APECE-302: Radio & Television Engineering

Applied Physics, Electronics & Communication Engineering

Lecture # 14

University of Dhaka | APECE DU

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Contents

- Elements of a Television (TV) System
- Analysis and Synthesis of TV Pictures
- Composite Video Signal
- Signal Transmission and Channel BW
- TV Camera Tubes
- Basic TV Broadcasting
- TV Receiver

Elements of a Television (TV) System

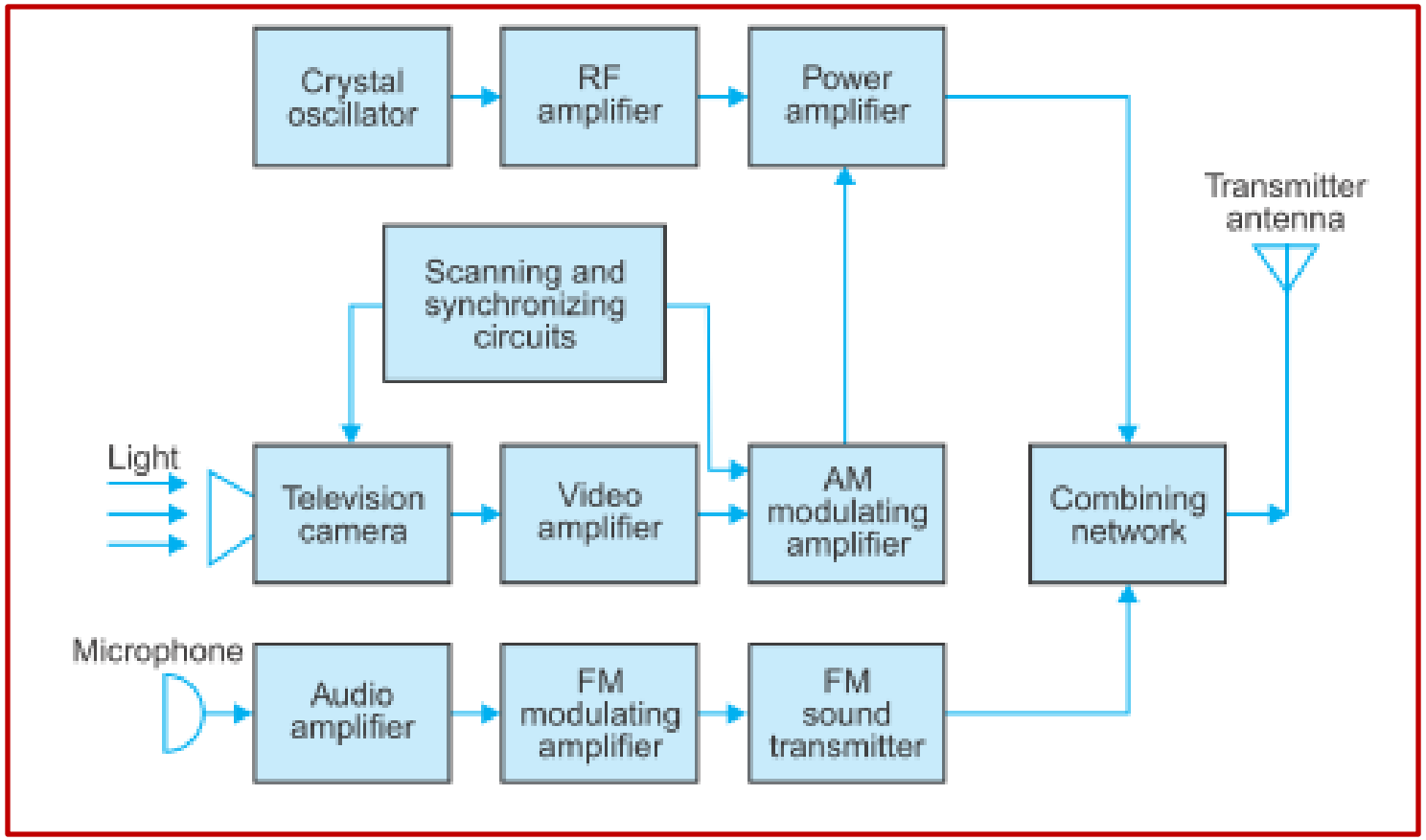
Frequency Distribution of BTV

BTV uses for terrestrial Broadcasting VHF band-3 Frequency (174-230 MHz)

Sl.no	Station	Channel No.	Power(KW)	Frequency(MHz)	Line description
01	Dhaka	9	10+10=20	202-209	625 Lines 50Hz
02	Chittagong	5	10	174-181	
03	Khulna	11	10	216-223	
04	Rajshahi	12	10	223-230	
05	Sylhet	7	10	188-195	
06	Rangpur	6	10	181-188	
07	Thakurgoan	10	10	209-216	
08	Patuakhali	7	10	188-195	
09	B -baria	5	10	174-181	
10	Jhenaidah	5	10	174-181	
11	Shathkhira	7	10	188-195	
12	Natore	8	10	195-202	
13	Noakhali	12	10	223-230	
14	Rangamati	8	10	195-202	
15	Ukhia	10	10	209-216	
16	Mymensing	12	10	223-230	

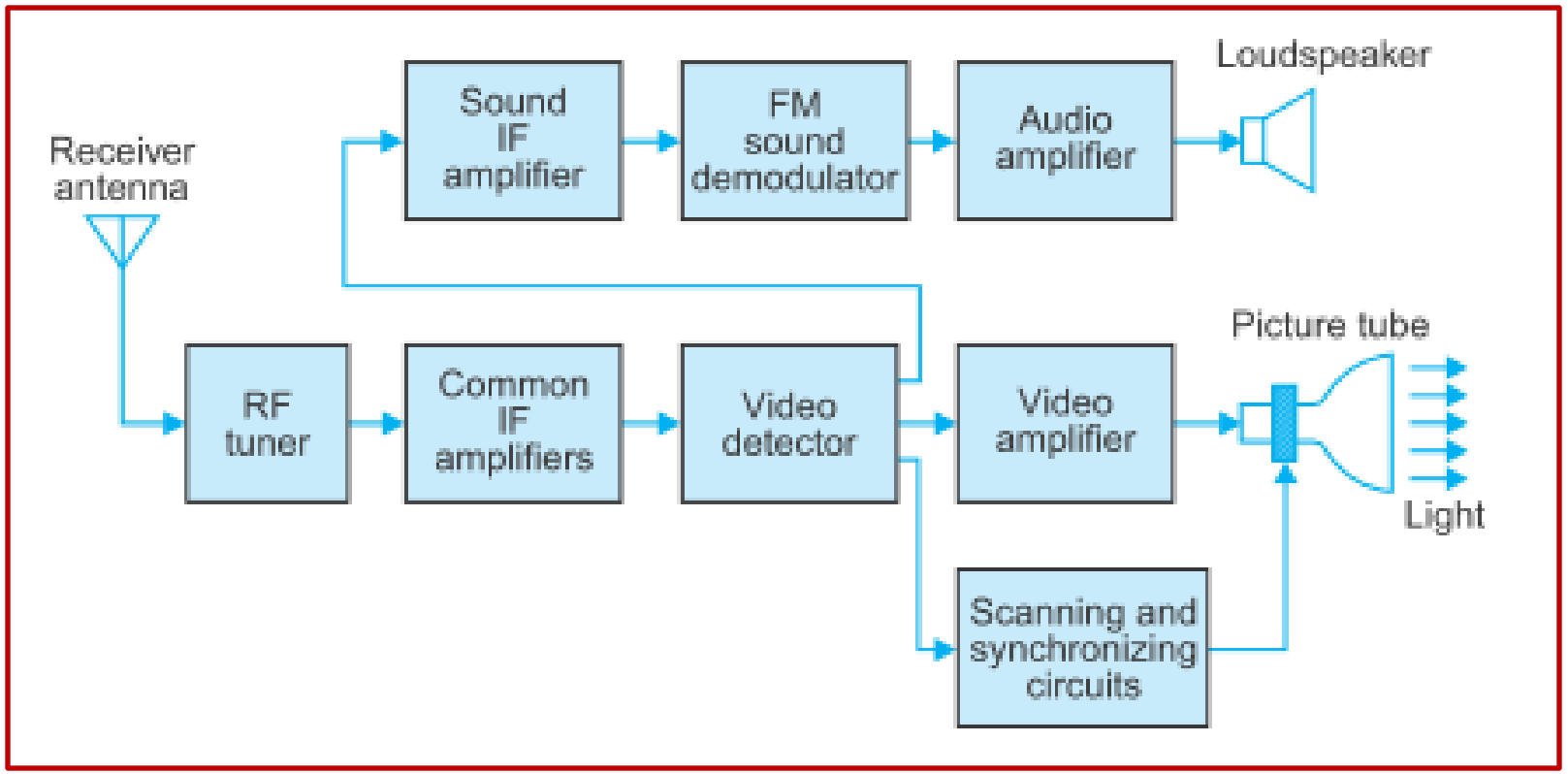
Elements of a Television (TV) System

- Tx:



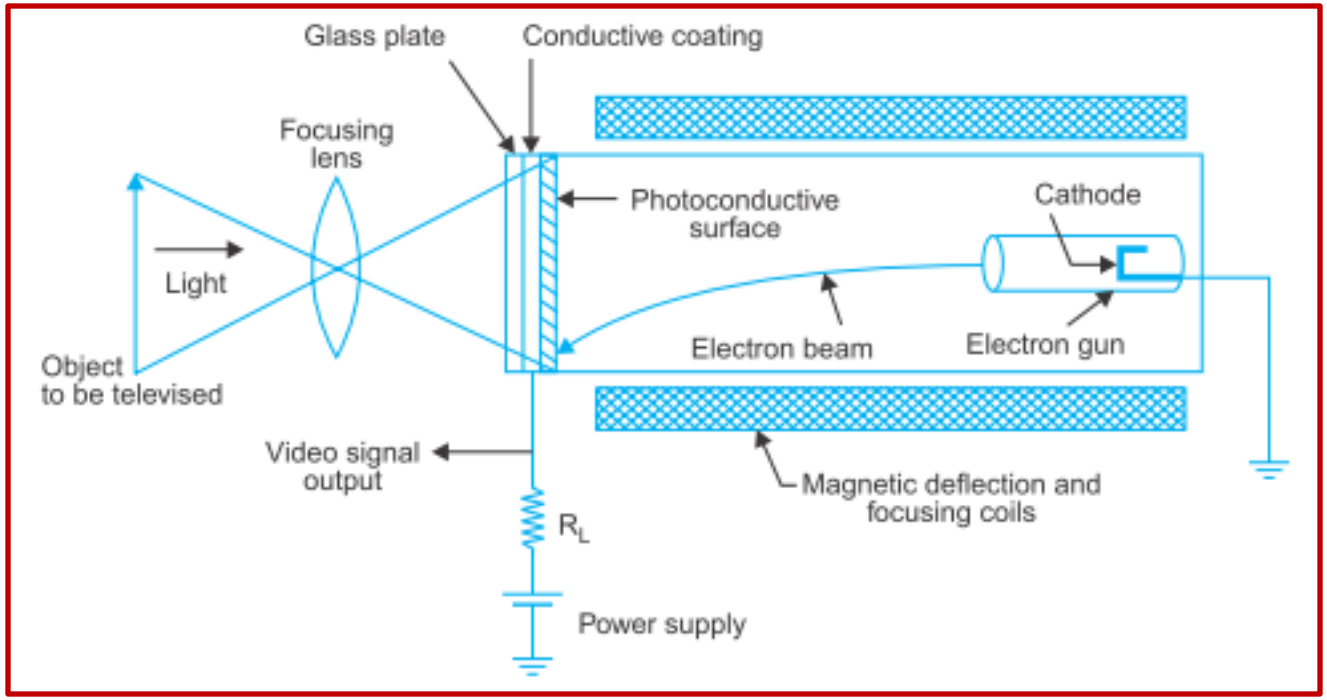
Elements of a Television (TV) System

- Rx:



Elements of a Television (TV) System

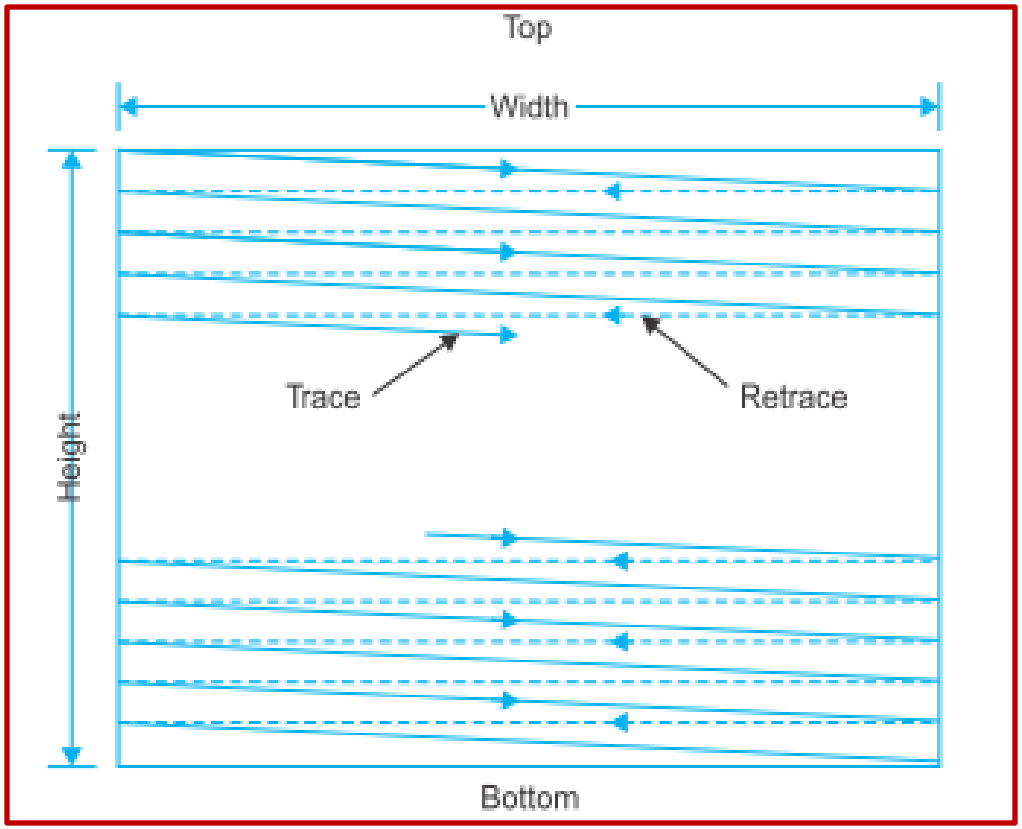
- **Picture Transmission:** Picture info➔ assemblage of a large number of bright and dark areas representing picture details; picture elements!



Vidicon Camera Tube

Elements of a Television (TV) System

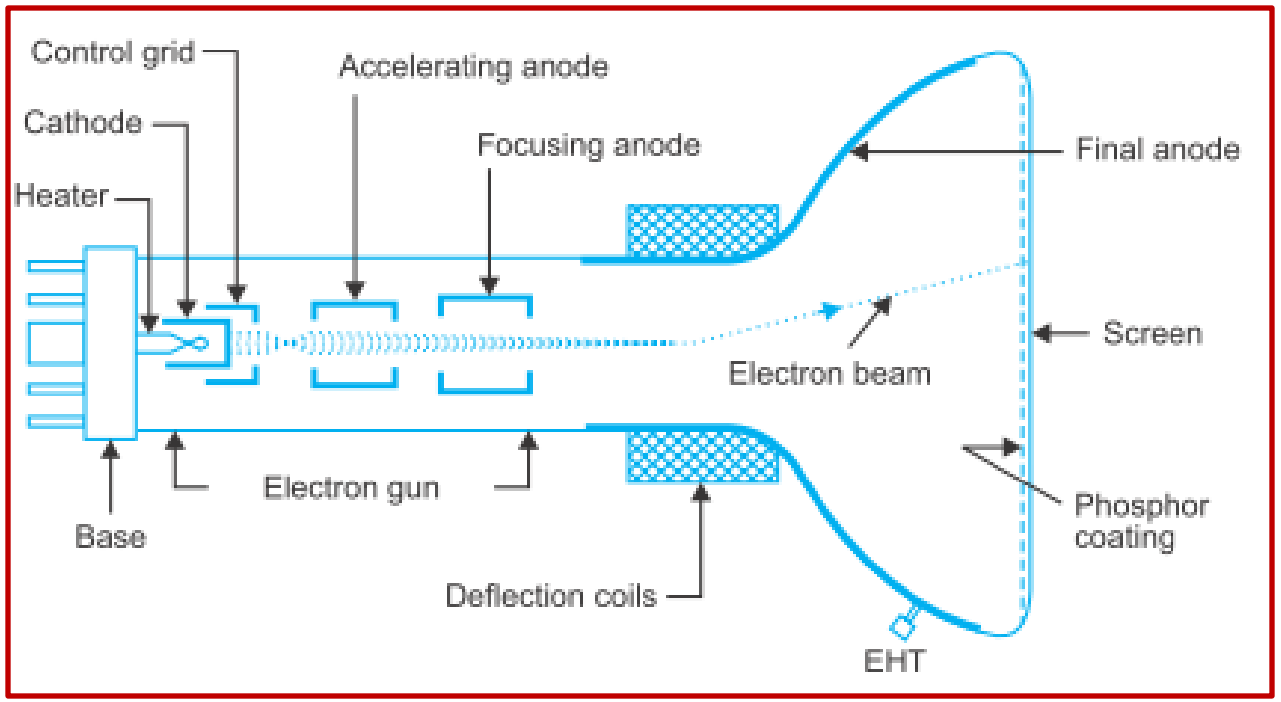
- Path of Scanning Beam:



Elements of a Television (TV) System

- Sound Transmission: the audio signal is FM modulated after amplification.

- Picture Reception:



Elements of a Television (TV) System

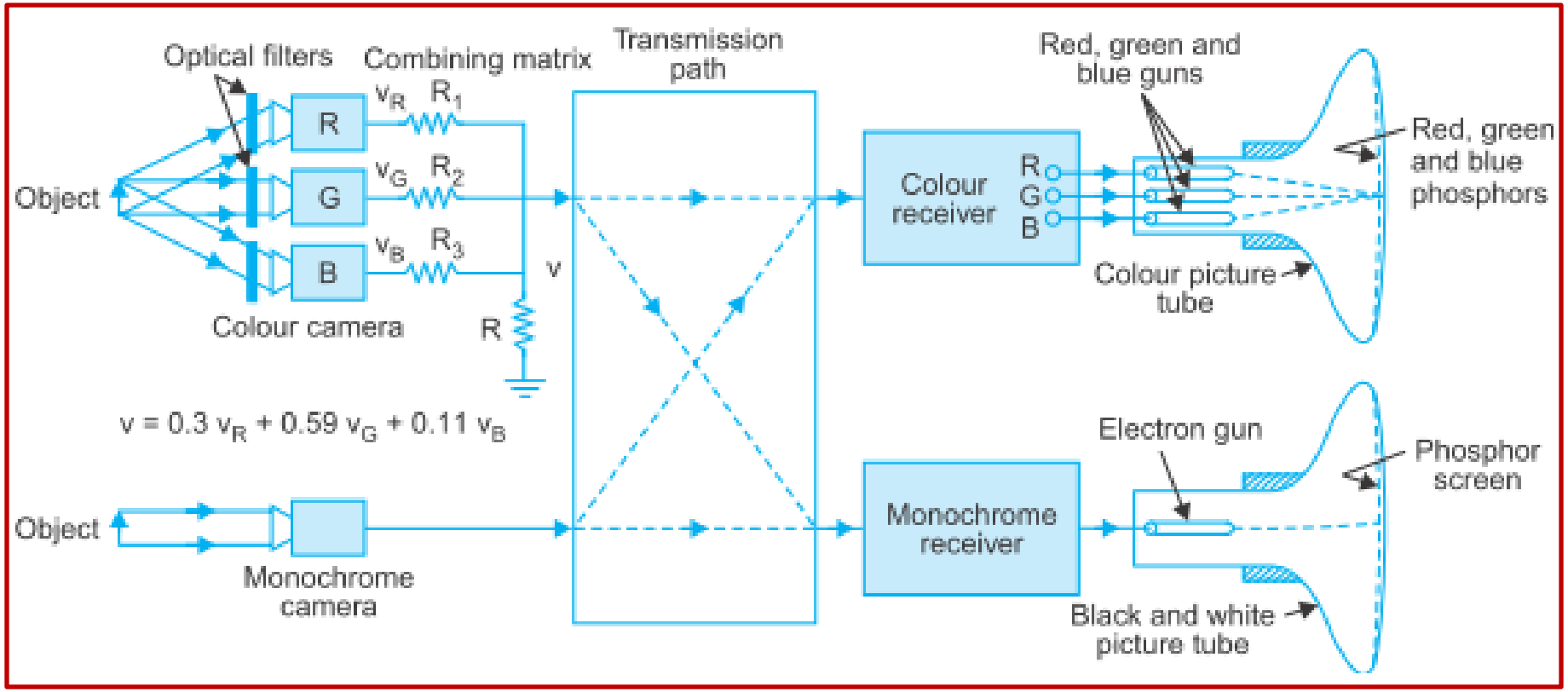
- **Sound Reception:** FM audio signal is demodulated after at least one stage of amplification.

- **Synchronization:** Same coordinates at any instant of time at the camera tube target plate and at the raster of the picture tube.
  - In addition to picture details, synchronizing pulses

- **Front-Panel Control:** Brightness, Contrast!

Elements of a Television (TV) System

- Color TV:



Analysis and Synthesis of TV Pictures

The basic factors with which the television system must deal for successful transmission and reception of pictures are:

(*a*) *Gross Structure:* Geometric form and aspect ratio of the picture.

(*b*) *Image Continuity:* Scanning and its sequence.

(*c*) *Number of Scanning Lines:* Resolution of picture details.

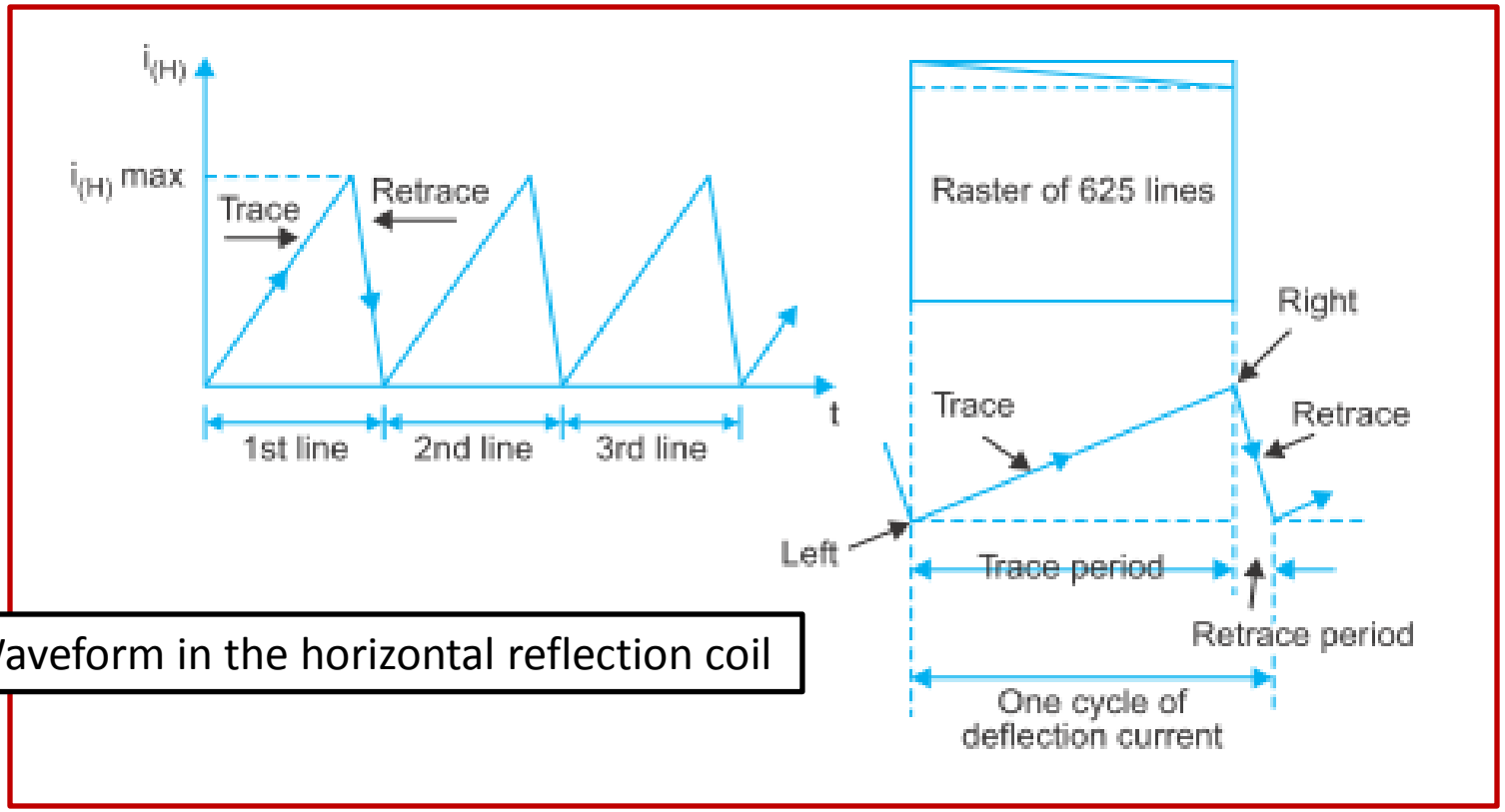
(*d*) *Flicker:* Interlaced scanning.

(*e*) *Fine Structure:* Vertical and horizontal resolution.

(*f*) *Tonal Gradation:* Picture brightness transfer characteristics of the system.

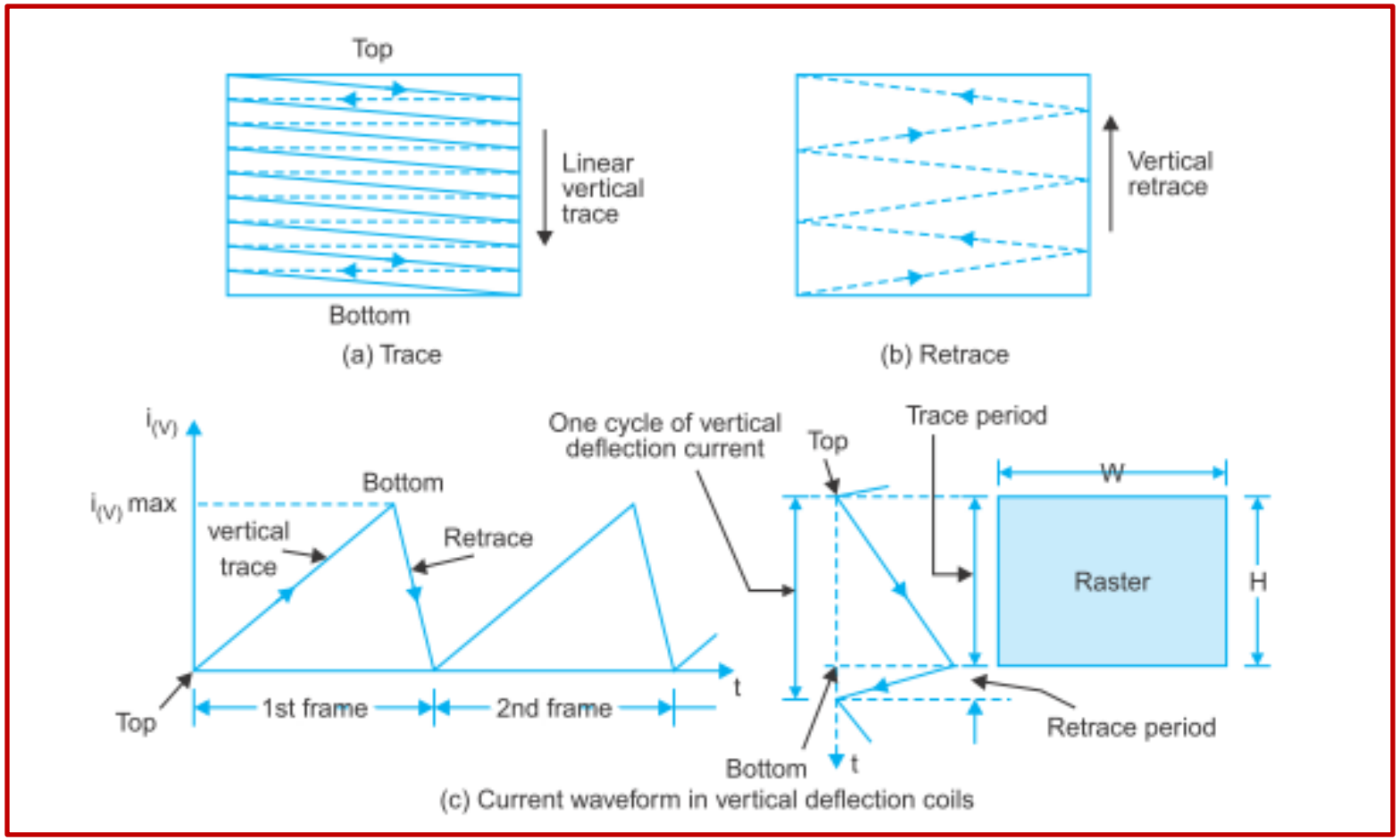
Analysis and Synthesis of TV Pictures

- Image Continuity: 1/16 sec Persistence of vision; Motion pictures 24 still pictures of the scene; 25 frames/sec in TV.



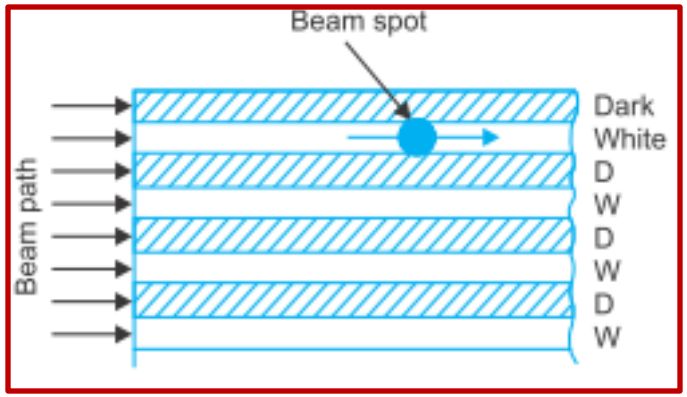
Current Waveform in the horizontal reflection coil

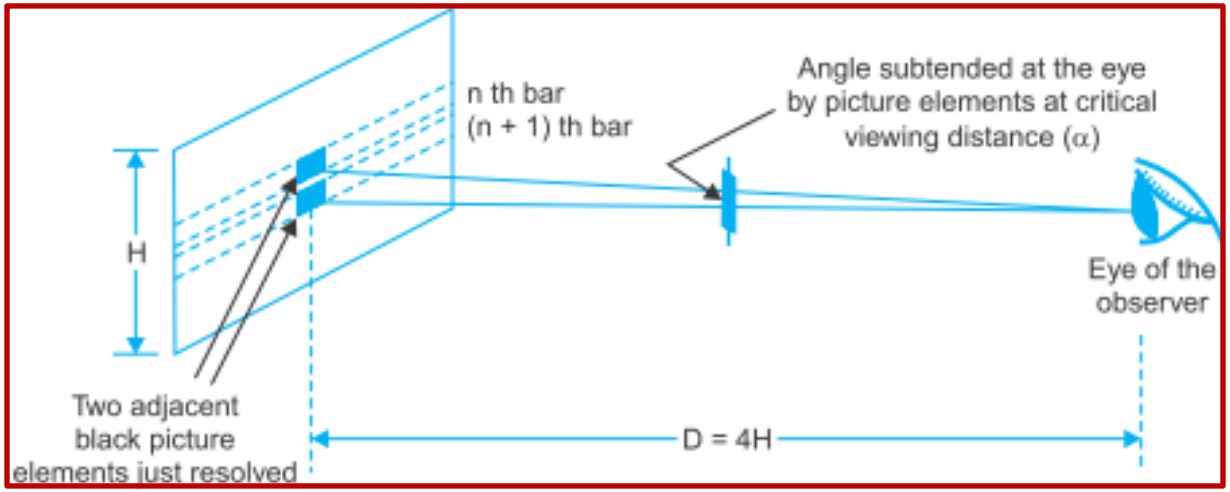
Analysis and Synthesis of TV Pictures



Analysis and Synthesis of TV Pictures

- Number of Scanning Lines





Analysis and Synthesis of TV Pictures

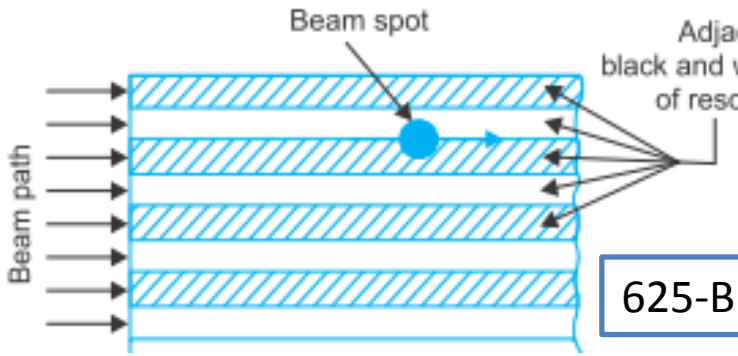
The maximum number of alternate light and dark elements (lines) which can be resolved by the eye is given by

$$N_v = \frac{1}{\alpha\rho}$$

where N_v = total number of lines (elements) to be resolved in the vertical direction, α = minimum resolving angle of the eye expressed in radians, and $\rho = D/H$ = viewing-distance/picture height.

For eye, structure of retina, brightness of pic

$$N_v = \frac{1}{(\pi / 180 \times 1/60) \times 4} \approx 860$$



70% of 860=602

625-B Monochrome TV Sys; 625 Lines

Analysis and Synthesis of TV Pictures

- **Flicker:** 24 pic/sec, 25 frames/sec is not rapid enough!
  - Each pic is shown twice>> increased blanking rate
- In TV 50 vertical scans/sec to reduce Flicker.
  - W. interlaced approach

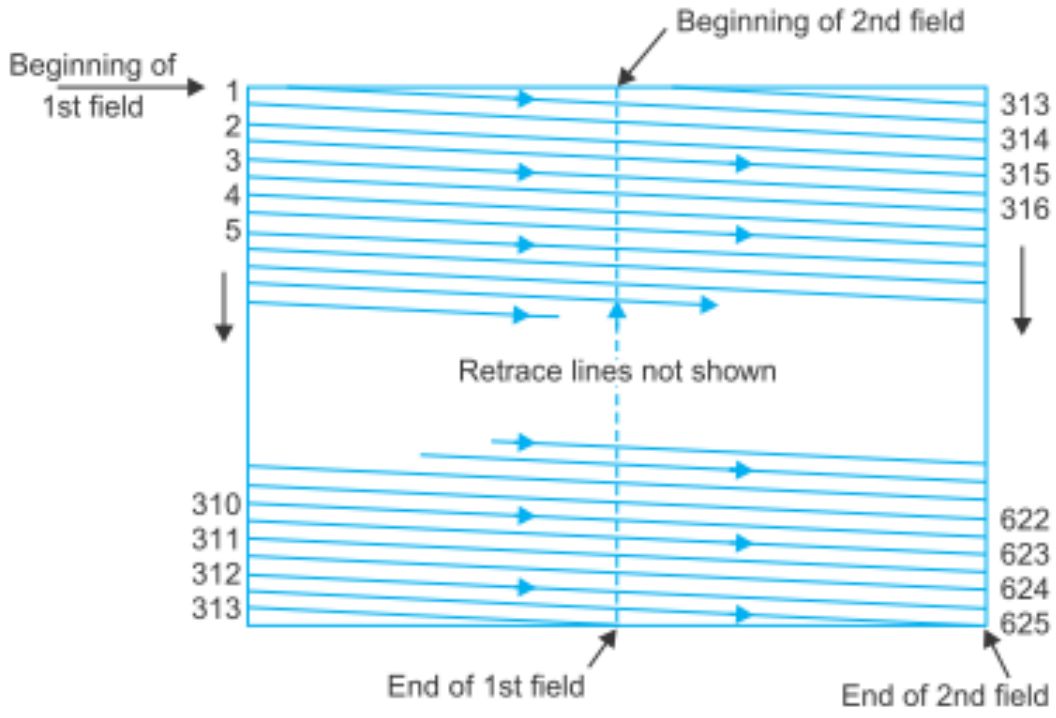


Fig. 2.4 Principle of interlaced scanning. Note that the vertical retrace time has been assumed to be zero.

Analysis and Synthesis of TV Pictures

- H sweep osc freq. 15625 Hz. (312.5*50) to scan the same no of lines per frame (15625/25=625).

- Scanning periods:

$$\left(\frac{1280\ \mu s}{64\ \mu s} = 20\ \text{lines}\right)$$

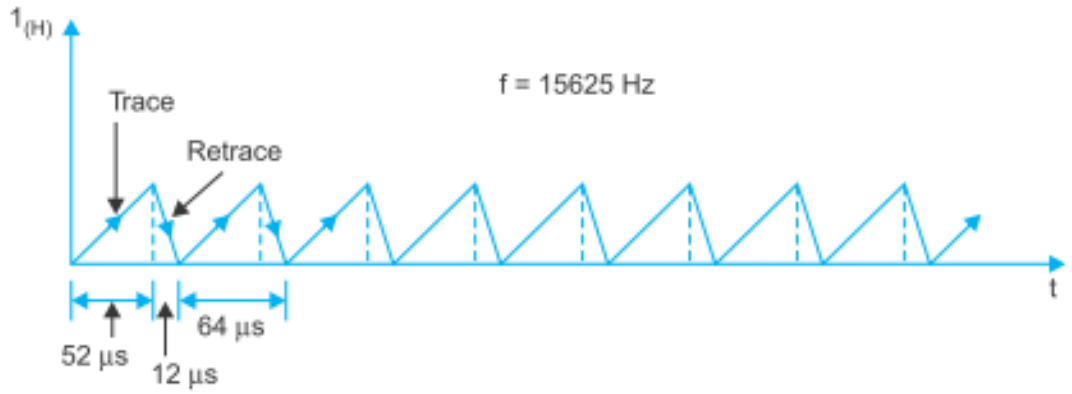
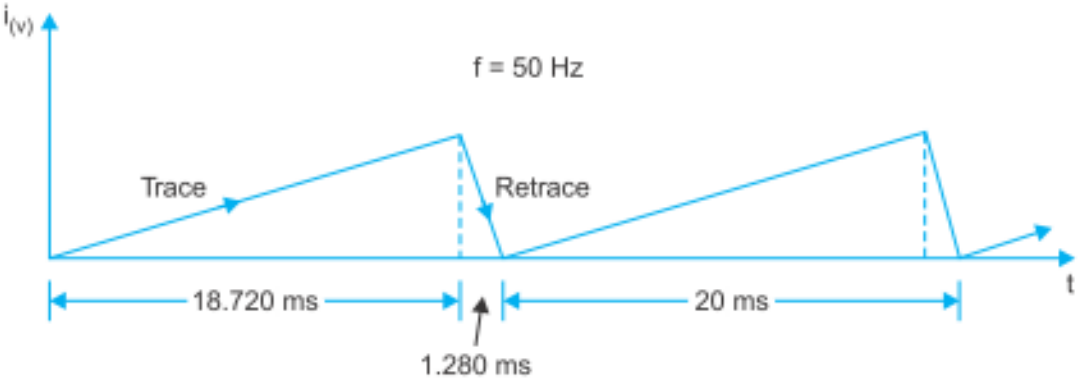
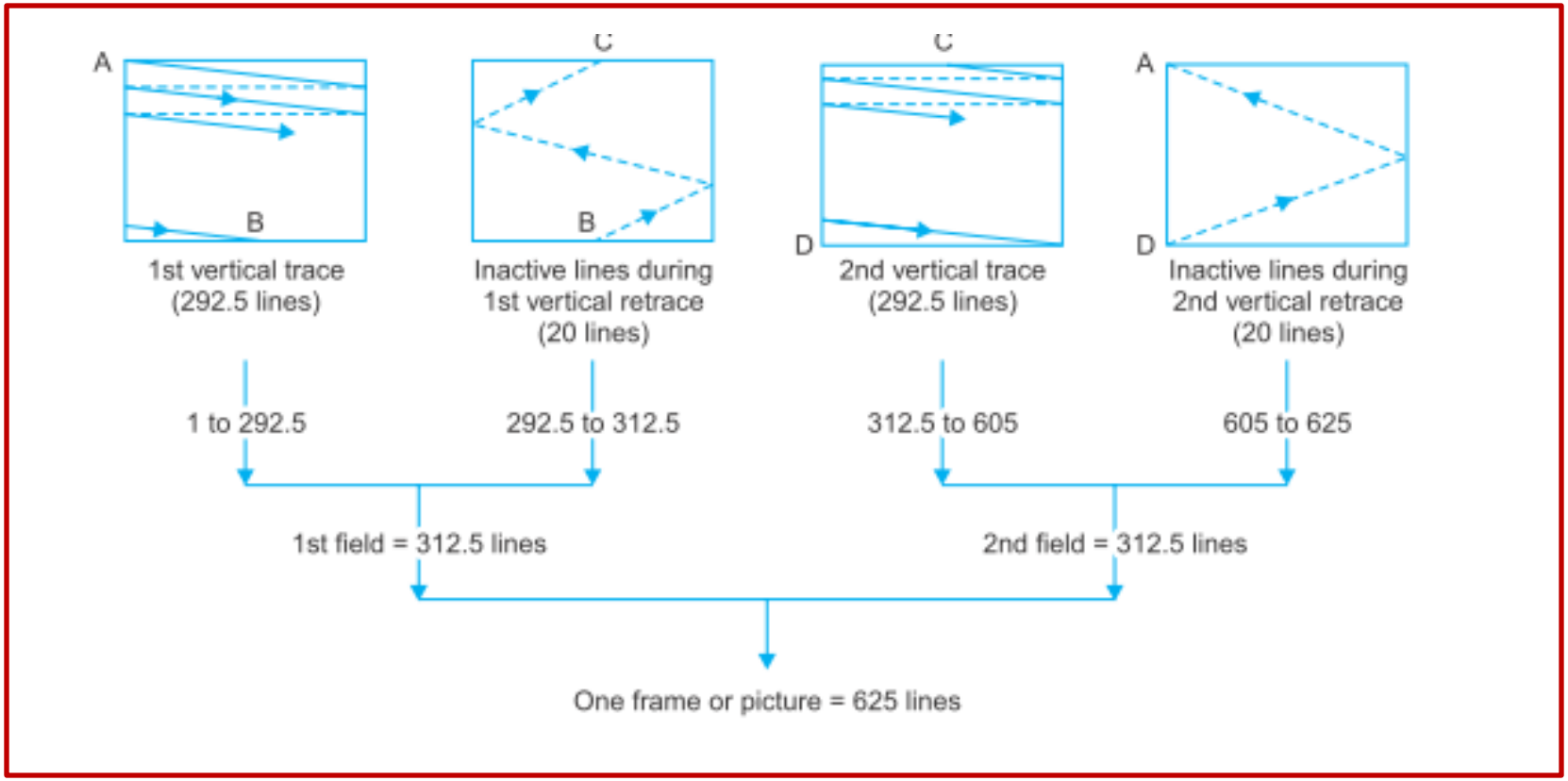


Fig. 2.5 (a) Horizontal deflection current.



Analysis and Synthesis of TV Pictures

- Scanning sequence



Analysis and Synthesis of TV Pictures

- Fine Structure:

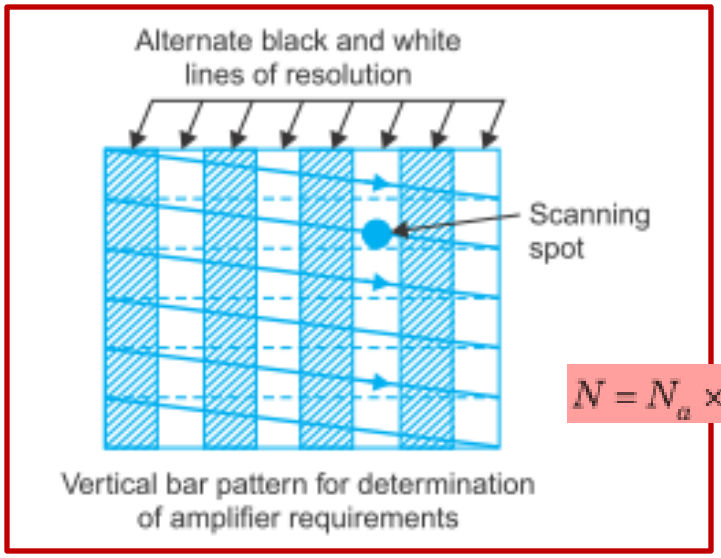
$$V_r = N_a \times k$$

where V_r is the vertical resolution expressed in number of lines, N_a is the active number of lines and k is the resolution factor (also known as Kell factor).

Assuming a reasonable value of $k = 0.69$,

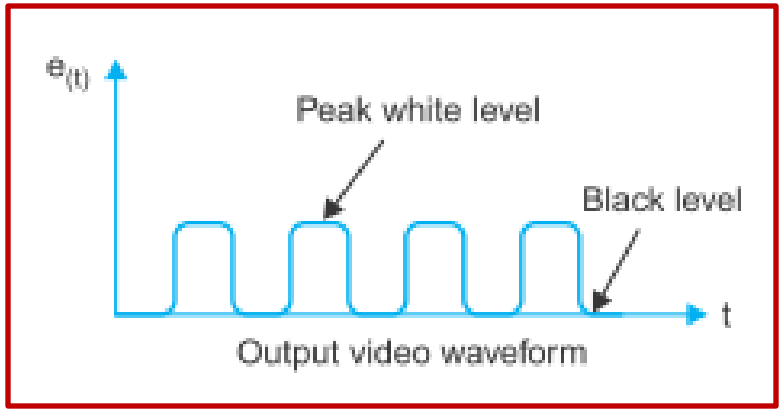
$$V_r = 585 \times 0.69 = 400 \text{ lines}$$

Horizontal Ratio:



$$N = N_a \times \text{aspect ratio} \times k = 585 \times 4/3 \times 0.69 = 533$$

Analysis and Synthesis of TV Pictures



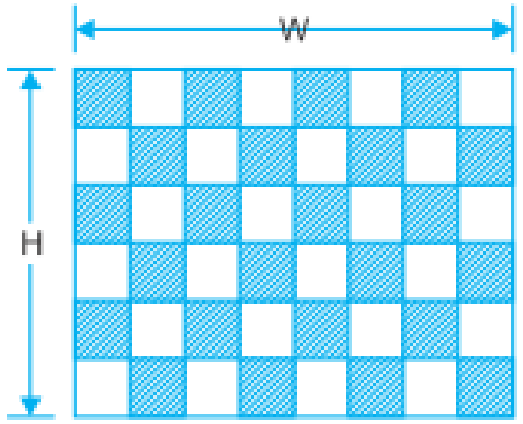


Fig. 2.7(b) Chess-board pattern for studying vertical and horizontal resolution.

Thus the time duration t_h of one square wave cycle is equal to

$$t_h = \frac{\text{active period of each horizontal line}}{\text{number of cycles}}$$

$$= \frac{52 \times 10^{-6}}{267} \text{ seconds}$$

$533/2 \approx 267$

$\therefore$ thg frequency of the periodic wave

$$f_h = \frac{1}{t_h} = \frac{267 \times 10^6}{52} = 5 \text{ MHz}$$

Analysis and Synthesis of TV Pictures

Bandwidth requirement for transmission of synchronising pulses. The equalizing pulses to be discussed later have a pulse width of 2.3 μs with an allowed rise time of 0.2 μs. The highest sinusoidal frequency which must lie in the pass band of the system for effective transmission of these pulses is given by the expression :

$$\text{Highest necessary frequency} = \frac{1}{2 \times \text{allowed rise time}} = \frac{10^6}{2 \times 0.2} = 2.5 \text{ MHz}$$

It is then clear that all sync pulses are safely preserved in the video circuitry where, as has been shown, a frequency bandwidth considerably in excess of this figure has to be maintained in order to preserve the required picture definition.

Composite Video Signal

- Consists of:
- Picture information
- Blanking pulse (to make the retrace invisible)
- Synchronizing pulse
  - Horizontal sync at the end of each line
  - Vertical sync after each field
  - Sync pulses are needed consecutively and simultaneously with the picture signal

Composite Video Signal

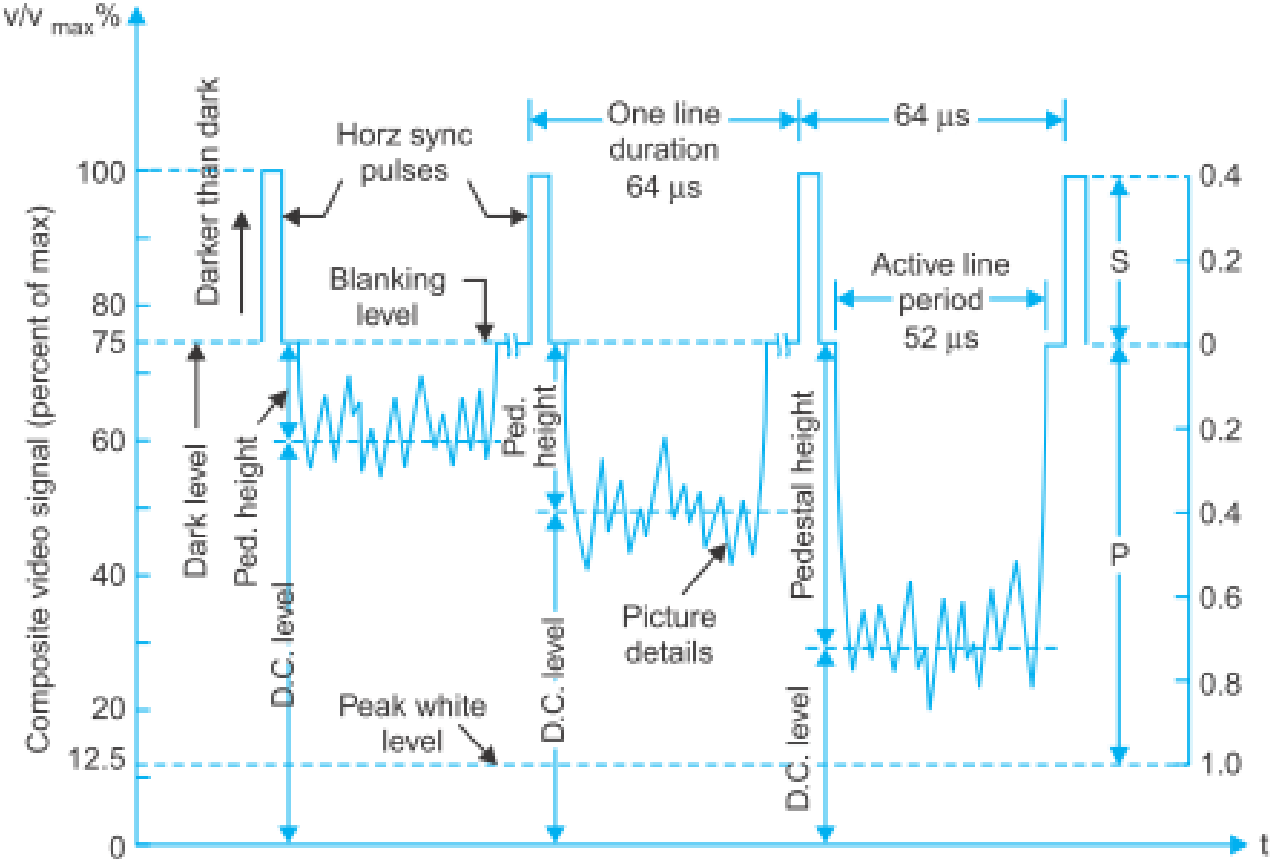


Fig. 3.1 Arbitrary picture signal details of three scanning lines with different average brightness levels. Note that picture to sync ratio P/S = 10/4.

Composite Video Signal

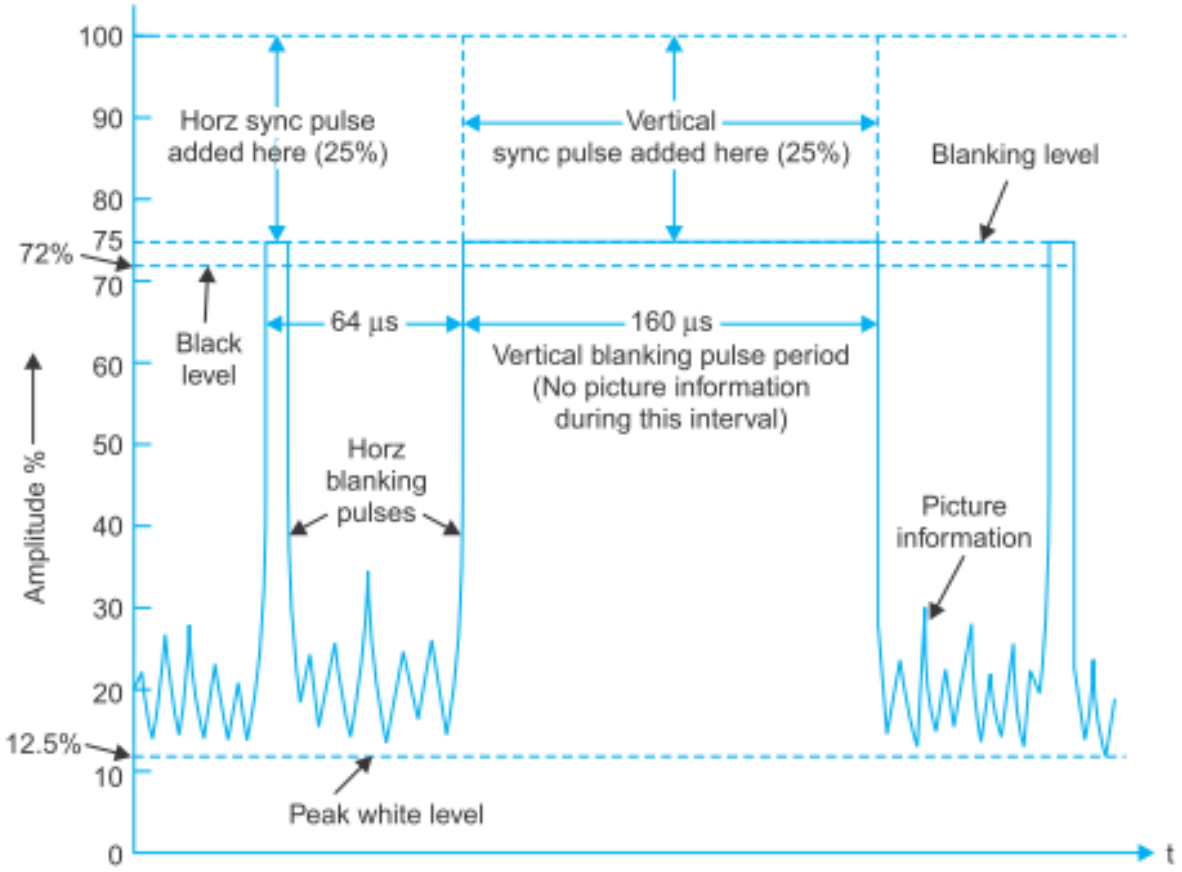


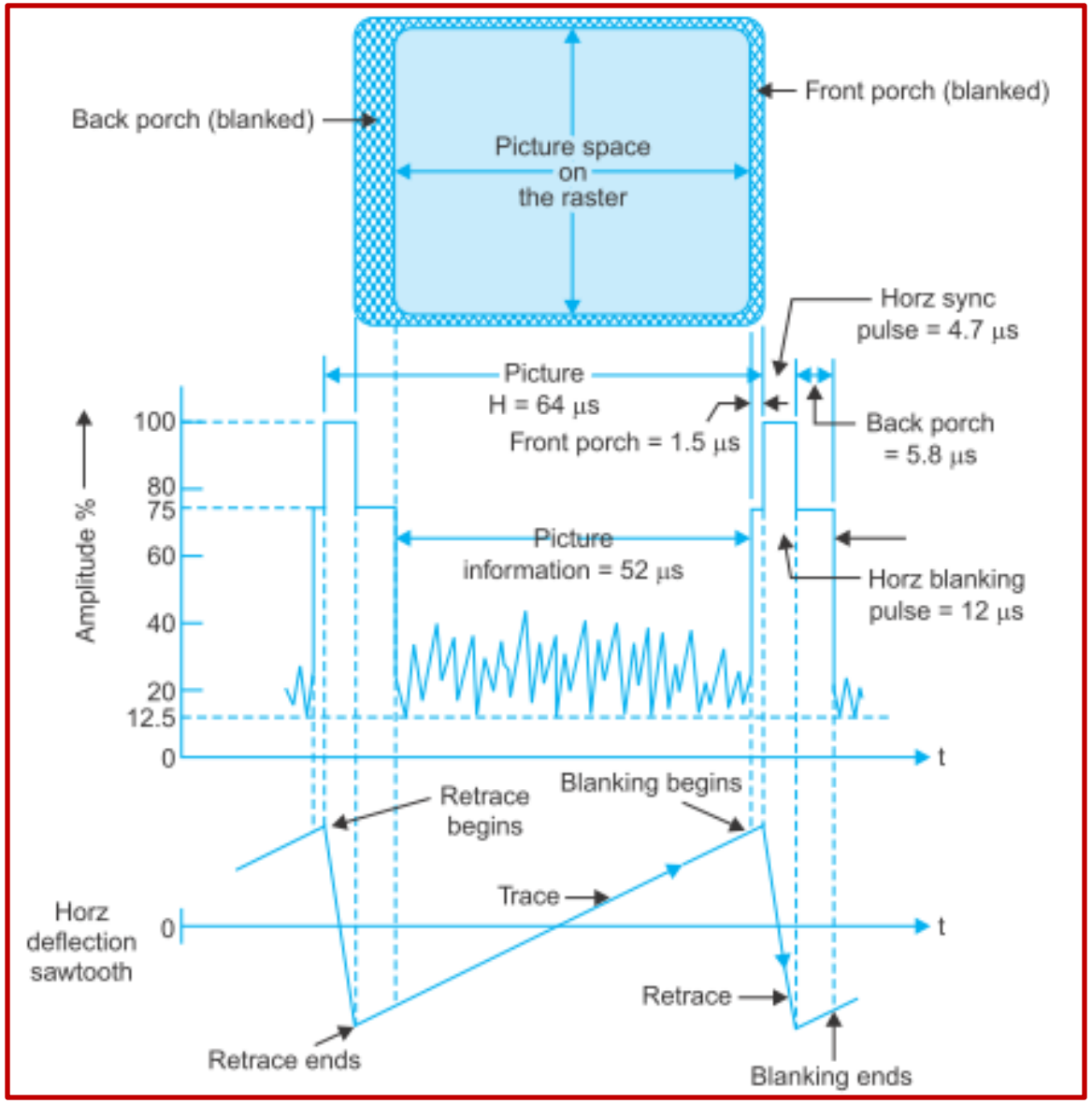
Fig. 3.2 Horizontal and vertical blanking pulses in video signal. Sync pulses are added above the blanking level and occupy upper 25% of the composite video signal amplitude.

CVS

- Horizontal Sync. Details

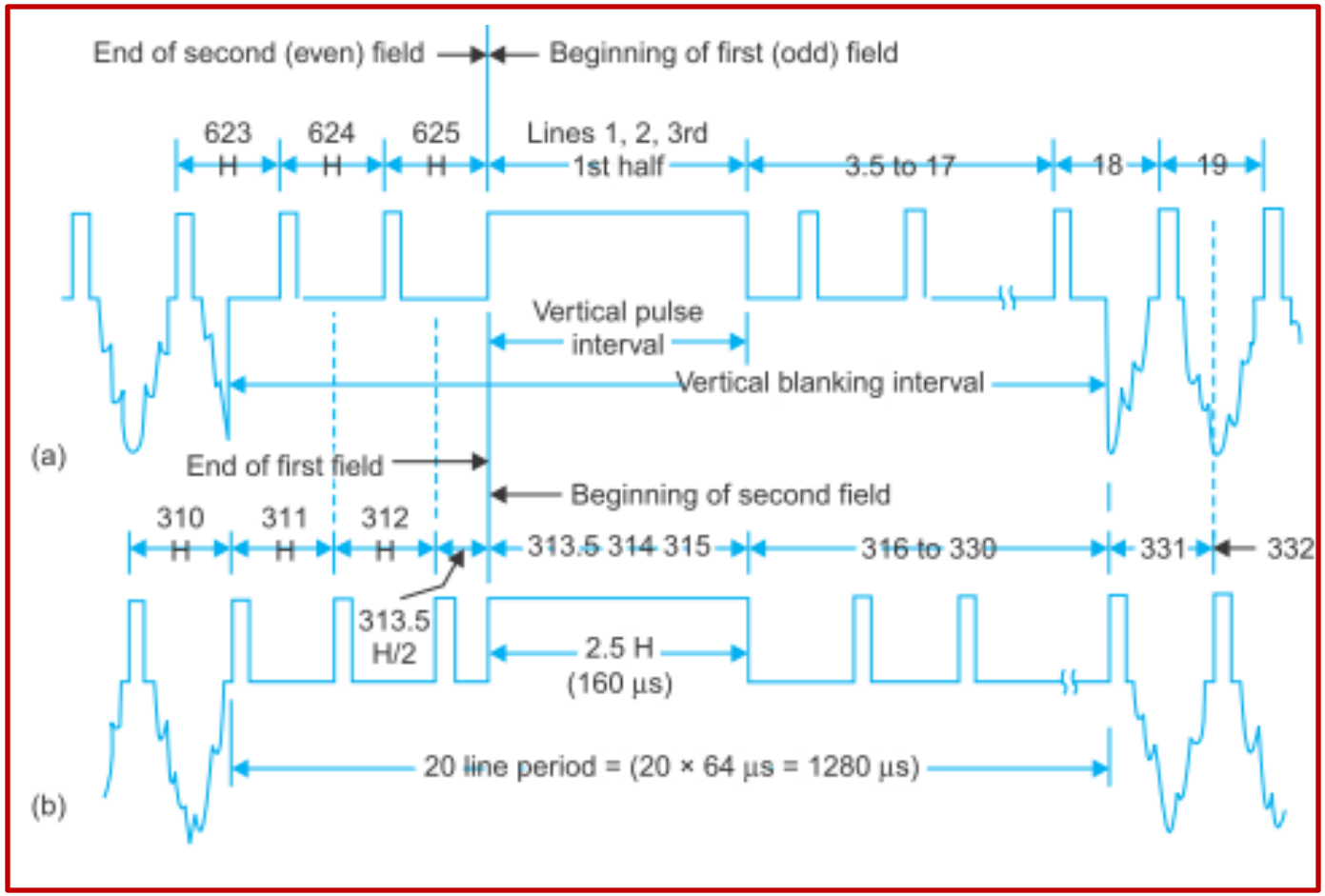
Details of Horizontal Scanning

Period	*Time (μs)*
Total line (*H*)	64
Horz blanking	12 ± .3
Horz sync pulse	4.7 ± 0.2
Front porch	1.5 ± .3
Back porch	5.8 ± .3
Visible line time	52



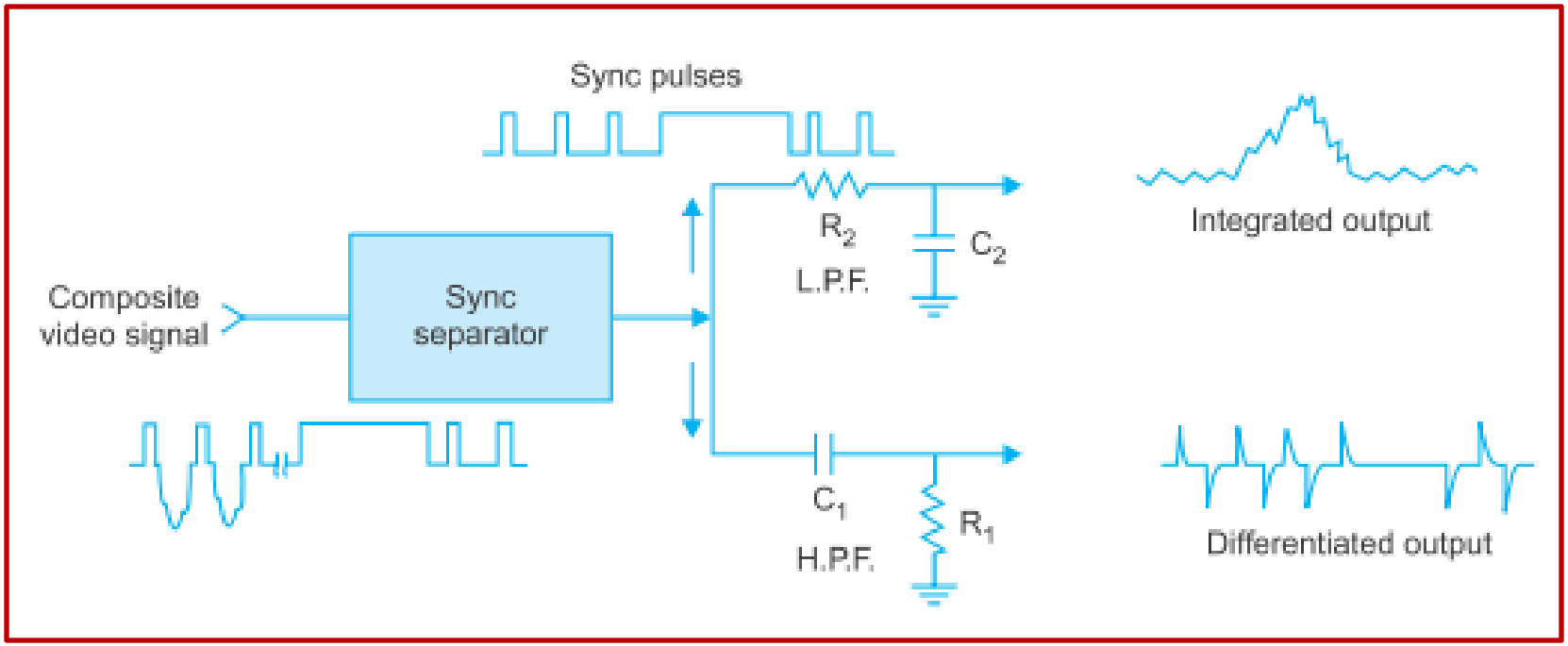
Composite Video Signal

- Vertical Sync. Details



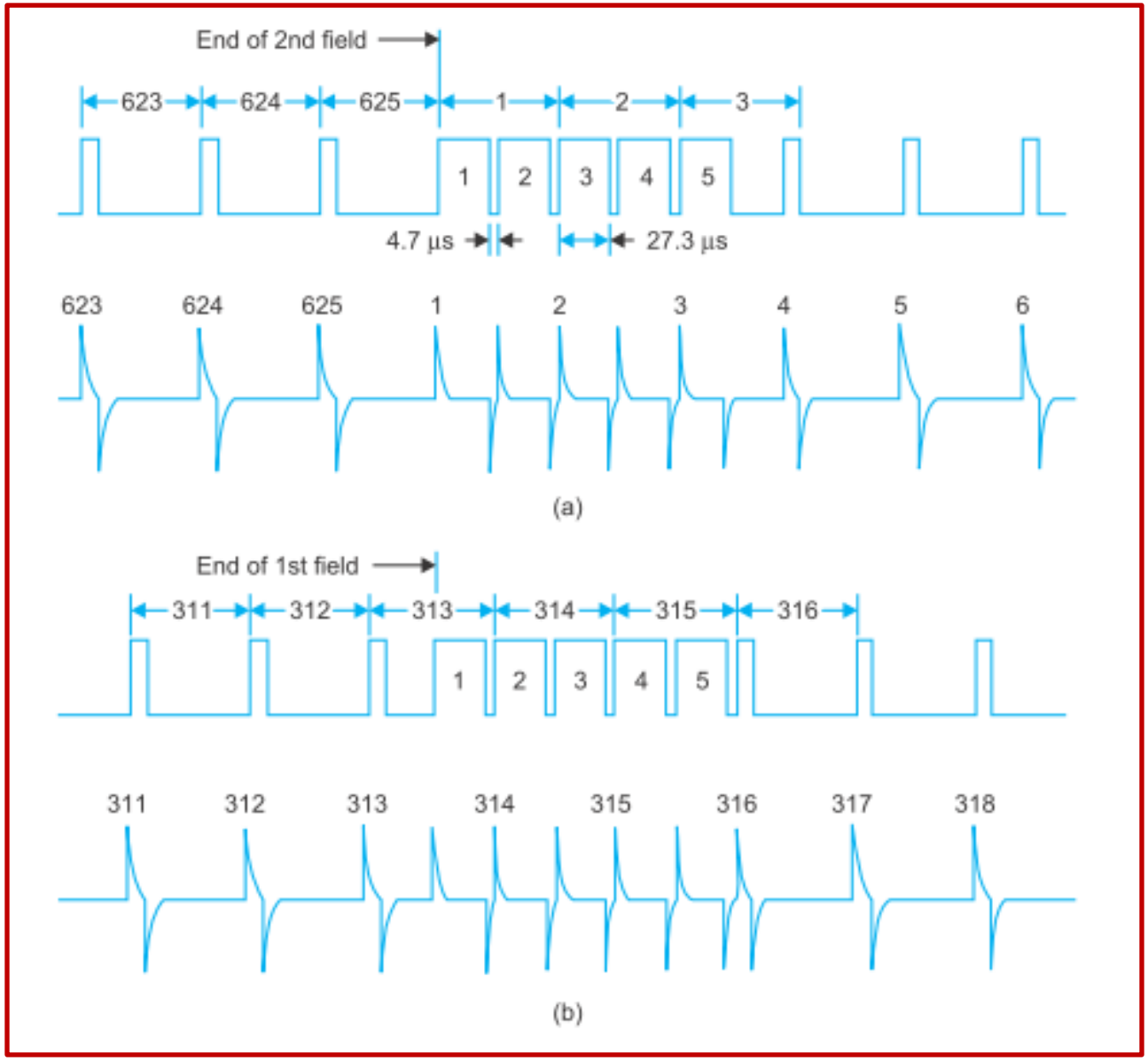
Composite Video Signal

- Vertical and Horizontal Sync. Separation



CVS

- No H. Sync. During Vertical Synch?



Channel BW

- DSB!

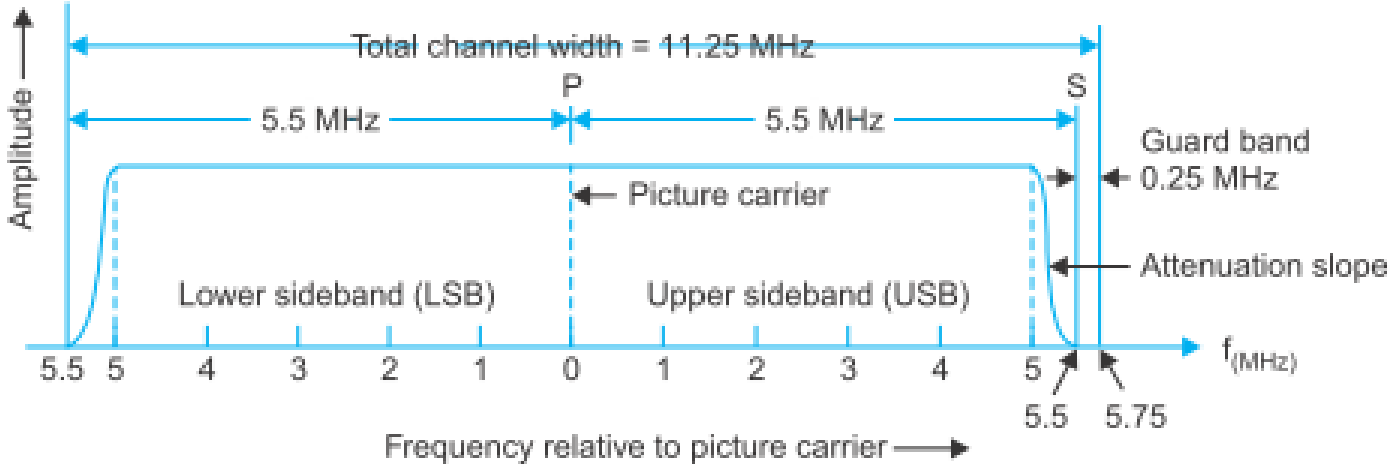
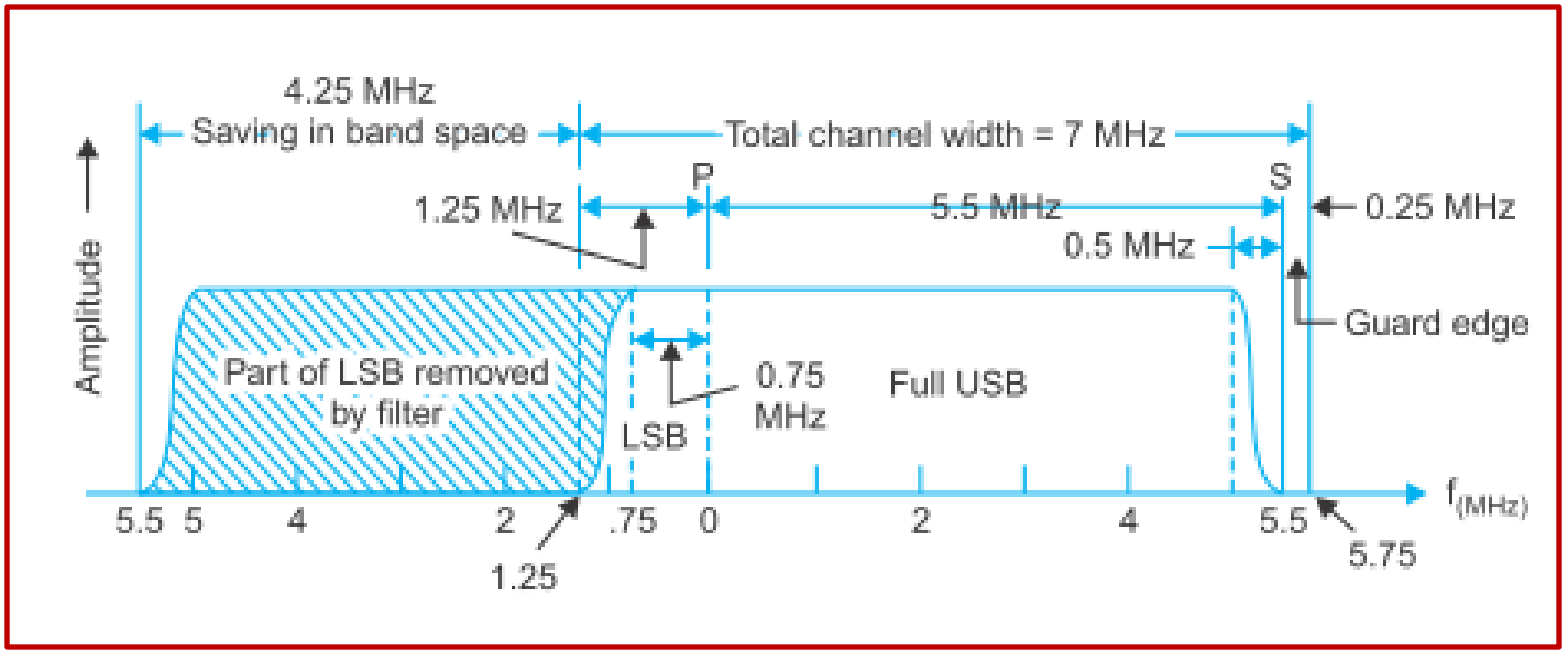


Fig. 4.2 Total channel bandwidth using double sideband picture signal. P is picture carrier and S is sound carrier.

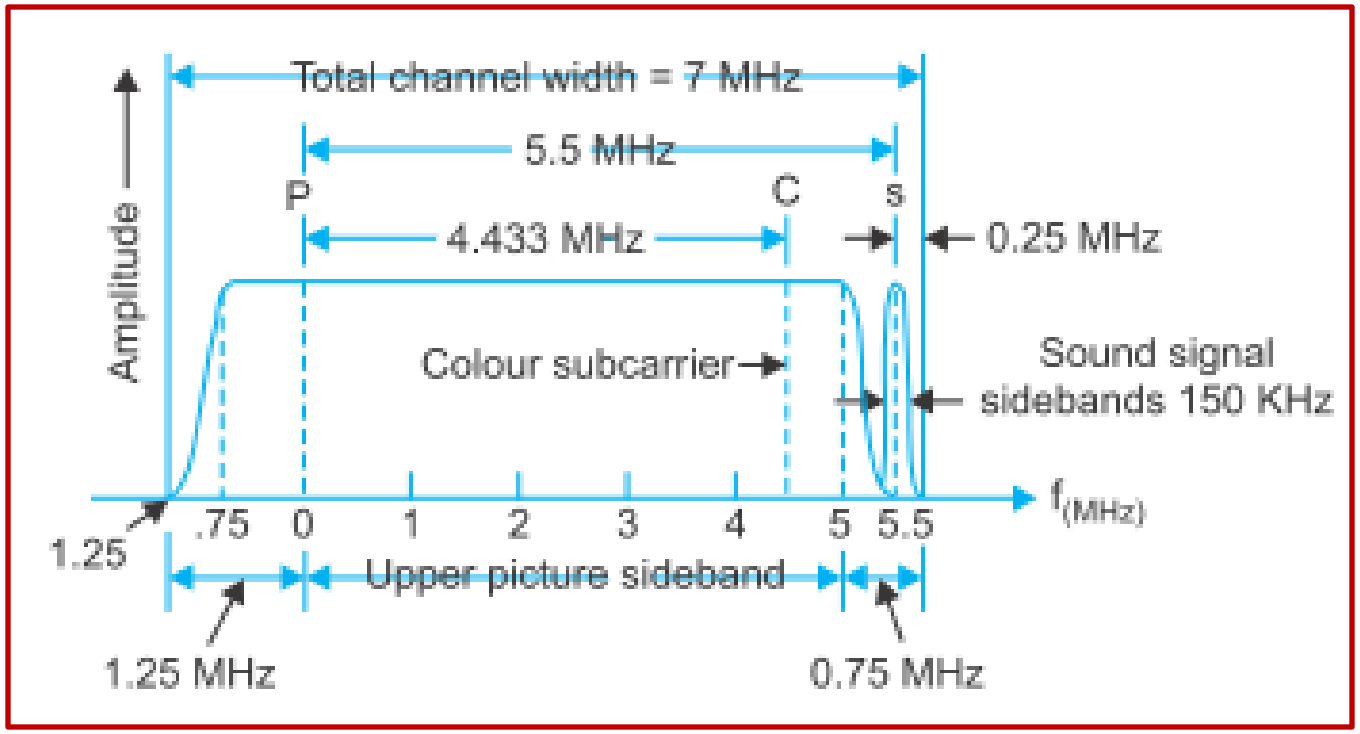
Channel BW

- VSB



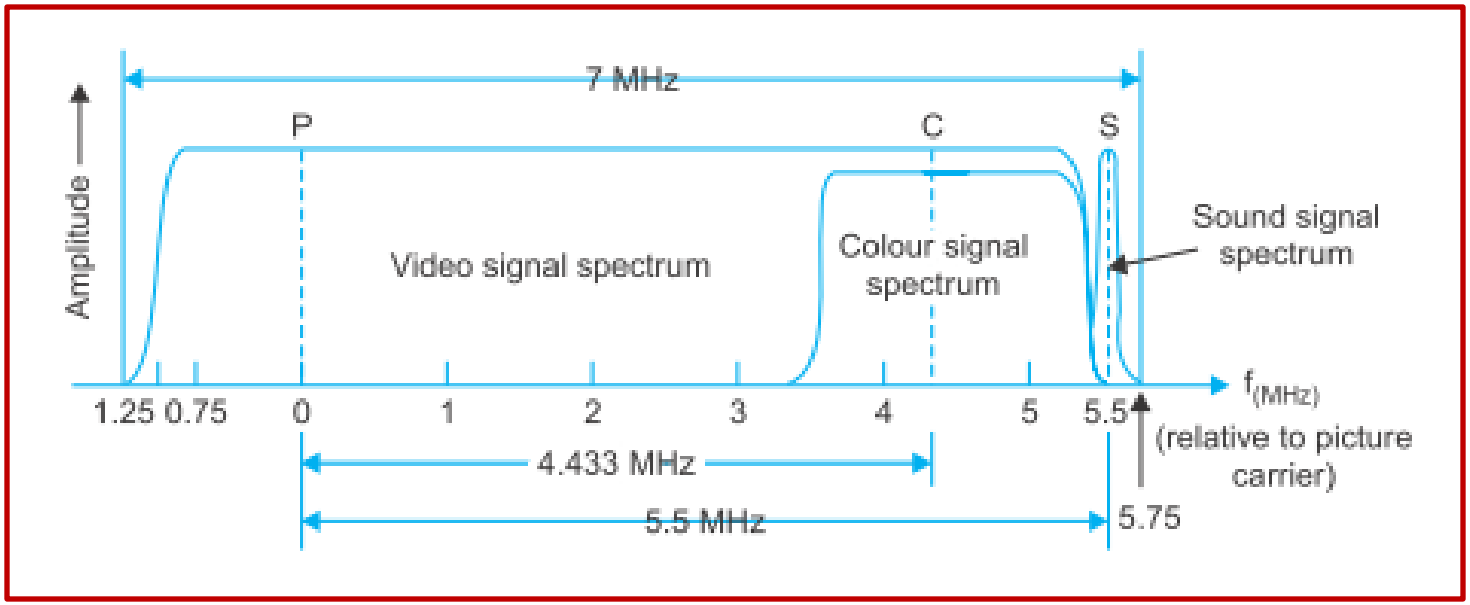
Channel BW

- Complete Channel BW



Channel BW

- BW for Color Tx:



Picture Tube

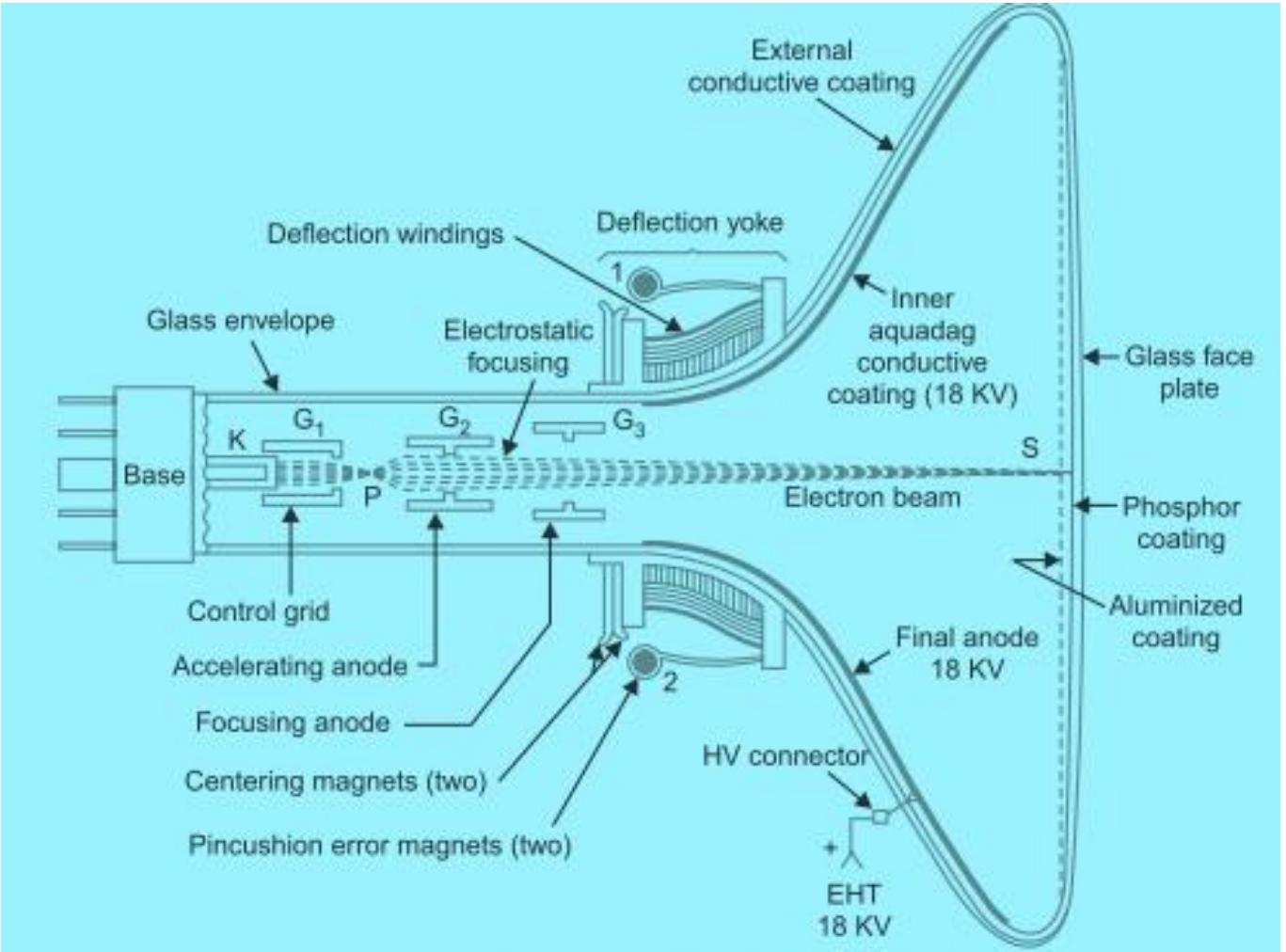


Fig. 5.2. Elements of a picture tube employing low voltage electrostatic focusing and magnetic deflection.

Camera Tubes

- Image Orthigon:

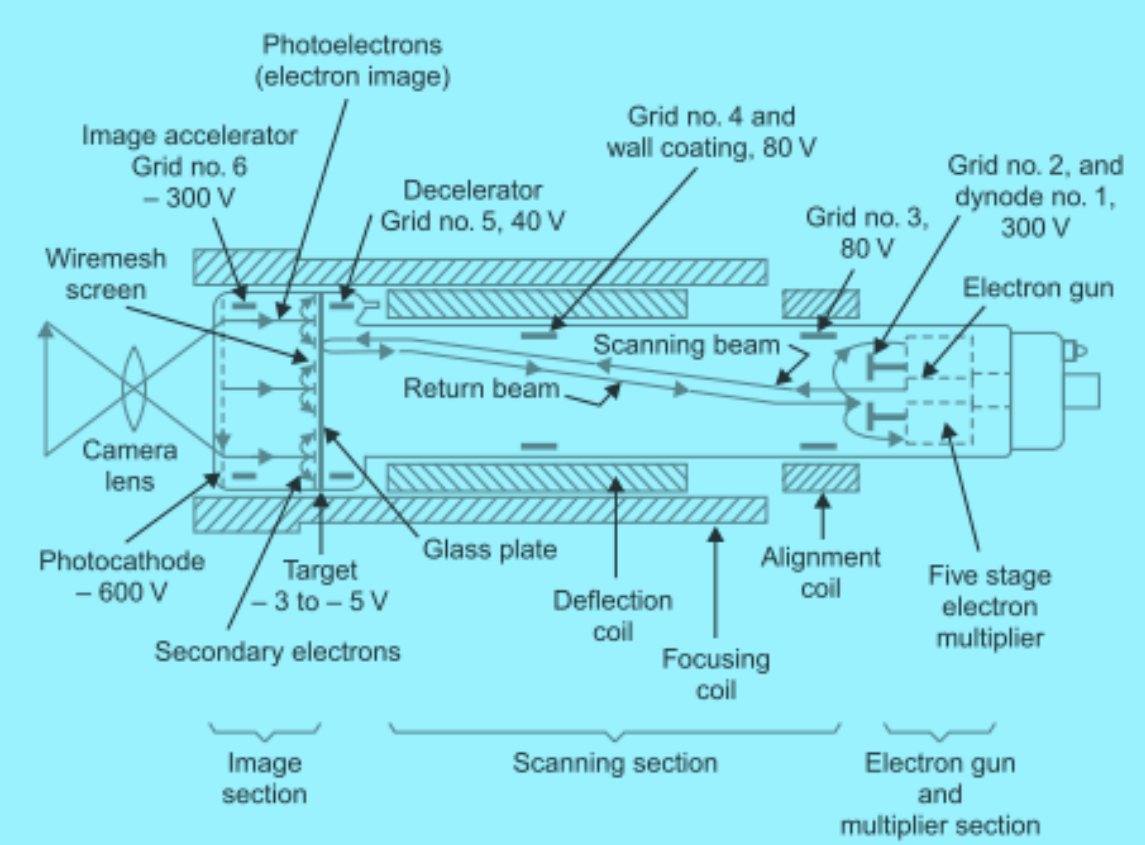
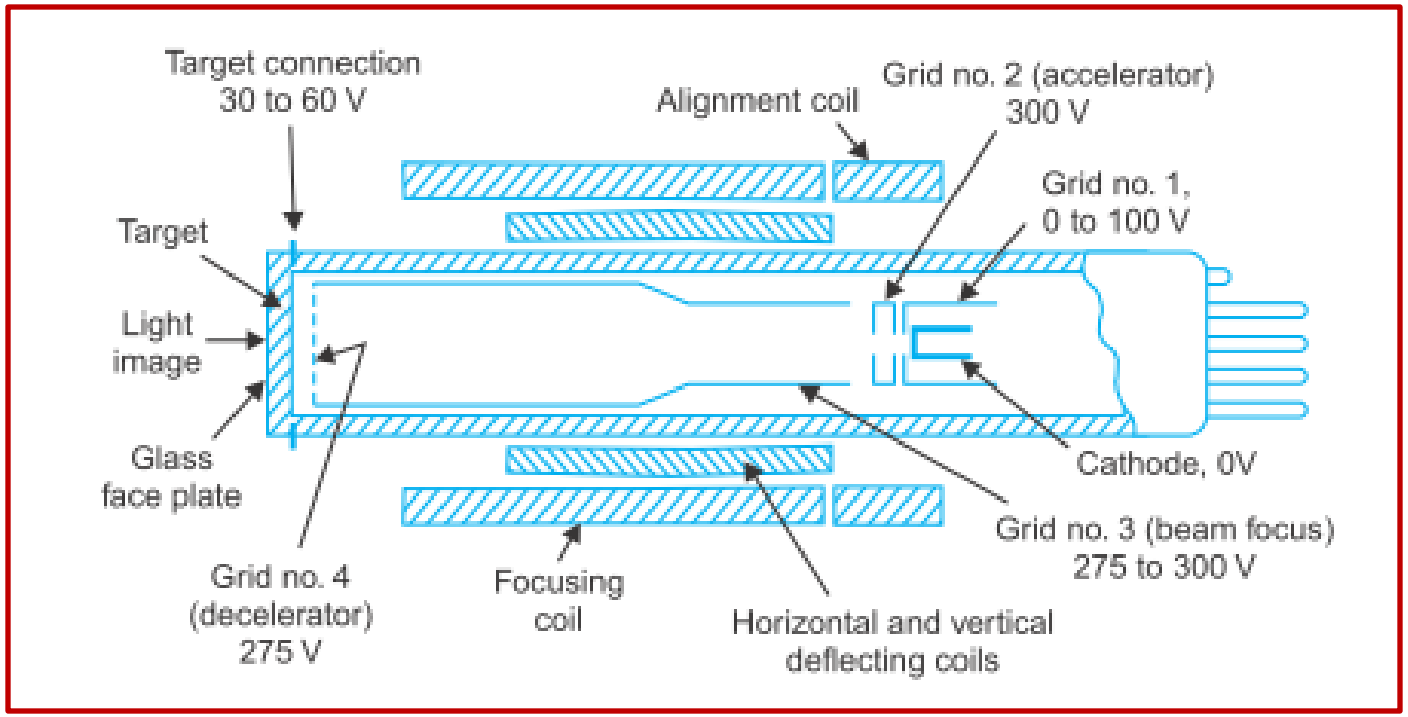


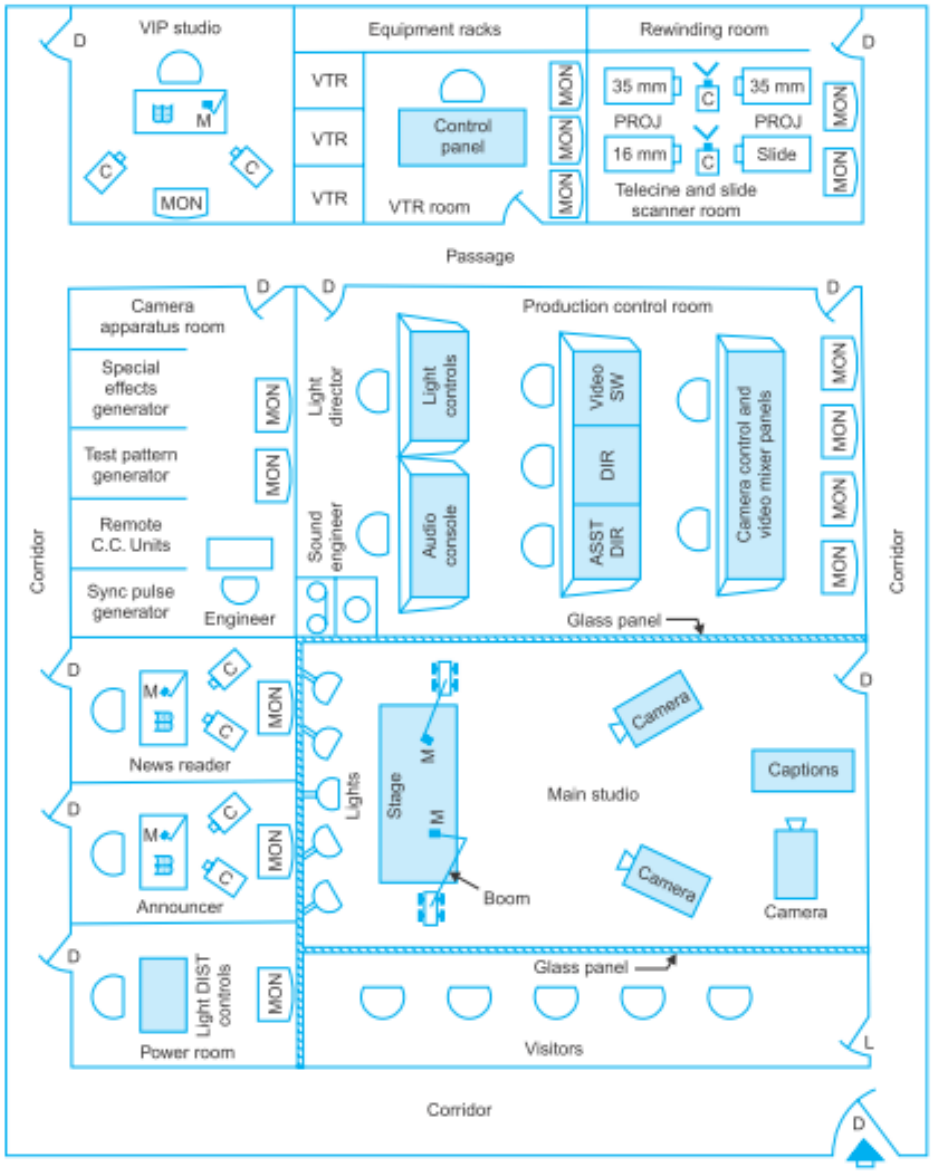
Fig. 6.3. Principle of operation of Image Orthicon (non-field mesh type).

Camera Tubes

- Vidicon:



TV Studio


VIP studio
Equipment racks
Rewinding room
VTR
VTR
VTR
Control panel
VTR room
MON
35 mm
35 mm
PROJ
PROJ
16 mm
Slide
Telecine and slide scanner room
Passage
Camera apparatus room
Special effects generator
Test pattern generator
Remote C.C. Units
Sync pulse generator
Engineer
Production control room
Light director
Light controls
Sound engineer
Audio console
Video SW
DIR
ASST DIR
Camera control and video mixer panels
Glass panel
Corridor
News reader
Announcer
Power room
Light DIST controls
Lights
Stage
Boom
Camera
Captions
Main studio
Visitors
Glass panel
Corridor

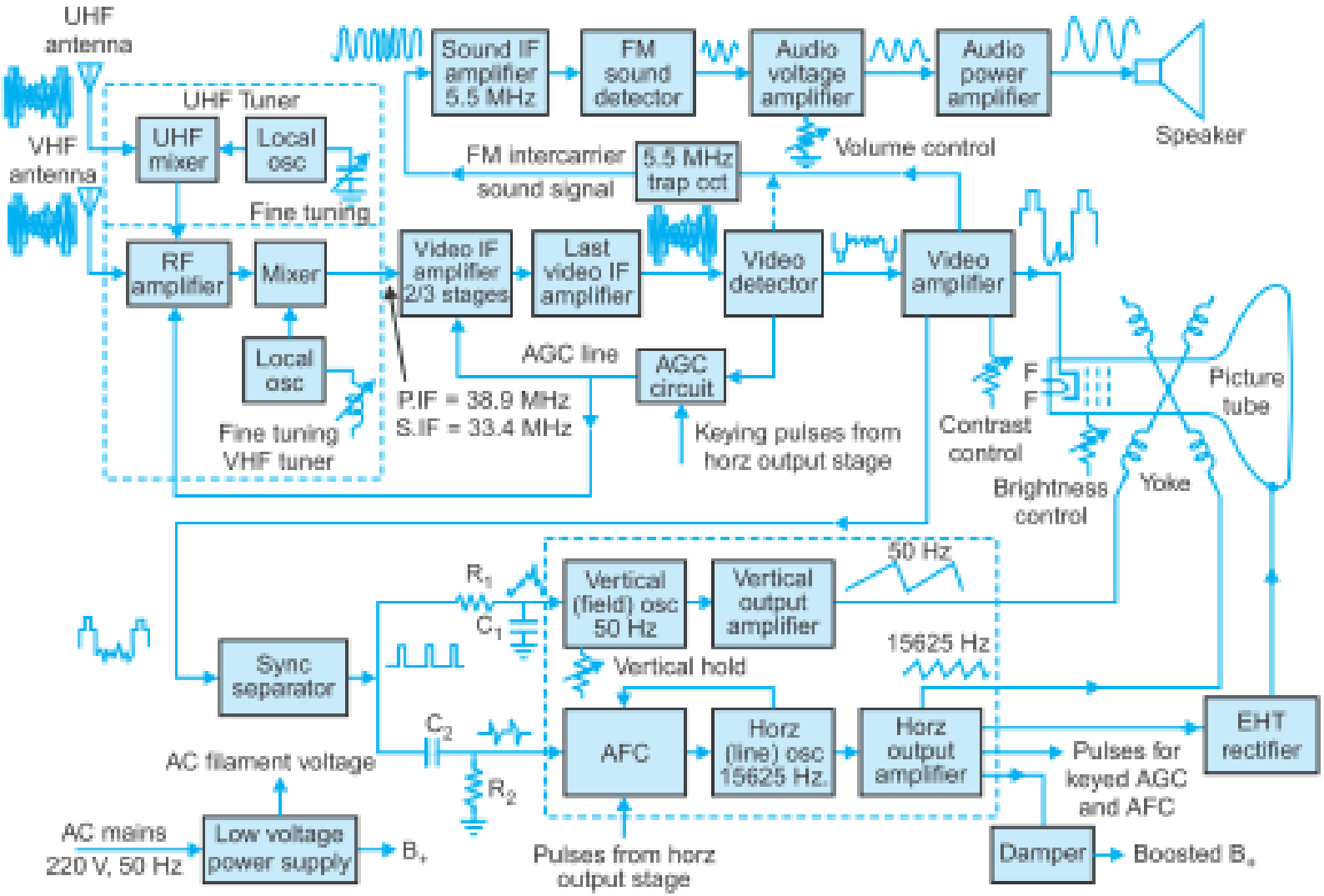


Fig. 8.2. Block diagram of a monochrome television receiver.

Q & A