

ANHEIM

XT-2000

**Product Specification
and
OEM Manual**

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MAXTOR

XT - 2000

PRODUCT SPECIFICATION

&

OEM MANUAL

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XT-2000 OEM MANUAL & PRODUCT SPECIFICATION

REVISION RECORD		
Revision	Date Published	Description of Changes
A	3/06/83	Preliminary Issue
B	12/20/84	Clarification and Minor Changes
Document No.: 11002		

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1.0 INTRODUCTION

1.1 General Description

The XT-2000TM disk drives are low cost, high capacity, high performance random access storage devices utilizing from 4 to 8 non-removable 5 1/4-inch disks as storage media. Each disk surface employs one moveable head to access 1224 data tracks. The total unformatted capacity of the disk drives range from 89.24 to 191.24 MB.

Low cost and high performance are achieved through the use of a rotary voice coil actuator and a closed loop servo system utilizing a dedicated servo surface. The innovative MAXTORQTM rotary voice coil actuator provides an average access time of better than 30 msec and a track-to-track access time of less than 5 msec; performance usually achieved only with larger sized, higher powered linear actuators. The closed loop servo system and dedicated servo surface combine to allow state-of-the-art recording densities (980 tpi, 11,155 bpi) in a 5 1/4-inch package.

High capacity is achieved by a balanced combination of high areal density and high density packaging techniques. Maxtor's advanced MAXPAKTM electronic packaging techniques utilize miniature surface mount devices to allow all electronic circuitry to fit on one printed circuit board. Advanced 3380 Whitney type head flexures and sliders allow closer spacing of disks and therefore allow a higher number of disks in a 5 1/4-inch package. Maxtor's unique integrated drive motor/spindle design allows a deeper deck casting than conventional designs, thus permitting more disks to be used.

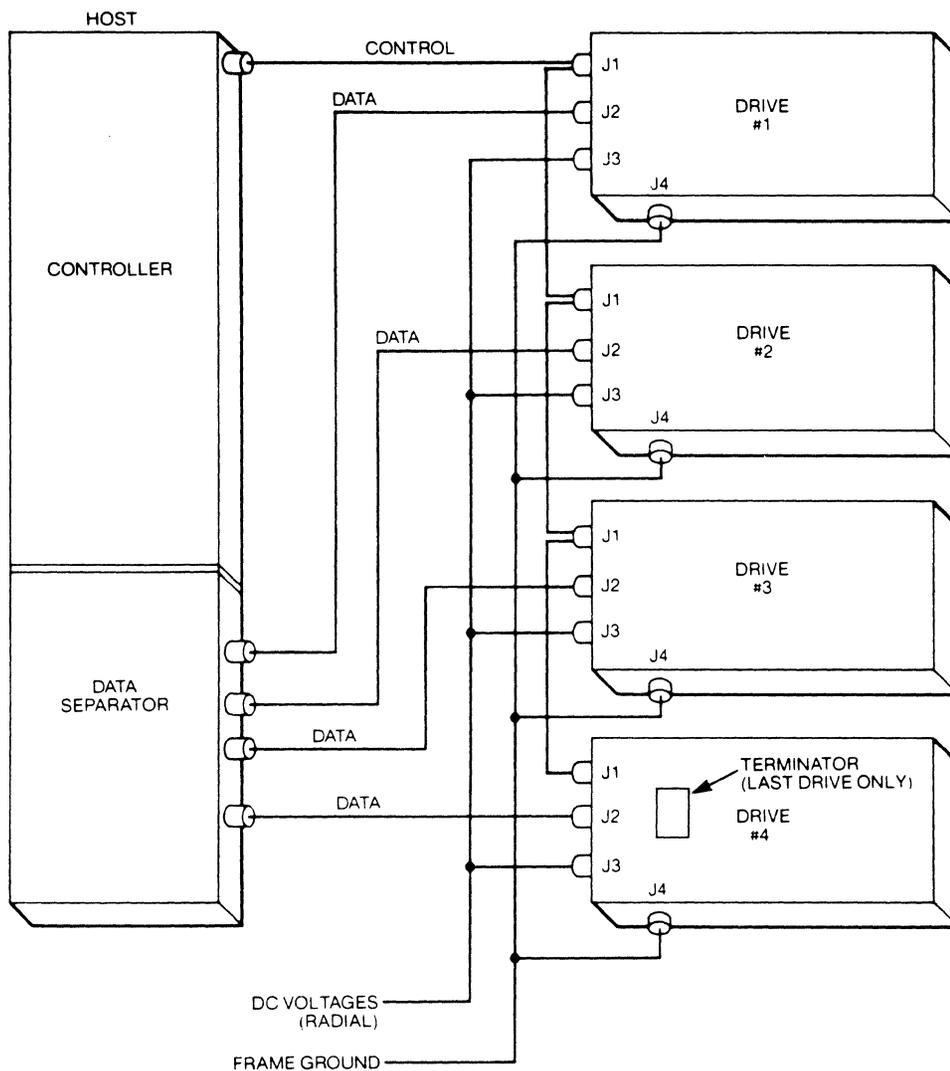
The XT-2000 electrical interface is compatible with the industry standard ST506/412 family of 5 1/4-inch fixed disk drives. The XT-2000 size and mounting are also identical to the industry standard 5 1/4-inch minifloppy and winchester disk drives, and they use the same DC voltages and connectors. No AC power is required.

Key Features:

- * Storage capacity of 89.24 to 191.24 megabytes unformatted (70.19 to 150.40 megabytes formatted with a ST506/412 compatible format).
- * Same physical size and mounting as standard minifloppy disk drives.
- * Same DC voltages as standard minifloppy disk drives.
- * No AC voltage required.

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- * Rotary voice coil and closed loop servo system for fast, accurate head positioning.
- * Microprocessor controlled servo for fast access times, high reliability, and high density functional packaging.
- * 5.0 megabit/second transfer rate.
- * ST412 compatible interface.
- * ST412 track capacity plus spare sector.
- * Plated media for higher bit density and resolution plus improved durability.
- * Single printed circuit board for improved reliability.
- * Automatic actuator lock.
- * Brushless DC spindle motor inside hub.
- * Microprocessor controlled spindle motor for precision speed control ($\pm 0.1\%$) under all load conditions.
- * Dynamic braking during power-down cycle.



D-104

Figure 6
Typical Connection, Four Drive System

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4.1 Control Input Lines

The control input signals are of two types: those to be multiplexed in a multiple drive system and those intended to do the multiplexing. The control input signals to be multiplexed are WRITE GATE, HEAD SELECT 2⁰, HEAD SELECT 2¹, HEAD SELECT 2², HEAD SELECT 2³, STEP and DIRECTION IN. The signal to do the multiplexing is DRIVE SELECT 1, DRIVE SELECT 2, DRIVE SELECT 3, or DRIVE SELECT 4.

The input lines have the following electrical specifications. Refer to Figure 6 for the recommended circuit.

TRUE: 0.0 VDC to 0.4 VDC @ I_L = -48mA (Max)

FALSE: 2.5 VDC to 5.25 VDC @ I_H = +250 uA (Open Collector)

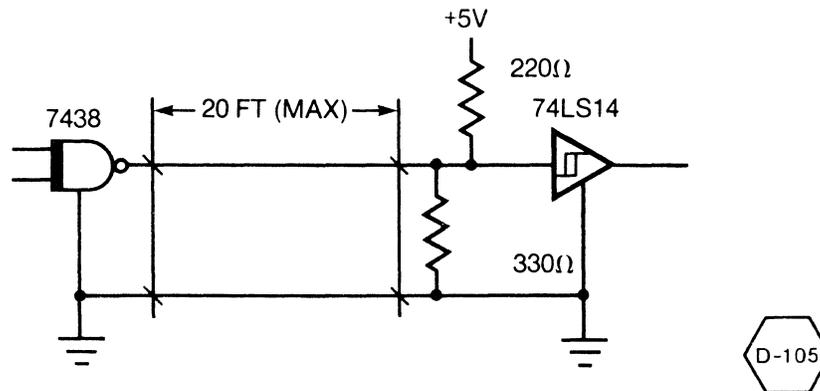


Figure 7

CONTROL SIGNALS DRIVER/RECEIVER COMBINATION

4.1.1 Reduced Write Current

This function is automatically performed by the drive microprocessor.

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4.1.2 Write Gate

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

A 220/330 ohm resistor pack allows for termination.

4.1.3 Head Select 2⁰, 2¹, 2², and 2³.

These four lines allow selection of each individual read/write head in a binary coded sequence. HEAD SELECT 2⁰ is the least significant line. Heads are numbered 0 through 15. When all HEAD SELECT lines are high (inactive), head 0 will be selected.

Addressing more heads than contained in the drive will result in a write fault when attempting to perform a write operation.

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

4.1.4 Direction In

This signal defines the direction of motion of the R/W heads when the STEP line is pulsed. An open circuit or high level defines the direction as "out" and if a pulse is applied to the STEP line, the R/W heads will move away from the center of the disk. If this line is a low level, the direction of motion is defined as "in" and the R/W heads will move toward the center of the disk. A change in direction must meet the requirement shown in Figure 8.

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

NOTE: DIRECTION must not change during step time.

4.1.5 Step

This interface line is a control signal which causes the Read/Write heads to move in the direction of motion defined by the DIRECTION LINE.

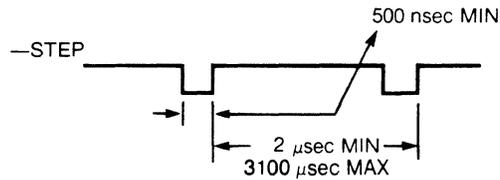
The access motion is initiated at the low to high level transition or trailing edge of the signal pulse. Any change in the DIRECTION line must be made at least 100 nsec before the leading edge of the step pulse. (refer to Figure 8A for general timing requirements).

A 220/330 resistor pack allows for line termination.

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4.1.6 Buffered Seek

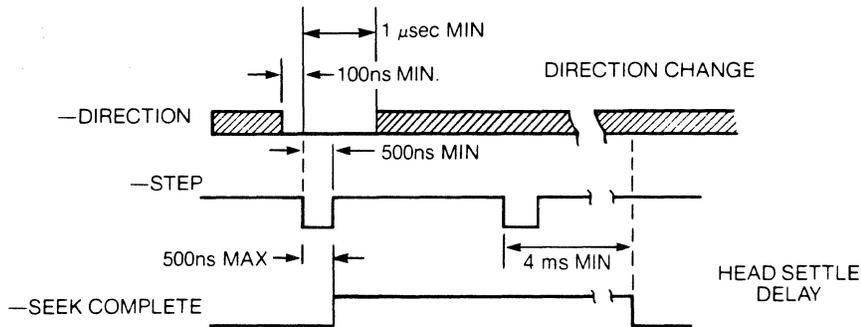
Microprocessor utilization on the XT-2000 adds the capability of capturing and storing up to 1224 step pulses for optimal seeking capability. Optimum seek times require that the time between step pulses be less than 13 usec; however, any time up to 3100 usec will be accepted by the drive.



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STEP PULSE TIMING

Figure 8A



D-107

GENERAL STEP TIMING

Figure 8B

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4.1.7 Drive Select

DRIVE SELECT, when low, connects the drive interface to the control lines. Positioning the DRIVE SELECT jumper between the two appropriate pins on the drive printed circuit board determines which drive will be selected. The following table indicates which drive will be selected for each jumper position.

<u>DRIVE SELECTED</u>	<u>JUMPER POSITION PIN NUMBERS</u>
Drive 0	1, 2
Drive 1	2, 3
Drive 2	4, 5
Drive 3	5, 6

4.2 Control Output Lines

The output control signals are driven with an open collector output stage capable of sinking a maximum of 48mA at low level or true state with maximum voltage of 0.4V measured at the driver. When the line driver is in the high level or false state, the driver transistor is off and collector leakage current is a maximum of 250uA.

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

Figure 7 shows the recommended circuit.

4.2.1 Seek Complete

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

SEEK COMPLETE will go false in three cases:

- 1) A recalibration sequence is initiated (by drive logic) at power on, if the R/W heads are not over track zero.
- 2) 500 nsec (max) after the leading edge of a step pulse or series of step pulses.
- 3) If +5 volts or +12 volts are lost momentarily but restored.

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4.2.2 Track 0

This interface signal indicates a low level or true state only when the drive's Read/Write heads are positioned at cylinder zero (the outermost data track).

4.2.3 Write Fault

This signal is used to indicate a condition at the drive that may cause improper writing on the disk. When this line is a low level or true, further writing and stepping is inhibited at the drive until the condition is corrected. Write fault can be reset by deselecting the drive.

Note: controller should edge detect this signal.

There are three conditions detected:

- a) Write current in a head without WRITE GATE active or no write current with WRITE GATE active and DRIVE SELECTED.
- b) Multiple heads selected, no head selected, or improperly selected.
- c) Head not properly positioned over track (OFF-TRACK detected).

4.2.4 Index

This interface signal is provided by the drive once each revolution (16.67 ms nominal) to indicate the beginning of a track. Normally, this signal is high and makes the transition to low to indicate INDEX. Only the transition from high to low is valid.

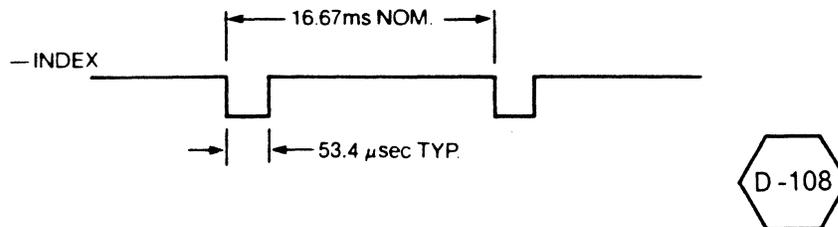


Figure 9

INDEX TIMING

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4.2.5 Ready

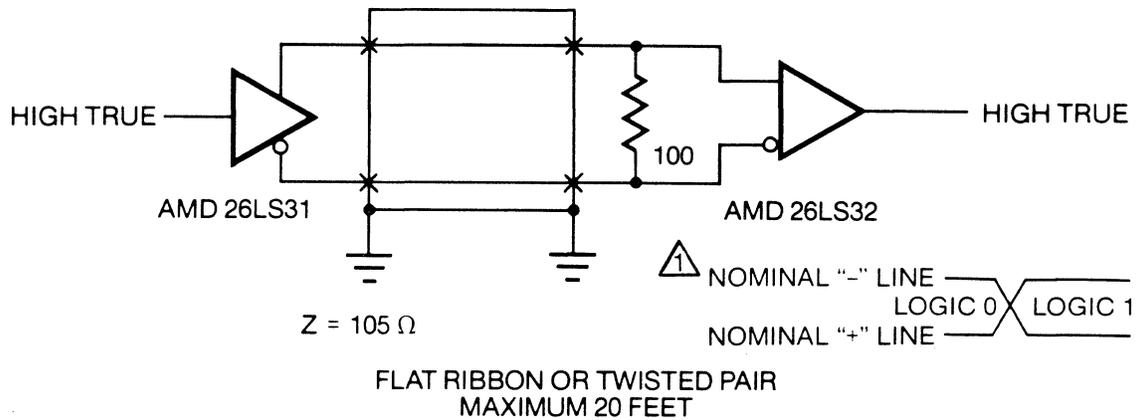
This interface signal when true together with SEEK COMPLETE, indicates that the drive is ready to read, write or seek, and that the I/O signals are valid. When the line is false, all writing and seeking is inhibited.

The typical time after power on for READY to be true is 15 seconds.

4.3 DATA TRANSFER LINES

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

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



NOTE: Any EIA RS 422 Driver/receiver pair will interface.



Figure 10

DATA LINE DRIVER/RECEIVER COMBINATION

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4.3.1 MFM Write Data

This is a differential pair that defines the transitions to be written on the track. The transition of +MFM WRITE DATA line going more positive than the - MFM WRITE DATA will cause a flux reversal on the track provided WRITE GATE is active. This signal must be driven to an inactive state (+ MFM WRITE DATA more negative than - MFM WRITE DATA) by the host system when in a read mode.

No write precompensation is required by the drive; if write precompensation is used, some loss in performance (window margin within the data separator) may result.

4.3.2 MFM Read Data

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

4.3.3 Read/Write Timing

The timing diagram as shown in Figure 12 depicts the necessary sequence of events (with associated timing restrictions for proper read/write operation of the drive).

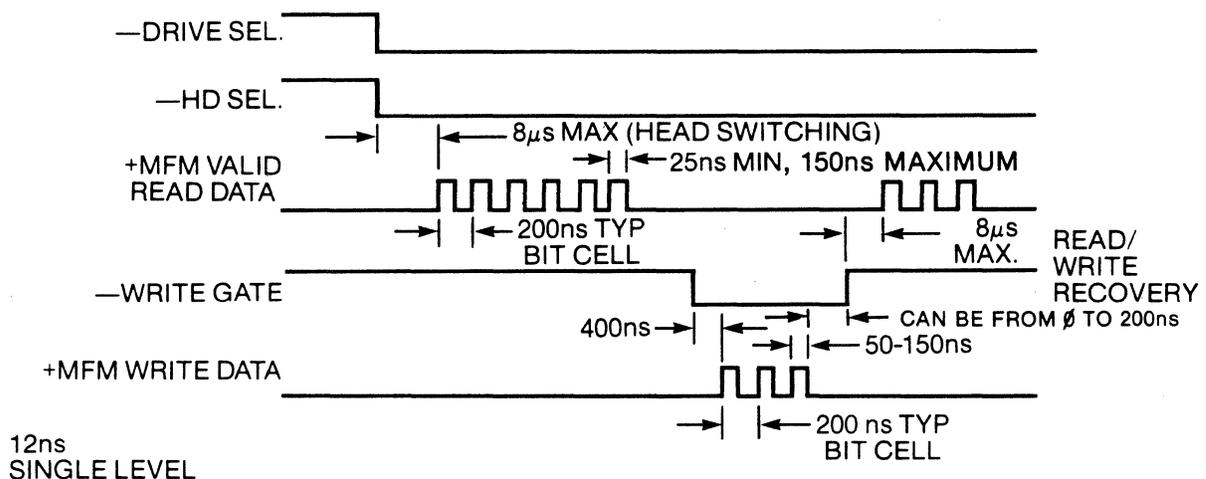


Figure 11

READ/WRITE DATA TIMINGS



4.4 Drive Selected

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

The DRIVE SELECTED line is driven by a TTL open collector driver as shown in Figure 7. This signal will go active only when the drive is programmed as drive n (n= 1,2,3, or 4) by the drive. The DRIVE SELECT N line at J1/PI is activated by the host system.

4.5 General Timing Requirements

Figure 12 is a timing diagram showing the necessary sequence of events and associated timing restrictions for proper operation of the drive.

Note that an automatic recalibration to track 0 occurs during the DC power-on sequence. At DC power off, the disks are brought to a complete stop in approximately 20 seconds.

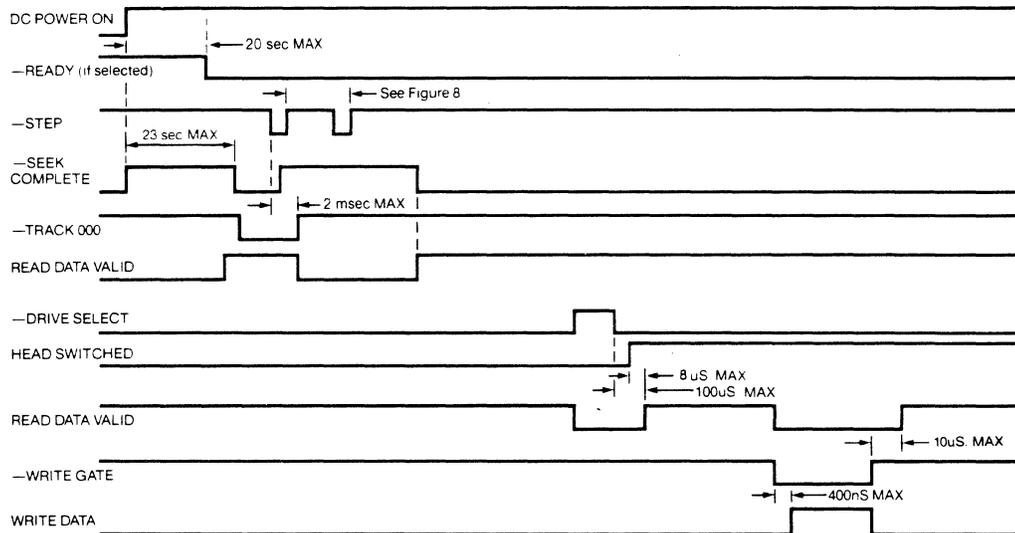


Figure 12

GENERAL TIMING REQUIREMENTS

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5.0 PHYSICAL INTERFACE

The electrical interface between the XT-2000 and the host controller is via four connectors:

1. J1 - Control signals (multiplexed)
2. J2 - Read/write signals (radial)
3. J3 - DC power input
4. J4 - Frame ground

Refer to Figure 13 for connector locations.

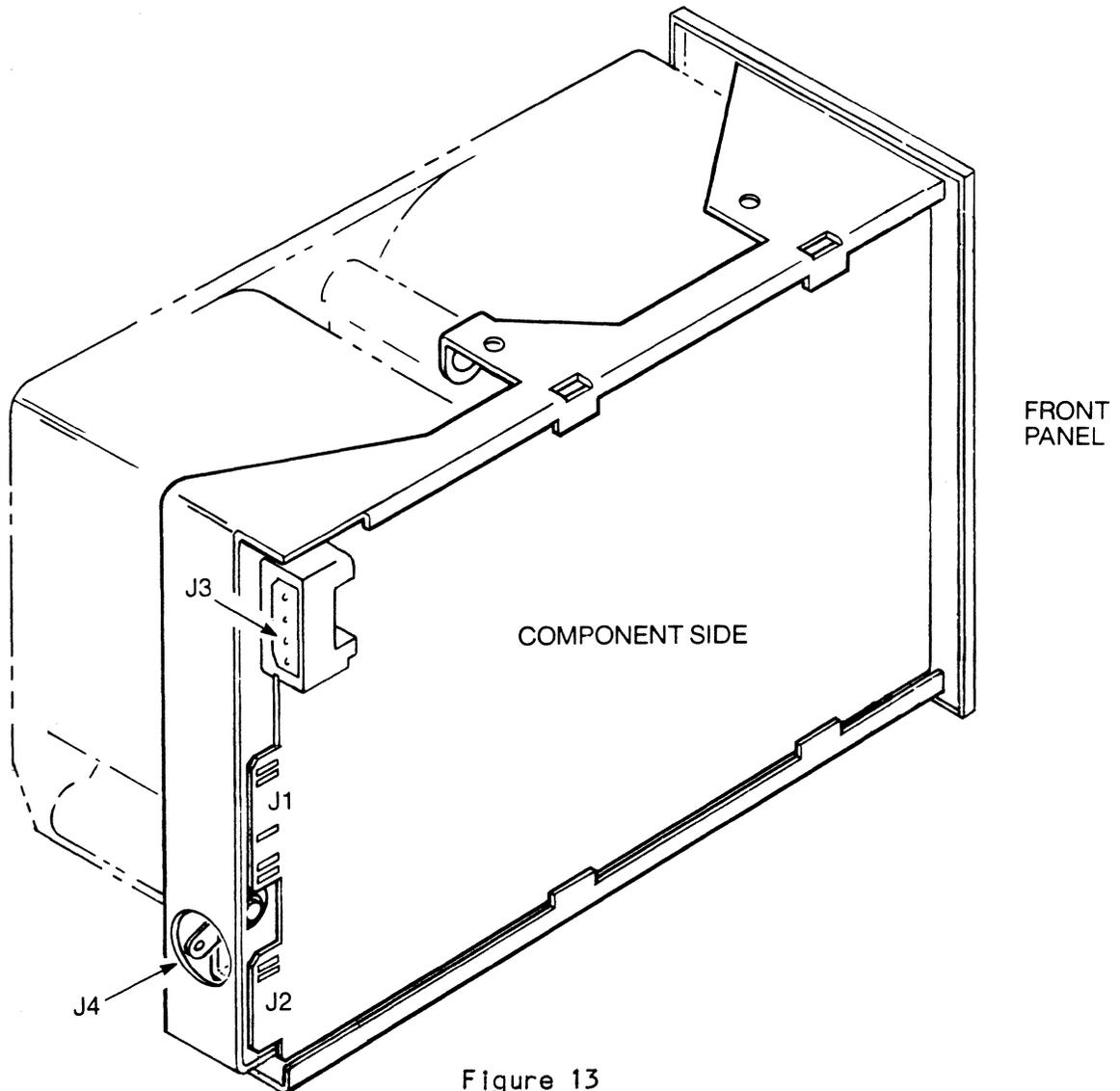


Figure 13

INTERFACE CONNECTOR PHYSICAL LOCATION

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5.1 J1/P1 CONNECTOR

Connection to J1 is via a 34 pin PCB edge connector. The dimensions for this connector are shown in figure 14. The pins are numbered 1 through 34 with the even pins located on the component side of the PCB. Pin 2 is located on the end of the PCB connector closest to the DC power connector J3/P3. A key slot is provided between pins 4 and 6. The recommended mating connector for P1 is AMP ribbon connector PIN 88373-3.

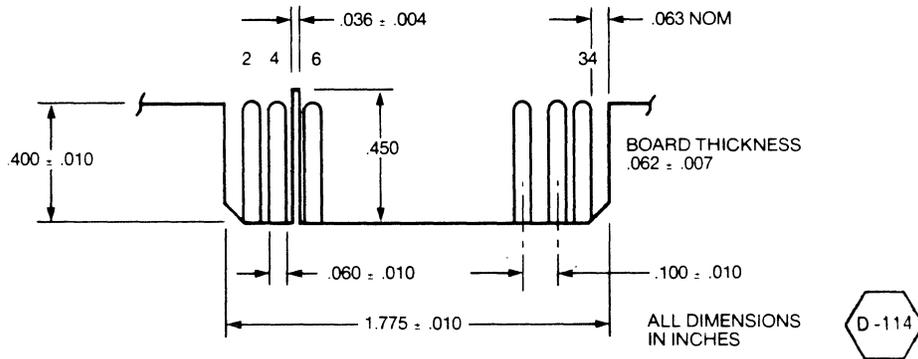


Figure 14

J1 CONNECTOR DIMENSIONS

5.2 J2/P2 CONNECTOR

Connection of J2 is via a 20 pin PCB edge connector. The dimensions for the connector is shown in figure 15. The pins are numbered 1 through 20 with the even pins located on the component side of the PCB. The recommended mating connector for P2 is AMP ribbon connector P/N 88373-6. A key slot is provided between pins 4 and 6.

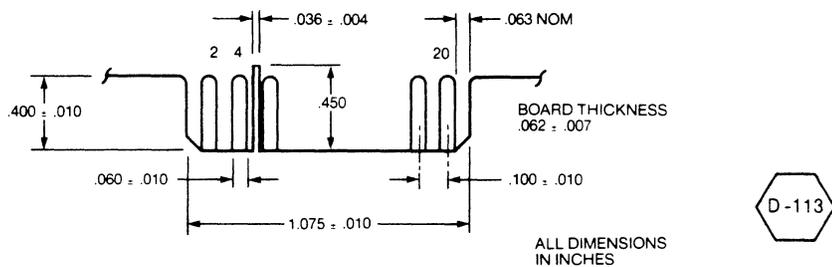


Figure 15

J2 CONNECTOR DIMENSIONS

5.3 J3/P3 CONNECTOR

The DC power connector (J3), Figure 16, is a 4 pin AMP MATE-N-LOCK connector P/N 350543-1 mounted on the solder side of the PCB. The recommended mating connector (P3) is AMP P/N 1-480424-0 utilizing AMP pins P/N 350078-4 (strip) or P/N 61173-4 (loose piece). J3 pins are numbered as shown in Figure 16.

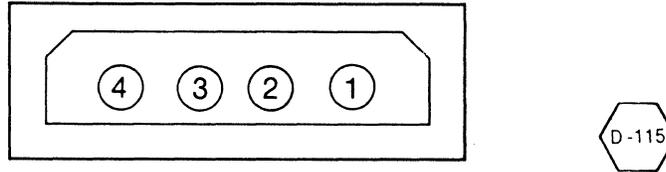


FIGURE 16

J3 CONNECTOR (DRIVE PCB SOLDER SIDE)

The required voltages and current levels on connector J3/P3 are shown below.

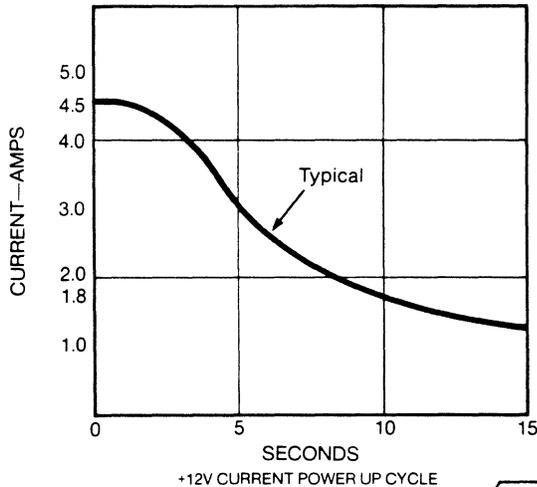


Figure 17

J3 CONNECTOR	
PIN 4	+5 VOLTS DC ± 5%
PIN 3	+5 VOLT RETURN
PIN 1	+12 VOLTS DC ± 5%*
PIN 2	+12 VOLT RETURN

* ±10% AT POWER ON OR SEEKING.



Table 4

MOTOR START CURRENT REQUIREMENTS

DC POWER REQUIREMENTS

5.4 J4/P4 Frame Ground Connector

The frame ground connection is a Faston type connection, AMP P/N 61761-2. The recommended mating connector is AMP 62187-1. If wire is used, the hole in J1 will accommodate a wire size of 18AWG maximum.

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6.0 PHYSICAL SPECIFICATIONS

This section describes the mechanical and mounting recommendations for the XT-2000.

6.1 Mounting Orientation

The XT-2000 may be mounted in any orientation. In any final mounting configuration, insure that the operation of the three shock mounts which isolate the base casting from the frame is not restricted.

6.2 Mounting Holes

Eight mounting holes, four on the bottom and two on each side are provided for mounting the drive into an enclosure. The size and location of these holes, shown in figure 18, are identical to industry standard minifloppy drives.

```
*****
*
*      CAUTION: DO NOT USE SCREWS WHICH PROJECT OVER      *
*              1/8 INCH FROM MOUNTING SURFACE.             *
*
*              SCREWS SHALL NOT BE TORQUED TO MORE         *
*              THAN 9 LB-INS.                               *
*
*****
```

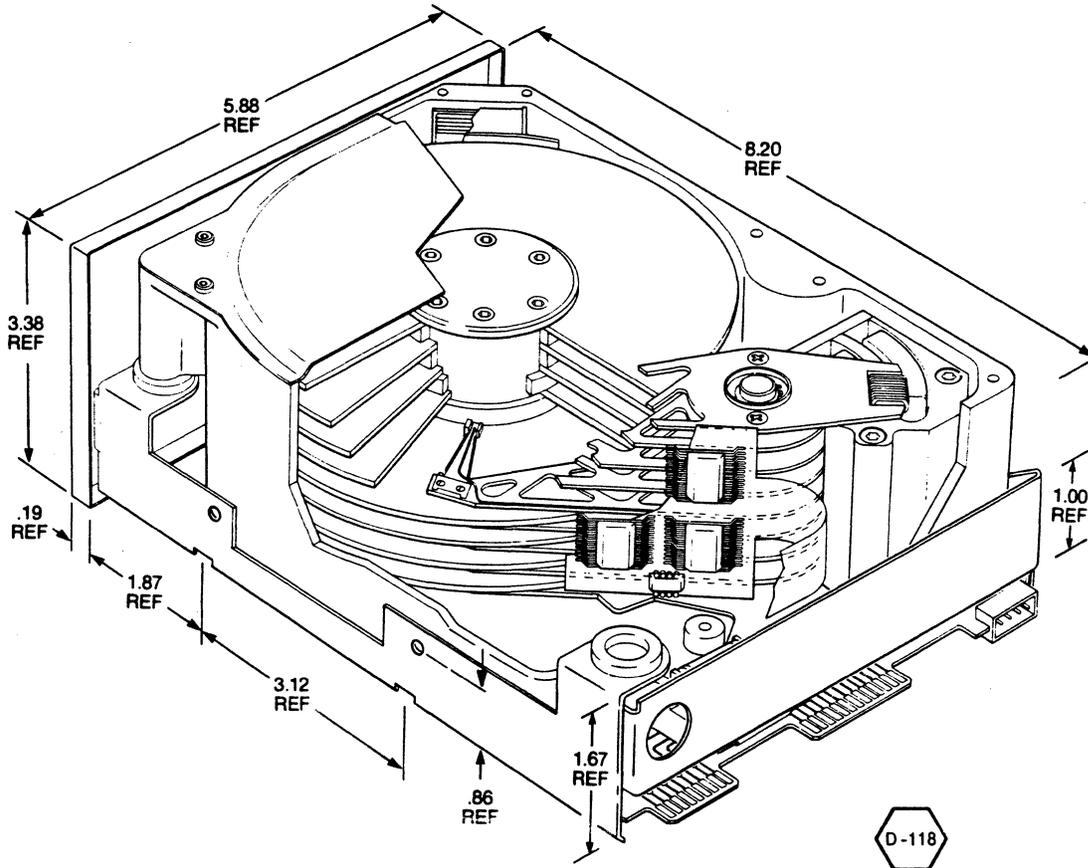
6.3 Physical Dimensions

Overall height, width, and depth along with other key dimensions are shown in Figures 18 and 19. As in the case of the mounting holes, the dimensions are identical to the industry standard minifloppy drives, thus allowing a direct physical replacement.

6.4 Shipping Requirements

At powerdown, the heads are automatically positioned over the non-data, dedicated landing zone on each disk surface. The automatic shipping lock solenoid is also engaged at this time.

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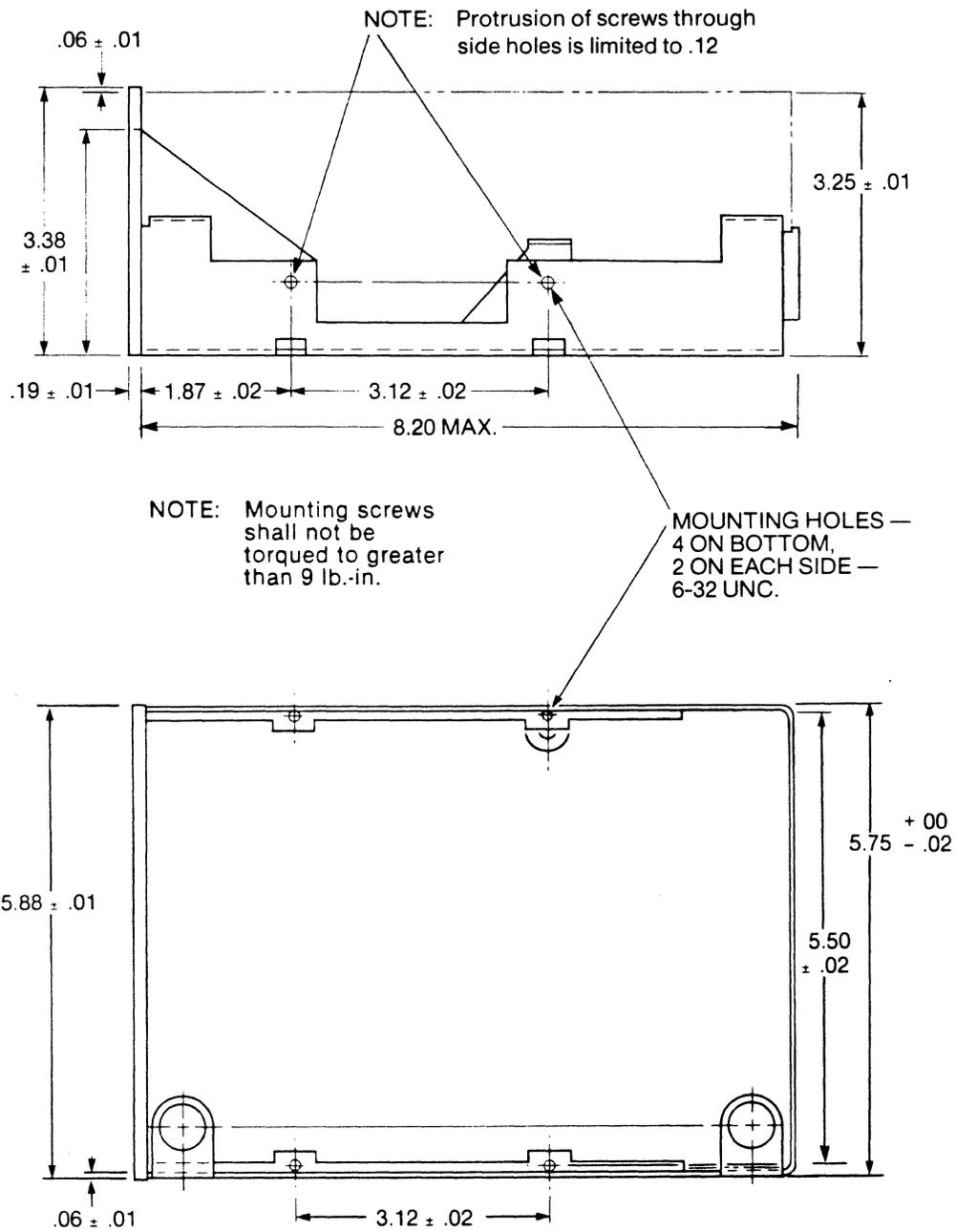
XT-2000 MECHANICAL OUTLINE

and

MOUNTING HOLE LOCATION

Figure 18

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ALL DIMENSIONS IN INCHES.

XT-2000 MECHANICAL OUTLINE
BOTTOM AND SIDE VIEWS

Figure 19

XT-2000 OEM MANUAL & PRODUCT SPECIFICATION

7.0 MEDIA DEFECTS AND ERRORS

Defects on the media surface will be identified on a defect map provided with each drive. This defect map will indicate the head number, track number, and number of bytes from index for each defect.

The maximum allowable number of defects per drive shall not exceed an average of thirteen (13) per disk surface. Cylinder 0 is certified to be defect-free.

The maximum number of defects per drive is listed below:

<u>Model</u>	<u># of Disks</u>	<u># of Data Surfaces</u>	<u>Maximum # of Defects</u>
XT-2085	4	7	91
XT-2140	6	11	143
XT-2190	8	15	195

In addition, the following limit will also be met:

The maximum number of defects per surface shall not exceed thirty (30).

* * * * *
* Warning: The defect map attached *
* to the cover of each drive should *
* be removed before operating. *
* * * * *

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8.0 XT-2000 DRIVE ADDRESS SELECTION JUMPER

In multiple drive configurations, it is necessary to configure each drive (maximum of 4 per host controller) with a unique address. This is accomplished by locating the jumper plug over the correct pins as indicated in Figure 22 and Table 5. The standard drive is shipped as Drive 1.

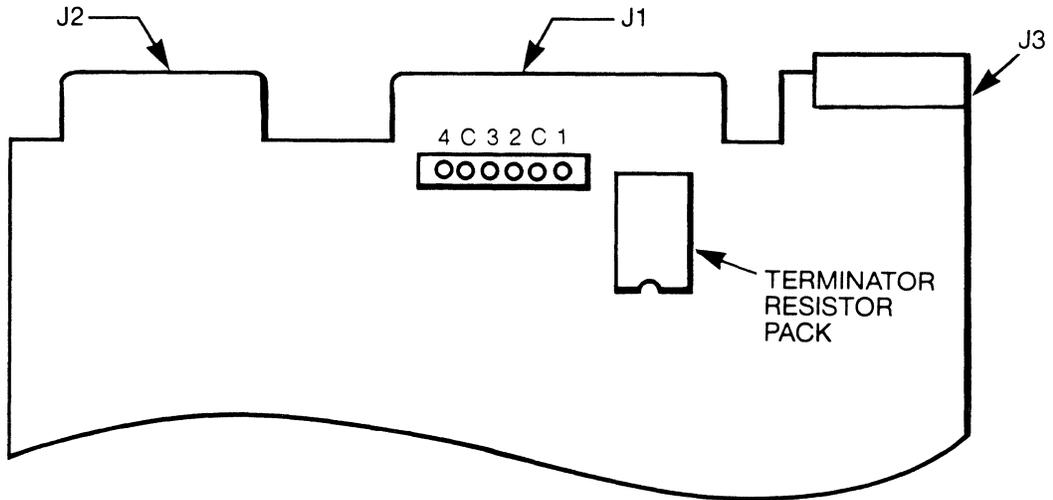


Figure 20

DRIVE SELECT JUMPER OPTIONS

Function	Jumper Block Pin Numbers
Drive Select 0	1,C
Drive Select 1	2,C
Drive Select 2	3,C
Drive Select 3	4,C



Table 5

DRIVE SELECT JUMPER OPTIONS

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9.0 APPENDIX

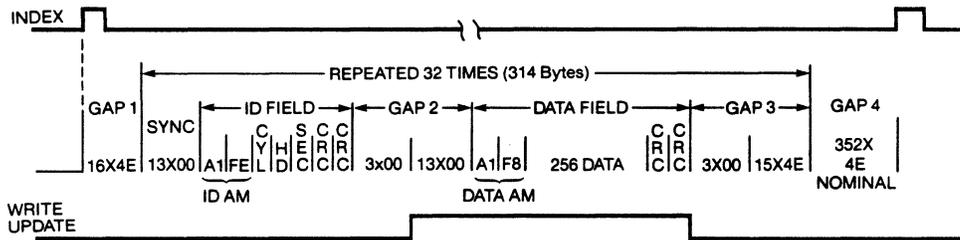
9.1 Track Format

The purpose of a format is to organize a data track into smaller sequentially numbered blocks of data called sectors.

9.2 ST506/412 Format

The format shown below in Figure 21, the ST506/412 format, is a format commonly used on lower performance disk drives. It's efficiency of 81% (unformatted capacity/formatted capacity) is typical; however other efficiencies can be obtained by varying the number of sectors per track. The ST506/412 format is a soft sector type of sector which means that the beginning of each sector is defined by a prewritten Identification (ID) field which contains the physical sector address plus cylinder and head information. The ID field is then followed by a user supplied data field.

The ST506/412 format is a slightly modified version of the IBM System 34 double density format which is commonly used on floppy disk drives. The encoding method is Modified Frequency Modulation (MFM).



- NOTES: 1. Nominal Track Capacity = 10416 Bytes unformatted
 2. Total Data Bytes/Track = 256 × 32 = 8,192
 3. Sector interleave factor is 4. Sequential ID Fields are sector numbered 0, 8, 16, 24, 1, 9, 17, 25, 2, 10, 18, 26...etc.
 4. Data Fields contain the bit pattern 0000 as shipped
 5. CRC Fire Code = $x^{16}+x^{12}+x^2+1$
 6. Bit 7 of Head Byte ID Field equals 1 in a defective sector (Cylinder 0 is error free)
 7. Bit 6 of Head Byte ID Field is cylinder 2⁸ bit
 8. Bit 5 of Head Byte ID Field is cylinder 2⁹ bit
 9. Bit 4 of Head Byte ID Field is reserved for cylinder 2¹⁰ bit
 10. Bit 0-3 of Head Byte are Head 2⁸ to Head 2³ respectively



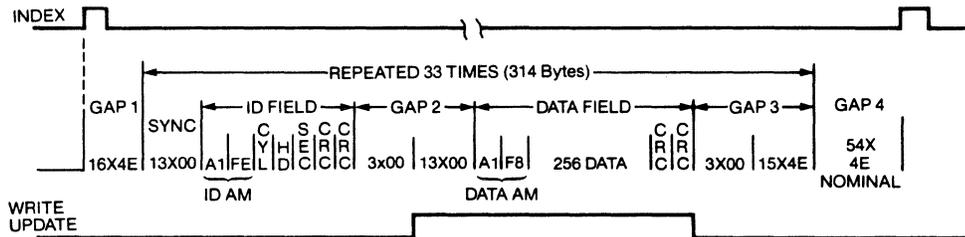
Figure 21

ST506/412 FORMAT

XT-2000 OEM MANUAL & PRODUCT SPECIFICATION

9.3 XT-2000 Alternate Track Format

Figure 22 shows an alternate format available on the XT-2000. This format is similar to the ST506/412 format with the exception that it contains 33 sectors per track instead of 32. The additional sector is available because the XT-2000 maintains a tighter tolerance on rotational speed (3600 rpm +0%, -0.2%) than comparable drives, hence a smaller Gap 4 can be allowed. A total of 8448 bytes are available, each having 256 bytes of user data.



- NOTES:
1. Nominal Track Capacity = 10416 Bytes unformatted
 2. Total Data Bytes/Track = 256 × 33 = 8,448
 3. Data Fields contain the bit pattern 0000 as shipped
 4. CRC Fire Code = $x^{16} + x^{12} + x^5 + 1$
 5. Bit 7 of Head Byte ID Field equals 1 in a defective sector (Cylinder 0 is error free)
 6. Bit 6 of Head Byte is cylinder 2⁹ bit
 7. Bit 5 of Head Byte is cylinder 2⁸ bit
 8. Bit 4 of Head Byte is reserved for cylinder 2¹⁰ bit
 9. Bit 0-3 of Head Byte are Head 2⁹ to Head 2⁶ respectively



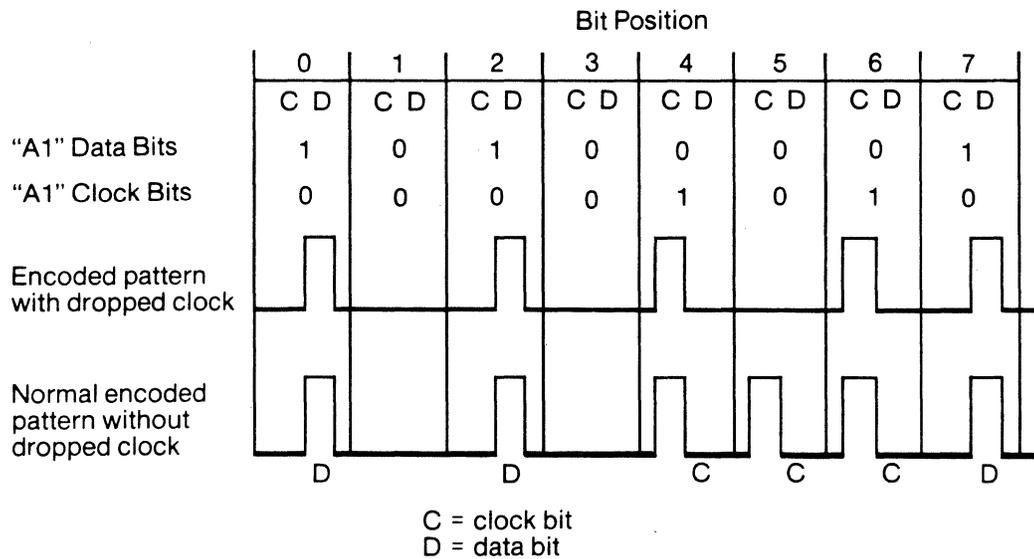
Figure 22

XT-2000 ALTERNATE TRACK FORMAT

9.4 Address Marks

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

The "A1" pattern is made unique by violating the encoding rules of MFM by omitting one clock bit. This makes the address mark pattern unique to any other serial bit combination that could occur on the track. See figure depiction of the "A1" byte. Each ID and data field is followed by a 16 bit cyclic redundancy check (CRC) character used for a particular data pattern; an error correction code (ECC) may be used instead.



D-123

Figure 23

"A1" ADDRESS MARK BYTE

9.5 Gap Length Calculations

Gaps surrounding the ID and data fields establish physical and timing relationships between these fields.

9.5.1 Gap 1

Gap 1 is to provide for variations in Index detection. As shipped, gap 1 is 16 bytes long, but must be at least 12 bytes. Gap 1 is immediately followed by a sync field preceding the first ID field.

9.5.2 Gap 2

Gap 2 follows the CRC or ECC bytes of the ID field, and continues to the data field address mark. It provides a known area for the data field write splice to occur. The latter portion of this gap serves as the sync up area for the data field AM. Gap 2 is normally 16 bytes; however, its minimum length is determined by the "lock up" performance of the phase-lock-loop in the data separator, which is part of the host control unit.

9.5.3 Gap 3

Gap 3 following each data field allows for the spindle speed variations. This allows for the situation where a track has been formatted while the disk is running slower than nominal, then write updated with the disk running faster than normal. Without this gap, or if it is too small, the sync bytes or ID field of the next field could be overwritten. As shipped, the gap allows for a + 0.5% rotational speed variation. Minimum gap is 8 bytes for a 256 byte record size.

9.5.4 Gap 4

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

9.6 Sector Interleaving

The ST506/412 format normally uses an interleave factor of 4: that is, sequentially sectored ID numbers are 0, 8, 16, 24, 1, 9, 17, 25, 2, 10, 18, 26, etc. This allows sufficient system turnaround time to process multiple sectors during a single revolution, thus enhancing through-put of typical file read/write operations. Other interleave factors can be used.

9.7 Unpacking and Inspection

To be supplied.

9.8 Installation

To be supplied.

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