

**MK-50FB SERIES
5.25-INCH FIXED DISK DRIVES
OEM MANUAL**

**TOSHIBA AMERICA, INC.
DISK PRODUCTS DIVISION**

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SECTION 1

INTRODUCTION

1.1 PURPOSE OF MANUAL

The purpose of this manual is to describe the MK-50FB Series 5.25-inch fixed disk drives to the level of detail required for product integration.

System designers planning to develop a custom controller and others who require additional product information should refer to the MK-50FB Series Product Specification for additional product and interfacing details.

1.2 RELATED DOCUMENTS

Detailed product and interfacing information is given in the MK-50FB Series Product Specification, document number 71Y101361.

Table 1 lists OEM Manuals that are available for other Toshiba disk products. The MK-50FB is included to indicate how its storage capacity compares to other disk products available from Toshiba.

Toshiba Product	Media Size	Storage Technology	Unformatted Capacity (MB)	Type Of Interface	Document Number
MK-134FA	3.5	Winchester	23 to 53	ST506/412	DW32-01-012
MK-50FB	5.25	Winchester	43 to 86	ST506/412	DW54-01-006
MK-150FA	5.25	Winchester	86 to 173	ESDI	DW54-01-007
MK-250FA	5.25	Winchester	382.5	ESDI	DW54-01-014
MK-180FB	8.0	Winchester	83 to 166	SMD	DW80-01-008
MK-280FC	8.0	Winchester	340 to 510	HSMD	DW80-01-009
MK-388FC	8.0	Winchester	720	HSMD	DW80-01-013

Table 1 — Related Documents

Contact your nearest Toshiba Disk Products Division Sales Representative to order a manual or obtain more detailed technical information.

1.3 GENERAL DESCRIPTION

The MK-50FB Series is a family of 5.25-inch Winchester disk drives designed primarily to be incorporated into systems supporting multi-user and multi-tasking applications. Three models comprise the MK-50FB Series: MK-53FB, MK-54FB and MK-56FB.

An industry standard ST506/412 interface provides compatibility with other 5.25-inch Winchester storage products and commercially available controllers. The MK-50FB also complies with the ST506/412 size, mounting and power requirements.

When used with conventional ST506/412 controllers, the MK-50FB Series offers capacities of 43, 61 or 87 megabytes.

When used with a controller supporting 2,7 (RLL) coded data, these capacities are increased to 65, 91 and 130 megabytes, respectively, without changes in the drive. Because of the manner in which data is recorded, 2,7 (RLL) encoding increases bits per inch without affecting the number of flux changes per inch.

The Head Disk Assembly (HDA) is enclosed in a die cast aluminum base plate and shroud and incorporates numerous safety features to maximize reliability:

The base plate and shroud assembly provides mechanical mounting and EMI (Electronic Magnetic Interference) shielding for the heads, disks and actuator.

The sealed assembly incorporates an air recirculatory system and a 0.3 micron lifetime filter to ensure a contamination-free environment and even thermal distribution.

A barometric filter in the HDA provides ambient pressure equalization.

When power is removed, a fail-safe system automatically returns the heads to a dedicated landing zone and a solenoid automatically locks the carriage in this location. This prevents head and media damage during transit.

Use of a center stack servo system improves head positioning accuracy across the full environmental operating range and allows servo writing to be performed with the disk stack mounted in the drive.

Careful planning in regard to the location of components on the circuit card, especially those with electrical noise potential, contributes to very low levels of read channel noise and enhances data recovery.

To further reduce read channel noise, DC voltages are filtered before being used on the read channel.

Extensive use of VLSI minimizes the number of components and optimizes MTBF (Mean Time Between Failures).

SECTION 2

SPECIFICATIONS

2.1 STORAGE CAPABILITY

STORAGE CAPACITY	MK-53FB	MK-54FB	MK-56FB
Unformatted Capacity - MFM (10,416 bytes per track)	43.2MB	60.5MB	86.5MB
Unformatted Capacity - 2,7 (RLL) (15,624 bytes per track)	64.8MB	90.7MB	129.8MB
Number of Disks	3	4	6
Number of Data Read/Write Heads	5	7	10

Table 2 — Storage Capability

2.2 FUNCTIONAL SPECIFICATIONS

Specifications are the same for both models			
Number of Cylinders	830		
Tracks per Inch	900 TPI		
Bits per Inch	9,383 MFM/14,075 (RLL)		
Flux Changes per Inch	9,383 (MFM or RLL)		
MFM Data Transfer Rate	5.0 Megabits per Second		
2,7 (RLL) Data Transfer Rate	7.5 Megabits per Second		
Recovery Time: Head Switch	13 Microseconds		
Write to Read	8 Microseconds		
Seek Time:* (including step pulse and settling)			
Track-to-Track	6 Milliseconds		
Average	25 Milliseconds		
Full Stroke	45 Milliseconds		
* As shown, average and maximum seek times will vary if very long step pulse periods are used.			
STEP PULSE PERIOD IN MICROSECONDS	SEEK TIME IN MILLISECONDS		
	AVERAGE	MAXIMUM	
40	26	50	
50	28	57	
75	33	75	
100	38	95	
150	51	135	
200	63	177	
Start Time	20 Seconds Typical - 30 Seconds Maximum		
Stop Time	20 Seconds Typical - 30 Seconds Maximum		
Rotational Speed:	3,600 RPM ± 1%		
Average Latency Time	8.33 Milliseconds		
Maximum Latency Time	17.10 Milliseconds		

Table 3 — Functional Specifications

2.3 ENVIRONMENTAL SPECIFICATIONS

Specifications are the same for all models	
<p>Operating Environment:</p> <p style="padding-left: 20px;">Ambient Temperature</p> <p style="padding-left: 20px;">Temperature Gradient</p> <p style="padding-left: 20px;">Relative Humidity</p> <p style="padding-left: 20px;">Altitude</p> <p style="padding-left: 20px;">Vibration (all axis)</p> <p style="padding-left: 20px;">Shock (recoverable errors allowed)</p> <p>Cooling:</p> <p style="padding-left: 20px;">Convection Cooling</p>	<p>41° to 113° F (5° to 45° C)</p> <p>27° F per Hour (15° C)</p> <p>20 to 80%, No Condensation</p> <p>-984 to 9,842 Feet (-300 to 3,000 Meters)</p> <p>0.25 G Peak at 5 to 200 Hz</p> <p>10.0 G Peak*</p> <p>Any enclosure (see Section 3) must allow the drive to operate within specified environmental limits.</p>
<p>Non-Operating (Unpacked) Environment:</p> <p style="padding-left: 20px;">Ambient Temperature</p> <p style="padding-left: 20px;">Temperature Gradient</p> <p style="padding-left: 20px;">Relative Humidity</p> <p style="padding-left: 20px;">Altitude</p> <p style="padding-left: 20px;">Vibration</p> <p style="padding-left: 20px;">Shock</p>	<p>14° to 122° F (-10° to 50° C)</p> <p>27° F per Hour (15° C)</p> <p>10 to 80%, No Condensation</p> <p>-984 to 9,842 Feet (-300 to 3,000 Meters)</p> <p>0.5 G/0.04 Inch (1.0 mm) at 5 to 200 Hz</p> <p>40.0 G Peak*</p>
<p>Storage (Packed) Environment:</p> <p style="padding-left: 20px;">Ambient Temperature</p> <p style="padding-left: 20px;">Temperature Gradient</p> <p style="padding-left: 20px;">Relative Humidity</p> <p style="padding-left: 20px;">Altitude</p> <p style="padding-left: 20px;">Vibration</p> <p style="padding-left: 20px;">Shock (maximum free drop)</p>	<p>-40° to 140°F (-40° to 60° C)</p> <p>27° F per Hour (15° C)</p> <p>20 to 80%, No Condensation</p> <p>-1,312 to 49,212 Feet (-400 to 15,000 Meters)</p> <p>2 G/0.1 Inch (2.5 mm) at 5 to 400 Hz</p> <p>27 Inches (0.7 Meter)</p>
<p>* When fixed to a rigid structure (excluding resonances) and when an 11 millisecond half-sine-wave impulse is applied to the rigid structure.</p>	

Table 4 — Environmental Specifications

2.4 RELIABILITY CHARACTERISTICS

CHARACTERISTIC	MK-53FB	MK-54FB	MK-56FB
Media Defects:			
Maximum Defects per Surface	20	20	20
Maximum Defects per Drive	50	70	100

At the time of factory shipment, Track 00, Heads 0 and 1 have no media defects and no defect is greater than 11 bits in length.

A defect map, identifying the location of known media defects by cylinder, head and number of bytes from Index for both MFM and 2,7 (RLL), is attached to the drive.

Error Rates:

Recoverable
Unrecoverable
Seek

1 in 10^{10} Bits
1 in 10^{12} Bits
1 in 10^6 Seeks

Preventive Maintenance

Not Required

Mean Time Between Failures (MTBF)*

30,000 Hours

Mean Time To Repair (MTTR)

Less than 0.5 hour

Service Life

5 Years

*A failure is defined as the drive's inability to perform to specification when operated within the defined limits. Exclusions are shipping and handling damage and operator, user, service, environmental or system induced faults.

Table 5 — Reliability Characteristics

2.5 POWER REQUIREMENTS

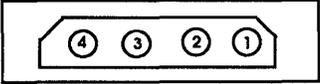
Requirements are the same for all models											
<p>+5 VDC \pm 5%: Current</p> <p>Allowable Ripple/Noise</p>	<p>1.3 Amperes Maximum 0.9 Amperes Typical 100 Millivolts Peak-to- Peak</p>										
<p>+12 VDC \pm5%: Power-On Current</p> <p>Seek Operation Current</p> <p>On-Track Current</p> <p>Allowable Ripple/Noise</p>	<p>3.8 Amperes Maximum 3.3 Amperes Average 4.2 Amperes Maximum 2.7 Amperes Average 1.5 Amperes Average 100 Millivolts Peak-to-Peak</p>										
<p>DC Power Connector:</p>	<p>AMP 480424-0 with pin (strip) 3500784 or pin (loose) 61173-4, or equivalent.</p>										
<p>Power Plug Pin Assignment:</p>  <p>(as viewed from rear of drive)</p>	<table border="1"> <thead> <tr> <th>Pin Number</th> <th>Assignment</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>+12 VDC</td> </tr> <tr> <td>2</td> <td>+12 VDC Return</td> </tr> <tr> <td>3</td> <td>+ 5 VDC Return</td> </tr> <tr> <td>4</td> <td>+ 5 VDC</td> </tr> </tbody> </table>	Pin Number	Assignment	1	+12 VDC	2	+12 VDC Return	3	+ 5 VDC Return	4	+ 5 VDC
Pin Number	Assignment										
1	+12 VDC										
2	+12 VDC Return										
3	+ 5 VDC Return										
4	+ 5 VDC										

Table 6 — Power Requirements

2.6 PHYSICAL DIMENSIONS, WEIGHT AND MOUNTING

Refer to the following diagram. Nominal dimensions and weight of the MK-50FB are:

Height:	3.25 ± 0.04 Inches (82.5 ± 1 Millimeter)
Width:	5.75 ± 0.04 Inches (146.1 ± 1 Millimeter)
Depth:	8.0 ± 0.04 Inches (203.2 ± 3 Millimeters)
Weight:	6.6 Pounds (3 Kilograms)

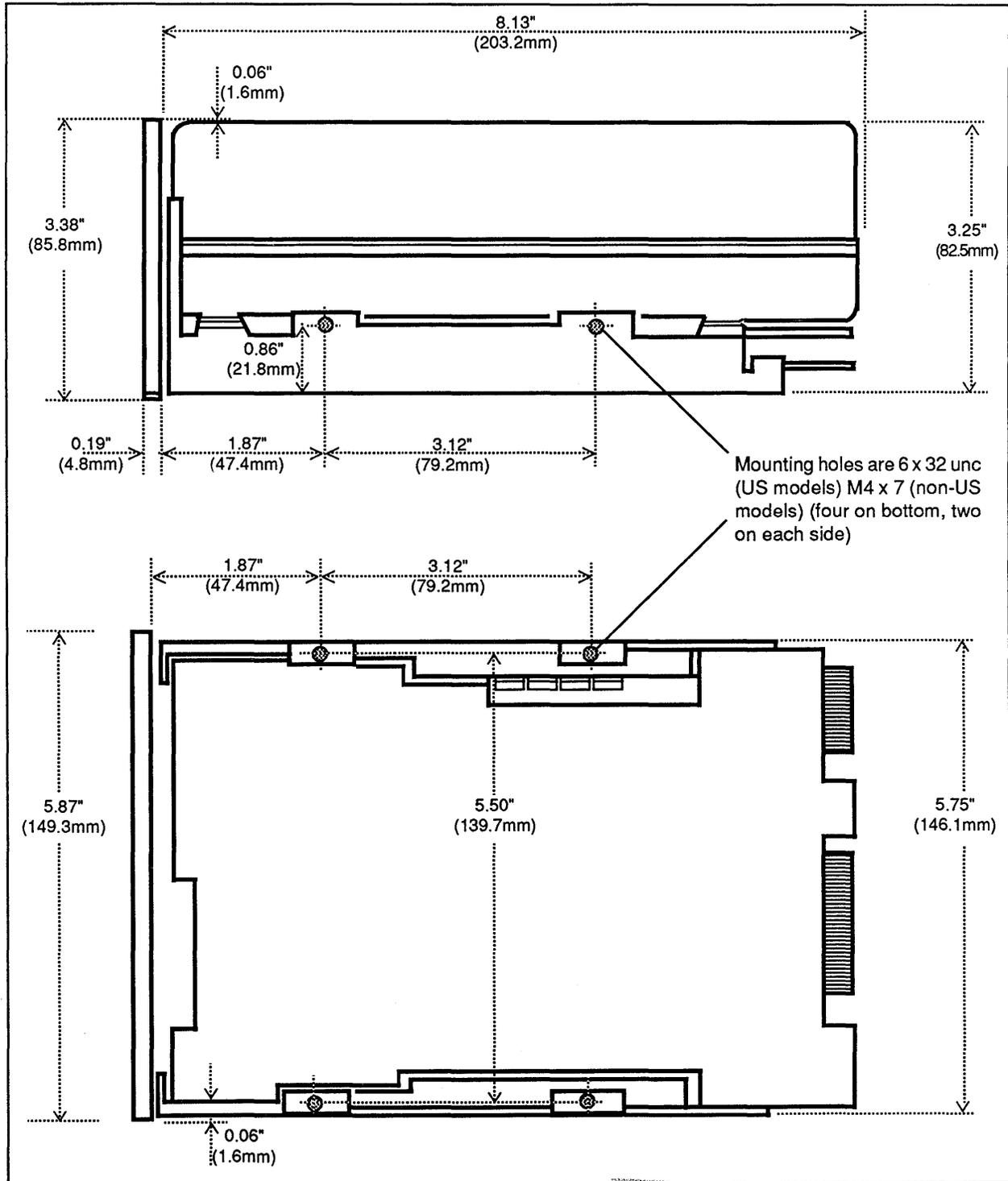


Figure 1 — MK-50FB Dimensions and Mounting Holes

SECTION 3

INSTALLATION

3.1 MOUNTING ORIENTATION

Location of the mounting holes is shown in Figure 1. Recommended mounting orientations are shown in Figure 2.

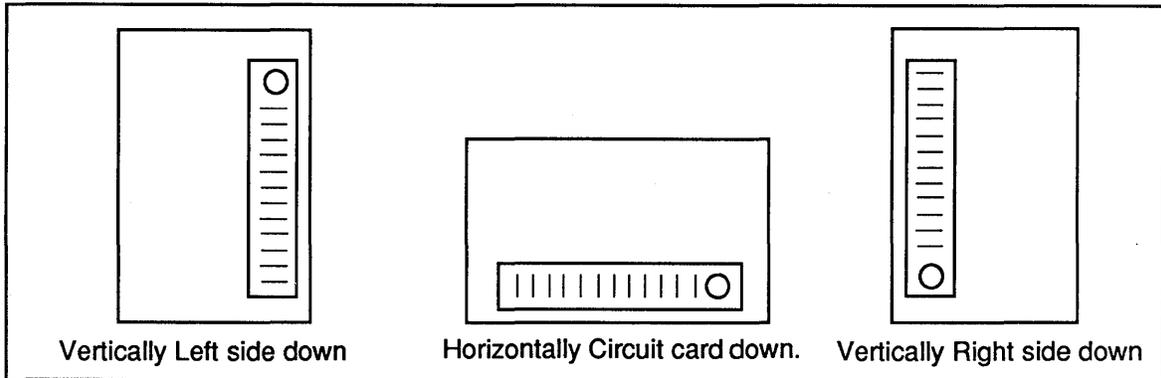


Figure 2 — Mounting Orientation

3.2 COOLING AND DISK DRIVE ENCLOSURE

Convection cooling is used. It is recommended that cabinetry design allow for air flow. The disk enclosure must be designed to maintain an even temperature within the drive's environmental limits and throughout the drive's various components. Minimum clearance requirements for a disk enclosure are shown in Figure 3.

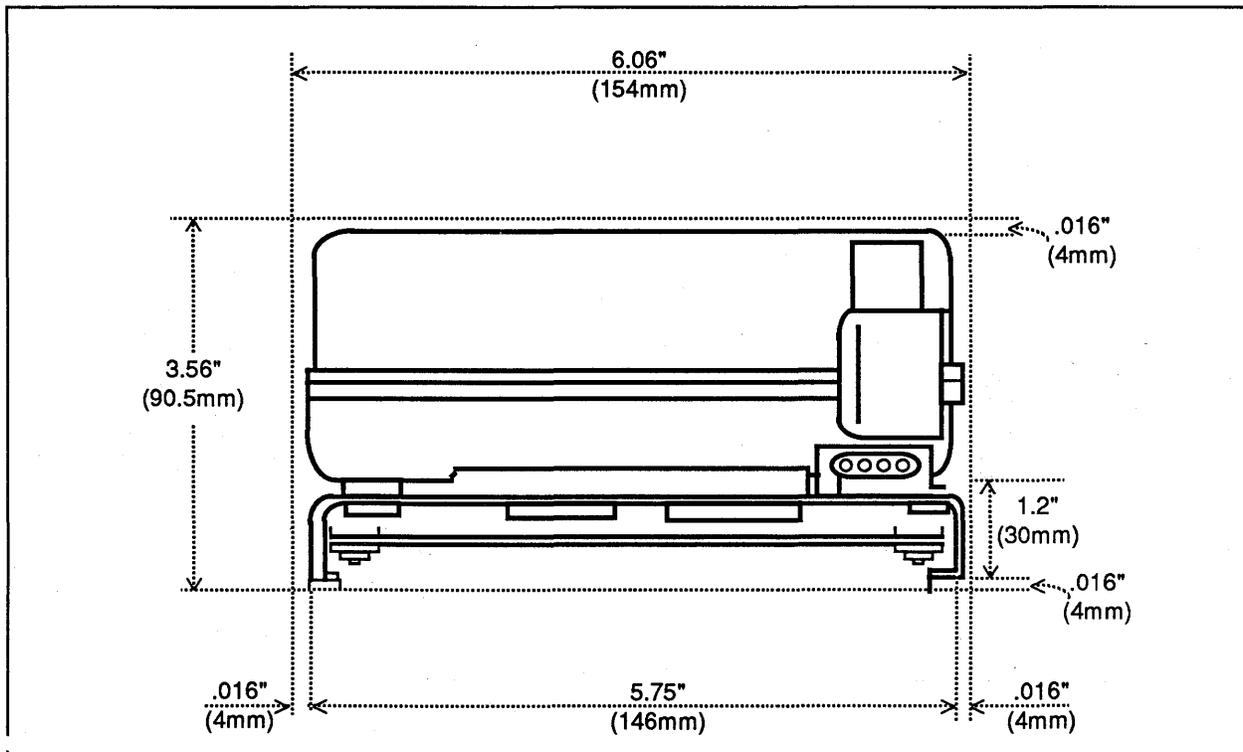


Figure 3 — Clearance Requirements

3.3 SWITCH AND JUMPER FUNCTIONS

All switches and jumpers must be set **before** applying power to the drive. Refer to Figure 4 or 5 (depending on PCB version) for location of jumpers and switches.

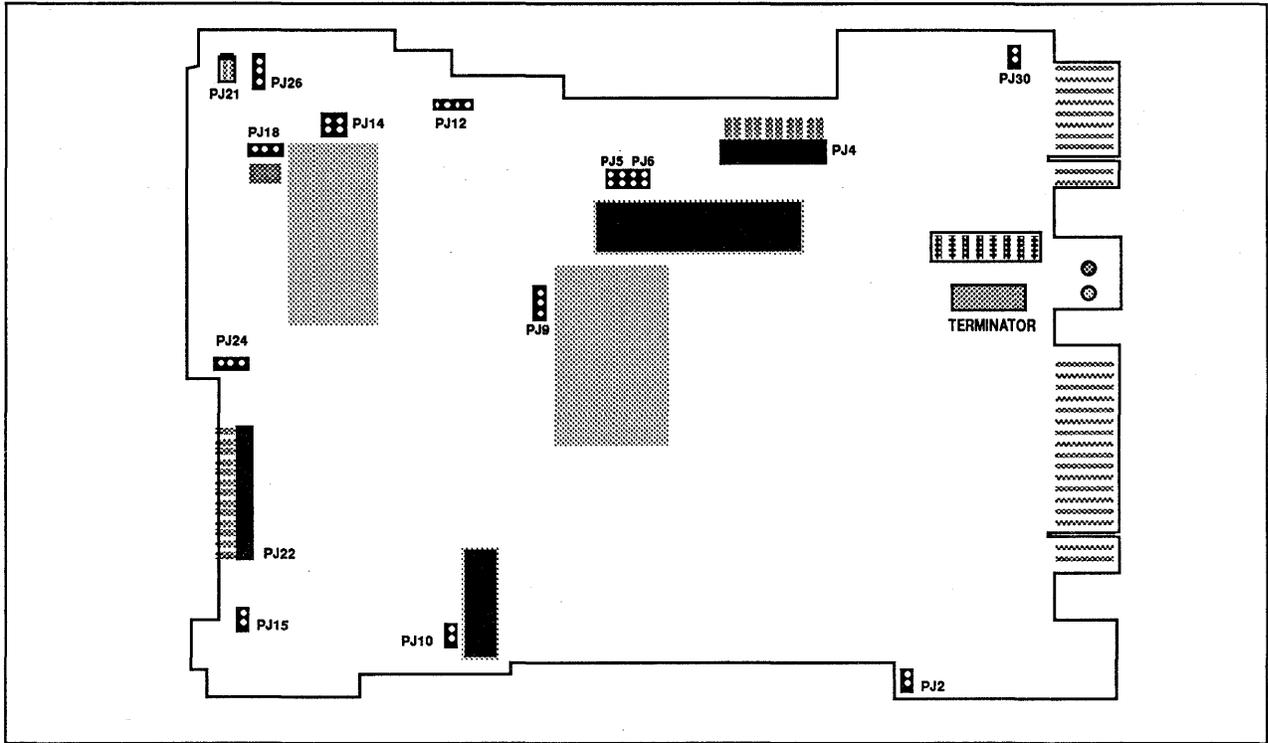


Figure 4 — PCB Board (F5A-A4)

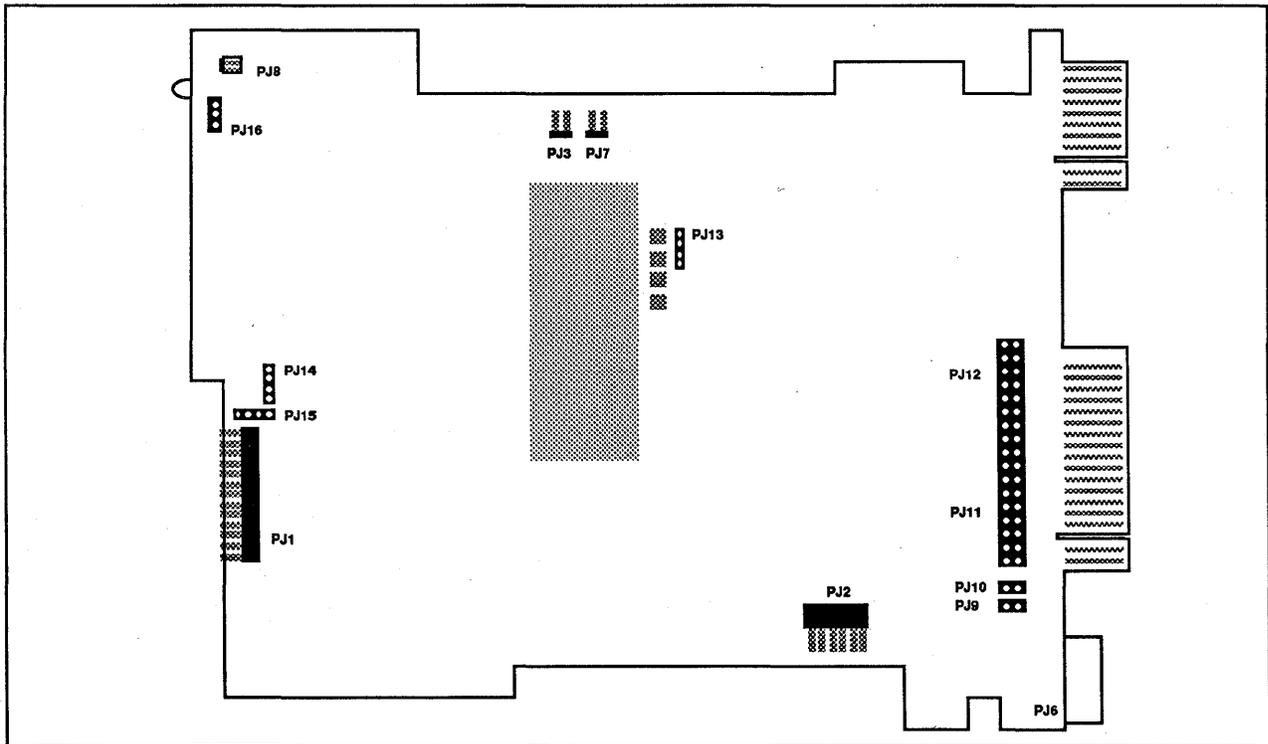


Figure 5 — PCB Board (F5A-Z4)

DIP switch and jumper functions are shown in Figures 6 - 8.

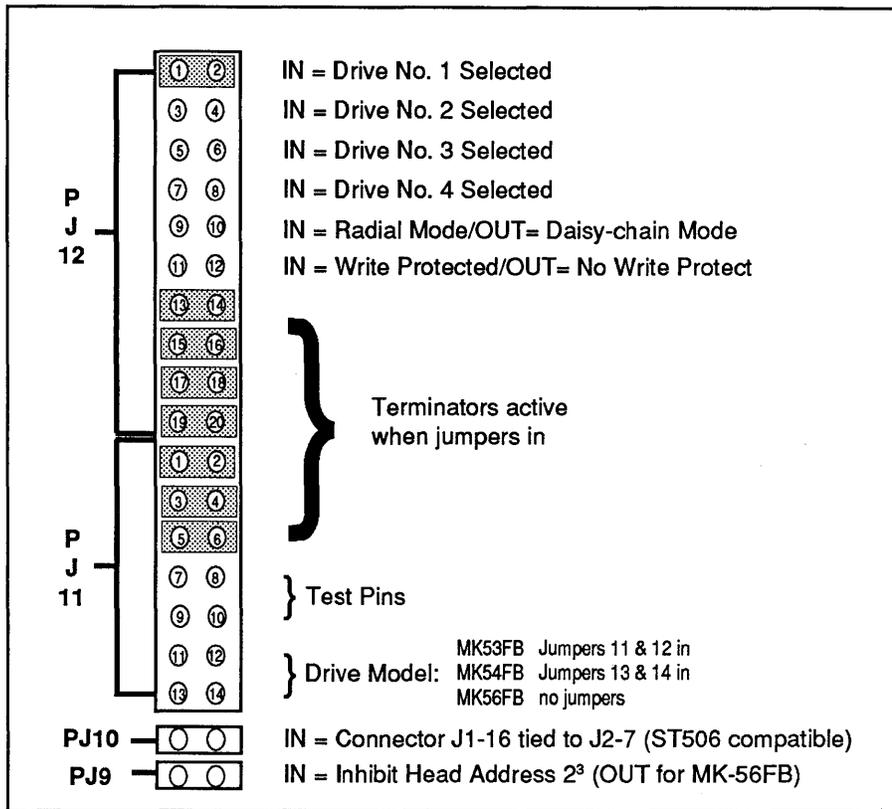


Figure 6 — Jumper Settings (for F5A-Z4 PCB)

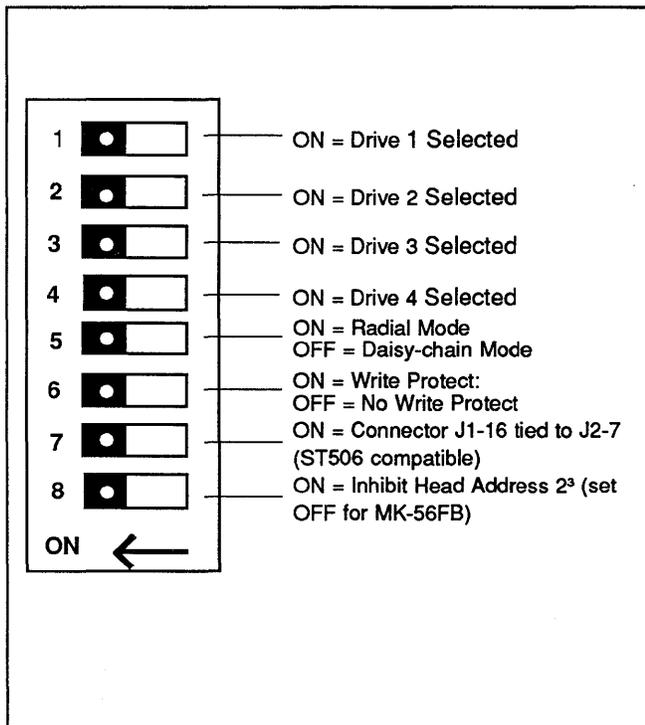


Figure 7 — Switch Settings (for F5A-A4 PCB)

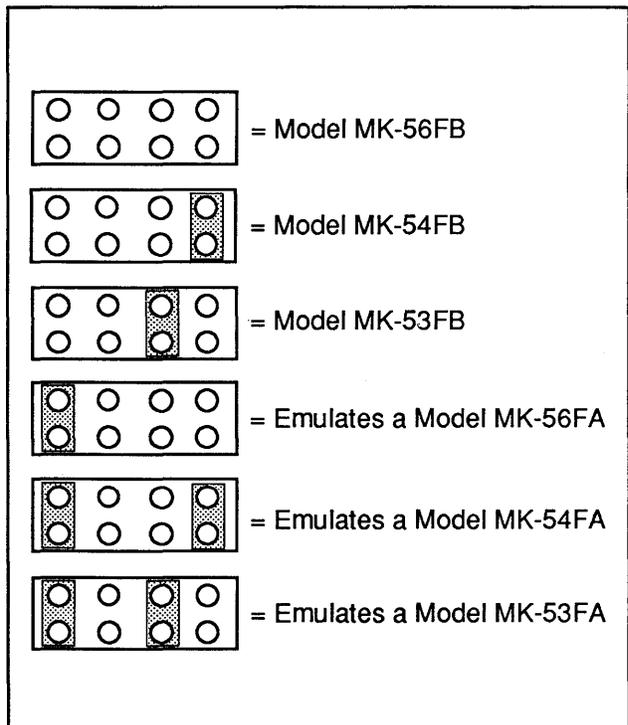


Figure 8 — PJ5/6 Settings (for F5A-A4 PCB)

SECTION 4

INTERFACE

4.1 CONTROL CABLE

The daisy-chained Control Cable consists of 17 matched pairs (34-conductors).

The 34-position connector recommended for the Control Cable is AMP part number 88373-3, or equivalent.

Maximum cable length is 20 feet (6 meters).

Control Cable signals are TTL compatible.

Control Cable signals, with the exception of the four DRIVE SELECT lines, are ignored by the drive until it is selected.

Pin-16 on the Control Cable (J1-16) is connected to pin-7 on the Data Cable (J2-7) when the drive is set in ST506 mode (see Section 3.3).

Selection of heads 8 and 9 may be inhibited by appropriate switch/jumper options (see Section 3.3).

Pin assignments for the Control Cable are given on Page 4-2.

In a daisy-chain configuration **only** the terminators on the last drive in the chain must be activated (see Section 3.3). Depending on the PCB board, the 16-pin terminator chip or terminator jumpers (located on an IC socket on the main circuit card) must be installed **only** on the last drive.

4.2 DATA CABLE

The star-configured Data Cable consists of 10 matched pairs (20-conductors).

The 20-position connector recommended for the Data Cable is AMP part number 88373-6, or equivalent.

Maximum cable length is 20 feet (6 meters).

Data Cable signals are differential signal pairs, with the exception of DRIVE SELECTED which is TTL compatible.

Data Cable signals are enabled at all times, regardless of the drive's selected status.

Pin assignments for the Data Cable are given on Page 3-2.

Pin-7 on the Data Cable (J2-7) is connected to Pin-16 on the Control Cable (J1-16) when the drive is set in ST506 mode (see Section 3.3).

4.3 CONTROL CABLE PIN ASSIGNMENTS

SIGNAL NAME	PIN NUMBERS		MK-50FB
	SIGNAL	GROUND	<small>Input means input to drive. Output means output to drive.</small>
HEAD SELECT 2 ³ *	2	1	Input
HEAD SELECT 2 ²	4	3	Input
WRITE GATE	6	5	Input
SEEK COMPLETE	8	7	Output
TRACK 00	10	9	Output
WRITE FAULT	12	11	Output
HEAD SELECT 2 ⁰	14	13	Input
RESERVED**	16	15	N/A
HEAD SELECT 2 ¹	18	17	Input
INDEX	20	19	Output
READY	22	21	Output
STEP	24	23	Input
DRIVE SELECT 1	26	25	Input
DRIVE SELECT 2	28	27	Input
DRIVE SELECT 3	30	29	Input
DRIVE SELECT 4	32	31	Input
DIRECTION IN	34	33	Input

* Head Select 2³ can be inhibited (see Section 3.3).
 ** Pin-16 can be jumpered to pin-7 in the Data Cable, for ST506 compatibility (see Section 3.3).

Table 7 — Control Cable Pin Assignments

4.4 DATA CABLE PIN ASSIGNMENTS

SIGNAL NAME	PIN NUMBERS		MK-50FB
	SIGNAL	GROUND	<i>Input means input to drive. Output means output to drive.</i>
DRIVE SELECTED	1	2	Output
RESERVED	3	4	N/A
RESERVED	5	6	N/A
RESERVED*	7	8	N/A
NOT CONNECTED	9	10	N/A
GROUND	11	12	N/A
+WRITE DATA	13	N/A	Input
-WRITE DATA	14	N/A	Input
GROUND	15	16	N/A
+ READ DATA	17	N/A	Output
- READ DATA	18	N/A	Output
GROUND	19	20	N/A

* Pin-7 can be jumpered to pin-16 in the Control Cable, for ST506 compatibility (see Section 3.3).

Table 8 — Data Cable Pin Assignments

SECTION 5

DATA FORMATS

5.1 SOFT SECTOR FORMATS

Figure 9 shows a typical Soft Sector Format. Each sector has the same number of bytes (256 data bytes and 59 overhead bytes). Any remaining bytes are recorded in Gap 4, between the last sector and the Index Pulse.

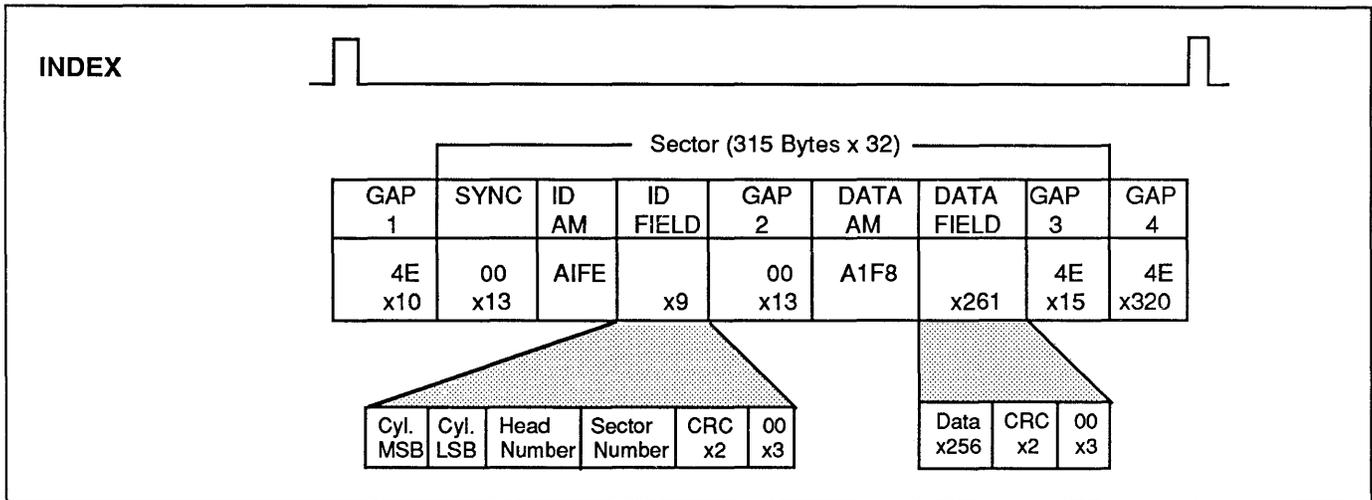


Figure 9 — Soft Sector Formats

5.2 DEFINITION OF FIELDS

- Gap 1:** Minimum of 10 bytes allows variance in the detection position of the Index Pulse.
- Sync:** 13 bytes of zeros to allow read channel synchronization prior to detection of the ID Field Address Mark.
- ID Field:** Identified by a unique Address Mark; contains cylinder, head and sector addresses, two bytes of CRC and three bytes of zeros.
- Gap 2:** Serves as a tolerance area when the Data Field is recorded; contains 13 bytes of zeros (Data Field Sync) to allow read channel synchronization prior to detection of the Data Field Address Mark.
- Data Field:** Identified by a unique Address Mark; contains 256 data bytes, two bytes of CRC and three bytes of zeros (CRC + zeros may be used for ECC).
- Gap 3:** Minimum of 8 bytes required; allows sector length variances caused by rotational speed. In the above example, 15 bytes are shown.
- Gap 4:** Allows variance in the track length due to rotational speed. In the above example, 320 bytes are shown.

SECTION 6

MAINTENANCE CONSIDERATIONS

6.1 EQUIPMENT MAINTENANCE

Refer to Toshiba America, Inc., Disk Products Division (herein after referred to as "Toshiba America") Maintenance Policies and Procedures for a complete description of in-warranty procedures, terms and conditions.

6.1.1 In-Warranty Maintenance

Toshiba America will provide parts and labor at no charge to the customer for all in-warranty repair actions. The drive must be returned to Toshiba America's Customer Service point of repair (see paragraph 6.1.3 for instructions) at the customer's expense, inclusive of shipping and insurance costs.

6.1.2 Out-of-Warranty Maintenance

Toshiba America repairs major assemblies on a fixed cost basis and all other repairable assemblies on an hourly rate plus parts basis. The drive or repairable assembly must be returned to Toshiba America's Customer Service point of repair (see paragraph 6.1.3 for instructions) at the customer's expense, inclusive of shipping and insurance costs.

6.1.3 Equipment Return Instructions

A Return Authorization Number is required and must accompany any equipment returned for repair. Contact a Toshiba America Customer Service Representative for return instructions and a Return Authorization Number. All equipment must be returned to the address listed below.

**Toshiba America, Inc.
Disk Products Division
Customer Service Center
9740 Irvine Blvd.
Irvine, CA 92718
714/583-3000**