01295	SN 7420N	3
1820-0077	INTEGRATED CIRCUIT, TTL	01295	SN 7474N	6
1820-0099	INTEGRATED CIRCUIT, TTL	01295	SN 7493N	2
1820-0141	INTEGRATED CIRCUIT, TTL	04713	MC 3001P	1
1820-0174	INTEGRATED CIRCUIT, TTL	01295	SN 7404N	11
1820-0192	INTEGRATED CIRCUIT	28480	1820-0192	1
1820-0207	INTEGRATED CIRCUIT, TTL	28480	1820-0207	1
1820-0233	INTEGRATED CIRCUIT, TTL	01295	SN 74193N	2
1820-0239	INTEGRATED CIRCUIT, TTL	28480	1820-0239	12
1820-0250	INTEGRATED CIRCUIT, TTL	28480	1820-0250	1
1820-0282	INTEGRATED CIRCUIT, TTL	01295	SN 7486N	2
1820-0301	INTEGRATED CIRCUIT, TTL	01295	SN 7475N	4
1820-0305	INTEGRATED CIRCUIT	01295	SN 7483N	2
1820-0398	INTEGRATED CIRCUIT	12040	LM 710C	2

Table 6-8. Printed-Circuit Assembly Replaceable Parts (Continued)

HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	QTY
1820-0477	INTEGRATED CIRCUIT	28480	1820-0477	5
1820-0493	INTEGRATED CIRCUIT	12040	LM 307N	5
1820-0511	INTEGRATED CIRCUIT, TTL	01295	SN 7408N	4
1820-0514	INTEGRATED CIRCUIT, TTL	01295	SN 7426N	1
1820-0515	INTEGRATED CIRCUIT, TTL	07263	U7B960259X	6
1820-0535	INTEGRATED CIRCUIT, TTL	01295	SN 75451	1
1820-0537	INTEGRATED CIRCUIT, TTL	28480	1820-0537	7
1820-0577	INTEGRATED CIRCUIT, TTL	01295	SN 7416N	4
1820-0722	INTEGRATED CIRCUIT, TTL	01295	SN 75109N	1
1820-0723	INTEGRATED CIRCUIT, TTL	01295	SN 75107N	1
1820-0799	INTEGRATED CIRCUIT	28480	1820-0799	1
1826-0064	INTEGRATED CIRCUIT	07263	U6A7733393	1
1826-0075	INTEGRATED CIRCUIT, lin zero voltage switch	02735	CA 3079	1
1826-0068	INTEGRATED CIRCUIT	28480	1826-0068	1
1853-0010	TRANSISTOR, silicon, PNP	28480	1853-0010	13
1853-0012	TRANSISTOR, silicon, PNP	80131	2N2904A	1
1853-0020	TRANSISTOR, silicon, PNP	28480	1853-0020	1
1853-0036	TRANSISTOR, silicon, PNP	80131	2N3906	3
1853-0305	TRANSISTOR, silicon, PNP	04713	2N5875	1
1854-0039	TRANSISTOR, silicon, NPN	80131	2N3053	3
1854-0045	TRANSISTOR, silicon, NPN	04713	2N956	9
1854-0053	TRANSISTOR, silicon, NPN	80131	2N2218	1
1854-0071	TRANSISTOR, NPN (Selected from 2N3704)	28480	1854-0071	8
1854-0072	TRANSISTOR, silicon, NPN	80131	2N3054	2
1854-0215	TRANSISTOR, silicon, NPN	80131	2N3904	16
1854-0260	TRANSISTOR, silicon, NPN	28480	1854-0260	2
1854-0518	TRANSISTOR, silicon, NPN	28480	1854-0518	2
1854-0519	TRANSISTOR, silicon, NPN	28480	1854-0519	4
1855-0056	TRANSISTOR, silicon, FET	80131	2N4342	4
1855-0078	TRANSISTOR, silicon, FET	28480	1855-0078	2
1884-0012	RECTIFIER, silicon controlled, 2N3528	02735	2N3528	2
1884-0054	THYRISTOR	02735	40526	1
1884-0076	THYRISTOR, triac, 400V	86684	40430	1
1884-0088	THYRISTOR, scr, 200V	86684	2N3228	1
1901-0016	DIODE, silicon	04713	1N1566	1
1901-0026	DIODE, silicon, 200 piv, 0.75A	04713	SR 1358-8	2
1901-0040	DIODE, silicon, 30 mA, 30 wV	07263	FDG 1088	55
1901-0044	DIODE, silicon, 20 mA/1V	28480	1901-0044	1
1901-0049	DIODE, silicon, 50 PIV	28480	1901-0049	7
1901-0416	DIODE, silicon, 200 PIV, 3A	28480	1901-0416	10
1901-0418	DIODE, silicon, 400 PIV	04713	1N5000	3
1901-0450	DIODE, silicon, 100 mA, 50 wV	28480	1901-0450	19
1901-0460	DIODE, silicon	03508	STB 523	7
1902-0025	DIODE, breakdown, 10.0V, 5%, 400 mW	28480	1902-0025	5
1902-0041	DIODE, breakdown, 5.11V, 5%	04713	SZ10939-98	1
1902-0049	DIODE, breakdown, 6.19V, 5%	04713	SZ10939-122	2
1902-3003	DIODE, breakdown, 2.37V, 2%	04713	SZ10939-3	1

Table 6-8. Printed-Circuit Assembly Replaceable Parts (Continued)

HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	TQ
1902-3036	DIODE, breakdown, 3.16V, 5%	04713	SZ10939-38	1
1902-3059	DIODE, breakdown, silicon, 3.83V, 5%	28480	1902-3059	1
1902-3110	DIODE, breakdown, silicon, 5.9V, 2%	15818	CD 35641	1
1902-3149	DIODE, breakdown, 9.09V, 5%	28480	1902-3149	2
1902-3203	DIODE, breakdown, silicon, 14.7%, 5%	28480	1902-3203	2
1902-3205	DIODE, breakdown, 15.0V, 5%	28480	1902-3205	2
1990-0085	PHOTOTRANSISTOR, 30V	07263	FPT-100	2
2100-2489	RESISTOR, var, flm, 5k, 10%, lin, 1/2W	28480	2100-2489	2
2100-2514	RESISTOR, var, cermet, 20k, 10%, lin, 1/2W	28480	2100-2514	2
2100-2517	RESISTOR, var, flm, 50k, 10%, lin, 1/2W	28480	2100-2517	1
2100-2521	RESISTOR, var, flm, 2k, 10%, lin, 1/2W	28480	2100-2521	1
2140-0094	LAMP, incandescent, 5.3V	92966	7153	2
2140-0343	LAMP, incandescent, 14V, 0.8A	98978	330	5
3101-1219	SWITCH, toggle, SPDT, subminiature	09353	7101PC	1
5040-1485	CONDUCTOR ASSY, plug-in jumper	28480	5040-1485	3
8159-0005	JUMPER	00736	L-2007-1	2
9100-1623	COIL/CHOKE, 27 μ H, 5%	99800	1537-48	2
9100-1627	COIL/CHOKE, 39 μ H, 5%	82142	15-1315-2J	2
07900-60063	BARRIER BLOCK			

Table 6-9. Reference Designations and Abbreviations

REFERENCE DESIGNATIONS		
A = assembly	K = relay	TB = terminal board
B = motor, synchro	L = inductor	TP = test point
BT = battery	M = meter	U = integrated circuit, non-repairable assembly
C = capacitor	P = plug connector	V = vacuum tube, photocell, etc.
CB = circuit breaker	Q = semiconductor device other than diode or integrated circuit	VR = voltage regulator
CR = diode	R = resistor	W = jumper wire
DL = delay line	RT = thermistor	X = socket
DS = indicator	S = switch	Y = crystal
E = Misc electrical parts	T = transformer	Z = tuned cavity, network
F = fuse		
FL = filter		
J = receptacle connector		
ABBREVIATIONS		
A = amperes	gra = gray	PCA = printed-circuit assembly
ac = alternating current	grn = green	PWB = printed-wiring board
Ag = silver	H = henries	ph = pan head
Al = aluminum	Hg = mercury	phh = phillips head
ar = as required	hr = hour(s)	pk = peak
adj = adjust	Hz = hertz	p-p = peak-to-peak
assy = assembly	hdw = hardware	pt = point
b = base	hex = hexagon, hexagonal	prv = peak inverse voltage
bp = bandpass	ID = inside diameter	PNP = positive-negative-positive
bpi = bits per inch	IF = intermediate frequency	pwv = peak working voltage
blk = black	in. = inch, inches	porc = porcelain
blu = blue	I/O = input/output	posn = position(s)
brn = brown	int = internal	pozi = pozidrive
brs = brass	incl = include(s)	rf = radio frequency
Btu = British thermal unit	insul = insulation, insulated	rdh = round head
Be Cu = beryllium copper	impgrg = impregnated	rms = root-mean-square
cpi = characters per inch	incand = incandescent	rwv = reverse working voltage
coll = collector	ips = inches per second	rect = rectifier
cw = clockwise	k = kilo (10 ³), kilohm	r/min = revolutions per minute
ccw = counterclockwise	lp = low pass	RTL = resistor-transistor logic
cer = ceramic	m = milli (10 ⁻³)	s = second
com = common	M = mega (10 ⁶), megohm	SB, TT = slow blow
crt = cathode-ray tube	My = Mylar	Se = selenium
CTL = complementary-transistor logic	mfr = manufacturer	Si = silicon
cath = cathode	mom = momentary	scr = silicon controlled rectifier
Cd pl = cadmium plate	mtg = mounting	sst = stainless steel
comp = composition	misc = miscellaneous	stl = steel
conn = connector	met. ox. = metal oxide	spcl = special
compl = complete	mintr = miniature	spdt = single-pole, double-throw
dc = direct current	n = nano (10 ⁻⁹)	spst = single-pole, single-throw
dr = drive	nc = normally closed or no connection	Ta = tantalum
DTL = diode-transistor logic	Ne = neon	td = time delay
depc = deposited carbon	no. = number	Ti = titanium
dpdt = double-pole, double-throw	n.o. = normally open	tgl = toggle
dpst = double-pole, single-throw	np = nickel plated	thd = thread
em = emitter	NPN = negative-positive-negative	tol = tolerance
ECL = emitter-coupled logic	NPO = negative-positive zero (zero temperature coefficient)	TTL = transistor transistor logic
ext = external	NSR = not separately replaceable	U(μ) = micro (10 ⁻⁶)
encap = encapsulated	NRFR = not recommended for field replacement	V = volt(s)
elctlt = electrolytic	OD = outside diameter	var = variable
F = farads	OBD = order by description	vio = violet
FF = flip-flop	orn = orange	Vdcw = direct current working volts
flh = flat head	ovh = oval head	W = watts
flm = film	oxd = oxide	ww = wirewound
fxd = fixed	p = pico (10 ⁻¹²)	wht = white
filh = fillister head	PC = printed circuit	WIV = working inverse voltage
G = giga (10 ⁹)		yel = yellow
Ge = germanium		
gl = glass		
gnd = ground(ed)		

Table 6-10. Code List of Manufacturers

CODE NO.	MANUFACTURER NAME	ADDRESS
00779	Amp Inc. (Aircraft Marine Prod.)	Harrisburg, Pennsylvania
00853	Sangamo Electric Company, Pickens Division	Pickens, South Carolina
01002	General Electric Company	Hudson Falls, New York
01121	Allen Bradley Company	Milwaukee, Wisconsin
01295	Texas Instruments Inc., Semiconductor Components Division	Dallas, Texas
01963	Cherry Electrical Products Corporation	Highland Park, Illinois
02288	Allied Control Company, Inc.	Plainsville, Connecticut
02735	RCA Solid State & Receiving Tube Division	Somerville, New Jersey
03296	Nylon Molding Corporation	Springfield, New Jersey
03508	G.E. Company, Semiconductor Prod. Dept.	Syracuse, New York
03511	General Electric Company	Fort Wayne, Indiana
03930	Connecticut Investment Casting Corporation	Pawcatuck, Connecticut
04009	Arrow, Halt & Hegeman Elect. Company	Hartford, Connecticut
04713	Motorola Semiconductor Prod., Inc.	Phoenix, Arizona
05397	Union Carbide Corporation, Elect. Division	New York, New York
07233	Cinch-Graphik, Division United Carr, Inc.	City of Industry, California
07263	Fairchild Camera & Inst. Corp., Semiconductor Division	Mountain View, California
09353	C & K Components, Inc.	Newton, Massachusetts
12040	National Semiconductor Corporation	Danbury, Connecticut
13103	Thermalloy Company	Dallas, Texas
14480	Rollin J. Lobaugh	So. San Francisco, California
18121	Wilshire Foam Products, Inc.	Torrance, California
18583	Curtis Instruments, Inc.	Mt. Kisco, New York
18911	Cutler-Hammar, Inc., Durant Digital Inst.	Milwaukee, Wisconsin
22670	G M Nameplate, Inc.	West Seattle, Washington
23589	Nippon Miniature Bearing Company, Ltd.	Culver City, California
24446	No M/F Description for the Mfg Number	
27191	Cutler-Hammer, Inc., Power Dist. & Control Division	Milwaukee, Wisconsin
27264	Molex Prod. Company	Downers Grove, Illinois
28480	Hewlett-Packard Company	Palo Alto, California
28520	Heyman Mfg. Company	Kenilworth, New Jersey
37942	No M/F Description for the Mfg Number	
40920	Miniature Bearing Division MPB Corp.	Keene, New Hampshire
56289	Sprague Electric Company	No. Adams, Massachusetts
59730	The Thomas and Betts Company	Elizabeth, New Jersey
60399	Torin Corporation	Torrington, California
70276	Allen Mfg. Company	Hartford, Connecticut
70903	Belden Corporation	Chicago, Illinois
71400	Bussmann Mfg. Div. McGraw-Edison Company	St. Louis, Missouri
71744	Chicago Miniature Lamp Works	Chicago, Illinois
71765	Cinch Mfg. Company, Div. Trw, Inc.	Elk Grove Village, Illinois
71785	Cinch Mfg. Company	Chicago, Illinois
72136	Electro Motive Mfg. Company, Inc.	Willimantic, Connecticut
72962	Elastic Stop Nut Div. Amerace Esna Corporation	Union, New Jersey
72982	Erie Technological Prod., Inc.	Erie, Pennsylvania
73518	Arthur S. Brown Mfg. Company	Tilton, New Hampshire
73631	Curtis Development and Mfg. Company	Milwaukee, Wisconsin
73662	Dormeyer Industries, Inc.	Chicago, Illinois
73734	Federal Screw Prod., Inc.	Chicago, Illinois
73957	Groov-Pin Corporation	Ridgefield, New Jersey
75263	Keystone Carbon Company	St. Marys, Pennsylvania
75915	Littelfuse, Inc.	Des Plaines, Illinois

Table 6-10. Code List of Manufacturers (Continued)

CODE NO.	MANUFACTURER NAME	ADDRESS
76381	Minnesota Mining and Mfg. Co.	St. Paul, Minnesota
77342	American Machine & Foundry Co., Potter & Brumfield Division	Princeton, Indiana
77969	Rubbercraft Corp. of Calif., Ltd.	Torrance, California
78189	Shakerproof Division Illinois Tool Works	Elgin, Illinois
78452	Thompson-Bremer & Company	Chicago, Illinois
78471	Tilley Mfg. Company	San Carlos, California
79136	Waldes Kohinoor, Inc.	Long Island City, New York
79251	Wenco Mfg. Company	Chicago, Illinois
79725	Wiremold Company	Hartford, Connecticut
79727	Continental-Wirt Electronics Corporation	Philadelphia, Pennsylvania
80120	Schnitzer Alloy Prod. Company	Elizabeth, New Jersey
80131	Electronic Industries Association	Washington, D. C.
82142	Airco Speer Elect. Company	DuBois, Pennsylvania
83259	Parker Seal Co.	Culver City, California
83930	Adel Products Division	Huntington, West Virginia
84830	Lee Spring Company, Inc.	Brooklyn, New York
85474	R M Bracamonte and Company	San Francisco, California
86684	RCA Electronic Components	Harrison, New Jersey
90201	Mallory Capacitor Company	Indianapolis, Indiana
91001	Buckbee Mears Company	St. Paul, Minnesota
91961	Nahm-Bros. Spring Company	Oakland, California
92194	Alpha Wire Corporation	Elizabeth, New Jersey
92966	Hudson Lamp Company	Kearny, New Jersey
94142	Phelps Dodge Cooper Prod. Corp., Habirshaw Cable & Wire Div.	Yonkers, New York
95987	Weckesser Company, Inc.	Chicago, Illinois
96881	Thumson Ind., Inc.	Manhasset, New York
97464	Pettibone Mercury Corporation	Tualatin, Oregon
98376	Zero Mfg. Company	Burbank, California
98976	American Machine and Solvents Co., Inc.	Queens, New York
98978	International Elect. Research Corporation	Burbank, California
99800	Delevan Electronics Corporation	East Aurora, New York

APPENDIX A

LOGIC SYMBOLOGY

A-1. INTRODUCTION.

A-2. This appendix covers basic logic information and symbology as used in this manual and related manuals.

A-3. LOGIC STATES.

A-4. The logic signals are always in one of two possible states, a "1" or a "0." These two states are also referred to as high (H) or low (L). The high and low states reflect the relative voltage levels of the signals; the high state is always relatively more positive than the low state. Note that both states may have actual voltage values that are positive, or both may be absolutely negative; the significance is in the relative levels of the two states. In the text of the manuals, logic states are normally described as "high" or "low."

A-5. The "not" bar associated with signal names is used to indicate whether the "active" state of the signal is high or low. For example, if the presence of data on a signal line is represented by a low signal, the signal name for the line might be "not" Data 1; if a signal clears the output register when the signal is low, the signal might be described as "not" Clear Output Register (\overline{COR}). The "not" bar must be considered an integral part of the signal name; this means that there are high states for "not" signals and low states for "not" signals, just as there are high and low states for signals without the "not" bar.

A-6. LOGIC SYMBOLOGY.

A-7. Three basic symbol shapes distinguish the major classes of logic circuits depicted in this manual. These are gates, regenerative switching elements, and amplifiers. Each symbol and a brief explanation of its operation is given in the following paragraphs.

A-8. In addition to the basic symbols, a general multipurpose symbol is used wherever a standardized logic symbol does not exist. A brief explanation of this multipurpose symbol is included.

A-9. INVERSION.

A-10. Logic inversion is indicated by an inversion dot at the input or output of a logic symbol. When this dot appears at the input of a logic symbol, the input will be effective when the input signal is low. When the dot appears at the output of a logic symbol the output will be of the opposite state to what would be delivered if the dot were not present.

A-11. GATES.

A-12. A gate is a circuit that produces a binary output when certain input conditions are met. The gate symbol has input lines connecting to one side of the symbol, and output lines connecting to the other side, as shown in figure A-1. Since the inputs and outputs are easily identifiable, the symbol can be shown left-facing, right-facing, or facing up or down.

A-13. There are four basic types of gates: "and," "or," "nand," and "nor," each named for the logic function that it performs. Each of these gates is described in the following paragraphs. In addition, a brief explanation of an "expander" gate is given following the descriptions of the basic logic gates.

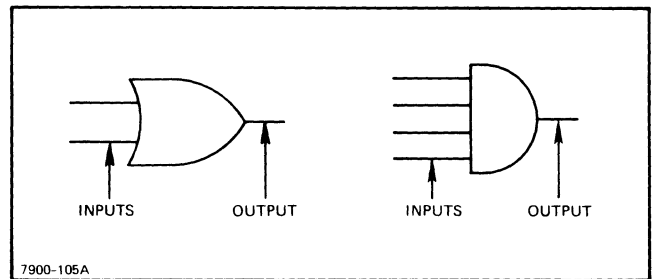
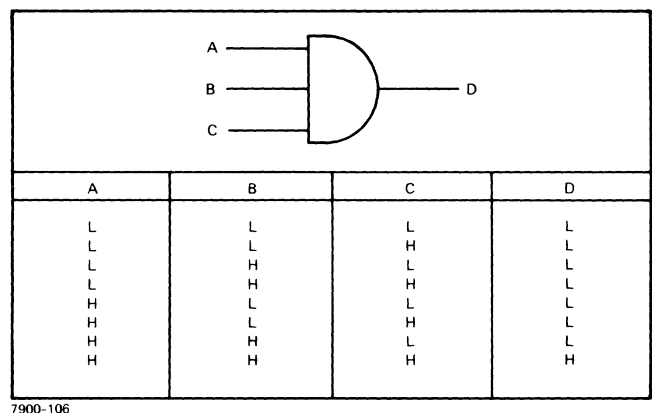


Figure A-1. Gate Symbols

A-14. "AND" GATE.

A-15. The "and" gate shown in figure A-2 performs a logical "and" function. It will produce a high output only when all of the input lines are high. Input A and input B and input C must be high for a high output to be generated.



7900-106

Figure A-2. Three-Input "And" Gate Logic Symbol and Truth Table

A-26. When more than one expander gate is used, the gate outputs are connected as in parallel, as shown by the dashed lines in figure A-8.

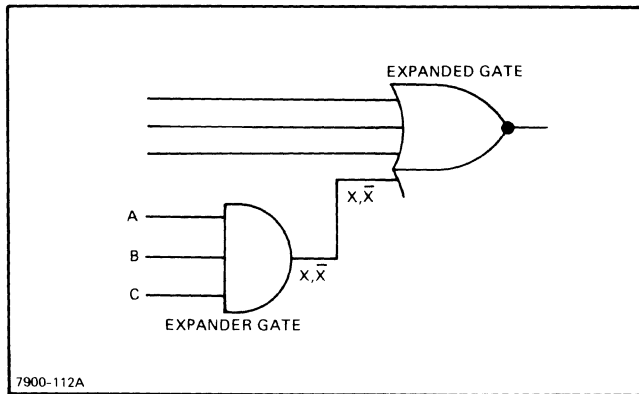


Figure A-7. Simplified Expander Gate Logic Symbol

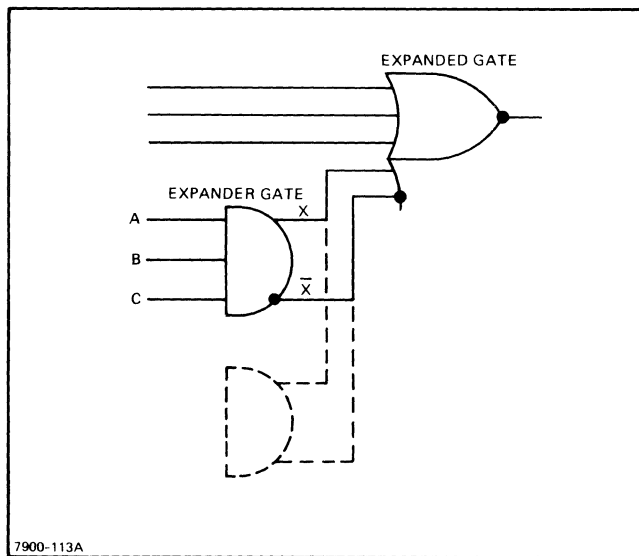


Figure A-8. Actual Expander Gate Logic Symbol

A-27. ENCODING GATE.

A-28. The encoding gate (figure A-9) has one input and multiple outputs. When the input is high, all outputs (B, C, and D) are high. When the input is low, the outputs are either low or high, in accordance with the state of the logic element to which each is connected.

A-29. A typical circuit for an encoding gate is shown in figure A-10. With A high, all diodes conduct and all outputs are clamped high. With A low, each diode is practically an open circuit, and points B, C, and D assume the voltage level of the circuit to which each is connected.

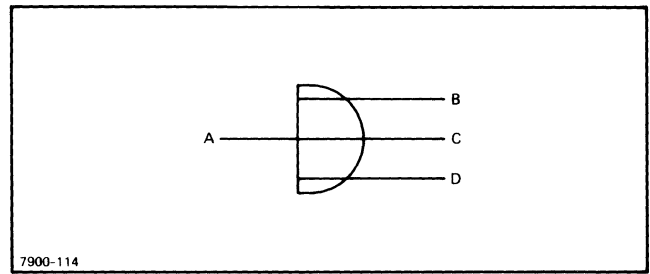


Figure A-9. Three-Input Encoding Gate, Logic Symbol

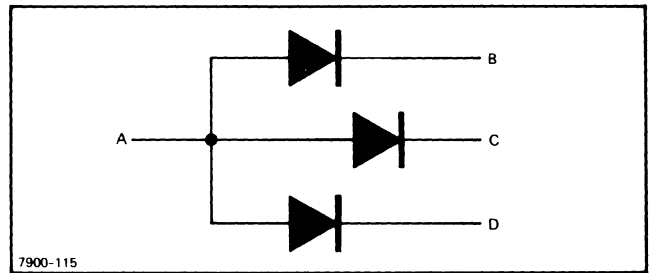


Figure A-10. Typical Encoding Gate Circuit

A-30. MULTIVIBRATORS.

A-31. The multivibrators described here are of four main types: flip-flops, Schmitt trigger circuits, one-shot multivibrators, and free-running multivibrators. All furnish a binary output. However, unlike gate circuits, the duration of a multivibrator output signal is not dependent on the duration of an input signal.

A-32. The basic logic symbol for a multivibrator is a rectangle as shown in figure A-11. Letters in the symbol indicate the type of multivibrator. The rectangle is divided horizontally, with the upper portion representing the "set side" and the lower portion representing the "clear side." The multivibrator is considered set when the output from the set side is high. It is considered cleared when the output from the clear side is high. To avoid confusion, the symbol is always oriented as shown in figure A-11; inputs on the left, outputs on the right.

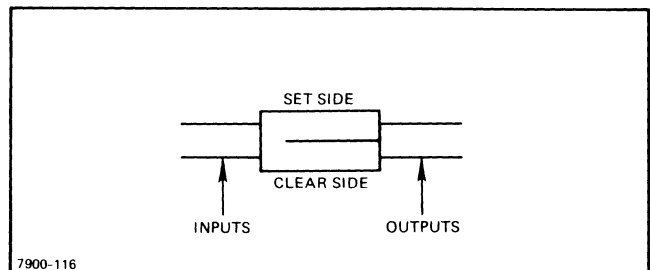


Figure A-11. Basic Logic Symbol Multivibrator

A-33. FLIP-FLOP.

A-34. The symbol for a flip-flop is shown in figure A-12. The letters "FF" preceded by the name of the flip-flop distinguish this symbol from other types of multivibrators. Additional identification, described later, identifies the particular type of flip-flop.

A-35. A flip-flop is a bistable switching device; an external signal is required to set the flip-flop and another to clear it. The flip-flop remains in its current state until switched to the opposite state by the appropriate external signal. Various forms of flip-flops exist, of which seven are described here: the R-S (reset-set), clocked R-S, J-K, clocked J-K, toggle, latch, and delay flip-flops.

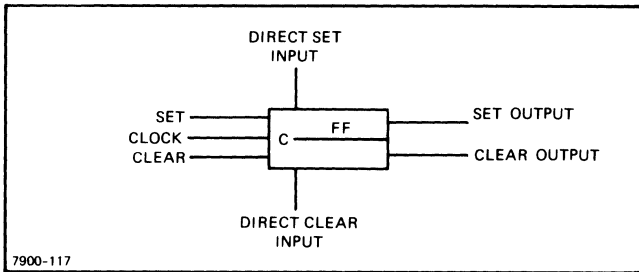


Figure A-12. General Flip-Flop Logic Symbol

A-36. R-S FLIP-FLOP. The symbol for the R-S flip-flop as shown in figure A-13 can be recognized by the fact that there is no information in the symbol identifying it as one of the other six types. The R-S flip-flop has a minimum of two input terminals (A and B in figure A-13) and one or two output terminals Q and \bar{Q} . One or two additional input terminals, C and D, may be used.

A-37. The R-S flip-flop is set by a high input at A (assuming no inverting dot at this point). It can also be set by a high input at C, if this input terminal is present. The flip-flop is cleared by a high input at B or D. Figure A-13 includes a truth table, showing the flip-flop outputs resulting from various input conditions.

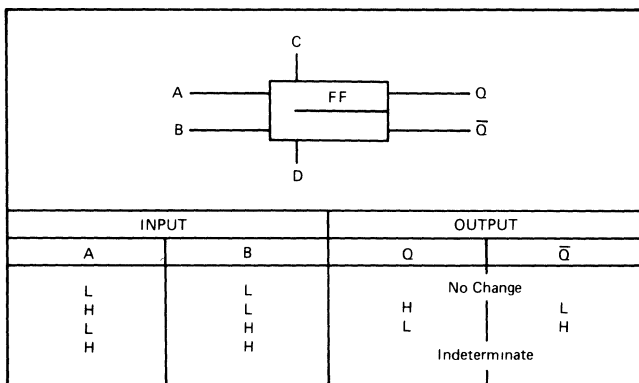


Figure A-13. R-S Flip-Flop, Logic Symbol, and Truth Table

A-38. After being set or cleared, the R-S flip-flop remains in that condition after termination of the set or clear pulse. If the flip-flop is either set or clear and it receives an input to place it in the existing state no change takes place in the state of the flip-flop.

A-39. Simultaneous high set and clear input signals normally are not permitted, and circuit design usually prevents occurrence of this condition at a time when the flip-flop outputs are used. If simultaneous set and clear inputs are received, both outputs of the flip-flop are high for the duration of the simultaneous inputs. The eventual state of the flip-flop is determined by the input that remains longest in the activating condition.

A-40. CLOCKED R-S FLIP-FLOP. The clocked R-S flip-flop is similar to the R-S flip-flop, but it has a clock pulse input as shown in figure A-14. The logic symbol can be recognized by the letter "C" at this input terminal. At the positive-going transition of the clock pulse, the flip-flop becomes set if input A is high, or it becomes clear if input B is high (assuming no inverting dot at the clock pulse input terminal). If inputs A and B are both low during the clock pulse, the flip-flop does not change state. It is not permissible that A and B both be high when the positive-going clock pulse transition takes place.

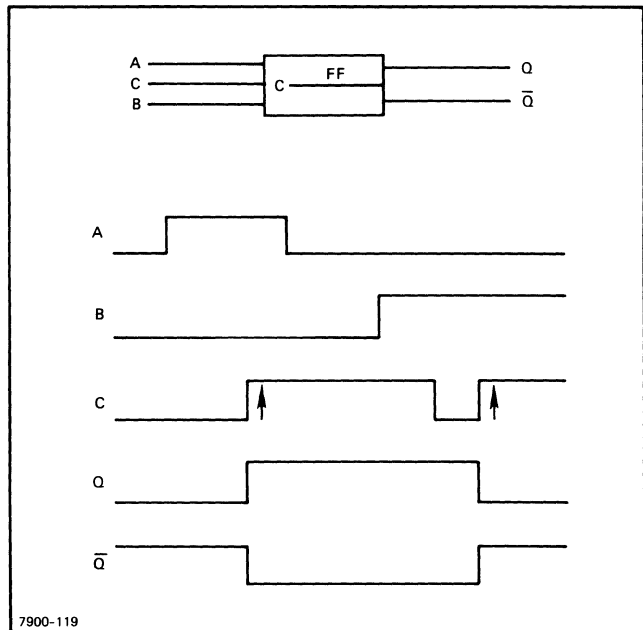


Figure A-14. Clocked R-S Flip-Flop, Logic Symbol, and Switching Waveforms

A-41. When the clocked R-S flip-flop has an inverting dot at the clock pulse input (figure A-15), the negative-going transition of the clock pulse is the transition that is effective in setting or clearing the flip-flop.

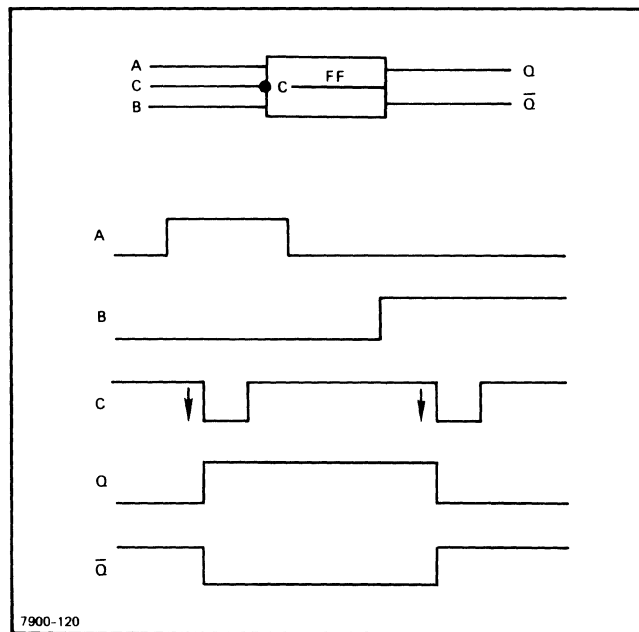


Figure A-15. R-S Flip-Flop with Inverted Clock Input, Logic Symbol, and Switching Waveforms

A-42. In some cases the clocked R-S flip-flop has a set and clear input at the top and bottom of the logic symbol (inputs D and E, figure A-16). These inputs are independent of the clock pulse, and are referred to as the direct set and direct clear inputs. They function as a result of a high or low level, rather than a positive- or negative-going transition. An inverting dot at the direct set or clear input indicates that a low level is required to set or clear the flip-flop. No dot indicates that a high level is required. The direct set and clear inputs are also used on other types of flip-flops.

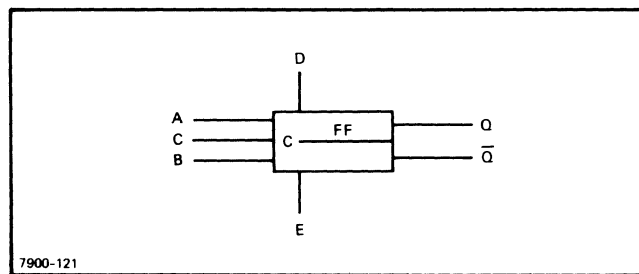


Figure A-16. Logic Symbol for Clocked R-S Flip-Flop with Direct Set and Direct Clear Inputs

A-43. TOGGLE FLIP-FLOP. The symbol for the toggle flip-flop as shown in figure A-17 can be recognized by the letter "T" in the symbol. This flip-flop has a single input. If there is no inverting dot at this input, each time the input signal becomes high, outputs Q and Q-bar change state. Since two inputs are required to produce one complete cycle of the output, the toggle flip-flop functions as a divide-by-two element, and is commonly used in groups in counting circuits, with the output of one flip-flop driving the next. Figure A-17 shows the switching waveforms for one flip-flop.

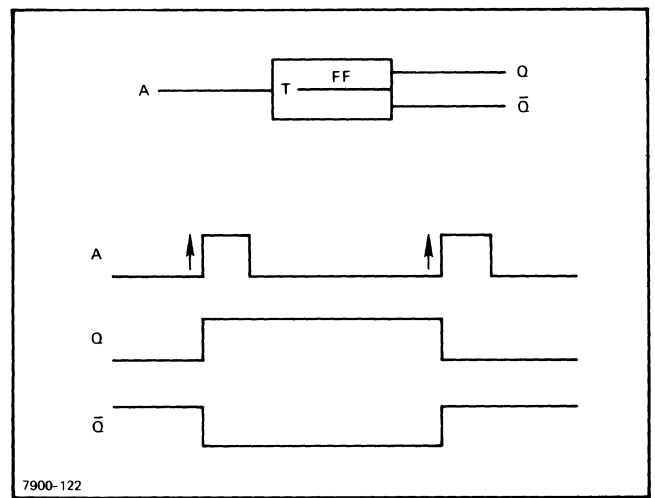


Figure A-17. Toggle Flip-Flop Logic Symbol and Switching Waveforms

A-44. If a toggle flip-flop symbol has an inverting dot at the input connection, the flip-flop changes state at the negative-going transition of the input. The symbol and waveforms for this type of flip-flop are shown in figure A-18.

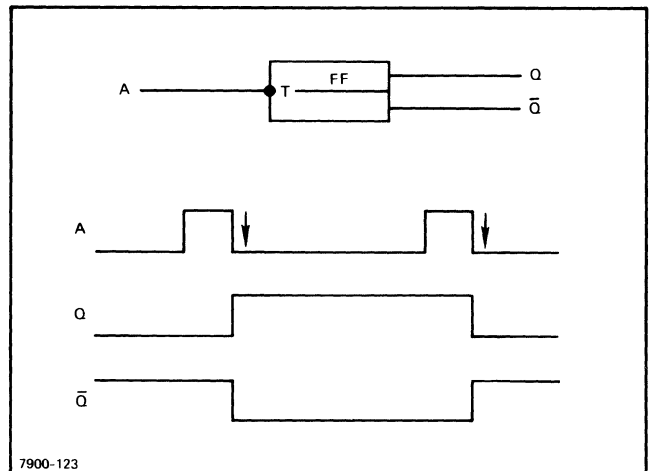


Figure A-18. Toggle Flip-Flop with Inverted Input, Logic Symbol, and Switching Waveforms

A-45. J-K FLIP-FLOP. In the J-K flip-flop, simultaneous high inputs for both set and clear will reverse the existing state of the flip-flop. This requires some method of storing two conditions, the previous output state and the new output state, until the clock pulse time. The set and clear inputs are labeled J and K respectively. In order to provide the necessary output storage the flip-flops are combined in a dual-rank configuration, together with the necessary gates to form a single logic element. For simplicity the internal dual-rank arrangement of the flip-flop is not usually shown. (See figure A-19.)

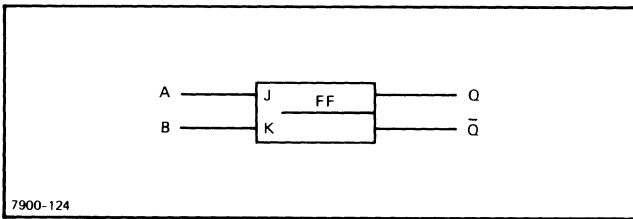


Figure A-19. J-K Flip-Flop Logic Symbol

A-46. **CLOCKED J-K FLIP-FLOP.** The clocked J-K flip-flop as shown in figure A-20 is similar to the clocked R-S flip-flop. However, simultaneous set and clear inputs to the J-K flip-flop are permissible. Under these conditions, the J-K flip-flop changes its state at the occurrence of each positive-going clock pulse transition. With an inverting dot at the clock pulse input, the flip-flop changes state at the negative-going clock pulse transition. If both J and K inputs are high, the flip-flop will toggle when a clock pulse is received.

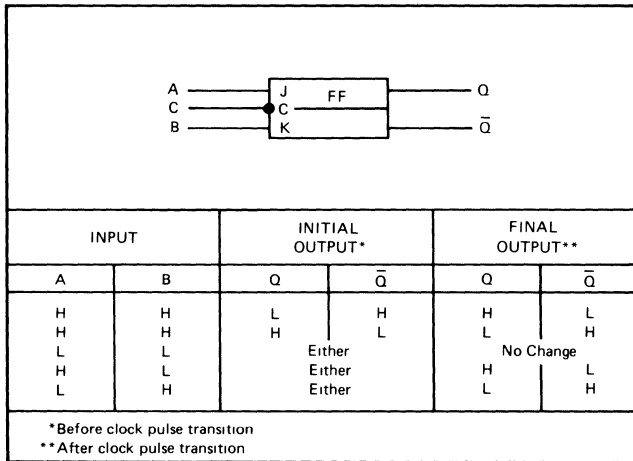


Figure A-20. Clocked J-K Flip-Flop Logic Symbol and Truth Table

A-47. The J-K flip-flop can also be operated with one high input and one low input. It then functions in the same manner as the clocked R-S flip-flop.

A-48. Figure A-20 includes a truth table showing operation of the J-K flip-flop. Note that with both inputs high at the time of clock pulse transition, the final state of the flip-flop (after clock pulse transition) depends on the state before the transition. With only one input high, the initial state of the flip-flop is immaterial.

A-49. In some cases the J-K flip-flop consists of two separate flip-flops, with the output of one applied to the input of the other. Usually, a single flip-flop logic symbol is used to illustrate this circuit. The clock pulse inverting dot, or the lack of it, indicates the clock pulse transition that affects the output flip-flop of the pair.

A-50. **LATCHING FLIP-FLOP.** The latching flip-flop shown in figure A-21 can be recognized by the letter "L" in

the symbol. The flip-flop has a clock input and a data input. Although the logic symbol shows two input-signal connections to the flip-flop, in reality there is only a single, physical data input connection to the flip-flop. This single input separates inside the integrated circuit pack to form the two inputs shown. After separation, one input is inverted (indicated by the inverting dot) before application to the flip-flop.

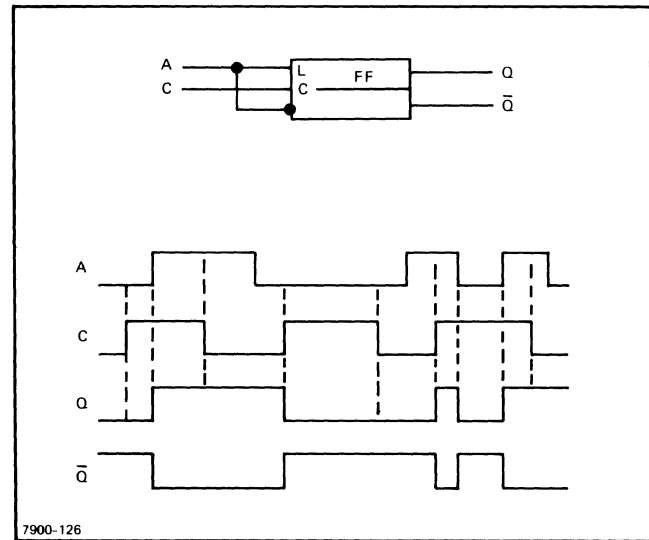


Figure A-21. Latching Flip-Flop Logic Symbol and Switching Waveforms

A-51. The set-side input is responsive to high signal levels at A in figure A-21, and the clear input is responsive to low signal levels at A. If there is no inverting dot at the clock input, this response takes place when the clock pulse is high. While the clock pulse remains high, the outputs follow any changes in the logic level at A as these changes take place. When the clock pulse becomes low, the flip-flop retains its current state, and no longer responds to changes of the input signal.

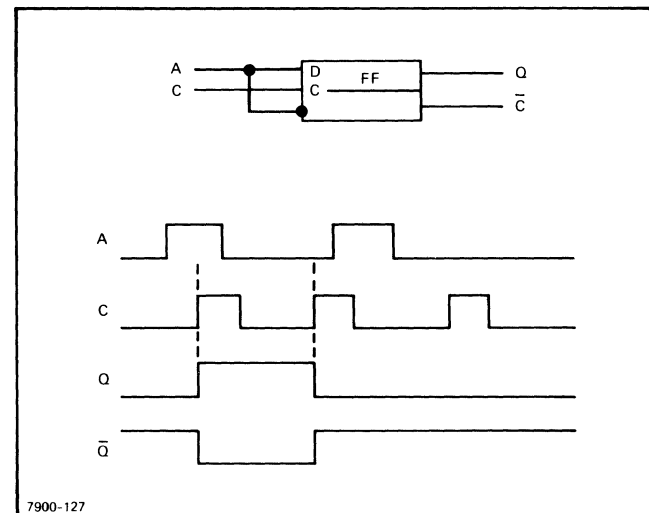


Figure A-22. Delay Flip-Flop Logic Symbol and Switching Waveforms

A-52. If the clock input connection of a latching flip-flop has an inverting dot, the flip-flop responds to the input signal while the clock pulse is low.

A-53. DELAY FLIP-FLOP. The delay flip-flop shown in figure A-22 is identified by a letter "D" inside the flip-flop symbol. This type of flip-flop is similar to the latching flip-flop, except that it responds to the input signal only at the transition of the clock pulse. The delay flip-flop thus does not follow changes in the input signal as these changes take place.

A-54. GATE FLIP-FLOP. The gate flip-flop is made up of two logic gates, connected as shown in figure A-23. The number of inputs to each gate can vary from that shown. The flip-flop can also be made up of two "nor" gates. The circuit may have a set output, a clear output, or both.

A-55. The gate flip-flop functions like an R-S flip-flop, but it has the advantage that it can "or" inputs without the addition of a separate "or" gate. Another reason for use of the gate flip-flop is that if two spare gates are available in integrated circuits on a circuit card, they can be employed as an R-S flip-flop without the need to add another integrated circuit to the card.

A-56. If the flip-flop is made up of two "nand" gates, as in figure A-23, it is set by a low input at either A or B. Similarly, it is cleared by a low input at C or D. When the flip-flop is in the quiescent state (not undergoing transition), the inputs at A, B, C, and D are all high.

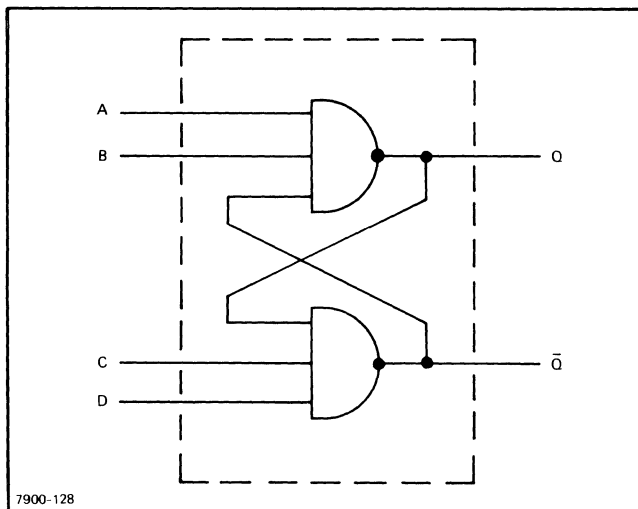


Figure A-23. "Nand" Gate Flip-Flop, Logic Symbol

A-57. A "nor" gate flip-flop is shown in figure A-24. In this type of flip-flop all inputs are low when the device is in the quiescent state. A high input at A sets the flip-flop, and a high input at B clears it. The outputs cross in the illustration in order to align the set and clear inputs with the set and clears outputs, respectively.

A-58. In most circuits using the "nand" or "nor" gate flip-flop, input signals are such that the flip-flop does not receive high set and clear input signals simultaneously. If circuit design does permit this to occur, both the set- and the clear-side outputs are high for the duration of the condition. The eventual state of the flip-flop is determined by the input that remains longest in the activating condition.

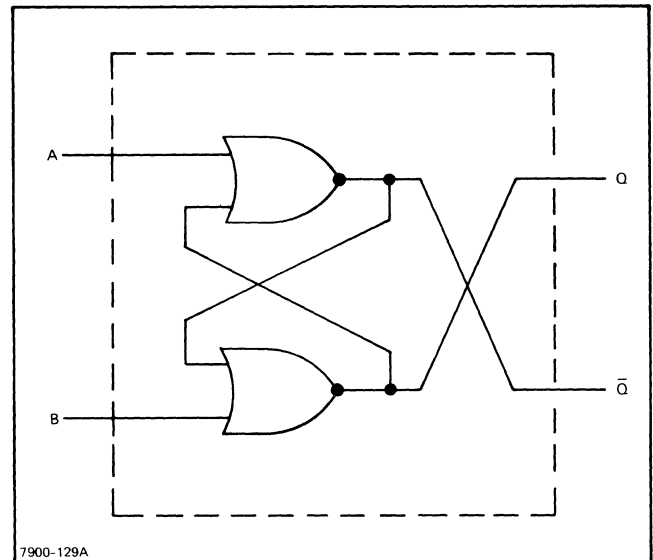


Figure A-24. "Nor" Gate Flip-Flop Logic Symbol

A-59. SCHMITT TRIGGER CIRCUIT.

A-60. The Schmitt trigger circuit shown in figure A-25 can be identified by the letters "ST" appearing in the logic-diagram symbol. Like the various types of flip-flops this circuit is a two-state device which does not perform a Boolean function. It serves for level sensing or signal squaring. It may have a set-side output, a clear-side output, or both.

A-61. When the input voltage at A is below a certain level, the Schmitt trigger is in the clear state. When the input voltage rises above the reference level, the trigger assumes the set state. Circuit constants establish the reference level.

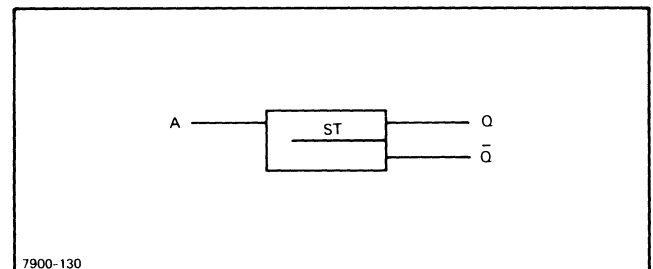


Figure A-25. Schmitt Trigger Circuit Logic Symbol

A-62. Switching between states takes place rapidly, and the Schmitt trigger is therefore useful for squaring signals that have poor rise and fall times. It can produce a square-wave from a sine wave. Other uses of the Schmitt trigger are voltage level restoration, and detection of the rise of the input signal above a given level.

A-63. ONE-SHOT MULTIVIBRATOR.

A-64. The one-shot multivibrator (figure A-26) is a monostable switching element, used to produce a pulse of predetermined duration. The device is triggered into its unstable state by an external signal. It returns to the stable state after a time interval determined by circuit constants.

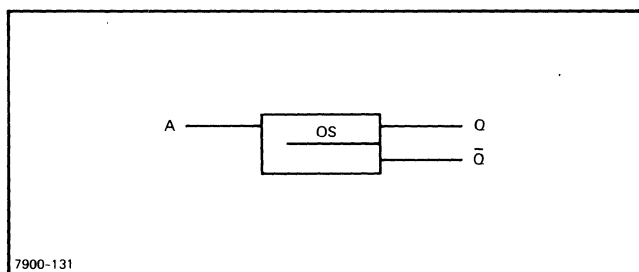


Figure A-26. One-Shot Multivibrator Logic Symbol

A-65. If there is no inverting dot at the input, triggering is accomplished when input A undergoes a positive-going transition. If there is an inverting dot, a negative-going transition is required. The one-shot multivibrator may have a set-side output, a clear-side output, or both.

A-66. The symbol for the one-shot multivibrator is always drawn with the orientation shown in figure A-26, with the input at the left and the output or outputs at the right.

A-67. FREE-RUNNING MULTIVIBRATOR.

A-68. The free-running multivibrator shown in figure A-27 can be distinguished by the letters "MV" appearing in the symbol. This device produces trains of complementary pulses at Q and Q-bar. Pulse width is determined by circuit constants.

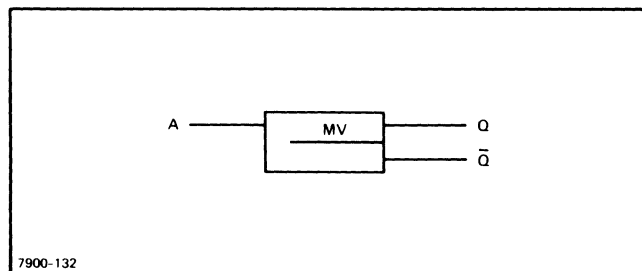


Figure A-27. Free-Running Multivibrator Logic Symbol

A-69. In some instances a control signal is applied to the free-running multivibrator. If there is no inverting dot at the signal input to the symbol, the multivibrator runs when the control signal is high, and stops when the signal is low. When it is stopped, the multivibrator is in the clear condition. If there is an inverting dot at the control signal input, a low input is required to bring the multivibrator into operation. This type of multivibrator is in the set condition when it is not running.

A-70. Figure A-28 shows typical waveforms for a controlled free-running multivibrator that runs when the control signal is high. The high and low portions of the output waveforms need not be of equal duration.

A-71. The symbol for the free-running multivibrator is always drawn with the orientation shown in figure A-28, with the input (if any) at the left, and the output or outputs at the right.

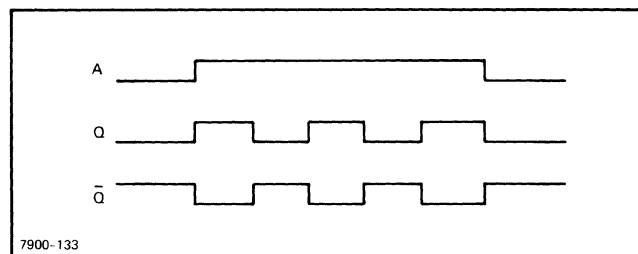


Figure A-28. Input and Output Waveforms of Controlled Free-Running Multivibrator

A-72. AMPLIFIER.

A-73. The symbol for an amplifier is shown in figure A-29. A differential amplifier is illustrated in figure A-30. Like gates, these symbols may be oriented in any of four positions.

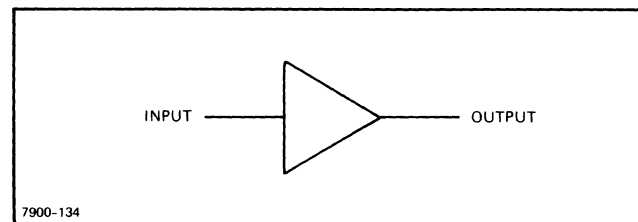


Figure A-29. Amplifier Logic Symbol

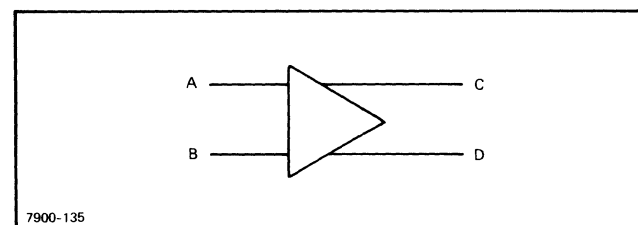


Figure A-30. Differential Amplifier Logic Symbol

A-74. In most instances, the amplifier symbol has a non-binary input. A circuit which restores the voltage level of a binary input, or which furnishes a low-impedance output from a binary input, is indicated by a one-input "and" gate symbol. An inverting dot at the output of an amplifier symbol indicates that the amplifier inverts the input signal.

A-75. Figure A-31 is the symbol for a phase splitter.

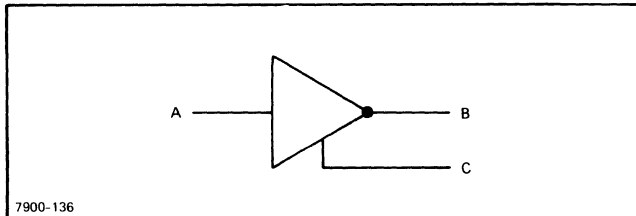


Figure A-31. Phase-Splitter Logic Symbol

A-76. MULTIPURPOSE LOGIC SYMBOL.

A-77. The multipurpose logic symbol is used to indicate a logic function that has not received a standardized logic symbol. The multipurpose symbol is also used to depict multiple logic elements that act together to perform a single overall logic function such as decoding, data storage, or counting. The symbol shown in figure A-32 may be of varying proportions (mostly commonly 2:1 or 1:2), but rectangular in shape. The symbol includes a descriptive name indicating the overall logic function performed. All active inputs should be labeled to indicate the effect on the overall function. Other descriptive information may be included as needed.

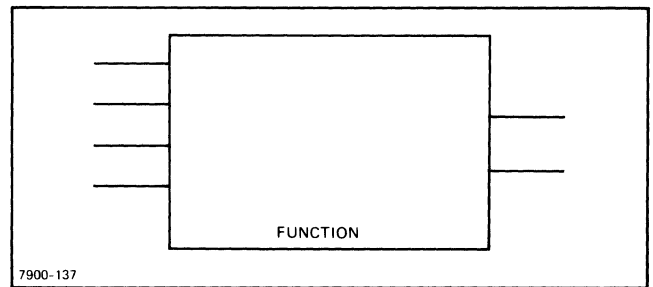


Figure A-32. Multipurpose Logic Symbol

A-78. Examples of nonstandard symbols are given in figure A-33. Figure A-33a shows a binary-to-octal decoder. Figure A-33b shows a four-bit up/down counter.

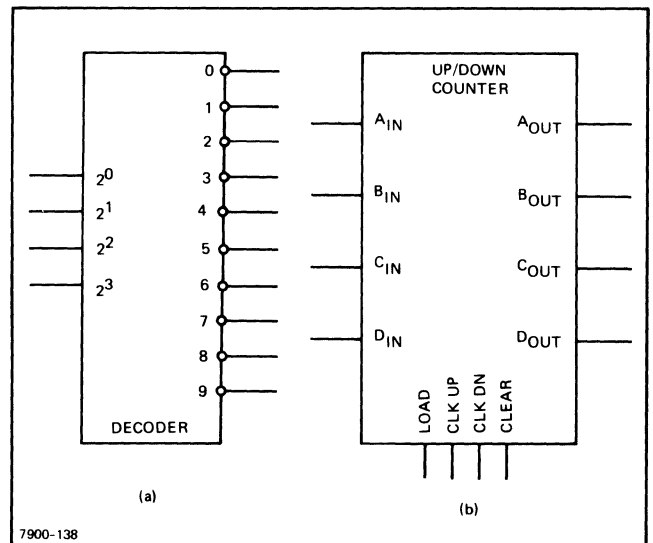


Figure A-33. Nonstandard Logic Symbols

APPENDIX B

BACKDATING INFORMATION

This backdating appendix provides information for making this manual applicable to earlier versions of the HP 7900A

Disc Drive. The table below lists the changes required to make this manual applicable to those earlier versions.

Serial No. Prefix	Changes
1130	1 thru 46
1137	4 thru 46
1143	5 thru 46
1149	6 thru 46
1202	7 thru 46
1205	8 thru 46
1213	9 thru 46
1217	10 thru 46
1218	11 thru 46
1220	12 thru 46
1223	13 thru 46
1249	16 thru 46
1232, 1233, 1235	19 thru 46
1245	21 thru 46
1250	25 thru 46
1311	28 thru 46
1320	32 thru 46
1338	35 thru 46
1341	37 thru 46
1344	41 thru 46
1347	(No change to manual)

CHANGE	DESCRIPTION
1	<p>Page 5-39, figures 5-27 and 5-28.</p> <ul style="list-style-type: none">a. On figure 5-27, change HP series code from B-1137 to A-1129.b. On figure 5-28, change series code from 1137 to 1129.c. Add connection from U31C pin 6 to U33B pin 4.d. Delete connection from U33B pin 4 to U33B pin 5.
2	<p>Page 5-41, figures 5-29 and 5-30.</p> <ul style="list-style-type: none">a. On figure 5-29, change HP series code from B-1137 to A-1116.b. On figure 5-30, change series code from 1137 to 1116. Change R7 from 27.8k to 26.1k; R9 from 42.2k to 27.8k. <p>Page 5-40, table 5-12.</p> <ul style="list-style-type: none">a. Change R7 from 27.8k, part no. 0698-4007 to 26.1k, part no. 0698-3159.b. Change R9 from 42.2k, part no. 0698-3450 to 27.8k, part no. 0698-4007.
3	<p>Page 5-43, figure 5-32. Change C14 from 60 μF to 47 μF.</p> <p>Page 5-42, table 5-13. Change C14 from 60 μF, part no. 0180-0106 to 47 μF, part no. 0180-1704.</p>
4	<p>Page 5-53, figures 5-41 and 5-42.</p> <ul style="list-style-type: none">a. On figure 5-41, change series code from B-1143 to A-1128.b. On figure 5-42, change series code from 1143 to 1128. <p>Page 5-52, table 5-18. Change K1 from 472 ohms, 5A, 24V coil, part no. 0490-0984 to 470 ohm, 10A, 24V coil, part no. 0490-1052.</p>
5	<p>Page 5-51, figures 5-39 and 5-40.</p> <ul style="list-style-type: none">a. On figure 5-39, change HP series code from C-1149 to B-1127.b. On figure 5-40, change series code from 1149 to 1127. Change R35 from 909 ohms to 619 ohms. <p>Page 5-50, table 5-17. Change R35 from 909 ohms, part no. 0757-0422 to 619 ohms, part no. 0757-0418. Change Q10 and Q14 from part no. 1854-0019 to part no. 1854-0260.</p>
6	<p>Page 6-17/6-18, table 6-5. Delete item 10 and 11, part nos. 07900-00107 and 07900-00109, respectively.</p>
7	<p>Page 5-51, figures 5-39 and 5-40.</p> <ul style="list-style-type: none">a. On figure 5-39, change series code from D-1205 to C-1149.b. On figure 5-40, change series code from 1205 to 1149. Change R51 and R52 from 10k to 14.7k.

CHANGE

DESCRIPTION

7
(Cont)

Page 5-50, table 5-17. Change R51 and R52 from 10k, part no. 0757-0442 to 14.7k, part no. 0698-3156. Change CR3-6, 9-22, and 24 from part no. 1901-0040 to 1901-0450.

8

Page 5-41, figures 5-29 and 5-30.

a. On figure 5-29, change series code from B-1213 to B-1137.

b. On figure 5-30, change series code from 1213 to 1137. Change R9 from 44.2k to 42.2k and R7 from 28.7k to 27.8k.

Page 5-40, table 5-12. Change R9 from 44.2k, part no. 0698-4207 to 42.2k, part no. 0698-3450. Change R7 from 28.7k, part no. 0698-3449 to 27.8k, part no. 0698-4007.

9

Page 5-49, figures 5-37 and 5-38.

a. On figure 5-37, change series code from B-1213 to A-1128; delete R65; add R9 (potentiometer) just below R1; add R61 between R47 and R35.

b. On figure 5-38, change series code from 1213 to 1128; add R9 and R61 between U7 pin 6 and ground (with R61 to ground); delete connection between U7 pin 6 and R47 and connect R9 wiper to R47 instead. Delete R65. Change R59 from 270k to 1M. Change R47 from 100k to 90.9k.

Page 5-48, table 5-16. Change R47 from 100k, part no. 0757-0465 to 90.9k, part no. 0757-0464. Change R59 from 270k, part no. 0683-2745 to 1M, part no. 0683-1055. Delete R65. Add R9, variable resistor, 5k, part no. 2100-2489. Add R61, resistor, 5k, part no. 0698-4002.

Page 5-10, paragraph 5-44. Replace paragraphs 5-44 and 5-45 with the following procedure:

a. Connect the disc service unit to A6J1 on the disc drive and install the 50 Hz test oscillator. (Refer to the Disc Service Unit Operating and Service Manual.)

b. Turn on disc power supply and set the LOAD/UNLOAD switch to LOAD.

c. Set the RESET DRIVE FAULT switch on the disc service unit to ON.

d. Set the ACCESS MODE switch on the disc service unit to SINGLE SEEK and the DRIVE OPERATION CONTROL switch to ALLOW ACCESS mode. The set cylinder light should be on.

e. Push RUN on the disc service unit. Set switch 128 up in the ADDR A switch register; all other register switches should be down.

f. Push the SINGLE OP button on the disc service unit. The carriage should move towards the spindle.

g. Set the ACCESS MODE switch on the disc service unit to SINGLE CYCLE (Servo Inhibited) and push RUN.

h. Set the disc service unit 50 Hz oscillator switch to VELOCITY. Attach the oscillator output to A12TP7.

i. Connect the oscillator output to encoder assembly TACHOMETER AMPLIFIER output A12TP2.

j. Using a clip lead, attach TP5 on encoder assembly A12 to A12TP1 (ground).

CHANGE

DESCRIPTION

9

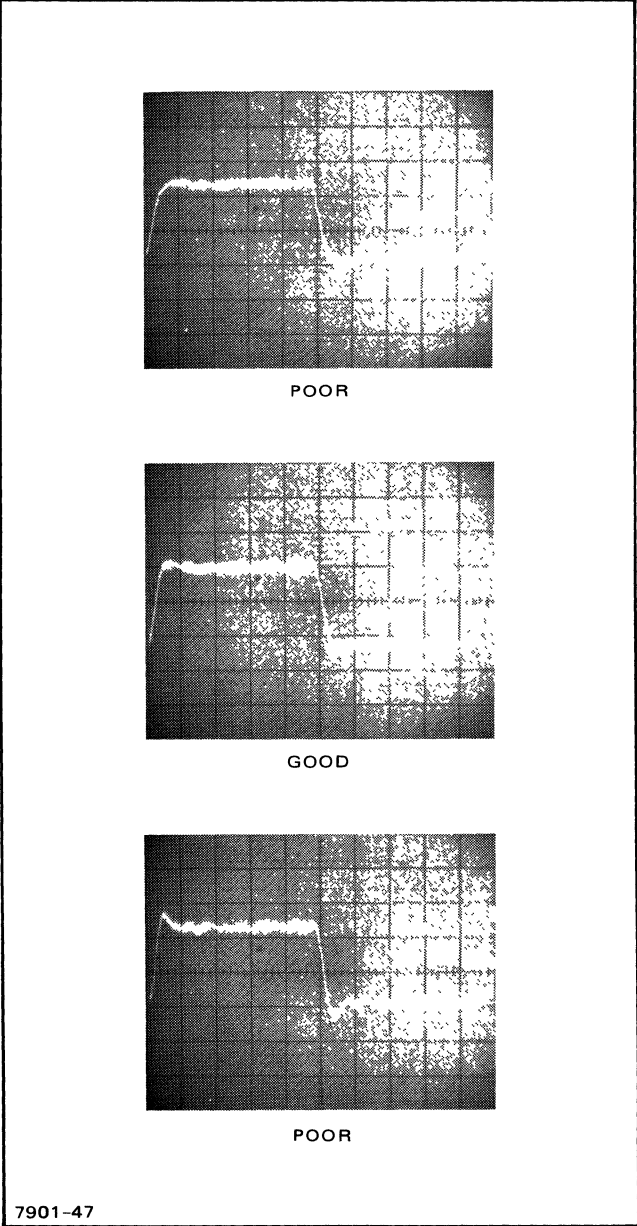
CAUTION

The above step disables the position control circuitry for the carriage. The carriage assembly may move slowly. The operator must manually maintain the carriage in the center of travel by firmly but slowly moving it if it approaches one end of travel.

k. Adjust encoder assembly A12 VEL GAIN variable resistor for one small overshoot in the A12 TP4 waveform as shown below.

Oscilloscope Setup:

Time Base 2 ms/cm
Vertical Sensitivity 0.05 V/cm



7901-47

l. Set the disc service unit oscillator switch to POSITION.

CHANGE

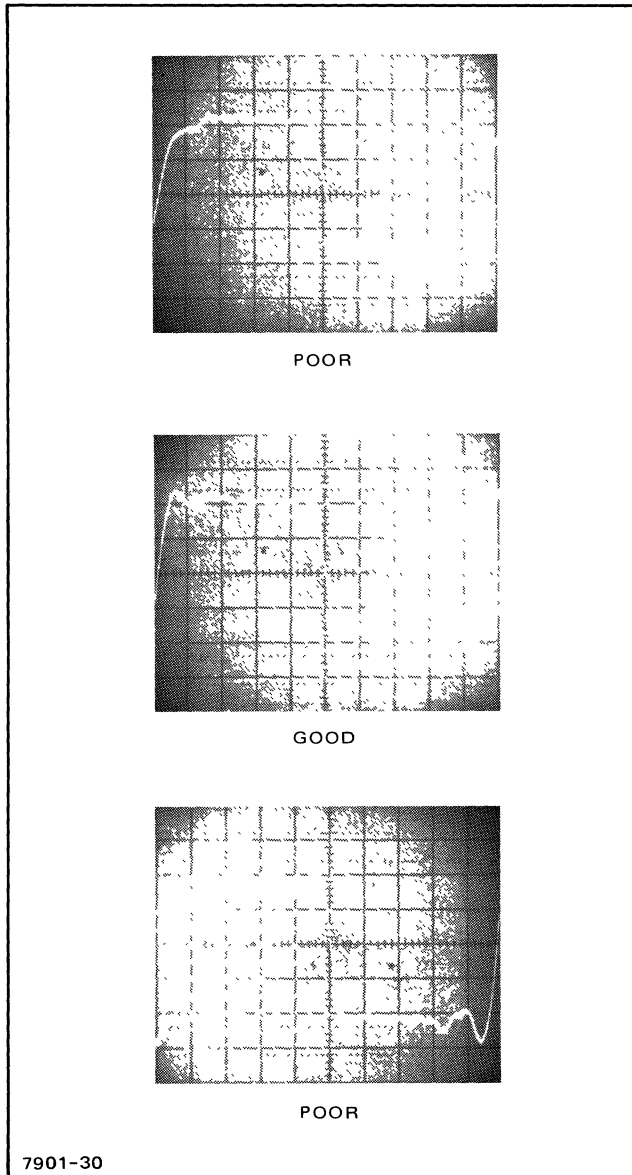
DESCRIPTION

9
(Cont)

- m. Remove the clip lead between A12TP5 and A12TP1.
- n. Connect the oscilloscope to the channel A amplifier output (A12TP5).
- o. Adjust the A GAIN variable resistor for a small overshoot on the leading edge of the waveform, as shown below.

Oscilloscope Setup:

Time Base 2 ms/cm
 Vertical Sensitivity 0.5 V/cm



- p. Unload the disc drive and remove disc drive power.
- q. Disconnect the 50 Hz oscillator and remove it from the disc drive.
- r. Turn on disc power supply.
- s. Set the ACCESS MODE switch on the disc service unit to SINGLE SEEK.

CHANGE

DESCRIPTION

9

CAUTION

Do not push RUN on the disc service unit at this point in the procedure.

- t. Set the LOAD/UNLOAD switch to the LOAD position.
- u. Program the disc service unit to alternately seek between cylinder 000 and 202. (Refer to Disc Service Unit Operating and Service Manual.)
- v. Connect the oscilloscope to the ACCESS READY test point on the disc service unit.
- w. Adjust the VEL CMND variable resistor on cylinder address assembly A11, such that the Access Ready signal is low (0 volts) for 52 ± 1 milliseconds.
- x. Set the DRIVE OPERATION CONTROL on the disc service unit to ACCESS STOP.
- y. Set the LOAD/UNLOAD switch to UNLOAD and remove drive power.
- z. Install receiver and remove head installation tool.
- aa. Install spare cartridge and perform alternate seeks between cylinder 000 and 200 to ensure disc drive is performing properly. (Refer to Disc Service Unit Operating and Service Manual.)

10

Page 6-20, table 6-6. Change items 13 and 14 as follows:

- a. Motor Mounting Plate part no. from 07900-00110 to 07900-40010.
- b. Motor Plate Cover part no. from 07900-00111 to 07900-00018.
- c. Extension Spring (item 13) part no. from 1460-1323 to 1460-1286.

11

Page 5-14, paragraph 5-50. Delete the Carriage Vernier adjustment procedure.

Page 6-15, figure 6-3; page 6-13, table 6-3. Delete item 41.

12

Page 3-2, figure 3-1; pages 5-1 through 5-6.

Delete all references to the DOOR UNLOCKED indicator.

13

Page 5-27, figure 5-17. Delete DS6 and CR3.

14

Page 5-26, table 5-6; page 5-27, figures 5-16 and 5-17.

a. Change Indicator PCA part no. from 07900-60063 to 07900-60051. Change PCA series number from 1148 to 1128.

b. In table 5-6, delete DS6.

15

Page 6-7/6-8, table 6-2. Change item 40 part no. from 07900-60063 to 07900-60051.

16

Page 5-48, table 5-16. Delete Q9, R66, R67, and R68. Change U9 and U12 from 1826-0068 to 1820-0493.

17

Page 5-49, figure 5-37. Delete Q9, R66, R67, and R68. Change PCA series no. from 1341 to 1235.

CHANGE	DESCRIPTION
17	<p>Page 5-26, table 5-6; page 5-27, figures 5-16 and 5-17.</p> <p>a. Change Indicator PCA part no. from 07900-60063 to 07900-60051. Change PCA series number from 1148 to 1128.</p> <p>b. In table 5-6, delete DS6.</p>
18	Page 6-7/6-8, table 6-2. Change item 40 part no. from 07900-60063 to 07900-60051.
19	Page 5-48, table 5-16. Delete Q9, R66, R67, and R68. Change U9 and U12 from 1826-0068 to 1820-0493.
20	Page 5-49, figure 5-37. Delete Q9, R66, R67, and R68. Change PCA series no. from 1341 to 1235.
21	Page 5-49, figure 5-38. Delete Q9, R66, R67, R68, U13D, and U13. Substitute a straight-through connection between U8A pin 3 (At Home) and XA12B pins 15 and 5. Change PCA series from 1235 to 1213.
22	<p>Page 5-54, table 5-19.</p> <p>a. Delete R8 and R9; add R8 to R6 entry.</p> <p>b. Add C2, 0180-0098, CAPACITOR, fxd, elect, 100 μF, 20%, 20 VDCW, 56289, 150D107X0020S2-DYS.</p> <p>c. Add R1, 0683-4725, RESISTOR, fxd, comp, 4.7k, 5%, 1/4W, 01121, CB 4725</p> <p>d. Add R3 to R4 entry.</p> <p>e. Add U1, 1826-0075, INTEGRATED CIRCUIT, 01121, CA 3079.</p>
23	Page 5-55, figures 5-43 and 5-44. Substitute figures 5-43 and 5-44 attached at the back of this appendix.
24	Page 5-42, table 5-13. Delete C21, CR17, CR18, R29, and W1.
25	Page 5-43, figure 5-31. Delete C21, CR17, CR18, R29, and W1. Change PCA series no. from 1223 to 1137.
26	<p>Page 5-43, figure 5-32.</p> <p>a. Delete U15B circuit including C21, CR17, CR18, and R29. Substitute a straight-through connection between XA9A pin 12 (LOAD SWITCH OFF) and U42E pin 10; and between U44C pin 6 (Speed Sense circuit) and U33A pin 5.</p> <p>b. Delete jumper W1 and substitute a straight-through connection.</p> <p>c. Delete connection between U30 pin 3 and XA9A pin 8,J (OP AMP TEST); substitute a connection between XA9A pin 8,J and junction of C18 and CR14.</p> <p>d. Change PCA series no. from 1223 to 1137.</p>
27	<p>Page 6-21/6-22, table 6-6.</p> <p>a. Add to item 14 attaching parts: MOTOR PLATE COVER, part no. 07900-00111.</p> <p>b. Change item 11 part no. from 07900-00115 to 07900-00043.</p>
28	Page 5-56, table 5-20. Change diode CR8 from 1902-3110; 5.9V, 2% to 1902-3117, 6.34V, 2%.

CHANGE	DESCRIPTION
29	Page 5-57, figure 5-46. Change PCA series no. from 1311 to 1128.
30	Page 5-57, figure 5-47. Change CR18 rating from 5.9V to 6.34V. Change PCA series no. from 1311 to 1128.
31	Page 6-2, table 6-1. Change item 26 part no. from 07900-60073 to 07900-60030. Add an asterisk to this item and a note at the bottom of the table as follows. *All 7900A units will have the mandatory change to part no. 07900-60083 incorporated when repaired.
32	Page 6-10, table 6-3. Change item 11 part no. from 07900-20084 to 07900-20025. Add a double asterisk to this item and a note at the bottom of the table as follows. **All 7900A units will have the mandatory change to part no. 07900-20098 incorporated when repaired.
33	Page 6-17/6-18, table 6-5. Change item 12 part no. from 07900-20083 to 0050-1660.
34	Page 6-12, table 6-3. Change item 29 part no. from 07900-40044 to 07900-40013.
35	Page 5-42, table 5-13. Delete jumper W2; add diode CR7 to CR1-6, 8-17 listing.
36	Page 5-43, figure 5-31. Substitute CR7 designation for W2 designation. Change PCA series no. from 1338 to 1223.
37	Page 5-43, figure 5-32. In the START SPINDLE MOTOR circuit, delete jumper W2 and substitute diode CR7 with cathode connected to U23A pin 2. Change PCA series no. from 1338 to 1223.
38	Page 5-48, table 5-16. Change R34 from 0757-0434, 3.65k to 0757-0279, 3.16k.
39	Page 5-49, figure 5-38. Change R34 value from 3.65k to 3.16k. Change PCA series no. from 1341 to 1235.
40	Page 2-2. Change paragraph 2-12b to read as follows: “b. Attach the rack mount brackets to the rack cabinet using eight number 1/4-20, 0.5-inch hexagon-head screws with eight number 1/4 split lock washers and eight number 1/4-20 spring nuts as shown in figure 2-4. Before tightening to rack cabinet, ensure that the mounting brackets are level from front to rear.”
41	Page 2-4, figure 2-4. Replace figure 2-4 with figure 2-4 attached at the back of this appendix.
42	Page 2-7/2-8. Add the following paragraph 2-23: 2-23. The disc drive should never be shipped in a rack-mounted configuration because of the possibilities of shock and vibration that may occur. Ship the disc drive only as described in this section.
43	Page 6-5, figure 6-1. Delete items 18 and 22 (insulator spacer).
44	Page 5-46, table 5-15. a. Delete “R17,23” and “R29” entries. b. Change “R1 thru R8” entry to read R1 thru 5, 17, 23; 0683-2225; 2.2k; 01121; CB 2225.

CHANGE

DESCRIPTION

- c. Add R6, 29; 0757-0280; RESISTOR, fxd, met flm, 1k, 1%, 1/8W; 28480; 0757-0280.
 - d. Add R7, 8; 0757-0420; RESISTOR, fxd, met flm, 750 ohms, 1%, 1/8W; 28480; 0757-0420.
- 45 Page 5-47, figure 5-35. Change PCA series no. from 1349 to 1127.
- 46 Page 5-47, figure 5-36. Change R1, 2, 3, 4, and 5 values from 470 ohms to 2.2k; R6 from 470 ohms to 1k; R7 and R8 from 470 ohms to 750 ohms. Change PCA series no. from 1349 to 1127.

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TWX 810-459-1925

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Columbus 43229
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OKLAHOMA

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TWX 910-830-6862

OREGON

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Tualatin 97062
Tel: (503) 620-3350
TWX 510-467-8714

PENNSYLVANIA

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Tel: (206) 454-3971
TWX 910-443-2446

1021 8th Avenue
King of Prussia Industrial Park
King of Prussia 19406
Tel: (215) 265-7000
TWX 510-660-2670

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Houston 77027
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VIRGINIA

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Richmond 23228
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TWX 710-956-0157

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Bellevue Office Pk
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Bellevue 98004
Tel: (206) 454-3971
TWX 910-443-2446

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Tel: (416) 678-9430
TWX 610-492-4246

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Hewlett-Packard (Canada) Ltd
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Pointe Claire H9R 1G7
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TWX 610-422-3022
Telex 05-821521 HPCL

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Ste-Foy G1H 4G4
Tel: (418) 688-8710

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Hewlett-Packard Argentina
S A C e I
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Buenos Aires
Tel: 35-0436, 35-0627, 35-0341
Telex 012-1009
Cable HEWPACK ARG

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Stambuk & Mark (Bolivia) LTDA
Av. Mariscal, Santa Cruz 1342
La Paz
Tel: 40626, 53163, 52421
Telex 3560014
Cable BUKMAR

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Hewlett-Packard Do Brasil
I E C Ltda
Rua Frei Caneca 1119
01307-Sao Paulo-SP
Tel: 288-7111, 287-5858
Telex 309151/2/3
Cable HEWPACK Sao Paulo

Hewlett-Packard Do Brasil
I E C Ltda
Praça Dom Feliciano, 78
90000-Porto Alegre-RS
Rio Grande do Sul (RS) Brasil
Tel: 25-8470
Cable HEWPACK Porto Alegre

CHILE

Héctor Calcagni y Cia, Ltda
Casilla 16 475
Santiago
Tel: 423 96
Cable CALCAGNI Santiago

COLOMBIA

Instrumentacion
Henrik A. Langebaek & Kier S A
Carrera 7 No. 48-59
Apartado Aéreo 6287
Bogotá, I D E
Tel: 45-78-06, 45-55-46
Cable AARIS Bogota
Telex 44400INSTCO

COSTA RICA

Lic. Alfredo Gallegos Gurdían
Apartado 10159
San José
Tel: 21-86-13
Cable: GALGUR San José

ECUADOR

IPESA
Laboratorios de Radio-Ingeniería
Calle Guayaquil 1246
Post Office Box 3199
Quito
Tel: 212-496, 219-185
Cable HORVATH Quito

EL SALVADOR

Electronic Associates
Apartado Postal 1682
Centro Comercial Gigante
San Salvador, El Salvador C A
Paseo Escalon 4649-4* Piso
Tel: 23-44-60, 23-32-37
Cable ELECAS

GUATEMALA

IPESA
Avenida La Reforma 3-48,
Zona 9
Guatemala
Tel: 63627, 64736
Telex 4192 TELTRO GU

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Hewlett-Packard Mexicana,
S A de C V
Torres Adalid No 21, 11 - Piso
Col del Valle
Mexico 12, D F
Tel: 543-42-32
Telex 017-74-507

NICARAGUA

Roberto Terán G
Apartado Postal 689
Edificio Terán
Managua
Tel: 3451, 3452
Cable ROTERAN Managua

PANAMA

Eléctrico Balboa, S A
P.O. Box 4929
Ave. Manuel Espinosa No 13-50
Bldg Alina
Panama City
Tel: 230833
Telex 3481103, Curunda,
Canal Zone
Cable ELECTRON Panama City

PARAGUAY

Z J Melamed S R L
Division Aparatos y Equipos
Medicos
Scientificos y de
Investigacion
P O Box 676
Chile, 482, Edificio Victoria
Asuncion
Tel: 4-5069, 4-6272
Cable RAMEL

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Compañía Electro Médica S A
Ave Enrique Canual 312
San Isidro
Casilla 1030
Lima
Tel: 22-3900
Cable ELMED Lima

PUERTO RICO

San Juan Electronics, Inc
P O Box 5167
Ponce de Leon 154
Pda 3-PTA de Tierra
San Juan 00906
Tel: (809) 725-3342, 722-3342
Cable SATRONICS San Juan
Telex SATRON 3450 332

URUGUAY

Pablo Ferrando S A
Comercial e Industrial
Avenida Italia 2877
Casilla de Correo 377
Montevideo
Tel: 40-3102
Cable RADIUM Montevideo

VENEZUELA

Hewlett-Packard de Venezuela
C A
Apartado 50933
Edificio Segre
Tercera Transversal
Los Ruices Norte
Caracas 107
Tel: 35-00-11
Telex 21146 HEWPACK
Cable HEWPACK Caracas

FOR AREAS NOT LISTED,

CONTACT:
Hewlett-Packard
Inter-Americas
3200 Hillview Ave
Palo Alto, California 94304
Tel: (415) 493-1501
TWX 910-373-1267
Cable HEWPACK Palo Alto
Telex 034-8300, 034-8493

