Chapter 8   Floppy Disk Drives

8.1 Introduction

Originally introduced by IBM in the 8-in format as a paper tape replacement for loading microcode programs into the 370 mainframe computer. The device is also used as a punch card replacement for key-punch machines like the IBM 3740. In batch processing, the data is entered by key-punch operators at data entry stations. The data entered is captured and stored on the 8-in diskette. These are then loaded into a magazine, very much like a CD changer, which then picks up each diskette in turn, reads in the data and processes them.

Alan Shugart was at that time an engineer at IBM. With the introduction of the first hobby 8 bit microcomputers like the Apple-II, he recognised the potential of the floppy disk as a random access storage device and formed Shugart Associates to address this market. For this early PC market, a smaller 5.25 inch format was introduced with a capacity of 90 KB. However the storage demands grew quickly, and users were cutting a notch on the diskette jacket and flipping the diskette over to use the other side. Subsequently, double sided and higher density drives were developed.

8.2 Floppy Disk
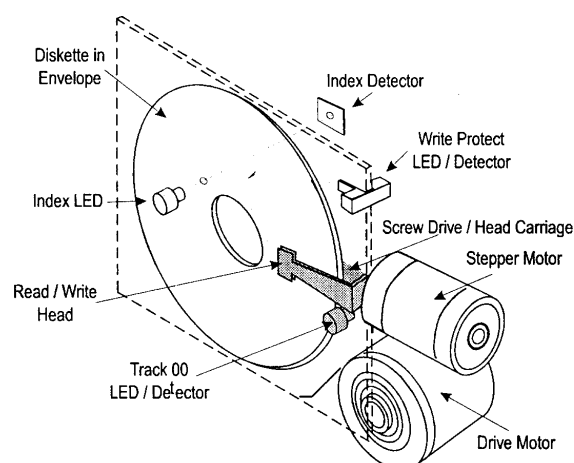
Figure 0-1 Floppy Disk Construction.

Figure 0-1 shows the construction of the 5.25 floppy disk drive. The diskette media is inserted into the drive through a slot in the front panel. Operating a manual lever clamps the

hub of the diskette to the drive and loads the read/write heads by placing them in contact with the surfaces of the diskette.

To reduce wear and tear on the heads and media, the drive motor is not activated until a read or write command is received. After a short delay following the last read/write operation the motor is stopped again. An open-loop head positioning mechanism is used. The head is usually driven by a stepper motor through either a screw drive assembly or by winding and unwinding a metal band. An optical zero track sensor is used to identify track 00 and the subsequent tracks is accessed based on the track count. Should there be a read, write or seek failure, the system resets, the head is retracted back to track 00 and the positioning of the head is re-executed. The Index LED/detector assembly provides the synchronization for the sector counts.

8.3 Performance metrics

A number of parameters are used to measure and characterizes the performance of the disk drive.

Table 1 Definitions of some disk performance parameters.

Access time:	i. Average latency time + time for a random seek, or
	ii. Average latency time + time taken for 1/3 of full stroke seek (Estimate).
Seek time	Time to move the Read/Write Head from current position to the desired track location
Random seek time	Time to move from any random track to another random track at any time.
Full stroke:	Head movement from track 0 to track N-1 or vice versa, where N is the total number of tracks
Average latency:	Time taken for 1/2 of a disk revolution

Table 2 gives a comparison of the early SSSD (Single-Sided, Single Density) drives with the present DSDD (Double-Sided Double Density) and HD (High Density) drives.

Table 2 Typical specifications of floppy disks

Format	5.25 in. SSSD	5.25 in. DSDD	5.25 in. HD	3.5 in.
Rotational speed, rpm	300	300	360	300
Average latency, ms	100	100	83.3	100
Average seek time, ms	90	90	90	150
Transfer rate MFM, bps	250K	250K	500K	500K
Formatted capacity, bytes	90K	360K	1200K	1440K

The performance of the floppy disk with hard disks are compared in Table 3

Table 3 Comparison of Disk Parameters (Typical specifications)

Disk Type	5.25 in. FD	3.5 in. FD	ST 157A
Formatted capacity, bytes	1.2 M	1.44 M	44 M
No of tracks	80	80	615* (1024)
Sectors/track	15	18	26*(17)
No of heads (tracks per cylinder)	2	2	6*(16)
Recording method	MFM	MFM	RLL(2,7)
Rotational speed, rps	6	5	60
t_L, Average latency, ms	83.3	100	8.33
t_A, Average access time, ms	200#	300#	28#
t_F, Full stroke time, ms	330#	600#	70#
t_T, Track-to-track access time, ms	80#	140#	8#
Read time for 1 sector, ms	11	11	0.7
Read time for 1 full track, ms	167	200	16.7

#Experimantal Values   * Remapped for DOS

8.4 Superdisk (LS120)

Cover

Optical Pickup

Carriage Subassembly

Voice Coil Motor

Eject Motor
Under Software Control

Linear Encoder

Standard 3.5" Floppy
Media Load Mechanism

Laser Diode
Hologram
Linear Lens Array

LS-120 UHD Diskette

Light Detector

Rooftop Mirror

Linear Encoder