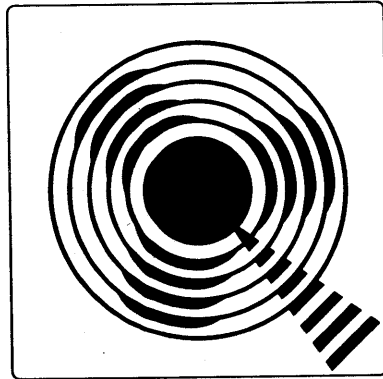


**SQ312RD  
OEM  
Manual**



**SyQuest**  
TECHNOLOGY

# TABLE OF CONTENTS

SECTION 1 — INTRODUCTION .....	1
1.1 General Description .....	1
1.2 Physical Specifications .....	3
1.3 Reliability Specifications .....	5
1.4 Performance Specifications .....	5
1.5 Functional Specifications .....	6
SECTION 2 — FUNCTIONAL CHARACTERISTICS ..	7
2.1 General Operation .....	7
2.2 Read/Write and Control Electronics .....	7
2.3 Drive Mechanism .....	8
2.4 Door Mechanism/Door Lock Solenoid .....	8
2.4.1 General Description .....	8
2.4.2 Opening Sequence Procedure .....	8
2.5 Positioning Mechanism .....	9
2.6 Read/Write Heads and Disks .....	10
2.7 Cartridge Interlock Mechanism .....	10
SECTION 3 — FUNCTIONAL OPERATIONS .....	15
3.1 Power Sequencing .....	15
3.2 LED Operation .....	16
3.2.1 Red .....	16
3.2.2 Green .....	16
3.2.3 Orange .....	16
3.2.4 Slow Flashing Red .....	16
3.2.5 Rapidly Flashing Red .....	17
3.3 Drive Selection .....	17
3.4 Track Accessing .....	17
3.5 Restore .....	18
3.5.1 Method 1 .....	18
3.5.2 Method 2 .....	18
3.5.3 Method 3 .....	18
SECTION 4 — ELECTRICAL INTERFACE .....	19
4.1 General Description .....	19
4.2 Control Input Lines .....	25
4.2.1 Write Gate .....	26

## TABLE OF CONTENTS (continued)

4.2.2	Head Select 2 <sup>0</sup> .....	26
4.2.3	Direction In .....	27
4.2.4.	Step .....	27
4.2.5	Recalibrate .....	28
4.2.6	Recovery Mode .....	30
4.2.7	Drive Select 1-4 .....	31
4.2.8	Change Cartridge .....	31
4.3	Control Output Lines .....	32
4.3.1	Seek Complete .....	32
4.3.2	Track 0 .....	33
4.3.3.	Write Fault .....	33
4.3.4	Index .....	34
4.3.5	Ready .....	35
4.3.6	Drive Selected .....	35
4.3.7	Cartridge In .....	35
4.3.8	Write Protected .....	35
4.3.9	Cartridge Changed .....	36
4.3.10	Radial Index .....	36
4.4.	Data Transfer Lines .....	36
4.4.1	MFM Write Data .....	37
4.4.2	MFM Read Data .....	37
4.4.3	Read/Write Timing .....	37
4.5	Drive Selected .....	38
4.6	Option Shunt Block .....	39
SECTION 5 — PHYSICAL INTERFACE .....		40
5.1	J1/P1 Connector - Control Signals .....	41
5.2	J2/P2 Connector - Data Signals .....	42
5.3	J3/P3 Connector - DC Power .....	42
SECTION 6 — PHYSICAL SPECIFICATIONS .....		43
6.1	General Description .....	43
6.1.1	Mounting Orientation .....	43
6.1.2	Mounting Holes .....	43
6.1.3	Physical Dimensions .....	43
6.1.4	Air Flow Requirement .....	44
6.1.5	Shipping Requirement .....	44

## TABLE OF CONTENTS (continued)

SECTION 7 — TRACK FORMAT .....	45
7.1 Gap 1 .....	50
7.2 Gap 2 .....	50
7.3 Gap 3 .....	50
7.4 Gap 4 .....	51
7.5 Sector Interleaving .....	51
7.6 Defective Sector Flags .....	51
SECTION 8 — CARTRIDGE ACCLIMATIZATION ..	52
SECTION 9 — CLEANING CARTRIDGE .....	53
9.1 Materials Required .....	53
9.2 Procedure .....	53
9.3 Maintenance .....	55
SECTION 10 — MOUNTING OPTIONS .....	56
10.1 General Description Option III .....	56
10.1.1 Procedure .....	56
10.2 General Description Option I .....	59
10.2.1 Procedure .....	60
SECTION 11 — SQ312RD OPTIONS .....	62
11.1 General Description .....	62
11.1.1 Write Data Termination .....	62
11.1.2 Read Data Termination .....	62
11.1.3 Change Cartridge .....	62
11.1.4 Fault Latch .....	62
11.1.5 Recovery .....	62
11.1.6 Recalibrate .....	63
11.1.7 Auto Recovery Mode .....	63

## LIST OF FIGURES

2-1	Air Filtration System .....	11
	With Switch Locations	
2-2	Cartridge Insertion .....	12
2-3	Cartridge Removal .....	13
2-4	Track Format and Positioning System .....	14
4-1	Power-Up Sequence .....	19
4-2	Control Signals .....	20
4-3	Data Signals .....	21
4-4	Typical Connection, 4 Drive System .....	22
4-5	Control Signals .....	26
	Driver/Receiver Combination	
4-6	Head Select .....	28
4-7	Slow Seek Timing .....	29
4-8	Buffered Seek Timing .....	29
4-9	Index Timing .....	34
4-10	Data Line Driver/Receiver Combination ....	36
4-11	Read/Write Data Timings .....	38
4-12	Option Shunt Block .....	39
5-1	Interface Connector Physical Locations ....	40
5-2	J1 Connector Dimensions .....	41
5-3	J2 Connector Dimensions .....	42
5-4	J3 Connector-Drive PCB Solder Side .....	42
7-1	Mounting Physical Dimensions .....	46
7-2	Dimensional View .....	47
7-3	Track Format As Shipped .....	48
7-4	"A1" Address Mark Byte .....	49
9-1	C-PAK Instructions .....	54
10-1	Mounting Option Half-Height Option Kit ....	57
10-2	Mounting Bracket Option Spacing .....	58
10-3	Mounting Bracket Full-Height Option Kit ...	60
11-1	Option Jumper .....	63

## LIST OF TABLES

<b>4-1</b>	<b>J1/P1 Connector Pin Assignment .....</b>	<b>23</b>
<b>4-2</b>	<b>J2/P2 Connector Pin Assignment .....</b>	<b>24</b>
<b>4-3</b>	<b>J3/P3 Power Connector Pin Assignment .....</b>	<b>25</b>
<b>7-1</b>	<b>DC Power Requirements .....</b>	<b>47</b>
<b>7-2</b>	<b>Motor Start Current Requirements .....</b>	<b>48</b>



# SECTION 1

## INTRODUCTION

### 1.1 General Description

The SQ312RD disk drive is a random access storage device utilizing removable 100mm disks as storage media. Each disk surface employs one moveable head to service 615 data tracks. The total formatted capacity of the two heads and surfaces is 10 megabytes (32 sectors per track, 256 bytes per sector, 1224 tracks).

The SQ312RD Model has removable media in the form of a cartridge.

Low cost and unit reliability are achieved through the use of a band actuator and closed loop stepper head positioning mechanism. The inherent simplicity of mechanical construction and electronic controls permits maintenance free operation throughout the life of the drive. Both electronic PCB's are mounted outside the head disk assembly.

Mechanical and contamination protection for the heads, actuator, and disks is provided by an impact resistant aluminum enclosure. A self-contained recirculation system supplies clean air through a 0.3 micron filter. The spindle and disk act as a pump, assuring adequate air flow and uniform temperature distribution throughout the head and disk area. The on-board microcomputer does thermal compensation during power-up. This provides significantly greater off track margin and the ability to immediately perform read and write operations after power-up with no thermal stabilization delay.

The SQ312RD electrical interface is identical to the pin-out, data transfer rates, and track/sector formats as the Seagate ST506/412 or equivalent and insures full



compatibility with a wide host of 5¼" Winchester disk drive controllers. The half-size form factor (half-height) design allows two SQ312RD drives to fit within the space of one 5¼" floppy Winchester envelope, and the DC power requirements and connector for the SQ312RD are the same as for the industry standard 5¼" Winchester. No AC power is required.

## Key Features

- 12.75 Mbyte storage capacity.
- Half-height minifloppy form factor.
- Removable cartridge media that requires no purge cycle upon power-up.
- Buffered seek mode for faster data access.
- Closed-loop servo system with imbedded digital servo for full cartridge interchangeability between any SQ312RD drive.
- Same interface and track format as standard 5¼" Winchester.
- Utilizes existing 5¼" Winchester controllers.
- Ruggedized for portable systems.
- Same DC voltages and current as the minifloppy.
- Band actuator and .90° stepper motor head positioning mechanism.
- Data Recovery Mode.
- Solenoid controlled door lock.

## 1.2 Physical Specifications

### ENVIRONMENTAL LIMITS

#### Ambient Temperature:

(operating)	40° to 122°F (4° to 50°C)
(non-operating)	-14° to 140°F (-10° to 60°C)

#### Maximum Temperature:

##### Gradient:

(operating)	18°F/Hr. (10°C)
(non-operating)	Below Condensation

#### Relative Humidity

8 to 80 percent  
(non-condensing)

#### Maximum Elevation:

(operating)	10,000 feet
(non-operating)	-1,000 to 35,000 feet

#### Shock:

(operating)	10G's, 11 msec. half sine
(non-operating)	40G's, 11 msec. half sine (in shipping container)

#### Vibration:

(operating)	2 to 10 Hz 0.10" Double Amplitude 10 to 500 Hz 0.5G Peak to Peak
-------------	---

## ENVIRONMENTAL LIMITS (continued)

### Vibration:

(non-operating)

2 to 10 Hz  
0.40" Double Amplitude

10 to 500 Hz  
2.0G Peak to Peak

### DC Power Requirements

+12V  $\pm$  5% @ .9 amps  
(50mv P-P max. ripple)

+5V  $\pm$  5% @ .9 amps  
(50mv P-P max. ripple)

## MECHANICAL DIMENSIONS

Height .....	1.63 inches
Width .....	4.8 inches
Depth .....	8.0 inches
Weight .....	2.4 lbs.
Shipping Weight .....	4.3 lbs.

## CARTRIDGE MECHANICAL DIMENSIONS

Height .....	0.43 inches
Width .....	4.33 inches
Length .....	4.41 inches
Weight .....	0.3 lbs.

## HEAT DISSIPATION

13½ watts (46BTU/Hr) Maximum

### 1.3 Reliability Specifications

MTBF .....	11,000 POH, typical usage
PM .....	Not Required
MTTR .....	30 minutes
Component Design Life .....	5 Years

#### Error Rates:

Soft read errors .....	1 per $10^9$ bits read
Hard read errors .....	1 per $10^{12}$ bits read
Seek errors .....	1 per $10^6$ seek

**NOTE:** Error rate performance achieved with an available MFM data window of better than 80 nsec.

### 1.4 Performance Specifications

#### Capacity (Unformatted)

Per Drive .....	12.76 Megabytes
Per Surface .....	6.38 Megabytes
Per Track .....	10417 Bytes

#### Capacity (Formatted)

Per Drive .....	10.0 Megabytes
Per Surface .....	5.0 Megabytes
Per Track .....	8192 Bytes
Per Sector .....	256 Bytes
Sectors Per Track .....	32

Transfer Rate .....	5.0 Mbits/sec
---------------------	---------------

### Access Time (Includes Setting)

One Track .....	45 (typical)
Average* .....	135 (typical)
Maximum* .....	250 (typical)

Average Latency ..... 8.46 ms

## 1.5 Functional Specifications

Rotational Speed .....	3,545 rpm $\pm$ 1%
Recording Density .....	12,608 bpi max
Flux Density .....	12,608 fci
Track Density .....	741 tpi
Cylinders .....	615
Tracks .....	1230
Read/Write Heads .....	2
Disks .....	1
Index .....	1

### Access Times

To guarantee 100% interchangeability of cartridges between drives, the SQ312RD Model uses a unique imbedded digital servo scheme (Digilok™). This results in a variance of access times which insures the customers' data integrity.

Both heads have servo in the index burst which remains transparent to the user. A 1.25 MHZ signal is injected in the Read Data stream during the period the micro-processor is sampling the servo information and, thus, eliminates any lock-up problems which may occur in certain controllers.

**\* Using Buffered Seek**

# SECTION 2

## FUNCTIONAL CHARACTERISTICS

### 2.1 General Operation

The SQ312RD disk drive consists of read/write, servo and control electronics, read/write heads, track positioning actuator, and air filtration system. The Model SQ312RD also has a cartridge interlock mechanism. The components perform the following functions:

1. Interpret and generate control signals.
2. Position the heads over the desired track.
3. Read and write data.
4. Provide interchangeability between SQ200 cartridges.

### 2.2 Read/Write and Control Electronics

Electronics are packaged on two printed circuit boards. The primary board to which power, control and data signals are connected includes:

1. Index detection circuit.
2. Head position/actuator circuit.
3. Read/write circuits.
4. Drive speed detector.
5. Head select circuit.
6. Write fault detection circuits.
7. Servo decoder and control.
8. Stepper motor drive circuit.
9. Drive select circuit.
10. Track zero detector.

The second PCB, mounted at the rear of the drive, derives its power from the primary board and provides power and speed control to the spindle drive motor and the solenoid interlock mechanism.

## **2.3 Drive Mechanism**

The brushless DC drive motor rotates the spindle at 3545 rpm. The spindle is driven directly with no belt or pulley being used. The motor and spindle are dynamically balanced to insure a low vibration level. Dynamic braking is used to quickly stop the spindle motor when power is removed. The head/disk assembly is shock mounted to minimize transmission of vibration through the chasis or frame.

## **2.4 Door Mechanism/Door Lock Solenoid**

### **2.4.1 General Description**

The door lock solenoid feature of the SQ312RD disk drive, disengages power to the spindle motor and allows mechanical removal of the cartridge media. This prevents media and/or head damage, but allows removal of the cartridge media even in a power off situation, insuring data security. Figure 2-1 shows the door lock solenoid position in relation to the disk drive. The door mechanism is shown in Figure 2-3.

### **2.4.2 Opening Sequence Procedure**

1. Depress the front panel switch. This cuts off 12 volt power to the spindle motor while the microprocessor moves the heads to track 20 position and removes power to the stepper motor.

2. Wait until the front panel LED stops flashing and depress the front panel switch fully until the front door automatically opens partially. Manually open the door to a right angle position with the front opening. The carriage then moves to retract position at the outer diameter. The heads unload and the cartridge is lifted off the spindle by the cartridge guides.
3. Depress the front door open fully and the cartridge ejects. **Note:** The front door will return to right angle position when pressure is released.

**NOTE:** Door should be closed at all times with the exception of cartridge insertion or removal.

## **Air Filtration System**

The disks and read/write heads are fully enclosed in a module using an integral recirculation air system and absolute filter to maintain a clean environment. The total air volume of the drive and cartridge is purged through the absolute filter once per second.

## **2.5 Positioning Mechanism**

The read/write heads are mounted on a ball bearing supported carriage which is positioned by a band actuator connected to the stepper motor shaft. The drive uses a microstepping stepper positioner which steps at 0.9 degrees per step. The closed-loop imbedded servo control design extends the accuracy of the SQ312RD metal band positioner to 20 microinches. The imbedded burst servo



scheme, where servo control data resides within a single wedge per track, affords users full definition control of sector formats.

## **2.6 Read/Write Heads and Disks**

The recording media consists of a single, 100mm "thin film" metallic alloy platter. The glass-like carbon overcoat that protects the magnetic substrate makes the thin film disks impervious to environmental contaminants such as dust, smoke particles, and ambient humidity. The carbon overcoat also eliminates the need for extended purge cycles; and coupled with the low load force/low mass flying heads, permits reliable contact start/stop operation and exceedingly high durability.

Data on each of the two disk surfaces is read by a read/write head, each of which accesses 615 tracks. The SQ312RD utilizes industry standard composite heads.

## **2.7 Cartridge Interlock Mechanism**

The fail-safe cartridge interlock mechanism ensures procedural compliance by users as the cartridge is only permitted to be inserted in the appropriate position. The interlock mechanism disengages the composite heads from the media upon opening the front door.

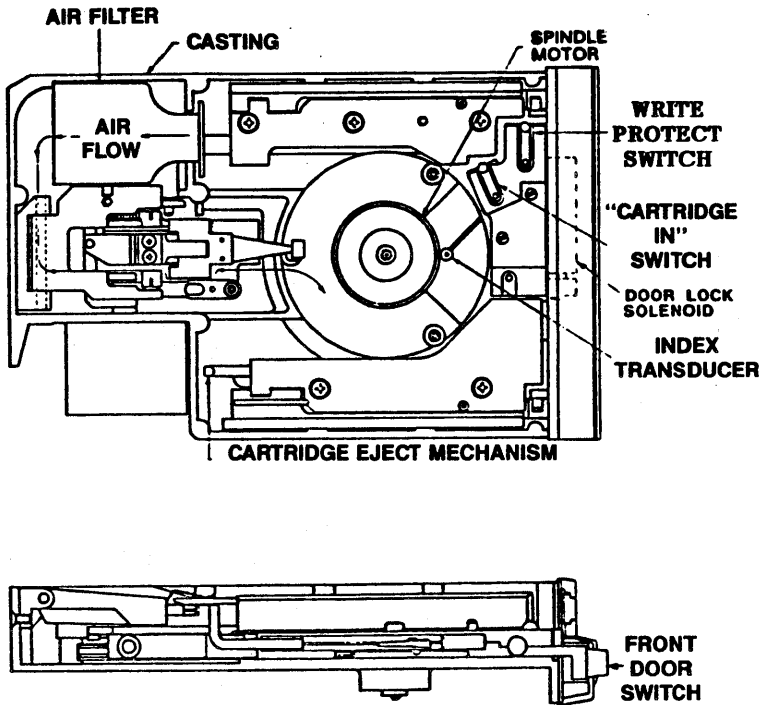
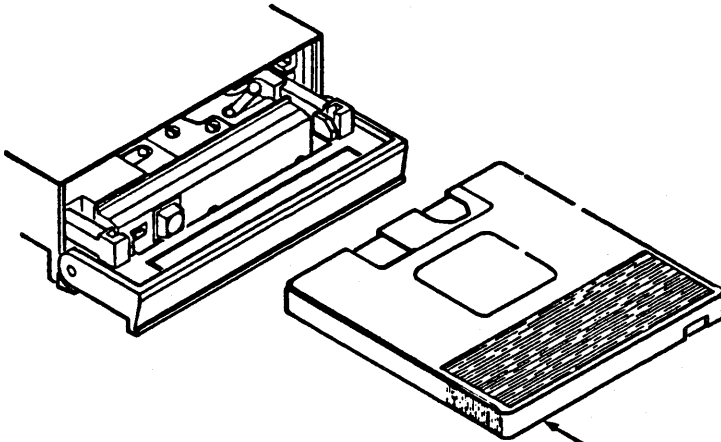
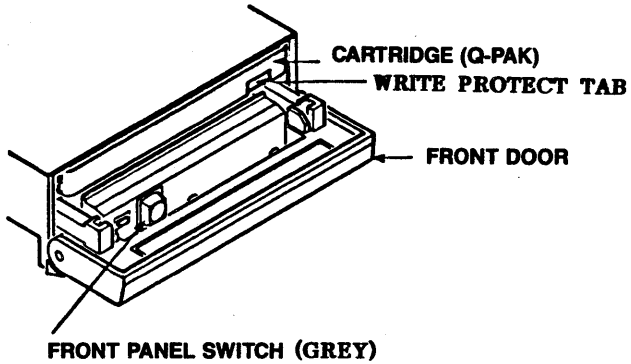


FIGURE 2-1

AIR FILTRATION SYSTEM WITH SWITCH LOCATIONS



**PRESSURE SHOULD BE APPLIED TO THIS REGION FOR ENGAGEMENT**



**FIGURE 2-2**  
**CARTRIDGE INSERTION**

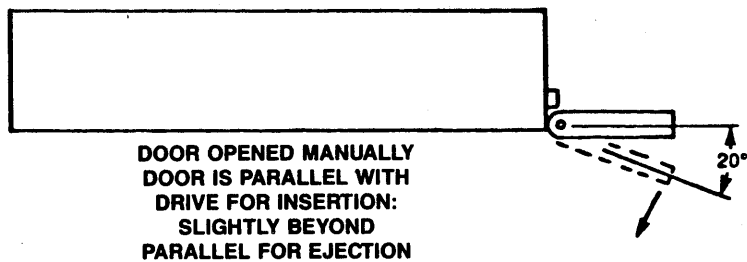
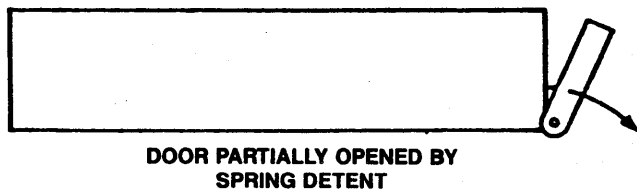
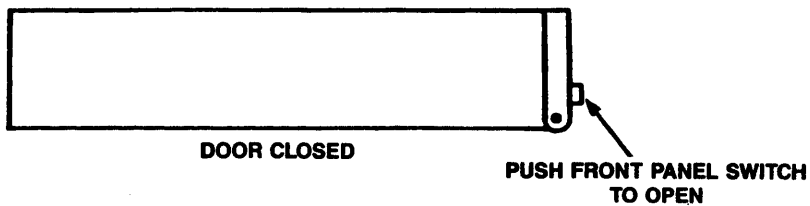


FIGURE 2-3

CARTRIDGE REMOVAL

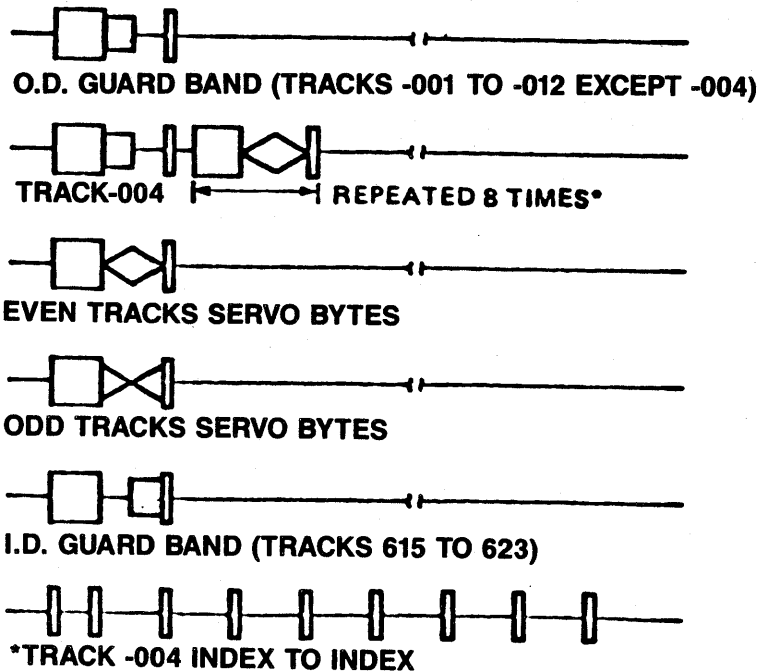
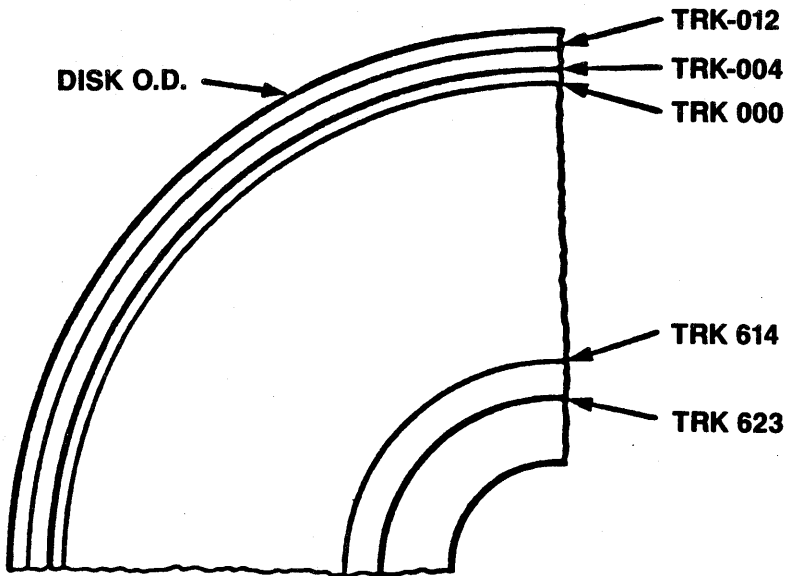


FIGURE 2-4

TRACK FORMAT AND POSITIONING SYSTEM

# SECTION 3

## FUNCTIONAL OPERATIONS

### 3.1 Power Sequencing

+5 and +12 volts may be applied in any order, however, +12 volts must be applied to start the spindle drive motor. A speed sense measures this index time to within 2% of operational speed. After the spindle drive motor reaches operating speed, the on-board microcomputer initiates a calibration procedure. The procedure follows:

- a) Find track 0 and set track 0 true.
- b) Seek to track minus 4.
- c) Read the pre-recorded Reference track on the cartridge.
- d) Divide the 615 cylinders on the cartridge into 20 different zones.
- e) Seek to each zone, read the servo information, and store head offset values in memory.
- f) After all 20 zones have been read successfully, seek to track 0.
- g) Set SEEK COMPLETE and READY TRUE.

If the drive is unable to read the reference track, the spindle motor will power-down and the LED on the front panel will rapidly flash red. The operator should remove and reinsert the cartridge.

The drive will not perform read, write, or seek functions until READY becomes true and the front door LED turns green. When selected, the LED will turn orange.

During the power-up sequencing, the microcomputer monitors the WRITE FAULT condition. If a WRITE FAULT is detected, the drive will not become ready. The controller can also cause a WRITE FAULT condition if Drive Select and Write Gate are true during the power-up sequencing.

If fault option is selected, the drive circuit will latch on for a fault condition. This latch can be cleared by deselecting and reselecting the drive.

## **3.2 LED Operation**

The LED in the front panel is multicolor which allows 5 states of the drive to be displayed.

### **3.2.1 Red**

State 1 is red. This indicates that the drive may be in a power up initialization process or head motion may be in process. SEEK COMPLETE is false.

### **3.2.2 Green**

State 2 is green. This indicates that the drive is READY, SEEK COMPLETE is true, and the drive is not selected.

### **3.2.3 Orange**

State 3 is orange. This indicates that the drive is READY, SEEK COMPLETE is true and selected.

### **3.2.4 Slow Flashing Red**

State 4 is flashing red. This indicates that the drive is in a spin-down sequence.

### **3.2.5 Rapidly Flashing Red**

State 5 is rapidly flashing red. This indicates an excessive runout condition with the Q-PAK. Remove Q-PAK and reinsert.

## **3.3 Drive Selection**

Drive selection occurs when one of the DRIVE SELECT lines is activated. Only the selected drive will respond to the input signals, and only that drive's output signals are then gated to the controller interface. (See Section 4.6 for exception; See Figure 4-12 for jumpering of drive select.)

## **3.4 Track Accessing**

Read/write head positioning is accomplished by:

- a) Deactivating Write Gate.
- b) Activating the appropriate Drive Select Line.
- c) Being in the READY condition with SEEK COMPLETE true.
- d) Selecting the appropriate direction.
- e) Pulsing the Step Line.

Each step pulse will cause the heads to change and/or move either 1 track in or 1 track out depending on the level of Direction line. A low level on the Direction line will cause a seek inward toward the spindle; a high, outward toward track 0.



## **3.5 Restore**

The controller can cause the drive to recalibrate to track 0 by any one of three methods.

### **3.5.1 Method 1**

The controller can execute a buffered seek command and issue 615 or more step pulses. This will cause the drive to slew to TRACK 0. The Direction control line is ignored during this operation.

### **3.5.2 Method 2**

The controller can execute a buffered seek command and issue step pulses greater than the available tracks in the direction requested. This will cause the drive to slew to TRACK 0.

### **3.5.3 Method 3**

The controller can execute single track seeks towards the O.D. while checking for TRACK 0 after each SEEK COMPLETE.

The procedure described in Paragraph 3.5.1 is recommended for maximum drive performance.

# SECTION 4

## ELECTRICAL INTERFACE

### 4.1 General Description

The interface to the SQ312RD can be divided into three categories, each of which is physically separated:

1. Control Signals
2. Data Signals
3. DC Power

All control lines are digital in nature (open collector TTL) and either provide signals to the drive (input) or signals to the host (output) via interface connection J1/P1. The data transfer signals are differential in nature and provide data either to (write) or from (read) the drive via J2/P2 (defined by EIA RS-422).

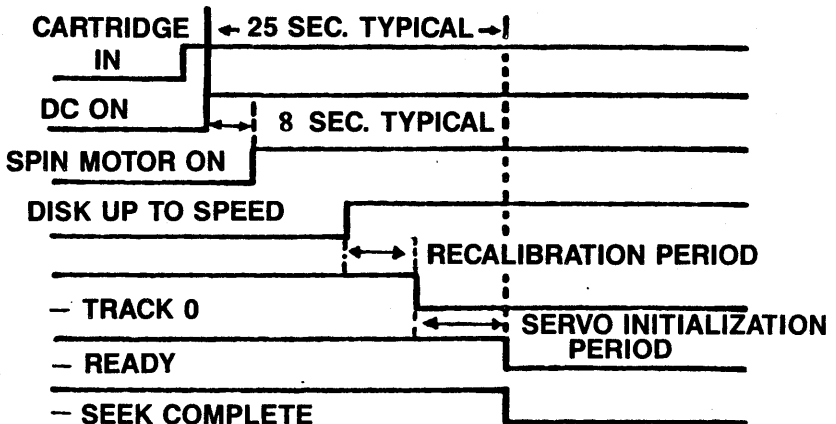


FIGURE 4-1

POWER UP SEQUENCE

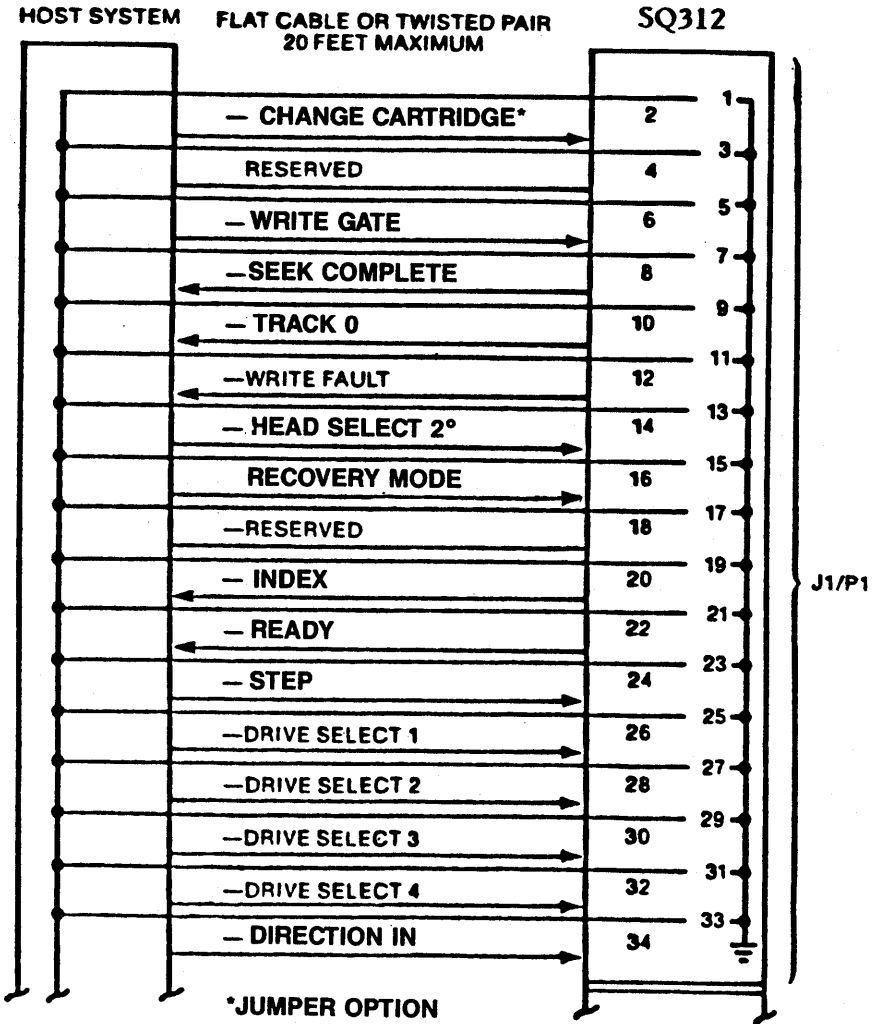
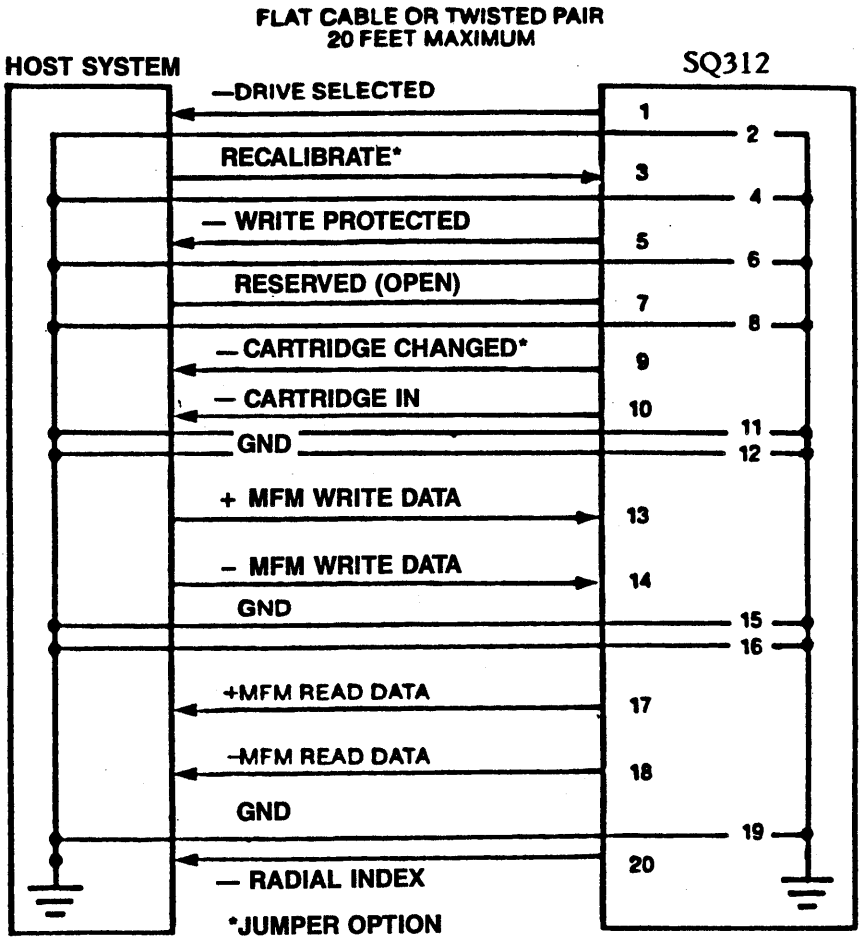


FIGURE 4-2  
CONTROL SIGNALS



**FIGURE 4-3  
DATA SIGNALS**

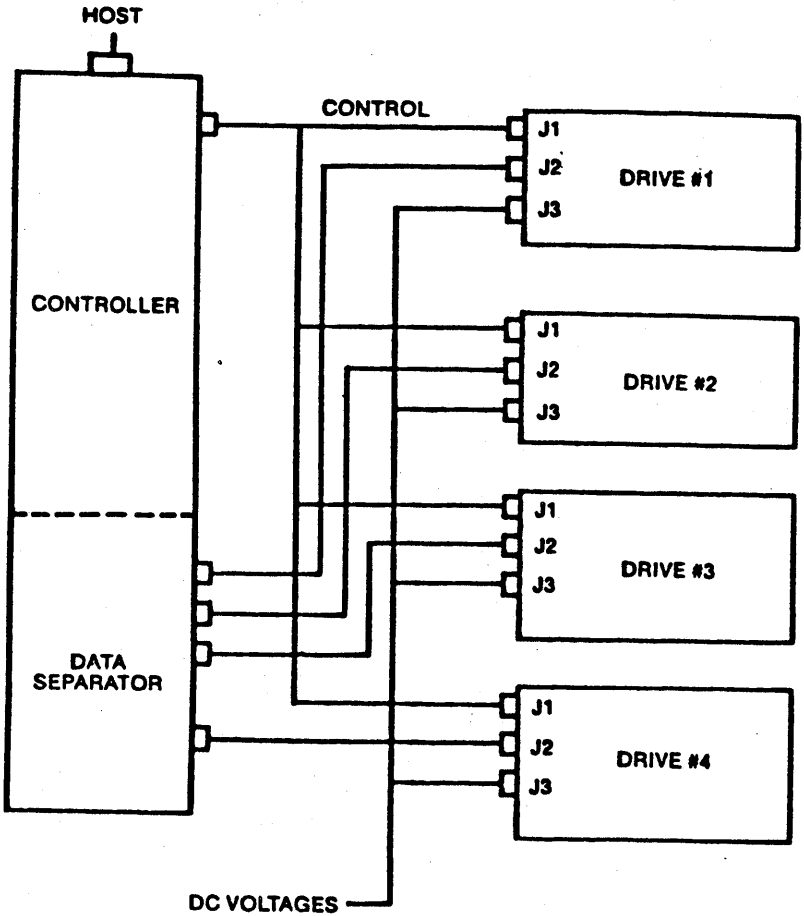


FIGURE 4-4  
TYPICAL CONNECTION, 4 DRIVE SYSTEM

**TABLE 4-1**  
**J1/P1 CONNECTOR PIN ASSIGNMENT**

GND PIN	SIGNAL	SIGNAL NAME
1	2	-Change Cartridge*
3	4	-Reserved
5	6	-Write Gate
7	8	-Seek Complete
9	10	-Track Zero
11	12	-Write Fault
13	14	-Head Select 2 <sup>0</sup>
15	16	-Recovery Mode*
17	18	-Reserved
19	20	-Index
21	22	-Ready
23	24	-Step
25	26	-Drive Select 1
27	28	-Drive Select 2
29	30	-Drive Select 3
31	32	-Drive Select 4
33	34	-Direction In

**\* Jumper Option**

**TABLE 4-2****J2/P2 CONNECTOR PIN ASSIGNMENT**

<b>GND PIN</b>	<b>SIGNAL</b>	<b>SIGNAL NAME</b>
2	1	-Drive Selected
4	3	Recalibrate*
6	5	-Write Protected
8	7	Reserved
	9	-Cartridge Changed
	10	-Cartridge In
12	11	GND
	13	+Write Data
	14	-Write Data
16	15	GND
	17	+Read Data
	18	-Read Data
	19	GND
	20	-Radial Index

**\* Jumper Option**

**TABLE 4-3****J3/P3 POWER CONNECTOR PIN ASSIGNMENT**

<b>PIN</b>	<b>VOLTAGE</b>
1	+12 Volts DC @ .9 AMPS
2	GND
3	GND
4	+5 Volts DC @ .9 AMPS

+12 Volts requires 1.5 AMPS maximum at power-on.

## **4.2 Control Input Lines**

The control input signals are two of types; those to be multiplexed in a multiple drive system and those intended to do the multiplexing. The control input signals to be multiplexed are Write Gate, Head Select 2<sup>0</sup>, Change Cartridge, Step, Direction In, Recovery Mode, and Recalibrate.

The input lines have the following electrical specifications. Refer to Figure 4-5 for the recommended circuit.

**TRUE:** 0.0 VDC to 0.4 VDC @I = 40 mA (MAX)

**FALSE:** 2.5 VDC to 5.25 VDC @I = 250 uA (OPEN COLLECTOR)



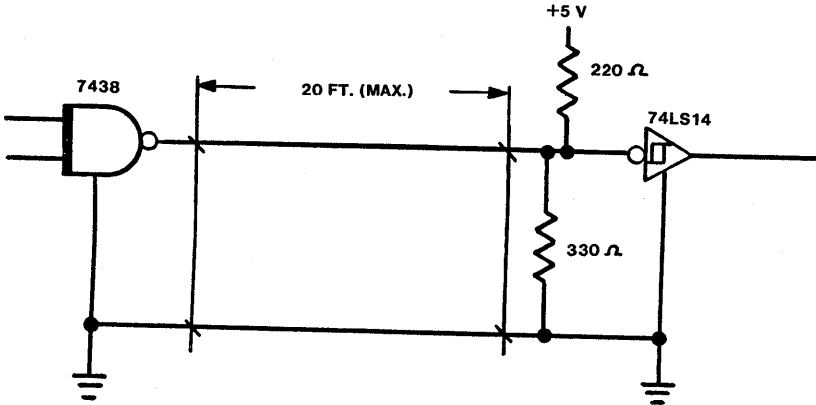


FIGURE 4-5

## CONTROL SIGNALS DRIVER/RECEIVER COMBINATION

### 4.2.1 Write Gate

The active state of this signal, or low level, enables write data to be written on the disk. The inactive state of this signal, or high level, enables data to be transferred from the drive.

A 220/330 ohm resistor pack allows for line termination.

### 4.2.2 Head Select 2°

This line allows selection of each individual read/write head. Heads are numbered 0 and 1, with head 0 being the bottom head in the drive. When

the state of the head select line is changed, Seek Complete will go false within 100 nsec, while the heads are moved to their nominal position. The state of the head select line is latched in the drive with Drive Select and should be static for 100 nsec before Drive Select goes true to 100 nsec after Drive Select goes false. For optimum performance, namely a combined seek and head select, the head select line should be active for 200  $\mu$  sec maximum before the first step pulse to 200  $\mu$  sec maximum after the last step pulse as shown in Figure 4-6.

A 220/330 ohm resistor pack allows for line termination.

### **4.2.3 Direction In**

When this signal is active and the Step line is pulsed, the R/W heads are moved in toward the center of the disk. When the Step line is pulsed and the Direction In signal is inactive, the R/W heads are moved out away from the center of the disk. This signal, along with DRIVE SELECT, must be true at least 100 nsec prior to the leading edge of the first step pulse and must remain true for a minimum of 100 nsec after the last step pulse as shown in Figure 4-7.

### **4.2.4 Step**

The R/W heads are moved when this signal is pulsed. The motion is initiated on the leading edge of the pulse which must be at least 100 nsec in duration.

For buffered seek, the step rate is 2  $\mu$  sec minimum to 200  $\mu$  sec maximum and for slow seek, the step rate is 3 msec minimum to 5 msec maximum. Any pulses issued at a rate between 200  $\mu$  sec and 3 msec

may be lost. If no pulse is issued for 5 msec, then additional pulses should not be issued until Seek Complete is true.

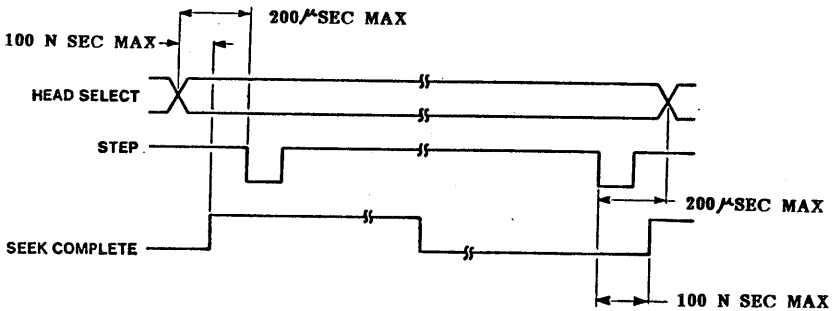


FIGURE 4-6

### HEAD SELECT

#### 4.2.5 Recalibrate

If W9 is installed, then a pulse on J2 pin 3 will initiate a rezone function in the drive. During the zoning process, track location and cartridge runout are reprogrammed by the drive microprocessor. Drive Select and Ready must be true and the minimum pulse width shall be 100 nsec.

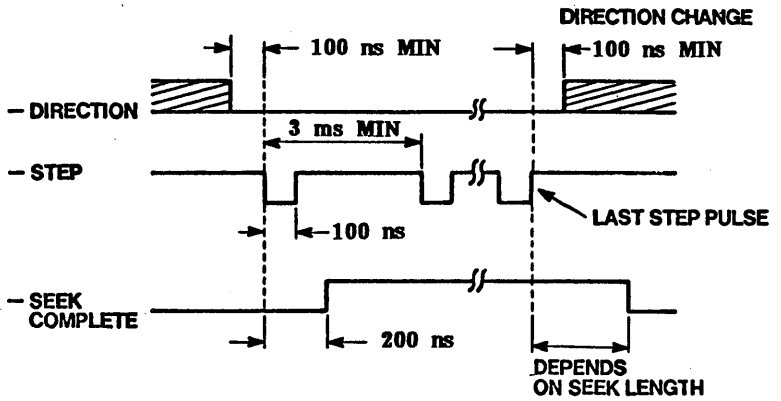


FIGURE 4-7

SLOW SEEK TIMING

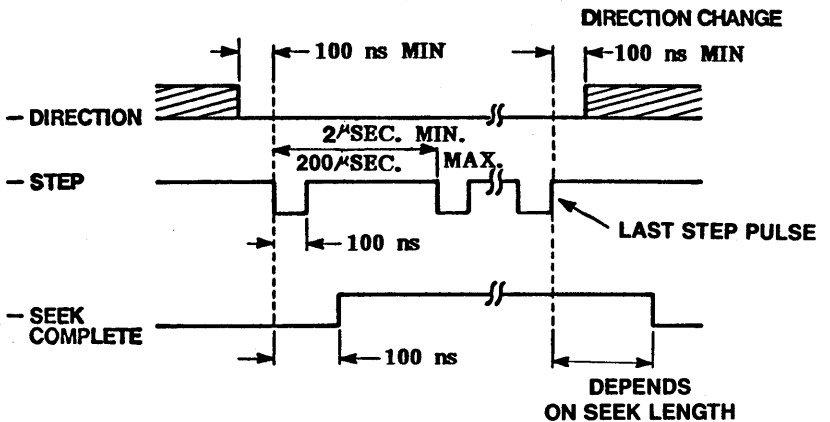


FIGURE 4-8

BUFFERED SEEK TIMING

## **4.2.6 Recovery Mode**

### **a) Single Track Recover Mode (ECL 3 and above only)**

When Auto Recovery is not active, single track recovery may be initiated by setting Recovery Mode active. A seek or head switch operation may be combined with Recovery Mode. This signal must be static within 200  $\mu$  secs after the last seek pulse or head switch. If recovery mode is true and seek complete is active, the following sequence will be executed.

1. The heads will be positioned +60 microinches from the track center for 3 revolutions.
2. The heads will be positioned at the track center for 3 revolutions.
3. The heads will be positioned -60 microinches from the track center for 3 revolutions.

The heads will be positioned at the track center at the end of the sequence. While Recovery Mode is held active, the cartridge will be internally write protected. When Recovery Mode is changed to the false state, Seek Complete will go to the false state while the heads are moved to the nominal position and the internal write protect will be removed.

### **b) Auto Recovery Mode**

Continuous offset seeking Recovery Mode may be selected by holding Recovery Mode active or installing the recovery mode jumper during power-up or during a door closure. In continuous Recovery Mode, whenever Seek Complete is active, the heads will be stepped at one increment each two revolutions (32 msec) between the extremes of the cartridge runout. In this mode, the controller should

perform continuous retries for a minimum of 32 revolutions or 1.02 seconds for each sector/track to be recovered. Continuous offset seeking Recovery Mode allows the disk cartridge to operate with excessive runout. Writing data is not allowed. Seeks may be performed as usual.

If W8 is installed, then both Recovery Modes can be activated from the interface as specified and W10 is not necessary. If W8 is not installed, then Auto Recovery can be activated by using the W10 jumper option.

#### 4.2.7 Drive Select 1-4

**DRIVE SELECT** is when a low level connects the drive interface to the control lines. The following table indicates location of **DRIVE SELECT** shunt:

<u>DRIVE SELECT</u>	<u>SHUNT PLACEMENT</u>
1	Pins 1 and 2
2	Pins 2 and 3
3	Pins 4 and 5
4	Pins 5 and 6
Radial	Pins 7 and 8

#### 4.2.8 Change Cartridge

The Change Cartridge is a jumper option. This feature can be selected by installing a jumper at W3 on the control PCB. When selected, the spindle motor will cycle down when the Change Cartridge line becomes active. This feature can be used in conjunction with a message to the operator that a cartridge change is required. The operator must

press the **FRONT PANEL SWITCH** and open the drive door. The spindle motor will cycle back up to speed when a new cartridge is inserted and the door is closed. The minimum pulse width for this signal to be recognized is 100 nsec.

### 4.3 Control Output Lines

The control output signals are Seek Complete, Track 0, Write Fault, Index, Ready, Drive Selected, Cartridge In, Write Protected, Cartridge Changed\*, and Radial Index\*. The output control signals are driven with an open collector output stage capable of sinking a maximum of 48mA at low level, or true state, with maximum voltage of 0.4V measured at the driver. When the line drive is in the high level, or false state, the driver transistor is off and the collector leakage current is a maximum of 250uA.

All J1 output lines are enabled by their respective **DRIVE SELECT** line.

Figure 4-5 shows the recommended circuit.

#### 4.3.1 Seek Complete

This line will go to a low level, or true state, when the Read/Write heads have settled on the final track at the end of a seek. Reading or writing should not be attempted when Seek Complete is false.

**SEEK COMPLETE** will go false in six cases:

1. A recalibration sequence is initiated (by drive logic) at power-on, or the recalibrate signal is set true.
2. 100 ns after the leading edge of a step pulse or series of step pulses.

3. If +5 volts or +12 volts are lost momentarily but restored, or Write Fault status is active.
4. If the Drive is selected, SEEK COMPLETE will go false 100 nsec after a new head is selected.
5. When Recovery Mode is changed to the inactive state after being active.
6. If Change Cartridge is set active.

#### **4.3.2 Track 0**

This interface signal indicates a low level, or true state, when the drive's Read/Write heads are positioned at cylinder zero (the outermost data track). This line will be active after the first rezero operation during power-up or after the execution of the Recalibrate function or a rezero operation. A rezero will occur if a seek is made to a track less than track 0 or greater than track 614. Any normal seek, including a seek to track 0, will cause the track 0 status to go false.

#### **4.3.3 Write Fault**

This signal is used to indicate a condition exists in the drive that may cause improper writing on the disk. When this line is a low level or true, further writing and stepping is inhibited in the drive until the condition is corrected. To insure data integrity, a Write Fault condition cannot be reset via the interface. If the Write Fault is persistent, the cause must be identified and corrected.

The following conditions will cause a Write Fault:

1. Write Gate is active when the operating cartridge has a Write Protect Tab installed.



2. Multiple or no heads are selected or improperly selected.
3. No write transitions or write current.
4. DC voltages are grossly out of tolerance.
5. Attempting to write with Recovery Mode.
6. Attempting to write when Seek Complete is false.

If W4 is not installed, the drive will latch on a fault condition. This latch may be cleared by deselecting and reselecting the drive.

#### 4.3.4 Index

This interface signal is provided by the drive once each revolution (16.9 ms nom.) to indicate the beginning of a track. Normally, this signal is a high level and makes the transition to a low level to indicate **INDEX**. Only the transition from high to low is valid. See Figure 4-9.

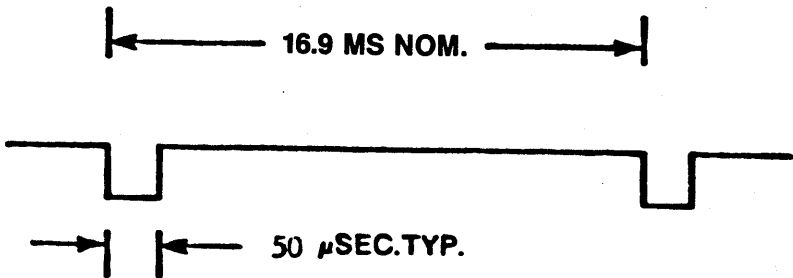


FIGURE 4-9  
INDEX TIMING

#### **4.3.5 Ready**

The drive is Ready to read, write, or seek when this and the Seek Complete signals are active. This line shall become active 25 seconds after power is applied to the drive.

The signal is not active when:

- a) Disk is not rotating at the correct speed.
- b) DC voltages are grossly out of tolerance.
- c) Write Fault is active.

#### **4.3.6 Drive Selected**

An active state of this signal indicates the selected drive has received a Drive Select signal. The activity LED will be orange when the drive is Selected and Seek Complete is true.

#### **4.3.7 Cartridge In**

Active state of this signal indicates a cartridge has been inserted in the drive and the door is closed.

#### **4.3.8 Write Protected**

When the cartridge's Write Protect Tab is installed, or if Recovery Mode is active, the drive is prevented from writing on the disk and the signal is active.

### 4.3.9 Cartridge Changed

This signal is true after a cartridge is removed from the drive. It remains true until the drive is selected then deselected, or if Select is true, Until select is false.

### 4.3.10 Radial Index

This signal is not gated with Drive Select in order to provide continuous sector timing. The timing for the signal is the same as the Index signal.

## 4.4 Data Transfer Lines

All lines associated with the transfer of data between the drive and the controller are differential in nature and may not be multiplexed. These lines are provided at the J2/P2 connectors on all drives.

Two pair of balanced signals are used for the transfer of data; **WRITE DATA** and **READ DATA**. Figure 4-10 illustrates the driver/receiver combination used in the drive for data transfer signals.

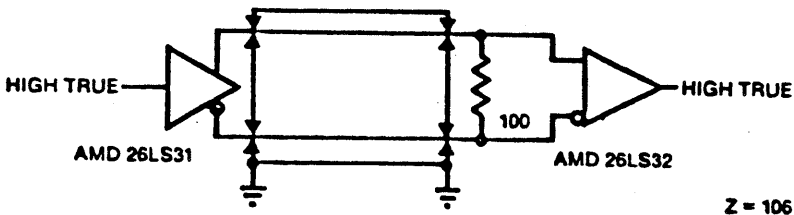


FIGURE 4-10

DATA LINE DRIVER/RECEIVER COMBINATION

#### **4.4.1 MFM Write Data**

This is a differential pair that defines the transitions to be written on the track. The transition of **+MFM WRITE DATA** line going more positive than the **-MFM WRITE DATA** will cause a flux reversal on the track provided **WRITE GATE** is active. **NO WRITE PRECOMPENSATION IS TO BE PERFORMED BY THE CONTROLLER.** An optional 100 ohm resistor is used for termination.

#### **4.4.2 MFM Read Data**

The data recovered by reading a pre-recorded track is transmitted to the host system via the differential pair of **MFM READ DATA** lines. The positive transition of the **+MFM READ DATA** line represents a flux reversal on the track of the selected head.

**NOTE: An optional 100 ohm resistor is used for termination.**

#### **4.4.3 Read/Write Timing**

The timing diagram as shown in Figure 4-11 depicts the necessary sequence of events (with associated timing restrictions) for proper read/write operation of the drive.

## 4.5 Drive Selected

A status line is provided at the J2/P2 connector to inform the host system of the selection status of the drive.

The **DRIVE SELECT** line is driven by a TTL open collector driver as shown in Figure 4-5. This signal will go active only when the drive is programmed as drive x (x = 1, 2, 3, or 4) (refer to Figure 4-12 by moving the shunt on the drive.) The **DRIVE SELECT X** line at J1/P1 is activated by the host system.

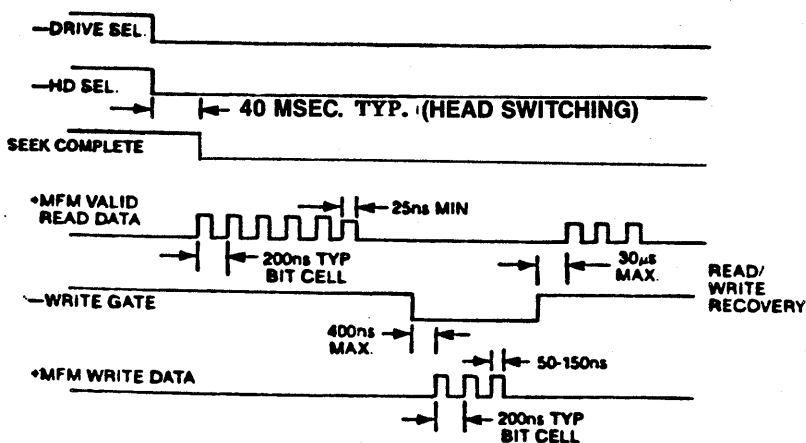


FIGURE 4-11

### READ/WRITE DATA TIMINGS

## 4.6 Option Shunt Block

The Radial Option is implemented via a shunt block position "R" on the main printed circuit board for customer configuration of drive functions.

As shipped, the shunt block is plugged in "1" position. This results in a daisy chain operation. Outputs are not active until the drive is selected. Moving the shunt block to "R" position results in radial operation. In this case all output signals are active and the drive is always selected.

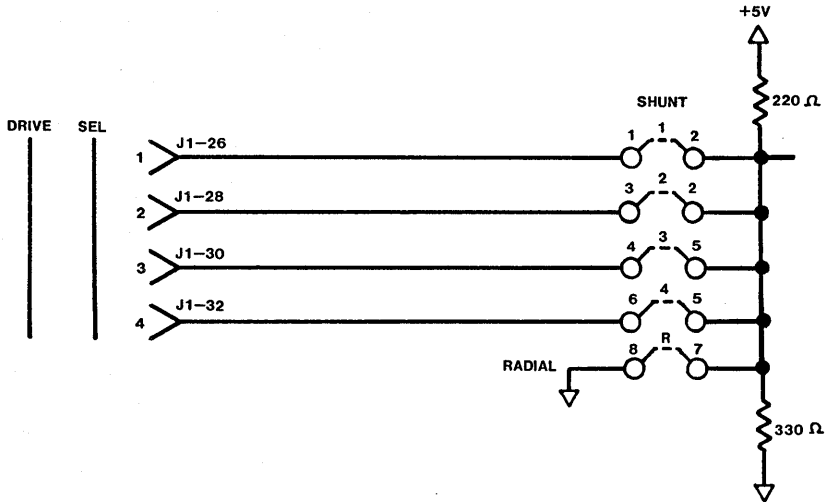


FIGURE 4-12

OPTION SHUNT BLOCK

# SECTION 5

## PHYSICAL INTERFACE

The electrical interface between the SQ312RD and the host controller is via three (3) connectors:

1. J1 - Control signals (multiplexed)
2. J2 - Read/write signals (radial)
3. J3 - DC power input

Refer to Figure 5-1 for connector locations.

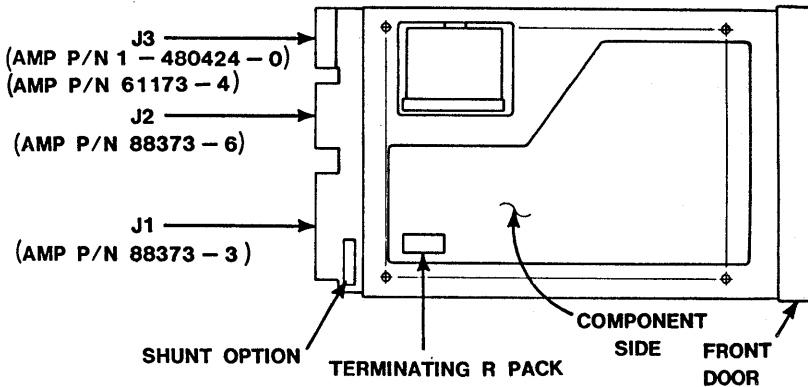


FIGURE 5-1  
INTERFACE CONNECTOR PHYSICAL LOCATIONS





## 5.2 J2/P2 Connector - Data Signals

Connection to J2 is through a 20 pin edge connector. The dimensions for the connector are shown in Figure 5-3. The pins are numbered 1 through 20 with the even pins located on the component side of the PCB. The recommended mating connector for P2 is AMP ribbon connector P/N 88378-6 or Molex P/N 15-35-1201.

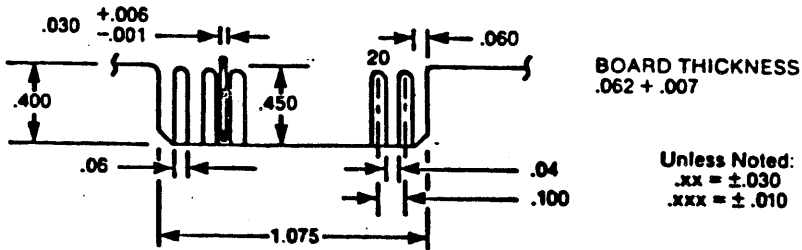


FIGURE 5-3

### J2 CONNECTOR DIMENSIONS

## 5.3 J3/P3 Connector - DC Power

DC power connector (J3) is a 4 pin AMP Mate-N-Lok connector, P/N 61173-4, mounted on the edge of the PCB. The recommended mating connector (P3) is AMP P/N 350078-4 (Strip) or P/N 61173-4 (Loose Piece).

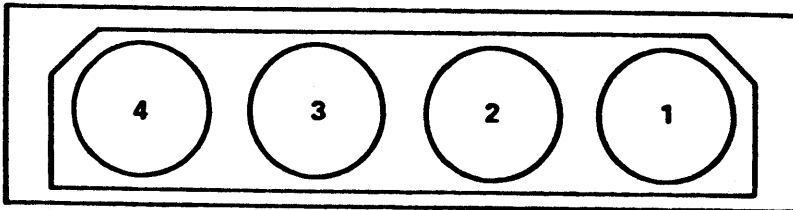


FIGURE 5-4

### J3 CONNECTOR-DRIVE PCB SOLDER SIDE

# SECTION 6

## PHYSICAL SPECIFICATIONS

### 6.1 General Description

This section describes the mechanical dimensions and mounting recommendations for the SQ312RD.

#### 6.1.1 Mounting Orientation

Recommended orientation is either vertical on either side or horizontal with PCB down. In final mounting configuration, insure that operation of the four shock mounting screws do not protrude inside the frame more than 0.125 inches.

#### 6.1.2 Mounting Holes

Eight mounting holes, four on the bottom and two on each side, are provided for mounting the drive in an enclosure. The size and location of these holes are shown in Figure 7-1. Insure that the four mounting screws do not protrude inside the drive frame more than 0.125 inches.

#### 6.1.3 Physical Dimensions

Overall height, width, depth, and other key dimensions are shown in Figures 7-1 and 7-2.

#### **6.1.4 Air Flow Requirement**

Air flow must be provided to cool the PCB's. The drive mounting frame has perforated holes to allow air to flow over the PCB.

#### **6.1.5 Shipping Requirement**

For shipping the heads are positioned over track 000.

# SECTION 7

## TRACK FORMAT

The purpose of a format is to organize a data track into smaller sequentially numbered blocks of data called sectors. The format is a soft sector type which means that the beginning of each sector is defined by a pre-written identification (ID) field which contains the physical sector address plus cylinder and head information. The ID field is then followed by a user supplied data field.

The format is a slightly modified version of the IBM System 34 double density format which is commonly used on floppy disk drives. The encoding method is Modified Frequency Modulation (MFM).

Figure 7-3 shows the track format as shipped; 8192 Bytes/user data are available on each track, based on 32 sectors, each having 256 bytes of user data.

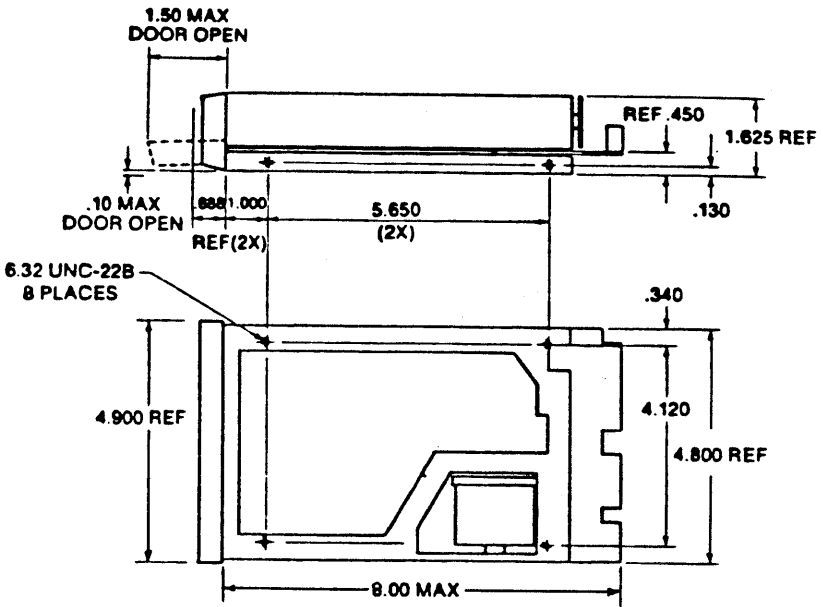
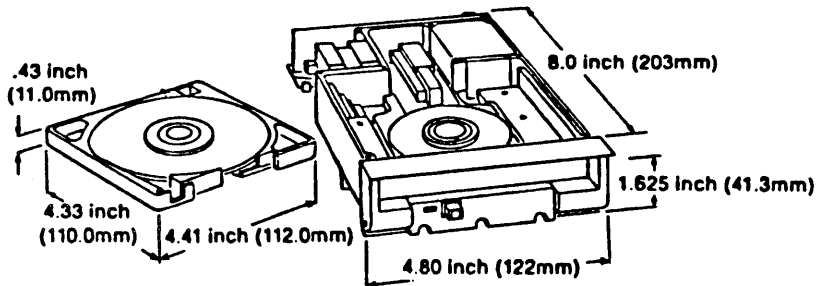


FIGURE 7-1

MOUNTING PHYSICAL DIMENSIONS



**FIGURE 7-2**  
**DIMENSIONAL VIEW**

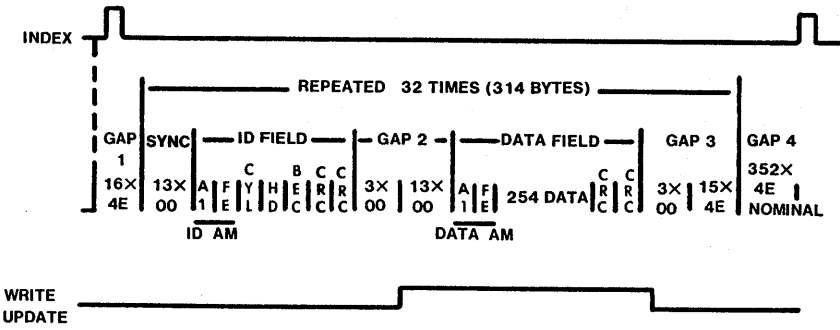
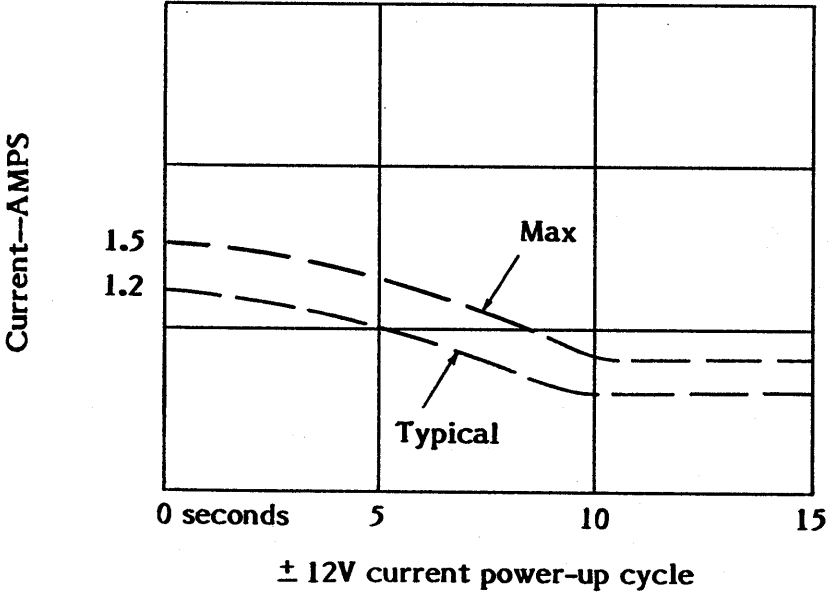
**TABLE 7-1**  
**DC POWER REQUIREMENTS**

J3 Connector	Current AMPS	
	Max	Typ
Pin 4 +5 Volts DC $\pm$ 5%	1.0	.8
Pin 3 +5 Volt Return		
Pin 1 * +12 Volts DC $\pm$ 5%	1.5	.8
Pin 2 * +12 Volt Return		

\* $\pm$  10% at power-on or seeking, +5% for reading or writing.

\*Occurs only during power-up, per curve, Table 7-2.

**TABLE 7-2**  
**MOTOR START CURRENT REQUIREMENTS**



**FIGURE 7-3**  
**TRACK FORMAT AS SHIPPED**

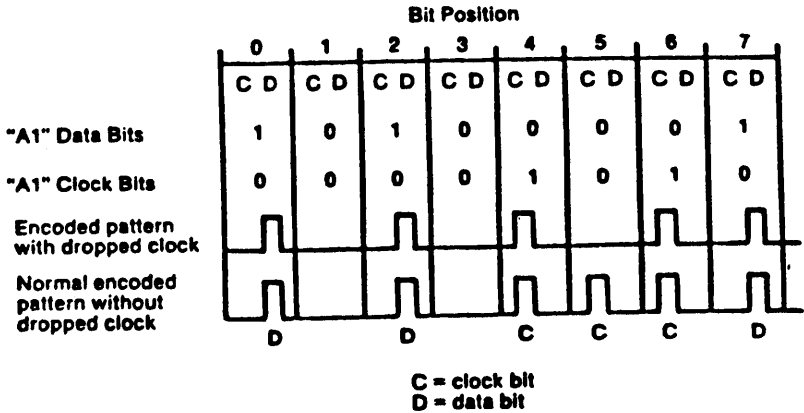


FIGURE 7-4

### "A1" ADDRESS MARK BYTE

The beginnings of both the ID field and the data field are flagged by unique characters called address marks. An address mark is two bytes in length. The first byte is an "A1" data pattern. This is followed by either an "FE" pattern for an ID address mark, or an "F8" pattern for the data address mark.

The "A1" pattern is made unique by violating the encoding rules of MFM by omitting one clock bit. This makes the address mark pattern unique to any other serial bit combination that could occur on the track. See Figure 7-4 depiction of the "A1" Byte. Each ID and data field is followed by a 16 bit cyclic redundancy check (CRC) character used for a particular data pattern.

Surrounding the ID and data fields are gaps to establish physical and timing relationships between these fields.



## **7.1 Gap 1**

Gap 1 is to provide for variations in index detection. Gap 1 must be at least 16 Bytes. Gap 1 is immediately followed by a sync field preceding the first ID field.

## **7.2 Gap 2**

Gap 2 follows the CRC Bytes of the ID field and continues to the data field address mark. It provides a known area for the data field write splice to occur. The latter portion of this gap serves as sync-up area for the data field AM. Minimum length required is determined by the "lock up" performance of the phase-lock-loop in the data separator which is part of the host control unit.

## **7.3 Gap 3**

Gap 3 following each data field allows for the spindle speed variations. This allows for the situation where a track has been formatted while the disk is running faster than nominal, then write updated with the disk running slower than normal. Without this gap, or if it is too small, the sync Bytes or ID field of the next field could be over written. As shipped, the gap allows a  $\pm 3\%$  speed variation (actual drive spec is  $\pm 1\%$ ). Minimum gap is 8 Bytes for a 256 Byte record size.

## **7.4 Gap 4**

Gap 4 is a speed tolerance buffer for the entire track, which is applicable in full track formatting operations to avoid overflow into the index area. The format operation which writes ID fields, begins with the first encountered index and continues to the next index. The actual Bytes in Gap 4 depends on the exact rotating speed during the format operation.

## **7.5 Sector Interleaving**

As shipped, the track format uses an interleave factor of 4. That is sequentially sectored ID Numbers are 0, 8, 16, 24, 1, 9, 17, 25, 2, 10, 18, 26, etc. This allows sufficient system turnaround time to process multiple sectors during a single revolution, thus enhancing throughput of typical file read/write operations.

## **7.6 Defective Sector Flags**

A printout will be provided with each cartridge which lists the location of defects in terms of head number, cylinder number, sector, and Byte.

No units will be shipped to customers if surface analysis identifies more than 16 hard errors per cartridge.

A hard read error (non-recoverable) is defined as an error which cannot be recovered within eight retries, providing that the data had previously been written correctly. No errors will be present on cylinder 0.

## **SECTION 8**

# **CARTRIDGE ACCLIMATIZATION**

The Cartridge should be allowed to stabilize at room temperature of operating environment for a minimum of one hour to insure Cartridge interchangeability and Data Reliability.

# SECTION 9

## CLEANING CARTRIDGE

### 9.1 Materials Required

- a. Cleaning Cartridge - Red Plastic Cartridge.
- b. Clean Replaceable Foam Pad.
- c. Freon - Mallinckrodt #2857 (112 Trichloro - 122 Trifluoroethane).

### 9.2 Procedure

1. Apply two to three drops of freon to the foam pad which is affixed to the center of the cleaning cartridge. Foam pad should be moist, but not soaked, prior to each cartridge insertion. See Figure 9-1.
2. Insert the cleaning cartridge into the drive. See Figure 9-1.
3. Close the drive door and wait 15 seconds.
4. Push the drive door button and wait for the blinking light to stop.
5. When the blinking light has stopped, remove the cleaning cartridge from the drive.
6. Proceed with normal operating procedure.

**NOTE: Freon is available in most electronic retail stores.**

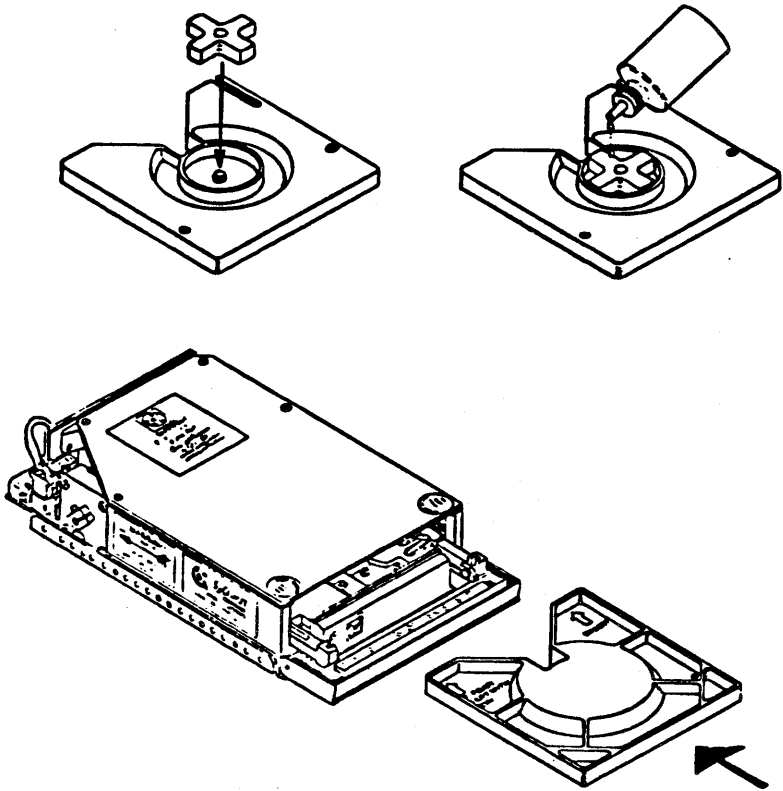


FIGURE 9-1

C-PAK™ INSTRUCTIONS

### **9.3 Maintenance**

Replace foam pad when dirty (approximately every 10 insertions). See Figure 9-1.

1. Remove old foam pad from the cleaning cartridge.
2. Remove the paper back from a new foam pad.
3. Affix the new foam pad (sticky side toward the cleaning cartridge) onto the cleaning cartridge.
4. Keep the cleaning cartridge and the foam pads in a clean area so that no contaminants accumulate on the cartridge or the foam pads.

# SECTION 10

## MOUNTING OPTIONS

### 10.1 General Description Option III

**Option III:** Assembly kit for mounting the SyQuest disk drive into a half-height 5.25" drive enclosure.

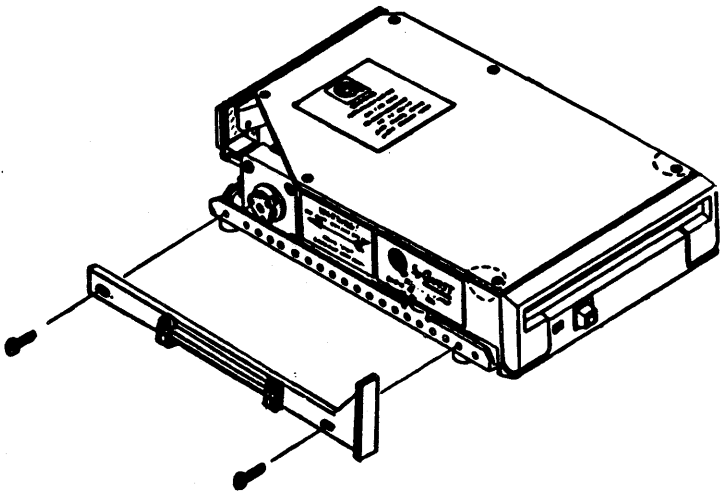
Each kit should contain the following:

Item	Part No.	Description	Qty.
1	92039-002	Bracket Assy. Left Side	1
2	92039-001	Bracket Assy. Right Side	1
3	50673-500	Screw, Panhead, Phillips 6-32 x 7/16	4

#### 10.1.1 Procedure

The following procedure should be performed in the listed sequential order to save time and avoid damage to the disk drive and/or the mounting bracket assembly. The following should be performed on a flat and level surface.

1. Place the drive on its right side and attach the left side bracket assembly (Item #1) with 2 of the mounting screws (Item #3) provided as shown in Figure 10-1. Do not tighten the mounting screws.
2. Slide the left side bracket assembly forward to the door panel assembly until the two assemblies make contact. Move the bracket assembly back enough to break contact with the door panel assembly (See Figure 10-2) and tighten the mounting screws.



**FIGURE 10-1**

**MOUNTING OPTION HALF-HEIGHT OPTION KIT**



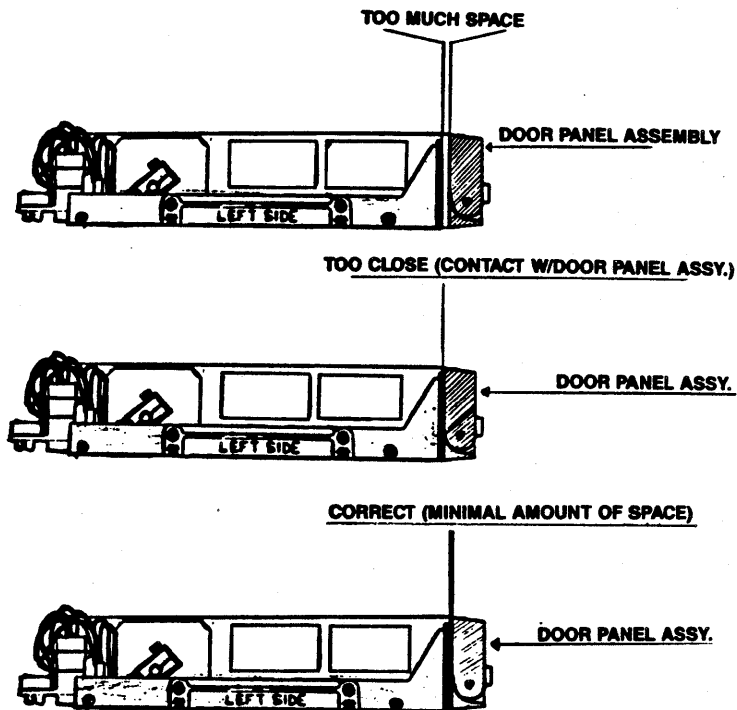


FIGURE 10-2

MOUNTING BRACKET OPTION SPACING

**CAUTION:** The bracket assembly **must not** be installed in a manner where the bracket makes contact with the door panel assembly. The door panel assembly and the frame assembly are isolated by chock mounts. Allowing the bracket and door panel to make contact will result in vibration transfer, thus the possibility of damage to the drive and/or the media.

3. The front Bezel has one smooth edge and one edge with a small lip in it. The smooth edge should be against the bottom of the disk drive.
4. Repeat Steps 1 and 2 to mount the right side bracket assembly.

**NOTE:** The drive must be held while mounting right side bracket assembly so the unit does not fall over.

## 10.2 General Description Option I

**Option I:** Assembly kit for mounting the SyQuest disk drive into a 5.25" drive enclosure.

Each kit should contain the following:

Item	Part No.	Description	Qty.
1	90041-001	Bracket Assy. Left Side	1
2	90040-001	Bracket Assy. Right Side	1
3	51672-375	Screw, Panhead, Phillips 6-32 x 5/16	10
4	90039-001	Front Panel	1

### 10.2.1 Procedure

The following procedure should be performed in the listed sequential order to save time and avoid damage to the disk drive and/or the mounting bracket assembly. The following should be performed on a flat and level surface.

1. Place the drive on its right side and attach the left side bracket assembly (Item #1) with 2 of the mounting screws (Item #3) provided as shown in Figure 10-3. Do not tighten the mounting screws.

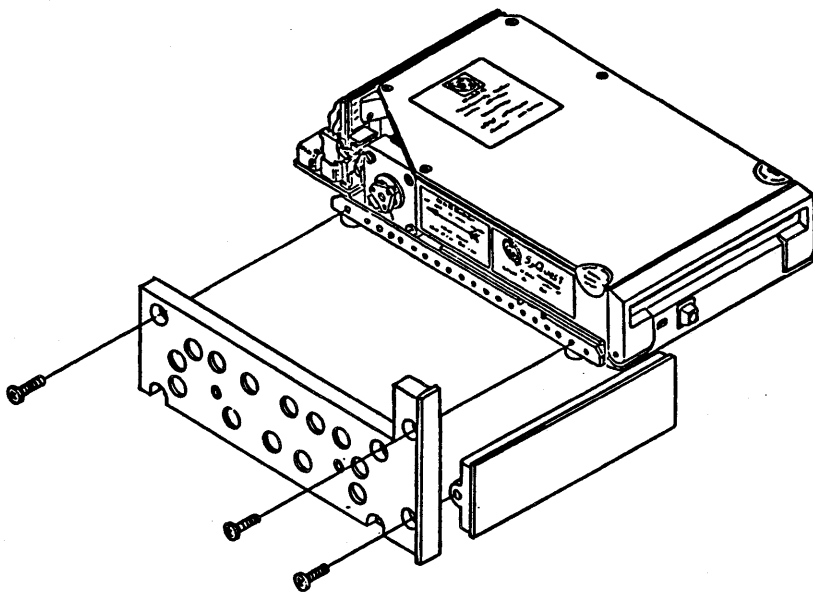


FIGURE 10-3

**MOUNTING BRACKET FULL-HEIGHT OPTION KIT**

2. Slide the left side bracket assembly forward to the door panel assembly until the two assemblies make contact. Move the bracket assembly back enough to break contact with the door panel assembly (See Figure 10-2) and tighten the mounting screws.

**CAUTION:** The bracket assembly **must not** be installed in a manner where the bracket makes contact with the door panel assembly. The door panel assembly and the frame assembly are isolated by shock mounts. Allowing the bracket and door panel to make contact will result in vibration transfer, thus the possibility of damage to the drive and/or the media.

3. The front Bezel has one smooth edge and one edge with a small lip in it. The smooth edge should be against the bottom of the disk drive. Repeat Steps 1 and 2 to mount the right side bracket assembly.

**NOTE:** The drive must be held while mounting right side bracket assembly so the unit does not fall over.

4. If two drives are being mounted, do not use the front Bezel.

# SECTION 11

## SQ312RD OPTIONS

### 11.1 General Description

The following options are available on the SQ312RD disk drive. See Figure 11-1 for location and Table 11-1 for option function.

#### 11.1.1 Write Data Termination

See Section 4 for detailed description.

#### 11.1.2 Read Data Termination

See Section 4.4.2 for detailed description.

#### 11.1.3 Change Cartridge

See Section 4.3.9 for detailed description.

#### 11.1.4 Fault Latch

See Section 4.3.3 for detailed description.

#### 11.1.5 Recovery

See Section 4.2.6 for detailed description.

### 11.1.6 Recalibrate

See Section 4.2.5 for detailed description.

### 11.1.7 Auto Recovery Mode

See Section 4.2.6 for detailed description.

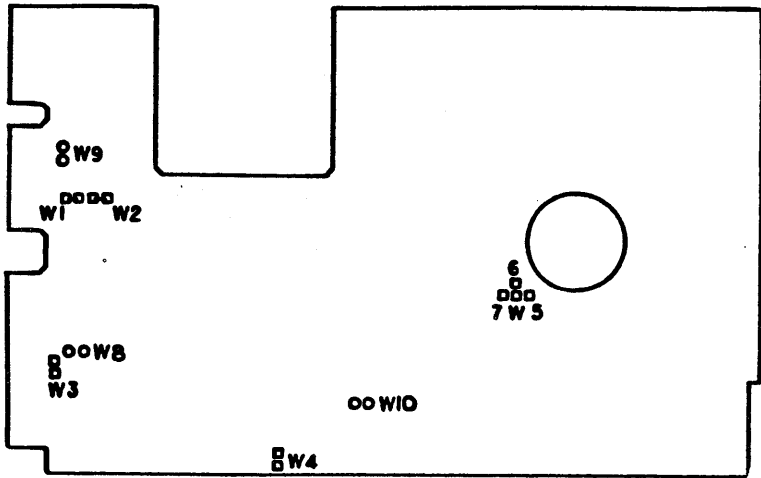


FIGURE 11-1

OPTION JUMPER

**TABLE 11-1**  
**OPTION SELECTION**

<b>JUMPER</b>	<b>FUNCTION</b>
W1	Write Data Termination (Normally connected by PCB trace)
W2	Read Data Termination (Normally connected by PCB trace)
W3	Change Cartridge Option†
W4	Fault Latch Option (Normally connected by PCB trace - cut for latched operation)
W5	Factory Use Only
W6	Factory Use Only
W7	Factory Use Only
W8	Recovery Option†
W9	Recalibrate Option†
W10*	Connect for Auto Recovery Mode (Open for normal operation)

† Cut Jumper To Defeat Option

\* Jumper Plug Option

**(Note: Drives shipped from the factory have these jumpers installed.)**

## NOTES