FLUORESCENT MULTILAYER DISC

PRESENTED BY

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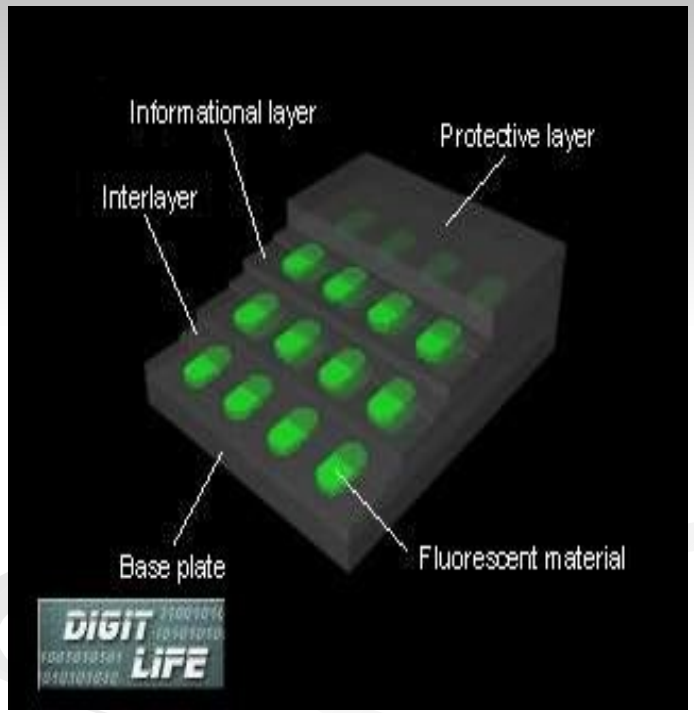
ROLL NO:22

FLUORESCENT MULTILAYER DISC (FMD)

- Fluorescent Multi-Layer Discs (FMDs) are a new technology being developed by Constellation 3D Inc.
- Implement the concept of volumetric storage of information.
- FMD stores digital data in three dimensions.
- It is an optical data storage format similar in size and appearance to regular CD-ROMs and DVDs.
- FMD is a readable and re-writable disc.

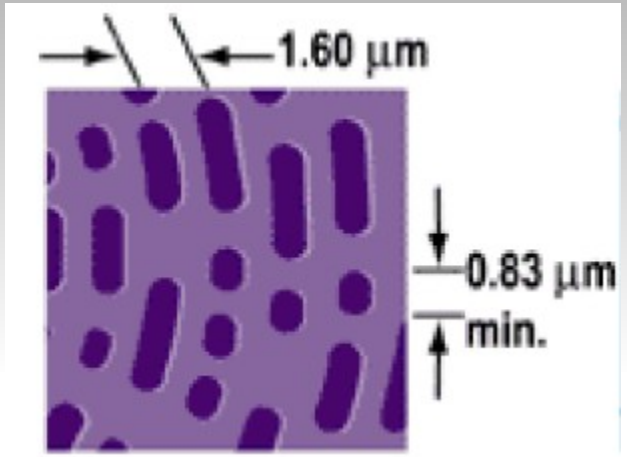
- Max data transfer rates are approximately 1GB/sec.
- FMD is a transparent disc.
- It consists of multiple data layers.
- Data is recorded on multiple layers inside a disc.
- Capacity of each data layer is 4.7 GB.
- Each data layer consists of pits & groves.
- Pits are embedded with transparent fluorescent material.

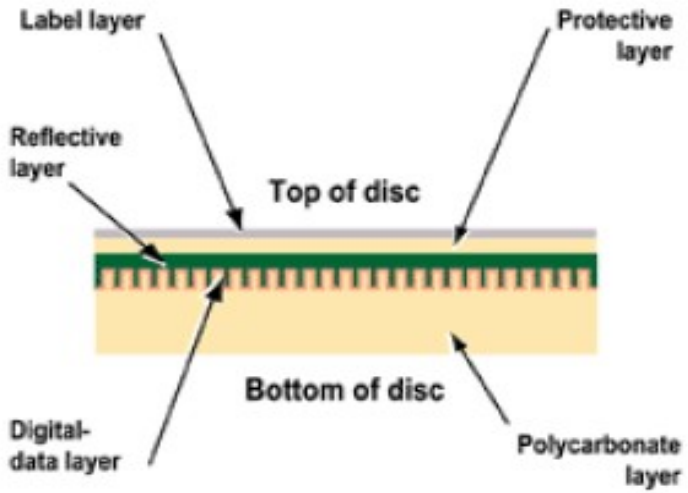
- Recording, reading & storing of data is accomplished by fluorescent material.
- Fluorescent material emit radiation when exited by an external light source.
- FMD can hold up to 20-140GB of data on 12-30 data layers, with total thickness under 2mm.



OVERVIEW ON CD-ROM

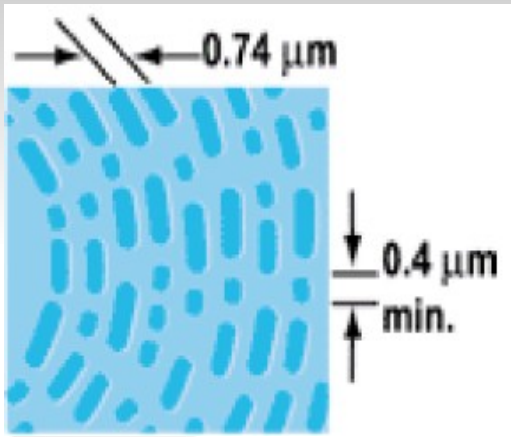
- Single data layer
- Data layer - Reflective (Aluminum)
- Data bits stored in the form of physically molded pits.
- Smooth area surrounding pits are called lands.
- Red laser is used to read data.
- Storage capacity : 650MB.
- Data access speed range: 80 to 120ms
- Max data transfer rate: 5MB/sec.





OVERVIEW ON DVD-ROM

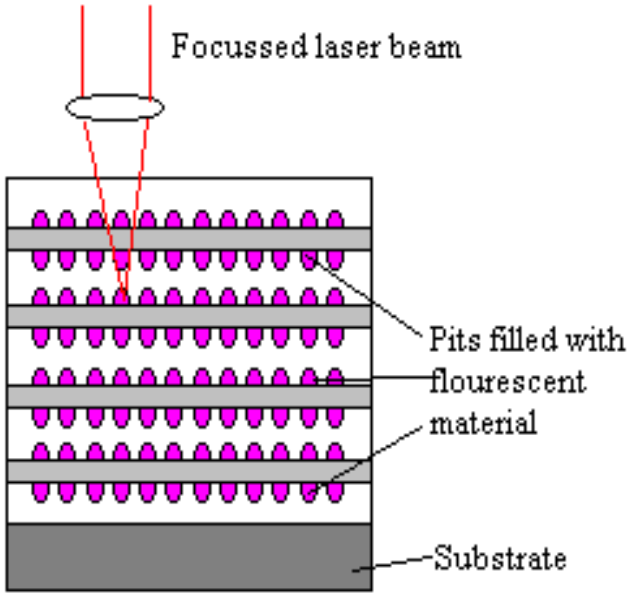
- DVD consists of 2 data layers.
- Data layer - Reflective (Aluminum)
- Distance between recording tracks: less than half of CDs.
- Pit size is less than half of that of CD-ROMs.
- Red laser is used to read data.
- Require reduced laser wavelength to read small size pits.
- Storage capacity : 40GB



TECHNOLOGICAL OVERVIEW OF FMD

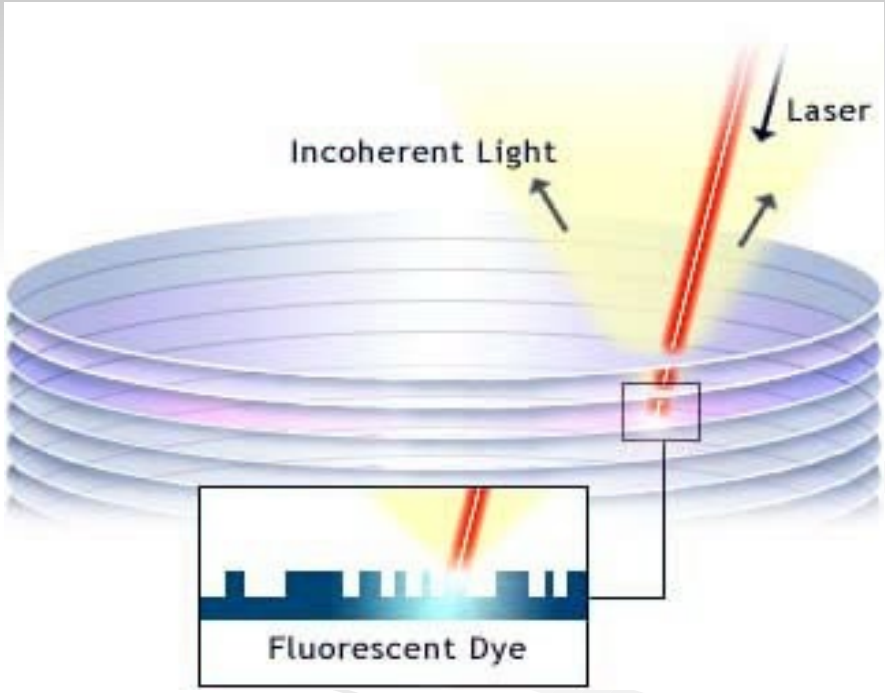
- FMD is a transparent disc.
- No reflective layer like CD/DVD.
- Technology in CD:
  - Beam of laser hits on data layer
  - It reflects from aluminum data layer
  - Fixed with a detector-receiver

- Technology in FMD:
- No reflected laser beam.
- Principle of operation based on a phenomenon "photochromism"
  - An organic material called '***stable photochrome***' is used as fluorescent material.
  - Photochrome initially doesn't possess fluorescent properties.
  - Photochrome when acted upon by laser beam starts photo chemical reactions & obtain the fluorescent properties.

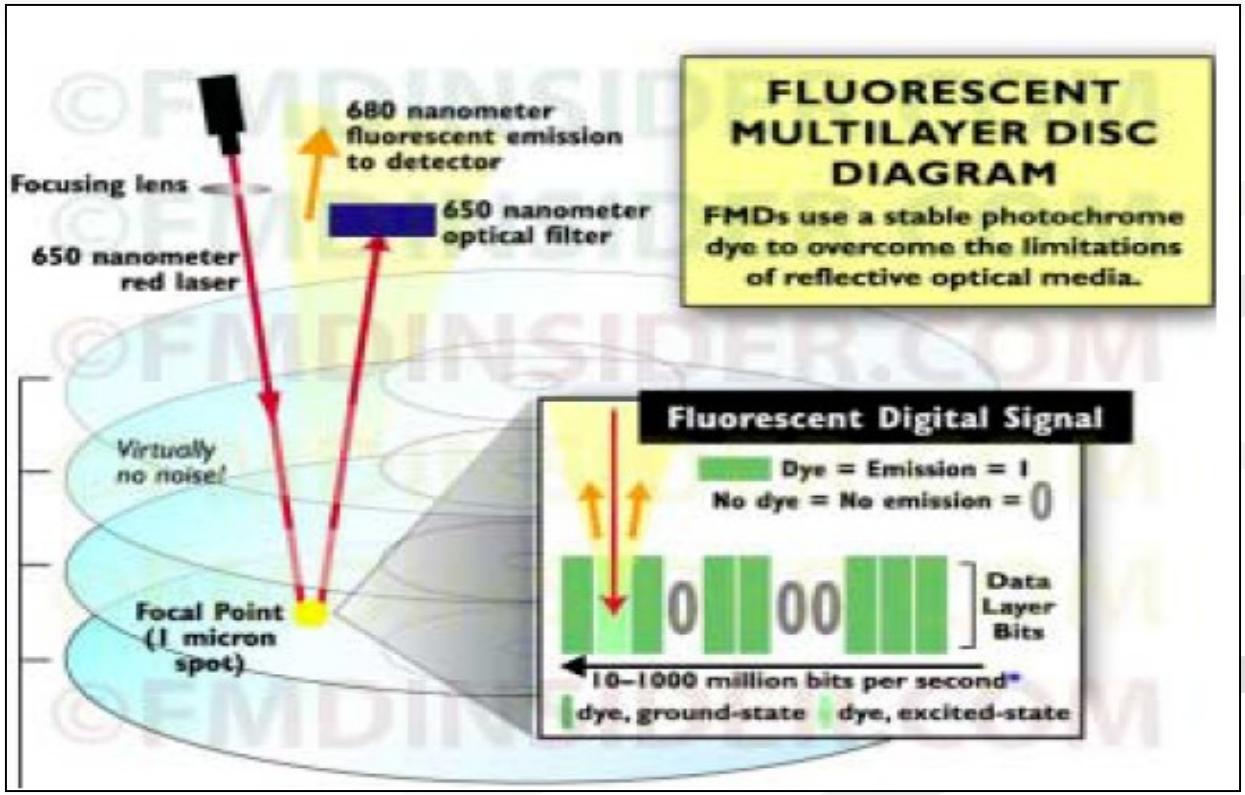


An 8 layer FMS

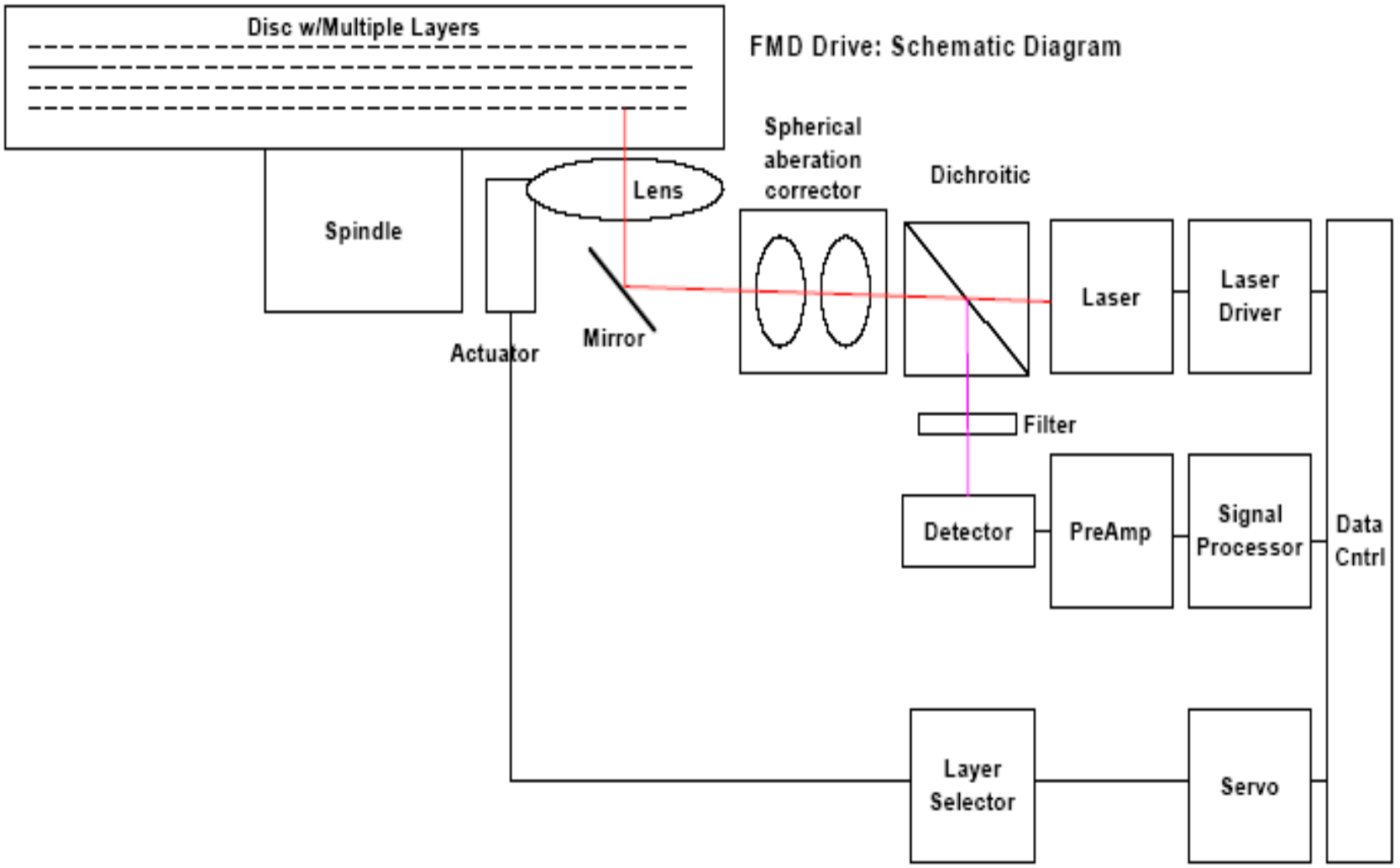
- Simulation of fluorescent material by laser to produce incoherent light.
- Emission of data stored incoherent light.
- Incoherent light passes through adjacent data layers without getting distorted.
- Filtration of emitted light before it reaches the drive's detector.
- Only the data-carrying fluorescent light passes after filtration.



- Filtration reduces the effect of stray light and interference.
- This fluorescence light is caught up by the photo receiver.
- And assigns a value “1”.

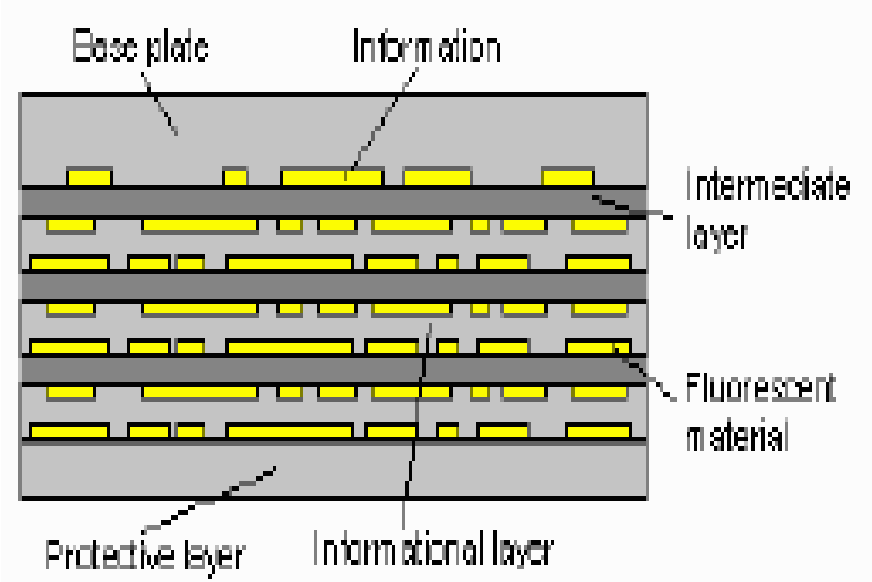


FMD DISC DRIVE



TECHNOLOGICAL PROCESS OF MANUFACTURE

- Two types of technological process for FMD manufacture.
  - Hot Stamping
  - Photo Polymerization
- Hot Stamping
  - Pressing of polycarbon sheets with two stamps at high temperature.
  - Formation of a layer with two information sides.

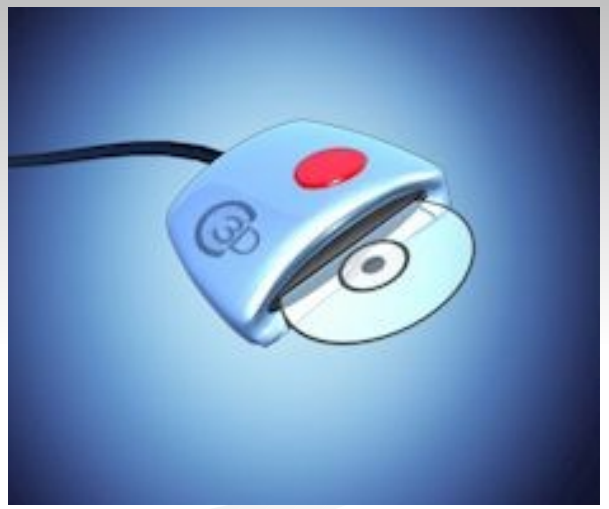


- Filling pits with fluorescent material.
- Pressing of informational layers when material gets hard.

- Photo Polymerization
  - For production of multiple disc by stacking of discs one after other.
  - Manufacture of thin plastic film for informational layer.
  - Plastic film is of 25-30 micron width.
  - Film is stamped & then installed on external surface of a nickel matrix that carry negative copy of produced information layer.

- Pit formation: On rotation of matrix, photopolymer matter is evenly brought in space between stamp surface & plastic film.
- Film get detached from stamp surface when it gets hard
- The base plate now contain pits of definite geometry.
- When a layer with required position of pit is ready, they are filled with fluorescent material (covers whole informational side)
- Chemical processing & defect checking.
- Layers stuck to the base plate 0.6mm in width
- Finally covered with a protective layer

FMD RECORDING



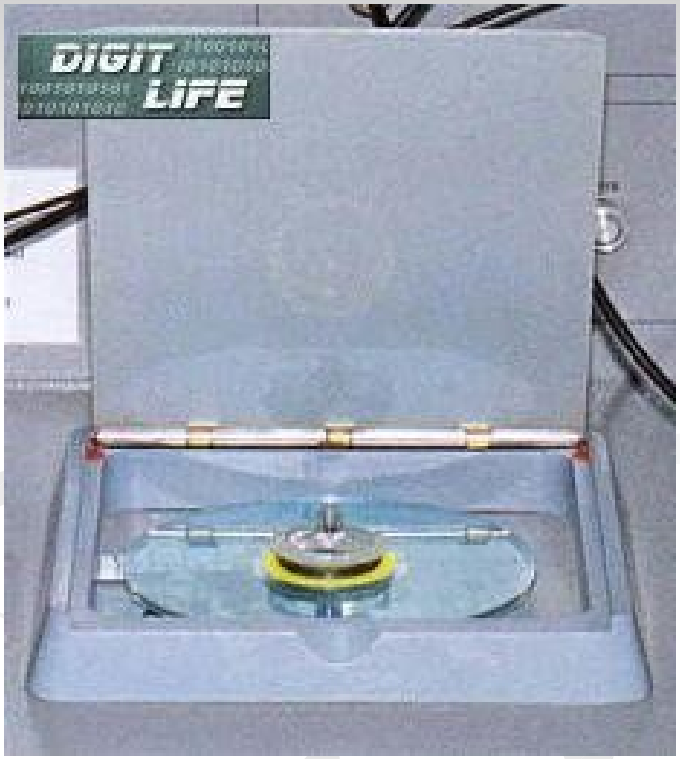
- Technology used: WORM (Write Once Read Many)
- A series of rewritable discs called FMD WORM
- Two rules to be followed while recording :
  - The write laser should able to turn the fluorescence on or off.
  - Threshold power of laser for recording & less power for reading.

Recording principles in FMD

- **Thermal:**
  - Usage of materials that possesses fluorescent properties from beginning (logical one).
  - When recording the segments, which are thermally acted upon with laser, the fluorescent properties are lost (logical zero)
- **Chemical:**
  - Usage of a material that doesn't possess fluorescent properties form the beginning.
  - When acting upon with a laser a photochemical reaction starts, and the material gets fluorescent properties.
  - a low power laser is enough, or even a usual LED

FMD READ DEVICE

- Drives for FMD can easily understand CD/DVD.

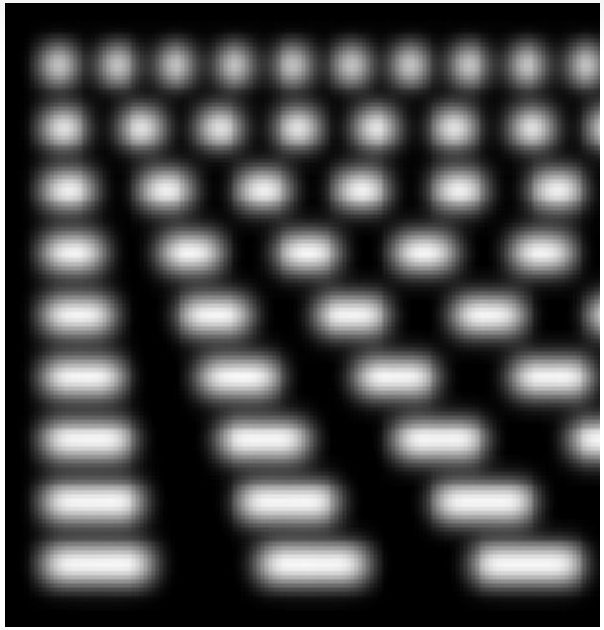


- FMD drives are similar to CD/DVD.

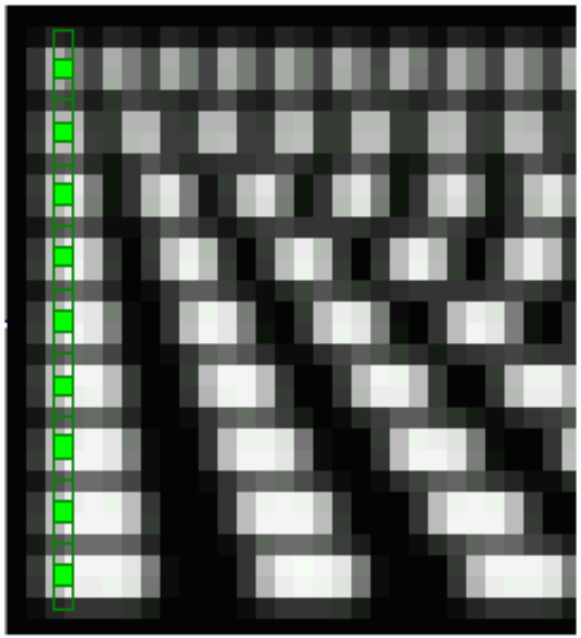
- Three types of reading:
  - Successive reading
  - Successive-parallel reading
  - Parallel reading

- Parallel Reading
  - A sequence of bits is recorded not along a track but deep into layers.

- Reading process is carried out with the help of a photosensitive element (an array of CCD cameras)
- Device can read low-power fluorescence of several tens MHz.
- Reading speed reaches 1 gigabit/s
- Mechanical speed of the drive is 450 times lower than that of DVD.



12x enlargement of FMD segment received with CCD cameras



Signals received from each element of CCD array

ADVANTAGES OF FMD

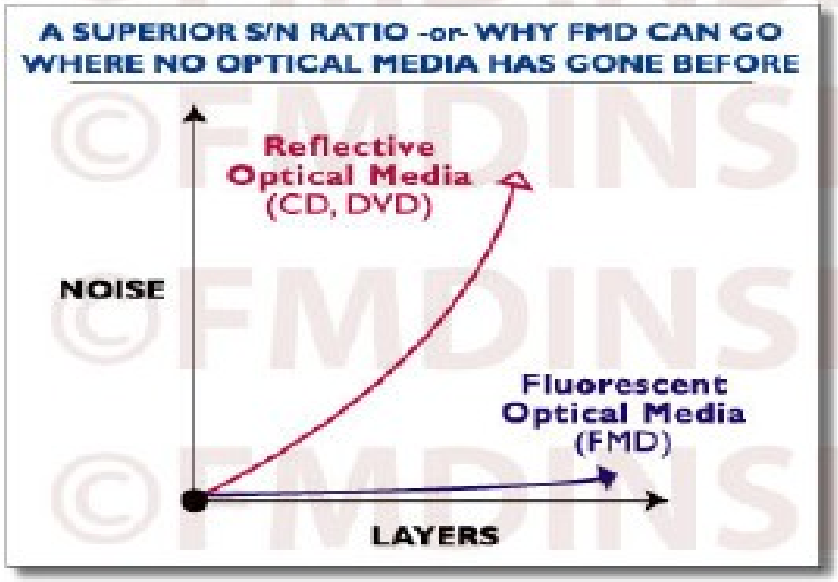
- Increased disc capacity
- Quick parallel access and retrieval of information
- Media tolerances & Usage flexibility
- Optically transparent and homogeneous multilayer system
- Emission of incoherent light eliminates interference.
- Compatible with present CD/DVD formats & ability to withstand more extreme conditions.
- Unique dye chemistry of FMD offers an extraordinary amount of security.
- Cost of production of FMD discs is relatively cheap.

COMPARISON OF CD,DVD,FMD

Parameter	CD	DVD	FMD
Disc diameter, mm	120	120	130
Capacity, GBytes	0.64	17.4	50.8
Number of layers	1	2 (each side)	12
Distance between layers, Micron	-	40	25/5
Total width of informational layers, Micron	0.11	2	275
Format	CD	DVD	Modified DVD
Distance between tracks, Micron	1.6	0.74	0.8
Optical system wavelength, NM	780	635-650	532

PUSHING THE OPTICAL STORAGE ENVELOPE

CD, DVD, and FMD use the same form factor and red laser configuration, with radically different results.



1000MB = 1 gigabyte [GB]
1000GB = 1 terabyte [TB]

REFLECTIVE PARADIGM

FLUORESCENT PARADIGM

DVD INCREASES PIT DENSITY

FMD INCREASES VOLUME

1 CD	7 CDs	12 CDs	25 CDs	38 CDs	75 CDs	469 CDs
CD-ROM	DVD-5	DVD-9	DVD-18	FMD-25	FMD-50	FMD-Z¥
0.64 GB	4.37 GB	7.95 GB	15.9 GB	24 GB	48 GB	@300 GB
1 layer	1 layer	2 layers	2 layers/side	@8 layers†	@16 layers	100 layers

APPLICATIONS

- Storage of a very high detailed archive of maps.
- Ability to store a large amount of files in uncompressed format.
- Ability to store the whole of a series of TV programme (eg, 20 episodes, each an hour long).
- Digital cinema film, HDTV players.
- Internet content streaming and data backup storage.

CONCLUSION

- Man's need for additional storage space is increasing .
- The FMD Digital Cinema disc has the potential to provide a secure, removable, single disc distribution method.
- The FMD can provide us with a staggering 140 GB of storage space seems to be an enticing solution for the storage - hungry masses.

THANK YOU

QUESTIONS ?