

Floptical® Technology Primer



Ω-MEGA
Makers of Bernoulli™

Floptical® Technology Primer

Iomega and the Iomega logo are registered trademarks of Iomega Corporation. Floptical is a registered trademark of Insite Peripherals. All other company and product names are trademarks of their respective companies.

Copyright © 1992
Iomega Corporation, All Rights Reserved
Printed in USA

Iomega Corporation
1821 West 4000 South
Roy, Utah 84067

PREFACE

Floptical® technology is a new standard in floppy disk storage for microcomputers. Since the days of the original Personal Computer, floppy disk storage has been a part of almost every machine. During the last decade, the power and presence of personal computers have expanded at a vociferous rate.

However, the progress of floppy disk storage has lagged behind—until now. Now a **new generation** of storage with Floptical drives and media will expand the possibilities of the desktop computer. The capacity of Floptical diskettes will fulfill the growing data storage requirements of today's large disk drives and handle your needs for **compatibility** with 3½-inch flexible disk media. And this new dimension in storage is possible on the computer you are already using.

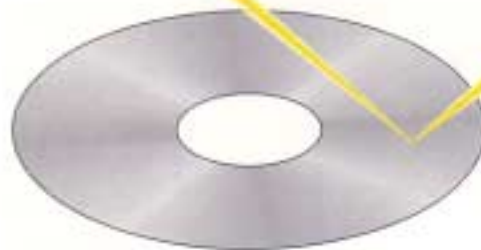
Relative Disk Storage

Floptical technology stores 21 MB per diskette, fourteen times previous high density floppies, providing greater convenience for users.



TABLE OF CONTENTS

INTRODUCTION	1
APPLICATIONS	2
FEATURES AND BENEFITS	3
FLOPTICAL TECHNOLOGY ASSOCIATION	4
FLOPTICAL TECHNOLOGY	5
DISKETTE TECHNOLOGY	7
THE FUTURE.	8
GLOSSARY	9



INTRODUCTION

Think for a moment about the floppy disk drive in the computer you use today. For most of you, it is a 3½-inch drive that stores either 720KB or 1.44MB of information per disk. Now imagine a drive inside your computer that could read, write, format, and boot your traditional 3½-inch floppy disks, but also had the ability to store 21 megabytes (MB) of information on a single disk. Plus, the new drive performs three times faster than your regular floppy drive. This is the Floptical drive.

A Floptical drive is simply a removable data

storage device that uses a new generation of 3½-inch Floptical diskettes with 21MB of capacity. The new drive works just like your system's current floppy disk drive, and will actually read and write your existing 3½-inch double-density (DD) 720KB and high-density (HD) 1.44MB floppy disks. (These are often referred to as 1MB and 2MB floppies based on unformatted capacities.) Thus, a Floptical drive can replace the existing 3½-inch floppy drive in your system or can add functionality of high-capacity storage to your system. Floptical technology is a

new **industry standard** for Very High Density (VHD) storage. Drives, diskettes, and host

adapter cards are available from a number of different vendors to ensure you the best possible products in a competitive market.

This Primer has been written to give you a clear understanding of this exciting technology so you can see how Floptical products can benefit your work. In the next section, we will explore some of these applications in more detail and show you some of the advantages. This booklet will also explain the features and benefits of Floptical products including drives and diskettes. Next, there is a section on the Floptical Technology Association, an industry group of companies developing and advancing the technology. Then, a technical description of drives and diskettes will explain how it all works. It concludes with a few



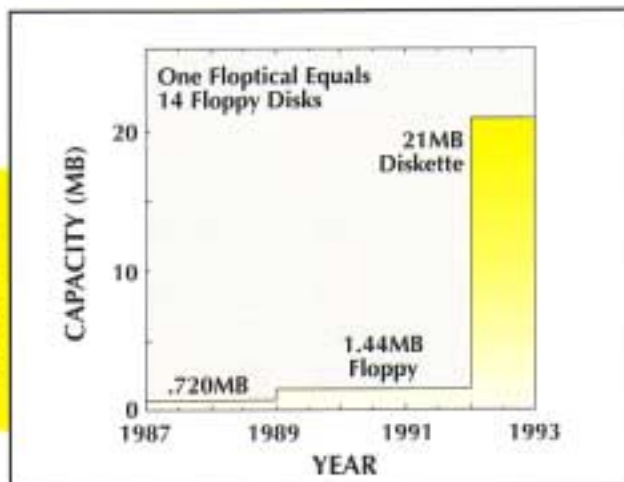
Floptical Diskettes . . .

. . . look similar to the billions of 3½-inch floppies already in use.

words about the future of Floptical technology.

Floptical Technology . . .

. . . provides high capacity removable storage to complement growing file sizes and hard disk capacities.



APPLICATIONS

Floptical drives and diskettes open a whole new set of application possibilities but the real power of this new technology is that it is also ideally suited to the applications you are already using on your computer today. A Floptical drive is just like a floppy disk drive—*only bigger and faster*. It can handle all of your needs for personal removable

storage such as:

File Storage. Whether removing old files from a hard disk drive, archiving project data, or simply organizing less frequently used data, 21MB capacity per diskette is ideal.

Backup. Today's large hard disk drives demand backup to protect the important data they store. Using traditional floppies, however, can be very time consuming and inconvenient. Using a 21MB Floptical drive, this task is much faster and much easier.

File Security. Floptical diskettes have the capacity to store large data files

and can be physically removed from the PC and locked in a safe or file cabinet for maximum protection.

Data Transfers. Nearly everyone has the need to share information with others locally or around the world. Traditional floppy disks often do not have enough capacity but compact, rugged Floptical diskettes are excellent for such file transfers.

Convenient Storage of Large Data Sets. New applications for computers are proliferating that demand large amounts of convenient storage. Multimedia, desktop publishing, presentation graphics,

Key Applications of Floptical Technology

- File Storage
- Backup
- Security
- Data Transfers
- Convenient Storage of Large Files

CAD/CAM, animation, imaging, still video, pen-based computers, local storage for diskless networked systems, workflow processing, large

databases, and other applications are expected to be new growth markets for Floptical technology. In fact, Floptical drives are suited for use

by anyone who is currently using a high volume of floppy disks and is looking for a more convenient and efficient method to store data.

FEATURES AND BENEFITS

Floptical technology offers many features that directly benefit users.

Capacity. With 21MB of storage, a Floptical diskette provides more than 14 times the storage capacity of high-density floppies. When using many backup programs that include a compression feature, capacity of over 40MB per disk is possible.

Compatibility. One of the unique features of Floptical drives is downward compatibility with previous floppy disks. Since 3½-inch floppies are now the standard, the market expects compatibility with existing media. The result is a single drive that can replace a standard 3½-inch floppy drive, with more capacity and greater speed, and still read, write, format, and boot a traditional floppy disk. Floptical

drives can be installed as drive A: on a personal computer and be the boot device, or set as any other drive volume and used as another storage resource.

Form Factor. The familiar 3½-inch standard has been used for floppies for many years. Over seven billion floppy disks are already in use throughout the world! Floptical diskettes and drives have the same small form factor. The familiar size diskette is convenient for handling the media, and allows drives to be compact enough to fit in 3½-inch storage bays.

Performance. Floptical drives offer higher performance than standard floppy drives. Typical access time is 65 milliseconds compared to as much as 150 ms for a conventional floppy drive. Rotational speed is increased to 720 rpm, which reduces average latency to 42 ms vs typical floppy drives that run at 300 rpm, which translates to an average latency of 100 ms. Performance of a Floptical drive relative to a floppy will vary by application, but the improvement will be about three times overall.

Key Features and Benefits of Floptical Technology

Features	Benefits
Capacity	Convenient Storage of Data
Compatibility	Replace or Enhance Your Floppy Drive
Form Factor	Small Size
Performance	Saves Time
Wide Support	Availability of Variety of Competitive Products

Wide Support. Many manufacturers of drives, diskettes, host adapters and computers offer Floptical products for a wide range of computers,

including IBM-compatible PCs based on ISA/EISA and Microchannel architectures; Apple Macintosh/Quadra computers; workstations; and

networks. This ensures broad availability of competitive products to the market.

FLOPTICAL TECHNOLOGY ASSOCIATION

ΩMEGA
Makers of Bernoulli®

3M **INSITE**
MKE

maxell.

Founding Companies . . .

. . . of the FTA include Insite Peripherals, Omega Corporation, Maxell, 3M Corporation, and Matsushita-Kotobuki Electronics Industries, Ltd.

An industry trade association comprised of major manufacturers, the Floptical Technology Association (FTA), was formed to establish Floptical drives and media as the standard for Very High Density (VHD) flexible storage. Founding members of the FTA

include Insite Peripherals, Omega Corporation, Maxell, 3M Corporation, and Matsushita-Kotobuki Electronics Industries, Ltd. In addition there are several Associate and Supporting member companies. Approved Floptical compatible products can be identified by the use of the FTA logo.

The FTA's goal is to establish Floptical technology as the next *de facto* standard by ensuring compatibility of drives, diskettes, and host adapters. This trade association has set standards for interchange of media in any Floptical drive and enjoys the participation and support of all the major manufacturers in Floptical products. Floptical technology has already received endorsement as the VHD floppy standard from the Microcomputers

Managers Association (MMA), an influential group of IS managers and system professionals in Fortune 500 companies. The benefit to users is availability of Floptical products from a variety of sources. Multiple manufacturers ensure that the market will receive competitive and compatible products and offer security that the technology will continue to progress long into the future.



Approved . . .

. . . Floptical compatible products can be identified by the FTA logo.

FLOPTICAL TECHNOLOGY

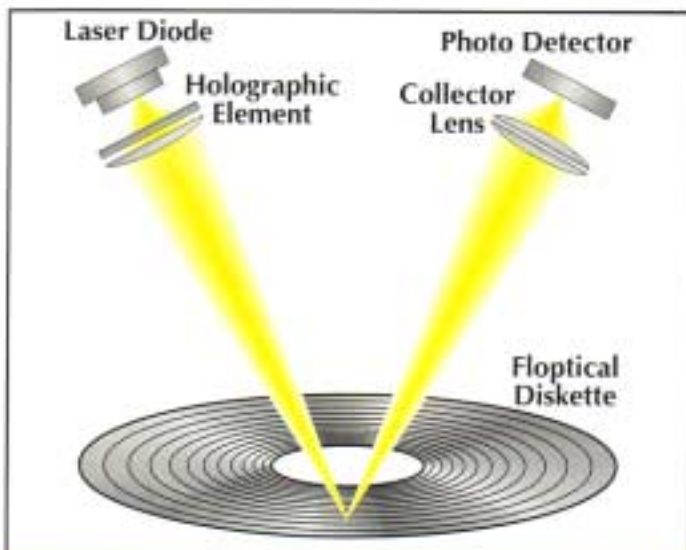
To appreciate the improvements of Floptical technology, it may be helpful to get an understanding of conventional floppy disk recording. Flexible disks have their roots in digital magnetic recording developed in the 1950s. Over time, form factors have been reduced from 8-inch diameter disks to 5¼-inch to 3½-inch form factors since then. A standard 3½-inch flexible disk drive uses a magnetic recording scheme with a density of

135 tracks per inch. This results in 1.44MB of usable data storage on a 2MB (unformatted) high-density disk. Tracking is done using a stepper motor to move the head to a pre-determined radial position. A floppy drive is "blind" in that there is no continual feedback process to sense the actual head position relative to the disk. The ability for different drives to accurately set the head position to the correct track necessary for interchange of

media has limited the track spacing, hence limited capacities for these devices.

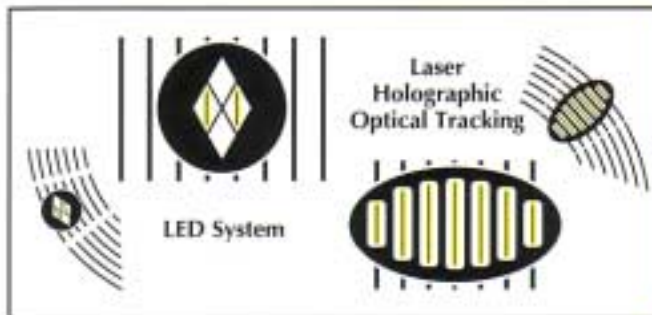
The name Floptical comes from a combination of flexible magnetic media and optical positioning. Floptical technology accomplishes its 14-fold increase in capacity by putting more tracks of data on each side of the diskette. Floptical drives use the same proven magnetic recording of conventional floppy drives with an optical tracking system to allow very precise and repeatable positioning of the head over the disk. Floptical diskettes are manufactured with a permanent pattern of concentric grooves stamped or etched into the media at a spacing of 20.4 microns. The flat areas between grooves, called *lands*, provide a higher reflective surface than the grooves. Since the servo tracks are permanently embedded in the disk, they cannot be erased.

The closed loop servo tracking system starts



Floptical Technology . . .

. . . achieves high capacity by using optical servo positioning to pack more tracks on a disk than conventional floppies.



Tracking Schemes

Some Floptical drives employ an **LED system** to position the magnetic head over the optical tracks. In other diskettes **Laser Holographic Optical Tracking** creates a Moiré pattern that detects position over multiple tracks simultaneously for higher signal-to-noise ratio and greater reliability.

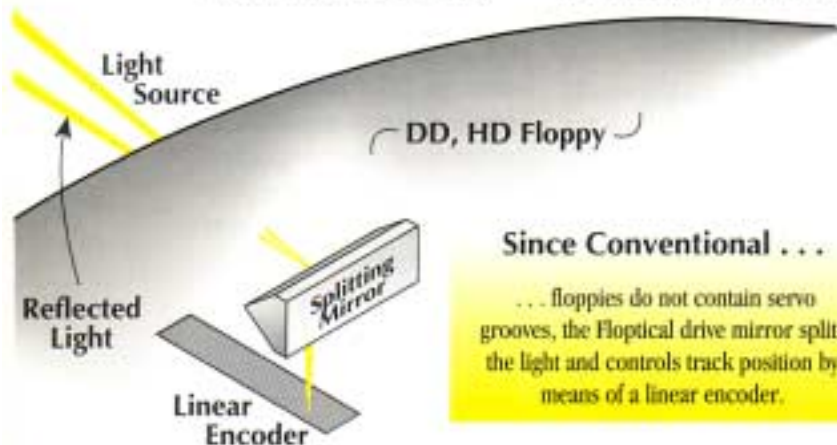
with a Light Emitting Diode or laser as a light source. Light travels through a set of lenses and optical elements, then is directed via a mirror to the diskette surface. The reflected light is passed back through the mirror, focused through a lens to a photodetector, completing the servo loop. The signal in the photodetector is monitored to constantly update the head position over the diskette. This **optical servo** process enables a track density of 1245 tracks per inch, compared to 135 tracks

per inch for floppies, that results in very high capacity per disk. On more advanced drives, **Holographic Optical Tracking** is used instead of conventional single track following. With this technique a grating pattern is projected onto the diskette surface. This Moiré detection method enables reflection over an area of the disk several tracks wide resulting in higher signal-to-noise ratio (see figure at upper left).

Previous generations of floppy disk media do not

have grooves for the optical system to follow. In this case the Floptical drive relies on either a stepper motor or reflections from an optical linear encoder mounted on the base to simulate the track spacing used on conventional disks (see figure at lower left).

Like conventional flexible disks, actual recording on a Floptical diskette is done using a magnetic head that alters the magnetic orientation of the minute particles on the diskette. Floptical diskettes are coated with barium ferrite (BaFe), a magnetically sensitive material. Barium ferrite magnetic particles have a hexagonal shape that lay flat on the surface. This provides longer magnetic retention and allows higher density recording than needle-shaped particles used in conventional gamma ferric oxide media. This higher grade

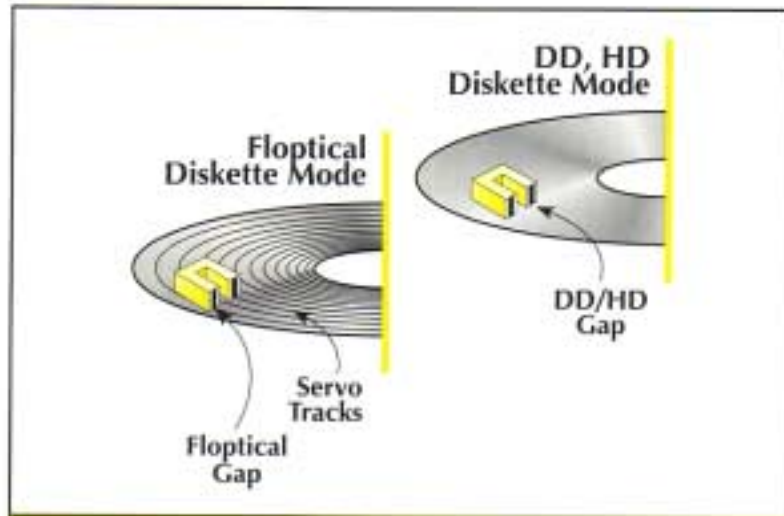


Since Conventional . . .

. . . floppies do not contain servo grooves, the Floptical drive mirror splits the light and controls track position by means of a linear encoder.

magnetic particle is also more environmentally stable to ensure reliability in extreme conditions.

Compatibility with conventional floppy disks is achieved with a dual gap magnetic head in the Floptical drive. One gap has a very narrow spacing for reading and writing Very High Density Floptical diskettes. The other gap has geometries for reading and writing double-density and high-density floppy disks (see figure at right).



Dual Recording Modes

The dual gap magnetic head in a Floptical drive will read and write Floptical diskettes or conventional floppies for compatibility with existing media.

DISKETTE TECHNOLOGY

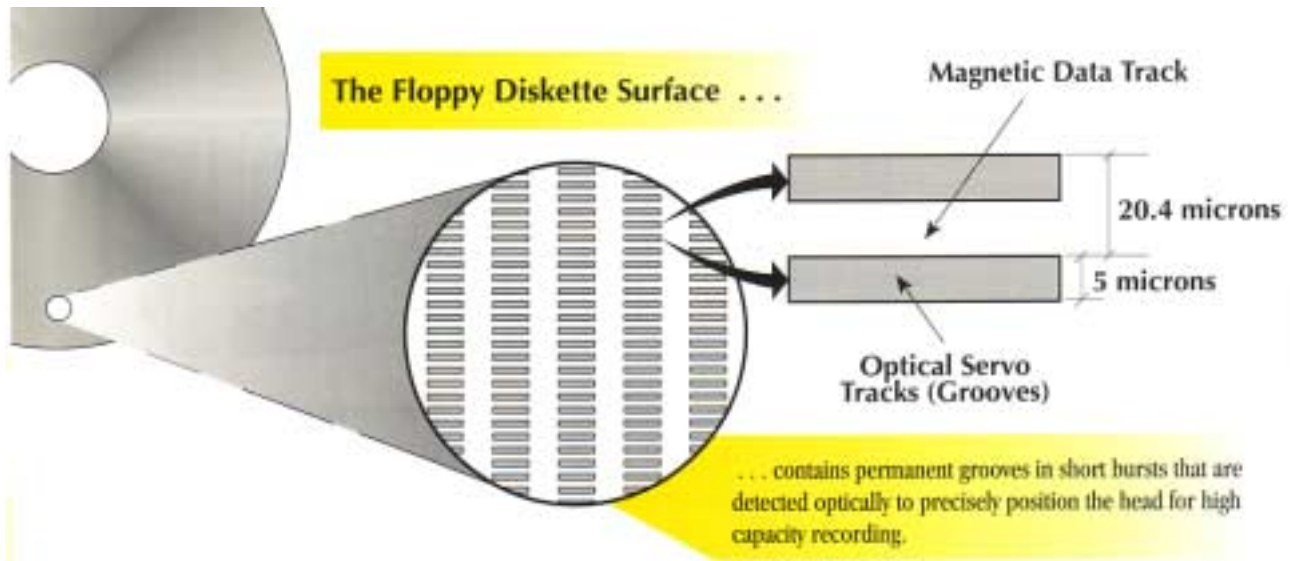
As you learned in the last section, Floptical technology relies on the servo tracks or grooves embedded in the disk surface for accurate positioning to achieve high capacity. These grooves are not continuous but are laid down in short bursts, somewhat like the markings that divide lanes on a highway. There are, in fact, 1,499,400 distinct marks on each Floptical diskette.

There are two fundamental manufacturing processes that are used: stamping and laser etching.

In a stamping process, a master die is created first. From this master, daughter dies are made that are used to manufacture individual diskettes. After a diskette is coated, cut and ready for its servo markings, it is placed in a large hydraulic press which carefully squeezes the grooves into the sur-

face from the die. As the die penetrates the diskette surface, material is displaced up as well as down, leading to possible variation in surface reflectivity. Dies must be kept extremely clean to avoid any material between the diskette and the die which would cause imperfections in the finished media.

For the laser etching process, each diskette is placed on a precision spindle and an Argon Ion



laser etches each of the servo marks as the disk spins. This process ensures an optical pattern for high contrast while maintaining a smooth surface. At the same time, this process allows for the

magnetic reference track to be located on the diskette with very high accuracy using the laser guidance system. With laser etching, every diskette is essentially a master.

Floptical diskettes from all approved manufacturers, whether stamped or laser etched, are capable of working in any Floptical drive.

THE FUTURE

Floptical technology uses magnetic recording and optical tracking to achieve high capacity and compatibility. This clever synergy of proven technologies has created a new standard that meets the market demand for reliable and convenient removable storage. But where do we go from here?

Certainly, observers of

computer technology know that successful technologies are continually improving. Manufacturers of Floptical drives, adapters, and diskettes intend to make this happen as well. The future of Floptical technology is sure to include higher capacities from tighter track spacing and bit spacing, and lower costs from manufacturing efficiencies at higher vol-

umes. In addition, performance and reliability will continue to be enhanced with improved designs. The biggest change, however, will be the large number of computer users who will demand, then expect, the capabilities provided by this technology.

GLOSSARY

Average Latency. The time required for a disk to rotate one-half revolution.

Barium Ferrite. A type of magnetic particle used in some recording media including Floptical diskettes.

Downward Compatibility. The ability to read and write earlier generation media such as conventional floppy disks.

Floptical Technology. The combination of optical servo track positioning and magnetic read-and-write technologies used in 3½-inch Very High Density floppy disk drives. Floptical is a registered trademark of Insite Peripherals.

Gammic Ferric Oxide. The type of magnetic particle used in conventional floppy disks.

Holographic Optical Tracking. An optical servo system that uses a holographic element to project a pattern onto the disk surface and measure the reflection over several tracks simultaneously. This technology is patented by Iomega Corporation.

Laser Etching. A manufacturing process used to create the servo markings in Floptical diskettes by etching grooves in the surface of the diskette with a laser.

LED. Light Emitting Diode, which is an electronic light source.

Millisecond. One thousandth of a second.

Moiré pattern. An independent pattern seen when two geometrically regular patterns, such as sets of parallel lines, are superimposed.

Optical element. Items including lenses, prisms, slits, etc. that form and control a light beam.

Reference Track. A special magnetic track placed on Floptical diskettes used by the drive to calibrate the optical tracking system with respect to the magnetic recording tracks.

Servo. In a disk drive, a system that controls the output of a device such as head actuator position by monitoring the signal of another device such as optical signal strength.

VHD. Very High Density diskette.

Omega Corporation
1821 West 4000 South
Roy, Utah 84067