Principles of Communication (BEC-28)

Unit-2

Angle Modulation

DR. DHARMENDRA KUMAR

ASSISTANT PROFESSOR

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

MMM UNIVERSITY OF TECHNOLOGY, GORAKHPUR–273010.

Content of Unit-2

Introduction to Angle Modulation: Frequency modulation, Narrowband and Wideband FM, Generation of FM waves, direct FM and Indirect FM, FM modulators and demodulators, Phase locked loop, Angle Modulation by Arbitrary Message Signal, Phase Modulation, Pre-emphasis and De-emphasis, Linear and Nonlinear Modulation, Comparison between Angle Modulation and Amplitude Modulation, Radio Receivers.

Pre-emphasis and De-emphasis

- Pre and de-emphasis circuits are used only in frequency modulation.
- Pre-emphasis is used **at transmitter** and de-emphasis **at receiver**.

1. Pre-emphasis

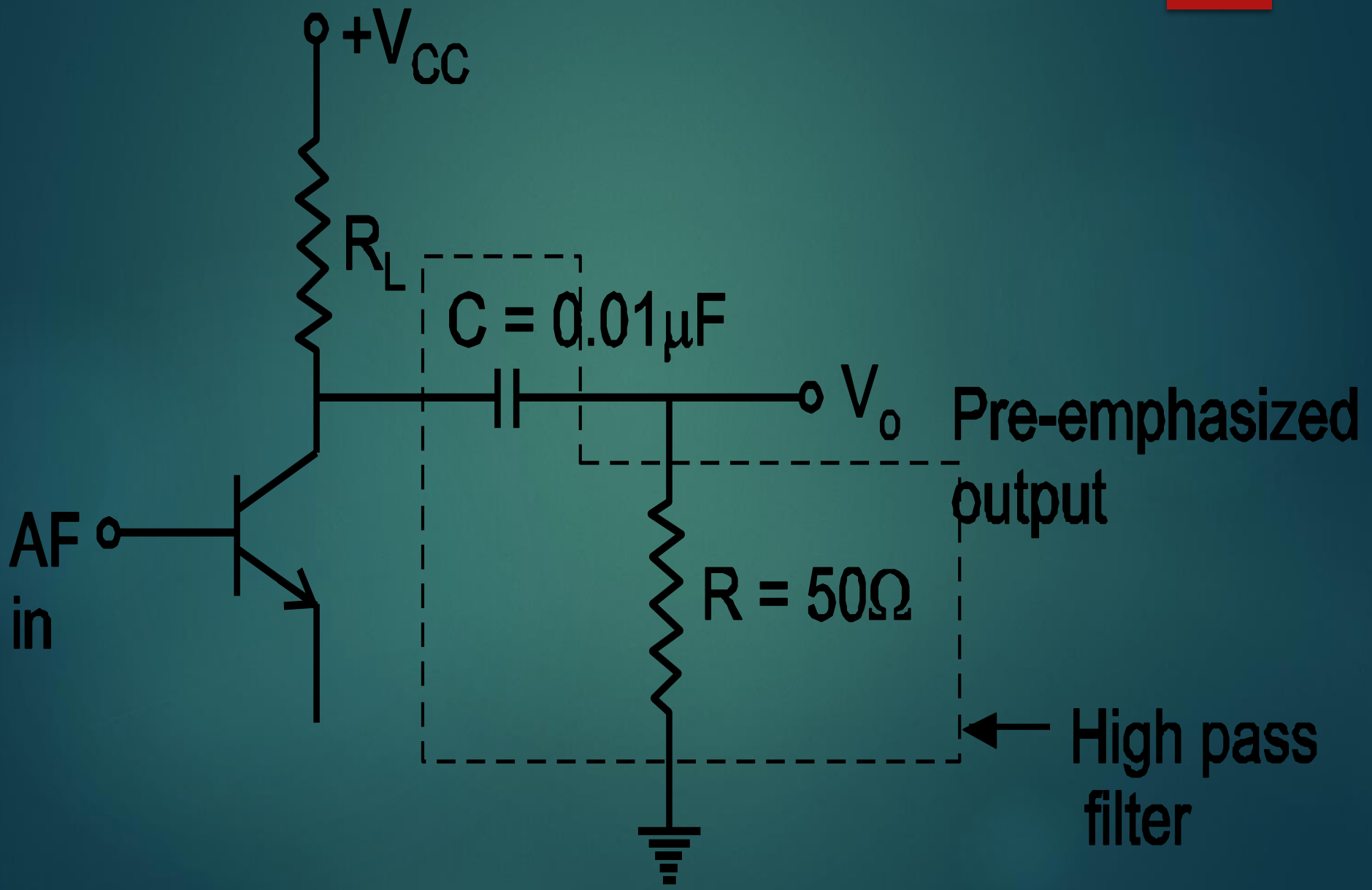
- In FM, the noise has a greater effect on the higher modulating frequencies.
- This effect can be reduced by increasing the value of modulation index (m_f), for higher modulating frequencies.
- This can be done by increasing the deviation 'δ' and 'δ' can be increased by increasing the amplitude of modulating signal at higher frequencies.

Definition:

The artificial boosting of higher audio modulating frequencies in accordance with prearranged response curve is called pre-emphasis.

- Pre-emphasis circuit is a high pass filter as shown in Fig. 1

Fig.1 Pre-emphasis Circuit



- As shown in Fig. 1, AF is passed through a high-pass filter, before applying to FM modulator.
- As modulating frequency (f_m) increases, capacitive reactance decreases and modulating voltage goes on increasing.
- $f_m \propto$ Voltage of modulating signal applied to FM modulator
- Boosting is done according to pre-arranged curve as shown in Fig. 2

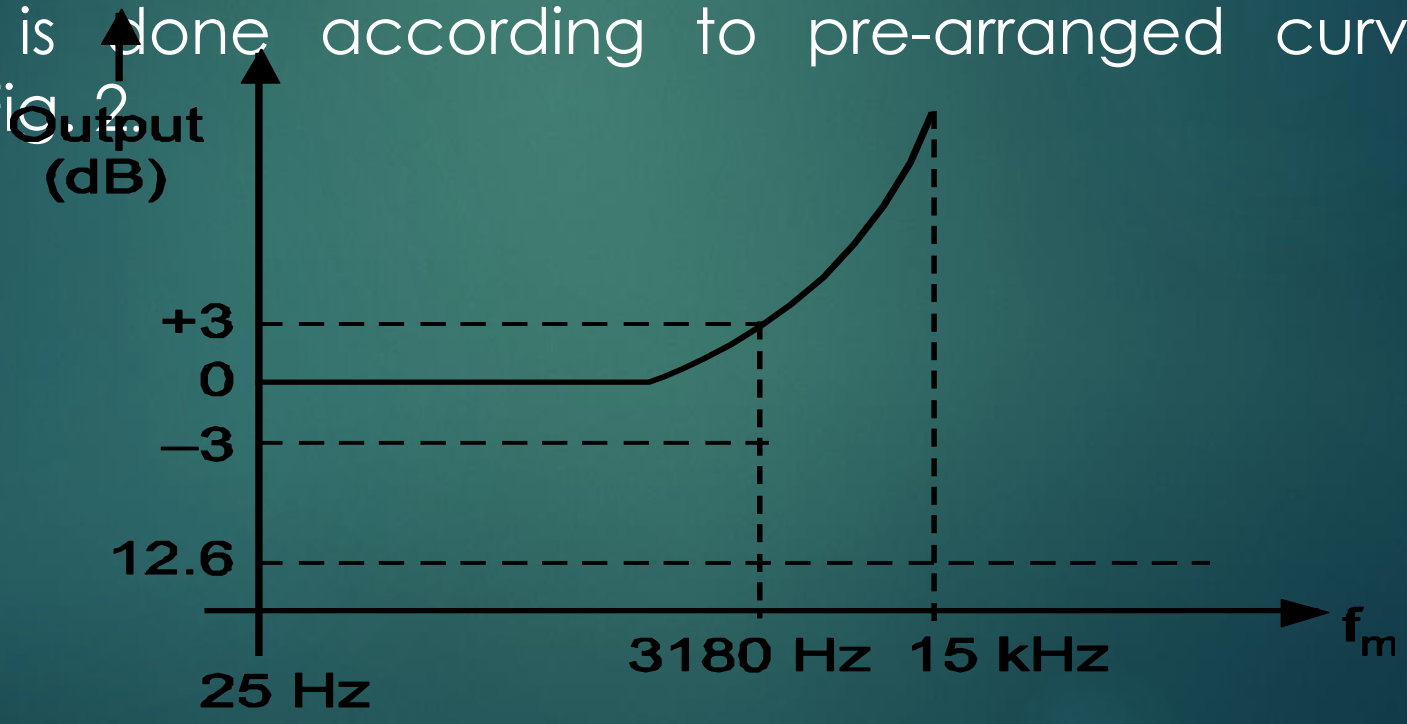


Fig. 2: P re-emphasis Curve

The time constant of pre-emphasis is at 50 μs in all CCIR standards.

- In systems employing American FM and TV standards, networks having time constant of 75 μsec are used.
- **The pre-emphasis is used at FM transmitter** as shown in Fig. 3.

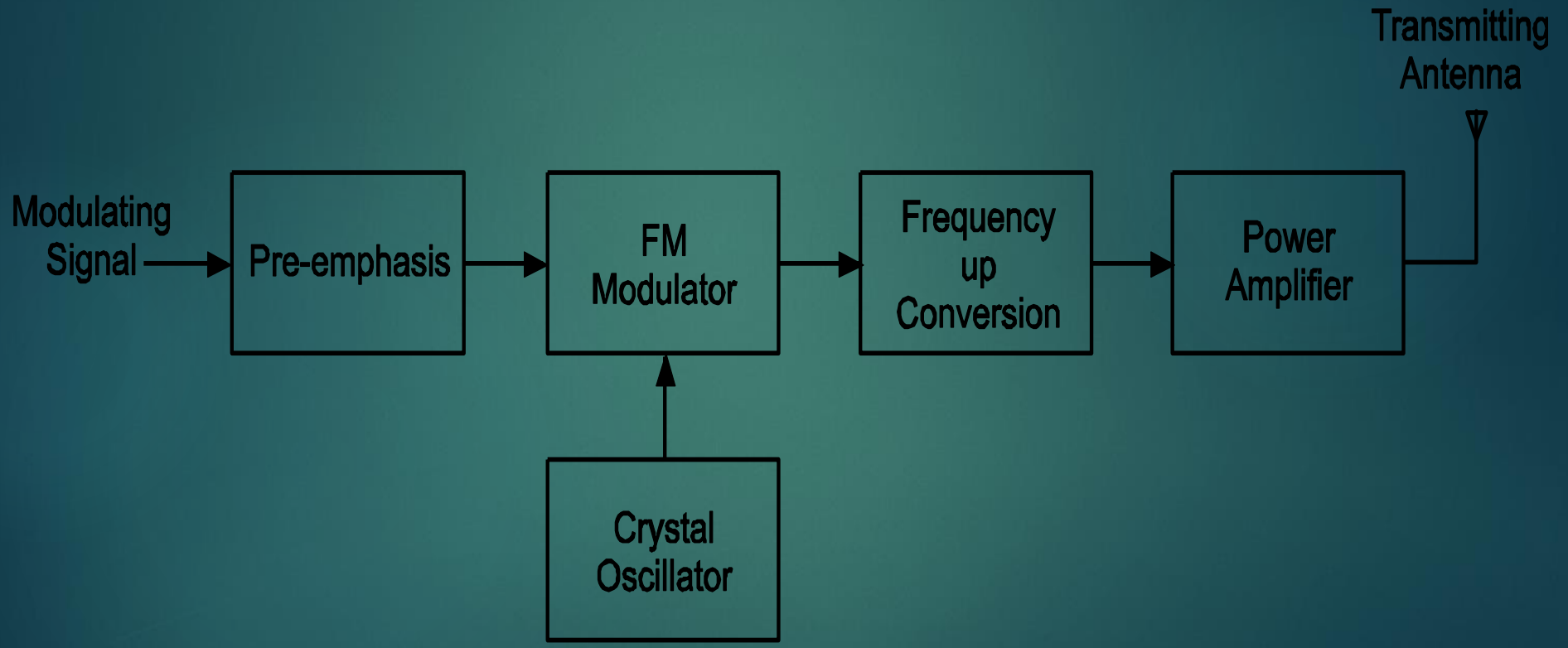


Fig. 3: FM Transmitter with Pre-emphasis

2. De-emphasis

- De-emphasis circuit is **used at FM receiver**.

Definition:

The artificial boosting of higher modulating frequencies in the process of pre-emphasis is nullified at receiver by process called de-emphasis.

- De-emphasis circuit is a low pass filter shown in Fig. 4.

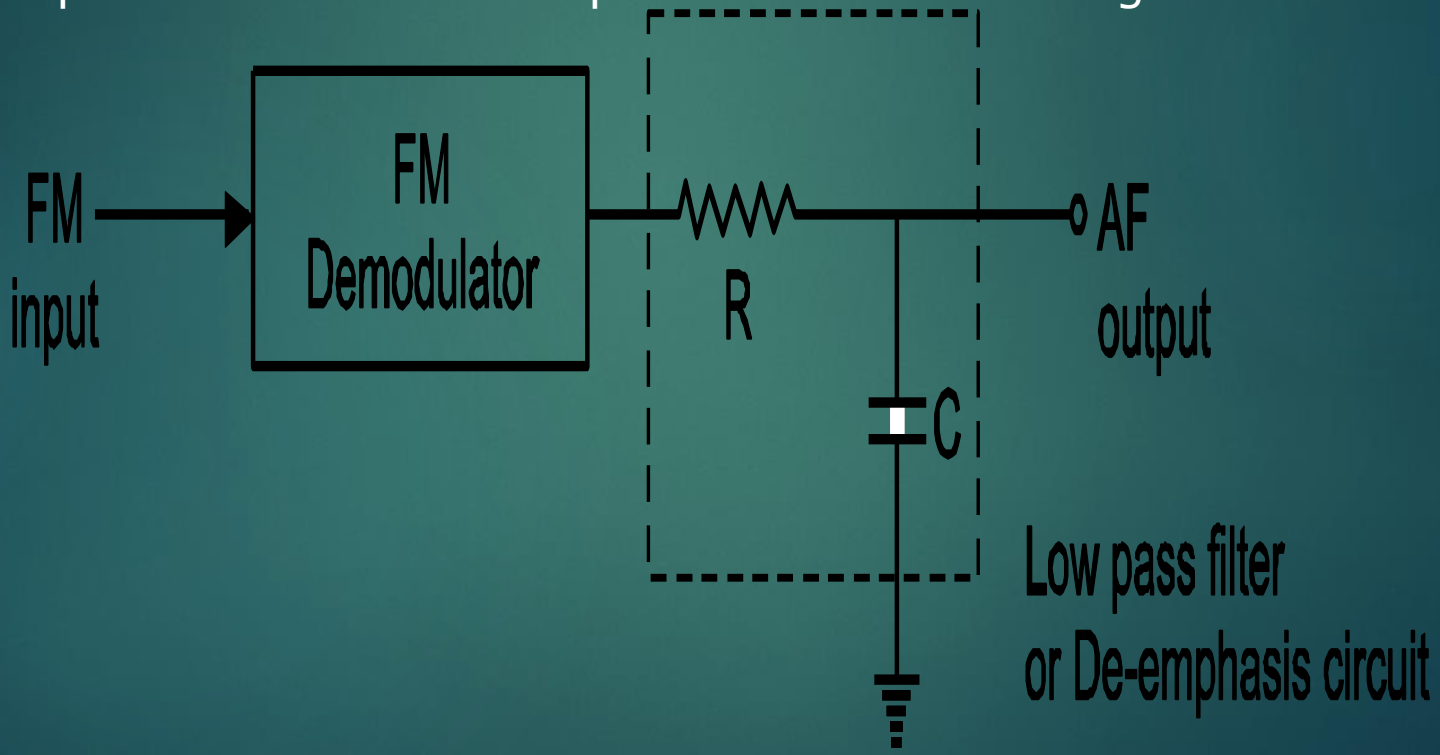


Fig. 4: De-emphasis Circuit

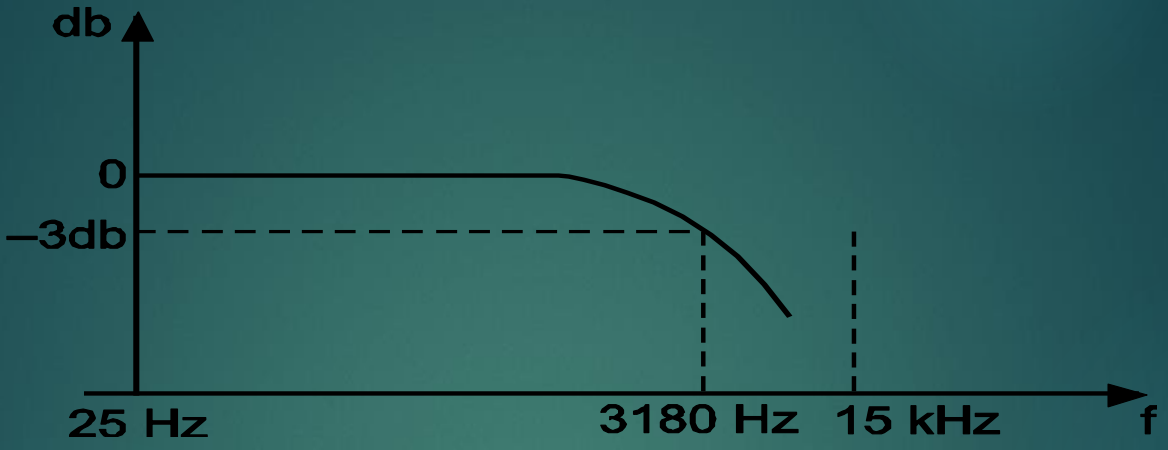


Fig. 5: De-emphasis Curve

As shown in Fig.5, de-modulated FM is applied to the de-emphasis circuit (low pass filter) where with increase in f_m, capacitive reactance X_c decreases. So that output of de-emphasis circuit also reduces

- Fig. 5 shows the de-emphasis curve corresponding to a time constant 50 μs. A 50 μs de-emphasis corresponds to a frequency response curve that is 3 dB down at frequency given by,

$$f = 1/2\pi RC$$
$$= 1/2\pi \times 50 \times 1000$$
$$= 3180 \text{ Hz}$$

The de-emphasis circuit is used after the FM demodulator at the FM receiver shown in Fig. 6.

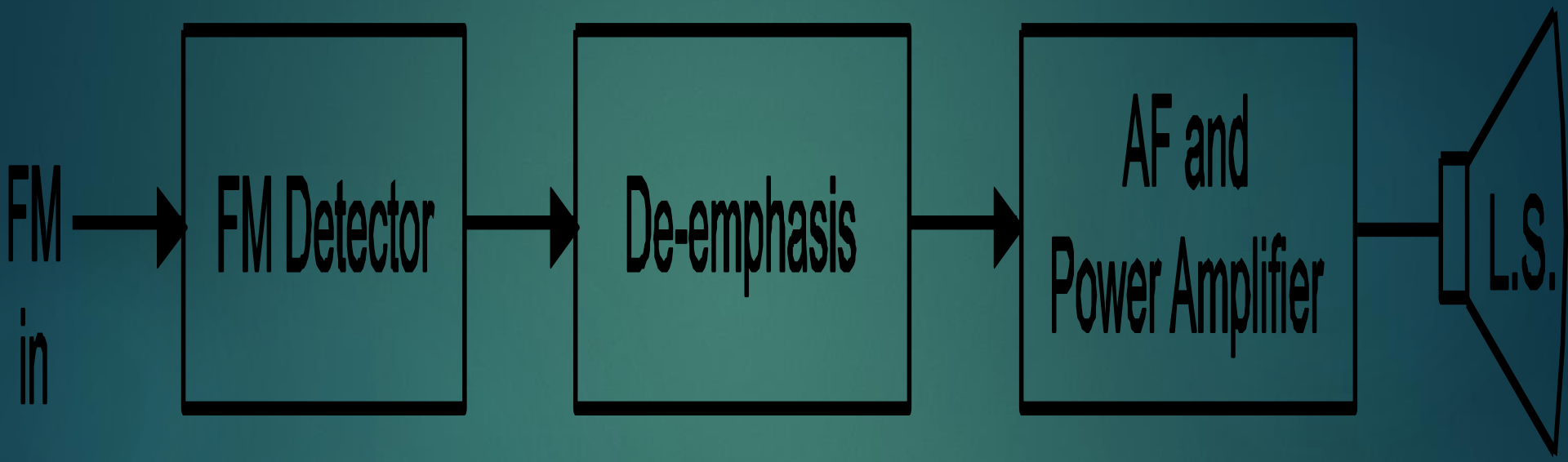
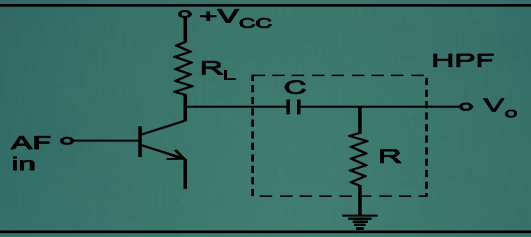
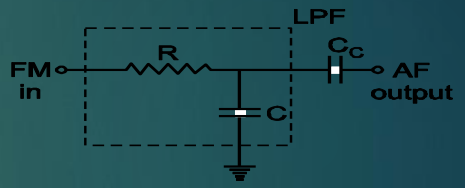
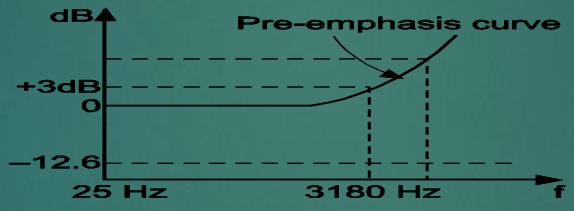
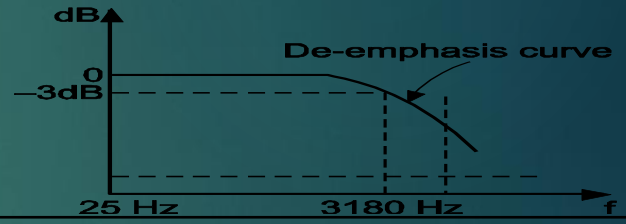


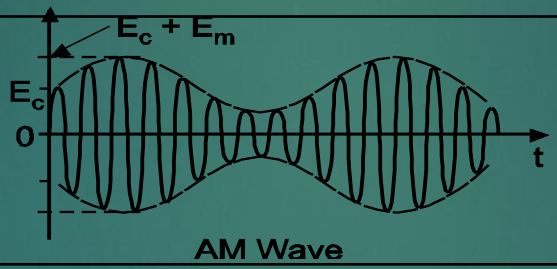
Fig. 6: De-emphasis Circuit in FM Receiver

Cont...

Comparison between Pre-emphasis and De-emphasis

Parameter	Pre-emphasis	De-emphasis
1. Circuit used	High pass filter.	Low pass filter.
2. Circuit diagram		
3. Response curve		
4. Time constant	T = RC = 50 μs	T = RC = 50 μs
5. Definition	Boosting of higher frequencies	Removal of higher frequencies
6. Used at	FM transmitter	FM receiver.

Comparison between AM and FM

Parameter	AM	FM
1. Definition	Amplitude of carrier is varied in accordance with amplitude of modulating signal keeping frequency and phase constant.	Frequency of carrier is varied in accordance with the amplitude of modulating signal keeping amplitude and phase constant.
2. Constant parameters	Frequency and phase.	Amplitude and phase.
3. Modulated signal	 AM Wave	 FM Wave
4. Modulation Index	m=Em/Ec	m = δ/ fm
5. Number of sidebands	Only two	Infinite and depends on m_f.
6. Bandwidth	BW = $2f_m$	BW = 2 ($\delta + f_{m\,(max)}$)
7. Application	MW, SW band broadcasting, video transmission in TV.	Broadcasting FM, audio transmission in TV.


Thank You

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Radio Receiver

INTRODUCTION

❖ What is radio receiver?

- *A radio receiver is an electronic device that*
  - *picks up the desired signal,*
  - *rejects the unwanted signal*
  - *amplifies the desired signal*
  - *demodulates the carrier signal to get back the original modulation frequency signal.*

Characteristics of Radio receiver

- Selectivity
- Sensitivity
- Fidelity

Selectivity

- *It refers to the ability of a receiver to select a signal of desired frequency while reject all others.*
- *The bandwidth of a tunned circuit is a measure of the selectivity .*

❖ *Sensitivity :*

- *The ability of receiver to detect the weakest possible signal is known as sensitivity*
- *It is expressed in microvolts or in decibels*
- *The sensitivity of receiver mostly depends on the gain of the IF amplifiers.*

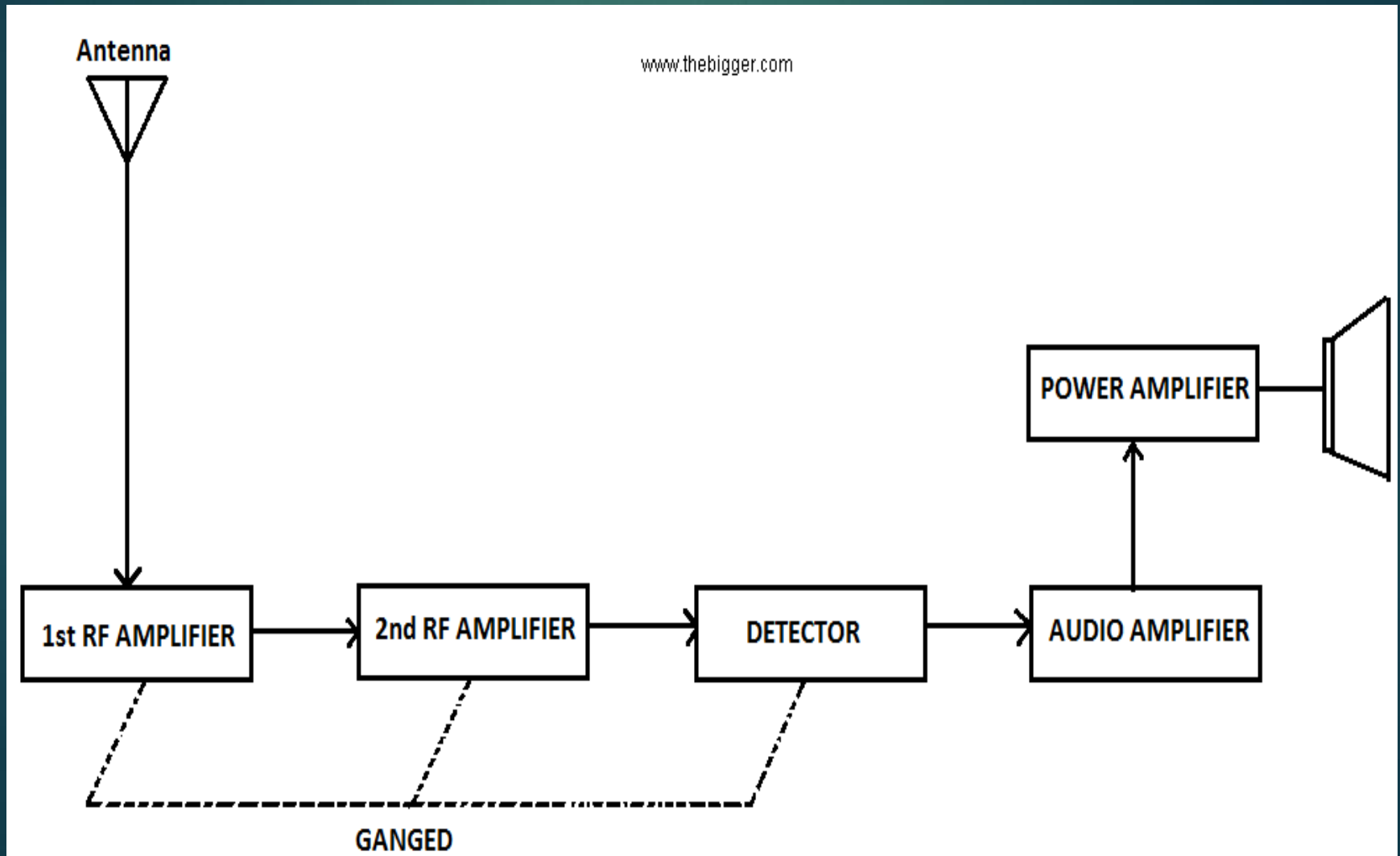
❖ *Fidelity :-*

- *The ability of receiver to reproduce faithfully all the frequency components in the baseband signal is called fidelity*
- *Fidelity is difficult to obtain in AM receiver because good fidelity requires more bandwidth*

Types of Radio receiver

- ***Tuned Radio Frequency (T.R.F) Receiver***
- ***Superheterodyne Receiver***

Tuned Radio Frequency *(T.R.F) Reciever*



(i) RF amplifier

- *It has following basic components-*

(ii) Detector

(iii) Audio amplifier

(iv) Power amplifier

Disadvantages:

- *Tracking of tuned circuit.*
- *Instability*
- *Variable bandwidth*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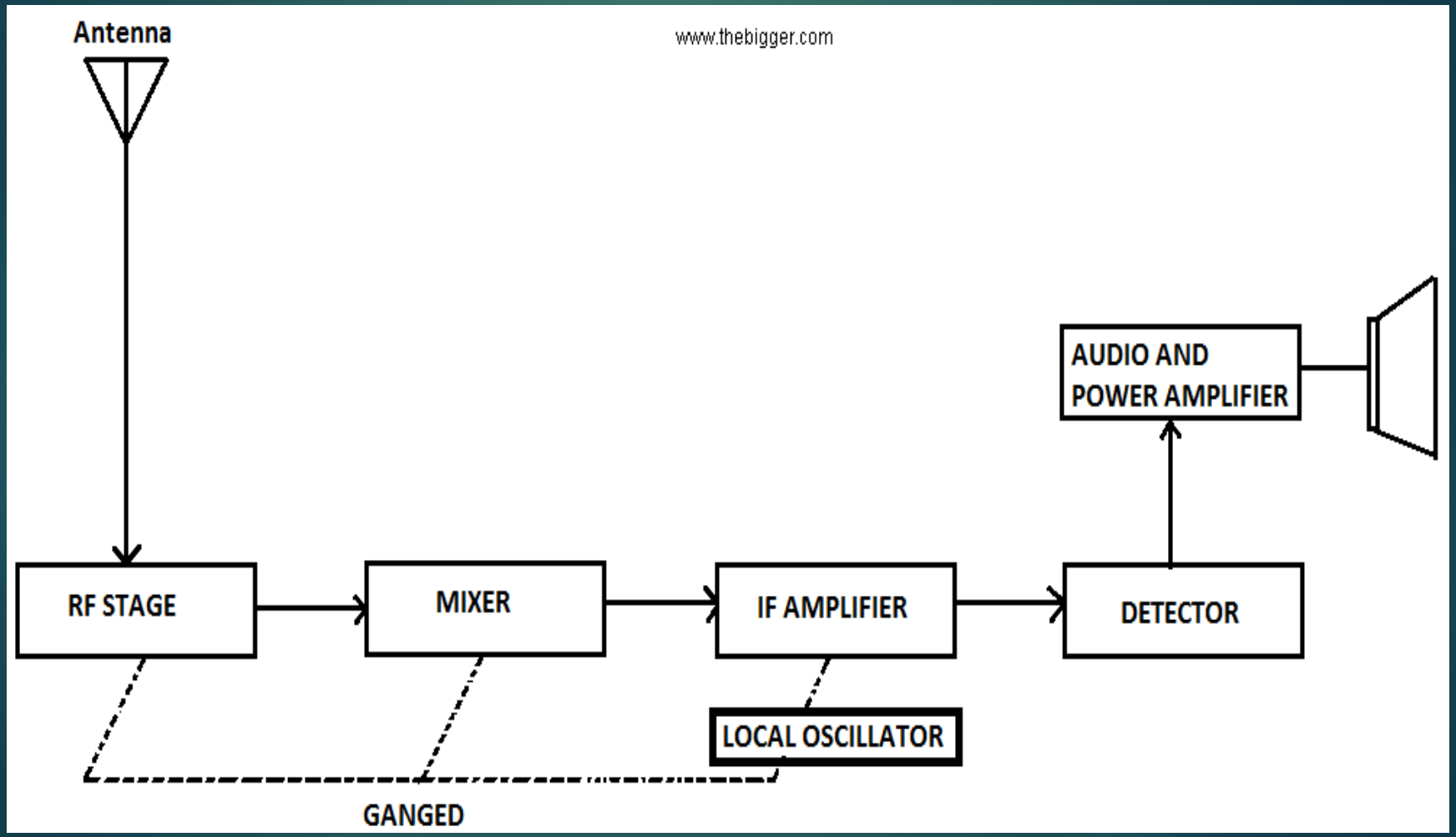
Superheterodyne Receiver



- *It has following components:-*

(i)Antenna *:- it picks up the weak signal feed into RF amplifier*

(ii)RF Amplifier *:- it provides initial gain and selectivity*

(iii)Local Oscillator *:-it provides operating limits for receiver*

(iv) Mixer :- it receives the output of RF amplifier and input of local oscillator

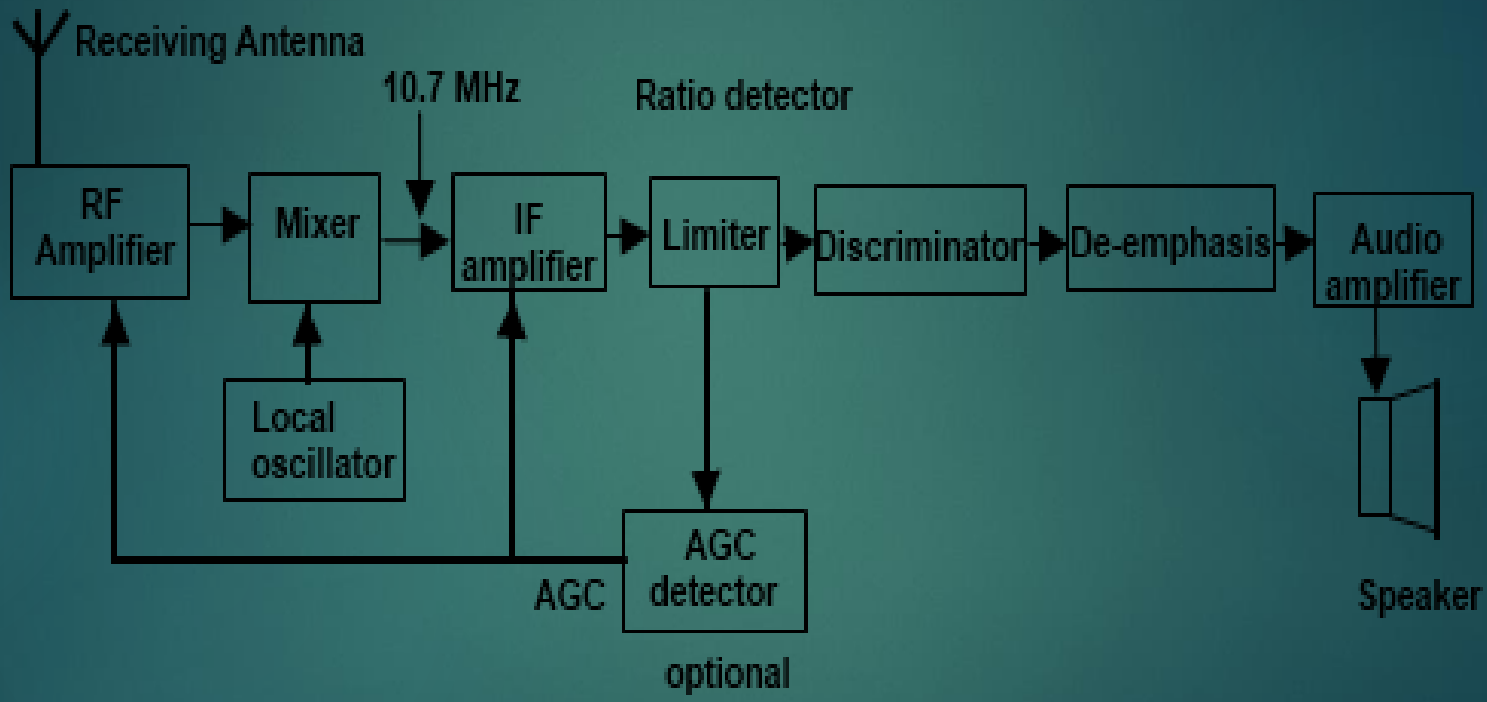
(v) IF Amplifier :- most of the receiver gain obtained here

Another important circuit in superheterodyne *receiver are :-*

(i)Automatic gain control (A.G.C):- *it is use to maintain a constant output voltage level over a wide range of RF input signal level*

(ii)Automatic frequency control (A.F.C):- *it is used to maintain frequency stability*

FM Receiver


Receiving Antenna
10.7 MHz
Ratio detector
RF Amplifier
Mixer
IF amplifier
Limiter
Discriminator
De-emphasis
Audio amplifier
Local oscillator
AGC detector
AGC
Speaker
optional

- The **FM receiver** is very similar to an AM receiver up to the IF Amplifier.
- Instead of a Detector however, the FM receiver uses two different stages:
  - *Limiter*
  - *Frequency Discriminator*


Thank You