19OE107 – CONSUMER ELECTRONICS

UNIT 4 -VIDEO SYSTEMS AND DISPLAYS

Monochrome TV Receiver & Picture Tube

Monochrome TV Receiver

•A monochrome TV receiver is a television that can only display images in one color (typically grayscale or black and white).

•It was the first type of television technology before color TV became popular. Monochrome televisions were popular until the 1960s, but they were progressively displaced by color television.

•However, they are still employed in specialized applications such as night vision monitors, medical imaging, and scientific instruments.

Key Components of Monochrome TV Receiver

Receiving Antenna
Tunner
IF Stages
Video Detector
Video Amplifier
Deflection Stage
Picture Tube
Frequency Amplifier
FM Detector
Audio Amplifier
Loudspeaker

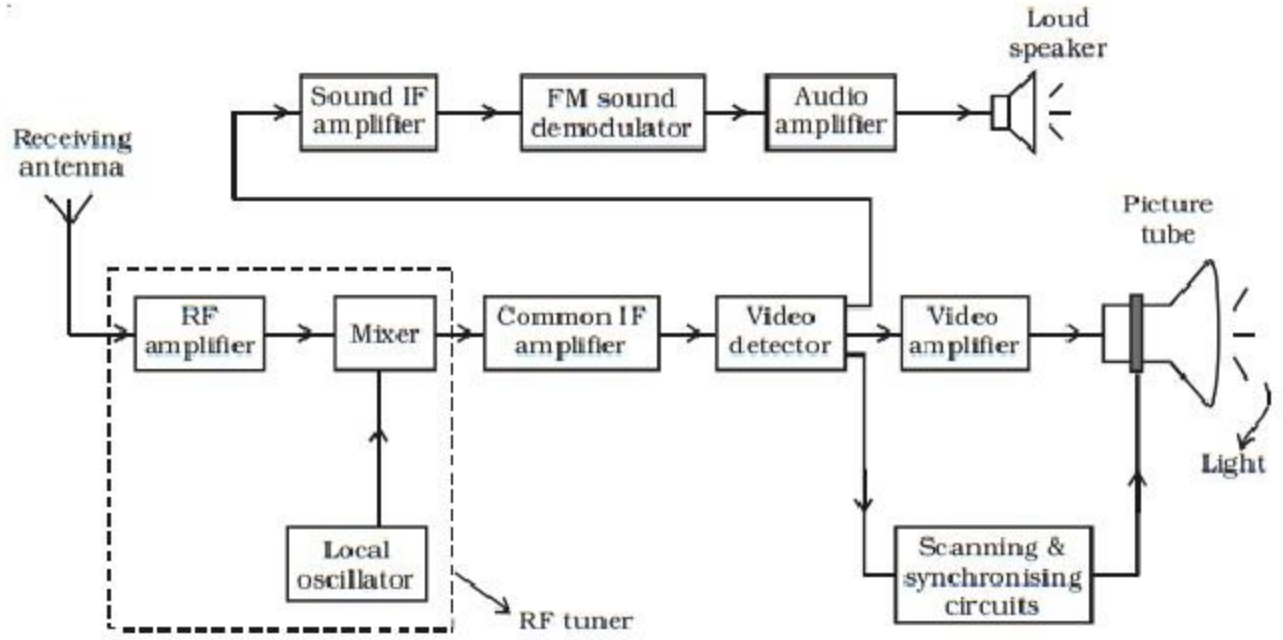


Fig Elementary block diagram of a monochrome TV receiver

Working Principle

•A monochrome television receiver receives and processes television signals to produce black-and-white visuals.
•The process begins with an antenna or cable receiving broadcast signals that include both visual and audio data.
• The tuner picks the appropriate channel, and the demodulator decodes the video signal.
•The video amplifier improves the brightness (luminance) information while disregarding the color data.
•This processed signal is then directed to the cathode ray tube (CRT), where an electron beam scans the screen in a predetermined pattern.
•The strength of the beam varies based on the brightness information, resulting in various shades of gray on the screen.

•Simultaneously, the audio stream is split and transmitted to the speaker system for output.

•The image is continuously refreshed at a fast speed, resulting in smooth animation.

•This complete procedure allows a monochrome television to display clear black-and-white images from transmitted signals.

Tuner and IF Stages: The receiver is a superheterodyne receiver to achieve high selectivity and high gain. In a superheterodyne receiver, the radio frequency signal, duty amplified by a pre-amplifier, is mixed nonlinearly with the oscillations of higher frequency but of fixed amplitude, generated by a local oscillator.

The output of the mixer consists of several intermodulation products, one of which is a signal having a frequency equal to the difference of frequencies of the two signals.

The difference frequency is called intermediate frequency, which is selected and amplified. The advantages of the superheterodyne technique are better selectivity and higher gain.

Video Detector and Trap Circuit: The amplified IF goes to the video detector which recovers video signal from the modulated wave and feeds it to the video amplifier for amplification through the trap circuit, which prevents the video signal from entering into the audio channel.

Video Amplifiers: These are wideband RC coupled amplifiers. The amplified video signal goes to the picture tube.

Picture Tube: The video signal varies the strength of the electron beam. This beam strikes the phosphor dots on the fluorescent screen which glow, the intensity of the glow is proportional to the intensity of the video signal.

Deflection Stages: The phosphor dots glow in quick succession from left to right and top to bottom with the help of scanning currents in the deflection coils. The synchronizing pulses, recovered by the detector, trigger the scanning circuits which produce deflection currents, duly synchronized with the scanning currents used in the transmitter. The deflection currents go to the deflection coils to deflect the electron beam horizontally and vertically on the fluorescent screen to reproduce the picture.

Sound Section: It consists of a sound IF(SIF) amplifier, FM detector, audio amplifier, and loudspeaker. The difference in frequency between frequency-modulated IF and video carrier IF is called intercarrier frequency, second IF, or sound IF.

It is received from the video detector and passes to the SIF amplifier through a trap circuit, which prevents the SIF signal from going into the video amplifier.

The FM detector detects the audio signal which is then amplified by audio Amplifiers. The amplified signal goes to the loudspeaker which converts it into sound. Thus, the original sound is reproduced.

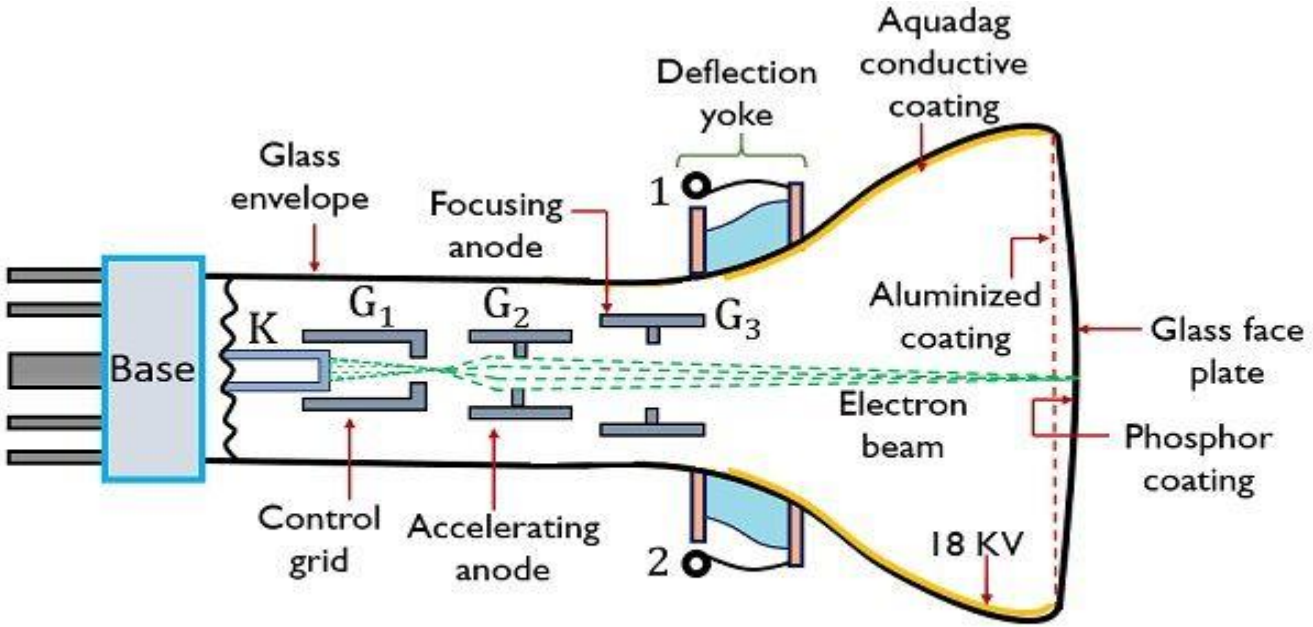
Monochrome PictureTube

•In all TV and video monitoring systems, a picture tube is used to convert video signals into variations of light.

•In monochrome monitors or monochrome picture tubes, it consists of an electron gun, comprising of an indirectly heated cathode, a control grid, screen grid or accelerating anode, and a focus grid.

• It produces an electron beam resulting in a sharply focused spot on a fluorescent screen.

•A large angle deflection of the electron beam is caused by the strong magnetic field produced by saw tooth currents through horizontal and vertical deflection coils (yoke) mounted on the neck of the picture tube.



Elements of a Picture Tube

Electronics Desk

Cathode: The cathode is a heated element that emits electrons. It plays a crucial role in the electron gun, providing the source of electrons required for image formation.

Heater: The heater surrounds the cathode and heats it to facilitate thermionic emission. This emission releases electrons necessary for the electron beam.

Control Grid (G-1): The control grid modulates the intensity of the electron beam. It controls the brightness of the image by regulating electron flow.

Screen Grid (G-2): The screen grid helps accelerate the electrons moving toward the screen. It improves beam focus and minimizes the influence of unwanted electric fields.

Focus Grid (G-3): This component fine-tunes the electron beam, ensuring it converges to a sharp point on the screen. It helps maintain image clarity

Yoke: The yoke consists of deflection coils responsible for guiding the electron beam horizontally and vertically. It controls the scanning of the beam across the screen.
Beam Centering Ring Magnet: This magnet adjusts the alignment of the electron beam to ensure it reaches the correct spot on the screen.
Inter Aquadag Coating: The internal conductive coating, known as inter aquadag, maintains an equipotential surface inside the tube and aids in electron movement.
External Aquadag Coating: The external coating is grounded and helps remove excess charge from the tube, preventing electrical buildup.
Aluminum Coating: This layer assists in enhancing brightness and contrast by reflecting light emitted by the fluorescent screen back toward the viewer.
Fluorescent Coating: When struck by the high-energy electrons, this coating emits visible light, forming the displayed image.
Face Plane: The front part of the tube where the image is displayed. It consists of the fluorescent coating that produces the visible picture.


Thank
you