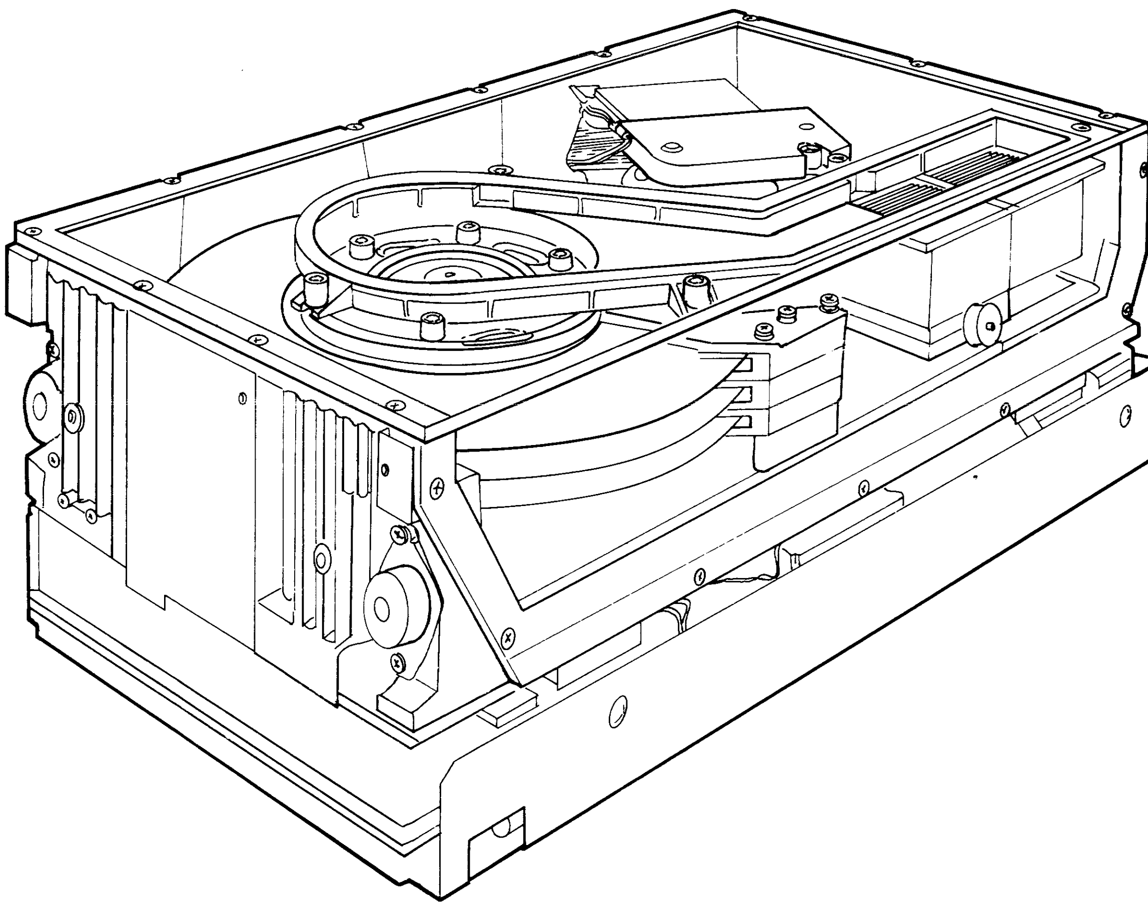
D22x7 SERIES 8-INCH WINCHESTER DISK DRIVE PRODUCT DESCRIPTION



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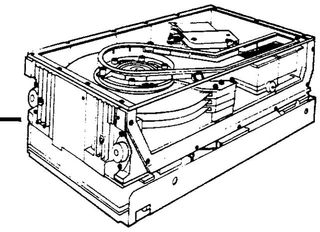
List of Abbreviations

A	Ampere
ac	alternating current
AM	Address Mark
AWG	American Wire Gauge
CA	Cylinder Address
CRC	Cyclic Redundancy Check
dc	direct current
DE	Disk Enclosure
DIP	Dual-inline-packaged
DKC	Disk Controller
DKU	Disk Unit
ECC	Error Correction Code
EOR	End of Record
GND	Ground
HA	Head Address
HEX	Hexadecimal
IGB	Inner Guard Band
I/O	Input/Output
LED	Light emitting diode
m	meter
MB	Megabyte
MFM	Modified Frequency Modulation
MHz	Megahertz
mm	Millimeter
ms	Millisecond
mV	Millivolt
MTBF	Mean Time Between Failures
MTTR	Mean Time to Repair
NRZ	Non-Return-to-Zero
ns	Nanosecond
OGB	Outer Guard Band
PCB	Printed Circuit Board
PLO	Phase Locked Oscillator
RMS	Root-Mean-Square
ROM	Read only memory
RPM	Revolutions per Minute
R/W	Read/Write
SA	Sector Address
TTL	Transistor/Transistor Logic
V	Volt
μs	microsecond

Chapter 1

System Overview



The D2257 and D2247E disk drives are the newest models in the NEC D2200 series. They are compact, highly reliable, low-cost disk drives fully compatible with earlier D2200 models. They offer up to 167.7 megabytes (MB) of unformatted data storage on 8-inch platters. Actual storage capacity depends upon the model and formatting method used.

1.1 D22X7 SYSTEM DESIGN

Both models use fixed-disk, Winchester-type technology, which provides the most advanced method of storing and retrieving large amounts of data. Each 22x7 disk drive contains a number of 8-inch platters (see Table 1-1) sealed within a protective, air-tight enclosure. This enclosure protects the recording platters from atmospheric dust and dirt, thus improving operational reliability. A spindle, a drive motor, a rotary actuator assembly, and movable read/write heads are also contained within the enclosure. Figure 1-1 shows the major components of the D22x7 series.

Table 1-1 D22x7 Disk Drive Storage Capacity

MODEL	UNFORMATTED CAPACITY (MB)	NUMBER OF 8-INCH DISK PLATTERS	NUMBER OF MOVABLE R/W HEADS
D2257	167.7	5	8
D2247E	103.2	3	5

Figures 1-2 and 1-3 show the arrangement of recording platters and read/write heads within the D2257 and D2247E disk drives.

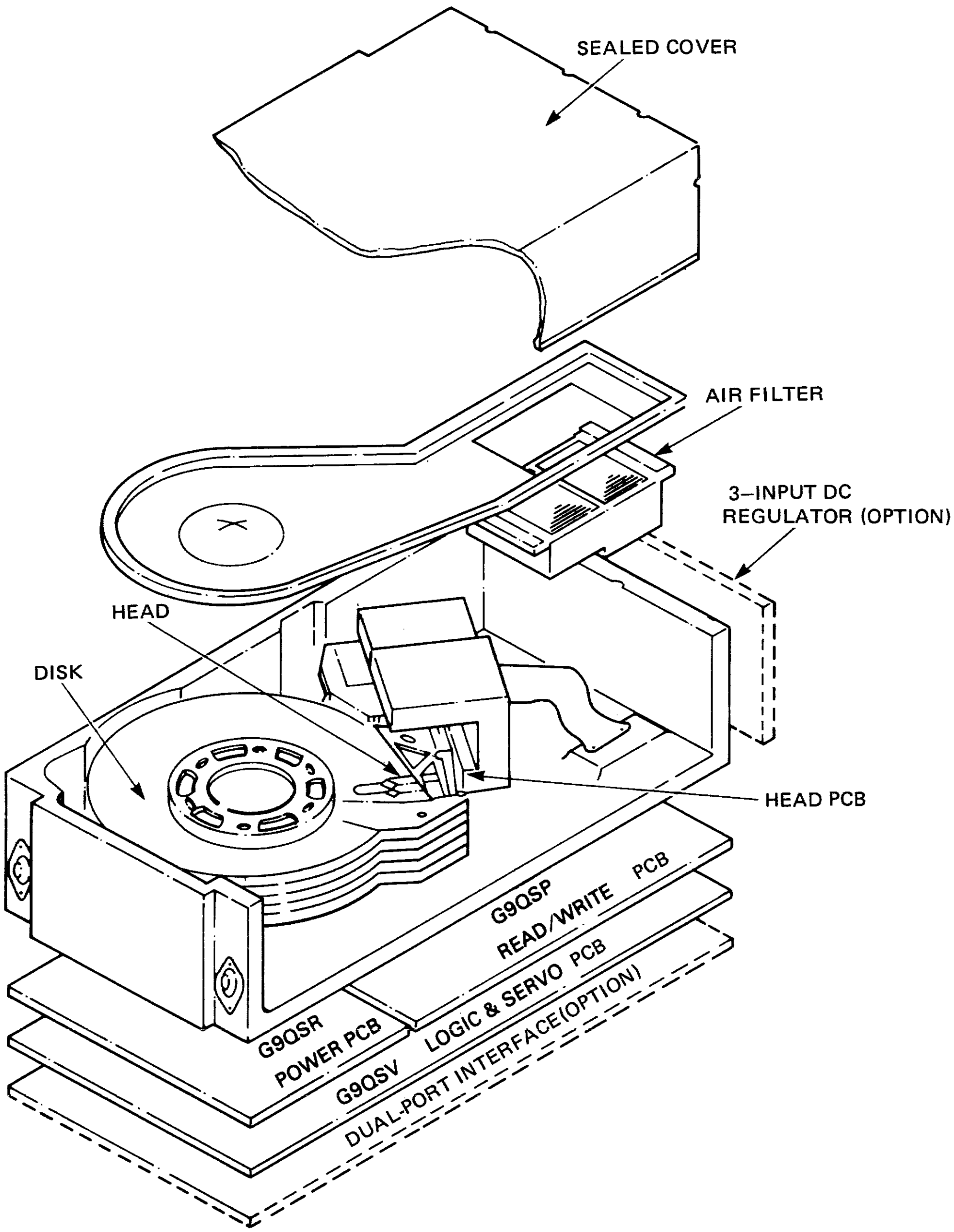


Figure 1-1 Major Components of the D22x7 Series Disk Drive

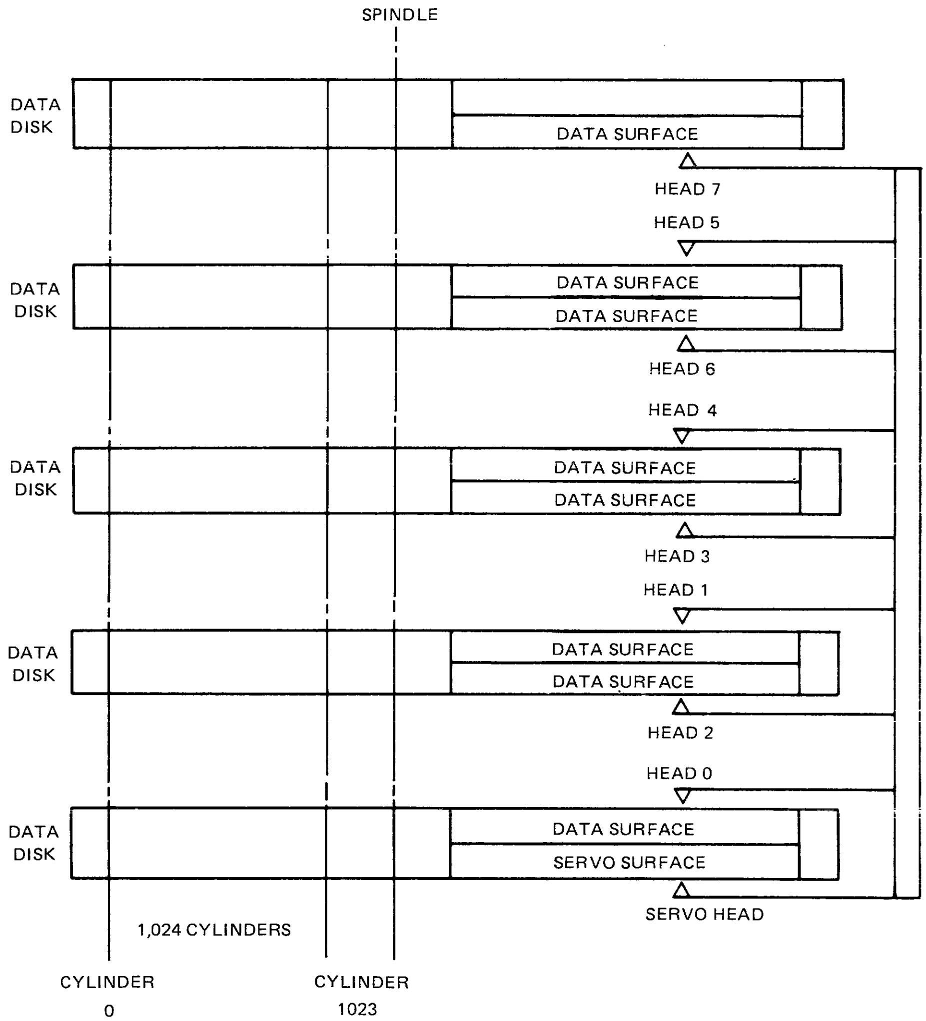


Figure 1-2 D2257 Disk Arrangement

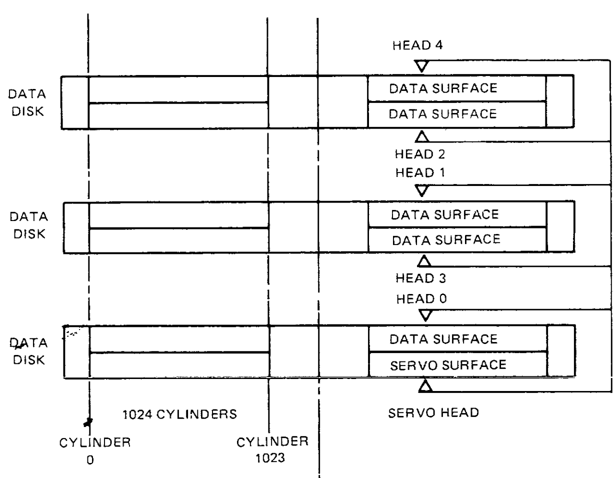


Figure 1-3 D2247E Disk Arrangement

The servo disk surface is shown in Figure 1-4.

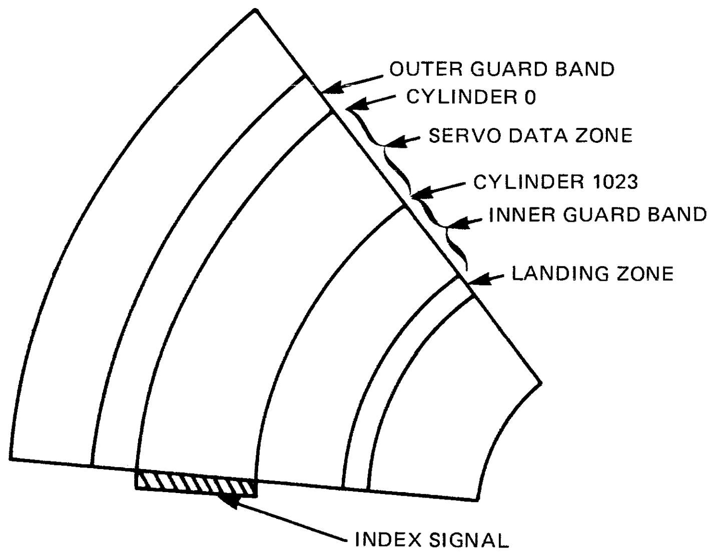


Figure 1-4 Servo Disk Surface

The Index is a six-bit pattern written along one radius of the servo surface. It provides orientation information identifying the beginning of a recording track. The index pattern repeats each time the radius intersects one of the recording tracks.

The servo data zone contains 1024 concentric recording tracks. Prerecorded positioning data on each of these tracks provides the necessary information to position the read/write heads. Prerecorded control data on each track also provides the signals required to maintain the read/write heads on track, and required clock and synchronization signals.

The inner and outer guard bands are essentially blank surfaces that bracket the servo data zone. The inner and outer guard bands contain six-bit patterns that distinguish them from the servo data zone. These patterns recur every 320 bytes. Table 1-2 lists the bit patterns used on the servo surface.

Table 1-2 Servo Surface Bit Patterns

SIGNAL	BIT PATTERN
Index	0 1 1 0 1 0
Inner Guard Band	0 1 1 0 0 1
Outer Guard Band	0 1 1 1 0 0

The landing zone is a silicon-coated surface where the read/write heads rest when the recording disks are not spinning. During read, write, and seek operations the heads "float" approximately 20 microinches above the surface of the disk, supported by aerodynamic forces.

1.2 DRIVE CIRCUITRY

A block diagram of a D22x7 disk drive is shown in Figure 1-5. The functional components consist of the interface, the read/write circuits, the servo control, and the motor control circuits.

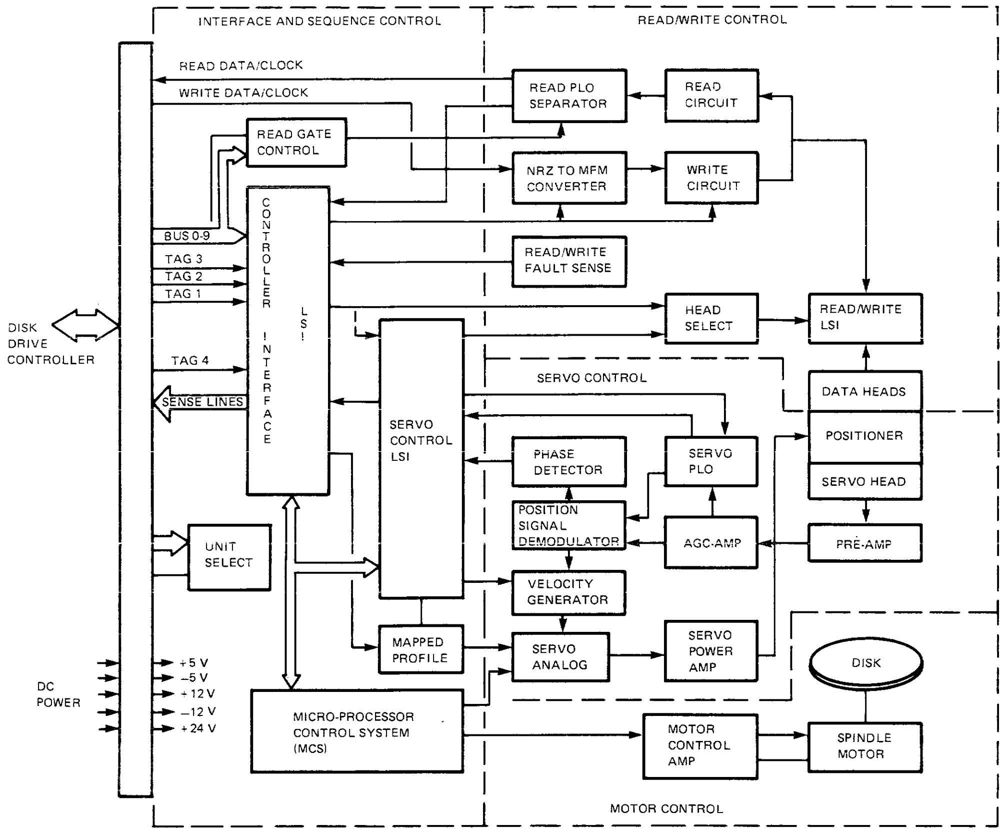


Figure 1-5 D22x7 Functional Block Diagram

The interface routes data, addresses, status information, and control signals between the disk drive and the controller.

The read/write circuits control the transfer of data from the disk (read operation), and the transfer of data to the disk (write operation). During a write operation, the circuits receive serial Nonreturn-to-Zero (NRZ) format data from the controller and convert the data to a Modified Frequency Modulation (MFM) format. The MFM data is then written on the disk. During a read operation, the circuits read and amplify the data from the disk, convert it from MFM to NRZ format, and send the NRZ data serially to the controller.

The servo control reads the data prerecorded on the servo disk. The servo control uses this data to position and maintain the read/write heads on the correct cylinder. The motor control circuits drive the spindle motor.

1.3 POWER REQUIREMENTS

D22x7 disk drives operate on externally supplied dc power. DC power requirements are listed in Table 1-3.

Table 1-3 DC Power Requirements

REQUIRED VOLTAGE	TOLERANCE	DAMAGE THRESHOLD	CURRENT	RIPPLE (PEAK TO PEAK)
+5.0V	±0.25V	±25%	4.0A	100mV
-5.0V	±0.25V	±25%	0.5A	100mV
+12.0V	±0.60V	±25%	0.6A	100mV
-12.0V	±0.60V	±25%	0.5A	100mV
+24.0V	±2.40V	±25%	2.7A* 5.0A**	240mV

*2.7A — average running current
**5.0A — peak starting current (25 seconds maximum duration)

All power line voltages must be established within 500 milliseconds (ms) of power on. When power is turned on, voltages must be enabled in the following order: +5V, -5V, ±12V, +24V. When power is turned off, lines must be disabled in the reverse order: +24V, ±12V, -5V, +5V.

Refer to Appendix A for information on the optional 3-Input DC Regulator.

1.4 FEATURES

Shorter access times, high-speed data transfers, and mechanical reliability are required for efficient computer network operations. To meet these demands the NEC D22x7 disk drives offer the following features.

1.4.1 Seek Time

Seek time is the time required to find requested data on the disk. Both D22x7 models have an average seek time of 20 ms, and a maximum seek time of 40 ms.

1.4.2 Data Transfer Rate

Both the D2257 and the D2247E offer a data transfer rate of approximately 1.2 MB per second.

1.4.3 Compact Mounting

The D22x7's compact size allows for either horizontal or vertical mounting in a limited space. The drive's lock mechanism is easily accessible even after the drive has been placed within a system cabinet.

D22x7 drives also feature an integrated cooling fan that reduces space and power requirements.

1.4.4 Maintenance

The air-tight, sealed disk/head assembly and the D22x7's simplified design produce a disk drive that requires no periodic maintenance. Neither installation nor field service requires special tools. Motor electronics are placed outside the head/disk assembly and do not need "clean room" repair facilities.

An optional diagnostic panel is available for test and maintenance purposes. Refer to the *D22x7 Maintenance Guide* for information on the diagnostic panel.

1.4.5 Design Reliability

D22x7 disk drives use lightweight, contact-type start/stop heads that eliminate damage to the heads and disk. A simplified rotary actuator, directly coupled, brushless dc motor, and a closed-loop air circulation system comprise the system's major mechanical components. The control logic is microprocessor controlled and designed to minimize electronic components. The design strategy ensures high reliability and low cost.

1.4.6 Standard Interfaces

Both the D2257 and the D2247E use the same standard original equipment manufacturer interfaces for connection to a disk controller and to a power supply.

1.4.7 Safety

D22x7 models conform to Underwriter's Laboratories Safety Regulation UL478.

1.4.8 System Configuration Flexibility

One to sixteen D22x7 disk drives can be connected to a single controller in either a daisy-chain or radial system (see Figures 1-6 and 1-7).

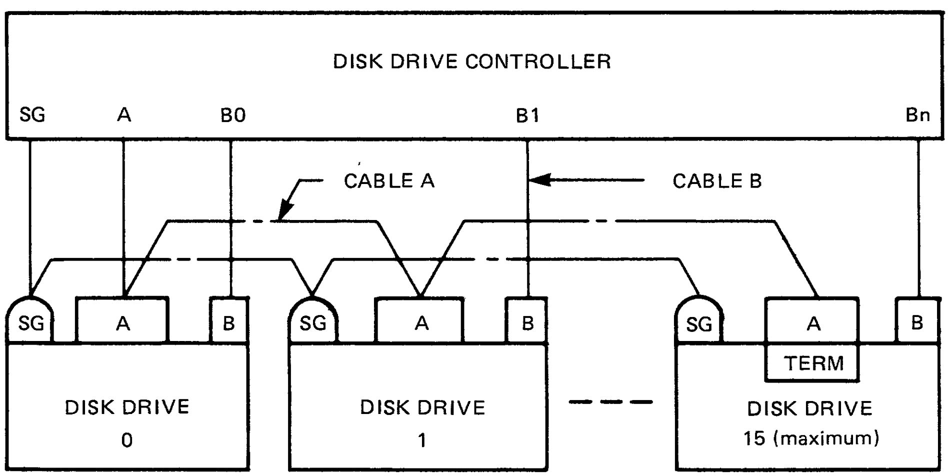


Figure 1-6 Daisy-Chain Connection Layout

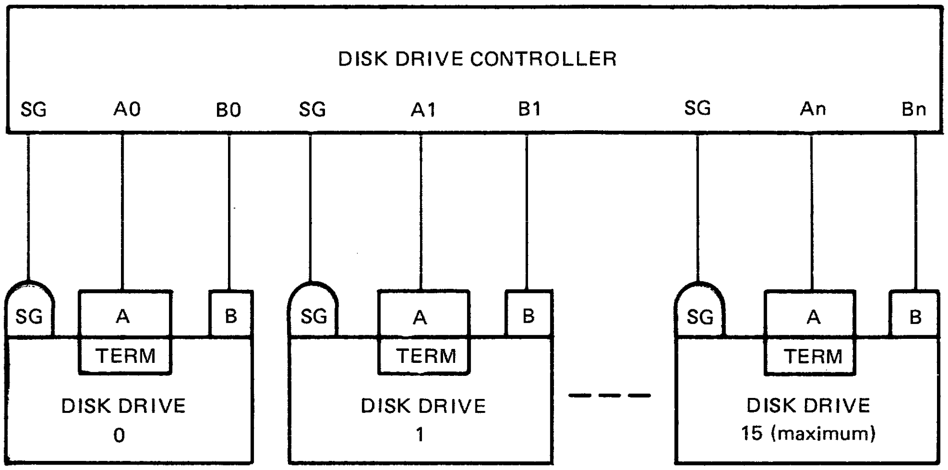


Figure 1-7 Radial Connection Layout

1.5 OPTIONS

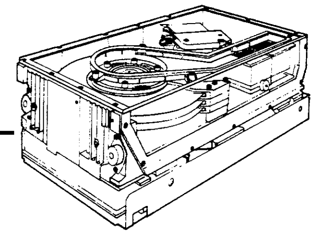
Table 1-4 lists available options for D22x7 disk drives.

Table 1-4 Available Options

OPTION	DESCRIPTION
3-Input DC Regulator Option	Supplies internal dc "power set" (+24V, +12V, +5V, -5V, -12V) by converting external dc input of +24V, +5V, and -12V.
Dual-Port Option	Enables a D22x7 drive to interface with two controllers.
DC Power Supply	Supplies internal dc "power set" (+24V, +12V, +5V, -5V, -12V) from ac input power. The unit provides power for two disk drives.
Diagnostic Panel	Maintenance tool for monitoring and testing disk drive operation.

Chapter 2

Specifications



This chapter describes the operational and design specifications of the D22x7 series of disk drives.

2.1 OPERATING SPECIFICATIONS

Table 2-1 lists operating specifications for the D2257 and D2247E disk drives.

Table 2-1 Operating Specifications

FEATURE	SPECIFICATION
General	
Start Time	Less than 35 seconds
Stop Time	Less than 25 seconds
Recording Mode	MFM
Interface Mode	NRZ
Head Positioning	Closed servo rotary actuator
Track Following	Modified-dipulse pattern
Basic Power Requirements	
Voltage and Current	+5 Vdc, 4.0 A -5 Vdc, 0.5 A +12 Vdc, 0.6 A -12 Vdc, 0.5 A +24 Vdc, 2.7 A (average) 5.0 A (peak)
Power Dissipation	100 W (average) 150 W (peak)
Heat Generation	86 BTU/hour

Table 2-1 Operating Specifications (cont'd)

FEATURE	SPECIFICATION
Environmental	
Temperature (Ambient)	
Operating	41° to 104° F (5° to 40° C)
Nonoperating	14° to 140° F (–10° to 60° C)
Storage*	-40° to 158° F (–40° to 70° C)
Temperature (Gradient/maximum)	
Operating	18°F per hour (10°C per hour)
Nonoperating	27°F per hour (15°C per hour)
Storage	45°F per hour (25°C per hour)
Relative Humidity (No Condensation)	
Operating	20% to 80% relative humidity
Nonoperating	10% to 90% relative humidity
Storage	5% to 95% relative humidity
Vibration	
Operating	0.2G
Nonoperating	0.5G
Storage	1.5G
Shock	
Operating	2G (20 ms)
Nonoperating	5G (10 ms)
Storage	15G (30 ms)
Altitude (Maximum)	
Operating	10,000 feet (3,048 meters)
Nonoperating	40,000 feet (12,192 meters)
Storage	40,000 feet (12,192 meters)

*Storage-unopened, as shipped from factory

2.2 DESIGN SPECIFICATIONS

Table 2-2 lists design specifications for the D2257 and D2247E disk drives.

Table 2-2 Design Specifications

FEATURE	MODEL D2257	MODEL D2247E
Unformatted Storage Capacity		
Per Unit (MB)	167.7	103.2
Per Cylinder (bytes)	163,840	100,800
Per Track (bytes)	20,480	20,480
General		
Recording Disks	5	3
Data Heads	8	5
Servo Heads	1	1
Cylinders	1,024	1,024
Track Density (tracks/inch)	960	960
Bit Density (bits/inch)	9,420	8,670
Data Transfer Rate (MB/second)	1.19	1.20
Spindle Rotation (RPM)	3,510	3,600
Average Latency Time (ms)	8.55	8.33
One Cylinder Seek Time (ms)	5	5
Average Seek Time (ms)	20.0	20.0
Maximum Seek Time (ms)	40.0	40.0
Sectors per Track	Switch Selectable	
Reliability		
Mean Time-Between-Failures (MTBF)	12,000 hours	
Mean Time-to-Repair (MTTR)	less than one hour	
Service Life	approximately 5 years	

2.3 PHYSICAL DIMENSIONS

Table 2-3 summarizes the physical dimensions of the D22x7 disk drives. Figures 2-1 and 2-2 show the basic unit and the standard assembly.

Table 2-3 Physical Dimensions

DIMENSIONS	BASIC UNIT	STANDARD ASSEMBLY*
Width	8.54 in. (217 mm)	8.89 in. (226 mm)
Height	5.47 in. (139 mm)	5.62 in. (143 mm)
Depth	16.53 in. (420 mm)	18.50 in. (470 mm)
Weight	30.46 lbs. (13.8 kg)	32.45 lbs. (14.7 kg)

*The standard assembly includes a frame bracket.

2.4 MOUNTING AND VENTILATION

D22x7 disk drives must be mounted as shown in Figure 2-3. Figure 2-3 also shows the required ventilation for each mounting position. An air flow rate of at least 1.1 cubic yards per minute (1.1 yd^3/minute) on a 0.4-inch surface is required.

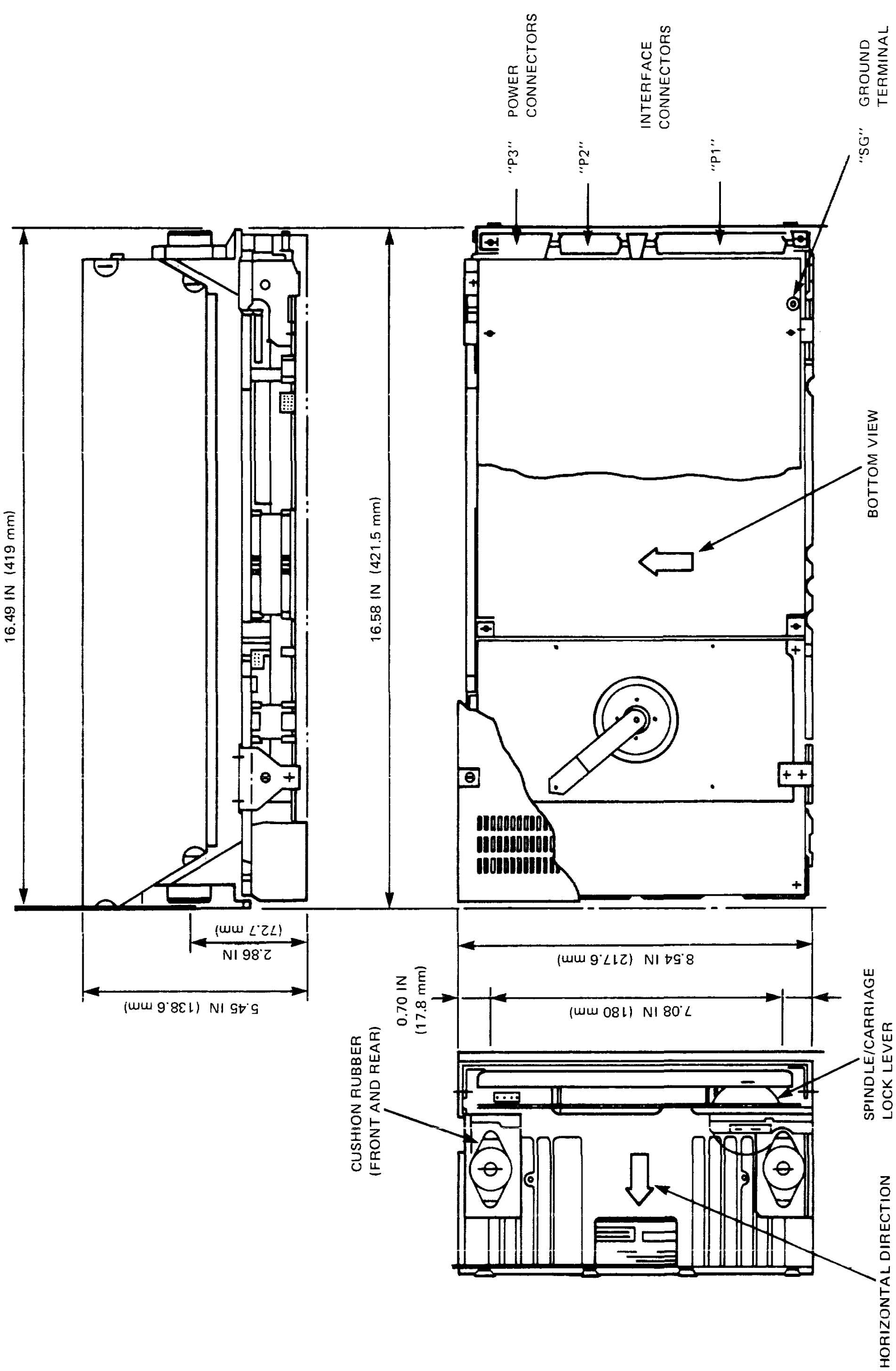


Figure 2-1 D22x7 Basic Assembly Dimensions

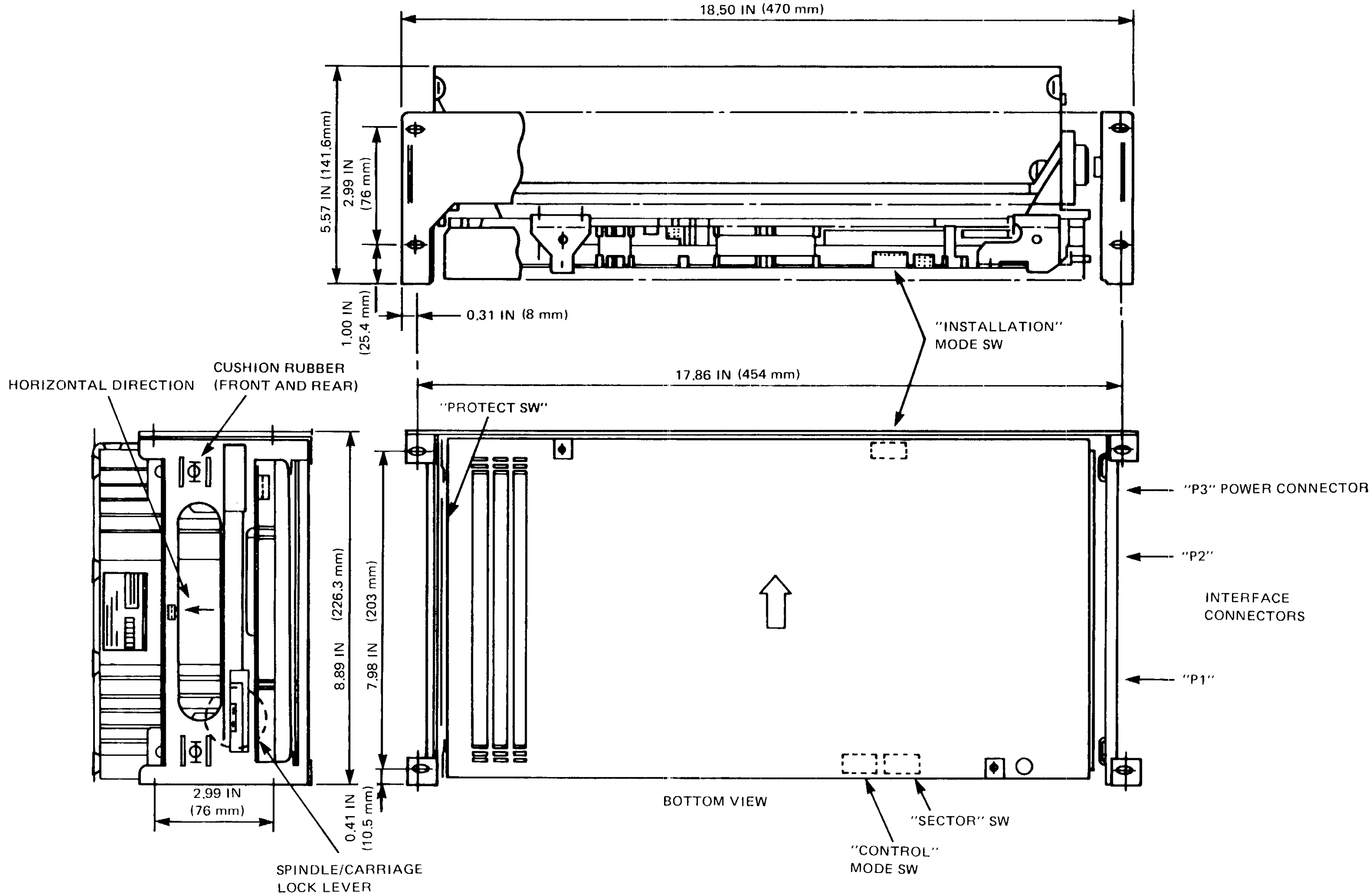


Figure 2-2 D22x7 Standard Assembly Dimensions

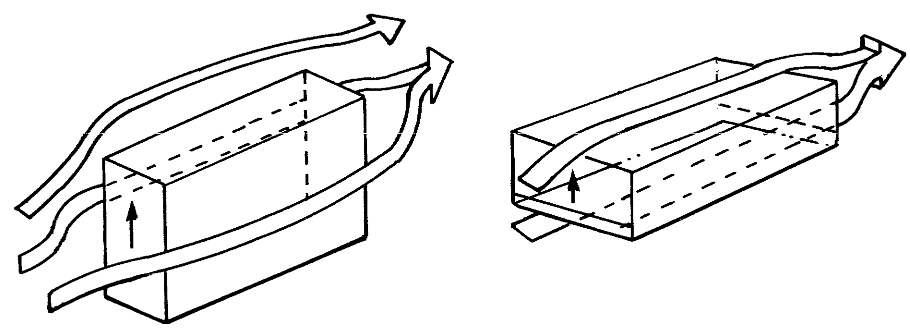


Figure 2-3 Mounting and Ventilation

2.5 CABLES AND CONNECTORS

A minimum of three cables is required to operate a D22x7 disk drive. Two cables, labeled A and B, carry control instructions, read/write data, and clock signals between the drive and the controller. A third cable, the power cable, connects the drive to the power supply. All three cables connect to the G9QSV logic and servo printed circuit board (PCB) as shown in Figure 2-4.

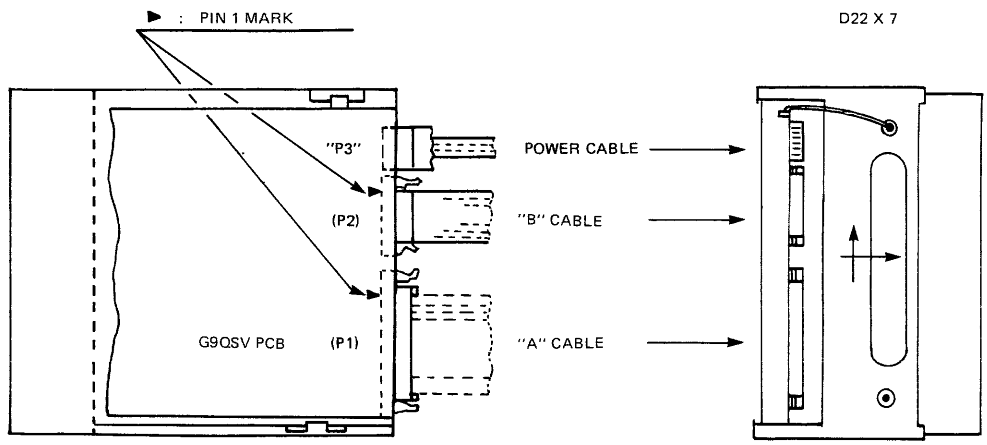


Figure 2-4 G9QSV PCB Cable Connections

2.5.1 Cable A

Cable A is a 60-pin, twisted-pair, flat cable. A terminating resistance at the transmitter and receiver end of each transmission line of cable A is provided on the G9QSV PCB. A terminating resistance is also required at the controller end of each line of cable A, except for the Open Cable Detect Line.

2.5.2 Cable B

Cable B is a 26-pin, ribbon-type, flat cable with a ground plane and drain wire. A terminating resistance is required at the receiving end of each cable B transmission line. These resistors are provided on the G9QSV PCB.

2.5.3 Cable A and B Characteristics

Table 2-4 summarizes cable A and B characteristics.

Table 2-4 Cable A and B Characteristics

	CABLE A	CABLE B
TYPE	Flat cable, 30 twisted pairs	Flat cable, 9 twisted pairs with ground plane and drain wire
IMPEDANCE	$100\ \Omega \pm 10\ \Omega$	$130\ \Omega \pm 15\ \Omega$
WIRE	28 AWG, 7 strands	28 AWG, 7 strands
PROPAGATION DELAY TIME	5.6 ns/meter (nominal)	5.5 ns/meter (nominal)
MAXIMUM CABLE LENGTH	98.4 ft. (30 m)	49.2 ft. (15 m)
VOLTAGE RATING	300 V (RMS)	300 V (RMS)
PART NUMBER	Spectra Strip SS-455-248-60	3 M 3476-26

2.5.4 Cable A and B Connector Characteristics

Table 2-5 summarizes connector characteristics for cables A and B.

Table 2-5 Cables A and B Connector Characteristics

CABLE	CABLE CONNECTOR ASSEMBLY	G9QSV PCB CONNECTOR ASSEMBLY
A	60-pin connector 3 M, #3334-6000 (or equivalent)	60-pin vertical adapter TPD, #R60L NEC, #802-710100-560 (or equivalent)
B	26-pin connector 3 M, #3399-3000 (or equivalent)	26-pin vertical adapter TPD, #R26L (or equivalent)

2.5.5 Power Connector and Cable

The dc power connector on the G9QSV logic and servo PCB is shown in Figure 2-5. Table 2-6 lists the connector pin assignments.

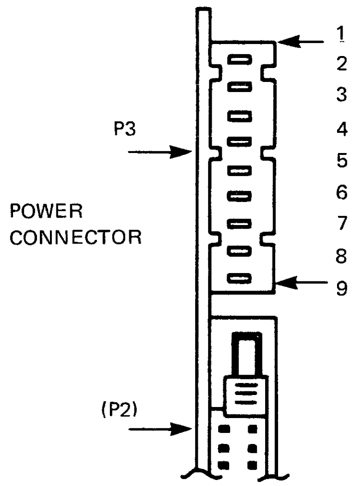


Figure 2-5 Power Connector

Table 2-6 Pin Assignments, Power Connector

PIN NUMBER	FUNCTION
1	GND (±5V)
2	+5V
3	+5V
4	-5V
5	-12V
6	GND (±12V)
7	+12V
8	+24V
9	+24V Return

Recommended characteristics of the dc power cable are as follows:

- cable wire — 18 to 22 AWG standard wire
- cable housing — AMP P/N 87159-9
- receptacle contact — AMP P/N 87027-1

2.5.6 Option Connectors

The G9QSV PCB also provides a connector for the optional diagnostic panel and for an operator control panel. These connectors are shown in Figure 2-6.

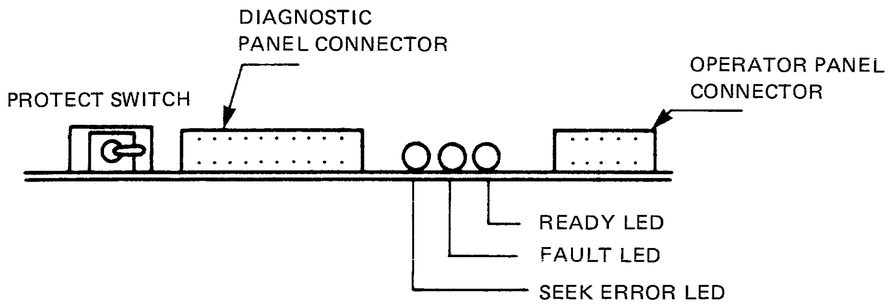


Figure 2-6 Option Connectors

The operator panel connector is shown in detail in Figure 2-7. Pin assignments are listed in Table 2-7.

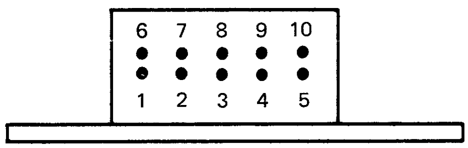


Figure 2-7 Operator Panel Connector

Table 2-7 Pin Assignments, Operator Control Panel Connector

PIN NUMBER	FUNCTION
1	Fault/Clear
2	Protect
3	Stop/Start
4	Ready
5	Protect
6	Ground
7	Not Used
8	Not Used
9	+5V

This connector permits the addition of an operator control panel. Light emitting diodes (LEDs) on the control panel can be connected to display "Ready," "Fault," and "Protect" functions. An operator control panel is not supplied with the D22x7 disk drive.

2.6 DATA INTEGRITY

The D22x7 disk drives provide highly efficient and accurate data transfer. Errors caused by media defects, or power and equipment failures, are excluded when read and seek error rates are calculated.

2.6.1 Read Errors

A recoverable read error is one that can be read correctly within 15 retries. The retry procedure is shown in Figure 2-8. The recoverable error rate is 1 per 10^{10} bits.

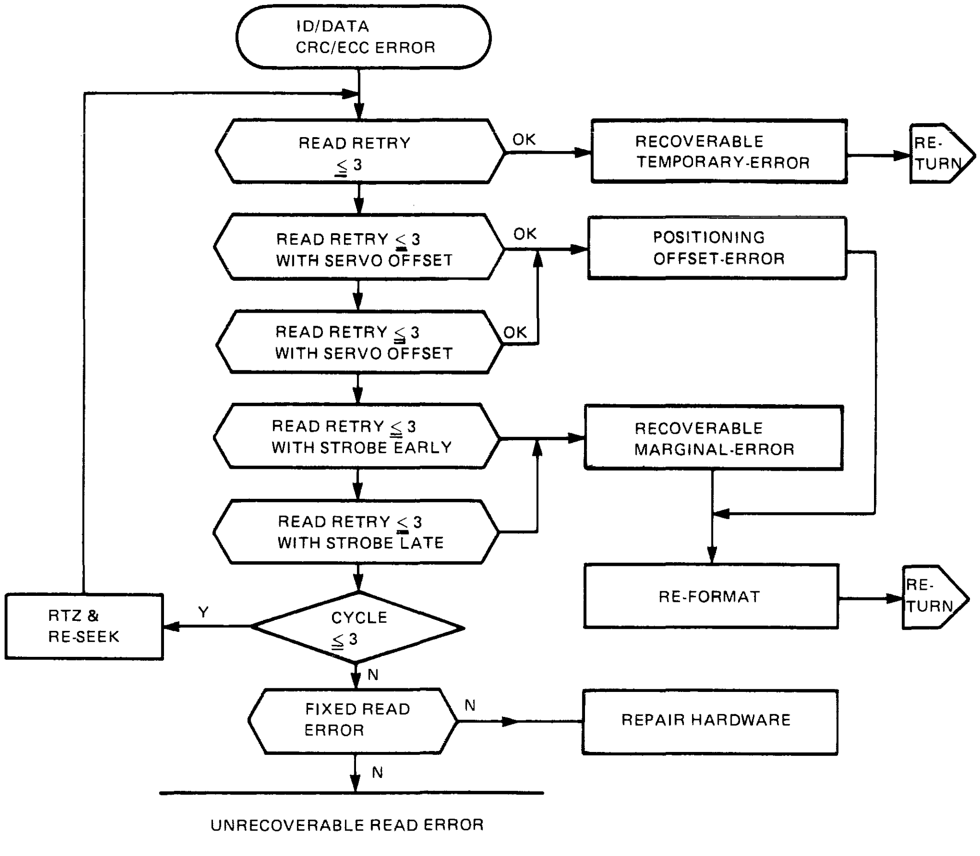


Figure 2-8 Read Retry Procedure

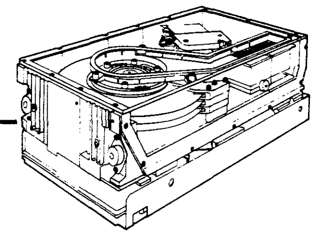
An unrecoverable error is one that cannot be read correctly within 15 retries. The unrecoverable error rate is less than 1 in 10^{13} bits.

2.6.2 Seek Errors

A seek error occurs when the read/write heads are improperly positioned. The seek error rate is less than 1 in 10^{7} seeks.

Chapter 3

Interface



This chapter describes communication between D22x7 disk drives and a controller. Available signal and data lines, the electrical characteristics of these lines, and signal sequences are described. Refer to Appendix C for timing information.

3.1 ELECTRICAL INTERFACE

The D22x7 interface transmits data, address and status information, and control signals between the disk drive and the controller. All signals are transmitted across one of two input/output (I/O) cables labeled A and B.

All I/O signals are digital. I/O voltages are 0V to +3V. Industry standard transmitters and receivers (SN75110A/SN75107) are used to provide a terminated, balanced transmission system. Figure 3-1 shows the interface circuitry for cables A and B. Figures 3-2 and 3-3 show the transmitter and receiver signals.

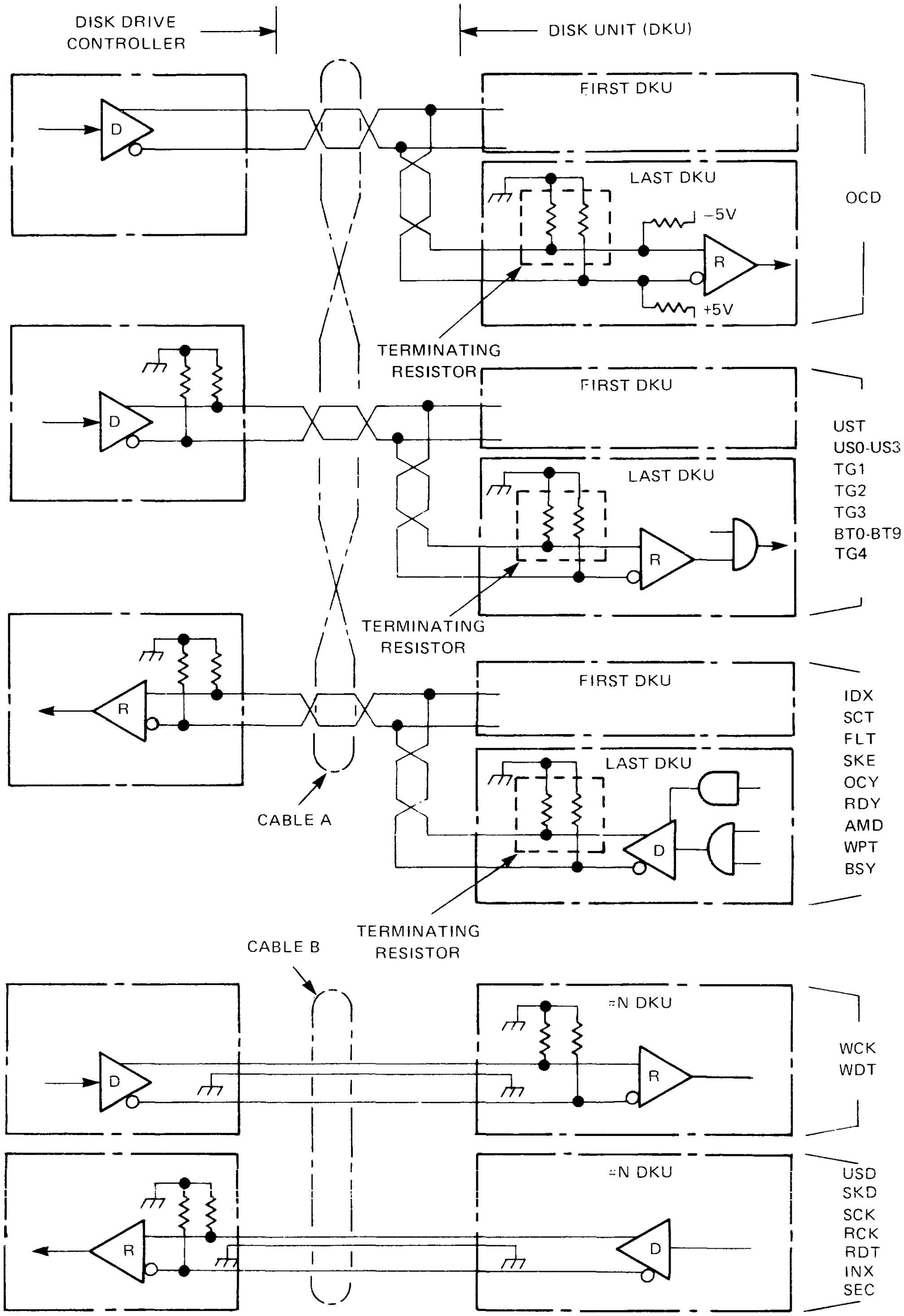


Figure 3-1 Cables A and B Interface Circuits

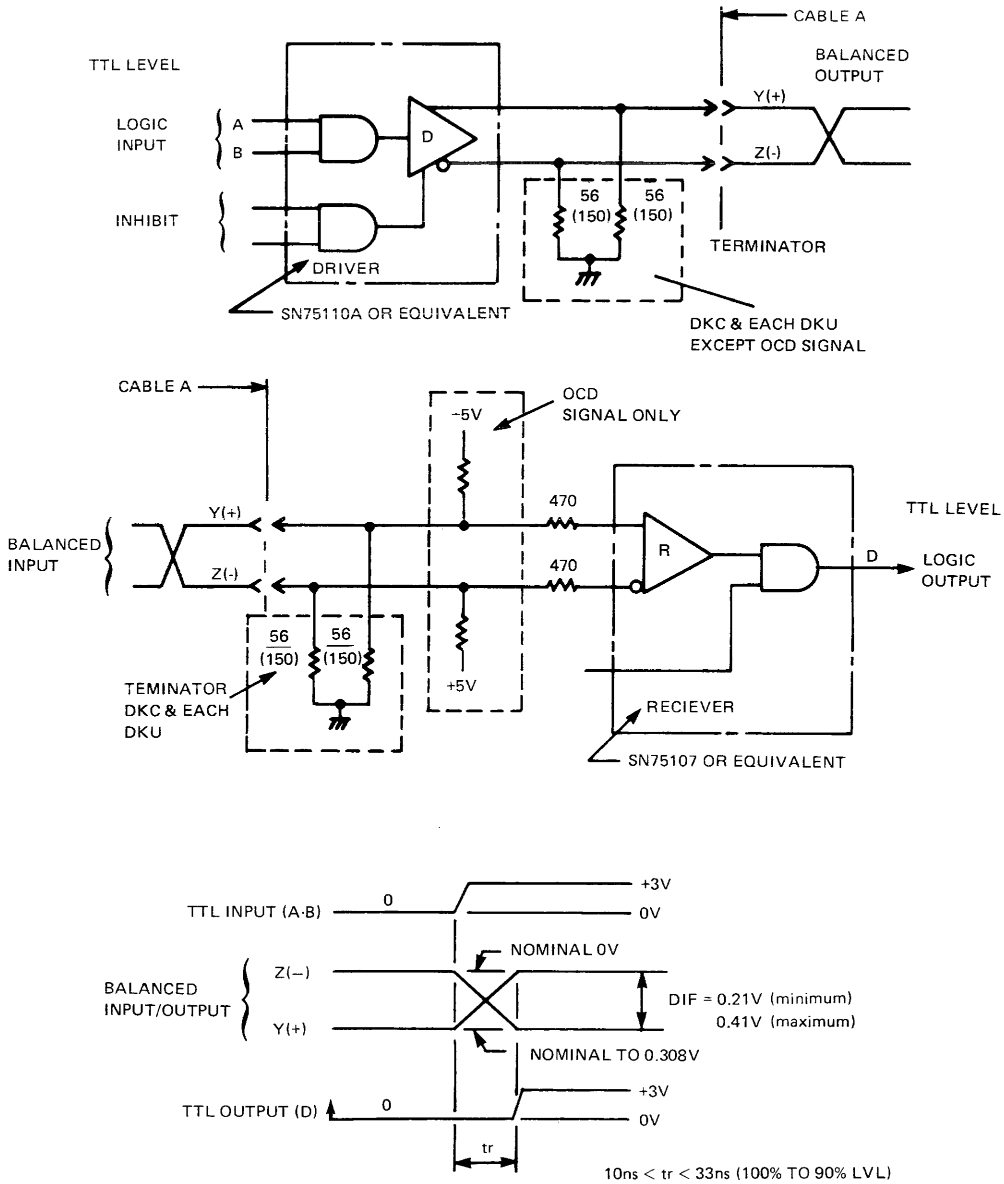


Figure 3-2 Cable A Transmitter and Receiver Signals

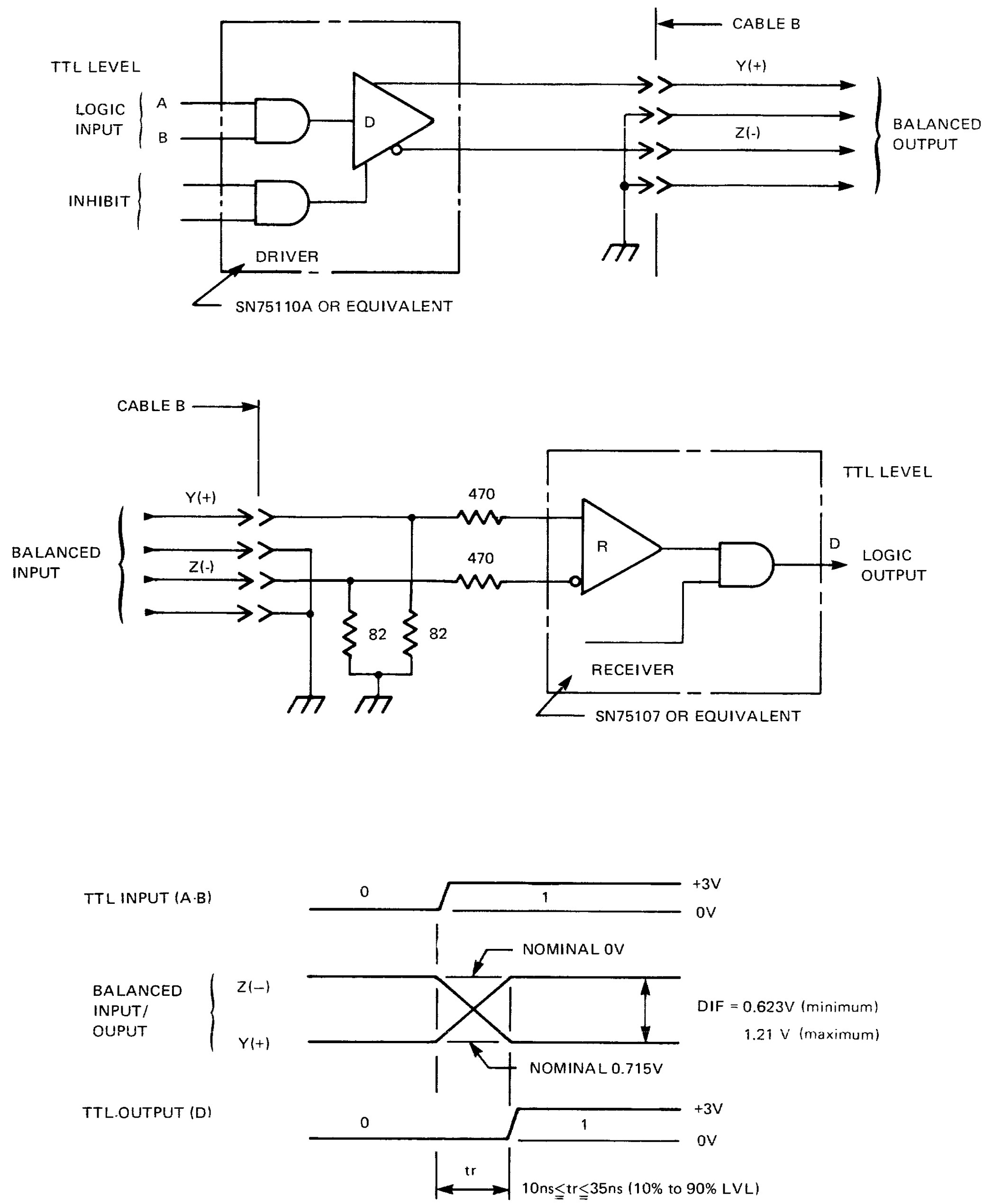


Figure 3-3 Cable B Transmitter and Receiver Signals

Differential signals are transmitted across the interface using twisted pairs of wires. Each pair consists of a Y (or +) wire, and a Z (or -) wire. A logic 1 is received or transmitted when the voltage measured across the Y wire is more positive than the voltage measured across the Z wire. A logic 0 is received or transmitted when the voltage measured across the Y wire is less positive than the voltage measured across the Z wire.

3.2 CABLE A SIGNALS

Cable A is used to transmit head and cylinder addresses, disk drive status information, and control signals between the D22x7 and the controller. Cable A signals are shown in Figure 3-4.

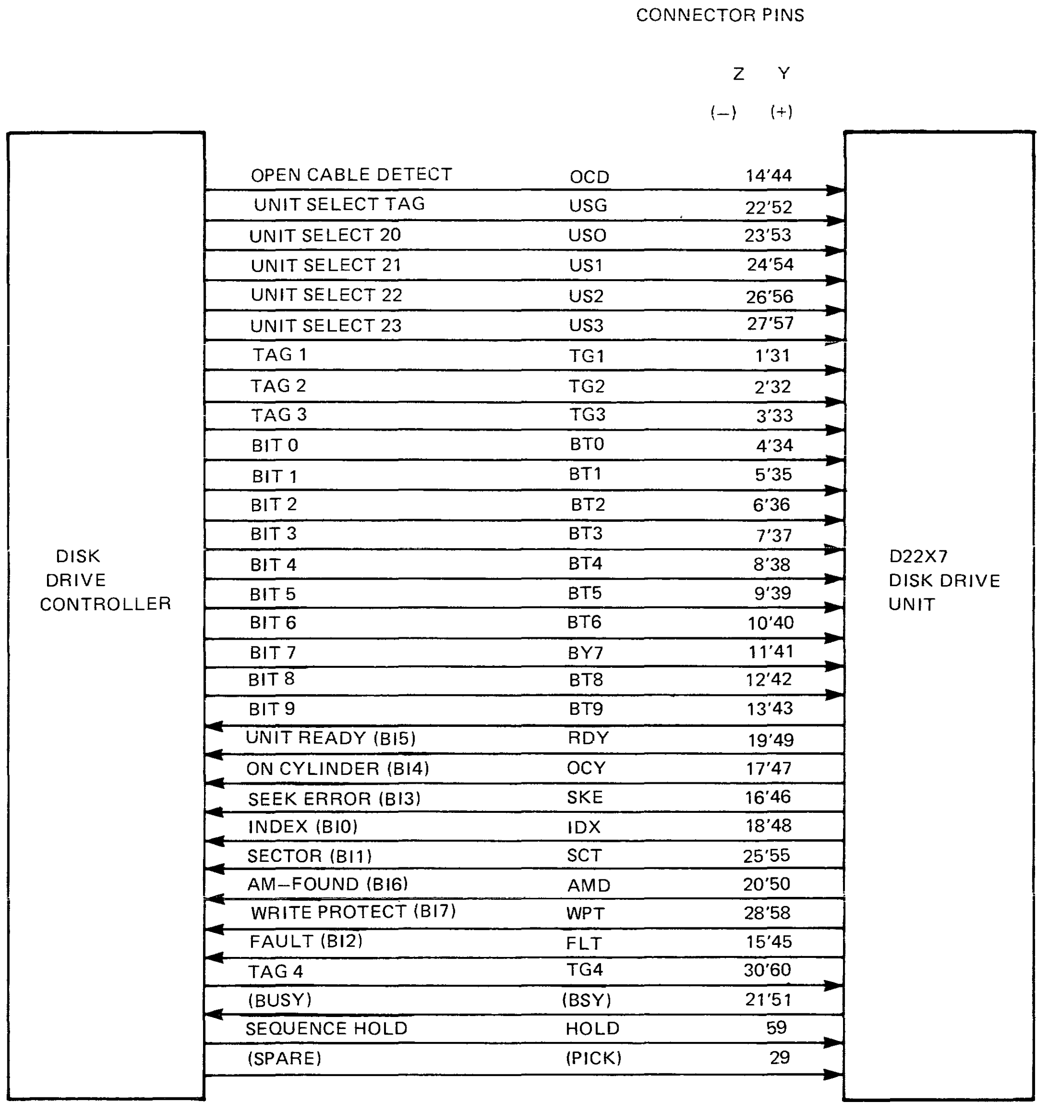


Figure 3-4 Cable A Signals

3.2.1 Unit Select 2^0, 2^1, 2^2, 2^3

These four lines transmit binary-coded device address data from the controller to the D22x7.

3.2.2 Unit Select Tag

The Unit Select Tag selects the disk drive designated by the Unit Select lines. The drive is selected approximately 600 nanoseconds (ns) after the leading edge of this signal.

3.2.3 Tag 1

The Tag 1 signal selects the binary-coded cylinder address designated by the 10 bus lines (labeled bit 0 through bit 9). The cylinder address is selected approximately 500 ns after the leading edge of the Tag 1 signal.

3.2.4 Tag 2

The Tag 2 signal selects the binary-coded head address designated by the 10 bus lines. The head address is selected approximately 500 ns after the leading edge of the Tag 2 signal.

3.2.5 Tag 3

Tag 3 is used in conjunction with the 10 bus lines to transmit commands from the controller to the drive. These commands are discussed in the following sections.

3.2.5.1 WRITE COMMAND (BIT 0/TAG 3)

Bit 0 and Tag 3 enable a write operation; data is transferred to the D22x7 from the controller.

3.2.5.2 READ COMMAND (BIT 1/TAG 3)

Bit 1 and Tag 3 enable a read operation; data is transferred from the D22x7 to the controller.

3.2.5.3 SERVO OFFSET PLUS (BIT 2/TAG 3)

The Servo Offset Plus command is part of the error recovery procedure. Bit 2 and Tag 3 adjust the read/write head position 1.7 micrometers toward the outer circumference of the disk. The drive unit issues On Cylinder and Seek End signals to the controller when the plus offset adjustment is complete.

3.2.5.4 SERVO OFFSET MINUS (BIT 3/TAG 3)

The Servo Offset Minus command is part of the error recovery procedure. Bit 3 and Tag 3 adjust the read/write head position 1.7 micrometers toward the center of the disk. The drive unit issues On Cylinder and Seek End signals to the controller when the minus offset adjustment is complete.

3.2.5.5 FAULT CLEAR (BIT 4/TAG 3)

Bit 4 and Tag 3 clear the Fault signal if the fault condition no longer exists. The Fault Clear signal should be at least 100 ns in duration.

3.2.5.6 ADDRESS MARK WRITE (BIT 5/BIT 0/TAG 3)

Bit 5, bit 0, and Tag 3 write the address mark pattern on the D22x7.

3.2.5.7 ADDRESS MARK SEARCH (BIT 5/BIT 1/TAG 3)

Bit 5, bit 1, and Tag 3 search for the address mark pattern on the D22x7.

3.2.5.8 RETURN-TO-ZERO (BIT 6/TAG 3)

The Return-to-Zero command is used for recalibration. Bit 6 and Tag 3 move the read/write heads to cylinder 0, reset the head address register, and clear the Seek Error signal. The Return-to-Zero signal must be greater than 100 ns, but less than 1 ms.

3.2.5.9 DATA STROBE EARLY (BIT 7/TAG 3)

The Data Strobe Early command is part of the error recovery procedure. Bit 7 and Tag 3 accelerate data strobing. Normal strobe timing resumes when this signal becomes inactive.

3.2.5.10 DATA STROBE LATE (BIT 8/TAG 3)

The Data Strobe Late command is part of the error recovery procedure. Bit 8 and Tag 3 delay data strobing. Normal strobe timing resumes when this signal becomes inactive.

3.2.5.11 RELEASE (BIT 9/TAG 3)

The Release command is used only with the dual-port option. Refer to Appendix B.

3.2.6 Bus Lines

The 10 bus lines are used in conjunction with Tag 1 and Tag 2 to transmit cylinder and head addresses from the controller to the disk drive. In conjunction with Tag 3, the bus lines transmit commands from the controller to the disk drive. Table 3-1 summarizes these addresses and commands.

Table 3-1 Tag/Bus Encoding

BUS BIT	TAG 1 CYLINDER ADDRESS	TAG 2 HEAD ADDRESS	TAG 3 COMMAND
0	1	1	Write
1	2	2	Read
2	4	4	Servo Offset Plus
3	8	8	Servo Offset Minus
4	16		Fault Clear
5	32		
6	64		Return-to-Zero
7	128		Data Strobe Early
8	256		Data Strobe Late
9	512		Release
5/0			Address Mark Write
5/1			Address Mark Search

3.2.7 Sense Lines

Eight sense lines transmit status condition information from the disk drive to the controller.

3.2.7.1 INDEX SIGNAL

The Index signal has a pulse width of 3.3 microseconds (μs) and is transmitted to the controller each time the index bit pattern on the servo disk is detected. The leading edge of the Index signal functions as the leading edge of sector 0.

3.2.7.2 SECTOR SIGNAL

The Sector signal is transmitted to the controller each time a new sector is detected on the servo disk. The number of sectors per track is switch-selectable from 1 to 128.

3.2.7.3 FAULT SIGNAL

A Fault signal is issued when the D22x7 detects a fault. The drive immediately switches to the write protect mode to prevent data destruction. This signal must be reset by the Fault Clear signal when the fault condition no longer exists.

3.2.7.4 SEEK ERROR SIGNAL

A Seek Error signal is issued when the D22x7 detects a seek fault. The drive immediately switches to the write protect mode to prevent data destruction. This signal must be reset by a Return-to-Zero signal when the fault condition no longer exists.

3.2.7.5 ON CYLINDER SIGNAL

An On Cylinder signal is transmitted when the read/write heads are positioned on the selected cylinder. The signal is reset by any seek instruction. A zero seek instruction deactivates the On Cylinder signal for approximately 30 μs.

3.2.7.6 UNIT READY SIGNAL

The Unit Ready signal is issued in response to a unit select sequence. The Unit Ready signal indicates that the selected unit is up to speed and that the read/write heads are properly positioned. When this signal is active, the drive can perform read, write, and seek operations. The signal is inactive if a fault condition is detected.

3.2.7.7 WRITE PROTECT SIGNAL

The Write Protect signal is active if the PROTECT switch is turned on.

3.2.7.8 ADDRESS MARK FOUND SIGNAL

The Address Mark Found signal is issued by the D22x7 in response to an Address Mark Search command from the controller. The Address Mark Found signal is an 8μs pulse issued immediately after the recognition of the address mark pattern.

After receiving the Address Mark Found signal, the controller deactivates the Address Mark Search command. The disk drive then deactivates the Address Mark Found signal within 8 μs.

3.2.7.9 BUSY SIGNAL

This signal is used only with the dual-port option. Refer to Appendix B.

3.2.8 Control Lines

Two control lines, Open Cable Detect and Sequence Hold, detect a break in the cable A signal, and initiate or terminate the power sequence to the D22x7 disk drive.

3.2.8.1 OPEN CABLE DETECT

The Open Cable Detect signal disables the interface when cable A is disconnected or when the controller loses power.

3.2.8.2 SEQUENCE HOLD

The Sequence Hold signal starts or stops the spindle motor when the D22x7 is in Remote mode. The spindle motor achieves full speed approximately 30 seconds after the Sequence Hold signal. The spindle motor stops approximately 30 seconds after the Sequence Hold signal deactivates.

3.2.9 Tag 4

The Tag 4 line is enabled by a switch on the G9QSV PCB. Tag 4 is used in conjunction with bus bits 8 and 9 to provide an extended interface mode that allows the controller to request specific status and diagnostic information from the drive. Tag 4 status commands are listed in Table 3-2.

Table 3-2 Tag 4 Status Commands

TAG 4	BUS BIT 8	BUS BIT 9	COMMAND
Active	Inactive	Inactive	Read Detail Status
Active	Inactive	Active	Device Type Request
Active	Active	Inactive	Read Sector
Active	Active	Active	Reset Priority Select
Active=1 Inactive=0			

When Tag 4 is active, the eight sense lines (see section 3.2.7) function as a data bus over which the D22x7 transmits binary-coded responses to Tag 4 status commands. The following four sections discuss Tag 4 status commands and responses.

3.2.9.1 READ DETAIL STATUS COMMAND

The Read Detail Status command solicits information to identify the cause of a Fault or Seek Error signal. The command generates an 8-bit response issued by the drive across the sense lines. Table 3-3 lists the bus functions of the sense lines when responding to a Read Detail Status command.

Table 3-3 Read Detail Status Response Coding

SENSE LINE	BUS DESIGNATION	BINARY VALUE	CODE
Index	BI0	2^0	
Sector	BI1	2^1	Error
Fault	BI2	2^2	
Seek Error	BI3	2^3	
On Cylinder	BI4	2^0	
Unit Ready	BI5	2^1	Stage
Address Mark Found	BI6	2^2	
Write Protect	BI7	2^3	

Table 3-4 lists the D22x7 operational stages. Table 3-5 lists the coded responses to the Read Detail Status command.

Table 3-4 D22x7 Operational Stages

STAGE	DESCRIPTION
1	Power on sequence/Initialization
2	Stop state
3	Start delay
4	Motor start-up (90% RPM achieved)
5	Motor speed increase (97% RPM achieved)
6	Motor speed attained
7	Phase-locked oscillator
8	Recalibrate out
9	Recalibrate in
A	Ready (on cylinder)
B	Move out (seek)
C	Interface check
D	Move in (seek)
E	(Reserved)
F	Fault (ready)

Table 3-5 Read Detail Status Responses

STAGE	CODE		DESCRIPTION
	STAGE	ERROR	
Power on sequence/ Initialization	1	1	Voltage fault
	1	2	ROM fault
	1	4	Fault latch
Stop state	2	1	Voltage fault
Start delay	3	1	Voltage fault
Motor start up	4	1	Voltage fault
	4	3	Motor speed fault
	4	4	Rotation fault
Motor speed increase	5	1	Voltage fault
	5	2	Motor speed too slow
	5	3	Motor speed too high
Motor speed attained	6	1	Voltage fault
	6	2	Motor speed loss
	6	3	Motor speed over
Phase-locked oscillator	7	1	Voltage fault
	7	2	Motor speed loss
	7	4	Loss of index
	7	5	No inner guard band found

Table 3-5 Read Detail Status Responses (cont'd)

STAGE	CODE STAGE	CODE ERROR	DESCRIPTION
Recalibrate out	8	1	Voltage fault
	8	4	Loss of index
	8	5	No outer guard band found
	8	6	No N lin found
	8	7	No half track found
	8	8	No Q lin found
	8	9	No difference = 0 found
	8	C	Overshoot check
	8	D	Overshoot check
Recalibrate in	9	1	Voltage fault
	9	4	Loss of index
	9	5	No outer guard band found
	9	9	No N lin found
	9	C	Overshoot check
	9	D	Overshoot check
Ready (on cylinder)	A	1	Voltage fault
	A	2	Motor speed loss
	A	3	Motor speed over
	A	4	Loss of index
	A	C	Off track
Move out (seek)	B	1	Voltage fault
	B	4	Loss of index
	B	9	No difference = 0 found
	B	C	Overshoot check
	B	D	Overshoot check
	B	E	Overshoot (outer guard band)
	B	F	Overshoot (inner guard band)
Interface check	C	1	Invalid cylinder address
	C	3	Tag 1 while not ready
Move in (seek)	D	1	Voltage fault
	D	4	Loss of index
	D	9	No difference = 0 found
	D	C	Overshoot check
	D	D	Overshoot check (time out)
	D	E	Overshoot (outer guard band)
	D	F	Overshoot (inner guard band)
Seek calibration	E	1	Seek unsuccessful
	E	2	Seek speed too low
	E	3	Seek speed too high
	E	4	Offset/PLO fault
	E	5	Offset/offtrack
	E	6	Offset command fault
	E	7	Set seek speed lower

3.2.9.2 DEVICE TYPE REQUEST COMMAND

The Device Type Request command identifies a drive by model number and determines if the address mark function is active. Table 3-6 lists responses to the Device Type Request command.

Table 3-6 Device Type Request Responses

BI7	BI6	BI5	BI4	BI3	BI2	BI1	BI0	MODEL	ADDRESS MARK FUNCTION
0	1	0	0	1	1	1	1	D2257	disabled
0	1	1	0	1	1	1	1	D2257	enabled
0	1	0	0	1	0	0	0	D2247E	disabled
0	1	1	0	1	0	0	0	D2247E	enabled

3.2.9.3 READ SECTOR COMMAND

When switches on the G9QSV PCB are set, the Read Sector command requests the current sector address. The D22x7 transmits an 8-bit response across the sense lines. The most significant bit is transmitted across BI7, the least significant bit across BI0.

3.2.9.4 RESET PRIORITY SELECT COMMAND

The Reset Priority Select command is used with the dual-port option. Refer to Appendix B.

3.3 CABLE B SIGNALS

Cable B carries both read/write data and clock signals between the controller and the D22x7 disk drive. Four dedicated sense lines also transmit status condition information from the drive to the controller. Cable B signals are shown in Figure 3-5.

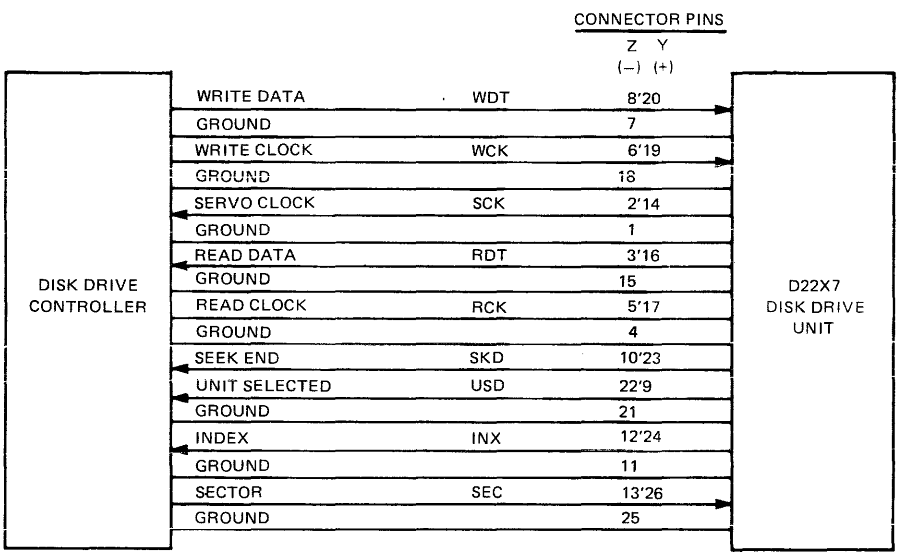


Figure 3-5 Cable B Signals

3.3.1 Data and Clock Lines

Read/write data and clock signals are sent on five lines: Write Data, Write Clock, Servo Clock, Read Data, and Read Clock.

3.3.1.1 WRITE DATA

The Write Data line transfers NRZ data from the controller to the D22x7.

3.3.1.2 WRITE CLOCK

The Write Clock, synchronized to the Write command, is the controller's echo of the Servo Clock during a write operation. The Write Clock must be transmitted at least 250 ns before the Write command.

3.3.1.3 SERVO CLOCK

The Servo Clock is a phase-locked 9.58 MHz clock signal issued by the servo track tripulse.

3.3.1.4 READ DATA

The Read Data line transfers NRZ data from the drive to the controller.

3.3.1.5 READ CLOCK

The Read Clock defines the beginning of a data cell.

3.3.2 Dedicated Sense Lines

Four sense lines transmit status condition information from the drive to the controller.

3.3.2.1 SEEK END SIGNAL

The Seek End signal signifies the completion of a seek operation. This signal is transmitted approximately 30 μs after a zero seek.

3.3.2.2 UNIT SELECT SIGNAL (SINGLE PORT MODE)

The Unit Select signal becomes active after the completion of a unit select procedure.

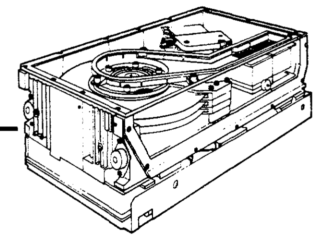
3.3.2.3 INDEX SIGNAL

D22x7 series disk drives are unique in offering an Index signal in cable B. For a description of the Index signal, see section 3.2.7.1.

3.3.2.4 SECTOR SIGNAL

For a description of the Sector signal, see section 3.2.7.2.

Chapter 4



Data Format

The controller supervises the formatting of data as it is written to the disk. The Index and Sector signals indicate the beginning of a track or a sector to the controller. The various bytes in the selected data format must be counted with reference to the Index or Sector signals.

4.1 FIXED SECTOR FORMAT

The fixed sector format is recommended for use with the D22x7 disk drives. The number of sectors per track is selectable by switches on the G9QSV PCB. A maximum of 128 sectors can be written on a single track. An example of a fixed sector format is shown in Figure 4-1. This example could be redesigned or modified to meet specific customer requirements.

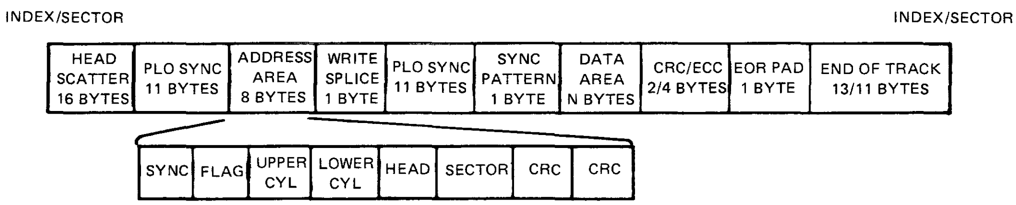


Figure 4-1 Fixed Sector Data Format

4.1.1 Head Scatter Gap

The head scatter gap contains 16 bytes of zeros. The head scatter gap provides a stabilization period for the read amplifier. This period is required after a read/write head selection, or after a change from a write to a read operation.

4.1.2 Phase-Locked Oscillator Synchronization Gap

This gap, consisting of 10 bytes of zeros, is reserved for phase-locked oscillator synchronization.

4.1.3 Synchronization Byte

A one-byte pattern defines the beginning of the address and the data areas.

4.1.4 Address Area

The address area consists of eight bytes as shown in Figure 4-1. Synchronization and flag bytes are designed by the customer.

4.1.5 Write Splice

The write splice consists of one byte of zeros. The write splice and the following phase-locked oscillator synchronization gap provide a 12-byte isolation zone before the data area.

4.1.6 Data Area

Data is written into this area.

4.1.7 Cyclic Redundancy Check

The recommended cyclic redundancy algorithm is $X^{16} + 1$. The cyclic redundancy generation and check algorithm is shown in Figure 4-2.

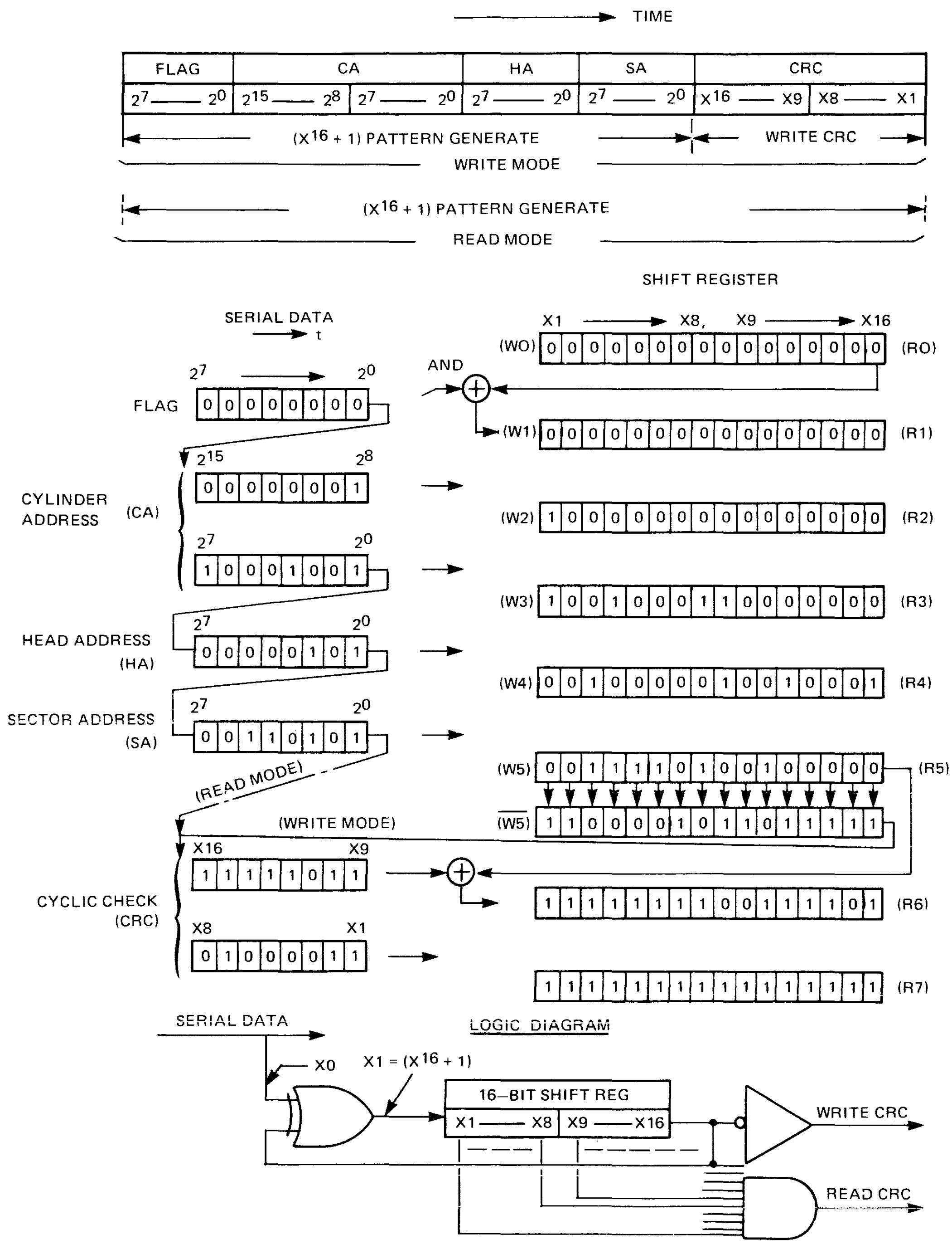


Figure 4-2 Cyclic Redundancy Check Algorithm

4.1.8 Error Correction Code

The recommended error correction code is $(X^{21} + 1)$ multiplied by $(X^{11} + X^2 + 1)$.

4.1.9 End of Record Pad

The end of record pad consists of one byte of zeros.

4.1.10 End of Track

The end of track consists of from 11 to 13 bytes of zeros.

4.2 VARIABLE SECTOR FORMAT

D22x7 disk drives also offer a variable sector data format. Variable sector format is enabled by a switch on the G9QSV PCB. The variable sector format is shown in Figure 4-3.

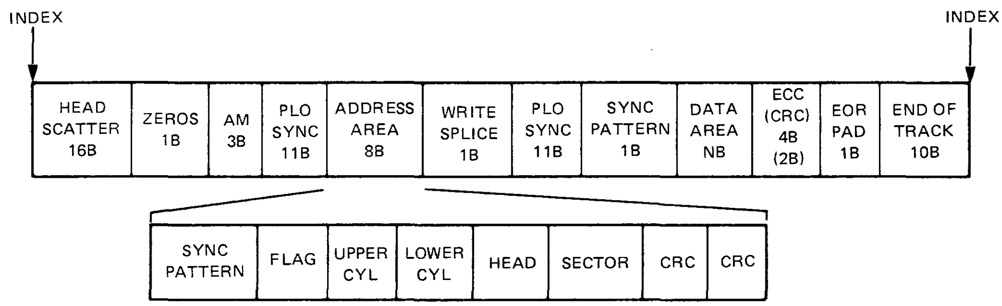
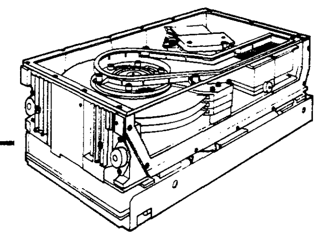


Figure 4-3 Variable Sector Data Format

When the variable sector format is used, a blank, three-byte area is written prior to the beginning of each record on the data track. Other variable sector format components are identical to those used by the fixed sector format.

Chapter 5

Switches and Indicators



Three eight-position, dual-inline-packaged (DIP) switch assemblies on the G9QSV PCB configure the D22x7 to communicate with the controller, and set the sector count. DIP switch assembly locations are shown in Figure 5-1.

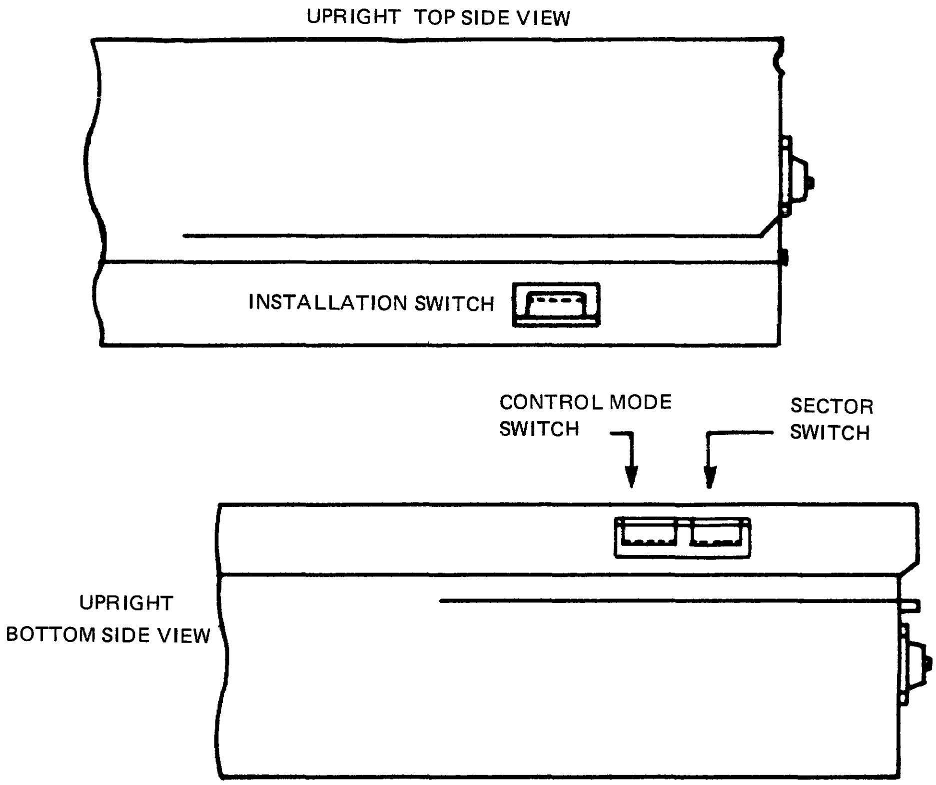


Figure 5-1 DIP Switch Locations

5.1 INSTALLATION SWITCH ASSEMBLY

The installation switch assembly, shown in Figure 5-2, sets the device address and controls the power-on sequence. Switches 1, 2, 3, and 4 assign the device address, a hexadecimal number from 0 to F. Switch 5 determines which of the Unit Select bit lines are used to transmit the device address. For device addresses 0 to 3, set switch 5 to the 0 position; for addresses 4 to F, set switch 5 to the 1 position.

Switch 7 enables a 30-second delay in the start-up time of the spindle motor. This switch can be used in dual-drive configurations to insure that both drives do not overload the power supply by simultaneously activating their power-up sequence. Switch 8 places the D22x7 in local or remote mode at power-on. Switch 6 of this assembly is not used.

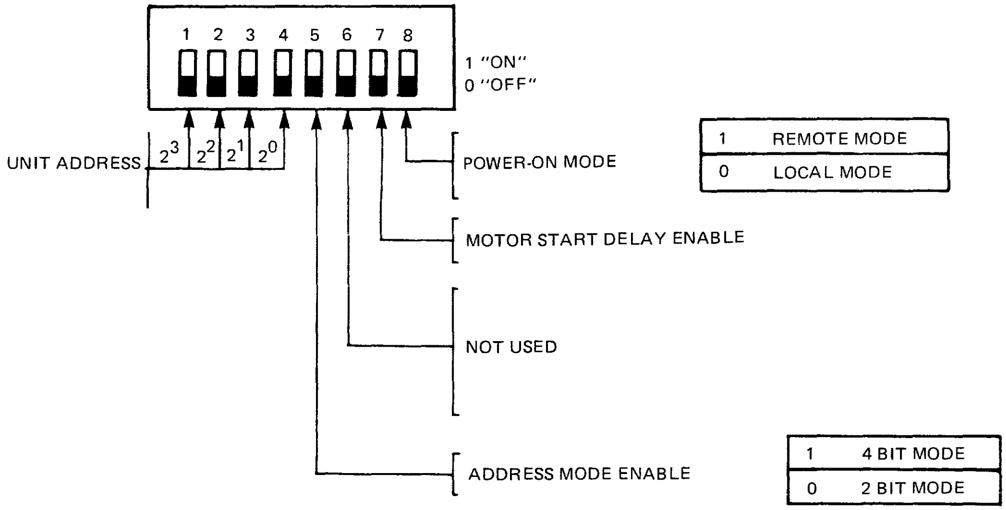


Figure 5-2 Installation DIP Switch Assembly

5.2 CONTROL MODE SWITCH ASSEMBLY

The control mode switch assembly (shown in Figure 5-3) configures the D22x7 to communicate with the disk controller and enables certain optional drive features.

Switches 1, 2, and 3 are set according to the D22x7 model used (see Figure 5-3).

Switch 4 enables the Address Mark function.

Switch 5 enables the Read Sector function.

Switch 6 enables the Format Write Release Option used with some controllers.

Switch 7 enables the Tag 4 line.

Switch 8 enables the controller interface.

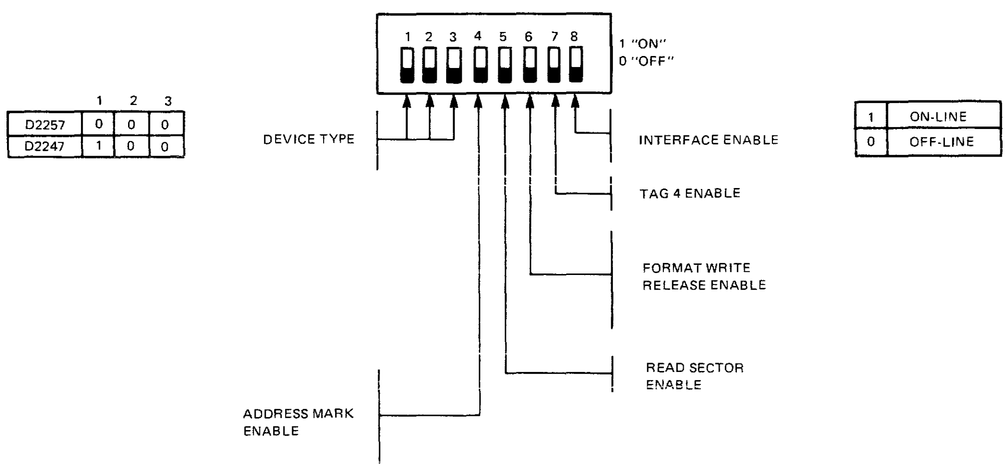


Figure 5-3 Control Mode DIP Switch Assembly

5.3 SECTOR SELECT SWITCH ASSEMBLY

The Sector Select switch sets the number of sectors per track. Any number of sectors from 1 to 128 may be chosen.

Switch 1 of this assembly determines the disposition of odd or remainder bytes. These are extra bytes that must be allocated when the available bytes per track are not evenly divisible by the number of sectors per track. With switch 1 in the 0 position, odd bytes are grouped together in an extra sector at the end of the track. With this switch in the 1 position, the last sector is reduced to account for odd bytes.

Figure 5-4 shows the allocation of 33 sectors using each of these disposition methods.

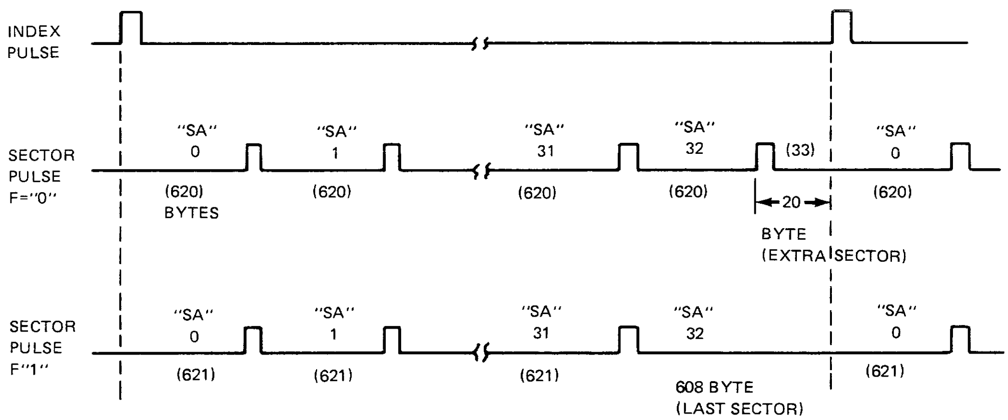
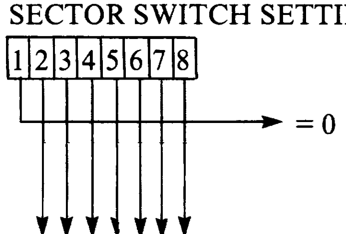


Figure 5-4 Sector Allocation

Tables 5-1 and 5-2 list Sector Select switch settings and the resulting sector allocations for D22x7 drives.

Table 5-1 Sector Selection List (Disposition Switch = 0)

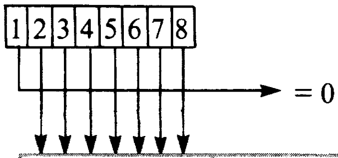
SECTOR SWITCH SETTING



$2^6 2^5 2^4 2^3 2^2 2^1 2^0$	SECTORS PER TRACK	BYTES PER SECTOR (TRACK = 20,480 BYTES)	EXTRA SECTOR BYTES (TRACK = 20,480 BYTES)
0 0 0 0 0 0 1	1	20480	0
0 0 0 0 0 1 0	2	10240	0
0 0 0 0 0 1 1	3	6826	2
0 0 0 0 1 0 0	4	5120	0
0 0 0 0 1 0 1	5	4096	0
0 0 0 0 1 1 0	6	3413	2
0 0 0 0 1 1 1	7	2925	5
0 0 0 1 0 0 0	8	2560	0
0 0 0 1 0 0 1	9	2275	5
0 0 0 1 0 1 0	10	2048	0

Table 5-1 Sector Selection List (Disposition Switch = 0) (cont'd)

SECTOR SWITCH SETTING



		TRACK = 20,480 BYTES	
$2^6 2^5 2^4 2^3 2^2 2^1 2^0$	SECTORS PER TRACK	BYTES PER SECTOR	EXTRA SECTOR BYTES
0 0 0 1 0 1 1	11	1861	9
0 0 0 1 1 0 0	12	1706	8
0 0 0 1 1 0 1	13	1575	5
0 0 0 1 1 1 0	14	1462	12
0 0 0 1 1 1 1	15	1365	5
0 0 1 0 0 0 0	16	1280	0
0 0 1 0 0 0 1	17	1204	12
0 0 1 0 0 1 0	18	1137	14
0 0 1 0 0 1 1	19	1077	17
0 0 1 0 1 0 0	20	1024	0
0 0 1 0 1 0 1	21	975	5
0 0 1 0 1 1 0	22	930	20
0 0 1 0 1 1 1	23	890	10
0 0 1 1 0 0 0	24	853	8
0 0 1 1 0 0 1	25	819	5
0 0 1 1 0 1 0	26	787	18
0 0 1 1 0 1 1	27	758	14
0 0 1 1 1 0 0	28	731	12
0 0 1 1 1 0 1	29	706	6
0 0 1 1 1 1 0	30	682	20
0 0 1 1 1 1 1	31	660	20
0 1 0 0 0 0 0	32	640	0
0 1 0 0 0 0 1	33	620	20
0 1 0 0 0 1 0	34	602	12
0 1 0 0 0 1 1	35	585	5
0 1 0 0 1 0 0	36	568	32
0 1 0 0 1 0 1	37	553	19
0 1 0 0 1 1 0	38	538	36
0 1 0 0 1 1 1	39	525	5
0 1 0 1 0 0 0	40	512	0
0 1 0 1 0 0 1	41	499	21
0 1 0 1 0 1 0	42	487	26
0 1 0 1 0 1 1	43	476	12
0 1 0 1 1 0 0	44	465	20
0 1 0 1 1 0 1	45	455	5
0 1 0 1 1 1 0	46	445	10
0 1 0 1 1 1 1	47	435	35
0 1 1 0 0 0 0	48	426	32
0 1 1 0 0 0 1	49	417	47
0 1 1 0 0 1 0	50	409	30

Table 5-1 Sector Selection List (Disposition Switch = 0) (cont'd)

SECTOR SWITCH SETTING

1 2 3 4 5 6 7 8

= 0

		TRACK = 20,480 BYTES	
$2^6 2^5 2^4 2^3 2^2 2^1 2^0$	SECTORS PER TRACK	BYTES PER SECTOR	EXTRA SECTOR BYTES
0 1 1 0 0 1 1	51	401	29
0 1 1 0 1 0 0	52	393	44
0 1 1 0 1 0 1	53	386	22
0 1 1 0 1 1 0	54	379	14
0 1 1 0 1 1 1	55	372	20
0 1 1 1 0 0 0	56	365	40
0 1 1 1 0 0 1	57	359	17
0 1 1 1 0 1 0	58	353	6
0 1 1 1 0 1 1	59	347	7
0 1 1 1 1 0 0	60	341	20
0 1 1 1 1 0 1	61	335	45
0 1 1 1 1 1 0	62	330	20
0 1 1 1 1 1 1	63	325	5
1 0 0 0 0 0 0	64	320	0
1 0 0 0 0 0 1	65	315	5
1 0 0 0 0 1 0	66	310	20
1 0 0 0 0 1 1	67	305	45
1 0 0 0 1 0 0	68	301	12
1 0 0 0 1 0 1	69	296	56
1 0 0 0 1 1 0	70	292	40
1 0 0 0 1 1 1	71	288	32
1 0 0 1 0 0 0	72	284	32
1 0 0 1 0 0 1	73	280	40
1 0 0 1 0 1 0	74	276	56
1 0 0 1 0 1 1	75	273	5
1 0 0 1 1 0 0	76	269	36
1 0 0 1 1 0 1	77	265	75
1 0 0 1 1 1 0	78	262	44
1 0 0 1 1 1 1	79	259	19
1 0 1 0 0 0 0	80	256	0
1 0 1 0 0 0 1	81	252	68
1 0 1 0 0 1 0	82	249	62
1 0 1 0 0 1 1	83	246	62
1 0 1 0 1 0 0	84	243	68
1 0 1 0 1 0 1	85	240	80
1 0 1 0 1 1 0	86	238	12
1 0 1 0 1 1 1	87	235	35
1 0 1 1 0 0 0	88	232	64
1 0 1 1 0 0 1	89	230	10
1 0 1 1 0 1 0	90	227	50

Table 5-1 Sector Selection List (Disposition Switch = 0) (cont'd)

SECTOR SWITCH SETTING

1 2 3 4 5 6 7 8

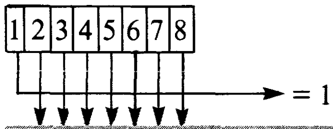
= 0

TRACK = 20,480 BYTES

$2^6 2^5 2^4 2^3 2^2 2^1 2^0$	SECTORS PER TRACK	BYTES PER SECTOR	EXTRA SECTOR BYTES
1 0 1 1 0 1 1	91	225	5
1 0 1 1 1 0 0	92	222	56
1 0 1 1 1 0 1	93	220	20
1 0 1 1 1 1 0	94	217	82
1 0 1 1 1 1 1	95	215	55
1 1 0 0 0 0 0	96	213	32
1 1 0 0 0 0 1	97	211	13
1 1 0 0 0 1 0	98	208	96
1 1 0 0 0 1 1	99	206	86
1 1 0 0 1 0 0	100	204	80
1 1 0 0 1 0 1	101	202	78
1 1 0 0 1 1 0	102	200	80
1 1 0 0 1 1 1	103	198	86
1 1 0 1 0 0 0	104	196	96
1 1 0 1 0 0 1	105	195	5
1 1 0 1 0 1 0	106	193	22
1 1 0 1 0 1 1	107	191	43
1 1 0 1 1 0 0	108	189	68
1 1 0 1 1 0 1	109	187	97
1 1 0 1 1 1 0	110	186	20
1 1 0 1 1 1 1	111	184	56
1 1 1 0 0 0 0	112	182	96
1 1 1 0 0 0 1	113	181	27
1 1 1 0 0 1 0	114	179	74
1 1 1 0 0 1 1	115	179	10
1 1 1 0 1 0 0	116	176	64
1 1 1 0 1 0 1	117	175	5
1 1 1 0 1 1 0	118	173	66
1 1 1 0 1 1 1	119	172	12
1 1 1 1 0 0 0	120	170	80
1 1 1 1 0 0 1	121	169	31
1 1 1 1 0 1 0	122	167	106
1 1 1 1 0 1 1	123	166	62
1 1 1 1 1 0 0	124	165	20
1 1 1 1 1 0 1	125	163	105
1 1 1 1 1 1 0	126	162	68
1 1 1 1 1 1 1	127	161	33
0 0 0 0 0 0 0	128	160	0

Table 5-2 Sector Selection List (Disposition Switch = 1)

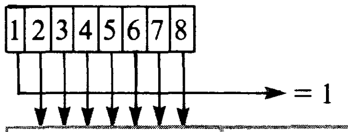
SECTOR SWITCH SETTING



		TRACK = 20,480 BYTES	
$2^6 2^5 2^4 2^3 2^2 2^1 2^0$	SECTORS PER TRACK	BYTES PER SECTOR	LAST SECTOR SHORTER
0 0 0 0 0 0 1	1	20480	0
0 0 0 0 0 1 0	2	10240	0
0 0 0 0 0 1 1	3	6827	-1
0 0 0 0 1 0 0	4	5120	0
0 0 0 0 1 0 1	5	4096	0
0 0 0 0 1 1 0	6	3414	-4
0 0 0 0 1 1 1	7	2926	-2
0 0 0 1 0 0 0	8	2560	0
0 0 0 1 0 0 1	9	2276	-4
0 0 0 1 0 1 0	10	2048	0
0 0 0 1 0 1 1	11	1862	-2
0 0 0 1 1 0 0	12	1707	-4
0 0 0 1 1 0 1	13	1576	-8
0 0 0 1 1 1 0	14	1463	-2
0 0 0 1 1 1 1	15	1366	-10
0 0 1 0 0 0 0	16	1280	0
0 0 1 0 0 0 1	17	1205	-5
0 0 1 0 0 1 0	18	1138	-4
0 0 1 0 0 1 1	19	1078	-2
0 0 1 0 1 0 0	20	1024	0
0 0 1 0 1 0 1	21	976	-16
0 0 1 0 1 1 0	22	931	-2
0 0 1 0 1 1 1	23	891	-13
0 0 1 1 0 0 0	24	854	-16
0 0 1 1 0 0 1	25	820	-20
0 0 1 1 0 1 0	26	788	-8
0 0 1 1 0 1 1	27	759	-13
0 0 1 1 1 0 0	28	732	-16
0 0 1 1 1 0 1	29	707	-23
0 0 1 1 1 1 0	30	683	-10
0 0 1 1 1 1 1	31	661	-11
0 1 0 0 0 0 0	32	640	0
0 1 0 0 0 0 1	33	621	-13
0 1 0 0 0 1 0	34	603	-22
0 1 0 0 0 1 1	35	586	-30
0 1 0 0 1 0 0	36	569	-4
0 1 0 0 1 0 1	37	554	-18
0 1 0 0 1 1 0	38	539	-2
0 1 0 0 1 1 1	39	526	-34
0 1 0 1 0 0 0	40	512	0

Table 5-2 Sector Selection List (Disposition Switch = 1) (cont'd)

SECTOR SWITCH SETTING



		TRACK = 20,480 BYTES	
$2^6 2^5 2^4 2^3 2^2 2^1 2^0$	SECTORS PER TRACK	BYTES PER SECTOR	LAST SECTOR SHORTER
0 1 0 1 0 0 1	41	500	-20
0 1 0 1 0 1 0	42	488	-16
0 1 0 1 0 1 1	43	477	-31
0 1 0 1 1 0 0	44	466	-24
0 1 0 1 1 0 1	45	456	-40
0 1 0 1 1 1 0	46	446	-36
0 1 0 1 1 1 1	47	436	-12
0 1 1 0 0 0 0	48	427	-16
0 1 1 0 0 0 1	49	418	-2
0 1 1 0 0 1 0	50	410	-20
0 1 1 0 0 1 1	51	402	-16
0 1 1 0 1 0 0	52	394	-8
0 1 1 0 1 0 1	53	387	-31
0 1 1 0 1 1 0	54	380	-40
0 1 1 0 1 1 1	55	373	-35
0 1 1 1 0 0 0	56	366	-16
0 1 1 1 0 0 1	57	360	-40
0 1 1 1 0 1 0	58	354	-52
0 1 1 1 0 1 1	59	348	-52
0 1 1 1 1 0 0	60	342	-40
0 1 1 1 1 0 1	61	336	-16
0 1 1 1 1 1 0	62	331	-42
0 1 1 1 1 1 1	63	326	-58
1 0 0 0 0 0 0	64	320	0
1 0 0 0 0 0 1	65	316	-60
1 0 0 0 0 1 0	66	311	-46
1 0 0 0 0 1 1	67	306	-22
1 0 0 0 1 0 0	68	302	-56
1 0 0 0 1 0 1	69	297	-13
1 0 0 0 1 1 0	70	293	-30
1 0 0 0 1 1 1	71	289	-39
1 0 0 1 0 0 0	72	285	-40
1 0 0 1 0 0 1	73	281	-33
1 0 0 1 0 1 0	74	277	-18
1 0 0 1 0 1 1	75	274	-70
1 0 0 1 1 0 0	76	270	-40
1 0 0 1 1 0 1	77	266	-2
1 0 0 1 1 1 0	78	263	-34
1 0 0 1 1 1 1	79	260	-60
1 0 1 0 0 0 0	80	256	0

Table 5-2 Sector Selection List (Disposition Switch = 1) (cont'd)

SECTOR SWITCH SETTING

1	2	3	4	5	6	7	8

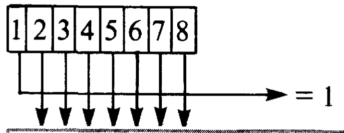
→ = 1

TRACK = 20,480 BYTES

$2^6 2^5 2^4 2^3 2^2 2^1 2^0$	SECTORS PER TRACK	BYTES PER SECTOR	LAST SECTOR SHORTER
1 0 1 0 0 0 1	81	253	-13
1 0 1 0 0 1 0	82	250	-20
1 0 1 0 0 1 1	83	247	-21
1 0 1 0 1 0 0	84	244	-16
1 0 1 0 1 0 1	85	241	-5
1 0 1 0 1 1 0	86	239	-74
1 0 1 0 1 1 1	87	236	-52
1 0 1 1 0 0 0	88	233	-24
1 0 1 1 0 0 1	89	231	-79
1 0 1 1 0 1 0	90	228	-40
1 0 1 1 0 1 1	91	226	-86
1 0 1 1 1 0 0	92	223	-36
1 0 1 1 1 0 1	93	221	-73
1 0 1 1 1 1 0	94	218	-12
1 0 1 1 1 1 1	95	216	-40
1 1 0 0 0 0 0	96	214	-64
1 1 0 0 0 0 1	97	212	-84
1 1 0 0 0 1 0	98	209	-2
1 1 0 0 0 1 1	99	207	-13
1 1 0 0 1 0 0	100	205	-20
1 1 0 0 1 0 1	101	203	-23
1 1 0 0 1 1 0	102	201	-22
1 1 0 0 1 1 1	103	199	-17
1 1 0 1 0 0 0	104	197	-8
1 1 0 1 0 0 1	105	196	-100
1 1 0 1 0 1 0	106	194	-84
1 1 0 1 0 1 1	107	192	-64
1 1 0 1 1 0 0	108	190	-40
1 1 0 1 1 0 1	109	188	-12
1 1 0 1 1 1 0	110	187	-90
1 1 0 1 1 1 1	111	185	-55
1 1 1 0 0 0 0	112	183	-16
1 1 1 0 0 0 1	113	182	-86
1 1 1 0 0 1 0	114	180	-40
1 1 1 0 0 1 1	115	179	-105
1 1 1 0 1 0 0	116	177	-52
1 1 1 0 1 0 1	117	176	-112
1 1 1 0 1 1 0	118	174	-52
1 1 1 0 1 1 1	119	173	-107
1 1 1 1 0 0 0	120	171	-40

Table 5-2 Sector Selection List (Disposition Switch = 1) (cont'd)

SECTOR SWITCH SETTING



TRACK = 20,480 BYTES

$2^6 2^5 2^4 2^3 2^2 2^1 2^0$	SECTORS PER TRACK	BYTES PER SECTOR	LAST SECTOR SHORTER
1 1 1 1 0 0 1	121	170	-90
1 1 1 1 0 1 0	122	168	-16
1 1 1 1 0 1 1	123	167	-61
1 1 1 1 1 0 0	124	166	-104
1 1 1 1 1 0 1	125	164	-20
1 1 1 1 1 1 0	126	163	-58
1 1 1 1 1 1 1	127	162	-94
0 0 0 0 0 0 0	128	160	0

5.4 WRITE PROTECT SWITCH

The PROTECT toggle switch (see Figure 5-5) places the D22x7 in the write protected mode. In this mode, write operations are disabled.

5.5 LIGHT EMITTING DIODE (LED) INDICATORS

Three LED indicators labeled RDY (Ready), FLT (Fault), and SKE (Seek Error) are on the G9QSV as shown in Figure 5-5.

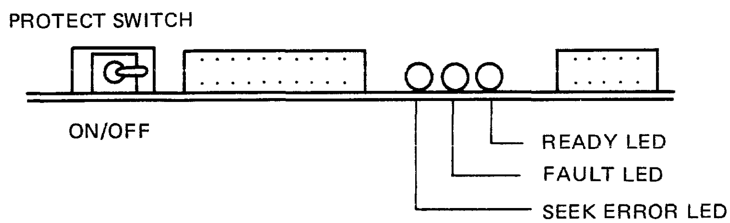


Figure 5-5 PROTECT Switch and LEDs

5.5.1 RDY

The green RDY LED lights when the D22x7 is up to speed and the heads are on cylinder. The RDY indicator lights whenever these conditions are met, even if a fault condition exists.

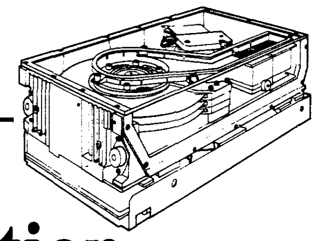
5.5.2 FLT

The red FLT LED lights when a fault condition has been detected. The indicator is turned off by a Fault Clear signal.

5.5.3 SKE

The orange SKE LED lights when a seek error has been detected. It is turned off by a Return-to-Zero signal.

Appendix A



DKU0000-H3P7 3-Input DC Regulator Option

This appendix assumes overall familiarity with the operation of the 3-Input DC Regulator and describes only the regulator's configuration.

A.1 GENERAL DESCRIPTION

The 3-Input DC Regulator requires an input set of three dc voltages: +24V, +5V, and -12 V. From this input set, the regulator supplies the power set of dc voltages for the D22x7 disk drive: +24V, +12V, +5V, -fV, and -12V.

The 3-Input DC Regulator contains an input connector, a signal ground terminal, voltage converters, and an output cable that connects to the power connector on the G9QSV PCB. The regulator does not affect the exterior dimensions of the standard D22x7 assembly.

Figure A-1 shows the block diagram for the 3-Input DC Regulator.

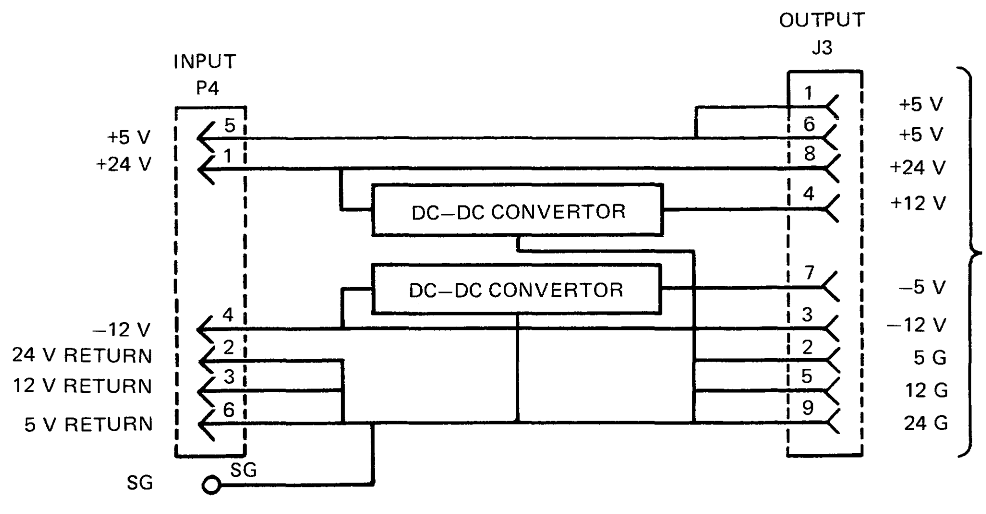


Figure A-1 Block Diagram: 3-Input DC Regulator

A.2 INTERFACE REQUIREMENTS

The following three sections describe specific interface requirements.

A.2.1 DC Power Connector (P4)

A six-pin AMP connector (No. 1-380999-0) is used for power input. Figure A-2 shows this connector, and Table A-1 lists its pin functions.

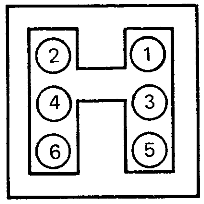


Figure A-2 Power Connector

Table A-1 Power Connector Pin Assignments

PIN NUMBER	FUNCTION
1	+24 Vdc
2	24 V return
3	12 V return
4	-12 Vdc
5	+ 5 Vdc
6	5 V return

The recommended mating connector is described below.

- Cable side housing — AMP P/N 1-480270-0
- Receptable contact — AMP P/N 60617-4
  AMP P/N 60619-4
- Cable wire — No. 18 AWG standard wire

A.2.2 Signal Ground Terminal

The signal grounding wire is connected to the SG terminal. The recommended connector for the SG terminal is described below.

- Cable side housing — AMP Plasti-Grip Terminal
- Receptacle contact — AMP P/N 170782-1
- Cable wire — No. 18 AWG standard wire

A.2.3 DC Power Input Requirement

Table A-2 lists dc input requirements.

Table A-2 DC Power Requirements

VOLTAGE	TOLERANCE	CURRENT	RIPPLE (Peak to Peak)
+5.0 V	±0.25 V	4.0 A	100 mV
-12.0 V	±0.60 V	1.0 A	100 mV
+24.0 V	±2.40 V	3.0 A (running current) 5.5 A (peak current)	240 mV

A.2.4 DC Power Output

Table A-3 lists the electrical specifications of the 3-Input DC Regulator.

Table A-3 Electrical Specifications

VOLTAGE	TOLERANCE	CURRENT	RIPPLE (Peak to Peak)
+5.0 V	±0.25 V	5.0 A	100 mV
-12.0 V	±0.60 V	1.0 A	100 mV
+24.0 V	±2.40 V	5.0 A	240 mV
+12.0 V	±0.60 V	0.6 A	100 mV
-5.0 V	±0.25 V	1.2 A	100 mV

A.3 PHYSICAL DIMENSIONS

Figure A-3 shows the dimensions of the 3-Input DC Regulator Option.

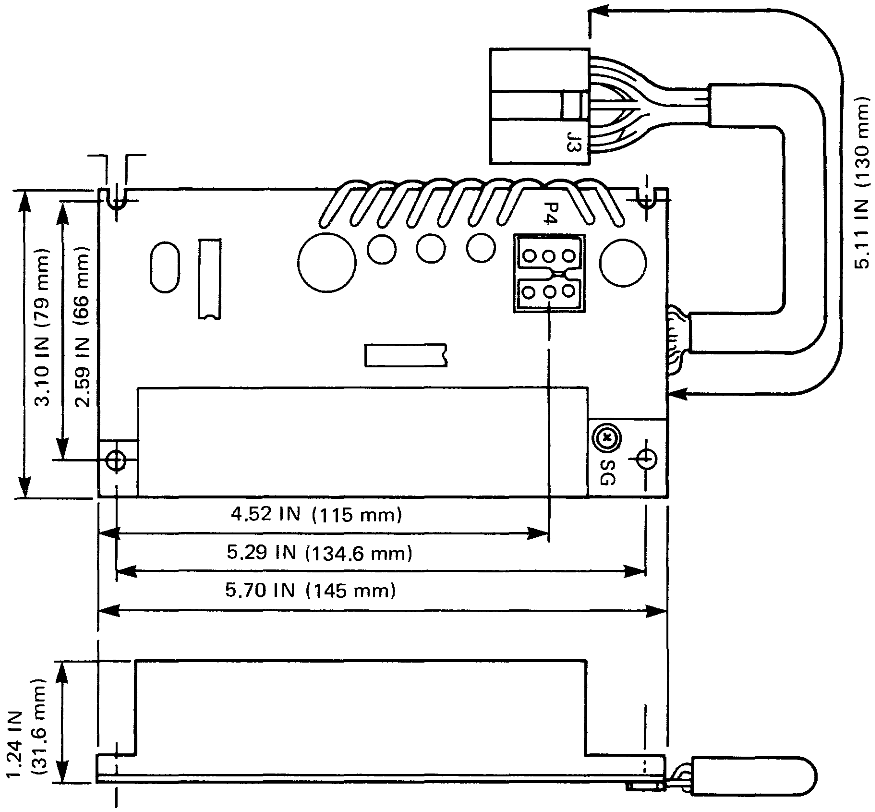
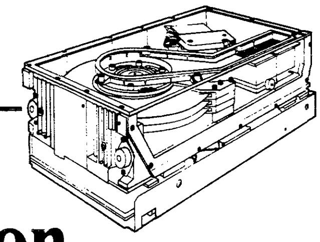


Figure A-3 3-Input DC Regulator Dimensions

Appendix B



DKU000-HDP2 Dual-Port Interface Option

This appendix assumes overall familiarity with the operation of the Dual-Port Interface, and describes only certain of its features.

B.1 GENERAL DESCRIPTION

The interface specifications of the Dual-Port Interface (including line receivers and transmitters, cables and cable connectors, signal definitions, and pin assignments) are the same as those described in Chapters 2 and 3. The major difference is that D22x7 disk drives equipped with the Dual-Port option have two identical interfaces providing communications channels with two controllers.

These two identical interfaces are designated port A and port B. Communication links into and from port A are designated route 0; communication links into and from port B are designated route 1. Each port is physically connected to its controller by an A and a B cable.

Figure B-1 shows a dual-port cabling diagram.

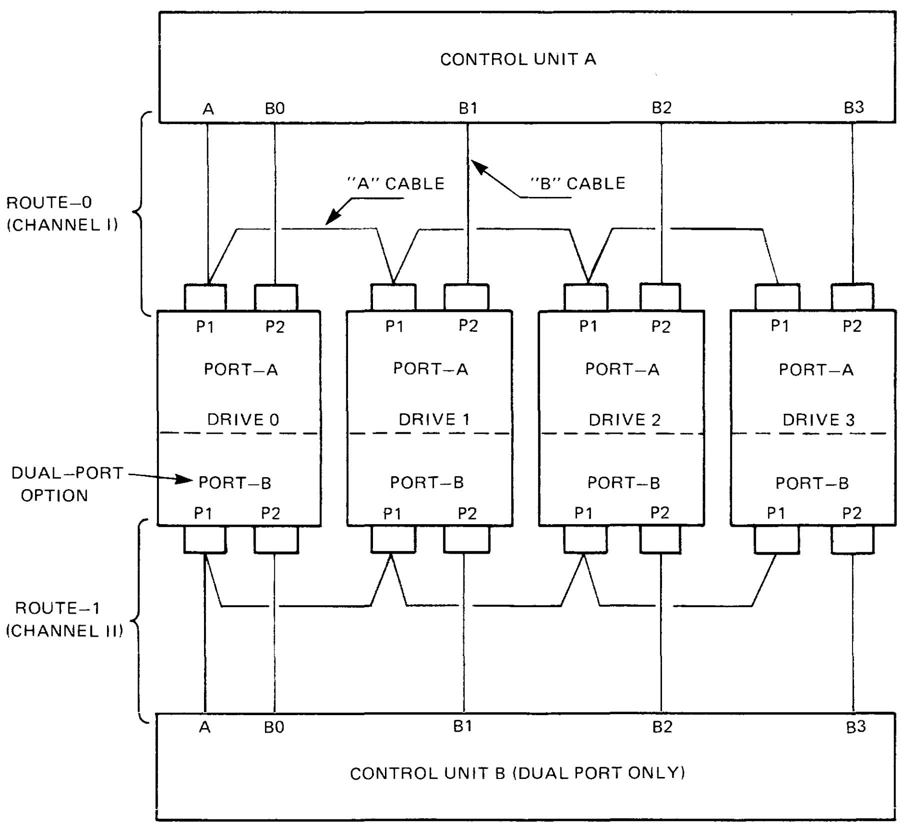


Figure B-1 Dual-Port System Cabling

B.2 OPERATIONAL DESCRIPTION

The Dual-Port Interface allows access to one drive by two controllers. In allowing dual access, the interface functions as a switch that routes the necessary control and data signals to and from the correct controller. Once controller selection has been made, the interface is essentially transparent. The interface, in addition to providing the required signal switching, provides a special status response (Busy) to a control unit attempting to select an engaged or reserved drive.

B.2.1 Drive Selection

Drive selection is controlled by the G9TXW PCB on the Dual-Port Interface. Selection is enabled by toggle switches on the PCB. When no controller has the drive reserved, the drive is available and may then be selected or reserved from either port. The interface automatically engages with the first port to complete a drive selection.

Drive selection is accomplished by the controller setting the appropriate Unit Select lines and the Unit Select Tag. The drive becomes reserved to the selecting port, and remains reserved until a Release signal, a release timer function, or a dc power-down/power-up occurs.

If the drive is already reserved or selected, a Busy signal is issued on cable A of the controller attempting the select. This signal is issued within 60 ns of the selection attempt, and remains until the drive is no longer busy.

B.3 SWITCHES AND INDICATORS

Three switches and four LED indicators are located on the G9TXW PCB. These switches and indicators are shown in Figure B-2.

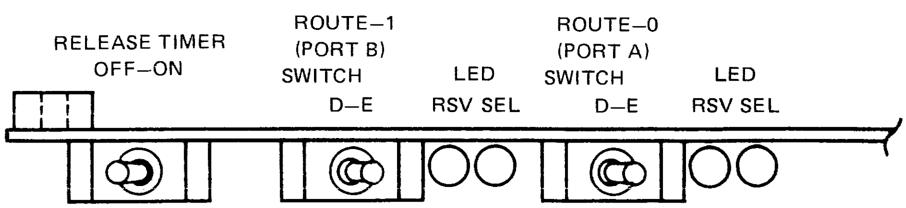


Figure B-2 Dual-Port Control Switches

B.3.1 Port A (Route 0) Switches and Indicators

- Toggle Switch — In the "E" (Enable) position, this switch opens route 0. In the "D" (Disable) position, this switch closes route 0.
- RSV (LED) — When lit, indicates that the D22x7 has been priority-selected by the route 0 controller.
- SEL (LED) — When lit, indicates that the D22x7 has been selected by the route 0 controller.

B.3.2 Port B (Route 1) Switches and Indicators

- Toggle Switch — In the "E" (Enable) position, this switch opens route 1. In the "D" (Disable) position, this switch closes route 1.
- RSV (LED) — When lit, indicates that the D22x7 has been priority-selected by the route 1 controller.
- SEL (LED) — When lit, indicates that the D22x7 has been selected by the route 1 controller.

B.3.3 Release Timer: ON/OFF Switch

This switch controls the release timer, a device that allows alternate controller access to the drive. With this switch in the OFF position, a drive remains selected until specifically released by the operating controller. With this switch in the ON position, the release timer can clear the reserve status approximately 500 ms after the last device selection. This feature allows both controllers access to the drive independent of a Release signal. The release timer does not disable a priority select.

B.4 INTERFACE SIGNALS

The Dual-Port Interface has two additional commands and one additional status line in the control cable (cable A). The read/write cable (cable B) has the same signals as the standard cable for the D22x7 drive.

B.4.1 Release Command

This command (bus bit 9 and Tag 3) is transmitted to the drive from the controller. It releases controller reserve and priority select, freeing the drive for use by the other controller.

B.4.2 Priority Select

The Priority Select signal (bus bit 9, Unit Select lines, and Unit Select Tag) is issued by a controller. This signal forces the drive to become unconditionally selected and absolutely reserved by the controller issuing the Priority Select signal. While this signal is active, the partner controller is denied access to the drive.

B.4.3 Busy Status

When the D22x7 is selected and/or reserved by one controller, the Busy signal is active on cable A, and the Unit Select signal is active on cable B connecting the drive to the other controller. These signals are issued from the D22x7 within 600 ns of the selection attempt, and remain in this status while the drive is selected.

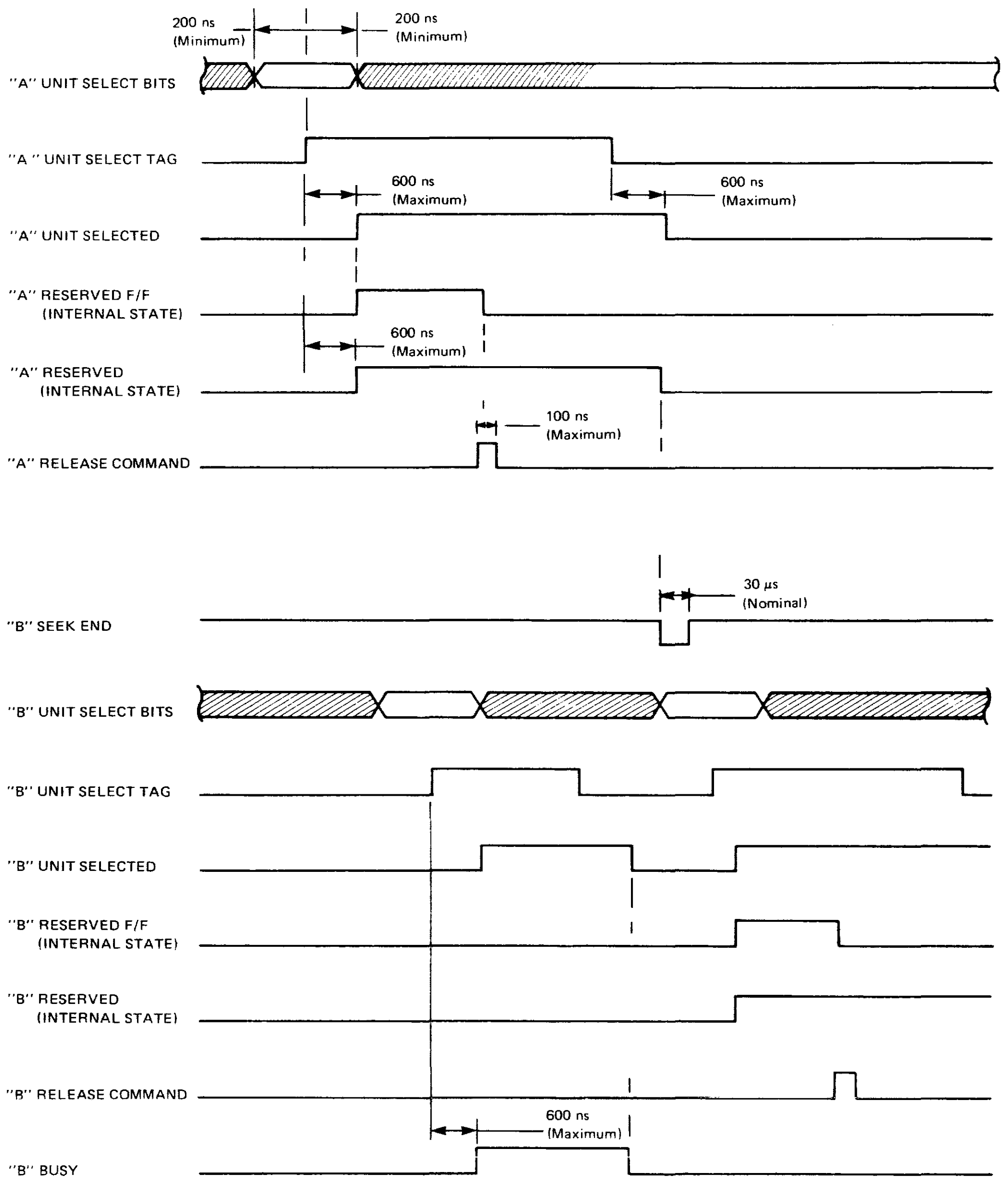


Figure B-3 Unit Select Timing for Dual-Port Option

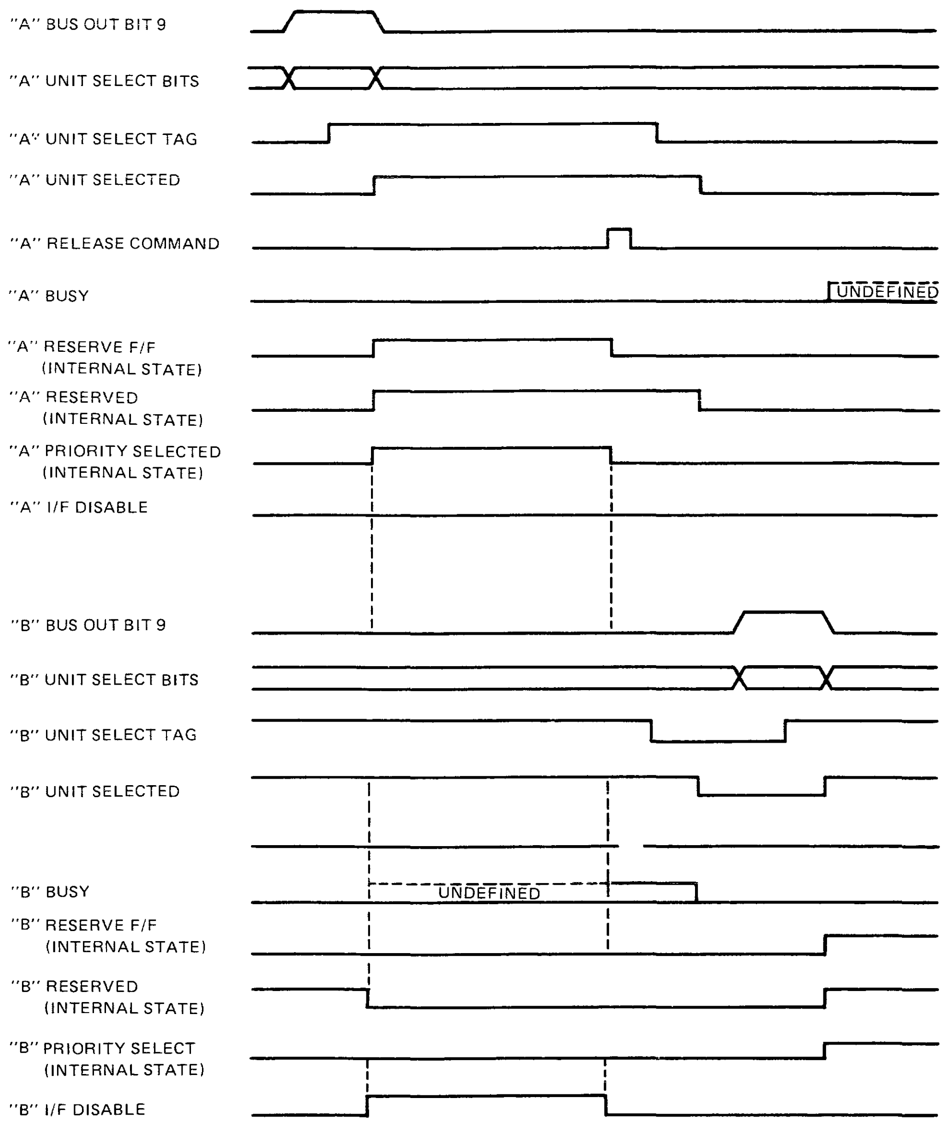
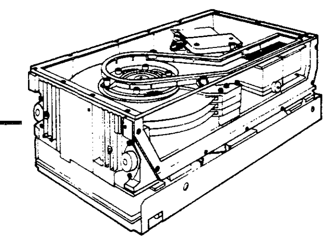


Figure B-4 Sample Priority Select Timing

Appendix C

Timing Diagrams



Signals shown in the following diagrams are timed from their entrance into the D22x7 interface cable connector.

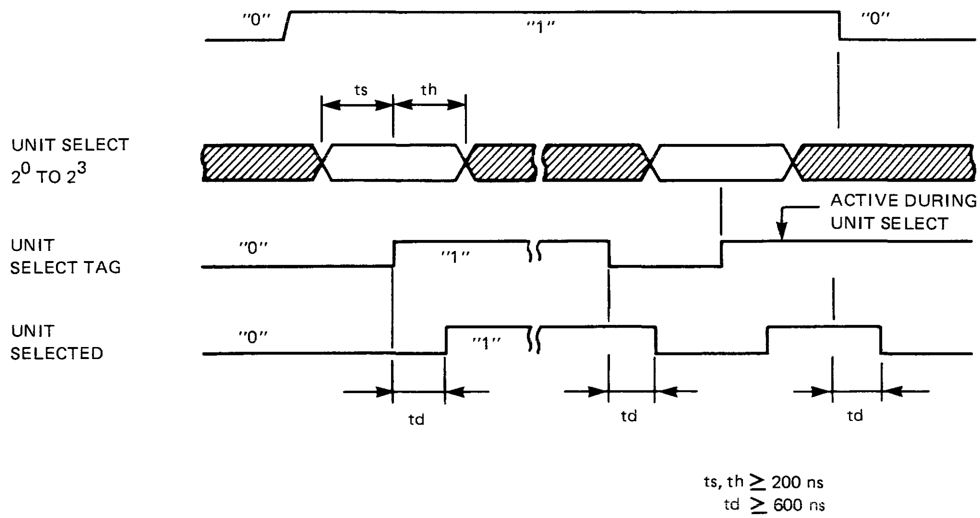


Figure C-1 Unit Select Timing

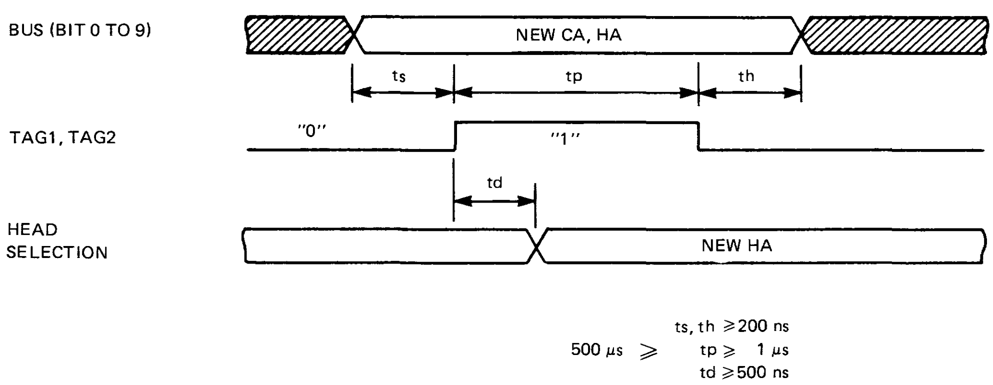


Figure C-2 Tag/Bus Timing

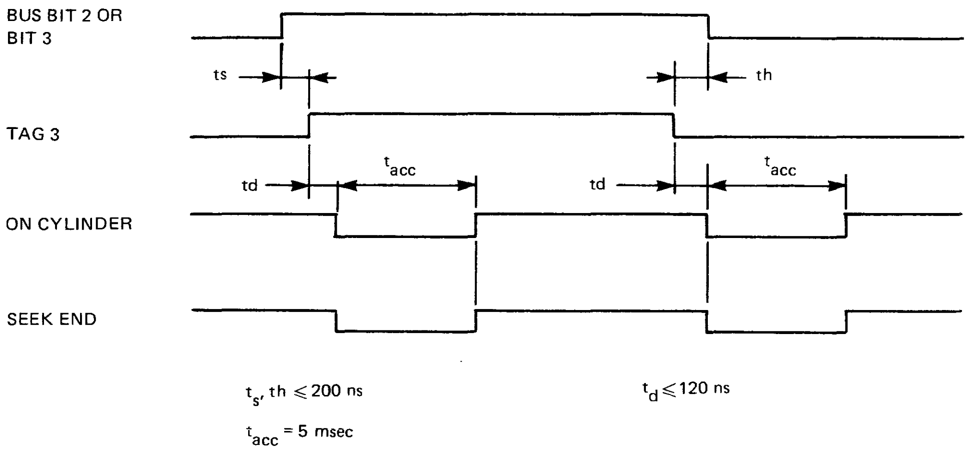


Figure C-3 Servo Offset Plus and Minus Timing

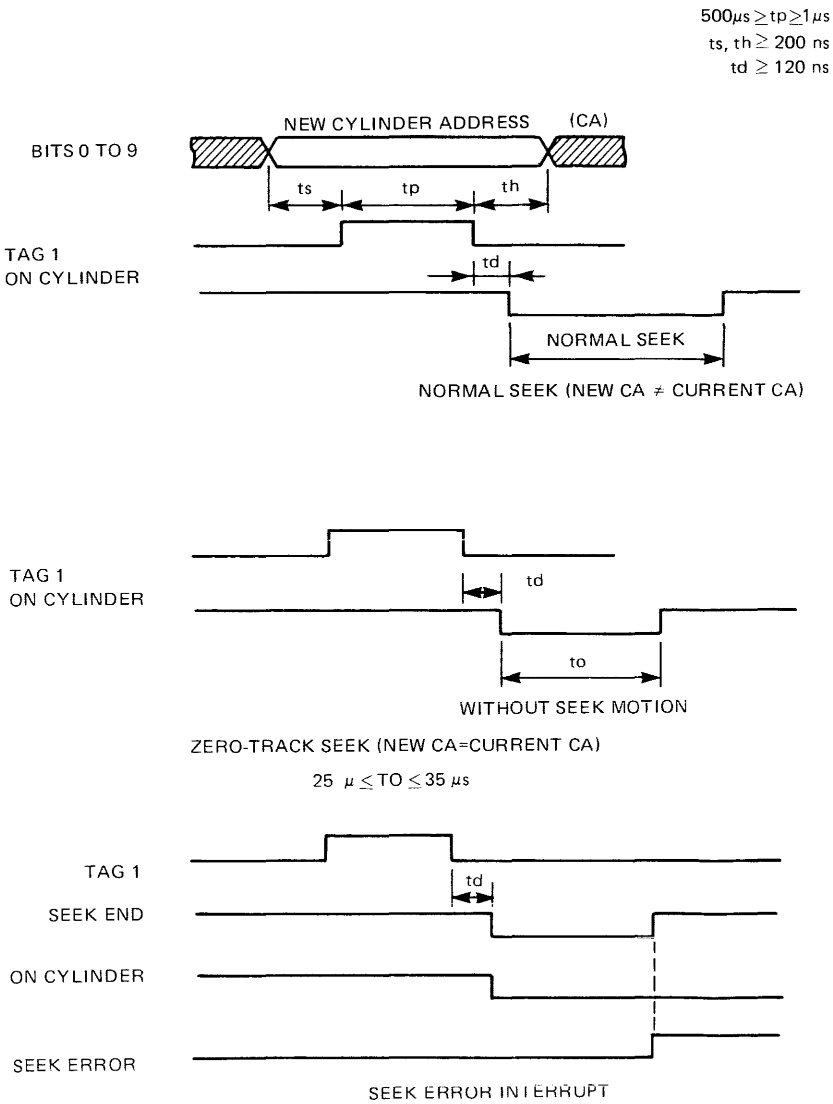
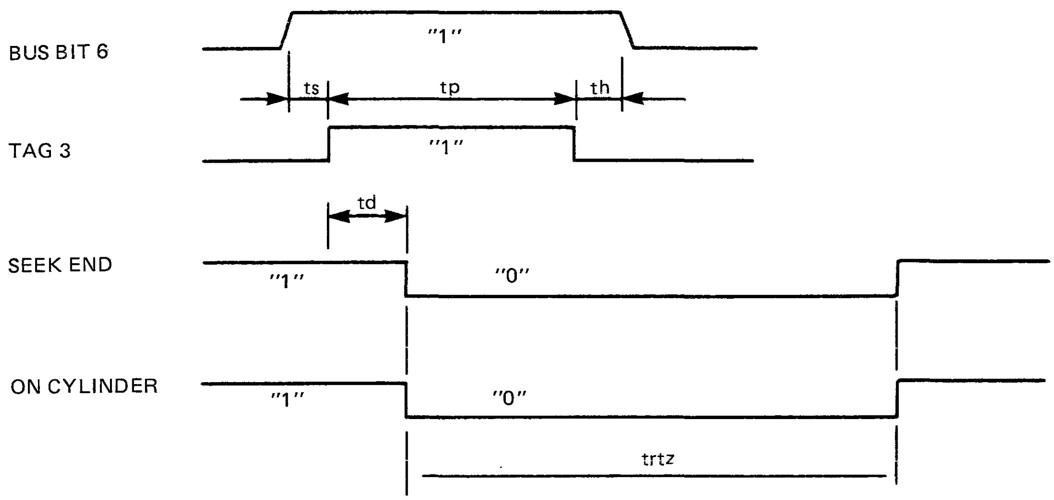
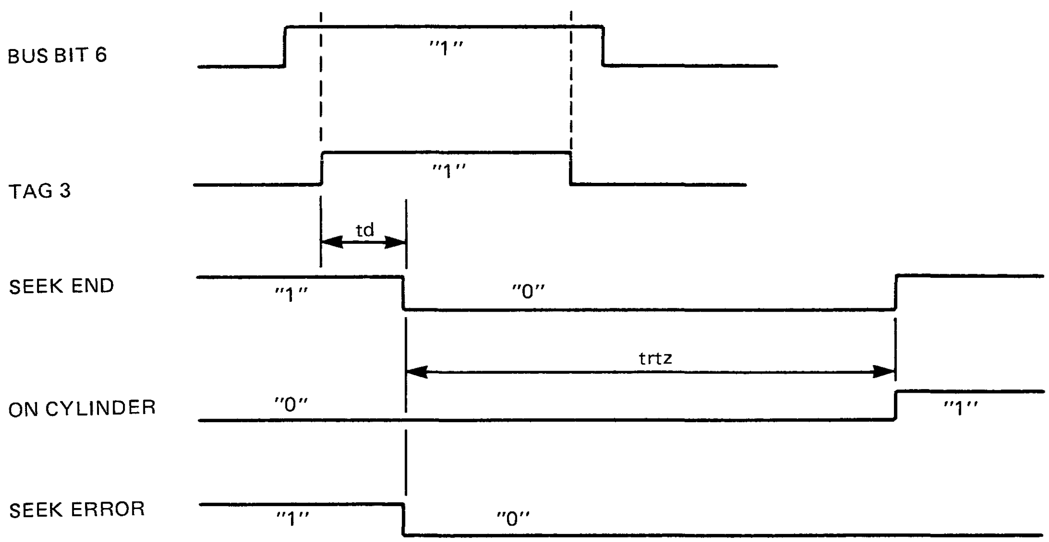


Figure C-4 On Cylinder Timing



(a) NORMAL RETURN TO ZERO



(b) RETURN-TO-ZERO FOR SEEK ERROR

1 ms $\geq$ tp $\geq$ 100 ns
ts, th $\leq$ 0 ns
td $\leq$ 200 ns
trtz $\leq$ 2 sec

Figure C-5 Return-to-Zero Timing

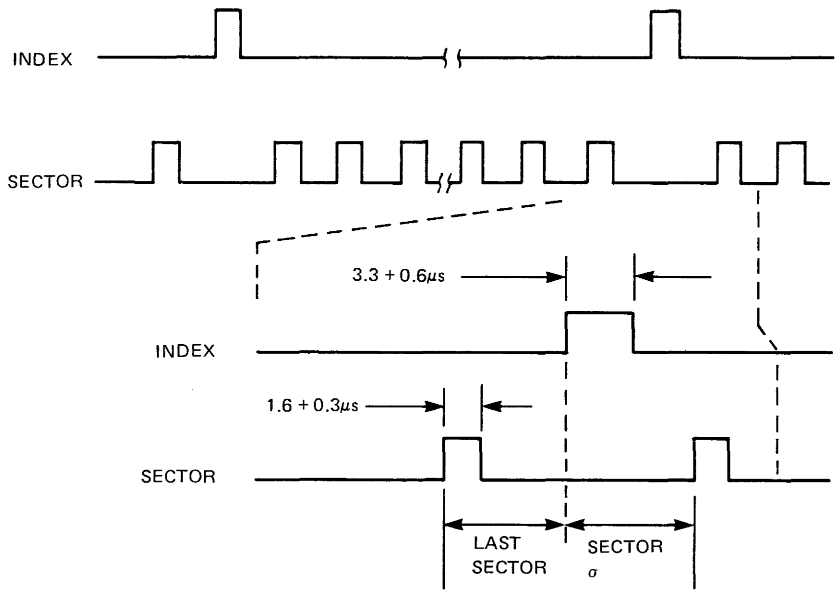


Figure C-6 Index/Sector Timing

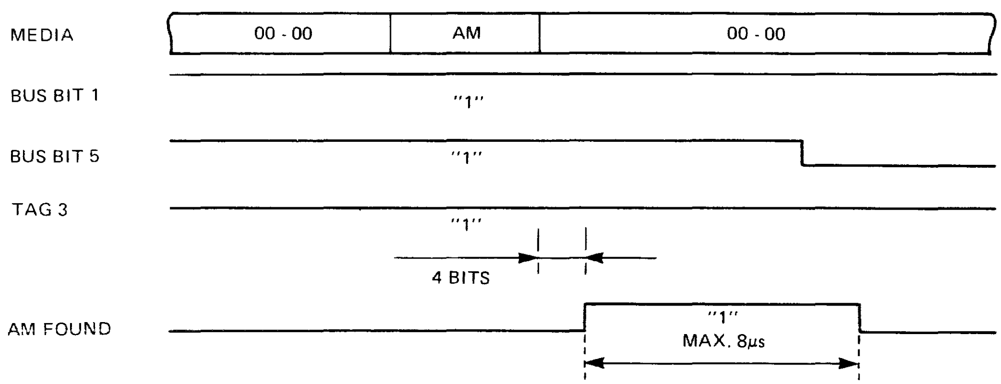


Figure C-7 Address-Mark-Found Timing

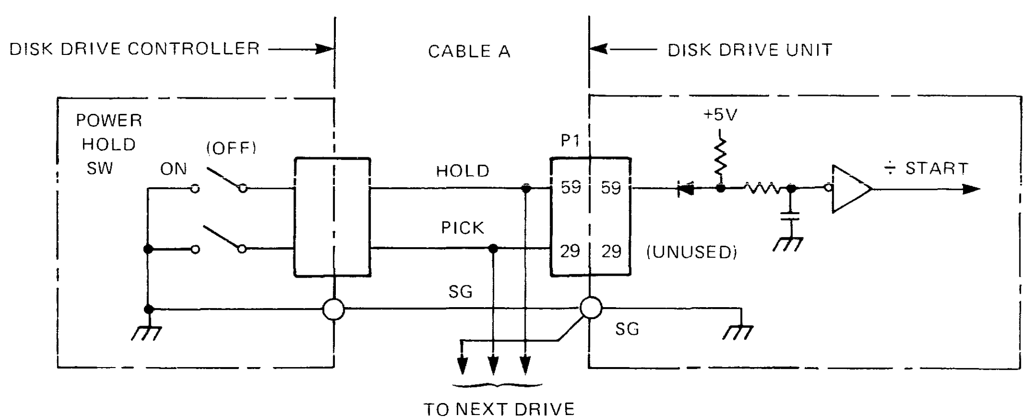


Figure C-8 Spindle Motor Power Sequence Control

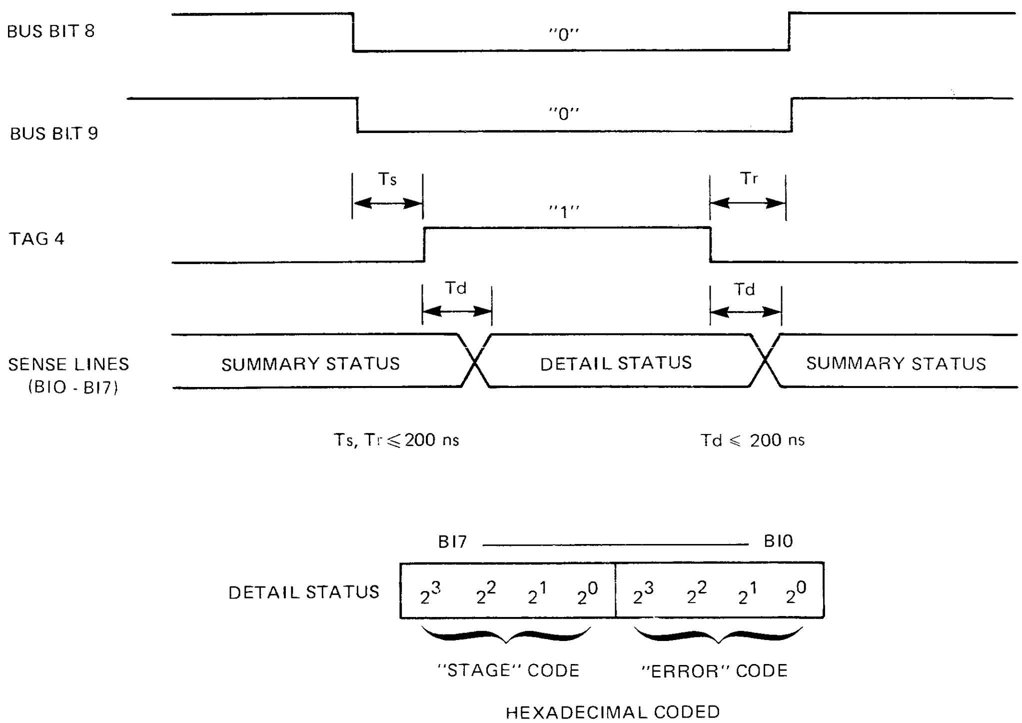


Figure C-9 Read Detail Status Timing

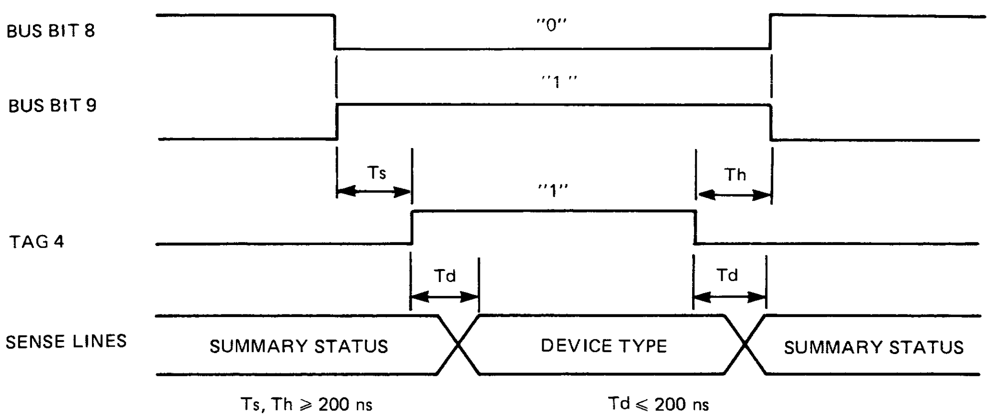


Figure C-10 Device Type Request Timing

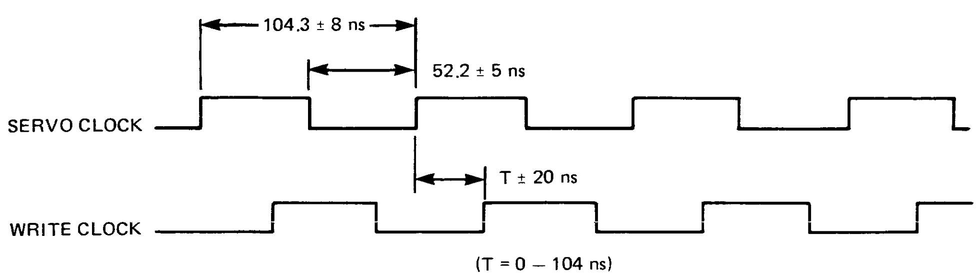


Figure C-11 Servo Clock Versus Write Clock Timing

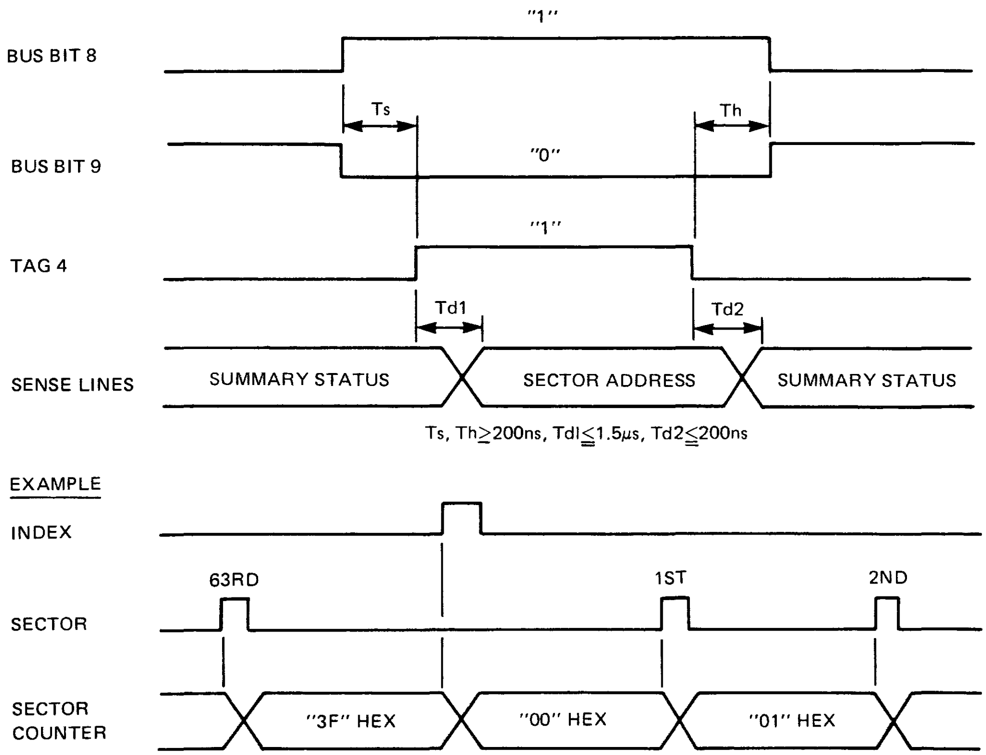
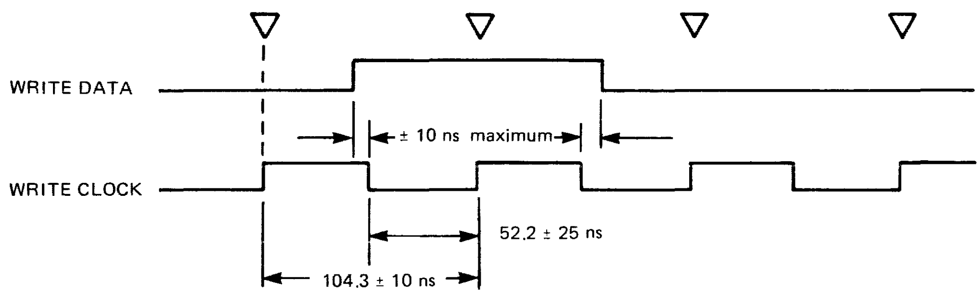


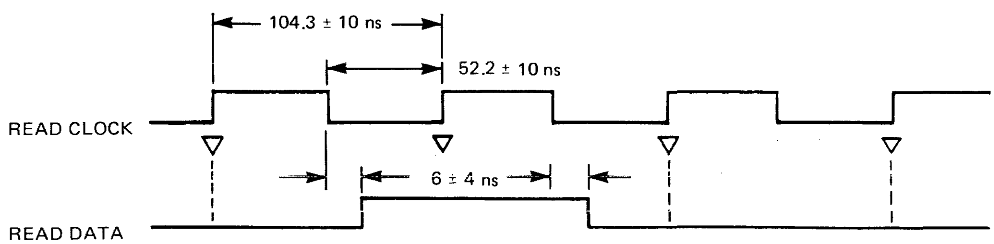
Figure C-12 Read Sector Timing



WRITE DATA VERSUS WRITE CLOCK

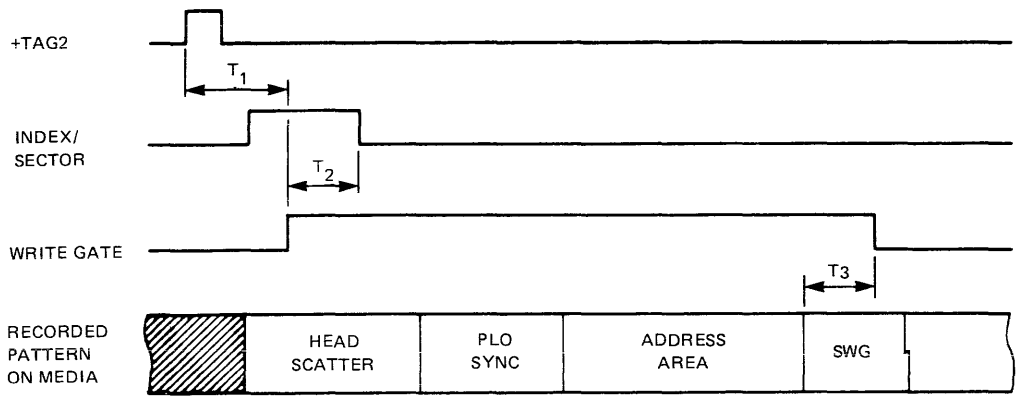
NOTE: INCLUDES ROTATING SPEED VARIATION AND PLO JITTER.

Figure C-13 Write Operation Timing



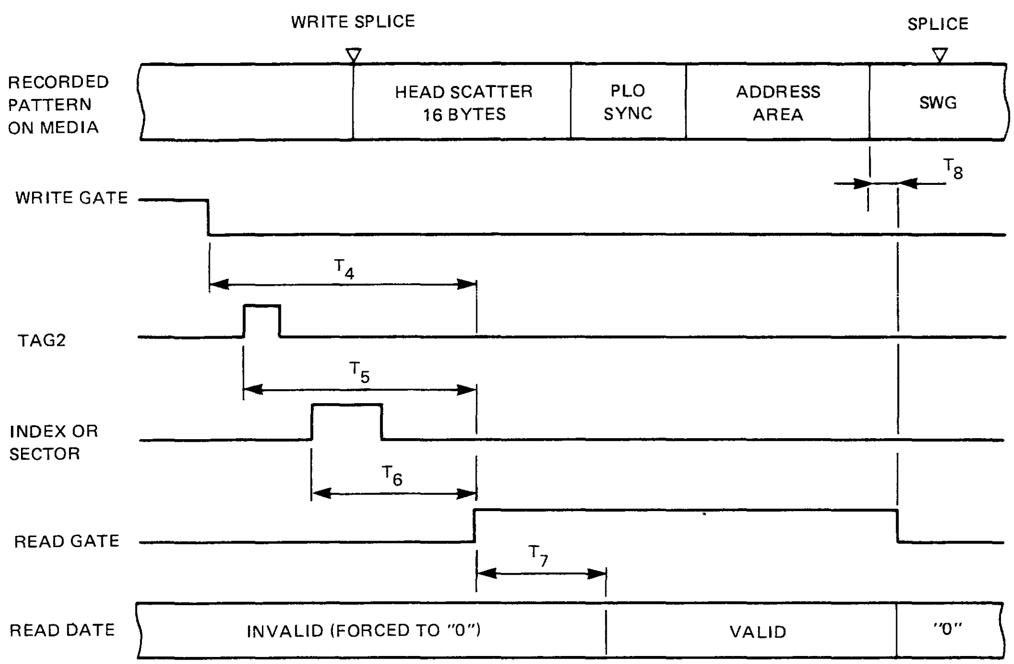
NOTE: INCLUDES ROTATING SPEED VARIATION AND PLO JITTER.

Figure C-14 Read Operation Timing



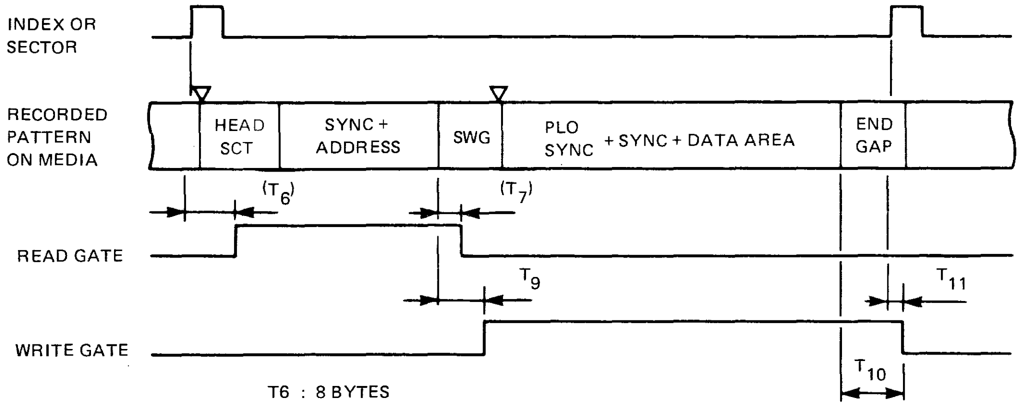
T1 : 5 μS minimum
T2 : 1 μS maximum
T3 : 4 BYTES

Figure C-15 Write Format



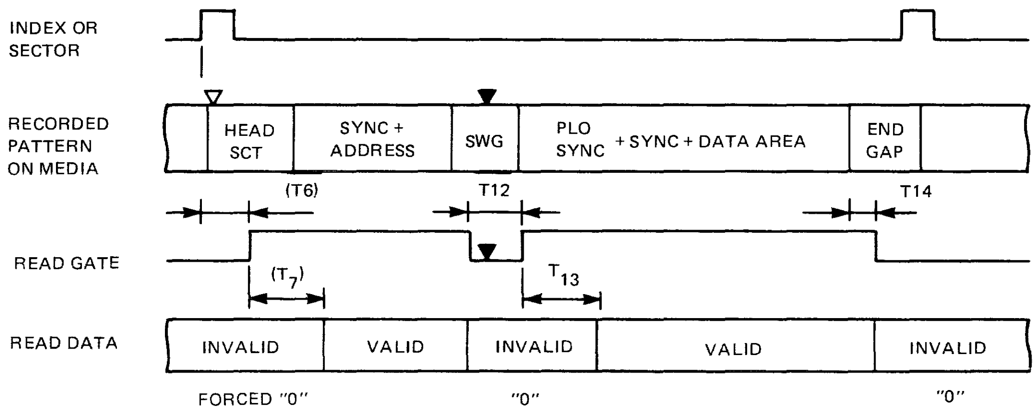
T4 : 10 μS minimum
T5 : 5 μS maximum
T6 : 8 BYTES (HALF OF THE HEAD SCATTER)
T7 : 52 TO 54 BITS
T8 : 1 BYTE

Figure C-16 Read Format



T6 : 8 BYTES
T7 : 1 BYTE
T9 : 2 BYTES
T10: 4 BYTES minimum
T11: 1 μS maximum

Figure C-17 Write Data



NOTE 1: FORCED ALL "0" PATTERN IS SENT BACK TO CONTROLLER DURING INVALID READ DATA.

T6: 8 BYTES
T7: 52 TO 54 BYTES
T12: 4 BYTES (AVOID WRITE SPLICE)
T13: 52 TO 54 BITS
T14: 1 BYTE

Figure C-18 Read Data

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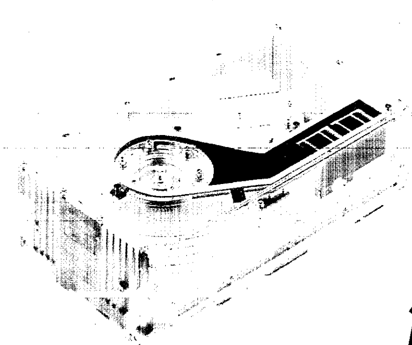

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