CHAPTER 3


# Transmitters and Receivers

## LEARNING OBJECTIVE

In this chapter, the students can easily study and understand the

- Basic concepts of communication
- Working principle of transmitter
- Sideband Transmission techniques
- Functions of AM radio transmitter
- Functions of FM radio transmitter
- Working principle of AM radio receiver
- Working principle of FM radio receiver
- Servicing of FM radio receiver
- Scanning Concepts
- Working principle of camera tube
- Description of TV transmitter
- Description of TV receiver
- Functions of LCD TV
- Functions of LED TV

## CONTENT

## Introduction

In this 21st century, the world is ruled by communication gadgets. Though there are so many latest communication devices like Cell Phone, Computer (Internet) etc., still people are much enjoying the utility of Radio and Television receivers. It is so powerful and strong to the extent, which make the people to sit in front of those devices even hours together. Hence, it is inevitable to study and learn about the principle, working and applications of Radio and TV transmitters and receivers.

As a user, we are always familiar with receivers (either Radio or TV). Rightly to say, without transmitter (transmission) the receiver cannot exist. So, naturally before the arrival of the receiver the transmitter would have born. Hence, let us discuss about the functions of the transmitter first.

## 3.1 Transmitter

An equipment which is used to transmit RF waves by producing carrier waves and then modulated with AF waves is called as transmitter.

**HISTORY OF TRANSMISSION**

Radio waves were first mathematically predicted in 1864 by Scottish mathematical physicist **James clerk Maxwell**. Using this concept, in November 1888 German scientist **Heinrich Rudolf Hertz** became the first person to transmit electromagnetic waves in free space.

James Clerk Maxwell

Heinrich Rudolf Hertz

DO YOU KNOW?

**Initially, radio waves were called as hertzian waves.**

### 3.1.1 Radio transmitters

However, various types of radio transmitters are in use, we shall discuss here only about AM and FM transmitters.

Generally, transmission is of three types.

1. Single Sideband Transmission (SSB)
2. Double Sideband Transmission (DSB)
3. Vestigial Sideband Transmission (VSB)

First let us discuss about Sideband.

## 3.2 Sideband

A **sideband** is a band of frequencies higher than or lower than the value of carrier frequency, as a result of the modulation process.

If the modulating signal (audio or video signal) is modulated with the carrier signal, the resultant signal has carrier with sidebands in both sides (lower and upper values) of the carrier signal. Fig. 3.1 shows the carrier and its sidebands.

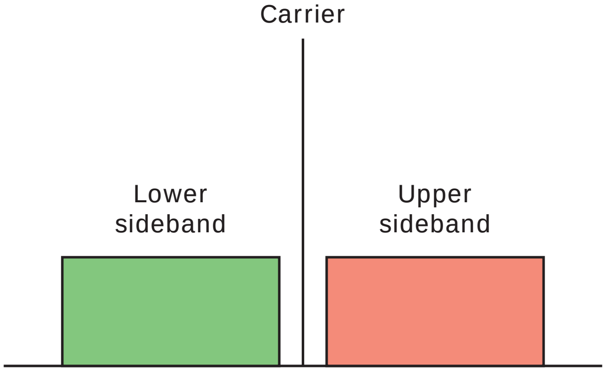



FIGURE 3.1 Modulated carrier showing sidebands in either side of the carrier

For example, if a carrier signal of 1000 kHz is modulated with 5 kHz audio signal, the resultant signal has 1000 kHz $\pm 5$ kHz , that is 995 kHz to 1005 kHz. The difference between this range (995 to 1005 KHz) is 10 kHz, which is called as bandwidth. The range 995 to 1000 kHz is called as lower sideband (LSB) and the range 1000 to 1005 kHz is termed as upper sideband (USB). Figure 3.1 shows LSB and USB with carrier. Both sidebands (one is the mirror image of the other) have same information. Any one sideband is enough to send information (audio or video).

### 3.2.1 Single sideband transmission (LSB)

It is a type of transmission which uses carrier signal with any one of the sidebands (usually USB) is called as single side band transmission. The other sideband is filtered. It uses lesser bandwidth. As a result, the power requirement for transmission is less.

### 3.2.2 Double sideband transmission (DSB)

It is a type of transmission which uses carrier signal with both of the sidebands (LSB & USB) is called as double side band transmission. It uses high bandwidth and hence needs more power to transmit. It is used in AM and FM transmission.

### 3.2.3 Vestigial sideband transmission (VSB)

It is a type of transmission which uses carrier signal with any one of the sidebands (LSB or USB) and part of the other sideband is called as vestigial side band transmission. It is used in TV transmission. The other sideband cannot be filtered fully because of very high frequency. So, part of the sideband is used with one full sideband. It uses lesser bandwidth and power than DSB, but uses more bandwidth and power than SSB.

## 3.3 AM Radio Transmitter

It is an equipment which transmits the amplitude modulated waves.

AM Radio transmitter uses double sideband transmission. Its bandwidth is 10 kHz. AM transmission broadcast range lies from 540 kHz to 30 MHz. It is classified as various bands such as medium wave band and shortwave bands.

Figure 3.2 shows the block diagram of AM Radio transmitter. It consists of the following stages.

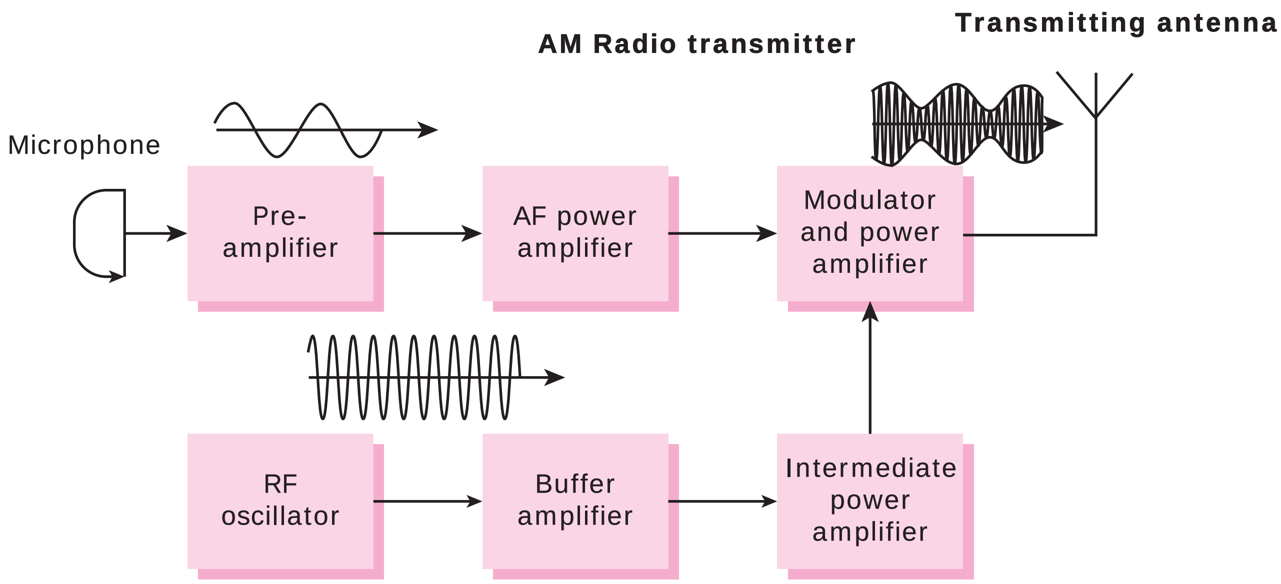



FIG 3.2 Block diagram of AM Radio transmitter

### Microphone

It converts AF signal into electrical signal

### Audio pre amplifier

This is the first stage voltage amplifier. Here, noise is filtered and AF signal voltage is amplified.

### AF power amplifier

It amplifies the power of the AF signal and fed to the modulator and power amplifier.

### RF Oscillator

It produces high frequency noiseless carrier waves using crystal. It is designed in such a way that its frequency is not affected by the voltage fluctuations and heat. Therefore, a crystal is used to generate the oscillations and hence it is called as crystal oscillator.

### Buffer Amplifier

It is an impedance matching Class-A type amplifier. It prevents crystal oscillator and power amplifier from overload and signal loss. Hence, the frequency of the carrier waves is maintained constant. It also amplifies the power of the carrier waves.

### Intermediate power amplifier

It amplifies the high frequency carrier signal and sends to the modulator.

### Modulator and Power amplifier

Here, AF signal and carrier signal are amplitude modulated. Power amplifier amplifies the modulated waves and sends to the transmitting antenna.

### Transmitting antenna

It converts the modulated waves into electromagnetic waves and transmits into space.

## 3.4 FM Radio Transmitter

It is an equipment which transmits the frequency modulated waves.

FM transmission broadcast range lies between 88 MHz and 108 MHz. FM Radio transmitter uses double sideband transmission. The bandwidth of an FM signal is not as straight forward to calculate as that of an AM signal. Taking the example of a typical broadcast FM signal that has a deviation of ±75 kHz and a maximum modulation frequency of 15 kHz, the bandwidth of 98% of the power approximates to 2(75+15) = 180 kHz. Figure 3.3 shows the block diagram of FM Radio transmitter. It consists of the following stages.

### Microphone

It converts AF signal into electrical signal, which is sent to an audio pre-amplifier.

### Audio pre-amplifier

It amplifies the incoming AF signal and feeds to pre-emphasis stage.

### Pre emphasis

Here AF signal's amplitude is artificially boosted to improve S/N ratio and sent to the frequency modulator stage.

### Crystal Oscillator

It produces noiseless high frequency waves and sends to the frequency modulator stage. It uses crystal.

### Frequency modulator

In this stage, AF signal and RF signal are frequency modulated and sent to RF power amplifier.

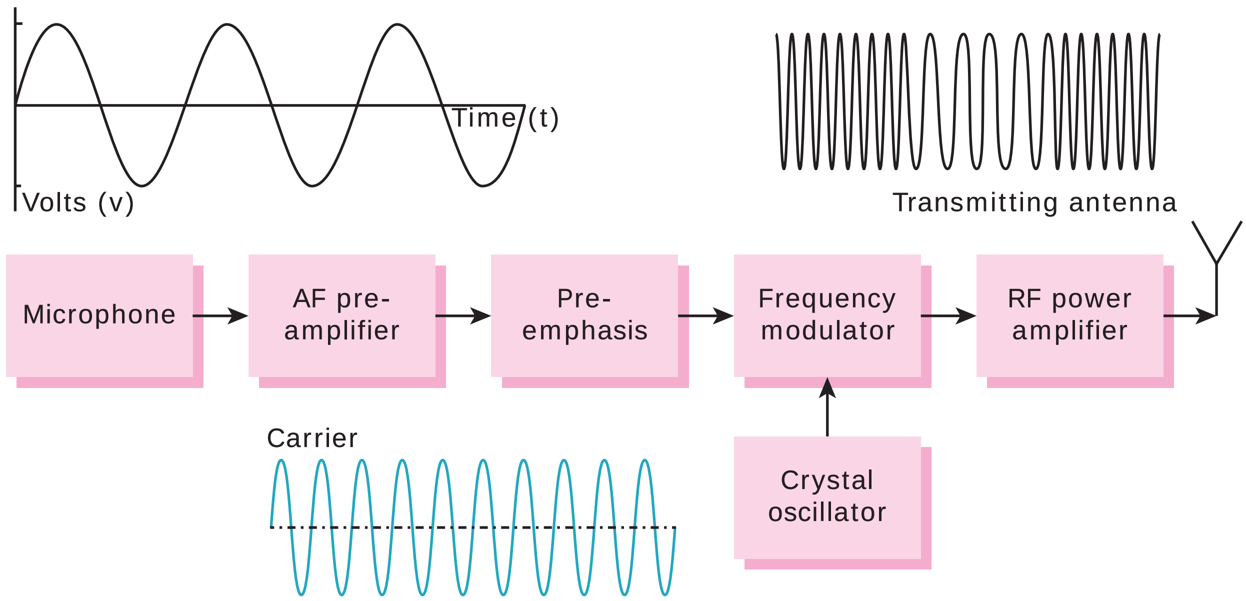



FIGURE 3.3 Block diagram of FM Radio transmitter

### RF power amplifier

Here, RF waves are amplified and sent to the transmitting antenna.

### Transmitting antenna

It converts the modulated waves into electromagnetic waves and transmits into space.

## Activity 1

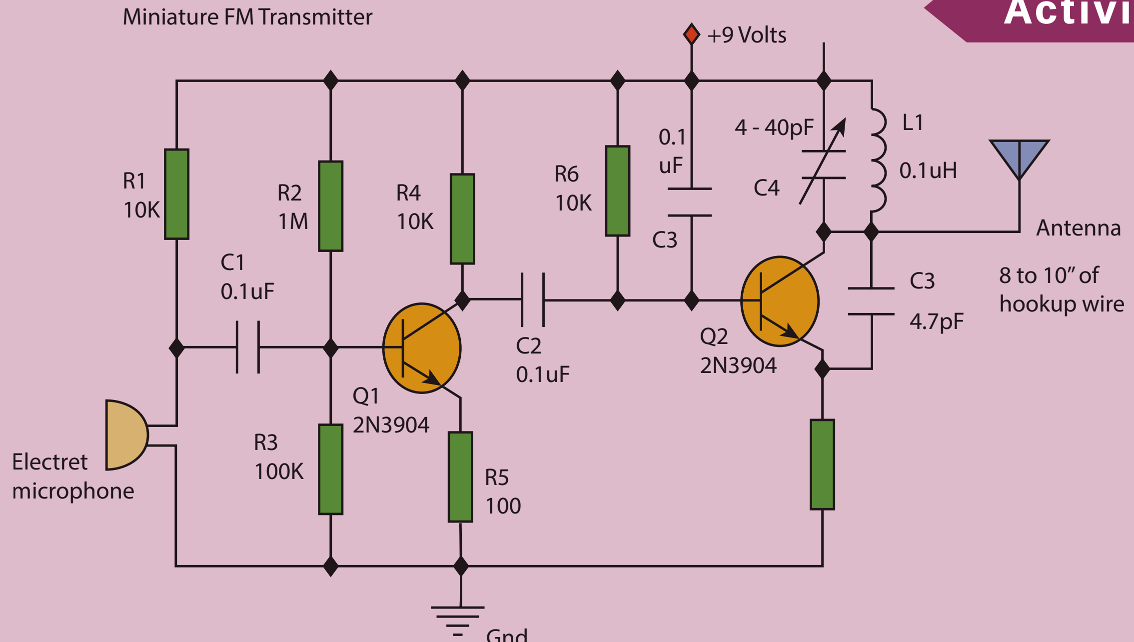



FIG 3.4 Low power FM transmitter

Construct a low power FM transmitter circuit as in the Fig 3.4 and check it with an FM receiver.

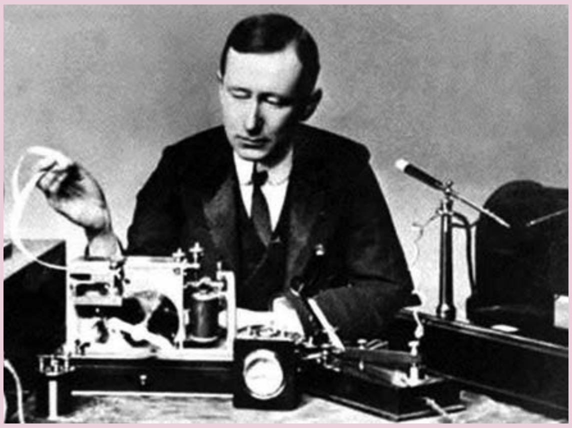
## 3.5 Radio Receiver

It is an instrument, which receives the radio signals from the broadcasting stations and reproduce sound.

**HISTORY OF RADIO RECEIVER**

In 1895, Italian scientist Guglielmo Marconi succeeded in telecommunication, which is called as Radio communication. He proved the wireless telecommunication through Morse code in December 12, 1901 over a distance about 3500 km.

The simplest radio receiver is the crystal radio receiver. It was made by Henrich Hertz German scientist in the year 1907. It was designed to work up to 50 Kilometers. Then, in the year 1909, the Tuned Radio Frequency receiver was made.



### Basic Principle

The principle of operation of the radio receivers is more or less similar in all type of radio receivers and is summarized below.

### Reception

An aerial is necessary for the reception of radio waves. It receives the radio waves into the receiver.

### Selection

It is the ability to select a desired radio station from various radio station. This work is performed by a LC resonant network.

### Detection

In this process, radio frequency signals are converted into audio frequency signals. It is performed by a crystal diode.

### Reproduction

The conversion of audio signal into sound is called reproduction. It is performed by a speaker.

### Abilities of Receivers

The quality and specialty of a radio receiver is determined on the basis of the following abilities.

### Sensitivity

It is the ability to produce sufficient audio output even for weak input radio frequency signal. It depends on the R.F. and I.F amplification capabilities.

### Selectivity

It is the ability to select only the desired signal or radio station from the signals, which are received by the aerial. It depends on accurate alignment of the tuned circuits. Hence, converter and R.F amplifier are designed in such a way to improve the selectivity. If selectivity increases, frequency and adjacent channels interference of a receiver decreases.

### Fidelity

It is the ability to amplify the complete range of audio frequency without loss. It depends upon the design of AF amplifiers.

### Stability

It is the ability to produce stable output without variation. AVC circuit is used to produce stability in the sound.

### Signal to Noise ratio

It is the ratio between the signal and noise. A noise limiter stage is used to improve this quality.

**Types of Radio Receivers**

Generally, the radio receivers are classified into the following two types.

1. TRF radio receiver
2. Superhetrodyne radio receiver

## 3.5.1 TRF Radio receiver

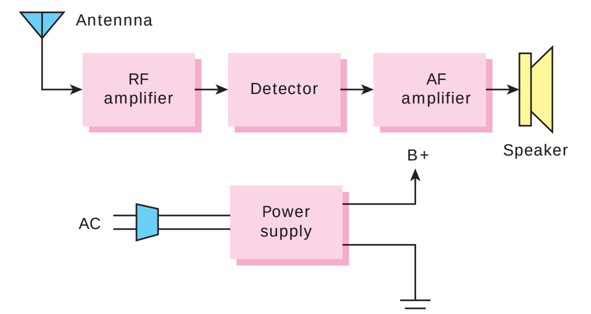



**FIG 3.5** TRF radio receiver

Fig. 3.5 shows the block diagram of a tuned radio frequency receiver. The functions of each block are discussed below:

> **DO YOU KNOW?** **TRF receiver is also called as straight radio receiver.**

### RF amplifier

It is a tuned radio frequency amplifier. It amplifies the radio frequency signal which is selected by antenna.

### Detector

It is employed between the RF and IF amplifiers. It works as amplitude modulated detector. It converts RF signal into AF signal. In this section, crystal and signal diodes are used.

### AF amplifier

It amplifies the strength of audio signals. It contains pre-amplifier, driver and output amplifiers. The pre and driver amplifiers are voltage amplifiers. The output amplifier is power amplifier. The speaker converts audio signal into sound.

### Power supply

It supplies the required voltage to all stages of the receiver. Battery or battery eliminator is used as power supply.

**Merits**

1. It is a simple receiver.
2. Simple circuits are used.
3. Alignment is not necessary.

**Demerits**

1. Sensitivity and selectivity are low.
2. Poor fidelity.
3. Low stability.

## 3.5.2 Superhetrodyne Radio Receiver

This receiver works under the principle of heterodyning. Modern radio receivers are mostly of super heterodyne types. It has converter stage which changes the incoming single into intermediate frequency (IF) signals.

> **DO YOU KNOW?** **Major Edwin Howard Armstrong** was an American inventor, developed FM radio and the super heterodyne receiver system.
>
> **Major Armstrong** designed a different type of radio of radio receiver in the year 1917. This receiver is known as Super heterodyne (shortly superhet) receiver. It's sensitivity and selectivity are high. All the modern radio receivers work under the principle of Super heterodyne. In USA, the first regular broadcast began in 1920. In India, first Radio station was established in 23rd July 1927 at Bombay.

Major Edwin Howard Armstrong

## Ganged Capacitors

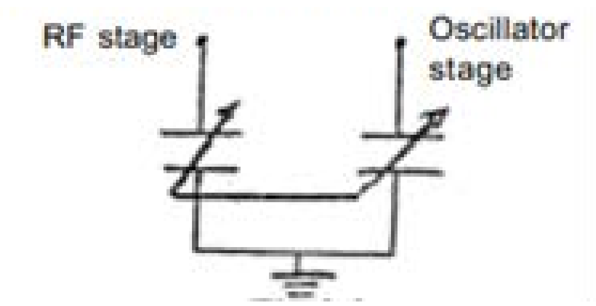



FIG 3.6 Ganged capacitors

If two variable capacitors are fitted in a common shaft, it is called as Ganged capacitor. One variable capacitor is used to select the desired radio station at the RF stage and the other one is used in oscillator stage to produce the suitable oscillator frequency to the desired radio station. Fig 3.6 shows the connection of two variable capacitors as Gang.

## Ganged Tuning

Selecting required radio station using Ganged capacitors is called as Ganged tuning.

## Electronic Tuning

Presently, varicap diode is used to select a required radio station in electronic tuning. For that, digital tuning circuits are used.

## Principle of Superhetrodyne Receiver

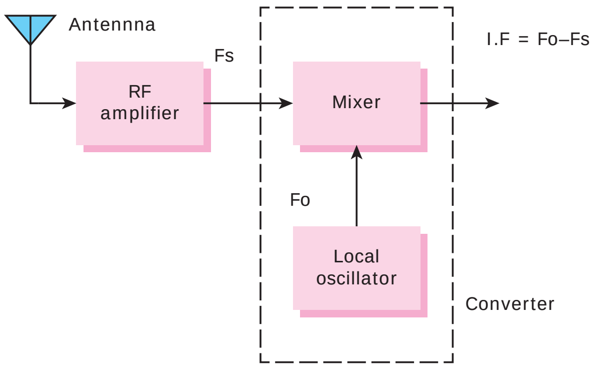



FIGURE 3.7 Block diagram explaining super heterodyning principle

The process of beating (mixing) two different signals to produce a new signal is called as Heterodyning. Fig 3.7 shows the block diagram of super heterodyning principle.

### 3.5.3 Super heterodyning principle

If two different signals are mixed through a transistor, four types of signals are obtained in the output of the transistor. They are

1. First signal ($F_o$)
2. Second signal ($F_s$)
3. Addition of the two signals is represented as ($F_o + F_s$)
4. Difference between the two signals is represented as ($F_o - F_s$)

Apart from these, an unwanted signal called harmonics is produced due to the mixing of the two signals. Out of them, the difference between the two is taken as intermediate frequency (IF) and the remaining signals are filtered. This is the principle of superheterodyning. The receivers which follow this principle are named as superhet receivers. This principle is used in AM, FM, Communication, Radar and Television receivers.

### Merits

1. Good sensitivity and selectivity
2. Good fidelity
3. Good stability

### Demerits

1. It needs alignment and tracking
2. Complicated circuits are used

### 3.5.4 Interferences in Superhet Radio receiver

Generally, Superhet receivers have better selectivity and sensitivity. But, the following two interferences are occurred.

1. Image frequency
2. Adjacent channels interference.

#### Image frequency and method of rejecting it

If two nearby radio stations being received at a time, this defect is said to be image frequency. Rejecting image frequency depends upon the selectivity of RF stage. It should be rejected before

IF stage. Once it enters IF stage, it cannot be eliminated.

#### Adjacent channel interference

In superhet receiver, when the bandwidth is reduced from required level, this type of interference is developed. When two different radio stations are selected very closely, interference occurs. To eliminate this, low IF signal should be selected. So, in superhet receivers, low intermediate frequency (low IF signal) is selected to avoid both the interferences. In double conversion receivers, these two interferences are eliminated completely, because they use two different IF signals, one is high and the other is low. So a double conversion receiver should have two converters and two IF amplifiers.

### 3.5.5 AM Radio Receiver

A receiver which receives amplitude modulated radio signals is called amplitude modulated (AM) radio receiver. Figure 3.8 shows the block diagram of AM radio receiver.

#### RF Amplifier

It consists of an aerial. The aerial receives the electromagnetic waves and convert them into RF electrical signals. This stage amplifies the RF signals obtained from the aerial. Its output signal is coupled with converter stage.

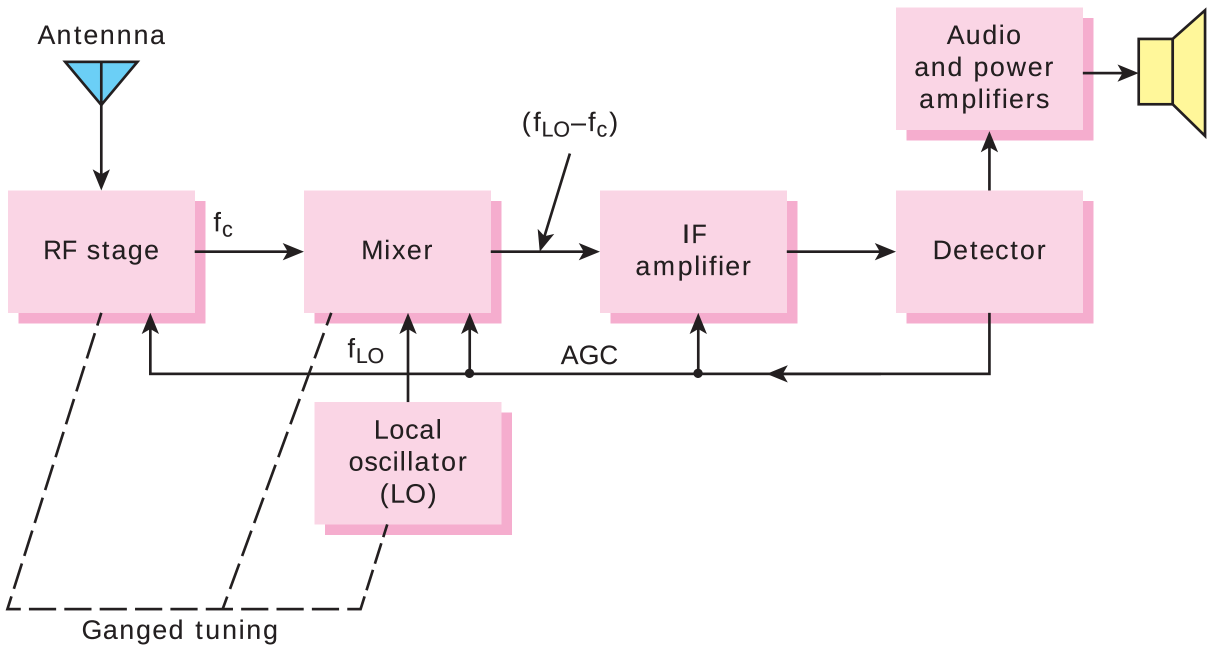



FIG. 3.8 Block diagram of AM radio receiver

### Converter

It is also known as first detector or frequency changer. It has mixer and local oscillator stages. The local oscillator produces unmodulated radio frequency signals. The mixer stage mixes the oscillator signal and RF signal. In the output of this stage, intermediate frequency (IF) is selected. The value of IF signal is equal to the difference of oscillator and signal frequencies ($IF = F_o - F_s$). The value of IF in AM radio receiver is 455 KHz.

### IF Amplifier

It amplifies the strength of IF signals to improve the sensitivity. It is a transformer coupled amplifier. Its input has tuned circuit. IF transformers (IFT) are used in it. It employs one or two tuned intermediate frequency amplifiers.

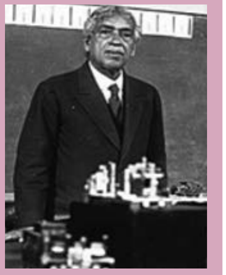
### Detector

It is also known as demodulator or detector. The signal diodes are used in this stage. It filters the carrier signal and separates the audio signal from the IF signal and AF signal is sent to the audio stage. Diode detectors are used in this type.

DO YOU KNOW?

**Sir Jagadish Chandra Bose**

Crystals were first used as a detector of radio waves in 1894 by Sir Jagadish Chandra Bose.He was born in Munsiganj, Bengal Presidency (now Bangladesh), during British governance of India. Bose graduated from St. Xavier's College, Kolkata. **Sir Jagadish Chandra Bose** invented the Mercury Coherer (together with the telephone receiver) used by Guglielmo Marconi to receive the radio signal in his first transatlantic radio communication.



Sir Jagadish Chandra Bose

### Automatic Volume Control (AVC)

#### Fading

In radio reception, variations in the signal strength are called fading. The signal received by the antenna varies continuously. Because, the signals reaches the receiving aerial from the transmitting antenna through ionosphere. Since, the density of ionosphere changes continuously, the signal voltage also varies continuously. So, an instable output sound would be produced in the receiver. An automatic volume control (AVC) is employed to eliminate the fading. It controls the volume of the receiver automatically.

### Audio amplifiers

This stage consists of voltage and power amplifiers. The voltage amplifier is working as pre-amplifier, whereas the power amplifier is working as output amplifier. This stage amplifies the voltage and power of the audio signals. Hence, the fidelity is improved by this stage. Push-pull amplifier is used as output amplifier. The loudspeaker converts the audio signals into sound.

### Power supply

Power source is supplied through either battery or battery eliminator.

### Uses of AM radio receivers

It was widely used for communication in the recent past years. After FM receivers are used widely, presently the usage of AM receivers became obsolete.

## 3.6 FM Radio Receiver

A receiver which receives frequency modulated radio signals is called frequency modulation (FM) radio receiver. It is also called as superhet receiver. Fig 3.9 shows the block diagram of FM receiver.

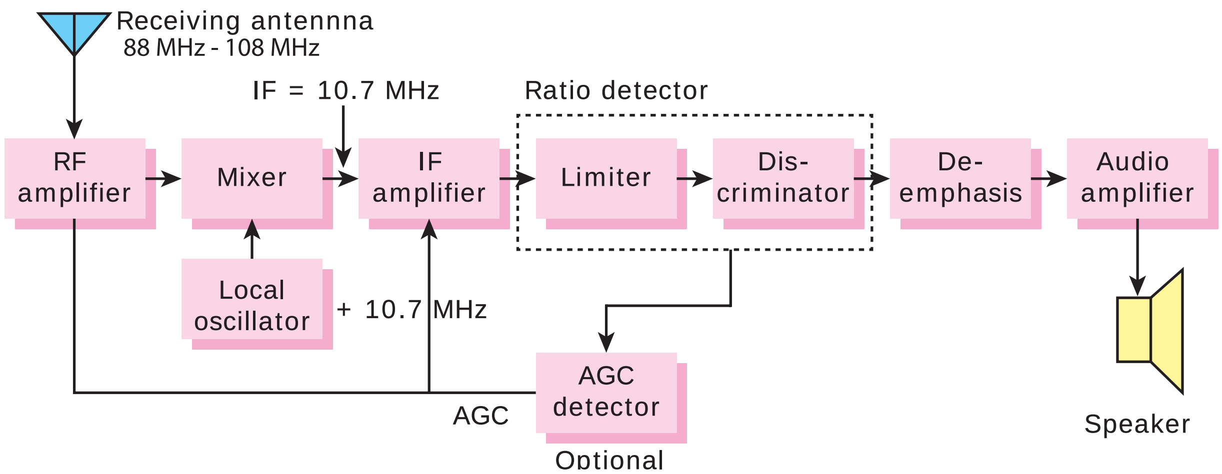



**FIG 3.9** FM receiver Block diagram

### RF Amplifier

It selects the desired RF signals through the aerial. It amplifies the RF signals, by which it improves the selectivity.

### Local oscillator

It is a Hartley oscillator. It produces un-modulated radio frequency signals and fed into the mixer.

### Mixer

It receives two signals as inputs viz. RF signal and oscillator signal. It mixes them and gives IF signal as output. The value of IF is 10.7 MHz.

### IF Amplifier

This is employed between the discriminator and the mixer. It amplifies the IF signal and also improves the sensitivity.

### Limiter

It controls the noise pulses which are mixed with signals. It works as a clipper.

### AVC

It is an automatic volume control. It controls the volume of the receiver automatically.

### Discriminator

It is a demodulator. It separates audio signal from frequency modulated IF signal. Crystal diodes are used as detector diodes. Quadrature detectors are used in IC used circuits.

### De- emphasis

Pre-emphasised audio signals are de-emphasised into its original state by using RC network.

### Audio amplifier

This stage amplifies the audio frequency signal. It is divided into pre-amplifier, driver, and output amplifier. Pre and driver amplifiers are voltage amplifiers. Output amplifier is a power amplifier. It improves the fidelity.

### Power supply

Power source is supplied through either battery or eliminator.

## 3.6.1 Construction of modern FM receiver

Modern FM receivers use CXA 1619. It has all stages except power supply. It has both AM and FM receiving circuits. Using

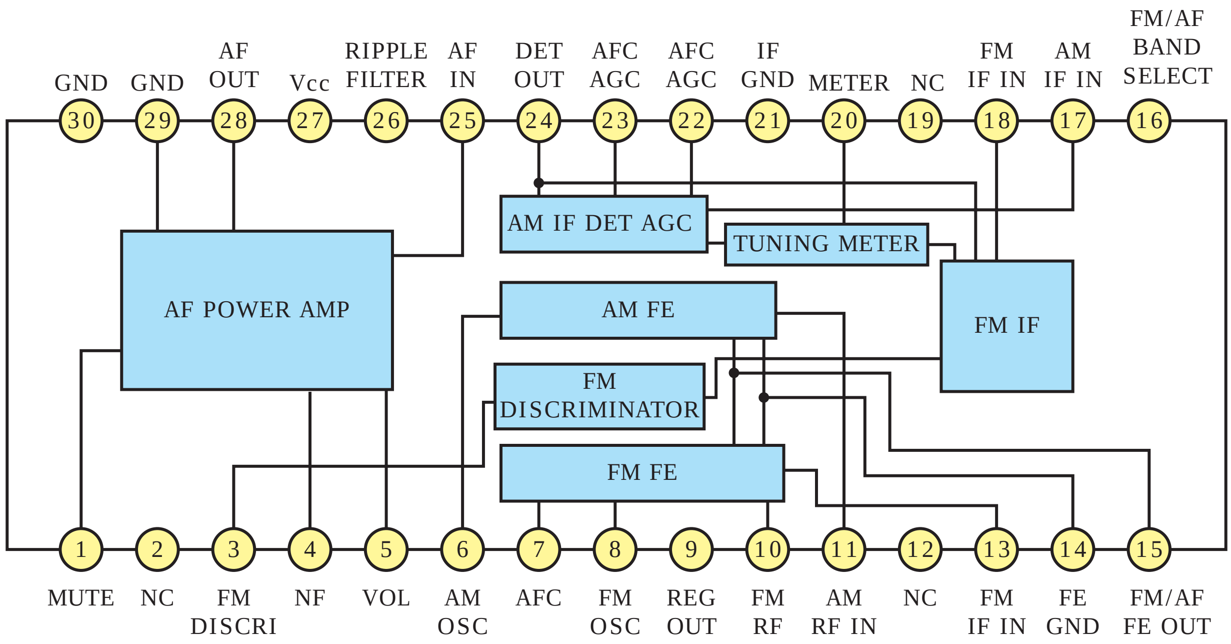



**FIG 3.10** Internal construction of CXA 1619 with AF amplifier

a band selector switch, we can select either AM or FM reception. Also it has an audio power amplifier. This IC operates on a 6 volts DC power source. The internal construction of IC CXA 1619 is shown in Figure 3.10.

## 3.6.2 Audio amplifier IC

If the main IC has no audio amplifier, a separate audio section IC is used in modern FM receivers. Most of the radio receivers have IC TBA810/CA810 as audio section.

### Internal construction of IC TBA810/CA810

Fig 3.11 shows internal construction of audio IC TBA810/CA810. It has both voltage amplifiers and a power amplifier. Its operating voltage is about 6 to 12 volt DC.

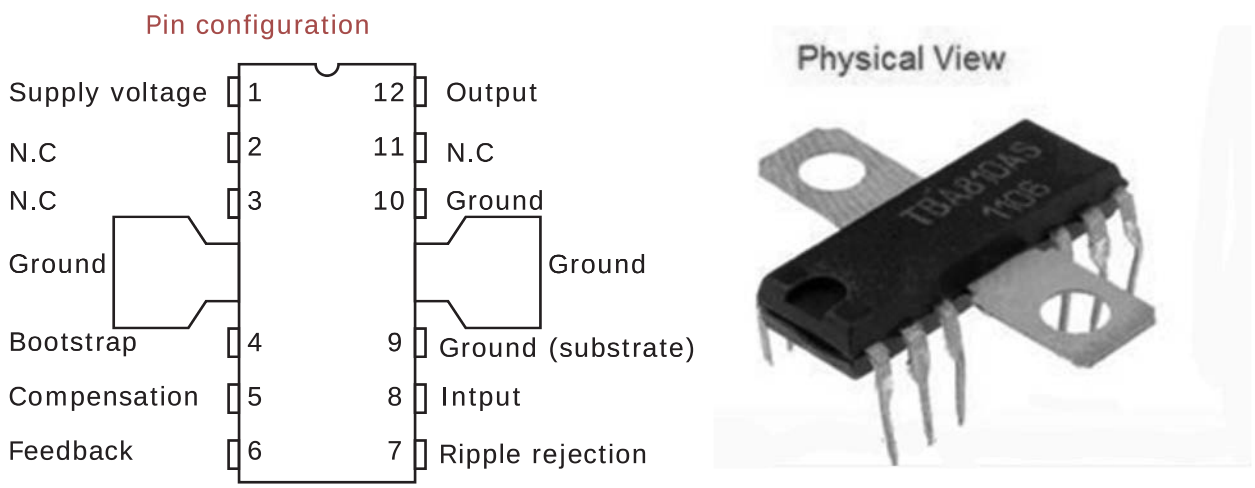



**FIGURE 3.11** Internal construction of audio IC TBA 810 / CA 810

Important pin details are summarized below:

**Supply voltage**: Pin number 1 should be given positive supply voltage and pin number 9 and 10 should be connected to ground (earth).

**Audio input**: Pin number 8 should be given AF input from volume control center pin.

**Audio output**: Pin number 12 and an earth connection should be connected to speaker.

It has two heat sinks on either side of the IC to reduce heat.

#### Advantage of FM receivers

Clear reception than AM.

#### Disadvantage of FM receivers

It can only be transmitted and received to a shorter distance than AM.

#### Uses of FM receivers

It is widely used for communication and entertainment purpose.

### 3.6.3 Comparison between AM and FM Receivers

The comparison between AM and FM receivers are listed in Table 3.1.

### 3.6.4 De-emphasis & Limiter

**De-Emphasis**

At the FM receiver, an operation opposite to pre-emphasis is used, known as De-emphasis. The amplitude of high frequency signal is decreased relatively. RC low-pass filter network is used. This network is having a time constant of 75 μs. It also helps to reduce the noise frequency of the signal.

#### Limiter

The amplitude of FM signal should be constant. But, while traveling form transmitter to receiver, fading, absorption and reflection of radio waves produce unwanted variation in the amplitude of signals. Hence, the variations should be removed for clear reception. So, limiter is used for this purpose. It is used prior to discriminator.

It is also known as 'clipper'. It is similar to IF amplifier which works as a saturated amplifier. In this stage, the input FM Signal is operated between the cut-off point and saturation point of amplifier. Any amplitude variations beyond these points does not reach the output.

**TABLE 3.1 Comparison between AM and FM Receiver**

| S.No. | AM Receiver | FM Receiver |
|---|---|---|
| 1. | Receives and Processes the AM Signals | Receives and Processes the FM Signals |
| 2. | Operating frequency range is from 500 kHz to 30 MHz | Operating frequency range is from 88 MHz to 108 MHz |
| 3. | Intermediate Frequency (IF) value is 455 kHz | Intermediate Frequency (IF) value is 10.7 MHz |
| 4. | Bandwidth is 10 kHz | Bandwidth is 200 kHz |
| 5. | Employs detector | Employs discriminator |
| 6. | Does not employ limiter | Employs limiter |
| 7. | Interference and distortion are more | Interference and distortion are less. |

### 3.6.5 FM Detectors

Generally, three types of detector or discriminator circuits were used in FM receivers. They are,

1. Travis discriminator
2. Foster- Seeley discriminator
3. Ratio detector

But, presently Quadrature detector is used in IC based radio receiver circuits.

#### Quadrature detector

This type of FM detector only requires one coil and some external components, making it ideally suited for use within integrated circuits. In this circuit, using RC phase shift network, 90 degree phase shift of IF signal is produced and mixed with the original signal (signal before phase shift) in a mixer to get the carrier waves removed.

**Activity 2**

Construct an FM receiver on your own using CXA 1619 IC

#### Double Conversion

If two different IFs are used in a receiver, it is said to be Double conversion. It is used in communication receivers.

### 3.6.6 Communication Receivers

It is a special type of superhet receiver which receives code words. For that purpose, it contains Beat Frequency Oscillator. It is also based on the principle of super heterodyning. Two different IF stages are used in it. It is capable of receiving signals in the 2 to 16 MHz range.

#### Uses of Communication receivers

1. Used in sending telegraph messages, but now became obsolete.
2. Amateur radio communication.

### 3.6.7 Digital audio broadcasting (DAB)


FIG 3.12 DAB radio receiver

Digital Audio broadcasting (DAB) is an advanced radio technology. It provides higher quality sound than FM and has greater SNR. In many countries, DAB stations are broadcast in either Band III (174–240 MHz) or L band (1.452–1.492 GHz). The snapshot of the DAB radio receiver is shown in Figure 3.12.

#### Advantages

1. Crystal clear reception than FM
2. A single DAB station transmits a wide 1500 kHz bandwidth signal that carries from 9 to 12 Channels, from which the listener can choose his/her choice.

#### Disadvantages

1. Incompatible with other types of radio receivers, so that a new DAB receiver must be purchased.
2. High cost radio receiver.

### 3.6.8 Satellite radio receiver


**FIGURE 3.13** Satellite radio receiver

Radio receivers receiving programs using satellites are called satellite radio receivers.

The basic formatting of satellite radio is identical to terrestrial radio broadcasts, but most of the stations are presented without commercial interruptions. This is due to the fact that satellite radio is subscription-based, just like cable and satellite television. Satellite radio also requires specialized radio receiver just like satellite television. Satellite radio uses the 2.3 GHz S-band in North America. Satellite radio reception can also be received through DTH TV Satellite set-top box.

#### Advantages

1. Crystal clear reception than FM.
2. No commercial advertisements.

#### Disadvantages

1. Incompatible with other types of radio receivers, so that a new satellite receiver must be purchased.
2. High cost radio receiver.
3. Subscription should be paid for receiving satellite radio reception.

### Alignment of Radio receivers

Alignment is a process which makes a receiver works with accuracy.

Since most of the modern digital tuning receivers use crystal, which do not need alignment for receivers. But in some receivers, variable capacitors and button trimmers are used. It needs small adjustment, whenever necessary.

### 3.6.9 Testing of Radio receivers

#### Static Test

It is also known as primary test. It is the test which is done before giving the supply to the receiver.

#### Dynamic test

It is also known as secondary test. It is the test which is done after giving supply to the receiver. This test is nothing but measurement of voltage and current.

#### Soak Test

After servicing a receiver we should test it by putting in 'ON' condition for long hours to confirm whether it operates well or not. This type of testing is called as **Soak test**.

#### Vibration Test

After servicing an intermittently working receiver, we should vibrate it slightly to confirm whether it is working properly or not. This method of testing is called as **Vibration test**. Mostly, this test is performed after resoldering of dry soldered components in the receiver.

### Signal Test

It is also called as signal injection. It is the test which is used to check the stages by giving external signals. Signal injectors or signal generators are used for this purpose. Faulty stages can be identified by this test.

## 3.7 Servicing of FM Radio receivers

### Trouble shooting techniques

It includes both the fault finding and its rectification. It is a sensitive job. It requires circuit diagram, proper tools, test equipment and identical components.

#### Precautions to be taken before servicing receivers

1. First, note the name, model, number of bands and stages in the receiver. Then, list the number of transistors and integrated circuits used in the circuit.
2. To prevent shock, the receiver should not be opened until the mains-cord is unplugged.
3. After opening the receiver, the missed and burnt components (parts) should be observed.
4. After giving the supply to the receiver, observe for any spark, smoke or burning smell.

### Types of faults

The defects in a receiver can commonly be classified into two types.

1. Live fault
2. Dead fault

### Live fault

If some sound is heard from a faulty radio in 'ON' condition, but receiver not working properly, it is termed as '**Live fault'**.

### Dead fault

If no sound is heard even after a radio receiver is in 'ON' condition, it is said to be '**Dead Fault'**.

### 3.7.1 Rectification

#### Dead fault

1. Check power cord.
2. Check on-off switch & AC fuse.
3. Check for defective Power transformer.
4. Check for Defective Bridge diodes.
5. Check the main filter capacitor.
6. Check the second B+ filter capacitor.
7. Check for dry soldering and copper track cut.
8. Check B+ to Audio IC like TBA 810/ CA 810 for testing the condition of the IC.
9. Check B+ to CXA 1619 IC for ensuring its reliability.

### Live faults

#### Distorted audio

1. Check speaker.
2. Check the volume control.
3. Check for defective filter capacitor.
4. Check for faulty series capacitor connected with speaker
5. Check for faulty Audio IC TBA 810 or defective CXA 1619 IC.

#### Low volume

1. Check speaker.
2. Check the volume control.
3. Check for low B+.

4. Check for faulty series capacitor connected with speaker.
5. Check for dry soldering or copper track cut.
6. Check for faulty Audio IC TBA 810.
7. Check for defective CXA 1619.

#### Noise only: No signal (Radio stations not received)

1. Ganged capacitor may be faulty
2. Faulty trimmer.
3. Faulty CXA 1619 IC

#### Hum with distorted audio

This fault occurs due to pulsating DC supplied to the receiver.

1. Defective power transformer.
2. Defective diodes.
3. Defective main filter capacitor.
4. Defective $2^{nd}$ B+ filter capacitor.

## 3.8 TV Transmission And Reception

### Introduction - TV transmission principle

Television means “To see from a distance”. Video and audio signals are transmitted from TV transmitter and is viewed in various places using TV receivers.

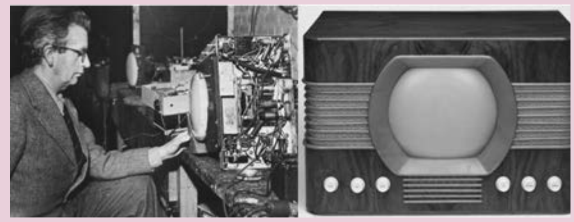
> **DO YOU KNOW?** Initially, television was called as televisor.

Television comprises of the following three activities:

1. Capturing Pictures—Camera
2. Recording and Transmission
3. Reception or Reproduction

We discuss about these concepts in the following Sections.

**HISTORY OF TELEVISION**



J.L.Baird

CF Jenkins

V.K.Zworykin

T.Farnsworth

The first demonstration of actual television was given by J.L.Baird in UK and C.F.Jenkins in USA around 1927. However a complete shape of television was developed by V.K.Zworykin and T.Farnsworth. We could understand that prior to the development of Television, the camera tube would have been developed, since any image shown in the TV should be captured through the camera first. Of course the camera tube was also developed by Zworykin. Initially TV was developed through vacuum tubes then by semiconductor devices like transistors and ICs. In this fast developing world, the Television is playing important role in Communication.

### 3.8.1 Scanning

Scanning can be compared to our eyes. While reading a book, the eye starts to read from left end and move towards right end. On finishing the right end, automatically the eye will come to the next line i.e., left end of the next line and starts to read towards right end and this will continue. As like this, the same activity should be happened in camera tube and television picture tube. When this is happened in the camera tube the image falls on the camera tube is divided into many parts and these separated parts are once again framed as a picture in the television picture tube. This is achieved through the process called scanning.

The electron ray from the electron gun moved from left to right and right to left and top to bottom and bottom to top of the television screen and camera tube is known as Scanning as shown in Fig. 3.14.

To form a picture on the television screen we need 15625 scanning lines per second. Since the scanning speed is very high, it is not visible to our eyes. Because the eye's persistent of vision is 1/16th of a second. Thus, if the scanning rate per second is made greater than sixteen, the eye is not able to integrate the changing levels of brightness in the scene. The motion picture on the television is easily compared with the screening of cinema. In cinema projection, 24 picture frames should be crossed in front of the camera in one second. If there is any change in this, the action may not be real.

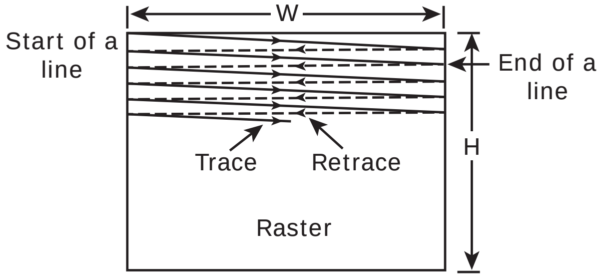



FIGURE 3.14 Scanning

Just like the same, in television, 15625 scanning lines are divided into 25 picture frames. Therefore, one frame consists of 625 (15625/25) scanning lines. Hence, as we seen earlier for a complete action picture, we need $(25 \times 625) = 15625$ scanning line. The electron ray moving from left to right and right to left is called as horizontal scanning and the ray moving from top to bottom and bottom to top is called vertical scanning.

During scanning there are two important points are worth noting.

1. The electron ray which moves from left to right alone is visible to our eyes, since it alone carries the signal. This line is termed as Trace line.
2. When the ray is moved from right to left, it don't have any signal in it and it is blanked by applying blanking pulses. This line is termed as Retrace line.

#### Sequential Scanning or Progressive Scanning

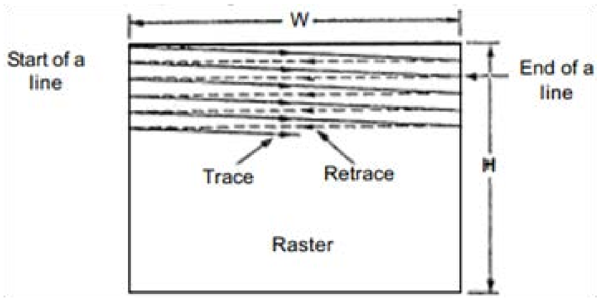



FIGURE 3.15 Sequential Scanning Or Progressive Scanning

The electron ray starts to scan from line one and follow continuously (trace line and retrace line) making full scanning of 15625 lines in 25 frames in one second is called as progressive scanning as shown in Fig. 3.15. In this method, there was an unavoidable problem occurred.

### Flicker Effect

Although the rate of 24 frames per second in motion pictures and that of scanning 25 frames per second in television pictures is enough to cause an illusion of continuity, they are not rapid enough to allow the brightness of one picture or frame to blend smoothly into the next through the time, when the screen is blanked between successive frames. This results in a definite flicker of light that is very annoying to the observer, when the screen is made alternately bright and dark. This problem can be solved in motion pictures by showing each picture twice, so that 48 views of the scene are shown per second although there are still the same 24 frames per second. As a result of the increased blanking rate, flicker is eliminated.

### 3.8.2 Interlaced Scanning

In television pictures, effective rate of 50 vertical scenes per second is utilized to reduce flicker. This is accomplished by increasing the downward rate of travel of the scanning electron beam, so that every alternate line gets scanned instead of every successive line. Then, when the beam reaches the bottom of the picture frame, it quickly returns to the top to scan those lines that were missed in the previous scanning. Thus, the total number of lines are divided into two groups called' 'Fields'. Each field is scanned alternatively. This method of scanning is known as interlaced scanning and is illustrated in the Figs 3.16 and 3.17. It reduces flicker to an acceptable level, since the area of the screen is covered at twice the start of a rate. This is like reading alternate lines of a page from top to bottom once and then going back to read the remaining lines down to the bottom.

In the 625 line TV system, for successful interlaced scanning, the 625 lines of each frame or picture are divided into sets of 312.5 lines and each set is scanned alternately to cover the entire picture area. To achieve this the horizontal sweep oscillator is made to work at a frequency of 15625 Hz (15625/25 = 625 lines), but the vertical sweep circuit is run at a frequency of 50 instead of 25 Hz. Note that the beam is deflected from top to bottom in half of the time and the horizontal oscillator is still operating at 15625Hz, only half the total lines, i.e. 312.5 (625/2=312.5) get scanned during each vertical sweep. Since the first field ends in a half line and the second field commences at middle of the line on the top of the target plate or screen (see Fig 8.17), the beam is able to scan the remaining 312.5 alternate lines during its downward journey. Thus, the bean scans 625 lines (312.5 X 2=625) per frame at the scan rate of 15625 lines (312.5 × 50 =15625) per second. Therefore, with interlaced scanning the flicker effect is eliminated without increasing the speed of scanning, which in turn does not need any increase in the channel bandwidth.

#### Horizontal Sync & Blanking Pulse Detail

The line period for one complete horizontal line is 64 µs. In that, trace line period is 52 µs and retrace time period is 12 µs.

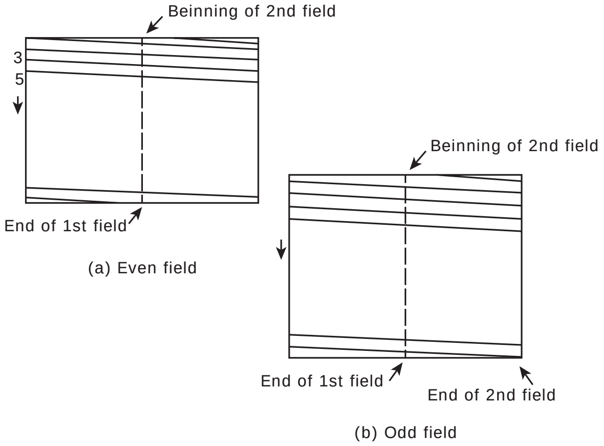



**FIG 3.16** Odd and Even fields of interlaced scanning

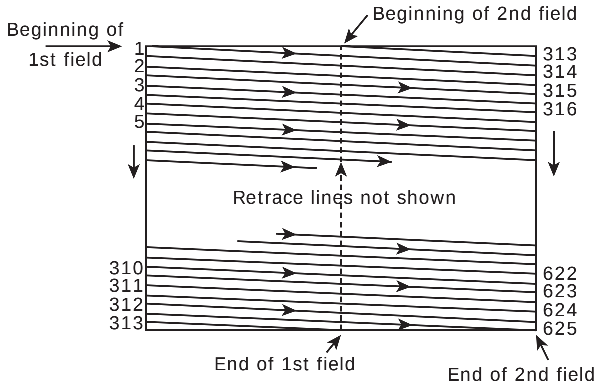



**FIG 3.17** Interlaced Raster (Full frame)

**Vertical Sync and blanking pulse detail**

The time period of one field is 20 ms. In this, vertical the time taken for trace is 18.72 ms and 1.28 ms is for retrace.

### 3.8.3 Colour Picture tube

> Picture tube converts electrical signal into picture.

Colour picture tube has three cathodes viz., Red, Green and Blue. Further, it has three filaments, three control grids and three accelerating grids and three focussing grids and one final anode. A particular colour electron beam strikes on the phospor stripes and makes primary and secondary colours as shown in Figure 3.18.

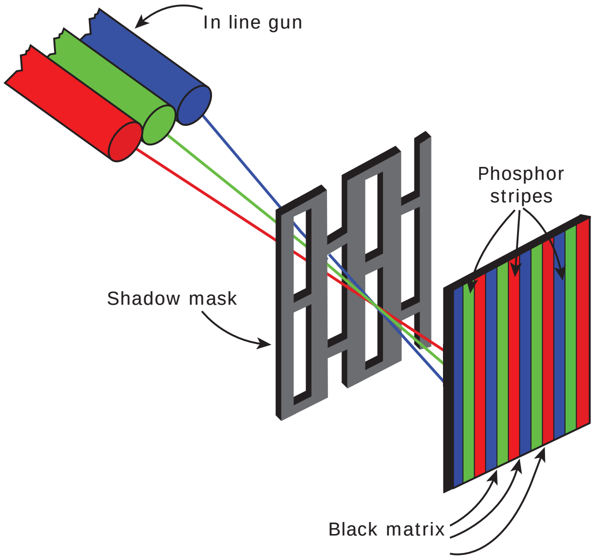



FIGURE 3.18 Colour Picture Tube Technology

> DO YOU KNOW? Deflection yoke works using the principle of electromagnetic deflection whereas in a CRO electrostatic deflection is used.

## 3.9 Camera Tube

A Television camera tube may be called the eye of a Television system. It converts an optical image into a sequence of electrical signal.

**Photo emission**

Converting optical images into electrical signal is called as photo emission.

**Photo conductivity**

The resistance value of target material varies when exposed to light. When resistance value varies, the conductivity also varies. This is known as **photo conductivity**.

There are four types of camera tubes.

1. Iconoscope
2. Image Orthicon
3. Vidicon
4. Plumbicon

The first developed storage type of camera tube was 'Iconoscope'. Now, it has been replaced by Image-Orthicon (IO) of its high light sensitivity, stability and high quality picture capabilities. The light sensitivity is the ratio of the signal output to the incident illumination. IO uses photo emissive principle.

Next developed camera tube was the Vidicon and is much simpler in operation. Similar to the Vidicon is another tube known as Plumbicon developed by Philips of Holland. Both tubes follow the principle of photo conductivity.

### 3.9.1 Characteristics of Camera tubes

**Light transfer characteristics**

It is nothing but, the output current of the camera tube, which depends upon the light falls on the glass face plate.

**Spectral Response**

The camera tube could able to sense the light variation that our eyes could able sense.

### Sensitivity

It is the capacity of converting video signal of very small image. The camera tube should have a required level of sensitivity.

### Dark current

The output signal received, when no light falls on the glass face plate, is called Dark current.

### Lag characteristics

When the camera tube could not able to sense the high speed light variation, it is known as Lag characteristics.

### Resolving Power

Sensing the White and Black portions of the picture and giving the output accordingly is known as Resolving power.

### Mixing of colours

Red, Green and Blue are primary colours. Mixing these primary colours results in all the other colors viz., Magenta, Cyan and yellow, called as complementary colors.

Mixing of colors is done in two methods. a) Additive mixing b) Subtractive mixing

### Additive mixing

This process is performed by adding (mixing) primary colours and as a result complementary colours are produced as shown in Figure 3.19.

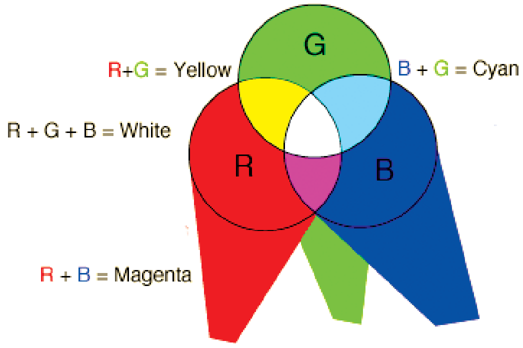



FIGURE 3.19 Additive mixing

### Percentage of mixing

30% Red + 59% Green = Yellow (89%)

30% Red + 11% Blue = Magenta (41%)

11% Blue + 59% Green = Cyan (70%)

30% R + 59% G + 11% B = White (100%)

### Subtractive mixing

It is performed by subtracting (filtering) colours from white as shown in Fig 3.20.

White – Blue – Green = Red

White – Green = Magenta

White – Green – Red = Blue

White – Blue = Yellow

White – Blue – Red = Green

White – Red = Cyan

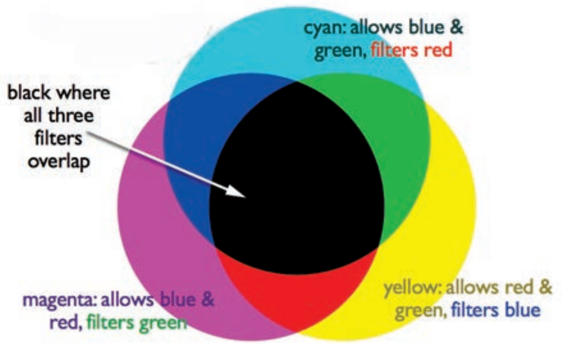



FIGURE 3.20 Subtractive mixing

Color matrix and color burst circuits are used for the mixing of colors.

### Hue

It is defined as the shade of color, i.e., red or green or blue.

### Saturation

It is defined as the intensity of color, i.e., high saturation of red is nothing but dark based (thick) red and low saturation of red is dull red.

If we combine hue and saturation together, we get Chroma or chrominance signal, which we can define as the overall value of the color. If we remove all chrominance information, we have only gray scale signal.

**Gray scale**

It is a range of gray (or grey) shades from white to black. The gray scale is luminance signal (Monochrome signal).

> DO YOU KNOW? Gray scale means black, white and gray signals.

Color video signal has 2 basic components such as the luminance information (brightness) and the chroma information (color).

### 3.9.2 Colour camera tube principle

**Basic colour camera tube principle**

Figure 3.21 illustrates the working principle of a Colour Camera Tube. Dichroic mirrors are used to split the white light from the lens into the 3 separate colors and sent to the color tubes in the camera. Zinc sulphide and cryolite are coated in the glass plate to form dichroic mirrors. Dichroic mirrors reflects or allow particular colour light. Thus, Red, Green and Blue colour light are fed to relevant camera tube. RGB Camera tubes convert light into electrical video signal.

The individual color signals from the tubes are encoded (modulated) and added to the luminance signals generated by a matrix circuit. Finally, sync pulses are also added. The combination of chrominance signal, luminance signal and sync pulses are called as Composite Colour Video Signal (CCVS).

## 3.10 TV Transmitter

Figure 3.22 depicts the complete block diagram of a TV transmitter. The individual functions of the major sections are briefly explained here:

### TV Camera & Composite Video Signal

Any program that is produced in the studio must be captured by the camera and converted into a signal. In this stage, deflection and

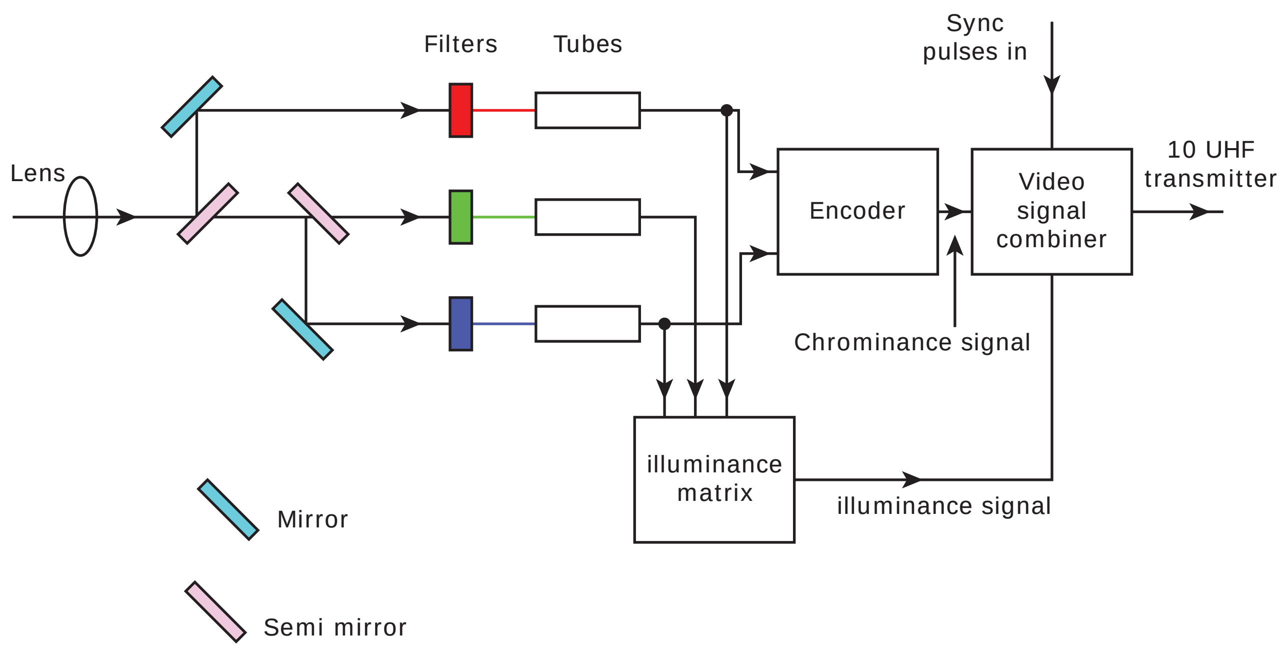



FIG 3.21 Working Principle of Colour Camera Tube

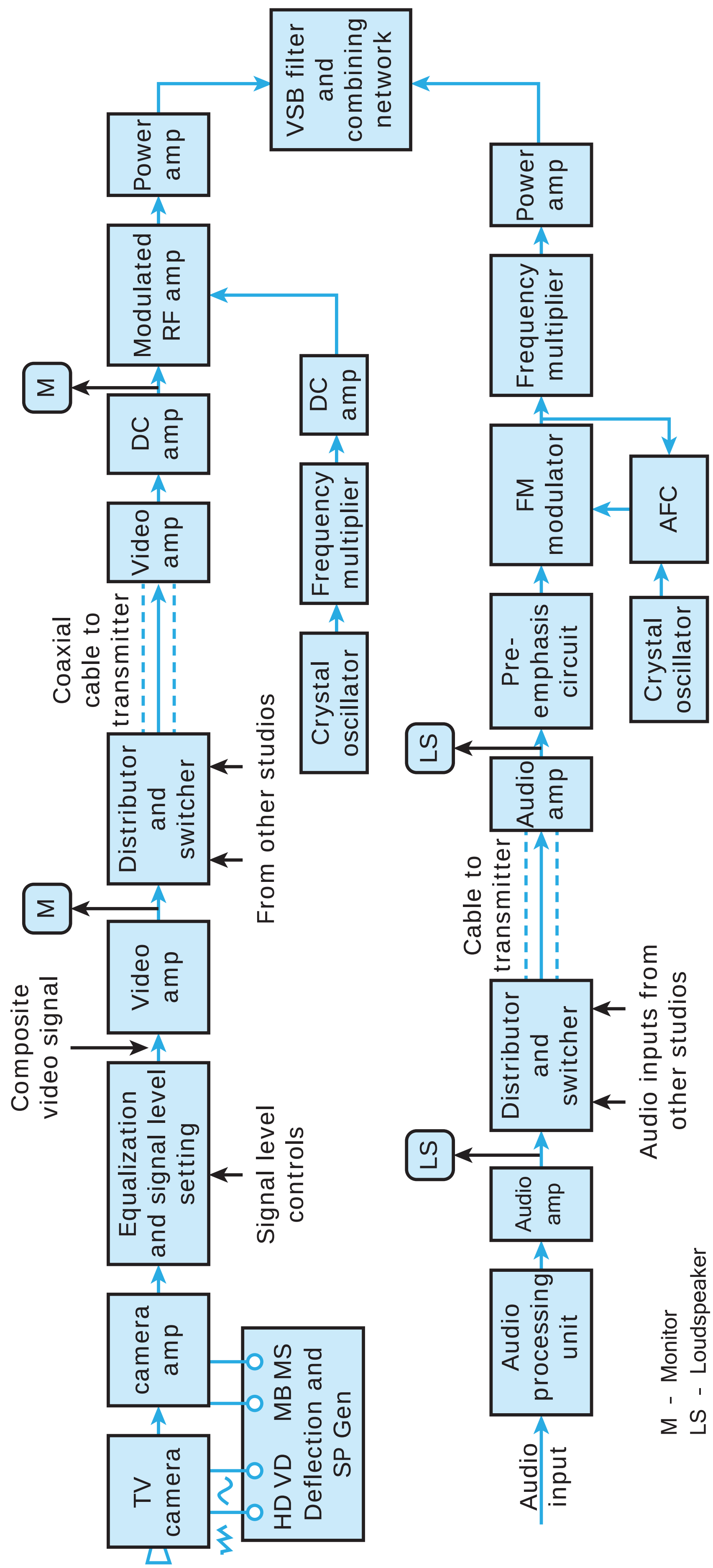



FIGURE 3.22 TV Transmitter block diagram

synchronizing pulses are also produced. The deflection pulses are sent to the camera and the synchronizing pulses are sent to the camera amplifier. In camera amplifier, the signals from camera tube and sync pulses are attached. It is amplified and fixed to certain level. This is composite video signal.

### Video amplifier and monitor

The composite video signal produced is amplified to the required level. The quality of the signal is monitored through the monitor placed.

### Distributor & Switcher

The signal from other transmission studios are received here and amplified. The quality of the signal is monitored by a monitoring room.

### Modulation and Transmission Section

In TV transmission, video waves are amplitude modulated and sound waves are frequency modulated. Hence, the respective carrier waves are generated through crystal oscillators are fed to the modulators. Vestigial sideband transmission is used in TV broadcasting. The modulations are carried over and sent to the transmitter for transmission.

### Types of TV transmission

There are three types of color TV transmission

1. Phase Alternation by Line (PAL, Germany)
2. National Television Systems Committee (NTSC, America)
3. Sequential Colour And Memory (SECAM, France)

### PAL encoder

Figure 3.23 shows PAL encoder, the RGB signals are mixed and formed as Y signal (30% R + 59% G + 11% B = White (100%)). B-Y (U signal) is derived by mixing B and Y and R-Y (V signal) is derived by mixing R and Y. These U and V signals are called as colour difference signals. G-Y signal is not used to transmit, because it takes a lot of bandwidth, it will be retrieved from mixing of R-Y and B-Y signals in the receiver.

U signal is modulated by colour subcarrier frequency of 4.43 MHz with 90° shift. It is referred as FU. V signal is modulated by the colour subcarrier frequency of 4.43 MHz with 0 or 180° shift. It is referred as ± Fv. Both are added in a matrix circuit and given to final matrix. In final matrix circuit, delayed Y, colour signals, sync and blanking signals are given to form as Composite colour video signal.

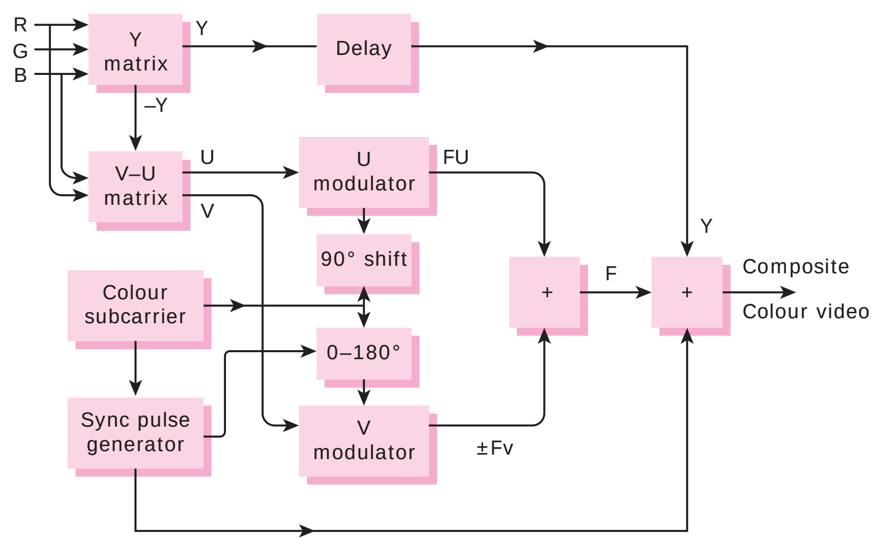



FIG 3.23 Phase Alternation by Line encoder (PAL encoder)

## PAL Receiver

Figure 3.24 shows the block diagram of the PAL receiver. The functions of each component is briefly elucidated here.

## Antenna

It receives RF signals and converts into electrical signal and then fed to the tuner.

## Tuner

TV receiver also uses super heterodyning principle. It has RF amplifier, mixer and local oscillator, which generate the IF output.

## Common IF Amplifier

This stage filters noise and amplifies the two IF signals. Video IF is 38.9 MHz and sound IF is 33.4 MHz.

## Video Detector

It filters the carrier signal and separates the composite colour video signal.

## Video section

PAL decoder detects the chrominance signals U and V. It is further mixed to get R-Y, B-Y and G-Y signals. Adder circuit combines these signals with delayed Y signal to get RGB signal. RGB signals are amplified to a large extent by three separate video amplifiers and are fed to the corresponding cathodes of the picture tube.

## Colour Picture Tube

Here, RGB signals are converted into electron beam by the RGB cathodes and then scanned line by line of the picture using deflection stage. The corresponding RGB stripes are illuminated by the electrons. Thus, colour scenes can be seen in the screen.

## Automatic Gain Control (AGC)

AGC circuit controls gain of RF and IF stages to deliver almost constant signal gain to the receiver, despite changes in the signal gain from TV station.

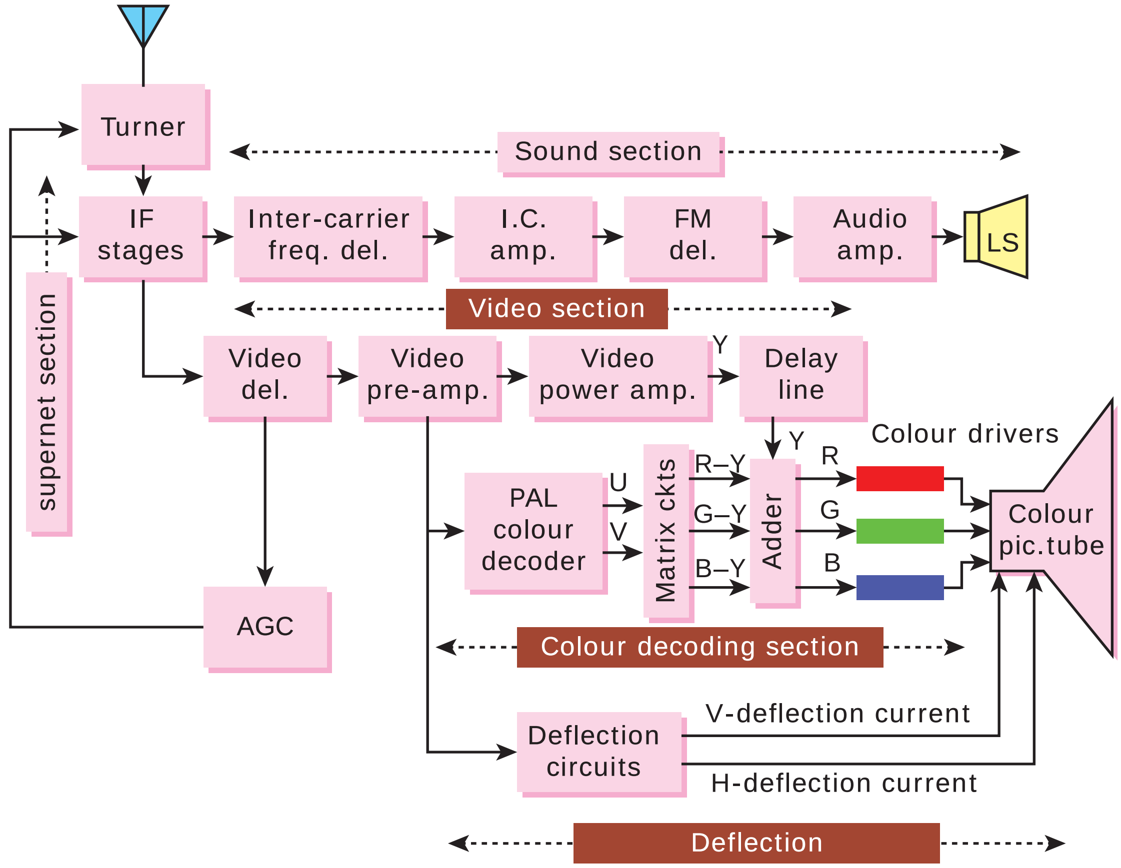



FIG 3.24 Block diagram of PAL receiver

### Deflection Section

This section has two sub divisions such as 1) Horizontal deflection 2) Vertical deflection

Horizontal section deflects the electron beam from the RGB cathodes horizontally to get line by line picture. Vertical section creates frame by frame (Fields) of picture by deflecting the beam vertically.

### Sound section

Inter-carrier sound IF of 5.5 MHz is amplified and detected to get audio signal. Audio signal is amplified and fed to the Speaker.

### Speaker

It converts audio signal into sound.

### Power supply

It gives regulated voltage to the TV receiver. Mostly, Switched Mode Power Supply circuit (SMPS) is used.

### PAL decoder

Figure 3.25 shows the PAL decoder section. Here, Y signal is separated from CCVS, amplified, delayed and fed to the RGB matrix circuit. U and V (colour difference signals) are detected using sub-carrier signals and 64 μs delay and phase reverse switch and fed to the matrix circuit. R-Y, G-Y and B-Y signals are fed from the matrix circuit are given to the RGB matrix. After processing with Y signal, R, G and B signals are obtained.

## 3.11 TV Receivers

This 21st Century witnessed major change in television technology. The prime and important device which is essential to convert the video signal into visual picture is the CRT tube that has tremendous developments such as LCD, LED, QLED, etc. These devices have so many advantages like handy, easy to handle, consuming less power, giving better picture quality, which ultimately replaced the traditional CRT TV screens. Let us study about LCD and LED TV screens in this Section.

## 3.12 LCD (Liquid Crystal Display) Receivers

Figure 3.26 shows Modern colour TV receivers use LCD screens instead of Cathode ray tube screens. Usually, the colour video signal is in analogous state, which is converted into 8 or 10 bits digital data signal using Analog to digital converter circuit. That is, Red signal is converted into $R_0$, $R_1$ $R_2$ $R_3$ $R_4$ $R_5$ $R_6$ and $R_7$, Green is converted into $G_0$ to $G_7$ and Blue is converted into $B_0$ to $B_7$.

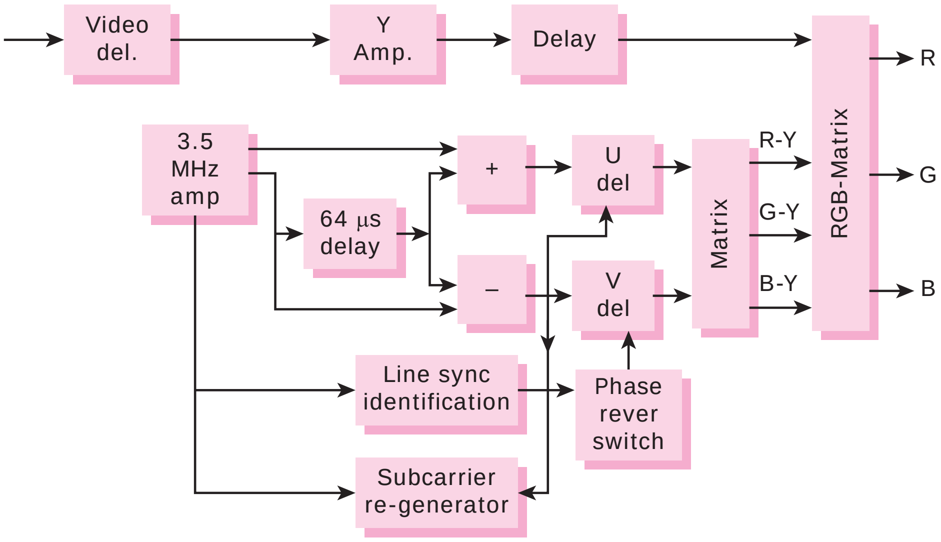



FIGURE 3.25 PAL decoder

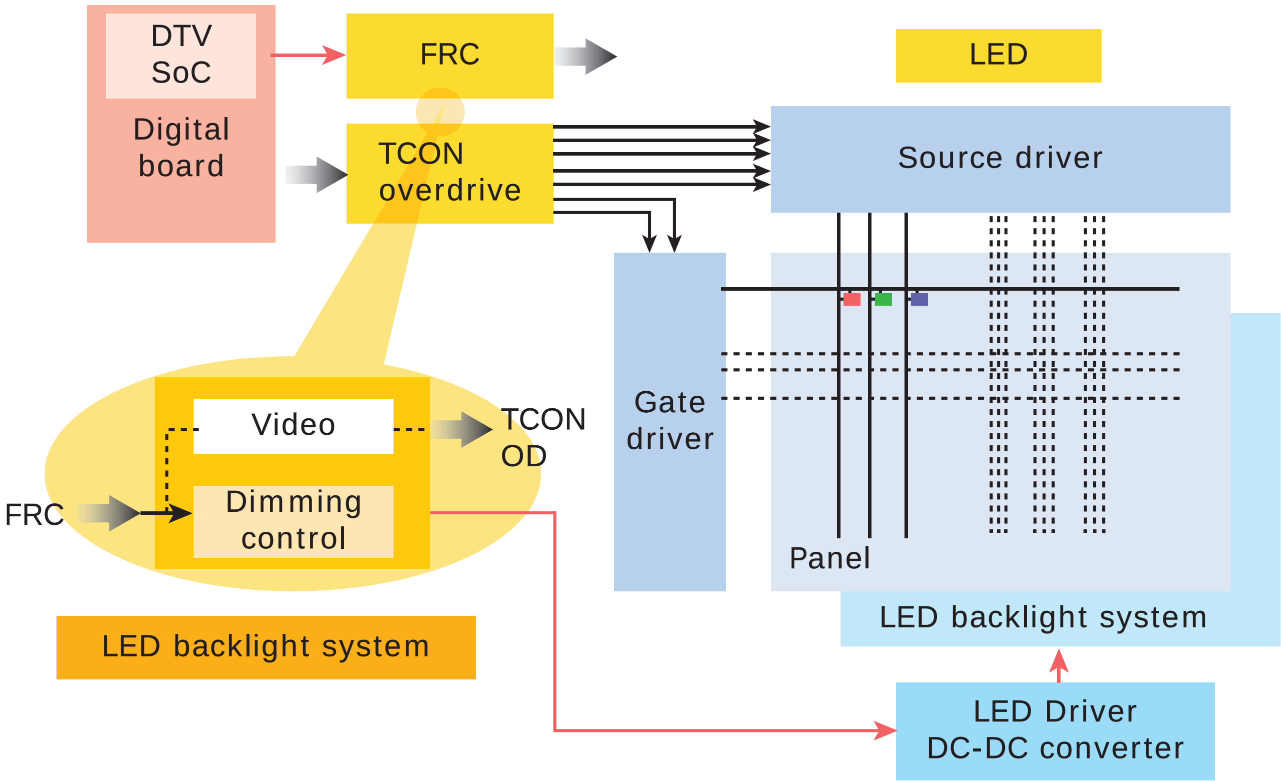



FIG 3.26 Block diagram of LCD display

Over 10 lakh of MOSFETs (Thin film transistors TFT) are used in the LCD panel. Figure 3.27 shows a single thin film MOSFET illuminating a single pixel in LCD screen. The MOSFET's gate is controlled by Timing control circuit (TCON). Source is given the digital data signal. The drain is earthed. The corresponding MOSFET works when RGB data is given and makes the sub pixel (dot) RGB to be illuminated. This is called as addressing of sub pixels.

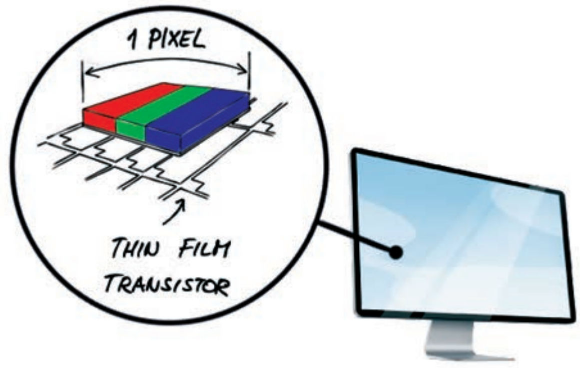



FIGURE 3.27 A single thin film MOSFET to illuminate a single pixel (dot)

TCON is Timing control circuit. TCON controls the Gate of MOSFET. Dimming control controls the LED driver to enable the brightness variation in scenes. TCON drives the gate of MOSFET in time, to get the sub pixel R or G or B or to be illuminated. Figure 3.28 shows the block diagram of an LCD screen.

## Backlight

There are two main types of backlights used in LCD screens: CCFL and LEDs.

## LCD panel with CCFL backlight (LCD TV)

If a CCFL (cold-cathode fluorescent lamp) backlit the LCD screen then, the type of TV receiver is called as LCD TV. In this type, backlight is given using a series of fluorescent tubes placed behind the screen as shown in Figure 3.28. These tubes are very similar to the fluorescent lamps (tube lights) used almost everywhere, but smaller in size. An inverter circuit is used to illuminate the CCFL.

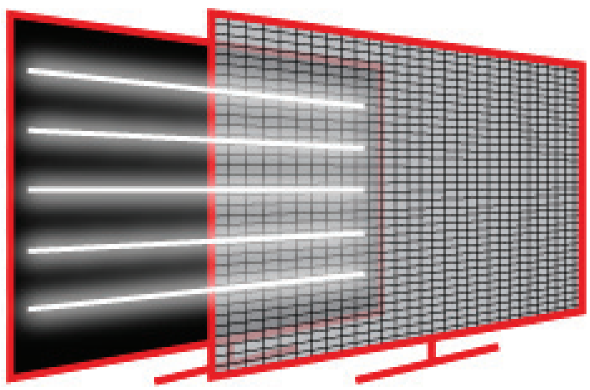


FIG 3.28 LCD panel with CCFL backlight

## 3.13 LED (Light Emitting Diode) TV

If Light emitting diodes are used to backlit an LCD screen, then this type of TV receiver is called as LED TV. This type of backlight is a series of LEDs placed behind the screen as shown in Fig 3.29. LEDs are more energy efficient and a lot smaller than a CCFL, enabling a thinner television screen.

### Plasma Display

Plasma means semi solid form. A **plasma display panel** is a type of flat panel display

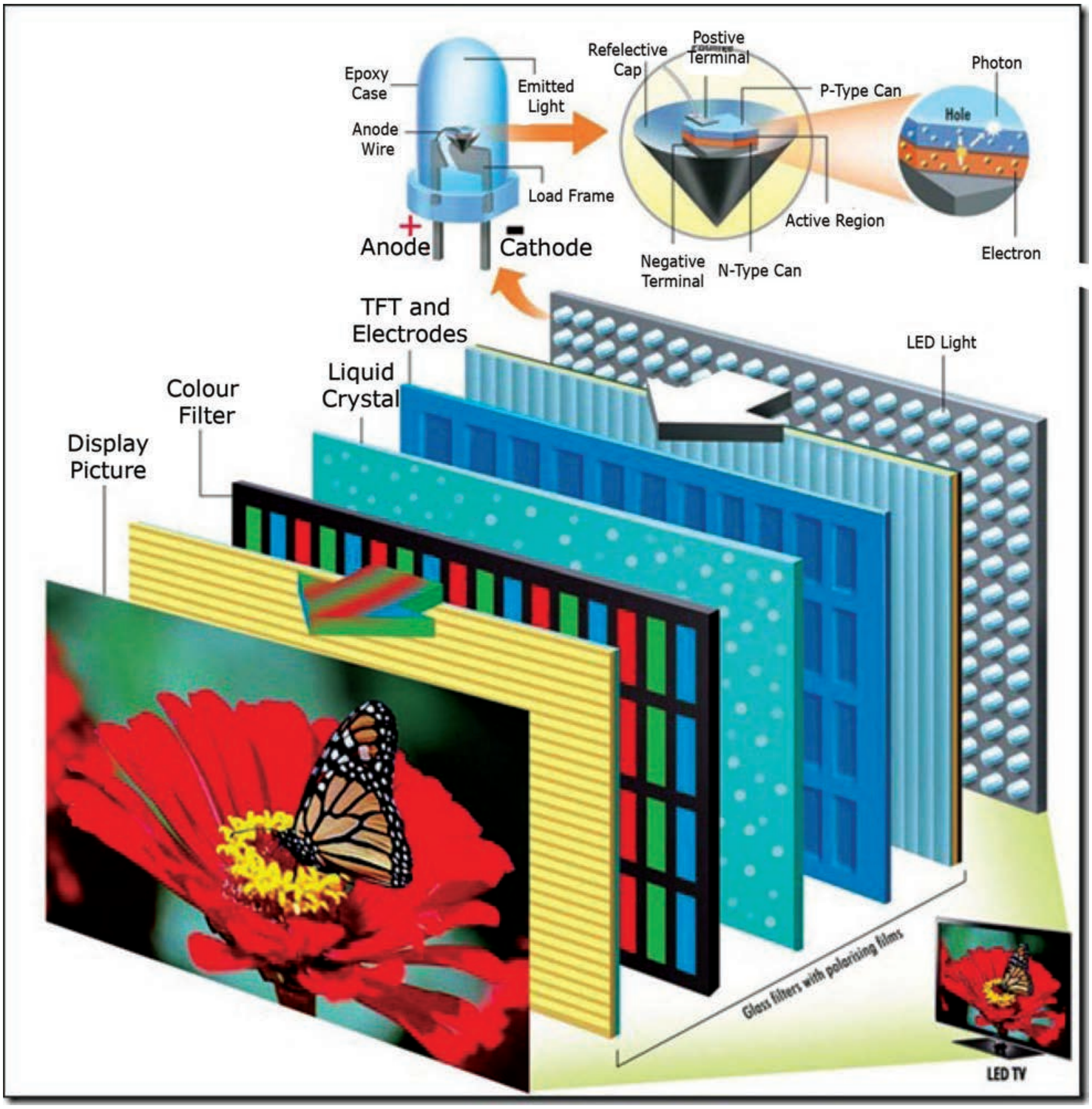



FIG 3.29 LCD Panel with Led Backlight

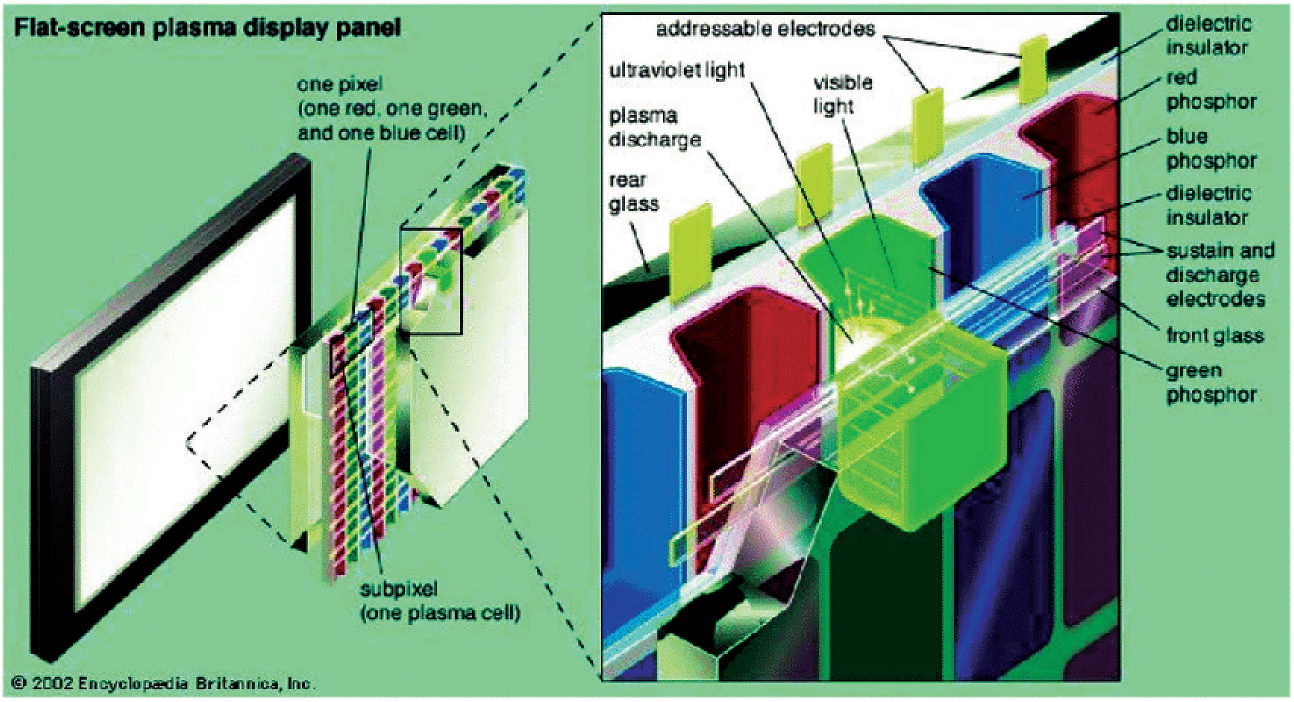



FIG 3.30 Plasma display

common to large TV displays of 30 inches (76 cm) or larger as shown in Figure 3.30. They are called "plasma" displays because they use small cells containing electrically charged ionized gases, which are plasmas. Plasma screens work by exciting tiny pockets of gas (Xenon and Neon), changing them to a plasma state. In that state, the electrons of that gas emit ultraviolet light, which is not visible to the human eye. The ultraviolet light is then absorbed and re-emitted into the visible spectrum of light by the phosphor inside each cell. Each pixel consists of three sub pixels: one red, one blue, and one green. The more excited the gas, the brighter the color produced.

### 3.13.1 Quantum LED screen (Q LED)

QLED refers to an LED TV using quantum dots to enhance its performance and that TV is called as QLED TV.

Quantum dots don't directly emit the colors we see and the colours are spread on a piece of film that acts almost as a filter within an LED TV panel as shown in Fig 3.31. LED backlights beam pass through this film and the light is refined to an ideal color temperature. This enhances the brightness and color of the pixel.

### 3.13.2 OLED TV

OLED stands for Organic Light-Emitting Diode. OLEDs are made with organic compounds that light up when fed electricity, hence the term emissive display. A single OLED is the size of one pixel, so it takes millions of them lighting up and shutting off independently to fill the TV screen. It requires no backlight. Because of this flexibility, when an OLED TV's pixels are shut off, they are completely off and appear completely black. While QLED TVs can be made very thin, OLED TVs can be made even thinner, and even flexible. Figure 3.33 shows a typical OLED TV.

### Resolution of modern LED TV receivers

Resolution refers to the number of pixels that forms the picture on the TV. It is termed in rows and columns. A single pixel or discrete picture element consists of a tiny dot on the

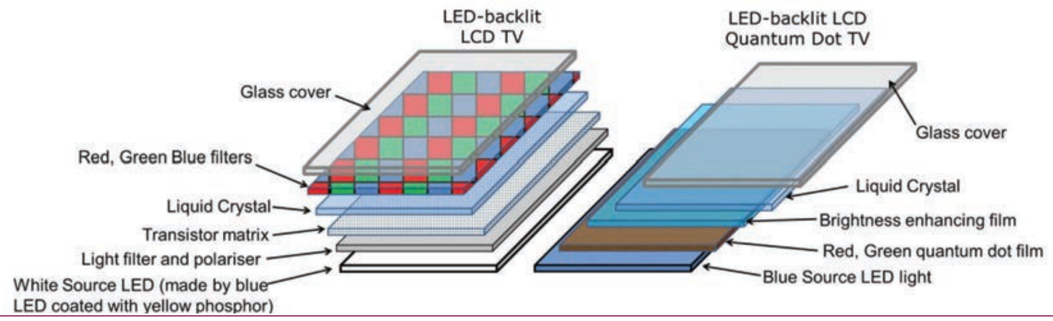



**FIGURE 3.31** QLED TV Display

screen. In today's TVs, there are one million to eight million such dots approximately. To look very closely or using a magnifying glass, these pixel can be perceived. Higher the number of pixels, resolution, i.e., clarity of the picture increases.

Three types of high definition LED TV systems are available.

1. High Definition 1024 × 1080 (rows × columns) = 11,05,920 pixels.
2. Full High Definition 1920 × 1080 = 20,73,600 pixels.
3. Ultra High definition or 4 K resolution 3840 × 2160 = 82,94,400 pixels.

### 3.11.5 Servicing of LED TV Receivers

**Symptom: No light on the screen; sound ok.**

Show a torch light on the display. If video is seen in that particular area.

**If fault is in LCD TV**

1. Fault is with inverter circuit.
2. CCFL may be defective.

**If fault is in LED TV**

1. Open the back cover of LED TV and switch ON the TV. If white LED array does not glow, check the supply voltage given to LED array.
2. Check each LED separately.
3. Replace the defective LEDs.

**Standard definition:** A picture is divided into rows and columns. A picture with 640 rows × 480 columns is called as Standard definition.

This method contains 640 × 480 = 307200 pixels.

**FIG 3.32** OLED display

## LEARNING OUTCOME

At the end of this chapter, the student could understand working principles of

- AM and FM Radio transmission
- Working principles of AM and FM Radio receiver
- Various Radio & TV fault finding techniques
- Working principles of TV transmission and reception
- The principles of LCD and LED TV panels

## GLOSSARY

| | |
|---|---|
| **Lower side band** | The sideband lower in frequency than the transmitter's carrier |
| **Upper side band** | The sideband higher in frequency than the transmitter carrier |
| **Fading** | Gradually grow faint and disappear |
| **Alignment** | Adjusting all of the tuned circuits to the correct frequency |
| **Scanning** | It is the process by which an electron beam spot is made to move across perfect angular area |
| **Flicker** | It is a visible change in brightness between cycles displayed on video displays |
| **High definition** | Providing images that show a lot of detail very clearly |
| **Remote control** | Equipment that we use for controlling television system from a short distance |
| **Tuner** | The part of a radio or television that receives broadcast signals |

## QUESTIONS

### Part – A (1 Mark)

**I. Choose the correct answer**

1. The bandwidth of AM transmission is _____

   (a) 5 kHz (b) 10 kHz
   (c) 20 kHz (d) 100 kHz

2. AM broadcast range is from _____

   (a) 88 MHz – 108 MHz
   (b) 540 kHz – 30 MHz
   (c) 100 kHz – 1000 kHz
   (d) 200 kHz – 200 MHz

3. The bandwidth of FM transmission is __________

   (a) 10 kHz (b) 20 kHz
   (c) 100 kHz d. 200 kHz

4. FM broadcast range is from _____

   (a)88 MHz – 108 MHz
   (b) 100 kHz – 30 MHz
   (c) 500 kHz to 5000 KHz
   (d) 200 kHz – 200 MHz

5. First radio station was established in _____________

   (a) Chennai (b) Mumbai
   (c) Delhi (d) Calcutta

6. The intermediate frequency of AM radio receiver is _______

(a) 10 kHz (b) 100 kHz
(c) 455 kHz (d) 445 kHz

7. The intermediate frequency of FM radio receiver is _______

(a) 10.7 MHz (b) 10.2 MHz
(c) 15.5 MHz (d) 13.5 MHz

8. Which radio receiver is used double conversion __________.

(a) Tune Radio frequency receiver
(b) Amplitude modulated radio receiver
(c) Frequency modulated radio receiver
(d) Communication radio receiver

9. If no sound is heard even after a radio receiver is connection, it is said to be______

(a) Live fault
(b) Dead fault
(c) Hum fault
(d) Intermediate fault

10. Frame frequency of Television receiver is _____.

(a) 25 Hz
(b) 50 Hz
(c) 625 Hz
(d) 15625 Hz

11. Horizontal frequency of television receiver is ____________.

(a) 25 Hz (b) 50 Hz
(c) 625 Hz (d) 15625 Hz

12. Each pixel consists of ______ sub pixels

(a) One (b) Two
(c) Three (d) Four

13. How many MOSFETs are used in an LED TV screen approximately?

a) 1000 b) 10
c)100 d) 10,00,000

14. In a 8 bit LED TV, Red colour signal is converted into _____ digital signals.

a) $R_0$ to $R_7$
b) $R_0$ to $R_1$
c) $R_0$ to $R_2$
d) $R_O$ to $R_3$

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15. CCFL means

a) Colour coded Fluorescent lamp
b) Cold cathode filament light
c) Cold-cathode fluorescent lamp
d) Colour controlled filament lamp

16 What gases are used in Plasma display?

a) Oxygen and carbon mono oxide
b) Xenon and Neon
c) Hydrogen and helium
d) Nitrogen and helium

## Part – B (3 Marks)

**II Answer in one or two sentences**

1. What are the types of transmission?
2. Define: VSB transmission.
3. What are the basic principles of radio receiver?
4. What is double conversion?
5. What are the advantage and disadvantage of digital audio broadcasting?
6. Give two reasons for hum in receiver
7. What is meant by scanning?

8. Write any three types of camera tube

9. What is resolving power?

10. What are the three types of resolution of High definition LED TV systems?

## Part – C (5 Marks)

**III Answer in a paragraph**

1. Describe the various abilities of radio receiver.

2. Draw and explain the block diagram of TRF receiver.

3. Explain about the principle of Superhetrodyne receiver.

4. Write the difference between AM and FM receiver.

5. Explain the construction of Q LED screen.

## Part – D (10 Marks)

1. Draw and explain the block diagram of AM radio transmitter.

2. Draw and explain the block diagram of FM receiver.

3. What are the reasons for dead fault in radio receiver?

4. write note on
   i. Resolution of Modern LED TV
   ii. Servicing of LED TV receivers

### ANSWERS

| | | | | | |
|---|---|---|---|---|---|
| 1. (a) | 2. (a) | 3. (c) | 4. (c) | 5. (d) | 6. (a) |
| 7. (c) | 8. (b) | 9. (b) | 10. (d) | 11. (a) | 12. (c) |
| 13. (d) | 14. (a) | 15. (c) | 16. (b) | | |