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15 AUGUST 1988

IDENTIFYING TECHNICAL PUBLICATION SHEET

I. PURPOSE.

This technical publication sheet is issued for the purpose of identifying commercial off-the-shelf manuals for support of the KC-135 Operational Flight Trainer System.

A/F 37A-T87/T88

BOEING MILITARY AIRPLANES
F33657-85-C-0020

OPERATION AND MAINTENANCE MANUAL
HALF HEIGHT FLOPPY DISK STORAGE SYSTEM

901181-731

January 1987

Manufacturer: Evans and Sutherland Computer Corp
580 Arapeen Dr
Salt Lake City, Utah 84108

II. SUPPLEMENTAL DATA.

Supplemental data attached.

LIST OF EFFECTIVE PAGES

INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES

NOTE: The portion of text affected by the changes is indicated by a vertical line in the outer margins of the page. Changes to illustrations are indicated by miniature pointing hands. Changes to wiring diagrams are indicated by shaded areas.

Dates of issue for original and changed pages are:

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TOTAL NUMBER OF PAGES IN THIS SUPPLEMENT IS 4 CONSISTING OF THE FOLLOWING:

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Title	0						
A	0						
i	0						
ii blank	0						

*Zero in this column indicates an original page

2-1. Related Publications.

2-1.1. The following is a list of related publications to this manual, supplemented to include KC-135 Operational Flight Trainer system publication numbers.

Vendor No.	Title	Publication No.
700225	Novoview SP1T Visual System Operation and Maintenance Instructions	A/F 37A-T88-04-1-0001
901181-618B	SP1 and SP1T Computer Image Generation System Operation and Maintenance Manual	A/F 37A-T88-06-1-0001
901181-392	Floppy Quad Disc Storage System Signal Tracing Guide	A/F 37A-T88-06-1-0810
TJ2-30255A	8-Inch Flexible-Disk Drive Model M2896-63 Half Height OEM Manual	A/F 37A-T88-09-1-0001

901181-731

TECHNICAL MANUAL

OPERATION & MAINTENANCE

HALF HEIGHT FLOPPY DISK

STORAGE SYSTEM

Evans & Sutherland Computer Corporation

JANUARY 1987

LIST OF EFFECTIVE PAGES

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PAGE NO.	CHANGE NO.
i - viii	0
1-1 - 1-4	0
2-1 - 2-16	0
3-1 - 3-28	0
4-1 - 4-12	0
5-1 - 5-86	0
6-1 - 6-12	0
A-1 - A-2	0

CONTENTS

CONTENTS

SECTION 4 THEORY OF OPERATION

SECTION 5 MAINTENANCE

SECTION 6 PARTS LIST

APPENDIX A E&S HALF HEIGHT APPLICATION NOTE

ILLUSTRATIONS

TABLES

SAFETY SUMMARY

The following general safety precautions are not related to any specific procedures and therefore do not appear elsewhere in this publication. These are precautions that personnel must understand and apply during operation.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must at all times observe all safety regulations. Do not replace components or make adjustments inside the equipment with high voltage supplies turned on. Under certain conditions, dangerous potentials may exist when the power control is in the off position, due to charges retained by capacitors. To avoid casualties, always remove power and discharge and ground a circuit before touching it.

DO NOT SERVICE OR ADJUST ALONE

Under no circumstances should any person reach into the enclosure for the purpose of servicing or adjusting the equipment, except in the presence of someone who is capable of rendering aid.

RESUSCITATION

Personnel working with or near high voltages should be familiar with methods of resuscitation.

WARNING

HIGH VOLTAGES CAPABLE OF CAUSING DEATH ARE USED IN THIS EQUIPMENT. USE EXTREME CAUTION WHEN SERVICING POWER SUPPLIES OR THEIR LOAD COMPONENTS.

SECTION 1

INTRODUCTION

1.1 MANUAL SCOPE

This manual describes how to install, operate, and maintain the Evans & Sutherland Half Height Disk Drive unit. Diagnosis and repair of the system are covered down to the replaceable unit or circuit card level. Manual sections are as follows:

SECTION	TITLE	PURPOSE
1	INTRODUCTION	What the system is and does.
2	INSTALLATION	How to install the system.
3	OPERATION	How to operate the system.
4	THEORY OF OPERATION	How the system operates.
5	MAINTENANCE	How to maintain, diagnose, and repair the system.
6	PARTS LIST	How to locate parts for repair.

1.2 INTRODUCTION

The Evans & Sutherland Half Height System is a double density diskette (Floppy Disk) storage unit using Dual Head Drives. The storage medium used in the Half Height is an IBM type soft sectored diskette. The storage and data formats are described in Section 3.5.

The main Cabinet contains the formatter board with control logic for up to four drives, a drive electronics board for up to four drives, a power supply for up to four drives and one or two Floppy Disk Drives (A & B). The slave unit contains power cables and signal cables, and one or two additional Drives connected to the Master Unit.

The Formatter is a powerful, general purpose disk controller capable of multiplexed control. It performs all functions related to Drive Selection, Head Positioning, Seek Verification, Data Formatting and Error Checking.

Interface Cables connect the disk storage unit to the Disk Interface Card. The Disk Interface Card may reside in the I.G. or it may be mounted in the G.P. backpanel dependent upon the system configuration.

1.3 FUNCTIONAL DESCRIPTION

The functional relationship of the Half Height (Master Unit) to the CPU and to the Half Height (Slave Unit) is shown in Figure 1-1. The Formatter defines the operational characteristics of the Floppy Disk Subsystem as viewed by the system through its interface card.

Command and Status Words prescribe the control and monitoring of the Floppy disks by the CPU. The format of these Command and Status Words are explained in Section 3.8.

The Formatter is capable of performing a number of operations under program control such as Read, Write and diskette Initialization. Manually engaging the IPL Switch on the Control Panel forces the Formatter into a special sequence -- Initial Program Load (IPL). These operations are described in Section 3.12.

The Control Panels include the switches and indicators to aid the operator. Section 3-4 describes the Control Panel.

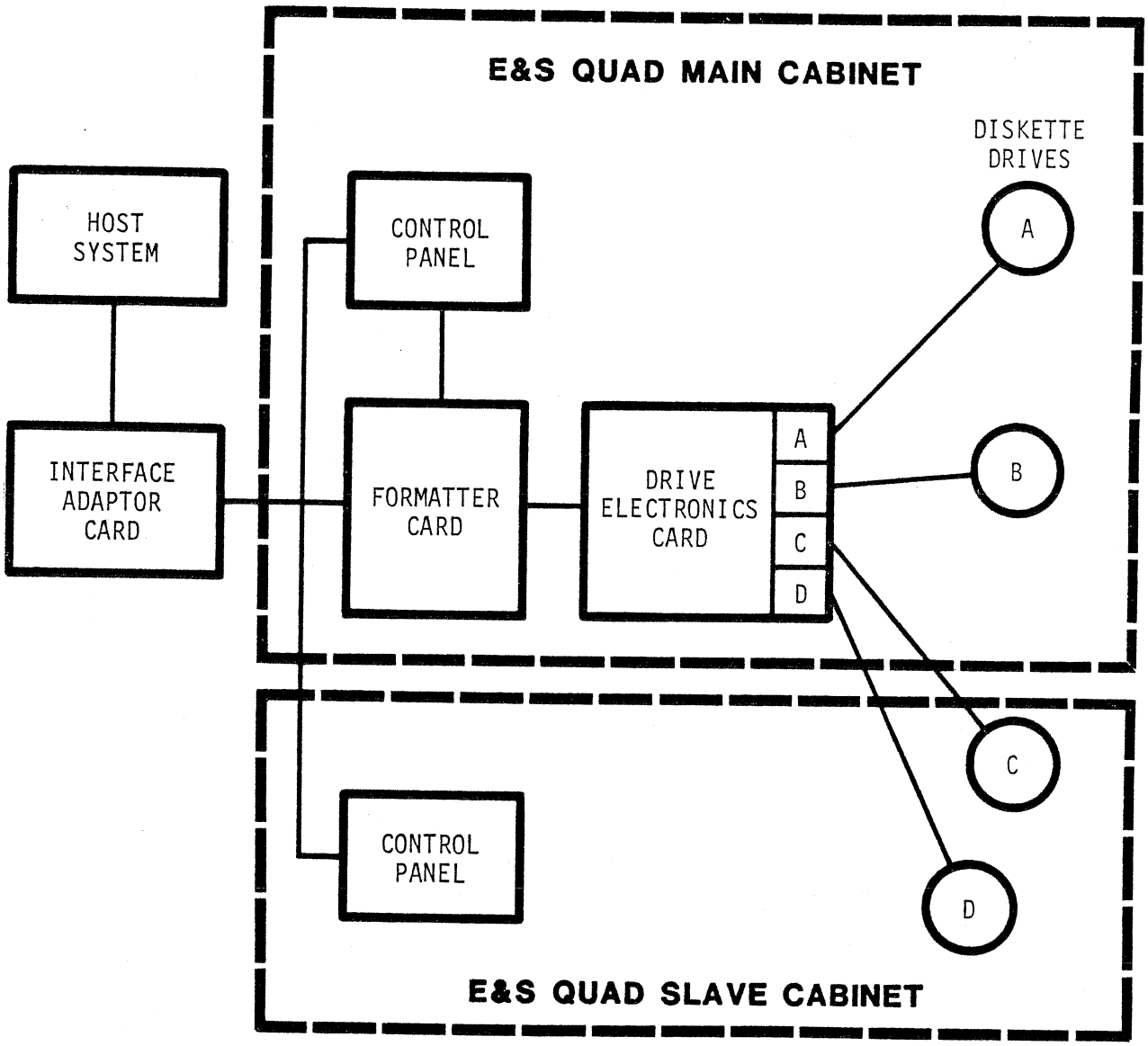

FIGURE 1-1
FUNCTIONAL DIAGRAM

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SECTION 2

INSTALLATION

2.1 INTRODUCTION

This section describes the installation and interfacing requirements of the Half Height Disk Drive.

2.2 MOUNTING DIMENSIONS AND WEIGHT

The E&S Half Height Disk Drive System has the following physical specifications (Table 2-1):

TABLE 2-1
PHYSICAL SPECIFICATIONS

PHYSICAL DIMENSIONS:	
E&S Half Height BASIC CABINET	Height 7.5" (13.3cm) Width 17.8" (45.2cm) Depth 25.0" (63.5cm)
WEIGHT:	
E&S Half Height System	42 lbs (19kg) 1 Drive System 55 lbs (25kg) 2 Drive System

Chassis Slides are available for mounting in a standard RETMA/EIA 19" wide rack. Hardware to secure the Half Height master or Slave unit are provided with the slides.

2.3 ENVIRONMENTAL AND POWER REQUIREMENTS

Tables 2-2 and 2-3 summarize the environmental and power requirements for the E&S Half Height disk drive master unit and slave unit.

TABLE 2-2
MASTER UNIT ENVIRONMENTAL AND POWER REQUIREMENTS

	1 DRIVE (A)	2 DRIVES (A & B)
VOLTAGE:	Either 110-130 Volts AC or 220-260 Volts AC	Same as 1 drive
CURRENT IN AMPERES:	Depending on Master Unit. @ 115V AC: 1.0 @ 230V AC: 1.0	 2.0 2.0
AC LINE FREQUENCY:	47-63 Hz	47-63 Hz
TEMPERATURE: 41°F. - 110°F (5°C - 43°C)		
RELATIVE HUMIDITY LIMITS: 20% to 80% with a maximum wet bulb temperature of 78°F (25°)		

TABLE 2-3
SLAVE UNIT ENVIRONMENTAL AND POWER REQUIREMENTS

	3 DRIVE (C)	4 DRIVES (C & D)
VOLTAGE:	Same as 1 drive	Same as 1 drive
CURRENT IN AMPERES:	@ 115V AC: 1.0 @ 230V AC: 1.0	2.0 2.0
AC LINE FREQUENCY:	47-63 Hz	47-63 Hz
TEMPERATURE: 41°F. - 110°F (5°C - 43°C)		
RELATIVE HUMIDITY LIMITS: 20% to 80% with a maximum wet bulb temperature of 78°F (25°)		

2.3.1 TEMPERATURE AND HUMIDITY RANGES

The E&S Half Height Disk Drive is designed to operate within the temperature and humidity ranges specified in Table 2-4.

TABLE 2-4
TEMPERATURE AND HUMIDITY RANGES FOR HALF HEIGHT AND DISKETTE

TEMPERATURE	OPERATING	NON-OPERATING
	41°F to 110°F 50°C to 43°C	14°F to 113°F -10°C to 45°C
RELATIVE HUMIDITY at maximum of 78°F (26°C) Wet Bulb Temperature	20% to 80%	90% maximum
HEAT GENERATED (maximum)	100 BTU/hr for elect's plus 346 BTU/hr per Disk Drive	NONE

The system must be used within the operating temperature and humidity conditions specified in Table 2-4 to insure interchangeability of the diskettes. Also, exposure of the diskette to magnetic fields greater than 50 Oersteds can cause loss of data.

Performance of the Half Height can be seriously degraded by improper environment. Dust and other airborne contaminants are a major threat to the operating life of the recording components and the actuator. Environmental protection similar to that used for magnetic tape and removable disk installations should be observed.

2.4 DRIVE SPECIFICATIONS

The E&S Half Height unit has a number of important protection and reliablility features. The Formatter automatically performs a positive Position Verification during every Read and Write operation before transferring any user data. The Formatter generates Cyclic Redundancy Check (CRC) words for all information recorded on the disk, including Address I.D.'s used in the Position Verification; the Formatter can detect a CRC Error during the Address Verification phase of write and Read operations and during the Data Transfer phase of Read operations. Table 2-5 is a summary of the unit specifications.

TABLE 2-5
UNIT SPECIFICATIONS

DRIVE UNIT	TYPICAL SPECIFICATIONS
Drive Rotational Speed	360 rpm
Average Latancy (1/2 rotation)	83 msec.
Track to Track Access Time	3 msec./10 msec.
Head Settle Time at Last Track	15 msec./20 msec.
Data Transfer Rate	500 kilobits/sec.
Mean Time Between Failures	10,000 hours
NOTE	
These Specifications are drive dependent	
DISKETTE	
Media	IBM Diskette or equivalent
Number of Tracks	77 per side
Recording Density	6400 bpi (inside tracks)
Soft Errors	10^{-9}
Hard Errors	10^{-12}
Life	Over 5×10^{6} per track

2.5 CHASSIS CONFIGURATION OPTIONS

The Half Height system accommodates up to four disk drive units (A,B,C & D). Drives "A" and "B" are housed in the Half Height main unit; drives "C' and "D" are housed in the auxiliary slave housing . The Control Panel on the main housing contains error LED's, function switches, power switch, and logic select switches for drives "A" and "B". Slave housing has logic select switches and LED's for drives "C" and "D".

2.5.1 TRACK FORMATS

The unit provides a complete diskette initialization facility. This allows a user to create a data format that is best suited to the users application. A track may be initialized to contain from 1 to 210 sectors; sector sizes may range from 2 bytes to 10,752 bytes. Table 2-6 shows a few typical track formats.

TABLE 2-6
TYPICAL TRACK FORMATS

SECTORS/TRACK	1	2	4	8	16	30	52	210
BYTES/SECTOR	10,752	4096	2048	1024	512	256	128	1

2.6 INTERFACING

An Interface (i.e., interface card) is required to connect the Half Height disk drive to a CPU. This Section includes the design information on the E&S interface card.

The Formatter includes all the control electronics required for drive selection, seek and verification, data formatting and error detection; consequently, the Interface is quite simple in design.

The functional responsibilities of the Interface card can be summarized as follows:

1. Provide a means of allowing the CPU (central processing unit)to access a Status Word, which is maintained by the Formatter;

2. Provide a means of allowing the CPU to issue a Command Word to the Formatter;

3. Transfer Data Words from the Formatter to the CPU, when requested to do so by the Formatter during a Read operation;

4. Transfer Data Words from the CPU to the Formatter, when requested to do so by the Formatter during a Write operation;

5. Signal the CPU when the Formatter finishes an Initialize, Read, or Write operation.

2.6.1 INTERFACE BOARD LOCATIONS

In most systems, the interface board is housed in the CPU mainframe or satellite chassis. However, the Half Height chassis provides adequate space, ventilation and power for one interface board. Card guides may be installed in the chassis to hold the board in a horizontal position on top of the formatter card. Removing the top cover provides access to the board. The Interface board provided by E&S is mounted inside the image generator main cabinet, or in the CPU cabinet in the case of modeling systems.

2.6.2 INTERFACE CABLE DESCRIPTION

All interfacing to the Half Height is through one Formatter cable. The standard Formatter cable is a 50 wire flat cable, (every other wire being a logic ground). E&S supplies a 6' (183cm) cable unless the user specifies another length.

The CPU controls the Formatter with a 16-bit Command Word. The Formatter's status is available as a 16-bit Data Words, or optionally as 8 bit bytes.

The interface cable emerges from the chassis through a clamped slot in the Rear Panel. This slot may be used instead for the CPU I/O bus cable should the user elect to install the interface board in the chassis.

Pin assignments for the interface cable are given in Table 2-7. All even numbered pins (2-50) are connected to logic ground.

2.6.3 INTERFACE FORMAT

Command Words, Status Words and Data Words all have a 16-bit format. For CPU with a 16-bit organization, the interface normally need not provide intermediate buffering. For CPU with an organization other than 16-bit, the interface must reconcile the two format requirements. The interface may be designed to transfer data between the CPU and the Formatter using either Programmed I/O or DMA.

2.6.4 INTERFACE SIGNALS

The interface to the Half Height is composed of 16 bidirectional data lines, four control lines, two status line, one function line, and two power monitor lines, as represented in Figure 2-1.

Data, control and status information are transferred to and from the Formatter via the 16 bidirectional data lines designated D0-D15. The interpretation of the information on the data lines is determined by which of the four control lines (Data In, Data Out, Command Out or Status In) is active during the time of the information. No two control lines should be active at any one time.

The 2 Status Flags are Data Flag and Device End. Data Flag indicates that the Formatter has completed an operation.

The Function Line, IPL, indicates that the Formatter has initiated an Initial Program Load operation. (See Section 3.12).

Two Power Monitor lines, CPU Reset and Device Available, are also provided. The E&S Half Height Signals are summarized in Table 2-7.

TABLE 2-7
INTERFACE SIGNALS

*SIGNAL	PIN	FUNCTION
D0	35	16 bidirectional data lines used to transfer Command Words to the Formatter, Status Words from the Formatter, Data Words from the Formatter during Read operations and Data Words to the Formatter during Write operations.
D1	31	
D2	7	
D3	5	
D4	29	
D5	21	
D6	19	
D7	15	
D8	1	
D9	3	
D10	43	
D11	37	
D12	41	
D13	47	
D14	25	
D15	11	
CO	23	Command Out (CO) indicates that a Command Word is present on the Data Lines. CO causes the Formatter to accept the Command Word and initiate the specified operation.
SI	27	Status In (SI) is used to gain access to the Status Word maintained by the Formatter. When SI is active the Formatter will gate the Status Word onto the Data Lines.
DO	13	Data Out (DO) is used to transfer a Data Word to the Formatter during a Write operation via data lines. DO should be activated only when Data Flag is active.
DI	49	Data In (DI) is used to transfer a Data Word from the Formatter during a Read operation. When DI is activated, the Formatter will gate the Data Word onto the Data Lines. DI should be activated only when Data Flag is active.

TABLE 2-7 (CONT.)
INTERFACE SIGNALS

*SIGNAL	PIN	FUNCTION
DATA FLAG	33	Data Flag, when active, indicates that the Formatter is ready for the transfer of a Data Word. During a Write operation it means the the Formatter is ready to receive the next Data Word. During a Read operation it means that the Formatter is ready to send the next Data Word.
DEVICE END	39	Device End is true when the Formatter has completed an operation.
IPL	45	Initial Program Load (IPL) is active only during the time that the IPL on the Control Panel is engaged. (When the switch is raised, the Formatter will do a Read of Sector 00, Track 00 on Logical Drive 0.)
CPU RESET	9	Signal originates from CPU interface indicating lack of power. This resets all formatter control logic.
DEVICE AVAILABLE	17	Signal originates at the formatter stating that power is on and that the device is now available to operate.

* The active level for all signals is low (at zero voltage).

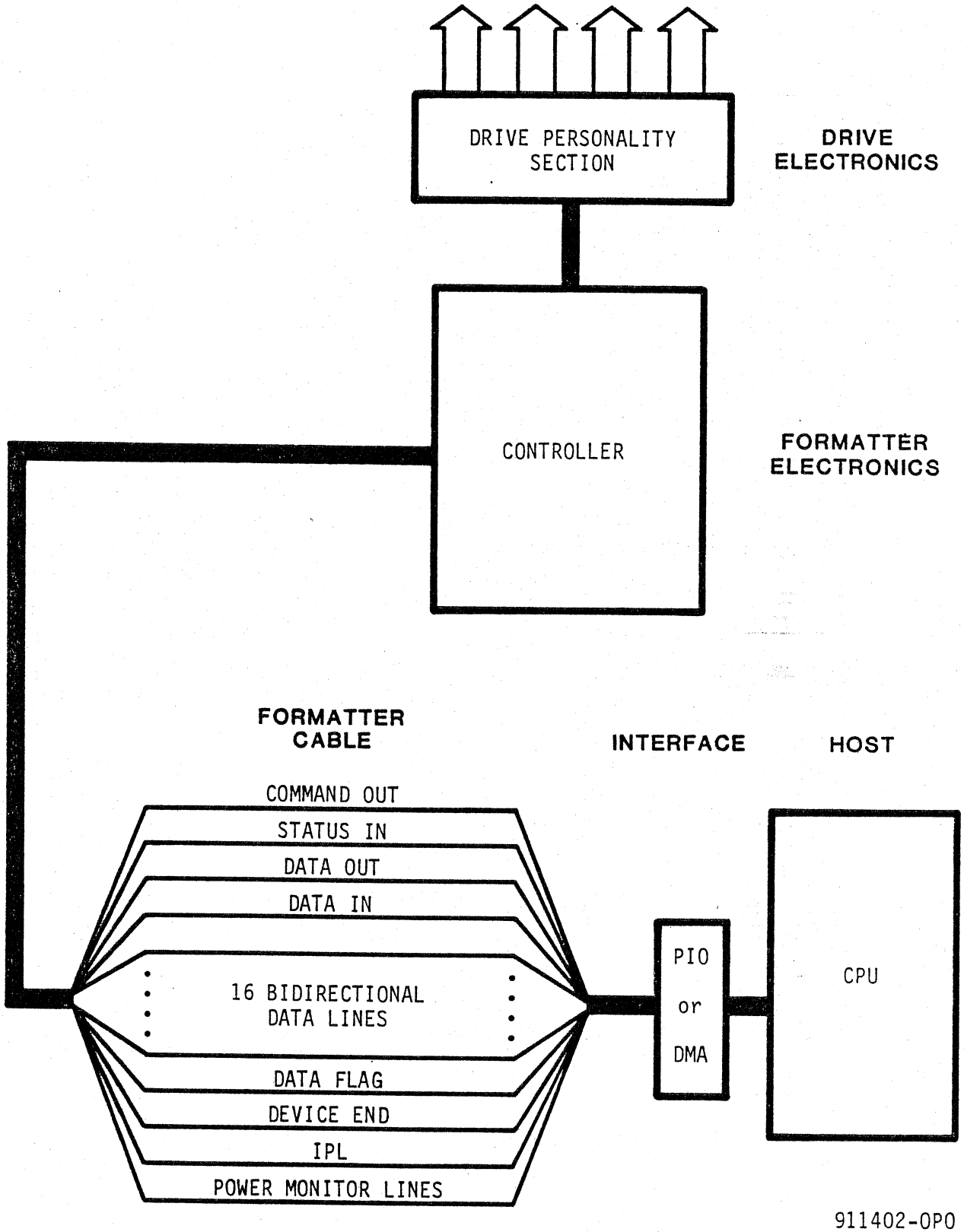


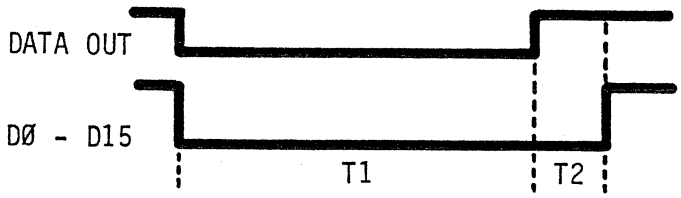
FIGURE 2-1
INTERFACE SIGNALS

2.7 SIGNAL TIME CONSIDERATIONS

Proper timing of the four control lines is important to assure the information on the bidirectional data lines is properly interpreted and latched.

2.7.1 COMMAND OUT AND DATA OUT TIMING

The Formatter uses the trailing edge of Command Out to latch command information (Figure 2-2). The Interface assures that the Command Word is stable on the data lines at the trailing edge of Command Out. Data and Command Out remain active for at least 100 nanoseconds. The Interface assures that a Data Word is stable on the data lines at the trailing edge of Data Out. Data Out remains active for at least 100 nanoseconds.

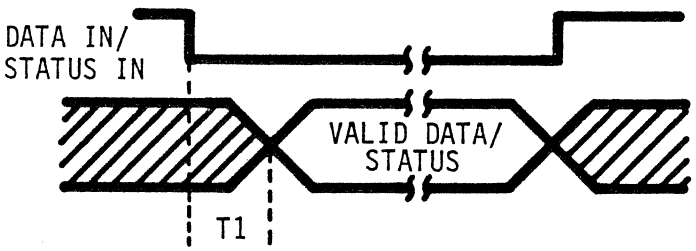


T1 - TYPICALLY 100 ns
T2 - 50 ns MINIMUM 911404-0P0

FIGURE 2-2
COMMAND/DATA OUT TIMING

2.7.2 STATUS IN AND DATA IN TIMING

When the interface asserts Status In or Data In (Figure 2-3), the Formatter gates either the contents of its Status Register or the contents of its Data In Buffer onto the Data Lines. The interface keeps Data In or Status In active for enough time to assure the integrity of the information before the status or data is latched or presented to the CPU. This time consideration allows for at least 6 gate delays and the delay of the cable plus any internal delays within the interface.



T1 = 100 ns (TYPICALLY) + 2 ns/ft OVER 10' CABLE

911405-0P0

FIGURE 2-3
DATA IN/STATUS IN TIMING

2.7.3 DATA TIMING

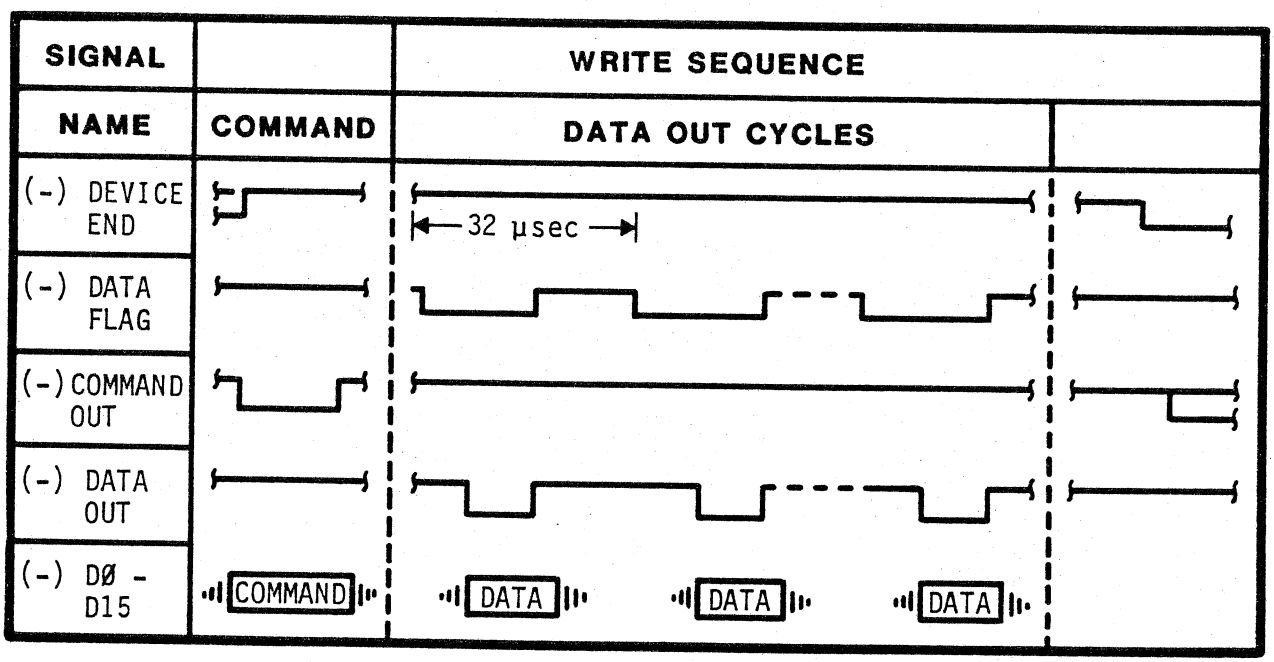
For both Read and Write operations, the Formatter requests Data Word transfers by activating Data Flag. Once Data Flag becomes true, the interface has typically 32 microseconds in which to complete a Data In or Data Out cycle. The Formatter will reset Data Flag on the leading edge of Data In or Data Out.

2.8 DATA TRANSFER SEQUENCES

This section discusses interface signal sequences for operations involving data transfers.

2.8.1 DATA OUT SEQUENCE

During Write and Initialize Write operations, the CPU interface must transfer Data Words to the Formatter. A Data Out sequence is illustrated in Figure 2-4.



911401-0P0

FIGURE 2-4
DATA OUT SEQUENCE

For each 16-bit Data Word transferred to the Formatter, a Data Out cycle is required. The Formatter requests a Data Word from the interface byte activating Data Flag. the interface may use Data Flag to initiate a DMA request to the CPU, or the interface may allow the CPU to interrogate the state of Data Flag and transfer data via program control. When the Data Word has been accessed from the CPU, the interface gates the Data Word onto the data lines and activates Data Out (see Section 2.7 for detailed timing requirements). On the leading edge of Data Out, the Formatter clears its request (i.e., Data Flag goes false). Should the interface fail to activate Data Out within approximately 32 usec of Data Flag, Data Flag will be cleared for the duration of the operation. The Formatter will stop making requests for the entire record. The last word received will be written during the remainder of the record. The Formatter automatically generates and records a CRC word at the end of the record.

When the Formatter has completed the operation, it activates Device End. The interface may use Device End to generate an interrupt to the CPU or tell the adapter the unit is no longer busy.

2.8.2 DATA IN SEQUENCE

During Read and IPL operations, the CPU must accept Data Words from the Formatter.

For each 16-bit Data Word transferred from the Formatter to the interface, a Data In cycle is required. The Formatter activates Data Flag when it has a Data Word in its input buffer ready to transfer to the CPU. The interface may use Data Flag to initiate a DMA request to the CPU, or the interface may allow the CPU program to interrogate the state of Data Flag and Transfer Data via Program Control. The interface activates Data In to cause the Formatter to gate the Data Word onto the data lines and to clear Data Flag. Should the interface fail to activate Data In within approximately 32 usec of Data Flag, Data Flag will be cleared for the duration of the operation. The Formatter will stop activating Data Flag for the entire record. The Formatter automatically reads and verifies the CRC word at the end of the data record, at which time the Formatter may detect a Data Check Error.

When the Formatter has completed the operation, it activates Device End. The interface may use Device End to generate an interrupt to the CPU.

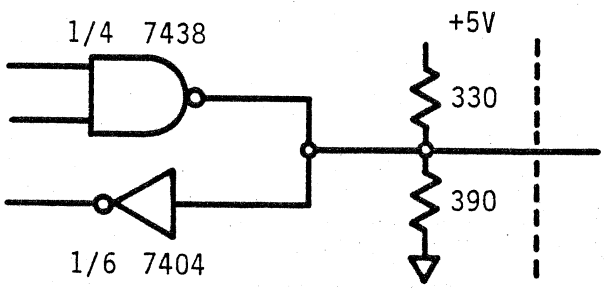
2.9 ELECTRICAL CONSIDERATIONS

E&S IG system uses the interface circuitry shown below. E&S uses transistor-transistor logic (TTL) with bus signals asserted 'LOW'. In all cases:

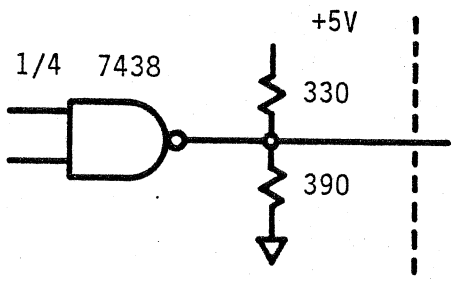
HIGH = FALSE = LOGICAL "0"

LOW = TRUE = LOGICAL "1"

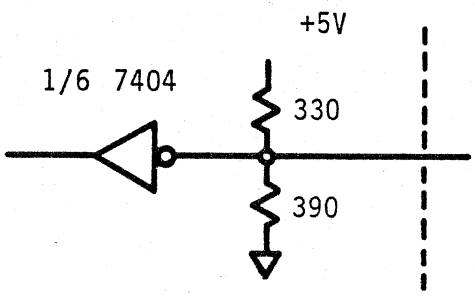
Output drivers are standard SN 7438 TTL buffers with open collector outputs. Input receivers are standard SN 7404 inverters. All lines are terminated by resistor networks of 330 ohms to +5 volts and 390 ohms to logical ground.



CIRCUIT FOR DATA TRANSCEIVERS



CIRCUIT FOR OUTPUT DRIVER



CIRCUIT FOR INPUT RECEIVER

911413-0P0

FIGURE 2-5
HALF HEIGHT INTERFACE CIRCUITS

2.10 FLOPPY DISK DRIVE POWER SUPPLY ADJUSTMENTS

The purpose of this installation procedure is to verify the correct adjustment of the Half Height power supplies. Follow the procedure listed below to check the operation of the power supplies.

1. Turn the system power OFF.

2. Slide drive system forward.

3. Remove the drive system top.

4. Locate two identical power connectors on rear panel of floppy drive drawer. These connectors are wired the same. Each feeds a drive.

   a. Measure 24 volts at pin 1 (purple wire) on pin of either connector. This voltage must be in the range 24 to 26 volts. It can be measured, without disconnecting connectors, by probing pin 1. Pin 3 (black wire) is ground.

   b. Measure 5 volts at pin 4 (red wire) on either connector. This voltage must be within the range +4.9 VDC to +5.2 VDC.

   If either voltage is outside the specified ranges, proceed to Steps 5 through 13.

5. Remove the two circuit cards in the Half Height unit. These are the drive circuit card (smaller of the two) and the formatter. (See Figure 5-20, Section 5).

6. Remove the paper insulator revealing the power supply.

7. Power the Half Height system ON.

8. Using a voltmeter measure

   +24 VDC (unregulated)
   +24 VDC should be between 24 VDC and 26 VDC

9. Adjust the +24 VDC by moving terminal to a different tap along the large transformer.

10. Turn the system OFF.

BLANK

SECTION 3

OPERATION

3.1 INTRODUCTION

This section describes how to operate the E&S Half Height system on a normal daily basis. The controls and indicators found on the Master Control panel and the Unit Control panel are illustrated and explained. Procedures for the system initialization and operation are given. The following subsections detail procedures for manual and program operation of the Half Height Disk Drive.

3.2 TURN-ON AND TEST E&S HALF HEIGHT FLOPPY DISK DRIVE SYSTEM

The front panel switches of the Half Height should be set to specific positions and the unit turned on in the following manner:

1. Be sure the CPU-to-interface cable and power cord are properly connected.

2. Place the WRITE PROTECT (WP) and the INITIALIZE (INIT), switches to OFF (down).

3. Set the A and B drive selector switches to the desired logical address (0 to 3). The operator must assign a unique logic address to each of the physical drives to avoid Select Errors.

4. After the unit is plugged in turn on the power switch on the front of the Half Height unit. (Figure 3-2.)

5. The Read/Write heads of all drivers are positioned to track 00 when power is applied.

6. Run the E&S Half Height diagnostics. Take the diagnostic diskette from the documentation and its protective envelope. Be sure the diskette is fully inserted, (Figure 3-1), then close the drive door. With the diskette inserted and the door closed, run the diagnostics tests listed in Section 5.

CAUTION

Within the information packet is a diagnostic diskette and instructions for its proper use. Read the instructions carefully prior to inserting the diskette, or you may obliterate the diagnostics.

3.3 DISKETTE LOADING AND HANDLING

The diskette consists of a flexible disk permanently encased in a plastic jacket. The diskette is inserted in the drive unit by: opening the drive unit door, inserting the diskettes fully into the drive (see Figure 3-1) and closing the door. Diskettes may be installed or removed with all power on.

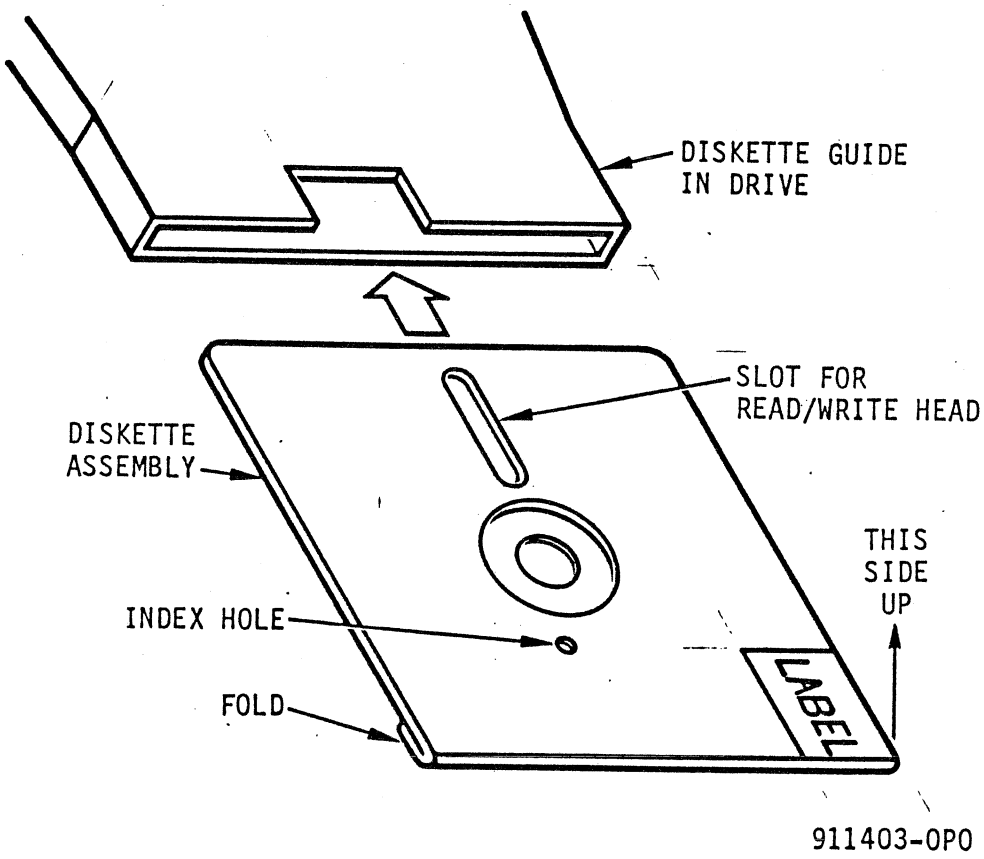


FIGURE 3-1
INSERTING DISKETTE INTO DRIVE

3.3.1 DISKETTE INTERCHANGEABILITY

To insure interchangeability, diskettes should be stored in a location that is within ± 5°F (3°C) of the using system ambient temperature and within ± 10% of the using system humidity. Diskettes stored outside the recommended ranges must be placed in the using system environment at least 20 minutes prior to use.

3.3.2 PHYSICAL DAMAGE

When removed from the Half Height, the diskette should be stored in its envelope. To protect the diskette, the same care and handling procedures specified for computer magnetic tapes apply. Additional precautionary procedures are as follows:

1. Return the diskette to its storage envelope whenever it is removed from the drive unit.

2. Store diskettes vertically.

3. Keep diskettes away from any magnetic fields.

4. Replace storage envelopes when they become worn, cracked or distorted. Envelopes are designed to protect the diskette.

5. Gently write on the label. Writing pressure may damage the disk. If writing is necessary, use only a felt tip pen.

6. Don't smoke while handling the diskettes. Heat and contamination from a carelessly dropped ash can damage the diskette and subsequently the drive R/W Head.

7. Do not expose diskettes to heat or sunlight. The Read/Write heads on the drive cannot properly track a warped disk.

8. Do not touch or attempt to clean the disk surface. Abrasions may cause loss of stored data.

3.4 CONTROL PANEL DESCRIPTION

The following subsections describes the switches and indicators on the Half Height Master Control Panel. The Control Panel (see Figure 3-2) is mounted on the front of the Half Height Chassis. It includes IPL, INIT, Write Protect and Power Switches, Error and Status Indicators, a power-on light, and Logical Select Switches for Drives "A" and "B". The Control Panel on the slave unit contains Logic Select Switches, and Status Lights for Drive "C" and "D".

3.4.1 DRIVE SELECT SWITCHES

Thumbwheel switches allow the operator to assign logical addresses to each of the four physical drives which are controlled by the Half Height Formatter. Switches labeled A and B are located on the Master Control Panel on the Half Height unit. Switches labeled C and D are located on the Slave unit Panel. Any of drives A thru D may be selected as Logical Drive 0 thru 3 by use of these switches. Commands issued by the CPU specify logical Addresses for drive selection. Switches should not be placed above 3 as logical 4 = 0; 5 = 1, etc.

3.4.2 DRIVE SELECT INDICATORS

When the CPU issues a command to the Half Height, the Select Indicator corresponding to the selected physical drive will light up. The indicator will extinguish while the command is active and remain illuminated until another command is issued.

3.4.3 ERROR INDICATORS

Certain error conditions may occur during drive operation. Errors are reported to the CPU control program via the Status Word and to the operator via four indicators.

The SELECT ERR (SEL ERR) indicator will light if the CPU issues a command specifying a Logical Select Address that is not currently assigned to any physical drive, or that is assigned to more than one physical drive.

The ADDRESS CHECK (ADRS CHK) indicator will light if the Formatter fails to find and correctly read the ADDRESS I.D. for the track and sector specified in a Read or Write operation. This indicates a negative Address Verification, and no new data will be transferred. Address Check will also occur if a Read Address I.D. command is given and no Address Marks are found.

The NO RECORD FOUND (NO RCRD) indicator will light if the Formatter fails to find a Data Mark within 1.2 milliseconds after a positive Address Verification during a Read operation. This usually indicates that the diskette in question is improperly written.

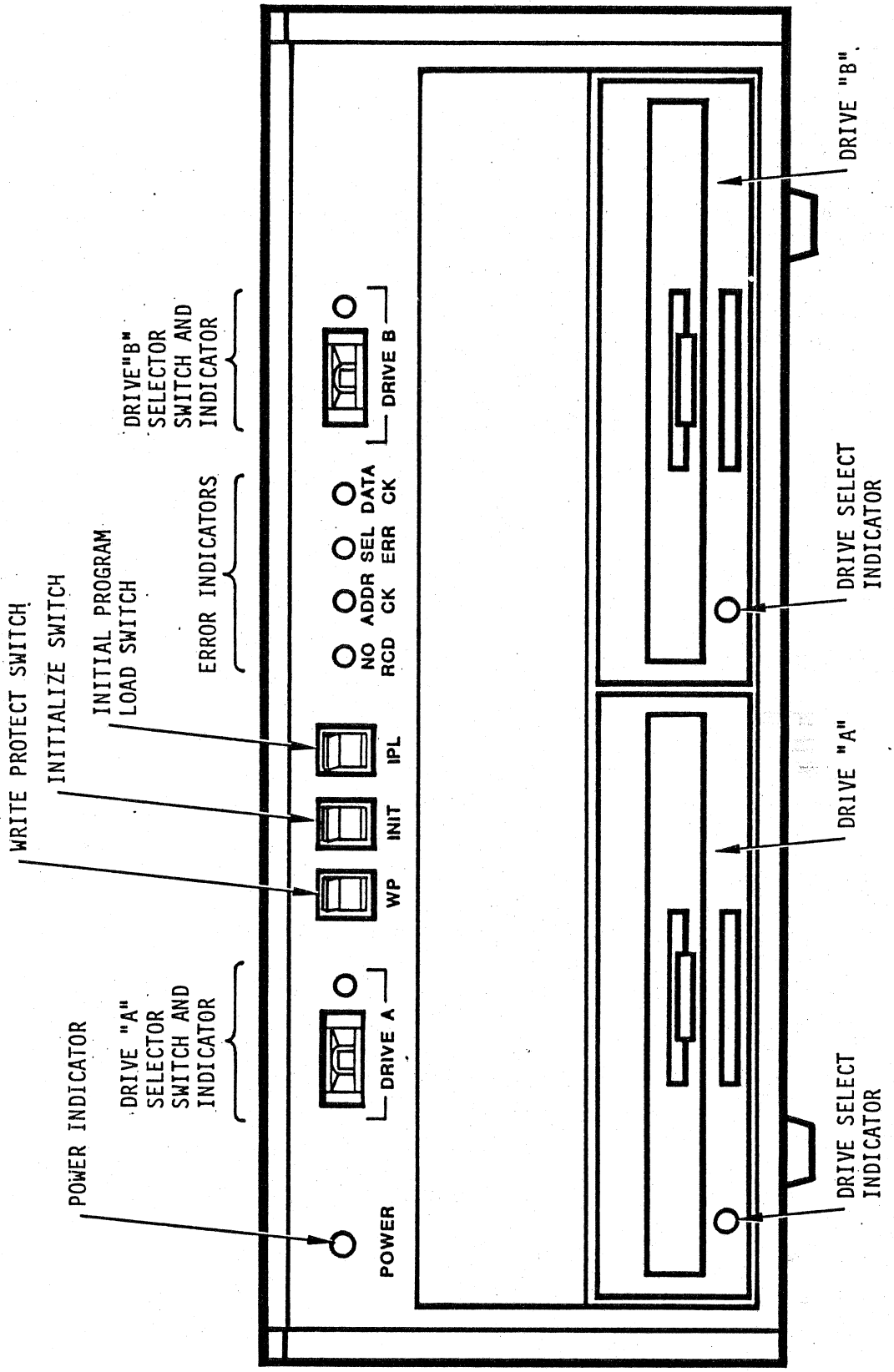


FIGURE 3-2
HALF HEIGHT FRONT CONTROL PANEL

The DATA CHECK (DATA CHK) indicator will light if the Formatter can't read the specified Data Record correctly. This means that the Formatter detected a CRC error. In most cases, erroneous data will have been transferred to the CPU.

3.4.4 INITIALIZE SWITCH (INIT)

This two position switch allows or disallows initialization of diskettes. When this switch is in the up position, the Formatter will accept the Initialize Start/Stop command from the CPU. When this switch is down, the Formatter will reject the command and report an Initialize Error in the Status word.

3.4.5 WRITE PROTECT SWITCH (WP)

This two-position switch allows the operator to Write Protect Logical Drive 0. When this switch is in the up position, the formatter will inhibit all Writing on Logical Drive 0. The write operation will continue through its entire operation, but no data will be stored on the diskette.

3.4.6 INITIAL PROGRAM LOAD SWITCH (IPL)

When this spring-loaded switch is raised it forces the Formatter to read Sector 0 of Track 00 Logical Drive 0. The CPU need not issue any commands to the Half Height; however, the CPU computer must be capable of accepting data.

3.5 STORAGE MEDIUM AND DATA FORMATS

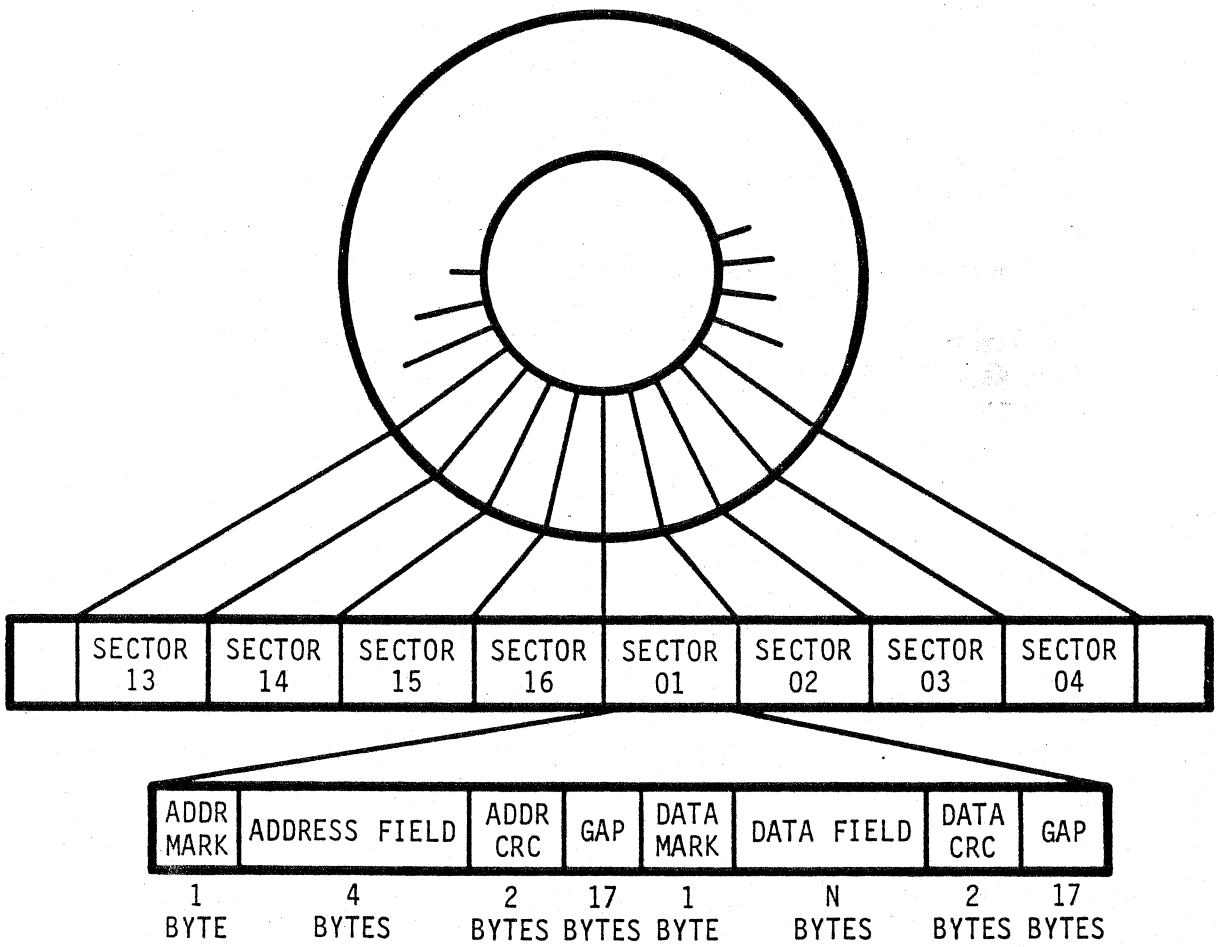
The Diskette is a flexible magnetic coated Disk permanently encased in a semi-rigid protective jacket. When installed in a drive unit, the central drive hub contacts and rotates the Disk freely within the jacket. The drive's Read/Write head accesses the Disk recording surface through an oval slot in the jacket. The index hole in the jacket permits the drive unit to sense the recording surface as the single hole on the media passes by once per revolution.

The Diskette recording surface is divided into 77 concentric tracks (Figure 3-3). The outer track is called Track 00 and the inner track is called Track 76.

The E&S Half Height Unit employs the Modified Frequency Modulation (MFM) recording technique which doubles the data bit frequency compared to the IBM 3741-type Frequency Modulation (FM) recording. a comparison of the standard density (IBM 3741 FM) and the double density (MFM) 01011001 bit patterns is shown in Figure 3-4.

In FM recording, Clock bits recorded on the data cell boundary provide synchronization for the standard density floppy disk Read/Write electronics. For the data pattern 01011001, the read/write head senses the FM pattern shown in Figure 3-4 for an effective thruput of 250,000 data bits per second.

In MFM recording, Clock bits are only recorded when required. Thus, Data bits usually provide the synchronization for the read/write electronics. For the same data pattern (01011001), the read/write head senses the MFM pattern shown in Figure 3-4 for an effective thruput of 500,000 data bits per second.



911399-0P0

FIGURE 3-3
STORAGE MEDIUM AND DATA FORMAT

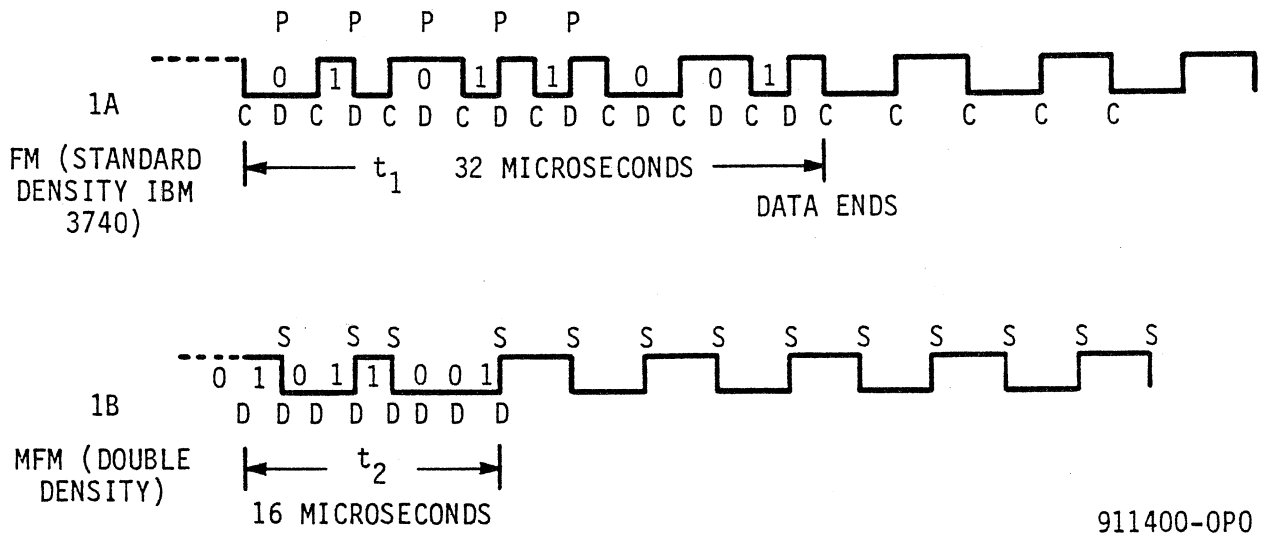


FIGURE 3-4
DATA BIT FREQUENCY PATTERNS

3.6 SELECT ADDRESS ASSIGNMENT

The physical drives are designated Drive A, Drive B, Drive C, and Drive D as noted on the Front Panels. A thumbwheel Select Switch and a Select Indicator are associated with each physical drive.

The operator uses the Unit Select Switches to assign Logic addresses to the corresponding physical drives. Any physical drive may be assigned the Logic address 0, 1, 2, or 3 (4-9 should not be used). If the operator assigns the select address 3 to Drive B, a subsequent command to the Half Height that specifies Logical Drive No. 3 will select Drive B and Drive B's Select Indicator will be illuminated at the completion of a data transfer.

The operator must assign a unique logic address to each of the existing physical drives to avoid Select Errors. The logic address assigned to a nonexistent physical drive may affect system operation.

3.7 GENERAL PROGRAMMING CONSIDERATIONS

For efficient system operation, it is important to coordinate CPU program operations with any manual operations that may be required. On some systems, this can be accomplished by having the CPU program type operator instructions and messages on a suitable output printer (e.g., teletype).

A diskette should be installed in a drive before issuing a command to that drive. If a diskette is not installed, an "Address Check Error" will be reported in the Status Word after a time-out period of approximately two seconds. The "On Line" bit (D13) in the Status Word indicates that the selected drive unit has a diskette installed and turning and that the diskette is installed in an Index Bit orientation (smooth side of the jacket toward the top of the drive unit). If it is desireable to use both sides of a diskette in a single head drive for information storage, the diskette may be installed with the smooth side of the jacket toward the bottom of the drive unit. However, neither the "On Line" nor the "Index Flag" condition will be reported in the Status Word.

CAUTION

Not all diskette manufacturers guarantee that both sides of the diskette are useable for information storage. When ordering diskettes be aware of this potential problem.

3.7.1 INITIALIZATION PROCEDURE

A diskette must be initialized (formatted) before it can be used for information storage. The initialization procedure need be performed only once during the life of the diskette unless the user wishes to change the sector format. Often, users will purchase diskettes that are initialized to a format that is suitable for their application; these users need not be concerned with the intitialization procedure.

CAUTION

Reinitializing a diskette destroys previously written data.

The initialization procedure is considered an attended operation. The programmer should provide detailed operator instructions with his "Diskette Initialization" Program. The INIT Switch on the Control Panel must be in the up position in order for the Formatter to accept and Initialize Start/Stop command. If the INIT Switch is down, an "Initialize Error" will be reported in the Status Word after the command is issued. The command sequences required for diskette initialization are described in Section 3.9.2.

3.7.2 WRITE PROCEDURE

To initiate a Write operation, the CPU program issues a Write command. Depending upon the design of the interface for a particular system, the program may have to perform certain functions such as loading memory address and word count registers before issuing the Write command (Type 1 and then a Type 0 command).

To assure that a data record has been accurately recorded, the program may read the record using the Read procedure described in Section 3.7.3. A Data Check Error will persist on repeated reading if the data was not properly recorded; the CPU program need not compare the data read with that which was written to assure data integrity. To correct an erroneously recorded record, another Write operation must be performed.

3.7.3 READ PROCEDURES

To intiate a Read operation, the CPU program issues a Read command. Depending upon the design of the interface for a particular system, the program may have to perform certain functions such as loading memory address and word count registers before issuing a Read command (Type 1 and then Type 0 command).

Most errors that occur during Read operations will be "soft" errors; that is, by performing an error recovery procedure, the data will be recovered. Soft errors are usually caused by the following:

1. Contaminents that pass between the Read/Write head and the diskette.

2. Random electrical noise which usually lasts for a few microseconds.

3. Small defects in written data and/or track not deleted during the Write operation, which may cause a soft error during a Read.

The following procedures are recommended to recover from the above mentioned soft errors:

1. Reread the track 5 times or until such time as the data are recovered.

2. If data are not recovered after using Step 1, access the head to the adjacent track in the same direction previously moved, then return to the desired track (i.e., if at track 29, a move to track 30 causes an error, move to track 31, and return to track 30).

3. Repeat Step 1.

4. Try Rezero/Seek and Reread.

5. If data are not recovered, the error is not recoverable and is considered a "hard" error.

3.8 COMMAND AND STATUS WORDS

A disk drive unit operation is initiated by issuing a Command Word to the Formatter. The Formatter maintains a Status Word that reflects conditions in the Formatter and in the Drive units.

The following subsections present the format of the Command Word and the Status Word as viewed by the Formatter. The form in which a particular CPU may issue a command or interrogate status is governed by the design of the interface (See Section 2.6 for Interfacing).

3.8.1 COMMAND WORD FORMAT

There are four types of LD Command Words. The contents of bit positions 5 and 6 identify the Command Word type. The detailed formats of each of he four Command Word types are illustrated below. The following text describes the way in which the various Command Words are used and the operations that the Formatter performs in response to the commands.

3.8.2 TYPE 0 COMMAND WORD

This Command Word is used to initiate an Initialize, Read or Write operation on the specified track. The functions defined below are discussed in detail in Section 3.9.1. The TYPE 0 Command Word has the following format:

D0 D1	D2 D3 D4	D5 D6	D7	D8	D9 D10 D11 D12 D13 D14 D15
UNIT	FUNCTION	0 0	DC	I S	TRACK

BIT DESCRIPTION

D0	D1	
		UNIT SELECT
0	0	Selects Logical Drive #0.
0	1	Selects Logical Drive #1.
1	0	Selects Logical Drive #2.
1	1	Selects Logical Drive #3.

D2	D3	D4	
			FUNCTION:
0	0	0	Write Sector with Data Mark $C0_{16}$.
0	0	1	Read Sector.
0	1	0	Write Sector with Data Mark $C2_{16}$.
0	1	1	Initialize Start/Stop.
1	0	0	Write Sector with Data Mark $C1_{16}$.
1	0	1	Read I.D. (Address)
1	1	0	Write Sector with Data Mark $C3_{16}$.
1	1	1	Rezero/Seek.

D5	D6	
0	0	Type 0 Command Word.

D7	DRIVE CONTROL BIT - When set selects Head 1 for Dual Head Drives. Should be 0 with Single Head Drives.
D8	INHIBIT SEEK - (i.e. assume head is already positioned at specified track).
D9 - D15	TRACK 0 Identifies the track to be operated upon ($0-76_{10}$).

3.8.3 TYPE 1 COMMAND WORD

This Command Word is used to specify the sector for a subsequent Read or Write operation; it is normally issued immediately preceding a Type 0 Command Word, but it only needs to be issued when a new sector is specified. The Type 1 Command Word has the following Format:

D0 D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15
UNIT	0	0	0	0	1	0	SECTOR							

BIT DESCRIPTION

D0	D1	
		UNIT SELECT
0	0	Selects Logical Drive #0.
0	1	Selects Logical Drive #1.
1	0	Selects Logical Drive #2.
1	1	Selects Logical Drive #3.

D8 - D15 SECTOR - Identifies the sector for a subsequent Read or Write operation.

3.8.4 TYPE 2 AND TYPE 3 COMMAND WORD

These Command Words are issued only when an Initialize Start/Stop function is in effect. These commands load the high and low order parts, respectively, of a byte count register in the Formatter. The Type 3 Command Word causes the Formatter to enter an Initialize write sequence (discussed in Section 3.9.2). The Type 2 and Type 3 Command Words have the format shown below:

D0 D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15
UNIT	0	0		1	0	0			M	S	B	C		

D0 D1	D2 D3 D4	D5 D6	D7	D8 D9 D10 D11 D12 D13 D14 D15
UNIT	0 0	1 0	0	L S B C

BIT DESCRIPTION

D0 D1 — UNIT SELECT

D0	D1	
0	0	Selects Logical Drive #0.
0	1	Selects Logical Drive #1.
1	0	Selects Logical Drive #2.
1	1	Selects Logical Drive #3.

D5 D6

D5	D6	
1	0	Type 2 Command Word
1	1	Type 3 Command Word

D8 - D15 — MSBC - Specifies the most significant part of the byte count. (Type 2 CMD. Word).

D8 - D15 — LSBC - Specifies the least significant part of the byte count. (Type 3 CMD. Word).

3.8.5 STATUS WORD FORMAT

The Status Word maintained by the Formatter always reflects conditions on the logical Drive selected by the last Command Word issued to the Formatter. The Status Word has the following format:

D0	D1	D2	D3	D4	D5	D6	D7	D8 D9	D10	D11	D12	D13	D14 D15
IF	IX	DC ER	AD ER	SL ER	NR ER	WP ER	IN ER	NOT USED	1	IM	R/W	OL	DMIF

BIT DESCRIPTION

IF (bit 0) — INITIALIZE FLAG: Used during the intialize diskette process; after initialize has been started (function 3). IF is set each time a word of zeros is written on the diskette (16 microseconds).

IX (bit 1) — INDEX BIT: Used for diagnostic and initialization purposes; set on each disk revolution when track Index Hole passes light beam. Remains set for approximately 1.5 milliseconds.

DCER (bit 2) — DATA CHECK ERROR: Set when the CRC failed to compare in the Data Portion of the Record. (See ADER for Header CRC ERRORS.)

ADER (bit 3) — ADDRESS CHECK ERROR: If set, one of the following conditions has occurred:

- An invalid sector number was given in the Sector Command Word.
- An invalid track number was given in the Track Command Word.
- A Head Positioning Error exists in the drive.
- The CRC for the Address ID Record has failed to check.
- The Selected Drive has no diskette inserted.
- No Address Marks were found for a Read ID Command.

SLER (bit 4) — SELECT ERROR: Is set if one of the following conditions occur:

- The Logical drive unit specified in the Command Word is not dialed on any Select Switch.
- More than one switch is dialed to the specified Logical Drive number.
- No drive in the logical selected drive port.

NRER (bit 5) — NO RECORD FOUND ERROR: The Address ID Record for the given sector was successfully found, but there was no Data Record following it; either the diskette was not initialized correctly or a probable hardware malfunction occurred.

WPER (bit 6) — WRITE PROTECT ERROR: A Write operation was attempted on a drive which was Write Protected. Either the diskette is write protected or the WP front panel switch is set, protecting Drive 0.

INER (bit 7) — INITIALIZE ERROR: A Start/Stop Initialize function was given in a Type 0 Command Word and the INIT Switch on the panel is not in the engaged position.

Bits 8 & 9 — NOT USED

1 (bit 10) — Half Height Identifier

IM (bit 11) — INITIALIZE MODE: When True, indicates that the Initialize function is active.

RW (bit 12) — READ WRITE OVERRUN: Indicates failure to service a pending Data Flag prior to a subsequent Data Flag (timing error). In Read operations, it may indicate that the "read" command requested a record length that was less than a full sector size.

OL (bit 13) — ON LINE: When OL = 1, indicates that the selected drive has a diskette installed (label up) and is rotating.

DMID (bit 1415) — DATA MARK ID: Set in response to a Read Sector operation. Identifies the Data mark type present with the Data. The Data ID's are 0 = C0, 1 = C1, 2 = C2, 3 = C3.

3.9 BASIC OPERATIONS

The operations supported by the formatter under program control are as follows:

Rezero/Seek
Diskette Initialization
Read Address ID
Write Sector (4 variation)
Read Sector

The Formatter also supports an Initial Program Load operation, which is activated by engaging the IPL Switch on the Control Panel.

3.9.1 REZERO/SEEK

The Rezero/Seek operation is initiated by issuing a Rezero/Seek Command (Type 0 Command Word with a function field containing 111_2). In response to this command, the controller will return the Read/Write head of the selected drive to Track 00 and then position the head to the track specified in the command. The controller signals the completion of the operation by raising the Device End Status condition.

The Rezero/Seek operation is normally used for diagnostic purposes or in attempting to recover from an Address Check Error. The Inhibit Seek bit is also ignored during this operation.

3.9.2 DISKETTE INITIALIZATION

Before a diskette can be used for information storage, it must be formatted. The formatting process is also called initialization and it need be performed only once per diskette. Most users will purchase diskettes from Evans & Sutherland that are already initialized in a format suitable for their needs. These users need not concern themselves with the initialization process described in this section.

CAUTION

Reinitializing a diskette destroys previously written data.

The initialization process determines the sector formatting and the number of sectors on each track on the diskette. During the initialization of a track, inter-record gaps (zero data bytes), Track/Sector Address I.D.'s and initial sector data records are recorded on the selected track. The size (number of bytes) of the inter-record gaps, the information in the Track/Sector Address I.D.'s and the size and initial content of the sector data areas are all under program control during initialization.

The general format of an initialized track is as follows:

1. Leading Gap (bytes of zero).

2. Address I.D.
   a. 17 bytes of zeros.
   b. $C6_{16}$ Address Mark.
   c. 4 byte Address Field.
   d. 2 byte CRC for Data Field.

3. Sector Area
   a. 17 bytes of zeros.
   b. $C3_{16}$ Address Mark.
   c. Variable Data Field (even number of bytes).
   d. 2 byte CRC for Data Field.

4. Variable Gap (bytes of zeros, Optional)

5. Trailing Gap (to meet leading gap)

To start initialization of a track, the program issues an Initialize, Start/Stop command, (Type 0 Command Word with a function field containing 011_2) (the INIT Switch must be engaged). In response to this command, the Formatter positions the Read/Write head of the selected drive to the track specified in the command. Once positioned at the specified track, Device End is generated. The Formatter begins recording bytes of zeros (i.e., an inter-record gap). Each time the Formatter begins recording the first byte of a two byte pair, it raises the Initialize Flag status indicator. The Formatter lowers the flag when it begins recording the second byte of the two byte pair. Consequently, the Initialize Flag makes a transition approximately every 16 microseconds. The program can sense the flag transitions and therefore regulate the size of the gap.

To initiate each recording of an Address I.D. or a Data Area, the program issues an Initialize Write sequence, which consists of a Type 2 Command Word followed by a Type 3 Command Word. The Type 2 Command Word loads the high order part of a byte count register in the Formatter. The Type 3 Command word loads the low order part of the byte count register and causes the Formatter to enter either a Write Address I.D. or Write Sector Area mode. The first time the initialize Write sequence is issued the Formatter will enter a Write Address I.D. mode.

Thereafter, each time the Initialize Write sequence is issued, the Formatter will alternate between the two modes; this allows the recording of an Address I.D., followed by a Sector Area, followed by an Address I.D., followed by a Sector Area, etc.

When the program has counted off the desired leading gap, it issues an Initialize Write sequence to write the first Address I.D. The byte count register must be loaded with the size of the Address Field in the Address I.D. which in all cases is 4. Thus, the Type 2 Command Word must specify the high order part of the byte count to be 0 and the Type 3 Command Word must specify the low order part of the byte count to be 4. In response to this sequence, the Formatter will:

1. Record 17 bytes of zeros.
2. Record $C6_{16}$ Address Mark.
3. Request the four bytes (two words) of the address Field from the Computer and record them as they are supplied.
4. Record the two byte CRC that the controller has accumulated for the address Field.
5. Signal the Device End Status condition.
6. Resume recording bytes of zeros (i.e. gap).

The four byte (two word) Address Field that the program must supply has the following format:

D0 D1 D2 D3 D4 D5 D6 D7	D8 D9 D10 D11 D12 D13 D14	D15
TRACK	LOSS	HD

D0 D1 D2 D3 D4 D5 D6 D7	D8 D9 D10 D11 D12 D13 D14 D15
SECTOR	HOSS

Please note a positive byte count.

Where:

TRACK — Must contain the current track number.

LOSS — Contains the low order part of the number of bytes in the sector Data Field that is to follow. (D14 equals 2 bytes)

HD — Contains the current head selection bit. Must be zero for a single head drive.

SECTOR — Contains the sector number that will be used to identify the sector Data Field that is to follow.

HOSS — Contains the high order part of the number of bytes in the Sector Data Field. (D15 equals 256 bytes.)

The concatenation of HOSS and LOSS specifies the number of bytes in the Data Field of the sector Data Area that is to follow. HOSS-LOSS contents are interpreted literally.

After receiving the Device End indication, the program must then issue Type 2. Then a Type 3 Command automatically provides a 17 byte gap. The program issues another Initialize Write sequence to write the Sector Area. The byte count specified in this Initialize Write sequence must be the same as the count that was recorded in the previous Address Field, as this count determines the actual size of the sector Data Field. In response to this sequence, the Formatter will:

1. Record 17 bytes of zeros.
2. Record $C3_{16}$ Data Mark.
3. Request the number of bytes specified in the byte count, from the computer and record them in the Data Field.
4. Record the two byte CRC that the controller has accumulated for the Data Field.
5. Signal the Device End Status condition.
6. Resume recording bytes of zeros (i.e., gap).

The program alternates between writing Address I.D. and Sector record (i.e., one diskette revolution). The program then issues another Initialize Start/Stop command, which turns off the initialization for the current track. Any Type 0 Command will terminate the initialization.

Each track on the diskette is initialized using the procedure described above. this procedure is represented in the flow chart in Figure 3-5. Note that the sensing of the Index status condition is optional. Many drives require Index to identify dual sided media and will lock out any operation to the second side of standard single sided media.

By using the following formulas the programmer may design a track format that is suitable for this application.

3.10 DISK CAPACITY

Theoretical maximum number of 16 bit words/track is 5208.33.

Computation is:

$$\frac{1 \text{ Second}}{6 \text{ Revolutions of Diskette}} \times \frac{1 \text{ (16 Bit Word)}}{32 \times 10^{-6} \text{ Second}} = 5208.33 \text{ (16 bit words)}$$

Assuming a 1-5% high speed variation in disk rotation speed the maximum number of 16 bit words/track is reduced to:

5208.33 x 98.5 % = 5130 (16 Bit Words/Track)

3.10.1 HALF HEIGHT TRACK FORMAT

GAP 17 BYTES	ADDRESS 7 BYTES	GAP 17 BYTES	DATA MARK 1 BYTE	RECORD N BYTES	CRC 2 BYTES

OVERHEAD:

44 BYTES OVERHEAD + N BYTES = # BYTES/SECTOR

WRITE OVERHEAD =

GAP 16 BYTES	DATA MARK 1 BYTE	CRC 2 BYTES

= 19 BYTES

ADDITIONAL WRITE OVERHEAD @ 1.5% HIGH SPEED = 1.5% (N + 19)

TOTAL OVERHEAD = 17 + 7 + 17 + 1 + 2 + 1.5% (N + 19)

TOTAL OVERHEAD=44 BYTES + 1.5% N BYTES + 1.5% 19=45 BYTES=1.5% N BYTES

TOTAL OVERHEAD (22.5 TWO BYTE WORDS + 05N TWO BYTE WORDS)

RECORD SIZE: (See Table 1-2 for some Common Formats and Capacities)

Total Record Size = (n + 22.5 + .05n) Two Byte Words = 1.05n + 22.5

S = NUMBER OF SECTORS/TRACK = # WORDS/SECTOR

$$S = \frac{10,259}{N + 44.5\ S}$$

$$N = \frac{10,259 - 44.5}{S}$$ = MAXIMUM NUMBER OF 16 BIT DATA WORDS/SECTOR

The initialization procedure is considered an attended operation. The programmer should provide detailed operator instructions with his "Diskette Initialization" Program. The INIT Switch on the Control Panel must be in the up position in order for the Formatter to accept the Initialize Start/Stop command. If the INIT Switch is down, an "Initialize Error" will be reported in the Status Word after the command is issued.

3.11 READ ADDRESS ID

The Read Address I.D. operation is initiated by issuing a Read Address I.D. Command (Type 0 Command Word with a function field containing 101_2). In response to this command, the Formatter will:

1. Position the read/Write Head of the selected drive to the specified track.
2. Begin reading information until encountering a $C6_{16}$ Address Mark.
3. Read the 4 bytes (2 words) of the address Field and requires the computer to accept them as they are read.
4. Signal the Device End Status condition.

The Read Address I.D. function is used mainly for diagnostic purposes.

3.11.1 WRITE SECTOR

The Write Sector operation is initiated by issuing a two-command sequence. The first command specifies the sector on which data is to be written (Type 1 Command Word). The second command specifies the track and initiates the operation (Type 0 Command Word).

There are four variations of the Write Sector operation, which differ only in the Data Mark that the Formatter records immediately preceding the data. The contents of the function field in the Type 0 Command Word format in Section 2.2).

The user may attach any significance he desires to the four possible Data Marks: $C0_{16}$, $C1_{16}$, $C3_{16}$. Note that during Initialization the Formatter always records a $C3_{16}$ Data Mark; however, a subsequent Write Sector operation can specify any of the four possible Data Marks.

In response to the Write Sector command sequence, the Formatter will:

1. Position the Read/Write Head of the selected drive unit to the track specified in the Type 0 Command Word.

2. Begin reading Address Fields (as marked by $C6_{16}$ Address Marks) until finding the Address Field for the desired track/sector or determining that a Address Check Error condition has occurred.

3. Having found the desired Address Field, read the high and low order parts of the sector byte count and verify the Address Field's CRC error code.

4. Write 17 bytes of zero.

5. Write the Data Mark specified by the Type 0 Command Word $C0_{16}$, $C1_{16}$, $C2_{16}$, $C3_{16}$.

6. Request the computer to supply data words as required and record the data bytes until the sector byte count, which was read in Step 3, is satisfied.

7. Record the accumulated two-byte CRC error for the data.

8. Signal the Device End Status condition.

If the computer fails to supply a data word within the required time, the Formatter will fill the remaining portion of the sector with the last data word that was transferred, then indicate the R/W overrun status.

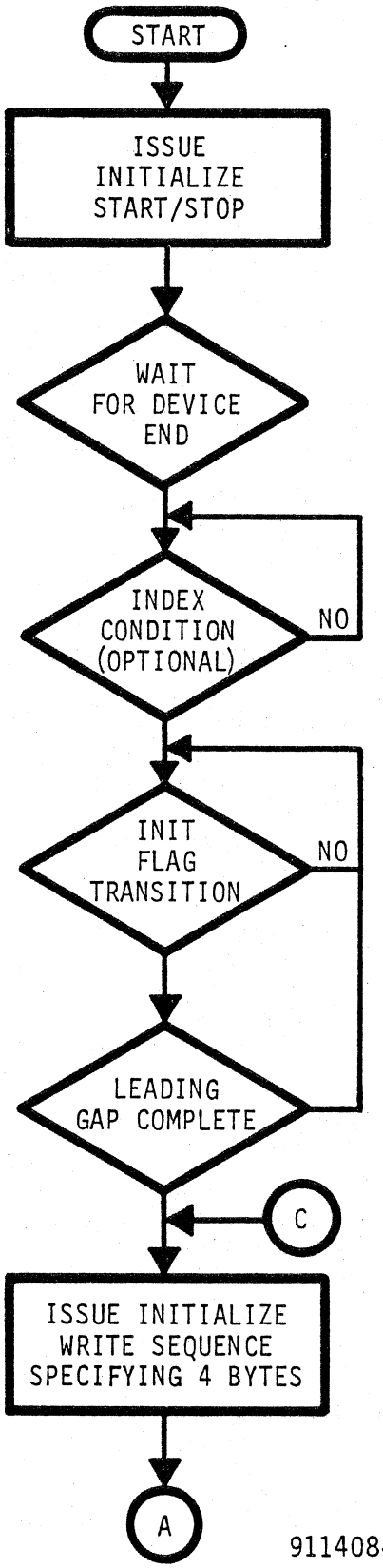


FIGURE 3-5 (SHEET 1 OF 3)
FLOW CHART FOR INITIALIZATION OF ONE TRACK

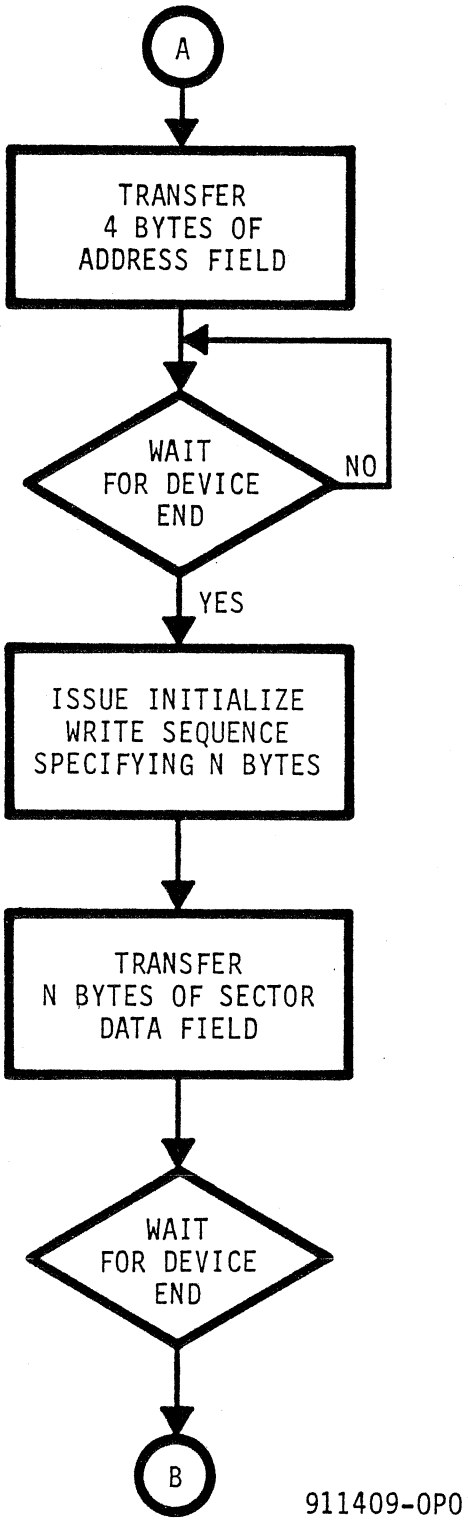


FIGURE 3-5 (SHEET 2 OF 3)
FLOW CHART FOR INITIALIZATION OF ONE TRACK

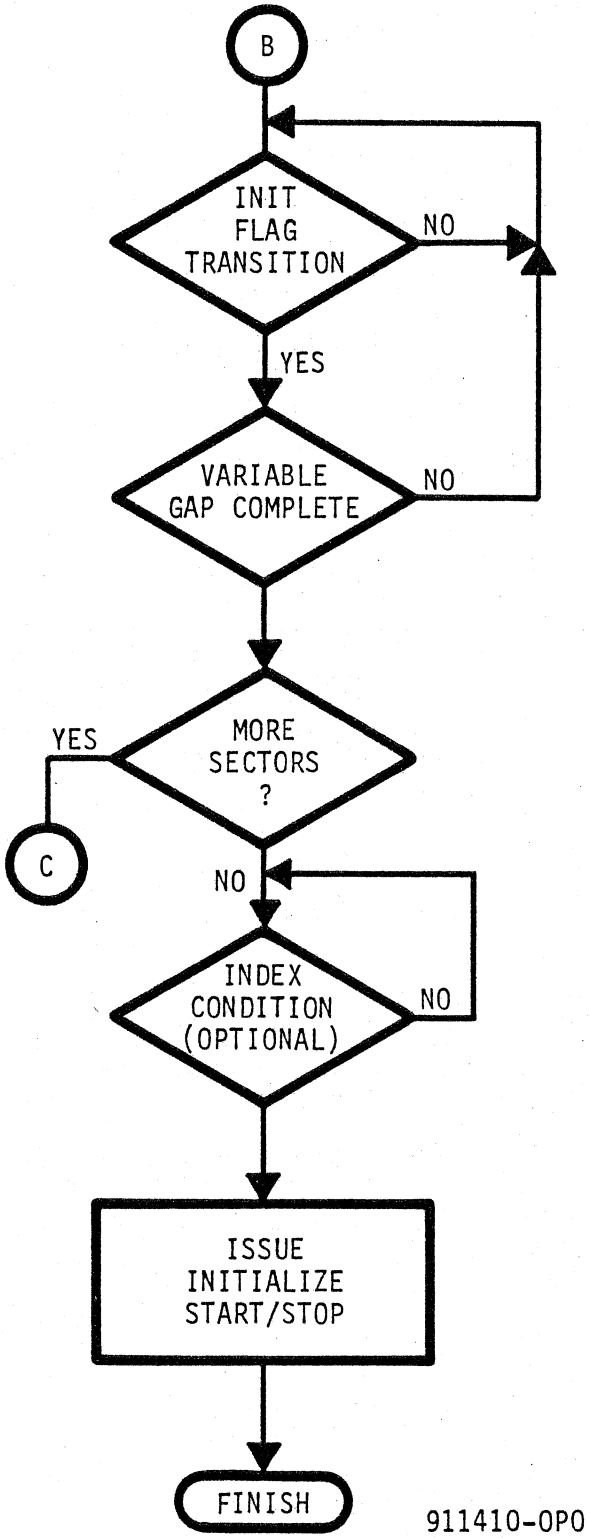


FIGURE 3-5 (SHEET 3 OF 3)
FLOW CHART FOR INITIALIZATION OF ONE TRACK

3.11.2 READ SECTOR

The Read Sector operation is initiated by issuing a two-command sequence. The first command specifies the sector from which data is to be read (Type 1 Command Word). The second command specifies the track and initiates the operation (Type 0 Command Word with a function field containing 001_2).

In response to the Read Sector Command sequence, the Formatter will:

1. Position the Read/Write Head of the selected drive unit to the track specified in the Type 0 Command Word.

2. Begin reading Address Fields (as marked by $C6_{16}$ Address Marks) until you find the Address Field for the desired track/sector or you determine that an Address Check Error condition has occurred.

3. Having found the desired Address Field, read the high and low order parts of the sector byte count and verify the Address Field's CRC error.

4. Read zeros until encountering a Data Mark ($C0_{16}$, $C1_{16}$, $C2_{16}$, or $C3_{16}$).

5. Store the least significant 2 bits of the data mark into the status Data Mark ID bit.

6. Read data words and request the computer to accept them until exhausting the sector byte count.

7. Read and verify the two-byte CRC error for the Data Field.

8. Signal the Device End status condition.

If the computer fails to accept a data word within the required time, the Formatter will cease making requests to the computer. However, the controller will read the remainder of the Data Field and verify the CRC. Read/Write overrun (bit 12 of status word) will be set.

At the completion of the operation, the program may determine which Data Mark accompanied the Data Field by examining the Data Mark I.D. in the Status Word (See Section 3.8). The program can also check the Data Check Error condition to see if the data it received was valid.

3.12 INITIAL PROGRAM LOAD (IPL)

The Formatter enters the Initial Program Load sequence when the IPL Switch on the Master Control Panel is manually engaged. The Formatter performs the same sequence it would perform if it were issued a read command sequence for Sector number 0, Track 00 on Logical Drive 0. NOTE: For Dual Headed Drives the IPL is accomplished from Head 0. The CPU need not issue any commands to the Half Height; however, the CPU computer must be capable of accepting data.

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SECTION 4

THEORY OF OPERATION

4.1 INTRODUCTION

This section describes the operation of the Formatter and Drive Electronics at the block level (Figure 4-1).

4.2 CONTROLLER ORGANIZATION

The Controller consists of a Formatting Section and one to four identical Drive sections. The Formatting Section is implemented on one large PC Board (Formatted Board). Sections are implemented on a smaller PC Board (Drive Electronics Board). Both the Formatter Board and the Drive Electronics Board are housed in the Half Height Cabinet as described in Section 5.

4.2.1 FORMATTING SECTION

The Formatting Section controls the transfer of information with the CPU, drive selection, Write and Read Timing, Data Formatting and Error Checking. Figure 4-2 identifies the following functional areas within the Formatting section.

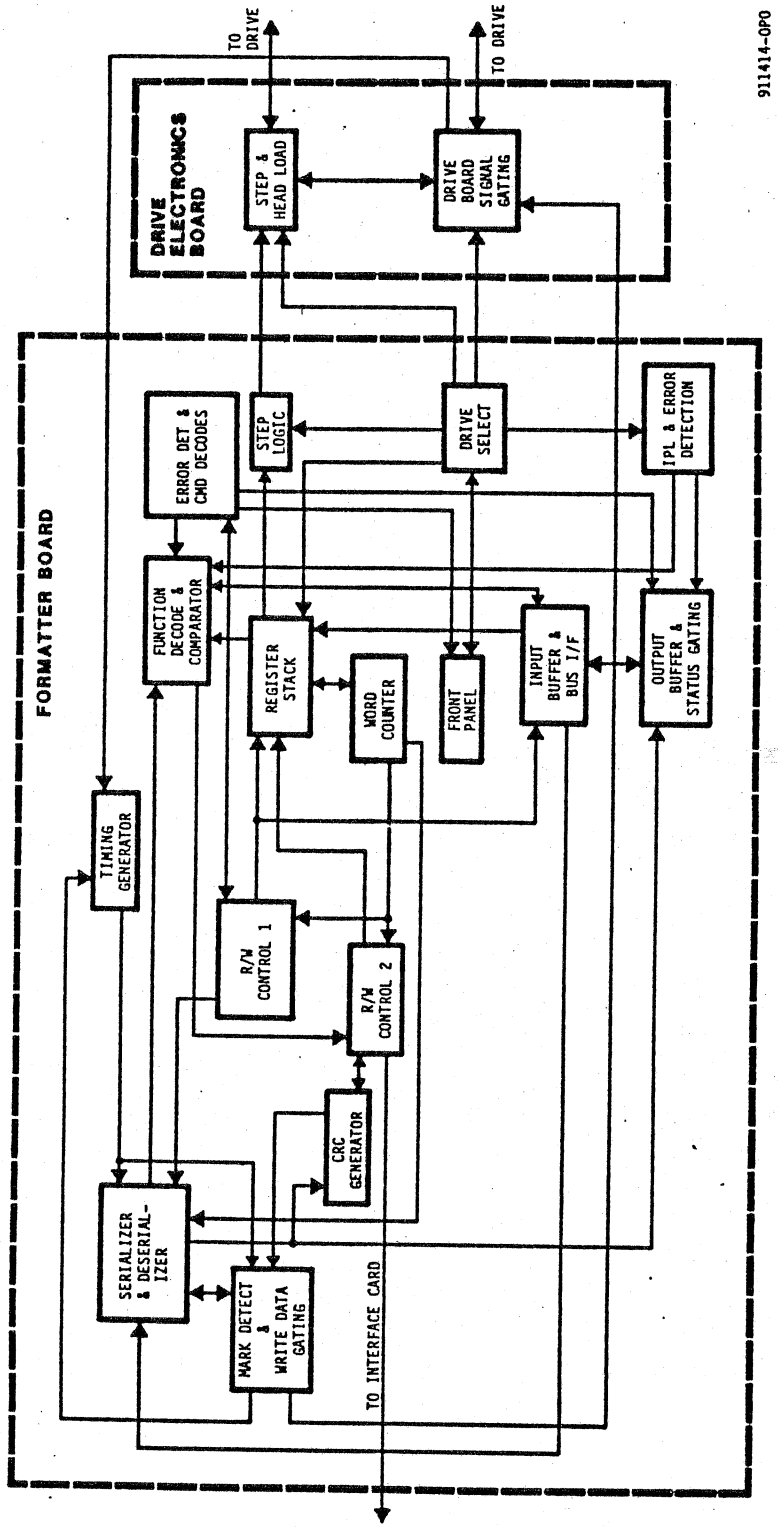


FIGURE 4-1 (SHEET 1 OF 2)
FORMATTER AND DRIVE FUNCTIONAL SCHEMATIC

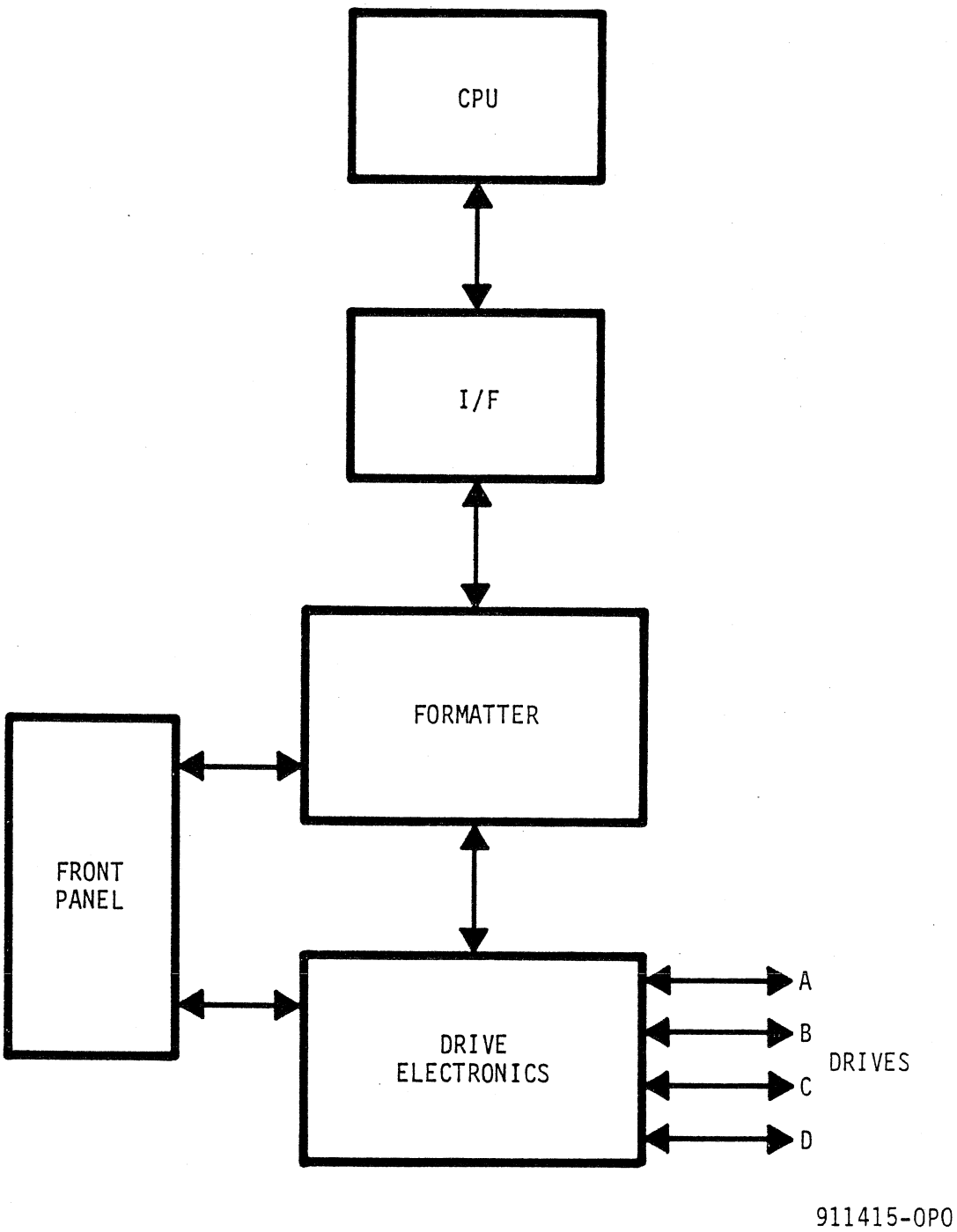


FIGURE 4-1 (SHEET 2 OF 2)
FORMATTER AND DRIVE FUNCTIONAL SCHEMATIC

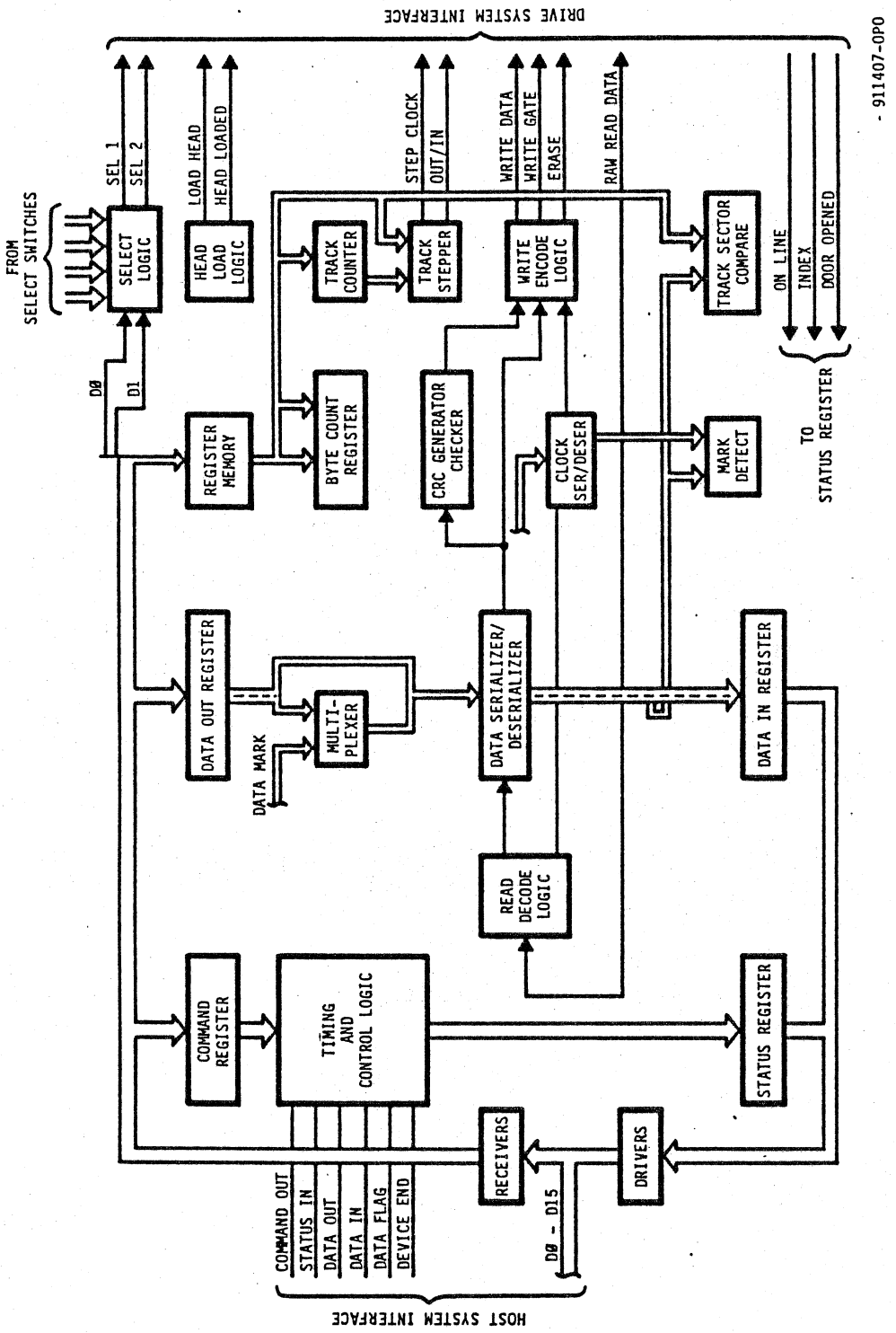


FIGURE 4-2
FORMATTER BOARD DIAGRAM

USER INTERFACE - consists of 16 bidirectional Data Lines Command Out, Status In, Data Out, Data In, Device End, IPL, Power Reset and Device Available.

RECEIVERS AND DRIVERS - used for the user interface signals.

COMMAND REGISTER - used for latching and decoding Type and Function bits in the Command words.

DATA OUT REGISTER - used for latching and decoding Type and Function bits in the Command words.

DATA IN REGISTER - used for latching Data Words sent by the user system.

REGISTER MEMORY - holds four bytes of information for each physical drive (current track number, sector number, high order record byte count, low order record byte count).

MULTIPLEXER - selects either the low order byte of the Data Out Register or a Data Mark into the low order byte position of the Data Serializer/Deserializer.

DATA SERIALIZER/DESERIALIZER - performs parallel to serial conversion for Write and serial to parallel conversion for Read.

CLOCK DESERIALIZER - deserializes clock pattern that accompanies Address and Data Marks.

MARK DETECT - monitors bit pattern in Clock Deserializer and low order byte of Data Serializer/Deserializer to detect Data and Address Marks.

CRC GENERATOR/CHECKER - performs Cyclic Redundancy Check (CRC) generation and checking for Address Fields and Data Fields.

READ DECODE LOGIC - decodes raw Read Data into clock and Data bits. These bits are fed into the clock Deserializer and Data Serializer/Deserializer.

WRITE ENCODE LOGIC - encodes clock and data bits into raw Write Data.

WORD COUNT REGISTER - holds the high and low order bytes of the record byte count and is decremented to zero during a Read and Write operation.

TRACK COUNTER - holds the current track number for the selected drive and is incremented or decremented during a Seek operation.

TRACK STEPPER - compares the current track number with the desired track number and generates track positioning sequences.

TRACK/SECTOR COMPARE - verifies the track and sector during a Read or Write operation.

STATUS REGISTER - incorporates the various condition latches within the Formatting and Drive sections that constitute the Status Word.

SELECT LOGIC - performs selections and Select Error detection; converts the logical to a physical address.

HEAD LOAD LOGIC - controls Read/Write head loading and unloading.

TIMING AND CONTROL LOGIC - provides timing and control functions for the Formatting section.

4.2.2 DRIVE SECTIONS

There is one Drive Section for each physical drive unit in the system. A Drive Section provides an interface between its drive unit and the Formatting section. The Drive sections are connected to the Formatting section by a common bus; however, only the selected Drive section communicates with the Formatting section during an operation.

Figure 4-3 identifies the following functional areas on the Drive Board (only components of the Drive section for Drive A are illustrated):

SELECT DECODE - decodes Sel 1 and Sel 2 into Drive A, B, C and D for use on the Drive board.

DEMULTIPLEXERS - routes Write signal to the selected Drive section.

MULTIPLEXERS - routes signals from the selected Drive section to Formatting section.

WRITE COMPENSATION - compensates for Data Bit shift.

HEAD POSITIONING AND LOADING LOGIC - controls the positioning and loading of the respective drive unit's Read/Write head.

ON-LINE LOGIC - maintains the ON-Line indicator for the respective drive unit.

DRIVERS AND RECEIVERS - for drive unit interface signals.

4.3 OPERATIONAL PHASES

The following subsections describe the various operational phases that characterize Read, Write and Initialize sequences as performed by the Formatter.

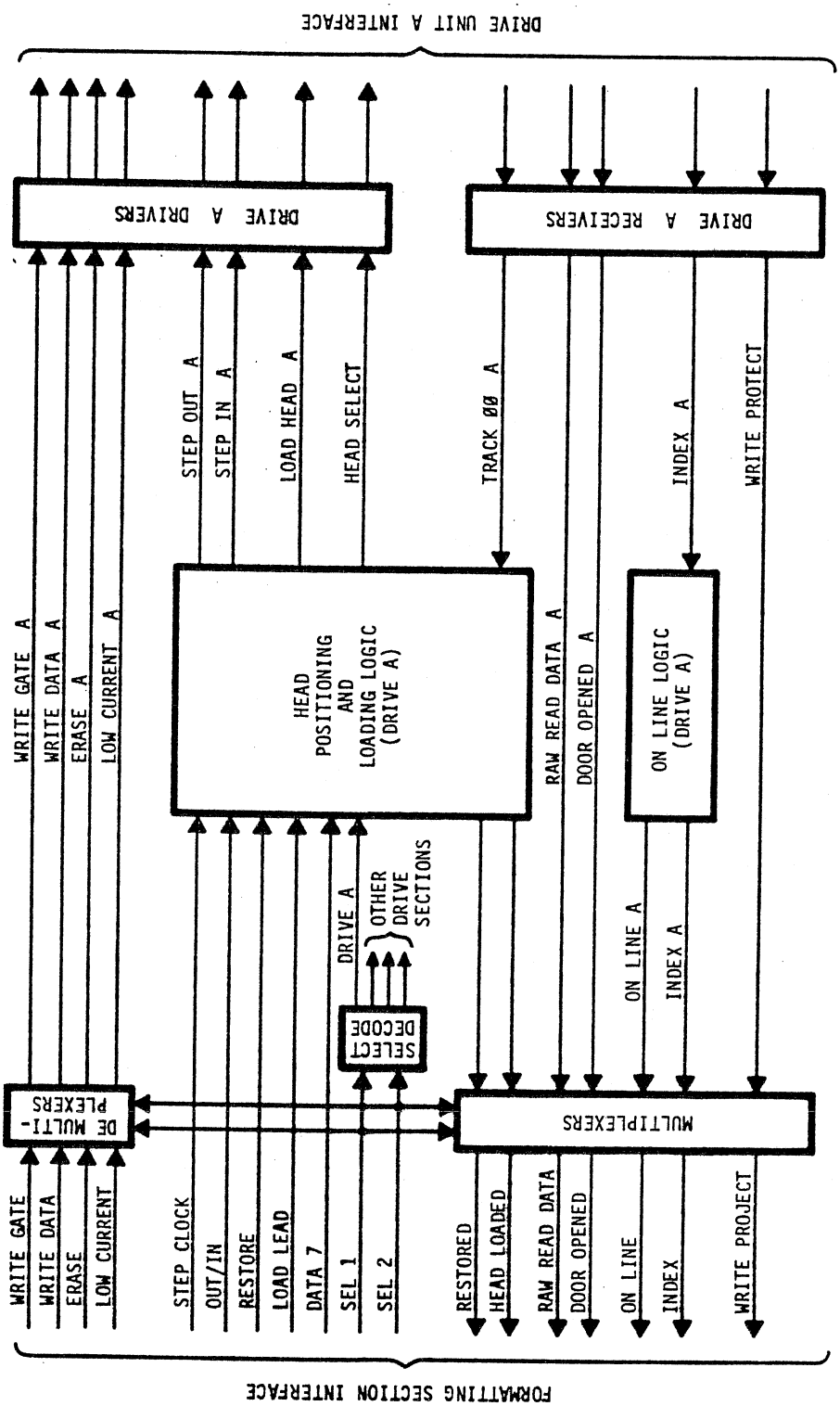


FIGURE 4-3
DRIVE ELECTRONICS BOARD
FUNCTIONAL DIAGRAM

4.3.1 RESET AND RESTORE

When power is applied to the unit, Formatting and Drive Electronics are reset. The Restore Latch in each Drive Section is set, which causes a Step Out sequence to take place on each drive. The Step Out sequence continues on each drive until the respective Read/Write head is positioned to Track 00, which causes the Restore Latch to be reset.

4.3.2 STATUS IN

When Status In is activated by the interface, the contents of the latches that constitute the Status Word are gated onto the 16 bidirectional data lines. The Index Flag, and the On-Line Flag are provided by the physical Drive Section that was last selected by a Command Word.

4.3.3 COMMAND OUT, DRIVE SELECTION AND LOAD REGISTER MEMORY

To initiate a Formatter operation, the Interface gates a Command Word onto the 16 bidirection Data Lines and activates Command Out. When Command Out is activated, Device End and all Status Error Latches in the Formatting Section are reset. While Command Out is active, the Select Logic compares the Select Switch settings for each Drive with D0 and D1, which are the Select code bits in the Command Word. If the Select Code matches more than one Select Switch setting or no Select Switch setting, the Select Error Latch is set. A Select Error causes Device End to be set and the operation is terminated.

The Register Memory can hold sixteen bytes of information four bytes for each physical drive. Each of the four Command Word types carries with it one byte of information; they must be loaded into the appropriate Register Memory location for the selected drive.

During Device selection, the contents of the low order byte of Command Word are loaded into the appropriate Register Memory cell. In the case of a Type 0 Command Word (which carries a track number), the old contents of the appropriate Register Memory location (current track position of selected drive) must be transferred to the Track Counter before the new track number is loaded into the Register Memory.

The sole function of Type 1 and Type 2 Command Words is to load a sector number and a high order part of a record byte count into the Register Memory. In addition to loading the Register Memory, Type 0 and Type 3 Command Word initiate an operation.

4.3.4 POSITION AND LOAD READ/WRITE HEAD

All Type 0 Command Words imply a Seek operation. During selection, the Track Counter is loaded with the current track number (i.e., current head position) of the selected drive, and the Register Memory is loaded with the desired track number. The Track Stepper Logic compares the contents of this location in the Register Memory with the contents of the Track Counter. The Track Stepper generates either Step In or Step Out pulses. It provides step and direction signals if the two track numbers are not equal. For each Step the Track Counter is incremented or decremented and the Read/Write head of the selected drive is moved one track in or out.

When a drive is selected for an operation, the Head Load Logic for the selected drive generates a signal to the drive that causes the head to be loaded (load arm pushes the media against the head).

4.3.5 ADDRESS VERIFICATION

An Address Verification is performed for every Read and Write operation. The Address Verification involves reading Address I.D. Fields from the selected Drive section, after the head has been positioned and loaded, until finding an Address I.D. that contains a track and sector number that agrees with the track and sector number of the desired record.

4.3.6 INITIALIZE START/STOP

When the Controller receives a Type 0 Command Word that specifies an Initialize Start/Stop function, it will accept the command only if the INIT Switch on the Control Panel is engaged. Accepting the command involves Device Selection, loading the Track Counter and loading the Register Memory as described in Section 3.

The command toggles an initialize flip-flop in the Formatter. When the Initialize flip-flop is set, the Initialize function is in effect. Thus, each time the Initialize Start/Stop command is issued, the Initialize function is alternately started or stopped.

When the Initialize function is in effect, the Timing and Control Logic clocks the Data Serializer/Deserializer and Data words of zero are recorded on the selected drive. The Timing and Control Logic toggles the Initialize Flag in the Status Word for each zero data byte recorded. The Initializer Flag allows the CPU to count the number of zero bytes recorded and thus regulate the size of inter-record gaps.

While the Initialize flip-flop is set, the Formatter is in a mode to accept Initialize Write commands. This causes Address I.D.'s and Data Records to be alternately recorded on the current track, as described in the next section.

4.3.7 INITIALIZE WRITE

While an Initializer Start/Stop function is in effect (i.e., the Initialize flip-flop is set), an Initialize Write command (Type 3 Command Word) may be issued to cause the Formatter to alternately record an Address I.D. or a Data Area.

The Byte Count Register is loaded from the Register Memory with the high and low order parts of the Record Byte Count for the Address or Data Field to be recorded. (The Register Memory must have been previously loaded with the high order part of the byte count by a Type 2 Command Word. The Register Memory was loaded with the low order part of the byte count by the current Initialize Write command, which is a Type 3 Command Word.)

The Timing and Control Logic counts out 17 bytes of zero, which are shifted out of the Serializer/Deserializer through the Write Encode Logic. Then, either an Address Mark ($C6_{16}$), or Data Mark ($C3_{16}$) byte is gated through the Multiplexer into the Serializer/Deserializer. The data and clock patterns are shifted through the Write Encode Logic and a Mark byte is recorded on the medium.

Data bytes are recorded immediately following the Mark byte. For each byte pair transferred, a Data Out cycle is required. The Timing and Control Logic activates Data Flag. The interface puts a Data Word onto the 16 bidirectional Data Lines and activates Data Out. Data Out loads the Data Out Register and indicates to the Timing and Control Logic that a Data Word is present. The leading edge of Data Out clears Data Flag. When the Serializer/Deserializer has shifted out a Data Word, the Data Word in the Data Out Register is latched into the Data Serializer/Deserializer. The Timing and Control Logic again activates Data Flag since the Data Out Register is now available. Data Out cycles continue until the Byte Count Register is decremented to zero.

Having counted out enough data byte pairs to fill the Address Field or the Data Field (as the case may be), the contents of the CRC Generator/Checker are shifted out through the Write Encode Logic. Device End is activated and the current Initializer Write phase is complete. The Formatter continues shifting out words of zero and toggling the Initialize Flag since the Initialize flip-flop is still set.

The CPU will ordinarily continue to issue Initialize Write commands to alternately record Address I.D.'s and Data Field until the entire track is initialized. The CPU will then issue another Initialize Start/Stop command to clear the Initialize flip-flop and thereby terminate the recording of bytes of zero.

4.3.8 WRITE DATA MARK, DATA AND CRC WORD

After the Address verification, the Read/Write head of the selected drive will be positioned behind the Address I.D. for the sector that is to be written. Also, the Register Memory will contain the high and low order parts of the record byte count (which determines the number of data bytes that will be written).

The Timing and Control Logic counts out 17 bytes of zero. A Data Mark pattern is gated through the Muiltiplexer into the Data Serializer/Deserializer (certain bits of the Data Mark come from the Write Command Word) that identifies the four possible Data Marks. The high and low order parts of the Byte Count Register are loaded from the Register Memory.

After the Data Mark is shifted out, data byte pairs (two data bytes equal one Data Word) are recorded. For each Data Word transferred, a Data Out cycle is required. The Timing and Control Logic activates Data Flag. The interface puts a Data Word onto the 16 bidirectional Data Lines and activates Data Out. Data Out loads the Data Out Register and indicates to the Timing and Control Logic that a Data Word is present.

The leading edge of Data Out clears Data Flag. When the Data Serializer/Deserializer has shifted out the Data Mark or a Data Word, the Data Word in the Data Out Register is loaded into the Data Serializer/Deserializer. The Timing and Control Logic again activates Data Flag since the Data Out Register is now available. The Data Flag and Data Out Sequence will continue until the full sector has been written. The Data Flag generation will be terminated early if the CPU computer interface does not respond within 32 microseconds. At this time the Read/Write overrun will be set and the rest of the sector will be filled with the last data word transferred. The Timing and Control Logic continues to clock the Serializer/Deserializer until the rest of the data record is filled with data words or the last word received (i.e., the byte count register equals zero). In either case the CRC character will be appended to the data field.

If a match occurs, the next byte of the Address Field, which is the high order part of the record byte count, is shifted into the Data Serializer/Deserializer. It is then latched into the Data In Register and finally loaded into the appropriate position in the Register Memory.

The sector number byte of the Address Field is shifted in and compared with the desired sector number, which is stored in the Register Memory. If the comparison fails, then searching continues for the next Address Mark byte and the above process is repeated. If the sector numbers match, the final byte of the Address Field, which is the low order part of the record byte count, it is then shifted into the Data Serializer/Deserializer. It is then latched into the Data In Register and finally loaded into the appropriate position in the Register Memory.

After the Address Field has been shifted into the Serializer/Deserializer and the CRC word has been shifted through, the CRC Generator/Checker should contain all zeros. If the CRC verification is successful, the Formatter will enter the Read or Write Data phase of the operation. If the CRC verification fails, for the correct Address Field the Address Check Error, Seek Error and Device End are set.

Having counted out enough Data Words to fill the data space, the CRC word from the CRC Generator/Checker is shifted out. Device End is activated and the Write operation is complete.

4.3.9 READ DATA MARK, DATA AND CRC WORD

After the Seek verification, the Read/Write head of the selected drive will be positioned after the Address I.D. for the sector that is to be read. Also, the Register Memory will contain the high and low order parts of the record byte count (which specifies the number of data bytes in the sector to be read).

The Timing and Control Logic continues to shift data and clock bits into the Data and Clock Deserializer until a Data Mark pattern is detected. Two bits of the Data Mark pattern are latched into the Status Words flip-flop. By doing this the CPU may later determine the type of Data Mark that accompanied the Data record by examining the Status Word. The high and low order parts of the Byte Count Register are loaded from the Register Memory.

When a Data Word has been shifted into the Data Serializer/Deserializer, the Data Word is loaded into the Data In Register, and Data Flag is activated. When the interface is ready to accept a Data Word, it activates Data In, which gates the contents of the Data In buffer onto the 16 bidirectional data lines and clears Data Flag. This cycle is repeated for each Data Word transferred. If the interface fails to activate Data In, the Timing and Control Logic generates Read Write overrun and continues to shift Data Words through the Data Serializer/Deserializer so the CRC Generator/Checker can accumulate the CRC Word for the entire record.

When the Byte Count Register has been decremented to zero, the CRC word is shifted through the Data Serializer/Deserializer. At this point, the CRC Generator/Checker should obtain all zeros, Device End is activated and the Read operation is satisfactorily complete. If the CRC Generator/Checker does not contain all zeros, Data Check error is set signifying an unsatisfactory Read operation.

SECTION 5

MAINTENANCE

5.1 INTRODUCTION

This section describes the cleaning, maintenance, troubleshooting and calibration of the Half Height disk drive. It also describes the operation and functions of the diagnostic programs.

5.2 PREVENTIVE MAINTENANCE SCHEDULE

The Electronics in the Half Height Systems require no preventive maintenance. The Disk Drives require minimal preventive maintenance and cleaning every six months providing the environment is reasonably dust free. For dirty environments, increased frequency of maintenance is required.

Mechanical maintenance is limited to cleaning and visual inspection with replacement of worn parts every 6000 power-on hours.

The main operations to be performed are:

Disk Drive Cleaning

Periodic Service Inspection

E&S Half Height Drive Calibration and Alignment Verification

Disk Drive Troubleshooting

5.2.1 DISK DRIVE CLEANING

The drives should be cleaned every six months as outlined below.

CAUTION

Do not attempt to clean the disk slot or the read/write heads in the E&S Half Height head/carriage assembly. The heads and head support springs are extremely delicate and easily lose their performance characteristics if tampered with.

1. Eject the disk, if installed.
2. Follow the subassembly removal in Section 5.8 to gain access to the drive's interior.
3. Detach the (J1) and DC (J5) connectors from the unit. (See Figure 5-3.)
4. With the drives removed gently blow and brush accumulated dust and lint from the drives, boards, spindle drive motor and surrounding area. (Use a soft camel-hair or other suitable soft brush.)
5. Be sure to leave the drive free from lint.

5.3 MECHANICAL MAINTENANCE

Mechanical maintenance consists of replacement of worn or failed parts during inspection. Refer to Section 5.8 for removal and replacement procedures.

Use the troubleshooting procedures in Section 5.5 and/or the diagnostics in Section 5.6 to isolate malfunctions then follow the corrective procedures.

5.3.1 PERIODIC SERVICE INSPECTION

A periodic service inspection should be performed every 6000 power-on hours. This inspection should include the following:

1. Check the entire drive unit for dirt, corrosion or any evidence of wear or binding.
2. Check for loose components or connectors.

3. Re-tighten loose screws, but be careful not to change the setting of adjustment screws, especially in the head/carriage and carrier assembly areas.

4. Inspect the spindle drive belt and replace it if any evidence is found of fraying, cracking or other weakened areas.

5. Replace parts which show evidence of wear or binding; refer to Section 5.8 for removal and replacement procedures as required.

CAUTION

The head/carriage assembly in the E&S Half Height is factory adjusted and tested and is not field serviceable. Do not, for any reason, attempt to make reapirs or internal adjustments on this assembly, or clean the R/W heads. This can cause severe damage to the head surfaces or to the recording media.

NOTE

Periodic adjustments are not required under normal operating conditions.

5.3.2 GENERAL TEST INFORMATION

The following general information concerning diskettes and waveform generation are helpful in understanding the maintenance test procedures.

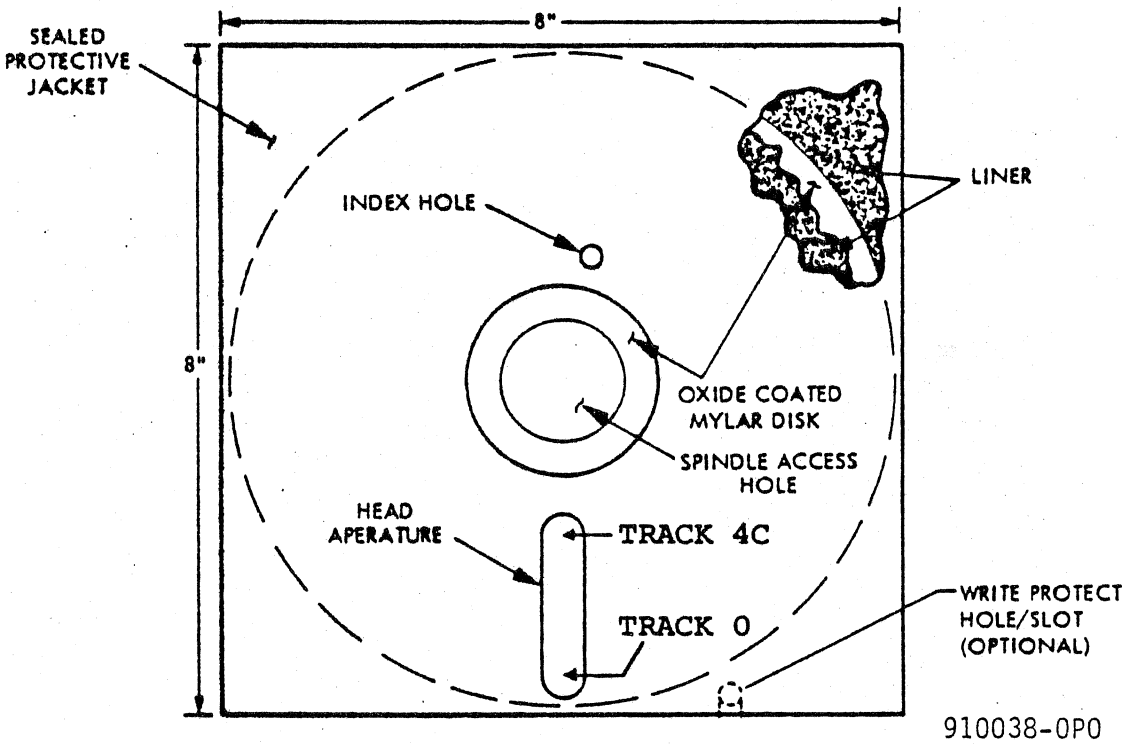


FIGURE 5-1
STRUCTURE OF FLOPPY DISKETTE

5.3.2.1 DISKETTE TRACKING

The diskette tracks (see Table 5-1 and Figure 5-1) are numbered hexidecimally from 0 to 4C, with 0 the outer and 4C the inner track. The following tracks on the Dysan alignment diskette are used by the alignment procedures:

TABLE 5-1
DISKETTE TRACKS

TRACK	CONTENTS	PRIMARY USE
0	Data track	Compliance, read amp gain
1	Burst marks	Skew alignment
26	Cat's-eye pattern	Head alignment
4C	Burst marks	Skew alignment

5.3.2.2 WAVEFORM GENERATION

All of the oscilloscope waveforms in these procedures are generated by using the index hole (see Figure 5-1) sensor signal as a sweep trigger. The waveforms displayed are the amplified output of the read/write head. The index hole is a physical hole punched through the Mylar diskette; the index hole sensor is an LED/phototransistor assembly. Because these waveforms are mechanically- generated, slow-trigger-rate signals, they tend to be unstable and require extra care to read.

5.4 ALIGNMENT VERIFICATION

The Evans & Sutherland Half Height Disk Drive unit may contain interchangeable disk drive components from any one of three different vendors; Qume, YD Data, or Mitsubishi. The alignment verificaton procedures for the different vendor components are not identical. These different procedures are presented in sequence in the following paragraphs. First Qume, then YD Data, and finally Mitsubishi.

5.4.1 QUME DISK DRIVE

This section describes service and alignment procedures for the Qume disk drives contained within the floppy disk unit. Misalignment of this key unit can affect the performance of the entire system. Table 5-2 lists the tools and test equipment needed for system checks. This section contains the following procedures:

1. Mechanical and Electrical Test Setup
2. Load System Monitor
3. Power tests
4. Index Lamp and Sensor Alignment Check
5. Index Timing
6. Drive Assemblies Service Checks
7. Head Load Time Check
8. Read Write Head Amplitude Check
9. R/W Head Azimuth Check
10. Head/Carriage Assembly Radial Alignment

5.4.1.1 MECHANICAL AND ELECTRICAL TEST SETUP

Some of the following procedures were adapted from the disk drive maintenance manual to make them directly usable with the system. They are not all-encompassing; if running them does not solve a particular disk drive problem, then consult the vendor disk drive maintenance manual for further guidance.

This procedure establishes the system and test equipment setup required by the rest of the procedures in this section.

STEP	INSTRUCTION	RESPONSE
Steps 1-5:	Disk drive mechanical test setup	
1.	Turn A/C power OFF at the back of the Half Height unit.	Power light on the front of the drive goes OUT.

2.	CAUTION: avoid damage to ribbon cables during this step. Pull the Half Height unit out of the rack as far as its chassis slide rails will allow.	Chassis slide rails lock in the out position.
3.	Remove, from the bottom of the Half, Height the 4(four) Phillip's-head screws that hold the disk drive inside the Half Height unit.	No response
4.	CAUTION: Avoid damage to ribbon cables during this step. Push the Half Height unit completely back inside the rack (chassis slide lock release levers are located on the side of each chassis rail).	No response
5.	CAUTION: With the screws removed, the Qume drive can fall completely free of the Half Height case. Pull the Qume disk drive unit out of the Half Height case until free. Rotate drive, placing PCB up facing operator. Place the front of the drive on a support table of the correct height; allow the rear of the drive (about one inch) to rest inside the Half Height case.	The circuit card is accessible for connection of oscilloscope and multi-meter probes. (See Figure 5-3.)
6.	Verify jumpers are installed as illustrated in Figure 5-2.	No response

CAUTION

Whenever performing any work on the disk drive with the disk removed, a clean piece of paper must be inserted in place of the disk between the R/W heads to prevent their surfaces from contacting each other.

TABLE 5-2
TOOLS AND TEST EQUIPMENT FOR QUME DRIVE

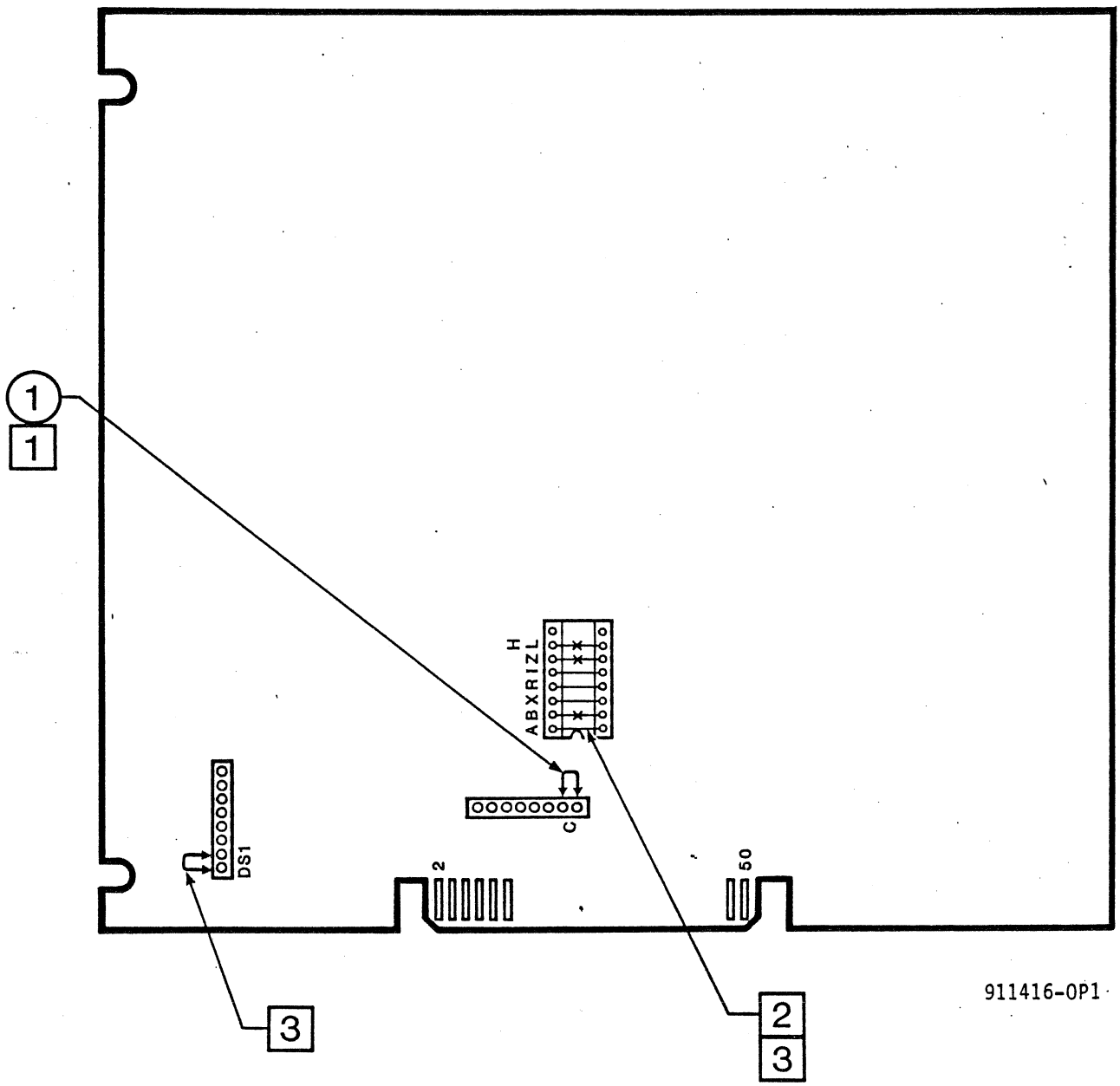
TOOLS AND TEST EQUIPMENT	DESCRIPTION OR P/N
E-Z Clip Leads	18 to 24 inch
Oscilloscope	Tektronix 465 or equivalent
Alignment diskette	Dysan Part No. 800630,
Diagnostic diskette	Supplied by E&S with system
Support table	Correct height to support frame of disk drive while back rests in rack
Screwdriver	Phillips head, number 2 point 1/4 inch blade, 8 inch length (approximate)
Nut driver	For 1/4 inch hex-head screws
Tweezers	4 to 6 inch needlepoint
Allen wrench (3)	1.5mm, 2.0mm, 2.5mm
Metric feeler gauge set	To 4.0mm (combined)
Spring hook (2)	8-inch 12-inch
Soft brush	MIL-B-23958
Cloth or paper	MIL-C-85043
Thread locking compound	MIL-S-79160
Multimeter	20K/V or better
Diskette	Certified R/W scratch

WARNING

SOME OF THESE PROCEDURES ARE RUN WHILE POWER IS APPLIED TO THE EQUIPMENT. OBSERVE ALL PRECAUTIONS LISTED IN THE SAFETY SUMMARY AT THE FRONT OF THE MANUAL.

CAUTION

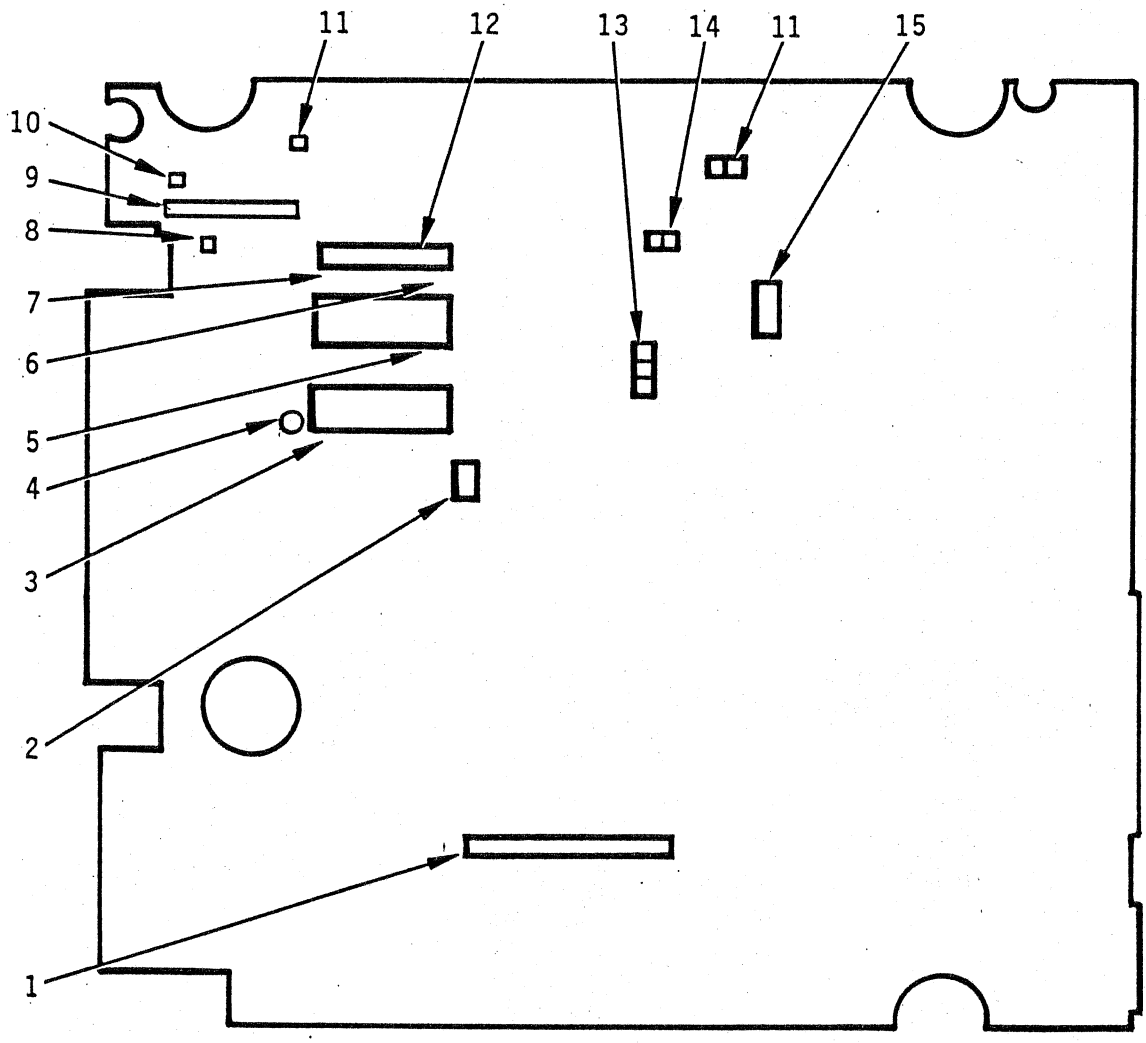
To protect the alignment diskette used in these procedures from damage, the disk drive WP (write protect) switch must be set to the up position before the alignment diskette is loaded into the drive, and must remain up while it is in the drive.



NOTES

[1] ADD JUMPERS "C", "Y".
[2] DELETE JUMPER "B", "Z", "HL".
[3] VERIFY THE FOLLOWING JUMPERS ARE INSTALLED
"A", "X", "R", "I", "DS1"

FIGURE 5-2
QUME DRIVE HALF HEIGHT CONFIGURATION



LEGEND

1. Test Pins
2. Switch Filter Option Pins - SF
3. Programmable Shunt Trace/Cut Options - A,B,X,R,I,Z,HL
4. Optional I/O Pins - 2S,DC D,C
5. Alternate Output Index Pad - 1
6. Alternate Output Ready Pad - R
7. Radial Ready/Index Option Pads - RR,R1
8. Side Select Option Pads - S1,S2,S3
9. Drive Select Address Pins - DS1,DS2,DS3,DS4
10. 2-Double Sided Drive Side Select Option Pads - B1,B2,B3,B4
11. 8-Drive Multiplex Option Pads - D1,D2,D4,DDS
12. Optional I/O Pins - Y,DL,HA,T40
13. Enable/Disable Write Protect Option Pads - WP,NP
14. Stepper Power Enable (used with HL) - SP
15. Door Lock Solenold Power Configuration Pins - DLS 1,2,3

FIGURE 5-3
PCB OPTIONS

5.4.1.2 LOAD SYSTEM MONITOR

The steps shown in table 5-3 describe how to load the system monitor in preparation to run the disk drive tests. Use these procedures whenever a step instruction requires LOAD SYSTEM MONITOR.

There are two procedures to load the system monitor, one for the TI980B computer and one for the E&S SPC9800 computer. Use the corresponding procedure to execute the monitor. Both procedures assume that all power is on, the system cabled for operation, and the monitor diskette is inserted in drive selected zero.

TABLE 5-3
LOAD SYSTEM MONITOR

SCP9800 Computer System Monitor Load		
STEP	INSTRUCTION	RESPONSE
1.	Set the Mode switch to Halt.	Run light is off.
2.	Press Reset.	Address 0000 is displayed.
3.	Press Load.	The system monitor will load and execute on the console ESX-980 xxx-xx MONXxx.
TI980 Computer System Monitor Load		
STEP	INSTRUCTION	RESPONSE
1.	Set all three position switches to the middle position and all two position switches down.	The run light will be off.
2.	Press RESET twice.	All lights on the front panel will estinguish.
3.	Set DATA switches to 000F.	None.
4.	Press PC up.	Data lights 12-15 will be on.
5.	Set the MODE switch to RUN.	None.
6.	Press the LOAD switch to up.	The computer memory will be initialized The IDLE light will remain ON. Data lights 11 and 15 are on.

TABLE 5-3 (CONTINUED)
LOAD SYSTEM MONITOR

STEP	INSTRUCTION	RESPONSE
7.	Press RESET twice.	All computer front panel lights will go out.
8.	Press IPL on the Disk Drive System.	A clunk will be heard as the disk is read and the light will come on on drive zero.
9.	Press START on the TI980B computer.	The monitor will load and execute printing its herald: ESX-980 xxx-xxx MONXxxx.

NOTE

"x" describes the date and version number of the program which may vary depending upon the software delivered with the system.

5.4.1.3 POWER TESTS

STEP	INSTRUCTION	RESPONSE
1.	Load system monitor. (Table 5-3.)	Herald: ESX-980 Xxx-xx MONXxxx.
2.	Assure that the following voltages are present at the specified PCB test points as shown in Figure 5-3: J5, pin 1 to GND should be +21.6V to +26.4V J5, pin 5 to GND should be +4.75V to +5.25V	Step 2 verifies system power supplies.
3.	J2-B8 to GND should be +2.0V to +3.4V	Verifies Index Lamp Assembly voltage.

NOTE

The index lamp assembly is properly aligned when it is seated snugly on the carrier assembly against its mounting stops.

STEP	INSTRUCTION	RESPONSE
4.	Between PCB test points J2-A7 and GND, check for +4.0 to +5.25 volts without a diskette installed and the drive door closed.	
5.	At the same test points, check for 0 to +0.3 volts with a disk installed UPSIDE DOWN (so that the index hole cannot line up with the index lamp and sensor) and the door closed.	
6.	Under the same conditions as above (Steps 5 and 6), check for the same voltages between PCB test point A6 and GND.	Steps 5 thru 7 Verifies Index Sensor Assembly voltage.

NOTE

The index sensor assembly is properly aligned when it is seated snugly on the main frame against its mounting stops.

5.4.1.4 INDEX LAMP AND SENSOR ALIGNMENT CHECK

STEP	INSTRUCTION	RESPONSE
1.	Verify that the pointer on the front of the index lamp assembly and the timing line on the index sensor assembly line up when the drive door is closed.	None.
2.	Insert a diskette with monitor file into drive 0. (Load System Monitor (Table 5-3)	

STEP	INSTRUCTION	RESPONSE
3.	Load DSKXxx (Section 5.7.) Insert diskette containing DSKXxx into drive 0. Type: EXE FDO DSKXxx (cr)	Terminal prints: DSKX05 V01-01 AED 6200LP-6200LD DISK SUBSYSTEM SET THE DRIVE BEING TESTED TO 0. SET ALL OTHER DRIVES TO 1. LOAD THE SCRATCH DISK IN DRIVE #0.
4.	Type: D (cr)	Terminal prints: .DSK>
5.	Type: U (cr)	Terminal prints: ..UTL>
6.	Type: A (cr)	Terminal prints: WHICH SIDE (0 or 1)?
7.	Type: 0 (cr)	Terminal prints: RAISE THE WP SWITCH AND TYPE RETURN WHEN READY
8.	Raise WP switch and type (cr)	Terminal prints: WHICH TRACK (0-4C)?
9.	Raise SSW 1 on the computer.	None.
10.	Insert the Alignment Diskette into drive 0.	Add check light will flash about 1 second.
11.	Type: 1 (cr)	Program is now looping on track 1).
12.	Use a dual trace oscilloscope and: Connect channel 1 to PCB test point 1A; Connect channel 2 to PCB test point 1B; Connect scope ground to PCB test point GND; Set vertical deflection for both channels to 50mv/div; Set both channels to AC; Add channel 1 to channel 2; Connect the external trigger probe to PCB test point 3 (INDEX); Set trigger source to external; Select normal trigger mode; Select AC trigger coupling; Set horizontal deflection to 100usec/div; Trigger on the leading edge of the index pulse.	

STEP	INSTRUCTION	RESPONSE
13.	Observe the timing between the start of a sweep and the first peak of the index burst. It should be between 0 usec and 1000 usec. (See Figure 5-4.)	Waveform displayed is from track 1.
14.	Lower SSW1.	(Ignore the terminal printout.)
15.	Raise SSW1 and type: (cr)	Terminal prints: WHICH SIDE (0 or 1)?
16.	Type: 0 (cr)	Ignore the terminal printout
17.	Type: (cr)	Terminal prints: WHICH TRACK, (0-4C)?
18.	Type: 4C (cr)	(Program is now looping on track 76_{10}).
19.	Verify that the timing between the start of a sweep and the first peak of the index burst is between 0 usec and 1000 usec. (See Figure 5-4.)	(Don't be alarmed by a change in burst width.)
20.	Verify the timing on the other disk side by performing Steps 14 thru 19 and typing "1" instead of "0" in Step 16. Be sure to verify the timing at track 0 and track 4C (Step 18).	None.
21.	To get out of the DSKXxx program, proceeed as follows:	
	Lower SSW1 and type: (cr)	Lower the WP switch and type RET when ready.
	Lower the WP switch and type: (cr)	Terminal prints: ..UTL>
	Type: X (cr)	Terminal prints: .DSK>
	Type: X (cr)	Terminal prints: ESX-980 XXX-XX >

5.4.1.4.1 INDEX TIMING

1. Load System Monitor (Table 5-3).

2. Insert a scratch diskette into the drive and close the drive door.

3. Connect an oscilloscope as follows:

   Connect channel 1 probe to PCB test point 3 (INDEX);
   Connect probe ground clip to PCB test point GND;
   Set the vertical deflection for 2v/div;
   Set channel 1 to DC;
   Set the horizontal deflection to 20ms/div;
   Set trigger mode to NORM;
   Set trigger source to channel 1;
   Set trigger coupling to AC.

4. Measure the period of one cycle (leading edge of one pulse to the leading edge of the next pulse). The time between pulses should be 166.7ms $\pm$ 3ms. (See Figure 5-5.)

5.4.1.5 DRIVE ASSEMBLIES SERVICE CHECKS

5.4.1.5.1 TRACK 00 SENSOR ASSEMBLY SERVICE CHECK

1. Power down the disk drive.

2. Move the head/carriage assembly by hand all the way against the stop at the rear of the drive (away from the spindle).

3. Power up the disk drive.

4. Check for +1.0 to 1.7 volts between PCB J2-B12 and GND.

5. Check for +0.0 to +0.3 volts between PCB J2-A11 and GND.

6. Power down the disk drive.

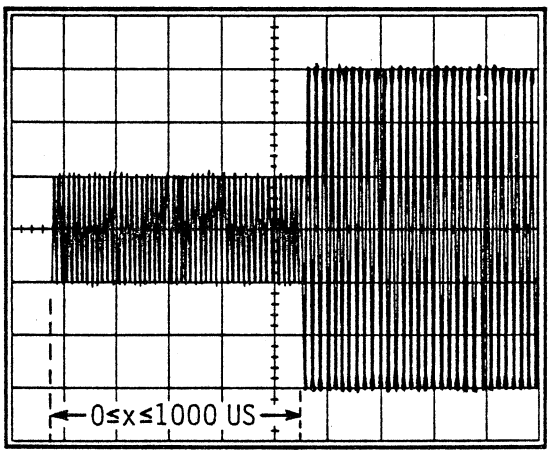
7. Move the head/carriage assembly by hand a random distance toward the spindle hub.

8. Power up the disk drive.

9. Check for +4.0 to +5.25 volts between PCB J2-A11 and GND.

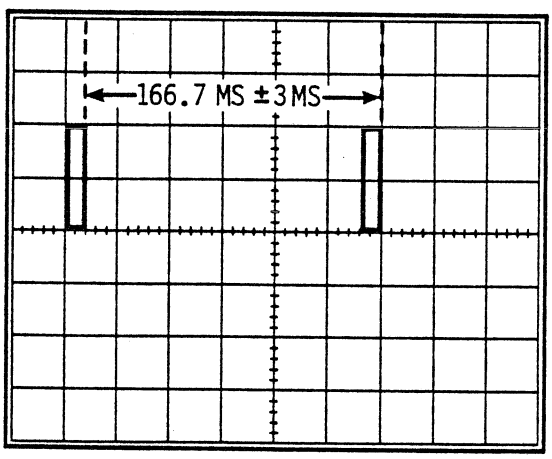
NOTE

There is no alignment procedure for the track 00 sensor; its positioning on the main frame is not adjustable.



911698-0P0

FIGURE 5-4
INDEX TIMING



911699-0P0

FIGURE 5-5
INDEX PERIOD

5.4.1.5.2 IN-USE LED SERVICE CHECK

1. Power up the disk drive.
2. Check for +5 volts ±5% between PCB test points B15 and GND.
3. Temporarily connect a jumper from PCB connector J2 pin A15 to GND. The IN-USE LED on the front of the drive should light up. Remove the jumper.

5.4.1.5.3 WRITE PROTECT SENSOR ASSEMBLY SERVICE CHECK

1. Power up the disk drive (with no disk).
2. Check for +2.0 to +3.4 volts between PCB J2-B14 and GND.
3. Check between PCB J2-A13 and GND for +0.0 to +0.3 volts WITHOUT a disk installed and the drive door closed.
4. Between J2-A13 and GND, check for 4.0 to +5.25 volts with an unprotected disk (no write protect notch) installed and the drive door closed.

NOTE

The write protect sensor assembly is not adjustable.

5.4.1.5.4 HEAD LOAD SOLENOID ASSEMBLY ADJUSTMENT CHECK

1. With no power applied, position the disk drive on a stable flat surface, with the drive motor side up (PCB side down).
2. Remove the spring from the Pop-Up assembly.
3. Install a disk in the drive and close the drive door.
4. Power up the disk drive.
5. Load the heads against the disk.

NOTE

The heads may be loaded against the disk by installing a temporary jumper across shunt HL on the PCB (see Figure 5-3).

6. Verify that there is a gap between the bail and the carriage arm tag throughout the entire travel of the carriage assembly.

7. Remove the jumper from across HA. (This unloads the heads.)

NOTE

The controller cable should be disconnected from the rear of the drive (J1).

8. Remove the disk from the drive and close the door.

9. Verify with an inspection mirror that there is a gap between the heads.

10. Install the spring in the pop-up assembly.

5.4.1.5.5 UNLOADED HEAD GAP ADJUSTMENT CHECK

CAUTION

The R/W head surfaces should not be brought into contact with each other; avoid this whenever possible, as it may cause head damage. Also, DO NOT place any object between the heads to measure the head gap.

1. With power off, rotate the disk drive so that the right-hand rear corner of the main frame casting with the blue Qume label is at the near edge of the supporting surface (right-hand side of the operator).

2. Slide the head/carriage assembly by hand to approximately the track 40 position (middle of it's range of travel).

NOTE

The controller cable should be disconnected from the rear of the drive (J1).

3. Close the drive door and power up the disk drive.

4. Load and unload the heads ONE time. (Use a jumper across PCB shunt HL.)

5. Using an inspection mirror look at the gap between the unloaded R/W heads.

6. The gap should be between 0.004 to 0.010 inch (0.1 to 0.25 mm).

NOTE

This measurement is very subjective. As you can tell, it is almost too small to judge by sight. Only if there is no gap between the heads or if the gap appears too wide, should there be cause for concern.

7. If there is no gap between the heads, or if the gap appears too wide (approximately 1/4 inch or more), refer to Qume Maintenance Manual.

5.4.1.6 HEAD LOAD TIME CHECK

The floppy disk drive alignment verification procedures require oscilloscope observation of special signals generated by the alignment diskette. When system monitor is loaded, perform the following steps to complete head load verification.

The head loading time should be checked after maintenance involving the bail, bail base, head load solenoid, or head/carriage assemblies. This check verifies the free and proper movement and interaction of head solenoid plunger, bail, and R/W head lifting mechanism.

1. Load system monitor (Table 5-3).

2. Insert a prerecorded disk and close the drive door.

3. Use a dual trace oscilloscope (Tektronix 465 or equivalent) and:

   a. Connect channel 1 to test point 1A and channel 2 to test point 1B on the disk drive PCB.
   b. Attach the probe ground clips to the ground (GND) test point on the PCB.
   c. Set the vertical deflection for both channels to 50mV/div.
   d. Set both inputs to AC.
   e. Invert channel 2.
   f. Add channel 1 to channel 2.
   g. Set horizontal sweep to 10ms/div.
   h. Attach the external trigger probe to programmable shunt jumper HL (head load) on the disk drive PCB.
   i. Select external trigger source.
   j. Set the trigger coupling to AC and the trigger mode to normal.
   k. Preset the trigger for a positive slope.

4. Load the drive heads against the disk. This may be done by controller signal DRIVE SELECT in a factory configured drive, or by HEAD LOAD controller signal with jumper B removed and jumper C installed, or by disconnecting interface connector P1/J1 and closing a remote single pole switch temporarily connected between jumper pins HA and GND on the drive PCB.

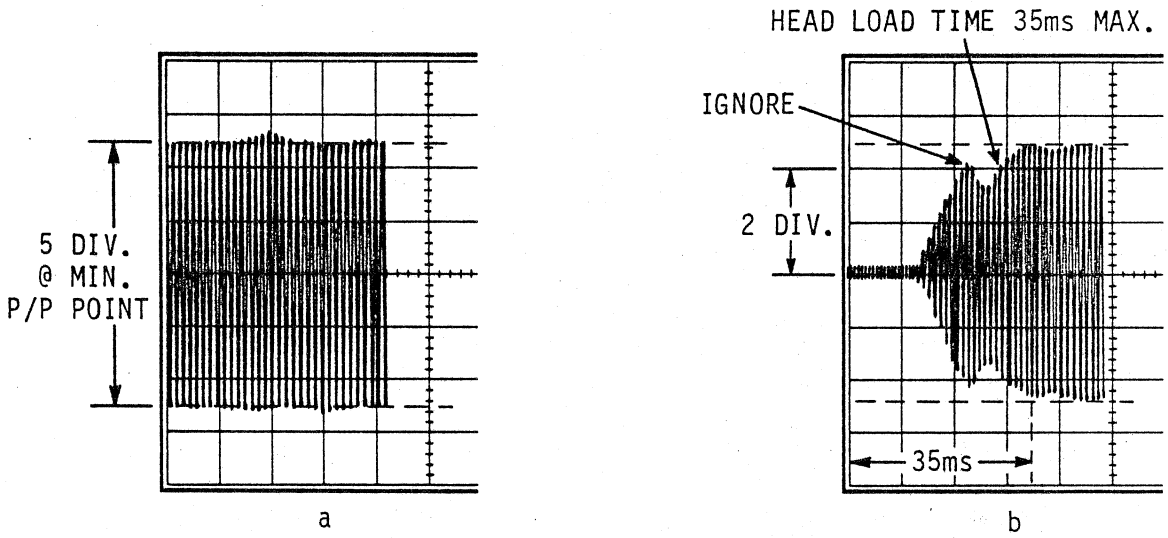


FIGURE 5-6
HEAD LOAD TIME CHECK

5. Select on side 1 a track with 1F data pattern. (all 0's)

6. Observe the read signal waveform on the scope and adjust the scope vertical gain for an amplitude of 5 divisions (100%) at the lowest peak-to-peak point of the dsiplayed envelope. (See Figure 5-6).

7. Repeatedly load and unload the heads and adjust the scope's trigger slope control so that the scope display trace will be triggered by the head load command.

8. Read on the scope screen the time it takes for the signal envelope to reach and remain above the 80% amplitude point (2 divisions above center line) from the beginning (trigger point) of the display trace. This head loading time must be less than or equal to 35 ms as shown in Figure 5-7.

9. Select a track with 1F data pattern on the second disk side and repeat Steps 7 and 8 above.

10. Disconnect the oscilloscope from the disk drive: remove the prerecorded disk; restore the PCB jumper status as required for system operation.

    If the head load time of 35 ms is exceeded on either disk side, check for a binding solenoid plunger, binding bail hinge, or improperly adjusted bail gap or head gap; if none of these are the cause, the head/carriage assembly may need to be replaced.

5.4.1.7 R/W HEAD READ AMPLITUDE CHECK

1. Load system monitor Table 5-3.

2. Verify good track alignment (refer to R/W Head Track Alignment).

3. Insert a good quality Certified R/W Disk.

4. Select a disk side and load the R/W heads onto the disk.

5. Step to track 76 and write a 2F data signal (all "1").

6. Read the just recorded 2F signal.

7. Connect an oscilloscope (e.g., Tektronix model 465 or equivalent):

   a. Vertical input probe (channel 1) to test point 1A.
   b. Probe ground to the ground (GND) test point on the PCB.
   c. Set vertical deflection to 50 mV/division.
   d. Select AC input.
   e. Set the trigger source to internal.
   f. Set the trigger mode to normal.
   g. Select DC trigger coupling.
   h. Set the horizontal sweep to 0.5 msec./division.
   i. Trigger on the (channel 1) input signal.

8. Note the amplitude of the displayed read signal; it should be at least 100 mV pp if the R/W disk is good.

9. Write 1F data (all "0") on track 76.

10. Read the just recorded 1F signal and note the display amplitude on the scope.

11. Divide the 2F read amplitude by the 1F read amplitude. Minimum acceptable ratio is 0.4 (or 40%).

12. Select the other disk side (second R/W head) and repeat steps 5, 6, and steps 8 through 11 above.

13. Move the scope probe from test point 1A to test point 1B and repeat the above procedure for both disk sides (both R/W heads).

14. Unload the R/W heads from the disk.

15. Remove the R/W disk from the drive.

16. Disconnect the oscilloscope from the disk drive.

If any one of the four above ratios falls below 40%, the head/carriage assembly may need to be replaced, provided this is not caused by an increased head gap, faulty head azimuth, the head lifting off the disk surface, or by poor track alignment or worn media (disk surface). Perform R/W Head Azimuth Check, Head/Carriage Assembly, Radial Alignment check and use an alternate Certified R/W Disk before replacing the head/carriage assembly.

CAUTION

The head/carriage assembly is factory adjusted and tested. In the field there must be no adjustment or repair attempted on the entire head/carriage assembly.

5.4.1.8 READ/WRITE (R/W) HEAD AZIMUTH CHECK

The R/W head azimuth significantly influences the signal amplitude of recorded and of read data. A head azimuth with $\pm$12 min. of zero is typical, while the head/carriage assembly needs to be replaced if the azimuth exceeds $\pm$ 18 min. Head azimuth cannot be adjusted.

1. Load system monitor (Table 5-3).

2. Insert an alignment disk in the drive and close the drive door.

3. Load the R/W heads onto the CE disk.

4. Select a disk side.

5. Step the head/carriage assembly to track 76.

6. Use a dual trace oscilloscope (Tektronix 465 or equivalent) and:

   a. Connect channel 1 to test point 1A and channel 2 to test point 1B on the disk drive PCB.
   b. Attach the probe ground clips to the ground (GND) test pont on the PCB.
   c. Set the vertical deflection for both channels to 50mV/div.
   d. Set both inputs to AC.
   e. Invert channel 2.
   f. Add channel 1 to channel 2.
   g. Set the horizontal sweep to 0.5ms/div.
   h. Attach an external trigger to test point 3 (index timing) on the PCB and set the trigger source to external.
   i. Set the trigger coupling to AC and the trigger mode to external.
   j. Trigger on the leading edge of the index pulse.

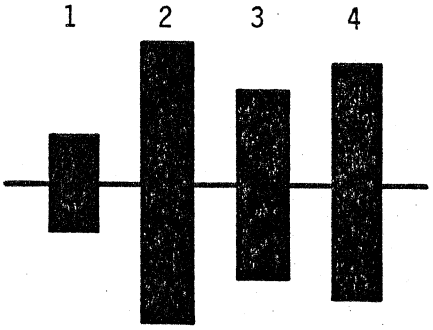
7. Compare the waveform displayed to the Azimuth Check illustration Figure 5-7. If the displayed waveform is not within $\pm$18 minutes, the head/carriage assembly needs to be replaced.

8. Select the other disk side to test the second head and repeat Step 7.

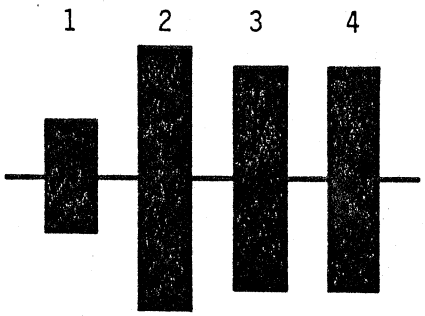
9. Unload the R/W heads.

10. Remove the CE disk from the drive.

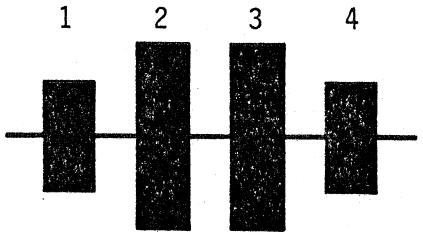
11. Disconnect the oscilloscope from the disk drive.



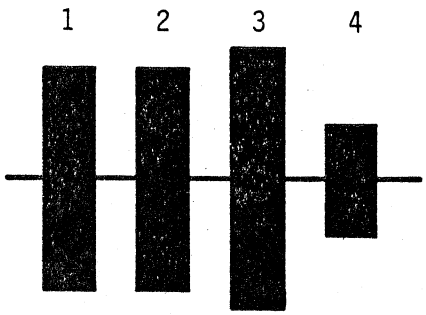
MAXIMUM ALLOWABLE AZIMUTH ERROR OF +18 MINUTES. BURST #4 IS 25% LARGER IN AMPLITUDE THAN BURST #3.



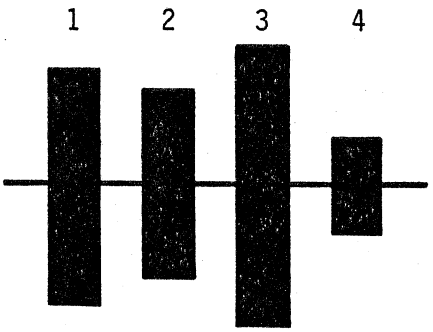
TYPICAL AZIMUTH ERROR OF +12 MINUTES. BURSTS #3 AND #4 ARE EQUAL IN AMPLITUDE.



AN OPTIMUM ALIGNMENT OF ZERO MINUTES AZIMUTH ERROR. BURSTS #1 AND #4 ARE EQUAL IN AMPLITUDE, AS ARE BURSTS #2 AND #3.



TYPICAL AZIMUTH ERROR OF -12 MINUTES. BURSTS #1 AND #2 ARE EQUAL IN AMPLITUDE.



MAXIMUM ALLOWABLE AZIMUTH ERROR OF -18 MINUTES. BURST #1 IS 25% LARGER IN AMPLITUDE THAN BURST #2.

911701-OPO

FIGURE 5-7
AZIMUTH CHECK

5.4.1.9 HEAD/CARRIAGE ASSEMBLY RADIAL ALIGNMENT

This procedure establishes precise on-track positioning of the R/W heads. It is to be done on a certified two-sided CE alignment disk.

CAUTION

The head/carriage assembly is factory adjusted and tested and is not field serviceable. Do not, for any reason, attempt to make repairs or internal adjustments on this assembly, or clean the R/W heads. This can cause severe damage to the head surfaces or the recording media.

1. Remove the spring from the pop-up assembly.

2. If disconnected, restore power connections and power up the disk drive.

3. Use a dual trace oscilloscope (Tektronix 465 or equivalent) and:

   a. Connect channel 1 to test point 1A and channel 2 to test point 1B on the main PCB.
   b. Attach the probe ground clips to the ground (GND) test point on the PCB.
   c. Set the vertical deflection for both channels to 50mV/div.
   d. Set both inputs to AC.
   e. Invert channel 2.
   f. Add channel 1 to channel 2.
   g. Set the horizontal sweep to 20ms/div.
   h. Attach an external trigger to test point 2 (INDEX) on the PCB and set the trigger source to external.
   i. Set the trigger coupling to AC and the trigger mode to external.

NOTE

Before usisng the CE disk, allow a minimum of 30 minutes for the disk to adapt to the ambient temperature in which it is to be used.

4. Insert a certified CE alignment disk in the drive and close the drive door.

5. Load the R/W heads onto the CE disk and select a disk side.

CAUTION

Do not record on the CE disk. Recording on the CE disk will render it useless for alignment checks. A write protect; notch has been placed in the disk jacket to reduce the possibility of accidental recording.

6. Step the head/carriage assembly to track 40.

7. Using the trigger slope level control, synchronize the scope to obtain (from the R/W head of the selected side) the "cat eyes" display shown on cat's eye waveform illustration, Figure 5-8.

   The oscilloscope will display two amplitude lobes. The R/W head is correctly aligned when the lobes are equal in amplitude, or at least within 80 percent of each other (refer to the Figure 5-8).

8. If the lobes are not within 80 percent of each other, loosen the two screws on the PCB side of the main frame which secure the stepper motor and slowly rotate the stepper motor assembly until the lobes are of equal amplitude.

9. Select the second disk side and note the "cat eyes" amplitude relationship.

   a. By turning the stepper motor assembly and alternately selecting disk sides 0 and 1, balance the radial alignment of the two R/W heads with each other as much as possible while still remaining within the 80 percent alignment specification for each R/W head. Balance the left lobe of R/W head 0 with the right lobe of R/W head 1.

   b. If a balanced condition (within the 80 percent specification) between both R/W heads cannot be obtained with the available rotational range of the stepper motor, it may be advisable to replace the head carriage assembly.

10. Alternately tighten the two screws securing the stepper motor assembly to the main frame a little at a time to maintain the R/W head alignment.

11. To check the accuracy of the alignment, step to track 39 and back to track 40, and then step to track 41 and back to track 40.

    Note the difference in "cat eyes" amplitudes which may result when approaching track 40 from either direction.

If the 80 percent specification is exceeded by either R/W head in either direction, loosen the stepper motor mounting screws again and optimize the offset. In this case Steps 12 and 13 above, followed by Step 15, must be repeated.

12. Unload the R/W heads from the disk.

13. Remove the CE disk from the drive.

14. Disconnect the oscilloscope from the disk drive.

15. Install the spring on the pop-up assembly.

16. Power down the disk drive.

17. Rotate the pop-up adjustment screw on the carrier assembly clockwise as much as possible.

18. Close the drive door and latch the pop-up slider by sliding it toward the rear of the drive (away from the front door) until it engages under the pawls of the pop-up lever.

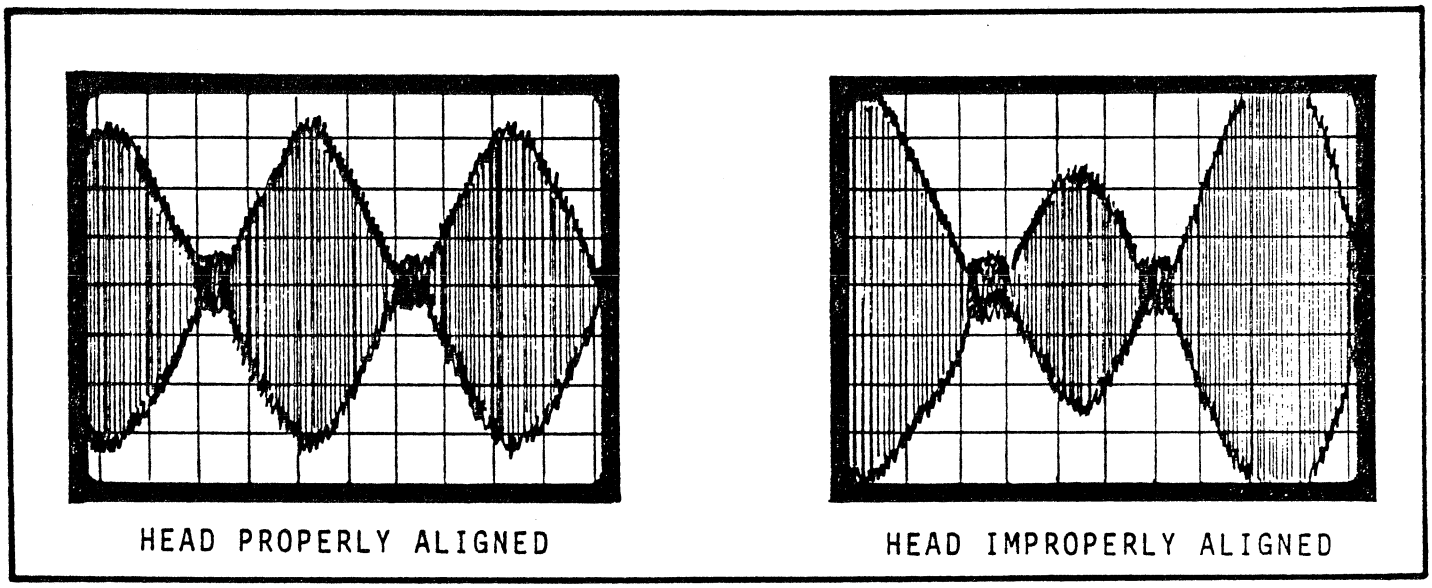


FIGURE 5-8
CAT'S EYE WAVEFORM

5.4.2 YD-180 DISK DRIVE

This section describes service and alignment procedures for the YD-180 disk drives contained within the floppy disk unit. Misalignment of this key unit can affect the performance of the entire system. Table 5-4 lists the tools and test equipment needed for system checks. This section contains the following procedures.

1. Mechanical and Electrical Test Setup
2. Loading System Monitor
3. Index Lamp Check
4. Track 00 Sensor Test
5. Write Protect Check
6. Carrier Assembly Check
7. Pop up Assembly Test
8. Head Load Solenoid Check
9. Head Radial Alignment Check

TABLE 5-4
TOOLS AND TEST EQUIPMENT FOR YD-180 DRIVE

TOOLS & TEST EQUIPMENT	DESCRIPTION OR P/N
Tool Kit	141771-01
Phillips Screwdriver	140264-01
Phillips Screwdriver	141627-01
Flat Head Screwdriver	141035-01
Inspection Mirror	140268-01
Cutters	140269-01
Needle Nose Pliers	140372-01
Tweezers	140265-01
Allignment Diskette	Dysan 800630
Diagnastic Diskette	Supplied by E&S
Scratch Diskette	Certified R/W Scratch

WARNING

Some of these procedures are run while power is applied to the equipment. Observe all precautions listed in the safety summary at the front of the manual.

CAUTION

To protect the alignment diskette used in these procedures from damage, the disk drive WP (write protect) switch must be set to the up position before the alignment diskette is loaded into the drive, and must remain up while it is in the drive.

5.4.2.1 MECHANICAL & ELECTRICAL TEST SETUP

Some of the following procedures were adapted from the disk drive maintenance manual to make them directly usable with the system. They are not all-encompassing; if running them does not solve a particular disk drive problem, then consult the vendor disk drive maintenance manual for further guidance.

This procedure establishes the system and test equipment setup required by the rest of the procedures in this section.

STEP	INSTRUCTION	RESPONSE
1.	Turn A/C power OFF at the back of the Half Height unit.	Power light on the front of the drive goes OUT.
2.	CAUTION: avoid damage to ribbon cables during this step. Pull the Half Height unit out of the rack as far as its chassis slide rails will allow.	Chassis slide rails lock in the out position.
3.	Remove, from the bottom of the Half, Height the 4(four) Phillip's-head screws that hold the disk drive inside the Half Height unit.	No response
4.	CAUTION: Avoid damage to ribbon cables during this step. Push the Half Height unit completely back inside the rack (chassis slide lock release levers are located on the side of each chassis rail).	No response

5.	CAUTION: With the screws removed, the Qume drive can fall completely free of the Half Height case. Pull the Qume disk drive unit out of the Half Height case until free. Rotate drive, placing PCB up facing operator. Place the front of the drive on a support table of the correct height; allow the rear of the drive (about one inch) to rest inside the Half Height case.	The circuit card is accessible for connection of oscilloscope and multi-meter probes.

5.4.2.2 LOADING SYSTEM MONITOR

The steps shown in table 5-3 describe how to load the system monitor in preparation to run the disk drive tests. Use these procedures whenever a step instruction requires LOAD SYSTEM MONITOR.

There are two procedures to load the system monitor, one for the TI980B computer and one for the E&S SPC9800 computer. Use the corresponding procedure to execute the monitor. Both procedures assume that all power is on, the system cabled for operation, and the monitor diskette is inserted in drive selected zero.

5.4.2.3 INDEX LAMP ASSEMBLY CHECK

STEP	INSTRUCTION	RESPONSE
1.	Turn the drive power ON.	Power on light illuminates.
2.	Meassure voltage between connector pins J2-B8 and PWB GND.	Voltage should be between +2.0 and +3.4 VDC.
3.	If voltage is incorrect replace the index lamp assembly.	

5.4.2.3.1 INDEX SENSOR ASSEMBLY CHECK

1. Turn the drive power on
2. Without a disk inserted close the door and check for a voltage between +4.0V and +5.25VDC between J2-47 and PWB GND.
3. With a diskette installed upside down (to prevent an index symbol), close the door and check for a voltage between +0.0V and 0.3VDC between J2-47 and PWB GND.
4. Check for the same voltages under the same conditions as in steps 2 & 3 only measure between J2A6 and PWB GND.

5. If voltages in steps 2,3, or 4 are incorrect, replace the index sensor assembly.

5.4.2.4 DRIVE ASSEMBLY SERVICE CHECKS

5.4.2.4.1 TRACK OO SENSOR ASSEMBLY CHECK

1. Move the head/carriage assembly by hand to the stop at the rear of the drive.

2. Turn the drive power ON. (positions the head at track OO).

3. Check for +1.0 to +1.7V between J2-B12 and PWB GND.

4. Check for +0.0V to +0.3V between J2-A11 and PWB GND.

5. Turn drive power off and move the head/carriage assembly by hand towards the spindle about 2mm (track4).

6. Turn drive power on and check for +4.0V to +5.25V between J2-A11 and PWB GND.

7 If voltage in steps 3,4, or 6 is incorrect, replace the track OO sensor assembly.

5.4.2.4.2 WRITE PROTECT SENSOR ASSEMBLY CHECK

1. Turn drive power ON.

2. Check for +2.0V to +3.4V between J2-B14 and PWB GND, without a disk installed.

3. Check for 0.0V to +0.3V between J2-A13 and PWB GND.

4. Install an unprotected diskette (no write protect notch) and close the drive door.

5. Check for 4.0V to +5.25V between J2-A13 and PWB GND.

6. Remove the disk.

7. If any of the above voltages are incorrect, replace the write protect sensor assembly.

5.4.2.4.3 CARRIER ASSEMBLY CHECK

1. Close the drive door.
2. Check for a gap between the carrier and the E-ring on the shaft of the collet assembly.
3. If there is no gap, replace the carrier assembly, on reinstall the carrier assembly so a gap is present.

5.4.2.4.4 POP-UP ASSEMBLY CHECK

1. Install a disk in the drive and latch the pop-up slider.
2. Remove the disk and close the front door.
3. While holding the front door, push the pushbutton.
4. Open the door slightly until the pop-up slider is just unlatched.
5. Check for a gap of 2 to 4 mm between the spindle hub surface and the top of the collet assembly.
6. If gap is wrong perform the following steps.
7. Latch the pop-up slider by sliding it toward the rear of the drive.
8. Lossen the 2 screws securing the pop-up lever to the carrier assembly.
9. Close the front door.
10. Hold the door so the gap between the spindle hub surface and the top of the collet assembly is approximately 2.5mm.
11. Secure the two pop-up level screws just at the point where the pop-up slider becomes unlatched.
12. Repeat steps 1-5.
13. If still incorrect, replace the pop-up assembly.

5.4.2.4.5 HEAD LOAD SOLENOID CHECK

Insert a piece of clean paper between the upper and lower read/write heads to that their surfaces do not contact each other.

Remove the pop-up spring in the pop-up slider. Failure to do this may cause damage to the heads if a disk pops out with the heads loaded.

1. Remove the pop-up spring from the pop-up assembly with tweezers.

2. Insert a disk in the drive and close the front door.

3. Turn drive power on. Install a shorting plug across test points HL on the PWB to load the heads against the disk.

4. Check for a gap between the bail and the carriage arm tab throughout the range of travel of the head/carriage assembly.

5. Remove the shorting plug installed in step 3 and turn the drive power off.

6. Remove the diskette from the drive and close the front door.

7. With power off, check for a gap between the upper and lower heads.

8. Install the pop-up spring to the pop-up slider.

9. Slide the head-carriage assembly by hand to some where near track 40.

10. Position the disk drive horizontally with the PWB down.

11. Turn drive power on.

12. Install a shorting jumper across test points HL on the PWB to load the heads and then remove the plug to unload the heads.

13. Check the gap between the upper and lower heads with power on. The gap should be between 1.5 and 2.5mm.

NOTE

Because the head gap cannot be actually measured, look through the opening between the main frame and the pop-up base to check the gap size.

14. If the gap is incorrect, perform the following steps.

15. Close the front door.

16. Slide the head carriage assembly arm tab to the middle of the bail plate.

17. Position the drive horizontally with the PWB down.

18. Turn drive power on. Install a shorting plug across test points HL on the PWB to load the heads, then remove the plug to unload the heads.

19. With power on, adjust the interhead gap to between 1.5 and 2.5mm.

5.4.2.5 HEAD/CARRIAGE RADIAL ALIGNMENT

This procedure establishes precise on-track positioning of the R/W heads. It is to be done on a certified two-sided CE alignment diskette.

CAUTION

The head/carriage assembly is factory adjusted and tested and is not field serviceable. Do not, for any reason, attempt to make repairs or internal adjustments on this assembly, or clean the R/W heads. This can cause severe damage to the head surfaces or the recording media.

1. Remove the spring from the pop-up assembly.

2. If disconnected, restore power connections and power up the disk drive.

3. Use a dual trace oscilloscope (Tektronix 465 or equivalent) and:

   a. Connect channel 1 to test point 1A and channel 2 to test point 1B on the main PCB.
   b. Attach the probe ground clips to the ground (GND) test point on the PCB.
   c. Set the vertical deflection for both channels to 50mV/div.
   d. Set both inputs to AC.
   e. Invert channel 2.
   f. Add channel 1 to channel 2.
   g. Set the horizontal sweep to 20ms/div.
   h. Attach an external trigger to test point 3 (INDEX) on the PCB and set the trigger source to external.

   i. Set the trigger coupling to AC and the trigger mode to external.

NOTE

Before using the CE disk, allow a minimum of 30 minutes for the disk to adapt to the ambient temperature in which it is to be used.

4. Insert a certified CE alignment disk in the drive and close the drive door.

5. Load the R/W heads onto the CE disk and select a disk side.

CAUTION

Do not record on the CE disk. Recording on the CE disk will render it useless for alignment checks. A write protect; notch has been placed in the disk jacket to reduce the possibility of accidental recording.

6. Step the head/carriage assembly to track 40.

7. Using the trigger slope level control, synchronize the scope to obtain (from the R/W head of the selected side) the "cat eyes" display shown on cat's eye waveform illustration, Figure 5-11.

   The oscilloscope will display two amplitude lobes. The R/W head is correctly aligned when the lobes are equal in amplitude, or at least within 80 percent of each other (refer to the Figure 5-8).

8. If the lobes are not within 80 percent of each other, insert a flat head screwdriver between the stepper side and the frame and move the stepper inward or outward to obtain the correct alignment.

9. Select the second disk side and note the "cat eyes" amplitude relationship.

   a. By turning the stepper motor assembly and alternately selecting disk sides 0 and 1, balance the radial alignment of the two R/W heads with each other as much as possible while still remaining within the 80 percent alignment specification for each R/W head. Balance the left lobe of R/W head 0 with the right lobe of R/W head 1.

   b. If a balanced condition (within the 80 percent specification) between both R/W heads cannot be obtained with the available rotational range of the stepper motor, it may be advisable to replace the head carriage assembly.

10. To check the accuracy of the alignment, step to track 39 and back to track 40, and then step to track 41 and back to track 40.

    Note the difference in "cat eyes" amplitudes which may result when approaching track 40 from either direction.

    If the 80 percent specification is exceeded by either R/W head in either direction, loosen the stepper motor mounting screws again and optimize the offset. In this case Steps 12 and 13 above, followed by Step 15, must be repeated.

11. Unload the R/W heads from the disk.

12. Remove the CE disk from the drive.

13. Disconnect the oscilloscope from the disk drive.

5.4.3 MITSUBISHI DISK DRIVE

This section describes service and alignment procedures for the Mitsubishi disk drives contained within the floppy disk unit. Misalignment of this key unit can affect performance of the entire system. Table 5-5 lists the tools and test equipment needed for alignment and maintenance. This section contains the following procedures:

1. Mechanical & Electrical Test Setup
2. Loading System Monitor
3. Index Sensor Check
4. Track 00 Sensor Check
5. R/W Radial Head Alignment
6. Head Azimuth Check

TABLE 5-5
TOOLS AND TEST EQUIPMENT FOR MITSUBISHI DRIVE

TOOLS & TEST EQUIPMENT	DESCRIPTION OR P/N
Phillips Screwdriver	No. 2 Point
Oscilloscope (W/Probe)	Triggerable at least 10MHZ
CE Alignment Diskette	P/N DC342795-001
Diagnostic Diskette	Supplied by E&S

WARNING

Some of these procedures are run while power is applied to the equipment. Observe all precautions listed in the safety summary at the front of the manual.

CAUTION

To protect the alignment diskette used in these procedures from damage, the disk drive WP (write protect) switch must be set to the up position before the alignment diskette is loaded into the drive, and must remain up while it is in the drive.

5.4.3.1 MECHANICAL & ELECTRICAL TEST SETUP

STEP	INSTRUCTION	RESPONSE
1.	Turn A/C power OFF at the back of the Half Height unit.	Power light on the front of the drive goes OUT.
2.	CAUTION: avoid damage to ribbon cables during this step. Pull the Half Height unit out of the rack as far as its chassis slide rails will allow.	Chassis slide rails lock in the out position.
3.	Remove, from the bottom of the Half, Height the 4(four) Phillip's-head screws that hold the disk drive inside the Half Height unit.	No response
4.	CAUTION: Avoid damage to ribbon cables during this step. Push the Half Height unit completely back inside the rack (chassis slide lock release levers are located on the side of each chassis rail).	No response
5.	CAUTION: With the screws removed, the Qume drive can fall completely free of the Half Height case. Pull the Qume disk drive unit out of the Half Height case until free. Rotate drive, placing PCB up facing operator. Place the front of the drive on a support table of the correct height; allow the rear of the drive (about one inch) to rest inside the Half Height case.	The circuit card is accessible for connection of oscilloscope and multi-meter probes.
6.	Verify jumpers are installed as shown in Figure 5-9.	

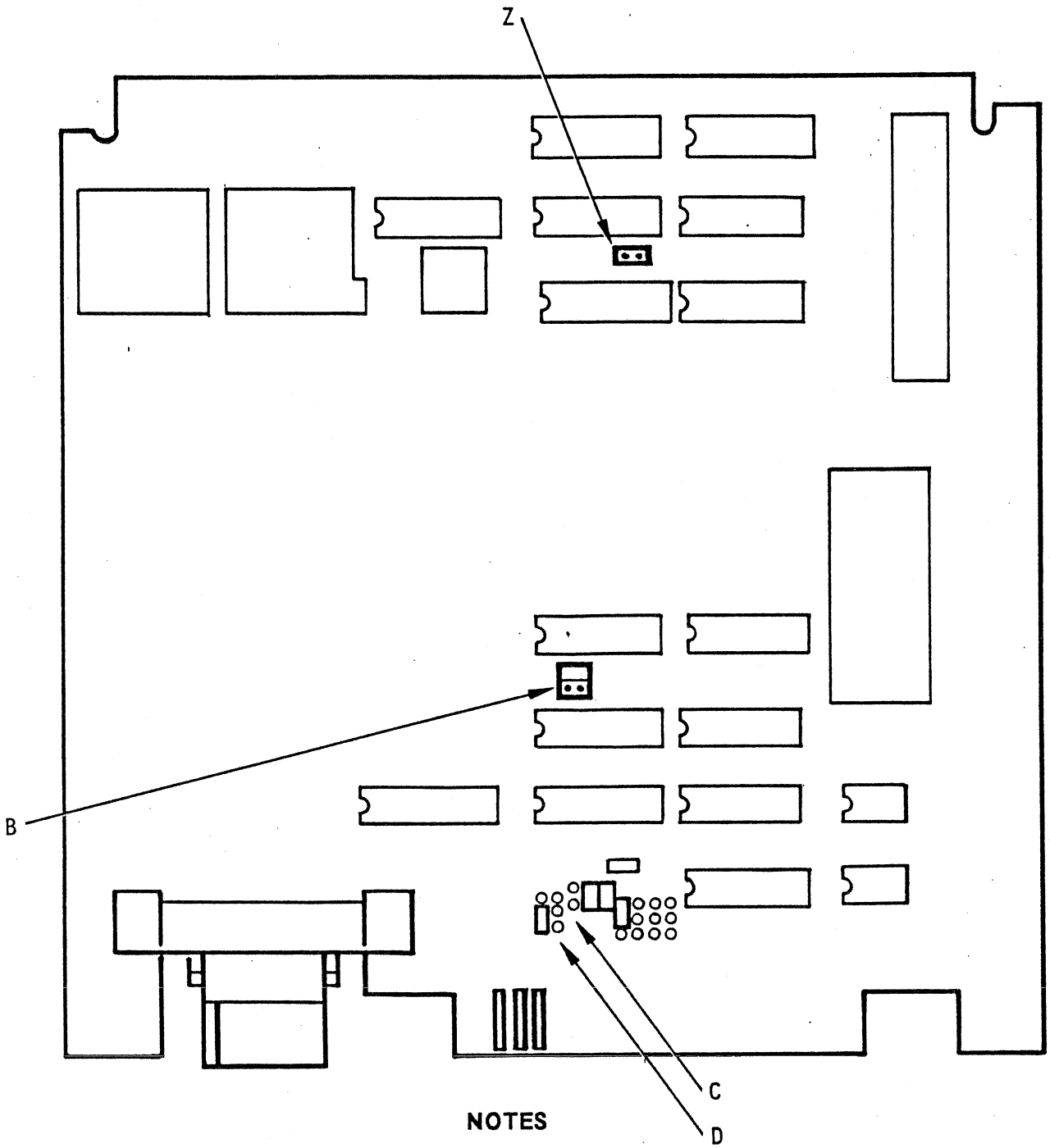
CAUTION

Whenever performing any work on the disk drive with the disk removed, a clean piece of paper must be inserted in place of the disk between the R/W heads to prevent their surfaces from contacting each other.

5.4.3.2 LOAD SYSTEM MONITOR

The steps shown in table 5-3 describe how to load the system monitor in preparation to run the disk drive tests. Use these procedures whenever a step instruction requires LOAD SYSTEM MONITOR.

There are two procedures to load the system monitor, one for the TI980B computer and one for the E&S SPC9800 computer. Use the corresponding procedure to execute the monitor. Both procedures assume that all power is on, the system cabled for operation, and the monitor diskette is inserted in drive selected zero.



NOTES

1. Add Jumpers "C", "D"
2. Delete Jumpers "B", "Z"
3. Verify Following Jumpers Installed: JF6, DS1, SI, IT, I, R, S2, HY, M2, P5, R5, RF, Z, WP, A, B, X, HVD, Terminator.

FIGURE 5-9
MITSUBISHI DRIVE CONFIGURATION

5.4.3.2.1 INDEX SENSOR CHECK

1. Connect TP-WP to ground to prevent recording on the CE alignment diskette in the event of a malfunction.

2. Load system monitor.

3. Insert the CE alignment diskette.

4. Connect and setup the oscilloscope as follows:

   a. Connect channel 1 to TP-AD3 and channel 2 to TP-AD.
   b. Attach probe GND clips to GND on PCB.
   c. Vertical deflection to 500mv/DIV.
   d. Horizontal deflection to 200msec/DIV.
   e. Both inputs to AC.
   f. Invert channel 2.
   g. Add channel 1 to channel 2.
   h. Attach trigger probe to TP-1X.
   i. Select external trigger.
   j. + slope for trigger.
   k. Trigger mode-normal.

5. Load the heads.

6. Reading should be within following tolerance (See Figure 5-10) T=700 ± 200ms (for both track 00 and track 73).

7. If out of alignment replace the drive.

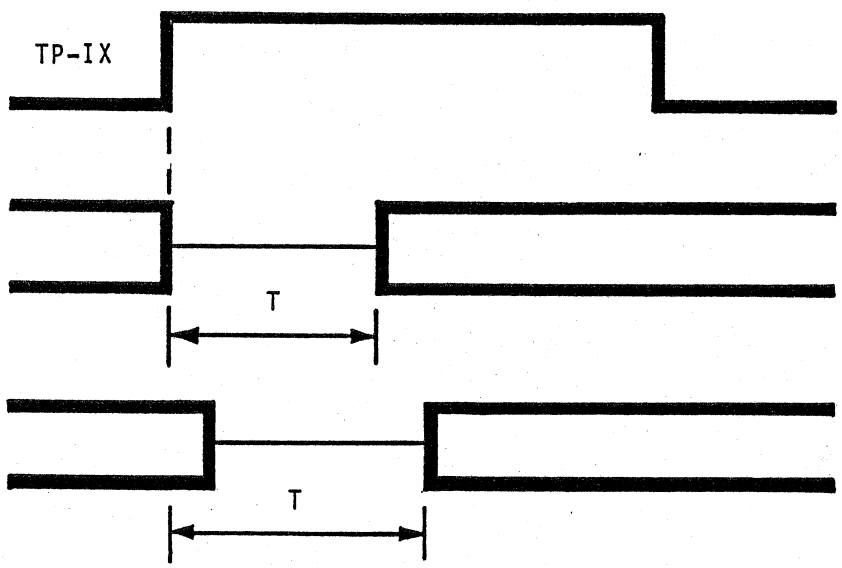


FIGURE 5-10
INDEX SENSOR TIMING

5.4.3.2.2 R/W RADIAL HEAD CHECK

CAUTION

To protect the CE alignment diskette be sure the WP (write protect) is turned on.

1. Load system monitor.
2. Insert CE alignment diskette.
3. Connect TP-WP to ground.
4. Connect and setup the oscilloscope as follows:

   a. Connect channel 1 to TP-AD3 and channel 2 to TP-AD4.
   b. Attach probe GND clips to GND.
   c. Vertical deflection to 100mv/DIV.
   d. Horizontal deflection to 20msec/DIV.
   e. Both inputs to AC.
   f. Invert channel 2.
   g. Add channels 1&2.
   h. Select external trigger.
   i. + trigger slope.
   j. Trigger to normal.

5. Read track 38 for side 0 and track 34 for side 1.
6. Load the heads.
7. Should be within 60% of being equal in amplitude.
8. If out of tolerance, replace the drive.

5.4.3.2.3 R/W HEAD AZIMUTH CHECK

1. Connect TP-WP to ground.
2. Load system monitor.
3. Insert the CE alignment diskette.

4. Connect and setup the oscilloscope as follows:

   a. Connect channel 1 to TP-AD3 and channel 2 to TP-AD4.
   b. Attach probe ground clips to ground.
   c. Vertical deflection to 50mv/DIV.
   d. Horizontal deflection to 5 msec/DIV.
   e. Both inputs to AC.
   f. Invert channel 2.
   g. Add channels 1 and 2.
   h. Attach trigger probe to TP-1X.
   i. Select external trigger.
   j. + trigger slope.
   k. Trigger set to norm.

5. Select track 76 for side 0, track 72 for side 1.

6. Load the head.

7. Oscilloscope should show figure similar to the pattern in figure 5-8.

8. If head azimuth is not acceptable and out of tollerance, replace the disk drive.

5.4.3.2.4 TRACK 00 SENSOR CHECK

1. Confirm radial alignment is within tolerance.

2. Load system monitor.

3. Insert the CE alignment diskette.

4. Connect and setup the oscilloscope as follows:

   a. Connect channel 1 to TP-STP and channel 2 to TP-TK00.
   b. Attach probes ground clips to ground.
   c. Vertical deflection to 1v/DIV.
   d. Horizontal deflection to 1msec/DIV.
   e. Attach trigger probe to TP-STP.
   f. Select EXT trigger.
   g. + slope.
   h. Trigger mode to norm.

5. Repetively seek between track 00 and track 1 and confirm TP-TK00 timing is within tolerance, (2.7 msec).

NOTE

The step time (track to track time) of the head carriage must be 3 +0.2 -0.0 msec.

6. Confirm output of TP-TKOP is within tolerance (See figure 5-11).

   Track 00 Above +2.5V
   Track 01 Below +0.5V

7. If out of tolerance, perform the following steps:

8. Turn the setscrew of the track 00 sensor counter clockwise to loosen it (rotate 1/2 to 1 turn).

9. Connect and setup the oscilloscope as follows:

   a. Connect channel 1 to TP-STP and channel 2 to TP-TKOP.
   b. Connect probe GND clips to ground.
   c. Vertical deflection to 1V/DIV.
   d. Horizontal deflection to 1msec/DIV.
   e. Connect trigger probe to TP-STP.
   f. EXT trigger.

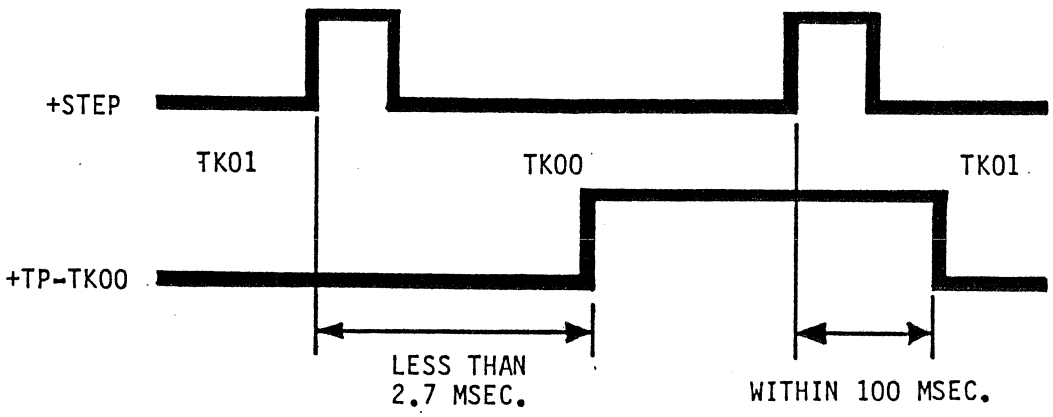


FIGURE 5-11
TRACK 00 SENSOR TIMING

10. Repetitively seek tracks 00-02.

11. Move the Track 00 sensor either right or left, adjust to the standard level, and tighten the set screw. (See figure 5-12).

Standard TP-STP Timing T1= 4.0 to 5.0 msec
T2= 6.0 to 8.0 msec
TP-TKOP output Track 00 +2.5V or above
Track 02 +0.5V or below

NOTE

Move the track 00 sensor right or left for adjustment while pushing the sensor toward the paded surfaces of the frame.

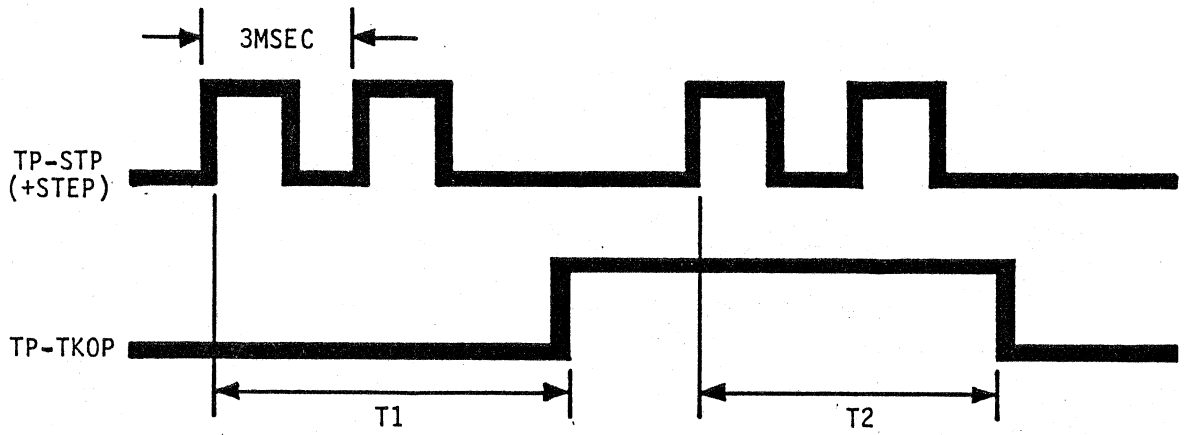


FIGURE 5-12
TRACK T1 AND T2 SENSOR TIMING

5.5 HALF HEIGHT FLOPPY DISK DRIVE TROUBLESHOOTING

All programs and models for the system are supplied on floppy diskettes. The floppy disk drive reads the diskettes and transfers the information to the general purpose computer.

Whenever possible, spare sub-assemblies should be substituted to isolate and correct faults.

The following basic troubleshooting procedure is suggested:

1. Check for obvious problems: equipment not properly cabled, fuse blown, faulty diskettes, etc.

2. Verify that the Power Supply levels at the DC Distribution Panel lie within the limits given in Table 5-6.

3. Be sure the media turns when properly installed in the Drive Unit.

4. Run the diagnostic program. (Section 5.9)

5. Use the information in Table 5-7 as a preliminary guide to isolating the problem.

6. Replace the suspected sub-assembly to verify the diagnosis.

5.5.1 OVERVIEW OF HALF HEIGHT TROUBLESHOOTING AIDS

The following aids will help to diagnose trouble down to the major parts of the Half Height disk drive:

Troubleshooting the disk drive is limited to tracking down the cause of one of the basic malfunctions listed in Table 5-8.

TABLE 5-6
POWER SUPPLY LEVELS

VOLTAGE	RANGE	OUTPUT CURRENT
+ 5V	+4.75V to +5.25V	12 Amps
+24V	+23V to +25V	6 Amps

NOTE

All voltages measured at the power supply distribution panel.

TABLE 5-7
HALF HEIGHT TROUBLESHOOTING GUIDE

SYMPTOM	PROBABLE CAUSE
DRIVE SELECT PROBLEM	SELECT LOGIC ON DRIVE BOARD. THUMBWHEEL SELECT SWITCH ON CONTROL PANEL. USE ONLY ADDRESS 0, 1, 2, or 3.
HEAD POSITIONING PROBLEM	HEAD POSITIONING LOGIC ON DRIVE OR FORMATTING BOARD. DRIVE UNIT NOT RESPONDING TO STEP PULSES.
HEAD LOADING	HEAD LOAD LOGIC ON DRIVE BOARD. HEAD LOAD MECHANISM IN DRIVE UNIT.
ADDRESS CHECK	DRIVE NOT ROTATING. NO DISKETTE IN DRIVE. IMPROPERLY INITIALIZED DISKETTE. MAY INDICATE HEAD POSITIONING PROBLEM (SEE ABOVE). ADDRESS COMPARE LOGIC ON FORMATTING BOARD. INITIALIZE LOGIC ON FORMATTING BOARD.
DATA CHECK	READ OR WRITE ELECTRONICS IN DRIVE UNIT. CRC ERROR LOGIC ON FORMATTING BOARD. ADDRESS VERIFICATION LOGIC ON FORMATTING BOARD.
BITS DROPPED IN DATA WORDS	DRIVER OR RECEIVER ON INTERFACE BOARD. DRIVER OR RECEIVER ON FORMATTING BOARD. DATA OUT BUFFER ON FORMATTING BOARD. DATA IN BUFFER ON FORMATTING BOARD.

TABLE 5-8
TROUBLESHOOTING HALF HEIGHT DISK DRIVE

MALFUNCTION	TROUBLESHOOTING ROUTINE
Power failure	Figure 5-13
Not ready	Figure 5-14
Seek error	Figure 5-15
Read error	Figure 5-16
Write error	Figure 5-17
No head load	Figure 5-18

Troubleshooting these malfunctions is presented in flowchart format, Figures 5-13 through 5-18.

SECTION	TITLE	USE
FIG 5-13 thru FIG 5-18	Half Height Fault Tree	Follow these troubleshooting flow charts if the cause of the problem is not immediately apparent.
5.6.3	Maintenance	This section gives guidelines for maintaining floppy diskettes.
5.8	DSKXxx Test	Use this software disk test to Program check the operation of the Half Height disk drive and the disk interface cards that interfaces them to the system.

5.5.2 HALF HEIGHT FAULT TREES

When it is determined that there is a problem in the Half Height, the fault tree routines of Figures 5-13 through 5-18 should be followed. The following outline discusses the steps involved:

1. First, place power switch in the ON position. The POWER-ON indicator should be illuminated (RED) indicating that power is available within the unit. If the power-on indicator is out check that the power cable is connected and that the fuse is not blown (open).

2. Be sure that a properly initialized diskette is being used. The diskette should be correctly inserted in the drive unit by the following procedure:

   a. Open the drive unit door by pushing the release at the top of the door.

b. Insert the disk fully into the drive until the disk is held by the tab at the right side of the diskette guide.

c. Close the door when the diskette is fully inserted.

3. Check that the drive switches are selected for the assigned logical address (Logical drive 0 thru 3 as selected by the thumbwheel switches).

4. Check that the following front panel switches are in the proper position:

a. Initialize Switch (INIT) - This switch is positioned DOWN except when initializing a diskette.

b. Write Protect Switch (WP) - Normally DOWN except when desiring to write protect logical drive #0.

c. Initial Program Load Switch (IPL) - Normally DOWN except when it is desired for the formatter to read sector 0 of track 00 of logical drive #0 (initial program load).

5. Check error indicators. Certain error conditions may occur during drive operation. Errors are reported to the computer system control program via the status word and to the operator via four front panel indicators. The four indicators are listed below:

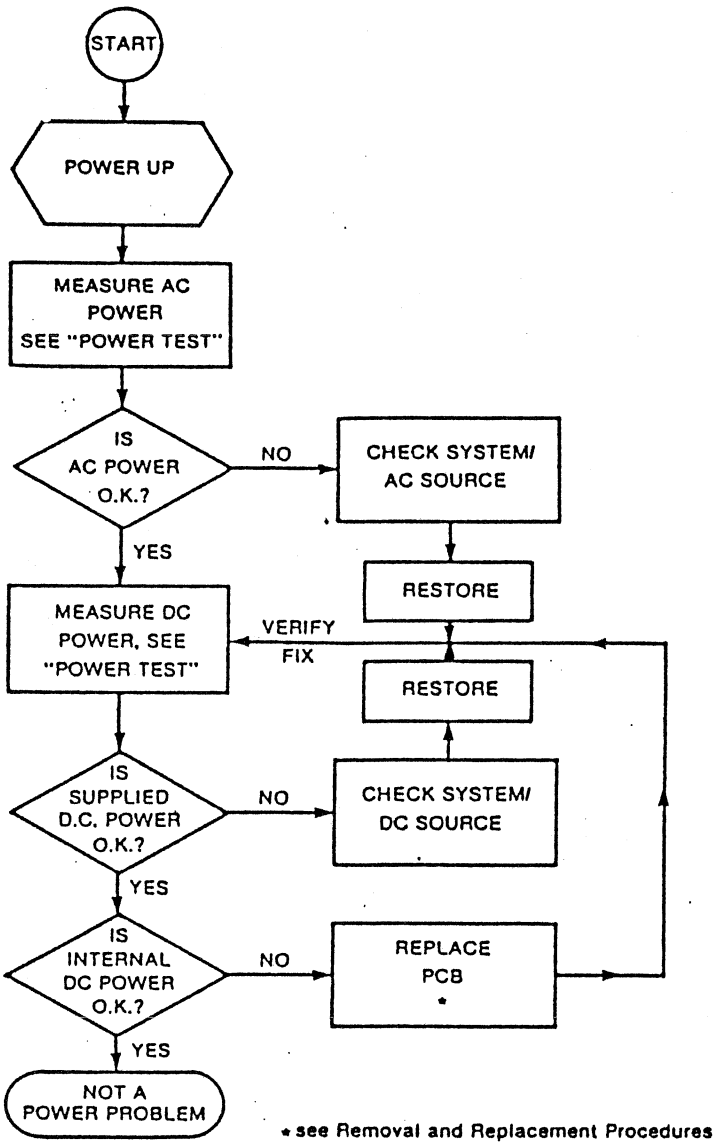
a. Select Error (SEL ERR) - Will illuminate if the computer system issues a command specifying a logical select address that is not currently assigned to any drive.

b. Address Check (ADRS CHK) - Indicator will light if the formatter fails to find and correctly read the address I.D. for the track and sector specified.

c. No Record Found (NO RCRD) - Will illuminate if the formatter fails to find a Data Mark within 1.2 microseconds after a positive seek verification during a read operation. This usually indicates that the diskette is improperly formatted (initialization).

d. Data Check (DATA CHK) - Indicator will light if the formatter cannot read the specified data correctly. This usually means that the formatter detected a Cyclic Redundancy Check (CRC) error (checking for data fields).

6. Perform the floppy disk storage system test (DSKXxx Section 5.7) to determine the area of the Half Height that is not functioning correctly.



911706-0P1

FIGURE 5-13
POWER FAILURE TROUBLESHOOTING ROUTINE

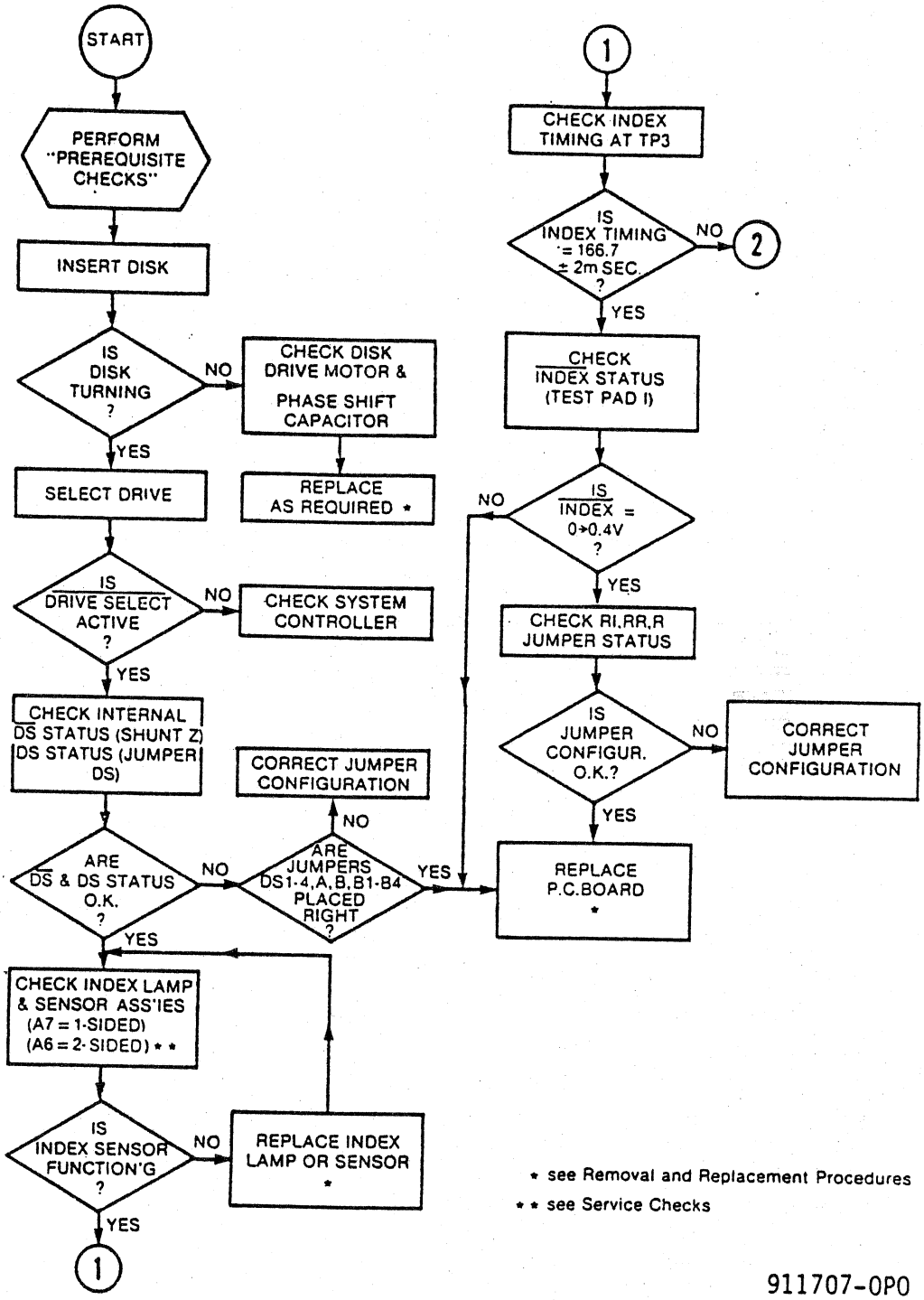


FIGURE 5-14 (SHEET 1 OF 2)
NOT READY TROUBLESHOOTING ROUTINE

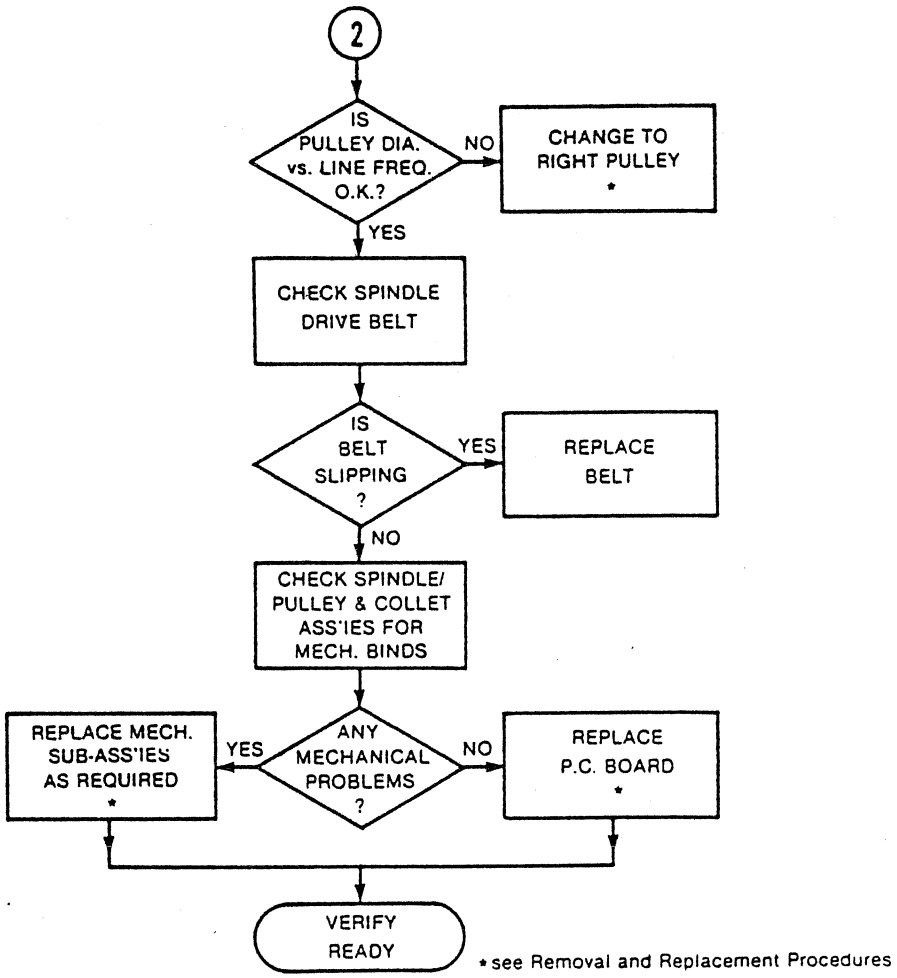


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FIGURE 5-14 (SHEET 2 OF 2)
NOT READY TROUBLESHOOTING ROUTINE

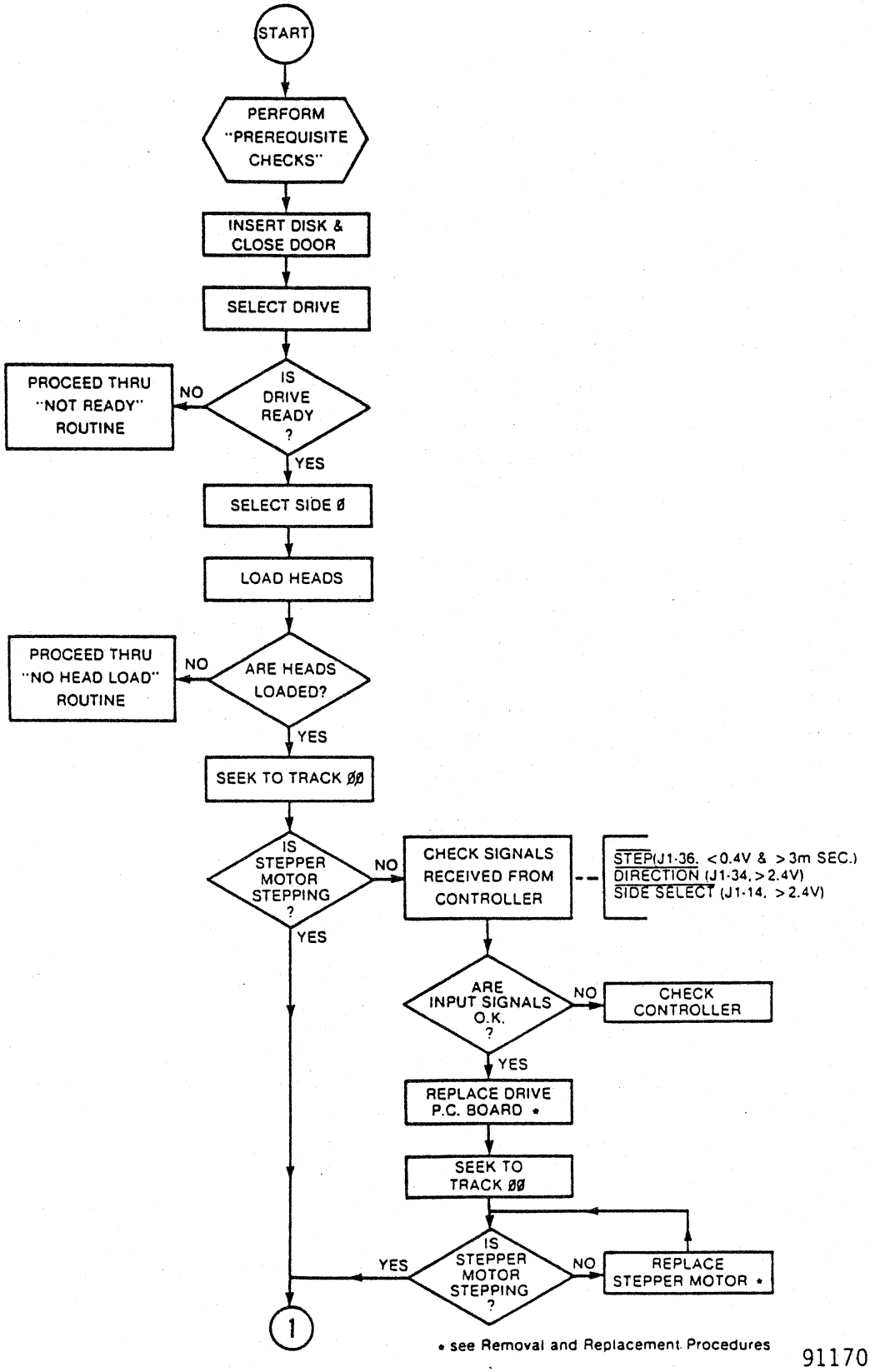

FIGURE 5-15 (SHEET 1 OF 3)
SEEK ERROR TROUBLESHOOTING ROUTINE

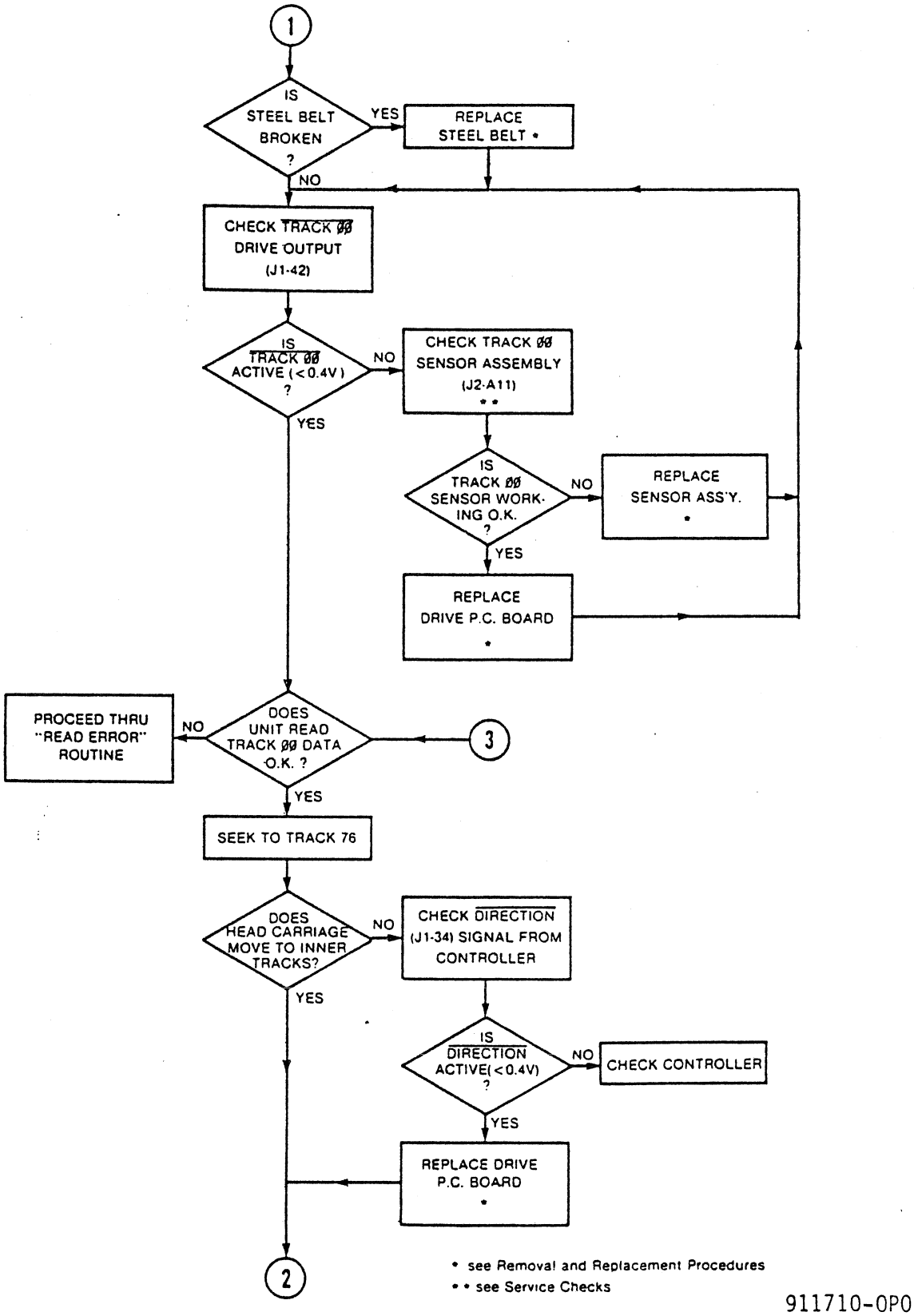

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FIGURE 5-15 (SHEET 2 OF 3)
SEEK ERROR TROUBLESHOOTING ROUTINE

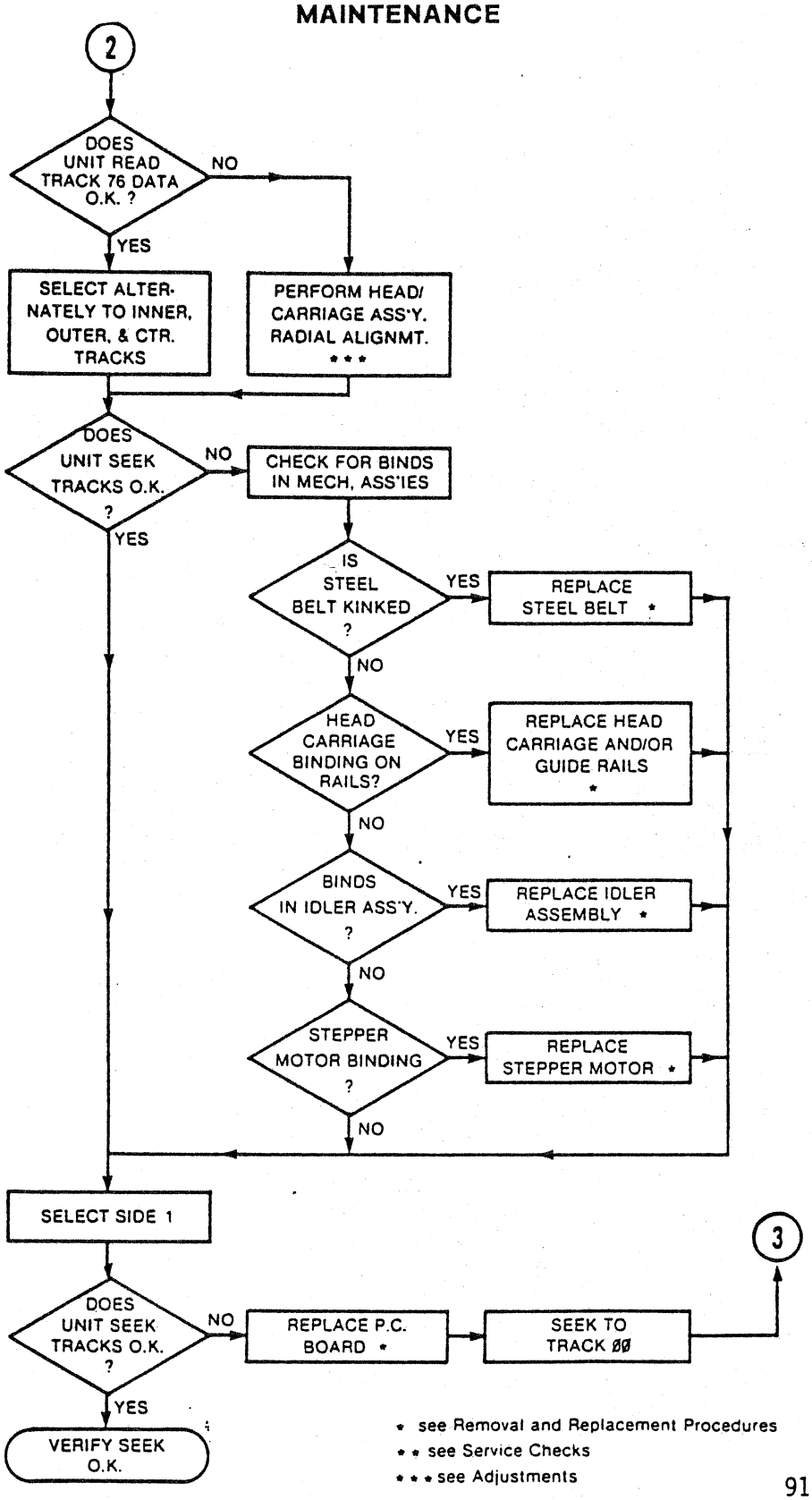
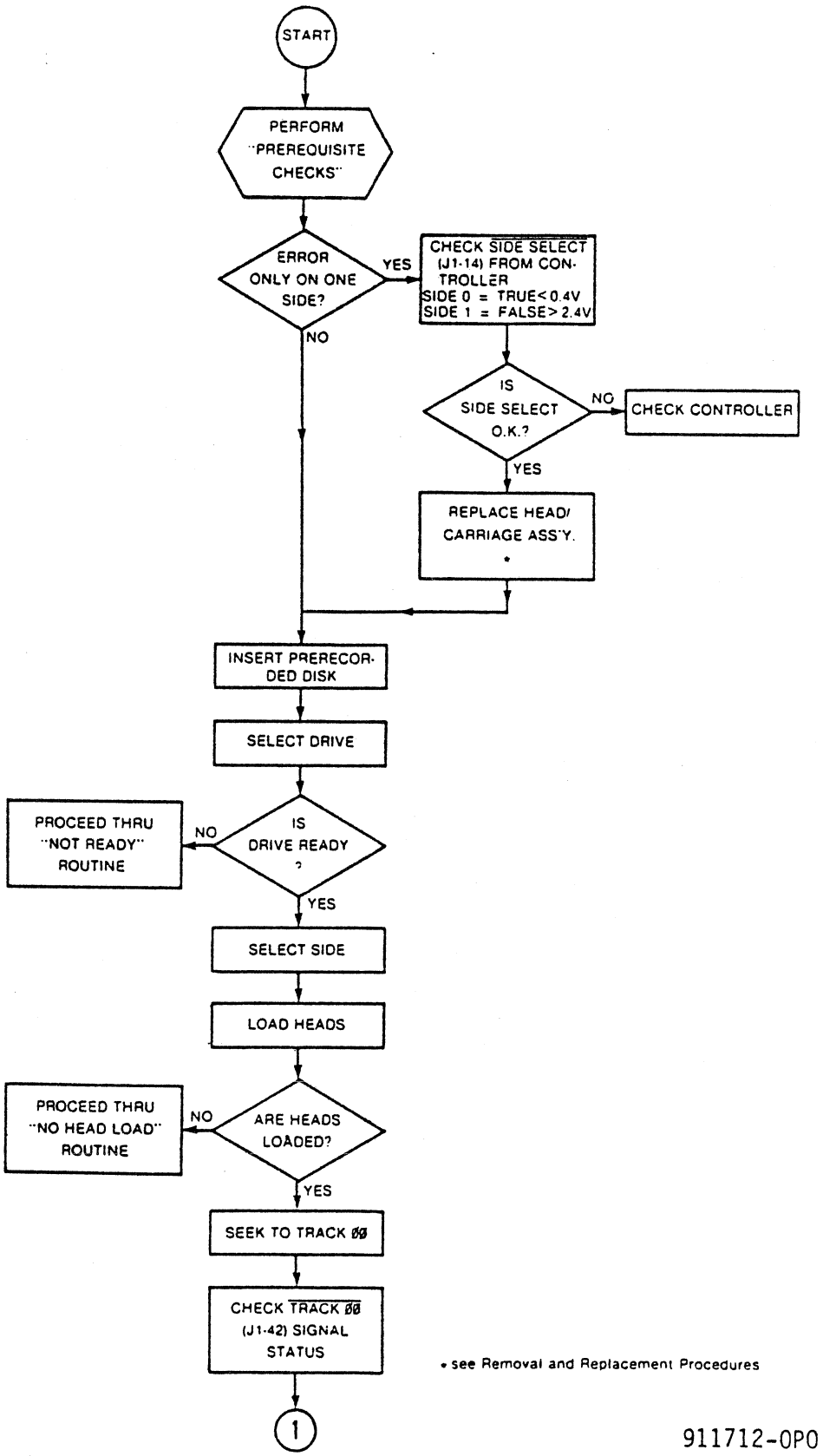


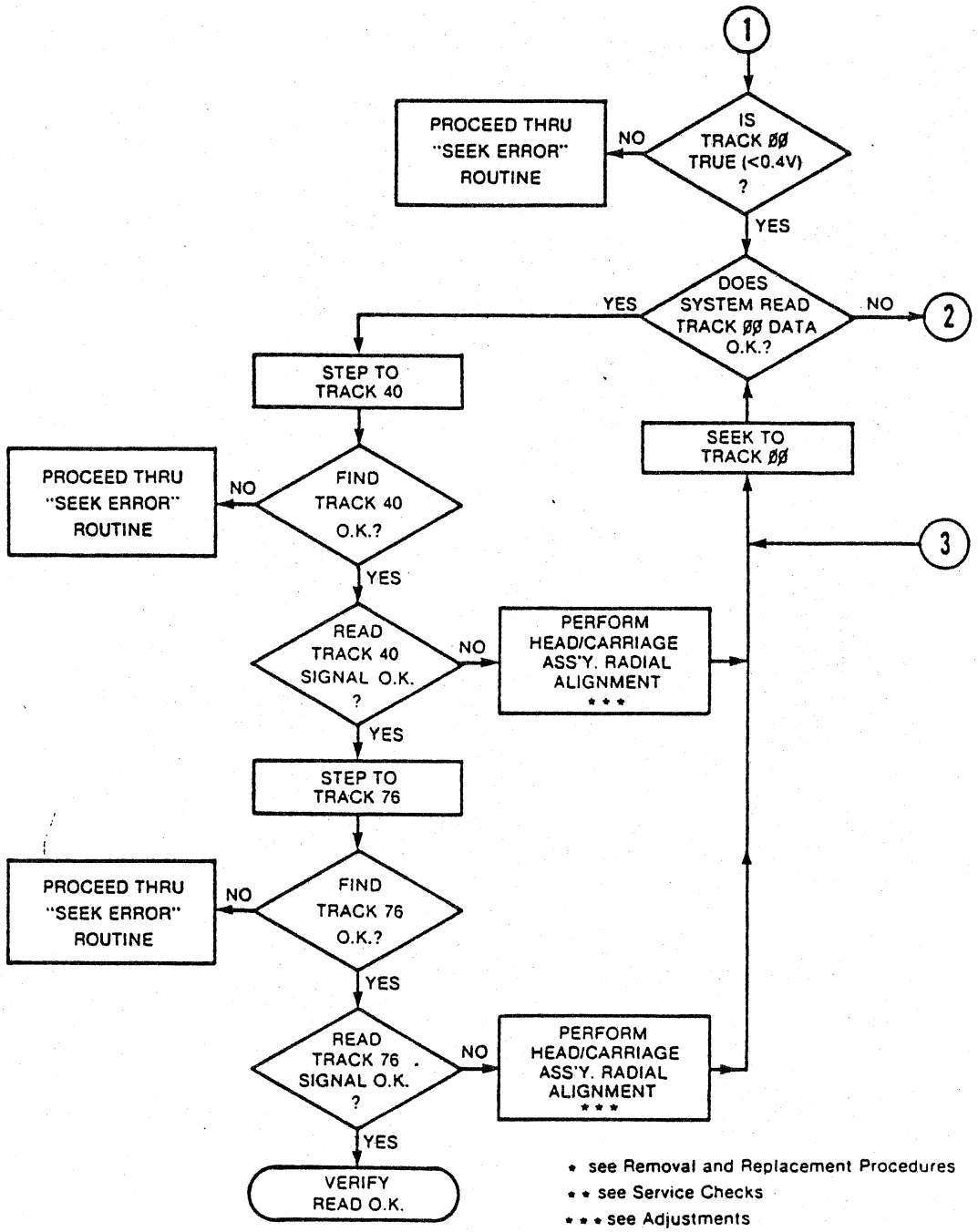
FIGURE 5-15 (SHEET 3 OF 3)
SEEK ERROR TROUBLESHOOTING ROUTINE



* see Removal and Replacement Procedures

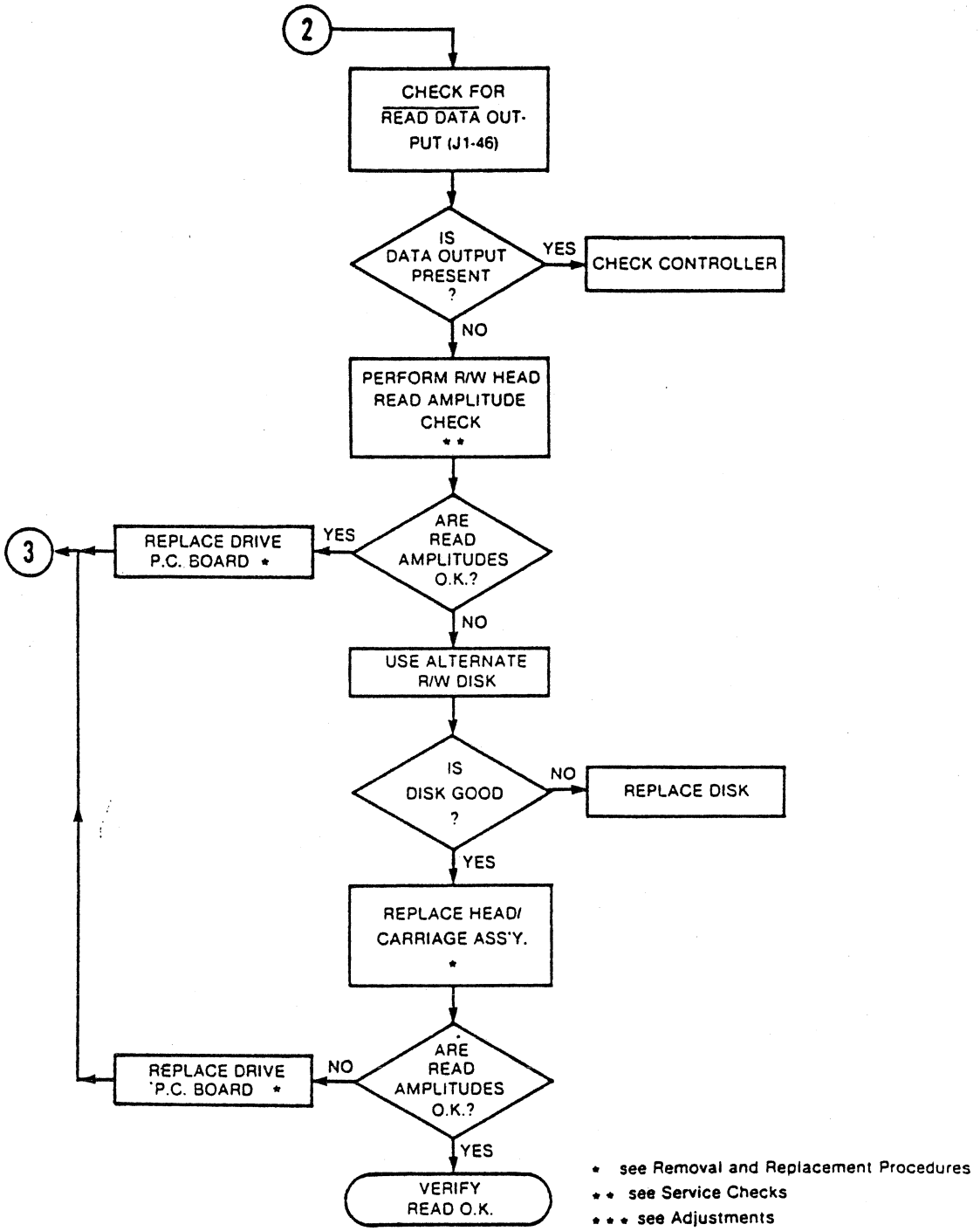
911712-0P0

FIGURE 5-16 (SHEET 1 OF 3)
READ ERROR TROUBLESHOOTING ROUTINE



911713-0P0

FIGURE 5-16 (SHEET 2 OF 3)
READ ERROR TROUBLESHOOTING ROUTINE



911714-0P0

FIGURE 5-16 (SHEET 3 OF 3)
READ ERROR TROUBLESHOOTING ROUTINE

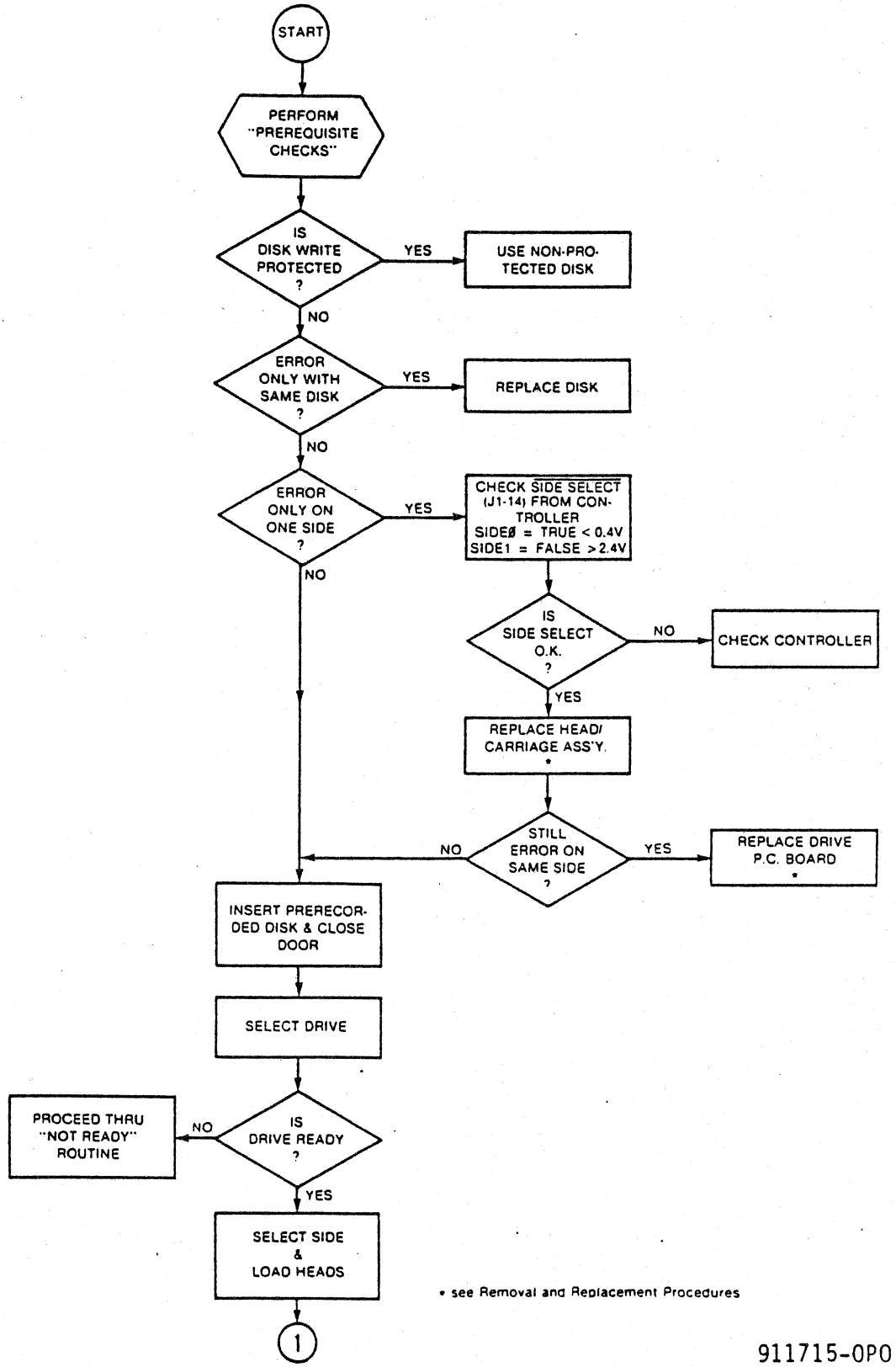
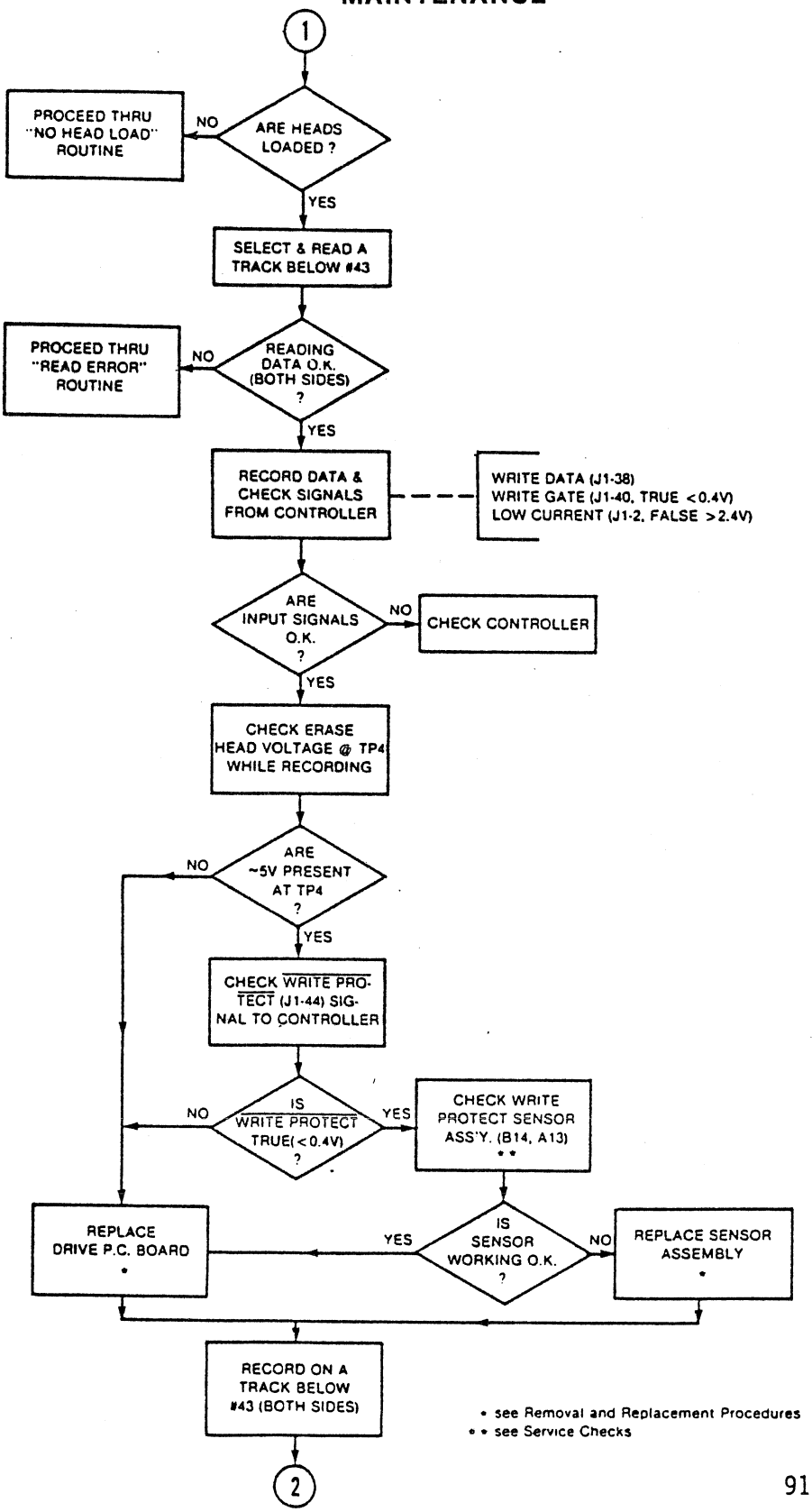
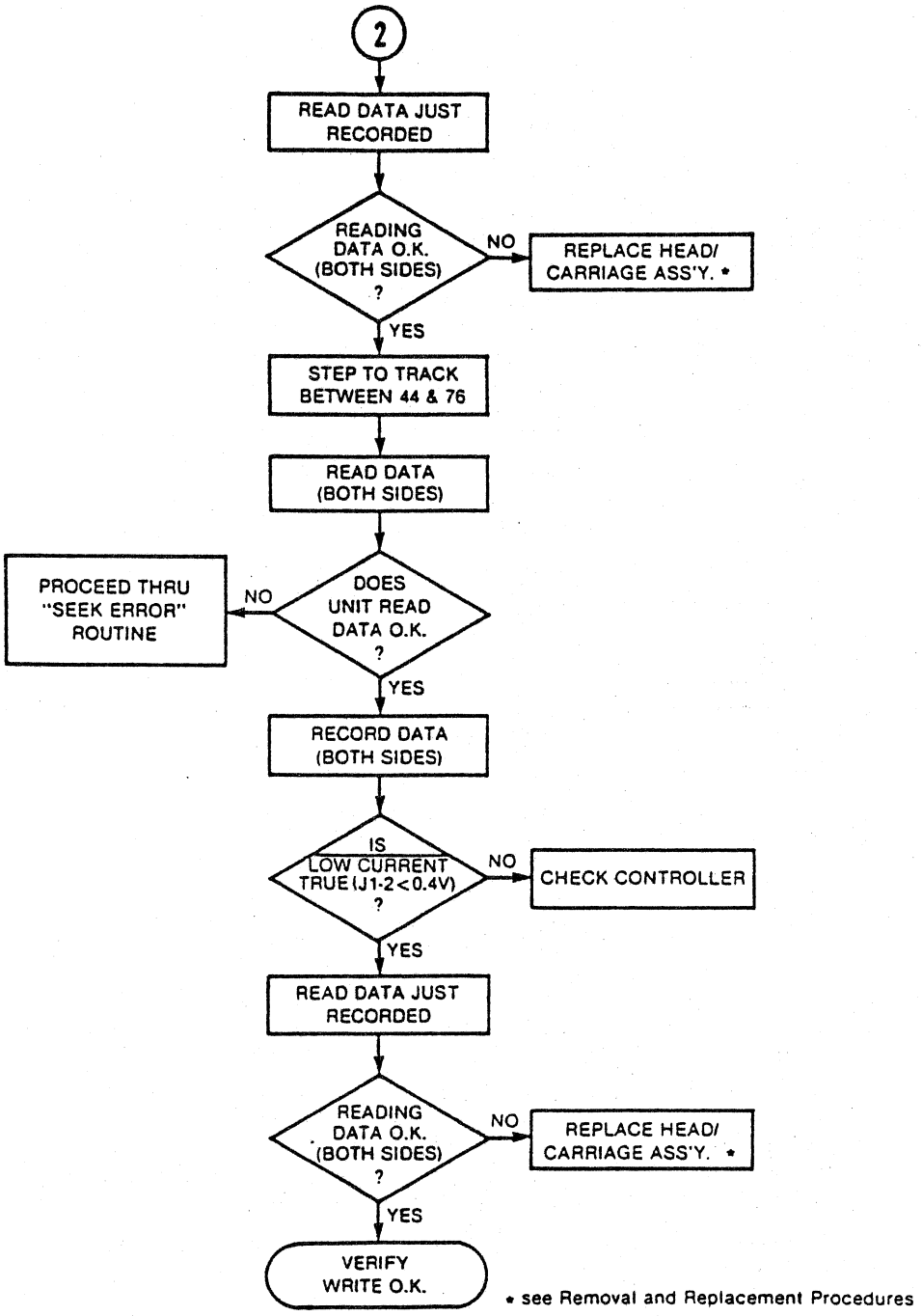


FIGURE 5-17 (SHEET 1 OF 3)
WRITE ERROR TROUBLESHOOTING ROUTINE



911716-0P0

FIGURE 5-17 (SHEET 2 OF 3)
WRITE ERROR TROUBLESHOOTING ROUTINE



911717-0P0

FIGURE 5-17 (SHEET 3 OF 3)
WRITE ERROR TROUBLESHOOTING ROUTINE

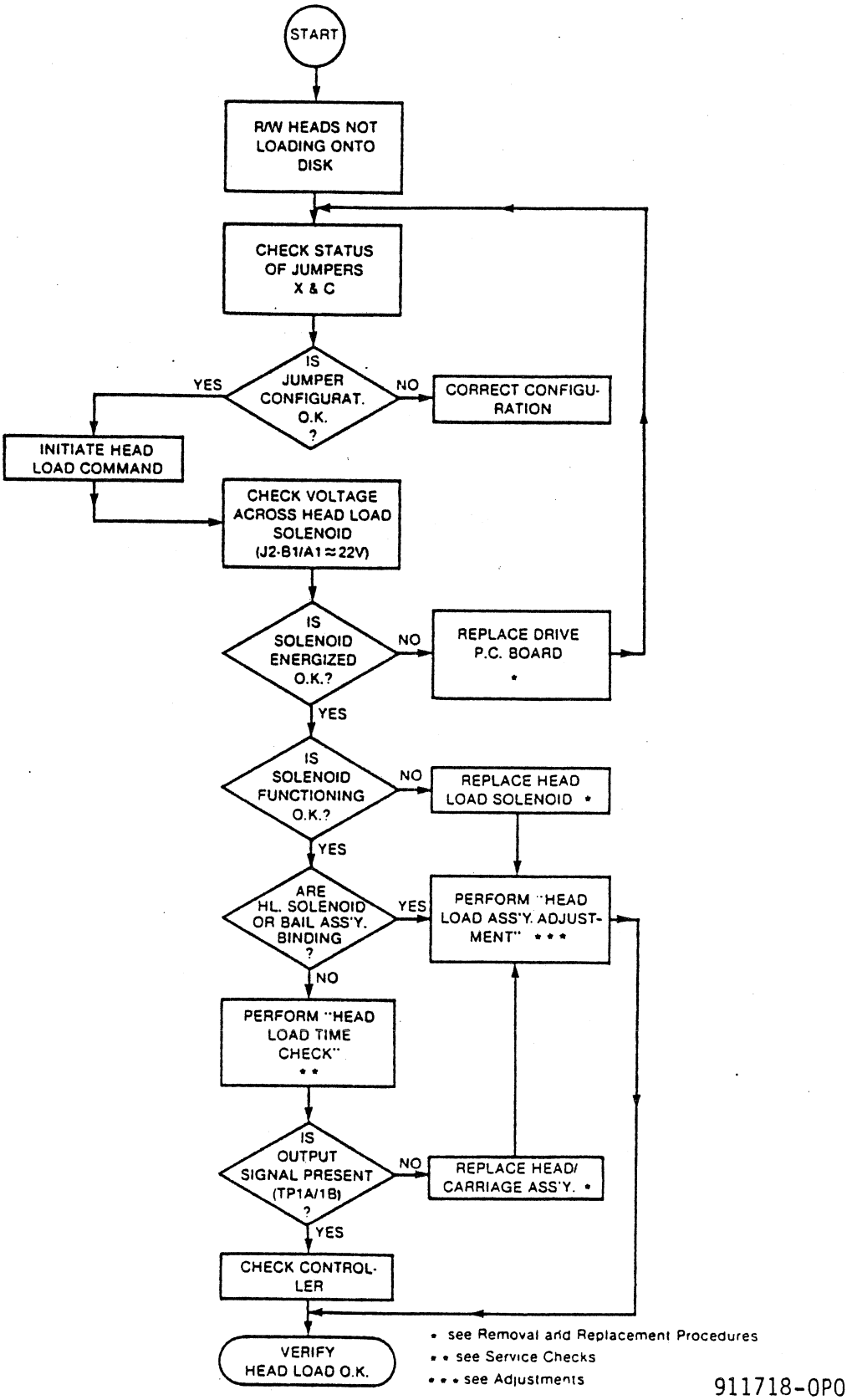


FIGURE 5-18
NO HEAD LOAD TROUBLESHOOTING ROUTINE

5.5.3 MAINTAINING FLOPPY DISKETTES

There are two types of diskette damage: data damage and physical damage. Data damage occurs when the diskette is written on accidentally or comes in contact with a magnetic field; it is corrected by reinitializing and recopying the diskette. Physical damage usually occurs as the diskette wears out; a part of its surface can no longer store data. When this happens, discard the diskette.

If you follow the guidelines given in Section 3, diskette loading and handling, then the only problems you should experience with the floppy diskettes are as follows:

Operations Diskette	This diskette gets little use. The image generation program is read from it once each time the system is booted. It is not written on. Expect physical damage only after a long period of time. To protect this diskette further, remove it from the drive right after the program is loaded.
Model Data Diskettes	These diskettes are read from and written to during the training exercises. Expect them to wear out sooner than the operations diskette.
Diagnostic Diskette	This diskette is read from and written to constantly during troubleshooting. Because it is easy to make a mistake while using this diskette to troubleshoot the equipment, expect a higher rate of data damage. In addition, expect physical damage if the diskette has been used a great deal. Removing the diskette from the drive at the wrong time is one common cause of data damage. To prevent this, always type ABT (abort program) and "FRE" (Free Subroutine) or wait for instructions from the program before removing the diskette.

5.5.3.1 TROUBLESHOOTING A FLOPPY DISKETTE

If you suspect a floppy diskette has data damage or physical damage, follow this procedures:

1. Recopy the appropriate programs onto the suspected diskette by using the backup diskette and the copy diskette procedure given in Section 3.

2. Re-run the same procedure or re-create the situation that caused the error before.

3. If the error is gone, then the data damage has been corrected. If the error is still present, then run the floppy diskette Verification test in the disk diagnostic program DSKXxx (Section 5.8). Note: Verification will erase the programs on the diskette. Certification of the diskette can also be performed by the DSC program Initialize and Certify functions.

4. If certification fails, discard the diskette. If it passes, then the diskette is probably not at fault. Go to the next step.

5. Copy the appropriate programs back onto the certified diskette using the backup diskette and the copy diskette procedure given in Section 3.

5.5.3.2 SYMPTOMS OF A DEFECTIVE FLOPPY DISKETTE

1. A diskette is probably defective if the error message S0000 (NDL system error: diskette data defective) is printed, if any DU0002 through DU0007 diskette unit error message is printed, or if the system error, LUN 0005 occurs. See Section 3 for an explanation of these errors.

2. If the S and DU errors still happen after the diskette has been verified and recopied, then suspect the disk drive. If two drives are present, try the other drive.

3. If programs can't be loaded from the diskettes, then suspect the disk drive, the interface cards in the backpanel, or the interconnecting cables.

5.6 FLOPPY DISK DRIVE PERFORMANCE TEST (DSKXxx)

The Half Height floppy disk drive units communicates with the CPU computer through the disk interface card and the DMA interface card. The Half Height maintains a status word that reflects processing and error conditions within the drive based on the last command issued to the drive. DSKXxx uses this word for error information. "Status" in the following sections refers to the contents of this word.

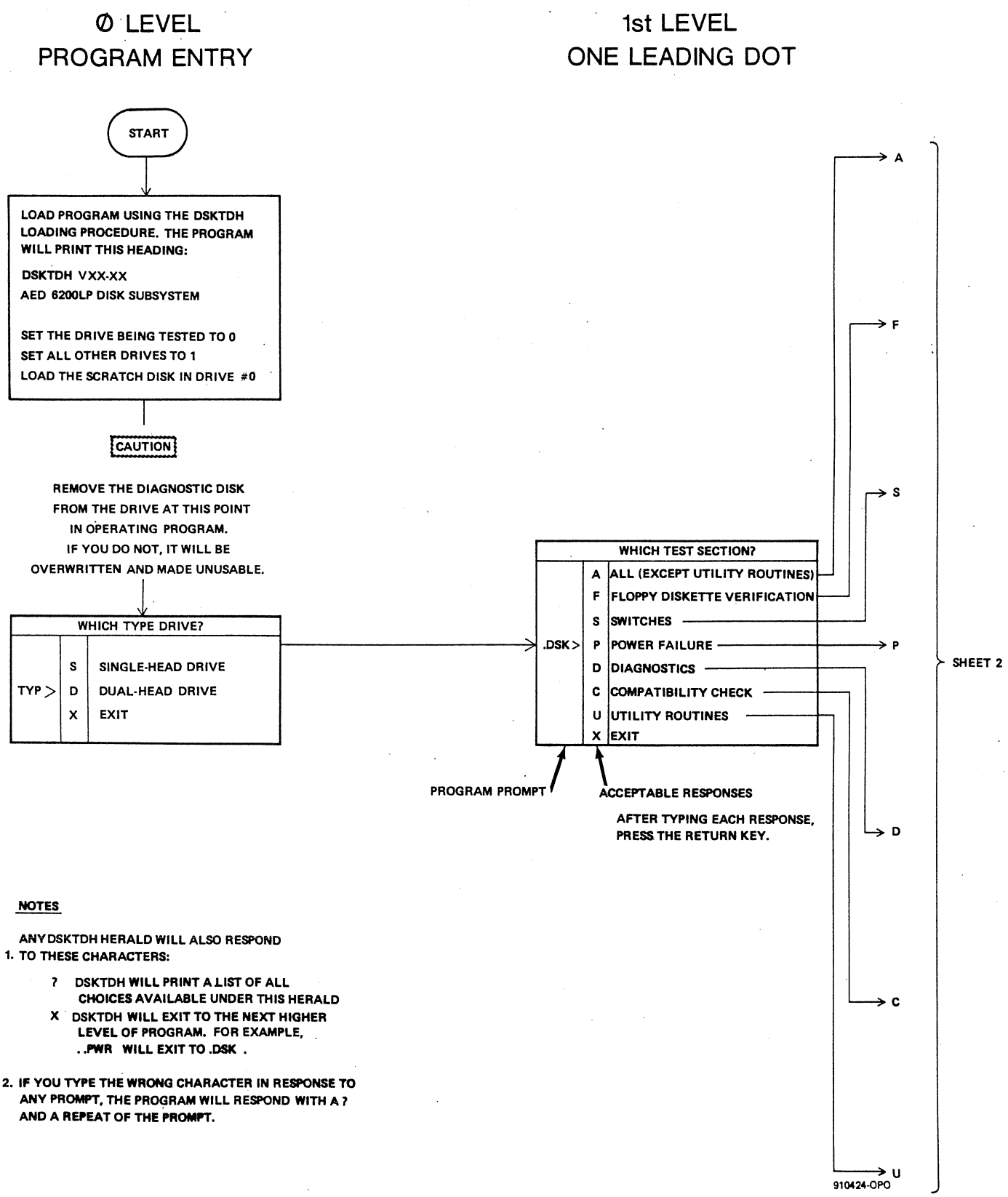
5.6.1 DSKXxx FUNCTION

The DSKXxx program tests the diskette, the mechanical operation of the disk drive, and the data handling circuitry of the drive. In addition, a set of utility routines are provided for custom testing.

DSKXxx is divided into these six major functional test sections, each of which contains a series of individual tests or routines:

1. Floppy diskette verification
2. Switches
3. Power failure
4. Diagnostics
5. Compatibility check
6. Utility routines

The purpose and testing philosophy of each individual test is discussed separately in the following text under the appropriate major functional heading. See Figure 5-19 for an overview of the structure of the entire program.



NOTES

ANY DSKTDH HERALD WILL ALSO RESPOND
1. TO THESE CHARACTERS:

   ? DSKTDH WILL PRINT A LIST OF ALL CHOICES AVAILABLE UNDER THIS HERALD

   X DSKTDH WILL EXIT TO THE NEXT HIGHER LEVEL OF PROGRAM. FOR EXAMPLE, . .PWR WILL EXIT TO .DSK .

2. IF YOU TYPE THE WRONG CHARACTER IN RESPONSE TO ANY PROMPT, THE PROGRAM WILL RESPOND WITH A ? AND A REPEAT OF THE PROMPT.

FIGURE 5-19, (SHEET 1 OF 2)
DSKXxx OPERATING FLOWCHART

2nd LEVEL
TWO LEADING DOTS

3rd LEVEL
THREE LEADING DOTS

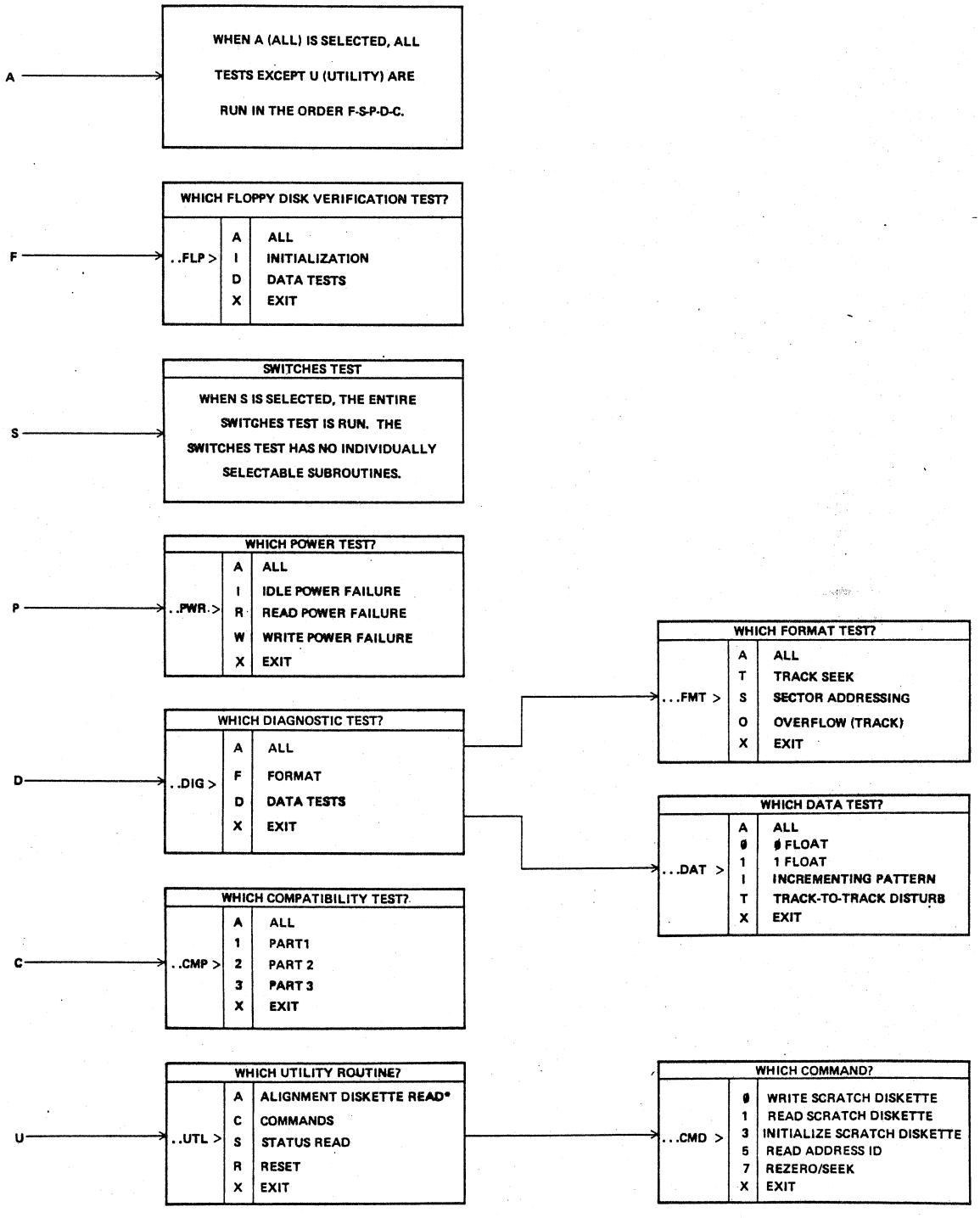


FIGURE 5-19, (SHEET 2 OF 2)
DSKXxx OPERATING FLOWCHART

SENSE SWITCH	CONDITION	EXPLANATION
1	DOWN	Do not loop on failed tests; print passed messages and test names.
	UP	Loop on failed test; do not print passed messages and test names.
2	DOWN	Print error messages
	UP	Do not print error messages.
3	DOWN	Sound tone on each error message.
	UP	Do not sound tone on each error message.
4	DOWN	Continue with current test on error.
	UP	Stop the current test on error.

5.6.1.1 VERIFICATION TESTS

These tests verify that the floppy diskette is not defective. They assume that the hardware is working correctly. Because they overwrite existing data, they cannot be used to test a diskette containing information that must be saved. Be sure that the disk is not write protected and that the IN switch is on.

I	Initialization	This test verifies that the diskette can be initialized. It first writes the enter-record gaps, the track sector address identification, and the initial sector data records, then reads the diskette to verify that initialization was done correctly.
D	Data Tests	This test verifies that data can be written to and read from the diskette. It writes a pattern into every word on the diskette, then reads it back. The test is repeated for four different patterns. If either test fails rerun same test. Upon 2nd failure discard diskette.

5.6.1.2 SWITCHES TEST

The switch test checks operation of the write protect switch, sensing of an open drive door, and operation of the drive select switches. The thumbwheel drive select switches are set to all usable values, and the test checks to see that a selected drive can be accessed and that the other drives cannot be accessed. There are no individually selectable tests within the switches test. Error message will point to specific failure area. Usually suspect select logic on drive boards or thumbwheel switches.

5.6.1.3 POWER FAILURE TESTS

These tests verify that loss of power will not destroy data on the diskette. All three tests first write five adjacent tracks of data on the diskette, then position the head for operation on the center track; then they ask the operator to turn the Half Height power off, then on. Individual variations in the tests are as follows:

I	Idle Power Failure	The head is idling above the diskette when the operator turns the drive off/on. All five tracks are then read for errors.
R	Read Power Failure	The head is reading from the center track when the operator turns the drive off/on. All five tracks are then read for errors.
W	Write Power Failure	The head is writing on the center track when the operator turns the drive off/on. The four other tracks are then read for errors.

If any of the above tests fail suspect controller and drive boards, see Figure 5-16, 5-17.

5.6.1.4 DIAGNOSTIC FORMAT AND DATA TESTS

These tests check the mechanical operation of the disk drive mechanism and the electrical operation of the data handling circuitry. They assume that the diskette is not defective. Be sure to read error messages carefully as they will point in the direction of failure.

T	Track Seek	This test verifies that the disk drive can locate all the tracks on the diskette. The head is moved back and forth from the outermost track (0) to the innermost track (4C), to 0, to 4B, to 0, to 4A, to 0, to 40 and so on until all tracks have been located. Upon failure use Figure 5-15.
S	Sector Addressing	This test verifies that the disk drive can correctly locate every sector on the diskette. First, it writes the address of each sector in the first word of that sector. This is done for every sector of every track on the diskette. Next, it reads all the first words back to verify that the disk drive can locate all the sectors. Upon failure use Figure 5-5.
O	Overflow (Track)	This test verifies that the head can move from track to track while reading data. It issues a single command to the drive to read 33 consecutive sectors of data.

O	Overflow (Track)	Since each track contains 32 sectors, the head is forced to move to another track during the read operation. Upon failure see Figure 5-5.
0	0 Float	This test checks for stuck bits in the hardware. Eighteen words of 1's are written on the diskette, then read out. Next, the first bit is changed to 0 and the entire pattern is again read out. Each time the cycle is repeated, the 0 bit is advanced one position until it has occupied every position in the eighteen words. Upon failure suspect both drive and formatter boards.
1	1 Float	This test checks for stuck bits in the hardware. It is the same as the 0 Float test, except that a 1 is floated through a field of 0's. Upon failure suspect both drive and formatter boards.
I	Incrementing Pattern	This test verifies that all hardware registers can have all possible combinations of two successive numbers written into them. The incrementing pattern used ensures that each hardware register (consisting of a 4-bit IC) can go from any 0-to-16 value to any 0-to-16 value. Upon failure suspect both drive and formatter boards.
T	Track-To-Track Disturb	This test verifies that the head can write data on a given track without disturbing data on adjacent tracks. All tracks on the diskette are checked. The test first writes to the track under test, then writes to both adjacent tracks, then reads the track under test for errors. Upon failure use Figure 5-16 and 5-17. Also check azimuth and cat's eye alignments.

5.6.1.5 COMPATIBILITY TEST

This test verifies that different drives can write to and read from the same diskette. In the following description, the two drives under test are referred to as the first and second drives. All three tests must be run in order on one diskette.

1	Part 1	After the diskette has been loaded in the first drive, this test writes data into the odd sectors of all even tracks.
2	Part 2	After the diskette has been moved to the second drive, this test first reads the data from the odd sectors of all even tracks, then writes data into the even sectors of all odd tracks.

3	Part 3	After the diskette has been moved back to the first drive, this test reads all sectors of all tracks.

In the event of failure in any one of the above tests perform: cat's eye alignment and retest.

5.6.1.6 UTILITY ROUTINES

The utility routines control the disk drive while its circuitry is being diagnosed with test equipment. The action of each routine on the disk drive is explained in the DSKXxx operation Section.

5.7 DSKXxx TEST OPERATING PROCEDURE

The DSKXxx program is found on the diagnostic diskette. All DSKXxx test functions are controlled by the terminal and by the general purpose computer's sense switches. All error and information messages are printed on the terminal. The procedure to load and run it is as follows:

STEP	INSTRUCTION	RESPONSE
Step 1-6:	Memory Initialization. Run Steps 1-6 once whenever the General Purpose computer is turned on. Skip to step 7 if these steps have already been performed as part of another program load.	
1.	Set MODE to HALT	
2.	Press RESET	
3	Set data switches to 000F	
4.	Set MODE to RUN	
5.	Press PC up	
6.	Press LOAD up	IDLE light comes on, data lights display 0011.
Steps 7-10:	System Loader Program Operation	
7.	Load the diagnostic diskette in the drive set to 0. Set other drives to 1.	
8.	Press RESET down	
9.	Press IPL	
10.	Press START	Terminal prints: ESX-980 AUG 82 MONX18

STEP	INSTRUCTION	RESPONSE
11.	Type: //EXECUTE,FDO,DSKXxx Press the RETURN key.	Terminal prints: DSKXxx VXX-XX E&S HALF HEIGHT DISK SUBSYSTEM SET THE DRIVE BEING TESTED TO 0 SET ALL OTHER DRIVES TO 1 LOAD THE SCRATCH DISKETTE IN DRIVE #0
12.	Set sense switches to desired positions (see above).	.DSK>
13.	Remove the diagnostic diskette from the system and insert the scratch diskette in the drive to be tested. If the diagnostic diskette is not removed, DSKXxx may write on and damage it.	None
14.	Set the drive being tested to 0 and set all other drives to 1.	None
15.	Type one of the appropriate responses below: ? = What responses are available S = Single head drive D = Dual head drive X = Exit	.DSK>
16.	Type the appropriate responses below: A = All F = Floppy disk V = verification S = Switches P = Power failure D = Diagnostics C = Compatibility U = Utility X = Exit	Terminal will print prompt instructions for selected test.
17.	Follow the prompts as printed on the Data terminal.	See printout examples Section 5.7.

5.7.1 INDIVIDUAL TEST OPERATING PROCEDURES

The following tests and commands require further operator action after they have been selected:

TESTS	COMMANDS
ALL	Read Address ID
SWITCHES	Write Scratch Diskette
POWER	Read Scratch Diskette
COMPATIBILITY	Initialize Scratch Diskette Rezero/Seek

Operation of each of the above is covered separately in the following sections for clarification. Each of the following sections assumes that you have run steps 11-14 of the main operating procedure first. See Figure 5-19 for the DSKTST operating flowchart.

5.7.1.1 OPERATION OF THE ALL TEST (.DSK>A)

When you type A in response to the .DSK> prompt, the terminal will print the following set of instructions. Perform each step as it is printed. The ADDR CK and SET ERROR lights will illuminate during check, and it is a normal function of the tests.

Running Time: 45 minutes

```
ESX-980 AUG 82 MONX18
//EXECUTE,FD0,DSKXxx.

DSKXxx    V01-01
E&S HALF HEIGHT DISK SUBSYSTEM

SET THE DRIVE BEING TESTED TO 0
SET ALL OTHER DRIVES TO 1
LOAD THE SCRATCH DISK IN DRIVE *0

TYPE>?
SINGLE-HEAD DRIVE
DUAL-HEAD DRIVE
XIT (EXIT)
?
TYP>D
.DSK>?
SW1=1:LOOP & SUPPRESS NONERROR MESSAGES
SW2=1:SUPPRESS ERROR MESSAGES
SW3=1:SUPPRESS BELL
SW4=1:ABORT ON ERROR
ALL (EXCEPT UTILITY ROUTINES)
FLOPPY DISKETTE VERIFICATION
SWITCHES
```

```
POWER FAILURE
DIAGNOSTICS
COMPATIBILITY CHECK
UTILITY ROUTINES
XIT (EXIT)
?
.DSK>A
RAISE THE INIT SWITCH & TYPE RETURN WHEN READY
DISK INITIALIZATION PASSED
SIDE=1:
DISK INITIALIZATION PASSED
SIDE=0:
DISK DATA TEST PASSED
SIDE 1:
DISK DATA TEST PASSED
SIDE=0:
LOWER THE INIT SWITCH & TYPE RETURN WHEN READY
RAISE THE WP SWITCH & TYPE RETURN WHEN READY
LOWER THE WP SWITCH & TYPE RETURN WHEN READY
OPEN THE DOOR ON DRIVE #0 & TYPE RETURN WHEN READY
CLOSE THE DOOR ON DRIVE #0 & TYPE RETURN WHEN READY
SET THE DRIVE BEING TESTED TO 1
SET THE DRIVES NOT BEING TESTED TO 3
TYPE RETURN WHEN READY
SET THE DRIVES NOT BEING TESTED TO 2
TYPE RETURN WHEN READY
SET THE DRIVES NOT BEING TESTED TO 2
SET THE DRIVES NOT BEING TESTED TO 0
TYPE RETURN WHEN READY
SET THE DRIVE NOT BEING TESTED TO 3
TYPE RETURN WHEN READY
SET THE DRIVES BEING TESTED TO 3
SET DRIVES NOT BEING TESTED TO 1
TYPE RETURN WHEN READY
SET THE DRIVES NOT BEING TESTED TO 0
TYPE RETURN WHEN READY
SET THE DRIVE BEING TESTED TO 0
SET THE DRIVES NOT BEING TESTED TO 2
TYPE RETURN WHEN READY
SET THE DRIVES NOT BEING TESTED TO 1
TYPE RETURN WHEN READY
SWITCH TESTS PASSED
SET THE DRIVE BEING TESTED TO 0
SET ALL OTHER DRIVES TO 1
LOAD THE SCRATCH DISK IN DRIVE #0
LOWER ALL DRIVE SWITCHES
TYPE RETURN WHEN READY
POWER DOWN THE DISK DRIVE & TYPE RETURN WHEN READY
POWER UP THE DISK DRIVE & TYPE RETURN WHEN READY
IDLE POWER FAILURE TEST PASSED
AFTER THE TONE, POWER DOWN THE DISK DRIVE
TYPE RETURN WHEN READY
```

```
POWER UP THE DISK DRIVE & TYPE RETURN WHEN READY
READ POWER FAILURE TEST PASSED
AFTER THE TONE, POWER DOWN THE DISK DRIVE & TYPE RETURN WHEN
READY
POWER UP THE DISK DRIVE & TYPE RETURN WHEN READY
READ POWER FAILURE TEST PASSED
AFTER THE TONE, POWER DOWN THE DISK DRIVE AND TYPE RETURN
WHEN READY.
POWER UP THE DISK DRIVE AND TYPE RETURN WHEN READY.
WRITE POWER FAILURE TEST PASSED
TRACK SEEK TEST PASSED
SIDE=1:
TRACK SEEK TEST PASSED
SIDE=0:
SECTOR ADDRESSING TEST PASSED
SIDE=1:
SECTOR ADDRESSING TEST PASSED
SIDE=0:
TRACK OVERFLOW TEST PASSED
SIDE=1:
TRACK OVERFLOW TEST PASSED
SIDE=0:
0 FLOAT TEST PASSED
1 FLOAT TEST PASSED
INCREMENTING PATTERN TEST PASSED
TRACK TO TRACK DISTURB TEST PASSED
SIDE=1:
TRACK TO TRACK DISTURB TEST PASSED
SIDE=0:
COMPATIBILITY CHECK PART 1 PASSED
SIDE=1.
COMPATIBILITY CHECK PART 1 PASSED
SIDE=0:
PUT DISK IN OTHER DRIVE.
DRIVE IN USE=0, OTHERS=1.
TYPE RETURN WHEN READY
COMPATIBILITY CHECK PART 2 PASSED
SIDE=1:
COMPATIBILITY CHECK PART 2 PASSED
SIDE=0:
PUT DISK IN OTHER DRIVE.
DRIVE IN USE=0, OTHERS=1.
TYPE RETURN WHEN READY
COMPATIBILITY CHECK PART 3 PASSED
SIDE=1:
COMPATIBILITY CHECK PART 3 PASSED
SIDE=0:
```

NOTE: When the compatibility check is run as part of the All test, the scratch diskette is not moved back and forth between drives.

5.7.1.2 SWITCHES TEST (.DSK>S)

When you type S in response to the .DSK> prompt, the terminal will print the following set of instructions. Perform each step as it is printed. Set drive being tested to 0 and all other drives to 1. Set thumbwheels as indicated even if a second drive is not present. "Drive switches" in the following printout are the WP, INIT, and IPL rocker switches.

Running time: 5 minutes

```
.DSK>S
RAISE THE WP SWITCH & TYPE RETURN WHEN READY
LOWER THE WP SWITCH & TYPE RETURN WHEN READY
OPEN THE DOOR ON DRIVE #0 & TYPE RETURN WHEN READY
CLOSE THE DOOR ON DRIVE #0 & TYPE RETURN WHEN READY
SET THE DRIVE BEING TESTED TO 1
SET THE DRIVES NOT BEING TESTED TO 3
TYPE RETURN WHEN READY
SET THE DRIVES NOT BEING TESTED TO 2
TYPE RETURN WHEN READY
SET THE DRIVE BEING TESTED TO 2
SET THE DRIVES NOT BEING TESTED TO 0
TYPE RETURN WHEN READY
SET THE DRIVES NOT BEING TESTED TO 3
TYPE RETURN WHEN READY
SET THE DRIVE BEING TESTED TO 3
SET THE DRIVES NOT BEING TESTED TO 1
TYPE RETURN WHEN READY
SET THE DRIVES NOT BEING TESTED TO 0
TYPE RETURN WHEN READY
SET THE DRIVE BEING TESTED TO 0
TYPE RETURN WHEN READY
SET THE DRIVES NOT BEING TESTED TO 2
TYPE RETURN WHEN READY
SET THE DRIVES NOT BEING TESTED TO 1
TYPE RETURN WHEN READY
SWITCH TESTS PASSED
SET THE DRIVE BEING TESTED TO 0
SET ALL OTHER DRIVES TO 1
LOAD THE SCRATCH DISK IN DRIVE #0
LOWER ALL DRIVE SWITCHES
TYPE RETURN WHEN READY
.DSK>
```

5.7.1.3 FAILURE TESTS (.DSK>P)

When you type P in response to the .DSK> prompt, the terminal will print the ..PWR> herald. Depending on your response, the program will print all or part of the following set of instructions. Perform each step as it is printed.

Running time: 1 minute

```
.DSK>P
..PWR>A
POWER DOWN THE DISK DRIVE & TYPE RETURN WHEN READY
POWER UP THE DISK DRIVE & TYPE RETURN WHEN READY
IDLE POWER FAILURE TEST PASSED
AFTER THE TONE, POWER DOWN THE DISK DRIVE & TYPE RETURN
  WHEN READY
POWER UP THE DISK DRIVE & TYPE RETURN WHEN READY
READ POWER FAILURE TEST PASSED
AFTER THE TONE, POWER DOWN THE DISK DRIVE & TYPE RETURN
  WHEN READY
POWER UP THE DISK DRIVE & TYPE RETURN WHEN READY
WRITE POWER FAILURE TEST PASSED
..PWR>X
.DSK>
```

5.7.1.4 COMPATIBILITY TEST (..CMP>)

Compatibility verifies that two different drives can write to and read from the same diskette. For this operating procedure, the two drives being tested for compatibility will be referred to as the first and second drives. They can be in the same system under the control of the same Visual computer, or they may be in completely separate systems under the control of two different Visual computers. The term "set the drive" used below means "set the thumbwheel switch above the drive to the number indicated".

Running time: 5 minutes

STEP	INSTRUCTION	RESPONSE
1.	Bring up DSKXxx in the computer(s) associated with each disk drive by following the DSKXxx operation procedure given in Section 5.8. Bring the programs(s) up to the ..CMP> herald.	See Section 5.8

STEP	INSTRUCTION	RESPONSE
2.	Load the scratch diskette in the first disk drive under test.	
3.	Set the first drive under test to 0	
4.	Set all other drives in this system to 1	
5.	Enter 1 in response to ..CMP> herald, then press RETURN.	After 60 seconds, terminal prints: COMPATIBILITY CHECK PART 1 PASSED ..CMP>
6.	Remove the scratch diskette from the first drive under test, and load it in the second drive under test.	
7.	Set the second drive under test (the one now containing the scratch diskette) to 0.	
8.	Set all other drives in this system to 1.	
9.	Enter 2 in response to the ..CMP> herald, press RETURN.	After 90 seconds, terminal then prints: COMPATIBILITY CHECK PART 2 PASSED ..CMP>
10.	Remove the scratch diskette from the second drive under test and load it back into the first drive under test.	
11.	Set the first drive under test (the one now containing the scratch diskette) to 0	
12.	Set all other drives in this system to 1.	

STEP	INSTRUCTION	RESPONSE
13.	Enter 3 in response to the ..CMP> herald, press RETURN.	After 30 seconds, terminal then prints: COMPATIBILITY CHECK PART 3 PASSED ..CMP>
14.	Remove the scratch diskette from the drive and set all drives back to their normal setting.	
15.	Exit from the DSKXxx program	

Following is a printout of a complete successful DSKTST compatibility check:

```
?
..CMP>A
COMPABILITY CHECK PART 1 PASSED
SIDE=1:
COMPATIBILITY CHECK PART 1 PASSED
SIDE=0:
PUT DISK IN OTHER DRIVE.
DRIVE IN USE=0, OTHERS=1.
TYPE RETURN WHEN READY
COMPATIBILITY CHECK PART 2 PASSED
SIDE=1:
COMPATIBILITY CHECK PART 2 PASSED
SIDE=0:
PUT DISK IN OTHER DRIVE.
DRIVE IN USE=0, OTHERS=1.
TYPE RETURN WHEN READY
COMPATIBILITY CHECK PART 3 PASSED
SIDE=1:
COMPATIBILITY CHECK PART 3 PASSED
SIDE=0:
..CMP>X
.DSK>U
```

5.7.1.5 UTILITY ROUTINES AND COMMANDS (..UTL>)

The utility routines and commands are used to control the disk drive while its circuitry is being diagnosed with test equipment. Each is discussed separately below.

5.7.1.6 ALIGNMENT DISKETTE READ ROUTINE (..UTL>A)

The alignment diskette read routine allows you to read any track of the alignment diskette once or continuously.

The alignment diskette is a special diskette used to align the Half Height.

When you type A in response to the ..UTL> herald, the terminal will print the following set of instructions. Perform each step as directed. Set sense switch 2 down to read the track once; set it up to read the track continuously. To stop a continuous read, set sense switch 2 down.

X's in the following printout indicate where you must enter the track number.

```
..UTL>A
RAISE THE WP SWITCH & TYPE RETURN WHEN READY
WHICH TRACK, (0-40)? XX
LOWER THE WP SWITCH & TYPE RETURN WHEN READY
..UTL>
```

5.7.1.7 STATUS READ ROUTINE (..UTL>S)

"Status" is the status word of the Half Height disk drive. When you type S in response to the ..UTL> herald, the status word will be read, if there are no errors in it, the entire printout of this test will be as follows:

```
..UTL>S
..UTL>
```

If an error is detected, an error header will be printed along with the contents of the status word in hexidecimal as follows:

```
..UTL>S
FAILED********
STATUS ERROR    STATUS=08A3
..UTL>
```

5.7.1.8 RESET ROUTINE (..UTL>R)

The reset routine clears error flags in the Half Height status word. When you type R in response to the ..UTL> herald, the status word will be cleared. The entire printout of this test will be as follows:

```
..UTL>R
..UTL>
```

5.7.1.9 WRITE SCRATCH DISKETTE COMMAND (...CMD>0)

This routine allows you to write data on any track of the diskette. When you type 0 in response to the ..CMD> herald, the routine will respond with prompts requesting the track and data required. X's in the following printout indicate where you must enter information:

```
...CMD>0
WHICH SIDE (0 OR 1) ?0
WHICH TRACK, (0-4C)? XX
WHAT DATA, (0-FFFF)/XXXX
...CMD>
```

5.7.1.10 READ SCRATCH DISKETTE COMMAND (...CMD>1)

This routine allows you to read data from any track of the diskette. It also checks the Half Height status word after the data is read. When you type 1 in response to the ...CMD> herald, the routine will respond with a prompt requesting the track to be read. The data is not printed out; this test is intended only to aid in test equipment diagnosis of the Half Height circuit cards. X's in the following printout indicate where you must enter the track number:

```
...CMD>1
WHICH SIDE (0 OR 1)? 0
WHICH TRACK, (0-4C)? XX
...CMD>
```

5.7.1.11 INITIALIZE SCRATCH DISKETTE COMMAND (...CMD>3)

This routine allows you to initialize any track of the diskette. When you type 3 in response to the ...CMD> herald, the routine will respond with prompts requesting you to raise the initialize switch, enter the track number, and lower the initialize switch. X's in the following printout indicate where you must enter the track number:

```
...CMD>3
WHICH SIDE (0 OR 1)? 0
RAISE THE INIT SWITCH & TYPE RETURN WHEN READY
WHICH TRACK, (0-4C)? XX
LOWER THE INIT SWITCH & TYPE RETURN WHEN READY
...CMD>
```

5.7.1.12 READ ADDRESS ID COMMAND (...CMD>5)

This routine allows you to read the address of any track of the diskette. When you type 5 in response to the ...CMD> herald, the routine will respond with a prompt requesting you to enter the track number. The routine will respond with two four-digit hexidecimal numbers. The first two digits of the first number is the track identification number. The second four-digit number is the sector identification number.

20 in the following printout indicates where you must enter the desired track number:

```
...CMD>5
WHICH SIDE (0 OR 1)? 0
WHICH TRACK, (0-5C)? 20
2000,1D01
...CMD>
```

5.7.1.13 REZERO/SEEK COMMAND (...CMD>7)

The routine allows you to return the head to the 0 track, then go to any specified track on the diskette. When you type 7 in response to the ...CMD> herald, the routine will respond with a prompt requesting you to enter the track number. X's in the following printout indicate where you must enter the track number:

```
...CMD>7
WHICH SIDE (0 OR 1)? 0
WHICH TRACK, (0-4C)? XX
...CMD>
```

5.7.2 DSKXxx ERRORS

DSKXxx identifies errors by printing a heading consisting of the name of the test, the word failed, and a string of asterisks. Following the heading will be information relative to the test just performed. For example:

```
DISK INITIALIZATION FAILED********
     TRACK ID          SECTOR ID
     EXPECTED 1B00       0901
     RECEIVED 1B3F       F6FC
```

"Expected" is the data that should have been received from the diskette or hardware; "received" is the actual incorrect data that was received. The errors are self-explanatory. To find the problem causing the error, take into account the contents of the message and the function of the test routine that generated it.

5.8 SUBASSEMBLY REMOVAL AND REPLACEMENT

The Half Height Cabinet includes the following subassemblies:

1. Formatter and Drive Electronics.
2. Control Panel.
3. Power Supply.
4. Drive Unit(s).
5. Furnished Interface (optional).
6. AC/DC Distribution Modules.

The Half Height Slave unit includes the following subassemblies:

1. Formatter and Drive Electronics.
2. Control Panel.
3. Power SUpply.
4. Drive Unit(s).

5.8.1 FORMATTING AND DRIVE BOARDS

The Half Height circuitry is implemented on one large Formatter Board and a smaller Drive Electronics Board. The Formatting and Drive Boards are accessed through the removal of the Top Cover from the Half Height Chassis. (See Figure 5-20.)

The Drive Board is held in place by four (4) screws which are located in three corners of the board and in the middle of the outside edge. There is a power cable, a cable between the drive and formatter boards and from one to two cables between the drive board and the disk drives. Once the retaining screws are removed, the drive board can be elevated for easy removal of the cables.

The Formatter board is held in place by four nylon nuts and two nylon posts. Two flat ribbon cables, one to the drive board and one to the I/O and power cable must be disconnected in order to complete the removal of the Formatter.

5.8.2 POWER SUPPLY

The Power Supply is held in place by four (4) screws which enter from the bottom of the chassis.

5.8.3 DRIVE UNITS

Each Drive Unit is held in place by two screws inserted through the bottom of the chassis. The screws are located in the inside flange(s) of the drive, and it is important that they be replaced in the same locations when reinserting the drives. Once the screws have been removed, the drive unit can be pulled forward to expose the logic and power cable attached to the back of the drive. Remove the two cable retaining screws and push the cable out of its drive socket.

CAUTION

Do not pull on the cable or the plug cable connections may be damaged.

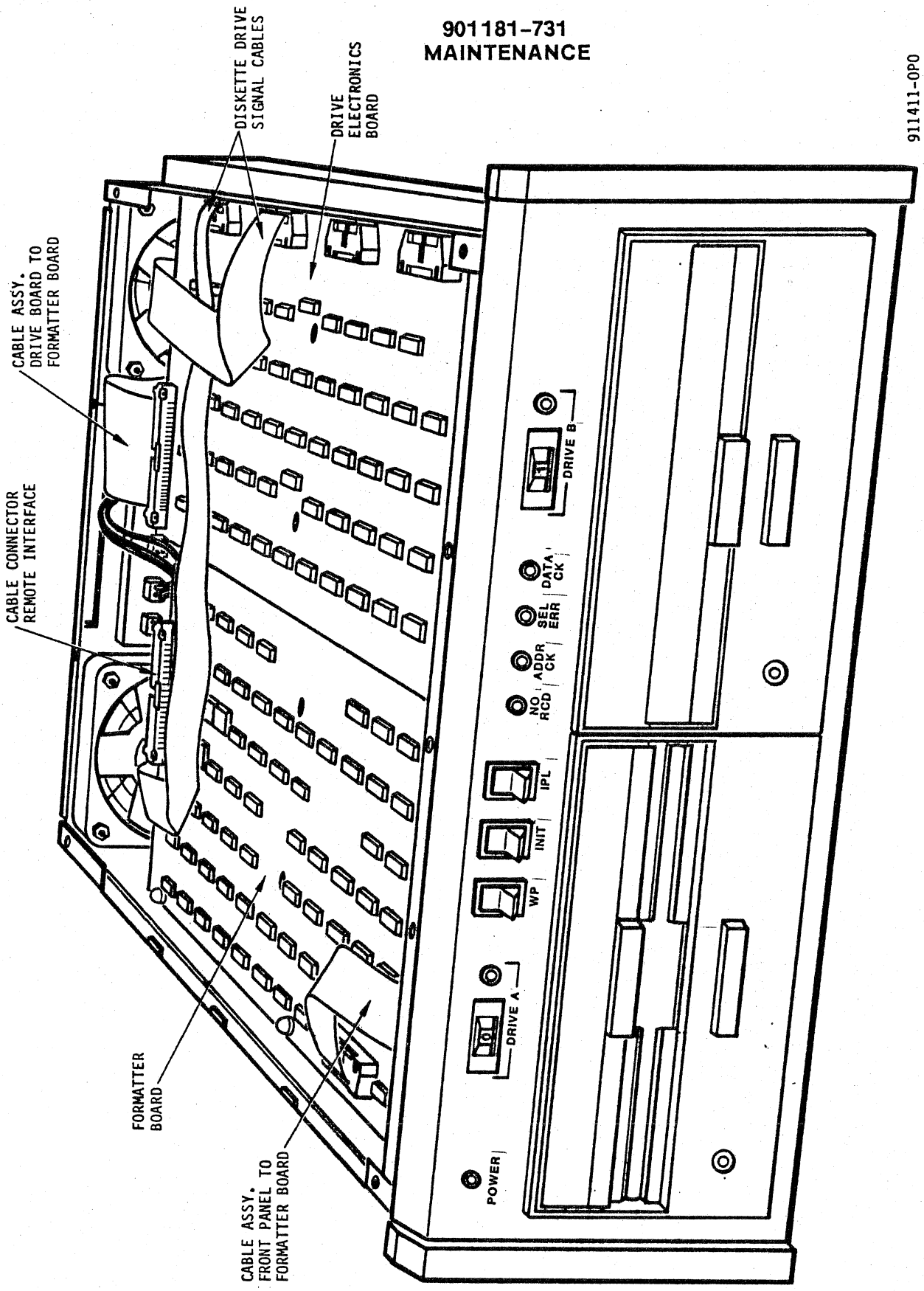


FIGURE 5-20
DRIVE AND FORMATTER BOARD LOCATION

SECTION 6

PARTS LIST

6.1 INTRODUCTION

This Section contains the electrical and significant mechanical parts for the disk drive unit. When ordering parts please include Reference Designation, Description, Quantity, and E&S Part Number.

6.1.1 MAJOR ASSEMBLIES

The E&S Half Height Double Density Floppy Disk System is composed of a cabinet, front panel, top cover, two floppy disk drives, a formatter board, a dual drive electronics board, a power supply, a power distribution system, and fan assembly. A cable between the formatter and an external interface connects the Half Height to a separate computer. The major assemblies are listed and on subsequent pages each major assembly is further broken down into component parts.

200470-100 CARD, HALF HEIGHT DRIVE

REF DESIG/ITEM	NAME/DESCRIPTION	E&S P/N
U38 U43	IC, BUFFER-INVERT	807011-646
U9 U13 U14	IC, NAND, 2-INPUT	807400-642
U8 U27 U28 U30 U32 U40 U51	IC, NAND, 2-INPUT	807400-646
U33 U39	IC, NAND, 2-INPUT	807401-646
U2 U7 U12 U55	IC, NOR, 2-INPUT	807402-646
U1 U6 U11 U16 U21 U26 U29	IC, NAND, 2-INPUT	807403-642
U50 U54	IC, AND, 2-INPUT	807408-646
U20 U25	IC, NAND, 3-INPUT	807410-646
U44 U45	IC, SHIFT-REGISTER	807413-646
U3 U4 U5 U34 U37	IC, INVERTER, HEX	807416-646
U15	IC, NAND, 4-INPUT	807420-642
U35	IC, NAND, 8-INPUT	807430-646
U17 U18 U19 U22 U23 U24 U41 U46 U49	IC, FLIP/FLOP	807474-646
U36 U52	IC, MULTIPLEXER	807653-646
U10 U42 U47	IC, MULTIVIBRATOR	807690-646
U48 U53	IC, SHIFT-REGISTER	807695-446
U31	RES NET, 330/390	807720-391
ITEM 1	CARD, BASIC	200470-500
M2	CABLE, DC PWR	200473-100
ITEM 2	JUMPER	801148-007
J1 J2	CONN, RT ANGLE	801290-026
J5	CONN, RT ANGLE	801290-050
M6	STANDOFF, 1/4 NYL	802378-205
R1 R3 R6 R13 R14 R15 R16 R17 R18 R19 R20 R23	RES, 1K .25W 5%	803201-102
R5	RES, 110 .25W 5%	803201-111
R4	RES, 220 .25W 5%	803201-221
R2	RES, 27K .25W 5%	803201-273
R22	RES, 300K .25W 5%	803201-304
R25 R26 R27	RES, 330 .25W 5%	803201-331
R12 R21	RES, 390 .25W 5%	803201-391
R8 R9 R10 R11	RES, 47K .25W 5%	803201-473
R7	RES, 5.1K .25W 5%	803201-512

200470-100 CARD, HALF HEIGHT DRIVE (CONT)

REF DESIG/ITEM	NAME/DESCRIPTION	E&S P/N
C9 C10 C11 C12 C13 C14 C15 C16 C17 C18 C19 C20 C21 C22 C23 C24 C25 C26 C27 C28 C29 C30 C31 C32 C33 C34 C35 C36 C37 C38	CAP, .01uf 10% 1KV	804103-103
C1	CAP, 100pf 500V 5%	804104-101
C8	CAP, 100uf 16V 20%	804134-107
C3 C4 C5 C6 C7	CAP, 22uf 16V 20%	804134-226
C2	CAP, 4.7uf 35V 20%	804134-475
CR2	DIODE, ZENER	810747-001
CR1 CR3 CR4 CR5 CR6	DIODE	810914-001
Q1	TRANSISTOR	823640-001
Q2	TRANSISTOR	825137-001

200470-101 CARD, HALF HEIGHT DRIVE

REF DESIG/ITEM	NAME/DESCRIPTION	E&S P/N
ITEM 1	CARD, BASIC	200470-500
ITEM 2	JUMPER	801148-007
M2	CABLE, DC PWR	200473-100
M6	STANDOFF, 1/4 NYL	802378-205
C1	CAP, 100pf 500V 5%	804104-101
C2	CAP, 4.7uf 35V 20%	804134-475
C3 C4 C5 C6 C7	CAP, 22uf 16V 20%	804134-226
C8	CAP, 100uf 16V 20%	804134-107
C9 C10 C11 C12 C13 C14 C15 C16 C17 C18 C19 C20 C21 C22 C23 C24 C25 C26 C27 C28 C29 C30 C31 C32 C33 C34 C35 C36 C37 C38	CAP, .01uf 50V 20%	804115-103
CR2	DIODE, ZENER	810747-001
CR1 CR3 CR4 CR5 CR6	DIODE	810914-001
J1 J2	CONN, RT ANGLE	801290-026
J5	CONN, RT ANGLE	801290-050
Q1	TRANSISTOR	823640-001
Q2	TRANSISTOR	825137-001
R1 R3 R6 R13 R14 R15 R16 R17 R18 R19 R20 R23	RES, 1K .25W 5%	803201-102
R2	RES, 27K .25W 5%	803201-273
R4	RES, 220 .25W 5%	803201-221
R5	RES, 110 .25W 5%	803201-111
R7	RES, 5.1K .25W 5%	803201-512
R8 R9	RES, 47K .25W 5%	803201-473
R12 R21	RES, 390 .25W 5%	803201-391
R22	RES, 300K .25W 5%	803201-304
R25 R26 R27	RES, 330 .25W 5%	803201-331
U1 U6 U16 U21 U26 U29	IC, NAND, 2-INPUT	807403-642
U2 U7 U55	IC, NOR, 2-INPUT	807402-646
U3 U4 U5 U34 U37	IC, INVERTER, HEX	807416-646
U8 U27 U28 U30 U32 U40 U51	IC, NAND, 2-INPUT	807400-646
U9 U13 U14	IC, NAND, 2-INPUT	807400-642
U10 U47	IC, MULTIVIBRATOR	807690-646
U15	IC, NAND, 4-INPUT	807420-642
U17 U18 U19 U22 U23 U24 U41 U46 U49	IC, FLIP/FLOP	807474-646
U20	IC, NAND, 3-INPUT	807410-646
U33 U39	IC, NAND, 2-INPUT	807401-646

200470-101 CARD, HALF HEIGHT DRIVE (CONT)

REF DESIG/ITEM	NAME/DESCRIPTION	E&S P/N
U38 U43	IC, BUFFER-INVERT	807011-646
U35	IC, NAND, 8-INPUT	807430-646
U31	RES NET, 330/390	807720-391
U36 U52	IC, MULTIPLEXER	807653-646
U44 U45	IC, SHIFT-REGISTER	807413-646
U48 U53	IC, SHIFT-REGISTER	807695-446
U50 U54	IC, AND, 2-INPUT	807408-646

200471-100 CD, HALF HEIGHT FORMATTER B1

REF DESIG/ITEM	NAME/DESCRIPTION	E&S P/N
	CONN, RT ANGLE	801290-026
	CONN, RT ANGLE	801290-050
	SOC, DIP, 14-PIN	801611-514
	SOC, DIP, 16-PIN	801611-516
	WIRE, 30AWG UL1432	802068-005
ITEM 1	CARD, BASIC	200471-500
ITEM 2	CABLE, DC PWR	200473-100
ITEM 4	STANDOFF, 1/4 HEX	802272-005
C1 C9 C15	CAP, 100pf 500V 5%	804104-101
C2 C16	CAP, 1uf 35V 10%	804102-105
C3 C5	CAP, 10pf 500V 5%	804104-100
C4	CAP, .068uf 100V 5%	804192-683
C6	CAP, 1.5uf 35V 10%	804102-155
C8 C10 C13	CAP, 220pf 500V 5%	804104-221
C12	CAP, 470pf 500V 5%	804104-471
	CAP, .01uf 50V 20%	804115-103
C14 C17	CAP, .01uf 50V 20%	804115-104
C18	CAP, 100uf 16V 20%	804134-107
CR1 CR2 CR3 CR4 CR5	DIODE	810914-001
R1 R3	RES, 220 .25W 5%	803201-221
R2	RES, 330 .25W 5%	803201-331
R4	RES, 15K .25W 5%	803201-153
R5	RES, 200 .25W 5%	803201-201
R6	RES, 180 .25W 5%	803201-181
R7	RES, 51K .25W 5%	803201-513
R9 R11	RES, 620 .25W 5%	803201-621
R10	RES, 75 .25W 5%	803201-750
R12	RES, 6.8K .25W 5%	803201-682
R13 R18	RES, 22 .25W 5%	803201-220
R14 R17 R19 R20	RES, 110 .25W 5%	803201-111
R15 R16	RES, 390 .25W 5%	803201-391
R21 R22 R29	RES, 1.5K .25W 5%	803201-152
R23 R25 R31	RES, 1K .25W 5%	803201-102
R24	RES, 10K .25W 5%	803201-103
R26	RES, 56 .25W 5%	803201-560
R27	RES, 12K .25W 5%	803201-123
R28	RES, 100 .25W 5%	803201-101
R30 R32	RES, 39K .25W 5%	803201-393
R33	RES, 10.0K .25W 1%	803414-100
R34	RES, 30K .25W 5%	803201-303
R35	RES, 4.7K .25W 5%	803201-472
Q1 Q2 Q5	TRANSISTOR	823640-001
Q3 Q4	TRANSISTOR	823646-001
U1 U10 U19 U21 U34 U43 U44 U45 U48 U76 U79 U82 U83 U87 U88 U96 U98 U101 U112 U114 U115 U124 U130 U138	IC, FLIP/FLOP	807474-646

200471-100 CD, HALF HEIGHT FORMATTER (CONT)

REF DESIG/ITEM	NAME/DESCRIPTION	E&S P/N
U2 U59 U64 U104 U139 U144 U153	IC, NOR, 3-INPUT	807439-646
U3 U39 U51 U70 U86 U94 U120 U127 U141 U154 U158	IC, NAND, 3-INPUT	807410-646
U6 U12 U14 U15 U17 U25 U26 U27 U29 U1127	IC, NAND, 2-INPUT	807403-642
U7 U9 U31 U35 U37 U50 U53 U55 U68 U71 U108 U152 U156 U157	IC, NAND, 2-INPUT	807400-646
U8 U143	IC, INVERTER, HEX	807416-055
U11 U18 U30 U40 U42 U61 U66 U117 U140	IC, INVERTER, HEX	807416-646
U13 U16	RES NET, 330/390	807520-331
U20 U62 U122 U135 U146 U151 U159	IC, COMPARATOR	807685-246
U22 U24 U33 U46 U56 U57 U67 U75 U97 U100 U132 U147 U161 U166	IC, NOR, 2-INPUT	807402-646
U23 U58 U84 U102 U142	IC, AND, 2-INPUT	807408-646
U28 U41 U107 U134	IC, LATCH	807012-646
U32	IC, MULTIVIBRATOR	807622-647
U36 U131 U155	IC, MULTIVIBRATOR	807690-646
U49	IC, FLIP/FLOP	807474-055
U60	IC, COUNTER, BINARY	807663-246
U63	IC, NAND, 2-INPUT	807400-055
U65	IC, GENERATOR-CHECK	807013-255
U69 U73	IC, AND, 3-INPUT	807411-646
U77 U145	IC, NAND, 2-INPUT	807400-642
U78 U160	IC, NOR, 4-INPUT	807502-646
U80 U81	IC, FLIP/FLOP	807473-646
U89 U90	IC, SHIFT-REGISTER	807413-646
U91 U105 U119 U133	IC, SHIFT-REGISTER	807695-446
U92 U106	IC, MULTIPLEXER	807657-646
U99	IC, BUFFER-INVERT	807011-646
U116	IC, COUNTER, DECADE	807490-646
U118	IC, NAND, 8-INPUT	807430-646
U126	IC, NAND, 4-INPUT	807420-642
U129	RES NET, 220	807750-221
U148 U169	RES NET, 1K	807699-102
U149 U162	IC, RAM, 4X6	807601-446
U167 U168	IC, OR, 2-INPUT	807486-055
U122 U123 U136 U137 U150 U163 U164	IC, COUNTER, BINARY	807619-246
Y1	XTAL, 10.0000MHZ	806013-010

200472-100 POWER SUPPLY

REF DESIG/ITEM	NAME/DESCRIPTION	E&S P/N
ITEM 1	PWR SUPPLY, 24V 3.6A	801865-324
ITEM 2	PWR SUPPLY, 5V 9A	801865-105
ITEM 3	BRACKET	500484-001
ITEM 10	CONN, PLUG 3 PIN	802324-003
ITEM 11	CONN, PLUG 6 PIN	802324-006
ITEM 12	CONT, 14-20AWG	802326-001

200473-100 CABLE, DC POWER

REF DESIG/ITEM	NAME/DESCRIPTION	E&S P/N
ITEM 1	CONN, PLUG	802324-404
ITEM 2	CONT, 14-20AWG	802326-001
ITEM 3	WIRE, 14AWG	802509-000
ITEM 4	WIRE, 18AWG	802509-222

200474-100 AC DISTRIBUTION

REF DESIG/ITEM	NAME/DESCRIPTION	E&S P/N
ITEM 1	WIRING BOARD	200474-500

200479-100 DC DISTRIBUTION

REF DESIG/ITEM	NAME/DESCRIPTION	E&S P/N
ITEM 1	BRACKET	500482-001
ITEM 2	CD, BASIC BOARD	200487-500
ITEM 3	CONN, RECPT 6-PIN	802323-006
ITEM 4	CONN, RECPT 3-PIN	802323-204
ITEM 5	CONT, 22-18AWG	802325-101
ITEM 6	TERM, MALE 16-14AWG	802238-016
ITEM 7	WIRE, 14AWG	802507-555
ITEM 8	TERM TURRET, .90D	802329-001

200480-100 GROUND CABLE ASSY

REF DESIG/ITEM	NAME/DESCRIPTION	E&S P/N
ITEM 1	WIRE, 16AWG	802508-555
ITEM 2	TERM RING, 12-10AWG	802133-014
ITEM 4	TERM, FML 16-14AWG	802235-001

200481-100 FRONT PANEL ASSY

REF DESIG/ITEM	NAME/DESCRIPTION	E&S P/N
ITEM 1	FRONT PANEL	500477-500
ITEM 2	DIODE	814655-001
ITEM 4	WIRING BOARD	200481-500
ITEM 6	SWITCH, SPDT,ROCKER	801246-202
ITEM 7	SWITCH, SPDT,ROCKER	801246-203
ITEM 10	SWITCH, BCD	801153-001
ITEM 12	CONN, FLAT-RIB	801614-026
ITEM 14	RES, 330 .25W 5%	803201-331
ITEM 16	CABLE, FLAT, 28AWG	802163-026
ITEM 26	TRIM BAR, RIGHT	500476-003
ITEM 27	TRIM BAR, LEFT	500476-004

200482-100 AC DISTRIBUTION, HALF HEIGHT FLOPPY DISK

REF DESIG/ITEM	NAME/DESCRIPTION	E&S P/N
ITEM 1	PLATE, BASE,AC DIST	500478-001
ITEM 2	COVER, AC DIST	500479-001
ITEM 3	CABLE, POWER	802089-018
ITEM 4	CABLE, GROUND	200480-100
ITEM 5	CD, AC DISTRIBUTION	200474-100
ITEM 6	BUSHING	802102-102
ITEM 8	SWITCH, SPDT	801247-001
ITEM 9	FUSE HOLDER	801083-342
ITEM 10	FUSE, SLO-BLO 5A	802296-050
ITEM 16	FILTER, LINE	804902-005
ITEM 17	CONT, 14-20AWG	802326-001
ITEM 18	TERM RING, NO. 10	802131-010
ITEM 21	CONN, PLUG 3 PIN	802324-003
ITEM 22	CONT, 22-18AWG	802325-102
ITEM 23	CONN, RECPT 3-PIN	802323-003
ITEM 25	TERM, FML 22-18AWG	802235-022

200483-100 PANEL, REAR, HALF HEIGHT FLOPPY DISK

REF DESIG/ITEM	NAME/DESCRIPTION	E&S P/N
ITEM 1	PANEL, REAR	500480-001
ITEM 2	AC DISTRIBUTION	200482-100
ITEM 4	DC DISTRIBUTION	200479-100
ITEM 5	CLAMP, REAR	500481-001
ITEM 6	FAN FINGER GUARD	801835-007
ITEM 7	FAN, 75 CFM	801088-301
ITEM 16	CONN, PLUG 3 PIN	802324-003
ITEM 17	CONT, 18-22AWG	802326-002

200485-100 CABLE ASSY, AC POWER DRIVE

REF DESIG/ITEM	NAME/DESCRIPTION	E&S P/N
ITEM 2	CONN, PLUG 3 PIN	802324-003
ITEM 3	CONT, SOC, 20-14AWG	802386-101
ITEM 4	CONT, 18-22AWG	802326-002
ITEM 5	WIRE, 18AWG	802509-999
ITEM 6	WIRE, 18AWG	802509-555
ITEM 7	WIRE, 18AWG	802509-000

200489-100 QUME DRIVE ADAPTER BOARD

REF DESIG/ITEM	NAME/DESCRIPTION	E&S P/N
ITEM 1	WIRING BOARD	200489-500
ITEM 2	CABLE, FLAT, 28AWG	802163-026
ITEM 3	CONN, PC TO FLAT	801280-026
ITEM 4	CONN, CARD EDGE	801148-050
ITEM 5	CONN, FLAT-RIB	801614-026

200490-100 GROUND WIRE EXTENSION

REF DESIG/ITEM	NAME/DESCRIPTION	E&S P/N
ITEM 1	TERM RING, 16-14AWG	802132-008
ITEM 2	WIRE, 14AWG	802507-555
ITEM 3	TERM, MALE 16-14AWG	802238-016

200491-100 CABLE ASSEMBLY

REF DESIG/ITEM	NAME/DESCRIPTION	E&S P/N
ITEM 1	CONN, SOCKET HSG	801089-016
ITEM 2	CONN, PLUG 6 PIN	802324-006
ITEM 3	WIRE, 14AWG	802507-777
ITEM 4	WIRE, 14AWG	802507-999
ITEM 5	WIRE, 14AWG	802507-000
ITEM 6	WIRE, 14AWG	802507-222
ITEM 9	CONT, 14-20AWG	802326-001
ITEM 10	CONT, SOC, 20-14AWG	802386-101

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APPENDIX A

E&S HALF HEIGHT APPLICATION NOTE

A.1 E&S HALF HEIGHT APPLICATION NOTE

DISKETTE TYPES:

Two sided diskettes are required to record as a two sided disk. Single sided diskettes can be read/recorded on side ZERO only.

INDEX HOLES:

The drive uses the periodic detection of index holes to enable operation. If a diskette is inserted such that the index hole is not exposed to the sensor, then the diskette cannot be read or written.

Two sided diskettes have their index hole located differently than one sided diskettes, allowing detection of diskette type, and preventing one sided diskettes from being used as two sided diskettes.

DOOR LOCK:

The door lock is standard on E&S Half Height drives. The door is locked whenever the head is loaded onto the diskette, preventing an operator from aborting a data read or write operation. The door is unlocked two seconds after the last access to the Half Height controller. If the operating software continuously accesses a controller without idle intervals, the doors will remain continuously locked. In this case, the operating software must provide a method of stop accesses to the controller (through the system console, for example) to allow diskette changes.

INTER-RECORD GAP (IRG):

The disc drives use a delayed erase gate operation requiring device end to occur 640 microseconds after end of a write. In order to read the next sector immediately following address field, the IRG between sectors must be greater than 37 bytes. An IRG less than this will still operate properly, but will take a full rotation after a write to read the next physical sector (read operations will immediately read the next sector).

STEP RATE:

The Half Height step rate is 3.3 ms. Settling time is 20.0 ms. Latency is 167 ms per revolution.

IN USE INDICATOR:

A LED "in use" indicator is located on each drive front panel. It is turned on whenever the heads are loaded and the door is locked on each drive. Next to the unit select switches are LED "select" indicators indicating which drive was last selected, when the controller is not busy. Because of a two second delay after the controller goes not busy before the heads are unloaded, the "in use" indicators and one of the "select" indicators may be on simultaneously for short intervals in normal operation.

PDP-11/LSI-11 DIAGNOSTIC OPERATION:

The diagnostic is designed to test two headed drives. This requires diagnostic 900133-xx revision I or higher.

After loading the diagnostic, enter through the console:

Heads = 2 Type = P

Diagnostic test 1 (status), 2 (Record size), and 3 (seek) use only head 0. Tests 4 (data reliability), 5 (read verify), and 6 (read verify worst case) use both head 0 and 1.