MC8309

DISK STORAGE DRIVE
TYPE 8418-02/03,04/05

OPERATION &
SERVICE MANUAL

CUSTOMER ENGINEERING
FEBRUARY, 1977

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HANDBOOK CHANGE BULLETIN
CUSTOMER ENGINEERING

BOOK: MC8309 DISK STORAGE DRIVE   Effective Date: June 6, 1978
        TYPE 8418-02/03,04/05
        OPERATION AND SERVICE MANUAL

<u>HANDBOOK APPLICATION</u>   HCB-2

SPERRY UNIVAC 90/30, HB 2402 Disk Storage Drive
                            Type 8418-02/03,04/05 Servicing

<u>DESCRIPTION OF CHANGES</u>

NOTE: Vertical bars in the margins of the attached revised pages
indicate where engineering data has been added, deleted, or
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page that was completely rewritten will have a vertical bar
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new or revised data will only carry the new revision level
at the bottom of the page.

The contents of Chapters 5 and 6 have been revised.

This document reflects all engineering changes and includes
all information released in Technical Documentation Notices
through December, 1977.

<u>INSTRUCTIONS</u>

Replace the following pages:

     vi, vii, ix, x
     1-1, 1-12
     5-21 through 5-33
     6-1, 6-3, 6-4, 6-5, 6-9, 6-11, 6-12, 6-13, 6-14, 6-16,
     6-18 through 6-28

Retain this HCB cover sheet behind the book's title page.

DISK STORAGE DRIVE TYPE 8418-02/03,04/05 OPERATION AND SERVICE MANUAL

MC8309, UD002525-1

ISS

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HANDBOOK CHANGE BULLETIN
CUSTOMER ENGINEERING

BOOK: MC8309 DISK STORAGE DRIVE   EFFECTIVE DATE: May 18, 1977
TYPE 8418-02/03, 04/05
OPERATION & SERVICE MANUAL

HCB-1

HANDBOOK APPLICATION

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      will only carry the new revision level at the bottom
      of the page.

      The entire contents of Chapter 4 has been revised and
      rewritten.

      This document reflects all engineering changes and includes
      all information released in Technical Documentation Notices
      through February 1, 1977.

INSTRUCTIONS

      All revised pages are labeled REVISION: HCB-1.

      The entire book has been reprinted to facilitate handling. Replace
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      this HCB cover sheet behind the book's title page.

PREFACE

This publication contains detailed operation and maintenance information for the service engineer. The information is arranged in sections in the following order:

Chapter One. Introduction - This chapter contains a description of the device, specifications for the device, and a summary of component locations in the device.

Chapter Two. Installation - This chapter contains a detailed, step-by-step procedure for device installation and checkout. Complete cabling/configuration information is included.

Chapter Three. Operational Description - This chapter contains a complete description of control panel operation. Describes the use and meaning of all switches and indicators.

Chapter Four. Functional Description - This chapter provides sufficient information to troubleshoot the disk drive to a PWA level. Complete listings of signal mnemonics from each PWA are listed. Input/Output mnemonics for the System Interface PWA are also given. Abbreviated listings of major input/output signals for each PWA are provided. Additionally simplified and expended block diagrams and descriptions are provided for the major PWA assemblies. Functional block diagrams with graphic-keyed signal flow for various modes of operation are also provided.

Chapter Five. Maintenance - This chapter describes the methods, tools, and test equipment required to implement the maintenance philosophy for the device. Includes safety precautions and a comprehensive procedural set of checks and adjustments.

Chapter Six. Removal/Replacement Procedures - This chapter contains detailed information on the removal and replacement of filters, assemblies, and components.

Related Publications

The following is a list of publications providing reference information for the 8418. Part numbers with a letter "U" prefix are ISS publication numbers.

8418 Illustrated Parts Breakdown - Part NumberMC8310 (UP002525-1)

Provides a cross-reference listing of parts and part numbers with appropriate illustrations. Major assemblies are shown in disassembly order.

Appendix A lists generic name each tool and piece of test equipment required to implement maintenance on the drive.

8418 Operator Reference Manual - Part Number UP002540-1

Provides a complete description of operator actions associated with the device, including disk pack removal and replacement. Describes the use and meaning of all control panel switches and indicators.

8418 Diagrams Manual - Part Number UD002525-2

Provides reference and troubleshooting information for the service engineer. Includes detailed functional block diagrams, timing diagrams, input/output diagrams, and a summary of logic conventions used in the diagrams.

8416/8418 Drive Exerciser Diagnostic Unit (DEDU) Manual - Part Number MC8327 (UD002534-1)

Provides a complete set of operating instructions for using the DEDU in conjunction with either the 8416 or 8418. Includes complete instructions for attaching the DEDU, online and offline operation, head alignment, and testing unsafe conditions.

AC Power Distribution Box (Type 2408) Operation, Service, Diagrams Manual - Part Number MC8335 (UD002539-1)

Provides detailed configuration, installation, and maintenance data for the Type 2408-00, 01, 02, 03.

Customer Engineering Tool Catalog - Part Number MI1109

Provides the Customer Engineer with a tool catalog to identify and facilitate ordering tools and test equipment.

Publication Revisions

Information contained in this publication is current as of the date of printing. Page revisions will be issued as required to support technical changes.

CONTENTS

CONTENTS (CONT'D)

CONTENTS (CONT'D)

CONTENTS (CONTINUED)

CONTENTS (CONTINUED)

ILLUSTRATIONS

ILLUSTRATIONS (CONTINUED)

TABLES

CHAPTER 1

INTRODUCTION

1.1   GENERAL INFORMATION

The Univac Model 8418 Disk Storage Drive is a high-performance, direct access storage device for data processing systems. The Univac 8418 is connected to the 90/30 system through the F1621-00 Integrated Disk Adapter (IDA). Under control of the 90/30 system, data can be stored on or retrieved from a removable/interchangeable disk pack.

A disk pack contains on-line storage of 28 million or 57 million bytes, depending on the model. Table 1-1 is a summary of the performance characteristics of the drive.

Table 1-1. Univac 8418 Performance

Model	Average Access Time	Net Storage Capacity	Gross Storage Capacity	AC Power
8418-02	33 millisec	57.92 million bytes	73.7 million bytes	60 Hz
8418-03	33 millisec	57.92 million bytes	73.7 million bytes	50 Hz
8418-04	27 millisec	28.96 million bytes	36.8 million bytes	60 Hz
8418-05	27 millisec	28.96 million bytes	36.8 million bytes	50 Hz

The disk pack comprises four stacked magnetic recording disks with a total of eight surfaces, as shown in Figure 1-1. Seven of the surfaces are used for recording, and the eighth surface, the servo surface, is used as a precision reference for locating the read/write heads on a cylinder. The top and bottom disks are not used for recording.

The seven recording surfaces and the servo surface in the pack are serviced by a moving EMA (Electro Magnetic Actuator) that contains the seven read/write heads and the servo head. Each surface has a head.

The disk pack can be removed and interchanged only between Univac 8418 Disk Drives. The disk pack physically cannot be installed on other disk drives.

1.2   MODEL 8418 FEATURES

The following is a summary of Model 8418 features:

● Interchangeable Storage Media (disk pack) - F1216-02. This feature expends the drive capacity to the capacity of the disk packs on hand.

- Single Head Per Surface - this feature increases the disk-pack capacity by allowing the drive to process data to and from tracks (cylinders) spaced approximately 2.7 milli-inches apart - much closer than the physical limitations of the heads.

- Pre-Recorded Servo Control Information - the disk packs contain one surface prerecorded with timing and position information. This information enables the drive to detect the location of each track on the disk surface, and maintain accurate position control of the heads over track center during read and write operation.

- Multiple Track Processing - because the heads are arranged on a common carriage forming a cylinder of seven tracks per carriage position, data may be read and processed from multiple tracks without additional seek delays.

- Read/Write Phase Locked Oscillator (PLO) - clock signals, developed from the PLO signal, strobe serial data onto the write line and into the file during write operations. This procedure ensures accurate bit identification in subsequent read operations regardless of any variations in drive speed while data is written.

- Cylinder-to-Cylinder Access - cylinders are accessed by loading the drive registers with a position difference, and seek direction. The Processor keeps track of the carriage position and calculates the difference and direction necessary to move to a new cylinder.

1.3   MODEL 8418 SPECIFICATIONS

A complete summary of device specifications for the Model 8418 Disk Drive is shown in Table 1-2.

MC8309

Table 1-2. Device Specifications

CHARACTERISTICS	SPECIFICATIONS
AC Power	50 or 60 Hz
Voltage Input	3 phase AC from system - single phase in each drive. 200/208/240 VAC +6%, -15% @ 60 Hz +2%, single phase. Initial current surge <30 amps and operating current 5.2 amps nominal at 208 VAC -- 200/220/230/240 VAC +6%, -15% @ 50 Hz +2%, single phase. Initial current surge <30 amps and operating current 5.0 amps nominal @ 220 VAC.
Nominal AC Power Requirement	1.0 KVA typical, 1.4 KVA maximum. (806 Kilogram - calories)
Heat Dissipation	3200 BTU/hour nominal, 4000 BTU/hour maximum (1008 Kilogram-calories).
System-Supplied Voltages	+24 VDC +15%, -10% @ maximum current of 50 milliamps. +5 VDC +2%, -6.5% @ maximum current of 0.5 amps.
ACCESSING:	
Access drive motor	Electromagnetic actuator
Access control	Closed-loop, track-following, servo positioning
Direct access motion:	
Coarse positioning mode	Initially moves heads to desired cylinder region
Fine positioning mode	Locates head assembly in registration at the selected cylinder
Access times:	8418-02,03 8418-04,05

One cylinder seek
  Average seek
  Maximum seek
  Average rotational latency
    time
	10 ms 10 ms
	33 ms 27 ms
	60 ms 45 ms
	10.7 ms 10.7 ms

OPERATION:	
Start up time (head load and seek to cylinder 000)	30 seconds

Table 1-2. Device Specifications (Contd)

CHARACTERISTICS	SPECIFICATIONS	
Disk rotational speed	2800 rpm, ±3.5%, 60 Hz models (counter-clockwise)	
	2800 rpm, ±3.5%, 50 Hz models (counter-clockwise)	
Stop time (retract heads and stop disk rotation)	30 seconds	
Disk drive motor	1/2 hp induction, 1-phase	
DISK PACK:		
Type	ISS 8418 disk pack (F1216-02)	
Disk diameter	14 inches	
Number of disks	6	
Magnetic recording surfaces	7 (top recording surface is numbered zero)	
Servo control disk	1	
READ/WRITE:		
Number of read/write heads	7 (plus 1 read head for the servo)	
Cylinders per disk pack	411 (0 to 410) or 815 (0 to 814)	
	8418-04,05	8418-02,03
Tracks per cylinder	7	7
Total number of tracks	2877 per disk pack	5754 per disk pack
Data bytes per track	10,240	10,240
Data bytes per cylinder	71,680	71,680
Data bytes per disk pack	28,958,720	57,917,440
Number of cylinders	404 + 7	808 + 7
Data rate (nominal)	625,000 bytes/sec	
Recording density (approximate)	4040 bpi (inner track)	
Track density	370 tracks/inch	
Write data:		
Phase locked oscillator	10.0 MHz (100 ns period) nominal	
MFM data bit cell time (nominal)	200 ns (all 1's or 0's)	
	300 ns (011 pattern)	
	400 ns (010 pattern)	
Write data pulse width	50 ±15 ns	
Read data:		
Bit cell time	200 ns nominal	

Table 1-2. Device Specifications (Contd)

CHARACTERISTICS	SPECIFICATIONS
ENVIRONMENT:	
	Minimum Maximum
Operating temperature range	50°F (10°C) 94°F (34°C)
Non-operating temperature range	-8°F (10°C) 117°F (47°C)
Humidity range	20% 85%
	(non-condensing environments only)
Drive cooling (internal)	Forced air
Heat dissipation	3200 btu/hr nominal (806 Kilogram-calories)
CABINET:	
Service covers	Lower front cover, right and left side covers, rear cover, rear top cover, access cover, and EMA cover
Dimensions:	
Height	40 inches (1.01 meters)
Width	22.4 inches, add 0.8" for each side cover (56.9 centimeters, add 2 cm for each side cover).
Depth	32 inches (81.3 centimeters)
Mounting	Casters and levellers
Weight	Approximately 368 pounds (167 Kilograms)
Installation clearances:	
Front	48 inches (1.22 meters)
Rear	48 inches (1.22 meters)
Left side (end device only)	12 inches (30.5 centimeters)
Right side (end device only)	None required

1.4   COMPONENT LOCATIONS

The 8418 Disk Storage Drive is a self-contained unit consisting of electrical and mechanical subsystems (figures 1-2 and 1-3) that: provide forced air cooling in the drive; convert the AC input power into DC voltages required by the drive; retract, load, or position the read/write heads to process data to and from the tracks on the disk surfaces; provide safety interlocks protecting the operator, the drive, and data integrity from human error; and provide interface control between the IDA and the recording media (disk pack). Table 1-3 provides reference designators and part numbers for all major assemblies in the drive. The main functional elements are described below:

- Disk Pack
- Controls and Indicators
- Power
- Air Circulation
- Disk Rotation
- Cylinder Positioning
- Read/Write System
- Control

1.5   DISK PACK (F1216-02)

The disk pack, shown in figure 1-1, consists of six 14-inch diameter disks. The protective top and bottom disks are not used for recording. Data may be recorded on the seven recording surfaces that exist on both the top and bottom surfaces of the four disks, excluding the servo surface (the top surface of the third disk from the top). Disk pack data recording surfaces are assigned numerical addresses 0 through 6 from top to bottom. The physical layout of a recording disk is shown in figure 1-4.

Disk packs are supplied encased in a plastic pack cover with a bottom protective cover. The bottom cover is used to seal the disk pack for storage and must be removed before the disk pack and top cover are installed in the drive. The cover is removed when the pack is installed in the drive by turning the pack handle clockwise. When the cover is removed, the pack is secured to the drive spindle by the pack lock screw assembly. Disk packs are removed from the drive by installing the disk pack cover, turning the cover handle counterclockwise to release the pack from the drive spindle and to secure the cover on the pack. When a pack is removed from the drive, the pack bottom protective cover should be reinstalled for storage.

While a disk pack is installed in the drive, the cover for the pack can be stored in a top-mounted rack.

MC8309

DISK PACK COVER

815 CYLINDERS
TOTAL PER
DISK PACK

CYLINDER 000
AT OUTER EDGE

MODELS 8418-02,
AND 8418-03
ACCESS AREA
808 PRIMARY TRACKS
7 SPARES

MODELS 8418-04,
AND 8418-05
ACCESS AREA
404 PRIMARY TRACKS
7 SPARES

TOP DISK NOT USED
FOR RECORDING

DISK PACK
4 RECORDING DISKS
7 DATA SURFACES
SERVO SURFACE IS THE TOP
SURFACE OF THE FOURTH
DISK FROM THE TOP

BOTTOM DISK NOT
USED FOR RECORDING

BOTTOM PACK COVER

NOTE:
EACH CYLINDER POSITION INTERSECTS
A DISK DATA SURFACE TO ESTABLISH
A TRACK LOCATION.

PB000917
7/75

Figure 1-1. Disk Pack

MOTOR ASSEMBLY

OPERATOR PANEL

POWER SUPPLY

HEADS, SPINDLE
AND CARRIAGE

HINGED
TOP COVER

ABSOLUTE
FILTER

BLOWER
ASSEMBLY

LIBRARY

PLENUM

FAN
MOTORS (2)

PREFILTER
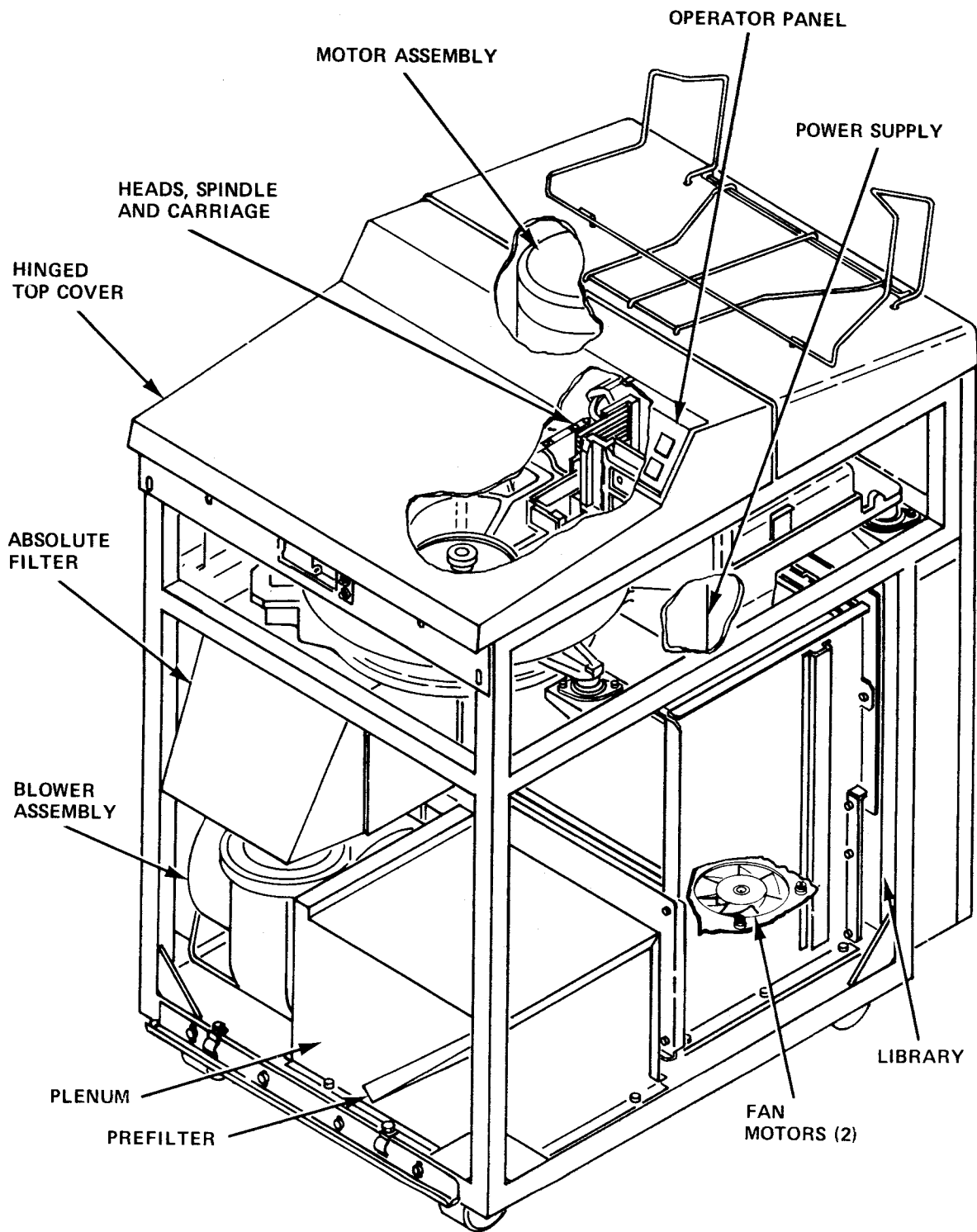
PB000919
7/75

Figure 1-2. Component Locations

MC8309

A4

A2

A3

A1

A5

A6
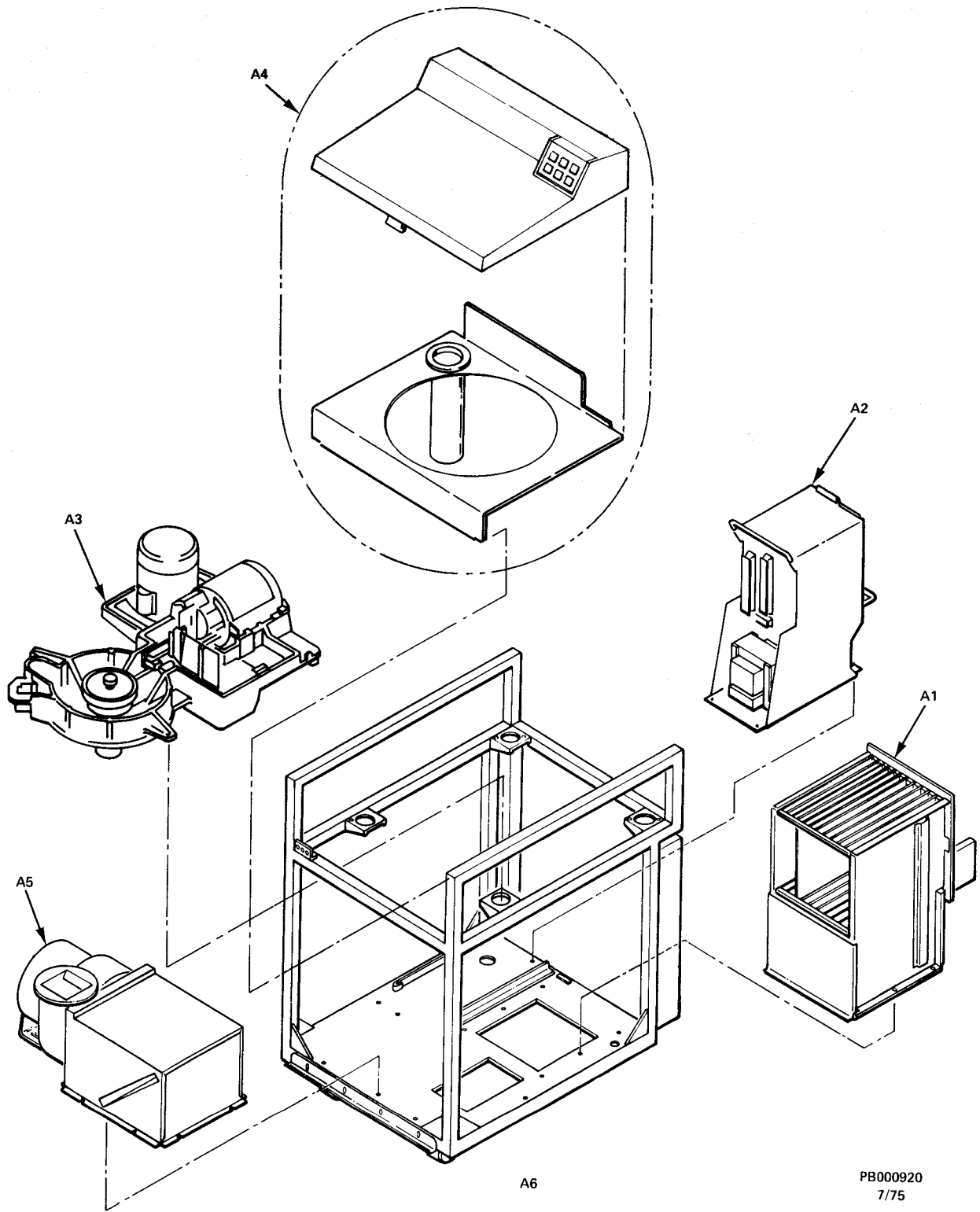
PB000920
7/75

Figure 1-3. Reference Designators

8418-02,03

000 ◄─────────► 815

808 PRIMARY TRACKS
7 SPARES

8418-02/03 ONLY

000 ◄───► 411

8418-04/05

404 PRIMARY TRACKS
7 SPARES

**INNER GUARD
BAND**

**OUTER GUARD
BAND**

PB000921
7/75
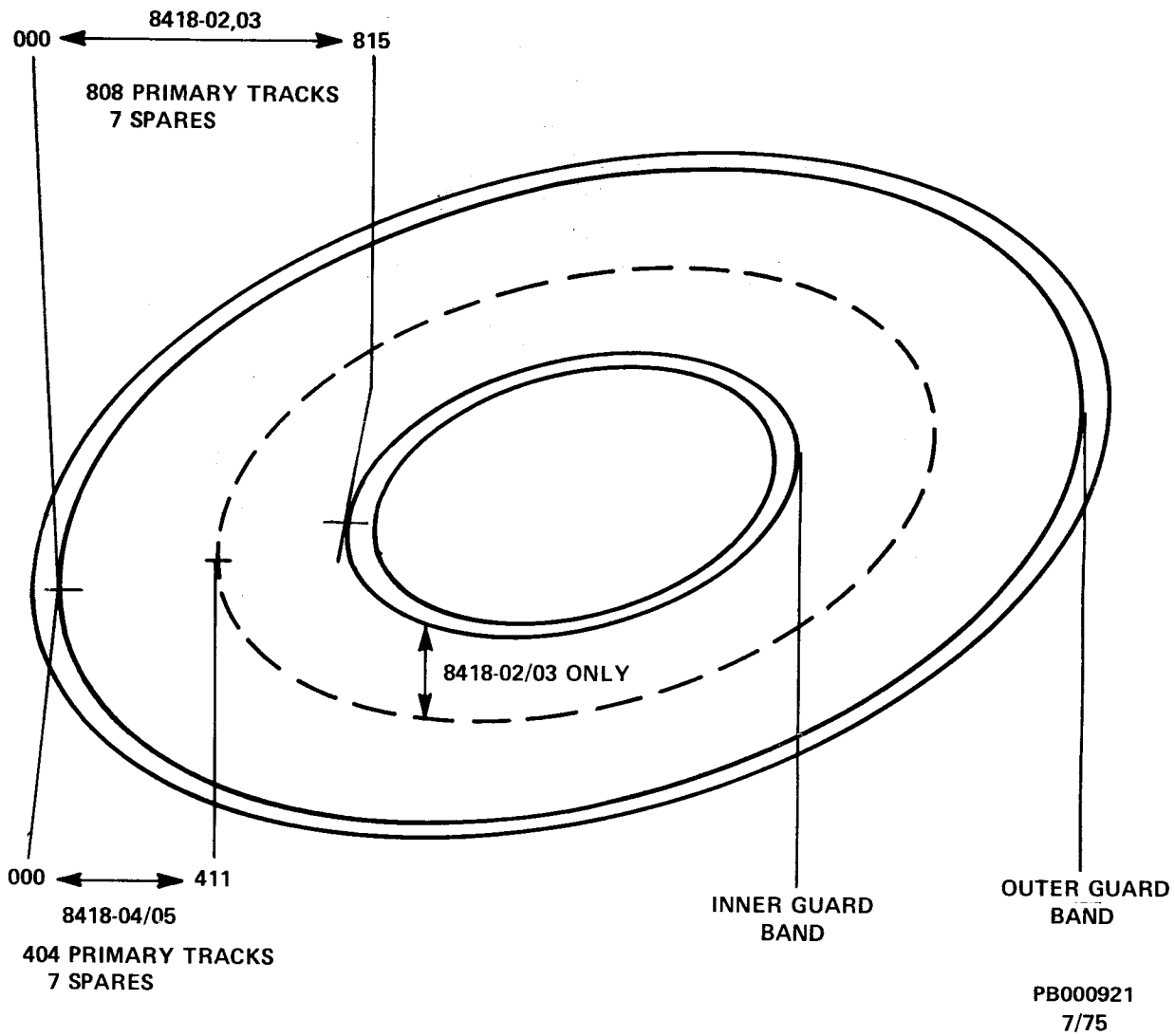
Figure 1-4. Disk Track Layout

Table 1-3. Reference Designators

Machine Assembly   9023812-00

<u>A1</u> Library   9023735-00

Designator	Description	Part Number
<u>A1A1</u>	PWA Read/Write	9023650-01
<u>A1A3</u>	PWA System Interface	9023667-02
<u>A1A5</u>	PWA Access Control	9023668-02
<u>A1A6</u>	PWA Disk Speed PLO & DEMOD	9023669-01
<u>A1A7</u>	PWA Tach/Servo Velocity Safe	9023671-01
<u>A1A8</u>	PWA Pulser Driver	9023698-01
<u>A1A9</u>	PWA Power Supply	9023654-01
<u>A1A10</u>	PWA Power Regulator	9023653-01
<u>A1A11</u>	PWA EMA Driver	9023651-00
<u>A1A12</u>	Backpanel Assembly Wired	9023736-00
<u>A1A13</u>	PWA Ribbon Interface	9023657-00
<u>A1A14</u>	Fan Assembly	9023743-00

        <u>A1A14B2</u>   Fan Connector

Designator	Description
<u>A1J15</u>	Power Sequence Harness Connector
<u>A1J16</u>	Drive Sequence Cable Out Connector
<u>A1J17</u>	Drive Sequence Cable In Connector
<u>A1J18CE</u>	Interface Connector
<u>A1J19</u>	Ribbon Interface Connector
<u>A1J20</u>	Read Write Connector
<u>A1J21</u>	Servo Head Connector
<u>A1J22</u>	Control Panel Connector
<u>A1J23</u>	Harness Switched Connector
<u>A1J24</u>	Velocity Sense Connector

<u>A2</u>   Power Supply   9023711-00

Designator	Description	Part Number
<u>A1J1</u>	Power Sequencer Connector	
<u>A2J2</u>	Filter Rectifier Connector	
<u>A2J3</u>	AC Power In Connector	
<u>A2J4</u>	AC Power Out Connector	
<u>A2T1</u>	Transformer Assembly	9023693-00
<u>A2A1</u>	PWA Power Sequencer	9023666-01
<u>A2A2</u>	Filter & Rectifier Assembly	9023752-00

Designator	Description
<u>A2A2J2</u>	DC Power to Gate Connector
<u>A2A2-11V</u>	.250 Slip on Receptacle
<u>A2A2-GND</u>	.250 Tab

Table 1-3. Reference Designators (continued)

A3   Base Plate Assembly   9023778-00

A3B4	Drive Motor Assembly	9023773-00
A3L1	EMA Assembly	9023138-00
A3A2	Velocity Sensor	
A3S3	HDS Retract Switch	
A3S1	Pack On Switch	
A3DSS	Disk Speed Sensor	9023130-00
A3A3	Read/Write PWA Matrix	9023658-03

	A3A3A9	Matrix Connector	
	A3E1	Base Plate Ground	
	A3E2	Base Plate Ground	
	A3M2	EMA Ground	
	A3H1	Top Most Head	88008683-02
	A3H2		88008682-02
	A3H3		88008683-02
	A3H4		88008682-02
	A3H5	Servo Head	9023857-00
	A3H6		88008682-02
	A3H7		88008683-02
	A3H8	Bottom Most Head	88008682-02

A4   Top Cover and Shroud Assembly Front   9023726-00
                                                  9023829-00

A4A1	PWA Control Panel	9023652-01

	A4A1P2	Control Panel Connector

A4S1	Latch Override Switch	
A4L1	Solenoid Plug (Latch)	
A4S2	Drive Motor Fail Safe Switch	

A5   Blower Assembly   9024123-00

A5B3	Blower Motor	

	A5B3J9	Blower Motor Plug

A6   Frame Assembly   9023813-00

DAISY II HARNESS DESIGNATORS
FOR FIELD SERVICING DOCUMENTS

H01	Velocity Sensor Harness	9023682-00
H02	Harness, Switches	9023683-00
H03	Harness Assy, AC Power	9023684-00
H04	Harness, DC Power	9023685-00
H05	Harness Assy, Control Panel	9024227-00
H06	Harness Assy, Control Panel Interconn.	9023687-00
H07	Harness, Sequencer Power	9023688-00
H08	Harness Assy, Plenum Fan	9023689-00
H09	Harness Assy, Read/Write	9024228-00
H10	Harness Assy, AC Power I.0	9024217-00
H11	Jumper Assy, Ground Strap	9023695-00
H12	Harness Assy, EMA Power	9023696-00
H13	Harness Assy, Drive Motor	9023697-00
H14	Harness, Servo Head (Part of 9023857-00)	
H15	Harness, Latch Solenoid (Part of 9023694-00)	
H16	Disk Speed Sensor Harness (Part of 9023130-00A)	
H17	Harness, Pack Blower (Part of 9024123-00)	
H18	Harness, Transformer, Primary (Part of 9023693-00A)	
H19	Harness Transformer, Secondary (Part of 9023693-00B)	

CHAPTER 2

INSTALLATION

2.1   INTRODUCTION

This chapter includes the procedures required to unpack and install the Model 8418 Disk Drive. A checklist (table 2-1) is provided to check off each completed procedural step while installing a drive.

2.2   DEVICE CONFIGURATIONS

The 8418 Disk Drive is designed to allow installation as a remote, stand-alone device or in a cluster of up to 8 drives. A special corner adapter is available to provide a wide range of device configurations (figure 2-1, sheet 3). In any configuration the longest device cable should not be greater than 55 feet (16.7 meters) or tags/status cable lengths greater than 88 feet (26.8 meters). Note that an additional AC power cabinet (type 2408) is required if more than four devices are to be attached to a system.

2.3   CABLING

There are six cable types for each 8418 Disk Drive.

1. AC power cable
2. Device select cable
3. Tags and status signal cable
4. Bus signal cable
5. Ground wire to system ground
6. Sequencing cable

Two cable channels and appropriate cutouts on the underside of the drive provide cable routing paths. Floor cutouts are not normally required, but the cable lengths must be correct to avoid the buildup of excess cable in the cable channel (figure 2-1, sheets 9-14).

2.3.1   AC Power Cables

The AC power cables are limited to a maximum accumulated length of 100 feet. The drive-to-drive AC power cable is available in two standard lengths - 30 inches (P/N 9023662-30) and 78 inches (P/N 9023662-78).

The 90/30-to-first-drive AC power cable (P/N 9023663-08) is 8 feet in length for drives attached to the mainframe. Drives that have the Free-standing Feature, F1773, can have cable lengths of 13, 18, 23, or 28 feet depending on the amount of separation from the mainframe.

Table 2-1. Checklist of 8418 Installation Requirements

PARAGRAPH	ITEM	CHECKED
2.5	Unpacking and Inspection	
	OFF-LINE CHECKOUT	
2.6.3	Drive Interconnections	
2.6.1	Input Power Requirements	
5.8.1	Power Supply Voltage Check	
5.9.2	System Offset Zero Adjustment	
5.9.4	Head Load Check	
5.9.3	Access Velocity Check and Adjustment	
5.9.4	Read/Write Head Alignment	
	ON-LINE CHECKOUT	
3.2.1	On-Line Diagnostics	
3.2	Power-On, Drive Start, Sequence Check	
5.4	Equipment Cleanup	

MC8309

CONVERSION DATA CHART

TYPE, FEATURE, OR SELECTION	FIND NO.	PART OR IDENT. NO.	DESCRIPTION		REMARKS	REF QTY
TYPE 841B-02	1	9023810-01	MACHINE ASSY	60 HZ	ONE MUST BE SELECTED	1
TYPE 841B-03		9023811-01		50 HZ		
TYPE 841B-04		9023810-00		60 HZ		8
TYPE 841B-05		9023811-00		50 HZ		
TYPE 2408-00	2	9024103-XX	DISK EXP, PWR. BOX	60 HZ	SELECT ONE WHEN COMPLEMENT OF DRIVES EXCEEDS FOUR.	0
TYPE 2408-01			DISK EXP, PWR. BOX	50 HZ		
TYPE 2408-02			DISK EXP, PWR. BOX	60 HZ		
TYPE 2408-03			DISK EXP, PWR. BOX	50 HZ		1
FEATURE 1216-02	3	9023565-01	DISK PACK		ONE REQ'D PER DRIVE	1 / 8
FEATURE 1769-01	4	9024077-XX	CORNER CABINET ADAPTER		ONE MAY BE SELECTED	0 / 1
FEATURE 1773-00	5	9024113-XX	FREE STANDING FEATURE		ONE MAY BE SELECTED	0 / 1
FEATURE 2198-00	6	9024110-00	HIGH DENSITY FEATURE		APPLICABLE TO TYPES 841B-04 & 841B-05. INCLUDED IN TYPES 841B-02 & 841B-03.	0 / 8
	7	9023656-01	TERMINATOR		ONE REQ'D ON LAST DRIVE ON LEAD MACHINES WITH 9023736-XX BACK PANELS USE 9023656-00	1
	8	9024052-00	KIT, S DECOVER 9030 INTERFACE		SELECT ONE FOR BASIC SYSTEM REFER TO F1773-00 FOR FREE STANDING REQUIREMENTS	0 / 1
	9	3005408-00	CABLE IDENT. CLAMP		TWO REQ'D FOR EACH CABLE	12 / 100
	10	9024045-00	LABEL, IDENT		FOR LOGICAL IDENTIFICATION	1
	11	9024048-00	KIT, SIDEPANEL		SELECT ONE	1
	R07	9024051-00	KIT, HARDWARE		INCLUDED IN ITEM 1	REF
	13	9023657-01	RIBBON CABLE INTERCONNECT		SELECT ONE TO 7 ON LEAD MACHINES WITH 9023736-XX BACK PANELS USE 9023657-00	0 / 7

NOTES:

I. GENERAL

A. SELECTION OF ITEMS LISTED UNDER -00 IN PL IS DETERMINED BY CONVERSION DATA CHART.

B. OPERATION AND SERVICE MANUAL SEE (R03)

C. ILLUSTRATED PARTS MANUAL SEE (R03)

D. DIAGRAMS MANUAL SEE (R03)

E. LOGIC DIAGRAMS SEE (F51)

F. U/L LISTING- EQUIPMENT CONFORMS TO NFPA TYPE II STD AND MEETS ALL U/L REQUIREMENTS FOR DATA PROCESSING EQUIPMENT.

G. FOR FEATURES AND SELECTIONS SEE CONVERSION DATA CHART

H. FOR INTERFACE WITH 841G DISK DRIVE SEE NOTE V.

II. APPLICATION

1. POWER REQUIREMENTS TYPE 841B-02, -04
   A. VOLTAGE 200/240 VAC
   B. PHASE- SINGLE. 3 PHASE POWER IS SUPPLIED FROM SYSTEM. ONLY SINGLE PHASE POWER IS UTILIZED IN ANY SINGLE DRIVE.
   C. AMPS- START CURRENT SURGE LESS THAN 30 AMPS AND RUN CURRENT 5 AMPS, NOMINAL AT 208 VAC.
   D. FREQUENCY- 60 HZ ±2%.

2. POWER REQUIREMENTS TYPE 841B-03, -05
   A. VOLTAGE 200/240 VAC
   B. PHASE- SINGLE. 3 PHASE POWER IS SUPPLIED FROM SYSTEM. ONLY SINGLE PHASE POWER IS UTILIZED IN ANY SINGLE DRIVE.
   C. AMPS- START CURRENT IS LESS THAN 30 AMPS AND RUN CURRENT 5.3 AMPS NOMINAL AT 220 VAC.
   D. FREQUENCY- 50 HZ ±2%.

3. PHYSICAL DATA
   A. WEIGHT 368 LBS
   B. FLOOR LOADING UNDER LEVELING PADS 61 LB./SQ. IN. (4 LEVELING PADS).
   C. POWER DISSIPATION- 3400 BTU/HR NOMINAL.
   D. AIR FLOW - APPROX. 200 CFM
   E. OPERATING TEMP. +50° F MIN , +94° F MAX
   F. RELATIVE HUMIDITY 5% MIN , 90% MAX

III. MANUFACTURING

1. SHIPPING AND STORAGE
   A. UP TO 72 HRS. -40°F MIN , +140° F MAX
      RELATIVE HUMIDITY 5% MIN , 90% MAX
   B. 72 HRS. TO 6 MOS. -8°F MIN , +117°F MAX
      RELATIVE HUMIDITY 5% MIN , 90% MAX
   C. FOR SHIPPING INSTRUCTIONS SEE YS100013.

NOTES (CONTINUED):

IV. INSTALLATION

1. MECHANICAL
   A. MACHINE LEVELING ADJUSTED - FOUR LEVELING PADS ADJUSTABLE WITH OPEN TYPE WRENCH.

2. ELECTRICAL
   A. POWER LINE INSTALLATION
      1. UNLESS OTHERWISE SPECIFIED, STANDARD UNITS ARE FACTORY SUPPLIED (AS PER SELECTION MATRIX) WITH A FLEXIBLE CORD SET THAT WILL BRING AC POWER FROM THE PROCESSOR OR THE DISK EXPANSION UNIT.
      2. IF LOCAL ELECTRICAL CODE PROHIBITS THE USE OF FLEXIBLE CORD, A CONDUIT OR BX CONNECTION MAY BE INSTALLED BETWEEN THE DRIVE AND THE PROCESSOR USING CONDUIT TERMINATION KIT 9024099 WHERE THE USE OF A DISK EXPANSION UNIT IS NECESSARY THE USER'S AC POWER MAY BE HARDWIRED DIRECTLY TO THE UNIT AS SHOWN IN DETAIL H OF SHEET 8.
   B. D.C. GROUND INSTALLATION
      1. WHEN CONNECTING DC GROUND CABLE (22), (23), (24), (25), (26), (27), (28), (29) (W9, W10, W11, W12, W13, W14, W15, W16, W17, W18) REMOVE GREEN WITH YELLOW STRIPE WIRE (SAFETY GROUND) FROM A01E13 AND STOW.
      2. WHEN CONNECTING DC GROUND CABLE (26) (W51) TO (2) REMOVE GRN/YELLOW WIRE FROM W1 AND STOW.

C. CABLE IDENTIFICATION
   1. TAG CABLES PER UNIVAC PROCESS SPEC DS 00273 (S01) AT EACH END OF CABLE.

D. TERMINATOR INSTALLATION
   1. TERMINATOR 9023656-01, FIND NO. 7, IS TO BE INSTALLED AT THE LAST DRIVE.

E. FOR CABLE ROUTING THRU U-100 CABINET AND 3029 PROCESSOR SEE R01.

(CONTINUED ON SHEET 2).

DRAWING NO.	X	9023700

DETAIL, VIEW SECTION	A	B	C	D	E		G	H	J	K	L	M	N	P
PAGE	9	7	7	7	7		7	8	8	15	16	4	8	20

PAGE INDEX	REV	L	K	K	K	K	L	K	K	K	K	K	K	K	K	K	K	K	K	K
	PAGE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

ISS SPERRY-UNIVAC

DRAWING NO. X 9023700

TITLE: 841B DISK DRIVE, TYPE 841B-02,-03,-04,-05 INTERFACE CONTROL ASSY

GRAWN BY A. HUGHES 3-9-76

Figure 2-1. ICA Drawings (Sheet 1 of 20)

CONVERSION DATA CHART (CONT'D)

DRAWING NO. X 9023700

TYPE, FEATURE OR SELECTION	FIND NO.	PART OR IDENT NO.	DESCRIPTION	REMARKS	REF QTY
	14	9023952-08	CABLE, DEVICE 00 SELECT	SELECT 1	0 / 1
	15	9023953-10	CABLE, DEVICE 01 SELECT	SELECT 1	0 / 1
	16	9023954-12	CABLE, DEVICE 02 SELECT	SELECT 1	0 / 1
	17	9023955-14	CABLE, DEVICE 03 SELECT	SELECT 1	0 / 1
	18	9023956-17	CABLE, DEVICE 04 SELECT	SELECT 1	0 / 1
	19	9023957-19	CABLE, DEVICE 05 SELECT	SELECT 1	0 / 1
	20	9023958-21	CABLE, DEVICE 06 SELECT	SELECT 1	0 / 1
	21	9023959-23	CABLE, DEVICE 07 SELECT	SELECT 1	0 / 1
	22	9023664-12		SELECT 1	0 / 1
	23	9023664-14		SELECT 1	0 / 1
	24	9023664-16		SELECT 1	0 / 1
	25	9023664-18	CABLE, D.C. GND	SELECT 1	0 / 1
	26	9023664-21		SELECT 2	0 / 2
	27	9023664-22		SELECT 1	0 / 1
	28	9023664-24		SELECT 1	0 / 1
	29	9023664-26		SELECT 1	0 / 1
	30	9023677-08	CABLE, TAGS, BUS & STATUS	SELECT 1	0 / 1
	31	9023678-45	CABLE, BUS & STATUS	SELECT 1 TO 6	0 / 6
	32	9023678-57		SELECT 1	0 / 1
	35	9023676-45	CABLE, TAGS	SELECT 1 TO 6	0 / 6
	36	9023676-57		SELECT 1	0 / 1
	39	9023675-08	CABLE, EXT. SYS. SEQUENCE	SELECT 1	0 / 1
	40	9023674-36	CABLE, SEQUENCE	SELECT 1 TO 8	0 / 8
	43	9023663-08	CABLE, EXT SYSTEM AC	SELECT 1 NOT USED WHEN FIND NO. 49 IS SELECTED	0 / 1
	44	9023663-08	CABLE, AC	SELECT 1	0 / 1
	47	9023662-30		SELECT 1 TO 7	0 / 7
	48	9024177-XX	KIT, 8418 DRIVE INSTALLATION	SELECT 1 TO INTERFACE 8418 DISK DRIVE WITH TYPE 8416 DISK DRIVE GROUP. SEE TABULATION ON SHEET 17.	0 / 1
	49	9024099-00	KIT, CONDUIT TERMINATION	SELECT 1	

NOTES: CONTINUED

Ⅳ. INTERFACE WITH TYPE 8416 DISK DRIVES.

1. MECHANICAL INTERFACE IS SHOWN ON SHEETS 15 & 16.
2. ELECTRICAL INTERFACE (SEE SHEET 17).
   A. TERMINATOR PWA (9023570-1) LOCATED IN LAST 8416 DISK DRIVE GATE ASSY, POSITION B07, SHALL BE REMOVED.
   B. DEVICE SELECT CABLE (S) (W2, W3, W4, W5, W6, W7, & OR W8) AND D.C. GROUND CABLE (S) W10 W11 W12, W13 W14 W15 W16 & OR W51) ARE SELECTED FROM CABLE MATRIX OR FEATURE INCLUDED IN DISK DRIVE GROUP CONFIGURATION.
   C. 8416 DISK DRIVE TO 8418 DISK DRIVE INTERFACE CABLES ARE INCLUDED IN SELECTED ITEM 48. SEE TABULATION ON SHEET 17 FOR SELECTION.
3. 8416 DISK DRIVE (S) SHALL PRECEED THE 8418 DRIVE (S).

DRAWING NO. X 9023700
DEVELOPMENT NO.
RELEASED FOR ASSY | QTY

TITLE: 8418 DISK DRIVE TYPE 8418-02,-03,-04,-05 INTERFACE CONTROL ASSY

ISS SPERRY UNIVAC X 9023700

Figure 2-1. ICA Drawings (Sheet 2 of 20)

CONFIGURATION A CONFIGURATION B CONFIGURATION G

CONFIGURATION C CONFIGURATION H CONFIGURATION L

CONFIGURATION M

CONFIGURATION D CONFIGURATION N

CONFIGURATION J CONFIGURATION P

CONFIGURATION E

CONFIGURATION S

CONFIGURATION F CONFIGURATION R

CONFIGURATION K

Figure 2-1. ICA Drawings (Sheet 3 of 20)

Figure 2-1. ICA Drawings (Sheet 4 of 20)

CORNER TRANSITION GROUP CONFIGURATIONS

FOR ADDITIONAL DATA SEE SHEET 4

Figure 2-1. ICA Drawings (Sheet 5 of 20)

Figure 2-1.   ICA Drawings (Sheet 6 of 20)
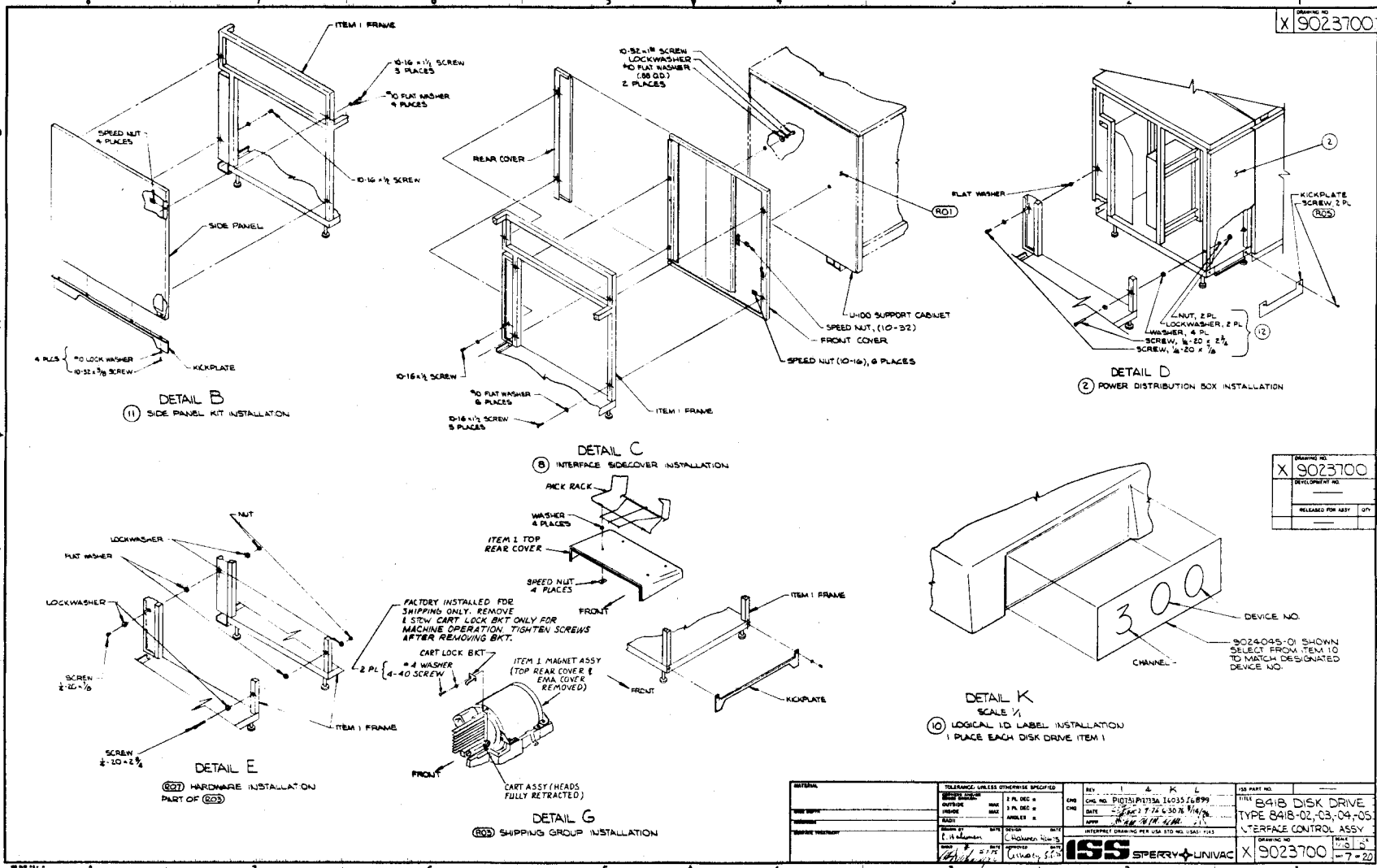
Figure 2-1. ICA Drawings (Sheet 7 of 20)

X 9023700
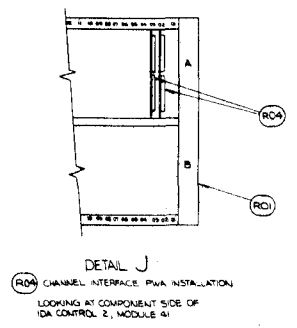
DETAIL J

(RO4) CHANNEL INTERFACE PWA INSTALLATION

LOOKING AT COMPONENT SIDE OF
IDA CONTROL 2, MODULE 41

FRAME, DEVICE 00
REMOVE CABLE TRAY
REAR COVER NOT SHOWN

FRONT

OPENING FOR 3/4
CONDUIT FITTING
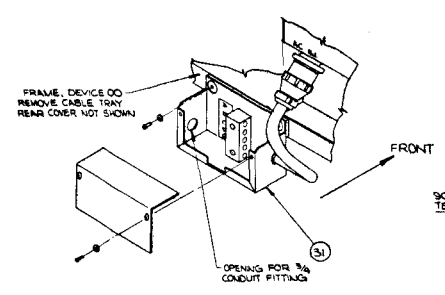
(31) INSTALLATION
CONDUIT TERMINATION KIT
CONDUIT WIRING 12 AWG

90/30 ATMG   CONDUIT BOX
TERMINATION   TERMINATION

TB1-1	Ø1	TB-A
TB1-2	Ø2	TB-B
TB1-3	Ø3	TB-C
TB1-4	N (50 HZ 380-415 VAC OLLY)	TB-N
E1	GROUND	TB-G

WIRING DIAGRAM

'E1' #10 STUD
TB1

SEE CHART FOR
WIRE CONNECTION

INSPECTION PLATE

CUSTOMER SUPPLIED & INSTALLED
CONDUIT & WIRE

1.66 DIA HOLE
FOR CONDUIT FITTING

TO 3029
PWR CONTROL
ASSEMBLY
A2TB1

2408-01,-02,-03,-04(50 & 60 HZ)
HARDWIRING INSTALLATION
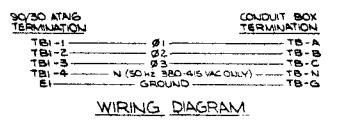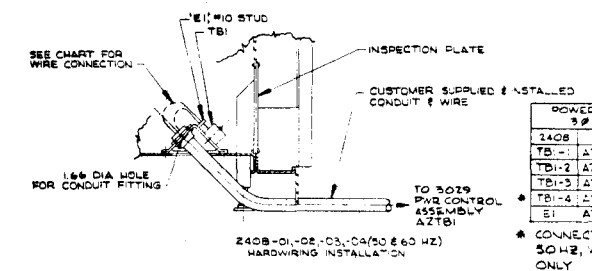
DETAIL H

(2) DISK EXPANSION POWER CONNECTIONS
SCALE: 1/4

X 9023700

POWER CONNECTIONS
3Ø 50/60 HZ

2408	3029	REMARK
TB1-1	A2TB-AC1	
TB1-2	A2TB-AC2	
TB1-3	A2TB-AC3	
TB1-4	A2TB1-NEU	NEUTRAL
E1	A2E1	GROUND

✱ CONNECT FOR 345-440 VAC,
50 HZ, WYE 'Y' POWER
ONLY

S4 8 DISK DRIVE
TYPE 84 8-02,-03,-04,-05
INTERFACE CONTROL ASSY

ISS SPERRY+UNIVAC

9023700

Figure 2-1.   ICA Drawings (Sheet 8 of 20)

X 9023700

② IS LOCATED AFTER ITEM 4
WHEN SELECTED

SEE DETAIL A

⑬

TO PROCESSOR
SEE SH. 17

TO IDA

TOP
W21 W23 W25 W27 W39
W1
W29
BOTTOM W17

SEE NOTE
IV 2B

TOP
W21 W23 W25 W27 W39
W1
W29
BOTTOM W17

SEE NOTE IV 2B

W42
W43
W51

AC IN

W1
J16
J17

J1

W43
W47

DEVICE 00

⑬

DETAIL A
RIBBON CABLE HOOKUP
SCALE: NONE

J1
J2
J3
J4
J5

J1
J2
J3
J4
J5

⑬ REF
INTERMEDIATE
DEVICE

J1
J2
J3

⑦ FINAL DEVICE

INTERFACE CABLE ROUTING
CABINET REAR COVERS REMOVED

④

X 9023700
DEVELOPMENT NO

RELEASED FOR ASSY | QTY

MATERIAL		TOLERANCE, UNLESS OTHERWISE SPECIFIED		REV	4 K		ISS PART NO	
		2 PL DEC ±		ENG	CHG NO.		TITLE	
		3 PL DEC ±		CHG	DATE		841B DISK DRIVE	
	OUTSIDE MAX	ANGLES ±		APPR			TYPE 841B-02,-03,-04,-05	
	INSIDE MAX			INTERPRET DRAWING PER USA STD NO. USAS·Y14.3			INTERFACE CONTROL ASSY	
	DRAWN BY A. HUGHES 3/7/75	DESIGN	DATE					
		APPROVED		ISS SPERRY UNIVAC		X 9023700	SCALE 1/4	SIZE D
							SH 9 of 20	
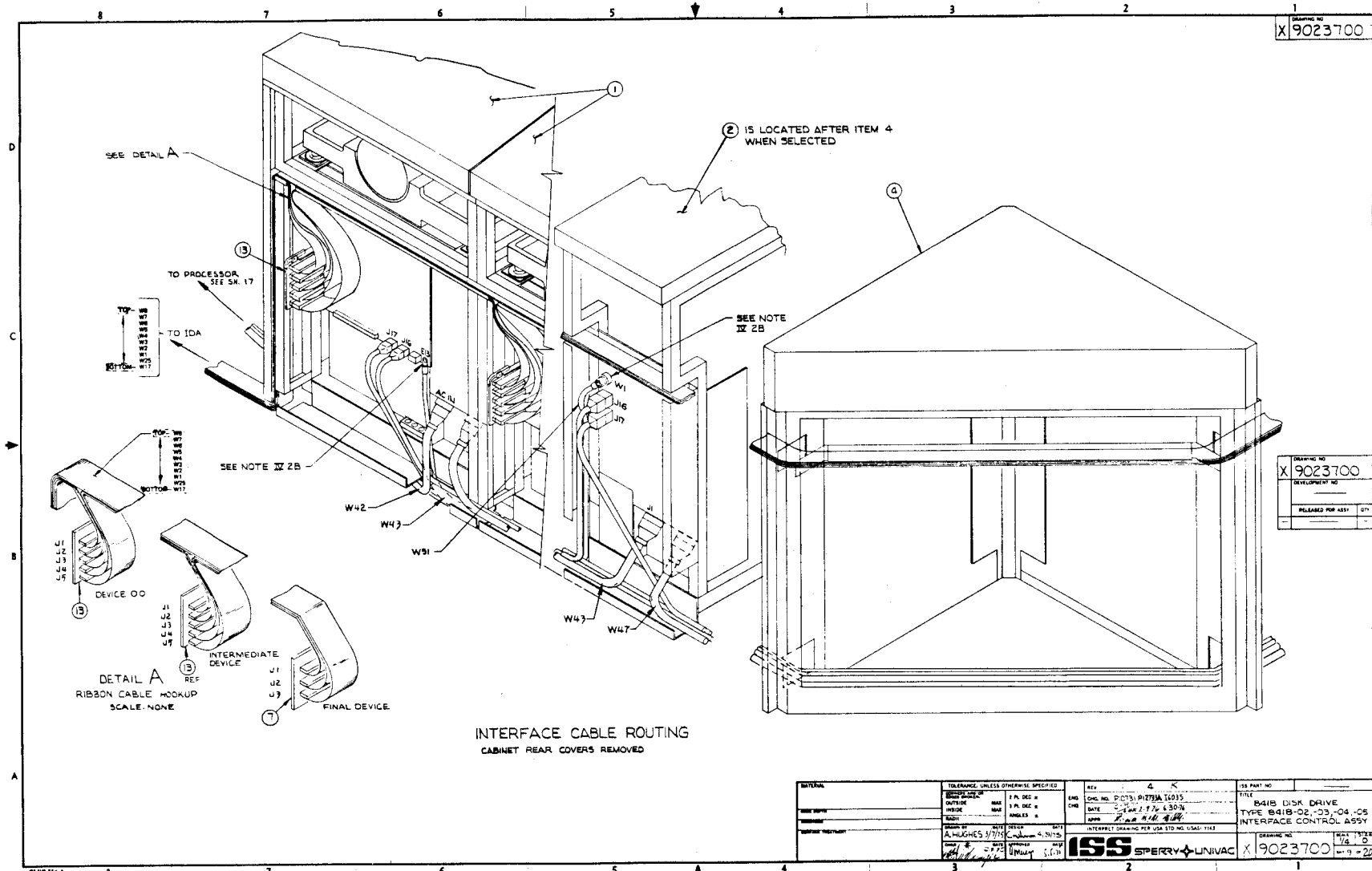
Figure 2-1. ICA Drawings (Sheet 9 of 20)

Figure 2-1. ICA Drawings (Sheet 10 of 20)

INTERCONNECTING WIRING DIAGRAM
FOR CONFIGURATIONS OF 5 TO 8 DISK DRIVES (SEE SH3)
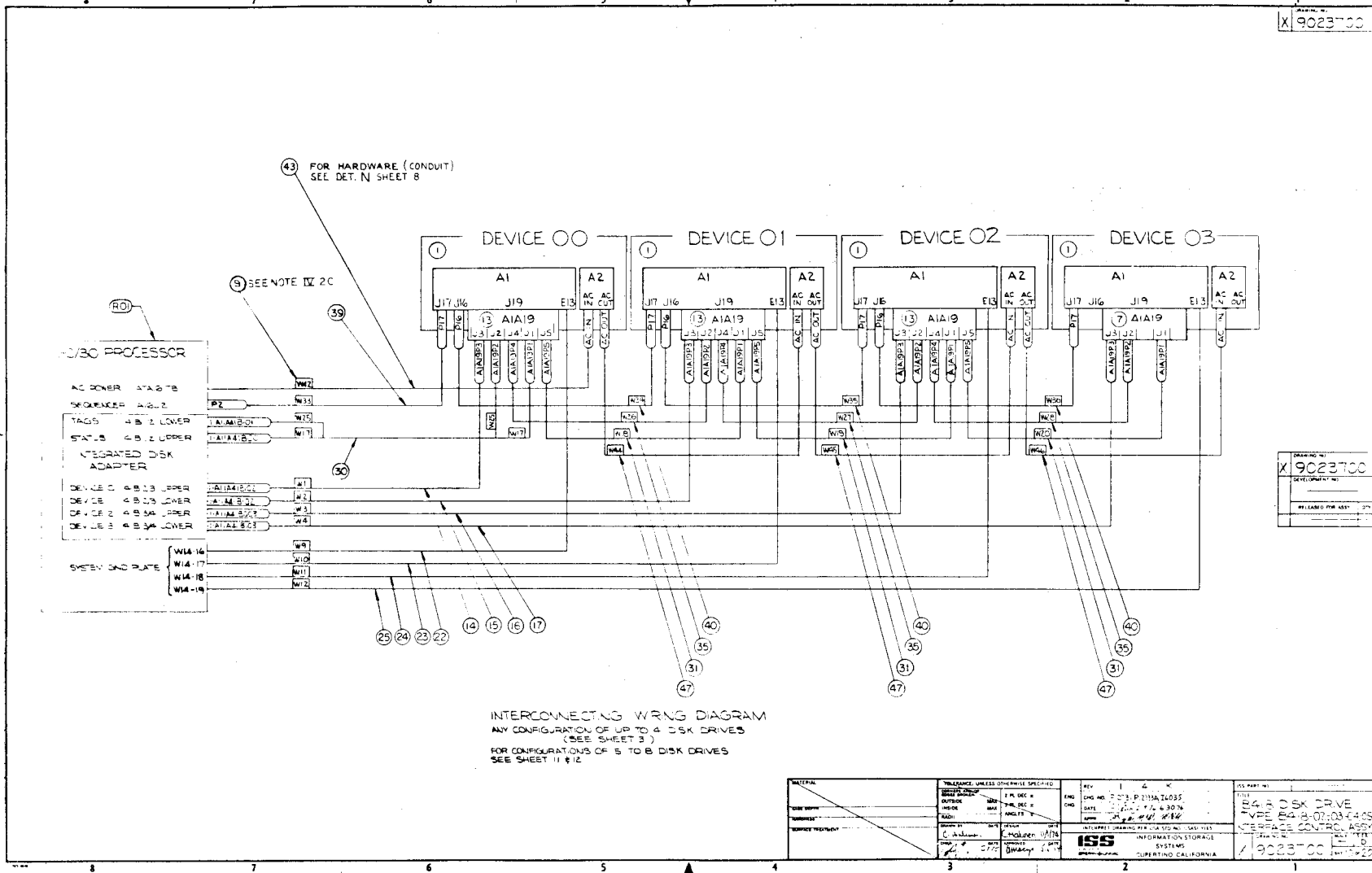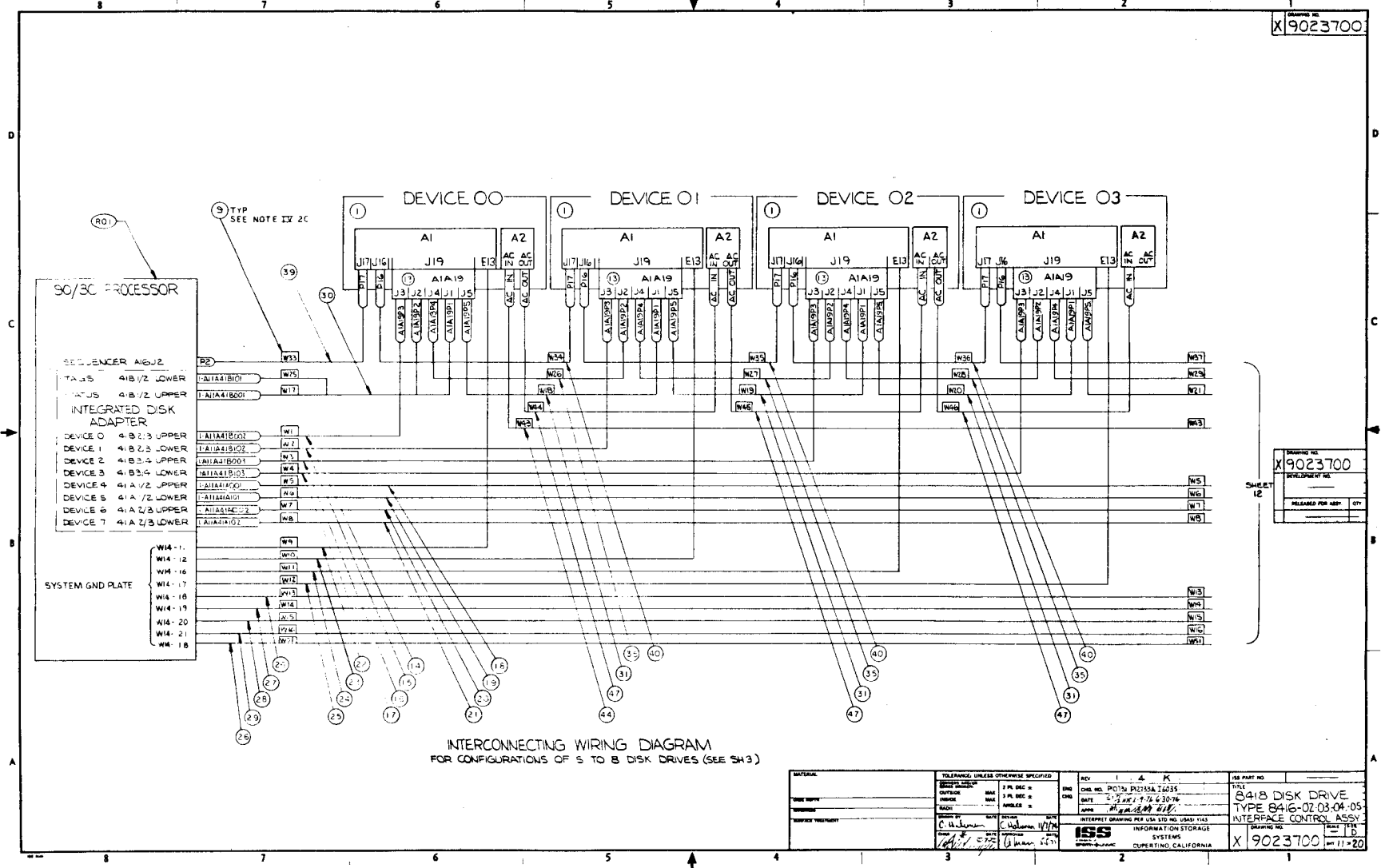
Figure 2-1. ICA Drawings (Sheet 11 of 20)
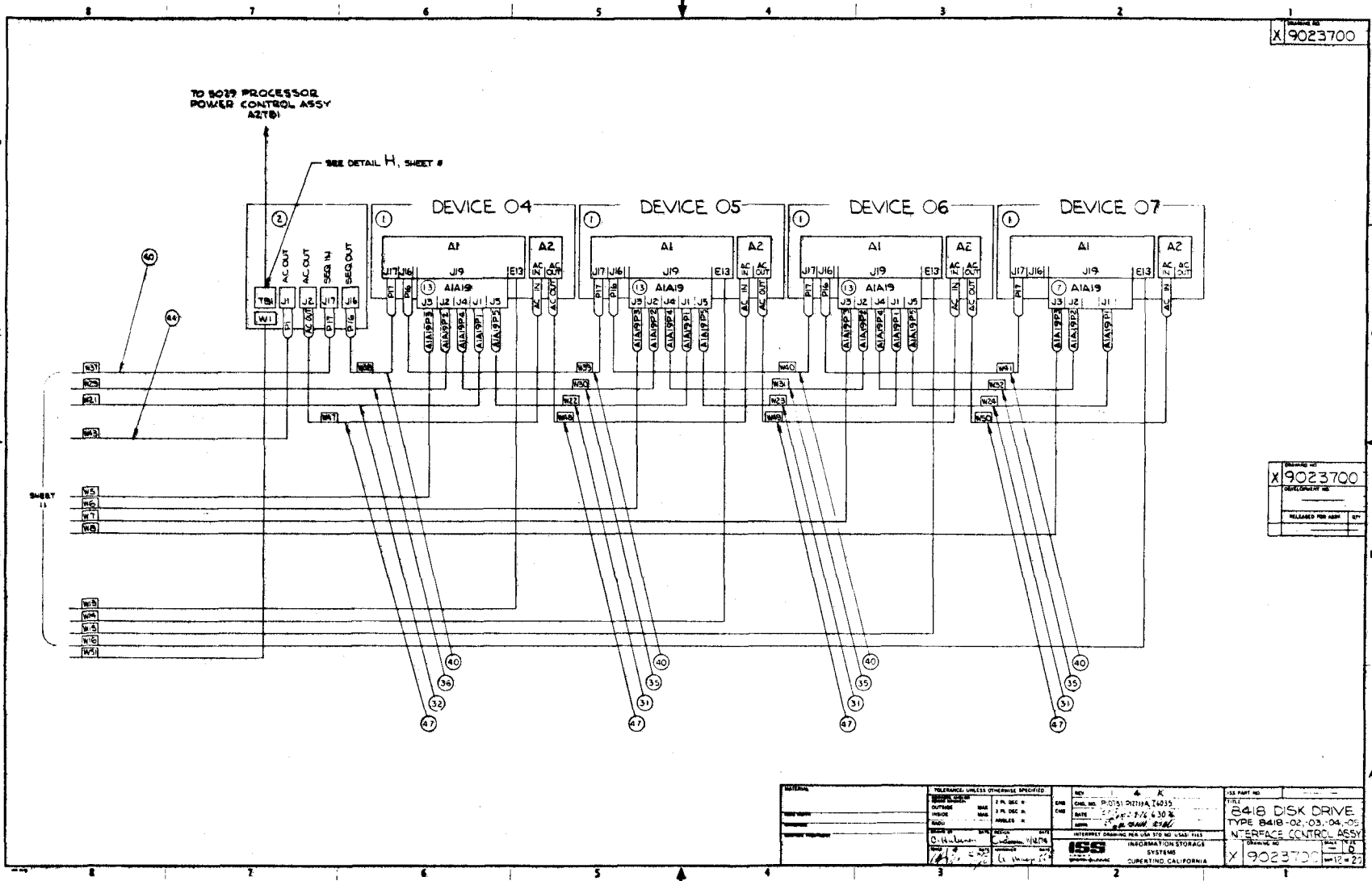
Figure 2-1. ICA Drawings (Sheet 12 of 20)

INTERFACE CABLE MATRIX

Figure 2-1. ICA Drawings (Sheet 13 of 20)

INTERFACE CABLE MATRIX

X 9023700

Figure 2-1. ICA Drawings (Sheet 14 of 20)

Figure 2-1.   ICA Drawings (Sheet 15 of 20)

Figure 2-1. ICA Drawings (Sheet 16 of 20)

Figure 2-1. ICA Drawings (Sheet 17 of 20)
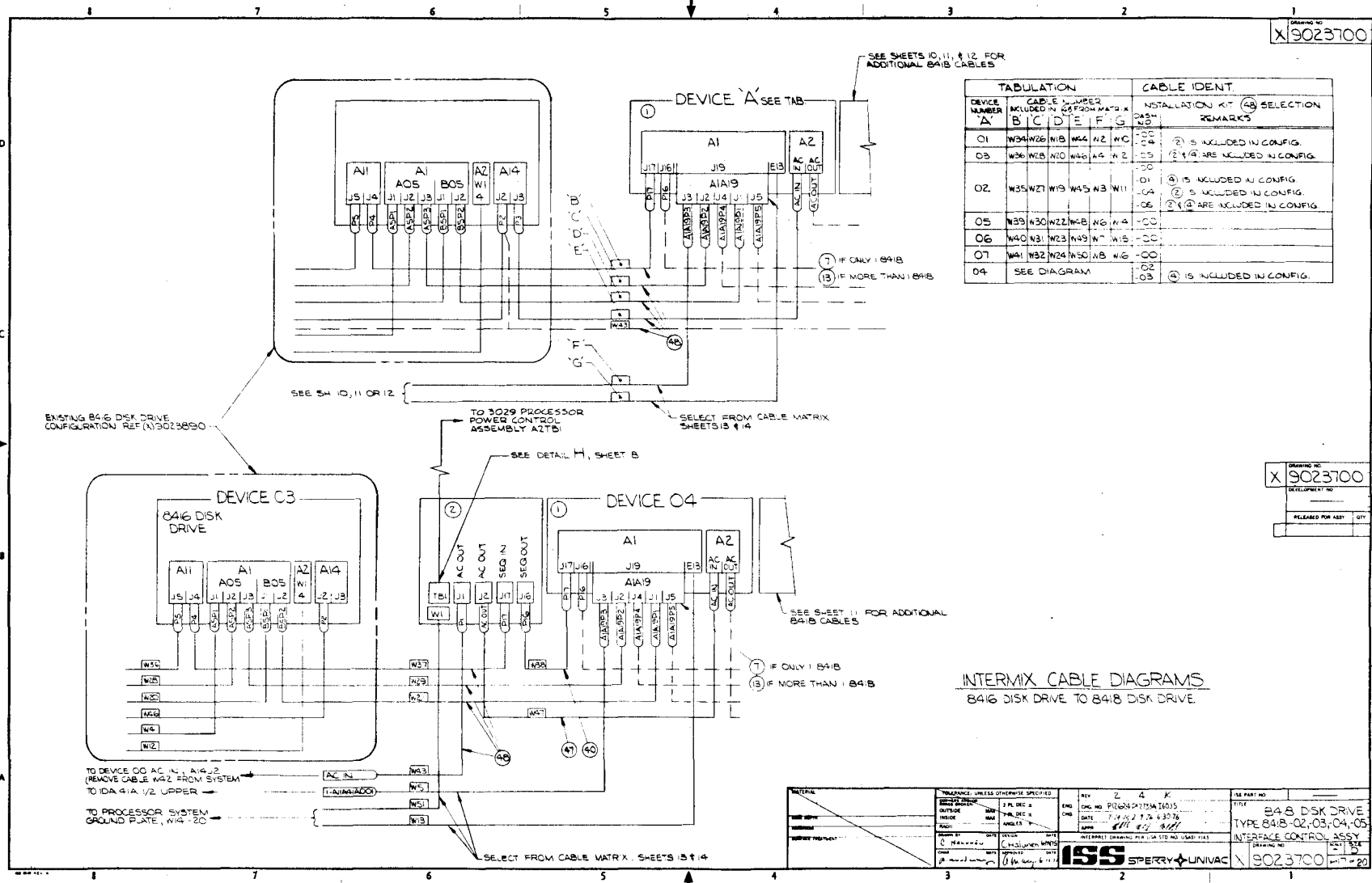
PLAN VIEW
CABLE ROUTING
DEVICE OO TO ROI
FOR FRONT VIEW SEE SHEET 19

Figure 2-1. ICA Drawings (Sheet 18 of 20)

FRONT VIEW
CABLE ROUTING
DEVICE 00 TO ROI
FOR PLAN VIEW SEE SHEET 18

Figure 2-1.   ICA Drawings (Sheet 19 of 20)

VIEW P - P

ROTATED 90° CCW
SCALE ½
LOGIC GROUND CABLE
CONNECTIONS TO W14

PROCESSOR PRIOR TO COST
REDUCTION SERIAL SPLIT

PROCESSOR AFTER COST
REDUCTION SERIAL SPLIT
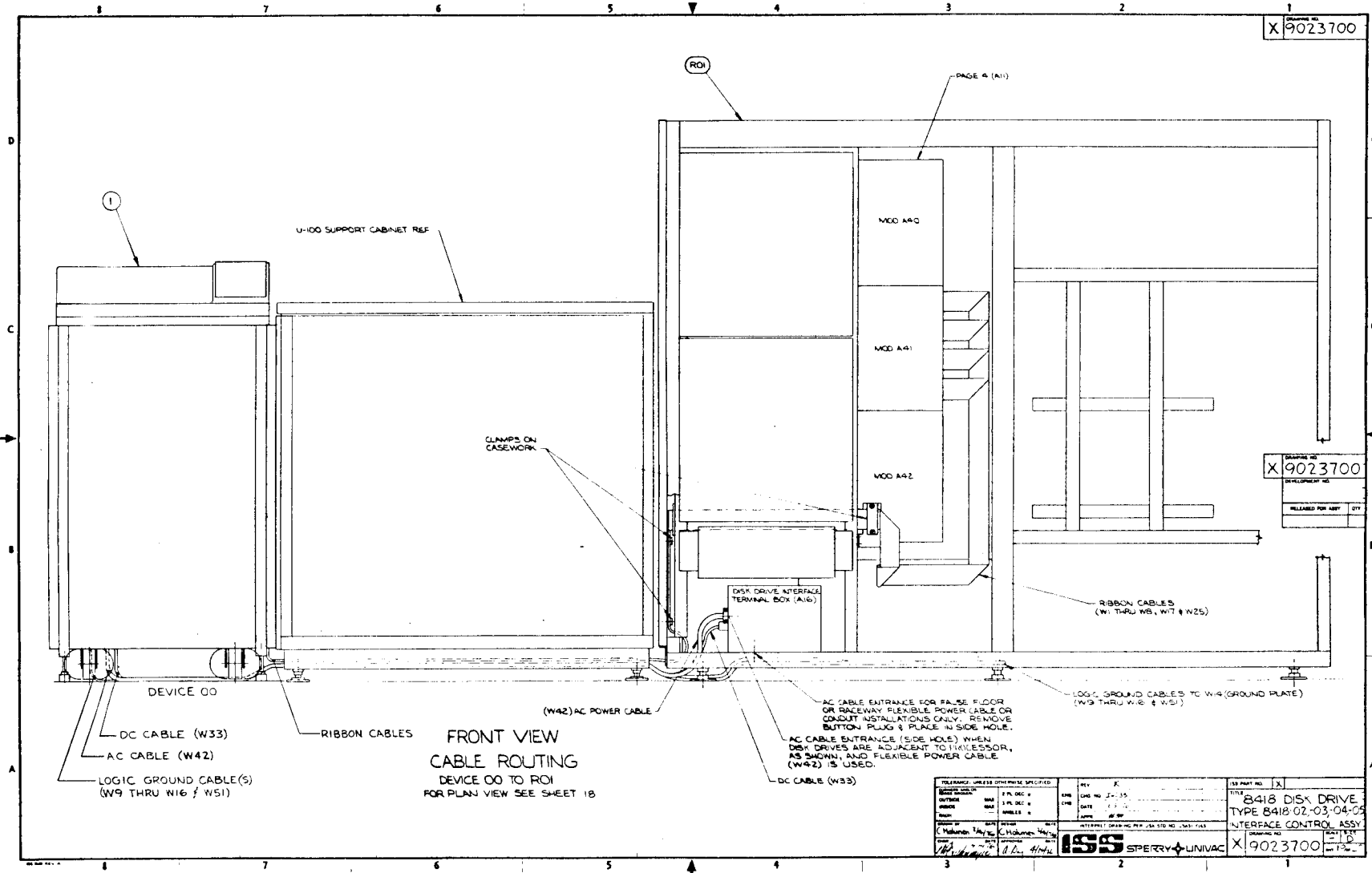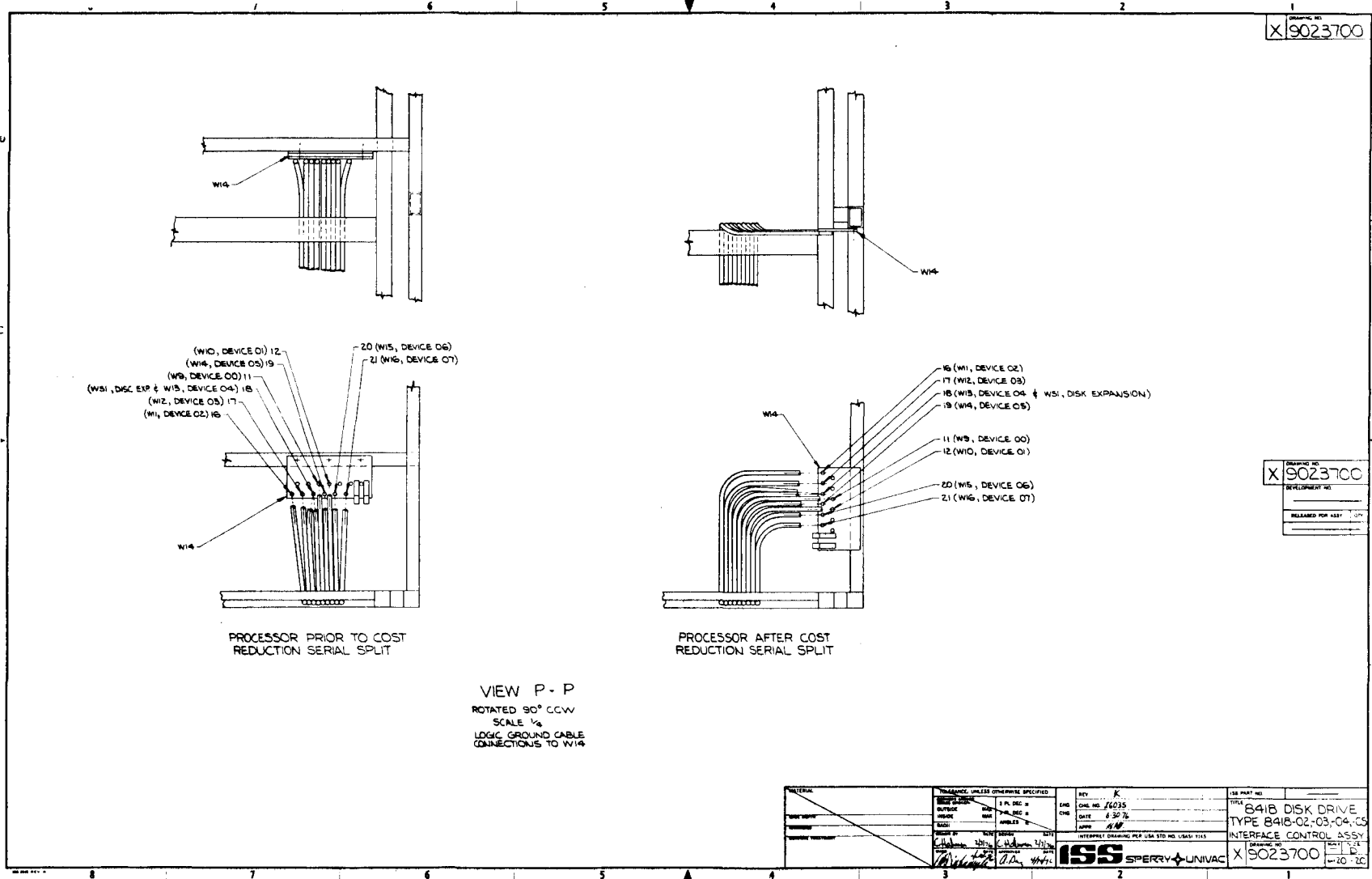
Figure 2-1.   ICA Drawings (Sheet 20 of 20)

As shown in figure 2-1, sheet 10, for drive configurations with four drives or less, the AC power is routed from the mainframe. Drive configurations with five or more drives must have the Disk Expansion AC Power Cabinet, 2408, installed, figure 2-1, sheet 11. With this feature AC power for the drives is routed through the in-line power cabinet to all of the drives in the configuration.

<div align="center">

CAUTION

The 8418 must be configured to
match the input voltage to the
90/30 system. If the type 2408
Disk Expansion AC Power Cabinet
is attached, the 8418 must be
configured to match the voltage
of the 2408.

</div>

2.3.2 Device Select Cable

This ribbon cable carries device select information between the IDA and all attached drives. The cable is connected to the ribbon interface PWA at J19 on the back panel.

2.3.3 Tags and Status Signal Cable

These are ribbon cables that carry tag, bus, and status signal information between the IDA and all attached drives.

2.3.4 Ground Wire to System Ground

A ten gauge insulated wire (P/N 9023664-XX) connects each drive to the W14 system ground plate in the 3029 Processor.

2.3.5 Sequencing Cable

To the first drive in the system, there is a cable from the system sequencer that connects to the drive at J17 at the bottom edge of the back panel. The part number of this cable is 9023675-XX. Between drives the sequencing cable (P/N 9023674-XX) is used.

2.4 DISK EXPANSION AC POWER CABINET

The Disk Expansion AC Power Cabinet (Type 2408) provides AC power for 90/30 Systems configurations containing from 5 to 8 drives. Systems configurations containing up to four drives derive AC power from the 90/30 System. The cabinet provides AC power distribution for up to eight drives, independent from the 90/30 system. Installation data is shown in figures 2-2 and 2-3.

2.4.1 Underwriters Laboratories (U/L) Safety Performance

Type 2408-XX conforms to National Fire Prevention Association (NFPA) standards Type II and satisfies U/L Data Processing Equipment safety requirements. The following table (2-2) describes each of the models available as Type 2408.

PB000922 (A) 7/75
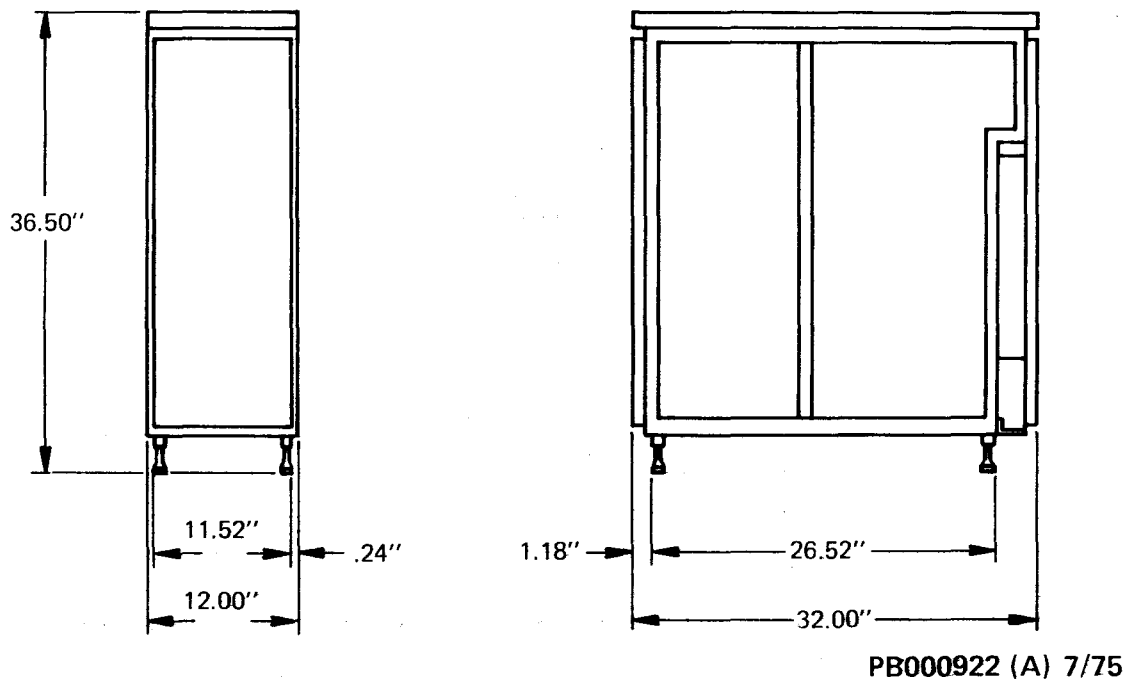
Figure 2-2. Leveling Pad Locations for 2408

FLOOR CUT OUT FOR POWER CORD
IN SUB—FLOOR INSTALLATION

PB000922 (B) 7/75
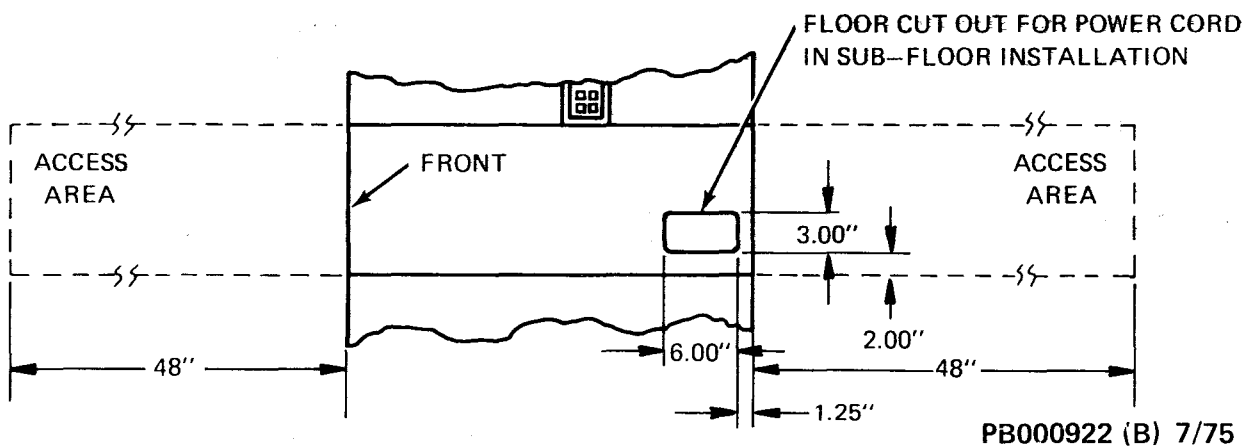
Figure 2-3. Floor Cutout for 2408

Table 2-2. Conversion Data Chart

MODEL	FIND NO.	PART NO.	DESCRIPTION	REMARKS	REF QTY
Type 2408-00	1	9023847-01	Disk expansion - AC power box - wired 60 Hz	This unit is used when 5 to 8 8416 and 8418 disk drive units are to be powered. For system installation use ICA 9023890-XX or ICA 9023700-XX. One must be selected.	1
Type 2408-01	1	9023847-03	Disk expansion - AC power box - wired 50 Hz		
Type 2408-02	1	9023847-00	Disk expansion - AC power box - wired 60 Hz w/auto transformer		
Type 2408-03	1	9023847-02	Disk expansion - AC power box - wired 50 Hz w/auto transformer		
F1621-99	2	3621724-00	Channel interface PWA		2
	3	9023853-00	Ship group	Refer to ICA 9023890-XX or 9023700-XX for installation of parts. Item 3 not shown.	

Table 2-3. AC Power Requirements

(All Type 2408-XX operate using 3 Phase AC). Tolerances conform to SU00060.

TYPE 2408-	3 PHASE RMS VOLTAGE INPUT Nominal AC Volts	CURRENT (In Amps)	FREQUENCY (In Hertz)	POWER DISSIPATION (KVA)
2408-00	200-240	35**	60	.08
2408-01	200-240	35**	50	.08
	380-415	20**	50	.08
2408-02	200-240*	35**	60	.53
2408-03	200-240*	35**	50	.53
	345-435*	20**	50	.53

*With Transformer; to be used only with 8416 Drives at 200 VAC 50/60 Hz, or 8416 or 8418 drives are to be powered from 435 VAC 50 Hz.
**Current requirement is for total demand on the AC connector; includes AC power box and up to and including 8 drives.

Table 2-4. Heat Dissipation

TYPE	HEAT DISSIPATION		POWER LOSS (In KW)
	In BTUs/Hr	In Gram Cals/Sec	
2408-00	240	16.8	0.07
2408-01	240	16.8	0.07
2408-02	1250	87.5	0.37
2408-03	1250	87.5	0.37

2.5 SHIPPING AND RECEIVING

The Model 8418 may be crated, as for overseas shipment, or it may be packaged in a heavy, transparent protective plastic covering, as for domestic and most air freight shipments. Because the drive weighs approximately 375 pounds (170 kilograms), a forklift or adequate manpower (a minimum of four men) must be used to lift a drive.

CAUTION

Always grasp drive by frame structure
to move or lift. Do not hold any
portion of the top or side covers.

1. If crated, disassemble wooden shipping crate. Retain packing parts, spacers, and any special protective devices for reuse if the drive has to be moved in the future. Remove cardboard sleeve.

2. Remove the plastic covering from the drive.

3. Visually inspect the drive exterior for evidence of shipping damage. Retain original packaging materials and receipts to use when claims are filed for shipping damage. All claims for damage should be filed promptly with the transportation company involved. Notify the manufacturer's representative of any claim.

4. Remove all service covers for inspection (see section 6). Remove the shipping package from inside the drive. Verify that contents include kickplates with hardware and 8418 Operation and Service manual.

   NOTE: 1. Do not remove the top front cover assembly.

   2. Side covers are not used between drives when the drives are to be bolted together. Only the exposed side(s) is covered.

5. Push and release the operator cover latch, then lift the operator cover. Remove and retain the cart lock shipping bracket (figure 2-1, sheet 7) for the access mechanism. Manually turn the spindle counterclockwise) to verify that it spins freely. Depress the cone shaped pack-lock actuator at the left front of the spindle and manually turn the spindle clockwise. The spindle should lock to verify that it holds the pack and permits disk pack top cover removal. <u>Do not push the carriage into the access area</u> - the heads may click together and be damaged.

6. Visually inspect the drive. Tighten all subassembly mounting hardware and all terminal connections.

7. Check the drive power requirements stamped on the nameplate. If they do not agree with the facility power, refer to paragraph 2.6.5 for conversion procedure. Verify the power system wiring by the procedure provided in paragraph 2.6.5.

8. Check all printed wiring assemblies (PWAs) to ensure that all are securely seated in their sockets.

9. Check positioning of Matrix PWA on cam tower for proper seating in socket. Also ensure that all head plugs are properly seated and that their retainer is in place.

10. Visually check cam-follower surface of each head-arm assembly to verify that arms are properly engaged with cams on tower assemblies.

11. Measure EMA coil assembly resistance across coil leads to determine that the resistance is 12 ohms (typical) and to ensure that no shorts or opens exist.

12. Replace all service covers removed in step 4, if off-line checkout is not to be accomplished at this time.

13. Check for adequate service clearances as shown in figure 2-4.

2.6   INITIAL SET-UP

2.6.1   Power Requirements

Disk drives intended for use in the domestic market are designed to operate with 200 volt, 3-phase, 60 Hz power or 240 volt, 3-phase, 60 Hz power. Disk drives intended for use in the international market are designed to operate with 230 volt, 3-phase, 50 Hz, delta power or 400 volt, 3-phase, 50 Hz WYE power. Drives are shipped from the factory wired as specified on the Disk Preinstallation Report.

The input power connection configuration for each drive is specified on a label attached to the top of the baseplate. Before connecting the drive to the AC line, check the line voltage in the facility and verify that it agrees with the voltage on the label. If the voltages are different, it may be

FOR END
CABINET
ONLY

LEFT
SIDE

(TOP VIEW)

8418-02, 03,
04, 05

FRONT

48″

48″

12″

PB000922 (C) 7/75
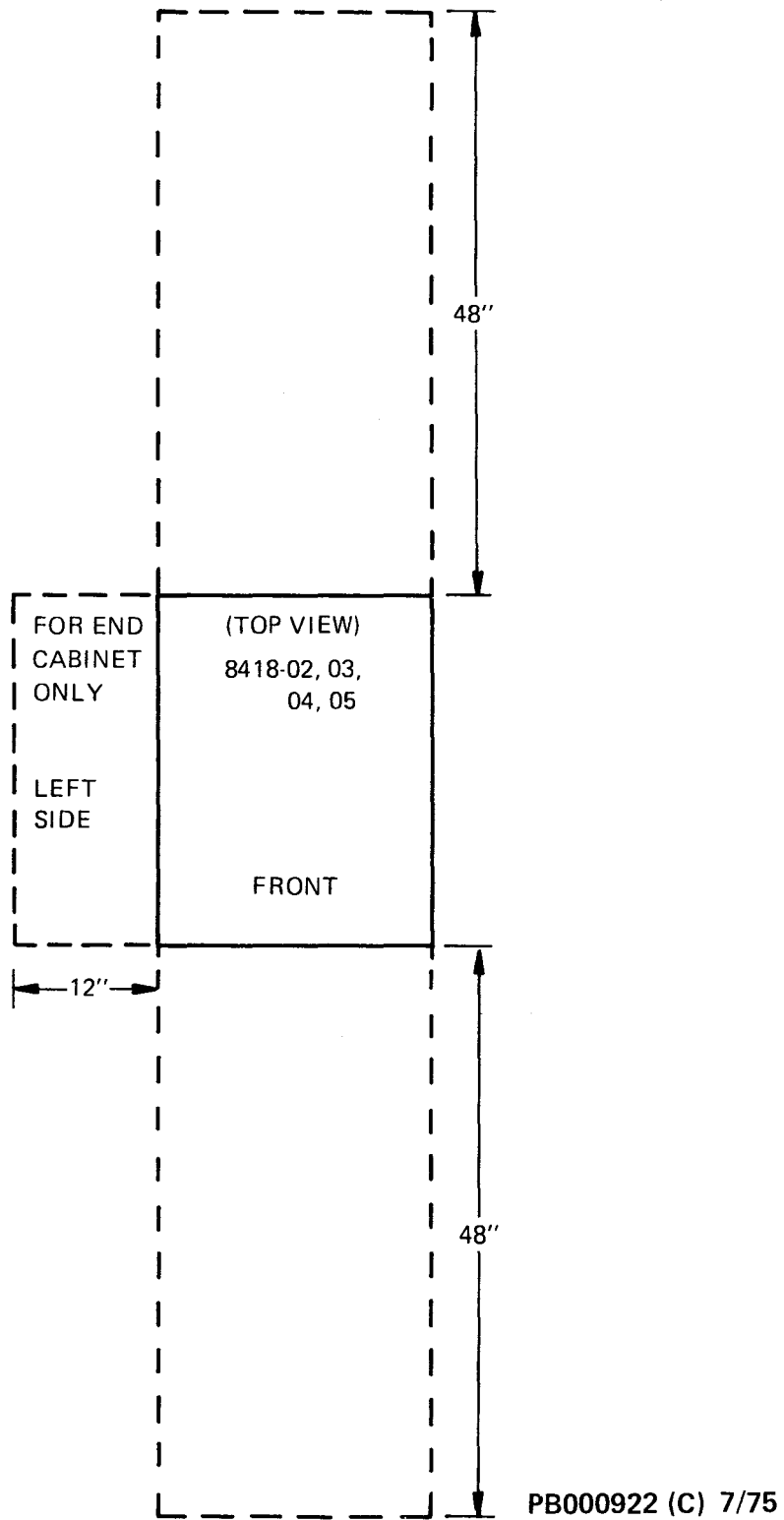
Figure 2-4. Service Clearances for 8418

MC8309

necessary to change taps on the line transformer in the drive. The procedure for changing the taps and converting the AC power input is located immediately following the installation procedure in this section.

The optional 50 Hz version of the drive includes special power transformers, drive motor, and associated components for use with 220/230/240 volts, 3-phase 50 Hz delta or 380/390/400 volt Wye. Conversion between 60 and 50 Hz input power is performed at the factory.

Installations with five or more 8418 drives must have the 2408 cabinet. This cabinet provides a supplemental AC power sequence and distribution system. The model must match the frequency and line voltage of the system.

2.6.2   Power-Off Checks

Before beginning the installation determine that the correct cables and features are available for the desired configuration. The Corner Transition Feature (F1769-01) is required if the disk drives are not to be arranged in a straight line to the left of the mainframe.

1. Roll the drive to its assigned location in the 8418 subsystem and position it in place. Level the drive by lowering the four levellers to remove all weight from the casters. Levellers should be adjusted so that the top of the drive is even with the tops of the other drives in the subsystem. Use four bolts to bolt the drive frames together (two bolts on each side - front and rear).

2. Set CB1 on drive power supply assembly of each drive in subsystem to OFF.

2.6.3   Cable Attachment (figure 2-1)

1. Route AC power cabling, ground wires, sequencing cables, and signal cabling through drive frames to IDA if units are bolted together; or through a cable trough above or below a false floor if free standing feature, F1773-00 is installed. Remove the yellow and green ground wire from frame to back panel if connected.

```
┌─────────────┐
│  CAUTION    │
└─────────────┘
```

90/30 should be powered down and AC power removed before installing cables.

2. Connect AC power cables, P/N 9023662-XX, between drive AC input connectors (A2ACin) and drive AC output connectors (A2ACOUT) on adjacent drives, and cable P/N 9023663-XX between the first drive (Drive 0) second Processor AC output terminal strip, A16-TB1. If more than one drive is being connected in a subsystem, connect the last drive in the power chain first, then work back until connecting the first drive to the processor. (If more than four drives, first and fourth drives will connect to the 2408.)
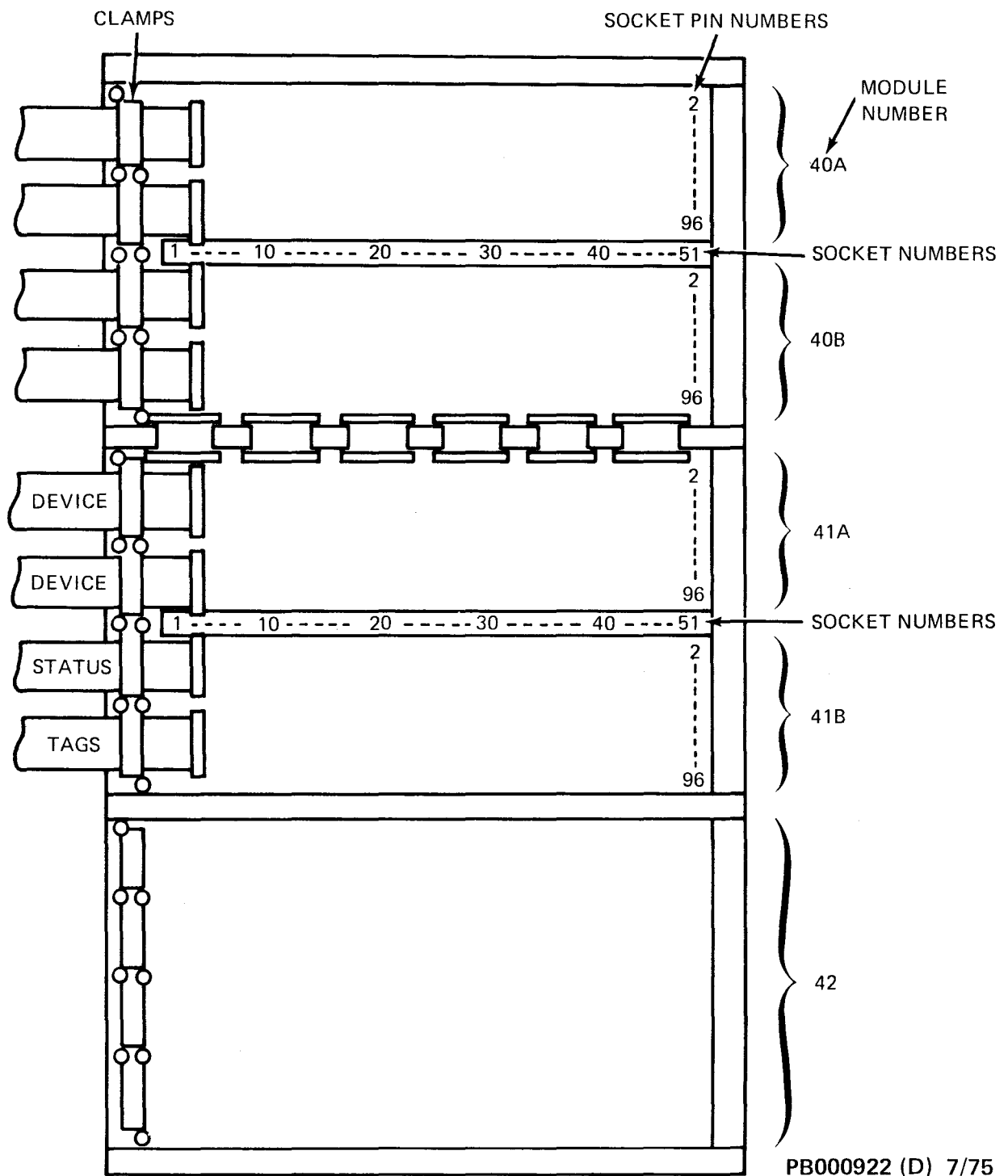
Figure 2-5. Drive Connection to IDA
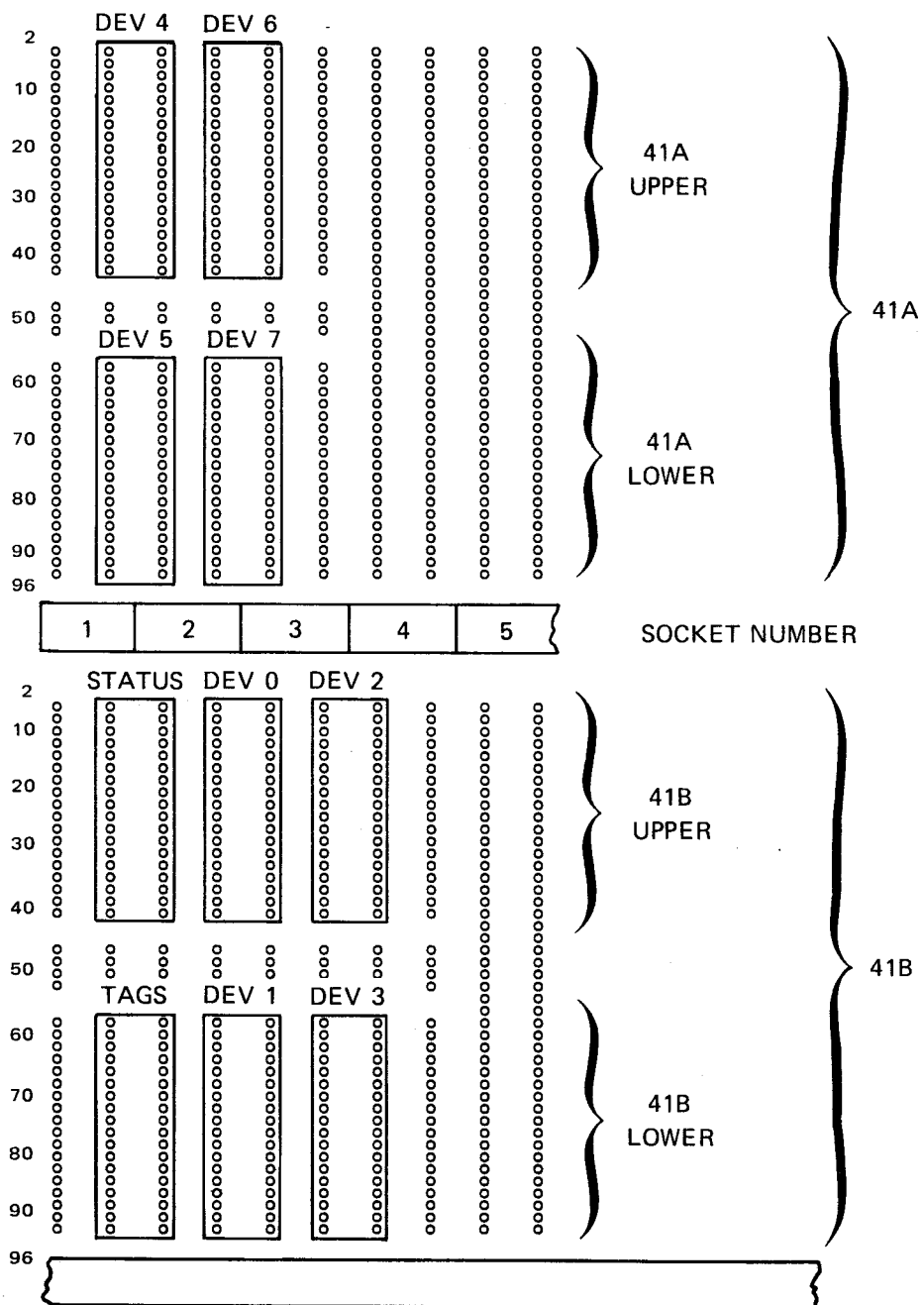
PB000922 (D) 7/75

Figure 2-6. Detail for Connection Points in IDA
for Ribbon Cables to Drives

3. Install terminator board, P/N 9023656-01, into socket A01J19 on the back panel of the last drive only. Install the ribbon interface board, P/N 9023657-01 into socket A01J19 of the remaining drives, if not already in place.

4. Connect J3 end of device cables W1 through W8 (system addresses 300-307), P/N 9023952-XX through 9023959-XX, to J3 connectors on the terminator board at A01J19 of the last drive; on the remaining drives, connect to the J3 connector on ribbon interface board at A01J19. Connect (-41A or -41B) to the appropriate IDA connectors corresponding to the desired system address for each drive. Figures 2-5 and 2-6 show how to connect to the IDA.

5. Connect J1, J2 (inputs) and J4, J5 (outputs), drive-to-drive status cables W18 through W24, P/N 9023678-XX, and drive-to-drive TAG cables W26 through W32, P/N 9023676-XX, respectively, into their matching connectors on the ribbon interface board and J1, J2 connectors on the terminator board. Connect the J1 end of W17, drive-to-IDA STATUS cable, and the J2 end of W25, drive to IDA TAGS cable, to their corresponding connectors (J1 and J2) on the ribbon interface board plugged into A01J19 of the drive closest to the IDA. (Both of these cables are the same and have the same part number, P/N 9023677-XX.) Finally, plug W25 into 41B ½ Lower and plug W17 into 41B ½ Upper in the IDA. Information on connecting 8418's to existing 8416's may be obtained by referencing figure 2-1, sheets 15 - 17.

6. Install power sequence and ground cables. Power sequence cabling for the 8418 is shown in Figure 2-7.

2.6.4   Power-On Checks

Chapter 5 of this manual includes procedures for verifying the performance of a disk drive and performing any necessary adjustments. When a drive is first installed or returned to service after major repair, the following installation checks should be performed:

> Power Supply Voltage Check
> Hold Reverse Current Check
> Head Load Check
> Access Velocity Check
> Read/Write Check
> Offset
> Head Alignment
> Hold Reverse Current

1. Perform the Power On, Drive Start, Sequence Check routine with the drive operating on line to verify performance of the drive power control system.

Figure 2-7. Sequence Cabling

IN

OUT

CABLE K9023675

CABLE K9023674-XX

9030

P17

J17

J16

P16

P2

A16J2
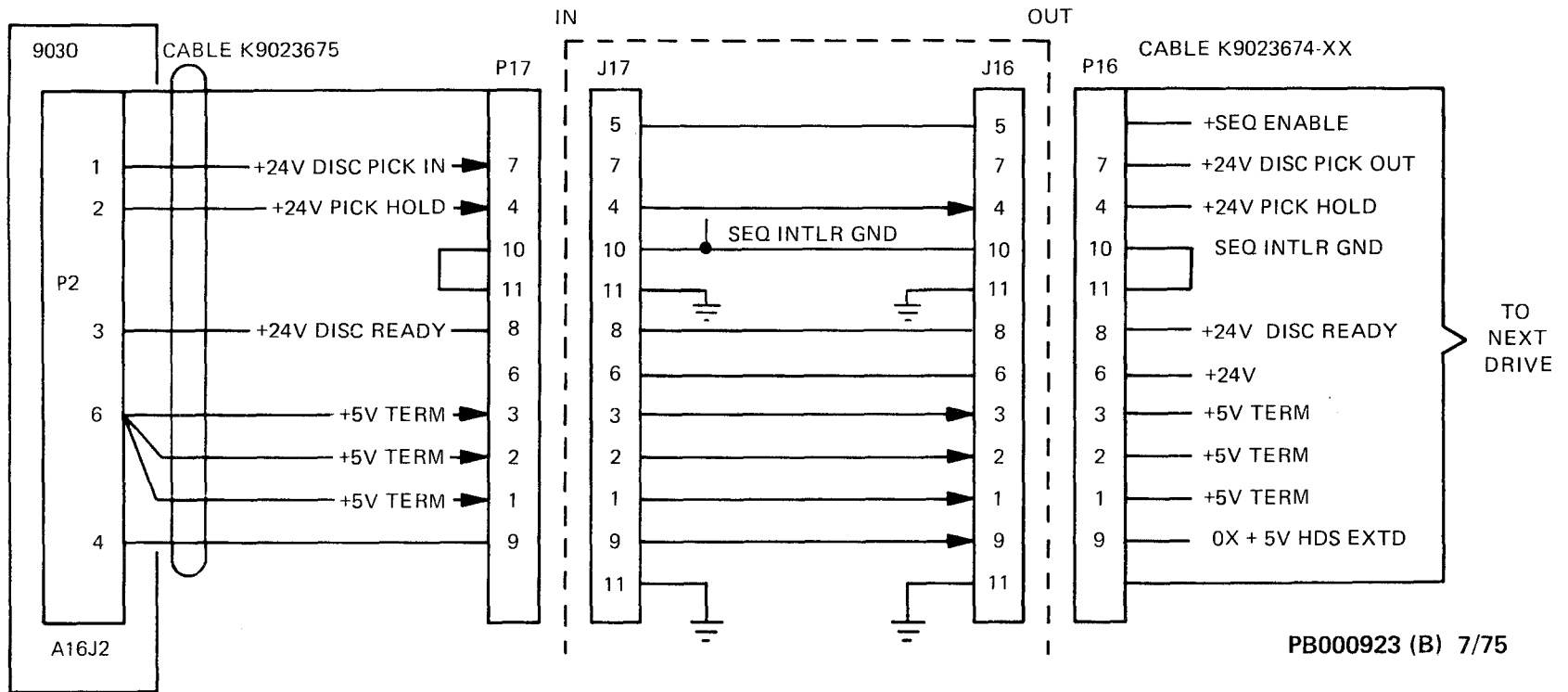
PB000923 (B) 7/75

2.6.4.1 AC Network

The basic 8418 Disk Drive power system includes a sequencer, a power supply, a logic control, a drive motor, and a fan motor. Sixty Hertz drives shipped from the factory are wired for 208 volt, 3 phase AC power or 230 volt, 3 phase AC power. Fifty Hertz drives shipped from the factory are wired for 230 volts, 3 phase-delta AC power, or for 400 volt, 3 phase-Wye AC power. The factory wiring is indicated on the drive name tag. If the drive power marked on the name tag does not agree with the facility power, convert the drive wiring as shown in the following paragraphs and figure 2-8.

2.6.5 Power Conversion

In Table 2-5 the wire locations and colors are shown for the various 50 and 60 Hz AC input voltages. Table 2-6 lists the part numbers of the components that must be changed for power conversion.

Table 2-5.   Input Power Connections

Frequency	Voltage	Color	Termination
60 Hz	230/240 VAC	Brown Black	TB2-1 A2J2-15
	200/208 VAC	Brown Black	A2J2-15 TB2-1
50 Hz	200 VAC	Gray Brown Black	A2J2-15 TB2-1 TB2-2
	215/220 VAC	Gray Brown Black	TB2-1 A2J2-15 TB2-2
	230/240 VAC	Gray Brown Black	TB2-1 TB2-2 A2J2-15

MC8309

Figure 2-8. Power Interconnections
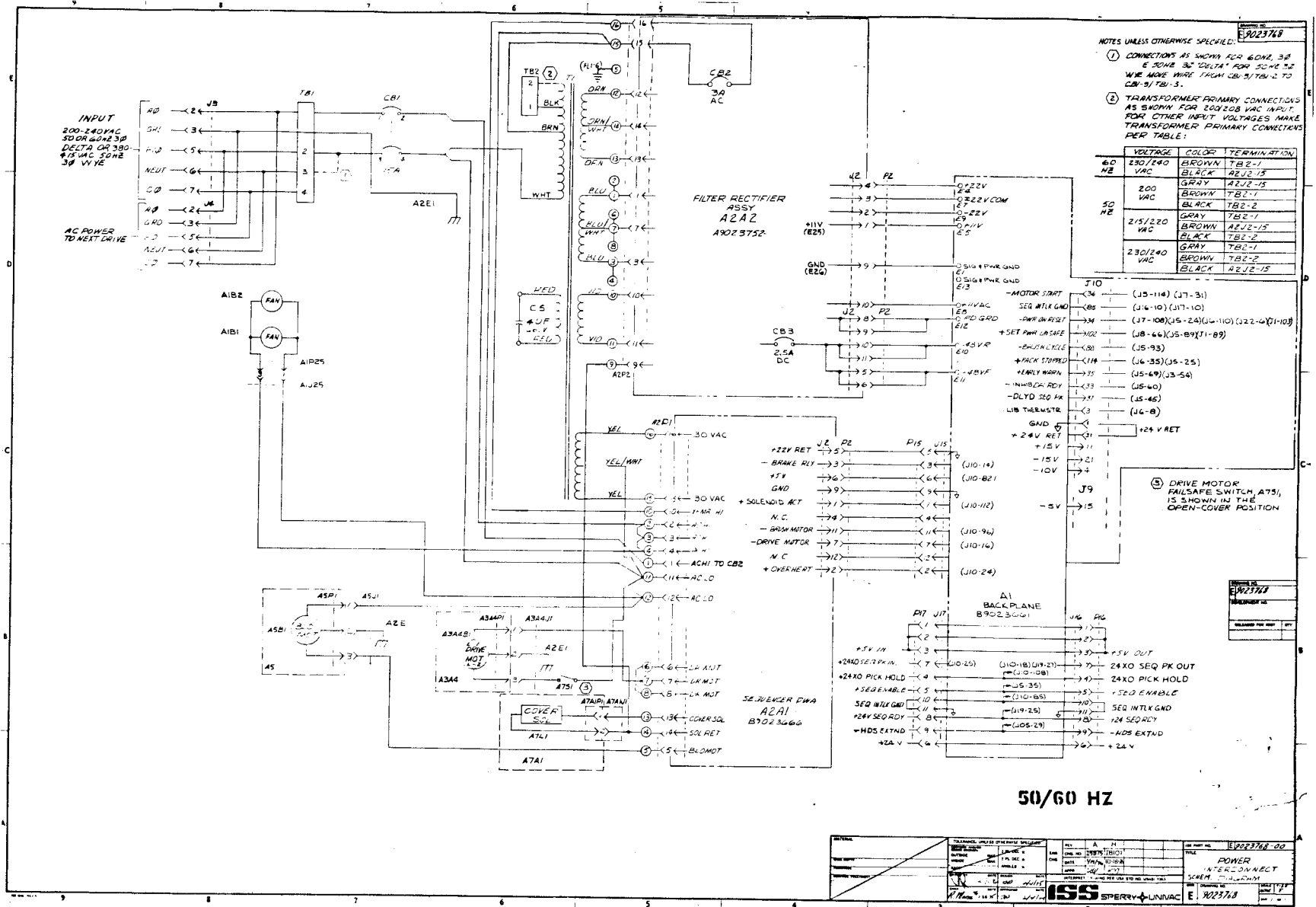
2.6.5.1 Delta or Wye Input Conversion

The 3-phases are input to TB1-1, TB1-3, and TB1-5. For 50 Hz Wye input, connect jumper wire from CB1-3/TB1-2 to CB1-3/TB1-3.

Table 2-6. Power Conversion Guide

Assembly	60 Hertz	50 Hertz
Drive Motor Assembly	P/N 9023773-01	P/N 9023773-00
Transformer T-1	P/N 9023693-00	P/N 9023991-00
Drive Belt	P/N 9001856-08	P/N 9001856-07
Blower Assembly	P/N 9023938-00	P/N 9023756-00
Power Supply	P/N 9023711-01	P/N 9023711-00
Pulley Assembly	P/N 9023128-01	P/N 9023128-02
Backpanel Jumper		J6, connect from 113 to 101

CHAPTER 3

OPERATIONAL DESCRIPTION

This chapter contains the information and procedures for operating the SPERRY UNIVAC 8418 Disk Subsystem. The subsystem consists of an IDA (Integrated Disk Adapter) in the mainframe and one to eight SPERRY UNIVAC 8418 Disk Storage Units (disk storage unit). Subsystems containing more than four 8418 Disk Storage Units have an AC power box (Type 2408). The AC power box has no operator controls or indicators.

3.1   OPERATOR RESPONSIBILITIES

The operator is responsible for preparing the disk subsystem for operation and for performing the routines required for efficient operation.

To assume his responsibilities, the operator must know the locations and functions of all operator-oriented controls and indicators involved in daily use of the subsystem.

- turn on and turn off of the disk subsystem, as required;

- observing and responding to fault indications; and

- loading and unloading disk packs.

The disk storage unit (figure 3-1) contains an operator control panel (figure 3-2). The panel is located on the top right corner on the front of the cabinet. Device addresses are established by the field engineer at the time of installation.

3.2   POWER ON SEQUENCE

The function of each of the controls and indicators on the operator control panel (figure 3-2) is described in table 3-1. Note on figure 3-2 that the LOW DENSITY switch is used on 8418-02 and 8418-03 only. The switches and indicators are all backlighted.

The red STOP indicator is lit when power is initially applied to the drive. When the white ON/OFF switch is toggled ON, its indicator is lit and the STOP indicator remains lit also.

The drive spindle picks up speed until operating speed is reached. At this point the heads are loaded and located at cylinder 00, but the drive remains off-line. When the RUN switch is pressed and released, it illuminates, and the STOP indicator is extinguished. The drive is now in the on-line state and ready for system operation. The RUN switch and the ON switch are both lit (figure 3-2). A simplified power on sequence is shown in figure 3-3.
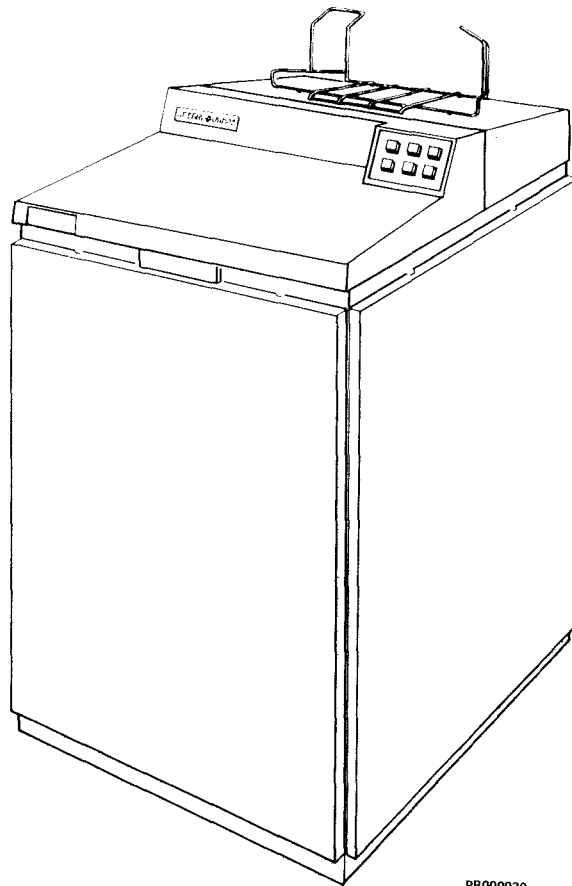
PB000930
8/75

Figure 3-1. 8418 Disk Drive

| ON OFF | RUN | STOP |
| DEVICE CHECK | FILE PROTECT | LOW DENSITY |
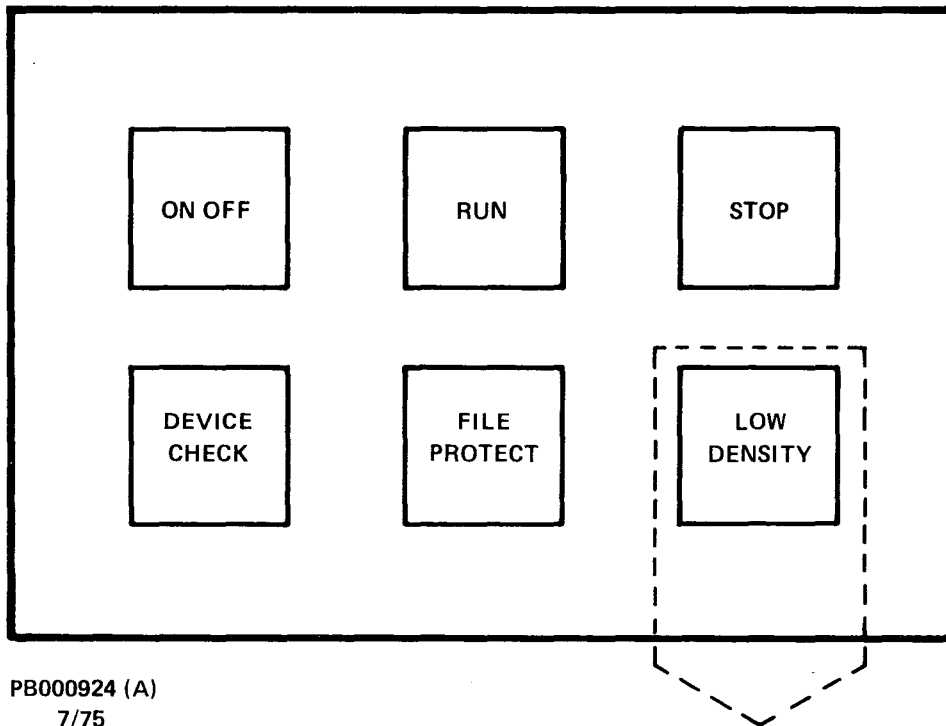
PB000924 (A)
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APPEARS ON 8418-02, 03 ONLY

Figure 3-2. Operator Panel

POWER

```
        STOP          ⎰ LIT WHEN POWER IS
                      ⎱ APPLIED TO DRIVE


         ON           ⎧ PUSH TO ON—INDICATOR LIGHTS,
        OFF           ⎨ SPINDLE COMES TO OPERATING SPEED,
                      ⎩ HEADS LOADED AT TRACK 00


        RUN           ⎰ PUSH


        STOP          ⎰ INDICATOR IS EXTINGUISHED


        RUN           ⎰ INDICATOR IS LIT
```

PB000924 (B)
7/75
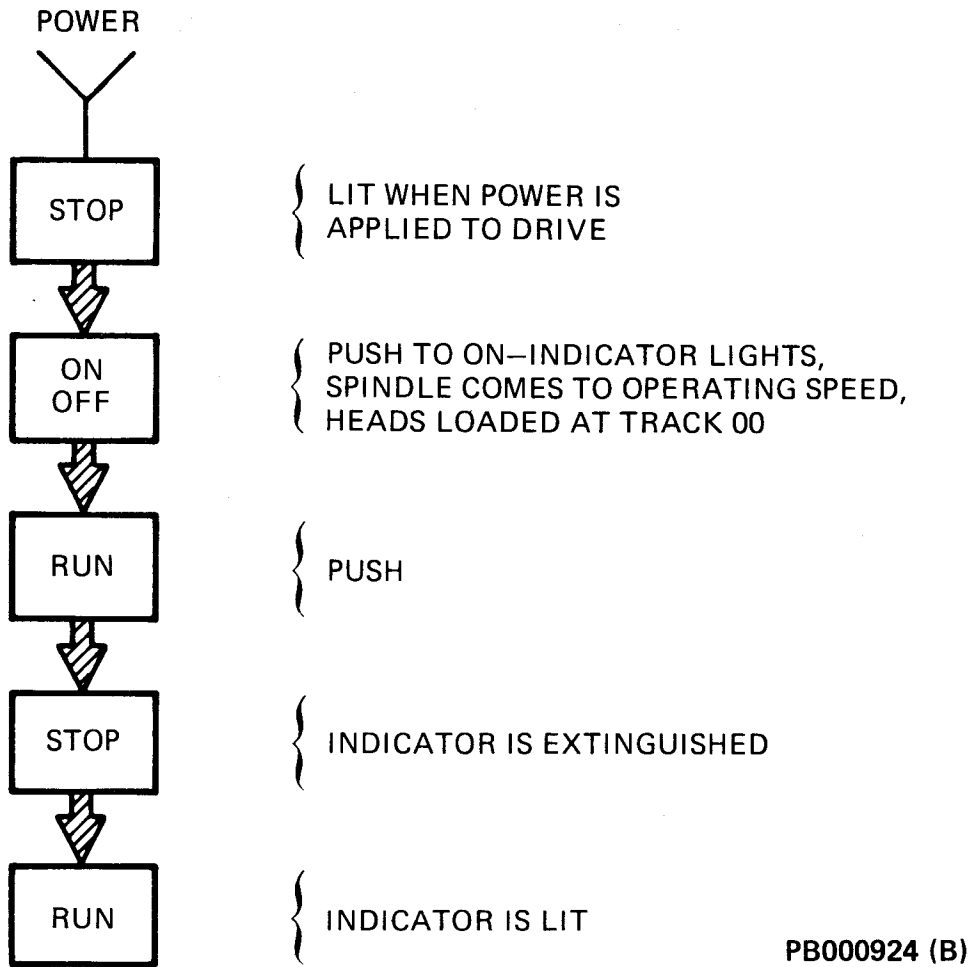
Figure 3-3. Simplified Power On Sequence

If the ON/OFF switch is ON when AC power is applied to the drive, the operator need only press the RUN switch. The STOP indicator is lighted as soon as power is applied. When the spindle is up to operating speed and the heads are loaded at track 00, the ON switch and the RUN switch are lit. The STOP indicator is extinguished when the RUN switch has been pushed. The drive is now in the on-line state ready for system operation.

3.2.1   On-Line Diagnostics

Run applicable on-line diagnostic tests described in the Storage Control Unit Maintenance Diagnostic Manual.

3.3   CONTROLS AND INDICATORS

3.3.1   ON/OFF Switch

In the ON state, this white switch is lighted. It applies power to the drive motor. When the switch is toggled OFF, the RUN switch is extinguished; the STOP switch lights up and the ON/OFF switch flashes intermittently until the spindle has stopped.

If the cover is not closed or a disk pack is not mounted when the ON switch is pressed, the ON switch is lit and the STOP switch begins to flash on and off. When the cover is closed after the switch is pressed ON, the normal power consequence continues.

If the drive motor temperature increases, a thermal switch cuts power to the motor until it has cooled to a safe level. While the thermal switch is open, the ON/OFF switch lights according to the state of the switch, but power to the motor remains open until the motor has cooled.

3.3.2   RUN Switch

This green switch is lit after it is pressed and released under the following conditions:

    1. ON switch lighted
    2. Disk pack loaded
    3. Cover closed
    4. Drive spindle at operating speed
    5. Heads loaded at track 00
    6. No device check condition in the drive

If the above conditions are met, the RUN switch is lit and the STOP switch is extinguished. At this point, the ON and RUN switches are both lit and the drive is ready for system operation.

If the RUN switch is pressed and released before the above conditions are met, the STOP switch is extinguished as soon as the RUN switch is released, but the RUN switch lights when all the conditions are met.

3.3.3 STOP Switch

When AC power is applied to the drive, this red switch is lit. It remains lit until the RUN switch is pressed and released under the conditions described in subsection 3.3.2.

When the STOP switch is pressed, all of the panel indicators and switches are lighted to test the lamps. As soon as the STOP switch is released, the lamp test ends and only the STOP switch remains lit.

The STOP switch flashes on and off if a disk pack is not mounted or the cover is not closed when the ON/OFF switch is pressed ON.

Certain error conditions that cannot be reset by the host system result in the RUN switch being extinguished and DEVICE CHECK and STOP being lit.

3.3.4 DEVICE CHECK Indicator

This red indicator is lit as a result of conditions detected within the drive that affect the normal operation of the drive. A condition that causes a DEVICE CHECK must be cleared before normal drive operation can be resumed.

There are two general types of conditions that cause a DEVICE CHECK, soft unsafes and hard unsafes. Soft unsafes are those that can be reset by the system. If the soft unsafe cannot be cleared by the automatic recovery procedure initiated by the system, the unsafe is considered to be hard. A hard unsafe requires operator intervention at the drive.

To reset a hard unsafe condition the operator turns the drive off and then on again. If the DEVICE CHECK recurs immediately, corrective maintenance is required. (See Chapter 5).

The DEVICE CHECK indicator is lighted for any (soft or hard) unsafe, but only a hard unsafe causes the drive to go off-line. When the drive goes off-line the RUN switch is extinguisehed and the STOP switch and DEVICE CHECK indicator are both lit.

A DEVICE CHECK cannot be cleared by the RUN or STOP switches. While the DEVICE CHECK condition exists, the affected drive cannot be placed in the RUN state.

3.3.5 FILE PROTECT Switch

This yellow switch is lit when the FILE PROTECT switch is on. In the on state, write operations are inhibited. If an operation is in progress when the FILE PROTECT switch is pressed, that operation continues to completion before the FILE PROTECT function is activated.

3.3.6 LOW DENSITY Switch

This white switch is used only on the 8418-02 and 8418-03. When LOW DENSITY mode is in effect, the indicator is lit and only tracks 00-410 can be accessed. Reading and writing can be done on all of the tracks from 00 through 410. The 8418-04 and 8418-05 operate in this mode only, and do not have the switch.

This switch allows disk packs to be interchanged between drives that have different track capacities.

3.4 SYSTEM POWER TURN ON

Power is turned on/off from the CPU. Unless the power box is used, AC and DC are always present in the drive.

3.5 PACK HANDLING

3.5.1 Loading the Disk Pack

Disk packs must be protected against improper handling and environmental abuse. The operator should use the instructions provided by the disk pack manufacturer as a reference source.

The disk pack, conditioned to room temperature before installation, is carried by the built-in handle on the top cover. A self-locking device in the handle permits removal of the disk pack top cover only when the pack is mounted on the drive. Other precautions are listed in subsequent paragraphs.

3.5.2 Loading Precautions

1. Do not drop the disk pack onto the disk drive spindle; the first threads of the spindle may be damaged.

2. Ensure that the protective cover is completely released from the disk pack before attempting removal; an upward pull applied to the drive-shaft lock can damage the threads.

3. Avoid excessive loading torque; extra clockwise twisting to ensure that the disk pack is locked on the shaft is not necessary and can damage the spindle threads.

3.5.3 Loading Procedure

Loading the disk pack in preparation for operation requires operator attention to both the operator controls and the disk pack.

1. Push and release the cover latch. The cover will spring upward. Lift the cover to fully expose the spindle area. Keep the amount of time the cover is open to a minimum to limit contamination of the pack area by airborne particles.

2. Remove the disk pack bottom cover by squeezing the bottom cover release mechanism.

3. Place the disk pack on the spindle.

4. Turn the disk pack top cover handle in a clockwise direction until it comes to a full stop. Continue to turn the handle, even though the cover may disengage, to ensure that the full-stop point is reached and the pack-on switch is closed.

5. Remove the disk pack cover.

6. Close and latch the drive operator cover. Store the disk pack top and bottom covers in the rack on the drive or in a designated area.

7. Press the ON/OFF switch, then the RUN switch. When the drive reaches operating speed, the RUN switch is lighted and the drive is ready for operation.

3.5.4   Unloading the Disk Pack

Unloading is done only when all disk pack motion has stopped.

3.5.5   Unloading Precautions

1. To prevent damage to the threads, do not attempt to lift the disk pack from the spindle threads until the pack is completely disengaged.

2. A clicking sound can be heard when the spindle releases the disk pack (after the pack is turned counterclockwise for removal); do not permit more than one or two clicks before removing the pack or damage to the threads can result.

3. Store the disk pack in the same environment as the disk storage unit.

3.5.6   Unloading Procedure

To remove or replace a disk pack:

1. Press the ON/OFF switch. This will cause a stop condition. The ON/OFF indicator will continuously flash untilthe pack rotation stops.

> NOTE: A solenoid-operated latch locks the operator cover closed until pack rotation stops.

2. Once pack rotation stops, release the operator cover latch and lift the cover to fully expose the spindle area.

3. Position the disk pack cover over the pack.

4. Turn the cover counterclockwise for two full turns so that the cover becomes securely fastened to the disk pack, thus forming an integral unit.

5. Remove the disk pack by its top handle.

6. Immediately attach the bottom cover to create a positive dust seal, and store in a designated area.

7. Close and latch the operator cover.

3.6   RECOVERY PROCEDURES

Operator response to an indicated fault is limited to observing the indication and, in most cases, making one or more efforts to restart the halted operation.

Indicator bulbs can be tested by pressing the STOP switch. All the bulbs should be lighted while STOP is pressed. If the indicator does not light, but the proper function occurs, either notify the Sperry Univac customer engineer of the condition or change the indicator bulb, depending on site policy.

The DEVICE CHECK indicator is lighted when conditions are detected within the drive that might affect normal operation of the drive. A DEVICE CHECK (as indicated by the RUN indicator going off and DEVICE CHECK and STOP on) caused by a hard unsafe must be cleared before normal drive operation can be resumed. A DEVICE CHECK indicator on accompanied by an EARLY WARNING indication on the processor is a signal for operations to be terminated as soon as possible before the temperature problem in the drive results in a thermal trip condition.

To reset a hard unsafe generated DEVICE CHECK condition, the operator turns the drive off and then back on. Note the occurrence in the system log. If the DEVICE CHECK recurs, corrective maintenance is required and the Sperry Univac customer engineer should be notified.

CHAPTER 4

FUNCTIONAL DESCRIPTION

4.1   INTRODUCTION

The Univac 8418 Disk Drive is an on-line peripheral storage device within a data processing or computing system. The 8418 performs the following functions:

1.   Power Control and power sequencing.

2.   Rotates the disk pack.

3.   Positions the read/write heads to a specified cylinder.

4.   Selects a read/write head.

5.   Transfers data between the system interface and the disk pack.

6.   Monitors the operation of the drive and provide appropriate status information to the host system.

This chapter provides detailed functional descriptions of the operations performed by the 8418, and relates the descriptions to specific areas of the device.

Component locations and assembly locations within the drive are shown in Chapter 1. In addition, Chapter 1 describes the method used for identifying assemblies, subassemblies, and components within the drive. This method of identification is called the reference designator system, and is also used by the Illustrated Parts Breakdown (IPB).

This chapter is made up of graphic presentations for the service engineer. The combination of functional flow diagrams, block diagrams, timing charts, and their functional descriptions should allow the service engineer to isolate a failing function to a specific area of the 8418 in a relatively short time. In most cases the problem can be isolated to a single PWA and the PWA replaced. If troubleshooting to component level on a PWA is required, this chapter should be used in conjunction with the 8418 Diagrams Manual, Part Number UD002525-2.

4.2   SYSTEM INTERFACE DESCRIPTION

The 8418 Disk Drive is designed to be interfaced with the Univac 90/30 computer through an Integrated Disk Adapter (IDA). The IDA is integral to the main frame of the 90/30. Refer to Figure 4-1.

4.2.1   Cable Descriptions

A maximum of eight disk drives may be interconnected to the 90/30 through the IDA. Installation requiring more than four drives will necessitate the use of an AC Power Distribution Box, Type 2408, between the fourth and fifth drives.

Figure 4-1.   90/30 to 8418 Cabling - 4 Drive Complex

Each 8418 Disk Drive is interconnected to the 90/30 through six cables.

1. Device Select Cable - one cable from each drive to the IDA. The Drive Select Cable includes the Read/Write lines, PLO (Phase Lock Oscillator) line; Mod Select Line, and the Gated Attention Line.

2. Tags & Bus Cables - cables are from the IDA to each drive in parallel. The Tags and Bus Lines are the media for the drive control function from the IDA.

    An operation for a particular drive is initiated by activating its specific Mod Select Line. Drive control functions on the bus lines are strobed into the disk drive and identified by activating of the three Tag lines. The Tag lines are Set Head and Direction, Set Difference, and Control.

3. Status & Softscope Cable - this cable runs in parallel from the drives back to the IDA.

    The status cables provide the Selected Seek Incomplete, Unsafe, Index, On-Line, File Protect, High Density Mode, and Early Warning signals to the IDA.

4. Sequencer Cable - this cable is connected to the first disk drive and then daisy chained from drive to drive.

    This cable carries the initialization power-up commands to the disk drive.

5. AC Power Cable - this cable is connected to the first drive in sequence. This cable provides AC power to the first drive in sequence. Each drive supplies AC power to the next drive in line.

4.2.2   Signal Line Terminations

All the bussed signal lines between the CPU and the drives require terminations in the last drive on the bus. The terminating resistors receive +5 volts +2% from the sequencing cable.

4.3   SYSTEM INTERFACE LINES

Interface between the CPU and the 8418 Disk Drives is accomplished through three operational ports, the Sequencer, IDA (Integrated Disk Adapter) and the AC Distribution Panel.

The following paragraphs define the system interface lines from each port to its respective termination at the disk drive.

4.3.1   Control Input Lines (CPU to Disk Drive)

The Control Input Lines to the Drive consist of 8 multi-function drive bus lines, 3 tag lines, and a module select line. The 8 bus lines allow

transmission of functions which are decoded at 3 discrete and sequential intervals: Set Head & Direction Tag, Set Difference Tag, and Control Tag. The line descriptions are given as follows.

1. Set Difference Tag

When this line is at the active level, it indicates to the selected disk drive that the Drive Bus now contains positioning information. The positioning information is the difference between the disk drives current cylinder address and the desired cylinder address. The most significant bits of the Difference Magnitude are not included here but are included with the Set Head and Direction information.

Drive Bus	Difference Magnitude
0	128
1	64
2	32
3	16
4	8
5	4
6	2
7	1

2. Set Head, Direction and Difference MSB Tag

When this line is at the active level, it indicates to the selected disk drive that the Drive Bus now contains head information and accessor direction information. The Most Significant Bits of the Difference Magnitude are included. The bit assignments are:

Drive Bus	Function
0	Accessor Reverse Direction*
1	Difference Magnitude 512
2	Difference Magnitude 256
3	Not Used
4	Not Used
5	Head Address 4
6	Head Address 2
7	Head Address 1

*Reverse is motion away from the spindle.

3. Control Tag

When this line is at the active level, it indicates to the selected disk drive that the Drive Bus now contains Control information. Bit assignments are as follows:

Drive Bus	Control Command

0   Write Gate - Enables the write drivers. Write Gate is blocked whenever offset is active.

1   Read Gate - Enables the digital read data line and resets interrupt latches.

2   Seek Start - When this line is at the active level, it initiates a cylinder positioning sequence in the direction previously selected by Set Head and Direction Tag. Seek Start initiates offset if Bus 7 is active and resets offset if Bus 7 is inactive. It also initiates an offset movement at the end of a seek or immediately if a difference of zero was specified during the set difference tag.

3   Offset Magnitude - The active level indicates larger offset (700 microinches). When inactive it indicates the smaller offset (350 microinches).

4   Offset Direction - The active level indicates the offset shall be toward the disk perimeter. When inactive the offset shall be toward the disk spindle.

5   Head Select - Enables the head indicated by the contents of the head address register to read or write.

6   Restore - Initiates positioning motion to cylinder zero and clears any stored offset. The stored head address is not reset under this command.

7   Offset Control - When active it enables the amount and direction of offset specified by bits 3 and 4 to be performed. The Seek Start command (bit 2) is also necessary to initiate the offset movement.

           Refer to Figure 4-2 for the Command Timing Structure from IDA to 8418 Disk Drive.

4.3.2   Module Select

This unique line to each drive is used to select the drive. Only the selected drive is able to communicate over the interface. A low level initiates selection.

4.3.3   Write or Read Data Line (CPU to or from Disk Drive)

The Write or Read Data Line is a 2 conductor, differential, bi-directional signal line for data from (to) the CU that is to be written on (read from) the selected disk drive. This is a unique line to each drive.

BUS OUT 0	ACCESSOR DIRECTION	DIFF MAGN. 128	WRITE GATE	
BUS OUT 1	DIFF MAGN 512	DIFF MAGN. 64	READ GATE	DROPS OFF AFTER COMMAND IS
BUT OUT 2	DIFF MAGN.256	DIFF MAGN. 32	SEEK START	ACCEPTED BY THE SELECTED DRIVE; IDA WILL WAIT FOR
BUS OUT 3	NOT USED	DIFF MAGN. 16	OFFSET MAGNITUDE	ATTENTION INTERRUPT WHICH
BUS OUT 4	NOT USED	DIFF MAGN. 8	OFFSET DIRECTION	SIGNIFIES THAT DRIVE HAS COMPLETED REQUIRED OPERA-
BUS OUT 5	HEAD ADDRS 4	DIFF MAGN. 4	HEAD SELECT	TION (CONTROL TAG COMMAND)
BUS OUT 6	HEAD ADDRS 2	DIFF MAGN. 2	RESTORE TO 000 (RECAL)	DURING READ OR WRITE CMDS, BOTH MOD SELECT AND CONTROL
BUS OUT 7	HEAD ADDRS 1	DIFF MAGN. 1	OFFSET CONTROL	TAG REMAIN ACTIVE.

SELECTION OF DESIRED
DRIVE AT THIS POINT.
DRIVE IS UP AND RUNNING
AND INITIAL HEAD LOAD
AND RESTORE TO CYL 000
IS COMPLETE.

READ GATE   RESETS GATED ATTENTION
                          INTERRUPT

OFFSET MAG
OFFSET DIR ⟩OFFSET CONTROLS

LOGIC	DIR. MAG.
0	FWD 350μ"
1	REV. 700μ"

Figure 4-2.   Command Timing Structure - IDA to 8418

4.3.4   Status Output Lines (Disk Drive to CPU)

All lines are bussed except Gated Attention. All lines are gated by Module
Select except Gated Attention and Early Warning. The line descriptions are
as follows:

1. Selected Seek Incomplete

    When this line is at the active level, it indicates that: (1) the
    selected disk drive was unable to complete a seek operation and/or has
    failed to return a Gated Attention signal to the controller within 107
    milliseconds after beginning a seek, or (2) more than 300 milliseconds
    have elapsed between the start of a restore operation to the detection
    of inner pack guard band. A Restore command, or a drive motor power
    Off/On sequence will clear the seek error condition, return the heads
    to cylinder zero, and, if the carriage physically returns to cylinder
    zero, will cause a Gated Attention signal to be sent to the CPU.
    Whenever an incomplete seek condition is detected the drive automat-
    ically does a restore and raises Gated Attention at the completion of
    the restore. For either of the two types of seek incompletes just
    described, the seek incomplete status is active as soon as the drive
    detects it and stays active until a restore command is received from
    the CPU. If a failure occurs such that a successful seek can never be
    made, the drive may continuously do restores and present seek incom-
    plete status. Service will be required to correct this failure.
    Refer to section 2.5.1 for the effect of the "unsafe" conditions on
    this signal.

2. Selected Drive Unsafe

    When this line is at the active level, it indicates that an unsafe
    condition exists in the disk drive. One or more hard unsafe con-
    ditions will:

    a. Generate Selected Drive Unsafe

    b. Disable write driver circuits

    c. Disable Head Select

    d. Set all status output lines except Selected Drive Unsafe, and
        Early Warning to the inactive level.

    Unless a permanent failure has occurred, drive unsafe status can be
    cleared by cycling the drive motor from power ON to OFF and back to
    power ON. Normally, only hard unsafes require clearing in this
    manner. The spindle drive motor power cycling is controlled by the
    ON/OFF switch.

3. Selected Index

   A 20 microsecond minimum pulse, whose leading edge indicates the
   beginning of a track. This pulse occurs once per pack revolution.
   This signal is disabled by Drive Unsafe.

4. Selected On Line

   This line indicates that the selected disk drive is available. It
   can only be active when the drive has sequenced up and the heads are
   loaded. Lock-out conditions are:

   a. Drive in STOP state.

   b. No Module Select.

   c. Drive Unsafe.

5. Gated Attention

   When at the active level, this unique line indicates that a seek and/
   or an offset has been completed. The seek could have been initiated
   by either a power on sequence, a seek command, a restore command, or
   a drive-initiated restore caused by detection of a seek incomplete.
   This signal, which may be used as an interrupt, is presented to the
   interface as soon as a power on sequence is completed. The Gated
   Attention signal is reset by Read Gate. A "power on" sequence will
   generate a Gated Attention upon completion of the sequence only if
   the RUN switch has been depressed after the ON/OFF switch has been
   switched to "ON". Each transition from STOP to RUN will also cause a
   Gated Attention.

6. Selected File Protect

   When this line is at the active level, it indicates that the selected
   drive is unavailable for writing data onto the disk pack.

7. Early Warning

   When this line is at the active level, it signals the approach of an
   overheat condition in the drive. This is an unselected status line
   capable of being activated by any drive at any time (Selected Drive
   Unsafe will not be activated). The Device Check light will illuminate
   on any drive that has this condition, but the drive will not be
   powered down.

4.3.5   Write Oscillator Output Line (PLO)

The Write Oscillator Line is a two (2) conductor, differential signal line for
transferring the Write Oscillator Output Signal to the CU for use as the Clock
during a Write Operation. This signal is synchronized to the disk speed. The
line is unique to each drive.

4.3.6 Power Sequence Input Lines (CPU to Disk Drive)

1. Disk Pick

   This is a two state, open or +24 volt (nominal), line from the 90/30 Power Control unit. In the high state, if all conditions are satisfied, the blower and drive motor will be energized and the unit will cycle up and load the heads to cylinder zero.

2. Pick Hold

   This is a two state, open or +24 volt (nominal), line from the 90/30 Processor Power Control Unit. In the high state, this line allows the blower and drive motor to start and the heads to load when the pack is up-to-speed. When the drive is powered up with the heads on the pack, this line going low will unconditionally cause the heads to retract and the motor and blower to power down. All drives on the system will power down simultaneously. The power supply and cooling fans will remain on and can be turned off only by turning off the system circuit breaker or the drive main circuit breaker.

   The drive will power up and allow the Heads to Load if the Sequence Cables are disconnected from the drive. The drive detects the absence of the cables and internally generates Disk Pick and Pick Hold.

4.3.7 Power Sequence Output Line (Disk Drive to CPU)

Disk Ready

This line is a two state, open or +24 volt (nominal), line that goes high when the spindle drive motor is up-to-speed. This serves as the Disk Pick signal for the next disk drive. The last disk drive returns this line to the 90/30 Power Control Unit. When the ON/OFF switch is OFF this line will be propagated directly through the drive to the next drive in line.

4.3.8 Drive to Drive Sequence Line

1. Sequence Enable

   This line active (high), allows the next drive in the sequencing chain to power up if Disk Pick and Pick Hold are also present. A drive pulls this line inactive when sequencing up, and allows this line to go active high again when the pack reaches the correct speed.

   This line prevents more than one drive from sequencing up at the same time in the case where more than one drive has its ON/OFF switch in the ON position when Disk Pick and Pick Hold are activated.

2. Heads Extended

   When the heads on any drive are on the pack, this line is at ground. When the heads on all drives are retracted, this line is open.

4.3.9   Softscope (Disk Drive to CPU)

Each softscope line is gated with Mod Select.

   1. Softscope 1 (Index)

      See Paragraph 4.3.4 number 3 for description.

   2. Softscope 2 (Cylinder Pulse)

      Indicates that the heads are at or crossing a cylinder.

   3. Softscope 3 (Access Ready)

      Indicates that the heads are positioned on a cylinder at the end of
      a Seek, Seek Incomplete, Head Load or Restore.

4.4.   8418 OPERATIONAL BLOCK DIAGRAM DESCRIPTION

4.4.1   Initialization - Power-On Sequence

The initialization of a disk drive is initiated by a Sequence Pick signal from
90/30 computer. The first drive in sequence with the Operator Control OFF/ON
switch in the ON position will start if all safety requirements are met. When
the disk pack is up to 90% of its rotational speed a Sequence Enable signal
is generated which allows the next drive in-sequence to initialize. Shortly
after the disk pack achieves 90% rotational speed the heads are loaded onto the
pack and a restore operation is performed.

The restore operation moves the heads from the outer disk surface to the inner
guard band and then back to cylinder 000. Refer to figure 4-5 for the Power
On/Head Load Sequence flow chart and figure 4-6 for the Power On/Head Load
Sequence timing diagram.

Any drive which has been by-passed because the operator ON/OFF was not ON, can
be cycled up at a later time, if no other drive is being initialized.

4.4.2   Initialization Head Load Sequence - Figure 4-5 and Figure 4-6

The head load cycle includes two of five modes of servo operation. The other
three modes of servo operation are discussed in paragraph 4.4.3 Servo Modes.

The head load cycle consists of two phases. The first phase is an optical/
mechanical operation (utilizing the velocity sensor servo configuration) which
places the heads on the pack past the guard band. The second phase is the
track following recalibration (restore) cycle which moves the heads to the
inner guard band and then back to cylinder zero.
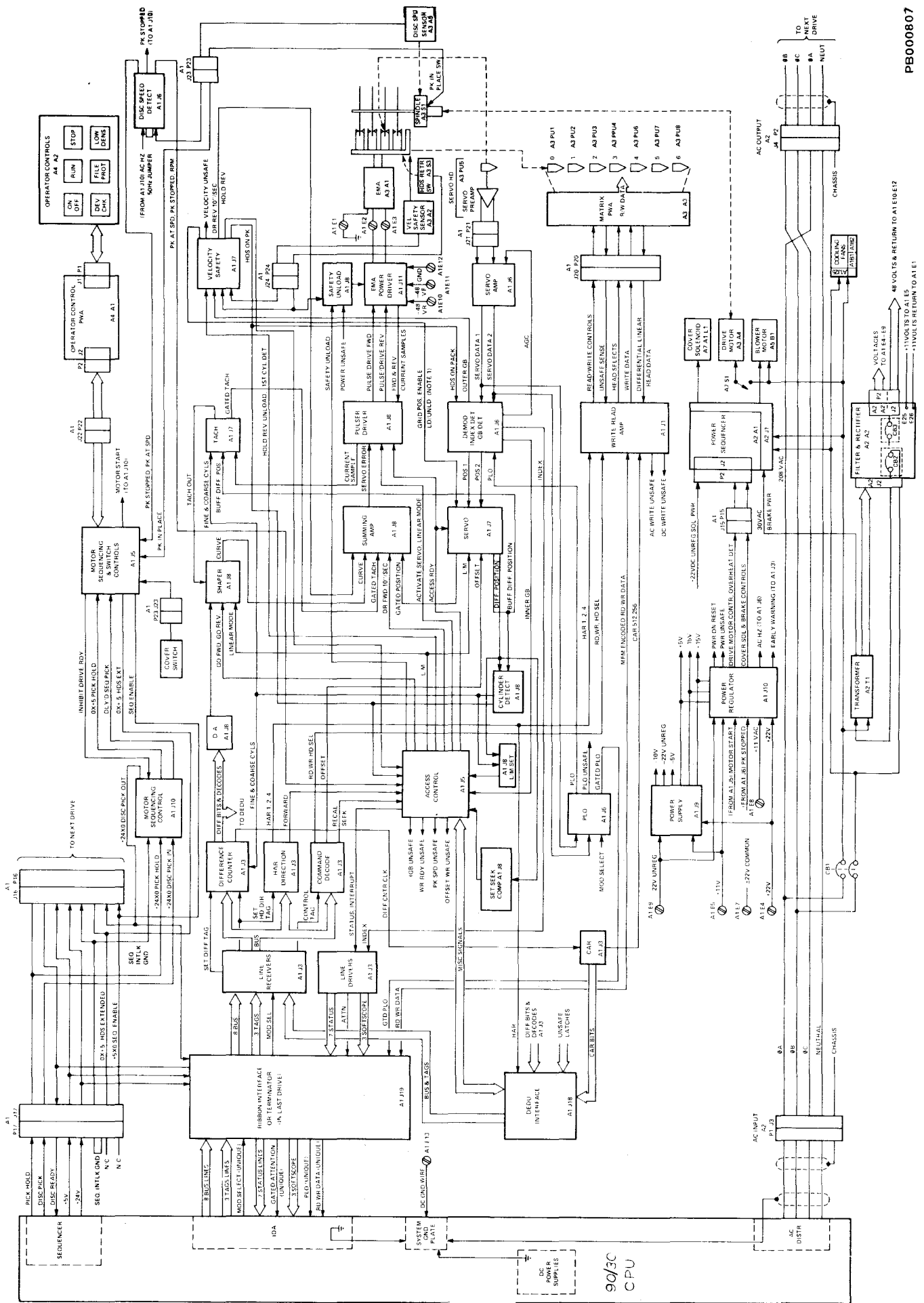
Figure 4-3. 8418 Functional Block Diagram

PB000807
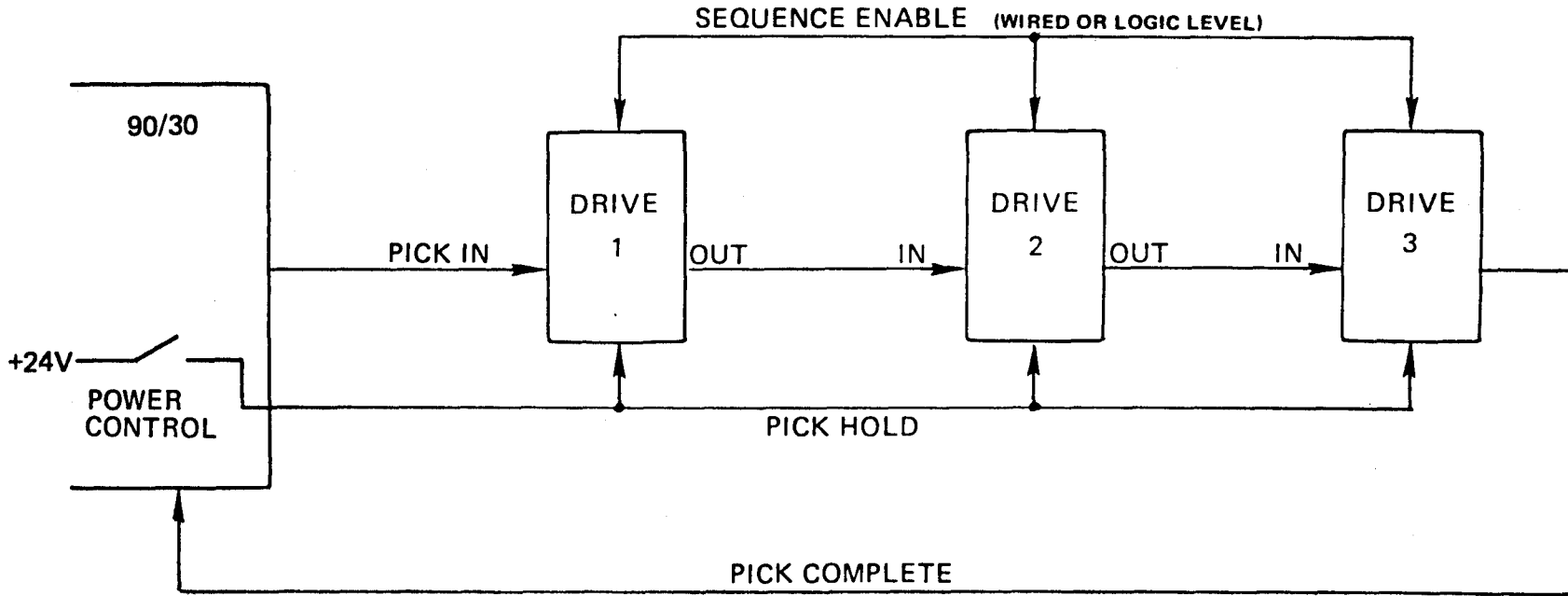
Figure 4-4. 90/30 Drive Sequence Flow Chart Line Configuration
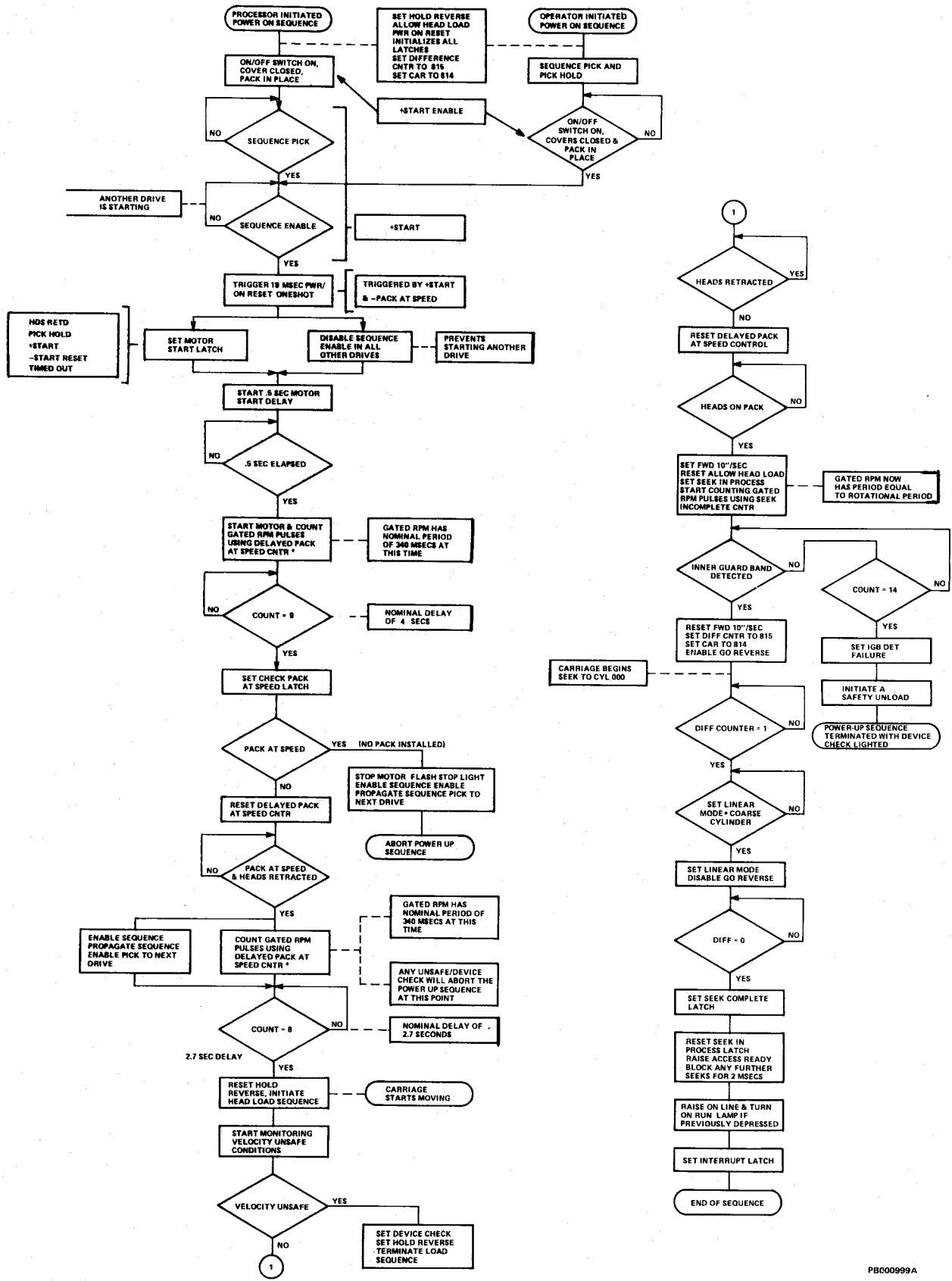
PB001010-1

Figure 4-5. Power On/Head Load Sequence Flow Chart

POWER ON RESET

DISK PICK, PICK HOLD ON/OFF SW,
COVER CLOSED = START ENABLE

POWER ON/START RESET

—MOTOR START

—DRIVE MOTOR

+SEQUENCE ENABLE

—PACK AT SPEED

+CHECK PACK AT SPEED

DELAYED PACK AT SPEED COUNTER

—HOLD REVERSE

—ALLOW HEAD LOAD

—GO FORWARD

—GO REVERSE

+HEADS ON PACK

+FWD 10"/SEC

+INNER GUARD BAND

DIFFERENCE CNTR

—DIFF = 0

—LINEAR MODE

—SEEK IN PROCESS

+ACCESS READY

+INTERRUPT

J05

J05

21 MSECS

J05

.5 SECS

90%

9 SECS NOMINAL

6 SECS NOMINAL

0   16   0   8   CNTR RESET

2.7 SECS NOMINAL

HIGH INACTIVE

PULSES

DIFF = 0

CNTR SET TO 815   COUNTING DOWN

PB001013-1A

Figure 4-6. Power On/Head Sequence - Timing

1. Phase 1 - Head Loading - Figure 4-7

    In normal operation, after the pack has achieved 90% rotational speed
    and there is no unsafe conditions, the EMA (Electro Mechanical
    Actuator) starts to move the carriage at an initial velocity of 10 IPS
    to overcome friction away from the backstop.

    There is a Velocity Safety Grid (slotted metal grid) located on the
    head carriage which is used with a light emitting source (LED) and
    photo sensor for Phase 1 head loading operation. As the carriage
    moves the slotted grid, the light emitting source is detected by the
    sensor at each slot. This produces a signal which is directed to the
    head load tachometer. The carriage begins to move at 10 IPS and when
    two (2) slits have been detected a latch is set. This latch is tested
    when the "heads retracted" switch goes to "heads extended" therefore
    the latch must be set before the switch is tripped.

    The "velocity > 4 IPS" test is made to verify correct operation of
    the velocity unsafe timer. In this test the velocity timer is
    inhibited from indicating an "unsafe" and its timing is modified so
    that its output should overlap the time interval between two slits.
    When this overlap occurs a latch is set to indicate normal operation
    of the timer, and proper carriage speed. The latch must set before
    the carriage has moved 0.48 inches (24 slits).

    Also the heads retracted switch must trip to the heads extended pos-
    ition during the 24 slits interval. This test prevents an incorrect
    head status indication which might leave the heads on the pack during
    an unload operation. The head load speed is reduced to 5 IPS when
    the carriage passes the velocity > 4 IPS test.

2. Phase 2 - Head Loading

    Phase 2 of the head loading sequence commences with the detection of
    76 slits. At that time the head loading tachometer is disabled and
    the track following tachometer is enabled. The disk drives does a
    recalibration using the track following data on the servo disk
    surface. The recalibration causes the EMA to drive forward to the
    inner guard band at a velocity of 10 IPS. When the inner guard band
    is detected the drive does a Recalibrate to cylinder 000. When the
    heads are positioned over cylinder zero, the gated attention line goes
    active and the drive is ready for access.

4.4.3   Operational Mode - Cylinder Selection & Servo Mode - Figures 4-8 and 4-9

The CPU determines the disk drive, cylinder, and read/write head to be enabled
and the read or write mode. When these parameters are determined the IDA per-
forms the following operations:

1. The Mod Select line to a specific drive is made active.

2. Drive Status checked. If acceptable (on line and not unsafe) the
    sequence continues.
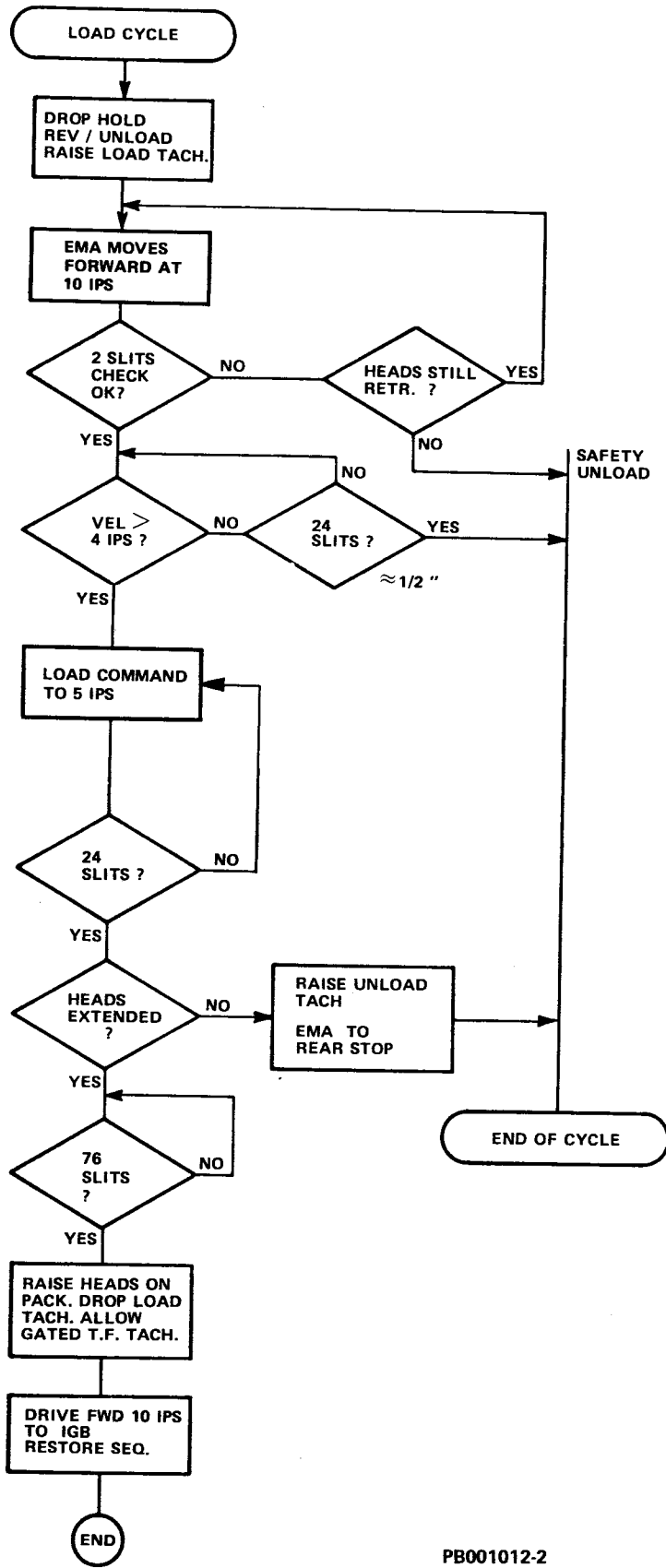
Figure 4-7. Head Load Cycle/Safety Check Flow Chart

FIXED SPEED SERVO DRIVE
FORWARD AT 10IPS INPUT: DC REF = 10IPS
1- START OF RECAL
2- INITIAL HEADLOAD SEQ
WHEN +HDS ON PACK ACTIVE
TERMINATED BY IGB
REVERSE AT 10IPS
STARTS → NORMAL HEAD UNLOAD
(ON/OFF SWITCH)
TERMINATES: OGB DETECTION RESET

INPUT: DC REF = 10IPS
FEEDBACK: TRACK FOLLOWING TACK

OGB
0   IGB

HDS
ON
PACK

MECHANICAL LINKAGE

J11   EMA DRIVER

EMA

PR   PF

2Ω

DF   -48V   DR

CURRENT
INST.

DIFFERENCE INPUT

CURR SAMP.

COMMANDS
DR DF
PR PF

VELOCITY SLITS

GRID
DETECTOR

TACHOMETER
CIRCUITS

TACH OUT
GATED TACH

CURVE
GEN
D A C

LINEAR
MODE
DETECT

VEL. GRATE

CURVE OUTPUT

LOAD/UNLOAD ERR

HEAD LOAD/
UNLOAD
CONTROL
LOGIC

DIFF POS.

BUFFERED
DIFFERENCE
POSITION

COARSE
CYL. DET.

COARSE CYL

FINE
CYL. DET.

FINE CYL

J06   DSS/PLO/DEMOD

INDEX
& GB DET.

SERVO
DATA

PLO GEN

OFFSET
CMD
CONTROL

PREAMP
SERVO
DATA

SERVO
AMP

DEMOD

FILTER

TF POS. 1
TF POS. 2

BUFFER

GATED
POSITION
FILTER

GATED POSITION

SUMMING
AMP.

SERVO
ERROR

PULSER
DRIVER
COMPARATOR
AND LOGIC

FORWARD
(REVERSE)

DC REF

SAFETY
UNLOAD

REVERSE
MOTOR
CURRENT
SENSE

AGC

SERVO
HEAD

J07   SAFETY TACH/POSITION

J08   PULSER DRIVER/CURVE/CYLINDER

DISC

PB001003

Figure 4-8.   Fixed Speed Servo Drive Functional Block Diagram
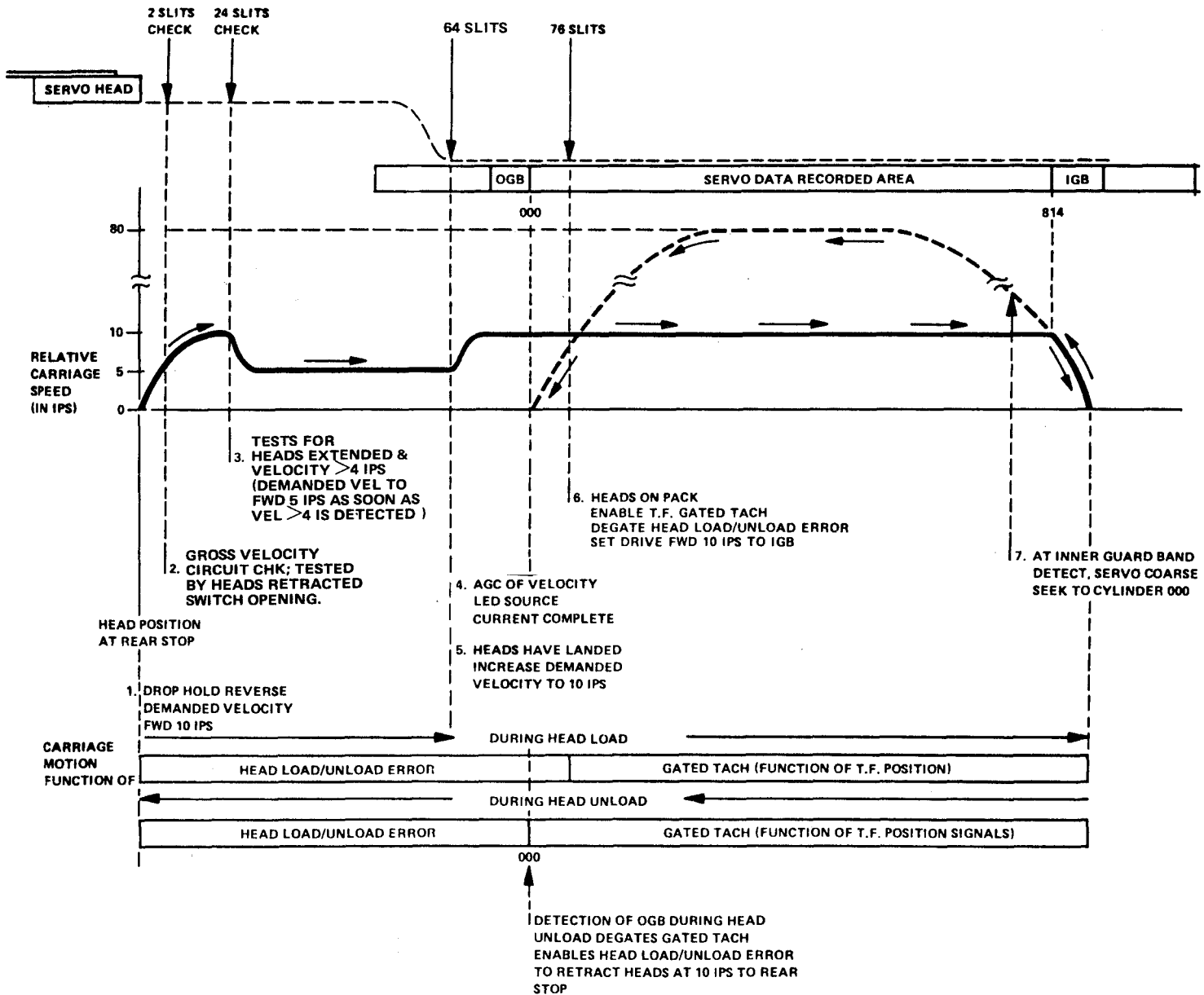
Figure 4-9. Load/Unload Control - Motion Concept Diagram

SLIT COUNTER

A.	**2 SLITS TEST:**	GROSS CIRCUIT OPERATION OK — CHECKED WHEN HEADS EXTEND AND OPEN HEADS RETRACTED SWITCH

- VELOCITY LED/LST ON
- VELOCITY SENSOR AMP AND SLITS LOGIC INCLUDING SINGLE SHOT OK

B.   24 SLITS TEST:

- HEADS EXTENDED
- VELOCITY EXCEEDS 4 IPS
- CARRIAGE HAS MOVED FORWARD ~ 1/2"

C.   76 SLITS:

- SET HEADS ON PACK
- CARRIAGE HAS MOVED ~ 1–1/2" FROM REAR STOP
- HEADS ARE OUT ON PACK
- INHIBIT LOAD TACH; ENABLE T.F. GATED TACH

D.   GUARD BAND BACK-UP SCHEME: (FOR UNLOAD ONLY)

- USED IF SERVO DATA GB DETECTOR FAILS
- MOD 2 COUNTER SET BY 2 SLITS DETECTED AFTER NO MORE CYLINDER CROSSINGS (@ CYL 000)
- CLEARS HEADS ON PACK
- ENABLES HEAD UNLOAD TACH; INHIBITS T.F. GATED TACH*
- NORMAL OUTER GB DETECTION WOULD OCCUR WELL BEFORE 2 SLITS ARE DETECTED — THROUGH DECODE OF DIBITS

*GATED TACH NOT ACCURATE BECAUSE OF MOTOR CURRENT INTEGRATION
GREAT ERROR AS MOTOR CURRENT INCREASES TO RETRACT HEADS OVER CAM AREA

SLIT EDGES: .010" APART
CYLINDER
   CROSSINGS: .0027" APART

PB001008-2

Slit Counter/Safety Check Timing

3. The balance of the cylinder address magnitude 256 and 512 (Drive Bus 0 & 1) is strobed into the Difference Counter (J3) by the Set Head, Direction, and Difference Tag.

4. The cylinder address, Difference Magnitude 1 through 128 (Drive Bus 7 through 0) are strobed into the drive Difference Counter (J3) by the Set Difference Tag.

5. The Start-Seek command (Drive Bus 2) is strobed into the drive Command Decode Logic (J3) by the Control Tag.

In normal operation, after the heads have been loaded and the CPU is requesting access of the drive, the read/write heads are placed over a specific requested cylinder by an integral servo system. This system operates in a two mode configuration, course and linear. The operational servo system discussed herein includes the use of the Disk Servo Surface, DSS/PLO/DEMOD (J6), Safety Tach & Position (J7), Pulser Driver-Curve Generator (DAC) (J8), System Interface-Difference Counter (J3) and the EMA.

1. Coarse Mode - Figure 4-10

   The coarse mode is used when seeking from one cylinder to another. The Difference Counter is set to the number of cylinders to be moved. The magnitude of the digital number set in the Difference Counter is directed to the summing inputs of a Digital-to-Analog Converter/Curve Generator producing an analog signal whose magnitude is proportional to the distance to be moved. This signal is directed through a Summing Amplifier to produce the Servo Error signal directed to the Pulser Driver. This causes the EMA (Electro Magnetic Actuator) to move the carriage toward the proper cylinder. The velocity at which the carriage moves is proportional to the distance between the present position and the new cylinder location. As the carriage moves, signals from the Servo Heads are directed back through the Tachometer and into the Summing Amplifier where the signal from the DAC/Curve Generator and Tachometer are compared to maintain a controlled carriage velocity.

   Additionally the servo head signals are directed to the Difference Counter. The Difference Counter is decremented each time a cylinder is crossed. When the digital value in the Difference Counter drops below 256 the output of the DAC/Curve Generator decreases, causing the EMA to slow down. The closer the heads get to the specified cylinder, the slower the EMA moves. When the heads are within one half cylinder of the specified position the servo system is switched to the linear mode of operation.

2. Linear Mode - Figure 4-11

   The linear mode of servo operation is effective when the heads are within one half cylinder of their specified location. In the linear mode, the signal from the servo heads is directed through Filtering and Lead-Lag circuits to the Summing Amplifier to control the EMA and
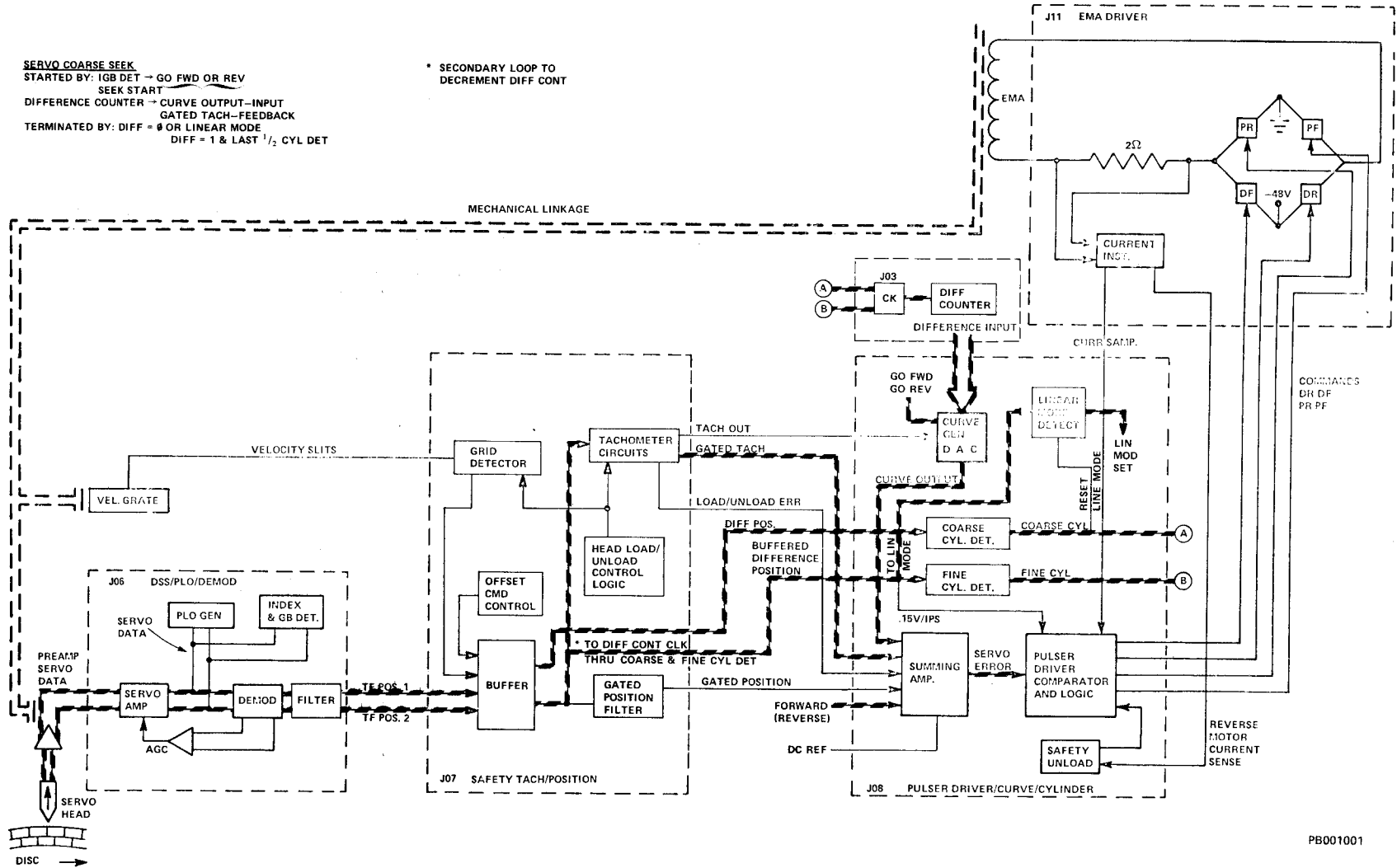
Figure 4-10. Servo System - Course Seek Block Diagram

SERVO FINE POSITION—(LINEAR MODE)
INITIATED BY: LINEAR MODE
            LATCH SET BY: LINEAR MODE SET
                          DIFF = 0 (IMPLIED SEEK)
            LATCH RESET BY: SEEK START
                          RECAL

LINEAR MODE LATCH SET
DEGATES CURVE OUTPUT
GATED TACH

MECHANICAL LINKAGE

J11   EMA DRIVER

EMA

2Ω

PR   PF

DF   −48V   DR

CURRENT
INST.

J03
CK
A
B

DIFF
COUNTER

DIFFERENCE INPUT

CURR SAMP.

COMMANDS
DR DF
PR PF

CURVE
GEN
D A C

LINEAR
MODE
DETECT

VELOCITY SLITS

GRID
DETECTOR

TACHOMETER
CIRCUITS

TACH OUT
GATED TACH

VEL. GRATE

LOAD/UNLOAD ERR

CURVE OUTPUT

DIFF POS.

COARSE
CYL. DET.

COARSE CYL

A

BUFFERED
DIFFERENCE
POSITION

FINE
CYL. DET.

FINE CYL

B

J06   DSS/PLO/DEMOD

HEAD LOAD/
UNLOAD
CONTROL
LOGIC

SERVO
DATA

PLO GEN

INDEX
& GB DET.

OFFSET
CMD
CONTROL

OFFSET
DC LEVEL

BUFFER

GATED
POSITION
FILTER

GATED POSITION

SUMMING
AMP.

SERVO
ERROR

PULSER
DRIVER
COMPARATOR
AND LOGIC

PREAMP
SERVO
DATA

SERVO
AMP

DEMOD

FILTER

TF POS. 1

TF POS. 2

FORWARD
(REVERSE)

DC REF

SAFETY
UNLOAD

REVERSE
MOTOR
CURRENT
SENSE

AGC

SERVO
HEAD

J07   SAFETY TACH/POSITION

J08   PULSER DRIVER/CURVE/CYLINDER

DISC →

PB000998

Figure 4-11.   8418 Servo System - Block Diagram

maintain on-track positioning. The Filtering and Lead-Lag Circuits are implemented to prevent head oscillations. Any movement off track center will be detected and corrected by the linear mode servo system.

3. Linear Mode - Offset - Figure 4-12

Linear Mode Offset may be commanded by the IDA when data reading errors are detected and is accomplished by directing an error voltage to the servo system. This voltage causes the heads to move 350 or 700 micro-inches off track center in either direction which may allow for reading of damaged data or data which may be off track center for some reason.

4.4.4   Head Unload Mode - Figure 4-13 and Figure 4-14

The head unload cycle, like the load cycle, is a two phase operation.

1. Phase 1 - Fixed Velocity Mode

When a power-down command is issued either from the CPU or the Operator Control Panel, the heads are moved from their present position to the outer guard band in the fixed velocity, 10 IPS, mode. As the heads move accross the pack the servo heads direct signals through the Track Following Tachometer to the Summing Amplifier for EMA control. When the servo heads reach the outer guard band the Track Following Tachometer is disabled and the load/unload tachometer is enabled for phase 2 the unload operation.

2. Phase 2 - Optical-Mechanical Mode

The heads are unloaded using the Velocity Safety Grid in the same manner as the load operation. When the carriage nears the backstop the heads retracted switch is activated, allowing the spindle motor to shut off. The unload continues until the carriage is stopped by the rear stop. This completes the unload cycle.

4.5.5   Safety Unload Mode - Figure 4-15

The safety unload mode is used to rapidly remove the heads from the pack in the event of any unsafe condition, except read or write unsafe. The unsafe conditions are listed in subsequent paragraphs. In the safety unload mode, the normal servo circuitry is disabled and power is directed to the EMA through the driver transistors on the Pulser Driver Board (J8). The EMA current is compared to a reference standard to maintain the safety unload velocity at 13 IPS. The safety unload cycle is terminated upon actuation of the heads retracted switch at the carriage back stop.

ON TRACK/ISSUE OFFSET/CHANGE OFFSET DIRECTION

+SEEK COMMAND

+OFFSET CONTROL

* +OFFSET DIRECTION LATCH

OFFSET MAGNITUDE LATCH
(+ = H1)

+OFFSET SINGLE SHOT — 14 MSECS

+SEEK TO OFFSET LATCH

+INTERRUPT — RESET BY READ GATE

−ENABLE SERVO OFFSET
INPUTS AND DIRECTION

FROM TRACK "A" TO TRACK "B" WITH OFFSET/RESET OFFSET

+SEEK COMMAND

+HEAD/DIR TAG

+DIFF. TAG

+OFFSET CONTROL

**+OFFSET DIRECTION AND
MAGNITUDE

+OFFSET SINGLE SHOT — 14 MSECS

−ENABLE SERVO OFFSET
INPUTS AND DIRECTION

+SEEK COMPLETE

+DIFF = 0

+INTERRUPT — RESET BY READ GATE

ON TRACK AND OFFSET/SEEK TO NEW TRACK WITHOUT OFFSET

+SEEK COMMAND

+HEAD/DIR TAG

+DIFF TAG

+OFFSET CONTROL

+OFFSET SINGLE SHOT — 14 MSECS

−ENABLE SERVO OFFSET
INPUTS AND DIRECTION

+SEEK COMPLETE

+DIFF = 0

+SEEK FROM OFFSET

SEEK START

OFFSET/SEEK DIRECTION
LATCH — DIRECTION LATCH IS SET AT
TRAILING EDGE OF HEAD/DIR. TAG
(NOTE: THIS IS NOT THE OFFSET
DIRECTION LATCH)

* FOR SIMPLICITY, THE LATCH IS ASSUMED RESET BEFORE
OFFSET COMMAND IS GIVEN
**THE DIRECTION AND MAGNITUDE LATCH ARE SET TO THE
APPROPRIATE STATES AT THE TIME OF THE ARROWS.

PB001014-4

Figure 4-12. Offset Mode Sequence

DRIVE POWER ON,
DISK AT SPEED

SHUT DOWN
CAUSED BY
DRIVE FAILURE

NO ← → YES

PICK HOLD
DEACTIVATED

NO → SHUT DOWN
INITIATED AT DRIVE

YES

SHUTDOWN
AT SYSTEM LEVEL

ON/OFF
SWITCH OFF

ACTIVATE
SAFETY UNLOAD

SET HOLD REVERSE
LATCH EXTINGUISH
RUN LIGHT DRIVE
GOES OFF LINE
LIGHT STOP LIGHT

CARRIAGE
MOVING TOWARDS
MAGNET

NO

RETRACT CARRIAGE
TO REAR STOP.
LIGHT DEVICE CHECK.
EXTINGUISH RUN
LIGHT.
LIGHT STOP LIGHT

ACTIVATE NORMAL
HEAD UNLOAD

YES

DIFF < 4

NO

DRIVE GOES
OFF LINE

YES

HEADS
RETRACTED

NO

RESET ON
LATCH

YES

RESET MOTOR
START LATCH.
TURN OFF MOTOR

ONESHOT IS ON
POWER REG. CARD

START .5 SEC.
ONESHOT

SET ON LIGHT
BLINK LATCH

ON LIGHT
STARTS
BLINKING

.5 SEC ONESHOT
RESET

NO

YES

ACTIVATE
MOTOR BRAKE

PACK
STOPPED

NO

YES

ON LIGHT TURNS OFF
BRAKE TURNS OFF

END OF SEQUENCE

PB001011-3

Figure 4-13. Power Off/Head Unload Sequence - F/C

ON/OFF SW

*—DIFF $<$ 4 · REVERSE ————→ IF WAITING FOR DIFF $<$ 4

+START ENABLE ————→ IF GOING TOWARD HOME ALREADY

—SET HOLD REVERSE

+HEADS RETRACTED

—MOTOR START

—STOP LAMP

—PACK STOPPED

—ON LAMP   ON LAMP BLINKS
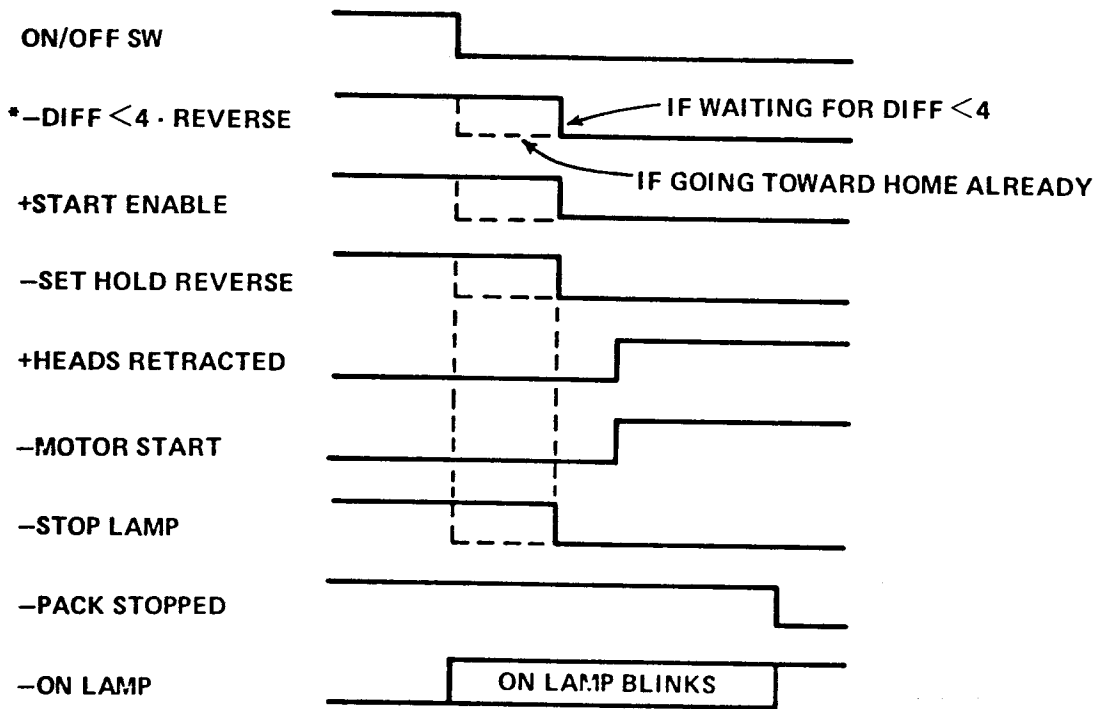
*IF CARRIAGE IS MOVING TOWARDS SPINDLE, THE ON/OFF SWITCH
IS NOT RECOGNIZED UNTIL THE DIFFERENCE COUNTER IS LESS
THAN 4. DOTTED LINES INDICATE EVENTS IF CARRIAGE IS MOVING
TOWARD MAGNET (REVERSE).

WRITE READY UNSAFE

ASSUME WRITE GATE AND ACCESS READY TO BE TRUE

—FINE CYL

+WR READY UNSAFE
  ONESHOT

+WR READY UNSAFE
  CHECK LATCH

—SET WRITE READY UNSAFE
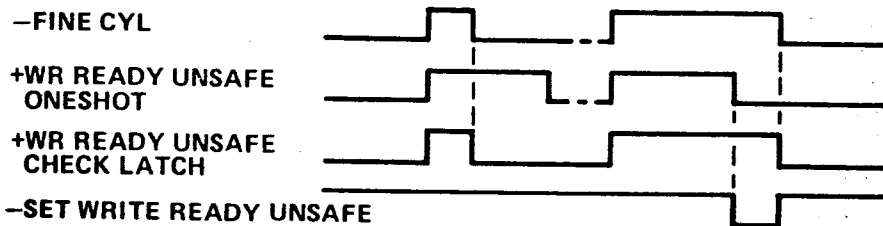
PB001010-3

Figure 4-14.   Power Off/Head Unload
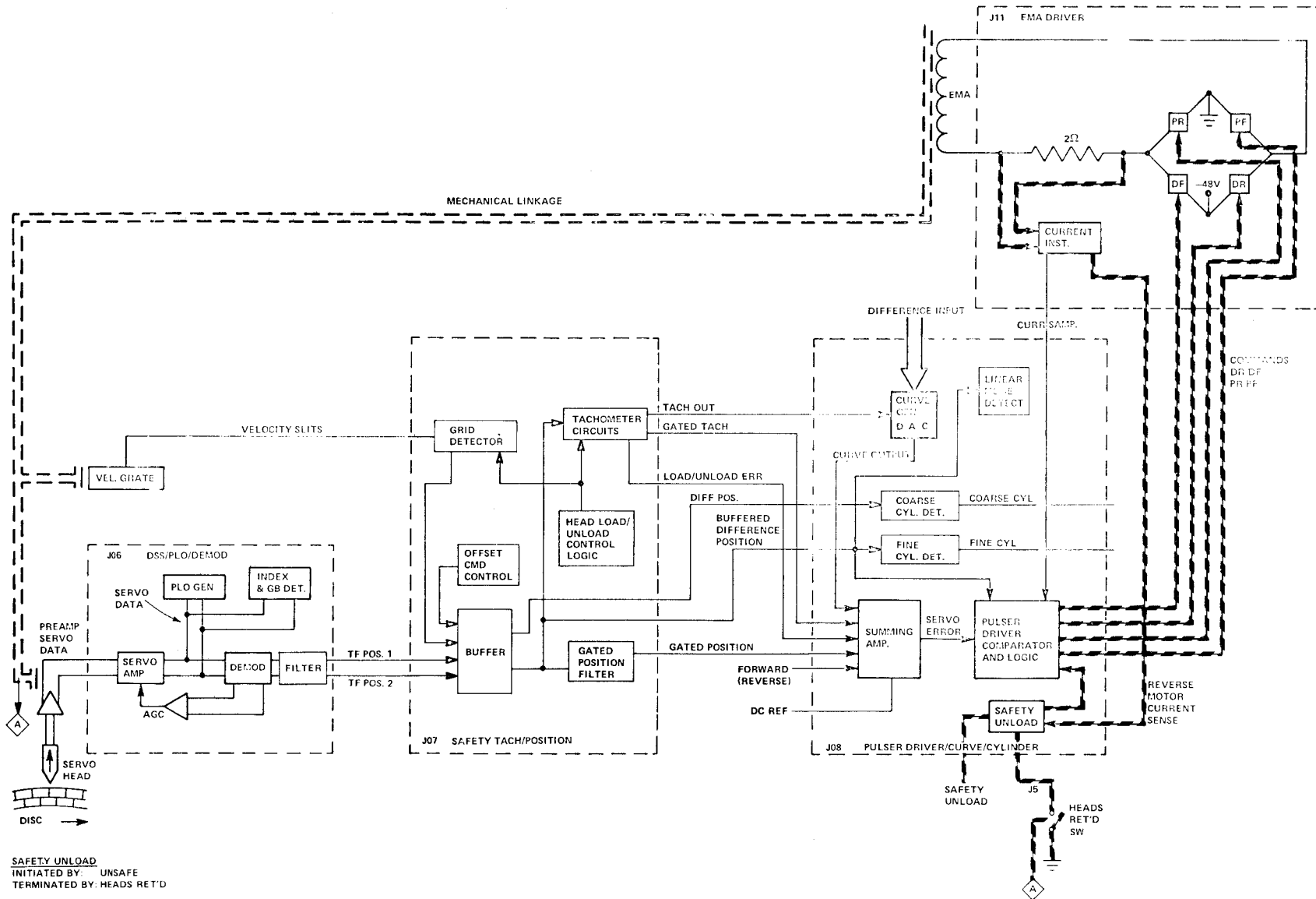
Figure 4-15. Safety Unload Function Diagram

PB001000

4.5 MEDIA ROTATION & SERVO DATA

The disk pack is secured to the drive spindle by a pack lock mechanism. Installation of the disk pack and rotating the pack cover handle in the clockwise direction secures the pack to the spindle. Rotation of the pack cover handle in the counterclockwise direction is required to release the pack from the spindle and secure the pack to the protective dust cover.

A Pack in Place switch provides a power interlock to prohibit starting the drive motor except when a pack is installed on the drive. The Pack in Place switch is a spring-loaded locking shaft, threaded on the upper end and located inside the spindle. When a pack is not installed, the shaft extends through the bottom of the spindle, where it rests over the Pack in Place switch ground flexure, preventing the electrical switch from closing.

Upon installation of a disk pack and removal of its cover, the disk pack spindle lock will engage the threaded portion of the locking shaft. The locking shaft is thereby retracted upwards away from the pack in place switch contact arms, activating the pack-in-place switch. Spring loading on the shaft engages a ball lock mechanism in the disk pack spindle lock, securing the disk pack to the spindle assembly and simultaneously freeing the top cover from the pack so it can be lifted away.

With the pack secured to the spindle and all start conditions satisfied the power control network is enabled and AC power is directed to the drive motor. The AC motor is coupled to the spindle by a belt. With power applied, the disk pack is rotated at 2800 RPM.

Refer to figure 4-16.

The storage medium, used in the 8418 Disk Storage Drive, consists of seven recording surfaces, one prerecorded servo surface, and top and bottom protective covers. The seven recording surfaces and servo surface are arranged on the top and bottom of the four (4) recording disks with the servo surface located on the top of the fourth platter from the top. Recording surfaces are composed of magnetic material that is polarized to conform to data patterns written on the pack.

4.5.1 Track and Cylinder Formation

Refer to figure 4-17.

Each of the seven recording heads are mechanically aligned in respect to the servo head to form a cylinder, thus when a particular cylinder (of 815 cylinders) is accessed, all seven data tracks of that cylinder are simultaneously in position for storage or retrieval of digital information by the R/W heads. Cylinders 000, 440, and 814 are illustrated. The head load zone is an erased area used to allow the heads to approach the disk during head load, thus protecting the data recorded on the disk from distortion caused by mechanical contact between the disk and head. The Outer Guard Band, composed of 23 odd servo data tracks, defines the outer limit of the disk pack. The inner guard band, consisting of 34 even servo data tracks, defines the inner limit of the disk pack. 815 tracks of servo data, alternating odd and even, define the corresponding R/W area of all surfaces.
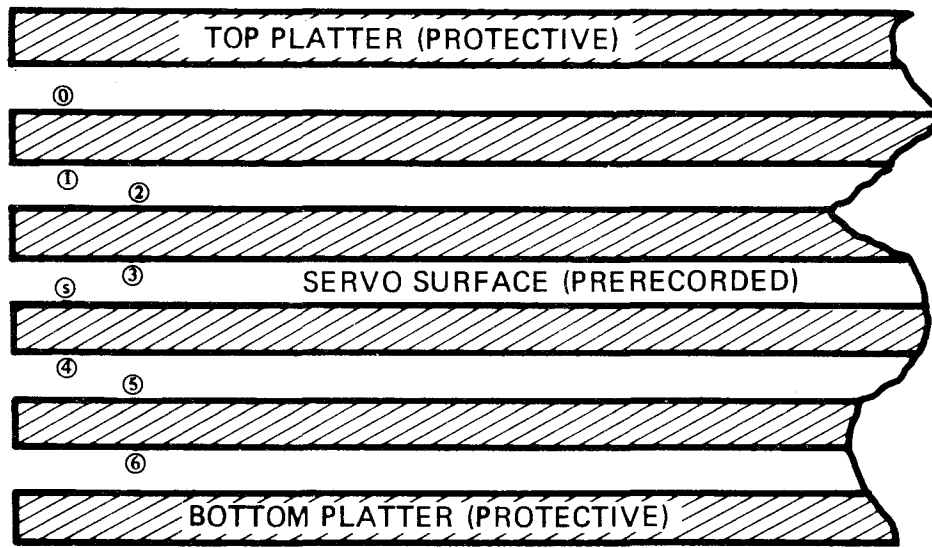
PB001008-1

Figure 4-16. 8418 Disk Pack Architecture
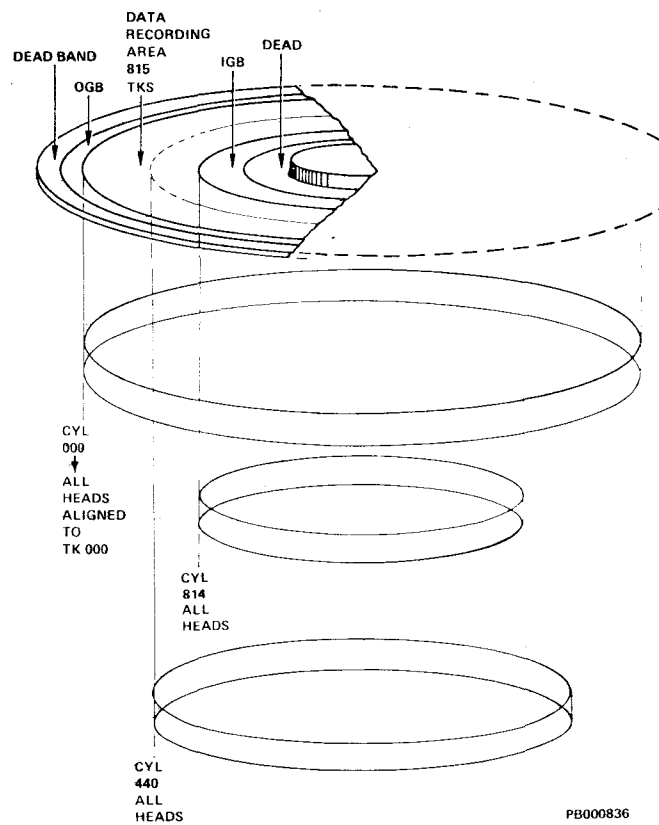
PB000836

Figure 4-17. Disk Pack Physical Servo and R/W Surface Format

4.5.2   Servo Data Format

Refer to figure 4-18.

Even servo data is defined as that which has negative then positive peaks. Each set of peaks is defined as a di-bit. Odd servo data is defined as that which has positive then negative peaks. The first half of each di-bit is used for servo (carriage and head) positioning error detection. The servo head is positioned so that it detects equal values of odd and even di-bits in straddling fashion; the R/W heads are designated as being on track at that point.
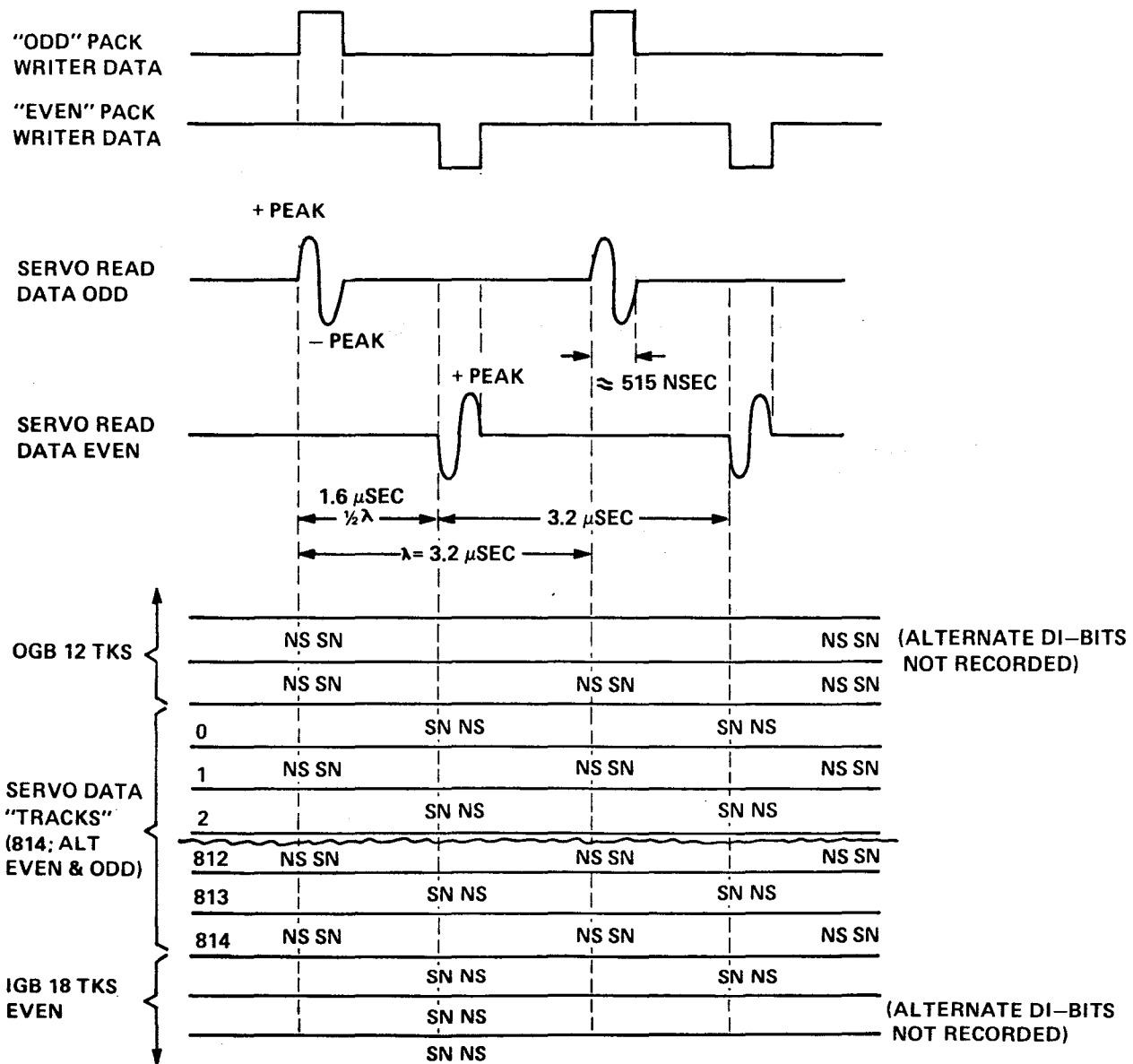
Figure 4-18.   Servo Track Data Format

Data Track (Cylinder) 814 is located at the boundary between the innermost odd servo data track and the first even track of the Inner Guard Band. The Inner Guard Band, composed of 34 even servo data tracks, defines the inner limit of the pack. Even servo data tracks with every other even Dibit missing are decoded by the drive logic as the Inner Guard Band during carriage positioning (seek and recalibrate) sequences.

4.5.3 On-Track Positioning

Figure 4-19 illustrates the basic theory of servo (carriage) positioning error detection when the R/W heads are positioned to cylinder 131.

The servo head is positioned over odd and even servo data so that it may detect both equally. This operation, called straddling, creates a null within the positioning drive circuits, and concurrently, all R/W heads are centered over their respective track 131 to create cylinder 131. If the servo head detects more even servo data than odd data, the resultant differential error (detected from the voltage peak of the first half of each di-bit) forces the servo positioning system to move the carriage in reverse (away from pack center) until null is once again achieved. Opposite motion occurs if the servo positioning system detects more odd, than even, data. The reverse is true if the servo positioning system is straddling for even R/W track (cylinder) detection (e.g., cylinder 132). This is controlled by the status of the Cylinder Address Register (CAR Bit 1) which always contains the address of the cylinder desired.

Figure 4-20 illustrates the detection of differential error track-following position signals (P1 and P2) from even and odd di-bit peaks. If the R/W heads are on track, the P1 and P2 DC voltages are equal. If data checks occur during a Read operation due to R/W head misalignment (OFFSET), the control unit executing the read operation may execute an offset command to the drive. The effect of this command is to introduce to the servo positioning system a DC voltage proportional to desired offset. The carriage is then positioned so that the DC voltage difference between P1 and P2 is equal and opposite to the DC offset voltage. Refer to paragraph 4.3.1 for the OFFSET COMMAND description as it controls servo positioning operation.

4.5.4 Servo Data for Seek Operation

Since one of the TF Position signals is subtracted from the other during a seek operation, it is convenient to consider their relationship by the waveforms as shown in figure 4-21.

The servo positioning system detects these waveforms as a series of clock pulses. The difference counter, previously loaded with the desired cylinder location is decremented by these clocks, its output at zero when actual and desired carriage positions coincide.

Figure 4-37 illustrates servo data di-bit patterns and resultant TF POSITION SIGNAL DC voltages (TF1 and TF2) when the servo head is positioned over EVEN and ODD servo data (views A and E), on track (view C), and with offset introduced (views B and D).

SUBSTRATE

PLATTER 3

BOTTOM

R/W HEAD

COATING

130

132

.0023"

SERVO PREAMP OUTPUTS

AMPL

SERVO SURFACE

ODD DATA   EVEN DATA   ODD DATA   EVEN

TOP

PLATTER 4

BOTTOM

R/W HEAD

130

132

R/W HEAD

130

132

PLATTER 5

.0027"
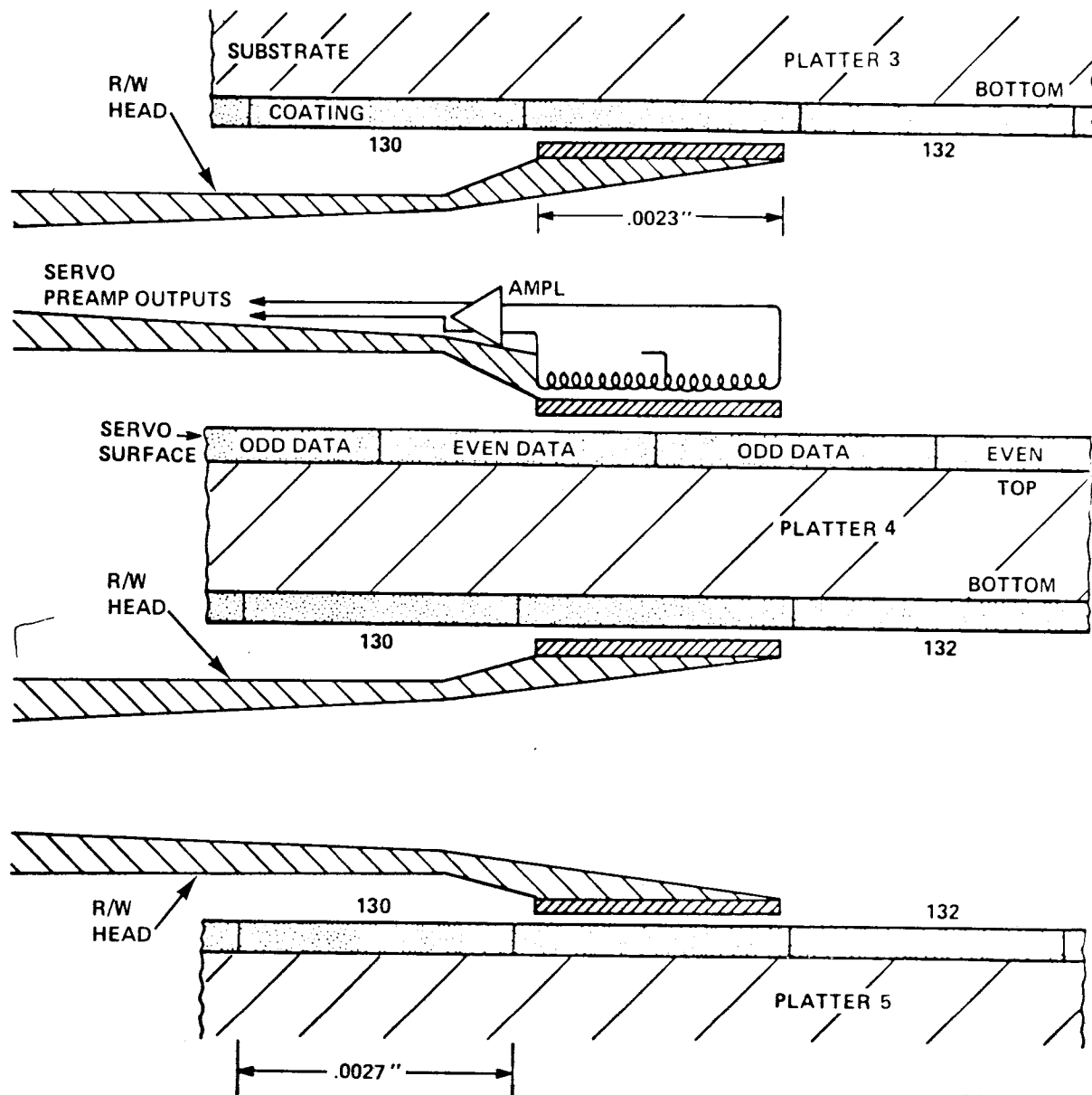
PB001013-4

Figure 4-19. Servo Track Detection
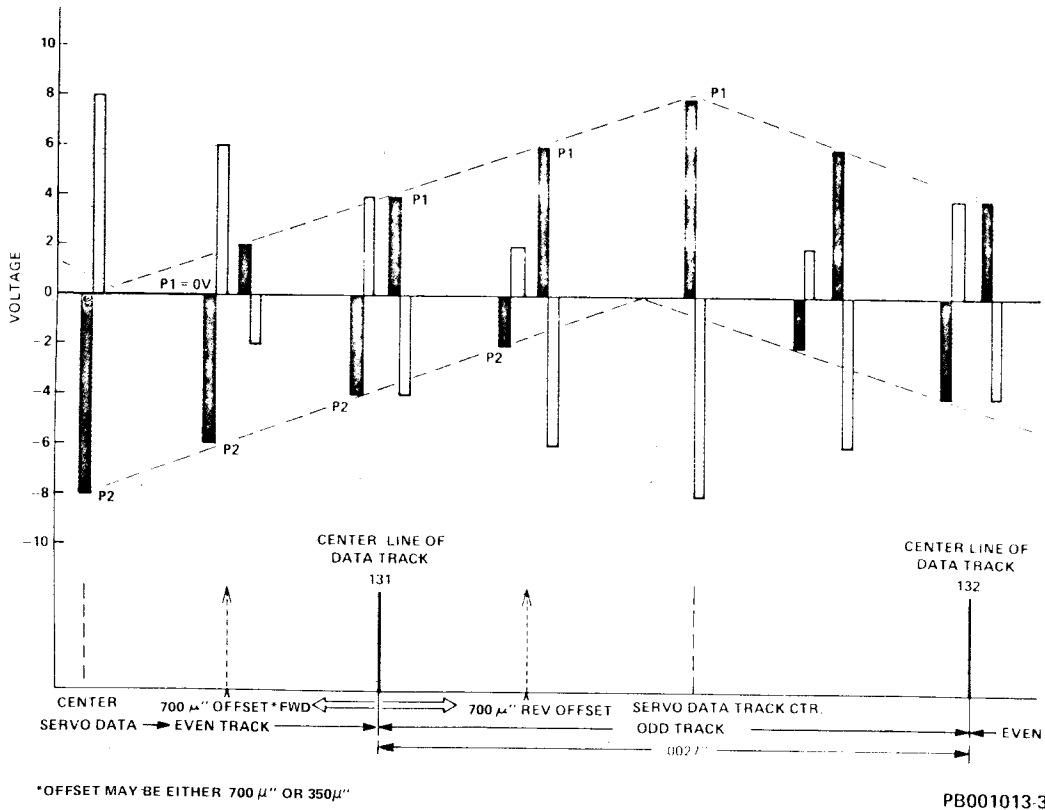
Figure 4-20. Track Following Position Signal Detection
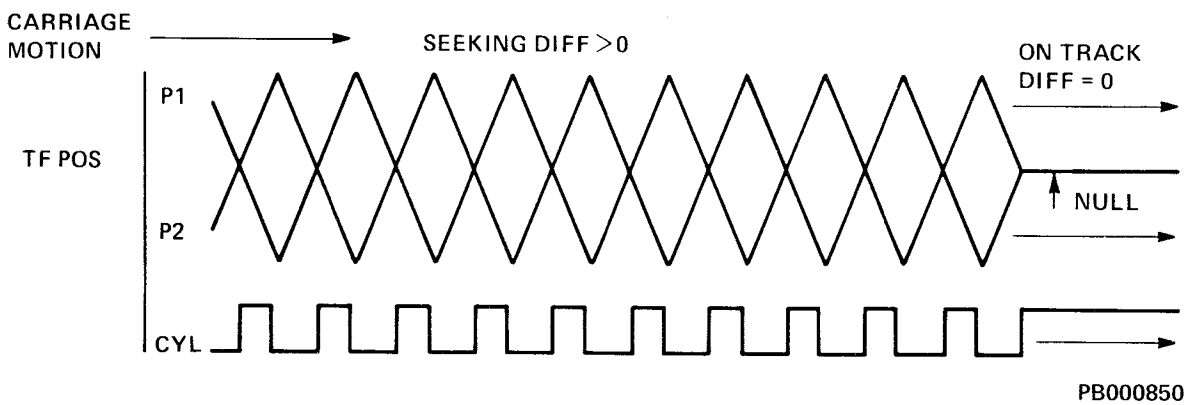
Figure 4-21. TF Position Information During Seek Operations

4.5.5 Servo Clock Data

SERVO CLOCK DATA (figure 4-22), detected from the <u>second half</u> of each dibit, provides the following clocked functions synchronous with pack speed:

- INDEX CLOCK — Used for detection of the start of each servo data track on the pack, and for clocking the sector logic for Rotational Position Sensing (RPS) IDA commands.

- PLO SYNC — Establishes the basic rate (1.59 μsec or 625Kb) at which byte data is written on, and read from, the pack.

- PHASE LOCKED OSC (PLO) — Output of 16 pulses synchronous with generation of PLO SYNC. Bit Cell time, the time required to write 1 bit of data, is 200 nsec; the period for each set of 2 PLO pulses.

Index Pattern

Refer to figure 4-36.

Index data patterns, located at the start of each track of odd or even servo data, are required by the drive in defining the limits of each R/W track during Format Write and Read operations, and by the IDA in order to select the next R/W head in sequence, after a previous head has read an entire track during sequential search operations.

4.6 READ-WRITE OPERATIONAL DESCRIPTION

The CPU commands the IDA to select a read-write head in a particular disk drive. The Mod Select Line for the drive to be accessed is made active and the IDA strobes the head select code into the HAR (Head Address Register) on the System Interface Board (J3), using the Head Set, Direction, MSB Tag. The head set code is directed to the Read-Write Board (J1), where it is checked for multiple head selection, and into the Read-Write Matrix (A3). The Read-Write Matrix decodes the address to select the proper read-write head.

4.6.1 Read Mode

The read mode is selected by the CPU through the IDA after read-write head selection. After the proper read-write head has been selected, the CPU issues a read command through the IDA which is strobed into the Command Decode Logic on the System Interface Board (J3) using the Control Tag. The read command is directed to the Read-Write Board to enable the read operation. In a read operation the proper head is selected by logically grounding the center tap of the heads' transducer. Data on the disk surface is detected by the transducer in the head and directed to the preamplifier located on the Read-Write Matrix where it is amplified, filtered, peak-detected and buffered before it is directed to the amplifier on the Read-Write Board. The output of the amplifier on
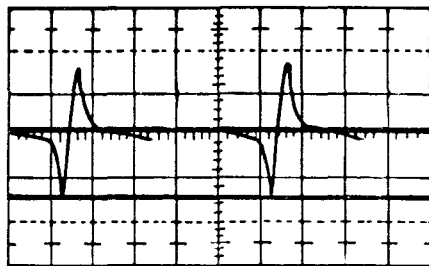
VIEW A. HEAD POSITIONED
OVER EVEN SERVO TRACK
(INNER GUARD BAND—EVERY
OTHER EVEN DI-BIT MISSING)
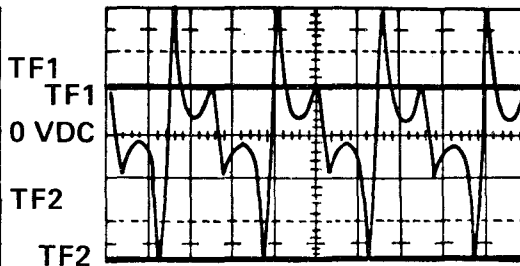
VIEW B. HEAD POSITIONED
WITH 700 MICROINCHES
FORWARD OFFSET FROM
THE CYLINDER POSITION
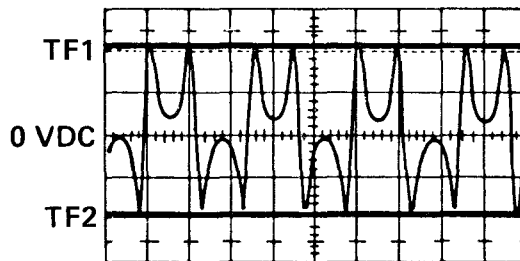
VIEW C. HEAD CORRECTLY
POSITIONED OVER CYLINDER
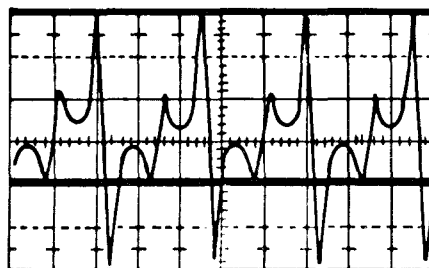
VIEW D. HEAD POSITIONED
WITH 700 MICROINCHES
REVERSE OFFSET FROM THE
CYLINDER POSITION
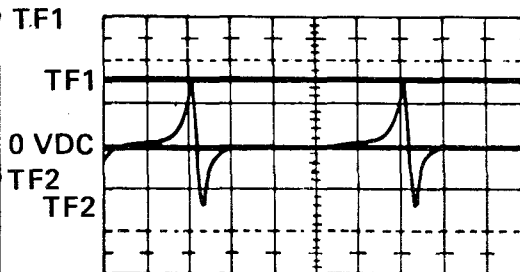
VIEW E. HEAD POSITIONED
OVER AN ODD SERVO TRACK
(OUTER GUARD BAND—EVERY
OTHER ODD DI-BIT MISSING)

PB001014-3

Figure 4-22. Track Following Servo Waveforms

the Read-Write Matrix is directed to the Input Amplifier on the Read-Write Board. This amplifier provides gain selection, buffering, filtering and limiting of the read data before it is directed through the IDA to the CPU for processing.

4.6.2   Write Mode

The write mode is selected by the CPU through the IDA after read-write head selection After the proper read-write head has been selected, the CPU issues a write command through the IDA which is strobed into the Command Decode Logic on the System Interface PWA using the Control Tag. The read command is directed through the Read-Write Board to the Read-Write Matrix to enable the write logic. Data is written on the disk surface in a MFM (Modified Frequency Modulation) format.

As the heads move toward the center of the pack they fly closer to the disk surface. Therefore, less current is required to drive the read-write transducers. The CAR (Carriage Address Register) 512 and 256 bits are directed to the Read-Write Matrix through the Read-Write Board where they are logically gated to select the write current relative to the head position on the disk.

4.7   READ/WRITE MATRIX PWA

4.7.1   Read/Write Matrix Output Mnemonics

PIN	SIGNAL	DESTINATION
7	I Write Sense	J20-27, J1-117
38	Transitions Detect	J20-18, J1-113
37	Multi Hd Sel	J20-17, J1-115
3	+Diff Sig	J20-23, J1-10
4	-Diff Sig	J20-24, J1-9

4.7.2   Read/Write Matrix Block Diagram Description

Figure 4-23 illustrates the major functional blocks of the Read/Write Matrix PWA. The Read/Write Matrix PWA contains the Read/Write Head Selection Circuits. These circuits logically ground the center tap of the read/write transducer comparator and monitor the head select circuits. When more than one head is selected for a read or write operation, it is detected by the Multiple Head Select Sensor and a Multiple Head Select signal is directed to the Read/Write PWA into the AC Write Unsafe circuits. In the read and write modes, the AC Current Sink is raised to a high level to enable the read amplifier input circuitry, or to enable the Write Drivers by supplying a current sink path to
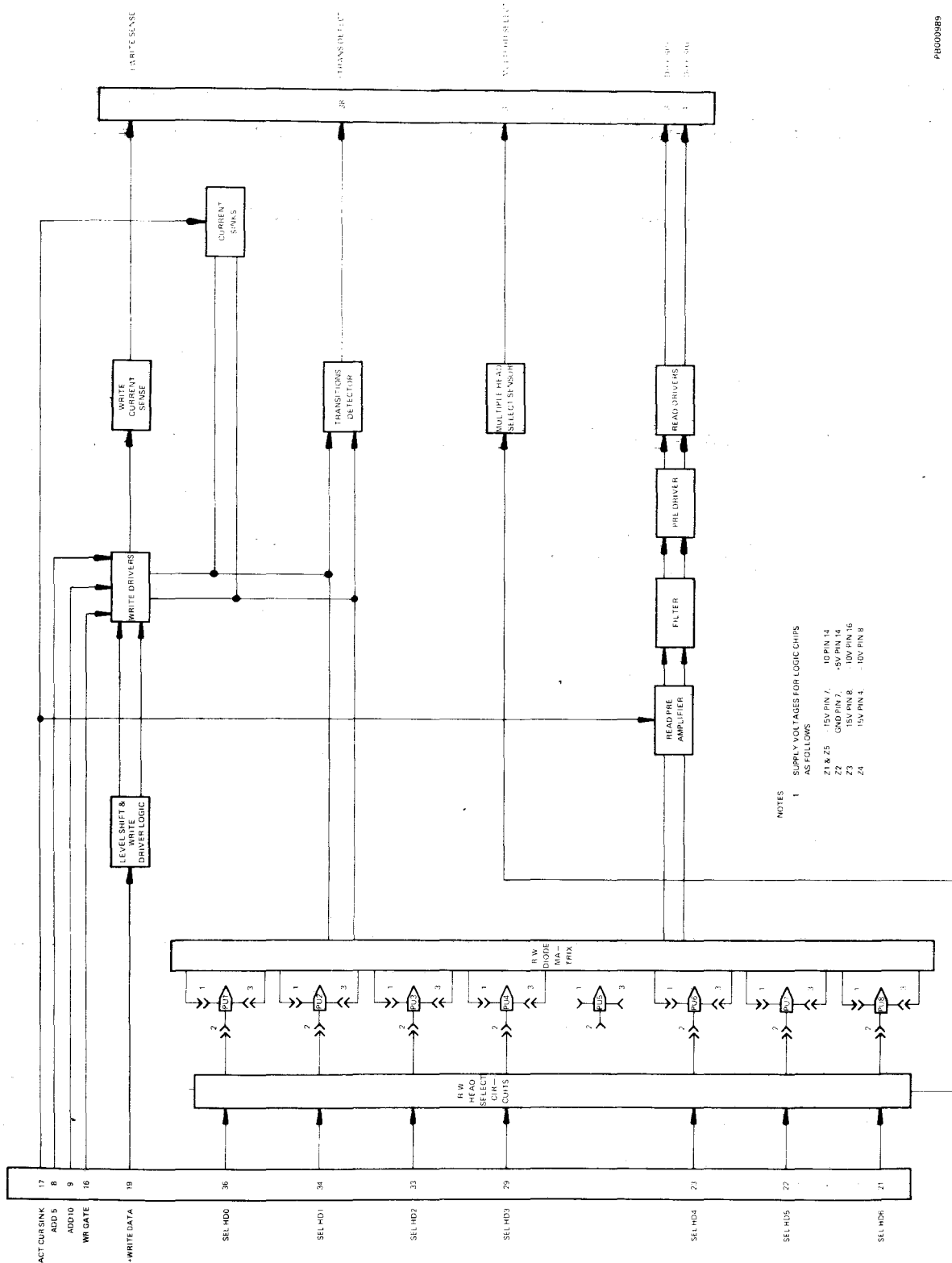
Figure 4-23. Read/Write Matrix PWA Block Diagram

the input of the Write Drivers. The Write Current Sense and the Transitions
Detector are used to monitor the activity of the Write Drivers. Their respec-
tive signals are directed to the Read/Write PWA to the Write Unsafe circuits.
The write current to the heads is adjusted by detecting and decoding the CAR
512 and 256 bits. Current is controlled by selection of precision collector
resistors in the output stages of the write drivers. In the read mode, the
signals from the heads are directed into the Read Preamplifier which has a
gain of approximately 5. It drives a Differentiator with a gain of approximately
2.5. The differentiator converts data signal peaks to zero crossings of approx-
imately 20 millivolts. The Differentiator drives the Filter Input Amplifier
whose gain is approximately 20. The signals are then passed through the filter
and into a Linear Impedance Predriver and then to the input of the Read Driver.
The output of the Read Driver will vary between 300 millivolts and 1 volt. The
Read Driver output is directed into the Input Differential Amplifier on the
Read/Write PWA.

4.8   READ/WRITE PWA

4.8.1   Read/Write Output Mnemonics

PIN	SIGNAL	DESTINATION
26	-Intlk	J5-J1, J5-99
30	+RD/WR Data	J20-39
32	RD/WR Data	J19-4
34	RD/WR Data	J19-3
83	-A Gate T.P.	
84	-B Gate T.P.	
85	-Delay Write Gate T.P.	
86	-Set DC Write Gate Unsafe	J5-54
91	-15 x -10 Add	10 J1-29
92	-15 x -10 Add	5 J2-28
94	-WR Gate	J2-36
95	+Act Curr Sink	J5-37
104	Sel HD 0	J2-16
106	Sel Hd 1	J2-14
108	Sel Hd 2	J2-13
109	Sel Hd 3	J1-9
110	Sel Hd 4	J2-3
111	Sel Hd 5	J1-2
112	Sel Hd 6	J2-1

4.8.2   Write/Read Amplifier Abbreviated Input/Output Mnemonics

When using this listing refer to figure 4-24 and figure 4-3.

INPUT SIGNALS	FROM	LOGIC BLOCK
HAR 1,2,4	System Interface (J3)	HAR DIRECTION
RD/WR HO Select	System Interface (J3)	Command Decode
MFM Encoded RD/WR Data	CPU	CPU
CAR 512, 256	System Interface (J3)	CAR
Unsafe Sense	Matrix (PWA) R/W Data (A3+A3)	Same
Differential Linear RO Data	Matrix PWA R/W Data (A3+A3)	Same
OUTPUT SIGNALS	TO	LOGIC BLOCK
Read/Write Controls	Matrix PWA (A3)	Same
Head Selects	Matrix PWA (A3)	Same
Write Data	Matrix PWA (A3)	Same
AC Write Unsafe		
DC Write Unsafe		

4.8.3   Read/Write PWA Block Diagram Description

Figure 4-25 illustrates the basic functional block of the Read/Write PWA. The Read/Write PWA contains the Head Select Logic, AC and DC Write Unsafe Circuitry, MFM Demodulator circuits, and the Read Amplifiers. Head selection is accomplished by raising the head select signal and decoding the HAR 1, 2 and 4 bits in the Head Decode Matrix. The AC Write Unsafe circuits monitor the outputs of the Read/Write Matrix PWA and the DC Write Unsafe circuits monitor the write current from the Read/Write Matrix PWA and the DC unsafe signals from the Power Supply Regulator PWA.

In the read mode the signals from the Read/Write Matrix are directed into the Input Differential Amplifier and through the Gain Change Logic. The Gain Change Logic attenuates the output of the Input Differential Amplifier in a range from 9 to 5. This is accomplished by decoding the CAR 512 and 256 bits and controlling the current through a pair of back-to-back diodes. The read signals are then directed into the Differential Buffer. The outputs of the Differential Buffer are directed into the A and B Gate Generator (11.5 Nanosecond Single Shot) and through the Linear Phase Delay Network into the Differential Limiter. The MFM Demodulator is made up of the Differential Limiter, Current Limiting and Gate Logic, A and B Gate Generator and the Pulse Maker. The wave forms on the Read/Write block diagram illustrate the output signals from the respective blocks.

MC8309

HAR ⟶ | | ⟶ READ/WRITE CONTROL
RD/WR HD SELECT ⟶ | WRITE/READ AMPLIFIER | ⟶ HEAD SELECTS
MFM ENCODED RD/WR DATA ⟶ | | ⟶ WRITE DATA
CAR 512, 256 ⟶ | |

UNSAFE SENSE ⟶ | | ⟶ AC WRITE UNSAFE
| | ⟶ DC WRITE UNSAFE
DIFFERENTIAL LINEAR READ DATA ⟶ | |
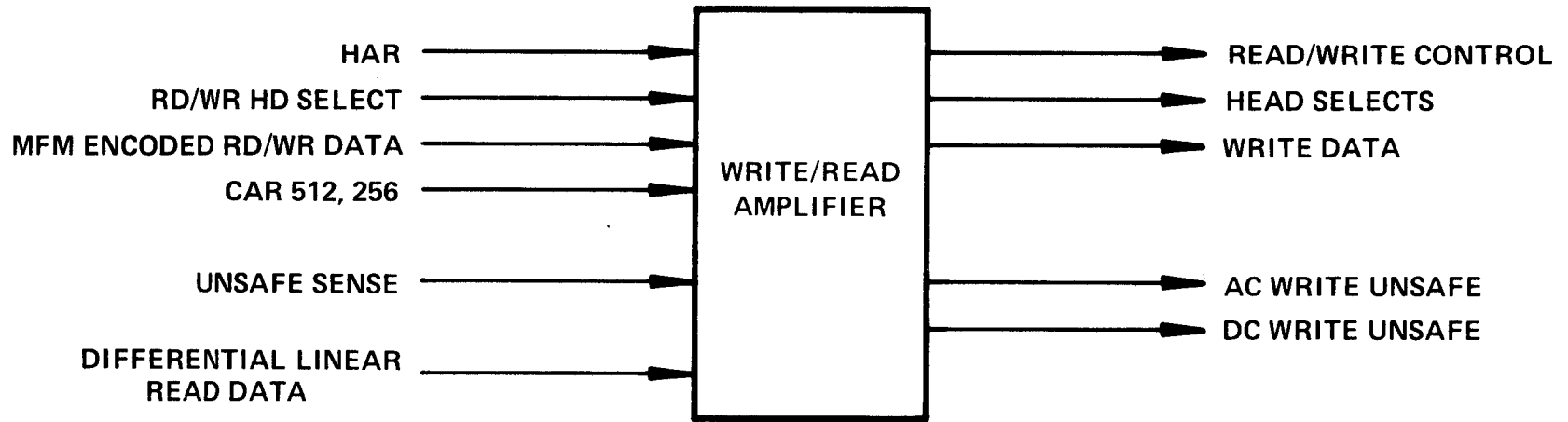
PB000991-2

Figure 4-24.   R/W PWA Abbreviated Block Diagram
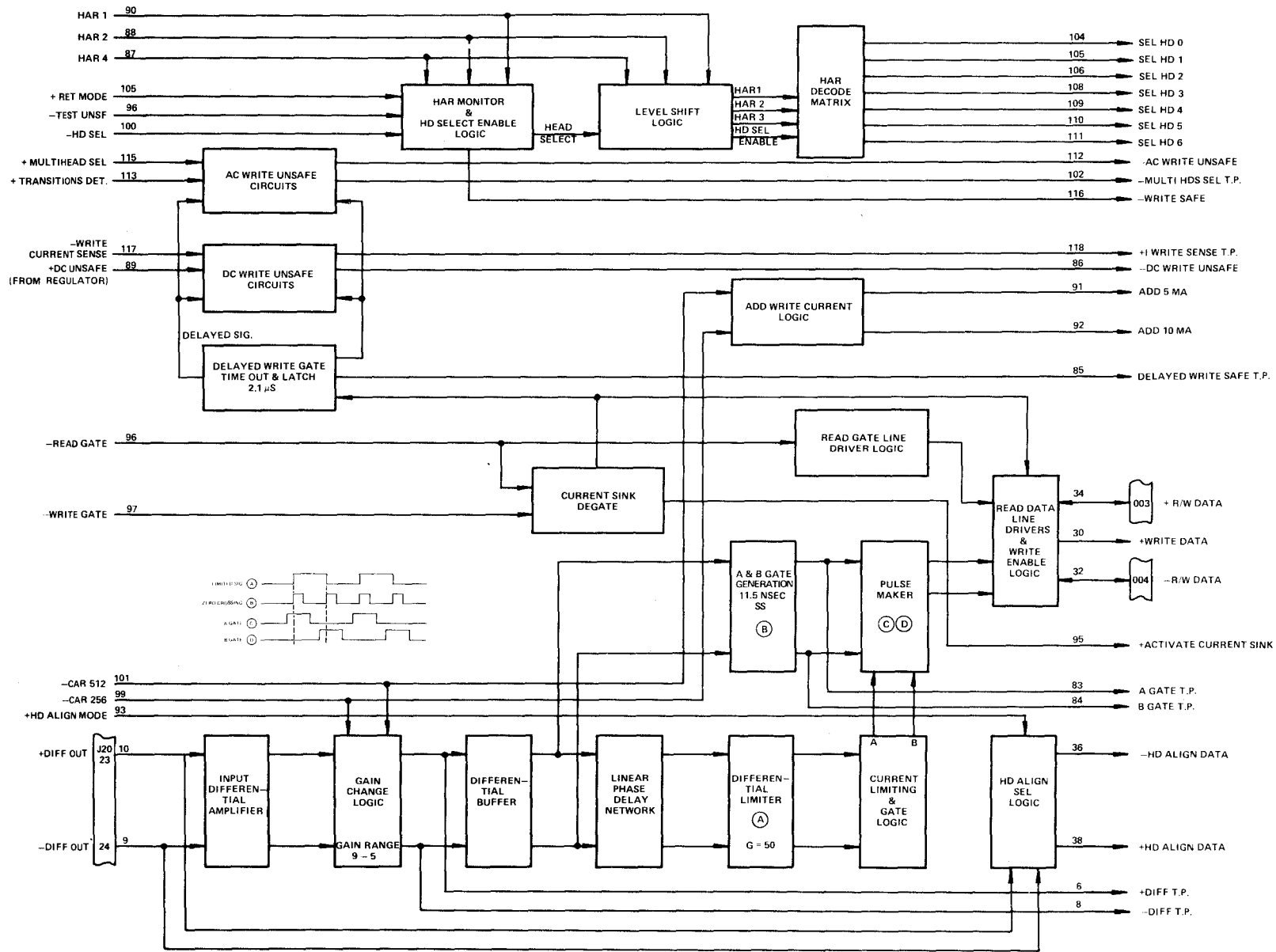
Figure 4-25. Read/Write Functional Block Diagram

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4.9   SYSTEM INTERFACE PWA

4.9.1   System Interface Input Mnemonics

PIN	SIGNAL	DESTINATION
1	GND	
2	GND	
6	-INTLK	J3-J6-J6-17
12	-RETR MODE	J5-105
15	-DIFF=0	J5-55, J18-23
18	-Linear Mode	J5-27
19	-HD ALIGN MOD	J18-85
21	-Set Diff Ctr TP	
27	T.P.	
28	T.P.	
30	-DR FWD 10 IPS	J5-31
34	-Coarse Cyl	J8-117
36	-Fine Cyl	J8-114
38	+Inner GB	J6-91
39	+5	
40	+5	
45	+LO DEN MODE	J22-39
46	+SEEK COMP	J5-34
51	-CE BOX INHIBIT	J19-33
53	RESET DIFF CNTR TP	
54		
56	+SET RECALL DIFF	J5-104
59	+FILE PROT LAT	J22-02
60	T.P.	
62	-TEST UNSAFES	J18-30
63	-HD ALIGN SW	J18-73
72	+SEEK INCOMP	J5-49
74	-ON LINE	J5-6
76	+INTERRUPT	J5-10
79	+INDEX	J6-85
81	+5	
82	+5	
85	-CE BUSS 4	J18-31
86	-CONTROL TAG	J19-28
87	-CE BUSS 1	J18-89
88	-BUSS 16	J19-7
89	-CE BUSS 64	J18-30
90	-BUSS 4	J19-5
91	-CE-BUSS 2	J18-32
92	-BUSS 32	J19-8
93	-CE BUSS 8	J18-88
94	-CE CONTROL TAG	J18-91
96	-CE BUSS 4	J18-72
98	-CE BUSS 16	J18-23
99	-SEL FILE PROT	J19-38
101	-MOD SEL	J19-12, J18-48

System Interface Input Mnemonics (Contd)

PIN	SIGNAL	DESTINATION
102	-BUSS 64	J19-9
103	-SEL HI DEN MOD	J19-36
104	+HD/DIR TAG	J19-30
106	-CE BUSS 128	J18-92
107	-BUSS 2	J19-24
109	-BUSS 1	J19-26
111	-CE HD/DIR TAG	J18-94
113	-CONTROL TAG	J19-32
115	-CE DIFF TAG	J18-87
116	+DEVICE CHECK	J5-38
117	-BUSS 128	J19-10
118	+ACCESS RDY	J5-53
119	GND	
120	GND	

4.9.2 System Interface Output Mnemonics

PIN	SIGNAL	DESTINATION
3		
4	+DIFF=1	J1B-74
5	Intlk	J10-24
7	-Diff=3	J7-89
8	+HAR 1	J1-90, J18-B3
9	+HAR 2	J1-88, J18-84
10	-Invalid Cyl	J5-106, J18-53
11	+HAR 2	J1-87, J18-77
14	-Read Gate	J1-98, J5-92
16	-Zero Seek Int	J5-15
17	+Seek Command	J5-112
20	-Reset Car TP	
22	-Test PLO Unsafe	J6-90
23	+CAR 1	J18-75
24	+CAR 16	J18-79
25	+CAR 2	J18-76
26	+CAR 8	J18-70
29	-Rev	J5-85, J7-84, J7-109
31	+CAR 128	J18-71
32	-Diff=1 Not L/M	J5-79, J8-20

System Interface Output Mnemonics (Contd)

PIN	SIGNAL	DESTINATION
33	+CAR 4	J18-61
35	+CAR 32	J18-69
37	+CAR 64	J18-80
41	-CAR 512	J1-101, J18-40
42	-Block Seek	J5-115
43	-CAR 256	J1-99, J18-41
44	+Offset Mvmnt	J5-76
47	+High Density Mode TP	
48	-Head Sel	J19-100
49	-Mod Select	J5-43, J6-48
50	+Offset2 (Lo)	J7-06
52	=Offset1 (Hi)	J7-95
55	-Diff Bit 512	J18-46
57	-Diff Bit 256	J18-47
58	+CAR 1 Calc.	J3-61
61	-Diff Bit 4	J8-100, J18-88
64	-Diff Bit 32	J18-37, J8-102
65	-Write Gate	J1-97, J5-46
66	-Diff Bit 64	J18-44, J8-112
67	-Offset Control T.P.	
68	-Diff Bit 128	J18-43, J8-116
69	-Recall Command	J5-96
70	-Diff Bit 16	J18-86, J8-88
71	-Set Off Wrun	J5-33
73	-Diff Bit 8	J8-83, J18-34
75	-Diff Bit 8	J8-83, J18-34
77	+Diff Cntr Clock	J5-75, J7-35
78	-Diff Bit	J8-90, J18-39
80	-Diff LT4	J5-90, J6-92, J7-37
83	-Sel On Line	J19-34
84	-Gated Attention	J19-6
95	-Sel Seek Inc	J19-35
97	-Select Index	J19-37
100	-Early Warn	J19-15
108	-Sel File Unsafe	J19-14
110	Sel Sft Scop 3	J9-13
112	-Sel Scop 1	J19-13
114	-Sel Sft Scop 2	J19-12

4.9.3 Abbreviated System Interface I/O Signals

When using this listing refer to Figure 4-26 and figure 4-3.

INPUT SIGNALS	FROM
8 Bus	CPU
3 Tag	CPU
Module Select	CPU
Bus & Tags	DEDU I/O
Status Interrupt	Access Control (J8)
Index	Disk Speed PLO & Demod (J6) -Demod/Index Det/ GB Det
Fine & Course Cyls	Pulser Drive (J8) - Cylinder Detect

OUTPUT SIGNALS	FROM LOGIC BLOCK	TO
7 Status	Line Drivers	CPU
Attention	Line Drivers	CPU
3 Softscope	Line Drivers	CPU
Diff Bits & Decode	Diff Counter	Pulser Drive (J8) D/A Converter DEDU I/O
CAR Bits	Cyl, Add. Reg	DEDU I/O
CAR 512, 256	Cyl Add Reg	Write/Read Amp (J1)
HAR 1,2,4	HAR/Direction	DEDU I/O Write/Read Amp (J1)
Forward	HAR Direction	Access Control (J5)
RD/WR/Hd Sel	Command Decode	Write/Read Amp (J1)
Offset	Command Decode	Tach Servo & Velocity Safe (J7) - Servo
Recall Seek	Command Decode	Access Control (J5)
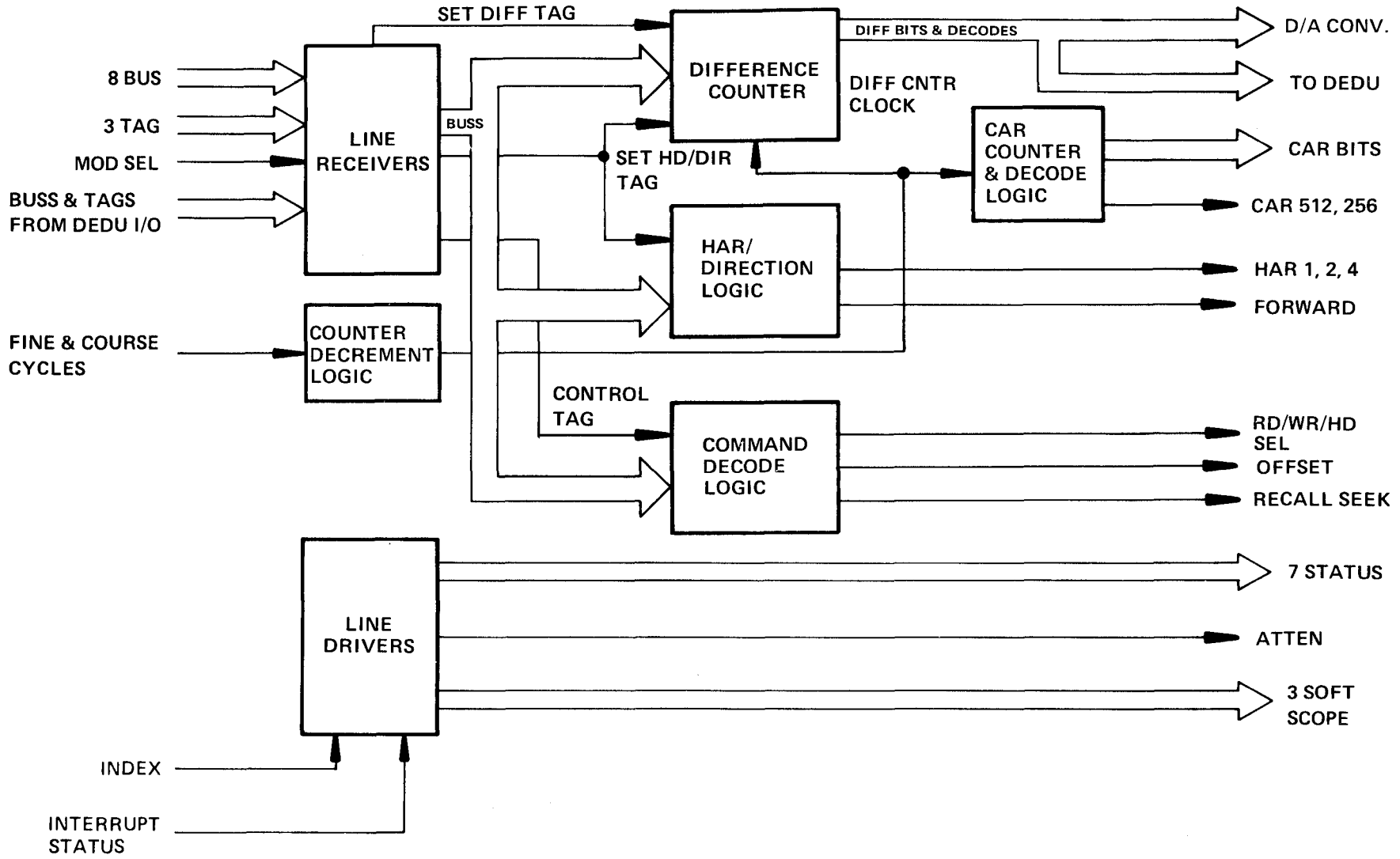
Figure 4-26. System Interface PWA Abbreviated Block Diagram

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4.9.4   System Interface Block Diagram Description

SYSTEM INTERFACE PWA

Figure 4-26 illustrates the simplified block diagram of the System Interface PWA. In its simplest configuration the System Interface PWA contains the Line Receivers which receive the cylinder address and functional commands from the IDA in the central processing unit. The Line Receivers also provide access for the DEDU simulated signals for troubleshooting and alignment purposes. Refer to paragraph 4.9.3 for a description of the major signals to and from the logic blocks within the System Interface PWA.

The expanded block diagram of the System Interface PWA, figure 4-27, illustrates its full functional configuration. Cylinder addresses and functional commands pass through the Line Receiver Input Logic and Buffers and are directed to the appropriate Difference Registers and Command Decode Logic. When a cylinder address is issued by the central processing unit, through the IDA, with the proper tag, the cylinder address is strobed out of the Difference Register into the Difference Counter. The digital output of the Difference Counter is directed to the input of the Digital-to-Analog Converter located on the Pulser Driver PWA. Additionally, the outputs of the difference counter are directed to the inputs of the Difference Counter Decode logic. As the EMA moves the read/write heads to the addressed cylinder location, signals from the servo surface are directed through logic on the Pulser Driver PWA to the Counter Decrement Logic on the System Interface PWA. The Difference Counter is decremented one count each time a servo track is crossed until the heads arrive at the selected track. The CAR Counter is loaded during initialization of the drive and/or in the recal mode when the carriage reaches the inner guard band. This counter is decremented as the carriage moves back toward cylinder zero. The CAR Control Logic enables the CAR Counter to be advanced or decremented by gating the forward, reverse, linear mode and difference counter clock signals. The outputs of the CAR Counter are directed to the CE bus to provide carriage position information for test and alignment purposes and into the CAR Counter Decode Logic. The CAR Counter 256 and 512 bits are also directed to the Read/Write PWA for write current control and read amplifier gain adjustment. The outputs of the Command Decode Logic and the information on the bus lines are directed to the Head Address Register to provide read/write head selection. The Command Decode Logic also provides read/write, recal and seek commands by decoding the information on the bus lines and the tags. Figure 4-2 illustrates the command timing structure of the difference bits and tags to the disk drive from the IDA. The generation of the various outputs of the System Interface PWA can be determined by inspection of the expanded block diagram.
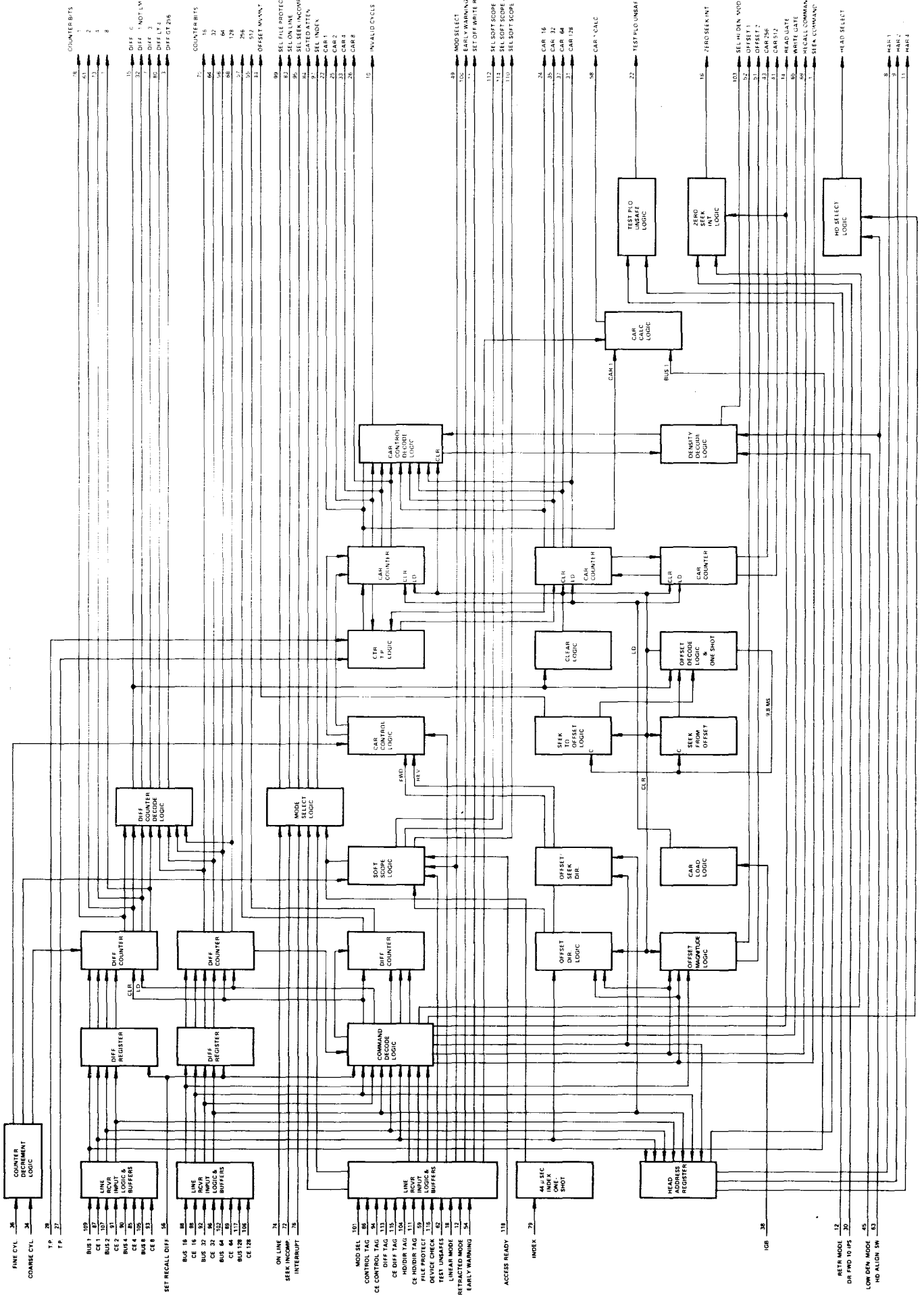
Figure 4-27. Expanded System Interface PWA Block Diagram

4.10 ACCESS CONTROL PWA

4.10.1 Access Control Output Mnemonics

PIN	SIGNAL	DESTINATION
3	+PWR Unsafe	J18-55
4	+OFF WR Unsafe	J18-57
5	+DC WR Unsafe	J18-58
6	+On Line	J3-74, J18-81
7	+PK Spd Unsafe	J18-65
8	-Light Run	J22-37
9	+PLO Unsafe	J18-60
10	+Interrupt	J3-76, J18-86
11	+Vel Unsafe Latch	J18-64
12	+IGB Det Unsafe	J18-59
14	+AC Write	J18-62
16	+Delay Pack At Spd T.P.	
20	+Start Enable T.P.	
21	-On Line T.P.	
22	+Safety Unload	J8-64
23	+Run S/S T.P.	
26	+Run Latch	
27	-Linear Mode	J3-18, J6-93, J7-88
29	-HDS Extnd	J16-9
31	-Dr Fwd 10IPS	J3-30, J8-69, J18-22
32	-800 μSec Sys T.P.	
34	+Seek Comp	J3-46
36	-Stop Light	J22-25
38	+Device Check	J3-16, J18-25
41	-Set Seek Incomp T.P.	
47	Gated Mod Sel	J22-23
49	+Seek Incomp	J3-72
51	-File Ready	
52	-Reset Unsafe	
53	+Access Ready	J3-18
57	-Seek Incomp Int T.P.	
59	+EVM Trk Stop	J7-91, J8-44
60	-Inhibit Dr Rdy	J10-33
63	-Act Servo	J8-50
66	+Set Sip T.P.	
71	-Sk Ovrshoot	J18-51
72	-Dev OK Light	J22-04
73	+Seek In Process	J18-82
74	+Seq Enable T.P.	
79	+Seek Dly T.P.	
80	+Hd Rev/Unld	J6-111, J7-112, J8-78
83	-Recall Latch T.P.	
93	-Brush Cycle	J10-88
98	-Go Rev	J8-58, J18-26
102	-Seek Too Long	J18-52
104	+Set Recal Dif	J3-56
105	-Retr Mode	J1-105, J3-12, J6-84

Access Control Output Mnemonics (Contd)

PIN	SIGNAL	DESTINATION
107	-Go Forward	J8-54, J18-28
110	-Pwr On or Strs	J18-56
111	+Seek Latch T.P.	
113	-First Cyl Det	J7-92, J7-111
114	-Motor Start	J7-31, J10-36

4.10.2 Abbreviated Access Control I/O Signals

When using this listing refer to figure 4-28 and figure 4-3.

INPUT SIGNALS	FROM	LOGIC BLOCK
(1) Motor Seq & SW Controls Blk		
Operator Controls	PWA - A4A1	Operators Control
Pick Hold	Power Regulator (J10)	Motor Seq Control
Delayed Seq Pick	Power Regulator (J10)	Motor Seq Control
Cover Switch	Cover SW	Cover Switch
Pack In Place	Pack In Place SW	N/A
Pk Stopped Pk at Speed	Disk Speed PLO & Demo (J6)	Disk Speed Det
(2) Access Control Blk		
Recall Seek	System Interface (J3)	Command Decode
Forward	System Interface (J3)	HAR 1 Direction
Pk Stopped, Pk at Spd, RPM	Disk Speed PLO & Demd (J6)	Disk Spd Det
Hds On Pack	Safety Tach Position (J7)	Velocity Safe
Hold Rev.	Safety Tach Position (J7)	Velocity Safe
*Set Seek Comp.	Pulser Driver (J8)	Set Seek Comp.
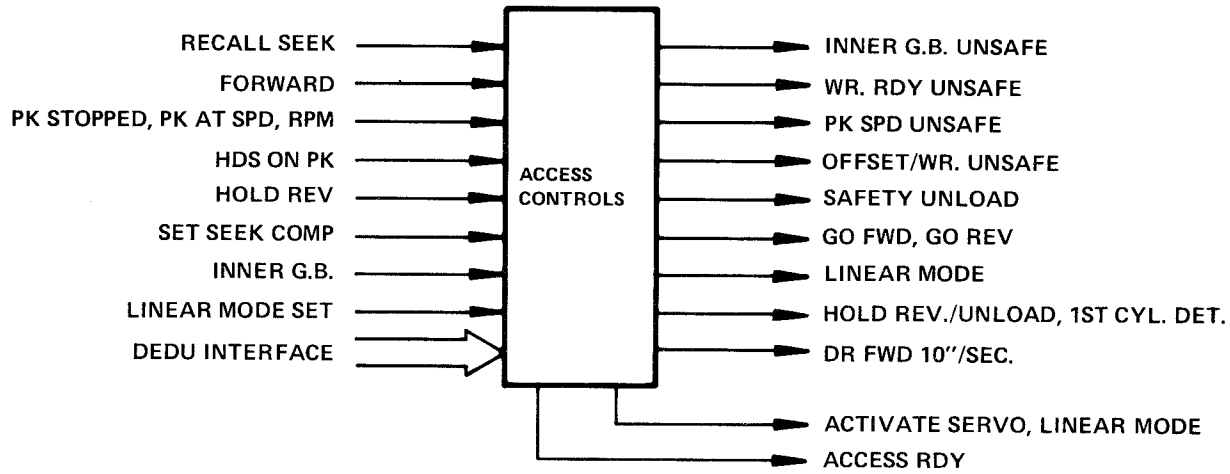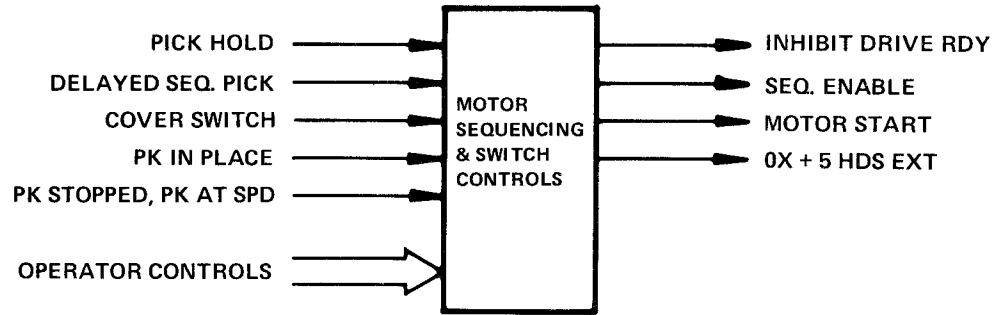
Figure 4-28. Access Control Block Diagram

PB001030

Abbreviated Access Control Module I/O Signals (Contd)

INPUT SIGNALS	FROM	LOGIC BLOCK
Inner G.B.	Disk Speed PLO Dmod (J6)	DMOD/Index Det/GB Det
Linear Mode Set	Pulser Driver (J8)	L/M Set
DEDU Interface	DEDU (J18)	DEDU Interface

OUTPUT SIGNAL	TO	LOGIC BLOCK
(1) Motor Sequencing & Switch Controls Logic Block		
Inhibit Drive Rdy	Access Control (J10)	Motor Seq Control
Sequence Enable	Connector J16	To next Drive
Motor Start	Power Regulator J10	Power Regulator
OX + 5 Heads Extended	Connector J16	To Disk Expansion Cabinet
(2) Access Control Logic Block		
Inner G.B. Unsafe		
WR RDY Unsafe		
Pk. Spd. Unsafe		
Offset/WR Unsafe		
Safety Unload	Pulser Driver (J8)	Safety Unload
Go Fwd, Go Rev	Pulser Driver (J8)	Shaper
Linear Mode	Pulser Driver (J8) Safety Tach Position (J7)	Shaper Servo
Hold Rev/Unload, 1st Cyl Det	Safety Tach Position (J7)	Velocity Safety
Dr Fwd 10"/Sec	Pulser Driver (J8)	Summing Amp.
Activate Servo, Lin. Mode	Pulser Driver (J8)	Pulser Driver
Access RDY	Tach Servo Velocity Safe (J7) Pulser Driver (J8)	Servo Pulser Driver

4.10.3 Access Control PWA Block Diagram Description

The Access Control PWA serves as an interlock between the CPU, Operator Control Panel, Read Write/Head Control and the media on the disk pack. This module is a totally digital configuration consisting of qualifying gates and latches to inhibit or enable access to, and operation of, the disk drive.

All signals from the Operator Control Panel are directed into the Access Control PWA. The Access Control PWA acknowledges the command from the Operator Control Panel by illuminating the lamp under the proper switch if the qualifying conditions for that command are met. Additionally the PWA generates the enable signal to allow the next drive in sequence to initialize.

Unsafe signals from the disk drive are directed to the Access Control PWA to set the Unsafe Latches. These latches remain set until reset by reinitialization of the drive. The outputs of the Unsafe Latches are directed to the CE Bus for fault isolation. In addition to monitoring the unsafe conditions, the Access Control PWA issues the safety unload command to the Pulser Driver PWA to remove the read/write heads from the disk pack.

The Access Control PWA monitors the pack-at-speed signal from the Disk Speed, PLO and Demod PWA to allow head loading and unloading.

The PWA monitors the Difference Counter Decode Logic and the CAR Counter Decode Logic on the System Interface PWA. The signals from the Difference Counter Decode Logic and the CAR 1 Calc signal are directed to the input of the Access Seek and First Cylinder Detect Logic. This logic directs the seek over-short, seek too-long and seek in progress signals to the CE Bus and the seek incomplete to the System Interface PWA.
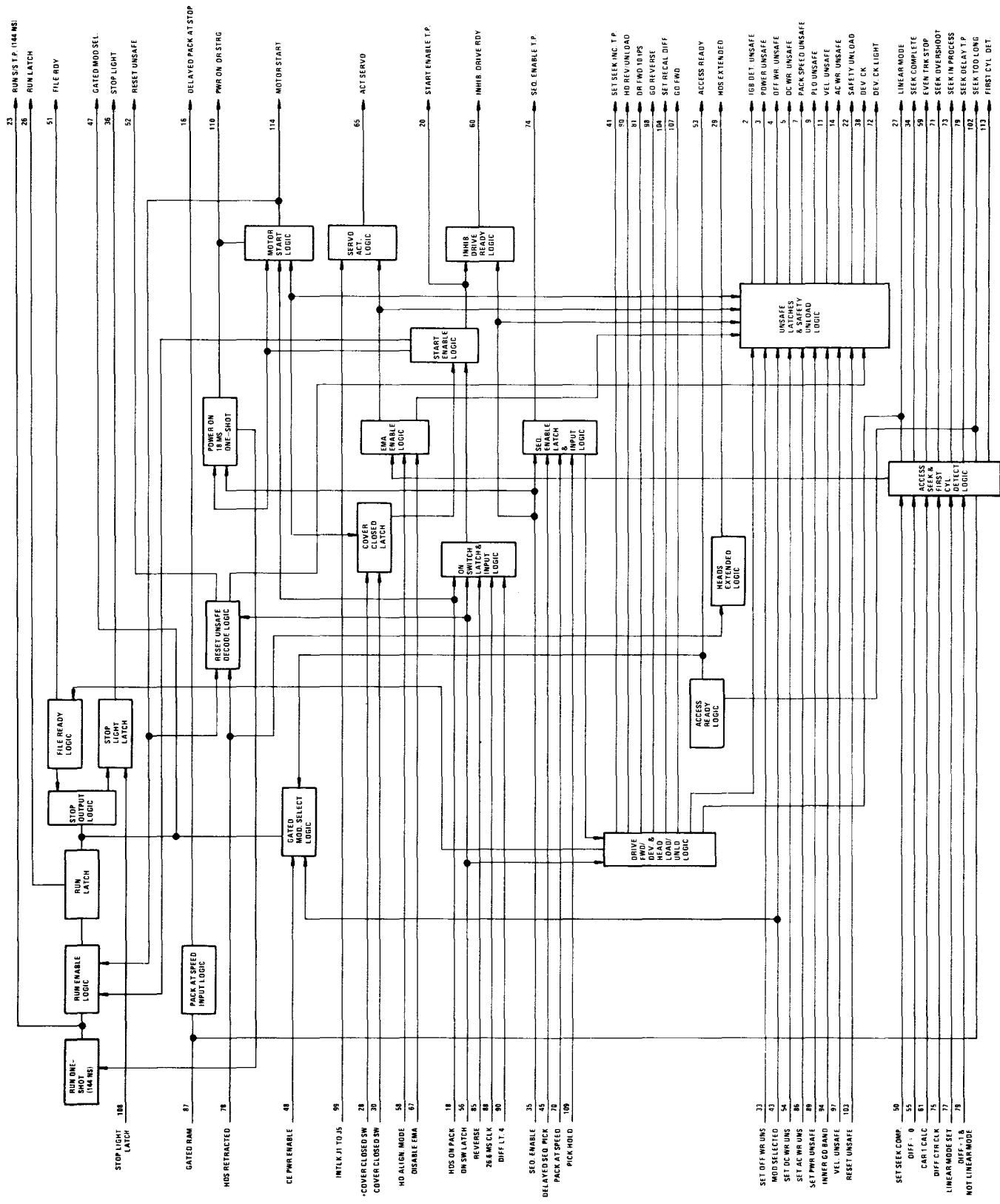
Figure 4-29. Access Control Module Expanded Block Diagram
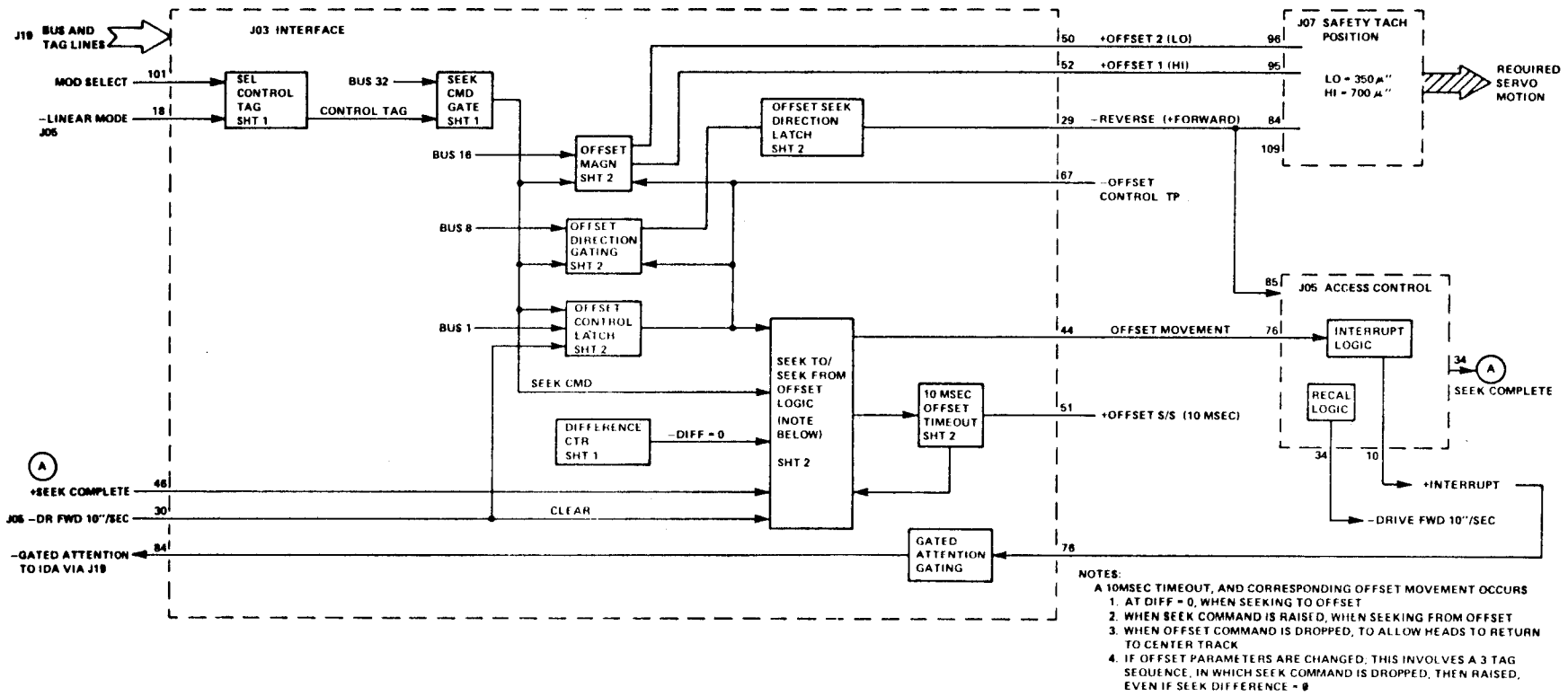
Figure 4-30. Data Error Recovery/Offset Control Block Diagram

PB001011-2

NOTES:
A 10MSEC TIMEOUT, AND CORRESPONDING OFFSET MOVEMENT OCCURS
1. AT DIFF = 0, WHEN SEEKING TO OFFSET
2. WHEN SEEK COMMAND IS RAISED, WHEN SEEKING FROM OFFSET
3. WHEN OFFSET COMMAND IS DROPPED, TO ALLOW HEADS TO RETURN TO CENTER TRACK
4. IF OFFSET PARAMETERS ARE CHANGED, THIS INVOLVES A 3 TAG SEQUENCE, IN WHICH SEEK COMMAND IS DROPPED, THEN RAISED, EVEN IF SEEK DIFFERENCE = 0

4.11   DDS/PLO/DEMOD PWA

4.11.1   DDS/PLO/DEMOD PWA Output Mnemonics

PIN	SIGNAL	DESTINATION
7	T.F. Pos 2	J7-18
9	T.P. Pos 1	J7-18
13	AGC T.P.	
17	INTLOC	J3-J6, J3-6
25	Servo Data 2 T.P.	
26	Servo Data 1 T.P.	
29	-6.2V Ref,	J7-117, J8-14
34	-Set PLO Unsafe	J5-101
35	+Pk Stp'd	J5-25, J10-114
37	Outer G.B.	J5-84, J7-100
83	+266 Msec Clk	J5-88
85	+Index	J3-79
86	Guard Bd T.P.	
91	+Inner G.B.	J5-94, J3-38
94	-Servo Data T.P.	
95	-Miss Even Peak	
99	-RPM T.P.	
102	-Gated RPM	J5-87
105	-AC HZ Dig T.P.	
109	+Reset T.P.	
112	+Clear T.P.	
114	-Unsafe Set T.P.	
115	-Pack at Spd	J5-70, J7-107
117	+PLO Write OSC	J19-21
118	-PLO Write OSC	J19-22

4.11.2 Abbreviated DSS/PLO/DEMOD I/O Signals

When using this listing refer to figure 4-31 and figure 4-3.

INPUT SIGNALS	FROM	LOGIC BLOCK
AC HZ	Power Regulator (J10)	Same
Disk Speed Sensor	Disk Speed Sensor (A3-A5)	Same
Hd's on Pack	Safety Tach Position (J7)	Velocity Safety
Servo Pre Amp	Servo Head	Same
Mod Sel	System Interface (J3)	Line Receivers
OUTPUT SIGNALS		
Gated RPM	Access Control (J5)	Access Control
PK at SPD, 266 Msec Clock	Access Control (J5)	Motor Seq. & Switch Controls
PK STPD	Power Regulator (J10) Access Control	Same Motor Seq. & Switch Control
TF Pos 1	Safety Tach & Pos. (J7)	Servo
TF Pos 2	Safety Tach & Pos. (J7)	Servo
Outer GB	Access Control (J5) Pulser Driver (J9)	Same Same
Inner GB	Access Control (J5) System Interface (J3)	Same Line/Drivers
INDEX		
PLO Unsafe	Access Control (J5)	Same
Gated PLO	Interface Connector (A1,J19)	Same
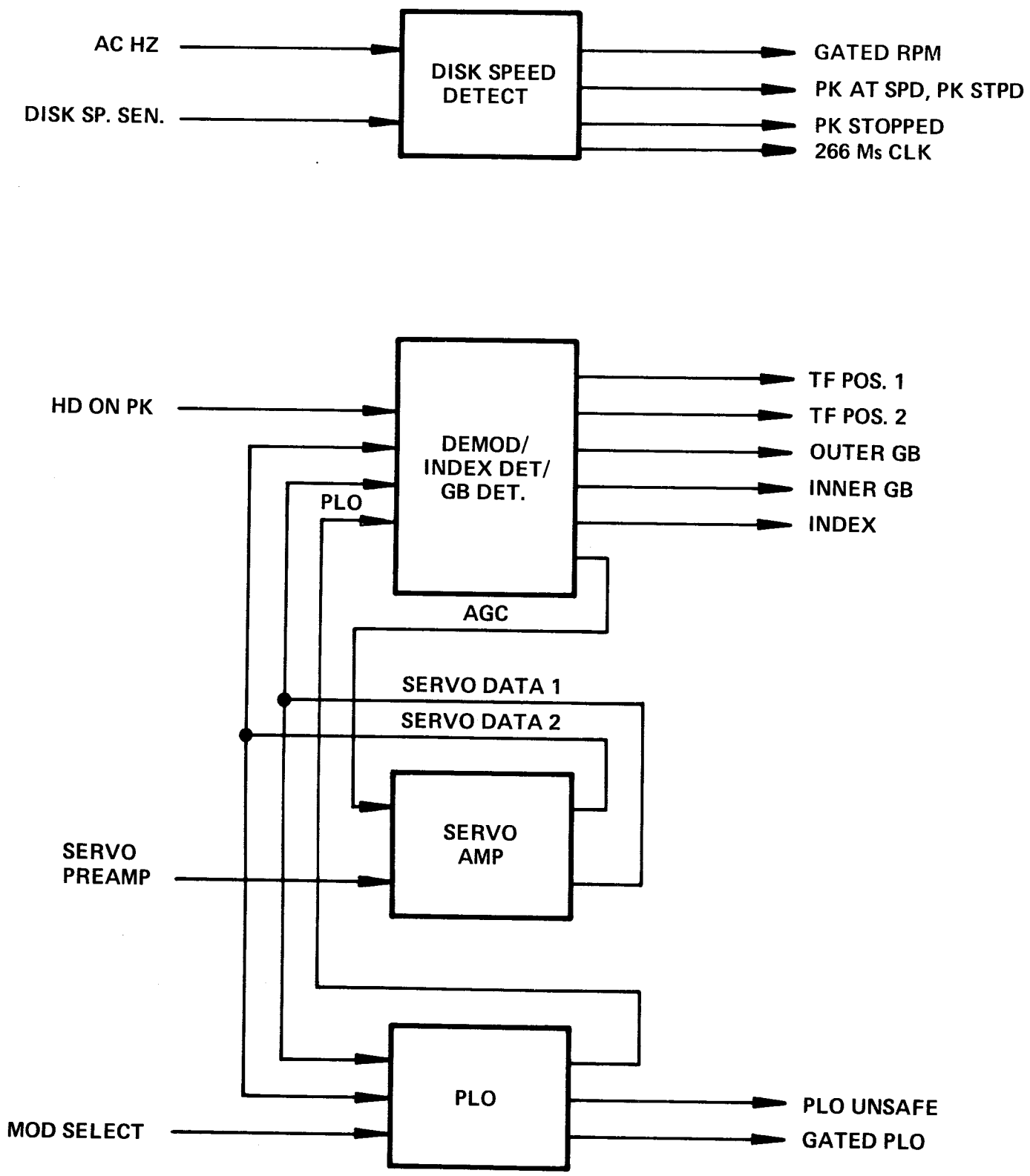
Figure 4-31.   Disk Speed, PLO & DEMOD Block Diagram

4.11.3 DDS/PLO/DEMOD Block Diagram Description

The simplified block diagram description (figure 4-31) of this module illus-
trates its four basic functional circuit groupings: (1) the disk speed
detector circuits; (2) the demodulator (index detect guard band detect); (3)
the servo amplifier, and (4) the phase lock oscillator. The expanded block
diagram (figure 4-32) illustrates the relationships between each of the afore-
mentioned circuit diagrams. The Disk Speed Sensor consists of a combination
of counters and decoders whereby the real time (50 Hz or 60 Hz) is compared
with the disk rpm. When the disk is up to speed, the Pack-at-Speed Latch is
set and the heads are allowed to load. The same logic is utilized to con-
tinually monitor the disk speed and generate the pack stop signal which allows
the cover to be opened when the pack is stopped. The operation of the Demod-
ulator and Phase Lock Oscillator may be better understood by making reference
to the functional diagram, figure 4-33. The functional block diagram (figures
4-32 and figure 4-33) will be referred to in this description.

Signals from the servo surface are directed through an RC Input Network and an
AGC circuit to the Servo Data Amplifiers. These amplifiers are made up of a
gain of 100 preamplifier and a low gain Servo Data Amplifier with DC offset
compensation. The output of the Servo Data Amplifier is directed to the DC
Offset Control and Dual Port Current Sources. This circuit maintains the
Servo Data Amplifier at zero DC offset and provides a constant current source
to the output stages of this amplifier. The differential outputs of the Servo
Data Amplifier are connected to the inputs of the Servo Data One Output Driver
and Servo Data Two Output Driver. Each of these drivers is a two transistor
configuration, 15 volt to 5 volt switch to produce logic compatability between
the Servo Data Amplifier output and the TTL input logic levels. The signals
from the Output Drivers are directed to the Even Bit Detectors and Odd Bit
Detectors. Signals from the Output Drivers are also directed to the Digital
Detect Logic with the PLO divide-by-eight signal to enable phase lock syn-
chronization. The output of the Phase Lock Oscillator is directed into the
PLO Drive to produce plus and minus PLO write oscillator signals. Additionally,
the output of the Phase Lock Oscillator is directed into the Sixteen Bit Counter
with the odd and even bit signals. The output of the Sixteen Bit Counter is
then directed into the Odd/Even Peak Detector Steering Logic to produce the
index, outer guard band and inner guard band detect signals. Servo data 1,
servo data 2, odd peak detect and even peak detect are directed to the peak
detecting track following circuits where they are gated with the output of the
slew Rate Logic to produce the TF position 1 and TF position 2 signals. The
TF position 1 and TF position 2 signals are directed to the input of the
Sample-and-Hold Integrator Amplifier for AGC control of the input servo data
from the servo surface. This is accomplished with the use of a two transistor
driver producing current flow through a series of four diodes which when
properly biased attenuate the input servo signal. Additionally, the TF
position 1 and TF position 2 signals are directed to the Velocity Safety Tach-
ometer Position PWA J7.

For more information on the phase lock oscillator and demodulator, refer to
Section 4.5 (Media Rotation) of this manual.
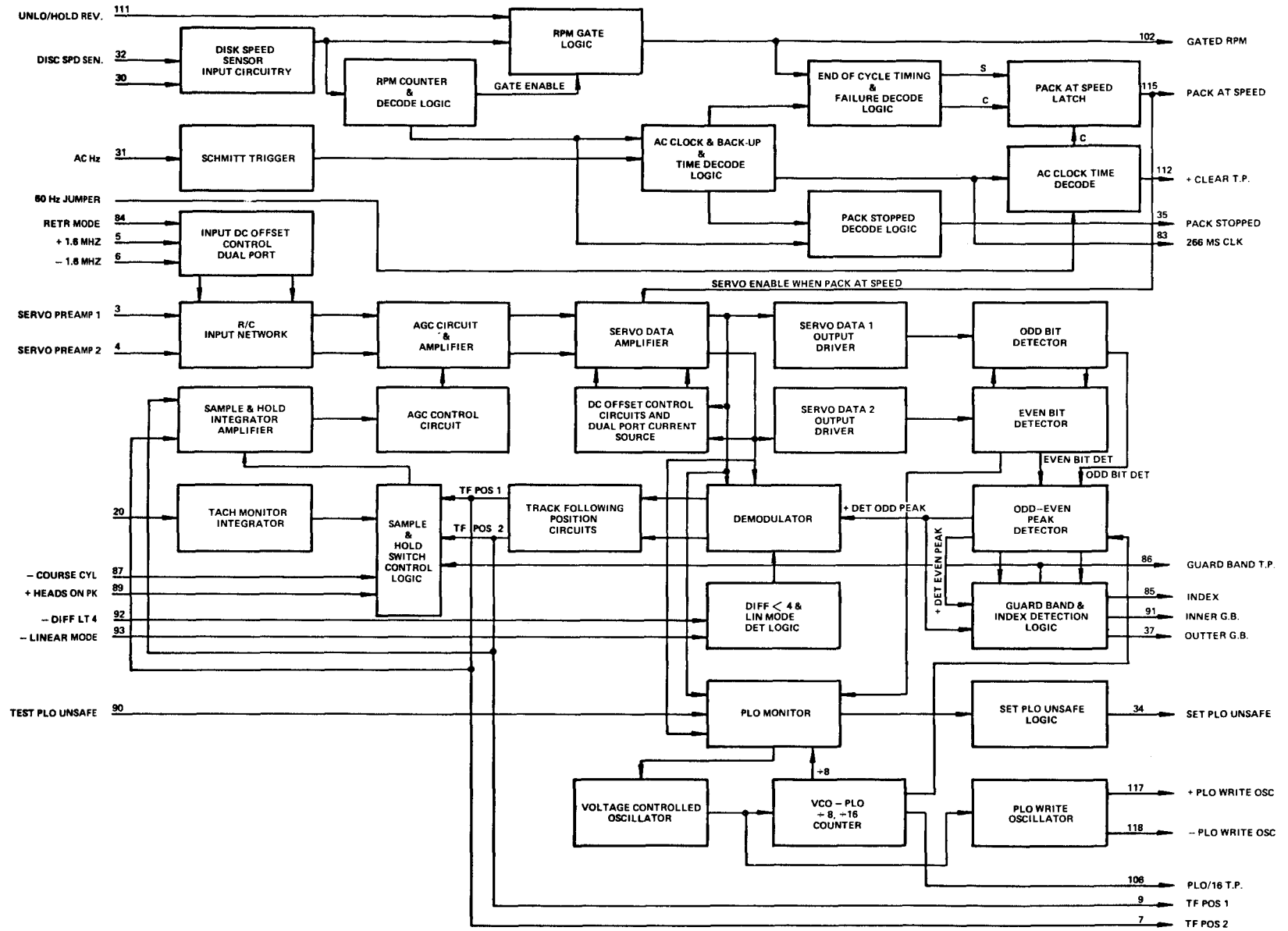
Figure 4-32. DSS/PLO/DEMOD Expanded Block Diagram
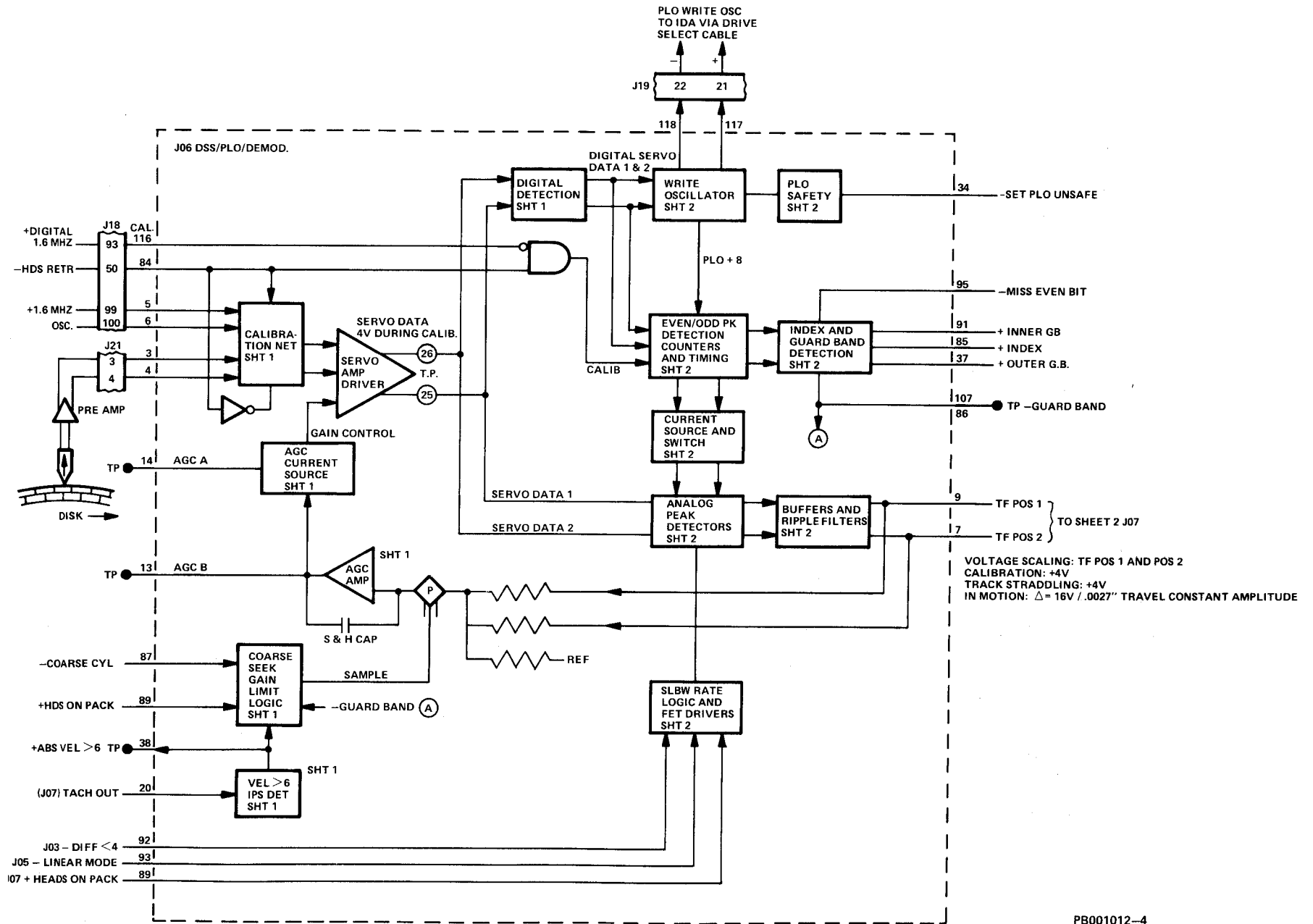
Figure 4-33. Servo Data Detection Circuits

TF POSITION

- COARSE CYLINDER

AGC FET ON; STORE AGC FROM
TF POSITION AT LOW LEVEL
= SAMPLE

AGC FET OFF

AGC AMPLIFIER IN SAMPLE HOLDING MODE
PREVENT SERVO DATA AMPLIFIER FROM
OVERDRIVING DURING COARSE SEEK

SERVO DATA AMPLIFIER HAS CONSTANT
GAIN DURING THIS TIME
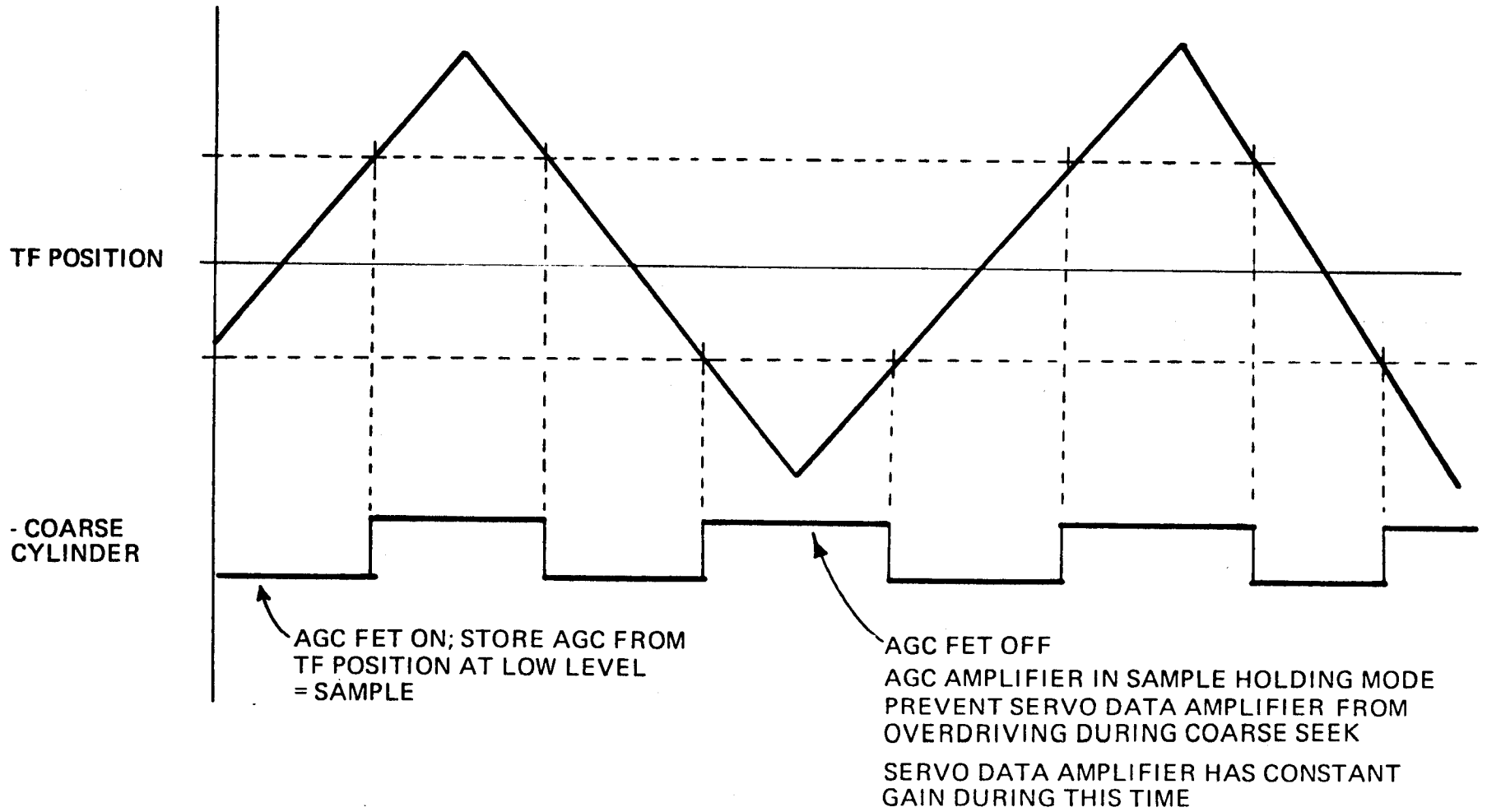
PB001010-4

Figure 4-34. Servo Data AGC Sample & Hold - Coarse Seek

MC8309

HCB-1

PB001010-2

4-63

1.6 μ SEC.

ODD   EVEN   ODD   EVEN   ODD

ON TRACK

+4V

SERVO DATA 1
S.D. 2 INV.

TF PEAK

TF PEAK

TF PEAK

0V

TF PEAK

TF PEAK

-4V

DIGITAL SERVO DATA 1

DIGITAL SERVO DATA 2

PLO

SET TIMER TO DETECT NEXT PEAK

155 N SEC BIT CELL TIME

ODD DIBIT PEAK DETECT PULSE

EVEN DIBIT PEAK DETECT PULSE
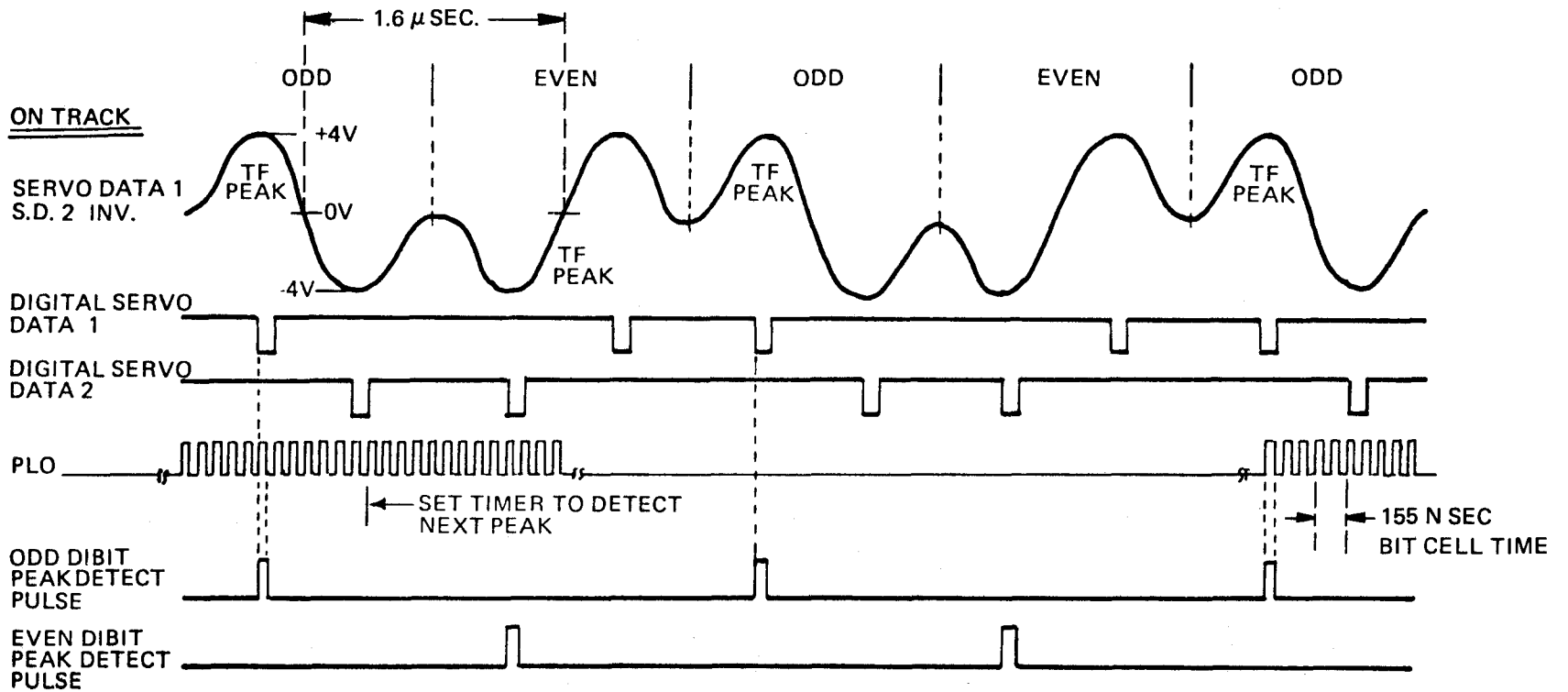
Figure 4-35. Servo Data Peak Detection Timing
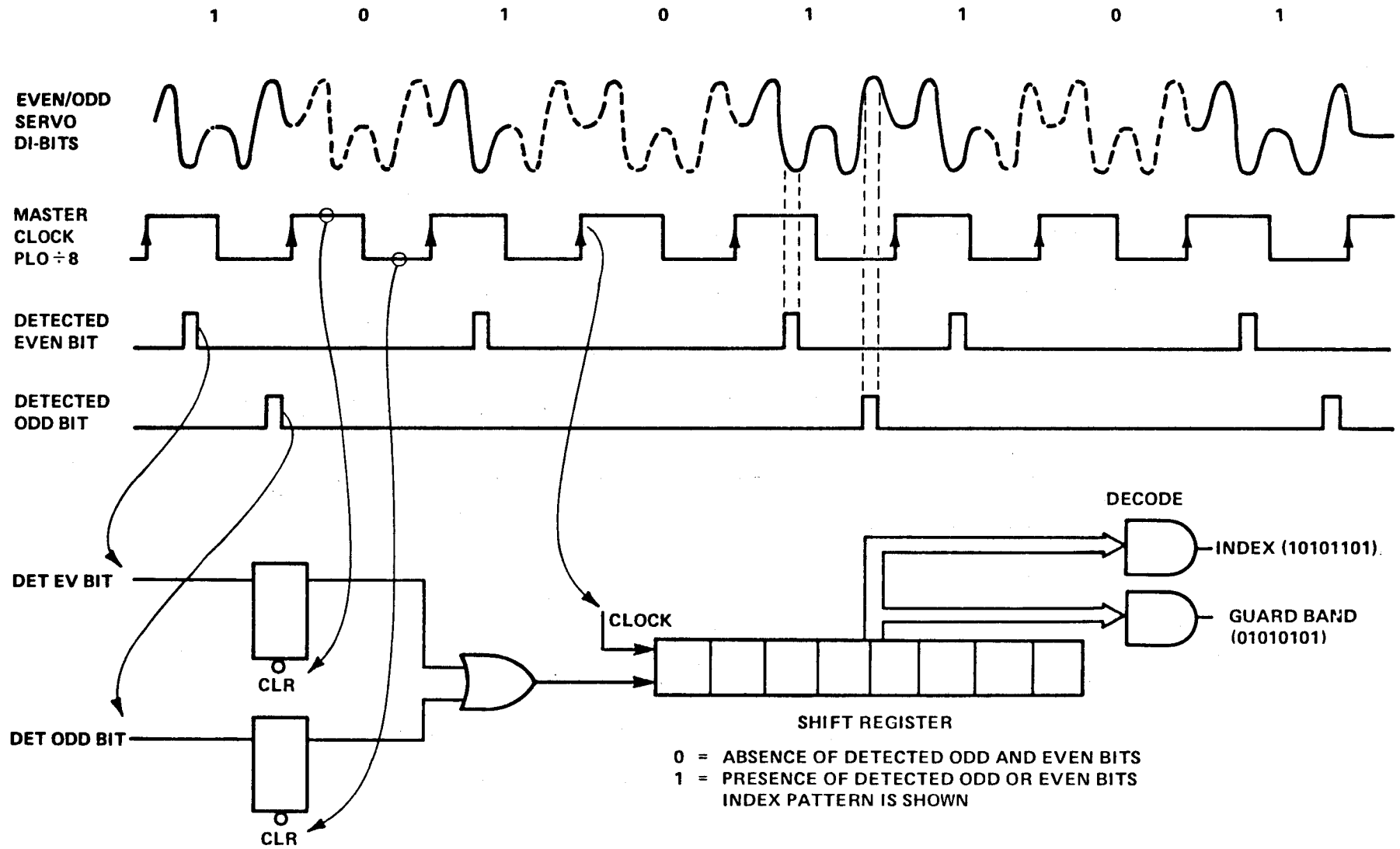
Figure 4-36. Servo Data Index/Guardband Detection Scheme

4.12 SAFETY TACHOMETER & POSITION PWA

4.12.1 Safety Tach & Position - PWA -03 Output Mnemonics

PIN	SIGNAL	DESTINATION
3	Gated Tach Out	J8-25
4	Gated Position	J8-24
5	Tach Out	J6-20, J8-52
6	SLITS T.P.	
9	LD/UNLD ERR	J8-13
23	Intlk A	J6-19
25	Intlk B	J8-113
19	-Unload	
33	+Hds Retc'd	J5-78, J8-24
36	ABS Velocity	J8-35
83	Grid Pos T.P.	
86	-Vel Unsafe TMR T.P.	
87	-Back Up Timer T.P.	
90	-Vel GT 4 IPS	J18-18
93	Delayed Return Mode	J8-36
99	+Hds On Pack	J8-85, J18-17, J6-89, J5-108
101	+Hold Rev	J8-74
102	-2 Slits Latch	J18-19
105	+Vel Unsafe	J5-97
106	+Dr Rev 10 IPS	J8-10
113	Vel Source Bias	J24-2
114	SLITS X2 EDGES T.P.	
115	*Head Unload	J8-32
116	*Head Load	J8-70
118	1KHz Ref	J8-70

4.12.2 Abbreviated Safety Position I/0 Signals

When using this listing refer to figure 4-37 and figure 4-3.

INPUT SIGNALS	FROM	LOGIC BLOCK
(1) Tach Block		
Fine & Course Cyls	Cylinder Det (J8)	Same
Current Sample	Pulser Driver (J8)	Same
(2) Velocity Safety Block		
Hold Rev/Unload 1st Cyl Det	Access Control (J5)	Same
Outer G.B.	Disk Speed, PLO & Demod (J6)	Demod/Index Det/GB Det
Vel Safety Sensor	Vel Safety Sensor (A3A2)	Same
Hds Retracted Sw	Hds Retr Sw (A3J3)	Same
(3) Servo Block		
Access Rdy	Access Control (J5)	Same
Linear Mode	Access Control (J5)	Same
Offset	System Interface (J3)	Same
TF Pos 1	Disk Speed PLO & Demod (J6)	Demod/Index Det/GB Det
TF Pos 2	Disk Speed PLO & Demod (J6)	Demod/Index Det/GB Det
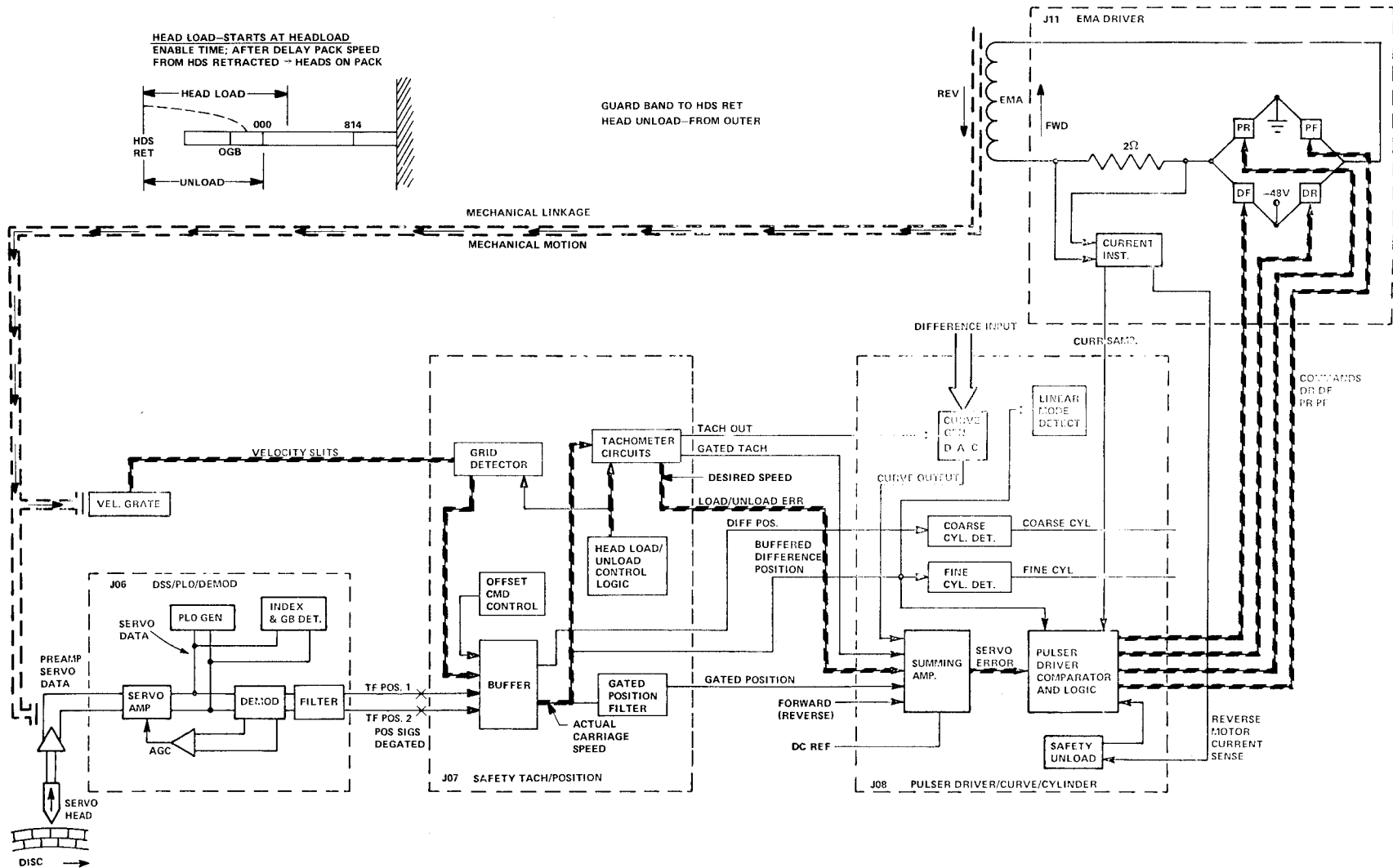
Figure 4-37. Head Load Functional Block Diagram

PB001002

4.12.3 Safety Tachometer and Position Block Diagram Description

The Safety Tachometer Position PWA contains the circuits required to monitor the carriage velocity during all modes of operation. This module contains all the circuitry required to monitor the head loading and unloading operations. The five modes of servo operation are discussed in detail in paragraphs 4.2.2 and 4.4.3 of this manual.

Figure 4-37 illustrates the functional head load operation and the signal flow through the Safety Tach/Position PWA. Figure 4-38 and 4-39 illustrate the functional block diagram of this module highlighting the head loading circuits.

The LED projects a light through the Velocity Grating into the LST (Light Sensitive Transistor). The output of the LST is directed through the Slit Amplifier into the Edge Generator which is a 20 microsecond single shot. A pulse is generated each time the light source is interrupted by a slit edge. Thus, two pulses are generated for every slit opening. The input of the Edge Generator provides the Slits X2 edges test point signals, and the input to the Digital Slits Clock Generator. The output of this circuit is directed to the input of the Slits Edge Counter. This circuit counts the slit edges and its output is directed into the Velocity Timer and Unsafe Section Logic. Additionally at a count of 76 slits a signal is directed to the Heads On Pack Logic to generate the Heads on Pack Signal.

The Safety Tach and Position PWA provides the Velocity Unsafe, Two Slits Latch, and velocity monitoring signals to the drive.

Figure 4-40 illustrates the circuitry for high velocity carriage mounting. This circuitry contains the logic required for this function. The logic drawings for this PWA illustrate the use of operational amplifiers with FET (field effect transistor) switches used to change the operational configurations from integration to differential modes. The FET switches are also used to control operational amplifier bandwidth at different carriage velocities and directions.
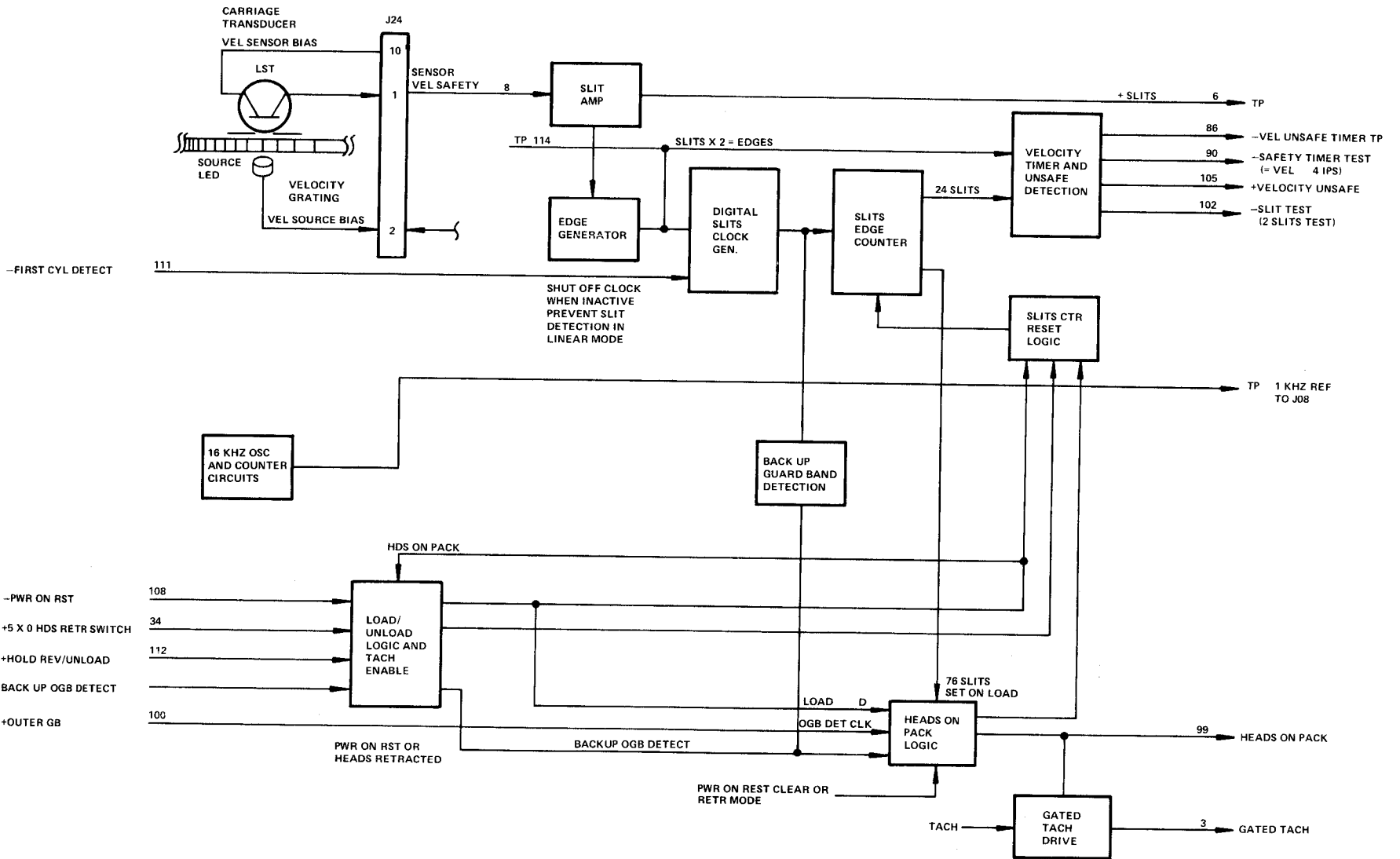
PB000979

Figure 4-38.   Velocity Tachometer Block Diagram
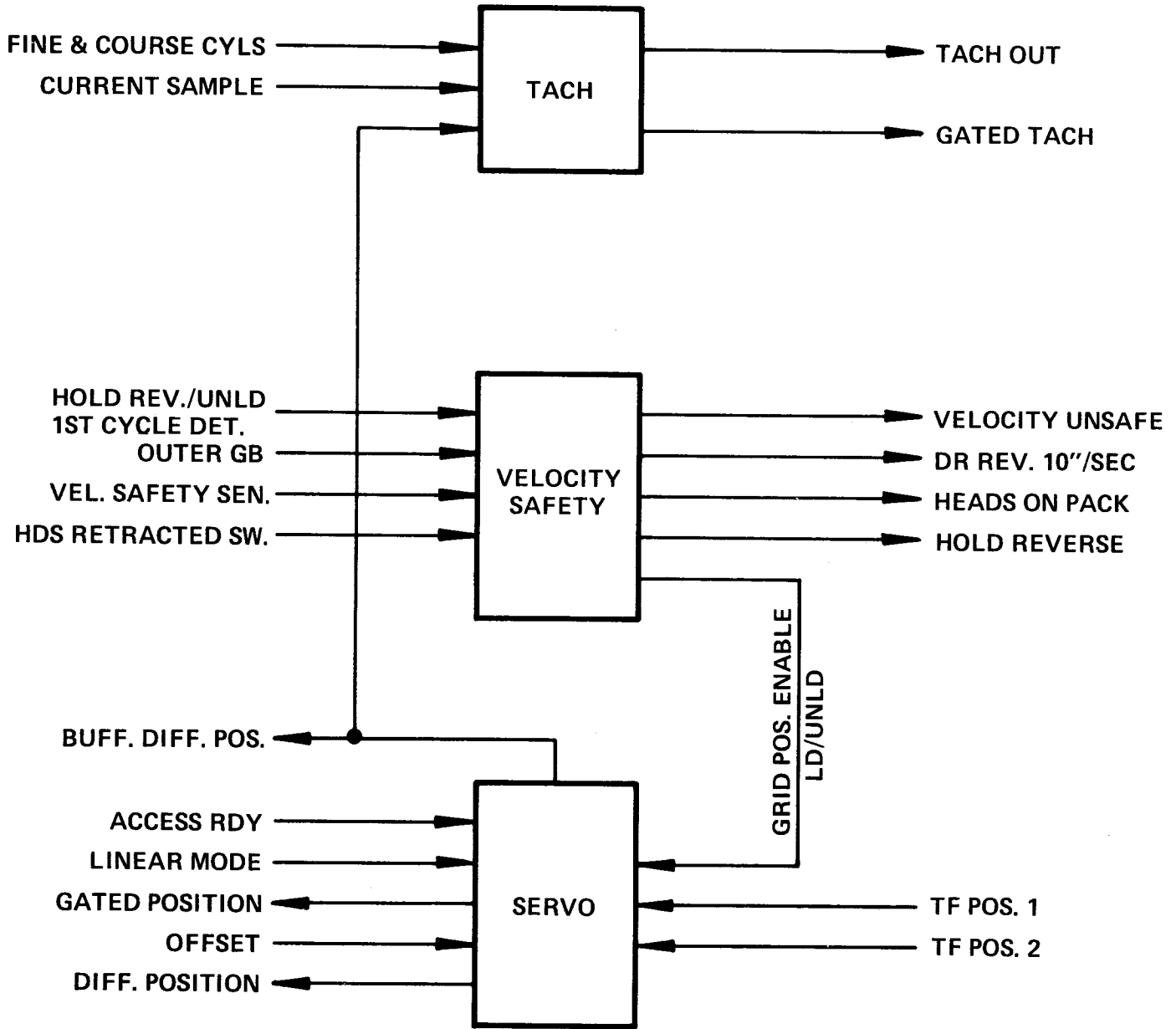
Figure 4-39. Vel-Safety-Tach

PB000990—1
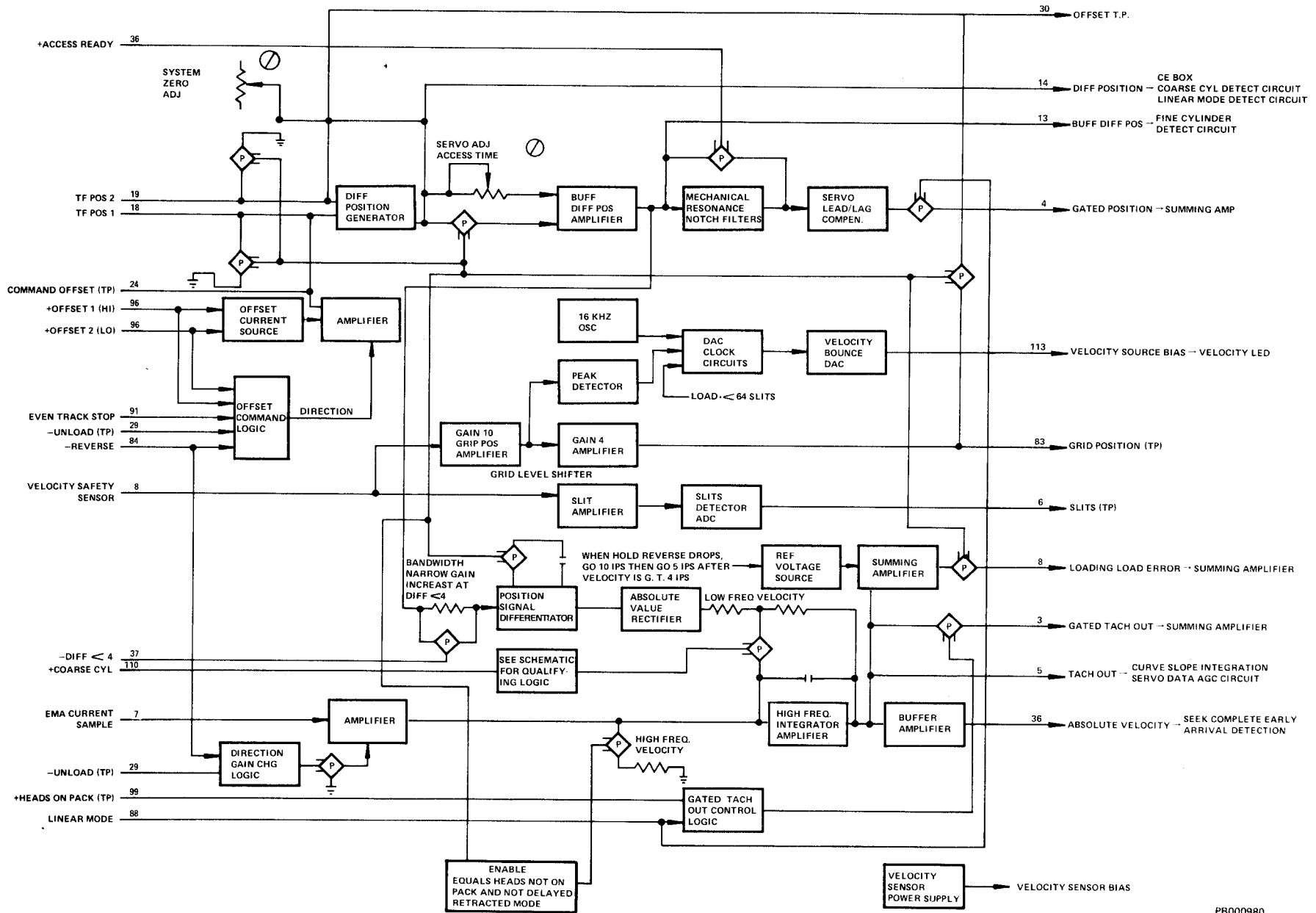
Figure 4-40. Velocity Safety Tach Functional Block Diagram

DIFF POSITION
J07084

+8V

-8V

COMPENSATED TO
BECOME GATED
POSITION

DIFFERENCE
COUNTER

7	6	5	4	3	2	1	0

RECTIFIED
DIFF POS.

1 DIODE DROP

CHARGE
PEAK
CAP

ENABLE
PEAK CAP

COARSE
CYLINDER
J07117

FINE
CYLINDER
J07114

DIFF CTR
CLOCK
J03077

LINEAR MODE
SET
J08033

SERVO POSITIONING
ERROR FROM

CURVE AND GATED TACH

GATED POSITION
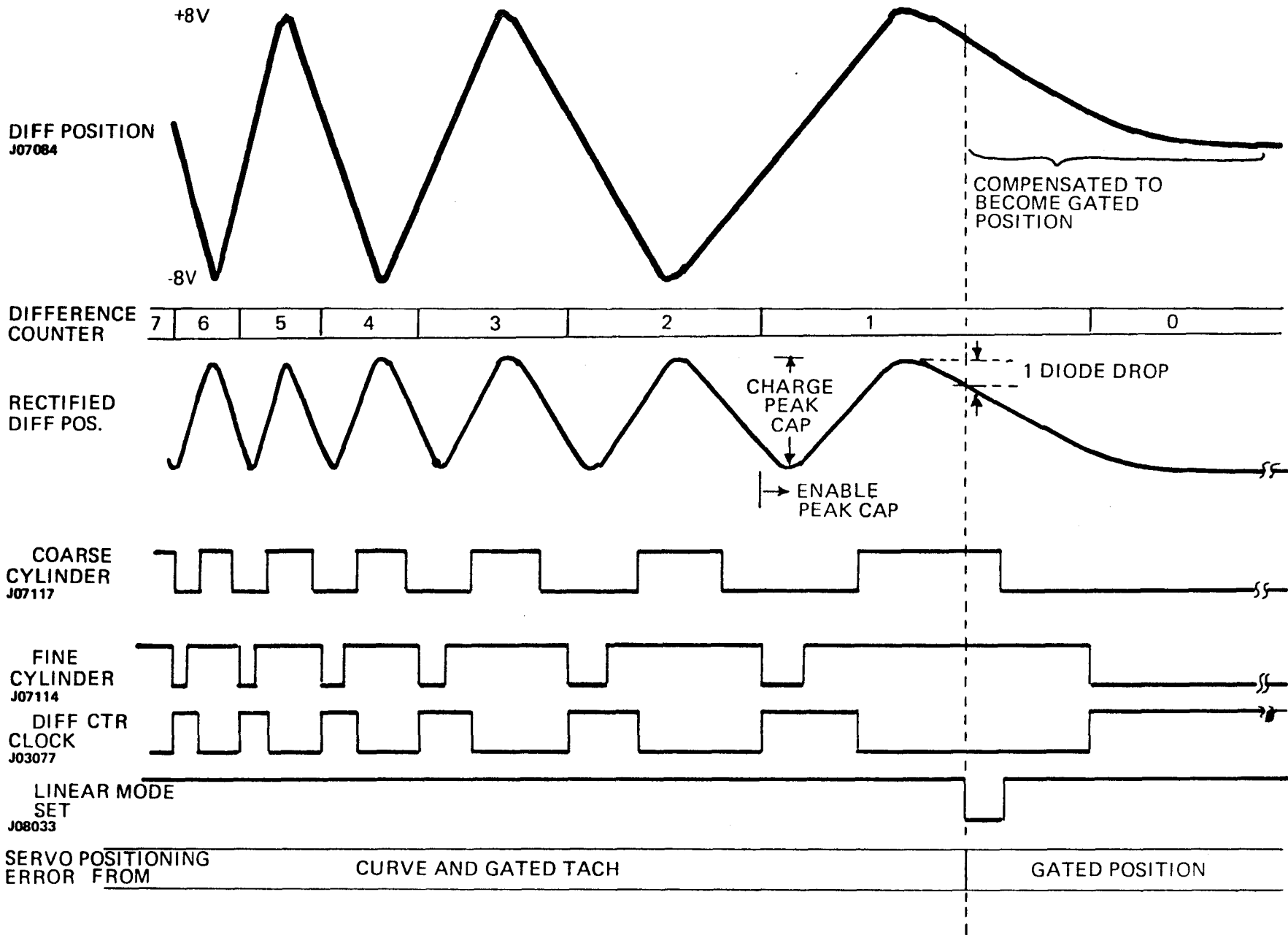
Figure 4-41. Difference Counter Clock Generation - Linear Mode Detection

PB001009-4

4.13 PULSER DRIVER PWA

4.13.1 Pulser Driver Output Mnemonics

PIN	SIGNAL	DESTINATION
6	-Set Seek Comp	J5-50
7	T.P.	
8	EMA Current Sample	J7-7
9	+Fine Cyl TP	
19	T.P.	
33	-Lin Mode Set	J5-77
42	T.P. Curve Gen	
80	+Con't Course Cyl	J7-110
86	Drive Rev	J11-98
94	Pulse Rev	J11-82
99	Drive Fwd	J11-97
110	Pulse Fwd	J11-83
113	Interlock	J7-J8, J7-25
114	-Fine Cyl	J3-36, J5-37, J7-94
115	Interlock	J8-Gnd, J8-119
117	-Course Cyl	J3-34, J6-cd

4.13.2 Abbreviated Pulser Driver Block Diagram I/O Signals

When using this listing refer to figure 4-42 and figure 4-3.

INPUT SIGNALS	FROM	LOGIC BLOCK
(1) Digital to Analog (D/A) Diff Bits & Decodes	System Interface (J3)	Difference Counter
(2) Shaper Block Go Fwd, Go Rev Linear Mode Tach Out	 Access Control (J5) Access Control (J5) Tach Servo Velocity Safe (J7)	 Access Access Tach
(3) Summing Amp Block Gated Position Gated Tach Dr Fwd 10"/Sec Dr Rev 10"/Sec Ld/Unld Err	 Safety Tach Position Safe (J7) Safety Tach Position Safe (J7) Access Control (J6) Safety Tach Position Safe (J7) Safety Tach Position	 Servo Tach Access Control Velocity Safe Load/Unload Tach
(4) Pulser Driver Block Activate Servo, Lin Mode Access Rdy Fwd/Rev Current Samples Dlvd Retrn Mode, Hold Rev, 1KHz Ref.	 Access Control (J5) Access Control (J5) EMA Driver (J11) Safety Tach Position	 Access Control Access Control EMA Driver Velocity Safety
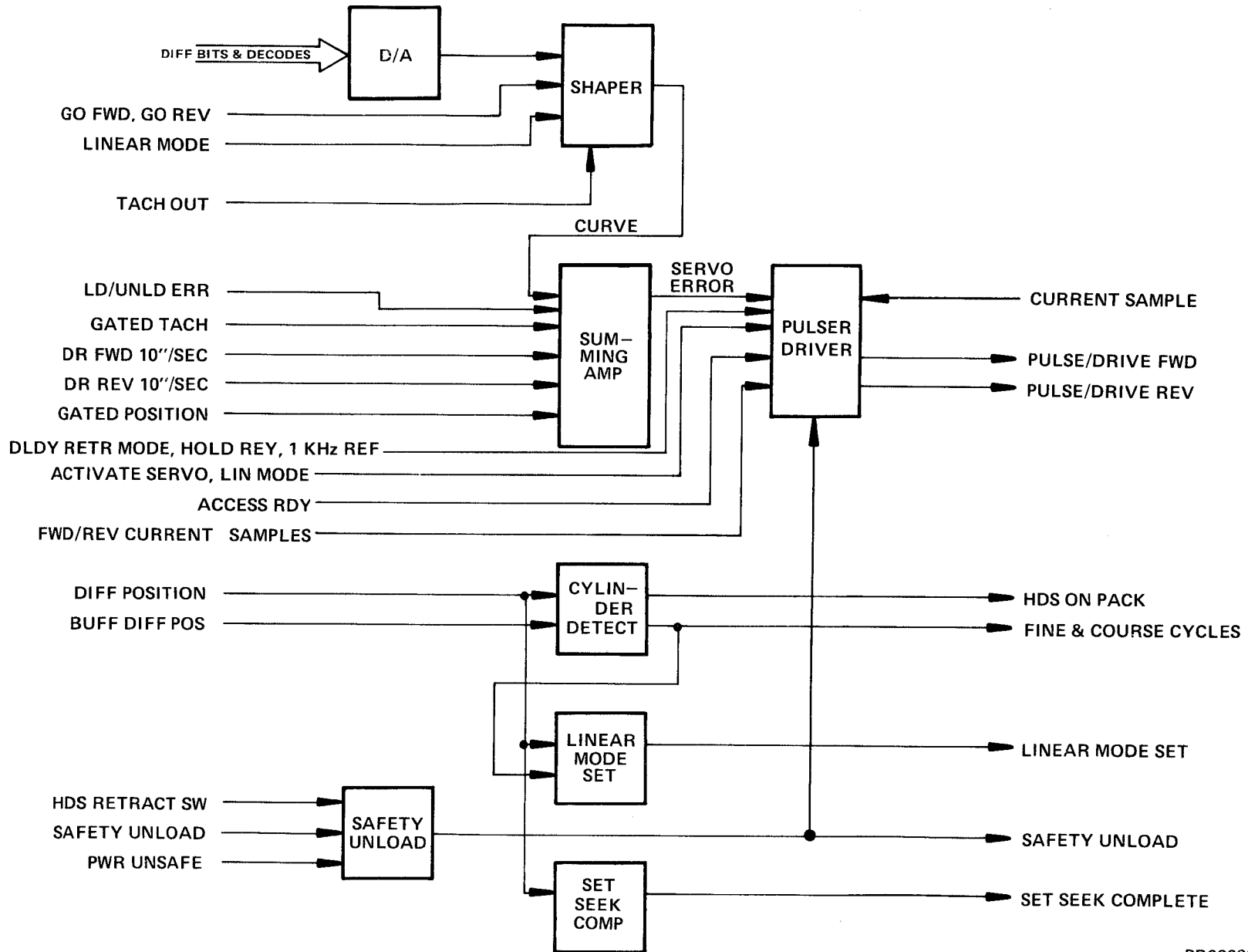
Figure 4-42. Pulser Driver Simplified Block Diagram

PB000992-1

Abbreviated Pulser Driver Block Diagram I/O Signals (Contd)

INPUT SIGNALS	FROM	LOGIC BLOCK
(5) Cylinder Detect Block Diff Position Buff Diff Position	 Safety Tach Position Safe (J7) Safety Tach Position Safe (J7)	 Servo Servo
(6) Linear Mode Set Block Diff Position	 Safety Tach Position Safe (J7)	 Servo
(7) Set Seek Complete Diff Position	 Safety Tach Position Safe (J7)	 Servo
(8) Safety Unload Block Hds Retract Sw Safety Unload Power Unsafe	 HDS RETR SW A3S3 Access Control (J5) Power Regulator (J10)	 Same Access Control Same

Abbreviated Pulser Driver Block Diagram I/O Signals (Contd)

When using this listing refer to figure 4-42.

OUTPUT SIGNALS	TO	LOGIC BLOCK
(1) Pulser Driver Current Sample Pulse/Drive Forward Pulse/Drive Reverse		
(2) Cylinder Detect Fine & Course Cyls	Access Control (J5) System Interface (J3) Safety Tach Position	Same Diff Counter
(3) Linear Mode Set Linear Mode Set	Access Control (J5)	Same
(4) Safety Unload Safety Unload	EMA Power Driver (J11)	
(5) Set Seek Comp. Set Seek Complete	Access Control (J5)	Same

4.13.3 Pulser Driver Block Diagram Description

The expanded block diagram of the Pulser Driver PWA is illustrated in figure 4-43. The difference bits from the Difference Counter on the Systems Interface PWA are directed into the Digital-to-Analog Converter. Digital-to-Analog conversion is accomplished by directing the digital value in the difference counter into a network of precision resistors which produce an analog current proportional to the digital value. The analog current is then directed to the input of an operational amplifier which is integral to the D to A Converter (DAC). Additionally, the output of the DAC operational amplifier is directed through a precision resistor network with controlled breakpoints to continually adjust the amplifier gain as a function of the changing digital difference at the DAC inputs. This circuitry is also integral to the DAC.

The output of the operational amplifier represents the speed which the carriage must not exceed at the distance the carriage is to be moved. This is defined as the curve generator signal at the curve generator test point and is directed through the Curve Control Logic into the Summing Amplifier. The Summing Amplifier, as illustrated in the expanded block diagram, is used to control EMA motion. The type of motion - either controlled velocity or track following - is determined by the curve control logic which causes one or more signals to be applied to the summary amplifier. During the seek operation, the tach signal is subtracted from the curve output. The result controls the polarity and magnitude of EMA current. The output of the Summing Amplifier is directed into the Servo Error Amplifier. The Servo Error Amplifier is basically a unity gain amplifier used for drive purposes; output is directed to the input of the Pulser Control Drive Command Logic and to the servo error test point. The Pulser Control consists of two operational summing amplifiers arranged in a push-pull configuration. The output of the EMA Current-to-Volts Amplifier, which is an operational amplifier in a differential configuration, produces an output of 2 volts per sampled ampere of EMA current. This signal is summed with the Servo Error Amplifier output to produce the PF (Pulse Forward) and PR (Pulse Reverse) signals which are directed into the Drive Command Logic. The PF and PR signals are gated with various other signals as illustrated in the expanded block diagram in the Drive Command Logic to produce the pulse forward/reverse and drive forward/reverse signals. These signals are directed through Level Converters and Driver Transistors to the EMA Driver PWA.

The Safety Unload Logic is utilized in the event the heads must be moved from the pack under emergency conditions. In the event a power unsafe condition or safety unload signal is generated, the Safety Unload Logic through the Safety Unload Decoupling Logic will cause the carriage to remove the heads from the pack. The Safety Unload Decoupling Logic consists of four decoupling diodes which are connected to the pulse forward/drive forward and pulse reverse/drive reverse lines which, through diode action, will strap the output lines directly to the Safety Unload Logic.

Other logic blocks included on the Pulser Driver PWA include the Linear Mode Set Logic which produces a linear mode set signal when the heads are within two tracks of the selected track and the heads are on track and the buffer difference position is near zero.
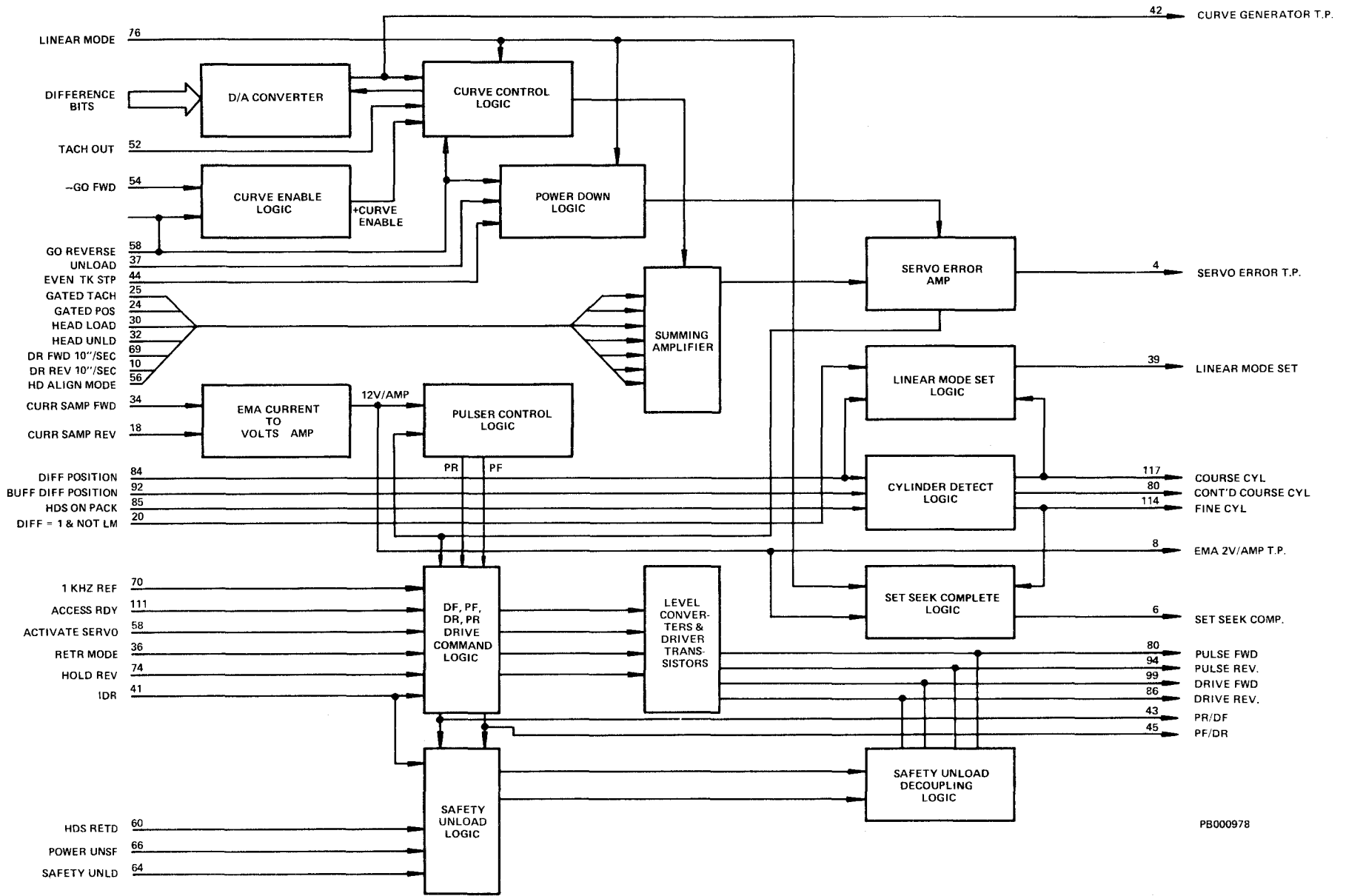
Figure 4-43. Pulser Driver Expanded Block Diagram

The Cylinder Detect Logic directs the coarse cylinder (on track) and fine
cylinder (write window) signals and the Set Seek Complete Logic to produce the
set seek complete signal when the EMA is no longer in motion and the Difference
Counter is at zero. Refer to figure 4-44 Set Seek Complete-Early and Late
Arrival.

4.14 POWER SUPPLY - FILTER & RECTIFIER PWA's

4.14.1 Power Supply PWA Output Mnemonics

PIN	OUTPUT
2	Gnd
4	-10V
11	+15V
12	+15V
15	-5V
16	-5V
18	-Pwr Supply Therm
21	-15V
22	-15V
24	-10 Sense
39	+5V
40	+5V
81	+5V
82	+5V
83	+5V
84	+5V
85	+5V
86	+5V
87	+5V
88	+5V
89	+5V
90	+5V
97	+15V
98	+15V
103	-15V
104	-15V
114	Gnd
115	Gnd
116	Gnd
117	Gnd
118	Gnd
119	Gnd
120	Gnd
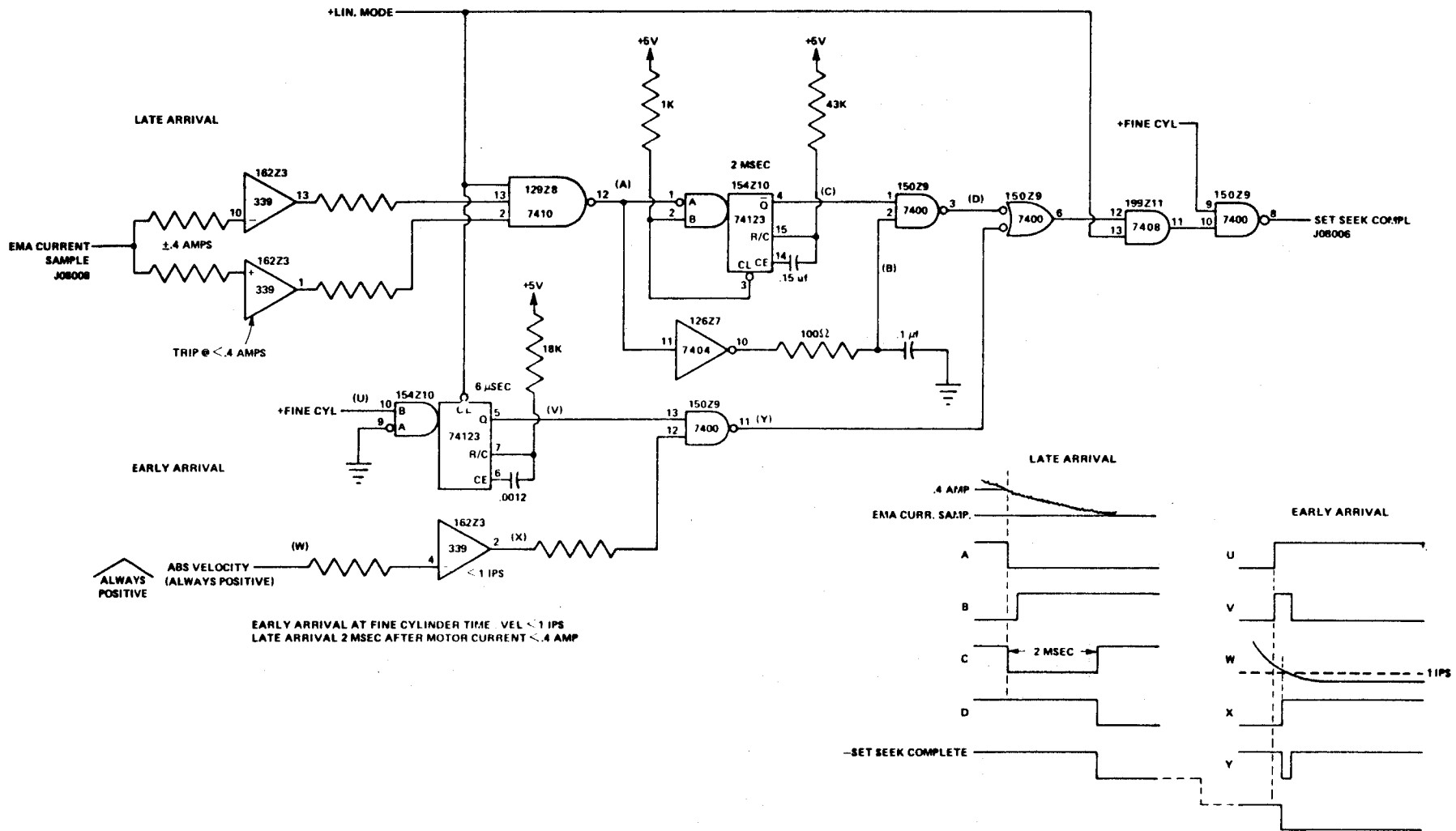
Figure 4-44. Set Seek Complete - Early and Late Arrival

PB001012-3

4.14.2 Filter & Rectifier PWA Output Mnemonics

PIN	SIGNAL
4	+22 volt, 1.5 Amp.
3	22 volt common
2	-22 volt, 2 Amp.
8/9	48 volt common
5/6	-48 volt Rev.
10/11	-48 volt Fwd.
E25	+11 volt
E26	11 volt common
1	11 volt unfiltered

4.13.2 Power Supply Functional Block Diagram Description

Figure 4-45 illustrates the functional block diagram of the disk drive power supply. This power supply consists of three modules: (1) the Filter and Rectifier PWA (Position A1A2), (2) the Power Regulator PWA (position J10), and (3) the Power Supply PWA (position J9).

The Filter and Rectifier PWA and Power Supply PWA will be discussed in this portion of the manual while the Power Regulator will be discussed in detail in Section 4.15.

The Filter and Rectifier PWA provides four unregulated voltage sources (refer to figure 4-46). The 22 volt unregulated source consists of a full wave rectifier bridge in a configuration which produces +22 volts, and -22 volts. The +22 volt output and -22 volt output are filtered by resistor capacitor networks. The outputs of the 22 volt sources are directed to the Power Supply and the Power Regulator PWAs.

The 11 volt unregulated source is produced by a half-wave rectifier and is passed through a capacitor filter. The output of the 11 volt source is directed to the Power Supply PWA and Power Regulator PWA.

The -48 volt source for EMA drive is produced by a full-wave rectifier bridge and an LC filter network. Circuit breaker CB3 is associated with the LC filter network to provide overcurrent protection for the EMA.

The +22 volt and -22 volt sources are directed into the Power Supply and Power Regulator. The 11 volt source is also directed into the Power Supply and Power Regulator PWAs. The Power Supply PWA accepts the unregulated voltages from the Filter Rectifier PWA as the raw DC supply. The regulator in turn corrects each of the unregulated voltages to its proper level. The Power Supply delivers the -10 volt, +5 volt, +15 volt, and -15 volt power to its series regulator transistor inputs. The Power Regulator controls the voltage at the output of each series regulator transistor.
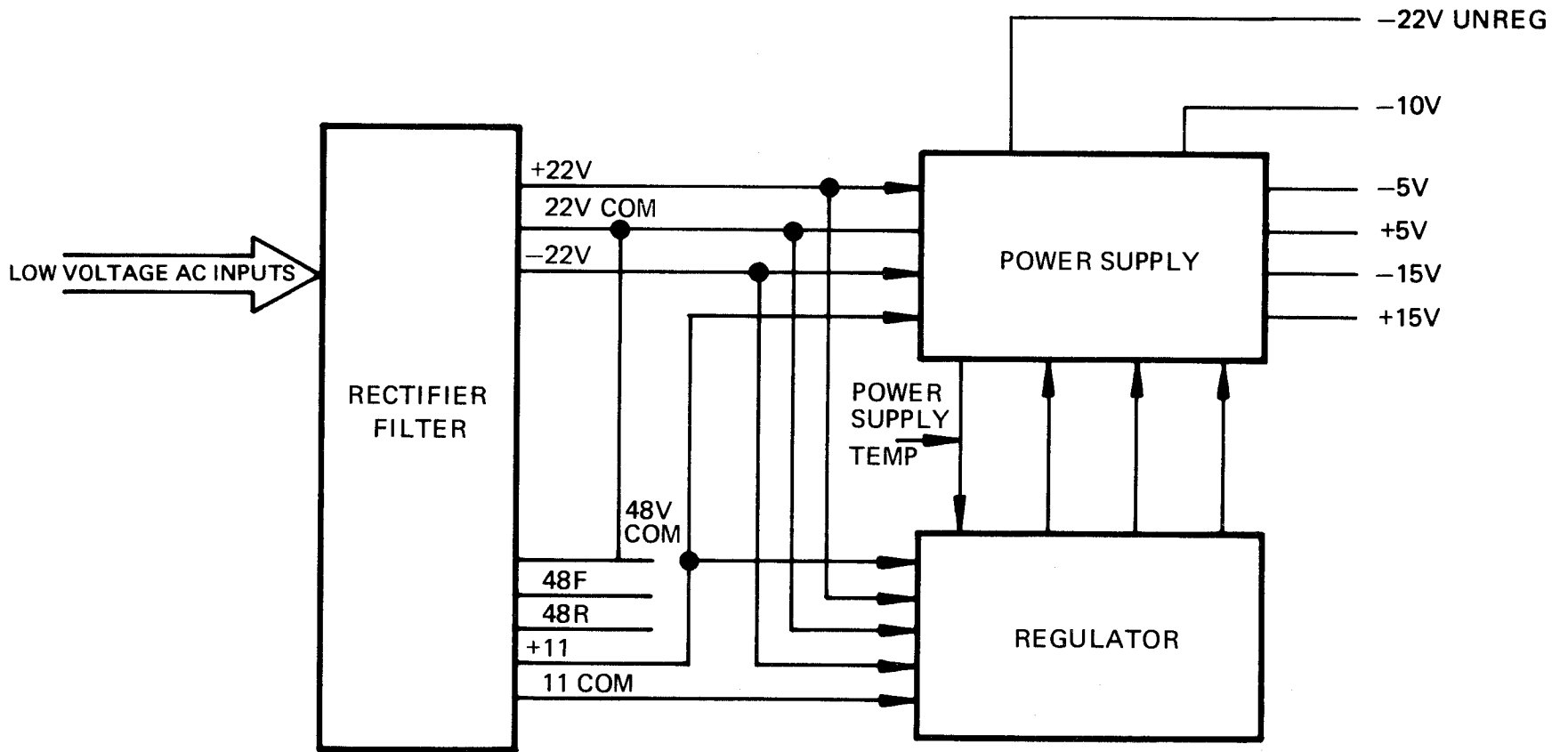
PB001006-3

Figure 4-45. Power Supply Functional Block Diagram
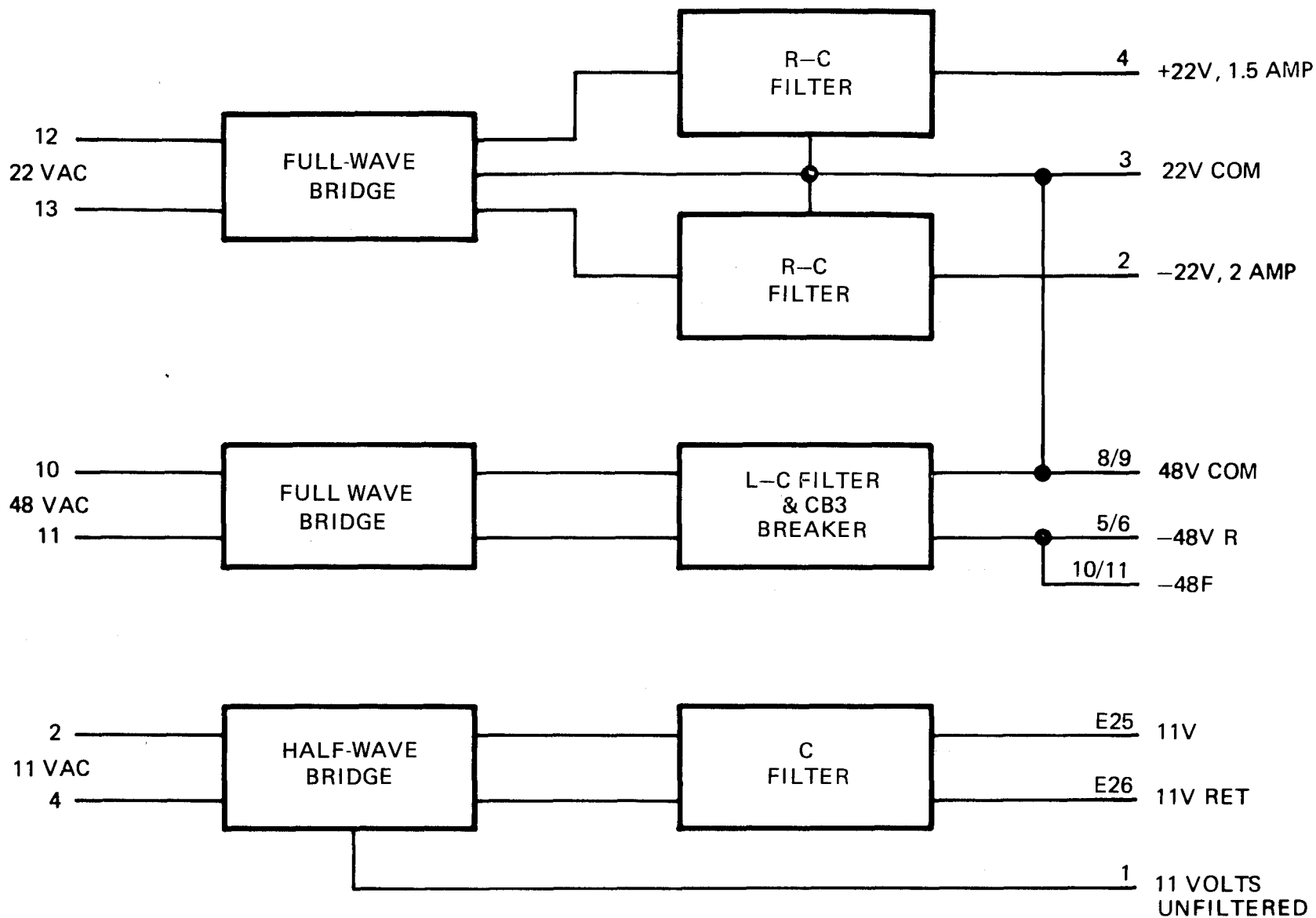
Figure 4-46. Filter and Rectifier PWA Block Diagram

PB001006-2

The power supply also contains the power supply thermistor. This thermistor is mounted on the heat sink of the +5 volt series regulator transistors within the Power Supply PWA. This thermistor sensor is part of the temperature mounting circuitry in the Power Regulator PWA.

4.15   POWER REGULATOR PWA

4.15.1   Power Regulator PWA Output Mnemonics

PIN	SIGNAL	DESTINATION
1	+24V Ret	J10-31
2	Gnd	
4	-10V	
7	+15V Current Sense	
9	+15V Drive	
11	+15V	
12	+15V	
14	-Break Rly	J15-3
16	-Drive Motor	J15-07
18	+24V Reg Pkout	J16-3, J19-27
19	-15V Current Sense	
21	-15V	
22	-15V	
23	-10V Sense	
24	+Overheat	J15-2
27	+22V	
29	-IOU Drive	
34	-PWR ON RESET	J1-103, J5-24, J6-110 J7-108, J22-06
35	-Early Warning	J3-54, J5-69
38	-ACH2	J6-31
39	-Dly Seq Pick	J5-45
81	+5	
82	+5	J15-6
84	-Pick Hold	J5-109
96	-Brush Motor	J5-11
97	+15V	
98	+15V	
99	+5 Current Sense	
102	+Set PWR Unsafe	J1-89, J5-89, J8-66
103	-15V	
104	-15V	
111	-15 Drive	
112	+Solenoid	J15-1
115	+5V Drive	J10-113
117	+5V Crowbar	
119	Gnd	
120	Gnd	

4.15.2 Power Regulator Block Diagram Description

The Power Regulator PWA contains circuitry (refer to figure 4-47) for the following functions:

- Early warning

- Voltage regulation

- Power on reset

- Motor start and pack stop

- Initialization and sequencing

EARLY WARNING

The early warning circuitry is made up of the Temperature Comparator and the Early Warning Logic. The purpose of the early warning circuitry is to advise the operator that the power supply assembly is overheating due to excessive current draw through the series regulator transistors. As the power supply temperature rises, the first operational amplifier will cause the device check light at the disk drive to be illuminated. Additionally, an early warning signal will be directed to the operator console of the central processing unit. Should the signals be disregarded, the second operational amplifier will be activated as the power supply temperature continues to rise. A signal then will be directed to Crowbar Logic to disable the +5 volt supply, which is the primary logic voltage supply for the disk drive.

VOLTAGE REGULATION

The Voltage Regulator PWA contains regulators for the following power supplies: (1) the +5 Volt Regulator, (2) the -10 Volt Regulator, (3) the -15 Volt Regulator and (4) the +15 Volt Regulator. The +5 Volt Regulator uses the +11 volt unregulated source for primary power, which is then regulated down to +5 volts. The output of the +5 Volt Regulator is directed to the +5 volt series regulator transistor in the Power Supply PWA and also to the Crowbar Logic. This regulator also contains current sensing for over-current monitoring of the 5 volt TTL logic supply. The -15 Volt Regulator uses the -22 volt unregulated supply for its primary source. The output of this regulator is directed to the -15 volt series regulator transistor in the Power Supply PWA. The -15 Volt Regulator also directs its output to the -10 Volt Regulator which produces the -10 volt drive to the associated series regulator transistor in the Power Supply PWA. Outputs from the -15 Volt Regulator are also directed to the Voltage Monitoring Logic. The +15 Volt Regulator uses the +22 volt source as its source of unregulated power. It develops the +15 volt drive signal to the series regulator transistor at the Power Supply PWA. Its output is also directed to the Voltage Monitoring Logic. The Voltage Monitoring Logic is used as a failsafe device in order to ensure that all power supply voltages which are critical to the operation of the disk drive at at their proper voltage level. The -48 volt EMA source, +5 volt source, -15 volt source, and +15 volt source are all directed to the inputs of the Voltage Monitoring Logic. Should

P.S. TEMP   17

TEMP. COMPARATOR

EARLY WARNING LOGIC

35   EARLY WARNING

CROW BAR LOGIC

117   + 5V CROW BAR

24   OVER HT

+11 VOLTS   39   40

+5V CURR SEN.   99

+5 VOLT REGULATOR

115   +5 VOLT DRIVE

−48 VOLTS   106

VOLTAGE MONITORING LOGIC

102   SET PWR UNSAFE

−10 VOLT SEN.   23

-10 VOLT REGULATOR

29   −10 VOLT DRIVE

−22 VOLTS   91, 92, 93, 94

−15 VOLT SEN.   19

+15 VOLT SEN.   7

−15 VOLT REGULATOR

21, 22, 103, 104   -15 VOLT

111   - 15 VOLT DRIVE

+15 VOLT REGULATOR

1, 2   GND, 24 VOLT RET.

11, 12, 97, 98   +15

9   +15 VOLT DRIVE

34   PWR ON RESET

POWER-ON RESET LOGIC

MOTOR START LOGIC

START/STOP LATCH

4   BRK RLY

16   DRIVE MOTOR

+22 VOLTS   26

PACK STOPPED LOGIC

112   + SOLENOID

PACK STOPPED   114

MOTOR START   36

MOTOR START DELAY LOGIC

37   DELAY SEQ. PICK

DELAY SEQ. PICK LOGIC

PICK HOLD LOGIC

84   PICK HOLD

SEQ. PICK INPT   25

+24 PICK HOLD   108

SEQ. INK GND   85

INHIB. DRIVE RDY   33

SEQ. PICK OUT LOGIC

18   SEQ. PICK OUT

+11 VOLTS UNFILT.   86

38   AC HZ

PB000984

Figure 4-47. Power Regulator Block Diagram

one of the regulator outputs drop below its minimum voltage limit, the Voltage Monitoring Logic will develop a power unsafe signal which is directed to various modules in the disk drive. The power unsafe signal will disable the Read/Write Module from the write mode of operation and cause a Safety Unload.

POWER ON RESET LOGIC

During the initialization of the disk drive +22 volts is directed to the input of the Power On Reset Logic. This logic develops a delayed pulse which is directed to the various counters and resetable latches throughout the disk drive for initialization of the complete system.

MOTOR START AND PACK STOP LOGIC

A motor start signal is directed to the Motor Start Delay Logic. After approximately 0.5 seconds, a signal is directed to the Motor Start Logic and to the Start Stop Latch to initialize the motor start drive motor signal. When the drive is shut down and the disk pack has stopped rotating, a pack stop signal is received and directed to the Pack Stop Logic which resets the Start Stop Latch to the stop state, shuts off the brake and permits the top cover of the drive to be opened.

INITIALIZATION AND SEQUENCING LOGIC

The sequence pick, pick hold, sequence interlock grounding and inhibit drive ready signals are directed to the Delay Sequence Pick Hold Logic and the Sequence Pick Out Logic. Each of these logic blocks produce the signals and the proper timing to enable its own disk drive to initialize and to enable the next drive in line to initialize.

4.16   EMA DRIVER

4.16.1   EMA Driver PWA Output Mnemonics

PIN	SIGNAL	DESTINATION
24	Current Sample Rev	J8-18
34	Current Sample Fwd	J8-34
38	IDR	J8-41
40	PF/DR	J8-45

4.16.2   EMA Driver Block Diagram Description

The EMA Driver PWA contains the power transistors for EMA Drive in the forward and reverse directions. Drive forward/pulse forward and drive reverse/pulse reverse signals from the Pulser Driver PWA are directed to the appropriate circuitry to accomplish EMA movement.
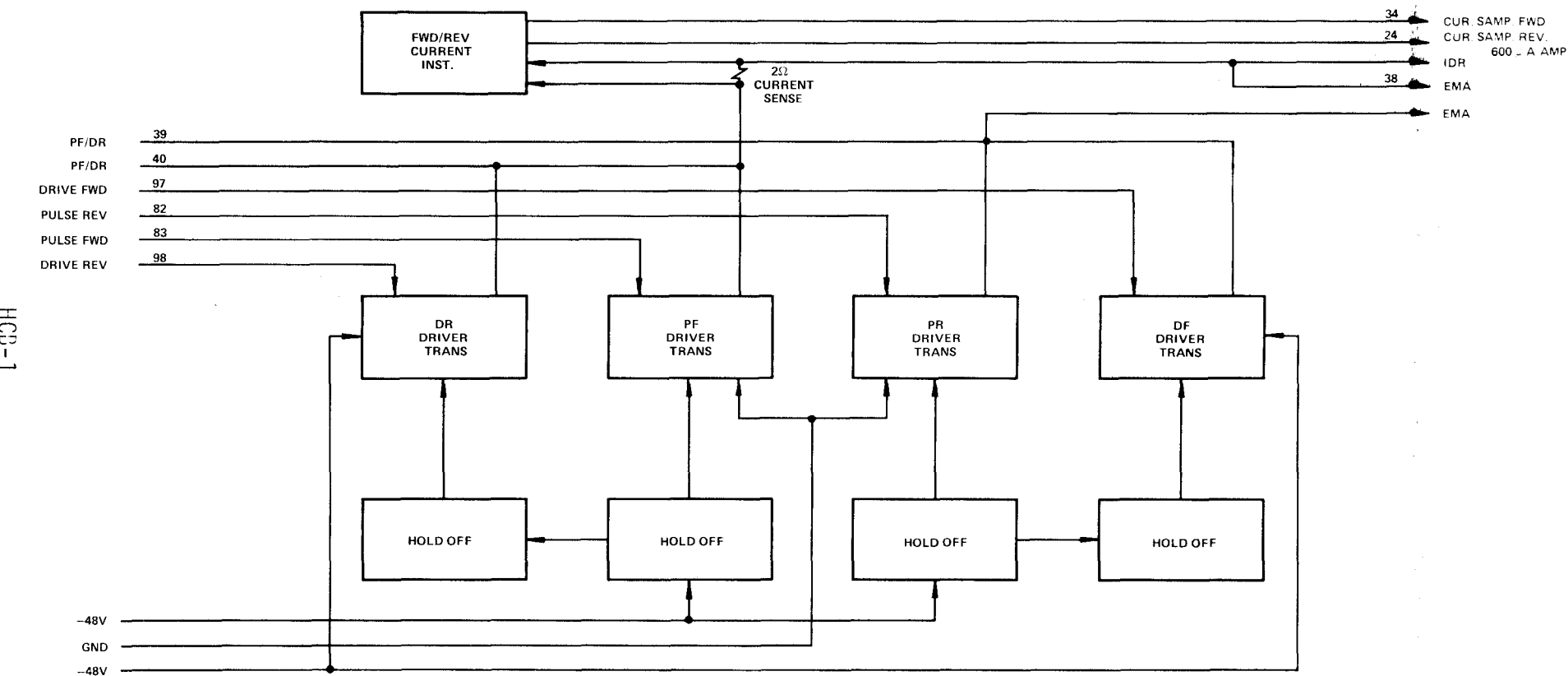
Figure 4-48. EMA Driver Block Diagram

ACCELERATE   DECELERATE   ON TRACK

+2.5   +5V   INITIAL CURRENT BUILDUP ; DF AND PF

DECREASE DUE TO
VELOCITY BUILDUP
CAUSING BACK EMF

EMA
CURRENT IN AMPS
J08008

PR / DR

PR & DR AND COLLAPSE OF BACK EMF

- 4.5   -9V

DIFF =   400   256   0

CURVE
.15V/ IPS
J08042

-12V   UNTIL NEW DIFFERENCE
                                            TAG AND BUS ASSERTION
                                            FROM IDA

GATED TACH
.15V/IPS
J08025   +12V

SERVO ERROR
J08004

LINEAR MODE
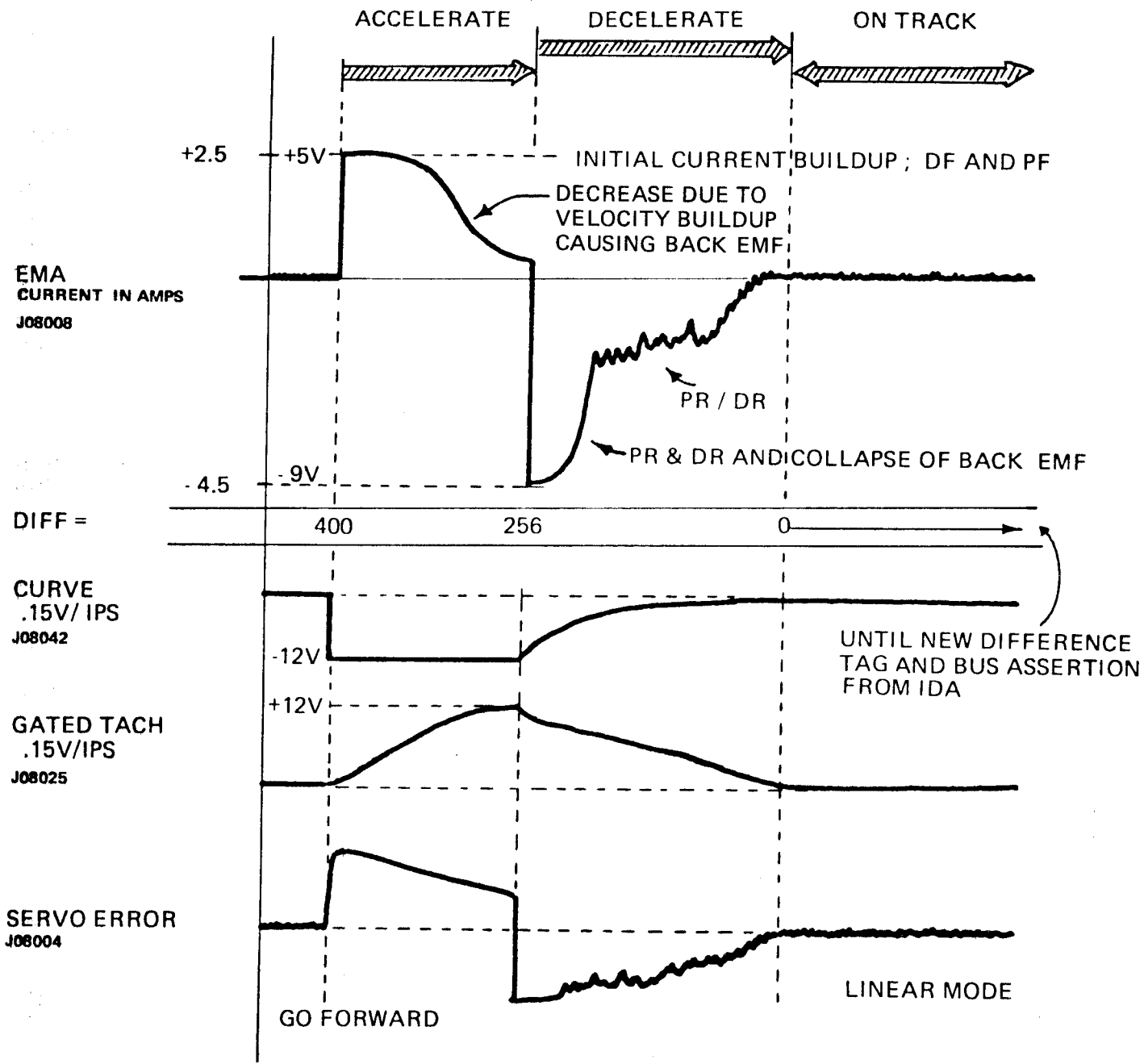
GO FORWARD

Figure 4-49.   EMA Current Characteristics - 400 Cylinder Seek

Forward and reverse motion is accomplished by changing the direction of the current flow through the EMA. A -48 volt supply provides all power needed for the EMA.

The forward and reverse current through the EMA is sampled and directed to the Pulser Driver PWA where it is used to control the EMA velocity.

4.17 OPERATOR CONTROLS

4.17.1 Operator Control PWA Output Mnemonics

PIN	SIGNAL	DESTINATION
15	-On Sw Latch	J22-35, J5-56
34	-Run Sw Latch	J22-14, J5-17
7	-Stop Sw Latch	J22-27, J5-108
22	+File Protect Latch	J22-2 J3-59
19	+Low Density	J22-39, J3-45

4.17.2 Operator Controls PWA Block Diagram Description

The Operator Controls PWA is illustrated in figure 4-50. The Operator Control PWA is located just under the Operator Control Panel in the disk drive. For removal of this assembly consult the maintenance sections of this manual. The Operator Control PWA contains a series of digital latches which are set and reset by the switches on the Operator Control Panel of the disk drive. Each digital latch and its input and output functions are defined on the block diagram, the physical switches and their associated lamp driver circuits are not shown. The lamp driver circuits consist of a single TTL element connected to a discrete transistor which serves as a driver for the lamp under the associated switch in the front panel.

--ON SW 28

+ ON SW 27

ON SW
LATCH

15 --ON SW LATCH

— RUN SW 31

+RUN SW 32

RUN
SW LATCH

34 --RUN SW LATCH

—STOP SW 33

+STOP SW 34

STOP SW
LATCH

7 --STOP SW LATCH

GATED MOD SEL 3

—FILE PROTECT SW 36

+FILE PROTECT SW 37

FILE
PROTECT
SW LATCH

GATED
FILE PROTECT
LOGIC &
LATCH

+FILE PROTECT
LATCH

—LOW DEN 24

+LOW DEN 25

LOW
DENSITY
INPUT
LOGIC

LOW
DENSITY
LATCH

19 +LOW DENSITY

PB001006-1
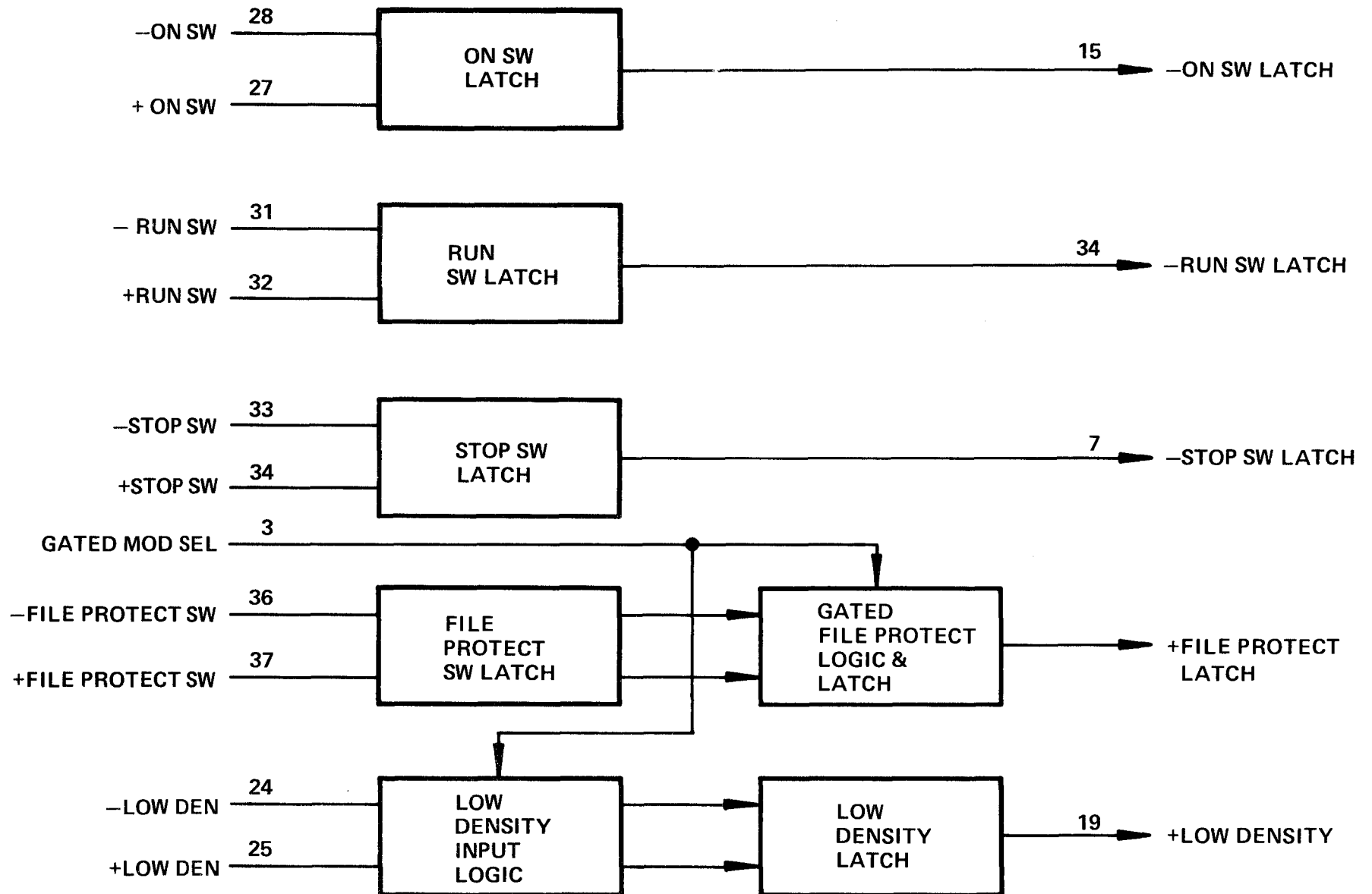
Figure 4-50. Operator Control Block Diagram

CHAPTER 5

MAINTENANCE

5.1 SAFETY PRECAUTIONS

Maintenance personnel should use the following safety procedures to prevent injury to themselves or damage to the equipment:

1. Keep fingers and hands out of area between carriage and disk pack while drive is on.

2. High potentials up to 240 VAC/400 VAC are present inside the drive power supply and on the transformer terminals when drive is not operating. Always remove AC power cables when performing maintenance in these areas.

3. The electromagnetic actuator (EMA) contains an extremely powerful magnet. While flux leakage is low in the pack area and outside the drive, use care when working in this area with magnetic materials. Use only nonmagnetic tools near the EMA. Keep read/write heads away from the EMA. Wrist watches should not be worn in this area - they may be magnetized by the field.

4. Avoid touching or blowing breath on read/write heads. Acids from the skin can etch and ruin heads. Breath can cause condensation deposits which will disfigure the gliding surface.

5. Never manually move the carriage assembly forward without a spinning disk pack in place, or until installation of the head-separator tool according to instructions (section 6).

6. Serious damage to disk surfaces will result from servicing practices that introduce particles into the shroud area.

7. Write only on 8418 CE disk pack cylinders 032-489, 503-775. Home address and record zero are prewritten on all cylinders.

8. When performing maintenance, always remove customer data pack and, if test pack is required, install the CE pack or a scratch pack.

9. Never remove or change PWAs without shutting down all internal drive DC power at CB2.

10. Be especially careful around moving parts if wearing a necktie or a ring.

11. If the drive is off-line for servicing and the DC ground wire to the processor has been disconnected, connect a jumper wire between frame ground and DC ground. Be sure to remove it before returning drive to service. Do not install a jumper if the DC ground wire is connected to the processor as it may cause errors on other drives.

12. Avoid unnecessary flexing of the ribbon cables. Don't bend the ribbon cables around a very short radius or fold up excess ribbon cable in the cable troughs.

13. Under certain failure conditions it may be possible to open the cover while the pack is spinning. Visually check the pack for motion before attempting to open the cover.

14. Don't rely on a circuit breaker or a switch. Before working on the deenergized side of either, check for voltage with a meter. This will also bleed off any residual charge.

15. Be especially careful with metal tools in the vicinity of the backplane. The pins are closely spaced and shorting can cause additional problems.

16. Don't allow the cover to remain open. Keeping the cover closed reduces the possibility of airborne contaminants causing HDI.

17. To protect the heads, install and remove disk packs only with the power ON. This allows the EMA to keep the heads retracted.

5.2   MAINTENANCE PHILOSOPHY

The primary aim of a maintenance program is to maintain the equipment so that it provides the highest possible levels of utility and availability for the user. A comprehensive preventive maintenance program is in process to evaluate and minimize the effect of known failure mechanisms on the equipment.

Corrective maintenance is intended to locate and repair equipment malfunctions with minimum impact on the user. In general, the fastest way to fix a problem is to isolate to a component and replace that component with one known to be operational. In most cases the replaceable component is the PWA (Printed Wiring Assembly).

> NOTE: Do not perform unnecessary maintenance.
> If a device is operating satisfactorily,
> perform only the scheduled preventive
> maintenance.

5.3   TOOLS AND TEST EQUIPMENT

Table 5-1 lists those standard tools that are contained in the Maintenance Engineers carrying case; Table 5-2 and Figure 5-1 illustrate special tools which are unique to the maintenance of the 8418 Disk Drive.

Table 5-1. List of Standard Tools

Alcohol, 91% Isopropyl
Bit, 26 Ga., Wrap Gun
Bit, 30 Ga., Wrap Gun
Brush, Head Cleaning
C-Cell Flashlight
Crimper, Super Champ
Crimper, AMP 45707-2
Diagonal Cutters, 4-3/4"
Extender, Ground Plane
Extension, 14", 1/4" Drive
Extension, 6", 1/4" Drive
Gage Set, Feeler, .0015-.035"
Hammer, Ball Peen, 8 oz.
Hex Bit, 1/8" - 1/4" Drive
Hex Bit, 9/64" - 1/4" Drive
Hex Bit, 5/32" - 1/4" Drive
Hex Bit, 3/16" - 1/4" Drive
Hex Bit, 1/4" Drive
Inspection Mirror
Nutdriver Set
Oilstone, Fine
Paddle, Head Cleaning
Penlight
Pin Punch, 1/16"
Pin Punch, 3/32"
Pin Punch, 1/8"
Pliers, Beryllium Long Nose, 6-3/4"
Pliers, Needle Nose, 5-1/2"
Pliers, Chain Nose, 5"
Probe, Nonconductive, Jiggle Stick PR 316-8
Screwdriver, Offset
Screwdriver, Beryllium, 4-1/4"
Screwdriver, Standard, 6-5/8"
Screwdriver, Beryllium, 8-5/8"
Screwdriver, Beryllium, 10-1/8"
Screwdriver, Stubby
Screwstarter, 6"
Screwstarter, 8"
Shim Gage, 3 Mil
Shim Gage, 5 Mil
Shim Gage, 2 Mil
Sleeve, 26 Gage, Wrap Gun
Sleeve, 30 Gage, Wrap Gun
Solder Wick
Solder, 60/40 Multicore
Soldering Iron
Tee Handle, 1/4" Drive
Tip, Soldering Iron, Small

Table 5-1. List of Standard Tools (Continued)

Tissue, Lint-Free
Carrying Case
Universal Joint, 1/4" Drive
Unwrap Tool, 30 Gage
Wire Stripper, .014 Gage
Wire Stripper, Ideal
Wire Wrap Gun
Wrench Set, Allen, .050-1/4"
Wrench, Adjustable, 8"
Wrench, 11/32" Combination
Wrench, 3/8" Combination
Wrench, 7/16" Combination
Wrench, 1/2" Combination
Wrench, 9/16" Combination
Wrench, 3/8" - 7/16" Open End
Wrench, 5/16" - 11/32" Open End
Wrench, 1/2" - 9/16" Open End
Wrench, 5/8" - 11/16" Open End
Wrench, 3/4" - 13/16" Open End
Wrench, Ratchet, 1/4" Drive

MC8309

Table 5-2. List of Special Tools

DESCRIPTION	PART NUMBER	
Initial Head Alignment	9006877-3	
Head Alignment	9006625-5	
Head Install	9006867-2	Space
Head Separator	9023528-2	provided in
Torque Wrench	9800317-00	DEDU for
Hex Bit 6"	9800039-10	carrying
Hex Bit 1 3/4"	9800039-11	these tools
Screwdriver Bit	9800039-12	
Trim Pot Tool	9007567-1	(P/N 9023456
Extractor	9023984-00	only)
Scratch Pack	9023565-00	
Alignment Pack	9023567-00	
Coil Alignment Tool	9023913-00	
Railspacer	9024189-00	
Extender	9023770-00	
Extender (Inverted)	9023772-00	
Air Measuring Kit	9007220-1	
Spring Scale	930838	
Pack Cone Adjustment Tool	9024104-00	
Diamond Pin, Magnet Alignment	9021251-00	
Dowel Pin (1 each) 3/16" x 1 1/2"	315485404	

HEAD FINE ALIGNMENT TOOL

VIEW **A**
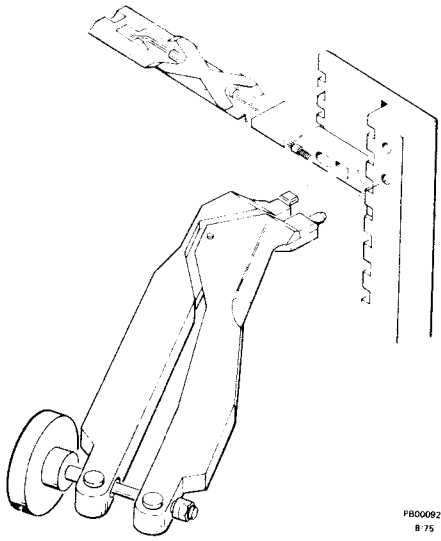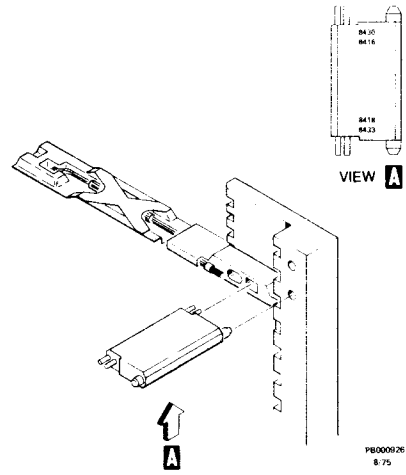
HEAD INITIAL ALIGNMENT TOOL
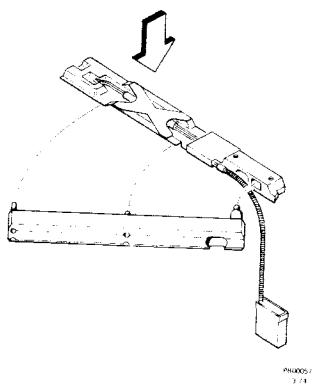
HEAD INSTALLATION TOOL
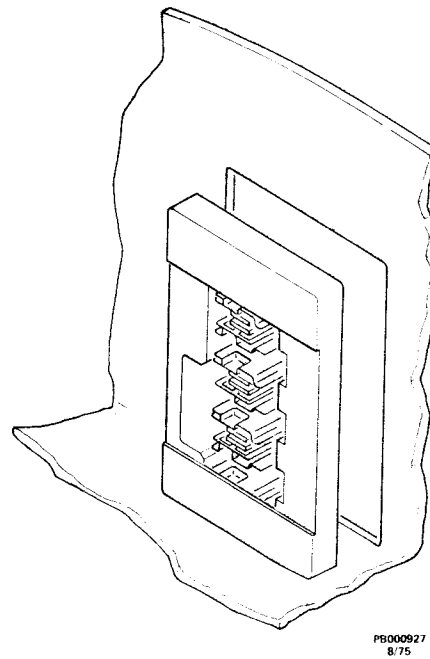
HEAD SEPARATOR TOOL

Figure 5-1.   Special Tools

Two items of standard test equipment are required for servicing and trouble-shooting: an oscilloscope and multimeter. Table 5-3 lists available accessories for this test equipment.

5.3.1 Oscilloscope

Read circuit troubleshooting requires an oscilloscope with delayed sweep capability, a minimum bandwidth of 100 MHz, a minimum rise time of 4 ns, and a vertical deflection of 5m V/cm. Tektronix Models 454 and 465 meet these specifications.

5.3.2 Multimeter

Multimeter requirements are not critical, but the meter selected should be of sufficient quality to meet the following minimum range and accuracy specifications:

```
AC/DC volts . . . . . . . . . . . . . 0 to 250 +5%
Resistance. . . . . . . . . . . . . . 0 to 20 Megohms +5%
Sensitivity DC. . . . . . . . . . . . 20,000 Ohms/Volt +5%
Sensitivity AC. . . . . . . . . . . . 10,000 Ohms/Volt +5%
```

Table 5-3. Standard Test Equipment Accessories

```
Jumper, 6-inch
Jumper, 12-inch
Jumper, 18-inch
Jumper Assy, Test Probe Wirewrap Pin
Probe, Tektronix DC-250 MHz, 10X
Probe Tip, HP, 0.025 Square Pin
Probe Tip, 6-32 Screw On, Straight
Tag Set, Probe Identification
Test Clip, IC
```

5.3.3 Special Test Equipment

DEDU

A Drive Exerciser/Diagnostic Unit (DEDU), P/N 9023456-01, is available as a portable test unit for the alignment and servicing of Univac Disk Storage Drives, Models 8416 and 8418. The DEDU, shown in figure 5-2, is an effective troubleshooting aid because all drive functions can be simulated and the results monitored on the DEDU panel display. The DEDU can be used for both on-line and off-line maintenance. When performing off-line maintenance, the DEDU is a substitute for the IDA (integrated device adapter). For additional information, refer to the DEDU User's Guide, MC8327 (UD002534-1) which contains descriptions, and operation and applications information.

5.4 PREVENTIVE MAINTENANCE

Preventive maintenance is primarily in one of the following categories:

1. Inspection
2. Cleaning
3. Lubrication

The goal of preventive maintenance is to prevent failures that impact the availability of the equipment to the user. Table 5-4 is a summary of a typical preventive maintenance schedule.
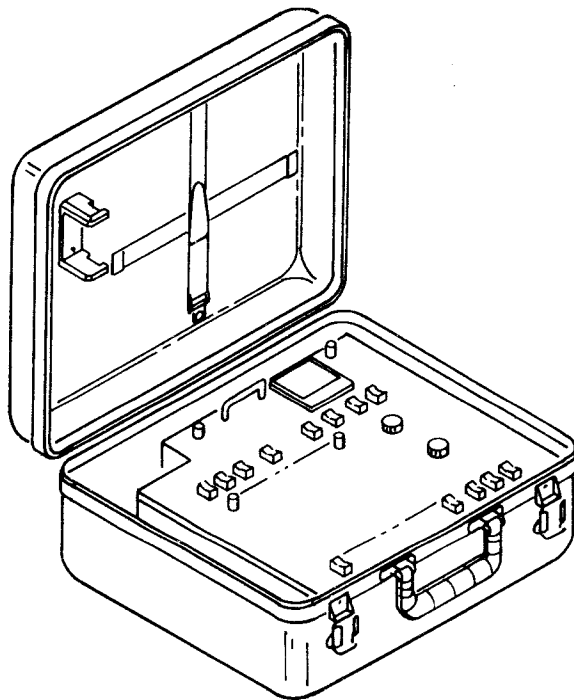
Figure 5-2. Drive Exerciser Diagnostic Unit (DEDU)

Table 5-4. 8418 Preventive Maintenance Schedule

INTERVAL (MONTHS)	ITEM	ACTION	REF PARA
	Shroud	Clean with 91% isopropyl alcohol and lint-free tissue	5.5.2
	Read/Write Heads	Inspect for oxide deposits	5.7.2
	Carriage rails	Clean with lint-free tissue slightly dampened with 91% isopropyl alcohol	5.7.4
	Spindle	Clean top of spindle frange with lint-free tissue slightly dampened with 90% isopropyl alcohol. Oil machined surfaces with light machine oil and wipe off excess oil with a lint-free wiper. The object is not to provide lubrication, but to prevent corrosion of the machined surfaces.	5.5.2
	Prefilter	Replace	6.3.1
3	Library Filter	Replace	
	Absolute Filter	Replace every 12 months.	6.3.2
	Shroud Screws	Inspect for tightness. Tighten as required	5.5.1
	Head Cables	Inspect cables and plugs for loose connectors and connector retainers	
	Control Panel Indicator Lamps	Inspect for illumination using the STOP button to test the lamp. Replace as required	6.4
	Drive Belt Tension	Check and adjust as required at end of 3 month, 6 month, 12 month period	5.9.8
	Front Topcover	Inspect counterbalance for particles. Clean as required with 91% isopropyl alcohol. Adjust jamnut as needed for proper cover operation	6.2.4
6	Spindle Ground Contact	Inspect for excessive wear. Replace as required	
	Read/Write Safety Circuits	Check for proper operation, using DEDU	5.9.10

Table 5-4. 8418 Preventive Maintenance Schedule (Continued)

INTERVAL (MONTHS)	ITEM	ACTION	REF PARA
12	Base and Covers	Clean with 91% isopropyl alcohol and lint-free tissue	
	Access Time	Check and adjust as required	5.9.3
As required	Disk Pack	Clean with 91% isopropyl alcohol and lint-free tissue on disk cleaning paddle.	5.6.1
	Read/Write Heads	Clean heads with head cleaning paddle. For stubborn deposits, slightly dampen one end of head cleaning paddle with 91% isopropyl alcohol solvent. Support back of read/write head and gently but thoroughly scrub head face with rotary motion. Dry head surface with dry end of head cleaning paddle. Check head alignment to ensure read/write compatibility. Inspect with dental mirror.	5.7.1

5.4.1   Inspection

Inspection can be a very useful aid in a preventive maintenance program. For example, look for chafing or frayed insulation at stress points in the cabling. Look for metallic dust or oxide deposits that may indicate a higher-than-normal rate of wear. Look for PWAs or cable connectors that are not firmly seated in their locations. Look for surface or stress cracking in metal parts.

5.4.2   Cleaning

Clean oil and grease accumulations from surfaces where they don't belong. Keep air pickup vents clear of dust and particles.

5.4.3   Lubrication

Check lubrication at hinge points. Lubricate latches and metal-to-metal surfaces using an appropriate lubricant for the application. Don't overdo lubrication.

> **NOTE:** Do not lubricate in the carriage area (i.e., carriage rails).

5.4.4 Cleaning Materials and Procedures

Throughout this section all references to alcohol (for cleaning purposes) are to be 91% reagent grade alcohol mixed with up to 9% distilled water. Ordinary rubbing alcohol should <u>never</u> be used because it leaves a residue when it evaporates.

References to lint-free cloths are to Texwipe No. TX304 or the equivalent. References to lint-free foam swabs are to Texwipe No. TX700 or equivalent. Disk cleaning wand references are to Texwipe No. TX800 or equivalent; Texpads, used with the wand, are Texwipe No. TX801 or equivalent.

5.5 SHROUD AND SPINDLE SERVICING

5.5.1 Visual Inspection and Checks

Carefully check for metal particles in the shroud area. Very small particles are particularly dangerous. The airflow within the shroud is designed to flush most foreign matter out of the shroud area. However, particles left in the shroud can be deposited on the spindle and in the disk pack.

Particle generation normally occurs with wear. Any two rubbing surfaces will generate particles. If particles are discovered, clean the shroud area, inspect the disk pack and heads, and check for the following conditions:

1. Proper operation of operator cover (no binding or grinding when opening and closing).

2. Proper operation of pack lock screw and latching mechanism.

3. Proper fit of disk pack top cover and proper clearance between handle recess and pack hub when cover is placed on pack.

Inspect all shroud screws for tightness. Tighten as required.

5.5.2 Shroud and Spindle Cleaning

Clean the shroud area by lightly dampening a lintfree tissue with 91% isopropyl alcohol and wipe the shroud area to remove all dirt and smudges. Pick up any remaining dirt or metal particles with a wad of adhesive tape turned adhesive side out.

To clean the spindle, wipe the flange surfaces thoroughly with 91% isopropyl alcohol. After drying, apply a thin film of rust preventative oil to the machined surfaces on the spindle to prevent corrosion. Wipe off all excess oil with a lint-free wiper.

5.6   DISK PACK CLEANING

Disk packs should be cleaned only when they appear to be dirty and contain a buildup of lint or oxide, or when read errors occur that appear to result from dirty surfaces. If particle damage or oxide buildup is suspected, refer to Disk Pack Inspection, to evaluate disk pack condition. If the inspection reveals that disk pack cleaning is required, clean the disk pack as follows:

1. Install disk pack on inspection fixture.

2. Wrap lint-free tissue around disk cleaning paddle or use an approved disk cleaner such as the Texwand No. TX400, or equivalent so that insertion between disk surfaces will allow simultaneous cleaning of top and bottom surfaces without forcing.

3. Slightly dampen the tissue on the disk cleaning paddle at one end with 91% isopropyl alcohol.

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CAUTION
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Excessive alcohol can be detrimental to disk pack surfaces and will leave a residue which could cause head-to-disk interference. Alcohol must not be allowed to dry by evaporation on disk surface. Wipe the surface dry.

4. Insert paddle between disks so that it fits snug against top and bottom disk surfaces, then manually rotate disk pack. If oxide buildup on the disk is heavy, the use of a cleaning medium such as the Texwand No. TX400 and the Texsleeve, No. TX403 or TX404 is recommended.

5. With pack rotating, slowly withdraw paddle across disk surfaces.

6. Repeat cleaning operation until no residue remains on tissue after withdrawl.

7. Repeat procedure using dry tissue.

8. Remove disk pack from inspection fixture.

9. Discard used tissue after use.

   NOTE: Clean disk pack top cover by dampening a lint-free tissue with 91% isopropyl alcohol and wiping inside and outside surfaces to remove dirt and smudges.

5.6.1 Disk Pack Inspection

Disk pack inspection is required when it is suspected that head-to-disk interference (HDI) has occurred, or when read errors occur that appear to have been caused by dirty disk surfaces. HDI is caused by the presence of a foreign particle in the airstream between the head face and disk surface, or a protrusion on the head or disk which interferes with the air bearing as the head glides over the disk. If the problem is not corrected, it can cause damage from pack-to-pack or drive-to-drive. The propagated damage results when the operator does not recognize or understand HDI symptoms and therefore does not correct the cause of the problem.

The presence of fingerprints, films, or stains on the surface of either disk or heads leaves a deposit of oils and salts which may build up to a height greater than the gliding height of the head, causing head-to-disk interference. A tinkling, zinging, or scratching sound is an indication of HDI. This can be an initial symptom and may not continue if the particle is disloged. If allowed to continue, the noise can become louder, and the damage more serious. The approximate radial position of the embedded particle can be determined by noting the carriage cylinder positions where the sounds occurred. This requires thorough inspection and cleaning of the head, disk surface, and spindle area. If a disk pack is reinstalled after cleaning and inspection, allow it to run for a few minutes, then remove and reinspect. Never reinstall a disk pack which is suspected to be defective.

> **NOTE:** Heads used in the 8418 Disk Drives
> are not interchangeable with the
> heads used in other disk drives.

5.6.1.1 Procedure

1. Install suspected disk pack on inspection fixture.

2. Use a high-intensity light to illuminate each disk surface. Use a dental mirror to observe the surface.

3. Manually rotate the pack while searching for the following damage indications:

   a. Deposits or smears that cannot be totally removed with alcohol and cleaning paddle.

   b. Scratches in oxide on the recording surface that show the aluminum substrate. Aluminum visible on disk edge is not serious, because it is not used for recording.

   > **NOTE:** Scratches in oxide which are 0.0027
   > inch apart indicate that a head with
   > an embedded particle or other
   > protrusion has been used on the disk.

   c. Embedded particle with a trailing scratch (comet trail).

d. Unacceptable bands, a concentric, circular ring or strip that is
    1/32 inch or wider. Bands can be identified by color, texture,
    or reflective variations from the other disk surfaces (except
    the servo surface).

    NOTE: Bands which are not black in color and
           possess a high degree of reflectivity,
           or which shine more than remaining disk
           surfaces, are acceptable for use.
           Unacceptable bands are black in color
           and may be dull in comparison to other
           disk surfaces. Such areas have been
           damaged by HDI and could result in
           further HDI if pack is reused.

4. Perform evaluation as follows for a disk pack that is suspected of
    having imperfections other than those previously described:

    a. Install disk pack on inspection fixture.

    b. Clean disk surfaces suspected of having defects.

5. Examine the disk surface finish to determine if the disk pack can be
    used without causing damage to heads. Only small defects of the
    following types are permitted to enable the disk pack to be reused:

    a. Small areas of light-colored stains or other discolorations which
        remain after the disk pack has been thoroughly cleaned are
        acceptable.

    b. Small pin holes in the disk surface coating are permitted. These
        areas are preflagged by the disk pack manufacturer.

5.7 PREVENTION OF HDI CONDITION

1. Periodically inspect read/write heads. Perform read/write head servic-
    ing as described in the following paragraphs according to Preventive
    Maintenance schedule of table 5-4.

2. Do NOT allow particles to accumulate in shroud area. Clean shroud
    as specified in Preventive Maintenance schedule of table 5-4.

3. Ensure that air filtering system does not leak and that functioning
    (clean) filters are used in the drive. Dirty filters cause contamin-
    ation to accumulate and also produce heat in the drive. Inspect
    prefilter at each service call and replace at least every three
    months.

4. Ensure that foreign particles are not being generated within the drive.
    Clean spindle as specified in Preventive Maintenance schedule of table
    5-4.

5. Avoid leaving the operator cover open for long periods other than while performing maintenance.

6. Use only head-cleaning brushes or paddles for cleaning heads to avoid introducing particles in the head/disk area. Discard tissue after use.

5.7.1 Read/Write Head Servicing

Read/write heads are to be inspected at three-month intervals or when diagnostic symptoms indicate that a head is causing errors. If inspection reveals imperfections, the head should be cleaned. The heads are not to be cleaned as a scheduled maintenance requirement. Cleaning is accomplished only when visual checks indicate the presence of contaminants.

> **NOTE:** If damage is found while inspecting the head, isolate the cause of damage by referring to the previous descriptions of head-to-disk interference (Disk Pack Inspection) before attempting to replace the head.

5.7.2 Read/Write Head Inspection

1. Position a dental mirror close to the head and use a high-intensity light to inspect the head. Do NOT place the dental mirror between the heads or allow it to touch the heads because damage could result.

2. Inspect all heads to ensure that cam-follower surfaces on arms properly engage the cams.

3. Look for the following types of contamination (or damage) on each head.

   a. Light-brown streaks of oxide on face or on trailing edge of shoe. These can usually be cleaned and reused. A record should be kept in the machine of these cleaned heads to determine if a specific head is picking up excessive oxide at a frequent interval. Heads should be cleaned only when necessary.

   b. Hydrocarbon tar-like substance on leading edge of shoe. This indicates that the drive is not sealed, or has been operated extensively with the covers open. Check the covers for damaged seals.

   c. Heavy deposit on face of head.

   d. Non-particle damage: stains, film residue, lint, dust, etc. on flexure spring and face.

   e. Particle damage: scratches, nicks, burrs, etc. on face. A succession of 0.0027-inch grooves indicates an embedded particle in the disk surface, which could still be present on the disk.

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┌─────────┐
│ CAUTION │
└─────────┘
```

Do NOT touch the face of read/write
or servo head with fingers. Oil from
the skin can cause deposits of foreign
materials to build up. Do NOT leave
any residue or lint on the head. Do
NOT blow on the heads because
moisture from breath will cause con-
tamination.

4. If contaminants are present, clean the read/write or servo head. If
   head is damaged, isolate the cause and replace the head. Any head
   which has residue on its surface that cannot be removed with alcohol
   and a rigid cleaning tool must be replaced. Residue can be spotted
   by reflecting light off the head face and observing it with a dental
   mirror.

5.7.3   Read/Write Head Cleaning

Read/write heads are to be cleaned only when inspection reveals that oxide
deposits or other contaminants are present. Observe the CAUTION notes in this
and the previous paragraphs.

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┌─────────┐
│ CAUTION │
└─────────┘
```

Do NOT attempt to clean a head that is
operating satisfactorily. Only the
contaminated head should be cleaned.
Do NOT apply excessive pressure to the
head while cleaning. Such action could
alter head attitude set by the manu-
facturer or could bend the arm stiffener.

1. Slightly dampen head-cleaning brush paddle at one end with 91%
   isopropyl alcohol.

2. Gently scrub head face. Use only sufficient pressure to thoroughly
   wet head and remove contamination. Excessive pressure may damage
   head attitude.

3. Use dry end of head-cleaning paddle to gently wipe head face dry. Use
   only sufficient pressure to dry head face.

5.7.4   Carriage Rails Cleaning

Clean carriage rail surfaces, top and angled sides with lint-free tissue or
cotton swab slightly dampened with 91% isopropyl alcohol. Carriage rail surface
must be immaculately clean. Any foreign material on this surface will adversely
affect access motion.

MC8309

```
┌─────────────┐
│  CAUTION    │
└─────────────┘
```

Do NOT apply too much alcohol to
rails. Do NOT allow alcohol to
enter the bearing seals. Do NOT
oil the carriage rails.

5.8   CORRECTIVE MAINTENANCE

Corrective maintenance is aimed at finding and fixing drive problems with the
least possible impact on drive availability to the user.

5.8.1   Power Supply Voltage

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┌─────────────┐
│  WARNING    │
└─────────────┘
```

Use care when probing power circuits.
Voltage levels of 208/230 VAC are
present on TB1 and on the line side of
CB1 when the drive is turned off.

5.8.2   Voltage Levels

DC voltage levels of +15V, +5V, -5V, -15V, -10V, -22V, and +22V are used through-
out the electronic gate. DC potentials of -48V are present in some circuits.
These voltage values must be within the specified ranges when referenced to
DC ground. DC voltage specifications are shown in table 5-5. The voltages
are checked at the points shown in the figure.

Unregulated voltages can be checked at E4 through E11 terminals on the back-
panel. Regulated voltages can be checked at Read/Write PWA (A1) J1, J6, J8,
or as shown in Table 5-5.

Table 5-5. DC Voltage Specifications

Test Point	Nominal DC Voltage	Limits of DC Voltage
A1J1-2	0.0	Ground
A1J1-4	-10.0	9.5 to 10.5
A1J1-12	+15.0	+14.25 to +15.75
A1J1-40	+5.0	+4.75 to +5.25
A1J1-16	-5.0	-4.75 to -5.25
A1J1-22	-15.0	-14.25 to -15.75
A1J6-28	-22.0	-20.7 to -24.4
A1J8-108	-48.0	-45.4 to -50.6
A1J9-28	+22.0	+20.7 to +24.4

5.8.3   Logic Levels

High and low logic voltage levels used in the drive circuits are labeled plus (+) or minus (-) in front of the line name and represent the following voltage values for high-low states:

    + (H), High Level. . . . . . +2.5V to +5.0V (+3.5V Typical)
    - (L), Low Level . . . . . . 0.0V to +0.5V (+0.2V Typical)

Special logic voltages, other than those just described, are indicated on the diagrams for the affected line name. The lines have logic levels listed as +5X-48, -3X+0.5, 0X-48, -31X+5, 0X+3, etc. The first value (+5, -3, 0, -31, etc.) denotes the active state of the line. The second value (-48, +0.5) denotes the inactive state of the line. The "X" separates the two voltage values.

5.8.4   Read/Write Input Voltage Filtering

The Read/Write PWA and the Read/Write Matrix PWA have the same power supply configuration for input voltage filtering. DC voltages of -10V and -15V are designed to supply voltages to two different areas of the PWA's. The voltages are supplied directly from the edge connectors and routed through a 91µh choke. It is possible for the choke to burn out leaving only half the board supplied with power.

When troubleshooting for either a -10V or a -15V voltage failure, check at the edge connector side and on the supply side of the choke.

5.8.5   Operator Control PWA

The Operator Control PWA contains logic associated with the Switch Panel Assembly. The Operator Control Logic includes control latches and lamp drivers. Control commands are generated and directed to the Access Control PWA (A5). Setting any switch on the operator panel to the ON position directs a signal into the Access Control PWA logic. An acknowledge signal is directed from the Access Control PWA back to the Operator Control Logic, thus illuminating the lamp under its respective switch.

If any switch is depressed to the ON or OFF state and the drive does not respond, an error may be suspected in either the Access Control PWA or the Operator Control PWA.

5.9   OFF LINE TESTS AND ADJUSTMENTS

5.9.1   DEDU Installation

Complete the following steps to connect the DEDU to an on-line drive for off-line control and monitoring. For on-line monitoring, perform all steps except step 5.

1. Obtain permission from the system operator to remove the drive from the data processing operation.

2. Stop drive by pressing ON-OFF switch and wait for the ON-OFF switch indicator to stop flashing. The indicator flashes until the disk pack stops spinning.

> **NOTE:** Performing step 3 resets all latched unsafe conditions. These unsafe conditions are individually stored in latches and are reset only by turning off all AC Power (CB1), DC Power (CB2), or by reset from the CE box. Therefore, historical information regarding the occurrence of any unsafe conditions since the last AC power off can be obtained by probing the latch output with a meter or scope. The outputs are listed in paragraph 5.9.9.

3. Remove rear cover and set CB1 to OFF.

4. Insert DEDU paddle assembly into J18 connector on backplane.

5. If off-line control from the DEDU is desired, disconnect interface ribbon cable paddle card from A1J19 (the paddle card need not be removed from the card holder). The DEDU DISABLED LED (figure 5-3) should now be off, indicating the control functions of the DEDU are now enabled.

> **NOTE:** If disconnecting last drive in interface string from the IDA, card at A1J19 will be a terminator card and must be plugged into a previous drive for proper termination of interface.

6. Ensure that the DEDU switch labeled DISABLE EMA is set to OFF.

7. Set drive CB1 to ON.

The DEDU is now ready to use in monitor mode, or, if step 5 was performed, can be used to control and observe the operation of the drive.

5.9.2   System Offset Zero Adjustment

Tools required for system offset zero adjustment are: DEDU, P/N 9023456-01; Trimpot Adjustment Tool.

Figure 5-3. DEDU Panel

MC8309

DISABLE EMA   LOOP ON ERROR   RESET   SEEK CK   RECAL/RST   LOAD 2ND CYL   TEST UNSAFES   METER CALIB   METER RANGE ±100

UNSAFE

±1000

512	256	128	64	32	16	8	4	2	1

#											#
1	HEAD LOAD	2 SLITS LATCH	VEL > 4"/SEC	HEADS ON PACK	DR FWD 10"/SEC	GO REV	DIFF < 256	DIFF = 1	LINEAR MODE	ACCESS READY	1
2	CAR 512	CAR 256	CAR 128	CAR 64	CAR 32	CAR 16	CAR 8	CAR 4	CAR 2	CAR 1	2
3	DIFF 512	DIFF 256	DIFF 128	DIFF 64	DIFF 32	DIFF 16	DIFF 8	DIFF 4	DIFF 2	DIFF 1	3
4	HOLD REV/ UNLOAD	HEADS EXT	DR FWD 10"/SEC	GO FWD	GO REV	SEEK IN PROC	DIFF = 1	LINEAR MODE	DIFF=0	ACCESS READY	4
5	HD/DIR TAG	DIFF TAG	CONTR TAG	INTER	ON LINE	REV	HEAD ALIGN ERROR	HAR 4	HAR 2	HAR 1	5
6	POWER	VEL	INNER GUARD BAND	PACK SPEED	PLO	A.C. WRITE	D.C. WRITE	WRITE READY	WRITE OFFSET		6
7	INCOR SEEK LENGTH	DIFF TOO LARGE	INVAL SEEK FWD	INVAL SEEK REV		SEEK INCOMP	LONG SEEK TIME	SEEK OVER SHOOT		INVAL CYL (>410)	7
8/11		ACCESS READY	32	16	8	4	2	1	.50	.25	8/11
9	OUTPUT 1	2	3	OUTPUT 4	ADDRESS 32	16	8	4	2	ADDRESS 1	9
10	DIFF REGISTER 512	256	128	64	32	16	8	4	2	DIFF REGISTER 1	10

512	256	128	64	32	16	8	4	2	1

COMMAND OFFSET — SAFE / HEAD ALIGN

RECAL/SEEK — HEAD SEL/READ

SEEK/SEEK —

ROUTINE

8418
11 SERVO ADJ
HD LOAD 1   10 DIFF REG
CAR 2   9 PROM
DIFF CNTR 3   8 ACCESS TIME (MS)
SERVO 4   7 ERRORS
TAGS/HAR 5   6 UNSAFES

DISPLAY

DEDU DISABLED

START   STOP

STEP
SINGLE
RUN

MODE

OFFSET
CONTROL   700 µin.   REV.
350 µin.

The drive track-following system offset zero is adjusted (with the carriage retracted) by varying a potentiometer on the Safety/Tach Pos PWA (A1J07). This pot is the top pot on board and can be reached through a hole labeled SYSTEM OFFSET in the backplane. The hole is below and to the left of A1J07039.

This adjustment is made while observing the DEDU meter. System offset normally requires adjustment after changing the DSS/PLO/DEMOD PWA (socket A1J06), the SAFETY/TACH/POSITION PWA (socket A1J07), the POWER SUPPLY PWA (socket A1J09), or the POWER REGULATOR PWA (socket A1J10). To adjust system offset, start with the DEDU connected to the drive, turn on CB1, CB2, and CB3, but do not start the drive. Complete the adjustment with the following steps:

1. Verify the DEDU meter calibration by setting the RANGE switch to 1000µinch (coarse range). Press the METER CALIB button and check the meter for zero. Adjust the mechanical zero on the meter face (if needed) for exactly zero.

2. Set DEDU ROUTINE switch to the SK/SK or RECAL/SK position.

3. Adjust potentiometer through hole marked SYSTEM OFFSET in drive backplane for a zero meter indication, switching range switch to 100µinch (fine range) when near zero.

4. The offset adjustment is complete at this point.

> **NOTE:** System zero adjustment affects head alignment. When this adjustment has been made, verify head alignment before returning the drive to service.

5.9.3 Access Time Adjustment*

Access Time (Servo) is checked to determine the interval of the DRIVE FORWARD IO IPS signal. The elapsed time is displayed in binary form on the DEDU LED indicators when the DISPLAY switch is set at position 11, 8418 SERVO ADJUST. The value assigned to each LED position is indicated on DEDU display chart, row 8.

Tools required for access time adjustment are: DEDU, P/N 9023456-01; Trimpot Adjustment Tool.

To determine access time (servo), perform the following procedure.

1. Connect the DEDU to the drive for off-line operation as directed in subsection 5.9.1, step 5.

2. Set the DEDU DISPLAY switch to position 8, 8418 ACCESS TIME. Set ROUTINE switch to SEEK/SEEK.

---

*Units having self adapt speed device (SRK 8418-15). Do not use this procedure. See 5.9.3.1 for procedure to check self adapt speed operation.

3. Press RECAL/RST switch.

4. Add row 8 display chart values below each illuminated LED.

5. For the 8418-02/03 the sum displayed on the LED's should be between 55.5 and 56.5 ms, which represents the duration of a DR FWD 10 IPS command over 815 cylinders. (The actual access time (servo) over 815 cylinders should be between 247.5 and 248.5 ms, however, because the LED display only counts up to 64 ms, it "wraps around" three times (192 ms) and then counts to between 55.5 and 56.5 the forth time around).

> NOTE: If the access time (servo) is not within the acceptable range set DEDU switch to position 11, press the RECAL/RST switch repetitively while adjusting the SERVO ADJUST potentiometer on A1J07 (accessible through a hole in the backpanel).

6. For the 8418-04/05 the sum displayed should be between 39.5 and 40.5 for a 410 track forward seek.

5.9.3.1 Access Time Adjustment

Units having self adapt speed device automatically adjust time. Procedure 5.9.3 is not applicable.

To verify correct operation of the automatic circuitry perform the following procedure.

Tools required: DEDU, P/N 9023456

1. Disconnect ribbon interface or terminator from drive.

2. Attach DEDU to drive.

3. Place CB1 to ON position.

4. Place ON/OFF switch to ON position.

5. Place DEDU Mode switch to RUN position.

6. Place DEDU Routine switch to RECAL/SEEK.

7. Depress DEDU Start switch.

8. Place (10) ten DEDU Cylinder Address Register switches to OFF position.

9. Attach oscilloscope probe channel 1, J08 pin 79 curve reference, and set amplitude of scope for 2 volts per division.

10. Set scope to TRIGGER on J08 pin 69 negative edge (external sync negative).

11. Set scope TIMEBASE to 2 milliseconds per cm.

12. Verify curve reference is between +6.8V and +10V. Signal should appear as in Figure 5-4.

13. Place ON/OFF switch to OFF position.

14. Place CB1 to OFF position.

15. Disconnect DEDU and Scope from the drive.

16. Place CB1 to ON position.

17. Place ON/OFF switch to ON position.

18. Reconnect Ribbon Interconnect or Terminator.

19. Depress RUN button.

20. Run I93110 and DVR's to verify machine performance.
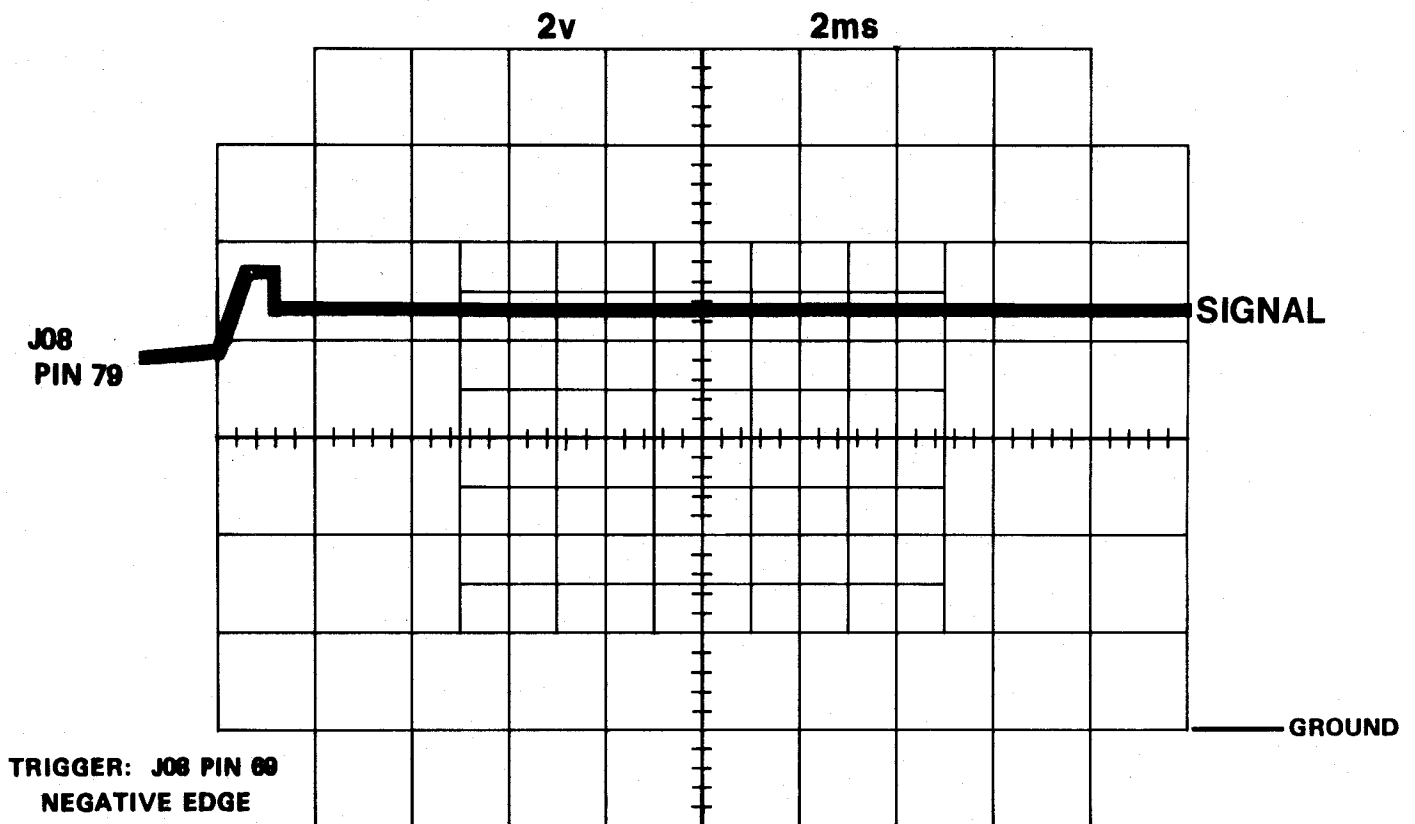
Figure 5-4. Oscilloscope Display

PB001424

5.9.4 Head Alignment Adjustment

Head alignment is accomplished by aligning heads sequentially.

Tools required for head alignment are: DEDU, P/N 9023456-01; CE Pack, P/N 9023567-01; Initial Head Alignment Tool, Head Fine Alignment Tool, Torque Wrench, and Hex Bit 1-3/4" x 5/16.

> ## CAUTION
>
> To avoid head drift problems that
> may occur after heads are aligned,
> it is mandatory that head washers,
> P/N 9006766-01 be installed,
> smooth (rounded) side towards head,
> before implementing head alignment
> procedure.

1. Connect DEDU to drive for off-line operation as directed in subsection 5.9.1 of this manual; perform all steps.

2. Place drive in FILE PROTECT mode by depressing switch on the drive operator control panel.

3. Install CE Alignment Disk Pack, P/N 9023567-01, in drive.

4. Start drive and allow 15 minutes warm up time before proceeding.

5. Remove top rear cover assembly.

6. Remove EMA cover. Do not reinstall EMA cover until head alignment is complete.

7. Set DEDU METER RANGE switch to 1000 microinches.

8. Set DEDU ROUTINE switch to HEAD ALIGN and MODE switch to RUN.

9. Depress the DEDU START switch. The drive will perform a recalibration and then automatically seek to cylinder 496. Verify the cylinder address by checking the lighted LED's in DISPLAY position 2 (CAR).

Alignment Cylinder	Display
496	0 ● ● ● ● ● 0 0 0 0

● = LED is lit

The HEAD ALIGN SAFE LED should now
be lighted. Do NOT continue if it
is not lighted.

10. Depress the RECAL/RST switch. The heads will move off track and the
EMA will deactivate, leaving the heads on the pack.

WARNING

Several injuries to servicing
personnel's hands and/or damage to
components may occur if the proper
precautions are not taken when
aligning heads. If the carriage
assembly has performed a recalibrate
or resists manual movement, a
problem exists in the HEAD ALIGNMENT
SAFETY circuit. Troubleshoot this
problem before continuing head
alignment adjustment.

11. Set the DEDU ROUTINE switch to SEEK/SEEK or RECAL SEEK. A safety
unload will occur. SEEK CK/UNSAFE LED should light.

12. With the heads retracted, check and adjust meter calibration and
system offset with steps 13 through 21.

13. Set DEDU METER RANGE switch to 1000 microinches.

14. Press and hold METER CALIB switch.

15. Adjust screw on meter face for mechanical zero, and release METER
CALIB switch.

16. Set METER RANGE switch to 100 microinches.

17. Adjust the SYSTEM OFFSET pot (through hole in backplane) on A1J07 PWA
for meter zero.

18. Press RESET on the DEDU. The drive will perform a head load.

19. Set DEDU ROUTINE switch to HEAD ALIGN and MODE switch to RUN.

20. Depress the DEDU START switch. The drive will perform a recalibration
and then automatically seek to cylinder 496. Verify the cylinder
address by checking the lighted LED's in DISPLAY position 2 (CAR).

21. Press and hold METER CALIB switch until meter settles to zero. If
meter does not zero, a malfunction exists in the auto zero circuit of
the DEDU. The DEDU cannot perform head alignment until the problem is
corrected.

22. Return ROUTINE switch to HEAD ALIGN and set DISPLAY switch to position 5 (Tags/HAR). The desired Head Address may now be set using DATA switches 1, 2 and 4 and pressing the DEDU START switch.

23. Set METER RANGE switch to 1000 microinches.

> **NOTE:** Throughout the head align process the HEAD ALIGN ERROR LED (Display position 5) should be off. This LED is lighted only if misalignment is so great as to position a head beyond the 6-cylinder band of di-bits written on either side of the alignment track. The initial alignment tool is used in this instance to reestablish head position within the alignment band. To verify that the error detection circuit is working, select HD7 (1, 2 and 4). The LED should come on.

24. To select a Head Address, change Data Switches 1, 2 and 4 to the desired address and depress START. The displayed Head Address changes accordingly. Read Gate and Head Select are again enabled automatically.

> **NOTE:** DEDU meter readings to right of zero are positive (+) and to left of zero are negative (-).

25. Select each head with DEDU METER RANGE set to 100 microinches. Note all heads out of tolerance (alignment) by more than ± 75 microinches.

26. Loosen and adjust head clamp screws on out of tolerance heads (noted in step 23) to 4 inch-pounds, using a torque wrench and hex bit.

<div style="text-align:center">

CAUTION

Retighten heads to 7 inch-pounds prior to leaving HEAD ALIGN mode for any reason.

</div>

27. Install the Head Fine Alignment Tool (Figure 5-5) in the selected head and adjust until DEDU meter is at zero reading ± 25 microinches.

28. Torque head clamp screws to 5 inch-poinds using torque wrench.

29. Readjust out of tolerance heads (to ± 25 microinches). Torque head screws to 6 inch-pounds.

30. Readjust out of tolerance heads (to ± 25 microinches). Torque head screws to 7 inch-pounds and readjust out of tolerance heads (to ± 25 microinches.)
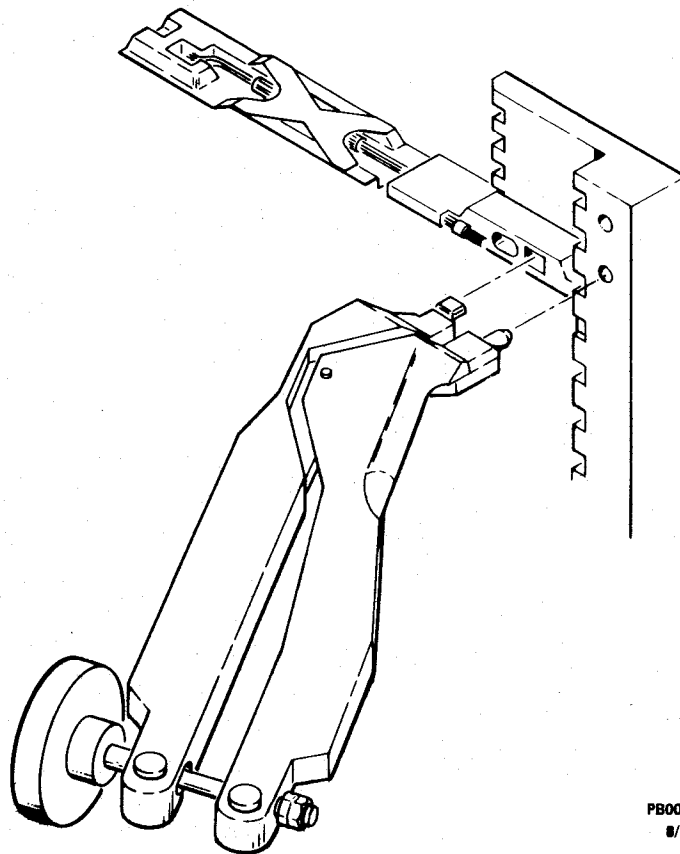
PB000925
8/75

Figure 5-5. Head Fine Alignment Tool Installed

31. Carefully release tension and remove the Head Fine Alignment Tool
while observing the meter. Note that meter reading does not exceed
±25 microinches. Repeat steps 25 to 28, if required.

CAUTION

Before proceeding, remove tools and
hands from vicinity of carriage.

32. Reset DEDU METER RANGE switch to 1000 microinches.

33. Reset the ROUTINE switch to SEEK/SEEK.

34. For models 8418-02/03 (high density), set data switches 512, 256, 32,
8, 4 and 2 (cylinder 814) to ON, all others to OFF; for models
8418-04/05 (low density), set data switches 256, 128, 16, 8 and 2
(cylinder 410) to ON, all others to OFF.

35. Press START. The drive will perform continuous seeks between cylinders
0 and 814 (410 low density). Allow drive to cycle for approximately 30
seconds.

36. Press the DEDU STOP switch to discontinue seek operation.

37. Set DEDU ROUTINE switch to HEAD ALIGN and MODE switch to RUN.

38. Depress the DEDU START switch. The drive will perform a recalibration
     and then automatically seek to cylinder 496. Verify the cylinder
     address by checking the lighted LED's in DISPLAY position 2 (CAR).

39. Select Head Addresses 0 to 6 and verify that all heads are within +75
     microinches of zero. For any alignment discrepancy, loosen head
     screw(s) to 4 inch-pounds and repeat steps 25 to 29.

            NOTE: If at any time it is desirable to
                   recover from the Head Align routine,
                   retighten heads to 7 inch-pounds,
                   REMOVE TOOLS AND HANDS FROM HEAD/
                   CARRIAGE AREA, and change the routine
                   switch from HEAD ALIGN Mode to any
                   other routine, then depress RECAL/
                   RST; the drive will recalibrate.

40. Replace the EMA cover assembly.

41. Replace the top rear cover assembly.

42. Power down drive, remove CE Alignment Disk Pack and depress FILE
     PROTECT switch to OFF.

43. Interrupt data processing operation and set drive CB1 to OFF.

44. Disconnect DEDU and reinsert the ribbon interface card into A1J19.

45. Reset CB1 to ON.

46. Power up drive and run read verification diagnostics before returning
     the drive to the system.

5.9.5   Pack-On Switch Assembly Adjustment

The pack-on switch assembly is adjusted by manually forming the contact arm
assembly until a clearance of 0.020 inch to 0.040 inch exists between switch
contacts without a disk pack installed.

1. Obtain permission to stop DP operations.

2. If a disk pack is installed, open operator cover and remove.

3. Set CB1 to OFF.

4. Using long-nose pliers, form contact arm assembly on pack-on switch
    assembly for clearance of 0.020 to 0.040 inch between switch contacts.

5. Install disk pack and verify that switch contacts are closed.

5.9.6 Speed Sensor Assembly Adjustment

The externally threaded speed sensor assembly screws into a hole in the bottom of its mounting bracket and is held in place by a locknut. The clearance between the top of the speed sensor assembly and the bottom of the motor driven speed sensor disk must be between 0.005 and 0.007 inch.

1. Obtain permission to stop DP operations, then turn off drive at operator panel. Wait for ON/OFF indicator to stop flashing.

2. Set CB1 to OFF.

3. Remove front cover assembly.

4. Use thickness gauges to verify that .005 to .007 inch clearance exists between top of speed sensor assembly and bottom surface of speed sensor disk. Position speed sensor disk manually, as required.

5. To adjust clearance, disconnect speed sensor assembly wires, loosen locknut, and rotate speed sensor assembly so that a .006 inch thickness gauge may be inserted between sensor and disk. Rotate speed sensor assembly so that thickness gauge is contacted by both disk and sensor, then tighten locknut.

6. Verify that clearance is not less than 0.005 nor more than 0.007 inch then reconnect speed sensor assembly wires and replace front panel assembly.

5.9.7 Velocity Source-Sensor Adjustment

The adjustment is made by:

1. Loosening the two hex head screws holding the source-sensor housing to the aluminum plate, and

2. Moving the housing up or down, adjusting for .003"-.007" clearance between the sensor and the top of the metal grating.

3. Tighten screws and check for .005" $\pm$.002" clearance.

There is no adjustment required on velocity grating. The grating mount bracket should never be loosened or shifted in relation to the carriage.

5.9.8 Belt Tension Adjustment

Motor belt tension should be checked periodically as specified in the preventive maintenance chart, or if the tension is suspect. If adjustment is required, perform the following sequence:

Tools required: Spring Scale (0 to 10 lbs)

1. Obtain permission from the system operator to stop the drive. Turn the drive off at the operator panel. Wait for the ON/OFF indicator to stop flashing - approximately 30 seconds.

2. Set CB1 to OFF (down position for the switch handle).

3. Remove front cover assembly and rear belt guard.

4. Loosen idler pulley bracket bolts.

5. Install back end of spring scale in idler bracket ear.

6. While holding the spring scale to the right, adjust the tension until the scale reads 7 lbs. $\pm$ 1/4 lb. and tighten the idler bracket bolts.

7. Remove the spring scale, replace the belt guard, and replace the front cover assembly.

8. Set CB1 to ON.

9. Bring drive power up and return the drive to on-line status.

5.9.9   Unsafe CE Latch Outputs

These outputs are available at the DEDU Paddle Connector A1J18 as listed in Table 5-6.

Table 5-6.   Unsafe CE Latch Outputs

PIN	UNSAFE
55	+Power Unsafe
57	+Write/Offset Unsafe
58	+DC Write Unsafe
59	+PGB Detect Unsafe
60	+PLO Unsafe
62	+AC Write Unsafe
64	+Velocity Unsafe
65	+Pack Speed Unsafe
66	+Write Ready Unsafe

NOTE: All of the above stored unsafe conditions may be reset by momentarily grounding pin 68 on A1J18 or by setting CB1 to OFF.

55 Power Unsafe - Indicates any DC voltage unsafe, detects
    supplies below allowed limits.

57 Offset/Write Unsafe - Write gate on while offset active.

58 DC Write Unsafe - Write current sensed while write gate is
    not on.

59 Inner Guardband Detection Unsafe - This unsafe can occur
    only during a head load or a restore operation. It
    indicates a failure to detect the inner guardband area of
    the pack during an initial head load or a restore oper-
    ation.

60 PLO Unsafe - Write oscillator not in synchronization with
    the disk speed.

62 AC Write Unsafe - This unsafe is either of the following:

    (a) Multiple heads selected while write gate is on.
    (b) No write transitions detected when write gate is on.

64 Velocity Unsafe - A detection that the heads were moving
    too fast.

65 Pack Speed Unsafe - Occurs when the pack speed falls to less
    than approximately 90 percent of normal when the heads are
    extended.

66 Write Ready Unsafe - Write gate on while not on cylinder.

5.9.10   Testing Unsafe Conditions

This procedure describes the use of the DEDU in forcing and testing for unsafe
conditions. The test procedure for each unsafe condition is described with the
condition. Note that more than one unsafe condition may be forced; however,
only the condition under test is guaranteed to appear. The assumption is made
throughout that all the detection circuits are functioning properly.

For the first four tests in the following sequence, the drive has power, but
the heads are not loaded during the tests. The remaining tests are performed
with the drive on and the heads loaded. Unsafe conditions and forcing
procedures are shown in Table 5-7.

> NOTE: Immediately AFTER THE DC POWER IS
>   TURNED ON THE HEADS MUST BE ALLOWED
>   TO LOAD onto the pack at least once
>   before any unsafe testing is done.
>
>   Similarly always leave the "File
>   Protect" and the "Low Density"
>   (8418-02/03 drives only) switches
>   in the OFF position.

Table 5-7. Unsafe Conditions

STEP	UNSAFE CONDITION	FORCING SEQUENCE	HEADS On Pack	HEADS Off Pack
1	DC WRITE Unsafe	1. Press Test UNSAFES 2. DC WRITE lighted		X
2	Multiple Head Select	1. Set Data Switch = 7 2. Set Function Switch = HEAD SEL/RD 3. Press START 4. Press TEST UNSAFES 5. AC WRITE lighted		X
3	AC Write Transitions	1. Set Data Switch = 0 2. Set function Switch = HEAD SEL/RD 3. Press START 4. Press TEST UNSAFES 5. AC WRITE lighted		X
4	WRITE OFFSET Unsafe SEE NOTE BELOW {	1. Set Data Switch = 32 2. Set Function Switch = OFFSET 3. Press and hold TEST UNSAFES 4. Press START 5. WRITE OFFSET lighted 6. Press RESET switch 7. Set Data Switch = 32 to OFF 8. Press START		X
5	PLO Unsafe	1. Set Data Switch = 8 2. Set Function Switch = HEAD SEL/RD 3. Press START 4. Press TEST UNSAFES 5. PLO lighted	X	
6	WRITE READY Unsafe (Not used with 9023668-01,02)	1. Set Data Switch = 256 2. Set Function Switch = SEEK/ SEEK 3. Press START 4. Press TEST UNSAFES 5. WRITE READY light blinks	X	

NOTE: These steps must be performed in order
for the other Test Unsafe steps to work.

MC8309

Table 5-7. Unsafe Conditions (Continued)

STEP	UNSAFE CONDITION	FORCING SEQUENCE	HEADS	
			On Pack	Off Pack
7	INNER GUARD BAND UNSAFE (Not used with 9023668-02)	1. Press TEST UNSAFES until PACK SPEED lights. It may take up to 5 seconds.	X	
8	Velocity Unsafe	1. Momentarily disable EMA 2. VEL lighted	X	
9	PACK SPEED UNSAFE	1. Press TEST UNSAFES 2. PACK SPEED lighted	X	

CHAPTER 6

REMOVAL AND REPLACEMENT PROCEDURES

The removal and replacement procedures in this chapter pertain to items or assemblies likely to require removal and replacement. In addition, certain items are included that are difficult to remove and replace or that have critical tolerances. In certain cases, special tools, equipment, or materials required to complete the task are listed at the beginning of the procedure.

8418 Illustrated Parts Breakdown, P/N UP002525-1 is a useful aid in the removal and installation of items not covered in this chapter. The Parts Catalog provides sufficient detail to permit parts and assemblies to be assembled and reassembled in the proper sequence.

Procedures for service covers and certain other components that must be removed to provide access to other components are described at the beginning of in chapter. In no case does a general statement direct removal of an item unless a detail procedure for removal has already been presented.

6.1 DRIVE POWER REMOVAL AND RESTORATION

Many replacement procedures in this chapter require drive power removal.

6.1.1 Power Off Procedure

1. Obtain permission from the system operator to power down the drive to avoid disrupting DP operation.

2. Press the ON/OFF switch once to set it to OFF.

3. Remove the rear cover assembly and set CB1 to OFF (switch toggle down).

6.1.2 Power On Procedure

1. Set CB1 to ON (switch toggle up). In addition, CB2 and CB3 must be on before the drive can be powered up.

2. Press ON/OFF switch once to set it to ON. Press the RUN switch.

6.2 SERVICE COVERS

Service covers on the 8418 are removable to provide easy access for drive maintenance (Figure 6-1).

6.2.1 Front Cover

To remove the front cover, perform the following steps:

1. Locate the two eccentric retainers that fit into the slots on the top edge of the front cover.
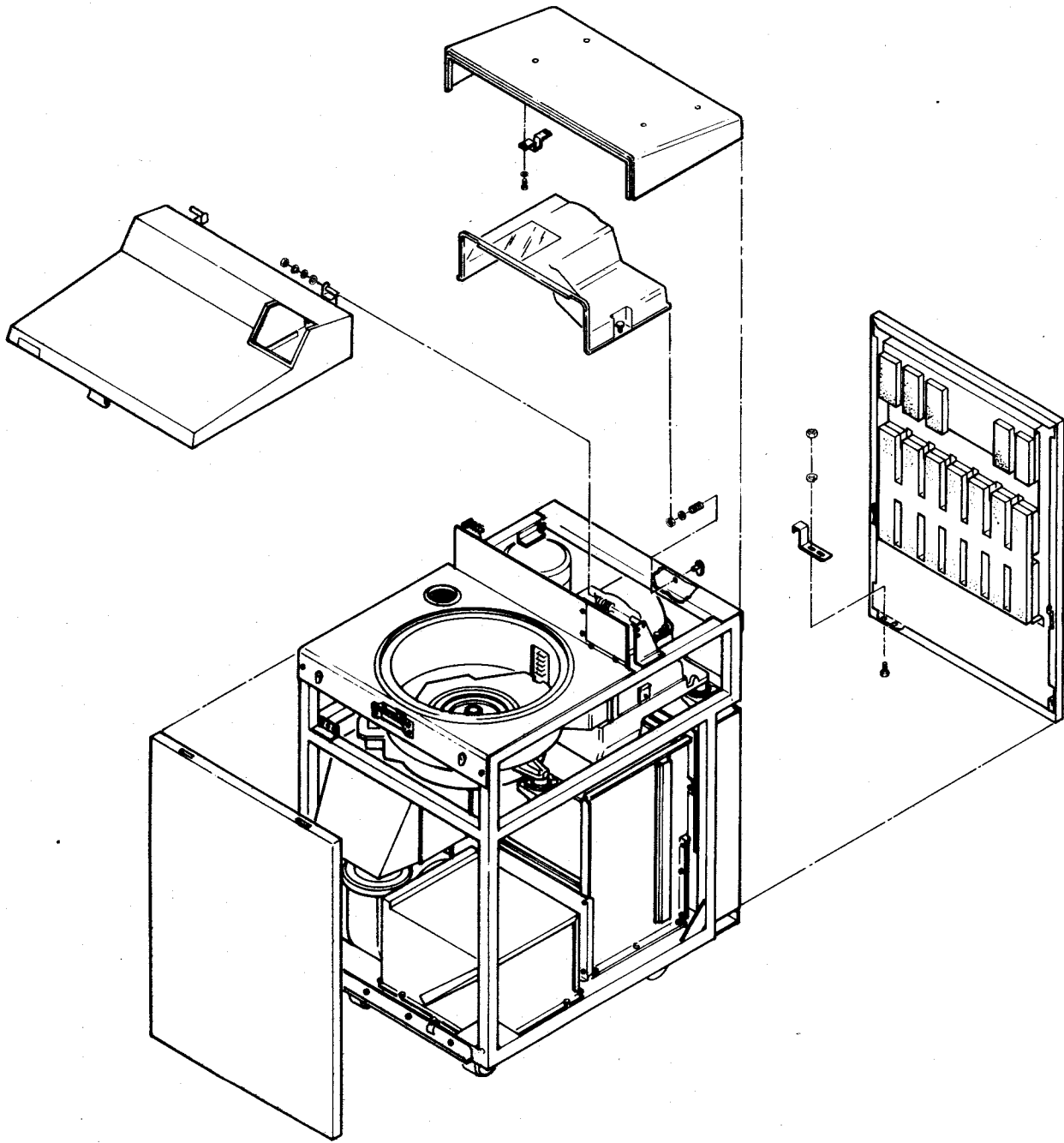
Figure 6-1. Service Covers

2. Using a screwdriver, rotate the retainers approximately 90^o until they clear the slots in the cover.

3. Pull the top edge of the cover away from the drive and lift the cover free of the drive.

6.2.2   Side Covers

The right and left side covers are attached in the same way. To remove the cover, perform the following steps:

1. Locate the two eccentric retainers that fit into the slots on the top edge of the side cover.

2. Rotate the retainers until they clear the slots.

3. Grasp the cover by the edges, near the top, and pull away from the drive.

4. Lift until cover is free of bottom retainers and the cover is free of the drive.

6.2.3   Rear Cover

1. Locate the two eccentric retainers that fit into the slots on the top edge of the rear cover.

2. Rotate the retainers approximately 90^o until they clear the slots in the cover.

3. Pull the top edge of the cover away from the drive and lift the cover free of the drive.

6.2.4   Top Rear Cover

This cover must be removed to gain access to the EMA cover or to service the top front cover. Perform the following steps for removal:

1. Remove the rear cover.

2. Reach in under the top rear cover and locate two thumb screws, one on the right side and one on the left side.

3. Turn the thumb screws counterclockwise until they are loose.

4. Slide the cover toward the rear of the drive.

5. Lift the cover free of the drive.

6.2.5   Top Front Cover

The top front cover should not be removed for normal servicing. In case of damage to the cover it may be necessary to replace the cover to maintain a good flow of air through the disks. Perform the following steps to remove the cover:

1. Remove the top rear cover.

2. Lift the top front cover.

3. Remove the operator panel by loosening the retaining screws that secure the plug to the operator control PWA. The operator panel, back panel wiring, and the plug can be removed as a unit (see Figure 6-3).

4. Remove the Operator Control PWA by unsnapping the PWA from the snap guides. Tilt the PWA until it can be removed from the rear. Be careful of the connector pins when handling the PWA. If the operator control PWA is replaced, remove the two retaining screws for J2 and unplug it from the PWA. When replacing the PWA, note that the J2 side of the PWA connects to the cable from the drive and J1 connects to the the operator panel.

5. Raise up the top cover. Loosen the four (4) 11/32' nuts that retain the hinge plate to the cover assembly. With all four nuts loose enough to be turned with the fingers, support the cover with one hand and remove the four 11/32 nuts, washers, and lockwashers. Lift the cover free of the drive.

   NOTE: Clean very thoroughly any particles
   that remain in the shroud area.

6. To replace the cover reverse the previous steps. Cover alignment is described in Section 5.

6.2.6 EMA Cover

The top rear cover must be removed to gain access to the EMA cover. The previous procedure describes removal of the top rear cover. To remove the EMA cover, perform the following steps:

1. Remove the top rear cover.

2. Pull on the two retainers at the right and left sides of the cover.

3. Lift the cover toward the rear of the drive until it is free of the drive. Be careful not to damage the ribbon cable.

```
╔═══════════╗
║  CAUTION  ║
╚═══════════╝
```

Use care in handling the EMA cover
assembly. The EMA cover assembly
is installed to direct the flow of
filtered air to the EMA assembly
in order to ensure adequate EMA
assembly cooling. The seal around
the EMA cover assembly can be
damaged by careless handling during
cover removal, storage, or instal-
lation. A damaged seal can cause
air leaks and a resultant reduction
of cooling air flow to the EMA
assembly.

4. Store the EMA cover in a clean location with the seal facing up.

5. Before replacing the EMA cover, inspect the seal and the cover body
   for damage or contamination. Repair or replace faulty parts. Clean
   as required.

6. When replacing the top rear cover, make sure that it is positioned
   properly before tightening the thumb screws.

6.2.7   Type 2408 Front Cover or Rear Cover

Type 2408 is the AC power box, which is used when 5 to 8 8418 Disk Drives (or
8416/8418 combinations) are attached to a 90/30 Processor. To remove the front
or rear cover, perform the following steps:

1. Locate the two eccentric retainers that fit into the slots on the top
   edge of the cover.

2. Using a screwdriver, rotate the retainers approximately 90o until they
   clear the slots in the top edge of the cover.

3. Pull the top edge of the cover away from the drive and lift the cover
   free of the drive.

6.2.8   Type 2408 Top Cover

1. Remove either the front cover or the rear cover.

2. Locate the two slotted-head hex nuts on the inside edge of the frame
   on each side.

3. Loosen all four of the nuts, but do not remove them.

4. The top can now be lifted free of the power box.

6.3   FILTERS

Two replaceable filters (figure 6-2) are also in the air circulating system:
the prefilter traps the larger airborne particles; the absolute filter traps
the smaller airborne particles. Filter efficiency is 99.9% (0.3 micron
particles). The filters are replaced as part of the preventive maintenance
schedule of Table 5-4. The filters should be replaced earlier than scheduled
if they become dirty and limit air flow. The prefilter is easily inspected
for dirt buildup.

> ### CAUTION
>
> Do NOT attempt to clean and reuse
> either filter. They are not
> reclaimable and must be discarded
> after use.

6.3.1   Prefilter

The prefilter is located in the lower front of the drive at the right side.
Perform the following steps to replace it:

1. Remove the front cover.

2. Grasp the edge of the prefilter and pull it out of the plenum.

3. Clean around and inside the slot with lint-free tissue dampened
    with 90° isopropyl alcohol.

4. Insert new prefilter.

5. Replace front cover.

6.3.2   Absolute Filter

To replace the absolute filter, perform the following steps:

1. Remove drive power.

2. Remove the front cover.

3. Loosen tube clamps on air tubing at absolute filter intake and
    discharge air pressure measurement taps, and remove tubing from
    filter.

4. Release air system clamp at blower-outlet/absolute-filter-intake
    flanges. Lift clamp to rest on top of flanges.

5. Loosen hose clamp on air hose at absolute filter discharge
    opening. Lift hose and clamp from filter.

6. Remove and discard absolute filter.
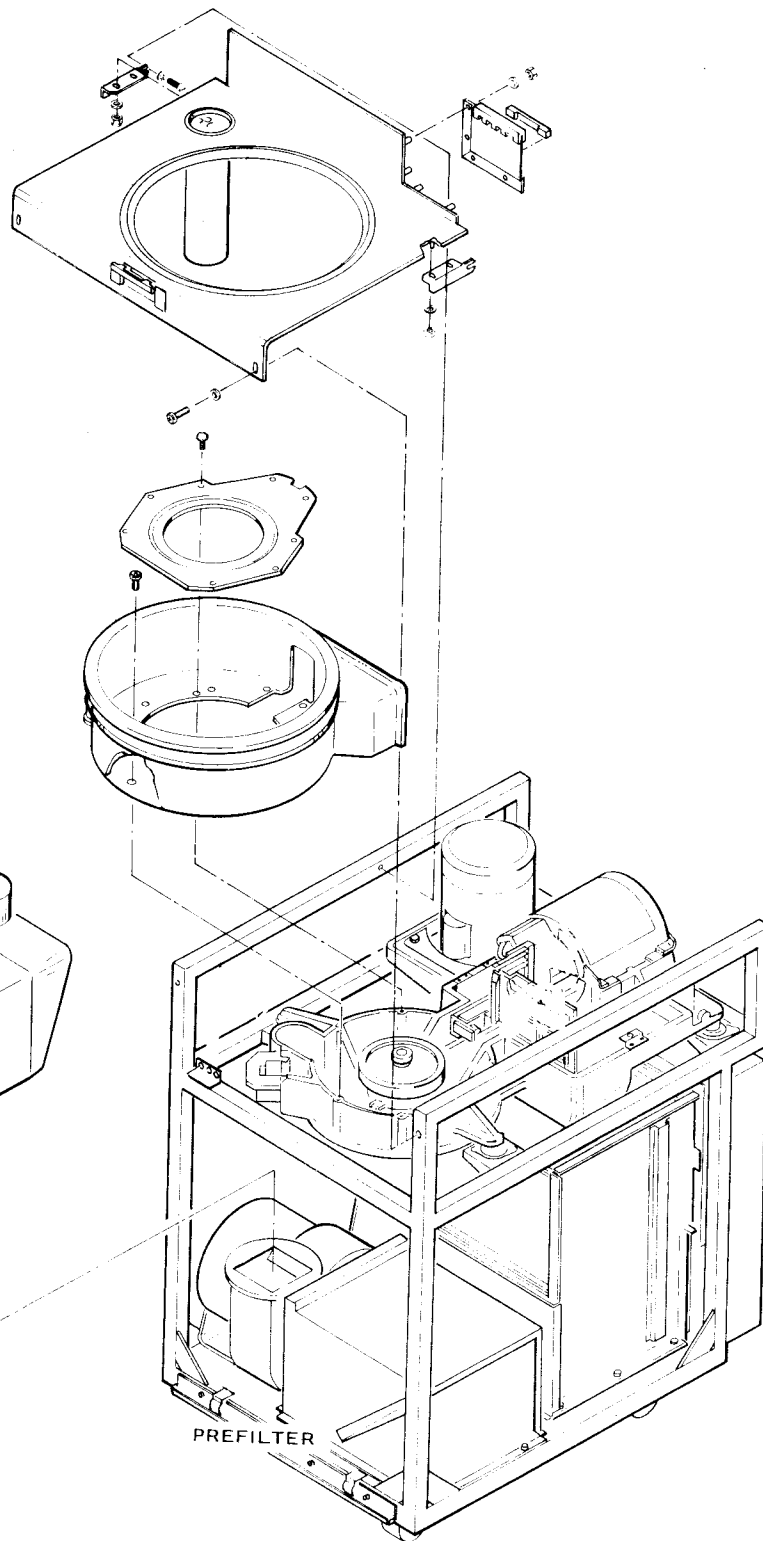
ABSOLUTE FILTER
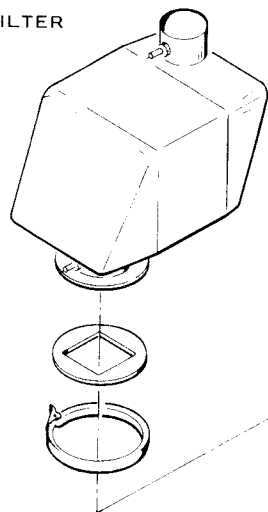
PREFILTER

Figure 6-2. Air Filters

7. Inspect blower outlet gasket, pressure measurement air tubing, and filter discharge air hose for damage or deterioration. Replace as required.

6.4 INDICATOR LAMPS

Indicator lamps are located on the Operator Control Panel (figure 6-3). Because lamp failures do not affect drive operations, lamps are replaced only after failure. Pressing the stop button illuminates all the lamps for operation verification. Replace a defective lamp as follows:

1. Grasp the plastic pushbutton and pull until it separates from the switch.

2. Remove the defective lamp from within the switch housing.

3. Insert new lamp.

4. Insert pushbutton and press firmly into place.
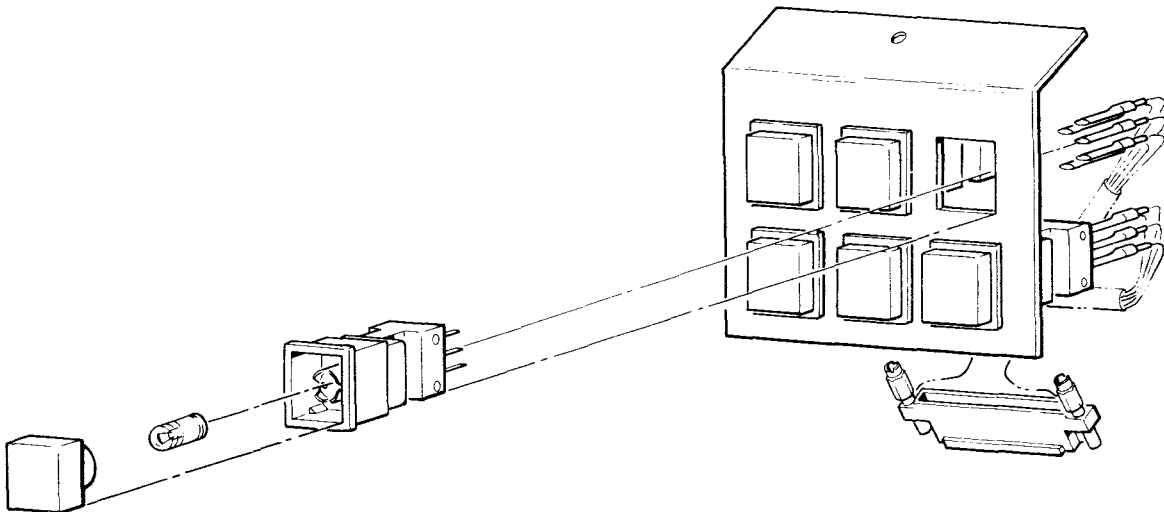
5. Push the switch panel back into its place.

Figure 6-3. Indicator Lamp Replacement

MC8309

6.4.1 Operator Panel Removal

Remove the plastic shield that fits on top of the panel. Loosen the hex head screw in the top of the panel. Pull the top of the panel toward the front of the drive to clear the retainer and then lift the panel up.

6.5 PRINTED WIRING ASSEMBLIES

New PWAs are individually packaged in a plastic bag for protection from shock, moisture and dust. Avoid dropping, stacking, or unnecessarily handling PWAs when the protective packaging is removed.

CAUTION

Always remove DC voltage by setting
CB1 to OFF before removing or insert-
ing any PWA.

Library Configuration Records are attached to the top of the plenum assembly. These records show the current dash level of each PWA installed in the library without having to physically remove them for inspection. Ten spaces are pro- vided on each record to enter each change as it is made. Typically, only two field entries are required, i.e., the changed dash number and the date of the change. Each item in the record is also identified and defined.

6.5.1 Library Assembly PWA Replacement

PWA's installed in the Library Assembly are identified by name, part number and position in the 8418 Illustrated Parts Catalog, the 8418 Diagrams Manual and on the Library Configuration Records attached to the end of the Library Assembly.

Tools required for PWA replacement are: PWA Extractor, Retainer

1. Remove drive power.

2. Remove front cover assembly to gain access to the library. The library contains PWA's A1A1, A1A3, A1A5, A1A6, A1A7, A1A8, A1A9, A1A10 and A1A11.

3. Loosen screws securing extractor tool in retaining position on library.

4. Insert prongs of extractor tool into slotted holes in PWA handle and pull the PWA from its socket.

5. Remove packaging material from new PWA.

6. Inspect new PWA to ensure that it is the correct replacement part for that library position.

7. Insert new PWA into proper library position. Check alignment in card guides before seating in socket. Push firmly into socket.

8. Replace extractor tool and tighten retaining screws.

LIBRARY ASSEMBLY PWA REPLACEMENT

LOC.	NAME	SHIPPED	CHANGE & DATE					PART NUMBER
A1 J01	Read/Write							9723650
A1 J02	Not Used							
A1 J03	System Interface							9723667
A1 J04	Not Used							
A1 J05	Access Control							9723668
A1 J06	DSS/PLO/Demodulator							9723660
A1 J07	Safety Tach & Position							9723671
A1 J08	Pulser/Driver							9723698
A1 J09	Power Supply							9723654
A1 J10	Power Regulator							9723653
A1 J11	EMA Driver							9723651

LOC - factory entries are made in this column to identify the socket number of each PWA installed in the gate.

NAME - factory entries are made in this column to identify the title of each PWA installed in the gate.

PART NUMBER - factory entries are made in this column to identify the basic part number of each PWA installed in the gate.

SHIPPED - factory entries are made in this column to identify the dash number (revision level) of each PWA installed in the gate when the unit was shipped from the factory.

CHANGE & DATE - ten columns are provided to enter the dash number and date of any PWA change made in the field. Enter the date on which the change was made and enter the dash number of the PWA installed on that date, if it differs from the dash number entered in the SHIPPED column.

6.5.2 Other Drive PWA's

6.5.2.1 Matrix PWA

A Matrix PWA, P/N 9723658-03, is installed on the back of the tower assembly. The Matrix PWA includes a head lead support for the cable from the servo head and preamplifier.

REMOVAL

1. Remove drive power.

2. Remove rear top cover.

3. Remove EMA cover assembly.

4. Remove head connector retainer.

5. Remove head connectors from Matrix PWA.

6. Pull the two black button retainers on the PWA toward the rear of the drive until they snap free. The matrix PWA can now be lifted to gain access to the connector at the bottom.

7. Disconnect Matrix PWA from connector socket.

INSTALLATION

Install the Matrix PWA by reversing the removal procedure.

6.5.2.2 Sequencer and Filter/Rectifier

The Power Sequencer PWA, P/N 9700692 and the Filter/Rectifier PWA, P/N 9023752 are located in the power supply assembly.

REMOVAL

1. Remove drive power.

2. Remove rear cover assembly.

3. Remove the safety cover by loosening the retaining screw.

4. To replace the power sequencer, disconnect the cable and remove PWA.

5. To replace the Filter/Rectifier, disconnect all cables to both boards and remove PWA.

INSTALLATION

Install PWA by reversing the removal procedure.

6.5.2.3 Operator Control PWA

The Operator Control PWA (A4A1) is installed in the Top Front Cover directly behind the Switch Panel Assembly. The PWA contains edge connectors at J1 and J2 to accept interface harnesses. Connector J1 interfaces with the Operator Control Panel (A4A2) by the Control Panel Interconnect Harness. Connector J2 interfaces with the Access Control PWA (A1A5), in the Library at connector A1J22, by the Control Panel Harness.

REMOVAL

1. Remove drive AC power (CB1 switch toggle down).

2. Remove the switch panel assembly using directions in 6.4.1.

3. Release the Operator Control PWA from the circuit board hold-downs and pull the PWA with the two associated harnesses through the Switch Panel opening in the top cover.

4. Loosen the harness connector jackscrews and remove the PWA.

INSTALLATION

1. Install the new Operator Control PWA by reversing the removal procedure.

6.6 TOWER ASSEMBLY CAM

The cam surface is tapered to ease head arm assembly loading onto the cam. Cams are more easily replaced if an assistant is used.

6.6.1 Removal

1. Remove drive power.

2. Remove front and top cover assemblies.

3. Remove EMA cover.

4. Open top front cover and remove disk pack.

5. Position head separator tool (Figure 6-4) inside shroud and against cams.

```
┌─────────────┐
│   CAUTION   │
└─────────────┘
```

Use extreme care in performing step
6 to ensure that heads properly
load onto head separator tool.
Replace any heads that click together.

6. Manually load heads onto head separator tool and position carriage fully forward.
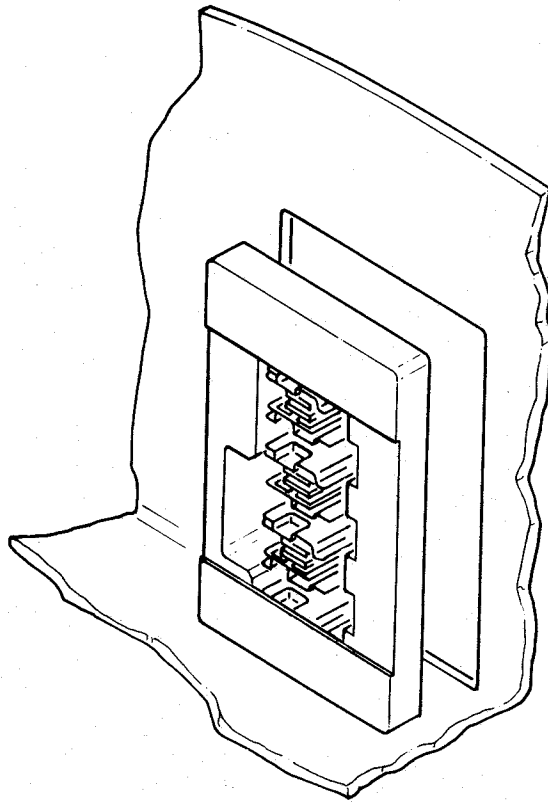
PB000927
8/75

Figure 6-4. Head Separator Tool

7. Carefully remove three 4-40 x 1/2-inch binding head screws that secure cam to tower assembly and remove cam.

6.6.2   Installation

1. Position new cam in place and install screws.

2. Retract carriage so that head arm assemblies are loaded onto tower assembly cam.

3. Remove head separator tool.

4. Reassemble drive by reversing removal procedure, steps 1 through 4.

6.7   READ/WRITE AND SERVO HEADS

Special tools required for head removal and installation are listed in Chapter 5.

6.7.1 Removal

1. Remove drive power.

2. Remove EMA cover.

3. Remove connector retainer, head lead support, and head lead connector from Matrix PWA. If removing servo head, also remove 7-pin plug from baseplate receptacle.

4. Install the head installation tool (Figure 6-5) on head arm assembly.

5. Hold head arm assembly in place with pressure on head installation tool, and remove head clamp screw.

```
CAUTION
```

Do NOT allow heads to click together during removal or installation. Heads which click together must be replaced with new heads.

6. Grasp head installation tool and remove tool and head arm assembly by moving them to side and to rear.
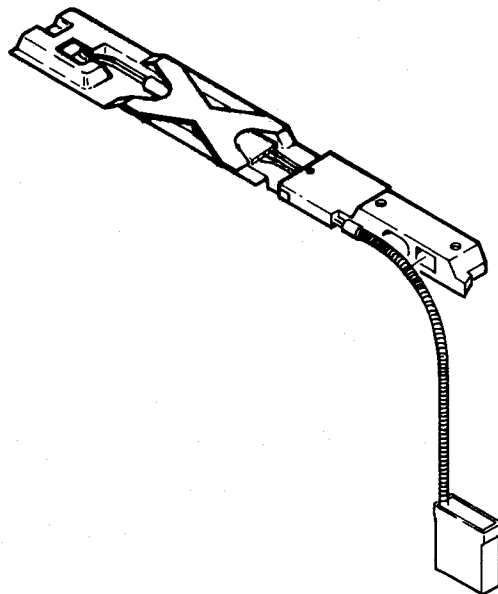
PB000577
3/74

Figure 6-5. Head Installation Tool

6.7.2 Installation

$$\boxed{\text{CAUTION}}$$

a. Do NOT touch head face with fingers. Oil from skin can cause buildup of deposits on surface. Do NOT leave lint or residue on heads. Do NOT blow on heads; moisture from breath will cause contamination.

b. Do NOT use ohmmeter to verify continuity through head elements; ohmmeter voltage may burn out elements.

c. Keep heads away from front of EMA assembly. While there is little flux leakage outside EMA assembly, leakage is maximum at air gap in EMA assembly front, and could affect read/write operations.

d. Do NOT use a head if any distorations or abnormalities are evident; replacement is cheaper than lost data.

e. Do NOT install any head in drive unless it is cleaned immediately before installation.

1. Install head installation tool in new head arm assembly. Do NOT deflect head arm any more than necessary to install tool, so that head preload is not altered.

2. Clean head as directed in Chapter 5.

3. Grasp head installation tool, position head arm assembly on proper cam, and slide it to rear to mate with proper T-block slots.

4. Install and slightly tighten head clamp screw. Do NOT tighten screw at this time.

5. Carefully remove head installation tool from installed head arm assembly.

NOTE: If installing read/write head,
insert initial alignment tool dowel
pins into T-block and head arm
assembly and slide assembly as
close to EMA assembly as possible.
This sets the initial alignment.

If installing servo head, slide it
to rear to mate with proper T-block
slots and pin. Also install 7-pin
plug in baseplate receptacle (A5J5).

6. Tighten head clamp screw to seven inch-pounds.

7. If used, remove head initial alignment tool.

8. Lift operator cover open and inspect head arm assemblies to ensure
    that all are properly seated on cams.

9. Clean carriage rail surface as directed in chapter 5, to remove any
    foreign matter that may have been dropped.

10. Align heads as directed in Chapter 5.

6.8 SHROUD ASSEMBLY

The air circulating system (Figure 6-6) forces filtered air through the shroud
assembly to the EMA assembly. The shroud assembly is sealed to prevent air
leaks, so that maximum cooling air is supplied to the EMA assembly.

6.8.1 Removal

1. Raise the top front cover and remove the disk pack.

2. Remove drive power.

3. Remove front cover assembly.

4. Remove eight binding head screws that secure shroud plate to shroud
    and to baseplate assembly. Lift out shroud plate.

5. Remove the three binding head screws that secure the shroud to
    baseplate assembly.

6. Disconnect the connector in the black and white twisted wire pair.

7. Disconnect the connector at the microswitch in the cover latch
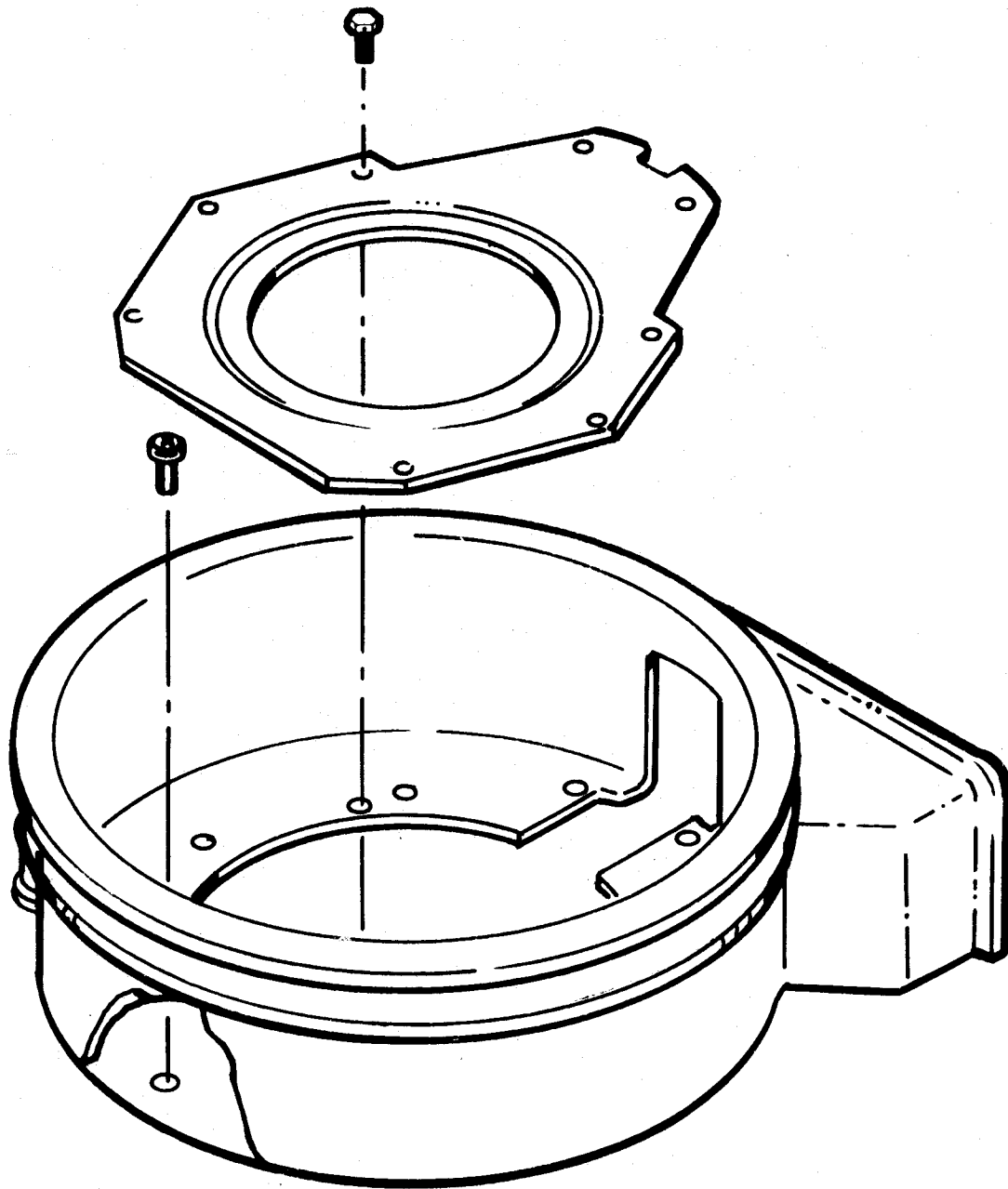   assembly.

Figure 6-6. 8418 Shroud Assembly

8. Loosen, but do not remove, the two 5/16" screws at the right and left rear of the baseplate assembly.

9. Remove the two 5/16" screws from the front of the baseplate.

10. Unsnap the retaining ring for the air ducting at the absolute filter.

11. Roll the large "O" ring down about 2" on the outside of the shroud.

12. Slide baseplate assembly toward front of drive approximately 1" and lift the baseplate free of the drive.

13. Lift out the plastic shroud.

14. Leave the large flexible "O" ring around the outside of the shroud assembly so that it will be in place for reassembly.

6.8.2   Installation

1. For reassembly, roll the "O" ring down toward the base and then roll it back up and over the outside of the rubber shroud seal, holding the seal firmly in place.

2. To complete the reassembly, reverse the removal procedure beginning with step 13.

6.9   EMA MAGNET AND COIL ASSEMBLIES

The EMA magnet and coil assemblies require special tools for alignment. The EMA magnet should never be loosened or removed from the baseplate unless the following specified tools are available:

Magnet and Coil Alignment Tools - Head Separator, P/N 9023528-02; Diamond Pin, P/N 902151-00; Dowel Pin, P/N 3154854-02; 3/16 Allen Wrench; 6 x 3 Torque Wrench, P/N 9800317-00; Hex Bit 6", P/N 9800039-10; Coil Alignment Fixture, P/N 9023913-00.

EMA Magnet and Coil Assemblies Alignment Procedure:

1. Check with system operator prior to removing drive from system. Then turn off drive and remove pack.

2. Turn CB1 off.

3. Remove rear cover.

4. Remove top rear cover.

5. Remove EMA cover.

6. Install Head Separator.

7. Loosen two screws securing flex lead assembly housing to EMA magnet assembly. Gently lift housing and set it aside. Be careful not to damage the flex leads.

8. Remove magnet ground strap from rear of EMA.

9. Loosen and remove four Allen screws securing EMA to baseplate.

10. Remove cross rail at top rear of frame assembly.

11. Carefully slide EMA magnet assembly to rear, supporting its weight until it is clear of the coil.

12. Slide EMA magnet clear of drive baseplate and store in a clean place.

13. If coil assembly must be removed or replaced, go on to step 14; otherwise, reassemble the EMA magnet assembly beginning with step 28.

14. Remove the two bowed E-rings from the plastic studs on the outer surface of the coil. Carefully lift the conductors free of coil stud. DO NOT flex conductors more than necessary to remove from studs. Remove flex leads.

15. Remove four coil mounting screws that secure the coil assembly to the T-block. Screws are accessible from inside rear of coil housing.

16. Remove coil.

17. Fasten the Coil Alignment Fixture to the baseplate. Use the 3/16" diameter by 1" long Dowel Pin and the Diamond Pin to position the fixture on the baseplate.

    NOTE: Check resistance of coil between flex lead connectors on the coil (should be approximately 11 ohms).

18. Fasten the EMA coil to the carriage cart assembly, so the coil is positioned against the mounting face of the cart, by lightly tightening the four coil mounting screws.

19. Move the carriage cart backwards until it contacts the rail backstop.

    NOTE: Because the coil outside diameter is tapered, the coil can only be aligned properly when the coil cart is in the backstop position.

20. Using light hand pressure, push the coil down onto the locating points of the alignment fixture.

21. Torque the four coil mounting screws to eight inch-pounds.

22. Visually check that the coil is in contact with the contact points on the alignment fixture.

   > **NOTE:** Ensure the head separator is properly installed.

23. Push the coil along the rail, for approximately 1/8 inch, checking for excess binding between the coil and alignment fixture. The coil should move freely with only light hand pressure applied.

24. If a bind should occur, loosen the coil mounting screws, reposition the coil as described in steps 18 through 20 and retorque.

25. Remove the coil alignment fixture from the baseplate.

26. Replace the flex leads on coil in reverse order of step 14.

27. The coil alignment is complete.

28. Using light hand pressure, push the coil to the forward position while holding flex leads to prevent damage. Slide the magnet assembly over the coil until the 3/16" wide by 0.35" long slots are approximately centered over the 3/16" holes in the baseplate.

29. On the flex lead assembly side (right side) of the EMA magnet, insert the diamond pin in the front mounting slot joining the magnet to the baseplate; insert the 3/16" by 1" long dowel pin in the rear mounting slot.

30. Fasten the magnet assembly to the baseplate with two Allen screws in unpinned locations.

31. Remove the two alignment pins installed in step 29 and replace the remaining two Allen screws.

32. Disconnect the flex lead assembly. See Note Step 33.

33. Push the carriage cart through the full travel, checking for any binding or drag between the coil and the magnet assembly.

   > **NOTE:** One lead on the flex lead assembly block (mounted on the EMA magnet) must be disconnected to prevent back EMF. Reconnect lead before continuing to Step 34.

34. The EMA magnet alignment is complete.

35. Ready drive for return to the system by reversing steps 1 through 8.

36. Run applicable diagnostics to verify performance.

6.10 CARRIAGE ASSEMBLY

The carriage assembly (Figure 6-7) is replaced only when a failure of the assembly is suspected.   In no case should the carriage assembly position be altered or the assembly removed unless the tools necessary for the removal and installation, and the respective procedures, are available. Tools necessary are:

    Rail Alignment Tool, P/N 9024189-00
    Loctite* 222, P/N 3154747-09
    Adhesive Primer, P/N 3006030-01

6.10.1   Removal

1. Obtain permission from system operator then remove drive power.

2. Remove the disk pack.

3. Remove the rear cover and set CB1 to off (switch toggle down).

4. Remove top rear cover.

5. Remove EMA cover.

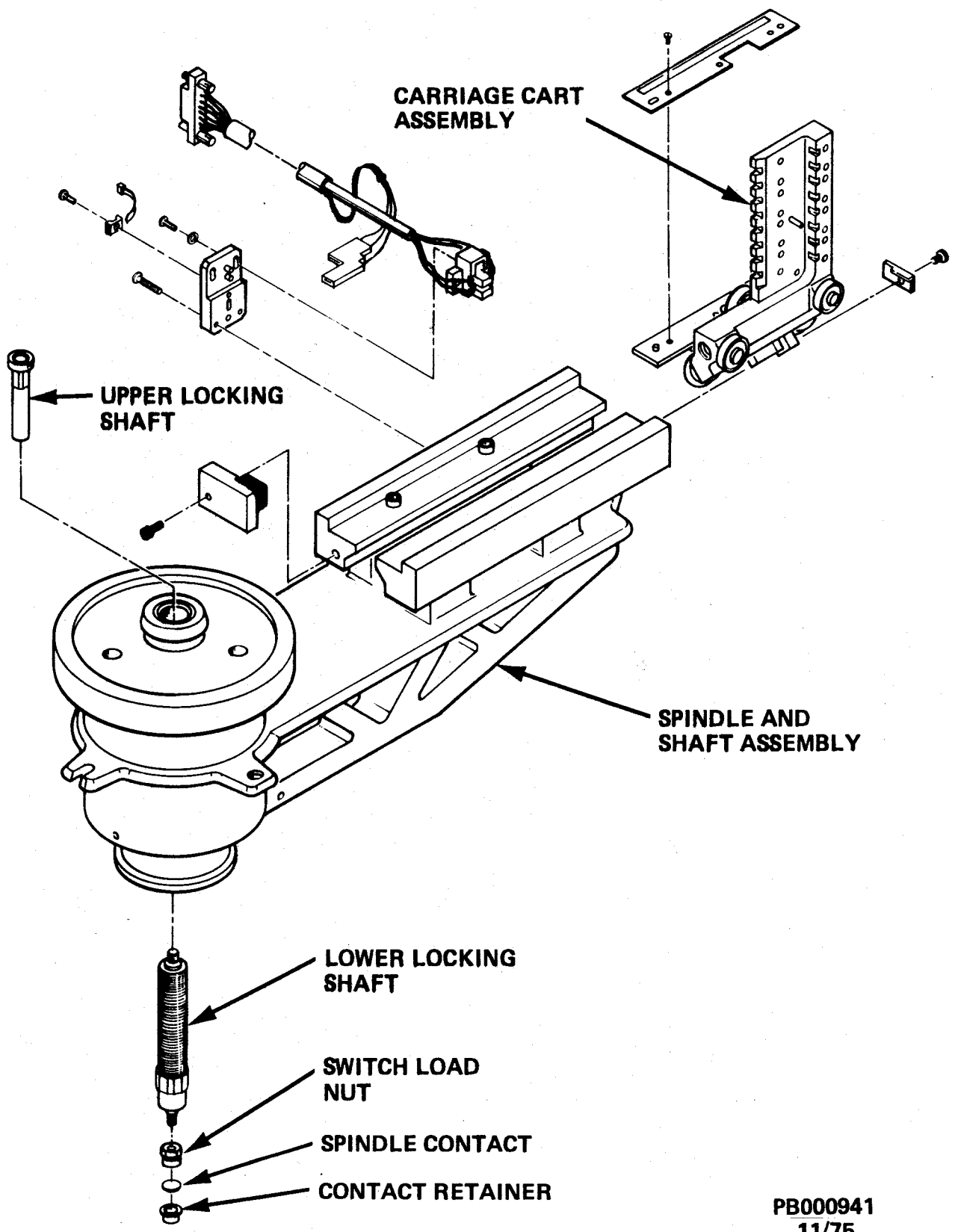6. Remove read/write and servo heads as directed in subsection 6.7.

> **NOTE:** When removing the read/write and servo heads, visual inspection may reveal that cleaning is necessary. If so, observe the CAUTION notes in maintenance subsection 5.7.3.

7. Disconnect EMA drive leads and remove EMA assembly as directed in subsection 6.9.

> **NOTE:** Before removing the EMA assembly, check that the Magnet and Coil Alignment Tools, as specified in subsection 6.9, are available for reinstallation.

8. Remove two (2) screws securing carriage retract switch to baseplate. Gently lift switch and set it aside.

9. Remove screws securing ground flex strap between carriage assembly and right hand rail.

10. Remove four (4) screws that fasten the coil assembly to the T-block (screws are accessible from inside rear of coil housing).

11. Remove the carriage backstop from the right hand rail.

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CARRIAGE CART ASSEMBLY

UPPER LOCKING SHAFT

SPINDLE AND SHAFT ASSEMBLY

LOWER LOCKING SHAFT

SWITCH LOAD NUT

SPINDLE CONTACT

CONTACT RETAINER

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Figure 6-7.   Carriage Assembly

12. Slide the carriage assembly to the rear, supporting its weight until it is clear of the rails.

13. If rail replacement or alignment is necessary, go on to step 14; otherwise, reinstall the carriage assembly as directed in subsection 6.10.2.

14. Remove eight binding head screws that secure shroud plate to shroud and lift out plate. This allows access to the two front rail mounting screws.

15. Remove two screws securing velocity source-sensor housing to left rail. Gently lift assembly and set it aside.

16. Remove forward stop assembly from left rail.

17. Remove four socket head screws that secure the left and right rails to the spindle shaft. Remove the rails.

6.10.2   Installation

1. Install the forward stop assembly onto the left rail.

2. Apply adhesive primer to screws removed in step 16 of removal procedure.

3. Install the left rail onto spindle shaft. Apply Loctite 222 to threads of screws and torque to 20 inch-pounds.

4. Install the right rail onto the spindle shaft. Apply Loctite 222 to threads of screws and install loosely.

5. Place rail alignment tool between the two rails. Tighten the two halves of the tool together.

6. Holding the two rails together against the alignment tool torque the two screws on the right rail to 20 inch-pounds.

> NOTE: Check to be sure there is no clearance between the tool and the rails after alignment.

7. Loosen tool and remove. The rail alignment is complete.

8. Replace shroud plate removed in step 13 of removal procedure.

9. Fasten the velocity source-sensor housing onto the left rail.

10. Install the carriage assembly by reversing the removal procedure; beginning with step 11.

> NOTE: When reinstalling the ground flex strap, check that the strap is clear of the carriage cart wheel and the mounting bracket.

11. Perform the velocity source-sensor adjustment in accordance with the procedure in subsection 5.9.7.

12. Check system offset in accordance with the procedure in subsection 5.9.2.

13. Align the heads in accordance with the procedure in subsection 5.9.4.

6.11 SPINDLE AND LOCKING SHAFT ASSEMBLY

Field maintenance may not require that the entire spindle and locking shaft assembly be replaced. If damaged threads on the locking shaft are the sole problem, only the shaft need be replaced. Replacement of the entire spindle and locking shaft assembly is described below in subsection headings Assembly Removal and Assembly Installation. Replacement of the locking shaft alone is described below under headings Shaft Removal and Shaft Installation.

Tools required for the removal and replacement of the spindle and the upper and lower locking shaft assemblies (Figure 6-8) are: a 1/2" x 9/16" Open End Wrench, P/N 920051, or equivalent; Loctite 222, P/N 3154747-09; Loctite 271, P/N 3012691-00; Adhesive Primer, P/N 3006130-01; Locking Shaft Extractor Tool, P/N 9008783-01.
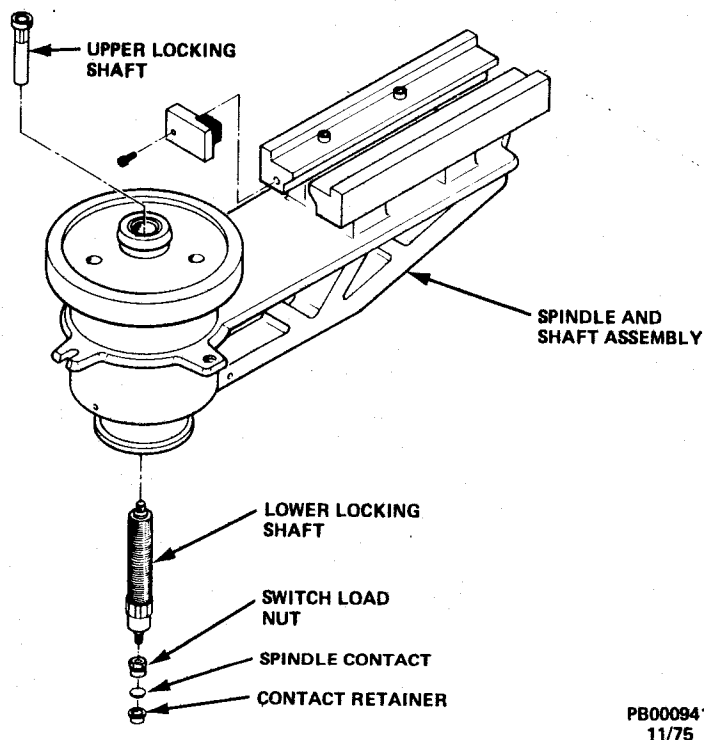

UPPER LOCKING SHAFT

SPINDLE AND SHAFT ASSEMBLY

LOWER LOCKING SHAFT

SWITCH LOAD NUT

SPINDLE CONTACT

CONTACT RETAINER

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Figure 6-8.   Spindle Locking Shaft Assembly

6.11.1 Assembly Removal

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┌─────────────┐
│  CAUTION    │
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The replacement of the Spindle and
Locking Shaft Assembly is an involved
procedure requiring the removal of
many major drive assemblies including:

- EMA Assembly
- Shroud Assembly
- All heads
- Carriage Assembly and Rails

therefore, it is important to be
familiar with their respective removal
and installation procedures before
beginning this procedure.

NOTE: If spindle is being replaced, new
spindles do not include rails.
Remove rails from old spindle and
locking shaft assembly and install
on new assembly before beginning
assembly installation.

1. Obtain permission from system operator to power down the drive to avoid disrupting DP operation.

2. Remove disk pack.

3. Remove the rear cover and set CB1 to OFF position (switch toggle down).

4. Remove the top rear cover, front and side panels.

5. Remove read/write and servo heads as directed in subsection 6.7.

6. Disconnect EMA drive leads and remove EMA assembly as directed in subsection 6.9.

7. Remove Carriage Assembly and rails as directed in subsection 6.10.

8. Remove shroud cover assembly as follows:

   a. Remove two wires from drive motor failsafe switch, at rear flange of cover.

   b. Disconnect solenoid and AC power interlock connectors at front of cover.

   c. Loosen transition duct clamp at absolute filter.

d. Remove two (2) 10-32 screws that secure the shroud cover to the main frame (at front of machine), and loosen two 10-32 screws at the left and right mounting brackets; slide the cover forward and clear of the machine.

9. Remove Shroud Assembly as directed in subsection 6.8.

10. Remove Pack Lock Assembly.

11. Disconnect harness from base of spindle and remove belt guard.

12. Locate the two (2) 4-40 screws securing the speed sensor to the baseplate. Remove the screw nearest the shaft and loosen the other. Rotate the sensor clear of the spindle.

13. Remove two (2) 8-32 screws securing pack-on switch assembly to base-plate and set to one side.

14. Remove idler pulley assembly and detach belt from spindle pulley.

15. Remove three (3) 1/4-20 screws that secure spindle and locking shaft assembly to baseplate and lift from baseplate.

6.11.2 Assembly Installation

Inspect spindle and locking shaft assembly and baseplate assembly surfaces before installation. Clean mating surfaces and replace pressure sensitive tape on spindle and locking shaft assembly surfaces, as required.

1. Lower spindle and locking shaft assembly into position on baseplate aligning slot, at front of assembly, with locating dowel pin.

2. Replace and tighten three (3) 1/4-20 screws removed in step 15 of removal procedure.

3. Reassemble the spindle and locking shaft assembly by reversing the removal procedure; beginning with step 14.

4. When reassembly is completed, perform the following:

a. Adjust pack-on switch contact gap in accordance with procedure in subsection 5.9.5.

b. Check speed sensor-to-disk clearance in accordance with procedure in subsection 5.9.6.

c. Check motor belt tension in accordance with procedure in subsection 5.9.8.

d. Clean carriage rail surfaces with 91% isopropyl alcohol.

e. Carefully check for metal particles in the shroud area.

f. Align read/write and servo heads as directed in subsection 5.9.4.

6.11.3 Shaft Removal

| CAUTION |

Damaged locking-shaft threads may have
been caused or propagated by disk
packs. To isolate and end the problem,
inspect threads on all disk packs used
on the drive as well as the locking
shaft threads on all companion drives.

1. Obtain permission from system operator to power down the drive to avoid disrupting DP operation.

2. Remove disk pack.

3. Remove the rear cover and set CB1 to OFF position (switch toggle down).

4. Remove the front and side panels.

5. On the underside of the spindle and shaft assembly, locate the two (2) 8-32 screws securing the pack-on switch assembly to the baseplate. Remove the screw nearest the shaft and loosen the other. Rotate the assembly clear of the spindle.

6. Using a screwdriver, unsnap the plastic contact retainer holding the spindle ground contact on the switch load nut (located on the lower locking shaft).

7. Using the 1/2" wrench, remove the switch load hex nut.

8. Engage the locking shaft extractor tool on the threads of the lower locking shaft.

9. Using the 1/2" wrench, turn the extractor tool clockwise (from the bottom of the unit) until the lower locking shaft is free from the upper locking shaft.

10. Raise the upper locking shaft (by pushing upward gently with the lower locking shaft) and remove it from the top of the spindle assembly. The lower locking shaft will drop free of the assembly.

6.11.4 Shaft Installation

1. Thoroughly clean all threads on the new upper and lower locking shaft assemblies, as well as the switch load nut.

2. Apply adhesive primer to the mating threads of both the upper and lower locking shaft assemblies.

3. Apply Loctite 222 to the upper threads of the new lower locking shaft assembly.

4. Install and seat the new upper locking shaft assembly in the spindle assembly.

5. Thread the extractor tool onto the lower threads of the lower locking shaft assembly and screw the assembly into the upper locking shaft. Remove the extractor tool.

6. Apply adhesive primer and Loctite* 271 to the lower threads of the lower locking shaft assembly and the switch load nut.

7. Screw the switch load nut onto the lower locking shaft and tighten with the 1/2-inch wrench.

8. Place the spindle ground contact into the contact retainer and snap the retainer onto the switch load nut.

9. Install the pack-on switch.

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