CONTROL DATA CORPORATION

SPEC	77738212
CD	8
REV	D
DATE	August 1987

PRODUCT SPECIFICATION

FOR

WREN™ III DISK DRIVE

MODEL 94166

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FOR

WREN™ III DISK DRIVE

MODEL 94166

SUMMARY

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

NAME	MODEL NUMBER *	PRODUCT SPECIFICATION	INTERFACE	CAPACITY (MEGABYTES)
WREN II	94155-XX	77715909	CDC 506 (ST506 COMP.)	48, 57, 67, 77 or 86
WREN II	94156-XX	77738019	ESDI	46, 67 or 86
WREN II	94151-YY	77738208	SCSI (SASI™ Subset)	25 to 80
WREN II HH	94205-XX	77738161	CDC 506 (ST506 COMP.)	30, 41 or 51
WREN III	94166-XXX	77738212	ESDI	101, 141 or 182
WREN III	94161-YYY	77738270	SCSI **	86, 121 or 155 (512 Byte)
WREN III HH	94211-YY	77765250	SCSI **	91 (512 Byte)
WREN III HH	94216-XXX	77765276	ESDI	106
WREN IV	94171-YYY	77738386	SCSI **	307 (512 Byte)

* XX(X) denotes unformatted drive capacity in megabytes. For example, Model number 94166-182 is a WREN III with ESDI Interface and an unformatted capacity of 182 megabytes.

YY(Y) denotes formatted drive capacity.

** These drives allow the user to reformat using any integer data block size between 256 and 2048 bytes. Units are normally formatted at the factory with 512 byte data block size, with capacity dependent on number of data heads.

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1.0 SCOPE

This specification describes the Control Data Corporation Model 94166 WREN III Disk Drive. This 5 1/4-inch member of the rigid disk family supports the Enhanced Small Device Interface (ESDI) and is offered in three different capacities. The basic configurations are listed in section 4.2 of this specification.

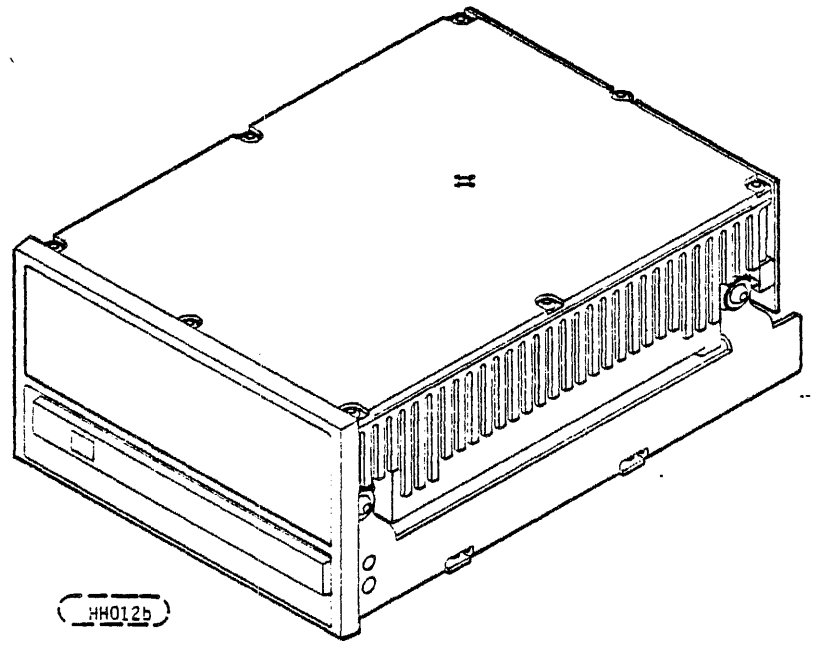


FIGURE 1. 94166-XX(X) WREN III

2.0 APPLICABLE DOCUMENTS

2.1 STANDARDS

The WREN III has been developed as a system peripheral to the highest standards of design and construction. The WREN III depends upon its host equipment to provide adequate power and environment in order to achieve 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.

2.1 (continued)

The WREN III complies with CDC standards as noted in the appropriate sections of this specification.

The WREN III is a UL Recognized component per UL478 and a CSA Certified Component per CSA C22.2, No. 154-M1983. It also meets the requirements of DIN IEC380/VDE0806/8.81.

The WREN III, as delivered, is designed for system integration before use. It is supplied as a Class A Computing Device per the FCC Rules and Regulations, Part 15, Subpart J governing EMI of computing devices.

CAUTION

To avoid potential repair problems, observe the following precautions:

- Labels must not be put over the breather holes on the top of the drive.
- If a label has been placed over the breather holes, do not poke holes through the label, as the filter underneath is certain to be damaged, allowing contamination to enter. REMOVE THE LABEL. Do not use solvents to remove the adhesive residue. Small amounts of solvent may migrate down the breather holes and contaminate the disk.
- CDC/MPI factory installed labels must not be removed from the drive or covered with additional labels, as they contain information required when repairing.
- DC power should not be switched on to the drive by plugging an electrically "live" DC source cable into the drive power connector. This practice adversely affects the reliability of the connector contacts.

2.2 DOCUMENTATION

2.2.1 Applicable Documents

The documents listed below are referenced in this specification.

77738216	OEM Manual
77738076	CDC ESDI Specification

2.2.2 Reflected Changes

Changes to individual pages of this specification are reflected in the revision letter at the top right corner of the page, after the part number. The revision letter applies to that page only and does not change unless a change was made on the page, in which case it takes the latest revision letter of the specification. In comparing different revisions of the specification, note that the pages with the same revision letters as the specification were the ones changed to achieve that particular specification revision.

3.0 GENERAL DESCRIPTION

The WREN III is a member of a family of low cost, high performance, highly reliable, random access storage devices designed to meet the needs of the OEM marketplace.

The WREN III is designed to record and recover data on three, four, or five 5-1/4 inch (130 mm) fixed disks. It does not have removable media capability.

The Model 94166 WREN III supports the Enhanced Small Device Interface (ESDI) as described in Control Data's ESDI Specification (77738076). This product specification was created to be used in conjunction with this industry standard interface specification. The information contained in these two documents defines the product performance characteristics and the interface characteristics of the Model 94166 WREN III.

The WREN III is designed to support the Serial Mode of ESDI Operation.

The head, disk and actuator chamber is environmentally sealed at the factory. Air is recirculated within the HDA through a nonreplaceable filter to maintain a contamination free disk/actuator environment.

Refer to Figure 2 for an exploded view of the WREN III. 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.

The WREN III uses a dedicated landing zone at the innermost radius of the media thus eliminating the possibility of destroying or degrading data by landing in the data zone.

The WREN III incorporates an automatic shipping lock which prevents potential damage to the heads and disks caused by movement during shipping and handling. The shipping lock is automatically disengaged when power is applied to the drive.

The WREN III decodes Track 0 location from the dedicated servo surface thereby eliminating mechanical transducer adjustments and related reliability concerns.

The WREN III uses a high performance actuator assembly consisting of a low inertia, balanced, straight arm (Patent Pending) which provides excellent performance with minimal power dissipation.

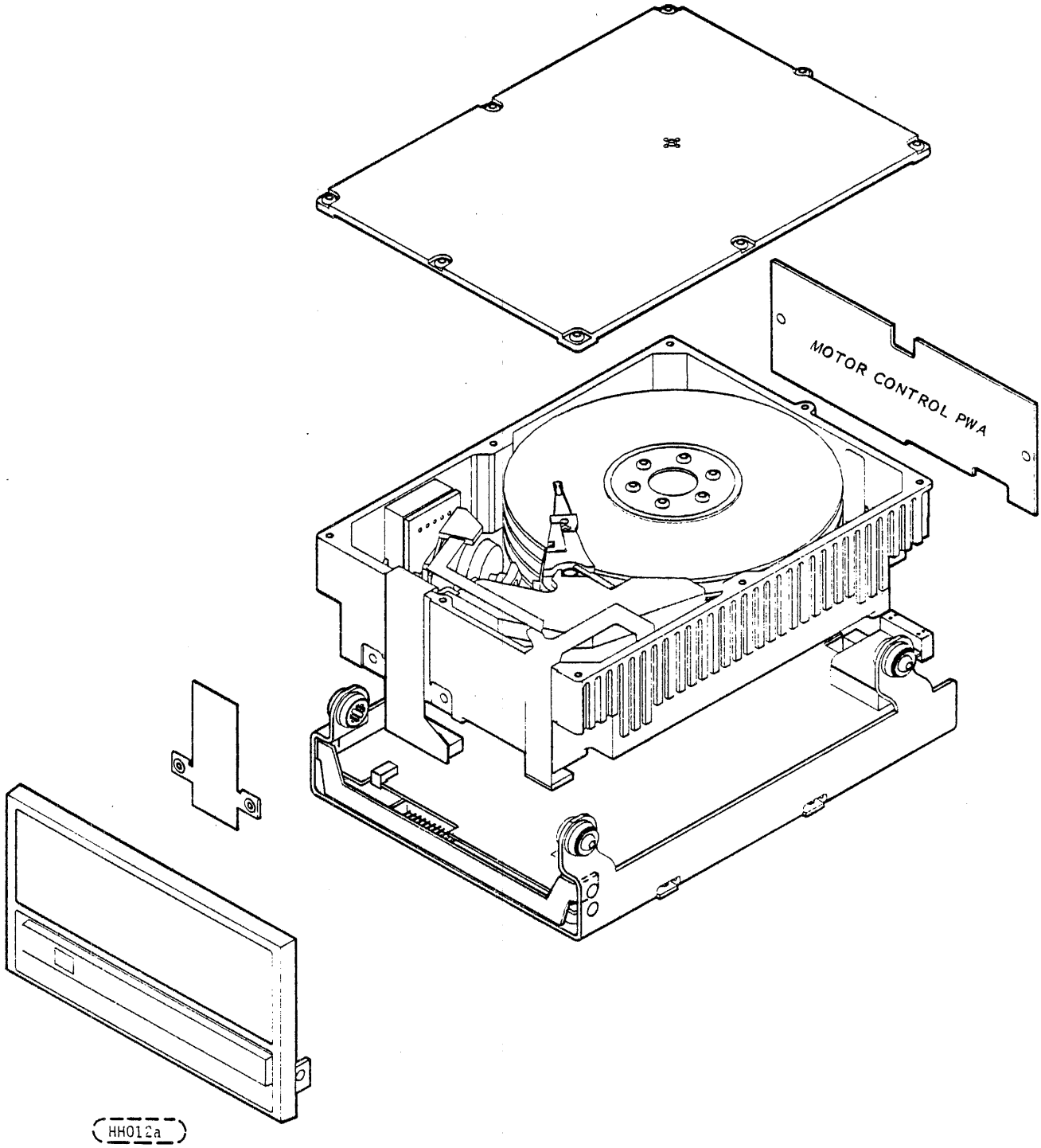


FIGURE 2. Model 94166 WREN III

4.0 FEATURES

4.1 STANDARD FEATURES

The Model 94166 WREN III has the following standard features:

- Industry standard interface
- Data recovery circuitry contained in the drive
- Multiple capacity configurations
- Sealed head, disk, and actuator (HDA) chamber
- No preventive maintenance required
- LSI circuitry for high reliability
- Low audible noise for office environments
- Vertical or horizontal mounting
- Low power consumption
- Balanced low mass rotary voice coil actuator
- Automatic shipping lock
- Terminators
- Integral HDA shock and vibration isolation mounts
- Dedicated head landing zone
- Dynamic spindle braking

4.2 OPTIONAL CONFIGURATIONS

The following optional capacities are available as a factory installed option.

Model 94166-182	182 MB
Model 94166-141	141 MB
Model 94166-101	101 MB

The following options are incorporated at the time of manufacture when specified for delivery. (See Section 12.0.)

- Front Panel with indicator - (See Figure 5)
- Custom Formatting
- Single Unit Shipping Pack
- Soft Sector Operation

4.3 OPTIONAL ACCESSORIES (USER INSTALLED)

The following accessories are available to the user to facilitate his needs. All kits may be installed in the field. (See Section 13.0.)

- Front Panel Kit and indicatior - (See Figure 5)
- Single Unit Shipping Pack Kit

5.0 PERFORMANCE CHARACTERISTICS

Model 94166 WREN III capacity (unformatted)

- Model 94166-182
  182,094,480 Bytes (unformatted)
  160,745,470 Bytes (formatted*)
  5 Disks per Drive
  9 Data Surfaces

- Model 94166-141
  141,629,040 Bytes (unformatted)
  125,024,250 Bytes (formatted*)
  4 Disks per Drive
  7 Data Surfaces

- Model 94166-101
  101,163,600 Bytes (unformatted)
  89,303,040 Bytes (formatted*)
  3 Disks per Drive
  5 Data Surfaces

Data Capacity Parameters (Unformatted)

Maximum Number of Data Heads	9
Bytes/Track	20,880 Bytes
Bytes/Surface	20,232,720 Bytes
Tracks/Surface	969 Tracks
Tracks/Inch	960 TPI
Bits/Inch	19,058 BPI
Recording Code	2, 7
Data Transfer Rate	10.0 Megabits/sec (1.25 Megabytes/sec)
Data Bit Clock Period(R_{RC}) (Reference/Read Clocks)	100 ns $\pm$ 1.0%
Read Propagation Delay	7 to 9 Bit Times
Write Propagation Delay	4 to 6 Bit Times

*Based on 36 sectors with 512 Data Bytes each. Consideration for defect management not included.

5.0 PERFORMANCE CHARACTERISTICS (continued)

Data Interface	NRZ Encoded Data
Rotational Speed	3597 r/min ±0.5%
Rotational Period	16.68 ms ± 0.5%
Average Latency	8.34 ms
Single Track Seek Time	Typical 4 ms - NOTE 3 Maximum 5 ms - NOTES 1 & 2
Average Seek Time	Typical 16.5 ms - NOTE 3 Maximum 18 ms - NOTES 1 & 2
Maximum Seek Time (969 Tracks)	Typical 40 ms - NOTE 3 Maximum 43 ms - NOTES 1 & 2

NOTE 1: See Seek Command Description 11.1.5.1.

NOTE 2: Maximum times are specified over the worst case conditions of temperature, voltage margins and drive orientation. All seek times include settle time. When comparing seek times, care should be taken not to mix typical seek times with maximum seek times. The only true comparison is with system benchmark tests.

NOTE 3: Typical seek values are measured under nominal conditions of temperature, voltage, and horizontal orientation as measured on a representative sample of drives. All seek times include settle time.

5.1 ACCESS TO DATA CHARACTERISTICS

5.1.1 Seek Time

Seek time is defined as the elapsed time from the receipt of a seek command until the drive signals the controller that it is ready to perform another seek or read/write function on the new cylinder. Average seek time is determined by dividing the sum of the times for all possible movements by the total number of movements. See also paragraphs 11.1.5.1 and 13.1.1.6.

5.1.2 Spindle Speed and Latency

The spindle speed is 3597 ±0.5% r/min. The speed tolerance includes motor performance and motor control circuit tolerances.

The average latency time is 8.34 milliseconds, based on a nominal disk speed of 3597 r/min. The maximum latency time is 16.76 milliseconds based on a minimum disk speed of 3579 r/min.

5.2 READ DATA TRANSFER RATE

The read serial data transfer rate is 10.0 Megabits per second, 1.25 Megabytes per second.

5.3 START/STOP TIME

The WREN III 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.

There is no power control switch on the WREN III.

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	
Soft Read Errors (Recoverable)	Less than 1 in 10^{10} bits transferred
Hard Read Errors (Unrecoverable)	Less than 1 in 10^{12} bits transferred
Seek Errors	Less than 1 in 10^{6} seeks
MTBF	30,000 hours
Service Life	5 years or 30,000 hours
Preventive Maintenance	None required

6.1 ERROR RATES

The error rates stated in this specification assume the following:

a. WREN III is operated per this specification using DC Power as defined in this specification (see Section 7.2).
b. A data format is employed fulfilling the requirements of the WREN III as outlined in the CDC ESDI Specification.
c. Errors caused by media defects or host system failures are excluded from error rate computations. Refer to paragraph 8.0, Media Characteristics.

6.1.1 Read Errors

Before the determination 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.

A recoverable read error is one that can be read correctly in 2 sets of 10 retries. After 10 retries, a recalibrate (RTZ) and reseek to the suspected cylinder must be accomplished. The recoverable read error rate for any read operation shall be less than one error in 10^{10} bits read.

An unrecoverable read error is one that cannot be read correctly in 2 sets of 10 retries. The unrecoverable read error rate for any read operation shall be less than one bit in 10^{12} bits read.

Retries should use a combination of early and late data strobes as well as plus and minus actuator offsets.

6.1.2 Environmental Interference

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

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

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

A seek error is defined as a failure of the WREN III to position the heads to the addressed track when the correct information has been presented to the WREN III. This condition must be determined by the controller by reading headers. There shall be no more than one recoverable seek error in 10^6 physical seek operations. A recoverable seek error is a positioning error which can be corrected by issuing a RTZ command and then reseeking the addressed track. Unrecoverable seek errors are classified as failures for MTBF calculations.

6.2 RELIABILITY AND SERVICE

6.2.1 Mean Time Between Failure

The Mean Time Between Failure (MTBF) shall exceed 30,000 hours for the WREN III. MTBF is defined as "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, controller 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 III 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

Special equipment and environment is required to repair the WREN III HDA. Repairs may be performed only at a properly equipped and staffed depot service and repair facility.

6.2.5 Installation

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

6.2.6 Service Tools

No special tools are required for site installation and none are recommended for site maintenance. Refer to paragraph 6.2.4. If field repair of items external to the HDA is desired, two sizes of 6 point Torx drivers (T10 and T15) are required. They may be purchased through most commercial tool catalogs.

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 III are shown in the following table. Values indicated apply at the drive power connector.

TABLE 1. DC POWER REQUIREMENTS

Voltage	+5 V	+12 V
Regulation	±5%	±5% (2)
Noise Immunity (3)	100 mV	100 mV
Maximum Operating Current (1)	1.0 A	2.3 A
Average Idle Current (1) (4)	0.8 A	1.4 A
Maximum Starting Current (Peak)	1.4 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.

(3) Noise is specified as periodic and random distribution of frequencies covering a band from DC to 10 MHz. Peak to peak values are listed.

(4) See +12V current profile Level T6 in Figure 3A.

NOTE 1:

At powerup, 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 average operating current shown in Table 1.

NOTE 3:

The +5 V and +12 V returns are tied together in the drive, but separate returns to the power supply should be used to minimize noise coupling between the supplies.

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. (Reference Table 1).

7.2.1 Power Sequencing

Power sequencing is not required for the WREN III. 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 cables.

7.2.2 12 V Current Profile

Figure 3A identifies the WREN III 12 V current profile. The current during the various times is as shown:

T1 Power is initially applied to the drive and the spindle begins to accelerate under current limiting.

T2 The spindle continues to accelerate under current limiting conditions.

T3 The arm restraint solenoid is released.

T4 The spindle is up to speed (3597 r/min).

T5 The autovelocity adjust sequence is performed.

T6 Velocity is set and the WREN is ready for reading and writing.

T7 Power is removed from the WREN.

NOTE

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

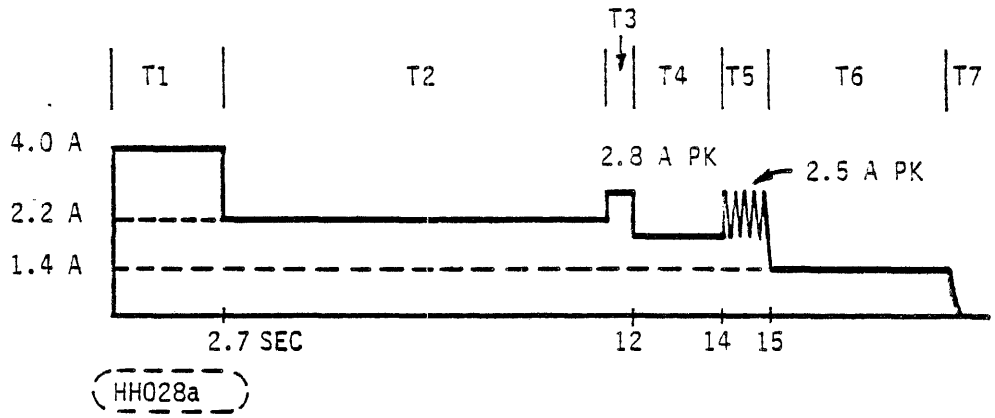


FIGURE 3A. TYPICAL WREN III +12 V CURRENT PROFILE

7.3 HEAT/POWER DISSIPATION

Each WREN III will dissipate no more than 33.0 watts (113 BTUs per hour) of DC power average. Typical power dissipation under idle operating conditions is less than 21 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 temperature is 82°F (28°C).

7.4.1 Temperature

a. Operating

50°F to 122°F (10°C to 50°C) operating ambient with a maximum gradient of 18°F (10°C) per hour. Above 1000 feet (305 metres) altitude the maximum temperature is derated linearly to 112°F (44.4°C) at 10,000 feet (3048 metres). Cabinet packaging designs must provide ample air circulation around the WREN III 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 III. The temperature of the base deck must not exceed 135°F when measured at the isolation mount adjacent to the front panel LED.

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 III.

c. Storage

14° to 130°F (-10° to 54°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 metres)

b. Transit
-1,000 to +40,000 feet (-305 to +12,210 metres)

c. Storage
-1000 to +10,000 feet (-305 to +3048 metres)

7.4.4 Shock and Vibration

Shock and vibration limits specified in this document are measured directly on the drive chassis. If the WREN III 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 III movement in excess of the stated limits. If this situation is apparent, it may be necessary to modify the enclosure to minimize WREN III 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 3B.

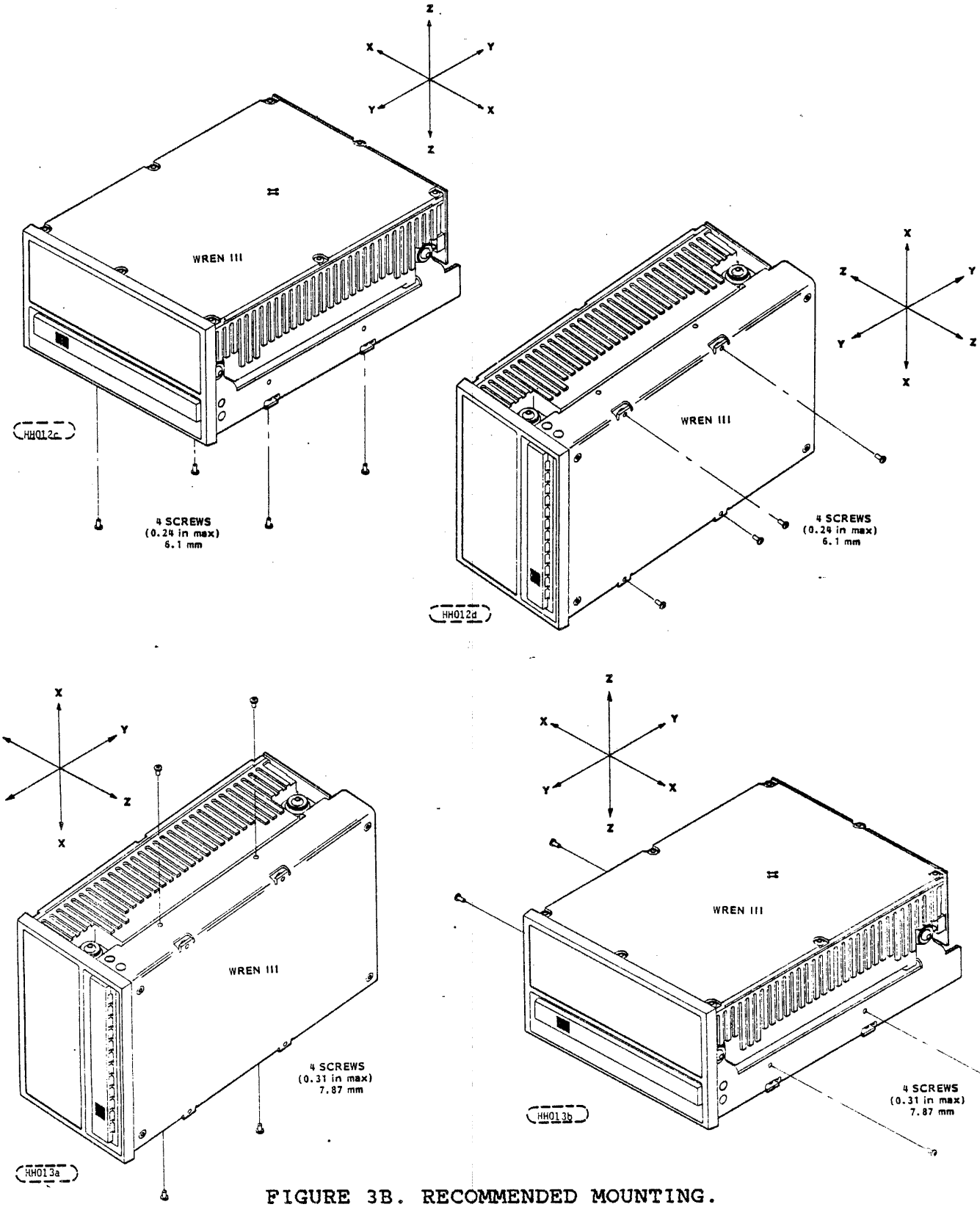


FIGURE 3B. RECOMMENDED MOUNTING.

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.

c. Nonoperating

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

Equipment subjected to nonrepetitive 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.

d. Packaged

A WREN III drive as packaged by CDC for commercial freight shipment shall withstand drop test from 42 inches (1070 mm) against a concrete floor or equivalent. (See Figure 4.) This applies to the single unit pack only.

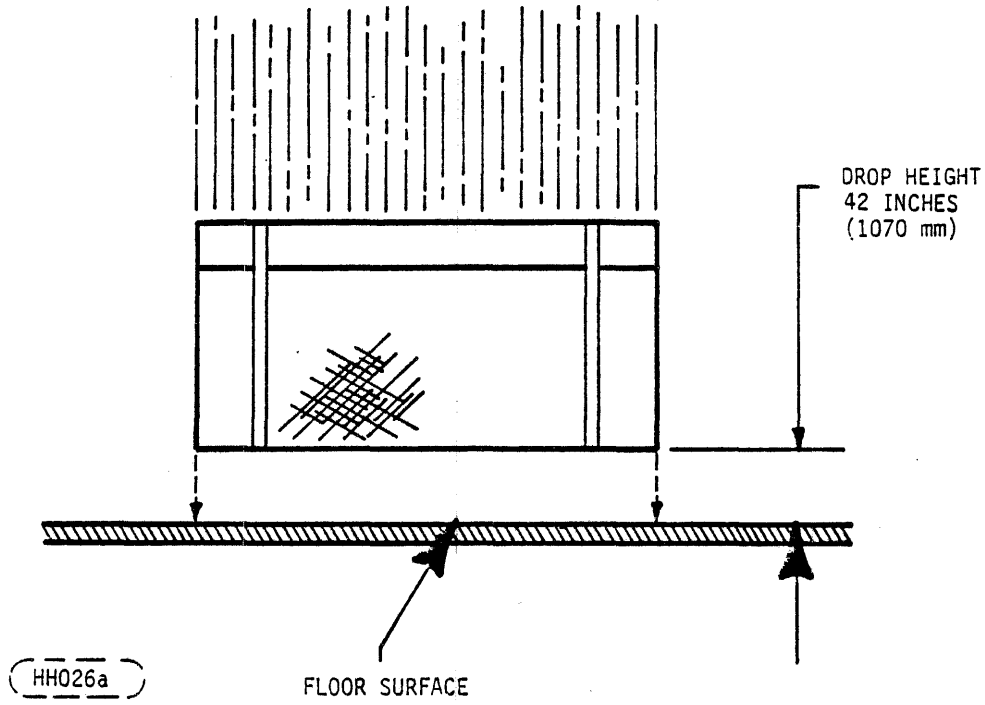


FIGURE 4. FLAT DROP TEST

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 (0.25 mm) 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 subject to periodic vibration not exceeding

15 minutes duration at major resonant frequency
5-22 Hz @ 0.010 inches (0.25 mm) 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 resume 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. Nonoperating
The limits of nonoperating 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

5-22 Hz @ 0.020 inches (0.50 mm) displacement
22-500 Hz @ 1.00 g

Vibration may be applied in the X, Y, or Z axis.

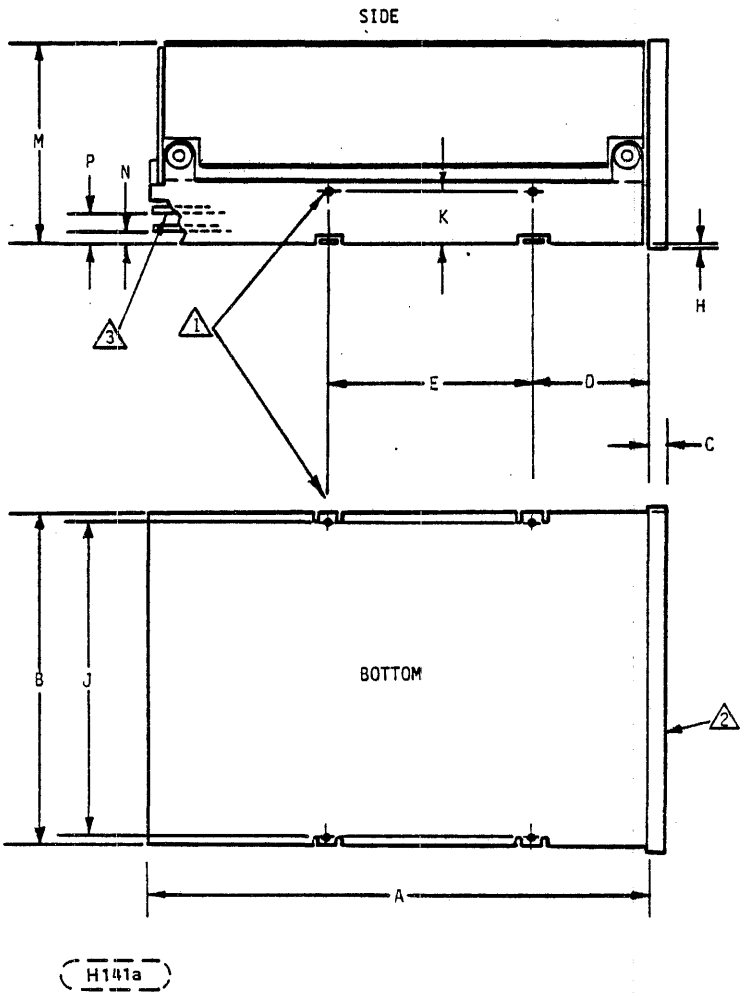
7.4.5 Air Cleanliness

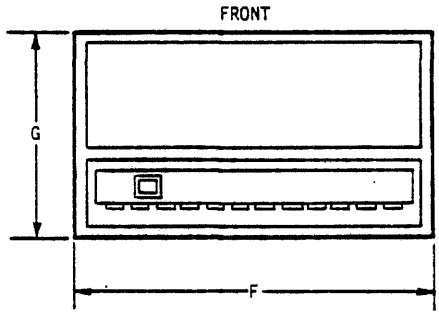
The WREN III is designed to operate in a typical office environment with minimum environmental control.

7.5 MECHANICAL SPECIFICATIONS

The following nominal dimensions are exclusive of the decorative front panel accessory. Refer to Figure 5 for detailed mounting configuration dimensions.

Height:	3.25 inches	82.55 mm
Width:	5.75 inches	146.05 mm
Depth:	8.0 inches	203.2 mm
Weight:	7.6 pounds	3.4 kilograms





NOTES:

1. MOUNTING HOLES. FOUR ON BOTTOM, TWO ON EACH SIDE. 6-32 UNC. MAX SCREW LENGTH INTO SIDE OF CHASSIS 0.31 IN. (7.87 mm). MAX SCREW LENGTH INTO BOTTOM OF CHASSIS IS 0.24 IN. (6.1 mm).
2. FRONT PANEL ACCESSORY
3. POWER AND INTERFACE CONNECTIONS

	IN	mm
A	8.0 MAX	203.2
B	5.75 ± 0.03	146
C	0.29 ± 0.01	7.4
D	1.87 ± 0.02	47.5
E	3.12 ± 0.01	79.2
F	5.88 ± 0.01	149
G	3.38 ± 0.01	85.8
H	0.065 ± 0.02	1.65
J	5.50 ± 0.02	139.7
K	0.86 ± 0.02	21.8
M	3.25 ± 0.04	82.5
N	0.37 REF	9.4 REF
P	0.63 REF	16 REF

FIGURE 5. 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. The uppermost surface must be maintained in a level position or drive performance may be adversely affected. Mounting with either end down (front or rear) is not permissible. The drive may not be mounted inverted (upside down) in the horizontal orientation. It is recommended for optimum performance that data written in a given orientation be read in that same orientation.

7.5.2 Cooling

Cabinet cooling must be designed by the customer so that the ambient temperature immediately surrounding the WREN III will not exceed temperature conditions specified in 7.4.1. Specific consideration should be given to make sure adequate air circulation is present around the circuit board at the rear of the drive.

8.0 MEDIA CHARACTERISTICS

8.1 MEDIA DESCRIPTION

The media used in the WREN III has a diameter of approximately 5 1/4 inches (130 mm). The aluminum substrate is coated with a thin film magnetic material, and lubricated to permit the heads to contact the surface when starting and stopping.

Each data surface has a total of 969 tracks and is capable of recording 20,232,720 bytes of unformatted data.

Media defects are characterized as correctable or uncorrectable depending on the type and magnitude of the media flaw. Various error correction codes may be implemented. The code chosen should be consistent with Control Data media testing and certification methods. WREN III media certification is performed using the following standards:

1. An error burst of 11 bits or less is a correctable error.

2. An error burst greater than 11 bits in length is an uncorrectable error.

8.1 (continued)

Host systems using the WREN III should have, as a minimum, resident capabilities to recognize and map defective tracks and perform track reallocation routines.

At the time of shipment from the point of manufacture, the WREN III recording surfaces will meet the following requirements.

1. 969 total tracks per surface.

2. Track 0 to be error free on each data surface.

3. 30 defects per surface maximum.

4. Cumulative defects not to exceed 1 per megabyte, based on total available drive capacity.

9.0 DEFECT AND ERROR MANAGEMENT

The WREN III, as delivered, complies with this specification. The read error rate and specified storage capacity are not dependent upon use of defect management routines. However, a carefully chosen defect management plan can significantly enhance overall system performance.

Identified defects are recorded on the defects list tracks per CDC ESDI specification (Sections 5.5 and 6.5). It is recommended that these known defects be reallocated during the initial format operation. Sector reallocation is suggested because, in general, it is more efficient and may offer significant performance improvement. Error Correction Code (ECC) should be used to correct additional flaws as they occur. ECC is recommended since most of the defects are recoverable with ECC. If ECC is not used, defects are usually unrecoverable and need to be reallocated as they are discovered.

10.0 INTERFACE CABLING REQUIREMENTS/OPTIONS

10.1 RADIAL CONFIGURATION

Interface cabling options for the WREN III are shown in Figure 6. View A of Figure 6 shows each drive interfaced to its own control cable, which allows interfacing an arbitrary number of drives and a variety of system operational techniques. Each drive has its data cable and control cable connected to the host controller. The length of each individual cable must not exceed 10 feet (3.0 metres). Terminator resistors must be installed in the host controller for each data cable and for each control cable. For this configuration, a terminator resistor pack must be installed in each WREN III Disk Drive. The orientation of Pin 1 of the terminator resistor does not matter. Either way is correct.

10.2 DAISYCHAIN CONFIGURATION

A daisychain configuration connects a maximum of seven drives in parallel on a common control cable. (See paragraph 11.1.1). Only the drive selected by the host system has its control signals enabled through this common interface. View B of Figure 6 illustrates a daisychain of WREN III Disk Drives or other ESDI devices. A terminator resistor pack is required in the host controller for each data cable. Only the last ESDI device in the daisychain requires a terminator resistor pack for the control cable. Terminator resistor packs for the control cable of other drives must be removed. See Figure 7 for location of the terminator pack. The total combined control cable length (from the controller to the first drive, to the second and subsequent drives) must be not more than 10 feet (3.0 metres).

Refer to paragraph 11.1.1 for logical drive selection.

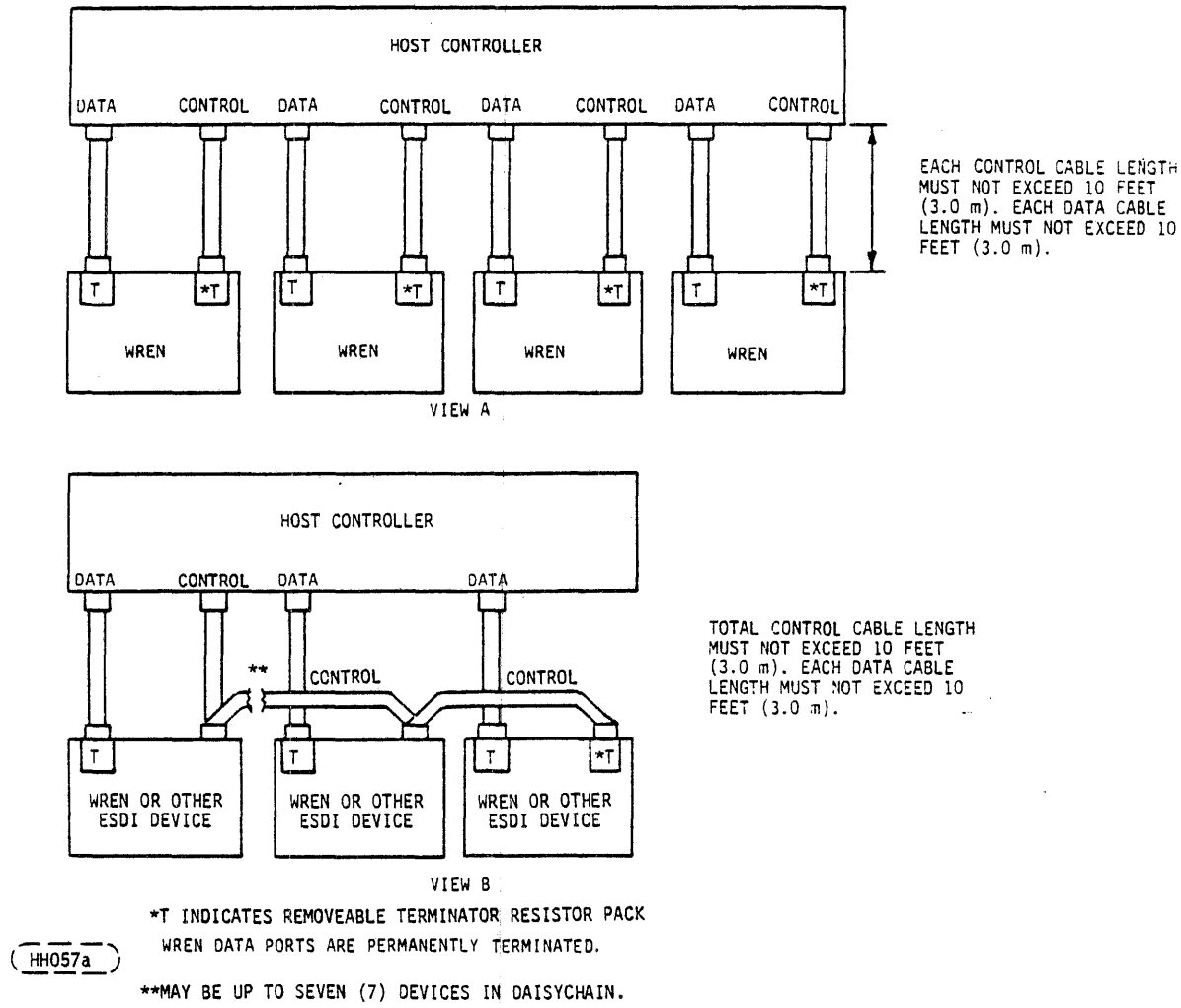


FIGURE 6. INTERFACE CABLING OPTIONS

10.3 DC CABLE AND CONNECTOR

The WREN III receives DC power through a 4 pin right angle connector (see Table 2 for pin assignment) mounted on the servo circuit board (see Figure 7). Recommended part numbers of the mating connector are provided, but equivalent parts may be used (See Table 3).

TABLE 2. DC INTERFACE

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

TABLE 3. EQUIVALENT PARTS

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

10.4 DATA CABLE AND CONNECTOR

The I/O connector for the data interface is a 20 pin board edge connector (Figure 8 and 9a). The odd pins are located on the noncomponent side of the printed circuit board. The even pins are on the component side of the printed circuit board. A key slot is provided between pins 3 and 5. CDC recommends keying this connector to prevent installing it upside down. However, the WREN will not be damaged if the connector is installed upside down.

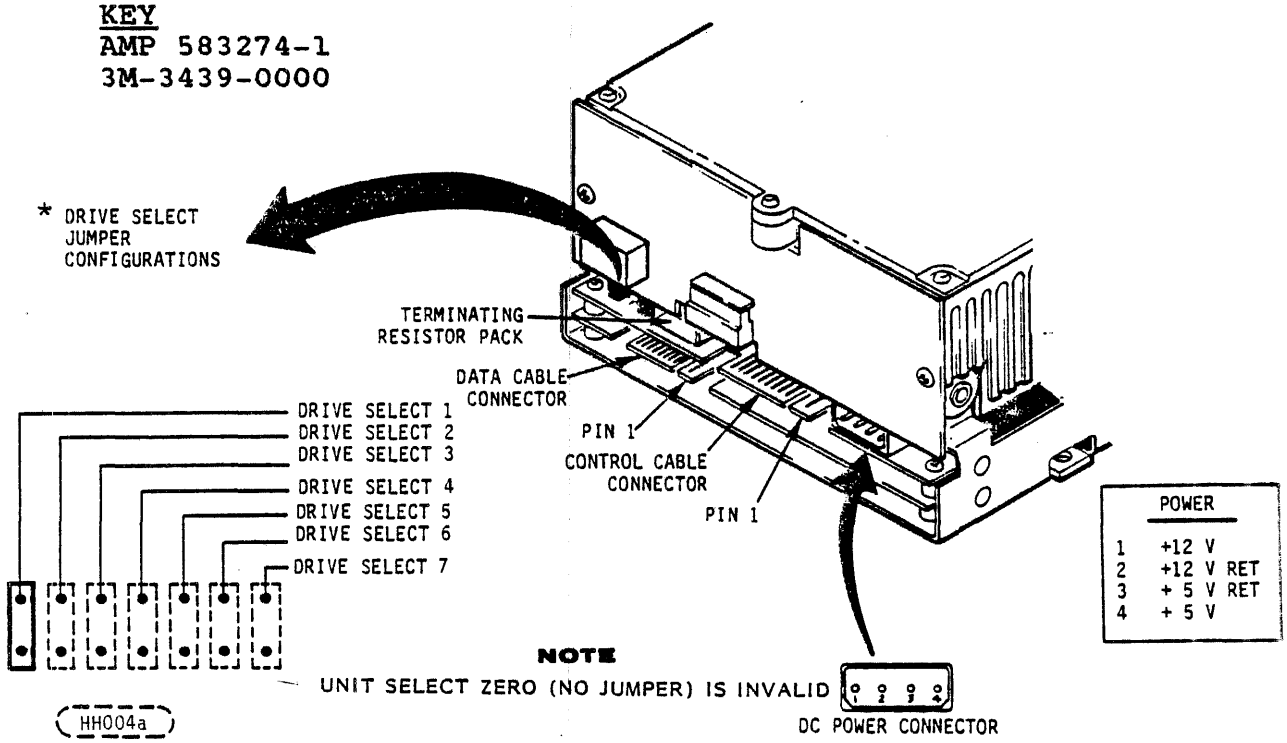
10.4 (continued)

Recommended part numbers for the mating connector are included below, but equivalent parts may be used.

CONNECTOR (20 PIN)
3M-3461-0001
AMP 88373-6

CABLE
Flat Cable (Stranded AWG 28) 3M-3365-20
Flat Cable (Stranded AWG 28) 3M-3517-20 (Shielded Cable)

KEY
AMP 583274-1
3M-3439-0000



* The position of this jumper when drive is shipped is determined by a customer configuration document.

FIGURE 7. I/O CONNECTION

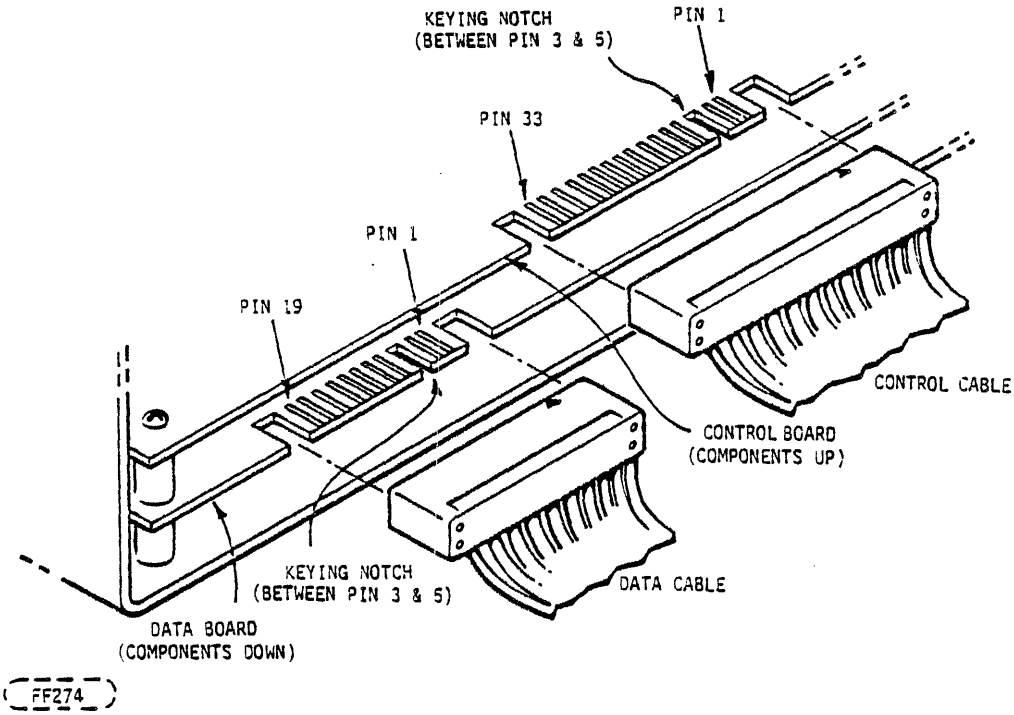


FIGURE 8. CABLE CONNECTION

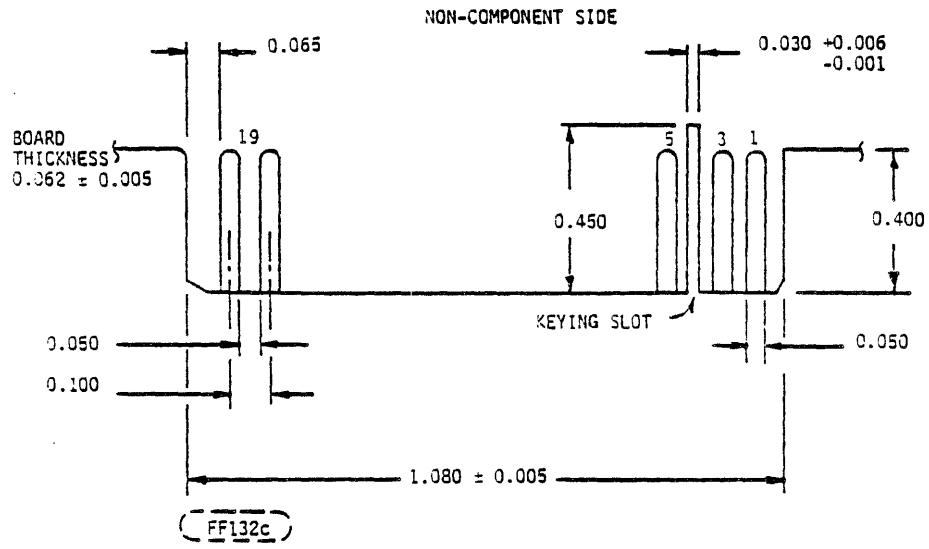


FIGURE 9a. DATA CABLE INTERFACE

10.5 CONTROL CABLE AND CONNECTOR

The I/O connector for the control interface is a 34 pin board edge connector. The odd pins are located on the component side of the printed circuit board and are connected to the ground plane. The even pins are on the noncomponent side of the printed circuit board. A key slot is provided between pins 3 and 5. (See Figure 8 and 9b.) CDC recommends keying this connector to prevent installing it upside down. However, the WREN will not be damaged if the connector is installed upside down.

Recommended part numbers for the mating connector are provided, but equivalent parts may be used.

CONNECTOR (34 PIN)
3M-3463-0001
AMP 88373-3

KEY
AMP 583274-1
3M-3439-0000

CABLE
Flat Cable (Stranded AWG 28) 3M-3365-34
Flat Cable (Stranded AWG 28) 3M-3517-34 (Shielded Cable)
Spectra Strip Twist'n Flat 455-248-34 (Stranded AWG 28 Twisted Pair)

10.6 INTERFACE DRIVERS/RECEIVERS

The WREN III uses two types of signals; single ended and balanced differential. The data and clock signals use balanced differential drivers and receivers. All other signals use single ended drivers and receivers.

10.6.1 Single Ended Drivers/Receivers

10.6.1.1 Transmitter Characteristics

The WREN III uses the 7406 open collector hex inverter buffer/driver to transmit status to the host. This driver is capable of sinking a current of 40 mA with a low level output voltage of 0.7 V. (See Figure 10).

10.6.1.2 Receiver Characteristics

The WREN III uses the 74LS14 Hex Inverter with hysteresis gate as a line receiver. The input of each receiver is terminated in a 150 ohm pullup resistor as shown in Figure 10.

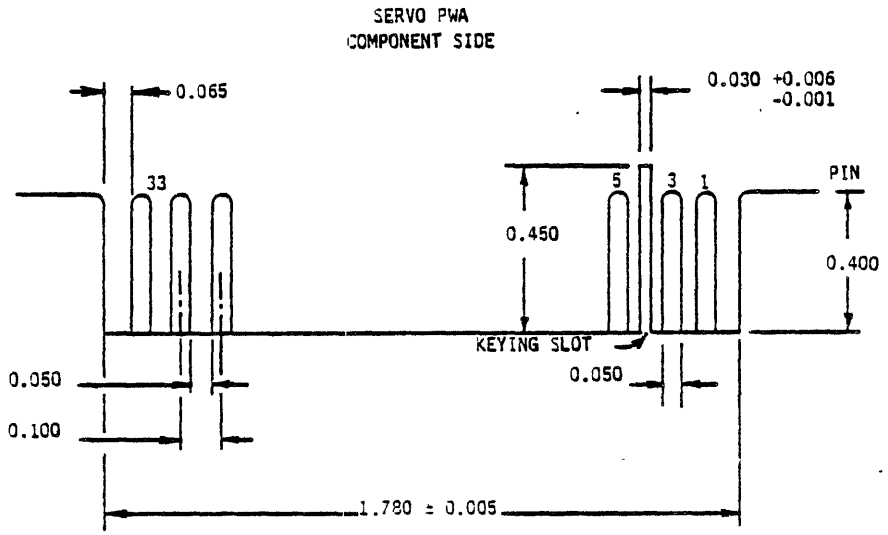
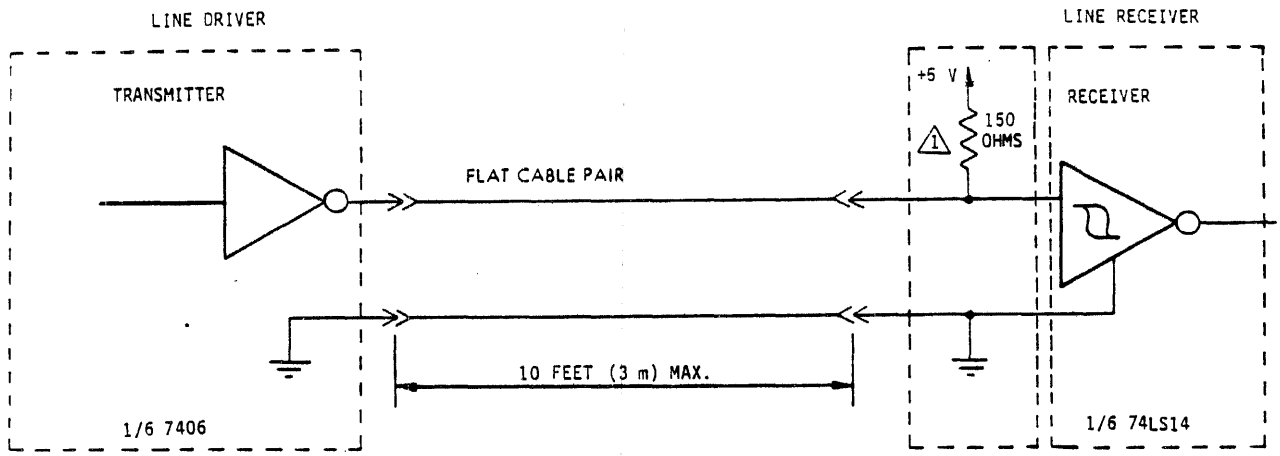


FIGURE 9b. CONTROL CABLE INTERFACE



1 PART OF REMOVABLE RESISTOR PACK. (SEE FIGURE 9.)

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

LOGIC LEVEL	DRIVER OUTPUT	RECEIVER INPUT
HIGH (NEGATED) (0)	≥2.5 V; ≤5.25 V	≥2.0 V; ≤5.25 V
LOW (ASSERTED) (1)	≤0.7 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 10. SINGLE ENDED TRANSMITTERS AND RECEIVERS

10.6.1.3 Terminator Characteristics

The terminator is a resistor module that plugs into a socket in the last drive in a daisychain as shown in Figure 7. Each drive is furnished with a terminator. Terminators must be removed from all except the last drive on the cable prior to daisychain operation. (See Figure 6.) An equivalent terminator must be provided in the controller on each input signal line from the drive to the controller. Only the Control cable resistor module is removable.

10.6.2 Balanced Differential Drivers/Receivers

10.6.2.1 Transmitter Characteristics

The WREN III uses 26LS31 type balanced differential drivers. An assertion on the interface is defined when the "+" output is more positive than the "-" output. (See Figure 11.)

10.6.2.2 Receiver Characteristics

The WREN III uses 26LS32 type balanced differential receivers terminated per Figure 11. An assertion on the interface is defined when the "+" input is more positive than the "-" input. (See Figure 11.)

10.6.2.3 Terminator Requirements

Each differential receiver in the drive is terminated with a 100 ohm resistor. (See Figure 11.) An equivalent terminator must be provided in the controller on each input signal line from the drive to the controller.

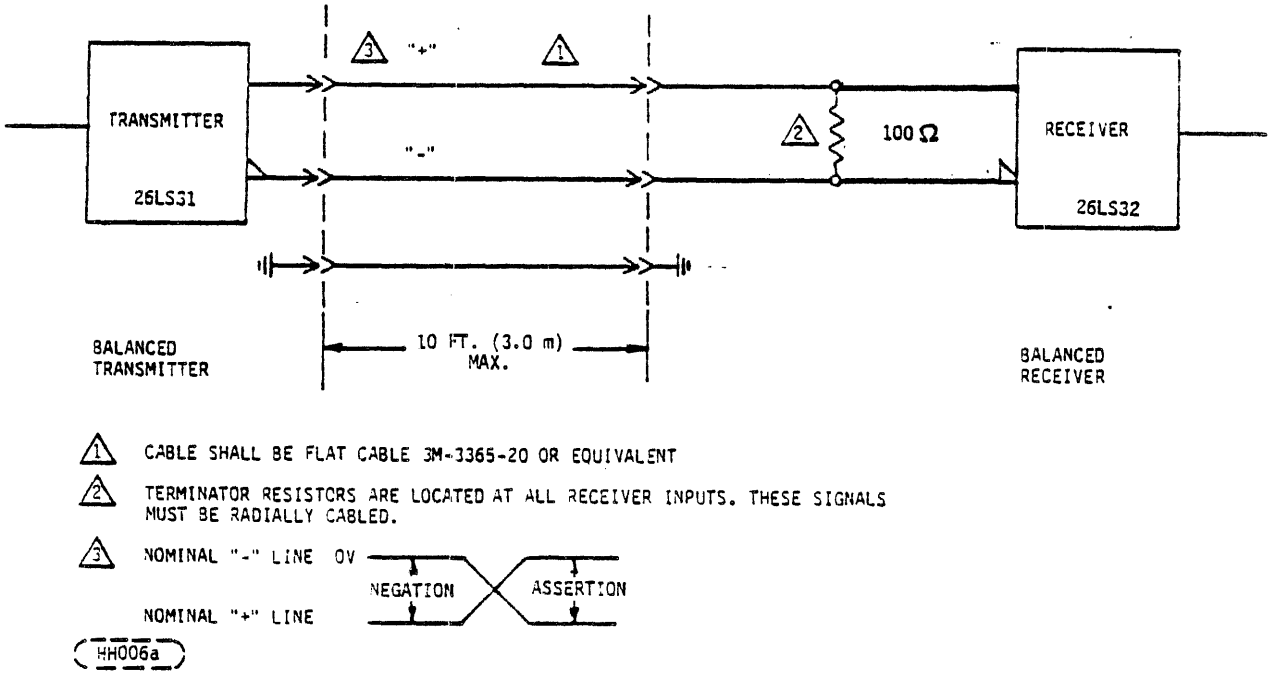


FIGURE 11. BALANCED DIFFERENTIAL DRIVERS/RECEIVERS

10.7 SIGNAL/CHASSIS GROUNDS

The WREN III Disk Drives are manufactured with the signal and chassis grounds common. Zero ohm resistors (designated W3 and W4) on the Data board allows modification of this relationship at the customer's option. The results of connecting/disconnecting the zero ohm resistors are listed in Table 3A. The customer can select any of these grounding options by removing W3 and/or W4. A customer configurator document specifies which of the Table 3A configurations a drive will have when shipped.

TABLE 3A

W4	W3	RESULT
X	X	Grounds common, quick connect terminal tied to common ground (as manufactured).
X	0	Grounds separate, quick connect terminal tied to chassis ground.
0	X	Grounds separate, quick connect terminal tied to signal ground.
0	0	Grounds separate, quick connect terminal floating.

X = Connected
0 = Not Connected

See Figure 11b for physical locations of W3 and W4 and Figure 11a for schematic.

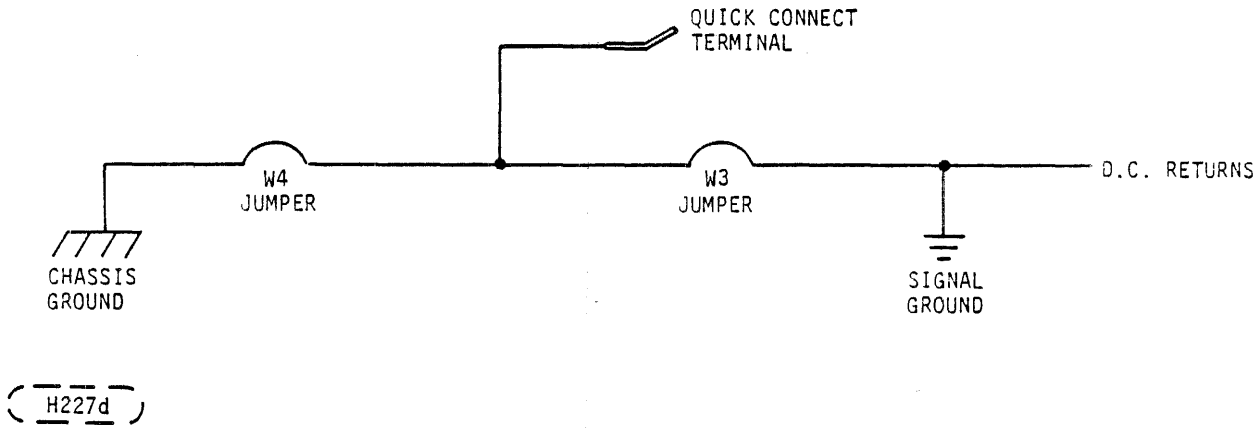


FIGURE 11a. SCHEMATIC DIAGRAM OF W3 AND W4

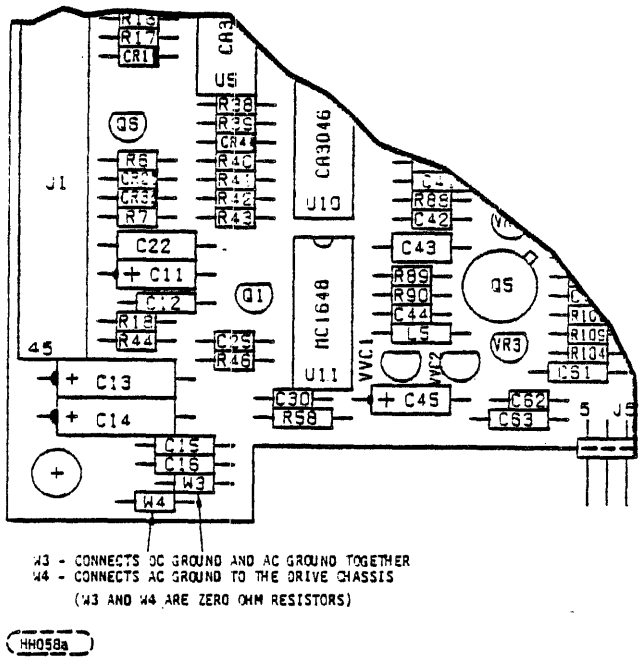


FIGURE 11b. ESDI DATA PWA SHOWING W4

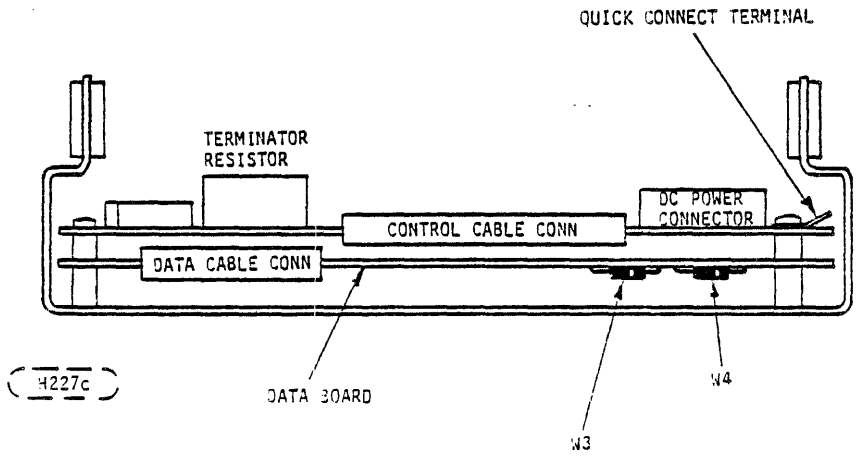


FIGURE 11c. LOCATION OF W3 AND W4

11.0 SERIAL MODE INTERFACE SIGNAL DESCRIPTION

This Section (11) specifies standard WREN III ESDI parameters for the SERIAL mode of operation. Section 5.0 of the ESDI Specification (77738076) contains a detailed description of the SERIAL mode and must be referenced to define the ESDI interface operation.

Figures 9 and 10 of the ESDI Specification lists the signals between the drive and the controller for the SERIAL mode of operation. These same signals are used by the standard model 94166 WREN III. WREN III does not support the ESDI step mode of operation.

11.1 CONTROL INPUT LINES

11.1.1 Drive Select

Refer to ESDI Specification Section 5.1.1.

The following characteristics apply to the DRIVE SELECT lines:

1. Logical unit designation for up to 7 drives is performed during installation by installing the jumper on the baseboard assembly as shown in Figures 7 and 12 of this specification.

2. The controller shall not attempt to select the drive until 1 second after DC power is applied. The READY output will be valid (whether asserted or negated) within 1 us after the drive is selected. Refer to Fig. 13.

3. The drive will be selected (and the DRIVE SELECTED Signal asserted) within 1 us after the DRIVE SELECT lines contain that unit's select address. The drive will be deselected (and the DRIVE SELECTED signal negated) within 1 us after the DRIVE SELECT lines contain another unit's select address.

4. The DRIVE SELECT lines must remain asserted for 1 us after a write operation.

5. When the DRIVE SELECT lines are asserted, a head change will occur per Section 11.1.2 requiring a delay before a read or write operation can be initiated. Refer to Figure 12.

11.1.1 (continued)

Install the drive select jumper for the desired logical unit address. Refer to Figure 7 for location of unit select header. The logical address is selected by installing the select jumper in the Drive Select header as shown in Figure 7.

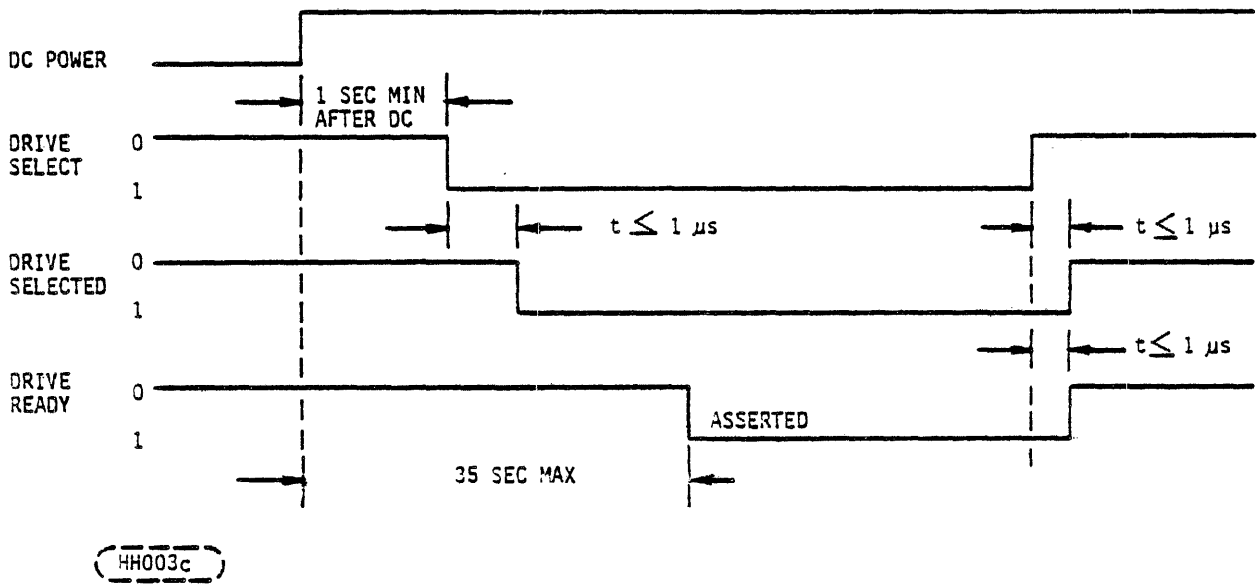


FIGURE 12. POWER TURN ON AND DRIVE SELECTION

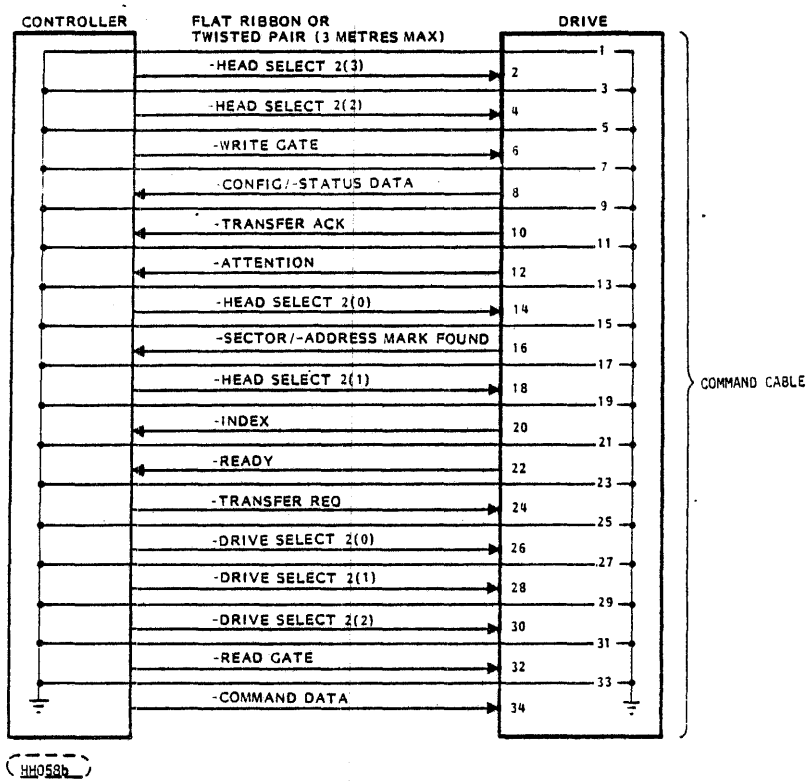
11.1.2 Head Select 2(0), 2(1), 2(2), and 2(3)

Refer to ESDI Specification Section 5.1.2.

These lines select the proper media and head for data transfer. See Table 4.

Head selection may be changed at any time following assertion of DRIVE SELECT, but must occur a minimum of 5 us prior to a write operation. WRITE GATE must be negated a minimum of 1 us prior to a head change. READ DATA will be valid within 10 ns from a head selection (change) if the drive is selected, READ GATE is asserted, the DRIVE READY line is asserted, the COMMAND COMPLETE line is asserted, and a PLO Sync field is present.

Neither the DRIVE READY line or the COMMAND COMPLETE line will change as a result of a head selection (change).



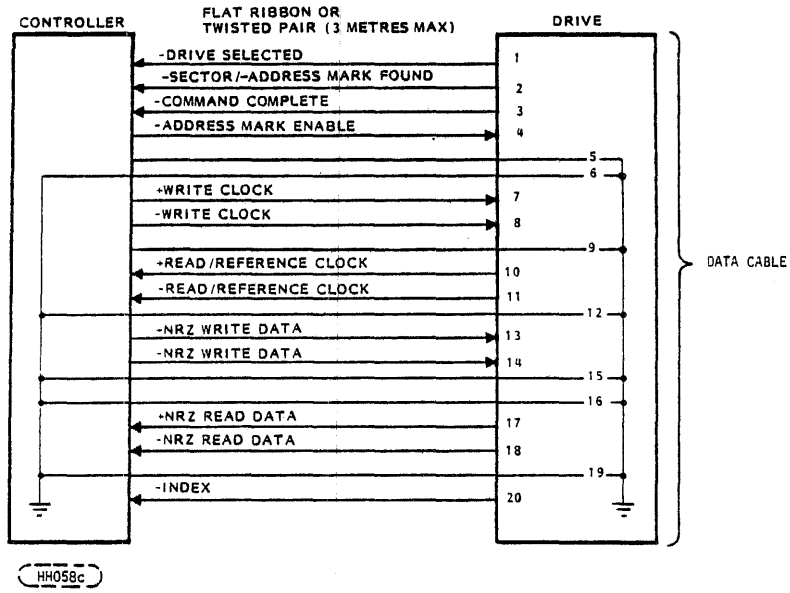
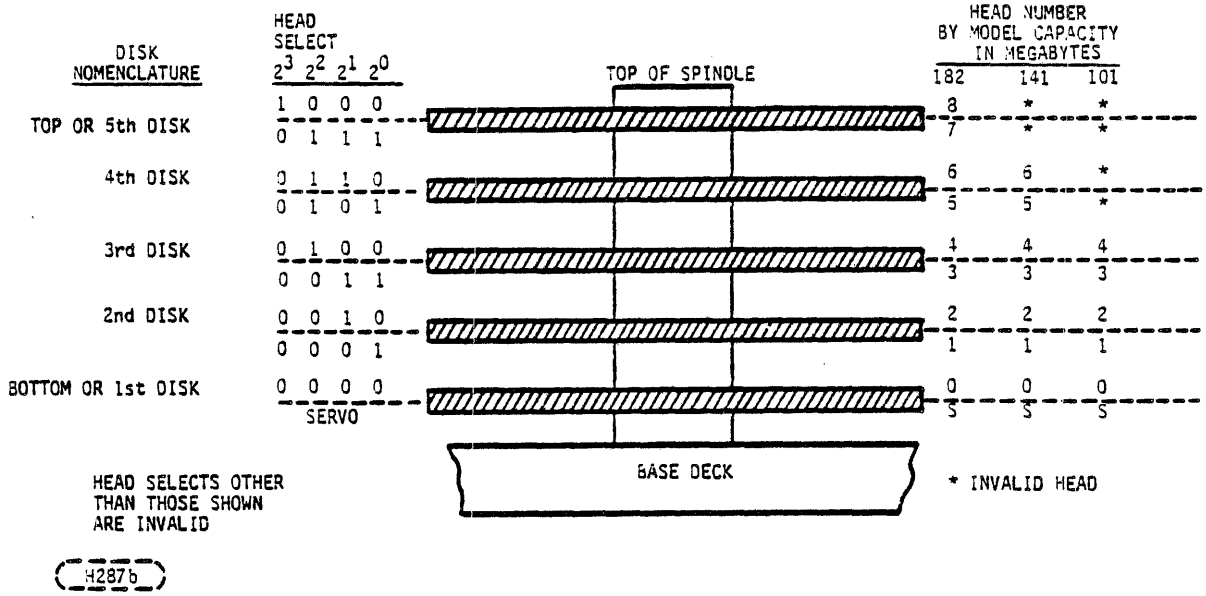


FIGURE 12a. ESDI INTERFACE PINOUTS

11.1.2 (continued)

TABLE 4. HEAD SELECT ENCODING



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11.1.3 Write Gate

Refer to ESDI Specification Section 5.1.3.

11.1.4 Read Gate

Refer to ESDI Specification Section 5.1.4.

11.1.5 Command Data

Refer to ESDI Specification Section 5.1.5. (Figure 12a)

The WREN III responds with TRANSFER ACK in typically 2 us from either edge of TRANSFER REQ. This promotes significantly improved performance over the allowed 10 ms and should be recognized.

11.1.5.1 Command Data Bits 15 thru 12 Decode Definition

Refer to ESDI Specification Section 5.1.5.1.

The 94166 WREN III implementation of the ESDI command set is summarized in the following table. Any ESDI command not implemented will be treated as an Invalid Command. A command transfer attempt to the drive should not be initiated until the COMMAND COMPLETE line from the drive is asserted just before the transfer.

11.1.5.1 (continued)

SERIAL MODE COMMAND SET IMPLEMENTED	WREN III
• SEEK	YES
• RECALIBRATE	YES
• REQUEST STATUS	
-STANDARD	YES
-VENDOR UNIQUE	YES
• REQUEST CONFIGURATION	YES
• SELECT HEAD GROUP	NO
• CONTROL	
-RESET ATTENTION AND STANDARD STATUS 0-11	YES
-STOP MOTOR	NO
-START MOTOR	YES
• DATA STROBE OFFSET - 3 LEVELS/ ONE PHYSICAL OFFSET	YES
• TRACK OFFSET - 3 LEVELS/ THREE PHYSICAL OFFSETS	YES
• INITIATE DIAGNOSTICS	YES
• SET BYTES PER SECTOR	YES
• SET CONFIGURATION	YES

The following ESDI commands are recognized by the Model 94166 WREN III. Additional information not contained in the ESDI specification is included.

SEEK (0000):

The SEEK times defined in Section 5.0 of this specification are measured from the time the last bit of the command word is received by the drive. The COMMAND COMPLETE signal line will be asserted when the drive has completed the SEEK operation and is ready to accept the next command word.

11.1.5.1 (continued)

RECALIBRATE (0001):

The maximum time to complete the Recalibrate function is 100 milliseconds, and is measured from the time the last bit of the command word is received by the drive. The COMMAND COMPLETE signal line will be asserted when the Recalibrate function is completed.

REQUEST STATUS (0010):

I. REQUEST STANDARD STATUS (command modifier equals 0000)

The controller need only request standard status in response to the drive's assertion of the ATTENTION line.

The controller asserts the COMMAND COMPLETE line after it has read the drive's standard status word.

The controller should always first request the Standard Status in response to the assertion of the ATTENTION line. The "Vendor Unique Status Available" bit in the Standard Status Word defines whether or not the Vendor Unique status words are valid.

See Section 11.2.3.2 for the response to the "Request Status" Command.

II. REQUEST VENDOR UNIQUE STATUS (command modifiers 0001 through 1111)

The Vendor Unique Status consists of up to 15 unique words of status and is valid only if bit 2 of the Standard Status is a one.

This status is only intended to be used by trained field maintenance personnel and is not intended to be interpreted by disk controllers or operating systems. If this bit is detected the controller should attempt to reset Standard Status and reattempt the original function a minimum of three times prior to defining the drive as inoperative. After the last attempt the Vendor Unique Status words should be read by the controller and sent back to the system for a print out of these codes which may then be used by the field maintenance personnel.

11.1.5.1 (continued)

REQUEST CONFIGURATION (0011):

Configuration data is sent to the controller via the CONFIG-STATUS line as a result of receiving a "Request Configuration" command. The exact Configuration Word sent is dependent upon the Configuration Word requested by the controller via the Command Modifier Bits. (See Table 5.)

See Section 11.2.3.1 for the responses to the "Request Configuration" commands listed in Table 5.

CAUTION

Configuration status cannot be requested until COMMAND COMPLETE is asserted. This occurs 35 seconds after the beginning of power up.

TABLE 5.SUMMARY OF CONFIGURATION INFORMATION REQUESTED

COMMAND MODIFIER BITS				CONFIGURATION INFORMATIION REQUESTED
11	10	9	8	
0	0	0	0	GENERAL CONFIGURATION OF DRIVE AND FORMAT (See Table 6)
0	0	0	1	NUMBER OF CYLINDERS FIXED
0	0	1	0	NUMBER OF CYLINDERS REMOVABLE
0	0	1	1	NUMBER OF HEADS
0	1	0	0	MINIMUM UNFORMATTED BYTES PER TRACK
0	1	0	1	UNFORMATTED BYTES PER SECTOR (HARD SECTOR ONLY)
0	1	1	0	SECTORS PER TRACK (HARD SECTOR ONLY)
0	1	1	1	MINIMUM BYTES IN ISG FIELD
1	0	0	0	MINIMUM BYTES PER PLO SYNC FIELD
1	0	0	1	NUMBER OF WORDS OF VENDOR UNIQUE STATUS AVAILABLE
1	0	1	0	INVALID CONFIGURATION REQUEST CODES
1	0	1	1	
1	1	0	0	
1	1	0	1	
1	1	1	0	
1	1	1	1	VENDOR INDENTIFICATION

11.1.5.1 (continued)

CONTROL (0101):
Refer to ESDI Specification Section 5.1.5.1.

The WREN III will implement the following Control Commands (as specified by the Command Modifier Bits). Any Command Modifier received which is not listed will be treated as an Invalid Command.

a. Reset Interface Attention and Standard Status bits (Command Modifier 0000)

   This command must be sent to reset the interface ATTENTION line and the Standard Status Bits (0-11). This command should not be sent until the controller has read the Standard Status Word to determine what caused the ATTENTION line to be asserted.

b. Start Motor (Command Modifier 0011)
   This command must be sent by the controller to turn on the spindle motor when the "Motor Control Option Implemented" General Configuration bit is asserted (see Sections 11.2.3.1 and 12). This command is not required to turn on the spindle motor if the "Motor Control Option Implemented" configuration bit is negated, and will be treated as an Invalid Command.

   The interface COMMAND COMPLETE line will be asserted when the Control Command has been executed.

NOTE

If the "Motor Start" option is implemented (see Section 12.1), only the following five commands are recognized as valid before the Motor Start command is issued (i.e., while the "Spindle Motor Stopped" bit is set in the Standard Status word - see Section 11.2.3.2).

COMMAND	COMMAND CODE (Bits 15-0)
Request Standard Status	2000H
Request Vendor Unique Status	2100H - 2F00H
Request General Configuration	3000H
Reset Interface Attention	5000H
Start Spindle Motor	5300H

Any other commands will cause "ATTENTION" to be asserted and an "INVALID COMMAND" status returned.

DATA STROBE OFFSET (0110): The drive will accept all of the Data Strobe Offset Commands but will only offset from nominal by a single amount.

11.1.5.1 (continued)

TRACK OFFSET (0111):-The drive will accept all of the Track Offset Commands and can execute three physical offset levels. This command may require up to 3 milliseconds for command execution after the command word has been received.

INITIATE DIAGNOSTICS (1000):-The drive will accept this command. If an error state exists in the drive, the ATTENTION signal will be asserted when the COMMAND COMPLETE signal is asserted to signify that status is available.

If no error state exists in the drive, the COMMAND COMPLETE signal will be asserted and the ATTENTION signal will not be asserted.

SET UNFORMATTED BYTES PER SECTOR (1001):-All zeros in bits 0 through 11 is an invalid parameter. The maximum value in bits 0 thru 11 is 4,095 (decimal). The minimum value is 82 (decimal).

COMMAND DATA CODES 1010 THROUGH 1101 AND 1111:-These codes are invalid Command codes.

Codes 1010, 1011, 1100, 1101 AND 1111 are reserved for use by the WREN III. If these commands are used by the Controller, the interface ATTENTION line will be asserted and an Invalid Command Standard Status bit will be asserted.

SET CONFIGURATION (1110)

This command provides a soft switch capability such that the controller can override the soft sector/hard sector option switches SW-2, SW-3, and SW-4 (paragraph 12.1). After power down/power up, the configuration reverts to that specified by the "hard" option switches. The controller can then change the setting with the Set Configuration command. Command format is shown below.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	P
CMD FUNCTION				SOFT SWITCH NO.				SOFT SWITCH PARAMETER								
1	1	1	0	0	0	0	1	xxxx xx01 = Set Soft Sector xxxx xx10 = Set Hard Sector								

11.1.6 Transfer Request

Refer to ESDI Specification Section 5.1.6.

11.1.7 Address Mark Enable

Refer to ESDI Specification Section 5.1.7 and Section 11.1.3 of this document.

NOTE: In the fixed sector mode, ADDRESS MARK ENABLE does not cause an ADDRESS MARK to be written on the media. The trailing edge of ADDRESS MARK ENABLE with WRITE GATE asserted initiates the writing of the header PLO sync field.

11.2 CONTROL OUTPUT LINES

11.2.1 Drive Selected

Refer to ESDI Specification Section 5.2.1. and Section 11.1.1 of this specification.

11.2.2 Ready

Refer to ESDI Specification Section 5.2.2.

11.2.3 Config/Status Data

11.2.3.1 Configuration Response Bits

In response to the "Request Configuration" command (see Section 11.1.5.1) 16 bits of configuration information is returned to the controller. The Command Modifier bit code (Bits 11-8) selects the specific configuration information to be returned.

COMMAND MODIFIER BITS (11-8)	CONFIGURATION STATUS
0000	General configuration status information shown in Table 6 is returned.

11.2.3.1 (continued)

TABLE 6. DRIVE GENERAL CONFIGURATION STATUS

CONFIGURATION BIT	FUNCTION	WREN III VALUE	
15	NOT A MAGNETIC DISK DRIVE	0	
14	FORMAT SPEED TOLERANCE GAP REQUIRED	0	1
13	TRACK OFFSET OPTION AVAILABLE	1	
12	DATA STROBE OFFSET OPTION AVAILABLE	1	
11	ROTATIONAL SPEED TOLERANCE IS > 0.5%	0	
10	TRANSFER RATE > 10 MHz	0	
9	TRANSFER RATE > 5 MHz ≤ 10 MHz	1	2
8	TRANSFER RATE ≤ 5 MHz	0	
7	REMOVABLE CARTRIDGE DRIVE	0	
6	FIXED DRIVE	1	
5	MOTOR CONTROL OPTION IMPLEMENTED	1 OR 0	6
4	HEAD SWITCH TIME > 15 μs	0	3
3	NOT MFM	1	5
2	CONTROLLER SOFT SECTORED (ADR MARK)	0 OR 1	4
1	DRIVE HARD SECTORED (SECTOR PULSES)	1 OR 0	
0	CONTROLLER HARD SECTORED (BYTE CLK)	0	

1. THE ZERO INDICATES THAT NO SPEED TOLERANCE GAPS ARE REQUIRED (EITHER BETWEEN SECTORS OR AT THE END OF A TRACK) IN THE WREN FORMAT.
2. SEE SECTION 5.0 OF THIS SPECIFICATION FOR EXACT VALUE.
3. THE ZERO INDICATES THAT THE HEAD SWITCH TIME IS LESS THAN 15 MICROSECONDS AND THAT THE COMMAND COMPLETE LINE WILL NOT BE NEGATED WHEN A HEAD CHANGE IS PERFORMED BY THE DRIVE.
4. THE APPROPRIATE BIT WILL BE ASSERTED TO INDICATE THAT THE SIGNAL WHICH IS CURRENTLY BEING TRANSMITTED ON THE SECTOR/ADDRESS MARK FOUND SIGNAL LINES IN THE INTERFACE. THESE ARE SWITCH SELECTABLE (SEE SECTION 12.0).
5. INTERNAL RECORDING MECHANISM IS RLL. DRIVE REQUIRES ZEROS FOR THE PLO SYNC FIELD.
6. SWITCH SELECTABLE (SEE SECTION 12).

H237a

11.2.3.1 (continued)

COMMAND MODIFIER BITS (11-8)	CONFIGURATION STATUS
0001	Number of Cylinders, FIXED - Value returned equals the maximum number of drive cylinders.
0010	Number of Cylinders, REMOVABLE - Value returned is 0 to signify no removable media.
0011	Number of Heads - Value returned in bits 15-8 is 0 to signify no removable media is present. Value returned in bits 7-0 (in decimal) is either 5, 7 or 9 and is determined by the number of R/W heads installed (i.e., model number).
0100	Minimum Unformatted Bytes per Track. Value returned is 20,880 (decimal).
0101	Unformatted Bytes per Sector. The Value will be the Integer value of 20,880 (decimal) divided by the number of Sectors per Track (see following command modifier code 0110).
0110	Sectors per Track. The default value is determined by switch settings at the time of installation (see Section 12.0). The Default value may be overridden by the Set Bytes per Sector command. See also "Set Bytes per Sector" command which results in a value of integer 20,880 divided by desired number of bytes per sector.
0111	Minimum Bytes in ISG Field Value returned in bits 15-8: 12 (decimal). Value returned in bits 7-0: 16 (decimal)
1000	Minimum Bytes per PLO Sync Field Value returned in bits 15-8: 0 Value returned in bits 3-0: 11 (decimal)
1001	Maximum number of vendor unique status words available. Value returned is 15 (decimal).
1010 thru 1110	Invalid command modifier codes when part of "REQUEST CONFIGURATION" command.
1111	Vendor Identification.

11.2.3.2 Status Response Bits

In response to the "Request Status" command (see Section 11.1.5.1) 16 bits of status information is returned to the controller.

The WREN III will support the following standard status bits as referenced in the ESDI Specification Section 5.2.3.2.

SERIAL MODE STANDARD STATUS BITS SUPPORTED WREN III

Bit(s)	Function	
15, 11, 10	RESERVED AND WILL BE ZERO	YES
14	REMOVABLE MEDIA NOT PRESENT	NA (=0)
13	WRITE PROTECTED, REMOVABLE MEDIA	NO (=0)
12	WRITE PROTECTED, FIXED MEDIA	NO (=0)
9	SPINDLE MOTOR STOPPED	YES
8	POWER ON RESET CONDITIONS EXIST	YES
7	COMMAND DATA PARITY FAULT	YES
6	INTERFACE FAULT	YES
5	INVALID OR UNIMPLEMENTED COMMAND FAULT	YES
4	SEEK FAULT	YES
3	WRITE GATE WITH TRACK OFFSET FAULT	YES
2	VENDOR UNIQUE STATUS AVAILABLE	YES
1	WRITE FAULT	YES
0	REMOVABLE MEDIA CHANGED	NA (=0)

11.2.3.2 (continued)

The individual standard status bit definitions are defined as follows:

a. Reserved - (Bits 15, 11, and 10)
These bits are reserved and will be zero.

b. Removable Media Not Present (Bit 14)
This bit will always be a 0 for the WREN III drive. The WREN Drive contains only fixed media.

c. Write Protected, Removable Media (Bit 13)
This bit will always be zero for the WREN III drives.

d. Write Protected, Fixed Media (Bit 12)
This bit will always be zero for the WREN III drives.

e. Spindle Motor Stopped (Bit 9)
This bit is asserted when the spindle motor is stopped. (See also Section 12.)

f. Power On Reset Conditions Exist (Bit 8)
This bit is asserted after a Power On Reset occurs or when an internal drive fault condition occurs which would cause an internal Power On Reset operation to occur (e.g., a momentary loss of a DC voltage, etc). This bit is intended to notify the controller that the drive has reinitialized itself for the default drive characteristics (e.g., default Number of Bytes Per Sector, etc.). The controller should read the configuration words to determine if the default drive characteristics are the desired operating conditions and/or send the required commands to the drive to set up the desired drive operating conditions. (See also Section 12 if the "Spindle Motor Control Option Implemented" is selected.)

g. Command Data Parity Fault (Bit 7)
This bit will be asserted when a parity error is detected on the Serial Command Data received from the controller. The drive will not attempt execution of a command if a parity error is detected. The controller should reset the Standard Status and attempt to send the original command to the drive at least 3 times prior to defining the drive as inoperable.

11.2.3.2 (continued)

h. Interface Fault (Bit 6)
This bit will be asserted when an interface protocol violation is detected by the drive. This bit will be asserted when either the Command Word or Configuration/ Status word I/O handshake protocol is violated (e.g., 10 ms handshake response limit is exceeded).

A command transfer attempt should not be initiated if the drive's COMMAND COMPLETE interface line is negated.

i. Invalid or Unimplemented Command Fault (Bit 5)
This bit is asserted when any of the following conditions are detected by the drive:

1. A Command Function (bits 15, 14, 13, and 12 of the command word) defined as reserved in the ESDI specification is received.

2. A Command Function plus Command Modifier defined as reserved in the ESDI specification is received.

3. A legal ESDI command which is not implemented by the drive is received.

4. A legal ESDI command with an invalid command parameter is received (e.g., illegal seek address, etc.).

j. Seek Fault (Bit 4)
This bit is asserted when the drive detects a problem with its actuator electronics or mechanism(s). This bit is asserted when the Drive is unable to maintain the Read/Write heads within the recording zone of the media.

If the Seek Fault bit is asserted the controller should attempt to Reset the Standard Status, send a RTZ command and reissue the SEEK command a minimum of three times prior to defining the drive as inoperable.

NOTE

It is the controller's responsibility to verify that a Seek Command resulted in an actuator movement to the desired physical track.

11.2.3.2 (continued)

k. Write Gate With Track Offset Fault (Bit 3)
This bit is asserted when the drive actuator is offset from the normal On Cylinder location and the controller asserts the WRITE GATE signal. Writing to the drive media will be inhibited. If this bit (bit 3) is asserted the controller should return the actuator to zero offset, reset Standard Status and then reattempt the write function.

l. Vendor Unique Status Available (Bit 2)
This bit is asserted to indicate that additional Vendor Unique Status is available in the Vendor Unique Status word(s).

m. Write Fault (Bit 1)
This bit is asserted to indicate that a Write Fault condition has occurred in the drive and that further writing will be inhibited until the fault is cleared.

NOTE

The interface Attention signal will be asserted in real time when the Write Fault condition is detected. The controller should inhibit writing as soon as the Attention is detected to enable the controller to ascertain on which sector the write fault occurred.

The following conditions will create a write fault:

1. Write current in a head without Write Gate Asserted or no write current with Write Gate Asserted and Drive Selected.

2. Write Gate asserted and multiple heads selected, no head selected or heads improperly selected.

3. Write Gate and the head not "On Cylinder".

4. Write Gate and Read Gate both asserted.

5. Write Gate and power supply voltages not within tolerance.

11.2.3.2 (continued)

The controller should attempt to reset the Write Fault at least three times prior to defining a drive as inoperable.

n. Removable Media Changed (Bit 0)
This bit will always be zero for the WREN III drives.

11.2.4 Transfer Ack

Refer to ESDI Specification Section 5.2.4.

11.2.5 Attention

Refer to ESDI Specification Section 5.2.5.

11.2.6 Index

This signal occurs once per revolution or 16.68 ms nominal. The asserted pulse width is 16 times the reference clock period or 1.596 us, ±1.0%.

Refer to ESDI Specification Section 5.2.6 and Section 5.0 of this document.

11.2.7 Sector/Byte Clock/Address Mark Found

The WREN III supports the controller soft sector (ADR Mark) and drive hard sector (Sector Pulses) format modes. Refer to Section 12.0 for configuration information, and to ESDI Specification Section 5.2.7 and Section 5.0 of this document.

11.2.7.1 Sector (Drive Hard Sector)

Refer to ESDI Specification section 5.2.7.1
The Sector Pulse asserted pulse width is 16 times the reference clock period or 1.596 us ±1.0%.

11.2.7.2 Byte Clock

Not supported by the WREN III.

11.2.7.3 Address Mark Found (Controller Soft Sector)

Refer to ESDI Specification section 5.2.7.3.

11.2.8 Command Complete

Refer to ESDI Specification Section 5.2.8.

Command Complete will be asserted (following a negation) in the following cases:

11.2.8 (continued)

1. After a drive logic initiated recalibration function has been completed.

2. After a received command has been executed with no detected error (and the actuator is on cylinder).

3. After the requested information has been sent to the controller via the CONFIG-STATUS line.

4. After a Command Transfer or Configuration Status Transfer or command execution has been terminated due to a detected fault condition.

11.3 DATA TRANSFER LINES

Refer to ESDI Specification Section 5.3

The nominal data transfer rate is 10.0 MHz which will result in a Read/Write Clock period (T) of 100 ns in Figure 21 of the ESDI Specification.

11.4 READ, WRITE, AND FORMAT PARAMETERS

Refer to ESDI Specification Section 5.4 except 5.4.3.5 and 5.4.4.5 which are not applicable. The intersector gap is 16 bytes long and is oriented to begin four bytes before a sector (Index) pulse.

Read propagation delay ranges between 7 and 9 bit times.

Write propagation delay ranges between 4 and 6 bit times.

The PLO Sync Field length is 11 bytes minimum. See also Configuration Data Specifications in Section 11.2.3.1 of this specification.

NOTE

Format Speed Tolerance gaps are not required for the WREN for a Fixed Sector Format (Figure 22 of the ESDI Specification).

ESDI fixed sector drives (e.g. WREN III) require that a PLO sync pattern be written prior to each read function boundary (see 5.1.7 in the ESDI Specification). The WREN III will automatically write the required sync pattern but the controller must define the point at which the PLO sync pattern is to be written. A header PLO sync field write is initiated by the trailing edge of ADDRESS MARK ENABLE with WRITE GATE asserted. A header or data PLO sync field write is initiated with the leading edge of WRITE GATE while ADDRESS MARK ENABLE is negated. The format function initiated by the host must define the point at which the PLO sync pattern is to be written for each address and data field written.

11.5 DEFECTS LIST

The WREN III provides media defect information in accordance with the ESDI Specification. Refer to ESDI Specification Section 5.5 for details.

The CRC seed will be zero. The byte sync characters are included in the CRC written.

12.0 OPTIONS

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

12.1 DRIVE CONFIGURATION SWITCHES

The WREN III is configured by turning on/off the switches in SW1 on the Servo PWB. SW1 is located behind the front panel as shown in Figure 13. These switches will be set at the factory to be shipped with SW1-1 OFF, SW1-2 ON, SW1-3 ON and SW1-4 OFF.

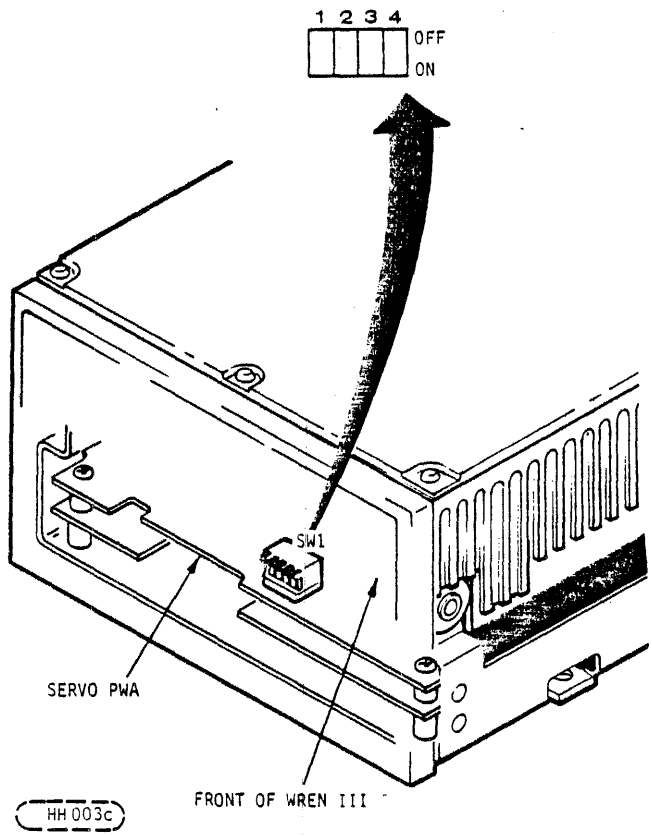

FIGURE 13. CONFIGURATION SWITCH LOCATIONS (See Table 6.)

12.1 (continued)

Table 7 shows the options that can be selected using SW1. (Reference Figure 13.)

TABLE 7. WREN III OPTION SWITCH SETTINGS

SWITCH PURPOSE	SW1-1			OPTION	
MOTOR OPTION	OFF			MOTOR START ON POWER UP	[1]
	ON			MOTOR START WITH COMMAND	[2]
	SW1-2	SW1-3	SW1-4		
SECTOR MODE	OFF	OFF	OFF	64 SECTORS PER TRACK	
SELECT AND	ON	OFF	OFF	35 SECTORS PER TRACK	
DEFAULT SECTOR	OFF	ON	OFF	36 SECTORS PER TRACK	
SIZE	ON	ON	OFF	34 SECTORS PER TRACK	[1]
OR					
ADDRESS MARK MODE SELECT	ON	ON	ON	SOFT SECTOR OPERATION	[3]

[1] Drives are shipped with these switch settings.

[2] When the SW1-1 switch is on, a MOTOR ON command is required from the controller to start the spindle motor. When power is applied to the drive, the drive will generate an ATTENTION signal and assert Standard Status Bits (Section 11.2.3.2) 8 and 9 signifying "Power On Reset Conditions Exist" and "Spindle Motor Stopped". The controller must then respond with a command to Reset the Interface ATTENTION line and also the Start Motor Command in order to start the spindle motor.

NOTE

This procedure is required anytime that the "Power On Reset Condition Exists" status bit is received by the controller if the "Motor Control Implemented" switch is on.

[3] See paragraph 12.4.

12.2 FRONT PANEL

The WREN III is available with a black front panel. The panel has a single red rectangular LED which indicates the drive is selected when glowing. A flashing LED indicates the presence of a nonrecoverable fault. A fault indication is displayed irrespective of DRIVE SELECT status.

12.3 CUSTOM FORMATTING

The WREN III is formatted during production. CDC maintains custom formatting capability which can incorporate many of the unique formats used in the Winchester marketplace. A majority of special format requirements can be implemented as specified.

12.4 SOFT SECTOR OPTION

The WREN III supports the use of the soft sector format as described in the CDC ESDI Specification, 77738076, Section 6.4.4.

To implement the optional soft sectored format operation, select "Address Mark" mode in the WREN III by positioning option switches SW1-2, SW1-3 and SW1-4 to the ON position. See Figure 13 and the table following it.

12.5 SINGLE UNIT SHIPPING PACK

The WREN III is normally shipped in bulk packaging to provide 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.

13.0 ACCESSORIES

All accessories are designed for implementation by the customer.

13.1 FRONT PANEL KIT

Same as 12.2 but includes all mounting hardware to support field installation.

13.2 SINGLE UNIT SHIPPING PACK KIT

Same as 12.5 except kit provides the necessary packing materials required to package and ship one WREN III 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 270
Phone: (405) 324-3061

Control Data Corporation
P.O. BOX 12313
Oklahoma City, Oklahoma
73157

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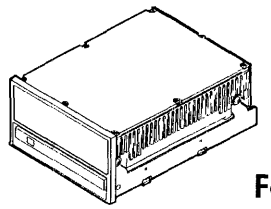
MODEL 94166 INSTALLATION MANUAL



77765441
Revision A
February 1990

PREFACE

This manual provides the basic information and instructions for installing and operating Seagate WREN™ 3 ESDI Disc Drive; Model 94166. It also provides information to aid in servicing those parts of the drive external to the sealed head, disk assembly (HDA).

WARNINGS

WARNING: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with these instructions, may cause interference to radio communications. The WREN 3, as delivered, is designed to provide reasonable protection against interference when installed in a suitable enclosure.

WARNING: This product is an electromechanical device which could present hazards if improperly handled. The device should be maintained only by qualified personnel. Careless disassembly or maintenance procedures may result in damage to the device or injury to personnel. Observe all WARNINGS and CAUTIONS attached to the device and contained in this manual.

These WARNINGS and CAUTIONS are not exhaustive. The manufacturer cannot know in advance all possible maintenance procedures, or tools, which may be devised by persons who choose not to follow the instructions in this manual. Any deviation from the prescribed procedures may entail risks which have not been evaluated by the manufacturer. Any persons who use a nonapproved procedure or tool must satisfy themselves that no injury to personnel, no damage to the device, and no deterioration of device performance will result.

DESCRIPTION

The Seagate WREN 3 ESDI is a small, low cost, high performance, random access rotating disc, mass memory device designed to record and recover data on five rigid 5-1/4 inch fixed disc media. The WREN uses low mass flying read/write heads attached to a precisely controlled rotary positioner. Model 94166 supports the Enhanced Small Device Interface (ESDI) as described in the ESDI Specification 77738076.

MODEL NUMBER	UNFORMATTED MEGABYTES	FORMATTED* MEGABYTES	NUMBER OF CYLINDERS**	NUMBER OF DATA HEADS
94166-182	182	155.9	969	9
94166-141	141	121.3	969	7
94166-101	101	86.6	969	5

* Formatted with 512 Byte Sectors, 35 Sectors per track, one spare sector per track for flawed sector reallocations.
** 967 User Accessable Tracks

STANDARD FEATURES

The WREN 3 has the following standard features:

- o Industry Standard Interface
- o Sealed head, disc, and actuator chamber
- o No preventive maintenance required
- o No adjustments required
- o LSI circuitry for high reliability
- o Low audible noise for office environments
- o Vertical (side) or horizontal (bottom) mounting
- o Low power consumption
- o Balanced low mass rotary voice coil actuator
- o Automatic shipping lock and dynamic spindle brake
- o Easy access terminator
- o Integral HDA shock and vibration isolation mounts
- o Dedicated head landing zone

ACCESSORIES

The following accessories are available for WREN 3:

- o Front Panel Kit
- o Single Unit Shipping Pack Kit

CAUTIONS

CAUTION: The circuit assemblies and components contained in this equipment can be degraded or destroyed by Electrostatic Overstress (EOS) or by Electrostatic Discharge (ESD).

Static electrical charges can accumulate quickly on personnel, clothing, and synthetic materials. The electrostatic fields due to these charges cause EOS or ESD which, when brought in close proximity to susceptable circuit assemblies and components, can result in degraded reliability or immediate failure of the affected component or assembly.

To insure optimum reliable equipment operation, it is required that technical support personnel discharge themselves by wearing a grounding strap around the wrist and be connected to a grounding terminal while working in the vicinity of, and while handling, EOS/ESD susceptible assemblies/parts. This procedure is especially important when handling printed wiring assemblies (PWAs).

PWAs should be placed on a static dissipative work surface during all maintenance procedures on these PWAs. If possible, all persons coming near the equipment should stand on a static dissipative floor mat installed according to established procedures. PWAs should be handled or transported in electrically conductive plastic bags to insure optimum protection against potential EOS/ESD damage. Delicate components soldered into circuits are NOT immune to EOS/ESD damage.

CAUTION: To avoid potential repair problems, observe the following precautions:

- o Labels must not be put over the breather holes on the top of the drive. (See Figure 1).
- o If a label has been placed over the breather holes, do not poke holes through the label, as the filter underneath is certain to be damaged, allowing contamination to enter the HDA. REMOVE THE LABEL. Do not use solvents to remove the adhesive residue. Solvent may migrate down the breather holes and contaminate the HDA.
- o Imprimis factory installed labels must not be removed from the drive or covered with additional labels, as they contain information required when repairing.
- o DC power should not be switched on to the drive by plugging an electrically "live" DC source cable into the drive power connector. This practice adversely affects the reliability of the connector contacts and may damage other susceptable components.

UNPACKING

Visually inspect the shipping container for any obvious damage. Exercise care so that any tools being used do not damage the unit.

As the WREN is unpacked, inspect it for possible shipping damage. All claims of this type should be filed promptly with the transporter involved. If a claim is filed for damages, save the original packing materials.

After the drive is unpacked, inspect the drive for any visible damage. Verify all parts listed on the shipping bill are received with the equipment. Discrepancies or damage should be reported to the shipping company. Save the packing materials; they can be used for reshipment.

OPERATING ENVIRONMENT

The environmental conditions required for optimum performance of the disc drive are, in general, the same as those in an office environment with minimal environmental control. These conditions are:

Temperature	50° to 122°F (10° to 50°C)	Humidity	8% to 80%
Altitude	-1000 to +10,000 feet (-305 to +3,048 metres)	Wet Bulb	82°F (28°C) maximum

The room temperature should not change more than 18°F (10°C) per hour. Avoid high relative humidity as much as possible since it can result in condensation in the drive under adverse conditions.

COOLING

A sometimes overlooked consideration when mounting several drives in the same enclosure is heat dissipation. Because power supplies, for example, are typically heavy, they are frequently mounted in the bottom of an enclosure, where they produce heat. This heat rises to the top of the cabinet or enclosure and the temperature can reach very high levels. Cabinet ventilation, by natural convection or forced cooling, must be provided to keep the internal air temperature adjacent to the disk drive within the limits specified above.

Temperature of the HDA should not exceed 135°F (57.2°C) during opertion when measured at the shock isolation mount on the side closest to the LED.

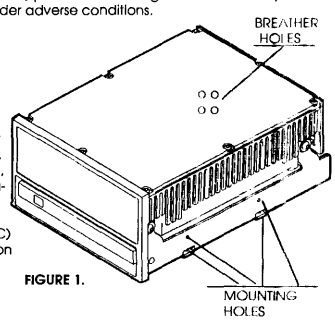


FIGURE 1.

SAFETY INSTRUCTIONS

1. The WREN is to be installed in a customer supplied enclosure where the surrounding air does not exceed 50°C.
2. Four(4) 6-32 UNC-2A screws are required for installation, maximum screw length into chassis mounting holes is 0.12 in (3.17 mm).
3. The power requirements are:
   +5 V ±5% 1.0 A
   +12 V ± 5% 2.3 A (4.5 A, +12 V ±10% regulation, for a maximum of 10 seconds at power up).
4. The power supply must satisfy the safety requirements for SELV (Safety Extra Low Voltage) circuits.
5. Service is to be provided only by trained service personnel.
6. The incorporation of the WREN into a customer supplied enclosure must meet the appropriate safety requirements of the country in which it is to be used (e.g. UL, 478, CSA 22.2 No. 220 and IEC950).

NOTE: Power off when connecting or disconnecting.

SICHERHEITSANLEITUNG

1. Das Gerät ist ein Einbaugerät, vorgesehen für eine maximale Umgebungstemperatur von 50°C.
2. Zur Befestigung der Wren Drive werden 4 Schrauben benötigt (6-32 UNC-2A). Die maximale Länge der Schrauben in der unteren Seite des Chassis darf nicht mehr als 0.12 in (3.17 mm) betragen, die in der oberen 0.12 in (3.17 mm).
3. Als Versorgungsspannungen werden benötigt:
   + 5 V ±5% 1.0 A
   +12 V ±5% 2.3 A (Spitzenstrom zur Zeit der Einschaltung: 4.5 A, +12 V ±10% regelung, für 10 Sekunden max.)
4. Die Versorgungsspannung muss SELV entsprechen.
5. Alle Arbeiten dürfen nur von ausgebildetem Service personnel durchgeführt werden.
6. Der Einbau des Drives muss den Anforderungen gemäss DIN IEC 380/VDE 0806/8.81 oder EN60 950 entsprechen.

EMI CONSIDERATIONS

The WREN 3, as delivered, is designed for system integration and installation into a suitable enclosure prior to use. As such the WREN 3 is supplied as a sub-assembly and is not subject to Subpart J of Part 15 of the FCC Rules and Regulations nor the Radio Interference Regulations of the Canadian Department of Communications. However, the unit has been tested using proper shielding and grounding and found to be compliant with Class A limits of of the FCC Rules and the Regulations of The Canadian Department of Communications.

The physical design characteristics of the WREN 3 serve to minimize radiation when installed in an enclosure that provides reasonable shielding. As such, the WREN 3 is capable of meeting the Class B limits of the FCC Rules and Regulations of the Canadian Department of Communication. However, it is the users responsibility to assure that the WREN 3 meets the appropriate EMI requirements in their system. Shielded I/O cables may be required if the enclosure does not provide adequate shielding. If the I/O cables are external to the enclosure, shielded cables should be used, with the shields grounded to the enclosure and to the host controller.

DRIVE MOUNTING ORIENTATION

The WREN 3 may be mounted with a horizontal orientation (PCB down) or with either of two vertical orientations (on side orientation). Four 6-32 tapped holes are provided in the bottom of the chassis and two on each side. (See Figure 1). The drive may be mounted using four bottom screws or four side screws (two in each side). Four bottom screws are preferred and recommended. Screws must be of sufficient length to engage the threaded holes, but must not penetrate more than 0.12 in. (3.17mm) into the chassis. A sway space of 0.050 in. is required on top and bottom.

CABLING

The WREN 3 can be connected in radial or daisychain configurations. In the daisychain configuration, a maximum of seven drives can be connected.

RADIAL CONFIGURATION

Figure 2 View A shows each WREN 3 Disc Drive interfaced to its own control cable, which allows interfacing an arbitrary number of drives and a variety of system operational techniques. Each drive has its data cable and control cable radially connected to the host controller. The length of each individual cable must not exceed 10 feet (3.0 metres). Each control and data cable must be terminated at each end in its characteristic impedance. The termination of these cables is accomplished in the drive by a plug - in terminating resistor pack for the control cables and by resistors on the Servo (upper) PWA for the data cables. These same resistor values must be installed in the host controller. See TERMINATION RESISTORS for terminator installation instructions.

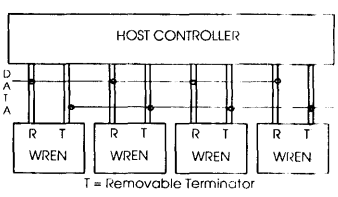


FIGURE 2. VIEW A

DAISYCHAIN CONFIGURATION

In a daisychain configuration, the drives are connected in a daisychain on the control cable, the data cables are connected in a radial configuration. The total length of all control cables used shall be not greater than 10 feet (3.0 metres). The logical address of each drive in the daisychain is determined by the "DRIVE SELECT" plug on the Servo (upper) PWA. Each data and control cable must be terminated in the Host Controller.

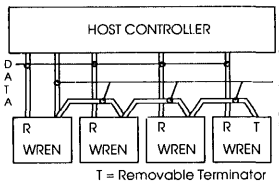


FIGURE 2. VIEW B

DC POWER REQUIREMENT

No AC power is required.

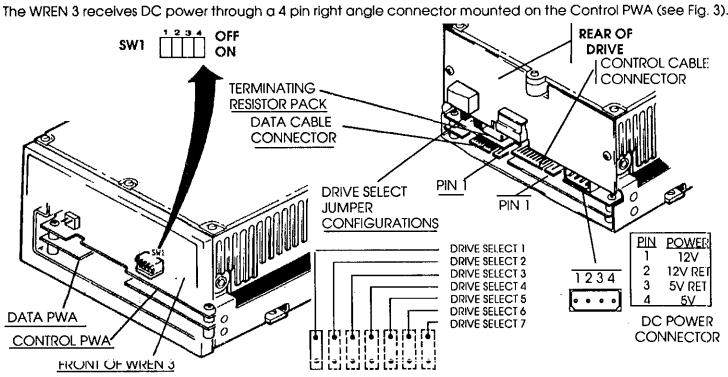
The voltage and current requirements for a single WREN 3 are shown in the following table. Values indicated apply at the drive power connector.

DC POWER REQUIREMENTS (5 VOLT)		DC POWER REQUIREMENTS (12 VOLT)	
VOLTAGE	+5 V	VOLTAGE	+12V
REGULATION	±5%	REGULATION	±5% (3)
RIPPLE.(MAXIMUM PEAK-TO-PEAK)	100 mV	RIPPLE (MAXIMUM PEAK-TO-PEAK)	100 mV
MAXIMUM OPERATING CURRENT (1) (WORST CASE)	1.0 A	MAXIMUM OPERATING CURRENT (1) (WORST CASE)	2.3 A
TYPICAL IDLE CURRENT (1)	0.8 A	TYPICAL IDLE CURRENT (1)	1.4 A
MAXIMUM STARTING CURRENT (PEAK) (2)	1.4 A	MAXIMUM STARTING CURRENT (PEAK) (2)	4.5 A

(1) Measured with average reading DC ammeter.
(2) Occurs during 10 second start up.
(3) A 10% tolerance is permissible during power up. ±5% must be maintained commencing with unit ready.

DC CABLE AND CONNECTOR

The WREN 3 receives DC power through a 4 pin right angle connector mounted on the Control PWA (see Fig. 3).



NOTE

PINS ON THE DRIVE SELECT AND CONFIGURATION SELECT HEADER ARE PROVIDED TO FACILITATE MANUAL DRIVE CONFIGURATION. NO DEVICES OTHER THAN JUMPERS SHOULD BE CONNECTED TO THESE PINS. IMPROPER CONNECTION TO EXTERNAL DEVICES (SWITCHES, CONNECTORS,ETC.)COULD ADVERSELY AFFECT DRIVE PERFORMANCE. EXACT LOCATION OF THESE PINS AND HEADERS MAY CHANGE WITHOUT NOTICE.

NOTE

UNIT SELECT ZERO (NO JUMPER) IS INVALID.

SW1 CONFIGURATION SWITCH SETTINGS (2)					
B/SEC	SECTOR/TRACK	-1	-2	-3	-4
512	34 (3)	(1)	ON	ON	OFF
512	35 (3)	(1)	ON	OFF	OFF
512	36 (3)	(1)	OFF	ON	OFF
256	64 (3)	(1)	OFF	OFF	OFF
X	ADDRESS MARK (4)	(1)	ON	ON	ON

(1) When the SW1-1 switch IS ON, a MOTOR ON command is required from the controller to start the spindle motor. When power is applied to the drive, the drive will generate an ATTENTION signal and activate Standard Status Bits 8 and 9 signifying "Power On Reset Conditions Exist" and "Spindle Motor Stopped". The controller must then respond with the command to Reset the Interface ATTENTION line and with the Start Motor Command to start the spindle motor.
NOTE: This procedure is required anytime the "Power On Reset Condition Exists" status bit is received by the controller, if the "Motor Control Implemented" switch is ON.
(2) Switch Up is OFF; Switch Down is ON.
(3) Hard sector configurations
(4) Address Mark mode is used with soft sectored controllers which create their own sector boundaries. Note that all other combinations of switches 2 and 3 with switch 4 active select sector formats usable only during factory tests.

FIGURE 3.

DRIVE SELECTION AND TERMINATION

The logical address of the WREN 3 is selected by installing a jumper in the appropriate location on the DRIVE SELECT header (J8), which is accessible from the back of the drive, located on the Control PWA (see Figure 3). This selection is done at the time of installation.

For radial configurations, it is recommended that the jumper be connected to Drive Select 1 (Position 1). However, check the system manufacturer's instructions.

For daisychain operation, the drive select jumpers should be connected in accordance with the system assignments. Be sure to check the system manufacturer's device selection instructions. "XT" type systems usually require Drive Select 1, "AT" type systems usually require Drive Select 2. In a typical system the drive select lines (Pins 26, 28, 30, of the 34 Pin connector) are usually transposed so that every device on a daisychain has the same drive select number.

TERMINATION RESISTORS

Every drive connected in a radial configuration needs a termination resistor pack (as supplied). The termination resistor pack should be removed from all daisychain drives except the drive in the last position of the daisychain. The terminator resistor pack is a 14 pin DIP (Dual Inline Package) module of 150 Ohm resistors plugged into a DIP socket on the Control PWA, accessible from the rear of the drive (see Figure 3). Drives may be ordered with or without the removable terminator DIP installed. An equivalent terminator must be provided in the Host Controller on each input signal line from the WREN to the controller.

SOFT SECTOR MODE

The WREN 3 supports the use of the soft sector format as described in the ESDI Specification 77738076.To implement the optional soft sectored format operation, select "Address Mark" mode in the WREN 3 by installing option jumper plugs 2, 3, and 4. See Figure 3.

WRITE PRECOMP AND HEAD PARKING TRACK

These two parameters are handled within the drive. Use some value greater than maximum track for each.WREN 3 requires no command from the Host controller to park the heads, as this is automatically done by the drive.

INITIAL CHECKOUT AND STARTUP PROCEDURE

1. Mount the WREN, horizontally or vertically, in the enclosure using standard hardware (four (4) #6-32 screws see DRIVE MOUNTING ORIENTATION).
2. Connect the ribbon cables for radial or for daisychain configuration. Terminate and verify jumper settings.
3. Attach DC power cable from power supply to connector on the rear of the WREN.
4. Apply power.
5. Run system diagnostic to verify the operability of the disk subsystem.
6. If the drive fails to select, be sure the system manufacturer's instructions on the assignment of device select ID have been followed.

SERVICE REQUIREMENTS

The special facilities required for the manufacture of the WREN generally prohibit repair in the field. If problems occur during installation, please contact your supplier for assistance. Some items external to the sealed HDA may be replaced by a technically competent individual.

CAUTION

- o NEVER remove the cover of the WREN. Servicing items in the sealed HDA (heads, media, actuator, etc.) requires special facilities.
- o Opening the sealed HDA voids the unit warranty.

TROUBLE SHOOTING

WREN disc drives are designed as field replaceable units. They should be returned to the repair depot if failure occurs. Circuit board exchange, if desired, may be performed by technically competent individuals. No adjustments are required. Field repair is discouraged, because of the extensive diagnostic equipment required for effective servicing. Frequently, problems believed to be disc drive failures are not, and it is important to recognize this before taking repair action on the disc drive. The following disc power up sequence is provided to assist in identifying possible disc drive problems. Generally, if performance doesn't follow this sequence either the drive or power supply should be questioned.

POWER UP SEQUENCE

- o Power is applied to the disc drive. The LED will glow during motor start up if the drive is selected during that time.
- o Spindle motor speeds up until operating velocity is reached (approx 10 seconds). No speed variations should be heard afterward.
- o Arm restraint solenoid releases, producing an easily heard characteristic sounc.
- o The drive performs up to 32 velocity adjustment seeks, as evidenced by head motion sounds.
- o Drive finds and stays at track zero, comes ready, makes no further noises, except as the system commands may demand.
- o If the drive has successfully cycled up, the front panel LED will light up when the unit is selected by the system.
- o Boot up activity may appear as random LED flickering as the drive is randomly selected and deselected.
- o Unit spindles down if it cannot come ready. The LED will blink continually indicating a drive fault has occurred. Removing and reapplying power may or may not clear this fault indication. If the fault condition persists, the drive may require service. Power supply problems can also create drive fault status.
- o CAUTION: Do not remove drive until spin down is completed.

POWER DOWN SEQUENCE

- o Power is removed.
- o The arm restraint solenoid release should be heard within three seconds after power is removed.
- o The dynamic brake relay cut in sound may be heard many seconds later.
- o Spindle rotation should stop in about 30 seconds.

PRODUCT REPAIR INFORMATION

To properly service and maintain warranty, before returning drives to CSC for repair, first telephone 405-491-6262 for a return authorization. Then send to:

Seagate Technology, Inc.
Att: Customer Service Center
301 N. MacArthur
Oklahoma City, OK 73127

The return authorization number must be referenced on any enclosed documentation and in all correspondence concerning the returned drive. TECHNICAL ASSISTANCE IS NOT AVAILABLE AT THIS LOCATION. CONTACT DRIVE PURCHASE SOURCE, or call 1-900-820-3001 or 1-800-468-3472.

SAFETY AND SPECIAL SERVICE PRECAUTIONS

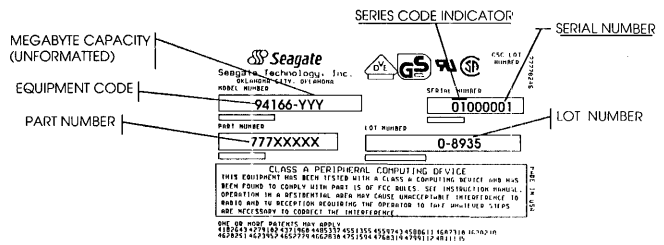
- o Avoid overtightening hardware (screws, nuts, etc.) when replacing assemblies and components.
- o Do not connect or disconnect cables without first removing all power from the drive.
- o Place drive on a flat static dissapative surface.

REMOVAL/REPLACEMENT

Only the PWAs and front panel, external to the sealed area, can be replaced without special facilities. Be sure to observe the EOS/ESD precautions at all times to avoid damage to the electrical assemblies.
The following tool is required for removal and replacement of these items.

TOOL	APPLICATION	
TORX ™ TX-10	Six spline socket drive machine screws	This can be purchased through most commercial tool catalogs.

SAMPLE LABEL OF WREN 3 DISC DRIVE



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WREN™ 3 FULL HEIGHT
MODEL 94166