FUJITSU

M253XM

3 1/2" MINI-FLEXIBLE DISK DRIVE

DESCRIPTION

M2532M

INDUSTRY STANDARD 9 SECTOR 720KB

M2537M

INDUSTRY STANDARD 720KB OR 1.44MB

STORAGE CAPACITY SUMMARY

Model #	Density	Spindle RPM	Transfer Rate	Unformatted Capacity	Formatted Sectors[3]	Formatted Capacity[4]
M2532M	Normal[1]	300	250 Kbs	1.0 MB	9 Sectors	720 Kbytes
M2537M	Normal	300	250 Kbs	1.0 MB	9 Sectors	720 Kbytes
	High	300	500 Kbs	2.0 MB	18 Sectors	1.44Mbytes

Notes:
1. M2532M does not have a High Density mode of operation.
2. All sectors are 512 bytes.
3. Formatted capacities are in IBM convention, which rounds down sector capacity to 500 bytes per sector when calculating formatted capacities.

KEY FEATURES

- 1.0 to 2.0 Megabytes of Unformatted Storage
- High ESD immunity, up-to 20KV (no hard erros)
- 16,000 P.O.H. Mean Time Before Failure
- TTL or Power Saving CMOS Versions
- Single Source 5V only, operation
- 4-Phase Stepper Motor and Lead Screw Driven Head Positioner
- Rubber isolation mounting rails for maximum shock/vibration immunity
- High Quality and Reliability
  Achieved with the use of LSI and surface mount technology, proven manufacturing techniques, and attention to detail.
- FUJITSU AMERICA Support

OPTIONS

BEZEL

5.25" OR SONY COMPATIBLE

5.25" MOUNTING FRAME

DUST COVER

DISK HANDLING

DISK INJECT OR EJECT

MFM STORAGE CAPACITY

MODEL NUMBER	M2532M	NORMAL DENSITY M2537M	HIGH DENSITY M2537M
BITS PER INCH	8717	8717	17434
TRANSFER RATE	250 Kbs	250 Kbs	500 Kbs
UNFORMATTED CAPACITY			
Per Track	6.25 KB	6.25 KB	12.5 KB
Per Disk	1.0 MB	1.0 MB	2.0 MB
FORMATTED CAPACITY			
9 Sector Format			
Per Sector	512 Bytes	512 Bytes	---
Per Track	4.096 KB	4.096 KB	---
Per Disk	737.28 KB	737.28 KB	---
18 Sector Format			
Per Sector	---	---	512 Bytes
Per Track	---	---	9.216 KB
Per Disk	---	---	1.475 MB

Storage Capacity is one-half of the values listed above with FM Recording.

DISK MECHANISM

RECORDING SURFACES	Two (Each side of the disk)
SPINDLE SPEED	300 RPM M2532M and M2537M
AVERAGE LATENCY	100 msec at 300 RPM
SPEED VARIATION Instantaneous Variation Long Term Variation	 ±3.0% Maximum ±1.5% Maximum
ROTATIONAL CONTROL	AC Tachometer Controlled Frequency Servo
SPINDLE MOTOR TYPE	Direct Drive DC Brushless Motor
SPINDLE MOTOR START TIME	400 milliseconds maximum

TRACK ACCESS MECHANISM

# OF CYLINDERS / TRACKS	80 Cylinders / 160 Tracks
TRACK DENSITY	135 Tracks per inch
TRACK 00 RADIUS TRACK 79 RADIUS	Side 0 - 39.5 mm Side 1 - 38.0 mm Side 0 - 24.7 mm Side 1 - 24.2 mm
POSITIONING ACCURACY	Within ±20 micrometers, using a standard test diskette (track 32, at 23 ±2°C, 40-60% RH)
HEAD SETTLING TIME	15 milliseconds maximum (does not include track access time)
ACCESS TIME Track to Track Average Maximum	 3 millisecond (excludes settling time) 94 milliseconds (includes settling time) 252 milliseconds (includes settling time)
HEAD CARRIAGE DRIVE	2 Phase Stepper Motor and Lead Screw
TRACK 00 DETECTION	LED and Phototransistor Detection Mechanical stop on head carriage

INDEX PULSE

NUMBER OF PULSES	One (1) INDEX Pulse per disk revolution
INDEX DETECTION	Magnet and Hall effect sensor
INDEX DURATION	Between 1.2 and 8 milliseconds (use the leading edge)
TIME BETWEEN INDEX PULSES	200 milliseconds ±4 ms
INDEX ACCURACY	±400 microseconds from the beginning of the INDEX hole on a standard test diskette
FIRST INDEX PULSE	400 millisecond nominal after Motor Start

READ/WRITE HEAD SPECS

TYPE OF R/W HEAD	Gimbal supported with Tunnel Erase
HEAD LOAD MECHANISM	Conducted in combination with disk chucking
NUMBER OF R/W HEADS	Two (one on each surface)
R/W HEAD TRACK WIDTH	0.131 mm standard 0.117 ±0.010 mm after Tunnel Erase:
ERASE HEAD WIDTH	0.71 mm standard, both sides
WRITE/READ - ERASE GAP	0.35 ±0.05 mm
WRITE/READ GAP AZIMUTH	0±14° on standard test diskettes

TTL POWER SUPPLY REQUIREMENTS

+5 VOLTS DC -6%, +10%	±5% allowable variance 100 millivolts maximum peak-to-peak ripple voltage (including noise spikes)
Operating Mode	0.32 Amperes typical average current consumption 0.60 Amperes maximum average current consumption 0.9 Amperes Peak consumption
Stand-by Mode	0.005 Amperes Typical 0.009 Amperes Maximum
POWER CONSUMPTION	1.5W Watts nominal in operating mode 25 mW nominal in stand-by mode

ENVIRONMENTAL CONDITIONS

	OPERATING	STORAGE	TRANSPORT*
Ambient Temperature	41 to 113° F 4 to 50° C	-4 to 140° F -20 to 60° C	-40 to 140° F -40 to 65° C
Temperature Gradients (Max. Non-condensed)	25° F/hour 15° C/hour	Not Specified	50° F/hour 30° C/hour
Relative Humidity Maximum Wet-Bulb (Non-condensed)	20 to 80% Max. 29° C	10 to 90% Max. 40° C	5 to 95% Max. 40° C
Vibration Tolerance (Maximum)	1.5G (10 - 100 Hz) 1.0G (100 - 200 Hz) 0.5G (300 - 600 Hz)	Not Specified	3.0G (10 - 100 Hz)
Shock Tolerance (Maximum)	19.0G Maximum (Max. 11 msec)	Not Specified	60G Maximum (Max. 11 msec)
Electric Static Discharge	Units can withstand non-destructive ESD up to 20,000 volts. Units are capable of withstanding non-data loss (on the bezel lever) of up to 12,000 volts.		
Electric Magnetic Interference (EMI)	Units can withstand EMI in the environment as follows: Frequency — Intensity DC - 40 KHz: -25 dB 40 KHz - 60 KHz: -30 dB 60 KHz - 100 KHz: -38 dB 100 KHz - 200 KHz: -48 dB 200 KHz - 1.5 MHz: -53 dB Intensity is with respect to a field of 1 Gauss peak-to-peak		

* Packed in designated crates with conditions conforming to JIS-Z0200 - Provisions for Correctly Packed Freight Testing methods; Level II.

When transportation takes place over an extended period (such as trans-oceanic by ship) the Storage Environmental Conditions apply.

RELIABILITY

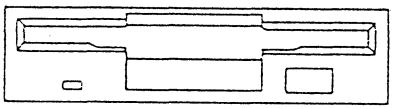
MEAN TIME BETWEEN FAILURES (MTBF)	16,000 Power-on hours
MEAN TIME TO REPAIR (MTTR)	30 Minutes Maximum to subassembly level
PERIODIC MAINTENANCE	Not required Head Cleaning if necessary
PRODUCT LIFE	5 years
DISK LIFE	Three per 10^6 passes/track minimum
DISKETTE INSERTIONS	One per 10^4 minimum
SAFETY STANDARDS	Meets U.L. and CSA Standards TUV U.L. #E78564 and CSA #60527 #R95635
DATA ERROR RATES:	
Soft Read Error Rate	One per 10^9 bits (up to 2 re-reads)
Hard Read Error Rate	One per 10^{12} bits (more than 2 re-reads)
SEEK ERROR RATE	One per 10^6 seeks

INSTALLATION

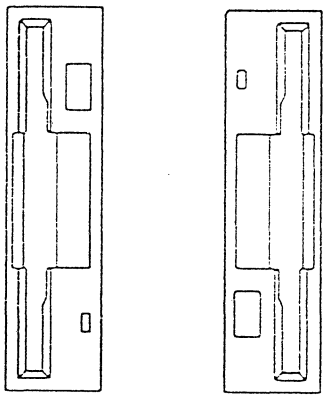
MOUNTING ORIENTATION

Unless otherwise indicated, inspections and adjustments may be made either horizontal or vertical posture as shown below.

Horizontal posture



Vertical posture



COOLING

When the disk drive is mounted in an environment that provides a free flow of air over the components, convection cooling allows operation of the drive within the specified temperature range.

When the drive is mounted in a confined environment, air flow may have to be provided to maintain the specified temperature range in the vicinity of the main circuit board, motors, and diskette.

POWER

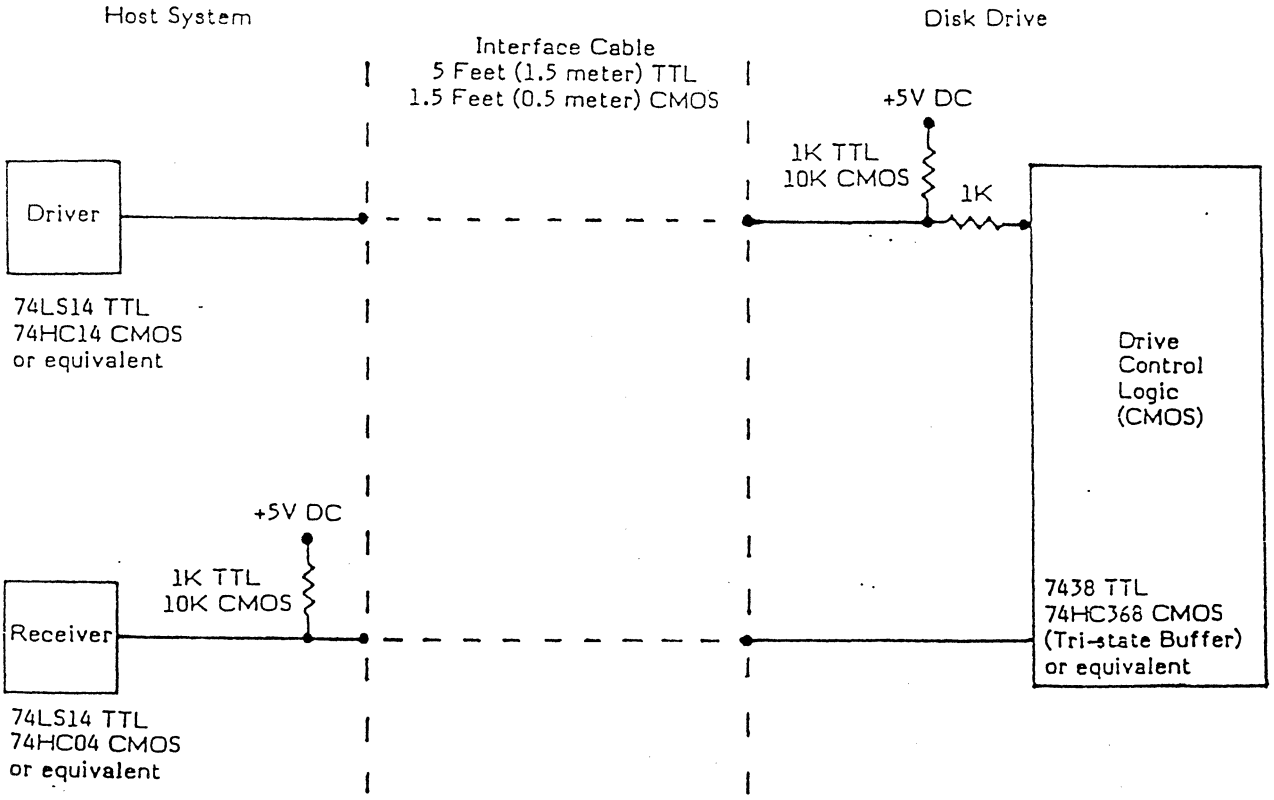
Paragraph 2.9 provides complete power supply requirements for both the TTL and CMOS versions of the M253XM disk drive. Paragraph 4.9 provides power supply interface information.

Power to the drive is via connector J2, located on the component side of the main circuit board near the interface connector. Both TTL and CMOS version of the disk drive uses only +5VDC.

INTERFACE
DRIVERS AND RECEIVERS

M253XM Disk Drives, with a TTL interface, use LSI TTL 74LS14 or equivalent circuits to drive or receive input/output signals.

M253XM Disk Drives, with a CMOS interface, use LSI CMOS 74C04 or equivalent circuits to drive or receive input/output signals.



JUMPER DEFINITIONS

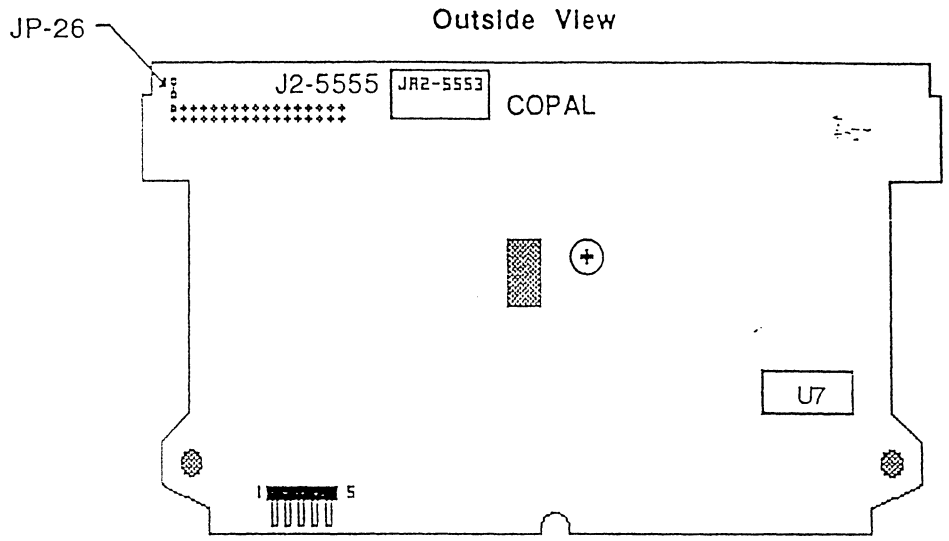
5.25" COMPATIBLE

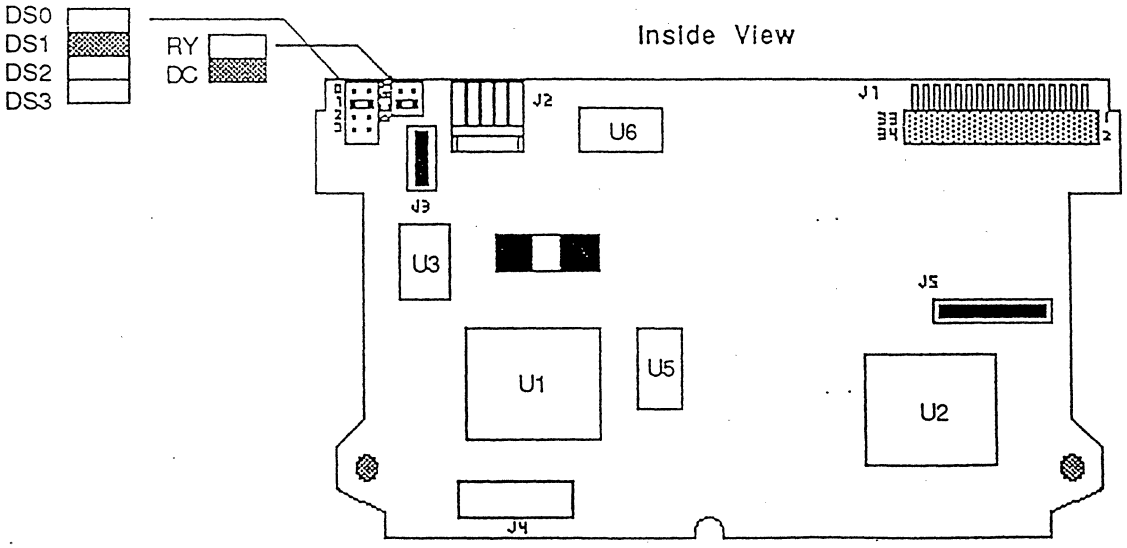
Name	Option	Revision			
		A2	A3	Comments	Type
DS0	Drive Select 0	X			Opt.
DS1	Drive Select 1	X			Std.
DCR	Disk Change Reset		X	JP-2 (Sony I/F)	Opt.
STR	Step DC Reset	X			Std.
DC	Disk Change	X			Std.
RY	Ready	X			Opt.
LS	LED on w/ DS	X			Std.
L1	LED on w/ DS + In Use		X	JP-7	Opt.
MS	Motor on w/DS		X	JP-4	Opt.
MM	Motor on w/ Motor Sig	X			Std.
HST	Density Status pin 2		X	JP-31, JP-32	*Opt.
SDC	Disk Chg pin 2		X	JP-31, JP-32 (Sony I/F)	*Opt.
	no connection pin 2	X		JP-31, JP-32	*Std.
	In Use pin 4	X			Std.
	Density Status pin 4		X	JP-36	Opt.
JP26	Auto Eject pin 1	X		JP-26	Opt.
	DC Reset pin 1		X	JP-11 (Sony I/F)	Opt.

Pin 2 Signal	JP-32	JP-31
Disk Change	O	X
HD Status	X	O
Open	O	O

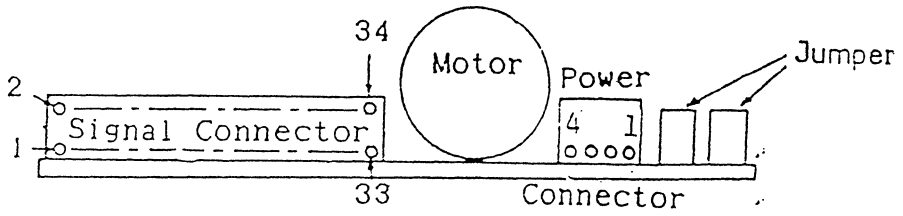
X = *Jumpered
O = *Open

JUMPER LOCATIONS





INTERFACE CONNECTOR



INTERFACE SIGNAL-PIN

Table 4-3 Interface Signal-Pin Designation

Signal Name	Direction	Signal-Pin Number	Return-Pin Number
DISK CHANGE RESET / NC / AUTO EJECT	Note 1	1	-
DISK CHANGE/DENSITY / NC	Note 2	2	-
IN USE / HIGH DENSITY OUTPUT	Input	4	3
RESERVED	Input	6	5
INDEX	Output	8	7
DRIVE SELECT 0	Input	10	9
DRIVE SELECT 1	Input	12	11
RESERVED	Input	14	13
MOTOR-ON	Input	16	15
DIRECTION	Input	18	17
STEP	Input	20	19
WRITE DATA	Input	22	21
WRITE GATE	Input	24	23
TRACK 00	Output	26	25
WRITE PROTECT	Output	28	27
READ DATA	Output	30	29
SIDE ONE SELECT	Input	32	31
READY / DISK CHANGE	Note 3	34	33

Note 1: Disk Change Reset signal is only on Sony compatible interface. Ground signal on pin 1 is only on 5.25" compatible interface.

Note 2: Disk Change signal (pin 2) is for 3.5" Sony compatible interface. Density signal is only on 5.25" compatible interface (except with an M2532M where the Density signal is not available).

Note 3: Sony compatible interface allows only Ready signal on pin 34. 5.25" compatible interface allows Ready or Disk Change signal (jumper selectable) on pin 34.

INPUT CONTROL SIGNALS

DISK CHANGE RESET/GROUND

Disk Change Reset function is only available on pin 1 of a Sony Compatible interface.

The trailing edge of a Disk Change Reset signal pulse on pin 1, resets the Disk Change signal (on pin 2), if the DSR/DCR jumper option is enabled and the drive is selected.

Note: The Disk Change signal (on pin 2) is reset with the trailing edge of the Step signal if the DSR/DCR jumper is removed and the STR jumper is installed.

DISK CHANGE DENSITY

On a Sony compatible interface a Disk Change output signal is provided on pin 2. The Disk Change signal is provided on pin 34 of a 5.25' Compatible interface.

The Disk Change output signal indicates true (low) when the diskette has been removed. This signal is set true when power is initially turned on, or when the drive's diskette has been removed while the drive was deselected. The Disk Change signal is reset false (high) when power is turned on and a diskette is inserted into the drive, or as stated above in paragraph 4.5.1.

On a 5.25" compatible interface pin 2 is the Density signal that functions as follows:

An M2532M does not use the Density signal.

DRIVE SELECT

Placement of a Drive Select jumper determines which Drive Select line activates the interface for each disk drive. There are two Drive Select lines (DS0 and DS1). Only one Drive Select line may be set true at any time.

The Drive Select Jumper, located on top of the circuit board near the J-1 connector, determines which Drive Select line activates the interface for each disk drive. M2532M19A Disk Drives are shipped with the Drive Select jumper installed in the DS1 (Drive Select-1) position, all other Disk Drives are shipped with the jumper in the DS0 (Drive Select-0) position.

When the host system sets a Drive Select signal line low, the drive with a jumper installed in the corresponding Drive Select line, has its interface signals (connector P1/J-1) connected to the host interface cable.

Note: DS1 must be selected on every drive used in an IBM PC/XT/AT configuration.

IN USE

Placement of the In Use and HD (High Density) jumpers determine the function performed by this interface pin.

When the In Use jumper is installed:

A low input signal causes the LED on the drive's bezel to be turned on.
A high input signal causes the LED on the drive's bezel to be turned off.

When the HD jumper is used, the status of the media sensing switch is output on this line.

MOTOR-ON

Placement of the MM and MS jumpers determine when the Spindle Motor will begin rotating.

When the MM jumper is installed:

A low input signal causes the Spindle Motor to start rotating.
A high input signal causes the Spindle Motor to stop rotating.

When JP-4 jumper is soldered:

The spindle motor will rotate when the drive is selected.
The spindle motor will stop rotating when the drive is deselected.

Note: Spindle motor speed is stabilized within 400 milliseconds from the leading edge of the Motor-on (or Drive Select) signal that starts rotation.

DIRECTION

Defines the direction of Read/Write head carriage movement (the Read/Write head carriage moves only with each Step signal pulse).

When this signal is low, the carriage will move inwards (towards an inner track). When this signal is high, the carriage will move outwards (towards an outer track).

STEP

Moves the Read/Write head carriage one track for each Step pulse. Minimum pulse width is 1.0 microsecond. Head carriage movement is initiated at the trailing (low to high) edge of the pulse.

If the head carriage is in motion, 3 milliseconds minimum is required between pulses. To change the direction of movement, 18 milliseconds minimum is required between pulses.

SIDE ONE (HEAD) SELECT

Selects the Read/Write head. When this signal is low, the top (side 1) head is selected. When this signal is high, the bottom (side 0) head is selected.

OUTPUT CONTROL SIGNALS

INDEX

Use the leading (high to low) edge of Index. The Index pulse is 1 to 8 milliseconds in duration, provided once per disk revolution (each 200 milliseconds at 300 RPM and each 166.6 milliseconds at 360 RPM). Index pulse indicates the beginning of a data track.

The first valid Index pulse occurs typically within 400 milliseconds after the Spindle Motor is started (with a Motor-on or Drive Select signal). Index will not be output until two index pulses have been detected at the appropriate duration. Its output is gated with Ready, internally, as described below.

TRACK 00

A low level signal that is provided when the Read/Write heads are positioned at the outermost data track.

Track 00 signal is valid within 1.0 millisecond after Drive Select and within 2.8 milliseconds after the Step signal that positioned the heads at Track 00.

WRITE PROTECT

A low level signal that is provided when a diskette, with its Write Protect slide switch closed, is inserted into the drive. Writing is inhibited (by the disk drive) when the Write Protect signal is true.

Write Protect signal is valid within 1.0 millisecond after Drive Select.

READY / DISK CHANGE

With a 5.25" Compatible interface, this interface pin (with internal jumpers) indicates either Ready status or Disk Change status. The host computer uses the output level on pin 34 to determine the Ready or Diskette status.

Ready status is set true when the RY jumper is installed and the disk drive is ready to seek, read, or write. This signal is set true within 1.0 second after the Spindle Motor is started, if:

1. Power is correctly applied.
2. A diskette is properly inserted.
3. Disk rotation is at least 90% of nominal speed and two INDEX pulses have been received.

Ready status is set false if any of the above conditions are not set.

Disk Change status is set true when the DC jumper is installed and the loaded diskette is removed from the drive when the drive is deselected.

Disk Change will be set false if:

1. Power is turned on and a diskette is inserted.
2. Internal jumper DSR is installed and the Drive Select signal goes false (the rising edge of Drive Select is used).
3. Internal jumper STR is installed, the drive is selected, and the Step signal goes false (the rising edge of the Step signal is used).

DATA TRANSFER SIGNALS

WRITE GATE

A low level input signal erases old data and permits new data to be written. This signal is invalid when the Write Protect signal is true.

The following prerequisites must be set before Write Gate will change to the true level:

The disk drive's internal Ready signal must be true
18 milliseconds must have elapsed since the last Step pulse
100 microseconds must have elapsed since the last Side One Select change

At least 1 millisecond must elapse, after the signal is set false, before:

Stopping the Spindle motor (Motor-on set false)
Changing the selected disk drive (Drive Select false)
Starting head movement (Step pulse true)
Changing the Read/Write head (Side One Select change)

WRITE DATA

Pulses that are 0.15 to 1.1 microseconds in duration. Each pulse defines a data transition that is written on the diskette (by the selected Read/Write head).

The leading edge of each pulse is used. Write Data signals are only valid when Write Gate is true (Low) and Write Protect is false (High).

READ DATA

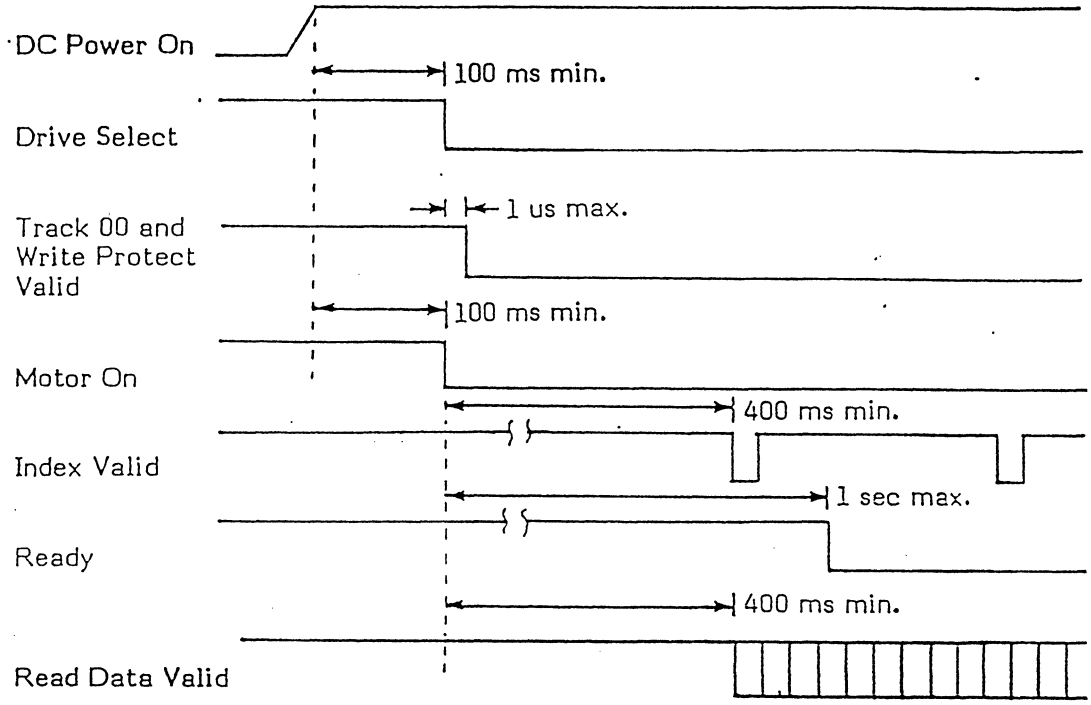
Pulses that define the clock and data pulses (intermixed) read from a pre-recorded data track.

The leading edge of each pulse is used. Read Data signals are only valid when:

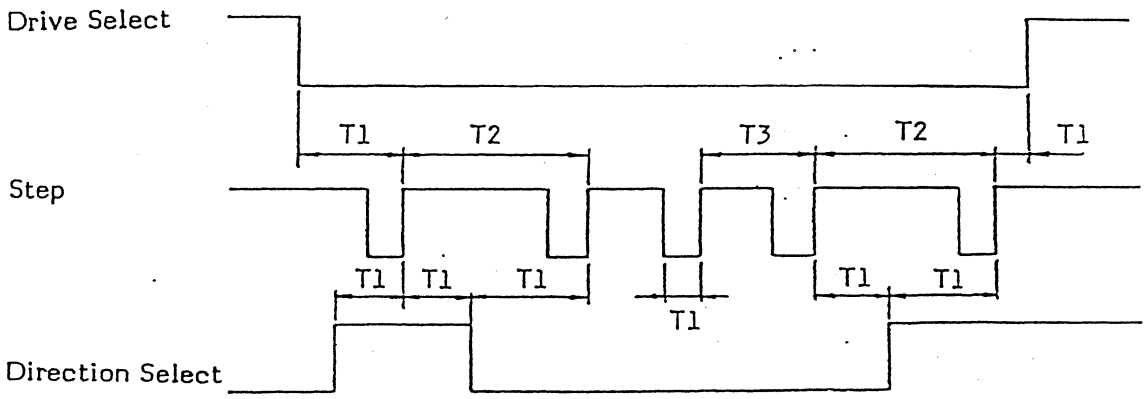
The Selected Disk Drive's Ready signal is set true
18 milliseconds has elapsed since the last Step pulse
500 msecs has elapsed since the last Side One Select change
1.5 milliseconds has elapsed since Write Gate was set false

TIMING RELATIONSHIPS

POWER AND I/O CONTROL

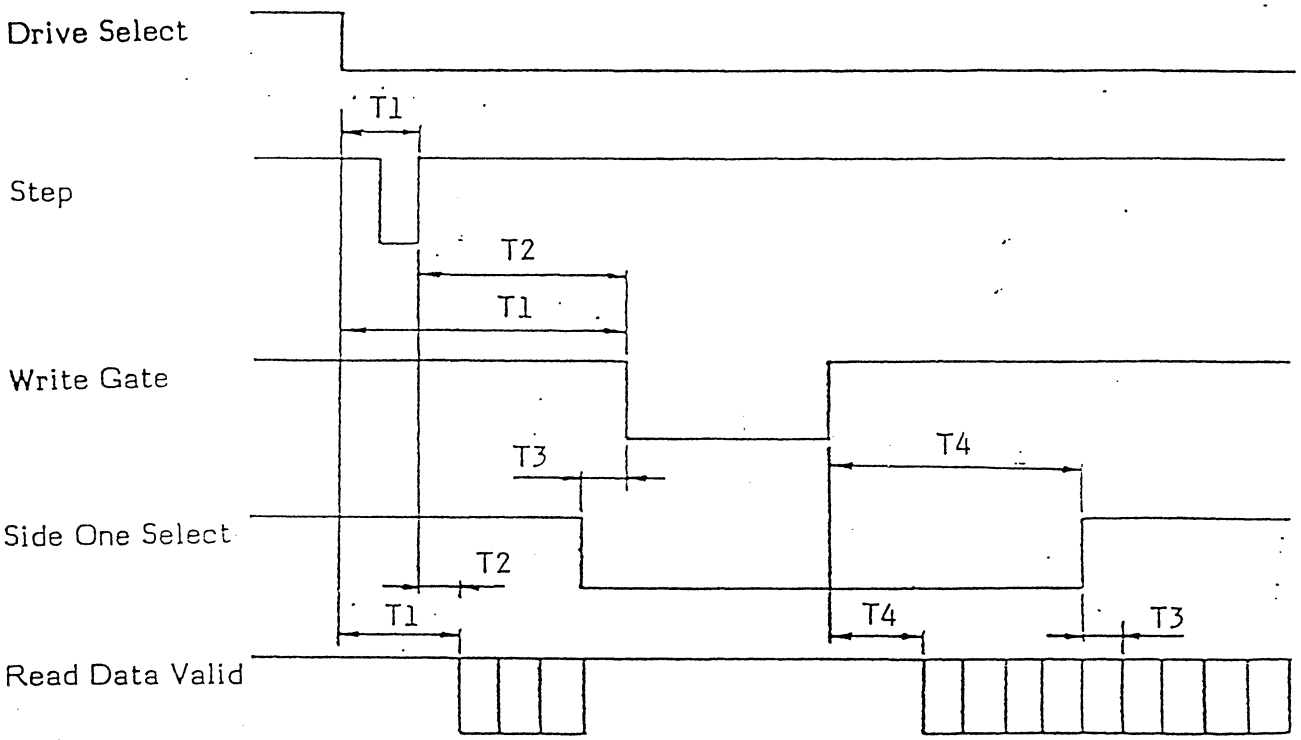


STEP SIGNAL TIMING



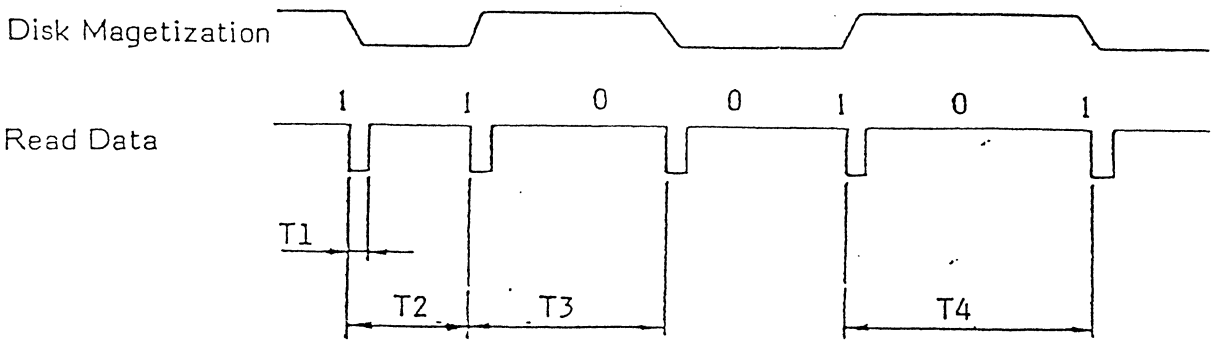
Model	T1	T2	T3
M2532M	1 usec. minimum	18 msec. minimum	3 msec. minimum
M2537M	1 usec. minimum	18 msec. minimum	3 msec. minimum

READ OPERATION TIMING



Model	T1	T2	T3	T4
M2537	1 usec. minimum	21 msec. minimum	100 usec. minimum	1 msec. minimum
M2532M	1 usec. minimum	18 msec. minimum	100 usec. minimum	1 msec. minimum

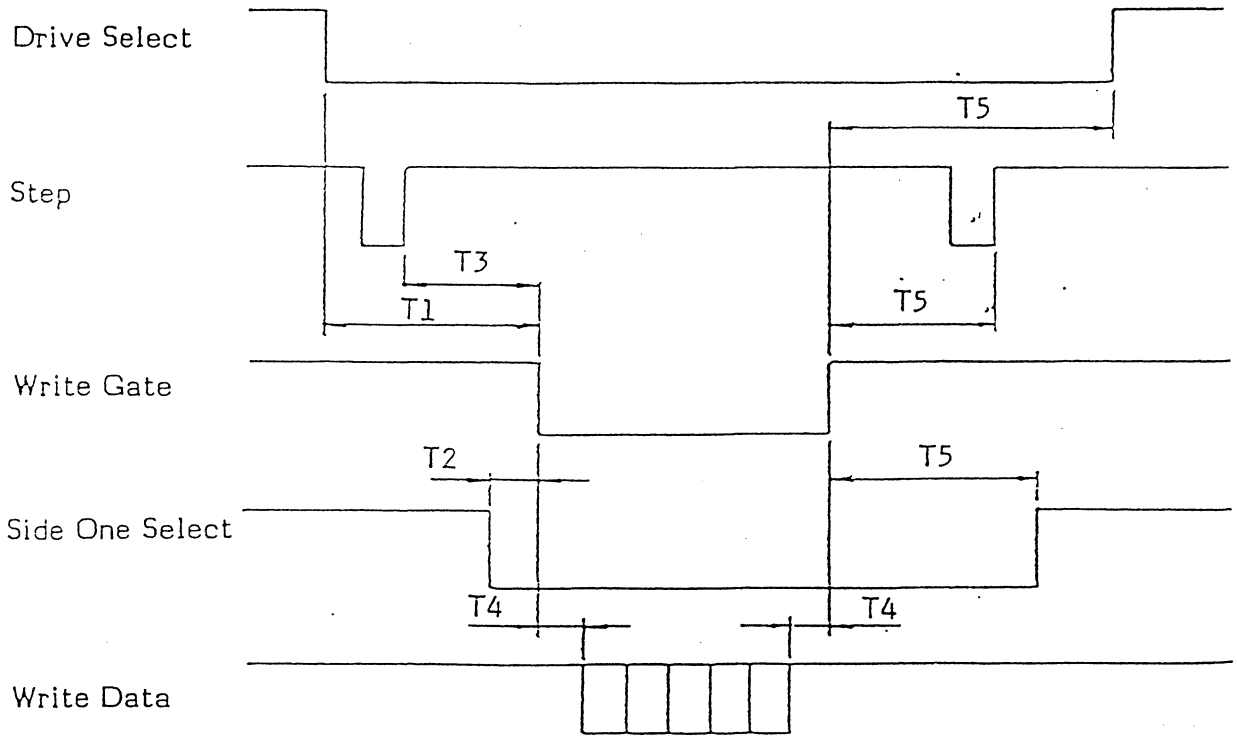
READ DATA TIMING
MFM RECORDING



The leading edge of each pulse must be detected within ±15% (T5) from the edge of the pulse to the interval of the pulse.

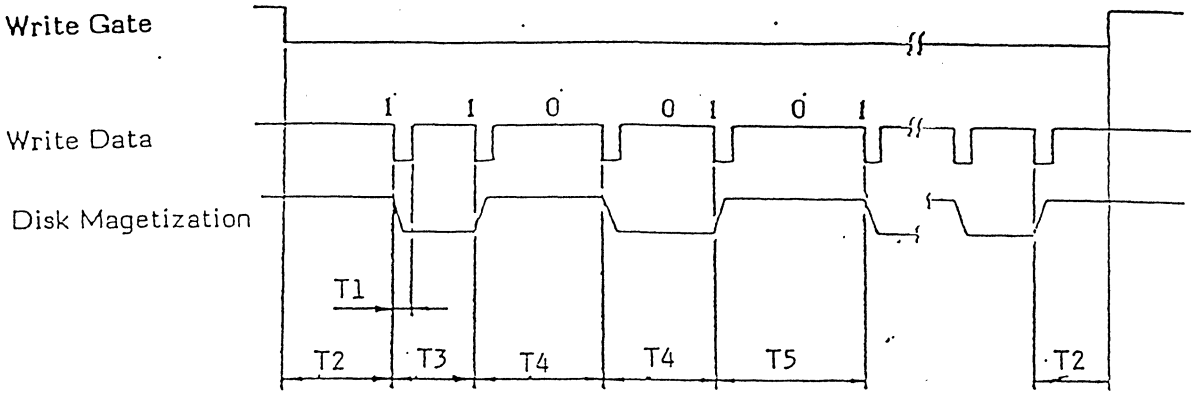
	T1	T2	T3	T4	T5
300 RPM HIgh Density	500 nsec. ±250 nsec.	2.0 usec. nominal	3.0 usec. nominal	4.0 usec. nominal	±300 nsec.
300 RPM Normal Density	500 nsec. ±250 nsec.	4.0 usec. nominal	6.0 usec. nominal	8.0 usec. nominal	±600 nsec.

WRITE OPERATION TIMING



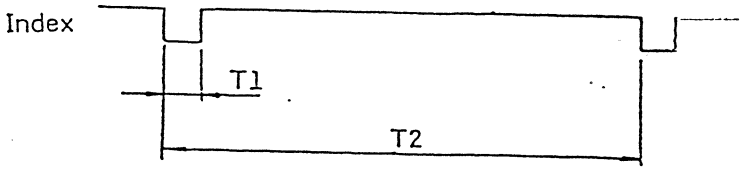
Model	T1	T2	T3	T4	T5
?	TBD	TBD	TBD	TBD	TBD
M2532M TTL	1 usec.	100 usec.	18 msec.	8 usec.	1 msec.

WRITE DATA SIGNALS
MFM RECORDING



Mode	T1	T2	T3	T4	T5	Drive Type
High Density 300 RPM	0.15 to 1.1 usec.	4.0 usec. maximum	2.0 usec. nominal	3.0 usec. nominal	4.0 usec. nominal	M2537M
Normal Density 300 RPM	0.20 to 1.1 usec.	8.0 usec. maximum	4.0 usec. ±20 nsec.	6.0 usec. ±30 nsec.	8.0 usec. ±40 nsec.	M2532M M2537M

INDEX SIGNAL TIMING

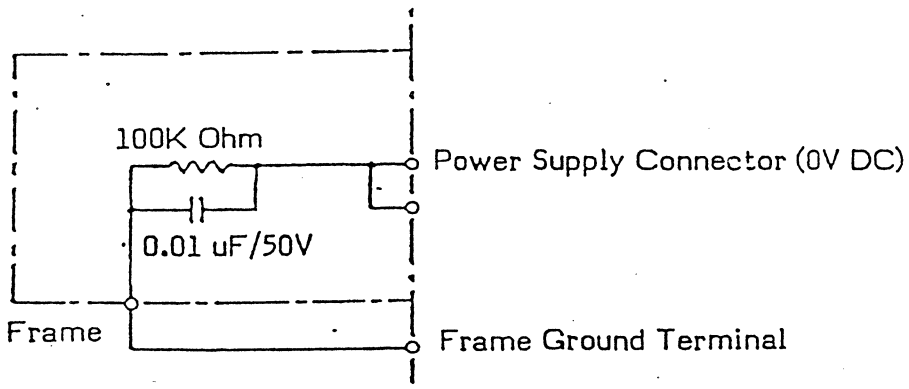


Rotational Speed	T1	T2
300 RPM	From 1.2 to 8.0 milliseconds	200.0 milliseconds ±2.0%

FRAME GROUND

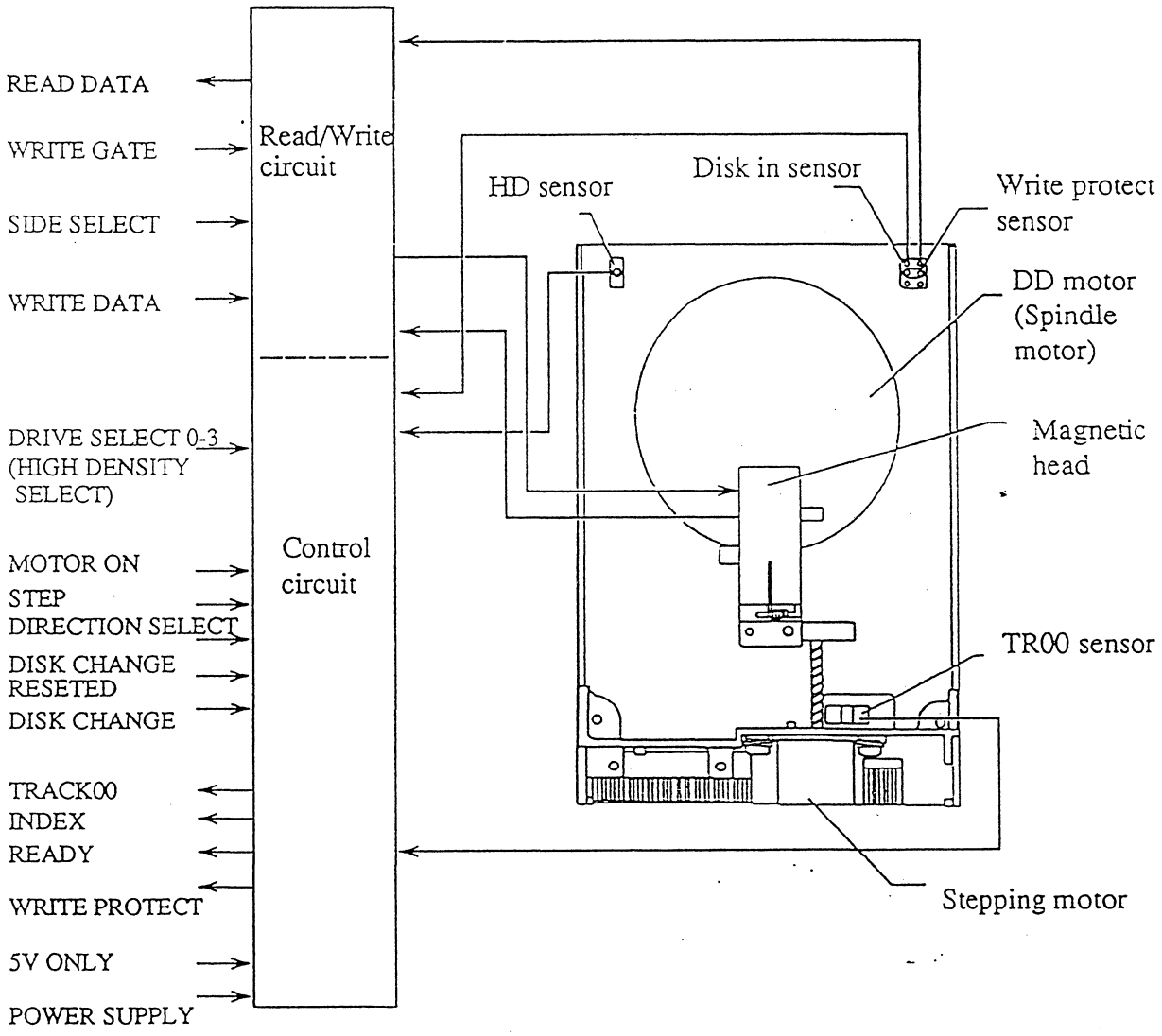
RECOMMENDED CIRCUIT TO CONNECT FRAME GROUND TO SIGNAL GROUND

Frame ground is isolated from signal ground. To connect signal ground to frame ground, use the circuit shown in Figure 4-13. Resistance between frame and signal ground must be at least 80K Ohm at 50 Volts DC. The frame ground terminal is mounted to an M2.6 hole on the rear of the disk drive.



MAINTENANCE

OVERALL BLOCK DIAGRAM



PERIODIC MAINTENANCE ITEMS

As long as M253XM is used at the normal rate, periodic maintenance such as parts replacement, lubrication, etc. is not required for 5 years.

Cleaning of magnetic heads using a cleaning disk, however, is effective for improving data reliability so it is recommended doing this at the intervals given in Table 201. Further, concerning those parts used in FDD and having limited life time, especially in case of highly frequent operating parts or operating more than 5 years, it is recommended to replace them as per the period shown in Table 203.

Change parts in accordance with the item 2-4,5, referring to the item 2-2.

Periodic Maintenance Item	Recommended Interval	Time Required	Reference Item
Cleaning of magnetic head	Refer to 2-3	5 min.	2-3
Replacement of maintenance parts	Refer to 2-1-3, 2-5		

INSPECTION AND ADJUSTMENT ITEMS

	Inspection and Adjustment	Time Required	Reference Items
1	File protect sensor inspection	5 min.	2-4-1
2	Disk rotation speed inspection	5 min.	2-4-2
3	Head touch inspection	5 min.	2-4-3
4	Asymmetry inspection	5 min.	2-4-4
5	Read level inspection	5 min.	2-4-5
6	Resolution inspection	5 min.	2-4-6
7	Track alignment inspection and adjustment	10 min.	2-4-7
8	Track 00 sensor inspection and adjustment	5 min.	2-4-8
9	Index burst timing inspection and adjustment	5 min.	2-4-9

MAINTENANCE PARTS LIST

Maintenance Parts		Parts Replacement		
Parts Names	Number	Recommended Interval	Time Needed	Ref.
Carriage ass'y	JA3-5713	7,000hs/motor on or 5 million seeks	45 min.	2-5-1
Stepping motor.	J4-5720	5 million seeks	30 min.	2-5-2
Disk drive motor	J3-5746	10,000hs/motor on	20 min.	2-5-3
Main PCB ass'y	1MB:JA2-5572 2MB:JA2-5553		20 min.	2-5-4
Front bezel	JA4-6405		2 min.	2-5-5
Dust cover	J3-5737		2 min.	2-5-6
Eject button	J4-5735		2 min.	2-5-7

TOOLS REQUIRED FOR MAINTENANCE

The measuring instruments, jigs and tools required for complete maintenance of M253XM are as follows:

(A) Measuring instruments

(1) FDD control system (BRIAN FDD Tester or equivalents) and DC power supply
(2) 2-phenomena oscilloscope
(3) Frequency counter
(4) Digital voltmeter
(5) Thermometer
(6) Relative hygrometer

(B) Tools

(1) Phillips screwdrivers M2, M2.6, M3
(2) Small minus screwdriver
(3) Tweezers
(4) Fine brush
(5) Poise (20g)

(C) Disks

(1) Work disk (normal commercially available disk)
(2) Cleaning disk for double sides (see item 2-3), dry-type
(3) Alignment disk for double sides 135 tpi

(D) Maintenance consumable parts

(1) Anhydrous alcohol (ethanol)
(2) Cotton, gauze
(3) Screwlock (3 Bond, 1401B)
(4) Epoxy (Sumitomo Chemical Industry, Cyano Bond SF red)
(5) Screw (see item 3-2-2)
(6) Lubricating oil (Kanto Kasei 948P)
(7) Light oil (Nikko shoji Doubrex EL)