# AED 6200P FLOPPY DISK STORAGE SYSTEM

# TECHNICAL MANUAL 105498-01A

ADVANCED ELECTRONICS DESIGN, INC.

### SCOPE OF MANUAL

This manual describes the AED 6200P Floppy Disk Storage System without reference to any particular host system. This manual includes information for the AED 6200P operator, programmer, interface designer and service technician. For maintenance purposes, this manual is intended to be used with:

### Pertec FD510 Flexible Disk Drive Maintenance Manual

For AED 6200 programming and maintenance information specific to a particular host, consult the appropriate <u>Host System/AED 6200 Interface Supplement</u>.



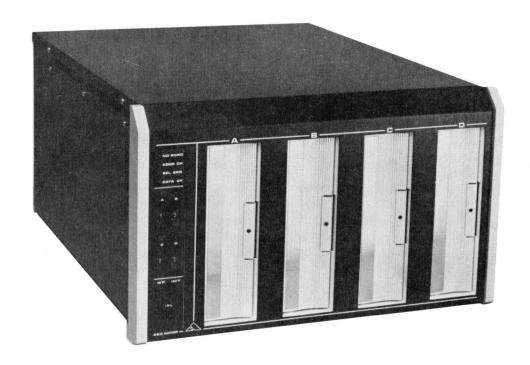
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HAZARD OF ELECTRICAL SHOCK DISCONNECT POWER SOURCE BEFORE SERVICING.

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AED 6200P DOUBLE DENSITY DISKETTE SYSTEM

### SECTION 1

### INTRODUCTION

The AED 6200P is a double density diskette (Floppy Disk) Subsystem. The 6200P is packaged in the compact cabinet pictured above. The 6200P Cabinet contains the Formatter with Control Logic for up to four drives, a drive electronics board for up to four drives, a power supply for drives A thru D, and up to four Pertec FD510 Floppy Disk Drives (A,B,C,D). The Master Control Panel is mounted on the front of the 6200P 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" thru "D". The CPU Interface Card may reside in the 6200P Cabinet. The 6200P System may be mounted in a standard 19" rack with optional Chassis Slides.

The 6200P Formatter is a powerful, generalized disk controller capable of multiplexed control of up to four drive units. It performs all functions related to Drive Selection, Head Positioning, Seek Verification, Data Formatting and Error Checking. The design of the Formatter makes the 6200P extremely easy to interface to most popular minicomputer models; the Interface Cable has only 23 signals. The Host System controls the Formatter with a 16-bit Command Word. The Formatter's status is available as a 16-bit Command Word. Data is transferred between the Host System and the Formatter in units of 16-bit Data Words, or optionally as 8 bit bytes.

The 6200P provides a complete diskette initialization facility. This allows a user to create a track format that is best suited to his application. A track may be initialized to contain from 1 to 210 sectors; sectors sizes may range from 2 bytes to 9380 bytes. Table 1-1 shows a few typical track formats.

The AED 6200P has a number of important protection and reliability features. The 6200P Formatter automatically performs a positive Seek 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 Seek Verification; the Formatter can detect a CRC Error during the Seek phase of Write and Read operations and during the Data Transfer phase of Read operations.

### 1.1 CHARACTERISTICS

### DRIVE UNIT

Drive Rotational Speed	360	rpm
Average Latency $(\frac{1}{2} \text{ rotation})$	83	msec.
Track to Track Access Time	11	msec.
Head Settle Time at Last Track	11	msec.
Data Transfer Rate	500	kilobits/sec.
Mean Time Between Failures	10,000	hours

### DISKETTE

Media	IBM Type soft sectored Diskette
Number of Tracks	77
Recording Density	6400 bpi (inside tracks)
Soft Errors	10 <sup>-9</sup>
Hard Errors	10 <sup>-12</sup>
Life	Over 5 x 10 per track

### 1.2 ENVIRONMENTAL AND POWER REQUIREMENTS

Table 1-2 summarizes the environmental and power requirements for the AED 6200P.

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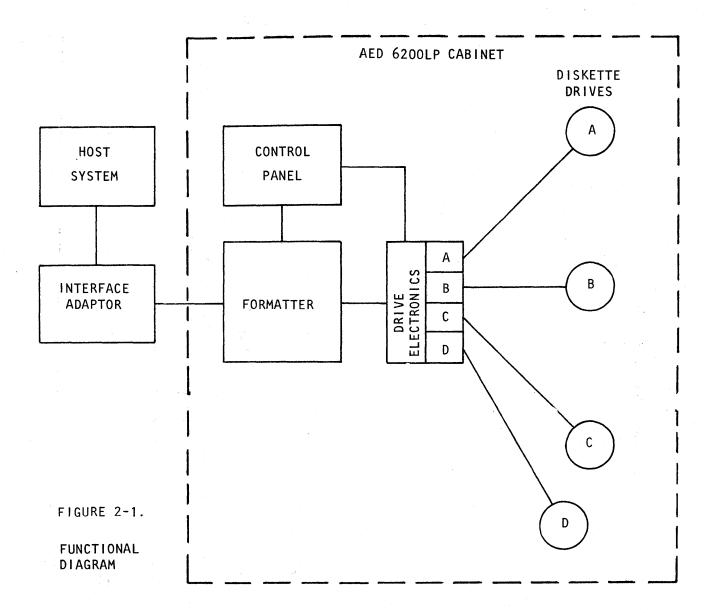
TABLE 1-1 (See See	ction 4.3.4)	,	TYPICAL TE	RACK FORMATS	)			
SECTORS/TRACK	1	2	4	8	16	30	52	210
BYTES/SECTOR	9380	4096	2048	1024	512	256	128	1

TABLE 1-2

# ENVIRONMENTAL AND POWER REQUIREMENTS

SYSTEM:	1 DRIVE	2 DRIVES	3 DRIVES	4 DRIVES
VOLTAGE:	Either 110-130 Volts AC	-	_	-
	or 220–260 Volts AC	-	-	-
CURRENT: @115V AC:	2 Amperes	2.3 Amperes	2.7 Amperes	3 Amperes
@230V AC:	1 Amperes	1.2 Amperes	1.4 Amperes	1.5 Amperes
AC LINE FREQUENCY:	Either 47-63 Hz	-	<b>-</b> '	
WEIGHT:	53 lbs.	65 lbs.	77 lbs.	89 lbs.
	25 kg.	30 kg.	35 kg.	40 kg.
SIZE: Basic Cabinet:	Height 10.5 in., Width 17. Height 26.7 cm, Width 45.			
TEMPERATURE:	50°F 100° F. (10° C -	38° C)		
RELATIVE HUMIDITY LIMITS:	20% to 80% with a maximum	n wet bulb temperature	of 78° F (25° C).	

SECTION 2
FUNCTIONAL DESCRIPTION



The functional relationship of the AED 6200LP (Master Unit) to the host system and to the AED 6200LP/2 (Slave Unit) is shown above. The Formatter defines the operational characteristics of the Floppy Disk Subsystem as viewed by the host system through its interface adapter.

Command and Status Words prescribe the control and monitoring of the Floppy Disks by the host system. The format of these Command and Status Words are explained in Section 2.1

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. These operations are described in Section 2.2

The Control Panel includes the switches and indicators the operator requires for manual operations. Section 2.3 describes the Control Panel.

The storage medium used in the 6200 is an IBM type soft sectored diskette. The diskette and data formats are described in Section 2.4.

### 2.1 COMMAND AND STATUS WORDS

An AED 6200 operation is initiated by issuing a Command Word to the Formatter. The Formatter maintains a Status Word that reflect 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 6200P Formatter. The form in which a particular host system may issue a command or interrogate status is governed by the design of the interface adaptor. (See Section 3 for AED 6200 Interfacing).

### 2.1.1 COMMAND WORD FORMAT

There are four types of 6200 Command Words. The contents of bit positions 5 and 6 identify the Command Word type. The detailed formats of each of the four Command Word types are illustrated below. Section 2.2 describes the way in which the various Command Words are used and the operations that the 6200 Formatter performs in response to the commands.

### TYPE O 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 2.2. The TYPE O Command Word has the following format:

DO	DI	D2	D3 [	D4 D5	D6-	D7	D8	D9 D10 D11 D12 D13 D14 D15
	UNIT	FUNC	TION	0	0	DL	15	TRACK
			DO	Dl			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		FUNCT	
			0	0	0			Write Sector with Data Mark CO <sub>16</sub> .
			0	0.	1			Read Sector.
			0	1	0			Write Sector with Data Mark Cl <sub>16</sub> .
			0	1	1			Initialize Start/Stop.
			1	0	0			Write Sector with Data Mark C2 <sub>16</sub> .
			1	0	1			Read I.D.
			1	1	0			Write Sector with Data Mark C3 <sub>16</sub> .
			1	1	1			Rezero/Seek.
		. !	D5	D6				Type 0 Command Word

D7 D8 D9 - D15	Door Lock - when bit is set the door lock solenoid in the FD510 is engaged. It inhibits the door opening of that unit.
D8	INHIBIT SEEK - (i.e. assume head is already positioned at specified track).
D9 - D15	TRACK - Identifies the track to be operated upon $(0-76_{10})$ .

### TYPE 1 COMMAND WORD

This Command Word is used to specify the sector for a subsequent Read or Write operation. This Command Word is normally issued immediately preceding a Type O Command word. The Type I Command Word has the following Format:

 DO D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	DII	D12	D13	B D14	D1:	5
UNIT				0	- 1				(	SECT	OR				
DO	DI					UNIT	SEL	ECT:	:						· · · ·
0	0						Se 1	ects	Log	gica	1 Dr	i ve	<b>#0.</b>	3.5	
0	1						Sel	ects	Log	gica	1 Dr	i ve	#1.		
1	0						Sel	ects	Lo	gica	1 Dr	i ve	#2.		
1	, 1						Sel	ects	Log	gica	1 Dr	ive	#3.		
D8	- D1	5				SECT									
						subse	eque	nt r	kead	or 1	Nrite	e op	perat	: Ion	•

### TYPE 2 AND TYPE 3 COMMAND WORDS

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 6200 Formatter. The Type 3 Command Word causes the 6200 Formatter to enter an Initialize Write sequence (discussed in Section 2.2.2). The Type 2 and Type 3 Command Words have the format shown below:

DO	Dl	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15
UN	ΙT				1	0		المناعب والتعالي	М		S	В	С		
DO	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15
UN	ΙΤ				1	1			L		S	В	С		
I	00		D1				UN I	T SE	LECT	•					
	0		0					Se	lects	s Log	gica	l Dri	ive i	<b>#0.</b>	
	0		1					Se	lects	Log	ji ca	Dr	ive i	#1.	
	1		0					Se	lects	s Log	gica	Dr	ive i	<b>#2.</b>	
	1		1					Se	lects	s Log	gica	Dri	ive i	#3.	
I	05		D6												
	1		0					Ty	pe 2	Com	nand	Word	<del>1</del>		
	1		1					Ту	pe 3	Com	nand	Word	1		

D12 - D15 MSBC - Specifies the most significant part of the byte count.

D8 - D15 LSBC - Specifies the least significant part of the byte count.

### 2.1.2 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:

DO D1		D3											D14 D15
IF IX	DC ER	SK ER	SL ER	NR ER	WP ER	IN ER	$/\!/\!/$	////	0	IM	RW	OL	DMID

### Where:

- IX (bit 1) INDEX BIT Used for diagnostic purposes; set on each disk revolution when track Index Mark passes. Remains set for 5 milliseconds.
- DCER (bit 2) DATA CHECK ERROR: Set when the CRC Error Code failed to compare when a record was Read.
- SKER (bit 3) SEEK ERROR: 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 Code for the Address ID Record has failed to check.

\*The Selected Drive has no diskette inserted.

SLER (bit 4) - SELECT ERROR: Is set if one of the following condidtions 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.

- 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 probable hardware malfunction.
- WPER (bit 6) WRITE PROTECT ERROR: A Write operation was attempted on a drive which was Write Protected.

### Where:

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

- 0 (bit 10) AED 6200LP Indentifier
- RW (bit 12) READ WRITE OVERRUN: Indicates failure to service a pending Data Flag prior to a subsequent Data Flag (timing error). Or, 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) When = 1, indicates that the selected drive has a diskette installed (label down on right side) and is turning.
- DMID (bit 14-15) 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 = Co, 1 = Cl, 2 = C2, C = C3.

### 2.2 BASIC OPERATIONS

The operations supported by the Formatter under program control are:

- Rezero/Seek
- Diskette Initialization
- Read Address I.D.
- Write Sector (4 variations)
- Read Sector

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

### 2.2.1 REZERO/SEEK

The Rezero/Seek operation is initiated by issuing a Rezero/Seek Command (Type 0 Command Word with a function field containing Ill<sub>2</sub>). 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 a Seek Error.

### 2.2.2 DISKETTE INITIALIZATION

Before a diskette can be used for information storage, it must be formatted. The formatting process is called initialization and it need be performed only once per diskette. Many users will purchase diskettes from AED 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.

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 byte) 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 L.D.
  - a) 17 bytes of zeros

  - b) C6<sub>16</sub>Address Markc) 4 bytes DATA for Address Field
  - d) 2 byte CRC for Address Field
- Variable Gap (bytes of zero) (Optional)
- 4. Sector Area
  - a) 17 bytes of zeros
  - b) C3<sub>16</sub> Data Mark
  - c) Variable Data Field (even number of bytes)
  - d) 2 byte CRC for Data Field
- Variable Tap (bytes of zeros) (Optional)
- 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 011a) (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, 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 us. 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 load 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 is 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<sub>16</sub> 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 code 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	Dl	D2	D3	D4	D5	D6	D7	D8	D9	D10 D11 I	D12	D13	D14	D15
TRACK					LOSS									
DO	Dl	D2	D3	D4	D5	D6	D7	D8	D9	D10 D11 I	D12	D13	D14	D15
SECTOR					HOSS									

### 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.

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.

The concatenation of HOSS and LOSS specify the number of bytes in the Data Field of the sector Data Area that is to follow. It must always be an even number. HOSS-LOSS contents are interpreted literally.

After receiving the Device End indication, the program may again count Initialize Flags until a desired Variable Gap is obtained. When the program has counted off the desired gap (none is required since the Formatter

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 zero.
- 2. Record a C3<sub>16</sub> 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 code the controller has accumulated for the Data Field.
- Signal the Device End Status condition.
- Resume recording bytes of zero (i.e., gap).

The program alternates between writing Address I.D. and Sector Area, with intervening gaps as required, until the entire track has been recorded (i.e., one diskette revolution). The program then issues another Initialize Start/Stop command, which turns off the initialization for the current track.

Each track on the diskette is initialized using the procedure described above. This procedure is represented in the flow chart in Figure 2.2. Note that the sensing of the Index status condition is optional. Performance inprovements and use of reverse side of standard diskette media are possible when format does not depend on Index Status.

### 2.2.3 READ ADDRESS I.D.

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<sub>2</sub>). In response to this command, the Formatter will:

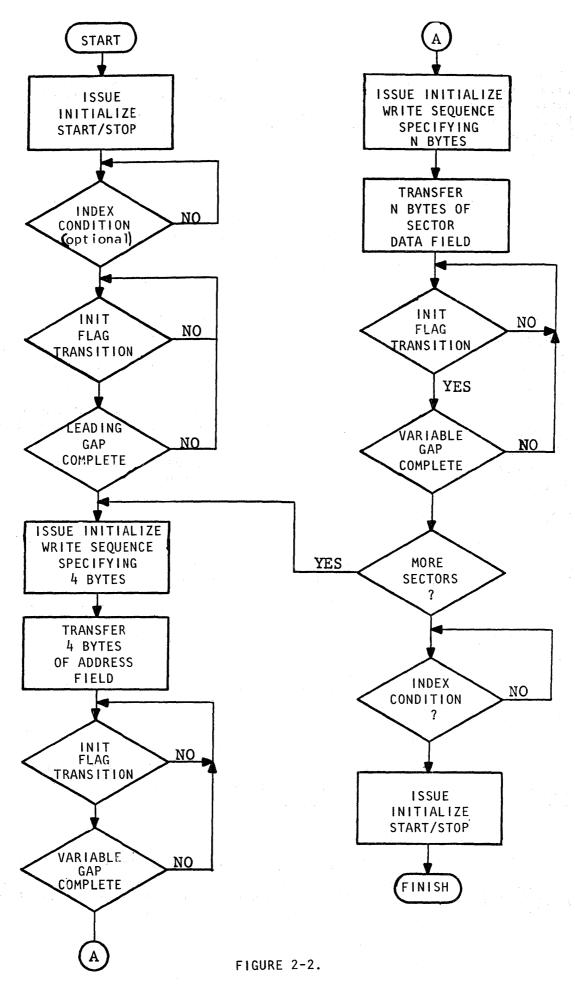
- 1. Position the Read/Write Head of the selected drive to the specified track.
- 2. Begin reading information until encounting a C6 Address Mark.
- 3. Read the 4 bytes (2 words) of the Address Field and request the computer to accept them as they are read.
- 4. Signal the Device End Status condition.

The Address Field has, of course, the format shown in Section 2.2.2.

The Read Address I.D. function is used mainly for diagnostic purposes. It is also useful in determining the rotational position of a diskette at any particular time.

### 2.2.4 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 I Command Word). The second command specifies the track and initiates the operation (Type O Command Word).



FLOW CHART FOR INITIALIZATION OF ONE TRACK

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 O Command Word determines the Data Mark that the Formatter will record (See Type O Command Word format in Section 2.1).

The user may attach any significance he desires to the four possible Data Marks: CO<sub>16</sub>, Cl<sub>16</sub>, C3<sub>16</sub>. Note that during Initialization the Formatter always records a C3<sub>16</sub> 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:

- Position the Read/Write Head of the selected drive unit to the track specified in the Type O Command Word.
- 2. Begin reading Address Fields (as marked by C6<sub>16</sub> Address Marks) until finding the Address Field for the desired track/ sector or determining that a Seek 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  $^{\rm CO}_{16}$ ,  $^{\rm C1}_{16}$ ,  $^{\rm C2}_{16}$ ,  $^{\rm C3}_{16}$ ).
- 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 code 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 use the last data word that was supplied.

### 2.2.5 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 O Command Word.
- 2. Begin reading Address Fields (as marked by C6<sub>16</sub> Address Marks) until finding the Address Field for the desired track/sector or determining that a Seek Error condition has occurred.

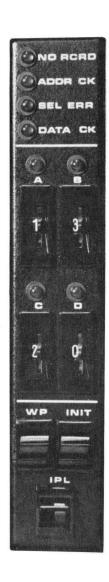


Figure 2-3 AED 6200P Control Panel

- 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. Read zeros until encountering a Data Mark  $(C0_{16}, C1_{16}, C2_{16}, or C3_{16})$ .
- Read data words and request the computer to accept them until exhausting the sector byte count.
- 6. Read and verify the two-byte CRC error code for the Data Field.
- 7. 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 error code. 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 2.1.2).

### 2.2.6 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  $\emptyset$ , Track  $\emptyset\emptyset$  on Logical Drive  $\#\emptyset$ .

### 2.3 CONTROL PANEL DESCRIPTION

The following subsections describe the switches and indicators on the AED 6200P Control Panel, which is pictured in Figure 2-3.

### 2.3.1 DRIVE SELECT SWITCHES

Four thumbwheel switches, labeled A,B,C, and D, allow the operator to assign logical addresses to each of the up to four physical drives that may be housed in the 6200P enclosure. Commands issued by the host system specify logical addresses for drive selection. Any of drives A thru D may be selected as Logical Drive O thru 3 by use of these switches.

### 2.3.2 DRIVE SELECT INDICATORS

When the host system issues a command to the 6200P, the Select Indicator corresponding to the selected physical drive will light up. The indicator will blink while the command is active and remain illuminated until another command is issued.

### 2.3.3 ERROR INDICATORS

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

The SELECT ERROR (SEL ERR) indicator will light if the host system 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 Seek Verification, and no data will be transferred. Address Check will also occur if Read or Write 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 microseconds after a positive Seek Verification during a Read operation. This usually indicates that the diskette in question is improperly formatted.

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

### 2.3.4 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 host system. When this switch is down, the Formatter will reject the command and report an Initialize Error in the Status Word.

### 2.3.5 WRITE PROTECT SWITCH (WP)

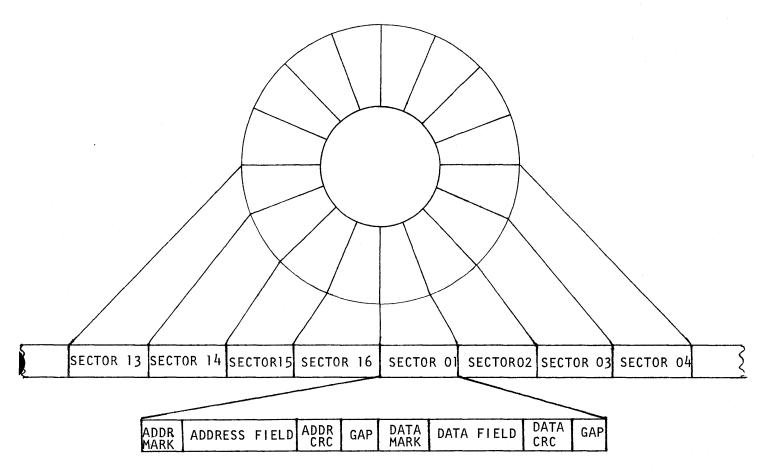
This two position switch allows the operator to Write Protect Logical Drive #0. When this switch is in the up position, the Formatter will reject all Write commands specifying Logical Drive #0.

### 2.3.6 INITIAL PROGRAM LOAD SWITCH (IPL)

When this spring-loaded switch is raised and subsequently released, it forces the Formatter to read Sector 0 of Track 00 of Logical Drive #0. The host system need not issue any commands to the 6200P; however, the computer must be in an operating mode such that it can accept the data.

### STORAGE MEDIUM AND DATA FORMAT (16 SECTOR EXAMPLE)

2.4

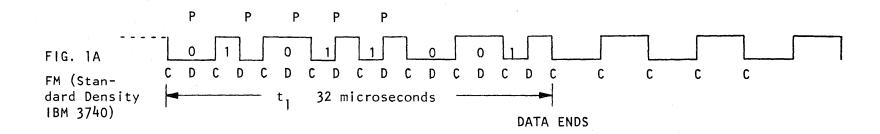


The Diskette used in the 6200P is of the IBM - type used in the IBM 3740 and 3600. The Diskette is removable from the 6200P and can be interchanged between machines using the IBM type diskette, provided the user's 6200P host system software is format compatible.

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 index hole for operation with IBM formats. For operations with non-IBM formats, use of the index is optional and both sides of the diskette may be used for data storage. However, if it isn't used, the Index Bit in section 2.1.2 will not be set.

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





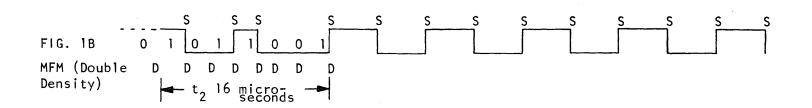


FIGURE 2-4. DATA BIT FREQUENCY PATTERNS

The AED 6200 employs the Modified Frequency Modulation (MFM) recording technique which doubles the data bit frequency possible with 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 Figures 1A and 1B.

In figure 1A, alternate <u>Clock</u> and data bits provide synchronization <u>Patterns</u> for the standard density floppy disk read/write electronics. For the data pattern 01011001, the read/write head senses 8 bits in 32 microseconds for an effective thruput of 250,000 data bits per second.

In Figure 1B, no <u>Clock</u> bits are required. Thus, Data bits provide the <u>Synchronization</u> for the read/write electronics. For the same data pattern (01011001), the read/write head sense 8 bits in 16 microseconds for an effective thruput of 500,000 data bits per second. Thus, double density recording requires no greater performance from the head or the media than that required for standard density recording (1BM 3741).

### SECTION 3

### AED 6200P INTERFACING

An adaptor (i.e. interface card) is required to connect the AED 6200P to a host system. This section includes the AED 6200P information the user needs to design such an adaptor.

The 6200P Formatter includes all the control electronics required for drive selection, seek and verification, data formatting and error detection; consequently, for most host systems the adaptor is quite simple in design.

The functional responsibilities of the adaptor can be summarized as follows:

- 1. Provide a means of allowing the host system to access a Status Word, which is maintained by the Formatter;
- 2. Provide a means of allowing the host system to issue a Command Word to the Formatter;
- Transfer Data Words from the Formatter to the host system, when requested to do so by the Formatter during a Write operation;
- 5. Signal the host system when the Formatter finishes an Initialize, Read, or Write operation.

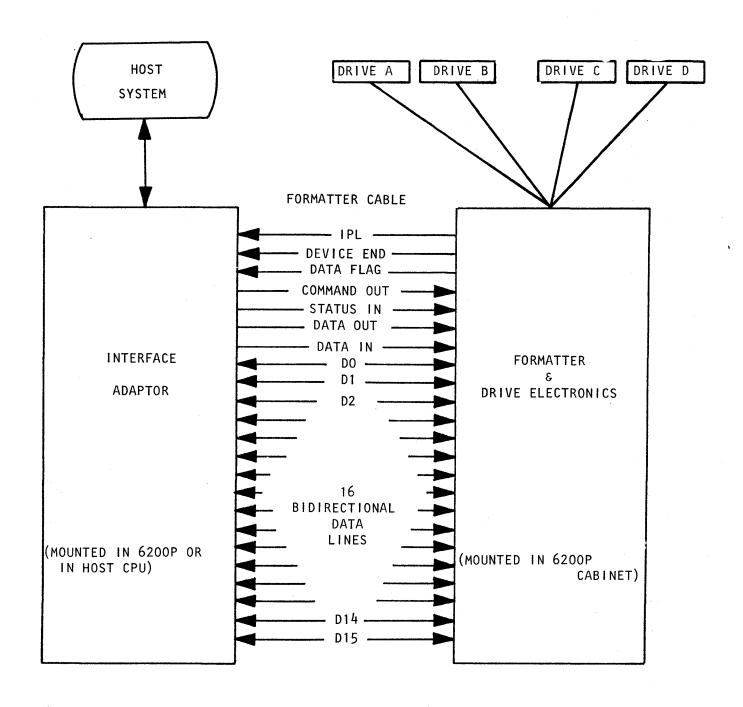
Command Words, Status Words and Data Words all have a 16-bit format. For host systems with a 16-bit organization, the adaptor normally need not provide intermediate buffering. For host systems with an organization other than 16-bit, the adaptor must reconcile the two format requirements. The adaptor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

### 3.1 AED 6200P INTERFACE SIGNALS

The interface to the AED 6200P is composed of 16 bidirectional data lines, 4 control lines, 2 status lines and 1 function line, as represented in Figure 3-1.

Data, control and status information are transferred to and from the Formatter via the 16 bidirectional data lines designated DO-D15. The interpretation of the information on the data lines is determined by which of the 4 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.

FIGURE 3-1
AED 6200 P INTERFACE SIGNALS



The 2 Status Flags are Data Flag and Device End. Data Flag indicates that the Formatter is ready to send or receive a data word to or from the host system. Device End indicates that the Formatter has completed an operation.

The Function Line, IPL, indicates that the Formatter has initiated an Initial Program Load operation.

The AED 6200P Interface Signals are summarized in Table 3-1.

TABLE 3-1 AED 6200P INTERFACE SIGNAL SUMMARY
\*The active level for all signals is low or 0 volts.

SIGNAL	PIN#	FUNCTION
D0 D1 D2 D3 D4 D5 D6 D7 D8 D9 D10 D11 D12 D13 D14 D15	35 31 7 5 29 21 19 15 1 3 43 47 25 11	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.
СО	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.
\$1	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.
DATA FLAG	35	Data Flag, when active, indicates that the Formatter is ready for the transfer of a Data Word. During a Write operation it means that 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.

TABLE 3-1. AED 6200P INTERFACE SIGNAL SUMMARY (CON'T)

\*The active level for all signals is low (or 0 volts).

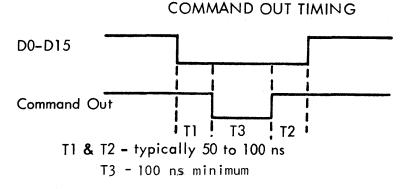
SIGNAL	PIN#	FUNCTION
DEVICE END	39	Device End is true when the Formatter has completed an operation.
IPL	45	Initial Program Load (IPL) is active only during the time that the IPL Switch on the Control Panel is engaged. (When the switch is released, the Formatter will do a Read of Sector 00, Track 00 on Logical Drive #0).

## 3.2 SIGNAL TIMING CONSIDERATIONS

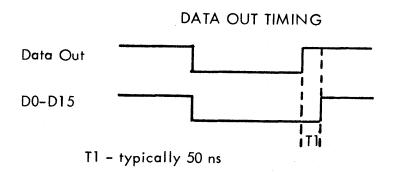
Proper timing of the four control lines is important to assuring that the information on the bidirectional data lines is properly interpreted and latched.

### 3.2.1 COMMAND OUT AND DATA OUT TIMING

The 6200P Formatter uses both the leading and trailing edges of Command Out to latch command information. The adaptor must assure that the Command Word is stable on the data lines at both the leading and trailing edges of Command Out. Command Out must remain active for at least 100 nanoseconds.



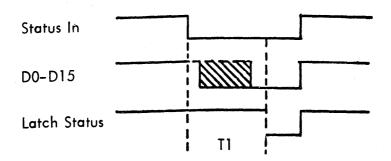
The adaptor must assure that a Data Word is stable on the data lines at the trailing edge of Data Out. Data Out must remain active for at least 50 nanoseconds.



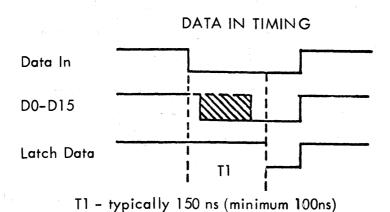
### 3.2.2 STATUS IN AND DATA IN TIMING

When the adaptor asserts Status In or Data In, the Formatter gates either the contents of its Status Register or the contents of its Data In Buffer into the Data Lines. The adaptor must keep 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 host system. This time consideration should allow for at least 6 gate delays and the delay of the cable plus any internal delays within the adaptor and host interface.

### STATUS IN TIMING



T1 - typically 150 ns (minimum 100 ns)



### 3.2.3 DATA TIMING

For both Read and Write operations, the Formatter requests Data Word transfers by activating Data Flag. Once Data Flag becomes true, the adaptor 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 the trailing edge of Data Out.

### 3.3 DATA TRANSFER SEQUENCES

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

### 3.3.1 DATA OUT SEQUENCE

During Write and Initialize Write operations, the host system interface adaptor must transfer Data Words to the Formatter. A Data Out sequence is illustrated in Figure 3-2.

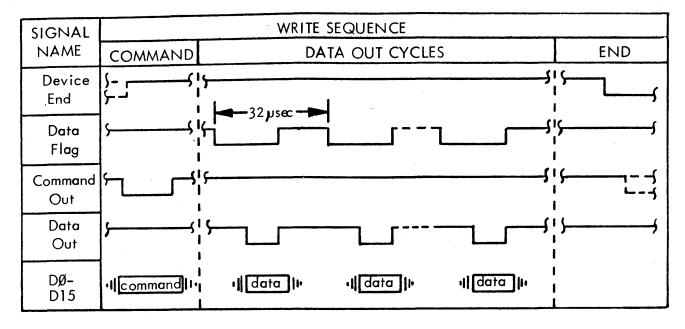


FIGURE 3-2. DATA OUT SEQUENCE

For each 16-bit Data Word transferred to the Formatter, a Data Out cycle is required. The Formatter requests a Data Word from the adaptor by activating Data Flag. The adaptor may use Data Flag to initiate a DMA request to the host system, or the adaptor may allow the host system to interrogate the state of Data Flag. When the Data Word has been accessed from the host system, the adaptor gates the Data Word onto the data lines and activates Data Out (See Section 3.2.1 for detailed timing requirements). On the trailing edge of Data Out, the Formatter clears its request (i.e., Data Flag goes false). Should the adaptor fail to activate Data Out within approximately 32  $\mu sec.$  of Data Flag, Data Flag will be cleared for the duration of the operation. Otherwise, the Formatter will stop making requests when the entire record space has been recorded. 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 (and clears Data Flag, if it is true). The adaptor may use Device End to generate an interrupt to the host system.

### 3.3.2 DATA IN SEQUENCE

During Read and IPL operations, the host system must accept Data Words from the Formatter. Data In sequences are illustrated for Read and IPL operations in figures 3-3 and 3-4.

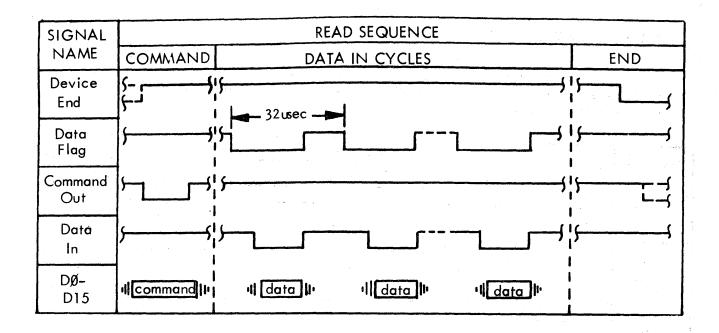


FIGURE 3-3. DATA IN SEQUENCE

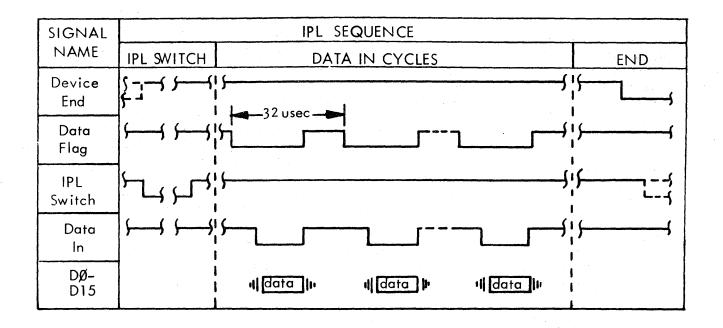


FIGURE 3-4. IPL SEQUENCE

For each 16-bit Data Word transferred from the Formatter to the adaptor, 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 host system. The adaptor may use Data Flag to initiate a DMA request to the host system, or the adaptor may allow the host system program to interrogate the state of Data Flag. The adaptor activates Data In to cause the Formatter to gate the Data Word onto the data lines and to clear Data Flag (See Section 3.2.1 for detailed timing requirements). Should the adaptor fail to activate Data In within approximately 32 µsec of Data Flag, Data Flag will be cleared for the duration of the operation. Otherwise, the Formatter will stop activating Data Flag when the entire data record has been read. 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 adaptor may use Device End to generate an interrupt to the host system.

### 3.4 ELECTRICAL CONSIDERATIONS

AED recommends that the host system use the interface circuitry shown below. AED uses transistor-transistor logic(TTL) with bus signals asserted 'LOW'. In all cases:

HIGH = FALSE = LOGICAL "O"

LOW = TRUE = LOGICAL "1"

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

### CIRCUIT FOR 16 BIDIRECTIONAL DATA LINES

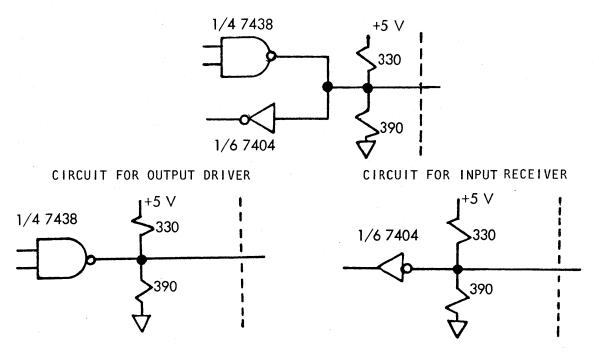


FIGURE 3-5. AED 6200 P INTERFACE CIRCUITS

### 3.5 MECHANICAL CONSIDERATIONS

### 3.5.1 INTERFACE ADAPTOR BOARD LOCATIONS

In most systems, the interface adaptor board is housed in the host system mainframe or satellite chassis. However, the AED 6200P chassis provides adequate space, ventilation and power for one interface adaptor board. Card guides may be installed in the AED 6200P chassis behind the Control Panel to hold the board in a vertical position. Removing the rear cover provides access to the board.

### 3.5.2 INTERFACE CABLE DESCRIPTION

All interfacing to the AED 6200P is through one Formatter cable. The standard Formatter cable is a 50 wire flat cable, every other wire being a logic ground, with 3M part #3425-1000 male connector on the formatting board. The other end plugs into a 3M part #3425-1000 male connector that the user must install on his interface adaptor board if he elects to employ the standard interface cable. AED supplies a 6' (183 cm) cable unless the user specifies another length.

The interface cable emerges from the AED 6200P chassis through a clamped slot in the Rear Panel. This slot may be used instead for the host system 1/0 bus cable should the user elect to install the interface adaptor board in the AED 6200P chassis.

Pin assignments for the interface cable are given in Table 3-1. All even numbered pins (2-50) are logic ground.

### SECTION 4

### INSTALLATION AND OPERATION

### 4.1 INSTALLATION

### 4.1.1 MOUNTING DIMENSIONS AND WEIGHT

The AED 6200P has the following physical specifications:

Physical Dimens	sions:	10.5" hig 17.8" wid 18.6" dee	e (45.2 cm	n)
Weight:			1-drive system 2-drive system 3-drive system 4-drive system	

Chassis slides are available for mounting in a standard RETMA/EIA 19" wide rack. Hardware to secure the AED 6200P is provided with the slides.

### 4.1.2 CHASSIS CONFIGURATION OPTIONS

An AED 6200P chassis accommodates up to four disk drive units. One, two or three drive systems may have either a blank front panel section option or a cartridge storage bin option installed in the cabinet in the unused drive position(s).

In applications where it is not desireable to allow an operator to access the Control Panel, a blank front panel section may be installed in front of the recessed Control Panel.

### 4.1.3 ENVIRONMENT

The AED 6200P is designed to operate within the temperature and humidity ranges specified in Table 4-1.

TABLE 4-1. TEMPERATURE-HUMIDITY RANGES FOR 6200P AND DISKETTE

	OPERATING	NON-OPERATING
TEMPERATURE	50 <sup>°</sup> F to 100 <sup>°</sup> F 10 <sup>°</sup> C to 38 <sup>°</sup> C	-40°F to 160°F -40°C to 71°C
RELATIVE HUMIDITY at maximum of 78°F (26°C) Wet Bulb Temperature	20% to 80%	90% maximum
HEAT GENERATED (max.)	100 BTU/hr for Elect's plus 346 BTU/Hr per Disk Drive	NONE

#### 4.2.1 DISKETTE INTERCHANGEABILITY

To insure interchangeability, diskettes should be stored in a location that is within  $\pm$  5°F (3°C) of the using system ambient temperature and with  $\pm$  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.

#### 4.2.2 PHYSICAL DAMAGE

When removed from the 6200P, the diskette is 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 magnetic fields.
- 4. Replace storage envelopes when they become worn, cracked or distorted. Envelopes are designed to protect the disk.
- 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 clog the drive R/W Head.
- Do not expose diskettes to Heat or sunlight. The Read/ Write head on the 6200P cannot properly track a warped disk.
- 8. Do not touch or attempt to clean the disk surface.
  Abrasions may cause loss of stored data.

#### 4.3 OPERATION PROCEDURES

The following subsections detail procedures for manual and program operation of the AED 6200P.

#### 4.3.1 POWER ON

Before applying power to the AED 6200P, the interface cable should be connected to the host system. Once the AC power cord is plugged into a suitable source, power may be applied by actuating the circuit breaker on the rear frame of the unit. The Read/Write heads of all drives are positioned to track ØØ when power is applied.

### 4.3.2 SELECT ADDRESS ASSIGNMENT

The physical drives are designated Drive A, Drive B, Drive C, and Drive D as noted on the Front Panel. 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 computer command to the 6200P 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 non-existent physical drive does not in any way affect system operation.

#### 4.3.3 GENERAL PROGRAMMING CONSIDERATIONS

For efficient system operation, it is important to coordinate host system program operations with any manual operations that may be required. On some systems, this can be accomplished by having the host system 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, a "Seek 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 right side of the drive unit). If it is desireable to use both sides of the diskette for information storage, the diskette may be installed with the smooth side of the jacket toward the left side of 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. Order diskettes from AED for assured performance).

# 4.3.4 INITIALIZE 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 initialization procedure.

A sector, as it is recorded on the medium, has the following format:

- Variable Gap (17 bytes minimum);
- Address Mark (1 byte);
- Address Field (4 bytes);
- 4. CRC Code (2 bytes);
- 5. Variable Gap (17 bytes minimum)
- 6. Data Mark (1 byte);
- Data Field (N bytes where N is even);
- 8. CRC Code (2 bytes);

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

# DISK CAPACITY:

Theoretical maximum number of 16 bit words/track is 5208.33

Computation is:

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

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

$$2604.166 \times 95\% = 4948 \quad 16 \text{ Bit Words/Track}$$

# TRACK FORMAT

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

#### OVERHEAD:

WRITE OVERHEAD = DATA

GAP MARK CRC

16 BYTES 1 BYTE 2 BYTES = 19 BYTES

ADDITIONAL WRITE OVERHEAD @ 5% HIGH SPEED = 5% (N + 19)

TOTAL OVERHEAD = 17 + 7 + 17 + 1 + 2 + 5% (N + 19)

TOTAL OVERHEAD = 44 BYTES + 5% N BYTES + 5% 19 = 45 BYTES = 5% N BYTES

TOTAL OVERHEAD = (22.5 16 BIT WORDS) + .05n 16 BIT WORDS

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

TOTAL RECORD SIZE = (n + 22.5 + .05n) 16 BIT WORDS = 1.05n + 22.5

- S = NUMBER OF SECTORS/TRACK =  $\frac{MAX \# WORDS}{\# WORDS/SECTOR}$
- $S = \frac{4948 \text{ WORDS}}{(1.05n + 22.5) \text{ WORDS/SECTOR}}$
- $n = \frac{4948 22.5S}{1.05S} = MAXIMUM NUMBER OF 16 BIT DATA WORDS/SECTOR$

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 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 2.2.2.

### 4.3.5 WRITE PROCEDURE

To initiate a Write operation, the host system program issues a Write command. Depending upon the design of the interface adaptor 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.

To assure that a data record has been accurately recorded, the program may read the record using the Read procedure described in Section 4.3.6. A Read Check Error will persist on repeated reading if the data was not properly recorded; the host 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.

#### 4.3.6 READ PROCEDURES

To initiate a Read operation, the host system program issues a Read command. Depending upon the design of the interface adaptor 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.

Most errors that occur duing 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:

- 1. Airborne contaminents that pass between the Read/Write head and the disk.
- 2. Random electrical noise which usually lasts for a few usec.
- 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 is recovered.
- 2. If data is 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. If data is not recoverd, the error is not recoverable and is considered a "hard" error.

#### SECTION 5

#### AFD 6200P FORMATTER THEORY OF OPERATION

This section describes the operation of the AED 6200P Formatter at the block level. Figures 5-1 and 5-2 illustrate the two major sections of the Formatter: the Formatting Section and the Drive Section.

#### 5.1 FORMATTER ORGANIZATION

The Formatter consists of a Formatting Section and from one to four identical Drive sections. The Formatting Section is implemented on one large PC Board (Formatter Board) and the Drive sections are implemented on a smaller PC Board (Drive Electronics Board). Both the Formatting Board and the Drive Electronics Board are housed in the 6200P Cabinet as described in Section 6.

#### 5.1.1 FORMATTING SECTION

The Formatting Section controls the transfer of information with the host system, device selection, Write and Read Timing, Data Formatting and Error Checking. Figure 5-2 identifies the following functional areas within the Formatting section:

> <u>User Interface</u> - Consists of 16 bidirectional Data Lines Command Out, Status In, Data Out, Data In, Device End and IPL (as described in Section 3);

Receivers and Drivers - for the user interface signals;

<u>Command Register</u> - used for latching and decoding Type and Function bits in the Command Words;

<u>Data Out Register</u> - used for latching Data Words sent by the user system;

<u>Data In Register</u> - used for latching Data Words, which are sent to the user system during a Read operation;

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);

<u>Multiplexer</u> - 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;

<u>Data Serializer/Deserializer</u> - performs parallel to serial conversion for Write and serial to parallel conversion for Read;

<u>Clock Deserializer</u> - deserializes clock pattern that accompanies data and Data Marks;

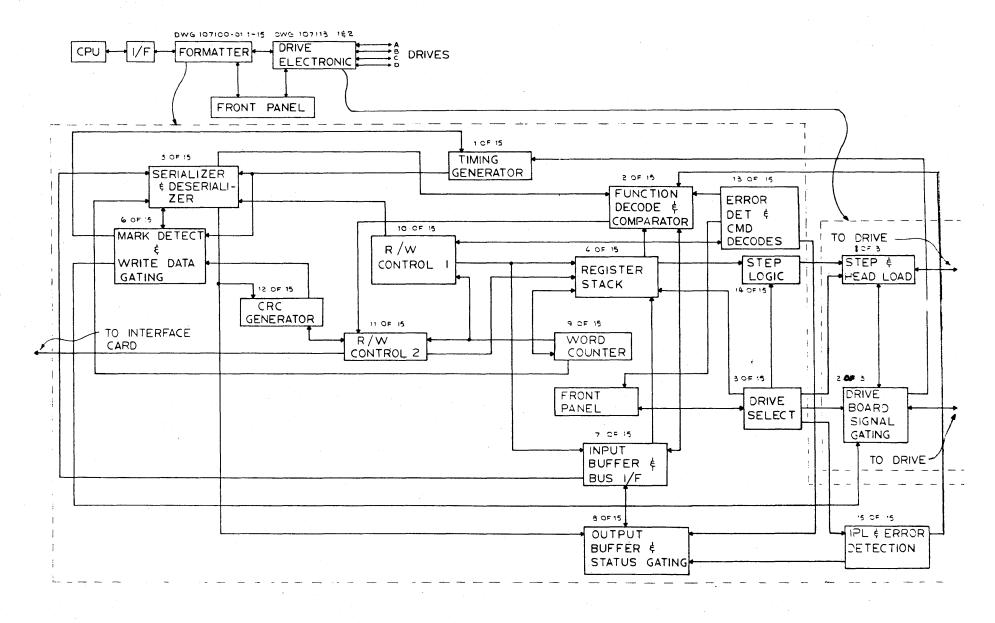


FIGURE 5-1. AED 6200P FUNCTIONAL SCHEMATIC

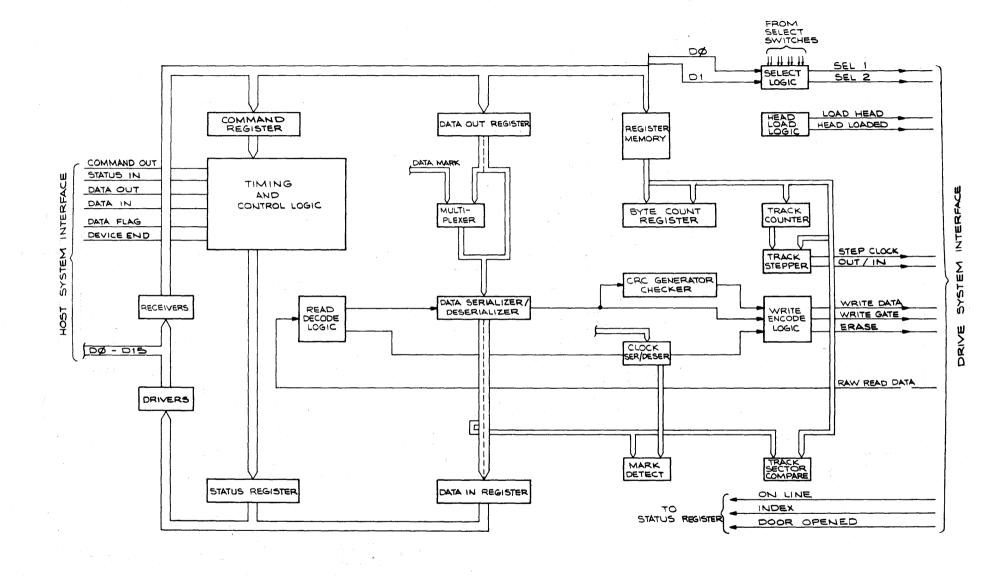


FIGURE 5-2. FORMATTER BOARD DIAGRAM

<u>Mark Detect</u> - monitors bit pattern in Clock Deserializer and low order byte of Data Serializer/Deserializer to detect Data and Address Marks;

CRC Generator/Checker - performs CRC generation and checking for Address Fields and Data Fields.

Read Decode Logic - decodes raw Read Data into clock and data bits, which are fed into the clock Deserializer and Data Serializer/Deserializer;

Write Encode Logic - encodes clock and data bits into raw Write Data;

<u>Word Count Register</u> - holds the high and low order bytes of the record byte count and is decremented to zero during a Read or Write operation;

Track Counter - holds the current track number for the selected drive and is incremented or decremented during a Seek operation;

<u>Track Stepper</u> - 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;

<u>Status Register</u> - incorporates the various condition latches within the Formatting and Drive sections that constitute the Status Word;

<u>Select Logic</u> - performs Drive selections and Select Error detection;

Head Load Logic - controls Read/Write head loading and unloading;

<u>Timing and Control Logic</u> - provides timing and control functions for the Formatting section.

# 5.1.2 DRIVE SECTIONS

There is one Drive Section for each physical drive units 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 5-3 identifies the following functional areas on the Drive Board (only components of the Drive section for Drive A are illustrated);

<u>Select Decode</u> - decodes Sel 1 and Sel 2 into Drive A, B, C and D for use on the Drive Board.

<u>Demultiplexers</u> - routes Write signal to the selected Drive section.

<u>Multiplexers</u> - route signals from the selected Drive section to the Formatting section.

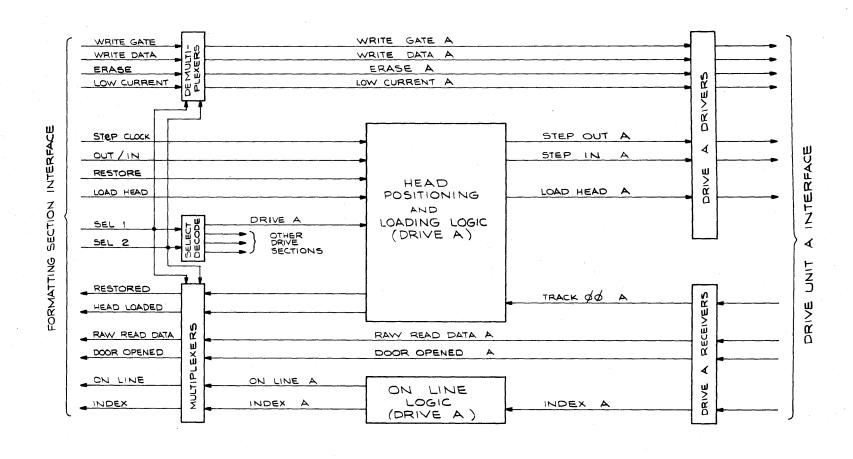


FIGURE 5-3. DRIVE ELECTRONICS BOARD

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.

# 5.2 OPERATIONAL PHASES

The following subsections describe the various operational phases that characterize Read, Write and Initialize sequences as performed by the 6200P Formatter.

# 5.2.1 RESET AND RESTORE

When power is applied to the 6200P, 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  $\emptyset\emptyset$ , which causes the Restore Latch to be reset.

#### 5.2.2 STATUS IN

When Status In is activated by the interface adaptor, 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.

# 5.2.3 COMMAND OUT, DRIVE SELECTION AND LOAD REGISTER MEMORY

To initiate a Formatter operation, the Interface Adaptor 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 Logic compares the Select Switch settings for each Drive with DO and DI, 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 and 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 is loaded into the appropriate Register Memory cell. In the

case of a Type O 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 Words initiate an operation.

#### 5.2.4 POSITION AND LOAD READ/WRITE HEAD

All Type O 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 if the two track numbers are not equal. For each Step In or Step Out, 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 (contacts the diskette).

# 5.2.5 INITIALIZE START/STOP

When the Formatter 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 theRegister Memory as described in Section 5.2.3.

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 Initialized function is in effect, the Timing and Control Logic clocks and the Data Serializer/Deserializer and Data words or zero are recorded on the selected drive. The Timing and Control Logic sets and resets the Initialize Flag in the Status Word at the beginning and middle, respectively, of each zero data word recorded. The Initialize Flag allows the host system 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, which cause Address I.D.'s and Data Records to be alternately recorded on the current track, as described in the next section.

#### 5.2.6 INITIALIZE WRITE

While an Initialize 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 adaptor 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 trailing 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 is shifted out through the Write Encode Logic. Device End is activated and the current Initialize 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 host system will ordinarily continue to issued Initialize Write commands to alternately record Address I.D.'s and Data Fields until the entire track initialized. The host system will then issue another Initialize Start/Stop command to clear the Initialize flip-flop and thereby terminate the recording of bytes of zero.

#### 5.2.7 SEEK VERIFICATION

A Seek Verification is performed for every Read and Write operation. The Seek 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.

When a Read or Write operation has been established and the selected drive's Read/Write head has been positioned and loaded, Read Data and Read Clocks are shifted into the Data and CLock Deserializer until an Address Mark is detected by the Mark Detect Logic (C6<sub>16</sub> data pattern with EB<sub>16</sub> clock pattern). The next byte (which is the track number in the Address Field) is shifted into the Data Serializer/Deserializer and compared with the desired track number, which is stored in the Register Memory.

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 fails, searching continues for the next address byte, Seek Error and Device End are set. If the CRC verification is successful, the Formatter will enter the Read or Write Data phase of the operation.

# 5.2.8 WRITE DATA MARK, DATA AND CRC WORD

After the Seek verification, the Read/Write head of the selected drive will be position 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 high and low order parts of the Byte Count Register are loaded from the Register Memory. The Timing and Control Logic counts out 17 bytes of zero. A Data Mark pattern is gated through the Multiplexer into the Data Serializer/Deserializer (certain bits of the Data Mark come from the Write Command Word).

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 adaptor 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 trailing 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. Data Out cycles continue until the interface adaptor fails to respond to a Data Out cycle. The Timing and Control Logic continues to clock the Serializer/Deserializer until the rest of the data record is filled with data words of the last word received (i.e. the byte count register equals zero).

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.

# 5.2.9 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 high and low order parts of the Byte Count Register are loaded from the Register Memory. 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 so that the host system may later determine the type of Data Mark that accompanied the Data record by examining the Status Word.

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 adaptor 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 adaptor fails to activate Data In, the Timing and Control Logic continues to shift Data Words through the Data Serializer/Deserializer so that 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 contain 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 and Device End is set, signifying an unsatisfactory Read operation.

#### SECTION 6

#### MAINTENANCE

This section is intended to assist the user in servicing the AED 6200P. For detailed information on servicing the Drive Unit, refer to the "Pertec FD500 Disk Drive Maintenance Manual", an extra cost item.

#### 6.1 PREVENTATIVE MAINTENANCE SCHEDULE

The Electronics in the AED 6200P Systems require no preventative maintenance. The Pertec FD510 Flexible Disk Drives require minimal preventative maintenance on an annual basis, if the environment is 'office clean.' For dirty environments, increase the frequency of maintenance.

The main operations to be performed are:

- A) Step Motor Lead Screw Cleaning & Lubrication;
- B) Head Cleaning;
- C) Head Load Pad Replacement;
- D) Drive Electronics Check.

#### A) LUBRICATION OF THE STEP MOTOR

Prior to lubrication, the step motor shaft (lead screw) should be cleaned. This is accomplished by wiping the shaft with a lint-free cloth lightly moistened with isopropyl alcohol or Freon TF. Lubricate the shaft using a cotton swab moistened with a <a href="mailto:small">small</a> amount of light weight lubricant similar to clock oil.

# CAUTION

DO NOT CONTAMINATE THE MAGNETIC RECORDING HEAD OR THE HEAD PAD WITH LUBRICANT. DAMAGE TO THE RECORDING SURFACE CAN BE CAUSED BY LUBRICANT DEPOSITED ON THE MAGNETIC HEAD OR LOAD PAD BEING TRANSFERRED TO THE DISK.

#### B) CLEANING THE HEAD

To clean the magnetic head, use a lint-free cloth or cotton swab moistened in isopropyl alcohol or DuPont Freon TF. Wipe the head carefully to remove all accumulated oxide and dirt. Dry the head using a lint-free cloth.

# NOTE

The magnetic head must be cleaned after replacement of the head load pad.

#### CAUTION

ROUGH OR ABRASIVE CLOTHS SHOULD NOT BE USED TO CLEAN THE MAGNETIC RECORDING HEAD. USE ONLY ISOPROPYL ALCOHOL OR DUPONT FREON TF. USE OF OTHER CLEANING SOLVENTS, SUCH AS CARBON TETRACHLORIDE, MAY RESULT IN DAMAGE TO THE HEAD LAMINATION ADHESIVE.

# C) HEAD PAD REPLACEMENT

The head load pad must be replaced when it loses it nap, or becomes impregnated with an excessive amount of iron oxide from the diskettes.

#### NOTE

THE MAGNETIC HEAD MUST BE CLEANED AFTER THE HEAD PAD IS REPLACED.

- 1. Raise the spring loaded head load arm. With tweezers, remove the old pad and its adhesive backing from the load arm.
- 2. Clean the load pad necess in the load arm.
- 3. Holding a new load pad with tweezers, remove the paper backing from the adhesive.
- 4. Place the replacement load pad, adhesive side first, in the recess in the load arm.
- 5. Push the load pad firmly into the recess in the load arm. Use a clean flat surface tool for this purpose.
- 6. Clean the magnetic head:
  - a) Load a working diskette in the drive, apply power, and load the magnetic head.
  - b) Perform a repetitive step-in operation to position the Read/Write head at track 76.
  - c) Write an all ones pattern at track 76.
  - d) Set the oscilloscope time base to 20 milliseconds per division.
  - e) Attach the signal probes of the oscilloscope to TP4 and TP5 on the FD510 PCBA. Adjust the oscilloscope to read differentially (A + B with B inverted).

f) Apply light finger pressure to the load arm directly over the load pad. Should the signal level observed on the oscilloscope increase by more than 10 percent, reseat or replace the load pad.

# D) DRIVE ELECTRONICS CHECK (SEE FIGURE 6-1)

# 1. CAT EYE ALIGNMENT (SEE FIGURE 6-2)

Put WP Switch up. Load CE alignment diskette in a drive addressed as Ø and execute a continuous read at (50°) (40°). Sync on TP 10, set the time base to 20MS/CM, and observe TP 4 and TP 5 added differentially. (A + B with B inverted) A "CAT EYE" signal should be balanced (+ 10 percent) in amplitude. If the heads are not in alignment, loosen the holding screws on the step motor and position it in or out to obtain a balanced "cat eye" signal.

#### INDEX TO DATA BURST CHECK

Put WP Switch up. Sync on TP-10 and observe TP-4 and 5. (A + B with B inverted). Insert C.E. Alignment diskette in a drive addressed a  $\emptyset$ , step to track  $\emptyset$  and execute a continuous read. Set the oscilloscope time base to 20 usec/division.

The Data Burst should occur  $40 \text{usec} \pm 40 \text{usec}$  after the Sync signal. If it does not fall within the time specified, loosen the retaining screw and reposition the phototransistor bracker. Secure the retaining screw and execute a continuous read at track  $66_{10}$  ( $102_8$ ). The burst should appear within  $\pm 20 \text{us}$  of the position of the burst for track  $\emptyset$ . If it is out of tolerance it may be adjusted by rotating the step motor.

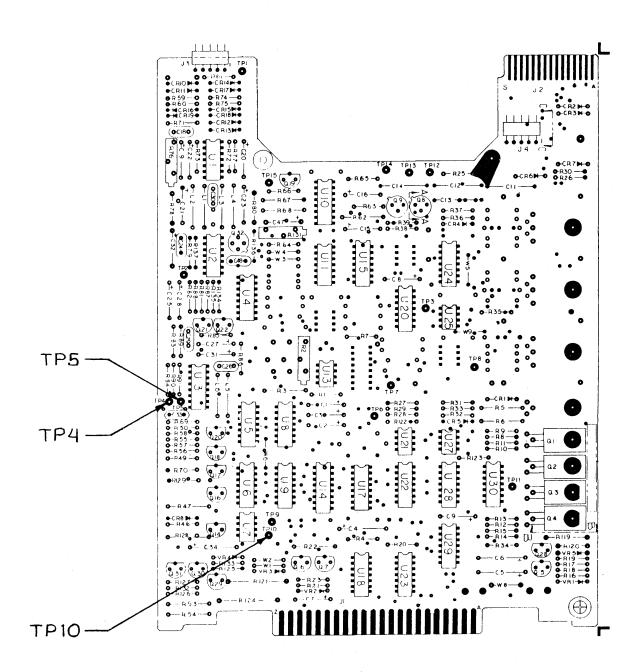
# 3. READ GAIN ADJUSTMENT

Set the scope time base to 20MS/CM; scope TP-4 and TP-5 added differentially (A + B with B inverted), and Sync on TP-10 leading edge.

Insert a spare diskette and write on all ones pattern on track zero. Read the data and adjust R-76 until you have a 3.5V pp signal +5V, -0V at the minimum point of the one bit envelope.

# 6.2 CORRECTIVE MAINTENANCE

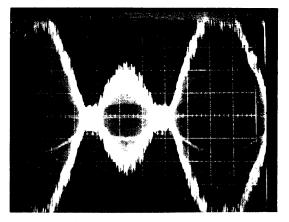
AED provides a comprehensive diagnostic program with the interface adaptors that AED supplies. If the user designs his own interface adaptor he must write a suitable diagnostic program. Examples of diagnostic programs are available from AED.



FD 510 P.C.B.

FIGURE 6-1.

20 Milliseconds/Division

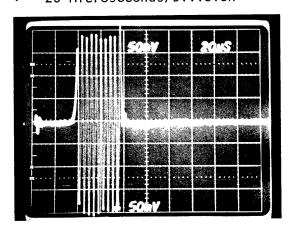


**Head Properly Aligned** 

Head Improperly Aligned

C.E. Alignment Oscilloscope Patterns

←---20 Microseconds/Division---→



Index Sensor Alignment Oscilloscope Pattern

FIGURE 6-2. "CATS EYES"

Whenever possible, spare sub-assemblies should be substituted to isolate and correct faults (See Section 6.3 for Sub-assembly removal and replacement).

The following basic trouble shooting procedure is suggested:

- 1. Check for obvious problems; equipment not properly cabled, fuse blown, etc.
- 2. Verify that the Power Supply levels at the DC Distribution Panel lie within the limits given in Table 6-1.
- 3. Be sure the media turns when properly installed in the Drive Unit.
- 4. Run the diagnostic program.
- 5. Use the information in Table  $6^{-2}$  as a preliminary guide to isolating the problem.
- 6. Replace the suspected sub-assembly to verify the diagnosis.

# 6.3 SUBASSEMBLY REMOVAL AND REPLACEMENT

The AED 6200P Cabinet includes the following subassemblies:

- Formatter and Drive Electronics;
- 2. Control Panel;
- Power Supply;
- 4. Drive Unit (s);
- 5. Perhaps an AED furnished Interface

TABLE 6-1. POWER SUPPLY LEVELS

VOLTAGE	RANGE	OUTPUT CURRENT	
+5V	+4.75V to +5.25V	10 AMPS	
+24V	UNREGULATED	6 AMPS	
-5V	-4.75 to -5.25V	3/4 AMPS	

<sup>\*</sup>ALL VOLTAGES MEASURED AT THE POWER SUPPLY DISTRIBUTION PANEL.

TABLE 6-2. AED 6200P TROUBLE SHOOTING GUIDE

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

# 6.3.1 FORMATTING AND DRIVE BOARDS

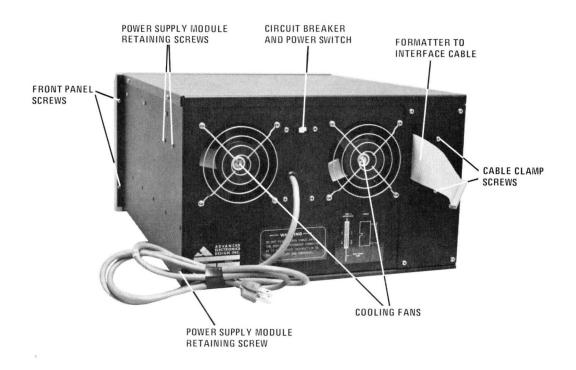
The AED 6200P Formatter is implemented on one Formatting Board and one smaller Drive Board. Both boards are housed in the upper section of the 6200P chassis.

# To remove the Drive Board:

- 1. Remove the Top Cover; remove the four retaining screw (Figure 6-1) and lift off the Top Cover.
- Remove the Rear Panel: loosen the two Interface Cable clamp screws and remove the four Rear Panel retaining screws (Figure 6-1).
- 3. Disconnect the Drive Cables and the Formatting Board Cable (Figure 6-2).
- 4. Disconnect the Drive Board's DC Power connector from the DC Distribution Panel on the Power Supply (Figure 6-5).
- Remove the six Drive Board retaining screws (Figure 6-2) and lift out the Drive Board.

# To remove the Formatting Board:

- Disconnect the Interface Cable if desired (Figure 6-2).
- 2. Disconnect the Formatting Board's DC Power connector from the DC Distribution Panel (Figure 6-5).
- 3. Remove the three nylon hex nuts and the two nylon spacers (Figure 6-2).
- 4. Lift the Formatting Board up enough to disconnect the Control Panel Cable (Figure 6-2).
- 5. Lift out the Formatting Board.



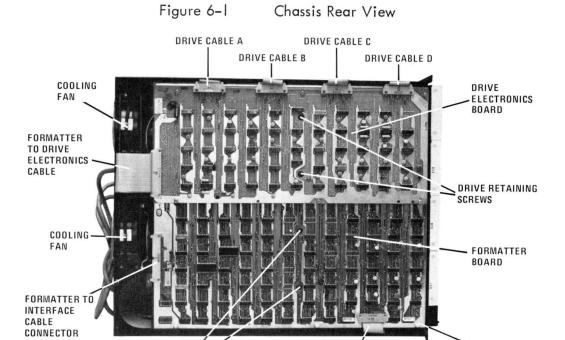


Figure 6-2 Drive and Formatter Board Location

DRIVE RETAINING

SCREWS

CONTROL

PANEL

CABLE

NYLON RETAINING

NUT

### 6.3.2 CONTROL PANEL

Operator switches and indicators are located on the removable Control Panel subassembly. To remove the Control Panel:

- 1. Remove the Drive and Formatting Boards, as described in Section 6.3.1
- 2. Remove the Front Panel: remove the four retaining screws (Figure 6-1).
- 3. Remove the two Control Panel retaining screws on the bottom of the chassis (Figure 6-4).
- 4. Remove the two Control Panel retaining screws on the upper chassis deck (Figure 6-3).
- 5. Withdraw the Control Panel from the front of the chassis while guiding the Control Panel cable through the slot in the upper chassis deck.

# 6.3.3 POWER SUPPLY

The Power Supply sub-assembly consists of the Power Supply, the AC Distribution Panel and the DC Distribution Panel. To remove the Power Supply sub-assembly:

- 1. Remove the four Power Supply retaining screws on the bottom of the chassis (Figure 6-4).
- 2. Remove the two Power Supply retaining screws on the rear of the chassis.
- 3. Slide the Power Supply sub-assembly slightly toward the center of the chassis and swing it out far enough to allow more convenient access to the DC Distribution Panel.
- 4. Disconnect the Drive Unit DC Power cable(s) from the DC Distribution Panel (Figure 6-5).
- 5. Slide the Power Supply out of the chassis.

# 6.3.4 DRIVE UNIT(S)

Each Drive Unit is a self-contained sub-assembly. To remove a Drive Unit:

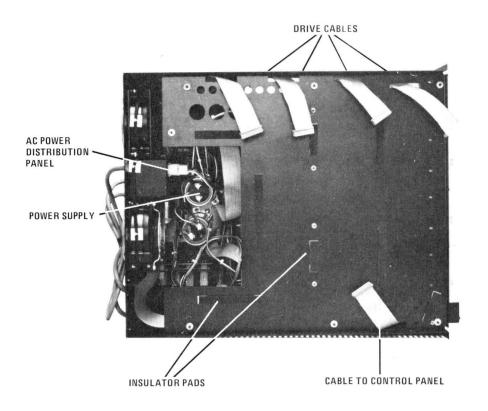


Figure 6–3 Chassis Top View

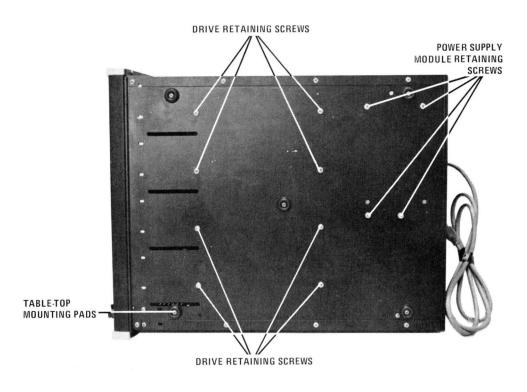


Figure 6-4 Chassis Bottom View

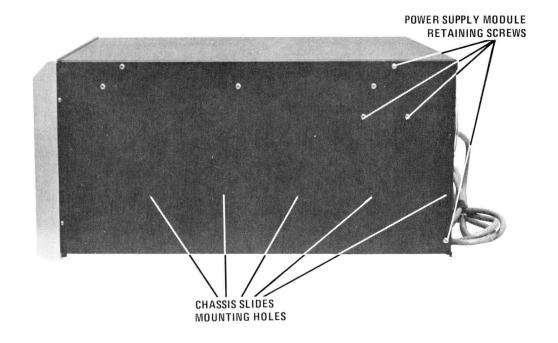


Figure 6-5 Power Supply Removal

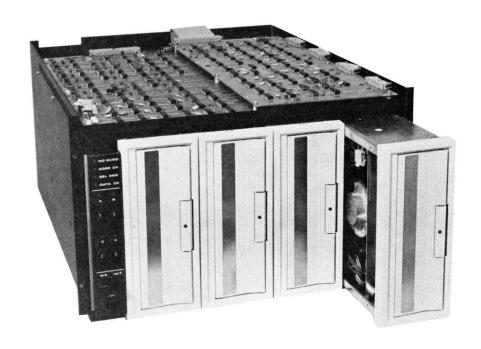


Figure 6-6 Drive Unit Removal

# DISC DRIVE POWER CONNECTIONS.

BLACK - GND WHITE - 24 R VIOLET - +240 ORANGE - - 120 RED - +50

RIBBON # 17 S 21 15 7 3 1 9 11 13 19 25 21 12 12 14 15 12 14 15 19