XT - 1000/2000
**Product Specification
and
OEM Manual**

REVISION RECORD

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1.0   INTRODUCTION

1.1   General Description

The XT-1000/2000™ disk drives are low cost, high capacity, high performance random access storage devices utilizing from 5 to 8 non-removable 5 1/4-inch disks as storage media. Each disk surface employs one movable head to access up to 1224 data tracks. The total unformatted capacity of the disk drives range from 85.32 to 239.98 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 MAXTORQ™ rotary voice coil actuator provides an average access time of better than 26 msec and a track-to-track access time of less than 4 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 (1070 tpi, up to 14,901 bpi) in a 5 1/4-inch package.

High capacity is achieved by a balanced combination of high aerial density and high density packaging techniques. Maxtor's advanced MAXPAK™ 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-1000/2000 electrical interface is compatible with the industry standard ST506/412 family of 5 1/4-inch fixed disk drives. The XT-1000/2000 size and mounting are also identical to the industry standard 5 1/4-inch floppy and Winchester disk drives, and they use the same DC voltages and connectors. No AC power is required.

Key Features:

*   Storage capacity of 85.32 to 239.98 megabytes unformatted (67.1 to 196.60 megabytes formatted with a ST506/412 compatible format).

*   Same physical size and mounting as standard floppy disk drives.

*   Same DC voltages as standard floppy disk drives.

*   No AC voltage required.

*   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 for drives using MFM.

*   7.5 megabit/second transfer rate for drives utilizing RLL 2.7 encoding (XT-1120R, XT-1240R)

*   ST412 compatible interface.

*   ST412 track capacity plus spare sector.

*   Thin film metallic 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 disk hub.

*   Microprocessor controlled spindle motor for precision speed control (+0.1%) under all load conditions.

*   Dynamic braking during power-down cycle.

1.2   SPECIFICATION SUMMARY

1.2.1   Physical Specifications

- Environmental Limits 0.

  Ambient Temperature
  Operating: 50° to 113° F (10° to 45° C)
  Non-Operating: -40° to 140° F (-40° to 60° C)

- Maximum Temperature Gradient
  Operating or Non-operating: 18° F/hr. (10° C/hr), below condensation

- Relative Humidity: 8 to 95% non-condensing

- Maximum Elevation
  Operating: 10,000 ft.
  Non-Operating: -1000 ft. to 40,000 ft.

- Shock (inputs to the frame of drive)
  Operating shock (all axes):   11 ms. pulsewidth (1/2 sine)...2G,
                                    10G with recal allowed
  Non-operating shock (all axes): 11 ms. pulsewidth (1/2 sine)..20G

- Vibration (inputs to frame of drive)
  Operating vibration (all axes)
      5-25 hz, 0.006 inches P-P
      25-500 hz, 0.20G peak acceleration

  Non-operating vibration (all axes)
      5-31 hz, 0.02 inches P-P
      31-500 hz, 1G peak acceleration

- DC Power Requirements
      +12V + 5%, 1.57A typical, 4.5A max. (at power on)
      +5V + 5%, 1.7A typical, I.9A maximum
      +5V Maximum Ripple = 50mV P-P
      +12V Maximum Ripple = 120mV P-P

- Mechanical Dimensions

Height .... 3.25 inches
Width .... 5.75 inches
Depth .... 8.20 inches
Weight .... 7.1 lbs (3.2kg)
Shipping Weight .... 9.3 lbs (4.2kg)

- Heat Dissipation   25 watts typical, 28 watts maximum

1.2.2 Performance Specifications

	XT-1085	XT-1140	XT-2190	XT-1120R	XT-1240R
Capacity, unformatted					
Per drive (Mbytes)	85.32	143.43	191.23	127.99	239.98
Per surface (Mbytes)	10.66	9.56	12.74	15.99	15.99
Per track (bytes)	10,416	10,416	10,416	15,624	15,624
Capacity, XT-1000/2000 alternate format (per section 9.1.1)					
Per drive (Mbytes)	69.2	116.3	159.80	104.85	196.60
Per surface (Mbytes)	8.65	7.75	10.65	13.10	13.10
Per track (bytes)	8704	8704	8704	12,800	12,800
Per sector (bytes)	512	512	512	512	512
Sectors/track	17	17	17	25	25
Capacity, ST506/412 compatible format (per section 9.1.2)					
Per drive (Mbytes)	71.3	119.85	159.80	104.85	196.60
Per surface (Mbytes)	8.91	7.99	10.65	13.10	13.10
Per track (bytes)	8704	8704	8704	12,800	12,800
Per sector (bytes)	512	512	512	512	512
Sectors/track	17	17	17	25	25
Transfer rate, Mbits/sec	5.0	5.0	5.0	7.5	7.5

	XT-1085	XT-1140	XT-2190	XT-1120R	XT-1240R
Access Time, msec, maximum					
Average*	27	26	28	27	27
Track-to-track*	4	4	4	4	4
Maximum*	46	43	43	46	46

* Includes settling

1.2.3   Functional Specifications

Rotational Speed (rpm) **	----------------------------------3600--------------------------------				
Average latency (ms)	---------------------------------- 8.33-------------------------------				
Recording density (bpi)	9934	9280	11,155	14,901	14,901
Flux Density (fci)	9934	9280	9280	9934	9934
Track density	1070	1070	1070	1070	1070
Cylinders	1024	918	1224	1024	1024
Tracks	8192	13,770	18,369	8,192	15,360
Sectors	139,264	234,090	312,120	204,800	384,000
Data heads	8	15	15	8	15
Servo heads	1	1	1	1	1
Disks	5	8	8	5	8
Interface	--------------ST506/412 ------------			------ST506/RLL------	

** Accurate to +0%,-0.2%

1.2.4   Reliability Specifications:

- MTBF: 30,000 POH, typical usage
- PM: Not Required
- MTTR: 30 minutes
- Component Design Life   5 years

1.2.5   Error Rates

- Soft read errors   10 per 10^{11} bits read
- Hard read errors *   10 per 10^{13} bits read
- Seek errors   10 per 10^{7} seeks

* Not recoverable within 16 retries

2.0   FUNCTIONAL CHARACTERISTICS

2.1   General Theory of Operation

The XT-1000/2000 disk drive consists of read/write and control electronics, read/write heads, servo head, head positioning actuator, media, and air filtration system. The components perform the following functions:

1.   Interpret and generate control signals.
2.   Position the heads over the desired track.
3.   Read and write data.
4.   Provide a contamination free environment.

2.2   Read/Write and Control Electronics

Drive Electronics are packaged on a single printed circuit board. This board, which includes two microprocessors, performs the following functions:

1. Reading/writing of data
2. Index detection
3. Head positioning
4. Head selection
5. Drive selection
6. Fault detection
7. Voice coil actuator drive circuitry.
8. Track 0 detection
9. Recalibration to track 0 on power-up
10. Track position counter
11. Power and speed control for spindle drive motor.
12. Braking for the spindle drive motor.
13. Drive up-to-speed indication circuit.
14. Reduced write current on the inner tracks.
15. Monitoring for write fault conditions
16. Control of all internal timing
17. Generation of seek complete signals

2.3   Drive Mechanism

A brushless DC drive motor contained within the spindle hub rotates the spindle at 3600 rpm. The spindle is direct driven with no belt or pulleys being used. The motor and spindle are dynamically balanced to insure a low vibration level. Dynamic braking is used to quickly stop the spindle motor when power is removed. The head/disk assembly is shock mounted to minimize transmission of vibration through the chassis or frame.

2.4 Air Filtration System

The XT-1000/2000 has an air filtration system. (Refer to Figure 1). The disks and read/write heads are assembled in an ultra clean-air environment and then sealed within the module. The module contains an internal absolute filter mounted inside the casting to provide constant internal air filtration. A second filter, located on the enclosure top cover, permits pressure equalization between internal air and ambient air.

RECIRCULATING FILTER

ROTARY
VOICE
COIL

AIR FLOW PATH
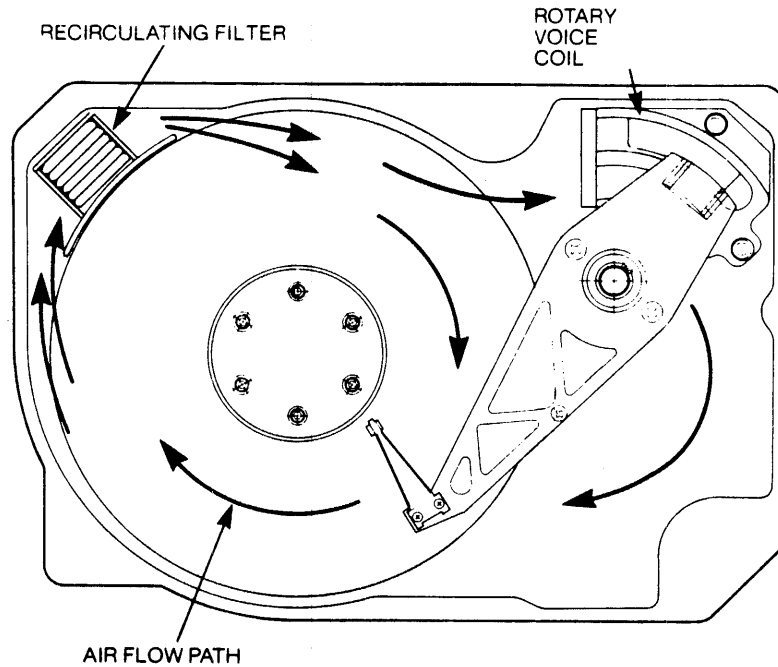
Figure 1
XT-1000/2000 Air Filtration System

2.5 Positioning Mechanism

The XT-1000/2000 has a specific head positioning system. (Refer to Figure 2, page 8). The read/write heads are mounted on a head arm assembly which is then mounted to a ball-bearing supported shaft. The voice coil, an integral part of the head/arm assembly, lies inside the magnet housing when installed in the drive. Current from the power amplifier, controlled by the servo system, causes a magnetic field in the voice coil which either aids or opposes the field around the permanent magnets. This reaction causes the voice coil to move within the magnetic field. Since the head-arm assemblies are mounted to the voice coil, the voice coil movement is translated through the pivot point directly to the heads and achieves positioning over the desired cylinder.

Actuator movement is controlled by the servo feed-back signal from the servo head. The servo head is located on the lower surface of the bottom disk, where servo information is pre-written at the factory. This servo information is used as a control signal for the actuator to provide track-crossing signals during a seek operation, track-following signals during ON CYLINDER operation, and timing information such as index and servo clock.
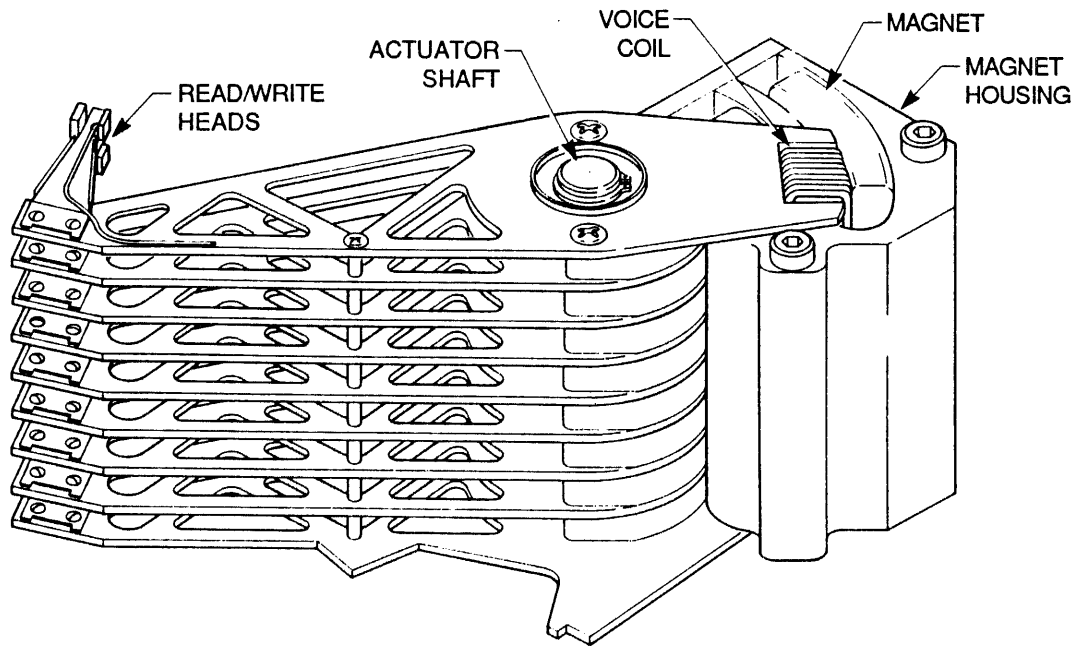
Figure 2
XT-1000/2000 Head Positioning System

2.6   Read/Write Heads and Disks

The XT-1000/2000 employs composite manganese-zinc ferrite 3380 "Whitney" type head sliders and flexures. The manganese-zinc is used instead of the conventional nickel-zinc formulation to maximize head output and to allow wide bandwidth read/write capability. The Whitney type sliders and flexures provide improved aerodynamic stability, superior head/disk compliance and a higher signal-to-noise ratio.

The XT-1000/2000 media utilizes thin metallic deposited on I30mm diameter aluminum substrates. The coating formulation together with the low load-force/low mass Whitney type heads permits highly reliable contact start/stop operation. The nickel-cobalt metallic film yields high amplitude signals, and very high resolution performance compared to conventional oxide coated media. The metallic media provides a highly abrasion-resistant surface, decreasing the potential for damage caused by shipping shock and vibration.

Data on each of the data surfaces is read by one read/write head, each of which accesses up to 1224 tracks. There is one surface dedicated to servo information in each drive.

2.7   Cooling Requirements

To insure reliable operation, it is recommended that airflow of at least 3 CFM be provided across the disk drive and printed circuit board assembly in the final installation configuration.

3.0   FUNCTIONAL OPERATIONS

3.1   Power-Up Sequencing

DC power (+5V and +12V) may be supplied to the drive in any order, but +12VDC is required to start the spindle motor. When the spindle reaches full speed, the actuator lock automatically disengages and the heads then recalibrate to track 0. (Refer to Figure 3)

NOTE: Audible noise during the recalibration sequence is normal. Step pulses received during the recalibration sequence will be ignored. Upon a successful recalibrate, TRACK 0, READY, and SEEK COMPLETE status signals will be true. The unit will not perform any Read/Write or Seek functions until READY is true. (If after starting, 1000 rpm is not reached in 10 seconds, an automatic shutdown procedure is initiated; power to the spindle motor is shut off and the drive will not come READY.)
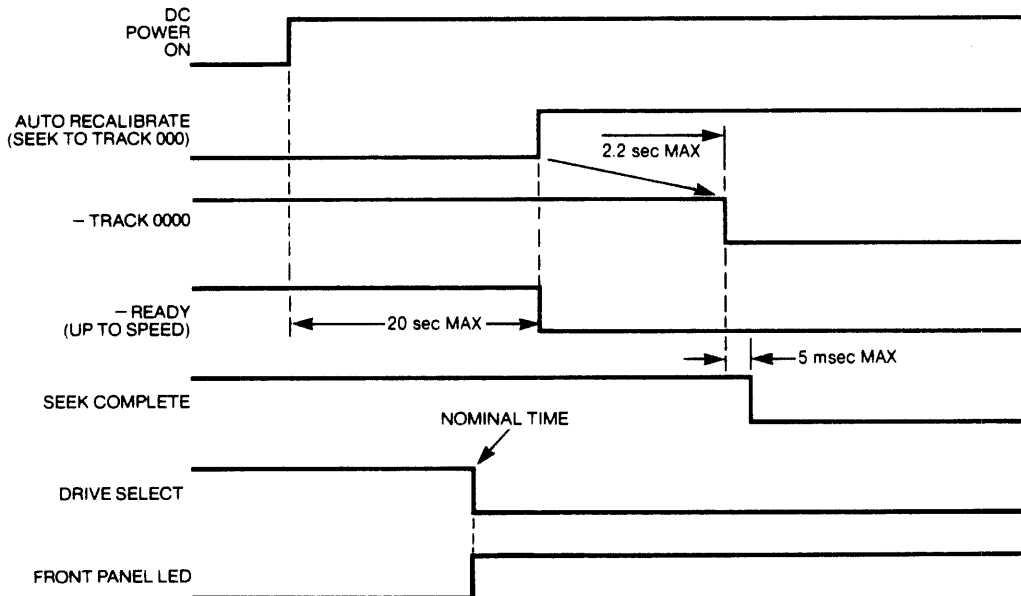
Figure 3
Power-up Sequence

3.1.1   Spindle Power Control Option (Jumper JE)

NOTE: This is only available on PCB Part #1059085.

The spindle motor can be controlled via J2 pin 5 on the interface of the XT-1000/2000 series drive. A low level on this pin will keep the spindle from powering up when system power is applied. This feature is used to allow power sequencing on multi-drive systems. Installing Jumper JE enables this option. The drive is shipped from the factory with this jumper IN. (Refer to Figure 7, page 18).

3.2 Drive Selection

Drive selection occurs when one of the DRIVE SELECT lines is activated from the controller. Only the selected drive will respond to the input signals, and only that drive's output signals are then gated to the controller. (Refer to Figure 23 and Table 8 on page 36).

3.3 Track Accessing

Read/Write head positioning is accomplished by:
- a) Deactivating WRITE GATE.
- b) Activating the appropriate DRIVE SELECT line.
- c) Being in the READY condition with SEEK COMPLETE true.
- d) Selecting the appropriate direction
- e) Pulsing the STEP line

Each STEP pulse will cause the heads to position either 1 track in or 1 track out depending on the level of the DIRECTION line. A low level on the DIRECTION line will cause a seek inward toward the spindle; a high level will cause a seek outward toward track 0.

All seeks performed by the XT-1000/2000 are "buffered" type seeks. Optimal seek times are dependent upon the drive receiving STEP pulses at a rate greater than one pulse every 13 usec. In addition, STEP pulses slower than this causes average access times to degenerate. The seek performance versus the step time is listed in Table 1.

STEP TIME (μsec)	AVERAGE ACCESS TIME (msec)	MAXIMUM ACCESS TIME (msec)
1-13	27	46
14-26	37	75
30	45	85
35	47	90
40	48	95
45	48	102
50	50	110
60	52	122
70	58	128
80	60	134
90	62	142
100	65	142
150	83	210
200	100	263
300	140	383
400	180	503
500	220	623
600	260	745
700	300	865
800	340	990
900	380	1110
1000	420	1235

TIME BETWEEN STEP PULSES CANNOT EXCEED 3.1 msec.

ALL SEEK TIMES INCLUDE SETTLING, AND BEGIN UPON RECEPTION OF THE FIRST STEP PULSE.

(NOTE: THE XT-1085 HAS 1024 CYLINDERS)

Table 1

Seek Performance vs Step Time

XT-1140

3.4   Head Selection

Any of the drive's data heads can be selected by placing the head's binary address on the four HEAD SELECT lines (Refer to Section 4.1.3).

3.5   Read Operation

Reading data from the disk is accomplished by:

    a) Deactivating the WRITE GATE line.

    b) Activating the appropriate DRIVE SELECT line.

    c) Assuring the drive is READY.

    d) Selecting the appropriate head.

3.6 Write Operation

Writing data on to the disk is accomplished by:

   a) Activating the appropriate DRIVE SELECT line.
   b) Assuring that the drive is READY.
   c) Selecting the proper head.
   d) Insuring no Write Fault conditions exist.
   e) Activating Write Gate and placing data on the WRITE DATA line.

3.6.1 Write Protect Option (Jumper J8)

A write protect option has been incorporated into the XT-1000/2000 series drive. This option is invoked by attaching a shorting plug or a switch across J8 pins 1 and 2 on the PCB. These pins are on .100" centers for ease of installing a switch connector. If a shorting plug is installed between J8 pins 2 and 3, the drive may be write protected by a signal on interface line J2-3 (Remote Write Project). (Refer to Figure 7, page 18).

4.0 ELECTRICAL INTERFACE

The interface to the XT-1000/2000 can be divided into three categories, each of which is physically separated.

1. Control signals
2. Data signals
3. DC power

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

The XT-1000/2000 is designed with connector pin assignments and interconnection of cabling between the host controller and drives. (Refer to Figure 4, page 15; Figure 5, page 16; Table 2, page 16; Table 3, page 17).

FLAT RIBBON OR
TWISTED PAIR MAX 20 FEET

HOST SYSTEM   XT-1000/2000

1

--HEAD SELECT 2^3 → 2

3

--HEAD SELECT 2^2 → 4

5

--WRITE GATE → 6

7

← -SEEK COMPLETE

8

9

← --TRACK 0

10   11

← -WRITE FAULT

12

13

--HEAD SELECT 2^0 → 14

15

← --RESERVED (TO J2 PIN 7)

16

17   } J1/P1

--HEAD SELECT 2^1 → 18

19

← --INDEX

20

21

← --READY

22

23

--STEP → 24

25

--DRIVE SELECT 1 → 26

27

--DRIVE SELECT 2 → 28

29

--DRIVE SELECT 3 → 30

31

-DRIVE SELECT 4 → 32

33

--DIRECTION IN → 34

+5 VDC →

+5V RETURN

+12VDC →   } J3/P3

+12V RETURN

DC GND — FRAME GROUND —   } J4/P4
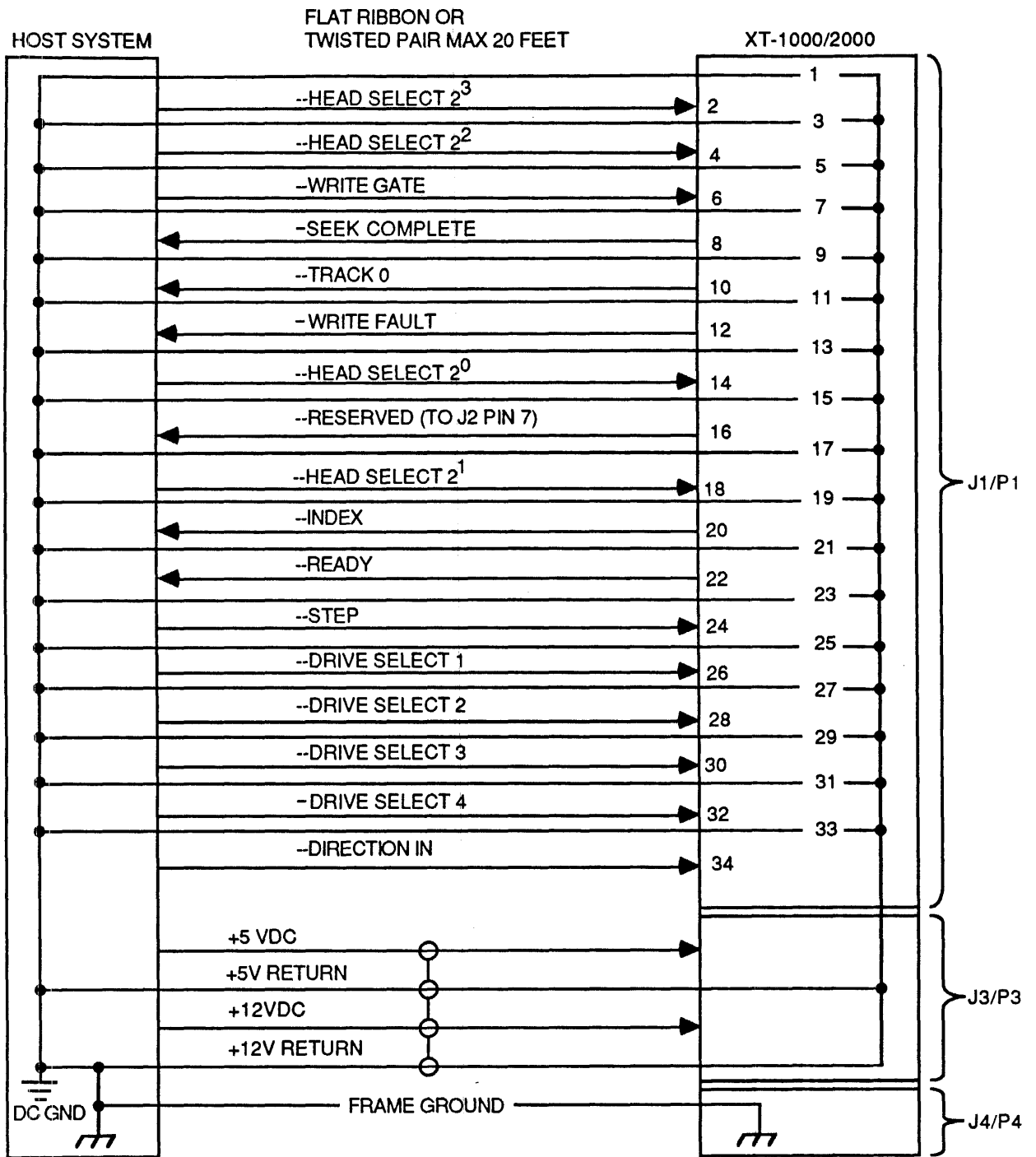
Figure 4
J1/P1 Connector Pin Assignment

SIGNAL NAME	SIGNAL PIN	GROUND PIN
--HEAD SELECT 2^3	2	1
--HEAD SELECT 2^2	4	3
--WRITE GATE	6	5
--SEEK COMPLETE	8	7
--TRACK 0	10	9
- WRITE FAULT	12	11
--HEAD SELECT 2^0	14	13
RESERVED (TO J2 PIN 7)	16	15
--HEAD SELECT 2^1	18	17
--INDEX	20	19
--READY	22	21
--STEP	24	23
--DRIVE SELECT 1	26	25
--DRIVE SELECT 2	28	27
--DRIVE SELECT 3	30	29
-DRIVE SELECT 4	32	31
--COMMAND DATA	34	33

Table 2
Control Signals (Daisy Chained)
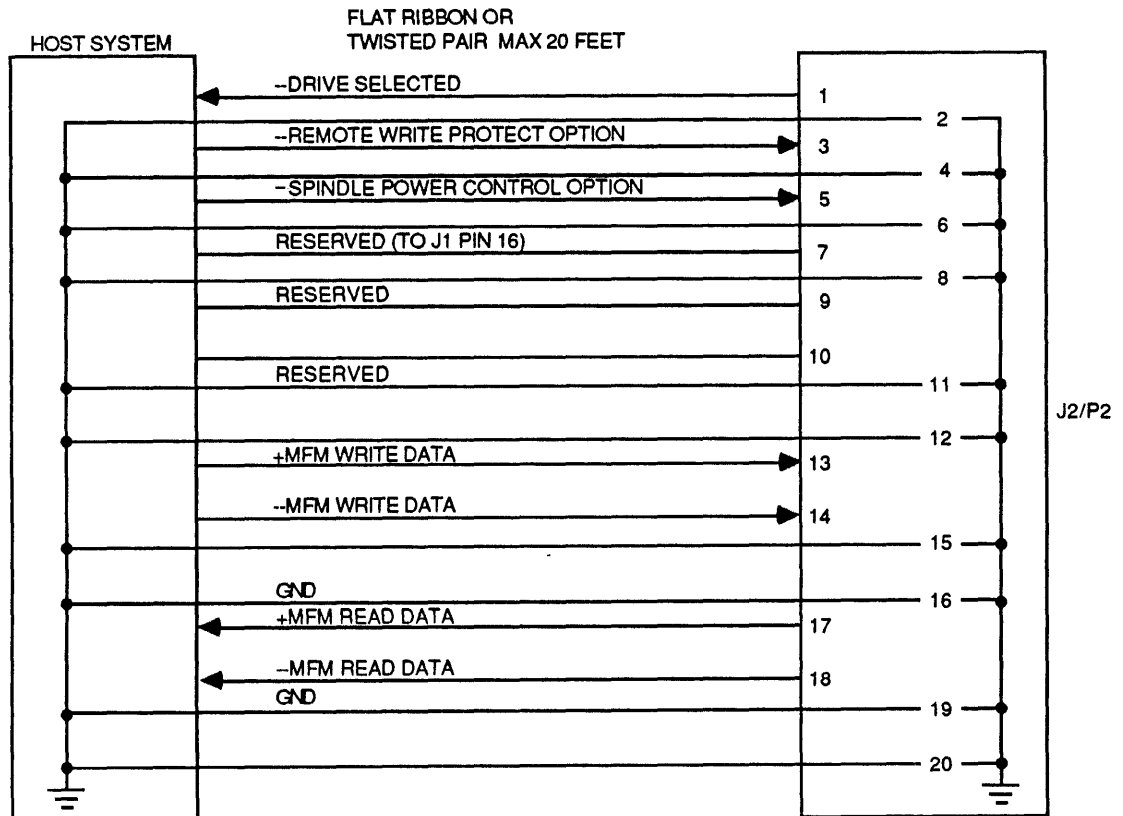
Figure 5
J2/P2 Connector Pin Assignment

SIGNAL NAME	SIGNAL PIN	GROUND PIN
--DRIVE SELECTED	1	2
--REMOTE WRITE PROTECT OPTION	3	4
--SPINDLE POWER CONTROL OPTION	5	6
RESERVED (TO J1 PIN 16)	7	8
RESERVED	9,10	
GND	11	12
+MFM WRITE DATA	13	
--MFM WRITE DATA	14	
GND	15	16
+MFM READ DATA	17	
--MFM READ DATA	18	
GND	19	20

Table 3
Data Signals (Radial)
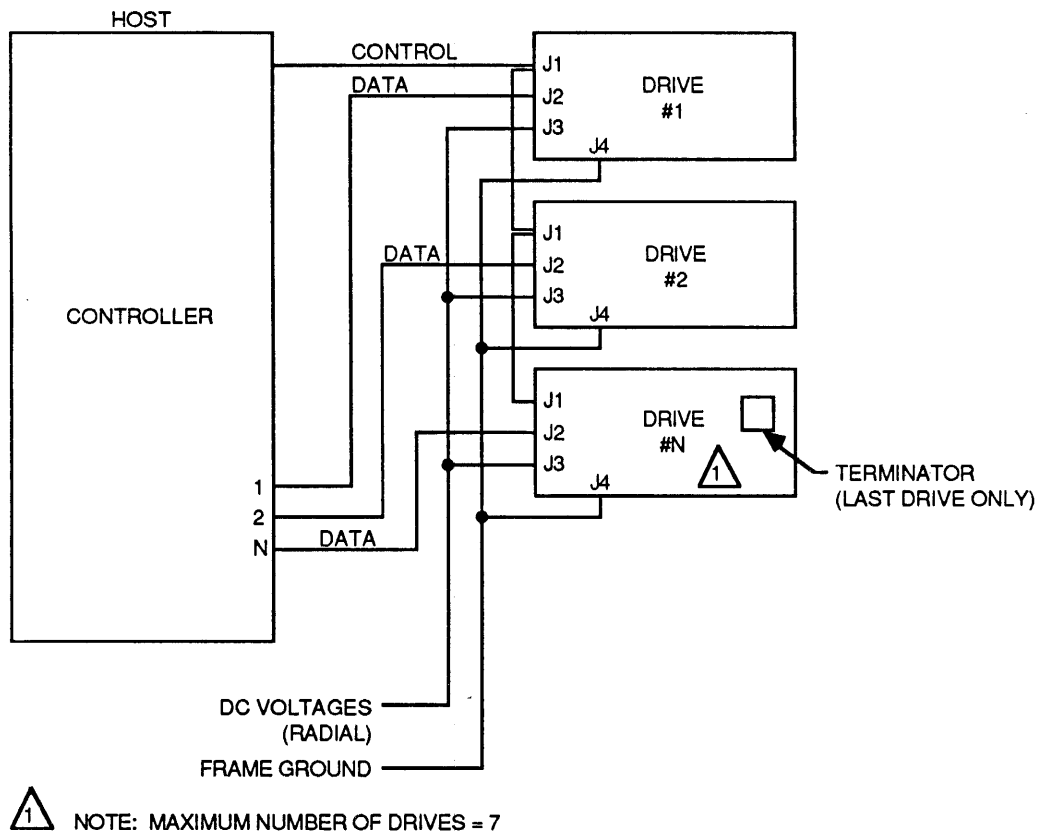
Figure 6
Typical Connection, Four Drive System

JUMPER JD
Factory Use Only
From Factory: In

JUMPER JE
Spindle Power Control
From Factory: In

JUMPER J7
Drive Select
From Factory: In I-C

JUMPER JC
Factory Use Only
From Factory: In

JUMPER JF
2^3 Head Select
From Factory: In

JUMPER JA
Factory Use Only
From Factory: In

JUMPER J8
Write Protect
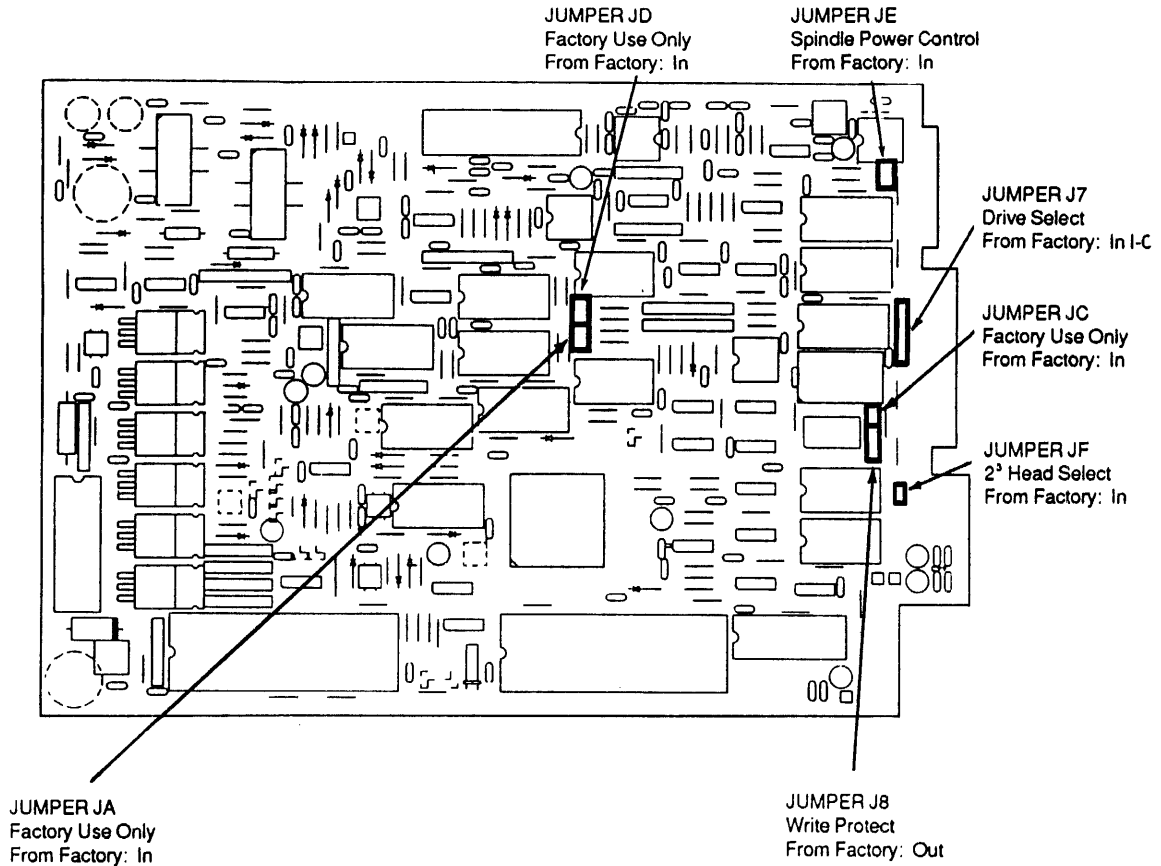From Factory: Out

Figure 7
XT-1000/2000 Jumper Locations

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 2^0, HEAD SELECT 2^1, HEAD SELECT 2^2, HEAD SELECT 2^3, 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. The control signal-driver/receiver combination is the recommended circuit. (Refer to Figure 8, page 19).

TRUE: 0.0 VDC to 0.4 VDC @ 1= -48mA (Max)

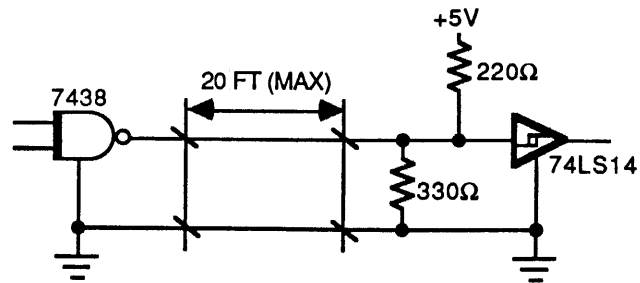FALSE: 2.5 VDC to 5.25 VDC @ 0= +250 uA (Open Collector)

Figure 8
Control Signal-Driver/Receiver Combination

4.1.1. Reduced Write Current

This function is automatically performed by the drive microprocessor.

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.I.3 Head Select 2^0, 2^1, 2^2, and 2^3.

These four lines allow selection of each individual read/write head in a binary coded sequence. HEAD SELECT 2^0 is the least significant line. Heads are numbered 0 through 14. 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.

4.1.3.1 Head Select 2^3 Option Jumper JF

Note: This option is only available on PCB Part #1059085.

This feature applies only to drives with 8 heads or less (XT-1085). On these drives some systems use J1 pin 2 for something other than head select. In this case the head select 2^3 jumper (JF) must be removed.

4.1.4 Direction In

This signal defines the direction of motion of the Read/Write 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 Read/Write 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 Read/Write heads will move toward the center of the disk. 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 9A).
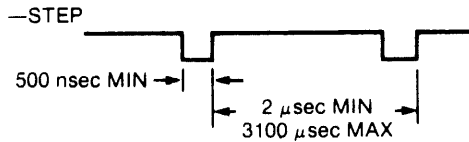
A 220/330 resistor pack allows for line termination.

Figure 9A
Step Pulse Timing

4.1.6   Buffered Seek

Microprocessor utilization on the XT-1000/2000 adds the capability of capturing and storing up to 1023 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.

Note: When performing a recalibrate function on the XT-1000/2000 drives, the step pulses must not be issued at a rate faster than 2 ms. per step pulse. If pulses are issued at a faster rate, the actuator could be driven into the crash stop at high velocity possibly resulting in damage to the drive. The recommended recal method is to issue an out DIRECTION, a STEP pulse, wait for SEEK COMPLETE and then test for TRACK 0.
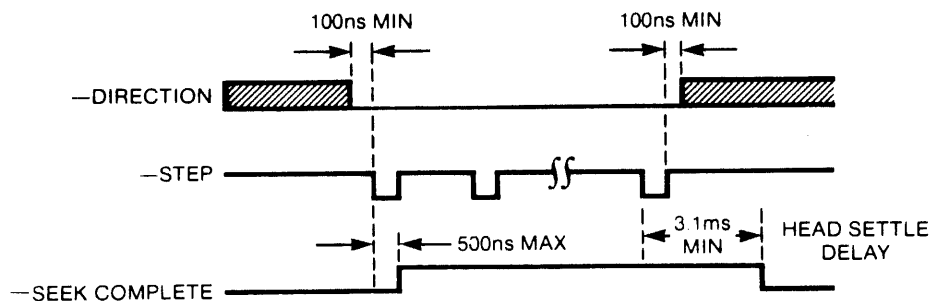

Figure 9B
General Step Timing

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. (Refer to Figure 23 and Table 8 on page 36).

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.

The control signal-driver/receiver combination is the recommended circuit. (Refer to Figure 8, page 9).

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 Read/Write 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.

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: The 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. (Refer to Figure 10). Only the transition from high to low is valid.
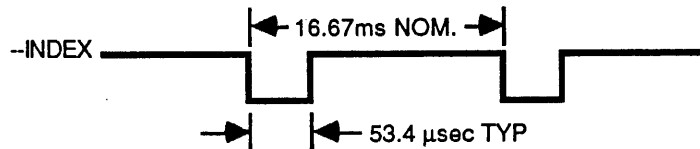

Figure 10
Index Timing

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. The driver/receiver combination used in the drive is for the data transfer signals. (Refer to Figure 11).
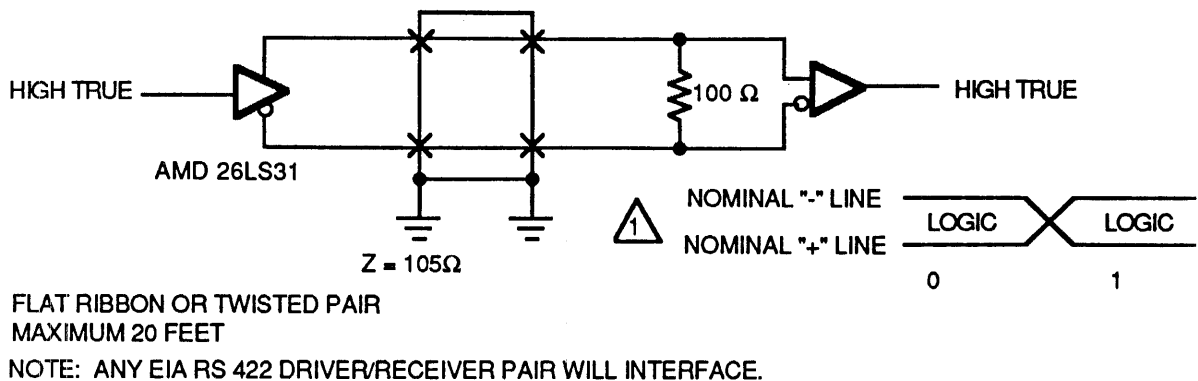

Figure 11
Data Line Driver/Receiver Combination

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 precomcompensation 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 including RLL. (Refer to Figure 12, page 24).

4.3.3   Read/Write Timing

The timing diagram depicts the necessary sequence of events including associated timing restrictions for proper read/write operation of the drive. (Refer to Figure 12, page 24).
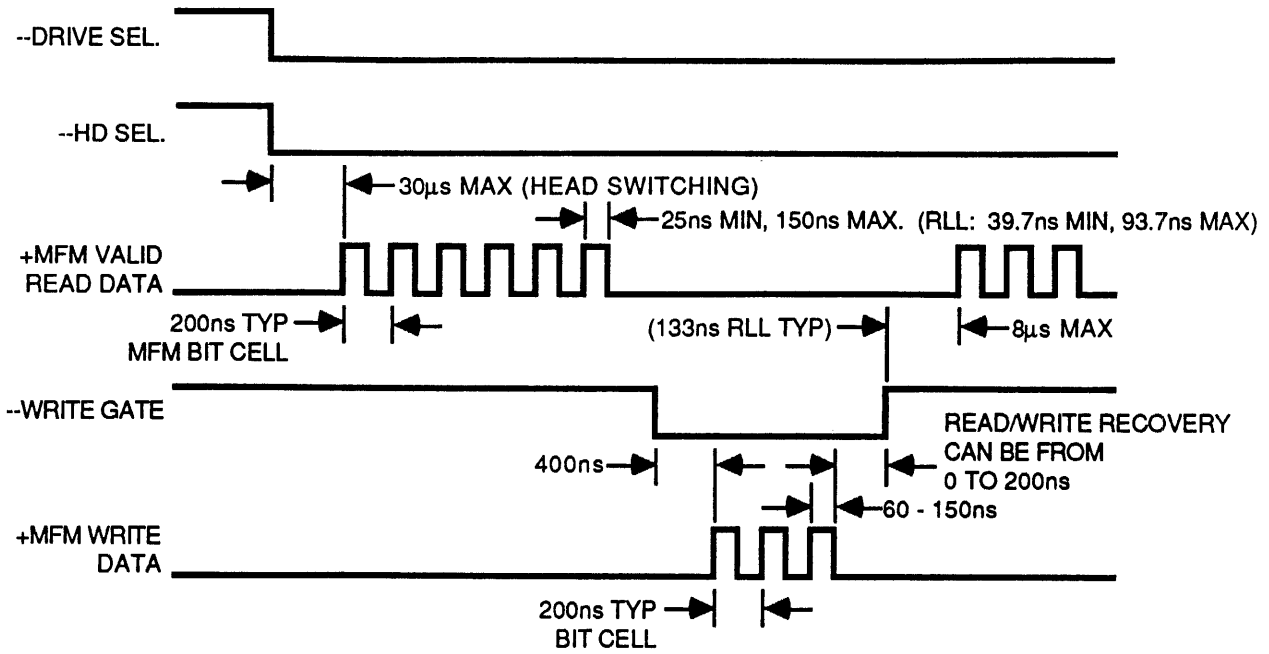
Figure 12
Read/Write Data Timings

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. 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

The timing diagram depicts the necessary sequence of events and associated timing restrictions for proper operation of the drive. (Refer to Figure 13, page 25).

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 13
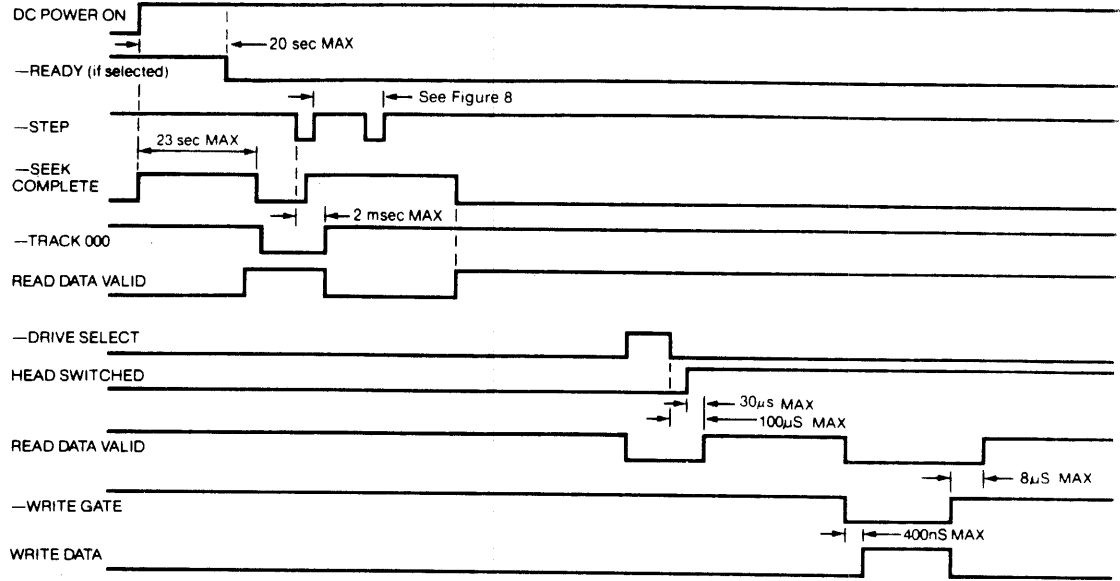**General Timing Requirements**

5.0   PHYSICAL INTERFACE

The electrical interface between the XT-1000/2000 and the host controller is via four connectors:

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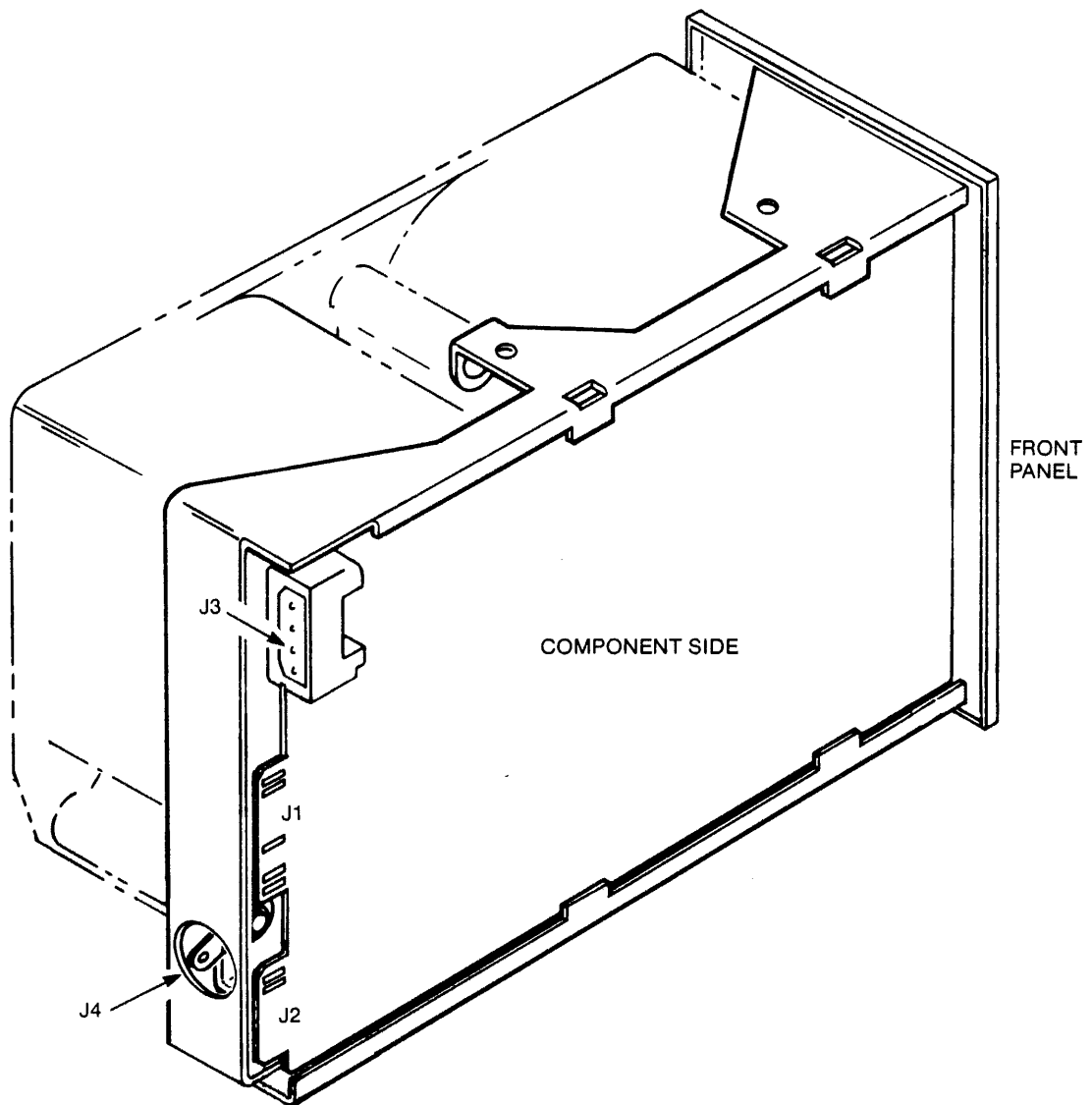4.   J4 - Frame ground

(Refer to Figure 14).

Figure 14
Interface Connector Physical Location

5.1   J1/P1 Connector

Connection to J1 is via a 34 pin PCB edge connector. (Refer to Figure 15). 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 P/N 88373-3.

Figure 15
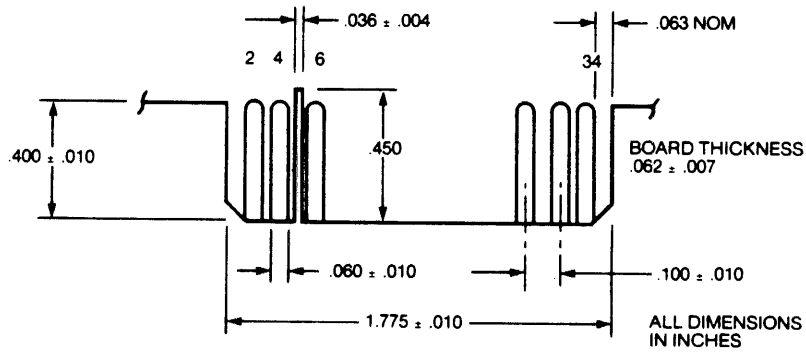**J1 Connector Dimensions**

5.2   J2/P2 Connector

Connection of J2 is via a 20 pin PCB edge connector. (Refer to Figure 16). 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.
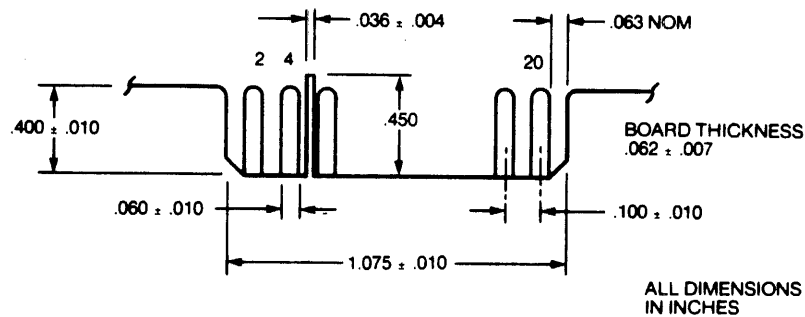

Figure 16
J2 Connector Dimensions

5.3   J3/P3 Connector

The DC power connector (J3), 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. (Refer to Figure 17).
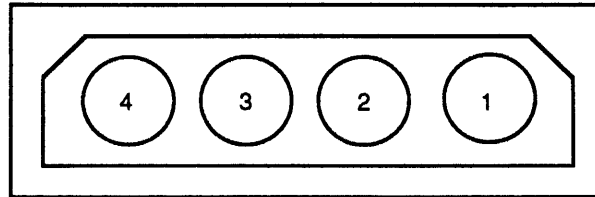
Figure 17
J3 Connector (Drive PCB Solder Side)

The required voltages and current levels on connector J3/P3 are shown below. (Refer to Figure 18 and Table 4).
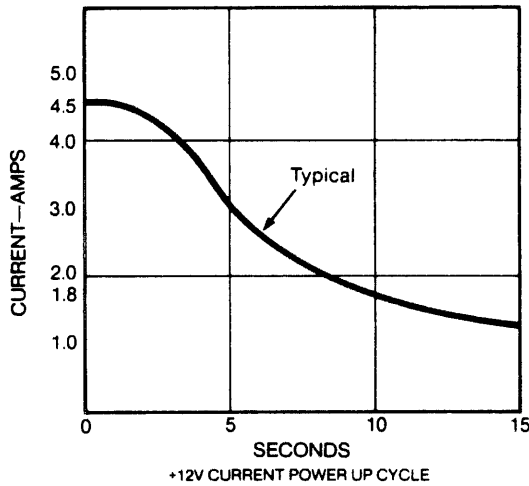
NOTE: IF A FULL LENGTH SEEK IS DONE AN ADDITIONAL ONE AMPERE IS REQUIRED FOR A DURATION OF 15 MILLISECONDS.

Figure 18
Motor Start Current Requirements

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
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 J4 will accommodate a wire size of 18AWG maximum.

6.0   PHYSICAL   SPECIFICATIONS

This section describes the mechanical and mounting recommendations for the
XT-1000/2000.

6.1   Removable Faceplate

Note: Available as of 1/87.

The faceplate may be removed in installations that require it. Remove the two C clips and
unplug the LED cable from the PCB. (Refer to Figure 19).

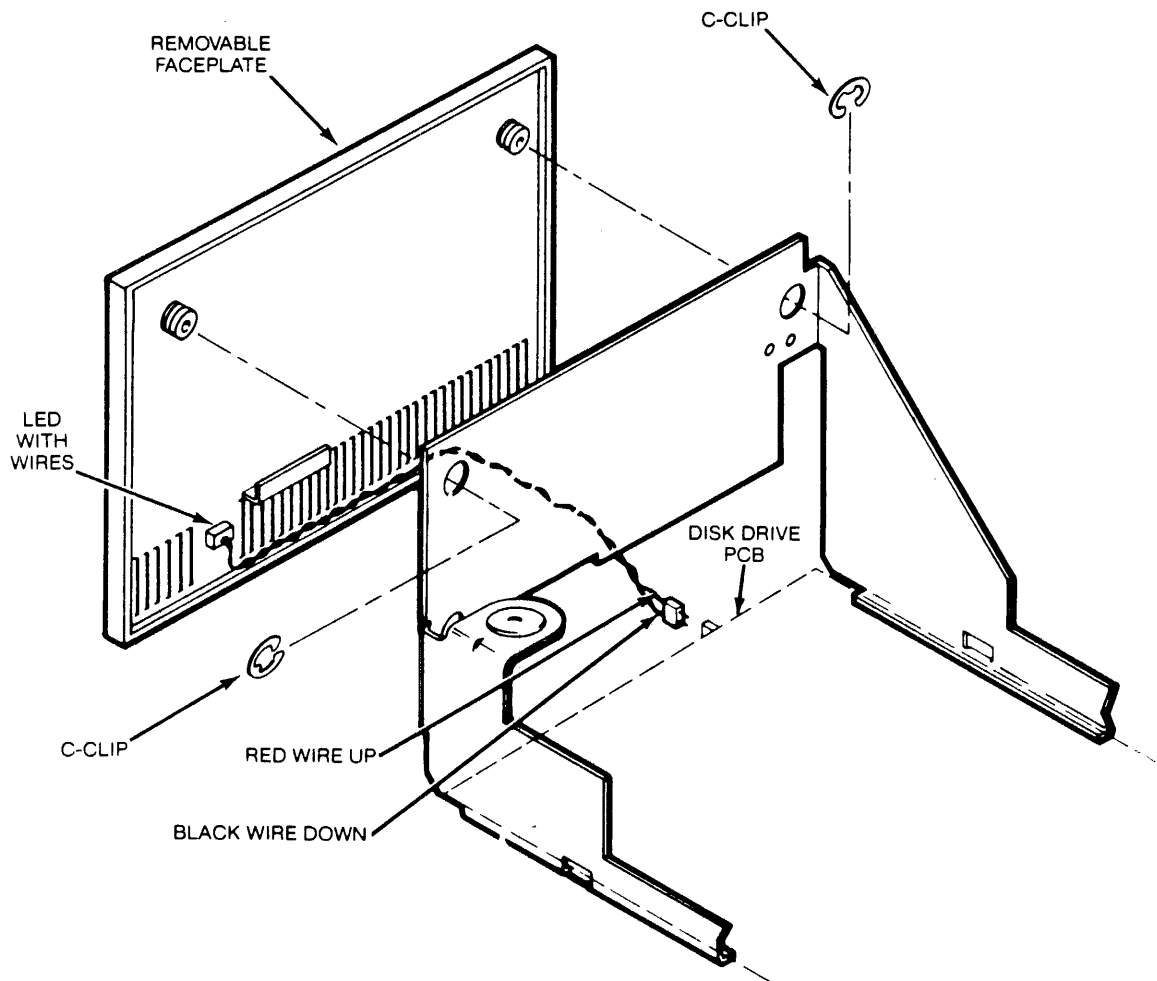**Figure 19**
Removable Faceplate

6.2   Mounting Orientation

The XT-1000/2000 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.

6.3   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, are identical to industry standard floppy drives. (Refer to Figure 20, page 31).

****

CAUTION

The casting is very close to the frame mounting holes in some locations. Mounting screw lengths must be chosen such that no more than .125" of the screw is available to enter the frame mounting hole. The torque applied to the mounting screws should be at least 9 inch-pounds but to avoid stripping the threads, the maximum torque applied shall not exceed 12 inch-pounds.

****

6.4   Physical Dimensions

The XT-1000/2000 overall height, width, and depth along with other key dimensions are shown. (Refer to Figure 20, page 31 and Figure 21, page 32). As in the case of the mounting holes, the dimensions are identical to the industry standard minifloppy drives, thus allowing a direct physical replacement.

6.5   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.
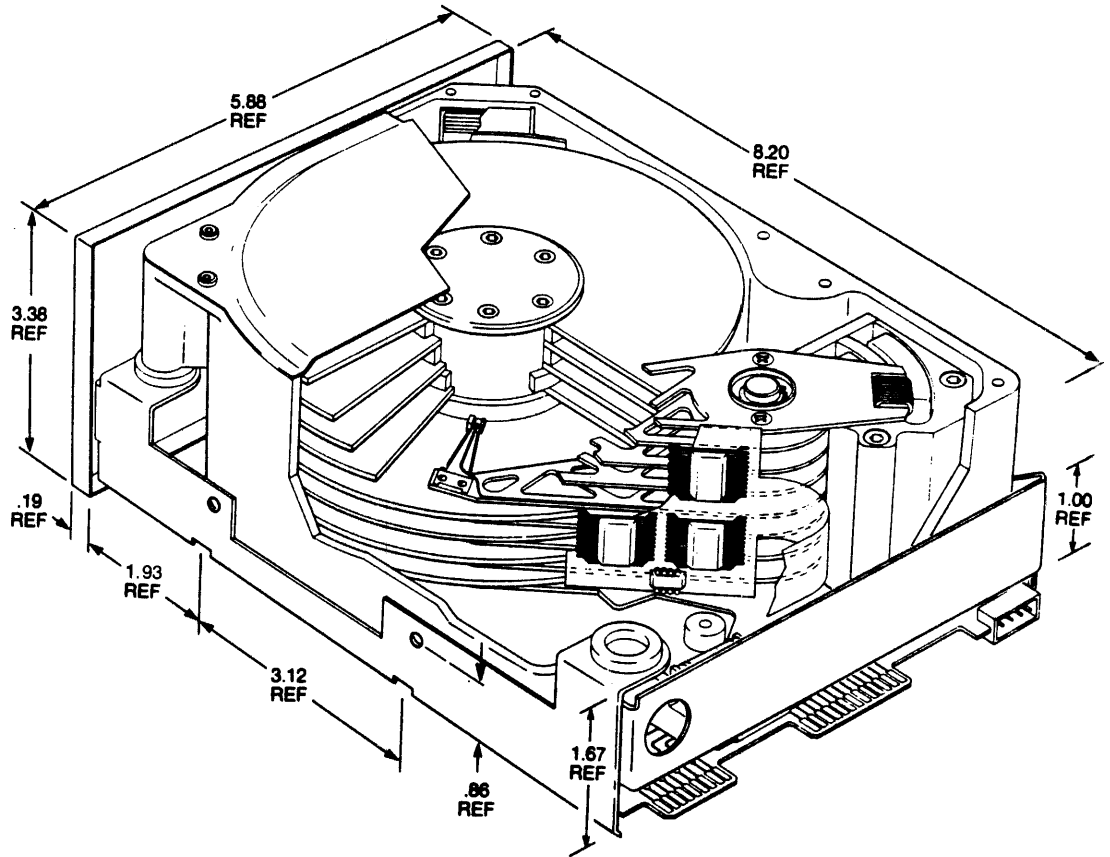
Figure 20
XT-1000/2000 Mechanical Outline and
Mounting Hole Location

NOTE: PROTRUSION OF SCREWS
THROUGH SIDE HOLES IS
LIMITED TO 0.125 INCH

.06 ± .01

3.38
±.01

2.75
±.02

3.25
± .01

.86
±.02

.06
±.01

.19 ± .01

1.93 ± .02

3.12 ± .02

8.20 MAX

NOTE: MOUNTING SCREWS
SHALL NOT BE
TORQUED TO GREATER
THAN 12 IN. -LB

MOUNTING HOLES
4 ON BOTTOM ,
2 ON EACH SIDE
6-32 UNC.

5.88
±.01

5.75
±.02

5.50
±.02

3.12 ± .02

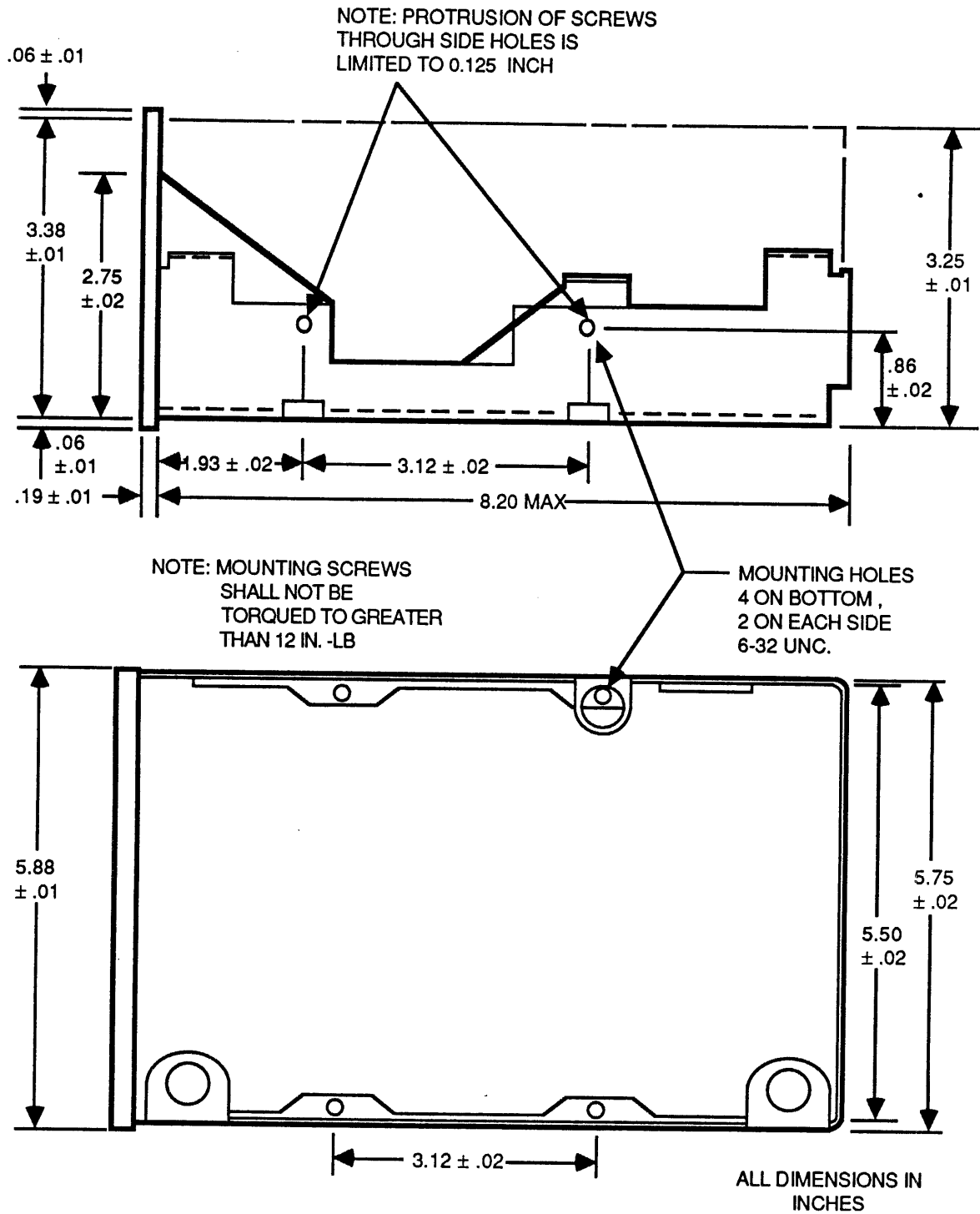ALL DIMENSIONS IN
INCHES

Figure 21
XT-1000/2000 Mechanical Outline
Bottom and Side Views

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 MFM bytes from index for each defect.

The maximum allowable number of defects per drive shall not exceed an average of ten (10) per disk surface. Cylinder 0 is certified to be defect-free.

The maximum number of defects per drive are listed in Table 5.

MODEL	NO. OF DISKS	NO. OF DATA SURFACES	MAXIMUM NO. OF DEFECTS
XT-1085	5	8	80
XT-1105	6	11	110
XT-1140	8	15	140
XT-2190	8	15	190
XT-1120R	5	8	120
XT-1140R	8	15	240

Table 5
Allowable Defects/Drive

In addition, the following limit will also be met:

The maximum number of defects per surface shall not exceed thirty-two (32).

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

7.1   Defect Map Format (for maps written on drives)

(Refer to Figure 22, page 35).

The format Maxtor uses for the defect maps written on the drive is as follows:

1) The format of the defect map information is as shown in Figure 22.
2) The defect map is written on the drive using an Adaptec controller format.
3) The defect map is written on all sectors of cylinder 0, maximum cylinder -8, maximum cylinder and maximum cylinder +1.

For clarification, the applicable cylinder numbers of XT-1000/2000 drives are listed in Table 6.

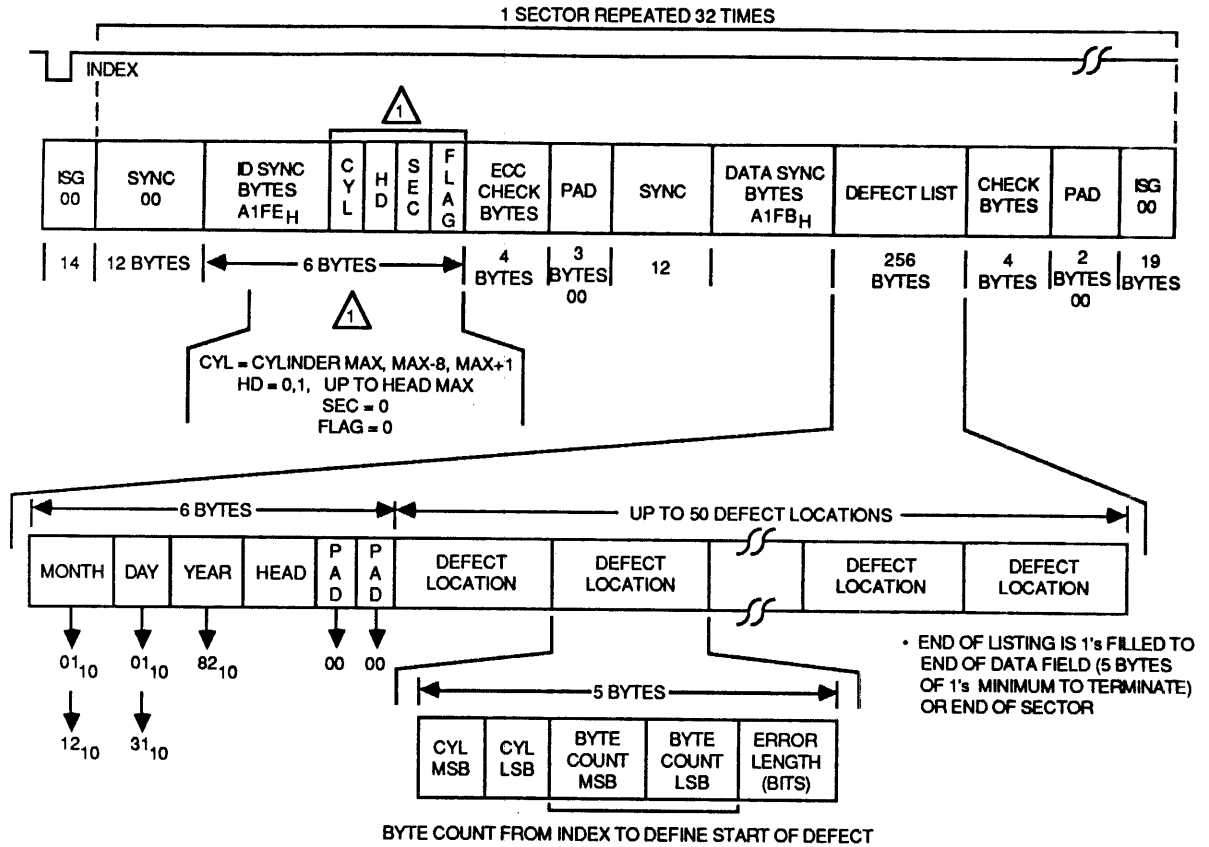| PRODUCT	MAXIMUM CYLINDER - 8	MAXIMUM CYLINDER	MAXIMUM CYLINDER + 1
XT-1085	1015	1023	1024
XT-1105	909	917	918
XT-1140	909	917	918
XT-2190	1216	1224	1225
XT-1120R	1015	1023	1024
XT-1140R	1015	1023	1024

Table 6
Defect Map Locations

Additional defect maps written on the drives are listed in Table 7.

FORMAT	LOCATION
ADAPTEC SINGLE HEAD	HEAD Ø, TRACK 919
WESTERN DIGITAL 800	HEAD 2, TRACK 919; HEAD Ø, TRACK 915
WESTERN DIGITAL 2010	HEAD 1, TRACK 919
WESTERN DIGITAL 1010	HEAD Ø & 1, TRACKS 1, 908, 916, 1214, 1222

NOTE: FOR FORMAT DETAILS PLEASE REFER TO THE ADAPTEC OR
       WESTERN DIGITAL MANUALS

Table 7
Defect Map Locations

Figure 22
MFM Defect Map Format

The disk drives defect map information resides on each sector of Cylinder 0, Maximum Cylinder -8, Maximum Cylinder, and Maximum Cylinder +1, as allowed by the Adaptec format.

The defects for each surface are written on that surface.

The format for the data field portion of each sector is 256 bytes.

Defect locations are 5 bytes long and the bytes are defined above.

The end of the defect list for each surface is indicated by 5 bytes of ones in the defect location field or the end of the sector.

The Byte count is the number of bytes from INDEX.

8.0   XT-1000/2000 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. (Refer to Figure 23 and Table 8). The standard drive is shipped as Drive 1.
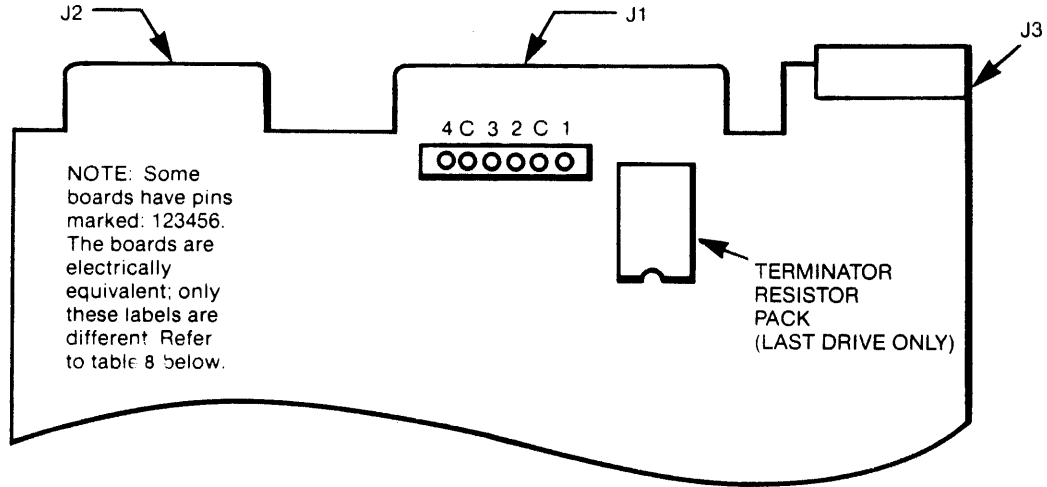
J2 ———   ———— J1   J3

4 C 3 2 C 1

NOTE: Some boards have pins marked: 123456. The boards are electrically equivalent; only these labels are different. Refer to table 8 below.

TERMINATOR
RESISTOR
PACK
(LAST DRIVE ONLY)

Figure 23
Drive Select Jumper Location

BOARD LABEL	4C32C1	123456
FUNCTION	JUMPER BLOCK PIN NUMBERS	JUMPER BLOCK PIN NUMBERS
DRIVE SELECT 0	1.C	5,6
DRIVE SELECT 1	2.C	4,5
DRIVE SELECT 2	3.C	2,3
DRIVE SELECT 3	4.C	1,2

Table 8
Drive Select Jumper Options

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 ST506/412 format, is a format commonly used on lower performance disk drives. (Refer to Figure 24). Its 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 sectored 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).
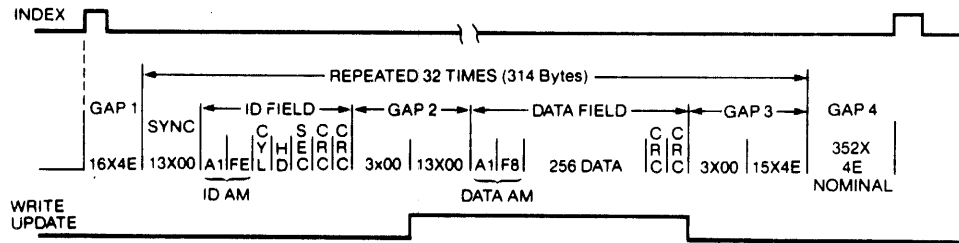
NOTES
1 NOMINAL TRACK CAPACITY = 10416 BYTES UNFORMATTED
2 TOTAL DATA BYTES/TRACK = 256 x 32 = 8,192
3 SECTOR INTERLEAVE FACTOR IS 4. SEQUENTIAL ID FIELDS ARE SECTOR NUMBERED 0, 8, 16, 24, 1, 9, 17, 25, 2, 10, 18, 26,...ETC.
4 DATA FIELDS CONTAIN THE BIT PATTERN 0000 AS SHIPPED
5 CRC FIRE CODE = $x^{16} + x^{12} + x^5 + 1$
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 IS CYLINDER 2^8 BIT
8 BIT 5 OF HEAD BYTE IS CYLINDER 2^9 BIT
9 BIT 4 OF HEAD BYTE IS RESERVED FOR CYLINDER 2^{10} BIT
10 BIT 0-3 OF HEAD BYTE ARE HEAD 2^0 TO HEAD 2^3 RESPECTIVELY
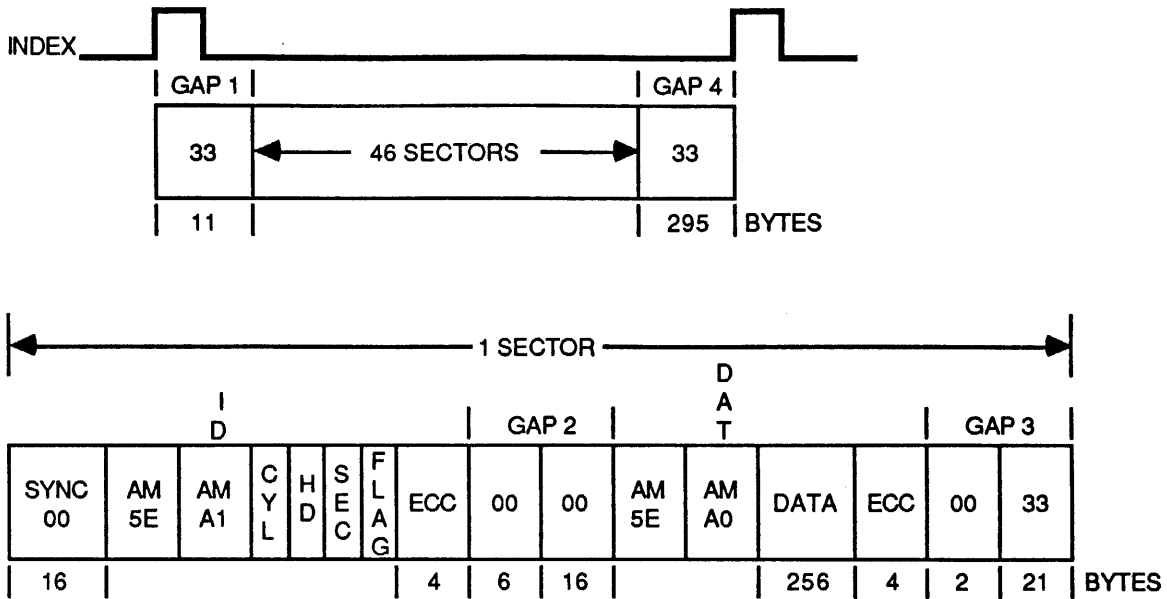
Figure 24

ST506/412 Format

Figure 25
ST506/412 Format (RLL)

9.3 XT-1000/2000 Alternate Track Format (MFM only)

An alternate format is available on the XT-1000/2000. (Refer to Figure 26). 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-1000/2000 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.
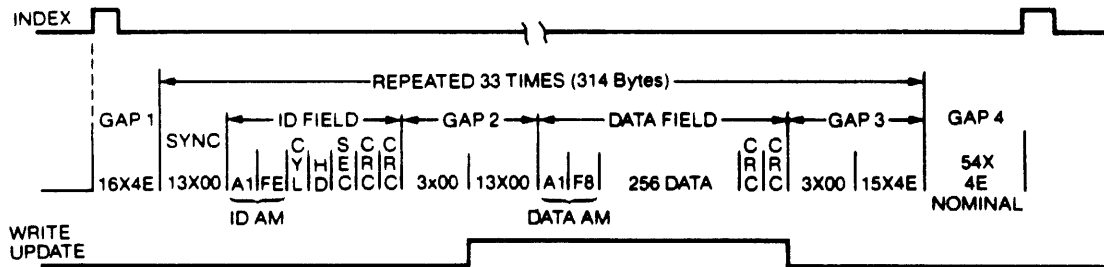
NOTES: 1. NOMINAL TRACK CAPACITY = 10416 BYTES UNFORMATTED
2. TOTAL DATA BYTES/TRACK = 256 x 33 = 8,448
3. DATA FIELDS CONTAIN THE BIT PATTERN 0000 AS SHIPPED
4. CRC FIRE CODE = $x^{16} + x^{12} + x^5 + 1$
5. BIT 7 OF HEAD BYTE ID FIELD EQUALS 1 IN A DEFECTIVE SECTOR (CYLINDER 0 IS ERROR FREE)
6. BIT 6 OF HEAD BYTE IS CYLINDER 2^8
7. BIT 5 OF HEAD BYTE IS CYLINDER 2^9 BIT
8. BIT 4 OF HEAD BYTE IS RESERVED FOR CYLINDER 2^{10} BIT
9. BIT 0-3 OF HEAD BYTE ARE HEAD 2^0 TO HEAD 2^3 RESPECTIVELY

Figure 26
XT-1000/2000 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 for MFM. 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. For RLL the first byte is a 5E followed by A1 for address mark, or an AØ 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. (Refer to Figure 27). 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.
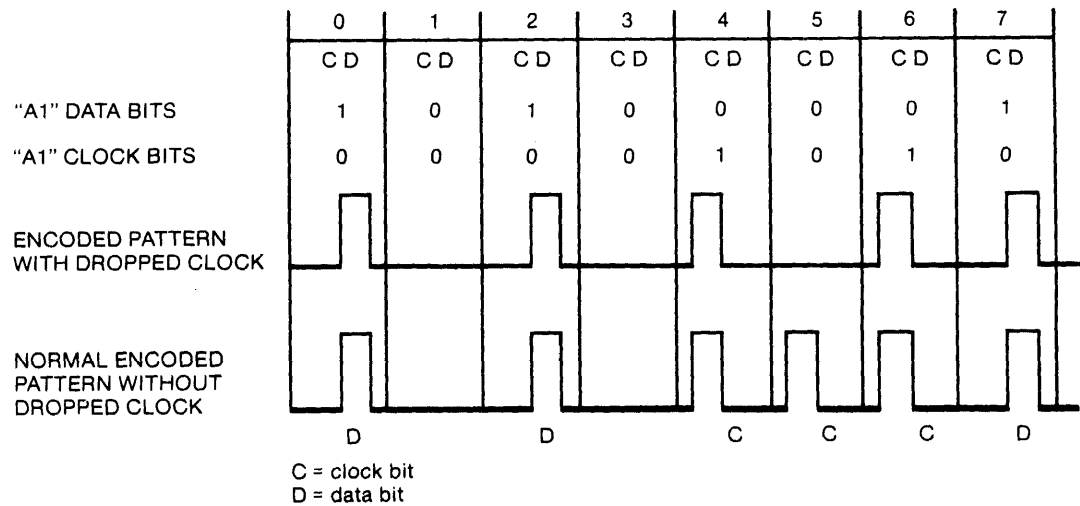
	0	1	2	3	4	5	6	7
	C D	C D	C D	C D	C D	C D	C D	C D
"A1" DATA BITS	1	0	1	0	0	0	0	1
"A1" CLOCK BITS	0	0	0	0	1	0	1	0

ENCODED PATTERN WITH DROPPED CLOCK

NORMAL ENCODED PATTERN WITHOUT DROPPED CLOCK

D   D   C   C   C   D

C = clock bit
D = data bit

Figure 27
"A1" Address Mark Byte

9.5 Gap Length Calculations MFM*

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.

*Same information applies to RLL, however, gap lengths differ. (Refer to Figure 25).

9.6 Sector Interleaving

The ST506/412 format normally uses an interleave factor of 4 for MFM and 3 for RLL;l 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.