SUBSIDIARY OF TRIUMPH-ADLER

PPC

PERTEC PERIPHERALS CORPORATION

DX SERIES FIXED DISK DRIVE WITH SMD INTERFACE PRODUCT SPECIFICATION

Document No. 84608 (5/84)

9600 Irondale Ave
Chatsworth, CA 91311
(818) 882-0030
TWX 910-494-2093

TABLE OF CONTENTS

		Page
1.0	Introduction	1
2.0	References	2
2.1	Regulatory Agency Requirements	2
2.2	Documentation	2
3.0	General Description	3
3.1	Product Description	3
3.2	Model Number Identification	4
4.0	Features	5
4.1	Standard Features	5
4.2	Accessories	5
5.0	Performance Specifications	6
5.1	Mechanical and Electrical Specifications	6
5.2	Unformatted Storage Capacity	6
5.3	Storage Media	6
5.4	Track Density	6
5.5	Rotational Speed	6
5.6	Data Transfer Rate	6
5.7	Seek Time	6
5.8	Latency Time	6
5.9	Start Time	8
5.10	Stop Time	8
6.0	Error Rate Specifications	9
6.1	Read Errors	9
6.2	Environmental Interference	10
6.3	Write Errors	10
6.4	Seek Errors	10
6.5	Data Security	10
7.0	Reliability and Service	11
7.1	Mean-Time-Between-Failure (MTBF)	11
7.2	Adjustments	11
7.3	Preventive Maintenance	11
7.4	Serviceability	11
7.5	Mean-Time-To-Repair (MTTR)	11
7.6	Service Life	11
8.0	Environmental Limitations	12
9.0	Shock and Vibration Limitations	13
9.1	Operating Shock	13
9.2	Non-Operating Shock	13
9.3	Operating Vibration	13
9.4	Non-Operating Vibration	13
9.5	Shipping Environment	13
10.0	Dimensional Specification	14
10.1	Mounting Orientation	14
10.2	Weight	14
10.3	Size	14
11.0	Audible Noise	16
11.1	Measurement Procedures	16
12.0	Power Requirements	17
13.0	Media Defect Specification	18
13.1	Media Defects	18
13.2	Defective Tracks	18
	13.2.1 Long Error	18
	13.2.2 Two or More Short Errors on the Same Track	18

TABLE OF CONTENTS (Continued)

		Page
	13.2.3 Falsely Detected Address Mark	18
13.3	Defect-Free Areas	19
13.4	Defect Logging	19
13.5	Defect Log Format	19
14.0	Physical Interface Specification	20
14.1	DC Power Connector	20
14.2	Interface Connector Requirements	20
14.3	Interface Cable Characteristics	20
14.4	Interface Cable Pin Assignments	20
15.0	Electrical Interface Characteristics	23
15.1	Control Line Transmitters	23
15.2	Data Line Transmitters	23
15.3	Control and Data Line Receivers	23
16.0	Interface Signal Definitions	27
16.1	Unit Select Lines 2^0 Through 2^3	27
16.2	Unit Select Tag	27
16.3	Unit Selected	27
16.4	Open Cable Detect	27
16.5	Unit Ready	28
16.6	Bus 0—9	28
16.7	Bus 10	28
16.8	Tag 1	28
16.9	Tag 2	28
16.10	On Cylinder	29
16.11	Seek End	30
16.12	Seek Error	30
16.13	Tag 3	31
	16.13.1 Write Gate (Tag 3/Bit 0)	31
	16.13.2 Read Gate (Tag 3/Bit 1)	31
	16.13.3 Servo Offset Plus	31
	16.13.4 Servo Offset Minus (Tag 3/Bit 3)	33
	16.13.5 Fault Clear (Tag 3/Bit 4)	33
	16.13.6 Address Mark (AM) Enable (Tag 3/Bit 5)	33
	16.13.7 Return To Zero (Tag 3/Bit 6)	32
	16.13.8 Data Strobe Early and Late (Tag 3/Bit 7 and 8)	35
16.14	Fault	36
	16.14.1 Power Fail	36
	16.14.2 Speed Error	36
	16.14.3 Head Load	36
	16.14.4 Read/Write Fault	36
	16.14.5 Head Select Fault	36
16.15	Address Mark (AM) Detect	37
16.16	Index	37
16.17	Sector Mark	37
16.18	Power Sequence Pick and Hold	38
16.19	Write Protect	38
16.20	Busy	39
16.21	Servo Clock	39
16.22	Write Clock	39
16.23	Write Data	39
16.24	Read Clock	39
16.25	Read Data	39

LIST OF ILLUSTRATIONS

Figure		Page
3-1	Model Number Identification	3
3-2	Assembly Location	4
10-1	Physical Dimensions and Mounting Holes	15
13-1	Defect Log Format	19
14-1	Interface Connector Pin Numbering	22
15-1	Control Transmitter	23
15-2	Control Transmitter Timing Diagram	24
15-3	Data Transmitter	24
15-4	Data Transmitter Timing Diagram	25
15-5	Line Receiver	25
15-6	Line Receiver Timing Diagram	26
16-1	Power Up and Select Timing Diagram	27
16-2	Tag 1 Timing Diagram	29
16-3	Tag 1, Tag 2 Timing Diagram	29
16-4	Seek Error Timing Diagram	30
16-5	Read/Write Control Timing Diagram	32
16-6	Servo Offset Timing Diagram	32
16-7	Fault Clear Timing Diagram	33
16-8	Address Mark Timing Diagram	34
16-9	Return To Zero Timing Diagram	35
16-10	Sector/Index Timing Diagram	37
16-11	Pick and Hold Routing	38
16-12	Servo and Write Clock Timing Diagram	39
16-13	Read Timing Diagram	40

LIST OF TABLES

Table		Page
5-1	Mechanical and Electrical Specifications (Nominal)	7
6-1	Read Recovery Attempts	9
8-1	Environmental Limitations	12
12-1	DC Power Requirements	17
14-1	DC Power Connector	20
14-2	Cable Recommendations	21
14-3	Cable A — Control Signal Definitions	21
14-4	Cable B — Read/Write Signals	22
16-1	Tag 1, Tag 2 Bus Assignments	28
16-2	Tag 3/Bus Functions	31

1.0 INTRODUCTION

This Product Specification describes the performance, features and reliability goals of the Pertec Peripherals Corporation (PPC™) DX Series Fixed Disk Drive and provides a detailed physical description of the drive and a complete electrical description of its interface requirements.

NOTE

PPC reserves the right to change this specification without prior notice.

2.0 REFERENCES

2.1 REGULATORY AGENCY REQUIREMENTS

(1) The DX Series Disk Drive shall be UL recognized as a component under UL 478 and certified under CSA C22.2 Number 154.

(2) The DX Series Disk Drives are designed to comply with IEC Publication Number 435.

(3) The DX Series Disk Drives are designed to minimize conducted and radiated electromagnetic interference.

2.2 DOCUMENTATION

The following documentation is available for field support of the DX Series Disk Drive.

(1) Operating and Service Manual No. 112952

(2) Installation and Operation Manual No. 112924

(3) Application Note No. 84606

3.0 GENERAL DESCRIPTION

3.1 PRODUCT DESCRIPTION

The DX Series Disk Drive with SMD interface is a random access, fixed media drive comprised of a sealed head/disk assembly (HDA), shock-mounted to an outer chassis with four major printed circuit board assemblies (PCBAs). The HDA houses the heads, media, head amplifiers, rotary-type actuator, spindle and air system components and is sealed to minimize the effects of environmental contamination. With the exception of the head amplifiers, all drive electronics are mounted outside the HDA for easy serviceability.

The Logic PCBA contains a microcomputer which communicates between the interface and the servo control electronics. The Servo PCBA contains voltage regulators, power sensing circuitry and the power devices which drive the spindle and head actuator. Read data recovery circuits are mounted on the Read PCBA, and an SMD PCBA is used to control the drive via an SMD-type interface.

The drive is designed to be rack-mounted in either European or domestic enclosures and features both fixed and variable (Address Mark) sectoring, phase-locked data separation, 2,7 Run Length Limited (RLL) code data conversion and daisy chain interfacing capability. Large Scale Integration (LSI) is used extensively with ECL technology. See Figure 3-1 for major assembly location.

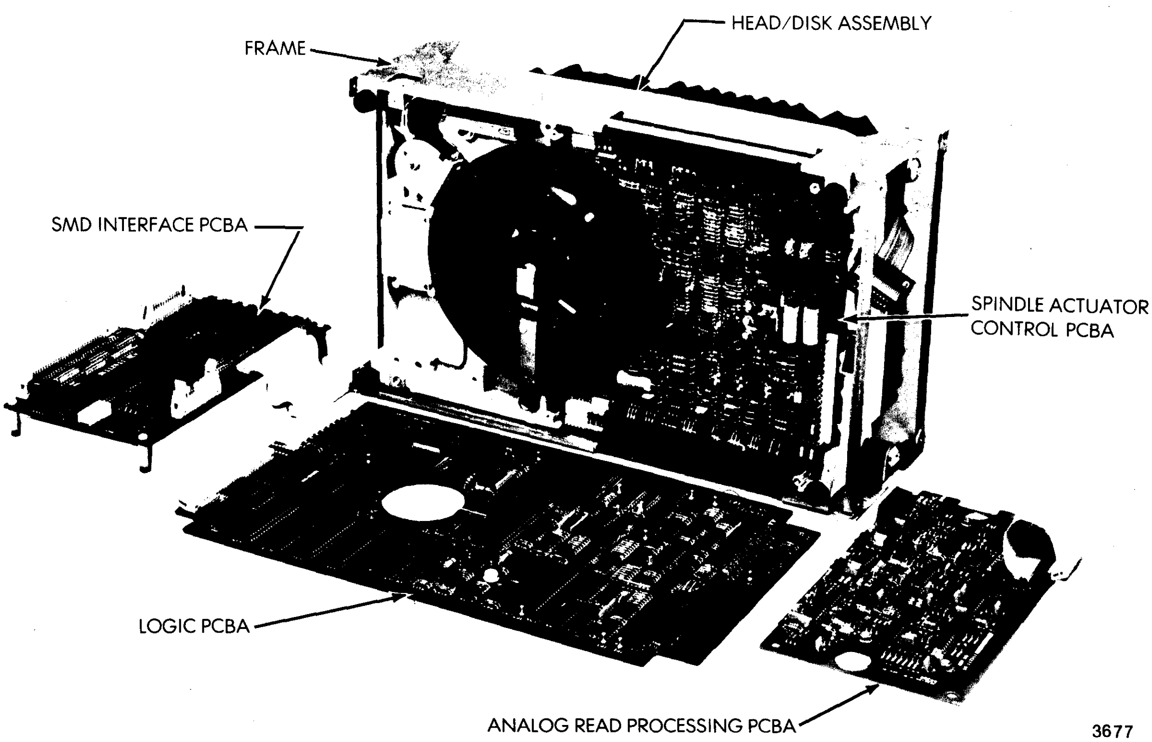


Figure 3-1. Assembly Location

3.2 MODEL NUMBER IDENTIFICATION

The model identification is shown in Figure 3-2.

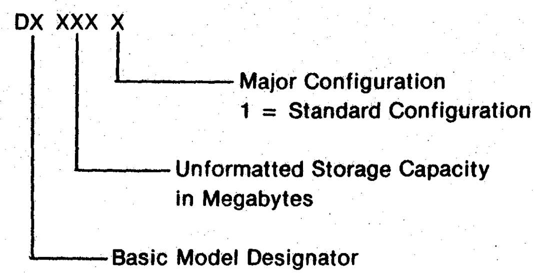


Figure 3-2. Model Number Identification

4.0 FEATURES

4.1 STANDARD FEATURES

The following features are standard equipment on each DX Series Disk Drive with SMD Interface.

(1) Replaceable, shock-mounted HDA.
(2) On-board microcomputer control.
(3) Custom LSIs for spindle, actuator, read and write control.
(4) Selectable hard or soft sector modes from 1 to 127 sectors.
(5) Imbedded flaw map using standard external format.
(6) Rotary voice coil actuator with automatic shipping lock.
(7) Direct drive, brushless dc spindle motor with brake/lock mechanism.
(8) Horizontal or side mounting.
(9) Installation and Operation Manual.
(10) No adjustments or preventive maintenance for the life of the unit.
(11) Switch selectable Spin Up with power on.
(12) Remote Spin Up and Spin Down using PICK and HOLD lines.
(13) Internal Write Protect maintenance switch.
(14) Cylinders 1024 and above addressable using either Volume Select or BUS 10.

4.2 ACCESSORIES

An Operating and Service manual can be ordered for the disk drive.

5.0 PERFORMANCE SPECIFICATIONS

5.1 MECHANICAL AND ELECTRICAL SPECIFICATIONS

The mechanical and electrical specifications summary is given in Table 5-1.

5.2 UNFORMATTED STORAGE CAPACITY

The nominal unformatted storage capacity of a disk drive is defined as the nominal track capacity times the number of tracks in that drive. The nominal unformatted track capacity is defined as the number of 8-bit bytes which may be recorded on a track when the disk is rotating at the nominal spindle speed of 3600 rpm. The nominal unformatted storage capacity is given in Table 5-1.

5.3 STORAGE MEDIA

The storage media is composed of an aluminum alloy substrate, coated on both surfaces with a layer of ferromagnetic oxide material suspended in a hardened binder. A lubrication overcoating is applied to minimize wear during contact start/stop operation.

5.4 TRACK DENSITY

The nominal track density is 987 tracks per inch.

5.5 ROTATIONAL SPEED

The spindle speed is 3600 rpm ± 1 percent.

5.6 DATA TRANSFER RATE

The data transfer rate is 9.67 megabits (1.21 megabytes) per second ± 2 percent.

5.7 SEEK TIME

Seek time is defined as the time required from the receipt of a seek or position command by the drive until the drive signals the controller it is ready to perform another seek or read/write function on the new cylinder.

Average seek time is determined by dividing the total time required to seek between all possible pairs of track addresses by the total number of these ordered pairs.

(1) Adjacent track seek time: 6 milliseconds maximum.

(2) Average seek time: 25 milliseconds maximum.

(3) Full stroke, 1493 tracks: 48 milliseconds maximum.

(4) Zero-track seek time: 40 ± 4 microseconds.

5.8 LATENCY TIME

Latency time is defined as the time required to reach a target sector after positioning is complete.

(1) The average latency time, based on a nominal disk speed of 3600 rpm, is 8.34 milliseconds.

(2) The maximum latency time, based on a minimum disk speed of 3564 rpm, is 16.84 milliseconds.

Table 5-1
Mechanical and Electrical Specifications (Nominal)

Recording Parameters	DX180	DX240	DX300
Capacity (Unformatted MBytes)	180.6	240.8	301.0
Recording Mode		(2,7)RLL	
Interface, Data		NRZ	
Media (Note 1)			
Disks	4	5	6
Data Surfaces	6	8	10
Tracks Per Surface		1,493	
Track Density (tpi)		987	
Track Capacity (bytes)		20,160	
Rotational Speed (rpm)		3,600	
Technology Type			
Head		Composite MgZn	
Media		Oriented Oxide	
Data Transfer Rate (Mbits/sec)		9.67	
Seek Time (msec)			
Track-to-Track		6	
Average		25	
Maximum		48	
Average Latency Time		8.34	
Zero Track Seek Time		40 microseconds	
MTBF (hours)			
Sealed Head/Disk Assembly		25,000	
Complete Unit		12,000	
MTTR (minutes)		30	
Error Rate			
Recoverable Error		1 in 10^{10} read errors	
Non-recoverable Error		1 in 10^{12} read errors	
Seek Error		1 in 10^{6} seeks	
Environmental Error		1 in 8 hours	
Operational Environmental			
Temperature		10° to 40°C (50° to 105°F)	
Humidity		10 to 80% (noncondensing)	
Shock		2g (3 axis, both directions)	
Vibration		0.006 inch (5 to 40 Hz), 0.5g (40 to 500 Hz)	
Altitude		−152 to 2,438m (−500 to 8,000 feet)	
Power Requirements		+24v dc at 5.4 amps (average) −24v dc at 1 amp (average) +5v dc at 2.2 amps (average) −5.2v dc at 2.9 amps (average)	
Power Dissipation (average)		Less than 175 watts	
Start Time (seconds)		60	
Stop Time (seconds)		15	
Physical			
Height		118 mm (4.65 inches)	
Width		218 mm (8.58 inches)	
Depth (with SMD PCBA attached)		407 mm (16.01 inches)	
Weight		12.25 kg (27 pounds)	
Planned Certifications		UL, CSA, and IEC	

NOTE:
1. Full unformatted capacity excluding defects or deallocation schemes.

188

5.9 START TIME

The drive will become ready within 60 seconds after application of dc power or, alternatively, after a spin up signal (i.e., PICK and HOLD) from the interface has been received.

5.10 STOP TIME

The spindle will stop within 15 seconds after dc power is removed or, alternatively, after the HOLD line goes false at the interface.

6.0 ERROR RATE SPECIFICATIONS

The initial error rates stated in this section are guaranteed only when all of the following conditions are met.

(1) The DX Disk Drive is operated within the environment specified in Paragraphs 8 and 9.

(2) A data format is used which fulfills the requirements of the drive outlined in Paragraph 16.

(3) Media defects, disk drive and host system failures are excluded from the error rate computations.

(4) The power requirements specified in Paragraph 12 are satisfied.

(5) System grounding requirements described in Paragraph 12 are satisifed.

(6) All read/write operations are done with the drive in the same physical orientation.

(7) A correct host/drive operational interface has been implemented to include all interface timings.

(8) All data transfers are performed with nominal strobes and no actuator offset.

6.1 READ ERRORS

Prior to the determination or measurement of read error rates:

(1) The data to be used for measurement of read error rates must be verified as having been correctly written on the media.

(2) All media defect-induced errors must be excluded from error rate calculations.

A read error is defined as recoverable (soft) if the data in question can be read correctly within three attempts at all combinations of head position and strobe timing outlined in Table 6-1.

A read error is defined as nonrecoverable (hard) if the data in question cannot be read correctly within 27 total attempts as outlined in Table 6-1.

The recoverable read error rate is not more than one error in 10^{10} bits transferred.

The nonrecoverable read error rate is not more than one error in 10^{12} bits transferred.

Table 6-1

Read Recovery Attempts

Head Position	Strobe Timing	Number of Attempts
Nominal	Nominal	3
	Early	3
	Late	3
+ Offset	Nominal	3
	Early	3
	Late	3
− Offset	Nominal	3
	Early	3
	Late	3
		27 Total

180

6.2 ENVIRONMENTAL INTERFERENCE

When operating at an effective data transfer of less than 10^{10} bits over an 8-hour period, the effective error rate may be expected to exceed the specified limits due to environmental interference. In this case, the recoverable read error rate will not exceed one error in 8 hours of operation.

6.3 WRITE ERRORS

Because write errors can be due to write data not being presented correctly, media flaws, environmental interference, or drive malfunction, write erorrs are not predictable as a function of the number of bits passed.

A write error is defined as unrecoverable if the data in question cannot be written and verified correctly within three attempts.

An unrecoverable write error occurring due to a disk drive malfunction is considered a drive failure affecting the MTBF.

The host system must include sector/track deallocation or skip displacement capabilities to ensure that valid data are not written over defective areas of the media.

6.4 SEEK ERRORS

A seek error is defined as the condition which occurs when the drive fails to position the heads over the addressed cylinder.

A seek error is defined as recoverable if the heads can be positioned over the correct cylinder after one retry preceded by a Return To Zero command.

A seek error is defined as unrecoverable if the heads cannot be correctly positioned after one retry preceded by a Return To Zero command.

The recoverable seek error rate does not exceed one in 10^6 physical seeks. An unrecoverable seek error is considered to be a failure affecting the MTBF.

6.5 DATA SECURITY

Under normal controller I/O operation, the drive will write only that pattern presented on the write data lines. The drive must be selected and on cylinder before a valid write operation can be initiated. Data are protected by internally inhibiting Write Gate during all fault conditions, including loss of On Cylinder or low dc voltage.

7.0 RELIABILITY AND SERVICE

7.1 MEAN-TIME-BETWEEN-FAILURE (MTBF)

MTBF is defined by the following formula.

$$\text{MTBF} = \frac{\text{Operating Hours}}{\text{Number of Equipment Failures}}$$

Operating Hours are the total power-on hours less any maintenance time. To establish a meaningful MTBF, the number of operating hours must be statistically significant and must include field performance data from all field sites.

Equipment Failure means any stoppage or substandard performance of the disk drive due to hardware malfunction which requires unscheduled repair or replacement. Equipment failures exclude malfunctions caused by operator errors, adverse environmental conditions, power failures, controller failures, cable failures, or other failures not attributable to the disk drive.

Failures occurring within the first 200 hours of operation are excluded from the MTBF calculations.

The MTBF shall exceed 7000 hours for units manufactured during the first year of production, and 9000 hours for units manufactured during the second year. The MTBF of subsequent units shall exceed 12,000 hours.

7.2 ADJUSTMENTS

No mechanical or electrical adjustments are required.

7.3 PREVENTIVE MAINTENANCE

Preventive maintenance is not required.

7.4 SERVICEABILITY

The disk drive can be serviced in the field at the board replacement level without special tools or fixtures. The HDA may be repaired only at a properly equipped facility. Breaking of the seals or removal of the HDA cover by unauthorized personnel will void the disk drive warranty.

7.5 MEAN-TIME-TO-REPAIR (MTTR)

The field MTTR is defined as the average time for an adequately trained serviceperson to diagnose and correct a malfunction external to the HDA while following recommended field service procedures. The MTTR does not include retest time or the time needed to remove and reinstall the drive in the system. The MTTR does not exceed 0.5 hour.

NOTE

Repairs that require opening the sealed HDA must be accomplished in an appropriate clean-room facility and are not included in the MTTR. Removing or breaking the warranty label or defeating the disk chamber seals by unauthorized personnel, voids the disk drive warranty.

7.6 SERVICE LIFE

The disk drive has a useful life of 10 years or 50,000 hours, whichever occurs first, before requiring factory overhaul. Replacement of major parts or depot repair will be permitted during the service life.

8.0 ENVIRONMENTAL LIMITATIONS

The following temperature and humidity specifications preclude condensation on or in any part of the disk drive. The temperatures specified are the ambient temperatures measured at any point 12.7 mm (0.5 inch) from the disk drive. When mounted in an enclosure, the user must provide cooling to ensure the temperature specification is not exceeded.

Power should be applied for 30 minutes prior to recording information on the disk drive.

Table 8-1
Environmental Limitations

Parameter	Operating	Shipping and Storage
Temperature	10°C to 40°C (50°F to 104°F)	−34°C to 66°C (−9.2°F to 150.8°F)
Maximum Rate of Change	7°C (12°F) per hour	20°C (36°F) per hour
Relative Humidity	10% to 80%	10% to 90%
Altitude	−152 to 2438 metres (−500 to 8000 feet)	−152 to 6096 metres (−500 to 20,000 feet)

188

9.0 SHOCK AND VIBRATION LIMITATIONS

The disk drive can withstand the following shock and vibration conditions without damage to its physical structure or function.

Shock and vibration shall be applied to and measurements shall be taken from the disk drive frame. If the shock or vibration is applied to an enclosure in which the drive is installed, internal resonances may occur within the enclosure which exceed these limits.

9.1 OPERATING SHOCK

The disk drive will withstand a half-sine shock pulse with a peak acceleration of 2g and a duration of 11 milliseconds in 3 axes, in either direction. Testing shall be limited to a maximum of 3 shocks per side (18 total).

9.2 NON-OPERATING SHOCK

The disk drive will withstand a half-sine shock pulse with a peak acceleration of 15g and a duration of 11 milliseconds in 3 axes, in either direction. Testing shall be limited to a maximum of 3 shocks per side (18 total).

9.3 OPERATING VIBRATION

The disk drive will withstand a sinusoidal vibration in each of 3 mutually perpendicular axes at a vibration level of 0.152 mm (0.006 inch) double amplitude from 20 to 40 Hz, and 0.5g peak from 40 to 500 Hz.

9.4 NON-OPERATING VIBRATION

The disk drive will withstand a sinusoidal vibration in each of 3 mutually perpendicular axes at a vibration level of 2.54 mm (0.1 inch) double amplitude from 5 to 17 Hz, and 1.5g (peak) from 17 to 500 Hz.

NOTE

The test procedure for the vibration frequencies is varied logarithmically from low-to-high-to-low. The maximum cycle rate is 40 minutes. Dwelling at any resonant frequency is not longer than 3 minutes maximum.

9.5 SHIPPING ENVIRONMENT

The DX disk drive, when packaged in the PPC-approved shipping container, will conform to the shipping requirements specified in the National Safe Transit Committee Pre-Shipment Test Procedure.

10.0 DIMENSIONAL SPECIFICATION

The drive mounts interchangeably into enclosures designed for standard-height 8-inch flexible disk drives.

10.1 MOUNTING ORIENTATION

The drive may be mounted horizontally with the HDA cover on top, or, when facing the rear of the drive (interface connectors visible), with the HDA facing towards the right.

10.2 WEIGHT

- 12.25 kg (27 pounds) maximum

10.3 SIZE

The physical dimensions of the drive are illustrated in Figure 10-1.

- Height: 118 mm (4.65 inches) maximum
- Width: 218 mm (8.58 inches) maximum, excluding slides
- Depth: 407 mm (16.01 inches) maximum, measured from the rear of the front panel to the rear of the SMD PCBA. This dimension excludes cables and connectors.

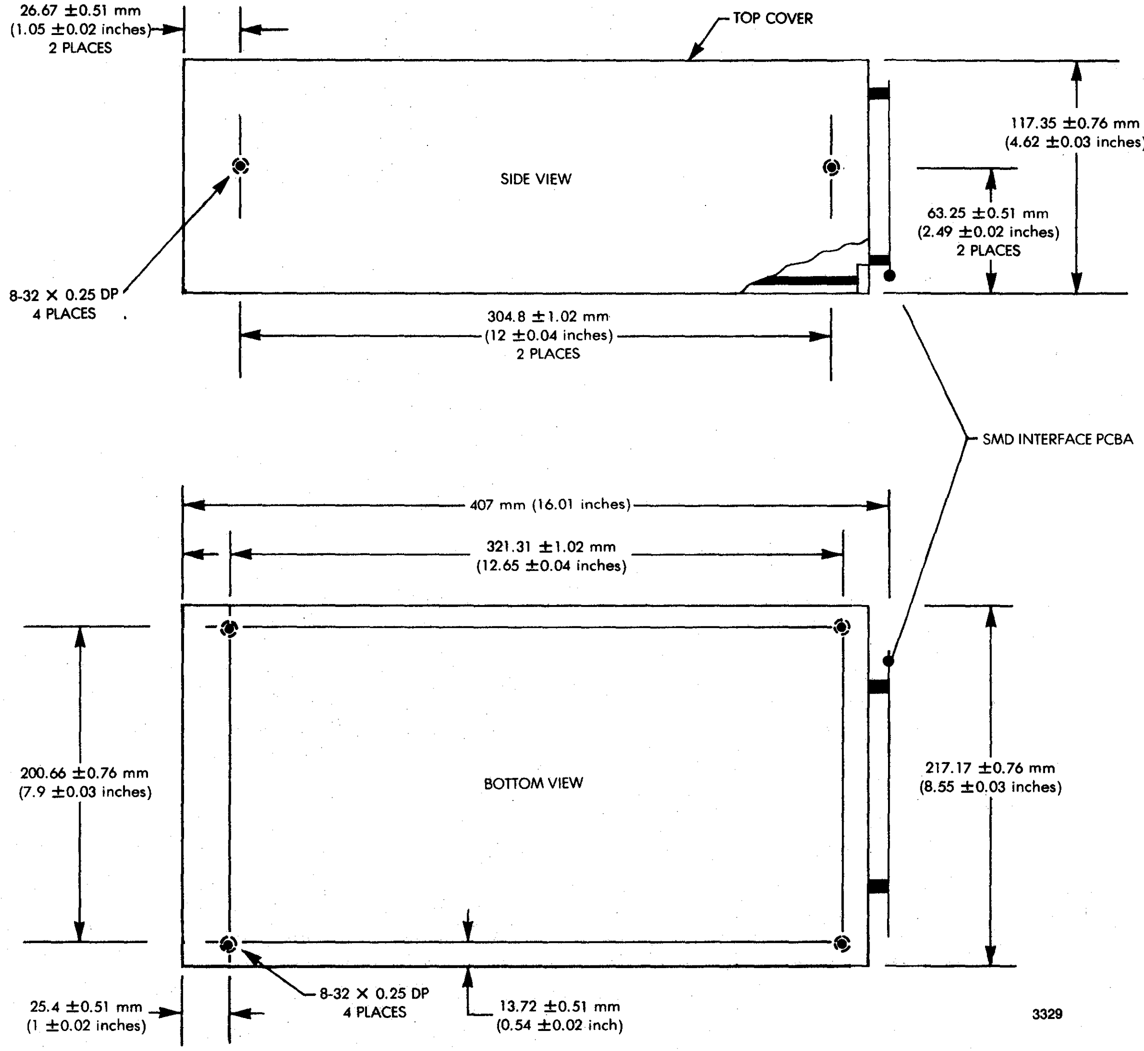


Figure 10-1. Physical Dimensions and Mounting Holes

11.0 AUDIBLE NOISE

The DX Disk Drive meets the maximum operating noise level limits defined by the International Organization for Standardization (ISO) noise rating NR-55 curve (31.5 to 8000 Hz range).

11.1 MEASUREMENT PROCEDURES

All measurements on the disk drive are to be conducted in an anechoic chamber. The drive to be tested must be mounted on a wooden surface between 864 and 914 mm (34 and 36 inches) from the floor.

The microphone used during the test must be located 914 mm (36 inches) from the most prominent noise source on the unit under test, and 914 mm (36 inches) from the floor.

12.0 POWER REQUIREMENTS

Table 12-1 lists the voltages and currents required by the disk drive as measured at its dc power connector. Ac power is not required.

It is recommended that separate grounds be brought in from the power supply for each voltage to the dc power connector on the disk drive.

It is also recommended that the drive frame be tied to the host cabinet ground with a braided type connector.

Table 12-1

DC Power Requirements

Voltage	+24v dc	−24v dc	+5v dc	−5.2v dc
Tolerance	±10%	±10%	±3%	±3%
Regulation	±2%	±2%	±1%	±1.5%
Ripple (60 Hz to 25 MHz) peak-to-peak	0.5v	0.5v	0.1v	0.1v
Maximum Current	12A	3A	3A	3A
Average Operating Current	5.4A	1.0A	2.2A	2.9A
Absolute Maximum Voltage Without Physical Damage To Disk Drive	+30v	−30v	+6v	−6v

NOTES:
1. When power is provided to multiple drives from a common supply, average and peak currents must be considered. The maximum current noted must be available to each drive to ensure proper spindle acceleration.
2. Average power dissipation is less than 175 watts.

188

13.0 MEDIA DEFECT SPECIFICATION

13.1 MEDIA DEFECTS

A media defect is a physical characteristic of the media which results in a repetitive read error when a properly adjusted drive is operated within the environment specified in this document. Sector/track deallocation or skip displacement techniques should be used to avoid writing data over known media defects.

At the time of shipment from the point of manufacture, the number of media defects per disk drive will not exceed the following:

	DX180	DX240	DX300
Defects	300	400	480

13.2 DEFECTIVE TRACKS

The following conditions may require that the entire track on which they occur be considered defective and therefore define a defective track.

13.2.1 LONG ERROR

A long error is an error greater than 20 bits in length which does not contain any span of error-free data longer than 20 bytes between the first bit in error and the last bit in error.

A long error may cause the read phase lock loop to lose phase lock such that the data following the error would not be properly decoded, even though it may be error free.

13.2.2 TWO OR MORE SHORT ERRORS ON THE SAME TRACK

An error is defined as short when its length is 20 bits or less and when the preceding and subsequent 20 bytes are error-free. A separation of more than 20 bytes of error-free data between the last bit in error of the first short error to the first bit in error of the second short error defines two short errors.

Two or more short errors occurring in different sectors of a given track would require that the entire track be deallocated if the host system is not capable of deallocating more than one sector per track.

13.2.3 FALSELY DETECTED ADDRESS MARK

In the soft sectored mode, the data integrity of the entire track becomes suspect if a media defect results in the detection of an address mark where none was written. Therefore, a falsely detected address mark anywhere in a track results in a defective track.

NOTE

The length of a defect is defined as the number of bits between the first bit in error and the last bit in error plus the first and last bits in error. The bits between the first and last bits in error may or may not contain an error.

At the time of shipment from the point of manufacture, the number of defective tracks per disk drive will not exceed the following:

	DX180	DX240	DX300
Defects	30	40	48

13.3 DEFECT-FREE AREAS

Cylinder 0, heads 0 and 1, are media defect-free areas.

13.4 DEFECT LOGGING

Each disk drive will be shipped with a hard copy attached to the drive with the following defect information.

(1) Cylinder location.

(2) Head.

(3) Length of the defect in bits.

(4) Location of the defect in bytes from Index.

In addition to the hard copy, each disk drive will be formatted at the factory with a Defect Log (Paragraph 13.5). The Defect Log is provided for those customers who wish to use it as part of their system initialization and track deallocation routines without recertifying the media. Customers so desiring must take precautions to prevent writing over this data until it has been recovered.

13.5 DEFECT LOG FORMAT

The Defect Log format is shown in Figure 13-1. The Defect Log is written on each track immediately following Index and is divided into two parts. The first part is a hard-sectored format written from byte 00—55. The second part is a soft-sectored format written from byte 56—104. The information in the data fields pertains only to the track on which the information was written.

(1) If a defect is sensed between the start of byte 15 and the end of byte 55, GAP 1 is increased from 30 bytes to 90 bytes and all subsequent information is shifted down track by 60 bytes.

(2) If a defect is sensed between the start of byte 56 and the end of byte 104, 60 bytes of 0s are inserted immediately preceding the address mark. The address mark and all subsequent information are shifted down track by 60 bytes.

(3) The first 4 errors on each track are logged. If the track is defective, the most significant bit of the first cylinder address byte will be set to 1. The information remaining on that track may or may not be valid.

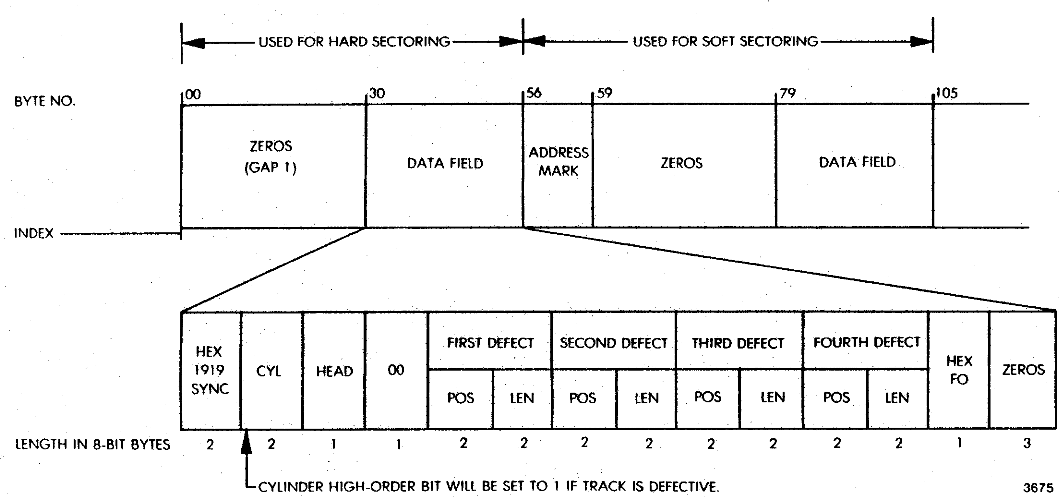


Figure 13-1. Defect Log Format

14.0 PHYSICAL INTERFACE SPECIFICATION

Cables and mating connectors are to be supplied by the user.

14.1 DC POWER CONNECTOR

The dc power connector on the drive is an AMP MATE-N-LOK 8-pin connector, AMP Part No. 640588-1. The correct mating connector is AMP Part No. 640586-1, or equivalent, using contact pins AMP Part No. 350536-3, or equivalent.

The power connection is made to the Logic PCBA. Refer to Table 14-1 for connector pin assignments.

14.2 INTERFACE CONNECTOR REQUIREMENTS

Interface connections are made to the SMD Adapter PCBA via two connectors. The A Cable connector on the PCBA is a 60 position connector, 3M Part No. 3372-2202, or equivalent, and accepts a mating connector such as Berg Part No. 65043-007 with Berg Part No. 75691-007 contact pins.

The B Cable connector on the PCBA is a 26 position connector, 3M Part No. 3429-2002, or equivalent, and accepts a mating connector such as a Berg Part No. 65043-024 with Berg Part No. 75691-007 contact pins.

14.3 INTERFACE CABLE CHARACTERISTICS

Interface connections are made to the disk drive via one 60-pin plug and one 26-pin plug. The following paragraphs and Table 14-2 delineate the cable arrangement recommended for interfacing the drive to the controller.

Cable A contains 30 differential signal twisted pairs. It carries control and status information which is not time-critical (e.g., unit select, status, and addressing) to and from the drive. Cable A must not exceed 100 feet measured from the host connector to the furthest drive on the cable.

Cable B consists of a 26-conductor, flat ribbon cable with ground plane shielding and a drain wire. It carries time-critical data and clock signals to and from the drive. Cable B must not exceed 50 feet measured from the host connector to the drive.

14.4 INTERFACE CABLE PIN ASSIGNMENTS

Tables 14-3 and 14-4 provide the pin assignments for Cables A and B, respectively. Figure 14-1 shows interface PCBA connector numbering as seen from the rear of the drive.

Table 14-1

DC Power Connections (J2)

Pin 1	+5.0v dc Return	Pin 5	−24v dc
Pin 2	+5.0v dc	Pin 6	−24v dc Return
Pin 3	−5.2v dc	Pin 7	+24v dc
Pin 4	−5.2v dc Return	Pin 8	+24v dc Return

188

Table 14-2
Cable Recommendations

Characteristic	Cable A	Cable B
Type	30 Twisted-pair, flat cable	26 Conductor flat cable with ground plane and drain wire
Twists per inch	2	——
Impedance	100 ± 10 Ohms	65 ± 10 Ohms
Wire size	28 AWG, 7 strands	28 AWG, 7 strands
Propagation time	1.6 to 1.8 nanoseconds per foot	1.5 to 1.8 nanoseconds per foot
Maximum cable length	100 feet cumulative	50 feet cumulative
Voltage rating	300v RMS	300v RMS

188

Table 14-3
Cable A — Control Signal Definitions

Signal Name	Differential Pins		Signal Source
	Low	High	
Unit Select 2^0	23	53	Controller
Unit Select 2^1	24	54	Controller
Unit Select 2^2	26	56	Controller
Unit Select 2^3	27	57	Controller
Unit Select Tag	22	52	Controller
Tag 1 — Cylinder Address	1	31	Controller
Tag 2 — Head Select	2	32	Controller
Tag 3 — Control Select	3	33	Controller
Bus Out 0	4	34	Controller
Bus Out 1	5	35	Controller
Bus Out 2	6	36	Controller
Bus Out 3	7	37	Controller
Bus Out 4	8	38	Controller
Bus Out 5	9	39	Controller
Bus Out 6	10	40	Controller
Bus Out 7	11	41	Controller
Bus Out 8	12	42	Controller
Bus Out 9	13	43	Controller
Bus Out 10*	30	60	Controller
Open Cable Detected	14	44	Controller
Index	18	48	Disk Drive
Sector Mark	25	55	Disk Drive
Fault	15	45	Disk Drive
Seek Error	16	46	Disk Drive
On Cylinder	17	47	Disk Drive
Unit Ready	19	49	Disk Drive
Address Mark Detected	20	50	Disk Drive
Write Protect	28	58	Disk Drive
Power Sequence Pick	—	29	Controller
Power Sequence Hold	—	59	Controller
Not Used	21	51	—

* Not in standard SMD interface. See Paragraph 16.7.

188

Table 14-4
Cable B — Read/Write Signals

Signal Name	Differential Pins		Signal Source
	Low	High	
Write Data	8	20	Controller
Ground	7	—	
Write Clock	6	19	Controller
Ground	18	—	
Servo Clock	2	14	Disk Drive
Ground	1	—	
Read Data	3	16	Disk Drive
Ground	15	—	
Read Clock	5	17	Disk Drive
Ground	4	—	
Seek End	10	23	Disk Drive
Unit Selected	22	9	Disk Drive
Ground	21	—	
Index	12	24	Disk Drive
Ground	11	—	
Sector	13	26	Disk Drive
Ground	25	—	

188

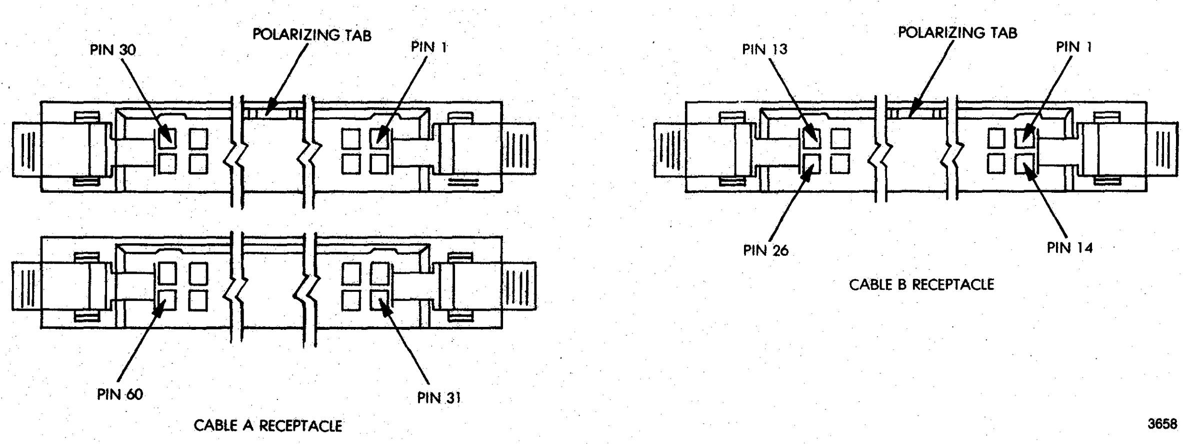


Figure 14-1. Interface Connector Pin Numbering

15.0 ELECTRICAL INTERFACE CHARACTERISTICS

All input and output interface signals are digital. Type 75110A and 75108 drivers and receivers are used. These provide a balanced, terminated signal transmission system for maximum noise immunity.

15.1 CONTROL LINE TRANSMITTERS

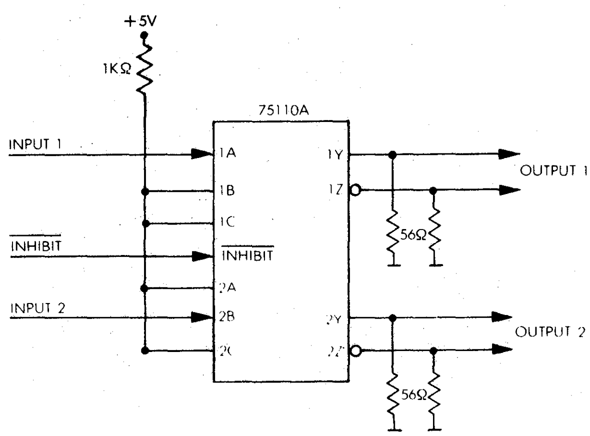
All control line transmitters in the disk drive are type 75110A and have the configuration shown in Figure 15-1. Transmitter timing is shown in Figure 15-2.

15.2 DATA LINE TRANSMITTERS

All read/write data and clock transmitters, and the servo clock transmitter, in the drive are type 75110A and have the configuration shown in Figure 15-3. Transmitter timing is shown in Figure 15-4.

15.3 CONTROL AND DATA LINE RECEIVERS

The disk drive uses Motorola MC3450 differential line receivers (or equivalent) throughout with a typical propagation delay of 17 nanoseconds. A representative input gate is shown in Figure 5-15. The timing diagram is shown in Figure 15-6.



TRUTH TABLE

INPUT		OUTPUT	
A	INH	Y	Z
X	L	OFF	OFF
L	H	L	H
H	H	H	L

NOTES:
L = LOGICAL LOW
H = LOGICAL HIGH
X = DON'T CARE
OFF = HIGH IMPEDANCE

3678

Figure 15-1. Control Transmitter

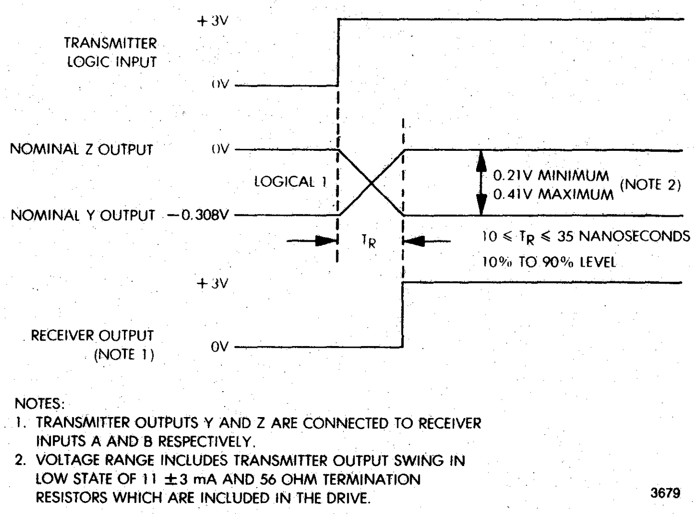
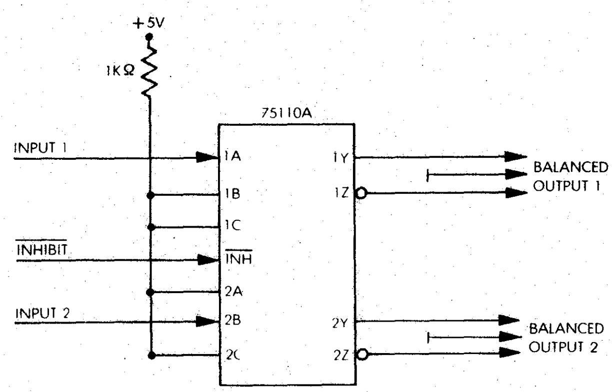


Figure 15-2. Control Transmitter Timing Diagram



TRUTH TABLE

INPUT		OUTPUT	
A	INH	Y	Z
X	L	OFF	OFF
L	H	L	H
H	H	H	L

NOTES:
L = LOGICAL LOW
H = LOGICAL HIGH
X = DON'T CARE
OFF = HIGH IMPEDANCE

3680

Figure 15-3. Data Transmitter

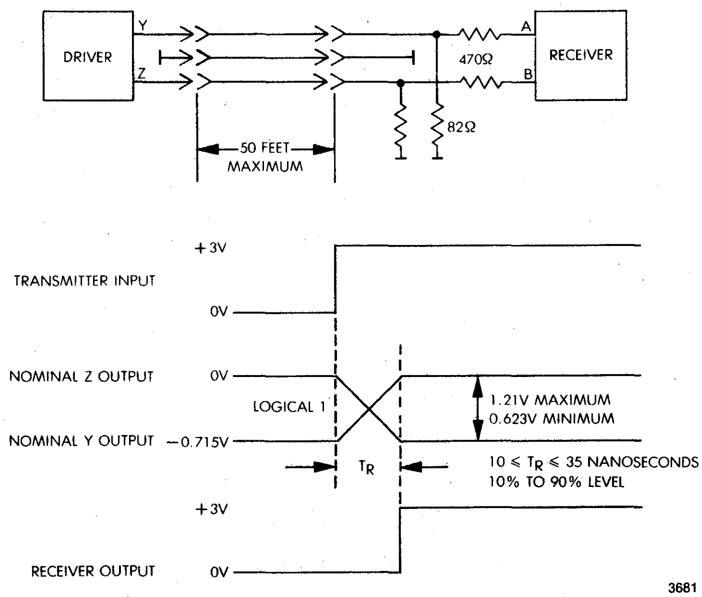
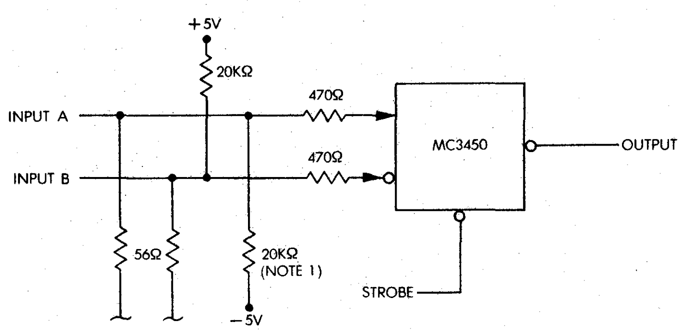


Figure 15-4. Data Transmitter Timing Diagram



NOTE:
1. THESE BIASING RESISTORS AND VOLTAGES ARE PROVIDED IN THE DX DISK DRIVE ON THE OPEN CABLE DETECT LINE ONLY.

TRUTH TABLE

INPUT	STROBE	OUTPUT
$V_{ID} \geq 25mV$	L	H
$V_{ID} \leq -25mV$	L	L
$-25mV < V_{ID} < 25mV$	L	*
$V_{ID} = X$	H	OPEN

NOTES:
$V_{ID} = V_A - V_B$
L = LOGICAL LOW
H = LOGICAL HIGH
X = DON'T CARE
OPEN = TRISTATE

3682

Figure 15-5. Line Receiver

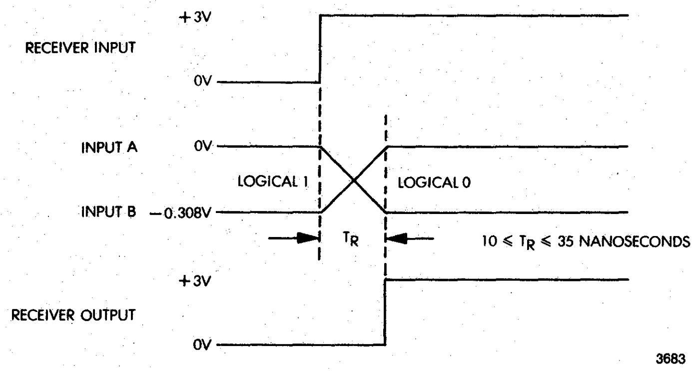


Figure 15-6. Line Receiver Timing Diagram

16.0 INTERFACE SIGNAL DEFINITIONS

The following paragraphs describe the disk drive response to each signal available on the SMD Interface. A true condition corresponds to a Logial 1 on the interface.

16.1 UNIT SELECT LINES 2^0 THROUGH 2^3

These 4 signals are compared to the settings of 4 Unit Select switches within the drive. Logical unit designation is accomplished during system integration by manually setting the appropriate switch combination. Up to 16 drives can be addressed. If the comparison is true, and if an open cable condition is not detected, the leading edge of the Unit Select Tag signal will cause the drive to be selected. The unit select timing diagram is shown in Figure 16-1.

16.2 UNIT SELECT TAG

This signal functions together with Unit Select 2^0—2^3 (Figure 16-1) and must be held true to keep the unit selected. The drive will respond by setting Unit Selected true.

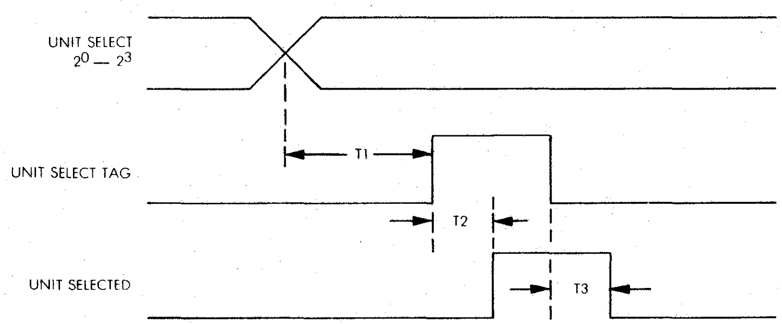
16.3 UNIT SELECTED

If the unit select comparison previously described is true, and if no open cable condition is detected, Unit Selected will go true 50 nanoseconds after the leading edge of Unit Select Tag is received. Unit Selected will remain true for a maximum of 120 nanoseconds after the trailing edge of Unit Select Tag is received.

16.4 OPEN CABLE DETECT

Open Cable Detect will go true and the interface will be disabled in the event that interface cable A is disconnected or controller power is lost.

If type 75110A transmitters are used to drive the Open Cable Detect lines from the controller, two transmitter outputs should be in parallel and the 56 ohm termination resistors to ground should not be used at the controller end.



NOTES:
1. INTERFACE OUTPUT LINES ARE UNDEFINED FOR ONE SECOND FOLLOWING POWER-ON.
2. UNIT SELECT TAG AND UNIT SELECTED ARE UNRELATED TO UNIT READY.
3. T1 = 200 NANOSECONDS MINIMUM
   T2 = 50 NANOSECONDS NOMINAL
   T3 = 120 NANOSECONDS MAXIMUM

3684

Figure 16-1. Power Up and Select Timing Diagram

16.5 UNIT READY

When the disk drive is selected, nominal speed is achieved, the heads are positioned over the recording tracks, and no fault conditions exist, Unit Ready will go true not later than 60 seconds after power is applied.

16.6 BUS 0—9

The information on this 10-bit bus is conditioned within the drive by Tag 1, Tag 2, and Tag 3, refer to Table 16-1. The effects of these three tag lines are described in subsequent paragraphs.

16.7 BUS 10

Bus 10 (pins 30 and 60) is not used in the standard SMD interface. In the DX disk drive, it can be used together with Tag 1 to access cylinders above 1023.

Bus 4, in conjunction with Tag 2, can be used as an alternate method of addressing cylinders above 1023. The choice is switch selectable by the user and is normally made at the time of system integration.

The bus lines must be stable for 200 nanoseconds prior to the leading edge of Tag 1 and Tag 2, and must remain stable for 200 nanoseconds following the trailing edge.

16.8 TAG 1

If the disk drive is selected, the leading edge of Tag 1 will strobe the states of the Bus 0—10 lines into a cylinder address register. On Cylinder will go false not later than 120 nanoseconds after the trailing edge of Tag 1 is received. A seek operation will commence. See Figures 16-2 and 16-3 for timing diagrams.

16.9 TAG 2

If the disk drive is selected, the leading edge of Tag 2 (Figure 16-3) will strobe the states of Bus 0—4 into a head address register. Bus 0—3 are binary weighted to select one of up to 10 heads.

If an attempt to select a nonexistent head is made, the disk drive will set the Fault line true within 100 microseconds.

Table 16-1

Tag 1, Tag 2 Bus Assignments

Bus Bit	Tag 1 Cylinder Address	Tag 2 Head/Volume Select
Bit 0	2^0	2^0
Bit 1	2^1	2^1
Bit 2	2^2	2^2
Bit 3	2^3	2^3
Bit 4	2^4	Volume Change**
Bit 5	2^5	
Bit 6	2^6	
Bit 7	2^7	
Bit 8	2^8	
Bit 9	2^9	
Bit 10*	2^{10}	

* Use of this line is optional.
** Use of this signal is optional.

188

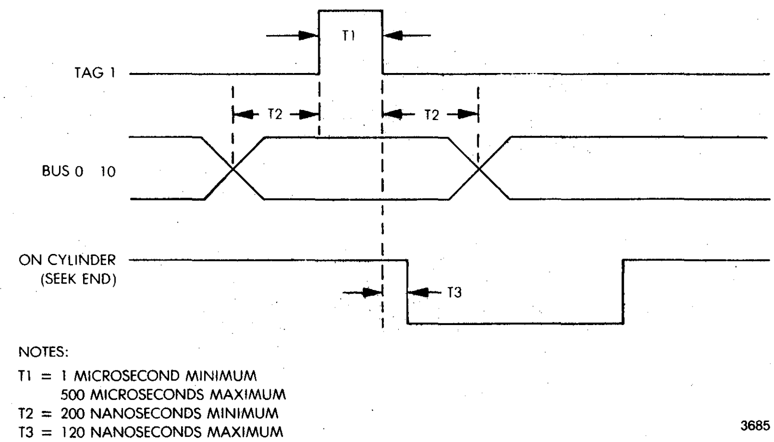


Figure 16-2. Tag 1 Timing Diagram

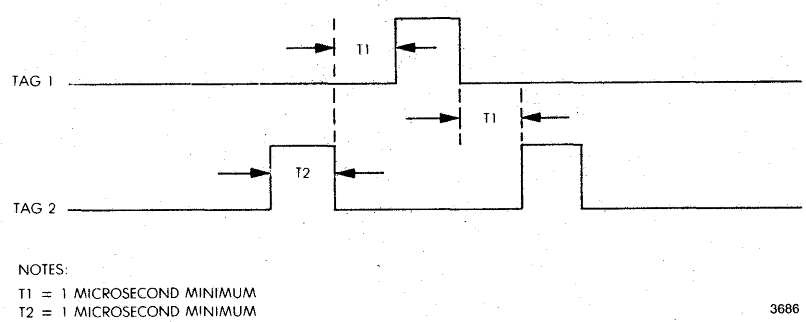


Figure 16-3. Tag 1, Tag 2 Timing Diagram

16.10 ON CYLINDER

This status signal from the drive is true when the heads are settled over a track. On Cylinder will go false 120 nanoseconds after the trailing edge of Tag 1 is received (Figure 16-2).

A zero-track seek causes the On Cylinder line to go false for a maximum of 40 microseconds after the command is received. An actuator offset in either direction causes On Cylinder to go false for a maximum of 2.75 milliseconds after the offset command is received.

A Return To Zero command causes On Cylinder to go false within 150 nanoseconds after the command is received.

16.11 SEEK END

The Seek End status signal is identical to On Cylinder (Figure 16-2) except when an attempt is made to seek to an illegal cylinder. In that case, Seek End goes false and remains false until either an RTZ command has been successfully completed or dc power is removed from and restored to the disk drive.

16.12 SEEK ERROR

Detection of the following conditions will cause Seek Error to go true (see Figure 16-4 for timing diagram).

(1) A Seek operation is not completed within 130 milliseconds .

(2) An RTZ operation is not completed within 650 milliseconds.

(3) A track crossing is sensed when the actuator should be locked on track.

(4) Presentation of an illegal cylinder address to the disk drive. Seek Error will go true within 250 microseconds following the trailing edge of Tag 1. The actuator will not move until an RTZ command is received.

When a seek error is detected, the disk drive disables the write circuitry. Seek Error goes false only on completion of a successful RTZ operation. When Seek Error goes false, the drive automatically reenables the write circuitry.

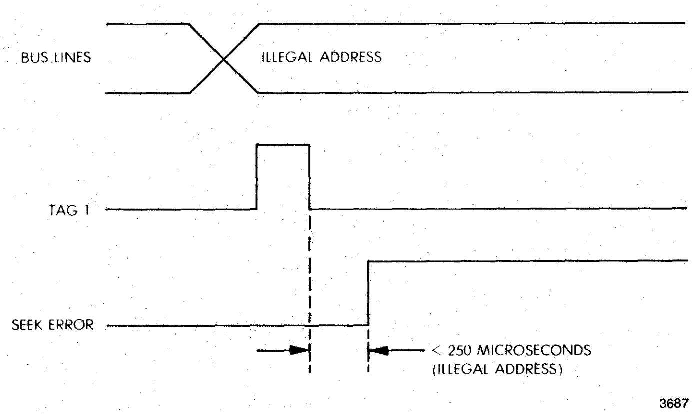


Figure 16-4. Seek Error Timing Diagram

16.13 TAG 3

Tag 3 is used in conjunction with Bus 0—8 (refer to Table 16-2) and can function as an enabling signal or as a strobe signal, depending on the operation desired. Refer to the individual descriptions of each operation for precise timing requirements.

16.13.1 WRITE GATE (TAG 3/BIT 0)

When the Write Gate function is active (see Figure 16-5), the disk drive will be conditioned to store data. The actual data to be written is controlled by the Write Data and Write Clock lines. If the drive is on-cylinder, not write-protected, and if no fault condition exists, write current is allowed to flow through the write heads.

The Write Gate function must not occur sooner than 300 nanoseconds after disabling the Read Gate function, or, in the case of a head change, not less than 5 microseconds after the leading edge of Tag 2.

16.13.2 READ GATE (TAG 3/BIT 1)

The leading edge of the Read Gate function (Figure 16-5) enables the disk drive circuits to synchronize on an all 0s pattern. The Read Gate function must remain active through detection of the sync pulse. Data will be presented to the interface as long as the Read Gate function is active.

16.13.3 SERVO OFFSET PLUS

The Servo Offset Plus function moves the heads closer to the spindle for the duration of the function. When the function is deactivated, the heads will return to the nominal on-cylinder position.

On Cylinder and Seek End will go false not later than 170 nanoseconds after the Servo Offset Plus function is activated (see Figure 16-6) and will remain false for a maximum of 2.75 milliseconds.

When deactivating Servo Offset Plus, the disk drive requires a 4 millisecond settling delay before a read or write operation is attempted.

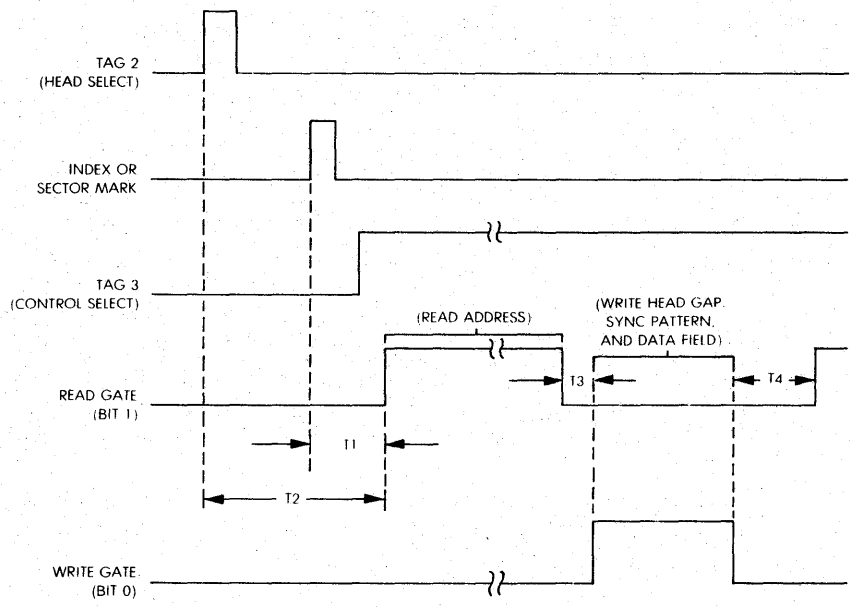
If an offset function is received while the Write Gate function is true, the internal write gate will be disabled. Fault will go true, and the heads will be offset.

If an offset function is received while the Read Gate function is true, Fault will go true and the heads will be offset.

Table 16-2
Tag 3/Bus Functions

Bus Bit	Tag 3 Function as Enable Line	Tag 3 Function as Strobe Line
0	Write Gate	—
1	Read Gate	—
2	Servo Offset Plus	—
3	Servo Offset Minus	—
4	—	Fault Clear
5	AM Enable	—
6	—	Return to Zero
7	Data Strobe Early	—
8	Data Strobe Late	—

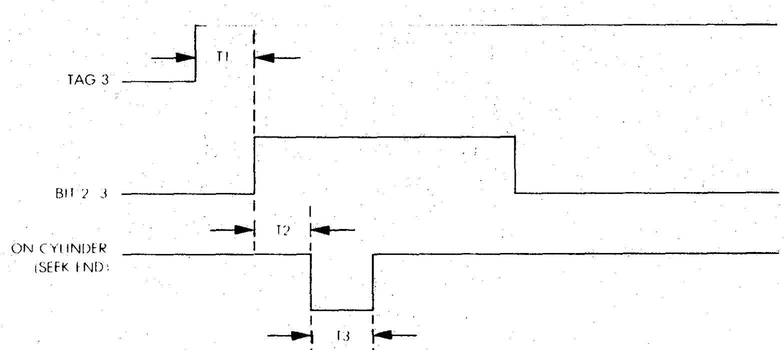
188



NOTES:
T1 = 6.0 ±0.5 MICROSECONDS
T2 = 15 MICROSECONDS MINIMUM
T3 = 300 NANOSECONDS MINIMUM
T4 = 10 MICROSECONDS MINIMUM

3688

Figure 16-5. Read/Write Control Timing Diagram



NOTES:
T1 = 200 NANOSECONDS MINIMUM
T2 = 170 NANOSECONDS MAXIMUM
T3 = 2.75 MILLISECONDS NOMINAL

3689

Figure 16-6. Servo Offset Timing Diagram

16.13.4 SERVO OFFSET MINUS (TAG 3/BIT 3)

This function operates exactly like Servo Offset Plus (Figure 16-6) except that the direction of the offset is away from the spindle.

If one offset is received while the other is active, On Cylinder and Seek End will not be pulsed and the physical offset itself will be cancelled.

16.13.5 FAULT CLEAR (TAG 3/BIT 4)

Fault will go false within 150 microseconds after the Fault Clear function is activated (see Figure 16-7), provided the fault condition no longer exists and the Fault Clear function is active for at least 100 nanoseconds.

16.13.6 ADDRESS MARK (AM) ENABLE (TAG 3/BIT 5)

The AM Enable function works together with the Write or Read Gate functions (see Figure 16-8) to generate or detect an address mark. The Address Mark feature is an alternative to sector pulse generation and is switch selectable.

If the Write Gate function is active, the write circuitry will erase data as long as the AM Enable function is active. The writing of an address mark inhibits the detection of any write fault in the disk drive. If the AM Enable function is active while the Read Gate function is active, the data recovery electronics will be conditioned to detect the absence of data.

If address marks are not to be used, Bus 5 must be held false during all control select (Tag 3) functions.

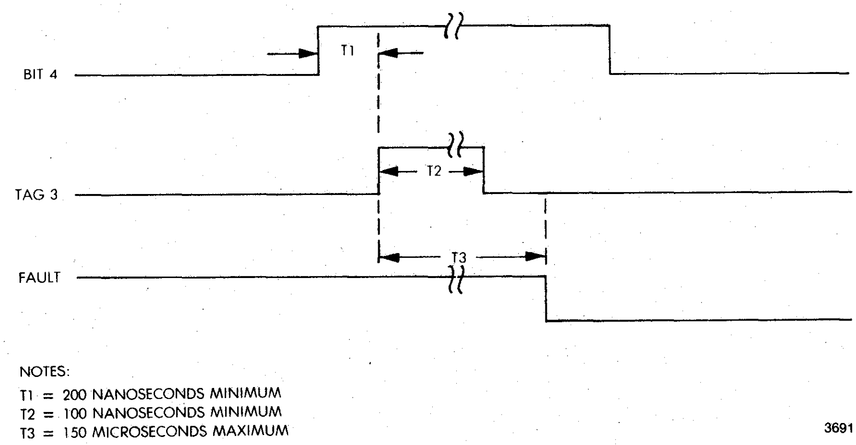
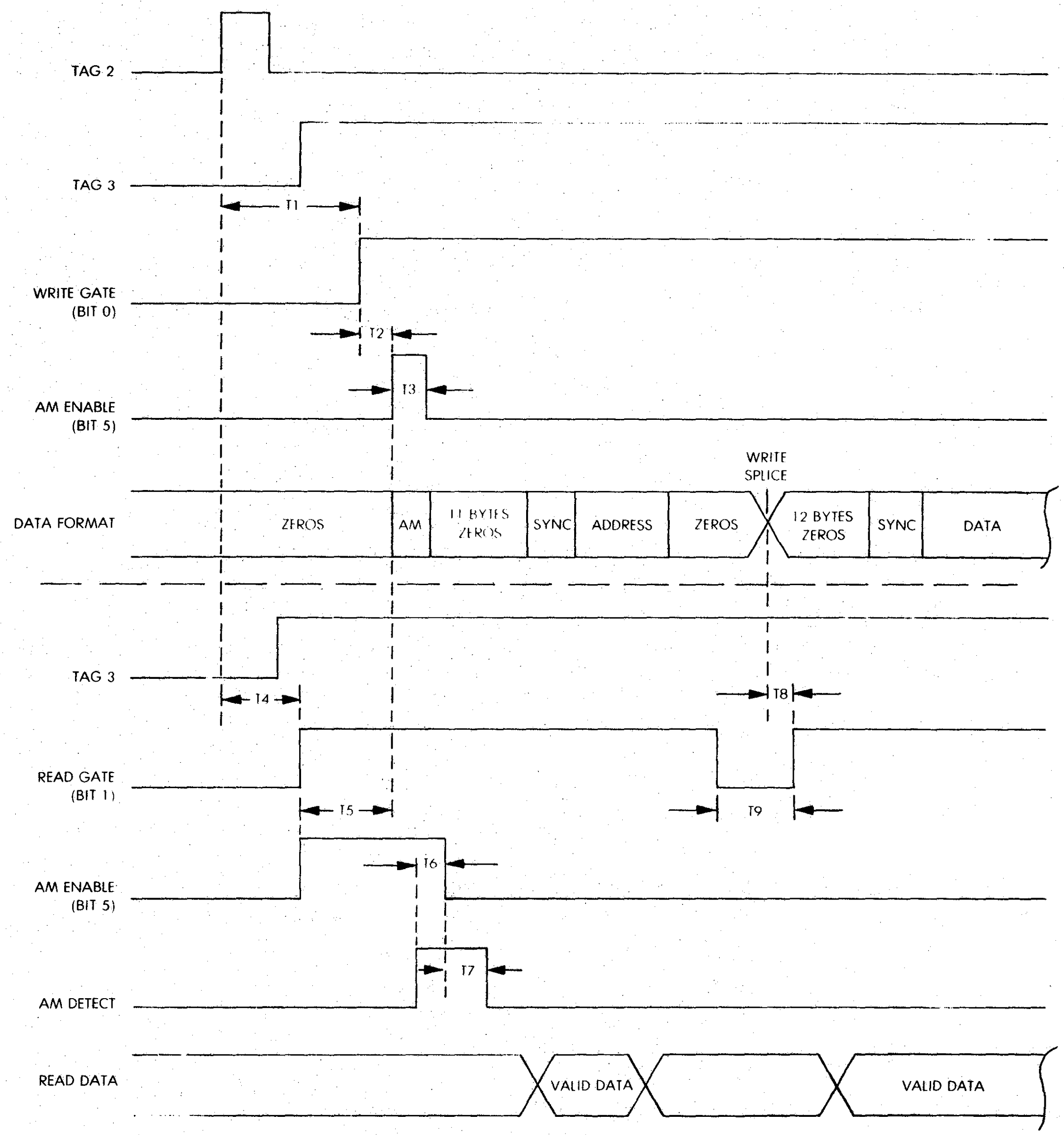


Figure 16-7. Fault Clear Timing Diagram



NOTES:

T1 = 5 MICROSECONDS MINIMUM
T2 = 1 BYTE MINIMUM
T3 = 3 BYTES MINIMUM, 3.5 BYTES MAXIMUM
T4 = 15 MICROSECONDS MINIMUM, AM SHOULD OCCUR TOGETHER WITH READ GATE
T5 = 200 NANOSECONDS MINIMUM
T6 = 1 MICROSECOND MAXIMUM
T7 = 8 MICROSECONDS MAXIMUM
T8 = 0.1 MICROSECOND MINIMUM
T9 = READ GATE MUST BE DROPPED PRIOR TO THE WRITE SPLICE. IT MUST BE REINITIATED AT LEAST 1 BIT AFTER THE WRITE SPLICE AND WITH AT LEAST 10 BYTES OF ZEROS REMAINING IN THE PLO LOCKUP FIELD. 12 BYTE EXAMPLE CONSISTS OF 1 BYTE FOR WRITE SPLICE AND 11 BYTES FOR PLO SYNC.

3690

Figure 16-8. Address Mark Timing Diagram

16.13.7 RETURN TO ZERO (TAG 3/BIT 6)

The heads will be returned to cylinder 0 and head 0 will be selected if the Return To Zero (RTZ) function is active for at least 250 nanoseconds (see Figure 16-9). Seek End and On Cylinder will go false within 170 nanoseconds after the RTZ function is activated. If the RTZ function does not exceed 650 milliseconds and if no new Seek Error was detected, On Cylinder and Seek End will go true when the physical RTZ operation is complete.

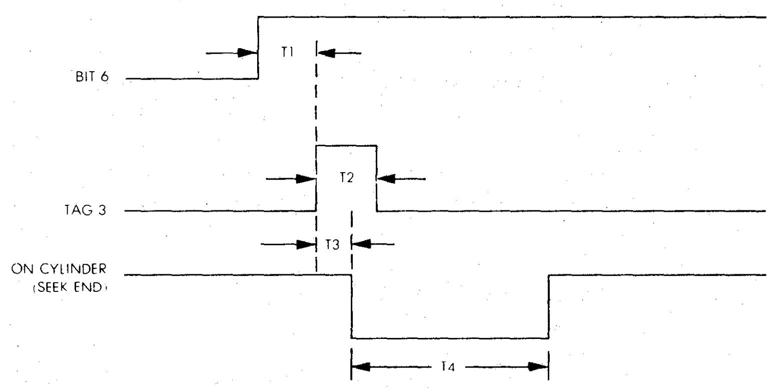
The RTZ function will clear Seek Error only if the physical RTZ operation is successful.

If the Servo Offset Plus or Minus function is active when the RTZ function is activated, the physical offset will be cancelled.

16.13.8 DATA STROBE EARLY AND LATE (TAG 3/BITS 7 AND 8)

The Data Strobe Early and Data Strobe Late functions are intended for use as an aid in recovering marginal data. When active, the data separator timing within the drive is altered from nominal. The timing will return to nominal when both functions are deactivated.

Data Strobe Early and Data Strobe Late functions do not affect the timing of any interface read or clock signals and are applicable only while reading data. If both are active at the same time, the data may not be valid.



NOTES:
T1 = 200 NANOSECONDS MINIMUM
T2 = 250 NANOSECONDS MINIMUM
1 MILLISECOND MAXIMUM
T3 = 170 NANOSECONDS MAXIMUM
T4 = 650 MILLISECONDS MAXIMUM

3692

Figure 16-9. Return To Zero Timing Diagram

16.14 FAULT

The following paragraphs describe the fault conditions that will cause the interface Fault line to go true.

16.14.1 POWER FAIL

If an under-voltage or no-voltage condition exists in one of the dc regulators (over-voltage conditions are not detected) when power is first applied, the drive will not spin-up. If this condition occurs during or after spin-up, the heads will retract and the drive will spin-down. Fault will go true when the spin-down is complete, if the condition still exists. Transient power faults will not be reported to the host. This fault condition will clear when all dc voltages are correct.

16.14.2 SPEED ERROR

(1) If the spindle speed is not within ±10 percent of nominal within 45 seconds following start-up, the drive will spin-down and Fault will go true when the spin-down is complete.

(2) After the spindle has reached nominal speed, a variation greater than ±5 percent will cause Fault to go true. The drive will spin-down.

These speed error conditions will be cleared when a successful spin-up is completed.

16.14.3 HEAD LOAD

If the heads do not load properly, Fault will go true, the heads will retract and the drive will spin-down. This fault condition will be cleared when a successful head load is completed.

16.14.4 READ/WRITE FAULT

If a write is attempted while the heads are offset, if a read or write is attempted during an off-cylinder condition, if any head movement is attempted while a Read or Write Gate function is active, if an attempt is made to write while write-protected, or if the Read and Write Gate functions are true at the same time, Fault will go true. These read/write fault conditions will be cleared when the fault no longer exists and a Fault Clear command is received.

The internal write gate is disabled whenever Fault is true.

16.14.5 HEAD SELECT FAULT

If an attempt is made to select a nonexistent head, Fault will go true within 100 microseconds. This fault condition will be cleared when a valid head is selected.

16.15 ADDRESS MARK (AM) DETECT

If the data recovery electronics detect at least 16 missing transitions followed by a 0, AM Detect will go true (Figure 16-8). AM Detect will go false a maximum of 8 microseconds after the AM Enable function is deactivated.

16.16 INDEX

Index is derived from information on the servo tracks and occurs once per spindle revolution to provide a known reference point. The leading edge of Index defines the beginning of Sector Zero (see Figure 16-10).

Index is gated by Unit Selected and is made available to interface cable A. It is also made available to interface cable B whenever Unit Ready is true. The timing of Index remains valid during seek operations.

16.17 SECTOR MARK

Sector marks are a function of user selectable switch settings and are generated from information on the servo tracks. Any number of sector marks per revolution from 1 to 127 can be chosen by closing the appropriate switches on the Logic PCBA, usually at system integration time. No sector pulse is provided for Sector Zero (Figure 16-10).

Sector Zero is 3.75 microseconds (4.5 bytes) longer than the remaining sectors. Sector Mark is gated by Unit Selected and made available to interface cable A. It is also available to interface cable B whenever Unit Ready is true. The integrity of Sector Mark is maintained throughout seek operations.

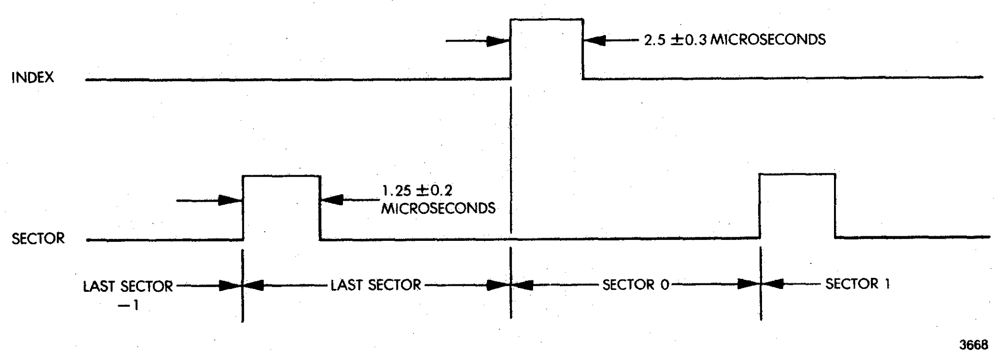


Figure 16-10. Sector/Index Timing Diagram

16.18 POWER SEQUENCE PICK AND HOLD

The disk drive has two modes of spin-up. In the Local mode, the spin-up takes place when power is applied to the drive. In the Remote mode, the spin-up takes place under control of the Pick and Hold signals (see Figure 16-11). The Remote/Local mode is switch selectable; selection is normally made during system integration.

Pick and Hold work together to allow one or more drives to spin-up in sequence from the controller. Hold is applied to all drives on interface cable A simultaneously, and when true, acts as an enabling signal.

In the Remote mode, Pick and Hold must not be activated until at least 1 second after power is applied to the drive.

If Hold is true, the leading edge of Pick will cause the first drive on cable A to spin-up. When the spin-up is complete, the drive will transfer the Pick signal to the next drive on cable A via the Pick Out line on J3.

Pick should remain true until it has been transferred to the last drive on cable A. Hold must remain true to keep the drives spinning.

Each drive will sink 9 milliamps of Hold current, and 9 milliamps of Pick current. In addition, each drive will source up to 1 amp of Pick current.

16.19 WRITE PROTECT

The DX disk drive has no operator-accessible write protect switch. However, there is an internal write protect switch that can be used for maintenance purposes, and there are several conditions under which the drive will automatically write-protect itself to maintain data security. Following are the conditions under which Write Protect will be true.

(1) During the initial spin-up cycle.
(2) When the maintenance write protect switch is active.
(3) When Seek Error or Fault is true.
(4) When Servo Offset Plus or Servo Offset Minus is true.

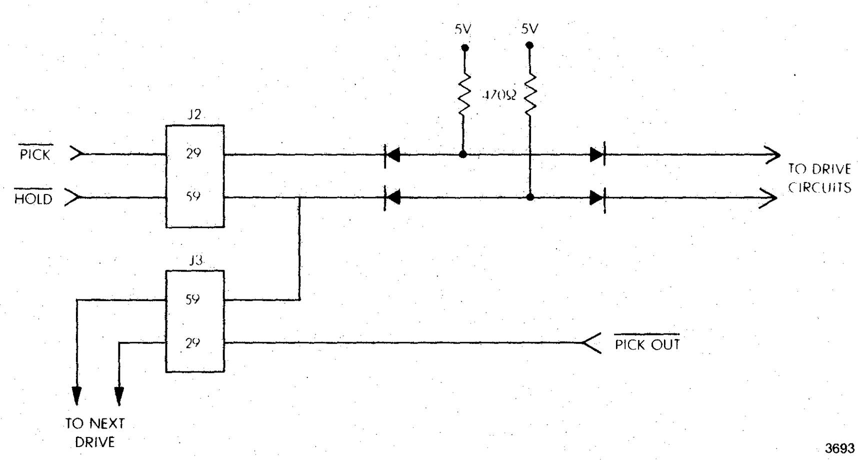


Figure 16-11. Pick and Hold Routing

16.20 BUSY

The Busy function is not implemented in the DX disk drive and there is no dual-channel operation.

16.21 SERVO CLOCK

This output is a 9.677 MHz clock (see Figure 16-12) generated from information on the servo tracks and phase-locked to disk rotation. It is transmitted continuously and can be used by the controller as a Write Clock back to the drive.

16.22 WRITE CLOCK

This line transmits a clocking signal which must be synchronized to Write Data as shown in Figure 16-12. Write Clock need not be transmitted continuously, but must be transmitted at least 250 nanoseconds before Write Enable goes true.

16.23 WRITE DATA

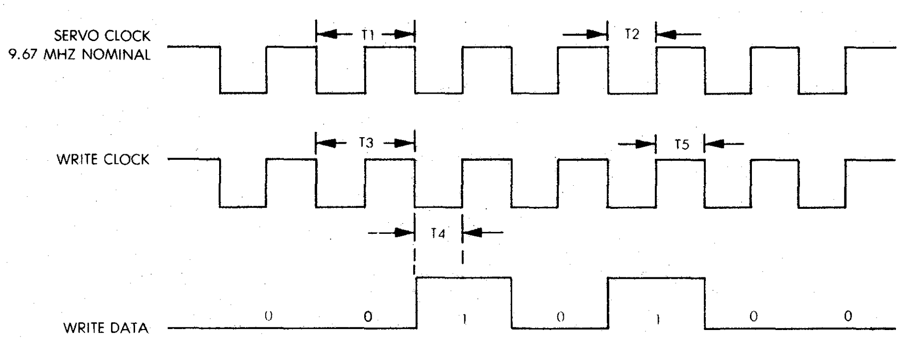
This line transmits the NRZ data to be recorded on the media. A logical 1 is defined as a true level on the Write Data line (Figure 16-12) during the negative-to-positive transition of Write Clock.

16.24 READ CLOCK

This output is an internally generated clocking signal (see Figure 16-13) that defines the beginning of a data cell. It is transmitted continuously and is phase-locked to the recorded data within 9 microseconds after Read Enable goes true.

16.25 READ DATA

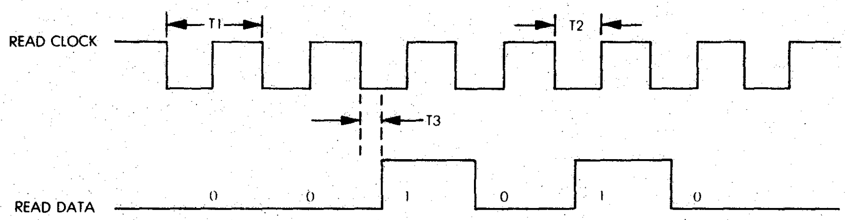
Recovered data is transmitted to the controller in NRZ form on the read data lines. A logical 1 is defined as a true level during the negative-to-positive transition of Read Clock (Figure 16-13).



NOTES:
1. ALL TIMES ARE MEASURED AT THE INTERFACE CONNECTOR.
2. T1 = 103.3 NANOSECONDS +4% −5%
   T2 = 51.6 ±3 NANOSECONDS
   T3 = 103.3 ±7.2 NANOSECONDS
   T4 = 50 ±30 NANOSECONDS
   T5 = 51.6 ±25 NANOSECONDS

3694

Figure 16-12. Servo and Write Clock Timing Diagram



NOTES:

1. ALL TIMES ARE MEASURED AT THE INTERFACE CONNECTOR.
2. T1 = 103.3 ±10 NANOSECONDS
   T2 = 51.6 ±5 NANOSECONDS
   T3 = 6.0 ±4 NANOSECONDS

3695

Figure 16-13. Read Timing Diagram