

ECE202 Analog Communication

Unit – 3 Transmitters and Receivers

Dr. A. Rajesh

Basic functions of transmitter

- ❖ Modulation
- ❖ Carrier generation
- ❖ Amplification (Power)

➤ It is an electronic unit which accepts the information signal to be transmitted and converts it into an RF signal capable of being transmitted over long distances .

Every transmitter has three basic functions as follows:

- ✓ The transmitter must **generate** a signal of **correct frequency** at a desired point in the spectrum.
- ✓ Secondly it must provide some form of **modulation** to modulate the carrier.
- ✓ Third it must provide sufficient **power amplification** in order to carry the modulated signal to a long distance.

Classification of radio transmitters

1. According to the type of modulation used
2. According to service involved
3. According to the frequency range involved
4. According to the power used

Classification based on types of modulation

- CW Transmitters
- AM Transmitters
- FM Transmitters
- SSB Transmitters

Classification based on type of service involved

- Radio broadcast transmitters
- Radio telephony transmitters
- Radio telegraph transmitters
- Television transmitters
- Radar transmitters
- Navigational transmitters

Classification based on transmitted frequency

- Low frequency (LF) transmitters (30 kHz- 300 kHz)
- Medium frequency (MF) transmitters (300 kHz-3 MHz)
- High frequency (HF) transmitters (3 MHz- 30MHz)
- Very high frequency (VHF) transmitters (30MHZ-300 MHZ)
- Ultra high frequency (UHF) transmitters (300 MHZ- 3GHZ)
- Microwave transmitters (>3GHZ)

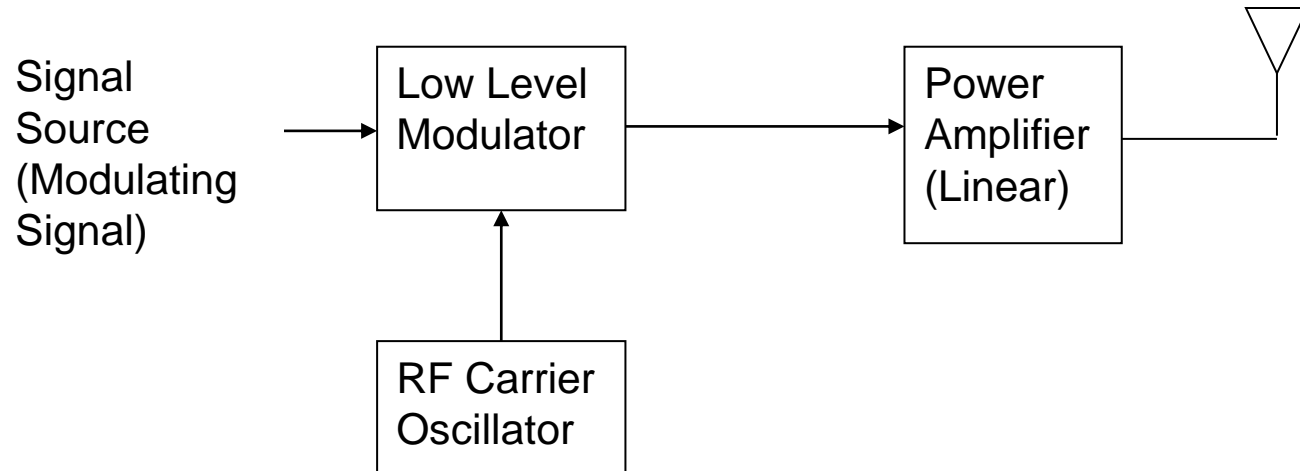
AM Transmitter

- Amplitude modulation technique is used in AM transmitters, here the amplitude of carrier is varied in proportion with the amplitude of the modulating signal, keeping its frequency and phase constant.
- Used in radio & TV broadcasting.
- In AM Transmitter, AM signal is transmitted by a transmitter. The information is contained in its amplitude variation.

Types of AM transmitters

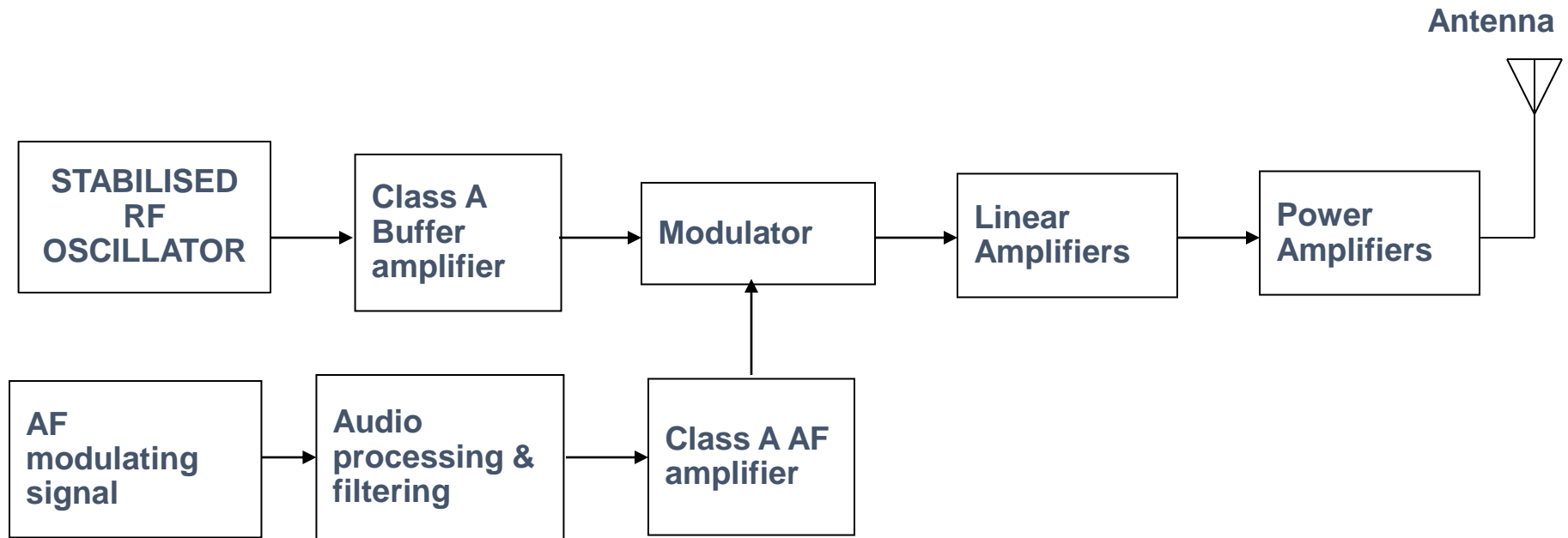
- Low Level modulation transmitters.
- High Level modulation transmitters.

Low level modulation transmitters



- The generation of AM wave takes place at a low power level
- The generated AM signal is then amplified using a chain of linear amplifier (A , AB or B).

Low level modulation transmitters



Low level modulation transmitters

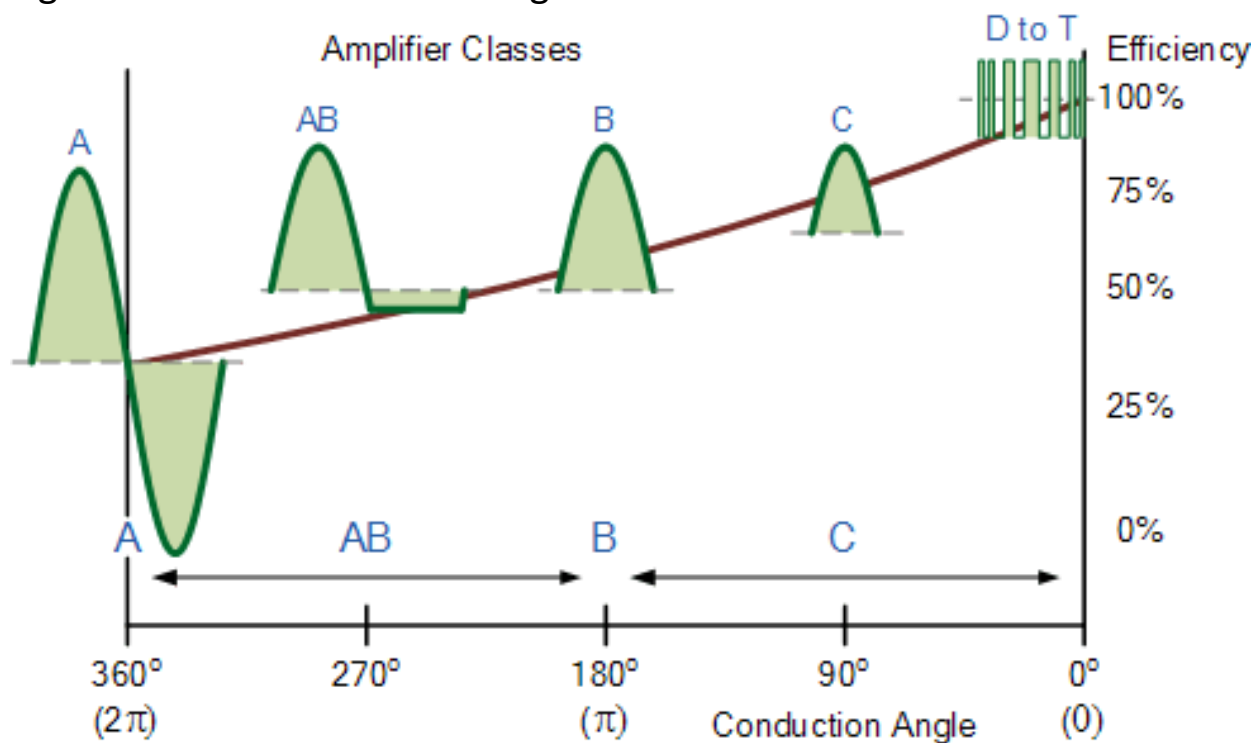
- The RF oscillator produces the carrier signal.
- The RF oscillator is stabilized in order to maintain the frequency deviation within the prescribed limit.
- The carrier frequency is equal to the transmitter frequency.
- Usually the transmitter operates on assigned frequencies or channels.
- Crystal provides the best way to obtain the described frequency with good stability.

Low level modulation transmitters

- We cannot use the LC oscillator because they have low frequency stability.
- The carrier signal from the crystal oscillator is applied to the modulator with a modulating signal.
- At the output of the modulator we get the AM wave.
- The modulating signal is obtained from a source such as a microphone and applied to a buffer processing unit.
- The buffer is a class A amplifier which isolates the AF source from the rest of high power circuit and amplifies it to an adequate level.

Low level modulation transmitters

- The amplified modulating signal is applied to the modulator along with the carrier. At the output of the modulator we get the AM wave.
- The AM signal is then amplified using a chain of linear amplifier to raise the power level.
- The linear amplifier can be class A, AB or B type amplifiers. The linear amplifier are used in order to avoid the wave form distortion in AM wave.
- The amplitude modulated signal is then transmitted using transmitted antenna.



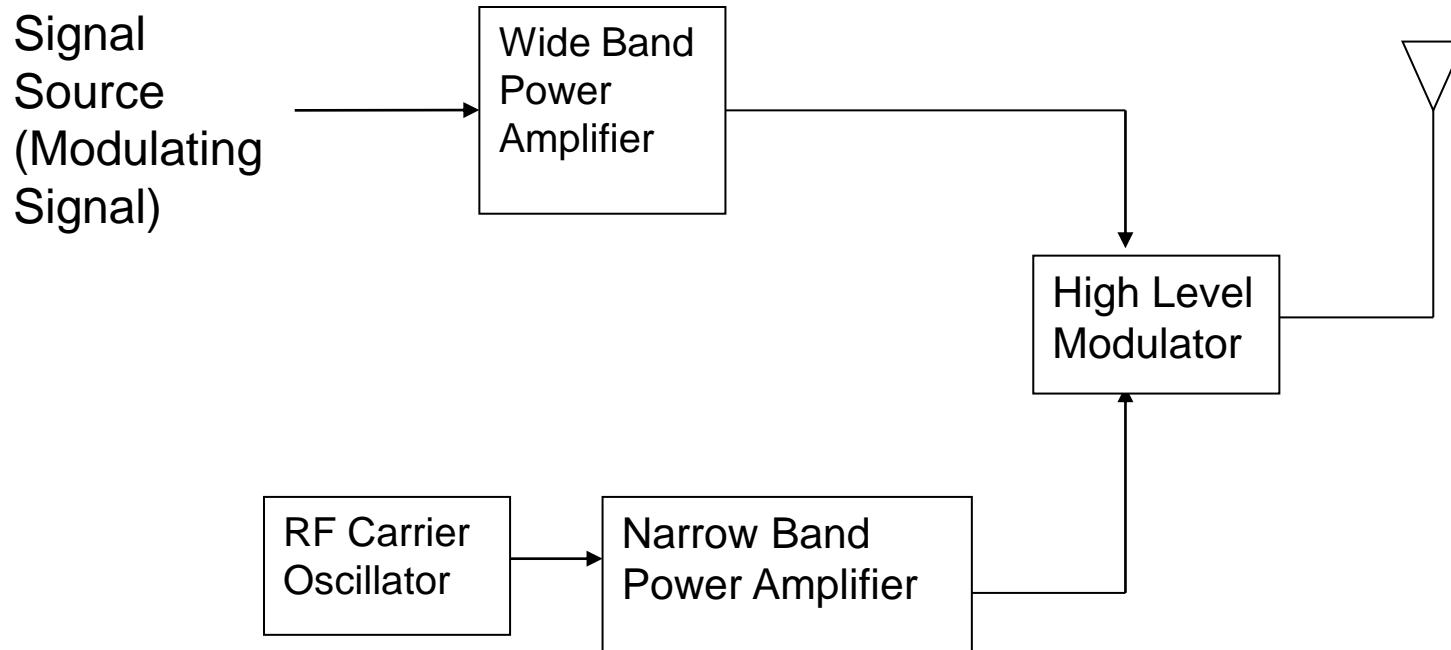
Low level modulation transmitters

- The transistorized modulator circuits can be used for low level modulator due to the low power which is to be handled.
- The low level transmitter does not require a large AF modulator power so its design is simplified.
- Overall efficiency is much lower compared to high level modulation . This reduce to the use of less efficient linear amplifiers.

Audio processing

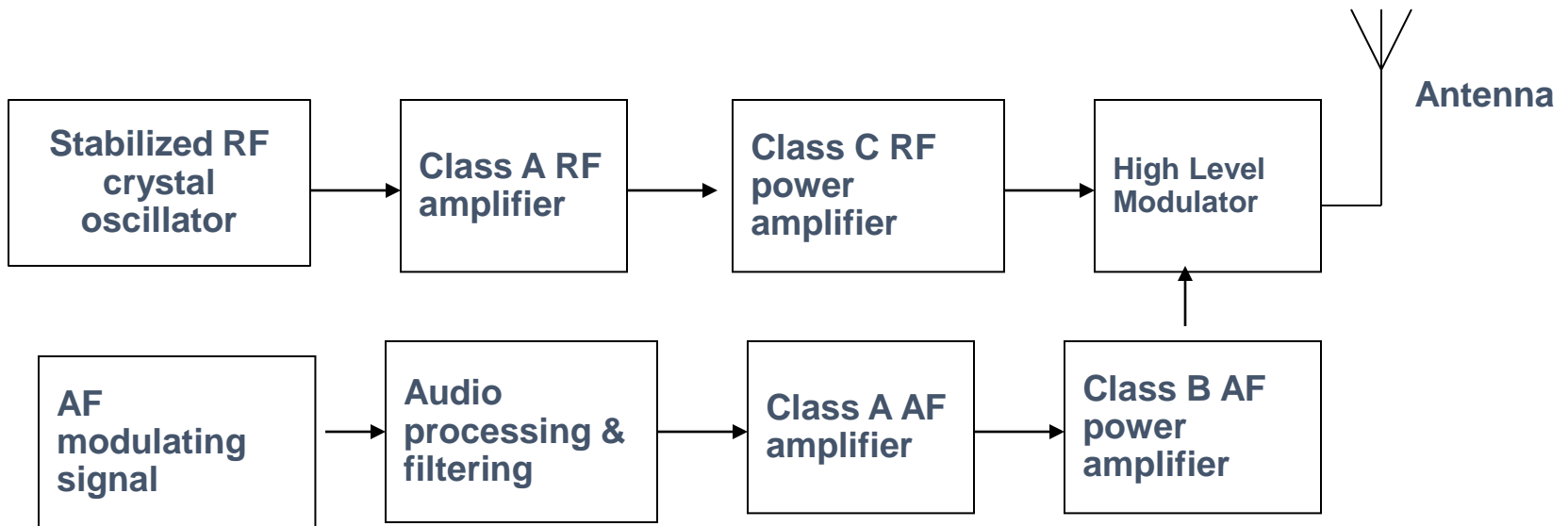
- The AF modulating signal is passed through an audio processing unit before applying it to the modulator.
- This block carries out some form of “speech processing” in the form of filtering and amplitude control.
- The weak signals amplified automatically with a higher gain and strong signals are amplified with smaller gain. This will bring all the signals to a sufficient level.

High level modulation transmitters



- The generation of AM wave takes place at high power levels.
- Highly efficient class C amplifier are used in high level modulation.
- Efficiency is more than low level modulation.

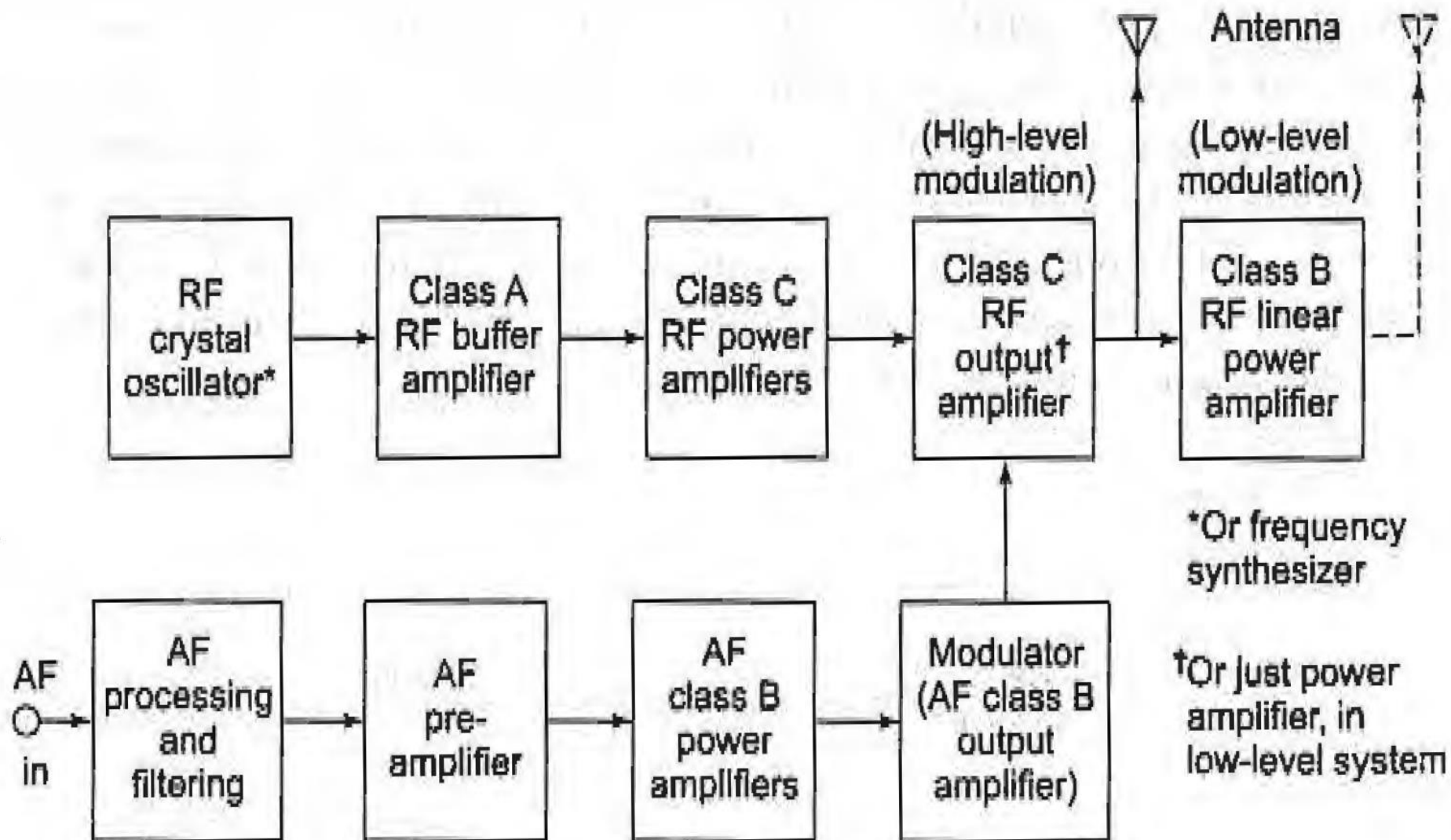
High level modulation transmitters



High level modulation transmitters

- Many of the AM transmitters use the high level modulation technique.
- The crystal oscillator produces the required carrier signal.
- The class A amplifier following the oscillator acts as a buffer which isolates the oscillator from the high power circuit.
- The output of this class A amplifier is applied to a class C power amplifier.
- It raises the power level of the carrier to an intermediately high value.
- The AF modulating signal is applied to the audio processing unit which processes this signal as discussed in the previous section.

AM Transmitter (Low and High Level)



AM Transmitter (Low and High Level)

- If the output stage in a transmitter is collector modulated in a low power transmitter, the system is called *high level modulation*.
- If the modulation is applied at any other point including some other electrode of the output amplifier, then *low level modulation* is produced.

Comparison between low-level and high-level modulation

1. Power level :

- Modulation is carried out at low power level.
- Modulation is carried out at high power level.

2. Amplifier stages:

- Need lesser amplifier stages.
- Need more amplifier stages.

Comparison between low-level and high-level modulation

3. Power efficiency :

- After modulation linear amplifiers can only be used. This gives lower power efficiency.
- Non linear amplifiers can also be used. This leads to higher power efficiency.

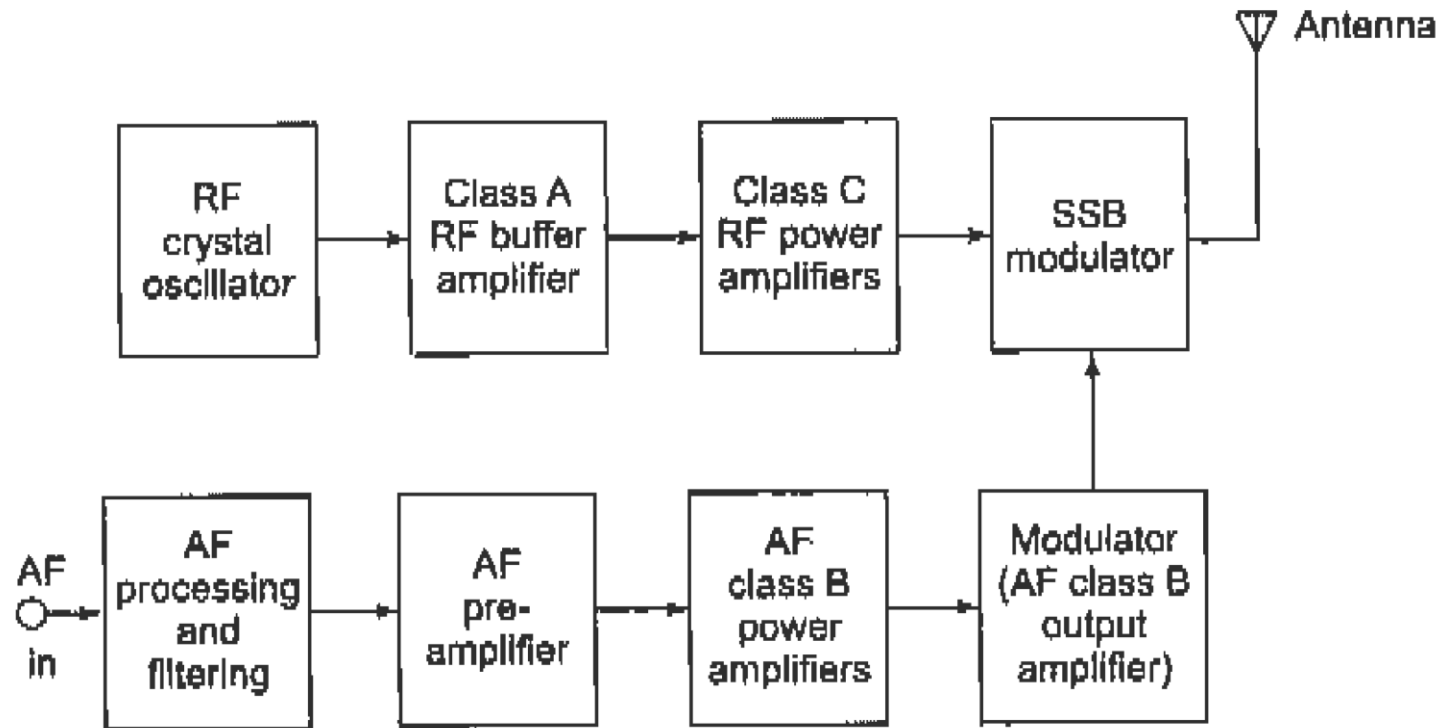
4. Power losses :

- Power losses in amplifiers is higher, the cooling problem is severe.
- Power losses is less, the cooling problem is not severe.

5. Applications :

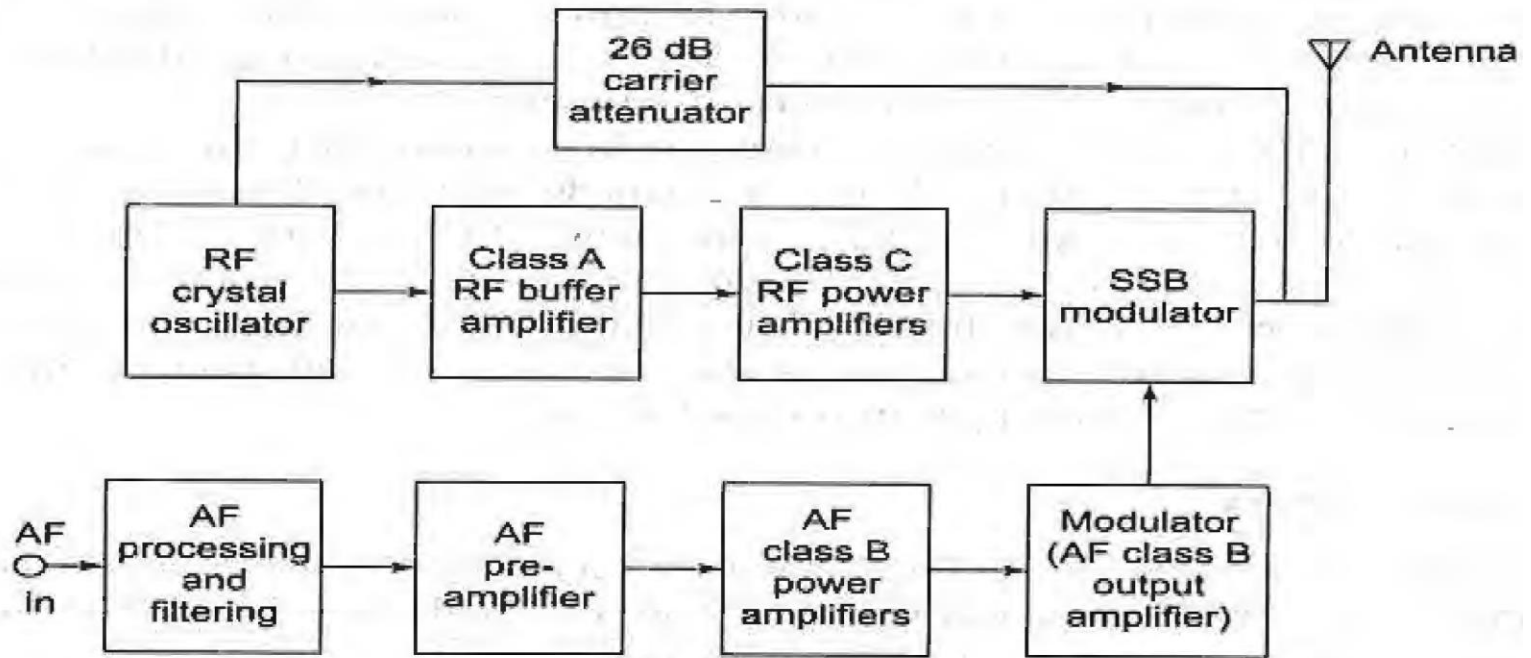
- Used as higher power broadcast transmitters.
- Used in TV transmitters.

SSB Transmitter



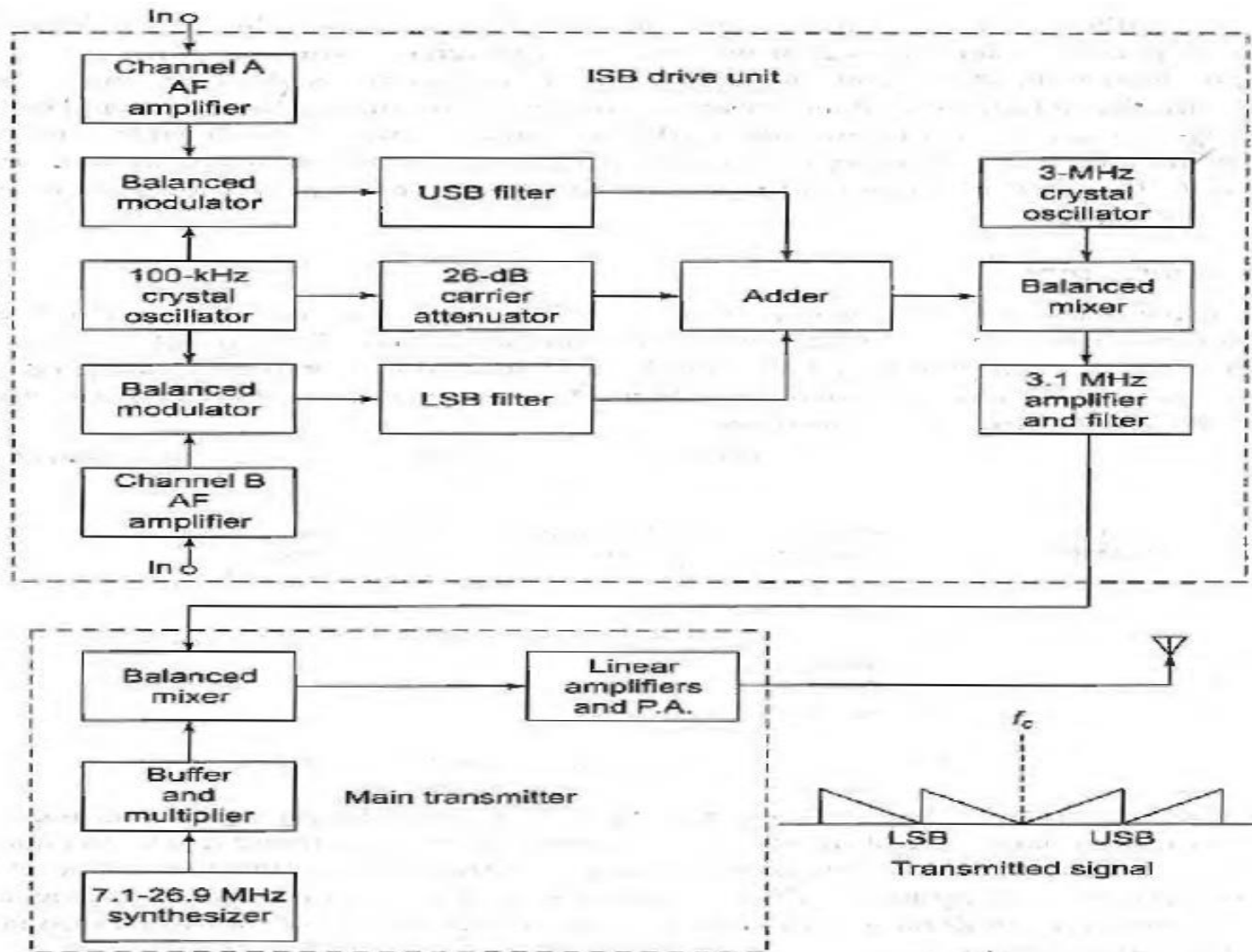
- The difficulty associated with SSB is due to the suppression of a carrier component
- Reinsertion of carrier at receiver causes frequency instability due to frequency shift
- These carrier instability is overcome using pilot carrier and ISB systems

Pilot Carrier Transmitter



- ❖ Here, we transmit a pilot carrier with the wanted sideband
- ❖ The receiver use AFC (Automatic Frequency Control) to control the frequency of carrier signal with the help of pilot carrier

Independent Side Band (ISB) Transmitter



- For transmission in HF band from 3 – 30 MHz.
- Balanced modulator is used to suppress the unwanted sideband