

# Design and Development of Superheterodyne Receiver for GSM using low noise amplifier

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# DESIGN AND DEVELOPMENT OF SUPERHETERODYNE RECEIVER FOR GSM USING LOW NOISE AMPLIFIER

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### **Introduction**

- Design and development of Superheterodyne Receiver for GSM(Global system for mobile communication) using low noise amplifier.
- Superhetrodyne Receiver is a type of receiver, that uses frequency mixing to convert a received signal to a fixed intermediate frequency(IF) which can be more conveniently processed than the original carrier frequency.
- **GSM** is an open and digital cellular technology **used** for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands.

#### **Block Diagram**



Single Conversion Superheterodyne Receiver



**Double Conversion Superheterodyne Receiver** 

### <u>Circuit Diagram</u>



# **Working**

- In the superheterodyne receiver, the incoming signal through the antenna is filtered to reject the image frequency and then amplified by the RF amplifier.
- RF amplifier can be tuned to select and amplify a particular carrier frequency within the AM broadcast range. Only the selected frequency and it two sidebands are allowed to pass through the amplifier.
- The carrier of the received signal is called radio frequency carrier and its frequency is radio frequency fRFfRF and the local oscillator signal operates at fOSCfOSC. The amplified RF frequency is then mixed with the local oscillator frequency.
- The combining of these two signals is done at the mixer which produces sum and difference frequency signals of the incoming carrier signal and local oscillator signal, which are fOSC+fRF and fOSC-fRFfOSC+fRF and fOSC-fRF.
- The sum frequency (fOSC+fRFfOSC+fRF) is rejected by the filter and the remaining difference frequency (fOSC fRF) signal which is a down converted frequency signal is called as intermediate frequency (IF) carrier (fIF=fOSC-fRFfIF=fOSC-fRF).
- The frequency of local oscillator is not same as the frequency to which RF amplifier is tuned. Local oscillator is tuned to a frequency that may be either higher or lower than the incoming frequency by an amount equal to the IF frequency.
- Thus idea of the superheterodyne receiver is to reduce the high frequency radio components of the incoming carrier to a fairly low, fixed value such as to be processed at the different stages of the receiver, and also to provide good stability, gain and proper selectivity and fidelity.
- The modulation of the IF carrier signal is same as that of the original carrier signal and it has a fixed frequency of 455kHz which is amplified by one or more stages of amplification.
- The IF signal is amplified with the help of IF amplifier which raises its level for the information extraction process. Also the IF amplifier fulfills most of the gain and bandwidth requirements of the receiver.

- IF amplifier operations are independent to the frequency at which receiver is tuned, maintaining the selectivity and sensitivity of the superheterodyne receiver considerably constant throughout the tuning range of the receiver.
- This amplified IF signal is applied to the detector to detect the information signal component from 455 kHz IF, to reproduce the original information data, which is generally in the form of audio signal.
- The detector stage eliminates one of the sidebands which is still present and separates the RF from the audio components of the other sideband.
- The RF component is filtered out and audio is supplied to the audio stages for amplification.
- The generated audio signal is then applied to the AF amplifier to increase the audio frequency level of the signal and to provide enough gain to drive the speaker or headphones.
- A speaker is connected to the AF amplifier to play the audio information signal.
- An important part of superheterodyne receiver is Automatic gain control (AGC) which is given to the RF, IF and mixer stages in order to generate constant output irrespective of the varying input signal.
- Superheterodyne radio receiver in spite of being more complicated than some of the other receivers offers many advantages in terms of performance, most importantly the selectivity. It is more efficiently able to remove unwanted and distorting signals than other forms like TRF and regenerative receivers.
- Due to the enormous advantages provided by the superheterodyne receivers compared to the other radio receivers, they are widely used in all broadcast radio receivers, commercial radios as well as televisions operate on the basis of the superheterodyne principle.

## **Conclusion**

- Superheterodyne receiver of mobile communication for GSM(Global system of mobile communication) is developed.
- Receiver for frequency bands 850MHz, 900MHz, 1800MHz and 1900MHz is developed using low noise amplifier.

### **References**

- <u>https://www.sciencedirect.com/topics/engineering/superheterodyne-receiver</u>
- https://en.wikipedia.org/wiki/Superheterodyne\_receiver