Advantages:

1. Most simplest type of receiver since it does not involve mixing & IF operation.
2. Very much suitable to receive single frequency.
3. Have good sensitivity.

Disadvantages:

1. Bandwidth changes with center frequency, when TRF receiver is used to receive wide range of frequencies.
2. Multiple stages of Rf amplifiers are used. This can lead to instability since they all are tuned to same center frequency. Hence Stagger tuning is to be used.
3. The gain of TRF Receiver is not uniform over wide range of frequencies.

Due to the above disadvantages, this method is not preffered & going for Superheterodyne receiver.

Superheterodyne Receiver:

This receiver converts all the incoming Rf frequencies to a fixed lower frequency, called INTERMEDIATE FREQUENCY (IF).

This IF is then amplified and detected to get the original signal.

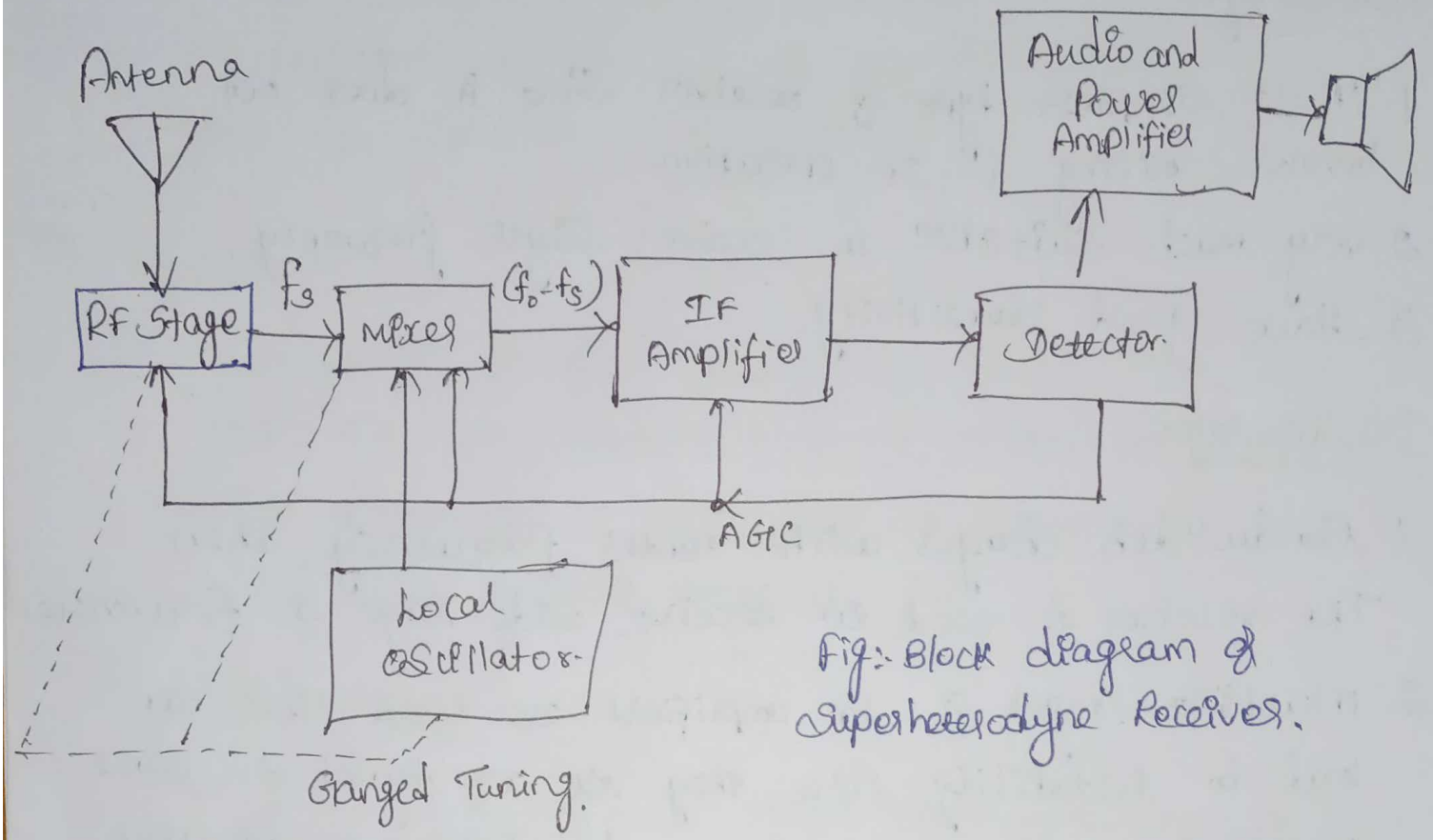


Fig:- Block diagram of Superheterodyne Receiver.

The antenna receives all the frequency signals and gives it to RF amplifier. The RF ~~amplifier~~ stage consists of

PRE SELECTOR &
RF AMPLIFIERS.

PRESELECTOR: It is broad-tuned bandpass filter. The center frequency of Preselector is adjustable and it is tuned to desired carrier frequency.

1. Preselector provides enough bandlimiting such that image frequency does not enter the receiver.
2. Preselector reduces noise bandwidth of the receiver and reduces overall receiver bandwidth.

RF AMPLIFIER: Amplifies the signals in the required range of frequencies. It provides Initial gain and selectivity.

→ Detector obtains the modulating signal from the modulated IF. The o/p of the detector is amplified & given to Speaker.

Advantages:

→ Selectivity of this receiver is better since its IF amplifiers are narrow band, & operate only at IF.

→ The design of IF amplifiers is relatively simple since they operate only at IF.

IF Requirements:

→ Since IF is used in Superheterodyne Receiver, the IF amplifiers have to work only at one frequency. Hence their design is relatively simple.

→ Adjacent channel selectivity,

→ Image frequency Rejection,

→ Fidelity,

→ Selectivity etc are the Performance Parameters depend upon IF amplifiers.

1. Should not fall in the tuning range of the Receiver.
2. Sufficiently high so that local oscilator does not have Stability problems.
3. Should not be very low, bcoz Image frequency rejection is poor at low frequencies.
4. High value of IF increases tracking difficulties

The Signal frequency f_s and local oscillator frequency f_o are mixed in the mixer in such a way that frequency difference $(f_o - f_s)$ is produced at the output of mixer. This difference $f_o - f_s$ is called Intermediate Frequency (IF).

→ The Signal at this IF contains the same modulation as the incoming Signal.

→ The IF is amplified by one or more IF amplifier Stages and given to the detector.

→ Most of the gain and the selectivity is provided by these IF Amplifiers.

→ IF is fixed for the AM Receivers.

→ To select a particular Station, the local oscillator frequency f_o is changed in such a way that the frequency 'f_s' of that Station and 'f_o' has the difference equal to IF.

→ Thus whatever is the Station being tuned, the IF is fixed.

→ Thus the IF amplifiers and detector operate at the single frequency i.e. IF.

→ Hence bandwidth of the IF amplifiers is relatively narrow.

→ A part of o/p is taken from the detector and it is applied to RF Amplifier, mixer and IF amplifiers for gain control. This is called Automatic Gain Control or AGC.

→ This AGC Maintains Constant o/p voltage level over wide range of RF i/p signals.

TRF RECEIVER	SUPERHETERODYNE RECEIVER.
1. IF is not used. All Stages till detector operate at incoming RF.	IF is used. Amplifiers after mixer stage operate at a common IF.
2. Tuning is required over a wide range of frequencies.	Tuning is required over a fixed range of frequencies except RF stage.
3. Good Sensitivity but poor Selectivity	Good Selectivity & Sensitivity.
4. Local oscillator stage is absent.	local oscillator stage is present.
5. RF stages can make the receiver unstable.	Instability problems are absent.
6. Used for single channel low frequency applications.	Multichannel and high frequency applications.

PERFORMANCE PARAMETERS / CHARACTERISTICS OF RECEIVERS:

→ Measured on the basis of its Selectivity, Sensitivity, fidelity and image frequency rejection.

1. Selectivity:

The Selectivity is the ability of the receiver to select a signal of a desired frequency while rejecting all others.

The Selectivity of the receiver is obtained partially by RF amplifier and mainly by IF amplifiers.

The Selectivity shows the attenuation that the receiver offers to signals at frequencies near to the one to which it is tuned.

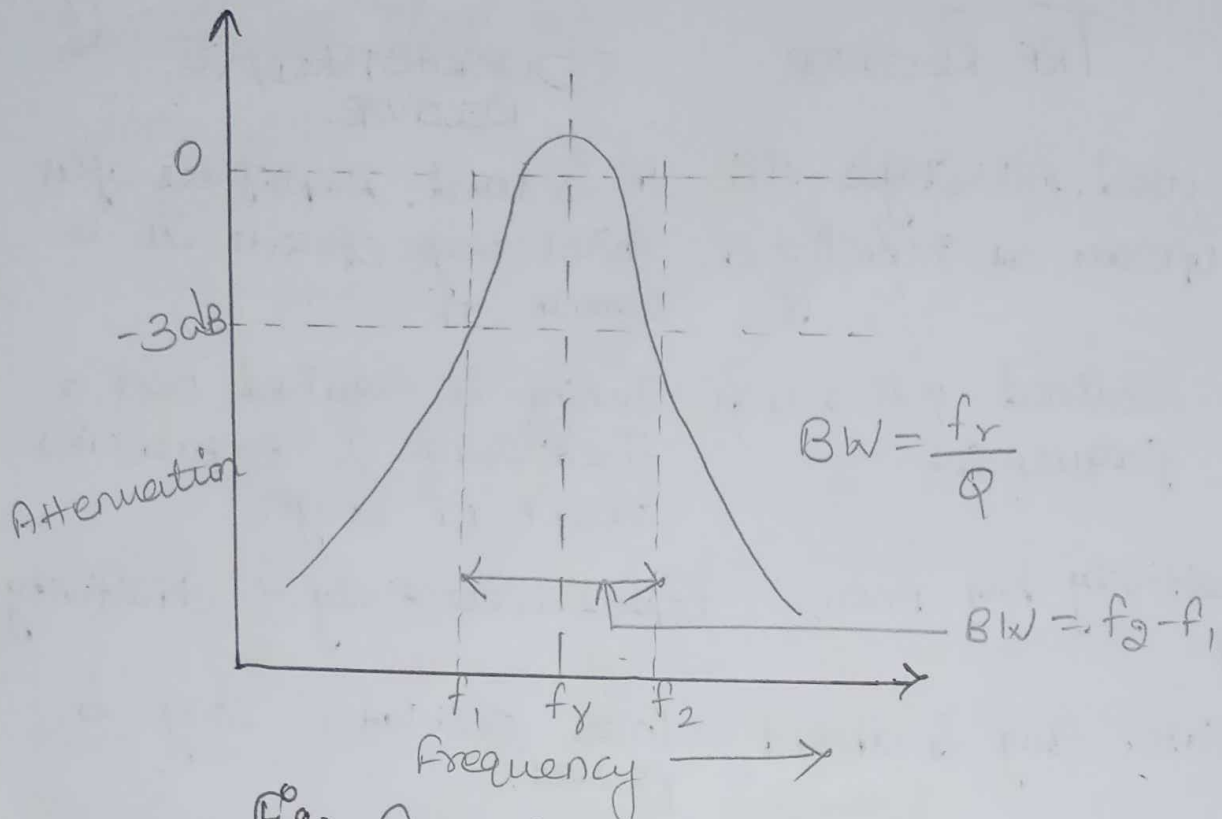


Fig:- Selectivity curve.

2. Bandwidth Improvement (Noise figure Improvement)

→ The thermal noise is directy proportional to bandwidth. In other words, the noise is reduced if bandwidth is reduced.

→ when the signal is passed through RF section, mixer and IF section, the bandwidth is reduced. This reduces the noise.

→ RF bandwidth is normally wider than IF bandwidth The bandwidth improvement is given as.

$$\text{Bandwidth Improvement} \left[BW_{\text{Improvement}}\right] = \frac{\text{BW of RF stage } (BW_{RF})}{\text{BW of IF stage } (BW_{IF})}$$

The reduction in noise figure due to reduction in bandwidth is called NOISE FIGURE IMPROVEMENT.

It is given as

Noise figure Improvement $= 10 \log_{10} BW_{Improvement}$

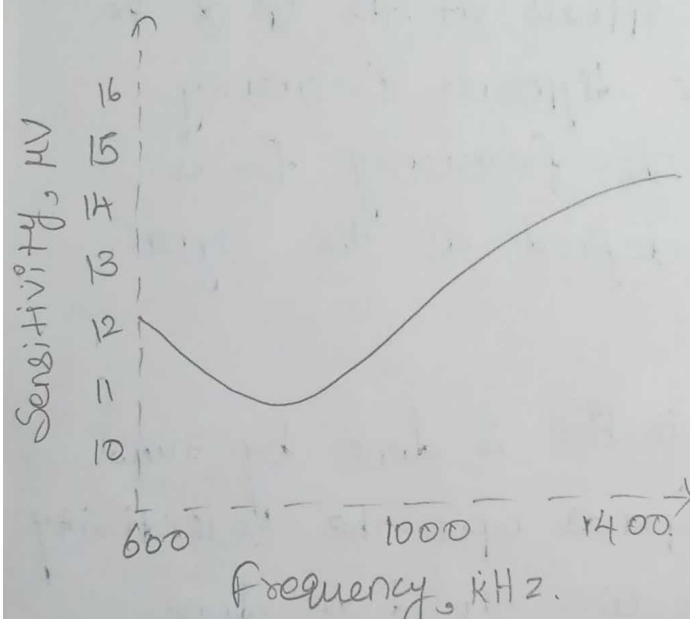
$[F_{improvement}]$

2. SENSITIVITY:

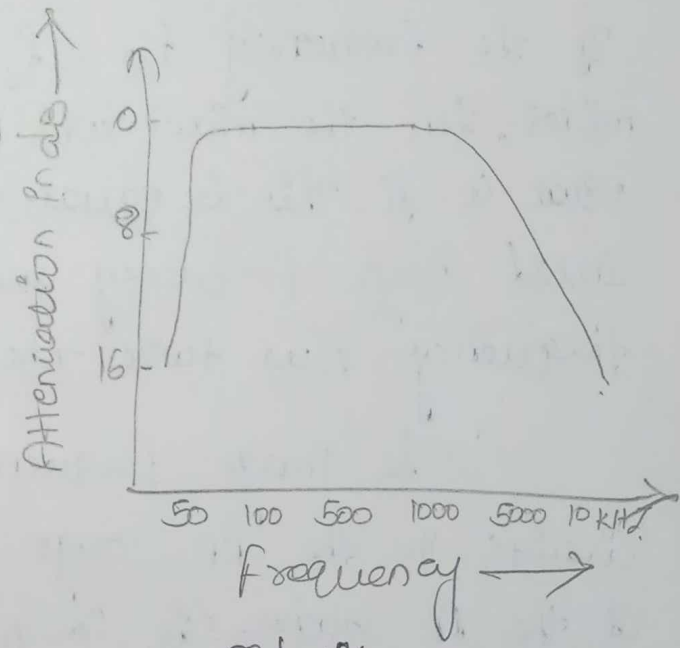
The ability of the receiver to pick up weak signals and amplify them is called SENSITIVITY.

It is often defined in terms of the voltage that must be applied to the receiver input terminals to give the standard output power, measured at the o/p terminals.

As the gain of the receiver is increased, sensitivity is also increased. The sensitivity is expressed in microvolts or decibels.



Sensitivity curve of a typical receiver.



Fidelity curve.

4. FIDELITY:

The ability of the receiver to reproduce all the range of modulating frequencies equally is called fidelity of the receiver.

→ The curve should be nearly flat over the required range of frequencies.

→ Good fidelity requires wide band of frequencies to be amplified.

→ For Good fidelity, more bandwidth of RF & IF stages is required. But this results in poor selectivity.

→ AM Receivers are not good fidelity receivers, since bandwidth in AM is low.

5. IMAGE FREQUENCY REJECTION:

$f_0 = f_s - f_s$

$\therefore f_0 = f_s + f_i$.

f_0 = local oscillator frequency
f_s = Signal frequency
f_i = Intermediate frequency

If the frequency $f_{si} = f_s + 2f_i$ appears at the i/p of the mixer, then the mixer will produce difference frequency equal to f_i. This is equal to IF. The frequency f_{si} is called Image frequency and is defined as the signal frequency plus twice the IF.

The image frequency rejection is done by tuned circuits in the RF stage. It depends upon the selectivity of the RF stage. The image rejection should be done before the IF stages.

$IFRR = \sqrt{1 + Q^2\rho^2}$ Q is Quality factor of Preselector and

$\rho = \frac{f_{si}}{f_s} - \frac{f_s}{f_{si}}$.