CONTROL DATA CORPORATION

SPEC	77738208
CD	6
REV	B
DATE	October 1985

PRODUCT SPECIFICATION

FOR

WREN II™ SCSI (SASI™ SUBSET)

DISK DRIVE

MODEL 94151

MAGNETIC PERIPHERALS, INC.
a Control Data Company

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THIS SPECIFICATION OUTLINES THE PRODUCT CHARACTERISTICS AND PERFORMANCE CRITERIA OF THE 94151 WREN II SCSI (SASI™ SUBSET).

SPECIFIC MODEL AVAILABILITY CAN BE CONFIRMED BY YOUR CDC OEM SALES REPRESENTATIVE.

SUMMARY

The CDC WREN Peripheral family is composed of the following members. For information on each refer to appropriate documents.

- WREN I 9415-5XX

  Product Specification: 77715793
  Interface: CDC 506 (ST506 Compatible)
  Unformatted Capacity: 21 to 38 MB

- WREN I 9415-3XX

  Product Specification: 77711078
  Interface: FDI
  Unformatted Capacity: 21 or 35 MB

- WREN II 94155-XX

  Product Specification: 77715909
  Interface: CDC 506 (ST506 Compatible)
  Unformatted Capacity: 48, 57, 67, 77 or 86 MB

- WREN II 94156-XX

  Product Specification: 77738019
  Interface: ESDI
  Unformatted Capacity: 48, 67 or 86 MB

- WREN II 94151-XX

  Product Specification: 77738208
  Interface: SCSI (SASI™ Subset)
  Formatted Capacity: 25 to 80 MB

The XX denotes unformatted drive capacity in megabytes. Model number 94156-86, for example, would be a WREN II with the ESDI Interface and 86 MB of unformatted capacity.

The WREN II Model 94151-XX is not available in unformatted models, so all capacities given are for formatted drives.

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1.0 SCOPE

This specification describes the Control Data Corporation Model 94151 Wren II SCSI (SASI™ Subset) Disk Drive. The Product incorporates the Standard WREN II HDA (Head/Disk Assembly) with an embedded SCSI (SASI™ Subset) controller.

The interface is a subset of the Small Computer System Interface (SCSI) and is compatible with the industry standard Shugart Associates System Interface (SASI™).

This interface will be referred to as SCSI for the remainder of this document. The Model 94151 WREN II is offered in different capacities with or without I/O termination.

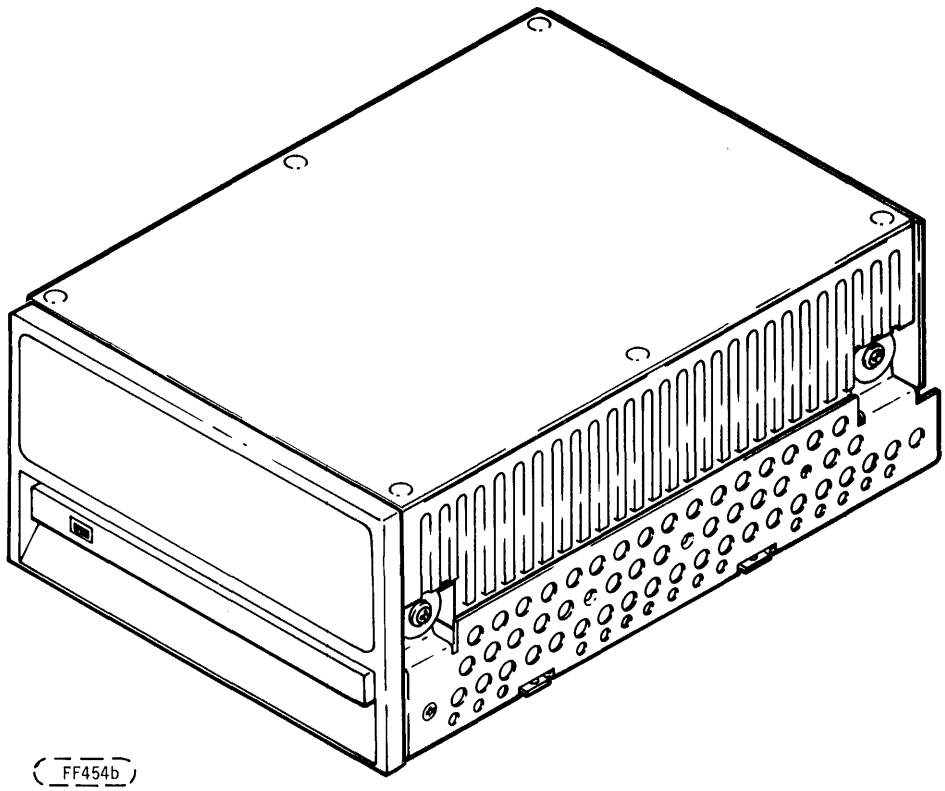


FIGURE 1. 94151 WREN II

2.0 APPLICABLE DOCUMENTS

2.1 STANDARDS

The WREN II has been developed as a system peripheral to the highest standards of design and construction. The drive, however, must depend upon its host equipment to receive adequate power and environment in order to provide optimum performance and compliance with applicable industry and governmental regulations. Special attention must be given in the areas of safety, power distribution, shielding, audible noise control and temperature regulation of the device to ensure specified performance and compliance with all applicable regulations.

The WREN II shall comply with CDC standards as noted in the appropriate sections of this specification.

In addition to the CDC standards, the WREN II shall be recognized by UL as a component under UL 478 and be certified by CSA as a component under CSA Standard C22.2 No. 154-1957 and meet the requirements of DIN IEC 380/VDE 0806/8.81.

The WREN II as delivered, is designed for system integration prior to utilization. The WREN II is supplied as a component and is not subject to standards imposed by FCC Rules and Regulations, Part 15, Subpart J governing EMI of computing devices. However, the WREN II tested as delivered, does comply with Class A of the referenced FCC regulations when installed as recommended.

2.2 DOCUMENTATION

77738035	OEM Manual
77738211	Hardware Maintenance Manual
77738148	Small Computer System Interface (SASI™ Subset) Specification

3.0 GENERAL DESCRIPTION

The WREN II is a member of a family of low cost, high performance, highly reliable, random access storage devices designed to meet the present and future needs of the OEM marketplace. It is designed to provide high performance storage and retrieval of digital data on 5-1/4 inch (130 mm) fixed media contained in an environmentally sealed Head and Disk Assembly (HDA).

3.0 (continued)

The Model 94151 WREN II supports the Small Computer System Interface (SASI™ Subset) as described in Control Data's (77738148) Interface Specification. This product specification was created to be used in conjunction with the Industry Standard Interface Specification. The information contained in these two documents defines the product performance characteristics and the interface characteristics of the Model 94151 WREN II.

The head, disk and actuator chamber is environmentally sealed at the factory. Air is recirculated within the HDA and passes through a non-replaceable absolute filter to ensure the maintenance of a contamination free disk-actuator environment.

Refer to Figure 2 for an exploded view of the WREN II. NEVER disassemble the WREN Head/Disk Assembly (HDA). This exploded view is for information only. Servicing items in the sealed environmental enclosure (heads, media, actuator, etc.) requires special facilities. The printed circuit boards and hardware external to the sealed area may be replaced without special facilities. Any disassembly of this type should be in accordance with the Hardware Maintenance Manual.

A dedicated landing zone located at the innermost radius of the media is used by the WREN II, thus eliminating the possibility of destroying or degrading data by landing in the data zone.

An automatic shipping lock is incorporated in the drive to prevent damage to the heads and disks caused by movement during shipping or handling. The shipping lock is automatically disengaged when power is applied to the drive.

The Track 0 location is decoded from the dedicated servo surface thereby eliminating mechanical transducer adjustment. There are no adjustments or preventive maintenance requirements.

The WREN II utilizes a high performance actuator assembly consisting of a low mass, balanced, straight-arm design (Patent Pending) which provides excellant performance with minimal power dissipation.

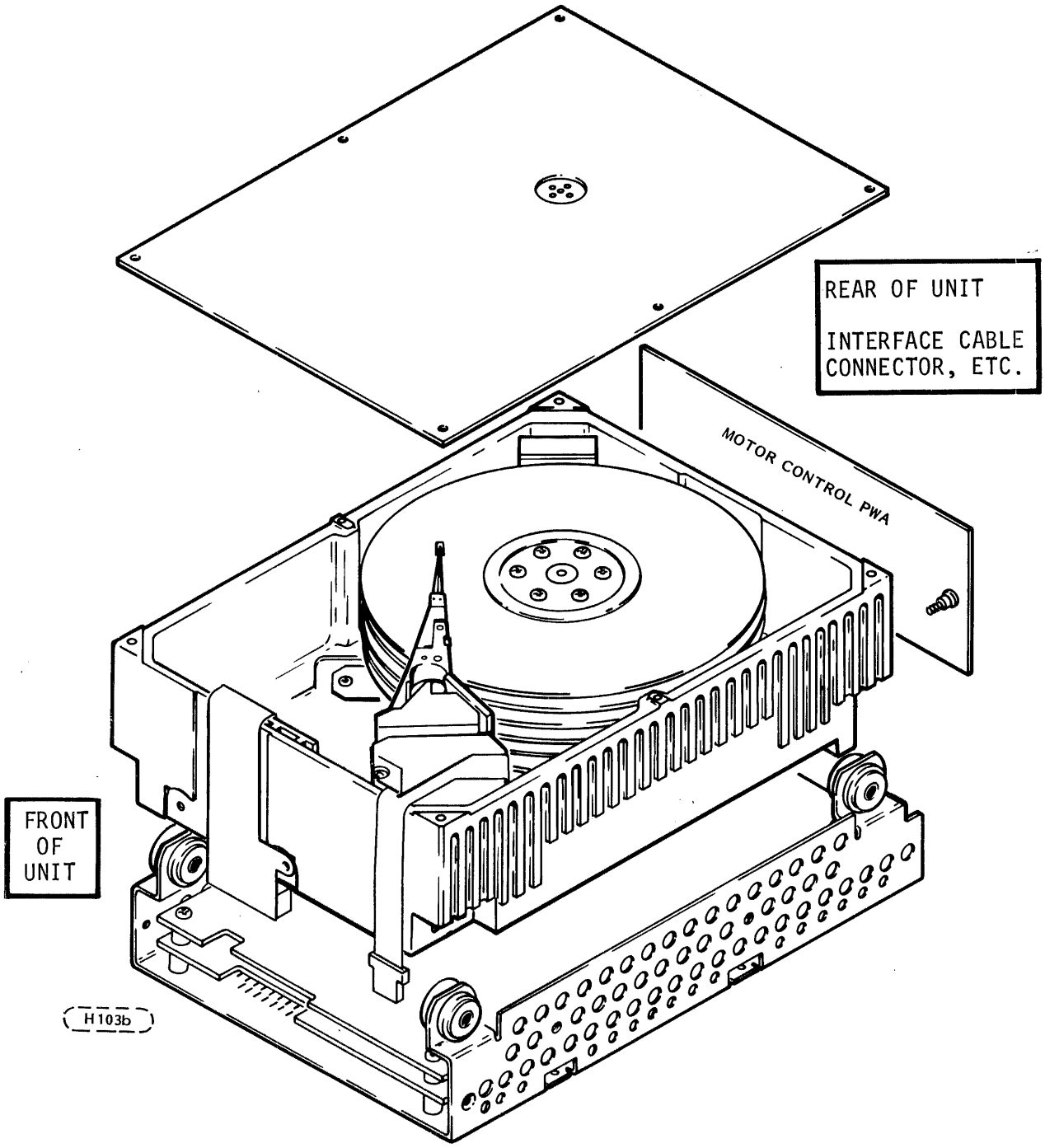


FIGURE 2. MODEL 94151 WREN II

4.0 FEATURES

4.1 STANDARD FEATURES

The Model 94151 WREN II has the following features:

- Integrated SCSI Controller (SASI™ Subset)
- 4K byte data buffer
- Automatic error recovery
- Automatic flawed sector reallocation
- 256 or 512 byte data block size
- 5 bit burst ECC
- Sealed head, disk, and actuator chamber
- No preventive maintenance required
- No adjustments required
- LSI circuity for high reliability
- Low audible noise for office environments
- Vertical (side) or Horizontal (bottom) mounting
- Low power consumption
- Balanced low mass rotary voice coil actuator
- Automatic shipping lock
- Integral shock mounts
- Dedicated head landing zone
- Dynamic spindle braking

4.2 OPTIONAL CONFIGURATIONS

WREN II SCSI configurations consist of four basic devices which differ physically by the number of installed heads and disks. Each of these devices may be formatted during production for 256 or 512 byte data blocks. The format provided is the option of the customer. This results in eight distinct models with formatted capacity as follows:

256 BYTE DATA BLOCKS		512 BYTE DATA BLOCKS	
MODEL #	CAPACITY	MODEL #	CAPACITY
94151-76*	75.9 MB	94151-80*	80.1 MB
94151-59	59.0 MB	94151-62	62.3 MB
94151-42*	42.2 MB	94151-44*	44.5 MB
94151-25	25.3 MB	94151-27	26.7 MB

*Initial production will consist of these models only.

4.3 ACCESSORIES (see Section 18.0)

- Front Panel Kit (Factory Installed)
- Hardware Maintenance Manual
- Single Unit Shipping Pack Kit

5.0 PERFORMANCE CHARACTERISTICS

5.1 INTERNAL DRIVE CHARACTERISTICS (Transparent to User)

Data Capacity Parameters (unformatted)

Bytes/Track	10,440 Bytes
Bytes/Surface	9,615,240 Bytes
Tracks/Surface	921 Tracks
Tracks/Inch	960 TPI
Bits/Inch	9600 BPI
Read/Write Heads	9 Data (Max), 1 Servo
Recording Mode	MFM
Internal Data Transfer Rate	5.0 Mbits/sec

5.2 SCSI DRIVE PERFORMANCE CHARACTERISTICS (Visible to User)

5.2.1 Seek Command Execution Time △1 △4

Average - Maximum	36 ms	△2
Typical	32 ms	△3
Single Track - Maximum	11 ms	△2
Typical	9 ms	△3
Full Stroke - Maximum	74 ms	△2
Typical	69 ms	△3

5.2.2 Format Drive Command Execution Time △1

(Maximum) 15 minutes

Minimum Acceptable Sector Interleave 2 to 1

Instantaneous SCSI Interface Data
Transfer Rate 1.25 MBytes/Sec (max)

Maximum SCSI Interface sustained Data Transfer Rate (Interleave factor equal to or greater than 2) △5 & △6

583 KBytes/Sec
Interleave +1

△ Notes are identified on Sheet 15 of this document.

5.2.3 Read Data Command Execution Time (4)
(512 Byte Sector Size)

a. From CDB reception to the drives request for the first data byte to be transferred to the Host

1. Typical (Zero Stroke Seek)	13 ms (2)
2. Typical (Average Seek)	43 ms (2)
3. Maximum (Full Stroke Seek)	107 ms (3)

b. Single Sector Read and Transfer of data to Host (time from receipt of last byte of the CDB to the request for a status byte transfer to Host) assuming a 2:1 interleave (6).

1. Typical (Zero Stroke Seek)	18 ms (2)
2. Typical (Average Seek)	48 ms (2)
3. Maximum (Full Stroke Seek)	112 ms (3)

5.2.4 Write Data Command Execution Time (4)
(512 Byte Sector Size)

a. From CDB reception to the request for the first byte of write data from the Host

1. Typical	2 ms
2. Maximum	2 ms

b. Single Sector Write (6) (7)

(Measured from receipt of the last byte of the CDB to the request for a completion status transfer to the Host)

1. Typical (Zero Stroke Seek)	13 ms (2)
2. Typical (Average Seek)	43 ms (2)
3. Maximum (Full Stroke Seek)	94 ms (3)

5.2.5 Device Command Execution Times

DEVICE COMMAND EXECUTION TIMES

COMMAND	EXECUTION TIME (8) TYP	EXECUTION TIME (8) MAX	EXECUTION TIME (1) TYP	EXECUTION TIME (4) MAX
Group Zero				
Test Drive Ready	NA	NA	450 µs	1 ms
Recalibrate	NA	NA	34 µs	89 ms
Request Sense	575 µs	1 ms	700 µs (9)	.5 ms
Check Track Format	NA	NA	550 µs	1 ms
Format Track	NA	NA	525 µs	1 ms
Format Bad Track	NA	NA	550 µs	1 ms
Read Verify		See Read Command		
Initialize Drive Characteristics	500 µs	1 ms	625 µs (9)	-
Read ECC Burst Error Length	550 µs	1 ms	675 µs (9)	-
Format Alternate Track	550 µs	1 ms	675 µs (9)	-
Write Sector Buffer	475 µs	1 ms	2.2 ms (9)	512 Byte Sector
Read Sector Buffer	475 µs	1 ms	2.2 ms (9)	512 Byte Sector
Group 07				
RAM Diagnostics	NA	NA	1.3 S	2.0 S
Drive Diagnostics	NA	NA	2.4 Min	3.0 Min
Internal Diagnostics	NA	NA	500 ms	1 S
Read Long		See One Sector Read		
Write Long		See One Sector Write		
Retry Statistics	1 ms	2 ms	1.2 ms (9)	-

NA means not applicable to the 94151.

NOTES:

(1) Execution time measured from drive receipt of the last Byte of the Command Descriptor Block (CDB) to the request for a Status Byte Transfer to the Initiator.

(2) Maximum times are specified over the worse case conditions of temperature, voltage margins and drive orientation. When comparing seek times, care should be taken not to mix typical seek times with maximum seek times. The only true comparison occurs with system benchmark tests conducted under identical conditions.

(3) Typical Seek values are measured under nominal conditions of temperature, voltage, and horizontal orientation as measured on a representative sample of drives.

(4) Assumes no errors and assumes that the sector has not been relocated.

(5) Rate measured from the start of the first sector transfer with the Host and assumes at least one head change as single track seek required plus less than 256 sectors transferred.

(6) Assumes an instantaneous data transfer rate between the drive and the Initiator of at least 625 KBytes per second divided by the Interleave factor.

(7) Assumes that the Initiator immediately begins sending Write Data to the drive when requested.

(8) Execution time measures from the drive receipt of the last byte of the Command Descriptor Block (CDB) to the first request for a Data Byte Transfer to the Host and assumes no errors were detected and no retries were required.

(9) Command execution requires a data transfer phase (not Data To/From the disk media). Assumes the initiator is instantly ready to send/receive the Data when the drive generates first request for a data byte transfer, and assumes an average data transfer rate between the drive and the Initiator of 312.5 K Bytes/Second. (i.e. 3 microseconds per data byte transfer).

5.3 START/STOP TIME

The WREN II will become ready less than 35 seconds after application of DC power. Stop time will be less than 30 seconds after removal of DC power

6.0 RELIABILITY SPECIFICATIONS

The following reliability specifications assume correct host/drive operational interface has been implemented, including all interface timings, power supply voltages, and environmental conditions.

Error Rates (3)	
Soft Read Errors (1) (Recoverable)	Less than 1 in 10^{10} bits transferred
Hard Read Errors (2) (Unrecoverable)	Less than 1 in 10^{12} bits transferred
Seek Errors (1)	Less than 1 in 10^{6} seeks
Error Rates with Retries and ECC Enabled (4)	
Probability of Not Recovering Data	TBD
Probability of Miscorrected Data	TBD
MTBF	Mature MTBF - 15,000 hours
Service Life	5 years or 30,000 hours
Preventive Maintenance	None required

NOTES:

(1) Drive automatic retry and error correction mechanisms disabled.

(2) Drive error correction mechanism disabled.

(3) Error rates are specified with drive retries and ECC disabled to allow convenient evaluation capability. During normal drive operation these features should be enabled (see section 16).

(4) See section 16 for error recovery philosophy.

6.1 ERROR RATES

The error rates stated in this specification assume that errors caused by media defects or host system failures are excluded from error rate computations. Refer to paragraph 8.0, Media Defect Recognition.

6.1.1 Read Errors

Prior to the determination or measurement of read error rates:

a. The data which is to be used for a measurement of read error rates must be verified as being written correctly on the media.
b. All media defect induced errors must be excluded from error rate calculations.

Assuming automatic retries and ECC are disabled, a recoverable error is one which can be reread correctly in 2 sets of 10 retries. After 10 retries, a seek to cylinder 0 and a seek to the desired address must be accomplished. The recoverable read error rate for any read operation with automatic retries and ECC disabled shall be less than one error in 10^{10} bits read.

6.1.2 Environmental Interference

When evaluating systems operation under conditions of Electromagnetic Interference (EMI), the performance of the WREN II within the system shall be considered acceptable if the device does not generate an unrecoverable condition.

An unrecoverable error, or condition, is defined as one which:

1. Is not detected and corrected by the device itself;
2. Or is not capable of being detected from the error or fault status provided through the device/system interface;
3. Or is not capable of being recovered by normal device or system recovery procedures without requiring operator intervention.

6.1.3 Write Errors

Write errors can occur as a result of the following: write data not being presented correctly, media defects, environmental interference, or equipment malfunction. As such, write errors are not predictable as a function of the number of bits passed.

If an unrecoverable write error occurs because of an equipment malfunction in the WREN II, the error is classified as a failure affecting MTBF. Unrecoverable write errors are those which cannot be corrected within two attempts at writing the record with a read verify after each attempt, (excluding media defects).

6.1.4 Seek Errors

Assuming automatic retries and ECC are disabled, a seek error is defined as a condition where the drive fails to position the heads to the addressed track provided the correct information has been presented to the WREN II. There shall be no more than one recoverable seek error in 10^6 physical seek operations. Unrecoverable seek errors are classified as failures for MTBF calculations.

6.2 RELIABILITY AND SERVICE

6.2.1 Mean Time Between Failure

The mature Mean Time Between Failure (MTBF) shall exceed 15,000 hours for the WREN II. MTBF is further defined as the "Operating Hours" divided by the "Number of Equipment Failures".

"Operating Hours" means total power on hours less any maintenance time. "Equipment Failure" means any stoppage or substandard performance of the equipment because of equipment malfunction, excluding stoppages or substandard performance caused by operator error, adverse environment, power failure, host adapter/initiator failure, cable failure, or other failure not caused by equipment.

The term equipment failure implies that maintenance is required because of a hardware failure.

6.2.2 Preventive Maintenance

No routine scheduled preventive maintenance shall be required.

6.2.3 Service Life

The WREN II shall have a useful service life of five years or 30,000 hours, whichever occurs first, before requiring factory refurbishment. Depot repair or replacement of major parts will be permitted during the lifetime (6.2.4).

6.2.4 Service Philosophy

Due to the sophisticated design and special equipment required to repair the WREN II HDA, repairs may only be performed at a properly equipped and staffed depot service and repair facility. Although WREN II is designed primarily for depot repair service, some items may be replaced in the field as defined in the Hardware Maintenance Manual.

6.2.5 Installation

The WREN II is designed, manufactured, and tested with a "Plug-in and Play" installation philosophy. Basically, this philosophy minimizes the requirements for highly trained personnel to integrate the WREN II into the OEM's system, whether in a factory or field environment.

6.2.6 Service Tools

No special tools are required for site installation or recommended for site maintenance. Refer to paragraph 6.2.4. The depot repair philosophy of WREN II precludes the necessity for special tools. Should field repair of items external to the HDA be desired, two sizes of 6 point Torx drivers are required. They may be ordered through CDC by the following part numbers:

PN 12263628-T9
PN 12263629-T15

7.0 PHYSICAL/ELECTRICAL SPECIFICATIONS

7.1 AC POWER REQUIREMENTS

None

7.2 DC POWER REQUIREMENTS

The voltage and current requirements for a single WREN II are shown in the following table. Values indicated apply at the drive power connector.

TABLE 1. DC POWER REQUIREMENTS

Voltage	+5 VDC	+12 VDC
Regulation	±5%	±5% (2)
Ripple	50 mV	100 mV
Maximum Operating Current (1)	1.5 A	2.4 A
Typical Operating Current (1)	1.2 A	2.0 A
Maximum Starting Current (Peak)	1.9 A	4.5

(1) Measured with average reading DC ammeter.

(2) A ±10% tolerance is permissible during power up. The ±5% must be maintained commencing with UNIT READY.

Note 1:
At power-up, the motor current regulator will limit the 12-volt current to a peak value of less than 4.5 amps.

Note 2:
Minimum current loading for each supply voltage is not less than 30% of the maximum operating current shown in Table 1.

Note 3:
The +5 and +12 volt supplies shall be separate returns.

Note 4:
Where power is provided to multiple drives from a common supply, careful consideration for individual drive power requirements should be noted. Where multiple units are powered on simultaneously, the peak starting current must be available to each device. (Ref. Table 1).

7.2.1 Power Sequencing

Power sequencing is not required for the WREN II. The drive protects against inadvertent writing during power up and down. Daisychain operation requires that power be maintained on the terminated unit to ensure proper termination of the peripheral I/O.

7.2.2 12 V - Current Profile

Figure 4 identifies the 12 V current profile for the WREN II. The current during the various times is as shown:

T1 - Voltage is applied to the drive and the spindle begins to accelerate.

T2 - The spindle continues to accelerate under current limiting conditions.

T3 - The spindle is up to speed (3600 RPM).

T4 - The auto-velocity adjust sequence is performed.

T5 - Velocity is set and the drive is ready for reading and writing.

T6 - Power is removed from the drive.

7.2.3 System Grounds

The WREN II is supplied with AC and DC grounds tied together and connected to chassis ground. The user may modify this ground arrangement to comply with his requirements. The AC to DC connecting shunt is W3 (see Figure 3A). The AC to chassis connecting shunt is W4 (see Figure 3B). Either ground system may be isolated by removing (cutting free) the appropriate shunt.

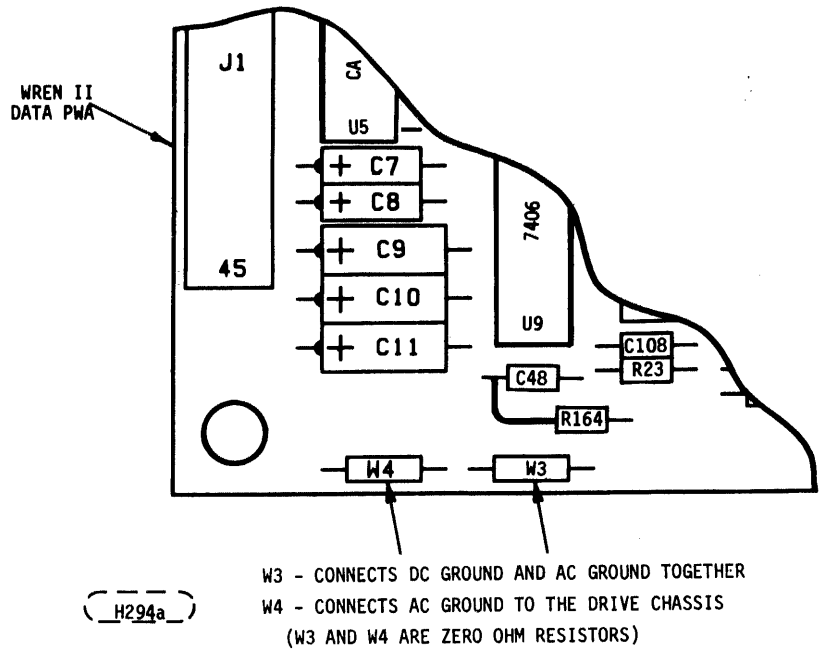


FIGURE 3A. DATA PWA SHOWING GROUND OPTIONS

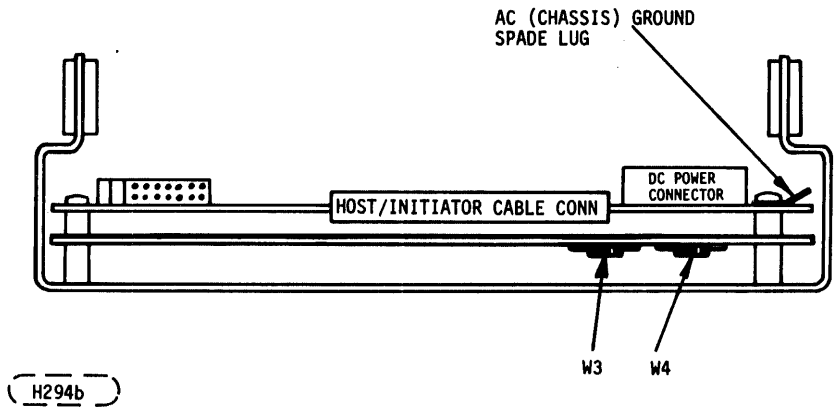


FIGURE 3B. LOCATION OF W3 AND W4.

7.2.2 (continued)

NOTE

All times and currents are typical. See Table 1 for maximum current requirements.

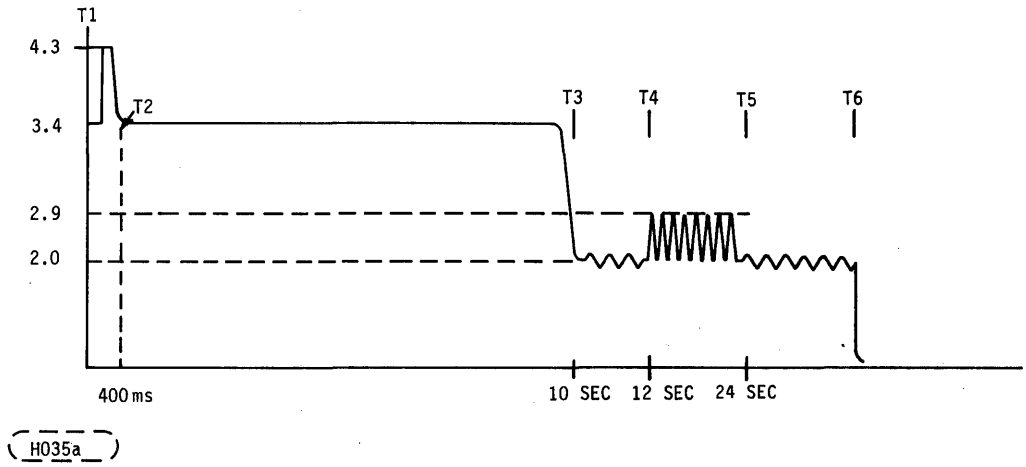


FIGURE 4. TYPICAL +12 V CURRENT PROFILE

7.3 HEAT/POWER DISSIPATION

Each WREN II will dissipate no more than 36 watts (123 BTUs per hour) of DC power average. Typical power dissipation under nominal conditions is less than 31 watts.

7.4 ENVIRONMENTAL LIMITS

Temperatures and humidity specifications preclude condensation on any drive part. Altitude and atmospheric pressure specifications are referenced to a standard day at 58.7°F (14.8°C). Maximum Wet Bulb 82°F (28°C).

7.4.1 Temperature

a. Operating

50° to 114.8°F (10° to 46°C) Operating Ambient with a maximum gradient of 18°F (10°C) per hour. Above 983 feet (300 meters) altitude the maximum temperature is derated linearly to 95°F (35°C) at 9840 feet (3000 meters). Cabinet packaging designs must provide ample air circulation around the WREN II to ensure environmental limits are not exceeded as a result of heat transfer from other system components. Operating Ambient for specification purposes is defined as the environment immediately surrounding the WREN II. The temperature of the base casting should not be allowed to exceed 135°F (57°C) at the hottest point. The hottest point may vary between different applications.

b. Transit

-40° to 158°F (-40° to 70°C) Package Ambient with a maximum gradient of 36°F (20°C) per hour. This specification assumes that the drive is packaged in the shipping container designed by CDC for use with WREN II.

c. Storage

14° to 122°F (-10° to 50°C) Device Ambient with a maximum gradient of 27°F (15°C) per hour.

7.4.2 Relative Humidity

a. Operating
8% to 80% relative humidity with a maximum gradient of 10% per hour.
b. Transit
5% to 95% relative humidity.
c. Storage
8% to 90% relative humidity.

7.4.3 Effective Altitude (Sea Level Reference)

a. Operating
-1000 to +10,000 feet (-305 to +3048 meters)
b. Transit
-1000 to +40,000 feet (-305 to +12,210 meters)
c. Storage
-1000 to +10,000 feet (-305 to +3048 meters)

7.4.4 Shock and Vibration

Shock and vibration limits specified in this document are measured directly on the drive chassis. If the WREN II is installed in an enclosure to which the stated shock and/or vibration criteria is applied, resonances may occur internally to the enclosure resulting in WREN II movement in excess of the stated limits. If this situation is apparent, it may be necessary to modify the enclosure to minimize WREN II movement.

The limits of shock and vibration defined within this document are specified with the drive mounted by any of the four methods shown in Figure 5.

7.4.4.1 Shock

a. Operating - Normal

Equipment, as installed for normal operation, shall comply with the complete specified performance while subjected to intermittent shock not exceeding 2 G at a maximum duration of 10 ms (half sinewave). Shock may be applied in the X, Y, or Z axis. Shock is not to be repeated more than two times per second.

b. Operating - Abnormal

Equipment, as installed for normal operation, shall not incur physical damage while subjected to intermittent shock not exceeding 6 G at a maximum duration of 10 ms (half sinewave). Shock occurring at abnormal levels may promote degraded operational performance during the abnormal shock period. Specified operational performance will continue when normal operating shock levels resume. Shock may be applied in the X, Y, or Z axis. Shock is not to be repeated more than two times per second.

7.4.4.1 (continued)

c. Non-Operating

The limits of non-operating shock shall apply to all conditions of handling and transportation. This includes both isolated devices and integrated equipment.

Equipment subjected to intermittent shock not exceeding 32 G at a maximum duration of 10 ms (half sinewave) shall not exhibit device damage or performance degradation. Shock may be applied in the X, Y, or Z axis. Shock is not to be repeated more than two times per second.

d. Packaged

The WREN II as packaged by CDC for van or air freight shipment shall withstand drop test from 48 inches (1219.2 mm) against a concrete floor or equivalent. (See Figure 6.)

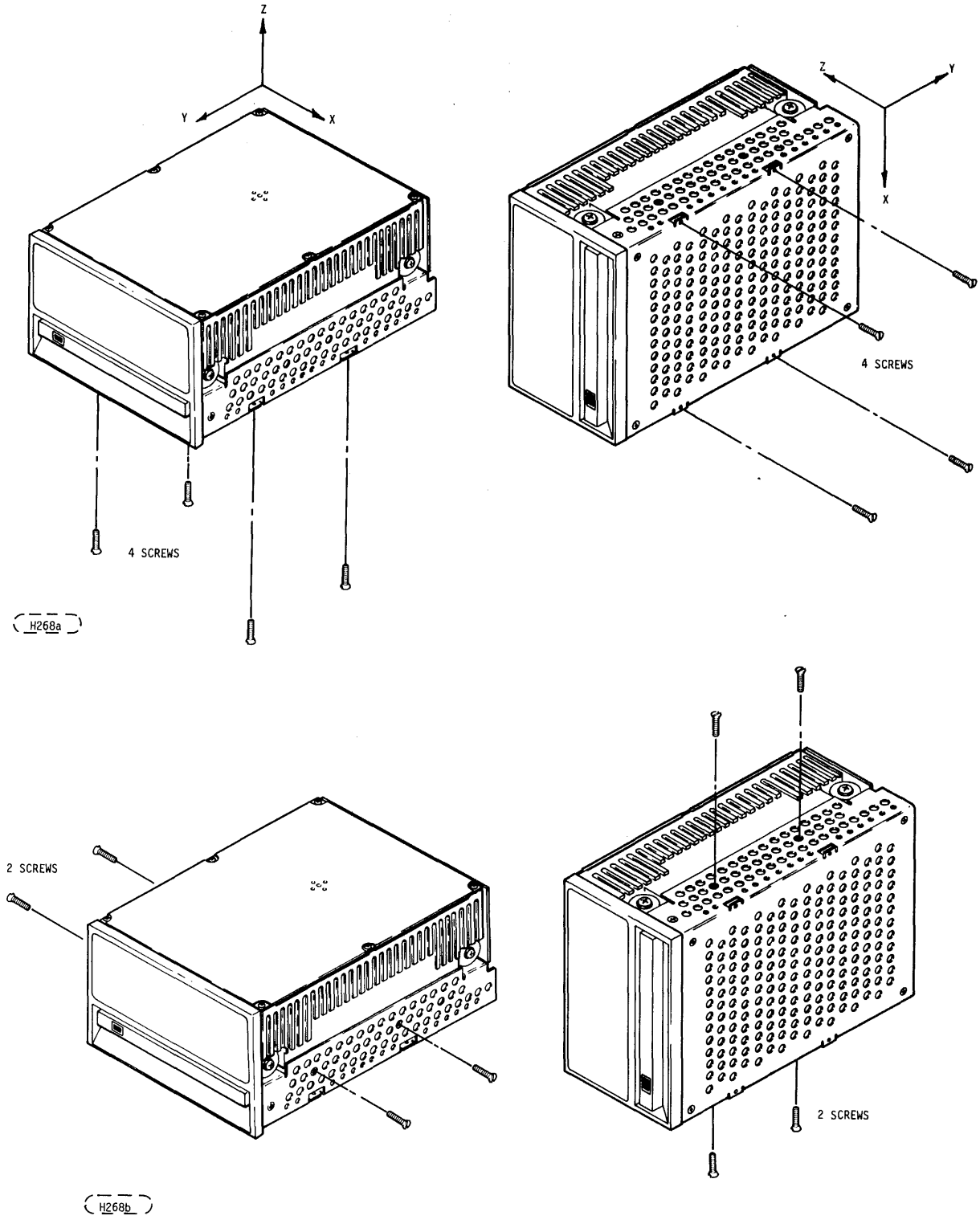


FIGURE 5. RECOMMENDED MOUNTING

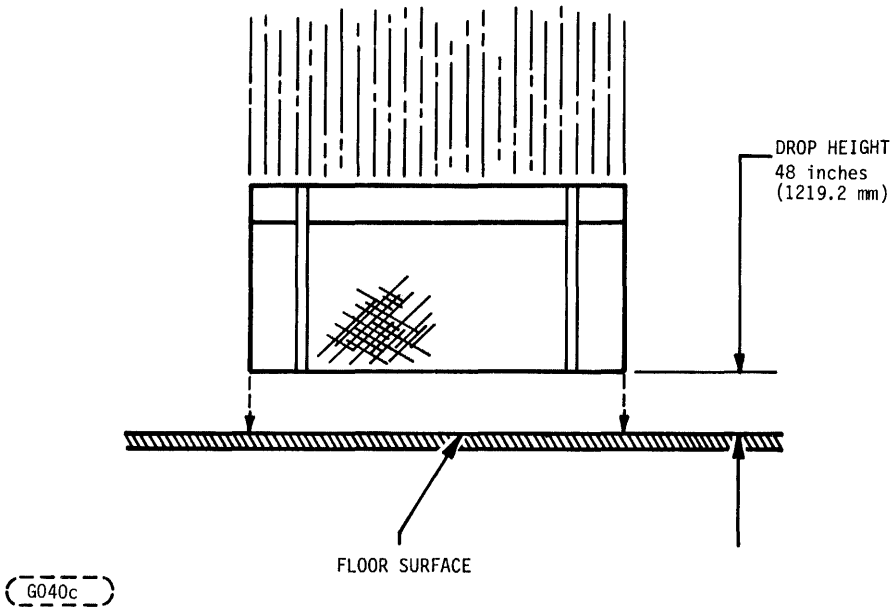


FIGURE 6. FLAT DROP TEST

7.4.4.2 Vibration

a. Operating - Normal
Equipment as installed for normal operation, shall comply with the complete specified performance while subjected to continuous vibration not exceeding
5-22 Hz @ 0.010 inches displacement
22-500 Hz @ 0.25 G
Vibration may be applied in the X, Y, or Z axis.

b. Operating - Abnormal
Equipment as installed for normal operation, shall not incur physical damage while subjected to periodic vibration not exceeding
15 minutes of duration at major resonant frequency
5-22 Hz @ 0.010 inches displacement
22-500 Hz @ 0.35 G

Vibration occurring at these levels may promote degraded operational performance during the abnormal vibration period. Specified operational performance will continue when normal operating vibration levels are resumed. This assumes system recovery routines are available. Abnormal vibration may be applied in the X, Y, or Z axis.

c. Non-Operating
The limits of non-operating vibration shall apply to all conditions of handling and transportation. This includes both isolated devices and integrated equipment.

Equipment shall not incur physical damage or degraded performance as a result of continuous vibration not exceeding
5-10 Hz @ 0.020 inches displacement
10-500 Hz @ 1.00 G
Vibration may be applied in the X, Y, or Z axis.

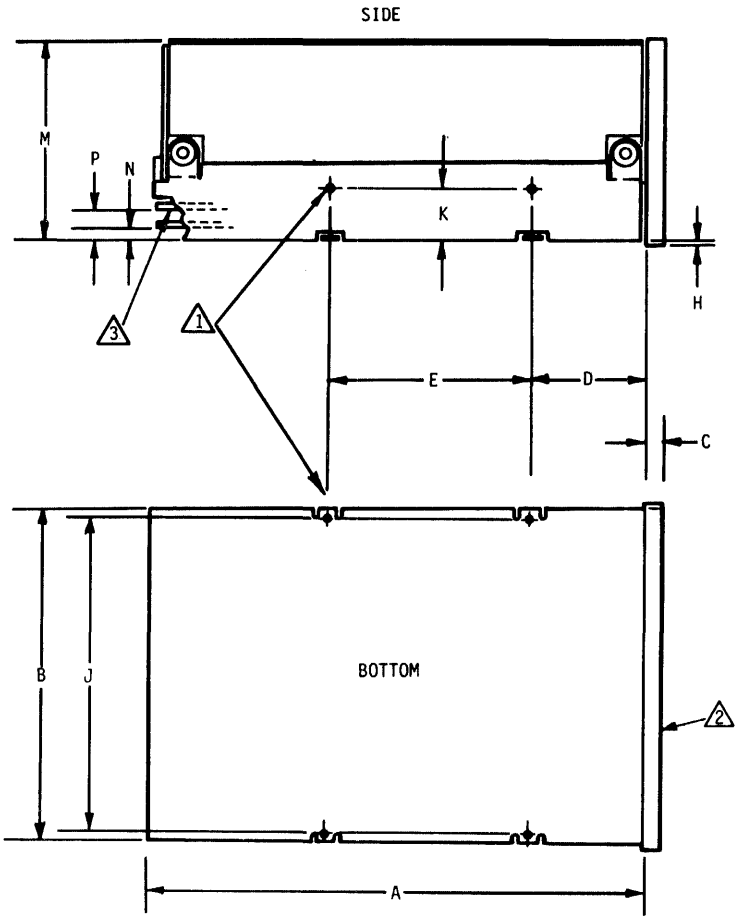
7.4.5 Air Cleanliness

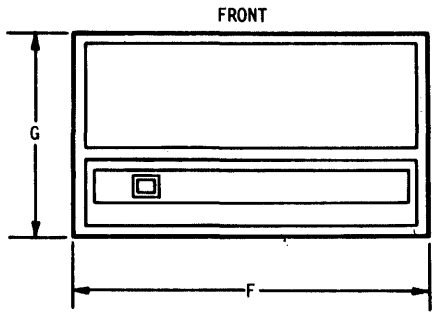
The WREN II is designed to operate in a typical office environment with minimum environmental control.

7.5 MECHANICAL SPECIFICATIONS

The following nominal dimensions are exclusive of the decorative front panel accessory. Refer to Figure 7 for detailed mounting configuration dimensions.

Height:	3.25 inches	82.55 millimeters
Width:	5.75 inches	146.05 millimeters
Depth:	8.0 inches	203.2 millimeters
Weight:	6.7 pounds	3.1 kilograms





△ NOTES:

1. MOUNTING HOLES, FOUR ON BOTTOM, TWO ON EACH SIDE. 6-32 UNC. MAX SCREW LENGTH INTO CHASSIS 0.31 IN. (7.87 mm)
2. FRONT PANEL ACCESSORY. TWO STYLES ARE AVAILABLE; STANDARD AND THIN
3. DRIVE INTERFACE CONNECTIONS

	IN	CM
A	8.0 MAX	20.32
B	5.75 + 0.00,-0.02	14.6
C	0.29 ± 0.02	.74
C*	0.19 ± 0.02	.48
D	1.87 ± 0.02	4.75
E	3.12 ± 0.01	7.92
F	5.88 ± 0.01	14.9
G	3.38 ± 0.01	8.58
H	0.065 ± 0.02	.165
J	5.50 ± 0.02	13.97
K	0.86 ± 0.02	2.18
M	3.25 ± 0.02	8.25
N	0.37 REF	.94 REF
P	0.63 REF	1.60 REF

*OPTIONAL "THIN" FRONT PANEL

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FIGURE 7. MOUNTING CONFIGURATION DIMENSIONS

7.5.1 Drive Orientation

Only two drive mounting orientations are permitted: disks in the horizontal plane and disks in the vertical plane. In either the horizontal or vertical mounting, the uppermost surface should be in a level position or drive performance may be affected. Mounting with either end down (front or rear) is not permissible. In the horizontal orientation, the spindle axis must be vertical with the disks on top. It is recommended that data written in a given orientation be read in that same orientation.

7.5.2 Cooling

The cabinet cooling must be designed by the customer so that the ambient temperature immediately surrounding the WREN II will not violate temperature conditions specified in 7.4.1. Specific consideration should be given to ensure adequate air circulation is present around the heat sinks on the circuit board at the rear of the drive.

8.0 MEDIA CHARACTERISTICS

The media used on the 94151 WREN II has a diameter of approximately 5 1/4 inches (130 mm). The aluminum substrate is coated with ferrous oxide and lubrication to permit the heads to contact the surface when starting and stopping.

Each data surface has a total of 921 user accessible tracks and is capable of recording 9,615,240 bytes of unformatted data.

Media defects will be identified and reallocated by the drive both at format time and during normal drive operation. If the drive is operated in the recommended mode (automatic retries and ECC enabled), media defects will be transparent to the user and any failure by the drive to reallocate a flawed sector should be considered a failure against MTBF.

9.0 DEFECT AND ERROR MANAGEMENT

The drive error recovery features (retries, ECC, and sector reallocation) are described in section 16.0 of this Specification.

10.0 INTERFACE CABLING REQUIREMENTS

10.1 DC CABLE AND CONNECTOR

The WREN II receives DC power through a 4-pin right angle connector (see Table 2 for pin assignment) mounted on the servo circuit board (See Figure 9). Recommended part numbers of the mating connector are included below, but equivalent parts may be used (See Table 3).

TABLE 2. DC INTERFACE

POWER LINE DESIGNATION	PIN NUMBER
+12 Volts	J2-01
+12 Volts Return	J2-02
+ 5 Volts Return	J2-03
+ 5 Volts	J2-04

TABLE 3. EQUIVALENT PARTS

TYPE OF CABLE	CONNECTOR	CONTACTS (20-14 AWG)
14 AWG	AMP 1-480424-0	AMP 60619-4 (Loose Piece) AMP 61117-4 (Strip)

10.2 PHYSICAL DESCRIPTION

Model 94151 WRENS may be daisychained together or with other compatible SCSI devices using a common cable. Both ends of the cable must be terminated. All signals are common between all SCSI devices. The Model 94151 WREN may only be daisychained with SCSI devices with Single Ended drivers and receivers. A maximum of 8 SCSI devices may be daisychained together. Only the last SCSI Device in the daisychain requires a Interface Cable Termination. (See Figure 8).

A minimum conductor size of 28 AWG should be employed to minimize noise effects.

10.2.1 Single-Ended Cable

A 50 conductor flat cable or 25 twisted pair cable shall be used. The maximum cable length shall be 6.0 meters.

Each drive shall have a 0.1 meter maximum stub length.

Bus termination capability will be internal to the drive.

The cable pin assignment is as shown in Table 4.

TABLE 4. SINGLE-ENDED CABLE PIN ASSIGNMENTS

SIGNAL (4)	PIN NUMBERS (3)
-DB(0)	2
-DB(1)	4
-DB(2)	6
-DB(3)	8
-DB(4)	10
-DB(5)	12
-DB(6)	14
-DB(7)	16
RESERVED (2)	18
GROUND	20
GROUND	22
GROUND	24
RESERVED (1)	26
GROUND	28
GROUND	30
RESERVED (2)	32
GROUND	34
-BSY	36
-ACK	38
-RST	40
-MSG	42
-SEL	44
-C/D	46
-REQ	48
-I/O	50

NOTES:

(1) Pin 26 is reserved. This pin will not be terminated by the drive's interface terminating resistors.
(2) Pins 18 and 32 are reserved. These pins will be terminated by the drive's interface terminating resistors.
(3) All odd pins except pin 25 will be connected to ground. Pin 25 will be left open.
(4) The minus sign next to the signals indicates active low.

10.2.2 CONNECTOR REQUIREMENTS

The nonshielded cable connector shall be a 50 conductor connector consisting of two rows of 25 female contacts with adjacent contacts 100 mils apart.

Recommended Flat Cable Connector Part Numbers are:

Closed End	3M-3425-7000	W/O Strain Relief
	3M-3425-7050	With Strain Relief
Open End (Daisychain)	3M-3425-6000	W/O Strain Relief
	3M-3425-6050	With Strain Relief

The nonshielded Model 94151 WREN device connector is a 50 conductor connector consisting of two rows of 25 male pins with adjacent pins 100 mils apart. The connector is not a keyed connector.

Drive Connector Part Number:

BERG - 65624 - 150

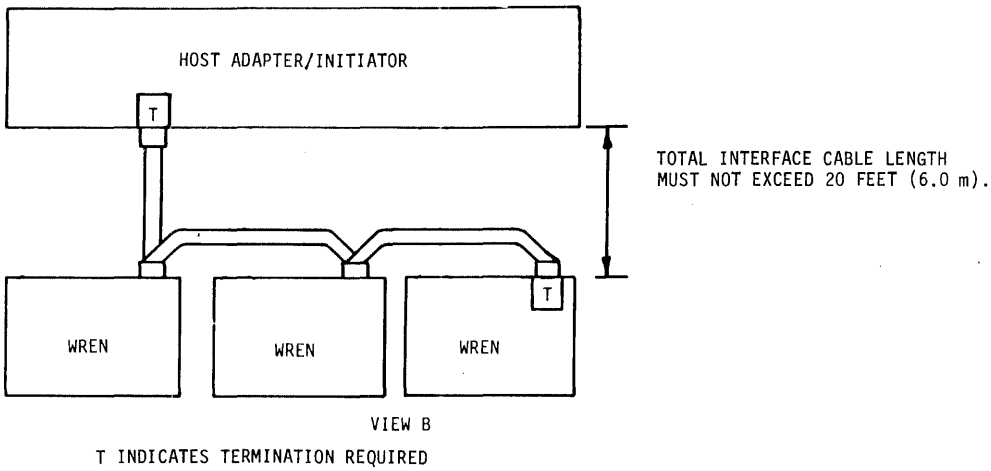

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FIGURE 8. INTERFACE CABLING

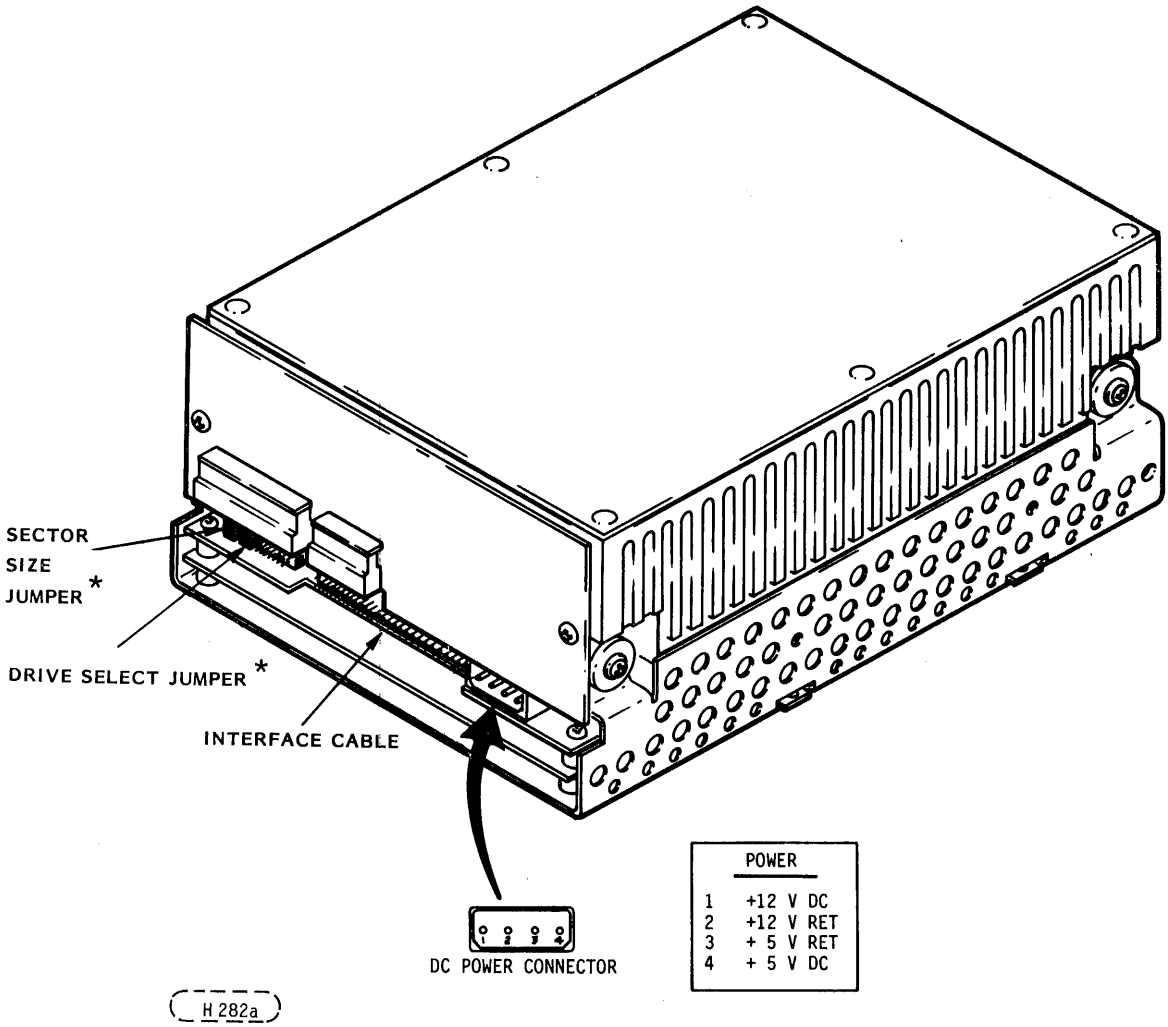


FIGURE 9. I/O CONNECTION

* See Figure 13 for detailed information

SEE FIGURE 13 FOR DEFINITION OF ID
SELECT AND BLOCK SIZE JUMPERS

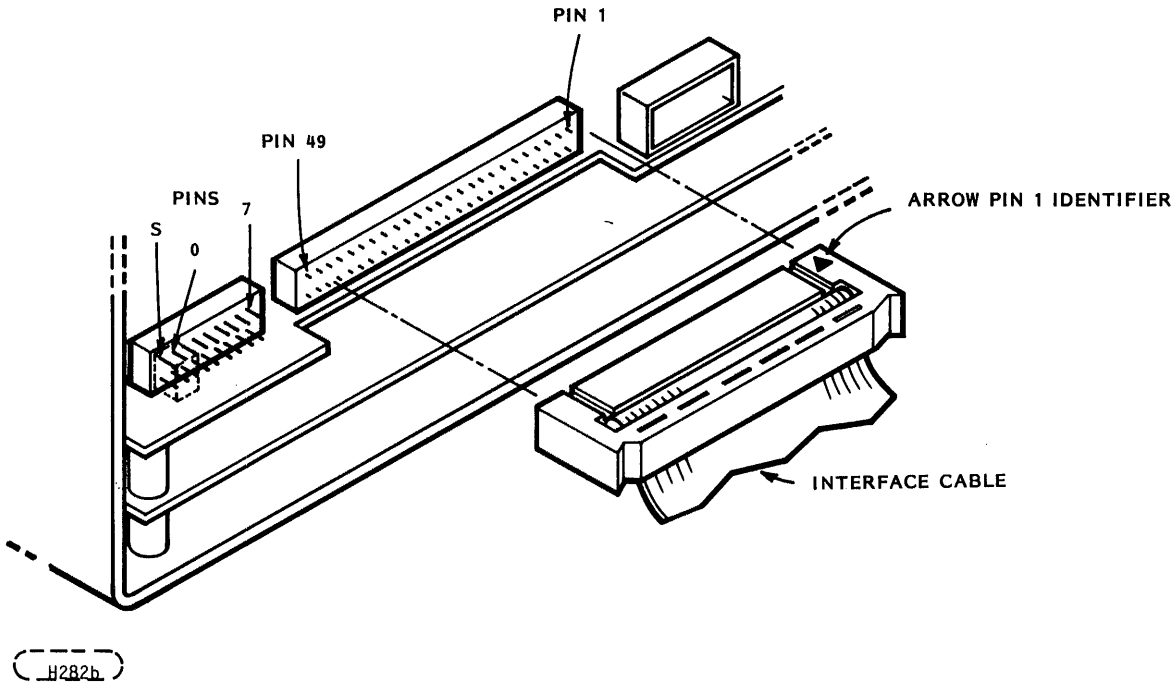


FIGURE 10. CABLE CONNECTION

10.3 SINGLE-ENDED DRIVERS/RECEIVERS

10.3.1 Transmitter Characteristics

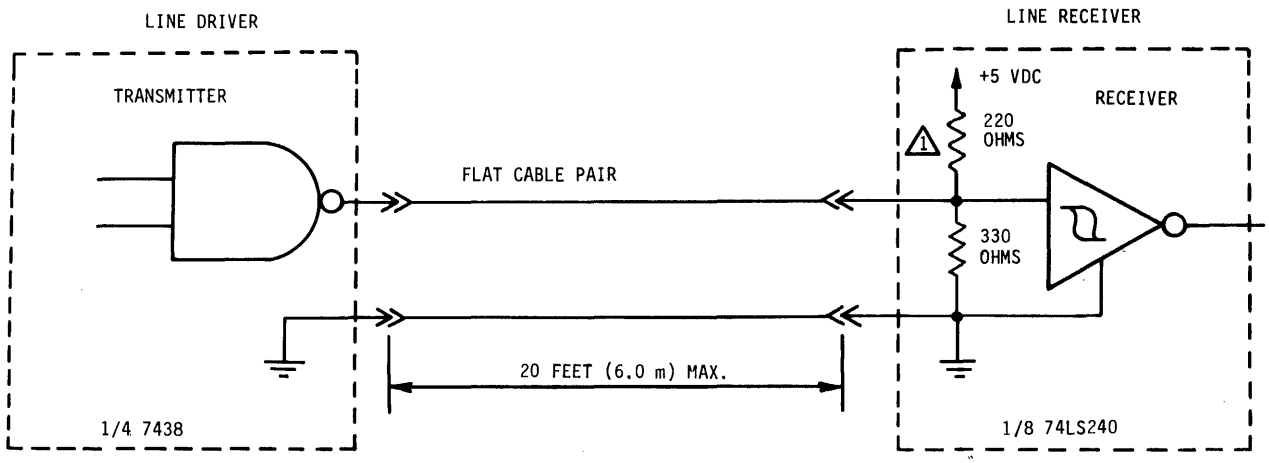
The WREN II uses the 7438 open collector quad-2-input driver to transmit status to the host. This driver is capable of sinking a current of 48 mA with a low-level output voltage of 0.4 volt (See Figure 11).

10.3.2 Receiver Characteristics

The WREN II uses the 74LS240 Octal Buffer with hysteresis gate as a line receiver. The input of each receiver is terminated in a 220/330 ohm pullup resistor network as shown in Figure 11.

10.3.3 Terminator Requirements

WREN II I/O termination consist of three resistor modules which plug into sockets on the Servo Board. Drives may be ordered with or without these termination resistors to facilitate a particular application. All single drive (non-daisychain) applications require that the WREN be properly terminated. Daisychain applications require that only the last physical unit on the chain be terminated. All other disk Drives on the chain should not be terminated. (See Figure 8). An equivalent termination must be provided at the Host Interface for each input signal line from the drive to the host.



1 PART OF REMOVABLE RESISTOR PACK.

INTERFACE SIGNALS LEVELS AND LOGICAL SENSE AT THE WREN I/O CONNECTOR ARE DEFINED AS FOLLOWS:

LOGIC LEVEL	DRIVER OUTPUT	RECEIVER INPUT
HIGH (FALSE OR DEACTIVATED) (0)	≥2.4 V; ≤ 5.25 V	≥2.0 V; ≤5.25 V
LOW (TRUE OR ACTIVATED) (1)	≤0.4 V; ≥0.0 V	≤0.8 V; ≥0.0 V

THE DIFFERENCE IN THE VOLTAGES BETWEEN INPUT AND OUTPUT SIGNALS IS DUE TO THE LOSSES IN THE CABLE.

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FIGURE 11. SINGLE-ENDED TRANSMITTERS AND RECEIVERS

11.0 SCSI BUS

Communication on the SCSI Bus is allowed between only two SCSI devices at any given time. There can be a maximum of seven SCSI devices and the host computer connected to the SCSI Bus. Each SCSI device has a SCSI ID Bit assigned as shown in Figure 12. The drives SCSI ID is assigned with a jumper during system configuration.

When two SCSI devices communicate on the SCSI Bus one acts as an initiator and the other acts as a target. The initiator (Typically a Host Computer) originates an operation and the target performs the operation. The WREN II Drive will operate only as a target.

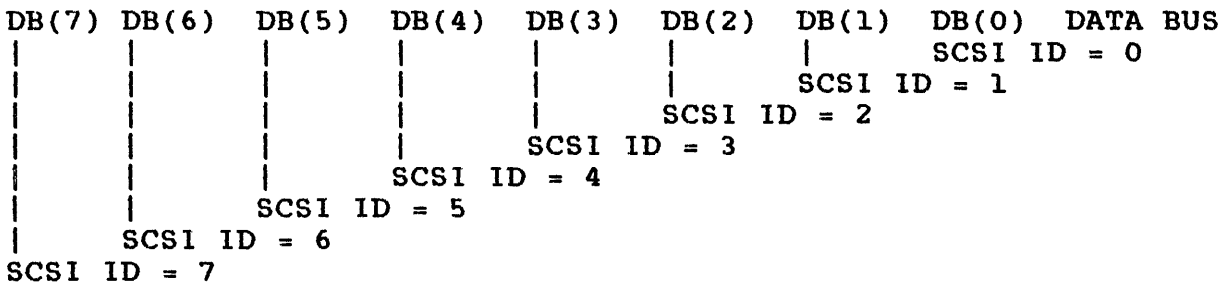


FIGURE 12. SCSI ID BITS

Certain SCSI Bus functions are assigned to the initiator and certain SCSI Bus functions are assigned to the drive. The initiator will select a particular drive. The drive will request the transfer of COMMAND, DATA, STATUS or other information on the data bus.

Information transfers on the data bus are asynchronous and follow a defined Req/Ack Handshake protocol. One byte of information will be transferred with each handshake.

11.1 SCSI BUS SIGNALS

There are eight control and eight data signals, as listed below:

DB(7-0)

- BSY
- SEL
- C/D
- I/O
- MSG
- REQ
- ACK
- RST

These signals are described as follows:

DB(7-0) (Data Bus)	Eight data bit signals which form a data bus. DB(7) is the most significant bit.
BSY (BUSY)	This signal indicates that the Bus is being used.
SEL (SELECT)	A signal used by the initiator to select a drive.
C/D (CONTROL/DATA)	A signal driven by the drive to indicate whether control or data information is on the data bus. A true indicates control.
I/O (INPUT/OUTPUT)	A signal driven by a drive which controls the direction of the data movement on the data bus with respect to the initiator. A true indicates input to the initiator.
MSG (MESSAGE)	A signal driven by the drive during the message phase.
REQ (REQUEST)	A signal driven by the drive to indicate a request for a Req/Ack data transfer handshake.

11.1 (continued)

ACK (Acknowledge)	A signal driven by an initiator to indicate an acknowledgement for a Req/Ack data transfer handshake.
RST (RESET)	A signal which indicates the reset condition. The drive will only receive and interpret this signal.

Refer to the Interface Specification -- WREN II SCSI (SASI™ Subset) Section 4.5 through 4.7.4 for detail description of the SCSI Bus.

11.1.1 Drive Select

Install jumpers as shown in Figure 13 for SCSI ID selection. Refer to Figure 9 for the location of the drive select header. The WREN II can have one or eight ID bits selected by installing a jumper in the drive select header. The jumper locations for all ID bit selections are shown below in Figure 13.

11.1.2 Sector Size

The WREN II Model 94151 can be configured with one or two different block (sector) sizes. Either 256 byte of 512 byte block format can be selected by utilizing the block size option jumper. If the option jumper is installed the 512 byte block size is selected and the track will have 19 sectors per track. If the block size option jumper is removed the 256 byte block size is selected and the track will format with 36 sectors per track. See Figure 13.

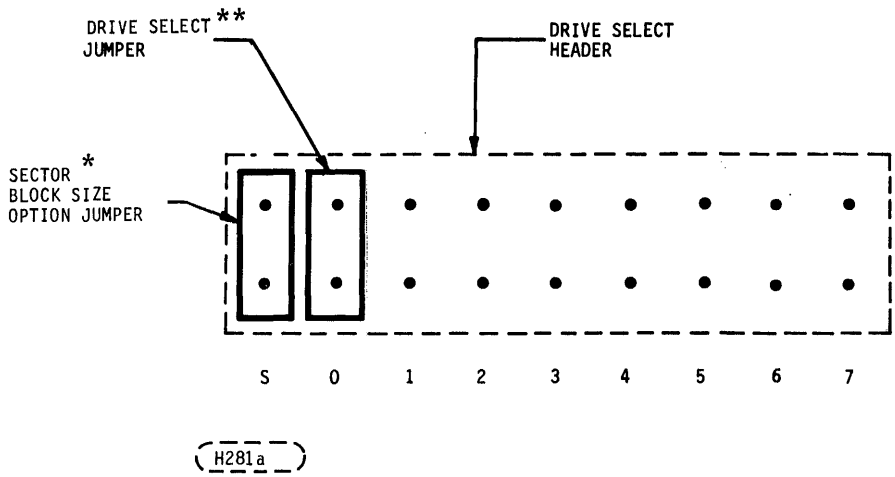


FIGURE 13. WREN II SCSI ID SELECT & BLOCK SIZE JUMPERS

* With Jumper S installed, the block size will be 512 bytes. If removed, the block size will be 256 bytes.

** Drive ID is consistent with the jumper position, i.e. Logical 0 Jumper would be Drive ID 0.

12.0 LOGICAL CHARACTERISTICS

12.1 SASI BUS PHASES

The Model 94151 drive will respond to 6 distinct phases:

BUS FREE phase	
SELECTION phase	
COMMAND phase	These phases are collectively
DATA (In and Out)	termed the Information Transfer
STATUS (In Only)	phases.
MESSAGE (In Only)	

The SCSI Bus can never be in more than one phase at any given time. Unless otherwise noted in the following description, signals that are not mentioned shall not be asserted.

12.1.1 BUS FREE Phase

The BUS FREE phase is used to indicate that no SCSI device is actively using the Bus and that the Bus is available for subsequent users.

The drive will detect the Bus Free phase whenever SEL and BSY are false while the RST signal is false.

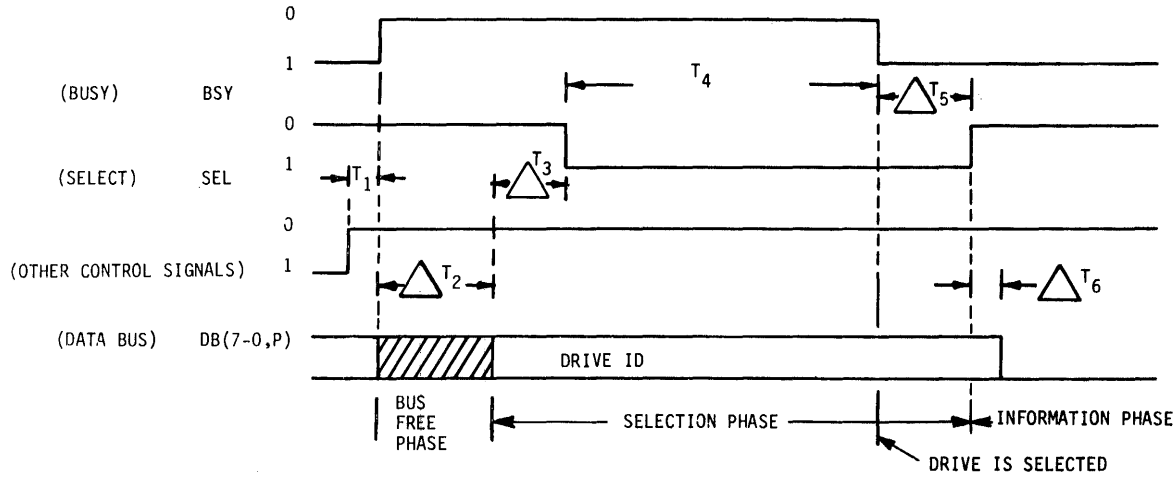
12.1.2 SELECTION Phase

The SELECTION phase allows an Initiator to select the drive for the purpose of initiating some drive function (e.g. Read or Write command).

The drive timing and required protocol for the SELECTION phase for systems without arbitration is shown in Figure 14.

12.1.2.1 Nonarbitrating Systems

The SELECTION phase is entered directly from the BUS FREE phase. The Initiator initiates the SELECTION phase by asserting the desired drives SCSI ID bit on the Data Bus and then asserting SEL per Figure 14. (the drive will allow the Initiator to assert its own initiator SCSI ID on the Data Bus as well). The selected drive will then assert BSY to signify selection. The selected drive will assert BSY within 150 nanoseconds of its detection of its SCSI ID bit with SEL true. After the Initiator detects the drives activation of BSY, the Initiator shall deactivate SEL and release the Data Bus to terminate the SELECTION phase.



$T_1 \geq 0$ - DRIVE DEACTIVATES OTHER CONTROL SIGNALS AND DATA BUS PRIOR TO DESELECTING ITSELF FROM THE INITIATOR.

$\triangle T_2 \geq 0$ - INITIATOR DETECTS BUS FREE PHASE AND SETS UP TO SELECT A DRIVE.

$\triangle T_3 \geq 90$ ns - DATA BUS SET UP TIME.

$T_4 \leq 150$ ns - DRIVE SELECTION TIME.

$\triangle T_5 \geq 0$ - INITIATOR TERMINATES THE SELECTION PHASE BY DEACTIVATING SEL.

$\triangle T_6 \leq 90$ ns - INITIATOR RELEASES BUS.

$\triangle T_i$ - INITIATOR CONTROLLED TIME

T_j - DRIVE CONTROLLED TIME

NOTE: ALL OTHER CONTROL SIGNALS ARE DEACTIVATED BY THE DRIVE DURING THE BUS FREE AND SELECTION PHASES.

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FIGURE 14. DRIVE SELECTION TIMING ASSUMING SYSTEMS WITH NO ARBITRATION

12.1.3 Information Transfer Phases

The COMMAND, DATA, STATUS and MESSAGE phases are all grouped together as the Information Transfer phases because they are all used to transfer data or control information via the Data Bus. The actual contents of the information is covered in future sections of this specification.

The C/D, I/O and MSG signals are used to distinguish between the different Information Transfer phases. See Table 5. The drive drives these three signals and therefore controls all changes from one phase to another after selection. The drive causes the BUS FREE phase by releasing MSG, C/D, I/O, and BSY.

TABLE 5. INFORMATION TRANSFER PHASES

SIGNAL MSG	C/D	I/O	PHASE NAME	DIRECTION OF TRANSFER	COMMENT
0	0	0	DATA OUT	(Initiator to Drive)	DATA
0	0	1	DATA IN	(Initiator from Drive)	Phases
0	1	0	COMMAND	(Initiator to Drive)	
0	1	1	STATUS	(Initiator from Drive)	
1	0	0	*		
1	0	1	*		
1	1	0	*		MESSAGE
1	1	1	MESSAGE IN	(Initiator from Drive)	Phase

NOTES: 0 = False 1 = True * = RESERVED for future standardization.

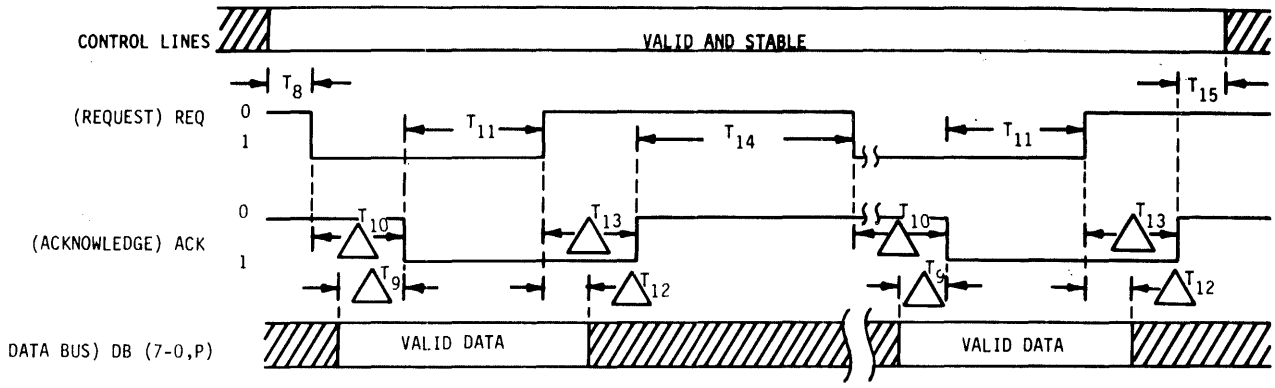
The Information Transfer phases use one or more REQ/ACK handshakes to control the information transfer. Each REQ/ACK allows the transfer of one byte of information. During the Information Transfer phases, BSY shall remain true and SEL shall remain false. Additionally, during the Information Transfer phases, the drive shall continuously envelope the REQ/ACK handshake(s) with C/D, I/O and MSG in such a manner that these control signals are valid for 400 ns minimum before the REQ of the first handshake and remain valid until the negation of ACK at the end of the last handshake.

12.1.3.1 Asynchronous Information Transfer

The drive shall control the direction of information transfer by means of the I/O signal. When I/O is true, information shall be transferred from the drive to the Initiator. When I/O is false, information shall be transferred from the Initiator to the drive.

The Information Transfer timing when the I/O line is False (Initiator to Drive) is shown in Figure 15. The drive initiates each byte transferred by activating the REQ line. The Initiator must then send the drive the requested information byte and activate its ACK line. The drive has no maximum limit on this Initiator response time, thus if the Initiator is not going to respond to the drives REQ line, the Initiator can only clear the drive by activating the RST line.

The Information Transfer timing when the I/O line is true (drive to Initiator) is shown in Figure 16. The drive initiates each byte transferred by putting valid data on the BUS and then activating the REQ line. The Initiator must accept the information and activate its ACK line. The drive has no maximum limit on this Initiator response time, thus if the Initiator is not going to respond to the drives REQ line, the Initiator can only clear the drive by activating the RST line.



400 ns ≤ T_8	CONTROL LINE SETTLE TIME (MIN.)
55 ns +2L ≤ T_9 △	DATA SET UP TIME
0 ns +2L ≤ T_{10} △	INITIATOR RESPONSE TIME
400 ns ≤ T_{11} ≤ 1200 ns	DRIVE RESPONSE TIME
0 ns + 2L ≤ T_{12} △	DATA HOLD TIME
0 ns + 2L ≤ T_{13} △	INITIATOR RESPONSE TIME
0 ≤ T_{14} ≤ 200 ns	DRIVE NEXT BYTE REQUEST RESPONSE TIME
0 ns ≤ T_{15}	CONTROL LINE HOLD TIME AFTER LAST BYTE TRANSFERRED

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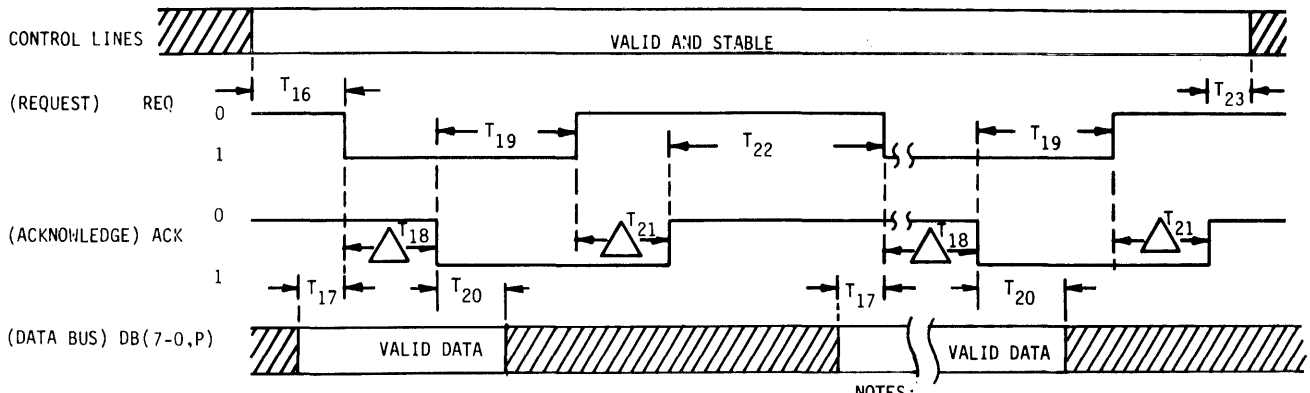
NOTES:

- ALL TIMING MEASURED AT CONNECTOR
- L = DELAY TIME (ns) FOR AMOUNT OF CABLE USED.
- △ T_i - INITIATOR CONTROLLED TIME
- T_j - DRIVE CONTROLLED TIME

FIGURE 15. INFORMATION PHASE BYTE TRANSFER TIMING-OUT CYCLES (INITIATOR TO DRIVE TRANSFERS)



400 ns $\leq T_{16}$ — CONTROL LINE SETTLE TIME

55 ns $\leq T_{17}$ — DATA SET UP TIME (TO REQ)

0 ns +2 L $\leq T_{18}\triangle$ — INITIATOR RESPONSE TIME

0 ns $\leq T_{19} \leq$ 300 ns — DRIVE RESPONSE TIME

0 ns $\leq T_{20}$ — DATA HOLD TIME

0 ns + 2L $\leq T_{21}\triangle$ — INITIATOR RESPONSE TIME

100 ns $\leq T_{22} \leq$ 1200 ns — DRIVE NEXT BYTE REQUEST RESPONSE TIME

0 ns $\leq T_{23}$ — CONTROL LINE HOLD TIME AFTER LAST BYTE TRANSFERRED

NOTES:
- ALL TIMING MEASURED AT DRIVE CONNECTOR
- L = DELAY TIME (ns) FOR AMOUNT OF CABLE USED
- $T_i\triangle$ = INITIATOR CONTROLLED TIME
- T_j = DRIVE CONTROLLED TIME

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FIGURE 16. INFORMATION PHASE BYTE TRANSFER TIMING-IN CYCLES (DRIVE TO INITIATOR TRANSFERS)

12.1.4 COMMAND Phase (Ref to SCSI Spec Section 5.1.6)

The COMMAND phase allows the drive to request command information from the Initiator.

12.1.5 DATA Phase (Ref to SCSI Spec Section 5.1.7)

The DATA phase is a term that encompasses the DATA IN phase and the DATA OUT phase.

12.1.6 STATUS Phase (Ref to SCSI Spec Section 5.1.8)

The STATUS phase allows the drive to request that status information be sent from the drive to the Initiator.

12.1.7 MESSAGE Phase (Ref SCSI Spec Section 5.1.9)

The MESSAGE phase is a term that references a MESSAGE IN phase. The transfer in this phase will be a single byte message.

12.1.8 Signal Restrictions Between Phases

When the SCSI Bus is between two Information Transfer phases, the following restrictions shall apply to the SASI Bus signals:

1. The BSY, SEL, REQ, and ACK signals shall not change.
2. The C/D, I/O, MSG, and Data Bus signals may change.
3. The RST signal may change as defined under the description for the RESET condition. See Section 12.2.1.

12.2 SCSI BUS CONDITIONS

The drive will recognize one asynchronous Bus condition, the Reset condition. This condition causes the drive to perform certain reset actions and alters the phase sequence. See Section 12.2.1.

12.2.1 Reset Condition

The Reset condition is used to immediately clear the drive from the bus. This condition will take precedence over all other phases and conditions. The Initiator creates the Reset condition by asserting RST for a minimum of 100 nanoseconds. During the Reset condition, the state of all SCSI bus signals other than RST is not defined.

12.2.1 (continued)

When a Reset is issued the drive begins a Diagnostic Self Check and should not be Selected for at least 20 μs after the Reset pulse. The drive can then be Selected but will not enter the Command Phase (i.e. Request for first byte of the CDB) until the diagnostic Self Check has been completed approximately one second later.

12.3 SCSI BUS PHASE SEQUENCES (Refer to SCSI Spec Section 5.3)

The drive sequences through the various SCSI Bus phases in a prescribed sequence. However, the Reset Condition will prematurely abort any phase and is always followed by the BUS FREE phase. The drive will remain in the BUS FREE phase until an Initiator generates a SELECTION Phase.

12.4 MESSAGE SYSTEM SPECIFICATION

The drive only implements the Command Complete Message In. The MESSAGE IN phase will always follow the STATUS phase and precede the BUS FREE phase and informs the Initiator that the drive is going to deselect itself and enter the BUS FREE phase. The Command Complete Message In will be a byte of all zeros transferred to the Initiator via the SCSI Bus.

13.0 SCSI COMMANDS (Ref SCSI Spec Section 6.0)

The sequence of events (Bus Phases) for a drive to receive and execute a command are defined by either Figure 17 or 18.

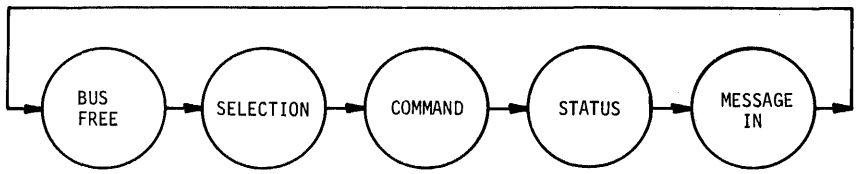
After selection, the drive will request a 6 byte Command Descriptor Block (CDB) from the Initiator. This CDB will define the command to be performed and also provide relevant command parameters.

13.1 COMMAND IMPLEMENTATION REQUIREMENTS

A Command Descriptor Block is required to specify any command to be performed by the drive. See Section 13.2.

13.2 COMMAND DESCRIPTOR BLOCK (CDB) (Ref to SCSI Spec Section 6.2)

A request for a drive to execute a command is performed by the Initiator sending a Command Descriptor Block to the drive. The drive will always request a 6 Byte CDB. For several commands the request is also accompanied by a list of parameters sent during the DATA OUT phase. See the specific commands for detailed information.



	BUS FREE	SELECTION	COMMAND	STATUS	MESSAGE IN
# BYTES TRANSFERRED VIA THE SASI BUS	NA	NA	6	1	1

NOTE: THE RESET CONDITION WILL ABORT ANY PHASE IN PROCESS.

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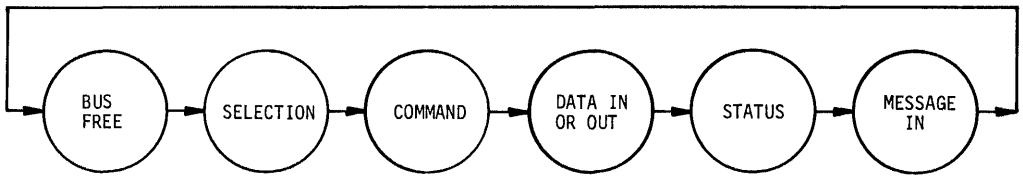
FIGURE 17. BUS PHASE SEQUENCING WITH NO DATA TRANSFERS



	BUS FREE	SELECTION	COMMAND	DATA IN OR OUT	STATUS	MESSAGE IN
# BYTES TRANSFERRED VIA THE SASI BUS	NA	NA	6	N	1	1

NOTE: THE RESET CONDITION WILL ABORT ANY PHASE IN PROCESS.

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FIGURE 18. BUS PHASE SEQUENCING WITH DATA TRANSFERS

14.0 COMMAND DESCRIPTION

14.1 GROUP 0 COMMAND DESCRIPTIONS (Ref to SCSI Spec Section 7.1)

Group Zero Command Codes and names are listed in Table 6.

TABLE 6. COMMAND CODES GROUP 00 COMMANDS

HEX OP CODE	1	DESCRIPTION
00		TEST DRIVE READY
01		RECALIBRATE
02		RESERVED
03		REQUEST SENSE
04		FORMAT UNIT
05		CHECK TRACK FORMAT (2)
06		FORMAT TRACK (2)
07		FORMAT BAD TRACK (2)
08		READ
09		READ VERIFY
0A		WRITE
0B		SEEK
0C		INITIALIZE DRIVE CHARACTERISTICS
0D		READ ECC BURST ERROR LENGTH
0E		FORMAT ALTERNATE TRACK (2)
0F		WR1TE SECTOR BUFFER
10		READ SECTOR BUFFER
11		RESERVED
12		RESERVED
13		RESERVED
14		RESERVED
15		RESERVED
16		RESERVED
17		RESERVED
18		RESERVED
19		RESERVED
1A		RESERVED
1B		RESERVED
1C		RESERVED
1D		RESERVED
1E		RESERVED
1F		RESERVED

(1) Group Code plus Command Code.

(2) Command is not applicable for the WREN II. For compatibility reasons, the Command is accepted and good completion status is returned. The Command function is not executed.

14.1.1 Sense Data

The Sense Data bytes for the drive are retrieved using the Request Sense command.

The Sense Byte Error Codes and definitions are listed in Table 7.

TABLE 7. SENSE BYTE ERROR CODE SUMMARY

ERROR CODE (HEX)	MEANING
00	No Error Detected (command completed OK).
01	No Index or Sector pulse detected.
02	No Seek Complete
03	Write Fault
04	Drive Not Ready
05	Not Used
06	Not Used
07	Not Used
08	Drive Still Seeking
09-0F	Not Used.
10	ID Field Read Error
11	Uncorrectable Read Error in the Data Field
12	Sync Byte Error
13	Not Used
14	Target Sector Not Found
15	Seek Error
16	Not Used
17	Not Used
18	Correctable Data Error
19	Not Used
1A	Format Error
1B-1F	Not Used
20	Invalid Command
21	Illegal Disk Address
22	Invalid Parameter
23-2F	Not Used
30	Ram Diagnostic Failure
31	Program Memory Checksum Error
32	ECC Diagnostic Failure
33-3F	Not Used

NOTE: The Address Valid Bit (bit 7) may or may not be set and is not included here for clarity.

Refer to SCSI Spec Section 7.1.

14.2 GROUP 7 COMMAND DESCRIPTIONS (Ref to SCSI Spec Section 7.2)

Group Seven Command Codes and Names are listed in Table 8.

TABLE 8. COMMAND CODES FOR GROUP 07 COMMANDS

HEX OP CODE*	DESCRIPTION
E0	RAM DIAGNOSTIC
E1	RESERVED
E2	RESERVED
E3	DRIVE DIAGNOSTIC
E4	INTERNAL DIAGNOSTIC
E5	READ LONG
E6	WRITE LONG
E7	RETRY STATISTICS
E8 thru EF	RESERVED

15.0 COMPLETION STATUS (Refer to SCSI Spec Section 8.0)

A status byte referred to as Completion Status will be sent from the drive to the Initiator during the STATUS phase at the termination of each command unless the command is cleared by the drive being powered down or by a SCSI Interface RESET condition.

16.0 ERROR RECOVERY PHILOSOPHY

The error recovery mechanisms used by the drive for a detected error will be dependent on the type of error detected plus the state of the "r" and "a" bits of the Control byte contained in the CDB for this command (see SCSI Interface Specification Section 6.2.5). In general the drive will first check the "r" (retry) bit state. If retries are enabled for the CDB, the drive will first attempt all applicable combinations of retries in order to recover. If the error still exists after all retries have been attempted or if retries had been disabled by the Initiator (by the "r" bit in the CDB), the drive will determine if the error is a data field ECC detected error during a Read command. If so, the drive will check the state of the "a" bit to determine if one reread is to be attempted prior to attempting to correct the read data by ECC manipulations. This philosophy is depicted in Figure 15. The error recovery mechanisms involved for various detected error conditions is defined in Section 16.1 through 16.5 with Section 16.5 defining the alternate sector processing function. (Reference Figure 19.)

*Group Code plus Command Code.

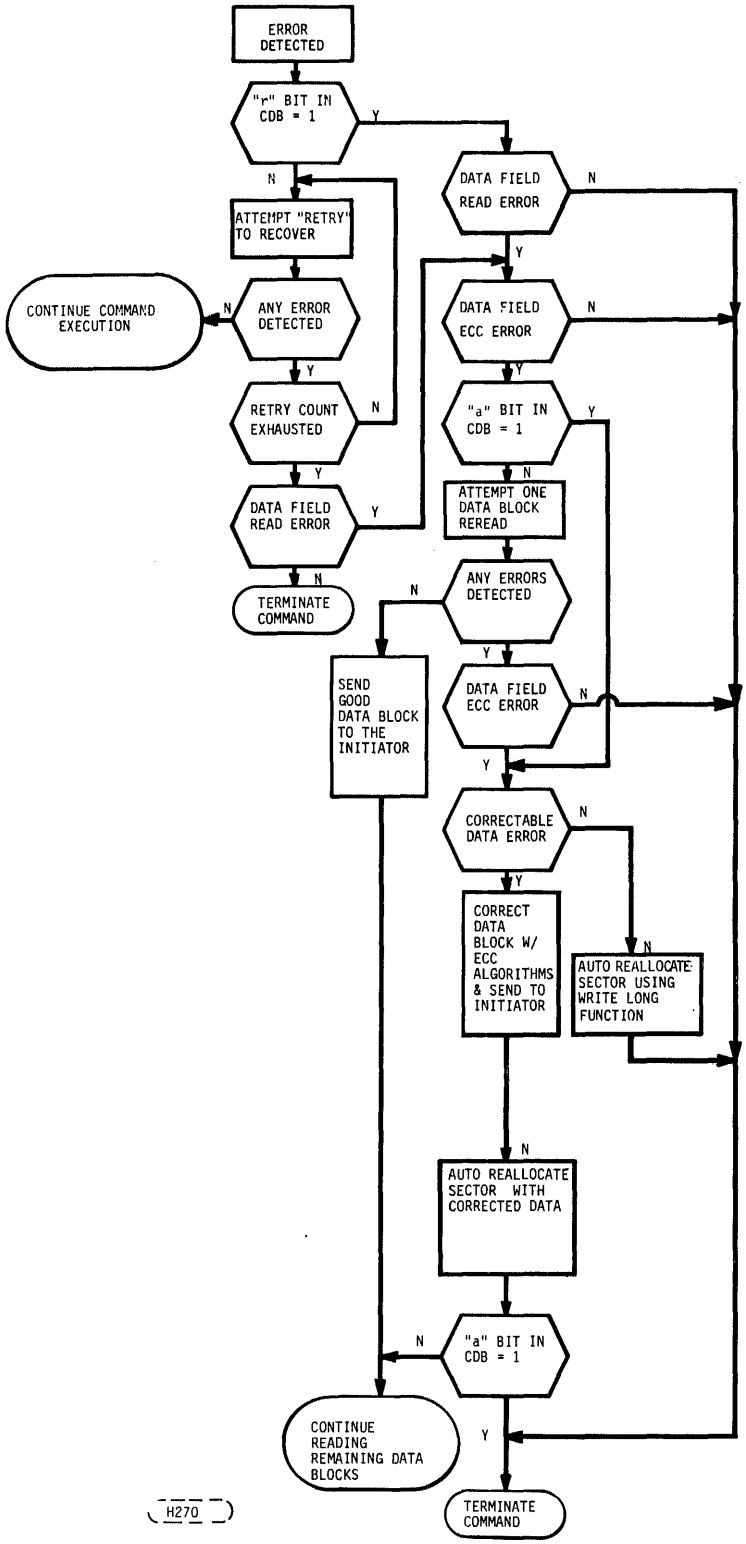

FIGURE 19. ERROR RECOVERY PHILOSOPHY

16.1 SEEK ERRORS (02 or 15 HEX ERROR CODE)

If the r bit in the CDB (bit 7 of byte 5 in the CDB) is zero, up to three retries will be attempted by positioning the heads to track zero and re-issuing the seek.

16.2 DATA FIELD WRITE FAULT (03 HEX ERROR CODE)

If a write fault is detected during the writing of the data field the operation will be immediately suspended. An internal write fault reset will be attempted and if the write fault is cleared, the drive will automatically perform a rewrite of the sector (up to 3 attempts will be made to clear the write fault and rewrite the sector).

If the write fault condition cannot be cleared the "Write Fault" error (03 Hex) will be reported in Sense Data.

16.3 DATA FIELD SYNC BYTE ERROR (12 Hex Error Code)

If the sync byte cannot be recovered during a read and if the r bit (bit 7 of byte 5 is the CDB) is a zero, up to 27 retries will be attempted using the offset and data strobe combinations shown in Figure 20.

16.4 DATA FIELD ECC ERROR (11 Hex or 18 Hex Error Code)

Data field ECC error correction will not be applied until all retry attempts (if enabled) are exhausted. If the ECC error persists and is within the correction length being used (normally 5 bits) the data is corrected and sent to the Initiator. For unrecoverable ECC errors an error code of 11 hex is reported.

16.4 (continued)

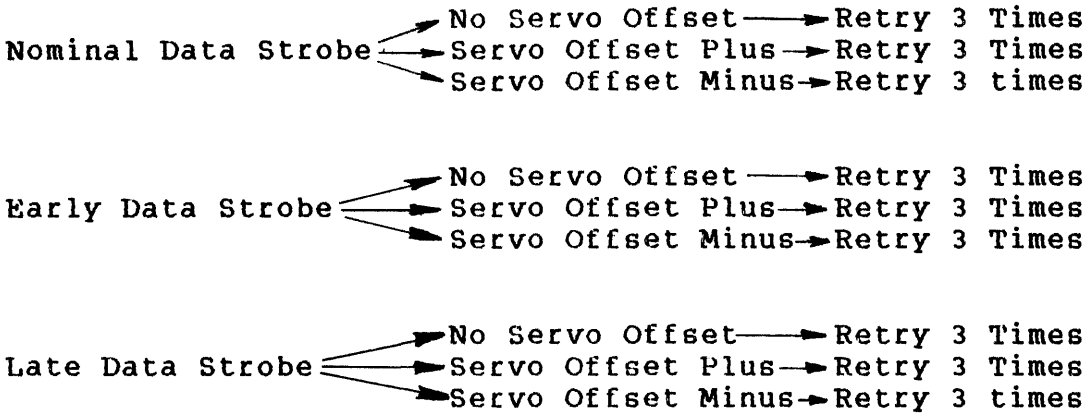

FIGURE 20. POSSIBLE DATA STROBE AND SERVO OFFSET COMBINATIONS USED BY THE SCSI WREN DURING READ RETRY

16.5 Alternate Sector Processing

Any media defect detected during format or listed internally in the factory recorded defect table will already have been assigned an alternate sector in an area not directly accessible by the Initiator.

Correctable (or uncorrectable) read errors that occur after formatting and require ECC correction to recover (or a uncorrectable ECC error) will cause the drive to automatically reassign the sector. The alternate sectors used will be in a reserved portion of the drive and be invisible to the Initiator.

17.0 OPTIONS

All options are either incorporated or packaged at the manufacturing facility.

17.1 FRONT PANEL

The front panel is available in two styles differing only by thickness of the panel. Each panel has a single red rectangular LED indicator which designates the drive is selected when illuminated.

17.2 CUSTOM FORMATTING

The Model 94151 WREN II is formatted during production. It will be formatted in one of the two formats defined in section 11.1.2. The user selects the format option prior to manufacture; however, the format may later be changed to the other format (256 or 512 user data bytes per section) if the user desires to do so.

17.3 AC/DC GROUND SEPARATION

The 94151 WREN II is provided with the AC ground (chassis) tied to DC logic ground. An option is provided for the user to isolate the AC and DC grounds. This option may be beneficial in reducing ground induced noise in some system applications.(Reference Figures 3A and 3B.)

17.4 SINGLE UNIT SHIPPING PACK

The 94151 WREN II is normally shipped in bulk packaging to ensure maximum protection against transit damage. Units shipped individually require additional protection as provided by the single unit shipping pack. Users planning single unit distribution should specify this option.

17.5 DRIVE TERMINATION

This option may be incorporated during manufacture at the request of the customer. Termination consist of three 220/330 ohm resistor modules which are installed on the servo PWA via sockets. The user may install or remove these but some drive disassembly is required.

18.0 ACCESSORIES

All accessories are designed for implementation by the customer.

18.1 FRONT PANEL KIT

Same as 17.1 but includes all mounting hardware to support field installation. Kits are provided in two styles differing only by panel thickness.

18.2 HARDWARE MAINTENANCE MANUAL

The manual provides detailed maintenance information to facilitate repair of items external to the HDA (Head/Disk Assembly).

18.3 SINGLE UNIT SHIPPING PACK KIT

Same as 17.4 except kit provides the necessary packing materials required to package and ship one WREN II device to be supplied by the user.

TECHNICAL INQUIRY

FILE REFERENCE

FROM:

Date _____

Name _____

Address _____

City _____

State _____ Zip Code _____

Area Code _____ Phone _____

FOR ADDITIONAL INFORMATION CONTACT:

Rigid Disk
Applications Engineering
Mail Station: OKM 272
Phone: (405) 324-3062

Magnetic Peripherals, Inc.
P.O. BOX 12313
Oklahoma City, Oklahoma
73157

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