APPLICATION		REVISIONS			
NEXT ASSY	USED ON	REV	DESCRIPTION	DATE	APPROVED
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SPECIFICATION CONTROL DRAWING

REVISION INDEX																																							
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UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES AND INCLUDE APPLIED FINISH

TOLERANCES
2 PLACE ± 3 PLACE ± ANGLES ±

MATERIAL:

DRAWN: R.G. RAMSDELL

COMP. ENGR. APPROVAL

ENGINEERING APPROVAL

ENGINEERING APPROVAL

QUALITY APPROVAL

RELEASE

DATAPOINT CORPORATION
9725 DATAPOINT DRIVE
SAN ANTONIO, TEXAS 78284

TITLE: 150 MEGABYTE FIXED MEDIA DISK DRIVE

PROJ

SIZE A

DWG NO. 85-0127-001

REV F

SCALE

SHEET 1 OF 55

K&E 10 9535 5-75 MC3723A•

DATAPOINT CORP.
PERIPHERAL PRODUCTS INC.

REVISION A

INITIAL
FUNCTIONAL SPECIFICATION

PRODUCT 150 MEGABYTE FIXED MEDIA DISK DRIVE

DATED 6/25/79

ORIGINATOR R. RAMSDELL

APPROVALS:

7/18/79 Phil Breeden
DATE: Phil Breeden - Director
Control Unit Development

6/26/79 Frank E Ruble
DATE: Frank Ruble - Director
Storage Products Development

John K. Clemens 6/26/79
DATE: Jack Clemens - Vice President
Product Development

DATE: Ronald Meyers - Assistant General
Manager & Vice President Marketing

DATE: John Walker - Sr. Vice President
and General Manager POD
Implementing Division

6/29/79
DATE: V. Poor - Sr. Vice President
Research & Development

DATE: H. Hensley - Vice President
General Manager International
Operations Division
Sponsoring Division

DATE: V. Balhorn - Vice President
and General Manager Customer
Service

DATE: Richard Palermo, Executive Vice
President, Data Processing Group

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150 MEGABYTE DISK DRIVE
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1.0 Purpose

This document describes the functional characteristics, performance specifications and interface requirements of a 150 Mbyte OEM disk drive. This OEM disk drive is a fixed media random access mass storage device. This device will be used in a high performance, stand alone mass memory storage subsystem.

2.0 Summary of Functional Characteristics

2.1 General Specifications

General specifications for the disk drive are listed in Table 1.

Table 1 - Specifications

PARAMETER	
STORAGE MEDIA	Fixed Media
Disks per drive	4
Track density (TPI)	476
Data Surfaces:	
Movable Heads	7
Servo & Fixed Heads	1
RECORDING TECHNIQUE:	MFM
Bit Density (BPI)	6366
Movable Heads per surface	2
Movable Heads per Drive	14
Servo Head	1
Optional Fixed Heads	60
Track per Cylinder	14
Cylinder per Drive (primary + alternate)	550 + 10
Tracks per Drive (primary + alternate)	7700 + 100

Table 1 - Specifications (Con't)

PARAMETER	150 MByte Model
DATA CAPACITY: (Unformatted)	
MOVABLE HEADS:	
Bytes/Track	19968
Bytes/Cylinder	279552
Megabytes/Drive (unformatted)	154
FIXED HEADS (Option):	
Bytes/Track	19968
Megabytes/Drive (unformatted)	1.20
DATA TRANSFER RATE: (Nominal)	
Megabytes/Second	1.198
Megabits/Second	9.585
ACCESS TIME: (Reference Section 4.2.3.1 for definition of measuring access time).	
OneTrack Seek	7 ms
Average Seek	35 ms
Maximum Length Seek	70 ms
DISK ROTATIONAL SPEED:	3600 RPM ± 4%
Maximum latency	16.67 MS ± 4%
Average latency	8.33 MS ± 4%
Start Up Time:	25 Sec Max
Stop Time:	60 Seconds

2.2 Operational Considerations

The Operator controls are located on the front panel of the drive. The panel contains AC Power ON/OFF and FILE PROT (Optional), and three indicator lamps. The red indicator lamp, when it is illuminated, indicates the AC power is applied to the drive. The green indicator lamp, when it is illuminated, indicates that the drive is in READY mode. The yellow indicator lamp, when it is illuminated, indicates that the drive is in WRITE PROTECT Mode.

2.2.1 Switches

2.2.1.1 AC Power ON/OFF Switch

The AC POWER ON/OFF is an alternate action switch. When the AC POWER switch is positioned to ON and the AC cable is connected to the appropriate AC outlet, the Power On indicator lamp shall be illuminated.

2.2.1.1.1 When the AC power switch is in ON position, the following conditions will occur:

2.2.1.1.1.1 Power-On Sequence

2.2.1.1.1.1.1 When the AC power is applied to the power supply, the DC voltages will be generated in the following sequence:

(1) +5VDC

(2) -5.2VDC, +12VDC, -12VDC

(3) +24VDC

When all the DC voltages are present and within their limits, the "DC POWER OK" status is generated to activate the disk motor brake solenoid and apply the AC power to the motor.

2.2.1.1.1.1.2 The "POWER-ON RESET" is generated to initialize all control flip/flops and counters.

2.2.1.1.1.3 When the speed monitor circuit detects the disk speed is within 80% of the nominal speed, the "EMA ENABLE" and power-up restore command are generated to position the read/write heads to cylinder 0. When the heads are successively positioned to cylinder 0, the UNIT READY status becomes true and the READY lamp is illuminated to indicate that the drive is ready for operation.

2.2.1.1.1.2 Power-Off Sequence

When the AC power switch is positioned to OFF, the following conditions will occur:

2.2.1.1.1.2.1 The AC power indicator lamp will not be illuminated.

2.2.1.1.1.2.2 The READY lamp will be extinguished.

2.2.1.1.1.2.3 The read/write heads will be returned to the landing zone of the disks.

2.2.1.1.1.2.4 The motor brake solenoid is de-energized and the brake is applied to the drive motor to stop disk rotation.

2.2.2 Indicators

2.2.2.1 AC Power Indicator (Red Lamp)

This indicator lamp, when it is illuminated indicates that the AC power is applied to the disk drive.

2.2.2.2 READY Indicator (Green Lamp)

This indicator lamp, when it is illuminated indicates that the disk drive is ready for operation.

2.2.2.3 FILE PROT Switch and Indicator (Yellow Lamp) (Optional Feature)

The FILE PROT is an alternate action switch. When the FILE PROT switch is positioned to ON, the indicator lamp shall be illuminated and the drive shall be placed in read only mode. The read only mode disables the write circuits within the drive and activiates the Write Protect status line. Upon receipt of a WRITE Command while the drive in Read Only Mode an UNSAFE shall be generated.

3.0 Product Configurations

3.1 Basic Configurations

The selective features are required for the configuration of the drives listed below.

Model	Description
150 MByte	Non-removable media disk drive with a movable head positioner assembly. The unformatted storage capacity is 154 MBytes on 550 cylinders on 4 disks. The power supply is included with the drive. The selective features are required. The interface cables and terminator are not furnished with the drive.

3.1.1 Selective Features

AC voltage and frequency (Reference Sections 7.7)

- 100 VAC, 50 or 60 Hz.
- 115 VAC, 50 or 60 Hz.
- 200 VAC, 50 or 60 HZ.
- 208 VAC, 50 or 60 Hz.
- 220 VAC, 50 or 60 Hz.
- 230 VAC, 50 or 60 Hz.
- 240 VAC, 50 or 60 Hz.

Disk Rotational Speed:

- 3600 RPM

Track Format:

- Address Mark or Sector Format. If Sector format is used, the number of Sectors per track must be specified.

3.1.2 Optional Features (Reference Sections 3.2 and 3.3)

- Fixed Head Option

3.2 Optional Features - Factory Installed

(1) FIXED HEAD ASSEMBLY - increases the data capacity by 1.2 megabytes. The fixed head assembly contains 20 read/write multi-element heads providing 60 tracks of data (1.2 mb).

3.3 Optional Features - Field Installed

(1) FIXED HEAD ASSEMBLY - provides 60 fixed head elements. This feature is field upgradable only by replacing with an HDA which has the fixed head assembly installed.

4.0 Functional Characteristics

4.1 Major Components

- Chassis
- Head Disk Assembly (HDA)
- 3 PWA Assemblies
- Drive motor

4.2 Description of System

4.2.1 Disk System

4.2.1.1 Media

The media consists of four disks 14 inches in diameter mounted on a single spindle and enclosed in a plastic and metal case. The disks are coated with magnetic oriented ferric oxide and lubricant.

4.2.1.2 Disk Organization

The disk drive has a single Head/Disk Assembly (HDA) which consists of four disks, four movable Data Head/Arm Assemblies, a fixed head/arm assembly (optional) and a single servo head/arm assembly. The HDA is a nonremovable module enclosed in a shroud with necessary electronics and hardware to allow movement of the heads and the reading and writing on the media.

4.2.2 Storage Organization

Each moving head data surface is divided into two data bands (outer and inner). Each data band contains 560 tracks (550 and 10 alternates) and a read/write head. Hence, there are 560 cylinders (550 with 10 alternates) for the moving heads on three to seven data surfaces. The bottom surface contains 560 servo tracks and 60 tracks for the optional fixed read/write heads. Figure 1a shows the Head/Disk Assembly.

4.2.3 Accessor Assembly

4.2.3.1 Positioning Times

The positioning time is defined as the time interval from true to false transition of the ON CYLINDER status to the ON CYLINDER status transition from false to true. The drive must be at zero offset prior to issuing a SET CYLINDER command. When executing repetitive seeks for the purpose of measuring positioning time, a 2 millisecond minimum delay is required after receiving ON CYLINDER prior to issuing the next SET CYLINDER command. Failure to include the delay may result in erroneous measured positioning times.

4.2.3.1.1 One Track Seek

The average positioning time of at least 1024 one track seek shall not exceed 7 milliseconds.

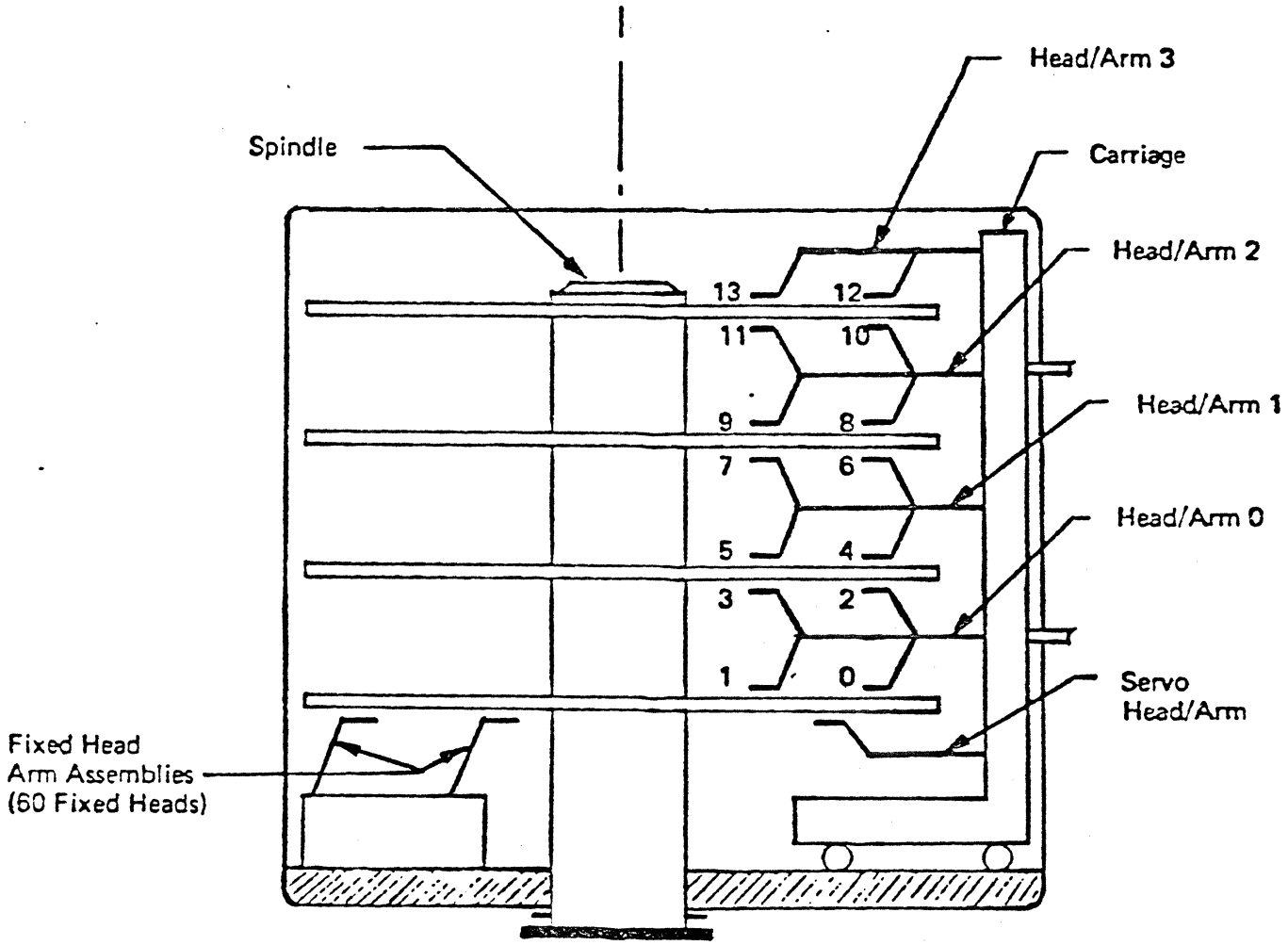


Fig 1a - Head/Disk Assembly (HDA)

4.2.3.1.2 Maximum Length Seek

The average positioning time of at least 1024 maximum length seeks (560 cylinders) shall not exceed 70 milliseconds.

4.2.3.1.3 Average Seek

The average positioning time is the sum of the time required to do all the possible combinations of seek divided by the number of such seeks. The average positioning time shall not exceed 35 milliseconds.

4.2.3.1.4 Recal

The positiong time for a RECAL command shall not exceed 0.6 seconds.

4.2.3.1.5 Zero Track Seek

The access mechanism does not move for a zero length seek, however, an internal delay is enabled. The false to true transition of ON CYLINDER status shall not exceed 15 microseconds from the trailing edge of the SET CYLINDER command.

4.2.3.2 Rotational Latency

The disk pack rotates at a speed of 3600 RPM ± 4% for the specified range of AC voltage and frequency inputs defined in paragraph 7.7 This speed results in a maximum (full revolution) latency of 17.34 millisecond and an average (half revolution) latency of 8.6 millisecond.

4.2.3.3 Track Offset

The 717 OEM disk drive has the capability to move the R/W heads off the nominal track center with the Servo Offset Plus and Servo Offset Minus interface commands. This function may be used to recover marginal

302 Bytes

ZEROS GAP	SYNC	DATA	ECC	WG PAD	END OF RECORD GAP
Bytes: 27	1	260	6	1	7

ZEROS GAP - 27 Bytes of Zeros; 16 Bytes for head skew and 11 Bytes for PLO Sync.

SYNC BYTE - Byte of Hex 01 for synchronization of serial read data to the controllers logic.

DATA - 260 Bytes of system data.

ECC - 6 Bytes of Error Correction Code.

WG PAD - 1 Byte of zeros written after last ECC byte prio to Write Gate turn-off.

EOR GAP - 7 Bytes of zeros.

DATA TRACK FORMAT
Figure 1b.

Table 2. Unformatted Sector Capacities

N	C	C_L	N	C	C_L
5	3993	3996	51	391	418
6	3328	3328	52	384	384
7	2852	2856	53	376	416
8	2496	2496	54	369	411
9	2218	2224	55	363	366
10	1996	2004	56	356	388
11	1815	1818	57	350	368
12	1664	1664	58	344	360
13	1536	1536	59	338	364
14	1426	1430	60	332	380
15	1331	1334	61	327	348
16	1248	1248	62	322	326
17	1174	1184	63	316	376
18	1109	1115	64	312	312
19	1050	1068	65	307	320
20	998	1006	66	302	338
21	950	968	67	298	300
22	907	921	68	293	337
23	868	872	69	289	316
24	832	832	70	285	303
25	798	816	71	281	298
26	768	768	72	277	301
27	739	754	73	273	312
28	713	717	74	269	331
29	688	704	75	266	284
30	665	683	76	262	318
31	644	648	77	259	284
32	624	624	78	256	256
33	605	608	79	252	312
34	587	597	80	249	297
35	570	588	81	246	288
36	554	578	82	243	285
37	539	564	83	240	288
38	525	543	84	237	297
39	512	512	85	234	312
40	499	507	86	232	248
41	487	488	87	229	274
42	475	493	88	226	306
43	464	480	89	224	256
44	453	489	90	221	299
45	443	476	91	219	258
46	434	438	92	217	221
47	424	464	93	214	280
48	416	416	94	212	252
49	407	432	95	210	228
50	399	417	96	208	208

N = Sectors per Track
C = Bytes per Sector
C_L = Bytes per Last Sector

Table 2. Unformatted Sector Capacities (Cont)

N	C	C_L	N	C	C_L
97	205	288	124	161	165
98	203	277	125	159	252
99	201	270	126	158	218
100	199	267	127	157	186
101	197	268	128	156	156
102	195	273			
103	193	282			
104	192	192			
105	190	208			
106	188	228			
107	186	252			
108	184	280			
109	183	204			
110	181	239			
111	179	278			
112	178	210			
113	176	256			
114	175	193			
115	173	246			
116	172	188			
117	170	248			
118	169	195			
119	167	262			
120	166	214			
121	165	168			
122	163	245			
123	162	204			

N = Sectors per Track
C = Bytes per Sector
C_L = Bytes per Last Sector

4.2.3.3 Track Offset (Con't)

Data resulting from small defects on the disk surface. The offset magnitude is 350 micro-inches.

4.2.4. Sectoring

Each track on the disk is divided into "n" sectors per revolution. The number of sectors per revolution is hardware programmable within the range of 5 to 128 sectors. The sector boundaries are difined by the Index and Sector status signals. The index signal defines the start of the first sector. A sector signal does not occur at the start of the first sector. Refer to Table 2 for definition of sector timing. If the sector size is not an integral submultiple of the track size the last sector will be larger as indicated in Table 2.

Drives will be configured for Datapoint with 66 sectors per track on 560 cylinders. The format of each sector recorded by Datapoint on the disk pack (HDA) is segmented as shown in Figure 1b.

4.2.5 Rotational Position Sensing (RPS)

The disk drive has the capability to sense the sector that is positioned under the R/W heads. In response to the Set Sector command, the drive will assert the Attention and Record Ready status signals when the specified sector address equals the sector count. The sector counter is set to zero by the index signal and advanced by the sector signal. An Invalid sector address will result in an Unsafe status.

4.2.6 Address Mark

The disk drive has the capability to read and write address marks using the Address Mark Enable interface command. During a write operation the Address Mark Enable command initiates the writing of an address mark. During a read operation the Address Mark Enable command initiates a search for an address mark which is acknowledged by the AM Found status signal. The Address Mark is a unique pattern that can be used to identify the beginning of a formatted data field on the track.

4.2.7 Unsafe Condition Monitor

The 150 MB disk drive contains circuits that will continuously monitor and identify the following unsafe conditions. The detection of an unsafe condition results in assertion of the UNSAFE status signal. The unsafe conditions may be cleared by the operator or control unit (reference paragraph 2.2) or may require service by qualified personnel.

4.2.7.1 DC Power Unsafe

DC Power Unsafe indicates loss of any DC voltages. This condition will cause the heads to move to the landing zone.

4.2.7.2 Pack Speed Unsafe

The pack speed is less than 80% of the normal operating speed when the heads are not in the landing zone. When this condition occurs, the heads are retracted to the landing zone.

4.2.7.3 PLO Unsafe

The write oscillator is not in synchronization with the servo clock.

4.2.7.4 Write Unsafe

No write transition detected when Write Gate is active and address mark writing is inactive.

4.2.7.5 Write Servo Offset

Write gate active with servo offset command enabled.

4.2.7.6 Index Error

Indicates that the Index was detected outside its window, or that the window occurred with no index and write gate is active and AM feature is not installed.

4.2.7.7 RPS Unsafe

Indicates a Record Ready condition has not occurred within 7 disk revolutions as a result of a Set Sector command.

4.2.7.8 AC Unsafe

This unsafe indicates loss of AC power.

5.0 Interface Definitions

The interface signal connector pin assignments and signal polarities are summarized in Tables 3 and 4. All lines in the interface are digital in nature and either provide signals to the drive or provide signals to the controller. All interface signals are transmitted on balanced, terminated transmission lines; twisted pair for address and control functions and twinax conductor for data and clock lines. The interface signals are grouped in two cables, A and B. The signals in cable A are multiplex lines which are related to address and control functions. The signals in cable B are simplex lines which are related to read/write data and clock, and interrupt function.

5.1 Line Drivers and Receivers

The interface line drivers and receivers shall be dual differential drivers and receivers equivalent to SN75110 and SN75107B. Figures 2 and 3 show the line driver and receiver with termination network.

5.2 Flat Cable Interface

The flat (ribbon) cables are unshielded.

5.2.1 A- Cable (Flat Cable Interface)

ITEM	DESCRIPTION	BERG P/N	SPECTRA-STRIP P/N
1	Connector, 60 Pos	65043-007	-
2	Contact, Insert	48048	-
3	Flat Cable, Twisted pair, 30 pair, 28 AWG	-	3CT-6028-7B-05-100

5.2.2 A- Cable Mating Receptacle on Drive (Flat Cable Interface)

ITEM	DESCRIPTION	AMP P/N
1	Vertical Header, 60 Pos	3-87227-0

5.2.3 B- Cable Read/Write Signal (Flat Cable Interface)

ITEM	DESCRIPTION	3M P/N
1	Connector, 26 Pos	3399-3000
2	Connector, Pull Tab	3490-2
3	Flat Cable, 26 conductor with ground plane and drain wire	3476-26

5.2.4 B- Cable Mating Receptacle on Drive (Flat Cable Interface)

ITEM	DESCRIPTION	AMP P/N
1	Vertical Header, 26 Pos	1-87227-3

Table 3

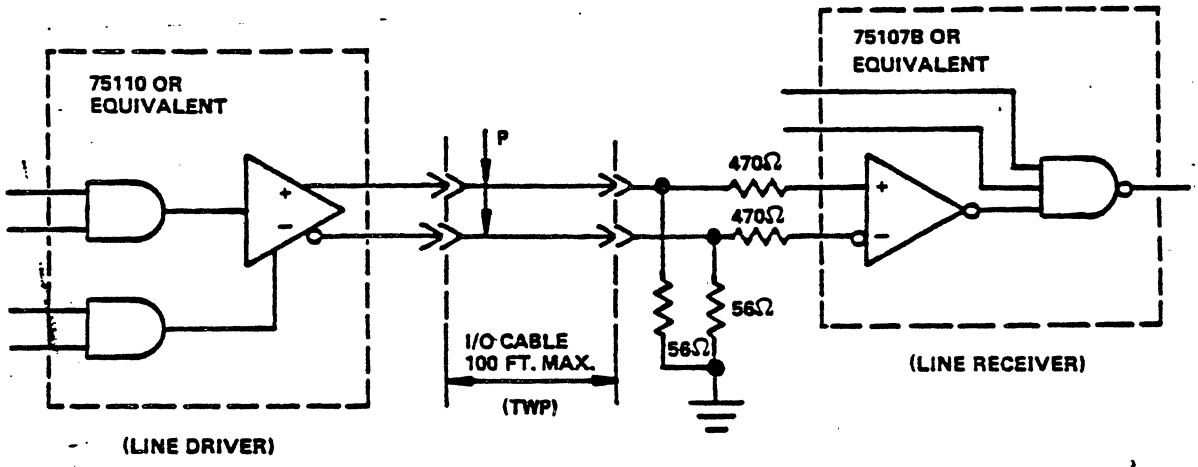
A-CABLE, CONTROL SIGNAL PIN ASSIGNMENT

SIGNAL NAME	FLAT CABLE INTF PIN POLARITY		SOURCE
	LO(-)	HI(+)	
Device Select 2^0	23	53	CU
Device Select 2^1	24	54	CU
Device Select 2^2	26	56	CU
Device Select 2^3	27	57	CU
Device Select Enable	22	52	CU
Set Cylinder (Tag 1)	1	31	CU
Set Head (Tag 2)	2	32	CU
Control Select (Tag 3)	3	33	CU
Set Sector (Tag 4)	30	60	CU
Bus Out 0	4	34	CU
Bus Out 1	5	35	CU
Bus Out 2	6	36	CU
Bus Out 3	7	37	CU
Bus Out 4	8	38	CU
Bus Out 5	9	39	CU
Bus Out 6	10	40	CU
Bus Out 7	11	41	CU
Bus Out 8	12	42	CU
Bus Out 9	13	43	CU
Interface Enable (Open Cable Detect)	14	44	CU
Index Mark	18	48	Drive
Sector Mark	25	55	Drive
Unsafe	15	45	Drive
Seek Incomplete	16	46	Drive
On Cylinder	17	47	Drive
Unit Ready	19	49	Drive
Write Protected	28	58	Drive
Address Mark Found	20	50	Drive
Busy (Dual Port)	21	51	Drive
Power Pick	29	--	CU
Power Hold	59	--	CU
Terminator Ground	--	--	CU

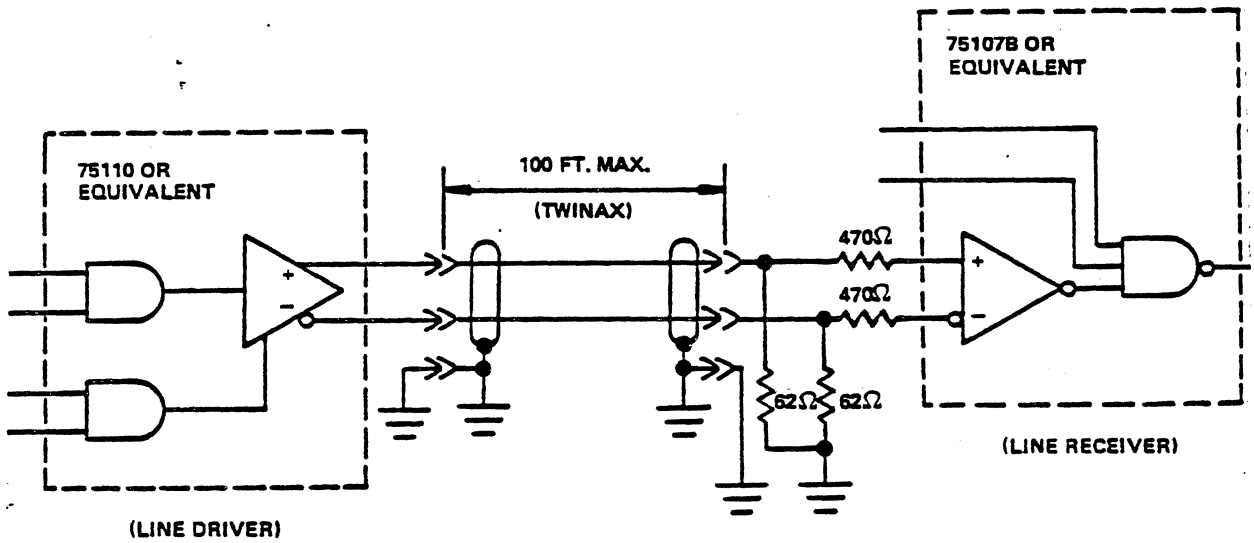
Table 4

B-CABLE, READ/WRITE SIGNAL PIN ASSIGNMENT

SIGNAL NAME	FLAT CABLE INTERFACE PIN POLARITY			SOURCE
	LO(-)	HI(+)	GROUND	
WRITE DATA	8	20	7	CU
SERVO CLOCK	2	14	1	Drive
READ DATA	3	16	15	Drive
READ CLOCK	5	17	4	Drive
WRITE CLOCK	6	19	18	CU
DEVICE SELECTED	22	9	21	Drive
ATTENTION	10	23	--	Drive
RECORD READY	12	24	11	Drive
RESERVED	13	26	25	Drive
NOT USED				
NOT USED				
NOT USED				
NOT USED				
NOT USED				
NOT USED				



A TYPICAL CONTROL/STATUS TRANSMISSION LINE

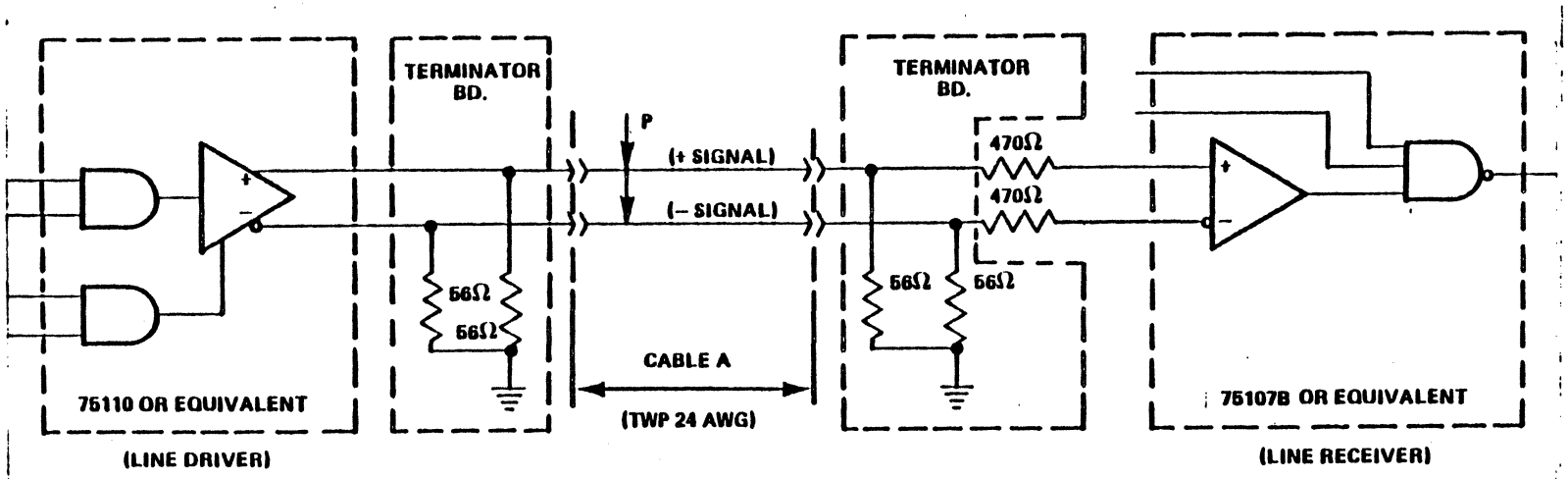


A TYPICAL DATA/CLOCK TRANSMISSION LINE

Figure 2. Radial Cable Transmission

DATAPOINT CORPORATION
Datapoint Peripheral Products Inc.

DWG NO. 85-0127-001
SHT 25
REV A



TYPICAL SIGNAL LEVELS: (AT THE INTERFACE TERMINATOR)

+SIGNAL = 0 VOLT

–SIGNAL = 0.3 VOLT (DOUBLE TERMINATION: DAISY CHAIN)
= –0.6 VOLT (SINGLE TERMINATION: RADIAL)

Figure 3 - Cable A Control/ Status Daisy Chain Transmission Line

5.3 Interface Signal Definitions

5.3.1 Output Signal Lines

The output signals are generated by the control unit and transmitted to the drive via A-cable or B-cable.

5.3.1.1 Device Select Lines (2^0, 2^1,2^2,2^3)

These four lines are binary coded to select one of sixteen drives on the control cable. The DEVICE SELECT lines must be held stable for 200 nanoseconds prior to and following the leading edge of DEVICE SELECT ENABLE. The device address is determined by the Device Address switch in the drive. The operator must verify that no duplicate Device Address switches are installed in the drives on the same Daisy Chain.

5.3.1.2 Device Select Enable

This signal is used to select the device whose address is specified in the DEVICE SELECT lines (2^0,2^1,2^2,2^3). The DEVICE SELECT ENABLE must remain stable for the duration of DRIVE SELECT. The DEVICE SELECTED signal becomes true within 0.5 microseconds after the leading edge of the DEVICE SELECT ENABLE if the address in the DEVICE SELECT lines compares with the address of the Device Address switch in drive. The PRIORITY SELECT command (Bus Out bit 9) is strobed by the leading edge of DEVICE SELECT ENABLE.

5.3.1.3 Set Cylinder (Tag 1)

5.3.1.3.1 This signal is a pulse (1.0us to 0.5ms) which is used to load the cylinder address specified by the BUS OUT lines into the cylinder address register of the selected drive. The cylinder address contained in the BUS OUT lines is the absolute address of a desired cylinder. A difference calculation is performed in the selected drive to determine the direction and actual number of cylinders that the drive must seek in order to position the heads to the desired cylinder. Upon completion of SET CYLINDER command, the selected drive generates a seek start to initiate the positioner to seek the number of cylinders contained in the difference counter in the direction that was determined by the difference calculation. The drive must be ON CYLINDER prior to application of SET CYLINDER. Figures 4 and 5 show the seek operation timing.

5.3.1.3.2 Drive has Fixed Head option. The fixed head address is derived from the information specified in the SET CYLINDER and SET HEAD tags. When the two highest order bits of the BUS OUT lines (8 and 9) are asserted during the SET CYLINDER tag, the drive will decode a FIXED HEAD SELECT and store the four lowest order BUS OUT bits (0 thru 3) in the Fixed Head Address Register. These four bits will form the least significant bits of the Fixed Head Address. The Fixed Head information contained in the SET CYLINDER tag is as follows:

BUS OUT BIT	FUNCTION
0	Fixed Head Address Bit 1
1	Fixed Head Address Bit 2
2	Fixed Head Address Bit 4
3	Fixed Head Address Bit 8
4	Not Used
5	Not Used
6	Not Used
7	Not Used
8	Fixed Head Mode
9	Fixed Head Mode

Since there is no positioner movement for fixed head selection, the ON CYLINDER and ATTENTION status will become false at the end of the SET CYLINDER tag and return to active state 15 us later.

In order to reset the Fixed Head Mode, the control system must issue the Set Cylinder with the appropriate movable cylinder address or the Recal Command. The ON CYLINDER and ATTENTION status will return to the controller in the normal seek operation.

5.3.1.4 Set Head (Tag 2)

5.3.1.4.1 This signal is a pulse (1.0us to 5us) which is used to load the head address contained in the BUS OUT lines (bits 0 through 3) into the Head Address Register in the selected drive. This command permits selection of one of the fourteen (14) heads which will be used to perform a read or write operation.

5.3.1.4.2 Drive has Fixed Head Option. When the Fixed Head Mode is enabled, the two least significant bits of the SET HEAD tag will be the highest order bits of the fixed head address. The fixed head information contained in the SET HEAD Tag BUS OUT lines is defined as follows:

BUS OUT BIT	FUNCTION
0	Fixed Head Address Bit 16
1	Outer Fixed Head Group
2	Not Used
3	Not Used
4	Not Used
5	Not Used
6	Not Used
7	Not Used
8	Not Used
9	Not Used

If BUS OUT bit 1 is active during SET HEAD tag, it indicates that the outer 30 fixed head group is selected. If BUS OUT bit 1 is inactive, it indicates that the inner 30 fixed head group is selected. These two bits along with the Set Cylinder Fixed Head address will enable the controller to select any one of the 60 fixed heads.

5.3.1.5 Control Select (Tag 3)

This signal enables the selected drive to sample the BUS OUT lines (bits 0 through 9) which contain the control functions as listed in Table 5. The control functions are described as follows:

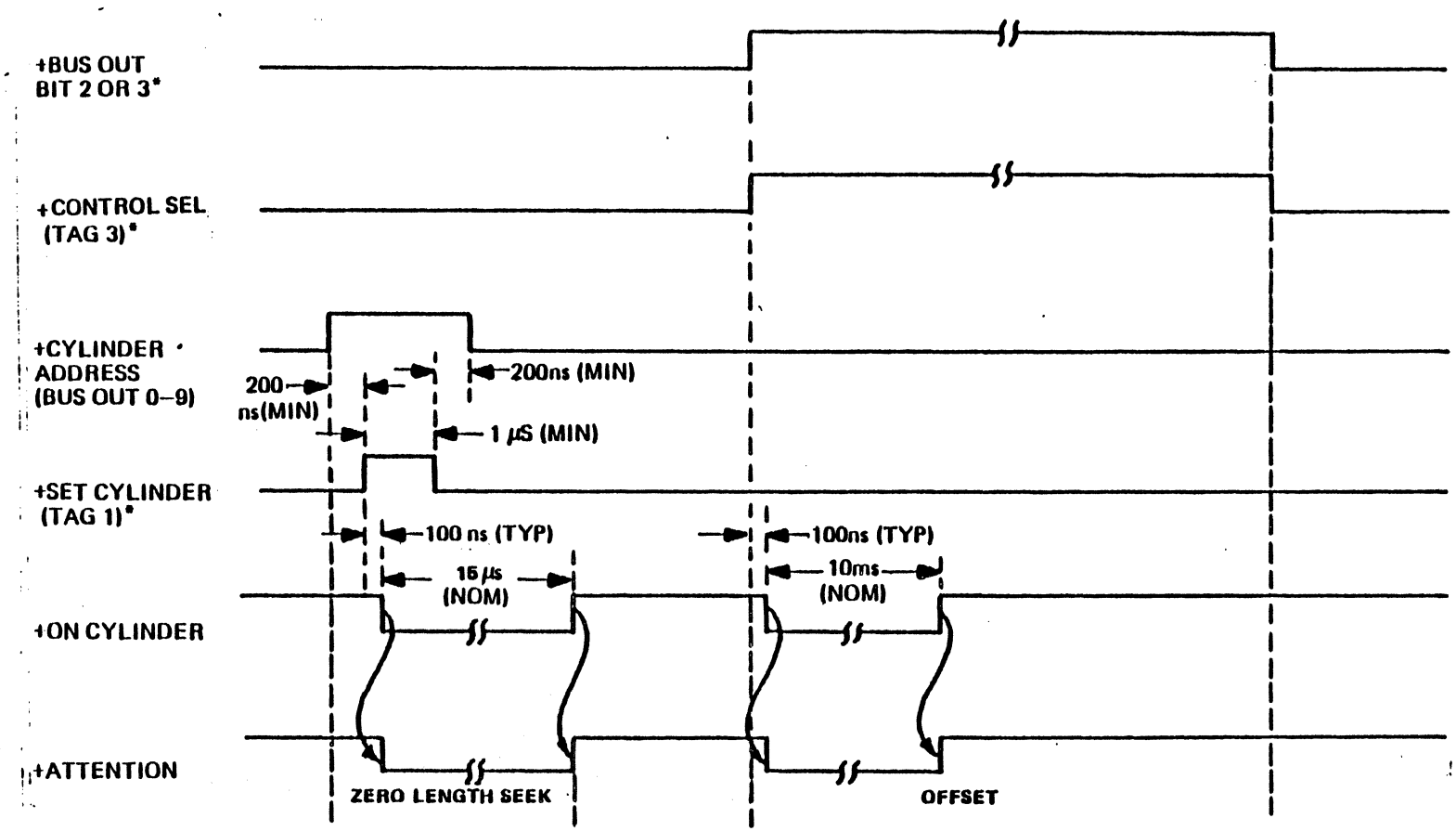
5.3.1.5.1 Bus Out 0 - Write Gate

This line, when true, enables the write drivers and the MFM encoder.

The WRITE GATE must be held stable for the entire duration of the writing operation. Figure 6 shows the required timing for the write operation.

5.3.1.5.2 Bus Out 1 - Read Gate

The READ GATE, when true, enables the read drivers and transmits the READ DATA (NRZ) and READ CLOCK to the control unit. Figure 7 shows the required timing for read operation.



* MUST BE MAINTAINED TRUE FOR DURATION OF OFFSET

NOTE: ALL TIMING RELATIONSHIPS ARE REFERENCED AT THE DRIVE INTERFACE CONNECTORS.

FIGURE 4: Zero Length Seek and Offset Timing

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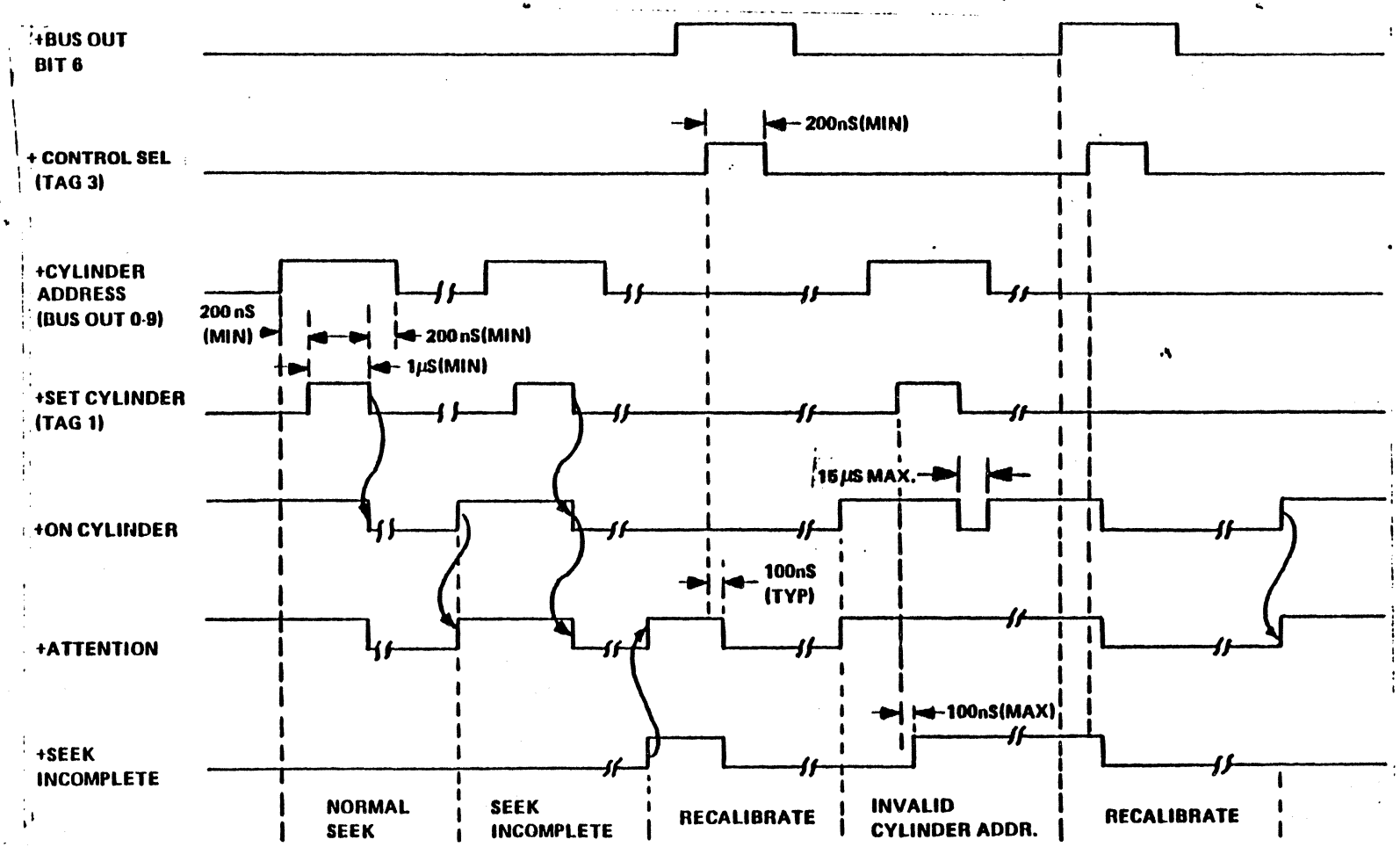

NOTE: ALL TIMING RELATIONSHIPS ARE REFERENCED AT THE DRIVE INTERFACE CONNECTORS.

FIGURE 5: Seek and Recalibrate Timing

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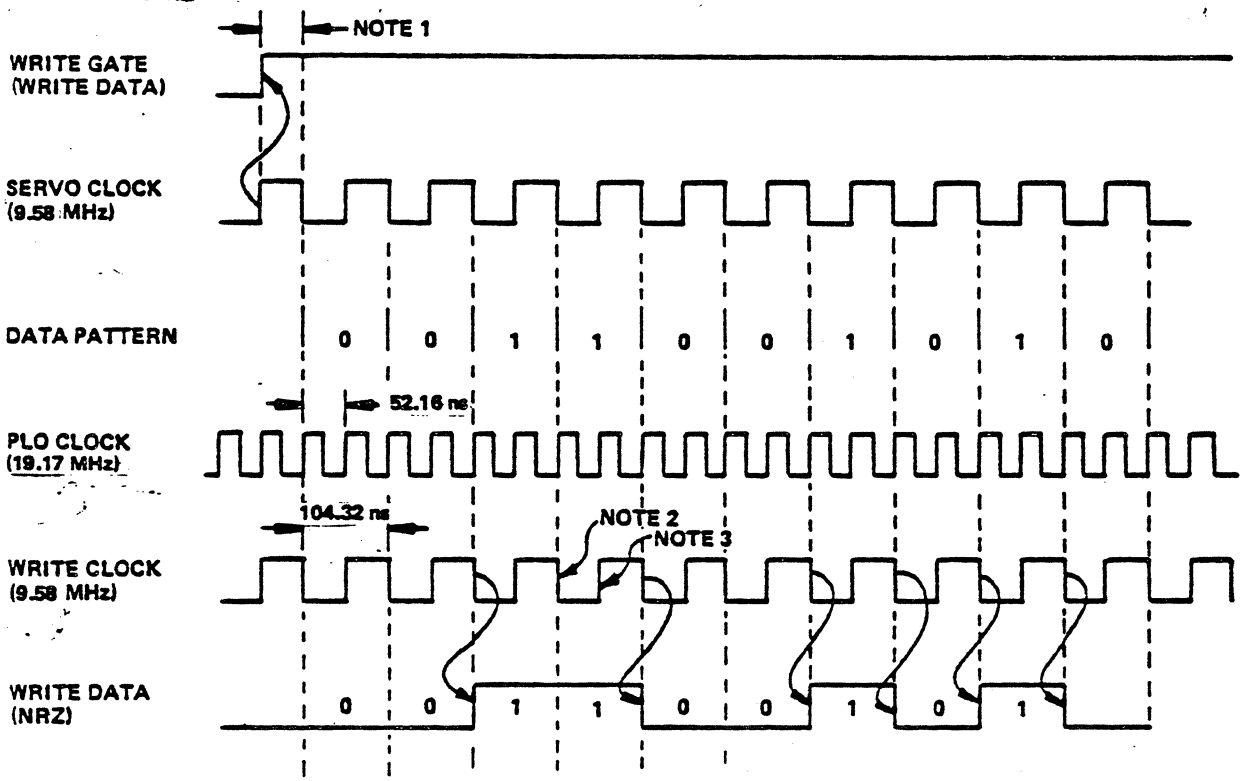
REV A

TABLE 5

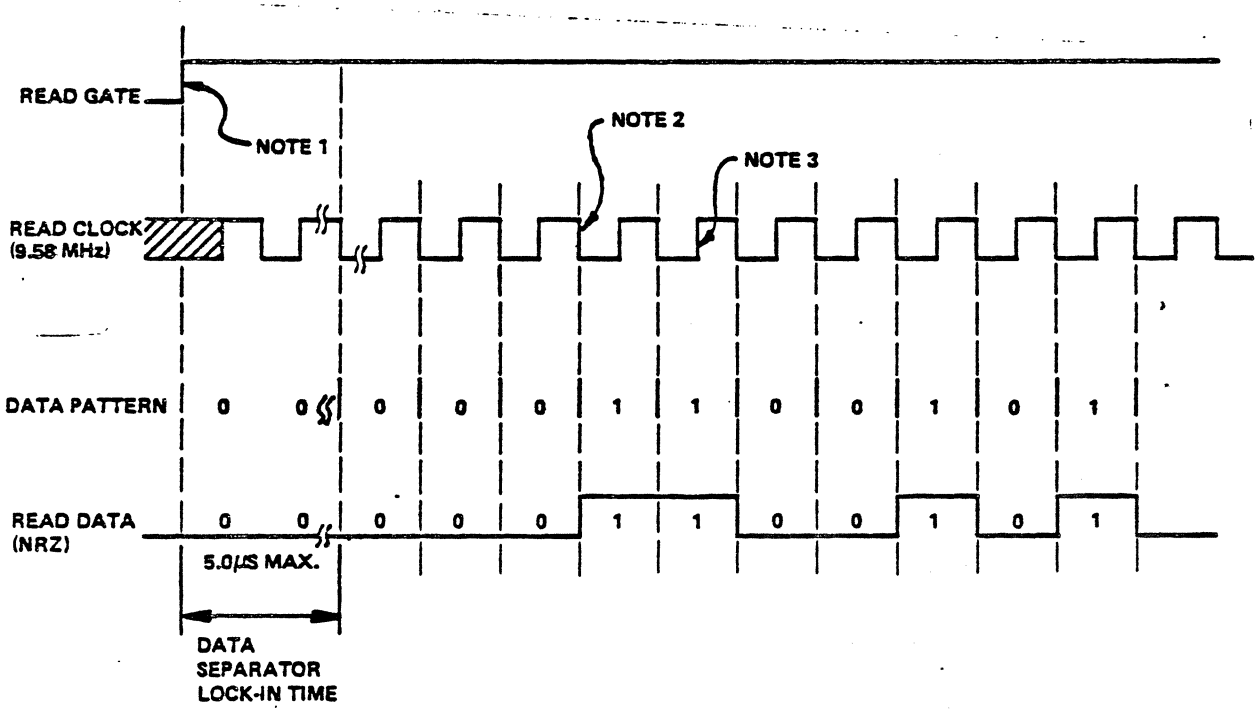
COMMAND DECODE FUNCTION

COMMAND LINES / BUS OUT BITS	SET CYLINDER (TAG 1)	SET HEAD (TAG 2)	CONTROL SEL (TAG 3)	SET SECTOR (TAG 4)
BUS OUT 0	CYL ADDR BIT 1	HEAD ADDR BIT 1	WRITE GATE	STR ADDR BIT 1
BUS OUT 1	CYL ADDR BIT 2	HEAD ADDR BIT 2	READ GATE	STR ADDR BIT 2
BUS OUT 2	CYL ADDR BIT 4	HEAD ADDR BIT 4	SERVO OFFSET PLUS	STR ADDR BIT 4
BUS OUT 3	CYL ADDR BIT 8	HEAD ADDR BIT 8	SERVO OFFSET MINUS	STR ADDR BIT 8
BUS OUT 4	CYL ADDR BIT 16		FAULT CLEAR	STR ADDR BIT 16
BUS OUT 5	CYL ADDR BIT 32		ADDRESS MARK ENABLE	STR ADDR BIT 32
BUS OUT 6	CYL ADDR BIT 64		RECAL	STR ADDR BIT 64
BUS OUT 7	CYL ADDR BIT 128			
BUS OUT 8	CYL ADDR BIT 256			
BUS OUT 9	CYL ADDR BIT 512		RELEASE	



NOTES:
1. DATA BIT MUST BE PRESENT WITHIN 200 ns FROM THE TIME WRITE GATE IS ENABLED. RECOMMENDED ENABLING AND DISABLING THE WRITE GATE BY A DATA BIT.
2. WRITE DATA CHANGE: NEGATIVE EDGE OF WRITE CLOCK.
3. DATA STROBE IN THE DRIVE IS THE POSITIVE EDGE OF WRITE CLOCK.
4. ALL TIMING RELATIONSHIPS ARE REFERENCED AT THE DRIVE INTERFACE CONNECTORS.

Figure 6: Write Data Timing (3600 RPM Drive)



NOTES:
1. READ GATE MUST BE ENABLED IN A VALID ZEROS AREA.
2. READ DATA CHANGE: NEGATIVE EDGE OF READ CLOCK.
3. DATA STROBE IN THE CONTROLLER IS THE POSITIVE EDGE OF READ CLOCK.
4. ALL TIMING RELATIONSHIPS ARE REFERENCED AT THE DRIVE INTERFACE CONNECTORS.

FIGURE 7: Read Data Timing

5.3.1.5.3 Bus Out 2 - Servo Offset Plus

The servo offset provides a means of positioning the read heads away from the normal track center for aiding data recovery. When SERVO OFFSET PLUS is active, the read heads shall be positioned by 350 microinches toward the spindle.

The servo offset cannot be accomplished and causes an UNSAFE condition during a write operation.

5.3.1.5.4 Bus Out 3 - Servo Offset Minus

This control function is the same as SERVO OFFSET PLUS, except the heads are positioned away from the spindle.

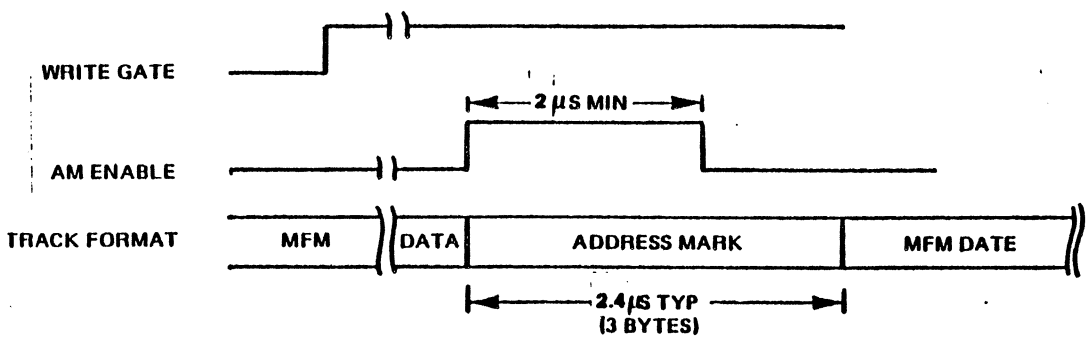
5.3.1.5.5 Bus Out 4 - Fault Clear

The FAULT CLEAR signal is a pulse (250 ns to 1.0 ms) which is used to reset the UNSAFE status provided the unsafe condition is no longer present.

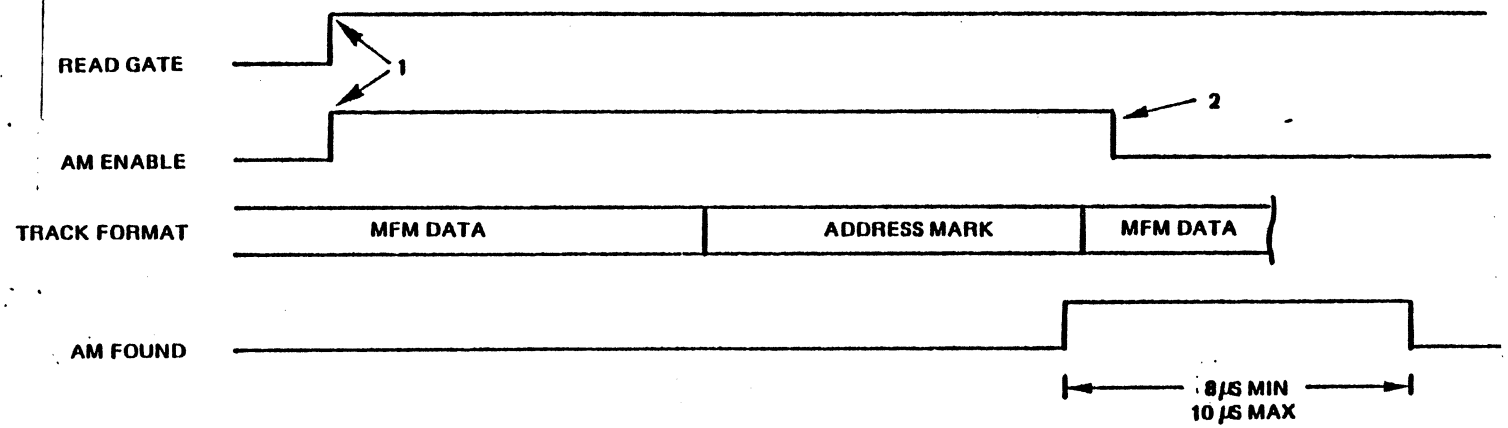
5.3.1.5.6 Bus Out 5 - Address Mark Enable (With AM feature installed only)

The ADDRESS MARK ENABLE signal is conjunction with WRITE GATE allows the control unit to write an address mark on the disk.

The ADDRESS MARK ENABLE signal in conjunction with the READ GATE initiates a search operation for an address mark. The ADDRESS MARK FOUND status notifies the control unit when the drive detected an address mark. Refer to Figure 8 for AM timing requirements.



WRITE AM TIMING



READ AM TIMING

NOTES:
1. READ GATE AND AM ENABLE SHOULD BE ASSERTED SIMULTANEOUSLY.
2. AM ENABLE SHOULD BE NEGATED AFTER DETECTING AM FOUND.

FIGURE 8: AM Timing

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5.3.1.5.7 Bus Out 6 - Recal

The RECAL signal is a pulse with a minimum width of 200 nsec. The RECAL, when true, commands the selected drive to seek to cylinder zero (provided the heads are not in the landing zone, UNSAFE is false and no seek is in process) and reset any seek error conditions. The RECAL also sets the head address, cylinder address, difference calculator and sector address registers to zero.

5.3.1.5.8 Bus Out 9 - Release

For a dual port drive, this command will reset the reserved latch in the drive, thus making the drive available to either control unit after DEVICE SELECT ENABLE is inactivated.

5.3.1.6 Set Sector (Tag 4)

The SET SECTOR Tag (1.5us + 0.5us pulse width) enables the selected drive to load the sector address specified in the Bus Out Lines (bits 0 through 6) into the Sector Address Register and initiate a sector search operation. The ATTENTION in conjunction with the RECORD READY status notifies the control unit that the read/write head is over the desired sector.

5.3.1.7 Interface Enable (Open Cable Detector)

This signal, when active, enables the drive's receivers and allows the drive selection and operation from the control unit.

5.3.1.8 Write Data

This line transmits the serial write data to the drive. The write data is converted to MFM within the drive.

5.3.2.9 Write Clock

This line is the SERVO CLOCK retransmitted to the drive. The WRITE CLOCK is phase-locked in the drive to permit reliable encoding of MFM data. The WRITE CLOCK must be synchronized with the WRITE DATA as shown in Figure 6 and be transmitted when write gate is active.

5.3.2 Input Signal Lines

These signal lines are generated by the disk drive to the controller. To activate the input signals defined in Cable A (Control Cable) to the interface, the drive must be selected.

5.3.2.1 Index

The INDEX is a pulse (2.5us $\pm$ 0.5us) which occurs once for each disk pack revolution. The leading edge of the index pulse is used to reset the sector counter.

5.3.2.2 Sector Mark

The SECTOR MARK is a pulse(1.5us $\pm$ 0.5us) which is used to identify the sector boundary. Each track on the disk is divided into n = number of sectors per revolution. The number of sectors are arranged by jumpers which provide the selection of 5 to 128 sectors. The following uniform length sector counts are available: 6,8,10,12, 13,16,24,26,32,39,48,52,64,78,104,and 128. There is no sector pulse to identify sector 0, and therefore the INDEX pulse is considered as sector 0 pulse. Figure 9 shows the INDEX and Sector timing.

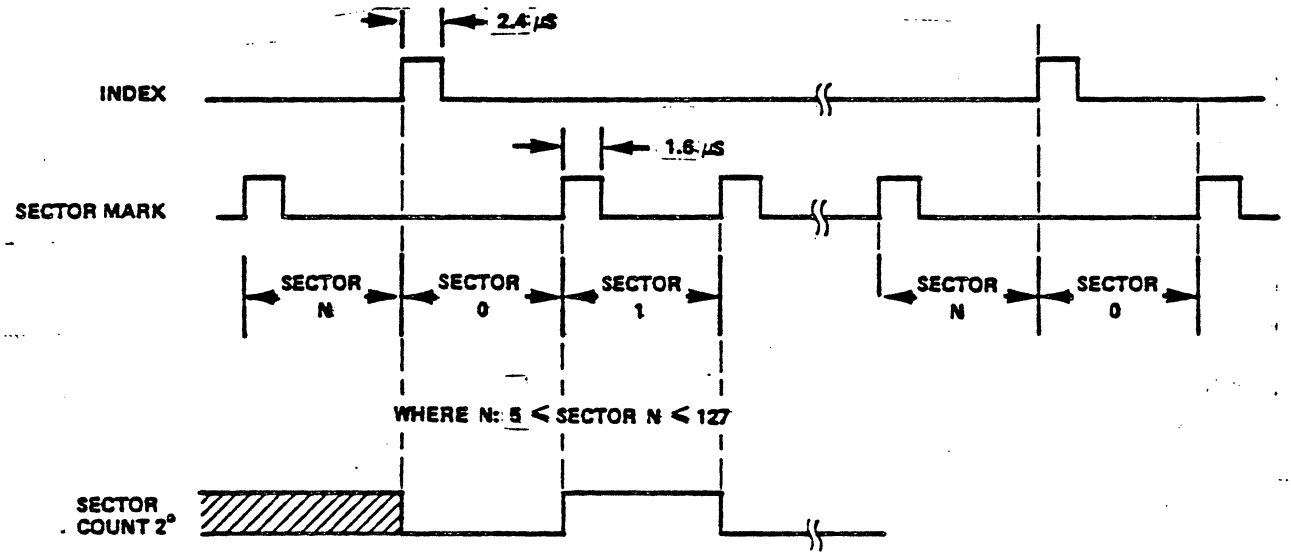

FIGURE 9 - Index and Sector Timing

5.3.2.3 Unsafe

The UNSAFE, when active, indicates to the controller, that a malfunction has occured in the drive electronics. Any one of the conditions listed in paragraph 4.2.7 will cause the UNSAFE status line to become active.

The drive must be selected for this status to be presented to the interface.

Unsafe shall be reset by a power-up reset, or the FAULT CLEAR command (Set Control and BUS OUT bit 4) provided the condition that caused the unsafe is no longer present.

5.3.2.4 Seek Incomplete

The SEEK INCOMPLETE status line, when active, indicates to the controller that a positioning error has occurred. This status line becomes active when one of the following conditions exists:

(1) Failure to complete a Seek operation within 216 milliseconds after initiation.

(2) An off-track condition is detected while not seeking or recalibrating.

(3) Guard band 1 or guard band 2 is detected under invalid conditions.

(4) An invalid cylinder address was received by the drive.

The RECAL command will reset SEEK INCOMPLETE status.

5.3.2.5 On Cylinder

The drive will indicate ON CYLINDER:

(1) As a result of a successful power-up sequence

(2) When the drive arrives on track after executing a valid non-zero length seek command or recalibrate command.

(3) 10 ms (nominal) after the acceptance of an offset command.

(4) 15 microseconds maximum after the acceptance of a zero length seek.

The drive will indicate not ON CYLINDER:

(1) When a valid or invalid seek command or a recalibrate command has been accepted.

(2) When an accepted offset command goes true.

(3) When an internally generated motion is made due to either a SEEK INCOMPLETE or to a SERVO UNSAFE.

5.3.2.6 Unit Ready

This status indicates that the drive is ready for operation and the following-conditions are met:

(1) Drive Selected

(2) No UNSAFE condition exists

(3) The drive has completed a successful power-up sequence or recovery from a SEEK INCOMPLETE.

5.3.2.7 Address Mark Found

This signal is asserted true when an address mark is identified as a result of an AM Search command. The controller should remove the ADDRESS MARK ENABLE line from the interface upon receiving ADDRESS MARK FOUND.

5.3.2.8 Servo Clock

This line transmits the phase-locked 9.58 MHz (nominal) clock derived from the servo track monopulses. This line is not gated with device select and is available at the interface at all times. The SERVO CLOCK shall be used to generate the NRZ write data in the control unit. Figure 6 shows the timing relationship of the SERVO CLOCK and WRITE DATA.

5.3.2.9 Read Data

This line transmits the serial READ data recovered from the disk to the controller. Figure 7 shows the timing requirement.

5.3.2.10 Read Clock

This line transmits the READ CLOCK which shall be used by the control unit to clock-in the serial READ DATA (NRZ). The READ CLOCK is transmitted continuously when the drive is selected.

5.3.2.11 Device Selected

This line indicates to the controller that the addressed drive is selected. The DEVICE SELECTED line becomes active within 0.5 us after receipt of the leading edge of the DEVICE SELECT ENABLE tag. For a dual port drive, if the drive is reserved to the other port the DEVICE SELECTED status will not be asserted.

5.3.2.12 Attention

The ATTENTION signal is a logical combination of ON CYLINDER, SEEK INCOMPLETE and RECORD READY. This signal informs the controller that the drive has completed an operation and/or requires controller's attention.

5.3.2.13 Record Ready

This signal is used to inform the control unit that the desired sector is passing under the Read/Write heads. This line will remain active for the entire duration of the desired sector specified in the SET SECTOR command for each disk revolution. The RECORD READY detection will be reset by READ, WRITE, FAULT CLEAR or RECAL commands.

5.3.2.14 Busy

This line is functional only with a dual port drive. BUSY with UNIT READY true indicates that the control of the drive is established by another controller.

6.0 Reliability and Serviceability

6.1 Duty

6.1.1 Duty for purposes of MTBF determination is taken to be the accessor moving not more than 50 percent of total operating time. Total operating time is the same as power on time.

6.1.2 Failure

For the purposes of calculating MFBF a failure is an inability of the unit to perform its specified function, requiring adjustment or replacement on an unscheduled basis. This excludes installation failures, operator errors, improper maintenance, adverse environment, cable failure, or failures not caused by the unit. Failures shall be classified as occurring in the "Infant Mortality" and random period.

6.1.3 Mean Time Between Failures (MTBF) & Field Performance

The MTBF over a population of machines is defined by the following expression:

$$MTBF = \frac{\text{POWER ON HOURS}}{\text{\# of Confirmed Failures}}$$

For confirmation of MTBF specified in 6.1.4 the measurement of MTBF will occur during the 13th through 15th month inclusive of operation after the first ship of production level disks. This period may be reasonably extended to meet minimum operating time requirements.

Each unit will complete an infant mortality period of 90 days prior to the measurement of MTBF. A minimum of 80 units distributed on five or more customer sites will comprise a population.

6.1.4 Mean Time between Failure Numerics

Excluding an infant mortality period of 90 days, field demonstrated MTBF TBF shall exceed 10,000 hours provided that specified maintenance philosophy and procedures are followed. For purposes of demonstration and calculation of MTBF, definition of 6.1.2 and 6.1.3 shall apply.

6.2 Mean Time to Repair (MTTR)

The MTTR is defined as the time for an adequately trained, experienced, and competent serviceman to diagnose and correct a malfunction. The MTTR assumes that the malfunction has been isolated by system diagnostics, etc., and the specified test equipment, online exercise programs and adequate spares are available at all sites where the MTTR must conform to this specification.

6.2.1 MTTR Numerics

The MTTR shall not exceed 1.0 man hour.

6.3 Preventive Maintenance Action Time (PMAT)

Routine schedule preventive maintenance should be performed by suitably trained and competent Customer Engineering personnel at intervals as specified below.

6.3.1 PMAT & Duration

Routine, scheduled, preventive maintenance should not exceed one man hour per 4000 hours of operating time per unit or six months, whichever comes first.

6.4 Machine Correctable Malfunctions (MCM)

A Machine Correctable Malfunction is a malfunction that is machine correctable and can be automatically recovered from/ by software routines and/or hardware. It does not require operator intervention. The following malfunctions are Machine correctable.

Malfunction	Corrective Action
Read	Re-read
Write	Re-write
Seek Incomplete	Restore to cylinder zero & Re-seek
Fault	System Retry (see Section 7.4.1.5.5)

6.5 Media Qualification

Each data track (560 per surface) will be scanned for media errors. A listing of all areas that have errors is to be shipped with each unit. An error is defined as any area that has low or marginal amplitude. Errors will be permitted as follows:

- o No read errors of any type at cylinder 0, head 00 and head 01.
- o No more than one error per track.
- o Error bursts can be a maximum of 100 bits in length (1 to 100 bits)

6.6 Data Error Rates

The error rate specifications apply to the read/write functional capabilities of the drive including the media. Special data recovering techniques applicable to this drive are used to enable achievement of the specified performance including the use of carriage offset, alternate track and error correcting coding (ECC) techniques. System architecture and operating system software for the host system must be designed to

implement the above methods of error recovery in the drive subsystem.

The error recovery routine, required for a data error to be defined as a "Recoverable Error" for the purposes of this specification shall be a total of 10 rereads using ECC at nominal track and a further 10 rereads at each of two offset positions. Successful acquisition of the data within these limits will indicate a recoverable or soft error. Inability to recover the data will indicate a nonrecoverable (hard) error due to component malfunction, write error, or media blemish.

Error rates as defined below are based on ECC capability of recovering errors of 5 bits or less. Any correcting capability in excess of 5 bits will reduce the number of non-recoverable errors.

Where:

R = Error Rate

Rt = Total Error Rate

Rnr = Nonrecoverable Error Rate

B = Total number of bits read

Er = Number of errors recovered using offset and ECC techniques

Enr = Number of errors nonrecoverable.

Therefore:

$Rt = \frac{Er + Enr}{B}$ = an error rate of less than one soft error in 10^8 bits of data transferred and measured in sample (B) of 10^9 bits minimum of data transferred.

and: $Rnr = \frac{Enr}{B}$ = an error rate of less than one nonrecoverable error in 10^{12} bits of data transferred and measured in sample (B) of 10^{13} bits minimum of data transferred.

6.7 Seek Error Rate

The access positioning error rate as indicated by header verification errors shall not exceed one seek error in 10^6 seeks.

7.0 Physical Installation Characteristics

Environmental Specifications

7.1 Reference Documents

1-930-806 Environmental Design Specification

These documents form the basis for all Datapoint Peripheral Products, Ins. desighs. Any exception to the above standards, are called out in this document.

7.2 Operating Condition (Ref. 1-930-806 Sect. 4.0)

Operating Environment Limits

Temperature	($^{o}C/^{o}F$)
Dry Bulb, Maximum	40/104
Dry Bulb, Minimum	15/59
Dry Bulb, Linear Gradient/Hour	5/9
Wet Bulb, Maximum	26/78.8
Wet Bulb, Minimum	7/44.6
Relative Humidity	**(%)**
Maximum	80
Minimum	8
Gradient/hour	20
Atmospheric Pressure	**(mm Hg)**
Maximum	780
Minimum	562

Vibration and shock

Equipment, as normally installed and positioned, shall meet the full specified performance while subject to the following conditions injected from the floor in a vertical direction:

a) Continuous Vibration as follows:

5-10 Hz	.004 in D.A.
10-15 Hz	.02 g's
15-50 Hz	.0016 in D.A.
50-500 Hz	.2 g's

b) Intermittent shocks of up to 2.0 g's and not exceeding 10 msec in duration. The time between consecutive shocks shall not be less than 0.5 seconds.

7.3 Non-Operating Conditions (Ref 1-930-806 Sec. 5.0)

Temperature 5-45°C (41°F to 113°F) dry bulb

Relative Humidity 10-90% with a 20%/hour gradient

Vibration and Shock

Equipment as normally installed and positioned, shall withstand the following conditions of vibration and shock injected from the floor in a vertical direction:

a) Continuous Vibration as follows:

5-10 Hz	.05 in D.A.
10-500 Hz	.2 g's

b) Intermittent shock of up to 3.0 g and not exceeding 10 msec duration. The time between consecutive shocks will not be less than .5 seconds.

7.4 Storage Conditions (Ref 1-930-806 Sec. 6.0)

Temperature -35 to 65°C dry bulb

Relative Humidity 10% to 90% with a 20%/hour gradient

Vibration and Shock

In transit, as packaged for shipment, with the equipment in its normal upright position, the equipment shall withstand the following conditions of vibration and shock injected from the floor in the three major mutually perpendicular axes:

a) Continuous vibration as follows:

5-50 Hz	.01 in D.A.
50-500 Hz	2.0 g's

7.4 Storage Conditions (con't)

Vibration and Shock

b) Shock of up to 5 g, not to exceed 10 msec in duration. The time between consecutive shocks shall not be less than 5 seconds.

c) Shipping container and packaging design shall be adequate to insure cosmetic and functional acceptability after intercontinental shipment.

7.5 Static Discharge

Disk Subsystem will meet the simulated operator discharge requirements as stated in 88-0005-801 specification, except that a failure is defined as any failure that requires operator intervention when operating under control of an operating system incorporating error recovery procedures contained in this document.

7.6 Physical Characteristics

Width - 17.75 inches (excluding front panel)

Height - approximately 8.75 inches

Depth - approximately 27.75 inches (excluding front panel)

Weight - approximately 125 lbs with power supply

Mounting - the drive is rack mountable on slides in a standard 19 inch rack

HDA Weight- approximately 28 lb. (excluding shipping container)

7.7 Power Requirements

7.7.1 Reference Documents

1-930-805 Utility supplied primary power
1-930-807 Electromagnetic Compatibility Design Spec.
1-930-505 Transient Conducted Noise Test

These documents form the basis for all Datapoint Peripheral Products Inc. designs. Any exception to the above standards are called out in this document.

7.7.2 60 Hz Configuration

The disk drives with a 60 Hz AC power configuration will operate from the following single phase power sources. Conversion of the drive between the voltage ranges of 200 and 230 VAC or between 100 and 120 VAC is accomplished by moving wires on the power transformer terminal block. The drive cannot be readily converted from the 200 volt ranges to 120 VAC. The 200 VAC ranges to 120 VAC conversion requires replacement of the drive motor.

	VOLTAGE RANGE	VOLTAGE TAP	FREQUENCY
a.	200 VAC + 10% - 15%	200V	60 Hz ± 2%
b.	208 VAC + 6% - 15%	215V	60 Hz ± 2%
c.	230 VAC + 10% - 15%	230V	60 Hz ± 2%
d.	120 VAC + 10% - 15%	115V	60 Hz ± 2%
e.	100 VAC + 10 - 15%	100V	60 Hz ± 2%

7.7.3 50 Hz Configuration

The disk drives with 50 Hz AC power configuration will operate from the following single phase sources. Conversion of the drive between the voltage ranges of 200 and 240 VAC or between 100 and 120 VAC is accomplished by moving wires on the power transfer terminal block. The drive cannot be readily converted from the 200 VAC ranges to 120 VAC. The 200 VAC conversion requires replacement of drive motor.

	VOLTAGE RANGE	VOLTAGE TAP	FREQUENCY
a.	200 VAC +10% - 15%	200V	50 Hz ± 2%
b.	220 VAC +15% - 15%	215V	50 Hz ± 2%
c.	230 VAC +10% - 15%	230V	50 Hz ± 2%
d.	240 VAC + 6% - 15%	230V	50 Hz ± 2%
e.	120 VAC +10% - 15%	115V	50 Hz ± 2%
f.	100 VAC +10% - 15%	100V	50 Hz ± 2%

7.7.4 Current Requirements

7.7.4.1 120 VAC Range 50/60 Hz Power

The surge current is less than 23 amps and the running current is 9.0 amps nominal at 115 VAC.

The nominal power requirement is 1.04 KVA and the maximum is 1.2 KVA.

7.7.4.2 200 VAC Range 50/60 Hz Power

The surge current is less than 18 amps and the running current is 5.0 amps nominal at 208 VAC.

The nominal power requirement is 1.1 KVA and the maximum is 1.4 KVA

7.7.4.3 Heat Dissipation

The heat dissipation shall be less than 4000 Btu/hr. The nominal heat dissipation is 3200 Btu/hr.

7.7.5 AC Power Cables

AC power cables consists of three 16 AWG conductor wrapped with aluminized polyester tape and covered with tinned copper braid and PVC jacket.

7.7.5.1 60 Hz Power Cable

For cable lengths in excess of 15 feet, an AC connector will not be provided.

7.7.5.1.1 100 to 120 VAC Range Cable

For cables less than 15 feet in length, a 15 amp parallel blade with grounding connector plug - will be provided on the cable.

7.7.5.1.2 200 to 230 VAC Range Cable

For cables less than 15 feet in length, a 15 amp tandom blade connector plug will be provided on the cable.

7.7.5.2 50 Hz Power Cable

No connector plugs will be provided for the power cables regardless of cable length.

Substitution Statement: **Only the item described on this drawing when procurred from a Suggested Source(s) is approved by Datapoint Corporation for use in application(s) specified. A substitute item shall not be used without prior approval from** Datapoint Peripheral Products, 686 W. Maude Avenue, Sunnyvale, California 94086.

Note: **When referring to Datapoint part numbers, specify complete Part Number including applicable dash numbers.**

SUGGESTED SOURCE LIST:

MANUFACTURERS'	MANUFACTURERS' PART/NO.	DATAPOINT PART/NO.
Information Storage Systems	717-03	85-0124-001

NOTE: This Document will not be modified without the approval of the Vice President of Product Development, Datapoint Peripheral Products, Inc., Sunnyvale, California.