EE 494 Presentation
Scott Basu
2/26/99

"Optoelectronics in the Audio Electronics Industry"

DVD-RW?

MD ⇒

Compact Disc ⇒

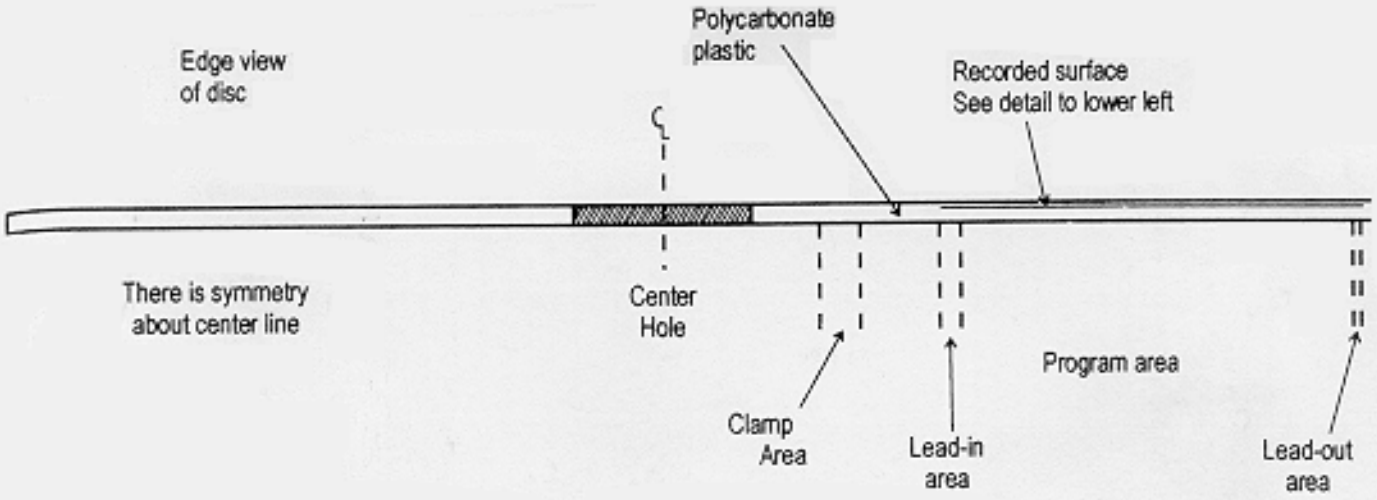
Analog Cassette Tape ⇒

LP Phonograph ⇒

References: "Consumer Electronics for Engineers," by Philip Hoff, Cambridge University Press, Cambridge UK, 1998.

"SonyDrive Audio Technology," by Sony Corporation of Japan, http://www.sony.co.jp/TechnoGarage/futureTech/audio.html

Disc Geometry



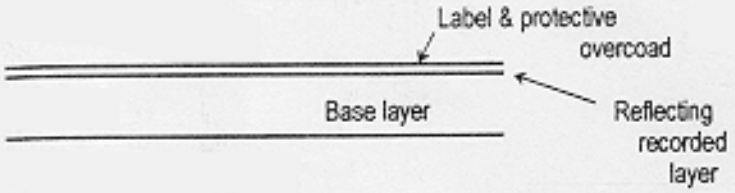


Fig. 9.1: Scale drawing of the structure and geometry of a CD. (a) Entire disc. (b) Close-up.

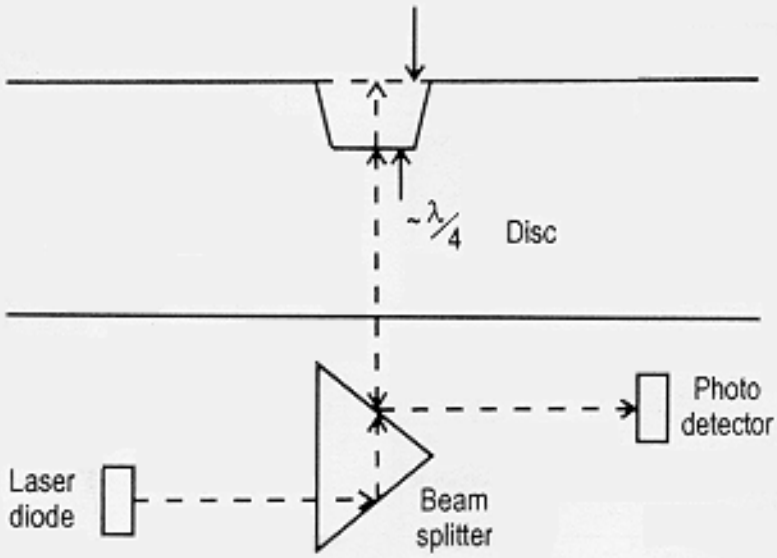


Fig. 9.2: Oversimplified drawing of the optics of a CD player.

Encoding / Recording to Disc (1)

Sony's Error Countermeasures

1. Alternating L and R 16-bit data words

(1 Frame = 32 bits [L & R] x 6 [samples] = 192 bits audio data)

2. Interleaving: Even bytes are delayed by 2 bytes ---> Interpolation is possible!

3. Reed-Solomon Error Correction Code (middle parity bits)

4. Cross Interleaving: Frames are spread out

5. Reed-Solomon Error Correction Code (middle parity bits added again)

6. One-byte Interleave: Nullify Random Errors

7. Control & Display bytes: Frame Sync,Channels (2 or 4), Selection #, Index #, Minutes, Seconds, Error Coding

Encoding / Recording to Disc (2)

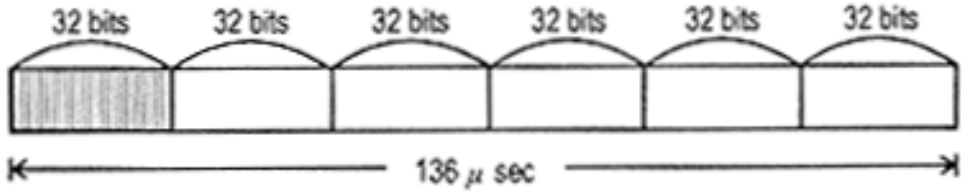


Fig. 9.3: Schematic representation of the data symbols in one frame of a CD recording.

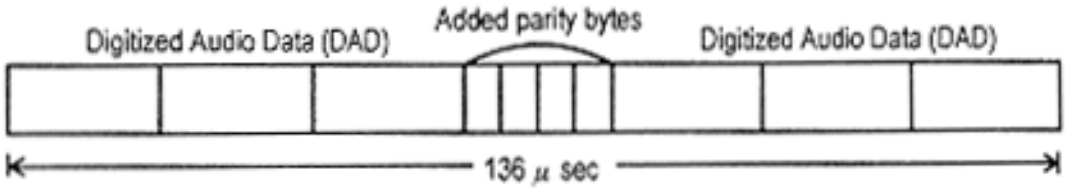


Fig. 9.4: Schematic representation of the same data as shown in Fig. 9.3, but with the addition of the four parity bytes introduced by the C2 Reed–Solomon encoder.

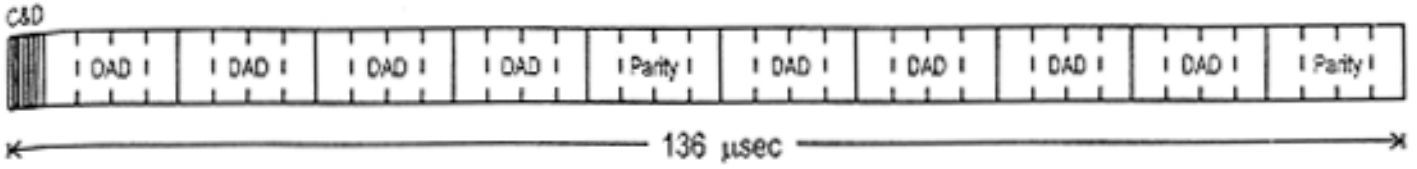


Fig. 9.5: Schematic representation of the same data as shown in Fig. 9.4, but with the addition of the four parity bytes introduced by the C1 Reed–Solomon encoder and the C & D byte.

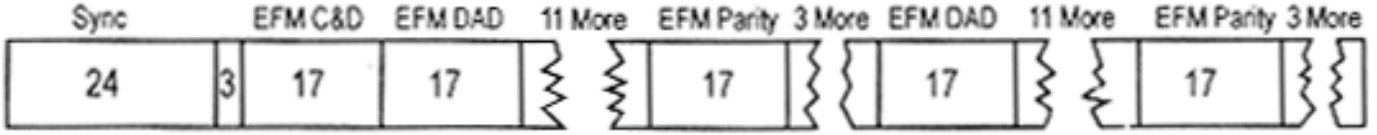
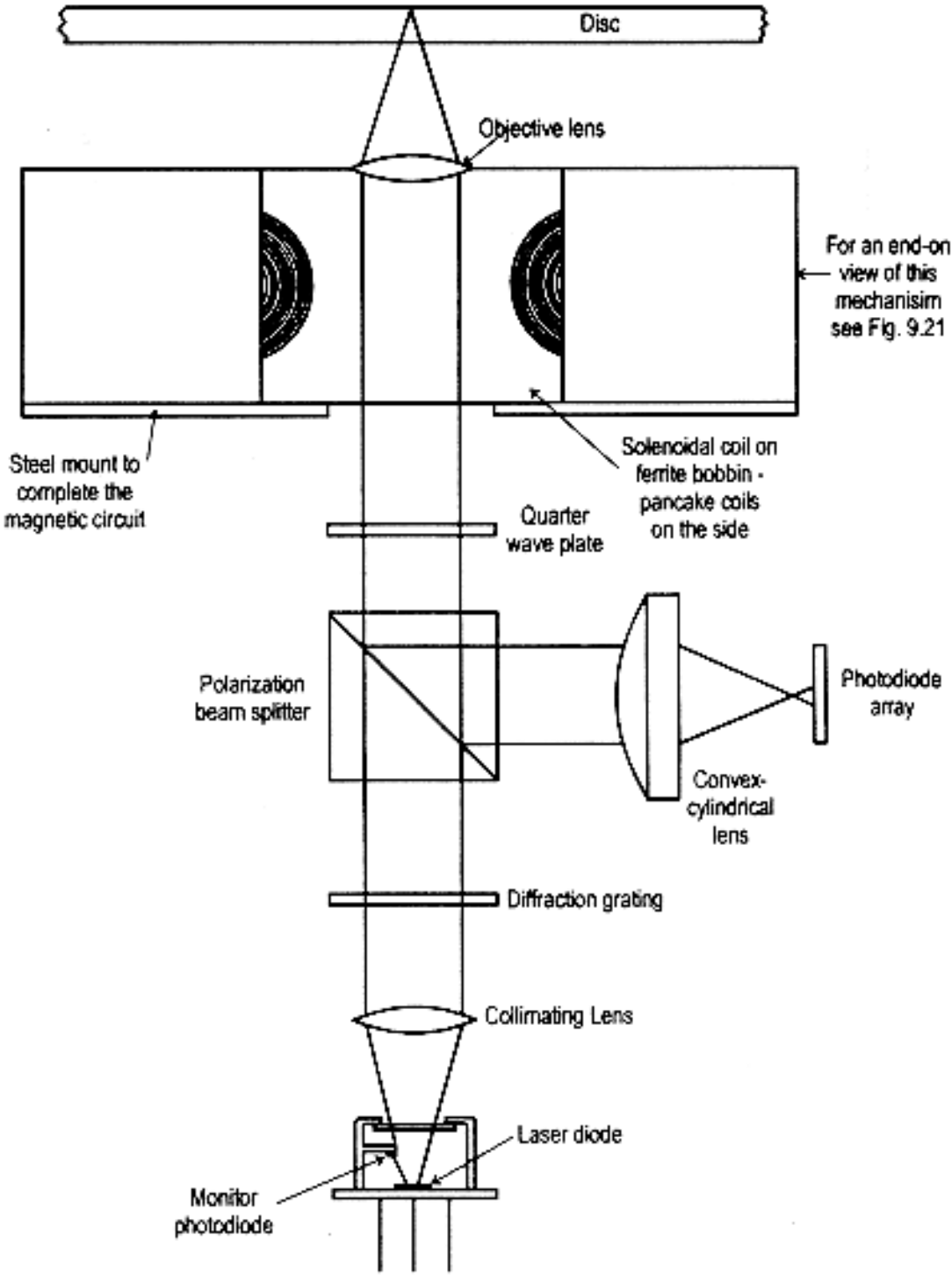


Fig. 9.6: Schematic representation of the same data as shown in Fig. 9.5, but with all of the symbols (bytes) having been EFM encoded and merged, and a 24-bit sync word appended to the beginning of the data. This then is the full 588-byte block of data that constitutes a frame in a CD recording.

CD Player Optics



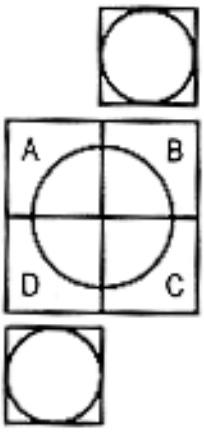


Fig. 9.16: Schematic representation of the structure of the photodiode assembly used in a three-beam CD player.

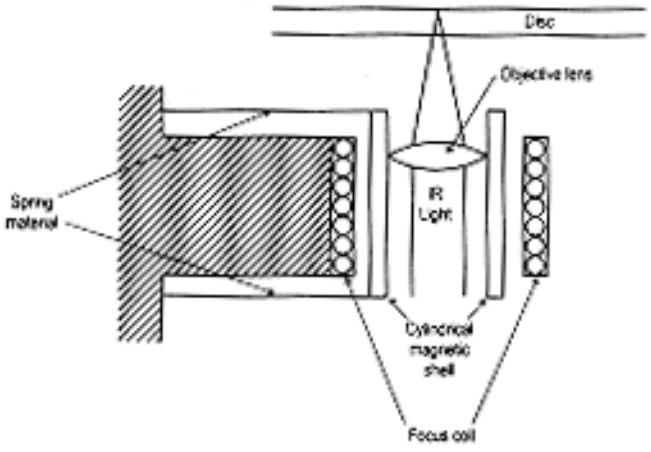


Fig. 9.19: Cross-sectional drawing of one type of focus assembly used in CD players.

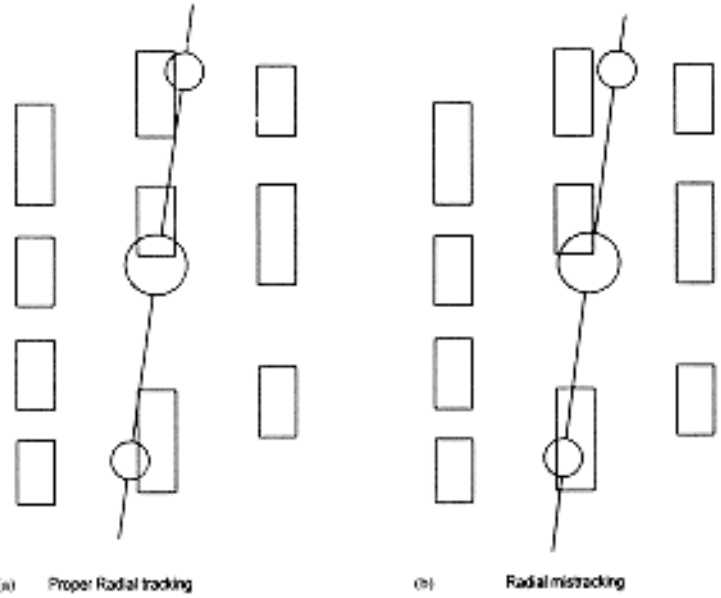
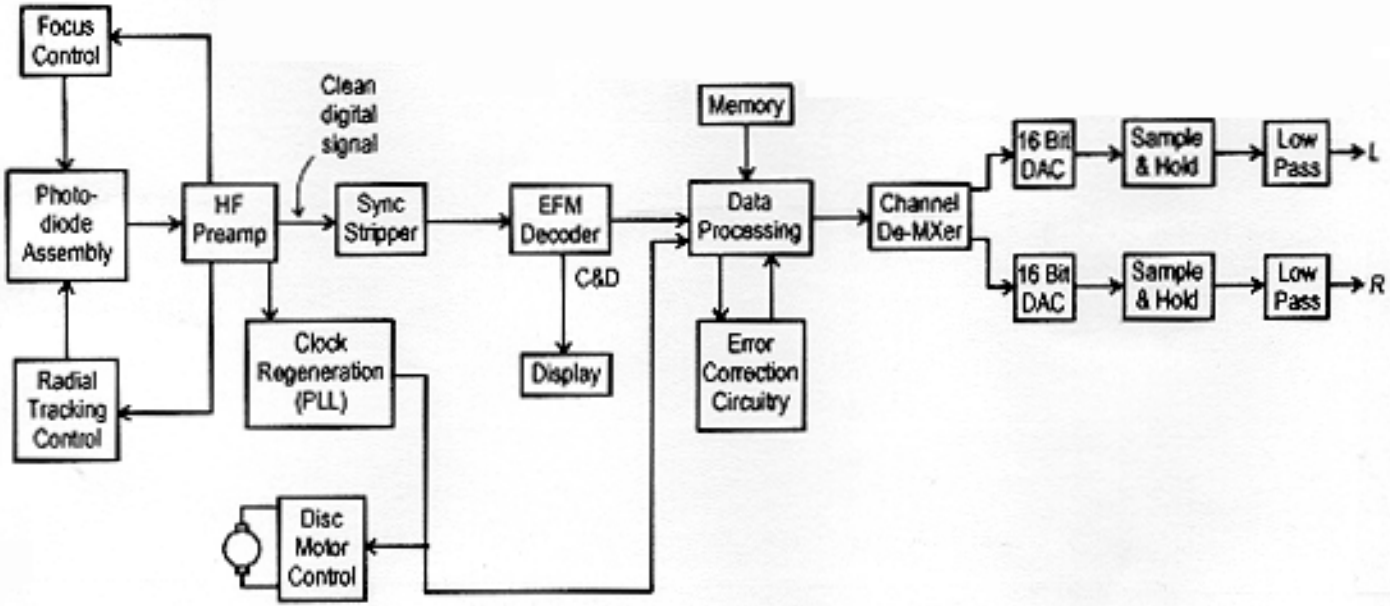


Fig. 9.20: A portion of the pit structure of a CD with the positions of the triple beam imposed upon it. (a) Proper radial tracking. Note that the tracking beams each overlap the edges of the pits by the same amount. (b) Radial mistracking. Note that the right hand tracking beam does not "see" any part of the pit, and the left one half overlaps it. This will cause a large difference in the light received by the two tracking photocells, which is interpreted as a tracking error.

Schematic Diagram of a CD Player



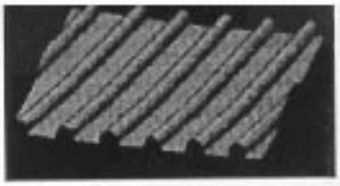


Diagram One

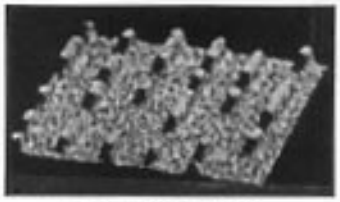


Diagram Two

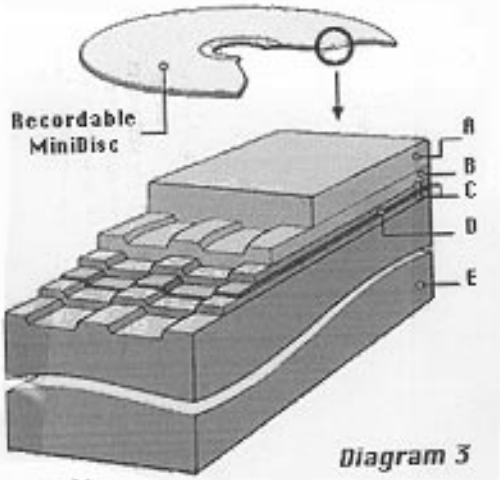
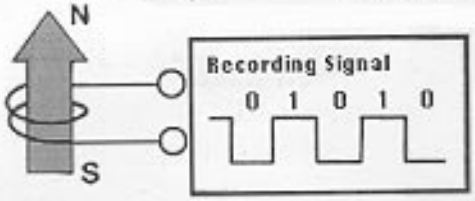


Diagram 3



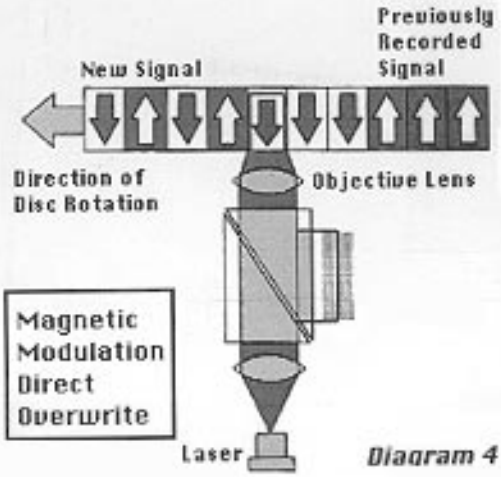


Diagram 4

The MD System

The Recordable MiniDisc (MD) is a cartridge-type disc. As seen in the animation at left, inside the outer shell of the Recordable MD is a Magneto Optical Disc similar to a common Compact Disc, though it is only 6.4 cm in diameter.

This section discusses the MD, points out advantages of the MD system, and showcases a product that uses the MD.

At a glance, these are the **MD System's Special Features:**

1. Quick Random Access
2. Recordable
3. High Quality Digital Sound
4. Lightweight and Compact
5. Easy to Handle
6. Strong Against Shock; Prevents Skipping
7. Superior Durability and Reliability

Please select from one of the links below, to learn about the ground-breaking technology in Sony's MiniDisc System.

LEADERS in CD-R and CD-RW Announce Phase-Change ReWritable, DVD-Compatible Disc Format

PALO ALTO, Calif., Sept. 3, 1997

Hewlett-Packard Company, Philips Electronics N.V., Sony Corporation, Mitsubishi Chemical Corporation, Ricoh Company Ltd. and Yamaha Corporation today announced the format specifications for Phase-Change ReWritable, a 120mm disc format designed to be read easily by future DVD-ROM drives. This data-storage format specifies an initial capacity of 3.0 gigabytes (GB) per disc surface. In the Constant Angular Velocity (CAV)(1) mode, high-performance random-access and transfer rates are achieved by using techniques similar to those used in hard-disk drives. The new format enables the development of products that will read DVD discs and write/rewrite ReWritable discs. According to the companies, these products will be known as DVD+RW drives.

disk diameter	120mm
disc thickness	0.6 mm x 2
physical address	FM modulated in CAV wobble groove
track pitch	0.8 micrometer
formatted capacity	3.0 GB/side
laser wavelength	650 nanometers
modulation code	8-16 modulation (2, 10) RLL
recording principle	mark-edge recording on phase-change material
writing method	CAV/CLV
written format	CLD (Constant Linear Density)