UNIT - 3

Radiometric and TV signals.

Radiometry : "Deals with black body radiations of the target".

It is nothing but collecting data from distant target based on the black body radiantion which can be measured in 2 forms - temparature and power

- Monitor the target at some distance
- Measure power and temp
- Collect data frequency
- Analyse & conclusion done based on data collected.

- Basic laws.

1. Planks radiation law:

Any target in free space absorbs or raduiate the energy which is incident on it.

power radiated by the body $P = KTB$

K - boltzmann constant

T - Temperature

B - Bandwidth

$$e(\text{emissivity of body}) = \frac{\text{Power radiated by the body}}{\text{power radiated by ideal black body}}$$

$$e = \frac{P_r}{KTB}$$

For a black body $e = 1$ coz $P_r = KTB$

Thus $0 < e < 1$

No absorption all radiations are reflected

complete absorption

> If T_B - Brightness temp of the body.
  T - Physical/actual temp of the body
then, $T_B = eT \Rightarrow T_B \leq T$ since $e \leq 1$

* Temp of sun varies b/w $6000°c < T < 1$ lakh °c
quiet sun — excited sun

> Various temp which is measured by radiometer
* 1. Sun temp during day time (T_S)
  2. Black body rad temp (T_B)
  3. Temp radiated from atm (T_{AR}) by reflection
  4. Direct radiation of atm (T_{AB})
  5. Other environment effects (T_{AE})

we can measure actual black body temp by rejected 1, 3 & 4, 5.

→ Accuracy of measuring T_B: parameters involved.
1. How receiver filter temps
2. Brightness / colour of the target
3. Observation angle
4. Freq at which we are measuring
5. Polarization
6. Attenuation of the signal (path loss)
7. Radiation pattern
8. Environmental conditions
9. Geographical locations - elevations
10. Cross section aperture of antenna.

Radiometry is multidisciplinary - electrical eng, electronics, comm eng, instrumentation, oceanography, geo phy, atm & space sciences etc.

→ Applications :-

1. Remote and environmental app^n
2. Measurement of soil moisture fertility - helpful for oil, gas & ore explorations.
3. Sea mapping for fisherman
4. Flood mapping.
5. Snow ice mapping
6. Monitoring wind pressure on ocean surface - imp in weather forcasting.
7. Atmospheric profiles - ozones. co. humidity.

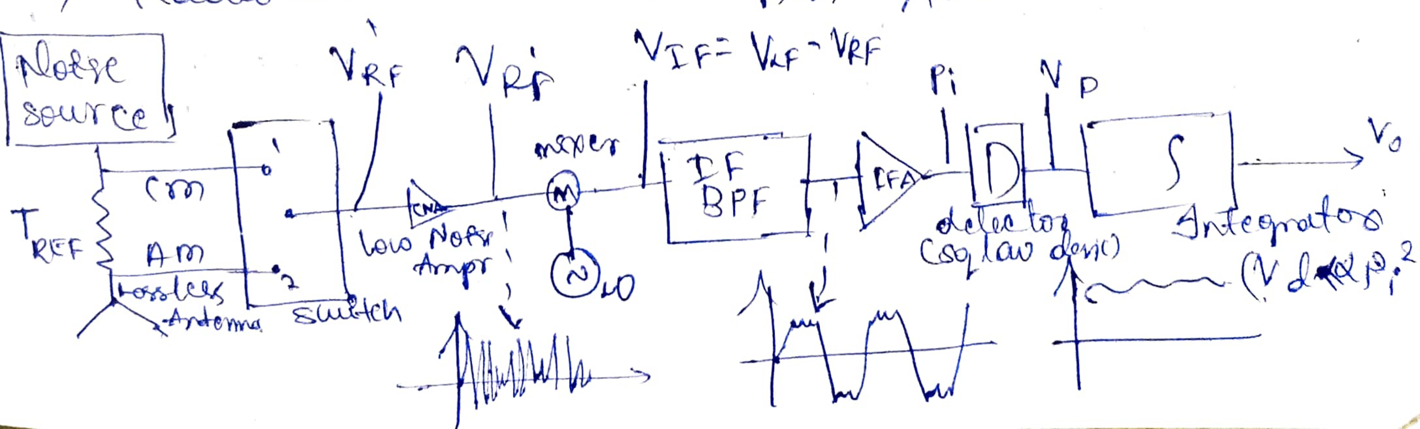
→ military app^n :-

1. Target detection
2. target recognition
3. Continuous surveillence
4. EWS - Early warning system
5. Mapping of geographical locations

→ Astronomical App^n

- Deep space tracking of heavenly bodies - stars, plants. milky way, comets, Nebulla.
- Planetary / Heavenly body motion.

→ Radiometric Receiver: CM - calliboration mode
AM - Actual mode



power $P_A = K T_B . B$ ---> ①

If T_R is the noise temp of Rx

power $P_B = K T_R B$

If G-gain of the reciever then o/p (vtg or power)

$$V_0 = G K B (T_B + T_R) \dashrightarrow ②$$

Eqn ② ÷ ① ⇒ $\frac{V_0}{P_A} = \frac{G}{T_B} (T_B + T_R)$

$$\therefore V_0 = P_A\left(1 + \frac{T_R}{T_B}\right) G$$

Errors:

1. ΔT_N = Error in measuring T_B due to noise fluctuation

$$= \frac{T_B + T_R}{\sqrt{B \cdot C}} \quad \text{as } \tau\uparrow,\ \Delta T_N\downarrow$$

2. ΔT_G = Random gain variation of amplifier in the reciever

$$= (T_B + T_R)\frac{\Delta G}{G}.$$ ΔG - rms gain in measured gain

proof

If $f = 10\,GHz$, $B = 100\,GHz$, $T_R = 500\,K$, $\tau = 0.01\,s$, $\frac{\Delta G}{G} = 0.0$

$T_B = 300°K$, find ΔT_N & ΔT_G

$$\Delta T_N = 0.8\,K$$

$$\Delta T_G = 8°K$$

⇒ Gain stablization is more imp coz error due to gain stablization is more stable wrt gain.

Dicke Null Reciever.

It uses -ve feedback for stablization of gain to measure brightness temp.

→ TV principles:

Tele - distance vision - seeing

Invented by Joseph baised at Bell laboratory

Standards of TV system.

↳ 1° std (Global) → (B)

↳ Derived std (adopted to particular country (area)) → (D)

→ Monitoring agencies.

> ITU - International Telecommunication union

> FCC - Federal communication commission

> CCIR - Consullative committee International of Radio

→ similarly in std:

- Sound signal modulⁿ - FM
- Picture - 11 - - AM
- Type of Tx - Vestigial SB Tx
- Interlace ratio - 2:1 (field freq : Frame rep freq)
- AR - Aspect ratio - 4:3
- Polarity - -ve modulation.

→ Derived stds.

(B) NTSC - National Television system committee

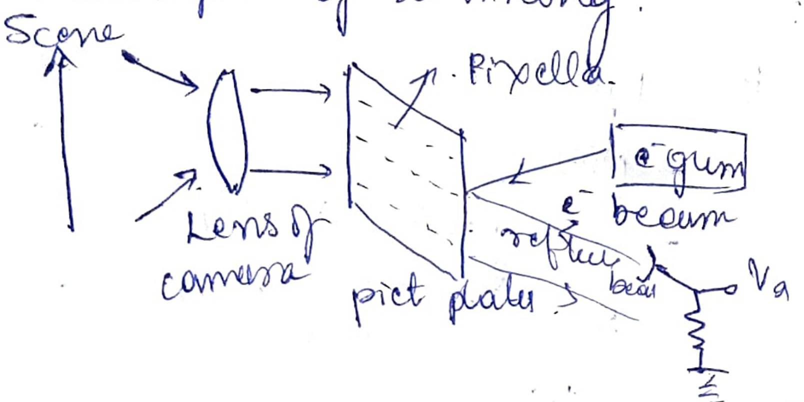
- Also called as M-Format
- Started in 1967 - USA
- Work with 110V Ac, 60Hz
- US Japan. Korea, SA, Canada
- Vedio b.w 4MHz
- High noise - Active lines = 486 (525 - over heads)
- Inter lace scanning is done to (39) aviod flicking

2) SECAM : Sequential colour waveve memory.

- Inventied in 1970 - France
- France, Belgium, Africa, Iran, Iraq
- 625 lines, 25 frames per
- Channel b.w - 6MHz.
- 220AC
- very High noise.

3) PAL - Phase Alternation by line
- Britain - Europe . India . western, Erop
- Vedio BW - 5MHz 230V AC, 50Hz
- No of lines - 625
- Noise effect is smaller.

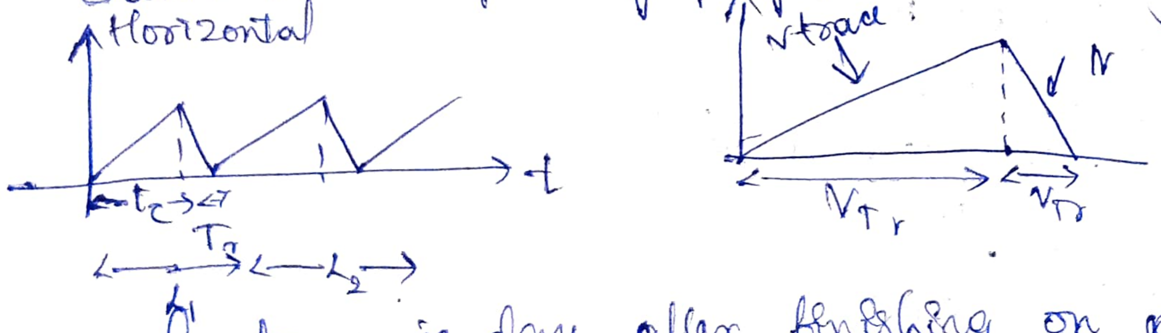
→ Principle of scanning.



scanning - Converting visual into electrical info
There are 2 type
- progressive scanning
- Interplace scanning

- Limitations.
It is slow process
(2) ODD & EVEN line tracing is done during odd &even f

Sawtooth waveform of progressive scanning



vertical trace is done after finishing on page scanning

→ Progressive scanning
- Each line is progressively covered
- Recovery of the frame is slow
- Flickering
- Reding a page in a book, similar to lead

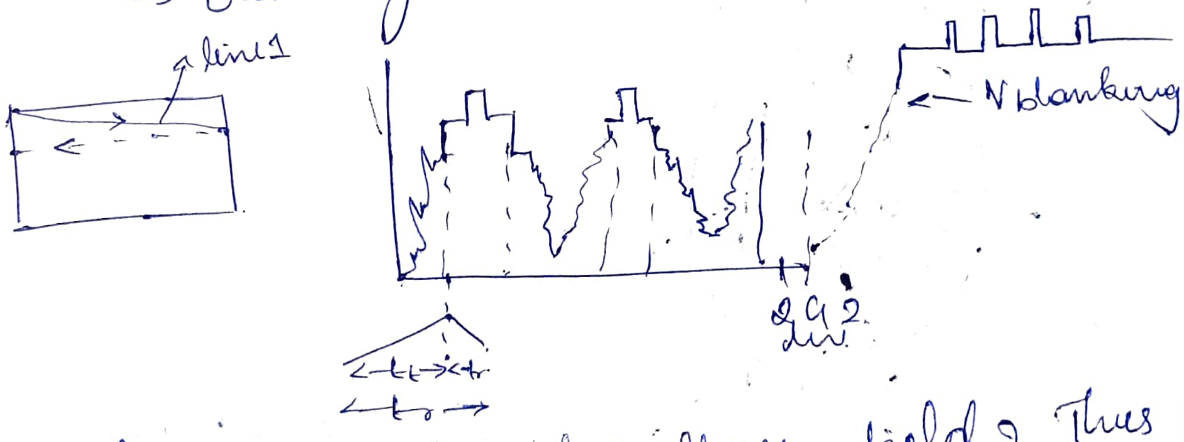
Interlace scanning

Field 1 (odd field) | Field 2 (even field)

Field 1 - 1 to 142
Field 2 - 243 to 504

525 total
- 504
21 lines are lost

→ 2 types of transmission is done during suppac period
→ Blanking (Hori. ver) → Synch.



* Field 1 - has 1/2 line less than field 2 Thus pseudo/dummy is added at V blanking for proper sych.

Composite vedio has 4 signal to be generated
→ Blanking H / V

principle of colour tx.

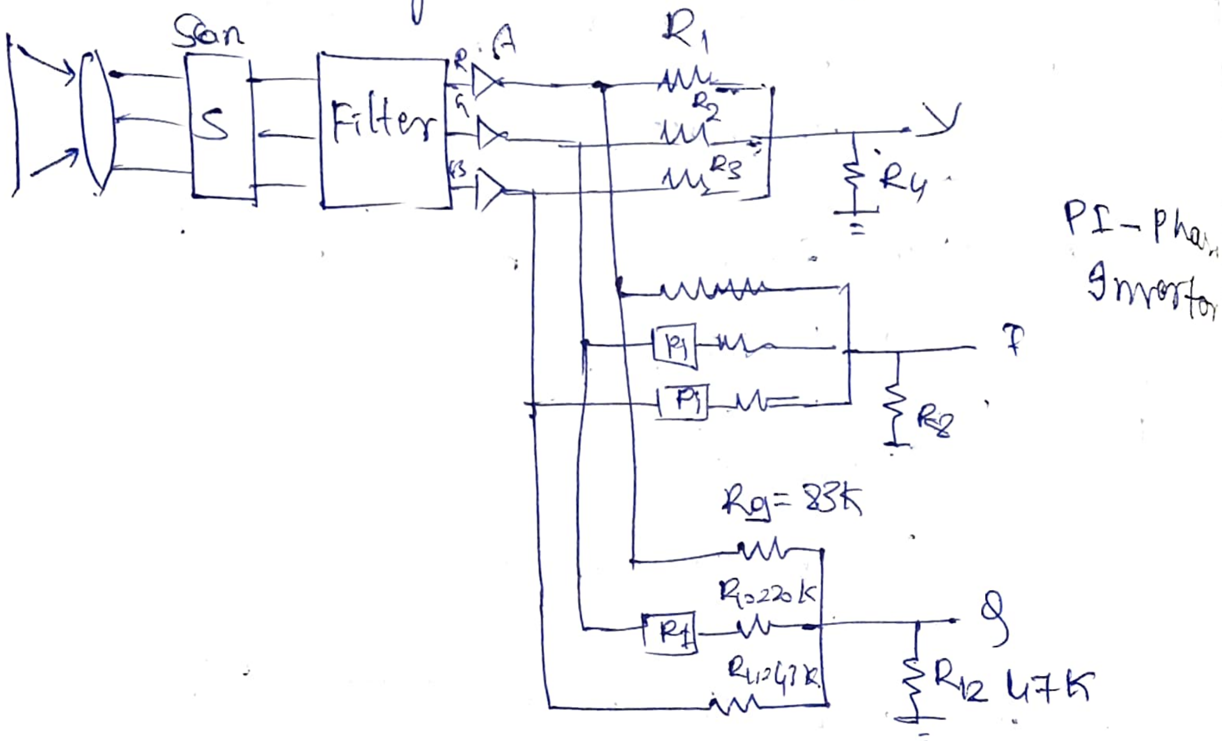
Requirements
- BW of 6MHz type used
- Compatibility

• For generating Y signal $0.3R + 0.59G + 0.11B$

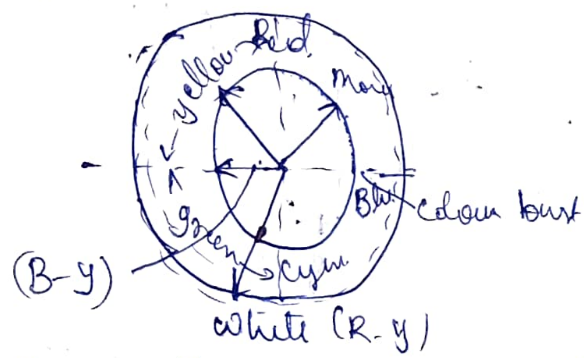
I signal $0.6R - 0.28G - 0.32B$

Q signal $0.21R - 0.52G + 0.31B$

Colour matrix generates Y, I, Q signals from R, G, B



In receiver, there will be a colour disk.



Eg – If $Q = 0$, $I = I_{max} \rightarrow$ Saturated reddish orange

$I < I_{max} \rightarrow$ Polar value of ↓

If $I = 0$, $Q = -Q_{max} \rightarrow$ Saturated yellowish green.

$0.8Q - 0.6I \rightarrow$ Pure blue

* Phosphorence – Principle on which TV screen works.

Limitations of analog tx sys.

1. Luminance signal has smaller resolution for big screens
2. Colour effect - chromenance sig has letter resolution along horiz direct but poor resol^n along vertical direction.
3. 4:3 aspect ratio is insufficient for motion pictures which require (16:9, 32:17)
4. To conserve bw. in 6MHz channl we interleave c's carrier This causes (cross luminesence)
5. Interface scanning is not suitable for medical/ & nupmerde displays.

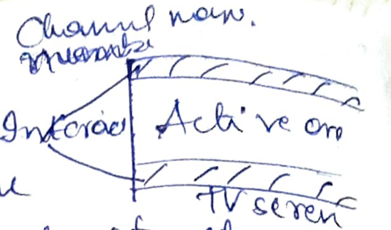
→ These can be overcome in digital system.

1. Use comb filtering to separate chromo & lumino signal. we can reduce cross luminosence
2. To improve vertical reduation, add additional scan lines to the sys.
3. Use DSP techniques to signal processing for letter
4. In digital format we can reduce noise distortion interference etc.
5. Compression method have ↑ the capacity of sy JPC, m/pu 12,3,4.

→ ComB Filter:

- Avoids interference b/w Y & c signal.
- DSP methods for signals conditionings. ~~distortn~~.
- In digital domain reduced noise interference, disru
- Picture in picture - for viewin multiple channel

→ • Better Boxing :- is possible.
• In short distance comm.
• DVD, VCR, separate channels are used for video, audio colour, intensity etc. This reduce interference.



– DTV standards: (Definition television)
↳ Primary std
↳ Broadcasting std

→ DVB – Digital vedio Broadcasting.
↳ DVB S – (satellites)
→ DVB-T. (terrestrial)
→ DVB-C-(Cable TV Applⁿ)
→ DVB-H (Hand held – mobile

→ ATSC – Advanced TV sys commettee
→ ISDB – Integrated services Digital Broadcasting

Info about DVB-T
- channel BW – 8MB
- Vedio compression MPEG – (lossy).
- Theater quality picture & CD-quality sound
- Coded EDM, 256AM, DOT, TCM.
- multipath interference is limited.
- Coding techniques are used to eleminate the error

→ Comparing of DVB

parameters	DVB-S	DVB-T	DVB-C
1. Interface with physical layer	← SPI ASI	— — —	→
2. Modulation	Single carrier QPSK	OFDM QAM	OFDM
3. Channel coding	← LPC+BCH	— —	→
4. Type of Transform	NA	DFT	Inverse FFT.

	Analog TV sys	Digital TV sys.
1. Modulation format	AM, FM	QAM, OFDM
2. Signal format	Composite vedio	Packet
3. Tx of signal	Y, I, Q	Y, B-Y, R-Y
4. Type of spectrum	AM, VSB	VSB, TCM, MyEHZ, AVC
5. Channel BW	←---- 6 MHz + Audio ---→	
6. signal distortion	Max	Nil
7. Type of screens	LED, phospher	LCD, plasma
8. Aspect ratio	4:3	16:9
9. Scanning	Interlace	Interlace, progr
10. Quality of signal	Moderate	Best

→ HDTV principles :-

- Eye is tolerant to quantization noise
- No. of bits used for sampling 8-10 bits for vedio
- For audio → 14 to 18 bits / sample

↳ Ear has less tolerence

- If m - no of bits used for coding $m = \frac{f_b}{N_{PT} \cdot R_f}$
- where, f_b - bit rate
  N_{PT} - No of pixels frame (Y/C)
  R_f - Frame Repetion Role
- Generally $N_{PZ} = N_H \times N_V$ where
  N_{PZ} - resolution of a frame
  N_H - Pixels in horizontal direction
  N_V - pixels in vertical direction

$N_{PT} = 1.5 N_{PZ}$

Ex: Vedio has 640×480 pixels. 8 bits per pixel, frame repetition rate: $R_f = 30Hz$, uses progressive scanning

solution:

$N_{PL} = N_H \times N_V = 307.2 \times 10^3$ pixels

$m = 8 \quad R_f = 30$

$N_{PT} = 1.5\, N_{PL} = 1.5(307.2 \times 10^3) = 460.8 \times 10^3$ pixels

$f_b = N_{PT}\, m\, R_f = 110.6\, Mbps.$