NTSC

Understanding the Basic Technical Information

Transmission Overview

- **TV uses 2 distinct transmission systems:**

1. **Visual transmitter** - operates as an AM radio transmitter, but modulates RF carrier with video signals
- visual signal is power-amplified and broadcast.

Transmission Overview

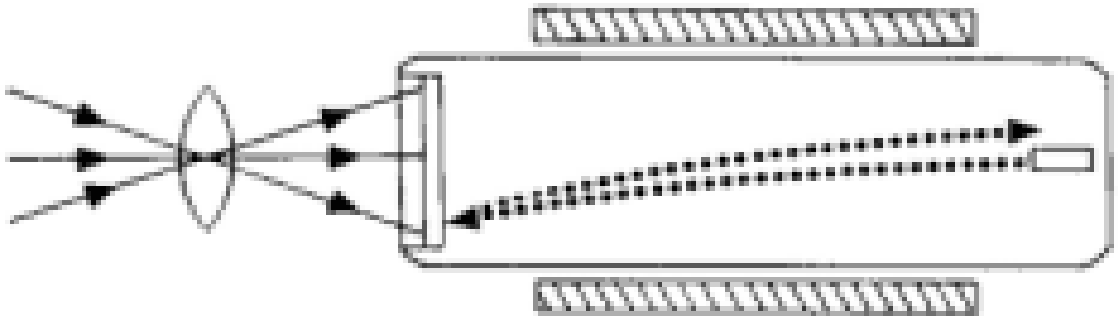
2. **Aural transmitter -** operates as a typical FM radio transmitter. It modulates an RF carrier with audio signals.

- Aural signal is then power amplified and sent to same antenna as visual signal
- TV receiver is actually 2 receivers in 1. An AM receiver for visual and FM receiver for audio

Creating a Video Signal: Transducing Light Into an Electrical Signal

electron beam traces an image

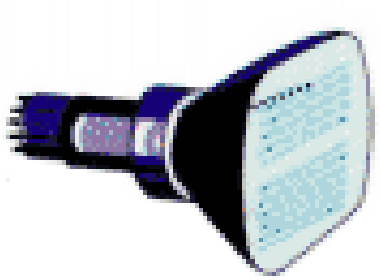
- voltage varies in proportion to light
- at TV receiver beam strikes phosphors on face of screen



Scanning an Image

- scanning occurs frame by frame and relies on persistence of human vision to work
- Persistence of vision is ability of eye to hold onto an image a few milliseconds after it has changed

CRT



- **Cathode Ray Tube**
- a vacuum tube that generates a focused beam of electrons which can be deflected by electric fields, magnetic fields, or both.
- The terminus of the beam is visible as a spot or line of luminescence caused by its impinging on a sensitized screen at one end of the tube.

NTSC and the Black and White Standard

- The NTSC system was first developed as a black and white system
- In order to allow people with black and white sets to continue to receive television signals, the color system adopted in the U.S. *had to be compatible* with the Black and White Standard

The Scanning Process: B&W Standard

- uses 525 horizontal scans in a frame
- there are 30 frames scanned in each second
- scanning process starts at the upper left of the picture area known as line1
- beam then proceeds horizontally to the upper right edge at a precise rate

The Scanning Process

- The beam quickly returns to the left edge to a point 2 lines below the previous scan
- it takes scanning beam 52.5 microseconds to scan from left to right and
- about 11 microseconds to return to the left again to begin scanning the next line

Scanning Process

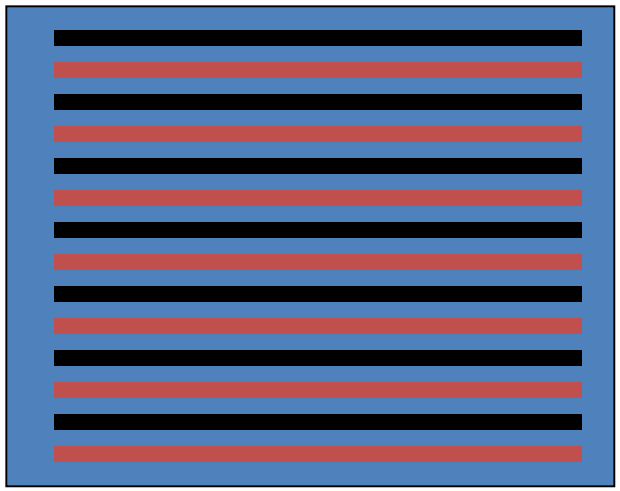
- Vertical Retracing: The beam is moved upward for about 1.3 milliseconds until the beam is at the top of the pictured area but positioned at line 2
- Field: 1 vertical downward scan and a vertical retrace contains 262 1/2 lines and occurs in 1/60 of a second.

Scanning Process

- FRAME: An image created by 2 successive fields
- 2 fields = one frame
- Field 1 scans all the odd numbered lines
- Field 2 scans all the even numbered lines

Interlaced Frame

- Sweeps the image as two fields that are interlaced to form a given frame.



Field One

Field Two

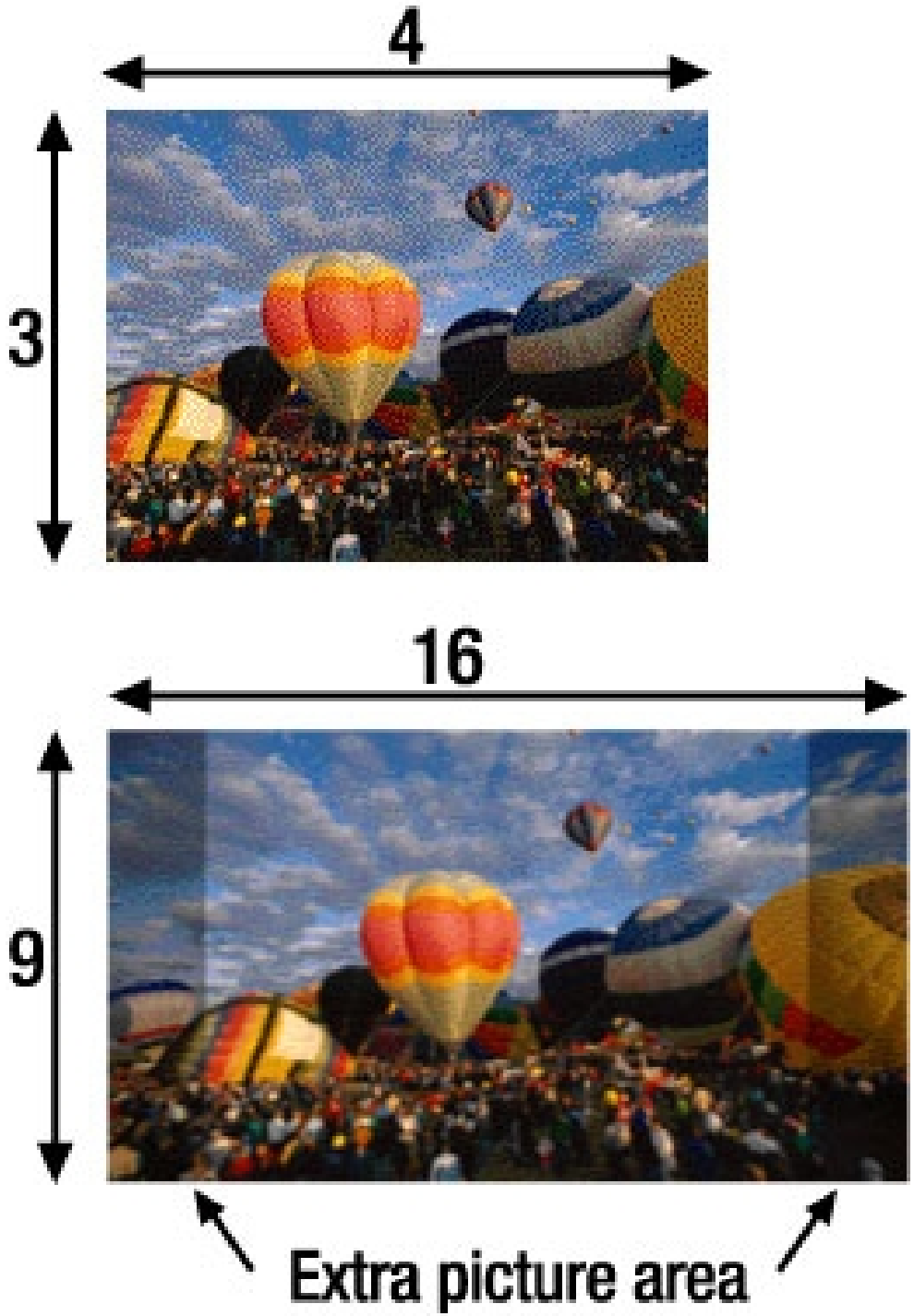
Aspect Ratio of NTSC

- **Ratio of width to height of the picture image**

4:3

1.33:1

Aspect Ratio



Principles of Color TV

- **Color TV sets require the ability to scan, transmit, and display the three primary colors (red, blue, green).**
- **For color TV to work in the U.S., the system had to be compatible with the black and white system already adopted**

Principles of Color TV

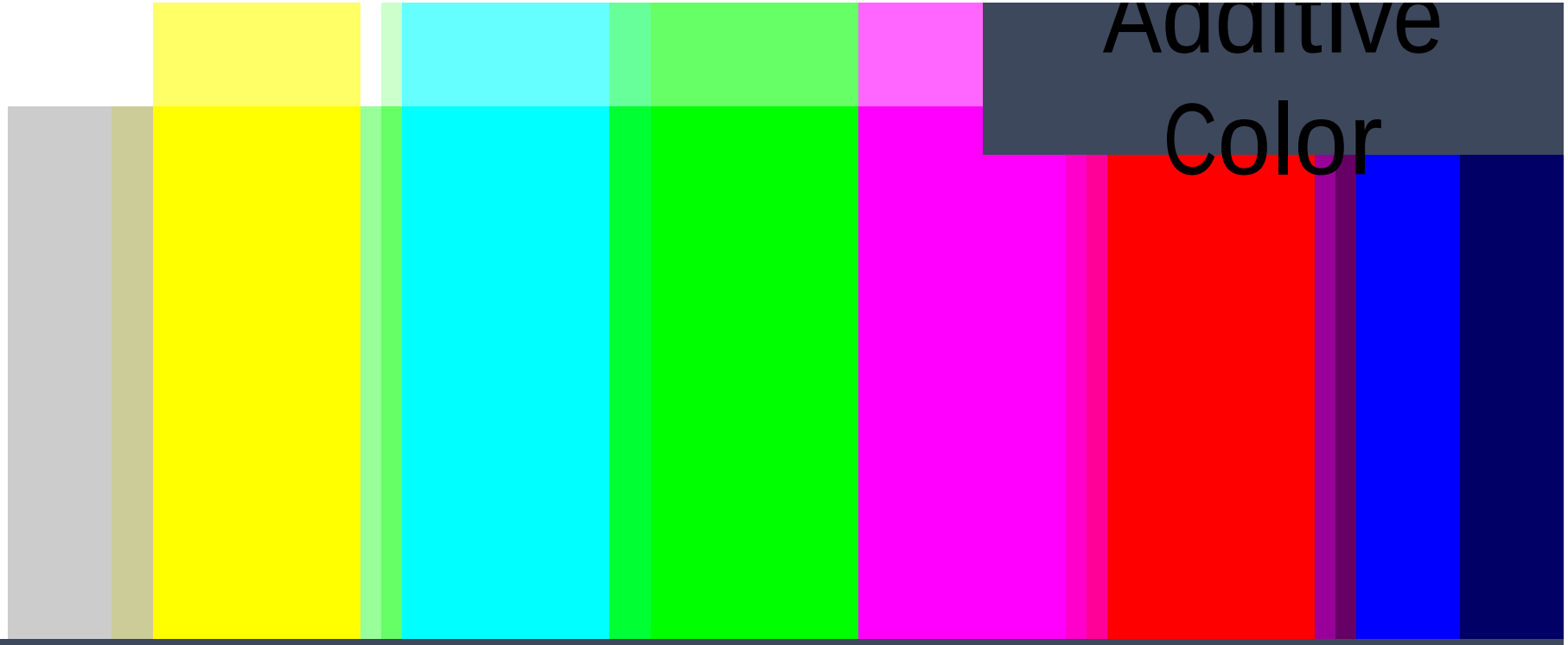
- Because the color information ***added*** to the amount of information to be transmitted, the ***TIMING*** of the signal changed slightly
- The **frame rate** changed from exactly 30 fps to 29.97 fps
- This had only minor effects, but editing **long** segments now had to be done with **drop frame time code** to remain accurate

Principles of Color TV

Engineers figured out how to convert the black and white (luminance) signal to a base signal.

- **Luminance channel is:**
  - **11% red**
  - **59% green**
  - **30% blue**

Additive Color



- Red, Green, and Blue are primary colors
- Magenta, Yellow, and Cyan are secondary colors
- White is the combination of all colors
- Black is the absence of light

Basic Color Properties

- Luminance: brightness or darkness
- Chrominance: combination of hue and saturation
  - Hue: color itself
  - Saturation: intensity of the color

Assignment

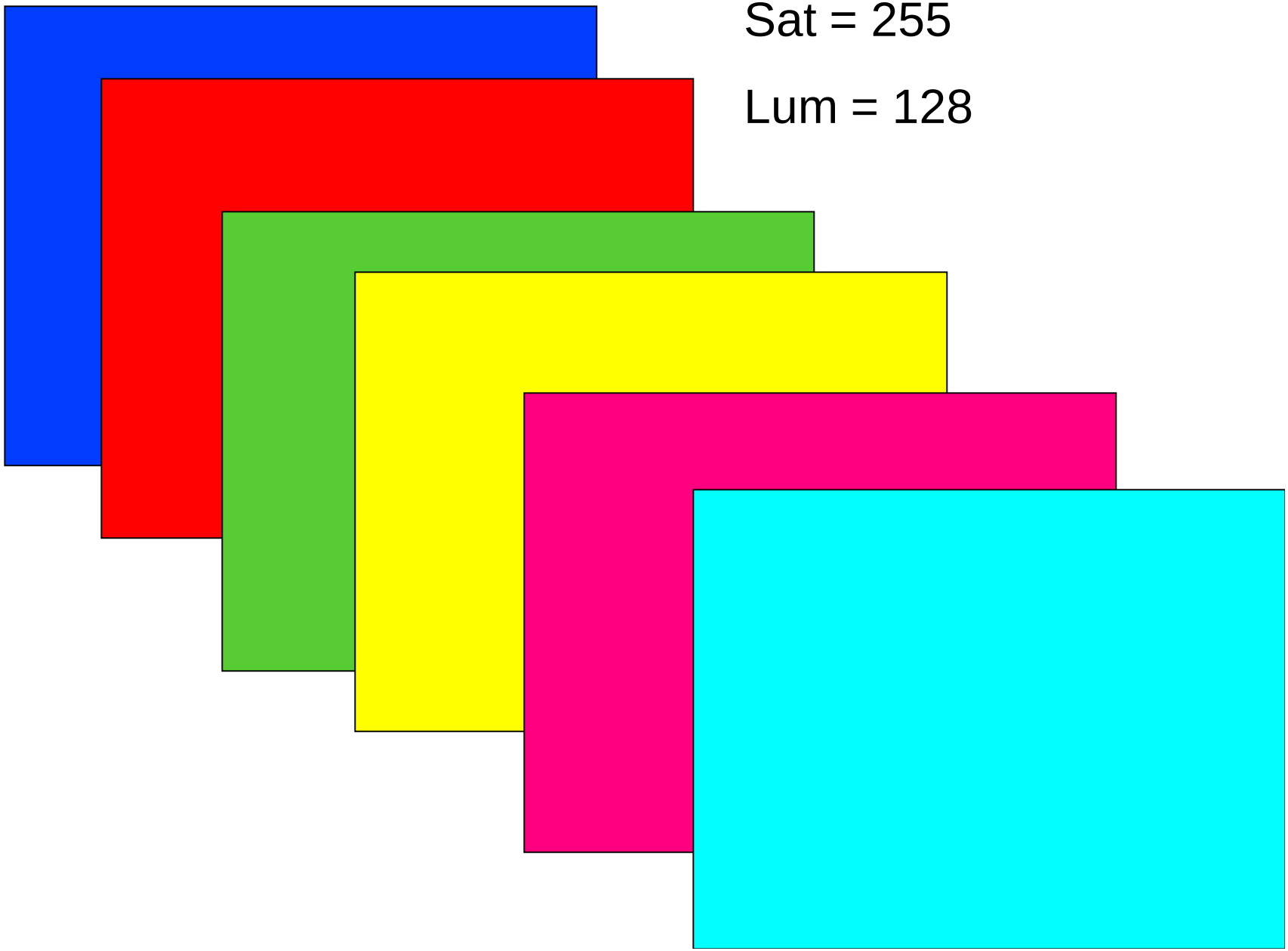
- Explain the principle of Colour TV with detail diagrams.

Color Theory

HUE

Sat = 255

Lum = 128

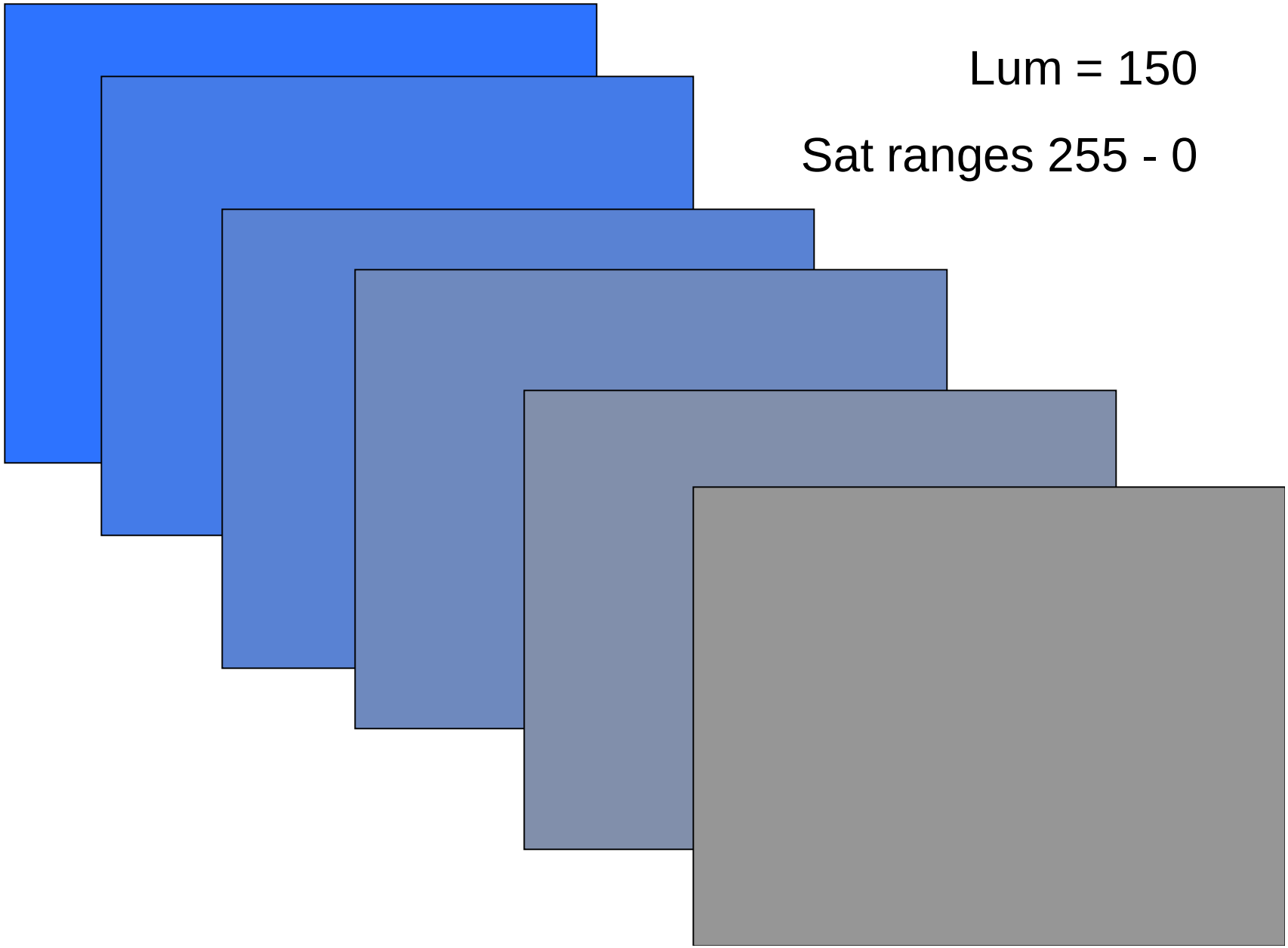


Saturation

Hue = 156

Lum = 150

Sat ranges 255 - 0

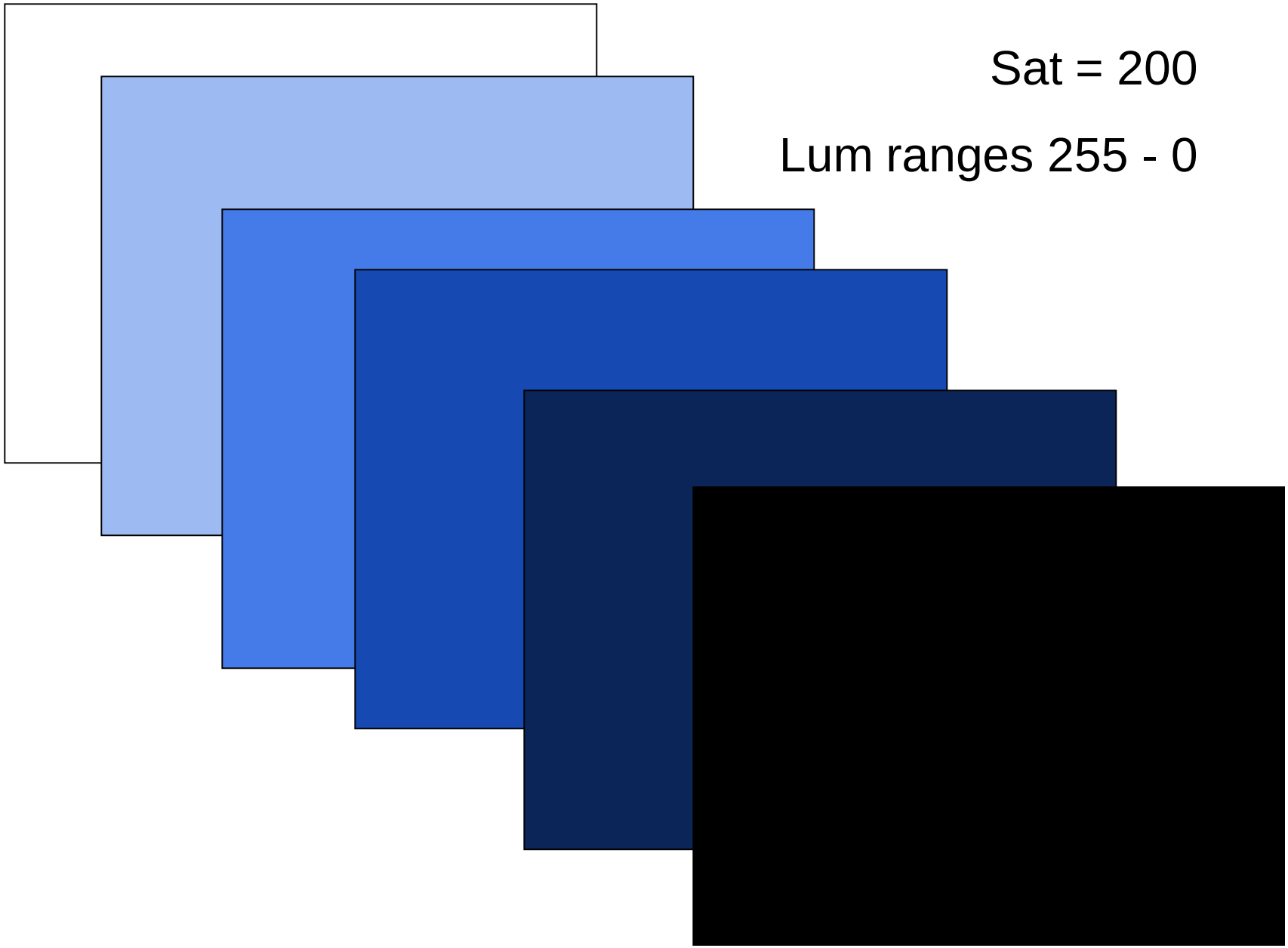


Luminance

Hue = 156

Sat = 200

Lum ranges 255 - 0



Synchronization

Blanking: sync pulses which tell the electron beam to shut off at the end of every horizonal line or vertical field

- Horizontal blanking: 60 times 262.5 = 15,750 lines per second
- Vertical blanking: 60 times per second at the end of every field

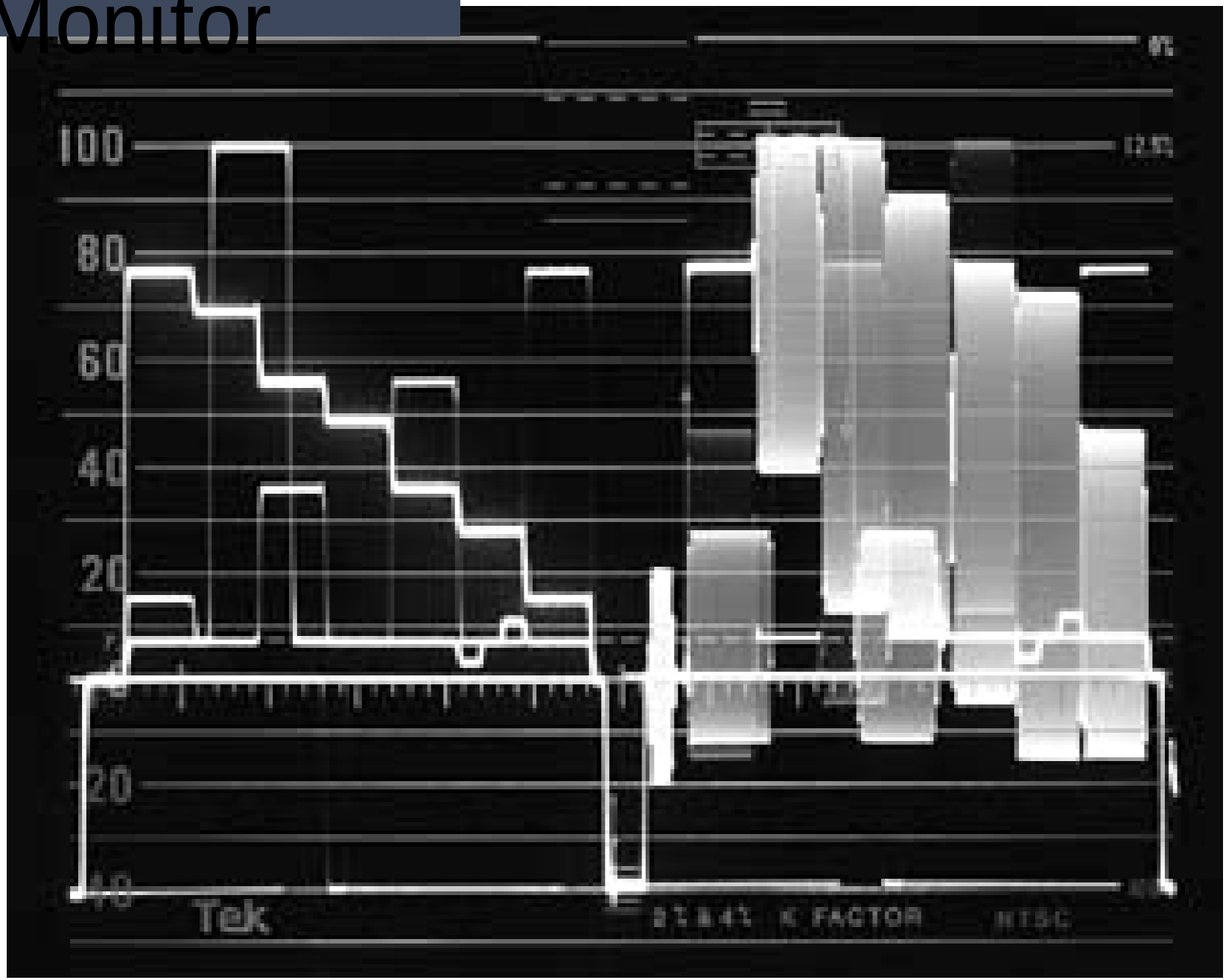
Measuring Video

- **Waveform monitor** measures synchronization information and luminance
- **Vectorscope** measures color/chroma information (saturation and hue)

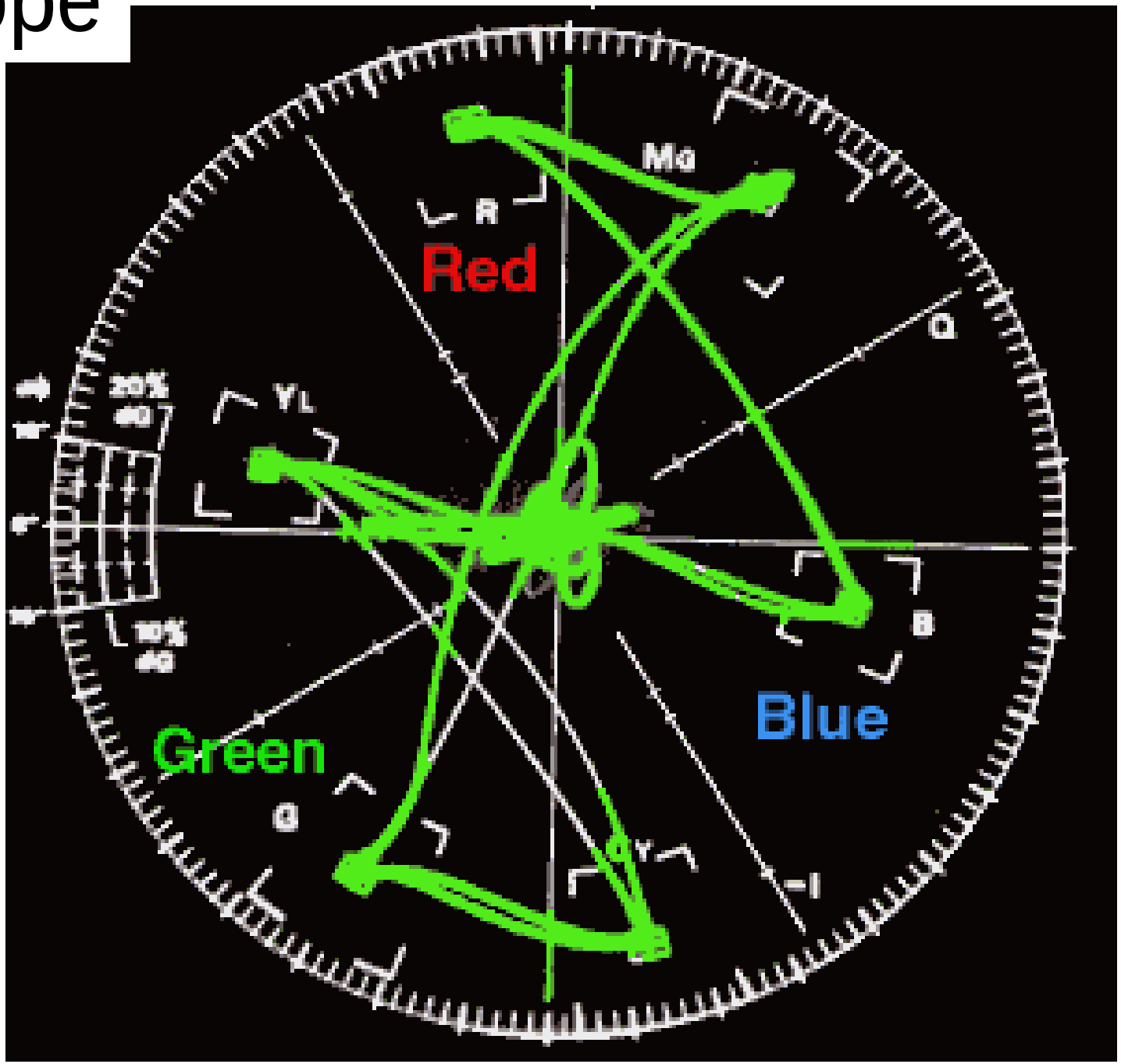
Composite TV Signal and the Waveform Monitor

- **IRE units:**
- peak white = 100 IRE
- reference black = 7.5 IRE
- blanking = 0 IRE
- sync tip = -40 IRE

Waveform Monitor



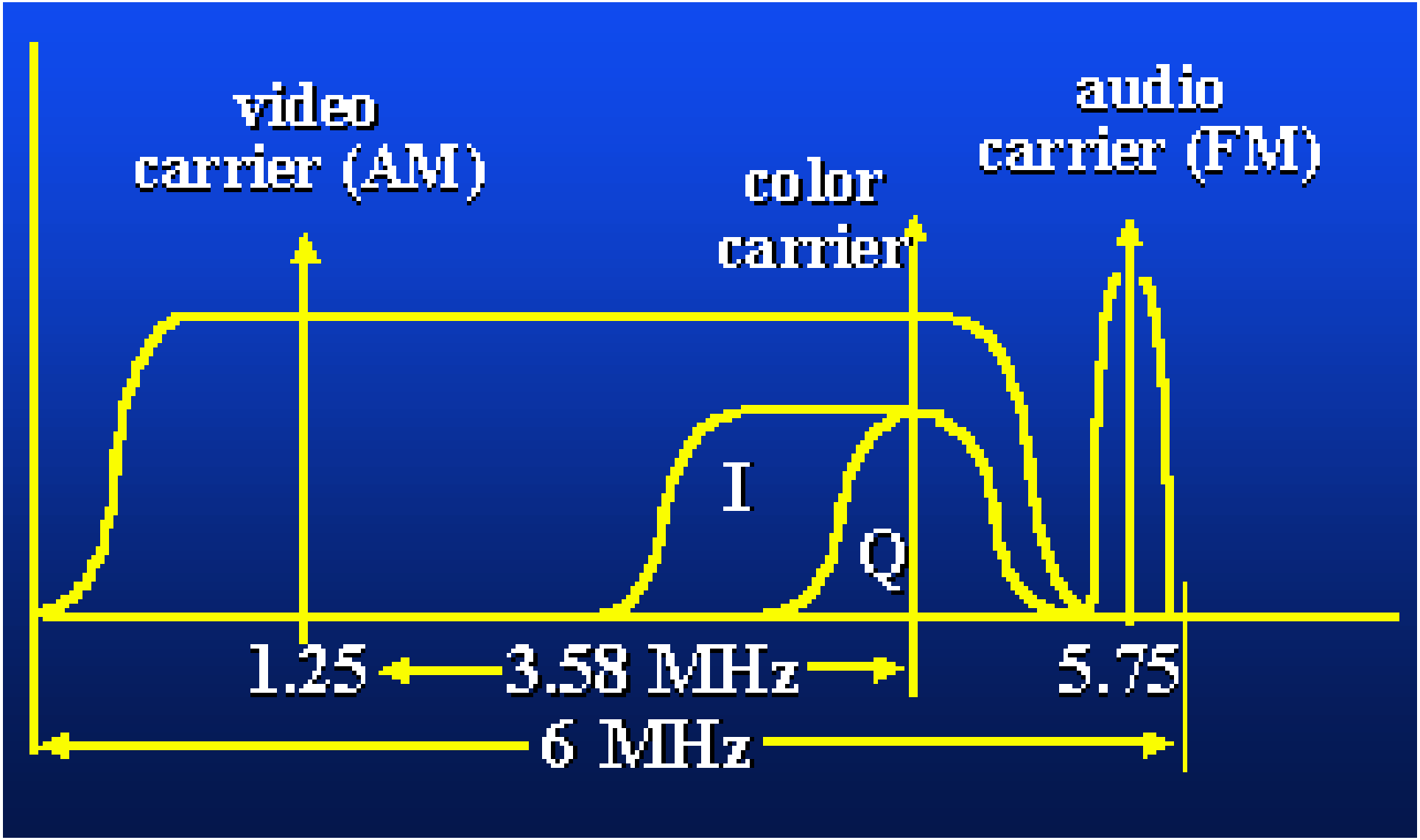
Vectorscope



Broadcast Video Signal

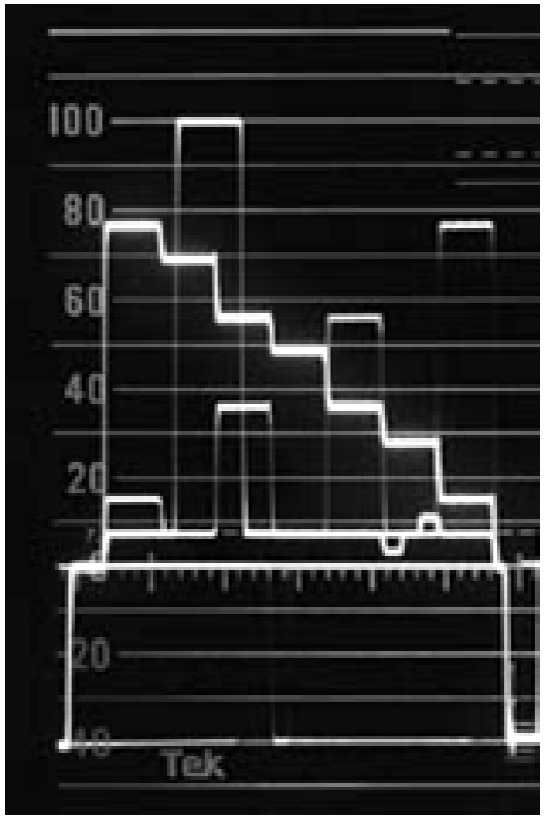
- **Bandwidth = 6 MHz**
- **Vestigial sideband AM**
- **Video carrier at 1.25 MHz**
- **Audio carrier at 5.75 MHz**
- Frequency modulated
- 15 KHz baseband, but 25 KHz freq. deviation

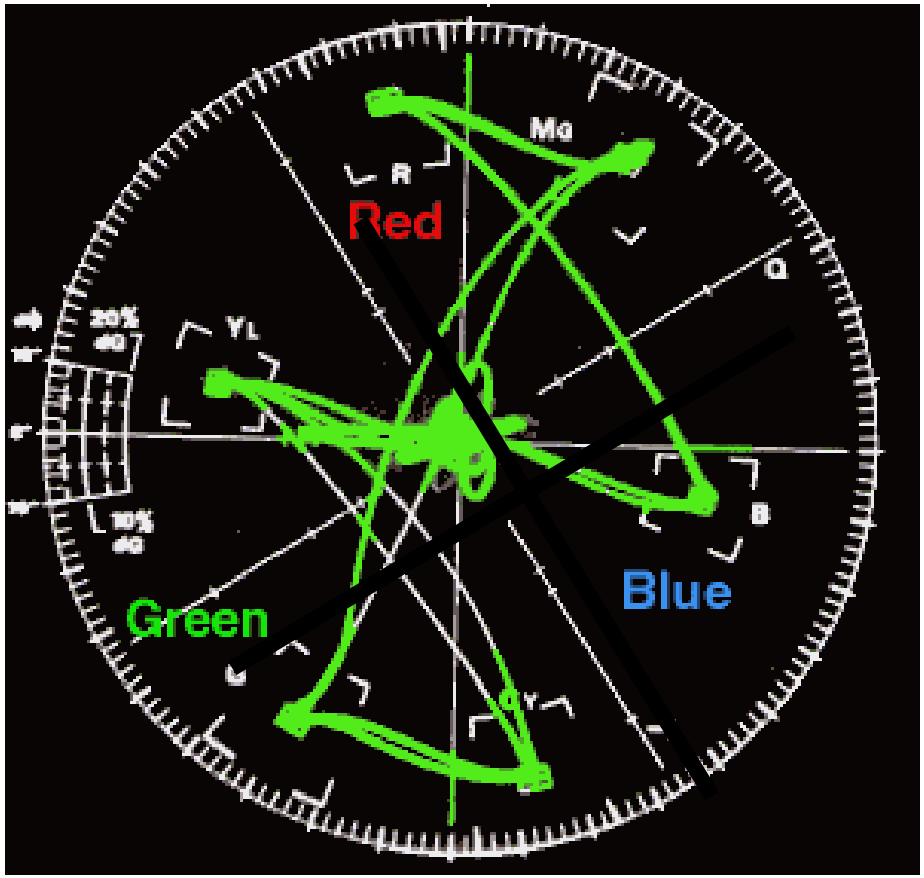
Spectrum of Video Signal



Principles of Color TV

- **“Y” is black and white signal**
- **“Color Difference” signals are “I” and “Q.”**





Color Difference

- **Subtract luminance from color signals**
- R-Y, B-Y, G-Y
- reduces to 0 if picture mainly grays
- **need to transmit only two, derive third**
- Y, R-Y, and B-Y (since most of Y is G)
- G-Y then derived

PAL (phase alteration by line)

- **Introduced in 1966**
- **PAL improves color distortions created by NTSC**
- **Has no hue controls on sets**
- **625 line system scanning at 50 fields (25 frames) per second**
- **PAL-M Brazil**
- **PAL-B, -G, -H Europe, Africa, Middle East**

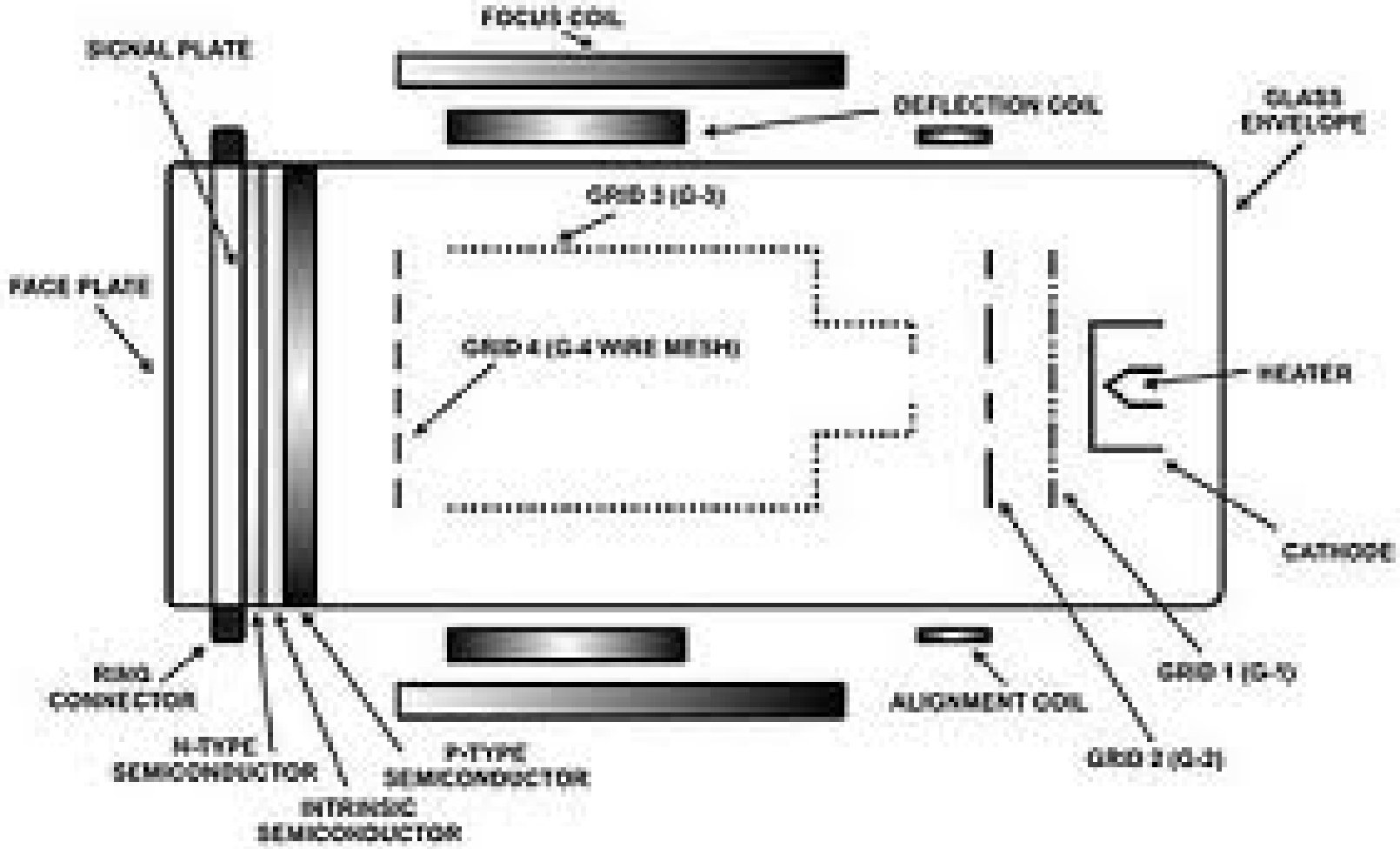
SECAM (Sequence Couleure avec Memoire)

- **1967 - instituted in France because French thought they could develop own market for TV sets**
- **designed to avoid color problems associated with NTSC**
- **719 line system that has a 50 field (25 frame) scan rate**
- **Used in France, Eastern Europe, Mid East, Africa**

Standards Conversion

- **standard converters: change 25 frames per second to 30**
- **Results:**
- judder: frames are dropped
- ghosting: frames are combined
- color smear

Picture tube



Picture tube cont..