

**Series 6000  
DISK DRIVE**

Front or Top Loading

**INSTRUCTION  
MANUAL**

REVISION P

**DYNEX**


# Series 6000 DISK DRIVE

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Revision P (October, 1978)

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# Series 6000 DISK DRIVE

## INTRODUCTION

Western Dynex Corporation commends you for your choice in selecting the Series 6000 Cartridge Disk Drive. Each Dynex drive represents the culmination of many years of rotating memory engineering and manufacturing experience, with thousands of units currently in use in a wide range of applications throughout the world.

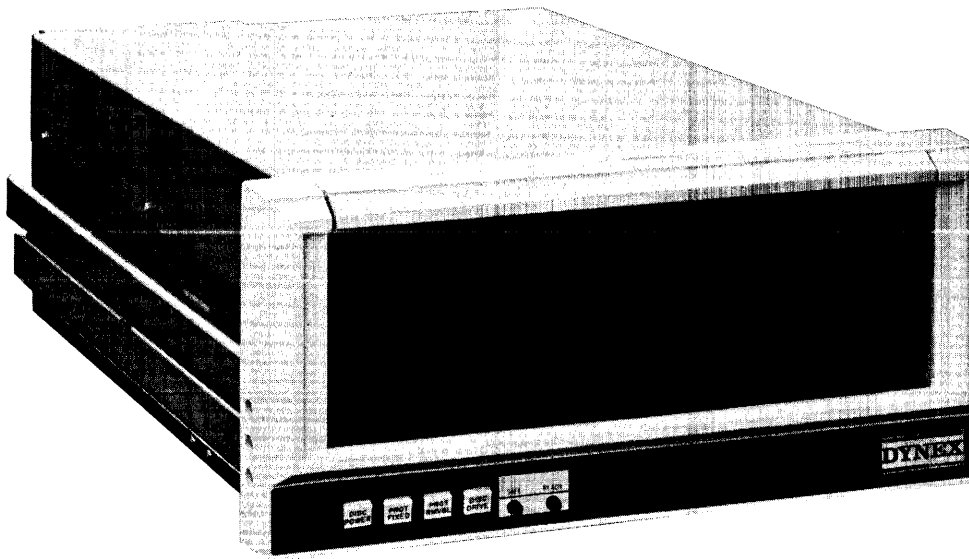
Within this manual, you will find comprehensive technical information in support of Series 6000 Cartridge Disk Drive models as listed in the table below. Information is presented at the technician level and assumes a practical knowledge of transistor and integrated circuit theory in conjunction with the use of suitable electronic test and measurement equipment. Prior to installation and operation of the disk drive equipment, we suggest that your personnel become familiar with the contents of this manual -- particularly Sections pertaining to Installation and Checkout, and Operating Procedures.

Prior to shipment, each Series 6000 drive is subjected to a "burn-in" period while being thoroughly "on-line" tested by a qualified product certification program -- guarantying that each unit meets the highest standards for operational tolerances, data reliability and media interchangeability between drives.

# Series 6000 DISK DRIVE



SERIES 6000 DISK DRIVE  
TOP LOADING



SERIES 6000 DISK DRIVE  
FRONT LOADING

# Series 6000 DISK DRIVE

## SECTION 1 -- GENERAL DESCRIPTION

### 1.1 General

Series 6000 Cartridge Disk Drives provide a family of high performance, removable media disk drives to serve today's complex computer system applications. Time proven reliability and ease of application have made Dynex Disk Drives a first choice of system designers the world over.

To meet the needs of a wide range of applications, Dynex drives are available in both single and dual disk configurations, with a choice of front or top loading, 1500 or 2400 RPM disk rotational speed, and 100 or 200 tracks-per-inch recording densities -- resulting in 25, 50 or 100 million bits of on-line data storage in a compact 8-3/4 inches of rack space. All disk drives are fully compatible with IBM 5440 (Top Load), IBM 2315 (Front Load) or equivalent removable disk cartridges -- providing large on-line data storage capacity and virtually unlimited off-line cartridge storage. Cartridges can be easily and quickly changed by the system operator. Dual disk units utilize the removable cartridge for bulk storage, plus a permanently installed disk for increased on-line storage, special data handling applications, or as an extension of core memory for program storage or other special programming requirements.

This totally self-contained drive unit is designed for convenient 19-inch RETMA rack mounting -- requiring only 8-3/4 inches of rack height and 28-inches of depth. Slide mounting allows top loading units to be extended for cartridge loading and ease of service. Front loading drives do not require slide mounting, however, slides are recommended for ease of maintenance.

Series 6000 Disk Drives contain the following basic sub-assemblies:

- Head positioner mechanism
- Rotational drive and cartridge loading system
- Electronics module
- Operator control panel
- Internal power supply

The Dynex developed head positioner mechanism contains a specially designed controlled velocity, voice coil type actuator and photo-optical servo system for high speed head positioning with repeatability accuracy of better than 50 millionths of an inch. Consistent positioning accuracy and repeatability allows cartridges to be written and read interchangeably on all Series 6000 Disk Drives.

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Positioning accuracy is achieved by use of a photo-optical system consisting of a precision, calibrated grating and reticle in combination with multiple photo cell pairs. This unique photo-optical system provides position and directional information to the actuator servo control during each seek operation. The combination of this high resolution servo system and low-mass head carriage, results in extreme accuracy, fast access times and superior reliability.

In addition to inherent, designed-in positioning accuracy, all 200 track-per-inch drives contain temperature sensitive thermistors to electrically compensate for dimensional changes caused by operational temperature variations -- thus further minimizing possible positioning accuracy variations. Precise head positioning accuracy, in combination with a time-proven data recovery system are by far the two most important factors contributing to the extremely low soft (recoverable) error rate -- less than one bit in  $10^{10}$  bits transferred. Error producing power line transients are effectively controlled by carefully designed power supply filtering and internal ground isolation techniques.

The Series 6000 rotational drive and cartridge mounting system is a precision assembly -- providing precise and repeatable disc clamping alignment, and a closed-loop servo speed control circuit. A rotational speed tolerance of less than  $\pm 2$  percent at both 1500 and 2400 RPM, and 50 or 60 Hz line frequency is standard on all drives.

In addition to the above mentioned thermistor compensation for head positioning accuracy, media environmental protection is provided by a pressurized absolute air filtration system. Dynex filtration removes virtually all potentially hazardous substances (dust, smoke, etc.) from the head/media area. This pressurized system also serves to temperature stabilize and continuously purge the drive unit.

For reliability and low heat disipation, integrated circuitry is used throughout the disk drive electronics system. Data, positioning and interface electronics are contained on four printed circuit boards which plug into a common backpanel. All logic and control circuits are functionally oriented, with test points for convenient and rapid fault isolation and correction.

To guarantee data integrity, each Series 6000 drive contains a comprehensive system of interlocks to protect against operator, as well as system operational errors which could possibly be destructive to stored data, the drive unit or possibly be a hazard to the operator. For example, on top load units, disk rotation is prevented unless the cartridge is correctly installed and manually "locked" in place. This "positive lock" assembly can only be manually activated when the

# Series 6000 DISK DRIVE

drive is in the "Safe" condition, thus preventing possible system damage by attempted cartridge removal during operation. On front load units, a mechanical cartridge access door "lock" serves an identical function. To protect the heads and disk surfaces, a logic interlock maintains the head carriage in the fully retracted position until the disk has reached the necessary rotational speed for safe and stable head aerodynamics. This same interlock automatically retracts the heads in the event disk speed is reduced by mechanical or power failure. To protect stored data from inadvertant erasure or over-writing by the operating software system, two manual Write Protect switches can be used to selectively inhibit all write functions for the fixed and removable disks.

Series 6000 interface circuits are TTL compatible, with the standard interface designed to meet the needs of a wide range of user interface requirements -- including compatibility with disk drives supplied by other manufacturers.

In the event of installation, application or equipment problems, Western Dynex Corporation provides 24-hour spare parts and customer service. Experienced engineers are available to provide consulting and training for preventive and emergency maintenance service. In addition, a portable test unit and exerciser is available for on-site troubleshooting and off-line checkout of all Series 6000 Disk Drives. The test unit simulates controller interface signals while displaying data and disk drive operating conditions.

# Series 6000

## DISK DRIVE

### 1.2 System Specifications and Configurations

#### SERIES 6000 SPECIFICATIONS

##### Disk Configuration

- Removable only or fixed and removable
- Front or top loading

##### Storage Capacity

- 25, 50 or 100 megabits

##### Cartridge Requirements

- IBM 5440 Top Loading Type
- IBM 2315 Front Loading Type

##### Recording Density

- 2200 BPI

##### Track Density

- 100 or 200 tracks per inch

##### Cylinders per Surface

- 203 with 100 TPI or,
- 406 with 200 TPI

##### Sector Formatting

- 8, 12, 14, 16, 20, 24 and 32 sectors/track. Others available.

##### Disk Rotational Speed

- 1500 rpm  $\pm$  2%
- 2400 rpm  $\pm$  2%

##### Data Transfer Rate (BPS)

- 1.562 MHz @ 1500 rpm
- 1.5885 MHz @ 1500 rpm
- 2.500 MHz @ 2400 rpm
- 2.540 MHz @ 2400 rpm

##### Head Positioning Accuracy

- Within 200 millionths of an inch

##### Head Positioning Repeatability

- Within 50 millionths of an inch

##### Rotational Latency

- 20 milliseconds, avg. at 1500 rpm
- 12.5 milliseconds, avg. at 2400 rpm

##### Mean Time Between Failure (MTBF)

- Greater than 5000 hours

##### Mean Time To Repair (MTTR)

- Less than one hour

##### Recoverable Error Rate

- Less than 1 bit/10<sup>10</sup> bits transferred

##### Non-Recoverable Error Rate

- Less than 1 bit/10<sup>12</sup> bits transferred

##### Air Filtration

- 0.3 micron, pressurized

##### DC Power

- Internal DC power supply

##### AC Power

- 100 or 115 VAC  $\pm$  10%, 50 Hz  $\pm$  2% or 60 Hz  $\pm$  1% at 4.5 Amps
- 208 or 230 VAC  $\pm$  10%, 50 Hz  $\pm$  2% or 60 Hz  $\pm$  1% at 2.3 Amps

# Series 6000 DISK DRIVE

## Mounting

- Standard 19-inch RETMA rack
- Height: 8-3/4 inches
- Depth: 28 inches (including cable clearance)

## Weight

- 120 pounds (with cartridge)

## Operating Environment

- 55 to 105°F
- 10 to 80% RH (no condensation)

Note: See Section 3.3.5 for Interface Signal Specifications

### SERIES 6000 DISK CONFIGURATIONS (FRONT OR TOP LOADING)

Drive Model	Number Of Disks	Number of Recording Surfaces	Track Spacing	Capacity Bits/ Drive	Data Transfer Rate (Bits-Per-Second)
DD-6121	1	2	100 TPI	25m	1.562 MHz @ 1500 rpm
DD-6221	2	4	100 TPI	50m	1.5885 MHz @ 1500 rpm
DD-6122	1	2	200 TPI	50m	2.500 MHz @ 2400 rpm
DD-6222	2	4	200 TPI	100m	2.540 MHz @ 2400 rpm
					Available All Models

# Series 6000 DISK DRIVE

## 1.3 Supporting Hardware

The following is a list of supporting hardware available for the installation and servicing of Series 6000 Disk Drives.

### Installation Hardware

<u>Item</u>	<u>Description</u>	<u>Part Number</u>
Cable, I/O	Interconnection between daisy-chained drives (5 feet)	D164G3
Cable, I/O	Interconnection between daisy-chained drives (11 feet)	D164G4
Cable, I/O	Connects user system to 1st drive (8 feet)	D164G1
Terminator PWB	120 ohm cable termination	C131G1
Slides Kit	Slides and cable retractor, Misc. installation parts (See Fig. 9-22 for installation instructions)	C439G1
Slides Kit	Slides, Misc. installation parts	C439G2
Disk Cartridge *	Front load, disk cartridge	DCA188
Disk Cartridge *	Top Load, disk cartridge	DCA147

\*Specify TPI, BPI and sector format when ordering

### Service Hardware

<u>Item</u>	<u>Description</u>	<u>Part Number</u>
CE Cartridge (Top Load)	Certified disk for disk drive alignment	DCA148
CE Cartridge (Front Load)	Certified disk for disk drive alignment	DCA189
PWB Extender	Extends circuit cards away from module for service access	C134G1
Disk Exercisor	Off-line test unit	DE5020

(continued on next page)



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## Service Hardware (cont'd.)

<u>Item</u>	<u>Description</u>	<u>Part Number</u>
Disk Suitcase Tester	Off-line test unit with data transfer	DT6020
Dummy Sector Ring (Top Load)	Sector Amplitude "standard"	DRD191P1
Dummy Sector Ring (Front Load)	Sector Amplitude "standard"	DRD192P2
Head Spacer	Used to prevent head loading during servo setup	B098P1
Cleaning Wand	Used for disk cleaning	HAA149P1

When ordering Installation or Service Hardware, contact:

Customer Service Department  
Western Dynex Corporation  
3536 West Osborn Road  
Phoenix, Arizona 85019  
(602) 269-6401/TWX (910) 951-4287

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## SECTION 2 -- OPERATING PROCEDURES

### 2.1 OPERATOR FUNCTIONS

Note: All operator accessed switches and indicators are located on the disk drive front panel. Extending the drive from the equipment rack is necessary "only" for cartridge insertion or removal on top loading drives.

#### 2.1.1 Power-On Procedure

1. Depress the "Disk Power" switch "ON". The Disk Power lamp will come "ON" -- indicating the internal power-on sequence has been initiated.
2. When the "Safe" lamp comes "ON", power-on initialization of the drive is complete. A "Safe" indication requires approximately 25 seconds from power application.
3. At this point, a disk cartridge may be inserted or removed from the drive.

Warning: The "Safe" lamp has but one function -- indicating to the operator that it is safe to insert or remove a disk cartridge. Do not attempt to insert or remove cartridges unless the "Safe" lamp is "ON", or system damage may occur.

Note: All front load drives and late model top load drives contain a mechanical "Positive Lock" assembly which prevents cartridge removal unless the "Safe" lamp is "ON". On top load units, the Positive Lock prevents cartridge cover removal, while on front load units, the cartridge access door is locked -- preventing cartridge removal. Once the Positive Lock is manually placed in the "locked" position (top load units) and the "Disk Drive" switch is depressed "ON", or the "Disk Power" switch is depressed "OFF", the lock can not be unlocked by the operator, thus preventing cartridge removal. On front load units, after inserting the cartridge, the cartridge access door will automatically "lock" on depressing the "Disk Drive" switch "ON" or the "Disk Power" switch "OFF".

#### 2.1.2 Disk Cartridge Load Procedure

1. If the "Disk Power" lamp is "OFF", perform steps 1 and 2 of the Power-On Procedure.

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2. With the "Safe" lamp "ON", manually move the "Positive Lock" arm back (top load units), then insert the cartridge and install the cartridge cover, then move the Positive Lock arm forward into the "locked" position. On front load units, pull open the cartridge access door, insert the cartridge, and then close the access door.
3. Depress the "Disk Drive" switch "ON". An electrically operated solenoid will lock the Positive Lock arm (or access door) in place and the Disk Drive lamp will come "ON", indicating that the internal operating sequencing has been initiated.
4. Approximately 90 seconds after depressing the "Disk Drive" switch "ON", the "Ready" lamp will come "ON", indicating the drive is ready for on-line user control.

Note: An interlock prevents disk rotation if the cartridge is not properly seated.

### 2.1.3 Disk Cartridge Unload Procedure

1. When the "Safe" lamp comes "ON", move the Positive Lock arm back to its unlocked position (top load units), or pull open the cartridge access door (front load units). The disk cartridge is in the unloaded state and may be removed at this time.
2. If the "Ready" lamp is "ON", depress the "Disk Drive" switch "OFF" -- "Disk Drive" and "Ready" lamps will go "OFF". On depressing the "Disk Drive" switch to "OFF", the heads will unload, the head carriage will seek a fully retracted position, and disk rotation will begin to decelerate. When the disk has completed its deceleration cycle, the "Safe" lamp will come "ON", indicating it is safe to remove the disk cartridge from the drive.

Warning: Should the Unload Procedure be executed during on-line user accessing, system errors may occur. Should user operation involve writing data, a logic interlock allows the write data sequence to be completed before the unload sequence is initiated. Once the Ready lamp is "OFF", the user can no longer access the disk drive.

3. If the disk drive contains a cartridge and disk drive power is "OFF", perform steps 1 and 2 of the Power-On Procedure. When the "Safe" lamp comes "ON", the cartridge may be removed.

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## 2.1.4 Power-Off Procedure

1. If the disk cartridge is "loaded" (Disk Drive Lamp ON), perform the Disk Cartridge Unload Procedure (Section 2.1.3).
2. When the "Safe" lamp comes "ON", remove the disk cartridge (if necessary), then depress the "Disk Power" switch "OFF". The Disk Power lamp will go "OFF", indicating all disk drive power has been removed from the unit.

Warning: Except under "Emergency Conditions" (see Section 2.1.5), the Power Off Procedure should never be performed without first initiating the Cartridge Unload Procedure. If the cartridge is not to be removed from the unit, the "Disk Power" switch may be depressed "OFF" as soon as the heads have unloaded (approximately 3 seconds after depressing the "Disk Drive" switch "OFF"). In this case, the cartridge will be locked in place.

## 2.1.5 Emergency Unload Procedure

1. Many emergency conditions are monitored and detected by special disk drive circuits. Should an emergency condition be detected, the head carriage will automatically retract and the "Safe" lamp will come "ON" -- allowing cartridge removal. However, should the operator detect an emergency condition (head scraping, unusual noises, etc.), perform an Emergency Unload by depressing the "Disk Power" switch to "OFF", to unload the heads, retract the positioner and remove all unit power.

Note: Data may be lost, if the system is in a Write Data mode and the Emergency Unload Procedure is performed.

## 2.1.6 Disk Cartridge Handling

Within each disk cartridge is a precision disk with an extremely thin magnetic coating which serves as a recording medium. Since the read/write heads "fly" only a few microinches from the recording surface, yet do not touch the surface, is it extremely important that proper care be exercised when handling and storing the disk cartridge. When considering the fact that individual data tracks are less than 5 thousandths of an inch wide and a data bit is less than 500 microinches long, it can be seen that extremely small areas of damage, or finger prints, or dust particles -- even continued exposure to cigarette smoke -- can render a disk cartridge inoperable with possible loss of customer data.

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To ensure data integrity, adequate precautions are necessary.

1. Clean the cartridge protective covers periodically to remove any build-up of dirt or dust. Use a clean, lint-free cloth.
2. Keep all foreign objects away from the disk surface.
3. Do not touch the disk surface.
4. Keep the cartridge lid in its proper place at all times. Should a cartridge be dropped or otherwise suspected to be damaged, have it inspected by maintenance personnel before using.
5. Do not allow liquids, such as coffee and other beverages, to be in the disk drive cartridge area.
6. Tobacco, its smoke and ashes, is a prime source of contamination -- keep these items out of the disk storage and operating area.
7. When a disk cartridge is first brought into the computer room (disk drive area) environment, always allow at least one (1) hour for the disk cartridge to temperature stabilize within the operating room environment. This stabilization is required to ensure correct head-to-track registration.

Note: It is recommended that all disk cartridges be stored within the computer room environment, or equivalent area.

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## SECTION 3 -- INSTALLATION

### 3.1 Unpacking and Initial Inspection (Ref. Fig. 9-22 and 9-23)

All Series 6000 Disk Drives are shipped in special containers designed to absorb normal vibration and shock loads encountered by common commercial carriers. Anticipated shock and vibration loads are as follows:

Shock: 25 G's for  $11 \pm 1$  milliseconds

Vibration: 5 G's from 1 to 300 Hz

Important: a) On delivery by commercial carrier, thoroughly inspect the exterior of the shipping container for physical damage. Any damage should be described and noted on the carrier's bill of lading.

b) During the unpacking process and incoming inspection, carefully note any damage. Should damage be observed, immediately notify the carrier and Western Dynex Corporation, Customer Service. If the unit is to be returned, carefully follow Section 3.2, Return Shipping Instructions.

1. Open the outer shipping container and remove the inner container (Keep all containers and packing materials in case return shipment should become necessary).
2. Carefully cut all tape seams and remove the disk drive from the inner container.
3. Remove top cover from the disk drive (six screws, 3 per side).
4. Visually inspect the disk drive assembly for possible shipping damage. Check all PWB's and connectors for proper connector "seating". Check for loose components and subassemblies.

Important: During unpacking and inspection, do not allow the disk drive to become contaminated with dirt, dust, etc. It is recommended that unpacking and inspection be performed in a clean, computer room type environment.

5. With the top cover removed, remove the two (2) screws which retain the positioner cover and coil lock. Remove the positioner cover and rotate the coil lock 180 degrees, such that the coil lock tab is toward the rear of the unit. Replace the positioner cover and screws.

Warning: Should the unit be subsequently moved or prepared for shipment, it is absolutely necessary that the coil lock be in place and secured.

6. Replace the top cover.

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7. The disk drive is now ready for installation per Section 3.3

### 3.2 Return Shipment Instructions

For disk drive shipment or facility move, it is recommended that each disk drive be repackaged in its original shipping container.

Warning: a) Never ship a disk drive with the disk cartridge installed.  
b) Prior to shipment or moving, it is absolutely necessary that the coil lock be in place and secured.

#### Notification of Return Shipment

Factory notification of all return shipments (warranty or otherwise) is necessary prior to shipment. Contact Western Dynex Corporation, Customer Service Department for shipping and disposition instructions.

All return shipments shall be freight pre-paid.

### 3.3 Installation Procedures

Warning: Following final installation and power connection, but prior to loading the heads, the removable disk heads (0 and 1) should be inspected for dust, dirt and other contamination which may have accumulated during shipment or customer storage. Normally, units shipped and stored in their original shipping containers will not require head or disk cleaning. However, any unit left uncovered or otherwise exposed for an extended length of time should be carefully inspected for contamination.

Should inspection of the top heads (0 and 1) reveal contamination, clean all heads (upper and lower) and the fixed disk per Maintenance Procedures -- Sections 5.3.2, Read/Write Heads; and 5.3.3, Disk Cleaning.

#### 3.3.1 Rack Mounting Procedures (Ref. Fig. 9-22)

1. Install slide supports (item 2) on to disk unit using button head screws in holes marked "A" (6-32 X 1/4, 3 places each support).

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2. Temporarily install left-hand slide (item 3) on to its respective support (item 2); align mounting holes and install at least two 6-32 X 1/4 button head screws in holes marked "B", to hold slide in place. Mark the relative location of the front end bracket (item 7) on the slide which will result in the proper RETMA rail-to-front panel clearance when installed (approximately 0.2 inches). Remove the slide from the unit and install the front end bracket to the slide with mounting hardware (8-32 X 3/8, low profile pan binding head screws with both flat and lock washers, 2 places). Re-install the left-hand slide on the unit.

Note: Slide mounting brackets should not be installed such that brackets fit between RETMA rails and the slides unless the distance between RETMA rails (across cabinet) is greater than 17.88 inches.

3. Install front end bracket (item 7) at same location on the right-hand slide.
4. Install unit stop spring (item 5) on to unit above the left-hand slide. Extend slide and install the unit lock plate (item 6) on to slide such that the slide will latch in the closed position as shown at location 7D on the reference drawing (Use 6-32 X 3/8 pan head screws with flat and lock washers, 2 places). After lock plate is adjusted and the screws have been secured, remove both the unit stop spring and the slide from the unit.

Note: An alternate unit stop spring mounting method is available (Ref. location 5A on Fig. 9-22).

5. Select the correct rear end bracket mounting holes in both slides (items 3 and 4) to allow mounting into the cabinet, and install the rear end brackets, item 7 (Use 8-32 X 3/8 low profile pan head screws with flat washers, two places for each bracket). Do not totally tighten rear end bracket screws. Mount slides into cabinet (RETMA rail mounting screws are not supplied) to determine precise location of rear end bracket. The rear end bracket screws can then be secured.
6. Set slide spacing (across cabinet) such that the distance between unit mounting members of the slides is  $16.75 \pm 0.02$  inches. Secure RETMA rail screws. Slides must be mounted parallel to each other and vertically parallel to the RETMA rail.
7. Extend slides. Spacing should still be  $16.75 \pm 0.02$  inches between slide unit mounting members (measure front and rear).
8. With slides extended, install four (4) miscellaneous screws (#6 screws, 3/4 inch or longer, no nuts required) into center slide members to keep the slides in the intended position. These holes are located approximately one-inch in front of the RETMA rails when slides are in the



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extended position. This keeps the slides from closing as the disk drive is being lifted onto the extended slide mounting members. Two persons (one per side) are required to lift the unit over the extended slide members and back to the correct mounting hole position. Be careful that the unit weight does not tilt the cabinet. The weight of the unit should not be put onto the slides until the unit is near its approximate mounting position. Also, before the unit weight is put onto the slides, check that unit slide supports fit correctly over the extended unit mounting members slide.

9. Align the unit mounting holes to the slides and install button head screws (6-32 X 1/4, at least two per side). Secure screws.
10. There should be  $0.060 \pm 0.015$  inches clearance between the unit and the slide cabinet mounting member (items 3 and 4). Remove the four (4) screws used to lock the slides into the extended position, and move the unit slowly into the cabinet. The 0.060 inch clearance should be maintained throughout the total travel. The unit should move freely.
11. With the unit extended, install unit stop springs (item 5) onto both sides of the unit (6-32 X 3/8 with flat washers, both sides). As the unit is moved into the cabinet position, the unit stop springs are to be depressed to clear the RETMA rails.
12. With the unit in the cabinet position, install cable retracting assembly per reference drawing. Maintain maximum separation between the AC power cable and the ribbon I/O cable. Be sure the chain pulls the cable retractor and not the ribbon cable. Fold the ribbon cable as indicated to give desired cable direction. Adjust cable clamps for the AC power cable to provide desired cable length and direction of travel. Check that all cables are maintained within an 8.75 inch space throughout the unit travel range.
13. For maintenance, disconnect the cable retractor from the rear RETMA rail and extend the unit to its normal stop position (unit stop springs catch on the RETMA rails). Press the unit stop springs toward the unit and pull the unit out to its maximum extended position. Check that the cable assembly is free to move to full extended position prior to moving. Normal maintenance can now be performed.

Warning: Be careful that the cabinet does not tilt due to unit weight while extended.


14. Carefully check installation and that all mounting screws are secure.

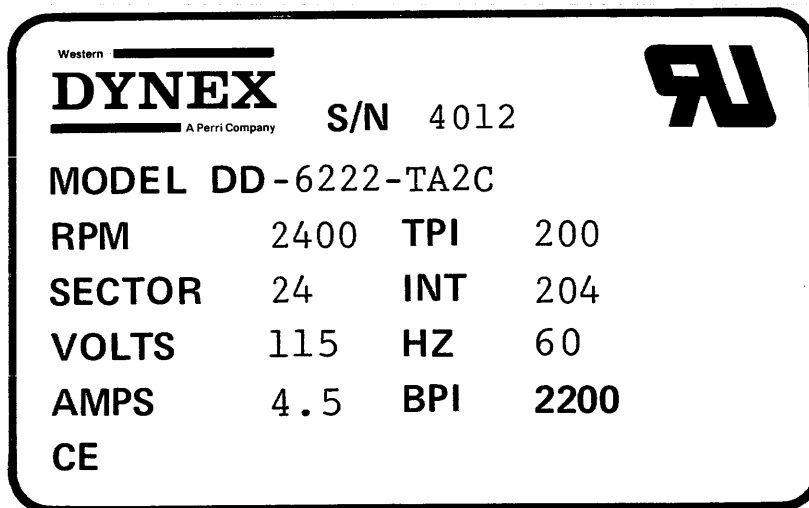
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## 3.3.2 AC Power Connection (Ref. Fig. 9-1)

Each Series 6000 Disk Drive is internally pre-wired for a designated AC power input as specified at time of order. A label on the side of the disk drive designates the required AC power input.

A sample label is shown below. Label designations are as follows:

S/N	Unit Serial Number
MODEL	DD-6222-TA2C
<u>DD-6222</u>	Defines a dual disk, 200 TPI unit
<u>TA</u>	Signifies a top load unit (FA - front load unit)
<u>2</u>	Defines the basic unit configuration (per Model List)
<u>C</u>	Defines the accessory package (cables, manuals, etc.)
RPM	2400 RPM
SECTOR	24 sectors per revolution (format)
VOLTS	115 VAC (primary power, pre-wired)
AMPS	4.5 Amps (primary power load, maximum operating)
CE	CE cartridge alignment method (Standard, if blank)
TPI	200 tracks-per-inch (format)
INT	204 type interface (204 - Customer I/O Interface)
Hz	60 cycle (primary power frequency)
BPI	2200 bits-per-inch recording density
	Recognized under the Component Program of Underwriters Laboratories Inc. (115 VAC, 60 Hz only).



SAMPLE UNIT LABEL

A pre-wired, 3-conductor power cord is supplied with each unit.

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- Warning:
- a) Prior to power application to the disk drive, verify that the power input source is as specified on the unit power input label.
  - b) Under no circumstances should an alternate power input source be applied -- disk drive damage will occur.
  - c) Under no circumstances should the customer attempt to modify the disk drive for an alternate power input source.

### 3.3.3 I/O Connection and Termination (Ref. Fig. 9-1 and Section 3.3.5)

Each Series 6000 Disk Drive contains two (2) 50-pin I/O cable connectors, located on the PWB backpanel at the rear of the unit. See Section 3.3.5 for I/O signal specifications. The two I/O connectors are physically wired in parallel -- accepting two I/O cable connectors for daisy chaining disk drives, or one I/O cable and a Termination PWB. (See figure 3-1)

A maximum of four (4) disk drives can be daisy chain connected to a single user I/O cable. Note that a Termination PWB is always required at the last unit -- regardless of the number of units connected (1, 2, 3 or 4 units).

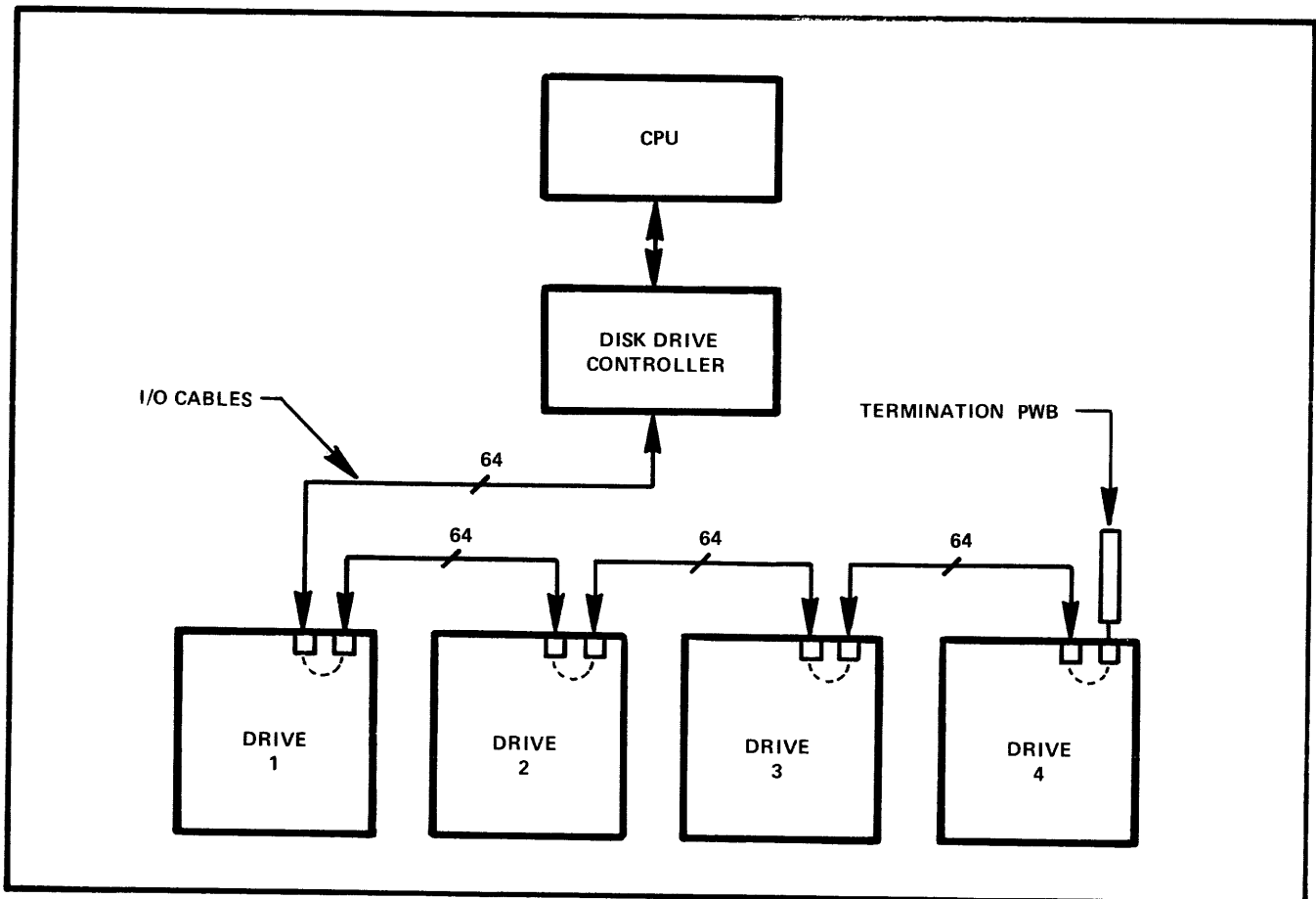


FIGURE 3-1  
I/O CABLE CONNECTION

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## 3.3.4 Jumper Connections (Ref. Fig. 9-1 and Appendix C)

From one (1) to four (4) disk drives may be daisy chain connected to a common user I/O cable. Within the operating software, each of the four units will be pre-designated as unit 1, 2, 3 or 4 and will retain this identity. Within each disk drive, the assignment of a Unit number is accomplished by two jumper connections -- Busy Select (1, 2, 3 or 4) and Unit Select (1, 2, 3 or 4). Jumper connections are made on the PWB backpanel, as viewed from the rear of the unit.

For both Busy and Unit Select jumpers, connect the respective common pin (Ref. Fig's. 3-2 and 9-1, Loc 7C) to the corresponding assigned number pin.

Note: The Busy and Unit Select common pins are normally set to the same identification number. As shipped from the factory, all units are pre-wired (jumpered) for "Drive 1" identification.

Note: All Series 6000 Disk Drives are shipped with a Customer Interface as specified on the Unit Label (See Section 3.3.2). Appendix "C" provides a listing of all disk unit jumper connections with corresponding definitions. Due to the large number of "special" interface configurations, individual interface configurations are not listed.

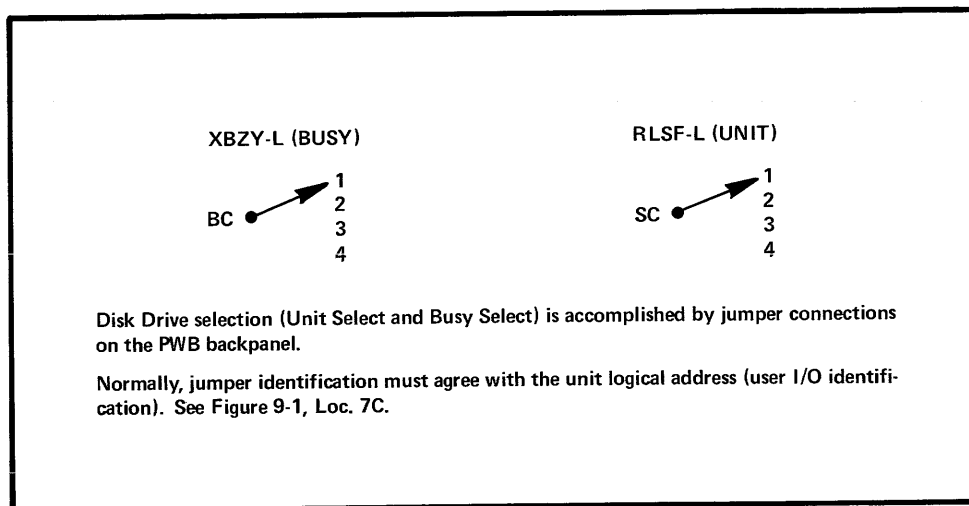


FIGURE 3-2  
UNIT/BUSY SELECT JUMPER CONNECTIONS

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## 3.3.5 I/O Signals and Specifications (Ref. Fig. 9-1)

I/O interface receiver/driver equivalent circuits are shown in Figure 3.3. All logic consists of TTL integrated circuits, with +2.5 to 5.3 VDC representing a "True" condition and  $0.2 \pm 0.2$  VDC representing a "False" logic condition.

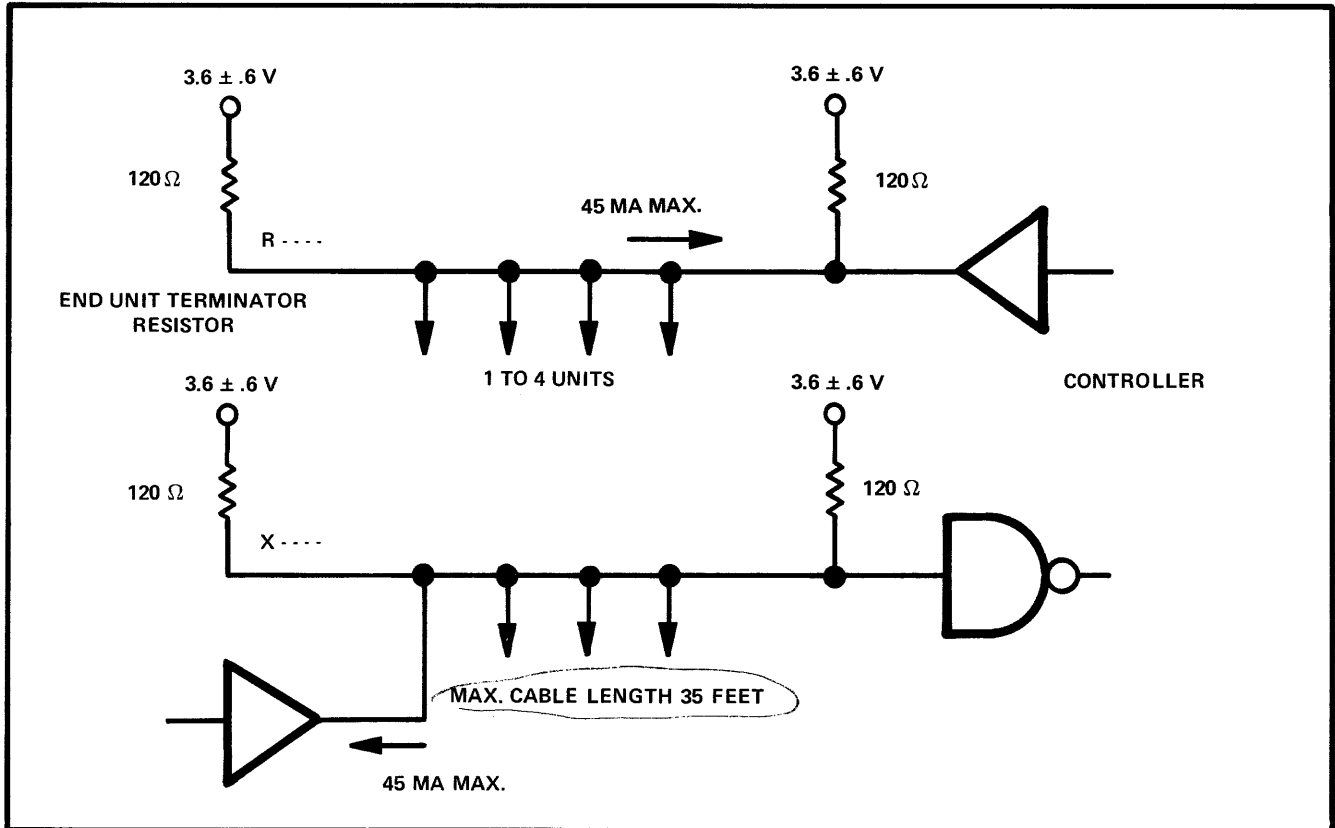


FIGURE 3-3  
I/O INTERFACE EQUIVALENT CIRCUITS

Table 3-1 provides a complete listing of Input/Output signals with corresponding cable pin numbers, conductor numbers, backpanel connector location and pin numbers, and individual signal logic nomenclature.

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Table 3-1  
I/O Signal Listing

Backpanel Location (Slot and Pin)	I/O PWB Hole No.	I/O Cable Conductor Number	Logic Name and Function
A5-48, A3-50	3	1	RDA8-L Track (Position) Addr. Bit 8 (200 TPI)
A5-50, A3-49	1	2	RDA7-L Track (Position) Addr. Bit 7
A5-49, A3-47	2	3	RDA6-L Track (Position) Addr. Bit 6
A5-47, A3-45	4	4	RDA5-L Track (Position) Addr. Bit 5
A5-45, A3-43	6	5	RDA4-L Track (Position) Addr. Bit 4
A5-43, A3-41	9	6	RDA3-L Track (Position) Addr. Bit 3
A5-41, A3-39	10	7	RDA2-L Track (Position) Addr. Bit 2
A5-39, A3-37	12	8	RDAl-L Track (Position) Addr. Bit 1
A5-37, A3-35	14	9	RDA0-L Track (Position) Addr. Bit 0
A5-22, A2-38	24	10	RDAR-L Track Addr. Restore (Demand Addr. Reset)
A5-46, A2-35	5	12	RDRE-L Disk Removable Enable
A5-44, A2-37	7	14	REDM-L Erase Data Mode
A5-42, A2-39	8	16	RWDM-L Write Data Mode
A5-40, A2-42	11	18	XUNL-L Malfunction
A5-38, A2-44	13	20	XILA-L Illegal Address
A5-36, A2-46	15	22	XWPM-L Write Protect Mode
A5-34, A2-48	17	24	RULC-L Unload Control (Unit Unload)
A5-32, Sel-04	18	26	RLF4-L File (Unit) Select 4
A5-30, Sel-03	20	27	RLF3-L File (Unit) Select 3
A5-28, Sel-02	21	28	RLF2-L File (Unit) Select 2
A5-26, Sel-01	22	29	RLF1-L File (Unit) Select 1
A5-35, A4-49	16	31	RHSO-L Head Select Top
A5-33, A4-45	19	33	RWDP-L Write Data Pulse
A5-24, A2-40	23	35	RDAS-L Track (Position) Addr. Strobe
A5-12, Busy-01	31	37	XBZ1-L Seek Complete 1
A5-14, Busy-02	28	39	XBZ2-L Seek Complete 2
A5-16, Busy-03	27	41	XBZ3-L Seek Complete 3
A5-18, Busy-04	25	43	XBZ4-L Seek Complete 4
A5-17, A1-38	26	45	XSRT-L Sector
A5-15, A1-40	29	47	XIND-L Index
A5-13, A1-42	30	49	XSBO-L Sector Addr. Bit 0
A5-11, A1-44	32	50	XSBl-L Sector Addr. Bit 1

(Continued on next page)

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## I/O Signal Listing (cont'd.)

<u>Backpanel Location (Slot and Pin)</u>	<u>I/O PWB Hole No.</u>	<u>I/O Cable Conductor Number</u>	<u>Logic Name and Function</u>
A5-09, A1-46	34	51	XSB2-L Sector Addr. Bit 2
A5-07, A1-48	35	52	XSB3-L Sector Addr. Bit 3
A5-05, A1-50	39	53	XSB4-L Sector Addr. Bit 4
A5-10, A1-37	33	55	XRDB-L Read Data Bit
A5-08, A1-41	36	57	XRDQ-L Read Data Clock
A5-06, A1-43	37	59	RRDE-L Read Data Enable
A5-04, A1-45	38	61	XFRY-L Ready
A5-01, A1-49	40	63	3.6V Terminating Voltage
A5-01, A1-49	41	64	3.6V Terminating Voltage

Notes:

- The I/O cable consists of 26 guage, 64 conductor, 2.5 inch wide flat ribbon cable. The "Brown" conductor is conductor number 1.
- Conductors 11, 13, 15, 17, 19, 21, 23, 25, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 54, 56, 58, 60 and 62 must be connected to DC ground by the user.
- Conductors 63 and 64 must be tied together, when used.
- EXAMPLE From Table 3-1: Conductor No. 1 connects to I/O PWB Pin 3, which connects to backpanel I/O slot A5, Pin 48 and then terminates at slot A3, Pin 50. Pin assignments in I/O slots A5 and A6 are identical (Ref. Fig. 9-1).

## INPUT SIGNAL DEFINITION

Note: Logic signal definition is as follows:

Sample: RXXX-L = RXXX = low level; RXXX-H = RXXX = high level

### RLF1-4-L (File Select)

A low level provides I/O selection of one (1) of four (4) disk drives daisy chained to a common I/O cable. Each disk drive must be internally jumpered to a designated File Select number (1, 2, 3 or 4).

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*Interface  
signals  
defined*

## RHSO-L (Head Select)

For a selected disk (upper and lower), a low level selects the "Top" head and a high level selects the "Bottom" head. Opposite polarity selection is available.

## RDRE-L (Disk Removable Enable)

A low level selects the "Removable Disk" and a high level selects the "Fixed Disk". Opposite polarity selection is available.

## RDAO-8-L (Track Position Address)

Low levels select one (1) of 406 data track positions on 200 TPI disk drives. Address bit "8" is not used on 100 TPI drives. The Track Address may follow the leading edge of the Address Strobe (RDAS-L) by up to 0.5 microseconds, maximum. However, it must trail the leading edge of the Address Strobe (RDAS-L) by at least 0.2 microseconds, minimum.

## RDAS-L (Track Position Address Strobe)

The Track Position Address Strobe (neg. pulse) will cause Address Restore (RDAR-L) and the Track Position Address (RDAO-8-L) to be sampled and compared with the stored current address. The head will then position to the specified new address location. Pulse width limits: 0.9 to 3.0 microseconds.

## RDAR-L (Track Address Restore)

Track Address Restore (low level) has priority over a Track Position Address (RDAO-8-L), and will always cause the heads to position to track address 000. The Track Address Restore signal must overlap the Address Strobe (RDAS-L) by 0.5 microseconds, minimum.

## RWDM-L (Write Data Mode)

The Write Data Mode signal (low level) enables Write Data Pulses (RWDP-L) to the write amplifier circuitry.

## RDWP-L (Write Data Pulse)

Encoded "Double Frequency" data. The "negative going" edges causes the encoded data to be recorded on the selected disk when Write Data Mode (RWDM-L) is low.



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### REDM-L (Erase Data Mode)

The Erase Data Mode signal (low level) enables the erase circuitry. REDM-L must be low, within two (2) microseconds of Write Data Mode (RWDM-L) going low, and must remain enabled for at least 28 (20 microseconds for 2400 RPM) microseconds after the last usable Write Data Pulse (RWDP-L), is received.

### RRDE-L (Read Data Enable)

The Read Data Enable signal (low level) enables Read Data Clocks (XRDQ-L) and Read Data Bits (XRDB-L) to be transmitted to the I/O interface -- as read from a previously selected Disk, Track and Sector.

### RULC-L (Unload Control)

A low level signal greater than one (1) microsecond in duration will cause all drive units on the I/O buss to "Unload". This signal allows the unit to be unloaded before I/O control becomes marginal -- Example: loss of user power could cause data to be written on the disk.

### OUTPUT SIGNAL DEFINITION

Note: Logic signal definition is as follows:

Sample: XXXX-L =  $\overline{\text{XXXX}}$  = low level; XXXX-H = XXXX = high level

### XBZ1-4-L (Seek Complete)

Within each disk drive, one (1) of four (4) Seek Complete lines is jumpered to the Seek Logic, providing a designated Seek Complete signal to the I/O interface. The Seek Complete line goes low, independent of File Select (RLF1-4-L) within one (1) microsecond after the leading edge of the Address Strobe (RDAS-L). It will stay low for 8 microseconds (minimum) and then go high when the heads reach and settle on the addressed track position. If the seek is not complete after three (3) seconds, the line will go high, Malfunction (XUNL-L) will go low, and Ready (XFRY-L) will go high. Seek Complete is available in opposite polarity, and is also available as being gated with File Select (RLF1-4-L).

### XILA-L (Illegal Address)

The Illegal Address line goes low within one (1) microsecond following the trailing edge of the Address Strobe (RDAS-L) if the track position address is greater than 202 (405 for 200TPI units) as received from the

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user. In this case, the address is ignored and the heads are not moved. The Illegal Address line returns to a high level within one (1) microsecond following the trailing edge of the Address Strobe (RDAS-L) when accompanied by a subsequent valid address.

## XIND-L (Index)

The Index line provides one (1)  $6 \pm 3$  microsecond, negative going pulse per disk revolution for the selected disk (RDRE-L).

## XFRY-L (File Ready)

The File Ready line provides a low level when the disk drive is conditioned and ready to respond to I/O user commands.

## XRDB-L (Read Data Bit)

The Read Data Bit signal, when enabled by Read Data Enable (RRDE-L) going low, contains decoded data "bits" as read from the selected Disk, Track and Sector. A low level pulse represents a data "1" bit in the "Double Frequency" data encoding and occurs between data clocks (XRDQ-L). An NRZ option is available.

## XRDQ-L (Read Data Clock)

This line, when enabled by the Read Data Enable (RRDE-L) going low, contains the data "clock" as separated from the encoded data. This  $80 \pm 25$  nanosecond negative pulse represents a data "Clock".

## XSBO-4-L (Sector Address)

The five (5) Sector lines specify the sector binary address of the selected disk (RDRE-L). The disk drive Sector Counters are continuously counting, being advanced by the leading edge of each sector pulse as it occurs. The Sector Counter is reset to "zero" (all Sector Address lines high) by the first Sector pulse following the Index pulse.

## XSRT-L (Sector)

The Sector line provides a formatted number of equally spaced  $6 \pm 3$  microsecond, negative going sector pulses per disk revolution -- each indicating the start of a particular sector for the selected disk (RDRE-L).

## XUNL-L (Malfunction)

This line indicates to the I/O Interface that a "malfunction" has occurred within the disk drive.

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### XWPM-L (Write Protect Mode)

A low level occurs when the front panel Write Protect switch for the selected disk (RDRE-L) is enabled.

### 3.6VDC (Two lines)

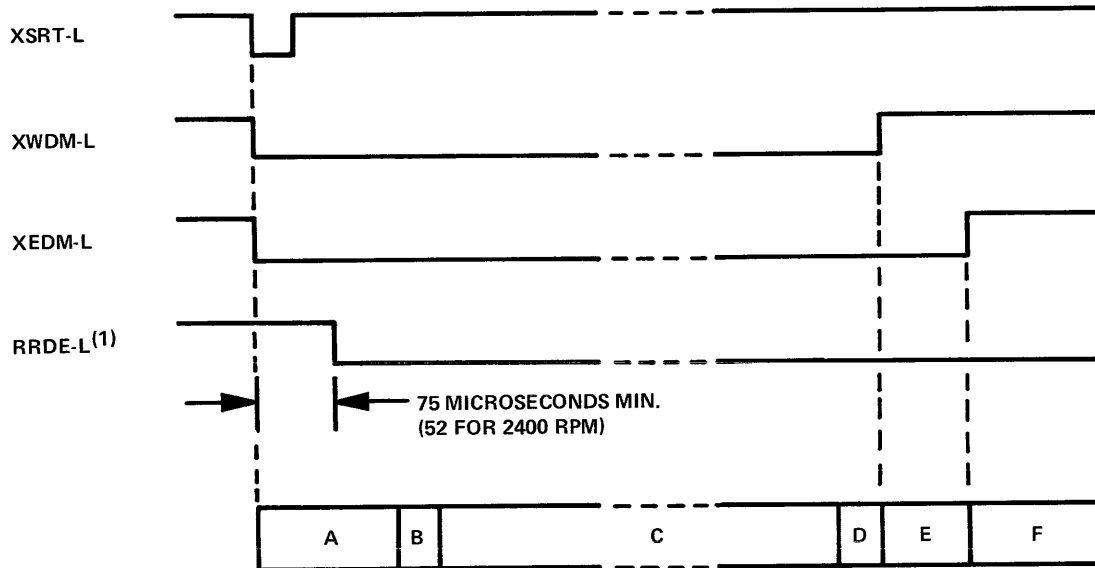
These two lines represent a  $3.6 \pm 0.6$  VDC (0.8 amp maximum) termination voltage for use in user resistor termination.

### MEDIA FORMATTING TOLERANCES

Note: ( ) = 2400 RPM

1. Write pulse oscillator frequency variation must be less than  $\pm 0.25$  percent.
2. Leading edge sector pulse variations, with respect to any one sector pulse to a fixed point on a disk, is  $\pm 30$  ( $\pm 20$ ) microseconds maximum.
3. The relative position of all sector slots to their nominal position is no greater than  $\pm 30$  ( $\pm 20$ ) microseconds.
4. Maximum disk speed variation is  $\pm 2$  percent.
5. Maximum write/erase gap variation is 28 (20) microseconds maximum.
6. Maximum read recovery time after a write, erase or head select is 30 microseconds.
7. 30 (20) microseconds of valid "zeros" must be allowed for phase locked loop acquiring and polarization to guaranty valid data separation.

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## FORMAT INFORMATION (2)

- A = Preamble, 120 (85) microseconds, minimum
- B = Marker Bit
- C = Usable Data Time = (total sector period; less tolerance gap, preamble, three (3) bits, and erase gap) X 0.980.
- D = Two (2) bits minimum
- E = Erase Gap, 28 (20) microseconds, minimum
- F = Tolerance Gap, 95 (76) microseconds, minimum

- (1) The first data clock can be shortened by the asynchronous timing of the read mode.
- (2) If a permanent header is to be used at the start of a data block, the header/data gap and length of header is to be used to determine the actual usable data block. The header must be followed by minimum of two (2) bits, and the erase gap must be maintained for an additional 28 (20) microseconds when writing the header. A minimum of 30 (20) microseconds is required for writing "zeros", which the VFO will use for synchronization prior to reading valid data when in the read mode. Changing from oscillator clock to read clock, etc., takes approximately  $\pm 3.5$  (2.5) microseconds.

Therefore, the minimum delay required for writing the data block marker is 64 (45) microseconds, starting with the last header bit. The read mode can therefore be enabled 61.5 microseconds after the header.

FIGURE 3-4  
DATA FORMAT TIMING  
NOTE: ( ) = 2400 RPM

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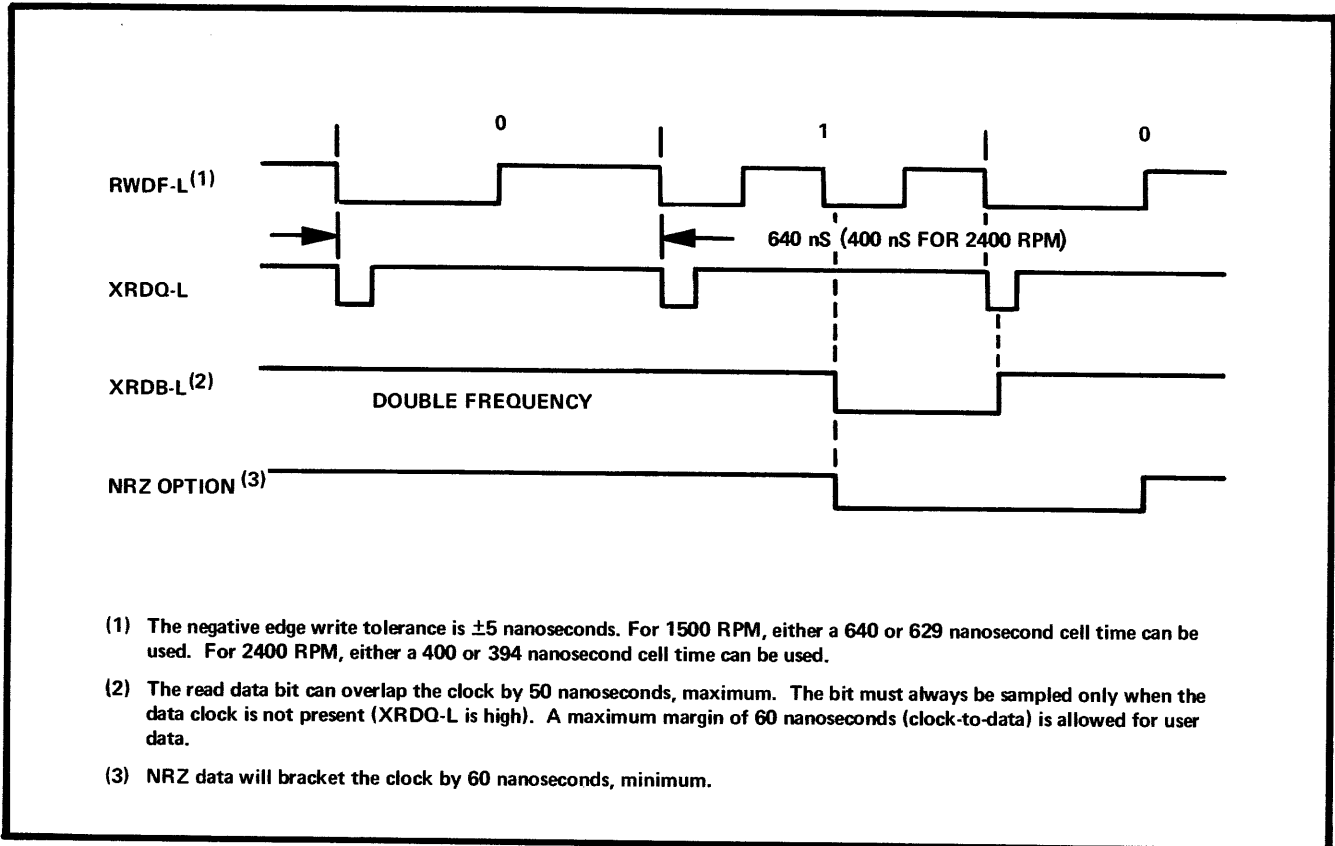


FIGURE 3-5  
DATA BIT TIMING

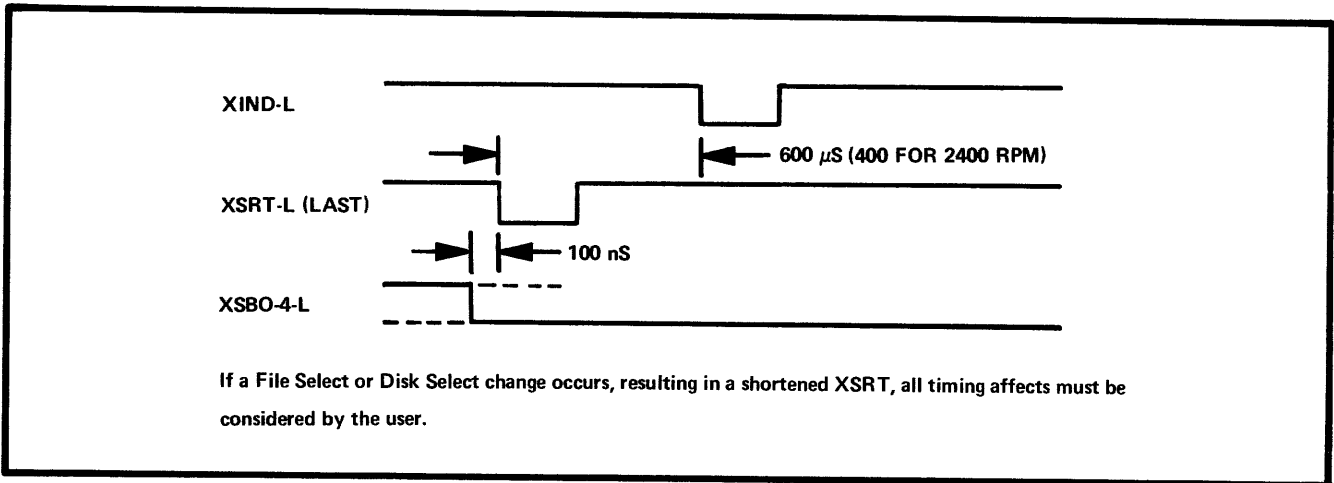


FIGURE 3-6  
SECTOR TIMING

# Series 6000 DISK DRIVE

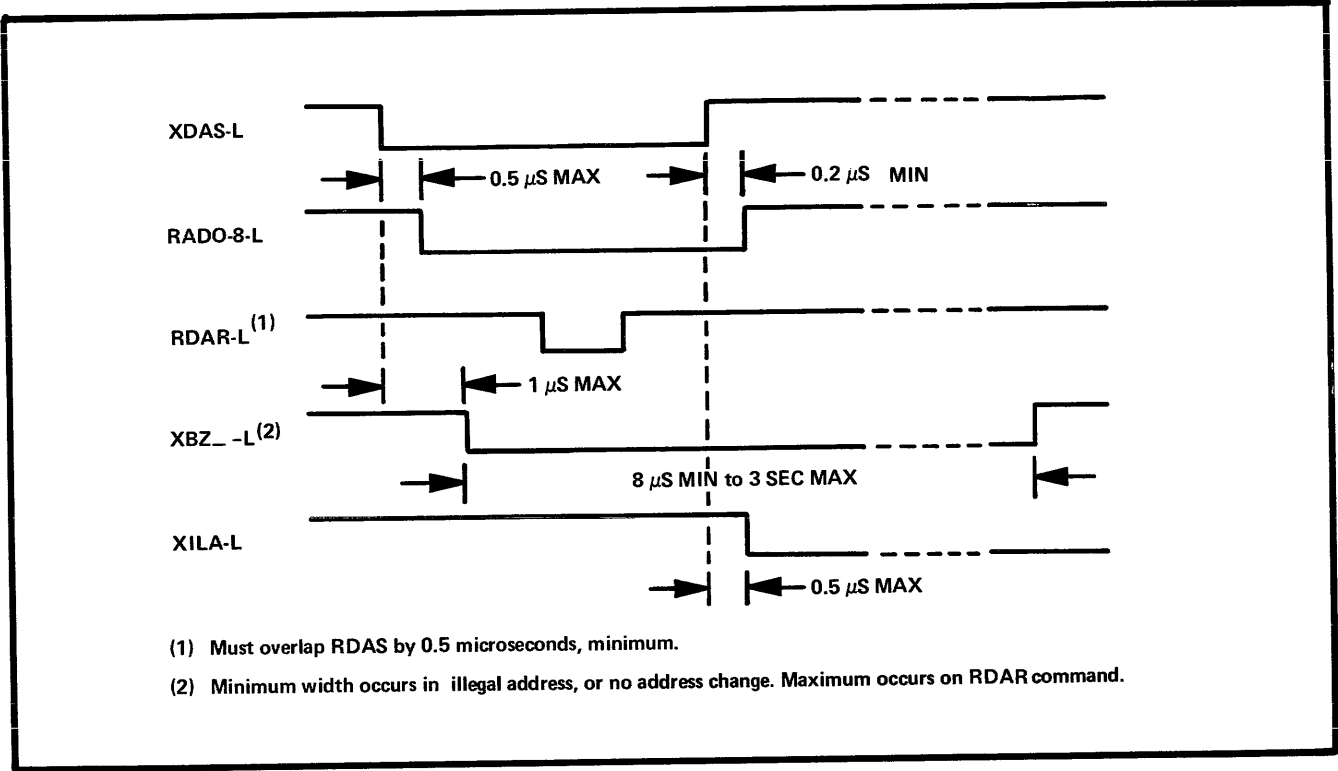


FIGURE 3-7  
SEEK TIMING

# Series 6000 DISK DRIVE

## SECTION 4 - THEORY OF OPERATION

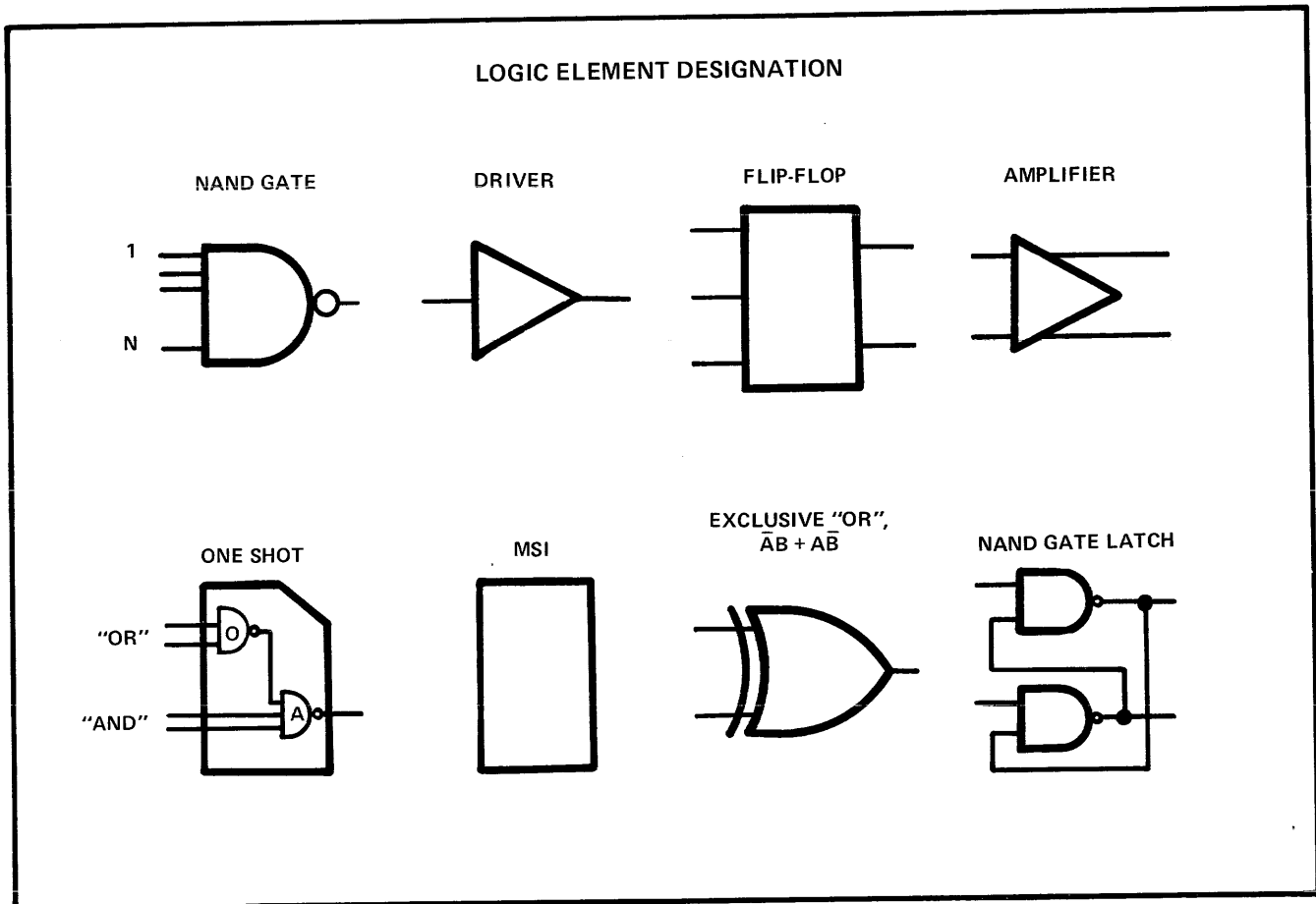
This section provides a detailed description of Series 6000 circuit, logic and operating functions. A thorough understanding of this section will greatly assist service personnel in maintenance, troubleshooting and general system operation.

Supporting schematic component location and mechanical assembly diagrams are located in Section 9. Reference to these diagrams during the study of system operating theory is highly recommended.

### 4.1 General Schematic Description

#### 4.1.1 Definitions

The basic Series 6000 logic family consists of TTL integrated circuits. Standard logic levels are: +2.5 to 5.3 VDC, "True"; and 0.2 ± 0.2 VDC, "False". Logic element designations are as follows:



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### 4.1.2 Logic Flow

The Unit Schematic (Figure 9-1) and Unit Block Diagram (Figure 9-2) provide convenient and quick reference to functional configuration and signal flow throughout the disk drive. In addition, Schematic Component Location diagrams for specific PWB's, modules and assemblies are provided in Section 9.

To better understand the basic logic flow and associated nomenclature, a typical logic structure is presented and explained in Figure 4-1. Logic (signal) nomenclature and location is listed in tables within each schematic diagram.

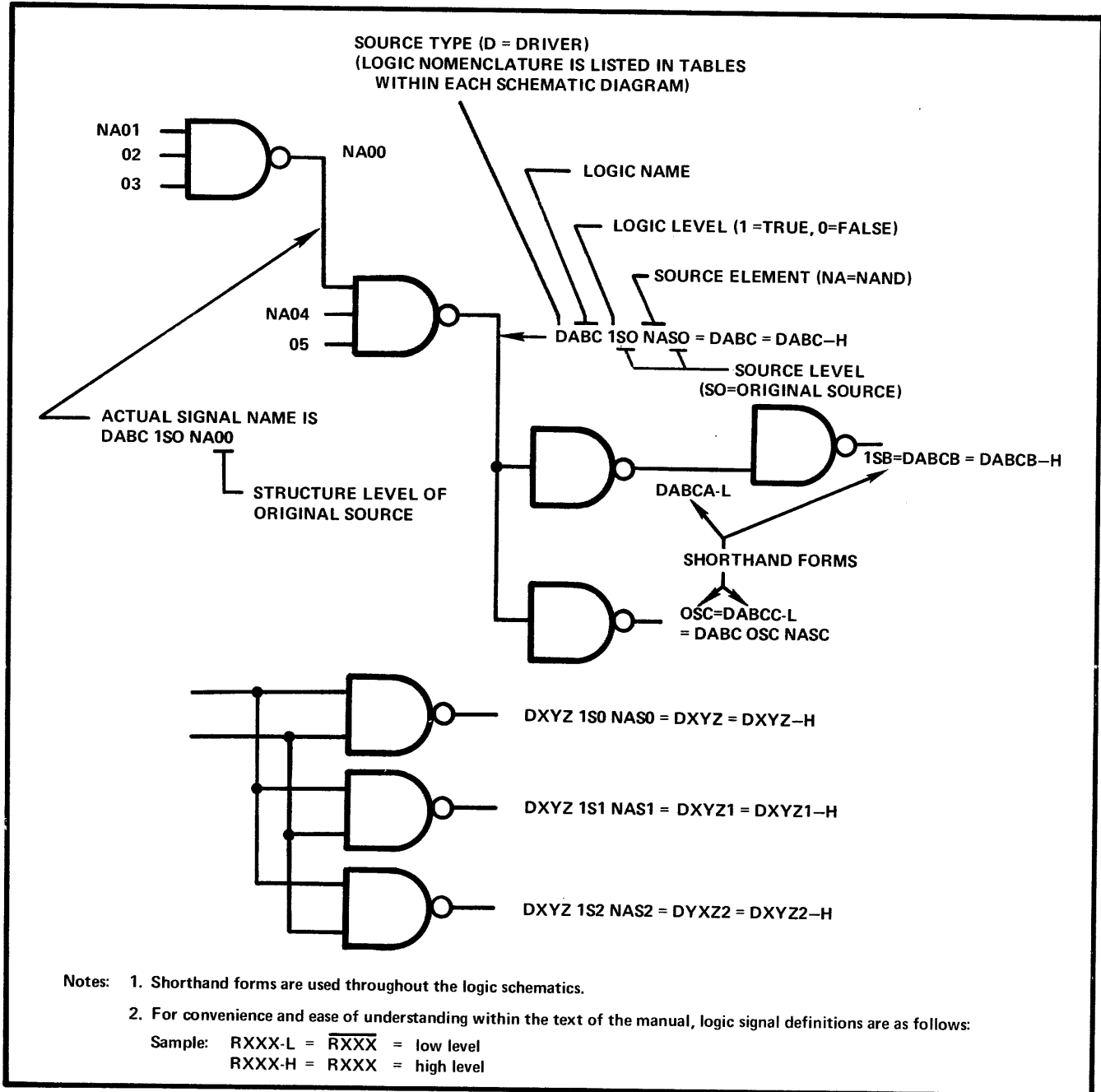


FIGURE 4-1  
LOGIC STRUCTURE AND NOMENCLATURE



# Series 6000 DISK DRIVE

## 4.2 PWB Locations

The Series 6000 electronics module contains four (4) Printed Wire Boards, which plug into a backpanel assembly located at the rear of the unit (See Fig. 9-1).

PWB location is as follows:

<u>Slot A1</u>	<u>VFO, Sector Counter PWB</u>
<u>Slot A2</u>	<u>Control PWB</u>
<u>Slot A3</u>	<u>Servo PWB</u>
<u>Slot A4</u>	<u>Data PWB</u>

A fifth PWB (Motor Control) is located on the drive motor assembly.

A sixth PWB (5-Volt Regulator) is located on the power supply assembly.

## 4.3 PWB Module Circuit Functions

### 1. VFO, Sector Counter PWB (Ref. Fig. 9-5, Sh. 1, 2 & 3)

This PWB contains the following circuits:

- VFO (variable frequency oscillator) circuit. The basic VFO circuit "locks" onto the frequency of the incoming raw data. The incoming data is then delayed and compared to a VFO flip-flop for decoding the raw input signal into data "ones" and a data "clock".
- This PWB also contains the Sector/Index decode electronics, sector counters, and other miscellaneous functions.
- To avoid a CE alignment when replacing this PWB, R84 should be set per Section 6.3.5, Circumferential Head Alignment Procedure.

### 2. Control PWB (Ref. Fig. 9-7, Sh. 1, 2 & 3)

This PWB contains the following circuits:

- Disk speed monitoring logic
- Head load logic
- Write protect logic
- Emergency unload logic
- Normal load and unload logic
- Illegal address logic
- Position address strobe logic
- Motor control logic
- No field adjustments are required when replacing this PWB.

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### 3. Servo PWB (Ref. Fig. 9-6, Sh. 1, 2 & 3)

This PWB contains the following circuits:

- Position demand address register
- Current position address register
- Difference logic (difference between demand and current address)
- Positioner velocity reference logic
- All analog electronics necessary for positioner servo operation
- On replacing this PWB, potentiometers must be set per Section 6.4, Servo Checks and Adjustments.

### 4. Data PWB (Ref. Fig. 9-4, Sh. 1 & 2)

This PWB contains all the electronics necessary for read/write operation, including:

- Write logic and drivers
- Erase circuits
- Head Decode and switching circuits
- Read amplifier and data decode circuits
- No field adjustments are required when replacing this PWB.

### 5. Motor Control PWB (Ref. Fig. 9-10, Sh. 1 & 2)

- This PWB contains all circuits necessary to transform the drive motor control signals from the Control PWB into signals for control of the AC spindle drive motor.
- No Field adjustments are required when replacing this PWB.

### 6. 5-Volt Regulator PWB (Ref. Fig. 9-9, Sh. 1 & 2)

- This PWB contains the +5 VDC regulator and over-current protection circuits.
- On replacing this PWB, the regulator must be set to 5.0 VDC (at back-panel) by adjusting the regulator potentiometer on the PWB.

## 4.4 Functional Logic and Circuit Descriptions

### 4.4.1 Unit Select Logic (Ref. Fig. 9-1 and 9-2)

The following flow chart (Fig. 4-2) illustrates the Unit Select sequence. The transmitted and received signals apply to the standard Series 6000 interface (See Section 3.3.5).

# Series 6000 DISK DRIVE

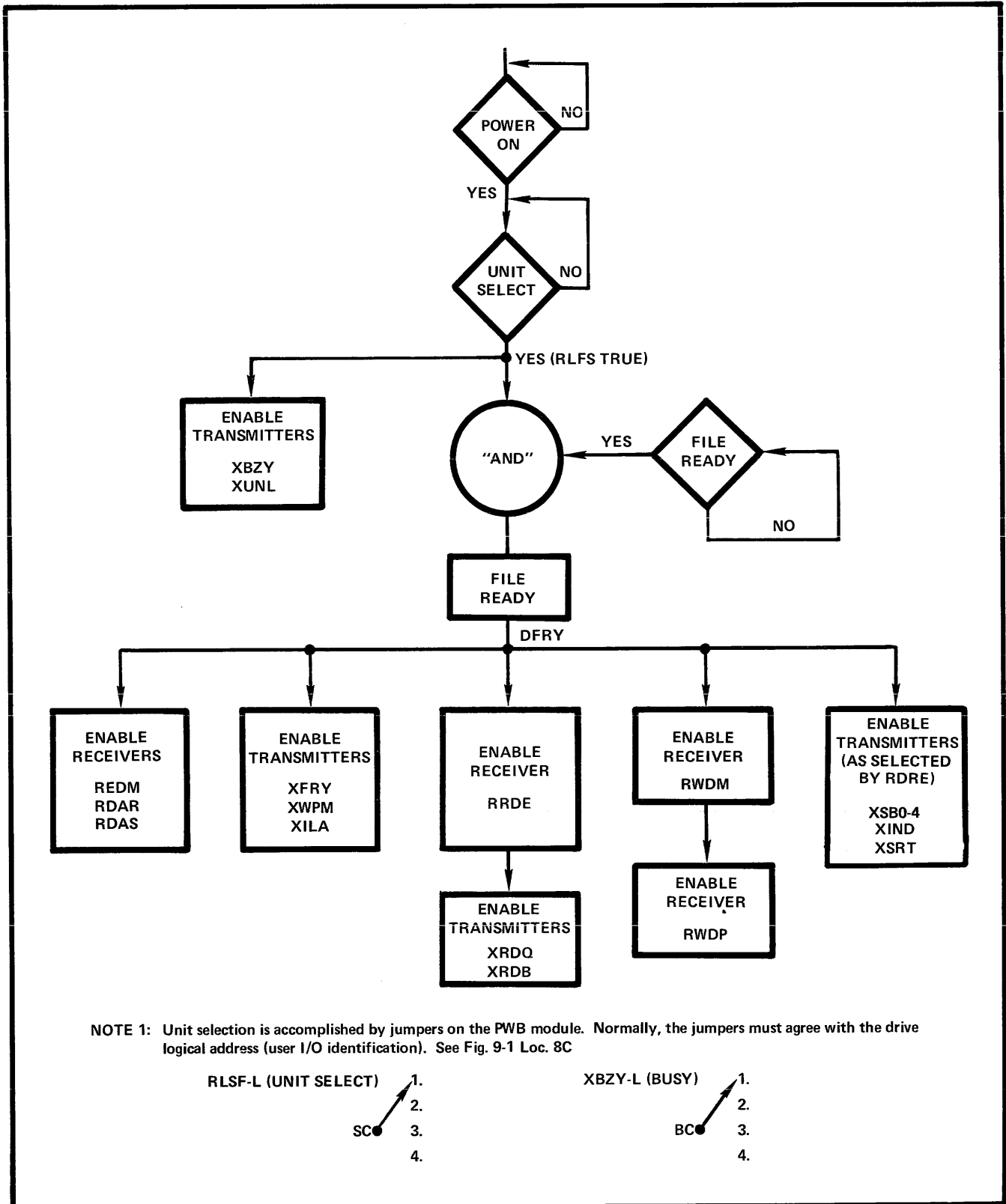


FIGURE 4-2  
UNIT SELECT FLOW CHART

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### 4.4.2 Load and Unload Sequence Flowchart

The following flowcharts (Fig's. 4-3 and 4-4) illustrate the disk unit Load and Unload sequence. See Section 4.4.3 for detailed circuit description.

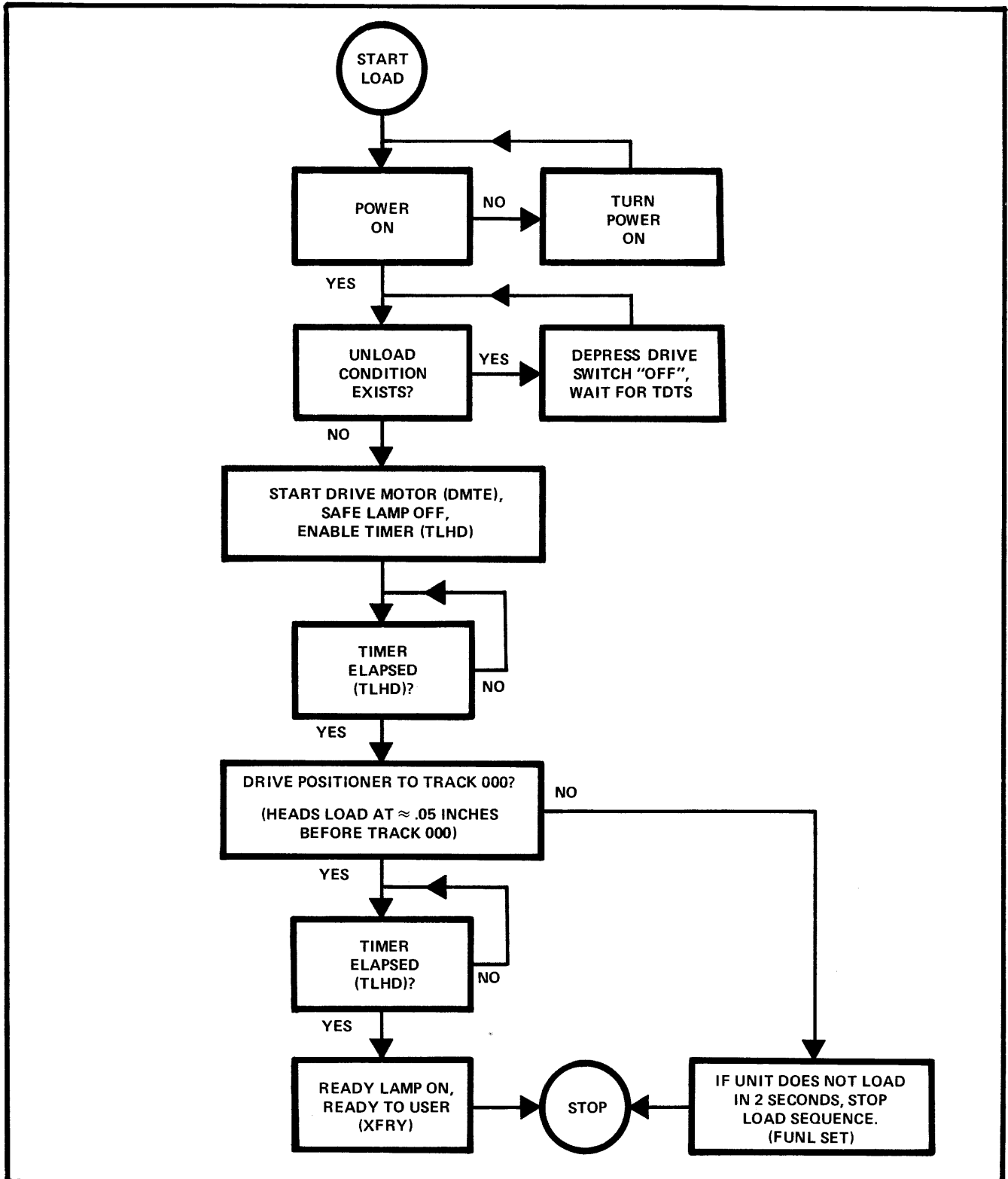


FIGURE 4-3  
LOAD SEQUENCE FLOWCHART

# Series 6000 DISK DRIVE

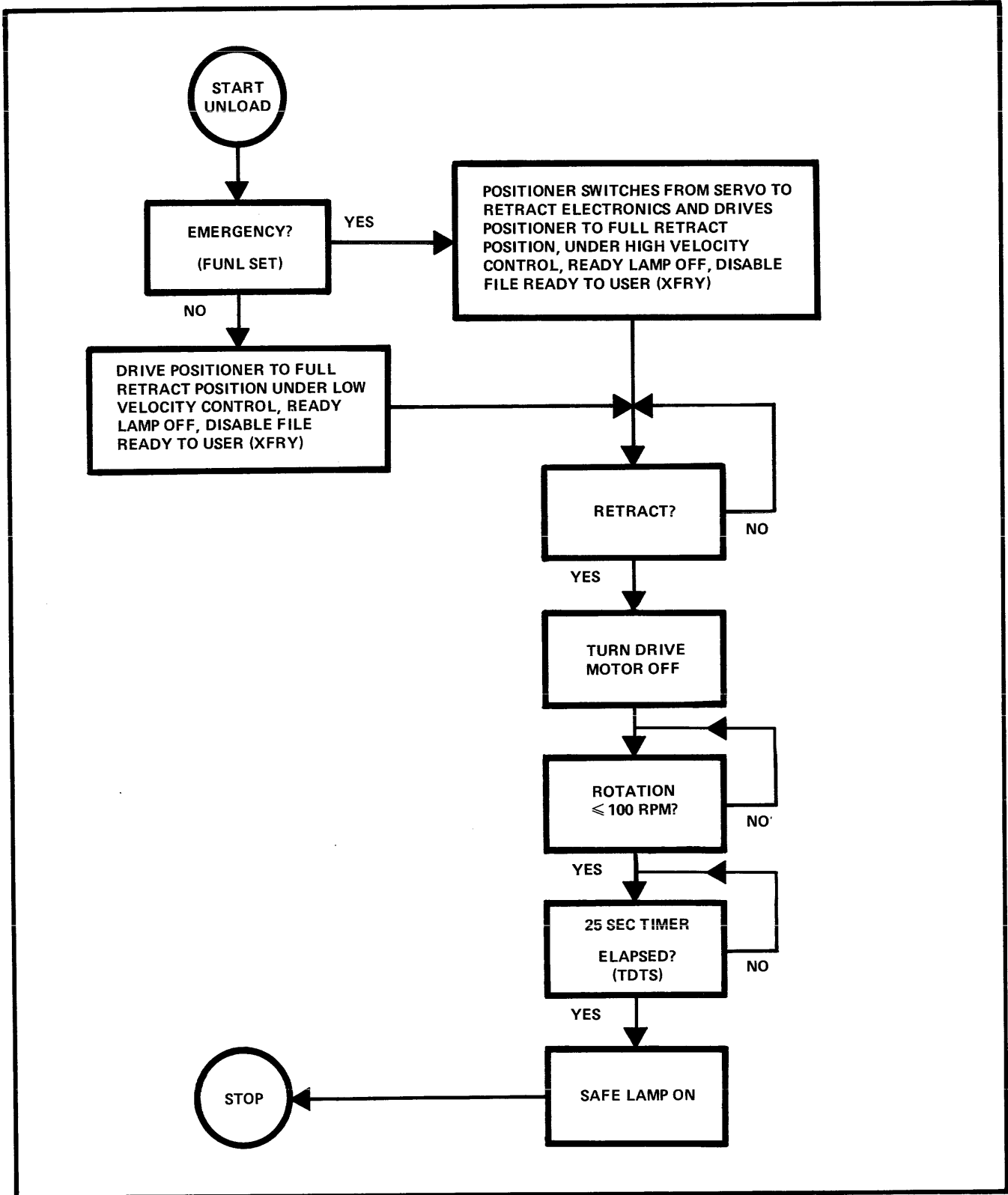


FIGURE 4-4  
UNLOAD SEQUENCE FLOWCHART

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### 4.4.3 Unload (Normal and Emergency)

See Figures 4-3 and 4-4

1. Normal Unload (FSLD set, Control PWB; Fig. 9-7, Sh. 3, Loc. 10E; and SULTS-L, Control PWB; Fig. 9-7, Sh. 2, Loc. 11E)

When the "Disk Drive" switch is depressed "Off" (Unload Switch SULTS-L goes false), and if the unit is not in an Erase Mode (DEDM-L is true) then the Load Latch FLDL is reset to start the normal velocity unload sequence.

A normal velocity unload condition can also be generated by I/O control. That is, FSLD (Stop Load) can be set by RULC-L (Unload Control) going false from the user in the event of a detected emergency condition. FSLD-L (Stop Load) holds the Load Latch (FLDL) reset.

Data loss can be expected if the user is in a write mode. The Unload Control line (RULC-L) is normally used for a user emergency power down condition when control of interface lines becomes marginal. FSLD can be reset by initiating a power-up sequence or by depressing the "Disk Drive" switch "OFF". After FSLD is reset, the unit can be loaded again by moving the "Disk Drive" switch to the "ON" position.

2. Emergency Unload (FUNL set, Control PWB; Fig. 9-7, Sh. 2, Loc. 7F)

Should an emergency unload condition be detected, then FUNL is set. FUNL can be reset by SULTS-L ("Disk Drive" switch depressed "OFF") "AND" TDTS-H (Down to Speed Pulse) both being true, "OR" by the power on reset FPOR-H "AND" TDTS-H both being true. FUNLA-H disables the relay on the Servo PWB, to allow switching in the emergency retract circuits. The emergency conditions are as follows:

- PPOR-L sets FUNL. PPOR-L goes low on a 5 volt supply voltage loss.
- If the Heads-Up switch (SHSU-L is true) indicates the heads are not retracted, and the disk is not up to speed (DUTS-L is true), then FUNL is set by FUNL NA02.
- If a normal seek operation continues for more than 100 milliseconds, FUNL is set. QDAQ-L (Demand Address Clock) triggers TBZC (Busy Check, 100 ms one-shot). If DLSL-L (Lock Servo Loop) "AND" DDAR-L (Demand Address Reset) are both true at the end of the 100 millisecond time period, then FUNL NA05 sets FUNL.

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- If the heads are not loaded within two (2) seconds after FLHD-H (Load Heads) goes true, FLDH-H "AND" FFWS-H (Forward Slow) generates FUNL NA01 to set FUNL. The two (2) second time out is accomplished by FLDH-H "AND" FFWS-H, enabling the unijunction Q5.
- The position transducer scale has an index area on each end of the scale. When the positioner is between these extremes, DPTI-L (Position Transducer Index) is true. In the retract position, DPTI-L is true, however, this is not significant. FPTE is normally held reset by FRVSA-L. FRVS is set by an unload condition (FLHD-H is false) or by address initialize (DADI-L is false, Restore Command). A restore command requires usage of the index area for relocating the positioner to track 000. Normally, when the unit is loaded and FRVS-H goes false, the reset to FPTE (Position Transducer Enable) is removed. At this point, the positioner will move forward into the valid range of the transducer scale. At this time, DPTIA-H (Position Transducer Index) goes false to set FPTE. If FPTE is set and DPTIA-H goes true again (in normal operation, then FPTE-H "AND" DPTIA-H generates FUNL NA04 to set FUNL.
- If the heads exceed a velocity of 90 inches per second, then DUDQ-H (Up-Down Clock) "AND" TMVC-H (Maximum Velocity Check) generates FUNL NA03. TMVC is a retriggerable one-shot which is triggered by DUDQ-H.
- If the motor is enabled (DMTEC-H), and the pack switch is not made (SLID-H true, disk not properly in place, for example), then the 300 millisecond unijunction Q7 times out to generate FUNL NA06 which sets FUNL. Normally, the pack interlock solenoid (top load), or door lock solenoid (front load) is disabled by DMTEA-H which will normally cause SLID-H to go false within 100 milliseconds of the start of a load sequence.

Note: Late revision Control PWB's (Rev. "L" or later) contain five (5) LED's (Ref. Fig. 9-7, Sh. 2, Loc. 10E) which will indicate one of five conditions which can cause FUNL to set. The latched indicators are for FUNL NA01, 2, 4, 5 and 6. FUNL NA03 does not have an indicator. The LED's can only be reset by SULS-L being false (when not in the Erase Mode; i.e., REDMA-H is false) "AND" TDTS-H being true, "OR" by FROR-H "AND" TDTS-H being both true. This means that approximately 25 seconds after "Power On", the LED latches will be reset, or if the "Disk Drive" switch is in the "OFF" position (SULS-L is true) and a TDTS pulse occurs (once every 25 seconds), then the LED latches will reset. If a malfunction occurs, only one LED should be "ON", i.e., the first LED latch to be set disables the remaining LED latches. The front panel "Disk Drive" switch will be "ON", the "Disk Drive" lamp "ON" , and the "Ready" lamp "OFF" as a result of the malfunction.

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### 4.4.4 Positioner Operation

The moving part (head carriage) of the positioner assembly is composed of a voice coil, velocity transducer magnet, position transducer scale, and read/write heads. The stationery part is composed of voice coil magnets, velocity transducer coil, and position transducer photo-cell read head.

The voice coil has an approximate travel range of 3-1/2 inches, of which, the normal on-line (data area) positioning range is approximately two (2) inches (heads loaded). The heads unloaded, or retracted range is about 1-1/2 inches. The full retract position is defined as when the voice coil is approximately 1/8 inch from its full reverse travel limit. The retract range is detected by the Heads-Up switch (SHSU-H is true).

The velocity transducer coil generates an output of approximately 60 mv-per-inch-per second and is used to control positioner travel velocity.

The position transducer read head is composed of five (5) photodiodes, which are used to generate the position transducer index (DPTI-L), the X + 0° position phase (2 cells), and the X + 90° position phase (2 cells). See Figure 9-1, Location 2E for implementation. Detailed positioner operating theory is discussed in the following sections.

Note: Electrically, the 100 TPI and 200 TPI units function identically. The 200 TPI unit, however, has a thermistor mounted on the positioner assembly to temperature compensate the servo as a function of position. Jumpers on the Servo PWB allow the positioner to move two (2) "200 TPI" tracks to generate one (1) "100 TPI" track. See Figure 9-6, Sh. 1, Loc. 10G, Servo PWB, for jumper information.

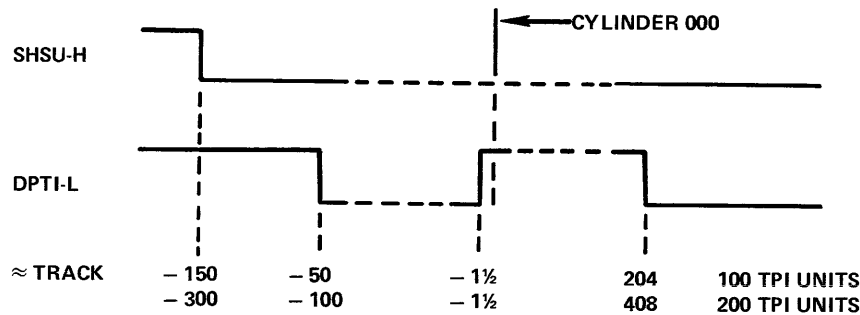
Mechanically, 200 TPI units use heads with a smaller read/write gap due to the higher track density.

### 4.4.5 Heads-Up and Position Transducer Index Signal

The Heads-Up (SHSU-H) and Position Transducer Index (DPTI-L) signals are shown below (Ref. Fig. 9-6, Sh. 3, Loc. 5D and 8B)



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The above timing assumes the positioner is moved forward from the full retract position at a constant velocity.

#### 4.4.6 Servo Load Operation (Ref. Fig's. 9-7, Control PWB; 9-6, Servo PWB; and 9-3, Servo Flow Diagram)

Refer to Section 4.4.2 for general load sequence.

In the unloaded state, FLHD-H (Load Heads) holds FRVS (Reverse Slow) set. When FLHD-H becomes true during the load sequence, FRVS will reset. This causes the voice coil to move forward from retract position (SHSU-H goes false) -- under velocity control -- at approximately 1-1/2 inches per second. DPTIA-H (Position Transducer Index) will go from true to false to set FPTE. FFWS (Forward Slow) is then reset by DUDQ-H "AND" FPTE-H -- allowing normal servo operation.

Normal servo operation entails the use of two (2) registers. One register is the Demand Address register (FDAH, FDAO-7; See Fig. 9-6, Sh. 2, Loc. 8F), which is held reset during the load operation by DDAR-L (Demand Address Reset), where DDAR-L is generated (goes false) by FFWS-L "OR" FRVS-L being false.

The other register (FCAH and FCAO-7; See Fig. 9-6, Sh. 2 Loc. 10C) is a nine (9) bit, current address, up/down counter. This counter will roll over from all one's to all zero's to give the servo its home address (track 000) at approximately 1-1/2 tracks from the index. This occurs when DDAR-L goes true to start normal servo

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operation. Refer to Section 4.4.8, Seek Command Logic and Figure 4-5, Load Operation Timing Description.

### 4.4.7 Servo Unload Operation (Ref. Fig's. 9-7, Control PWB; 9-6, Servo PWB; and 9-3, Servo Flow Diagram)

When the unit is unloaded, FLHD (Load Heads) will reset. FLHD-H then sets FRVS (Reverse Slow). This condition causes the positioner to move in the reverse direction -- under velocity control (approximately 1-1/2 inches per second) -- until SHSU-H (Heads Up) goes true. SHSU-H reduced voice coil power by turning Q12 "ON". Refer to Figure 9-6, Sh. 3, Loc. 4A.

### 4.4.8 Seek Command Logic - RDAS, Demand Address Set (Ref. Fig's. 9-7, Control PWB; 9-6, Servo PWB; 9-3, Servo Flow Diagram; and 4-6, Timing Diagram)

After the unit is Selected and goes Ready, a Seek Command from the user (RDAS-L, Demand Address Strobe; see Fig. 9-7, Sh. 3, Loc. 11D) will be accepted. This negative pulse (RDAS-L) will be between 900 nanoseconds and 3 microseconds wide, and is used to trigger a 10 microsecond one-shot (TVAE, Valid Address Enable). DFRYA-H "AND" the trailing edge of RDASA-H trigger TVAQ (Valid Address Clock). This trailing edge, 60 nanosecond pulse, will allow the Demand Address Register (FDAH, FDAO- 7; See Fig. 9-6, Sh. 2, Loc. 8F) to be loaded (QDAQ-H) with the new track address (RDA0-8-L) from the user, provided there is a valid address (less than 203, D203-L is true) and the servo is not busy (DBZY-L is true). If an invalid address prevails, then FILA (Illegal Address) is set. If FILA is set, then QDAQ-H will be disabled. FILA-H "AND" DFRY-H, both being true, generate the Illegal Address signal (XILA-L goes false), which is sent to the user.

A new valid address received will be compared with the old (current) address held in the Up/Down counter (FCAH-FCA0-7, Current Address; See Fig. 9-6, Sh. 2, Loc. 7C). A nine (9) bit subtractor generates the difference DDFH-L, DDF0-7-L; See Fig. 9-6, Sh. 2, Loc. 6C) for generation of the positioner velocity reference. The new difference causes DLSL-L (Lock Servo Loop) to go true. Twelve (12) decodes are generated from the difference, and are used as inputs to a D/A converter. The D/A converter generates a Velocity Reference (AVRF; See Fig. 9-6, Sh. 2, Loc. 1D) which approximates a square law curve as a function of distance. The polarity of the reference is controlled by the sign bit of the subtractor (DDFR-L, Difference Reverse), and the reference (AVRF) by the number of decodes that are "True".

The difference between the "reference" velocity and the "true" velocity (output of the velocity transducer -- See Fig. 9-1, Loc. 2E) is compared, and current is

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applied to the voice coil through a power driver as a function of this difference (See Fig. 9-1, Loc. 6G). Current feedback is used to limit the maximum coil current to six (6) amps (See Fig. 9-1, Loc. 6E).

Direction control is specified by DDFR-L (Difference Reverse). The servo will move according to this information and will generate signals (DPCL-L, Position Clock -- Ref. Fig. 9-1, Sh. 3, Loc. 7E, TP2; generated from X + 0 phase; and DDIR, Position Direction -- Ref. Fig. 9-6, Sh. 3, Loc. 6E, TP4; generated from the X + 90 phase) which will move the Up/Down counters in a direction such that the Up/Down counters will become equal to the Demand Address register. When the two registers are equal, the positioner is within one-half track of its final position.

When the positioner is within one-half track of its final position, DHFT-H (Half Track From Null) is true. DHFT-H "AND" DPCLC-H, both being true, now generates the servo direction control for the servo at distances of 1/2 to 1/4 track from the null, while DDRF-L generated direction control for differences greater than 1/2 track. Direction control is not needed from the logic when the positioner is within 1/4 track of null (DLSSL-L is false). When the positioner is within 1/4 track of its final position (DLSSL-L goes false), the velocity reference is zero and position loop is enabled. The analog X + 0 output is switched (Q2 on Servo PWB; See Fig. 9-6, Sh. 3, Loc. 9E) into the summing amplifier (IC41; See Fig. 9-6, Sh. 3, Loc. 6C) through a lead/lag network. This network controls the positioner velocity during settle-out in the control region, and therefore, the amount of settle-out overshoot. This network also helps achieve a very stiff position loop (approximately 8 pounds per mil) which is important for positioner accuracy. The position loop is active for  $\pm 1/4$  track around the null position. If the positioner should overshoot the null position, the Up/Down counters will count the number of tracks that the positioner overshoots and generate a corrective velocity reference to return the positioner to the correct null position.

Unit Busy, to the user, is generated by DLSSL-L "OR" TSTD-L "OR" TVAE-L being false. DLSSL-L going false triggers the settle-time one-shot (TSTD, Settle Time Delay). The timing diagram (Figure 4-6) helps to clarify the operation. It represents a repetitive single track 200 TPI move -- example: track 000 to 001, 001 to 000, etc.

#### 4.4.9 Restore Command -- RDAR, Demand Address Reset (Ref. Fig's. 9-7, Control PWB; 9-6, Servo PWB; and 9-3, Servo Flow Diagram)

If the unit is Selected and Ready (DFRYA-H is true), and Seek Command is received (RDAS-L, Demand Address Strobe; See Fig. 9-7, Sh. 3, Loc. 11D), then the

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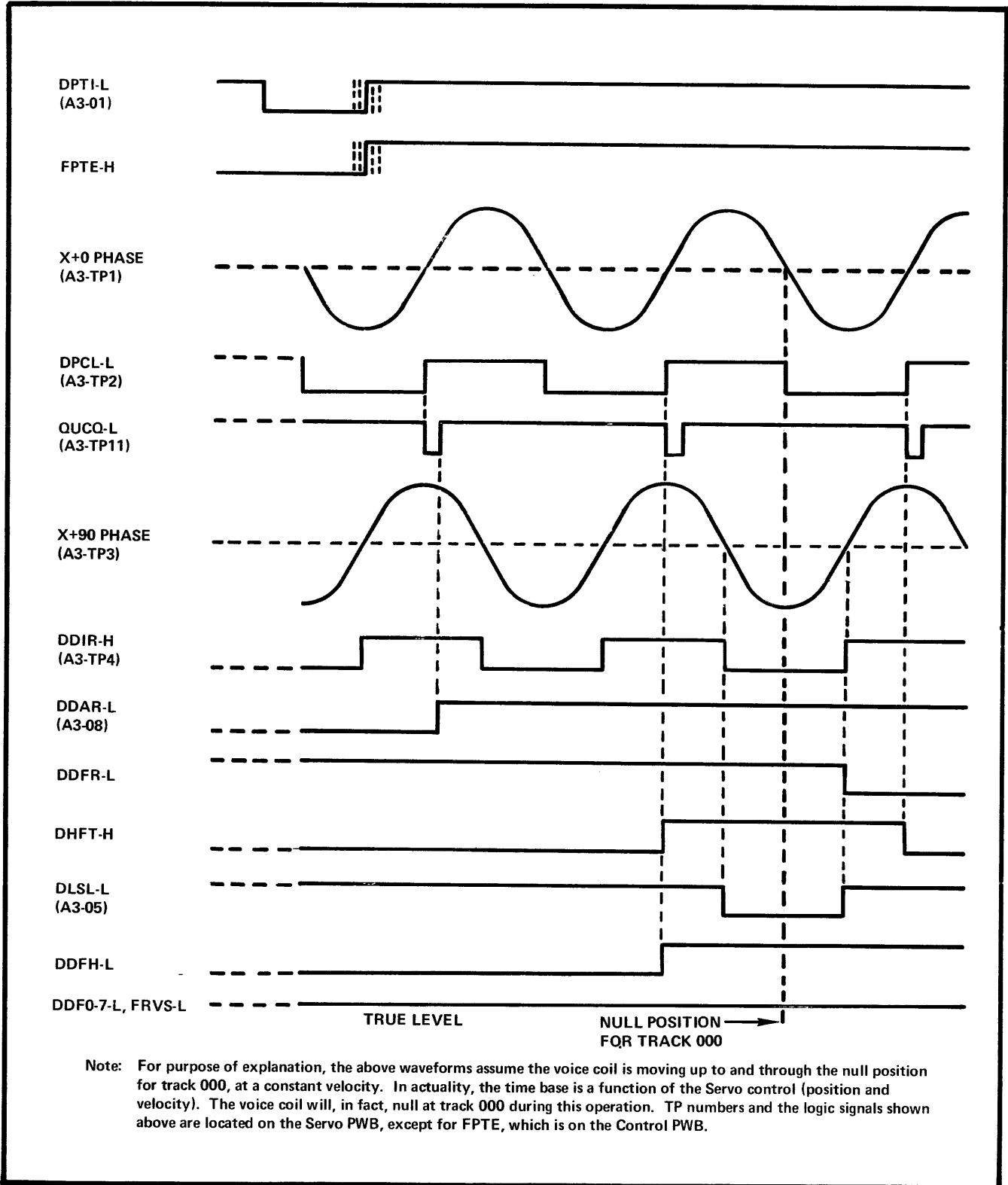
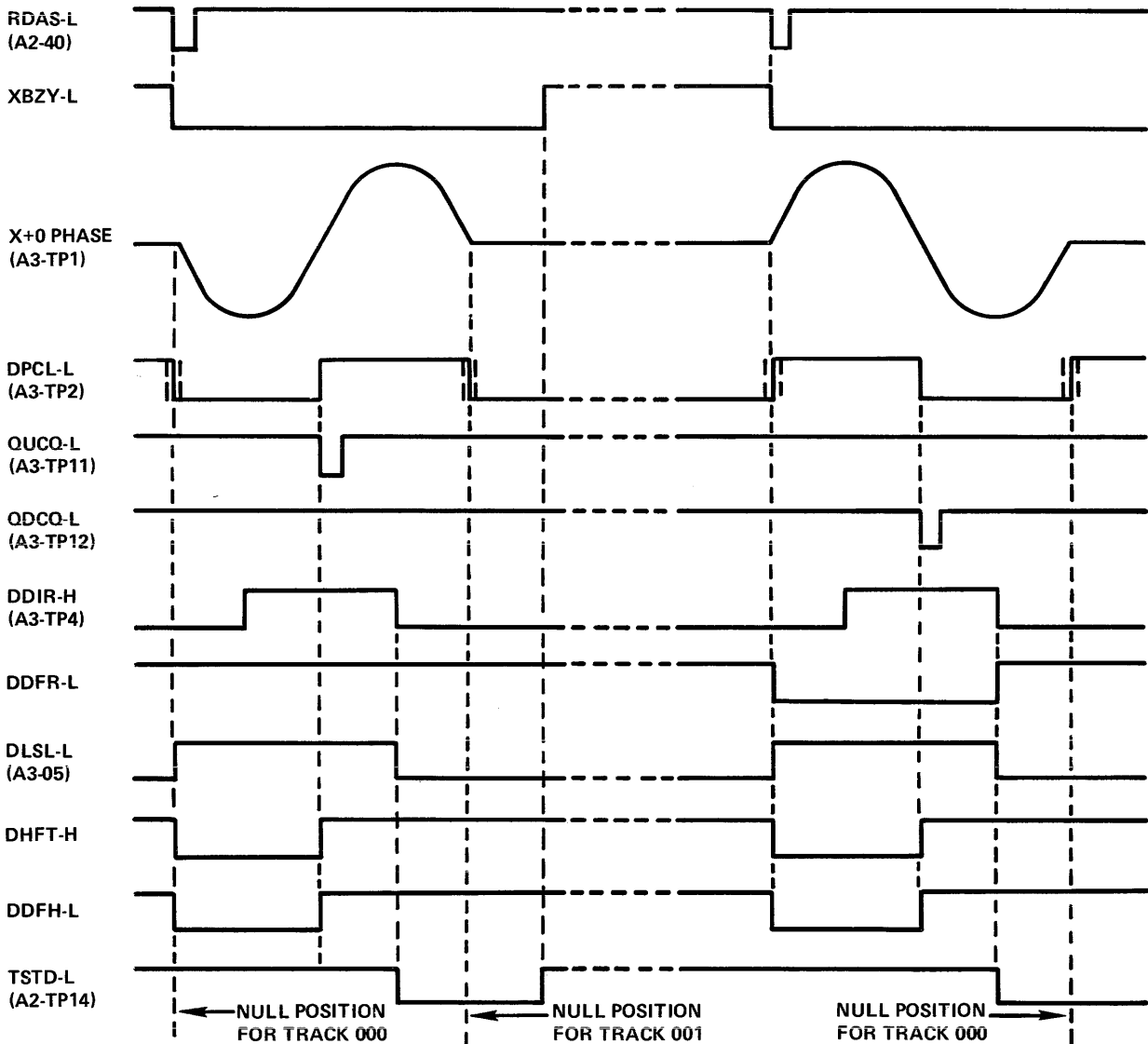


FIGURE 4-5  
LOAD OPERATION TIMING DIAGRAM

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Note: For purpose of explanation, the above waveforms assume the voice coil is moving at a constant velocity and nulls with no settle time ( $X + 0^\circ$  phase at TP1). In actuality the time base is a function of the servo control numbers and the (position and velocity) and there can be a small amount of overshoot. TP numbers and the logic signals shown above are located on the Servo PWB, except for TSTD, RDAS, and XBZY which are on the Control PWB.

FIGURE 4-6  
TIMING DIAGRAM, REPETITIVE SINGLE TRACK (200 TPI) SEEK

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10 microsecond Valid Address one-shot (TVAE) is triggered. RDAS-H "AND" DFRYA-H then trigger TVAQ. If the Restore Command signal (RDAR-L, Demand Address Reset) is present, then TVAQ-H "AND" RDAR-H, both being true, generate DADI-L (Address Initialize) and DADI-L sets FRVS (Reverse Slow). This causes the positioner to move in the reverse direction under velocity control (approx. 1-1/2 inches per second). When FRVS or FFWS (Forward Slow) is set, DDAR-L (Demand Address Reset) is false. DDAR-L, being false, will set the Up/Down counters and reset the Demand Address register. This will hold a difference of "one" in the servo difference lines (DDFH-L is false, DDFO-7-L are true; See Fig. 9-6, Sh. 2, Loc. 6C). When the index area is reached, DPTI-L (Position Transducer Index) goes false. DPTIA-H "AND" FRVS-H, both being true, will set FFWS (Forward Slow), which in turn resets FRVS. This causes the positioner to change direction and go forward, under velocity control, and null on track 000 as in the load operation (See Section 4.4.6). Unit Busy generation is identical to that of the normal seek operation (See Section 4.4.8). The unit can be Busy (XBZY-L is false) for up to two (2) seconds in the Restore Mode.

#### 4.4.10 Emergency Servo Control (Ref. Fig. 9-6, Servo PWB)

If an emergency unload condition should be detected (FUNL set, See Section 4.4.3, or a voltage loss is detected by Q13, 15 or 19 on the Servo PWB; See Fig. 9-6, Sh. 3, Loc. 3F) a relay on the Servo PWB switches out the main servo control loop (K1-N0 on the Servo PWB; See Fig. 9-6, Sh. 3, Loc. 1C) and switches in an auxiliary control loop thru K1-NC. The true velocity (IC38, pin 3) is compared with a fixed reference (IC38, pin 2) and current is applied directly to the voice coil by one power transistor (through CR36). The velocity during emergency unload is approximately 10 inches per second. When the Heads-Up switch (SHSU-H goes true) is reached (1/8 inch from full retract), power is removed from the positioner and the positioner will come to a stop, fully retracted.

#### 4.4.11 100-TPI/200-TPI Comparisons (Ref. Fig's. 4-7)

There have been two different positioners employed in Series 6000 Disk Drives. Very early drives were 100-TPI units and the corresponding 100 TPI positioners are no longer used (obsolete). Later drives were constructed to handle both 100-TPI and 200-TPI requirements with a 200 TPI type positioner.

The major difference between the two positioners is the physical spacing of the markings on the glass scale. This difference results in signals produced (X + 0 and X + 90) that represent 10 mils/cycle on a 100-TPI positioner, but only 5 mils/cycle on a 200-TPI positioner. Refer to Fig. 4-7. Jumpers on the Servo PWB

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(Ref. Fig. 9-6, Sh. 1, Loc. 10G) determines whether the 200 TPI positioner functions in the 100 TPI or 200 TPI mode.

Other changes necessary when operating a drive at 200-TPI are: use of read/write heads with a smaller gap; and the use of thermistor mounted on the positioner assembly to temperature compensate the servo as a function of temperature and position.

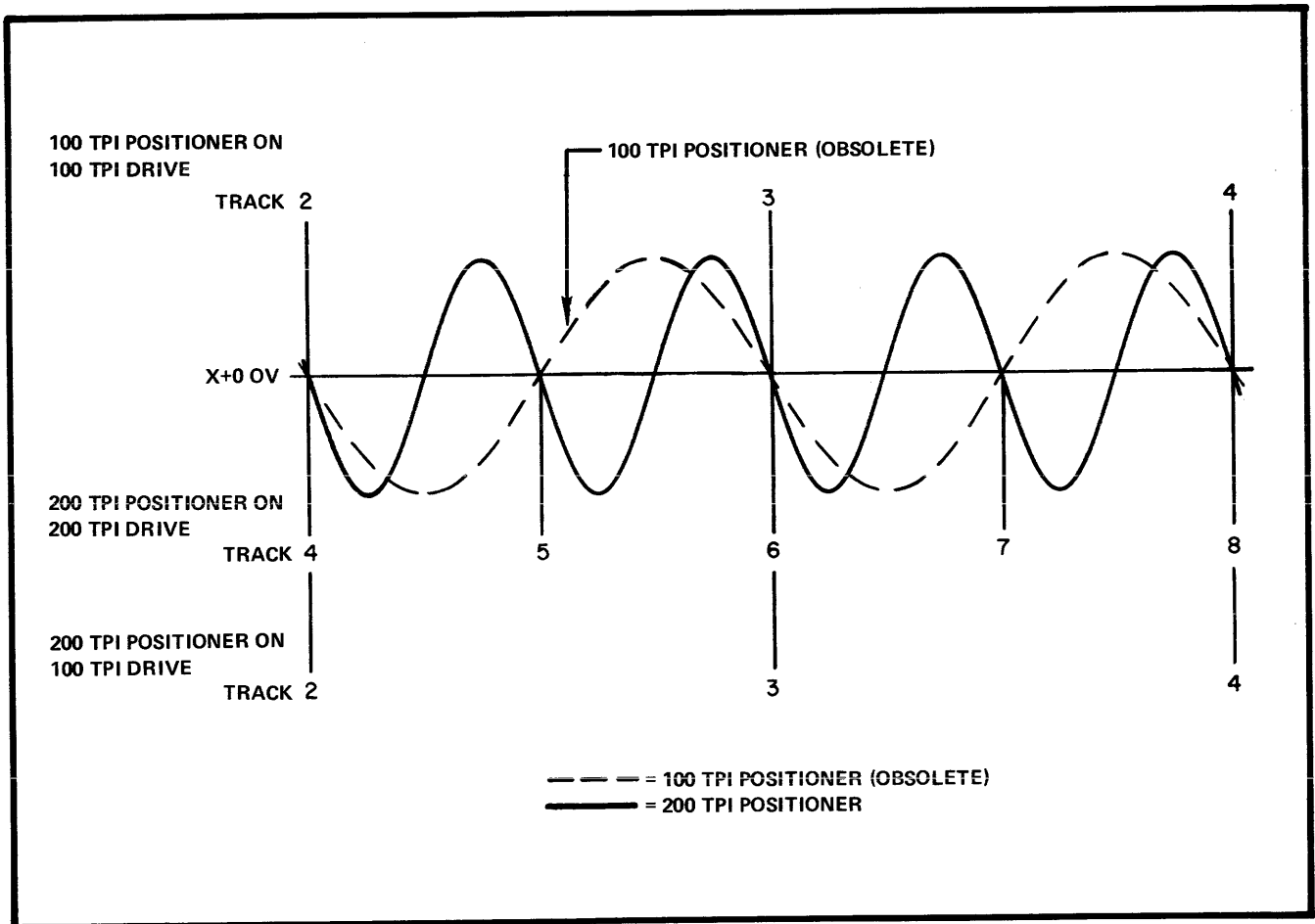


FIGURE 4-7  
100-TPI/200-TPI POSITIONER COMPARISON

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### 4.4.12 Disk Speed Monitoring (Ref. Fig's. 4-8, 4-9 and 9-7, Control PWB)

Since there is no speed control associated with 1500 RPM, 60 Hz drives, up-to-speed is monitored by a one-shot circuit (IC41 on Control PWB; See Fig. 9-7, Sh.2, Loc. 5B), which checks the interval between index pulses to determine if the disk is above 1100 RPM  $\pm$  22 percent. If not, DUTS-L (See Fig. 9-7, Sh. 2, Loc. 4B) goes true and sets FUNL by way of NA02 (if SHSU-L is true, i.e., heads are not retracted).

If the drive operates on 50 Hz power, or rotates at 2400 RPM, then a much more comprehensive speed control circuit is utilized. In this circuit, a crystal oscillator (Q1 and Q2 on Control PWB, See Fig. 9-7, Sh. 2, Loc. 11B) is used to increment a counter circuit. This counter is reset by each index pulse; thus, the count present when the next index pulse arrives, indicates the speed of rotation. Two speed points are of importance, the first being at 89 percent of desired rotation speed, and the second being 100 percent of desired rotation speed. The spindle drive motor is capable of rotation the disk approximately 10 percent over speed. The speed control circuits control the motor speed by the amount of power applied to the motor.

Up-to-speed is determined by checking bits 14 and 17 of the counter. If both bits are "true" (count - 147456), the motor speed is less than 89 percent, in which case, further incrementing of the counter is blocked (DSQC-L is false) and DUTS-L goes true and sets FUNL by way of NA02.

Normally, when the motor is up to speed, speed control is accomplished by checking bit 17 at index time. FMTE will be set if bit 17 is "true", motor speed is below 2400 (1500) RPM and full power is applied to the motor thru DMTO-H being true (See Fig. 9-7, Sh. 2, Loc. 4C). The motor speed then increases until bit 17 fails to be "true" before arrival of the next index. Motor power is then reduced, causing the disk to slow down.

Note: Partial power is always provided thru DMTEB being true (Motor Enable: See Fig. 9-7, Sh. 2, Loc. 3E) when the motor logic is enabled (DMTE, true).

### 4.4.13 Sector/Index Logic (Ref. Fig's. 4-10 and 9-5, VFO PWB)

Figure 4-10, Sector/Index Logic Flow, illustrates logic flow and timing for the disk unit Sector and Index functions.



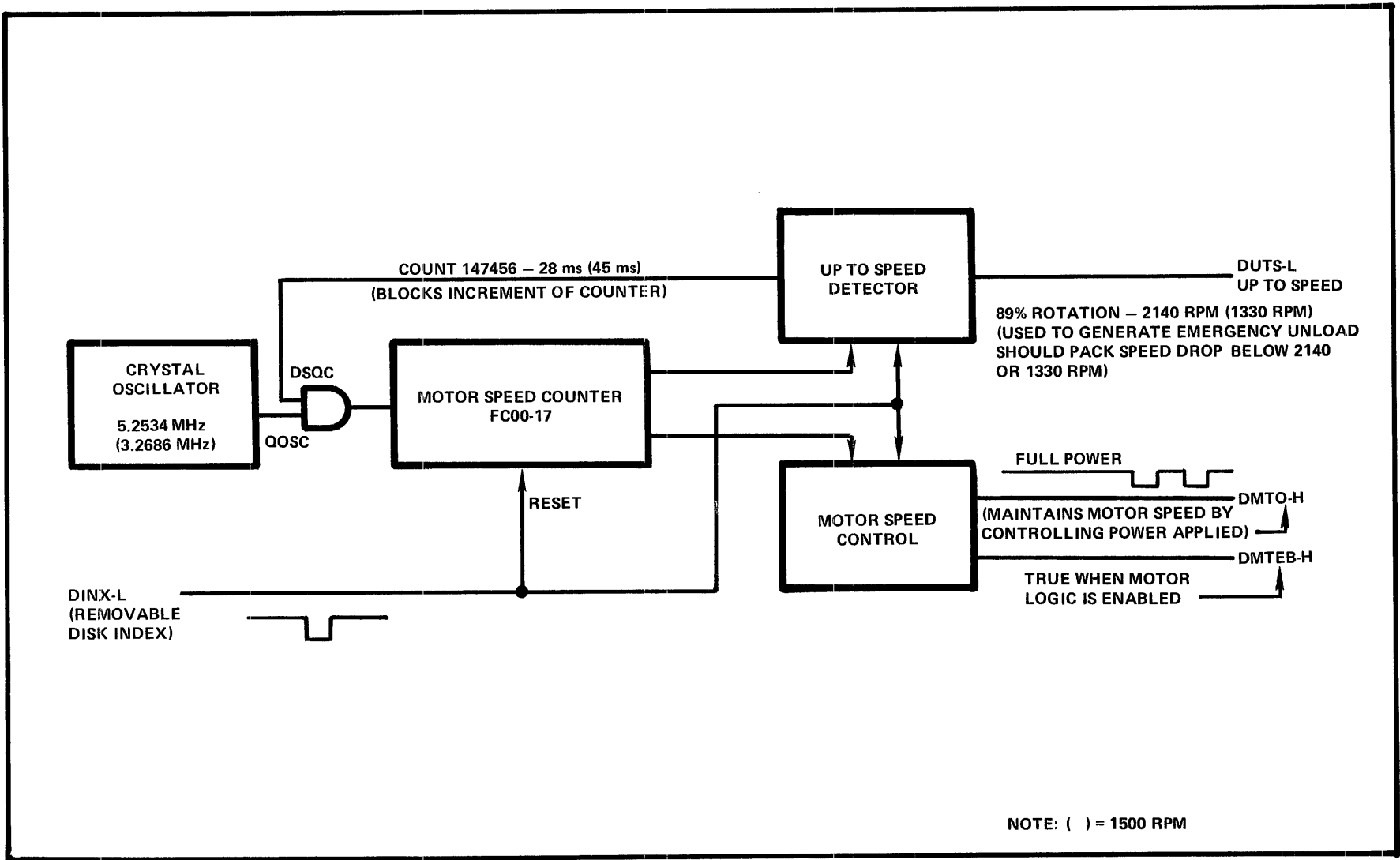


FIGURE 4-8  
DISK SPEED MONITORING  
50 Hz OR 2400 RPM

# Series 6000 DISK DRIVE

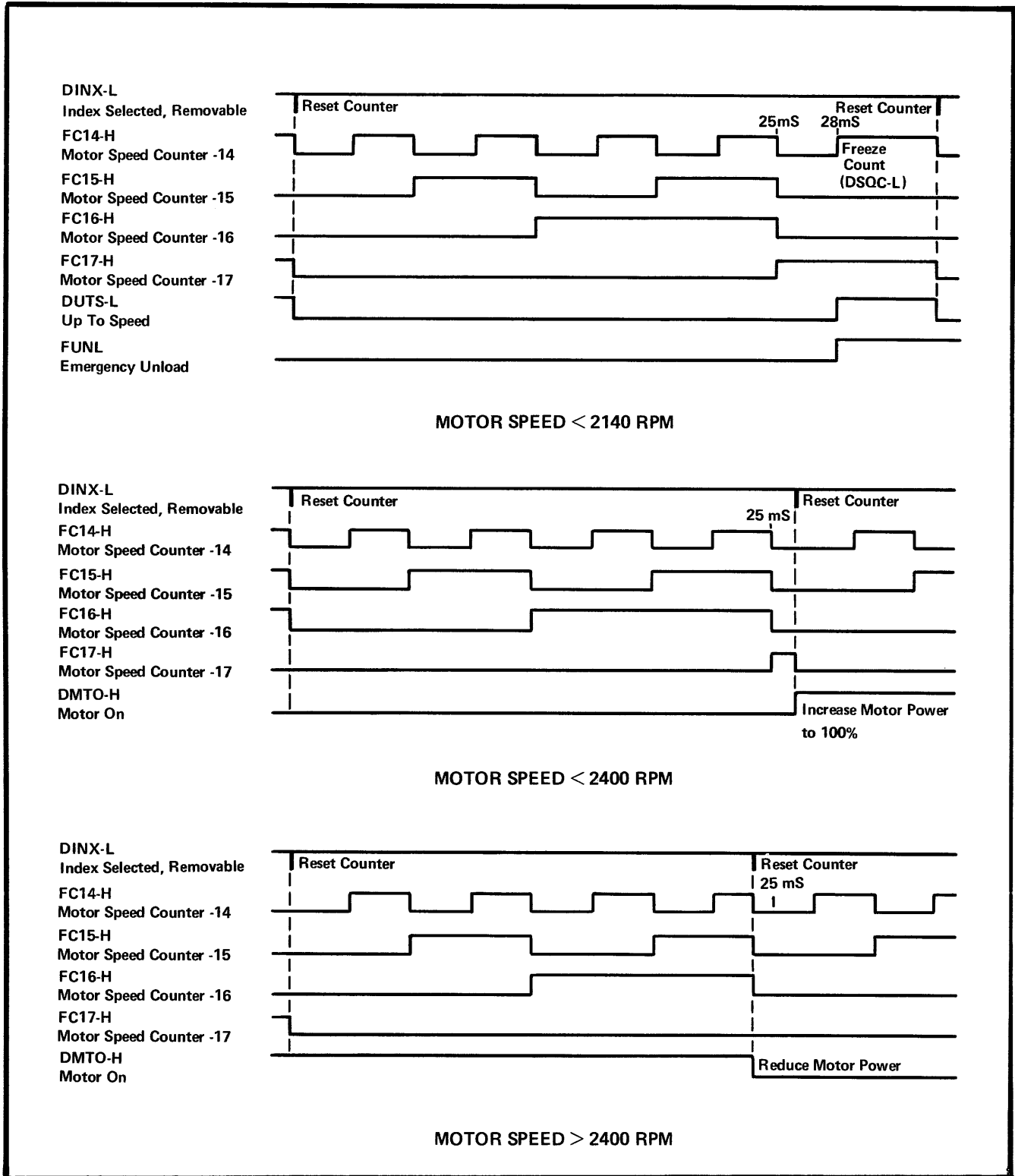
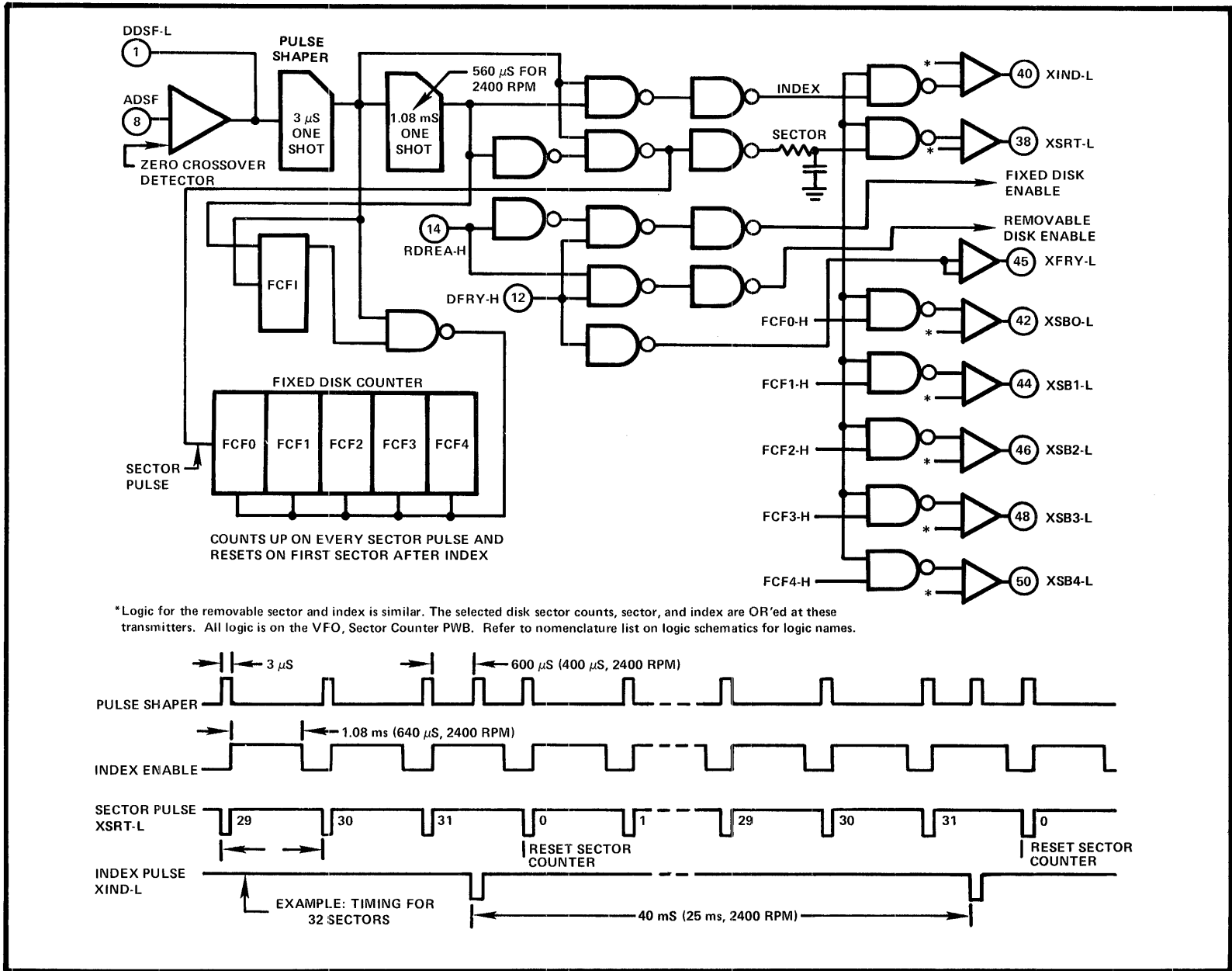


FIGURE 4-9  
DISK SPEED MONITORING, TIMING (EXAMPLE: 2400 RPM)



SECTOR, INDEX LOGIC FLOW  
FIGURE 4-10

# Series 6000

## DISK DRIVE

### 4.5 Read/Write Description (Ref. Fig's. 4-11, Head, Disk Selection and Data Flow; 4-12, Read/Write Data Conversion; and 9-4, Data PWB

#### 4.5.1 Head and Disk Selection

Selection is accomplished by signals from the user system and circuits (diode matrix) in the disk drive unit (See Fig. 9-4, Sh. 2, Loc. 7D). Heads are numbered 0 thru 3, top to bottom. Head 0 and 1 are on the top disk, 2 and 3 are on the bottom (fixed) disk.

The user I/O signal Head Select 0 (RHSO-L) allows selection of either a top or bottom head on the "Selected" disk. The user I/O signal Removable Disk Enable (RDRE-L) allows selection of either the top or bottom disk.

As an example, to select head 3, RHSO-L "AND" RDRE-L must be true -- thereby enabling Q16 (Fig. 9-4, Sh. 2, Loc. 8B) which selects the center tap on head 3 (Fig. 9-4, Sh. 2, Loc. 6C). Head 3's center tap is now at +5 volts while the remaining heads (0, 1 and 2) are at a negative voltage. Head 3 windings are now enabled for either a read or write operation.

#### 4.5.2 Write Circuits

Double frequency write data is received from the user by way of the Write Data Pulse (RWDP-L) line. The writing process is under complete control of the Data PWB. The drive is conditioned to write (if Ready and Selected) when the Write Data Mode (DWDM-L) and the Erase Data Mode (DEDM-L) signals are both false.

When the above conditions are true, the write amplifier is enabled to receive Write Data Pulses (RWDP-L). It should be noted that when in a Write Data Mode (DWDM-L is false) current immediately starts flowing through the head "write coil" -- erasing previously recorded data, even though no Write Data Pulses are being transmitted.

The double frequency Write Data Pulses (RWDP-L) are received from the user I/O and presented to the Write Amplifier JK flip-flop (IC7, Fig. 9-4, Sh. 2, Loc. 10E). The write JK toggles with each pulse to provide high/low outputs to the write drivers. With each toggle of the write JK, current flows in alternate halves of the read/write coil as controlled by Q11 and Q12 (Fig. 9-4, Sh. 2, Loc. 8E). The switching of write current causes magnetic flux reversals on the disk surface. When in the Erase Mode (DEDM-L is false), a current flows through the erase windings as controlled by Q6 (Fig. 9-4, Sh. 2, Loc. 9D) -- providing a tunnel erase effect. The tunnel erase serves to erase a narrow band on each side of the track, resulting in sharply defined data track with no cross-talk between tracks.

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## 4.5.3 Write Check Circuits

In order to assist in preventing the writing of erroneous information on a disk, due to a drive or controller failure, various checks have been incorporated on Revision J or later Data PWB's (Ref. Fig. 9-4). Items checked include: (write current without erase current, erase current without write current, and multiple heads selected.) *Illegal condition*

The erase/write current check is performed as follows: When there is no write current, Q23 (Ref. Fig. 9-4, Sh. 2, Loc. 8F) is "ON", causing its collector to be at "0" volts. When there is no erase current, Q20 (Ref. Fig. 9-4, Sh. 2, Loc. 9D) is "OFF", causing its collector to be at 5 volts. If both write and erase currents are "ON", then the previous logic levels are reversed. Exclusive "OR" logic (Ref. Fig. 9-4, Sh. 2, IC14 and IC12) will cause TP7 (Loc. 6A) to go "true" on a failure (write without erase or erase without write). TP7 will also go true (thru Q25, Loc. 7B) if multiple heads are selected and a write mode exists (DWDMA-H is true). TP7 is the true side of a nand latch which can only be reset by a power on reset (Q27, Loc. 7A), or by DPTI-L (position transducers index). DPTI-L will go "false" on a seek initialize command, which will cause the reset condition. The TP7 signal disables the write and erase signals (DDWE, Loc. 10F) to prevent further writing operations.

It should be noted that early units do not have the DPTI-L signal on the backpanel, therefore the only reset to TP7 is by powering off when a failure exists and requires correction.

## 4.5.4 Read Circuits (Ref. Fig. 4-11)

A read command allows read data to be transmitted from the selected track address and sector designation to the processing system. The reading process is under complete control of the system control circuits. The unit is conditioned to read when a head is selected and write data mode is false. Raw data in the form of a sine-wave is supplied through a preamplifier to the read amplifier. The read amplifier converts the sine wave signal to pulses which are then supplied to data decode circuits where raw read data is separated into clocks and data.

Output leads from the heads connect to the input of the preamplifier which is part of the Data PWB. An approximate 1 to 10 millivolt peak-to-peak signal, received from the read/write head, is boosted by the gain of the preamplifier (IC1, Fig. 9-4, Sh. 2, Loc. 6F) and is then supplied to the read amplifier.

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The actual read signal processing begins in the read amplifier. The amplifier filter circuit receives a differential signal from the preamplifier. This circuit provides additional amplification (IC2, pin 11; Fig. 9-4, Sh. 2, Loc. 5G) and filtering of the read signal. The signal is single-ended during filtering. The output of the amplifier filter circuit is supplied to the differentiator (network C19 & R90; Fig. 9-4, Sh. 2, Loc. 3F).

The differentiator amplified and shifts the signal approximately 60 degrees in time from the input, resulting in data signals whose crossovers coincide with the positive and negative peaks of the incoming signal. The signal from the differentiator then passes through the squaring amplifiers which amplify and limit the signal. This limited signal is used to generate a 90 nanosecond pulse (DDDD-H; Ref. Fig. 9-4, Sh. 2, Loc. 3C).

#### 4.5.5 Data Decode Circuits (Ref. Fig. 4-11)

The double frequency data decode circuit is a phase-locked loop decoder. It consists of a free-running variable frequency oscillator (VFO) which is adjusted in test to the nominal frequency. The frequency of this oscillator is controlled by the output of the phase detector. The control range of the oscillator is  $\pm 8$  percent, about the nominal. The phase detector is used to compare the phase of the incoming raw data with the phase of the VFO sawtooth output. If the incoming data is higher in frequency than the VFO, then an error voltage (See Fig. 9-5, Sh. 3, TP10, Loc. 7E) is generated by the phase detector which caused an increase in the frequency of the VFO. A VFO clock is generated from the VFO to toggle the VFO decode flip-flop which provides the decoding windows for the clocks and data. See Fig. 9-5, Sh. 3, TP's 5 and 7, Loc. 5C.

A 95 nanosecond delay line is used to delay the raw data into the center of the decoding windows. The delay line is also used to pulse-form (15 nanoseconds) the delayed raw data pulses (See Fig. 9-5, Sh. 3, TP4, Loc. 4E). The delay line taps are accurately selected in PWB test. The delayed data pulses are used to clock the data (FRDB) and the clocks (FRDQ) flip-flops whose inputs are controlled by the VFO decoding windows. FRDQ-H triggers the data clock one-shot (TRDQ) which is used to generate a read data clock signal to the user (XRDQ-L). TRDQ-L also resets FRDQ. FRDB-H is used to generate a read data bit signal to the user (XRDB-L). The decode flip-flop is polarized by monitoring the data clock one-shot output (TRDQ-L). If there is no clock output for 2.6 micoseconds, a retriggerable one-shot (2.6 microseconds) times out and inhibits the decode flip-flop from toggling on the next VFO clock. The next raw data pulse will then set the clock flip-flop and thereby enabling the retriggerable one-shot to retrigger continuously on the data clock.

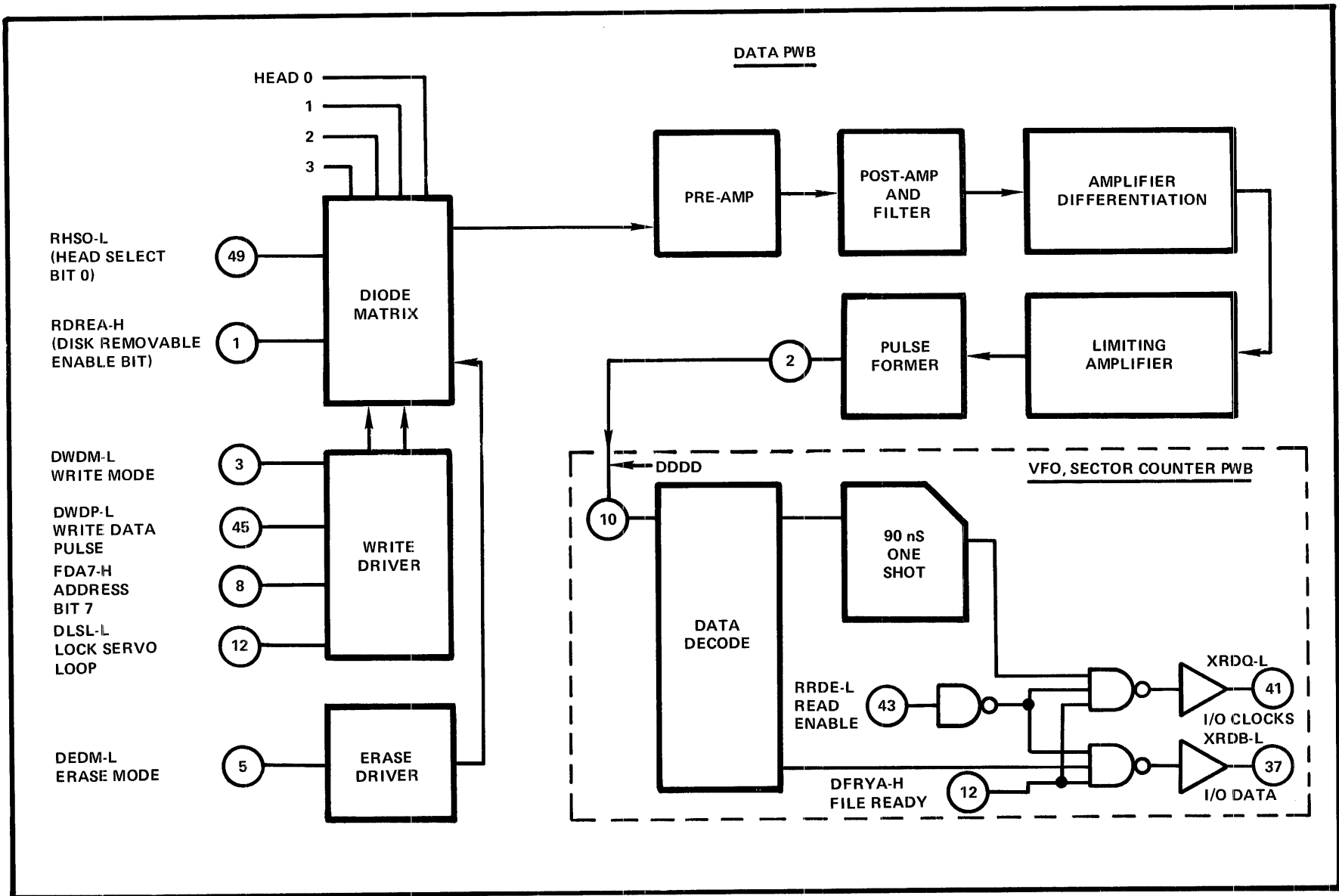


FIGURE 4-11  
HEAD, DISK SELECTION AND DATA FLOW

# Series 6000 DISK DRIVE

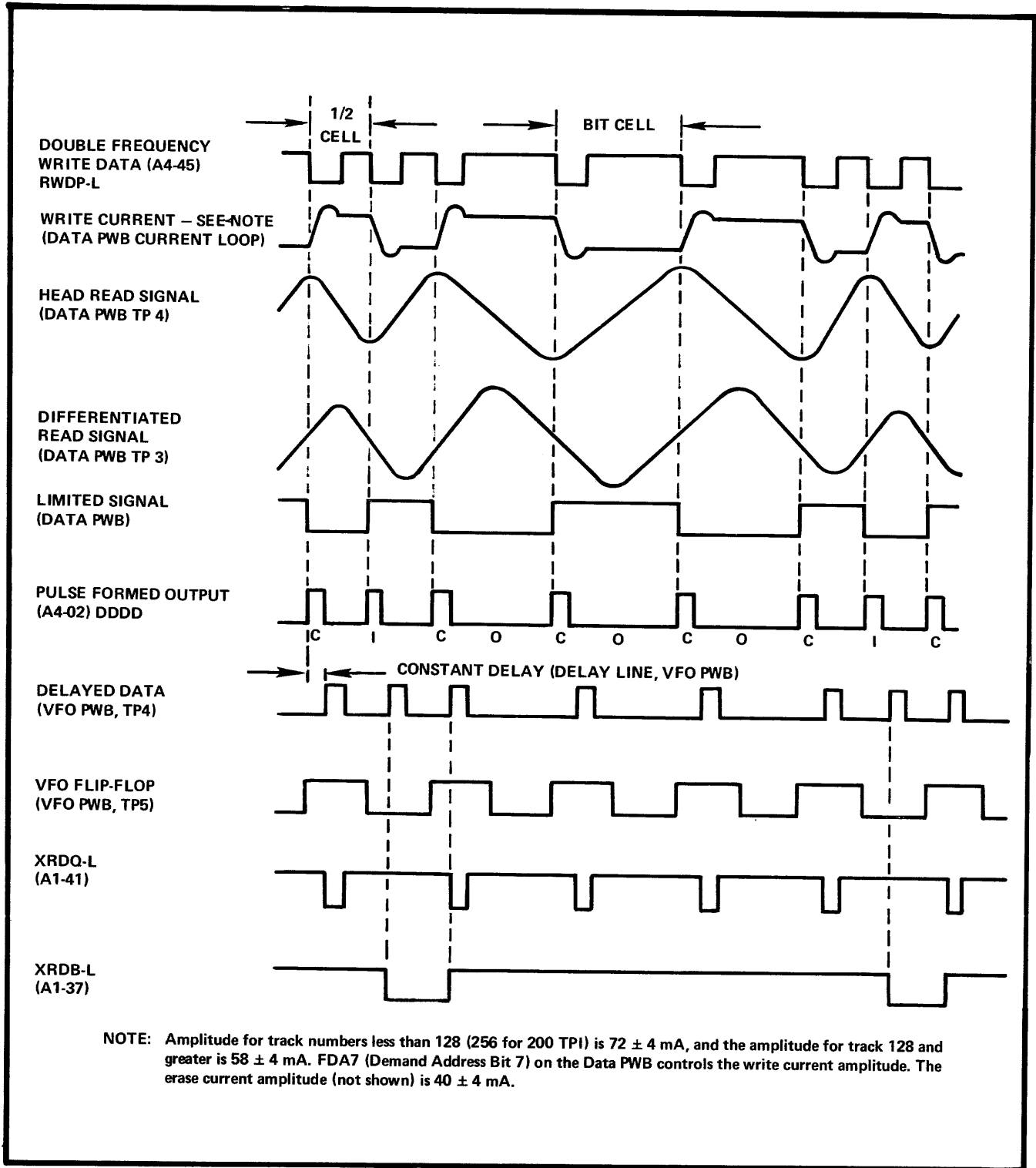


FIGURE 4-12  
READ/WRITE DATA CONVERSION



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The decode flip-flop is then polarized for correct data decoding. Figure 4-12 provides an illustration of the various data signals.

## 4.6 Cartridge Positive Lock Assembly

All front load drives and late model top load drives contain a mechanical "Positive Lock" assembly which prevents cartridge removal unless the "Safe" lamp is "ON". On top load units, the Positive Lock prevents cartridge cover removal, while on front load units, the cartridge access door is locked -- preventing cartridge removal. Once the Positioner Lock is manually placed in the "locked" position (top load units) and the "Disk Drive" switch is depressed "ON", or the "Disk Power" switch is depressed "OFF", the lock can not be unlocked by the operator, thus preventing cartridge removal. On front load units, after inserting the cartridge, the cartridge access door will automatically "lock" on depressing the "Disk Drive" switch "ON" or the "Disk Power" switch "OFF".

The Positive Lock "latching" assembly consists of a solenoid which is energized during a "Safe" condition -- allowing the locking arm to be manually move away from the disk on top load units, or allowing the cartridge access door to be manually opened on front load units.

Should the drive be in the Power "OFF" state, the cartridge can only be removed by either depressing the "Disk Power" switch "ON" and allowing the unit to come to a "Safe" status, or as follows: For emergency cartridge removal, there is a hole in the side of the unit chassis, adjacent to the respective solenoid. By inserting a small diameter rod through this hole, the solenoid locking pin can be manually "moved" -- thus unlatching the Positive Lock.

This method of cartridge removal should only be used in the event of a system failure or failure of the Positive Lock assembly. Should the cartridge be removed by this method, be certain the disk is not rotating and the heads are not loaded.

Note: Emergency cartridge removal should only be performed by qualified service personnel.

## 4.7 Power Supply Operation (Ref. Fig. 9-1, and 9-8)

The power supply assembly provides the following voltages:

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Plug P1 (To PWB Backpanel, Fig. 9-8, Sh. 2, Loc. 2D)

- +5 VDC
- +24VDC
- -24 VDC
- DC and chassis ground

Jack J11 (Fig. 9-8, Sh. 2, Loc. 11D)

- 24 VAC to Front Panel ON/OFF Switch

Jack J12 (Fig. 9-8, Sh. 2, Loc. 4F )

- AC power to the drive motor

By internal wiring changes, the Series 6000 power supply is capable of operation from various power input sources, including:

- 100 or 115 VAC  $\pm$  10%, 50 Hz  $\pm$  2% or 60 Hz  $\pm$  1% at 4.5 Amps
- 208 or 230 VAC  $\pm$  10%, 50 Hz  $\pm$  2% or 60 Hz  $\pm$  1% at 2.3 Amps

Major power supply components consists of the following (REF. Fig. 9-8, Sh. 2):

- Line filter, FL1 (Loc. 11E)
- Control transformer, T1 (Loc. 10D)
- Ferro-resonating transformer, T2 (Loc. 9D)
- Resonating capacitor, C1 (Loc. 9C)
- Contactor relay, K1 (Loc. 9E)
- Bridge rectifiers, BR1 & BR2 (Loc. 8D)
- Filter capacitors, C2, C3 & C4 (Loc. 7D)
- +5 VDC regulator (Loc. 6D)

AC power input is applied to the line filter input (FL1), with the filters output connected to contactor relay K1 and control transformer T1. The control transformer (T1) "step-down" secondary winding (24 VAC) is sent to the front panel Power ON/OFF switch through Jack J11. When the Power ON/OFF switch is depressed (Power On), the 24 VAC is returned to contactor relay K1 -- energizing relay K1 and applying AC input power to the primary of ferro-resonating transformer T2.

The secondary of transformer T2 generates a square wave AC voltage which is recitified by bridge rectifier BR1 (generating +24 and -24 VDC) and BR2 (generating +10 VDC).

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Associated regulator filter capacitors and bleeder resistors consist of C2, C3, C4 and R1, R2 and R5. The raw regulated +24 VDC voltages are connected to the PWB backpanel through Plug P1 (Loc. 2D), while the raw regulated +10 VDC voltage goes to the +5 VDC regulator circuit (Loc. 6D). The +5 VDC regulator output is sent to the PWB backpanel by way of Plug P1 (Loc. 2D). The AC voltage from contactor relay K1 (output) is sent to the drive motor assembly through Jack J12 (Loc. 4F).

## 4.8 Drive Motor Operation (Ref. Fig's. 9-1, 9-10)

### 4.8.1 Speed Control Circuits

The Series 6000 Drive Motor assembly consists of an AC drive motor, Motor Control PWB, mounting plates and other hardware. The assembly contains two cable connectors:

- Plug P5 -- Logic control, connecting the Motor Control PWB to the PWB backpanel (Ref. Fig. 9-10, Sh. 2, Loc. 7B)
- Plug P12 -- AC power input from the power supply (Ref. Fig. 9-10, Sh. 2, Loc. 5D)

AC input voltage is supplied through Plug P12 (See Fig. 9-1, Loc. 4C) from the power supply by way of contactor relay K1 (See Fig. 9-8, Sh. 2, Loc. 9E). Pin 2 of Plug P12 is a triac switched AC signal which is sent to the rear blower assembly (See Fig. 9-1, Loc. 4C) to provide speed control for the blower.

Plug P5 provides three logic control signals from the PWB backpanel. These signals are:

- Pin 3 -- DC logic ground
- Pin 6 -- DMTEB-H (Motor Enable)
- Pin 4 -- DMTO-H (Motor "ON", full speed)

NOTE: The following description applies to Revision H or earlier PWB's (See Fig. 9-10, Sheets 1 and 2, Rev. H).

Signal DMTEB-H is generated on the Control PWB (Fig. 9-7, Sh. 2, Loc. 2E), and functions to supply power to an LED photo-relay circuit (PR2) on the Motor Control PWB (Ref. Fig. 9-10, Sh. 2, Loc. 5C). DMTEB-H causes the photo-relay to change its photo resistance from 10 megohms to 1 Kohm, thereby supplying gate power to triac TR2 -- allowing TR2 to turn "ON" every halfcycle (when DMTEB-H is true). The enabling (turn on) of TR2 causes partial power to be supplied to the motor windings (See Fig. 9-10, Sh. 2, Loc. 3C) through resistor R1 to the motor

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## DISK DRIVE

main run windings. Speed control is required on all 2400 RPM and all 50 Hz drives. On 1500 RPM, 60 Hz drives triac TR2 supplies full power to all windings (no speed control). DMTEB-H is normally true whenever the "Disk Drive" switch is activated (depressed).

Signal DMTO-H (Motor On, full power) is also generated by the Control PWB (Fig. 9-7, Sh. 2, Loc. 4C), and functions to supply power to the LED photo-relay circuit PRL photo-relay to change its photo resistance from 10 megohms to 1 Kohm, thereby supplying gate power to triac TR1 -- allowing TR1 to turn on every halfcycle (when DMTO-H is true). DMTO-H is normally true during initialization of the head load sequence. When the heads start to load onto the disk (approximately 60 seconds after the head load initialization), the disk is normally rotating "over speed" by several percent. At this point, DMTO-H is turned "OFF" and "ON", maintaining the disk at specified rotational speed  $\pm$  one (1) percent.

NOTE: The following description applies to Revision I PWB's (See Fig. 9-10, Sheets 1 and 2, Rev. I).

Signal DMTEB-H is generated on the Control PWB (Fig. 9-7, Sh. 2, Loc. 2E) and functions to supply gate current to an optical SCR (IC2). Since the SCR can only supply current in one direction, a full-wave bridge circuit of high voltage diodes (CR14 thru 17) is required. The SCR can thereby supply (if DMTEB-H is true) positive and negative gate current to turn "ON" triac TR2 on each halfcycle. The enabling (turn on) of TR2 causes partial power to be supplied to the motor windings (See Fig. 9-10, Sh. 2, Loc. 3C) through resistor R1 to the motor main run windings. Speed control is required on all 2400 RPM and 50 Hz drives. On 1500 RPM, 60 Hz drives triac TR2 supplies full power to all windings (no speed control). DMTEB-H is normally true whenever the "Disk Drive" switch is activated (depressed).

Signal DMTO-H (Motor On, full power) is also generated by the Control PWB (Fig. 9-7, Sh. 2, Loc. 4C) and functions to supply gate current to an optical SCR (IC1). The SCR, in turn, (when DMTO-H is true) generates gate current thru the high voltage diodes (CR3 thru 6) to turn "ON" triac TR2 at each halfcycle interval. Transistor Q1 is turned "OFF" only within 20 volts peak of the AC zero crossing, thereby allowing the optical SCR to be enabled only at the AC zero crossing. DMTO-H is normally true during initialization of the head load sequence. When the heads start to load onto the disk (approximately 60 seconds after the head load initialization), the disk is normally rotating "over speed" by several percent. At this point, DMTO-H is turned "OFF" and "ON", maintaining the disk at specified rotational speed  $\pm$  one (1) percent.

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## 4.8.2 Dynamic Braking Circuits (Ref. Fig. 9-10, all revisions)

Units with Revision F or earlier Motor Control PWB's do not have dynamic braking. Units with Revision G Motor Control PWB's have the dynamic brake feature. The dynamic brake functions by always being "ON" whenever DMTEB-H (Motor Enable) is false. This condition is accomplished when TR2 (Fig. 9-10, Sh. 2, Loc. 5C) changes from its "ON" state to its "OFF" state. The power which originally was supplied to the TR2 gate, now supplies gate power to an SCR which supplies half-wave rectified AC to the motor start winding through brake resistor R2 (located physically below the Motor Control PWB).

Units with Revision H, I or later Motor Control PWB's have a dynamic brake which is enabled only for approximately 45 seconds after DMTEB-H goes false. This allows more power to be dissipated during braking, thereby decreasing stop time considerably over Revision G Motor Control PWB's. When DMTEB-H is low, the DC voltage on capacitor C5 is at "0" volts, capacitor C6 has been discharged through diode CR11. When DMTEB-H goes false (low) the power which originally was supplied to the TR2 gate will now supply charging current to capacitor C5. Capacitor C5 charges (within several cycles) to a DC voltage which is used to generate DC power for IC1 (See Fig. 9-10, Sh. 2, Loc. 6C). A fixed threshold for IC1 (pin 3) is determined by a resistor divider network. Capacitor C6 is charged (IC1, pin 2) through diode CR8 and a resistor to the threshold reference in about 45 seconds. When the C6 voltage is less than the reference voltage at IC1 (pin 2), the IC1 (pin 6) will supply a half-wave signal to turn the brake SCR "ON" each half cycle -- applying half-wave rectified AC to the motor start winding through brake resistor R2.

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## SECTION 5 -- MAINTENANCE PROCEDURES

During the maintenance procedures, various plugs and connectors must be connected or disconnected for certain operations. Table 5-1 provides quick reference to plug function and location.

TABLE 5-1

Connector Location Table

<u>Connector</u>	<u>Function</u>	<u>Reference</u>
P1-J1	Cable, connecting DC power from Power Supply to the PWB backpanel.	Fig. 9-1, Loc. 5E & 2C Fig. 9-8, Sh. 1, Loc. 9G Fig. 9-8, Sh. 2, Loc. 4E
P2-J2	Cable, connecting Positioner Drive Transistor (heat sink) to the PWB backpanel.	Fig. 9-1, Loc. 6F Fig. 9-12, Sh. 1, Loc. 6E & 8E
P3-J3	Cable, connecting Positioner Voice Coil to PWB backpanel.	Fig. 9-1, Loc. 5F Fig. 9-11, Loc. 7E Fig. 9-12, Sh. 1, Loc. 8E
J4	Cable, providing logic power to Disk Tester	Fig. 9-1, Loc. 5C Fig. 9-12, Loc. 9E
P5-J5	Cable, connecting Motor Module (speed control) to the PWB backpanel.	Fig. 9-1, Loc. 5C Fig. 9-12, Sh. 1, Loc. 9D Fig. 9-13, Loc. 10F
P6-J6	Cable, connecting Front Panel, Disk Interlock hardware and Sector Transducers to back of the Control PWB	Fig. 9-1, Loc. 9F Fig. 9-7, Sh. 1, Loc. 5F
P7-J7	Cable, connecting Positioner Assm. TB1 (Heads-Up Sw., Position Transducers and Velocity Coil) to back of the Servo PWB.	Fig. 9-1, Loc. 3F Fig. 9-6, Sh. 1, Loc. 5E

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Table 5-1

Connector Location Table

<u>Connector</u>	<u>Function</u>	<u>Reference</u>
P10-J10	Cable, connecting 5-Volt Regulator Assm. to the Power Supply.	Fig. 9-8, Sh. 1, Loc. 6D Fig. 9-8, Sh. 2, Loc. 6D Fig. 9-9, Sh. 1, Loc 6B Fig. 9-9, Sh. 2
P11-J11	Cable, connecting 24 VAC from the Power Supply to the Front Panel.	Fig. 9-1, Loc. 3C & 10D Fig. 9-8, Sh. 1, Loc. 7B Fig. 9-8, Sh.2, Loc. 11D
P12-J12	Cable, connecting AC power from the Power Supply to the Motor Module Assm.	Fig. 9-1, Loc. 3D Fig. 9-8, Sh. 1, Loc. 7C Fig. 9-8, Sh. 2, Loc. 4F Fig. 9-10, Sh. 2, Loc. 5D Fig. 9-13, Loc. 11D
P13-J13	Cable, Connecting Upper Sector Transducer to Plug P6.	Fig. 9-1, Loc. 10A
P15-J15	Cable, connecting Front Panel functions to Plug P6.	Fig. 9-1, Loc. 10E
P21-J21	Cable, connecting AC power to the Rear Blower Assm. from the Motor Module Assm.	Fig. 9-1, Loc. 4C Fig. 9-19, Loc. 4C

### 5.1 Safety Precautions

1. When performing maintenance or troubleshooting, always be aware that AC Power is present on terminals within the unit -- even though the unit has been unloaded and the "Disk Power" switch is "Off". Although safety shields and covers are used, extreme care should be exercised to avoid any form of contact with AC power -- personal injury or machine damage can occur.

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2. When cleaning the read/write heads and disks use only 91 percent isopropyl alcohol. Other types of alcohol or concentrations may cause damage and/or contamination due to impurities. Since 91 percent isopropyl alcohol is a flammable liquid, use with caution and keep only small quantities within the operating area. Also, when not in use, store the plastic alcohol dispenser in sealed metal container.  
Warning: When shipping 91 percent isopropyl alcohol, comply with federal, state and local regulations for the shipment of flammable liquids.
3. DC power must be "Off" (Disk Power "Off") before removing or inserting PWB's, or connecting or disconnection I/O cables. Failure to remove DC power may result in the loss of customer data and/or may cause equipment damage.

## 5.2 Special Procedures

### 5.2.1 Enabling Drive Motor (Manual)

Manually enabling the drive motor and loading the heads is required during certain preventive maintenance and alignment procedures. To manually enable the drive motor proceed as follows:

Warning: Do not load the heads unless called for.

1. Remove power from the disk drive
2. Remove the top cover (3 screws, each side).
3. Remove the magnetic shield (2 screws) from top of magnet assembly.
4. Remove the head air flow cover.
5. Ensure head carriage is in the fully retracted position.
6. Remove the voice coil cable plug P2 (See Table 5-1) to disable power to the positioner
7. Depress the "Disk Power" switch (Power On).
8. Manually move the voice coil (carriage) forward approximately 3/8 inch. Motor will start and come up to full speed. Do not load the heads.

Warning: Do not allow heads to load. If voice coil is moved forward too far, the heads will move off the head load ramps and load.

### 5.2.2 Loading the Heads (Manual)

To manually load the heads, proceed as follows:



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Warning: The disk must be rotating at full speed prior to loading the heads or severe head/disk damage may occur.

1. Manually enable the drive motor per Section 5.2.1, above.
2. Manually move the voice coil (carriage) forward until the heads come off their plastic load ramps. The heads are now in the loaded (flying) position on the disk.

Warning: During manual loading and unloading of the heads, do not allow the heads to hesitate (i.e., move the voice coil at a constant velocity) at the ramp load/unload point since this is a point of head flying instability. It takes approximately three (3) pounds of force to unload the heads past the ramps.

### 5.3 Preventive Maintenance

The performance of preventive maintenance as presented in this section is vitally important for long term, trouble-free operation. Periodic visual inspections will often identify potential problems or pending failures before they occur -- thus preventing possible data errors or loss, and unscheduled machine down time.

Warning: Absolute cleanliness must be stressed. Operating and maintenance procedures, and the computer room environment must be regulated to minimize the presence of contaminating elements -- particularly those contributed by computer room personnel (tobacco smoke and ashes, beverages, etc.).

Exercise caution when handling the disk cartridge and do not allow the disk surface to come in contact with foreign objects. Extremely small damage areas, or finger prints, or dust particles -- even continued exposure to cigarette smoke -- can render a disk cartridge inoperable with possible loss of customer data. See Figure 5-1, Contamination -- Disk/Head Damage.

To ensure data integrity, establish adequate precautions as follows:

1. Clean the cartridge protective covers periodically to remove any build-up of dirt or dust. Use a clean, lint-free cloth.
2. Keep all foreign objects away from the disk surface.
3. Do not touch the disk surface -- finger prints can result in severe damage to the heads and disk.
4. Keep the cartridge lid in its proper place at all times. Should a cartridge be dropped or otherwise suspected to be damaged, have it

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- inspected by maintenance personnel before using.
5. Do not allow liquids, such as coffee and other beverages, to be in the disk drive or cartridge area.
  6. Tobacco, its smoke and ashes, is a prime source of contamination -- keep these items out of the disk storage and operating area.
  7. When a disk cartridge is first brought into the computer room (or disk drive area) environment always allow at least one (1) hour for the disk cartridge to temperature stabilize within the operating room environment. This stabilization is required to ensure correct head-to-track registration.  
Note: It is recommended that all disk cartridges be stored within the computer room environment or equivalent area.
  8. Do not leave the disk drive (top load) extended from the cabinet except for the removal or insertion of disk cartridges. Should the unit be out of the cabinet for extended maintenance or any other reason, the heads and disks should be cleaned before returning to normal operation.

## The Disk Cartridge -- Special Considerations

A head crash can not only cause serious damage to the disk cartridge involved, but also damage the heads such that they lose their ability to "fly". Damaged heads could possibly damage every other disk cartridge used on that particular drive.

A common cause of head crashes involves the use of a disk cartridge that has been dropped and physically damaged. Should a cartridge be dropped, never return this cartridge to service until it has been carefully inspected and tested by maintenance personnel.

The user who notices that a particular drive/cartridge combination is producing an increasing number of errors, should take both the drive and the cartridge out of service until both can be thoroughly inspected and tested for damage.

An established program of disk cartridge inspection, at regular intervals, should be established. The inspection should include checking the disk surface for dirt, finger prints, scratches and any other irregularities. If a problem is suspected, take the disk cartridge out of service until the problem is corrected.

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Table 5-2 provides a Recommended Preventive Maintenance Schedule. The preventive maintenance frequency has been determined by an assumed disk drive usage rate of 200 hours per month. Actual frequency of cleaning and filter replacement is, however, determined by cleanliness of the operating environment, with the suggested frequency being altered according to experience within a given operating area.

Table 5-2

Recommended Preventive Maintenance Schedule

<u>Operation</u>	<u>Frequency</u> (months)	<u>Procedure</u> (Section)
Visual Inspection	2	5.3.1
Head Cleaning	2	5.3.2
Disk Cleaning	2	5.3.3
Head Positioner Cleaning	2	5.3.4
Spindle Assembly Cleaning	2	5.3.5
Air Filter Replacement	12	5.3.6
Head Alignment Check	12	5.3.7
Head Timing Check	12	5.3.8

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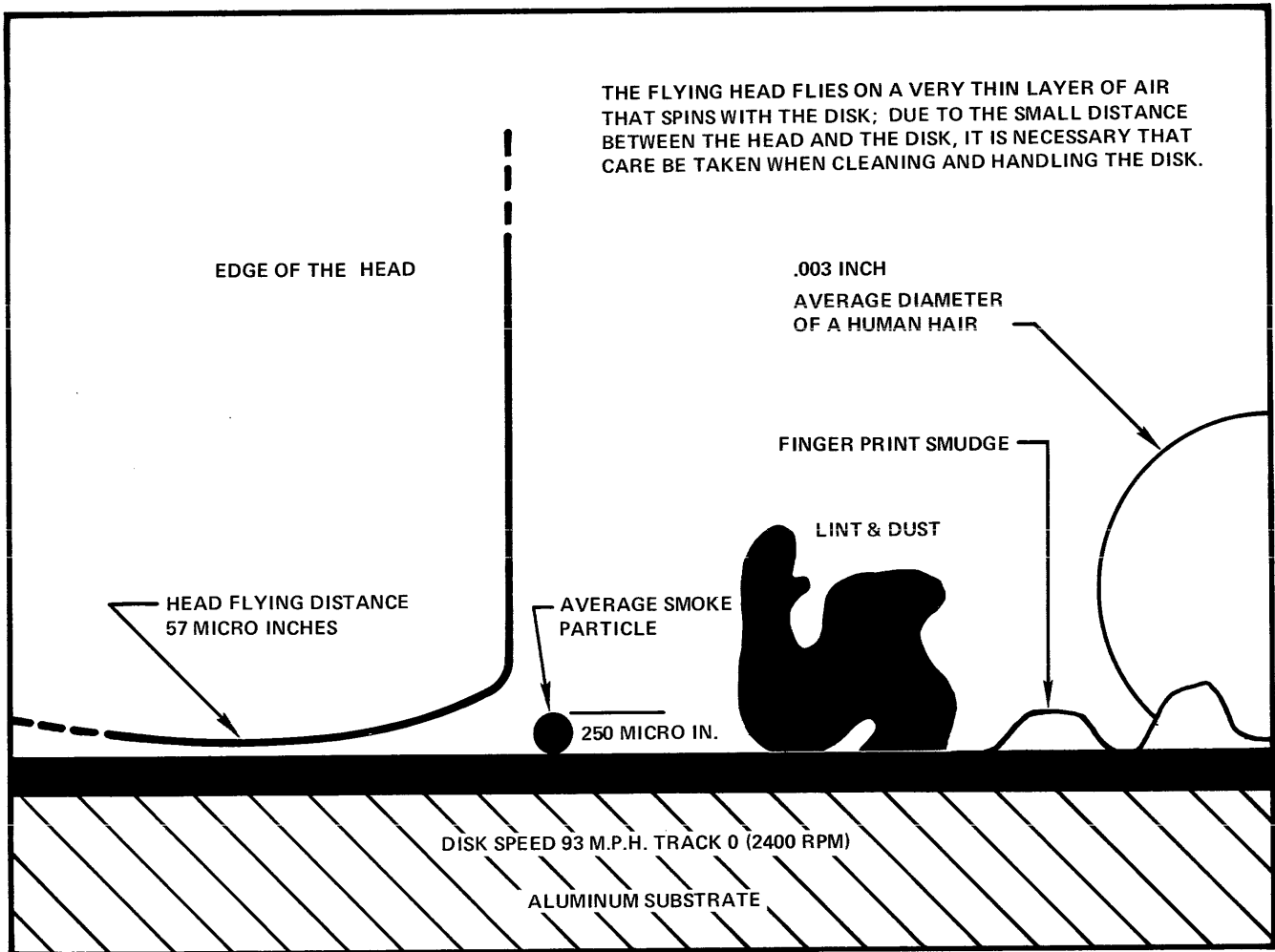


FIGURE 5-1  
CONTAMINATION – DISK/HEAD DAMAGE

# Series 6000

## DISK DRIVE

### 5.3.1 Visual Inspection

Check for dirt, dust, excessive wear, cracks, loose mechanical assemblies, and loose connections in wiring and cable/PWB connectors.

### 5.3.2 Read/Write Heads (Ref. Fig's. 5-2 and 9-11)

Use caution when handling or cleaning the read/write heads. Avoid touching the gliding ("flying") surface as acids from the skin may etch and damage the surface. Should a head be accidentally touched, clean immediately with 91 percent isopropyl alcohol. Also, do not load the heads manually, except as specified for maintenance purposes. Clean and inspect all heads for scratches and build-up of oxide. Severely scratched heads should be replaced. See Figure 5-2.

### Cleaning Procedure

1. Remove power from the disk drive
2. Remove the top cover (3 screws, each side) and the air flow cover.
3. Q-tips are used for cleaning heads. Soak one end in 91 percent isopropyl alcohol and leave the other end dry.
4. Gently insert the alcohol soaked end between the heads and clean using a gentle scrubbing motion. Before the alcohol dries, insert the dry Q-tip end between the heads to remove all excess alcohol and dry the heads.
5. Visually inspect the head flying surface to ensure no alcohol stains are present. Should alcohol stains be observed, re-clean the heads. Alcohol stains are caused by "puddled" alcohol drying on the head surface.  
Note: Should excessive oxide or other contamination be found on the head flying surfaces, the corresponding disk should also be cleaned (See Section 5.3.3).
6. Having cleaned the heads (and disk, if necessary), manually "load" the heads to check head/disk flying characteristics, per Section 5.2, Special Procedures.  
Warning: The drive motor must be at full speed before manually loading the heads or head/disk damage will occur.
7. To check head/disk flying characteristics, move the carriage throughout its normal travel range and carefully listen for any head-to-disk interference. Retract (unload) the heads when checking is complete.

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The top heads can be cleaned from the front by removing the top disk, while the lower heads can be accessed from the back. For the lower heads, use a Q-tip, held by two fingers or needle-nose pliers -- inserted from behind the heads on the side opposite the lamp. Use caution and do not bend the voice coil tapes or scratch the glass scale. (A dental mirror and flashlight can be used to assist in head cleaning.)

**WARNING:** Do not lift the heads off the load ramps during inspection or cleaning of the heads. This can cause serious damage to the head assemblies.

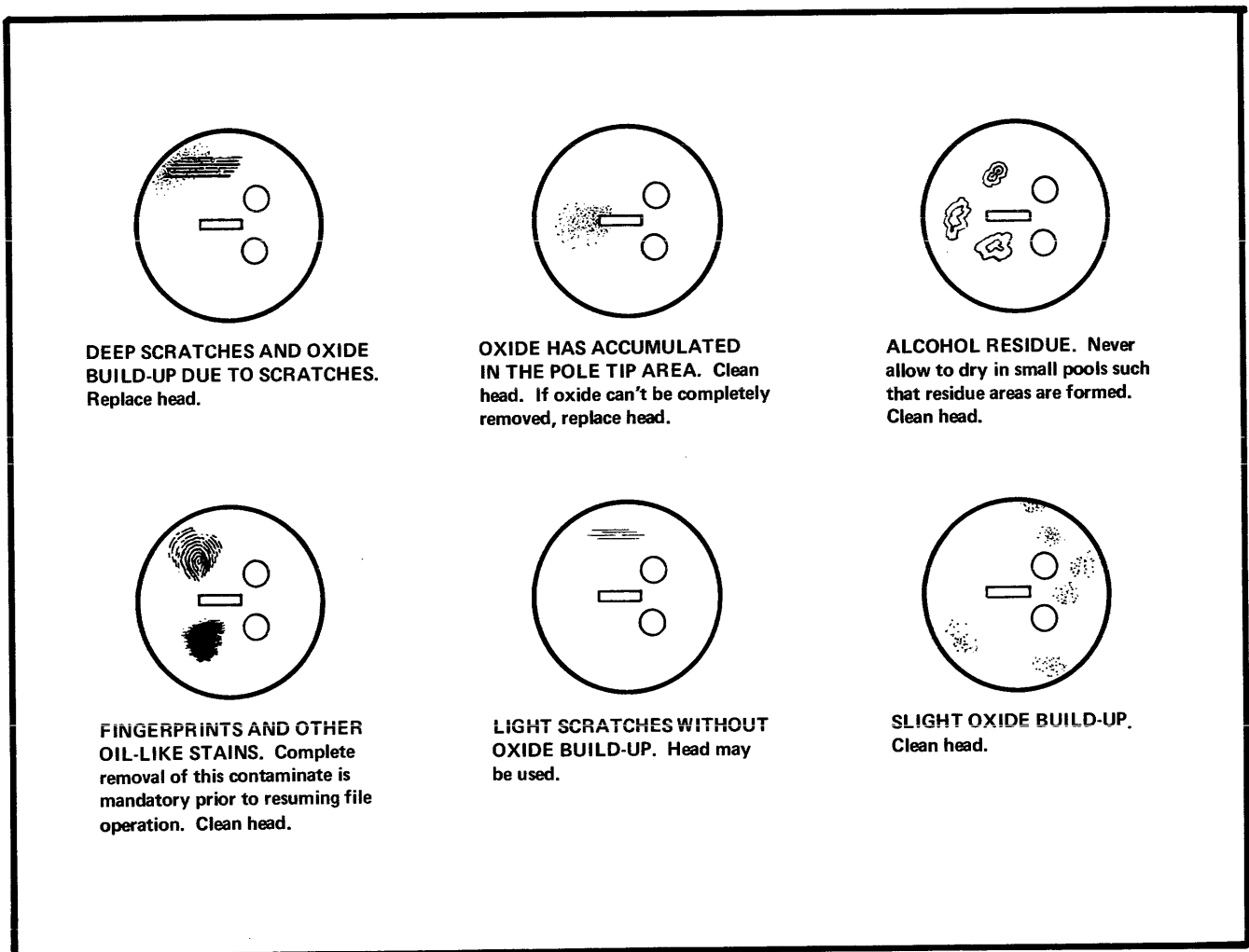


FIGURE 5-2  
INSPECTION OF READ/WRITE HEADS

# Series 6000

## DISK DRIVE

### 5.3.3 Disk Cleaning

Exercise extreme care when handling and cleaning disk surfaces. Do not allow foreign objects to come in contact with the disk surface, since small scratches or other surface damage can render the disk inoperative -- resulting in loss of data or unstable head flight aerodynamics. Should disk surface damage occur, do not rationalize the degree of damage -- remove the disk from service.

#### Cleaning Procedure (Fixed Disc)

1. Remove power from the disk drive.
  2. Remove the top cover (3 screws, each side).
  3. Pivot access plate on side of skin to allow access to the port cover on the side of the casting.
  4. Loosen the port cover screws (2) and pivot port cover to expose the fixed disk.
  5. Wrap lint-free tissue around "cleaning wand" and saturate with 91 percent isopropyl alcohol.
  6. Insert saturated cleaning wand through port and onto the disk surface (top or bottom).
  7. Manually turn spindle to determine location of inner disk mounting hub.
  8. With the cleaning wand on top (or bottom) of the inner most part of the disk surface, manually enable the drive motor per Section 5.2, Special Procedures.
9. After the drive motor is up to speed, slowly pull the cleaning wand outward -- keeping the alcohol pad in contact with the disk.
10. Stop the drive motor by moving the voice coil (carriage) to its fully retracted position.
11. Upon cleaning a disk surface, should the tissue be excessively brown in color, repeat steps 5 through 10, using clean tissue on the cleaning wand.
12. Repeat steps 5 through 10 for the other side of the disk, using clean tissue on the cleaning wand.

Warning: Do not allow heads to load. If voice coil is moved forward too far, the heads will move off the head load ramps and load.

Warning: Do not allow the plastic cleaning wand to come in contact with the disk surface during the cleaning operation.

Note: Before proceeding, clean both heads per Section 5.3.2.

After cleaning operations are complete enable the drive motor as noted in the instructions for step 8 above.

# Series 6000 DISK DRIVE

13. Manually "load" the heads to check head/disk flying characteristics, per Section 5.2, Special Procedures.

Warning: The drive motor must be at full speed before manually loading heads or head/disk damage will occur.

14. To check head/disk flying characteristics, move the carriage throughout its normal travel range and carefully listen for any head-to-disk interference. Retract (unload) the heads when checking is complete.

15. Remove power, replace all covers and return unit to operating status.

Warning: Remember to tighten the fixed disk port cover.

## Cleaning Procedure (Top Load Disk Cartridges)

Cleaning procedures for top load, removable disk cartridges is the same as for the Fixed Disk described above, except that the cleaning wand is inserted into the read/write head opening in the cartridge (drive motor side of read/write heads).

Warning: Be careful not to bend the voice coil steel tapes during the cleaning process.

## Cleaning Procedure (Front Load Disk Cartridges)

To clean front load disk cartridges, it is best to disassemble the cartridge and manually clean the disk with 91 percent isopropyl alcohol and lint-free tissues.

### 5.3.4 Head Positioner (Ref. Fig. 9-11)

Positioner guide rails and carriage bearings must be kept clean to minimize off-track head positioning errors.

## Cleaning Procedure

1. Remove power from the disk drive.
2. Remove the top cover (3 screws, each side) and the air flow cover (2 screws).
3. Remove plug P2 (See Table 5-1) to disable power to the positioner voice coil.
4. Soak Q-tips in 91 percent isopropyl alcohol.
5. With the head carriage in the fully retracted position (heads retracted), use saturated Q-tips to clean the top bearing tracking surfaces of both guide rails.
6. Since it is not possible to clean beneath the bearings in step 5, the drive motor must now be manually enabled to allow further cleaning. Manually enable the drive motor and load the heads per Section 5.2, Special Procedures.



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7. Again clean the rails while moving the head carriage accordingly to allow access to all rail surfaces.  
Warning: Do not allow the heads to come too close to the head load ramps in performing steps 7 through 9, since head flight becomes unstable at that point.
8. Hold a saturated Q-tip on each top bearing surface (3 bearings) as the carriage is moved to allow cleaning of the bearings.
9. Bend the Q-tip at a 45 degree angle and repeat steps 7 and 8 for the lower side of the rails (2 rails) and the lower bearings (3 bearings).
10. When cleaning is complete, the carriage should move freely (no hesitating points) throughout its total travel range. Retract (unload) the heads when checking is complete.
11. Remove power, replace all covers and restore unit to operating status.

### 5.3.5 Spindle Assembly (Ref. Fig's. 9-14, Sh. 1 and 9-15, Sh. 1)

For trouble-free and accurate disk clamping, it is important that the spindle disk locating base and magnetic chuck assembly be clean and free of contamination which could cause disk dynamic run-out.

#### Cleaning Procedure

1. Remove the magnetic chuck "pole piece" and clean with a dry lint-free tissue. Magnetic particles may be removed with adhesive tape. Do not use alcohol for cleaning.
2. Clean all spindle assembly surfaces (as required) with lint-free tissues. Do not use alcohol for cleaning. Alcohol will remove the protective seal used on all spindle assemblies. If the top spindle surface (disk mating surface) is corroding, WD-40 can be wiped (do not spray) on the surface to protect against further corrosion.

### 5.3.6 Air Filter Replacement (Ref. Fig's. 9-20, Sh. 2 and 9-21, Sh. 2)

The frequency of air filter replacement will vary with each installation and prevailing environmental conditions. However, replacement at 12 month intervals is recommended under normal operating conditions. High humidity and elevated residual environmental contaminants may necessitate more frequent filter replacement. After initial system installation, check the filter frequently -- establishing an experience factor for the frequency of subsequent replacement.

Note: Filter replacement is an important preventive maintenance consideration.

# Series 6000 DISK DRIVE

## Replacement Procedure

1. Remove the access plate on the underside of the unit (4 screws).
2. The filter element is held in place by two (2) clips. Disconnect the clips, using a flat blade screwdriver. The filter element can now be removed through the bottom of the drive unit.
3. Replace with new filter element, making sure the new filter is correctly seated. The gasket side should fit flush against the inside of the plenum.

### 5.3.7 Head Alignment Check (Radial)

The radial alignment check, in combination with the circumferential (timing) check, serves to guaranty read/write compatibility and thus disk cartridge interchangeability between Series 6000 disk drives. The radial alignment check is performed on heads 0 and 1 (removable disk heads) -- positioning each head recording track centerline to a CE Disk "track standard".

Refer to Section 6.3 Radial Alignment Check and Adjustment procedures.

Note: Should any head radial adjustment be performed, it is then necessary that a circumferential (timing) check be performed. See Section 5.3.8 below.

### 5.3.8 Head Timing Check (Circumferential)

The circumferential (timing) check, in combination with the radial alignment check, serves to guaranty read/write compatibility and thus disk cartridge interchangeability between Series 6000 disk drives. The circumferential check is performed on heads 0 and 1 (removable disk heads) -- positioning each head read/write gap to within specified timing limits with respect to a CE disk reference pulse "standard".

Refer to Section 6.3 for Head Timing Check and Adjustment procedures.

Note: Should any head circumferential alignment be performed, it is then necessary that a radial alignment check be performed. See Section 5.3.7.

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### 5.4 Disassembly and Assembly Procedures

This section provides step-by-step procedures for the disassembly and assembly of Series 6000 disk drive components and sub-assemblies. It is important that caution be exercised and the particular procedure be carefully followed (step-by-step) to prevent possible equipment damage or improper performance. Pay particular attention to WARNING statements and perform each procedure in the sequence provided.

Warning: Unless otherwise stated, AC Input Power should always be disconnected from the unit prior to performing any of the following procedures.

#### 5.4.1 Skin Removal

1. Disconnect AC power from unit.
2. Remove top cover (3 screws, each side).
3. Remove the rear blower assembly (3 screws, one connector)

Note: On early drives, the internal blowers (front of unit) must be removed.

4. Remove screws (2) from each casting mount (located on each side and at the rear of the unit). Pull out the AC power cord (and grommet) from slot in rear corner brace (remove corner braces on early units).
5. Unit can now be lifted from the skin.

Note: Two people are required -- one at the front panel, the other at the rear of the casting. Also, the bottom magnetic shield will remain loose in the skin. Leave all loose parts in the skin to avoid their possible loss.

#### 5.4.2 Positioner Assembly (Ref. Fig. 9-11)

##### Removal

Note: a) The positioner carriage guide rails and voice coil are not field replacement items and adjustment must not be attempted. Failure requires total assembly replacement.

b) The positioner carriage must be in the fully retracted position before proceeding.

1. Disconnect AC power from the unit.
2. Remove top cover (3 screws, each side).
3. Remove rear blower assembly (3 screws, one connector).
4. Remove the magnetic shield (2 screws) and air flow cover.
5. Disconnect the head connectors (4) from the Data PWB.

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6. Disconnect connector P7 (See Table 5-1) that attaches to the back of the Servo PWB.
7. Disconnect connector P3 (See Table 5-1) that connects the steel tapes to the backpanel.
8. Remove "front" 1/4-20 bolt that holds the positioner assembly in place (located in front of glass scale).

Warning: Be careful not to scratch or damage the glass scale.

9. Move heads forward slightly -- approximately 3/8 inch from the fully retracted position.

Warning: Do not move the heads off the head load ramps or the heads will load, resulting in head/disk damage.

10. Remove the two (2) bolts at the rear of the voice coil -- located inside the magnet assembly. Do not drop lock washers into the magnet assembly.

Warning: After removal of the two (2) bolts in step 10, move the voice coil back to the fully retracted position such that the lower heads will not contact the disk cover as the positioner assembly is removed.

11. Remove the positioner assembly by carefully lifting straight up while watching that the lower heads do not contact the disk cover. Note that the positioner is located by two (2) dowel pins. Release front dowel pin first.

Note: Lift positioner at bottom, rear of magnet assembly and at the center of either bearing rail.

Warning: When moving positioner, be careful not to damage the head leads or positioner harness.

## Installation

1. For positioner assembly installation, reverse the above "removal" procedure.

Note: Check that the head connectors (0, 1, 2 and 3) are connected to the correct Data PWB mating connectors.

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### 5.4.3 Velocity Coil Replacement (Ref. Fig. 9-11)

Warning: When replacing the velocity coil, be certain all leads are connected properly and the following checkout procedure is satisfactory. An improperly connected or inoperative velocity coil can result in serious damage, due to the loss of velocity control.

#### Removal

1. Disconnect AC power from the unit.
2. Remove top cover (3 screws, each side)
3. Remove all PWB's from backpanel
4. Disconnect velocity coil leads, TB1, terminals 7 and 8 (Ref. Fig. 9-1, Loc 2E; and 9-11, Loc. 6C).
5. Remove the cable clamps (3).
6. Remove the spring clip (one screw) that holds the velocity coil in place (rear of magnet assembly).
7. Remove the velocity coil from the magnet assembly.

#### Installation

1. Install replacement velocity coil by carefully pushing the coil into place.
2. Install spring clip and screw (1).

Warning: The rear of the coil should not extend beyond the back of the magnet assembly by more than 0.01 inches. The spring clip must hold the coil firmly in place, but be careful not to damage the coil while tightening the clip screw.
3. Install the velocity coil cable clamps (3) to the magnet assembly.
4. Check the velocity coil resistance readings as presented in "Velocity Coil Checkout" below. Checkout must be performed after coil installation and locking in place.

#### Velocity Coil Checkout

The velocity coil has three (3) leads (+, -, and shield). These leads connect to TB1, terminals 7 and 8 (ground).

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- a) Remove all backpanel PWB's.
  - b) With the velocity coil leads disconnected, the resistance between the red and black wires should be  $2.2 \text{ Kohms} \pm 30 \text{ percent}$ .
  - c) Resistance from the shield connection to either red or black wire should be an open.
  - d) Resistance from any of the lugs to the magnet assembly (frame ground) should be an open.
5. Connect velocity coil leads to TB1, terminals 7 and 8, and install all PWB's (Ref. Fig. 9-1, Loc. 2E; and 9-11, Loc. 6C).
  6. Disconnect voice coil plug P2 (See Table 5-1) from top, rear of PWB module.
  7. Reconnect AC power to unit.
  8. Manually enable the drive motor and load heads per Section 5.2, Special Procedures.
  9. Move the heads to the approximate center of the disk.
  10. Connect scope Channel 1 to TP7 on the Servo PWB. Be sure the Channel 1 Invert switch is not on.
  11. Manually move the carriage forward (toward spindle) at a reasonable speed. TP7 will go negative. This checks the velocity function up to TP7 on the Servo PWB.
  12. Unload the heads by moving the carriage at a constant velocity to the fully retracted position.
  13. Depress the "Disk Power" switch (Power OFF).
  14. Reconnect plug P2 (See Table 5-1).
  15. Depress the "Disk Power" switch (Power ON) and wait for "Safe".
  16. "Hold" the head carriage firmly (in case of malfunction) and depress the "Disk Drive" switch (Load Heads).
  17. With heads loaded and unit "Ready", perform Velocity Reference Adjustment per Section 6.4.5.
  18. With Velocity Reference Adjustment complete, remove power, install covers and return unit to normal status.

#### 5.4.4 Heads-Up Switch Replacement (Ref. Fig. 9-11)

##### Removal

1. Remove power from disk drive.
2. Remove top cover (3 screws, each side) and air flow cover (2 screws).
3. Remove switch connections (2), connected to end terminals of switch.
4. Remove switch mounting screws (2).

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### Installation

1. Install new switch (2 screws).

Note: Check that the new switch has been epoxied (at factory) to seal cracks between housing and terminals, or that the switch has pressed-in terminals such that sealing is not required. Do not install unless properly sealed from dust.

2. Adjust switch such that activation (changes state) occurs  $0.075 \pm 0.025$  inches (horizontal adjustment) from the voice coil fully retracted position.

Note: Always observe switch activation while the voice coil is being moved from its retracted position towards the spindle.

3. Check switch "over-travel". Switch over-travel (vertical adjustment) should be  $0.030 \pm 0.010$  inches.

Note: Over-travel is defined as the distance the switch contact roller moves upward from the point of switch activation, as the voice coil is moved to the full retract position.

4. Before returning unit to operating status, use an ohmmeter to verify switch operation.
5. Install switch connections, covers, and return unit to original operating status.

### 5.4.5 Voice Coil Driver Transistor Replacement (Ref. Fig. 9-12, Sh. 1)

1. Remove PMD10K50 and PMD11K60 transistors from heat sink assembly, located at the top of the backpanel assembly (2 self-tapping screws, each).
2. Install replacement transistors with new mylar insulators and silicon heat conducting grease. Tighten mounting screws securely.

Warning: Be sure transistor lead spacers are in place, and that the transistors are not shorted to the heat sink during installation.

Note: Early drives may have MJ2500 and MJ3000 transistors. Always replace the failed MJ2500 and MJ3000 devices with PMD11K60 and PMD10K60 devices respectively.

### 5.4.6 Head Replacement (Heads 0 or 1, Upper Set)

### Removal

1. Remove disk cartridge from disk drive.
2. Disconnect power from disk drive.

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3. Remove top cover (3 screws, each side).
4. Loosen the head lock screw nut and lock screw (Do not loosen the clamp plate screws).
5. Loosen the head "lead" spring clamp screw such that the springs for the two (2) upper heads can be removed.
6. Remove the top cable clamp (located next to top spring clamp screw -- previously loosened) such that the head can be freed.
7. Disconnect the head connectors from the Data PWB mating connectors.
8. The head should now be free to slide out of its slot. Pull the head toward the spindle until free.

Warning: The heads are spring loaded in their mounts. Therefore, use caution that the head being removed does not contact and damage the adjacent head during removal.

## Installation

1. To install the new head, reverse steps 4 through 8 of the Removal procedure. Be careful not to damage the head during installation.

Important: Ensure the correct version head is being installed (1500, 2400 RPM; 100, 200 TPI).

2. Tighten the head lock screw until there is approximately 0.01 inches deflection between the clamp plate and the head block -- tighten the lock nut.
3. When installing the head lead springs into their clamp, the spring ends must be set flush ( $\pm 0.04$  inches) with the bottom of the clamp.
4. The new head should be positioned to the same approximate location (front-to-back) as its adjacent head. If both heads (set) are replaced, position the two (2) heads to the same approximate location as the lower head set.
5. Connect the head connectors (0 through 3) to their corresponding connectors on the Data PWB.

Note: Head 0's lead spring must be located on the outside -- farthest away from the heads. Also, the head leads must be cable clamped (or, contained between the thermistor cable and the mounting bracket for 200 TPI units) such that the leads will not interfere with the carriage travel.

6. The head lead spring clamp lock washer should be fully compressed. The springs and clamp may require adjustment such that they track correctly through the total head travel range. This adjustment is accomplished by enabling the drive motor and loading the heads as described in step 10.



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7. Clean the heads per Section 5.3.2.
8. Insert a clean, spare disk cartridge into the drive (Do Not use the CE cartridge).
9. Connect AC power to the disk drive.
10. Enable the drive motor and load the heads per Section 5.2, Special Procedures.

Warning: Allow drive motor to attain full speed before loading heads.

Warning: Immediately upon loading heads, carefully listen for head/disk interference while moving heads across entire disk surface. If interference is detected (scraping, rubbing, ticking sounds, etc.), immediately unload heads by moving carriage to its fully retracted position.

11. If heads are flying with no head/disk interference, proceed to adjust (if required) the head lead spring and clamp for correct (interference-free) tracking over the total carriage travel range.
12. The top heads (0 and 1) should now be aligned per Section 6.3.
13. Upon final head alignment and determination of satisfactory operation, replace all covers and return unit to normal operating status.

### 5.4.7 Head Replacement (Heads 2 or 3, Lower Set)

#### Removal

1. Remove disk cartridge from disk drive.
2. Disconnect AC power from disk drive.
3. Remove top cover (3 screws, each side)

Warning: Extreme care must be used in removing either of the lower heads.  
Proceed as follows:

4. Insert head spacers between each set of heads (upper and lower sets). The spacers keep the heads separated such that the load ramps are not required to maintain head separation.
5. Disconnect head connectors from Data PWB.
6. Remove all connectors from the backpanel PWB's and remove the PWB's.

Note: An alternate method for replacement of heads 2 and 3 is to remove the entire positioner assembly per Section 5.4.2. This facilitates easier access to the lower heads.

7. Remove head lead holder and the voice coil harness (plug P1) cable clamp (one screw).

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8. Remove the thermistor (200 TPI units only) cable clamps (2) from head ramp support. Be careful not to damage the thermistor or drop any of the associated hardware.
9. Remove the remaining screws (2) that attach the clamp arms to the ramp support.
10. Loosen (do not remove) the screw (1) that attaches the ramp support to the bed casting.
11. Slide the ramp support (and ramps) away from the heads (spacers must be between heads).
12. Loosen (do not remove) the screws (4) that attach the head block assembly (assembly that heads are mounted to) and carefully slide assembly up and away from the carriage.

Warning: A right angle allen wrench (or shortened allen driver) is required to reach all screw heads. Be careful not to strip or damage the screw heads, scratch the glass scale, run the glass scale into the retical assembly, etc.

13. Upon removing the head block assembly, loosen the head lock nut and screw (not the clamp plate screws).
14. Loosen the head lead spring clamp screw such that the springs for the two (2) lower heads can be removed.
15. Remove the spacers and install a double-fold Kim-Wipe between the lower head set.
16. The heads can now be pulled out of its slot. Be careful not to damage the adjacent head.

## Installation

1. Install the new head(s) into slot until the head locates against its stop pin (insert fully).

Important: Ensure the correct version head is being installed.

2. With Kim-Wipe between heads, tightened the head lock screw until there is approximately 0.01 inches deflection between the clamp plate and the head block (do not overstress) -- tighten lock nut.
3. Install head spacers.
4. Inspect carefully for correct seating and installation.
5. Install head lead springs into their respective clamps.

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Note: The spring for head number 2 should be located to the outside after clamping (farthest from the heads). The ends of the head lead springs are to be flush with the bottom of the clamp. The springs and clamp may have to be adjusted such that they track correctly through the total range of carriage travel. This adjustment is accomplished by enabling the drive motor and loading the heads as described in step 16 below.

6. Slide the head block assembly all the way back until it contacts the stop pin on the carriage. The block retaining screws should be tightened such that (through their lock washers) they press lightly against the head block while sliding the block into position.
7. Slide head block up and down several times -- then leave it seated in its bottom position.

Warning: The head block must reference to the reference side of the carriage. Also, the head block must seat against the carriage stop pin on the bottom of the carriage. There can be no room for error -- inspect carefully.

8. Tighten head block holding screws (4) securely.

Warning: Be careful not to damage glass scale, screw heads, etc.

9. Install head lead spring clamp arms to the ramp support. Slide the ramp into place and tighten its holding screw securely.

Warning: The head ramp must be referenced to the edge of the bed casting and to its far forward position.

10. Remove the head spacers and check that the ramps provide correct head separation.
11. Clean the heads per Section 5.3.2.
12. Install thermistor (200 TPI units only) and the two cable clamps.
13. Install PWB's into backpanel and insert connectors previously removed.
14. Connect head connectors to mating Data PWB connectors.
15. Disconnect plug P2 (See Table 5-1) at top, rear of PWB module.
16. Connect AC power to the disk drive.
17. After careful inspection of the new installation, enable the drive motor, clean the fixed disk (per Section 5.3.3), and then load the heads per Section 5.2, Special Procedures.

Warning: Allow drive motor to attain full speed before loading heads.

Warning: Immediately upon loading heads, carefully listen for head/disk interference while moving the heads across the entire disk surface. If interference is detected (scraping, rubbing, ticking sounds, etc.) immediately unload heads by moving carriage to its fully

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retracted position.

18. If heads are flying with no head/disk interference, proceed to adjust the bottom head lead springs for correct tracking over the total carriage movement range.

Note: Head lead springs are to be adjusted in their clamps such that the springs clear the front carriage bearing and track to the inside (between screws and center of head block) of the two head block retaining screws, located on the Heads-Up switch side of the positioner. The spring clamp lock washer must be fully compressed to ensure springs are securely clamped.

19. When all adjustments and installation inspection is complete, replace all covers, reconnect plug P2, verify fixed disk integrity, and check the top heads for correct radial and circumferential alignment (See Section 6.3).

## 5.4.8 Position Read Head Lamp

### Removal

1. Disconnect leads (2) at lamp terminals.
2. Loosen lamp set screw and remove lamp.

### Installation

1. Install new lamp.
2. Rotate and position (turn in or out) lamp to achieve correct operating performance per Sections 6.4.2 through 6.4.3 and 6.4.5 through 6.4.7. Do not over tighten set screw.

Note: Normally, the checkout and adjustment sequence should be as follows:

- a) Adjust for X0 retract balance per Section 6.4.7 and amplitude/balance per Section 6.4.2.
- b) Adjust for X90 amplitude/balance per Section 6.4.3 and retract balance per Section 6.4.7 while maintaining settings of step (a) above.
- c) Adjust for index per Section 6.4.1 while maintaining settings of steps (a) and (b) above.

Note: The position read head can be moved or rotated to assist in achieving the required specifications per Section 6.4.8; however, this procedure is not recommended unless absolutely necessary.

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Note: Any replacement or adjustment of the Position Read Head Lamp requires that the top heads be checked for correct radial and circumferential alignment (See Section 6.3).

3. Upon satisfactory performance, reassemble unit and return to normal operating status.

### 5.4.9 Fixed Disk Assembly (Top Load Units)

#### Removal

1. Disconnect AC power from the disk drive.
2. Remove top cover (3 screws, each side).
3. Remove rear blower assembly (3 screws, one connector).
4. Remove the magnet shield (2 screws) and air flow cover from top of voice coil.

Note: All connectors can be left in place since the positioner is only to be moved back and not to be removed from the unit.

5. Remove front 1/4-20 bolt (located in front glass scale) that holds the positioner assembly in place.
6. Move head carriage forward slightly (approximately 3/8 inch).

Warning: Do not move heads off the load ramps or the heads will load.

7. Remove the two (2) bolts at the rear of the voice coil, being careful not to drop lock washers into magnet assembly.

Warning: Move head carriage back to fully retracted position before performing Step 8 to prevent the bottom heads from hitting the fixed disk cover upon removal.

8. Lift positioner up off its two (2) dowel pins and slide it back until the front bearing rail will allow removal of the top fixed disk cover (See Section 5.4.2, Positioner Assembly).

Note: Lift positioner at bottom, rear of magnet assembly and at the center of either bearing rail.

Warning: When moving positioner, be careful not to damage the head leads or positioner harness.

9. Remove the fixed disk cover screws (5).

Note: Note the location of the cover relative to the five (5) mounting screws such that the cover can be re-installed in the same relative location.

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10. Disconnect the sector transducer cable connector, located at the head opening for the fixed disk.
11. Lift the cover carefully up and past the spindle to expose the fixed disk.
12. Remove the disk clamp screws (8) and remove the disk.

## Installation

1. Carefully inspect the new disk for scratches or other damage.
2. Clean the heads per Section 5.3.2.
3. Install the new disk by reversing the above removal procedure.

Warning: a) Be sure the disk clamp screws are not cross threaded and are tightened evenly and securely.  
b) The disk cover must be re-installed in the same relative location (within 0.010 inches).  
c) Tighten the three (3) positioner bolts securely and be sure all connectors are properly connected.

4. Connect AC power to the disk drive.
5. After careful inspection, enable the drive motor, clean the fixed disk (per Section 5.3.3), and then load the heads per Section 5.2, Special Procedures.

Warning: Allow drive motor to attain full speed before loading heads.

Warning: Immediately upon loading heads, carefully listen for head/disk interference while moving heads across entire disk surface. If interference is detected, immediately unload heads by moving carriage to its fully retracted position.

6. If heads are flying with no head/disk interference, reconnect voice coil plug P2 and proceed to perform read/write pattern operations on all tracks of the fixed disk to check for data errors.

Note: The top sector transducer must be set to its approximate location for error free operation.

7. After verification of disk data integrity, CE disk alignment is required to set the top sector transducer for amplitude and circumferential alignment.
8. Adjust top sector transducer per Section 5.4.11.
9. Using the CE cartridge, check head radial alignment per Section 6.3.12.
10. Upon verification of performance, replace all covers and return unit to normal operating status.

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### 5.4.10 Fixed Disk Assembly -- Front Load Units (Ref. Fig's. 9-14 and 9-15)

#### Removal

1. Disconnect AC power from the disk drive.
2. Remove positioner head cover (2 screws).
3. Remove disk cartridge air cover (loosen 2 screws and remove clamp).
4. Remove cartridge receiver hold down springs (2, one per side).
5. Remove the door opening spring and its torsion return spring.
6. Remove the cartridge receiver by removing the pivot shoulder screws (2, one per side) located at the back of the receiver -- do not remove the "L" brackets.
7. Remove front 1/4-20 bolt (located in front of the glass scale) that holds the positioner assembly in place.

Note: All connectors can be left in place since the positioner is only to be moved back and not removed from unit.

8. Move the carriage forward slightly (approximately 3/8 inch).

Warning: Do not move heads off the load ramps or the heads will load.

9. Remove the two (2) bolts at the rear of the voice coil, being careful not to drop lock washers into the magnet assembly.

Warning: Move the carriage back to its fully retracted position.

10. Lift the positioner up off its two (2) dowel pins and slide it back until the front bearing rail will allow removal of the top fixed disk cover (Ref. Section 5.4.2, Positioner Assembly).

Note: Lift positioner at bottom, rear of magnet assembly and at the center of either bearing rail.

Warning: When moving the positioner, be careful not to damage the head leads or positioner harness.

11. Remove the fixed disk cover screws (6).

Note: The rear baffle plate is also removed since it is held in place by two (2) of the six cover screws. Note the location of the cover relative to the six (6) screws such that the cover can be re-installed in the same relative position.

12. Disconnect the sector transducer cable connector and the lid switch connector.

13. Lift the cover carefully up and past the spindle to expose the fixed disk.

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14. Remove the disk clamp screws (8) and remove the disk.

## Installation

1. Carefully inspect the new disk for scratches or other damage.
2. Clean the heads per Section 5.3.2.
3. Install the new disk by reversing the above removal procedure.

Warning: a) Be sure the disk clamp screws are not cross threaded and are tightened securely.

b) The disk cover must be installed in the same relative location (within 0.010 inches).

c) Tighten the three (3) positioner bolts securely and be sure all connectors are properly connected.

4. Connect AC power to the disk drive.
5. After careful inspection, enable the drive motor, clean the disk and load the heads per Section 5.2, Special Procedures.

Warning: Allow drive motor to attain full speed before loading heads.

Warning: Immediately upon loading heads, carefully listen for head/disk interference while moving heads across entire disk surface. If interference is detected, immediately unload heads by moving the carriage to its fully retracted position.

6. If the heads are flying with no head/disk interference, reconnect voice coil plug P2 and proceed to perform read/write pattern operations on all tracks of the fixed disk to check for data errors.

Note: The top sector transducer must be set to its approximate location for error free operation.

7. After verification of disk data integrity, CE alignment is required to set the top sector transducer for amplitude and circumferential alignment.
8. Adjust the top sector transducer per Section 5.4.12.
9. Using the CE cartridge, check head radial alignment per Section 6.3.
10. Upon verification of performance, replace all covers and return unit to normal operating status.

### 5.4.11 Upper Sector Transducer Assembly -- Top Load (Ref. Fig. 9-14, Sh. 1)

## Removal

1. Remove transducer cover (1 screw) and disconnect connector.



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2. Loosen transducer set screw.
3. Turn transducer out and remove from unit.

### Installation

1. Install new transducer.
2. Connect black lead to red lead at transducer.

Note: The polarity must be such that the positive polarity pulse arrives first at TPl of the VFO PWB. Do not reverse this connection.

3. Locate transducer at approximate same position as previous transducer and secure set screw. Use the dummy sector ring as a measuring reference.
4. Sector transducer replacement or movement requires checking and appropriate adjustment of Sector amplitude. Refer to Section 6.2 for Sector/Index Amplitude adjustment procedures.
5. Upon careful checking of installation and adjustment, replace all covers and return unit to normal operating status, and check Circumferential alignment per Section 6.3.

### 5.4.12 Upper Sector Transducer Assembly -- Front Load (Ref. Fig 9-15, Sh. 1)

### Removal

1. Remove positioner head cover (2 screws).
2. Remove disk cartridge air cover (loosen 2 screws and remove clamp).
3. Remove the cartridge receiver hold-down springs (2, one per side).
4. Remove the door opening spring and its torsion return spring.
5. Remove the cartridge receiver by removing the pivot shoulder screws (2, one per side) located at the back of the receiver -- do not remove the "L" brackets attached to the casting.
6. Note the location of the transducer pole piece with respect to the edge of the spindle -- measure such that the new transducer can be set to the same location.
7. Loosen the two (2) screws that hold the transducer in place.
8. Remove the cable clamp screws (3).
9. Remove the transducer and cable assembly.

### Installation

1. Install the new transducer and cable assembly and partially tighten

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the two (2) clamp screws.

2. Locate the transducer pole piece in the same relative location as the replaced transducer.
3. Set height (top of disk cover to top of transducer) to  $1.25 \pm 0.015$  inches.
4. Sector transducer replacement or movement requires checking and appropriate adjustment of Sector amplitude. Refer to Section 6.2 for Sector/Index Amplitude adjustment procedures.
5. Upon careful checking of installation and adjustment, replace all covers and return unit to normal operating status.

## 5.4.13 Lower Sector Transducer Assembly (Ref. Fig's. 9-14, Sh. 2 and 9-15, Sh. 2)

### Removal

1. Remove unit from its skin per Section 5.4.1.
2. Turn unit on its side, power supply down.
3. Replace transducer by removing lock nut and turning transducer.

Note: Before removing transducer, note the approximate size of the gap between the transducer pole piece and the pulley.

### Installation

1. Install new transducer and adjust pole piece to give same approximate gap to the pulley as the replaced transducer. Secure lock nut.
2. Connect transducer connector (black wire to red wire).  
Note: The positive pulse peak must arrive first for correct polarity at TP2 of the VFO PWB.
3. Sector transducer replacement or movement requires checking and appropriate adjustment of Sector amplitude. Refer to Section 6.2 for Sector/Index amplitude adjustment procedures.
4. When performance is satisfactory, re-assemble unit to original operating status.

Check the following during re-assembly:

- a) Head carriage is fully retracted.
- b) Belt tension correct
- c) Pulley and transducer lock nuts are secure
- c) Bottom skin magnet shield is in place.

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### 5.4.14 Sector Pulley Assembly (Ref. Fig's. 9-14, Sh. 2 and 9-15, Sh. 2)

#### Removal

1. Disconnect AC power from the disk unit.
2. Remove unit from its skin per Section 5.4.1.
3. Place unit on its side, power supply down.
4. Remove pulley drive belt.
5. While holding spindle, remove pulley lock nut (turn CCW) and remove pulley.

Warning: While removing and installing pulley, be careful not to damage the Sector transducer.

#### Installation

1. Install the new pulley.

Warning: Rotate pulley through full revolution to ensure it does not touch the sector transducer.

2. Tighten lock nut -- again check for sector transducer/pulley clearance.
3. Install belt.
4. Loosen the two (2) drive motor retaining bolts approximately 3 or 4 turns and adjust drive motor position such that adjustment spring is pre-loaded to provide correct belt tension (See Section 6.7).
5. Tighten motor retaining bolts (2).
6. Install dummy sector ring.
7. Connect AC power to the disk drive.
8. Check sector transducer amplitude output and "Safe" lamp operation per Section 5.4.13, Sector Transducer Installation, steps 3 through 14.
9. When performance is satisfactory, re-assemble unit and return to normal operating status.

### 5.4.15 Drive Motor Assembly (Ref. Fig's. 9-13, 9-20, Sh. 1; and 9-21, Sh. 1)

#### Removal

1. Disconnect AC power from the disk unit.
2. Remove unit from its skin per Section 5.4.1.
3. Place unit on its side, PWB module down.
4. Remove bottom magnetic shield from underneath casting (2 screws).
5. Disconnect motor assembly cable (2 clamps, one connector).

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6. Remove "Disk Power" switch harness (one clamp), located on bottom of motor assembly plate.
7. Remove motor assembly pre-load spring and drive belt.
8. Remove motor assembly (2 bolts).

## Installation

1. Install new drive motor assembly by reversing the removal sequence (check motor for correct voltage and frequency).

Note: The pre-load spring must be installed and set for correct pre-load before tightening the two (2) motor retaining bolts (See Section 6.7).

2. Connect AC power to drive and check motor for proper operation.
3. Check drive motor for correct operation prior to installing unit skins.
4. Reassembly unit and return to normal operating status.

## 5.4.16 Power Supply Assembly (Ref. Fig's. 9-8, 9-20, Sh. 1; and 9-21, Sh. 1)

### Removal

1. Disconnect AC power from disk drive.
2. Remove unit from its skin per Section 5.4.1.
3. Place unit on its side, PWB module down.
4. Remove bottom magnetic shield (2 screws) from underneath casting.
5. Disconnect plug P1 (See Table 5-1) from backpanel and remove cable clamp.
6. Remove "Disk Power" switch connector P11 (See Table 5-1).
7. Remove J12 (See Table 5-1) connector from motor and rear blower.
8. Remove the four (4) power supply mounting bolts.
9. Remove the power supply.

### Installation

1. Install new power supply by reversing the above removal procedure (check for correct input voltage and frequency).
2. Connect AC power to the unit and check all power supply voltages.
3. Reassembly unit and return to normal operating status.

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### 5.4.17 5-Volt Regulator Assembly (Ref. Fig. 9-8, Sh. 1)

#### Removal

1. Disconnect AC power from disk drive.
2. Remove top cover.
3. Remove regulator heat sink retaining screw (located on top of the power supply).
4. Lift regulator assembly up and out, and disconnect plug P10 (See Table 5-1).

#### Installation

1. Install new regulator assembly by reversing the above removal procedure.

- Note:
- a) On early regulator assemblies, the head sink must be twisted from side to side to allow removal.
  - b) On early units, before installing regulator assembly, back off bottom regulator screw slightly and "glue" screw threads to power supply plate, and "glue" flat washer to screw head. This will allow the heat sink assembly screw slot to slip between the power supply plate and the flat washer as the heat sink assembly is installed.

2. Connect AC power and check regulator voltages.
3. Reassemble unit and return to normal operating status.

### 5.4.18 Switch Panel Assembly (Ref. Fig's. 9-16, and 9-17)

#### Removal

1. Disconnect AC power from the disk drive.
2. Remove top cover.
3. Place unit on its side.
4. Remove air filter plate from underneath unit (4 screws).
5. Remove filter Assembly.
6. Disconnect front panel switch harness from unit harness (one connector).
7. Disconnect the "Disk Power" switch harness (2 quick disconnects).
8. Remove the switch panel insert from the front panel by coming through the filter plate opening (3 nuts, one clamp plate).
9. Switch panel problem may now be corrected (switch replacement, repair wiring, etc.)

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## Installation

1. Install switch panel by reversing above removal procedure.
2. Reassemble unit and return to normal operating status.

Note: Switch panel "lamps" can be replaced from the front of the panel by removing the individual switch lens.

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## SECTION 6 -- TEST AND ADJUSTMENT PROCEDURES

This section contains necessary Test and Adjustment Procedures for all Series 6000 Disk Drives.

For the convenience of experienced field service personnel (i.e., service personnel who are thoroughly familiar with Series 6000 Disk Drive theory and test procedures), the following Sections are presented in two forms:

- QUICK REFERENCE -- for quick and easy reference to test points, parameters, etc.
- EXPANDED PROCEDURE -- for step-by-step test and adjustment procedures.

### 6.1. Special Tools

#### Special Tools

<u>Part Number</u>	<u>Description</u>	<u>Recommended Quantity</u>	
		<u>Per Number of Units</u>	
		1-10	10-50
DCA148	CE Cartridge (Top Load)	1	2
DCA189	CE Cartridge (Front Load)	1	2
DE5020	Disk Exercisor	1	2
DT6020	Disk Suitcase Tester	1	2
DRD191P1	Dummy Sector Ring (Top Load)	1	2
DRD192P1	Dummy Sector Ring (Front Load)	1	1
C134G1	PWB Extender	1	2
HAA149P1	Cleaning Wand	2	5
B098P1	Head Spacers	3	5

### 6-2 Sector/Index Amplitude Check and Adjustment

This is a general CE alignment or troubleshooting check for both fixed disk and removable disk sector transducers (top load and front load models). Reference sector transducer replacement procedures, Sections 5.4.11 (removable disk, top load), 5.4.12 (removable disk, front load) and 5.4.13 (fixed disk).

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### 6.2.1 Removable Disk Sector/Index Amplitude Adjustment (Top Load)

Refer to Section 5.4.11 for disassembly and transducer replacement procedure.

#### QUICK REFERENCE

<u>Sequence</u>	<u>Test Points/ Adjustment</u>	<u>Limit Values</u>
1. Install dummy sector ring.		
2. Sync. scope Ch. 1 (VFO PWB)	TP12*	
3. Connect scope Ch. 2 (VFO PWB)	TP1	
4. Enable drive motor (manual)		
5. Check and adj. P-P amplitude (Ch. 2) Note: When setting amplitude, be sure to compensate for speed variation (2400 RPM or 50 Hz)	TP1	±10% of dummy ring amplitude standard (pos. pulse first). When re-adjusting, set to <u>±</u> 5%.
6. Per Section 6.3, check Circumferential timing range of IC34 (VFO PWB) to determine disk cover adj. require- ments.	R84 (CE Align.)	
*TP12 = Single-slot sector ring		

#### EXPANDED PROCEDURE

1. Install dummy sector ring.

Warning: Be careful not to contact the transducer when seating the dummy ring on the spindle. Turn the ring slowly and ensure that it does not touch the transducer.

2. Sync scope Channel 1 on TP12 (single-slot sector ring) on the VFO PWB. Sync will occur once per revolution when motor is turning at full speed.
3. Connect scope Channel 2 to TP1 on the VFO PWB.
4. Connect AC Power to disk drive.
5. Enable drive motor per Section 5.2, Special Procedures.

Warning: Do not load heads.

Note: Scope will not sync if transducer amplitude is very far "off", or motor is not turning.



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6. TPl on the VFO PWB must produce a peak-to-peak amplitude equivalent ( $\pm 10$  percent) to the index slot amplitude marked on the dummy ring (use delayed sweep, 0.1 ms/cm, to allow precise measurement). The positive pulse polarity must arrive first -- if not, the transducer connection is reversed.
7. Loosen set screw (slightly), and move transducer forward or backward for correct amplitude (Be careful of sector ring).

Note: Be sure to re-tighten set screw.

- Note:
- a) When setting the transducer, it should be adjusted to  $\pm 5$  percent such that it is well within the  $\pm 10$  percent value on all dummy sector rings.
  - b) Also, it should be noted that the index amplitude on a CE cartridge can be recorded for that given cartridge in reference to a dummy sector ring and be used as a standard (use delayed sweep of 0.1 ms/cm, main sweep of 5 ms/cm).
  - c) For 2400 RPM or 50 Hz disk drives (speed controlled drives), the speed percent must be compensated for.

Example: If the dummy sector ring is 3.0 volts  $\pm 5$  percent, and the disk is turning 5 percent fast, as determined by measuring time between TPO pulses on delayed sweep, then adjust the sector transducer for 3.15 volts  $\pm 5$  percent.

8. Per Section 6.3, determine that the head circumferential (timing) adjustment can be obtained within the adjusting range of IC34 (VFO PWB). If not, the fixed disk cover plate may have to be rotated to get within the correct range. Normally this is only required when the disk cover plate has been removed.

- Notes:
- a) IC34 (VFO PWB) will adjust from 17 to 70 microseconds (10 microseconds is equal to 0.005 inches at the sector transducer for 1500 RPM, and 0.008 inches for 2400 RPM).
  - b) If the transducer location is moved or changed for any reason, the transducer must be re-checked for amplitude.
  - c) IC34 is adjusted by R84 on the VFO PWB during CE alignment.

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### 6.2.2 Removable Disk Sector/Index Amplitude Adjustment (Front Load)

Refer to Section 5.4.12 for disassembly and transducer replacement procedures.

#### QUICK REFERENCE

<u>Sequence</u>	<u>Test Points/ Adjustment</u>	<u>Limit Values</u>
1. Install dummy sector ring.		
2. Sync scope Ch. 1 (VFO PWB)	TP0	
3. Connect scope Ch. 2 (VFO PWB)	TP1	
4. Enable drive motor (manual)		
5. Check and adj. P-P amplitude (Ch. 2) <u>Note:</u> When setting amplitude, be sure to compensate for speed variation (2400 RPM or 50 Hz)	TP1	± 10% of dummy sector ring amplitude standard (pos. pulse 1st). When re-adjusting, set for <u>±</u> 5%.
6. Check transducer height (between disk cover and top of transducer)		1.25 ± 0.015 inches
7. Per Section 6.3, check Circumferential timing range of IC34 (VFO PWB) to determine disc cover plate adj. requirements.	R84 (CE Align)	

#### EXPANDED PROCEDURE

1. Install dummy sector ring.

Warning: Be careful not to contact the transducer when seating the dummy sector ring. Turn the ring slowly and ensure that it does not touch the transducer at any point.

2. Sync scope Channel 1 to TP0, VFO PWB. Sync will occur once per revolution when motor is turning at full speed.
3. Connect scope Channel 2 to TP1, VFO PWB.
4. Enable drive motor per Section 5.2, Special Procedures.

Warning: Do not load heads.

Note: Scope will not sync if transducer amplitude is very far "off", or motor is not turning.

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5. TPl on the VFO PWB must produce a peak-to-peak amplitude equivalent ( $\pm 10$  percent) to the index slot amplitude marked on the dummy sector ring (use delayed sweep, 0.1 ms/cm to allow precise measurement). The positive pulse polarity must arrive first -- if not, the transducer connection is reversed.

Note: When setting the transducer, it should be adjusted to  $\pm 5$  percent such that it is well within the  $\pm 10$  percent value on all dummy sector rings.

6. Secure clamp screws when amplitude is correct and check amplitude again.
7. Check transducer height for  $1.25 \pm 0.015$  inches from top of disk cover to top of transducer.

Note: It should be noted that the index amplitude on the CE cartridge can be recorded for that given cartridge in reference to a dummy sector ring and be used as a standard.

8. If the disk drive is 2400 RPM or 50 Hz (speed controlled drives), the speed percent must be compensated for.

Example: If the dummy sector ring is 0.4 volts  $\pm 5$  percent, and the disk is turning 5 percent fast, as determined by measuring time between TPO pulses on delayed sweep, then adjust the sector transducer for  $0.42 \pm 5$  percent.

9. Reassemble and install the receiver unit, springs and other hardware per Section 5.4.12. Install a spare cartridge and ensure it seats properly and that the door opener spring functions correctly.
10. Remove spare cartridge and install CE cartridge.
11. Per Section 6.3, determine that the head circumferential (timing) adjustment can be obtained within the adjusting range of IC34 (VFO PWB). If not, the fixed disk cover plate may have to be rotated, or the transducer may have to be moved slightly to get within the correct range. Normally this is only necessary when the disk cover plate has been removed.

Note:

- a) IC34 (VFO PWB) will adjust from 17 to 70 microseconds (10 microseconds is equal to 0.005 inches at the sector transducer at 1500 RPM, and 0.008 inches for 2400 RPM).
- b) If the transducer location is moved or changed for any reason, the transducer must be re-checked for amplitude.
- c) IC 34 is adjusted by R84 on the VFO PWB during CE alignment.

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### 6.2.3 Fixed Disk Sector/Index Amplitude Adjustment

Refer to Section 5.4.13 for disassembly and transducer replacement procedures.

#### QUICK REFERENCE

<u>Sequence</u>	<u>Test Points/ Adjustment</u>	<u>Limit Values</u>
1. Install dummy sector ring.		
2. Sync scope Ch. 1 (VFO PWB)	TPO* or TP12*	
3. Connect scope Ch. 2 (VFO PWB)	TP2	
4. Enable drive motor (manual)		
5. Check maximum P-P amplitude (Ch. 2) <u>Note:</u> Adj. amplitude by rotating transducer (set to high end of voltage limit to ensure motor comes to "stop" before "Safe" lamp comes "ON")	TP2**	1.5 to 2.4 volts P-P (2.4 to 3.8 volts P-P for 2400 RPM)
6. Check signal runout variation	TP2	4 to 1 ratio (max.)
7. From "full" RPM verify motor comes to complete stop before "Safe" lamp comes "ON" (cartridge must be installed)	Observe	
8. If "Safe" lamp comes "ON" <u>before</u> motor stops, adj. transducer for <u>greater</u> amplitude per step 5, but stay within specified limits.		
9. Check extraneous signal (noise) level on baseline (Ch. 2).	TP2	25 mv (baseline-to-positive peak)
10. If extraneous signal level is "high", reduce transducer amplitude as necessary  <u>Note:</u> Steps 5 and 10 must both be satisfied.		

\*TPO = Front Load, Multi-slot sector ring; TP12 = Top Load Single-slot sector ring

\*\*Units with revision "H" or later motor brake PWB (See Section 4.8.2) are normally set at the minimum value (1.5 or 2.4 volts respectively).

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## EXPANDED PROCEDURE

1. Install dummy sector ring.

Warning: Use caution, AC terminals on the power supply are exposed.

2. Connect scope Channel 2 to TP2, VFO PWB.
3. Sync scope Channel 1 on TPO (Multi-slot sector ring) or TP12 (Single-slot sector ring). Sync will occur once per revolution when motor is turning at full speed.
4. Enable drive motor per Section 5.2, Special Procedures.
5. At full speed, maximum P-P signal at TP2 should be 1.5 to 2.4 volt peak-to-peak maximum (2.4 to 3.8 volts for 2400 RPM).

Note: Maximum allowable signal runout variation is 4 to 1.

6. Amplitude is adjusted by loosening the transducer lock nut and turning the transducer (Do not turn the pole piece into the pulley).

Warning: Never adjust transducer amplitude while disk is turning. Stop drive motor by moving the carriage to the fully retracted position and wait for disk to stop turning.

Note: Adjust transducer until amplitude is correct. It is best to adjust amplitude to high end of specification (approx. 2.1 or 3.3 volts).

7. Tighten lock nut and re-check amplitude.

Important: Transducer amplitude must be sufficient to guaranty that the motor has always come to a complete stop before the "Safe" lamp comes on. To check, perform the following steps:

8. Bring drive motor to full speed, then turn power off by retracting the carriage.
9. The drive motor must come to a complete stop before the "Safe" lamp comes on.

Note: There must be two (2) disks installed for this test (not the dummy sector ring).

10. If the drive motor does not stop before the "Safe" lamp comes "ON", adjust transducer for greater amplitude per step 6 above, but stay within specified limits.
11. With scope connected per steps 2 and 3 above, set delayed sweep to 0.1 ms/cm, and set Channel 2 to 50 mv/cm.
12. Using the variable delay, sweep "slowly" across the Channel 2 signal (TP2) and carefully observe the baseline (ground). Maximum allowable baseline-to-positive peak extraneous signal amplitude is 25 millivolts (Extraneous signals are caused by nicks, scratches, etc. in the pulley surface). Extraneous signal amplitude can be reduced by decreasing the sector amplitude, if necessary. Note that the circuit signal threshold is fixed at 50 millivolts.

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### 6.3 Head Alignment (Heads 0 and 1, Upper Set)

#### 6.3.1 General

#### QUICK REFERENCE

<u>Sequence</u>	<u>Test Points/ Adjustment</u>	<u>Limit Values</u>
1. Temperature stabilize disk drive. <u>Note:</u> Servo system adj. must be correct per Section 6.4 prior to any head alignment.		$77^{\circ}\text{F} \pm 5^{\circ}\text{F}$ (3 hours)
2. Connect Disk Drive Exerciser unit <u>Note:</u> If Suitcase Tester is used, jumper backpanel pins 38 and 40 together when a <u>single</u> index CE cartridge is used.	I/O Port	
3. Ground FUNLA signal on Control PWB (slot A2), Disables servo retract ckt.	Pin 9 to GND	
4. Place Write Protect switches "ON" (both)		
5. Insert CE cartridge, depress "Disk Drive" sw. "ON" and allow unit to temperature stabilize.		1 hour

#### EXPANDED PROCEDURE

- Remove top cover (3 screws, each side) and positioner cover (2 screws). Use caution, do not bend or damage voice coil tapes.
- Refer to Section 5.4.6 for head replacement procedures.
- During functional checking or alignment of the upper heads (0 and 1), environmental conditions must have been stable at an ambient temperature of  $77^{\circ}\text{F} \pm 5^{\circ}\text{F}$  for a period of three (3) hours prior to and during alignment.
- The front panel must not support any unit weight during alignment-- total weight should be supported by the outside skins.
- The servo system must be functioning correctly prior to any head alignment check or adjustments. See Section 6.4 for Servo checks and adjustments.

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6. The rear blower assembly must be installed and functioning.
7. For the following head alignment checks and adjustments, the Exerciser cable (see Note below) should be inserted into one of the backpanel I/O connectors, with all system I/O cables removed.  
Warning: DC power must be "OFF" while removing or inserting PWB's and I/O connectors.  
Note: If the Suitcase Tester is used, backpanel pins 38 and 40 (Slot A1) should be jumpered together when a single slot CE Cartridge is used (one slot on sector ring).
8. When installing new heads, the Radial Check and Alignment procedure should be performed before performing the Circumferential Check and Alignment procedure.  
Warning: Data should be transferred to a spare cartridge prior to inserting the CE Cartridge to verify that the heads are functioning properly.  
Warning: Pin 9 (FUNLA) of the Control PWB (Slot A2) must be grounded (jumpered to ground buss on module) prior to installing the CE Cartridge. This disables the servo retract circuits (See Section 4.4.10 for Emergency Servo Control theory) and prevents the positioner from retracting at "high velocity" under emergency conditions. The positioner can, however, still retract under an emergency power failure condition.
9. Insert the CE Cartridge -- depress the "Disk Drive" switch "ON" and allow the unit to come "Ready".  
Note: Allow the unit to remain in the "Ready" state for at least one (1) hour to temperature stabilize the disk drive unit and cartridge.
10. Once the disk drive has temperature stabilized, proceed to Sections 6.3.2 and 6.3.4 for Radial and Circumferential Head Check Procedures.

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### 6.3.2 Radial Head Check Procedure

#### QUICK REFERENCE

<u>Sequence</u>	<u>Test Points/ Adjustment</u>	<u>Limit Values</u>
1. Sync scope Ch. 1 on Index (VFO PWB)	TPO* or TP12*	
2. Connect scope Ch. 2 (Data PWB)	TP3	
3. Move head to "radial" align. track	Top Load Track 73, (100TPI) Track 146 (200TPI)	
	Front Load Track 100, (100TPI) Track 200, (200TPI)	
4. Check scope display pattern per Fig's. 6-1 and 6-2. <u>Note:</u> If Radial align. pattern is <u>not</u> correct, proceed to Section 6.3.3. If <u>correct</u> , proceed to Section 6.3.4 (Circumferential).		

\*TPO = Multi-slot CE Cartridge; TP12 = Single-slot CE Cartridge

#### EXPANDED PROCEDURE

1. Refer to Section 6.3.1 for General Head alignment information.
2. Sync scope Channel 1 on the index pulse (TP12 on VFO PWB for single-slot CE Cartridges; or TPO for multi-slot CE Cartridges).

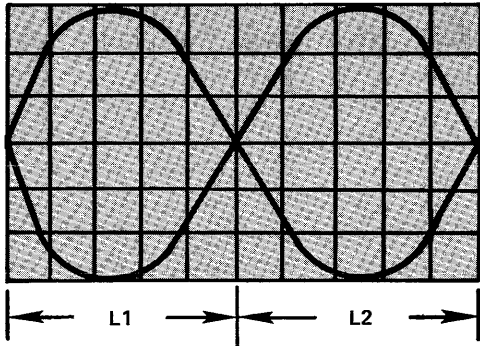
Warning: Do Not use a multi-slot CE Cartridge on any drive that uses a single slot cartridge in normal application without temporarily changing the "H" jumper on the VFO PWB (Ref. Fig. 9-5, Sh. 2, Loc. 6F). Changing the "H" jumper allows the cartridge to speed control (See Fig. 6-3).



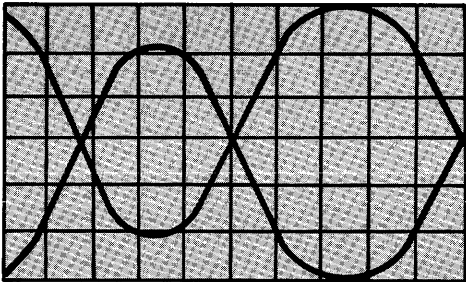
# Series 6000 DISK DRIVE

CE CARTRIDGE: TRACK 73 (100 TPI); TRACK 146 (200 TPI)

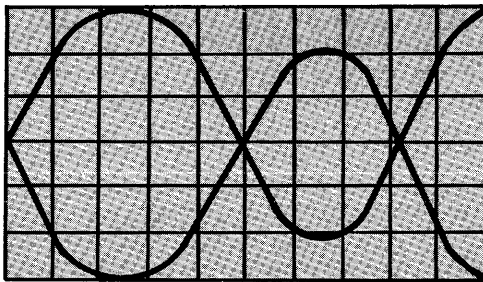
CORRECT ALIGNMENT L1 = L2 (NOTE 1)



APPROACHING TRACK 73 (146)



PAST TRACK 73 (146)



- Notes:
1. Use the horizontal sweep control to set the two (2) loops across 10 centimeters. Each loop is to be between 4.85 and 5.15 cm in length. Sweep setting will be approximately 2 mS per division.
  2. The above CE patterns may also be found on some front load CE Cartridges—depending on the CE Cartridge used.
  3. Center node, horizontal variation (end points held constant) of CE pattern is approximately 100 microinches per 0.2 cm.

FIGURE 6-1  
RADIAL ALIGNMENT PATTERN – TOP LOAD UNITS

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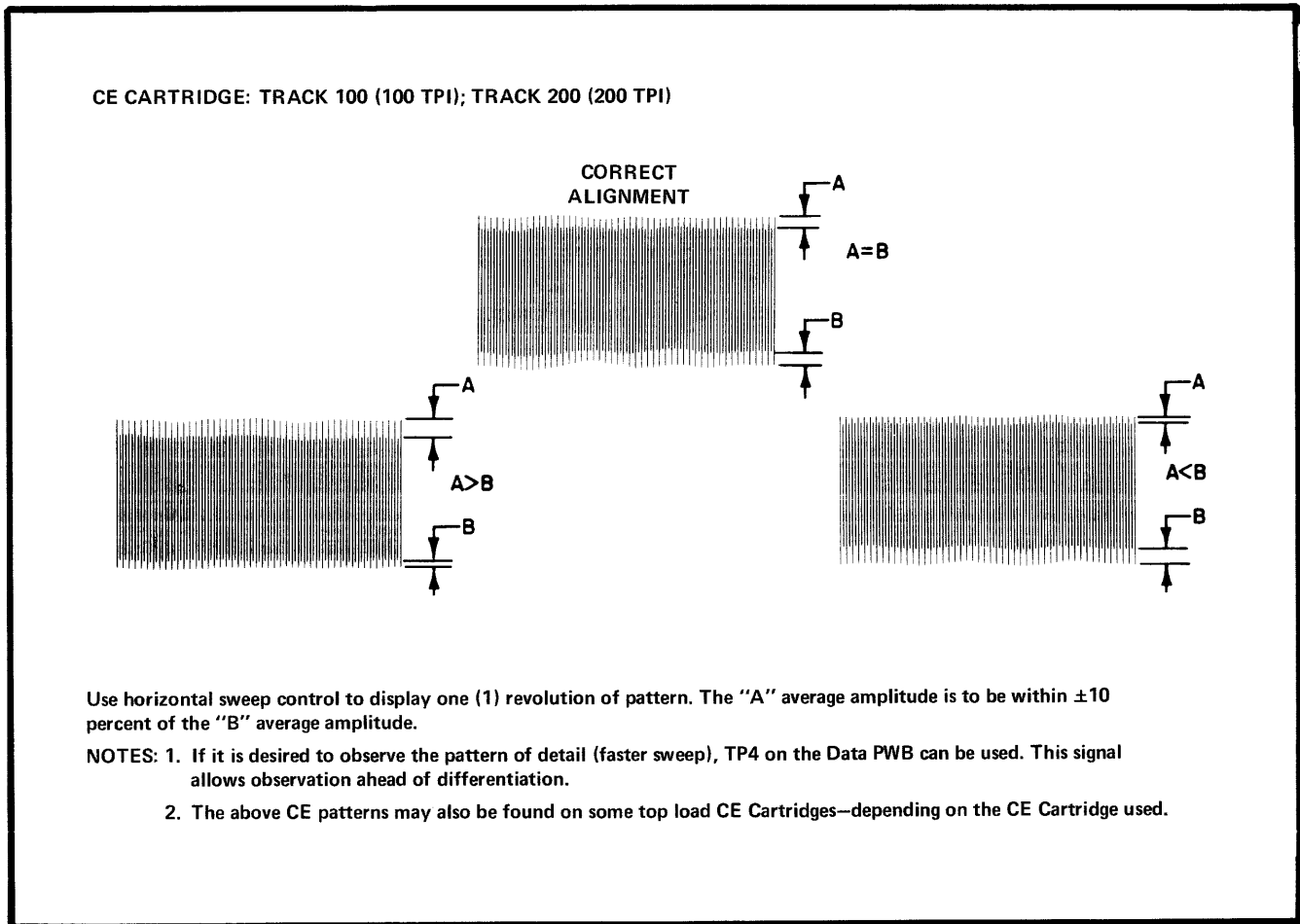


FIGURE 6-2  
RADIAL ALIGNMENT PATTERN — FRONT LOAD UNITS

# Series 6000 DISK DRIVE

3. Connect scope Channel 2 probe to TP3 of the Data PWB.
4. Set scope Channel 2 sensitivity to 200 mv/cm and time base to 2 ms/cm.
5. Move the positioner to radial alignment track as follows:
  - o Top Load Units: Track 73 (100 TPI); Track 146 (200 TPI)
  - o Front Load Units: Track 100 (100 TPI) Track 200 (200 TPI)

Note: Scope alignment patterns and specifications are provided in Figure 6-1 (Top Load Units) and Figure 6-2 (Front Load Units).

6. Observe scope display pattern for each head as specified in Figures 6-1 and 6-2.
7. If the Radial Alignment Pattern is not correct, proceed to Section 6.3.3, Radial Head Alignment. If the Radial Pattern is correct, proceed to Section 6.3.4, Circumferential Head Check Procedure.

### 6.3.3 Radial Head Adjustment Procedure

This procedure is a continuation of Section 6.3.2, Radial Head Check Procedure.

#### QUICK REFERENCE

<u>Sequence</u>	<u>Test Points/ Adjustment</u>	<u>Limit Values</u>
1. From Fig's. 6-1 and 6-2, determine direction each head (0 or 1) must be moved. 2. Move head in desired direction to obtain correct align. pattern. 3. Proceed to Section 6.3.4, Circumferential Head Check.		Fig's. 6-1 & 6-2

#### EXPANDED PROCEDURE

1. From Figures 6-1 or 6-2, determine which direction each head (0 or 1) must be moved.

Important: If both heads are aligned to within 150 microinches of each other, and have a common error of less than 125 microinches, then refer to Section 6.5, Servo Offset Adjustment.

2. Loosen the lock nut and clamp screw for the appropriate head. Align only one head at a time.

# Series 6000

## DISK DRIVE

3. Grasp the respective head by thumb and forefinger and carefully move the head in the correct direction until the desired pattern is observed. Always ensure that the head is referenced "flush" against the head block to minimize timing offset between heads.
4. Tighten the head clamp screw until the clamp deflects 0.01 inch from the head block -- then tighten the lock nut.
5. Recheck the patterns. Move the positioner away from the test track and then back again -- again check the patterns. Re-align as necessary.
6. When radial alignment is correct for both heads (0 and 1), proceed to Section 6.3.4, Circumferential Head Check.

### 6.3.4 Circumferential Head Check Procedure

Note: If any radial alignment is performed, a circumferential check is necessary.

#### QUICK REFERENCE

<u>Sequence</u>	<u>Test Points/ Adjustment</u>	<u>Limit Values</u>
1. Sync scope Ch. 1 on Index (VFO PWB)	TP0* & TP12*	
2. Connect scope Ch. 2 (Data PWB)	TP3	
3. Move head to Circumferential align. track (CE cartridge)	Top Load Track 05 (100TPI) Track 10 (200TPI)	
	Front Load Track 95 (100TPI) Track 190 (200TPI)	
4. Check <u>delay</u> from Index to center of timing pulse (check each head, 0 & 1). Ref. Fig's. 6-3 and 6-4.	TP3	30 ± 6 us (19 ± 4 us for 2400 RPM)
5. If Circumferential head align. is <u>not</u> correct, proceed to Section 6.3.5, Circumferential Alignment.		

\*TP0 = Multi-slot CE Cartridges; TP12 = Single-slot CE Cartridges

# Series 6000 DISK DRIVE

## EXPANDED PROCEDURE

1. Refer to Section 6.3.1 for General head alignment information.
2. Move the positioner to circumferential alignment track as follows:
  - o Front Load Unit: Track 95 (100 TPI); Track 190 (200 TPI)
  - o Top Load Unit: Track 05 (100 TPI); Track 10 (200 TPI)

Note: Scope alignment patterns and specifications are provided in Figures 6-3 (Speed Controlled Cartridges) and 6-4 (Non-Speed Controlled Cartridges).

3. Sync scope Channel 1 on index pulse (TP12 on VFO PWB, Slot A1, for single-slot, non speed controlled CE Cartridges; or TP0 for multi-slot, speed controlled CE Cartridges).

Warning: Do not use a multi-slot CE Cartridge on any drive that uses a single-slot cartridge in normal application without temporarily changing the "H" jumper on the VFO PWB (Ref. Fig. 9-5, Sh. 2, Loc. 6F). Changing the "H" jumper allows the cartridge to speed control (See Fig. 6-3).

4. Connect scope Channel 2 to TP3 on the Data PWB.
5. Set scope Channel 2 sensitivity to 500 mv/cm and time base to 5 us/cm.
6. Observe the time delay from the reference pulse to the peak of the timing pulse. The delay from the reference edge of the reference pulse to the center of the timing pulse should be  $30 \pm 6$  microseconds ( $19 \pm 4$  microseconds for 2400 RPM) for each head (0 and 1).
7. Refer to Figures 6-3 and 6-4 for circumferential alignment patterns and specifications.
8. If circumferential alignment is correct, restore the unit to normal operating status.
9. If circumferential alignment is not correct, proceed to Section 6.3.5, Circumferential Head Adjustment Procedure.

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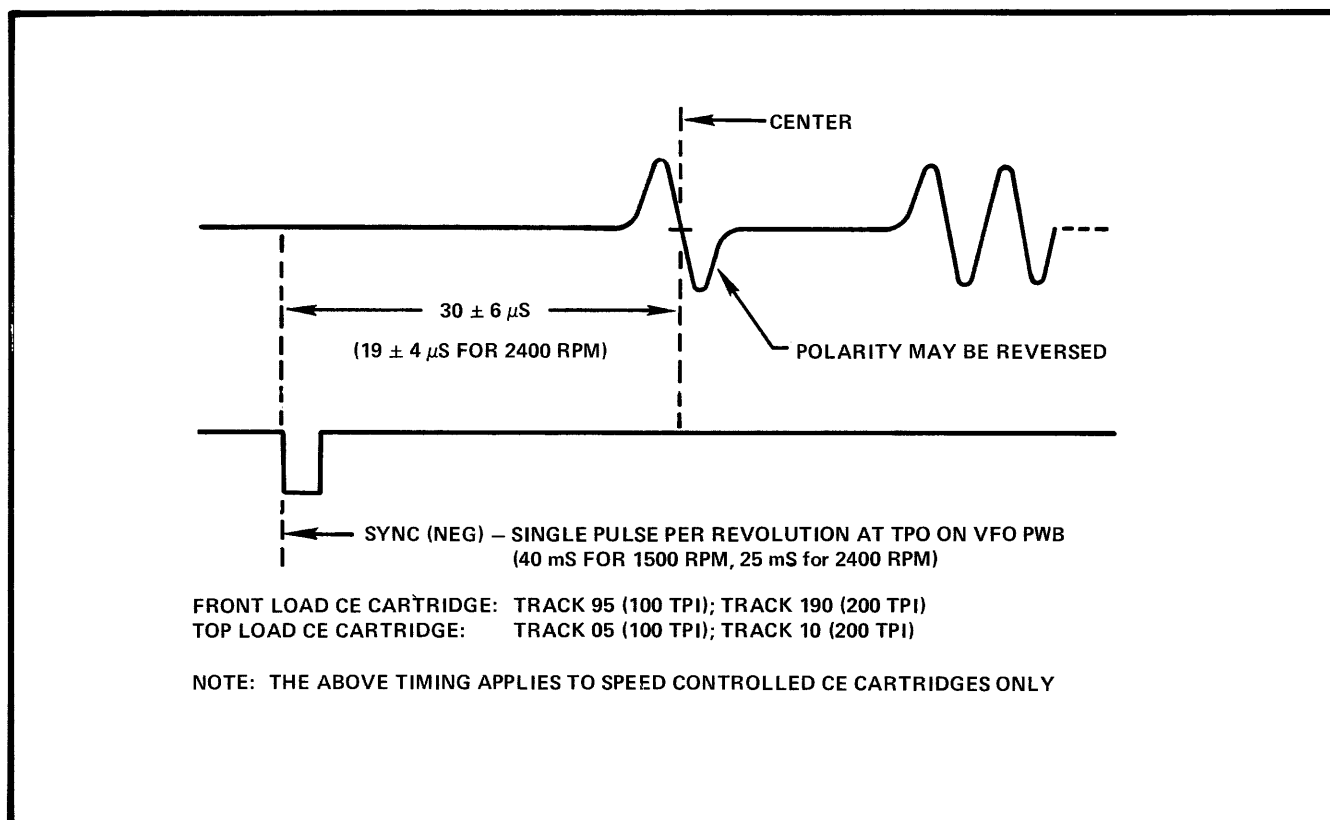
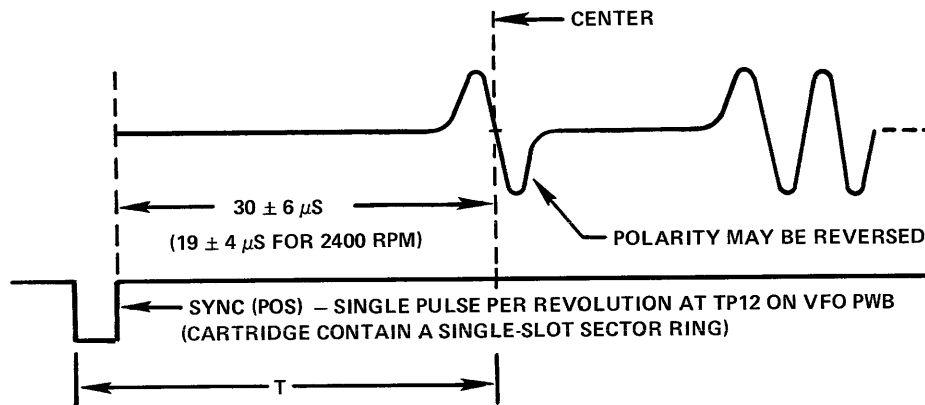


FIGURE 6-3  
CIRCUMFERENTIAL ALIGNMENT PATTERN  
(SPEED CONTROLLED CE CARTRIDGES - SEE FIG. 6-4  
FOR NON-SPEED CONTROLLED CARTRIDGES)

# Series 6000 DISK DRIVE



TOP LOAD CE CARTRIDGE: TRACK 05 (100TPI); TRACK 10 (200 TPI)

**NOTE:**

CE cartridges which have only one (1) slot on the sector ring, which are to be used on a drive where normal application cartridges (used on that drive) have multiple sector slots (8 thru 32 sectors and an index), must have the above timing values modified by the quantity  $T(SM/SN-1)$ . This quantity is algebraically added to each value to compensate for the disk speed control function. The speed control, in other words, will not function in the previous case, resulting in the disk turning fast. "T" is as measured above; SM is measured revolution time (use delayed sweep); SN is nominal revolution time (40 mS for 1500 RPM, 25 mS for 2400 RPM).

Speed control is used on 2400 RPM units and 50 Hz units only. The speed control will function, however, if the normally used disk cartridges agree with the CE cartridge sectoring (single or multiple slots). This is to say, there is a single negative pulse per revolution at TP0 on the VFO PWB.

**WARNING**

Do not use a multiple sector slot CE cartridge on any drive that uses a single slot cartridge in normal application without temporarily changing the "H" jumper on the VFO PWB (Ref. Fig. 9-5, Sh. 2, Loc. 6F). Changing the "H" jumper allows the cartridge to speed control (See Fig. 6-3).

**FIGURE 6-4**  
CIRCUMFERENTIAL ALIGNMENT PATTERN  
(NON-SPEED CONTROLLED CE CARTRIDGES -  
APPLIES TO TOP LOAD UNITS ONLY)

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## DISK DRIVE

### 6.3.5 Circumferential Head Alignment Procedure

This procedure is a continuation of Section 6.3.4, Circumferential Head Check Procedure.

#### QUICK REFERENCE

<u>Sequence</u>	<u>Test Points/ Adjustment</u>	<u>Limit Values</u>
1. Check timing pulse spread from head-to-head (0 and 1), Data PWB.  2. If Step 1 timing spread is incorrect, check head mounting-to-head block reference.  <u>Note:</u> If head mounting adj. is required, re-check radial head align. per Section 6.3.2, before proceeding.	TP3	12 us maximum (8 us maximum for 2400 RPM)
3. If timing pulses are out of spec per Fig's. 6-3 and 6-4, adj. sector transducer timing (Sector Counter PWB).  <u>Note:</u> If R84 adj. range is insufficient, rotate fixed disk cover "slightly".  <u>Note:</u> Remove GND jumper from pin 9 of Control PWB.	R84	30 ± 6 us (19 ± 4 us for 2400 RPM)

#### EXPANDED PROCEDURE

- If the timing pulse spread from head-to-head (0 and 1) is greater than 12 microseconds (8 microseconds for 2400 RPM), head referencing to the head block is incorrect. Should this be the case, readjustment of the head mounting to the head block reference is necessary.

Warning: Any re-adjustment of head mounting requires rechecking radial head alignment per Section 6.3.2 before proceeding with circumferential head alignment.

- If the timing pulses are out of specification with respect to Figures 6-3 and 6-4, then the sector transducer "rotational" position is incorrect. To correct, adjust potentiometer R84 on the Sector Counter PWB (Slot A1) for correct timing -- be careful not to adjust the wrong potentiometer.



# Series 6000 DISK DRIVE

Note: a) for top load units, the fixed disk cover may have to be rotated slightly if the adjustment range of R84 is insufficient.

b) To avoid "CE alignment" when field replacing the Sector Counter PWB, TP12 can be measured to within  $\pm 500$  nanoseconds and be used to preset R84 on the new PWB.

- If all radial and circumferential head alignment is correct, restore the unit to its normal operating status.

Note: Remember to remove the ground jumper from pin 9 of the Control PWB.

## 6.4 Servo Checks and Adjustments

### 6.4.1 Index Balance Check and Adjustment

#### QUICK REFERENCE

<u>Sequence</u>	<u>Servo PWB Test Points/ Adjustment</u>	<u>Limit Values</u>
1. Connect scope Ch. 1 (Servo PWB) to Analog Index Signal	TP5	
2. Connect scope Ch. 2 (Servo PWB) to DPTI-H, Digital Index Signal.	TP6 Auto Sync, Chopped Mode	
3. Enable drive motor (manual)		
4. Move carriage forward to <u>load</u> heads and observe voltage swing <u>above</u> and <u>below</u> ground.	TP5	2.0V + Peak-to-GND (min) 3.0V - Peak-to-GND (min)
5. Adj. Balance Pot (IB) for equal voltage swing with respect to GND -- maintaining peak-to-GND minimum limits. <u>Note:</u> This is an initial setting. Ref. Section 6.4.7 for final setting.	R30	
6. Observe DPTI, Digital Index Signal.	TP6	<u>Pos.</u> level when analog signal above GND. <u>Neg.</u> level when analog signal below GND. (Neg. edge = track $-1\frac{1}{2}$ from 000)
7. Unload heads unless required for other checks.		

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### QUICK REFERENCE

<u>Sequence</u>	<u>Servo PWB Test Points/ Adjustment</u>	<u>Limit Values</u>
<p><u>Note:</u> On PWB replacement, set TP5 positive peak (per step 4 above) equal to that of replaced PWB by adjusting the Balance Pot (IB).</p>	<p>TP5</p>	<p>Positive level to be within 0.2 volts of replaced PWB.</p>

### EXPANDED PROCEDURE

1. Connect scope Channel 1 to TP5 (analog index signal) on the Servo PWB, and set sensitivity to 2 volts/cm.
  2. Connect scope Channel 2 to TP6 (DPTI-H) and set sensitivity to 2 volts/cm.
  3. Set scope sweep to 10 ms/cm, Auto Sync, and Chopped Mode.
  4. Manually move head carriage forward to load heads (both removable and fixed disks must be installed). See Section 5.2, Special Procedures.
  5. TP5 should show a "minimum transition region" of 5 volts as the carriage is moved forward to load the heads (i.e., the signal will go from low to high, then high to low). The positive peak-to-ground signal must be 2.0 volts (minimum), and the negative peak-to-ground signal must be 3.0 volts (minimum).
  6. Adjust the Balance potentiometer R30 (IB) until the transition region is centered approximately at ground. This is an initial setting -- refer to Section 6.4.7 for the final setting.
  7. TP6 is a digital signal that will be high if the TP5 signal is above ground, and low if the TP5 signal is below ground. The negative going edge corresponds to approximately track location - 1½ from address 000.
  8. The heads can now be unloaded unless required for other checks and adjustments.
- Note: During Servo PWB replacement, to avoid CE alignment, adjust R30 (IB) until the TP5 most positive (per Step 5 above) voltage (index area as carriage is moved from retract position to the load heads position) is equal to that of the replaced PWB, within 0.20 volts. TP5 amplitude change should be within ± 15 percent of the replaced PWB.

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## 6.4.2 X0 Amplitude, Balance Check and Adjustment

### QUICK REFERENCE

<u>Sequence</u>	<u>Servo PWB Test Points/ Adjustment</u>	<u>Limit Values</u>
1. Connect scope Ch. 1 (Servo PWB) to "X0".	TP1	
2. Enable drive motor and load heads (manual).		
3. Move carriage back and forth and observe "X0".	TP1	
4. Adj. gain Pot (XG) for correct P-P voltage level at approx. center of disk recording band.	R37	9V $\pm$ 5% P-P
5. Adj. Balance Pot (XB) until sine wave is balanced with respect to GND.	R21	within 0.25 volts of GND
6. Unload heads unless required for other checks.		
<u>Note:</u> On PWB replacement, to avoid CE alignment, set X0 amplitude (per Step 4 above) and balance (per Step 5 above) to that of replaced PWB by adjusting the Gain Pot (XG) and Balance Pot (XB).	TP1	Within 0.2 volts of replaced PWB.

### EXPANDED PROCEDURE

1. Connect scope Channel 1 to TP1 (X0) on the Servo PWB, and set sensitivity to 2 volts/cm.
2. Set scope sweep frequency to 5 ms/cm.
3. With the heads loaded, manually move the carriage back and forth while monitoring X0 (TP1). See Section 5.2, Special Procedures.
4. Adjust R37 (XG) potentiometer until a 9 volt  $\pm$  5 percent P-P signal is observed at the approximate center of the normal disk recording band. This amplitude should always be between 8 and 9.4 volts peak (at center recording band) to allow correct servo operation.

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## DISK DRIVE

5. Adjust R21 (XB) potentiometer until the sine wave is balanced to within 0.25 volts of ground.
6. The heads can now be unloaded unless required for other checks and adjustments.  
Note: On PWB replacement, to avoid CE alignment, set X0 amplitude (per Step 4 above) and balance (per Step 5 above) to that of replaced PWB by adjusting the Gain Pot (XG) and Balance Pot (XB) to within  $\pm 0.2$  volts of previous PWB settings.

### 6.4.3 X90 Amplitude, Balance Check and Adjustment

#### QUICK REFERENCE

<u>Sequence</u>	<u>Servo PWB Test Points/ Adjustment</u>	<u>Limit Values</u>
1. Connect scope Ch. 1 (Servo PWB) to "X90".	TP3	
2. Enable drive motor and load heads (manual).		
3. Move carriage back and forth and observe "X90".	TP3	
4. Observe analog sine wave for amplitude and symmetry about GND. <u>Note:</u> On early model Servo PWB's, no adj. is available.	TP3	2.5 volts min. peak-to-GND.
5. On late model PWB's, adj. Pot (X90B) for correct sine wave balance about GND.	R160	Within $\pm 10\%$ of P-P amplitude
6. Unload heads unless required for other checks. <u>Note:</u> On PWB replacement, adjust R160 per steps 4 and 5 above.	R160	

#### EXPANDED PROCEDURE

1. Connect scope Channel 1 to TP3 (X90) on the Servo PWB, and set sensitivity to 5 volts/cm.
2. Set scope sweep frequency to 5 ms/cm.
3. With the heads loaded, move the head carriage back and forth while monitoring X90 (TP3). See Section 5.2, Special Procedures.
4. The analog sine wave signal should be greater than 5 volts peak-to-peak, and should be balanced around ground to within  $\pm 10$  percent of the peak-to-peak amplitude.

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5. The heads can now be unloaded unless required for other checks and adjustments.

- Note:
- a) On late model Servo PWB's, an R160 (X90B) potentiometer has been added to allow adjustment of correct balance (within  $\pm 30$  percent of the peak-to-peak amplitude).
  - b) The minimum allowable peak voltage amplitude to ground is 2.5 volts. Therefore, if X90 is 5 volts peak-to-peak, X90 must be perfectly balanced with respect to ground.
  - c) On Servo PWB replacement, Adjust R160 (per Note "a" above) to meet the above balance requirements.

#### 6.4.4 Up-Clock and Down-Clock Check

This check is to determine that the "directional clocks" are being generated correctly by the Servo PWB.

#### QUICK REFERENCE

<u>Sequence</u>	<u>Servo PWB Test Points/ Adjustment</u>	<u>Limit Values</u>
1. Connect scope Ch. 1 (Servo PWB) to DUDQ-H signal.	Pin 2	Sync Point (pos)
2. Connect scope Ch. 2 (Servo PWB) to "X0" signal.	TP1	
3. Enable drive motor and load heads (manual)		
4. Move carriage forward (towards spindle) and observe "X0" for correct polarity slope with respect to sync point	TP1	Pos. slope, starting within 1.5V of GND.
5. Move carriage in opposite direction (away from spindle) and observe "X0" for correct polarity slope with respect to sync point.	TP1	Neg. slope, starting within 1.5V of GND.
6. Unload heads unless required for other checks.		
<u>Note:</u> On Servo PWB replacement, this check is not normally required.	TP1	

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### EXPANDED PROCEDURE

1. Connect scope Channel 1 to pin 2, slot A3 (DUDQ-H, Servo PWB) and sync "positive" on Channel 1. Set sensitivity to 2 volts/cm and sweep frequency to 5 ms/cm.
2. Connect scope Channel 2 to TP1 (X0) and set sensitivity to 2 volts/cm.
3. With the heads loaded, manually move the carriage back and forth while observing X0 (TP1).
4. As the carriage moves forward, X0 will start in positive direction from the sync point (i.e., X0 will have a positive sine wave slope, starting within 1.5 volts of ground). Sync is a 4 microsecond wide (approx.) positive logic pulse.
5. Repeat step 4, but move the head carriage in the reverse direction (away from spindle). The X0 sine wave should now start with a negative slope from the sync start point.
6. The heads can now be unloaded unless required for other checks and adjustments.

Note: On Servo PWB replacement, this check is not normally required.

### 6.4.5 Velocity Reference Adjustment

### QUICK REFERENCE

<u>Sequence</u>	<u>Servo PWB Test Points/ Adjustment</u>	<u>Limit Values</u>
1. Manually unload heads (if loaded)		
2. Depress "Disk Power" sw. to "OFF" (if "ON")		
3. Connect voice coil Plug P2 (if disconnected)		
4. Connect Exerciser Unit or computer to I/O slot A5 or A6.		
5. Pre-set Pot "VR" two (2) turns CW	R63	(slow velocity)
6. Depress "Disk Power" sw. ("ON")		
7. Connect scope Ch. 1 to DLSL-L (Control PWB).	Pin 1	Sync Point (Pos)
8. Connect scope Ch. 2 to analog velocity (Servo PWB).	TP7	
(continued on next page)		

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# Series 6000 DISK DRIVE

## QUICK REFERENCE (cont'd.)

<u>Sequence</u>	<u>Servo PWB Test Points/ Adjustment</u>	<u>Limit Values</u>
9. Depress "Disk Drive" sw. and allow unit to go "Ready".		
10. Perform 64 track (128 for 200 TPI) repetitive seeks at three ranges (0-64, 64-128, 128-192 for 100 TPI units; or 0-128, 128-256, 256-384 for 200 TPI units).		
11. Select "fastest" repetitive seek range, then adj. Pot "VR" such that the start of the velocity waveform to the following edge of "DLSL-L" (sync point) is of correct timing.	TP7 R63	35ms
12. Connect scope Ch. 2 to Analog Index signal (Servo PWB).	TP5	
13. Having completed Step 11, perform max. move seek (203 tracks for 100 TPI; 406 tracks for 200 TPI) and verify that the Analog Index signal does not exceed the specified voltage limit.  <u>Note:</u> On PWB replacement, verify steps 10, 11 and 13 above.	TP5	-1.5 volts (max. pos. level)

## EXPANDED PROCEDURE

1. Manually unload the heads (if previously loaded) by moving the carriage to the fully retracted position. See Section 5.2, Special Procedure.
2. Depress the "Disk Power" switch (Power OFF).
3. Connect voice coil plug P2 (if previously disconnected).
4. Insert Test Unit or computer I/O cable into I/O slot A5 or A6.
5. Turn R63 (VR) potentiometer approximately two (2) turns clockwise. This ensures that the carriage velocity will be initially set for a slower than normal speed.
6. Depress the "Disk Power" switch (Power ON).

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## DISK DRIVE

7. Connect scope Channel 1 to pin 1, slot A2 (DLSSL-L, Control PWB), and sync "positive" on Channel 1. Set sensitivity to 2 volts/cm and sweep frequency to 5ms/cm.
8. Connect scope Channel 2 to TP7 (Servo PWB) and set sensitivity to 0.5 volts/cm.
9. Depress "Disk Drive" Switch and allow unit to come "Ready".
10. Perform 64 track (128 for 200 TPI units) repetitive seeks at three (3) ranges (0-64, 64-128, 128-192 for 100 TPI units; or 0-128, 128-256, 256-384 for 200 TPI units). The 64 (128 for 200 TPI) track seek is considered an average positioner move.
11. Select the repetitive seek range which is the "fastest" (of the three) and use that range while adjusting R63 (VR) potentiometer such that the "start" of the velocity waveform at TP7 to the following edge of DLSSL-L is 35 milliseconds.

- Note:
- a) If the time from the completion of a seek command to the start of another is greater than 10 milliseconds, the TP7 waveform should start approximately one (1) millisecond from the start of the command, and DLSSL-L can then be set for 35 milliseconds.
  - b) If the seek commands are close together, then the TP7 signal will be delayed from the start, and the 35 millisecond setting must be referenced to the start to TP7.

12. After the velocity adjustment has been set for the fastest average move, perform a maximum move seek (203 tracks for 100 TPI; 406 tracks for 200 TPI).
13. Connect scope Channel 2 to TP5 (Analog Index Signal) and set sensitivity to 2 volts/cm.
14. Monitor TP5 and verify that the signal does not go higher than -1.5 volts.

Note: On Servo PWB replacement, adjust velocity Pot (VR) per Steps 10 and 11 above, and verify steps 12 and 14.

### 6.4.6 Index to Clock Check

#### QUICK REFERENCE

<u>Sequence</u>	<u>Servo PWB Test Points/ Adjustment</u>	<u>Limit Values</u>
<p>Note: The heads should be loaded and under normal servo control.</p> <p>1. Connect scope Ch. 1 to DPTI-H (Servo PWB).</p> <p>(Continued on next page)</p>	TP6	



# Series 6000 DISK DRIVE

## QUICK REFERENCE (cont'd.)

<u>Sequence</u>	<u>Servo PWB Test Points/ Adjustment</u>	<u>Limit Values</u>
2. Connect scope Ch. 2 to DUDQ-H (Servo PWB).	Pin 2	
3. Perform repetitive initialize seek commands		
4. Check minimum time period between the negative edge of DPTI-H (TP6) and the occurrence of DUDQ-H clock. <u>Note:</u> Velocity adj. must be correctly set prior to Step 4 check.	TP6 Pin 2	400 us (min)
5. If the DUDQ-H clock is incorrectly set, the Index Balance (IB) may be offset. Ref. Section 6.4.1, Index Balance Check <u>Note:</u> On PWB replacement, verify Step 4 above.		

## EXPANDED PROCEDURE

1. The heads should be loaded on the disk and under normal servo control.
2. Connect scope Channel 1 to TP6 (DPTI-H) and set sensitivity to 2 volts/cm. Set sweep frequency to one (1) ms/cm.
3. Connect scope Channel 2 to pin 2, slot A3 (DUDQ-H, Servo PWB) and set sensitivity to 2 volts/cm.
4. Perform repetitive seek initialize commands.
5. The DUDQ-H clock should be greater than 400 microseconds from the negative edge of the TP6 signal (when in a repetitive seek, initialize mode).  
Note: Velocity must be set correctly prior to performing this test. Refer to Section 6.4.5, Velocity Reference Adjustment.
6. If the DUDQ-H clock is closer than 400 microseconds (before or after the negative edge) then the Index Balance (IB) may be offset to change the timing.
7. Re-adjust the Index Balance peak amplitude to ground (final setting) such that the DUDQ-H clock is 500 microseconds, or greater, from the negative edge of the TP6 signal. When complete, refer to Section 6.4.1, Index Balance

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## DISK DRIVE

Check, and verify the Index peak amplitude to ground requirement is still within specification.

Note: For Servo PWB replacement, the replacement PWB Index setting of Section 6.4.1, Index Balance Check, should automatically fulfill the above 400 microsecond requirement. Adjustment of the Index Balance can move a DUDQ-H clock from one side of the DPTI-H negative edge to another. This, in effect, can redefine track 000 to be the next adjacent track (CE alignment will, therefore, also be changed by one (1) track position as well).

### 6.4.7 Position Read Head Retract Balance Check

1. With the X0 (TP1) amplitude and balance correctly set (Refer to Section 6.4.2), X0 should be between +3 volts and -3 volts (+5 and -5 volts for 100 TPI units) when the head carriage is in the fully retracted position.
2. The X90 (TP3) retract voltage should be within the peak-to-peak signal envelope developed by X90 when the carriage is in its normal operating range (heads loaded). Refer to Section 6.4.3, X90 Amplitude/Balance Check.

Note: On PWB replacements, the above check is not normally required. See Sections 5.4.8 and 6.6 for lamp and position read head adjustment, respectively.

### 6.4.8 Position Read Head Phasing Check

#### QUICK REFERENCE

<u>Sequence</u>	<u>Test Points/ Adjustment</u>	<u>Limit Values</u>
1. Connect scope Ch. 1 to "X90" (Servo PWB).	TP3	
2. Connect scope Ch. 2 to DPCL-L (Servo PWB).	TP2	Algebraic Add (Sync on on pos. signal)
(continued on next page)		

# Series 6000 DISK DRIVE

## QUICK REFERENCE (cont'd.)

<u>Sequence</u>	<u>Test Points/ Adjustment</u>	<u>Limit Values</u>
3. Enable drive motor, load heads (manual) and move carriage forward (manually).	TP2 & TP3	± 15 degrees
4. Observe that the positive digital signal occurs within the specified angle of the positive analog peak signal.	TP2 & TP3	± 15 degrees
5. Move carriage in opposite direction and observe negative going digital signal occurs within the specified angle of the positive analog peak signal.  <u>Note:</u> On PWB replacement, this check is not normally required.		

- The heads should be loaded and under manual control (See Section 5.2.2).
- Connect scope Channel 1 to TP3 (Servo PWB), "X90", and set sensitivity to 2 volts/cm. Set sweep frequency to 5 ms/cm.
- Connect scope Channel 2 to TP2 (DPCL-L) and set sensitivity to 2 volts/cm.
- Set scope to Algebraic Add (Channel 1 added to Channel 2) and sync on the positive portion of the analog signal (Channel 1).
- With the heads loaded, move the carriage forward (manually). See Section 5.2, Special Procedures.
- The positive going digital signal (added to analog) should occur within ± 15 degrees of the positive peak of the analog signal.
- Move the carriage in the opposite direction (away from spindle) and check that the negative going digital signal occurs within ± 15 degrees of the positive peak of the analog signal.  
  
Note: On PWB replacement, the above check is not normally required. See Section 5.4.8 and 6.6 for lamp and position read head adjustments, respectively.

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### 6.5 Servo Offset Adjustment (X0 Balance)

1. During head alignment, radial adjustment (Refer to Section 6.6.3), if both heads are aligned to within 150 microinches of each other and have a common error of less than 125 microinches from nominal, then check the X0 Servo Offset by performing a one (1) track repetitive seek around the specified CE alignment track and observe TP1 (X0, Servo PWB).
2. The X0 balance (Refer to Section 6.4.2, X0 Amplitude /Balance Check) can be offset by up to 0.8 volts maximum (based on the 9.0 volt peak-to-peak requirement for X0). This means that by adjusting R21 (Balance potentiometer), Servo PWB, the servo null position can be changed by approximately 100 microinches (0.7 volts equals approximately 100 microinches).

Note: a) Do not offset the balance by more than 0.8 volts for an X0 peak-to-peak signal of 9.0 volts. That is, the minimum positive or negative peak-to-null voltage is 3.7 volts.

b) If the null position is changed by offset adjustment, recheck Radial Alignment.

3. If the common error can not be removed by the X0 Offset adjustment (R21), balance X0 to within 0.25 volts of ground and align head as specified in Section 6.3.3, Radial Head Adjustment.

### 6.6 Position Read Head and/or Lamp Adjustment

The replacement of the read head photocell assembly is not a recommended field replacement item. Also, the glass scale must never be replaced or adjusted in the field. Certain fundamental parameters can be affected by Lamp and photocell assembly adjustments and are discussed in the following paragraphs.

1. The output signal amplitude of all position read head cells can be increased or decreased by moving the position read head assembly (retical mask) closer to or further away from the glass scale.

To change signal amplitude, loosen the position read head assembly mounting screw at the mounting base.

Note: a) The mounting base must always be referenced to the bed casting dowel pin (front-to-rear referencing).

b) The position read head mask should never be closer than 0.01 inches from the glass scale. It must be set such that mask and

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scale will not touch under any conditions. To check the mask/scale clearance, move the carriage forward approximately one (1) inch (do not allow heads to load) until the front to the scale is in line with the center of the mask. Hold the end of the voice coil (end furthest from heads) and push to the left (towards PWB module) and check carefully that the scale does not touch the mask. Be careful that the heads do not fall off the head load ramps. If there is any contact, the read head must be moved back accordingly until no contact is assured. When complete, be certain the mounting screw is tight.

- c) Should the read head be moved for any reason, recheck all parameters and alignment in accordance with Section 6.3, Head Alignment, and Section 6.4, Servo Check and adjustment.
  - d) Read head phasing (Step 3) should not change as a result of the above amplitude adjustment.
  - e) The above amplitude adjustment is not normally required upon replacement of the lamp or Servo PWB.
2. The lamp can be rotated to change position of read head cell amplitude and balance. Loosen the set screw, rotate and position (turn in or out) lamp to achieve correct operating performance per Sections 6.4.1 through 6.4.3 and 6.4.6 through 6.4.7. Do not over tighten set screw.

Note: Normally, the checkout and adjustment sequence should be as follows:

- a) Adjust for X0 retract balance per Section 6.4.7 and amplitude/balance per Section 6.4.2.
- b) Adjust for X90 amplitude/balance per Section 6.4.3 and retract balance per Section 6.4.7 while maintaining settings of step (a) above.
- c) Adjust for index per Section 6.4.1 while maintaining settings of steps (a) and (b) above.

Note: The position read head can be moved or rotated to assist in achieving the required specifications per Section 6.4.8; however, this procedure is not recommended unless absolutely necessary.

Note: Any replacement or adjustment of the Position Read Head Lamp requires that the top heads be checked for correct radial and circumferential alignment (See Section 6.3).

3. The output amplitudes of the X0 and X90 lamps (Refer to Sections 6.4.2 and 6.4.3) will normally peak when the phasing (rotation of the position read head assembly) is adjusted to 90 degrees.

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Rotating the position read head will change the phasing as described in the Position Read Head Phasing Check (Section 6.4.8), and the Index-to-Clock Check timing (Section 6.4.6). In general, all the parameters associated with Servo Checks and Adjustments (Section 6.4) will be affected and require re-checking and adjustment.

To change position read head phasing, proceed as follows:

1. Manually enable the drive motor and load the heads per Section 5.2, Special Procedures.
2. Loosen the position read head locking screw (not the clamp set screw) and rotate the assembly for correct phasing.

Note: a) The phasing adjustment will be made while moving the carriage back and forth to generate X0 and X90 signals. Since this adjustment can be obtained at several rotational locations on the position read head, normally the location providing maximum amplitude of correct phase is used.

b) Also, the peak amplitude of X0 and X90 obtained when rotating the read head, and concurrently moving the carriage back and forth, may not be of the correct phase -- i.e., the phase may be lagging 90 degrees instead of leading.

c) It should be noted that the Index location (servo track 000) is changed as the read head rotation is changed. The head-to-ramp location at track 000 should be checked such that all heads are completely "off" the load ramps, with 0.02 inches minimum clearance, when they are loaded at track 000. Normally, when the top heads are aligned per Section 6.3, Head Alignment, they will be moved to compensate for any rotational (phase) change. The bottom heads, however, will change according to the position read head rotation.

d) The photocell amplitude and balance can change as a result of the phasing adjustment.

e) The phasing adjustment is normally not required and should be performed only if absolutely necessary.

3. When phasing alignment is complete, tighten the position read head locking screw.

Note: If the position read head is moved for any reason, carefully check all parameters and alignment procedures per Section 6.3, Head Alignment and Section 6.4, Servo Checks and Adjustments.

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## 6.7 Belt Tension Adjustment

1. With disk unit power "Off", loosen the 1/4-20 bolts (2) below the motor assembly mounting plate 3 or 4 turns.
2. The pre-load adjusting spring will automatically set proper belt tension.
3. Tighten the two (2) motor assembly mounting bolts.

Note: The disk unit can be in its normal upright position or on either side when performing the adjustment. If the unit is in its skin, there are two (2) access holes in the skin (below the motor) to allow the adjustment.

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## SECTION 7 -- TROUBLESHOOTING

### Fault Listing (Ref. Table 7-1 for Connector Location)

- 7.1.1 Unit Will Not Load and/or Go "Ready"
- 7.1.2 Unit Is "Ready" and a Malfunction Occurs
- 7.1.3 Data Error Conditions
- 7.1.4 Sector Transducer Malfunctions
- 7.1.5 Power Supply Malfunctions
- 7.1.6 +5 Volt Regulator Output
- 7.1.7 Drive Motor Malfunctions
- 7.1.8 Positioner Assembly Malfunctions
- 7.1.9 Positioner Velocity Coil Malfunctions
- 7.1.10 "Low" Positioner Power

### 7.1 Troubleshooting Procedures

When malfunctions occur within the disk drive unit, various symptoms will result which can be of assistance in finding and resolving the problem. Common symptoms, with possible reasons and solutions are provided below. In many cases, reference is made to the other Sections for more detailed understanding of logic functions, adjustments and replacement procedures. It should be noted that Revision "L" or later Control PWB's (Ref. Fig. 9-7, Sh. 2, Loc. 10D; and Section 4.4.3) have LED's mounted on the board which serve to indicate various malfunctions which may occur. The LED's can only be reset by SULS-L being true (when not in the Erase Mode; i.e., REDMA-H is false) "AND" TDTS-H being true, "OR" by FROR-H "AND" TDTS-H being both true. This means that approximately 25 seconds after "Power On", the LED latches will be reset, or if the "Disk Drive" is in the "OFF" position (SULS-L is false) and a TDTS pulse occurs (once every 25 seconds), then the LED latches will reset. If a malfunction occurs, only one LED should be "ON"; i.e., the first LED latch to be set disables the remaining LED latches.

TABLE 7-1

Connector Location Table

<u>Connector</u>	<u>Function</u>	<u>Reference</u>
Pl-J1	Cable, connecting DC power from Power Supply to the PWB backpanel.	Fig. 9-1, Loc. 5E & 2C Fig. 9-8, Sh. 1, Loc. 9G Fig. 9-8, Sh. 2, Loc. 4E

(continued on next page)



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Connector Location Table (cont'd.)

<u>Connector</u>	<u>Function</u>	<u>Reference</u>
P2-J2	Cable, Connecting Positioner Drive Transistors (heat sink) to the PWB backpanel.	Fig. 9-1, Loc. 6F Fig. 9-12, Sh. 1, Loc. 6E & 8E
P3-J3	Cable, connecting Positioner Voice Coil to PWB backpanel.	Fig. 9-1, Loc. 5F Fig. 9-11, Loc. 7E Fig. 9-12, Sh. 1, Loc. 8E
J4	Cable, providing logic power to Disk Tester.	Fig. 9-1, Loc. 5C Fig. 9-12, Loc. 9E
P5-J5	Cable, Connecting Motor Module (speed control) to the PWB backpanel.	Fig. 9-1, Loc. 5C Fig. 9-12, Sh. 1, Loc. 9D Fig. 9-13, Loc. 10F
P6-J6	Cable, connecting Front Panel, Disk Interlock hardware and Sector Transducers to back of the Control PWB.	Fig. 9-1, Loc 9F Fig. 9-7, Sh. 1, Loc. 5F
P7-J7	Cable, connecting Positioner Assm. TB1 (Heads-Up Sw., Position Transducers & Velocity Coil) to back of the Servo PWB.	Fig. 9-1, Loc. 3F Fig. 9-6, Sh. 1, Loc. 5E
P10-J10	Cable, connecting 5 Volt Regulator Assm. to the Power Supply.	Fig. 9-8, Sh. 1, Loc. 6D Fig. 9-8, Sh. 2, Loc. 6D Fig. 9-9, Sh. 1, Loc. 6B Fig. 9-9, Sh. 2
P11-J11	Cable, connecting 24 VAC from the Power Supply to the Front Panel.	Fig. 9-1, Loc 3C & 10D Fig. 9-8, Sh. 1, Loc. 7B Fig. 9-8, Sh. 2, Loc. 11D

(continued on next page)

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Connector Location Table (cont'.d)

<u>Connector</u>		
P12-J12	Cable, connecting AC power from the Power Supply to the Motor Module Assm.	Fig. 9-1, Loc. 3D Fig. 9-8, Sh. 1, Loc. 7C Fig. 9-8, Sh. 2, Loc. 4F Fig. 9-10, Sh. 2, Loc. 5D Fig. 9-13, Loc. 11D
P13-J13	Cable, connecting Removable Disk Sector Transducer to Plug P6.	Fig. 9-1, Loc. 10A
P15-J15	Cable, connecting Front Panel functions to Plug P6	Fig. 9-1, Loc. 10E
P21-J21	Cable, connecting AC power to the Rear Blower Assm. from the Motor Module Assm.	Fig. 9-1, Loc. 4C Fig. 9-19, Loc. 4C

7.1.1 Unit Will Not Load And/Or Go "Ready" -- Resulting In A Malfunction  
(FUNL Set, Ref. Fig. 9-7, Sh. 2, Loc. 7F)

Symptom 1 -- Load Malfunction

On depressing the "Disk Drive" switch "ON", the drive motor does not start and/or the "Safe" lamp (or Positive Lock solenoid) does not function properly.

To determine the possible reasons that can cause these various malfunctions, it is best to first understand those events that should normally take place.

Operation

- When the Disk Drive switch (SLDS-L) is depressed "ON", SLDS-L (J6, pin C, Control PWB; Fig. 9-7, Sh. 3, Loc. 10G) goes low and SULS-L (J6, pin L; Fig. 9-7, Sh. 2, Loc. 11E) goes high. These signals originate at the front switch panel (Ref. Fig. 9-1, Unit Schematic).
- The "Safe" lamp signal (J6, pin 5; Fig. 9-7, Sh. 3, Loc. 1E) should go from low (0.2 volts) to high (4.0 volts).

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- The solenoid driver (J6, pin H; Fig. 9-7, Sh. 3, Loc. 1E) should go from "ON" (0.5 volts) to "OFF" (24 volts) and release the solenoid.
- DMTEB-H (and DMTO-H, slot A2, pin 25 -- if 50 Hz or 2400 RPM) should go from ground to approximately 3 volts (slot A2, pin 22) and start the drive motor.
- FUNL (slot A2, pin 9) may or may not be set.

### Action

- If FUNLA-H (slot A2, pin 9) is high, a malfunction exists (Ref. 9-7, Sh. 2, Loc. 7F); or if RULC-L (slot A2, pin 48) went low for any reason, it will set FSLD (Ref. Fig. 9-7, Sh. 3, Loc. 9E). If FUNLA-H goes high a malfunction could exist on the Control PWB -- check LED's.

If FSLD is set, it is advisable to check RULC-L for being continuously true (greater than 3.0 volts).

### Symptom 2 -- Load Malfunction

Depressing the "Disk Drive" switch "ON" activates the drive motor, but the motor remains activated for only a few seconds.

### Operation

- DMTEB-H (A2, pin 21; Fig. 9-7, Sh. 2, Loc. 2E) goes high for approximately 300 ms (Refer to Section 4.4.3).
- FUNLA-H (A2, pin 9; Fig. 9-7, Sh. 2, Loc. 7F) went high.
- SLID-H (Cartridge switch J6, pin 4) should have gone low within 200 ms after DMTEB-H went high. If not, FUNL NA06 has probably detected a failure.
- LED DS6 (SW) on the Control PWB should have been enabled by FUNL NA06. (FUNLA at A2, pin 9 went high; Ref. Fig. 9-7, Sh. 2, Loc. 7F).

### Action

- Check adjustment of cartridge switches and other logic sequence functions.

### Symptom 3 -- Load Malfunction

Depressing the "Disk Drive" switch "ON" causes the motor to achieve full speed, but carriage does not activate (load heads). Motor then decelerates and stops.

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## Operation

- The carriage should move forward when FRVSA-L (A2, pin 8; Fig. 9-7, Sh. 3, Loc. 3B) goes high during the load sequence. See Section 4.4.6 and Fig. 9-3.
- When FRVSA-L goes high, TP8 (Ref. Fig. 9-6, Sh. 3, Loc. 7C) on the Servo PWB should also go from a low (minus several hundred mv) to a high (plus several hundred mv).
- TP10 (Ref. Fig. 9-6, Sh. 3, Loc. 1C) on the Servo PWB should then go from a negative voltage (minus several volts) to a positive voltage (approximately 22 volts for several milliseconds, then decrease as the voice coil starts to move forward). If the voice coil does not move forward then FUNL NA01 has probably detected a failure.
- LED DS1 (LD) on the Control PWB should be enabled by FUNL NA01 (FUNLA at A2, pin 9 went high; Ref. Fig. 9-7, Sh. 2, Loc. 7F).

## Action

- If FRVSA-L does not go high when it should, the Control PWB is probably at fault and all Control PWB LED's are probably "OFF"
- If TP8 and TP10 (Servo PWB) do not display the correct signals and FRVSA-L signal is correct, then FUNL NA01 has probably detected a failure. Temporarily replace the Servo PWB (do not attempt to adjust potentiometers).
- Attempt load sequence again
- If voice coil moves forward, then unload drive and set the potentiometers on the replacement Servo PWB (See Section 6.4)

## Symptom 4 -- Load Problem

Depressing the Disk Drive switch "ON" caused the motor to achieve full speed, but as the carriage moves forward, it travels approximately 0.1 inches and then retracts. Motor then decelerates and stops. See Section 4.4.3.

## Operation

- As the carriage moves forward, (approximately 0.1 inch) the Heads-Up switch (SHSU-H; Fig. 9-7, Sh. 3, Loc. 6E) changes state (goes low).
- When SHSU-H goes low, the up-to-speed (DUTS) circuits are enabled (Fig. 9-7, Sh. 2, Loc. 4B).
- Control LED DS2 (SP) on the Control PWB should be enabled by FUNL NA02 if DUTS-L is not false when SHSU-L goes true (Fig. 9-7, Sh. 2, Loc. 10G).

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### Action

- Check that TPO (VFO PWB; Fig. 9-5, Sh. 2, Loc. 6E) has one (1) negative pulse (3 us wide) per revolution (40 ms for 1500 RPM, 25 ms for 2400 RPM) when the drive motor is at full speed.
- If there are no pulses or intermittent pulses at TPO, check TP1 (Fig. 9-5, Sh. 2, Loc. 10F) to determine if all analog signals are greater than 150 mv, ground to positive peak. If not, the removable disk sector transducer has failed or is set improperly (Refer to Sections 5.4.11, 5.4.12 and 6.2).  
Note: The positive peak to TP1 should occur first (in time).
- The disk cartridge sector slots could also be out of specification on width or radial runout.
- If the VFO PWB failed to generate correct signals on TP0 and or TP1, replace VFO PWB.
- If the Control PWB failed to generate DUTS properly, replace the Control PWB.
- Any of the previous conditions can cause LED DS2 (SP) on the Control PWB to be enabled by FUNL NA02.

### Symptom 5 -- Load Problem

Depressing the Disk Drive switch causes the motor to achieve full speed. However, when the carriage moves forward, it continues past track position 000 and an emergency retract occurs the motor then decelerates and stops.

### Operation

- Initially, as FRVSA-L (A3, pin 4; Fig. 9-6, Sh. 2, Loc. 8D) goes high, the carriage moves forward. After traveling approximately 0.1 inches, SHSU-H goes low (See Section 4.4.4). Also refer to Section 4.4.5, Figure 9-1 (Servo Flow Diagram), and the load timing sequence, Section 4.4.7 (Fig. 4-5).
- As the carriage continues forward, the Index signal (DPTI-L; Fig. 9-7, Sh. 3, Loc. 7A) goes low (approximately 0.5 inches before track 000), and then high (approximately 0.015 inches before the heads reach track 000). Refer to Section 4.4.5.
- DUDQ-H and FPTE-H cause DDAR-L to go high (Fig. 9-7, Sh. 3, Loc. 1C) -- DLSL-L (Fig. 9-7, Sh. 3, Loc. 9C) should then go low to lock the servo.
- Control LED DS1 (LD) or DS4 (IN) should be enabled by either FUNL NA01 or NA04 (Fig. 9-7, Sh. 2, Loc. 9F) if the servo fails to lock.

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## Action

- If the DPTI-L signal is not correct (Refer to Section 6.4.1), or there are no DUDQ-H signals (4 us positive pulses, starting to occur during DPTI-L down time -- several milliseconds apart), then the Servo PWB is probably at fault. Replace the Servo PWB (set potentiometers to approximate positions) and check load operation. If problem is resolved, set potentiometers on the replacement Servo PWB per Section 6.4.
- If the DPTI-L and DUDQ-H signals are correct, but DDAR-L does not go high at the proper time, then the Control PWB is probably at fault. In this case, replace the Control PWB.

## Symptom 6 -- Load Problem

Identical to Symptom 5 above, except when the heads reach track 000, the carriage retracts.

## Operation

- This is usually caused by a malfunction within the Servo PWB position loop.
- Control LED DS1 (LD) or DS4 (IN) should be enabled by either FUNL NA01 or NA04 (Fig. 9-7, Sh. 2, Loc. 9F).

## Action

- Replace the Servo PWB (set potentiometers to approximate positions). If problem is resolved, set potentiometers per Section 6.4.

## Symptom 7 -- Load Problem

Heads move forward when depressing the "Power Switch" to "OFF".

## Operation

- The emergency retract relay (K1) or associated circuit on the Servo PWB has failed. Refer to Section 4.4.10 and Figure 9-3, Servo Flow Diagram.

## Action

- Replace the Servo PWB. Set potentiometer per Section 6.4

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### 7.1.2 Unit is "Ready" And a Malfunction Occurs (FUNL Set; Ref. Fig. 9-7, Sh. 2, Loc. 7F; and Section 4.4.3)

#### Symptom 1

The unit automatically retracts and reloads heads to track 000.

#### Operation

- Intermittent loss of power while unit is in the "Ready" state.

#### Action

- Electrical brown outs -- the 5 Volt detection circuit (Control PWB; Fig. 9-7, Sh. 3, Loc. 4D) detects low voltage (PPOR-L goes false) and causes unit to relocate to track 000. FUNL is automatically reset during power-up.

#### Symptom 2

The unit emergency retracts when no seek commands are being processed.

#### Operation

- Unit is in the "Ready" state, but unloads due to marginal "removable disk" index detection.

#### Action

This condition is generally caused by marginal index pulses or an intermittent removable disk sector transducer. See Section 7.1.1, Symptom 4 for detailed description.

LED DS2 (SP) on the Control PWB should be enabled by FUNL NA02.

#### Symptom 3

The unit emergency retracts while processing seek commands.

#### Operation

- Unit is performing seek commands and unloads due to various marginal conditions.

#### Action

- Index could be improperly set on Servo PWB (TP5). TP5 must be checked over entire range -- See Sections 6.4.1 and 6.4.5. Detection is sensed by FUNL NA04 (LED DS4 "ON") on the Control PWB.

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- If servo velocity is set "too fast", an unload can be caused through FUNL NA04 (LED DS4 "ON") or NA05 (LED DS5 "ON"). Refer to Section 6.4.5 for correct velocity adjustment procedures. Velocity can be reduced by several milliseconds to see if there is any effect on the problem.
- Marginal index pulses can cause an unload through FUNL NA02 (LED DS2 "ON"). The high currents generated by the voice coil can cause emergency unloads that would not be detected by FUNL NA02 if the voice coil was not moving.
- A Servo PWB malfunction can cause FUNL NA03, 04 (LED DS4 "ON") or 05 (LED DS5 "ON") -- resulting in an emergency unload condition. Note that there is no LED for NA03. If it is suspect, temporarily remove CRI7 to assist in isolating the problem (Ref. Fig. 9-7, Sh. 2, Loc. 8F).

## 7.13 Data Error Conditions

### Symptom 1

Excessive soft (recoverable) data errors.

### Action

- Check grounding system (frame ground connections and ground loops)
- I/O cables may be routed too close to AC power cables or transient sources
- Check for dirty head and/or disks

### Symptom 2

Hard data errors (recoverable by re-writing)

### Action

- Check for dirty head and/or disks
- Check for dirty positioner rails and/or bearings
- Written on unit with misaligned heads (no interchangeability)
- Servo system improperly set
- High ambient cabinet temperature. Internal rise should be less than 6°F for 200 TPI units, and 10°F for 100 TPI units.

### Symptom 3

Sector Address Errors (Intermittent)



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### Action

- o Sector ring and slots on removable disk -- out of specification. Check TP1 on VFO PWB. All analog sector signals are to be greater than 150 mv ground-to-peak, and all spurious signals are to be less than 20 mv ground-to-peak. The sector transducer must be checked against a standard reference before any conclusion can be reached. Refer to Sections 4.4.10 and 4.4.12.

### Symptom 4

Sector Address Errors (Hard Errors)

### Action

- o If solid errors occur on both heads for one disk, and the other disk functions correctly (both heads), then the VFO, Sector Counter PWB may have a sector counter malfunction.

### Symptom 5

Hard Data Errors (Non-Recoverable)

### Action

- o All heads -- Check Data PWB (DDDD, A4, pin 2; Fig. 9-4, Sh. 2, Loc. 3C) for  $85 \pm 20$  ns positive pulses (0 to 0.7 volts). There will be a pulse corresponding to each peak of the head signal (raw data) as observed at TP4 of the Data PWB.
- o All heads -- Check VFO PWB. When writing "zeros" there will be  $100 \pm 40$  nanoseconds negative pulses at slot A1, pin 41; Fig. 9-5, Sh. 3, Loc. 2C (XRDQ-L) for each cell time if read gate RRDE-L (slot A1, pin 43, Fig. 9-5, Sh. 3, Loc. 4C) is low (i.e., the drive is ready and selected). Slot A1, pin 37; Fig. 9-5, Sh. 3, Loc. 1E (XRDB-L) will be high. When writing "ones" XRDQ-L will be the same as above, but XRDB-L will contain pulses which are equal to one-half the cell time  $\pm 20$  percent (assumes Bc-B2 jumper on VFO PWB). If Bc-B1 jumper (NRZ) is connected, then the signal will be low for 90 percent (minimum) or the cell time on all "ones" pattern.

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- One or more heads -- check TP4 on the Data PWB for a minimum amplitude (200 TPI) of 70 mv p-p (95 mv for 2400 RPM) when reading all "ones" at the most inner track location. For 100 TPI units, the minimum amplitude is approximately twice the 200 TPI values. A particular head could be faulty; however, always try another disk (removable) before replacing the head.

## 7.1.4 Sector Transducer Malfunctions

### Symptom 1

Fixed disk Sector Transducer output incorrect as measured at TP2 and pin 8 of VFO PWB (Fig. 9-5, Sh. 2, Loc. 11D).

### Operation

- Correct maximum output will be 1.5 to 2.4 volts p-p (2.4 to 3.8 for 2400 RPM) when disk is turning at correct speed.
- Resistance across transducer, as measured at slot A2, pin 4 to ground buss will be  $110 \pm 20$  ohms.

### Action

- If resistance or voltage values are incorrect, fixed disk Sector Transducer may be faulty. Refer to Section 5.4.13 for replacement procedures and Section 6.2.3 for adjustment procedures.

### Symptom 2 -- Top Load (Removable Disk) Transducer

Removable disk Sector Transducer output (Top Load Units) incorrect as measured at TP1 and pin 6 of VFO PWB (Fig. 9-5, Sh. 2, Loc. 10F).

### Operation

- Correct output at TP1 will be the p-p voltage as specified on the dummy sector ring.
- Resistance across the transducer as measured at slot A2, pin 2 to the ground buss will be  $110 \pm 20$  ohms.
- The gap between the dummy sector ring and the transducer pole piece must exceed 0.012 inches.

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### Action

- If resistance or voltage measurements are incorrect, the Upper Transducer may be faulty. Refer to Section 5.4.11 for replacement procedure and Section 6.2.1 for adjustment procedures.

### Symptom 3 -- Front Load (Removable Disk) Transducer

Removable disk Sector Transducer output incorrect as measured at TP1 and pin 6 of the VFO PWB (Fig. 9-5, Sh. 2, Loc. 11D).

### Operation

- Correct output at TP1 will be the p-p voltage as specified on the dummy sector ring.
- Resistance across the transducer as measured at slot A2, pin 2 to the ground buss will be  $525 \pm 75$  ohms.
- The gap between the dummy sector ring and the transducer pole piece must exceed 0.012 inches.

### Action

- If resistance or voltage measurements are incorrect, the removable disk Sector Transducer may be faulty. Refer to Section 5.4.12 for replacement procedure and Section 6.2.2 for adjustment procedures.

## 7.1.5 Power Supply Malfunctions

### Symptom

Power supply does not function correctly (Ref. Fig. 9-8, Sh. 2).

### Operation

- Fuses should be Slo-Blo, 5A for 115 (or 100) VAC, and 3A for 230 (or 208) VAC.
- Raw voltages should be  $5.0 \pm 0.15$  volts,  $+24 \pm 4$  volts and  $-24 \pm 4$  volts under all operating conditions. Measure raw voltages at the PWB backpanel power buss (Ref. Fig. 9-1, Loc. 5D).
- If there is a problem with the +5 volt output, see Symptom 7.1.6 for a possible regulator problem.

# Series 6000 DISK DRIVE

## Action

- If fuses are functional, but raw voltage(s) is incorrect, supply may require replacement. Refer to Section 5.4.16 for replacement procedure.

## 7.1.6 +5 Volt Regulator Output

### Symptom

5-Volt output ( $5 \pm 0.2$  VDC) is not correct and can not be adjusted by R11 (Ref. Fig. 9-9, Sh. 2, Loc. 4B).

### Operation

- Check that C4+ (regulator raw voltage) from power supply is at  $10 \pm 2.5$  volts. Measure at collector of transistor Q2 (Fig. 9-9, Sh. 2, Loc. 5C).
- If a short is suspected, disconnect voice coil plug P2, all PWB's and the DC power cable plug P1. See Table 7-1 for plug location.

### Action

- If the power supply raw input voltage is correct and no output shorts are detected, regulator replacement may be required. Refer to Section 5.4.17 for replacement procedures.

## 7.1.7 Drive Motor Malfunctions

### Symptom

Drive motor will not turn, will not reach full speed, or will not speed control (if 2400 RPM or 50 Hz).

### Operation

- Upon depressing the Disk Drive switch, DMTEB-H (A2, pin 21; Fig. 9-7, Sh. 2, Loc. 2E) goes from 0 volts to  $3 \pm 0.5$  volts.
- For 2400 RPM or 50 Hz drives, DMTO-H (A2, pin 25; Fig. 9-7, Sh. 2, Loc. 4B) also goes from 0 volts to  $3 \pm 0.5$  volts. DMTO-H will normally start switching (3V to 0V to 3V, etc.) when the heads load, since that is when speed control is normally enabled. During a manual enable, the speed control does not function, therefore, DMTO-H will stay at 3 volts when the motor is enabled.
- If signal levels are correct, but motor does not function correctly, check that the spindle turns freely with no binding.

# Series 6000

## DISK DRIVE

- If the signal levels switch to +5 volts instead of the  $3 \pm 0.5$  volts, check TB3, pin 1 and 2 (Ref. Fig. 9-1, Loc. 5C; and Fig. 9-15, Sh. 2) to verify wiring harness is not open.
- If the control signals do not change correctly at the start of a load sequence, check the Control PWB for malfunction.

### Action

- If all inputs and control signals are correct, motor assembly may require replacement. Refer to Section 5.4.15 for replacement procedure.

### 7.1.8 Positioner Assembly Malfunctions

#### Symptom

Positioner assembly does not function properly.

Note: The bearings, rails and voice coil are not field replacement items and are not to be adjusted.

#### Operation

- The voice coil resistance as measured across the two steel tapes that supply current to the voice coil (plug P2 disconnected, Ref. Table 7-1) is  $1.8 \text{ ohms} \pm 8 \text{ percent}$  (at  $25^{\circ}\text{C}$ ). See Section 5.4.3.
- Rails must be clean and free of any nicks, scratches or other damage or inaccurate positioning will occur (See Section 5.3.4).
- All bearings must turn freely.

#### Action

- If the voice coil resistance is incorrect, or the carriage assembly does not move freely due to damaged (or worn) rails, bearings or other component -- replace positioner assembly.
- It should be noted that inaccurate positioning and resultant data errors can be caused by a servo system malfunction and other related positioner control systems. Unless the positioner is obviously defective, check all related systems before replacing positioner assembly. Refer to Section 5.4.2 for replacement procedure.

# Series 6000 DISK DRIVE

## 7.1.9 Positioner Velocity Coil Malfunction

### Symptom

Head positioner velocity can not be controlled by R63 (Fig. 9-6, Sh. 3, Loc. 7C) of the Servo PWB and no other malfunction exists (i.e., Servo PWB failure, etc.). See Section 6.4.5

### Operation

- The velocity coil has three (3) leads (+, -, and shield). They connect to TBl, terminals 7 and 8 (ground). Ref. Fig. 9-1, Loc. 2E.
- By disconnecting the lugs from terminals 7 and 8, resistance measurements can be made.
- The resistance between the red and black wire should be 2.2 Kohms  $\pm$  30 percent.
- The resistance from the shield connection to either the red or black wire should be an open.
- The resistance from any of the lugs to the magnet assembly should be an open.

### Action

If the resistance measurements are not satisfactory, replace velocity transducer. Refer to Section 5.4.3 for replacement procedure.

## 7.1.10 "Low" Positioner Power

### Symptom

The servo does not have sufficient power to perform a seek or to unload the heads from the disk. A Heads-Up switch failure (open) will cause this problem.

### Operation

Check TBl, pin 9 (Fig. 9-1, Loc. 2F) during manual positioner movement (disk drive power "ON" and voice coil plug P2 disconnected; See Table 7-1). TBl, pin 9 should indicate greater than 4 volts when the heads are retracted, and less than 0.2 volts when the voice coil is moved forward approximately 3/8 inch (the switch should change state during this move).

# Series 6000

## DISK DRIVE

### Action

- Check that the switch terminals are making proper contact (use ohmmeter for terminal continuity and resistance check). Replace switch as necessary. Refer to Section 5.4.4 for replacement procedure.

### 7.1.11 Incorrect Positioner Power

#### Symptom

The positioner can "lock" (electrically) against either crash stop (full retract or full in) due to excessive power applied per the respective direction by a shorted power transistor (See Section 5.4.5). The positioner can also have insufficient power to move in one or both directions due to an "open" power transistor.

#### Operation

Determine which power transistor(s) is defective.

Note: A failed power transistor can damage the Servo PWB (normally, resistors R119 and/or R120 on Fig. 9-6, Sh. 3, Loc. 2C).

#### Action

Replace power transistor(s) per Section 5.4.5.

# Series 6000 DISK DRIVE

## SECTION 8 -- RECOMMENDED SPARE PARTS AND TOOLS

### 8.1 Recommended Spare Parts

The following is a list of recommended spare parts and quantities based on the number of Series 6000 Disk Drives in service.

When ordering, list part number, description, quantity and other specific information as requested.

Address all orders to:

Western Dynex Corporation  
Customer Service Department  
3536 West Osborn Road  
Phoenix, Arizona 85019  
(602) 269-6401/TWX (910)951-4287



# Series 6000

## DISK DRIVE

### RECOMMENDED SPARE PARTS

<u>Part Number</u>	<u>Description</u>	<u>Recommended Quantity</u>	
		<u>Number of Units</u>	
		1-10	10-50
D058 G*	VFO, Sector Counter PWB	1	2
D121 G*	Control PWB	1	2
D114 G*	Servo PWB	1	2
D037 G*	Data PWB	1	2
D274 G*	Motor Control PWB	1	2
C392 P*	Prefilter	one (1) per unit per year	
HDA095 P*	Read/Write Head (Upper)	2	4
HDA095 P*	Read/Write Head (Lower)	2	4
DMA097 P*	Fixed Disk (Dual Disk Units Only)	1	2
DSA163 P1	Lamp, Push Button Switch	5	10
SWA099 P1	Micro Switch, Long Arm	1	2
SWA162 P1 (no lens)	Push Button Switch, Panel	1	2
SWA099 P2	Micro Switch, Roller Arm	1	2
DSA076 P1	Position Transducer Lamp	2	4
FIA079 P1	Absolute Filter	one (1) per unit per year	
C380 G1***	Sector Transducer	1	2
D081 G*	Positioner Assembly	---	1
D341 G*	Rear Blower Assembly	---	1
D213 G*	Power Supply Assembly	---	1
D217 G*	Drive Motor Assembly	1	2
SWA200 P1 (no lens)	Switch Rocker, Panel	1	2
BTA096 P2	Drive Belt (1500 RPM)	1	2
BTA096 P4	Drive Belt (2400 RPM)	1	2
QQA061 P10K60**	Power Transistor } part of	1	2
QQA061 P11K60**	Power Transistor } 422 G1	1	2
QQA061 PJ6264**	Power Transistor } part of	1	2
QQA061 PJ3055**	Power Transistor } 420 G1	1	2
C420 G1	Power Supply Heat Sink Assembly	1	2
C422 G1	Backpanel Heat Sink Assembly	1	2
FOA122*	Power Supply Fuse, Slo-Blow	5	10
C382 G1***	Sector Transducer	1	2
DSA163 P2	Rocker Switch, Lamp	5	10
C226 G1	Power Regulator PWB Assembly	1	2

(continued on next page)

# Series 6000 DISK DRIVE

## Recommended Spare Parts (cont'd.)

- \* Applicable information must be supplied when ordering these particular parts -- i.e., speed BPI, TPI, sector count, voltage, frequency, front or top load, etc.
- \*\* Use caution when installing these parts to prevent shorts to mounting hardware
- \*\*\* 382 G1 is used for front load, removable disk only. Otherwise 380 G1 is used.

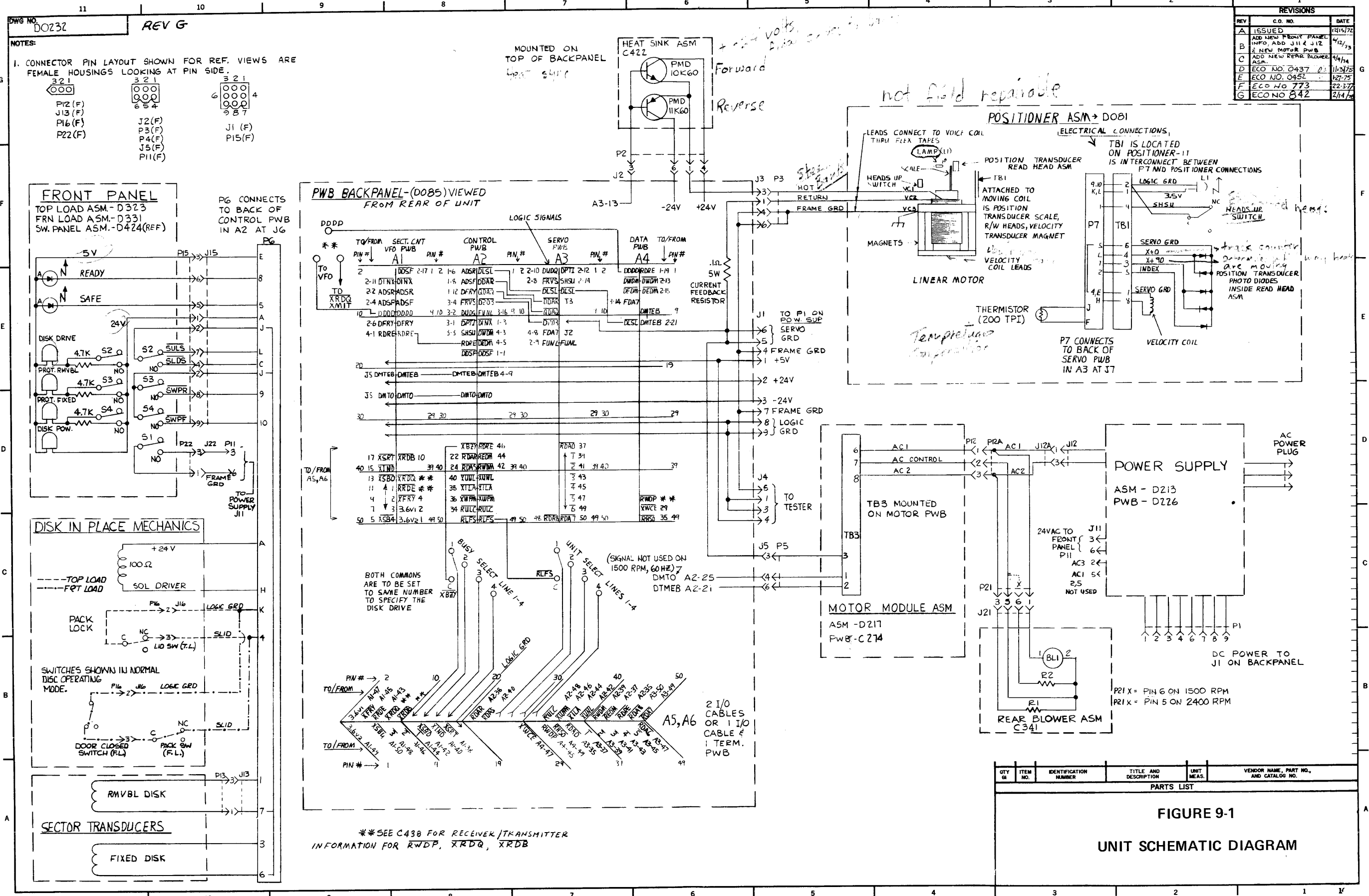
## 8.2 Recommended Special Tools

The following Special Tool List describes all necessary tools for Preventive Maintenance and Troubleshooting Series 6000 Disk Drives.

### RECOMMENDED SPECIAL TOOLS

<u>Part Number</u>	<u>Description</u>	<u>Recommended Quantity</u>	
		<u>Number of Units</u>	
		1-10	10- 50
DCA148	CE Cartridge (Top Load)	1	1
DCA189	CE Cartridge (Front Load)	1	2
DE5020	Disk Exerciser	1	2
DT6020	Disk Tester (Suitcase)	1	2
DRD191P1	Dummy Sector Ring, Top Load	1	2
DRD192P1	Dummy Sector Ring, Front Load	1	1
C134G1	PWB Extender	1	2
HAA149P1	Cleaning Wand	2	5
B098P1	Head Spacers	2	5

Note: In addition to the Recommended Special Tools, service personnel must have access to lint-free tissue, isopropyl alcohol (91%), Q-Tips, allen wrenches and other standard tools.



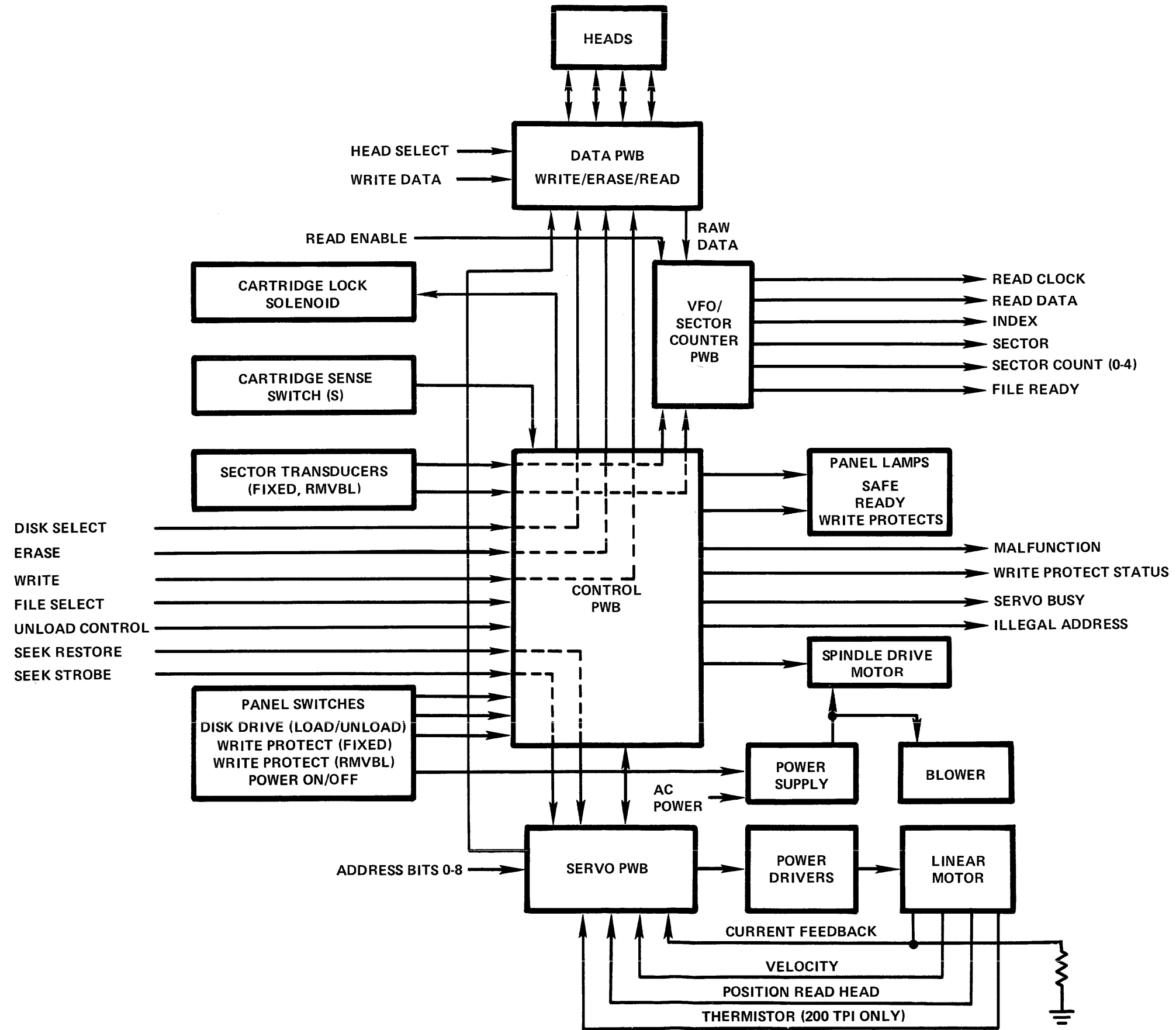
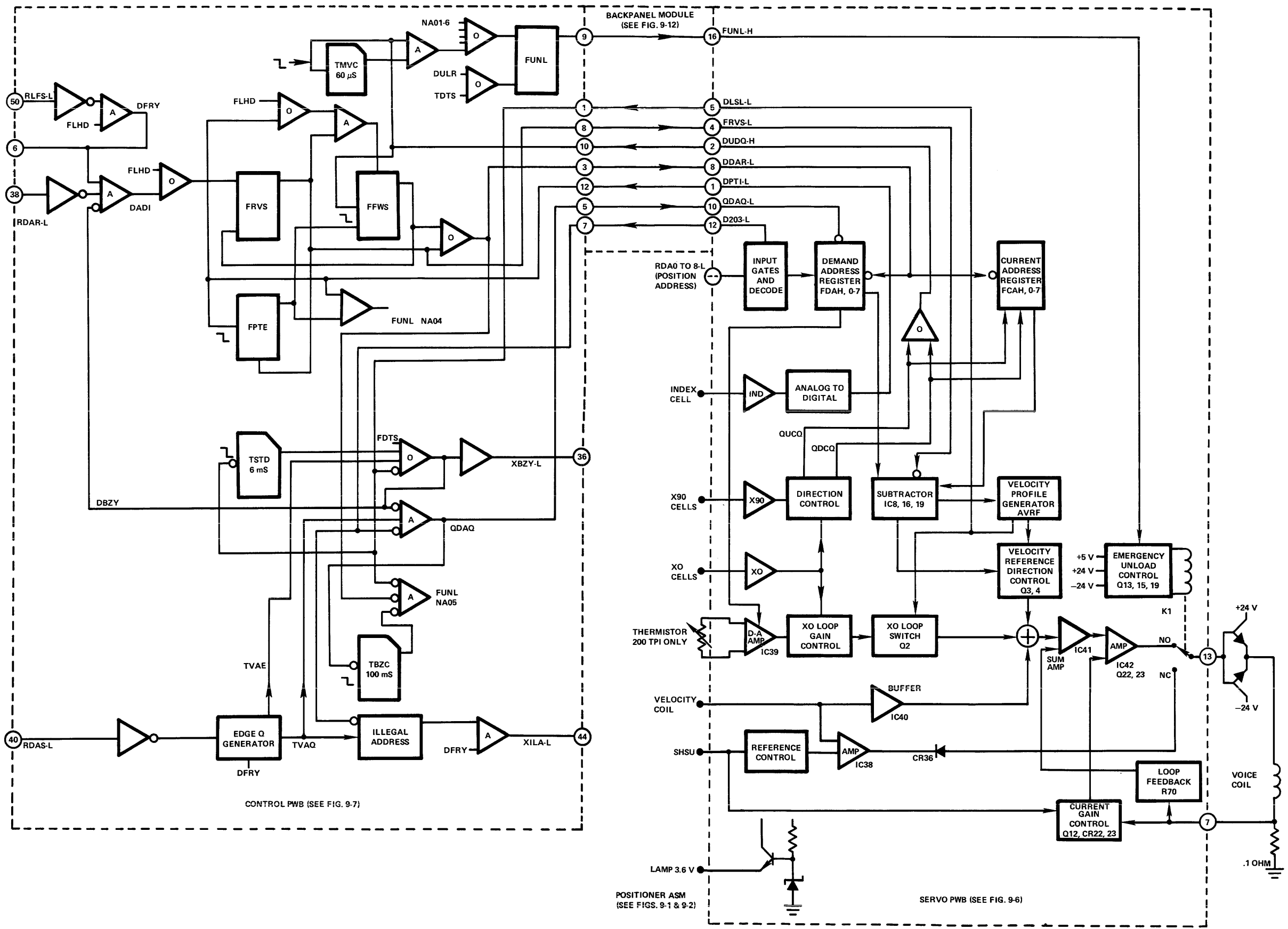
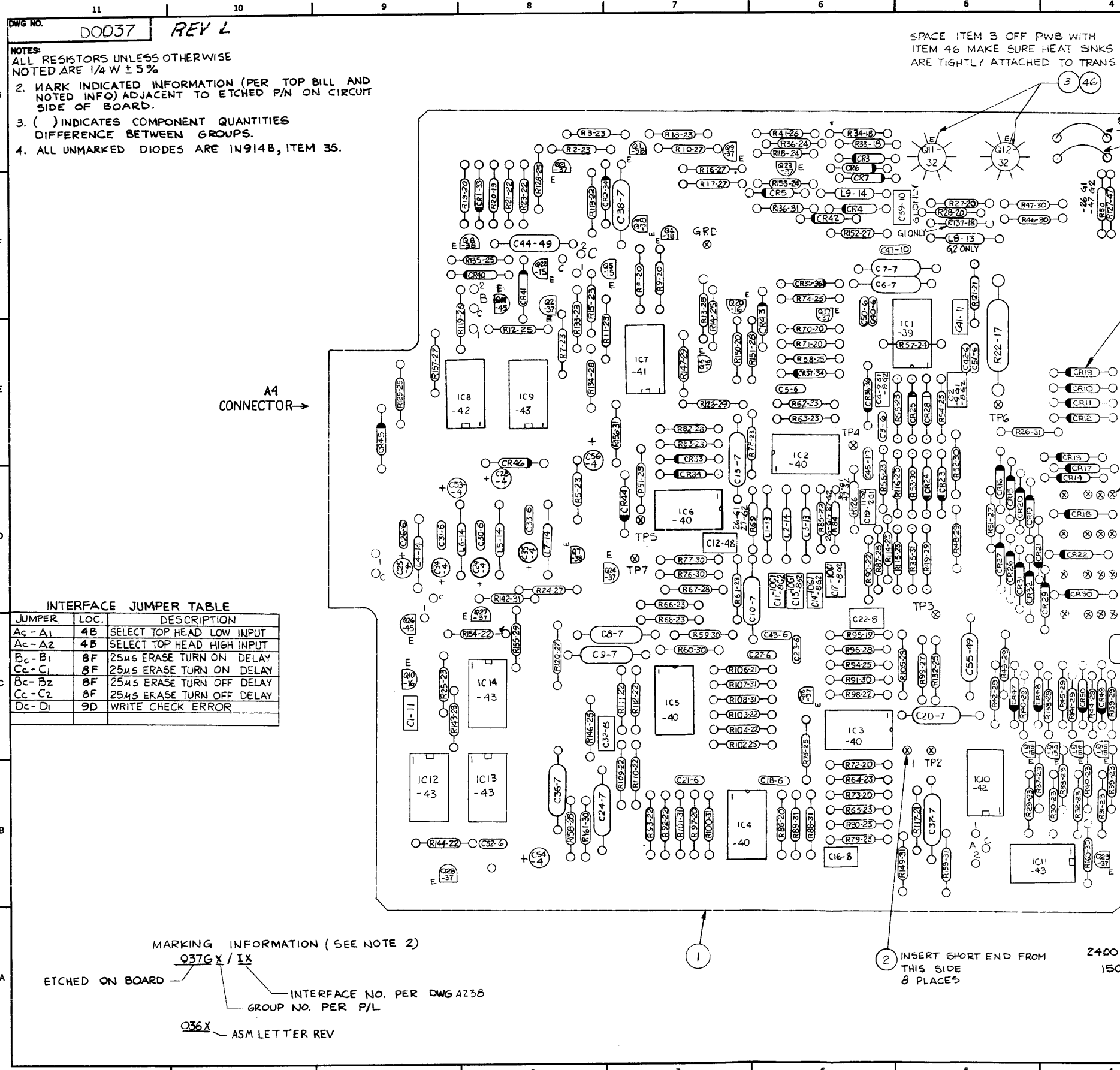


FIGURE 9-2  
 FUNCTIONAL BLOCK DIAGRAM



**FIGURE 9-3**  
**SERVO FLOW DIAGRAM**



DWG NO. **D0037 REV L**

NOTES:  
 1. ALL RESISTORS UNLESS OTHERWISE NOTED ARE 1/4 W ± 5%  
 2. MARK INDICATED INFORMATION (PER TOP BILL AND NOTED INFO) ADJACENT TO ETCHED P/N ON CIRCUIT SIDE OF BOARD.  
 3. ( ) INDICATES COMPONENT QUANTITIES DIFFERENCE BETWEEN GROUPS.  
 4. ALL UNMARKED DIODES ARE IN914B, ITEM 35.

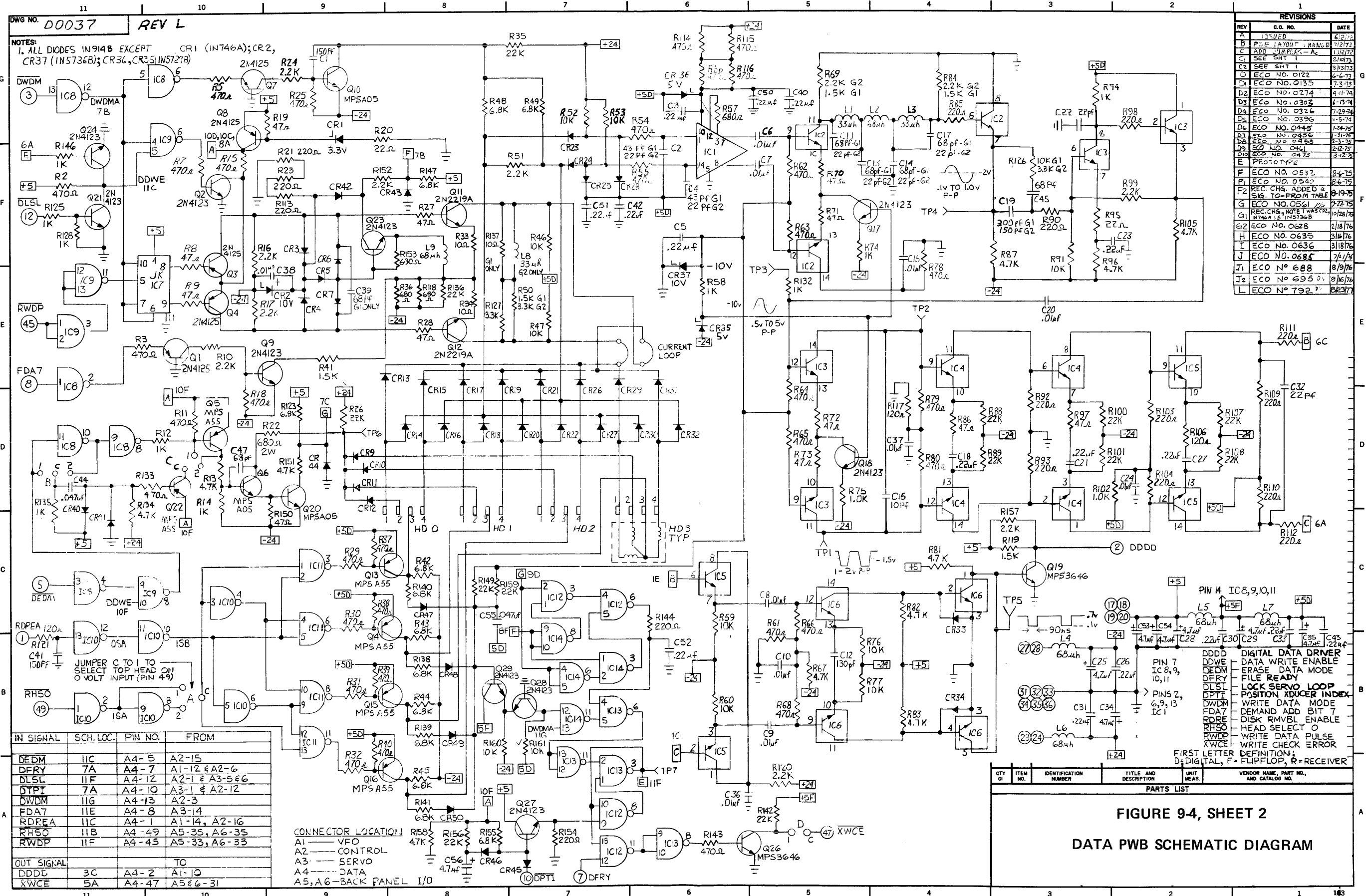
REVISIONS		REV	C.O. NO.	DATE
G1	ECO NO. 0561 P2	2/22/73		
G2	REC. CHG. SEE SH 2	10/28/73		
H	ECO NO. 0628	2/16/74	A	4/2/74
I	ECO NO. 0685	3/16/74	B	7/27/74
J	ECO NO. 0636	3/16/74	C	10/2/74
K	ECO NO. 0685	7/17/74		
L	ECO NO. 0688	8/19/74		
M	ECO NO. 0695	8/19/74		
N	ECO NO. 792	8/29/77		

**INTERFACE JUMPER TABLE**

JUMPER	LOC.	DESCRIPTION
Ac-A1	4B	SELECT TOP HEAD LOW INPUT
Ac-A2	4B	SELECT TOP HEAD HIGH INPUT
Bc-B1	8F	25μs ERASE TURN ON DELAY
Cc-C1	8F	25μs ERASE TURN ON DELAY
Bc-B2	8F	25μs ERASE TURN OFF DELAY
Cc-C2	8F	25μs ERASE TURN OFF DELAY
Dc-D1	9D	WRITE CHECK ERROR

QTY	QTY	ITEM	IDENTIFICATION	TITLE AND	UNIT	VENOR NAME, PART NO.,
52	GI	NO.	NUMBER	DESCRIPTION	MEAS.	AND CATALOG NO.
2	2	49	COG-0056P47333	CAPACITOR	EA	C44, 55 .047uF
1	1	48	COG-0057P13132	CAPACITOR	EA	C12 130PF
3	1	47	ROC-0062P332	RESISTOR	EA	R127 (R50,126-G2) 3.3K
2	2	46	TPA-0158 PI	TRANS. MT PAD	EA	
2	2	45	QOA-0061P3646	TRANSISTOR	EA	Q19, 26 MPS 3646
40	4	44	WIA-0049P2401	WIRE	IN	24 AWG
5	5	43	IC60041P7400	IC	EA	IC9, 11-14 7400
2	2	42	ICB-0041P7404	IC	EA	IC8, 10 7404
1	1	41	ICB-0041P74H103	IC	EA	IC7 74H103
5	5	40	ICB-0041P3046	IC	EA	IC2-6 CA 3046
1	1	39	ICB-0041P72733	IC	EA	IC1 72733
5	5	38	QOA-0061P4125	TRANSISTOR	EA	Q1, 3, 4, 7, 8, 2N 4125
10	10	37	QOA-0061P4123	TRANSISTOR	EA	Q2, 9, 17, 18, 21, 23, 24, 27-29, 2N4123
2	2	36	GRA-0042P5729B	DIODE	EA	CR 35, 36 SV IN5729B
42	42	35	P914B	DIODE	EA	CR3-7, 9-34, 40, 41-50 IN914B
2	2	34	P5736B	DIODE	EA	CR 2, 37 10V IN5736B
1	1	33	GRA-0042P746B	DIODE	EA	CR 1 3.3V IN746A
2	2	32	QOA-0061P2219A	TRANSISTOR	EA	Q11, 12 2N2219A
13	13	31	ROC-0062P2232	RESISTOR	EA	R26, 35, 36, 69, 100, 101, 107, 108, 136, 142, 149, 156, 159, 22K
11	12	30	P1032	RESISTOR	EA	R4, 47, 52, 53, 59, 60, 76, 77, 116, 161 (126-G) 10K
13	13	29	P6822	RESISTOR	EA	R42, 45, 48, 49, 123, 138-141, 147, 155 68K
11	11	28	P4722	RESISTOR	EA	R3, 67, 81, 83, 87, 96, 105, 134, 151, 158 4.7K
11	9	27	P2222	RESISTOR	EA	R10, 16, 17, 24, 51, 99, 120, 152, 157 (69, 84-62) 22K
2	2	26	P1522	RESISTOR	EA	R41, 119 (50, 69, 84-61) 1.5K
12	12	25	P1022	RESISTOR	EA	R12, 14, 58, 74, 75, 94, 102, 125, 126, 132, 135, 146 1K
4	4	24	P6812	RESISTOR	EA	R36, 57, 118, 153 680Ω
34	34	23	P4712	RESISTOR	EA	54-56, 61-66, 68, 78-80, 114-116, 133, 143 4.7K
16	16	22	P2212	RESISTOR	EA	R2, 3, 5, 7, 11, 15, 18, 25, 29, 32, 37-40 220Ω
3	3	21	P1212	RESISTOR	EA	R1, 23, 85, 90, 92, 93, 98, 103, 104, 109, 113, 144, 154 220Ω
12	12	20	P4702	RESISTOR	EA	R8, 9, 19, 27, 28, 70-73, 86, 97, 150 47K
2	2	19	P2202	RESISTOR	EA	R20, 95 22K
2	3	18	F1002	FUSE	EA	R33, 34, (137-61) 10A
1	1	17	ROC-0062P6815	RESISTOR	EA	R22 680Ω 2W
3	3	16	QOA-0061P55A05	TRANSISTOR	EA	Q6, 10, 20 MPSA05
6	6	15	QOA-0061P55A55	TRANSISTOR	EA	Q5, Q13-16, 22 MPSA55
6	6	14	LOC-0117P6802	INDUCTOR	EA	L2, 4-7, 9 68uH±10%
2	2	13	LOC-0117P3302	INDUCTOR	EA	L1, 3 (L8-G2) 33uH±10%
-	1	12	COG-0057P37132	CAPACITOR	EA	C19 300PF
3	2	11	COG-0057P15132	CAPACITOR	EA	C1, 41 (C19-G2) 150PF
2	7	10	P43032	RESISTOR	EA	(C13, 14, 17, 39-61) 45, 47 68PF
-	2	9	P43032	RESISTOR	EA	(C3, 4, 61) 43PF
8	2	8	COG-0057P22032	RESISTOR	EA	C22, 32 (C24, 11, 13, 14, 17 G2) 22PF
11	11	7	COG-0056P10333	RESISTOR	EA	C6-10, 15, 20, 24, 35, 37, 38 .01uF
16	16	6	COG-0118P22251	RESISTOR	EA	C3, 5, 8, 23, 26, 27, 30, 31, 33, 40, 42, 43, 50-52 22uF
1	1	5	COG-0057P10032	RESISTOR	EA	C16 10PF
8	8	4	COG-0055P47441	CAPACITOR	EA	C25, 28, 29, 34, 35, 53, 54, 56 4.7 uF
2	2	3	HSA-0124PI	HEAT SINK	EA	WAKEFIELD 204 AB
24	24	2	PIA-0059 P2	PINS	EA	AMP 85931-G
1	1	1	D0036	PWB	EA	

**FIGURE 9-4, SHEET 1**  
**DATA PWB**  
**COMPONENT LOCATION DIAGRAM**



DWG NO. **00037** REV **L**

NOTES:  
1. ALL DIODES IN 914B EXCEPT CR37 (IN5736B); CR36, CR35 (IN5727B)

REVISIONS		
REV	C.O. NO.	DATE
A	ISSUED	6/2/73
B	PAGE LAYOUT CHANGE	7/2/73
C	ADD SUPPLY AC	12/2/73
G	SEE SHIT 1	2/1/74
D2	SEE SHIT 1	3/13/73
D	ECO NO. 0122	6-6-73
D1	ECO NO. 0135	7-3-73
D2	ECO NO. 0274	4-11-74
D3	ECO NO. 0302	4-13-74
D4	ECO NO. 0326	7-29-74
D5	ECO NO. 0336	11-5-74
D6	ECO NO. 0445	1-24-75
D7	ECO NO. 0456	7-31-75
D8	ECO NO. 0468	8-3-75
D9	ECO NO. 0461	2-27-75
D10	ECO NO. 0473	3-2-75
E	PROTOTYPE	
F	ECO NO. 0532	8-4-75
F1	ECO NO. 0547	8-6-75
F2	REC CHG, ADDED & SIG. TO FROM TABLE	9-19-75
G	ECO NO. 0561	9-27-75
G1	REC CHG, NOTE 1 WAS CHG. IN 746A IS IN5736B	10/28/75
G2	ECO NO. 0628	2/18/76
H	ECO NO. 0635	3/16/76
I	ECO NO. 0636	3/18/76
J	ECO NO. 0685	7/1/76
J1	ECO N° 688	8/9/76
J2	ECO N° 695	8/16/76
L	ECO N° 792	8/23/77

IN SIGNAL	SCH. LOC.	PIN NO.	FROM
DEDM	11C	A4-5	A2-15
DFRY	7A	A4-7	A1-12 & A2-6
DLSL	11F	A4-12	A2-1 & A3-5 & 6
DTPT	7A	A4-10	A3-1 & A2-12
DWDM	11G	A4-13	A2-3
DDWE	11E	A4-8	A3-14
RDFEA	11C	A4-1	A1-14, A2-16
RHSO	11B	A4-49	A5-35, A6-35
RWDP	11F	A4-45	A5-33, A6-33
OUT SIGNAL			TO
DDDD	3C	A4-2	A1-10
XWCE	5A	A4-47	A5 & 6-31

CONNECTOR LOCATION:  
A1 --- VFO  
A2 --- CONTROL  
A3 --- SERVO  
A4 --- DATA  
A5, A6 --- BACK PANEL I/O

QTY	ITEM NO.	IDENTIFICATION NUMBER	TITLE AND DESCRIPTION	UNIT MEAS.	VENDOR NAME, PART NO., AND CATALOG NO.
PARTS LIST					

**FIGURE 9-4, SHEET 2**  
**DATA PWB SCHEMATIC DIAGRAM**

DWG NO **D058** REV **M3**

**NOTES:**  
 1. ALL RESISTORS ARE 1/4W, ±5%.  
 2. MARK INDICATED INFORMATION (PER TOP BILL AND NOTED INFO) ADJACENT TO ETCHED P/N ON CIRCUIT SIDE OF BOARD.  
 3. ADD 'O' FOR O SECTORS ON TAG, JUMPER HC-H2, REMOVE TC-T1 ADD 'X' FOR MULTIPLE SECTORS ON TAG, JUMPER HC-H1, TC-T1.  
 4. NOTE ON SHEET 1 OF INTERFACE DWG 10A238 IS GIVEN HERE FOR REFERENCE, "FOR SECTOR, VFO PWB; WHEN CUSTOMER INTERFACE SPECIFIES USE OF WIDE SECTOR SLOT, TOP LOAD CARTRIDGES ONLY (80 MIL WIDE) THEN INTERFACE IS TO BE SPECIFIED (AND MARKED ON UNIT S.N. TAG) AS, FOR EXAMPLE: 101W (ADD W). THE VFO PWB WILL BE MARKED ON ITS TAG AS, FOR EXAMPLE: 10W (ADD W). JUMPER AC-A2 (HIGH GAIN) WILL BE REMOVED AND REPLACED WITH AC-A1 (LOW GAIN) ON VFO PWB REVISION K OR LATER."

M3	ECO NO. 0656	1/11/74
J	ECO NO. 0281	4/23/74
J	ECO NO. 0318	7/4/74
K	ECO NO. 0338	8/6/74
K	ECO NO. 0349	9/18/74
K2	ECO NO. 0420	1/10/75
L	PROTOTYPE	9/17/75
M	ECO NO. 0562	11/15/75
M1	ECO NO. 0607	1/24/76
M2	ECO NO. 0639	3/17/76

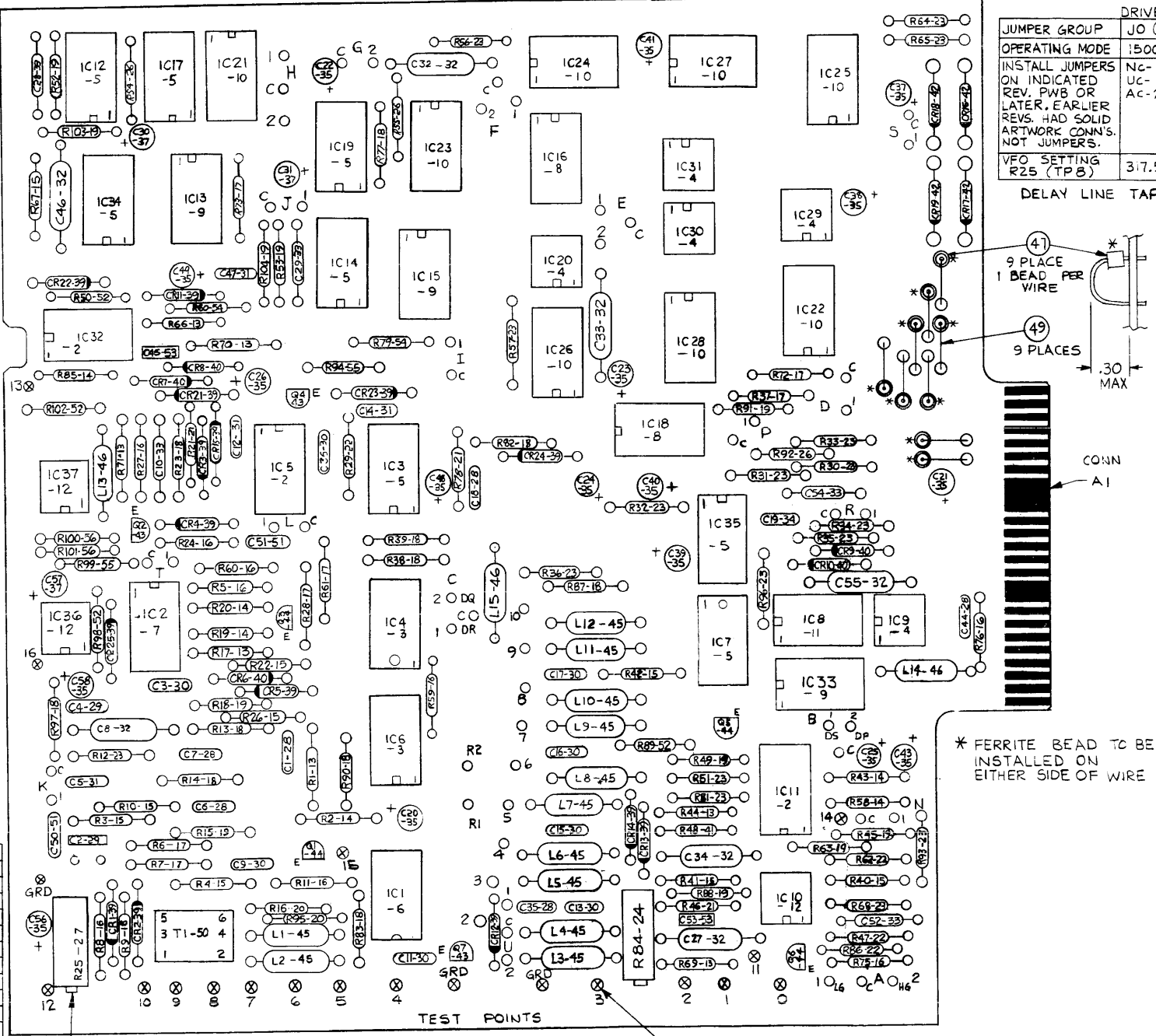
MARKING INFORMATION (SEE NOTE 2)  
**058GX/IX/JX/SX** SECTOR MARKING (NOTE 3)  
 ETCHED ON BOARD  
**057X** INTERFACE NO. PER DWG A238  
 ASM LETTER REV. GROUP NO. PER P/L.

REVISIONS		
REV	C.O. NO.	DATE
A	ISSUED	
B	SEE SH. 2	
C		
D		
E		
F		
G		
H		
I		
J		
K		
L		
M		
N		
O		
P		
Q		
R		
S		
T		
U		
V		
W		
X		
Y		
Z		

DRIVE FUNCTION JUMPERS				
JUMPER GROUP	J0 (TOP LOAD)	J1 (TOP LOAD)	J2 (FRONT LOAD)	J3 (FRONT LOAD)
OPERATING MODE	1500 RPM	2400 RPM	1500 RPM	2400 RPM
INSTALL JUMPERS ON INDICATED REV. PWB OR LATER, EARLIER REVS. HAD SOLID ARTWORK CONN'S. NOT JUMPERS.	NC-1 (REV. I) UC-1 (REV. M) AC-2, NOTE 4	SAME AS J3, ADD NC-1 (REV. J) AC-2, NOTE 4	UC-1 (REV. M)	IC-1, JC-1, KC-1 (REV. G) LC-1 (REV. H) PC-1 (REV. K) UC-1 (REV. M)
VFO SETTING R25 (TPB)	317.5 ± 1%	200 ± 1%	317.5 ± 1%	200 ± 1%

DELAY LINE TAP RETURNS R1 & R2 SET IN TEST  
 1500 OR 2400 RPM

QTY	ITEM NO.	IDENTIFICATION NUMBER	TITLE AND DESCRIPTION	UNIT MEAS.	VENDOR NAME, PART NO., AND CATALOG NO.
2	51	COC-057P4132	CAPACITOR	EA	CEO, CSI
1	50	TOA-127 P1	TRANSFORMER	EA	T1 TECHNITROL 11KGB
5	49	WIA-051 P22	WIRE, SOLID, BARE	IN	22 AWG
20	48	PIA-059 P2	PIN	EA	AMP 85931-G
9	47	FBA-126 P1	FERRITE BEADS		
3	46	LOC-117 P3302	INDUCTOR		L13, 14, 15
12	45	LOC-117 P2822	INDUCTOR		L1-12
4	44	QOA-061 P4123	TRANSISTOR-NPN		Q1, 3, 5, 6
3	43	QOA-061 P4125	TRANSISTOR-PNP		Q2, 4, 7
4	42	CRA-042 P414A	DIODE		CR16-19
1	41	ROC062 P6812	RESISTOR		R48
5	40	CRA-042 P5731B	DIODE		CR 6-10
15	39	CRA-042 P914B	DIODE		CR 1-5, 11-15, 21-25
3	37	COC-055 P1054	CAPACITOR		C30, 31, 57
2	36	COC-056 P27333			C27, 34
16	35	COC-055 P47441			C20-26, 37-41, 43, 48, 49, 56, 58
1	34	COC-057 P22032			C19
5	33	COC-056 P10433			C10, 28, 29, 52, 54
7	32	COC-056 P10333			C8, 27, 32, 33, 34, 46, 55
4	31	COC-057 P175122			C5, 14, 47, 12
8	30	COC-057 P13132			C3, 9, 11, 13, 15-17, 36
2	29	COC-118 P22251			C2, 4
6	28	COC-057 P43032	CAPACITOR		C1, 6, 7, 18, 35, 44
1	27	ROC-116 P2022	RESISTOR-ADJ		R25
2	26	ROC-062 P3332	RESISTOR		R54, 55, 92
2	25	COC-057 P15232	CAPACITOR		C12
1	24	ROC-116 P2032	RESISTOR ADJ.		R84
17	23	ROC-062 P1212	RESISTOR		R12, 30, 36, 51, 56, 57, 64, 65, 68, 81, 82, 96, 120
4	22	ROC-062 P1032			R29, 47, 62, 86
3	21	ROC-062 P3322			R21, 46, 78
2	20	ROC-062 P1002			R16, 95
14	19	ROC-062 P2232			R15, 18, 45, 49, 52, 53, 63, 88, 91, 103, 104, 22K
11	18	ROC-062 P1022			R13, 14, 23, 38, 39, 71, 82, 83, 87, 90, 97, 1K
7	17	ROC-062 P4722			R6, 7, 28, 37, 51, 72, 73
10	16	ROC-062 P4712			R5, 8, 11, 24, 27, 59, 60, 75, 76
9	15	ROC-062 P2222			R3, 4, 10, 22, 26, 40, 41, 42, 67
6	14	ROC-062 P4702			R2, 19, 20, 43, 53, 85
7	13	ROC-062 P2212	RESISTOR		R1, 17, 44, 66, 69, 70, 71
3	12	ICB-041 P72741	IC		IC10, 36, 37
1	11	ICB-041 P7410			IC8
8	10	ICB-041 P7400	TTL 2W GATE		IC21-28
3	9	ICB-041 P74107	TTL FF TTL		IC13, 15, 33
2	8	ICB-041 P7493			IC16, 18
1	7	ICB-041 P3046			IC2
1	6	ICB-041 P3002			IC1
8	5	ICB-041 P9601	ONE SHOT TTL		IC3, 7, 12, 14, 17, 19, 34, 35
5	4	ICB-041 P75451	DRIVER		IC9, 20, 29, 30, 31
2	3	ICB-041 P74103			IC4, 6
5	2	ICB-041 P72710	IC		IC5, 11, 32
1	1	TD-051	PWB	EA	

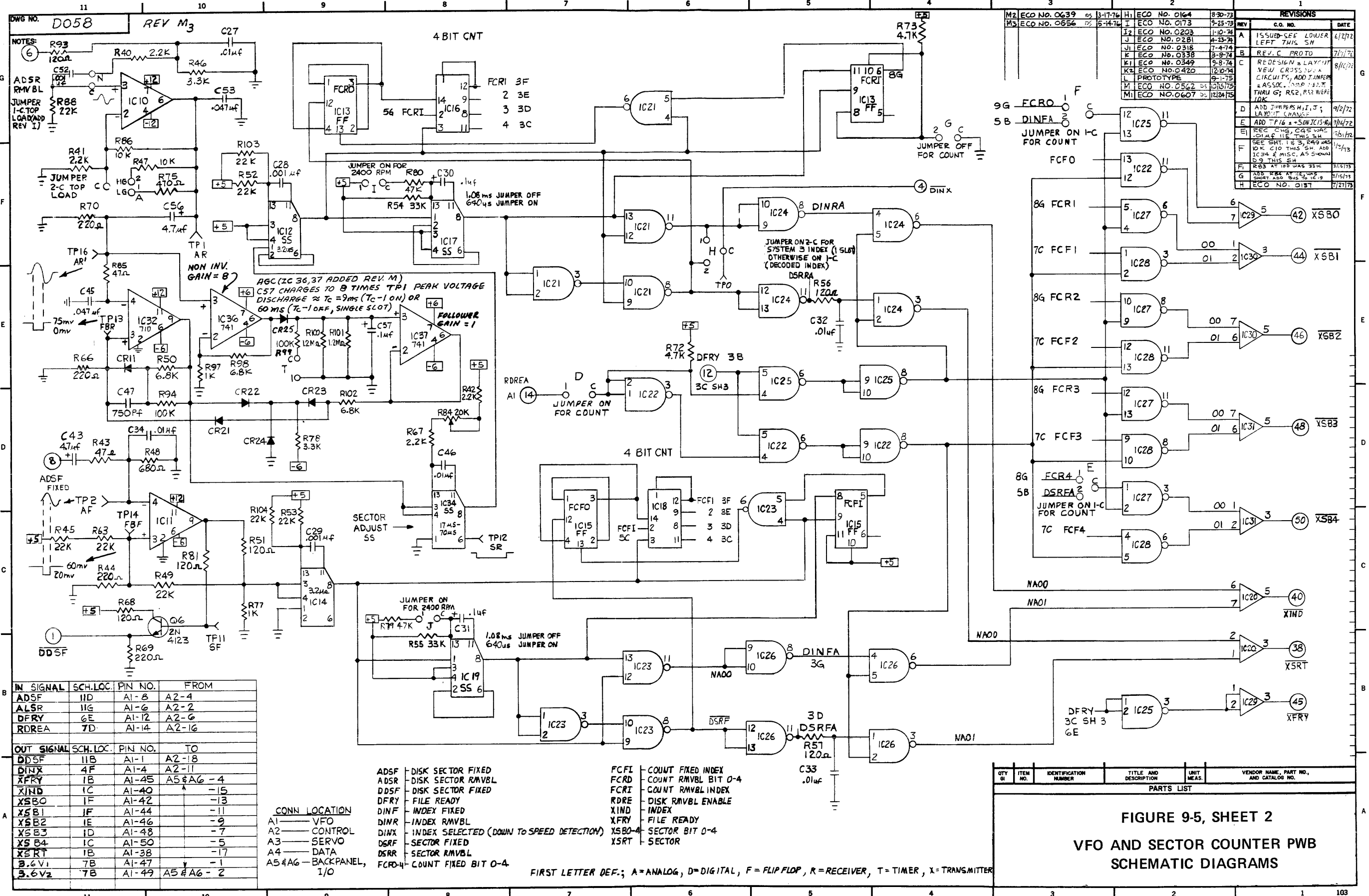


JUMPER	LOC	DESCRIPTION
AC-A1	5B	TOP LOAD (80 MIL SECTOR SLOTS)
AC-A2	5B	TOP LOAD (20/80 MIL SECTOR SLOTS)
BC-B1	5C	SEND NRZ DATA
BC-B2	5C	SEND DATA PULSE
CC-C1	7D	SEND RAW DATA
CC-C2	7D	SEND DECODED DATA
DC-D1	5E	SEND SELECTED SECTOR COUNT
EC-E1	7F	SEND SELECTED SECTOR COUNT
EC-E2	7F	SEND FIXED SECTOR PULSE
FC-F1	7F	SEND SELECTED SECTOR COUNT
FC-F2	7F	SEND RMVBL SECTOR PULSE
GC-G2	8G	DISABLES RMVBL SECTOR COUNT
RC-R1	5D	READ GATE DELAY
HC-H1	8F	DECODED INDEX SLOT
HC-H2	8F	SYSTEM 3 SINGLE INDEX SLOT
SC-S1	5F	CONNECT TERMINATING VOLTAGE
TC-T1	9D	SECTOR AGC TIME CONSTANT

2	56	ROC062 P1252	RESISTOR	EA	R100, 101	1.2 MEG.Ω
2	55	ROC062 P1042	RESISTOR	EA	R99, 94	100 K
2	54	ROC062 P4152	RESISTOR	EA	R79, 80	47K
2	53	COC118 P47351	CAPACITOR	EA	C53, 45	0.27 μF
4	52	ROC062 P6822	RESISTOR	EA	R50, 89, 98, 102	6.8K

FIGURE 9-5, SHEET 1  
 VFO AND SECTOR COUNTER PWB  
 COMPONENT LOCATION DIAGRAM





REV	C.O. NO.	DATE
1	ECO NO. 0173	9-25-73
2	ECO NO. 0203	1-10-74
3	ECO NO. 0281	4-23-74
4	ECO NO. 0318	7-4-74
5	ECO NO. 0338	8-8-74
6	ECO NO. 0349	9-8-74
7	ECO NO. 0420	12-10-74
8	ECO NO. 0562	10-15-75
9	ECO NO. 0607	12-24-75

DWG NO. **D058**  
REV **M3**

NOTES:  
⑥ AD5R RMVBL JUMPER 1-C TOP LOAD (REV 1)

IN SIGNAL	SCH. LOC.	PIN NO.	FROM
AD5F	11D	A1-8	A2-4
AL5R	11G	A1-6	A2-2
DFRY	6E	A1-12	A2-6
RDREA	7D	A1-14	A2-16

OUT SIGNAL	SCH. LOC.	PIN NO.	TO
DD5F	11B	A1-1	A2-18
DINX	4F	A1-4	A2-11
XFRY	1B	A1-45	A5 & A6 - 4
XIND	1C	A1-40	-15
X5B0	1F	A1-42	-13
X5B1	1F	A1-44	-11
X5B2	1E	A1-46	-9
X5B3	1D	A1-48	-7
X5B4	1C	A1-50	-5
X5RT	1B	A1-38	-17
3.6V1	7B	A1-47	-1
3.6V2	7B	A1-49	A5 & A6 - 2

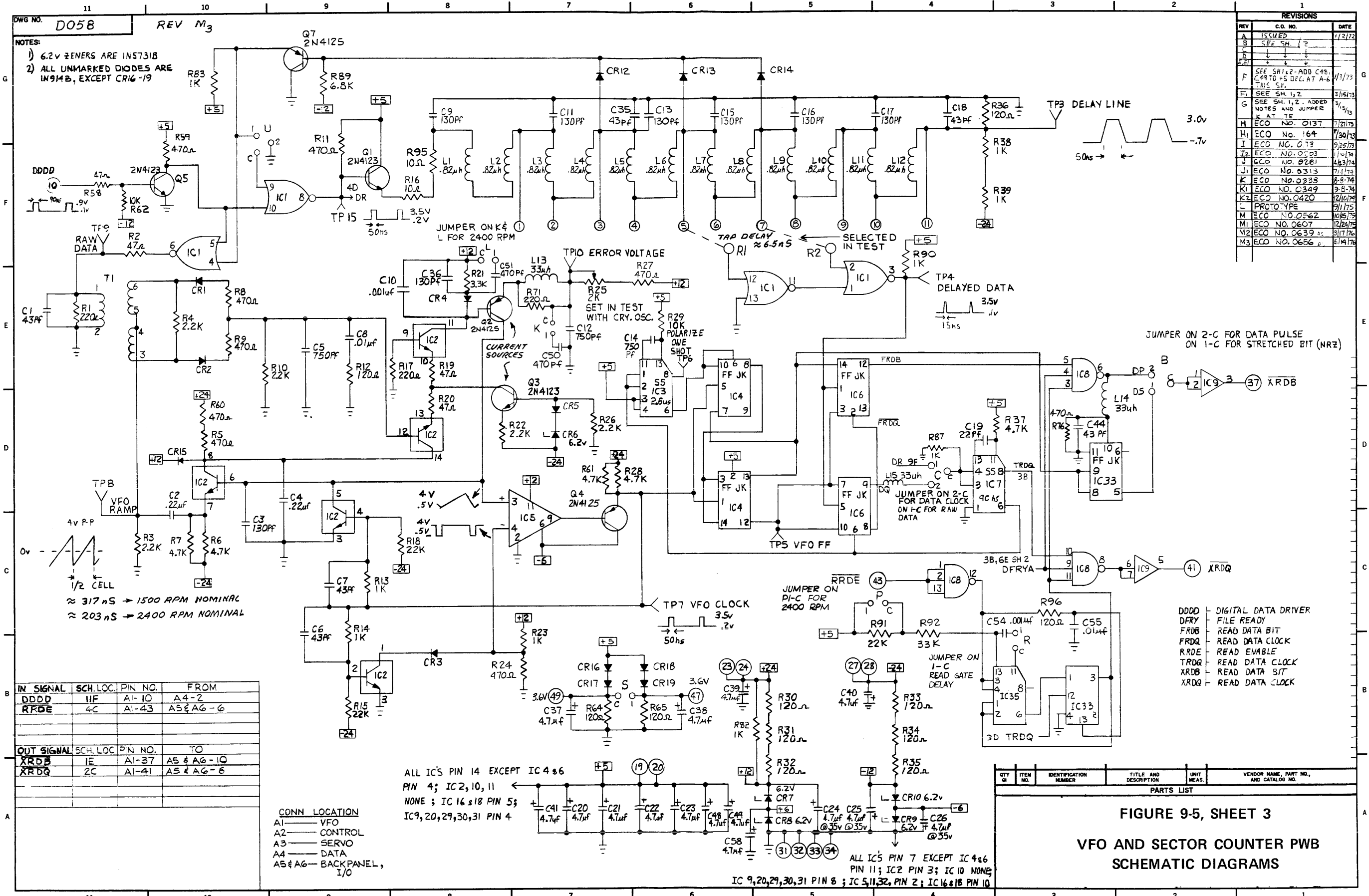
CONN LOCATION  
A1 - VFO  
A2 - CONTROL  
A3 - SERVO  
A4 - DATA  
A5 & A6 - BACKPANEL, I/O

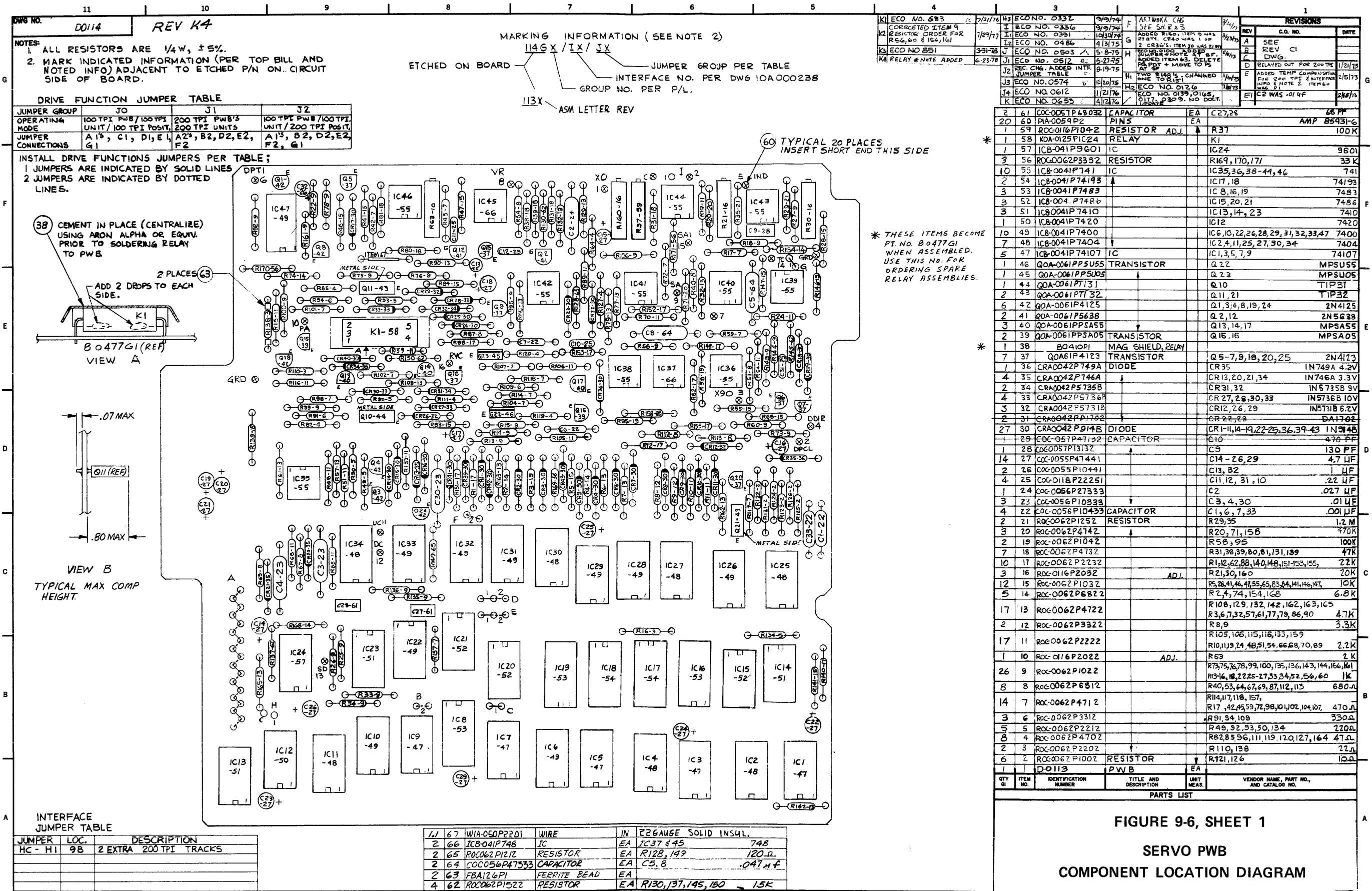
AD5F - DISK SECTOR FIXED  
AD5R - DISK SECTOR RMVBL  
DD5F - DISK SECTOR FIXED  
DINX - INDEX FIXED  
DFRY - FILE READY  
DINR - INDEX RMVBL  
DINX - INDEX SELECTED (DOWN TO SPEED DETECTION)  
DSRF - SECTOR FIXED  
DSRR - SECTOR RMVBL  
FCRD - COUNT FIXED BIT 0-4  
FCFI - COUNT RMVBL BIT 0-4  
FCRI - COUNT RMVBL INDEX  
RDRE - DISK RMVBL ENABLE  
XIND - INDEX  
XFRY - FILE READY  
X5B0-4 - SECTOR BIT 0-4  
X5RT - SECTOR

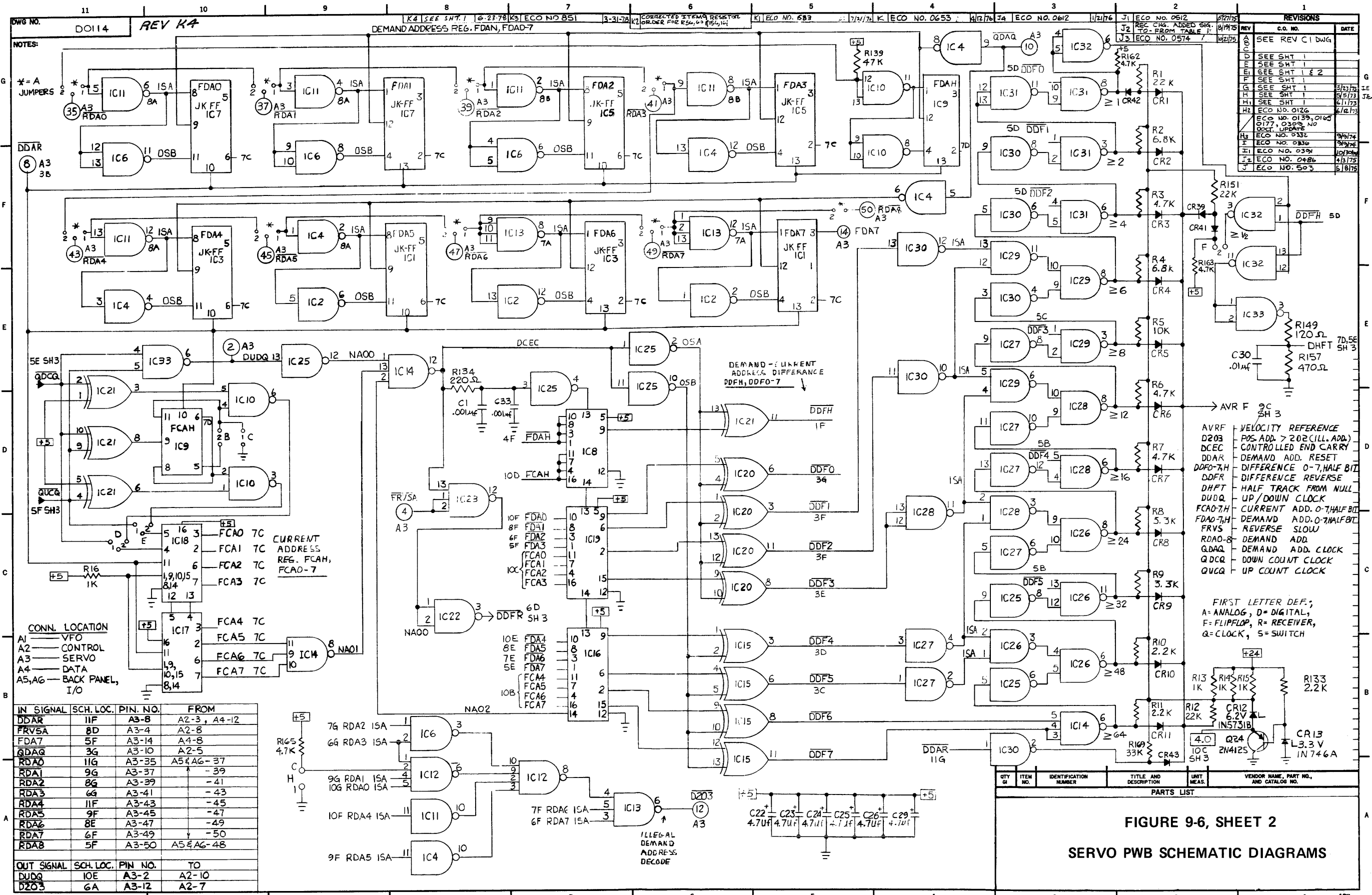
FIRST LETTER DEF.; A=ANALOG, D=DIGITAL, F=FLIP FLOP, R=RECEIVER, T=TIMER, X=TRANSMITTER

QTY	ITEM NO.	IDENTIFICATION NUMBER	TITLE AND DESCRIPTION	UNIT MEAS.	VENDOR NAME, PART NO., AND CATALOG NO.
PARTS LIST					

**FIGURE 9-5, SHEET 2**  
**VFO AND SECTOR COUNTER PWB**  
**SCHEMATIC DIAGRAMS**







NOTES:

\* = A  
JUMPERS

DDAR  
A3  
3B

F

E

D

C

B

A

IN SIGNAL	SCH. LOC.	PIN. NO.	FROM
DDAR	IIF	A3-8	A2-3, A4-12
FRVSA	8D	A3-4	A2-8
FDA7	5F	A3-14	A4-8
QDAQ	3G	A3-10	A2-5
RDA0	11G	A3-35	A5, A6-37
RDA1	9G	A3-37	-39
RDA2	8G	A3-39	-41
RDA3	6G	A3-41	-43
RDA4	11F	A3-43	-45
RDA5	9F	A3-45	-47
RDA6	8E	A3-47	-49
RDA7	6F	A3-49	-50
RDA8	5F	A3-50	A5, A6-48

OUT SIGNAL	SCH. LOC.	PIN. NO.	TO
DUDQ	10E	A3-2	A2-10
D203	6A	A3-12	A2-7

CONN. LOCATION  
A1 VFO  
A2 CONTROL  
A3 SERVO  
A4 DATA  
A5, A6 BACK PANEL, I/O

CURRENT ADDRESS REG. FCA0-FCA7

DEMAND - LINKED ADDRESS DIFFERENCE DDFH, DDF0-7

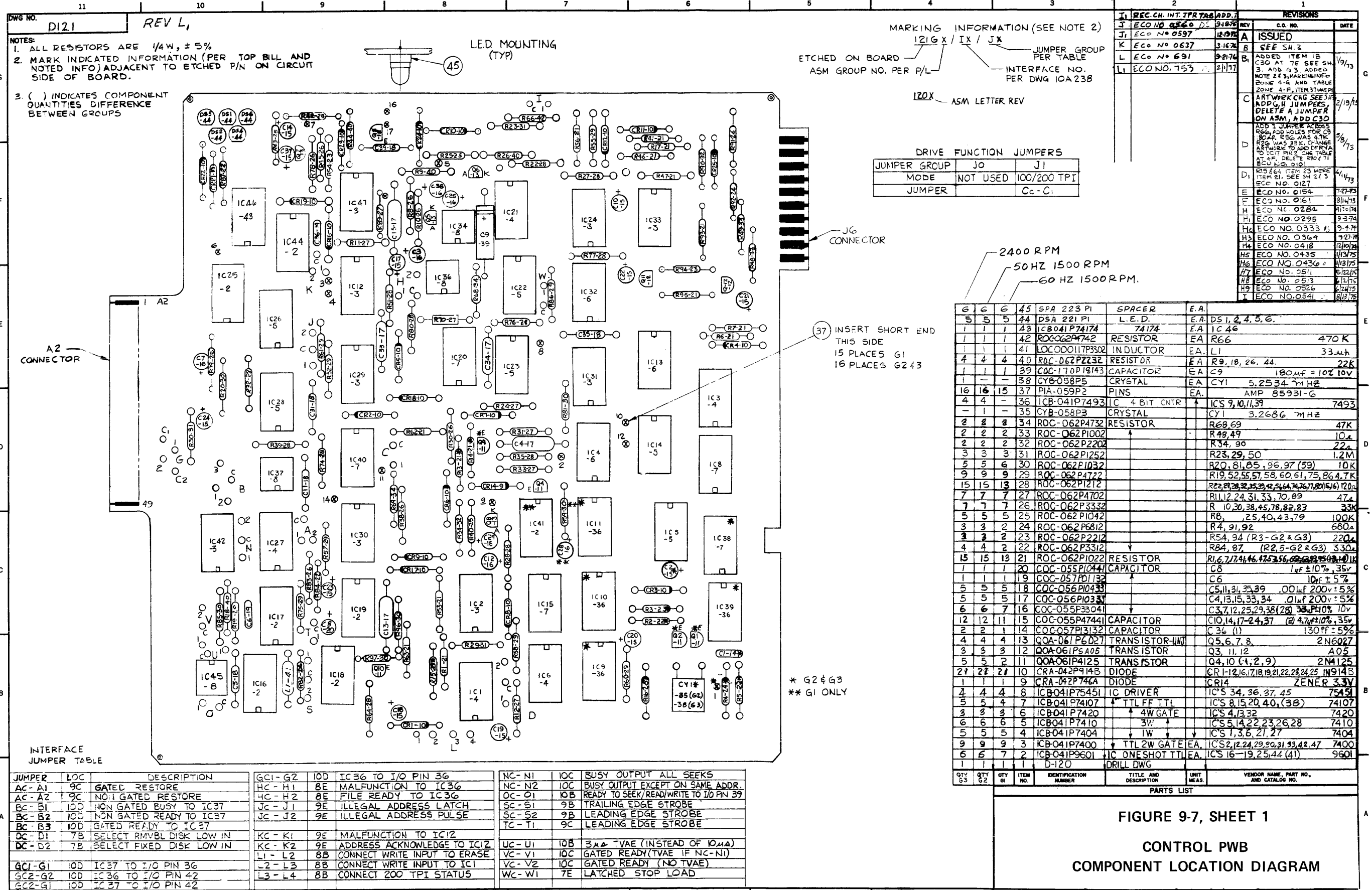
ILLEGAL DEMAND ADDRESS DECODE

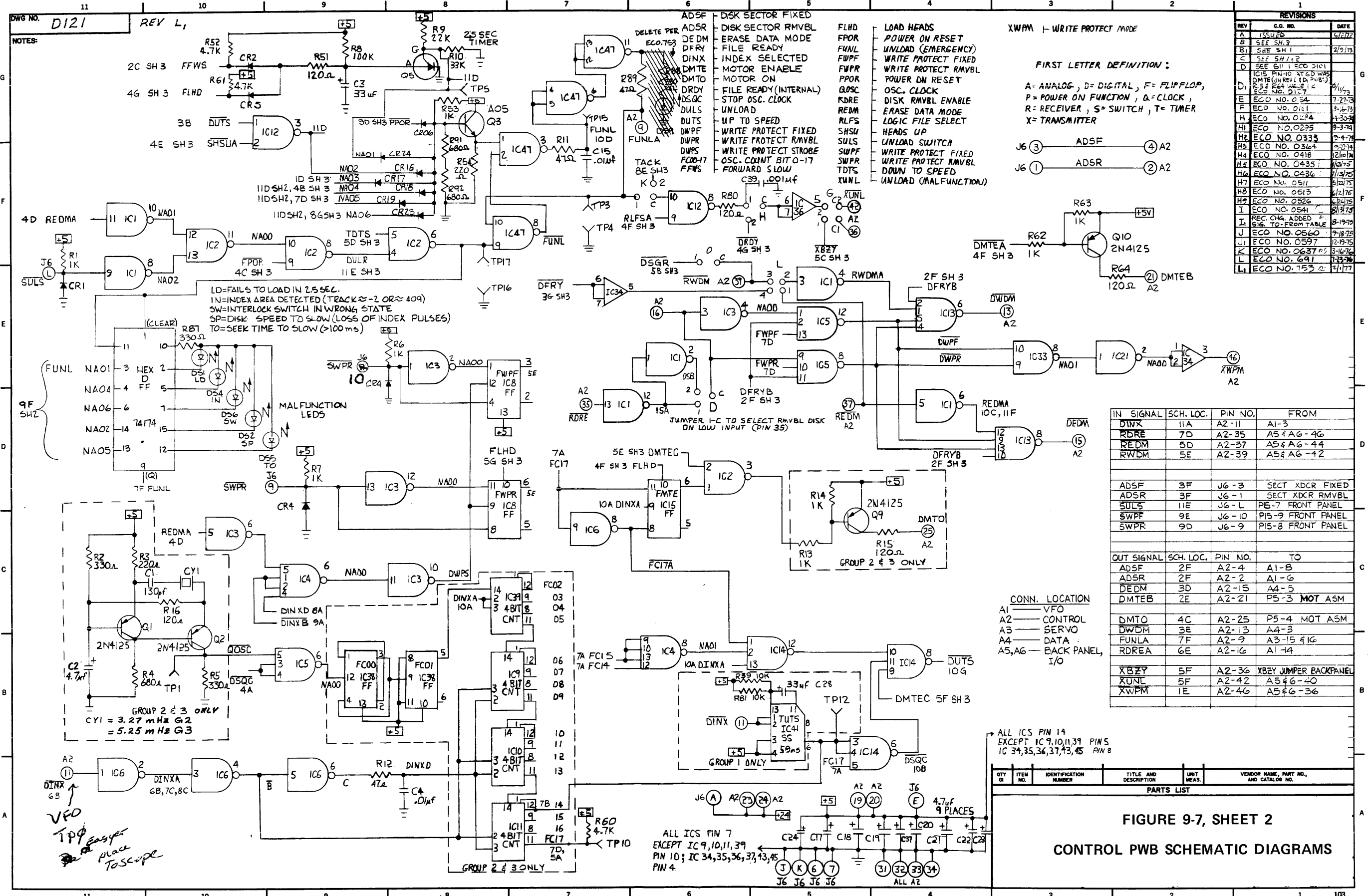
REV	ECO NO.	DATE
A	SEE REV C1 DWG	
B	SEE SHT 1	
C	SEE SHT 1	
D	SEE SHT 1 & 2	
E	SEE SHT 1	3/23/75
F	SEE SHT 1	5/5/75
G	SEE SHT 1	6/11/75
H	SEE SHT 1	6/12/75
I	ECO NO. 0126	6/12/75
J	ECO NO. 0139, 0140, 0177, 0329, No LOCK UPDATES	9/9/74
K	ECO NO. 0332	9/9/74
L	ECO NO. 0336	9/9/74
M	ECO NO. 0391	10/30/74
N	ECO NO. 0486	4/13/75
O	ECO NO. 503	5/18/75

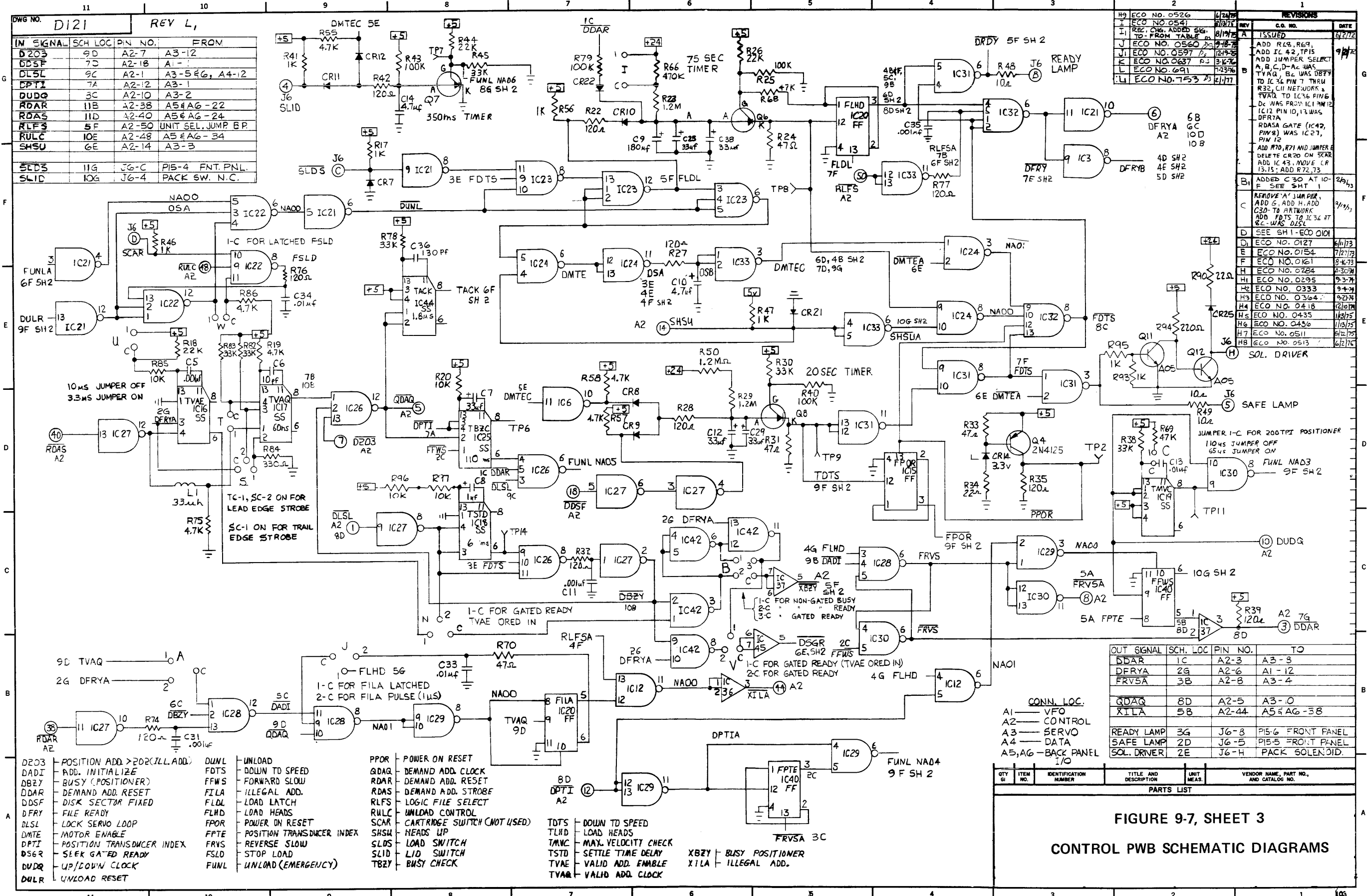
QTY	ITEM NO.	IDENTIFICATION NUMBER	TITLE AND DESCRIPTION	UNIT MEAS.	VENDOR NAME, PART NO., AND CATALOG NO.
PARTS LIST					

FIGURE 9-6, SHEET 2  
SERVO PWB SCHEMATIC DIAGRAMS









DWG NO. **D121** REV **L1**

IN SIGNAL	SCH LOC	PIN NO.	FROM
D203	9D	A2-7	A3-12
DDSF	7D	A2-18	A1-1
DL5L	9C	A2-1	A3-5 & G, A4-12
DPTI	7A	A2-12	A3-1
DUDQ	3C	A2-10	A3-2
RDAR	11B	A2-38	A5 & AG-22
RDAS	11D	A2-40	A5 & AG-24
RLFS	5F	A2-50	UNIT SEL. JUMP BR.
RULC	10E	A2-48	A5 & AG-34
SHSU	6E	A2-14	A3-3
SEDS	11G	J6-C	PI5-4 FNT. PNL.
SLID	10G	J6-4	PACK SW. N.C.

REVISIONS		DATE
REV	DESCRIPTION	DATE
1	ISSUED	6/27/72
2	ADD R48, R49, ADD J6-3, TP15, ADD JUMPER SELECT A, B, C, D-AE WAS TYPED, B-C WAS DFRYA TO IC36 PIN 7 THRU R32, LII NETWORK & TVAR, TO IC36 PIN 6 DC WAS FROM IC1 PIN 12 IC12 PIN 10, 13 WAS DFRYA, RDASA GATE (IC42, PIN 8) WAS IC27, PIN 12	9/1/72
3	ADD #70, #71 AND JUMPER & DELETE CR20 ON SCAR	9/1/72
4	ADD IC 43, MOVE CR 13, 14, ADD R72, 73	9/1/72
5	ADD R70, R71 AND JUMPER & DELETE CR20 ON SCAR	9/1/72
6	ADD IC 43, MOVE CR 13, 14, ADD R72, 73	9/1/72
7	ADD R70, R71 AND JUMPER & DELETE CR20 ON SCAR	9/1/72
8	ADD IC 43, MOVE CR 13, 14, ADD R72, 73	9/1/72
9	ADD R70, R71 AND JUMPER & DELETE CR20 ON SCAR	9/1/72
10	ADD IC 43, MOVE CR 13, 14, ADD R72, 73	9/1/72
11	ADD R70, R71 AND JUMPER & DELETE CR20 ON SCAR	9/1/72
12	ADD IC 43, MOVE CR 13, 14, ADD R72, 73	9/1/72
13	ADD R70, R71 AND JUMPER & DELETE CR20 ON SCAR	9/1/72
14	ADD IC 43, MOVE CR 13, 14, ADD R72, 73	9/1/72
15	ADD R70, R71 AND JUMPER & DELETE CR20 ON SCAR	9/1/72
16	ADD IC 43, MOVE CR 13, 14, ADD R72, 73	9/1/72
17	ADD R70, R71 AND JUMPER & DELETE CR20 ON SCAR	9/1/72
18	ADD IC 43, MOVE CR 13, 14, ADD R72, 73	9/1/72
19	ADD R70, R71 AND JUMPER & DELETE CR20 ON SCAR	9/1/72
20	ADD IC 43, MOVE CR 13, 14, ADD R72, 73	9/1/72

OUT SIGNAL	SCH. LOC	PIN NO.	TO
DDAR	1C	A2-3	A3-3
DFRYA	2G	A2-6	A1-12
FRV5A	3B	A2-8	A3-4
QDAQ	8D	A2-5	A3-0
XILA	5B	A2-44	A5 & AG-3B
READY LAMP	3G	J6-3	PI5-6 FRONT PNL.
SAFE LAMP	2D	J6-5	PI5-5 FRONT PNL.
SOL. DRIVER	2E	J6-H	PACK SOLENOID.

CONNECTION	DESCRIPTION
A1	VFO
A2	CONTROL
A3	SERVO
A4	DATA
A5, AG	BACK PANEL I/O

CONNECTION	DESCRIPTION
D203	POSITION ADD. > 202 (ILL. ADD.)
DADI	ADD. INITIALIZE
DBZY	BUSY (POSITIONER)
DDAR	DEMAND ADD. RESET
DDSF	DISK SECTOR FIXED
DFRY	FILE READY
DL5L	LOCK SERVO LOOP
DMTE	MOTOR ENABLE
DPTI	POSITION TRANSDUCER INDEX
DS6R	SEEK GATED READY
DUDQ	UP/DOWN CLOCK
DULR	UNLOAD RESET
DUNL	UNLOAD
FDT5	DOWN TO SPEED
FFWS	FORWARD SLOW
FILA	ILLEGAL ADD.
FLDL	LOAD LATCH
FLND	LOAD HEADS
FPOR	POWER ON RESET
FFTE	POSITION TRANSDUCER INDEX
FRVS	REVERSE SLOW
FSLD	STOP LOAD
FUNL	UNLOAD (EMERGENCY)
PPOR	POWER ON RESET
QDAQ	DEMAND ADD. CLOCK
RDAR	DEMAND ADD. RESET
RDAS	DEMAND ADD. STROBE
RLFS	LOGIC FILE SELECT
RULC	UNLOAD CONTROL
SCAR	CARTRIDGE SWITCH (NOT USED)
SHSU	HEADS UP
SLDS	LOAD SWITCH
SLID	LID SWITCH
TBZY	BUSY CHECK
TDTS	DOWN TO SPEED
TLHD	LOAD HEADS
TMVC	MAX. VELOCITY CHECK
TSDD	SETTLE TIME DELAY
TVAE	VALID ADD. ENABLE
TVAR	VALID ADD. CLOCK

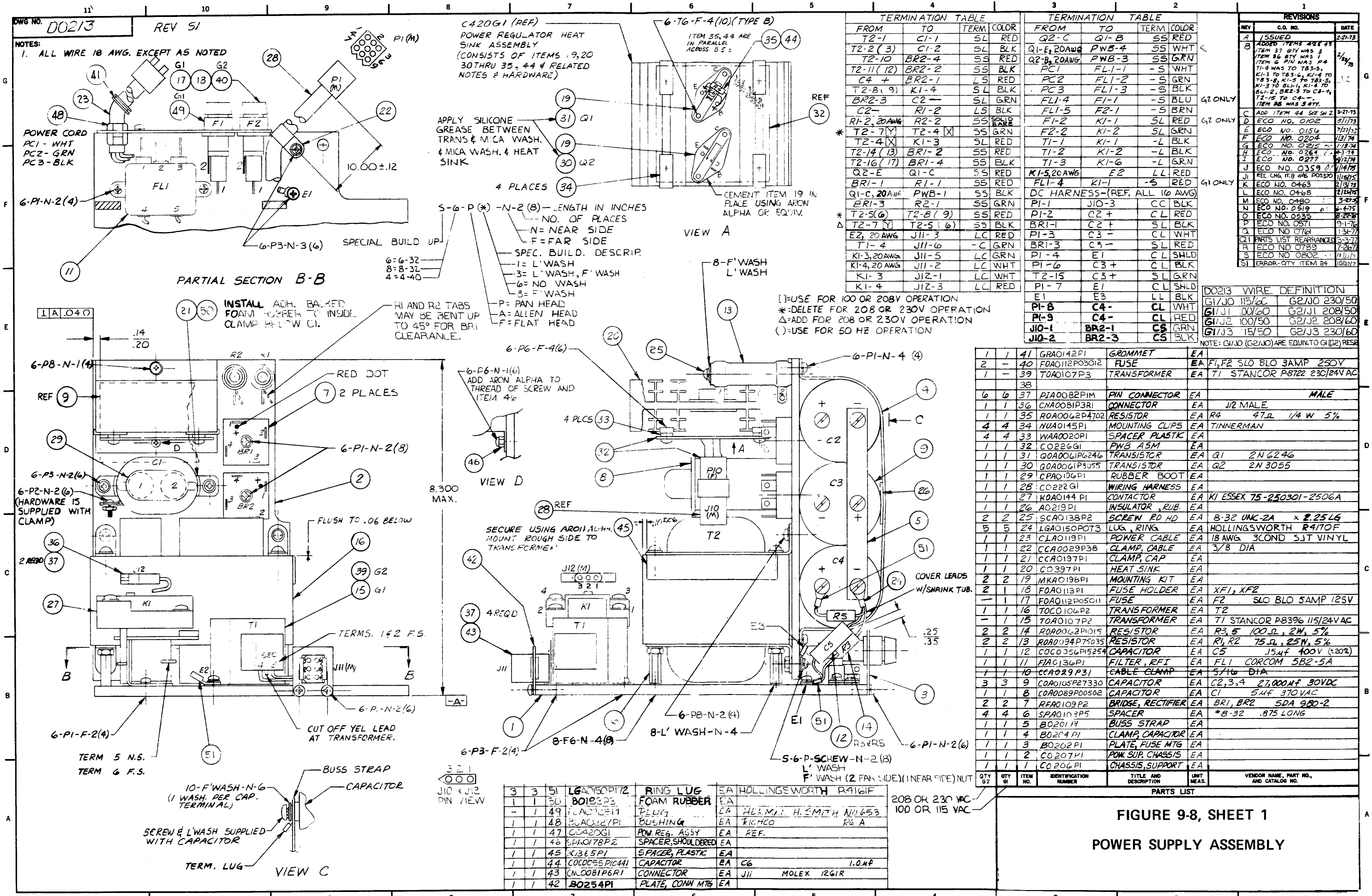
CONN. LOC.

A1	VFO
A2	CONTROL
A3	SERVO
A4	DATA
A5, AG	BACK PANEL I/O

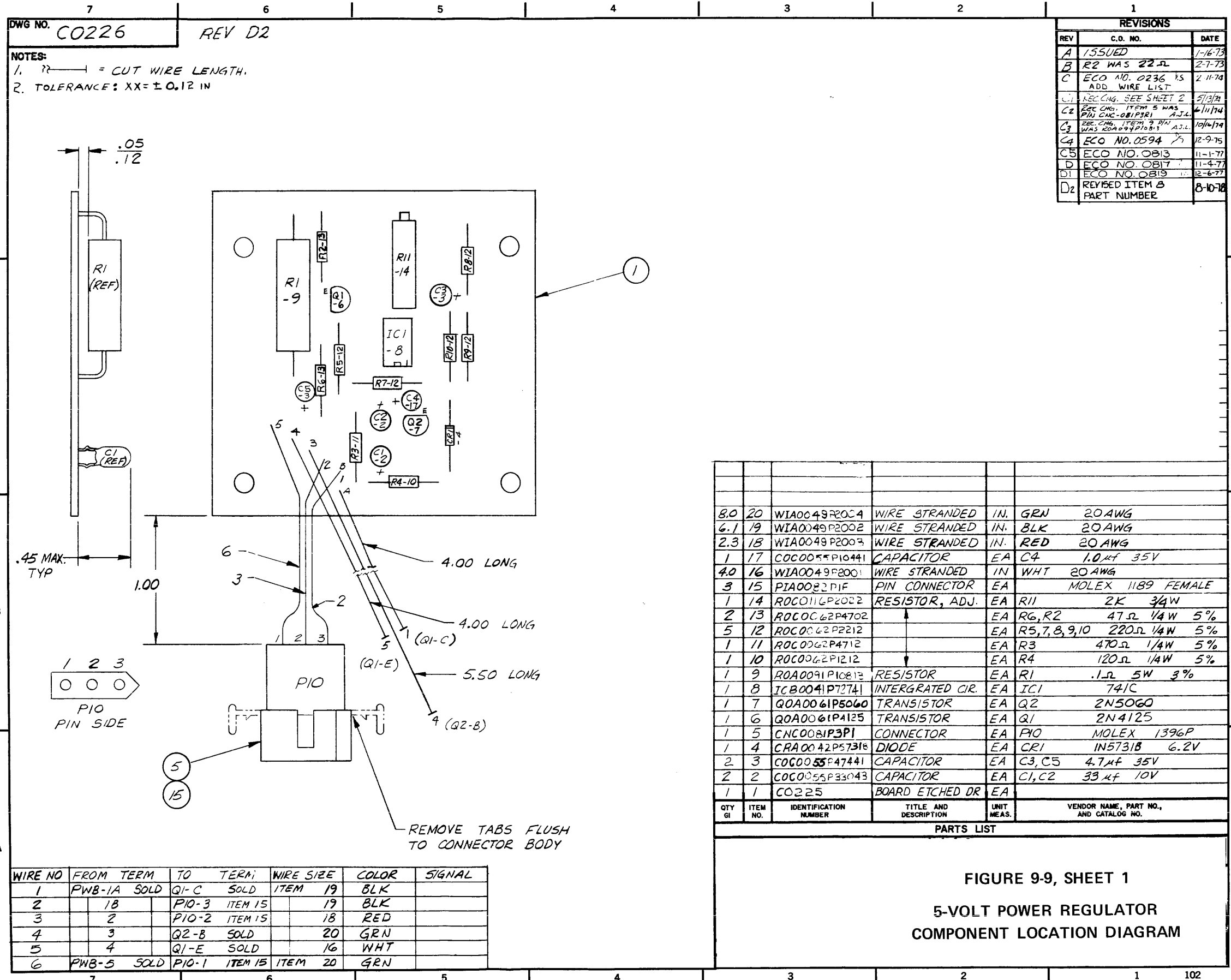
QTY	ITEM NO.	IDENTIFICATION NUMBER	TITLE AND DESCRIPTION	UNIT MEAS.	VENDOR NAME, PART NO. AND CATALOG NO.
PARTS LIST					

FIGURE 9-7, SHEET 3  
CONTROL PWB SCHEMATIC DIAGRAMS





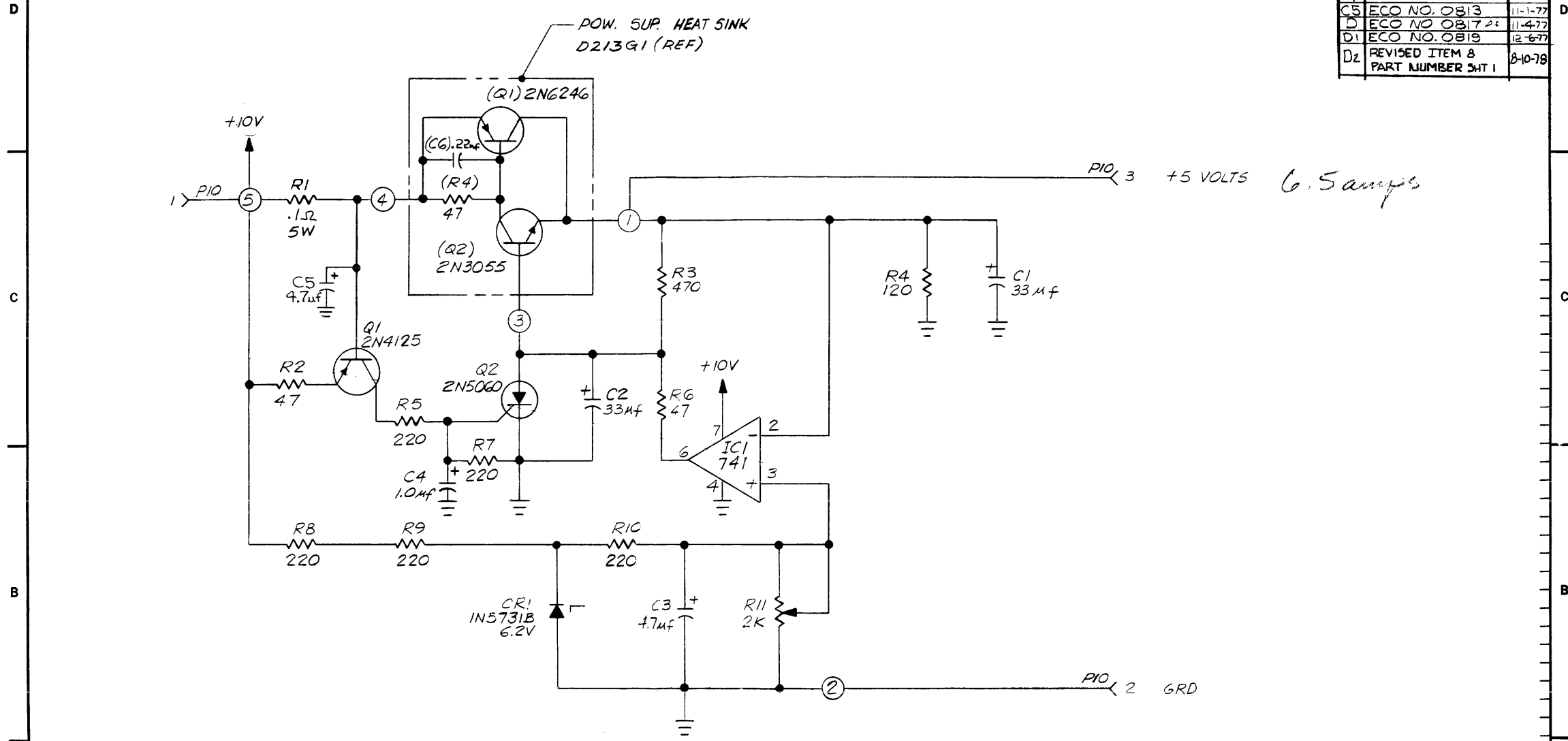




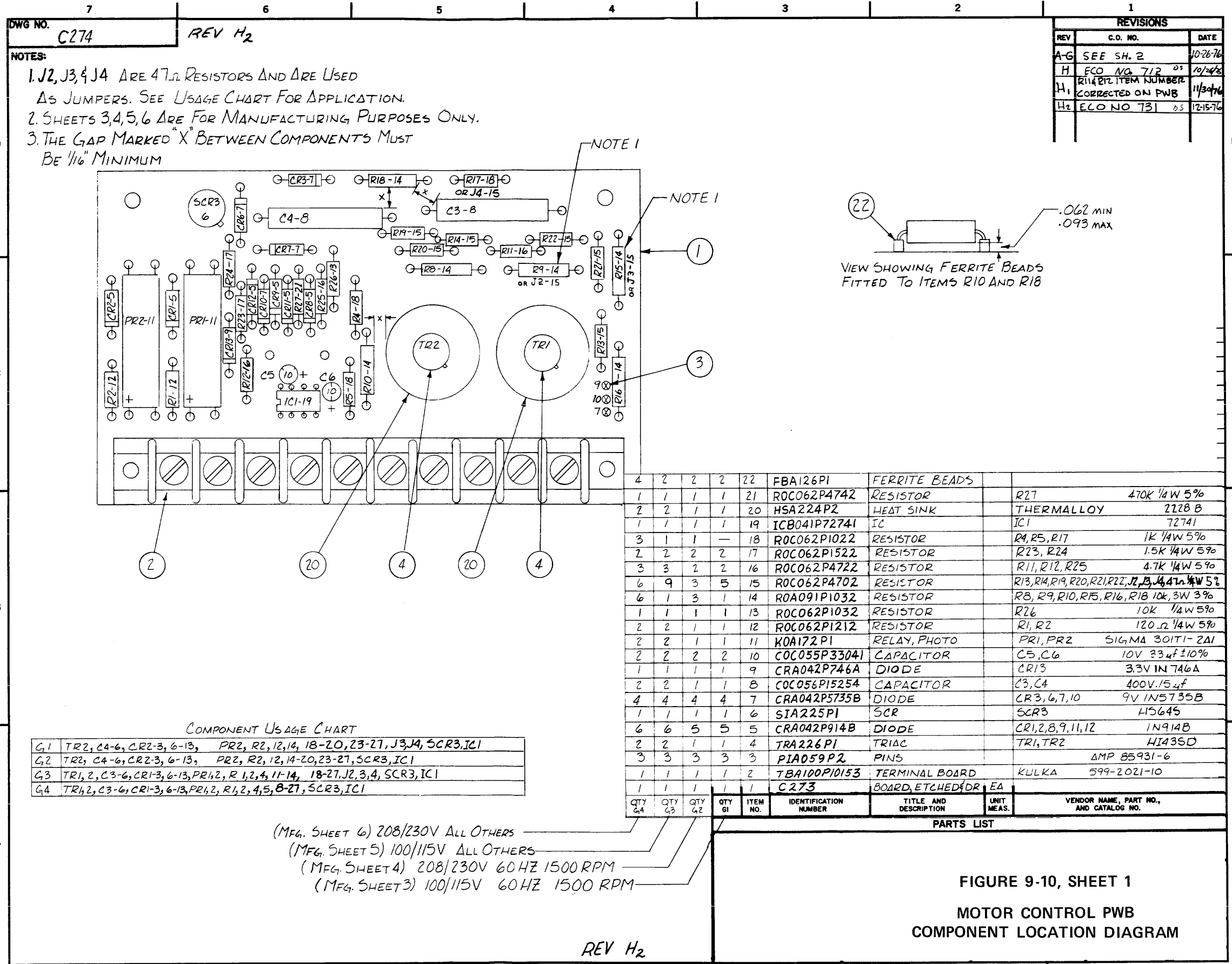
DWG NO. **C0226** REV **D2**

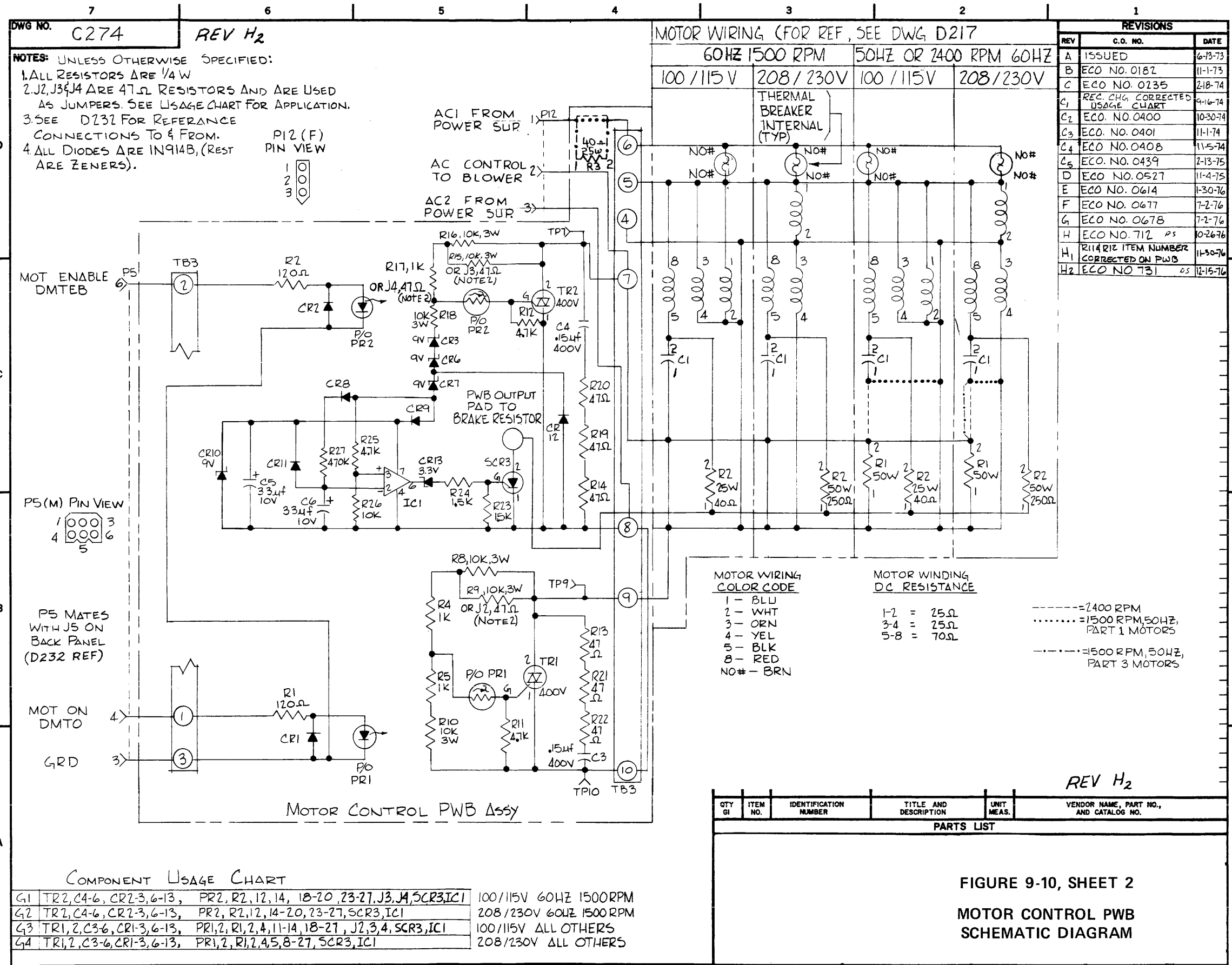
REVISIONS		
REV	C.O. NO.	DATE
A	ISSUED	1-16-73
B	SEE SH 1	2-7-73
C	ECO NO. 0236	2-11-74
C1	CR1 WAS IN 5731 (MOUNTED) IS IN 5731 (MOUNTED) A.J.L.	5/13/74
C2	SEE SH 1	4/11/74
C3	SEE SH 1	4/16/74
C4	ECO NO. 0594	12-9-75
C5	ECO NO. 0813	11-1-77
D	ECO NO 0817	11-4-77
D1	ECO NO. 0819	12-6-77
D2	REVISED ITEM 8 PART NUMBER SH 1	8-10-78

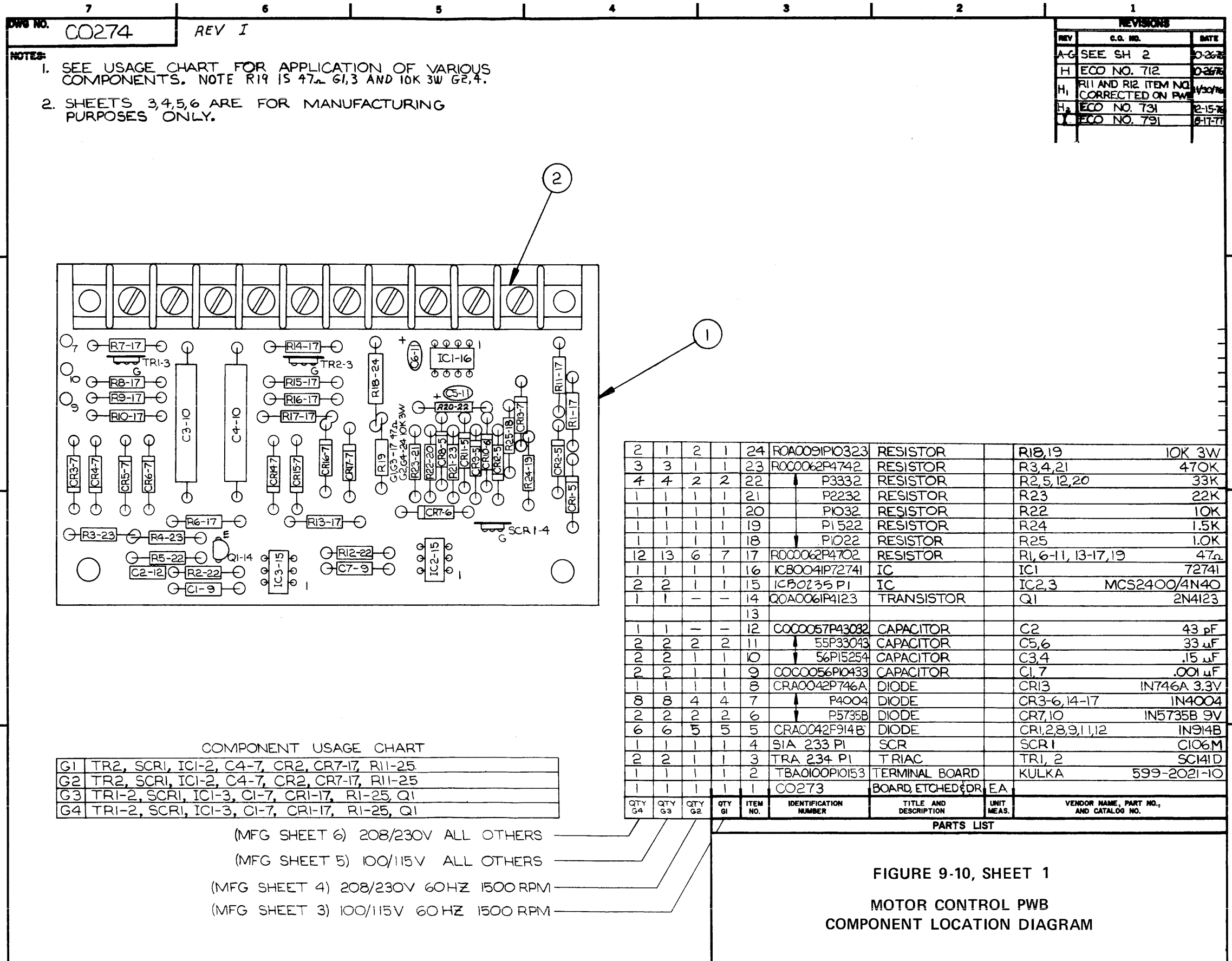
NOTES:  
 1. ALL RESISTANCE VALUES IN OHMS.  
 2. NOS. IN CIRCLES ARE COMPONENT BOARD TERMINATIONS.



QTY	ITEM	IDENTIFICATION	TITLE AND	UNIT	VENDOR NAME, PART NO.,
GI	NO.	NUMBER	DESCRIPTION	MEAS.	AND CATALOG NO.
PARTS LIST					
FIGURE 9-9, SHEET 2 5-VOLT POWER REGULATOR SCHEMATIC DIAGRAM					

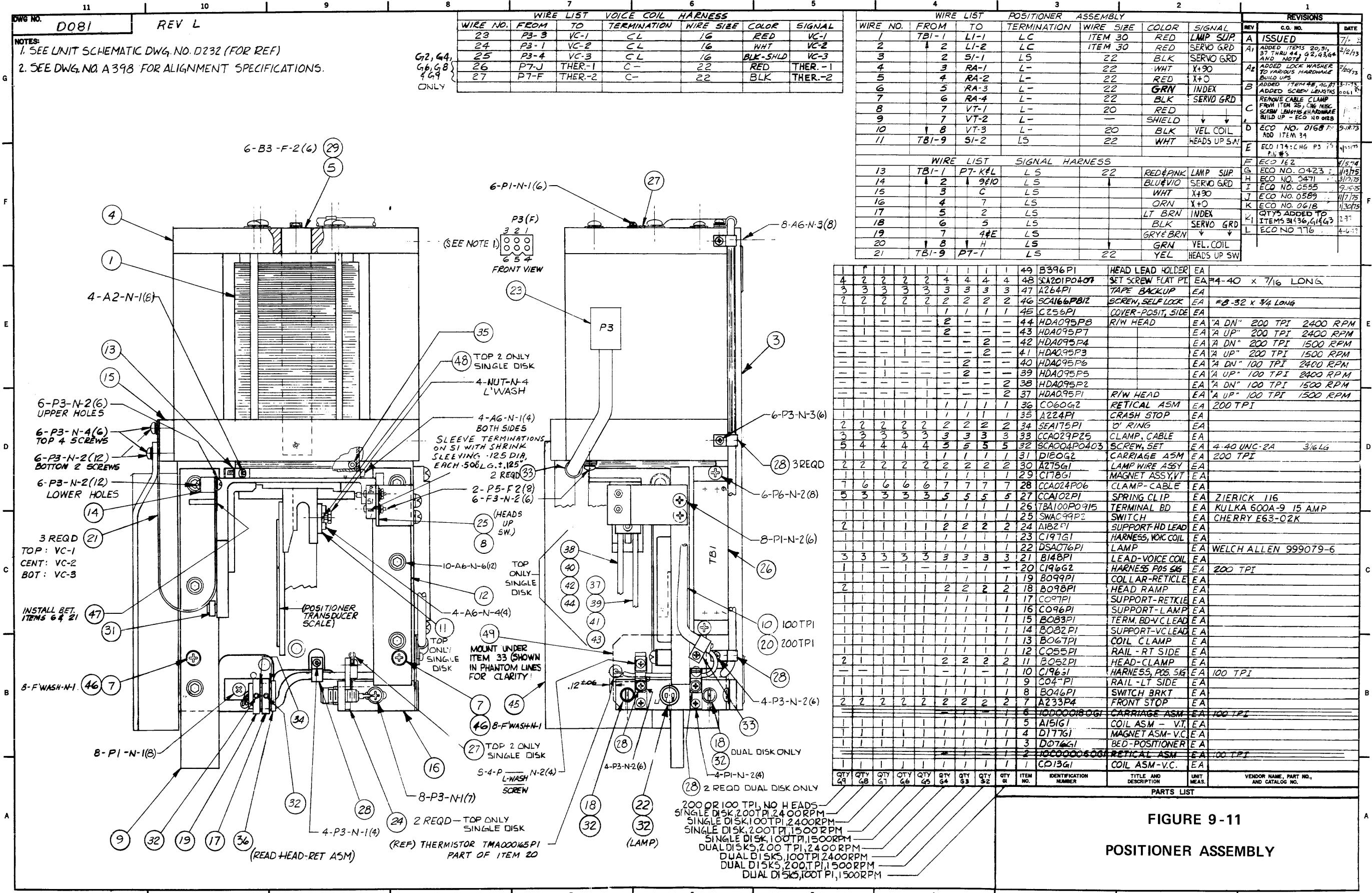












DWG NO. **D081** REV **L**

NOTES:  
 1. SEE UNIT SCHEMATIC DWG. NO. D232 (FOR REF)  
 2. SEE DWG. NO. A398 FOR ALIGNMENT SPECIFICATIONS.

G2, G4, G6, G8, G9 ONLY

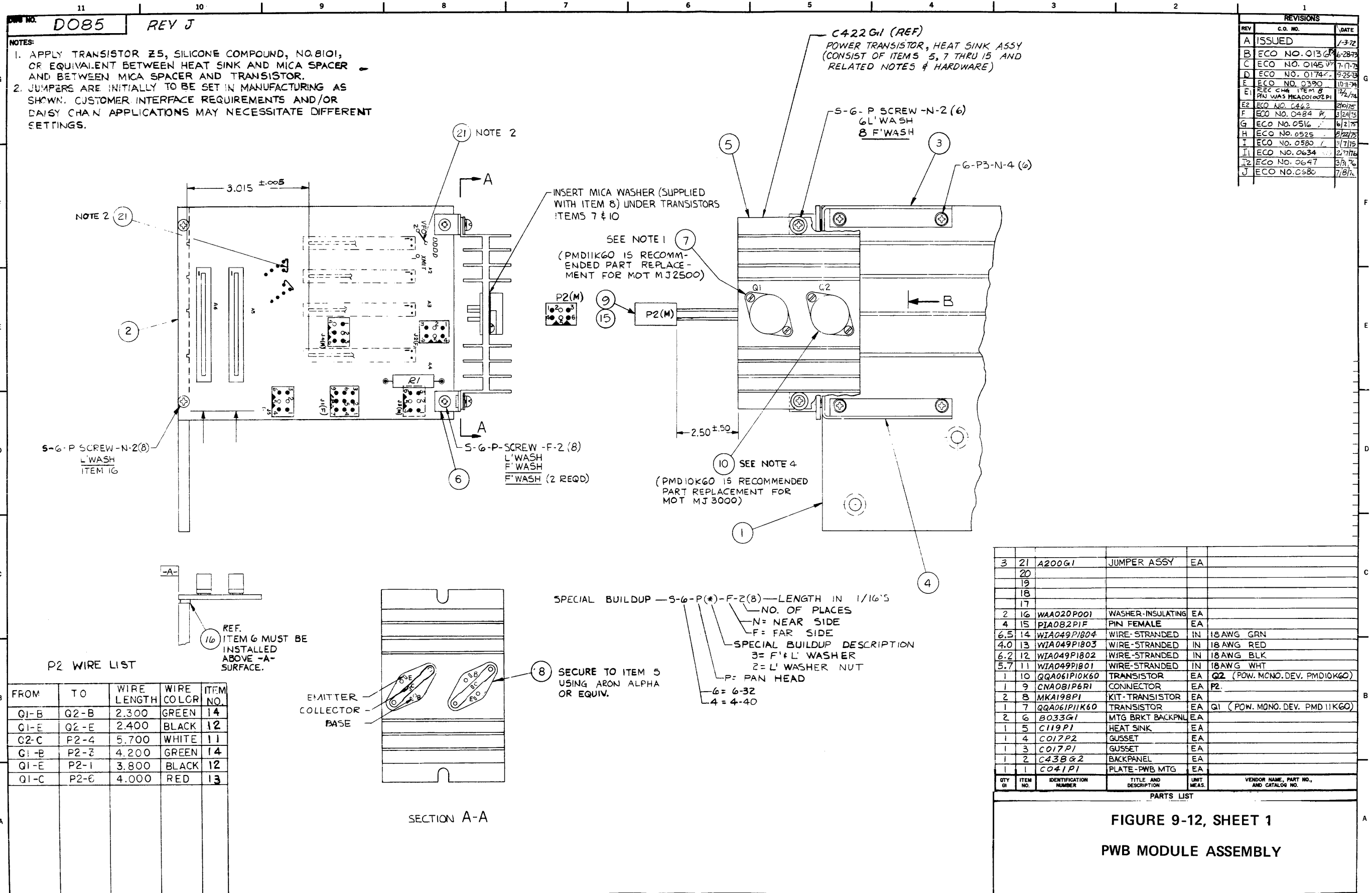
WIRE NO.	FROM	TO	TERMINATION	WIRE SIZE	COLOR	SIGNAL
23	P3-B	VC-1	CL	16	RED	VC-1
24	P3-1	VC-2	CL	16	WHT	VC-2
25	P3-4	VC-3	CL	16	BLK-SHLD	VC-3
26	P7-J	THER-1	C-	22	RED	THER-1
27	P7-F	THER-2	C-	22	BLK	THER-2

WIRE NO.	FROM	TO	TERMINATION	WIRE SIZE	COLOR	SIGNAL
1	TBI-1	LI-1	LC	ITEM 30	RED	LAMP SUP.
2	2	LI-2	LC	ITEM 30	RED	SERVO GRD
3	2	SI-1	L5	22	BLK	SERVO GRD
4	3	RA-1	L-	22	WHT	X+90
5	4	RA-2	L-	22	RED	X+0
6	5	RA-3	L-	22	GRN	INDEX
7	6	RA-4	L-	22	BLK	SERVO GRD
8	7	VT-1	L-	20	RED	VEL. COIL
9	7	VT-2	L-	20	SHIELD	VEL. COIL
10	8	VT-3	L-	20	BLK	VEL. COIL
11	TBI-9	SI-2	L5	22	WHT	HEADS UP SW

REV.	CO. NO.	DATE
A	ISSUED	7/73
A1	ADDED ITEMS 20, 31, 37 THRU 41, 92, 43, 44 AND MOD # 1, 2, 4, 5, 6	2/2/73
A2	ADDED LOCK WASHER TO VARIOUS HARDWARE BUILD UPS	2/2/73
B	ADDED ITEM #8, 46, 47, 48, 49	2/2/73
C	REMOVED CABLE CLAMP FROM ITEM 25; CHG MISC. SCREW LEADERS; HARDWARE BUILD UP - EGO NO 048B	2/2/73
D	ECO NO. 0168 P. 1	5/17/73
E	ECO NO. 0168 P. 2	5/17/73
F	ECO 174: CHG P3 TO 1.5"	4/13/73
G	ECO 182	1/15/74
H	ECO NO. 0423 P. 1	11/17/73
I	ECO NO. 0471	3/17/73
J	ECO NO. 0555	9/15/73
K	ECO NO. 0589	11/7/73
L	ECO NO. 0618	11/30/73
M	QTY'S ADDED TO ITEMS 31, 36, 41, 43	2/73
N	ECO NO 776	4-6-73

QTY	QTY	QTY	QTY	QTY	QTY	QTY	QTY	QTY	QTY	ITEM NO.	IDENTIFICATION NUMBER	TITLE AND DESCRIPTION	UNIT MEAS.	VENDOR NAME, PART NO., AND CATALOG NO.
4	2	2	2	2	4	4	4	4	4	49	B396P1	HEAD LEAD HOLDER	EA	
4	2	2	2	2	4	4	4	4	4	48	SLX201P0407	SET SCREW FLAT PT	EA	#4-40 x 7/16 LONG
3	3	3	3	3	3	3	3	3	3	47	A264P1	TAPE BACKUP	EA	
2	2	2	2	2	2	2	2	2	2	46	SCA166PB1Z	SCREW, SELF LOCK	EA	#8-32 x 3/4 LONG
1	1	1	1	1	1	1	1	1	1	45	C256P1	COVER-POSIT, SIDE	EA	
1	1	1	1	1	1	1	1	1	1	44	HDA095P8	R/W HEAD	EA	"A DN" 200 TPI 2400 RPM
1	1	1	1	1	1	1	1	1	1	43	HDA095P7	R/W HEAD	EA	"A UP" 200 TPI 2400 RPM
1	1	1	1	1	1	1	1	1	1	42	HDA095P4	R/W HEAD	EA	"A DN" 200 TPI 1500 RPM
1	1	1	1	1	1	1	1	1	1	41	HDA095P3	R/W HEAD	EA	"A UP" 200 TPI 1500 RPM
1	1	1	1	1	1	1	1	1	1	40	HDA095P6	R/W HEAD	EA	"A DN" 100 TPI 2400 RPM
1	1	1	1	1	1	1	1	1	1	39	HDA095P5	R/W HEAD	EA	"A UP" 100 TPI 2400 RPM
1	1	1	1	1	1	1	1	1	1	38	HDA095P2	R/W HEAD	EA	"A DN" 100 TPI 1500 RPM
1	1	1	1	1	1	1	1	1	1	37	HDA095P1	R/W HEAD	EA	"A UP" 100 TPI 1500 RPM
1	1	1	1	1	1	1	1	1	1	36	CO60G2	RETICAL ASM	EA	200 TPI
1	1	1	1	1	1	1	1	1	1	35	A224P1	CRASH STOP	EA	
2	2	2	2	2	2	2	2	2	2	34	SEA175P1	O' RING	EA	
3	3	3	3	3	3	3	3	3	3	33	CCA029P25	CLAMP, CABLE	EA	
5	4	4	4	4	3	3	3	3	3	32	SCA004P0403	SCREW, SET	EA	4-40 UNC-2A 3/16 LG
2	2	2	2	2	2	2	2	2	2	31	DIB0G2	CARRIAGE ASM	EA	200 TPI
2	2	2	2	2	2	2	2	2	2	30	A275G1	LAMP WIRE ASSY	EA	
1	1	1	1	1	1	1	1	1	1	29	CI78G1	MAGNET ASSY, VT	EA	
7	6	6	6	6	7	7	7	7	7	28	CCA024P06	CLAMP-CABLE	EA	
5	3	3	3	3	5	5	5	5	5	27	CCA102P1	SPRING CLIP	EA	ZIERICK 116
1	1	1	1	1	1	1	1	1	1	26	TBA100P0915	TERMINAL BD	EA	KULKA 600A-9 15 AMP
2	1	1	1	1	2	2	2	2	2	25	SWAC99P2	SWITCH	EA	CHERRY E63-02K
1	1	1	1	1	1	1	1	1	1	24	A182P1	SUPPORT-HD LEAD	EA	
1	1	1	1	1	1	1	1	1	1	23	CI97G1	HARNESS, VOIC COIL	EA	
1	1	1	1	1	1	1	1	1	1	22	DSA076P1	LAMP	EA	WELCH ALLEN 999079-6
3	3	3	3	3	3	3	3	3	3	21	B148P1	LEAD-VOICE COIL	EA	
1	1	1	1	1	1	1	1	1	1	20	CI96G2	HARNESS POS 5/6	EA	200 TPI
1	1	1	1	1	1	1	1	1	1	19	BO99P1	COLLAR-RETICLE	EA	
2	1	1	1	1	2	2	2	2	2	18	BO98P1	HEAD RAMP	EA	
1	1	1	1	1	1	1	1	1	1	17	CO97P1	SUPPORT-RETICLE	EA	
1	1	1	1	1	1	1	1	1	1	16	CO96P1	SUPPORT-LAMP	EA	
1	1	1	1	1	1	1	1	1	1	15	BO83P1	TERM. BD-VCL	EA	
1	1	1	1	1	1	1	1	1	1	14	BO82P1	SUPPORT-VCL	EA	
1	1	1	1	1	1	1	1	1	1	13	BO67P1	COIL CLAMP	EA	
1	1	1	1	1	1	1	1	1	1	12	CO55P1	RAIL - RT SIDE	EA	
2	1	1	1	1	2	2	2	2	2	11	BO52P1	HEAD-CLAMP	EA	
1	1	1	1	1	1	1	1	1	1	10	CI96G1	HARNESS, POS 5/6	EA	100 TPI
1	1	1	1	1	1	1	1	1	1	9	CO47P1	RAIL - LT SIDE	EA	
1	1	1	1	1	1	1	1	1	1	8	BO46P1	SWITCH BRKT	EA	
2	2	2	2	2	2	2	2	2	2	7	A233P4	FRONT STOP	EA	
1	1	1	1	1	1	1	1	1	1	6	IOO000180G1	CARRIAGE ASM	EA	100 TPI
1	1	1	1	1	1	1	1	1	1	5	A151G1	COIL ASM - VT	EA	
1	1	1	1	1	1	1	1	1	1	4	D177G1	MAGNET ASM-V.C.	EA	
1	1	1	1	1	1	1	1	1	1	3	D076G1	BED-POSITIONER	EA	
1	1	1	1	1	1	1	1	1	1	2	IOO000060G1	RETICAL ASM	EA	100 TPI
1	1	1	1	1	1	1	1	1	1	1	CO13G1	COIL ASM-V.C.	EA	

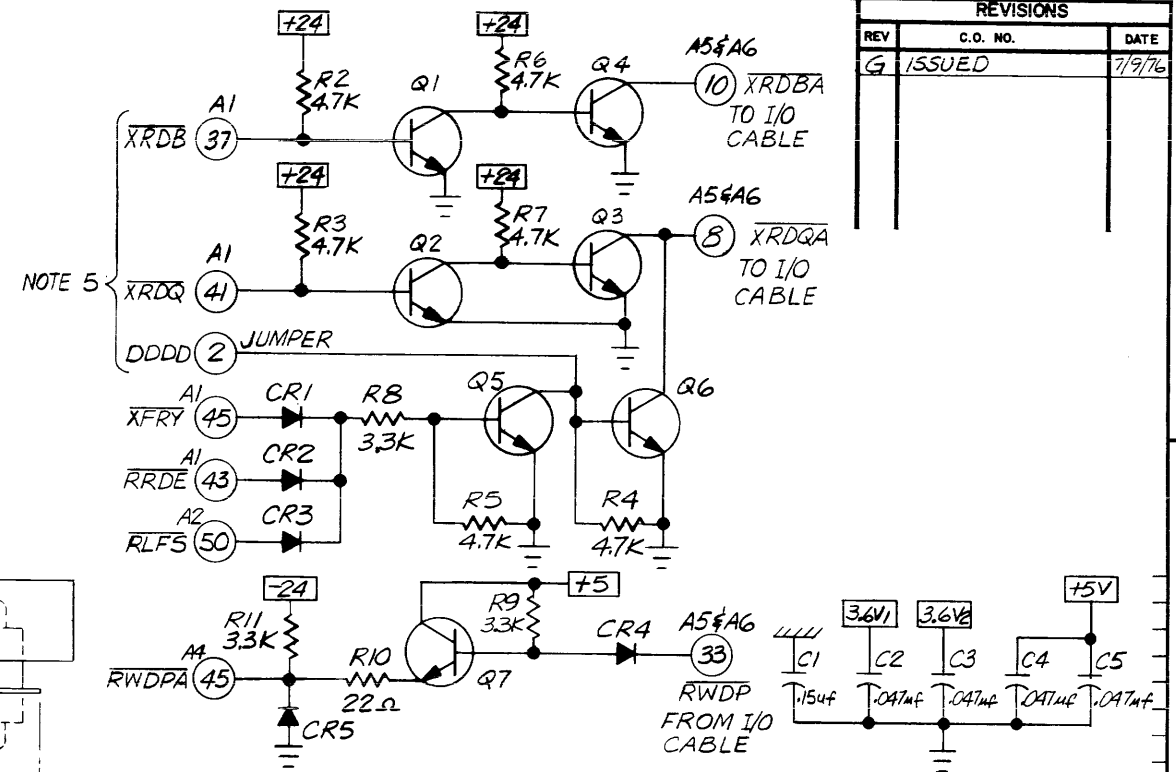
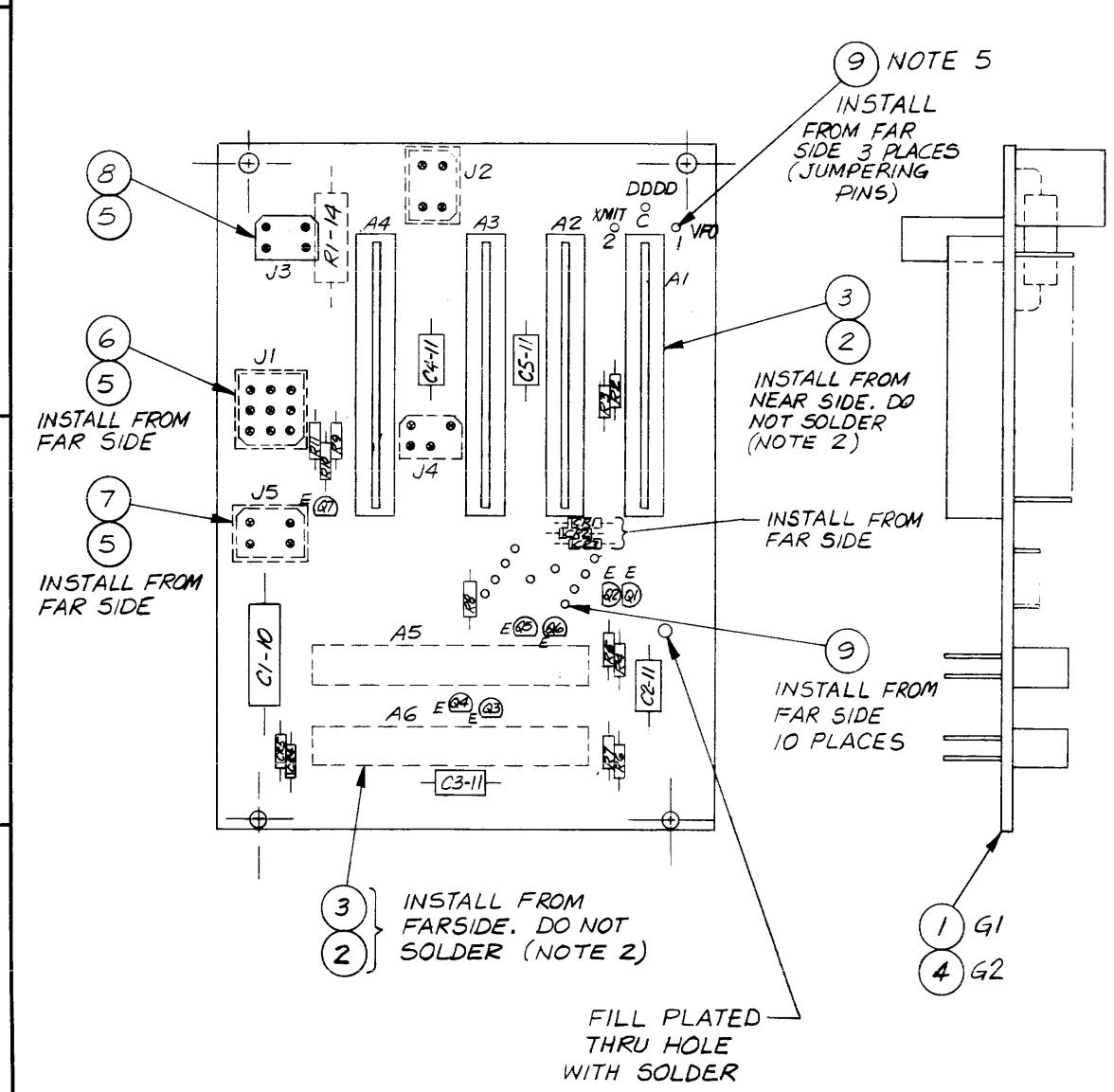
FIGURE 9-11  
 POSITIONER ASSEMBLY



DWG NO. **C438** REV **G**

REVISIONS		
REV	C.O. NO.	DATE
G	ISSUED	7/9/76

- NOTES:**
- UNLESS OTHERWISE SPECIFIED ALL COMPONENT LEADS AND PINS SOLDERED TO PWB ARTWORK.
  - CLEAN ALL SOLDERED CONNECTIONS AND CONNECTORS, ITEM 3, WITH ALCOHOL (91%) ONLY.
  - SEE UNIT SCHEMATIC, D232, FOR CONN. PIN TO PIN DIAGRAM.
  - INSTALL CONN. PINS IN SPACE INDICATED BY ● (NEAR SIDE) OR ⊗ (FAR SIDE).
  - WITH JUMPER CONNECTED FROM "C" TO "XMIT", RAW DATA IS SENT TO Q6 BASE. WITH JUMPER CONNECTED FROM "C" TO "VFO" RAW DATA IS DECODED ON VFO PWB AND SENT A OUT AS XRDB AND XRDQ.
  - MINIMUM INSERTION AND EXTRACTION FORCE OF PWB REQUIRED PER CONNECTOR CONTACT PAIR IS 2 OZ.

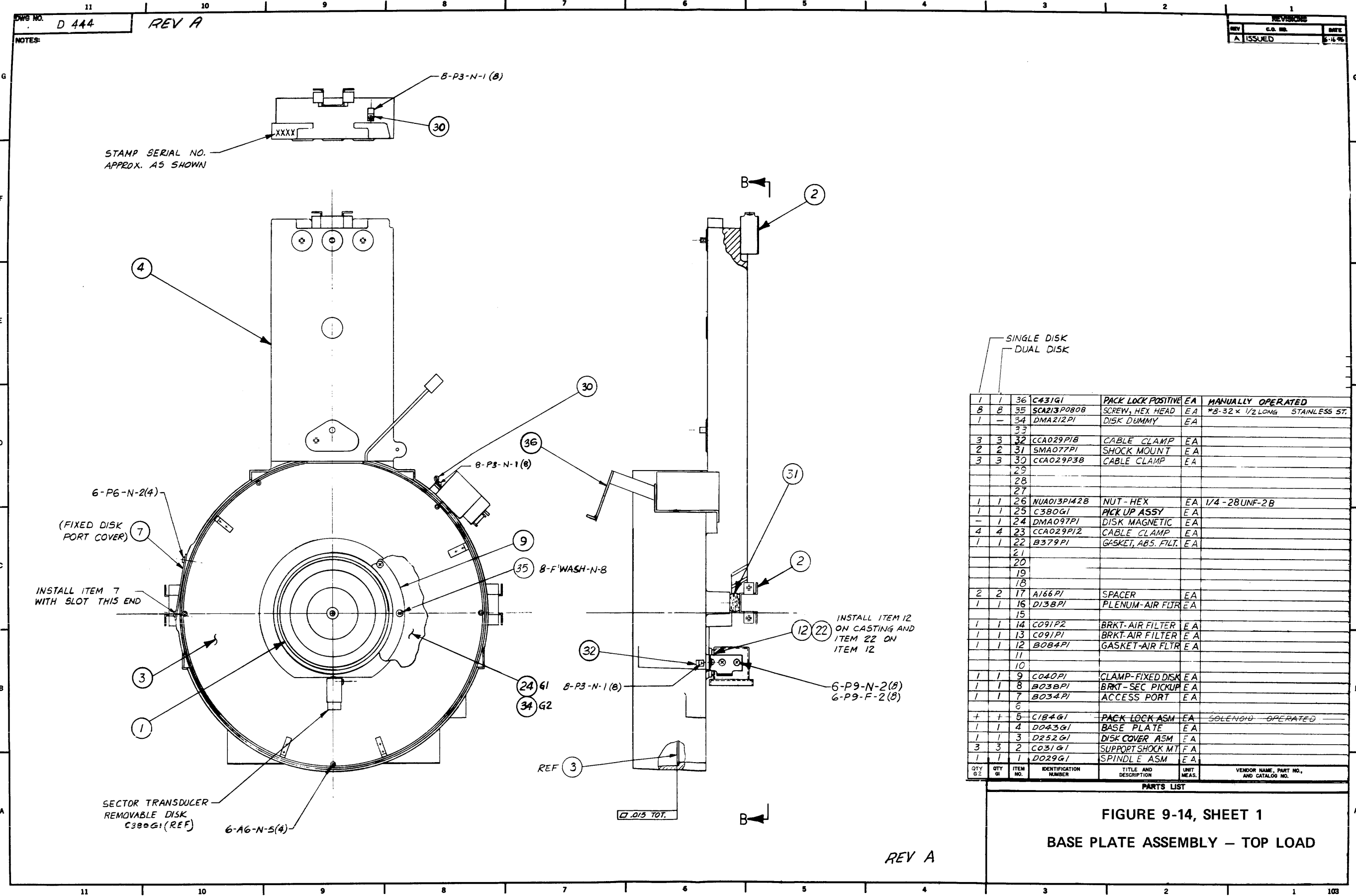


QTY G2	QTY G1	ITEM NO.	IDENTIFICATION NUMBER	TITLE AND DESCRIPTION	UNIT MEAS.	VENDOR NAME, PART NO., AND CATALOG NO.
		17	ROC062P2202	RESISTOR	EA	R10 22 Ω 1/4W
		16	ROC062P3322	RESISTOR		R8, R9, R11 3.3K 1/4W
		15	ROC062P4722	RESISTOR		R2-R7 4.7K 1/4W
		14	ROA091P10833	RESISTOR		R1 0.1 Ω, 5W, 3% WIRE WOUND
		13	QDA061P3646	TRANSISTOR		Q1-Q7 MPS3646
		12	CRA042P914B	DIODE		CR1-CR5 1N914B
		11	COC056P47333	CAPACITOR		C2-C5 .047 μF, 200V
		10	COC056P15254	CAPACITOR		C1 .15 μF, 400V
		9	PIA059P2	PIN		
		8	CNA081P6R1	CONNECTOR		J3, J4 MALE
		7	CNA081P6P1	CONNECTOR		J2, J5 FEMALE
		6	CNA081P9P1	CONNECTOR		J1 FEMALE
		5	PIA082P2M	PIN, CONN.		MALE
		4		PWB ASSY		
		3	CNA219P1	CONN. HOUSING		A1-A6
		300	PIA220P1	CONN. PIN, PRESS IN		.025 SQ POST
		1		PWB	EA	

FIGURE 9-12, SHEET 2  
PWB MODULE ELECTRICAL DIAGRAM

REV G



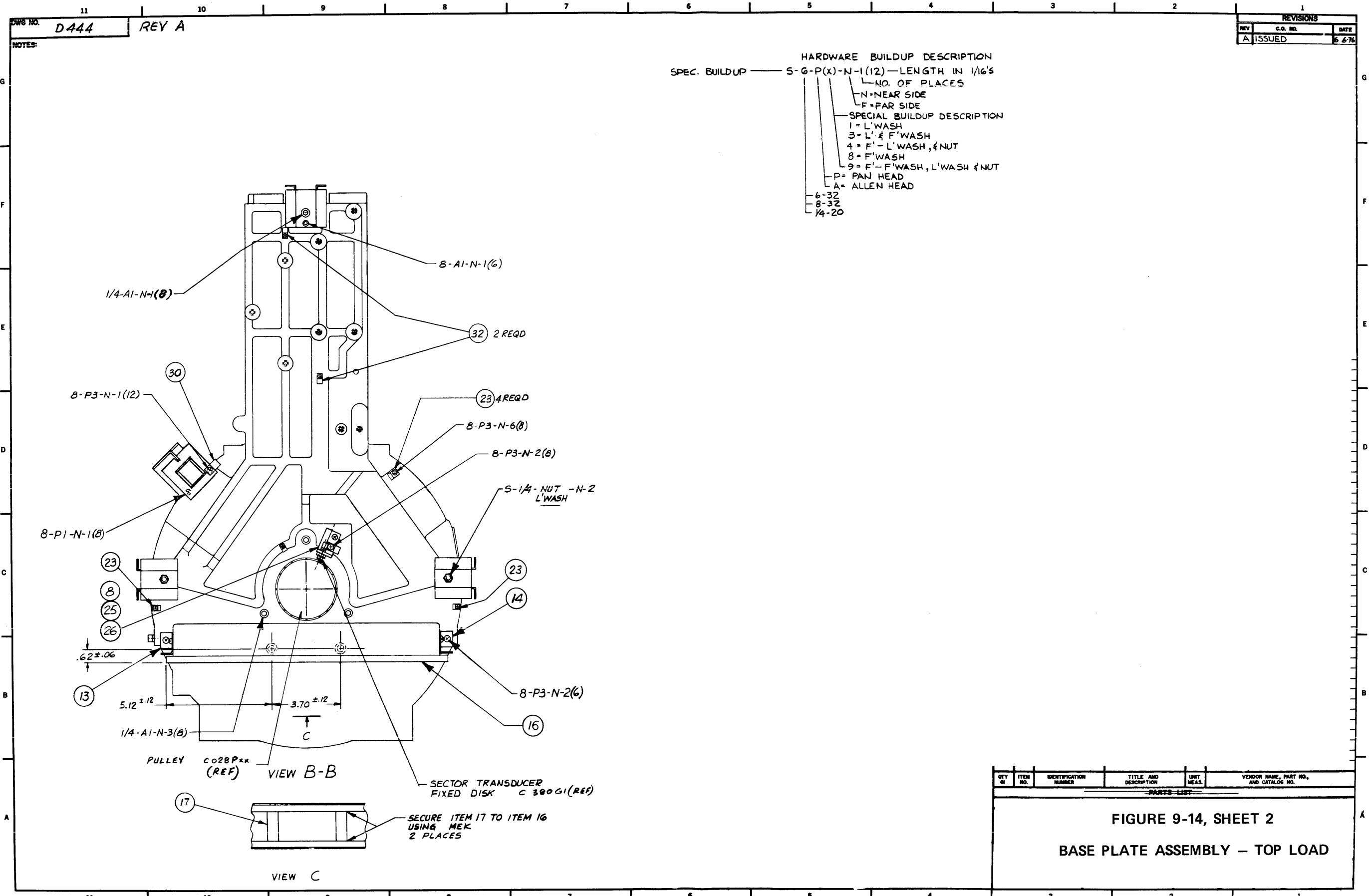


SINGLE DISK  
DUAL DISK

QTY G2	QTY U	ITEM NO.	IDENTIFICATION NUMBER	TITLE AND DESCRIPTION	UNIT MEAS.	VENDOR NAME, PART NO., AND CATALOG NO.
1	1	36	C431G1	PACK LOCK POSITIVE	EA	MANUALLY OPERATED
8	8	35	SCA213P0808	SCREW, HEX HEAD	EA	*#8-32 x 1/2 LONG STAINLESS ST.
1	-	34	DMA212PI	DISK DUMMY	EA	
		33				
3	3	32	CCA029PIB	CABLE CLAMP	EA	
2	2	31	SMA077PI	SHOCK MOUNT	EA	
3	3	30	CCA029P3B	CABLE CLAMP	EA	
		29				
		28				
		27				
1	1	26	NUA013PI42B	NUT-HEX	EA	1/4-28UNF-2B
1	1	25	C380G1	PICK UP ASSY	EA	
-	1	24	DMA097PI	DISK MAGNETIC	EA	
4	4	23	CCA029PI2	CABLE CLAMP	EA	
1	1	22	B379PI	GASKET, ABS. FLTR.	EA	
		21				
		20				
		19				
		18				
2	2	17	A166PI	SPACER	EA	
1	1	16	D138PI	PLENUM-AIR FLTR	EA	
		15				
1	1	14	C091P2	BRKT-AIR FILTER	EA	
1	1	13	C091PI	BRKT-AIR FILTER	EA	
1	1	12	B084PI	GASKET-AIR FLTR	EA	
		11				
		10				
1	1	9	C040PI	CLAMP-FIXEDDISK	EA	
1	1	8	B038PI	BRKT-SEC PICKUP	EA	
1	1	7	B034PI	ACCESS PORT	EA	
		6				
+	+	5	C184G1	PACK LOCK ASM	EA	SOLENOID OPERATED
1	1	4	D043G1	BASE PLATE	EA	
1	1	3	D252G1	DISK COVER ASM	EA	
3	3	2	C031G1	SUPPORT SHOCK MT	EA	
1	1	1	D029G1	SPINDLE ASM	EA	

FIGURE 9-14, SHEET 1  
BASE PLATE ASSEMBLY - TOP LOAD

REV A



DWS NO. **D444** **REV A**

NOTES:

REVISIONS		
REV	C.O. NO.	DATE
A	ISSUED	5 6 76

**HARDWARE BUILDUP DESCRIPTION**

SPEC. BUILDUP — S-G-P(X)-N-1(12) — LENGTH IN 1/16'S

- NO. OF PLACES
- N = NEAR SIDE
- F = FAR SIDE

**SPECIAL BUILDUP DESCRIPTION**

- 1 = L' WASH
- 3 = L' & F' WASH
- 4 = F' - L' WASH, & NUT
- 8 = F' WASH
- 9 = F' - F' WASH, L' WASH & NUT
- P = PAN HEAD
- A = ALLEN HEAD

6-32  
 8-32  
 1/4-20

QTY	ITEM NO.	IDENTIFICATION NUMBER	TITLE AND DESCRIPTION	UNIT MEAS.	VENDOR NAME, PART NO., AND CATALOG NO.
-PARTS LIST-					

**FIGURE 9-14, SHEET 2**  
**BASE PLATE ASSEMBLY - TOP LOAD**

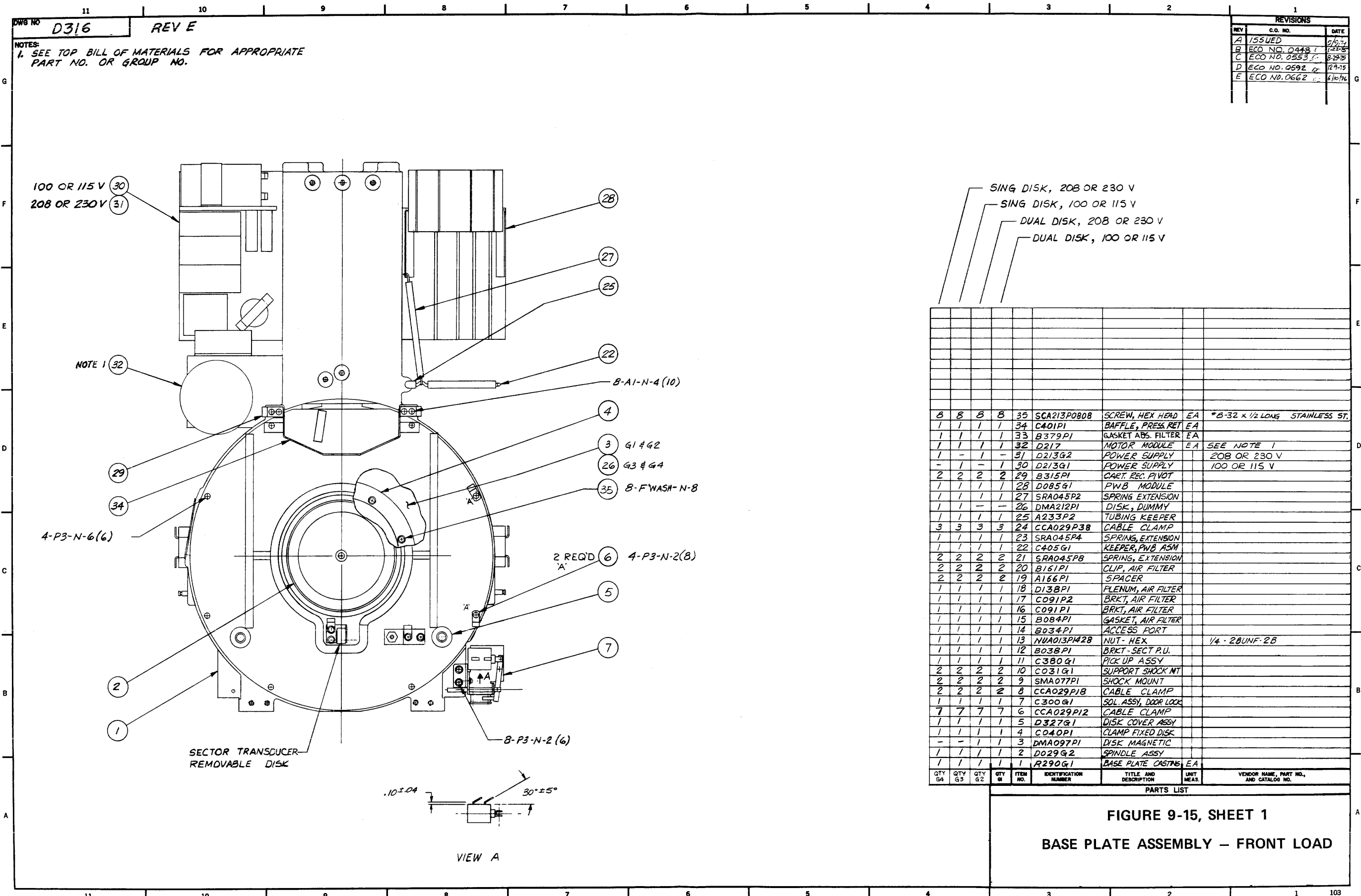
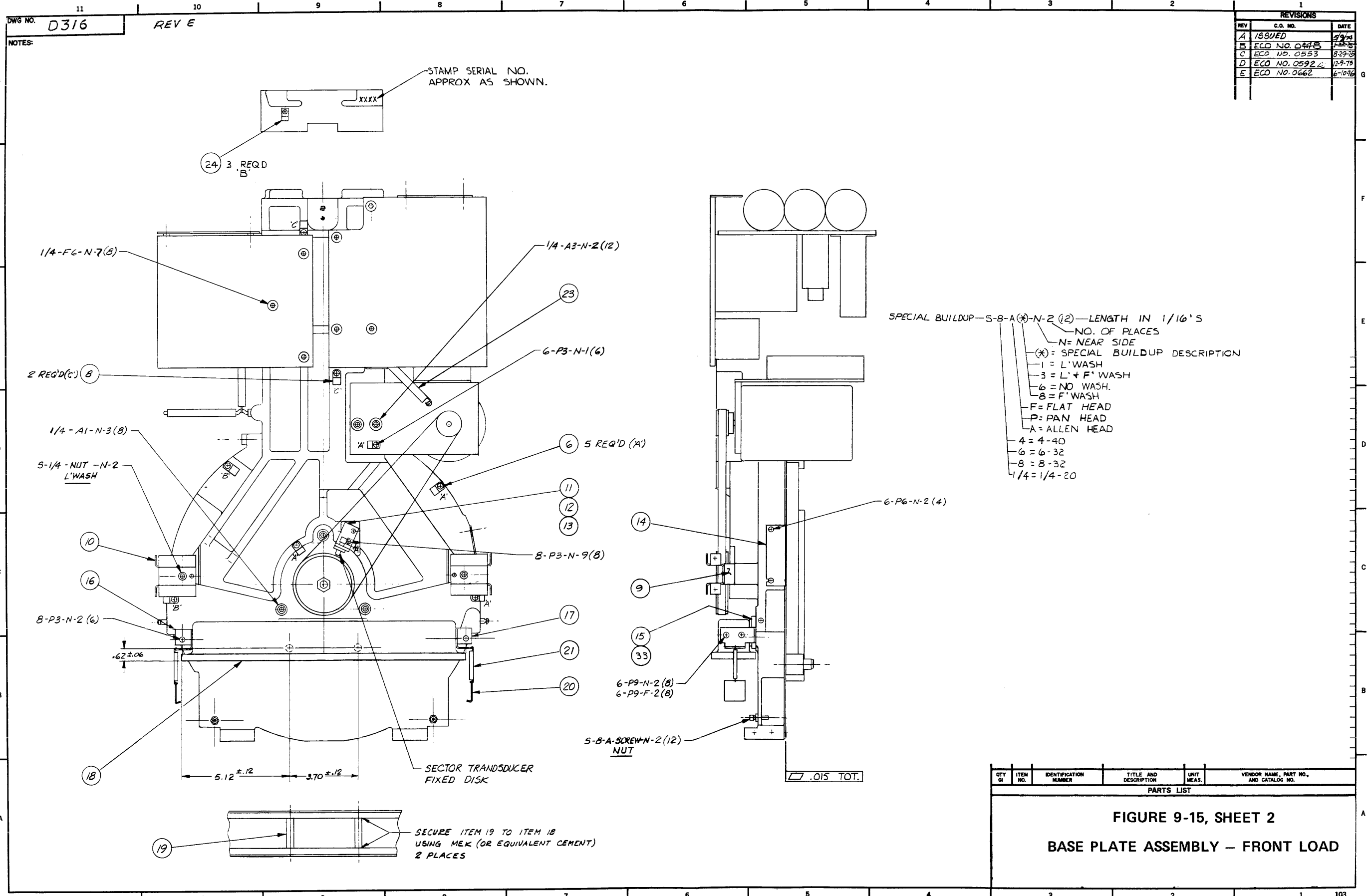


FIGURE 9-15, SHEET 1  
BASE PLATE ASSEMBLY - FRONT LOAD



DWG NO. **D316**

REV **E**

REVISIONS		
REV	C.O. NO.	DATE
A	ISSUED	8/2/74
B	ECO NO. 0448	1-2-75
C	ECO NO. 0553	8-29-75
D	ECO NO. 0592	12-7-75
E	ECO NO. 0662	6-10-76

NOTES:

STAMP SERIAL NO.  
APPROX AS SHOWN.

24 3 REQ'D  
B

1/4-F6-N-7(8)

1/4-A3-N-2(12)

2 REQ'D(C)  
8

6-P3-N-1(6)

1/4-A1-N-3(8)

6 5 REQ'D(A)

5-1/4-NUT-N-2  
L'WASH

10

8-P3-N-9(8)

16

8-P3-N-2(6)

.62 ±.06

18

5.12 ±.12      3.70 ±.12

SECTOR TRANSDUCER  
FIXED DISK

19

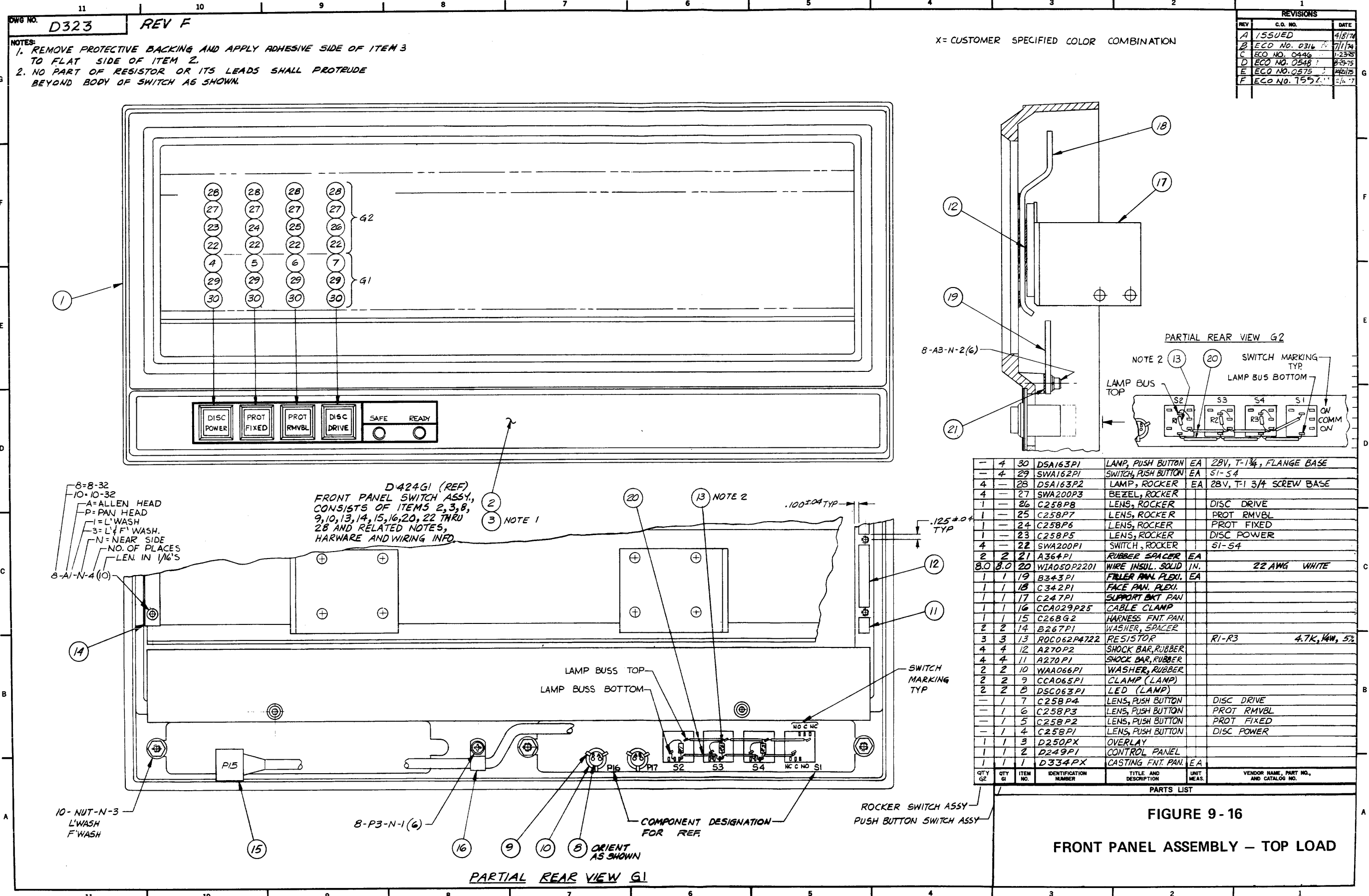
SECURE ITEM 19 TO ITEM 18  
USING MEK (OR EQUIVALENT CEMENT)  
2 PLACES

SPECIAL BUILDUP-S-B-A(X)-N-2(12)-LENGTH IN 1/16'S

- NO. OF PLACES
- N= NEAR SIDE
- (X)= SPECIAL BUILDUP DESCRIPTION
- 1 = L'WASH
- 3 = L' + F' WASH
- 6 = NO WASH.
- 8 = F' WASH
- F= FLAT HEAD
- P= PAN HEAD
- A= ALLEN HEAD
- 4 = 4-40
- 6 = 6-32
- 8 = 8-32
- 1/4 = 1/4-20

QTY	ITEM	IDENTIFICATION	TITLE AND	UNIT	VENDOR NAME, PART NO.,
SI	NO.	NUMBER	DESCRIPTION	MEAS.	AND CATALOG NO.
PARTS LIST					
<b>FIGURE 9-15, SHEET 2</b>					
<b>BASE PLATE ASSEMBLY - FRONT LOAD</b>					





DWG NO. **D323** REV **F**

NOTES:  
1. REMOVE PROTECTIVE BACKING AND APPLY ADHESIVE SIDE OF ITEM 3 TO FLAT SIDE OF ITEM 2.  
2. NO PART OF RESISTOR OR ITS LEADS SHALL PROTRUDE BEYOND BODY OF SWITCH AS SHOWN.

X= CUSTOMER SPECIFIED COLOR COMBINATION

REVISIONS		
REV	C.O. NO.	DATE
A	ISSUED	4/8/74
B	ECO NO. 0316	7/11/74
C	ECO NO. 0446	1-23-75
D	ECO NO. 0548	8-29-75
E	ECO NO. 0575	10/21/75
F	ECO NO. 7592	2/16/77

8-8-32  
10-10-32  
A=ALLEN HEAD  
P= PAN HEAD  
L=L'WASH  
3=L'F'WASH.  
N= NEAR SIDE  
NO. OF PLACES  
LEN. IN 1/16'S

D424G1 (REF)  
FRONT PANEL SWITCH ASSY,  
CONSISTS OF ITEMS 2,3,8,  
9,10,13,14,15,16,20,22 THRU  
28 AND RELATED NOTES,  
HARDWARE AND WIRING INFO.

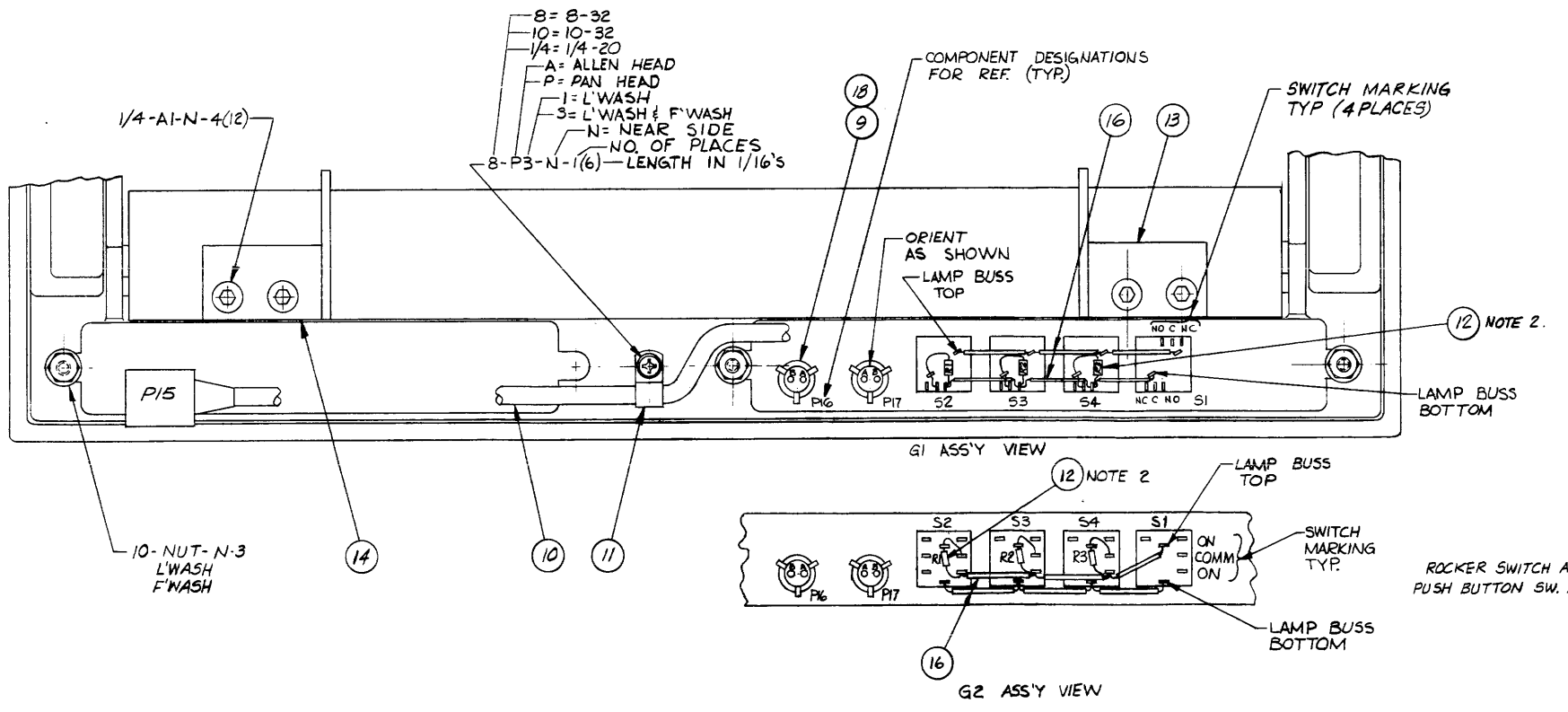
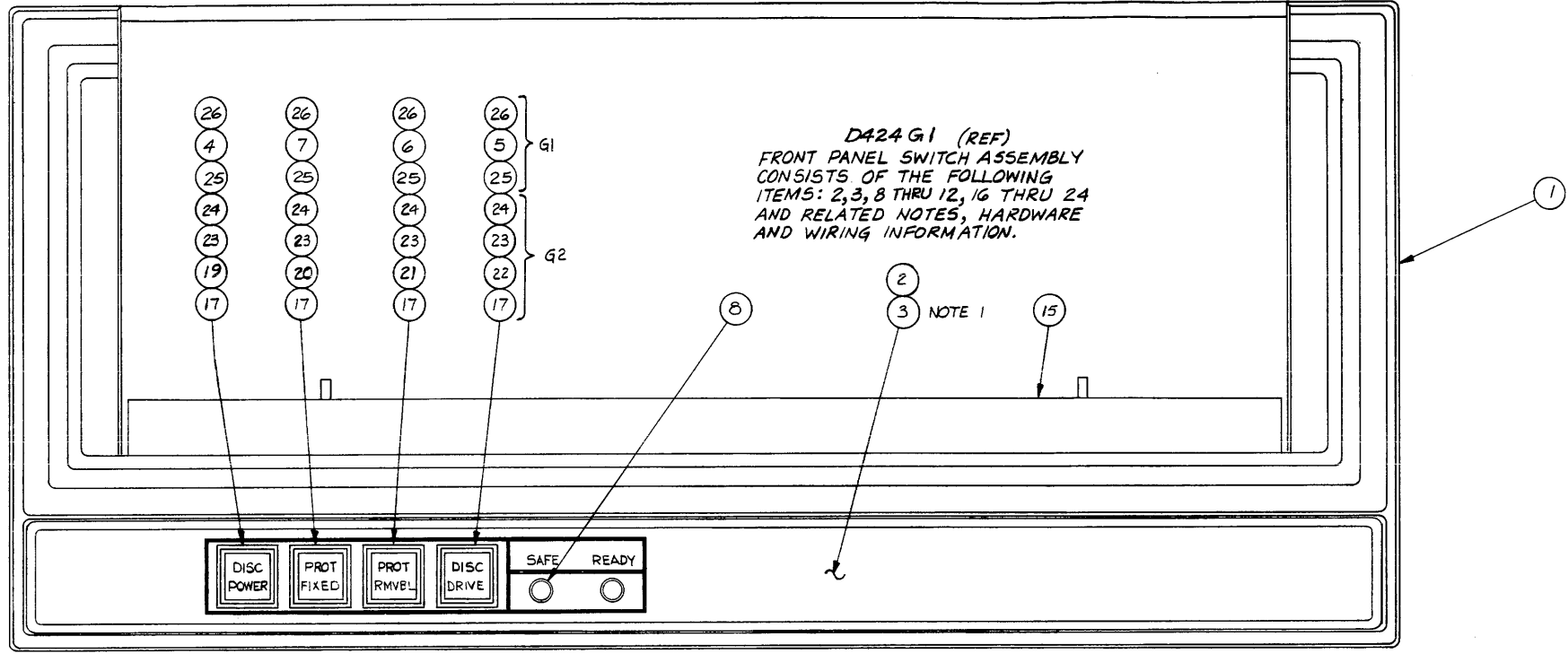
4	30	DSA163P1	LAMP, PUSH BUTTON	EA	28V, T-1 3/4, FLANGE BASE	
4	29	SWA162P1	SWITCH, PUSH BUTTON	EA	SI-54	
4	28	DSA163P2	LAMP, ROCKER	EA	28V, T-1 3/4 SCREW BASE	
4	27	SWA200P3	BEZEL, ROCKER			
1	26	C258P8	LENS, ROCKER		DISC DRIVE	
1	25	C258P7	LENS, ROCKER		PROT RMVBL	
1	24	C258P6	LENS, ROCKER		PROT FIXED	
1	23	C258P5	LENS, ROCKER		DISC POWER	
4	22	SWA200P1	SWITCH, ROCKER		SI-54	
2	21	A36+P1	RUBBER SPACER	EA		
8.0	20	WIA050P2201	WIRE INSUL. SOLID	IN.		22 AWG WHITE
1	19	B343P1	FIBER PAN. FLEXI.	EA		
1	18	C342P1	FACE PAN. FLEXI.			
1	17	C247P1	SUPPORT BKT PAN			
1	16	CCA029P25	CABLE CLAMP			
1	15	C268G2	HARNES FMT. PAN.			
2	14	B267P1	WASHER, SPACER			
3	13	ROC062P4722	RESISTOR		R1-R3	4.7K, 1/4W, 5%
4	12	A270P2	SHOCK BAR, RUBBER			
4	11	A270P1	SHOCK BAR, RUBBER			
2	10	WAA066P1	WASHER, RUBBER			
2	9	CCA065P1	CLAMP (LAMP)			
2	8	DSC063P1	LED (LAMP)			
-	7	C258P4	LENS, PUSH BUTTON		DISC DRIVE	
-	6	C258P3	LENS, PUSH BUTTON		PROT RMVBL	
-	5	C258P2	LENS, PUSH BUTTON		PROT FIXED	
-	4	C258P1	LENS, PUSH BUTTON		DISC POWER	
1	3	D250PX	OVERLAY			
1	2	D249P1	CONTROL PANEL			
1	1	D334PX	CASTING FMT. PAN.	EA		

FIGURE 9-16  
FRONT PANEL ASSEMBLY - TOP LOAD

DWG NO **D331** **REV E**

REVISIONS		
REV	C.O. NO.	DATE
A	ISSUED	1-16-74
B	ECO NO. 0265	1-23-74
C	ECO NO. 0444	1-23-74
D	ECO NO. 0549	2-29-75
E	ECO NO. 0578	10/21/75

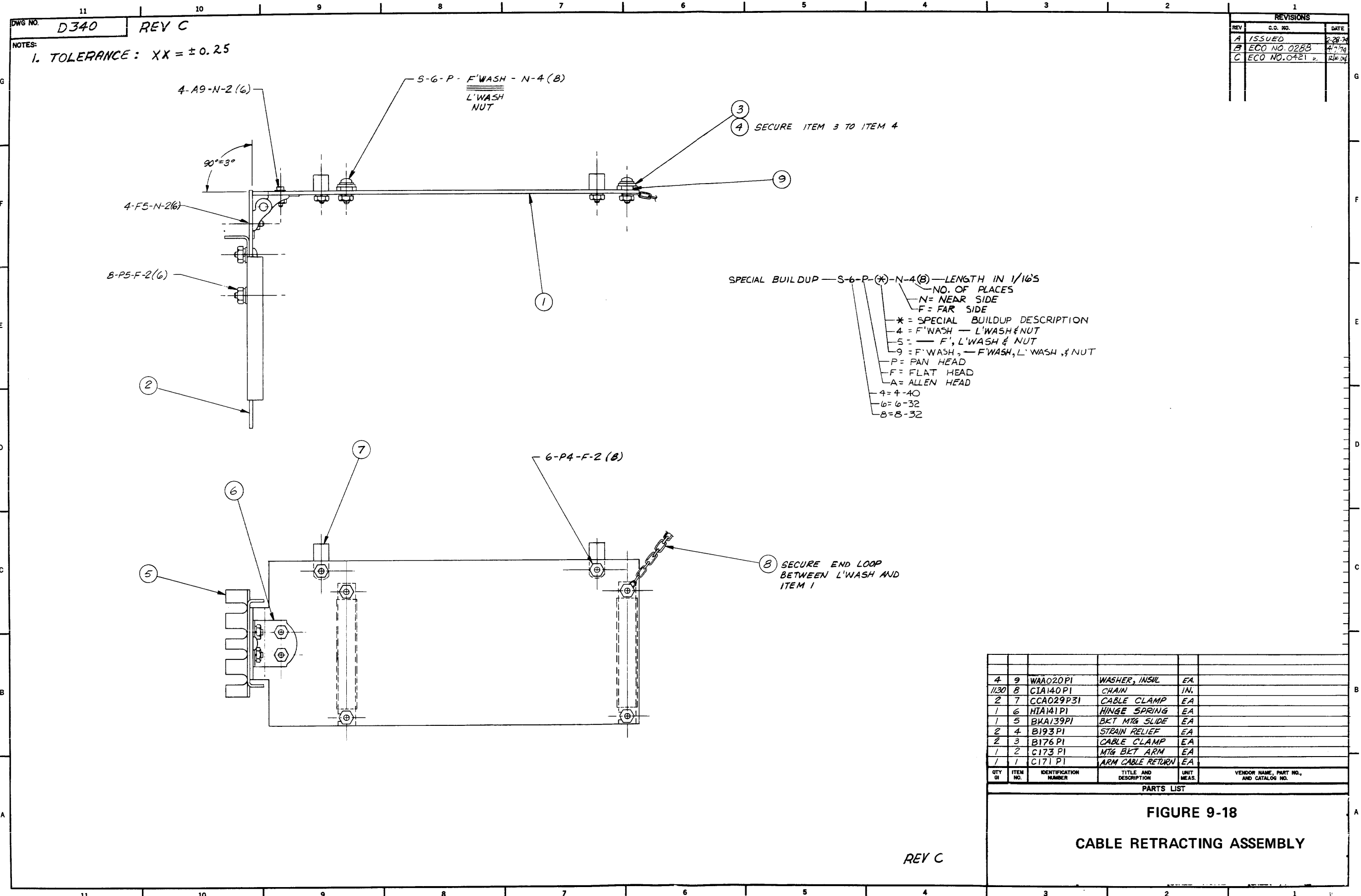
NOTES: 1. REMOVE PROTECTIVE BACKING AND APPLY ADHESIVE SIDE TO ITEM 2.  
2. RESISTOR LEADS MUST BE KEPT WITHIN SWITCH OUTLINE AS SHOWN.



X=CUSTOMER SPECIFIED COLOR COMBINATION

QTY	QTY	ITEM	IDENTIFICATION	TITLE AND	UNIT	VENDOR NAME, PART NO.,
QTY	QTY	NO.	NUMBER	DESCRIPTION	MEAS.	AND CATALOG NO.
-	4	26	DSA163P1	LAMP, PUSH BUTTON	EA	28V, T-1 3/4, FLANGE BASE
-	4	25	SWA162P1	SWITCH, PUSH BUTTON	EA	SI-54
4	-	24	DSA163P2	LAMP, ROCKER	EA	28V, T1 3/4, SCREW BASE
4	-	23	SWA200P3	BETZEL, ROCKER		
1	-	22	C258P8	LENS, ROCKER		DISC DRIVE
1	-	21	C258P7	LENS, ROCKER		PROT RMVBL
1	-	20	C258P6	LENS, ROCKER		PROT FIXED
1	-	19	C258P5	LENS, ROCKER		DISC POWER
2	2	18	WWA066P1	WASHER RUBBER		
4	-	17	SWA200P1	SWITCH, ROCKER	EA	SI-54
8.0	8.0	16	WIA050P2201	WIRE, INSUL. SOLID	IN.	22 AWG WHITE
1	1	15	B298P1	FILLER PANEL	EA	
1	1	14	C299P2	SUPPORT BKT		
1	1	13	C299P1	SUPPORT BKT		
3	3	12	ROC062P4722	RESISTOR		R1- R3 4.7K 1/4W 5%
1	1	11	CCA029P1B	CABLE CLAMP		
1	1	10	C268G2	HARNESSE FMT. PAN.		
2	2	9	CCA065P1	CLAMP, LAMP		
2	2	8	DSC063P1	LED (LAMP)		
-	1	7	C258P2	LENS, PUSH BUTTON		(PROT FIXED)
-	1	6	C258P3	LENS, PUSH BUTTON		(PROT RMVBL)
-	1	5	C258P4	LENS, PUSH BUTTON		(DISC DRIVE)
-	1	4	C258P1	LENS, PUSH BUTTON		(DISC POWER)
1	1	3	D250PX	OVERLAY		
1	1	2	D249P1	CONTROL PANEL		
1	1	1	D336PX	CASTING FMT. PAN.	EA	

**FIGURE 9-17**  
**FRONT PANEL ASSEMBLY - FRONT LOAD**



REVISIONS		
REV	C.S. NO.	DATE
A	ISSUED	2-28-74
B	ECO NO. 02BB	4-7-74
C	ECO NO. 0421	12-16-74

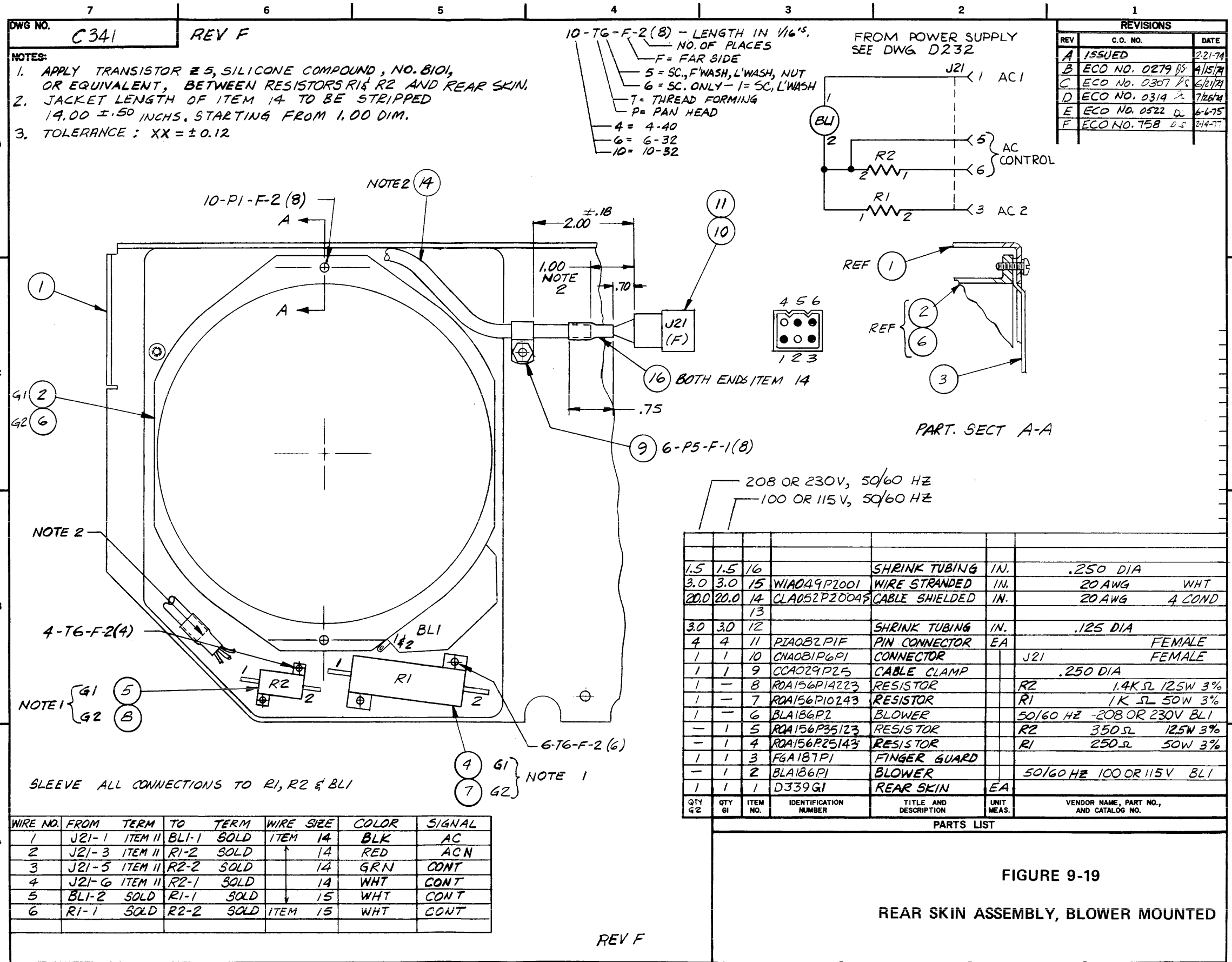
QTY	ITEM NO.	IDENTIFICATION NUMBER	TITLE AND DESCRIPTION	UNIT MEAS.	VENDOR NAME, PART NO., AND CATALOG NO.
4	9	WAA020PI	WASHER, INSUL	EA	
1/30	8	CIA140PI	CHAIN	IN.	
2	7	CCA029P3I	CABLE CLAMP	EA	
1	6	HIA141PI	HINGE SPRING	EA	
1	5	BWA139PI	BKT MTG SLIDE	EA	
2	4	B193PI	STRAIN RELIEF	EA	
2	3	B176PI	CABLE CLAMP	EA	
1	2	C173PI	MTG BKT ARM	EA	
1	1	C171PI	ARM CABLE RETURN	EA	

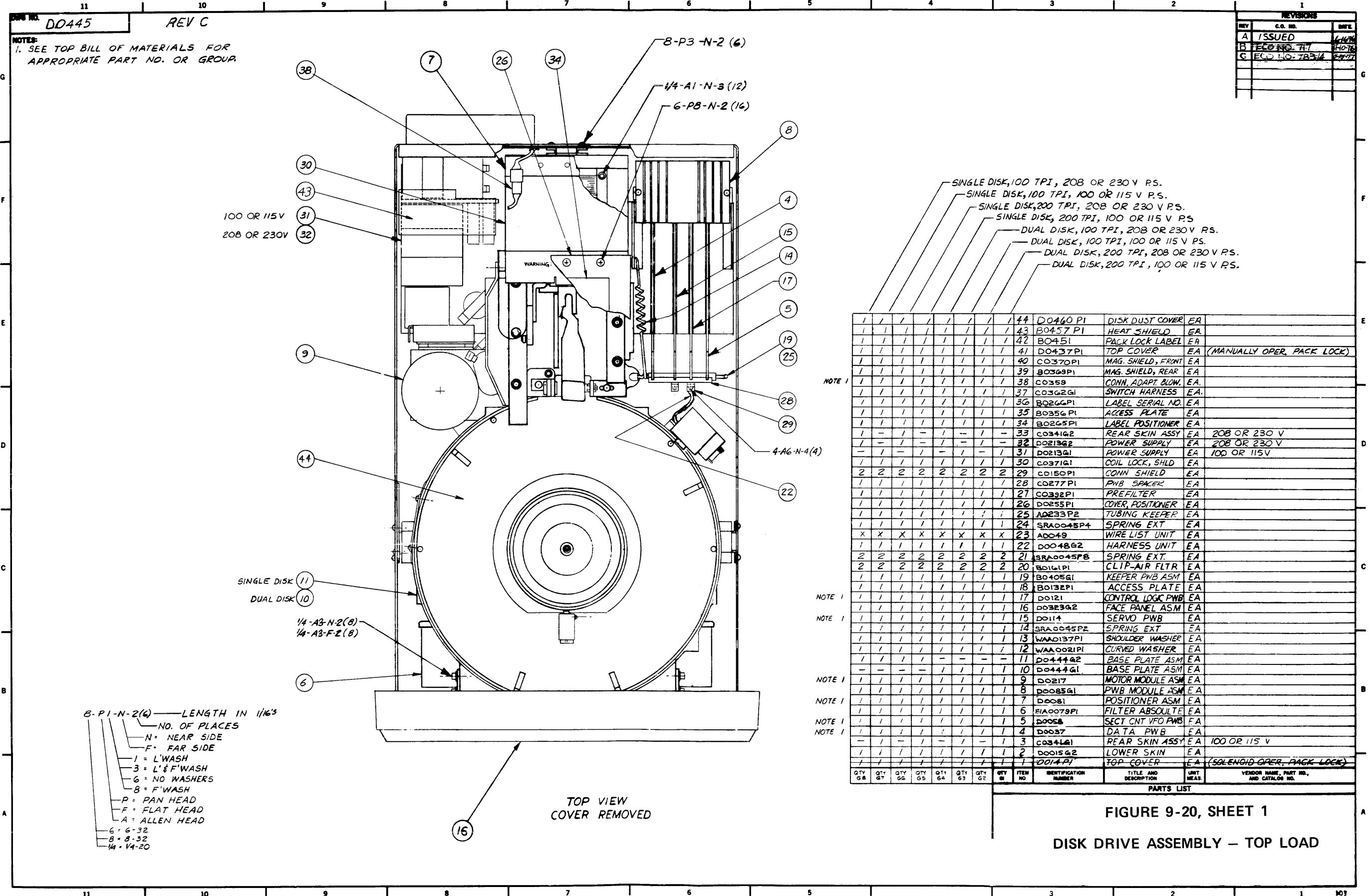
PARTS LIST

**FIGURE 9-18**

**CABLE RETRACTING ASSEMBLY**

REV C





DD445 REV C

NOTES:  
1. SEE TOP BILL OF MATERIALS FOR APPROPRIATE PART NO. OR GROUP.

REV	C.O. NO.	DATE
A	ISSUED	1/10/74
B	REVISION #17	1/10/74
C	ECO NO: 783/4	8/27/74

100 OR 115V  
208 OR 230V

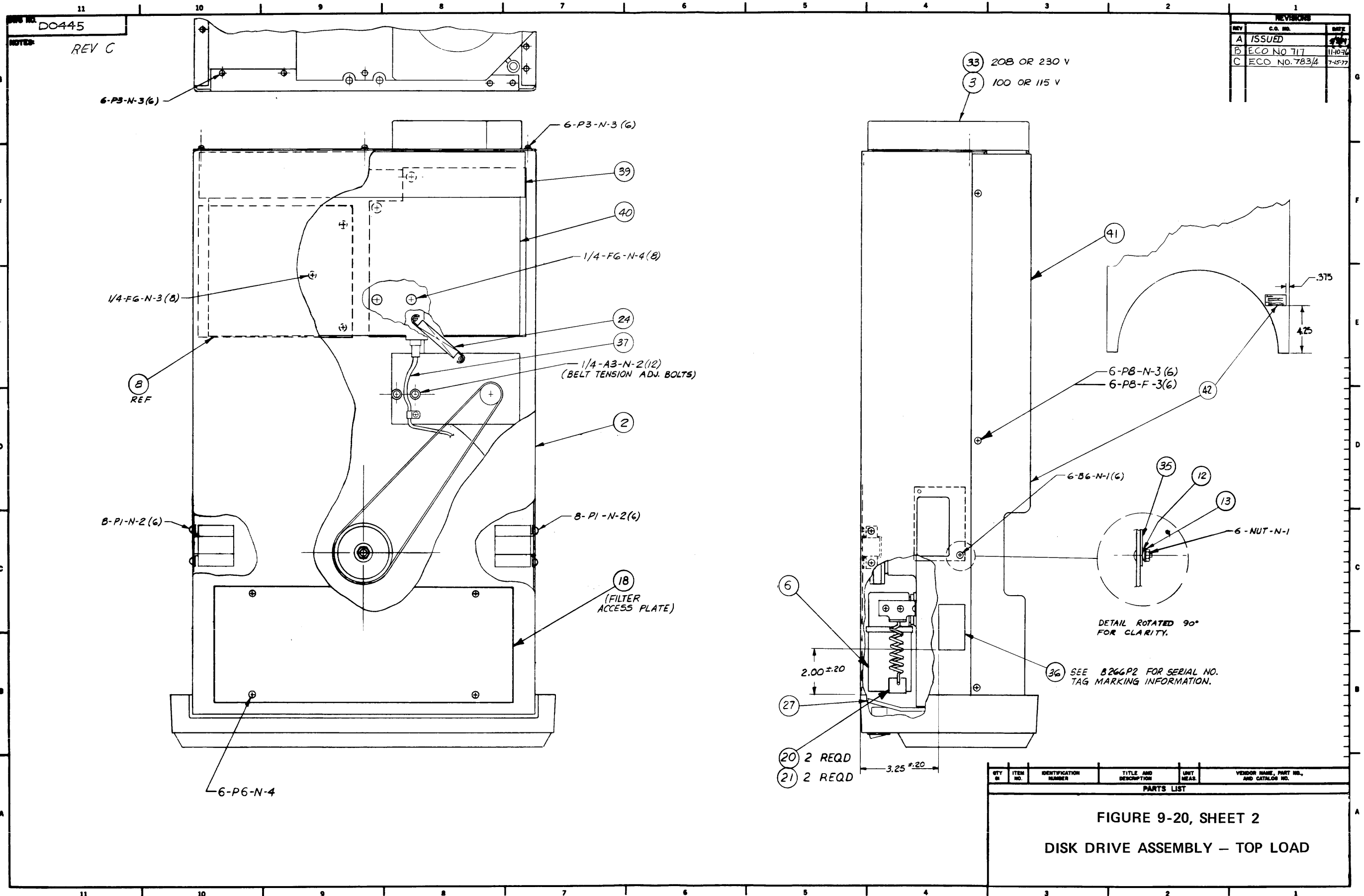
SINGLE DISK, 100 TPI, 208 OR 230 V P.S.  
SINGLE DISK, 100 TPI, 100 OR 115 V P.S.  
SINGLE DISK, 200 TPI, 208 OR 230 V P.S.  
SINGLE DISK, 200 TPI, 100 OR 115 V P.S.  
DUAL DISK, 100 TPI, 208 OR 230V P.S.  
DUAL DISK, 100 TPI, 100 OR 115 V P.S.  
DUAL DISK, 200 TPI, 208 OR 230 V P.S.  
DUAL DISK, 200 TPI, 100 OR 115 V P.S.

QTY	QTY	QTY	QTY	QTY	QTY	QTY	QTY	QTY	QTY	QTY	QTY	ITEM NO	IDENTIFICATION NUMBER	TITLE AND DESCRIPTION	UNIT MEAS.	VENDOR NAME, PART NO., AND CATALOG NO.
/	/	/	/	/	/	/	/	/	/	/	/	44	DO460 PI	DISK DUST COVER	EA	
/	/	/	/	/	/	/	/	/	/	/	/	43	BO457 PI	HEAT SHIELD	EA	
/	/	/	/	/	/	/	/	/	/	/	/	42	BO451	PACK LOCK LABEL	EA	
/	/	/	/	/	/	/	/	/	/	/	/	41	DO437 PI	TOP COVER	EA	(MANUALLY OPER. PACK LOCK)
/	/	/	/	/	/	/	/	/	/	/	/	40	CO370 PI	MAG. SHIELD, FRONT	EA	
/	/	/	/	/	/	/	/	/	/	/	/	39	BO369 PI	MAG. SHIELD, REAR	EA	
/	/	/	/	/	/	/	/	/	/	/	/	38	CO358	CONN. ADAPT. BLOW.	EA	
/	/	/	/	/	/	/	/	/	/	/	/	37	CO362 GI	SWITCH HARNESS	EA	
/	/	/	/	/	/	/	/	/	/	/	/	36	BO266 PI	LABEL SERIAL NO.	EA	
/	/	/	/	/	/	/	/	/	/	/	/	35	BO356 PI	ACCESS PLATE	EA	
/	/	/	/	/	/	/	/	/	/	/	/	34	BO265 PI	LABEL POSITIONER	EA	
/	/	/	/	/	/	/	/	/	/	/	/	33	CO341 G2	REAR SKIN ASSY	EA	208 OR 230 V
/	/	/	/	/	/	/	/	/	/	/	/	32	DO213 G2	POWER SUPPLY	EA	208 OR 230 V
/	/	/	/	/	/	/	/	/	/	/	/	31	DO213 GI	POWER SUPPLY	EA	100 OR 115V
/	/	/	/	/	/	/	/	/	/	/	/	30	CO371 GI	COIL LOCK, SHLD	EA	
2	2	2	2	2	2	2	2	2	2	2	2	29	CO150 PI	CONN. SHIELD	EA	
/	/	/	/	/	/	/	/	/	/	/	/	28	CO277 PI	PWB SPACER	EA	
/	/	/	/	/	/	/	/	/	/	/	/	27	CO392 PI	PREFILTER	EA	
/	/	/	/	/	/	/	/	/	/	/	/	26	DO255 PI	COVER POSITIONER	EA	
/	/	/	/	/	/	/	/	/	/	/	/	25	AD233 P2	TUBING KEEPER	EA	
/	/	/	/	/	/	/	/	/	/	/	/	24	SRA0045P4	SPRING EXT	EA	
X	X	X	X	X	X	X	X	X	X	X	X	23	AD049	WIRE LIST UNIT	EA	
2	2	2	2	2	2	2	2	2	2	2	2	22	DO048 G2	HARNESS UNIT	EA	
2	2	2	2	2	2	2	2	2	2	2	2	21	SRA0045PB	SPRING EXT.	EA	
2	2	2	2	2	2	2	2	2	2	2	2	20	BO161 PI	CLIP-AIR FLTR	EA	
/	/	/	/	/	/	/	/	/	/	/	/	19	BO405 GI	KEEPER PWB ASM	EA	
/	/	/	/	/	/	/	/	/	/	/	/	18	BO132 PI	ACCESS PLATE	EA	
/	/	/	/	/	/	/	/	/	/	/	/	17	DO121	CONTROL LOGIC PWB	EA	
/	/	/	/	/	/	/	/	/	/	/	/	16	DO323 G2	FACE PANEL ASM	EA	
/	/	/	/	/	/	/	/	/	/	/	/	15	DO114	SERVO PWB	EA	
/	/	/	/	/	/	/	/	/	/	/	/	14	SRA0045P2	SPRING EXT	EA	
/	/	/	/	/	/	/	/	/	/	/	/	13	WAA0137 PI	SHOULDER WASHER	EA	
/	/	/	/	/	/	/	/	/	/	/	/	12	WAA0021 PI	CURVED WASHER	EA	
/	/	/	/	/	/	/	/	/	/	/	/	11	DO444 G2	BASE PLATE ASM	EA	
/	/	/	/	/	/	/	/	/	/	/	/	10	DO444 GI	BASE PLATE ASM	EA	
/	/	/	/	/	/	/	/	/	/	/	/	9	DO217	MOTOR MODULE ASM	EA	
/	/	/	/	/	/	/	/	/	/	/	/	8	DO085 GI	PWB MODULE ASM	EA	
/	/	/	/	/	/	/	/	/	/	/	/	7	DO081	POSITIONER ASM	EA	
/	/	/	/	/	/	/	/	/	/	/	/	6	FIA0079 PI	FILTER ABSOLUTE	EA	
/	/	/	/	/	/	/	/	/	/	/	/	5	DO058	SECT CNT VFO PWB	EA	
/	/	/	/	/	/	/	/	/	/	/	/	4	DO037	DATA PWB	EA	
/	/	/	/	/	/	/	/	/	/	/	/	3	CO341 G1	REAR SKIN ASSY	EA	100 OR 115 V
/	/	/	/	/	/	/	/	/	/	/	/	2	DO015 G2	LOWER SKIN	EA	
/	/	/	/	/	/	/	/	/	/	/	/	1	DO014 PI	TOP COVER	EA	(SOLENOID OPER. PACK LOCK)

8-P1-N-2(6) — LENGTH IN 1/16'S  
NO. OF PLACES  
N = NEAR SIDE  
F = FAR SIDE  
1 = L' WASH  
3 = L' & F' WASH  
6 = NO WASHERS  
8 = F' WASH  
P = PAN HEAD  
F = FLAT HEAD  
A = ALLEN HEAD  
6 = 6-32  
8 = 8-32  
1/4 = 1/4-20

TOP VIEW  
COVER REMOVED

FIGURE 9-20, SHEET 1  
DISK DRIVE ASSEMBLY — TOP LOAD



REVISIONS		
REV	C.O. NO.	DATE
A	ISSUED	7-77
B	ECO NO 717	11-10-76
C	ECO NO. 783/4	7-15-77

QTY	ITEM NO.	IDENTIFICATION NUMBER	TITLE AND DESCRIPTION	UNIT MEAS.	VENDOR NAME, PART NO., AND CATALOG NO.
PARTS LIST					

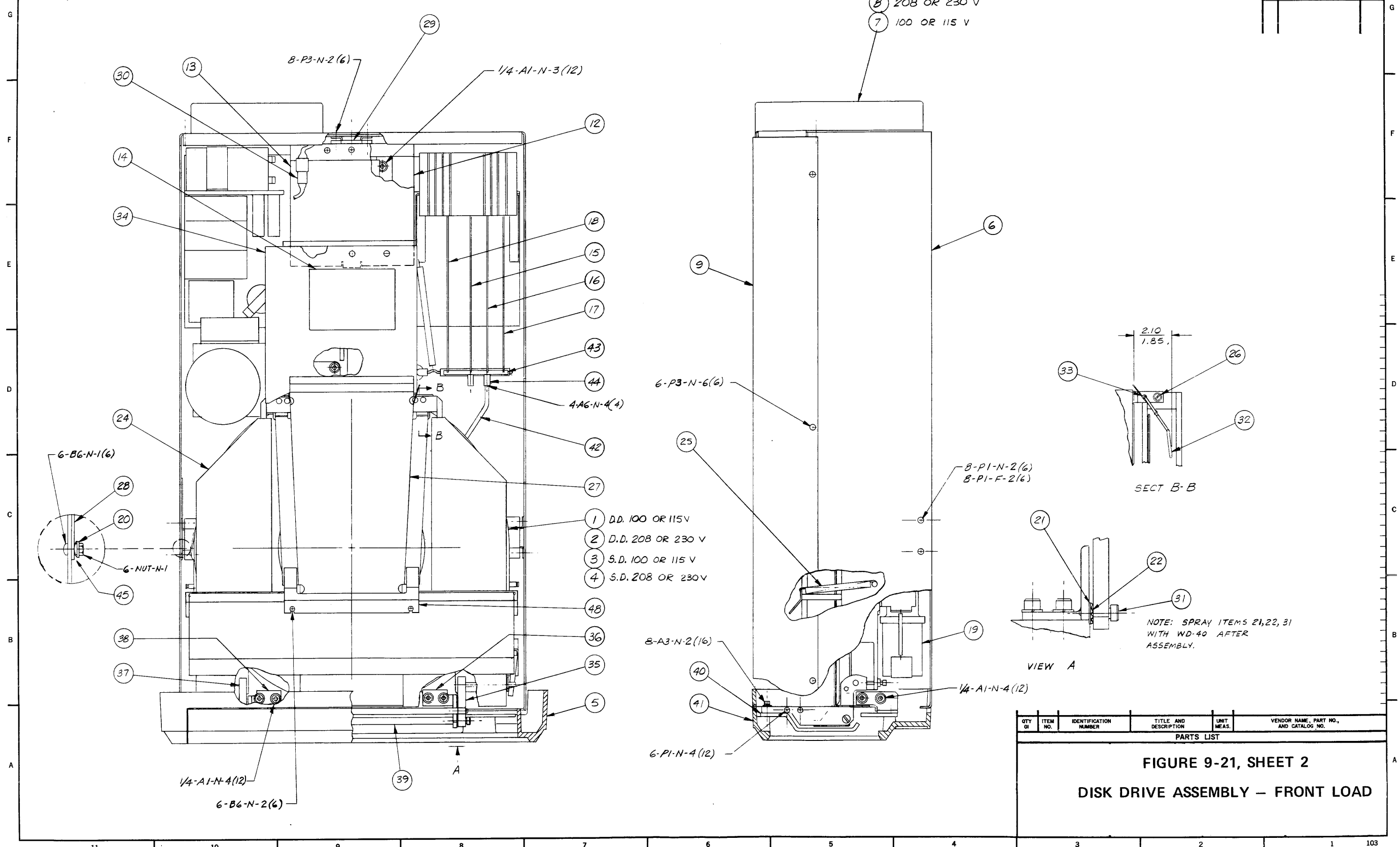
**FIGURE 9-20, SHEET 2**  
**DISK DRIVE ASSEMBLY – TOP LOAD**



DWG NO.	D347	REV	D
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NOTES:  
1. SEE TOP BILL OF MATERIALS FOR APPROPRIATE PART NO. OR GROUP NO.

REVISIONS		
REV	C.O. NO.	DATE
A	ISSUED	2/9/74
B	ECO NO. 422	1-24-75
C	ECO NO. 2557	2-15-75
D	ECO NO. 2603	2-27-76



- 1 D.D. 100 OR 115V
- 2 D.D. 208 OR 230 V
- 3 S.D. 100 OR 115 V
- 4 S.D. 208 OR 230V

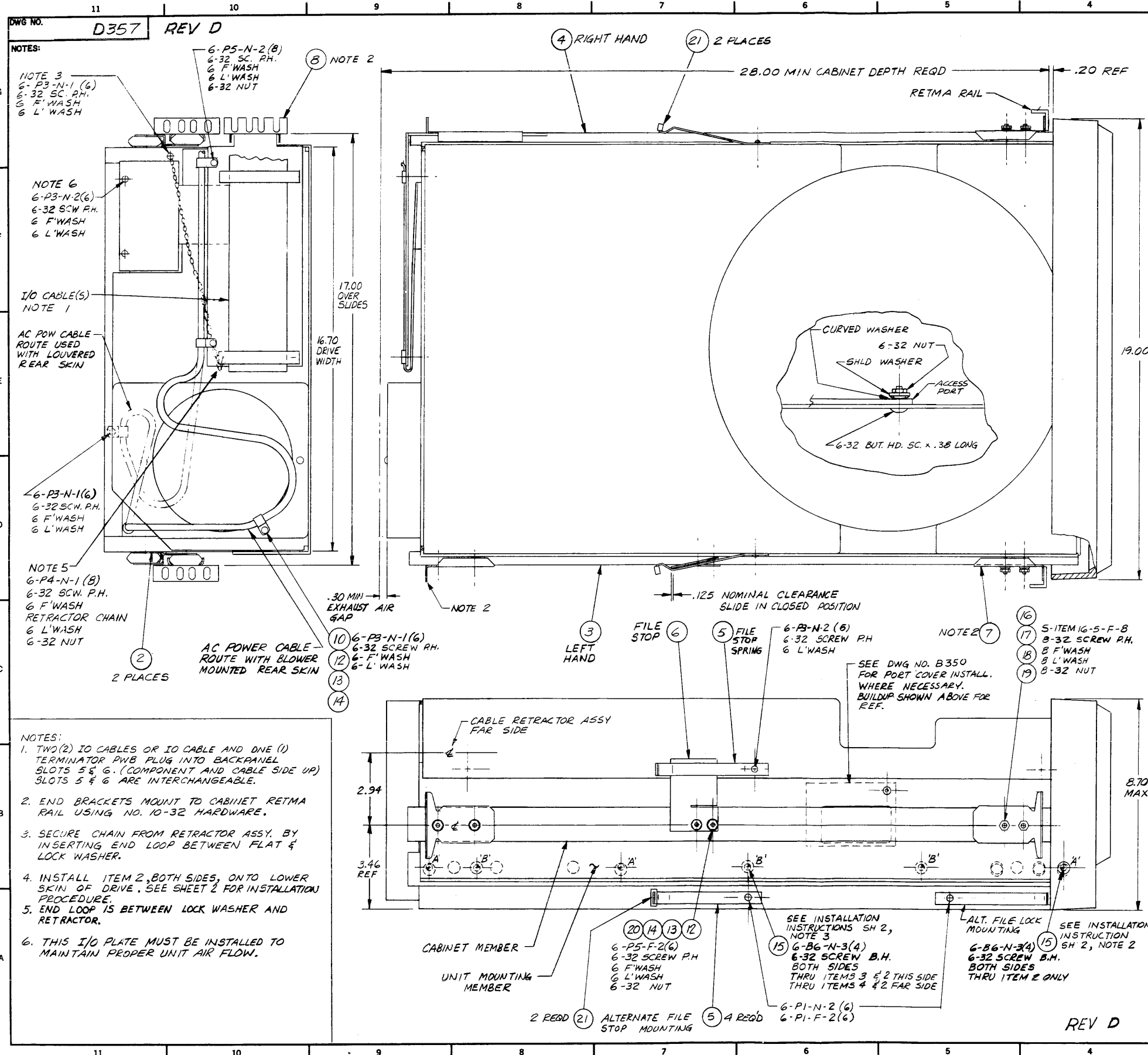
QTY	ITEM	IDENTIFICATION	TITLE AND	UNIT	VENDOR NAME, PART NO.,
OR	NO.	NUMBER	DESCRIPTION	MEAS.	AND CATALOG NO.

PARTS LIST

**FIGURE 9-21, SHEET 2**

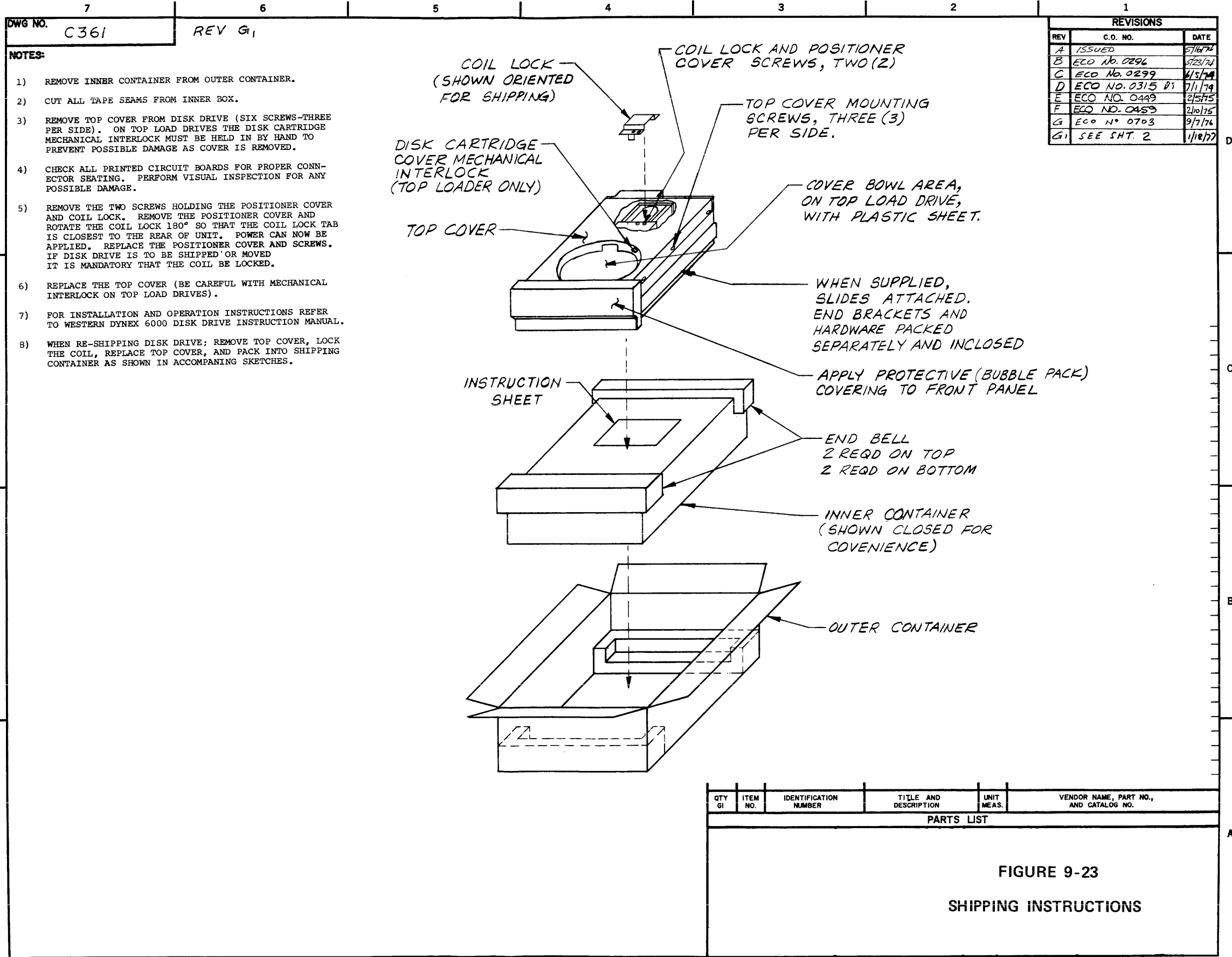
**DISK DRIVE ASSEMBLY - FRONT LOAD**





QTY	ITEM NO.	IDENTIFICATION NUMBER	TITLE AND DESCRIPTION	UNIT MEAS.	VENDOR NAME, PART NO., AND CATALOG NO.
	21	RUA185PI	RUBBER BUMPER	EA	
	20	NUA013P0632	NUT, HEX	EA	6-32
	19	NUA013P0832	NUT, HEX	EA	8-32
	18	WAR019P08	WASHER LOCK	B	
	17	WAR018P08	WASHER FLAT	B	
	16	SCA217P0806	SCREW BINDING HD	EA	8-32 x 3/8 LONG - SLOTTED LOW PRO
	15	SCA010	SCREW BUTTON HD	EA	6-32 x 1/4 LONG
	14	WAR019P06	WASHER LOCK	G	
	13	WAR018P06	WASHER FLAT	G	
	12	SCA001	SCREW PAN HD	EA	6-32 x 3/8 LONG
	11				
	10	CCA029P38	CLAMP CABLE	EA	
	9				
	8	D340G1	CABLE RETRACTOR	EA	
	7	BKA184PI	END BRACKET	EA	
	6	B352PI	FILE LOCK PLATE	EA	
	5	B353PI	FILE STOP SPRING	EA	
	4	SLA183P2	SLIDE R.H.	EA	
	3	SLA183PI	SLIDE L.H.	EA	
	2	C354PI	SLIDE SUPPORT	EA	
	1		DISK DRIVE	EA	

**FIGURE 9-22**  
**OUTLINE AND UNIT INSTALLATION**  
**DIAGRAM**



- DWG NO. **C361** REV **G<sub>1</sub>**
- NOTES:**
- 1) REMOVE INNER CONTAINER FROM OUTER CONTAINER.
  - 2) CUT ALL TAPE SEAMS FROM INNER BOX.
  - 3) REMOVE TOP COVER FROM DISK DRIVE (SIX SCREWS-THREE PER SIDE). ON TOP LOAD DRIVES THE DISK CARTRIDGE MECHANICAL INTERLOCK MUST BE HELD IN BY HAND TO PREVENT POSSIBLE DAMAGE AS COVER IS REMOVED.
  - 4) CHECK ALL PRINTED CIRCUIT BOARDS FOR PROPER CONNECTOR SEATING. PERFORM VISUAL INSPECTION FOR ANY POSSIBLE DAMAGE.
  - 5) REMOVE THE TWO SCREWS HOLDING THE POSITIONER COVER AND COIL LOCK. REMOVE THE POSITIONER COVER AND ROTATE THE COIL LOCK 180° SO THAT THE COIL LOCK TAB IS CLOSEST TO THE REAR OF UNIT. POWER CAN NOW BE APPLIED. REPLACE THE POSITIONER COVER AND SCREWS. IF DISK DRIVE IS TO BE SHIPPED OR MOVED IT IS MANDATORY THAT THE COIL BE LOCKED.
  - 6) REPLACE THE TOP COVER (BE CAREFUL WITH MECHANICAL INTERLOCK ON TOP LOAD DRIVES).
  - 7) FOR INSTALLATION AND OPERATION INSTRUCTIONS REFER TO WESTERN DYNEX 6000 DISK DRIVE INSTRUCTION MANUAL.
  - 8) WHEN RE-SHIPPING DISK DRIVE: REMOVE TOP COVER, LOCK THE COIL, REPLACE TOP COVER, AND PACK INTO SHIPPING CONTAINER AS SHOWN IN ACCOMPANYING SKETCHES.

REVISIONS		
REV	C.O. NO.	DATE
A	ISSUED	5/16/72
B	ECO NO. 0296	5/23/74
C	ECO NO. 0299	4/5/74
D	ECO NO. 0315 D's	7/1/74
E	ECO NO. 0449	2/5/75
F	ECO NO. 0453	2/10/75
G	ECO N° 0703	9/7/76
G <sub>1</sub>	SEE SHT. 2	1/18/77

**FIGURE 9-23**  
**SHIPPING INSTRUCTIONS**

# Series 6000 DISK DRIVE

## APPENIDX A

### DE5020 DISK EXERCISER OPERATING INSTRUCTIONS

#### A. SWITCH DEFINITIONS

1. Two Position Register Switches 1, 2---256:  
These switches represent the track address (true = up position).
2. Three Position Busy +, Busy -Switch:  
This switch allows seek complete (busy) interface polarity selection.

When this interface line is defined as being low for seek busy this switch is to be in the busy-position (down). When defined as being high this switch is to be in the busy +position (up).

The center position allows the seek commands to be processed independent of the seek complete signal. This position can, therefore, be used with either polarity. The internal timing allows continuous seek commands to be processed every 100 ms.

3. Three Position Increment, Decrement Switch:

The track address stored in the tester can be incremented (down position) by one or decremented by one (up position) during the start of a command sequence by this switch. The center position disables the above two operations.

The up position also selects the top head which is required for the CE alignment of the read/write heads. The other two positions select the bottom head. The head selection switch positions can be reversed (0 to 1) 1 to 0) if the I/O interface signal polarity defnintion has been reversed in the disk drive by customer option. This can be readily determined during a CE operation.

4. Three Position Repetitive, Initialize Switch:

If this switch is in the initialize position (up) the read/write heads will seek to track 000 during a seek command.

If this switch is in the repetitive position (down) the track address sent to the disk drive will alternate on each seek command between the internal

# Series 6000

## DISK DRIVE

tester register and the register switches, thereby, moving the read/write heads between any two valid selectable position ( 203 for 100 TPI, 406 for 200 TPI). If the switch is not in this position all track addresses sent will come from the internal register. The center position disables the above two operational modes.

The down position also selects the removable (top) disk which is required during CE alignment of the read/write heads. The disk selection switch positions can be reversed (top disk to bottom, bottom disk to top) if the I/O signal polarity definition has been reversed in the disk drive by customers option. This can be readily determined during a CE operation.

### 5. Three Position Load, Recycle Switch:

When this switch is moved to the load position (down) the contents of the register switches will be loaded into the tester track address register. Any command that may have been in process will be terminated.

When this switch is moved to the recycle position (up) seek commands will be continuously processed after starting a command using the load command switch.

When this switch is moved to the center position only one seek command will be processed for each change of the load command switch from the clear to the load position.

### 6. Two Position Load Command, Clear Switch:

Command processing is stopped when this switch is moved to the clear position (down).

Moving this switch to the load position (up) starts the processing of seek commands to the disk drive.

## B. TESTER OPERATING SEQUENCE FOR SEEK COMMANDS

1. Power off disk drive, connect tested I/O cable, (insert PWB connector wiring side up) and power connector to back of disk drive PWB backpanel.
2. Power on disk drive and allow it to come ready.
3. Set busy +, busy - switch to correct position.

# Series 6000 DISK DRIVE

4. Load desired track address from switches into register using load switch.
5. Set increment, decrement switch if the track address register is to be incremented or decremented at the start of each command.
6. If the track address is to alternate on seek commands from the register address to the switch address than set the repetitive, initialize switch to repetitive. If the disk drive is to be restored to track 000 by the initialize function (not track address) then set the switch to the initialize position.
7. If the command is to be processed continuously then set the load, recycle switch to the recycle position.
8. The command can now be started by moving the clear, load command switch from the clear to the load position.
9. If the command is being processed continuously (recycle on) the command sequence can be terminated by moving the load command switch to the clear position.

## C. TESTER OPERATING SEQUENCE FOR CE ALIGNMENT

1. Seek to proper alignment track and put load command switch in clear position. Then select the proper disk and head required for C.E. alignment.

# Series 6000 DISK DRIVE

## APPENDIX B

### DT6020 DISK TESTER OPERATING DESCRIPTION

#### A. General

The tester is composed of two basic registers; the address register and the data register. The address register contains the address of the data block. The data block pattern is contained in the data register. The data register also contains position information when used in the repetitive seek mode (See Section B-8).

The five basic commands are: seek, read address, format, compare, and automatic.

#### B. Switch Function Description

1. File Simulate - allows the tester to simulate a disk drive for the purpose of tester debug. A disk drive must not be connected when using this mode.
2. Select PC - allows display of program count bits 0 and 1.  
Select error - allows display of error conditions (compare and no sector).
3. Load Top - loads information from the register switches into the data (top) register.

Load Bottom - loads information from the register switches into the address (bottom) register.

4. Head Increment - allows all data commands to increment the head address.
5. Position Increment - allows all commands to increment the position address. The head increment mode must be functioning to allow the position increment if a data command is being processed.
6. Disk Increment - allows all commands to increment the disk address. The position increment mode must be functioning to allow the disk increment.
7. Error Stop - If an error occurs (compare or no sector) and the switch is in the stop position, the error condition will be displayed and the tester will halt in program count 00. If its a compare error (compare command) then the incorrect data will be in the data register. If the header address does not compare with the address register, then a no sector found error (read header or compare command) will exist.

# Series 6000

## DISK DRIVE

8. Initialize - allows tester to initialize the disk drive unit to track 000 during a seek operation. This position is to be used for seek commands only.

Repetitive - allows repetitive seek operations between the address in the data register and the address in the address register. This position is to be used for seek commands only.

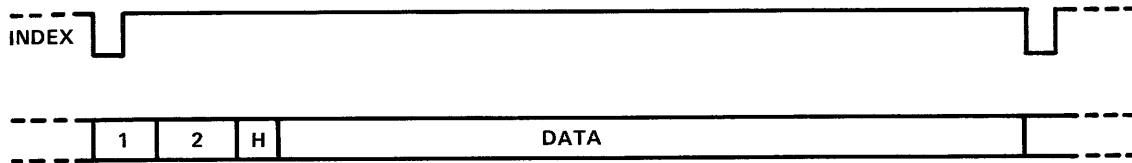
9. Recycle - allows command to be continuously recycled.
10. Clear - allows resetting of all tester functions. This must be done prior to the start of every command.

Load command - loads commands as determined by command select rotary switch (See Section B-11).

11. Command select - (see Section B-10). The five positions are:
  - a. Seek - moves read/write heads to the address in the address register. In the repetitive seek mode, it moves the heads between the address in the address register and address in the data register. In the initialize mode, it moves the heads to track 000.
  - b. Read Address - reads the header of each data block into the data register.
  - c. Format - writes data from the data register in the format of Section "C"
  - d. Compare - compares all data read in the format of Section "C" to the data in the data register.
  - e. Automatic - writes and compares all combinations of an eight bit word in the format of Section "C".

# Series 6000 DISK DRIVE

## C. Data Block Format:



- Gap 1 - Used to enable heads (time determined by tester)
- Gap 2 - Used to sync read circuits (time determined by tester)
- Header - Track Identifier
  - 1 bit - Head
  - 9 bits - Positioner (Cylinder)
  - 1 bit - Disk
  - 5 bits - Spare
- Data - Repeating 8 bit data byte
  - Written from data register when Format Command
  - Read into data register when Compare Command

## D. Tester Interface Jumper Options - Remove bottom plate to change jumpers. All testers are factory jumpered for Standard Interface.

1. Seek Busy - jumper FC01 to FC02 for Standard Interface.  
Seek Ready - jumper FC01 to FC03.

Also the busy jumper on the disk drive backpanel must be placed between Busy 1 and A2-42 if the normal seek ready line is not used (for example - Microdata).

2. Top disk select on low output - jumper WP08 to WP07 for Standard Interface.  
Top disk select on high output - jumper WP08 to WP06.
3. Double frequency read data bit - jumper FC28 to FC27 for Standard Interface.  
NRZ read data bit - jumper FC28 to FC26.

## E. Normal Operator Functions\*

1. Seek Mode
  - a. Put command rotary switch in seek position.
  - b. Load seek address into B reg. (momentarily press load bot. down after setting reg. switches).



# Series 6000

## DISK DRIVE

- c. Put recycle switch (RECY) up if command is to be continuous.
  - d. Move load switch to clear (down) and then move up to load command position. Command is now being executed.
  - e. If B reg. (seek address) is to be incremented by one, then put positive increment in up position.
  - f. If seek address is to be switched from B to D reg. put seek repetitive switch (seek rep.) down. The disk drive will now move between the respective addresses. The D reg. can be loaded a given address by setting reg. switches and pressing load top to up position.
  - g. For an automatic seek to address zero move seek initialize (seek init.) switch up.
  - h. To stop command, put recycle switch (RECY) down if it was up. If it was down, only 1 command sequence was executed.
  - i. The following switches have no effect on the seek operation: bottom head, error stop, head increment, disk increment, select PC error.
  - j. The file simulate (file sim.) must be down. This switch is to be used for tester debug only. It simulates signals from the drive for debug purposes.
2. Format
- a. Seek to starting address (See Section E-1).
  - b. Load data to be written in D reg. by setting register switches and momentarily moving load register switch up (load top).
  - c. Put command rotary switch in proper position.
  - d. If command is to function on both heads, put head increment up.
  - e. If command is to function on all positions, put position increment (pos. inc.) up.
  - f. If command is to function on both disks, put disk inc. up.
  - g. If command is to be continuous, put recycle switch (RECY) up.
  - h. Seek init-rep. switch must be in center position.
  - i. File sim. switch must be down.
  - j. To start command sequence, press load switch to clear position (down) and then up to the load command position.
  - k. The error stop switch and select PC error have no effect.
3. Read Header
- a. Seek to starting address (See Section E-1). Usually this is track 000.
  - b. Same as Section E-2, steps c through j.
  - c. The header address is read into the D reg.

\*Assume all switches down or in center position on momentary switches at start of each command.

# Series 6000

## DISK DRIVE

- d. If the error stop (err. stop) switch is on (up) and if B. reg. address does not compare with the header address read then a no sector (no sect.) error is indicated and the tester stops. To see the error indication, select PC-error switch must be in select error position.
4. Compare
    - a. Same as Section E-3, steps a, b and d.
    - b. If the error stop switch is on and the data in the D reg. does not compare with the data read, then a compare error is indicated. To see the error indication the sel. PC-error switch must be in select error position. When first starting the command, the data reg. can be loaded with the proper data by putting the error stop switch on when starting the command. An error will occur and the data in error is left in the D reg. (which in this case is the correct data). Loading the command again will then properly start the command.
  5. Auto
    - a. Same as Section E-3, steps a and b.
    - b. The data in the D reg. is written, compared and incremented by one until it rolls over (all ones). This completes one command sequence.
    - c. If the error stop (err. stop) switch is on, and the data in the D reg. does not compare with the data read then a compare error is indicated. The data in error is not read into the D reg. as in the compare mode. If the header address does not compare with the B reg. then a no sector error is indicated.