

# Magnetic storage devices



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**INTRODUCTION:**

Magnetic storage and magnetic recording are the term that refer to the storage of data on a magnetized medium. Magnetic storage uses different patterns of magnetization in a magnetizable material to store data and is a form of the non volatile memory. Using one or more read/write heads the information is accessed . Magnetic storage stores data by magnetizing microscopic particles on the surface of the device, whether it's a disk or it is a magnetic tape. There are several types of magnetic storage devices such as: Hard Disks, Floppy Disks, and Tapes. They can use Random Access or Sequential Access memory. Some magnetic storage devices can be moved from computer to computer and some can't. Some of them can be easily broken, and some are not, but most are sealed with a protective case.

Magnetic storage media and devices store data in the form of tiny magnetised dots. These dots are created, read and erased using magnetic fields created by very tiny electromagnets.

In the case of magnetic tape the dots are arranged along the length of a long plastic strip which has been coated with a magnetisable layer (audio and video tapes use a similar technology).

In the case of magnetic discs (e. g. floppy disc or hard-drive), the dots are arranged in circles on the surface of a plastic, metal or glass disc that has a magnetisable coating.

**HISTORY:**

Oberlin Smith was the first one to publicize magnetic storage in the form of audio recording on a wire in 1888. He filed a patent in September, 1878 but did not pursue the idea as his business was machine tools. The first publicly demonstrated magnetic recorder was invented by Valdemar Poulsen in 1898. Poulsen's device recorded a signal on a wire wrapped around a drum. In 1928, Fritz Pfleumer developed the first magnetic tape recorder. Early magnetic storage devices were designed to record analog audio signals. Computer and now most audio and video magnetic storage devices record digital data.

Magnetic storage was also used for primary storage in a form of magnetic drum, or core memory, core rope memory, thin film memory, twistor memory or bubble memory at old times. Unlike modern computers, magnetic tape was also often used for secondary storage.

**Magnetic recording classes****Analog recording**

Analog recording is based on the fact that remnant magnetization of a given material depends on the magnitude of the applied field. The magnetic material is normally in the form of tape, with the tape in its blank form being initially demagnetized. When recording, the tape runs at a constant speed. The writing head magnetizes the tape with current proportional to the signal. A magnetization distribution is achieved along the magnetic tape. Finally, the distribution of the magnetization can be read out, reproducing the original signal. The magnetic tape is typically made by embedding magnetic particles

in a plastic binder on polyester film tape. The commonly used magnetic particles are Iron oxide particles or Chromium oxide and metal particles with size of 0.5 micrometers. Analog recording was very popular in audio and video recording. In the past 20 years, however, tape recording has been gradually replaced by digital recording.

### **Digital recording**

Instead of creating a magnetization distribution in analog recording, digital recording only need two stable magnetic states, which are the +Ms and -Ms on the hysteresis loop. Examples of digital recording are floppy disks and HDDs. Since digital recording is the main process nowadays and probably in the coming future, the details of magnetic recording will be discussed in the rest of the project using the HDD as an example.

### **Magneto-optical recording**

Magneto-optical recording writes/reads optically. When writing, the magnetic medium is heated locally by a laser, which induces a rapid decrease of coercive field. Then, a small magnetic field can be used to switch the magnetization. The reading process is based on magneto-optical Kerr effect. The magnetic medium are typically amorphous R-Fe Co thin film (R being a rare earth element). Magneto-optical recording is not very popular. One famous example is Minidisc developed by Sony.

### **Domain propagation memory**

Domain propagation memory is also called bubble memory. The basic idea is to control domain wall motion in a magnetic medium that free of microstructure. Bubble refers to stable cylindrical domain. The information is

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then recorded by the presence/absence of bubble domain. Domain propagation memory has high insensitivity to shock and vibration, so its application are usually in space and aeronautics.

**Magnetic Storage Devices:**

The read/write capability of computer disk drives requires the relative motion of a magnetic media and a read/write magnetic head. Physical contact between the media and the head occurs during loading and unloading cycles. Tailoring the mechanical properties of the media and the head has become critical in order to minimize damage and loss of data. This application note is focused on the mechanical properties of the head slider. The tested head sliders are composed of an Al<sub>2</sub>O<sub>3</sub>-TiC composite with a thin 10 -20nm diamond-like-carbon protective overcoat. As shown in Figure 3, the slider surface is composed of two phases, Al<sub>2</sub>O<sub>3</sub> and TiC. The Hysitron Tribo Scope was the first instrument to report hardness differences for two material phases used in head sliders. The TriboScope is a quantitative depth sensing nanoindenter that can be interfaced with a scanning probe microscope to provide

This imaging capability distinguishes between phases in a composite material, making it possible to select the phase in which the indentation is to be performed. Once the indentation is performed, the surface is imaged a second time to characterize the indent. The applied force and the penetration depth of the indenter into the surface are measured simultaneously.

The lighter regions in the image correspond to the TiC phase while the darker regions can be attributed to the Al<sub>2</sub>O<sub>3</sub> phase. The insets in Figure 1 show the

indentations made in each phase. Both indentations were performed at the same peak applied force of 50 $\mu$ N.

### **Types of magnetic storage devices**

There are basically two type of storage devices

1. Removable storage devices
2. Fixed storage devices

### **Fixed storage devices**

#### **Fixed hard drive**

A hard-drive built into the case of a computer is known as 'fixed'. Almost every computer has a fixed hard-drive.

Fixed hard-drives act as the main backing storage device for almost all computers since they provide almost instant access to files (random access and high access speeds).

### **Removal magnetic storage devices**

#### **Portable Hard Drive**

A portable hard-drive is one that is placed into a small case along with some electronics that allow the hard-drive to be accessed using a USB or similar connection.

Portable hard-drives allow very large amounts of data to be transported from computer to computer.

Many portable music players (such as the iPod classic) contain tiny hard-drives. These miniature devices are just not much bigger than a stamp, but can still store over 100MB of data!

### **Magnetic Tape**

Magnetic tape is a large capacity, serial access medium. Because it is a serial access medium, accessing individual files on a tape is slow.

Tapes are used where large amounts of data need to be stored, but where quick access to individual files is not required. A typical use is for data back-up (lots of data, but rarely only accessed in an emergency)

Tapes are also used and in some batch-processing applications (e. g. to hold the list of data that will be processed).

### **Floppy Disc**

A removable, portable, cheap, low-capacity (1. 44MB) storage medium.

Floppy discs are random access devices used for transfer small amounts of data between computers, or to back-up small files, etc. Access times are slow.

Almost every PC used to have a floppy disc drive. These are obsolete now, having been replaced by higher capacity technology such as CD-ROMs, DVDs and USB memory sticks.

### **Zip Disc**

A removable and portable storage medium, similar in appearance to a floppy disk, but with a much higher capacity (100MB, 250MB or 750MB).

Zip discs are random access devices which were used for data back-up or moving large files between computers.

Another obsolete storage device, zip discs were a popular replacement for floppy discs for a few years, but they never caught on fully before being superseded by cheaper media like CD-ROMs and CD-Rs

### **Jaz Disc**

A removable and portable storage medium based on hard-drive technology, with a large capacity (1GB or 2GB).

Jaz discs are random access devices which were used for data back-up or moving large files between computers.

Discs were expensive to buy and not very reliable.

Like the Zip disc, this system never really caught on and was superseded by far cheaper and more reliable and cheaper technology.

### **Overview**

The Zip system is based loosely on Iomega's earlier Bernoulli Box system; in both systems, a set of read/write heads mounted on a linear actuator flies over a rapidly spinning floppy disk mounted in a sturdy cartridge. The linear actuator uses the voice coil actuation technology, related to modern hard drives. The Zip disk uses smaller media (about the size of a 9 cm (3½") microfloppy, rather than the Compact Disc-sized Bernoulli media), and a simplified drive design that reduced its overall cost.



This resulted in a disk that has all of the 9 cm (3½") floppy's convenience, but holds much more data, with performance that is much quicker than a standard floppy drive . The original Zip drive had a data transfer rate of about 1 megabyte/second and a seek time of 28 milliseconds on average, compared to a standard 1. 44MB floppy's 500kbit/s (62. 5KB/s) transfer rate and several-hundred millisecond average seek time. Today's average 7200RPM desktop hard drives have average seek times of around 8. 5-9ms.

Early generation Zip drives were in direct competition with the Super Disk or LS-120 drives, which held 20% more data and could also read standard 3½" 1. 44MB diskettes, but they had a lower data transfer rate due to lower rotational speed. The rivalry was over before the dawn of the USB era.

### **Compatibility**

Higher capacity Zip disks must be used in a drive with at least the same capacity ability. Generally, higher capacity drives also handle lower capacity media. However, the 250MB drive writes much more slowly to 100MB disks than does the 100MB drive, and it's unable to perform a long (i. e., thorough) format on a 100MB disk. The 750MB drive cannot write to 100MB disks at all, though they are the cheapest and most common of the three formats.

The retroreflective spot differs on the three media sizes such that if a larger disk is inserted in a smaller capacity drive, the disk is immediately ejected again without any attempt being made to access the disk.

### **Current usage**

As of 2007, common uses of magnetic storage media are for computer data mass storage on hard disks and the recording of analog audio and video

works on analog tape. Since much of audio and video production is moving to digital systems, the usage of hard disks is expected to increase at the expense of analog tape. Digital tape and tape libraries are popular for the high capacity data storage of archives and backups. Floppy disks see some marginal usage, particularly in dealing with older computer systems and software. Magnetic storage is also widely used in some specific applications, such as bank checks (MICR) and credit/debit cards (mag stripes).

### **Future**

A new type of magnetic storage, called MRAM, is being produced that stores data in magnetic bits based on the GMR effect. Its advantage is non-volatility, low power usage, and good shock robustness. However, with storage density and capacity orders of magnitude smaller than e. g. an HDD, MRAM is a niche application for situations where small amounts of storage with a need for very frequent updates are required, which flash memory could not support

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