# Experiment No: 5

## Experiment 5: SUPERHEERODYNE RECEIVER

Date: ___________

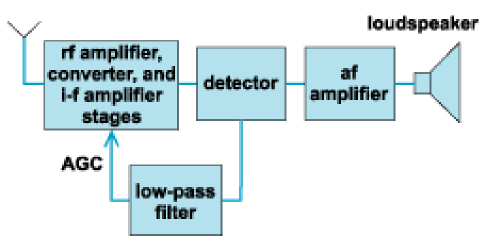
- **Aim** : To study about the Superheterodyne Receiver.
- **Apparatus** : Connecting Probes, Trainer Kit, Power Supply.
- **Theory** :

**Intoduction :**

In the the superheterodyne receiver, we will discuss the reasons for the use of the superheterodyne and various topics which concern its design, as the choice of intermediate frequency, the use of its RF stage, oscillator tracking, bandspread tuning & frequency synthesis.

Most of the information is standard text book material, but put together as an introductory article, it can provide somewhere to start if you are contemplating building a receiver, or if you are considering examining specifications with an objective to select a receiver for purchase.

**Block Diagram of reciever :**

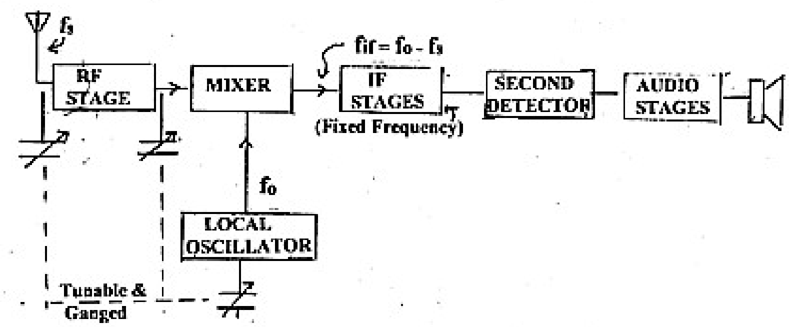



**The superheterodyne principle :**

The principle of operation in the superheterodyne is illustrated by the diagram in Figure. In this system, the incoming signal is mixed with a local oscillator to produce sum and difference of the frequency components.

The lower frequency difference component is called as the intermediate frequency (IF), is separated from the other components by fixed tuned amplifier stages set to the intermediate frequency.

The tuning of the local oscillator is mechanically ganged to the tuning of the signal circuit or radio frequency (RF) stages so that the difference intermediate frequency is always the same fixed value. Detection takes place at intermediate frequency instead of at radio frequency as in the TRFreceiver.




**Principle of a Superheterodyne Receiver**

**Use of the fixed lower IF channel gives the following advantages :**

**1.** For a given Q factor in the tuned circuits, the bandwidth is lower making it easier to achieve the required selectivity.

**2.** At lower frequencies, circuit losses are often lower allowing higher Q factors to be achieved and hence, even greater selectivity and higher gain in the tuned circuits.

**3.** It is easier to control, or shape, the bandwidth characteristic at one fixed frequency. Filters can be easily designed with a desired bandpass characteristic and slope characteristic, an impossible task for circuits which tune over a range of frequencies.

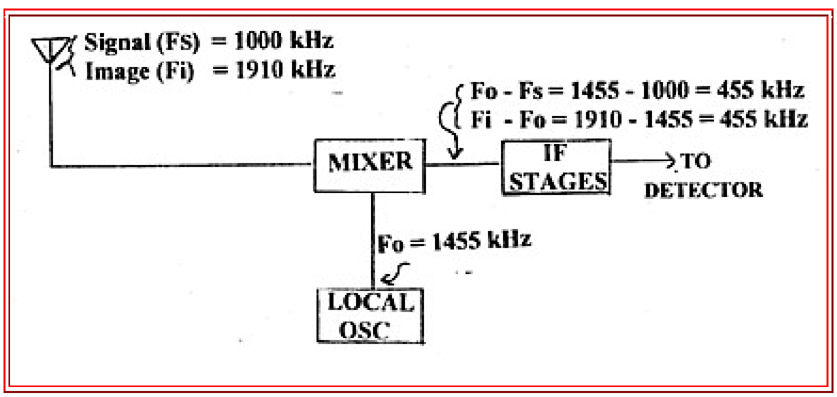
**4.** Since the receiver selectivity and most of the receiver pre-detection gain, are both controlled by the fixed IF stages, the selectivity and gain of the superheterodyne receiver are more consistent over its tuning range than in the TRF receiver.

**Second channel or image frequency :**

One problem, which has to be contended with in the superheterodyne receiver, is its ability to pick up a second or imago frequency removed from the signal frequency by a value equal to twice the intermediate frequency.

To illustrate the point, refer Figure 5. In this example, we have a signal frequency of 1 MHz which mix to produce an IFof 455kHz. A second or image signal, with a frequency equal to 1 MHz plus (2 x 455) kHz or 1.910 MHz, can also mix with the 1.455 MHz to produce the 455 kHz.

Reception of an image signal is obviously undesirable and a function of the RF tuned circuits (ahead of the mixer), is to provide sufficient selectivity to reduce the image sensitivity of the receiver to tolerable levels.




**An illustration of how image frequency provides a second mixing product**

**Choice of intermediate frequency**

Choosing a suitable intermediate frequency is a matter of compromise. The lower the IF used, the easier it is to achieve a narrow bandwidth to obtain good selectivity in the receiver and the greater the IF stage gain. On the other hand, the higher the IF, the further removed is the image frequency from the signal frequency and hence the better the image rejection. The choice of IF is also affected by the selectivity of the RF end of the receiver. If the receiver has a number of RF stages, it is better able to reject an image signal close to the signal frequency and hence a lower IF channel can be tolerated.

Another factor to be considered is the maximum operating frequency the receiver. Assuming Q to be reasonably constant, bandwidth of a tuned circuit is directly proportional to its resonant frequency and hence, the receiver has its widest RF bandwidth and poorest image rejection at the highest frequency end of its tuning range.

**Standard intermediate frequencies**

Various Intermediate frequencies have been standardised over the years. In the early days of the superheterodyne, 175 kHz was used for broadcast receivers in the USA and Australia. These receivers were notorious for their heterodyne whistles caused by images of broadcast stations other than the one tuned. The 175 kHz IF was soon overtaken by a 465 kHz allocation which gave better image response. Another compromise of 262kHz between 175 and 465 was also used to a lesser extent. The 465 kHz was eventually changed to 455 kHz, still in use today.

**Conclusion :**

The Superheterodyne receiver, its principle & frequencies selection were studied.

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