3 Types of TV's

- **SDTV** (Standard Definition TV)
- **EDTV** (Enhanced Definition TV)
- **HDTV** (High Definition TV)

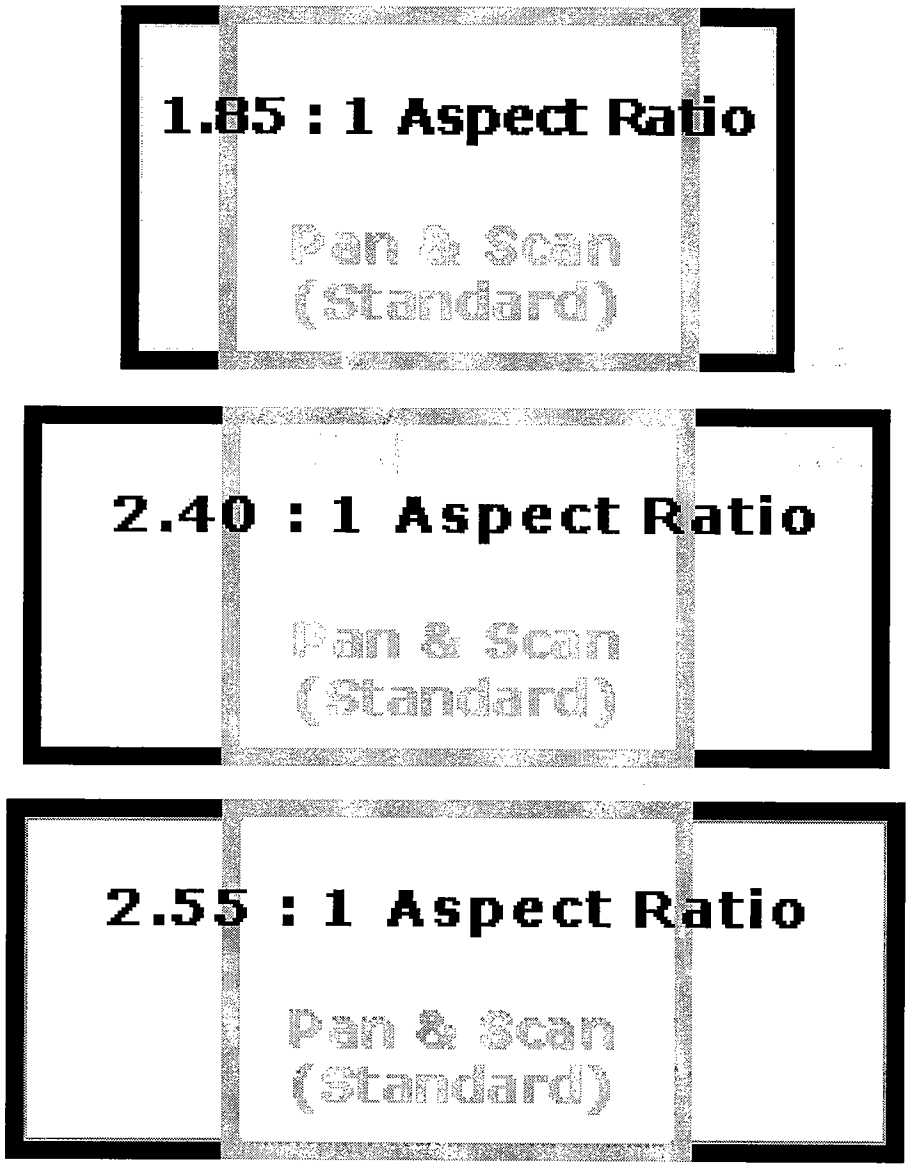
SDTV and Interlaced Scanning

- 525 lines are used (480 for the video, AKA 480i)
- 60 fields equals 30 frames
- Scans odd lines first
- Scans even lines second

EDTV and Progressive Scan

- Still 480 lines
- Scans from line 1 to 480 sequentially (no odd and even scanning).
- No "Jaggies"
- Each full field is displayed Twice (remember 60 fields make up 30 frames)
- 480p

The variations to “wide screen”



HDTV

HDTV

- December 31, 2006
- 1080i and 720P
- Smaller Pixels (4.5:1)
- ATSC (Advanced Television System Committee)
- 16:9 Aspect Ratio
- Dolby Digital Sound

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SDTV vs. HDTV

- 480i
- 2 Channel Stereo
- 4X3 Aspect Ratio
- 720 X 480 Resolution (345,600 pixels)

- 1080i or 720p
- 5.1 Dolby Digital
- 16X9 Aspect Ratio
- 1920 X 1080 Resolution (2,073,600 pixels)

HDTV Stations

- Consumers have to buy new equipment.
- Broadcasters have to buy new equipment.
- Cable has to convert boxes and equipment.
- New Broadcast Towers have to be built.

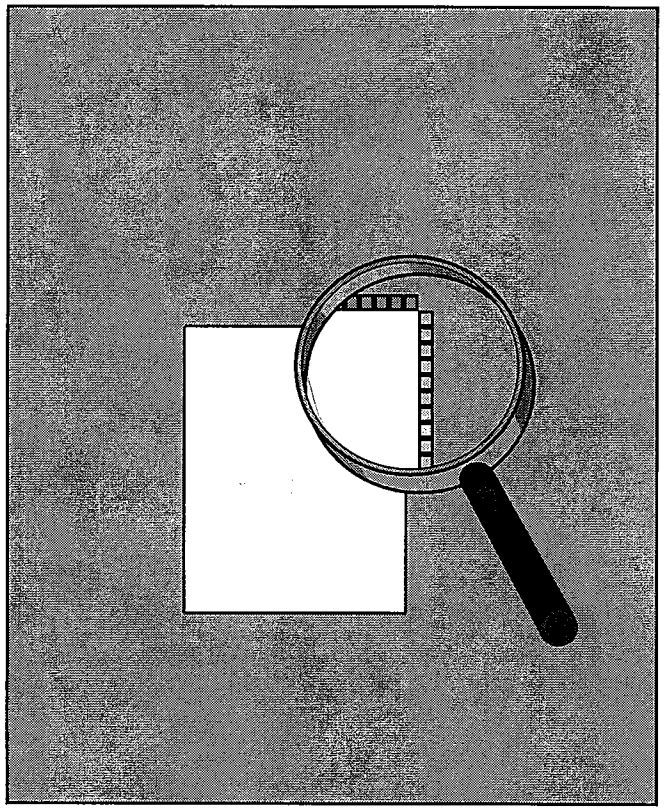
Today's HDTV sets come in two forms. HD-ready sets have the HDTV receiver/decoder built-in, while HD-capable sets require the addition of an external receiver/decoder needed to receive digital broadcasts. In an HD-capable set, the TV is essentially a monitor. You buy the receiver separately.

HDTV Broadcast Signal

- UHF Television Antenna
- Digital Cable
- Direct Broadcast Satellite (DBS)

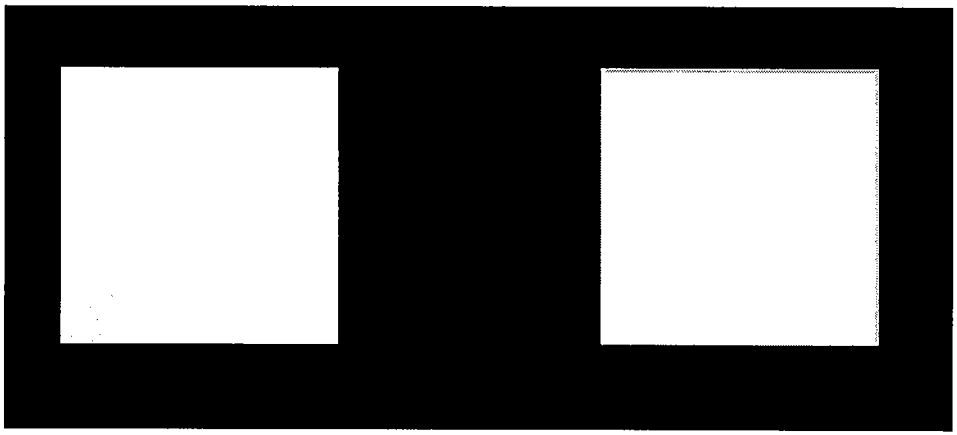
RPTV

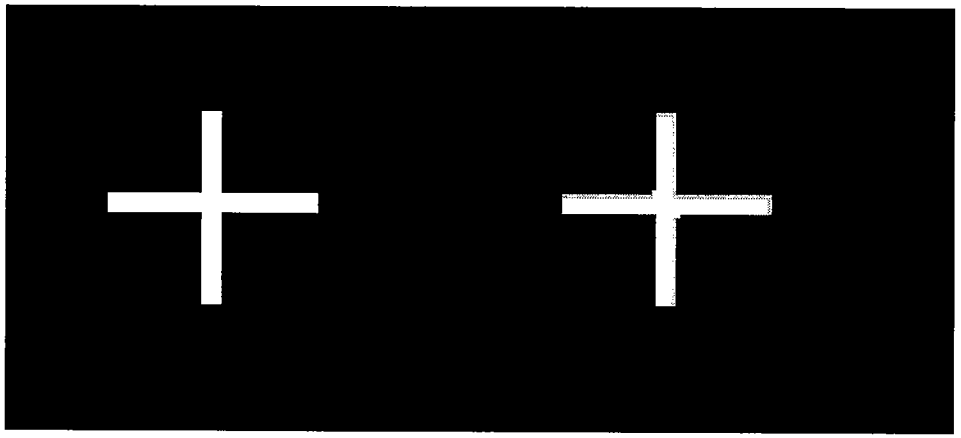
Convergence

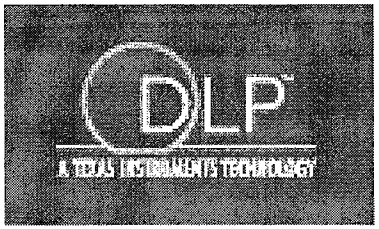


In many projectors, color is achieved by projecting separate red, green and blue images on top of each other. If the images don't "fit" exactly, colored edges can be observed around objects in the image.

How does it look...?







Digital Light Processing

- Tiny mirrors on a semiconductor. (DMD)
- Light source is directed at the mirrors (less heat)
- Mirrors can be tilted independently (at 50,000 times a second)
- Mirrors tilt to either the lens or non-reflective surface.
- 1024 shades of gray & over 16.7 million colors or over 35 trillion in a 3 chip model

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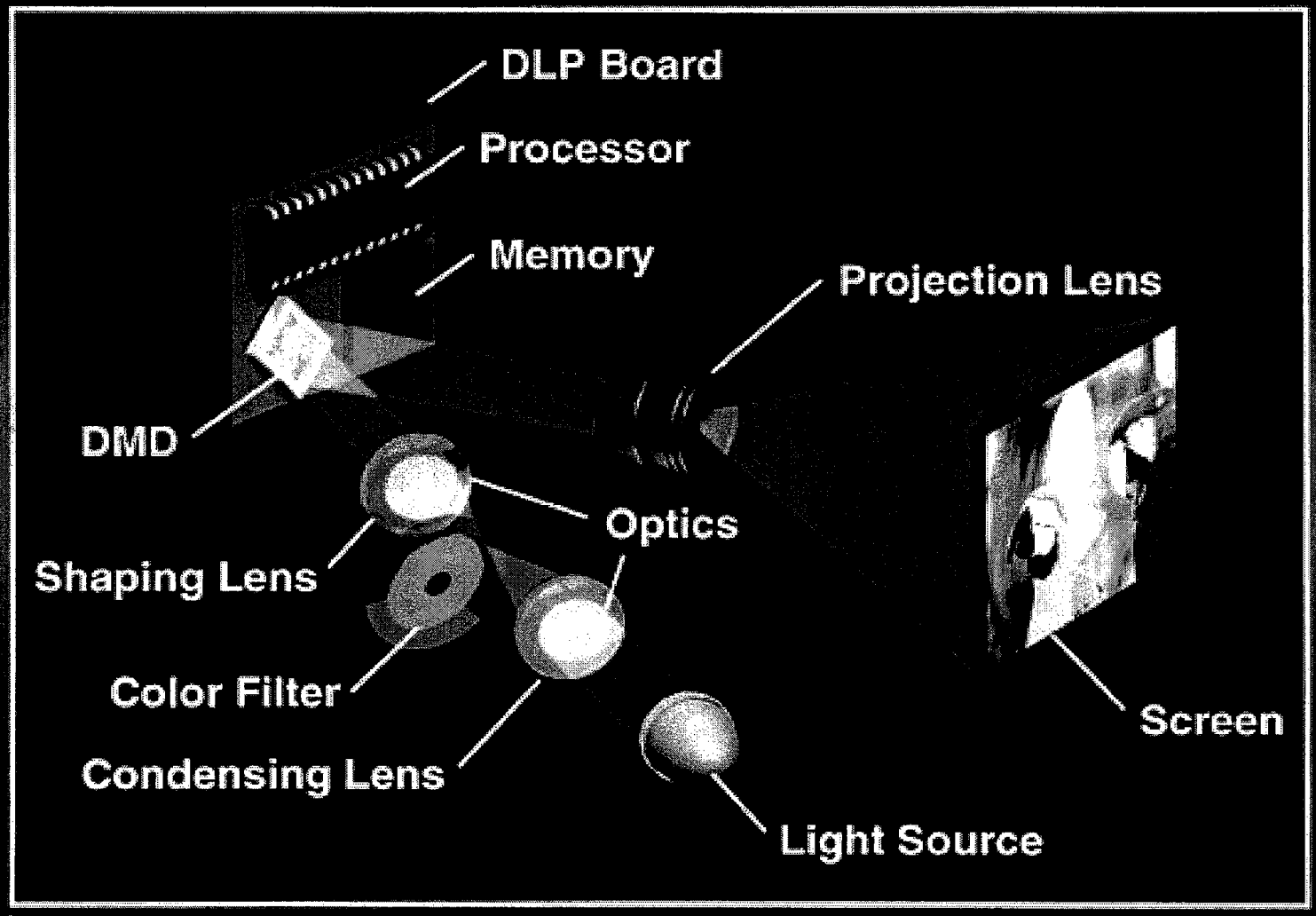
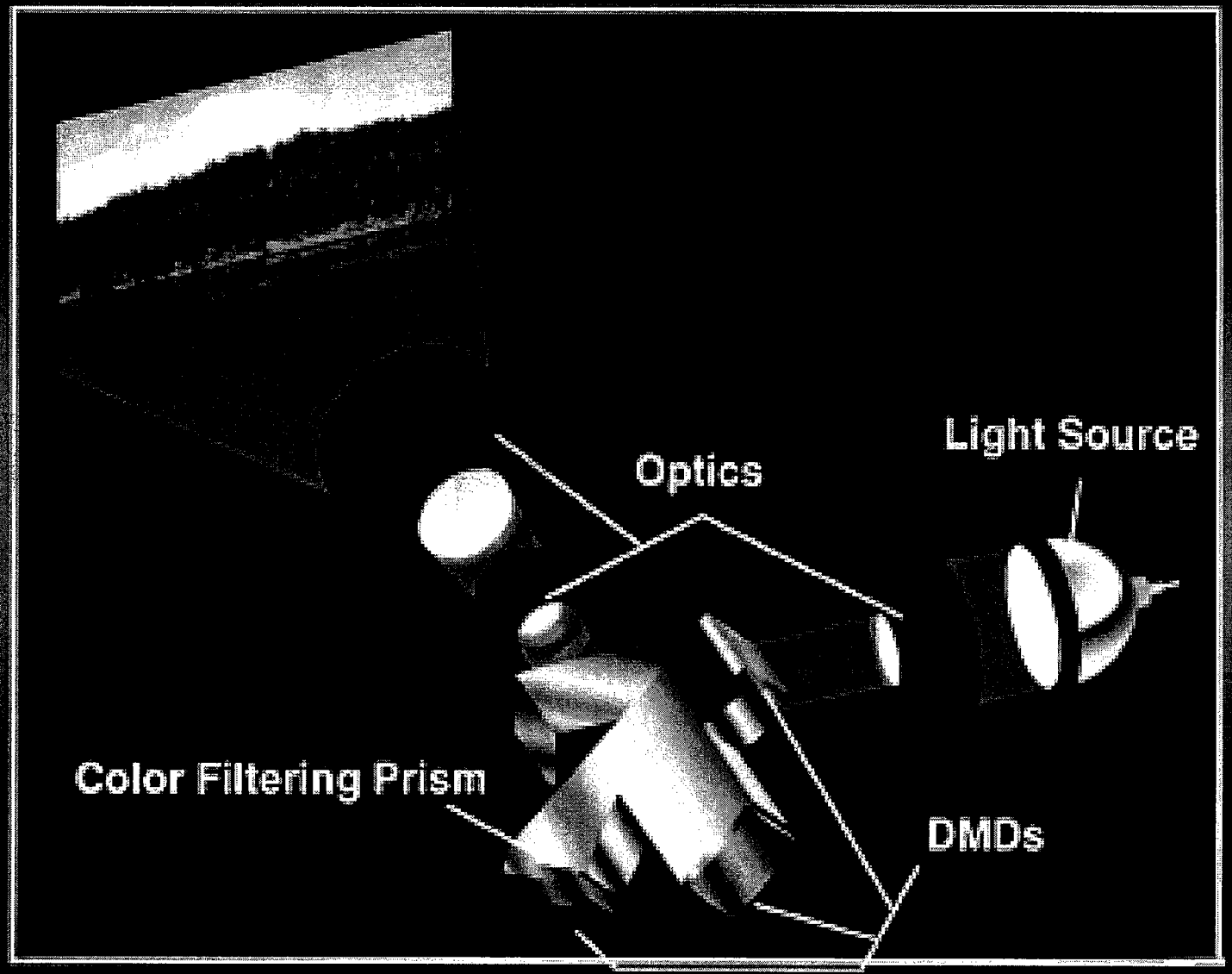
DMD

1 Chip DLP™ Projection



DLP™

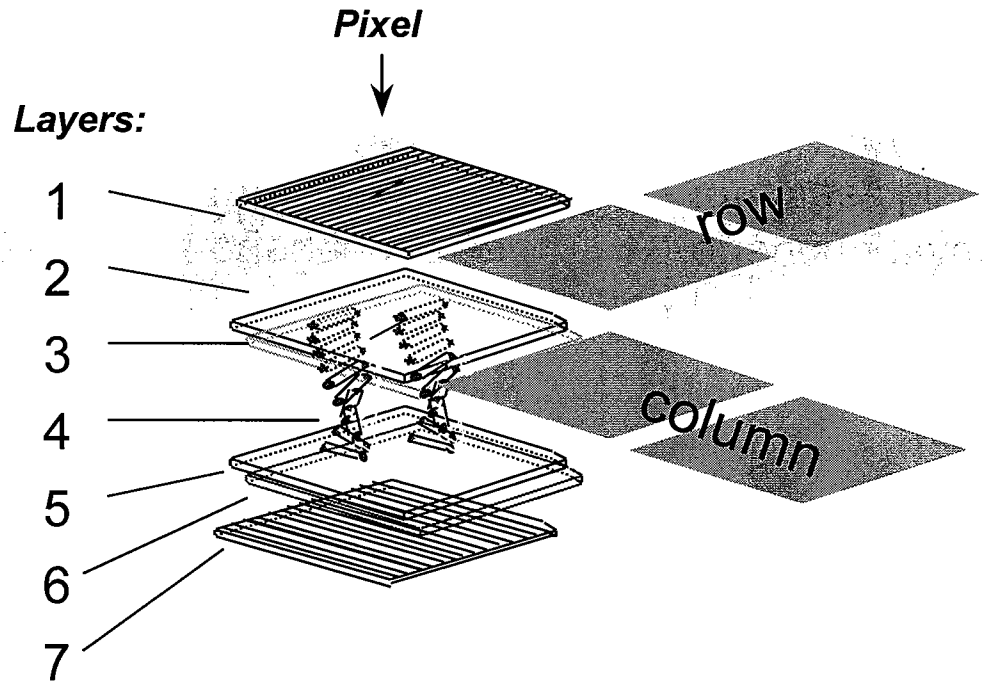
3 Chip DLP™ Projection



DLP™

Liquid Crystal Display

LCD Panel Construction

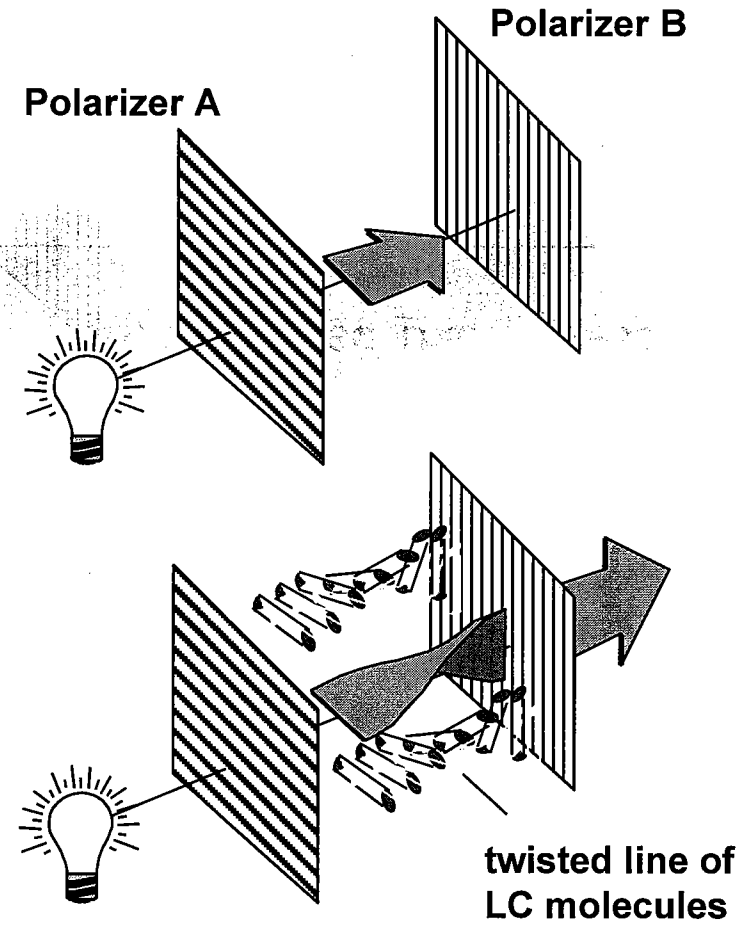


A Liquid Crystal **Display** (LCD) is composed of:

- Rows and Columns
- Layers:
  - polarizer (1)
  - top glass plate (2)
  - orienting layer (3)
  - Liquid Crystal (4)
  - orienting layer (5)
  - bottom glass plate (6)
  - analyzer (7)

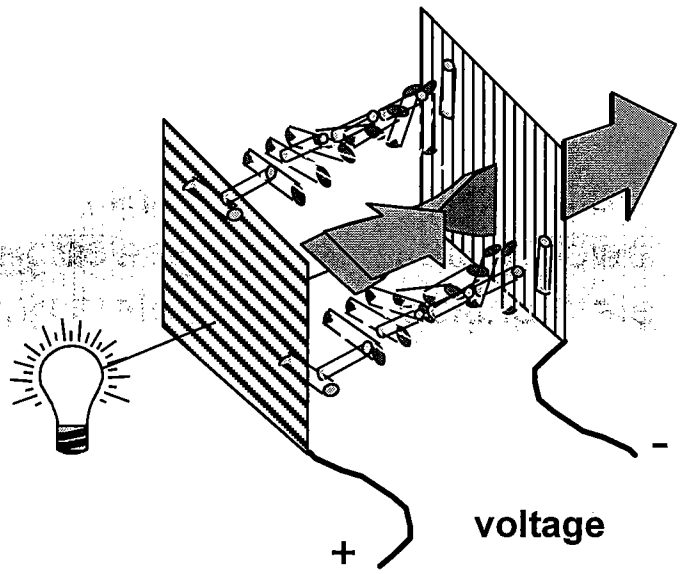
The point were a row and a column cross is called a *pixel*

LCD Principle



- Two polarizers placed in a perpendicular way **block the light-beam**
- By applying a **twisted structure** to the Liquid Crystals, the polarization direction follows the twisted line of molecules and **light can pass** through the perpendicular polarizers

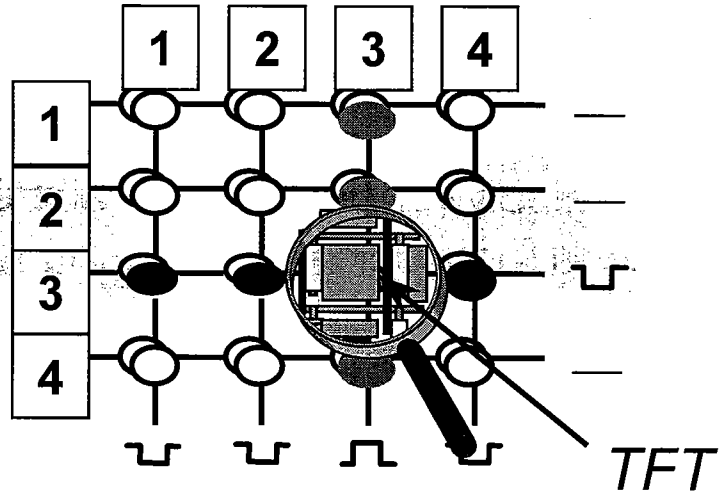
Transmission Control



- The manipulation of light through the Liquid Crystals is then obtained by **applying an electric field**: the TN structure unwinds and the polarization-rotating power is lost, resulting in a light blocking state

- So:
  - no field: light passes (white)
  - low voltage: light is dimmed (gray)
  - high voltage: light is blocked (black)

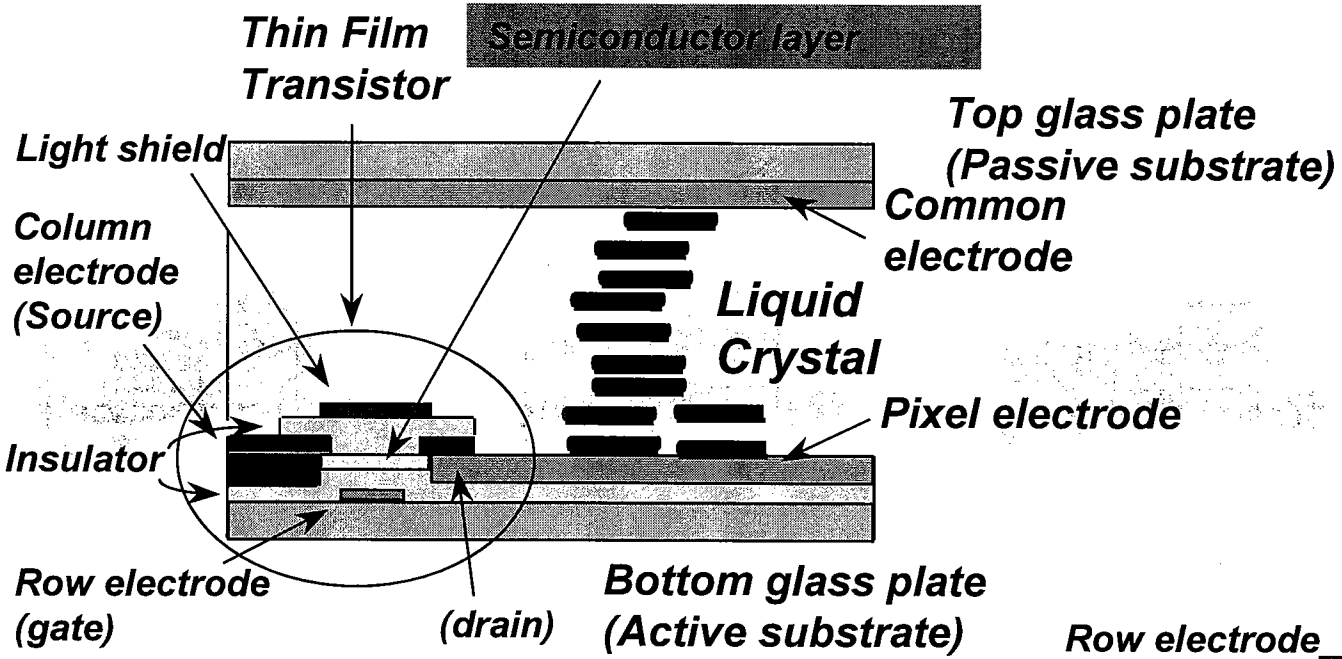
LCD Addressing

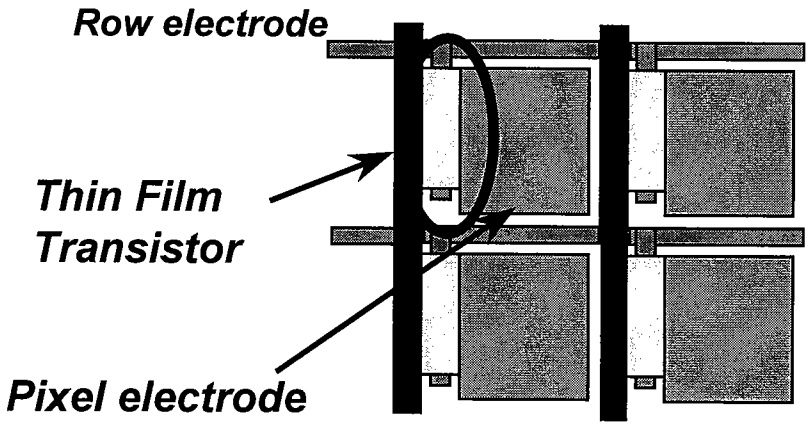


- **Active matrix addressing:**

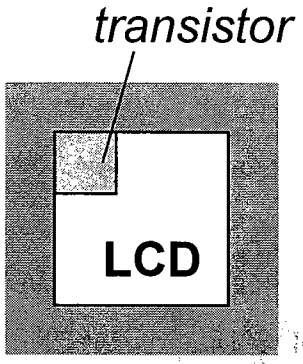
  By adding a small memory chip to each TN cell, each pixel becomes autonomous and can maintain the information until changed.
  This memory chip is called **Thin Film Transistor** (TFT).

LCD Cell Construction



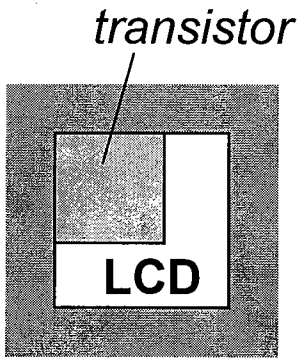


LCD Technologies



Poly-silicon TFT

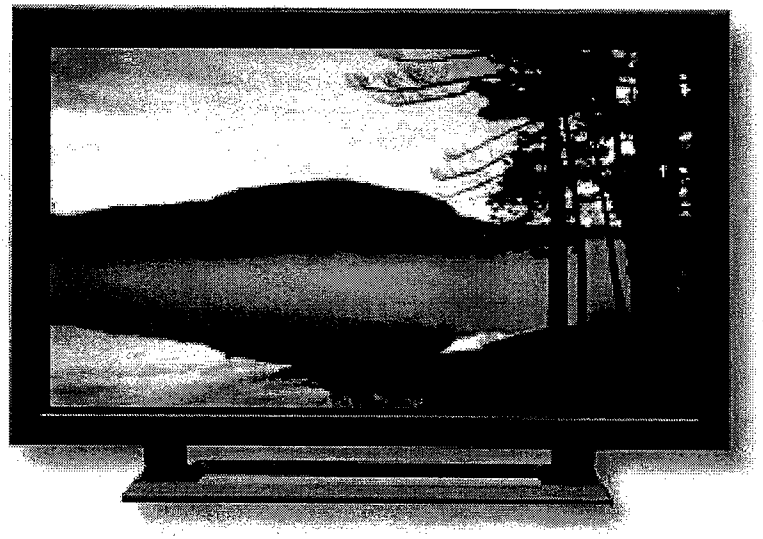
- Low temperature Poly-silicon
  - developed to reduce the size of the TFT transistor in computer LCD panels
  - brightness of amorphous silicon projectors can be improved while simultaneously reducing the size of the panels (+/- 2.2 “)
- High temperature Poly-silicon:
  - same production tools as for ICs, leading to excellent miniaturization possibilities (LCDs < 1.3“)



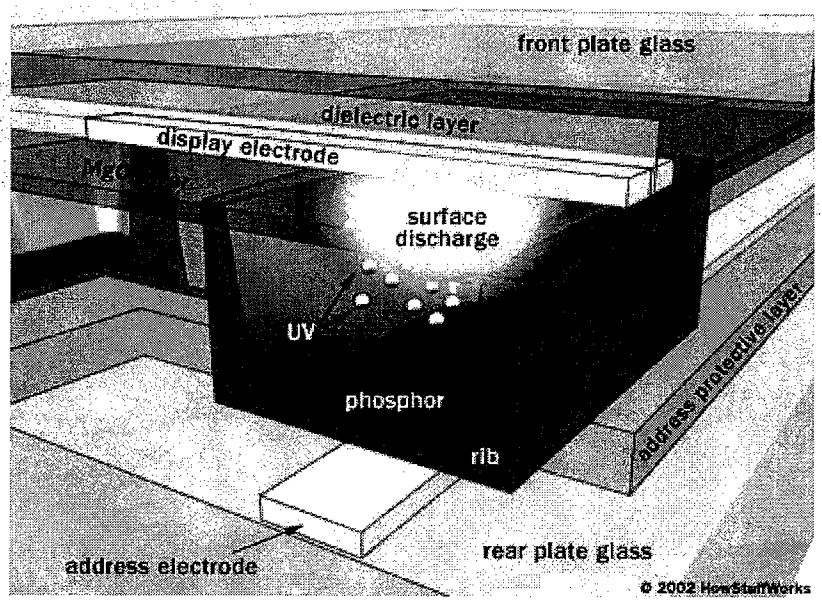
Amorphous silicon TFT

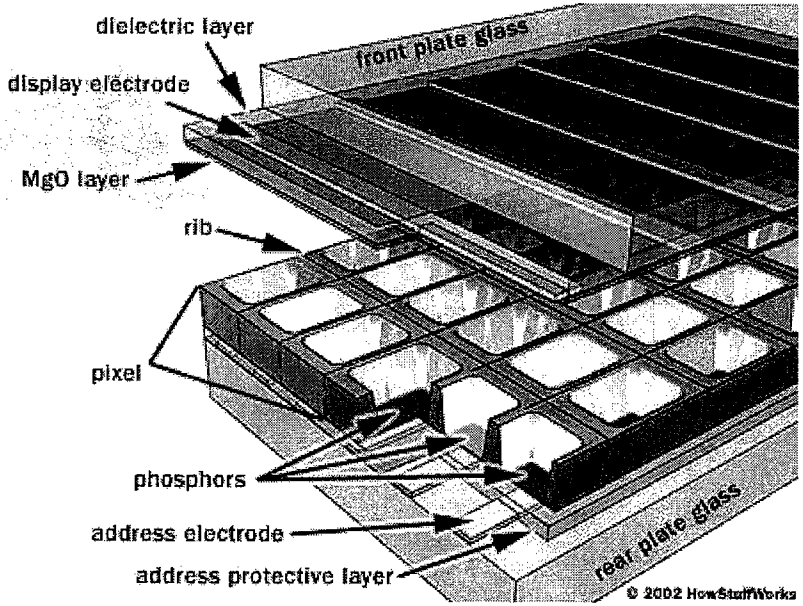
- Low temperature manufacturing process
- Large transistors, resulting in relatively low light transmission

Plasma

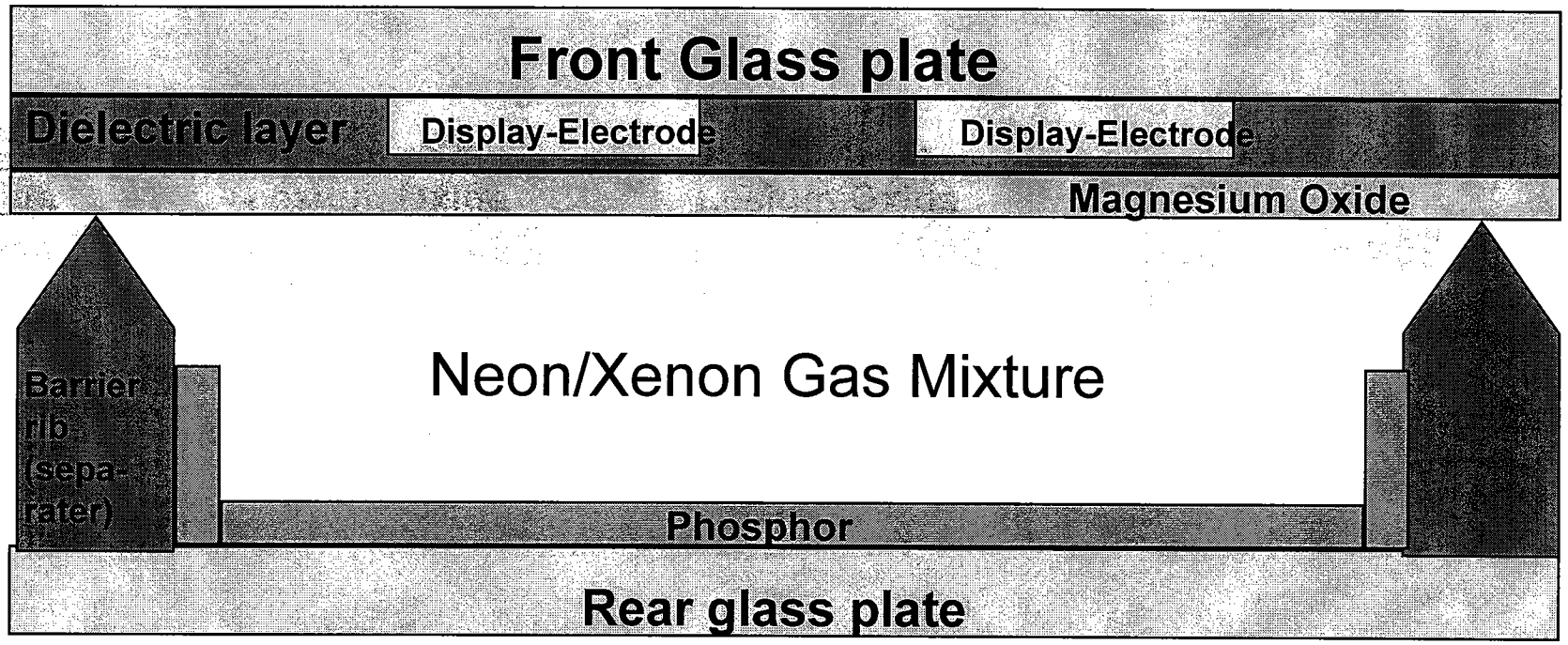


Plasma Display Technology

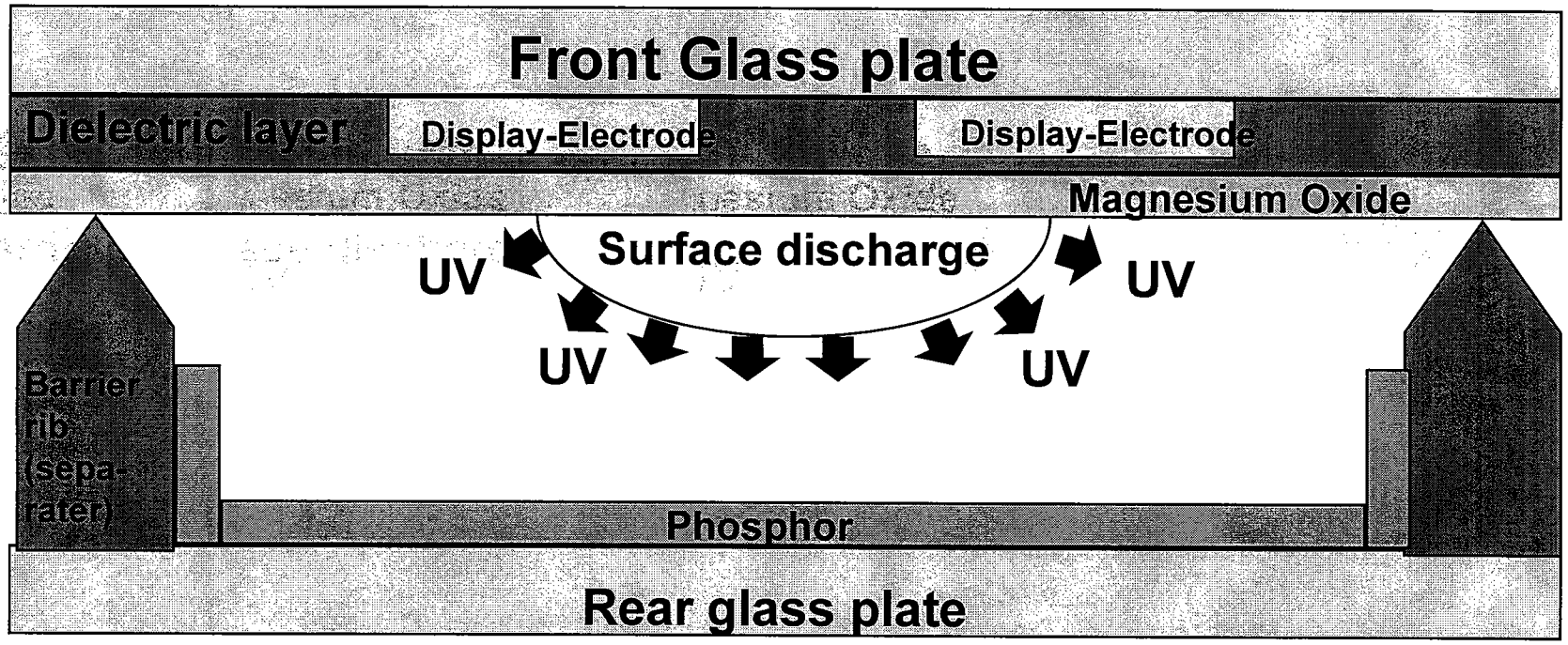




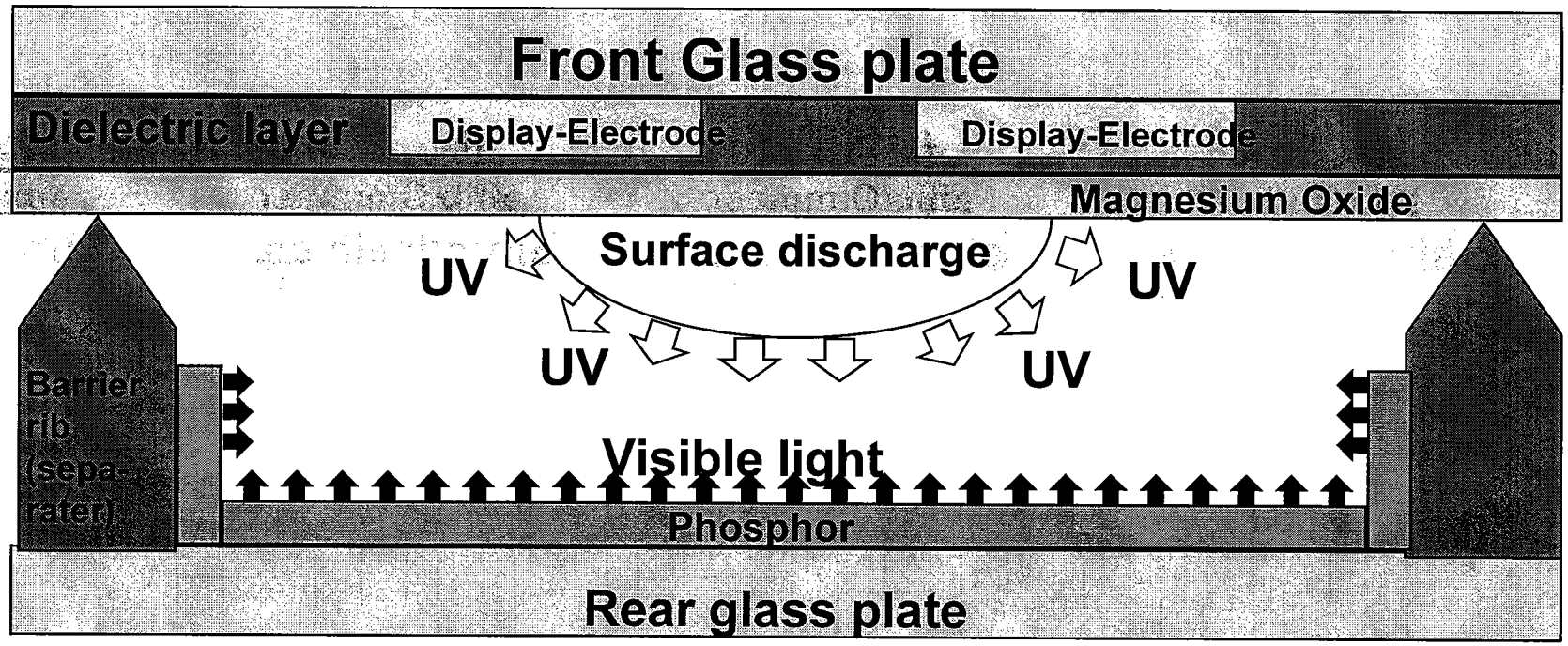
Plasma Display Technology



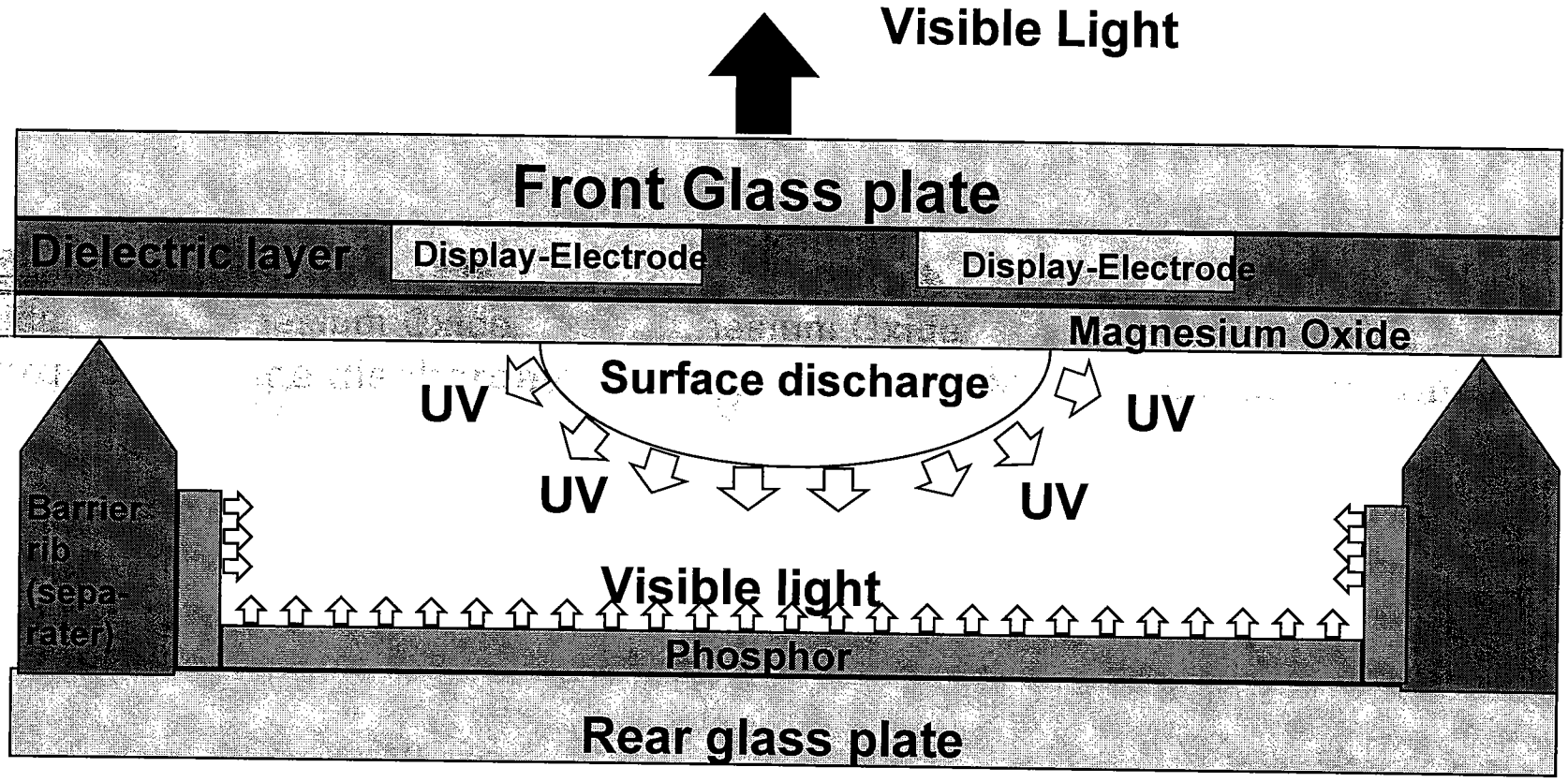
Plasma Display Technology



Plasma Display Technology



Plasma Display Technology



Overall Picture Performance

- To give a proper judgement of the performance of a picture and, hence, the performance of a projector, it is of crucial importance to weigh a **combination** of picture performance indicators and **not** fall into the trap of considering single factors only!

- The best projector will be the one that **excels on a total of performance indicators** instead of outperforming on a single one.

LCD/DLP/Plasma - Feature Comparison

Feature	LCD	DLP	Plasma
Convergence	Not Needed	Not Needed	Not Needed
Picture Flicker	NO	YES	NO
Image Burn In	NO	NO	YES
Magnetic Shielding	Not Necessary	Not Necessary	Needed
Vertical Viewing Angle	60 degrees	60 degrees	160 degrees
Replaceable Lamp	YES	YES	NO
Table Top Design	YES	Projector/ RPTV	YES
Brightness	Natural	Unnatural	Natural
Moving Parts	None	YES /color wheel	None
Altitude limits	NO	NO	YES
HDTV Compatible	YES (typically)	YES (typically)	YES (typically)
NTSC Tuner Built in	YES (typically)	RPTV (only)	YES (typically)
ATSC Tuner Built in	NO (typically)	NO (typically)	NO (typically)

Connections

- Coaxial cable (RG-59 or RG-6)
- Composite
- S-Video
- Component (Y'Pb'Pr)
- And…

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Firewire (IEEE1394)

- One simple cable
- Components "talk" to each other.
- Computer and Internet connection.
- 400 million bits per second (400Mbs soon to be 800Mbs 1394b). DVD is 3.5Mbs, 10Mbs peak.
- 3 options; Copy once, Copy never, Copy freely
- Digital Transmission Content Protection (DTCP) a.k.a. 5C named after Hitachi, Intel, Matsushita, Sony & Toshiba
- Requires M-PEG decoder @ display

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Digital Display Working Group

Digital Visual Interface (DVI)

- Open industry group led by Intel, Compaq, Fujitsu, Hewlett Packard, IBM, NEC & Silicon Image
- Sends uncompressed video through connection
- 4.95 billion bits per second (3.96Gbps for picture, Dual-link can allow 7.92Gbps)
- Resolutions from 640X480 @ 60Hz to 1080P/60 (1920X1080 @ 60Hz) or w/ Dual-link 2048X1536 (QXGA) @ 60Hz
- High-Bandwidth Digital Content Protection (HDCP)